UNIVERSIDADE D COIMBRA

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A Virtual Observatory methodology to identify and characterize asteroids in wide-field images

VOLUME I

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Master's Thesis

A Virtual Observatory methodology to identify and characterize asteroids in wide-field images

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This work was developed in collaboration with:

European Space Agency (ESA)[1]

European Space Astronomy Centre (ESAC)[2]

Centro de Astrobiología (CAB - INTA/CSIC)[3]

[1]`https://www.esa.int/`

[2]`http://www.esa.int/About_Us/ESAC`

[3]`https://cab.inta-csic.es/`

Declaration of Authorship

I, Cédric Pereira, declare that this thesis titled, "A Virtual Observatory methodology to identify and characterize asteroids in wide-field images" and the work presented in it is my own. I confirm that this work submitted for assessment is my own and is expressed in my own words. Any uses made within it of the works of other authors in any form (e.g., ideas, equations, figures, text, tables, programs) are properly acknowledged at any point of their use. A list of the references employed is included.

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- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed: ________________________________

Date: ________________________________

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The ESAC VIL-1 15-m S-band antenna.

* Sorry for the bee attack during the photo for my master thesis :)

"You can't connect the dots looking forward, you can only connect them looking backwards. So you have to trust that the dots will somehow connect in your future. You have to trust in something: your gut, destiny, life, karma, whatever. Because believing that the dots will connect down the road will give you the confidence to follow your heart, even when it leads you off the well worn path. And that will make all the difference. Your time is limited, so don't waste it living someone else's life. Don't be trapped by dogma which is living with the results of other people's thinking. Don't let the noise of others' opinions drown out your own inner voice. You've got to find what you love. And that is as true for your work as it is for your lovers. Your work is going to fill a large part of your life and the only way to be truly satisfied is to do what you believe is great work. And the only way to do great work... is to love what you do. If you haven't found it yet, keep looking and don't settle. have the courage to follow your heart and intuition. They somehow already know what you truly want to become."

Steve Jobs, 2005

Dedicated to all those who strive to create a better, more comprehensive and fairer society, to all those who care about the environment and the preservation of nature...

Abstract

The development of technology and science allowed us to know more about our solar system and how the characterization of asteroids is important for scientific evolution and to ensure the survival of our species. This dissertation presents the development of a methodology to analyze and process large field images, obtained by a ground-based observatory, to identify and characterize known asteroids. This work is based on use of Virtual Observatory[4] tools, of free access and which can be used by any user. In order to automate the whole process, some scripts previously developed by the scientific group will be used along with newly-added complementary scripts. From the astronomical data, the centroids of light sources of non-moving objects (for example stars) and moving objects (for example asteroids) will be calculated and astrometric calibrations will be performed in order to obtain the celestial coordinates for each light source. Photometric calibrations will be performed in order to obtain the apparent magnitude of each source, to obtain the absolute magnitude of each asteroid position and to extract their light curves. If the quantity and quality of the data allows, their periods will be calculated. After analyzing the provided data, the results will be submitted to the Minor Planet Center[5], where they can be approved for calibration of the orbits of the asteroids under study.

Keywords: Asteroids, Virtual Observatory, Astrometry, Photometry, Minor Planet Center.

[4] `http://www.ivoa.net/astronomers/applications.html`
[5] `https://minorplanetcenter.net/`

Resumo

O desenvolvimento da tecnologia e da ciência tem permitido conhecer melhor o nosso sistema solar e de que forma a caracterização de asteróides é importante para a evolução científica e para assegurar a sobrevivência da nossa espécie. Esta dissertação de mestrado apresenta o desenvolvimento de uma metodologia de análise e processamento de imagens de grande campo, obtidas em um observatório terrestre, para identificação e caracterização de asteróides conhecidos. Este trabalho tem como base o uso de ferramentas Observatório Virtual[4], de acesso livre e que poderão ser utilizadas por qualquer utilizador. De modo a automatizar todo o processo serão utilizados e adaptados alguns scripts anteriormente desenvolvidos pelo grupo científico e adicionados novos scripts complementares. Dos dados fornecidos serão calculados os centróides das fontes de luz correspondentes a objectos estáticos (como no caso das estrelas) e correspondentes a objectivos que apresentam movimento (como no caso dos asteróides) e serão realizadas calibrações astrométricas com o objectivo de obter as coordenadas celestes para cada uma das fontes. Também serão realizadas calibrações fotométricas de modo a obter as magnitudes aparentes de cada fonte, para posteriormente obter as magnitudes absolutas de cada posição dos asteróides e para extrair as suas curvas de luz. Se a quantidade e qualidade dos dados permitir serão ainda calculados os seus períodos. Após analise dos dados fornecidos, os resultados serão submetidos para a base de dados Minor Planet Center[5], onde poderão ser aprovados para a calibração das orbitas dos asteróides em estudo.

Palavras-Chave: Asteróides, Observatório Virtual, Astrometria, Fotometria, Minor Planet Center.

[4]`http://www.ivoa.net/astronomers/applications.html`
[5]`https://minorplanetcenter.net/`

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Abbreviations

SNR	Signal-to-Noise Ratio
FOV	Field of View
CCD	Charge-Coupled Device
FITS	Flexible Image Transport System
RMS	Root Mean Square
RA	Right Ascension
DEC	Declination
Mv.	Apparent Magnitude
Pos.	Positions
Det.	Detected Positions

Chapter 1

Introduction

"Asteroids have us in our sight. The dinosaurs didn't have a space program, so they're not here to talk about this problem. We are, and we have the power to do something about it. I don't want to be the embarrassment of the galaxy, to have had the power to deflect an asteroid, and then not, and end up going extinct."

Neil deGrasse Tyson

1.1 Asteroids and the Importance of their Characterization

When we look at the diagram of the Solar System we can see a large free space between Mars and Jupiter. A few centuries ago, it was thought that there was a planet in this region yet to be discovered. On 1st of January 1801, Giuseppe Piazzi discovered a small point of light in this region (Foderà Serio et al. 2002). In the beginning, Piazzi thought it would be a star, but when he realized the point of light was moving, he was convinced that it would be the such planet.

Despite moving at the right speed to be a planet, it was too small and too faint, so Piazzi initially announced his discovery as a comet (Foderà Serio et al. 2002). But, the following observations did not demonstrate the natural characteristics of a comet!

A year later another similar source was discovered, then another one in 1804 and another one in 1807. It began to be clear that a new class of Solar System objects was being discovered. The name given to this new class was "Asteroid", which means "star-like", because with the observation equipment of the time, these objects appeared to be points of light, distinguishable from stars only due to their apparent motion. In the end of the 19th century more than 400 asteroids (DeMeo et al. 2015) had been discovered - and more and more over the years. Nowadays we can count more than 700 000 known asteroids[1], but it is estimated that there are more than one billion asteroids with more than 1 meter of diameter, orbiting the Solar System.

Piazzi, in reality, discovered the biggest asteroid of the Solar System, Ceres (nowadays, Ceres is not classified as an asteroid but as a dwarf planet). Ceres is probably constituted by a rocky nucleus surrounding by ice water and then by a dense dust crust (McCord and Sotin 2005). Asteroids are basically rocky or metal bodies which orbit the Sun, small enough to not be called planets and bigger enough to not be called meteoroids.

Ceres is orbiting the Sun in a region between Mars and Jupiter, called Main Belt, where the majority of these objects are. This region has a defined structure because different asteroids with different speeds create different bands and gaps, similar to the Saturn's rings.

But there are other asteroids in other regions of the Solar System, as for example, Jupiter Trojans. This kind of asteroids orbits in the same orbit of Jupiter, grouped into two points, called the Lagrange points, located 60 degrees ahead of and behind the planet. There are Trojans asteroids also in Mars, Uranus, Neptune and even one in the Earth, discovered in 2010 (Murray 1997).

Other asteroids have different orbits, some have orbits that cross Mars (Mars Crossers), others have orbits that cross our planet (Apollo) or are inside the orbit of our planet's orbit (Atenas). Apollo and Atenas may have orbits very close to the Earth and can be classified as Near Earth Asteroids, but it does not mean that they will hit us, because their orbits can be tilted. On the other hand, some asteroid may have orbits that intersect the orbit of our planet, representing a risk for us, called Potentially Hazardous Asteroids.

[1] `https://solarsystem.nasa.gov/`

Many asteroids did a flyby on our planet with a distance smaller than the distance from Earth to the Moon and also, with a distance smaller than the altitude of geosynchronous communications satellites.

Apophis is one of the most controversial asteroids. In December of 2004, some initial observations show a small, but not negligible probability of Apophis hitting Earth in 2029. Additional observations eliminate this possibility, but there is also the possibility of Apophis crossing a gravitational resonance slit and changing its route, which would result in hitting Earth in 2036. Another further observations show that the probability of Apophis crossing this slit is too low (Noland 2006). Apophis broke the record of the most dangerous asteroid reaching, for a short time, level four in the scale of Turim (scale to measure the risk an asteroid represent for our planet) (Yeomans et al. 2004). After, the level was reduced to one and nowadays to zero. However, this asteroid needs to be monitored to correct the predicted orbit and check the risk for our planet. When the asteroid comes close to Earth in 2029, it will be possible to see it with naked eye.

One of the big problems is the existence of many asteroids of small dimensions not yet detected. Figure 1.1 shows the Near-Earth asteroid census by Wise survey, illustrating this problem. Small asteroids are difficult to detect and despite their reduced size, they may represent a high risk for humanity. One of the examples of a collision of a small asteroid is the Barringer Crater in Arizona, United States of America. This crater, with an approximate diameter of 1.186 kilometers[2], was created by the collision of an asteroid with about 50 m of diameter, 50 000 years[2] ago. An asteroid of these dimensions has the capacity to destroy a city, putting at risk several human lives.

Another recent example is the case of Chelyabinsk, in Russia. An asteroid with about 20 meters in diameter exploded in the Earth's atmosphere releasing energy greater than 30 times the energy released by the Hiroshima bomb (Popova et al. 2013). Several people were injured mainly by window shrapnels. The explosion and resulting impacts damaged buildings in six cities in the region of the event. This small asteroid was not detected before entering the Earth's atmosphere.

[2] https://www.barringercrater.com/

The detection and characterization of asteroids is very important to provide better monitoring, redefining and understanding of their orbits. Since these objects were created at the beginning of our Solar System, preserving a historical record of the events that occurred at that time, their characterization allows us to better understand the formation of our planetary system. Another increasingly appealing area is the mining of asteroids for extraction of rare earth materials. Some asteroids have large amounts of rare materials, such as gold, iridium, silver, etc. Some companies and organizations are developing ideas to extract these materials and bring them to the Earth.

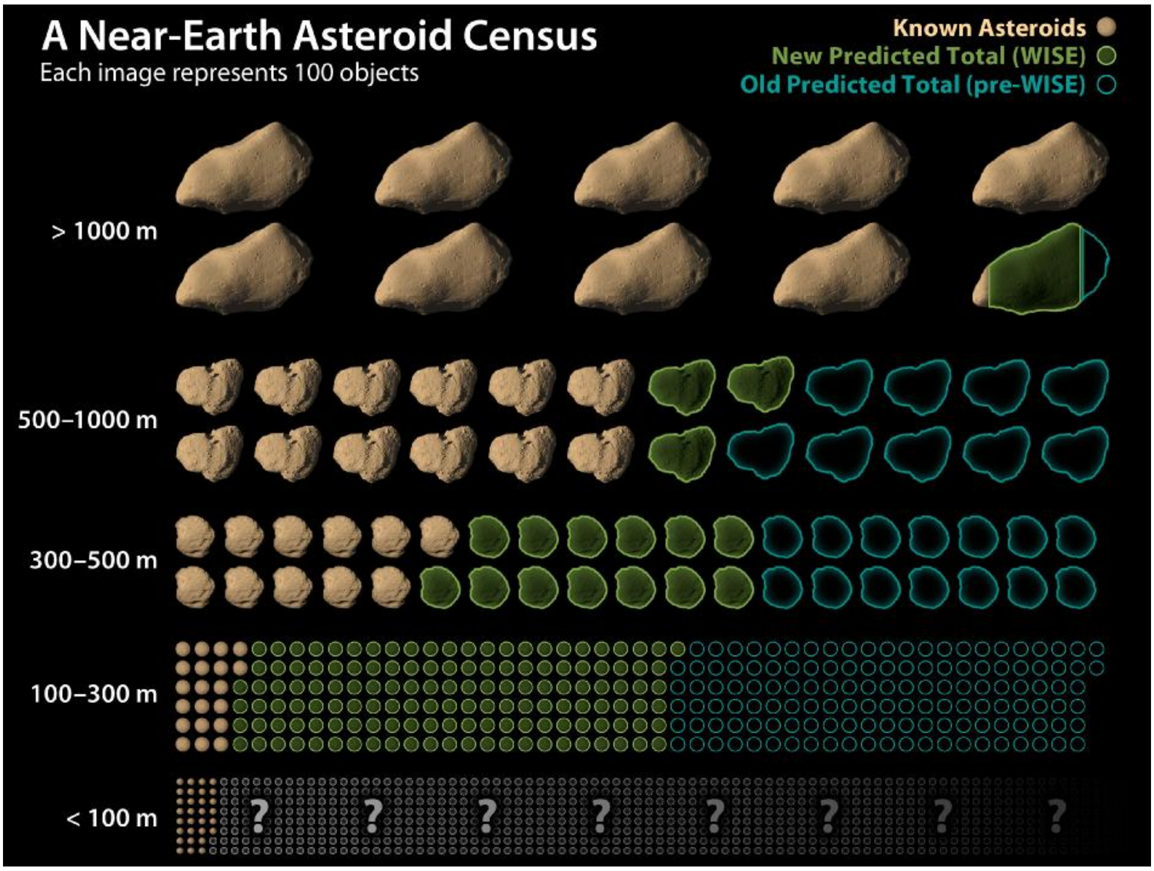


FIGURE 1.1: Near-Earth Asteroid Census by Wise Survey[3]: the number of asteroids with a diameter less than 100 m is unknown. With the technological evolution, the possibility of detecting these small asteroids becomes easier, increasing the chances of avoiding a collision of one of these asteroids with our planet.

[3]http://www.planetary.org/multimedia/space-images/small-bodies/wise-near-earth-asteroid.html

1.2 Objectives

The objective of this work is to analyze and process astronomical images to detect and characterize known asteroids that happen to cross them. The data were acquired by the ground-based observatory of La Sagra[4], for a specific science program of identification of asteroids. The objective is to recover the acquired data and extract more information related to the asteroids that serendipitously cross the field of view, in order to extract their celestial coordinates and contribute to the improvement of the Minor Planet Center[5] database. If it is possible, the photometry of each asteroid must be measured to build light curves and derive the rotational periods. To perform such tasks, some popular tools in the research group should be used, with special reference to Virtual Observatory[6] tools. Other professional astronomy software's will be used to perform more specific tasks and some script previously developed in IDL[7] should be adapted to build an autonomous pipeline.

1.3 Structure

The data received by the Observatory should be processed through the following steps:

1. Mapping of the number of datasets, number of images and respective directories - IDL;
2. Reducing the number of images through visual inspection in order to detect lack of quality, images with excessive artifacts, defects - Aladin, TOPCAT, AstroImageJ;
3. Reduction of images through the uniformization of the light field (flat correction), offset reduction between pixels (bias correction), removal of bad pixels (bad pixel correction) - IRAF;
4. Extraction of the centroid from the light sources contained in the images and respective statistical information - SExtractor, IDL;

[4] http://www.observatoriodelasagra.com/
[5] https://minorplanetcenter.net/
[6] http://www.ivoa.net/astronomers/applications.html

5. Astrometric calibration of the position of the light sources and insertion of the astrometric solution to the header of the images - SCAMP, MissFITS, IDL;
6. Extraction of the centroid from light sources with their celestial coordinates and statistical information - SExtractor, IDL;
7. Selection of images with better signal-to-noise ratio - STILTS, IDL;
8. Use of better signal-to-noise ratio images (non-consecutive) to produce a non-moving sources catalog and a catalog of moving sources - STILTS, IDL;
9. Calibration of the instrumental magnitude of the light sources through the Gaia DR2 catalog, in order to obtain the apparent magnitude - VizieR, STILTS, IDL;
10. Identification of the known asteroid positions in the images - SkyBoT, STILTS, IDL;
11. Filtering positions of asteroids close to stars that may negatively affect the calculation of the centroid - VizieR, STILTS, IDL;
12. Compilation of the results and production of summary tables - STILTS, IDL;
13. Filtering outliers points and checking the linearity of the positions of the asteroids and their proper motions - STILTS, IDL;
14. Joining the various positions of the same asteroid but different nights of observation in a single file - STILTS, IDL;
15. Visual inspection of results, positions and light curves - Aladin, TOPCAT, AstroImageJ;
16. Filtering outliers points and checking the linearity of the positions of the asteroids and their proper motions - STILTS, IDL;
17. Compilation of the results and production of summary tables - STILTS, IDL;
18. Extraction of light curves and computation of the phase-angle correction - Miriade, STILTS, IDL;
19. Calculation of rotation periods and comparison with existing literature - NASA Exoplanet Archive Periodogram.

1.4 Tools

These are the tools and services that I will use to fulfill the objectives of this work:

1. IDL[7]

   IDL is a scientific programming language popular in the astronomy and medical imaging fields, used for data analysis.

   Developed by: David Stern and ITT Visual Information Solutions

2. IRAF[8]

   IRAF is a software used to reduce and analyze astronomical data. It includes several internal packages for various operations with data obtained through optical sensors but also through infrared sensors. There are external packages that can be used to reduce and analyze data obtained with specific instruments, such as the Hubble Space Telescope.

   Developed by: National Optical Astronomy Observatory

3. SExtractor[9]

   SExtractor (Bertin and Arnouts 1996) is a software used to automatically detect sources in astronomical images, such as stars and galaxies. From an astronomical image this software allows to extract the positions of light sources, as well statistical information about them, signal-to-noise ratio, kind of object, photometry, etc.

   Developed by: Bertin, E. and Arnouts, S.

4. Scamp[10]

   Scamp (Bertin 2006) is a software used to read SExtractor catalogs and compute astrometric and photometric solutions, using reference catalogs from different space missions.

   Developed by: Bertin, E.

[7] `https://www.harrisgeospatial.com/Software-Technology/IDL`
[8] `http://iraf.noao.edu/`
[9] `https://www.astromatic.net/software/sextractor`
[10] `https://www.astromatic.net/software/scamp`

5. MissFITS[11]

   MissFITS (Marmo and Bertin 2008) is a software to read, write, edit, split, join or remove the FITS header of astronomical images. Also, it allows the user to create, check and update FITS checksum verification.
   Developed by: Marmo, C. and Bertin, E.

6. AstroImageJ[12]

   AstroImageJ (Collins et al. 2017) is a multipurpose software that reads and writes FITS images and standard headers, plate solve and adds WCS to images using the Astrometry.net web interface, provides object identification via an embedded SIMBAD interface, aligns image sequences and performs image calibration including bias, dark, flat, and non-linearity correction, computes differential photometry and performs many more possible tasks.
   Developed by: Wayne Rasband, Karen A.; Collins, John F.; Kielkopf.

7. Aladin[13]

   Aladin (Bonnarel et al. 2000) is a Virtual Observatory tool to visualize astronomical images or full surveys, cross-match astronomical catalogs and databases, and interactively access different services that can help to analyze data.
   Developed by: Bonnarel, F.; Fernique, P.; Bienaymé, O.; Egret, D.; Genova, F.; Louys, M.; Ochsenbein, F.; Wenger, M.; Bartlett, J. G.

8. TOPCAT[14]

   TOPCAT (Taylor 2005) is a Virtual Observatory tool to visualize and interact with tabular data and create useful plots. The software provides tools which are most often used by astronomers to analyze the data in an easy way. It is possible to cross-match different tables with different surveys, calculate statistics, create higher-dimensional

[11] `https://www.astromatic.net/software/missfits`
[12] `https://www.astro.louisville.edu/software/astroimagej/`
[13] `https://aladin.u-strasbg.fr/`
[14] `http://www.star.bris.ac.uk/~mbt/topcat/`

visualization and use many other options.

Developed by: Taylor, M. B.

9. STILTS[15]

   STILTS (Taylor 2006) is the command-line version software of TOPCAT. This software offers a more efficient and robust way to analyze and manipulate data.

   Developed by: Taylor, M. B.

10. SkyBoT[16]

    SkyBoT (Sky Body Tracker) (Berthier et al. 2006) is a Virtual Observatory service to retrieve information about Solar System objects from astronomical images, giving a region of the sky at a given epoch.

    Developed by: Berthier, J.; Vachier, F.; Thuillot, W.; Fernique, P.; Ochsenbein, F.; Genova, F.; Lainey, V.; Arlot, J.-E.

11. VizieR[17]

    VizieR is an astronomical catalog service. The service allows direct access to many catalogs, locating objects from different groups of data, desired wavelengths or keywords referring to missions or objects.

    Developed by: CDS - Centre de Données Astronomiques de Strasbourg.

12. Miriade[18]

    Miriade (Berthier et al. 2009) is a Virtual Observatory service to compute positional and physical ephemerides of known Solar System bodies.

    Developed by: J. Berthier; Benoit Carry; D. Hestroffer; Frédéric Vachier.

13. NASA Exoplanet Archive Periodogram[19]

    This tool from NASA Exoplanet Archive can compute periods from light curves, using different algorithms, returning the periodogram itself, with the spectral power as a function of frequency and a table of the peaks in the periodogram.

[15] http://www.star.bris.ac.uk/~mbt/stilts/
[16] http://vo.imcce.fr/webservices/skybot/
[17] https://vizier.u-strasbg.fr/viz-bin/VizieR
[18] http://vo.imcce.fr/webservices/miriade/?ephemph
[19] https://exoplanetarchive.ipac.caltech.edu/index.html

> Developed by: “This research has made use of the NASA Exoplanet Archive, which is operated by the California Institute of Technology, under contract with the National Aeronautics and Space Administration under the Exoplanet Exploration Program.”

In this project some tools from the Virtual Observatory are used. Virtual Observatory is a collection of tools and data archives with free access for any user to perform astronomical operations and to deal with astronomical data. The primary goals of these tools are to provide free and transparent data access and provide a research environment for many different projects. The International Virtual Observatory Alliance (IVOA)[20] is the organization responsible for the regulation of the technical standards of the tools and datasets, and to share and promoting the Virtual Observatory concept.

[20] `http://www.ivoa.net/`

Chapter 2

Data Acquisition

”Telescopes are in some ways like time machines. They reveal galaxies so far away that their light has taken billions of years to reach us. We in astronomy have an advantage in studying the universe, in that we can actually see the past. We've made so many advances in our understanding. A few centuries ago, the pioneer navigators learn the size and shape of our Earth, and the layout of the continents. We are now just learning the dimensions and ingredients of our entire cosmos, and can at last make some sense of our cosmic habitat.”

Sir Martin Rees

2.1 Astronomical Observatory of La Sagra

The “Astronomical Observatory of La Sagra” is an observatory located in Sierra de La Sagra, in the province of Granada. The Observatory was inaugurated on June 14, 2004 in order to respond to educational and scientific activities related to the areas of astronomy and astrophysics. Situated at 1530 m of altitude, it is in one of the regions with lower levels of light pollution of the Iberian Peninsula, thus providing good conditions for astronomical practices[1]. The Observatory operates under partnerships with the “Instituto de

[1] `http://www.observatoriodelasagra.com/`

Astrofísica de Andalucía”[2] and with the “Consejo Superior de Investigaciones Científicas” (IAA-CSIC)[3].

The “Instituto de Astrofísica de Andalucía” in collaboration with the “Consejo Superior de Investigaciones Científicas” carries out scientific activities with main focus in the study of the Solar System, from the study of Transneptunian Bodies to the study of the Giant Planets. The Observatory also collaborates with international institutions such as the “Observatoire de Paris”[4] and the “Observatório Nacional”[5] of Rio de Janeiro. The most relevant projects are the study of the relationship between meteorite impacts on the lunar surface and the entry of meteorites into the Earth’s atmosphere, the study and observation of star occultations, and an important observatory project called “La Sagra Sky Survey”[6].

2.2 La Sagra Sky Survey

La Sagra Sky Survey is a project focused on the detection and monitoring of Small Bodies of the Solar System, in this case asteroids and comets. The first detection occurred in June 2006 (2006 SX19): a Main Belt asteroid was discovered by the team of the “Observatorio Astronómico de Mallorca”[7] using data obtained in “Astronomical Observatory of La Sagra”. In November 2006, the “Astronomical Observatory of La Sagra” was officially included in the database of the Minor Planet Center, code J75[8]. In July 2007, the fourth asteroid was discovered that describes the same orbit as the planet Mars (2007 NS2) (Shiga 2007). In the following years, the equipment and methodologies of detection and reduction of data were continuously improved, thus allowing to detect new asteroids and to monitor the orbits of the known asteroids. In February 2012, the Duende asteroid was detected and it was calculated that the following year it would approach Earth to a distance of 34 000 km, which is approximate to the orbital distance of the geosynchronous satellites[9]. The Observatory

[2] https://www.iaa.csic.es/
[3] http://www.csic.es/
[4] https://www.obspm.fr/
[5] http://www.on.br/
[6] http://www.minorplanets.org/OLS/
[7] http://www.oamallorca.org/
[8] https://minorplanetcenter.net/
[9] https://www.minorplanetcenter.net/mpec/K12/K12D51.html

also counts on the discovery of two comets in 2009, the P/2009 QG31 and the P/2009 T2 and other numerous detections, including space junk.

2.3 Acquisition Equipment

To acquire the astronomical data images it is necessary to use several types of equipment, each with a specific function:

1. Telescope: Schmidt-Cassegrain Celestron C14[10]

   The telescope used is a Schmidt-Cassegrain type. This type of telescope combines the Cassegrain reflector's optical path with a Schmidt correction lens, in order to obtain a compact and easy to construct telescope, only with spherical mirrors. Usually they are economic telescopes with good apertures and great focal distances. Particularly, this telescope is very popular in the market and used by several observatories for educational and scientific purposes. This telescope has a focal length of 3910 mm and a aperture of 356 mm, with a focal ratio of f/11, producing a very small field of view. However, this telescope is prepared to use a HyperStar, a tool that can increase the field of view.

2. Telescope Mount: Paramount ME[11]

   To use the telescope it is necessary to install it on an electronic mount to point and track different targets or sky locations. For this operation a very accurate equatorial mount - Paramount ME - was chosen. This type of mount can track the targets only moving one axis, compensating the apparent motion of the night sky objects due to the rotation of the Earth. With the tracking system it is possible to take long exposure astronomical images, maximizing the signal-to-noise ratio. It is also possible to track asteroids with different speeds. This mount can carry instruments up to 109 kg or 218 kg with counterweights.

3. Camera: SBIG ST10[12]

   The imaging CCD camera is an enhanced KAF-3200ME imaging sensor from Kodak

[10] `https://www.celestron.com/products/edgehd-14-optical-tube-assembly`
[11] `http://www.bisque.com/sc/pages/ParamountMEII.aspx`
[12] `http://www.company7.com/sbig/products/st10.html`

with 3.2 million pixels, full-frame resolution of 2184 x 1472 pixels at 6.8 microns and 16 bit analog to digital converter. It is possible to use different binning configurations to change the field of view created by the camera. This camera has a good quantum efficiency level, reaching more than 65% for some specific wave lengths, ultra low dark current and two cooling stages that can decrease the sensor temperature approximately -40 °C below ambient temperature.

4. Extra: HyperStar 14"[13]

   The Celestron C14 is a telescope prepared to use a HyperStar equipment. Using this equipment, it is possible to reduce the focal length from 3910 mm to 712 mm, converting the telescope from f/11 to f/2 focal ratio. This equipment combined with the astronomical camera replaces the secondary mirror of the telescope, shortening the light path through the telescope. In this way, the field of view will increase drastically, producing better and easier astronomical images for the purpose of this project.

To acquire the astronomical images, the telescope plus the HyperStar equipment mentioned above were used to obtain wide field astronomical images. The astronomical camera was used with a working temperature defined to -25 °C, in order to decrease the dark current / noise in the images. The camera was also used with the binning mode of 2 x 2, changing the image resolution from 2184 x 1472 to 1092 x 736 pixels and the pixel size (combining pixels theoretical) from 6.8 to 13.6 microns, in order to adjust the field of view. The produced field of view is 75 x 50.6 arcmin of size. The astronomical images were not acquired with any filter. Using astronomical filters, for example Johnson filters, it is possible to classify and calculate the magnitude of stars and other sources.

2.4 Data

During 20 nights of observation, astronomical images were acquired for follow-up of some known asteroids, for an independent project of the Observatory. The entire process of data

[13] `https://starizona.com/store/hyperstar/hyperstar-c14/hyperstar-14`

acquisition is independent of this project, which exploits the astronomical images acquired to get more information about known asteroids.

The astronomical images were acquired from December 2017 to May 2018, in the "Astronomical Observatory of La Sagra". On each observing night one or more target asteroids were selected by the observer and successive images were obtained during the available time. Most of the data was acquired during the nocturnal period, however some of it was obtained during the astronomical twilight or in few cases during the nautical twilight, as figure 2.1 shows. Astronomical images obtained outside the night period may compromise the sample uniformity, resulting in images with greater background illumination that leads to a lower signal-to-noise ratio. Not all data can be used due to quality issues.

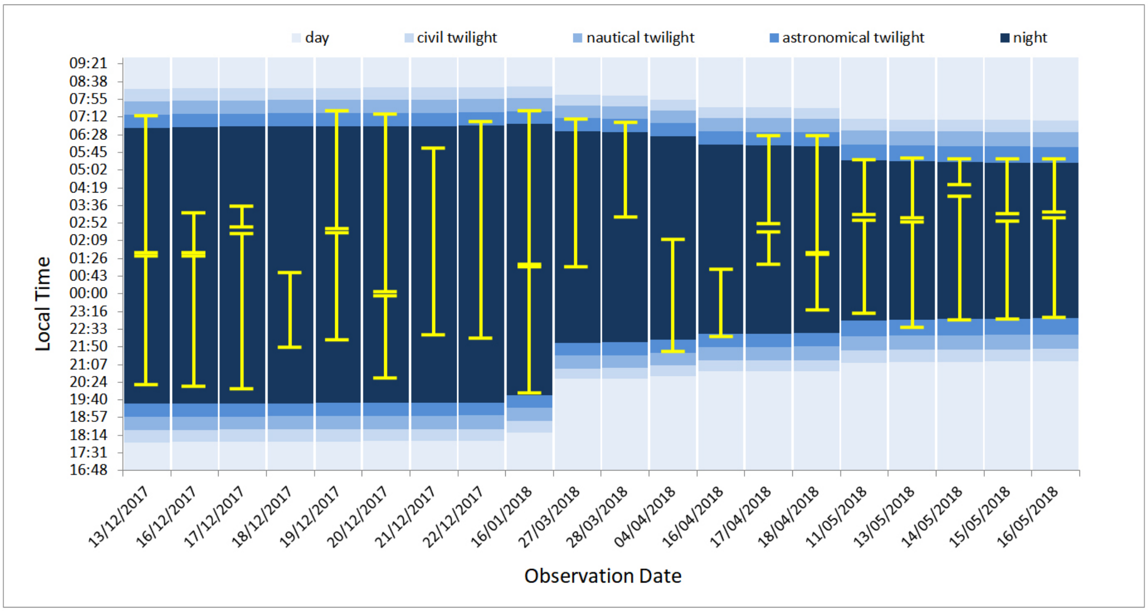


FIGURE 2.1: Observations summary: during 20 nights of observation, astronomical images were acquired. Daytime, crepuscular and nocturnal periods are represented and each set of data is marked in yellow.

The astronomical images were obtained mainly when the moon was under the horizon and also, when the moon had a low level of illumination, as figure 2.2 shows. However, in some cases, the data was obtained close to the full moon.

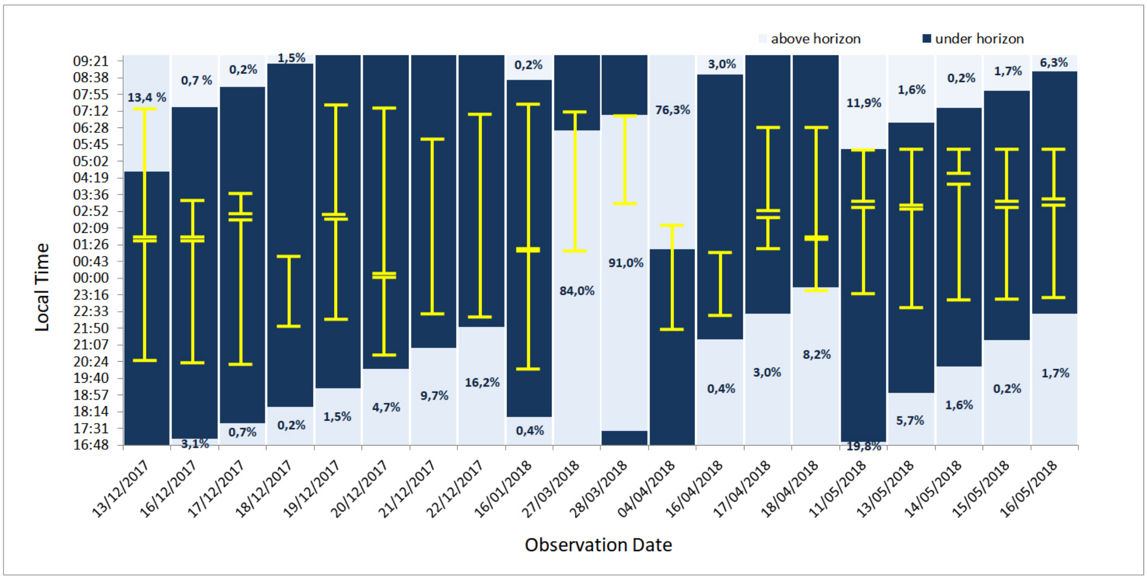


Figure 2.2: Moonrise, moonset and illumination: during 20 nights of observation, astronomical images were acquired. The moon periods above and under the horizon are represented and each set of data is marked in yellow.

One of the key parameters that has to be chosen in the CCD camera is the exposure time. The exposure time should vary according to the magnitude of the target asteroid. If the central asteroid that was followed has a large magnitude, the exposure time will be longer in order to increase the signal-to-noise ratio; if the asteroid has a small magnitude, the exposure time will be shorter to not saturate the pixels corresponding to the source. The exposure time should also vary according to atmospheric conditions, light sky contaminations, the percentage of moon illuminated and other factors. Figure 2.3 shows the exposure time used for each asteroid apparent magnitude.

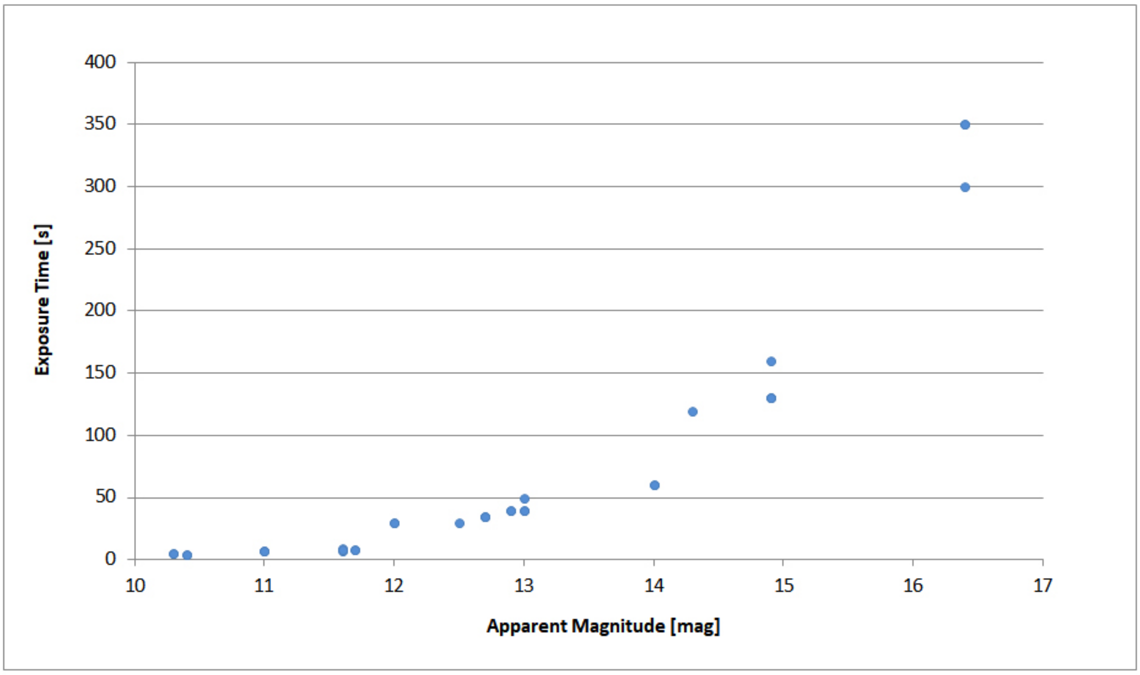


FIGURE 2.3: Exposure time versus magnitude: exposure time set according with the magnitude of the target asteroid.

The spatial distribution of the astronomical images is mainly around the ecliptic, as figure 2.4 shows, because the selected target asteroids are asteroids belonging to the asteroid Main Belt.

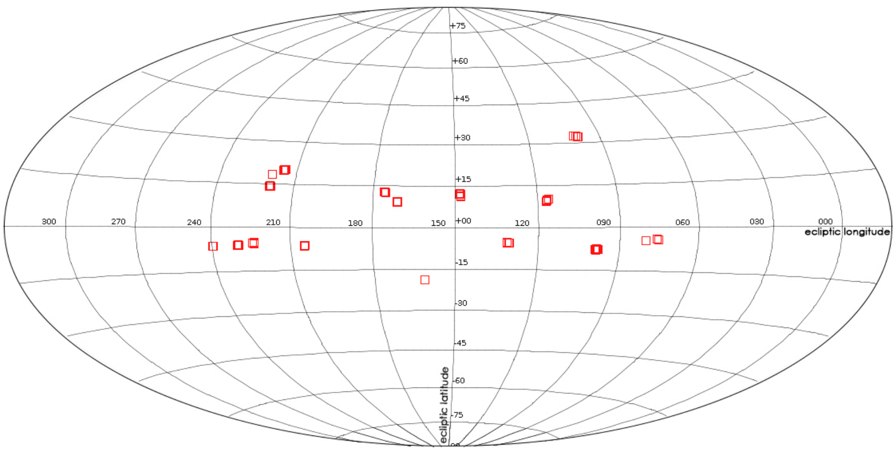


FIGURE 2.4: Data spatial distribution: distribution of the astronomical images acquired, represented with red squares. The spatial distribution of the data is around the ecliptic.

Chapter 3

Data Reduction and Calibration

"Not everything that can be counted counts, and not everything that counts can be counted."

Albert Einstein

3.1 Overview

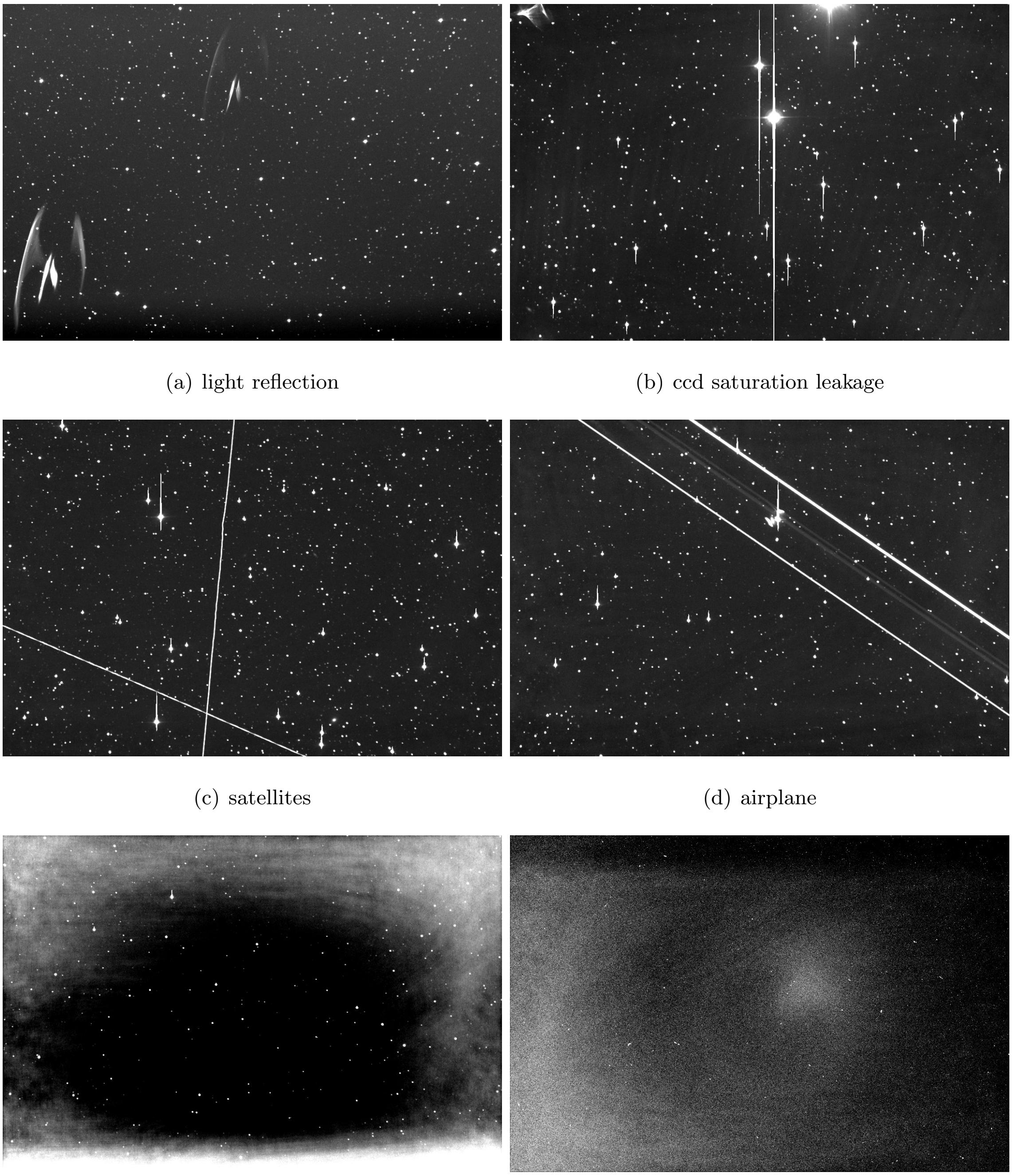
Before starting analyzing the astronomical data, it is necessary to prepare the astronomical images in order to get accurate results. To prepare them there are several steps to do:

- Removing astronomical images with poor quality, artifacts and defects;
- Reducting of the astronomical images applying bias, flat and bad pixels corrections;
- Astrometric calibration of the astronomical images to convert the XY position of each light source to celestial coordinates;
- Photometric calibration of the astronomical images to convert the instrumental magnitude of each light source to apparent magnitude.

:

3.2 Image Quality Control

Before starting the calibration of the astronomical images it is necessary to make a visual inspection, in order to detect images with lack of quality and/or defects. This is done using AstroImageJ software, where it is possible to upload a set of images and automatically view these images sequentially. Some defects, traces of satellites and airplanes, saturated stars, etc, may not deteriorate the detection and characterization of the asteroids, if their positions do not overlap. Images with excessive noise or light contamination are not suitable for the aim of this study. Figure 3.1 shows different examples of astronomical images not suitable for the project. Astronomical images not suitable for this projects due to the effects mentioned above, were deleted from the datasets.



(a) light reflection (b) ccd saturation leakage

(c) satellites (d) airplane

(e) light contamination (f) excess of noise

Figure 3.1: Images not suitable: some examples of poor quality images, artifacts or defects. When it is not possible to use these images, they are removed manually from the datasets.

After the image quality control, the quantity of astronomical images of some datasets were reduced. Figures 3.2 and 3.3 show the percentage of use of each dataset. The absence of percentages means that all dataset was used:

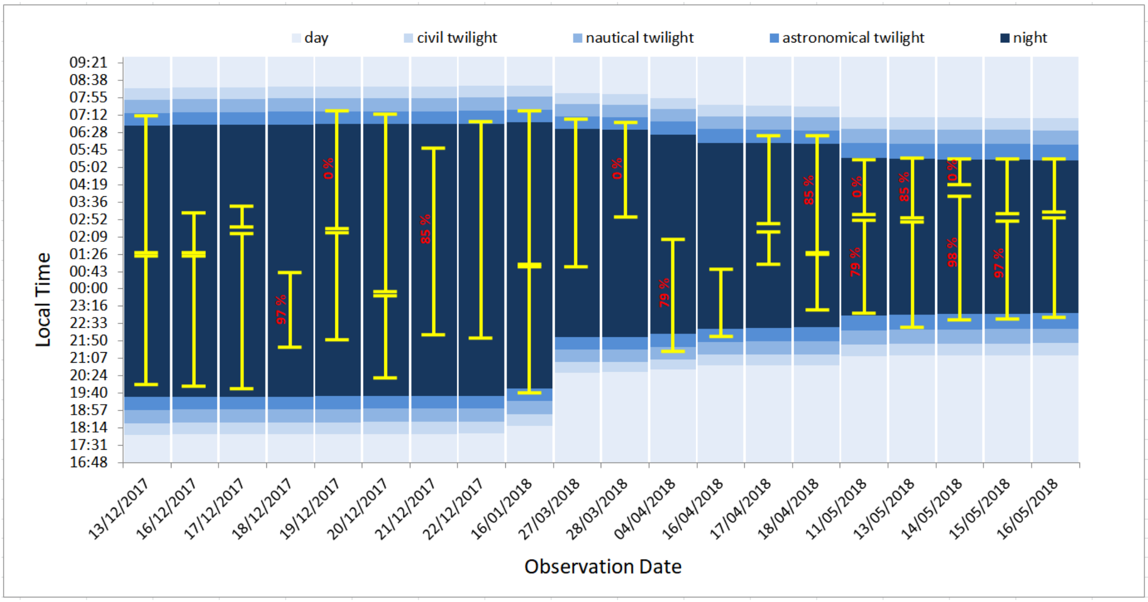


FIGURE 3.2: Observations summary - percentages of use: during 20 nights of observation, astronomical images were acquired. Daytime, crepuscular and nocturnal periods are represented and each set of data is marked in yellow. In red are the percentages of use of each dataset. The absence of percentages means that all dataset was used.

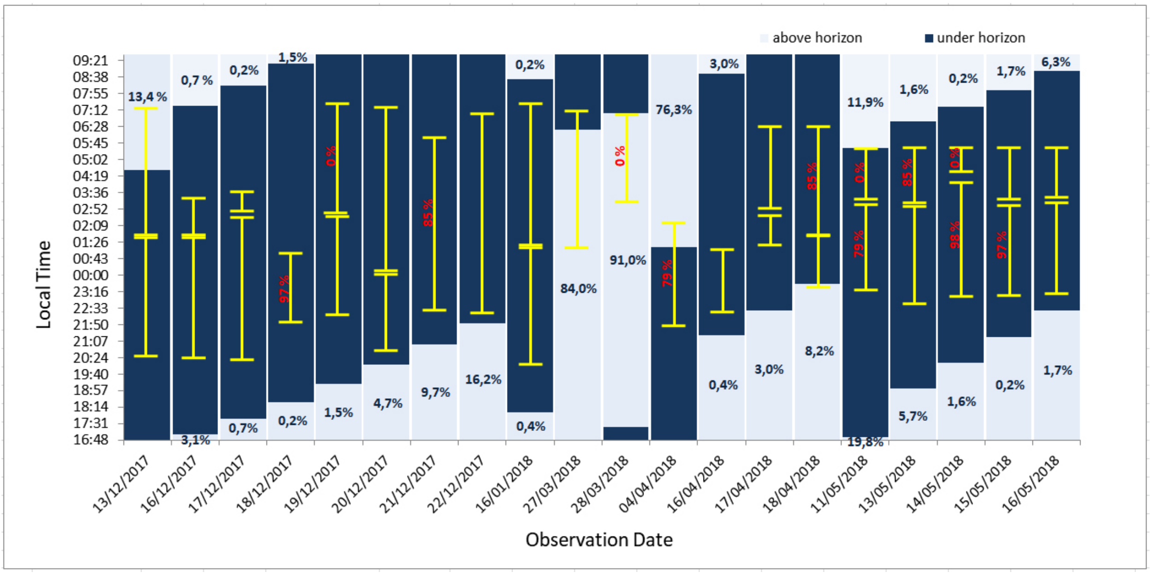


FIGURE 3.3: Moonrise, moonset and illumination - percentages of use: during 20 nights of observation, astronomical images were acquired. The moon periods above and under the horizon are represented and each set of data is marked in yellow. In red are the percentages of use of each dataset. The absence of percentages means that all dataset was used.

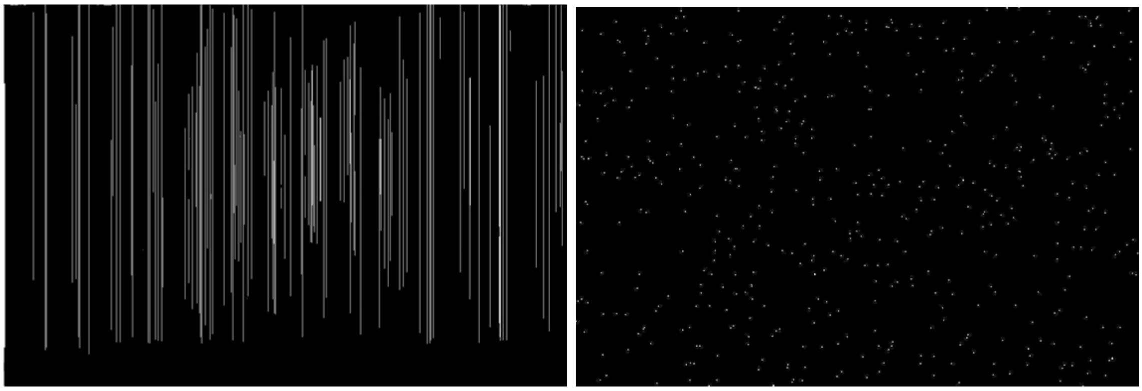
3.3 Data Reduction

To reduce the data received from the "Astronomical Observatory of La Sagra", IRAF software is used. The Observatory provides two calibration images ready to use, a master bias and a master flat. It would still be advantageous to use other calibration image, such as a master dark to reduce thermal noise levels and a mask containing information of dead/defective pixels, to be removed from the data images.

The lack of a master dark for reduction does not present a major problem. As the CCD sensor has an active cooling system that allows the temperature to stabilize at approximately -25^o C, the thermal noise present in the data is very low.

Although a dead/bad pixel mask was not provided, the IRAF software function "`ccdmask`" was used to create a mask . Usually the ratio between a master flat with high level of counts and a master flat with a low level of counts is calculated to create the dead/bad pixel mask. Since these two different master flats were not available, the provided master flat and the master bias were used experimentally to create two different masks, one with the master flat and another with the master bias.

Using the recommended standard parameters to calculate both masks with the different calibration images, the resulting mask using the master flat does not display correct values. This mask displays several vertical lines of dead/defective pixels, which we observe are not real. The mask calculated through the master bias presents only isolated pixels corresponding to the pixels with greater intensity of the original image, or in another words, the dead pixels. Figure 3.4 shows the comparison between bad pixel masks calculated through the master flat frame (on the left) and the master bias frame (on the right). The master mask calculated through the master bias frame reflects better the nature of the images.



(a) bias bad pixel mask

(b) flat bad pixel mask

Figure 3.4: Bad pixel mask: comparison between bad pixel masks calculated through the master flat frame (a) and through the master bias frame (b).

The first step in image reduction using the IRAF software is the Instrument Translation File configuration. This setting allows the software to search for and use the correct keywords contained in the image header for processing. For example, when a flat field correction is applied to an image, this information should be recorded in the image header. The default keyword to indicate this correction is "fltacor", however if a different Instrument Translation File is defined, the used keyword may change to "ff-flag". The Instrument Translation Files may also be created and used.

For this project the Instrument Translation File - "direct.dat" that uses the standard keywords was used. For data processing, it is not necessary to use the information contained in the image header, because the tasks to be performed can be completely parameterized in the software. Only the data header will be used to indicate the reductions/calibrations applied. Figure 3.5 list an example of the configuration parameters of the Instrument Translation File.

```
# Sample translation file.
exptime                 itime
darktime                itime
imagetyp                data-typ
subset                  f1pos
biassec                 biassec         [411:431,2:573]
datasec                 datasec         [14:385,2:573]

fixpix                  bp-flag         0
overscan                bt-flag         0
zerocor                 bi-flag         0
darkcor                 dk-flag         0
flatcor                 ff-flag         0
fringcor                fr-flag         0

'OBJECT (0)'            object
'DARK (1)'              dark
'PROJECTOR FLAT (2)'    flat
'SKY FLAT (3)'          other
'COMPARISON LAMP (4)'   other
'BIAS (5)'              zero
'DOME FLAT (6)'         flat

# Ficheiro de configuracao utilizado (direct.dat):
DARK                    dark
BIAS                    zero
OBJECT                  object
'DOME FLAT'             flat
'PROJECTOR FLAT'        flat
'COMPARISON LAMP'       comp
'SKY FLAT'              object
```

FIGURE 3.5: Example of a Instrument Translation File: the first column corresponds to the standard words, the second column to the words to be used instead of the standard words, and the third column to the default values to be used according to the required processing.

After an Instrument Translation File has been configured and selected, the data type must be set to perform the calculations and the output files. In this case the Real data type was used. A log file has also been defined to monitor all processing.

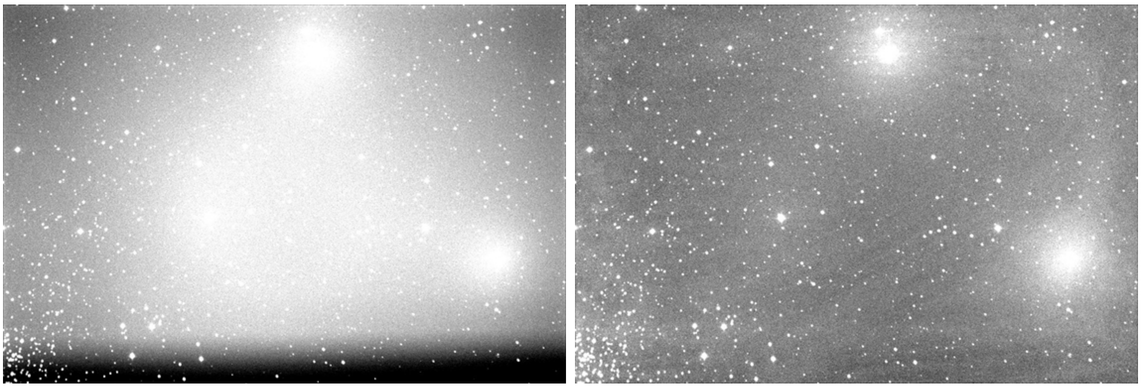
Subsequently the data can be reduced.

During a data acquisition session, according to the assembly and the telescope used, it may be necessary to perform a meridian flip to the equipment when the astronomical object crosses the meridian of the location. The equipment used at the "Astronomical Observatory of La Sagra" requires this execution. After the meridian flip, the images will have a 180º rotation compared to the previous images. However, the data acquisition software used by the Observatory performs an automatic rotation in the images to standardize all acquired data. Although the astronomical data have the same orientation, the orientation of the flat field, the bias field and the dead pixels will not be the same as in the previous data. The previous data should be reduced with the original calibration images, while the subsequent data should be reduced with the calibration images rotated 180º.

When the data images are acquired after the meridian flip, the keyword "Mirror Flip" is indicated in the image header. The IRAF software can perform a header check of each image and create two lists of data to be reduced with different orientations.

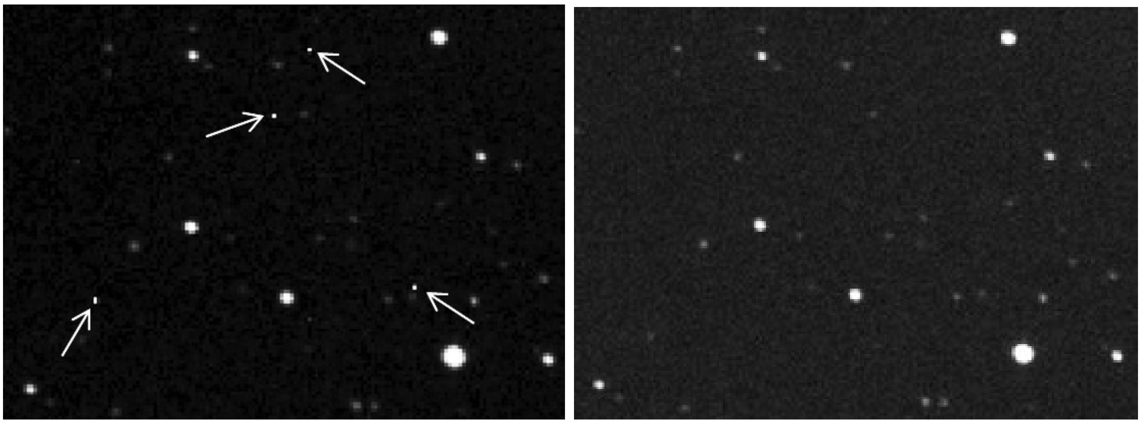
First, a list of all the images to be processed is created. From this list, the IRAF software will check which ones were acquired before and which ones were acquired after the meridian flip, creating two new lists. New calibration images are created from the originals, but rotated 180º. And finally, both lists of data are reduced with the correct calibration images.

Figures 3.6 and 3.7 show the final image after applying the bias, flat and bad pixel correction. It is easy to notice that the final image resulted in a uniform light field and the bad pixels were removed.



(a) before reduction (b) after reduction

FIGURE 3.6: Bias and flat correction: comparison between an image before applying the bias and flat correction (a) and after applying the correction (b).



(a) before reduction (b) after reduction

FIGURE 3.7: Bad pixel correction: comparison between an image before applying the bad pixel correction (a) and after applying the correction (b).

3.4 Data Calibration

3.4.1 Astrometric Calibration

The astrometric calibration consists of transforming the physical CCD position of each light source in the astronomical images to the celestial right ascension and declination positions, or celestial coordinates, through comparison with astrometric catalogs. To compute the astrometric solution it is necessary to extract the XY position of each light source using another tool, SExtractor. To detect the light sources, it is necessary to define some fundamental parameters, mainly the threshold/intensity pixel value and the minimum pixel area associated with each light source. These values have been empirically defined in order to detect the maximum light sources and the minimum noise. A convolution mask was also used to aid in the correct calculation of the centroid of each light source.

SExtractor outputs a table with the required values according with the chosen parameters. There are more than 400 different parameters which the user can choose. For the astrometric calibration were used the "XWIN_IMAGE" (X coordinate of windowed image centroid), "YWIN_IMAGE" (Y coordinate of windowed image centroid), "ALPHAWIN_SKY" (native right ascension of the windowed image centroid) and "DELTAWIN_SKY" (native declination of the windowed image centroid). The windowed method to calculate centroids is much more accurate than the other methods available by SExtractor, close to the theoretical limit due to the noise in the image. This method uses a circular Gaussian window scaled to each object, to integrate the pixel values.

SExtraxtor identifies light sources through a process called *segmentation*, which consists in the separation of areas of the image due to changes in brightness, textures, colors, edges, etc. For example, SExtractor can identify a light source due to a group of connected pixels that exceed a threshold value above the sky background. However, there are some limitations, noisy images, non-uniform background, and the overlap of sources can affect the software and create errors. In the end, SExtractor outputs a catalog with the XY positions of the extracted light sources, as shown in figure 3.9. If there is an astrometric solution provided in the header of the astronomical image, SExtractor will output another catalog with the celestial coordinates of each extracted light source.

Figure 3.8 shows the raw original image, in order to compare with the figure 3.9, after SExtractor identify the light sources in the astronomical image and extract their positions.

Figure 3.8: Raw image: original astronomical image.

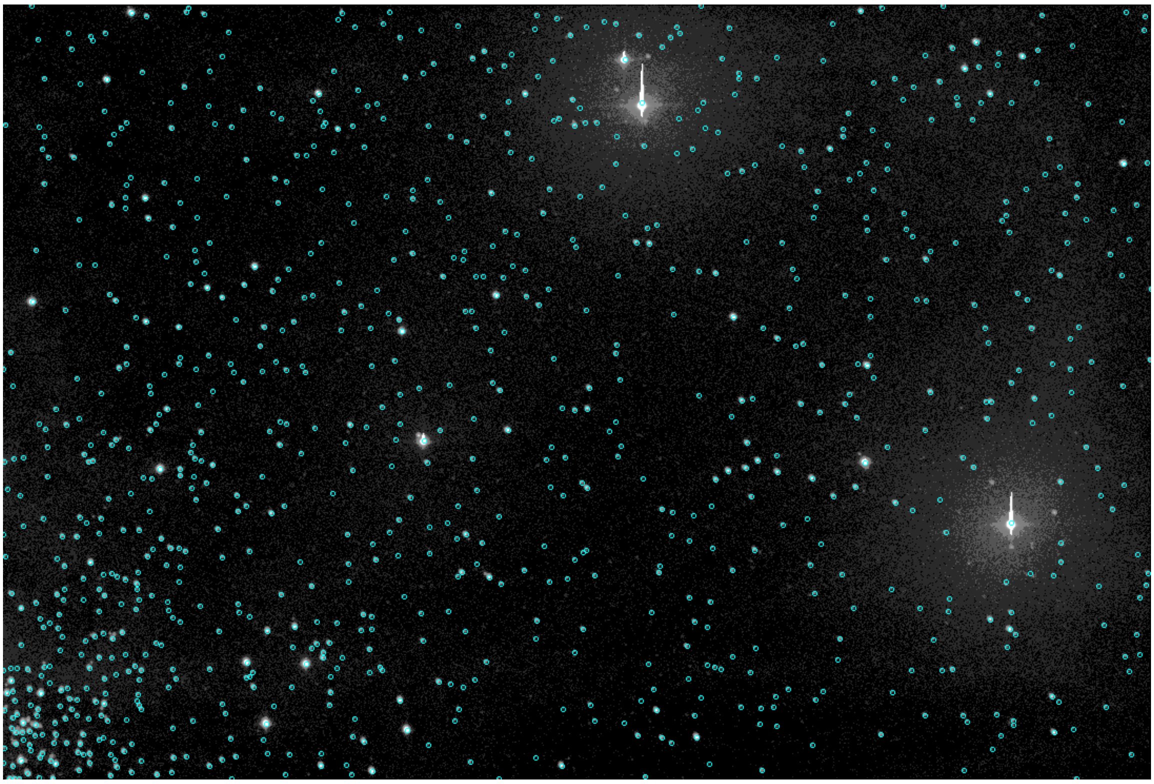


FIGURE 3.9: Light sources detected by SExtractor: the circles in blue represent the light sources detected and extracted.

After detecting and extracting the XY position of each light source, it is necessary to add some basic parameters to the header of each image for Scamp software to compute the astrometric solution, as shown in table 3.1. Some of these parameters are: "Equinox" - equinox used to compute the astrometric solution (2000); "CTYPEn" - indicates the type of the world coordinate system (equatorial) and the type of projection (gnomonic); "CUNITn" - indicates the unit type of the world coordinate system (degrees); "CRVALn" - indicates the world coordinate system value of the center of the image; "CRPIXn" - indicates the X or Y coordinate of the reference pixel at which projection and rotation refer; "CDi_j" - indicates rotation matrix, in order to calculate the rotation and scale of the image. "n" refers to the axis and "i" and "j" to the matrix index.

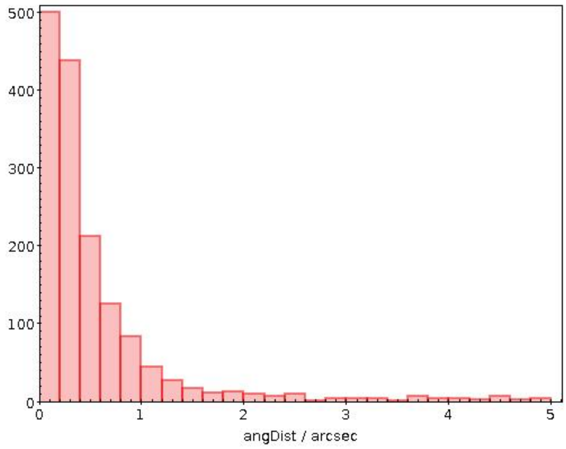
Keyword	Value	Description
EQUINOX	2000	Mean equinox
CTYPE1	RA—TAN	WCS type and projection type
CTYPE2	DEC–TAN	WCS type and projection type
CUNIT1	deg	WCS axis unit
CUNIT2	deg	WCS axis unit
CRVAL1	RA*	WCS value on this axis
CRVAL2	DEC*	WCS value on this axis
CRPIX1	X*	Reference pixel on this axis
CRPIX2	Y*	Reference pixel on this axis
CD1_1	-0.001	Linear projection matrix
CD1_2	0.00005	Linear projection matrix
CD2_1	0.00005	Linear projection matrix
CD2_2	0.001	Linear projection matrix

TABLE 3.1: Astrometric reference parameters: standard parameters necessary to add to the header of the images for Scamp to compute the astrometric solution.
*These parameters change from image to image and are replaced by their respective values.

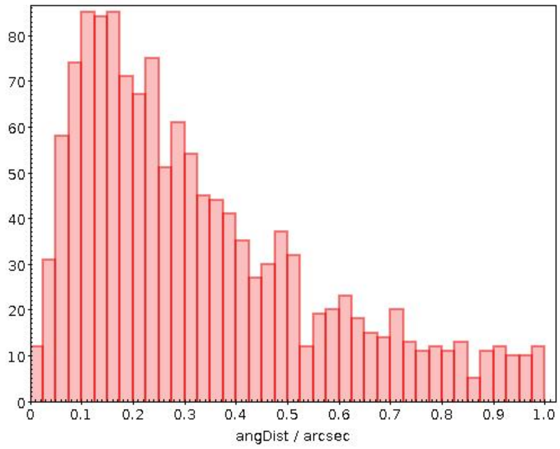
For Scamp to compute the astrometric solution it is necessary to define stellar catalog as a reference. Within the possibilities, the 2MASS catalog was chosen (Skrutskie et al. 2006). Preferably we would have used the new Gaia DR2 catalog (Brown et al. 2018), but this option is not available in this calibration software. After calibration, Scamp creates a file with the astrometric solution and this solution is added to the header of the respective image using another very simple software, MissFITS. Afterwards, SExtractor is used again to extract the sources, but this time with the equatorial coordinates instead of XY coordinates, making use of the astrometric solution provided by Scamp.

In order to verify the centroid calculation accuracy for each light source through the SExtractor software and the calculation efficiency of the astrometric solution, the software TOPCAT was used. With this software, we performed a cross-match between the equatorial coordinates of a given image with the equatorial coordinates given by the Gaia DR2 catalog. From the results obtained we can verify that the angular distance of about 84.68%

of the stars is less than 1 arcsec with a standard deviation of 0.24 arcsec. This reflects the high quality of the performed astrometric calibration. Figure 3.10 shows the distribution of the separation between calculated coordinates and Gaia DR2 coordinates.



(a) separation 0..5 arcsec



(b) separation 0..1 arcsec

FIGURE 3.10: Histogram of the separation between calculated coordinates and Gaia DR2 coordinates: figure (a) is a general overview of the angular distance and figure (b) is a close overview from 0 to 1 arcsec.

Table 3.2 shows the angular separation between calculated coordinates and Gaia DR2 coordinates. From a total number of 1606 sources there are 72 sources with angular separations greater than 5 arcsec, 46 sources with angular separations between 2.5 and 5 arcsec, 47 sources with angular separations between 1.5 and 2.5 arcsec, 81 sources with angular separations between 1.5 and 1 arcsec and 1 360 sources with angular separation less than 1 arcsec.

Angular Separation [arcsec]	Number of Sources	Percentage
angDist ≥ 5”	72	4.48%
5” > angDist ≥ 2.5”	46	2.86%
2.5” > angDist ≥ 1.5”	47	2.92%
1.5” > angDist ≥ 1”	81	5.04%
1” > angDist	1360	84.68%

TABLE 3.2: Separation distribution between calculated coordinates and Gaia DR2 coordinates.

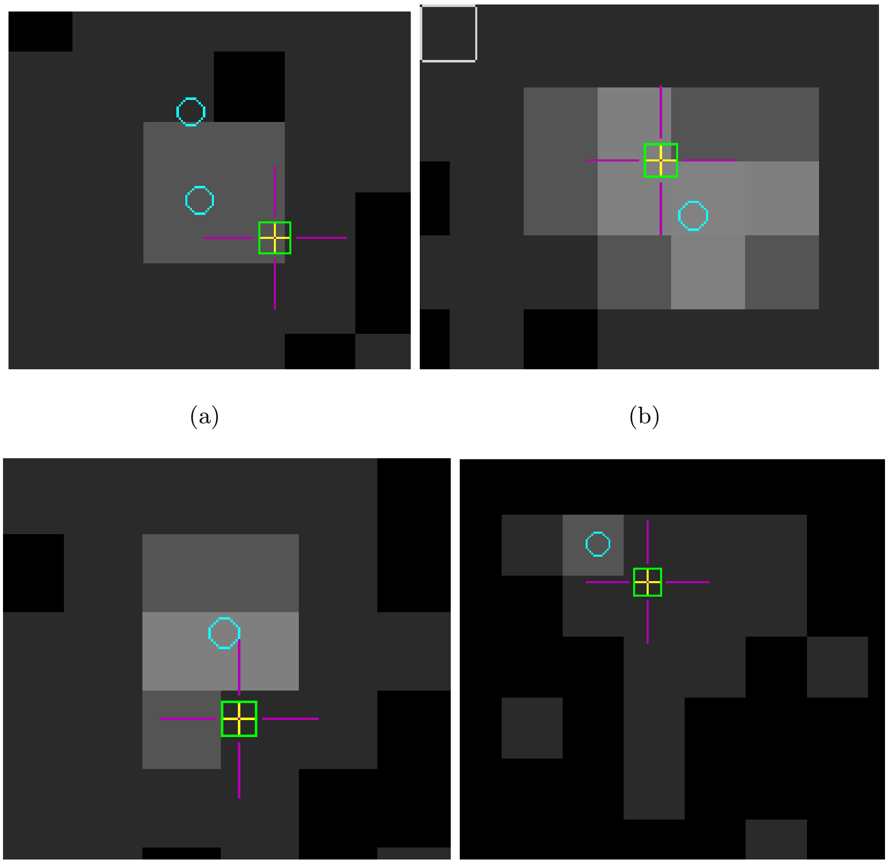
Some of the causes that result in angular separations greater than 1.5 arcsec are the following:

1. Bad Centroid Determination:

   (5" > angDist ≥ 2.5": 28% of 46 sources)

   (2.5" > angDist ≥ 1.5": 23% of 47 sources)

   See figure 3.11 for some examples.



(a) (b)

(c) (d)

FIGURE 3.11: Bad centroid: marked in blue are the positions of the Gaia DR2 catalog and marked with a cross are the positions of the calculated centroid.

2. Double Visual or Physical Stars:

   (5" > angDist ≥ 2.5": 39% of 46 sources)

   (2.5" > angDist ≥ 1.5": 38% of 47 sources)

   See figure 3.12 for some examples.

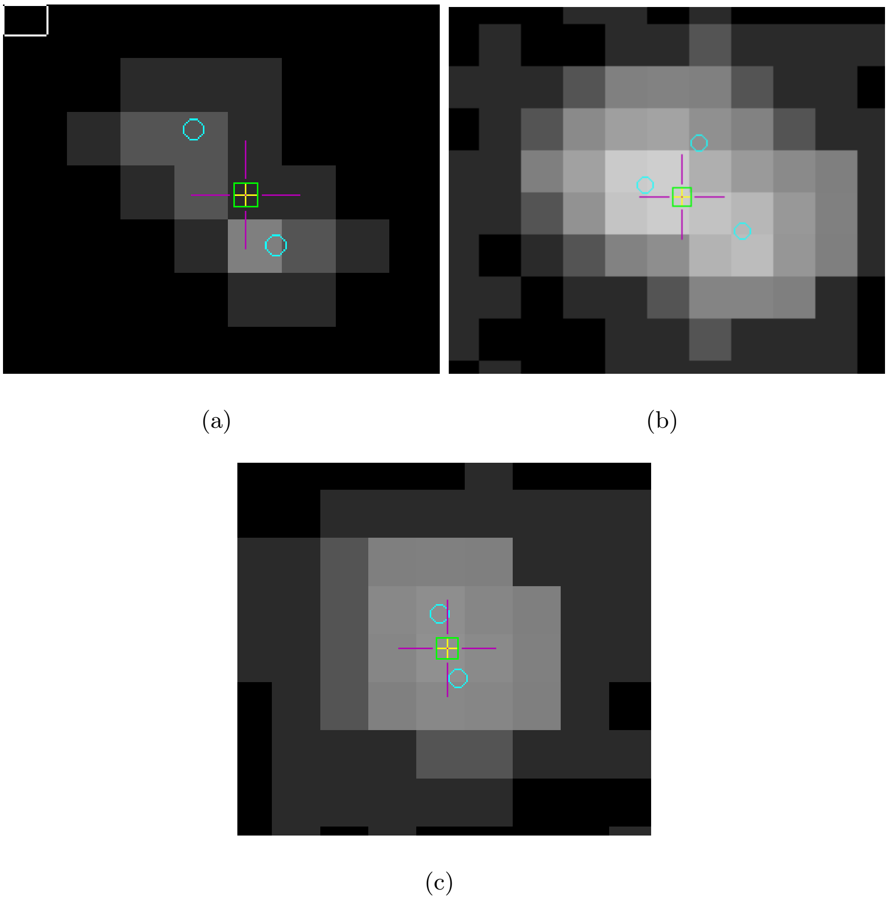


FIGURE 3.12: Double stars: marked in blue are the positions of the Gaia DR2 catalog and marked with a cross are the positions of the calculated centroid.

3. Source Lies at the Edges of the Images:

   (5" > angDist ≥ 2.5": 6% of 46 sources)

   (2.5" > angDist ≥ 1.5": 4% of 47 sources)

   See figure 3.13 for some examples.

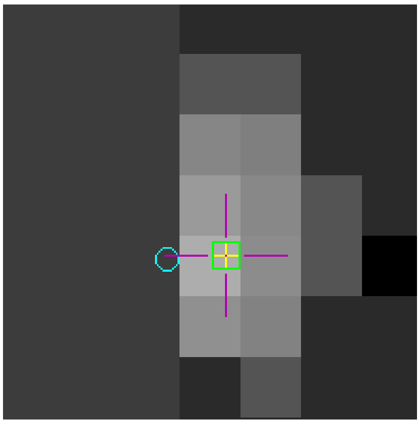


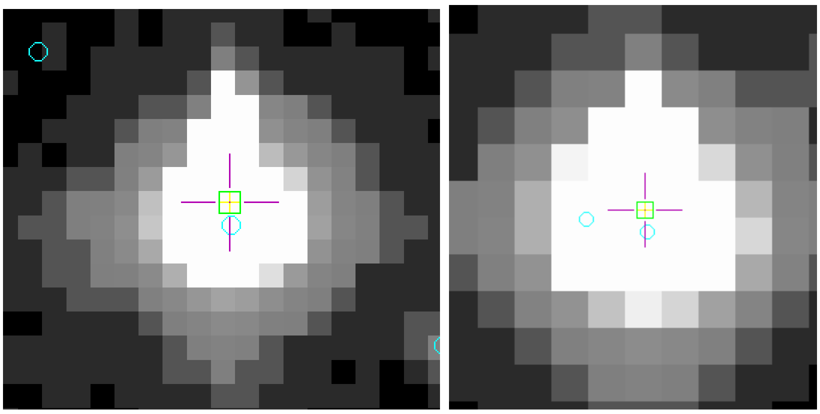
FIGURE 3.13: Edges: marked in blue are the positions of the Gaia DR2 catalog and marked with a cross are the positions of the calculated centroid.

4. Saturated Sources/Spikes:

   (5" > angDist ≥ 2.5": 11% of 46 sources)

   (2.5" > angDist ≥ 1.5": 2% of 47 sources)

   See figure 3.14 for some examples.

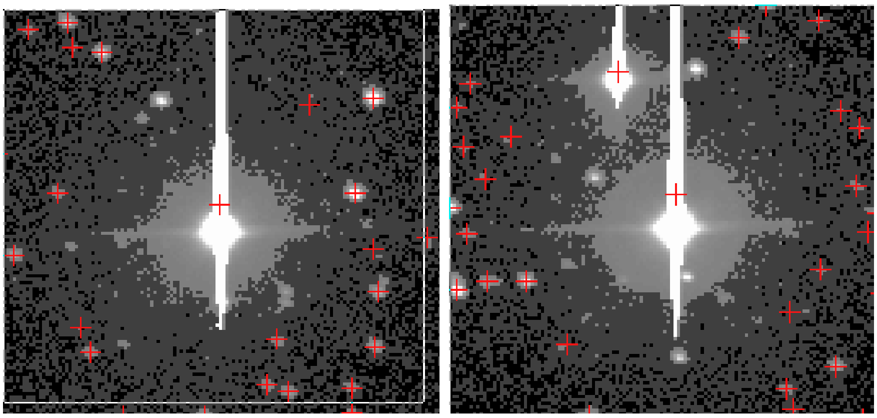


(a) (b)

FIGURE 3.14: Saturated/Spikes: marked in blue are the positions of the Gaia DR2 catalog and marked with a cross are the positions of the calculated centroid.

5. Missing Stars/Spikes: around the saturated stars, SExtractor had difficulties to extract sources.

   See figure 3.15 for some examples.



(a) (b)

FIGURE 3.15: Missing Stars/Spikes: marked in red are the positions of the calculated centroid.

According with the cases enumerated above, SExtractor has some difficulties to calculate the centroid of the stars mainly due to “bad centroid determination” and to “double visual or physical stars”. Stars that lie at the edges of the images and with spikes should be not considered because they will confuse the software. However, more than 84% of the sources have a good centroid determination with a angular separation less than 1 arcsec.

It is necessary to analyze the source position error obtained through the astrometric calibration. Since SExtractor does not provide coordinates uncertainties, we estimate their errors from the image with the best signal-to-noise ratio. Using STILTS, this image is cross-matched with the Gaia DR2 catalog and later, the standard deviation of the separation between the astrometric solution and Gaia DR2 catalog is calculated. The standard deviation value times 3 sigma will be used as a source position error.

Figure 3.16 shows the histogram of the errors calculated from all datasets. Source position errors range from 1.02 arcsec to 1.78 arcsec.

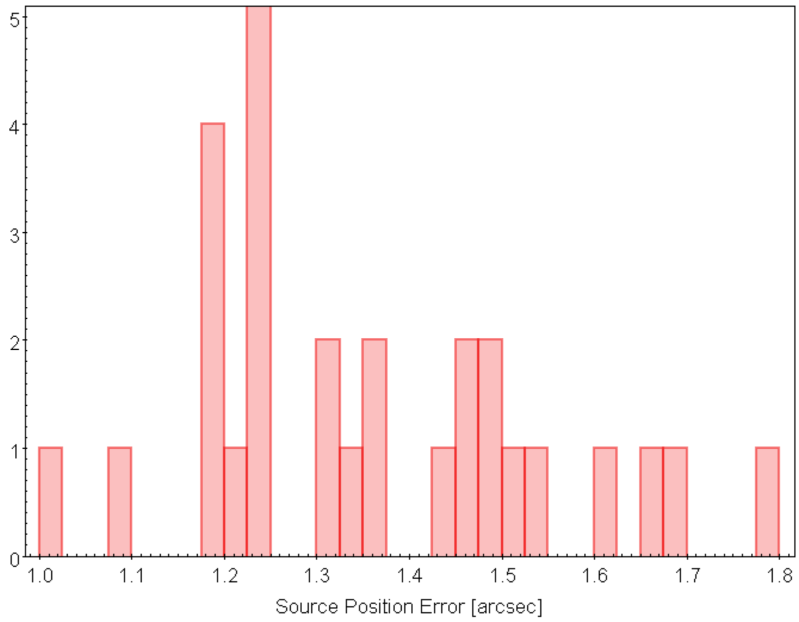


FIGURE 3.16: Source position error: histogram of the source position errors calculated from all datasets.

3.4.2 Photometric Calibration

For each light source, SExtractor calculates the instrumental magnitude, which needs to be calibrated, in order to be used scientifically. Once the instrumental magnitude of each light source is calibrated, the apparent magnitude is obtained and after, the light curves are extracted. There are variations in the sunlight reflected by the asteroid due to inhomogeneities in the surface of the asteroid and also from its rotational motion. With time, the rotational periods can be computed.

As explained in the astrometric calibration, SExtractor outputs a table with the required values according with the chosen parameters. For the photometric calibration were used the "MAG_ISOCOR" (corrected isophotal magnitude) and "MAGERR_ISOCOR" (RMS error estimate for the corrected isophotal magnitude). Corrected isophotal magnitude method works well for point sources as stars and asteroids. These parameters are the corrected version of the isophotal magnitudes method, due to some lost fraction of flux during the calculation.

Although the images were taken without any filters, a good choice for performing the photometric calibration would be a broad band filter, which comprises the widest interval of wavelengths. In this cases, we decided to use the Gaia DR2 G band (Brown et al. 2018).

Using the VizieR service, sources of the Gaia DR2 catalog in the field of view of each image were obtained. The selection of the Gaia DR2 catalog is then cross-matched with the catalog obtained with the SExtractor.

Because there are very faint light sources and some saturated light sources, it is necessary to choose which stars will be used in the magnitude calibration. The range of stars to be used should show linearity between the instrumental magnitude and the magnitude calculated by the Gaia satellite data. Figure 3.17 shows Gaia DR2 G magnitudes versus SExtractor instrumental magnitudes for an example image. The interval of magnitudes with linear behavior is shown with a blue color.

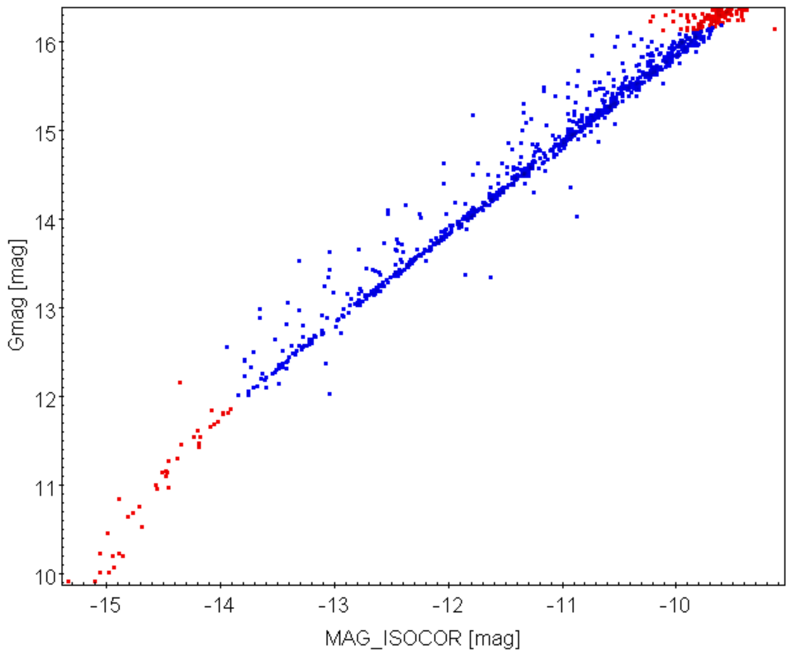


FIGURE 3.17: Calibration light sources: Gaia DR2 G magnitudes versus SExtractor instrumental magnitudes for an example image. In blue are the light sources chosen from the calibration, in red the light sources removed from the calibration. "Gmag" is the apparent G magnitude from Gaia DR2 catalog and "MAG_ISOCOR" is the instrumental magnitude from SExtractor.

To calibrate the magnitude one function that fits the data to the linear model "y = A + Bx" is used , by minimizing the chi-square error statistic. For each point of the instrumental magnitude the apparent magnitude is calculated based on the parameters given by the linear model. After calibration it is possible to extract the light curves for each asteroid with magnitudes that can be used scientifically. Figure 3.18 shows an example for the asteroid Polyxo.

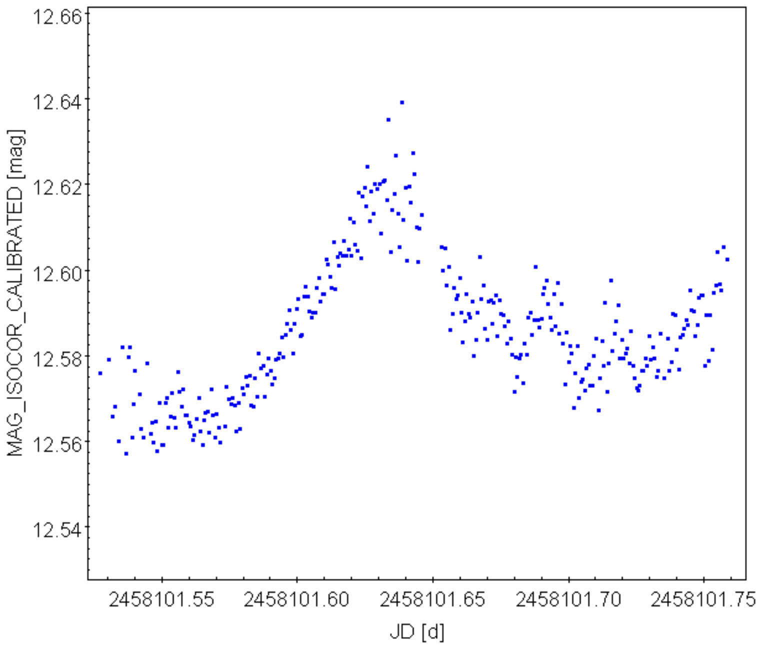


FIGURE 3.18: Asteroid light curve: example of an asteroid light curve after magnitude calibration. "MAG_ISOCOR_CALIBRATED" is the apparent magnitude calibrated with Gaia DR2 catalog and "JD" is the Julian Date.

The light curves must still be corrected in relation to the phase angle. Depending on the celestial position of the asteroid relative to the Sun, it may reflect different fraction of light.

Using the Miriade service, it is possible to obtain the parameters that allow to perform this correction and thus obtain the absolute magnitude (H): phase angle, heliocentric distance and distance to the observer. This H magnitude is usually provided as a function of the V-band. However, since the magnitudes provided in this work are related to the entire spectrum due to the lack of filter in the observations and the calibration is, besides, performed with the G-band, the H absolute magnitudes computed here are not the proper the H magnitudes used in science. For this it is necessary to indicate which asteroid we want to calibrate, the geographical coordinates where the observatory is located (or if the Observatory is recorded in the Minor Planet Center database, just a registration code) and the Julian dates referring to each position. Miriade will return to table with the calibrating parameters for each position.

According to equations 1, 2 and 3 in Carri et al. 2008, (Carry 2018) we can obtain the absolute magnitudes.

$$H = V + 2.5log(r^2\Delta^2) - 2.5log((1 - G)\phi_1 + G\phi_2) \tag{3.1}$$

$$\phi_1 = exp(-3.33tan(\alpha/2)^{0.63}) \tag{3.2}$$

$$\phi_2 = exp(-1.87tan(\alpha/2)^{1.22}) \tag{3.3}$$

where "V" is the apparent magnitude, "G" is the slope parameter, "r" is the heliocentric distance, "Δ" is the range to the observer, "ϕ_1 and "ϕ_2" are the phase functions and "α" is the phase angle.

The H-G equation shown above is a very important system to obtain the absolute magnitude according with the distance of the asteroid to the sun and according with the solar phase-angle. With this system is possible to compare different asteroid positions at different times, to study and characterize them about their shapes and poles.

The absolute magnitude obtain from the H-G equation is the magnitude of the asteroid if it were 1 AU from the Sun and from the Earth and completely illuminated. This is a hypothetical situation because for the asteroid be seen from the earth in this conditions, the phase-angle should be zero. The phase-angle is the angle between Sun-Asteroid-Earth. The slope parameter "G" is to correct the opposition effect. When an object with a considerable number of dust particles is observed near opposition, its brightness increases depending on the scattering of light by the particles. According with some studies, the typical value used for "G" is 0.15.

Figure 3.19 shows the diagram of the phase angle defined by Sun-Asteroid-Earth.

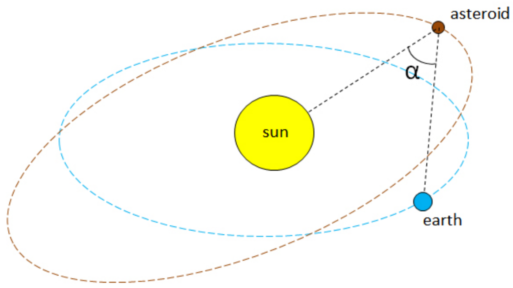


FIGURE 3.19: Phase angle: diagram of the phase angle defined by Sun-Asteroid-Earth.

Figure 3.20 shows the absolute magnitude after the phase angle calibration. There is a magnitude shift between figures 3.18 and 3.20 as expected.

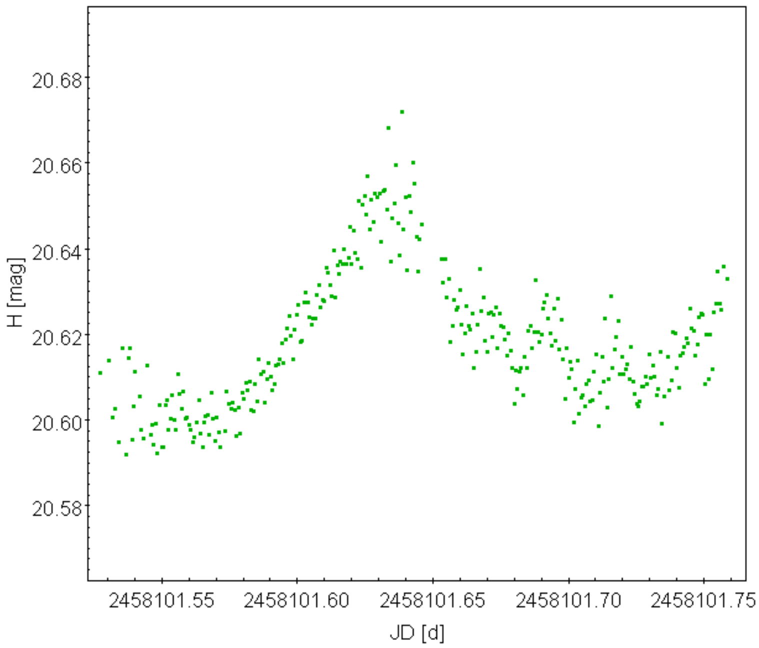


FIGURE 3.20: Asteroid light curve calibrated: example of an asteroid light curve after magnitude and phase angle calibration. 'H" is the absolute magnitude after applying the phase angle correction and "JD" is the Julian Date.

The magnitude limit of the astronomical images can be an useful information to use in some forward steps. To obtain it, it is created a histogram for each image. From the histogram is calculated where is the biggest bin bar and the value corresponding to this bin bar is used as the magnitude limit value. To calculate the bin size of the histogram is used the interquartile range, a measure of statistical dispersion equal to the difference between the third and the first quartiles:

$$bin_{size} = \left(\frac{2 * (q_3 - q_1)}{n}\right)^{\frac{1}{3}} \tag{3.4}$$

where, q_3 is the third quartil, q_1 is the first quartil and n is the number of elements of the distribution.

Figure 3.21 is the apparent magnitude limit histogram of all images from all datasets. Magnitudes limits range from 12.93 mag to 18.64 mag depending on the exposure times and the quality of the images. While the mean magnitude limit is 16.32 mag, the distribution shows two peaks around 15.4 mag and 16.5 mag.

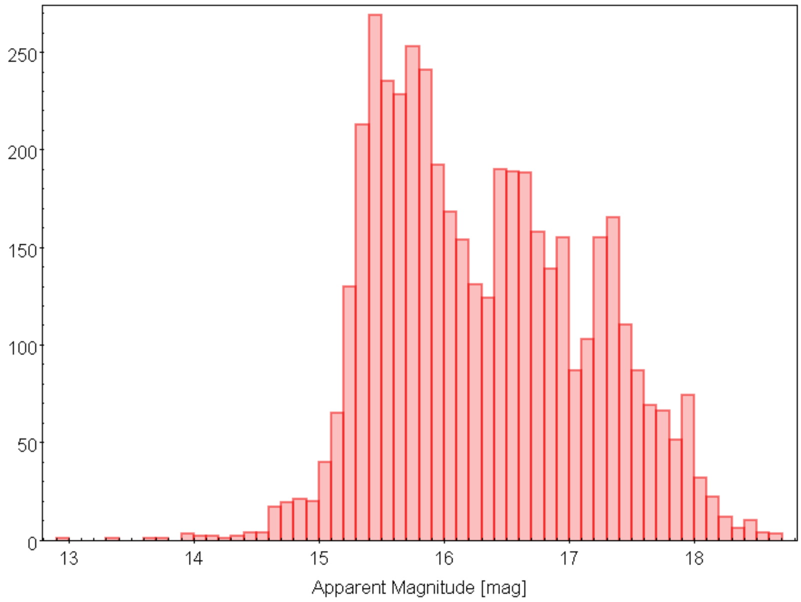


FIGURE 3.21: Magnitude limit: the apparent magnitude limit histogram of all images from all datasets.

Chapter 4

Data Analysis

"The truth may be puzzling. It may take some work to grapple with. It may be counter-intuitive. It may contradict deeply held prejudices. It may not be consonant with what we desperately want to be true. But our preferences do not determine what's true. We have a method, and that method helps us to reach not absolute truth, only asymptotic approaches to the truth—never there, just closer and closer, always finding vast new oceans of undiscovered possibilities. Cleverly designed experiments are the key."

Carl Sagan

4.1 Overview

The main objective of this project is to detect known asteroids in the collected astronomical images, in order to extract their positions and to contribute to the Minor Planet Center. The followed steps to obtain the positions are described bellow.

- Identifying every non-moving and moving source in the data, such as stars, bad pixels, etc.;
- Looking for asteroids in the field of view using the SkyBoT service. Matching the asteroids from the SkyBoT service with the existing sources in the data;

- Cleaning the asteroid counterparts and filtering the asteroids' positions in the data.

4.2 Methodology

4.2.1 Identifying every non-moving and moving source in the data

The first task is to identify non-moving and moving sources in the data. The idea is to compare several images from the same dataset and try to identify which sources remain in the same position and which sources have changed their position. In the end, there should be a catalog of non-moving sources (sources that do not show apparent motion from one image to another, such as stars, bad pixels, etc.) and another catalog of single sources (sources that show apparent motion from one image to another, such as asteroids, etc.).

Due to the slow apparent motion of asteroids in the collected data, the images should not be processed in a row, as the position of an asteroid in an image relative to the next image will be very similar. To differentiate two asteroid positions in the images is necessary to take in account some main parameters: the proper motion of the asteroid, the field of view of the telescope, the exposure time of each image and the interval between the acquired images. The field of view of the telescope and the interval between the acquired images are the same for all datasets. The exposure time of each image depends on the apparent magnitude of the target observing asteroid and depends on the seeing of the night. However, the strongest parameter is the proper motion of the asteroids. The slowest proper motions of the asteroids of this project are (for example, at a specific epoch and absolute values - values from SkyBOT service): Mannucci with 2.83 arcsec/h and Carlova with 3.93 arcsec/h in right ascension; Palma with 0.48 arcsec/h and Emmadesmet with 0.67 arcsec/h in declination.

Also, the best images should be selected in order to process images with a higher signal and lower noise. In this way it is possible to identify fainter objects which have higher magnitudes. SExtractor can calculate the the signal-to-noise ratio (gaussian-weighted signal-to-noise ratio) for each source. So, for each image the average signal-to-noise ratio from all sources is calculated and then the best images are chosen to process the catalogs according to the following criterium: a minimum interval of 15 images has been set from one image to another, according with the proper motion of the slowest asteroids. Firstly the image with the best signal-to-noise ratio is chosen, 15 images before and 15 images after are discarded, and then, from the remaining images, the new image with the best signal-to-noise ratio is chosen again. The process repeats until all the images are chosen or rejected.

Next step is the creation of non-moving sources and single sources catalogs, matching the sources from the best chosen images within a source position error value calculated before, during the astrometric calibration. This error will be used as a cross-match error to match the non-moving sources from one image to another.

Basic idea:

In the first iteration or processing image, all sources are considered as single sources and added to a new single catalog (the catalog that in the end will contain moving sources). In the second iteration or processing image, the celestial coordinates of the sources are compared with the coordinates previously added to the single catalog within 3σ, being σ the errors in the coordinates. The sources that match within the defined error will be moved from the single catalog to a new catalog, called the non-moving catalog (the catalog that in the end will contain non-moving sources). The process repeats until it process all the best chosen images.

Figure 4.1 shows a scheme of this process.

In detail:

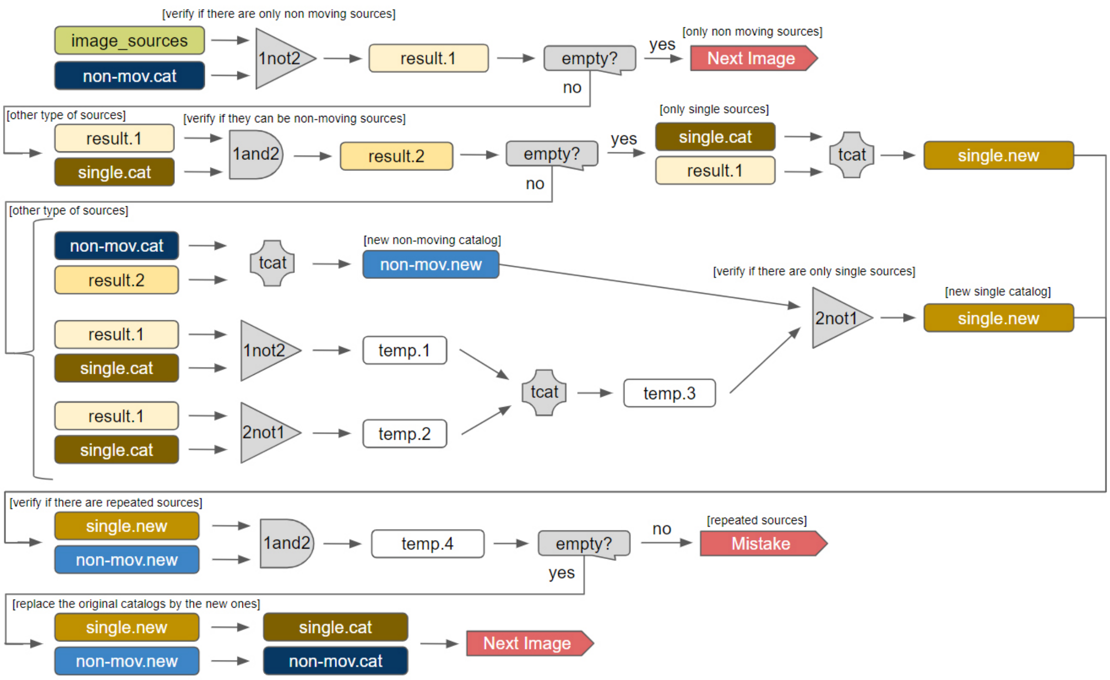


FIGURE 4.1: Single and non-moving catalogs schematic: block diagram of the methodology to identify single and non-moving sources.

1. The sources from the first image (image_sources) are compared with the non-moving catalog (non-mov.cat), through a "not" operation. It means that all the sources from the image that do not exist in the non-moving catalog will be added to a new table (result.1). If this table is empty it means that all of the sources from the image (image_sources) have a match in the non-mov.cat and, therefore, are non-moving sources and the script can process the next image. If the table is not empty, it means there are sources that, for the moment, appear only once in the same position and the script needs to go to the next step. Figure 4.2 illustrate the method explained in the step 1.

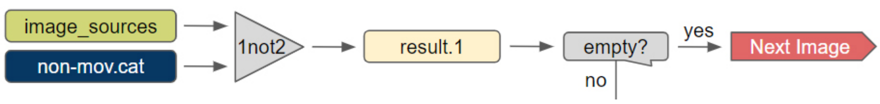


FIGURE 4.2: Close view schematic "Single and Non-Moving Catalogs" - step 1: verify if there are only non-moving sources.

2. The next step is to check if the sources that appear only once (result.1) could be non-moving sources (this is, appear again in an other image at the same position) identified

before as single sources (single.cat). For that, an “and” operation is used, meaning that all the sources from the “result.1” table that exist also in the single catalog (single.cat) will be added to a new table (result.2). If this table is empty, it means that the other sources (result.1) are not repeated in the single catalog (single.cat) and they are new single sources that need to be added to the single catalog, thus creating a new single catalog (single.new). If the table is not empty, it means that there are, at least, new non-moving sources in the table and the script needs to go to the next step. Figure 4.3 illustrate the method explained in the step 2.

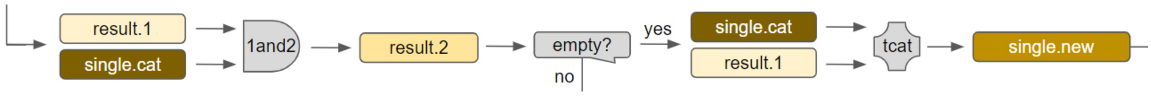


FIGURE 4.3: Close view schematic ”Single and Non-Moving Catalogs” - step 2: verify if the sources can be non-moving sources.

3. In this step, the new non-moving sources (result.2) will be added to the non-moving catalog (non-mov.cat). For that, “result.2” will be concatenated with the non-moving catalog (non-mov.cat), thus creating a new non-moving catalog (non-mov.new). On the other hand, there may be new single sources that need to be added to the single catalog. To verify if there are new single sources, two “not” operations are performed between the “result.1” table and the single catalog (single.cat). In the first one, all of the sources that exist in the “result.1” table but do not exist in the single catalog, will be added to a new table (temp.1). In the second one, all of the sources that exist in the single catalog but do not exist in the “result.1” table, will be added to a new table (temp.2). These two new tables will be concatenated in a new table (temp.3) and to assure that there are only single sources inside, a third “not” operation is performed between the “non-mov.new” table and the “temp.3” table. From this operation a new single catalog (single.new) is created. Figure 4.4 illustrate the method explained in the step 3.

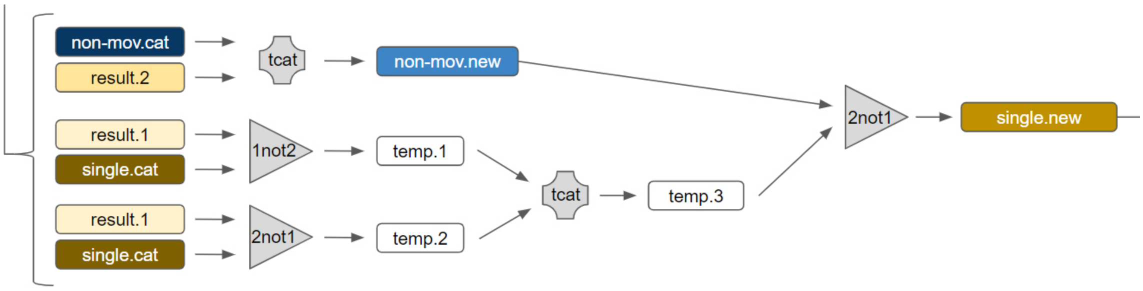


FIGURE 4.4: Close view schematic "Single and Non-Moving Catalogs" - step 3: create new single and non-moving catalogs, if there is more than one type of sources.

4. It is necessary to perform a small *end* task from the new non-moving catalog (non-mov.new) and from the new single catalog (single.new). It needs to be verified if there are not repeated sources between the new two catalogs and the names should be converted to the original ones, replacing the original catalogs. After that, the script can proceed to the next image. If there are repeated sources, an alarm message will be displayed and the script stops. This error checking task was implemented to avoid coding errors while writing the scripts. Figure 4.5 illustrate the method explained in the step 4.

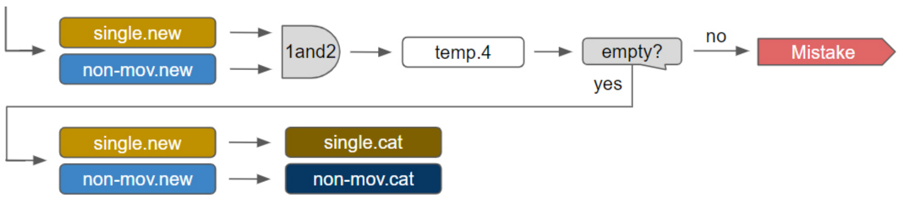


FIGURE 4.5: Close view schematic "Single and Non-Moving Catalogs" - step 4: verify if there are repeated sources between both catalogs and replace the original catalogs by the new ones.

Figure 4.6 shows the identified non-moving sources, figure 4.7 shows the identified moving sources and figure 4.8 shows an overview of the non-moving and moving sources together.

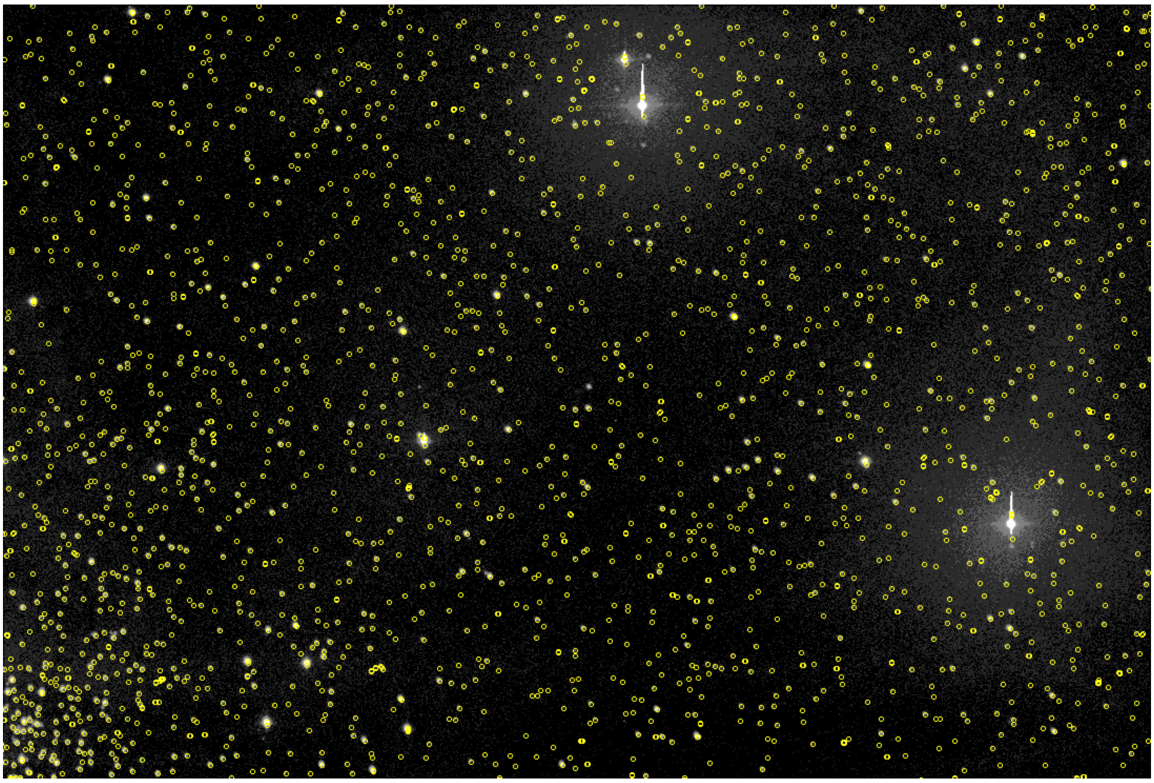


Figure 4.6: Non-moving catalog: identified non-moving sources, usually stars.

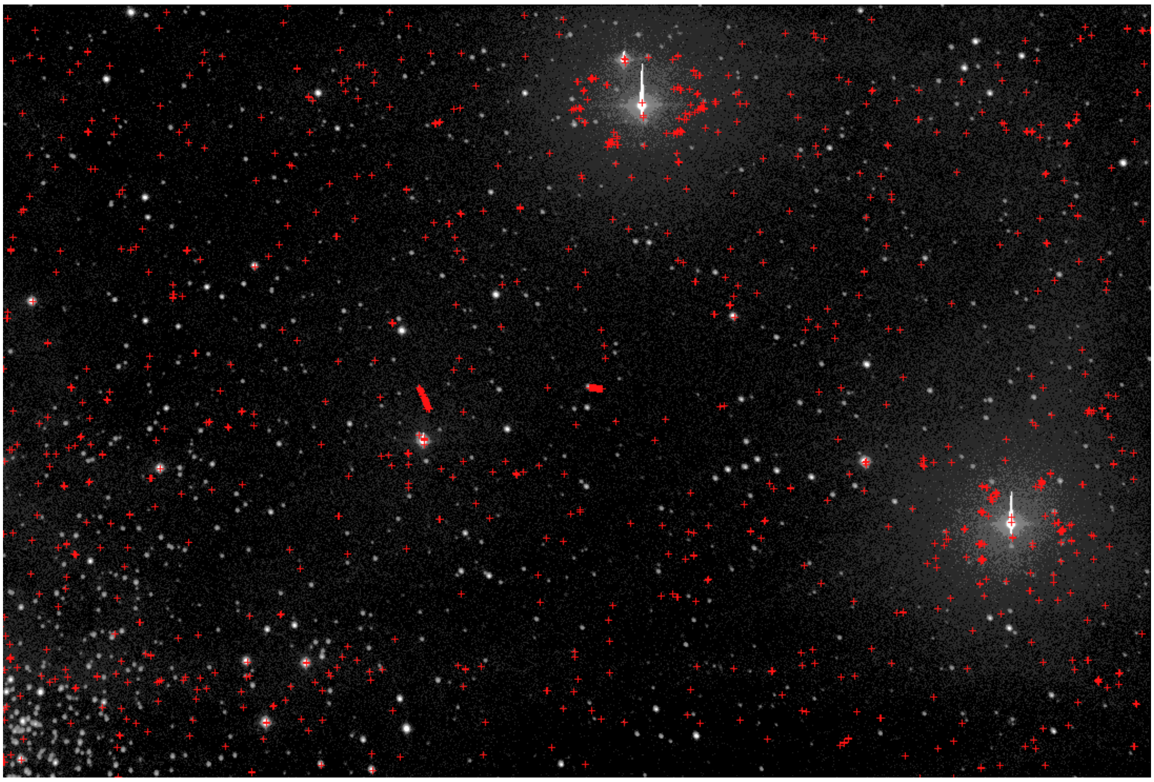


Figure 4.7: Moving catalog: identified moving sources, usually asteroids, single pixels.

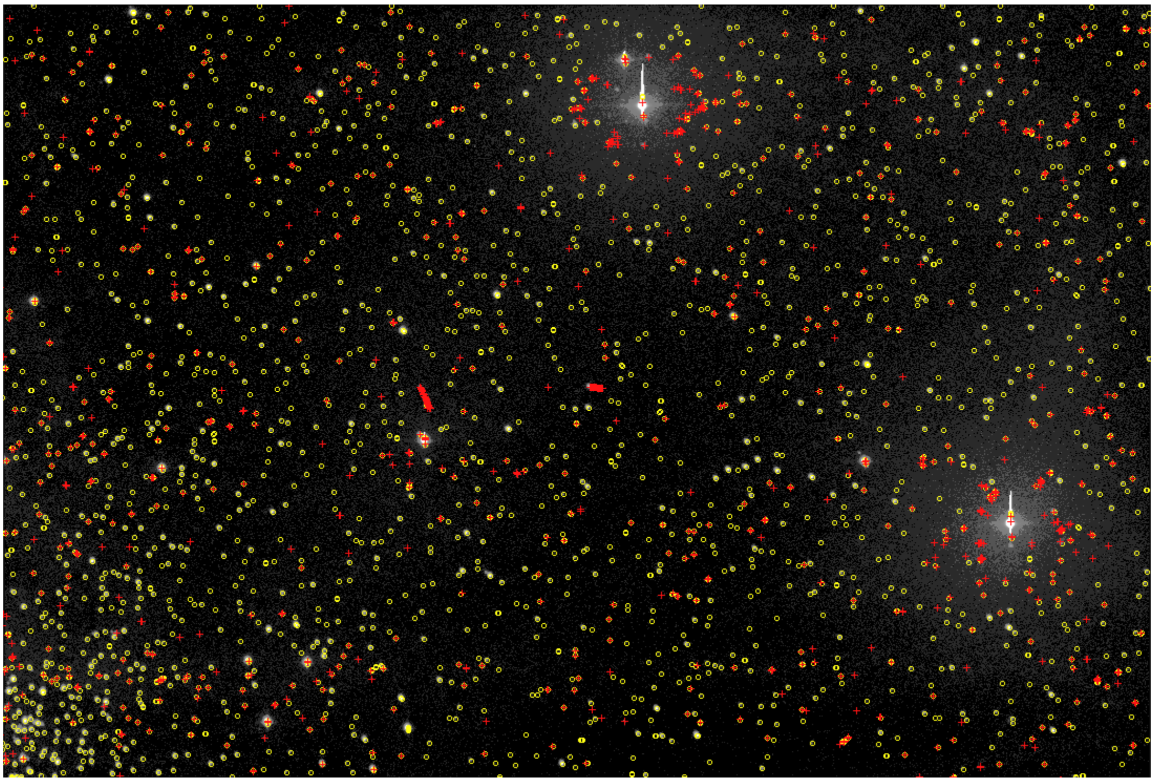


FIGURE 4.8: Non-moving and moving catalogs: an overview of the two catalogs together.

In figure 4.8 there are some single and non-moving sources overlapped. The reasons for that to occur are related with some noise present in the astronomical images and to some shifted centroids calculated by SExtractor (mentioned in the chapter “astrometric calibration” - 3.3.1). In sources with low signal-to-noise ratio is more likely to happen.

4.2.2 Looking for known asteroids in the field of view

After creating the catalogs of moving sources and non-moving sources, we can go to the next step to detect known asteroids in the images. For this, the Virtual Observatory service SkyBoT is used.

Basic idea:

The SkyBoT service makes it possible to identify where which asteroids may appear in the images. It is used to identify the asteroid positions for each image coordinates and epoch. Afterwards, these positions are compared with the positions of the light sources extracted by the SExtractor. If they match, it means that there could be known and detected asteroids in the images. If they do not match, it means that there are not detected asteroids crossing the field of view of the image. Log files are created at each step to monitor this very important task.

Figure 4.9 shows a scheme of this process.

In detail:

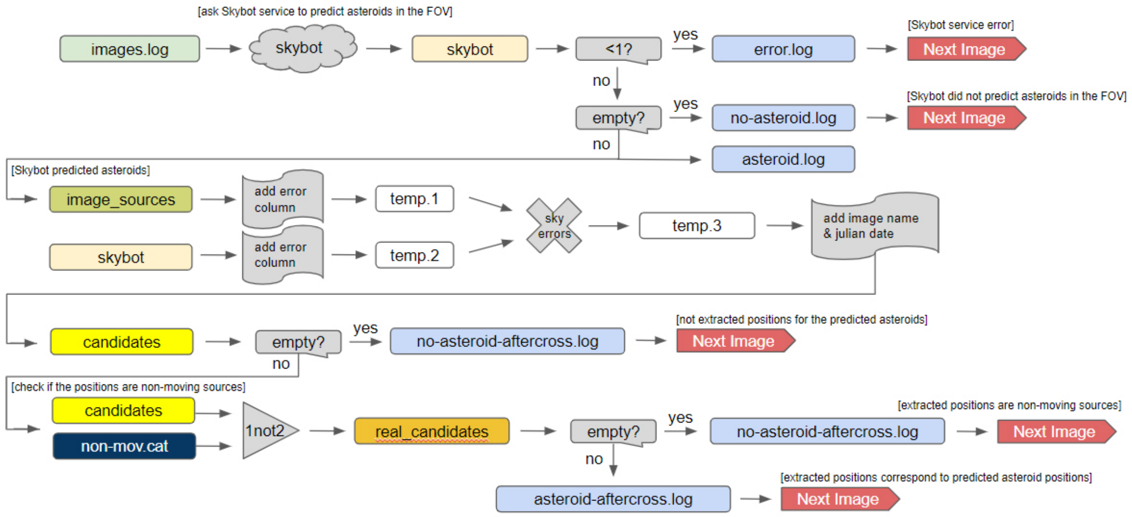


Figure 4.9: SkyBoT known asteroids schematic: block diagram of the methodology to identify known asteroids in the field of view.

1. The SkyBoT service makes it possible to identify where which asteroids may appear in the images. In order to use SkyBoT, it is necessary to provide the average Julian observation date, the central equatorial coordinates of the field of view, the area of the field of view to search in and the geographical coordinates where the observatory is located or, if the observatory is recorded in the Minor Planet Center database, just a registration code (images.log). SkyBoT will return a table (skybot) containing the predicted positions of the asteroids, according to the Minor Planet Center database. If the file contains less than 1 line, it means SkyBoT was unable to return the requested information due to a service interruption, an input error from the user in the provided parameters, etc. In this case, the image will be identified in an error log file (error.log) and the program will proceed to a new image. If the file is empty, it means there are no asteroids predicted in the image. In this case, the image will be identified in a

non-asteroid log file (no-asteroid.log) and the program will proceed to a new image. If the file is not empty, it means there are asteroids predicted by SkyBoT. The program will report that in a log file (asteroid.log) and proceed to the next step. Figure 4.10 illustrate the method explained in the step 1.

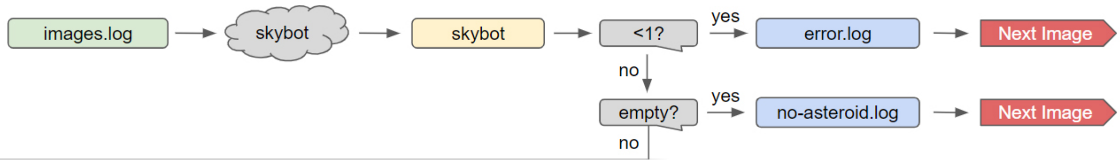


FIGURE 4.10: Close view schematic "SkyBoT Known Asteroids" - step 1: ask SkyBoT service to predict asteroids in the FOV.

2. The next step is to compare the position of light sources extracted by SExtractor (image_sources) with the positions of known asteroids given by SkyBoT (skybot). Using the STILTS tool an error column for each position both tables contain the estimated error for the coordinates provided by SExtractor. Subsequently, a cross-match is performed between the positions of both tables, using a cross-match error corresponding to 3σ times the uncertainty associated to the images, which is:

$$error = 3 * \sqrt{\sigma_{SkyBoT}{}^2 + \sigma_{SExtractor}{}^2} \tag{4.1}$$

where σ_{SkyBoT} and $\sigma_{SExtractor}$ are the position errors of SkyBoT and SExtractor, respectively. The position error given by SExtractor corresponds to the previously calculated position error during the astrometric calibration.

A result of the cross-match is a new table (temp. 3) with the corresponding positions, in other words, with the light sources extracted by SExtractor that correspond to the positions of known asteroids given by SkyBoT. These positions would be the asteroid candidate counterparts. The name of the image and the Julian date are added for each position in this table, because this information will be necessary in the future. If the resulting table (candidates) is empty, it means the script does not detect any position at the given search radius in our images and it will be reported in a log file (no-asteroid-aftercross.log). The program will proceed to a new image. Even if there are known asteroids in the images provided by SkyBoT, they can be very faint and

SExtractor is not capable to extract their positions due to the magnitude limit of the images. Figure 4.11 illustrate the method explained in the step 2.

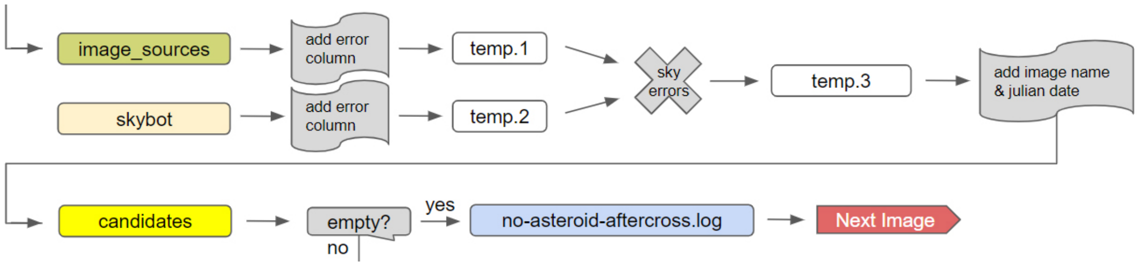


FIGURE 4.11: Close view schematic "SkyBoT Known Asteroids" - step 2: verify if there are sources extracted by SExtractor that correspond to the positions of known asteroids given by SkyBoT.

3. If the table (candidates) is not empty, it is necessary to cross-match it with the catalog of non-moving sources (non-mov.cat) by a "NOT" operation, in order to exclude possible contamination from non-asteroid sources (stellar sources, bad pixels...). This results in a new table (real_candidates). If this table is empty, it means that there are no asteroids in the image corresponding to the input from SkyBoT (but there may be unknown asteroids) and the program proceeds to a new image and reports in the log file "no-asteroid-aftercross.log". If the table contains information, it means that there are possible candidates detections to known asteroids in the image. The program proceeds to a new image and reports in the log file "asteroid-aftercross.log". Figure 4.12 illustrate the method explained in the step 3.

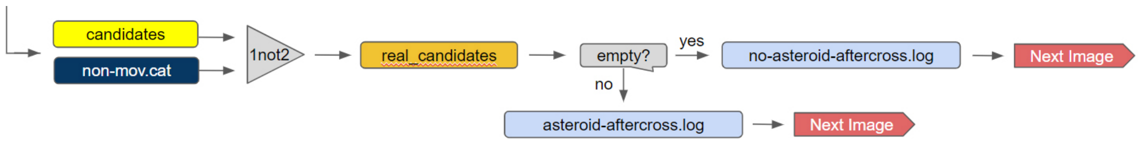


FIGURE 4.12: Close view schematic "SkyBoT Known Asteroids" - step 3: verify if the positions are non-moving sources.

Figure 4.13 shows the known asteroid positions predicted by SkyBoT service and figure 4.14 shows an overview of the moving sources catalog and the positions predicted by SkyBoT service. Some positions from the moving sources catalog match the positions predicted by SkyBoT service. The result can be seen in the figure 4.15.

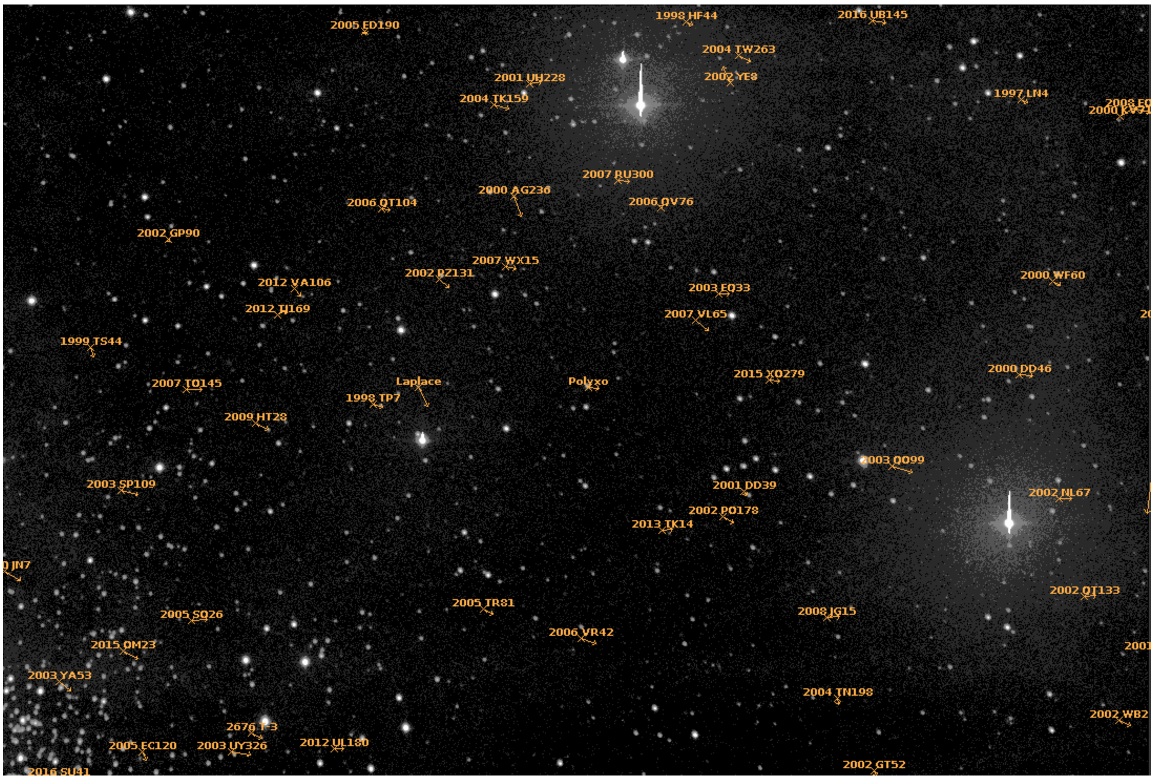


Figure 4.13: SkyBoT asteroids: known asteroids predicted by SkyBoT service.

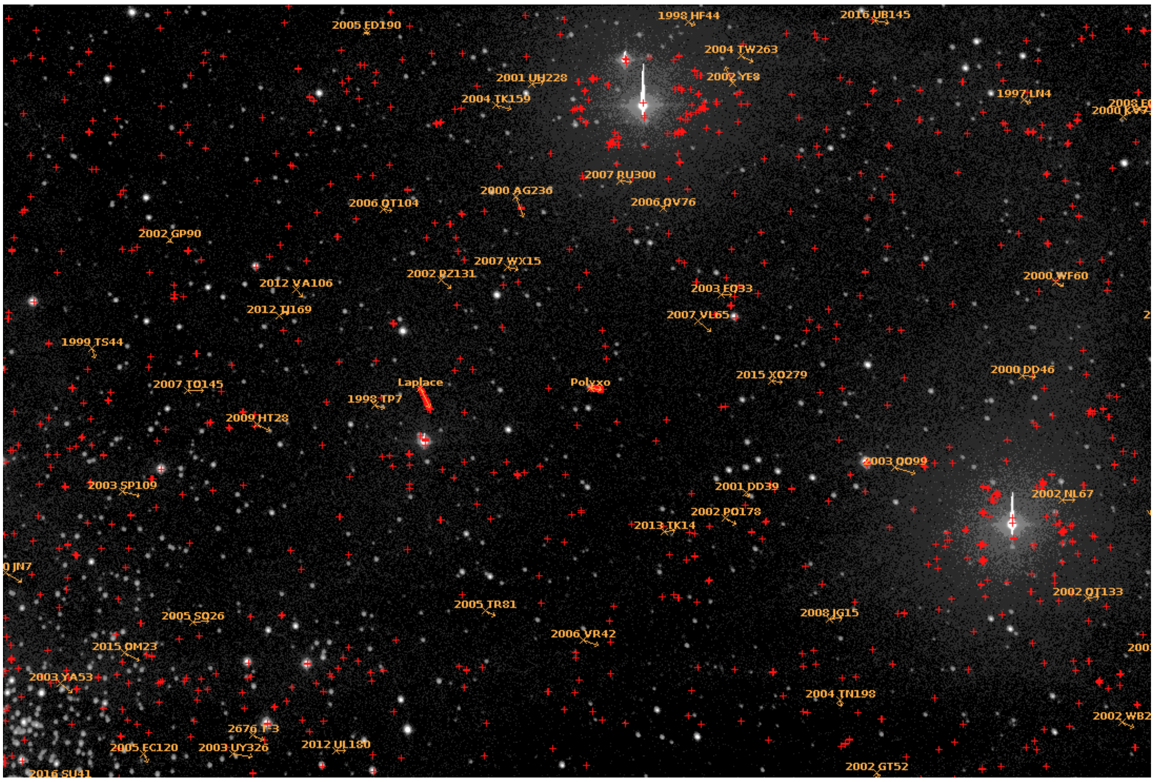


FIGURE 4.14: SkyBoT asteroids and moving sources catalog: an overview of the two catalogs together.

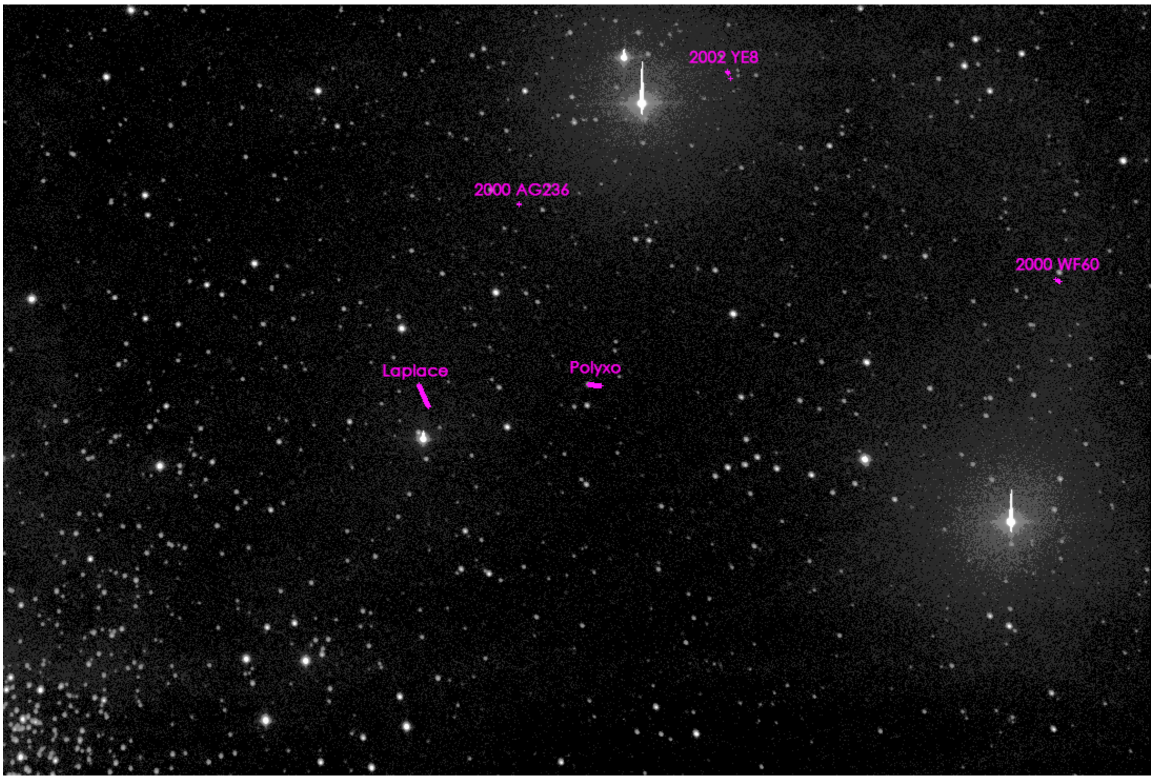


FIGURE 4.15: Known asteroids identified: known asteroids identified on the image, due to the cross-match between the light sources extracted with SExtractor and the SkyBoT table.

4.2.3 Cleaning the asteroid counterparts and filtering the asteroids' positions

Basic idea:

After getting the positions of the known asteroids in the images, it is necessary to analyze them in order to filter positions affected by nearby stars, filter outliers' positions, verify the behavior and the linearity of the positions for each asteroid.

In detail:

Stars close to asteroid positions can compromise the calculation of their centroid, as shown in the figure 4.17, marked in red. These positions should be removed. Using the non-moving sources catalog it is possible to cross-match the positions of the asteroids with these sources and remove the compromised positions.

As demonstrated during the astrometric calibration, there are some stars in the non-moving catalog with shifted centroids, when compared with the position in the Gaia DR2 catalog. One way to solve this problem would be to use the Gaia DR2 catalog to filter the compromised positions. However, maybe there are some artifacts or some sources in the images that compromise the calculation of the centroid and that are not included in the Gaia DR2 catalog. Thus, the catalog of non-moving sources is cross-matched with the Gaia DR2 catalog, in order to identify and remove stars with very big shifted centroids. To replace these shifted stars, the stars contained in the Gaia DR2 catalog are used instead, but only the stars up to the magnitude limit of each image. In this way all stars and artifacts can be identified.

Another aspect to take into account is the magnitude of each star. Stars with lower magnitudes are brighter and therefore the lightning-contamination radius is much larger than in fainter stars. A star with low magnitude can affect the calculation of the centroid of an asteroid at a given distance, but a star with higher magnitude may not affect the same position for the same distance. Figure 4.16 shows a possible asteroid trajectory only affected by the brightest star due to its bigger radius of light contamination. The brightest star has 9 mag of apparent magnitude and the fainter one, 13 mag of apparent magnitude. Thus, it was empirically defined that for a determined magnitude, stars with higher magnitudes have a certain radius of contamination and stars with lower magnitude have another radius of contamination. The value of this radius is used to cross-match the positions of asteroids with the non-moving and Gaia DR2 catalogs.

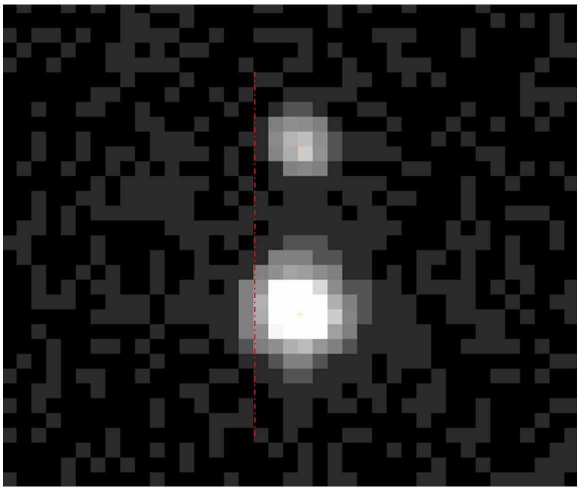


FIGURE 4.16: Star radius contamination: marked in red is a possible asteroid trajectory only affected by the brightest star.

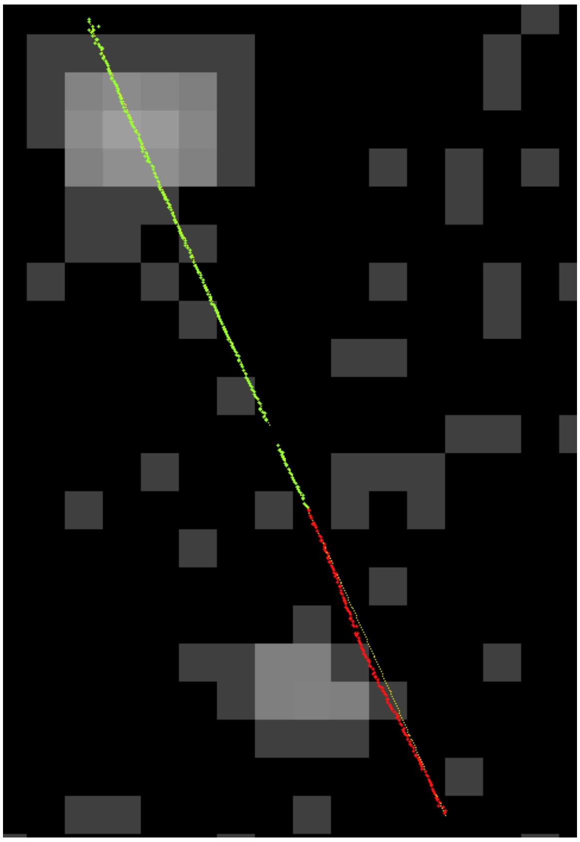
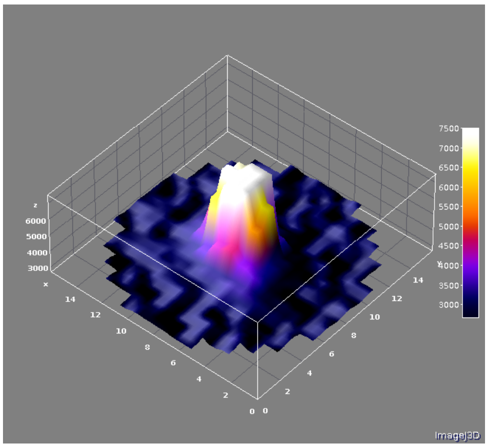
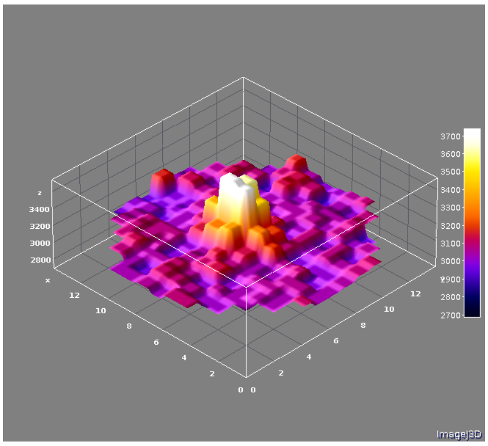


FIGURE 4.17: Asteroid positions affected by a nearby star: marked in yellow are the predicted positions by SkyBoT, marked in green the good asteroid positions and marked in red the affected asteroid positions due to a nearby star (star on the left side of the red positions). The asteroid blob (on the top) intersects this star and SExtractor cannot calculate the centroid correctly.

Another important filter is the filter to remove outliers' positions according with the separation between coordinates, due to the scattering that the data may have. Due to variations in the signal-to-noise ratio of the asteroid light source in different images, some of the positions may present significant dispersion and should be excluded. Figure 4.18 compare two light sources with different levels of signal-to-noise ratio.



(a) high SNR



(b) low SNR

FIGURE 4.18: Different SNR values: The light source (a) has a better SNR value comparatively with the light source (b).

To determine which positions should be excluded, the mean and standard deviation of the separations between the predicted position by SkyBoT and the actual position of the data are calculated for each asteroid and for each night. Then, a lower limit (Threshold-) and an upper limit (Threshold+) are calculated for each position:

$$Threshold- = Sep - (Sep_{mean} - 3 * St_{dev}) \tag{4.2}$$

$$Threshold+ = Sep - (Sep_{mean} + 3 * St_{dev}) \tag{4.3}$$

Positions with the lower limit (Threshold-) lower than 0 or the upper limit (Threshold+) greater than 0 will be removed from the data sample. This is, if the separation between coordinates is larger than the mean separation plus/minus 3 times the standard deviation. Figure 4.19 shows an example of two positions removed. If one of the positions is removed, the mean, standard deviation and lower/upper limits are recalculated and the check, repeated.

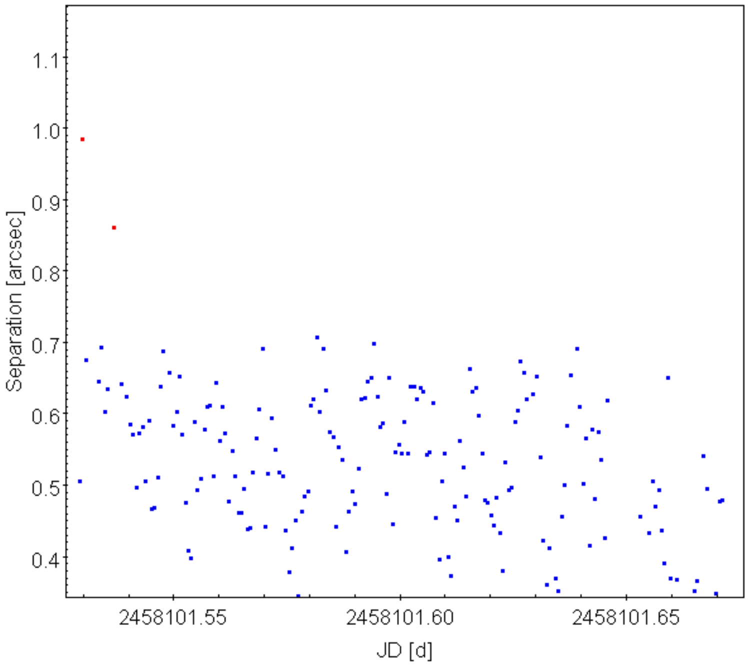


FIGURE 4.19: Outlier positions: the positions marked in red were removed due to scattering. "Separation" is the separation value between SkyBoT and the extracted positions and "JD" is the Julian Date.

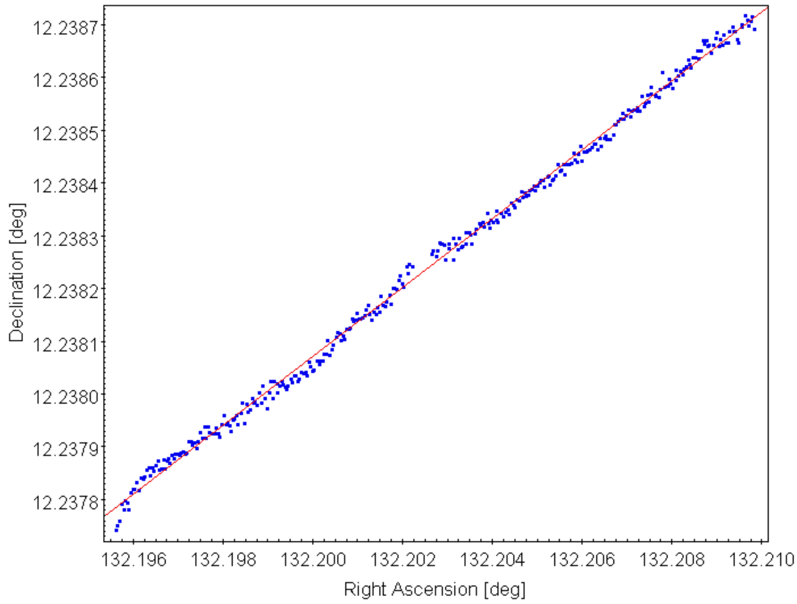
After applying the two filters explained above, it is still necessary to perform a visual inspection to verify if there are positions that should be removed and not detected by the scripts, as well as to identify and remove saturated positions.

To detect saturated asteroid positions, the software AstroImageJ was used. With this software it is possible to select a light source in the first image of the dataset and the software measures automatically the pixel intensity for the light source in all images of the dataset, even if the light source moves from one image to the next one (as an asteroid does). If the pixel intensity goes above a specific limit defined by the user, the software indicates which images are affected. The CCD camera used in the observatory has a resolution of 16 bits, it means each pixel has 65 536 gray levels (the higher the value, the closer to the white color will be the part of the image corresponding to the pixel) and the pixels should saturate when they reach this maximum value. However, due to technical reasons, the pixel will saturate before the maximum value and it is necessary to analyze the camera behavior to find the saturation limit. Without information about the saturation value and without access to the CCD camera, it was defined a safe value of 55 000 in the software (according with some tests completed in the past with similar cameras, usually they saturate closer to the maximum value than 55 000).

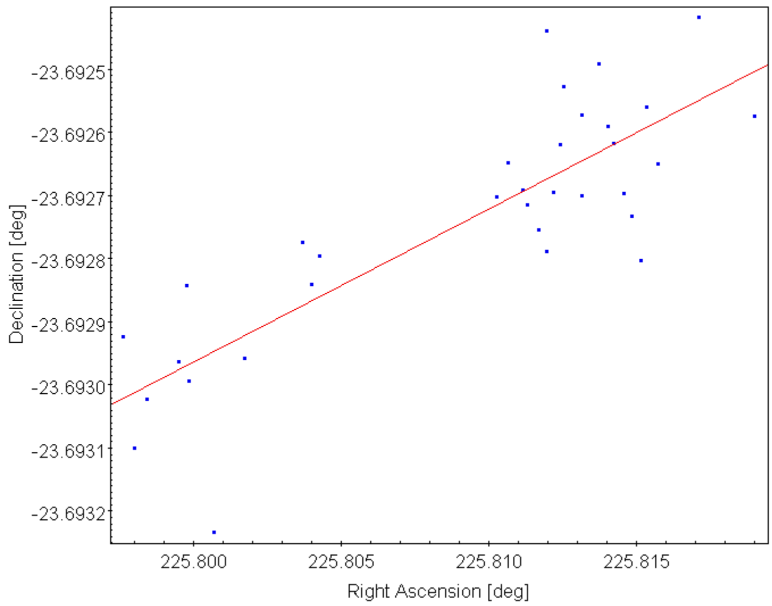
After all bad positions have been removed, we can then study the behavior of the positions or the trajectory of the asteroids.

For the different positions of a given asteroid, a function that performs a multiple linear regression fit and returns the correlation coefficients is used. The linear regression is calculated taking into account the equatorial coordinates of asteroid positions and the errors associated to these positions.

According to the Pearson correlation coefficient r, which measures the linear correlation between the α and δ position of the asteroid in different images (epochs), it is possible to evaluate the linear motion of the asteroid. Ideally, the positions of an asteroid acquired from one-night image acquisition session should follow a linear motion and, hence, the value of r should be close to 1, as shown in the figure 4.20 (a). Figure 4.20 (b) shows an example of a a correlation coefficient r equal to 0.85. The orbits of asteroids describes ellipses over time, with a greater or lesser eccentricity, but for the data acquisition time period of this project, it is really difficult to observe this behavior. A decrease of the correlation factor is mainly because of the dispersion of the asteroid positions due to low signal-to-noise ratio, that leads to an incorrect calculation of the asteroid's centroid.



(a) correlation factor = 0.998



(b) correlation factor = 0.850

FIGURE 4.20: Correlation factor: comparison between asteroid positions with a correlation factor of 0.998 (a) and with a correlation factor of 0.850 (b).

Another aspect to study is the behavior of proper motions for each equatorial coordinate (right ascension and declination).

For that, one function that fits the data (Julian date and right ascension or declination) to the linear model, y = A + Bx, is used by minimizing the chi-square error statistic.

The objective is to compute the proper motion according to the variation of every position (right ascension or declination) to the fitted line (this is, to measure the linear motion of the asteroids). In the end, the average value of the proper motion of all positions of the same asteroid within the same night is used to compare with the average value from SkyBoT service.

4.3 Periods from Asteroid Light Curves

With calibrated light curves and with the phase-angle correction, it is possible to obtain the rotation periods of the asteroids.

Rotation periods are important to characterize the asteroids about their shapes, poles and formation.

To calculate the periods, the Periodogram service from the NASA Exoplanet Archive was used in this project.

To calculate the periods, this tool converts the temporal data into a frequency domain and analyzes the repetitions of each signal using one of three available algorithms (Lomb-Scargle, Box-fitting Least Squares and Plavchan).

In this project it was used the "Lomb-Scargle" algorithm, which is recommended when there is irregular time space sampling and it is useful for identifying light curves with shapes resulting from the combination of sinusoidal waves.

The "Lomb-Scargle" algorithm was created due to the need to optimize the classic periodogram for data with irregular time space (Scargle 1982):

$$P_X(\omega) = \frac{1}{2}\left\{ \frac{\left[\sum_{j=1}^{N_0} X(t_j)\cos\omega(t_j-\tau)\right]^2}{\sum_{j=1}^{N_0} X(t_j)\cos^2\omega(t_j-\tau)} + \frac{\left[\sum_{j=1}^{N_0} X(t_j)\sin\omega(t_j-\tau)\right]^2}{\sum_{j=1}^{N_0} X(t_j)\sin^2\omega(t_j-\tau)} \right\} \tag{4.4}$$

where τ is the time phase, that makes the periodogram independent of constant translations in the times t_i, defined by:

$$\tan(2\omega\tau) = \frac{\left(\sum_{j=1}^{N_0} \sin 2\omega t_j\right)}{\left(\sum_{j=1}^{N_0} \cos 2\omega t_j\right)} \tag{4.5}$$

If the data has a regular time space, the redefined equations by Scargle turn into the classic periodogram equation:

$$\begin{aligned} P_X(\omega) &= \frac{1}{N_0}|DFT_X(\omega)|^2 = \frac{1}{N_0}\left|\sum_{j=1}^{N_0} X(t_j)\exp(-i\omega t_j)\right|^2 = \\ &= \frac{1}{N_0}\left[\left(\sum_{j=1}^{N_0} X(t_j)\cos\omega t_j\right)^2 + \left(\sum_{j=1}^{N_0} X(t_j)\sin\omega t_j\right)^2\right] \end{aligned} \tag{4.6}$$

For the calculation it is necessary to provide some initial parameters:

1. Period Range: minimum and maximum periods for periodogram power calculation. It was used the default values. The minimum period is twice the median time step of the data and the maximum period is obtained through the time span of the data;

2. Period Step Method: to calculate the power it is necessary to specify a set of candidate periods. There are four method to do it (Fixed Frequency, Fixed Period, Exponential, Plavchan). In this project was used the Fixed Frequency method, that choose frequencies according with a defined space interval between the defined minimum and maximum periods. The advantage of this method is the uniform frequency sampling along the frequencies;

3. Fixed Step Size: space interval to sampling the frequencies of the "Period Step Method"; The used value is the difference between the defined maximum period by the defined minimum period, divided by number of periods to sample, which is obtained through the number of datapoints times 10.

4. Number of Peaks: an output parameter that define how many periods the service will return. Default value is 50, but the more important ones are the periods with good power values.

Figure 4.21 shows the input interface:

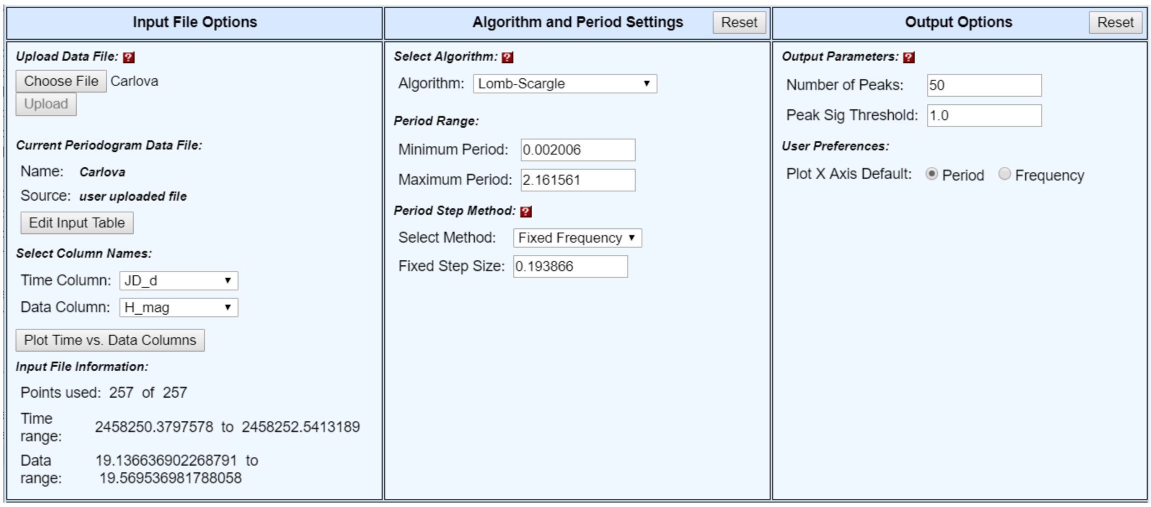


FIGURE 4.21: Periodogram input interface: interface to input data and specify parameters.

The service will output a table with the calculated periods and their respective power values (order from the maximum power value). Also, it will output a plot with the spectral power as function of frequency. From the table it is possible to visualize the plot of the folded light curves.

Figures 4.22 and 4.23 show the output returned by the service:

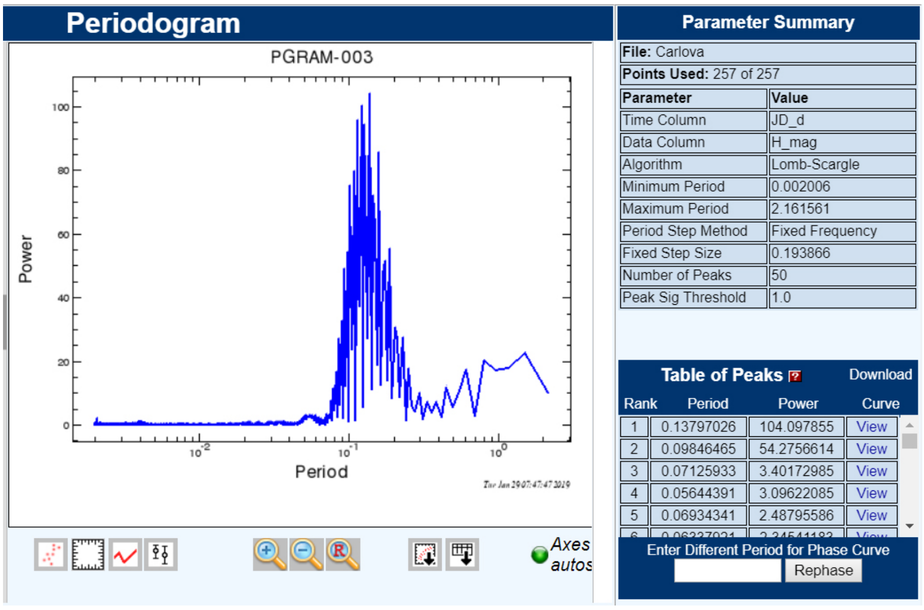


FIGURE 4.22: Periodogram output interface: output interface with the results.

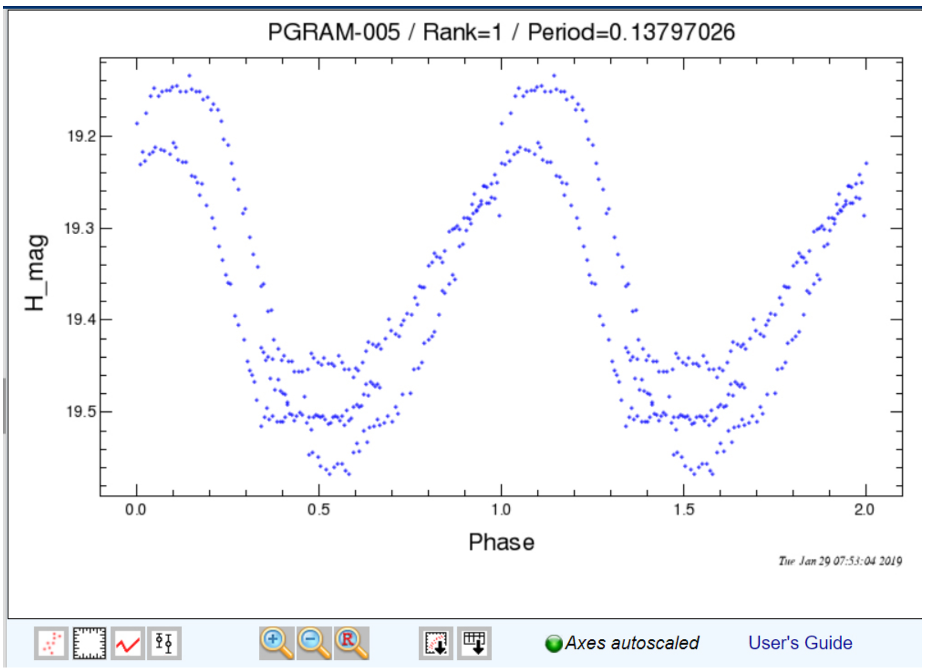


FIGURE 4.23: Periodogram output interface: output plot from one of the selected calculated periods.

4.4 Radius Estimation and Asymmetries

It is possible to obtain the asteroid radius from the apparent magnitude observed by the sunlight dispersion on the object.

According to the equations in Russel 1916, (Russel 1916):

$$p_{\mathrm{V}}\ \Phi(\alpha)\ r^2 = 2.24 \times 10^{22}\ R^2\ \Delta^2\ 10^{0.4(V_\odot - V(\alpha))} \tag{4.7}$$

where "p_{V}" is the geometric albedo (V band), "$V(\alpha)$" is the apparent magnitude of the object, "R" is the heliocentric distance, "Δ" is the range to the observer, "$V_\odot$" is the solar apparent magnitude (V band, $V_\odot = -26.76$), "$\Phi(\alpha)$" is the phase function and "α" the phase angle.

Considering the absolute magnitude "H_V", where "α" is equal to zero and "R" and "Δ" equal to 1 AU:

$$p_{\mathrm{V}}\ r^2 = 2.24 \times 10^{22}\ R^2\ \Delta^2\ 10^{0.4(V_\odot - H_V)} \tag{4.8}$$

It is possible to estimate the axial asymmetry of the object by the light curve (considering the body as an ellipsoid):

$$\Delta m = 2.5 \log \frac{\pi ac}{\pi cb} = 2.5 \log \frac{a}{b} \tag{4.9}$$

where "Δm" is the amplitude of the light curve, "a" is the semi-major axis, "b" is the semi-minor axis and "c" is the semi-middle axis. Figure 4.24 is a diagram of the considered ellipsoid body.

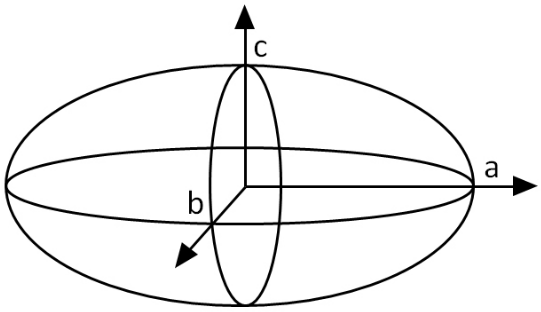


FIGURE 4.24: Ellipsoid body: diagram of an ellipsoid body.

From the equation 4.9 is possible to calculate the a/b ratio. Considering the body rotates around the semi-middle axis "c", perpendicular to the observer, the maximum area is "πac" (observed along the semi-minor axis "b") and the minimum area is "πbc" (observed along the semi-major axis "a").

Considerations about ellipsoids asteroid shapes: There are many ways to modeling asteroid shapes. One of the simplest way is the triaxial ellipsoids model. With this methodology is possible to modeling asteroid shapes with few points from the light curve or with sparse data. Sometimes the acquired data have few points that do not cover one entire rotation period and sometimes there are data acquired in different observing nights for the same asteroid. The triaxial ellipsoids model only required few free parameters to describe the shape of the asteroid (including convex and concave elements). The traditional methodologies required many free parameters that is no possible to obtain with sparse data.

The important GAIA space mission produced a large amount of sparse data, which it is a challenging to derive the rotational and shape properties from the asteroids light curves. One possible solution is the triaxial ellipsoid modeling shape.

See more information at: Larissa, V. et al. 2019 (Larissa et al. 2019)

Chapter 5

Results

"If science is to progress, what we need is the ability to experiment, honestly in reporting results - the results must be reported without somebody saying what they would like the results to have been - and finally - an important thing - the intelligence to interpret the results."

Richard Feynman

5.1 Asteroid Positions

From 17 nights of observation and 4 617 astronomical images, 560 different asteroids were predicted to be crossing the FOV of the images at the given epochs by the Skybot service, with a total of 130 626 positions within the field of view of the analyzed data. However, it is not possible to extract positions from most asteroids because of their faintness. Most of the asteroids provided by SkyBoT have apparent magnitudes around 21.5 mag in the V band, reaching asteroids and objects of the Kuiper Belt with magnitudes around 29, as shown in figure 5.1. With the equipment used for the data acquisition, it was possible to detect asteroids until a magnitude of 18.3 mag.

Although there are visible asteroids with magnitudes higher than 18.3 mag after modifying the brightness and contrast of images, it is no longer feasible to extract accurate positions due to the low signal-to-noise ratio when SExtractor calculate its centroid. In addition, to detect these asteroids the threshold value to detect sources from SExtractor needs to be decreased, which would consequently increase the amount of noise extracted as a light source.

Of 560 predicted asteroids, only 27 different asteroids were identified, corresponding to 8 024 positions. Of 8 024 different positions, 5 184 passed the quality tests carried out. For a clearly visualization of this information, see table 5.1.

Predicted Asteroids	Predicted Positions	Identified Asteroids	Identified Positions	Final Positions
560	130 626	27	8 024	5 184

TABLE 5.1: Asteroid positions overview: general overview of the asteroid positions extracted from the datasets.

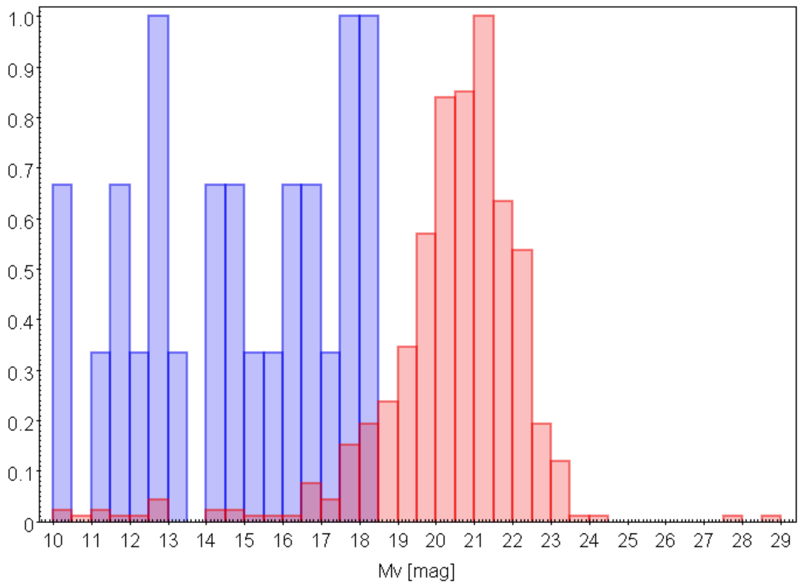


FIGURE 5.1: Normalized histogram of magnitude of detected asteroids versus all asteroids: the red bars correspond to the asteroids inside the field of view; the blue bars correspond to the detected asteroids. "Mv" is the apparent magnitude from SkyBoT service.

The asteroids found are mainly from the Main Belt region. There are some asteroids classified as Amor, Apollo, etc., but due to their high magnitude it was impossible to extract good positions. Table 5.2 lists the number of predicted and detected asteroids per asteroid class.

Asteroid Family	Predicted Asteroids	Identified Asteroids
MB>Middle	195	14
MB>Outer	173	8
MB>Inner	163	4
MB>Cybele	2	1
MB>Hungaria	4	0
MB>Hilda	3	0
NEA>Amor	3	0
NEA>Apollo	2	0
Mars-Crosser	7	0
Trojan	3	0
KBO>SDO	3	0
KBO>Resonant>7:4	2	0

Table 5.2: Types of asteroids found: number of predicted and detected asteroids per asteroid class.

Table 5.3 is the resume of all the asteroids extracted from the processed datasets. In the table it is possible to check, for each asteroid, how many positions there are according with SkyBoT and how many positions were extracted/detected. If there are less extracted/detected positions than positions according with SkyBoT, the column "Filter" contains a label for the justification, to be: “St” means that some positions were affected by a nearby star and were removed from the data; “Sc” means that some positions had some scattering and were removed from the data; “SNR” means that some positions had a very low signal-to-noise ratio and it was not possible to extract them with the software SExtractor; “Vi” means that some positions were removed by visual inspection of the images and the light curves; “Sa” means that some positions were removed because there were saturated pixels.

The column “Mean” is the average value of the separations between the extracted positions by SExtractor and between the positions from SkyBoT. The column “St.Dev.” is the standard deviation of the separations between the extracted positions by SExtractor and between the positions from SkyBoT.

The column “Behavior” shows some information regarding the linear correlation factor and the proper motions. For each asteroid there are 3 code letters, that can be “A” or “B”. The first letter is about the linear correlation factor, if it is "A", it means the linear correlation factor is greater than 0.9 and if it is "B", the linear correlation factor is less or equal to 0.9. The second and third letters are about the proper motions compared with SkyBoT's (second letter for the right ascension and third letter for declination proper motion). If the calculated error between the average proper motion and the nominal value from the Minor Planet Center database is less than 20% of the relative difference, the used letter is "A", if it is greater or equal to 20% of the relative difference, the used letter is "B". If there are two sets of flags (for example: "AAA BBA") it means more than one dataset for the same asteroid showed different behaviors.

ID	Name	Class	Mv [mag]	Pos.	Det.	Mean [arcsec]	St.Dev. [arcsec]	Filters	Behavior
13	Egeria	MB>Middle	10.3	499	327	1.03	0.19	St Sa	AAA
39	Laetitia	MB>Middle	10.4	229	214	0.60	0.19	Sc	AAA
372	Palma	MB>Outer	11.0	397	350	0.62	0.14	St Sc Sa	AAA
145	Adeona	MB>Middle	11.6	388	307	0.47	0.10	St Sc Vi	AAA
114	Kassandra	MB>Middle	11.7	244	128	0.76	0.10	St Vi	AAA
65	Cybele	MB>Cybele	12.0	454	446	0.56	0.11	Sc	AAA
68	Leto	MB>Middle	12.5	89	89	0.28	0.08		AAA
402	Chloe	MB>Middle	12.7	658	517	0.56	0.17	St Sc Sa Vi	AAA
308	Polyxo	MB>Middle	12.9	694	521	0.31	0.10	Sc	AAA
441	Bathilde	MB>Middle	13.0	434	349	0.70	0.10	St Sc Vi	AAA
360	Carlova	MB>Outer	14.0	258	252	0.28	0.11	Sc	AAA
976	Benjamina	MB>Outer	14.4	71	33	0.32	0.12	St	AAA
838	Seraphina	MB>Outer	14.9	158	152	0.50	0.06	Sc Vi	AAA
1626	Sadeya	MB>Inner	14.9	21	14	1.20	0.26	St	AAA
4628	Laplace	MB>Middle	15.1	334	201	0.53	0.12	St	AAA
9659	1996 Ej	MB>Middle	15.8	327	316	0.67	0.10	Sc Vi	AAA
1501	Baade	MB>Middle	16.3	242	224	0.83	0.21	Sc Vi	AAA
1427	Ruvuma	MB>Middle	16.4	65	59	0.40	0.13	Vi	AAA
2219	Mannucci	MB>Outer	16.8	89	84	0.44	0.22	SNR Sc	AAA
4745	Nancymarie	MB>Outer	16.8	244	53	0.68	0.31	St Sc Vi	AAA BBB
24837	Msecke Zehrovice	MB>Inner	17.1	244	26	0.88	0.31	SNR St Vi	AAA
10142	Sakka	MB>Middle	17.6	258	227	0.60	0.27	SNR Sc Vi	AAA
11922	1992 UT3	MB>Inner	17.7	89	30	0.76	0.32	SNR	AAA
39539	Emmadesmet	MB>Outer	17.9	192	34	0.93	0.28	SNR Vi	BAA
43227	2000 AR166	MB>Outer	18.0	276	79	0.69	0.22	SNR St Sc Vi	AAA
54041	2000 GQ113	MB>Inner	18.1	376	46	0.79	0.27	SNR Sc Vi	AAA BBA
41841	2000 WF60	MB>Middle	18.3	694	106	0.84	0.31	SNR St Sc Vi	AAA BAA

Table 5.3: Final results: resume of the asteroid positions detected from the datasets. "ID" is the numerical identifier provided by SkyBoT; "Mv" means apparent magnitude; "Pos." means the sum of the theoretical positions in the field of view of all images; "Det." means the sum of the detected positions after removing some positions due to bad effects, for example, positions affected by a nearby star or/and by some noise or low signal-to-noise ratio; "Mean" and "St.Dev." is the average value and the standard deviation, respectively, of the separations (in coordinates) between the extracted positions by SExtractor and between the positions from SkyBoT; "Filters" shows why some positions were removed (St: nearby star; Sc: scattering; Sa: saturated; SNR: low signal-to-noise ratio; Vi: visual inspection); "Behavior" shows the linear correlation factor (first letter; A: greater than 0.9; B: less or equal to 0.9) and the proper motion error when compared with the SkyBoT (second letter: right ascension proper motion; third letter: declination proper motion; A: less than 20% of the relative difference; B: greater or equal to 20% of the relative difference).

Figure 5.2 shows the apparent motion of the asteroid Cybele along the acquired astronomical images. Cybele has a total proper motion of 27.92 arcsec/h. The field of view is 6.5 arcmin. The astronomical images were obtained at 16/12/2017 from 19h07m0 6s PM to 00h29m50s PM (local time). It is only represented 9 frames of 386 available from one of the datasets.

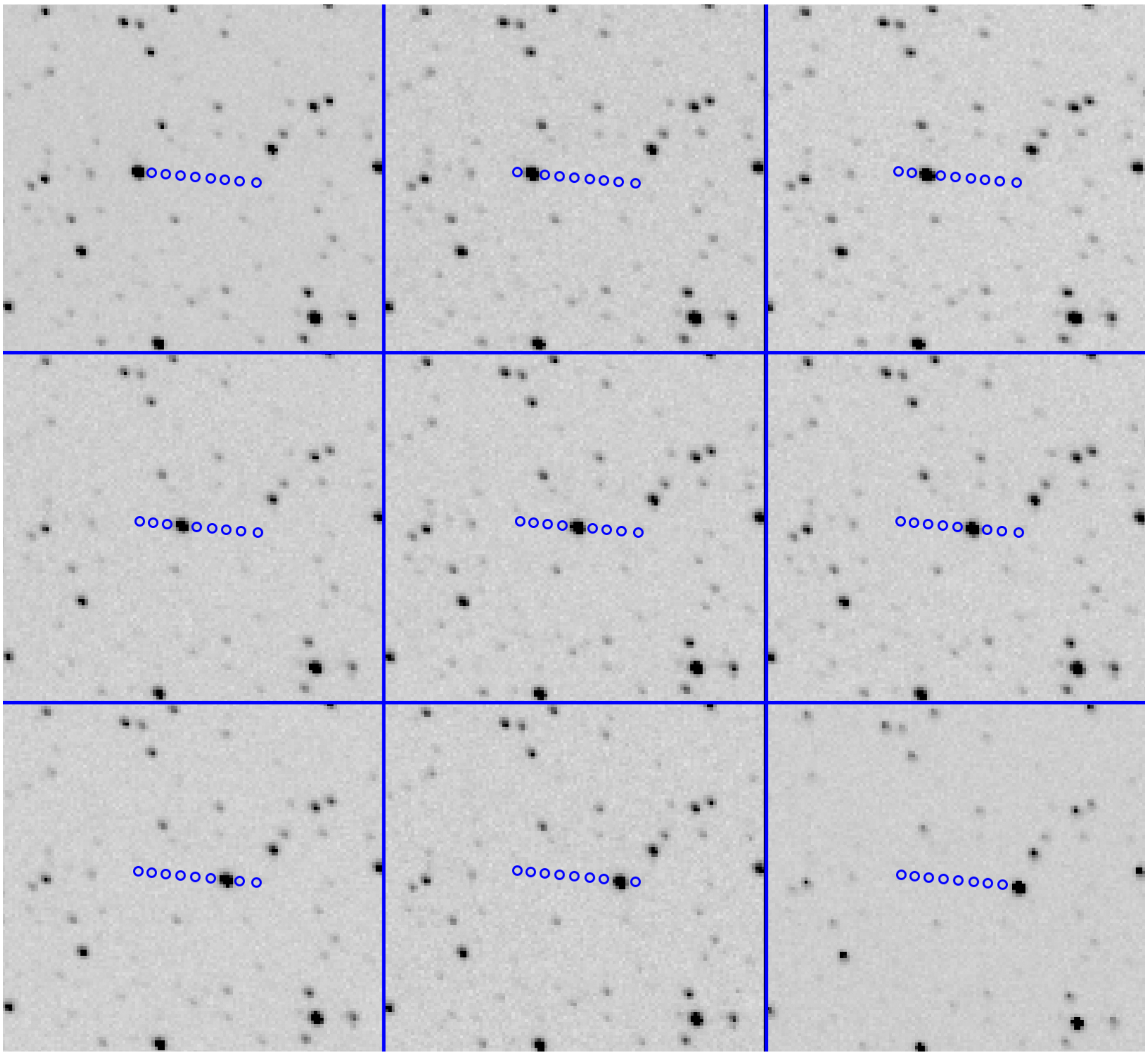


FIGURE 5.2: Example of asteroid positions: asteroid Cybele moving along the different acquired frames.

According to the results shown in Table 5.3, we can observe that practically all asteroids have removed positions due mainly to the scattering of data and the intersection of the asteroids apparent trajectory with stars in the field of view. The dispersion of positions tends to increase as the apparent magnitude of the detected asteroids increases. This reflects in the calculated standard deviation of the separation between SkyBoT coordinates and extracted centroids from SExtractor, as shown in figure 5.3. This effect is normal, because the greater the apparent magnitude, the lower the signal-to-noise ratio and consequently the greater the difficulty in extracting positions with good accuracy. However, the trend is not linear, since in addition to the apparent magnitude of the asteroids it is necessary to take into account other effects that compromise the signal-to-noise ratio, such as meteorological conditions, seeing, parameters of the CCD camera, etc.

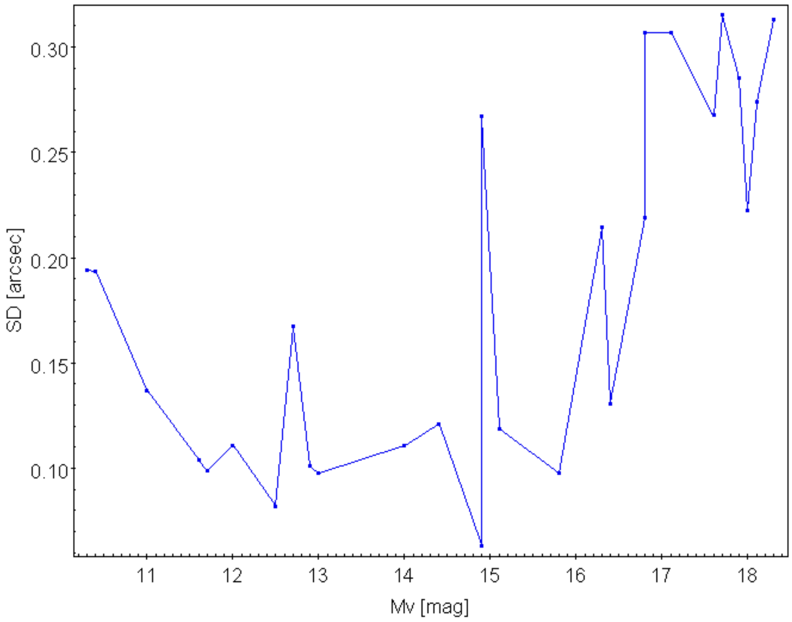


FIGURE 5.3: Standard deviation versus apparent magnitude: standard deviation of the detected positions of each asteroid versus its apparent magnitude. "Mv" is the apparent magnitude from SkyBoT service and "SD" is the standard deviation.

5.2 Asteroids Separations and Proper Motions

The separations between asteroid positions extracted by SExtractor and positions provided by SkyBoT service are an important quality parameter to check the efficiency of the method of this project. Figure 5.4 shows a histogram of the separations. The range of separations goes from 0.03 arcsec to 1.80 arcsec, with a average value of 0.59 arcsec and a standard deviation of 0.25 arcsec. 7.62% of separations are above 1 arcsec. The separation values agree with the separations from the astrometric calibration obtained between the calculated centroids and Gaia DR2 coordinates, as shown in figure 3.10. Due to the quality and noise levels of the astronomical images, it was not possible to obtain a better astrometric accuracy. However, this pipeline is ready to provide better results for images with better quality.

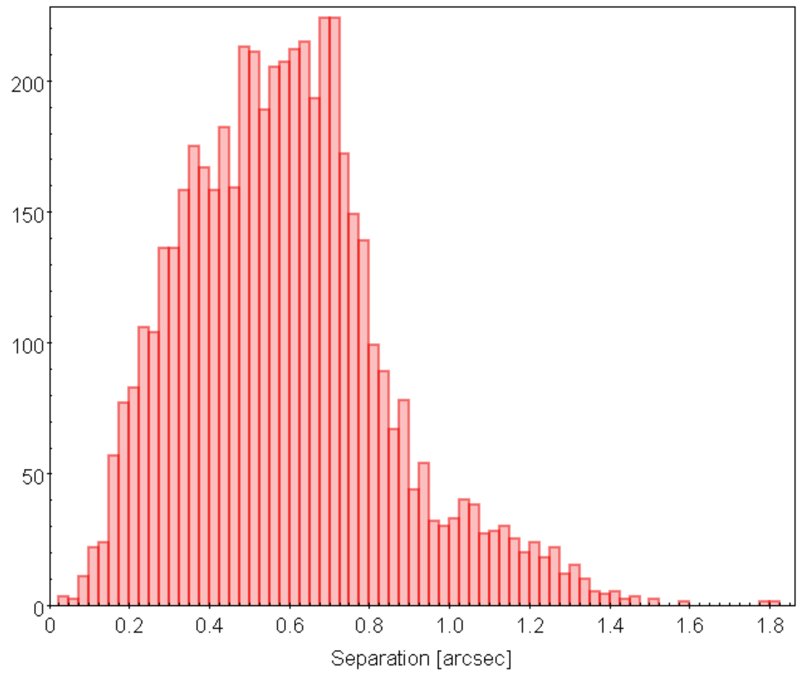


FIGURE 5.4: Separations histogram: histogram of the separations between extracted positions by SExtractor and positions provided by SkyBoT service.

Figure 5.5 shows the relation between the separations and the SkyBoT uncertainties. SkyBoT provide very accurate positions with uncertainties from 0.016 arcsec to 0.054 arcsec. The asteroids under study have a well determined orbit resulting of many years of study them, as these asteroids are very easy to detect/identify due to their brightness and very easy to acquire astronomical data.

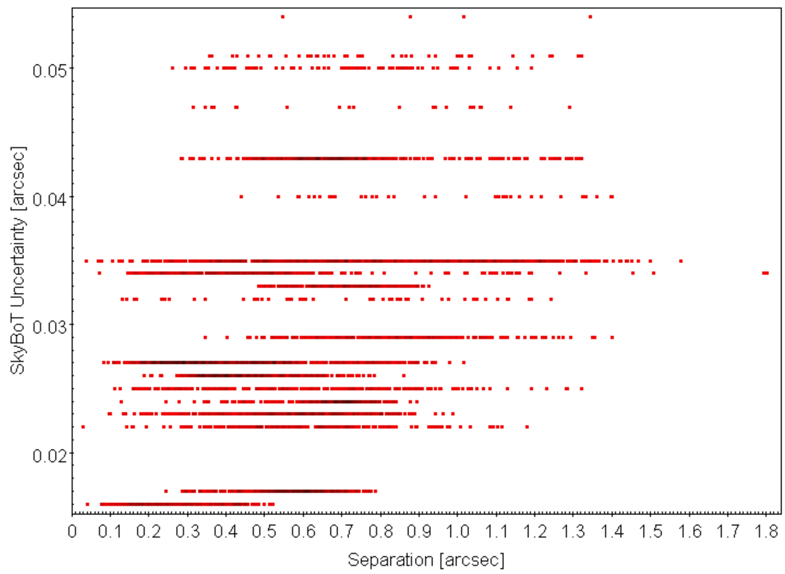


FIGURE 5.5: Separations versus SkyBoT uncertainties: relation between separations and SkyBoT uncertainties.

Proper motions are also an import study parameter for this project.

Figure 5.6 shows the motion of two different asteroids observed during the same night, with a time span of 5h36m. Polyxo moves ∼50.0 arcsec with a total proper motion of 8.9 arcsec/h. Laplace moves ∼1.6 arcmin with a total proper motion of 16.8 arcsec/h.

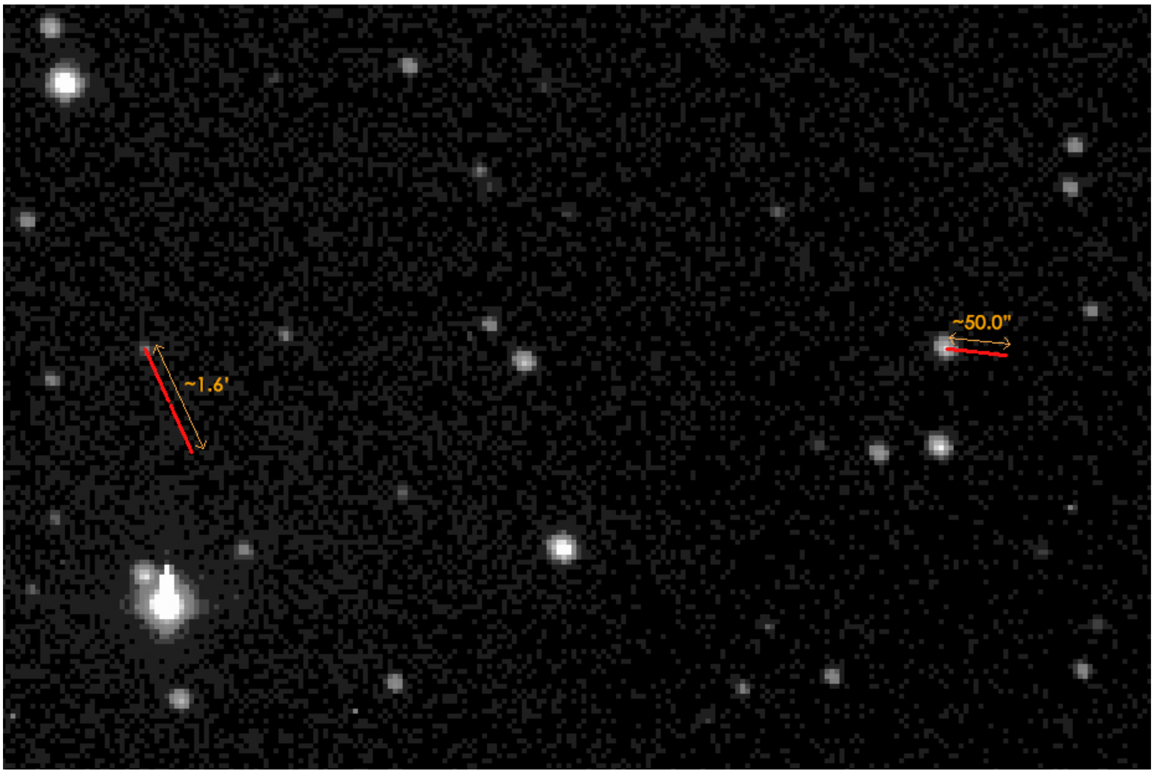


FIGURE 5.6: Comparison of proper motions between two asteroids: the proper motion of two different asteroids (Polyxo and Laplace) at the same observing night.

Different classes of asteroids have different proper motions. Figure 5.7 shows the proper motions according with their classes. In this project is difficult to see different classes of asteroids grouped with similar proper motions, because all the detected asteroids are from the main belt region with similar characteristics.

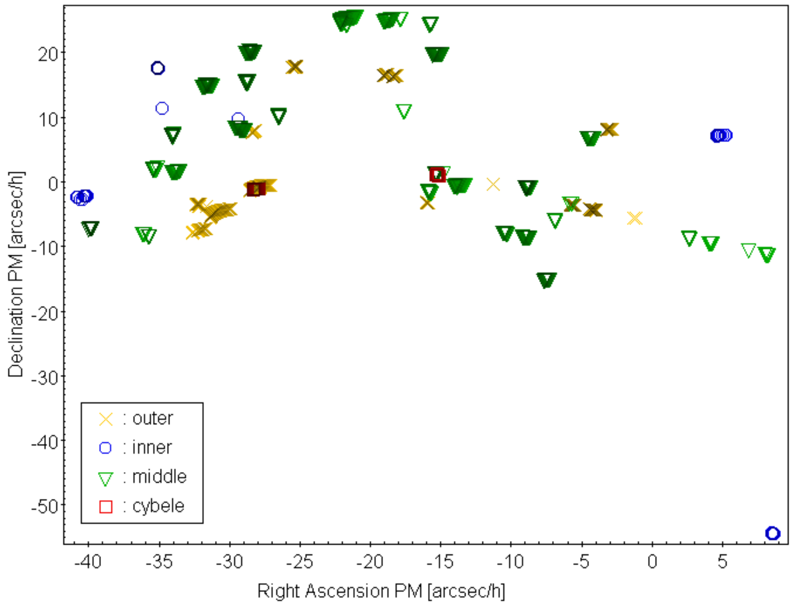


FIGURE 5.7: Asteroids proper motions by class: proper motions of the asteroids according with their class (Main Belt: outer, inner, middle and cybele).

Figure 5.8 shows the histogram of total proper motions. The range of total proper motions goes from 5.94 arcsec/h to 55.01 arcsec/h with an average value of 25.48 arcsec/h.

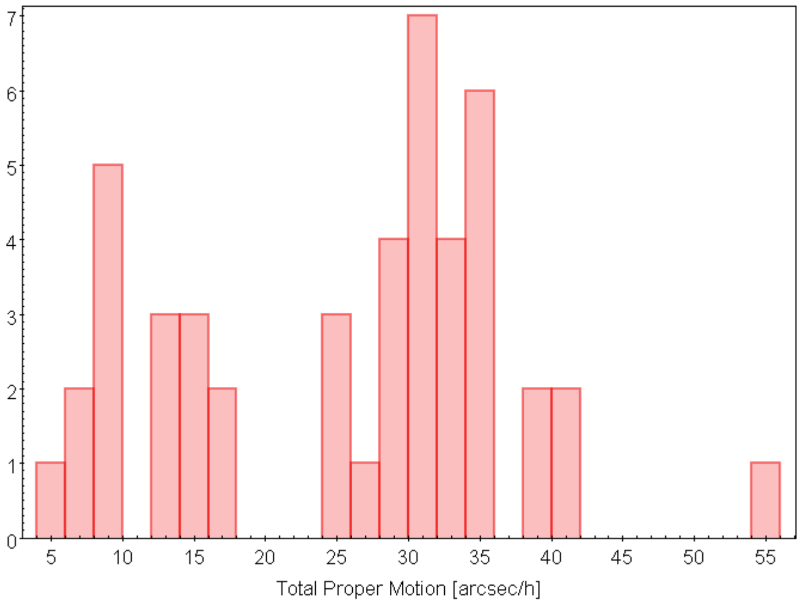
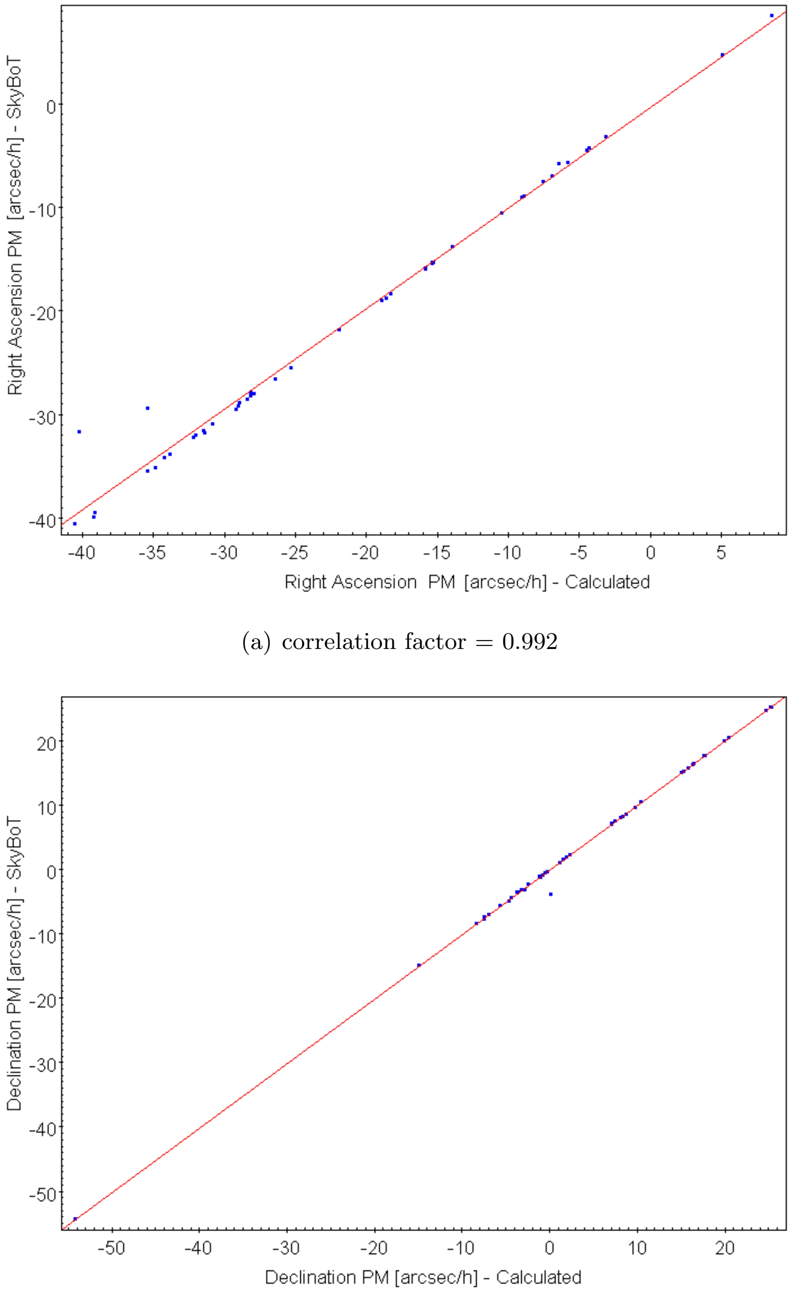


FIGURE 5.8: Total proper motion: histogram of total proper motions.

Figure 5.9 shows the relation between calculated proper motions and proper motions provided by SkyBoT service. As shown in the figures, there are two outliers for the right ascension proper motions and one outlier for the declination proper motion.



(a) correlation factor = 0.992

(b) correlation factor = 0.999

FIGURE 5.9: Calculated proper motion versus SkyBoT: comparison between calculated proper motions and proper motions provided by SkyBoT service. Error bars are to small to be seen.

Discussion about these outliers can be seen in the next paragraphs and in the figures 5.10 and 5.11.

Regarding linear correlations and proper motions between extracted data by SExtractor and the data provided by SkyBoT service, four of 27 asteroids show linear correlations lower than 0.9 for some specific datasets and, in three of these datasets, there are also proper motion with errors greater than 20% of the relative difference. These datasets are from asteroid with magnitudes equal or above 16.8 mag, (16.8 mag; 17.9 mag; 18.1 mag; 18.3 mag), asteroids with low signal-to-noise ration and magnitudes close to the magnitude limit of the images. So, in these cases, SExtractor has more difficulties to extract accurate centroids for the asteroid positions and in the end, these asteroids has few positions when compared with brighter asteroids.

The calculated linear correlations and proper motions are related with fit functions to fit the asteroid positions with linear models. If SExtractor does not provide accurate centroids and just extract few asteroid positions, the linear regression will get a significant error for the slope value. Figures 5.10, 5.11, 5.12 and 5.13 show the distinct linear fit of the asteroid positions extracted by SExtractor for the asteroids Nancymarie, 2000 GQ113, 2000 WF60 and Emmadesmet, respectively. These datasets with very few positions should have been removed from the results, when the visual inspection was made.

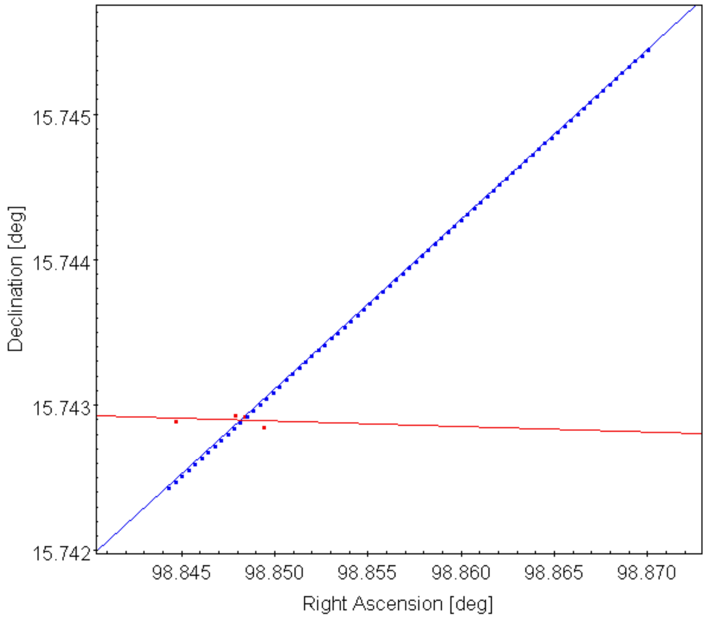


FIGURE 5.10: Nancymarie non-quality case: this dataset was classified with "BBB" behavior. In red are the asteroid positions extracted by SExtractor and the corresponding linear fit, and in blue are the asteroid positions provided by SkyBoT and the corresponding linear fit.

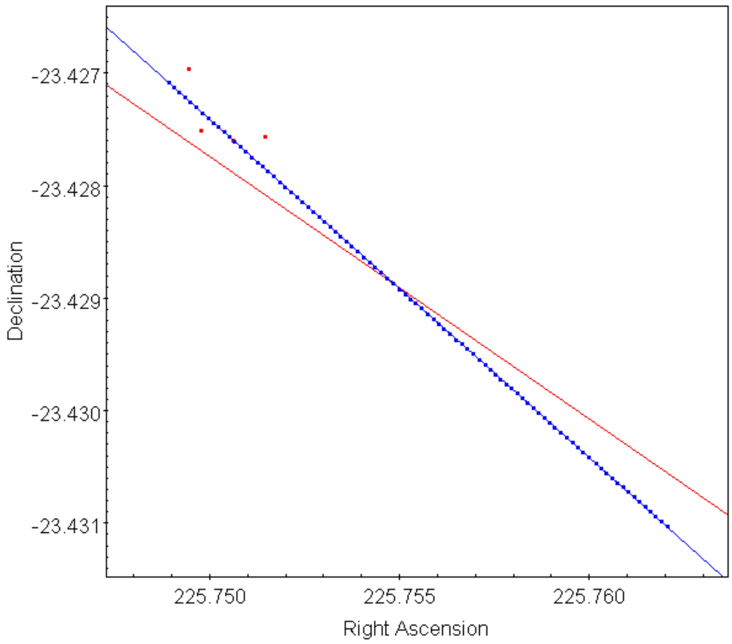


FIGURE 5.11: 2000 GQ113 non-quality case: this dataset was classified with "BBA" behavior. In red are the asteroid positions extracted by SExtractor and the corresponding linear fit, and in blue are the asteroid positions provided by SkyBoT and the corresponding linear fit.

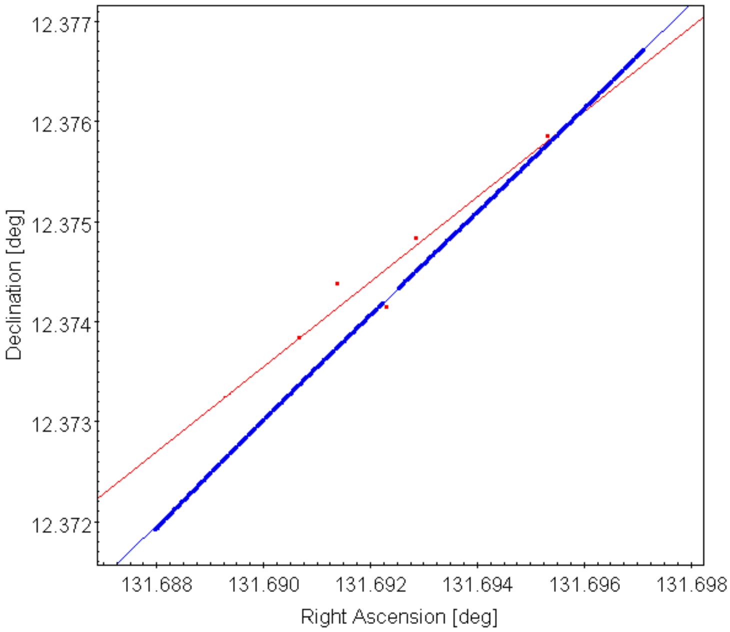


FIGURE 5.12: 2000 WF60 non-quality case: this dataset was classified with "BAA" behavior. In red are the asteroid positions extracted by SExtractor and the corresponding linear fit, and in blue are the asteroid positions provided by SkyBoT and the corresponding linear fit.

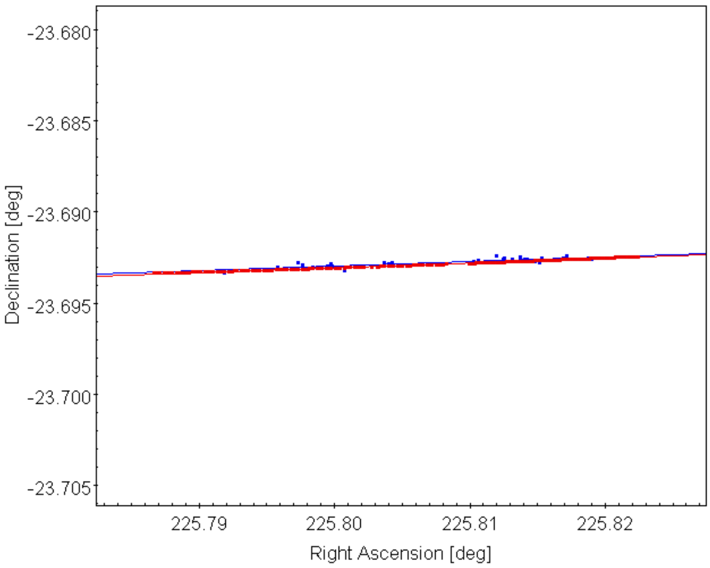
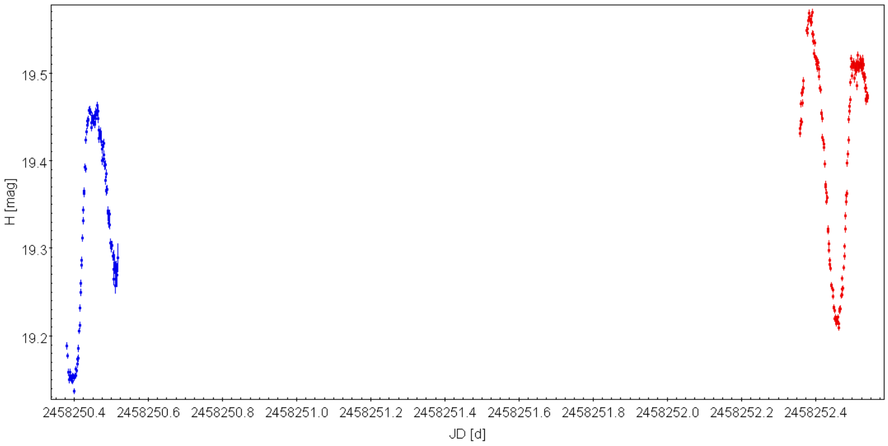


FIGURE 5.13: Emmadesmet non-quality case: this dataset was classified with "BAA" behavior. The linear fit of the SExtractor positions seems to coincide with the linear fit of SkyBoT, but it is only an effect due to the scale of the plot. In red are the asteroid positions extracted by SExtractor and the corresponding linear fit, and in blue are the asteroid positions provided by SkyBoT and the corresponding linear fit.

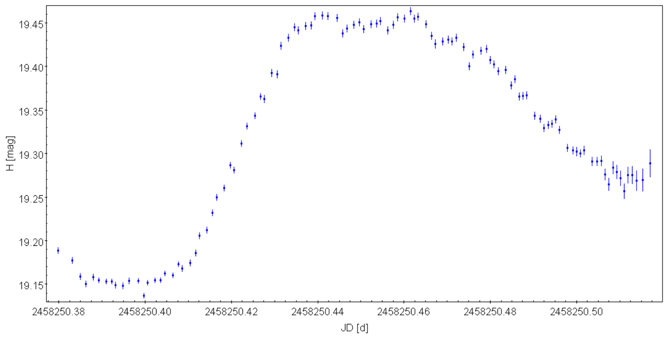
5.3 Asteroid Periods

From the calibrated light curves in respect to the absolute magnitude, it is possible to extract the rotation periods of the asteroids, an useful characterizing information.

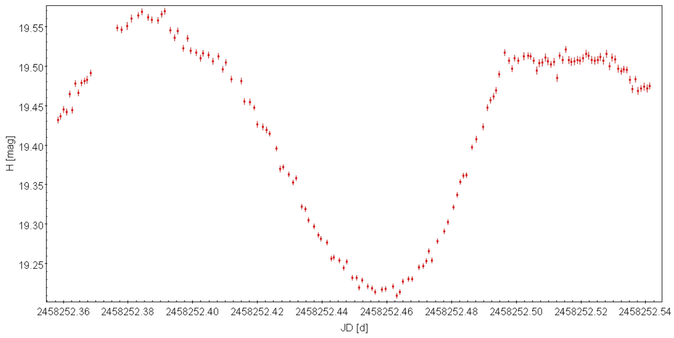
Figure 5.14 shows an example of the variation of the absolute magnitude of the calibrated light curves from the asteroid Carlova. Figures 5.14 (b) and (c) are close ups of the light curves at 5.14 (a).



(a)



(b)



(c)

FIGURE 5.14: Light curve - Carlova: calibrated light curve of the asteroid Carlova (a). Figures (b) and (c) are close ups of the light curves at (a).

According with the Asteroid Lightcurve Photometry Database[1] the rotational period of the asteroid Carlova is 6.1891 h. Different analysis of the rotation period, from 2006 until 2018, are concordant with this value. Table 5.4 shows the mentionated periods.

Reference	Year Observation	ALCDEF Period[1] [h]	Period Error [h]
Behrend et al.	2018	6.1891	0.0004
Hanus et al.	2017	6.189594	0.000002
Wang et al.	2015	6.189592	0.000002
Alton et al.	2012	6.1894	0.0003
Wang et al.	2006	6.19	0.02

s

Table 5.4: ALCDEF - Carlova periods: the periods obtained from different studies of the asteroid Carlova.

The Periodogram service from NASA Exoplanet Archive[2] is an easy and useful way to get periods from the light curves. Table 5.5 shows the different periods gotten from the light curves of the asteroid Carlova. The first table shows the results when it was used the two datasets to calculate the period, as shown in the figure 5.14 (a). The second and third table show the results when it was used the only one dataset to calculate the period, as shown in the figure 5.14 (b) and figure 5.14 (c), respectively.

Rank	Period [h]	Power
1	3.311286	104.097855
2	2.363152	54.2756614
3	1.710224	3.40172985
4	1.354654	3.09622085
5	1.664242	2.48795586

Rank	Period [h]	Power
1	3.296304	48.6949619
2	0.096798	1.72726069
3	0.723887	0.80450716
4	0.701393	0.69709332
5	0.747872	0.69059081

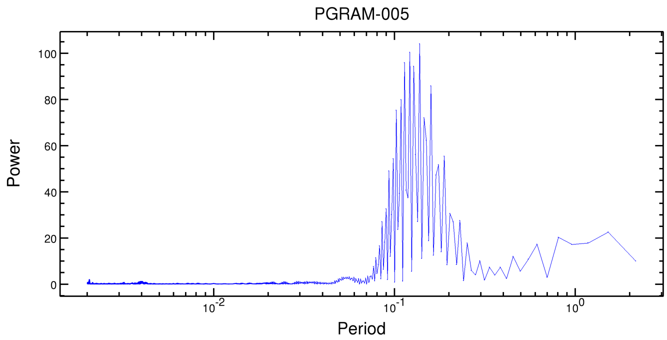
Rank	Period [h]	Power
1	3.140303	62.1346294
2	0.045237	1.66006805
3	0.049359	1.27432568
4	0.048031	0.95220368
5	0.101208	0.81160635

Table 5.5: Results - Carlova periods: peridos gotten from the Periodogram service of NASA Exoplanet Archive. The first table shows the results when it was used the two datasets to calculate the period, as shown in the figure 5.14 (a). The second and third table show the results when it was used the only one dataset to calculate the period, as shown in the figure 5.14 (b) and figure 5.14 (c), respectively.

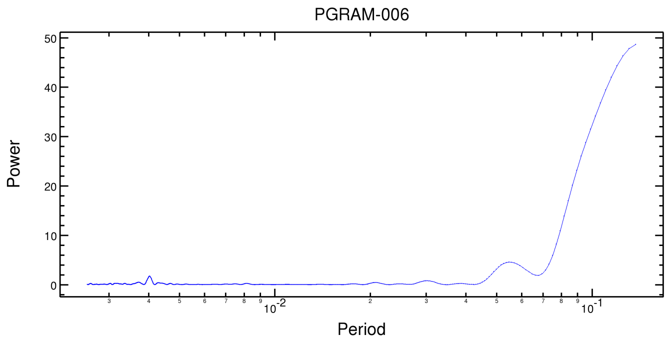
The results with the different datasets are concordant, with a range of 3.14 h to 3.31 h. Also the power of peaks for these periods is very distinct from the other powers. The calculated periods agree with the period from the Asteroid Lightcurve Photometry Database. It was found half of the period mentionated in literature, so it is possible to derive a complete period in concordance with the other studies.

[1] `http://alcdef.org/`
[2] `https://exoplanetarchive.ipac.caltech.edu/cgi-bin/Pgram/nph-pgram`

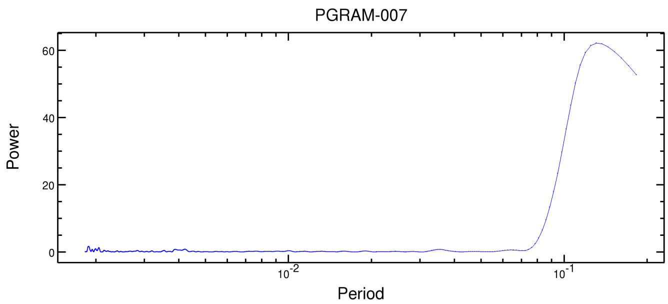
Figure 5.15 shows the periodograms. Figure (a) shows the result when it was used the two datasets to calculate the period, as shown in the figure 5.14 (a). Figures (b) and (c) show the result when it was used the only one dataset to calculate the period, as shown in the figure 5.14 (b) and figure 5.14 (c), respectively.



(a)



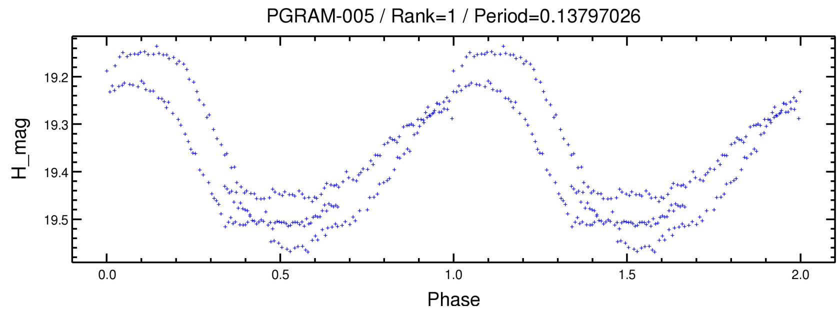
(b)



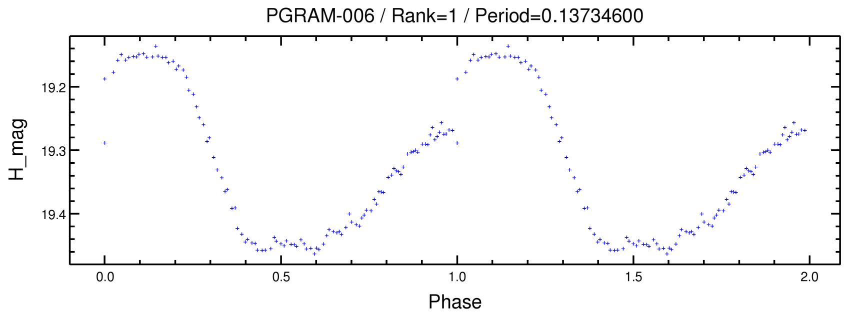
(c)

FIGURE 5.15: Power versus period - Carlova: power of the found peaks for extract periods. Figure (a) shows the results when it was used the two datasets to calculate the period, as shown in the figure 5.14 (a). Figures (b) and (c) show the results when it was used the only one dataset to calculate the period, as shown in the figure 5.14 (b) and figure 5.14 (c), respectively.

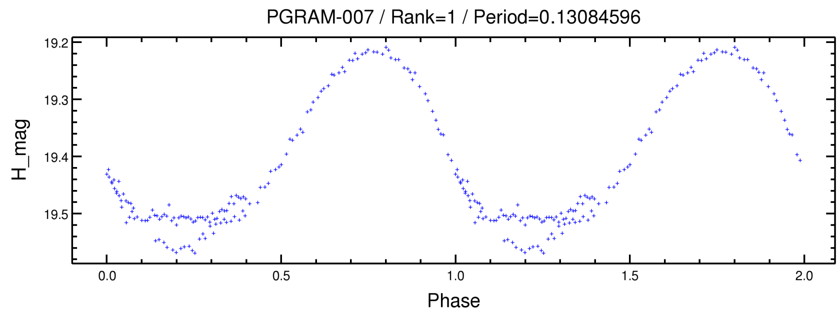
Figure 5.16 show the folded light curves. Figure (a) shows the result when it was used the two datasets to calculate the period, as shown in the figure 5.14 (a). Figures (b) and (c) show the result when it was used the only one dataset to calculate the period, as shown in the figure 5.14 (b) and figure 5.14 (c), respectively.



(a)



(b)



(c)

FIGURE 5.16: Periods curves - Carlova: curves from the resulted periods. Figure (a) shows the results when it was used the two datasets to calculate the period, as shown in the figure 5.14 (a). Figures (b) and (c) show the results when it was used the only one dataset to calculate the period, as shown in the figure 5.14 (b) and figure 5.14 (c), respectively.

According with the methodology described and looking to the light curves, the information of the periods in literature, the power of the peak in the periodogram and the folded light curves, it was calculated the periods for all the asteroids under study. Table 5.6 shows the results.

ID	Name	ALCDEF[3] Period [h]	Calculated Period [h]	Power
39	Laetitia	5.138 (Hanus 2017b)	4.662	50.4
372	Palma	8.579 (Hanus 2016a)	9.57	18.5
145	Adeona	15.071 (Pilcher 2010i)	14.928	55.9
114	Kassandra	10.743 (Durech 2018b)	8.096	24.6
65	Cybele	6.081 (Viikinkoski 2017)	5.379	54.8
68	Leto	14.845 (Hanus 2013b)	12.564	35.1
402	Chloe	10.700 (Devogele 2017)	11.914	44.9
308	Polyxo	12.029 (Pilcher 2014n)	12.824	37.5
441	Bathilde	10.443 (Hanus 2013a)	9.624	61.2
360	Carlova	6.189 (Hanus 2017b)	6.28	62.1
4628	Laplace	9.016 (Polakis 2018d)	10.371	64.9
9659	1996 Ej	-	3.539 *	11.0
1427	Ruvuma	4.797 (Bembrick 2006a)	4.602	7.2
2219	Mannucci	-	6.146 *	15.1
10142	Sakka	3.350 (Roland 2005)	3.055	6.9

TABLE 5.6: Calculated periods: calculated periods of all the asteroids under study.
* light curves show some trend but it is necessary to analyze deeply the period calculation.

From 27 asteroids, it was possible to compute periods for 15 of them. The periods are similar to the periods found in literature. With more data points it is possible to compute better and more accurate periods, due to the short covered nights of observation.

From some asteroids with apparent magnitudes fainter than 14.4 mag it was more difficult to get accurate periods due to the lower number of points in the light curves and due to the high scattering, for example the light curve of the asteroid Nancymarie shown in figure 5.17.

[3] `http://alcdef.org/`

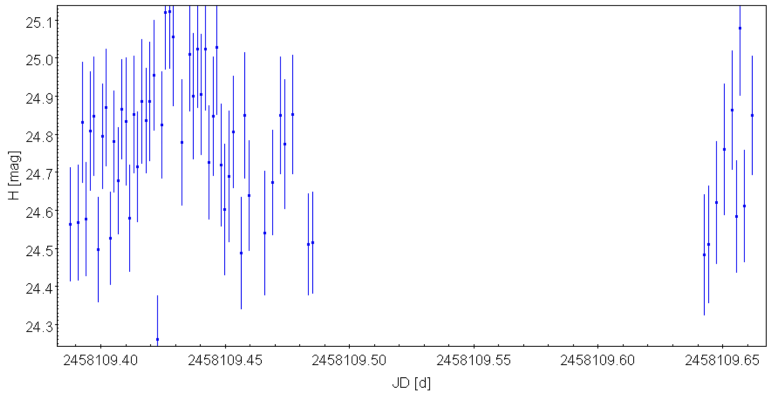


FIGURE 5.17: Analyze of periods - Example 1: the light curve of the asteroid Nancymarie.

However, the asteroid Sakka with an apparent magnitude of 17.6 mag shows an interesting light curve, with a well defined trend, as shown in the figure 5.18. From this asteroid it was possible to get a period of 3.055 d, close to the period of 3.350 d found in the literature.

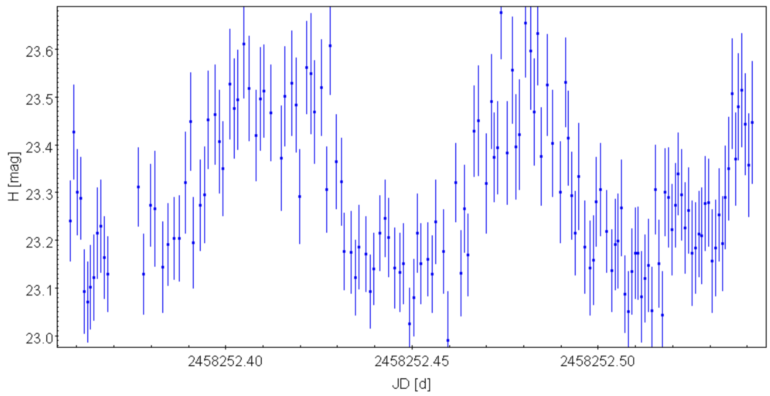


FIGURE 5.18: Analyze of periods - Example 2: the light curve of the asteroid Sakka.

Also the asteroid Ruvuma shows an interesting light curve where it was possible to get a period of 4.602 d, close to the period of 4.797 d found in the literature, as shown in figure 5.19.

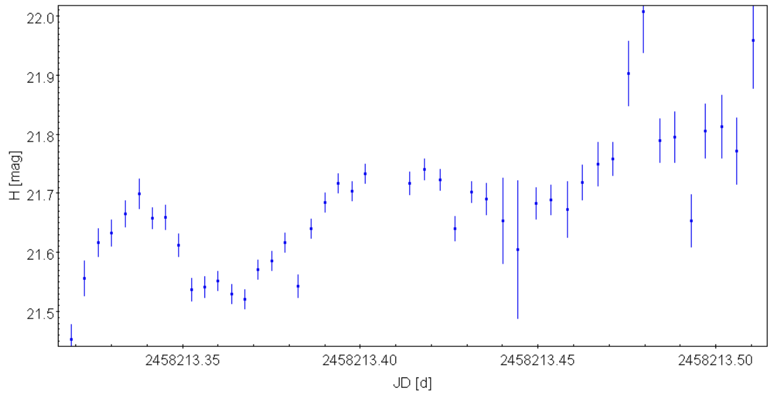


FIGURE 5.19: Analyze of periods - Example 3: the light curve of the asteroid Ruvuma.

Some asteroid have a light curve that show some trend but that raise some doubts, for example the light curve of the asteroid 1996 Ej shown in figure 5.20. From this asteroid, it was possible to get a period of 3.539 d, however, it needs a deeply analysis to conclude the value obtained.

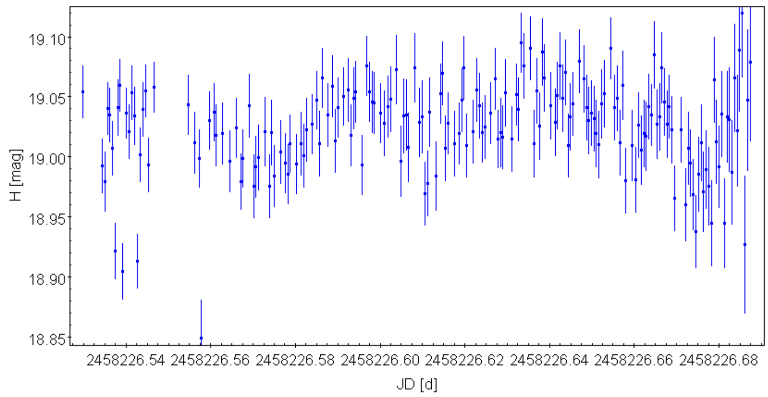


FIGURE 5.20: Analyze of periods - Example 4: the light curve of the asteroid 1996 Ej.

5.4 Contribution to the Minor Planet Center

It was not possible to submit the results to the Minor Planet Center due to reasons to request a new code for the Observatory, which includes the scientific team that acquired the data.

Chapter 6

Conclusions

"In science, all conclusions are provisional, subject to new evidence and better arguments, the very antithesis of religious faith."

Michael Shermer

6.1 Conclusions

The methodology to identify and characterize known asteroids presents a powerful method, with good results, according to the data sample used. The tools used demonstrated effectiveness and speed in the proposed objectives. The use of the programming language "IDL" facilitated the rapid execution of the pipeline and simplified the whole process. However, using a newer language, such as "Python", can offer greater versatility and greater support from the user community. The data provided by the terrestrial observatory presented the necessary requirements for this project. Several datasets presented a lack of quality and uniformity, but it should be noted that the observatory is mostly used for scientific dissemination and with limited resources. The lack of quality and standardization have advantages in order to strengthen the pipeline. The quality control of astronomical images was done manually. In case this pipeline is used systematically, it requires a demanding work by the user. Concerning the reduction of astronomical data, the tools did a good work and the results are as expected. The astrometric calibration also presented good results, however there were some difficulties in the selection of the parameters for calculating the centroids of the light sources. The photometric calibration also shows good results, however a filter should have been used in data acquisition to allow us to compare the magnitudes with other magnitude catalogs. The methodology used to identify the known asteroids presents good results. From the identified asteroids, these present linearities and proper motions with low errors when compared with the values in the literature. The filtering of asteroid positions affected by elements that result in erroneous positions, also reveals a success. Unfortunately it was not possible to use MPC as proof of check of the methodology used, but we certainly provide valuable information for orbit determination and period calculation.

Over 20 nights of data acquisition, 33 datasets were collected for a total of 5633 astronomical images. Of these images and due to the quality control, 4617 astronomical images were used, representing about 82%. Of the 560 predicted asteroids by the SkyBoT service in the images and epochs of the survey, with magnitudes from 10.3 mag to 29 mag, 27 asteroids were identified with magnitudes from 10.3 mag until 18.3 mag, resulting in 8 024 asteroid positions. From the 8 024 asteroid positions, 5 184 passed the quality tests carried out. In the predicted asteroids are different classes: Main Melt (Middle, Outer, Inner, Cybele, Hungaria, Hilda), NEA (Amor, Apollo), Mars-Crosser, Trojan, KBO (SDO, Resonant¿7:4), but the identified asteroids are just from Main Belt (Middle = 14, Outer = 8, Inner = 4 and Cybele = 1). The target asteroids are too close to the ecliptic plane so it is expected to find mainly Main Belt asteroids than other classes. However, there are asteroids from other classes, they are to faint to be identified. From the 27 identified asteroids proper motions were calculated ranging from 5.94 arcsec/h to 55.01 arcsec/h (total proper motions). 24 out of the 27 detected asteroids show calculated proper motions in very good agreement with the values provided by SkyBoT. The remaining three were calculated with very few asteroid positions and have large error bars. From 27 identified asteroid, it was possible to compute periods for 15 of them. For 12 asteroids we were not able to derive periods due to the short covered nights of observation.

6.2 Improvements

There are many improvements that can be done in this project, regarding the data acquisition and the programing of the pipeline:

Data acquisition:

1. Updating the master flat and master bias to calibrate correctly the data images. The master flat and master bias provided are from 2016. The conditions of the equipment change with time and it is necessary to update these calibration images;
2. Uniformization of the FITS headers. In some datasets were found FITS headers with different keywords from the usual, that can lead for programming errors in the pipeline. Other keywords are not identifying some image parameters correctly, for example, in the master bias there is: "type of image = dark frame";
3. Studying the camera linearity and saturation levels to improve the photometric data and the signal-to-noise ratio of the target source;
4. Improving the tracking system of the telescope mount. Some datasets were acquired with very good tracking and others with bad tracking;
5. Improving the acquired conditions to avoid light contamination, acquisitions during the twilight periods, etc.

Pipeline:

1. Creating a script to check the quality of the astronomical images to remove images with light contamination, excess of noise or blank images;
2. Creating a script to check saturated asteroid positions;
3. Changing the script that identifies a nearby star in the asteroid trajectory, in order to define an area around the star to remove asteroid positions according with the star brightness, instead of removing asteroid positions around a discrete area defined in the programming code;

4. Changing the script that performs the photometric calibration to define automatically which sources are in the linear region between the relation of the Gaia DR2 magnitude and instrumental magnitude;

5. Creating a script to identify satellites, airplanes and space junk in the field of view;

6. Organizing properly all the scripts and the master script that calls the other scripts;

7. Improving the astrometric calibration using the data from Gaia DR2 instead of 2MASS.

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All Data

Num	Name	JD [d]	Right Ascension [deg]	Declination [deg]	mag [mag]	emag [mag]
11922	1992 UT3	2458135,741	175,7457626	11,985678	17,57	1,74E-01
11922	1992 UT3	2458135,735	175,7454355	11,9858179	17,56	1,56E-01
11922	1992 UT3	2458135,729	175,7454448	11,9854608	17,61	1,62E-01
11922	1992 UT3	2458135,724	175,7453181	11,9851216	17,59	1,60E-01
11922	1992 UT3	2458135,718	175,7451248	11,9850373	18,05	1,82E-01
11922	1992 UT3	2458135,671	175,7433106	11,9826728	17,60	1,39E-01
11922	1992 UT3	2458135,664	175,7431196	11,9822843	17,68	1,58E-01
11922	1992 UT3	2458135,661	175,7433618	11,9822945	17,10	1,46E-01
11922	1992 UT3	2458135,655	175,7430039	11,9818534	17,42	1,43E-01
11922	1992 UT3	2458135,65	175,7427054	11,981823	17,45	1,58E-01
11922	1992 UT3	2458135,647	175,7424739	11,9817627	17,47	1,58E-01
11922	1992 UT3	2458135,635	175,7423696	11,9812317	17,38	1,54E-01
11922	1992 UT3	2458135,629	175,7418286	11,9808281	17,48	1,57E-01
11922	1992 UT3	2458135,626	175,7418323	11,980649	17,26	1,29E-01
11922	1992 UT3	2458135,624	175,7418456	11,9803148	17,62	1,60E-01
11922	1992 UT3	2458135,618	175,7418506	11,9804104	17,30	1,49E-01
11922	1992 UT3	2458135,592	175,7408801	11,9790949	17,77	1,64E-01
11922	1992 UT3	2458135,56	175,7397582	11,9771227	17,47	1,83E-01
11922	1992 UT3	2458135,539	175,7388401	11,9765484	17,56	1,75E-01
11922	1992 UT3	2458135,531	175,738844	11,9758418	17,94	2,30E-01
41841	2000 WF6	2458101,653	131,6923033	12,374146	18,16	1,95E-01
41841	2000 WF6	2458101,58	131,6953088	12,375859	18,17	1,96E-01
41841	2000 WF6	2458108,743	131,264546	12,2939105	18,36	2,10E-01
41841	2000 WF6	2458108,742	131,2649007	12,294182	17,84	1,64E-01
41841	2000 WF6	2458108,741	131,2647226	12,2941417	18,08	1,55E-01
41841	2000 WF6	2458108,737	131,2652743	12,2941361	17,95	1,61E-01
41841	2000 WF6	2458108,736	131,2651938	12,2943844	18,19	1,45E-01
41841	2000 WF6	2458108,734	131,2654267	12,2944424	17,98	1,76E-01
41841	2000 WF6	2458108,732	131,2657361	12,2943074	17,67	1,50E-01
41841	2000 WF6	2458108,729	131,2657422	12,2943464	18,28	1,94E-01
41841	2000 WF6	2458108,726	131,265986	12,294179	18,19	1,67E-01
41841	2000 WF6	2458108,722	131,2667036	12,2940955	18,24	1,88E-01
41841	2000 WF6	2458108,72	131,2667626	12,2941316	18,27	2,00E-01
41841	2000 WF6	2458108,718	131,2669037	12,2940345	17,78	1,65E-01
41841	2000 WF6	2458108,716	131,266983	12,2943405	18,28	2,00E-01
41841	2000 WF6	2458108,715	131,2671065	12,2944389	17,92	1,72E-01
41841	2000 WF6	2458108,713	131,26747	12,2941833	18,09	1,87E-01
41841	2000 WF6	2458108,713	131,2673027	12,2939092	18,09	1,91E-01
41841	2000 WF6	2458108,702	131,2682105	12,2939919	17,78	1,70E-01
41841	2000 WF6	2458108,7	131,2687797	12,2940775	17,91	1,79E-01
41841	2000 WF6	2458108,7	131,2687948	12,2944354	18,25	1,93E-01
41841	2000 WF6	2458108,698	131,2687061	12,2944918	18,19	1,74E-01
41841	2000 WF6	2458108,694	131,2690362	12,2942778	17,75	1,77E-01
41841	2000 WF6	2458108,691	131,2696126	12,294481	17,85	1,57E-01
41841	2000 WF6	2458108,691	131,2694769	12,2944073	18,17	1,70E-01
41841	2000 WF6	2458108,685	131,2701117	12,2946078	17,85	1,70E-01
41841	2000 WF6	2458108,683	131,2703968	12,2942985	18,02	1,88E-01
41841	2000 WF6	2458108,679	131,2707205	12,294607	18,21	2,09E-01
41841	2000 WF6	2458108,671	131,2713765	12,2947442	18,16	1,86E-01
41841	2000 WF6	2458108,667	131,2716096	12,2947399	18,13	1,78E-01
41841	2000 WF6	2458108,654	131,2727734	12,29441	18,21	1,87E-01
41841	2000 WF6	2458108,634	131,2750271	12,2946397	17,92	1,66E-01
41841	2000 WF6	2458108,625	131,2758083	12,2945104	18,01	1,77E-01
41841	2000 WF6	2458108,622	131,2762715	12,2945191	17,82	1,46E-01
41841	2000 WF6	2458108,62	131,2762488	12,2946498	18,34	1,77E-01
41841	2000 WF6	2458108,62	131,276336	12,2946104	18,17	1,73E-01
41841	2000 WF6	2458108,618	131,2766777	12,2944026	18,04	1,78E-01
41841	2000 WF6	2458108,617	131,2768574	12,2944214	17,89	1,78E-01
41841	2000 WF6	2458108,615	131,2767724	12,2944369	18,02	1,69E-01
41841	2000 WF6	2458108,61	131,2774713	12,2943616	17,99	1,72E-01
41841	2000 WF6	2458108,609	131,2774358	12,2945446	17,93	1,48E-01
41841	2000 WF6	2458108,605	131,2779163	12,29471	18,01	1,67E-01
41841	2000 WF6	2458108,598	131,2785737	12,2946165	18,11	1,59E-01
41841	2000 WF6	2458108,597	131,2784959	12,2945111	18,36	1,98E-01
41841	2000 WF6	2458108,595	131,278903	12,2946853	18,33	1,85E-01
41841	2000 WF6	2458108,589	131,2793897	12,2943103	17,86	1,76E-01
41841	2000 WF6	2458108,589	131,2792046	12,2947045	18,12	1,64E-01
41841	2000 WF6	2458108,588	131,2794218	12,2943775	17,86	1,72E-01
41841	2000 WF6	2458108,587	131,279495	12,2945308	18,30	1,73E-01
41841	2000 WF6	2458108,586	131,2795038	12,2944494	18,16	1,81E-01
41841	2000 WF6	2458108,584	131,2797622	12,2945079	17,62	1,57E-01
41841	2000 WF6	2458108,579	131,2800138	12,294487	18,32	2,02E-01
41841	2000 WF6	2458108,579	131,2804747	12,2946318	18,05	1,53E-01

41841	2000 WF6	2458108,568	131,2815279	12,2945003	18,14	1,79E-01
41841	2000 WF6	2458108,566	131,2815026	12,2944934	18,11	1,64E-01
41841	2000 WF6	2458108,565	131,2818469	12,2945822	18,32	1,83E-01
41841	2000 WF6	2458108,563	131,2816398	12,2945216	18,12	1,64E-01
41841	2000 WF6	2458108,563	131,2818744	12,2944304	18,31	1,71E-01
41841	2000 WF6	2458108,562	131,2820765	12,2946992	18,16	1,74E-01
41841	2000 WF6	2458108,556	131,2825162	12,294584	17,99	1,63E-01
41841	2000 WF6	2458108,554	131,2828255	12,2945111	18,02	1,68E-01
41841	2000 WF6	2458108,55	131,2831521	12,2945384	18,05	1,62E-01
41841	2000 WF6	2458108,549	131,2831755	12,2944263	18,41	1,86E-01
41841	2000 WF6	2458108,549	131,2831595	12,2943367	18,21	1,71E-01
41841	2000 WF6	2458108,547	131,2832918	12,2943378	17,58	1,35E-01
41841	2000 WF6	2458108,541	131,2839025	12,2945346	17,83	1,57E-01
41841	2000 WF6	2458108,54	131,2839731	12,2947048	18,11	1,74E-01
41841	2000 WF6	2458108,539	131,2842615	12,294559	17,52	1,42E-01
41841	2000 WF6	2458108,538	131,2843561	12,2944995	17,60	1,36E-01
41841	2000 WF6	2458108,537	131,2842191	12,2943993	17,93	1,48E-01
41841	2000 WF6	2458108,536	131,2843879	12,2944006	17,92	1,49E-01
41841	2000 WF6	2458108,536	131,284444	12,2945222	17,70	1,42E-01
41841	2000 WF6	2458108,534	131,284765	12,2945413	17,67	1,29E-01
41841	2000 WF6	2458108,532	131,2845623	12,2944687	17,82	1,44E-01
41841	2000 WF6	2458108,531	131,2849722	12,2945922	17,83	1,51E-01
41841	2000 WF6	2458108,53	131,2847961	12,2945271	17,72	1,51E-01
41841	2000 WF6	2458108,526	131,2854474	12,2944461	17,73	1,50E-01
41841	2000 WF6	2458108,524	131,2855349	12,2944661	17,72	1,52E-01
41841	2000 WF6	2458108,523	131,2855085	12,2945959	17,52	1,34E-01
41841	2000 WF6	2458108,521	131,2859264	12,2947076	17,69	1,31E-01
41841	2000 WF6	2458108,519	131,2857451	12,2943633	17,61	1,39E-01
41841	2000 WF6	2458108,518	131,2859364	12,2944425	17,83	1,50E-01
41841	2000 WF6	2458108,516	131,2858482	12,2944051	17,72	1,42E-01
41841	2000 WF6	2458108,516	131,2862223	12,2948747	17,82	1,46E-01
41841	2000 WF6	2458108,515	131,2859653	12,2947478	17,96	1,58E-01
41841	2000 WF6	2458108,514	131,2865572	12,2947058	17,60	1,34E-01
41841	2000 WF6	2458108,513	131,2863914	12,2945892	17,70	1,39E-01
41841	2000 WF6	2458108,506	131,2872289	12,2946811	17,90	1,53E-01
41841	2000 WF6	2458108,503	131,2875149	12,2947767	17,92	1,57E-01
41841	2000 WF6	2458108,501	131,2876932	12,294681	17,89	1,44E-01
41841	2000 WF6	2458108,5	131,2874153	12,294616	18,20	1,66E-01
41841	2000 WF6	2458108,499	131,2877271	12,294515	18,38	1,78E-01
41841	2000 WF6	2458108,498	131,287827	12,2948113	17,92	1,66E-01
41841	2000 WF6	2458108,496	131,2879658	12,2950229	17,86	1,48E-01
41841	2000 WF6	2458108,493	131,2884275	12,2947661	17,90	1,60E-01
41841	2000 WF6	2458108,492	131,2882539	12,2946775	18,19	1,72E-01
41841	2000 WF6	2458108,491	131,2885946	12,2948417	18,01	1,56E-01
41841	2000 WF6	2458108,489	131,2885948	12,2946125	17,99	1,47E-01
41841	2000 WF6	2458108,487	131,2890579	12,2949434	17,85	1,60E-01
41841	2000 WF6	2458108,485	131,289097	12,2948536	18,11	1,63E-01
41841	2000 WF6	2458108,484	131,2892153	12,2949322	18,13	1,73E-01
41841	2000 WF6	2458108,483	131,2893869	12,2946287	18,29	1,73E-01
41841	2000 WF6	2458108,479	131,2896281	12,2949099	17,95	1,58E-01
41841	2000 WF6	2458108,466	131,2905833	12,2947582	17,91	1,97E-01
41841	2000 WF6	2458108,465	131,2907885	12,2948545	17,74	1,67E-01
41841	2000 WF6	2458108,464	131,2909846	12,29504	17,75	1,84E-01
145	Adeona	2458104,595	121,0685573	29,885415	11,21	1,74E-03
145	Adeona	2458104,594	121,0687247	29,8851671	11,22	1,85E-03
145	Adeona	2458104,591	121,0691442	29,8846698	11,21	1,94E-03
145	Adeona	2458104,589	121,0693268	29,8844087	11,22	2,04E-03
145	Adeona	2458104,587	121,0695	29,8841716	11,21	2,04E-03
145	Adeona	2458104,586	121,06973	29,8838974	11,20	2,04E-03
145	Adeona	2458104,584	121,0698837	29,8836468	11,21	2,04E-03
145	Adeona	2458104,583	121,0701249	29,8833442	11,21	2,04E-03
145	Adeona	2458104,581	121,070337	29,8830494	11,22	1,94E-03
145	Adeona	2458104,58	121,0705075	29,8828167	11,22	2,13E-03
145	Adeona	2458104,578	121,070692	29,8825644	11,21	2,13E-03
145	Adeona	2458104,576	121,0708796	29,8823409	11,21	2,14E-03
145	Adeona	2458104,572	121,071463	29,8815088	11,21	2,15E-03
145	Adeona	2458104,57	121,0716197	29,8812847	11,20	2,14E-03
145	Adeona	2458104,568	121,071784	29,8809839	11,20	2,24E-03
145	Adeona	2458104,567	121,0720039	29,880695	11,20	2,24E-03
145	Adeona	2458104,565	121,0722267	29,8805263	11,18	2,25E-03
145	Adeona	2458104,564	121,0724051	29,88027	11,19	2,35E-03
145	Adeona	2458104,562	121,0726321	29,8799744	11,20	2,54E-03
145	Adeona	2458104,561	121,0728299	29,8797599	11,18	2,45E-03
145	Adeona	2458104,559	121,0730113	29,879485	11,18	2,46E-03
145	Adeona	2458104,557	121,0731571	29,8792393	11,20	2,55E-03
145	Adeona	2458104,556	121,0733931	29,8789213	11,20	2,64E-03
145	Adeona	2458104,554	121,0735288	29,878697	11,19	2,64E-03

145	Adeona	2458104,553	121,0737383	29,878412	11,18	2,76E-03
145	Adeona	2458104,551	121,0739518	29,8781647	11,17	2,87E-03
145	Adeona	2458104,55	121,07413	29,8778496	11,21	2,84E-03
145	Adeona	2458104,548	121,0742555	29,8776529	11,21	3,03E-03
145	Adeona	2458104,546	121,0745554	29,8773676	11,21	3,14E-03
145	Adeona	2458104,545	121,0746992	29,8771429	11,19	3,34E-03
145	Adeona	2458104,543	121,0749618	29,8769069	11,21	3,33E-03
145	Adeona	2458104,542	121,0751051	29,8766226	11,18	3,38E-03
145	Adeona	2458104,54	121,0752941	29,8763675	11,19	3,55E-03
145	Adeona	2458104,538	121,0754871	29,8760476	11,19	4,12E-03
145	Adeona	2458104,537	121,0757471	29,8758052	11,20	4,04E-03
145	Adeona	2458104,534	121,0760234	29,8753256	11,21	4,49E-03
145	Adeona	2458104,532	121,0762597	29,8749794	11,22	4,88E-03
145	Adeona	2458104,531	121,0764551	29,8747231	11,21	5,21E-03
145	Adeona	2458104,529	121,0766407	29,8745228	11,21	5,18E-03
145	Adeona	2458104,527	121,0768477	29,8742432	11,19	5,03E-03
145	Adeona	2458104,526	121,0770743	29,8740455	11,20	5,22E-03
145	Adeona	2458107,562	120,6980646	30,374245	11,17	2,54E-03
145	Adeona	2458107,561	120,6983084	30,3739833	11,18	2,23E-03
145	Adeona	2458107,559	120,6985665	30,373715	11,16	2,33E-03
145	Adeona	2458107,557	120,6987724	30,3734513	11,16	2,23E-03
145	Adeona	2458107,556	120,6990303	30,373182	11,16	2,23E-03
145	Adeona	2458107,554	120,6992713	30,3729188	11,16	2,14E-03
145	Adeona	2458107,553	120,6994926	30,3726257	11,18	2,03E-03
145	Adeona	2458107,551	120,6997477	30,372333	11,18	2,02E-03
145	Adeona	2458107,549	120,6999601	30,3720641	11,17	2,03E-03
145	Adeona	2458107,548	120,7002071	30,3718016	11,15	2,04E-03
145	Adeona	2458107,546	120,7004496	30,371497	11,17	1,94E-03
145	Adeona	2458107,545	120,7006725	30,371213	11,15	1,94E-03
145	Adeona	2458107,543	120,7009119	30,3709867	11,15	1,84E-03
145	Adeona	2458107,541	120,7011523	30,3707048	11,14	1,84E-03
145	Adeona	2458107,54	120,7013653	30,3704255	11,16	1,74E-03
145	Adeona	2458107,538	120,7015978	30,3701625	11,15	1,74E-03
145	Adeona	2458107,537	120,7018144	30,3699185	11,16	1,74E-03
145	Adeona	2458107,535	120,7020978	30,3696631	11,16	1,73E-03
145	Adeona	2458107,533	120,70231	30,3693641	11,16	1,73E-03
145	Adeona	2458107,532	120,7025343	30,3691091	11,15	1,63E-03
145	Adeona	2458107,53	120,7027705	30,3688841	11,16	1,63E-03
145	Adeona	2458107,528	120,7030022	30,3686324	11,15	1,53E-03
145	Adeona	2458107,527	120,7032501	30,3683357	11,16	1,63E-03
145	Adeona	2458107,525	120,7034942	30,3680928	11,16	1,53E-03
145	Adeona	2458107,524	120,7037343	30,367829	11,15	1,53E-03
145	Adeona	2458107,522	120,7039626	30,3675347	11,15	1,53E-03
145	Adeona	2458107,52	120,7042079	30,3672659	11,15	1,53E-03
145	Adeona	2458107,519	120,7044343	30,3670039	11,14	1,53E-03
145	Adeona	2458107,517	120,7046647	30,3667291	11,15	1,43E-03
145	Adeona	2458107,516	120,7048908	30,3664734	11,15	1,43E-03
145	Adeona	2458107,514	120,7051383	30,3661828	11,16	1,53E-03
145	Adeona	2458107,512	120,7053729	30,365932	11,15	1,53E-03
145	Adeona	2458107,511	120,7055897	30,3656637	11,14	1,43E-03
145	Adeona	2458107,509	120,7058183	30,3653927	11,14	1,53E-03
145	Adeona	2458107,508	120,7060526	30,3651318	11,16	1,43E-03
145	Adeona	2458107,506	120,7062758	30,3648717	11,15	1,43E-03
145	Adeona	2458107,504	120,7065375	30,3645727	11,16	1,43E-03
145	Adeona	2458107,503	120,7067496	30,3642821	11,14	1,43E-03
145	Adeona	2458107,501	120,7070116	30,3640383	11,15	1,43E-03
145	Adeona	2458107,5	120,7072098	30,3637398	11,15	1,53E-03
145	Adeona	2458107,498	120,7074389	30,3635056	11,15	1,43E-03
145	Adeona	2458107,496	120,7076942	30,3632248	11,14	1,43E-03
145	Adeona	2458107,495	120,7079274	30,3629322	11,15	1,53E-03
145	Adeona	2458107,493	120,7081521	30,3626858	11,15	1,53E-03
145	Adeona	2458107,492	120,7083967	30,3623691	11,14	1,43E-03
145	Adeona	2458107,49	120,7085915	30,3620732	11,13	1,53E-03
145	Adeona	2458107,488	120,7088288	30,3617797	11,14	1,53E-03
145	Adeona	2458107,487	120,7090709	30,3615384	11,13	1,43E-03
145	Adeona	2458107,485	120,7092975	30,3612685	11,15	1,43E-03
145	Adeona	2458107,484	120,7095601	30,3610659	11,14	1,43E-03
145	Adeona	2458107,482	120,7097658	30,3607861	11,14	1,43E-03
145	Adeona	2458107,48	120,7100175	30,360521	11,14	1,43E-03
145	Adeona	2458107,479	120,7102583	30,3602301	11,14	1,43E-03
145	Adeona	2458107,477	120,7104818	30,3599653	11,14	1,43E-03
145	Adeona	2458107,476	120,7107175	30,3597149	11,14	1,43E-03
145	Adeona	2458107,474	120,7109343	30,3594393	11,14	1,43E-03
145	Adeona	2458107,472	120,7111372	30,3591835	11,14	1,43E-03
145	Adeona	2458107,471	120,7114025	30,3588778	11,14	1,43E-03
145	Adeona	2458107,469	120,7116415	30,3586317	11,13	1,43E-03
145	Adeona	2458107,468	120,711872	30,3583318	11,13	1,43E-03

145	Adeona	2458107,466	120,7120764	30,3580292	11,13	1,43E-03
145	Adeona	2458107,464	120,7122959	30,3577501	11,14	1,43E-03
145	Adeona	2458107,463	120,7125641	30,3574941	11,12	1,33E-03
145	Adeona	2458107,461	120,7127726	30,357277	11,13	1,33E-03
145	Adeona	2458107,46	120,7130366	30,3570093	11,13	1,33E-03
145	Adeona	2458107,458	120,7132493	30,3567269	11,13	1,43E-03
145	Adeona	2458107,456	120,7134898	30,3564423	11,13	1,43E-03
145	Adeona	2458107,455	120,7136716	30,3560874	11,13	1,33E-03
145	Adeona	2458107,453	120,7139335	30,3558538	11,14	1,33E-03
145	Adeona	2458107,452	120,7141779	30,3556183	11,15	1,33E-03
145	Adeona	2458107,45	120,7144204	30,3553728	11,15	1,33E-03
145	Adeona	2458107,448	120,7146024	30,3550965	11,13	1,33E-03
145	Adeona	2458107,447	120,7148085	30,3547486	11,14	1,33E-03
145	Adeona	2458107,445	120,7150063	30,3544778	11,12	1,33E-03
145	Adeona	2458107,444	120,7152867	30,3542431	11,14	1,23E-03
145	Adeona	2458107,442	120,7154963	30,3540075	11,13	1,33E-03
145	Adeona	2458107,44	120,7157392	30,3537397	11,13	1,33E-03
145	Adeona	2458107,386	120,7233537	30,3444341	11,15	1,73E-03
145	Adeona	2458107,384	120,7236159	30,3441707	11,16	1,74E-03
145	Adeona	2458107,383	120,7238156	30,3439161	11,15	1,74E-03
145	Adeona	2458107,38	120,7242612	30,3433418	11,16	1,74E-03
145	Adeona	2458110,75	120,2164933	30,9060088	11,10	2,65E-03
145	Adeona	2458110,748	120,2166859	30,9057845	11,10	2,45E-03
145	Adeona	2458110,746	120,2169926	30,9054683	11,09	2,34E-03
145	Adeona	2458110,745	120,2172968	30,9052268	11,09	2,35E-03
145	Adeona	2458110,743	120,2174959	30,904955	11,09	2,14E-03
145	Adeona	2458110,742	120,2178427	30,9047323	11,10	2,14E-03
145	Adeona	2458110,74	120,2181034	30,9044704	11,09	2,04E-03
145	Adeona	2458110,738	120,2184367	30,9042314	11,08	1,94E-03
145	Adeona	2458110,683	120,2279441	30,8950934	11,09	1,23E-03
145	Adeona	2458110,681	120,2281291	30,8947929	11,10	1,23E-03
145	Adeona	2458110,679	120,2284631	30,8945258	11,09	1,23E-03
145	Adeona	2458110,678	120,2286989	30,8942387	11,09	1,23E-03
145	Adeona	2458110,676	120,228966	30,8940304	11,08	1,23E-03
145	Adeona	2458110,675	120,229221	30,8937625	11,08	1,23E-03
145	Adeona	2458110,673	120,2295151	30,8934841	11,10	1,22E-03
145	Adeona	2458110,671	120,2298846	30,8932508	11,10	1,23E-03
145	Adeona	2458110,67	120,230042	30,8929331	11,09	1,23E-03
145	Adeona	2458110,668	120,2303436	30,8926908	11,09	1,23E-03
145	Adeona	2458110,667	120,2306705	30,8924579	11,08	1,23E-03
145	Adeona	2458110,665	120,2308739	30,8921058	11,09	1,23E-03
145	Adeona	2458110,663	120,2311936	30,8918471	11,08	1,23E-03
145	Adeona	2458110,662	120,2314344	30,8916547	11,09	1,23E-03
145	Adeona	2458110,66	120,2316662	30,8913633	11,10	1,23E-03
145	Adeona	2458110,659	120,2319959	30,8910411	11,08	1,23E-03
145	Adeona	2458110,657	120,232226	30,8908648	11,09	1,23E-03
145	Adeona	2458110,656	120,232498	30,8905663	11,10	1,13E-03
145	Adeona	2458110,654	120,2327666	30,8902678	11,09	1,23E-03
145	Adeona	2458110,652	120,2330303	30,8899991	11,08	1,23E-03
145	Adeona	2458110,651	120,2333157	30,8897712	11,06	1,23E-03
145	Adeona	2458110,649	120,2335746	30,8894842	11,04	1,23E-03
145	Adeona	2458110,644	120,2344108	30,8887028	11,05	1,23E-03
145	Adeona	2458110,643	120,2346971	30,8884896	11,08	1,33E-03
145	Adeona	2458110,641	120,2350067	30,888197	11,07	1,34E-03
145	Adeona	2458110,64	120,2352531	30,8878932	11,07	1,33E-03
145	Adeona	2458110,638	120,2356107	30,8876662	11,07	1,23E-03
145	Adeona	2458110,636	120,2357549	30,8874124	11,07	1,34E-03
145	Adeona	2458110,635	120,2361128	30,8871591	11,07	1,34E-03
145	Adeona	2458110,633	120,236386	30,8868688	11,07	1,34E-03
145	Adeona	2458110,632	120,2366031	30,8865742	11,07	1,23E-03
145	Adeona	2458110,63	120,2368474	30,8863115	11,07	1,33E-03
145	Adeona	2458110,628	120,2371217	30,8860449	11,06	1,23E-03
145	Adeona	2458110,627	120,2374216	30,8857526	11,06	1,33E-03
145	Adeona	2458110,625	120,237711	30,8855484	11,07	1,23E-03
145	Adeona	2458110,624	120,2380189	30,8852823	11,05	1,33E-03
145	Adeona	2458110,622	120,238332	30,8850507	11,07	1,33E-03
145	Adeona	2458110,62	120,2385244	30,8847803	11,08	1,33E-03
145	Adeona	2458110,619	120,2388562	30,8844954	11,07	1,33E-03
145	Adeona	2458110,617	120,2391156	30,8842407	11,07	1,33E-03
145	Adeona	2458110,616	120,2393927	30,8839078	11,07	1,23E-03
145	Adeona	2458110,614	120,2396751	30,8837148	11,07	1,33E-03
145	Adeona	2458110,612	120,2398884	30,8834117	11,07	1,33E-03
145	Adeona	2458110,611	120,2402029	30,8831797	11,08	1,33E-03
145	Adeona	2458110,609	120,2404258	30,8828688	11,06	1,23E-03
145	Adeona	2458110,608	120,2406963	30,8826245	11,07	1,23E-03
145	Adeona	2458110,606	120,2410765	30,882378	11,07	1,23E-03
145	Adeona	2458110,605	120,2413287	30,8820467	11,06	1,23E-03

145	Adeona	2458110,603	120,2415713	30,8818038	11,06	1,23E-03
145	Adeona	2458110,601	120,2418183	30,8814697	11,07	1,23E-03
145	Adeona	2458110,6	120,2420903	30,8812157	11,08	1,23E-03
145	Adeona	2458110,598	120,2424558	30,8810403	11,07	1,23E-03
145	Adeona	2458110,597	120,2427272	30,8807534	11,06	1,23E-03
145	Adeona	2458110,588	120,2440631	30,8793611	11,11	1,23E-03
145	Adeona	2458110,587	120,2443598	30,8791329	11,09	1,23E-03
145	Adeona	2458110,585	120,2446417	30,8788083	11,10	1,23E-03
145	Adeona	2458110,584	120,244933	30,8785594	11,10	1,23E-03
145	Adeona	2458110,582	120,2451941	30,878299	11,08	1,23E-03
145	Adeona	2458110,581	120,2454478	30,8780341	11,11	1,23E-03
145	Adeona	2458110,579	120,245701	30,877754	11,08	1,23E-03
145	Adeona	2458110,577	120,2460005	30,8774817	11,09	1,23E-03
145	Adeona	2458110,576	120,2462622	30,8772314	11,11	1,23E-03
145	Adeona	2458110,574	120,2465608	30,8769761	11,11	1,23E-03
145	Adeona	2458110,573	120,2468157	30,8767044	11,09	1,23E-03
145	Adeona	2458110,571	120,2471606	30,8764318	11,11	1,23E-03
145	Adeona	2458110,569	120,2473847	30,8761843	11,10	1,23E-03
145	Adeona	2458110,568	120,2476194	30,8759089	11,10	1,13E-03
145	Adeona	2458110,566	120,2479348	30,8756477	11,11	1,23E-03
145	Adeona	2458110,565	120,2482297	30,8753974	11,13	1,23E-03
145	Adeona	2458110,563	120,2484936	30,8751192	11,11	1,23E-03
145	Adeona	2458110,561	120,2487891	30,8748933	11,11	1,23E-03
145	Adeona	2458110,56	120,2490838	30,8746361	11,12	1,23E-03
145	Adeona	2458110,558	120,2493447	30,8743655	11,11	1,23E-03
145	Adeona	2458110,557	120,2495925	30,8741009	11,09	1,23E-03
145	Adeona	2458110,555	120,2498885	30,873807	11,10	1,23E-03
145	Adeona	2458110,553	120,2501041	30,8735408	11,09	1,23E-03
145	Adeona	2458110,552	120,2504327	30,8732727	11,11	1,23E-03
145	Adeona	2458110,55	120,2507204	30,8730217	11,11	1,23E-03
145	Adeona	2458110,549	120,2509291	30,8727441	11,09	1,23E-03
145	Adeona	2458110,547	120,2512045	30,8724496	11,09	1,13E-03
145	Adeona	2458110,545	120,2514889	30,8721892	11,10	1,23E-03
145	Adeona	2458110,544	120,2517442	30,8719313	11,09	1,23E-03
145	Adeona	2458110,542	120,2520426	30,8716687	11,10	1,23E-03
145	Adeona	2458110,541	120,2523322	30,8714158	11,10	1,23E-03
145	Adeona	2458110,539	120,2525597	30,8711273	11,10	1,13E-03
145	Adeona	2458110,538	120,2528906	30,8708151	11,10	1,13E-03
145	Adeona	2458110,536	120,2531302	30,8705255	11,10	1,23E-03
145	Adeona	2458110,534	120,2534225	30,8703002	11,10	1,23E-03
145	Adeona	2458110,533	120,2536992	30,8700252	11,09	1,23E-03
145	Adeona	2458110,531	120,2539445	30,8697335	11,10	1,33E-03
145	Adeona	2458110,53	120,2541865	30,8694746	11,10	1,23E-03
145	Adeona	2458110,528	120,2544334	30,8691805	11,10	1,23E-03
145	Adeona	2458110,526	120,2547838	30,8689323	11,10	1,23E-03
145	Adeona	2458110,525	120,2550492	30,8687126	11,10	1,23E-03
145	Adeona	2458110,523	120,2552844	30,8683732	11,11	1,22E-03
145	Adeona	2458110,522	120,2555053	30,8680794	11,11	1,23E-03
145	Adeona	2458110,52	120,2558783	30,8678257	11,11	1,23E-03
145	Adeona	2458110,518	120,2561169	30,867614	11,10	1,23E-03
145	Adeona	2458110,517	120,2563602	30,8673444	11,10	1,23E-03
145	Adeona	2458110,515	120,2566294	30,8670453	11,10	1,23E-03
145	Adeona	2458110,514	120,256939	30,8667977	11,11	1,13E-03
145	Adeona	2458110,512	120,2572268	30,8665466	11,10	1,23E-03
145	Adeona	2458110,51	120,257476	30,8662108	11,11	1,23E-03
145	Adeona	2458110,509	120,257746	30,8659353	11,14	1,23E-03
145	Adeona	2458110,507	120,2580595	30,8656679	11,12	1,23E-03
145	Adeona	2458110,506	120,2582817	30,8653884	11,12	1,23E-03
145	Adeona	2458110,504	120,2585232	30,8651475	11,10	1,23E-03
145	Adeona	2458110,503	120,2587943	30,8648824	11,10	1,23E-03
145	Adeona	2458110,501	120,2590698	30,8645767	11,11	1,23E-03
145	Adeona	2458110,499	120,2593419	30,8643522	11,11	1,23E-03
145	Adeona	2458110,498	120,2596393	30,8640478	11,12	1,33E-03
145	Adeona	2458110,496	120,2598909	30,8637944	11,12	1,23E-03
145	Adeona	2458110,495	120,2601934	30,8635238	11,13	1,23E-03
145	Adeona	2458110,493	120,2604956	30,8632339	11,13	1,23E-03
145	Adeona	2458110,491	120,2607158	30,8629329	11,10	1,23E-03
145	Adeona	2458110,49	120,2610135	30,8627135	11,11	1,23E-03
145	Adeona	2458110,488	120,261227	30,8624302	11,11	1,23E-03
145	Adeona	2458110,487	120,2615701	30,8621917	11,11	1,23E-03
145	Adeona	2458110,485	120,2617913	30,8619216	11,11	1,23E-03
145	Adeona	2458110,483	120,2620454	30,8616788	11,10	1,23E-03
145	Adeona	2458110,482	120,2624019	30,8614227	11,12	1,23E-03
145	Adeona	2458110,48	120,2626149	30,8611751	11,11	1,23E-03
145	Adeona	2458110,479	120,262885	30,8608851	11,11	1,23E-03
145	Adeona	2458110,477	120,2631127	30,8606211	11,12	1,23E-03
145	Adeona	2458110,475	120,2634415	30,8603338	11,13	1,23E-03

145	Adeona	2458110,474	120,2637041	30,8600244	11,13	1,23E-03
145	Adeona	2458110,472	120,2640072	30,8597247	11,12	1,33E-03
145	Adeona	2458110,471	120,2641852	30,8594911	11,13	1,23E-03
145	Adeona	2458110,469	120,2644877	30,8591802	11,11	1,23E-03
145	Adeona	2458110,468	120,2647892	30,8589219	11,14	1,23E-03
145	Adeona	2458110,466	120,2650019	30,8586455	11,12	1,23E-03
145	Adeona	2458110,464	120,2652226	30,8583466	11,11	1,23E-03
145	Adeona	2458110,463	120,2656444	30,8580969	11,11	1,13E-03
145	Adeona	2458110,461	120,2658043	30,8579089	11,11	1,13E-03
145	Adeona	2458110,46	120,2661304	30,8576295	11,12	1,23E-03
145	Adeona	2458110,458	120,2664033	30,8573419	11,11	1,13E-03
145	Adeona	2458110,456	120,2666699	30,8570445	11,11	1,13E-03
145	Adeona	2458110,455	120,2668676	30,8567768	11,10	1,23E-03
145	Adeona	2458110,453	120,2671655	30,8564745	11,10	1,23E-03
145	Adeona	2458110,45	120,2676548	30,8559375	11,08	1,23E-03
145	Adeona	2458110,448	120,267978	30,855693	11,11	1,23E-03
145	Adeona	2458110,447	120,2682534	30,8554672	11,10	1,13E-03
145	Adeona	2458110,445	120,2684557	30,8551647	11,09	1,13E-03
145	Adeona	2458110,444	120,2687907	30,8548245	11,10	1,23E-03
145	Adeona	2458110,442	120,2690525	30,8545204	11,10	1,23E-03
145	Adeona	2458110,44	120,2693479	30,8542687	11,09	1,23E-03
145	Adeona	2458110,439	120,2695321	30,8540999	11,09	1,23E-03
145	Adeona	2458110,437	120,2698409	30,8538511	11,10	1,23E-03
145	Adeona	2458110,436	120,2700975	30,8535255	11,10	1,23E-03
145	Adeona	2458110,434	120,2703331	30,853253	11,10	1,13E-03
145	Adeona	2458110,433	120,2705768	30,8530295	11,10	1,23E-03
145	Adeona	2458110,431	120,2709406	30,8526693	11,09	1,23E-03
145	Adeona	2458110,429	120,2711473	30,8523925	11,09	1,23E-03
145	Adeona	2458110,428	120,2713742	30,8521742	11,09	1,23E-03
145	Adeona	2458110,426	120,2716195	30,851886	11,09	1,33E-03
145	Adeona	2458110,425	120,2719858	30,8515984	11,10	1,33E-03
145	Adeona	2458110,423	120,2721957	30,8513187	11,09	1,33E-03
145	Adeona	2458110,421	120,2724523	30,8510298	11,08	1,33E-03
145	Adeona	2458110,42	120,2727276	30,8507691	11,09	1,33E-03
145	Adeona	2458110,418	120,2730396	30,8504723	11,08	1,33E-03
145	Adeona	2458110,417	120,2733462	30,8501856	11,08	1,33E-03
145	Adeona	2458110,415	120,2734928	30,8499383	11,08	1,33E-03
145	Adeona	2458110,413	120,2738585	30,8496888	11,11	1,33E-03
145	Adeona	2458110,412	120,27412	30,8494472	11,08	1,33E-03
145	Adeona	2458110,41	120,2742737	30,8491297	11,08	1,23E-03
145	Adeona	2458110,409	120,274656	30,8488488	11,08	1,33E-03
145	Adeona	2458110,407	120,2749476	30,8485959	11,08	1,33E-03
145	Adeona	2458110,405	120,2750977	30,8483412	11,11	1,33E-03
145	Adeona	2458110,404	120,2753156	30,8480097	11,09	1,33E-03
145	Adeona	2458110,402	120,2755899	30,8477882	11,09	1,33E-03
145	Adeona	2458110,401	120,2758755	30,847509	11,08	1,44E-03
145	Adeona	2458110,398	120,2763636	30,8469351	11,07	1,43E-03
145	Adeona	2458110,394	120,2768672	30,8463377	11,09	1,43E-03
145	Adeona	2458110,393	120,2772974	30,8461378	11,07	1,43E-03
145	Adeona	2458110,391	120,2774907	30,8458933	11,07	1,53E-03
145	Adeona	2458110,388	120,2780174	30,8452914	11,05	1,53E-03
145	Adeona	2458110,381	120,2792392	30,8440031	11,08	1,43E-03
976	Benjamin	2458135,457	75,1479525	18,6562334	14,24	1,69E-02
976	Benjamin	2458135,454	75,1482821	18,6562418	14,20	1,55E-02
976	Benjamin	2458135,451	75,1485611	18,6563343	14,23	1,50E-02
976	Benjamin	2458135,448	75,1489791	18,6565172	14,46	1,54E-02
976	Benjamin	2458135,445	75,1492306	18,6565592	14,38	1,50E-02
976	Benjamin	2458135,442	75,14958	18,6566233	14,45	1,47E-02
976	Benjamin	2458135,44	75,1498395	18,6567009	14,41	1,62E-02
976	Benjamin	2458135,437	75,1502147	18,6567809	14,43	1,56E-02
976	Benjamin	2458135,434	75,150569	18,6568711	14,45	1,52E-02
976	Benjamin	2458135,431	75,1508807	18,6568903	14,39	1,49E-02
976	Benjamin	2458135,428	75,1511581	18,6569621	14,44	1,53E-02
976	Benjamin	2458135,425	75,151466	18,6570316	14,43	1,44E-02
976	Benjamin	2458135,422	75,1517951	18,6571098	14,42	1,43E-02
976	Benjamin	2458135,42	75,1521768	18,657147	14,43	1,47E-02
976	Benjamin	2458135,417	75,152405	18,6572389	14,42	1,42E-02
976	Benjamin	2458135,414	75,1527565	18,657284	14,41	1,46E-02
976	Benjamin	2458135,411	75,1531138	18,6573401	14,41	1,36E-02
976	Benjamin	2458135,409	75,1533819	18,6573899	14,37	1,37E-02
976	Benjamin	2458135,406	75,1536867	18,6574261	14,37	1,36E-02
976	Benjamin	2458135,403	75,1540095	18,6575109	14,36	1,32E-02
976	Benjamin	2458135,39	75,1555295	18,6578177	14,35	1,31E-02
976	Benjamin	2458135,387	75,1558011	18,6578558	14,40	1,42E-02
976	Benjamin	2458135,383	75,1561506	18,6579264	14,36	1,26E-02
976	Benjamin	2458135,381	75,1565131	18,6579832	14,41	9,99E-03
976	Benjamin	2458135,378	75,1568296	18,6579922	14,43	1,02E-02

976	Benjamin	2458135,375	75,1572054	18,658075	14,44	1,33E-02
976	Benjamin	2458135,372	75,1573805	18,6580783	14,48	9,49E-03
976	Benjamin	2458135,369	75,1577541	18,6582077	14,46	9,49E-03
976	Benjamin	2458135,366	75,1580399	18,6582497	14,49	9,57E-03
976	Benjamin	2458135,364	75,1583142	18,6582321	14,57	1,07E-02
976	Benjamin	2458135,361	75,1586302	18,6582958	14,66	1,08E-02
976	Benjamin	2458135,358	75,1589823	18,6583254	14,60	1,18E-02
976	Benjamin	2458135,355	75,1593069	18,6584203	14,56	1,03E-02
65	Cybele	2458104,521	79,6596236	18,4705743	12,00	5,29E-03
65	Cybele	2458104,52	79,6597135	18,4706108	12,01	5,13E-03
65	Cybele	2458104,52	79,6598213	18,4705782	12,02	5,16E-03
65	Cybele	2458104,519	79,6599305	18,4706005	12,01	5,31E-03
65	Cybele	2458104,519	79,6600544	18,4705913	12,00	5,15E-03
65	Cybele	2458104,518	79,6601426	18,4706273	12,01	5,43E-03
65	Cybele	2458104,518	79,6602491	18,4705994	12,00	5,08E-03
65	Cybele	2458104,517	79,6603799	18,4706182	12,00	5,36E-03
65	Cybele	2458104,516	79,6604719	18,4706213	12,01	5,17E-03
65	Cybele	2458104,516	79,6605919	18,4706154	12,00	5,37E-03
65	Cybele	2458104,515	79,6607031	18,4706225	12,00	5,25E-03
65	Cybele	2458104,515	79,660798	18,4706329	12,00	5,44E-03
65	Cybele	2458104,514	79,6609293	18,4706451	12,00	5,45E-03
65	Cybele	2458104,514	79,6610155	18,4706375	12,00	5,34E-03
65	Cybele	2458104,513	79,6611747	18,4706548	12,02	5,06E-03
65	Cybele	2458104,513	79,6612697	18,4706697	12,01	5,47E-03
65	Cybele	2458104,512	79,661359	18,4706651	12,01	5,47E-03
65	Cybele	2458104,511	79,6614722	18,4706579	12,00	5,38E-03
65	Cybele	2458104,511	79,6615542	18,4706642	12,00	5,45E-03
65	Cybele	2458104,51	79,6616475	18,470674	12,01	5,37E-03
65	Cybele	2458104,51	79,6617621	18,4706787	12,02	5,09E-03
65	Cybele	2458104,509	79,6618674	18,4706586	12,01	5,19E-03
65	Cybele	2458104,509	79,6619812	18,4706916	12,01	4,98E-03
65	Cybele	2458104,508	79,6620712	18,4706838	11,99	5,11E-03
65	Cybele	2458104,508	79,6622036	18,4706899	12,00	5,10E-03
65	Cybele	2458104,507	79,6623409	18,4707013	12,00	5,17E-03
65	Cybele	2458104,507	79,6624258	18,470717	11,99	5,40E-03
65	Cybele	2458104,506	79,6625922	18,4707143	11,99	5,19E-03
65	Cybele	2458104,505	79,6626208	18,4707028	12,00	5,38E-03
65	Cybele	2458104,505	79,6627803	18,4707177	12,01	5,25E-03
65	Cybele	2458104,504	79,6628699	18,4707279	11,99	5,22E-03
65	Cybele	2458104,504	79,6629576	18,4707359	12,00	4,97E-03
65	Cybele	2458104,503	79,6630952	18,4707175	12,00	4,90E-03
65	Cybele	2458104,503	79,663206	18,4707046	12,00	4,77E-03
65	Cybele	2458104,502	79,6632999	18,470728	12,00	4,97E-03
65	Cybele	2458104,502	79,663353	18,4707631	11,98	4,89E-03
65	Cybele	2458104,501	79,663527	18,4707186	11,99	4,77E-03
65	Cybele	2458104,5	79,6636537	18,4707255	11,98	4,80E-03
65	Cybele	2458104,5	79,6637345	18,4707485	11,99	4,79E-03
65	Cybele	2458104,499	79,6639016	18,470757	11,96	5,10E-03
65	Cybele	2458104,493	79,6652244	18,4708203	12,02	3,95E-03
65	Cybele	2458104,492	79,6653804	18,4708016	11,99	4,19E-03
65	Cybele	2458104,491	79,6654967	18,4708003	12,00	4,00E-03
65	Cybele	2458104,491	79,665574	18,4708172	11,99	4,21E-03
65	Cybele	2458104,49	79,6657183	18,4707951	12,01	3,98E-03
65	Cybele	2458104,49	79,665781	18,4708061	12,01	3,68E-03
65	Cybele	2458104,489	79,665932	18,4708014	11,99	3,99E-03
65	Cybele	2458104,489	79,6660515	18,470838	12,02	3,60E-03
65	Cybele	2458104,488	79,6661483	18,4708138	12,00	3,80E-03
65	Cybele	2458104,487	79,6662949	18,4708304	12,01	3,98E-03
65	Cybele	2458104,487	79,6664023	18,4708406	12,02	3,79E-03
65	Cybele	2458104,486	79,6665174	18,4708423	12,01	3,80E-03
65	Cybele	2458104,486	79,6665829	18,4708373	12,02	3,80E-03
65	Cybele	2458104,485	79,6666962	18,4708114	12,00	4,00E-03
65	Cybele	2458104,485	79,666827	18,4708163	12,03	3,79E-03
65	Cybele	2458104,484	79,666903	18,4708483	12,03	3,79E-03
65	Cybele	2458104,483	79,6670712	18,4708575	12,01	4,01E-03
65	Cybele	2458104,483	79,6671893	18,4708715	12,00	4,29E-03
65	Cybele	2458104,482	79,6673082	18,4708809	12,03	3,98E-03
65	Cybele	2458104,482	79,6673893	18,4708529	12,02	4,00E-03
65	Cybele	2458104,481	79,6675212	18,4708781	12,02	3,79E-03
65	Cybele	2458104,481	79,667621	18,470859	12,04	3,70E-03
65	Cybele	2458104,48	79,6677143	18,4708704	12,01	4,01E-03
65	Cybele	2458104,479	79,6679012	18,4708495	12,03	3,70E-03
65	Cybele	2458104,479	79,667932	18,4708848	12,03	4,08E-03
65	Cybele	2458104,478	79,6680472	18,4709032	12,05	3,89E-03
65	Cybele	2458104,478	79,668153	18,4708726	12,05	3,95E-03
65	Cybele	2458104,477	79,6682217	18,4708823	12,05	3,80E-03
65	Cybele	2458104,477	79,6683862	18,4709004	12,05	3,71E-03

65	Cybele	2458104,476	79,6685156	18,47086	12,03	4,09E-03
65	Cybele	2458104,476	79,6686131	18,4709031	12,03	4,37E-03
65	Cybele	2458104,475	79,66876	18,4709133	12,05	4,01E-03
65	Cybele	2458104,474	79,6688741	18,4709074	12,03	4,20E-03
65	Cybele	2458104,474	79,6689647	18,4709303	12,04	3,90E-03
65	Cybele	2458104,473	79,6690333	18,4709234	12,03	4,30E-03
65	Cybele	2458104,473	79,669187	18,4709431	12,05	4,19E-03
65	Cybele	2458104,472	79,669278	18,4709256	12,03	4,32E-03
65	Cybele	2458104,472	79,6693885	18,4709416	12,04	4,36E-03
65	Cybele	2458104,471	79,6695283	18,4709378	12,05	4,11E-03
65	Cybele	2458104,471	79,6696257	18,4709508	12,05	4,18E-03
65	Cybele	2458104,47	79,6697533	18,470956	12,04	4,19E-03
65	Cybele	2458104,47	79,6698204	18,4709634	12,04	4,31E-03
65	Cybele	2458104,469	79,6699493	18,4709817	12,03	4,49E-03
65	Cybele	2458104,468	79,6700217	18,4709719	12,04	4,56E-03
65	Cybele	2458104,468	79,6701128	18,4709474	12,06	4,61E-03
65	Cybele	2458104,467	79,6702783	18,4709546	12,04	4,68E-03
65	Cybele	2458104,467	79,6703418	18,4709845	12,05	4,61E-03
65	Cybele	2458104,466	79,6704982	18,4709755	12,07	4,48E-03
65	Cybele	2458104,466	79,6705697	18,4709796	12,06	4,89E-03
65	Cybele	2458104,465	79,6707096	18,4710243	12,05	4,89E-03
65	Cybele	2458104,465	79,6708269	18,4710021	12,07	4,75E-03
65	Cybele	2458104,464	79,6708852	18,4710056	12,02	4,77E-03
65	Cybele	2458104,464	79,6710212	18,4710579	12,06	4,48E-03
65	Cybele	2458104,463	79,6711605	18,4710293	12,05	4,30E-03
65	Cybele	2458104,462	79,6712433	18,4710522	12,05	4,20E-03
65	Cybele	2458104,462	79,6713492	18,4710404	12,04	4,30E-03
65	Cybele	2458104,461	79,6714404	18,4710418	12,06	3,91E-03
65	Cybele	2458104,461	79,671603	18,4710381	12,05	3,78E-03
65	Cybele	2458104,46	79,6716834	18,4710408	12,05	3,89E-03
65	Cybele	2458104,46	79,6717991	18,4710307	12,06	3,68E-03
65	Cybele	2458104,459	79,6719277	18,471045	12,04	3,99E-03
65	Cybele	2458104,459	79,6720177	18,4710648	12,05	3,58E-03
65	Cybele	2458104,458	79,6721755	18,4710603	12,03	3,62E-03
65	Cybele	2458104,457	79,6722624	18,4710566	12,04	3,60E-03
65	Cybele	2458104,457	79,672403	18,4710782	12,03	3,62E-03
65	Cybele	2458104,456	79,6724884	18,4710748	12,03	3,90E-03
65	Cybele	2458104,455	79,6726547	18,4710667	12,03	3,60E-03
65	Cybele	2458104,455	79,672714	18,4711078	12,04	3,41E-03
65	Cybele	2458104,454	79,6728102	18,4710876	12,04	3,51E-03
65	Cybele	2458104,454	79,6729491	18,4711068	12,05	3,39E-03
65	Cybele	2458104,453	79,6730222	18,4711444	12,03	3,61E-03
65	Cybele	2458104,453	79,6731745	18,4710795	12,05	3,41E-03
65	Cybele	2458104,452	79,6733029	18,4711271	12,05	3,41E-03
65	Cybele	2458104,452	79,6733926	18,4711369	12,03	3,52E-03
65	Cybele	2458104,451	79,6734936	18,4711359	12,04	3,30E-03
65	Cybele	2458104,451	79,6735936	18,471127	12,04	3,40E-03
65	Cybele	2458104,45	79,6737545	18,4711524	12,04	3,40E-03
65	Cybele	2458104,449	79,6738137	18,4711626	12,04	3,11E-03
65	Cybele	2458104,449	79,6739394	18,4711532	12,03	3,12E-03
65	Cybele	2458104,448	79,6740304	18,4711366	12,04	3,13E-03
65	Cybele	2458104,448	79,674167	18,4712144	12,04	3,12E-03
65	Cybele	2458104,447	79,6742761	18,4711812	12,05	3,11E-03
65	Cybele	2458104,447	79,67438	18,471177	12,05	3,21E-03
65	Cybele	2458104,446	79,6744798	18,4712234	12,05	3,21E-03
65	Cybele	2458104,446	79,6746253	18,4711938	12,04	3,31E-03
65	Cybele	2458104,445	79,6747062	18,4712094	12,05	3,23E-03
65	Cybele	2458104,445	79,6748204	18,4711426	12,04	3,51E-03
65	Cybele	2458104,444	79,6749074	18,4712006	12,03	3,51E-03
65	Cybele	2458104,443	79,6750632	18,4711674	12,06	3,31E-03
65	Cybele	2458104,443	79,6751325	18,4711823	12,06	3,29E-03
65	Cybele	2458104,442	79,6754037	18,4711279	12,03	3,70E-03
65	Cybele	2458104,441	79,675471	18,4711987	12,05	3,11E-03
65	Cybele	2458104,44	79,6756023	18,4712659	12,03	3,42E-03
65	Cybele	2458104,44	79,6757418	18,4712497	12,04	3,42E-03
65	Cybele	2458104,439	79,6758029	18,4712612	12,05	3,32E-03
65	Cybele	2458104,439	79,6759341	18,471267	12,06	3,30E-03
65	Cybele	2458104,438	79,6760344	18,4712417	12,06	3,30E-03
65	Cybele	2458104,438	79,676161	18,4712384	12,05	3,22E-03
65	Cybele	2458104,437	79,6762926	18,4712291	12,04	3,41E-03
65	Cybele	2458104,436	79,6764201	18,4712402	12,06	3,19E-03
65	Cybele	2458104,436	79,6764738	18,4712925	12,05	3,32E-03
65	Cybele	2458104,435	79,6765886	18,4712836	12,05	3,22E-03
65	Cybele	2458104,435	79,676788	18,4712706	12,03	3,41E-03
65	Cybele	2458104,434	79,6768551	18,4712667	12,05	3,22E-03
65	Cybele	2458104,434	79,6769809	18,4712971	12,04	3,31E-03
65	Cybele	2458104,433	79,6771355	18,4712952	12,04	3,12E-03

65	Cybele	2458104,432	79,677226	18,4712954	12,04	3,22E-03
65	Cybele	2458104,432	79,6773568	18,4712538	12,04	3,20E-03
65	Cybele	2458104,431	79,6774148	18,4713068	12,04	3,32E-03
65	Cybele	2458104,431	79,677542	18,4713066	12,04	3,32E-03
65	Cybele	2458104,43	79,6776571	18,4713218	12,03	3,21E-03
65	Cybele	2458104,429	79,6777804	18,4712904	12,03	3,31E-03
65	Cybele	2458104,429	79,6778613	18,4713006	12,05	3,12E-03
65	Cybele	2458104,428	79,6780265	18,4713273	12,03	3,14E-03
65	Cybele	2458104,428	79,6781297	18,4713177	12,03	3,12E-03
65	Cybele	2458104,427	79,6782486	18,4712979	12,03	3,04E-03
65	Cybele	2458104,427	79,6784002	18,4713268	12,03	3,01E-03
65	Cybele	2458104,426	79,6784504	18,4713235	12,03	3,03E-03
65	Cybele	2458104,426	79,6785941	18,4713271	12,04	3,02E-03
65	Cybele	2458104,425	79,6786553	18,4712965	12,04	3,32E-03
65	Cybele	2458104,424	79,6787956	18,4713009	12,04	3,02E-03
65	Cybele	2458104,424	79,678892	18,4713195	12,04	2,92E-03
65	Cybele	2458104,423	79,6789927	18,4713266	12,04	3,02E-03
65	Cybele	2458104,423	79,6791307	18,4713466	12,04	3,03E-03
65	Cybele	2458104,422	79,6792293	18,4713525	12,05	3,03E-03
65	Cybele	2458104,422	79,6793931	18,4713612	12,04	2,93E-03
65	Cybele	2458104,421	79,679507	18,4713608	12,05	2,80E-03
65	Cybele	2458104,42	79,6796114	18,4713402	12,02	3,12E-03
65	Cybele	2458104,42	79,6796681	18,4713392	12,05	2,93E-03
65	Cybele	2458104,419	79,6798216	18,4713517	12,04	2,92E-03
65	Cybele	2458104,419	79,6799389	18,4713467	12,05	2,82E-03
65	Cybele	2458104,418	79,679999	18,4713135	12,05	2,91E-03
65	Cybele	2458104,417	79,6801818	18,4713399	12,04	2,82E-03
65	Cybele	2458104,417	79,6802202	18,4713414	12,05	2,82E-03
65	Cybele	2458104,416	79,6803903	18,4713493	12,04	2,82E-03
65	Cybele	2458104,416	79,6804628	18,4713788	12,04	2,93E-03
65	Cybele	2458104,415	79,6806054	18,4713648	12,04	2,84E-03
65	Cybele	2458104,415	79,6807105	18,4713901	12,03	3,02E-03
65	Cybele	2458104,414	79,6807747	18,4713698	12,03	2,91E-03
65	Cybele	2458104,414	79,6809534	18,471371	12,01	2,94E-03
65	Cybele	2458104,413	79,6810219	18,4713676	12,03	3,02E-03
65	Cybele	2458104,413	79,6810977	18,4713712	12,03	2,92E-03
65	Cybele	2458104,412	79,6812404	18,4713737	12,03	2,92E-03
65	Cybele	2458104,411	79,681357	18,4713826	12,03	2,83E-03
65	Cybele	2458104,411	79,6814836	18,4713763	12,04	2,82E-03
65	Cybele	2458104,41	79,6815591	18,4713965	12,04	2,83E-03
65	Cybele	2458104,41	79,681742	18,4714016	12,02	2,82E-03
65	Cybele	2458104,409	79,6818295	18,4713988	12,03	2,83E-03
65	Cybele	2458104,408	79,681925	18,4714157	12,02	3,04E-03
65	Cybele	2458104,408	79,6820437	18,4714	12,03	2,83E-03
65	Cybele	2458104,407	79,6821795	18,4714159	12,03	2,93E-03
65	Cybele	2458104,407	79,6822766	18,4714288	12,03	3,02E-03
65	Cybele	2458104,406	79,6823732	18,4714155	12,02	3,12E-03
65	Cybele	2458104,406	79,6825303	18,4714339	12,03	3,02E-03
65	Cybele	2458104,405	79,6826009	18,4714081	12,04	3,03E-03
65	Cybele	2458104,404	79,6827791	18,4714568	12,04	3,33E-03
65	Cybele	2458104,404	79,6828672	18,471468	12,05	3,43E-03
65	Cybele	2458104,403	79,6829717	18,4714869	12,05	3,43E-03
65	Cybele	2458104,403	79,6831104	18,4714706	12,05	3,52E-03
65	Cybele	2458104,402	79,6832191	18,47145	12,04	3,74E-03
65	Cybele	2458104,402	79,683329	18,4715067	12,04	4,02E-03
65	Cybele	2458104,401	79,6834391	18,4714691	12,05	4,03E-03
65	Cybele	2458104,4	79,6835424	18,4715172	12,06	4,12E-03
65	Cybele	2458104,4	79,68365	18,4714972	12,07	4,30E-03
65	Cybele	2458104,399	79,6837693	18,4715602	12,08	4,50E-03
65	Cybele	2458104,399	79,6838924	18,4715051	12,09	4,39E-03
65	Cybele	2458104,398	79,6839923	18,4715475	12,08	5,10E-03
65	Cybele	2458104,397	79,6841304	18,4715664	12,08	5,62E-03
65	Cybele	2458104,397	79,6842321	18,4715654	12,10	5,30E-03
65	Cybele	2458104,396	79,6843572	18,4715474	12,09	5,08E-03
65	Cybele	2458104,396	79,68451	18,4715178	12,10	5,37E-03
65	Cybele	2458104,395	79,6846042	18,4715482	12,08	5,28E-03
65	Cybele	2458104,394	79,6847295	18,4715499	12,09	5,54E-03
65	Cybele	2458104,394	79,6848562	18,4715588	12,07	5,52E-03
65	Cybele	2458104,393	79,6849754	18,4715599	12,08	5,98E-03
65	Cybele	2458104,393	79,6851174	18,4715632	12,09	6,55E-03
65	Cybele	2458104,392	79,685227	18,471582	12,07	6,08E-03
65	Cybele	2458104,391	79,6853653	18,4716037	12,11	6,02E-03
65	Cybele	2458104,391	79,6854553	18,4715924	12,08	6,13E-03
65	Cybele	2458104,39	79,6855753	18,471602	12,08	6,38E-03
65	Cybele	2458104,39	79,685687	18,4716136	12,09	6,29E-03
65	Cybele	2458104,389	79,6857934	18,4715999	12,08	5,84E-03
65	Cybele	2458104,389	79,685899	18,4715892	12,08	6,01E-03

65	Cybele	2458104,388	79,6860173	18,4716105	12,09	5,81E-03
65	Cybele	2458104,387	79,6861324	18,4716068	12,07	5,74E-03
65	Cybele	2458104,387	79,6862227	18,4716432	12,08	5,54E-03
65	Cybele	2458104,386	79,6863134	18,4716274	12,06	5,83E-03
65	Cybele	2458104,386	79,6864817	18,4716711	12,07	5,95E-03
65	Cybele	2458104,385	79,6865714	18,4716392	12,05	5,58E-03
65	Cybele	2458104,385	79,686705	18,471629	12,05	5,38E-03
65	Cybele	2458104,384	79,686811	18,4716174	12,07	5,25E-03
65	Cybele	2458104,383	79,6869249	18,4716265	12,07	5,08E-03
65	Cybele	2458104,383	79,6870521	18,4716485	12,07	5,04E-03
65	Cybele	2458104,382	79,6871571	18,471648	12,07	5,52E-03
65	Cybele	2458104,382	79,687271	18,4716791	12,06	4,99E-03
65	Cybele	2458104,381	79,6874382	18,4716109	12,06	5,16E-03
65	Cybele	2458104,38	79,6875029	18,4716715	12,06	5,06E-03
65	Cybele	2458104,38	79,687648	18,4716467	12,07	5,33E-03
65	Cybele	2458104,379	79,6878461	18,4716879	12,06	4,66E-03
65	Cybele	2458104,378	79,687935	18,4717329	12,05	4,48E-03
65	Cybele	2458104,378	79,6880821	18,471674	12,04	4,80E-03
65	Cybele	2458104,377	79,6882097	18,4717269	12,08	4,84E-03
65	Cybele	2458104,376	79,6882875	18,4716921	12,08	4,95E-03
65	Cybele	2458104,376	79,6884381	18,4716749	12,05	4,95E-03
65	Cybele	2458104,375	79,6885185	18,4717043	12,06	4,60E-03
65	Cybele	2458104,375	79,6886549	18,4717215	12,06	4,39E-03
65	Cybele	2458104,374	79,6887651	18,4717292	12,05	4,63E-03
65	Cybele	2458104,373	79,6888806	18,4717332	12,05	4,62E-03
65	Cybele	2458104,373	79,6890035	18,4717461	12,06	4,40E-03
65	Cybele	2458104,372	79,6891403	18,4717374	12,04	4,71E-03
65	Cybele	2458104,372	79,6892581	18,4717576	12,06	4,40E-03
65	Cybele	2458104,371	79,6893191	18,4717429	12,04	4,25E-03
65	Cybele	2458104,371	79,6894622	18,4717772	12,06	4,39E-03
65	Cybele	2458104,37	79,6895303	18,4717503	12,03	4,34E-03
65	Cybele	2458104,369	79,6896673	18,4717837	12,05	4,23E-03
65	Cybele	2458104,369	79,6898333	18,4717903	12,04	4,22E-03
65	Cybele	2458104,368	79,6899274	18,4717785	12,07	4,02E-03
65	Cybele	2458104,368	79,6900391	18,471769	12,05	3,93E-03
65	Cybele	2458104,367	79,6901643	18,4717941	12,05	4,01E-03
65	Cybele	2458104,366	79,690269	18,4717765	12,06	3,62E-03
65	Cybele	2458104,366	79,6903697	18,4717869	12,05	3,83E-03
65	Cybele	2458104,365	79,6904763	18,471782	12,06	3,73E-03
65	Cybele	2458104,365	79,6906155	18,4717719	12,06	3,61E-03
65	Cybele	2458104,364	79,6906788	18,4718106	12,06	3,42E-03
65	Cybele	2458104,364	79,6908003	18,4717963	12,06	3,34E-03
65	Cybele	2458104,363	79,6909363	18,471792	12,06	3,33E-03
65	Cybele	2458104,363	79,6910486	18,471817	12,04	3,34E-03
65	Cybele	2458104,362	79,6911543	18,4718076	12,06	3,14E-03
65	Cybele	2458104,361	79,6912713	18,4717943	12,06	3,43E-03
65	Cybele	2458104,361	79,69141	18,4717915	12,05	3,24E-03
65	Cybele	2458104,36	79,6914642	18,4718583	12,07	3,14E-03
65	Cybele	2458104,36	79,6915964	18,4718046	12,06	3,35E-03
65	Cybele	2458104,359	79,6917489	18,4718176	12,05	3,34E-03
65	Cybele	2458104,358	79,6918393	18,4718719	12,06	3,25E-03
65	Cybele	2458104,358	79,6919278	18,4718629	12,05	3,16E-03
65	Cybele	2458104,357	79,6921061	18,4718714	12,08	3,13E-03
65	Cybele	2458104,357	79,6922165	18,471859	12,05	3,35E-03
65	Cybele	2458104,356	79,6923338	18,4718699	12,05	3,16E-03
65	Cybele	2458104,356	79,6924159	18,4718551	12,06	3,05E-03
65	Cybele	2458104,355	79,6925016	18,4718565	12,04	3,26E-03
65	Cybele	2458104,354	79,6926096	18,4718771	12,07	3,33E-03
65	Cybele	2458104,354	79,6927398	18,4718682	12,06	3,35E-03
65	Cybele	2458104,353	79,6928283	18,4718869	12,06	3,15E-03
65	Cybele	2458104,353	79,6929616	18,4718703	12,08	3,24E-03
65	Cybele	2458104,352	79,6930746	18,4718868	12,06	3,14E-03
65	Cybele	2458104,352	79,6932074	18,4718919	12,07	3,15E-03
65	Cybele	2458104,351	79,6933369	18,4718759	12,06	3,15E-03
65	Cybele	2458104,35	79,6934368	18,4718848	12,07	3,14E-03
65	Cybele	2458104,35	79,6936214	18,4718987	12,05	3,36E-03
65	Cybele	2458104,349	79,693719	18,4719085	12,06	3,06E-03
65	Cybele	2458104,349	79,6937757	18,4719197	12,06	3,06E-03
65	Cybele	2458104,348	79,6939246	18,47191	12,08	3,13E-03
65	Cybele	2458104,347	79,6940287	18,4718892	12,07	3,15E-03
65	Cybele	2458104,347	79,6941099	18,4719211	12,06	3,05E-03
65	Cybele	2458104,346	79,6942758	18,471936	12,07	3,14E-03
65	Cybele	2458104,346	79,6943988	18,4718957	12,05	3,26E-03
65	Cybele	2458104,345	79,6945274	18,4719117	12,06	3,35E-03
65	Cybele	2458104,344	79,6945874	18,4719191	12,07	3,25E-03
65	Cybele	2458104,344	79,6947196	18,4719133	12,08	3,44E-03
65	Cybele	2458104,343	79,6948387	18,4719221	12,08	3,35E-03

65	Cybele	2458104,343	79,6949023	18,4719643	12,07	3,25E-03
65	Cybele	2458104,342	79,6950137	18,4719351	12,09	3,33E-03
65	Cybele	2458104,342	79,6951122	18,4719874	12,07	3,25E-03
65	Cybele	2458104,341	79,6952549	18,4719289	12,08	3,16E-03
65	Cybele	2458104,341	79,6953377	18,471952	12,06	3,26E-03
65	Cybele	2458104,34	79,695488	18,4719516	12,07	3,06E-03
65	Cybele	2458104,339	79,6955974	18,4719996	12,07	3,07E-03
65	Cybele	2458104,339	79,6957436	18,4719507	12,08	3,05E-03
65	Cybele	2458104,338	79,6958552	18,4719747	12,08	3,07E-03
65	Cybele	2458104,338	79,6959592	18,4719593	12,07	3,27E-03
65	Cybele	2458104,337	79,6960963	18,4719711	12,08	3,15E-03
65	Cybele	2458104,336	79,6961903	18,4719895	12,07	3,26E-03
65	Cybele	2458104,336	79,6963059	18,4719555	12,08	3,06E-03
65	Cybele	2458104,335	79,696419	18,4719688	12,09	3,06E-03
65	Cybele	2458104,335	79,6964998	18,4720102	12,09	3,06E-03
65	Cybele	2458104,334	79,696627	18,4719911	12,09	3,16E-03
65	Cybele	2458104,334	79,6967386	18,4719755	12,09	2,97E-03
65	Cybele	2458104,333	79,6968577	18,4719778	12,09	3,07E-03
65	Cybele	2458104,332	79,6969845	18,4719875	12,08	3,16E-03
65	Cybele	2458104,332	79,6970599	18,4719983	12,08	3,28E-03
65	Cybele	2458104,331	79,697171	18,4720128	12,10	3,16E-03
65	Cybele	2458104,331	79,6972934	18,4720415	12,10	3,27E-03
65	Cybele	2458104,33	79,6974205	18,4720038	12,09	3,17E-03
65	Cybele	2458104,329	79,697655	18,4720469	12,10	3,56E-03
65	Cybele	2458104,328	79,6977722	18,4720023	12,10	3,28E-03
65	Cybele	2458104,328	79,6979132	18,472027	12,10	3,17E-03
65	Cybele	2458104,327	79,6980015	18,4720313	12,09	3,57E-03
65	Cybele	2458104,327	79,6980884	18,4720238	12,11	3,25E-03
65	Cybele	2458104,326	79,6982079	18,4720128	12,11	3,64E-03
65	Cybele	2458104,325	79,6983718	18,4720171	12,11	3,48E-03
65	Cybele	2458104,325	79,6984733	18,4720364	12,11	3,27E-03
65	Cybele	2458104,324	79,6985672	18,4720769	12,13	3,87E-03
65	Cybele	2458104,324	79,6986976	18,4720321	12,11	3,27E-03
65	Cybele	2458104,323	79,6988096	18,4720341	12,10	3,77E-03
65	Cybele	2458104,323	79,6988962	18,472092	12,10	3,87E-03
65	Cybele	2458104,322	79,6989925	18,4721301	12,10	3,68E-03
65	Cybele	2458104,321	79,6991149	18,4721205	12,12	3,85E-03
65	Cybele	2458104,321	79,699246	18,4720837	12,11	3,56E-03
65	Cybele	2458104,32	79,6994213	18,4720526	12,10	3,48E-03
65	Cybele	2458104,32	79,6994929	18,472071	12,09	3,49E-03
65	Cybele	2458104,319	79,6995476	18,4720927	12,11	3,37E-03
65	Cybele	2458104,319	79,6996877	18,47209	12,10	3,18E-03
65	Cybele	2458104,318	79,6997866	18,4721222	12,10	3,29E-03
65	Cybele	2458104,317	79,6999317	18,4721197	12,12	3,24E-03
65	Cybele	2458104,317	79,7000679	18,4720995	12,11	3,26E-03
65	Cybele	2458104,316	79,7001106	18,4720812	12,12	3,27E-03
65	Cybele	2458104,316	79,700252	18,472147	12,11	3,36E-03
65	Cybele	2458104,315	79,700405	18,4721752	12,08	3,47E-03
65	Cybele	2458104,314	79,7005322	18,4721207	12,10	3,06E-03
65	Cybele	2458104,314	79,7006572	18,4721633	12,12	3,45E-03
65	Cybele	2458104,313	79,7007484	18,4721362	12,11	3,15E-03
65	Cybele	2458104,313	79,7008283	18,4721619	12,11	3,25E-03
65	Cybele	2458104,312	79,7009815	18,4721322	12,11	3,07E-03
65	Cybele	2458104,311	79,7011031	18,4721237	12,10	2,96E-03
65	Cybele	2458104,311	79,7012325	18,4721411	12,12	3,15E-03
65	Cybele	2458104,31	79,7012801	18,4721443	12,10	2,96E-03
65	Cybele	2458104,31	79,7014038	18,4721399	12,10	2,87E-03
65	Cybele	2458104,309	79,7015372	18,4721492	12,10	2,98E-03
65	Cybele	2458104,309	79,70166	18,4721615	12,11	2,77E-03
65	Cybele	2458104,308	79,7017958	18,4721819	12,10	2,88E-03
65	Cybele	2458104,307	79,7018909	18,4721962	12,09	3,07E-03
65	Cybele	2458104,307	79,7019978	18,472154	12,10	2,97E-03
65	Cybele	2458104,306	79,7020961	18,4721816	12,11	2,98E-03
65	Cybele	2458104,306	79,7022019	18,4721549	12,11	2,87E-03
65	Cybele	2458104,305	79,7022976	18,4721771	12,10	2,77E-03
65	Cybele	2458104,305	79,7024394	18,4721842	12,09	2,78E-03
65	Cybele	2458104,304	79,7024905	18,4721983	12,09	2,87E-03
65	Cybele	2458104,304	79,7026693	18,4722123	12,09	2,88E-03
65	Cybele	2458104,303	79,7027825	18,4721952	12,09	2,88E-03
65	Cybele	2458104,302	79,7028567	18,4722147	12,10	2,86E-03
65	Cybele	2458104,302	79,7029392	18,4722373	12,09	2,78E-03
65	Cybele	2458104,301	79,7031267	18,472204	12,09	2,88E-03
65	Cybele	2458104,301	79,7032083	18,4722491	12,10	2,77E-03
65	Cybele	2458104,3	79,7033188	18,4722288	12,09	2,77E-03
65	Cybele	2458104,299	79,7034414	18,4722386	12,10	2,78E-03
65	Cybele	2458104,299	79,7035714	18,4722072	12,09	2,77E-03
65	Cybele	2458104,298	79,7037129	18,4722324	12,12	2,76E-03

65	Cybele	2458104,298	79,7038099	18,4722471	12,09	2,78E-03
65	Cybele	2458104,297	79,7038495	18,4722987	12,10	2,77E-03
65	Cybele	2458104,297	79,703992	18,4723063	12,10	2,77E-03
65	Cybele	2458135,502	74,7451755	18,4322961	12,60	2,95E-03
65	Cybele	2458135,499	74,745505	18,4322857	12,59	2,96E-03
65	Cybele	2458135,496	74,7458085	18,4322593	12,60	3,02E-03
65	Cybele	2458135,492	74,746275	18,4322471	12,62	2,93E-03
65	Cybele	2458135,489	74,7465545	18,4322392	12,62	2,85E-03
65	Cybele	2458135,487	74,7468622	18,4321911	12,61	2,84E-03
65	Cybele	2458135,484	74,7471769	18,4321914	12,62	2,64E-03
65	Cybele	2458135,481	74,7474476	18,4321463	12,61	2,83E-03
65	Cybele	2458135,477	74,7479285	18,4321697	12,61	2,83E-03
65	Cybele	2458135,474	74,7482211	18,4321103	12,60	2,84E-03
65	Cybele	2458135,471	74,7485929	18,4320963	12,60	2,75E-03
65	Cybele	2458135,468	74,7488326	18,432085	12,61	2,82E-03
65	Cybele	2458135,465	74,7491427	18,4320826	12,62	2,90E-03
65	Cybele	2458135,462	74,7494817	18,432065	12,61	2,82E-03
65	Cybele	2458135,459	74,749746	18,43202	12,58	2,74E-03
65	Cybele	2458135,457	74,7500512	18,4320047	12,59	3,01E-03
65	Cybele	2458135,454	74,7503579	18,431994	12,61	2,82E-03
65	Cybele	2458135,442	74,7515411	18,4319189	12,59	2,74E-03
65	Cybele	2458135,44	74,7519033	18,4319129	12,55	3,02E-03
65	Cybele	2458135,437	74,7522354	18,4319151	12,56	2,82E-03
65	Cybele	2458135,434	74,7524805	18,4318421	12,56	2,73E-03
65	Cybele	2458135,431	74,7527606	18,4318231	12,56	2,73E-03
65	Cybele	2458135,428	74,7531097	18,431835	12,56	2,54E-03
65	Cybele	2458135,425	74,7534153	18,4317865	12,55	2,54E-03
65	Cybele	2458135,422	74,7537173	18,4317785	12,54	2,65E-03
65	Cybele	2458135,42	74,7540349	18,4317673	12,54	2,64E-03
65	Cybele	2458135,417	74,7542989	18,4317549	12,54	2,64E-03
65	Cybele	2458135,414	74,7545921	18,4317282	12,55	2,63E-03
65	Cybele	2458135,411	74,754906	18,4316996	12,56	2,63E-03
65	Cybele	2458135,409	74,7552054	18,4316666	12,56	2,44E-03
65	Cybele	2458135,406	74,7555303	18,4316718	12,56	2,53E-03
65	Cybele	2458135,403	74,7557988	18,4316431	12,55	2,46E-03
65	Cybele	2458135,39	74,7572502	18,4315174	12,59	3,02E-03
65	Cybele	2458135,387	74,7576195	18,4314878	12,61	2,92E-03
65	Cybele	2458135,383	74,7579548	18,4314483	12,60	2,63E-03
65	Cybele	2458135,381	74,7582323	18,4314381	12,60	2,44E-03
65	Cybele	2458135,378	74,7586158	18,4314401	12,61	2,62E-03
65	Cybele	2458135,375	74,7588617	18,4313753	12,62	3,18E-03
65	Cybele	2458135,372	74,7591638	18,4313689	12,60	2,54E-03
65	Cybele	2458135,369	74,7594604	18,4313446	12,60	2,44E-03
65	Cybele	2458135,366	74,7597977	18,4313323	12,60	2,53E-03
65	Cybele	2458135,364	74,7600977	18,4313161	12,60	2,63E-03
65	Cybele	2458135,361	74,7604033	18,4312939	12,59	2,63E-03
65	Cybele	2458135,358	74,7606814	18,4312832	12,59	2,72E-03
65	Cybele	2458135,355	74,7610207	18,4312598	12,60	2,43E-03
65	Cybele	2458135,349	74,7615537	18,4312361	12,59	2,43E-03
65	Cybele	2458135,346	74,7619557	18,4311782	12,60	2,72E-03
65	Cybele	2458135,343	74,7622356	18,4311788	12,59	2,44E-03
65	Cybele	2458135,341	74,7625581	18,4311343	12,58	2,73E-03
65	Cybele	2458135,338	74,762832	18,431118	12,59	2,71E-03
65	Cybele	2458135,335	74,7631628	18,4311048	12,59	2,91E-03
65	Cybele	2458135,332	74,7634675	18,4310972	12,59	2,83E-03
65	Cybele	2458135,327	74,7640209	18,4310605	12,60	3,00E-03
65	Cybele	2458135,324	74,7643024	18,4310241	12,58	2,71E-03
65	Cybele	2458135,322	74,7646061	18,4310305	12,57	2,63E-03
65	Cybele	2458135,319	74,7648764	18,4309889	12,58	2,63E-03
65	Cybele	2458135,316	74,7651933	18,4309693	12,59	2,81E-03
65	Cybele	2458135,313	74,7654787	18,4309547	12,60	3,01E-03
65	Cybele	2458135,31	74,7657887	18,4309115	12,58	2,63E-03
65	Cybele	2458135,306	74,7661858	18,4308878	12,61	2,72E-03
65	Cybele	2458135,304	74,7665068	18,4308665	12,59	2,73E-03
65	Cybele	2458135,301	74,7668079	18,4308508	12,61	2,73E-03
65	Cybele	2458135,298	74,7671496	18,430817	12,57	2,73E-03
65	Cybele	2458135,295	74,7674658	18,4308104	12,59	2,82E-03
65	Cybele	2458135,289	74,7680533	18,4307374	12,60	3,02E-03
65	Cybele	2458135,286	74,7683925	18,4307571	12,58	2,83E-03
114	Kassandra	2458106,489	99,1920301	15,5287154	11,59	6,98E-03
114	Kassandra	2458106,487	99,1924602	15,5287207	11,56	2,74E-03
114	Kassandra	2458106,486	99,1927678	15,5286825	11,56	2,62E-03
114	Kassandra	2458106,484	99,1931952	15,5286562	11,56	2,93E-03
114	Kassandra	2458106,482	99,1935657	15,5286372	11,57	2,43E-03
114	Kassandra	2458106,481	99,1938884	15,5286168	11,57	2,82E-03
114	Kassandra	2458106,479	99,1943246	15,5286041	11,59	4,30E-03
114	Kassandra	2458106,478	99,1946427	15,5285998	11,57	2,73E-03

114	Kassandra	2458106,476	99,1950159	15,5285714	11,61	2,88E-03
114	Kassandra	2458106,474	99,1954256	15,5285597	11,60	2,62E-03
114	Kassandra	2458106,473	99,1957537	15,5285478	11,60	2,52E-03
114	Kassandra	2458106,471	99,1961749	15,5285129	11,61	3,02E-03
114	Kassandra	2458106,47	99,1965803	15,5284947	11,59	2,62E-03
114	Kassandra	2458106,468	99,197003	15,5284475	11,62	2,70E-03
114	Kassandra	2458106,466	99,1973069	15,5284521	11,60	2,53E-03
114	Kassandra	2458106,465	99,1976681	15,5284287	11,60	2,62E-03
114	Kassandra	2458106,463	99,1980616	15,5284142	11,58	2,61E-03
114	Kassandra	2458106,462	99,1984742	15,5283618	11,58	2,82E-03
114	Kassandra	2458106,46	99,1988396	15,5283776	11,57	2,52E-03
114	Kassandra	2458106,458	99,1991621	15,5283762	11,55	2,43E-03
114	Kassandra	2458106,457	99,1995634	15,5283134	11,55	2,62E-03
114	Kassandra	2458106,455	99,1999882	15,5283118	11,55	2,82E-03
114	Kassandra	2458106,454	99,2003324	15,528292	11,56	3,02E-03
114	Kassandra	2458106,452	99,2006667	15,5282486	11,54	2,61E-03
114	Kassandra	2458106,45	99,2010988	15,5282582	11,54	2,50E-03
114	Kassandra	2458106,449	99,2013876	15,5282873	11,53	2,60E-03
114	Kassandra	2458106,447	99,2018465	15,5282051	11,51	2,52E-03
114	Kassandra	2458106,446	99,2022082	15,5281997	11,51	2,60E-03
114	Kassandra	2458106,444	99,2025399	15,5281921	11,50	2,23E-03
114	Kassandra	2458106,443	99,2029264	15,5281821	11,52	2,31E-03
114	Kassandra	2458106,441	99,2033116	15,5281363	11,53	2,21E-03
114	Kassandra	2458106,439	99,2036774	15,5281105	11,48	3,72E-03
114	Kassandra	2458106,438	99,2039771	15,5280782	11,50	3,13E-03
114	Kassandra	2458106,436	99,2043332	15,528104	11,48	4,14E-03
114	Kassandra	2458106,435	99,2047781	15,5280401	11,54	2,08E-02
114	Kassandra	2458106,433	99,2051785	15,5280599	11,47	2,32E-03
114	Kassandra	2458106,431	99,2055062	15,5279897	11,47	2,22E-03
114	Kassandra	2458106,43	99,2059424	15,5280009	11,47	2,32E-03
114	Kassandra	2458106,428	99,206265	15,5280057	11,48	2,41E-03
114	Kassandra	2458106,427	99,2066849	15,5279896	11,47	2,32E-03
114	Kassandra	2458106,425	99,2070256	15,5279275	11,45	2,22E-03
114	Kassandra	2458106,423	99,207341	15,5278998	11,46	2,51E-03
114	Kassandra	2458106,422	99,2077809	15,5279193	11,46	2,41E-03
114	Kassandra	2458106,42	99,2081667	15,5279033	11,48	2,60E-03
114	Kassandra	2458106,419	99,2085659	15,527915	11,44	2,52E-03
114	Kassandra	2458106,417	99,2088927	15,5278465	11,44	2,61E-03
114	Kassandra	2458106,415	99,2092556	15,5277808	11,43	3,00E-03
114	Kassandra	2458106,414	99,2096368	15,5277752	11,42	3,30E-03
114	Kassandra	2458106,412	99,2100218	15,5277535	11,43	3,55E-03
114	Kassandra	2458106,411	99,2104087	15,5277512	11,41	4,38E-03
114	Kassandra	2458106,409	99,2107118	15,5277514	11,42	4,66E-03
114	Kassandra	2458106,407	99,2111521	15,5277266	11,43	5,13E-03
114	Kassandra	2458106,406	99,2115033	15,5277045	11,40	5,77E-03
114	Kassandra	2458106,404	99,211858	15,527663	11,40	6,43E-03
114	Kassandra	2458106,403	99,212268	15,5276401	11,41	7,04E-03
114	Kassandra	2458106,401	99,2126333	15,527645	11,40	7,95E-03
114	Kassandra	2458106,396	99,2136773	15,5275864	11,43	9,66E-03
114	Kassandra	2458106,393	99,2145102	15,5275212	11,42	9,15E-03
114	Kassandra	2458106,392	99,2148968	15,5275308	11,41	9,26E-03
114	Kassandra	2458106,388	99,2155763	15,5274924	11,38	2,03E-02
114	Kassandra	2458106,387	99,2159762	15,5274588	11,40	8,81E-03
114	Kassandra	2458106,385	99,2162966	15,5274675	11,38	3,01E-03
114	Kassandra	2458106,384	99,2167471	15,5274353	11,37	2,11E-03
114	Kassandra	2458106,382	99,2170202	15,5274109	11,34	2,12E-03
114	Kassandra	2458106,38	99,2174304	15,5273981	11,39	2,31E-03
114	Kassandra	2458106,379	99,2178013	15,5273676	11,40	2,38E-03
114	Kassandra	2458106,377	99,2181908	15,5273321	11,35	2,32E-03
114	Kassandra	2458106,376	99,2185242	15,5273629	11,35	2,22E-03
114	Kassandra	2458106,374	99,2189379	15,5272998	11,40	2,68E-03
114	Kassandra	2458106,372	99,2192748	15,5272977	11,37	2,30E-03
114	Kassandra	2458106,371	99,2196256	15,5272274	11,36	2,31E-03
114	Kassandra	2458109,638	98,4566958	15,5702256	11,36	2,29E-03
114	Kassandra	2458109,636	98,4571009	15,5701745	11,35	2,29E-03
114	Kassandra	2458109,595	98,4672921	15,5696013	11,52	2,11E-03
114	Kassandra	2458109,593	98,4676595	15,5695752	11,49	2,11E-03
114	Kassandra	2458109,592	98,4680114	15,5695702	11,50	2,01E-03
114	Kassandra	2458109,59	98,4684296	15,5695347	11,49	2,01E-03
114	Kassandra	2458109,588	98,4688111	15,5695234	11,47	2,01E-03
114	Kassandra	2458109,587	98,4692667	15,5695145	11,48	2,00E-03
114	Kassandra	2458109,585	98,4695784	15,5694529	11,47	2,00E-03
114	Kassandra	2458109,584	98,470025	15,5694344	11,46	2,01E-03
114	Kassandra	2458109,582	98,4704069	15,5694016	11,46	1,90E-03
114	Kassandra	2458109,58	98,470799	15,5693909	11,44	2,00E-03
114	Kassandra	2458109,579	98,4711739	15,5693898	11,44	1,91E-03
114	Kassandra	2458109,577	98,4715679	15,5693407	11,43	1,91E-03

114	Kassandra	2458109,576	98,4719834	15,5693142	11,41	1,91E-03
114	Kassandra	2458109,574	98,4723418	15,5693363	11,41	1,82E-03
114	Kassandra	2458109,572	98,4727582	15,5693028	11,42	1,91E-03
114	Kassandra	2458109,571	98,4731271	15,5692953	11,41	1,81E-03
114	Kassandra	2458109,569	98,4735434	15,569273	11,41	1,82E-03
114	Kassandra	2458109,568	98,473936	15,5691937	11,40	1,82E-03
114	Kassandra	2458109,566	98,4742978	15,5692203	11,39	1,82E-03
114	Kassandra	2458109,564	98,4746808	15,5691705	11,39	1,71E-03
114	Kassandra	2458109,563	98,4751164	15,5691433	11,40	2,00E-03
114	Kassandra	2458109,561	98,4755247	15,5691721	11,38	1,71E-03
114	Kassandra	2458109,56	98,4759033	15,5690821	11,38	1,81E-03
114	Kassandra	2458109,558	98,4762763	15,5690622	11,38	1,81E-03
114	Kassandra	2458109,556	98,4766789	15,56909	11,37	1,91E-03
114	Kassandra	2458109,555	98,477048	15,5690416	11,36	1,81E-03
114	Kassandra	2458109,553	98,4774858	15,568991	11,37	1,81E-03
114	Kassandra	2458109,552	98,4778314	15,5689773	11,36	1,91E-03
114	Kassandra	2458109,55	98,4782053	15,5690062	11,35	1,72E-03
114	Kassandra	2458109,549	98,478608	15,5689271	11,35	2,00E-03
114	Kassandra	2458109,547	98,4790348	15,5688909	11,34	1,81E-03
114	Kassandra	2458109,545	98,479426	15,5688689	11,30	2,29E-03
114	Kassandra	2458109,544	98,4797839	15,5688503	11,28	2,11E-03
114	Kassandra	2458109,542	98,480208	15,5688489	11,28	2,12E-03
114	Kassandra	2458109,541	98,4806025	15,5688118	11,27	2,12E-03
114	Kassandra	2458109,539	98,4809861	15,5687943	11,27	2,11E-03
114	Kassandra	2458109,537	98,4813611	15,568775	11,27	2,11E-03
114	Kassandra	2458109,504	98,4895305	15,5682655	11,22	2,62E-03
114	Kassandra	2458109,503	98,4898956	15,5682413	11,20	2,93E-03
114	Kassandra	2458109,501	98,490296	15,5682123	11,19	2,83E-03
114	Kassandra	2458109,499	98,4907247	15,5681513	11,19	2,93E-03
114	Kassandra	2458109,498	98,4910577	15,5681405	11,22	2,72E-03
114	Kassandra	2458109,496	98,4914887	15,5680781	11,21	2,52E-03
114	Kassandra	2458109,495	98,491816	15,5681045	11,20	2,32E-03
114	Kassandra	2458109,491	98,492669	15,568009	11,23	1,82E-03
114	Kassandra	2458109,49	98,4930284	15,5680264	11,22	1,92E-03
114	Kassandra	2458109,488	98,4934385	15,5679971	11,23	1,92E-03
114	Kassandra	2458109,487	98,4938626	15,5679849	11,23	1,82E-03
114	Kassandra	2458109,485	98,4942425	15,5679998	11,23	1,82E-03
114	Kassandra	2458109,483	98,4946427	15,5679434	11,24	1,82E-03
114	Kassandra	2458109,48	98,4954151	15,5678911	11,23	1,92E-03
114	Kassandra	2458109,41	98,5125433	15,5667437	11,33	2,12E-03
114	Kassandra	2458109,409	98,5129098	15,5667619	11,39	1,92E-03
114	Kassandra	2458109,407	98,513335	15,5667419	11,38	2,03E-03
114	Kassandra	2458109,405	98,5136665	15,5667029	11,33	2,23E-03
4628	Laplace	2458101,671	132,3913195	12,215685	15,36	2,34E-02
4628	Laplace	2458101,671	132,3913921	12,2157424	15,45	2,20E-02
4628	Laplace	2458101,67	132,391428	12,2157667	15,37	2,40E-02
4628	Laplace	2458101,669	132,3914784	12,2159338	15,38	2,36E-02
4628	Laplace	2458101,669	132,3914768	12,2159136	15,39	2,24E-02
4628	Laplace	2458101,668	132,3915019	12,2160279	15,42	2,33E-02
4628	Laplace	2458101,667	132,3915734	12,2160981	15,39	2,27E-02
4628	Laplace	2458101,666	132,3915946	12,2161076	15,38	2,37E-02
4628	Laplace	2458101,666	132,3916365	12,2161866	15,40	2,42E-02
4628	Laplace	2458101,665	132,3916529	12,2162533	15,36	2,26E-02
4628	Laplace	2458101,664	132,3916914	12,2162716	15,36	2,25E-02
4628	Laplace	2458101,664	132,3917214	12,2163727	15,38	2,20E-02
4628	Laplace	2458101,663	132,3917534	12,2164113	15,37	2,23E-02
4628	Laplace	2458101,662	132,3918005	12,2164591	15,38	2,31E-02
4628	Laplace	2458101,662	132,3918375	12,2165569	15,35	2,22E-02
4628	Laplace	2458101,661	132,3918693	12,216652	15,38	2,25E-02
4628	Laplace	2458101,66	132,3919289	12,2166905	15,37	2,20E-02
4628	Laplace	2458101,66	132,3919517	12,2167834	15,38	2,11E-02
4628	Laplace	2458101,659	132,3920393	12,2169094	15,37	2,33E-02
4628	Laplace	2458101,659	132,3920307	12,2169149	15,37	2,11E-02
4628	Laplace	2458101,658	132,3920947	12,2169759	15,35	2,23E-02
4628	Laplace	2458101,657	132,392109	12,2170788	15,34	2,27E-02
4628	Laplace	2458101,656	132,3921637	12,2171249	15,32	2,38E-02
4628	Laplace	2458101,656	132,3922152	12,2171901	15,35	2,34E-02
4628	Laplace	2458101,655	132,3921739	12,2172863	15,36	2,21E-02
4628	Laplace	2458101,654	132,3922502	12,2172999	15,31	2,17E-02
4628	Laplace	2458101,654	132,3922818	12,2173554	15,30	2,25E-02
4628	Laplace	2458101,653	132,392327	12,2174729	15,37	2,29E-02
4628	Laplace	2458101,646	132,3927311	12,2182277	15,26	2,07E-02
4628	Laplace	2458101,645	132,3927195	12,218259	15,26	2,08E-02
4628	Laplace	2458101,645	132,3927945	12,2183372	15,27	2,02E-02
4628	Laplace	2458101,644	132,3927917	12,218438	15,25	2,15E-02
4628	Laplace	2458101,643	132,392856	12,218462	15,26	1,95E-02
4628	Laplace	2458101,643	132,3929238	12,2185326	15,29	1,90E-02

4628	Laplace	2458101,642	132,3929154	12,2185837	15,22	1,92E-02
4628	Laplace	2458101,641	132,3929539	12,2187001	15,22	1,88E-02
4628	Laplace	2458101,64	132,3929725	12,2187555	15,26	1,82E-02
4628	Laplace	2458101,64	132,3930151	12,218846	15,20	1,96E-02
4628	Laplace	2458101,639	132,3930939	12,21892	15,23	1,76E-02
4628	Laplace	2458101,638	132,3931353	12,2190071	15,26	1,79E-02
4628	Laplace	2458101,638	132,393123	12,2190681	15,23	1,72E-02
4628	Laplace	2458101,637	132,3931601	12,2191139	15,22	1,87E-02
4628	Laplace	2458101,636	132,3932327	12,2191328	15,24	1,77E-02
4628	Laplace	2458101,636	132,3932319	12,2192133	15,16	1,92E-02
4628	Laplace	2458101,635	132,3932742	12,2192337	15,20	1,75E-02
4628	Laplace	2458101,634	132,3933123	12,2193051	15,20	1,84E-02
4628	Laplace	2458101,634	132,3933325	12,2193744	15,18	1,84E-02
4628	Laplace	2458101,633	132,3933943	12,2194433	15,19	1,75E-02
4628	Laplace	2458101,632	132,3934139	12,219498	15,20	1,86E-02
4628	Laplace	2458101,632	132,3934335	12,2196007	15,18	1,77E-02
4628	Laplace	2458101,631	132,3934986	12,2196887	15,19	1,74E-02
4628	Laplace	2458101,63	132,393531	12,2198027	15,18	1,77E-02
4628	Laplace	2458101,629	132,3935704	12,2198802	15,17	1,69E-02
4628	Laplace	2458101,629	132,3936422	12,2199692	15,15	1,72E-02
4628	Laplace	2458101,628	132,3936511	12,2200204	15,19	1,69E-02
4628	Laplace	2458101,627	132,3936765	12,2201036	15,15	1,66E-02
4628	Laplace	2458101,627	132,3937523	12,2201539	15,13	1,81E-02
4628	Laplace	2458101,626	132,3937524	12,2202154	15,14	1,72E-02
4628	Laplace	2458101,625	132,3937931	12,2202693	15,15	1,66E-02
4628	Laplace	2458101,625	132,3938221	12,2203093	15,12	1,79E-02
4628	Laplace	2458101,624	132,3938632	12,220371	15,12	1,75E-02
4628	Laplace	2458101,623	132,3939142	12,220434	15,10	1,72E-02
4628	Laplace	2458101,623	132,3938979	12,2204857	15,13	1,64E-02
4628	Laplace	2458101,622	132,3939599	12,2205518	15,11	1,67E-02
4628	Laplace	2458101,621	132,3940122	12,2206177	15,10	1,70E-02
4628	Laplace	2458101,621	132,3940159	12,2206907	15,09	1,65E-02
4628	Laplace	2458101,62	132,3940678	12,2207471	15,11	1,65E-02
4628	Laplace	2458101,619	132,3941065	12,2208186	15,11	1,59E-02
4628	Laplace	2458101,619	132,3941349	12,2208886	15,09	1,78E-02
4628	Laplace	2458101,618	132,3941802	12,2209706	15,11	1,69E-02
4628	Laplace	2458101,617	132,3942313	12,2210559	15,11	1,53E-02
4628	Laplace	2458101,617	132,3942518	12,2211428	15,11	1,61E-02
4628	Laplace	2458101,616	132,3943058	12,2212012	15,07	1,77E-02
4628	Laplace	2458101,615	132,3943467	12,2212734	15,07	1,72E-02
4628	Laplace	2458101,615	132,3943368	12,2213069	15,11	1,70E-02
4628	Laplace	2458101,614	132,3943944	12,2213784	15,10	1,62E-02
4628	Laplace	2458101,613	132,3944318	12,2214519	15,07	1,68E-02
4628	Laplace	2458101,613	132,3944406	12,2214964	15,06	1,76E-02
4628	Laplace	2458101,612	132,3944772	12,2215666	15,05	1,61E-02
4628	Laplace	2458101,611	132,3945007	12,2216073	15,09	1,69E-02
4628	Laplace	2458101,611	132,3945717	12,2216519	15,10	1,65E-02
4628	Laplace	2458101,61	132,3946192	12,2217739	15,07	1,70E-02
4628	Laplace	2458101,609	132,3946394	12,2218331	15,08	1,54E-02
4628	Laplace	2458101,609	132,3946484	12,2218775	15,06	1,57E-02
4628	Laplace	2458101,608	132,3947018	12,2219515	15,06	1,66E-02
4628	Laplace	2458101,607	132,3947648	12,2220551	15,05	1,50E-02
4628	Laplace	2458101,607	132,3947923	12,2221029	15,08	1,59E-02
4628	Laplace	2458101,606	132,3948244	12,2221701	15,06	1,61E-02
4628	Laplace	2458101,605	132,3948559	12,2222857	15,08	1,51E-02
4628	Laplace	2458101,604	132,3948899	12,2223634	15,06	1,63E-02
4628	Laplace	2458101,604	132,394932	12,2224204	15,04	1,64E-02
4628	Laplace	2458101,603	132,394959	12,2225031	15,07	1,69E-02
4628	Laplace	2458101,602	132,3950152	12,2225551	15,05	1,59E-02
4628	Laplace	2458101,602	132,3950416	12,2225905	15,06	1,66E-02
4628	Laplace	2458101,601	132,3950729	12,2226774	15,07	1,51E-02
4628	Laplace	2458101,6	132,3951096	12,2227286	15,03	1,68E-02
4628	Laplace	2458101,6	132,3951554	12,222788	15,04	1,71E-02
4628	Laplace	2458101,599	132,395176	12,2228646	15,04	1,59E-02
4628	Laplace	2458101,598	132,3952057	12,2228945	15,03	1,52E-02
4628	Laplace	2458101,598	132,3952605	12,2230225	15,04	1,62E-02
4628	Laplace	2458101,597	132,3952824	12,223049	15,04	1,69E-02
4628	Laplace	2458101,596	132,3953213	12,2231496	15,05	1,64E-02
4628	Laplace	2458101,596	132,3953312	12,2232308	15,03	1,68E-02
4628	Laplace	2458101,595	132,3953902	12,2232962	15,07	1,50E-02
4628	Laplace	2458101,594	132,3954538	12,2233742	15,04	1,59E-02
4628	Laplace	2458101,594	132,3954574	12,223448	15,04	1,51E-02
4628	Laplace	2458101,593	132,3954796	12,2235199	15,04	1,58E-02
4628	Laplace	2458101,592	132,3955487	12,223563	15,02	1,63E-02
4628	Laplace	2458101,591	132,3955771	12,2236339	15,02	1,57E-02
4628	Laplace	2458101,591	132,3955851	12,2236829	15,04	1,60E-02
4628	Laplace	2458101,59	132,3956204	12,2237308	15,01	1,61E-02

4628	Laplace	2458101,589	132,3956732	12,2237886	15,01	1,54E-02
4628	Laplace	2458101,589	132,39569	12,2238689	15,03	1,57E-02
4628	Laplace	2458101,588	132,3957232	12,2239164	15,04	1,53E-02
4628	Laplace	2458101,587	132,3957884	12,2240203	15,04	1,62E-02
4628	Laplace	2458101,587	132,3958427	12,2240881	15,05	1,53E-02
4628	Laplace	2458101,586	132,3958394	12,2241458	15,03	1,50E-02
4628	Laplace	2458101,585	132,3958797	12,224254	15,03	1,59E-02
4628	Laplace	2458101,584	132,3959293	12,2243251	15,02	1,63E-02
4628	Laplace	2458101,584	132,3959613	12,2244218	15,04	1,48E-02
4628	Laplace	2458101,583	132,3960269	12,2244952	15,01	1,50E-02
4628	Laplace	2458101,582	132,3960149	12,2245646	15,03	1,57E-02
4628	Laplace	2458101,582	132,3960893	12,2246362	15,02	1,47E-02
4628	Laplace	2458101,581	132,3960983	12,2246917	15,01	1,58E-02
4628	Laplace	2458101,58	132,3961466	12,2247446	15,02	1,54E-02
4628	Laplace	2458101,58	132,3961618	12,2247856	15,03	1,58E-02
4628	Laplace	2458101,579	132,396205	12,2248404	15,04	1,60E-02
4628	Laplace	2458101,578	132,3962268	12,2249059	15,01	1,57E-02
4628	Laplace	2458101,578	132,396248	12,2249493	15,02	1,71E-02
4628	Laplace	2458101,577	132,3963248	12,2250181	15,05	1,72E-02
4628	Laplace	2458101,576	132,3963501	12,2250877	15,03	1,75E-02
4628	Laplace	2458101,575	132,3963745	12,2251528	15,04	1,72E-02
4628	Laplace	2458101,575	132,3964059	12,2252476	15,04	1,75E-02
4628	Laplace	2458101,574	132,3964373	12,2253547	15,03	1,73E-02
4628	Laplace	2458101,573	132,3964943	12,2254059	15,06	1,53E-02
4628	Laplace	2458101,573	132,3965275	12,2255047	15,03	1,70E-02
4628	Laplace	2458101,572	132,3965545	12,2256178	15,05	1,66E-02
4628	Laplace	2458101,571	132,3965846	12,2256706	15,04	1,73E-02
4628	Laplace	2458101,57	132,3966078	12,2257193	15,04	1,76E-02
4628	Laplace	2458101,57	132,3967052	12,2258272	15,07	1,66E-02
4628	Laplace	2458101,569	132,3967492	12,2258605	15,07	1,69E-02
4628	Laplace	2458101,568	132,3967409	12,2259417	15,02	1,75E-02
4628	Laplace	2458101,568	132,3967701	12,2259965	15,04	1,77E-02
4628	Laplace	2458101,567	132,3968273	12,2260111	15,05	1,78E-02
4628	Laplace	2458101,566	132,396822	12,2261139	15,06	1,81E-02
4628	Laplace	2458101,566	132,3969185	12,2261322	15,07	1,70E-02
4628	Laplace	2458101,565	132,3969313	12,2262123	15,05	1,79E-02
4628	Laplace	2458101,564	132,3969589	12,2262863	15,05	1,78E-02
4628	Laplace	2458101,564	132,3969876	12,2263756	15,05	2,04E-02
4628	Laplace	2458101,563	132,3970142	12,2264602	15,06	1,94E-02
4628	Laplace	2458101,562	132,3970557	12,2265109	15,09	1,83E-02
4628	Laplace	2458101,561	132,3970716	12,2266348	15,06	1,77E-02
4628	Laplace	2458101,561	132,3971518	12,226684	15,07	1,92E-02
4628	Laplace	2458101,56	132,3971666	12,2267445	15,08	1,81E-02
4628	Laplace	2458101,559	132,3972147	12,2268377	15,09	1,97E-02
4628	Laplace	2458101,559	132,3972369	12,226868	15,04	1,84E-02
4628	Laplace	2458101,558	132,3972957	12,2269483	15,08	2,02E-02
4628	Laplace	2458101,557	132,397321	12,2270167	15,08	2,05E-02
4628	Laplace	2458101,557	132,3973458	12,2270775	15,03	2,06E-02
4628	Laplace	2458101,556	132,3973707	12,2271253	15,07	2,17E-02
4628	Laplace	2458101,555	132,3974091	12,2271971	15,03	2,24E-02
4628	Laplace	2458101,555	132,3974519	12,2272927	15,09	2,32E-02
4628	Laplace	2458101,554	132,3974617	12,2273106	15,07	2,15E-02
4628	Laplace	2458101,553	132,3975292	12,2273239	15,09	2,18E-02
4628	Laplace	2458101,553	132,397567	12,2274272	15,08	2,21E-02
4628	Laplace	2458101,552	132,3976072	12,2275299	15,13	2,12E-02
4628	Laplace	2458101,551	132,3976451	12,2276232	15,09	2,08E-02
4628	Laplace	2458101,551	132,397655	12,2276885	15,06	2,05E-02
4628	Laplace	2458101,55	132,3976952	12,2277433	15,12	2,26E-02
4628	Laplace	2458101,549	132,3977297	12,2278497	15,10	2,20E-02
4628	Laplace	2458101,548	132,3977912	12,227936	15,09	2,33E-02
4628	Laplace	2458101,548	132,3977883	12,2280042	15,06	2,46E-02
4628	Laplace	2458101,547	132,3978253	12,2280531	15,13	2,67E-02
4628	Laplace	2458101,546	132,3978336	12,2280899	15,13	2,41E-02
4628	Laplace	2458101,546	132,3978633	12,2281414	15,09	2,80E-02
4628	Laplace	2458101,545	132,3979141	12,2281911	15,17	3,13E-02
4628	Laplace	2458101,545	132,3979667	12,2282863	15,10	3,58E-02
4628	Laplace	2458101,544	132,3979924	12,2283263	15,16	3,60E-02
4628	Laplace	2458101,543	132,3980247	12,2284289	15,13	3,82E-02
4628	Laplace	2458101,542	132,3980636	12,2284979	15,11	3,65E-02
4628	Laplace	2458101,542	132,39809	12,2285423	15,10	4,11E-02
4628	Laplace	2458101,541	132,3980957	12,2286552	15,06	4,68E-02
4628	Laplace	2458101,54	132,3981527	12,228722	15,04	3,98E-02
4628	Laplace	2458101,54	132,3981814	12,2287978	15,01	3,93E-02
4628	Laplace	2458101,539	132,3982824	12,2288575	15,02	4,05E-02
4628	Laplace	2458101,538	132,3982732	12,2289192	15,02	4,09E-02
4628	Laplace	2458101,538	132,3983543	12,2290026	14,95	4,42E-02
4628	Laplace	2458101,537	132,398311	12,2291592	14,98	4,72E-02

4628	Laplace	2458101,536	132,3983336	12,2291877	15,05	4,35E-02
4628	Laplace	2458101,535	132,3984068	12,2292159	15,08	3,94E-02
4628	Laplace	2458101,535	132,3984275	12,2292784	15,07	4,34E-02
4628	Laplace	2458101,534	132,398526	12,2293263	15,03	4,17E-02
4628	Laplace	2458101,533	132,3985103	12,2294212	15,13	4,43E-02
4628	Laplace	2458101,533	132,3984802	12,2294209	15,12	4,80E-02
4628	Laplace	2458101,532	132,3986368	12,229547	15,15	6,95E-02
4628	Laplace	2458101,531	132,3986848	12,2296274	15,12	8,05E-02
4628	Laplace	2458101,53	132,3985971	12,2297309	15,19	9,25E-02
4628	Laplace	2458101,529	132,398759	12,2297198	15,12	8,59E-02
4628	Laplace	2458101,529	132,3986521	12,2298038	15,13	9,82E-02
4628	Laplace	2458101,528	132,3987576	12,2300179	14,93	8,09E-02
4628	Laplace	2458101,527	132,3987481	12,2299691	15,16	7,75E-02
68	Leto	2458135,769	175,516356	12,025996	12,21	5,85E-03
68	Leto	2458135,766	175,5164634	12,0258466	12,15	3,86E-03
68	Leto	2458135,763	175,5165323	12,0257061	12,13	3,06E-03
68	Leto	2458135,761	175,5166176	12,0256033	12,12	2,65E-03
68	Leto	2458135,758	175,5167151	12,0254825	12,13	2,15E-03
68	Leto	2458135,755	175,5167942	12,0253687	12,12	2,14E-03
68	Leto	2458135,752	175,5168936	12,0252362	12,12	1,96E-03
68	Leto	2458135,749	175,5169852	12,0251549	12,13	2,23E-03
68	Leto	2458135,747	175,517058	12,0249865	12,13	2,23E-03
68	Leto	2458135,744	175,5171678	12,0248437	12,11	1,95E-03
68	Leto	2458135,741	175,51724	12,0247007	12,12	2,04E-03
68	Leto	2458135,738	175,5173329	12,024557	12,11	1,85E-03
68	Leto	2458135,735	175,5174189	12,0244046	12,12	1,85E-03
68	Leto	2458135,732	175,5175254	12,0242985	12,11	1,76E-03
68	Leto	2458135,729	175,5175788	12,0241763	12,12	1,75E-03
68	Leto	2458135,727	175,5176851	12,0240281	12,10	1,85E-03
68	Leto	2458135,724	175,5177914	12,0238986	12,12	1,75E-03
68	Leto	2458135,721	175,517872	12,0237673	12,11	1,75E-03
68	Leto	2458135,718	175,5179698	12,0236311	12,12	1,84E-03
68	Leto	2458135,715	175,5180452	12,0235231	12,11	1,75E-03
68	Leto	2458135,713	175,5181228	12,0233876	12,11	1,65E-03
68	Leto	2458135,71	175,5182003	12,0232412	12,11	1,65E-03
68	Leto	2458135,707	175,5182887	12,023114	12,10	1,85E-03
68	Leto	2458135,703	175,5184189	12,0229447	12,10	1,85E-03
68	Leto	2458135,7	175,518534	12,0228141	12,09	1,75E-03
68	Leto	2458135,697	175,5186092	12,0226752	12,10	1,66E-03
68	Leto	2458135,695	175,5186689	12,0225228	12,09	1,76E-03
68	Leto	2458135,692	175,5187773	12,0224014	12,09	1,66E-03
68	Leto	2458135,689	175,5188744	12,022296	12,09	1,75E-03
68	Leto	2458135,686	175,5189484	12,0221462	12,08	1,76E-03
68	Leto	2458135,684	175,5190267	12,0220334	12,08	1,75E-03
68	Leto	2458135,681	175,5191167	12,0218954	12,08	1,75E-03
68	Leto	2458135,671	175,5194758	12,0214672	12,10	1,65E-03
68	Leto	2458135,667	175,5196138	12,0212635	12,08	1,75E-03
68	Leto	2458135,664	175,5197088	12,0211425	12,09	1,76E-03
68	Leto	2458135,661	175,5197876	12,0209961	12,09	1,75E-03
68	Leto	2458135,658	175,5198597	12,0208599	12,09	1,66E-03
68	Leto	2458135,655	175,5199675	12,0207327	12,09	1,76E-03
68	Leto	2458135,653	175,5200316	12,0205943	12,10	1,66E-03
68	Leto	2458135,65	175,5201379	12,0204636	12,08	1,76E-03
68	Leto	2458135,647	175,5202223	12,0203247	12,08	1,66E-03
68	Leto	2458135,644	175,5202921	12,0201832	12,08	1,75E-03
68	Leto	2458135,641	175,5204089	12,0200463	12,08	1,75E-03
68	Leto	2458135,638	175,5204663	12,0199172	12,09	1,75E-03
68	Leto	2458135,635	175,5205727	12,0197468	12,08	1,75E-03
68	Leto	2458135,632	175,5207028	12,0196215	12,09	1,84E-03
68	Leto	2458135,629	175,5207655	12,0194902	12,09	1,65E-03
68	Leto	2458135,626	175,5208535	12,0193938	12,11	1,56E-03
68	Leto	2458135,624	175,5209439	12,0192226	12,09	1,65E-03
68	Leto	2458135,621	175,5210061	12,0190939	12,09	1,76E-03
68	Leto	2458135,618	175,5211234	12,0189522	12,09	1,65E-03
68	Leto	2458135,615	175,5212131	12,0188149	12,10	1,65E-03
68	Leto	2458135,612	175,5213108	12,0187056	12,11	1,64E-03
68	Leto	2458135,609	175,521372	12,0185635	12,12	1,65E-03
68	Leto	2458135,606	175,5215036	12,0183938	12,11	1,75E-03
68	Leto	2458135,604	175,5215565	12,0182535	12,12	1,65E-03
68	Leto	2458135,601	175,5216168	12,0181411	12,12	1,65E-03
68	Leto	2458135,598	175,5217234	12,0179684	12,12	1,75E-03
68	Leto	2458135,595	175,5218228	12,0178882	12,13	1,85E-03
68	Leto	2458135,592	175,5219027	12,0177504	12,13	1,65E-03
68	Leto	2458135,589	175,5220057	12,0175891	12,14	1,75E-03
68	Leto	2458135,586	175,5220893	12,0174645	12,14	1,84E-03
68	Leto	2458135,583	175,5221964	12,0173317	12,17	1,84E-03
68	Leto	2458135,58	175,5222747	12,0172094	12,15	1,85E-03

68	Leto	2458135,578	175,5223801	12,017081	12,20	2,13E-03
68	Leto	2458135,575	175,5224217	12,016921	12,19	1,94E-03
68	Leto	2458135,572	175,5224994	12,0167641	12,20	1,94E-03
68	Leto	2458135,569	175,5226063	12,0166438	12,21	2,04E-03
68	Leto	2458135,566	175,5227052	12,0164652	12,22	2,13E-03
68	Leto	2458135,563	175,5226985	12,0163464	12,23	2,05E-03
68	Leto	2458135,56	175,5227913	12,0162808	12,24	2,14E-03
68	Leto	2458135,557	175,522971	12,0161074	12,24	2,23E-03
68	Leto	2458135,555	175,5230153	12,015992	12,26	2,33E-03
68	Leto	2458135,552	175,5230627	12,01585	12,25	2,15E-03
68	Leto	2458135,549	175,5232102	12,0156862	12,25	2,15E-03
68	Leto	2458135,546	175,5232687	12,0155461	12,24	2,35E-03
68	Leto	2458135,542	175,5233951	12,0153751	12,25	2,33E-03
68	Leto	2458135,539	175,5234331	12,0152638	12,26	2,23E-03
68	Leto	2458135,537	175,5235711	12,0151311	12,26	2,53E-03
68	Leto	2458135,534	175,5236174	12,0149486	12,25	2,33E-03
68	Leto	2458135,531	175,5237372	12,0148402	12,24	2,35E-03
68	Leto	2458135,528	175,5237678	12,0147054	12,25	2,32E-03
68	Leto	2458135,525	175,5238959	12,0145463	12,23	2,33E-03
68	Leto	2458135,522	175,5239666	12,0144223	12,25	2,53E-03
68	Leto	2458135,519	175,5240989	12,0142801	12,23	2,25E-03
68	Leto	2458135,516	175,5241039	12,0141154	12,23	2,15E-03
68	Leto	2458135,513	175,5242673	12,0140051	12,23	2,16E-03
68	Leto	2458135,51	175,5242602	12,0138597	12,24	2,25E-03
68	Leto	2458135,507	175,5243746	12,0136929	12,23	2,16E-03
2219	Mannucci	2458135,763	175,301313	12,2426481	16,91	1,46E-01
2219	Mannucci	2458135,761	175,3011803	12,2425031	16,79	1,26E-01
2219	Mannucci	2458135,758	175,3011753	12,2420631	16,92	1,12E-01
2219	Mannucci	2458135,755	175,3011682	12,2422276	16,87	1,12E-01
2219	Mannucci	2458135,752	175,3011614	12,2417604	16,86	9,55E-02
2219	Mannucci	2458135,744	175,3016096	12,2414303	16,63	9,34E-02
2219	Mannucci	2458135,741	175,3017851	12,2413153	16,63	9,68E-02
2219	Mannucci	2458135,738	175,3015177	12,2411976	16,73	9,20E-02
2219	Mannucci	2458135,735	175,3017647	12,2410505	16,74	9,38E-02
2219	Mannucci	2458135,732	175,3016624	12,2408545	16,90	9,18E-02
2219	Mannucci	2458135,729	175,3018295	12,2407279	16,71	8,31E-02
2219	Mannucci	2458135,727	175,3018106	12,2405546	16,62	8,09E-02
2219	Mannucci	2458135,724	175,3019731	12,240305	16,67	7,92E-02
2219	Mannucci	2458135,721	175,3018218	12,2400896	16,60	7,76E-02
2219	Mannucci	2458135,718	175,3019837	12,2400823	16,60	7,84E-02
2219	Mannucci	2458135,715	175,3022406	12,2399456	16,63	8,33E-02
2219	Mannucci	2458135,713	175,3020236	12,2397318	16,63	8,59E-02
2219	Mannucci	2458135,71	175,3023552	12,2396103	16,69	7,15E-02
2219	Mannucci	2458135,707	175,3024405	12,2394983	16,56	8,22E-02
2219	Mannucci	2458135,703	175,3024722	12,2393378	16,64	8,15E-02
2219	Mannucci	2458135,7	175,3025262	12,239233	16,70	7,83E-02
2219	Mannucci	2458135,697	175,3025616	12,2390049	16,66	7,15E-02
2219	Mannucci	2458135,695	175,302667	12,2387624	16,69	8,02E-02
2219	Mannucci	2458135,692	175,3026468	12,2387065	16,65	7,89E-02
2219	Mannucci	2458135,689	175,3027911	12,2386055	16,67	7,96E-02
2219	Mannucci	2458135,686	175,3026375	12,2384242	16,42	7,80E-02
2219	Mannucci	2458135,684	175,3027978	12,2382124	16,56	7,45E-02
2219	Mannucci	2458135,681	175,3030771	12,2380842	16,46	7,49E-02
2219	Mannucci	2458135,671	175,3031396	12,2375684	16,67	7,28E-02
2219	Mannucci	2458135,667	175,3033937	12,2374197	16,34	8,48E-02
2219	Mannucci	2458135,664	175,3032748	12,2371335	16,43	7,16E-02
2219	Mannucci	2458135,661	175,3034308	12,2370735	16,53	7,54E-02
2219	Mannucci	2458135,658	175,3034111	12,2370671	16,31	7,15E-02
2219	Mannucci	2458135,655	175,3034712	12,2367007	16,31	7,01E-02
2219	Mannucci	2458135,653	175,3035783	12,2366058	16,46	7,20E-02
2219	Mannucci	2458135,65	175,3034877	12,2364454	16,32	7,47E-02
2219	Mannucci	2458135,647	175,3035531	12,2362987	16,45	7,48E-02
2219	Mannucci	2458135,644	175,303701	12,2361599	16,51	6,61E-02
2219	Mannucci	2458135,641	175,3036924	12,2360133	16,49	7,89E-02
2219	Mannucci	2458135,638	175,3038876	12,2357211	16,33	7,55E-02
2219	Mannucci	2458135,635	175,3040155	12,23578	16,43	8,11E-02
2219	Mannucci	2458135,632	175,3040346	12,2355618	16,30	7,67E-02
2219	Mannucci	2458135,629	175,3040394	12,2352635	16,38	6,99E-02
2219	Mannucci	2458135,626	175,3040936	12,2351723	16,48	6,89E-02
2219	Mannucci	2458135,624	175,3040971	12,2351136	16,61	7,43E-02
2219	Mannucci	2458135,621	175,3043305	12,2349482	16,47	8,77E-02
2219	Mannucci	2458135,618	175,3042267	12,2347183	16,41	7,35E-02
2219	Mannucci	2458135,615	175,3043873	12,2345984	16,43	6,46E-02
2219	Mannucci	2458135,612	175,3044658	12,2343187	16,49	6,91E-02
2219	Mannucci	2458135,609	175,3043556	12,2341368	16,65	7,44E-02
2219	Mannucci	2458135,606	175,3044396	12,2340851	16,64	8,29E-02
2219	Mannucci	2458135,604	175,3045236	12,2339666	16,43	7,40E-02

2219	Mannucci	2458135,601	175,3045673	12,2336634	16,59	7,62E-02
2219	Mannucci	2458135,598	175,3047254	12,2336222	16,55	7,63E-02
2219	Mannucci	2458135,595	175,3048184	12,2333848	16,60	7,98E-02
2219	Mannucci	2458135,592	175,3049468	12,2333177	16,46	7,01E-02
2219	Mannucci	2458135,589	175,3048324	12,2331178	16,53	8,01E-02
2219	Mannucci	2458135,586	175,304816	12,2330325	16,64	8,02E-02
2219	Mannucci	2458135,583	175,3048963	12,2329646	16,57	8,46E-02
2219	Mannucci	2458135,58	175,3050807	12,2326681	16,65	8,00E-02
2219	Mannucci	2458135,578	175,3051061	12,2325163	16,63	9,10E-02
2219	Mannucci	2458135,575	175,305106	12,2325554	16,41	8,10E-02
2219	Mannucci	2458135,572	175,3052097	12,2322635	16,57	8,12E-02
2219	Mannucci	2458135,569	175,3053388	12,2319691	16,44	7,79E-02
2219	Mannucci	2458135,566	175,3054199	12,2317877	16,53	8,93E-02
2219	Mannucci	2458135,563	175,3053108	12,2319723	16,66	9,23E-02
2219	Mannucci	2458135,56	175,3055941	12,2316206	16,56	8,83E-02
2219	Mannucci	2458135,557	175,3055299	12,2312556	16,48	8,55E-02
2219	Mannucci	2458135,552	175,30552	12,2311043	16,52	8,33E-02
2219	Mannucci	2458135,549	175,3056439	12,2307924	16,56	8,38E-02
2219	Mannucci	2458135,546	175,3057392	12,2308515	16,49	1,03E-01
2219	Mannucci	2458135,542	175,3059001	12,2304856	16,38	9,35E-02
2219	Mannucci	2458135,539	175,305761	12,2303754	16,58	9,33E-02
2219	Mannucci	2458135,537	175,3058091	12,2304055	16,63	1,06E-01
2219	Mannucci	2458135,534	175,3059766	12,230384	16,54	9,83E-02
2219	Mannucci	2458135,531	175,306102	12,229919	16,51	1,01E-01
2219	Mannucci	2458135,528	175,3059516	12,2300413	16,60	9,31E-02
2219	Mannucci	2458135,525	175,3061791	12,2297941	16,53	9,82E-02
2219	Mannucci	2458135,522	175,3063168	12,2295978	16,66	1,09E-01
2219	Mannucci	2458135,519	175,3064183	12,2293407	16,53	9,44E-02
2219	Mannucci	2458135,516	175,3065377	12,2292416	16,56	9,25E-02
2219	Mannucci	2458135,513	175,3064388	12,2289779	16,47	9,24E-02
2219	Mannucci	2458135,51	175,3064298	12,228869	16,54	8,78E-02
2219	Mannucci	2458135,507	175,3064799	12,2288126	16,60	9,18E-02
24837	Msecke Zehrovice	2458109,643	98,9434226	15,3159567	16,88	1,61E-01
24837	Msecke Zehrovice	2458109,633	98,9461241	15,3161475	16,68	1,83E-01
24837	Msecke Zehrovice	2458109,617	98,9504228	15,3165797	16,98	1,83E-01
24837	Msecke Zehrovice	2458109,616	98,9509762	15,316402	16,67	1,74E-01
24837	Msecke Zehrovice	2458109,614	98,9513209	15,3165793	16,97	1,74E-01
24837	Msecke Zehrovice	2458109,531	98,9746147	15,3177705	16,47	1,57E-01
24837	Msecke Zehrovice	2458109,53	98,9752003	15,3177682	16,58	1,46E-01
24837	Msecke Zehrovice	2458109,514	98,979798	15,3182923	16,02	1,01E-01
24837	Msecke Zehrovice	2458109,512	98,9801158	15,3182712	16,13	1,14E-01
24837	Msecke Zehrovice	2458109,511	98,9803136	15,3183034	15,67	1,09E-01
24837	Msecke Zehrovice	2458109,509	98,9808665	15,3185391	16,14	1,37E-01
24837	Msecke Zehrovice	2458109,507	98,9809859	15,3183388	16,29	1,44E-01
24837	Msecke Zehrovice	2458109,506	98,9816336	15,3186664	16,20	1,53E-01
24837	Msecke Zehrovice	2458109,413	99,0078553	15,3197141	16,70	1,51E-01
24837	Msecke Zehrovice	2458109,412	99,0084019	15,3197178	16,42	1,37E-01
24837	Msecke Zehrovice	2458109,409	99,0092903	15,3198418	16,30	1,36E-01
24837	Msecke Zehrovice	2458109,407	99,0095348	15,3198286	16,56	1,52E-01
24837	Msecke Zehrovice	2458109,405	99,0100716	15,3200038	16,05	1,18E-01
24837	Msecke Zehrovice	2458109,404	99,0103949	15,3197387	16,31	1,27E-01
24837	Msecke Zehrovice	2458109,402	99,0107479	15,3197627	16,54	1,34E-01
24837	Msecke Zehrovice	2458109,401	99,0114583	15,3200231	16,45	1,42E-01
24837	Msecke Zehrovice	2458109,399	99,0118537	15,3201417	16,57	1,45E-01
24837	Msecke Zehrovice	2458109,397	99,01224	15,3199874	16,68	1,48E-01
24837	Msecke Zehrovice	2458109,394	99,0130483	15,3200247	16,62	1,38E-01
24837	Msecke Zehrovice	2458109,393	99,0135839	15,3200504	16,42	1,43E-01
24837	Msecke Zehrovice	2458109,391	99,0141531	15,3200133	16,49	1,38E-01
4745	Nancymarie	2458106,473	98,8479243	15,742929	16,54	1,59E-01
4745	Nancymarie	2458106,471	98,8484167	15,7429226	16,92	2,09E-01
4745	Nancymarie	2458106,466	98,8494038	15,7428443	16,55	1,64E-01
4745	Nancymarie	2458109,662	98,1564902	15,6625263	16,71	1,56E-01
4745	Nancymarie	2458109,659	98,1571196	15,6625231	16,47	1,48E-01
4745	Nancymarie	2458109,655	98,1578516	15,6626753	16,44	1,46E-01
4745	Nancymarie	2458109,654	98,1582149	15,6627741	16,72	1,56E-01
4745	Nancymarie	2458109,651	98,1588458	15,6629517	16,62	1,72E-01
4745	Nancymarie	2458109,485	98,1959481	15,6665644	16,37	1,34E-01
4745	Nancymarie	2458109,483	98,1963401	15,6667399	16,36	1,33E-01
4745	Nancymarie	2458109,477	98,1974457	15,6667723	16,71	1,57E-01
4745	Nancymarie	2458109,472	98,1989927	15,6670965	16,70	1,55E-01
4745	Nancymarie	2458109,469	98,1997571	15,6672391	16,53	1,38E-01
4745	Nancymarie	2458109,466	98,2001474	15,6673786	16,39	1,64E-01
4745	Nancymarie	2458109,46	98,201691	15,6672838	16,49	1,44E-01
4745	Nancymarie	2458109,458	98,2020948	15,66726	16,70	1,66E-01
4745	Nancymarie	2458109,456	98,2023172	15,6674726	16,34	1,47E-01
4745	Nancymarie	2458109,453	98,2029984	15,6675943	16,66	1,47E-01
4745	Nancymarie	2458109,452	98,203347	15,6674434	16,54	1,72E-01

4745	Nancymarie	2458109,45	98,2038138	15,6675865	16,46	1,72E-01
4745	Nancymarie	2458109,448	98,2041248	15,667618	16,57	1,61E-01
4745	Nancymarie	2458109,447	98,2042994	15,6676691	16,88	1,76E-01
4745	Nancymarie	2458109,444	98,2053899	15,667779	16,58	1,49E-01
4745	Nancymarie	2458109,442	98,2053878	15,6677394	16,88	1,62E-01
4745	Nancymarie	2458109,44	98,2058632	15,6679272	16,76	1,59E-01
4745	Nancymarie	2458109,439	98,2063733	15,6679137	16,88	1,53E-01
4745	Nancymarie	2458109,437	98,2065841	15,6679521	16,75	1,66E-01
4745	Nancymarie	2458109,436	98,2069089	15,6679905	16,86	1,50E-01
4745	Nancymarie	2458109,432	98,2074792	15,6679418	16,63	1,64E-01
4745	Nancymarie	2458109,429	98,2083515	15,6681179	16,91	1,82E-01
4745	Nancymarie	2458109,428	98,2088416	15,6682228	16,98	1,49E-01
4745	Nancymarie	2458109,426	98,209077	15,6682114	16,97	1,49E-01
4745	Nancymarie	2458109,424	98,2096278	15,6682996	16,68	1,40E-01
4745	Nancymarie	2458109,423	98,2098709	15,6684301	16,11	1,15E-01
4745	Nancymarie	2458109,421	98,2103952	15,6684102	16,81	1,44E-01
4745	Nancymarie	2458109,42	98,2106134	15,6684223	16,74	1,56E-01
4745	Nancymarie	2458109,418	98,2111319	15,6684743	16,69	1,38E-01
4745	Nancymarie	2458109,416	98,2113179	15,6686258	16,74	1,63E-01
4745	Nancymarie	2458109,415	98,2116078	15,6685017	16,57	1,45E-01
4745	Nancymarie	2458109,413	98,21209	15,6684421	16,70	1,54E-01
4745	Nancymarie	2458109,41	98,2126214	15,6686264	16,68	1,67E-01
4745	Nancymarie	2458109,409	98,2130805	15,6686569	16,72	1,31E-01
4745	Nancymarie	2458109,407	98,2135235	15,6688917	16,53	1,40E-01
4745	Nancymarie	2458109,404	98,2141511	15,6688229	16,38	1,21E-01
4745	Nancymarie	2458109,402	98,2144907	15,6687157	16,72	1,54E-01
4745	Nancymarie	2458109,401	98,2149667	15,6688924	16,65	1,37E-01
4745	Nancymarie	2458109,399	98,2151974	15,6689109	16,35	1,36E-01
4745	Nancymarie	2458109,397	98,215668	15,6689001	16,70	1,55E-01
4745	Nancymarie	2458109,396	98,2159068	15,6689271	16,66	1,56E-01
4745	Nancymarie	2458109,394	98,2162838	15,6692333	16,43	1,48E-01
4745	Nancymarie	2458109,393	98,2167225	15,6691611	16,68	1,57E-01
4745	Nancymarie	2458109,391	98,2170719	15,6691454	16,42	1,52E-01
4745	Nancymarie	2458109,388	98,217648	15,6691508	16,41	1,49E-01
372	Palma	2458101,521	105,9560741	55,4448552	10,63	1,93E-03
372	Palma	2458101,519	105,9566389	55,4448973	10,58	2,01E-03
372	Palma	2458101,518	105,957184	55,4449243	10,62	1,63E-03
372	Palma	2458101,514	105,9582169	55,4448916	10,62	1,53E-03
372	Palma	2458101,513	105,9587502	55,444973	10,63	1,33E-03
372	Palma	2458101,511	105,9593008	55,4449718	10,61	1,13E-03
372	Palma	2458101,51	105,9597927	55,4449756	10,62	1,03E-03
372	Palma	2458101,508	105,9602949	55,444957	10,64	1,22E-03
372	Palma	2458101,506	105,9608658	55,4449959	10,62	1,22E-03
372	Palma	2458101,505	105,9614178	55,4450258	10,62	1,23E-03
372	Palma	2458101,503	105,9619497	55,4450352	10,63	1,22E-03
372	Palma	2458101,502	105,9624378	55,445015	10,62	1,12E-03
372	Palma	2458101,5	105,9629915	55,4450486	10,62	1,33E-03
372	Palma	2458101,499	105,9635414	55,4450793	10,60	1,23E-03
372	Palma	2458101,497	105,9640736	55,4450671	10,61	1,43E-03
372	Palma	2458101,495	105,9645346	55,4450761	10,65	1,71E-03
372	Palma	2458101,494	105,9651575	55,4451025	10,62	1,23E-03
372	Palma	2458101,492	105,9656495	55,4451189	10,62	1,23E-03
372	Palma	2458101,491	105,9660988	55,445087	10,62	1,44E-03
372	Palma	2458101,489	105,9667079	55,4451532	10,64	1,60E-03
372	Palma	2458101,488	105,9671909	55,4451634	10,64	1,62E-03
372	Palma	2458101,486	105,9677461	55,4451678	10,62	1,74E-03
372	Palma	2458101,484	105,9682411	55,4451586	10,64	1,82E-03
372	Palma	2458101,483	105,9688144	55,4451812	10,63	1,93E-03
372	Palma	2458101,481	105,96932	55,4452105	10,63	1,82E-03
372	Palma	2458101,48	105,9698109	55,4451842	10,62	1,72E-03
372	Palma	2458101,478	105,9702732	55,4451796	10,65	1,90E-03
372	Palma	2458101,477	105,9709168	55,4452455	10,62	1,72E-03
372	Palma	2458101,475	105,9714192	55,4452158	10,66	1,80E-03
372	Palma	2458101,473	105,9718805	55,4452191	10,62	1,52E-03
372	Palma	2458101,472	105,9724789	55,4452822	10,61	1,43E-03
372	Palma	2458101,47	105,9729668	55,4452323	10,61	1,43E-03
372	Palma	2458101,469	105,9735425	55,4453121	10,61	1,43E-03
372	Palma	2458101,467	105,9740909	55,4453092	10,62	1,43E-03
372	Palma	2458101,465	105,9745828	55,4452951	10,61	1,23E-03
372	Palma	2458101,464	105,9751033	55,4453112	10,62	1,13E-03
372	Palma	2458101,462	105,9756043	55,4453123	10,62	1,13E-03
372	Palma	2458101,461	105,9761402	55,4453361	10,62	1,03E-03
372	Palma	2458101,459	105,9766608	55,4453555	10,61	1,03E-03
372	Palma	2458101,458	105,9772972	55,445358	10,61	1,03E-03
372	Palma	2458101,456	105,97777	55,4453939	10,62	1,03E-03
372	Palma	2458101,454	105,9782492	55,4453539	10,62	1,02E-03
372	Palma	2458101,453	105,9787627	55,4453684	10,61	1,02E-03

372	Palma	2458101,451	105,9791869	55,4453758	10,62	1,03E-03
372	Palma	2458101,45	105,9797997	55,4454043	10,61	1,03E-03
372	Palma	2458101,448	105,9803272	55,4454158	10,62	1,03E-03
372	Palma	2458101,447	105,9809199	55,4454208	10,61	1,02E-03
372	Palma	2458101,445	105,9813761	55,4454456	10,61	9,25E-04
372	Palma	2458101,443	105,981826	55,4454096	10,60	9,27E-04
372	Palma	2458101,442	105,9824454	55,4454598	10,60	9,27E-04
372	Palma	2458101,44	105,9829292	55,4454514	10,60	9,28E-04
372	Palma	2458101,439	105,9834441	55,4454426	10,60	9,28E-04
372	Palma	2458101,437	105,9840297	55,445496	10,60	9,28E-04
372	Palma	2458101,435	105,9844952	55,4454613	10,60	9,26E-04
372	Palma	2458101,434	105,9850979	55,445519	10,59	9,28E-04
372	Palma	2458101,432	105,9856043	55,4455155	10,60	9,26E-04
372	Palma	2458101,431	105,9861405	55,4455385	10,58	9,29E-04
372	Palma	2458101,429	105,9866306	55,4455131	10,60	1,03E-03
372	Palma	2458101,428	105,9871034	55,4455658	10,59	9,29E-04
372	Palma	2458101,426	105,9875966	55,4455329	10,58	9,27E-04
372	Palma	2458101,424	105,9882393	55,445572	10,58	9,27E-04
372	Palma	2458101,423	105,9887109	55,4455441	10,60	1,03E-03
372	Palma	2458101,421	105,9892818	55,4455795	10,58	1,03E-03
372	Palma	2458101,42	105,9897881	55,4455979	10,58	1,03E-03
372	Palma	2458101,418	105,9901854	55,4455471	10,58	9,28E-04
372	Palma	2458101,416	105,9908395	55,4455844	10,59	1,03E-03
372	Palma	2458101,415	105,9913209	55,4456114	10,58	9,29E-04
372	Palma	2458101,413	105,991812	55,4455965	10,59	9,28E-04
372	Palma	2458101,412	105,9923691	55,4456513	10,58	9,27E-04
372	Palma	2458101,41	105,9928283	55,4456096	10,59	1,03E-03
372	Palma	2458101,409	105,9934662	55,4456675	10,60	1,03E-03
372	Palma	2458101,407	105,9939822	55,4456306	10,59	1,03E-03
372	Palma	2458101,405	105,9944542	55,4456652	10,61	1,03E-03
372	Palma	2458101,404	105,994992	55,4456706	10,58	1,03E-03
372	Palma	2458101,402	105,9954703	55,4456645	10,59	1,03E-03
372	Palma	2458101,401	105,9960114	55,4456607	10,58	1,03E-03
372	Palma	2458101,399	105,9964364	55,4456762	10,58	1,03E-03
372	Palma	2458101,398	105,9970293	55,4456579	10,60	1,03E-03
372	Palma	2458101,396	105,9975386	55,445709	10,59	1,02E-03
372	Palma	2458101,394	105,998088	55,445707	10,58	1,03E-03
372	Palma	2458101,393	105,9986098	55,4457002	10,58	1,03E-03
372	Palma	2458101,391	105,9991051	55,4457103	10,60	1,03E-03
372	Palma	2458101,39	105,9995565	55,4457579	10,58	1,03E-03
372	Palma	2458101,388	106,0001649	55,4457299	10,58	1,03E-03
372	Palma	2458101,386	106,0006369	55,445726	10,60	1,02E-03
372	Palma	2458101,385	106,001244	55,4457491	10,59	1,03E-03
372	Palma	2458101,383	106,0017029	55,4457293	10,58	1,03E-03
372	Palma	2458101,382	106,002137	55,4457428	10,59	1,03E-03
372	Palma	2458101,38	106,0027056	55,4457941	10,58	1,03E-03
372	Palma	2458101,379	106,0031196	55,4457484	10,58	1,03E-03
372	Palma	2458101,377	106,003753	55,4457534	10,57	1,03E-03
372	Palma	2458101,375	106,0041725	55,4457882	10,58	1,03E-03
372	Palma	2458101,374	106,0049085	55,4457895	10,59	1,13E-03
372	Palma	2458101,372	106,0052201	55,4458141	10,57	1,03E-03
372	Palma	2458101,371	106,0058558	55,4457855	10,59	1,03E-03
372	Palma	2458101,369	106,0062892	55,4458211	10,59	1,03E-03
372	Palma	2458101,367	106,006777	55,4458118	10,58	1,03E-03
372	Palma	2458101,366	106,0073905	55,4458025	10,58	1,03E-03
372	Palma	2458101,364	106,0078294	55,4458319	10,59	1,03E-03
372	Palma	2458101,363	106,0083248	55,4458547	10,58	1,03E-03
372	Palma	2458101,361	106,008901	55,4458481	10,58	1,03E-03
372	Palma	2458101,36	106,0095015	55,4458642	10,58	1,03E-03
372	Palma	2458101,358	106,0098884	55,4458293	10,57	1,03E-03
372	Palma	2458101,356	106,0103303	55,4458298	10,59	1,02E-03
372	Palma	2458101,355	106,0108716	55,4458545	10,57	1,03E-03
372	Palma	2458101,353	106,0113308	55,4458787	10,57	1,13E-03
372	Palma	2458101,352	106,0119671	55,4458907	10,57	1,03E-03
372	Palma	2458101,35	106,0124688	55,4458684	10,57	1,03E-03
372	Palma	2458101,349	106,012915	55,4458384	10,57	1,13E-03
372	Palma	2458101,347	106,0135	55,4458753	10,57	1,13E-03
372	Palma	2458101,345	106,0141134	55,4458883	10,58	1,12E-03
372	Palma	2458101,344	106,0144107	55,4458739	10,58	1,12E-03
372	Palma	2458101,342	106,0151613	55,4459022	10,59	1,13E-03
372	Palma	2458101,341	106,0154828	55,4459138	10,58	1,13E-03
372	Palma	2458101,339	106,0159861	55,4459253	10,56	1,13E-03
372	Palma	2458101,337	106,0164436	55,4459269	10,60	1,31E-03
372	Palma	2458101,336	106,0169721	55,4458897	10,60	1,22E-03
372	Palma	2458101,334	106,0175636	55,445913	10,59	1,12E-03
372	Palma	2458101,333	106,0180681	55,4459662	10,58	1,13E-03
372	Palma	2458101,331	106,0185225	55,445909	10,60	1,22E-03

372	Palma	2458101,33	106,0192052	55,4459121	10,61	1,21E-03
372	Palma	2458101,328	106,0195268	55,4459424	10,61	1,32E-03
372	Palma	2458101,326	106,0199547	55,4459518	10,59	1,32E-03
372	Palma	2458101,323	106,0210938	55,4459684	10,59	1,32E-03
372	Palma	2458101,322	106,021666	55,4459655	10,62	1,31E-03
372	Palma	2458101,32	106,0220617	55,4459714	10,63	1,31E-03
372	Palma	2458101,318	106,0227572	55,445955	10,62	1,32E-03
372	Palma	2458101,317	106,0230123	55,4460434	10,63	1,41E-03
372	Palma	2458101,314	106,023889	55,446022	10,65	1,51E-03
372	Palma	2458101,312	106,0245132	55,4460453	10,62	1,62E-03
372	Palma	2458101,311	106,0250911	55,4459593	10,63	1,41E-03
372	Palma	2458101,309	106,0254256	55,4460987	10,61	1,32E-03
372	Palma	2458101,307	106,0261042	55,4460793	10,65	1,41E-03
372	Palma	2458101,306	106,0268421	55,4459733	10,62	1,42E-03
372	Palma	2458101,304	106,0268408	55,446146	10,61	1,83E-03
372	Palma	2458105,559	104,588886	55,3488119	10,56	1,03E-03
372	Palma	2458105,557	104,589605	55,3488909	10,58	1,03E-03
372	Palma	2458105,556	104,5901367	55,3488998	10,58	1,03E-03
372	Palma	2458105,554	104,5906949	55,3490043	10,59	1,03E-03
372	Palma	2458105,552	104,5913312	55,3490932	10,56	1,03E-03
372	Palma	2458105,551	104,5919182	55,3491115	10,59	1,02E-03
372	Palma	2458105,549	104,5924405	55,3491236	10,59	1,03E-03
372	Palma	2458105,548	104,5929874	55,3492261	10,59	1,03E-03
372	Palma	2458105,546	104,5935171	55,3492197	10,58	1,13E-03
372	Palma	2458105,544	104,5940784	55,3493309	10,59	1,03E-03
372	Palma	2458105,543	104,5948025	55,3493938	10,60	1,03E-03
372	Palma	2458105,541	104,5953011	55,3494654	10,61	1,13E-03
372	Palma	2458105,54	104,5959782	55,3494902	10,59	1,02E-03
372	Palma	2458105,538	104,5964683	55,3495693	10,61	1,12E-03
372	Palma	2458105,537	104,5970986	55,3496115	10,62	1,12E-03
372	Palma	2458105,535	104,597587	55,3496632	10,62	1,12E-03
372	Palma	2458105,533	104,5982916	55,3497272	10,62	1,12E-03
372	Palma	2458105,532	104,5987312	55,3498153	10,62	1,13E-03
372	Palma	2458105,53	104,5994257	55,3498278	10,61	1,03E-03
372	Palma	2458105,529	104,6000359	55,3498477	10,63	1,02E-03
372	Palma	2458105,527	104,6006432	55,3498642	10,63	1,03E-03
372	Palma	2458105,525	104,6011125	55,3499791	10,63	1,03E-03
372	Palma	2458105,524	104,6016812	55,3499695	10,63	1,02E-03
372	Palma	2458105,522	104,6022717	55,3501208	10,65	1,02E-03
372	Palma	2458105,521	104,6029198	55,3501567	10,64	1,02E-03
372	Palma	2458105,519	104,6034119	55,3502387	10,65	1,02E-03
372	Palma	2458105,518	104,6039968	55,350297	10,64	1,02E-03
372	Palma	2458105,516	104,6046369	55,3503148	10,64	1,02E-03
372	Palma	2458105,514	104,6052449	55,3503142	10,65	1,02E-03
372	Palma	2458105,513	104,6057857	55,3504291	10,66	1,02E-03
372	Palma	2458105,511	104,6063399	55,350554	10,64	1,03E-03
372	Palma	2458105,51	104,6069996	55,3505279	10,65	1,02E-03
372	Palma	2458105,508	104,60748	55,3506135	10,65	1,02E-03
372	Palma	2458105,507	104,6079971	55,3506916	10,65	9,24E-04
372	Palma	2458105,505	104,6086407	55,3506494	10,65	1,03E-03
372	Palma	2458105,503	104,6092449	55,3507949	10,64	1,02E-03
372	Palma	2458105,502	104,6098289	55,3508261	10,65	1,02E-03
372	Palma	2458105,5	104,6104198	55,3509081	10,64	1,03E-03
372	Palma	2458105,499	104,6110326	55,3509555	10,66	9,22E-04
372	Palma	2458105,497	104,6115764	55,3509934	10,65	1,02E-03
372	Palma	2458105,495	104,6121359	55,3510604	10,63	9,23E-04
372	Palma	2458105,494	104,6127035	55,3510989	10,62	9,22E-04
372	Palma	2458105,492	104,6132795	55,3511855	10,63	9,25E-04
372	Palma	2458105,491	104,6138582	55,351214	10,64	9,22E-04
372	Palma	2458105,489	104,6144462	55,3512092	10,63	9,23E-04
372	Palma	2458105,488	104,615042	55,3513285	10,64	9,24E-04
372	Palma	2458105,486	104,6156035	55,3512923	10,64	9,22E-04
372	Palma	2458105,484	104,61625	55,3514128	10,62	9,22E-04
372	Palma	2458105,483	104,6167736	55,3514539	10,62	9,22E-04
372	Palma	2458105,481	104,6173521	55,3514957	10,63	9,23E-04
372	Palma	2458105,48	104,6179061	55,3515866	10,63	9,25E-04
372	Palma	2458105,478	104,6185586	55,3516111	10,62	9,23E-04
372	Palma	2458105,476	104,6191043	55,3516729	10,63	9,24E-04
372	Palma	2458105,475	104,6196645	55,3517198	10,62	9,21E-04
372	Palma	2458105,473	104,6202558	55,351767	10,62	9,22E-04
372	Palma	2458105,472	104,6208317	55,3518201	10,62	9,23E-04
372	Palma	2458105,47	104,6213613	55,3519586	10,62	9,23E-04
372	Palma	2458105,469	104,6219445	55,3519178	10,60	9,25E-04
372	Palma	2458105,467	104,6225178	55,3520255	10,62	9,24E-04
372	Palma	2458105,465	104,6231041	55,3520308	10,62	9,22E-04
372	Palma	2458105,464	104,6237316	55,3521414	10,61	9,23E-04
372	Palma	2458105,462	104,6242097	55,3521221	10,61	9,25E-04

372	Palma	2458105,461	104,6249192	55,3521723	10,59	9,23E-04
372	Palma	2458105,459	104,6254643	55,3523003	10,61	9,25E-04
372	Palma	2458105,458	104,6260493	55,352279	10,59	9,23E-04
372	Palma	2458105,454	104,6272048	55,3524516	10,62	9,22E-04
372	Palma	2458105,453	104,6277047	55,3524462	10,60	9,24E-04
372	Palma	2458105,451	104,6283881	55,3525216	10,60	9,25E-04
372	Palma	2458105,45	104,6289127	55,3525576	10,61	9,24E-04
372	Palma	2458105,448	104,6294671	55,352633	10,58	9,25E-04
372	Palma	2458105,446	104,630003	55,3526531	10,60	9,25E-04
372	Palma	2458105,445	104,6306025	55,3526824	10,57	9,23E-04
372	Palma	2458105,443	104,6311583	55,3527833	10,59	9,23E-04
372	Palma	2458105,442	104,6317064	55,3527528	10,58	9,24E-04
372	Palma	2458105,44	104,632258	55,3528726	10,56	9,25E-04
372	Palma	2458105,439	104,6329553	55,352874	10,60	9,23E-04
372	Palma	2458105,437	104,6334824	55,3529775	10,58	9,24E-04
372	Palma	2458105,435	104,634051	55,3530261	10,59	9,25E-04
372	Palma	2458105,434	104,6346289	55,3531009	10,58	9,25E-04
372	Palma	2458105,432	104,6352731	55,3531125	10,59	9,24E-04
372	Palma	2458105,429	104,6363612	55,3531494	10,57	9,24E-04
372	Palma	2458105,427	104,6369646	55,3532843	10,58	9,25E-04
372	Palma	2458105,426	104,6374791	55,3532545	10,60	9,23E-04
372	Palma	2458105,424	104,6381833	55,3533784	10,59	9,23E-04
372	Palma	2458105,423	104,6385996	55,353375	10,59	9,24E-04
372	Palma	2458105,421	104,6393166	55,3534811	10,59	9,26E-04
372	Palma	2458105,42	104,6398726	55,3535009	10,60	9,27E-04
372	Palma	2458105,416	104,6408843	55,3535462	10,58	9,28E-04
372	Palma	2458105,415	104,6414687	55,3536286	10,61	9,24E-04
372	Palma	2458105,413	104,6420918	55,3536964	10,60	9,24E-04
372	Palma	2458105,41	104,6432754	55,3538054	10,59	9,24E-04
372	Palma	2458105,408	104,6439041	55,3537684	10,62	9,25E-04
372	Palma	2458105,407	104,6443485	55,3538777	10,58	9,26E-04
372	Palma	2458105,405	104,6449213	55,3539307	10,60	9,25E-04
372	Palma	2458105,404	104,6454313	55,3540041	10,61	9,26E-04
372	Palma	2458105,402	104,6461467	55,3540136	10,59	1,03E-03
372	Palma	2458105,399	104,6471871	55,3541999	10,59	9,26E-04
372	Palma	2458105,397	104,6477446	55,3541238	10,59	9,26E-04
372	Palma	2458105,396	104,6483009	55,3542757	10,59	9,28E-04
372	Palma	2458105,394	104,6489189	55,3542469	10,58	9,27E-04
372	Palma	2458105,393	104,6495314	55,3542764	10,60	1,03E-03
372	Palma	2458105,391	104,6501107	55,3543314	10,59	1,03E-03
372	Palma	2458105,39	104,6506204	55,3544633	10,59	9,26E-04
372	Palma	2458105,388	104,6511506	55,3544488	10,59	1,02E-03
372	Palma	2458105,386	104,6518501	55,3544281	10,60	1,03E-03
372	Palma	2458105,385	104,6523906	55,3545437	10,58	1,03E-03
372	Palma	2458105,383	104,6528627	55,3545349	10,58	1,03E-03
372	Palma	2458105,382	104,6535694	55,3546301	10,60	1,02E-03
372	Palma	2458105,38	104,654101	55,3546925	10,58	1,03E-03
372	Palma	2458105,378	104,654486	55,3546675	10,57	1,03E-03
372	Palma	2458105,375	104,6556548	55,354846	10,57	1,03E-03
372	Palma	2458105,374	104,6562201	55,3548016	10,58	1,03E-03
372	Palma	2458105,372	104,6568799	55,3549072	10,58	1,03E-03
372	Palma	2458105,371	104,6574433	55,3549431	10,57	1,03E-03
372	Palma	2458105,369	104,6579785	55,3549752	10,58	1,03E-03
372	Palma	2458105,367	104,6585142	55,3550565	10,57	1,03E-03
372	Palma	2458105,366	104,6591871	55,3550954	10,58	1,03E-03
372	Palma	2458105,364	104,6597175	55,3551749	10,56	1,03E-03
372	Palma	2458105,363	104,6602775	55,3551713	10,56	1,03E-03
372	Palma	2458105,361	104,6608926	55,355206	10,57	1,03E-03
372	Palma	2458105,36	104,6613944	55,355233	10,56	1,03E-03
372	Palma	2458105,358	104,662063	55,3553505	10,58	1,03E-03
372	Palma	2458105,356	104,6625278	55,3554185	10,57	1,03E-03
372	Palma	2458105,355	104,6630603	55,3554144	10,55	1,03E-03
372	Palma	2458105,353	104,6636382	55,3554417	10,54	1,03E-03
372	Palma	2458105,352	104,6641938	55,3554936	10,56	1,03E-03
372	Palma	2458105,35	104,6646953	55,3555534	10,54	1,13E-03
372	Palma	2458105,348	104,6653333	55,3555582	10,54	1,03E-03
372	Palma	2458105,347	104,6658524	55,355645	10,54	1,13E-03
372	Palma	2458105,345	104,6663634	55,3556682	10,54	1,03E-03
372	Palma	2458105,344	104,6669327	55,3557048	10,54	1,13E-03
372	Palma	2458105,342	104,6675226	55,3557411	10,55	1,23E-03
372	Palma	2458105,341	104,6681223	55,3558193	10,57	1,03E-03
372	Palma	2458105,339	104,6686809	55,3558157	10,53	1,13E-03
372	Palma	2458105,337	104,6691247	55,3559612	10,55	1,13E-03
372	Palma	2458105,336	104,6697652	55,3559362	10,53	1,13E-03
372	Palma	2458105,334	104,6703259	55,355927	10,54	1,03E-03
372	Palma	2458105,333	104,6708821	55,3560407	10,54	1,03E-03
372	Palma	2458105,33	104,6719214	55,3561412	10,54	1,13E-03

372	Palma	2458105,328	104,6726005	55,3561761	10,55	1,13E-03
372	Palma	2458105,326	104,6732265	55,3562429	10,56	1,13E-03
372	Palma	2458105,325	104,6737433	55,3562617	10,55	1,13E-03
372	Palma	2458105,323	104,6741887	55,356238	10,54	1,13E-03
372	Palma	2458105,322	104,6747261	55,3563418	10,54	1,13E-03
372	Palma	2458105,32	104,6753383	55,3563672	10,55	1,23E-03
372	Palma	2458105,318	104,6758867	55,356427	10,54	1,13E-03
372	Palma	2458105,317	104,6766046	55,3564787	10,55	1,23E-03
372	Palma	2458105,315	104,6770071	55,356585	10,53	1,13E-03
372	Palma	2458105,314	104,6776304	55,3565871	10,52	1,24E-03
372	Palma	2458105,312	104,6781845	55,3566056	10,55	1,13E-03
372	Palma	2458105,311	104,6786398	55,3566695	10,52	1,13E-03
372	Palma	2458105,309	104,6791875	55,356721	10,54	1,13E-03
372	Palma	2458105,307	104,6797895	55,3568074	10,55	1,13E-03
372	Palma	2458105,306	104,6804298	55,3568504	10,54	1,13E-03
372	Palma	2458105,304	104,6809808	55,3568431	10,52	1,13E-03
372	Palma	2458105,303	104,6815073	55,356857	10,54	1,24E-03
372	Palma	2458105,301	104,6819014	55,3569049	10,54	1,13E-03
372	Palma	2458105,3	104,6826293	55,3569556	10,56	1,13E-03
372	Palma	2458105,298	104,6832119	55,3570575	10,54	1,24E-03
372	Palma	2458105,296	104,683773	55,3570709	10,53	1,14E-03
372	Palma	2458108,456	103,543006	55,2140414	10,55	9,23E-04
372	Palma	2458108,454	103,5436009	55,2141403	10,59	1,02E-03
372	Palma	2458108,452	103,544227	55,2141977	10,56	9,22E-04
372	Palma	2458108,451	103,5448286	55,2143155	10,56	8,23E-04
372	Palma	2458108,448	103,5460732	55,2144497	10,57	9,24E-04
372	Palma	2458108,444	103,5472025	55,2146162	10,56	8,20E-04
372	Palma	2458108,399	103,5646648	55,2169647	10,59	9,24E-04
372	Palma	2458108,394	103,5664781	55,2171918	10,61	9,24E-04
372	Palma	2458108,392	103,5670558	55,2173088	10,62	9,22E-04
372	Palma	2458108,391	103,5675796	55,2173407	10,60	9,24E-04
372	Palma	2458108,389	103,5681712	55,2174913	10,61	9,25E-04
372	Palma	2458108,388	103,5687431	55,2174765	10,60	9,23E-04
372	Palma	2458108,384	103,5699563	55,2177036	10,59	1,03E-03
372	Palma	2458108,383	103,5705524	55,2177569	10,63	1,03E-03
372	Palma	2458108,38	103,5717652	55,2178974	10,63	1,02E-03
372	Palma	2458108,378	103,5723537	55,217971	10,64	1,02E-03
372	Palma	2458108,376	103,5730034	55,2180887	10,62	9,24E-04
372	Palma	2458108,375	103,5735928	55,2181278	10,61	9,26E-04
372	Palma	2458108,372	103,5747434	55,2183203	10,63	1,02E-03
372	Palma	2458108,37	103,5753256	55,2183526	10,63	9,23E-04
372	Palma	2458108,369	103,5759342	55,2185036	10,65	9,23E-04
372	Palma	2458108,367	103,5765252	55,2184962	10,64	9,22E-04
372	Palma	2458108,364	103,5776909	55,2187462	10,62	1,03E-03
372	Palma	2458108,362	103,5783764	55,2187477	10,62	9,23E-04
372	Palma	2458108,361	103,5788895	55,218866	10,64	1,02E-03
372	Palma	2458108,359	103,5795247	55,2189337	10,65	1,02E-03
372	Palma	2458108,357	103,5800785	55,2189526	10,61	1,02E-03
372	Palma	2458108,356	103,5807221	55,2191093	10,67	1,02E-03
372	Palma	2458108,354	103,5813185	55,2192332	10,60	9,25E-04
372	Palma	2458108,353	103,5818406	55,2192428	10,61	9,23E-04
372	Palma	2458108,351	103,5824447	55,2192886	10,63	1,02E-03
372	Palma	2458108,35	103,5830209	55,2193854	10,61	1,02E-03
372	Palma	2458108,348	103,5836655	55,2194738	10,62	1,02E-03
372	Palma	2458108,346	103,5841331	55,2195182	10,58	1,02E-03
372	Palma	2458108,345	103,5848242	55,2196533	10,61	1,02E-03
372	Palma	2458108,343	103,5854117	55,2196735	10,62	1,02E-03
372	Palma	2458108,342	103,5859258	55,2197676	10,59	1,02E-03
372	Palma	2458108,34	103,586568	55,2198479	10,57	1,03E-03
372	Palma	2458108,338	103,5871239	55,2198566	10,60	1,02E-03
372	Palma	2458108,337	103,5877367	55,2199823	10,60	1,03E-03
372	Palma	2458108,335	103,5883353	55,2200486	10,59	1,03E-03
372	Palma	2458108,334	103,5889433	55,2201969	10,58	1,03E-03
372	Palma	2458108,332	103,5894214	55,2202287	10,55	1,03E-03
372	Palma	2458108,329	103,5907961	55,2204485	10,59	1,03E-03
372	Palma	2458108,327	103,5913056	55,2204705	10,55	1,03E-03
372	Palma	2458108,326	103,5918974	55,2205508	10,57	1,13E-03
372	Palma	2458108,324	103,5924634	55,22067	10,54	1,13E-03
372	Palma	2458108,323	103,5930134	55,2206105	10,56	1,12E-03
372	Palma	2458108,321	103,5935957	55,2207733	10,56	1,13E-03
372	Palma	2458108,319	103,5942124	55,2208569	10,55	1,13E-03
372	Palma	2458108,318	103,5946994	55,22094	10,55	1,23E-03
372	Palma	2458108,316	103,5953584	55,2210081	10,56	1,22E-03
372	Palma	2458108,315	103,5959601	55,2210589	10,54	1,22E-03
372	Palma	2458108,313	103,5964992	55,2211612	10,55	1,22E-03
372	Palma	2458108,312	103,5972008	55,2212591	10,53	1,12E-03
308	Polyxo	2458101,761	132,195621	12,2377408	12,64	5,15E-03

308	Polyxo	2458101,76	132,1956633	12,2377514	12,63	4,73E-03
308	Polyxo	2458101,759	132,1957011	12,23776	12,62	4,29E-03
308	Polyxo	2458101,758	132,1957537	12,2377915	12,60	4,19E-03
308	Polyxo	2458101,758	132,1957947	12,2377799	12,61	3,77E-03
308	Polyxo	2458101,757	132,1958287	12,2377975	12,61	3,46E-03
308	Polyxo	2458101,756	132,1958731	12,237794	12,60	3,45E-03
308	Polyxo	2458101,756	132,1959103	12,2377799	12,60	3,37E-03
308	Polyxo	2458101,755	132,195959	12,2378117	12,60	3,14E-03
308	Polyxo	2458101,754	132,1959955	12,2378191	12,60	2,95E-03
308	Polyxo	2458101,754	132,1960379	12,2378192	12,59	2,95E-03
308	Polyxo	2458101,753	132,1960906	12,237833	12,58	3,14E-03
308	Polyxo	2458101,752	132,1961245	12,237817	12,59	2,94E-03
308	Polyxo	2458101,752	132,1961757	12,2378412	12,58	2,95E-03
308	Polyxo	2458101,751	132,1962235	12,2378392	12,59	2,75E-03
308	Polyxo	2458101,75	132,1962576	12,2378436	12,58	2,65E-03
308	Polyxo	2458101,75	132,1963114	12,2378554	12,59	2,74E-03
308	Polyxo	2458101,749	132,1963617	12,2378604	12,59	2,64E-03
308	Polyxo	2458101,748	132,1963898	12,2378455	12,59	2,63E-03
308	Polyxo	2458101,747	132,1964331	12,2378612	12,59	2,43E-03
308	Polyxo	2458101,747	132,1964694	12,2378535	12,58	2,53E-03
308	Polyxo	2458101,746	132,1965173	12,2378652	12,59	2,54E-03
308	Polyxo	2458101,745	132,1965591	12,2378741	12,59	2,34E-03
308	Polyxo	2458101,745	132,1965897	12,2378548	12,60	2,33E-03
308	Polyxo	2458101,744	132,196636	12,2378582	12,59	2,44E-03
308	Polyxo	2458101,743	132,1966825	12,2378761	12,59	2,44E-03
308	Polyxo	2458101,743	132,1967074	12,237857	12,59	2,44E-03
308	Polyxo	2458101,742	132,1967529	12,2378726	12,58	2,43E-03
308	Polyxo	2458101,741	132,1967871	12,2378779	12,58	2,44E-03
308	Polyxo	2458101,741	132,1968262	12,2378697	12,58	2,44E-03
308	Polyxo	2458101,74	132,1968745	12,2378844	12,58	2,54E-03
308	Polyxo	2458101,739	132,1969129	12,2378769	12,59	2,54E-03
308	Polyxo	2458101,739	132,1969536	12,2378857	12,59	2,43E-03
308	Polyxo	2458101,738	132,1969833	12,2378866	12,58	2,64E-03
308	Polyxo	2458101,737	132,1970428	12,2378848	12,58	2,63E-03
308	Polyxo	2458101,737	132,1970791	12,2378892	12,58	2,64E-03
308	Polyxo	2458101,736	132,1971207	12,2378912	12,56	2,84E-03
308	Polyxo	2458101,735	132,1971626	12,237885	12,57	2,74E-03
308	Polyxo	2458101,735	132,1972003	12,2378875	12,57	2,63E-03
308	Polyxo	2458101,734	132,1972409	12,2379101	12,59	2,64E-03
308	Polyxo	2458101,733	132,197288	12,237909	12,58	2,64E-03
308	Polyxo	2458101,733	132,1973231	12,237903	12,58	2,73E-03
308	Polyxo	2458101,732	132,1973761	12,2379068	12,58	2,53E-03
308	Polyxo	2458101,731	132,1974148	12,237897	12,58	2,34E-03
308	Polyxo	2458101,73	132,197448	12,2379087	12,58	2,23E-03
308	Polyxo	2458101,73	132,1974971	12,2379261	12,58	2,22E-03
308	Polyxo	2458101,729	132,1975475	12,2379156	12,58	2,13E-03
308	Polyxo	2458101,728	132,1975894	12,2379366	12,58	2,12E-03
308	Polyxo	2458101,728	132,1976139	12,237916	12,58	2,13E-03
308	Polyxo	2458101,727	132,1976649	12,2379367	12,58	2,13E-03
308	Polyxo	2458101,726	132,1977022	12,2379276	12,57	2,13E-03
308	Polyxo	2458101,726	132,1977593	12,2379257	12,57	2,23E-03
308	Polyxo	2458101,725	132,1977867	12,2379244	12,57	2,03E-03
308	Polyxo	2458101,724	132,19782	12,2379245	12,57	2,13E-03
308	Polyxo	2458101,724	132,1978601	12,2379363	12,58	2,03E-03
308	Polyxo	2458101,723	132,1978984	12,2379241	12,59	2,03E-03
308	Polyxo	2458101,722	132,1979334	12,2379179	12,58	2,14E-03
308	Polyxo	2458101,722	132,1979844	12,237942	12,58	2,03E-03
308	Polyxo	2458101,721	132,1980228	12,2379594	12,58	2,03E-03
308	Polyxo	2458101,72	132,1980681	12,2379426	12,58	2,03E-03
308	Polyxo	2458101,72	132,198097	12,2379447	12,58	2,04E-03
308	Polyxo	2458101,719	132,1981551	12,2379392	12,58	2,03E-03
308	Polyxo	2458101,718	132,1981698	12,2379291	12,59	2,14E-03
308	Polyxo	2458101,718	132,1982226	12,2379497	12,59	2,13E-03
308	Polyxo	2458101,717	132,1982689	12,2379533	12,59	2,14E-03
308	Polyxo	2458101,716	132,1983084	12,2379602	12,58	2,13E-03
308	Polyxo	2458101,716	132,1983431	12,2379425	12,60	2,03E-03
308	Polyxo	2458101,715	132,1984066	12,2379633	12,58	2,13E-03
308	Polyxo	2458101,714	132,19844	12,2379825	12,57	2,13E-03
308	Polyxo	2458101,714	132,1984726	12,2379444	12,59	2,13E-03
308	Polyxo	2458101,713	132,1985349	12,2379801	12,58	2,13E-03
308	Polyxo	2458101,712	132,1985565	12,2379647	12,58	2,23E-03
308	Polyxo	2458101,712	132,1986068	12,23797	12,57	2,23E-03
308	Polyxo	2458101,711	132,1986526	12,2379907	12,57	2,23E-03
308	Polyxo	2458101,71	132,1986817	12,237983	12,58	2,23E-03
308	Polyxo	2458101,71	132,1987229	12,2379852	12,58	2,23E-03
308	Polyxo	2458101,709	132,198773	12,2379785	12,57	2,24E-03
308	Polyxo	2458101,708	132,1988201	12,2380014	12,57	2,23E-03

308	Polyxo	2458101,707	132,198859	12,2379831	12,58	2,13E-03
308	Polyxo	2458101,707	132,1988996	12,2380146	12,58	2,22E-03
308	Polyxo	2458101,706	132,198946	12,2379917	12,57	2,13E-03
308	Polyxo	2458101,705	132,1989882	12,2379727	12,57	2,13E-03
308	Polyxo	2458101,705	132,1990319	12,2380031	12,57	2,04E-03
308	Polyxo	2458101,704	132,1990763	12,2380229	12,57	2,13E-03
308	Polyxo	2458101,703	132,1991234	12,2379919	12,58	2,04E-03
308	Polyxo	2458101,703	132,199153	12,2380234	12,58	2,03E-03
308	Polyxo	2458101,702	132,1992051	12,2380027	12,57	2,03E-03
308	Polyxo	2458101,701	132,1992271	12,2380189	12,58	2,04E-03
308	Polyxo	2458101,701	132,1992758	12,238015	12,58	2,13E-03
308	Polyxo	2458101,7	132,199316	12,2380232	12,58	2,14E-03
308	Polyxo	2458101,699	132,1993515	12,2380165	12,59	2,13E-03
308	Polyxo	2458101,699	132,1993878	12,2380123	12,57	2,04E-03
308	Polyxo	2458101,698	132,1994304	12,2380093	12,58	2,03E-03
308	Polyxo	2458101,697	132,1994549	12,2380145	12,59	2,14E-03
308	Polyxo	2458101,697	132,1995191	12,2380273	12,59	2,24E-03
308	Polyxo	2458101,696	132,1995381	12,2380222	12,60	2,14E-03
308	Polyxo	2458101,695	132,1995889	12,2380341	12,59	2,14E-03
308	Polyxo	2458101,695	132,1996214	12,2380341	12,59	2,13E-03
308	Polyxo	2458101,694	132,1996624	12,2380229	12,59	2,24E-03
308	Polyxo	2458101,693	132,1997032	12,2380287	12,59	2,14E-03
308	Polyxo	2458101,693	132,1997508	12,2380421	12,59	2,14E-03
308	Polyxo	2458101,692	132,1997954	12,2380396	12,60	2,13E-03
308	Polyxo	2458101,691	132,1998408	12,2380409	12,60	2,13E-03
308	Polyxo	2458101,691	132,1998717	12,2380344	12,59	2,14E-03
308	Polyxo	2458101,69	132,1999235	12,2380605	12,59	2,13E-03
308	Polyxo	2458101,689	132,1999535	12,2380523	12,59	2,14E-03
308	Polyxo	2458101,689	132,2000093	12,2380424	12,59	2,14E-03
308	Polyxo	2458101,688	132,200028	12,2380456	12,60	2,14E-03
308	Polyxo	2458101,687	132,200105	12,2380634	12,59	2,13E-03
308	Polyxo	2458101,687	132,2001404	12,2380557	12,58	2,24E-03
308	Polyxo	2458101,686	132,2001728	12,2380615	12,59	2,14E-03
308	Polyxo	2458101,685	132,2002215	12,2380636	12,59	2,14E-03
308	Polyxo	2458101,685	132,2002594	12,2380753	12,58	2,24E-03
308	Polyxo	2458101,684	132,2003	12,238075	12,58	2,23E-03
308	Polyxo	2458101,683	132,2003424	12,2381008	12,57	2,23E-03
308	Polyxo	2458101,683	132,2003891	12,2380726	12,58	2,14E-03
308	Polyxo	2458101,682	132,2004315	12,2380833	12,58	2,14E-03
308	Polyxo	2458101,681	132,2004689	12,2380933	12,58	2,13E-03
308	Polyxo	2458101,681	132,2005232	12,2381085	12,58	2,14E-03
308	Polyxo	2458101,68	132,2005587	12,238117	12,57	2,23E-03
308	Polyxo	2458101,679	132,2006006	12,2381134	12,58	2,24E-03
308	Polyxo	2458101,679	132,2006279	12,2381004	12,58	2,14E-03
308	Polyxo	2458101,678	132,2006821	12,2381103	12,59	2,13E-03
308	Polyxo	2458101,677	132,2007165	12,2381042	12,58	2,13E-03
308	Polyxo	2458101,677	132,2007549	12,2381223	12,59	2,14E-03
308	Polyxo	2458101,676	132,2008013	12,2381226	12,59	2,04E-03
308	Polyxo	2458101,675	132,2008243	12,2381245	12,59	2,14E-03
308	Polyxo	2458101,675	132,2008811	12,238142	12,59	2,13E-03
308	Polyxo	2458101,674	132,2009165	12,2381381	12,58	2,13E-03
308	Polyxo	2458101,673	132,2009495	12,2381409	12,59	2,14E-03
308	Polyxo	2458101,673	132,2009953	12,2381522	12,59	2,14E-03
308	Polyxo	2458101,672	132,2010294	12,2381427	12,59	2,04E-03
308	Polyxo	2458101,671	132,2010696	12,2381429	12,59	2,13E-03
308	Polyxo	2458101,671	132,201113	12,2381449	12,59	2,13E-03
308	Polyxo	2458101,67	132,201158	12,2381489	12,58	2,14E-03
308	Polyxo	2458101,669	132,2011984	12,2381584	12,59	2,14E-03
308	Polyxo	2458101,669	132,2012408	12,2381681	12,60	2,13E-03
308	Polyxo	2458101,668	132,2012742	12,2381507	12,59	2,14E-03
308	Polyxo	2458101,667	132,2013138	12,23814	12,60	2,14E-03
308	Polyxo	2458101,666	132,2013731	12,2381554	12,59	2,24E-03
308	Polyxo	2458101,666	132,2014161	12,2381518	12,58	2,24E-03
308	Polyxo	2458101,665	132,2014367	12,2381628	12,58	2,34E-03
308	Polyxo	2458101,664	132,2014904	12,2381541	12,59	2,24E-03
308	Polyxo	2458101,664	132,201524	12,2381855	12,59	2,23E-03
308	Polyxo	2458101,663	132,2015773	12,2381686	12,59	2,24E-03
308	Polyxo	2458101,662	132,201631	12,2381662	12,59	2,14E-03
308	Polyxo	2458101,662	132,2016529	12,2381744	12,59	2,24E-03
308	Polyxo	2458101,661	132,2017128	12,2381877	12,58	2,14E-03
308	Polyxo	2458101,66	132,2017419	12,2381694	12,59	2,23E-03
308	Polyxo	2458101,66	132,2017936	12,2382011	12,60	2,13E-03
308	Polyxo	2458101,659	132,2018235	12,2381994	12,59	2,14E-03
308	Polyxo	2458101,659	132,2018689	12,2381975	12,59	2,24E-03
308	Polyxo	2458101,658	132,2019318	12,2382163	12,60	2,14E-03
308	Polyxo	2458101,657	132,2019566	12,2382232	12,59	2,24E-03
308	Polyxo	2458101,656	132,2020015	12,2382086	12,59	2,34E-03

308	Polyxo	2458101,656	132,2020309	12,2382036	12,60	2,23E-03
308	Polyxo	2458101,655	132,2020994	12,2382418	12,60	2,33E-03
308	Polyxo	2458101,654	132,2021232	12,2382292	12,61	2,13E-03
308	Polyxo	2458101,654	132,2021607	12,2382463	12,60	2,23E-03
308	Polyxo	2458101,653	132,2022182	12,2382414	12,61	2,13E-03
308	Polyxo	2458101,646	132,2026525	12,2382656	12,61	2,14E-03
308	Polyxo	2458101,645	132,2026811	12,2382712	12,61	2,24E-03
308	Polyxo	2458101,645	132,2027456	12,2382597	12,60	2,34E-03
308	Polyxo	2458101,644	132,2027706	12,2382704	12,61	2,13E-03
308	Polyxo	2458101,643	132,2028276	12,2382868	12,62	2,15E-03
308	Polyxo	2458101,643	132,2028592	12,2382842	12,63	2,14E-03
308	Polyxo	2458101,642	132,2028959	12,2382853	12,62	2,14E-03
308	Polyxo	2458101,641	132,2029389	12,2382812	12,62	2,14E-03
308	Polyxo	2458101,64	132,2029616	12,2382544	12,60	2,24E-03
308	Polyxo	2458101,64	132,2030399	12,2382852	12,62	2,24E-03
308	Polyxo	2458101,639	132,2030424	12,2382761	12,61	2,14E-03
308	Polyxo	2458101,638	132,2031252	12,2382956	12,64	2,14E-03
308	Polyxo	2458101,638	132,2031419	12,2382533	12,61	2,14E-03
308	Polyxo	2458101,637	132,2031752	12,2382846	12,61	1,94E-03
308	Polyxo	2458101,636	132,2032308	12,2382733	12,63	2,04E-03
308	Polyxo	2458101,636	132,20327	12,238296	12,62	2,14E-03
308	Polyxo	2458101,635	132,2033167	12,2382774	12,61	2,14E-03
308	Polyxo	2458101,634	132,2033501	12,2382799	12,60	2,14E-03
308	Polyxo	2458101,634	132,2034071	12,2383049	12,64	2,04E-03
308	Polyxo	2458101,633	132,2034267	12,2382846	12,62	2,04E-03
308	Polyxo	2458101,632	132,2034855	12,2383063	12,62	2,14E-03
308	Polyxo	2458101,632	132,2035223	12,2383025	12,62	2,04E-03
308	Polyxo	2458101,631	132,2035421	12,2382842	12,61	2,24E-03
308	Polyxo	2458101,63	132,2036153	12,2383032	12,62	2,14E-03
308	Polyxo	2458101,629	132,2036546	12,2383117	12,62	2,04E-03
308	Polyxo	2458101,629	132,2037135	12,2383224	12,62	2,24E-03
308	Polyxo	2458101,628	132,2037381	12,2383187	12,61	2,14E-03
308	Polyxo	2458101,627	132,2037858	12,2383261	12,62	2,14E-03
308	Polyxo	2458101,627	132,2038294	12,2383158	12,61	2,04E-03
308	Polyxo	2458101,626	132,2038831	12,2383418	12,62	2,04E-03
308	Polyxo	2458101,625	132,2039098	12,2383235	12,62	2,14E-03
308	Polyxo	2458101,625	132,2039372	12,2383152	12,62	2,04E-03
308	Polyxo	2458101,624	132,2039769	12,2383286	12,62	2,14E-03
308	Polyxo	2458101,623	132,2040212	12,2383259	12,60	2,14E-03
308	Polyxo	2458101,623	132,2040944	12,2383473	12,62	2,14E-03
308	Polyxo	2458101,622	132,2040972	12,2383306	12,60	2,04E-03
308	Polyxo	2458101,621	132,2041268	12,2383248	12,61	2,14E-03
308	Polyxo	2458101,621	132,204199	12,2383427	12,61	2,24E-03
308	Polyxo	2458101,62	132,2042044	12,2383415	12,60	2,13E-03
308	Polyxo	2458101,619	132,2042615	12,2383364	12,61	2,03E-03
308	Polyxo	2458101,619	132,2043001	12,2383441	12,60	2,13E-03
308	Polyxo	2458101,618	132,2043478	12,2383489	12,60	2,13E-03
308	Polyxo	2458101,617	132,2043767	12,2383412	12,61	2,24E-03
308	Polyxo	2458101,617	132,2044353	12,2383612	12,60	2,13E-03
308	Polyxo	2458101,616	132,2044681	12,2383576	12,60	2,23E-03
308	Polyxo	2458101,615	132,2045086	12,238353	12,60	2,14E-03
308	Polyxo	2458101,615	132,2045624	12,2383682	12,60	2,03E-03
308	Polyxo	2458101,614	132,2045946	12,2383657	12,60	2,14E-03
308	Polyxo	2458101,613	132,2046507	12,2383838	12,61	2,03E-03
308	Polyxo	2458101,613	132,2046726	12,2383736	12,60	2,13E-03
308	Polyxo	2458101,612	132,204724	12,2383816	12,60	2,03E-03
308	Polyxo	2458101,611	132,2047651	12,2383739	12,60	2,14E-03
308	Polyxo	2458101,611	132,2047963	12,2383773	12,60	2,03E-03
308	Polyxo	2458101,61	132,2048372	12,2383866	12,59	2,23E-03
308	Polyxo	2458101,609	132,2048911	12,2383881	12,59	2,04E-03
308	Polyxo	2458101,609	132,2049275	12,2383935	12,59	2,14E-03
308	Polyxo	2458101,608	132,204957	12,2383858	12,60	2,13E-03
308	Polyxo	2458101,607	132,2050003	12,2383947	12,60	2,14E-03
308	Polyxo	2458101,607	132,2050467	12,2384009	12,59	2,13E-03
308	Polyxo	2458101,606	132,205091	12,2384054	12,59	2,13E-03
308	Polyxo	2458101,605	132,2051423	12,2384041	12,59	2,13E-03
308	Polyxo	2458101,604	132,2051684	12,238393	12,59	2,03E-03
308	Polyxo	2458101,604	132,2052258	12,2384109	12,59	2,13E-03
308	Polyxo	2458101,603	132,2052644	12,2384141	12,60	2,13E-03
308	Polyxo	2458101,602	132,2052949	12,2383961	12,59	2,04E-03
308	Polyxo	2458101,602	132,2053332	12,2384045	12,58	2,13E-03
308	Polyxo	2458101,601	132,2053638	12,2384079	12,58	2,14E-03
308	Polyxo	2458101,6	132,2054181	12,2384134	12,59	2,13E-03
308	Polyxo	2458101,6	132,2054574	12,2384354	12,59	2,23E-03
308	Polyxo	2458101,599	132,205509	12,2384219	12,59	2,03E-03
308	Polyxo	2458101,598	132,205535	12,238424	12,58	2,14E-03
308	Polyxo	2458101,598	132,2055924	12,2384345	12,59	2,13E-03

308	Polyxo	2458101,597	132,2056226	12,2384166	12,59	2,23E-03
308	Polyxo	2458101,596	132,2056646	12,2384343	12,59	2,13E-03
308	Polyxo	2458101,596	132,2057225	12,2384358	12,59	2,13E-03
308	Polyxo	2458101,595	132,2057565	12,2384371	12,58	2,03E-03
308	Polyxo	2458101,594	132,2058131	12,2384564	12,58	2,03E-03
308	Polyxo	2458101,594	132,2058428	12,2384427	12,58	2,13E-03
308	Polyxo	2458101,593	132,20588	12,2384395	12,58	2,03E-03
308	Polyxo	2458101,592	132,2059295	12,238455	12,58	2,14E-03
308	Polyxo	2458101,591	132,2059724	12,2384688	12,57	2,14E-03
308	Polyxo	2458101,591	132,2059975	12,2384417	12,57	2,04E-03
308	Polyxo	2458101,59	132,2060525	12,2384594	12,58	2,04E-03
308	Polyxo	2458101,589	132,2060959	12,2384595	12,58	2,04E-03
308	Polyxo	2458101,589	132,2061283	12,23846	12,58	2,04E-03
308	Polyxo	2458101,588	132,206179	12,2384623	12,57	2,04E-03
308	Polyxo	2458101,587	132,2062172	12,238468	12,58	2,03E-03
308	Polyxo	2458101,587	132,2062731	12,2384735	12,58	2,14E-03
308	Polyxo	2458101,586	132,2063054	12,2384737	12,58	2,04E-03
308	Polyxo	2458101,585	132,2063512	12,238464	12,57	2,13E-03
308	Polyxo	2458101,584	132,206389	12,2384854	12,57	2,14E-03
308	Polyxo	2458101,584	132,2064232	12,2384697	12,57	2,04E-03
308	Polyxo	2458101,583	132,2064938	12,238485	12,57	2,04E-03
308	Polyxo	2458101,582	132,2065174	12,2384889	12,58	2,13E-03
308	Polyxo	2458101,582	132,2065609	12,2384817	12,57	2,04E-03
308	Polyxo	2458101,581	132,2065918	12,2384816	12,57	2,04E-03
308	Polyxo	2458101,58	132,2066302	12,2384829	12,57	2,04E-03
308	Polyxo	2458101,58	132,2066908	12,2384905	12,57	1,94E-03
308	Polyxo	2458101,579	132,2067156	12,2385099	12,56	2,04E-03
308	Polyxo	2458101,578	132,2067631	12,2385114	12,57	2,04E-03
308	Polyxo	2458101,578	132,2067953	12,238518	12,56	2,14E-03
308	Polyxo	2458101,577	132,2068549	12,2385206	12,57	2,24E-03
308	Polyxo	2458101,576	132,2069005	12,2385313	12,57	2,13E-03
308	Polyxo	2458101,575	132,2069338	12,2385202	12,57	2,14E-03
308	Polyxo	2458101,575	132,2069807	12,2385273	12,57	2,24E-03
308	Polyxo	2458101,574	132,2070207	12,2385378	12,57	2,23E-03
308	Polyxo	2458101,573	132,2070735	12,2385246	12,56	2,14E-03
308	Polyxo	2458101,573	132,2071178	12,2385368	12,55	2,14E-03
308	Polyxo	2458101,572	132,2071653	12,2385391	12,56	2,24E-03
308	Polyxo	2458101,571	132,2072219	12,2385438	12,56	2,24E-03
308	Polyxo	2458101,57	132,2072363	12,2385373	12,57	2,33E-03
308	Polyxo	2458101,57	132,2072727	12,2385362	12,56	2,24E-03
308	Polyxo	2458101,569	132,2073427	12,238564	12,57	2,24E-03
308	Polyxo	2458101,568	132,2073881	12,2385442	12,57	2,23E-03
308	Polyxo	2458101,568	132,2074063	12,2385509	12,56	2,24E-03
308	Polyxo	2458101,567	132,2074609	12,2385657	12,57	2,13E-03
308	Polyxo	2458101,566	132,2074926	12,2385541	12,57	2,24E-03
308	Polyxo	2458101,566	132,2075466	12,2385811	12,57	2,24E-03
308	Polyxo	2458101,565	132,2075335	12,2385681	12,56	2,24E-03
308	Polyxo	2458101,564	132,2076426	12,2385651	12,56	2,14E-03
308	Polyxo	2458101,564	132,2076326	12,2385671	12,57	2,44E-03
308	Polyxo	2458101,563	132,2077043	12,2385623	12,57	2,34E-03
308	Polyxo	2458101,562	132,2077357	12,2385772	12,56	2,24E-03
308	Polyxo	2458101,561	132,2077979	12,2386085	12,56	2,24E-03
308	Polyxo	2458101,561	132,2078357	12,2385822	12,56	2,44E-03
308	Polyxo	2458101,56	132,2078484	12,2385813	12,56	2,43E-03
308	Polyxo	2458101,559	132,2079065	12,2385833	12,57	2,54E-03
308	Polyxo	2458101,559	132,2079413	12,238596	12,57	2,34E-03
308	Polyxo	2458101,558	132,2079611	12,238589	12,57	2,44E-03
308	Polyxo	2458101,557	132,2080153	12,2385803	12,57	2,44E-03
308	Polyxo	2458101,557	132,2080814	12,2386148	12,57	2,54E-03
308	Polyxo	2458101,556	132,2080937	12,2385945	12,58	2,63E-03
308	Polyxo	2458101,555	132,2081428	12,2386033	12,56	2,54E-03
308	Polyxo	2458101,555	132,2081823	12,2386111	12,57	2,64E-03
308	Polyxo	2458101,554	132,2082454	12,2386051	12,57	2,45E-03
308	Polyxo	2458101,553	132,2082796	12,2386165	12,57	2,44E-03
308	Polyxo	2458101,553	132,2083165	12,2386198	12,56	2,54E-03
308	Polyxo	2458101,552	132,2083582	12,2386323	12,57	2,63E-03
308	Polyxo	2458101,551	132,2083979	12,2386244	12,57	2,54E-03
308	Polyxo	2458101,551	132,2084307	12,2386184	12,56	2,54E-03
308	Polyxo	2458101,55	132,2084764	12,2386383	12,56	2,54E-03
308	Polyxo	2458101,549	132,2085232	12,2386369	12,57	2,65E-03
308	Polyxo	2458101,548	132,2085785	12,2386509	12,56	2,64E-03
308	Polyxo	2458101,548	132,2085929	12,2386357	12,56	2,64E-03
308	Polyxo	2458101,547	132,208648	12,23865	12,56	2,96E-03
308	Polyxo	2458101,546	132,2086966	12,2386688	12,56	2,85E-03
308	Polyxo	2458101,546	132,2087331	12,2386638	12,56	3,06E-03
308	Polyxo	2458101,545	132,208774	12,23867	12,60	3,56E-03
308	Polyxo	2458101,545	132,2087994	12,2386596	12,58	3,77E-03

308	Polyxo	2458101,544	132,208821	12,2386615	12,55	4,08E-03
308	Polyxo	2458101,543	132,2088631	12,2386463	12,56	4,08E-03
308	Polyxo	2458101,542	132,2089348	12,2386619	12,56	4,28E-03
308	Polyxo	2458101,542	132,208971	12,2386739	12,57	4,60E-03
308	Polyxo	2458101,541	132,2090063	12,2386847	12,59	5,10E-03
308	Polyxo	2458101,54	132,2090484	12,2386589	12,58	4,28E-03
308	Polyxo	2458101,54	132,2090903	12,2386719	12,57	4,17E-03
308	Polyxo	2458101,539	132,209122	12,2386607	12,56	4,28E-03
308	Polyxo	2458101,538	132,2091657	12,2386809	12,58	4,27E-03
308	Polyxo	2458101,538	132,2092022	12,238665	12,58	4,68E-03
308	Polyxo	2458101,537	132,2092494	12,2386659	12,56	4,69E-03
308	Polyxo	2458101,536	132,2092928	12,2386862	12,59	4,76E-03
308	Polyxo	2458101,535	132,2093646	12,238695	12,58	4,17E-03
308	Polyxo	2458101,535	132,2093926	12,2386864	12,63	4,71E-03
308	Polyxo	2458101,534	132,2094047	12,238686	12,56	4,28E-03
308	Polyxo	2458101,533	132,209467	12,2386723	12,55	4,58E-03
308	Polyxo	2458101,533	132,209478	12,2386663	12,57	5,35E-03
308	Polyxo	2458101,532	132,2095503	12,2387001	12,57	6,43E-03
308	Polyxo	2458101,531	132,209556	12,2386965	12,53	8,48E-03
308	Polyxo	2458101,53	132,2096311	12,2387181	12,58	9,16E-03
308	Polyxo	2458101,53	132,209683	12,2387075	12,64	9,23E-03
308	Polyxo	2458101,529	132,2097084	12,2386981	12,55	8,92E-03
308	Polyxo	2458101,529	132,2097551	12,2387057	12,66	9,89E-03
308	Polyxo	2458101,528	132,2097896	12,2387141	12,60	8,12E-03
308	Polyxo	2458101,527	132,2098428	12,2386914	12,58	7,96E-03
308	Polyxo	2458108,76	131,6479329	12,2630555	12,43	6,67E-03
308	Polyxo	2458108,76	131,648011	12,2630129	12,45	5,33E-03
308	Polyxo	2458108,759	131,6480652	12,2630147	12,44	3,98E-03
308	Polyxo	2458108,758	131,6481199	12,2629936	12,43	3,77E-03
308	Polyxo	2458108,758	131,6481829	12,2629972	12,43	5,43E-03
308	Polyxo	2458108,757	131,6482859	12,2630127	12,43	6,35E-03
308	Polyxo	2458108,756	131,6483314	12,262978	12,45	3,78E-03
308	Polyxo	2458108,756	131,6483949	12,2629656	12,44	2,54E-03
308	Polyxo	2458108,755	131,6484516	12,2629542	12,43	2,54E-03
308	Polyxo	2458108,754	131,6485127	12,2629511	12,44	2,75E-03
308	Polyxo	2458108,754	131,6485738	12,2629643	12,45	2,24E-03
308	Polyxo	2458108,753	131,6486491	12,2629301	12,45	2,24E-03
308	Polyxo	2458108,752	131,6487895	12,262912	12,44	2,03E-03
308	Polyxo	2458108,75	131,6489364	12,2628967	12,44	2,03E-03
308	Polyxo	2458108,75	131,6490109	12,2628556	12,45	1,73E-03
308	Polyxo	2458108,749	131,6490702	12,2628637	12,45	1,83E-03
308	Polyxo	2458108,748	131,6491343	12,2628511	12,45	1,73E-03
308	Polyxo	2458108,748	131,6492253	12,2628525	12,45	1,73E-03
308	Polyxo	2458108,747	131,6492706	12,2628463	12,45	1,73E-03
308	Polyxo	2458108,746	131,649355	12,2628391	12,45	1,73E-03
308	Polyxo	2458108,746	131,6494333	12,2628237	12,45	1,73E-03
308	Polyxo	2458108,745	131,6494902	12,2628439	12,45	1,73E-03
308	Polyxo	2458108,744	131,6495885	12,2628407	12,45	1,63E-03
308	Polyxo	2458108,743	131,6496481	12,2628277	12,45	1,73E-03
308	Polyxo	2458108,743	131,6497128	12,2628363	12,44	1,63E-03
308	Polyxo	2458108,742	131,6498019	12,26282	12,44	1,73E-03
308	Polyxo	2458108,741	131,6498913	12,2627724	12,44	1,72E-03
308	Polyxo	2458108,74	131,6500654	12,2627933	12,44	1,72E-03
308	Polyxo	2458108,739	131,6501203	12,262788	12,45	1,63E-03
308	Polyxo	2458108,738	131,6502194	12,2627682	12,45	1,73E-03
308	Polyxo	2458108,737	131,6502844	12,2627448	12,45	1,63E-03
308	Polyxo	2458108,737	131,650342	12,2627537	12,45	1,63E-03
308	Polyxo	2458108,736	131,6504281	12,2627439	12,45	1,63E-03
308	Polyxo	2458108,735	131,6504743	12,26273	12,45	1,63E-03
308	Polyxo	2458108,735	131,6505624	12,262707	12,45	1,73E-03
308	Polyxo	2458108,734	131,6506642	12,2627203	12,44	1,63E-03
308	Polyxo	2458108,733	131,6507143	12,2627243	12,45	1,62E-03
308	Polyxo	2458108,733	131,6507976	12,2627207	12,44	1,72E-03
308	Polyxo	2458108,732	131,6508604	12,2627245	12,44	1,72E-03
308	Polyxo	2458108,731	131,6509539	12,2627184	12,44	1,62E-03
308	Polyxo	2458108,729	131,6511268	12,2626731	12,44	1,72E-03
308	Polyxo	2458108,729	131,6511908	12,2626678	12,43	1,83E-03
308	Polyxo	2458108,728	131,6512642	12,2626669	12,44	1,73E-03
308	Polyxo	2458108,727	131,6513364	12,2626545	12,44	1,73E-03
308	Polyxo	2458108,727	131,6514071	12,2626461	12,44	1,83E-03
308	Polyxo	2458108,726	131,6514857	12,2626614	12,44	1,83E-03
308	Polyxo	2458108,725	131,6515836	12,262638	12,45	1,73E-03
308	Polyxo	2458108,725	131,6516355	12,2626322	12,45	1,73E-03
308	Polyxo	2458108,722	131,6519218	12,2626088	12,43	1,83E-03
308	Polyxo	2458108,72	131,6520926	12,2626103	12,43	1,83E-03
308	Polyxo	2458108,72	131,6521848	12,2626132	12,44	1,83E-03
308	Polyxo	2458108,719	131,6522392	12,2625891	12,44	1,82E-03

308	Polyxo	2458108,718	131,6523145	12,2625587	12,44	1,83E-03
308	Polyxo	2458108,717	131,6524117	12,2625711	12,44	1,83E-03
308	Polyxo	2458108,716	131,6525793	12,2625516	12,44	1,83E-03
308	Polyxo	2458108,715	131,6526539	12,2625521	12,44	1,73E-03
308	Polyxo	2458108,714	131,6527465	12,2625578	12,43	1,83E-03
308	Polyxo	2458108,713	131,6527881	12,2625206	12,44	1,83E-03
308	Polyxo	2458108,713	131,6528634	12,2624979	12,44	1,72E-03
308	Polyxo	2458108,712	131,6529744	12,2625142	12,45	1,72E-03
308	Polyxo	2458108,71	131,6531359	12,2625131	12,44	1,82E-03
308	Polyxo	2458108,709	131,6532251	12,2624841	12,44	1,82E-03
308	Polyxo	2458108,709	131,6532922	12,2624885	12,44	1,92E-03
308	Polyxo	2458108,708	131,6533598	12,2624885	12,45	1,82E-03
308	Polyxo	2458108,707	131,6534657	12,2624691	12,45	1,83E-03
308	Polyxo	2458108,706	131,6536195	12,2624496	12,45	1,83E-03
308	Polyxo	2458108,705	131,6536831	12,2624568	12,45	1,73E-03
308	Polyxo	2458108,704	131,6537555	12,2624348	12,45	1,73E-03
308	Polyxo	2458108,704	131,6538355	12,262426	12,45	1,83E-03
308	Polyxo	2458108,702	131,6539241	12,2624122	12,46	1,73E-03
308	Polyxo	2458108,701	131,6541058	12,2624041	12,46	1,83E-03
308	Polyxo	2458108,7	131,6541897	12,2623925	12,45	1,83E-03
308	Polyxo	2458108,7	131,6542379	12,2623817	12,45	1,83E-03
308	Polyxo	2458108,699	131,6543115	12,2623707	12,45	1,73E-03
308	Polyxo	2458108,698	131,6544334	12,2623634	12,46	1,83E-03
308	Polyxo	2458108,696	131,6546035	12,2623573	12,45	1,83E-03
308	Polyxo	2458108,696	131,6546645	12,2623319	12,45	1,83E-03
308	Polyxo	2458108,695	131,6547243	12,2623417	12,45	1,83E-03
308	Polyxo	2458108,694	131,6548584	12,2623277	12,46	1,83E-03
308	Polyxo	2458108,692	131,6550314	12,2622907	12,45	1,83E-03
308	Polyxo	2458108,691	131,6551096	12,2622795	12,45	1,93E-03
308	Polyxo	2458108,691	131,6552025	12,262281	12,46	1,93E-03
308	Polyxo	2458108,69	131,655272	12,2622785	12,46	1,93E-03
308	Polyxo	2458108,689	131,6553611	12,2622844	12,46	1,93E-03
308	Polyxo	2458108,687	131,6555151	12,2622555	12,46	1,93E-03
308	Polyxo	2458108,687	131,6555977	12,2622508	12,46	1,93E-03
308	Polyxo	2458108,686	131,6556828	12,2622484	12,46	1,92E-03
308	Polyxo	2458108,685	131,6558262	12,2622499	12,46	1,93E-03
308	Polyxo	2458108,683	131,6559738	12,2622185	12,47	1,93E-03
308	Polyxo	2458108,683	131,6560503	12,2622174	12,46	1,93E-03
308	Polyxo	2458108,681	131,6561604	12,2622077	12,45	1,93E-03
308	Polyxo	2458108,68	131,6563292	12,2621745	12,46	1,93E-03
308	Polyxo	2458108,679	131,6564268	12,2621821	12,46	1,93E-03
308	Polyxo	2458108,678	131,6564767	12,2621637	12,46	1,93E-03
308	Polyxo	2458108,677	131,6565943	12,2621591	12,46	2,03E-03
308	Polyxo	2458108,657	131,6587648	12,2619462	12,47	1,93E-03
308	Polyxo	2458108,656	131,6588694	12,261938	12,46	1,93E-03
308	Polyxo	2458108,654	131,6590331	12,2619137	12,47	1,93E-03
308	Polyxo	2458108,653	131,6591171	12,2619267	12,47	1,83E-03
308	Polyxo	2458108,652	131,6592236	12,2618858	12,46	1,83E-03
308	Polyxo	2458108,651	131,6593809	12,2618886	12,46	1,83E-03
308	Polyxo	2458108,65	131,6594588	12,2618664	12,47	1,83E-03
308	Polyxo	2458108,646	131,6599369	12,261836	12,48	1,83E-03
308	Polyxo	2458108,644	131,6600909	12,2617905	12,47	1,83E-03
308	Polyxo	2458108,643	131,6601793	12,2618372	12,47	1,83E-03
308	Polyxo	2458108,642	131,6602872	12,261804	12,46	1,83E-03
308	Polyxo	2458108,641	131,6604494	12,2617744	12,46	1,83E-03
308	Polyxo	2458108,64	131,6605099	12,2617585	12,46	1,83E-03
308	Polyxo	2458108,639	131,6606564	12,2617564	12,45	1,93E-03
308	Polyxo	2458108,637	131,6607887	12,2617355	12,46	1,73E-03
308	Polyxo	2458108,636	131,6609171	12,2617421	12,47	1,73E-03
308	Polyxo	2458108,635	131,6611021	12,2616918	12,46	1,83E-03
308	Polyxo	2458108,634	131,6612096	12,2617054	12,46	1,83E-03
308	Polyxo	2458108,625	131,6620128	12,2617343	12,51	1,84E-03
308	Polyxo	2458108,624	131,662103	12,2616828	12,50	1,94E-03
308	Polyxo	2458108,624	131,6621578	12,2617084	12,51	1,84E-03
308	Polyxo	2458108,623	131,6622379	12,2616882	12,51	1,84E-03
308	Polyxo	2458108,622	131,662353	12,2616977	12,51	1,84E-03
308	Polyxo	2458108,621	131,6624614	12,2616968	12,52	1,84E-03
308	Polyxo	2458108,62	131,6626259	12,2616612	12,51	1,84E-03
308	Polyxo	2458108,611	131,6636008	12,2615004	12,46	1,83E-03
308	Polyxo	2458108,608	131,6638627	12,2614715	12,44	1,73E-03
308	Polyxo	2458108,608	131,6639708	12,2614793	12,47	1,63E-03
308	Polyxo	2458108,606	131,6640267	12,2614474	12,43	1,63E-03
308	Polyxo	2458108,606	131,6641877	12,2614572	12,46	1,64E-03
308	Polyxo	2458108,605	131,6641274	12,2614344	12,40	1,64E-03
308	Polyxo	2458108,604	131,6642298	12,2614281	12,41	1,64E-03
308	Polyxo	2458108,603	131,6643369	12,2614185	12,43	1,63E-03
308	Polyxo	2458108,603	131,6643521	12,261415	12,39	1,63E-03

308	Polyxo	2458108,602	131,6644397	12,2614124	12,40	1,64E-03
308	Polyxo	2458108,601	131,6644812	12,261414	12,38	1,64E-03
308	Polyxo	2458108,601	131,6645811	12,2613937	12,39	1,63E-03
308	Polyxo	2458108,6	131,6646274	12,2613867	12,39	1,53E-03
308	Polyxo	2458108,599	131,6647484	12,2613845	12,40	1,63E-03
308	Polyxo	2458108,599	131,664774	12,2613871	12,39	1,54E-03
308	Polyxo	2458108,598	131,6649643	12,2613893	12,41	1,64E-03
308	Polyxo	2458108,597	131,664969	12,2613658	12,40	1,53E-03
308	Polyxo	2458108,596	131,6650538	12,2613567	12,39	1,63E-03
308	Polyxo	2458108,596	131,6651802	12,2613436	12,41	1,63E-03
308	Polyxo	2458108,595	131,6652189	12,2613593	12,41	1,53E-03
308	Polyxo	2458108,594	131,6653189	12,2613384	12,42	1,64E-03
308	Polyxo	2458108,594	131,6653983	12,2613335	12,40	1,63E-03
308	Polyxo	2458108,593	131,6654669	12,2613183	12,41	1,63E-03
308	Polyxo	2458108,592	131,6655416	12,2613194	12,42	1,64E-03
308	Polyxo	2458108,592	131,6656181	12,2613183	12,41	1,74E-03
308	Polyxo	2458108,591	131,6657138	12,2613063	12,43	1,63E-03
308	Polyxo	2458108,59	131,6657696	12,2612976	12,42	1,63E-03
308	Polyxo	2458108,589	131,6658402	12,2613023	12,43	1,63E-03
308	Polyxo	2458108,589	131,6659337	12,2612873	12,44	1,64E-03
308	Polyxo	2458108,588	131,6659708	12,2612891	12,43	1,63E-03
308	Polyxo	2458108,587	131,6660753	12,2612752	12,45	1,74E-03
308	Polyxo	2458108,587	131,6661409	12,2612703	12,43	1,63E-03
308	Polyxo	2458108,586	131,6662547	12,2612626	12,43	1,84E-03
308	Polyxo	2458108,585	131,6663184	12,2612501	12,44	1,63E-03
308	Polyxo	2458108,584	131,6663977	12,2612425	12,44	1,74E-03
308	Polyxo	2458108,584	131,6664614	12,2612241	12,43	1,74E-03
308	Polyxo	2458108,583	131,6665576	12,261237	12,44	1,74E-03
308	Polyxo	2458108,582	131,666612	12,2612191	12,44	1,74E-03
308	Polyxo	2458108,581	131,6667138	12,2612088	12,44	1,74E-03
308	Polyxo	2458108,581	131,6667708	12,2611917	12,43	1,73E-03
308	Polyxo	2458108,58	131,6668174	12,2611884	12,43	1,74E-03
308	Polyxo	2458108,579	131,6668907	12,2611791	12,44	1,63E-03
308	Polyxo	2458108,579	131,6669415	12,2611853	12,44	1,74E-03
308	Polyxo	2458108,578	131,6670297	12,2611768	12,39	1,84E-03
308	Polyxo	2458108,577	131,6671064	12,2611746	12,38	1,94E-03
308	Polyxo	2458108,577	131,6671891	12,2611624	12,38	1,94E-03
308	Polyxo	2458108,576	131,6672525	12,2611435	12,39	1,94E-03
308	Polyxo	2458108,575	131,6673501	12,2611263	12,44	1,74E-03
308	Polyxo	2458108,575	131,6674016	12,261146	12,39	1,94E-03
308	Polyxo	2458108,574	131,6674737	12,2611288	12,39	1,83E-03
308	Polyxo	2458108,573	131,6675674	12,2611037	12,39	1,94E-03
308	Polyxo	2458108,573	131,6676302	12,2611087	12,38	1,94E-03
308	Polyxo	2458108,572	131,6676991	12,2610858	12,38	1,84E-03
308	Polyxo	2458108,571	131,6677684	12,2610968	12,39	1,84E-03
308	Polyxo	2458108,571	131,6678667	12,2610856	12,38	1,84E-03
308	Polyxo	2458108,57	131,6679065	12,2610735	12,37	1,84E-03
308	Polyxo	2458108,569	131,667994	12,2610754	12,40	1,84E-03
308	Polyxo	2458108,568	131,6680378	12,2610694	12,39	1,84E-03
308	Polyxo	2458108,568	131,6681152	12,2610716	12,38	1,84E-03
308	Polyxo	2458108,567	131,6681941	12,2610622	12,38	1,84E-03
308	Polyxo	2458108,566	131,6682619	12,2610503	12,38	1,84E-03
308	Polyxo	2458108,566	131,6683418	12,2610394	12,38	1,84E-03
308	Polyxo	2458108,565	131,6684526	12,2610342	12,38	1,84E-03
308	Polyxo	2458108,564	131,6685033	12,2610283	12,39	1,83E-03
308	Polyxo	2458108,563	131,6685795	12,2610079	12,38	1,84E-03
308	Polyxo	2458108,463	131,6789361	12,2598756	12,39	1,95E-03
308	Polyxo	2458108,462	131,6790009	12,2598466	12,37	1,94E-03
1626	Sadeya	2458105,606	155,7287134	-10,0885748	14,91	1,98E-02
1626	Sadeya	2458105,604	155,7286531	-10,0881489	14,90	1,23E-02
1626	Sadeya	2458105,602	155,7285417	-10,0874738	14,86	1,37E-02
1626	Sadeya	2458105,6	155,7284157	-10,0867915	14,84	1,17E-02
1626	Sadeya	2458105,598	155,7283345	-10,0861454	14,83	1,17E-02
1626	Sadeya	2458105,597	155,7282352	-10,0855115	14,84	1,11E-02
1626	Sadeya	2458105,595	155,7281403	-10,084885	14,81	1,05E-02
1626	Sadeya	2458105,593	155,7280144	-10,0842504	14,80	1,02E-02
1626	Sadeya	2458105,591	155,7279593	-10,0836441	14,79	1,25E-02
1626	Sadeya	2458105,589	155,7278527	-10,0830294	14,81	1,29E-02
1626	Sadeya	2458105,588	155,7278275	-10,0822449	14,80	1,26E-02
1626	Sadeya	2458105,586	155,7277049	-10,0815347	14,81	1,15E-02
1626	Sadeya	2458105,584	155,7275343	-10,0810506	14,74	1,08E-02
1626	Sadeya	2458105,583	155,7273915	-10,0804083	14,72	1,09E-02
9659	1996 EJ	2458226,53	219,7237738	5,489335	15,66	2,16E-02
9659	1996 EJ	2458227,387	219,5665017	5,6056998	15,61	2,82E-02
9659	1996 EJ	2458226,534	219,7228705	5,4899761	15,60	2,23E-02
9659	1996 EJ	2458227,388	219,5662909	5,6057719	15,59	2,95E-02
9659	1996 EJ	2458226,535	219,7227237	5,4900455	15,59	2,47E-02

9659	1996 EJ	2458227,389	219,5661716	5,6059228	15,61	2,82E-02
9659	1996 EJ	2458226,536	219,7226819	5,4901367	15,64	2,19E-02
9659	1996 EJ	2458227,389	219,5661103	5,6059825	15,63	2,83E-02
9659	1996 EJ	2458226,536	219,7225815	5,4902044	15,64	2,23E-02
9659	1996 EJ	2458227,39	219,565931	5,6060899	15,53	2,77E-02
9659	1996 EJ	2458226,537	219,7224026	5,4902699	15,61	2,25E-02
9659	1996 EJ	2458227,39	219,565837	5,6060932	15,63	2,80E-02
9659	1996 EJ	2458227,391	219,5656757	5,6062148	15,65	2,67E-02
9659	1996 EJ	2458226,538	219,7221448	5,4903636	15,65	2,34E-02
9659	1996 EJ	2458227,392	219,5655501	5,6062684	15,61	2,53E-02
9659	1996 EJ	2458226,539	219,7220729	5,4904434	15,66	2,16E-02
9659	1996 EJ	2458227,392	219,565483	5,6063574	15,64	2,71E-02
9659	1996 EJ	2458227,393	219,5653159	5,6063677	15,66	2,54E-02
9659	1996 EJ	2458226,54	219,7217489	5,49061	15,64	2,11E-02
9659	1996 EJ	2458227,394	219,5652074	5,6064394	15,68	2,57E-02
9659	1996 EJ	2458226,541	219,721663	5,490686	15,62	2,22E-02
9659	1996 EJ	2458227,394	219,5651065	5,6065524	15,69	2,68E-02
9659	1996 EJ	2458226,541	219,7215861	5,4908297	15,66	2,21E-02
9659	1996 EJ	2458227,395	219,5649298	5,6066707	15,62	2,65E-02
9659	1996 EJ	2458226,542	219,7214084	5,4909678	15,64	2,37E-02
9659	1996 EJ	2458227,396	219,5648831	5,606699	15,67	2,61E-02
9659	1996 EJ	2458227,396	219,5646867	5,6068804	15,62	2,65E-02
9659	1996 EJ	2458226,543	219,72118	5,4911831	15,61	2,23E-02
9659	1996 EJ	2458227,397	219,5646172	5,6069275	15,62	2,76E-02
9659	1996 EJ	2458226,544	219,7210608	5,4912746	15,64	2,22E-02
9659	1996 EJ	2458227,398	219,5644695	5,6070544	15,66	2,76E-02
9659	1996 EJ	2458226,545	219,7208563	5,4913833	15,66	2,20E-02
9659	1996 EJ	2458227,398	219,5643462	5,6071739	15,59	2,84E-02
9659	1996 EJ	2458226,545	219,7208051	5,4914448	15,60	2,26E-02
9659	1996 EJ	2458227,399	219,5642391	5,6072875	15,64	2,61E-02
9659	1996 EJ	2458227,4	219,5640899	5,6073666	15,62	2,91E-02
9659	1996 EJ	2458226,547	219,7205427	5,4915528	15,66	2,12E-02
9659	1996 EJ	2458227,4	219,5639955	5,6074331	15,62	2,77E-02
9659	1996 EJ	2458226,555	219,7190608	5,4927178	15,65	2,47E-02
9659	1996 EJ	2458227,401	219,5639125	5,6075119	15,63	2,79E-02
9659	1996 EJ	2458226,556	219,7187292	5,4928774	15,62	2,54E-02
9659	1996 EJ	2458227,401	219,5637258	5,6075658	15,68	2,74E-02
9659	1996 EJ	2458226,557	219,7185055	5,4930091	15,60	2,42E-02
9659	1996 EJ	2458227,402	219,5636163	5,6076153	15,69	2,54E-02
9659	1996 EJ	2458227,403	219,5634814	5,6077243	15,66	2,68E-02
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9659	1996 EJ	2458227,403	219,5634045	5,6077715	15,64	2,50E-02
9659	1996 EJ	2458226,561	219,7178309	5,4935392	15,64	2,41E-02
9659	1996 EJ	2458227,404	219,5632093	5,607887	15,68	2,69E-02
9659	1996 EJ	2458226,561	219,7177423	5,4936489	15,62	2,52E-02
9659	1996 EJ	2458227,405	219,563098	5,6079422	15,68	2,72E-02
9659	1996 EJ	2458226,563	219,7174313	5,4938259	15,62	2,55E-02
9659	1996 EJ	2458227,405	219,5629573	5,6081259	15,64	2,70E-02
9659	1996 EJ	2458227,406	219,5628403	5,6081771	15,65	3,04E-02
9659	1996 EJ	2458226,565	219,7171441	5,4940708	15,60	2,53E-02
9659	1996 EJ	2458227,407	219,5627642	5,6082709	15,64	2,75E-02
9659	1996 EJ	2458226,566	219,7168291	5,4942742	15,62	2,46E-02
9659	1996 EJ	2458227,407	219,5627137	5,6083397	15,56	2,88E-02
9659	1996 EJ	2458226,567	219,7166313	5,4944094	15,58	2,28E-02
9659	1996 EJ	2458227,408	219,5624671	5,6084902	15,62	2,70E-02
9659	1996 EJ	2458226,568	219,716541	5,4944578	15,61	2,39E-02
9659	1996 EJ	2458227,409	219,5623732	5,6085757	15,67	2,62E-02
9659	1996 EJ	2458226,569	219,7162447	5,4946545	15,65	2,66E-02
9659	1996 EJ	2458227,409	219,5622378	5,6086432	15,68	2,88E-02
9659	1996 EJ	2458226,57	219,7160886	5,4948488	15,58	2,62E-02
9659	1996 EJ	2458227,41	219,5621606	5,608758	15,64	2,76E-02
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9659	1996 EJ	2458227,411	219,5618437	5,6088524	15,66	2,49E-02
9659	1996 EJ	2458226,573	219,7155523	5,4951812	15,62	2,88E-02
9659	1996 EJ	2458227,412	219,5617374	5,608926	15,65	2,67E-02
9659	1996 EJ	2458226,574	219,7153571	5,4952594	15,58	2,60E-02
9659	1996 EJ	2458227,412	219,5616738	5,6089871	15,53	2,83E-02
9659	1996 EJ	2458226,574	219,7152306	5,4954182	15,62	2,68E-02
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9659	1996 EJ	2458226,575	219,7151138	5,4954325	15,58	2,54E-02
9659	1996 EJ	2458227,414	219,5613381	5,6091926	15,65	2,65E-02
9659	1996 EJ	2458226,577	219,7147711	5,4956872	15,61	2,64E-02
9659	1996 EJ	2458227,414	219,5612512	5,6092601	15,66	2,53E-02
9659	1996 EJ	2458226,578	219,7146218	5,4958313	15,60	2,48E-02
9659	1996 EJ	2458227,415	219,5611259	5,6093666	15,54	2,81E-02

9659	1996 EJ	2458226,578	219,7144752	5,4958818	15,59	2,47E-02
9659	1996 EJ	2458227,416	219,5609887	5,6094468	15,66	2,74E-02
9659	1996 EJ	2458226,579	219,7143907	5,4960131	15,62	2,41E-02
9659	1996 EJ	2458227,416	219,5608676	5,6095904	15,70	2,74E-02
9659	1996 EJ	2458226,58	219,7141249	5,496197	15,60	2,48E-02
9659	1996 EJ	2458227,417	219,5607605	5,6097122	15,68	2,98E-02
9659	1996 EJ	2458226,581	219,7139232	5,4963522	15,61	2,65E-02
9659	1996 EJ	2458227,418	219,5606804	5,6098197	15,65	2,59E-02
9659	1996 EJ	2458226,582	219,71377	5,4964235	15,60	2,60E-02
9659	1996 EJ	2458227,418	219,5604952	5,6098879	15,64	2,83E-02
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9659	1996 EJ	2458227,419	219,5604051	5,6099531	15,67	2,69E-02
9659	1996 EJ	2458226,584	219,7133938	5,4967123	15,63	2,48E-02
9659	1996 EJ	2458227,42	219,5602411	5,6100164	15,65	2,43E-02
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9659	1996 EJ	2458227,42	219,5601347	5,6100652	15,71	2,66E-02
9659	1996 EJ	2458226,586	219,7130342	5,4969221	15,61	2,67E-02
9659	1996 EJ	2458227,421	219,5599459	5,6101703	15,65	2,61E-02
9659	1996 EJ	2458226,586	219,7129243	5,4970034	15,67	2,44E-02
9659	1996 EJ	2458227,422	219,5598883	5,6102559	15,62	2,50E-02
9659	1996 EJ	2458226,588	219,7126889	5,4972136	15,64	2,63E-02
9659	1996 EJ	2458227,422	219,5597995	5,6102974	15,69	2,65E-02
9659	1996 EJ	2458226,589	219,7124842	5,4973485	15,66	2,54E-02
9659	1996 EJ	2458227,423	219,5596508	5,6103405	15,55	2,65E-02
9659	1996 EJ	2458226,589	219,7123422	5,4973885	15,62	2,60E-02
9659	1996 EJ	2458227,423	219,5595572	5,6104772	15,52	2,80E-02
9659	1996 EJ	2458226,59	219,7122255	5,4975142	15,65	2,50E-02
9659	1996 EJ	2458227,424	219,5593934	5,6106551	15,64	2,48E-02
9659	1996 EJ	2458226,591	219,7119875	5,4978001	15,66	2,41E-02
9659	1996 EJ	2458227,425	219,5593051	5,6107262	15,65	2,67E-02
9659	1996 EJ	2458226,592	219,711799	5,4978779	15,66	2,63E-02
9659	1996 EJ	2458227,425	219,5591759	5,6108092	15,66	2,52E-02
9659	1996 EJ	2458226,593	219,711668	5,4979574	15,63	2,53E-02
9659	1996 EJ	2458227,426	219,559018	5,6109601	15,60	2,44E-02
9659	1996 EJ	2458226,594	219,7115332	5,4980484	15,65	2,57E-02
9659	1996 EJ	2458227,427	219,5589091	5,6110337	15,60	2,49E-02
9659	1996 EJ	2458226,594	219,711422	5,4981199	15,66	2,51E-02
9659	1996 EJ	2458227,427	219,5587899	5,6111265	15,61	2,65E-02
9659	1996 EJ	2458226,596	219,7111387	5,498357	15,60	2,45E-02
9659	1996 EJ	2458227,428	219,5586722	5,611202	15,62	2,49E-02
9659	1996 EJ	2458226,597	219,7109452	5,4984334	15,68	2,46E-02
9659	1996 EJ	2458227,429	219,5585174	5,6112665	15,56	2,66E-02
9659	1996 EJ	2458226,597	219,710856	5,4986168	15,66	2,47E-02
9659	1996 EJ	2458227,429	219,5583927	5,6112819	15,64	2,46E-02
9659	1996 EJ	2458226,598	219,7107176	5,4986611	15,65	2,52E-02
9659	1996 EJ	2458227,43	219,5583488	5,6113898	15,63	2,58E-02
9659	1996 EJ	2458226,599	219,710561	5,4986912	15,65	2,52E-02
9659	1996 EJ	2458227,431	219,5580912	5,6114362	15,67	2,23E-02
9659	1996 EJ	2458226,6	219,7102797	5,4988616	15,64	2,47E-02
9659	1996 EJ	2458227,431	219,5580141	5,6115477	15,65	2,43E-02
9659	1996 EJ	2458226,601	219,7101017	5,4990158	15,63	2,68E-02
9659	1996 EJ	2458227,432	219,5578713	5,6116105	15,61	2,57E-02
9659	1996 EJ	2458226,602	219,7099868	5,4991224	15,64	2,55E-02
9659	1996 EJ	2458227,432	219,5577434	5,6116913	15,63	2,36E-02
9659	1996 EJ	2458226,602	219,7098338	5,4992197	15,65	2,66E-02
9659	1996 EJ	2458226,604	219,7096112	5,4994553	15,67	2,82E-02
9659	1996 EJ	2458227,434	219,5575594	5,6119219	15,61	2,47E-02
9659	1996 EJ	2458226,605	219,7093661	5,4995698	15,60	2,92E-02
9659	1996 EJ	2458227,434	219,5574384	5,612076	15,61	2,51E-02
9659	1996 EJ	2458226,606	219,7092834	5,4996257	15,64	3,11E-02
9659	1996 EJ	2458227,435	219,5572923	5,6121295	15,61	2,68E-02
9659	1996 EJ	2458226,606	219,7091586	5,4997549	15,64	2,91E-02
9659	1996 EJ	2458227,436	219,5571601	5,6122612	15,64	2,61E-02
9659	1996 EJ	2458226,607	219,7090162	5,4997733	15,61	2,82E-02
9659	1996 EJ	2458227,437	219,5570103	5,6123729	15,61	2,47E-02
9659	1996 EJ	2458226,608	219,7087484	5,5000067	15,68	2,84E-02
9659	1996 EJ	2458227,437	219,5569227	5,6124381	15,64	2,70E-02
9659	1996 EJ	2458226,609	219,7085525	5,5001332	15,63	2,87E-02
9659	1996 EJ	2458227,438	219,5568226	5,6124732	15,64	2,53E-02
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9659	1996 EJ	2458227,438	219,556682	5,6125515	15,58	2,55E-02
9659	1996 EJ	2458226,611	219,7082753	5,5002864	15,57	2,65E-02
9659	1996 EJ	2458227,439	219,5565477	5,6126033	15,68	2,41E-02
9659	1996 EJ	2458226,611	219,7081603	5,5003837	15,58	2,71E-02
9659	1996 EJ	2458227,44	219,5563576	5,6126854	15,64	2,41E-02
9659	1996 EJ	2458226,612	219,7080469	5,500479	15,64	2,83E-02
9659	1996 EJ	2458227,441	219,5562744	5,6127685	15,64	2,43E-02

9659	1996 EJ	2458226,613	219,7078165	5,500701	15,59	2,85E-02
9659	1996 EJ	2458227,441	219,5560709	5,6128812	15,66	2,65E-02
9659	1996 EJ	2458226,614	219,7076198	5,5008586	15,65	2,47E-02
9659	1996 EJ	2458227,442	219,5560076	5,6130176	15,66	2,56E-02
9659	1996 EJ	2458226,615	219,7074857	5,5009118	15,67	2,61E-02
9659	1996 EJ	2458227,443	219,5558439	5,6131509	15,60	2,66E-02
9659	1996 EJ	2458226,615	219,7073462	5,5010085	15,61	2,67E-02
9659	1996 EJ	2458227,443	219,5556784	5,6132569	15,64	2,49E-02
9659	1996 EJ	2458226,616	219,7072292	5,5010794	15,63	2,51E-02
9659	1996 EJ	2458227,444	219,5555653	5,6133632	15,62	2,46E-02
9659	1996 EJ	2458226,618	219,7069521	5,5012855	15,61	2,68E-02
9659	1996 EJ	2458227,445	219,5555536	5,6134276	15,45	2,86E-02
9659	1996 EJ	2458226,619	219,7067586	5,5014545	15,62	2,52E-02
9659	1996 EJ	2458227,445	219,5553716	5,6135027	15,62	2,52E-02
9659	1996 EJ	2458226,619	219,7066379	5,501553	15,65	2,61E-02
9659	1996 EJ	2458227,446	219,555275	5,6135981	15,55	2,72E-02
9659	1996 EJ	2458226,62	219,7065353	5,5016269	15,68	2,60E-02
9659	1996 EJ	2458227,446	219,5551581	5,6136539	15,61	2,47E-02
9659	1996 EJ	2458226,62	219,7063823	5,5016462	15,61	2,66E-02
9659	1996 EJ	2458227,447	219,5550111	5,6137296	15,64	2,56E-02
9659	1996 EJ	2458226,622	219,7061491	5,5018869	15,62	2,60E-02
9659	1996 EJ	2458227,448	219,5548521	5,6138094	15,54	2,60E-02
9659	1996 EJ	2458226,623	219,7059563	5,5019971	15,66	2,59E-02
9659	1996 EJ	2458226,623	219,7058532	5,5020986	15,65	2,73E-02
9659	1996 EJ	2458227,449	219,5546147	5,6139042	15,65	2,25E-02
9659	1996 EJ	2458226,624	219,7056934	5,502205	15,63	2,51E-02
9659	1996 EJ	2458227,45	219,5544913	5,6139882	15,61	2,47E-02
9659	1996 EJ	2458226,625	219,7055715	5,5022977	15,63	2,65E-02
9659	1996 EJ	2458227,45	219,5543072	5,6140499	15,55	2,43E-02
9659	1996 EJ	2458226,626	219,7053347	5,5024599	15,64	2,55E-02
9659	1996 EJ	2458227,451	219,5543056	5,6141636	15,61	2,51E-02
9659	1996 EJ	2458226,627	219,7051017	5,5026281	15,67	2,54E-02
9659	1996 EJ	2458227,451	219,5541523	5,6142582	15,61	2,53E-02
9659	1996 EJ	2458226,628	219,7049924	5,5026644	15,62	2,42E-02
9659	1996 EJ	2458227,452	219,5540624	5,6143975	15,59	2,55E-02
9659	1996 EJ	2458226,628	219,7048781	5,5027241	15,63	2,85E-02
9659	1996 EJ	2458227,453	219,5538681	5,6145314	15,58	2,65E-02
9659	1996 EJ	2458226,629	219,7047672	5,5028271	15,62	2,64E-02
9659	1996 EJ	2458227,453	219,5537732	5,6146294	15,58	2,50E-02
9659	1996 EJ	2458226,63	219,7046703	5,5029733	15,66	2,76E-02
9659	1996 EJ	2458227,454	219,5536531	5,6147313	15,63	2,52E-02
9659	1996 EJ	2458226,631	219,7043933	5,5031549	15,62	2,69E-02
9659	1996 EJ	2458227,455	219,5535242	5,6148456	15,64	2,65E-02
9659	1996 EJ	2458226,632	219,7041788	5,5032838	15,66	2,55E-02
9659	1996 EJ	2458227,456	219,5533171	5,6148885	15,63	2,62E-02
9659	1996 EJ	2458226,633	219,7040677	5,5033445	15,65	2,66E-02
9659	1996 EJ	2458227,456	219,5532408	5,6149966	15,62	2,59E-02
9659	1996 EJ	2458226,633	219,7039306	5,5034558	15,70	2,44E-02
9659	1996 EJ	2458227,457	219,5531093	5,6150499	15,58	2,58E-02
9659	1996 EJ	2458226,634	219,7038235	5,5035386	15,68	2,71E-02
9659	1996 EJ	2458227,457	219,5529549	5,6151324	15,59	2,34E-02
9659	1996 EJ	2458226,635	219,70352	5,5037162	15,70	2,62E-02
9659	1996 EJ	2458227,458	219,5527842	5,6151934	15,65	2,29E-02
9659	1996 EJ	2458226,636	219,7033991	5,5038803	15,62	2,79E-02
9659	1996 EJ	2458227,459	219,5526773	5,6153036	15,55	2,30E-02
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9659	1996 EJ	2458227,46	219,5525418	5,6153406	15,58	2,32E-02
9659	1996 EJ	2458226,638	219,7031953	5,5040235	15,63	2,78E-02
9659	1996 EJ	2458227,46	219,552469	5,6155065	15,60	2,58E-02
9659	1996 EJ	2458226,638	219,7030452	5,5041065	15,70	2,75E-02
9659	1996 EJ	2458227,461	219,552321	5,6155408	15,61	2,77E-02
9659	1996 EJ	2458226,639	219,7028826	5,5042155	15,67	2,76E-02
9659	1996 EJ	2458227,461	219,5522138	5,6156731	15,60	2,57E-02
9659	1996 EJ	2458226,64	219,7026208	5,5043488	15,65	2,75E-02
9659	1996 EJ	2458227,462	219,5521018	5,6157482	15,63	2,83E-02
9659	1996 EJ	2458226,641	219,7024319	5,5044791	15,63	2,79E-02
9659	1996 EJ	2458227,463	219,5519566	5,6158777	15,57	2,47E-02
9659	1996 EJ	2458226,642	219,7023536	5,5046249	15,65	2,76E-02
9659	1996 EJ	2458227,463	219,5518781	5,6159731	15,58	2,52E-02
9659	1996 EJ	2458226,642	219,7022484	5,5047291	15,68	2,78E-02
9659	1996 EJ	2458227,464	219,5517556	5,6160712	15,59	2,44E-02
9659	1996 EJ	2458226,643	219,7020788	5,5047927	15,65	2,78E-02
9659	1996 EJ	2458227,465	219,5516202	5,6161311	15,60	2,69E-02
9659	1996 EJ	2458226,644	219,7019888	5,5048508	15,68	2,70E-02
9659	1996 EJ	2458227,465	219,5514555	5,616203	15,62	2,59E-02
9659	1996 EJ	2458226,644	219,7018951	5,5049341	15,61	2,65E-02
9659	1996 EJ	2458227,466	219,5513077	5,6163068	15,58	2,49E-02

9659	1996 EJ	2458226,645	219,7017669	5,5050346	15,64	2,75E-02
9659	1996 EJ	2458227,467	219,5512091	5,6163318	15,60	2,44E-02
9659	1996 EJ	2458226,646	219,7016561	5,5051359	15,65	2,63E-02
9659	1996 EJ	2458226,647	219,7013482	5,5053191	15,68	2,66E-02
9659	1996 EJ	2458227,468	219,5509195	5,6164334	15,56	2,27E-02
9659	1996 EJ	2458226,648	219,7011624	5,5054614	15,67	2,81E-02
9659	1996 EJ	2458227,469	219,5507733	5,616581	15,63	2,24E-02
9659	1996 EJ	2458226,649	219,7010231	5,5055256	15,65	2,72E-02
9659	1996 EJ	2458227,469	219,5507339	5,6166947	15,59	2,41E-02
9659	1996 EJ	2458226,649	219,7008988	5,5055849	15,64	2,79E-02
9659	1996 EJ	2458227,47	219,5505949	5,6167612	15,56	2,43E-02
9659	1996 EJ	2458226,65	219,7008141	5,5057116	15,64	2,73E-02
9659	1996 EJ	2458227,47	219,5504526	5,6169098	15,63	2,31E-02
9659	1996 EJ	2458226,65	219,700671	5,5058115	15,64	2,71E-02
9659	1996 EJ	2458227,471	219,5503486	5,6170126	15,57	2,43E-02
9659	1996 EJ	2458226,651	219,7005534	5,5058297	15,62	2,76E-02
9659	1996 EJ	2458227,472	219,5502465	5,6170837	15,61	2,54E-02
9659	1996 EJ	2458226,652	219,7004439	5,5059152	15,62	2,82E-02
9659	1996 EJ	2458226,652	219,7003954	5,5060501	15,65	2,85E-02
9659	1996 EJ	2458227,473	219,5499711	5,6173168	15,57	2,46E-02
9659	1996 EJ	2458226,653	219,7002568	5,5061517	15,66	2,79E-02
9659	1996 EJ	2458227,474	219,5498775	5,6173599	15,60	2,39E-02
9659	1996 EJ	2458226,654	219,6999698	5,50632	15,70	2,59E-02
9659	1996 EJ	2458227,474	219,5497688	5,6174039	15,60	2,46E-02
9659	1996 EJ	2458226,655	219,6997606	5,5064404	15,65	2,67E-02
9659	1996 EJ	2458227,475	219,549636	5,6174451	15,62	2,43E-02
9659	1996 EJ	2458226,656	219,6996245	5,5064928	15,65	2,69E-02
9659	1996 EJ	2458227,476	219,5494534	5,6175609	15,64	2,30E-02
9659	1996 EJ	2458226,657	219,6995531	5,5066237	15,62	2,69E-02
9659	1996 EJ	2458226,657	219,6994095	5,5066698	15,66	2,85E-02
9659	1996 EJ	2458227,477	219,5492045	5,6176643	15,65	2,33E-02
9659	1996 EJ	2458226,658	219,6992608	5,5067532	15,59	2,67E-02
9659	1996 EJ	2458227,477	219,5491101	5,6177479	15,61	2,40E-02
9659	1996 EJ	2458226,659	219,6989772	5,5069758	15,61	2,89E-02
9659	1996 EJ	2458227,478	219,5489536	5,6178152	15,64	2,29E-02
9659	1996 EJ	2458226,66	219,6988277	5,5071618	15,58	2,71E-02
9659	1996 EJ	2458227,479	219,5488897	5,6179322	15,60	2,36E-02
9659	1996 EJ	2458226,661	219,6986988	5,5072118	15,63	2,69E-02
9659	1996 EJ	2458227,479	219,5487985	5,6180488	15,59	2,59E-02
9659	1996 EJ	2458226,662	219,6986283	5,5073371	15,61	2,82E-02
9659	1996 EJ	2458226,662	219,6984658	5,507367	15,62	2,78E-02
9659	1996 EJ	2458226,663	219,698311	5,507461	15,62	2,89E-02
9659	1996 EJ	2458226,663	219,6982243	5,5075593	15,65	2,69E-02
9659	1996 EJ	2458226,664	219,6980758	5,5076235	15,64	2,58E-02
9659	1996 EJ	2458226,665	219,697995	5,5077302	15,69	2,74E-02
9659	1996 EJ	2458226,665	219,6978937	5,5078473	15,63	2,83E-02
9659	1996 EJ	2458226,666	219,6977855	5,5078807	15,63	2,77E-02
9659	1996 EJ	2458226,667	219,6976535	5,5079897	15,68	2,93E-02
9659	1996 EJ	2458226,667	219,6975506	5,5080768	15,65	2,75E-02
9659	1996 EJ	2458226,668	219,6974206	5,508099	15,63	2,80E-02
9659	1996 EJ	2458226,668	219,6973184	5,5082019	15,65	2,64E-02
9659	1996 EJ	2458226,669	219,6972423	5,5082828	15,62	2,78E-02
9659	1996 EJ	2458226,67	219,6970631	5,5083507	15,57	2,71E-02
9659	1996 EJ	2458226,671	219,6967736	5,5085941	15,63	2,69E-02
9659	1996 EJ	2458226,672	219,6966575	5,5087596	15,56	3,00E-02
9659	1996 EJ	2458226,673	219,696501	5,5088226	15,61	3,05E-02
9659	1996 EJ	2458226,673	219,6963635	5,5088948	15,60	2,82E-02
9659	1996 EJ	2458226,674	219,6962076	5,5089679	15,57	2,95E-02
9659	1996 EJ	2458226,675	219,6961329	5,5090075	15,54	2,97E-02
9659	1996 EJ	2458226,675	219,6960017	5,5091039	15,59	3,11E-02
9659	1996 EJ	2458226,676	219,6958845	5,5091785	15,61	3,17E-02
9659	1996 EJ	2458226,676	219,6958149	5,5093017	15,58	3,28E-02
9659	1996 EJ	2458226,677	219,6957015	5,5093786	15,59	3,22E-02
9659	1996 EJ	2458226,678	219,6955607	5,5094998	15,58	3,25E-02
9659	1996 EJ	2458226,678	219,6953996	5,5095318	15,55	3,55E-02
9659	1996 EJ	2458226,679	219,6953009	5,5096335	15,67	3,55E-02
9659	1996 EJ	2458226,679	219,6952616	5,5097478	15,61	3,44E-02
9659	1996 EJ	2458226,68	219,6950527	5,509785	15,59	3,37E-02
9659	1996 EJ	2458226,681	219,694986	5,5098606	15,64	3,57E-02
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9659	1996 EJ	2458226,682	219,6947519	5,5100438	15,64	3,78E-02
9659	1996 EJ	2458226,683	219,6946273	5,5101342	15,63	4,34E-02
9659	1996 EJ	2458226,683	219,6944385	5,5102123	15,59	4,35E-02
9659	1996 EJ	2458226,684	219,694393	5,5103754	15,67	4,46E-02
9659	1996 EJ	2458226,684	219,6943004	5,510377	15,62	4,65E-02
9659	1996 EJ	2458226,685	219,6942034	5,5105599	15,69	5,06E-02
9659	1996 EJ	2458226,686	219,6940589	5,510549	15,72	5,33E-02

9659	1996 EJ	2458226,686	219,6939223	5,5105919	15,53	5,67E-02
9659	1996 EJ	2458226,687	219,6937545	5,5107147	15,65	5,85E-02
9659	1996 EJ	2458226,687	219,6936994	5,5108718	15,69	6,56E-02
43227	2000 AR166	2458226,534	219,1503144	5,7732239	17,67	1,70E-01
43227	2000 AR166	2458227,389	219,0099605	5,8744651	17,92	1,58E-01
43227	2000 AR166	2458226,536	219,1501137	5,7734241	18,29	1,89E-01
43227	2000 AR166	2458226,536	219,1498614	5,7732761	18,04	1,58E-01
43227	2000 AR166	2458226,537	219,1498055	5,7737763	17,75	1,42E-01
43227	2000 AR166	2458226,537	219,149499	5,7735206	17,92	1,58E-01
43227	2000 AR166	2458226,538	219,1495247	5,7735223	18,08	1,69E-01
43227	2000 AR166	2458227,392	219,0093243	5,8747435	17,85	1,85E-01
43227	2000 AR166	2458226,539	219,1495608	5,7735918	17,81	1,69E-01
43227	2000 AR166	2458226,539	219,1493311	5,7737143	18,29	1,86E-01
43227	2000 AR166	2458226,541	219,1489641	5,7739178	17,82	1,72E-01
43227	2000 AR166	2458227,395	219,0086443	5,8749721	18,02	1,72E-01
43227	2000 AR166	2458227,396	219,0086117	5,8753808	17,88	1,77E-01
43227	2000 AR166	2458226,543	219,1486123	5,7742777	17,77	1,49E-01
43227	2000 AR166	2458227,397	219,0084063	5,875469	17,86	1,73E-01
43227	2000 AR166	2458226,544	219,1485302	5,7742483	17,93	1,61E-01
43227	2000 AR166	2458227,398	219,0082834	5,8753238	18,09	2,04E-01
43227	2000 AR166	2458226,545	219,1482962	5,7744784	17,93	1,56E-01
43227	2000 AR166	2458226,547	219,1480972	5,7746206	17,67	1,45E-01
43227	2000 AR166	2458227,402	219,0075304	5,8759824	17,72	1,62E-01
43227	2000 AR166	2458227,407	219,0067872	5,8766938	17,48	1,64E-01
43227	2000 AR166	2458227,408	219,0063055	5,8765577	17,76	1,81E-01
43227	2000 AR166	2458227,409	219,0064343	5,8766579	18,05	1,72E-01
43227	2000 AR166	2458227,41	219,0062506	5,876781	18,03	1,68E-01
43227	2000 AR166	2458227,411	219,0058487	5,8770688	18,06	1,73E-01
43227	2000 AR166	2458227,412	219,0059697	5,8772422	18,10	1,93E-01
43227	2000 AR166	2458227,412	219,0056497	5,8772828	18,05	1,72E-01
43227	2000 AR166	2458227,414	219,0055183	5,8772797	17,72	1,55E-01
43227	2000 AR166	2458227,414	219,0053973	5,8774049	17,48	1,49E-01
43227	2000 AR166	2458227,415	219,005247	5,8774502	17,77	1,74E-01
43227	2000 AR166	2458226,602	219,1388285	5,7812582	17,72	1,49E-01
43227	2000 AR166	2458226,602	219,1386962	5,7812097	18,15	1,67E-01
43227	2000 AR166	2458226,604	219,1384695	5,7817265	18,05	1,52E-01
43227	2000 AR166	2458226,605	219,1382871	5,781486	17,85	1,46E-01
43227	2000 AR166	2458226,609	219,1376385	5,7822272	18,06	1,64E-01
43227	2000 AR166	2458226,611	219,1372747	5,7824106	18,02	1,45E-01
43227	2000 AR166	2458226,612	219,1372082	5,7824924	17,98	1,79E-01
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43227	2000 AR166	2458226,618	219,1361892	5,7831578	18,03	1,65E-01
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43227	2000 AR166	2458226,619	219,1359311	5,7833889	18,03	1,65E-01
43227	2000 AR166	2458226,62	219,1356165	5,7835978	17,83	1,42E-01
43227	2000 AR166	2458226,623	219,135001	5,783766	17,72	1,39E-01
43227	2000 AR166	2458226,623	219,1351032	5,7838693	17,85	1,46E-01
43227	2000 AR166	2458226,624	219,1350059	5,7838837	17,87	1,54E-01
43227	2000 AR166	2458226,625	219,134988	5,7841404	17,86	1,48E-01
43227	2000 AR166	2458226,626	219,1346431	5,7842006	17,75	1,50E-01
43227	2000 AR166	2458226,627	219,1344563	5,78426	17,89	1,59E-01
43227	2000 AR166	2458226,628	219,1340911	5,7843705	17,86	1,50E-01
43227	2000 AR166	2458226,63	219,1340351	5,7845948	17,88	1,54E-01
43227	2000 AR166	2458226,631	219,1338297	5,7846975	17,65	1,50E-01
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43227	2000 AR166	2458227,46	218,9978162	5,8826799	17,63	1,79E-01
43227	2000 AR166	2458227,461	218,9976322	5,8828205	18,01	1,55E-01
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43227	2000 AR166	2458226,643	219,1317937	5,7860406	18,00	1,61E-01
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43227	2000 AR166	2458226,644	219,131697	5,7863454	17,94	1,47E-01
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43227	2000 AR166	2458226,645	219,1315559	5,7863827	18,08	1,45E-01
43227	2000 AR166	2458226,646	219,1313206	5,7864547	17,81	1,50E-01
43227	2000 AR166	2458226,647	219,1308654	5,7864605	17,73	1,69E-01
43227	2000 AR166	2458227,468	218,9963829	5,883717	17,62	1,66E-01
43227	2000 AR166	2458227,469	218,9962199	5,8838057	17,65	1,62E-01
43227	2000 AR166	2458227,47	218,9959066	5,883989	17,61	1,55E-01
43227	2000 AR166	2458226,65	219,1307065	5,7868898	17,96	1,55E-01
43227	2000 AR166	2458226,651	219,1304323	5,7872137	18,13	1,63E-01
43227	2000 AR166	2458227,472	218,9954641	5,8843876	17,86	1,46E-01

43227	2000 AR166	2458226,652	219,130151	5,7871175	17,96	1,57E-01
43227	2000 AR166	2458227,476	218,9946787	5,8848755	17,65	1,77E-01
43227	2000 AR166	2458227,477	218,9948261	5,8846058	17,79	1,73E-01
43227	2000 AR166	2458227,478	218,9946432	5,8848176	17,64	1,54E-01
43227	2000 AR166	2458227,479	218,9942204	5,8847484	17,53	1,50E-01
54041	2000 GQ113	2458253,417	219,5207542	-20,9361647	17,83	2,17E-01
54041	2000 GQ113	2458253,418	219,5206936	-20,9355252	17,63	2,05E-01
54041	2000 GQ113	2458253,419	219,5203558	-20,9356206	17,84	2,09E-01
54041	2000 GQ113	2458253,42	219,5201735	-20,9356002	17,81	1,85E-01
54041	2000 GQ113	2458253,424	219,5191401	-20,9351889	17,51	1,88E-01
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54041	2000 GQ113	2458253,428	219,5181525	-20,9345704	17,75	1,89E-01
54041	2000 GQ113	2458253,429	219,5179957	-20,9346982	17,43	1,57E-01
54041	2000 GQ113	2458253,43	219,517594	-20,9343636	17,62	1,79E-01
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54041	2000 GQ113	2458253,434	219,5168884	-20,934164	17,64	1,57E-01
54041	2000 GQ113	2458253,434	219,5165759	-20,9338916	17,66	1,62E-01
54041	2000 GQ113	2458253,436	219,516375	-20,9336083	17,99	1,66E-01
54041	2000 GQ113	2458253,437	219,5161237	-20,9336325	17,58	1,64E-01
54041	2000 GQ113	2458253,437	219,5159724	-20,9335177	17,89	1,78E-01
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54041	2000 GQ113	2458253,441	219,5148646	-20,9331168	17,89	1,54E-01
54041	2000 GQ113	2458227,553	225,7506306	-23,4276018	17,94	2,35E-01
54041	2000 GQ113	2458253,442	219,5146057	-20,9330718	17,76	1,49E-01
54041	2000 GQ113	2458253,443	219,5143902	-20,9328086	17,95	1,68E-01
54041	2000 GQ113	2458253,444	219,5143662	-20,9327612	17,68	1,61E-01
54041	2000 GQ113	2458227,556	225,7497688	-23,4275119	17,73	1,80E-01
54041	2000 GQ113	2458253,444	219,5139937	-20,9327693	17,81	1,60E-01
54041	2000 GQ113	2458253,445	219,5139231	-20,9325528	17,53	1,46E-01
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54041	2000 GQ113	2458253,453	219,5119269	-20,9318416	17,71	1,52E-01
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54041	2000 GQ113	2458253,457	219,5109096	-20,9312894	17,70	1,52E-01
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54041	2000 GQ113	2458253,464	219,5091295	-20,9304819	17,75	1,70E-01
54041	2000 GQ113	2458253,465	219,5087922	-20,9302319	17,58	1,57E-01
54041	2000 GQ113	2458253,466	219,5084339	-20,930332	17,89	1,80E-01
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54041	2000 GQ113	2458253,492	219,5021987	-20,9270229	17,46	1,31E-01
54041	2000 GQ113	2458253,493	219,5020613	-20,9269574	17,53	1,57E-01
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54041	2000 GQ113	2458253,497	219,5009185	-20,9264117	17,38	1,46E-01
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1501	Baade	2458253,37	220,1216368	-21,3494522	16,14	7,35E-02
1501	Baade	2458253,372	220,1213477	-21,3493343	16,33	1,72E-01
1501	Baade	2458253,374	220,1209014	-21,3493593	16,17	8,62E-02
1501	Baade	2458253,375	220,120449	-21,3493882	16,28	6,31E-02
1501	Baade	2458253,376	220,1203141	-21,3491494	16,36	1,03E-01
1501	Baade	2458253,379	220,1194571	-21,3492653	16,10	8,56E-02
1501	Baade	2458253,381	220,1188317	-21,3490156	16,30	7,28E-02
1501	Baade	2458253,382	220,1186937	-21,3490264	16,31	7,61E-02
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1501	Baade	2458253,387	220,1175504	-21,3486085	16,39	7,33E-02
1501	Baade	2458253,388	220,1173268	-21,3486735	16,34	8,13E-02
1501	Baade	2458253,389	220,1173323	-21,3486744	16,39	9,19E-02
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1501	Baade	2458253,391	220,116612	-21,3486019	16,34	8,30E-02
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1501	Baade	2458253,395	220,1156525	-21,3483973	16,29	7,46E-02
1501	Baade	2458253,395	220,1155159	-21,3483383	16,23	7,89E-02
1501	Baade	2458253,396	220,115211	-21,3481752	16,17	7,20E-02
1501	Baade	2458253,397	220,1152	-21,3482452	16,30	8,90E-02
1501	Baade	2458253,398	220,1150915	-21,3481313	16,34	8,56E-02

1501	Baade	2458253,398	220,1148785	-21,348199	16,37	8,86E-02
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1501	Baade	2458253,4	220,1143367	-21,3480614	16,21	7,58E-02
1501	Baade	2458253,401	220,1141467	-21,3480248	16,36	7,26E-02
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1501	Baade	2458253,41	220,1118605	-21,3477686	16,32	6,83E-02
1501	Baade	2458253,411	220,1117779	-21,3475233	16,31	8,29E-02
1501	Baade	2458253,411	220,1114615	-21,3474917	16,17	8,49E-02
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1501	Baade	2458253,423	220,1086453	-21,3470131	16,22	7,15E-02
1501	Baade	2458253,424	220,1084829	-21,3469951	16,23	6,73E-02
1501	Baade	2458253,425	220,108339	-21,3469368	16,29	6,33E-02
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1501	Baade	2458253,433	220,10632	-21,3464326	16,30	5,66E-02
1501	Baade	2458253,434	220,1062756	-21,3464967	16,42	6,10E-02
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1501	Baade	2458253,443	220,1039819	-21,345991	16,32	5,27E-02
1501	Baade	2458253,443	220,1038786	-21,3459641	16,26	5,10E-02
1501	Baade	2458253,444	220,1036816	-21,3459383	16,35	5,36E-02
1501	Baade	2458253,444	220,1035684	-21,345933	16,27	5,25E-02
1501	Baade	2458253,445	220,1033028	-21,3459011	16,38	5,31E-02
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1501	Baade	2458253,45	220,1021111	-21,3456619	16,41	4,77E-02
1501	Baade	2458253,451	220,1019155	-21,345455	16,41	5,38E-02
1501	Baade	2458253,452	220,1016455	-21,3455899	16,34	4,77E-02
1501	Baade	2458253,452	220,1015664	-21,3455476	16,35	4,84E-02
1501	Baade	2458253,453	220,1014222	-21,3454497	16,40	4,83E-02
1501	Baade	2458253,454	220,1012548	-21,3454717	16,38	5,02E-02
1501	Baade	2458253,454	220,1010268	-21,3454634	16,41	4,72E-02
1501	Baade	2458253,455	220,1009472	-21,3454372	16,39	4,84E-02
1501	Baade	2458253,456	220,100831	-21,3453821	16,39	4,79E-02
1501	Baade	2458253,456	220,1006095	-21,3453597	16,38	4,82E-02

1501	Baade	2458253,457	220,1003848	-21,3453659	16,39	4,81E-02
1501	Baade	2458253,458	220,1002566	-21,3452659	16,33	5,00E-02
1501	Baade	2458253,458	220,1001037	-21,3452607	16,37	5,17E-02
1501	Baade	2458253,459	220,0998984	-21,3451163	16,34	4,51E-02
1501	Baade	2458253,46	220,0997987	-21,3451717	16,31	5,15E-02
1501	Baade	2458253,46	220,0996264	-21,3451777	16,33	4,97E-02
1501	Baade	2458253,461	220,0994335	-21,3450464	16,27	5,12E-02
1501	Baade	2458253,462	220,099303	-21,3451364	16,34	5,25E-02
1501	Baade	2458253,462	220,0990839	-21,3449631	16,36	4,87E-02
1501	Baade	2458253,463	220,098962	-21,3449044	16,34	5,22E-02
1501	Baade	2458253,464	220,0987236	-21,3449892	16,38	5,24E-02
1501	Baade	2458253,464	220,0985909	-21,344902	16,30	5,00E-02
1501	Baade	2458253,465	220,0983431	-21,3449627	16,33	5,32E-02
1501	Baade	2458253,466	220,0982415	-21,3448447	16,31	5,26E-02
1501	Baade	2458253,467	220,0980553	-21,3447756	16,31	4,77E-02
1501	Baade	2458253,467	220,0978093	-21,3447903	16,31	5,32E-02
1501	Baade	2458253,468	220,0976572	-21,3446537	16,32	5,16E-02
1501	Baade	2458253,469	220,097573	-21,3446809	16,35	4,84E-02
1501	Baade	2458253,469	220,0973672	-21,3446332	16,32	5,23E-02
1501	Baade	2458253,47	220,0971167	-21,3445376	16,39	5,57E-02
1501	Baade	2458253,471	220,0970543	-21,3445946	16,36	6,07E-02
1501	Baade	2458253,471	220,0968061	-21,344607	16,33	5,36E-02
1501	Baade	2458253,472	220,096736	-21,3445481	16,28	5,55E-02
1501	Baade	2458253,473	220,0964487	-21,3444151	16,31	5,47E-02
1501	Baade	2458253,474	220,0964333	-21,344361	16,33	5,08E-02
1501	Baade	2458253,474	220,0961979	-21,3444573	16,38	5,08E-02
1501	Baade	2458253,483	220,0940548	-21,3439345	16,39	6,14E-02
1501	Baade	2458253,485	220,0936861	-21,3438987	16,34	6,27E-02
1501	Baade	2458253,486	220,0933856	-21,3437983	16,30	6,06E-02
1501	Baade	2458253,487	220,0931968	-21,343849	16,34	5,80E-02
1501	Baade	2458253,488	220,0927497	-21,3437676	16,34	5,42E-02
1501	Baade	2458253,489	220,092505	-21,3437994	16,33	5,69E-02
1501	Baade	2458253,49	220,0922622	-21,3436312	16,38	5,81E-02
1501	Baade	2458253,492	220,091951	-21,3436227	16,43	5,52E-02
1501	Baade	2458253,493	220,0917103	-21,3435055	16,40	5,31E-02
1501	Baade	2458253,494	220,0913069	-21,343547	16,26	5,51E-02
1501	Baade	2458253,495	220,0910282	-21,3434833	16,40	5,33E-02
1501	Baade	2458253,497	220,0906434	-21,3435386	16,40	6,21E-02
1501	Baade	2458253,499	220,0900558	-21,3432148	16,40	5,18E-02
1501	Baade	2458253,5	220,08984	-21,3431357	16,37	6,06E-02
1501	Baade	2458253,502	220,0894484	-21,3431262	16,38	5,86E-02
1501	Baade	2458253,503	220,0892359	-21,34307	16,35	5,38E-02
1501	Baade	2458253,503	220,0889764	-21,343058	16,44	6,25E-02
1501	Baade	2458253,505	220,0886217	-21,3429848	16,35	5,54E-02
1501	Baade	2458253,506	220,0883651	-21,3428447	16,38	5,97E-02
1501	Baade	2458253,507	220,088213	-21,3428328	16,24	6,19E-02
1501	Baade	2458253,507	220,0881414	-21,3429028	16,37	5,90E-02
1501	Baade	2458253,508	220,0880083	-21,3427061	16,42	6,24E-02
1501	Baade	2458253,51	220,0875013	-21,3427332	16,40	7,38E-02
1501	Baade	2458253,511	220,0872489	-21,3425544	16,41	7,17E-02
1501	Baade	2458253,511	220,0871435	-21,3425549	16,47	6,83E-02
1501	Baade	2458253,512	220,086847	-21,3426258	16,35	6,68E-02
1501	Baade	2458253,514	220,0865346	-21,3424642	16,45	6,98E-02
1501	Baade	2458253,515	220,086407	-21,3423668	16,48	7,57E-02
1501	Baade	2458253,515	220,0861292	-21,3425278	16,37	6,98E-02
1501	Baade	2458253,516	220,0858987	-21,3423785	16,35	6,72E-02
1501	Baade	2458253,518	220,0855726	-21,3422372	16,49	7,84E-02
1501	Baade	2458253,519	220,0852542	-21,3423278	16,47	7,48E-02
1501	Baade	2458253,52	220,085095	-21,3422188	16,36	7,23E-02
1501	Baade	2458253,521	220,084665	-21,3420871	16,36	6,64E-02
1501	Baade	2458253,523	220,0843657	-21,3420473	16,53	6,41E-02
1501	Baade	2458253,524	220,0840831	-21,3419435	16,42	6,81E-02
1501	Baade	2458253,524	220,0839299	-21,3419199	16,42	6,23E-02
1501	Baade	2458253,525	220,0838294	-21,3419453	16,49	6,86E-02
1501	Baade	2458253,527	220,0833354	-21,3418503	16,47	6,06E-02
1501	Baade	2458253,528	220,0831841	-21,3416879	16,42	6,49E-02
1501	Baade	2458253,528	220,0830134	-21,3417895	16,39	6,62E-02
1501	Baade	2458253,53	220,0825797	-21,3417454	16,36	6,80E-02
1501	Baade	2458253,531	220,0822465	-21,3415485	16,43	6,88E-02
1501	Baade	2458253,532	220,0819746	-21,3415924	16,54	6,32E-02
1501	Baade	2458253,533	220,0819229	-21,341463	16,49	6,73E-02
1501	Baade	2458253,534	220,0814907	-21,3415182	16,42	6,42E-02
1501	Baade	2458253,536	220,0812472	-21,3414282	16,40	6,35E-02
1501	Baade	2458253,536	220,0810885	-21,3412937	16,23	6,36E-02
1501	Baade	2458253,538	220,0806783	-21,3413105	16,52	6,68E-02
1501	Baade	2458253,539	220,080339	-21,3412913	16,47	6,29E-02
1501	Baade	2458253,54	220,0802094	-21,3412022	16,15	6,05E-02

1501	Baade	2458253,54	220,0799744	-21,3411929	16,39	6,43E-02
1501	Baade	2458253,541	220,079844	-21,341124	16,37	6,75E-02
1501	Baade	2458253,543	220,0793437	-21,3409011	16,49	6,21E-02
1501	Baade	2458253,544	220,0791967	-21,3409078	16,50	6,79E-02
1501	Baade	2458253,545	220,0790528	-21,3408771	16,21	7,10E-02
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1501	Baade	2458253,546	220,0786763	-21,340848	16,31	7,26E-02
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1501	Baade	2458253,55	220,077885	-21,3405627	16,39	6,84E-02
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1501	Baade	2458253,553	220,0767153	-21,3405893	16,16	6,90E-02
1501	Baade	2458253,554	220,0766547	-21,3403239	16,52	7,09E-02
1501	Baade	2458253,555	220,0764777	-21,3403552	16,27	6,84E-02
1501	Baade	2458253,556	220,0762997	-21,3403634	16,48	6,61E-02
1501	Baade	2458253,557	220,0759709	-21,3403075	16,42	7,08E-02
1501	Baade	2458253,558	220,075678	-21,3401666	16,15	7,42E-02
1501	Baade	2458253,559	220,0754304	-21,3401425	16,38	7,46E-02
1501	Baade	2458253,56	220,075221	-21,3401387	16,36	7,93E-02
1501	Baade	2458253,561	220,0750528	-21,3401154	16,49	8,68E-02
1501	Baade	2458253,563	220,0745629	-21,339866	16,27	7,97E-02
1501	Baade	2458253,564	220,0742775	-21,3398923	16,38	7,45E-02
1501	Baade	2458253,564	220,0741996	-21,3399808	16,48	7,69E-02
1501	Baade	2458253,565	220,0741207	-21,339848	16,41	7,24E-02
1501	Baade	2458253,567	220,073605	-21,33967	16,39	7,51E-02
1501	Baade	2458253,568	220,0732867	-21,3395757	16,37	7,27E-02
1501	Baade	2458253,57	220,0729012	-21,3396096	16,39	7,05E-02
1501	Baade	2458253,571	220,0726238	-21,3395985	16,40	7,66E-02
1501	Baade	2458253,573	220,0721349	-21,3394637	16,42	7,22E-02
1501	Baade	2458253,574	220,0720823	-21,3393599	16,39	7,07E-02
1501	Baade	2458253,574	220,071846	-21,3394752	16,45	6,59E-02
1501	Baade	2458253,575	220,0715192	-21,3393376	16,52	8,23E-02
1501	Baade	2458253,576	220,0715096	-21,3392655	16,46	7,20E-02
1501	Baade	2458253,576	220,0712381	-21,3394792	16,45	7,23E-02
1501	Baade	2458253,577	220,0711245	-21,3392699	16,51	7,44E-02
1501	Baade	2458253,578	220,070947	-21,3392076	16,44	6,55E-02
1501	Baade	2458253,579	220,0706076	-21,3392261	16,20	7,26E-02
1501	Baade	2458253,58	220,0702744	-21,3390694	16,50	6,77E-02
1501	Baade	2458253,581	220,0701476	-21,3389702	16,43	7,04E-02
1501	Baade	2458253,581	220,0699226	-21,3391003	16,39	6,27E-02
1501	Baade	2458253,582	220,0699068	-21,3390322	16,40	6,27E-02
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441	Bathilde	2458253,369	220,0610491	-21,312546	12,55	4,72E-03
441	Bathilde	2458253,37	220,0609298	-21,3123937	12,54	2,94E-03
441	Bathilde	2458253,371	220,0608298	-21,3123498	12,52	2,74E-03
441	Bathilde	2458253,374	220,0601595	-21,3121047	12,57	4,10E-03
441	Bathilde	2458253,375	220,0598219	-21,3119709	12,56	2,94E-03
441	Bathilde	2458253,379	220,0590061	-21,3115374	12,55	3,38E-03
441	Bathilde	2458253,381	220,0585393	-21,3112429	12,54	3,04E-03
441	Bathilde	2458253,382	220,0584207	-21,3112332	12,51	2,93E-03
441	Bathilde	2458253,384	220,0580839	-21,3110132	12,53	3,13E-03
441	Bathilde	2458253,387	220,0575469	-21,3107599	12,54	3,44E-03
441	Bathilde	2458227,499	225,395343	-23,6768577	12,75	4,93E-03
441	Bathilde	2458253,387	220,0573712	-21,3106666	12,53	3,15E-03
441	Bathilde	2458227,5	225,395195	-23,6767568	12,75	4,93E-03
441	Bathilde	2458227,501	225,3949678	-23,6766342	12,75	4,92E-03
441	Bathilde	2458227,502	225,3948405	-23,6765939	12,75	5,03E-03
441	Bathilde	2458253,39	220,0568017	-21,310211	12,56	3,23E-03
441	Bathilde	2458253,391	220,0566332	-21,3102665	12,54	3,24E-03
441	Bathilde	2458227,503	225,394566	-23,6765308	12,75	4,94E-03
441	Bathilde	2458253,391	220,0565896	-21,3103132	12,56	3,24E-03
441	Bathilde	2458227,504	225,3944463	-23,6764847	12,75	4,93E-03
441	Bathilde	2458253,392	220,0564301	-21,3101181	12,52	3,34E-03
441	Bathilde	2458227,505	225,3943185	-23,6763705	12,74	5,04E-03
441	Bathilde	2458253,393	220,0562734	-21,3100322	12,52	3,24E-03
441	Bathilde	2458227,505	225,3941516	-23,6763921	12,75	4,61E-03
441	Bathilde	2458253,393	220,0561062	-21,3099918	12,55	3,14E-03
441	Bathilde	2458227,506	225,3940579	-23,6763428	12,75	4,92E-03
441	Bathilde	2458253,394	220,0559812	-21,3099278	12,54	3,05E-03
441	Bathilde	2458227,507	225,3939344	-23,6763438	12,75	4,93E-03
441	Bathilde	2458253,395	220,0558822	-21,3099166	12,54	3,14E-03
441	Bathilde	2458227,507	225,3937633	-23,6762901	12,75	4,61E-03
441	Bathilde	2458253,395	220,0556854	-21,3098512	12,53	3,04E-03
441	Bathilde	2458227,508	225,3935977	-23,6762225	12,74	4,63E-03
441	Bathilde	2458253,396	220,0555618	-21,3097057	12,54	3,23E-03

441	Bathilde	2458227,509	225,393483	-23,6761917	12,75	4,61E-03
441	Bathilde	2458253,397	220,0554129	-21,3096669	12,52	3,34E-03
441	Bathilde	2458227,509	225,393331	-23,6761205	12,76	4,60E-03
441	Bathilde	2458253,398	220,0553376	-21,3095314	12,54	3,14E-03
441	Bathilde	2458227,51	225,3932394	-23,6761162	12,75	4,42E-03
441	Bathilde	2458253,398	220,055079	-21,3095675	12,57	3,13E-03
441	Bathilde	2458227,511	225,3931175	-23,6760206	12,76	4,51E-03
441	Bathilde	2458253,399	220,0550344	-21,309524	12,53	3,15E-03
441	Bathilde	2458227,511	225,3929429	-23,6759187	12,75	4,32E-03
441	Bathilde	2458253,4	220,054826	-21,3093707	12,55	3,03E-03
441	Bathilde	2458227,512	225,3927745	-23,6758896	12,75	4,11E-03
441	Bathilde	2458253,4	220,0547224	-21,3093224	12,56	2,93E-03
441	Bathilde	2458227,513	225,3926722	-23,6758204	12,74	4,21E-03
441	Bathilde	2458253,401	220,0545354	-21,3091414	12,55	2,94E-03
441	Bathilde	2458227,514	225,3925708	-23,6758	12,74	4,21E-03
441	Bathilde	2458253,402	220,0544216	-21,309188	12,56	2,94E-03
441	Bathilde	2458227,514	225,392413	-23,6757143	12,76	4,20E-03
441	Bathilde	2458253,403	220,0542489	-21,3090027	12,53	2,93E-03
441	Bathilde	2458227,515	225,3922766	-23,6757077	12,76	4,00E-03
441	Bathilde	2458253,403	220,0541618	-21,3089766	12,53	3,04E-03
441	Bathilde	2458227,516	225,3921749	-23,6756426	12,74	4,00E-03
441	Bathilde	2458253,404	220,0540179	-21,3089181	12,59	3,30E-03
441	Bathilde	2458227,516	225,3920582	-23,6756242	12,76	3,79E-03
441	Bathilde	2458253,405	220,0538036	-21,3088414	12,55	3,63E-03
441	Bathilde	2458227,517	225,3918869	-23,6755499	12,75	3,90E-03
441	Bathilde	2458253,405	220,0536899	-21,308834	12,52	3,14E-03
441	Bathilde	2458227,518	225,3917939	-23,6755533	12,76	3,80E-03
441	Bathilde	2458227,518	225,3916122	-23,6754709	12,75	3,80E-03
441	Bathilde	2458227,519	225,3915107	-23,6754095	12,75	3,70E-03
441	Bathilde	2458227,52	225,391407	-23,675401	12,77	3,70E-03
441	Bathilde	2458253,408	220,0530711	-21,3085051	12,59	3,23E-03
441	Bathilde	2458227,52	225,3912574	-23,6753009	12,75	3,69E-03
441	Bathilde	2458253,409	220,0529718	-21,3085134	12,57	3,04E-03
441	Bathilde	2458227,521	225,391102	-23,6753033	12,75	3,69E-03
441	Bathilde	2458253,41	220,0528478	-21,3083592	12,57	2,93E-03
441	Bathilde	2458227,522	225,3910174	-23,6752818	12,76	3,50E-03
441	Bathilde	2458253,41	220,0526552	-21,3083454	12,56	2,83E-03
441	Bathilde	2458227,522	225,3908325	-23,6752226	12,74	3,70E-03
441	Bathilde	2458253,411	220,0525609	-21,3081887	12,55	3,42E-03
441	Bathilde	2458227,523	225,3906643	-23,6751612	12,75	3,70E-03
441	Bathilde	2458227,524	225,3905587	-23,6751029	12,76	3,40E-03
441	Bathilde	2458227,524	225,39047	-23,6750961	12,75	3,49E-03
441	Bathilde	2458227,525	225,3903127	-23,6749764	12,75	3,29E-03
441	Bathilde	2458253,414	220,051794	-21,3077803	12,53	3,24E-03
441	Bathilde	2458227,526	225,3901411	-23,6749162	12,75	3,28E-03
441	Bathilde	2458253,415	220,0517617	-21,3077749	12,55	2,93E-03
441	Bathilde	2458227,527	225,3900026	-23,6748898	12,75	3,28E-03
441	Bathilde	2458227,527	225,3899139	-23,6748396	12,77	3,39E-03
441	Bathilde	2458227,528	225,3897677	-23,6748014	12,75	3,28E-03
441	Bathilde	2458253,417	220,0512503	-21,3075666	12,57	2,73E-03
441	Bathilde	2458253,418	220,0511755	-21,3075681	12,58	2,82E-03
441	Bathilde	2458227,529	225,3894698	-23,6746338	12,75	3,18E-03
441	Bathilde	2458253,418	220,0509495	-21,3074721	12,56	2,82E-03
441	Bathilde	2458253,419	220,0508303	-21,3074322	12,56	2,83E-03
441	Bathilde	2458227,531	225,3892641	-23,6745944	12,77	3,17E-03
441	Bathilde	2458253,42	220,0506902	-21,307244	12,57	2,94E-03
441	Bathilde	2458227,531	225,389108	-23,6745391	12,76	3,18E-03
441	Bathilde	2458227,532	225,3888961	-23,6744193	12,76	3,08E-03
441	Bathilde	2458253,421	220,0503678	-21,3070591	12,58	2,84E-03
441	Bathilde	2458227,533	225,3888205	-23,6744251	12,75	3,08E-03
441	Bathilde	2458253,422	220,0502603	-21,3071237	12,57	2,73E-03
441	Bathilde	2458227,534	225,3886805	-23,674375	12,76	3,07E-03
441	Bathilde	2458253,423	220,050072	-21,3069963	12,58	2,84E-03
441	Bathilde	2458227,534	225,3884672	-23,6743326	12,77	3,19E-03
441	Bathilde	2458253,423	220,0500286	-21,3068852	12,59	2,83E-03
441	Bathilde	2458227,535	225,3883769	-23,6743177	12,77	3,17E-03
441	Bathilde	2458253,424	220,0497621	-21,3067414	12,59	2,83E-03
441	Bathilde	2458227,536	225,3882372	-23,6742266	12,78	2,97E-03
441	Bathilde	2458253,425	220,0497691	-21,3067271	12,59	2,72E-03
441	Bathilde	2458227,537	225,3880849	-23,6742504	12,77	3,08E-03
441	Bathilde	2458253,425	220,0495909	-21,3066847	12,58	2,73E-03
441	Bathilde	2458227,537	225,3879399	-23,6741638	12,77	3,08E-03
441	Bathilde	2458253,426	220,0494122	-21,3066755	12,57	2,74E-03
441	Bathilde	2458227,538	225,3878271	-23,6741385	12,77	2,88E-03
441	Bathilde	2458253,427	220,0493077	-21,3065723	12,59	2,74E-03
441	Bathilde	2458227,539	225,387696	-23,6740692	12,78	3,08E-03
441	Bathilde	2458253,427	220,0491227	-21,3063396	12,60	2,63E-03

441	Bathilde	2458227,539	225,3875752	-23,6740725	12,76	2,87E-03
441	Bathilde	2458253,428	220,0490515	-21,3064034	12,59	2,64E-03
441	Bathilde	2458227,54	225,3873853	-23,6740339	12,77	2,88E-03
441	Bathilde	2458253,429	220,0487916	-21,3062983	12,59	2,74E-03
441	Bathilde	2458227,541	225,3873059	-23,6739572	12,78	2,87E-03
441	Bathilde	2458253,43	220,0486557	-21,3062085	12,61	2,54E-03
441	Bathilde	2458227,541	225,3871399	-23,6738631	12,77	2,98E-03
441	Bathilde	2458253,43	220,0485228	-21,3061511	12,59	2,54E-03
441	Bathilde	2458227,542	225,3870222	-23,673862	12,78	2,97E-03
441	Bathilde	2458253,431	220,0484438	-21,3060868	12,59	2,64E-03
441	Bathilde	2458227,543	225,3868744	-23,6737834	12,76	2,87E-03
441	Bathilde	2458253,432	220,0482946	-21,3060337	12,60	2,55E-03
441	Bathilde	2458227,543	225,3867562	-23,673746	12,78	2,87E-03
441	Bathilde	2458253,432	220,048127	-21,3060128	12,58	2,64E-03
441	Bathilde	2458227,544	225,3866602	-23,6736787	12,79	2,97E-03
441	Bathilde	2458253,433	220,0480185	-21,3058926	12,60	2,54E-03
441	Bathilde	2458227,545	225,386467	-23,6736254	12,78	2,97E-03
441	Bathilde	2458253,434	220,0478745	-21,3058208	12,58	2,44E-03
441	Bathilde	2458227,546	225,3863798	-23,6735389	12,80	3,07E-03
441	Bathilde	2458253,434	220,0476496	-21,3057191	12,58	2,64E-03
441	Bathilde	2458227,546	225,3862137	-23,6735771	12,79	2,97E-03
441	Bathilde	2458227,547	225,386062	-23,6735036	12,79	3,07E-03
441	Bathilde	2458253,436	220,0473301	-21,3055112	12,60	2,45E-03
441	Bathilde	2458227,548	225,3859364	-23,6734101	12,81	2,97E-03
441	Bathilde	2458253,437	220,04717	-21,3054712	12,59	2,45E-03
441	Bathilde	2458227,548	225,3858462	-23,6733611	12,81	3,16E-03
441	Bathilde	2458253,437	220,047041	-21,3054307	12,59	2,35E-03
441	Bathilde	2458227,549	225,3857129	-23,673319	12,81	3,06E-03
441	Bathilde	2458253,438	220,0469748	-21,3053992	12,59	2,65E-03
441	Bathilde	2458227,55	225,385563	-23,6733033	12,81	3,07E-03
441	Bathilde	2458253,439	220,0467985	-21,3053334	12,61	2,25E-03
441	Bathilde	2458227,55	225,385412	-23,6732198	12,81	2,86E-03
441	Bathilde	2458253,439	220,0467288	-21,3052274	12,60	2,25E-03
441	Bathilde	2458227,551	225,3852837	-23,6731796	12,80	3,07E-03
441	Bathilde	2458253,44	220,0465786	-21,3051393	12,60	2,46E-03
441	Bathilde	2458227,552	225,3851345	-23,6731327	12,81	2,97E-03
441	Bathilde	2458253,44	220,0463958	-21,305115	12,59	2,45E-03
441	Bathilde	2458227,552	225,3850255	-23,6730862	12,80	3,17E-03
441	Bathilde	2458253,441	220,0462455	-21,3049825	12,61	2,36E-03
441	Bathilde	2458227,553	225,3849331	-23,6730206	12,80	2,97E-03
441	Bathilde	2458253,442	220,0461201	-21,3049567	12,61	2,26E-03
441	Bathilde	2458227,554	225,3847638	-23,6729961	12,81	2,97E-03
441	Bathilde	2458253,443	220,0459872	-21,3048528	12,60	2,35E-03
441	Bathilde	2458227,554	225,3846389	-23,6729769	12,81	2,97E-03
441	Bathilde	2458253,443	220,0458439	-21,3048233	12,60	2,15E-03
441	Bathilde	2458227,555	225,3844817	-23,6729046	12,81	3,07E-03
441	Bathilde	2458253,444	220,0457648	-21,3047214	12,60	2,46E-03
441	Bathilde	2458227,556	225,3844038	-23,6728918	12,81	2,86E-03
441	Bathilde	2458253,444	220,045632	-21,3046312	12,61	2,26E-03
441	Bathilde	2458227,557	225,3842279	-23,6728354	12,81	2,87E-03
441	Bathilde	2458253,445	220,0454798	-21,3046063	12,62	2,25E-03
441	Bathilde	2458227,557	225,384084	-23,67281	12,83	2,86E-03
441	Bathilde	2458253,446	220,0452851	-21,3045081	12,63	2,35E-03
441	Bathilde	2458227,558	225,3839837	-23,6727526	12,81	2,97E-03
441	Bathilde	2458253,447	220,0451499	-21,3044512	12,64	2,26E-03
441	Bathilde	2458227,559	225,383848	-23,6727361	12,82	2,97E-03
441	Bathilde	2458253,447	220,0450646	-21,3044429	12,64	2,26E-03
441	Bathilde	2458227,559	225,3836984	-23,6726737	12,82	2,96E-03
441	Bathilde	2458253,448	220,0448898	-21,3042783	12,62	2,35E-03
441	Bathilde	2458227,56	225,3835936	-23,672641	12,81	2,87E-03
441	Bathilde	2458253,449	220,0447352	-21,3042266	12,62	2,25E-03
441	Bathilde	2458227,568	225,3819265	-23,6719974	12,85	3,05E-03
441	Bathilde	2458253,449	220,0445767	-21,3041029	12,63	2,26E-03
441	Bathilde	2458227,569	225,3817393	-23,6719679	12,85	3,46E-03
441	Bathilde	2458253,45	220,0444364	-21,3040052	12,62	2,26E-03
441	Bathilde	2458227,571	225,3814662	-23,6717457	12,85	3,15E-03
441	Bathilde	2458253,451	220,0442989	-21,3039789	12,62	2,35E-03
441	Bathilde	2458227,572	225,3812422	-23,6717792	12,86	3,45E-03
441	Bathilde	2458253,452	220,0440608	-21,3039657	12,63	2,26E-03
441	Bathilde	2458227,573	225,3809581	-23,6716194	12,86	3,26E-03
441	Bathilde	2458253,452	220,0439569	-21,3038757	12,64	2,25E-03
441	Bathilde	2458253,453	220,0438234	-21,3037092	12,61	2,47E-03
441	Bathilde	2458227,575	225,3806373	-23,671526	12,84	3,16E-03
441	Bathilde	2458253,454	220,043691	-21,3037591	12,64	2,25E-03
441	Bathilde	2458227,577	225,3802711	-23,6713883	12,87	3,25E-03
441	Bathilde	2458253,454	220,0435864	-21,3037	12,64	2,25E-03
441	Bathilde	2458227,578	225,3801251	-23,6713021	12,87	3,16E-03

441	Bathilde	2458253,455	220,0434473	-21,3035549	12,64	2,37E-03
441	Bathilde	2458227,579	225,3799246	-23,6712566	12,86	3,15E-03
441	Bathilde	2458253,456	220,0432907	-21,3035013	12,63	2,26E-03
441	Bathilde	2458227,58	225,3796246	-23,67114	12,88	3,25E-03
441	Bathilde	2458253,456	220,0431816	-21,3034562	12,65	2,15E-03
441	Bathilde	2458227,581	225,3794156	-23,6710878	12,87	3,35E-03
441	Bathilde	2458253,457	220,0430328	-21,3033511	12,65	2,26E-03
441	Bathilde	2458227,582	225,3792757	-23,6710286	12,87	3,15E-03
441	Bathilde	2458253,458	220,0428446	-21,3032906	12,66	2,36E-03
441	Bathilde	2458227,583	225,3791903	-23,6710531	12,86	3,36E-03
441	Bathilde	2458253,458	220,0427458	-21,3031939	12,67	2,26E-03
441	Bathilde	2458227,584	225,3789166	-23,6708818	12,86	3,35E-03
441	Bathilde	2458253,459	220,0425991	-21,3031346	12,65	2,26E-03
441	Bathilde	2458227,585	225,3786744	-23,6708167	12,88	3,55E-03
441	Bathilde	2458253,46	220,0424879	-21,3030678	12,66	2,15E-03
441	Bathilde	2458227,586	225,3785356	-23,6707702	12,88	3,44E-03
441	Bathilde	2458253,46	220,0423233	-21,3029785	12,68	2,26E-03
441	Bathilde	2458253,461	220,0421438	-21,3028991	12,65	2,26E-03
441	Bathilde	2458227,589	225,3780669	-23,6705396	12,87	3,34E-03
441	Bathilde	2458253,462	220,0420214	-21,3028771	12,67	2,27E-03
441	Bathilde	2458227,589	225,3778965	-23,6705171	12,87	3,35E-03
441	Bathilde	2458253,462	220,0418436	-21,3028108	12,65	2,26E-03
441	Bathilde	2458227,591	225,3776064	-23,6704234	12,90	4,12E-03
441	Bathilde	2458253,463	220,0417465	-21,3027254	12,65	2,36E-03
441	Bathilde	2458227,592	225,3773476	-23,6703636	12,89	3,42E-03
441	Bathilde	2458253,464	220,0415881	-21,3026656	12,66	2,27E-03
441	Bathilde	2458227,593	225,3771921	-23,6703375	12,89	3,63E-03
441	Bathilde	2458253,464	220,0414763	-21,3026007	12,66	2,36E-03
441	Bathilde	2458227,593	225,37714	-23,6702092	12,88	3,74E-03
441	Bathilde	2458253,465	220,0412671	-21,3025218	12,66	2,35E-03
441	Bathilde	2458227,595	225,3767216	-23,6701259	12,89	3,74E-03
441	Bathilde	2458253,466	220,0411096	-21,3024332	12,67	2,46E-03
441	Bathilde	2458227,598	225,376171	-23,6699833	12,90	3,92E-03
441	Bathilde	2458253,467	220,0410291	-21,302367	12,68	2,25E-03
441	Bathilde	2458227,601	225,375698	-23,6697392	12,91	4,33E-03
441	Bathilde	2458253,468	220,040695	-21,3021996	12,68	2,35E-03
441	Bathilde	2458227,601	225,3755898	-23,6696908	12,90	4,24E-03
441	Bathilde	2458253,469	220,0406301	-21,302098	12,68	2,26E-03
441	Bathilde	2458253,469	220,0404339	-21,3020341	12,67	2,65E-03
441	Bathilde	2458227,604	225,3750009	-23,6695246	12,89	4,35E-03
441	Bathilde	2458253,47	220,040306	-21,3018921	12,68	2,45E-03
441	Bathilde	2458253,471	220,0401838	-21,3019109	12,69	2,74E-03
441	Bathilde	2458227,605	225,3747543	-23,6694785	12,90	4,56E-03
441	Bathilde	2458253,471	220,0399619	-21,3018914	12,69	2,54E-03
441	Bathilde	2458227,607	225,3744396	-23,669339	12,90	4,48E-03
441	Bathilde	2458253,472	220,0398997	-21,3018021	12,69	2,45E-03
441	Bathilde	2458253,473	220,039754	-21,3016891	12,69	2,55E-03
441	Bathilde	2458227,609	225,3741618	-23,6691678	12,91	4,46E-03
441	Bathilde	2458253,474	220,0396545	-21,3016204	12,69	2,56E-03
441	Bathilde	2458227,61	225,3738064	-23,669088	12,90	4,49E-03
441	Bathilde	2458253,474	220,0394785	-21,3015413	12,69	2,56E-03
441	Bathilde	2458253,483	220,0376093	-21,3006073	12,73	2,44E-03
441	Bathilde	2458227,612	225,3735078	-23,6689578	12,91	4,37E-03
441	Bathilde	2458253,485	220,0373205	-21,3004455	12,75	2,44E-03
441	Bathilde	2458227,614	225,3732065	-23,668892	12,92	4,47E-03
441	Bathilde	2458253,486	220,0370544	-21,3002878	12,73	2,44E-03
441	Bathilde	2458227,615	225,3730101	-23,6688291	12,90	4,47E-03
441	Bathilde	2458253,487	220,0368865	-21,3002414	12,73	2,64E-03
441	Bathilde	2458227,615	225,3728854	-23,6686867	12,92	4,78E-03
441	Bathilde	2458253,488	220,0366047	-21,3001488	12,73	2,45E-03
441	Bathilde	2458227,617	225,3725662	-23,6685875	12,92	4,68E-03
441	Bathilde	2458253,489	220,0363652	-21,29999	12,73	2,54E-03
441	Bathilde	2458227,618	225,3723669	-23,668411	12,91	4,68E-03
441	Bathilde	2458253,49	220,0362109	-21,299924	12,72	2,65E-03
441	Bathilde	2458253,492	220,0358371	-21,2997518	12,74	2,44E-03
441	Bathilde	2458227,619	225,372139	-23,6683844	12,93	4,38E-03
441	Bathilde	2458253,493	220,0355944	-21,2996327	12,74	2,55E-03
441	Bathilde	2458227,62	225,3719871	-23,6683858	12,92	4,38E-03
441	Bathilde	2458253,494	220,0353179	-21,2995312	12,75	2,45E-03
441	Bathilde	2458227,621	225,3718004	-23,6683469	12,92	4,26E-03
441	Bathilde	2458253,495	220,0350885	-21,2994058	12,73	2,55E-03
441	Bathilde	2458227,622	225,371494	-23,6681708	12,93	4,38E-03
441	Bathilde	2458253,497	220,034761	-21,299204	12,74	2,44E-03
441	Bathilde	2458253,499	220,0342347	-21,2989109	12,75	2,44E-03
441	Bathilde	2458227,624	225,3712052	-23,6681198	12,92	4,28E-03
441	Bathilde	2458253,5	220,034097	-21,2988258	12,75	2,44E-03
441	Bathilde	2458227,625	225,3710474	-23,668026	12,90	4,67E-03

441	Bathilde	2458253,502	220,0337458	-21,2987693	12,75	2,44E-03
441	Bathilde	2458227,626	225,3707683	-23,667905	12,92	4,57E-03
441	Bathilde	2458253,503	220,0335533	-21,298555	12,76	2,64E-03
441	Bathilde	2458227,627	225,3705039	-23,6678416	12,91	4,76E-03
441	Bathilde	2458253,503	220,0333615	-21,2984899	12,74	2,73E-03
441	Bathilde	2458227,628	225,3704244	-23,6678165	12,91	4,27E-03
441	Bathilde	2458253,505	220,0330746	-21,2983561	12,76	2,54E-03
441	Bathilde	2458227,629	225,3702837	-23,6677237	12,92	4,57E-03
441	Bathilde	2458253,506	220,0328473	-21,2982258	12,74	2,53E-03
441	Bathilde	2458227,629	225,3701381	-23,6676436	12,91	4,47E-03
441	Bathilde	2458253,507	220,0326982	-21,2981743	12,74	2,64E-03
441	Bathilde	2458253,507	220,0326094	-21,2980962	12,74	2,74E-03
441	Bathilde	2458253,508	220,0324985	-21,2980022	12,74	2,62E-03
441	Bathilde	2458253,51	220,0320796	-21,2978251	12,76	2,81E-03
441	Bathilde	2458253,511	220,0318492	-21,2977034	12,73	2,92E-03
441	Bathilde	2458253,512	220,0316138	-21,2975538	12,76	2,92E-03
441	Bathilde	2458253,514	220,0313261	-21,2973342	12,75	2,92E-03
441	Bathilde	2458253,515	220,031075	-21,2972654	12,74	2,93E-03
441	Bathilde	2458253,515	220,030928	-21,2972342	12,73	2,92E-03
441	Bathilde	2458253,516	220,030796	-21,2971471	12,71	3,04E-03
441	Bathilde	2458253,518	220,0304837	-21,2968821	12,72	3,22E-03
441	Bathilde	2458253,519	220,0301805	-21,2968345	12,72	2,92E-03
441	Bathilde	2458253,52	220,030097	-21,2968231	12,73	2,93E-03
441	Bathilde	2458253,521	220,0297975	-21,2966136	12,71	2,83E-03
441	Bathilde	2458253,523	220,0294767	-21,2964378	12,71	2,74E-03
441	Bathilde	2458253,524	220,0292344	-21,2963696	12,71	2,64E-03
441	Bathilde	2458253,524	220,0291035	-21,2963089	12,70	2,54E-03
441	Bathilde	2458253,525	220,0289575	-21,2961926	12,71	2,54E-03
441	Bathilde	2458253,527	220,0286046	-21,2960828	12,71	2,84E-03
441	Bathilde	2458253,528	220,0284179	-21,2958959	12,73	2,63E-03
441	Bathilde	2458253,528	220,0282399	-21,2958876	12,71	2,83E-03
441	Bathilde	2458253,53	220,0279415	-21,2956769	12,72	2,72E-03
441	Bathilde	2458253,531	220,0277316	-21,2955694	12,71	2,93E-03
441	Bathilde	2458253,532	220,0274846	-21,2954396	12,71	2,64E-03
441	Bathilde	2458253,533	220,0273188	-21,2953608	12,69	2,74E-03
441	Bathilde	2458253,534	220,0270396	-21,2951771	12,70	2,74E-03
441	Bathilde	2458253,536	220,0268526	-21,2950936	12,71	2,44E-03
441	Bathilde	2458253,536	220,0266524	-21,295028	12,69	2,74E-03
441	Bathilde	2458253,538	220,0263219	-21,2949271	12,69	2,64E-03
441	Bathilde	2458253,539	220,0260874	-21,2946947	12,70	2,64E-03
441	Bathilde	2458253,54	220,0259267	-21,2947147	12,71	2,54E-03
441	Bathilde	2458253,54	220,0258099	-21,2946329	12,69	2,54E-03
441	Bathilde	2458253,541	220,0255922	-21,2944329	12,69	2,64E-03
441	Bathilde	2458253,543	220,025317	-21,2942792	12,70	2,63E-03
441	Bathilde	2458253,544	220,0250212	-21,2942218	12,68	2,74E-03
441	Bathilde	2458253,545	220,0249242	-21,2941085	12,69	2,83E-03
441	Bathilde	2458253,545	220,0247506	-21,2940142	12,66	2,94E-03
441	Bathilde	2458253,546	220,0246192	-21,294	12,63	3,44E-03
441	Bathilde	2458253,547	220,0243718	-21,29393	12,67	2,64E-03
441	Bathilde	2458253,548	220,0242676	-21,2937343	12,64	3,05E-03
441	Bathilde	2458253,55	220,0239191	-21,2936035	12,67	2,83E-03
441	Bathilde	2458253,551	220,0236336	-21,2935219	12,67	2,64E-03
441	Bathilde	2458253,552	220,023472	-21,293295	12,66	2,83E-03
441	Bathilde	2458253,553	220,0230421	-21,2932603	12,63	2,84E-03
441	Bathilde	2458253,554	220,0228912	-21,2930535	12,64	2,74E-03
441	Bathilde	2458253,555	220,0227356	-21,2930064	12,65	2,65E-03
441	Bathilde	2458253,556	220,02264	-21,2929492	12,62	2,85E-03
441	Bathilde	2458253,557	220,0224869	-21,2928351	12,62	2,94E-03
441	Bathilde	2458253,558	220,0222094	-21,2927384	12,62	2,94E-03
441	Bathilde	2458253,559	220,0219131	-21,2925379	12,63	2,94E-03
441	Bathilde	2458253,56	220,0217612	-21,2925157	12,63	3,04E-03
441	Bathilde	2458253,561	220,0215679	-21,2923538	12,62	3,13E-03
441	Bathilde	2458253,563	220,0211851	-21,2922399	12,60	3,22E-03
441	Bathilde	2458253,564	220,0209441	-21,2921245	12,62	2,94E-03
441	Bathilde	2458253,564	220,0208811	-21,292054	12,61	2,94E-03
441	Bathilde	2458253,565	220,0207356	-21,2919931	12,59	2,84E-03
441	Bathilde	2458253,566	220,0205911	-21,2918688	12,60	2,85E-03
441	Bathilde	2458253,567	220,0203332	-21,2916722	12,61	2,94E-03
441	Bathilde	2458253,568	220,0200052	-21,2916609	12,62	3,03E-03
441	Bathilde	2458253,57	220,0196863	-21,2914159	12,61	3,13E-03
441	Bathilde	2458253,571	220,0194963	-21,2914041	12,61	2,94E-03
441	Bathilde	2458253,573	220,0191755	-21,2911602	12,60	2,74E-03
441	Bathilde	2458253,574	220,018999	-21,2910794	12,60	2,54E-03
441	Bathilde	2458253,574	220,0188494	-21,2910201	12,62	2,55E-03
441	Bathilde	2458253,575	220,0187097	-21,2908688	12,59	2,95E-03
441	Bathilde	2458253,576	220,0185627	-21,2908686	12,58	2,86E-03
441	Bathilde	2458253,576	220,0184432	-21,2907627	12,60	2,44E-03

441	Bathilde	2458253,577	220,0183263	-21,2906946	12,62	2,64E-03
441	Bathilde	2458253,578	220,0181593	-21,2905804	12,59	2,55E-03
441	Bathilde	2458253,579	220,0178697	-21,2905543	12,59	2,54E-03
441	Bathilde	2458253,58	220,017629	-21,2903053	12,61	2,55E-03
441	Bathilde	2458253,581	220,0174593	-21,2902582	12,59	2,55E-03
441	Bathilde	2458253,581	220,0172742	-21,2903006	12,58	2,56E-03
441	Bathilde	2458253,582	220,0172197	-21,2901801	12,60	2,45E-03
441	Bathilde	2458253,583	220,0170541	-21,2901057	12,60	2,45E-03
360	Carlova	2458250,38	180,9583428	13,2531529	13,67	3,58E-03
360	Carlova	2458252,358	180,8981765	13,2021483	13,88	4,01E-03
360	Carlova	2458252,359	180,8981239	13,2021192	13,89	4,20E-03
360	Carlova	2458250,383	180,9582065	13,2531271	13,66	3,27E-03
360	Carlova	2458252,36	180,8980869	13,20212	13,90	4,00E-03
360	Carlova	2458250,385	180,9581541	13,2530625	13,64	3,38E-03
360	Carlova	2458252,361	180,8980311	13,2021001	13,89	4,01E-03
360	Carlova	2458250,386	180,958121	13,2530409	13,64	3,40E-03
360	Carlova	2458252,362	180,8980332	13,20209	13,92	3,98E-03
360	Carlova	2458250,388	180,9580443	13,2529679	13,64	3,38E-03
360	Carlova	2458252,363	180,8980053	13,2020812	13,90	4,18E-03
360	Carlova	2458250,389	180,9579758	13,252979	13,64	3,08E-03
360	Carlova	2458252,364	180,8979586	13,2020581	13,93	3,98E-03
360	Carlova	2458250,391	180,9579231	13,2529244	13,64	3,19E-03
360	Carlova	2458252,365	180,8979737	13,2020374	13,92	4,19E-03
360	Carlova	2458250,392	180,9578768	13,2529245	13,64	3,07E-03
360	Carlova	2458252,366	180,8979281	13,2020411	13,93	3,99E-03
360	Carlova	2458250,393	180,9578199	13,2528289	13,63	3,20E-03
360	Carlova	2458252,366	180,8978955	13,2019932	13,93	4,19E-03
360	Carlova	2458250,395	180,9577385	13,2527856	13,63	3,19E-03
360	Carlova	2458252,367	180,8978818	13,2019838	13,93	4,39E-03
360	Carlova	2458252,368	180,8978267	13,2019537	13,94	4,02E-03
360	Carlova	2458250,398	180,9576231	13,2527182	13,64	3,19E-03
360	Carlova	2458252,377	180,8975969	13,2017012	14,00	4,19E-03
360	Carlova	2458250,4	180,9575805	13,2527455	13,62	3,18E-03
360	Carlova	2458252,378	180,8975367	13,2016107	14,00	4,21E-03
360	Carlova	2458250,401	180,9575245	13,2526447	13,64	3,18E-03
360	Carlova	2458252,38	180,8975004	13,2016154	14,00	4,40E-03
360	Carlova	2458250,402	180,9574357	13,2525964	13,64	3,00E-03
360	Carlova	2458250,404	180,9574303	13,252631	13,64	3,19E-03
360	Carlova	2458252,383	180,8973773	13,2014804	14,02	4,21E-03
360	Carlova	2458250,405	180,9573668	13,2525496	13,65	3,08E-03
360	Carlova	2458252,384	180,8973634	13,2014989	14,02	4,09E-03
360	Carlova	2458250,406	180,9572495	13,252503	13,65	3,09E-03
360	Carlova	2458252,386	180,8973203	13,2014458	14,01	4,21E-03
360	Carlova	2458250,408	180,9572353	13,2525142	13,66	3,19E-03
360	Carlova	2458252,387	180,8972733	13,2013745	14,01	4,28E-03
360	Carlova	2458250,409	180,9571757	13,2524556	13,65	3,29E-03
360	Carlova	2458252,389	180,8972223	13,2013114	14,01	4,22E-03
360	Carlova	2458250,41	180,9571199	13,2524151	13,66	3,48E-03
360	Carlova	2458252,39	180,8971704	13,2012617	14,02	4,09E-03
360	Carlova	2458250,412	180,9571011	13,2524406	13,67	3,40E-03
360	Carlova	2458252,391	180,8971189	13,2012702	14,02	3,99E-03
360	Carlova	2458250,413	180,9570599	13,2523433	13,69	3,28E-03
360	Carlova	2458252,393	180,8970766	13,2011856	14,00	4,19E-03
360	Carlova	2458250,414	180,9569814	13,2523268	13,70	3,29E-03
360	Carlova	2458252,394	180,8970313	13,201171	13,99	4,10E-03
360	Carlova	2458250,416	180,9569055	13,2523525	13,72	3,37E-03
360	Carlova	2458252,395	180,8970102	13,2011417	14,00	4,09E-03
360	Carlova	2458250,417	180,9568532	13,2522818	13,73	3,38E-03
360	Carlova	2458252,397	180,8969547	13,2010637	13,97	4,29E-03
360	Carlova	2458250,418	180,9568237	13,2522916	13,75	3,39E-03
360	Carlova	2458252,398	180,8969198	13,2010691	13,99	3,88E-03
360	Carlova	2458250,42	180,9567311	13,2521838	13,77	3,50E-03
360	Carlova	2458252,399	180,8968729	13,2010153	13,97	3,88E-03
360	Carlova	2458250,421	180,9567032	13,2522477	13,77	3,61E-03
360	Carlova	2458252,401	180,8968235	13,2009394	13,97	3,90E-03
360	Carlova	2458250,422	180,9566413	13,2521363	13,80	3,51E-03
360	Carlova	2458252,402	180,8968487	13,2009994	13,96	4,00E-03
360	Carlova	2458250,424	180,9566488	13,2521582	13,82	3,60E-03
360	Carlova	2458252,403	180,8968049	13,2008804	13,97	3,90E-03
360	Carlova	2458250,425	180,9565466	13,2521192	13,83	3,73E-03
360	Carlova	2458252,405	180,8967778	13,200891	13,96	4,08E-03
360	Carlova	2458250,427	180,9564857	13,2520105	13,85	3,80E-03
360	Carlova	2458252,406	180,8967068	13,2008224	13,96	4,00E-03
360	Carlova	2458250,428	180,9564621	13,2520198	13,85	4,12E-03
360	Carlova	2458252,408	180,8966611	13,200746	13,96	3,78E-03
360	Carlova	2458250,429	180,9563545	13,2519621	13,88	3,91E-03
360	Carlova	2458252,409	180,8965889	13,2007933	13,95	3,88E-03

360	Carlova	2458250,431	180,9563288	13,2520196	13,88	4,22E-03
360	Carlova	2458252,41	180,8965495	13,2006924	13,95	3,87E-03
360	Carlova	2458250,432	180,9562597	13,2518986	13,91	3,90E-03
360	Carlova	2458252,412	180,896502	13,2006977	13,93	3,68E-03
360	Carlova	2458250,433	180,9562243	13,2519395	13,92	4,00E-03
360	Carlova	2458252,415	180,8964536	13,2005965	13,93	3,87E-03
360	Carlova	2458250,435	180,9561567	13,2518219	13,93	4,08E-03
360	Carlova	2458252,416	180,896419	13,2005183	13,91	3,79E-03
360	Carlova	2458250,435	180,9561132	13,2518239	13,93	4,03E-03
360	Carlova	2458252,418	180,8963674	13,2005044	13,90	3,66E-03
360	Carlova	2458250,437	180,9560483	13,251794	13,93	3,99E-03
360	Carlova	2458252,419	180,8962984	13,2004409	13,90	3,47E-03
360	Carlova	2458250,438	180,9560202	13,2517959	13,93	4,02E-03
360	Carlova	2458252,42	180,8962693	13,2004598	13,88	3,69E-03
360	Carlova	2458250,439	180,9559845	13,2518076	13,94	4,11E-03
360	Carlova	2458252,422	180,8962261	13,2003604	13,87	3,58E-03
360	Carlova	2458250,441	180,955885	13,2516787	13,94	4,11E-03
360	Carlova	2458252,424	180,8961973	13,2003595	13,87	3,48E-03
360	Carlova	2458250,445	180,9557924	13,2516262	13,94	3,99E-03
360	Carlova	2458252,426	180,8961206	13,20031	13,85	3,37E-03
360	Carlova	2458250,446	180,9557366	13,2516091	13,92	4,10E-03
360	Carlova	2458252,427	180,8960487	13,2002145	13,82	3,58E-03
360	Carlova	2458250,447	180,9556961	13,2515362	13,93	4,12E-03
360	Carlova	2458252,428	180,8960221	13,2002072	13,82	3,38E-03
360	Carlova	2458250,448	180,9556593	13,2515677	13,93	4,10E-03
360	Carlova	2458252,43	180,8959574	13,2001321	13,81	3,47E-03
360	Carlova	2458250,45	180,9555636	13,2514983	13,94	4,02E-03
360	Carlova	2458252,431	180,8959855	13,2001546	13,80	3,28E-03
360	Carlova	2458250,451	180,9555358	13,2514485	13,93	4,21E-03
360	Carlova	2458252,432	180,8959515	13,2001328	13,81	3,27E-03
360	Carlova	2458250,452	180,9555085	13,2514959	13,93	4,08E-03
360	Carlova	2458252,434	180,8958732	13,2000294	13,77	3,49E-03
360	Carlova	2458250,454	180,9554302	13,2513747	13,93	4,23E-03
360	Carlova	2458252,435	180,8958275	13,1999959	13,77	3,19E-03
360	Carlova	2458250,455	180,9553788	13,251363	13,94	4,09E-03
360	Carlova	2458252,436	180,8957934	13,2000077	13,76	3,38E-03
360	Carlova	2458250,456	180,9553348	13,2513927	13,93	4,21E-03
360	Carlova	2458252,438	180,8957491	13,1999026	13,75	3,27E-03
360	Carlova	2458250,458	180,9552377	13,2512937	13,93	4,29E-03
360	Carlova	2458252,439	180,8957415	13,1998768	13,74	3,27E-03
360	Carlova	2458250,458	180,9552452	13,2512578	13,94	4,39E-03
360	Carlova	2458252,44	180,8957328	13,1999002	13,73	3,09E-03
360	Carlova	2458250,46	180,9552131	13,2512539	13,94	4,20E-03
360	Carlova	2458252,441	180,8956677	13,1997954	13,73	3,18E-03
360	Carlova	2458250,462	180,9551052	13,2512035	13,95	4,20E-03
360	Carlova	2458252,443	180,8956055	13,1998039	13,71	3,17E-03
360	Carlova	2458250,462	180,9550864	13,2512224	13,94	4,23E-03
360	Carlova	2458252,444	180,8955599	13,1997562	13,71	3,09E-03
360	Carlova	2458250,463	180,9550706	13,2512184	13,94	4,41E-03
360	Carlova	2458252,445	180,8955013	13,1996621	13,70	3,07E-03
360	Carlova	2458250,465	180,9549687	13,2511007	13,93	4,30E-03
360	Carlova	2458252,447	180,8954727	13,1997273	13,70	2,98E-03
360	Carlova	2458250,466	180,9549338	13,2511274	13,92	4,53E-03
360	Carlova	2458252,448	180,8954402	13,1996227	13,70	3,07E-03
360	Carlova	2458250,467	180,954904	13,2511273	13,91	4,71E-03
360	Carlova	2458252,449	180,8954227	13,1995882	13,68	3,17E-03
360	Carlova	2458250,469	180,9548304	13,2510036	13,91	4,19E-03
360	Carlova	2458252,451	180,8953777	13,1995877	13,68	2,97E-03
360	Carlova	2458250,47	180,9547866	13,2510425	13,91	4,42E-03
360	Carlova	2458252,451	180,8953322	13,1995071	13,67	3,09E-03
360	Carlova	2458250,471	180,954763	13,2510397	13,91	4,40E-03
360	Carlova	2458252,452	180,8953039	13,1994616	13,68	3,07E-03
360	Carlova	2458250,472	180,9547223	13,2510135	13,92	4,32E-03
360	Carlova	2458252,454	180,8952637	13,1994699	13,67	3,07E-03
360	Carlova	2458250,474	180,9546537	13,2509346	13,91	4,29E-03
360	Carlova	2458252,455	180,8952421	13,1994174	13,67	3,07E-03
360	Carlova	2458250,475	180,9546079	13,2508484	13,88	4,44E-03
360	Carlova	2458252,456	180,8952183	13,1993691	13,66	3,18E-03
360	Carlova	2458250,476	180,9545752	13,2508476	13,90	4,42E-03
360	Carlova	2458252,458	180,8951758	13,1993479	13,67	3,07E-03
360	Carlova	2458250,478	180,9545138	13,2508655	13,90	4,31E-03
360	Carlova	2458252,46	180,8950925	13,1992779	13,67	3,44E-03
360	Carlova	2458250,479	180,9544524	13,2508209	13,90	4,40E-03
360	Carlova	2458252,462	180,8950671	13,1992022	13,67	2,97E-03
360	Carlova	2458250,48	180,9544025	13,2507785	13,89	4,40E-03
360	Carlova	2458252,463	180,8949905	13,1991729	13,66	3,17E-03
360	Carlova	2458250,481	180,9543627	13,2507226	13,89	4,44E-03

360	Carlova	2458252,464	180,8949892	13,1991684	13,66	2,87E-03
360	Carlova	2458250,482	180,9543042	13,2506972	13,88	4,43E-03
360	Carlova	2458252,465	180,894956	13,1991836	13,68	2,97E-03
360	Carlova	2458250,484	180,9542443	13,2506908	13,88	4,31E-03
360	Carlova	2458252,467	180,8949017	13,19905	13,68	3,07E-03
360	Carlova	2458250,485	180,954224	13,2507089	13,86	4,40E-03
360	Carlova	2458250,486	180,954183	13,2506441	13,87	4,52E-03
360	Carlova	2458252,47	180,8948237	13,199034	13,70	3,17E-03
360	Carlova	2458250,487	180,9541462	13,2505754	13,85	4,23E-03
360	Carlova	2458252,471	180,8947888	13,1989533	13,70	3,27E-03
360	Carlova	2458250,488	180,9541121	13,2505701	13,85	4,31E-03
360	Carlova	2458252,472	180,8947446	13,1989046	13,70	3,17E-03
360	Carlova	2458250,488	180,9540789	13,2505692	13,85	4,41E-03
360	Carlova	2458252,473	180,8947134	13,198872	13,72	3,06E-03
360	Carlova	2458250,49	180,9539963	13,2505815	13,83	4,51E-03
360	Carlova	2458252,474	180,8946831	13,198845	13,70	3,19E-03
360	Carlova	2458250,492	180,9539491	13,2504675	13,82	4,41E-03
360	Carlova	2458252,476	180,8946353	13,1988413	13,73	3,16E-03
360	Carlova	2458250,492	180,9539039	13,250422	13,81	4,43E-03
360	Carlova	2458250,493	180,9538977	13,2504023	13,82	4,50E-03
360	Carlova	2458252,478	180,8946271	13,1987768	13,74	3,47E-03
360	Carlova	2458250,494	180,9538442	13,2503905	13,82	4,51E-03
360	Carlova	2458252,479	180,8945774	13,1987016	13,75	3,28E-03
360	Carlova	2458250,495	180,9538035	13,2503907	13,82	4,51E-03
360	Carlova	2458252,481	180,8944807	13,1986357	13,77	3,39E-03
360	Carlova	2458250,496	180,9537806	13,2503817	13,81	4,40E-03
360	Carlova	2458252,482	180,8944942	13,1986456	13,79	3,38E-03
360	Carlova	2458250,498	180,9537148	13,2503607	13,79	4,50E-03
360	Carlova	2458252,483	180,8944762	13,1986463	13,80	3,38E-03
360	Carlova	2458250,499	180,9536748	13,2503315	13,79	4,61E-03
360	Carlova	2458252,484	180,8944534	13,1986383	13,81	3,37E-03
360	Carlova	2458250,5	180,9536625	13,2503042	13,79	4,62E-03
360	Carlova	2458252,485	180,8944178	13,1985936	13,81	3,49E-03
360	Carlova	2458250,501	180,9536061	13,2502451	13,78	4,60E-03
360	Carlova	2458252,486	180,8943719	13,1985372	13,85	3,48E-03
360	Carlova	2458250,502	180,9535707	13,2502097	13,79	4,80E-03
360	Carlova	2458252,488	180,8943101	13,19845	13,86	3,87E-03
360	Carlova	2458250,504	180,9535458	13,2502217	13,77	4,92E-03
360	Carlova	2458252,49	180,894263	13,1983765	13,87	3,87E-03
360	Carlova	2458250,505	180,9534543	13,2502101	13,77	5,02E-03
360	Carlova	2458252,491	180,8941922	13,1983401	13,90	3,77E-03
360	Carlova	2458250,506	180,953426	13,2501863	13,78	5,53E-03
360	Carlova	2458252,492	180,8941596	13,1983128	13,91	3,87E-03
360	Carlova	2458250,507	180,9533679	13,2501475	13,76	6,16E-03
360	Carlova	2458252,493	180,8941409	13,1982882	13,91	3,98E-03
360	Carlova	2458250,508	180,9533535	13,2501266	13,75	6,75E-03
360	Carlova	2458252,494	180,8941206	13,1982753	13,92	3,98E-03
360	Carlova	2458250,508	180,953332	13,2501146	13,77	7,25E-03
360	Carlova	2458252,495	180,8940956	13,1982738	13,94	3,99E-03
360	Carlova	2458250,509	180,9532709	13,2500741	13,76	7,46E-03
360	Carlova	2458252,496	180,8940528	13,1982496	13,97	3,89E-03
360	Carlova	2458250,51	180,9532434	13,2500802	13,76	8,37E-03
360	Carlova	2458252,498	180,8940438	13,1981911	13,96	3,90E-03
360	Carlova	2458250,511	180,9531908	13,2500372	13,74	8,58E-03
360	Carlova	2458252,499	180,8940142	13,198144	13,95	4,08E-03
360	Carlova	2458250,512	180,9531918	13,2500343	13,76	9,28E-03
360	Carlova	2458252,5	180,8939898	13,1981067	13,96	4,08E-03
360	Carlova	2458250,513	180,953142	13,2499949	13,76	9,99E-03
360	Carlova	2458252,501	180,8939566	13,1980611	13,96	4,09E-03
360	Carlova	2458250,514	180,9531188	13,2499708	13,75	1,15E-02
360	Carlova	2458252,502	180,8939118	13,19802	13,96	4,40E-03
360	Carlova	2458250,515	180,9530563	13,2499341	13,75	1,30E-02
360	Carlova	2458252,504	180,8938625	13,1980055	13,96	4,09E-03
360	Carlova	2458250,517	180,9530285	13,2498571	13,77	1,57E-02
360	Carlova	2458252,504	180,89383	13,1979636	13,96	4,09E-03
360	Carlova	2458252,505	180,8937852	13,1979282	13,96	4,19E-03
360	Carlova	2458252,506	180,8937695	13,1979208	13,94	4,39E-03
360	Carlova	2458252,507	180,8937372	13,1979016	13,95	4,31E-03
360	Carlova	2458252,508	180,8937215	13,1978635	13,95	4,40E-03
360	Carlova	2458252,509	180,8936908	13,1978227	13,96	4,49E-03
360	Carlova	2458252,51	180,8936598	13,1977972	13,96	4,31E-03
360	Carlova	2458252,511	180,8936283	13,1977672	13,95	4,30E-03
360	Carlova	2458252,512	180,8936124	13,1977349	13,95	4,40E-03
360	Carlova	2458252,513	180,8935614	13,1976888	13,93	4,70E-03
360	Carlova	2458252,513	180,8935518	13,1976668	13,96	4,19E-03
360	Carlova	2458252,514	180,8935273	13,1976563	13,96	4,50E-03
360	Carlova	2458252,515	180,8934875	13,1976278	13,97	4,16E-03

360	Carlova	2458252,516	180,8934652	13,1976022	13,96	4,47E-03
360	Carlova	2458252,517	180,8934431	13,1975667	13,95	4,50E-03
360	Carlova	2458252,518	180,8934239	13,1975706	13,95	4,38E-03
360	Carlova	2458252,519	180,8934005	13,197517	13,96	4,39E-03
360	Carlova	2458252,52	180,8933625	13,1974872	13,96	4,58E-03
360	Carlova	2458252,521	180,8933515	13,1974777	13,96	4,71E-03
360	Carlova	2458252,522	180,8933245	13,1974456	13,96	4,69E-03
360	Carlova	2458252,522	180,8932971	13,1974219	13,96	4,46E-03
360	Carlova	2458252,523	180,8932771	13,1973992	13,96	4,58E-03
360	Carlova	2458252,524	180,8932426	13,1973532	13,96	4,59E-03
360	Carlova	2458252,525	180,8932246	13,1973359	13,96	4,60E-03
360	Carlova	2458252,526	180,8932001	13,1973298	13,96	4,50E-03
360	Carlova	2458252,527	180,8931909	13,1973589	13,96	4,39E-03
360	Carlova	2458252,528	180,8931724	13,1973113	13,96	4,30E-03
360	Carlova	2458252,529	180,8931401	13,1973014	13,95	4,31E-03
360	Carlova	2458252,53	180,8931056	13,1972778	13,96	4,39E-03
360	Carlova	2458252,531	180,8930763	13,197225	13,96	4,39E-03
360	Carlova	2458252,531	180,8930727	13,1972245	13,95	4,49E-03
360	Carlova	2458252,532	180,8930346	13,1971737	13,94	4,29E-03
360	Carlova	2458252,533	180,8930111	13,1971284	13,94	4,21E-03
360	Carlova	2458252,534	180,8929706	13,1970969	13,94	4,28E-03
360	Carlova	2458252,535	180,8929679	13,1971091	13,93	4,38E-03
360	Carlova	2458252,536	180,8929417	13,1970437	13,92	4,41E-03
360	Carlova	2458252,537	180,8929043	13,1970025	13,93	4,28E-03
360	Carlova	2458252,538	180,892883	13,1969858	13,92	4,41E-03
360	Carlova	2458252,539	180,892868	13,1969812	13,92	4,30E-03
360	Carlova	2458252,54	180,8928188	13,1969243	13,92	4,31E-03
360	Carlova	2458252,54	180,8928153	13,1969003	13,92	4,40E-03
360	Carlova	2458252,541	180,8927877	13,1968772	13,92	4,21E-03
402	Chloe	2458226,53	219,4855345	5,4109194	12,19	1,46E-03
402	Chloe	2458227,387	219,3108141	5,4978616	12,14	1,66E-03
402	Chloe	2458205,46	222,7830432	2,8158157	12,47	4,66E-03
402	Chloe	2458205,461	222,7830094	2,8159145	12,46	4,57E-03
402	Chloe	2458205,462	222,7829566	2,8160139	12,47	4,37E-03
402	Chloe	2458226,536	219,4843346	5,4115331	12,23	1,46E-03
402	Chloe	2458227,389	219,3104037	5,4980394	12,13	1,66E-03
402	Chloe	2458205,462	222,7828946	2,8160724	12,46	4,30E-03
402	Chloe	2458226,536	219,4841947	5,4115948	12,21	1,46E-03
402	Chloe	2458227,39	219,3103091	5,4981234	12,16	1,76E-03
402	Chloe	2458205,463	222,7828089	2,8161432	12,45	4,57E-03
402	Chloe	2458226,537	219,4840559	5,4116396	12,22	1,46E-03
402	Chloe	2458205,464	222,7827329	2,8162736	12,45	4,49E-03
402	Chloe	2458205,464	222,7827139	2,8163494	12,46	4,37E-03
402	Chloe	2458226,538	219,4837833	5,4117644	12,22	1,46E-03
402	Chloe	2458227,392	219,3098739	5,4983144	12,16	1,66E-03
402	Chloe	2458205,465	222,782577	2,8164211	12,44	4,76E-03
402	Chloe	2458226,539	219,4836949	5,4118315	12,24	1,46E-03
402	Chloe	2458227,392	219,309759	5,4983852	12,17	1,66E-03
402	Chloe	2458205,466	222,7825232	2,8165172	12,45	4,60E-03
402	Chloe	2458226,539	219,4835325	5,4118778	12,22	1,46E-03
402	Chloe	2458205,466	222,78249	2,8166454	12,45	4,37E-03
402	Chloe	2458227,394	219,3094919	5,4984775	12,16	1,56E-03
402	Chloe	2458205,467	222,7824482	2,8167402	12,45	4,47E-03
402	Chloe	2458227,394	219,3093292	5,4985525	12,15	1,66E-03
402	Chloe	2458205,468	222,7823776	2,816819	12,48	4,18E-03
402	Chloe	2458227,395	219,3092101	5,4985999	12,15	1,56E-03
402	Chloe	2458205,468	222,7822779	2,8168836	12,47	4,50E-03
402	Chloe	2458226,542	219,4829669	5,4122187	12,26	1,46E-03
402	Chloe	2458227,396	219,3090564	5,4986503	12,14	1,66E-03
402	Chloe	2458205,469	222,7822197	2,8169863	12,47	4,27E-03
402	Chloe	2458227,397	219,3088015	5,4987421	12,12	1,56E-03
402	Chloe	2458205,47	222,7821123	2,8171677	12,48	4,36E-03
402	Chloe	2458227,398	219,3086472	5,4988466	12,15	1,56E-03
402	Chloe	2458205,471	222,7820437	2,8172246	12,46	4,47E-03
402	Chloe	2458227,398	219,308531	5,4988849	12,15	1,56E-03
402	Chloe	2458205,472	222,7819941	2,8173079	12,46	4,39E-03
402	Chloe	2458227,399	219,3084004	5,498968	12,14	1,56E-03
402	Chloe	2458205,472	222,7818726	2,8174035	12,44	4,68E-03
402	Chloe	2458227,4	219,3082597	5,4990465	12,15	1,56E-03
402	Chloe	2458205,473	222,7817836	2,8174899	12,45	4,29E-03
402	Chloe	2458227,4	219,3081179	5,4991189	12,14	1,56E-03
402	Chloe	2458205,474	222,7817896	2,8175704	12,45	4,48E-03
402	Chloe	2458226,555	219,4802077	5,4134287	12,31	1,56E-03
402	Chloe	2458227,401	219,3079792	5,4991551	12,13	1,56E-03
402	Chloe	2458227,401	219,3078993	5,4992432	12,14	1,66E-03
402	Chloe	2458205,475	222,781672	2,8177657	12,45	4,38E-03
402	Chloe	2458226,557	219,479716	5,4136826	12,32	1,56E-03

402	Chloe	2458205,475	222,7815734	2,8178156	12,47	4,18E-03
402	Chloe	2458227,403	219,30757	5,4994343	12,16	1,66E-03
402	Chloe	2458205,476	222,7814673	2,8179181	12,46	4,27E-03
402	Chloe	2458226,56	219,4791805	5,4139708	12,32	1,56E-03
402	Chloe	2458205,477	222,7814905	2,8179795	12,46	4,08E-03
402	Chloe	2458226,561	219,4789702	5,4140644	12,31	1,56E-03
402	Chloe	2458227,404	219,3072906	5,4995805	12,18	1,56E-03
402	Chloe	2458205,477	222,78138	2,8180664	12,46	4,09E-03
402	Chloe	2458226,561	219,4788446	5,4141269	12,32	1,66E-03
402	Chloe	2458227,405	219,3071246	5,499614	12,16	1,66E-03
402	Chloe	2458205,478	222,7813592	2,8181219	12,46	4,46E-03
402	Chloe	2458226,563	219,4784968	5,414301	12,33	1,56E-03
402	Chloe	2458227,405	219,3070292	5,4996654	12,18	1,76E-03
402	Chloe	2458205,479	222,781266	2,8181896	12,46	4,27E-03
402	Chloe	2458226,564	219,4783114	5,4143887	12,32	1,56E-03
402	Chloe	2458205,479	222,7811865	2,8183432	12,42	4,48E-03
402	Chloe	2458226,565	219,478139	5,4144648	12,33	1,66E-03
402	Chloe	2458227,407	219,3067718	5,4997742	12,16	1,66E-03
402	Chloe	2458205,48	222,7811384	2,8184151	12,46	4,15E-03
402	Chloe	2458226,566	219,4778443	5,4146198	12,33	1,66E-03
402	Chloe	2458227,407	219,3066616	5,499825	12,16	1,56E-03
402	Chloe	2458226,567	219,4776272	5,414747	12,34	1,56E-03
402	Chloe	2458227,408	219,3064731	5,4999158	12,18	1,66E-03
402	Chloe	2458205,481	222,7810225	2,8185853	12,45	4,47E-03
402	Chloe	2458226,568	219,4775161	5,4147556	12,36	1,66E-03
402	Chloe	2458205,482	222,78092	2,8186695	12,46	4,14E-03
402	Chloe	2458226,569	219,4771765	5,4149358	12,37	1,66E-03
402	Chloe	2458227,409	219,3061902	5,5000073	12,15	1,56E-03
402	Chloe	2458205,483	222,7808344	2,8187327	12,45	4,65E-03
402	Chloe	2458226,57	219,4769689	5,4150456	12,35	1,66E-03
402	Chloe	2458227,41	219,3060845	5,5000818	12,18	1,66E-03
402	Chloe	2458205,483	222,7808553	2,8188655	12,44	4,63E-03
402	Chloe	2458226,571	219,4768487	5,4151123	12,35	1,65E-03
402	Chloe	2458227,411	219,3059251	5,500118	12,14	1,56E-03
402	Chloe	2458205,484	222,7807811	2,818937	12,47	4,25E-03
402	Chloe	2458226,571	219,4767102	5,4151724	12,37	1,76E-03
402	Chloe	2458227,411	219,3057918	5,5002131	12,16	1,56E-03
402	Chloe	2458205,485	222,7806386	2,8190496	12,46	4,05E-03
402	Chloe	2458226,573	219,4763939	5,4152938	12,38	1,76E-03
402	Chloe	2458227,412	219,3056858	5,5002531	12,14	1,56E-03
402	Chloe	2458205,485	222,7805589	2,8191748	12,44	4,45E-03
402	Chloe	2458226,574	219,4761849	5,4154008	12,37	1,76E-03
402	Chloe	2458227,412	219,3055422	5,5003359	12,15	1,56E-03
402	Chloe	2458205,486	222,7805366	2,8192407	12,43	4,46E-03
402	Chloe	2458226,574	219,4760443	5,4154869	12,37	1,75E-03
402	Chloe	2458227,413	219,3053263	5,5004309	12,16	1,57E-03
402	Chloe	2458205,487	222,7804462	2,8192988	12,45	3,97E-03
402	Chloe	2458226,575	219,4759433	5,4155514	12,37	1,76E-03
402	Chloe	2458205,487	222,7803707	2,8194032	12,46	4,32E-03
402	Chloe	2458226,577	219,4756068	5,4157214	12,37	1,66E-03
402	Chloe	2458227,414	219,3050994	5,5006084	12,20	1,66E-03
402	Chloe	2458205,488	222,7803241	2,81951	12,45	3,98E-03
402	Chloe	2458226,578	219,4753837	5,4157948	12,41	1,66E-03
402	Chloe	2458227,415	219,3049904	5,5006492	12,17	1,66E-03
402	Chloe	2458205,488	222,7802714	2,8195479	12,45	4,06E-03
402	Chloe	2458226,578	219,4752535	5,4158597	12,39	1,66E-03
402	Chloe	2458227,416	219,3048334	5,5007152	12,19	1,56E-03
402	Chloe	2458205,489	222,7802462	2,819654	12,45	3,99E-03
402	Chloe	2458226,579	219,4751129	5,4159028	12,42	1,76E-03
402	Chloe	2458205,49	222,7801499	2,8197087	12,46	3,87E-03
402	Chloe	2458226,58	219,474816	5,4161008	12,39	1,65E-03
402	Chloe	2458227,417	219,3045612	5,5008476	12,17	1,56E-03
402	Chloe	2458226,581	219,4745798	5,4161679	12,41	1,66E-03
402	Chloe	2458226,582	219,4744643	5,4162398	12,41	1,56E-03
402	Chloe	2458227,418	219,3042463	5,5009815	12,19	1,56E-03
402	Chloe	2458205,492	222,7799656	2,8200068	12,45	4,06E-03
402	Chloe	2458226,583	219,4743295	5,4163286	12,40	1,66E-03
402	Chloe	2458205,492	222,779922	2,8201236	12,46	4,52E-03
402	Chloe	2458226,584	219,4740164	5,4164943	12,40	1,66E-03
402	Chloe	2458227,42	219,3039933	5,501088	12,21	1,56E-03
402	Chloe	2458205,493	222,779768	2,820171	12,44	4,25E-03
402	Chloe	2458226,585	219,4737974	5,4165603	12,42	1,66E-03
402	Chloe	2458227,42	219,3038557	5,5011364	12,17	1,56E-03
402	Chloe	2458205,494	222,7797177	2,8202606	12,44	4,64E-03
402	Chloe	2458226,586	219,4736548	5,4166071	12,43	1,66E-03
402	Chloe	2458227,421	219,3036937	5,5012122	12,20	1,56E-03
402	Chloe	2458226,586	219,4735314	5,4167132	12,40	1,66E-03

402	Chloe	2458227,422	219,3035496	5,5012686	12,18	1,66E-03
402	Chloe	2458205,495	222,7795961	2,8204425	12,44	4,16E-03
402	Chloe	2458226,588	219,4732216	5,4168404	12,42	1,66E-03
402	Chloe	2458227,422	219,3034605	5,501281	12,17	1,56E-03
402	Chloe	2458205,496	222,7795289	2,8205473	12,45	3,87E-03
402	Chloe	2458226,589	219,472997	5,4169723	12,40	1,76E-03
402	Chloe	2458227,423	219,3033629	5,5013707	12,21	1,56E-03
402	Chloe	2458205,497	222,7793893	2,8206623	12,45	3,70E-03
402	Chloe	2458226,589	219,4728761	5,4169937	12,43	1,66E-03
402	Chloe	2458227,423	219,3031941	5,5014071	12,17	1,56E-03
402	Chloe	2458205,497	222,7793545	2,8207565	12,45	3,79E-03
402	Chloe	2458226,59	219,4727429	5,4170553	12,44	1,76E-03
402	Chloe	2458227,424	219,3030512	5,5015121	12,19	1,56E-03
402	Chloe	2458205,498	222,7792709	2,820833	12,44	3,88E-03
402	Chloe	2458226,591	219,4724746	5,417257	12,42	1,66E-03
402	Chloe	2458227,425	219,3029002	5,5015638	12,18	1,56E-03
402	Chloe	2458205,499	222,7792226	2,820921	12,43	3,89E-03
402	Chloe	2458226,592	219,4722635	5,4173238	12,42	1,66E-03
402	Chloe	2458227,425	219,3027488	5,5016568	12,18	1,56E-03
402	Chloe	2458205,499	222,7791757	2,8209759	12,44	3,96E-03
402	Chloe	2458226,593	219,4720891	5,4174157	12,40	1,66E-03
402	Chloe	2458227,426	219,302626	5,5017421	12,21	1,56E-03
402	Chloe	2458205,5	222,7790999	2,8210642	12,45	4,04E-03
402	Chloe	2458226,594	219,4719773	5,4174631	12,40	1,66E-03
402	Chloe	2458227,427	219,3025047	5,5018055	12,20	1,56E-03
402	Chloe	2458205,5	222,7790528	2,8211655	12,44	3,97E-03
402	Chloe	2458226,594	219,4718433	5,4174878	12,42	1,66E-03
402	Chloe	2458227,427	219,3023471	5,5018794	12,20	1,56E-03
402	Chloe	2458205,501	222,7789849	2,8212207	12,45	4,51E-03
402	Chloe	2458226,596	219,4715074	5,4176808	12,40	1,66E-03
402	Chloe	2458205,502	222,7788075	2,8212927	12,45	4,77E-03
402	Chloe	2458226,597	219,4713174	5,4177676	12,42	1,66E-03
402	Chloe	2458227,429	219,3020681	5,5020433	12,24	1,56E-03
402	Chloe	2458205,503	222,7787734	2,8213962	12,45	4,31E-03
402	Chloe	2458226,597	219,4711834	5,4178026	12,41	1,66E-03
402	Chloe	2458227,429	219,3019411	5,5020862	12,22	1,56E-03
402	Chloe	2458205,503	222,7787559	2,8215607	12,45	4,04E-03
402	Chloe	2458226,598	219,4710572	5,4179091	12,39	1,66E-03
402	Chloe	2458227,43	219,3018007	5,5021336	12,21	1,55E-03
402	Chloe	2458205,504	222,7786955	2,8216125	12,45	3,93E-03
402	Chloe	2458226,599	219,4708962	5,4179531	12,42	1,66E-03
402	Chloe	2458205,505	222,7786404	2,8217129	12,45	3,77E-03
402	Chloe	2458226,6	219,4706006	5,4181159	12,42	1,66E-03
402	Chloe	2458227,431	219,3014943	5,5022575	12,25	1,56E-03
402	Chloe	2458205,505	222,7785638	2,8218127	12,44	3,87E-03
402	Chloe	2458226,601	219,4703894	5,4181919	12,43	1,76E-03
402	Chloe	2458227,432	219,3013815	5,5023161	12,22	1,56E-03
402	Chloe	2458205,506	222,7784897	2,8218569	12,44	3,96E-03
402	Chloe	2458226,602	219,4702443	5,4182588	12,43	1,76E-03
402	Chloe	2458227,432	219,3012409	5,5023563	12,23	1,56E-03
402	Chloe	2458205,506	222,7784303	2,8219456	12,45	3,77E-03
402	Chloe	2458226,602	219,4701339	5,4183527	12,41	1,76E-03
402	Chloe	2458205,507	222,7783526	2,8220002	12,45	3,77E-03
402	Chloe	2458226,604	219,4698201	5,4184956	12,41	1,85E-03
402	Chloe	2458227,434	219,3009752	5,5024824	12,22	1,56E-03
402	Chloe	2458205,508	222,7782896	2,8221035	12,44	3,86E-03
402	Chloe	2458226,605	219,4695996	5,4186012	12,41	1,85E-03
402	Chloe	2458227,434	219,3008503	5,5025441	12,24	1,56E-03
402	Chloe	2458205,508	222,7782555	2,8221808	12,44	3,77E-03
402	Chloe	2458226,606	219,4694605	5,4186935	12,41	1,95E-03
402	Chloe	2458227,435	219,3006943	5,5025789	12,22	1,56E-03
402	Chloe	2458205,509	222,7781733	2,8223126	12,45	3,57E-03
402	Chloe	2458226,606	219,4693415	5,4187271	12,41	1,95E-03
402	Chloe	2458227,436	219,3005707	5,5026799	12,23	1,56E-03
402	Chloe	2458205,51	222,7781412	2,8224065	12,43	3,69E-03
402	Chloe	2458226,607	219,4692007	5,418752	12,42	1,85E-03
402	Chloe	2458227,437	219,3003957	5,5027505	12,23	1,56E-03
402	Chloe	2458205,51	222,7780364	2,8224568	12,44	3,67E-03
402	Chloe	2458226,608	219,4688743	5,4189395	12,41	1,96E-03
402	Chloe	2458227,437	219,3002676	5,5028135	12,23	1,66E-03
402	Chloe	2458205,511	222,7780177	2,8225753	12,45	3,77E-03
402	Chloe	2458226,609	219,4686653	5,4190358	12,41	1,85E-03
402	Chloe	2458227,438	219,3001457	5,5028945	12,23	1,56E-03
402	Chloe	2458205,511	222,7779659	2,8226491	12,45	3,77E-03
402	Chloe	2458226,61	219,4685597	5,4191242	12,40	1,86E-03
402	Chloe	2458227,438	219,3000327	5,5029512	12,24	1,56E-03
402	Chloe	2458205,512	222,7778458	2,8227172	12,45	3,66E-03

402	Chloe	2458226,611	219,4684204	5,4192021	12,41	1,86E-03
402	Chloe	2458227,439	219,2998646	5,5030397	12,26	1,66E-03
402	Chloe	2458205,513	222,7778548	2,8228291	12,46	3,85E-03
402	Chloe	2458226,611	219,4682856	5,4192421	12,40	1,86E-03
402	Chloe	2458227,44	219,2997149	5,503135	12,27	1,66E-03
402	Chloe	2458205,513	222,7777705	2,8228709	12,45	3,75E-03
402	Chloe	2458226,612	219,4681568	5,4192898	12,39	1,86E-03
402	Chloe	2458227,441	219,2995329	5,5032348	12,27	1,76E-03
402	Chloe	2458205,514	222,7776481	2,8229837	12,45	3,67E-03
402	Chloe	2458226,613	219,4678162	5,4194493	12,40	1,76E-03
402	Chloe	2458227,441	219,2993767	5,5032831	12,26	1,66E-03
402	Chloe	2458205,515	222,7776207	2,823065	12,44	4,13E-03
402	Chloe	2458226,614	219,4676276	5,4195392	12,42	1,76E-03
402	Chloe	2458227,442	219,2992408	5,5033485	12,29	1,76E-03
402	Chloe	2458205,515	222,7775006	2,8231884	12,44	4,12E-03
402	Chloe	2458226,615	219,4674915	5,4196039	12,42	1,76E-03
402	Chloe	2458227,443	219,2990994	5,503428	12,29	1,66E-03
402	Chloe	2458205,516	222,777501	2,8232563	12,45	3,93E-03
402	Chloe	2458226,615	219,4673501	5,4196777	12,39	1,76E-03
402	Chloe	2458227,443	219,2989673	5,5034809	12,30	1,66E-03
402	Chloe	2458205,517	222,777404	2,8233436	12,45	3,56E-03
402	Chloe	2458226,616	219,4672086	5,4197604	12,38	1,76E-03
402	Chloe	2458227,444	219,2988432	5,5035533	12,31	1,66E-03
402	Chloe	2458205,518	222,7773077	2,8234222	12,44	3,85E-03
402	Chloe	2458226,618	219,4668929	5,4198607	12,40	1,66E-03
402	Chloe	2458227,445	219,2986723	5,5035943	12,28	1,66E-03
402	Chloe	2458205,518	222,7772687	2,8235358	12,44	3,76E-03
402	Chloe	2458226,619	219,4666996	5,4200118	12,40	1,66E-03
402	Chloe	2458227,445	219,298562	5,5036333	12,30	1,66E-03
402	Chloe	2458205,519	222,7771937	2,8236081	12,43	3,77E-03
402	Chloe	2458226,619	219,4665729	5,4200978	12,37	1,66E-03
402	Chloe	2458227,446	219,2984419	5,5036637	12,28	1,66E-03
402	Chloe	2458205,519	222,7771242	2,8236732	12,44	4,05E-03
402	Chloe	2458226,62	219,466434	5,4201356	12,38	1,66E-03
402	Chloe	2458227,446	219,2983159	5,5037254	12,29	1,66E-03
402	Chloe	2458205,52	222,7770454	2,8237338	12,44	3,96E-03
402	Chloe	2458226,62	219,4663082	5,420174	12,39	1,66E-03
402	Chloe	2458227,447	219,2981422	5,5037863	12,28	1,67E-03
402	Chloe	2458205,521	222,7770057	2,8238706	12,43	3,67E-03
402	Chloe	2458226,622	219,4659726	5,4203415	12,36	1,66E-03
402	Chloe	2458227,448	219,2980489	5,5038701	12,30	1,66E-03
402	Chloe	2458205,521	222,7769244	2,8239133	12,45	4,01E-03
402	Chloe	2458226,623	219,4657704	5,4204149	12,39	1,66E-03
402	Chloe	2458227,448	219,29789	5,5039072	12,28	1,66E-03
402	Chloe	2458205,522	222,7768649	2,824026	12,44	4,05E-03
402	Chloe	2458226,623	219,4656471	5,4204912	12,38	1,66E-03
402	Chloe	2458227,449	219,2978229	5,5039901	12,31	1,66E-03
402	Chloe	2458205,523	222,7767486	2,824156	12,43	3,76E-03
402	Chloe	2458226,624	219,4655237	5,4205726	12,36	1,66E-03
402	Chloe	2458227,45	219,2976072	5,5040408	12,30	1,66E-03
402	Chloe	2458205,523	222,7767136	2,824206	12,44	3,77E-03
402	Chloe	2458226,625	219,4653967	5,420632	12,34	1,56E-03
402	Chloe	2458227,45	219,2975044	5,5041385	12,32	1,67E-03
402	Chloe	2458205,524	222,7766747	2,8243446	12,45	3,91E-03
402	Chloe	2458226,626	219,4651022	5,4207393	12,37	1,66E-03
402	Chloe	2458227,451	219,2973506	5,5041845	12,30	1,66E-03
402	Chloe	2458205,525	222,77657	2,824381	12,43	3,76E-03
402	Chloe	2458226,627	219,4648843	5,4208915	12,34	1,66E-03
402	Chloe	2458227,451	219,2972205	5,5042684	12,31	1,66E-03
402	Chloe	2458205,525	222,7765318	2,8244527	12,45	4,03E-03
402	Chloe	2458226,628	219,4647623	5,4209671	12,32	1,56E-03
402	Chloe	2458227,452	219,2970974	5,5043331	12,30	1,76E-03
402	Chloe	2458205,526	222,7764263	2,8245627	12,44	4,40E-03
402	Chloe	2458226,628	219,464628	5,4210064	12,33	1,66E-03
402	Chloe	2458227,453	219,2969475	5,5044305	12,32	1,76E-03
402	Chloe	2458205,527	222,7763217	2,8246062	12,45	3,55E-03
402	Chloe	2458226,629	219,464521	5,4210536	12,33	1,66E-03
402	Chloe	2458227,453	219,2968421	5,5045054	12,35	1,86E-03
402	Chloe	2458205,527	222,7763963	2,8247786	12,45	3,76E-03
402	Chloe	2458227,454	219,2966925	5,5045626	12,33	1,76E-03
402	Chloe	2458205,528	222,7762452	2,8248006	12,44	4,04E-03
402	Chloe	2458226,631	219,4640434	5,4212735	12,33	1,56E-03
402	Chloe	2458227,455	219,2964849	5,5046735	12,35	1,76E-03
402	Chloe	2458205,529	222,7761606	2,8249109	12,45	3,58E-03
402	Chloe	2458226,632	219,4638315	5,4213664	12,33	1,66E-03
402	Chloe	2458227,456	219,2963437	5,5047073	12,34	1,76E-03
402	Chloe	2458205,529	222,7761205	2,8249873	12,44	3,84E-03

402	Chloe	2458226,633	219,4637193	5,4214247	12,32	1,56E-03
402	Chloe	2458227,456	219,2962039	5,5047801	12,36	1,76E-03
402	Chloe	2458205,53	222,7760245	2,8250506	12,43	3,67E-03
402	Chloe	2458226,633	219,4635929	5,4214764	12,31	1,66E-03
402	Chloe	2458227,457	219,296083	5,5048287	12,33	1,76E-03
402	Chloe	2458205,53	222,7759727	2,8251807	12,44	3,86E-03
402	Chloe	2458226,634	219,4634511	5,4215702	12,29	1,57E-03
402	Chloe	2458227,457	219,2959256	5,504869	12,35	1,76E-03
402	Chloe	2458205,531	222,7758856	2,825244	12,45	3,46E-03
402	Chloe	2458226,635	219,4631551	5,4217178	12,30	1,55E-03
402	Chloe	2458227,458	219,2957781	5,5049777	12,38	1,76E-03
402	Chloe	2458205,532	222,7758334	2,8253101	12,43	3,57E-03
402	Chloe	2458226,636	219,4629252	5,4218077	12,30	1,66E-03
402	Chloe	2458227,459	219,295608	5,5049714	12,36	1,76E-03
402	Chloe	2458205,532	222,7757801	2,8253913	12,43	3,56E-03
402	Chloe	2458226,637	219,4627978	5,4218862	12,28	1,56E-03
402	Chloe	2458227,46	219,2954566	5,5050534	12,34	1,86E-03
402	Chloe	2458205,533	222,775737	2,8255213	12,42	4,04E-03
402	Chloe	2458226,638	219,4626627	5,421957	12,28	1,56E-03
402	Chloe	2458227,46	219,2953396	5,5051225	12,35	1,76E-03
402	Chloe	2458205,534	222,7756446	2,8255671	12,42	3,39E-03
402	Chloe	2458226,638	219,4625435	5,4219931	12,27	1,56E-03
402	Chloe	2458227,461	219,2951915	5,5051732	12,35	1,76E-03
402	Chloe	2458205,534	222,7756002	2,8256672	12,43	3,37E-03
402	Chloe	2458226,639	219,4624269	5,4220379	12,29	1,57E-03
402	Chloe	2458227,461	219,2950851	5,5052308	12,35	1,76E-03
402	Chloe	2458205,535	222,7755042	2,8257167	12,43	3,38E-03
402	Chloe	2458226,64	219,462103	5,4221862	12,28	1,66E-03
402	Chloe	2458227,462	219,2949575	5,5052885	12,34	1,86E-03
402	Chloe	2458205,535	222,7754824	2,8258596	12,42	3,38E-03
402	Chloe	2458226,641	219,4618821	5,4222947	12,27	1,56E-03
402	Chloe	2458227,463	219,2948442	5,5053511	12,35	1,86E-03
402	Chloe	2458205,536	222,775405	2,8259685	12,42	3,28E-03
402	Chloe	2458226,642	219,4617496	5,4223518	12,28	1,66E-03
402	Chloe	2458227,463	219,2947141	5,5054533	12,37	1,86E-03
402	Chloe	2458205,537	222,7753423	2,8260316	12,43	3,38E-03
402	Chloe	2458227,464	219,2945473	5,5055391	12,36	1,76E-03
402	Chloe	2458205,538	222,7752561	2,8261401	12,42	3,37E-03
402	Chloe	2458226,643	219,4615121	5,4224895	12,27	1,56E-03
402	Chloe	2458227,465	219,2944436	5,5056005	12,36	1,86E-03
402	Chloe	2458205,538	222,7751535	2,8261911	12,42	3,37E-03
402	Chloe	2458226,644	219,461396	5,4225334	12,25	1,66E-03
402	Chloe	2458227,465	219,2942935	5,5056781	12,38	1,86E-03
402	Chloe	2458205,539	222,7751328	2,8263219	12,43	3,37E-03
402	Chloe	2458226,644	219,4612624	5,4226134	12,24	1,56E-03
402	Chloe	2458227,466	219,2941458	5,5057727	12,38	1,86E-03
402	Chloe	2458205,54	222,7750646	2,8263984	12,40	3,59E-03
402	Chloe	2458226,645	219,461128	5,4226671	12,25	1,56E-03
402	Chloe	2458227,467	219,2939767	5,5058456	12,40	1,86E-03
402	Chloe	2458205,54	222,7749996	2,8264597	12,39	3,57E-03
402	Chloe	2458226,646	219,460976	5,4227203	12,25	1,56E-03
402	Chloe	2458227,467	219,2938446	5,5058936	12,38	1,86E-03
402	Chloe	2458205,541	222,7748848	2,8265536	12,41	3,47E-03
402	Chloe	2458227,468	219,2937053	5,505955	12,40	1,86E-03
402	Chloe	2458205,541	222,7748747	2,8266623	12,42	3,45E-03
402	Chloe	2458226,648	219,4604756	5,4229715	12,22	1,56E-03
402	Chloe	2458227,469	219,2935486	5,506056	12,42	1,87E-03
402	Chloe	2458205,542	222,7747547	2,8267328	12,41	3,66E-03
402	Chloe	2458226,649	219,4603437	5,4230763	12,22	1,56E-03
402	Chloe	2458227,469	219,2934301	5,5060657	12,40	1,76E-03
402	Chloe	2458205,543	222,7747035	2,8268028	12,40	3,37E-03
402	Chloe	2458226,649	219,4602033	5,4230973	12,22	1,56E-03
402	Chloe	2458227,47	219,2932773	5,506107	12,39	1,86E-03
402	Chloe	2458205,543	222,7746393	2,8269059	12,41	3,37E-03
402	Chloe	2458226,65	219,4600676	5,4231486	12,23	1,56E-03
402	Chloe	2458227,47	219,2931296	5,5061657	12,41	1,77E-03
402	Chloe	2458205,544	222,7745774	2,8269739	12,41	3,37E-03
402	Chloe	2458226,65	219,4599638	5,4232036	12,23	1,56E-03
402	Chloe	2458227,471	219,2930351	5,50622	12,42	1,76E-03
402	Chloe	2458205,545	222,77453	2,8270701	12,41	3,37E-03
402	Chloe	2458227,472	219,2928589	5,506271	12,40	1,86E-03
402	Chloe	2458205,545	222,7744634	2,8271681	12,41	3,18E-03
402	Chloe	2458227,472	219,2927203	5,5063389	12,39	1,86E-03
402	Chloe	2458205,546	222,7744	2,827256	12,41	3,18E-03
402	Chloe	2458226,652	219,4595589	5,423414	12,21	1,56E-03
402	Chloe	2458227,473	219,2926002	5,506367	12,40	1,76E-03
402	Chloe	2458205,547	222,7743166	2,8273165	12,41	3,28E-03

402	Chloe	2458226,653	219,4594509	5,4235117	12,19	1,56E-03
402	Chloe	2458227,474	219,2924766	5,5064578	12,39	1,86E-03
402	Chloe	2458205,547	222,7742721	2,8274108	12,41	3,36E-03
402	Chloe	2458226,654	219,4591281	5,4236341	12,21	1,55E-03
402	Chloe	2458227,474	219,2923565	5,5064852	12,38	1,76E-03
402	Chloe	2458205,548	222,7741811	2,8275032	12,41	3,37E-03
402	Chloe	2458227,475	219,2922225	5,5065943	12,38	1,76E-03
402	Chloe	2458205,549	222,7741153	2,8276241	12,41	3,36E-03
402	Chloe	2458227,476	219,2920388	5,506683	12,39	1,76E-03
402	Chloe	2458205,549	222,7740256	2,8276755	12,40	3,58E-03
402	Chloe	2458226,657	219,4586529	5,4238546	12,21	1,56E-03
402	Chloe	2458227,476	219,2919412	5,5067522	12,39	1,76E-03
402	Chloe	2458205,55	222,7739801	2,8277557	12,40	3,65E-03
402	Chloe	2458226,657	219,4585127	5,4239426	12,19	1,56E-03
402	Chloe	2458227,477	219,291789	5,5068174	12,39	1,76E-03
402	Chloe	2458205,551	222,7739274	2,8278599	12,41	3,46E-03
402	Chloe	2458226,658	219,4583712	5,4239788	12,20	1,56E-03
402	Chloe	2458227,477	219,291675	5,5069154	12,39	1,76E-03
402	Chloe	2458205,551	222,7738205	2,8279406	12,40	3,27E-03
402	Chloe	2458226,659	219,4580555	5,4241241	12,20	1,56E-03
402	Chloe	2458227,478	219,291543	5,5069647	12,39	1,86E-03
402	Chloe	2458205,552	222,7737551	2,8280332	12,41	3,27E-03
402	Chloe	2458226,66	219,4578615	5,4242545	12,17	1,56E-03
402	Chloe	2458227,479	219,2914371	5,5070352	12,41	1,86E-03
402	Chloe	2458205,553	222,7737185	2,8281158	12,39	3,39E-03
402	Chloe	2458226,661	219,4577546	5,4243278	12,16	1,47E-03
402	Chloe	2458227,479	219,2912966	5,5070956	12,39	1,86E-03
402	Chloe	2458205,553	222,773668	2,8282099	12,40	3,55E-03
402	Chloe	2458226,662	219,4576222	5,4243684	12,17	1,56E-03
402	Chloe	2458205,554	222,7735726	2,8282944	12,40	3,28E-03
402	Chloe	2458226,662	219,4575012	5,4244174	12,18	1,56E-03
402	Chloe	2458205,554	222,7735218	2,8283613	12,41	3,36E-03
402	Chloe	2458205,555	222,7734481	2,8284566	12,41	3,28E-03
402	Chloe	2458205,556	222,7733609	2,8285469	12,40	3,18E-03
402	Chloe	2458205,556	222,7733317	2,8286445	12,40	3,29E-03
402	Chloe	2458205,557	222,7732678	2,8287286	12,38	3,39E-03
402	Chloe	2458226,665	219,4568086	5,4247356	12,18	1,56E-03
402	Chloe	2458205,558	222,7731953	2,8288028	12,42	3,17E-03
402	Chloe	2458226,666	219,4567128	5,4247805	12,18	1,56E-03
402	Chloe	2458205,558	222,7731373	2,8288893	12,41	3,27E-03
402	Chloe	2458226,667	219,4566044	5,424837	12,18	1,56E-03
402	Chloe	2458205,559	222,7730624	2,8289734	12,41	3,17E-03
402	Chloe	2458226,667	219,4564591	5,4249081	12,17	1,56E-03
402	Chloe	2458205,559	222,7730045	2,8290584	12,41	3,16E-03
402	Chloe	2458226,668	219,4563096	5,4249923	12,18	1,56E-03
402	Chloe	2458205,56	222,7729076	2,8291121	12,40	3,38E-03
402	Chloe	2458226,668	219,4561889	5,4250514	12,18	1,56E-03
402	Chloe	2458205,561	222,7728447	2,8291935	12,41	3,45E-03
402	Chloe	2458226,669	219,4560574	5,4250957	12,18	1,56E-03
402	Chloe	2458205,561	222,7727995	2,8293006	12,40	3,55E-03
402	Chloe	2458226,67	219,4559225	5,4251793	12,18	1,56E-03
402	Chloe	2458205,562	222,7727296	2,8293718	12,40	3,46E-03
402	Chloe	2458226,671	219,4556121	5,4253433	12,17	1,66E-03
402	Chloe	2458205,563	222,7726787	2,8294824	12,39	3,56E-03
402	Chloe	2458205,563	222,7726133	2,829547	12,41	3,17E-03
402	Chloe	2458205,564	222,7725501	2,829651	12,40	3,28E-03
402	Chloe	2458205,565	222,7724301	2,8297281	12,41	3,36E-03
402	Chloe	2458205,565	222,7723997	2,829809	12,41	3,27E-03
402	Chloe	2458226,675	219,4548735	5,4256969	12,16	1,66E-03
402	Chloe	2458205,566	222,7723323	2,8298925	12,41	3,37E-03
402	Chloe	2458226,675	219,4547609	5,4257518	12,17	1,66E-03
402	Chloe	2458205,566	222,7723063	2,8299956	12,41	3,45E-03
402	Chloe	2458226,676	219,4546365	5,4258512	12,14	1,76E-03
402	Chloe	2458205,567	222,7722243	2,8300388	12,41	3,35E-03
402	Chloe	2458226,676	219,4544898	5,4258819	12,14	1,66E-03
402	Chloe	2458205,568	222,7721376	2,8301233	12,42	3,44E-03
402	Chloe	2458226,677	219,4543785	5,4259473	12,15	1,76E-03
402	Chloe	2458205,568	222,7721032	2,8302293	12,42	3,43E-03
402	Chloe	2458226,678	219,4542687	5,4260283	12,16	1,76E-03
402	Chloe	2458205,569	222,7720214	2,830292	12,42	3,54E-03
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402	Chloe	2458205,57	222,7719286	2,8303877	12,41	3,27E-03
402	Chloe	2458226,679	219,4539944	5,4261062	12,16	1,96E-03
402	Chloe	2458205,57	222,7718442	2,8304629	12,41	3,17E-03
402	Chloe	2458205,571	222,7718128	2,8305216	12,42	3,37E-03
402	Chloe	2458205,571	222,7717562	2,830624	12,41	3,26E-03
402	Chloe	2458226,681	219,4535846	5,4262874	12,18	2,06E-03

402	Chloe	2458205,572	222,7717185	2,8307064	12,42	3,36E-03
402	Chloe	2458226,681	219,4534585	5,426387	12,17	2,06E-03
402	Chloe	2458205,573	222,7716159	2,8307818	12,41	3,36E-03
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402	Chloe	2458205,573	222,7715762	2,8308559	12,41	3,36E-03
402	Chloe	2458226,683	219,453226	5,4264791	12,17	2,27E-03
402	Chloe	2458205,574	222,771484	2,8309413	12,41	3,27E-03
402	Chloe	2458226,683	219,4530997	5,4265385	12,18	2,26E-03
402	Chloe	2458205,575	222,7714293	2,8310649	12,41	3,27E-03
402	Chloe	2458226,684	219,4529787	5,4265902	12,17	2,37E-03
402	Chloe	2458205,575	222,7713435	2,8311344	12,43	3,26E-03
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402	Chloe	2458226,686	219,4525635	5,4267956	12,17	2,89E-03
402	Chloe	2458205,577	222,7711874	2,8314031	12,42	3,17E-03
402	Chloe	2458226,686	219,4524556	5,4269024	12,18	2,87E-03
402	Chloe	2458205,578	222,7710879	2,8314785	12,41	3,37E-03
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402	Chloe	2458205,58	222,7708422	2,8318122	12,43	3,36E-03
402	Chloe	2458205,581	222,7707761	2,8318863	12,42	3,27E-03
402	Chloe	2458205,582	222,7706966	2,8320008	12,42	3,26E-03
402	Chloe	2458205,582	222,7706349	2,832086	12,43	3,34E-03
402	Chloe	2458205,583	222,7705674	2,8322037	12,42	3,37E-03
402	Chloe	2458205,584	222,770438	2,8322444	12,42	3,37E-03
402	Chloe	2458205,584	222,7704024	2,8323379	12,42	3,35E-03
402	Chloe	2458205,585	222,7703114	2,8324351	12,43	3,26E-03
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402	Chloe	2458205,586	222,7702196	2,8326233	12,42	3,26E-03
402	Chloe	2458205,587	222,7701466	2,8326953	12,43	3,16E-03
402	Chloe	2458205,588	222,7700732	2,8328115	12,42	3,18E-03
402	Chloe	2458205,588	222,7699991	2,832893	12,42	3,08E-03
402	Chloe	2458205,589	222,7699525	2,8329752	12,42	3,07E-03
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402	Chloe	2458205,592	222,7696184	2,8334088	12,42	3,19E-03
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402	Chloe	2458205,596	222,7692137	2,8339089	12,42	3,09E-03
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402	Chloe	2458205,598	222,7690138	2,8341646	12,42	3,08E-03
402	Chloe	2458205,599	222,7689207	2,8342719	12,40	3,39E-03
402	Chloe	2458205,599	222,7688761	2,834335	12,42	3,08E-03
402	Chloe	2458205,6	222,7688064	2,8344329	12,43	3,08E-03
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402	Chloe	2458205,601	222,7686783	2,8345968	12,43	3,08E-03
402	Chloe	2458205,602	222,7686093	2,8346866	12,43	3,08E-03
402	Chloe	2458205,602	222,7685561	2,8347687	12,45	3,08E-03
402	Chloe	2458205,603	222,7684627	2,8348674	12,44	3,09E-03
402	Chloe	2458205,604	222,7684175	2,8349331	12,45	2,98E-03
402	Chloe	2458205,604	222,7683479	2,8350166	12,45	3,08E-03
402	Chloe	2458205,605	222,76827	2,8350847	12,44	2,98E-03
402	Chloe	2458205,606	222,7682195	2,8351926	12,44	3,09E-03
402	Chloe	2458205,606	222,7681459	2,8352642	12,43	2,98E-03
402	Chloe	2458205,607	222,7680894	2,8353449	12,43	2,98E-03
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402	Chloe	2458205,609	222,7679033	2,8355953	12,44	2,88E-03
402	Chloe	2458205,609	222,7678053	2,835719	12,43	2,98E-03
402	Chloe	2458205,61	222,7677264	2,835824	12,43	2,99E-03
402	Chloe	2458205,611	222,7676834	2,8358963	12,42	3,07E-03
402	Chloe	2458205,611	222,7676108	2,8359707	12,44	2,87E-03
402	Chloe	2458205,612	222,7675261	2,8360535	12,43	2,99E-03
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402	Chloe	2458205,626	222,7661437	2,8378248	12,43	3,28E-03
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13	Egeria	2458252,545	235,5495103	-26,3065472	9,94	1,13E-03
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13	Egeria	2458252,546	235,5493723	-26,3064785	9,96	1,23E-03
13	Egeria	2458252,546	235,5492988	-26,3065215	9,97	1,12E-03
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13	Egeria	2458252,546	235,549091	-26,3066036	9,99	1,12E-03
13	Egeria	2458252,547	235,5490605	-26,3065914	9,96	1,12E-03
13	Egeria	2458252,547	235,5489925	-26,3066436	9,96	1,13E-03
13	Egeria	2458252,547	235,548944	-26,3066219	9,97	1,23E-03
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13	Egeria	2458252,547	235,548883	-26,3065704	9,98	1,23E-03
13	Egeria	2458252,547	235,5488157	-26,3066349	9,99	1,22E-03
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13	Egeria	2458252,549	235,5484183	-26,3066482	9,97	1,23E-03
13	Egeria	2458252,549	235,548411	-26,3066835	10,04	1,12E-03
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13	Egeria	2458252,55	235,5482097	-26,3066589	9,95	1,13E-03
13	Egeria	2458252,55	235,5481341	-26,3066331	9,97	1,02E-03
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13	Egeria	2458252,552	235,5475756	-26,3068721	10,02	1,01E-03
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13	Egeria	2458252,553	235,547267	-26,3068455	9,98	1,03E-03
13	Egeria	2458252,553	235,5472125	-26,3068543	9,96	1,03E-03
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13	Egeria	2458252,554	235,5469628	-26,3069523	10,00	1,23E-03
13	Egeria	2458252,554	235,5469339	-26,3069702	9,98	1,12E-03
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13	Egeria	2458252,554	235,5468246	-26,3069468	10,01	1,12E-03
13	Egeria	2458252,554	235,5468075	-26,3069741	9,97	1,12E-03
13	Egeria	2458252,554	235,5467431	-26,3069718	9,98	1,12E-03
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13	Egeria	2458252,557	235,5460503	-26,3070501	9,98	1,12E-03
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13	Egeria	2458252,59	235,5363729	-26,3085777	9,92	1,52E-03
13	Egeria	2458252,59	235,5361777	-26,3086502	9,99	1,62E-03
13	Egeria	2458252,59	235,536155	-26,3086398	9,93	1,64E-03
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13	Egeria	2458252,59	235,5360686	-26,3086402	9,93	1,63E-03
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13	Egeria	2458252,595	235,5347508	-26,3087445	10,02	1,73E-03
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13	Egeria	2458252,595	235,5346456	-26,3088435	9,97	1,73E-03
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13	Egeria	2458252,596	235,5341893	-26,3089192	10,00	1,62E-03
13	Egeria	2458252,596	235,5341429	-26,3089274	9,93	1,53E-03
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13	Egeria	2458252,597	235,5340722	-26,3089296	9,98	1,63E-03
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13	Egeria	2458252,598	235,5338745	-26,3089091	9,97	1,63E-03
13	Egeria	2458252,598	235,5338399	-26,3090001	9,97	1,64E-03
13	Egeria	2458252,598	235,5337682	-26,3089749	10,01	1,63E-03
13	Egeria	2458252,598	235,5337833	-26,3089083	10,04	1,62E-03
13	Egeria	2458252,598	235,5337606	-26,308913	10,04	1,73E-03
13	Egeria	2458252,599	235,5335632	-26,3088953	10,01	1,63E-03
13	Egeria	2458252,599	235,5334934	-26,3089255	10,00	1,63E-03
13	Egeria	2458252,599	235,5333926	-26,3089979	9,96	1,53E-03
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13	Egeria	2458252,6	235,5333427	-26,3089815	9,98	1,43E-03
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13	Egeria	2458252,601	235,5327381	-26,3091547	10,00	1,54E-03
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13	Egeria	2458252,602	235,5326043	-26,3090577	9,96	1,44E-03
13	Egeria	2458252,602	235,5325514	-26,3092486	10,02	1,53E-03
13	Egeria	2458252,602	235,5326387	-26,3092225	10,03	1,53E-03
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13	Egeria	2458252,604	235,5322414	-26,3092336	9,96	1,53E-03
13	Egeria	2458252,604	235,5322051	-26,3091661	9,97	1,43E-03
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39539	Emmadesmet	2458227,516	225,8190168	-23,6925744	17,36	2,06E-01
39539	Emmadesmet	2458227,526	225,8171263	-23,6924169	17,70	1,84E-01
39539	Emmadesmet	2458227,532	225,8157381	-23,6926497	17,80	1,86E-01
39539	Emmadesmet	2458227,534	225,8153583	-23,6925606	17,81	1,78E-01
39539	Emmadesmet	2458227,536	225,8151529	-23,6928029	17,79	1,69E-01
39539	Emmadesmet	2458227,537	225,8148559	-23,6927323	17,48	1,65E-01
39539	Emmadesmet	2458227,538	225,8145766	-23,6926969	17,70	1,94E-01
39539	Emmadesmet	2458227,54	225,8142503	-23,6926181	17,91	2,00E-01
39539	Emmadesmet	2458227,541	225,8140396	-23,69259	17,87	1,81E-01
39539	Emmadesmet	2458227,543	225,8137158	-23,692491	17,82	1,66E-01
39539	Emmadesmet	2458227,545	225,8131725	-23,6925723	17,66	1,73E-01
39539	Emmadesmet	2458227,546	225,8131436	-23,6927001	17,87	1,93E-01
39539	Emmadesmet	2458227,548	225,8125372	-23,6925279	17,68	1,90E-01
39539	Emmadesmet	2458227,549	225,8124347	-23,692619	17,69	1,75E-01
39539	Emmadesmet	2458227,55	225,8122018	-23,6926941	17,71	1,84E-01
39539	Emmadesmet	2458227,551	225,8119494	-23,6924385	17,69	1,67E-01
39539	Emmadesmet	2458227,552	225,8119573	-23,6927889	17,57	1,86E-01
39539	Emmadesmet	2458227,552	225,8116809	-23,6927541	17,94	2,13E-01
39539	Emmadesmet	2458227,554	225,8111431	-23,6926907	17,57	1,79E-01
39539	Emmadesmet	2458227,555	225,8113308	-23,6927154	17,92	1,95E-01
39539	Emmadesmet	2458227,557	225,8106508	-23,6926473	17,66	1,51E-01
39539	Emmadesmet	2458227,56	225,8102676	-23,6927029	17,70	1,62E-01
39539	Emmadesmet	2458227,589	225,8040026	-23,6928409	17,81	2,15E-01
39539	Emmadesmet	2458227,589	225,8042735	-23,6927949	17,73	1,68E-01
39539	Emmadesmet	2458227,591	225,803687	-23,6927744	17,77	2,25E-01
39539	Emmadesmet	2458227,601	225,80172	-23,6929586	17,35	1,92E-01
39539	Emmadesmet	2458227,605	225,8007057	-23,6932341	17,49	2,03E-01
39539	Emmadesmet	2458227,61	225,7998592	-23,6929941	17,34	1,93E-01
39539	Emmadesmet	2458227,611	225,7997647	-23,6928428	17,57	2,17E-01
39539	Emmadesmet	2458227,612	225,799501	-23,6929635	17,53	1,86E-01
39539	Emmadesmet	2458227,619	225,7984332	-23,6930229	17,39	1,85E-01
39539	Emmadesmet	2458227,62	225,7980057	-23,6930999	17,23	1,99E-01
39539	Emmadesmet	2458227,622	225,7976087	-23,6929231	17,06	1,90E-01
39539	Emmadesmet	2458227,629	225,7957839	-23,6930066	17,53	2,39E-01
39	Laetitia	2458254,548	221,6129517	-1,110325	10,46	1,05E-03
39	Laetitia	2458255,549	221,4215737	-1,0537108	10,44	1,15E-03
39	Laetitia	2458254,549	221,6127898	-1,1102413	10,44	1,05E-03
39	Laetitia	2458255,55	221,4216257	-1,0537493	10,41	1,26E-03
39	Laetitia	2458254,55	221,6126192	-1,1101972	10,46	1,05E-03
39	Laetitia	2458255,55	221,421337	-1,0537811	10,43	1,16E-03
39	Laetitia	2458254,551	221,6124467	-1,1101858	10,40	1,05E-03
39	Laetitia	2458255,551	221,4212097	-1,0535778	10,42	1,15E-03
39	Laetitia	2458254,552	221,6123205	-1,110058	10,40	1,05E-03
39	Laetitia	2458255,552	221,4209548	-1,0536364	10,44	1,15E-03
39	Laetitia	2458254,553	221,6121011	-1,1100619	10,43	1,05E-03
39	Laetitia	2458255,553	221,4207362	-1,0536325	10,45	1,15E-03
39	Laetitia	2458254,553	221,6119731	-1,1099987	10,39	1,05E-03
39	Laetitia	2458255,554	221,4206669	-1,0536225	10,45	1,25E-03
39	Laetitia	2458254,554	221,6117928	-1,1099115	10,40	1,06E-03
39	Laetitia	2458255,555	221,420572	-1,0533748	10,43	1,15E-03
39	Laetitia	2458254,555	221,6116088	-1,1098982	10,40	1,05E-03

39	Laetitia	2458255,556	221,4204512	-1,0533978	10,45	1,26E-03
39	Laetitia	2458254,556	221,6114768	-1,1098855	10,38	1,05E-03
39	Laetitia	2458255,556	221,4201024	-1,0534611	10,47	1,15E-03
39	Laetitia	2458254,557	221,6113027	-1,1098757	10,38	9,52E-04
39	Laetitia	2458255,557	221,4199576	-1,0533698	10,47	1,15E-03
39	Laetitia	2458254,558	221,6111541	-1,1097213	10,38	1,05E-03
39	Laetitia	2458255,558	221,4198647	-1,0533785	10,47	1,25E-03
39	Laetitia	2458254,559	221,610982	-1,1097215	10,37	1,05E-03
39	Laetitia	2458255,559	221,4196824	-1,0530192	10,47	1,16E-03
39	Laetitia	2458254,559	221,6107846	-1,1097261	10,38	9,50E-04
39	Laetitia	2458255,56	221,4194612	-1,0531322	10,48	1,25E-03
39	Laetitia	2458254,56	221,6105584	-1,1096192	10,36	1,05E-03
39	Laetitia	2458255,561	221,4192663	-1,0532833	10,52	1,25E-03
39	Laetitia	2458254,561	221,6104251	-1,109521	10,37	1,06E-03
39	Laetitia	2458255,561	221,4192139	-1,0530328	10,50	1,25E-03
39	Laetitia	2458254,562	221,6102836	-1,109501	10,38	1,05E-03
39	Laetitia	2458255,562	221,41891	-1,0530328	10,51	1,24E-03
39	Laetitia	2458254,563	221,610098	-1,1095013	10,37	1,05E-03
39	Laetitia	2458254,564	221,6099691	-1,10945	10,32	9,54E-04
39	Laetitia	2458255,564	221,418722	-1,0529987	10,54	1,25E-03
39	Laetitia	2458254,565	221,6098349	-1,1093141	10,34	1,05E-03
39	Laetitia	2458255,565	221,4184239	-1,0527989	10,51	1,25E-03
39	Laetitia	2458254,565	221,609634	-1,1092761	10,34	1,05E-03
39	Laetitia	2458255,566	221,4183449	-1,0530468	10,54	1,26E-03
39	Laetitia	2458254,566	221,6094449	-1,1093138	10,35	9,48E-04
39	Laetitia	2458255,567	221,4182228	-1,0529531	10,59	1,36E-03
39	Laetitia	2458254,567	221,6092696	-1,1092167	10,34	1,05E-03
39	Laetitia	2458254,568	221,6090761	-1,1091636	10,33	1,05E-03
39	Laetitia	2458255,568	221,4176997	-1,0527574	10,57	1,35E-03
39	Laetitia	2458254,569	221,6089457	-1,1090946	10,35	9,51E-04
39	Laetitia	2458255,569	221,4176572	-1,0527306	10,60	1,26E-03
39	Laetitia	2458254,57	221,6087743	-1,1090772	10,36	1,05E-03
39	Laetitia	2458255,57	221,4175667	-1,0527233	10,60	1,25E-03
39	Laetitia	2458254,571	221,608634	-1,1090287	10,36	1,05E-03
39	Laetitia	2458255,571	221,4173041	-1,0525242	10,59	1,35E-03
39	Laetitia	2458254,571	221,6084192	-1,1090029	10,31	1,05E-03
39	Laetitia	2458255,572	221,4169994	-1,052616	10,63	1,35E-03
39	Laetitia	2458254,572	221,6082535	-1,1089226	10,34	1,05E-03
39	Laetitia	2458255,573	221,4170093	-1,0524815	10,60	1,35E-03
39	Laetitia	2458254,573	221,6081479	-1,1088104	10,33	1,05E-03
39	Laetitia	2458255,573	221,4168925	-1,0523449	10,61	1,35E-03
39	Laetitia	2458254,574	221,6079116	-1,108815	10,36	1,05E-03
39	Laetitia	2458255,574	221,4167769	-1,0523733	10,65	1,34E-03
39	Laetitia	2458254,575	221,6078036	-1,1086781	10,35	1,05E-03
39	Laetitia	2458255,575	221,4164015	-1,0523406	10,66	1,35E-03
39	Laetitia	2458254,576	221,6075776	-1,1087627	10,35	1,05E-03
39	Laetitia	2458255,576	221,4162801	-1,052225	10,67	1,45E-03
39	Laetitia	2458254,576	221,6074683	-1,1086495	10,32	1,05E-03
39	Laetitia	2458255,577	221,4161742	-1,0522762	10,70	1,44E-03
39	Laetitia	2458254,577	221,6072358	-1,108647	10,35	1,05E-03
39	Laetitia	2458255,578	221,4159745	-1,0522912	10,70	1,35E-03
39	Laetitia	2458254,578	221,607153	-1,1085049	10,35	1,04E-03
39	Laetitia	2458255,579	221,4158795	-1,0520929	10,73	1,35E-03
39	Laetitia	2458254,579	221,6069027	-1,1085374	10,38	1,05E-03
39	Laetitia	2458255,579	221,4157175	-1,0521126	10,70	1,36E-03
39	Laetitia	2458254,58	221,6067474	-1,1084888	10,37	1,05E-03
39	Laetitia	2458255,58	221,4155499	-1,0521989	10,73	1,45E-03
39	Laetitia	2458254,581	221,6065714	-1,1084327	10,38	1,05E-03
39	Laetitia	2458255,581	221,415305	-1,0519949	10,71	1,55E-03
39	Laetitia	2458254,582	221,6064925	-1,1084071	10,37	1,05E-03
39	Laetitia	2458254,582	221,6062591	-1,1082859	10,37	1,05E-03
39	Laetitia	2458255,583	221,4150102	-1,0519921	10,73	1,45E-03
39	Laetitia	2458254,583	221,6060607	-1,1082716	10,38	1,05E-03
39	Laetitia	2458255,584	221,4149538	-1,051899	10,74	1,46E-03
39	Laetitia	2458254,584	221,6059808	-1,1081927	10,39	1,05E-03
39	Laetitia	2458255,584	221,4147574	-1,0516971	10,79	1,67E-03
39	Laetitia	2458254,585	221,6057126	-1,1081994	10,42	1,04E-03
39	Laetitia	2458255,585	221,4145135	-1,0518188	10,79	1,55E-03
39	Laetitia	2458254,586	221,6056063	-1,1081523	10,39	1,05E-03
39	Laetitia	2458254,587	221,6053733	-1,1080975	10,41	1,04E-03
39	Laetitia	2458254,588	221,6052768	-1,1079998	10,40	1,05E-03
39	Laetitia	2458255,588	221,4139255	-1,0517233	10,81	1,56E-03
39	Laetitia	2458254,588	221,6050686	-1,1079461	10,44	1,15E-03
39	Laetitia	2458255,589	221,4136163	-1,0517732	10,86	1,76E-03
39	Laetitia	2458254,589	221,6049617	-1,1078674	10,44	1,15E-03
39	Laetitia	2458255,59	221,4136293	-1,051414	10,84	1,65E-03
39	Laetitia	2458254,59	221,6047404	-1,1078833	10,48	1,14E-03

39	Laetitia	2458255,59	221,4133276	-1,0516893	10,82	1,67E-03
39	Laetitia	2458254,591	221,6046141	-1,1078651	10,46	1,14E-03
39	Laetitia	2458255,591	221,4131935	-1,0514015	10,86	1,56E-03
39	Laetitia	2458254,592	221,6044246	-1,1077989	10,43	1,05E-03
39	Laetitia	2458255,592	221,4133359	-1,05134	10,82	1,75E-03
39	Laetitia	2458254,593	221,604233	-1,10768	10,45	1,15E-03
39	Laetitia	2458255,593	221,4129811	-1,0514439	10,79	1,56E-03
39	Laetitia	2458254,593	221,6041264	-1,1076598	10,44	1,15E-03
39	Laetitia	2458255,594	221,4127009	-1,0513671	10,77	1,45E-03
39	Laetitia	2458254,594	221,6039651	-1,1076194	10,45	1,15E-03
39	Laetitia	2458255,595	221,4126824	-1,0512373	10,78	1,44E-03
39	Laetitia	2458254,595	221,603755	-1,1075244	10,44	1,15E-03
39	Laetitia	2458255,596	221,4124667	-1,0512085	10,78	1,55E-03
39	Laetitia	2458254,596	221,6035874	-1,1075584	10,46	1,05E-03
39	Laetitia	2458254,597	221,6033738	-1,1075066	10,47	1,15E-03
39	Laetitia	2458255,598	221,4120649	-1,0511296	10,66	1,48E-03
39	Laetitia	2458255,599	221,4118032	-1,051107	10,73	1,45E-03
39	Laetitia	2458254,6	221,6026391	-1,1071995	10,43	1,15E-03
39	Laetitia	2458255,601	221,4115189	-1,050781	10,67	1,46E-03
39	Laetitia	2458254,601	221,6025106	-1,1072033	10,41	1,15E-03
39	Laetitia	2458255,602	221,4114226	-1,0509158	10,66	1,36E-03
39	Laetitia	2458254,602	221,6024502	-1,1071457	10,49	1,15E-03
39	Laetitia	2458255,602	221,4112379	-1,050786	10,66	1,35E-03
39	Laetitia	2458254,603	221,6022277	-1,1071349	10,49	1,15E-03
39	Laetitia	2458255,603	221,4110533	-1,0508819	10,63	1,36E-03
39	Laetitia	2458254,604	221,6020365	-1,1070737	10,52	1,25E-03
39	Laetitia	2458255,604	221,4107502	-1,050762	10,58	1,36E-03
39	Laetitia	2458254,605	221,6018582	-1,1071303	10,53	1,25E-03
39	Laetitia	2458255,605	221,4107302	-1,0507238	10,55	1,46E-03
39	Laetitia	2458254,605	221,6016896	-1,107002	10,55	1,24E-03
39	Laetitia	2458255,606	221,4105754	-1,0506328	10,62	1,45E-03
39	Laetitia	2458254,606	221,6015511	-1,106921	10,55	1,25E-03
39	Laetitia	2458255,607	221,4101362	-1,0506078	10,53	1,37E-03
39	Laetitia	2458254,607	221,6014471	-1,1068924	10,56	1,25E-03
39	Laetitia	2458255,607	221,4102198	-1,0506278	10,55	1,35E-03
39	Laetitia	2458254,608	221,6012679	-1,1067543	10,56	1,24E-03
39	Laetitia	2458255,608	221,4099445	-1,0501971	10,54	1,47E-03
39	Laetitia	2458254,609	221,6010388	-1,1067487	10,59	1,24E-03
39	Laetitia	2458255,609	221,409809	-1,0505013	10,54	1,36E-03
39	Laetitia	2458254,61	221,6009122	-1,1067189	10,59	1,25E-03
39	Laetitia	2458255,61	221,4096437	-1,0502963	10,54	1,36E-03
39	Laetitia	2458254,611	221,6007921	-1,1066167	10,61	1,34E-03
39	Laetitia	2458255,611	221,4094972	-1,0503407	10,59	1,46E-03
39	Laetitia	2458254,611	221,6005969	-1,1065713	10,60	1,25E-03
39	Laetitia	2458255,612	221,4090536	-1,0503334	10,50	1,38E-03
39	Laetitia	2458254,612	221,6004385	-1,1065517	10,61	1,35E-03
39	Laetitia	2458255,613	221,4091422	-1,0502834	10,48	1,46E-03
39	Laetitia	2458254,613	221,6002216	-1,1065255	10,63	1,35E-03
39	Laetitia	2458255,613	221,4089071	-1,0502241	10,53	1,56E-03
39	Laetitia	2458254,614	221,600071	-1,1064892	10,60	1,35E-03
39	Laetitia	2458255,614	221,4089129	-1,0501578	10,45	1,27E-03
39	Laetitia	2458254,615	221,5999118	-1,1064929	10,64	1,35E-03
39	Laetitia	2458255,615	221,4087621	-1,0500141	10,49	1,25E-03
39	Laetitia	2458254,616	221,5996899	-1,1064087	10,63	1,45E-03
39	Laetitia	2458255,616	221,4084536	-1,0501448	10,46	1,35E-03
39	Laetitia	2458254,617	221,5996153	-1,1063742	10,64	1,34E-03
39	Laetitia	2458255,617	221,4083614	-1,0501677	10,43	1,26E-03
39	Laetitia	2458254,617	221,5993842	-1,1063072	10,65	1,35E-03
39	Laetitia	2458255,618	221,4083229	-1,0499224	10,51	1,45E-03
39	Laetitia	2458255,619	221,4080662	-1,0501959	10,49	1,46E-03
39	Laetitia	2458254,619	221,5990609	-1,1062497	10,68	1,34E-03
39	Laetitia	2458255,619	221,4080098	-1,050085	10,46	1,47E-03
39	Laetitia	2458254,62	221,5989171	-1,1061662	10,69	1,44E-03
39	Laetitia	2458255,62	221,4077032	-1,0497005	10,44	1,39E-03
39	Laetitia	2458254,621	221,5987009	-1,1061572	10,69	1,45E-03
39	Laetitia	2458255,621	221,4075458	-1,049826	10,46	1,35E-03
39	Laetitia	2458254,622	221,5985589	-1,1060404	10,70	1,45E-03
39	Laetitia	2458255,622	221,4074905	-1,0496391	10,43	1,35E-03
39	Laetitia	2458254,622	221,5984208	-1,1059768	10,68	1,45E-03
39	Laetitia	2458255,623	221,4071924	-1,0496037	10,42	1,36E-03
39	Laetitia	2458254,623	221,5982324	-1,1059201	10,70	1,45E-03
39	Laetitia	2458255,624	221,4071402	-1,0496053	10,47	1,35E-03
39	Laetitia	2458254,624	221,5980863	-1,1059221	10,70	1,45E-03
39	Laetitia	2458255,625	221,4068792	-1,0495606	10,39	1,36E-03
39	Laetitia	2458254,625	221,5978909	-1,1058746	10,67	1,46E-03
39	Laetitia	2458254,626	221,5977967	-1,1057472	10,71	1,44E-03
39	Laetitia	2458255,626	221,4065257	-1,0495803	10,44	1,35E-03

39	Laetitia	2458254,627	221,5975104	-1,1057788	10,73	1,55E-03
39	Laetitia	2458255,627	221,4063323	-1,049209	10,39	1,46E-03
39	Laetitia	2458254,628	221,5974289	-1,1057051	10,72	1,45E-03
39	Laetitia	2458255,628	221,4061003	-1,0495257	10,41	1,36E-03
39	Laetitia	2458254,628	221,597239	-1,1055857	10,72	1,56E-03
39	Laetitia	2458255,629	221,405981	-1,0495644	10,45	1,36E-03
39	Laetitia	2458254,629	221,5970336	-1,1056465	10,72	1,45E-03
39	Laetitia	2458255,63	221,4058797	-1,0494487	10,52	1,43E-03
39	Laetitia	2458254,63	221,5968934	-1,1055823	10,70	1,55E-03
39	Laetitia	2458255,63	221,4057401	-1,0491549	10,40	1,24E-03
39	Laetitia	2458254,631	221,5967041	-1,105547	10,71	1,55E-03
39	Laetitia	2458254,632	221,5965498	-1,1054986	10,71	1,55E-03
39	Laetitia	2458255,632	221,4053557	-1,0492018	10,36	1,36E-03
39	Laetitia	2458254,633	221,5963869	-1,1054533	10,69	1,55E-03
39	Laetitia	2458255,633	221,4052898	-1,0489902	10,39	1,47E-03
39	Laetitia	2458254,634	221,5962723	-1,105397	10,68	1,45E-03
39	Laetitia	2458255,634	221,4051015	-1,0491096	10,34	1,49E-03
39	Laetitia	2458254,634	221,5961053	-1,1053642	10,63	1,56E-03
39	Laetitia	2458255,635	221,4049397	-1,0490913	10,43	1,45E-03
39	Laetitia	2458254,635	221,595839	-1,1052938	10,65	1,54E-03
39	Laetitia	2458255,636	221,4047834	-1,0491403	10,41	1,46E-03
39	Laetitia	2458254,636	221,595783	-1,1052033	10,62	1,45E-03
39	Laetitia	2458255,636	221,4045002	-1,0489483	10,35	1,37E-03
39	Laetitia	2458254,637	221,595478	-1,1052545	10,62	1,45E-03
39	Laetitia	2458255,637	221,4045566	-1,0487611	10,35	1,35E-03
39	Laetitia	2458254,638	221,5954282	-1,1051091	10,59	1,45E-03
39	Laetitia	2458255,638	221,4041299	-1,0489469	10,40	1,46E-03
39	Laetitia	2458254,639	221,5953094	-1,1050631	10,59	1,45E-03
39	Laetitia	2458255,639	221,4040372	-1,0487002	10,34	1,47E-03
39	Laetitia	2458254,64	221,5950245	-1,1050321	10,59	1,45E-03
39	Laetitia	2458255,64	221,4036592	-1,048953	10,33	1,45E-03
39	Laetitia	2458254,64	221,5949343	-1,10497	10,54	1,46E-03
39	Laetitia	2458255,641	221,403743	-1,0486952	10,41	1,46E-03
39	Laetitia	2458254,641	221,594699	-1,1049742	10,57	1,55E-03
39	Laetitia	2458254,642	221,5946069	-1,104884	10,51	1,45E-03
39	Laetitia	2458255,642	221,4035249	-1,0486604	10,36	1,46E-03
39	Laetitia	2458254,643	221,5944335	-1,1048574	10,51	1,46E-03
39	Laetitia	2458255,643	221,4032126	-1,0486916	10,26	1,39E-03
39	Laetitia	2458254,644	221,5942278	-1,1047542	10,52	1,45E-03
39	Laetitia	2458255,644	221,4031639	-1,0484842	10,35	1,46E-03
39	Laetitia	2458254,645	221,5940228	-1,1047451	10,52	1,45E-03
39	Laetitia	2458255,645	221,4028817	-1,0486586	10,32	1,57E-03
39	Laetitia	2458254,645	221,5939333	-1,1046719	10,49	1,76E-03
1427	Ruvuma	2458225,341	154,3909006	23,0101176	16,31	2,59E-02
1427	Ruvuma	2458225,345	154,3906722	23,0099553	16,50	2,38E-02
1427	Ruvuma	2458213,319	155,3344662	23,2850445	16,59	5,04E-02
1427	Ruvuma	2458225,35	154,3904746	23,009784	16,48	2,37E-02
1427	Ruvuma	2458213,322	155,3340005	23,2849984	16,34	3,30E-02
1427	Ruvuma	2458225,354	154,3902513	23,00957	16,50	2,30E-02
1427	Ruvuma	2458213,326	155,3335163	23,2849729	16,44	2,75E-02
1427	Ruvuma	2458225,358	154,3900375	23,0094067	16,54	2,43E-02
1427	Ruvuma	2458213,33	155,3331679	23,284938	16,42	2,50E-02
1427	Ruvuma	2458225,363	154,38986	23,009279	16,61	2,80E-02
1427	Ruvuma	2458213,334	155,3327424	23,2848931	16,45	2,55E-02
1427	Ruvuma	2458225,367	154,389635	23,0091108	16,64	2,65E-02
1427	Ruvuma	2458213,338	155,3322535	23,2847659	16,49	2,73E-02
1427	Ruvuma	2458225,379	154,3889689	23,0086408	16,65	2,76E-02
1427	Ruvuma	2458213,341	155,3318581	23,2847588	16,41	2,00E-02
1427	Ruvuma	2458225,385	154,3887116	23,008482	16,76	2,85E-02
1427	Ruvuma	2458213,345	155,3313799	23,2847237	16,44	2,27E-02
1427	Ruvuma	2458225,389	154,3884465	23,0082823	16,69	2,56E-02
1427	Ruvuma	2458213,349	155,3309148	23,2847324	16,42	2,19E-02
1427	Ruvuma	2458225,394	154,3882333	23,0080801	16,83	3,25E-02
1427	Ruvuma	2458213,353	155,3305301	23,2847356	16,34	2,17E-02
1427	Ruvuma	2458225,399	154,3879548	23,0079406	16,74	3,87E-02
1427	Ruvuma	2458213,356	155,3301191	23,2847396	16,33	2,07E-02
1427	Ruvuma	2458225,404	154,3877397	23,0077243	16,59	4,92E-02
1427	Ruvuma	2458213,36	155,3297193	23,2847375	16,33	1,79E-02
1427	Ruvuma	2458225,409	154,3874719	23,0075182	16,58	6,38E-02
1427	Ruvuma	2458213,364	155,3292725	23,2847554	16,35	1,85E-02
1427	Ruvuma	2458225,414	154,387157	23,0072321	16,52	8,61E-02
1427	Ruvuma	2458213,368	155,328848	23,2847021	16,33	1,96E-02
1427	Ruvuma	2458213,371	155,3284085	23,2846817	16,37	1,88E-02
1427	Ruvuma	2458225,424	154,3866571	23,0069793	16,47	1,19E-01
1427	Ruvuma	2458213,375	155,3279806	23,2846526	16,37	1,91E-02
1427	Ruvuma	2458225,429	154,3865581	23,0067421	17,22	1,93E-01
1427	Ruvuma	2458213,379	155,3275401	23,2846404	16,40	1,77E-02

1427	Ruvuma	2458213,383	155,327142	23,2846156	16,31	2,14E-02
1427	Ruvuma	2458213,386	155,3267023	23,2845868	16,46	1,94E-02
1427	Ruvuma	2458213,39	155,3262465	23,2845482	16,52	1,92E-02
1427	Ruvuma	2458213,394	155,3258039	23,284523	16,50	1,83E-02
1427	Ruvuma	2458213,398	155,3253751	23,2845051	16,44	1,72E-02
1427	Ruvuma	2458213,401	155,3249289	23,2844677	16,54	1,91E-02
1427	Ruvuma	2458213,418	155,322993	23,2843157	16,58	2,07E-02
1427	Ruvuma	2458213,423	155,3224726	23,2842803	16,57	2,07E-02
1427	Ruvuma	2458213,427	155,3219834	23,2842507	16,46	2,33E-02
1427	Ruvuma	2458213,431	155,3214188	23,284209	16,52	2,09E-02
1427	Ruvuma	2458213,436	155,3209938	23,2841401	16,47	2,98E-02
1427	Ruvuma	2458213,44	155,3204958	23,2841265	16,40	7,64E-02
1427	Ruvuma	2458213,444	155,3199769	23,2840185	16,27	1,18E-01
1427	Ruvuma	2458213,454	155,3189178	23,2840451	16,51	2,83E-02
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1427	Ruvuma	2458213,471	155,3169284	23,2838726	16,56	3,16E-02
1427	Ruvuma	2458213,476	155,3163804	23,2838653	16,70	5,96E-02
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1427	Ruvuma	2458213,484	155,3154377	23,2838088	16,78	4,89E-02
1427	Ruvuma	2458213,488	155,3148885	23,2837587	16,83	5,99E-02
1427	Ruvuma	2458213,493	155,3144045	23,283717	16,54	5,53E-02
1427	Ruvuma	2458213,497	155,3138705	23,2836858	16,73	5,76E-02
1427	Ruvuma	2458213,502	155,3133446	23,283683	16,77	7,03E-02
1427	Ruvuma	2458213,506	155,3129321	23,2836175	16,75	7,55E-02
1427	Ruvuma	2458213,511	155,3123636	23,283492	16,77	9,12E-02
10142	Sakka	2458250,38	181,5560626	13,457604	17,64	1,10E-01
10142	Sakka	2458252,358	181,4304632	13,3536309	17,61	8,45E-02
10142	Sakka	2458252,359	181,4304204	13,3534953	17,82	1,00E-01
10142	Sakka	2458250,383	181,5558046	13,4573471	17,59	9,96E-02
10142	Sakka	2458252,36	181,4303516	13,353571	17,66	8,96E-02
10142	Sakka	2458250,385	181,5558545	13,4573516	17,69	1,12E-01
10142	Sakka	2458252,361	181,4303716	13,3535355	17,65	8,61E-02
10142	Sakka	2458250,386	181,5556039	13,4572327	17,96	1,09E-01
10142	Sakka	2458252,362	181,4302285	13,353369	17,44	8,88E-02
10142	Sakka	2458250,388	181,5555806	13,4571375	17,58	1,08E-01
10142	Sakka	2458252,363	181,4302793	13,3532372	17,42	8,42E-02
10142	Sakka	2458250,389	181,5555113	13,4571817	17,79	1,14E-01
10142	Sakka	2458252,364	181,4300952	13,3532343	17,49	9,03E-02
10142	Sakka	2458250,391	181,5551782	13,4571011	17,80	1,13E-01
10142	Sakka	2458252,365	181,4302127	13,3532222	17,48	9,03E-02
10142	Sakka	2458250,392	181,5551809	13,4570629	17,92	1,06E-01
10142	Sakka	2458250,393	181,5552534	13,4569964	17,59	1,08E-01
10142	Sakka	2458252,366	181,4298714	13,3530148	17,59	9,89E-02
10142	Sakka	2458250,395	181,5550796	13,4568642	17,66	1,10E-01
10142	Sakka	2458252,367	181,4298755	13,3529805	17,52	8,75E-02
10142	Sakka	2458250,398	181,5546906	13,4567017	17,74	1,00E-01
10142	Sakka	2458252,377	181,4294549	13,3526477	17,76	8,58E-02
10142	Sakka	2458250,4	181,5545589	13,4566447	17,53	9,67E-02
10142	Sakka	2458252,378	181,4293106	13,3524893	17,57	8,73E-02
10142	Sakka	2458250,401	181,5545309	13,4565313	17,65	9,17E-02
10142	Sakka	2458252,38	181,4291555	13,3524001	17,71	8,94E-02
10142	Sakka	2458250,405	181,5543787	13,4564441	17,49	1,04E-01
10142	Sakka	2458252,384	181,4288494	13,3521612	17,63	8,92E-02
10142	Sakka	2458252,386	181,428765	13,3520367	17,62	8,85E-02
10142	Sakka	2458250,408	181,5540432	13,4561272	17,53	1,02E-01
10142	Sakka	2458252,387	181,4286027	13,3519817	17,63	9,20E-02
10142	Sakka	2458250,409	181,5538255	13,4561934	17,33	9,06E-02
10142	Sakka	2458252,389	181,4286033	13,3518709	17,74	1,09E-01
10142	Sakka	2458250,41	181,5536685	13,4558742	17,48	9,57E-02
10142	Sakka	2458252,39	181,4285564	13,3518328	17,88	1,06E-01
10142	Sakka	2458250,412	181,5538635	13,4560322	17,46	8,60E-02
10142	Sakka	2458252,391	181,4283564	13,3517476	17,63	9,81E-02
10142	Sakka	2458250,413	181,5536931	13,4557517	17,36	8,80E-02
10142	Sakka	2458252,393	181,428358	13,3517435	17,69	9,87E-02
10142	Sakka	2458250,414	181,5535888	13,4556889	17,02	8,32E-02
10142	Sakka	2458252,394	181,4281822	13,3515924	17,73	1,05E-01
10142	Sakka	2458250,416	181,5534316	13,4557193	17,42	8,40E-02
10142	Sakka	2458252,395	181,428195	13,3514277	17,87	1,05E-01
10142	Sakka	2458252,397	181,428183	13,3515116	17,90	1,08E-01
10142	Sakka	2458250,418	181,5532489	13,4555364	17,36	9,04E-02
10142	Sakka	2458252,398	181,4280673	13,3515051	17,83	1,10E-01
10142	Sakka	2458250,42	181,5531277	13,4554403	16,99	8,48E-02
10142	Sakka	2458252,399	181,4279919	13,3514004	17,78	1,03E-01
10142	Sakka	2458250,421	181,5530413	13,4554457	17,49	9,63E-02
10142	Sakka	2458252,401	181,427912	13,3512235	17,96	1,18E-01
10142	Sakka	2458250,422	181,5530373	13,4554464	17,30	8,97E-02
10142	Sakka	2458252,402	181,4277708	13,3512666	17,92	1,07E-01

10142	Sakka	2458250,424	181,5528355	13,4554564	17,58	9,68E-02
10142	Sakka	2458252,403	181,4277936	13,3512306	17,91	1,08E-01
10142	Sakka	2458250,425	181,552932	13,4552383	17,02	8,69E-02
10142	Sakka	2458252,405	181,4276427	13,3510666	18,05	1,17E-01
10142	Sakka	2458250,427	181,5526905	13,4550633	17,49	9,87E-02
10142	Sakka	2458252,406	181,4275134	13,3510042	17,92	1,12E-01
10142	Sakka	2458250,428	181,5527199	13,4550849	17,34	8,68E-02
10142	Sakka	2458252,408	181,4273036	13,3507185	17,83	9,71E-02
10142	Sakka	2458250,429	181,5526303	13,4549326	16,99	8,59E-02
10142	Sakka	2458252,409	181,4273151	13,3507384	17,92	1,10E-01
10142	Sakka	2458250,431	181,552431	13,4549659	17,26	9,78E-02
10142	Sakka	2458252,41	181,4273085	13,3508663	17,94	1,00E-01
10142	Sakka	2458250,432	181,5524739	13,4550669	17,09	8,44E-02
10142	Sakka	2458252,412	181,4271406	13,3505714	17,89	1,04E-01
10142	Sakka	2458252,415	181,4269986	13,3504637	17,77	1,13E-01
10142	Sakka	2458250,435	181,5521637	13,4548241	17,01	8,98E-02
10142	Sakka	2458252,416	181,42702	13,3502768	17,89	1,05E-01
10142	Sakka	2458250,435	181,5520421	13,4547069	17,42	9,48E-02
10142	Sakka	2458252,418	181,4268908	13,3503002	17,94	1,13E-01
10142	Sakka	2458250,437	181,5519973	13,4546468	17,28	9,93E-02
10142	Sakka	2458252,419	181,4266415	13,3502285	17,92	1,02E-01
10142	Sakka	2458252,42	181,4266115	13,3500702	17,69	1,01E-01
10142	Sakka	2458250,439	181,5519371	13,4544973	17,47	9,25E-02
10142	Sakka	2458252,422	181,4266983	13,3500392	17,95	9,86E-02
10142	Sakka	2458250,441	181,5517186	13,4543885	17,41	1,02E-01
10142	Sakka	2458252,424	181,426423	13,3499818	17,86	1,10E-01
10142	Sakka	2458250,445	181,5515039	13,4541937	17,09	9,17E-02
10142	Sakka	2458252,426	181,4263367	13,3499357	17,92	1,04E-01
10142	Sakka	2458250,446	181,5514845	13,454128	17,50	1,04E-01
10142	Sakka	2458252,427	181,4262613	13,3499321	17,73	9,21E-02
10142	Sakka	2458250,447	181,5512335	13,454237	17,66	1,08E-01
10142	Sakka	2458252,428	181,4262326	13,3497082	18,01	1,04E-01
10142	Sakka	2458250,448	181,5511974	13,4540098	17,59	1,16E-01
10142	Sakka	2458252,43	181,4261282	13,3496729	17,80	1,02E-01
10142	Sakka	2458252,431	181,4260453	13,3495961	17,74	9,39E-02
10142	Sakka	2458250,451	181,550981	13,4538278	17,55	1,04E-01
10142	Sakka	2458252,432	181,4259379	13,3495061	17,61	8,40E-02
10142	Sakka	2458250,452	181,5509846	13,4537783	17,18	9,90E-02
10142	Sakka	2458252,434	181,4258848	13,349402	17,57	8,85E-02
10142	Sakka	2458250,454	181,5508374	13,4535822	17,58	1,10E-01
10142	Sakka	2458252,435	181,4257748	13,3492416	17,53	8,06E-02
10142	Sakka	2458250,455	181,5507721	13,4538615	17,42	9,94E-02
10142	Sakka	2458252,436	181,4256282	13,3493003	17,61	8,99E-02
10142	Sakka	2458250,456	181,5506067	13,4534968	17,41	1,06E-01
10142	Sakka	2458252,438	181,4257018	13,3492999	17,57	8,14E-02
10142	Sakka	2458250,458	181,5504804	13,4537289	17,82	1,21E-01
10142	Sakka	2458252,439	181,4254319	13,3489842	17,50	7,96E-02
10142	Sakka	2458250,458	181,5505387	13,4534832	17,66	1,12E-01
10142	Sakka	2458252,44	181,4254689	13,34907	17,52	7,72E-02
10142	Sakka	2458250,46	181,5503197	13,4533127	17,79	1,31E-01
10142	Sakka	2458252,441	181,4253515	13,3490962	17,60	7,96E-02
10142	Sakka	2458250,462	181,5503614	13,4533426	17,51	1,04E-01
10142	Sakka	2458252,443	181,425292	13,3488915	17,65	8,33E-02
10142	Sakka	2458250,462	181,5501778	13,4532185	17,43	1,19E-01
10142	Sakka	2458252,444	181,4251972	13,3489207	17,58	8,32E-02
10142	Sakka	2458250,463	181,5500866	13,4533081	17,64	1,20E-01
10142	Sakka	2458252,445	181,4251956	13,3487995	17,53	8,50E-02
10142	Sakka	2458250,465	181,5499983	13,4533629	17,84	1,26E-01
10142	Sakka	2458252,447	181,4249711	13,3486005	17,54	8,36E-02
10142	Sakka	2458250,466	181,5498107	13,4531778	17,82	1,31E-01
10142	Sakka	2458252,448	181,4249427	13,3485816	17,55	8,64E-02
10142	Sakka	2458250,467	181,5498037	13,4531463	17,63	1,30E-01
10142	Sakka	2458252,449	181,4249366	13,3486216	17,45	7,67E-02
10142	Sakka	2458250,469	181,5495212	13,4529315	17,81	1,30E-01
10142	Sakka	2458252,451	181,4248386	13,3484601	17,48	8,33E-02
10142	Sakka	2458250,47	181,5496643	13,4529727	17,48	1,25E-01
10142	Sakka	2458252,451	181,4246922	13,3483503	17,61	8,33E-02
10142	Sakka	2458250,471	181,5497313	13,4529098	17,88	1,21E-01
10142	Sakka	2458252,452	181,4246585	13,3485075	17,54	8,51E-02
10142	Sakka	2458250,472	181,549465	13,4528951	17,75	1,30E-01
10142	Sakka	2458252,454	181,4244722	13,3482991	17,55	7,84E-02
10142	Sakka	2458250,474	181,5493209	13,4528726	17,62	1,22E-01
10142	Sakka	2458252,455	181,4243928	13,3481964	17,52	8,14E-02
10142	Sakka	2458250,475	181,5492527	13,4528159	17,85	1,17E-01
10142	Sakka	2458252,456	181,4243382	13,3481971	17,62	8,83E-02
10142	Sakka	2458250,476	181,5492547	13,4528277	17,67	1,18E-01
10142	Sakka	2458252,458	181,4243715	13,3481473	17,56	9,04E-02

10142	Sakka	2458250,478	181,5489218	13,4526986	17,56	1,23E-01
10142	Sakka	2458250,479	181,5490954	13,4527127	17,80	1,29E-01
10142	Sakka	2458252,462	181,4241481	13,3478429	17,73	8,47E-02
10142	Sakka	2458250,48	181,5490221	13,4525707	17,47	1,09E-01
10142	Sakka	2458252,463	181,4240177	13,3477821	17,53	9,16E-02
10142	Sakka	2458250,481	181,5489107	13,4524785	17,49	1,20E-01
10142	Sakka	2458252,464	181,4240001	13,3477783	17,66	9,33E-02
10142	Sakka	2458250,482	181,5487876	13,4524804	17,44	8,56E-02
10142	Sakka	2458252,465	181,4238731	13,3476903	17,57	8,85E-02
10142	Sakka	2458250,484	181,5485726	13,4523587	17,69	1,12E-01
10142	Sakka	2458250,485	181,5486127	13,4522892	17,04	8,74E-02
10142	Sakka	2458250,486	181,5485767	13,4523835	17,57	1,23E-01
10142	Sakka	2458252,47	181,4236502	13,3474444	17,73	1,07E-01
10142	Sakka	2458250,487	181,5484774	13,4523587	17,41	1,06E-01
10142	Sakka	2458252,471	181,4235854	13,347429	17,88	1,01E-01
10142	Sakka	2458250,488	181,5483474	13,45225	17,04	9,92E-02
10142	Sakka	2458252,472	181,4235744	13,3473093	17,79	9,52E-02
10142	Sakka	2458250,488	181,5482841	13,4521491	17,51	9,67E-02
10142	Sakka	2458252,473	181,4234455	13,3471638	17,82	9,90E-02
10142	Sakka	2458250,49	181,5482518	13,452245	17,80	1,08E-01
10142	Sakka	2458252,474	181,4233565	13,3471536	18,07	9,94E-02
10142	Sakka	2458250,492	181,5481205	13,4519289	17,21	9,97E-02
10142	Sakka	2458250,492	181,5480826	13,4520368	17,56	1,20E-01
10142	Sakka	2458252,477	181,4231964	13,3470053	17,93	1,13E-01
10142	Sakka	2458250,493	181,547963	13,451974	17,38	9,73E-02
10142	Sakka	2458252,478	181,4231684	13,3470618	17,79	1,13E-01
10142	Sakka	2458250,494	181,5478894	13,4519472	17,68	1,26E-01
10142	Sakka	2458252,479	181,4229837	13,3468991	17,83	1,18E-01
10142	Sakka	2458250,495	181,5476864	13,4518323	17,50	1,30E-01
10142	Sakka	2458252,481	181,4228583	13,3469295	18,03	1,15E-01
10142	Sakka	2458250,496	181,5477897	13,4517671	17,01	9,98E-02
10142	Sakka	2458252,482	181,4228504	13,3466517	17,97	1,23E-01
10142	Sakka	2458250,498	181,5476262	13,4516659	17,45	1,20E-01
10142	Sakka	2458252,483	181,4228566	13,3466173	17,85	1,14E-01
10142	Sakka	2458250,499	181,5475111	13,4515418	17,54	1,21E-01
10142	Sakka	2458252,484	181,4227798	13,346461	18,04	1,11E-01
10142	Sakka	2458250,5	181,5475623	13,4515321	17,41	1,11E-01
10142	Sakka	2458252,485	181,422719	13,3465028	17,76	1,05E-01
10142	Sakka	2458250,502	181,5474679	13,4516309	17,41	1,34E-01
10142	Sakka	2458250,504	181,5471569	13,4513942	17,48	1,40E-01
10142	Sakka	2458252,49	181,4224739	13,3462674	17,69	1,08E-01
10142	Sakka	2458250,505	181,5471859	13,4514402	17,96	1,75E-01
10142	Sakka	2458252,491	181,4223255	13,3463266	17,89	9,45E-02
10142	Sakka	2458250,506	181,5471873	13,4511732	17,52	1,39E-01
10142	Sakka	2458250,507	181,5470781	13,4511863	17,51	1,54E-01
10142	Sakka	2458250,508	181,5466762	13,4510826	17,35	1,38E-01
10142	Sakka	2458252,494	181,422137	13,346066	17,58	8,95E-02
10142	Sakka	2458250,508	181,5466351	13,4507814	17,65	1,93E-01
10142	Sakka	2458252,495	181,4221941	13,3459494	17,72	1,13E-01
10142	Sakka	2458252,496	181,4219412	13,3459302	17,56	9,84E-02
10142	Sakka	2458250,51	181,546849	13,4509399	17,42	1,72E-01
10142	Sakka	2458252,498	181,4218955	13,3459595	17,50	1,00E-01
10142	Sakka	2458252,499	181,4219056	13,3458789	17,54	9,48E-02
10142	Sakka	2458252,5	181,4217305	13,3458188	17,67	9,55E-02
10142	Sakka	2458252,501	181,4217838	13,3457175	17,70	9,81E-02
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10142	Sakka	2458252,504	181,4215663	13,3455924	17,51	8,72E-02
10142	Sakka	2458252,504	181,4214439	13,3454724	17,57	9,62E-02
10142	Sakka	2458252,505	181,421441	13,3455353	17,55	9,89E-02
10142	Sakka	2458252,506	181,4214707	13,3454511	17,63	1,01E-01
10142	Sakka	2458252,507	181,4212933	13,3453508	17,46	8,22E-02
10142	Sakka	2458252,508	181,4212884	13,3451887	17,42	8,60E-02
10142	Sakka	2458252,509	181,4212379	13,3452988	17,49	9,01E-02
10142	Sakka	2458252,51	181,4210462	13,3451954	17,52	9,61E-02
10142	Sakka	2458252,511	181,421146	13,345233	17,55	9,90E-02
10142	Sakka	2458252,512	181,4209842	13,3449548	17,45	9,57E-02
10142	Sakka	2458252,513	181,42107	13,3450822	17,49	9,28E-02
10142	Sakka	2458252,513	181,4209896	13,3450727	17,50	9,72E-02
10142	Sakka	2458252,514	181,420866	13,3448957	17,43	9,34E-02
10142	Sakka	2458252,515	181,4208111	13,3448202	17,69	9,43E-02
10142	Sakka	2458252,516	181,4207313	13,3448023	17,54	9,27E-02
10142	Sakka	2458252,517	181,4206253	13,3447432	17,43	9,27E-02
10142	Sakka	2458252,518	181,4206139	13,3446808	17,68	9,27E-02
10142	Sakka	2458252,519	181,4205297	13,3447399	17,68	1,06E-01
10142	Sakka	2458252,52	181,4205159	13,3445701	17,60	9,57E-02
10142	Sakka	2458252,521	181,4205072	13,3446102	17,63	8,82E-02
10142	Sakka	2458252,522	181,4203716	13,3445004	17,71	8,72E-02

10142	Sakka	2458252,522	181,4203578	13,3444686	17,70	9,65E-02
10142	Sakka	2458252,523	181,420262	13,3443699	17,60	9,67E-02
10142	Sakka	2458252,524	181,4202398	13,3443741	17,62	8,97E-02
10142	Sakka	2458252,525	181,420144	13,3443036	17,56	1,12E-01
10142	Sakka	2458252,526	181,4201022	13,344391	17,57	9,69E-02
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10142	Sakka	2458252,528	181,4199513	13,3441319	17,61	1,03E-01
10142	Sakka	2458252,529	181,4200378	13,3440569	17,63	9,99E-02
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10142	Sakka	2458252,531	181,4198338	13,343928	17,56	1,10E-01
10142	Sakka	2458252,531	181,4198124	13,344124	17,56	1,03E-01
10142	Sakka	2458252,532	181,4198119	13,3439496	17,67	1,01E-01
10142	Sakka	2458252,533	181,4197628	13,3438416	17,60	1,00E-01
10142	Sakka	2458252,534	181,419779	13,3438023	17,72	1,12E-01
10142	Sakka	2458252,535	181,419618	13,3436889	17,75	1,10E-01
10142	Sakka	2458252,536	181,4195857	13,3435679	17,91	1,18E-01
10142	Sakka	2458252,538	181,4194945	13,3435594	17,91	1,16E-01
10142	Sakka	2458252,539	181,4194755	13,343512	17,90	1,21E-01
10142	Sakka	2458252,54	181,4193469	13,3435594	17,84	1,08E-01
10142	Sakka	2458252,54	181,4191638	13,3434564	17,75	1,10E-01
10142	Sakka	2458252,541	181,4190891	13,3433453	17,82	1,31E-01
838	Seraphina	2458254,369	200,7205677	-15,6905423	14,67	7,64E-03
838	Seraphina	2458255,369	200,5960758	-15,5814492	14,68	7,44E-03
838	Seraphina	2458254,371	200,7203991	-15,6903614	14,67	7,69E-03
838	Seraphina	2458255,371	200,5958875	-15,5812553	14,69	7,12E-03
838	Seraphina	2458254,373	200,7201591	-15,6901878	14,67	7,69E-03
838	Seraphina	2458255,373	200,5956601	-15,5810253	14,68	7,22E-03
838	Seraphina	2458254,374	200,719904	-15,6899977	14,67	7,68E-03
838	Seraphina	2458255,374	200,595429	-15,5808272	14,68	7,18E-03
838	Seraphina	2458254,376	200,7196992	-15,6897704	14,67	7,38E-03
838	Seraphina	2458255,376	200,595202	-15,5806857	14,69	6,80E-03
838	Seraphina	2458254,378	200,7194927	-15,689571	14,67	7,72E-03
838	Seraphina	2458255,378	200,5949785	-15,5805298	14,68	6,83E-03
838	Seraphina	2458254,379	200,7192665	-15,6893621	14,68	7,19E-03
838	Seraphina	2458255,38	200,5947775	-15,5803373	14,69	6,87E-03
838	Seraphina	2458254,381	200,7190167	-15,6892465	14,66	7,17E-03
838	Seraphina	2458255,381	200,5945731	-15,5801335	14,67	6,79E-03
838	Seraphina	2458254,383	200,7187671	-15,6890943	14,66	7,23E-03
838	Seraphina	2458255,383	200,5943299	-15,5798727	14,68	6,80E-03
838	Seraphina	2458254,385	200,7185614	-15,6888973	14,63	7,36E-03
838	Seraphina	2458255,385	200,5941229	-15,5796776	14,69	6,54E-03
838	Seraphina	2458254,386	200,7183768	-15,6886933	14,64	7,36E-03
838	Seraphina	2458255,386	200,5939012	-15,5795464	14,70	6,68E-03
838	Seraphina	2458254,388	200,7181281	-15,6884479	14,63	7,17E-03
838	Seraphina	2458255,388	200,5936745	-15,5793966	14,68	6,62E-03
838	Seraphina	2458254,39	200,7178882	-15,6882407	14,64	6,87E-03
838	Seraphina	2458255,39	200,5934332	-15,5792452	14,69	6,64E-03
838	Seraphina	2458254,392	200,7176654	-15,6880672	14,65	6,93E-03
838	Seraphina	2458255,392	200,5932378	-15,5789892	14,68	6,50E-03
838	Seraphina	2458254,393	200,7174346	-15,6879246	14,64	7,18E-03
838	Seraphina	2458255,393	200,5930271	-15,5787787	14,67	6,51E-03
838	Seraphina	2458254,395	200,7172108	-15,6877684	14,64	7,18E-03
838	Seraphina	2458255,395	200,5928169	-15,5785688	14,67	6,62E-03
838	Seraphina	2458254,397	200,7169689	-15,6875727	14,65	6,90E-03
838	Seraphina	2458255,397	200,5925772	-15,5783911	14,68	6,40E-03
838	Seraphina	2458254,398	200,7167506	-15,6873372	14,64	6,75E-03
838	Seraphina	2458255,398	200,5923214	-15,5782884	14,70	6,16E-03
838	Seraphina	2458254,4	200,7165569	-15,6871185	14,63	6,64E-03
838	Seraphina	2458255,4	200,5921074	-15,5781173	14,68	6,25E-03
838	Seraphina	2458254,402	200,716338	-15,6869249	14,64	6,77E-03
838	Seraphina	2458255,402	200,5919145	-15,5779173	14,68	6,39E-03
838	Seraphina	2458254,403	200,7160815	-15,6867891	14,64	6,78E-03
838	Seraphina	2458255,404	200,5917336	-15,5776933	14,66	6,50E-03
838	Seraphina	2458254,405	200,7158263	-15,6866428	14,64	6,70E-03
838	Seraphina	2458255,405	200,5914946	-15,5774739	14,67	6,42E-03
838	Seraphina	2458254,407	200,7156116	-15,686475	14,64	6,74E-03
838	Seraphina	2458255,407	200,5912775	-15,5772539	14,68	6,26E-03
838	Seraphina	2458254,409	200,7154301	-15,686272	14,63	6,72E-03
838	Seraphina	2458255,409	200,5910587	-15,5771262	14,68	6,05E-03
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838	Seraphina	2458255,41	200,5908476	-15,5769966	14,68	6,29E-03
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838	Seraphina	2458254,414	200,7147249	-15,6856389	14,63	6,43E-03
838	Seraphina	2458255,414	200,5904111	-15,576606	14,67	6,29E-03
838	Seraphina	2458254,417	200,7142921	-15,6853298	14,64	6,54E-03
838	Seraphina	2458255,426	200,5888611	-15,5752632	14,69	7,00E-03

838	Seraphina	2458255,428	200,5886135	-15,5750431	14,69	6,86E-03
838	Seraphina	2458254,429	200,7127818	-15,6840143	14,67	6,84E-03
838	Seraphina	2458255,43	200,588284	-15,5747509	14,69	6,97E-03
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838	Seraphina	2458254,433	200,7121209	-15,6834976	14,67	7,44E-03
838	Seraphina	2458255,435	200,5876786	-15,5742194	14,68	6,62E-03
838	Seraphina	2458254,435	200,7118562	-15,6832626	14,65	7,26E-03
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838	Seraphina	2458254,44	200,7112417	-15,6827922	14,65	7,62E-03
838	Seraphina	2458255,442	200,5868281	-15,5735168	14,66	6,76E-03
838	Seraphina	2458254,443	200,7108887	-15,6824652	14,65	7,65E-03
838	Seraphina	2458255,444	200,5864817	-15,5732478	14,66	6,49E-03
838	Seraphina	2458254,445	200,7106057	-15,6822304	14,65	7,45E-03
838	Seraphina	2458254,447	200,7102579	-15,681948	14,64	7,66E-03
838	Seraphina	2458255,45	200,5858203	-15,5726912	14,66	6,97E-03
838	Seraphina	2458254,45	200,7100188	-15,6816931	14,65	7,33E-03
838	Seraphina	2458255,452	200,5855366	-15,5724611	14,65	6,50E-03
838	Seraphina	2458254,452	200,7096321	-15,6814827	14,65	7,48E-03
838	Seraphina	2458255,454	200,5852314	-15,5721797	14,66	7,11E-03
838	Seraphina	2458254,454	200,709367	-15,6812258	14,62	7,78E-03
838	Seraphina	2458255,456	200,5849373	-15,5719141	14,66	6,70E-03
838	Seraphina	2458254,457	200,7090453	-15,6809234	14,66	7,38E-03
838	Seraphina	2458255,459	200,5846584	-15,5716583	14,68	6,95E-03
838	Seraphina	2458254,459	200,708782	-15,6806903	14,66	7,48E-03
838	Seraphina	2458254,462	200,70838	-15,6804272	14,68	7,11E-03
838	Seraphina	2458255,464	200,5839925	-15,5711506	14,69	6,94E-03
838	Seraphina	2458254,464	200,7081247	-15,6801723	14,66	7,61E-03
838	Seraphina	2458255,466	200,5837345	-15,5709324	14,69	6,79E-03
838	Seraphina	2458254,466	200,7077606	-15,6798351	14,67	7,44E-03
838	Seraphina	2458255,469	200,5834181	-15,5705887	14,66	7,52E-03
838	Seraphina	2458254,47	200,7072885	-15,6794701	14,67	7,52E-03
838	Seraphina	2458255,471	200,5831703	-15,5704026	14,67	6,77E-03
838	Seraphina	2458254,473	200,7069196	-15,6792026	14,67	7,70E-03
838	Seraphina	2458255,473	200,582805	-15,5700951	14,69	6,61E-03
838	Seraphina	2458254,475	200,706682	-15,6789796	14,66	7,37E-03
838	Seraphina	2458255,475	200,5825512	-15,5699199	14,69	6,83E-03
838	Seraphina	2458254,477	200,7064501	-15,6787755	14,63	8,25E-03
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838	Seraphina	2458254,483	200,7056526	-15,6780539	14,66	7,31E-03
838	Seraphina	2458255,483	200,5816577	-15,5690892	14,69	7,25E-03
838	Seraphina	2458254,485	200,7054134	-15,6778323	14,66	7,74E-03
838	Seraphina	2458255,485	200,5813817	-15,5689058	14,67	7,40E-03
838	Seraphina	2458254,487	200,7050644	-15,6775604	14,64	7,62E-03
838	Seraphina	2458255,486	200,5811735	-15,5686281	14,67	7,17E-03
838	Seraphina	2458254,49	200,7047763	-15,6773062	14,65	7,66E-03
838	Seraphina	2458255,489	200,5808296	-15,5683964	14,66	7,87E-03
838	Seraphina	2458254,491	200,7044986	-15,6771888	14,66	7,58E-03
838	Seraphina	2458255,491	200,5805443	-15,5681697	14,69	6,91E-03
838	Seraphina	2458254,494	200,7041813	-15,6768898	14,66	7,39E-03
838	Seraphina	2458255,493	200,5803656	-15,5679517	14,67	7,12E-03
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838	Seraphina	2458254,501	200,703252	-15,6760721	14,66	7,29E-03
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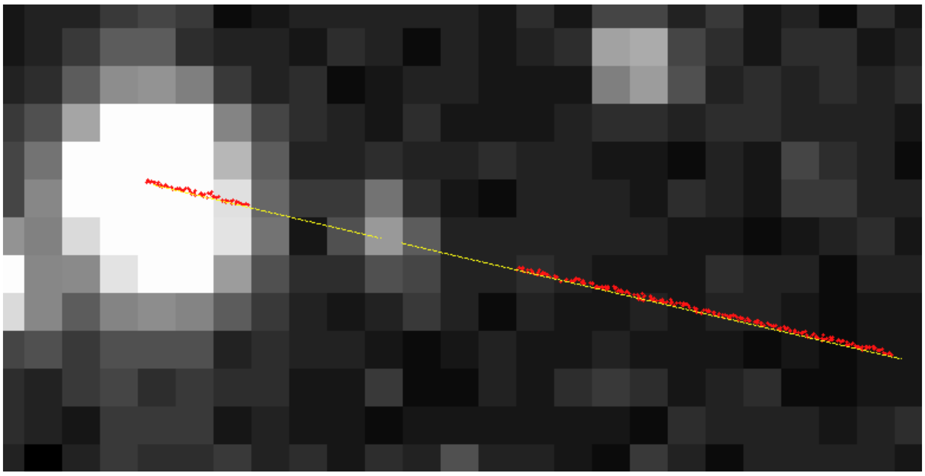
838	Seraphina	2458254,502	200,7030494	-15,675913	14,64	7,16E-03
838	Seraphina	2458255,5	200,5794161	-15,5671985	14,69	7,33E-03
838	Seraphina	2458254,505	200,7027191	-15,6756396	14,65	7,34E-03
838	Seraphina	2458255,503	200,5790865	-15,566922	14,68	7,57E-03
838	Seraphina	2458254,507	200,7024823	-15,6753766	14,65	7,58E-03
838	Seraphina	2458255,505	200,5788592	-15,5666885	14,68	7,34E-03
838	Seraphina	2458254,509	200,7022193	-15,6752491	14,65	7,47E-03
838	Seraphina	2458255,507	200,5785121	-15,5663488	14,69	7,82E-03
838	Seraphina	2458254,511	200,7018889	-15,6749332	14,64	7,42E-03
838	Seraphina	2458255,509	200,5782447	-15,5661558	14,68	7,24E-03
838	Seraphina	2458254,517	200,7011752	-15,6743426	14,65	7,28E-03
838	Seraphina	2458255,511	200,5780534	-15,5659534	14,68	7,26E-03
838	Seraphina	2458254,518	200,7009613	-15,6741244	14,58	8,68E-03
838	Seraphina	2458255,513	200,5777966	-15,565832	14,67	7,59E-03
838	Seraphina	2458254,521	200,7006073	-15,6738795	14,61	8,57E-03
838	Seraphina	2458255,515	200,5774359	-15,5655149	14,69	8,51E-03
838	Seraphina	2458254,523	200,700345	-15,6736151	14,60	8,38E-03
838	Seraphina	2458255,518	200,5771907	-15,5652967	14,66	8,70E-03

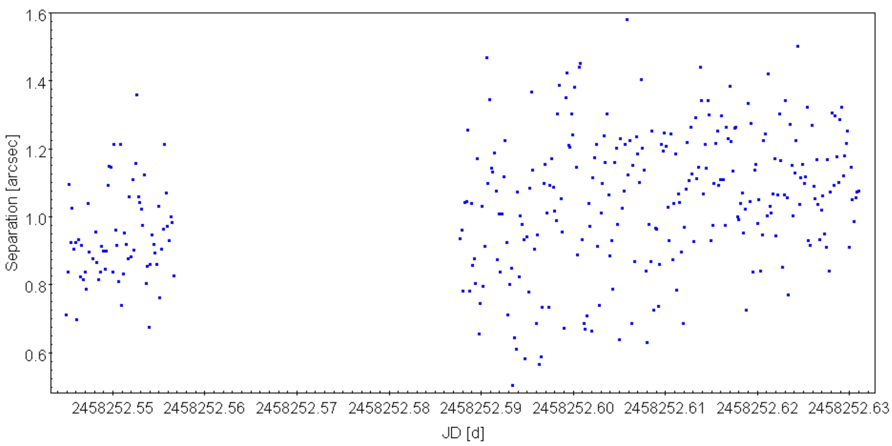
838	Seraphina	2458254,525	200,700099	-15,6734572	14,60	8,37E-03
838	Seraphina	2458254,527	200,6998137	-15,6731391	14,58	9,07E-03
838	Seraphina	2458255,522	200,5766552	-15,5648132	14,63	9,42E-03
838	Seraphina	2458254,53	200,6994921	-15,6728504	14,60	8,88E-03
838	Seraphina	2458255,524	200,5762936	-15,5646026	14,63	1,03E-02
838	Seraphina	2458254,534	200,6989922	-15,6724467	14,59	8,50E-03
838	Seraphina	2458255,526	200,5762047	-15,5643765	14,67	9,90E-03
838	Seraphina	2458254,535	200,6987332	-15,6723052	14,55	8,83E-03
838	Seraphina	2458255,528	200,5759258	-15,5641742	14,63	1,06E-02
838	Seraphina	2458254,537	200,6985062	-15,6720921	14,57	9,01E-03
838	Seraphina	2458255,53	200,575622	-15,5638973	14,64	1,09E-02
838	Seraphina	2458254,54	200,6981902	-15,6718297	14,58	8,67E-03
838	Seraphina	2458254,542	200,6979041	-15,6715914	14,55	9,05E-03
838	Seraphina	2458255,534	200,5751239	-15,5634918	14,65	1,06E-02
838	Seraphina	2458255,537	200,5748477	-15,5631358	14,69	9,91E-03
838	Seraphina	2458255,539	200,574515	-15,5629837	14,62	1,10E-02
838	Seraphina	2458255,543	200,5739532	-15,5625241	14,67	1,18E-02

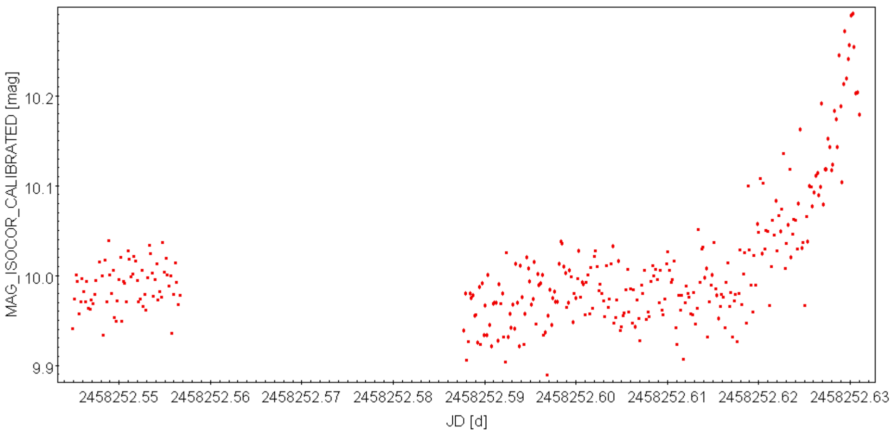
Num	Name	Dataset	µra [arcsec/h]	µdec [arcsec/h]	µra_e [arcsec/h]	µdec_e [arcsec/h]
11922	1992 UT3	20180116/20180116/68-Leto/	5,09	7,04	1,23E-08	1,32E-08
9659	1996 EJ	20180417/20180417/402-Chloe/	-28,42	20,48	2,41E-09	1,91E-09
43227	2000 AR166	20180418/20180418/402-Chloe/	-25,29	17,69	9,54E-09	7,46E-09
54041	2000 GQ113	20180418/20180418/441-Bathilde/	-35,40	9,75	6,07E-09	1,19E-08
54041	2000 GQ113	20180514/20180514/441-Bathilde/	-34,90	17,57	1,22E-08	1,14E-08
41841	2000 WF60	20171213/20171213/308-Polyxo/	-6,44	-2,85	1,13E-08	1,47E-08
41841	2000 WF60	20171220/20171220/308-Polyxo/	-13,98	-0,25	1,10E-08	1,18E-08
145	Adeona	20171216/20171216/145-Adeona/	-15,81	24,68	1,84E-09	1,88E-09
145	Adeona	20171219/20171219/145-Adeona/	-18,63	25,35	3,70E-09	2,69E-09
145	Adeona	20171222/20171222/145-Adeona/	-21,96	25,25	5,69E-09	7,95E-09
1501	Baade	20180514/20180514/441-Bathilde/	-34,25	7,49	4,21E-09	4,41E-09
441	Bathilde	20180418/20180418/441-Bathilde/	-26,40	10,44	3,39E-09	2,29E-09
441	Bathilde	20180514/20180514/441-Bathilde/	-28,93	15,78	3,20E-09	2,83E-09
976	Benjamina	20180116/20180116/65-Cybele/	-15,85	-3,18	2,32E-09	3,53E-09
360	Carlova	20180511/20180511/360-Carlova/	-5,78	-3,60	1,92E-09	1,91E-09
360	Carlova	20180513/20180513/360-Carlova/	-4,34	-4,37	2,04E-09	1,78E-09
402	Chloe	20180327/20180327/402-Chloe/	-15,35	19,98	3,46E-09	1,41E-09
402	Chloe	20180417/20180417/402-Chloe/	-31,50	15,29	2,05E-09	1,21E-09
402	Chloe	20180418/20180418/402-Chloe/	-31,36	15,05	4,39E-09	1,88E-09
65	Cybele	20171216/20171216/65-Cybele/	-28,15	-1,12	2,29E-09	1,69E-09
65	Cybele	20180116/20180116/65-Cybele/	-15,29	1,11	1,60E-09	1,31E-09
13	Egeria	20180513/20180513/13-Egeria/	-39,25	-6,95	7,07E-09	2,94E-09
39539	Emmadesmet	20180418/20180418/441-Bathilde/	-28,16	-0,73	8,64E-09	6,72E-09
114	Kassandra	20171218/20171218/114-Kassandra/	-33,86	1,85	2,44E-09	1,22E-09
114	Kassandra	20171221/20171221/114-Kassandra/	-35,45	2,29	1,90E-09	1,76E-09
39	Laetitia	20180515/20180515/39-Laetitia/	-29,18	8,67	3,74E-09	2,32E-09
39	Laetitia	20180516/20180516/39-Laetitia/	-29,03	8,30	6,73E-09	6,54E-09
4628	Laplace	20171213/20171213/308-Polyxo/	-7,54	-14,93	2,37E-09	2,02E-09
68	Leto	20180116/20180116/68-Leto/	-4,51	7,04	2,71E-09	1,46E-09
2219	Mannucci	20180116/20180116/68-Leto/	-3,10	8,07	5,91E-09	5,55E-09
24837	Msecke Zehrovice	20171218/20171218/114-Kassandra/	-39,12	-3,01	1,56E-08	1,34E-09
24837	Msecke Zehrovice	20171221/20171221/114-Kassandra/	-40,56	-2,51	2,43E-08	1,64E-08
4745	Nancymarie	20171218/20171218/114-Kassandra/	-40,24	0,05	8,55E-09	2,09E-09
4745	Nancymarie	20171221/20171221/114-Kassandra/	-32,22	-3,69	9,07E-09	1,09E-08
372	Palma	20171213/20171213/372-Palma/	-27,93	-0,79	5,90E-09	3,17E-09
372	Palma	20171217/20171217/372-Palma/	-30,85	-4,70	6,08E-09	5,90E-09
372	Palma	20171220/20171220/372-Palma/	-32,06	-7,44	2,70E-09	2,26E-09
308	Polyxo	20171213/20171213/308-Polyxo/	-8,93	-0,59	1,25E-09	8,05E-10
308	Polyxo	20171220/20171220/308-Polyxo/	-15,41	1,52	1,67E-09	1,66E-09
1427	Ruvuma	20180404/20180404/1427-Ruvuma/	-15,83	-1,11	2,10E-09	2,89E-09
1427	Ruvuma	20180416/20180416/1427-Ruvuma/	-6,94	-5,67	2,21E-09	2,10E-09
1626	Sadeya	20171217/20171217/1626-Sadeya/	8,56	-54,21	2,39E-09	4,54E-09
10142	Sakka	20180511/20180511/360-Carlova/	-10,44	-7,51	6,40E-09	6,95E-09
10142	Sakka	20180513/20180513/360-Carlova/	-9,05	-8,33	4,26E-09	4,67E-09
838	Seraphina	20180515/20180515/838-Seraphina/	-18,95	16,49	1,80E-09	1,75E-09
838	Seraphina	20180516/20180516/838-Seraphina/	-18,32	16,32	1,88E-09	2,03E-09

Asteroid Positions, Separations and Light Curves

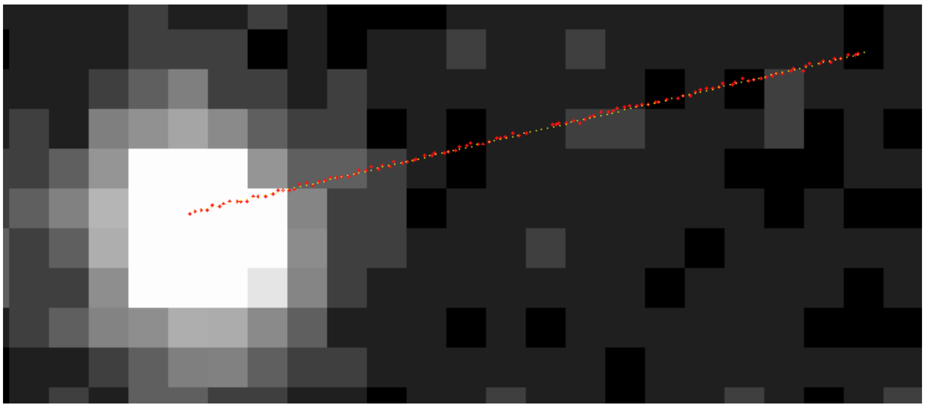
ID	Name	Class	Mv [mag]	Pos.	Det.	Mean [arcsec]	St.Dev. [arcsec]	Filters	Behavior
13	Egeria	MB>Middle	10.3	499	327	1.03	0.19	St Sa	AAA

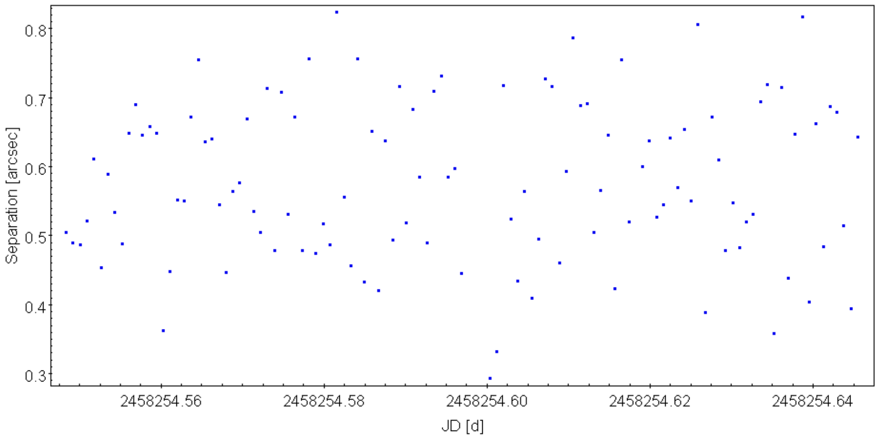


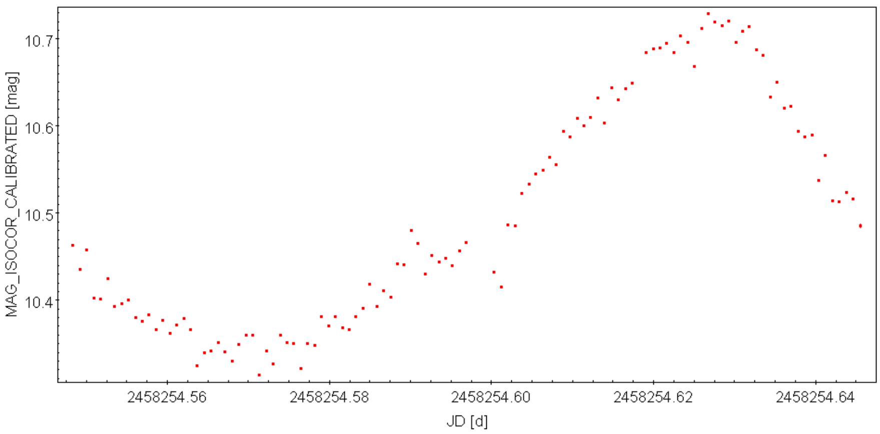


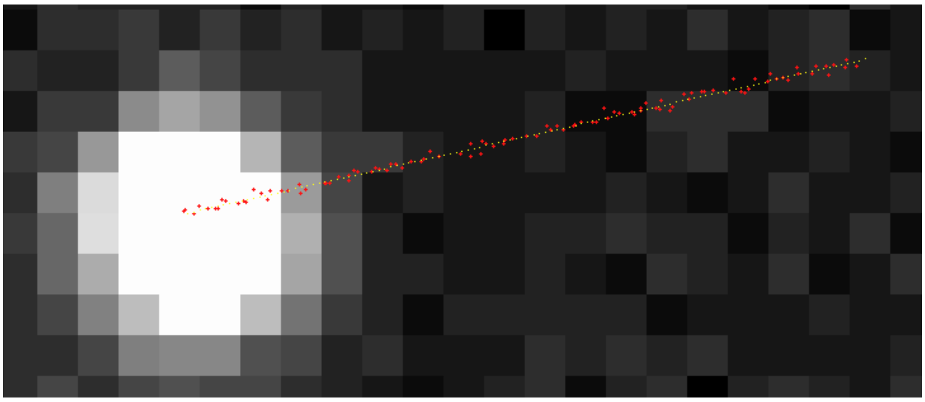


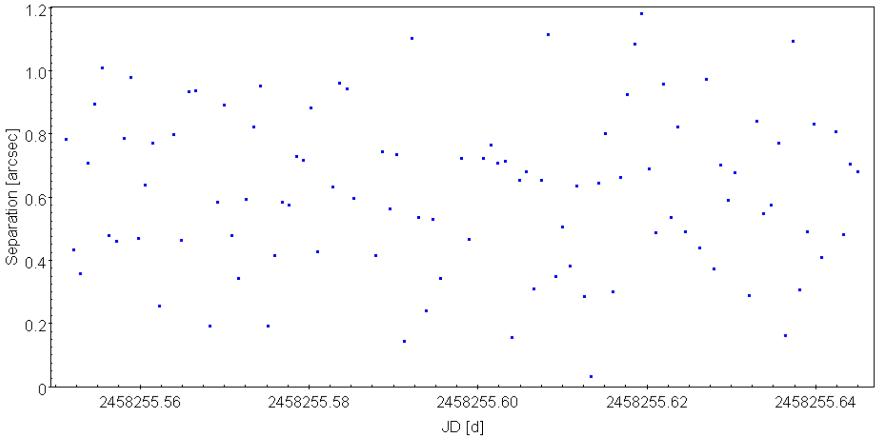
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
39	Laetitia	MB>Middle	10.4	229	214	0.60	0.19	Sc	AAA

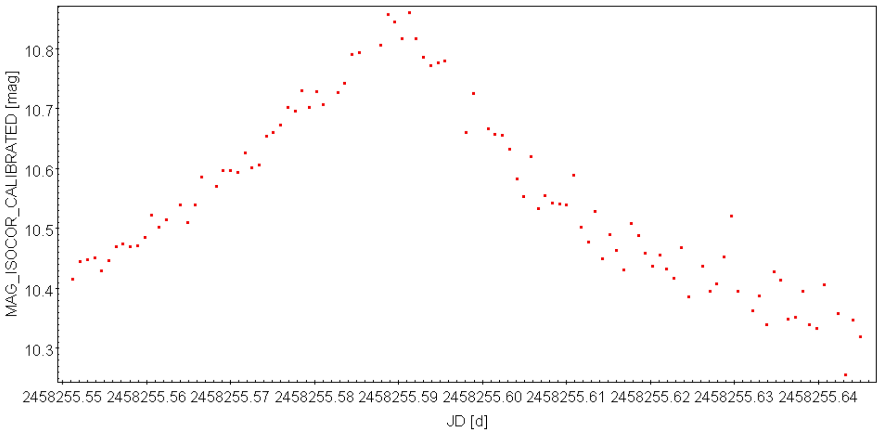




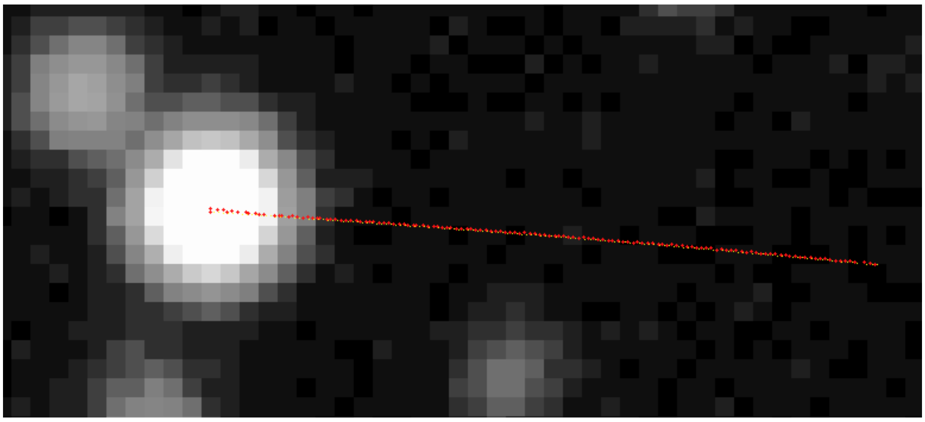


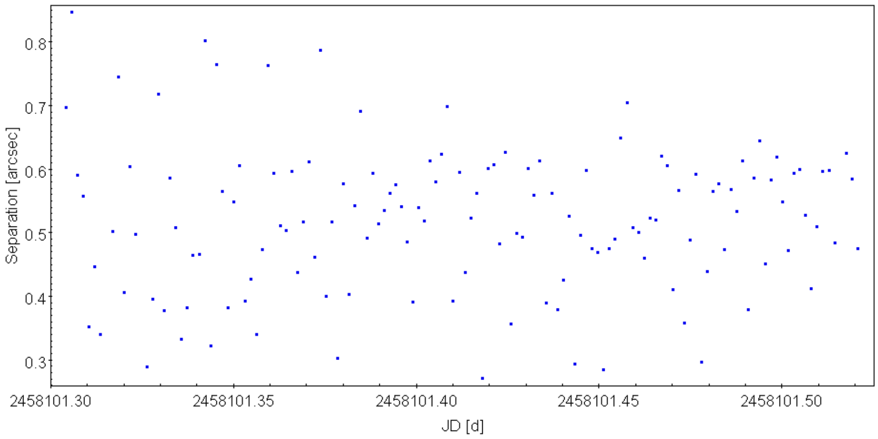


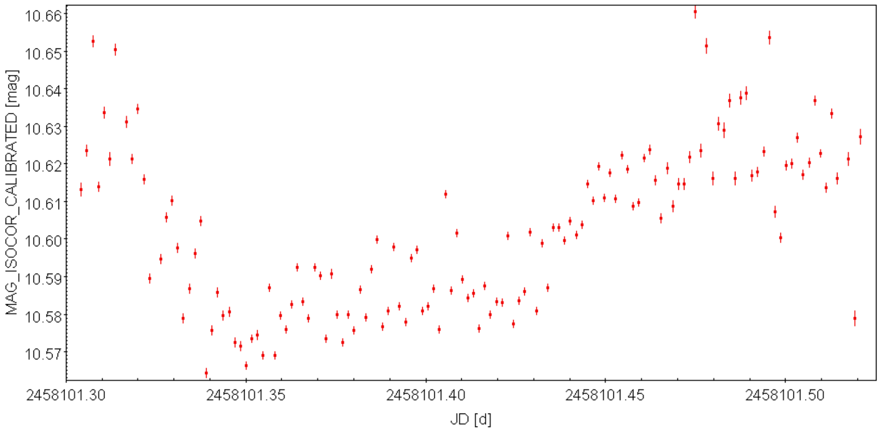

Separation [arcsec]
0
0.2
0.4
0.6
0.8
1.0
1.2
2458255.56
2458255.58
2458255.60
2458255.62
2458255.64
JD [d]

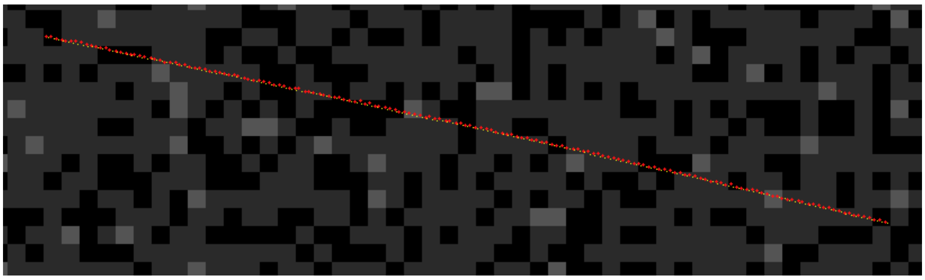

MAG_ISOCOR_CALIBRATED [mag]
10.3
10.4
10.5
10.6
10.7
10.8
2458255.55 2458255.56 2458255.57 2458255.58 2458255.59 2458255.60 2458255.61 2458255.62 2458255.63 2458255.64
JD [d]

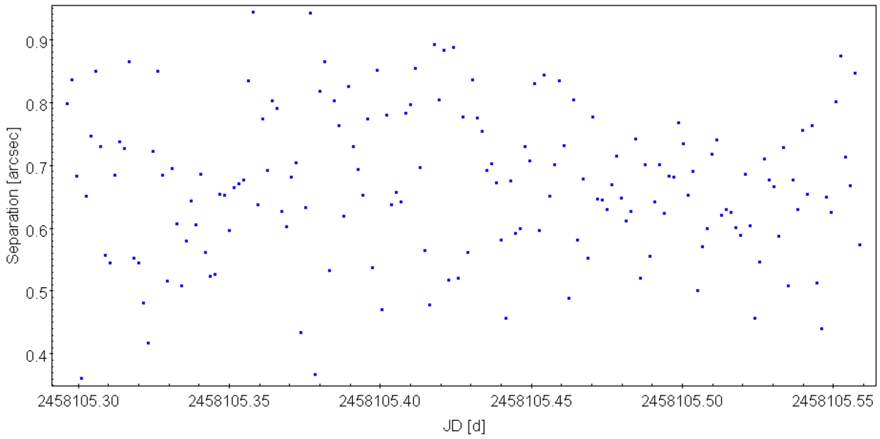
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
372	Palma	MB>Outer	11.0	397	350	0.62	0.14	St Sc Sa	AAA

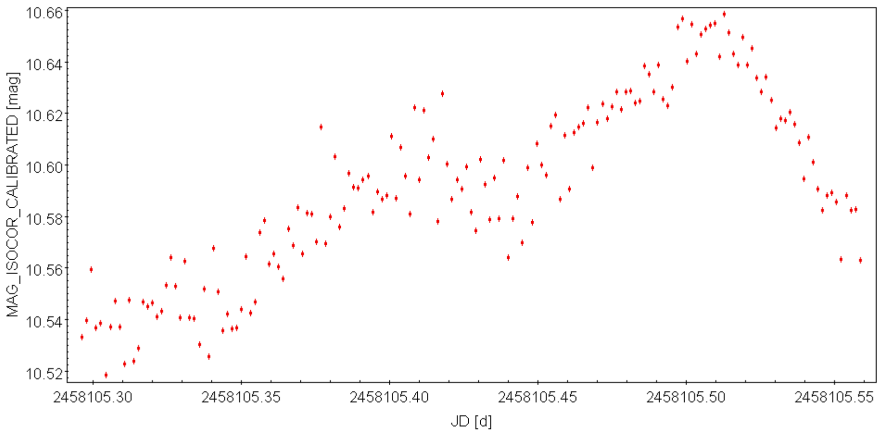


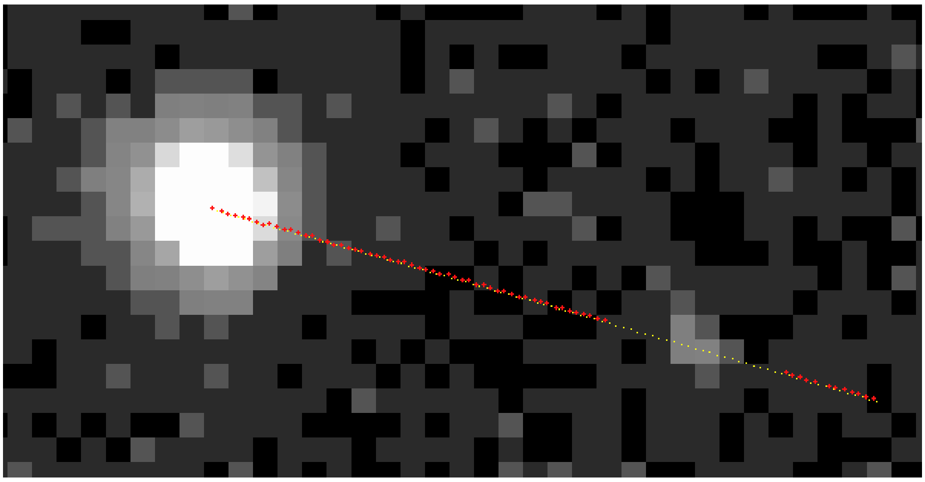


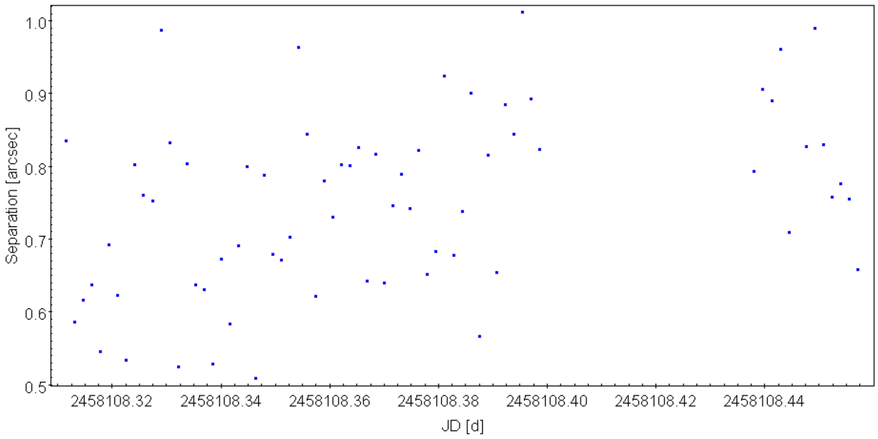


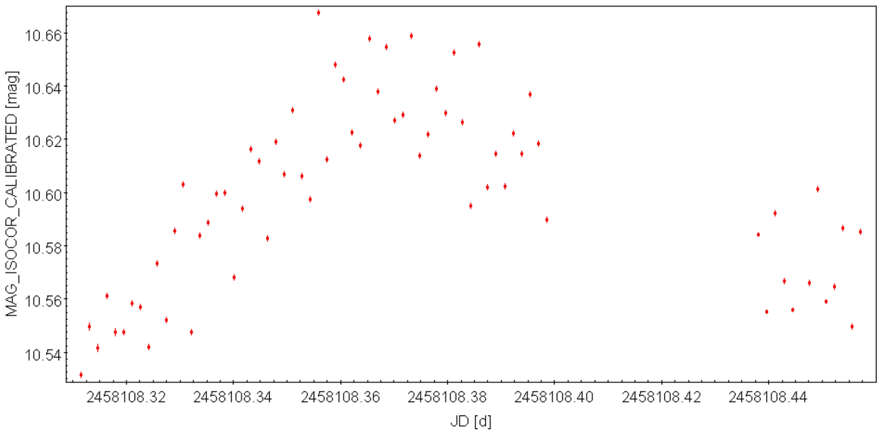



Separation [arcsec]
JD [d]
0.9
0.8
0.7
0.6
0.5
0.4
2458105.30
2458105.35
2458105.40
2458105.45
2458105.50
2458105.55

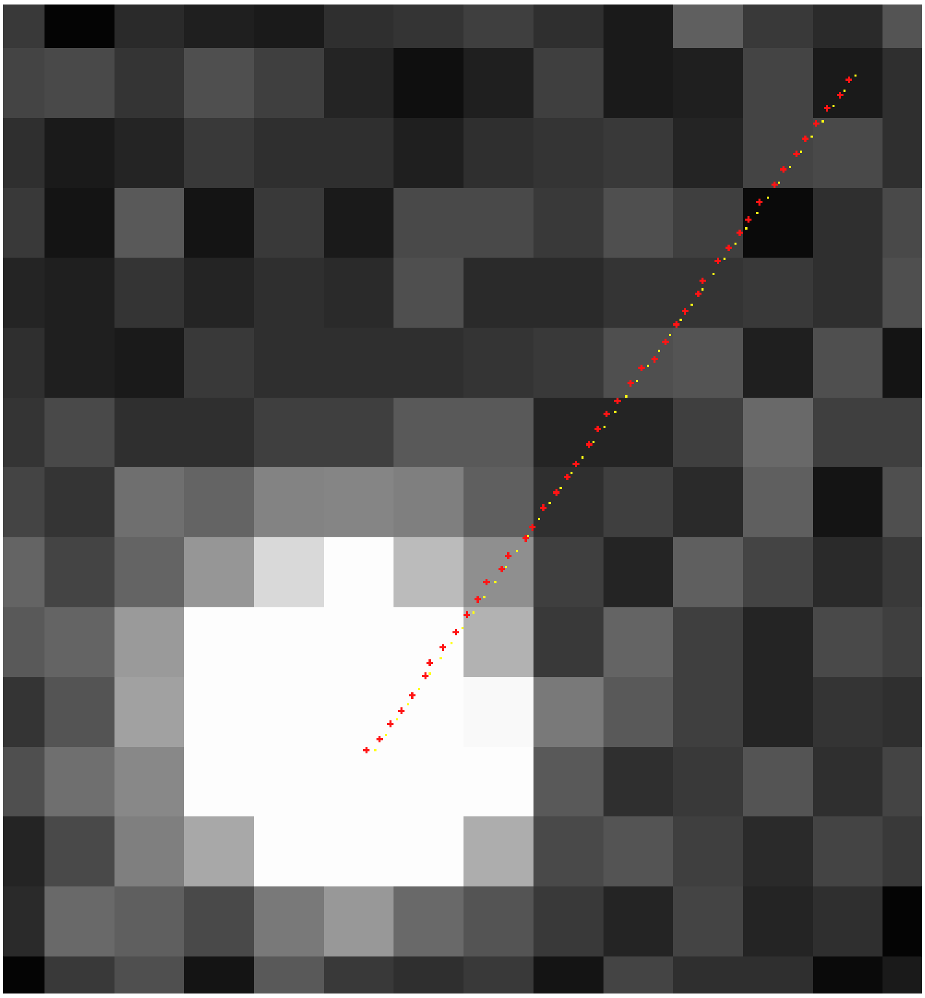

MAG_ISOCOR_CALIBRATED [mag]
JD [d]
10.66
10.64
10.62
10.60
10.58
10.56
10.54
10.52
2458105.30
2458105.35
2458105.40
2458105.45
2458105.50
2458105.55

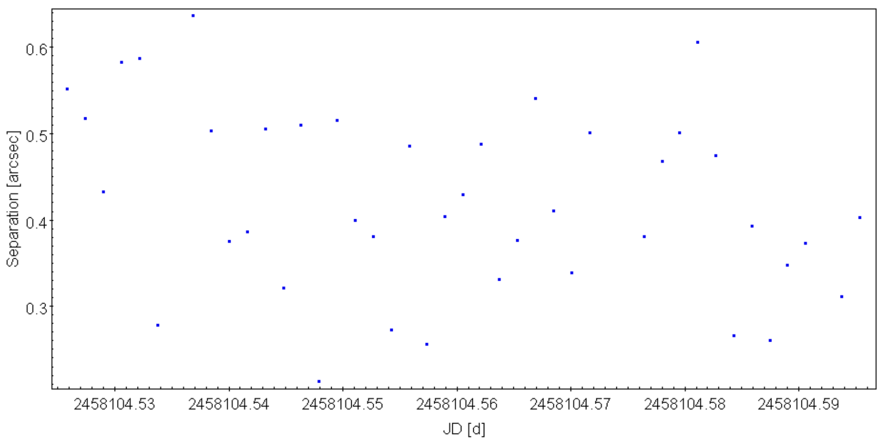


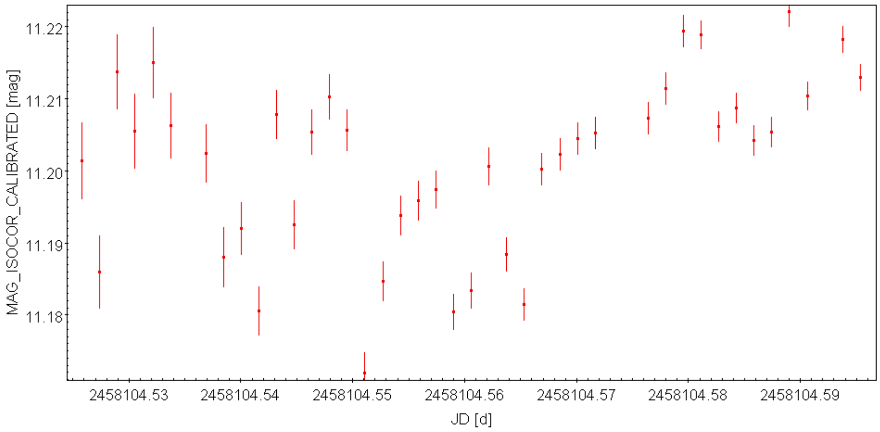

Separation [arcsec]
1.0
0.9
0.8
0.7
0.6
0.5
2458108.32
2458108.34
2458108.36
2458108.38
2458108.40
2458108.42
2458108.44
JD [d]

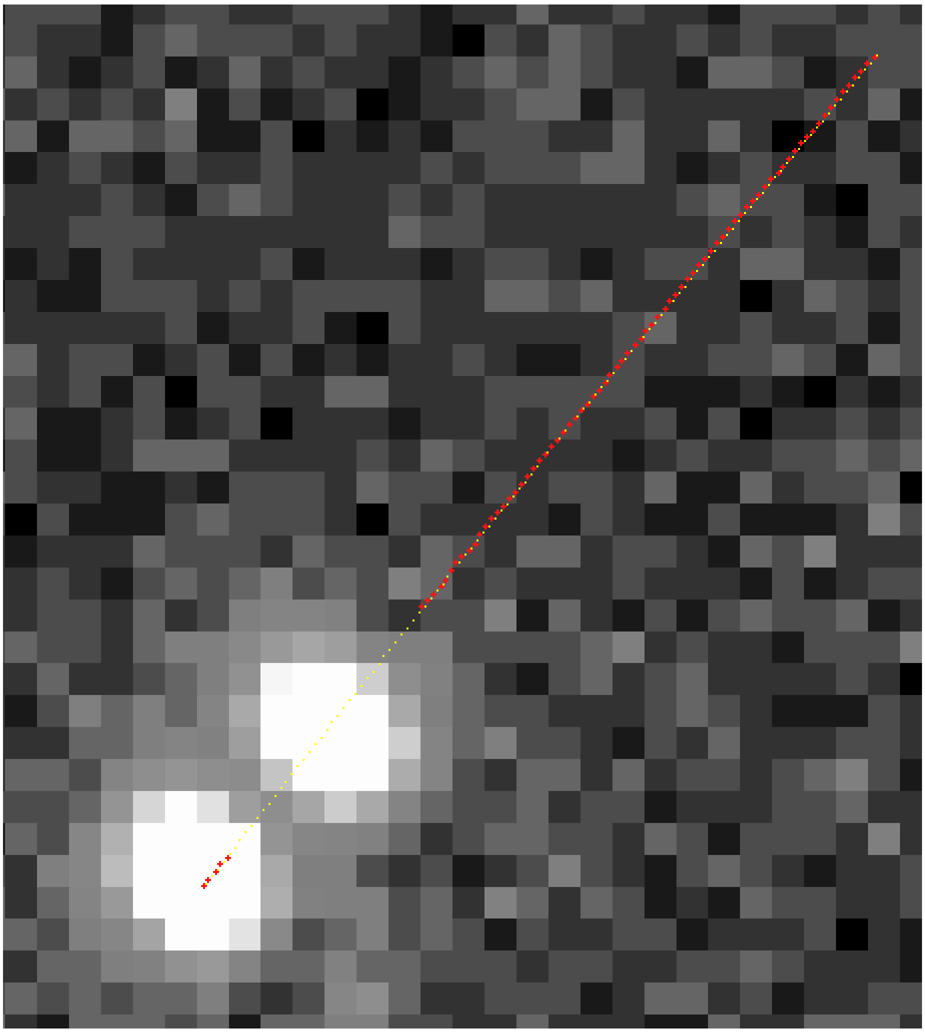

MAG_ISOCOR_CALIBRATED [mag]
10.66
10.64
10.62
10.60
10.58
10.56
10.54
2458108.32
2458108.34
2458108.36
2458108.38
2458108.40
2458108.42
2458108.44
JD [d]

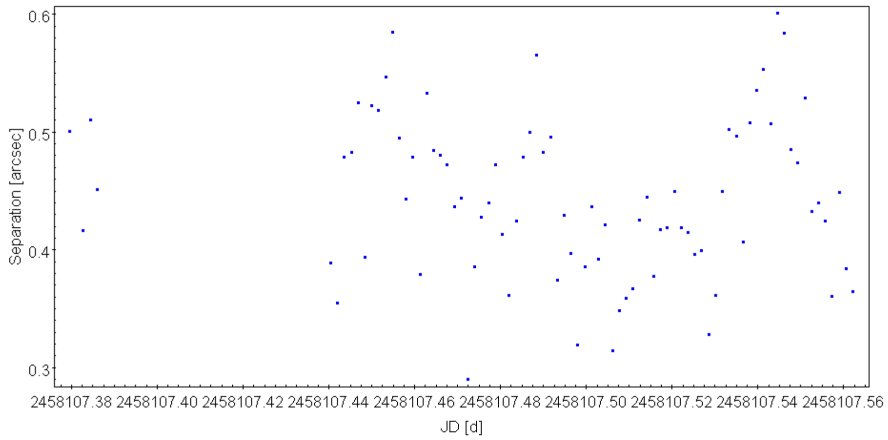
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
145	Adeona	MB>Middle	11.6	388	307	0.47	0.10	St Sc Vi	AAA



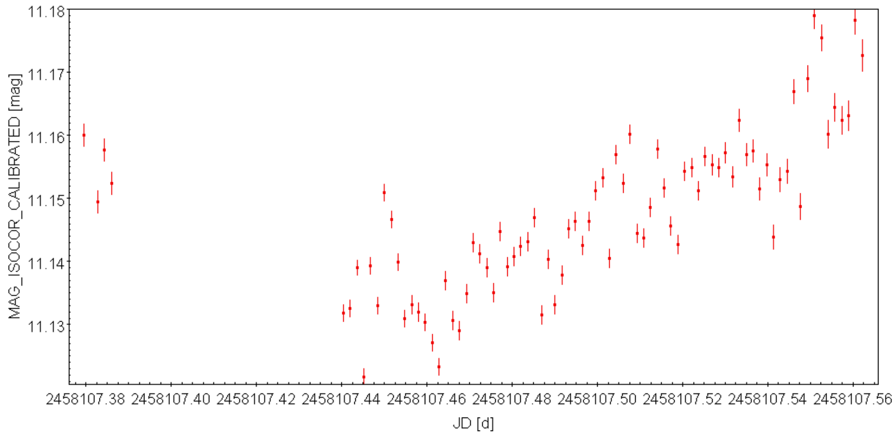



MAG_ISOCOR_CALIBRATED [mag]
11.22
11.21
11.20
11.19
11.18
2458104.53
2458104.54
2458104.55
2458104.56
2458104.57
2458104.58
2458104.59
JD [d]

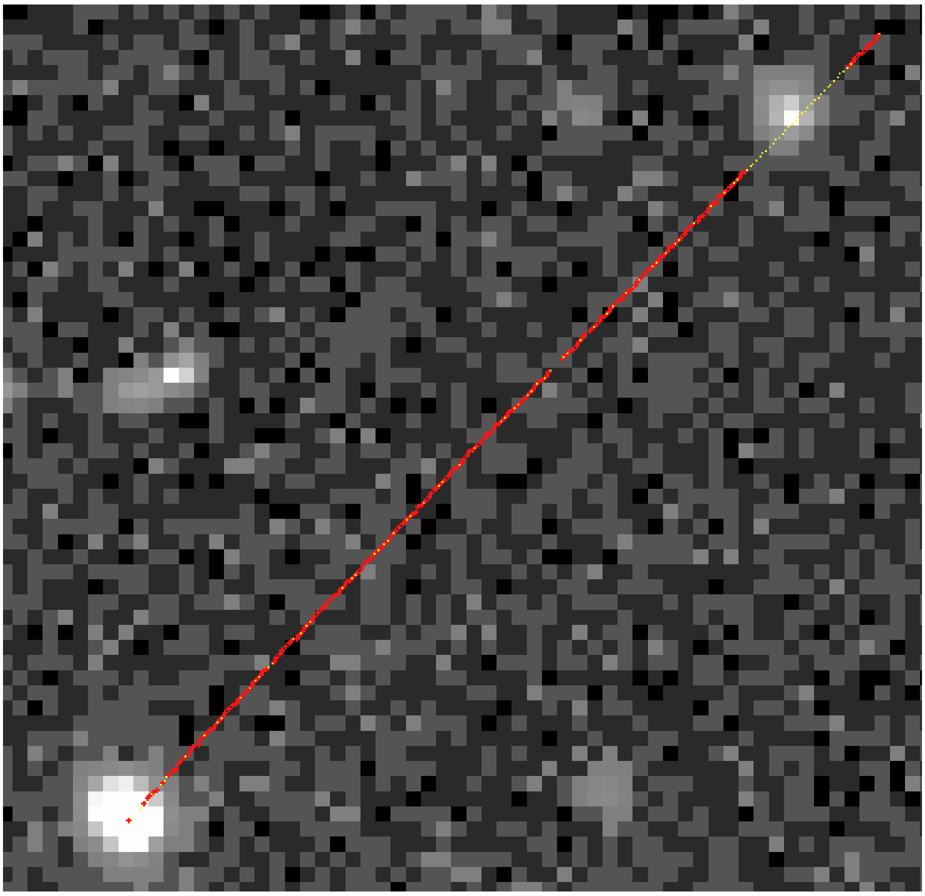


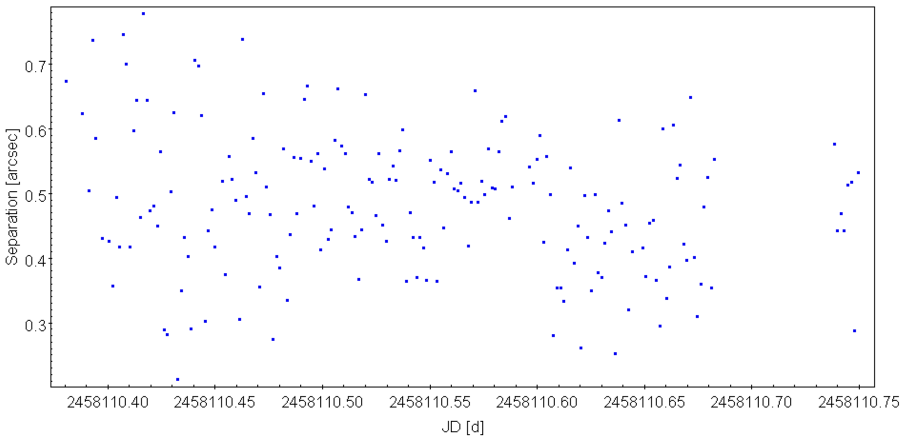


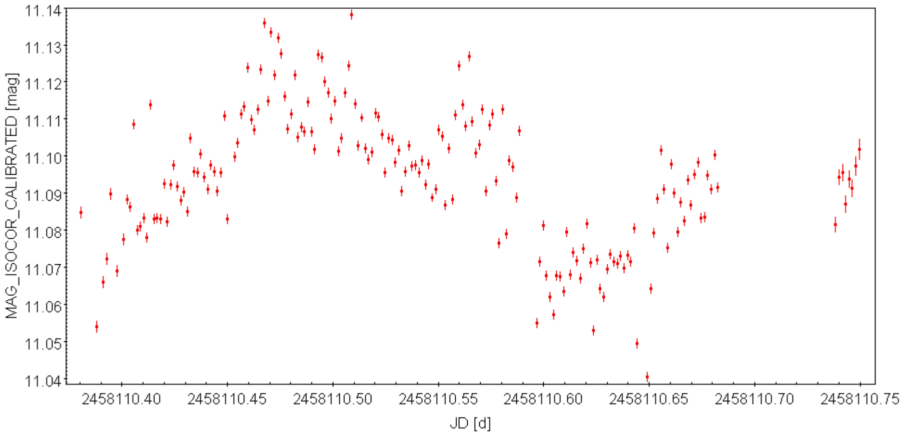
Separation [arcsec]
0.6
0.5
0.4
0.3
2458107.38 2458107.40 2458107.42 2458107.44 2458107.46 2458107.48 2458107.50 2458107.52 2458107.54 2458107.56
JD [d]



MAG_ISOCOR_CALIBRATED [mag]
11.18
11.17
11.16
11.15
11.14
11.13
2458107.38 2458107.40 2458107.42 2458107.44 2458107.46 2458107.48 2458107.50 2458107.52 2458107.54 2458107.56
JD [d]

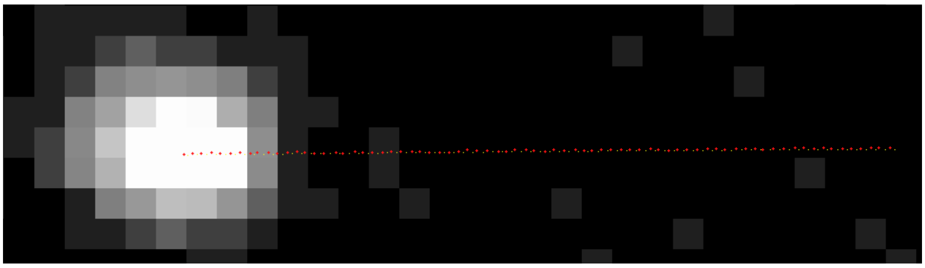


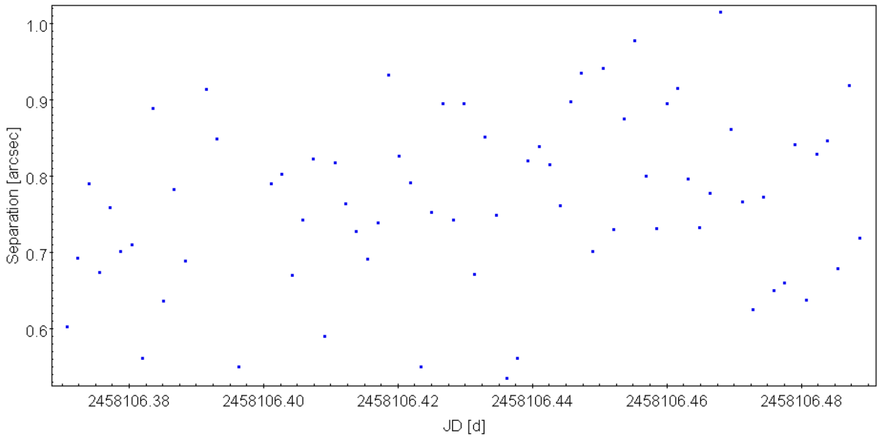

Separation [arcsec]
0.3
0.4
0.5
0.6
0.7
2458110.40
2458110.45
2458110.50
2458110.55
2458110.60
2458110.65
2458110.70
2458110.75
JD [d]

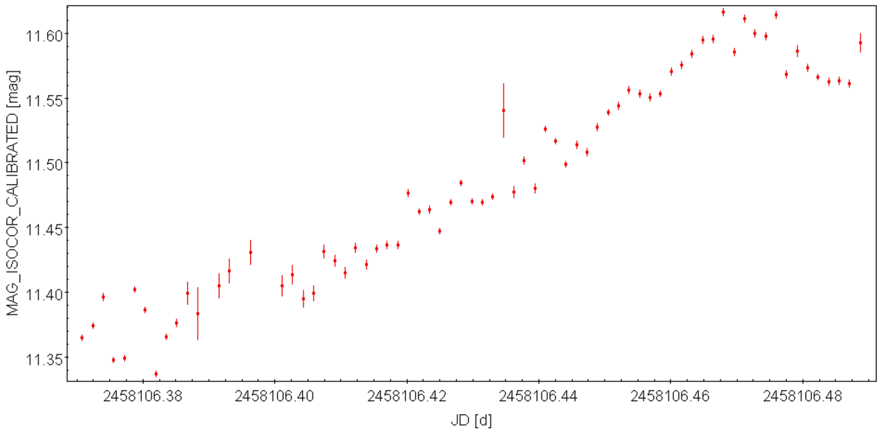


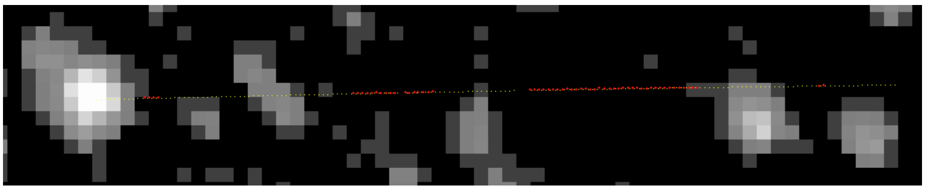
11.14
11.13
11.12
11.11
11.10
11.09
11.08
11.07
11.06
11.05
11.04
MAG_ISOCOR_CALIBRATED [mag]
2458110.40
2458110.45
2458110.50
2458110.55
2458110.60
2458110.65
2458110.70
2458110.75
JD [d]

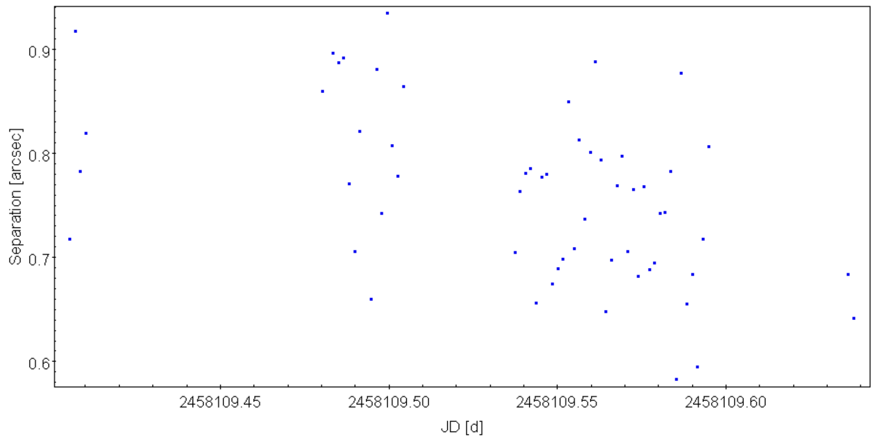
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
114	Kassandra	MB>Middle	11.7	244	128	0.76	0.10	St Vi	AAA



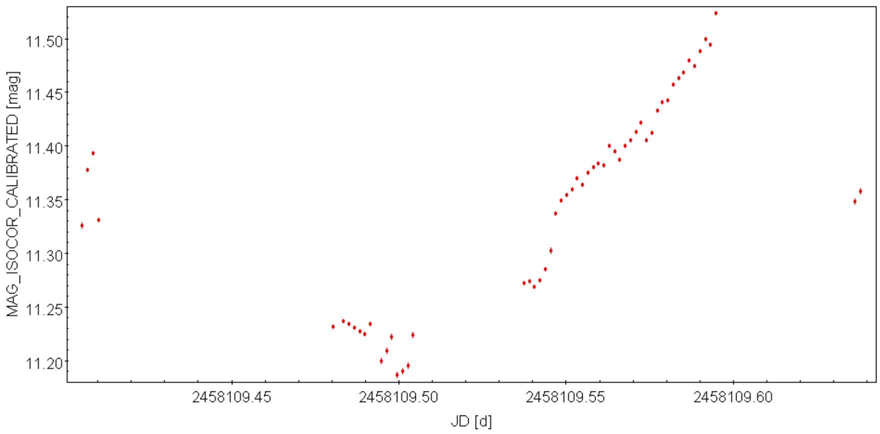






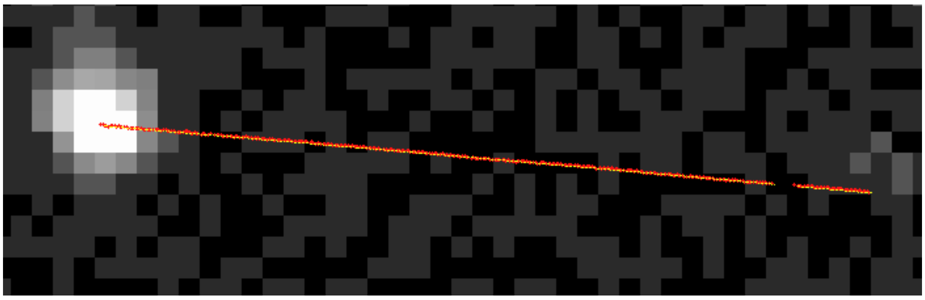


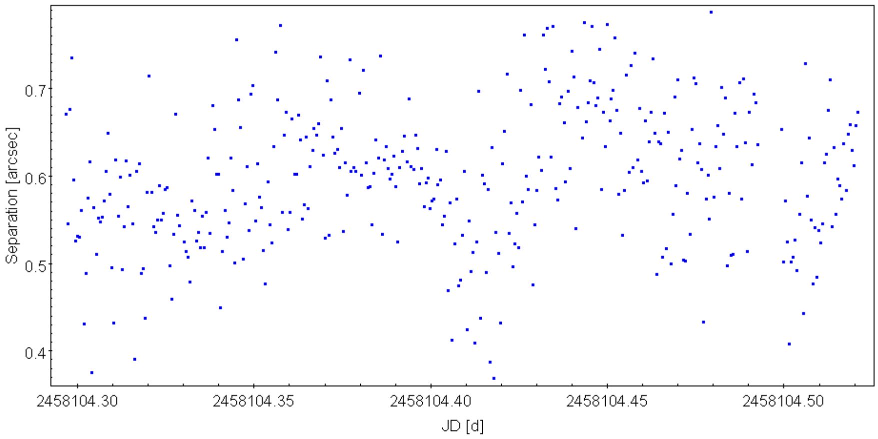
0.9
0.8
0.7
0.6
Separation [arcsec]
2458109.45
2458109.50
2458109.55
2458109.60
JD [d]

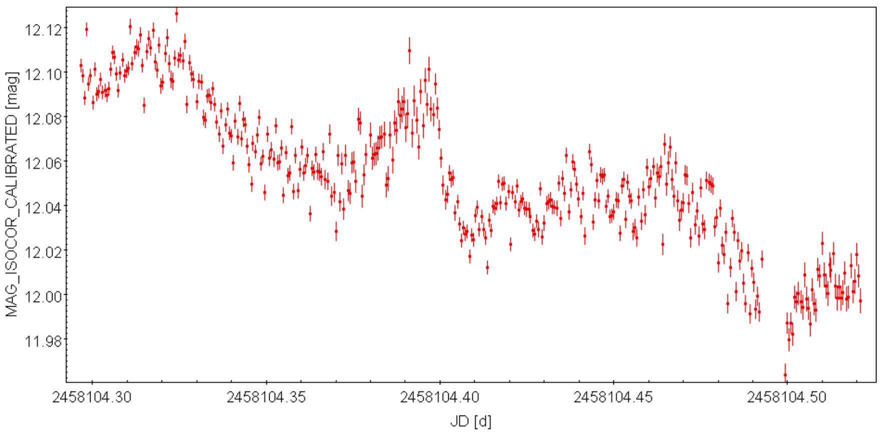


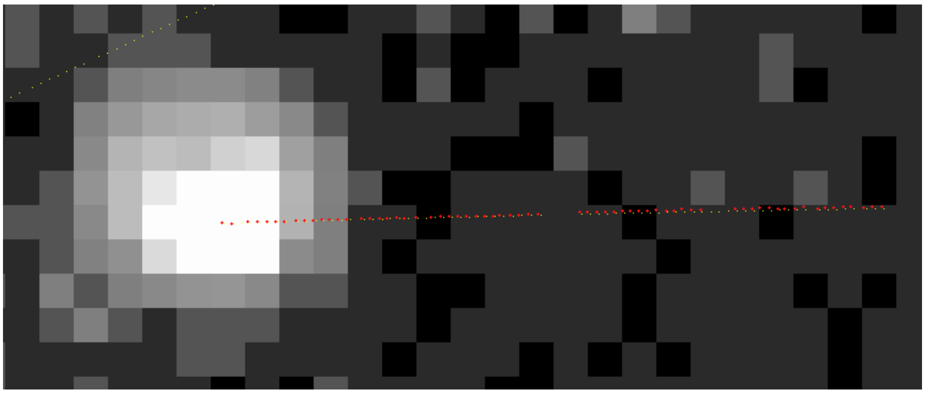
11.50
11.45
11.40
11.35
11.30
11.25
11.20
MAG_ISOCOR_CALIBRATED [mag]
2458109.45
2458109.50
2458109.55
2458109.60
JD [d]

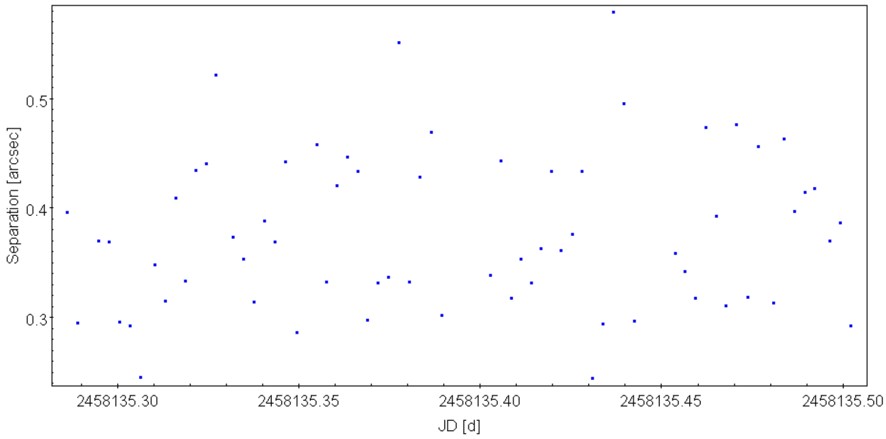
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
65	Cybele	MB>Cybele	12.0	454	446	0.56	0.11	Sc	AAA

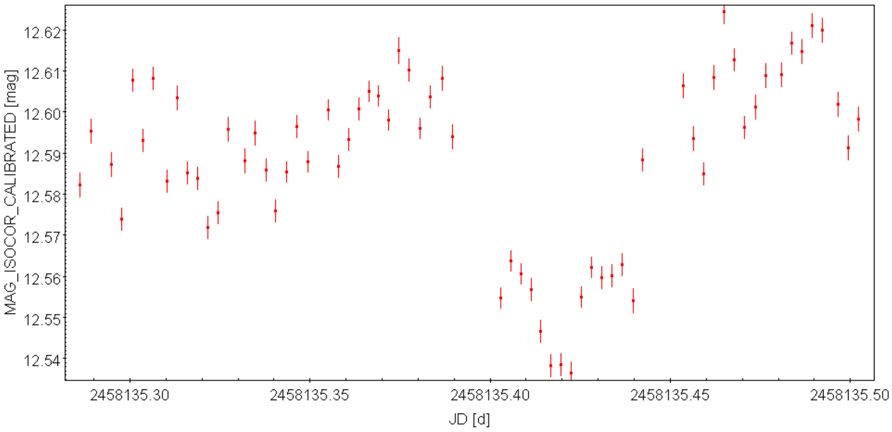




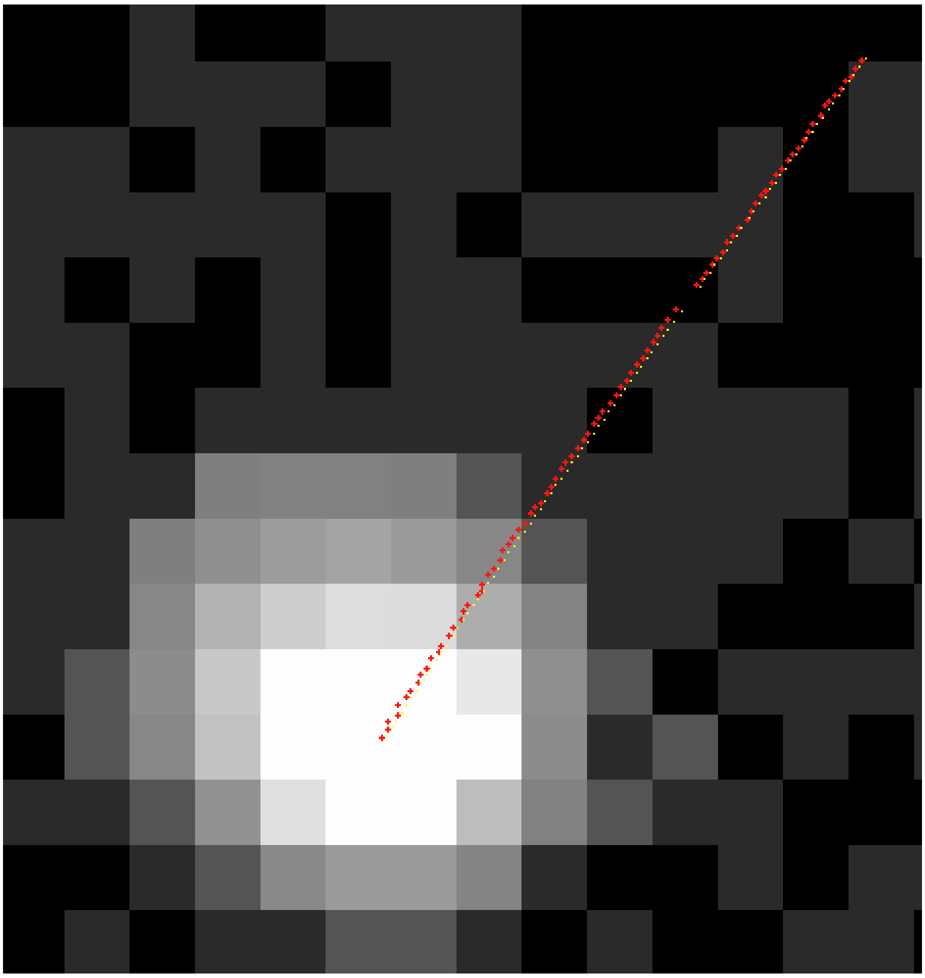


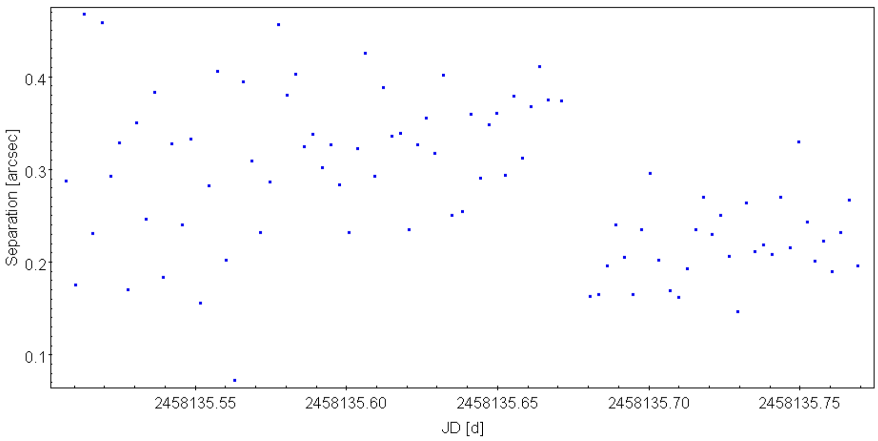


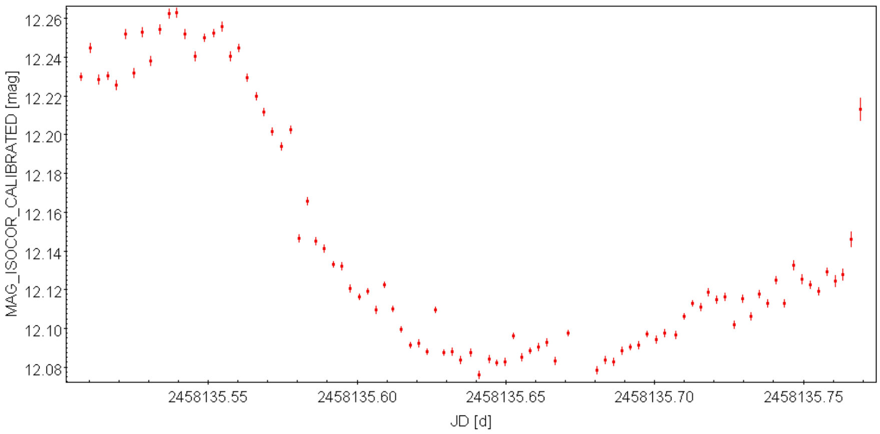

Separation [arcsec]
0.3
0.4
0.5
2458135.30
2458135.35
2458135.40
2458135.45
2458135.50
JD [d]


MAG_ISOCOR_CALIBRATED [mag]
12.54
12.55
12.56
12.57
12.58
12.59
12.60
12.61
12.62
2458135.30
2458135.35
2458135.40
2458135.45
2458135.50
JD [d]

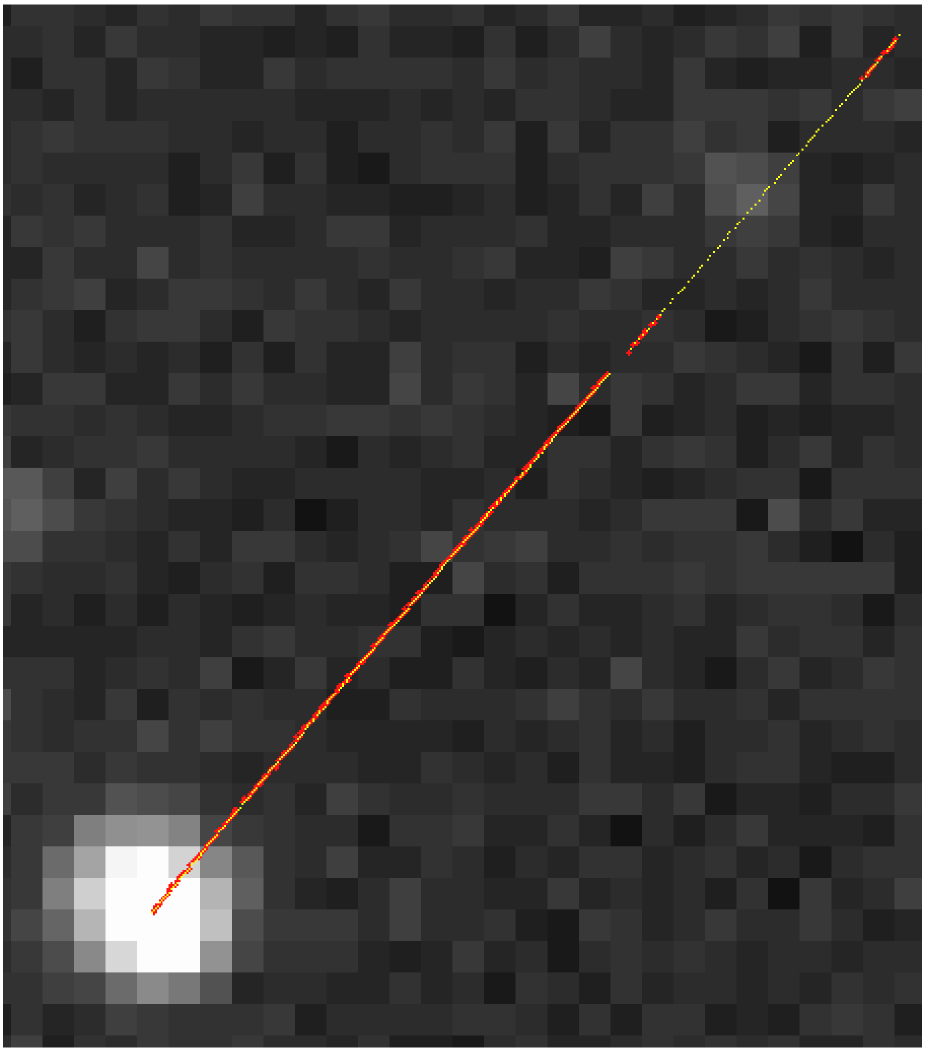
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
68	Leto	MB>Middle	12.5	89	89	0.28	0.08		AAA

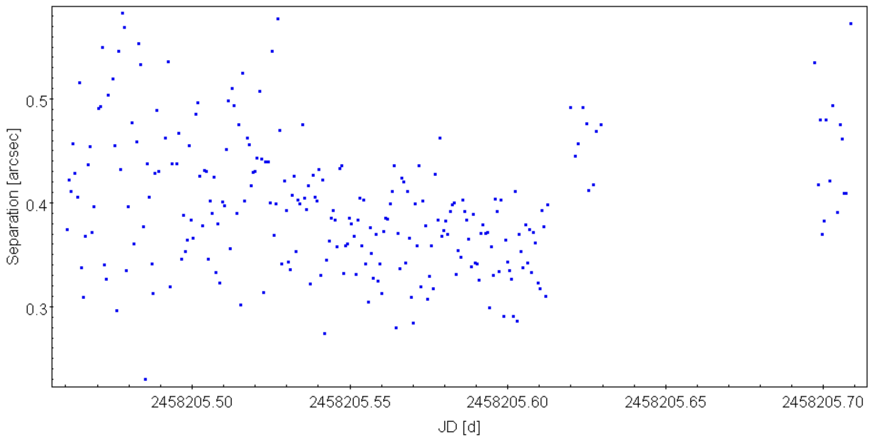


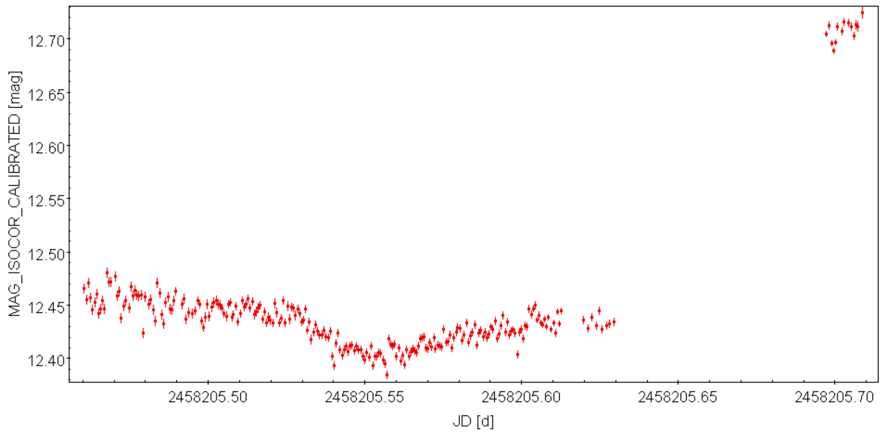


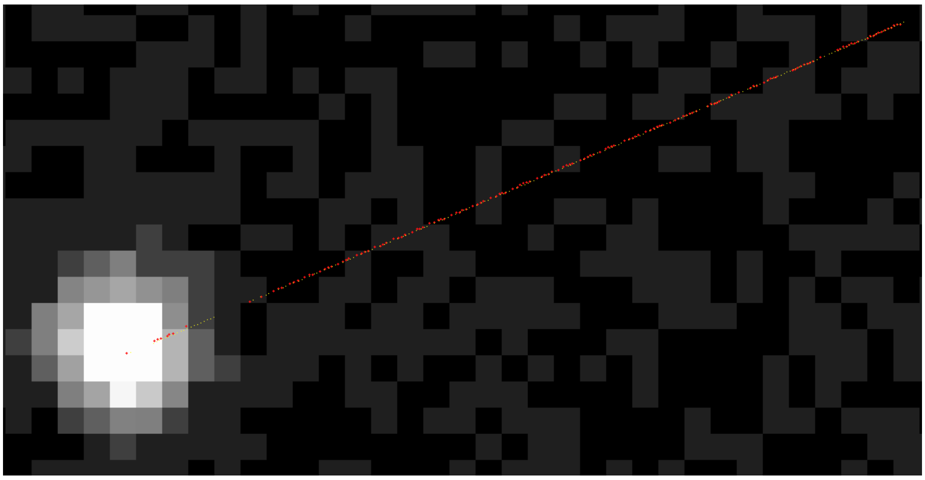

12.26
12.24
12.22
12.20
12.18
12.16
12.14
12.12
12.10
12.08
MAG_ISOCOR_CALIBRATED [mag]
2458135.55
2458135.60
2458135.65
2458135.70
2458135.75
JD [d]

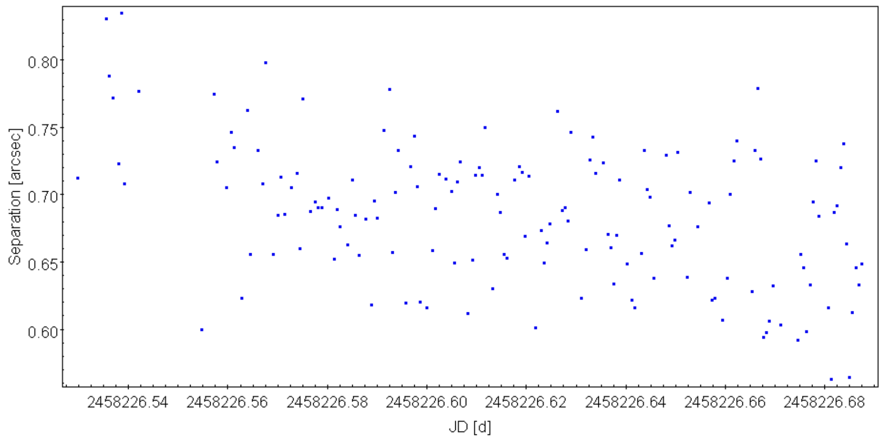
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
402	Chloe	MB>Middle	12.7	658	517	0.56	0.17	St Sc Sa Vi	AAA

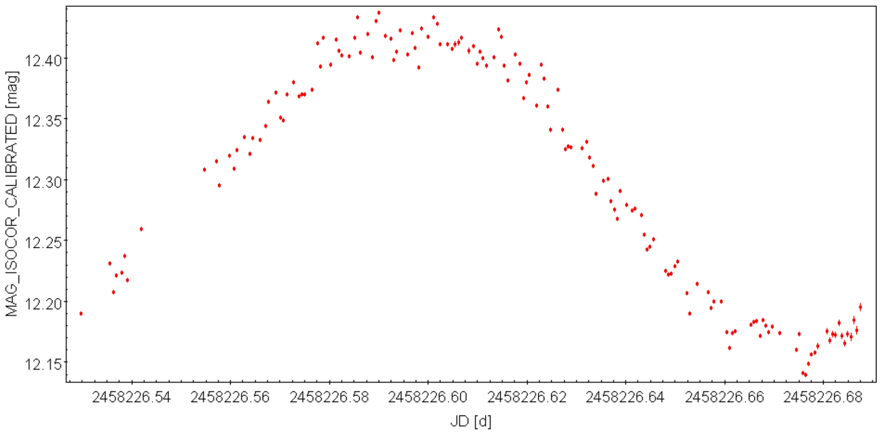


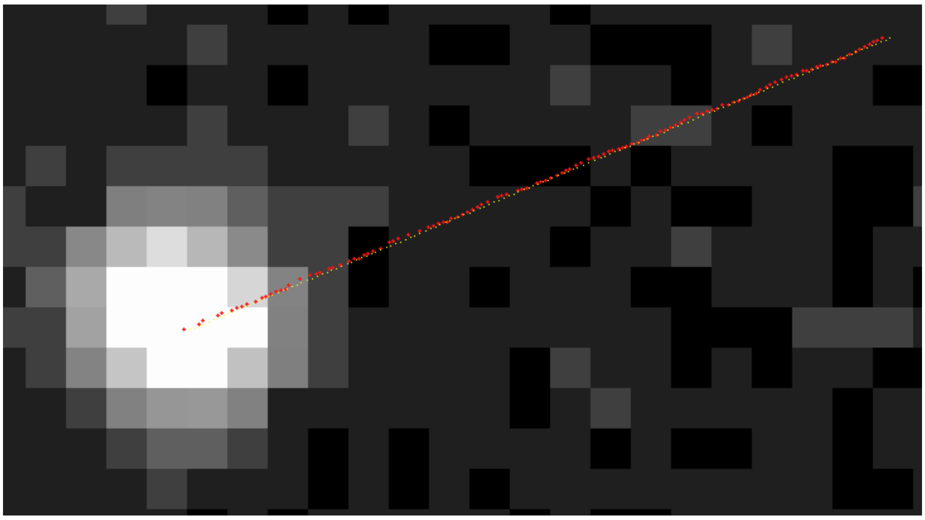


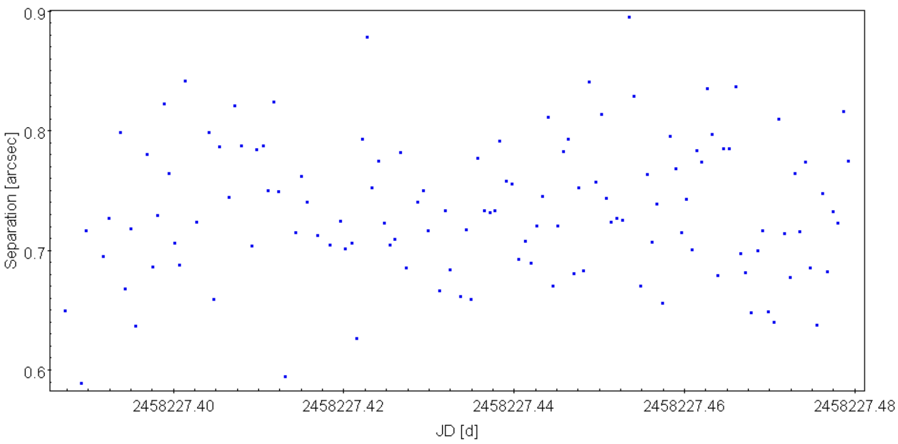

MAG_ISOCOR_CALIBRATED [mag]
JD [d]
12.70
12.65
12.60
12.55
12.50
12.45
12.40
2458205.50
2458205.55
2458205.60
2458205.65
2458205.70

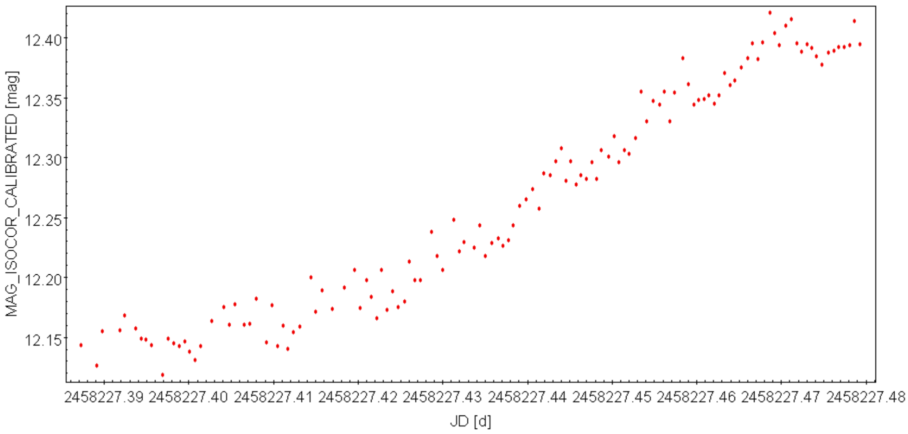



Separation [arcsec]
JD [d]
0.80
0.75
0.70
0.65
0.60
2458226.54
2458226.56
2458226.58
2458226.60
2458226.62
2458226.64
2458226.66
2458226.68

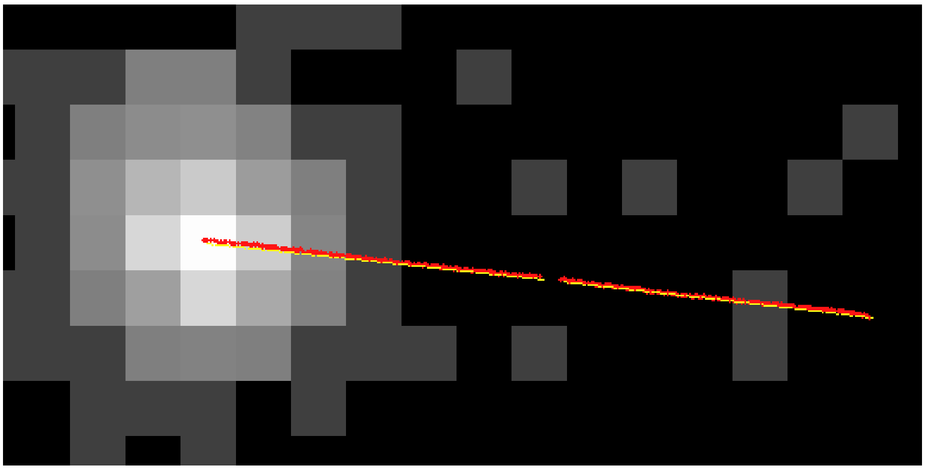

MAG_ISOCOR_CALIBRATED [mag]
12.40
12.35
12.30
12.25
12.20
12.15
2458226.54
2458226.56
2458226.58
2458226.60
2458226.62
2458226.64
2458226.66
2458226.68
JD [d]

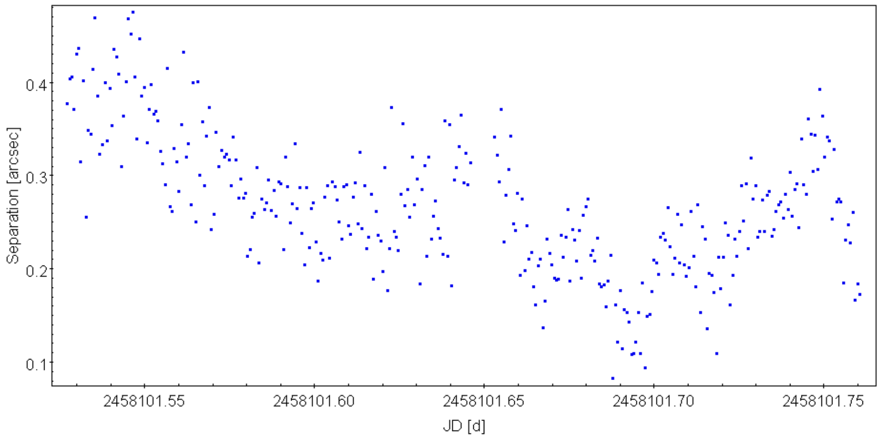


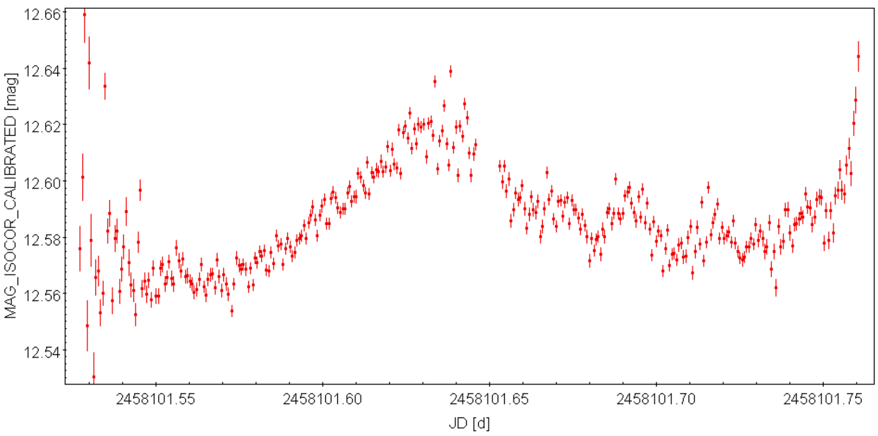

Separation [arcsec]
0.9
0.8
0.7
0.6
2458227.40
2458227.42
2458227.44
2458227.46
2458227.48
JD [d]

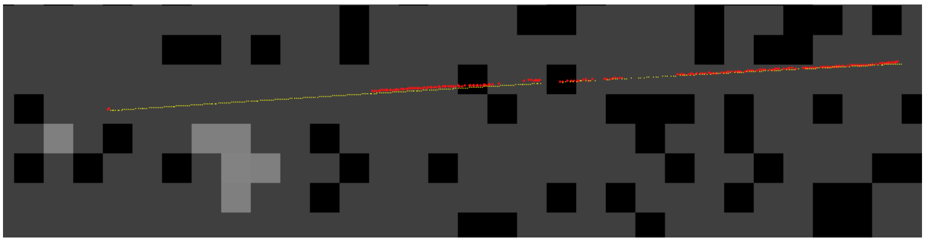

MAG_ISOCOR_CALIBRATED [mag]
12.40
12.35
12.30
12.25
12.20
12.15
2458227.39 2458227.40 2458227.41 2458227.42 2458227.43 2458227.44 2458227.45 2458227.46 2458227.47 2458227.48
JD [d]

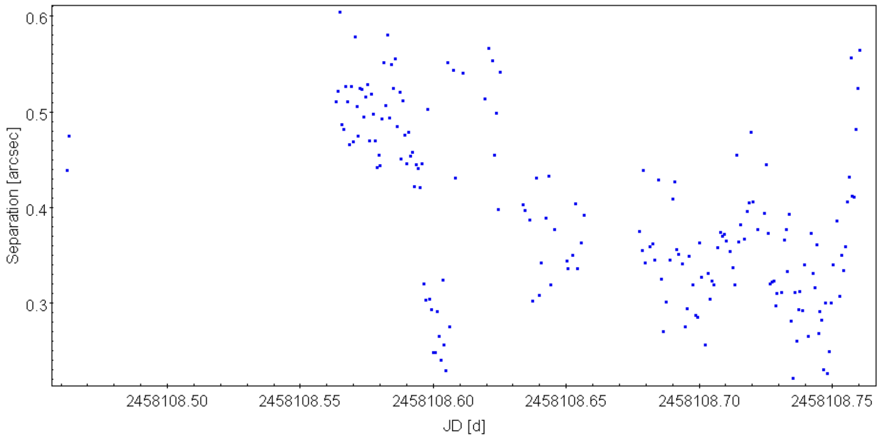
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
308	Polyxo	MB>Middle	12.9	694	521	0.31	0.10	Sc	AAA

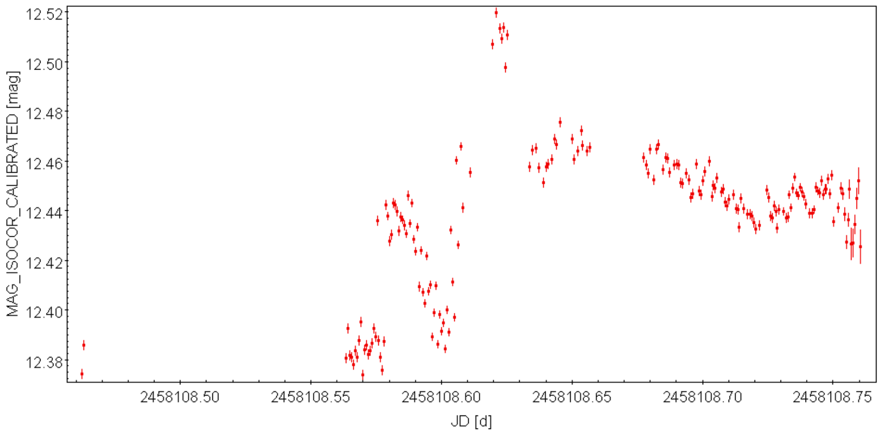




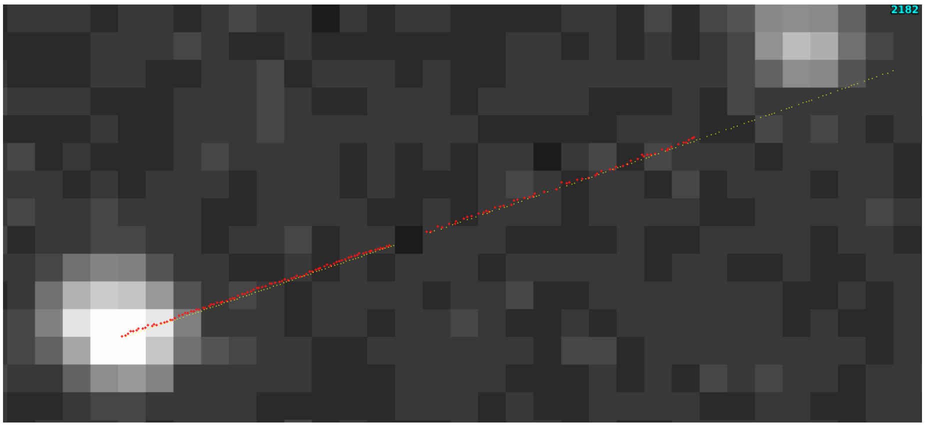


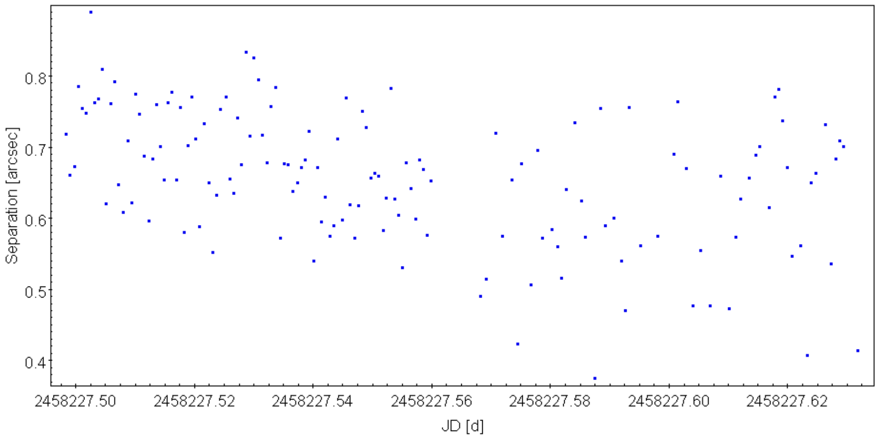


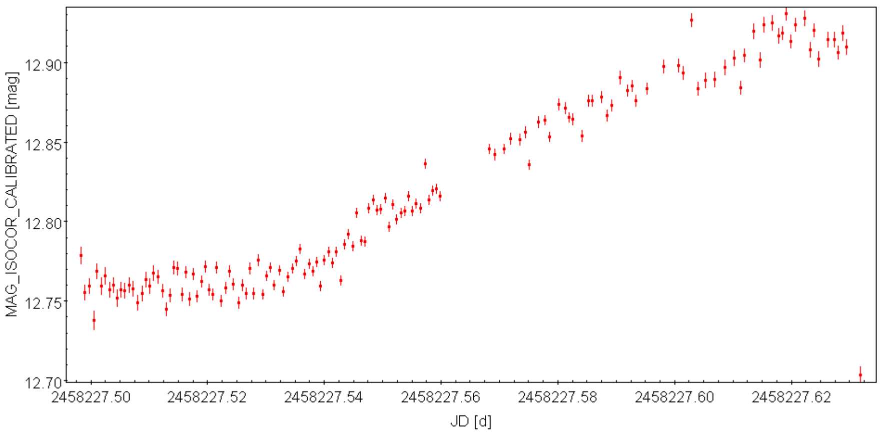

Separation [arcsec]
0.6
0.5
0.4
0.3
2458108.50
2458108.55
2458108.60
2458108.65
2458108.70
2458108.75
JD [d]

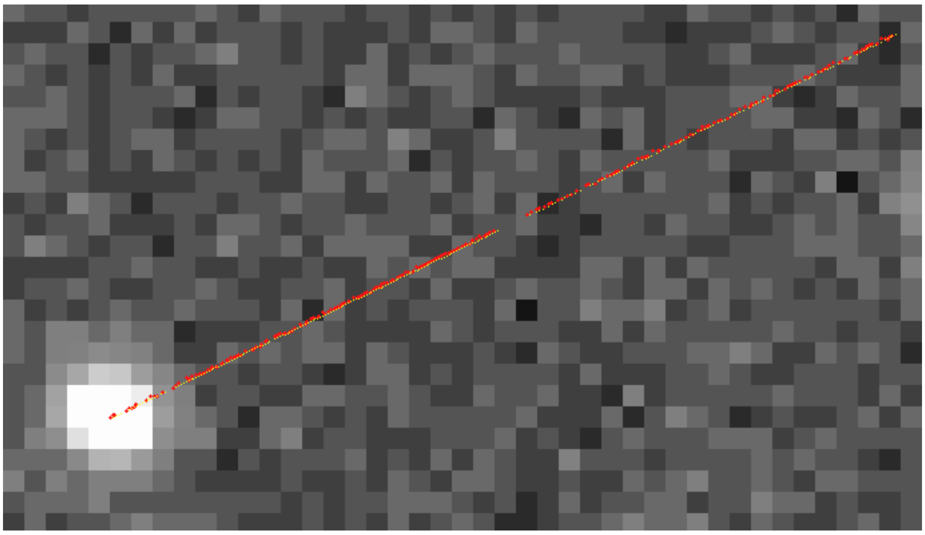

MAG_ISOCOR_CALIBRATED [mag]
12.52
12.50
12.48
12.46
12.44
12.42
12.40
12.38
2458108.50
2458108.55
2458108.60
2458108.65
2458108.70
2458108.75
JD [d]

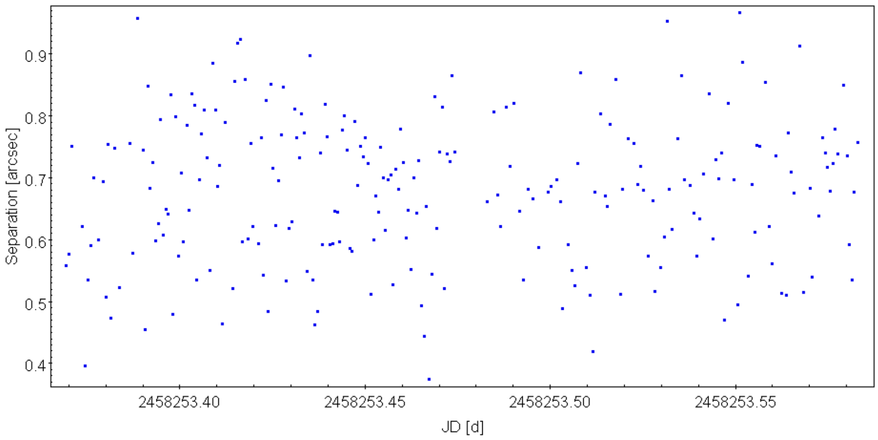
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
441	Bathilde	MB>Middle	13.0	434	349	0.70	0.10	St Sc Vi	AAA

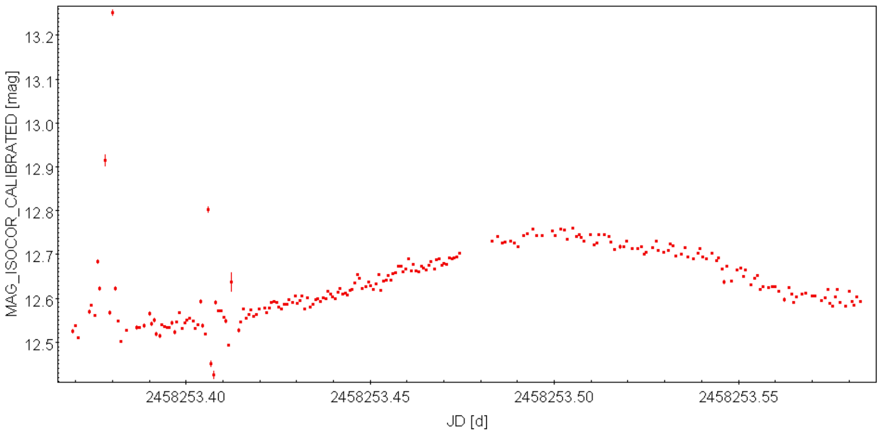




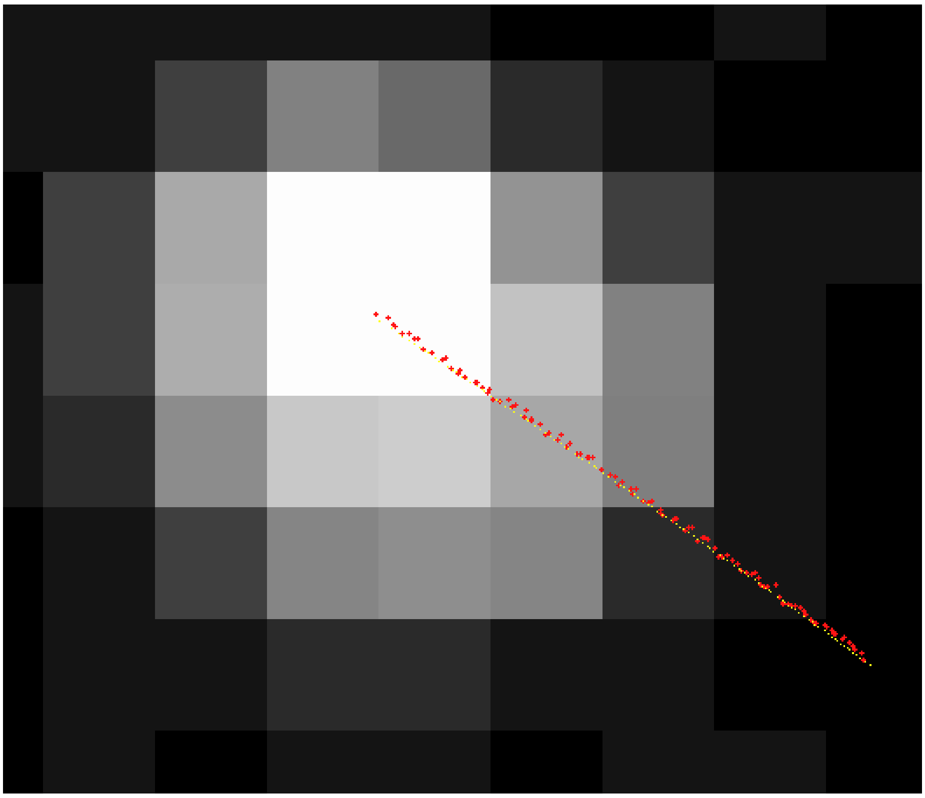


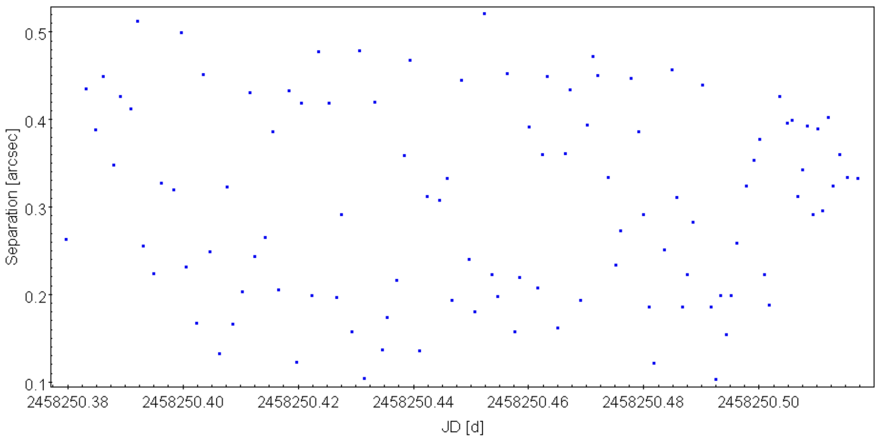


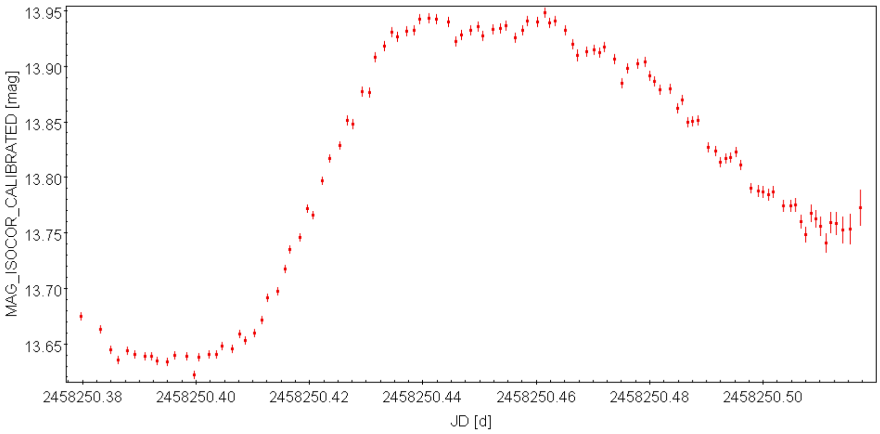

Separation [arcsec]
0.4
0.5
0.6
0.7
0.8
0.9
2458253.40
2458253.45
2458253.50
2458253.55
JD [d]


MAG_ISOCOR_CALIBRATED [mag]
12.5
12.6
12.7
12.8
12.9
13.0
13.1
13.2
2458253.40
2458253.45
2458253.50
2458253.55
JD [d]

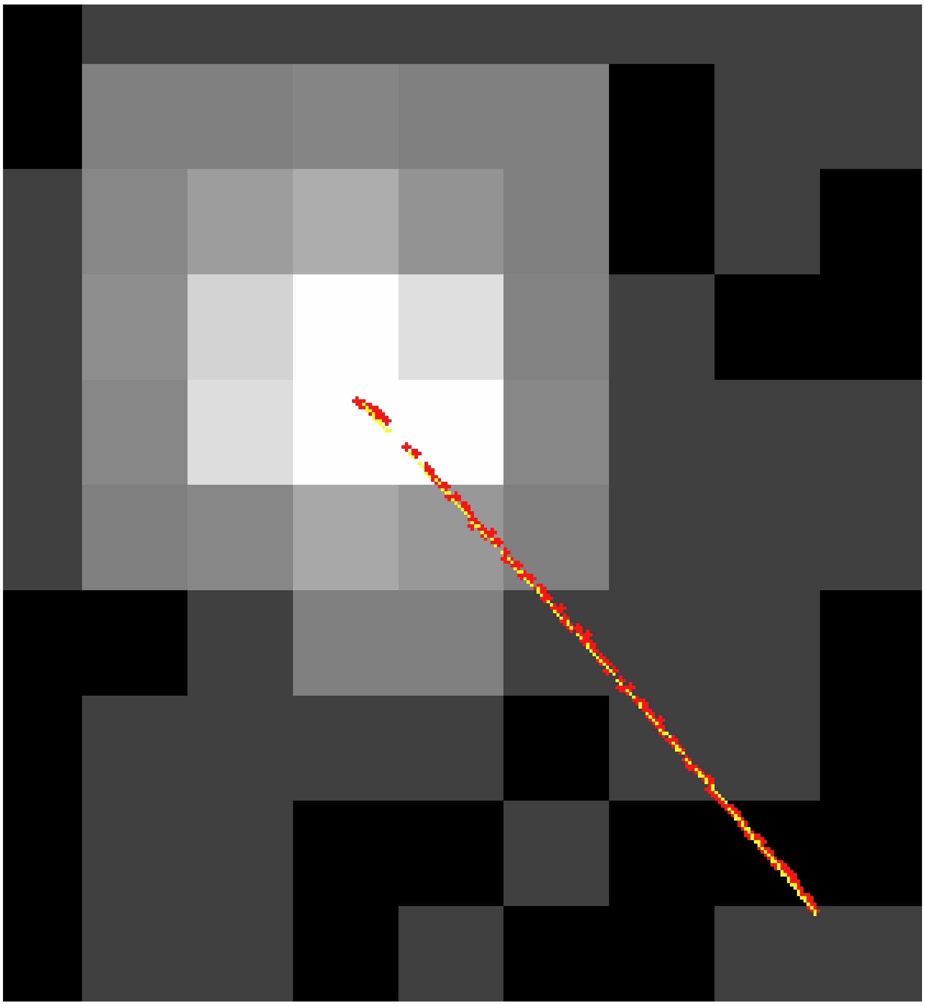
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
360	Carlova	MB>Outer	14.0	258	252	0.28	0.11	Sc	AAA

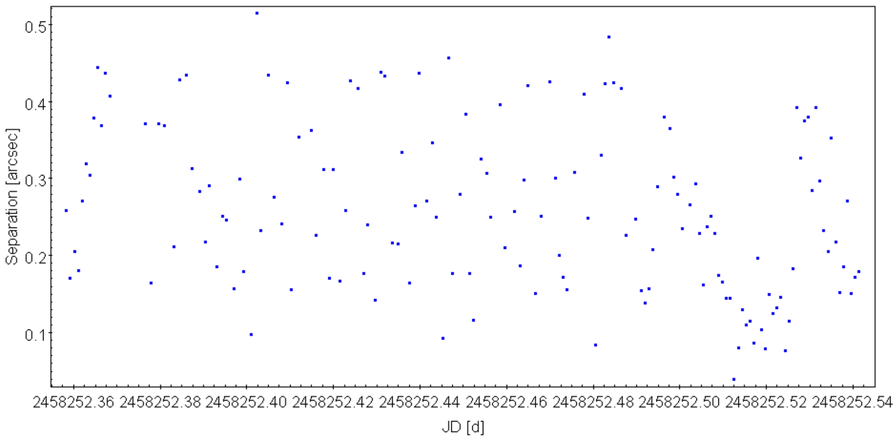


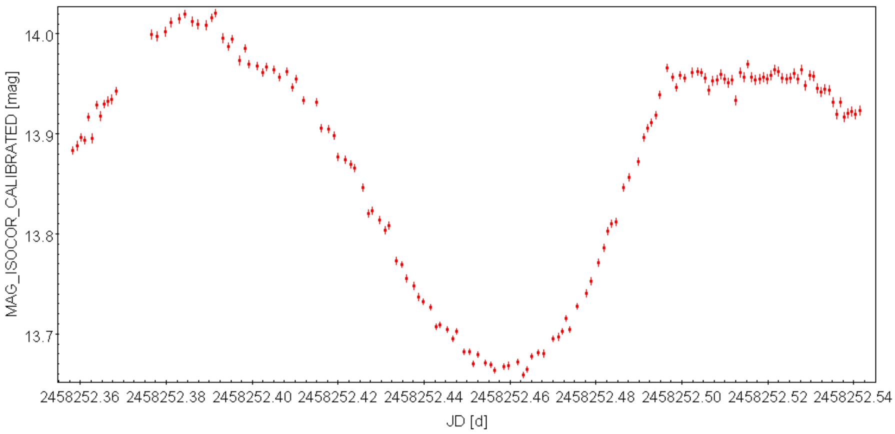




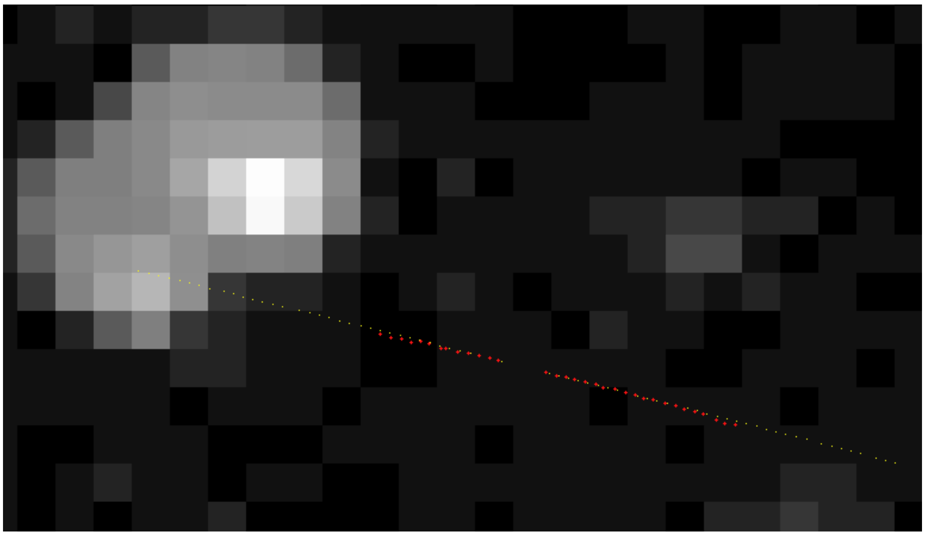
MAG_ISOCOR_CALIBRATED [mag]
13.95
13.90
13.85
13.80
13.75
13.70
13.65
2458250.38
2458250.40
2458250.42
2458250.44
2458250.46
2458250.48
2458250.50
JD [d]

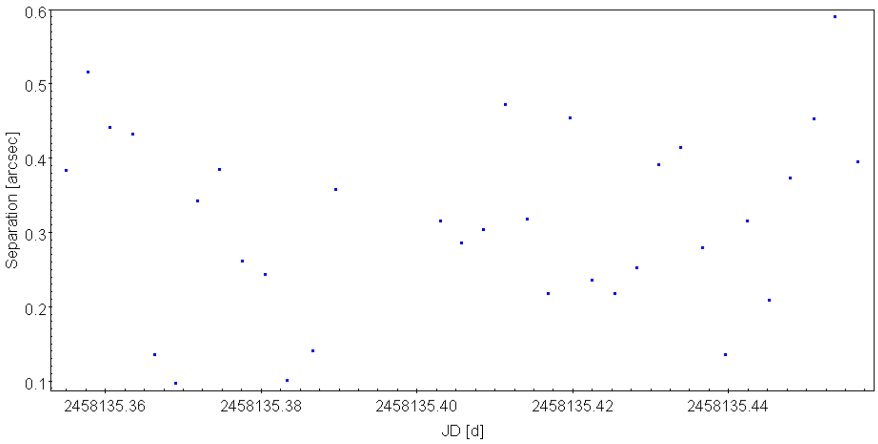


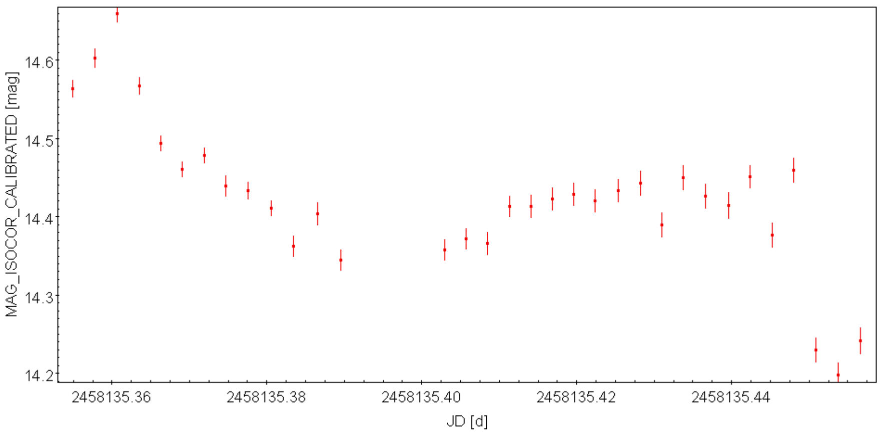

Separation [arcsec]
0.5
0.4
0.3
0.2
0.1
2458252.36 2458252.38 2458252.40 2458252.42 2458252.44 2458252.46 2458252.48 2458252.50 2458252.52 2458252.54
JD [d]


MAG_ISOCOR_CALIBRATED [mag]
14.0
13.9
13.8
13.7
2458252.36 2458252.38 2458252.40 2458252.42 2458252.44 2458252.46 2458252.48 2458252.50 2458252.52 2458252.54
JD [d]

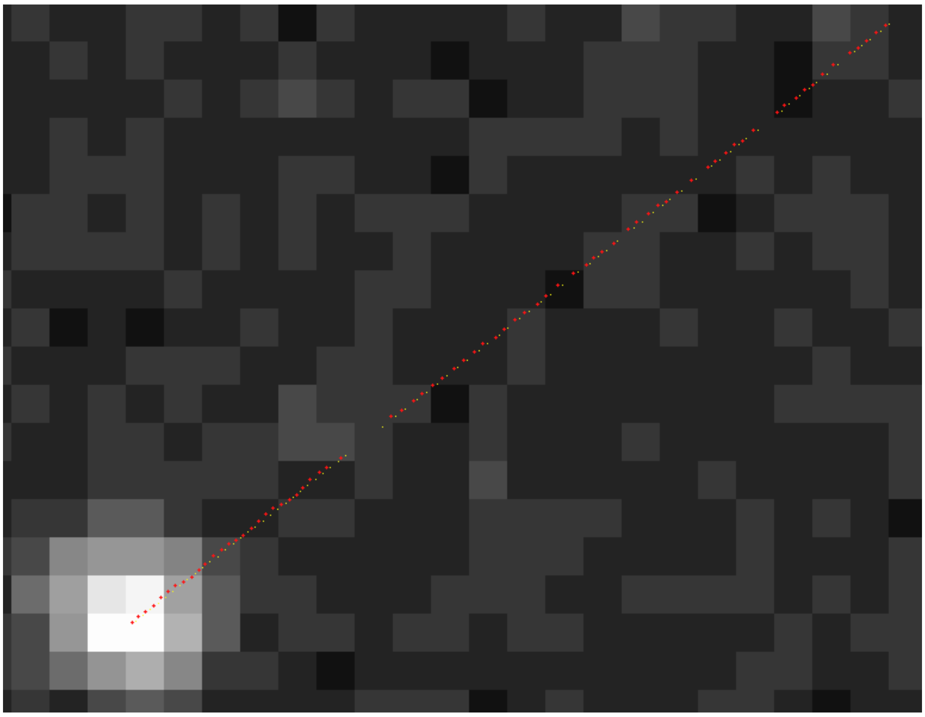
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
976	Benjamina	MB>Outer	14.4	71	33	0.32	0.12	St	AAA

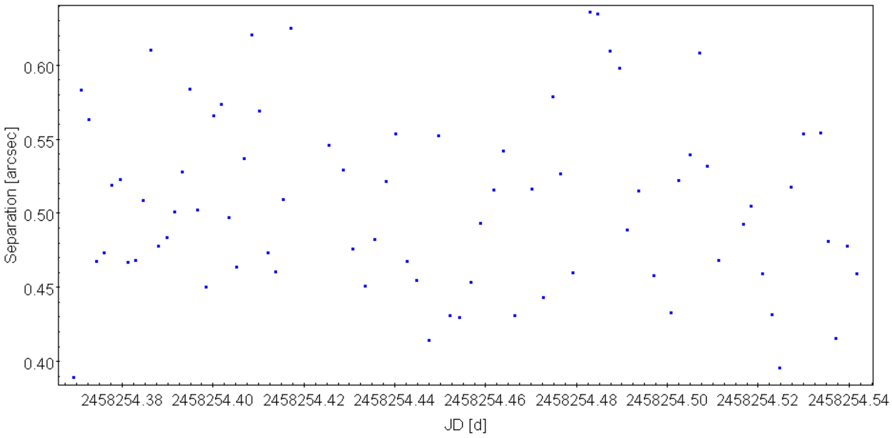


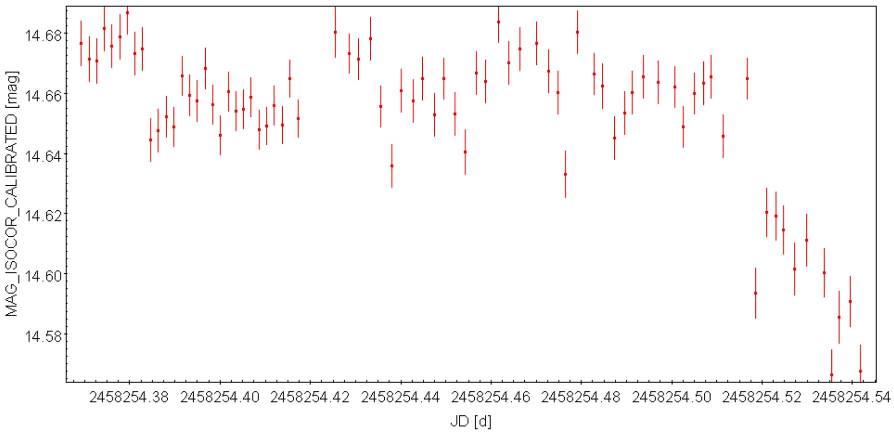


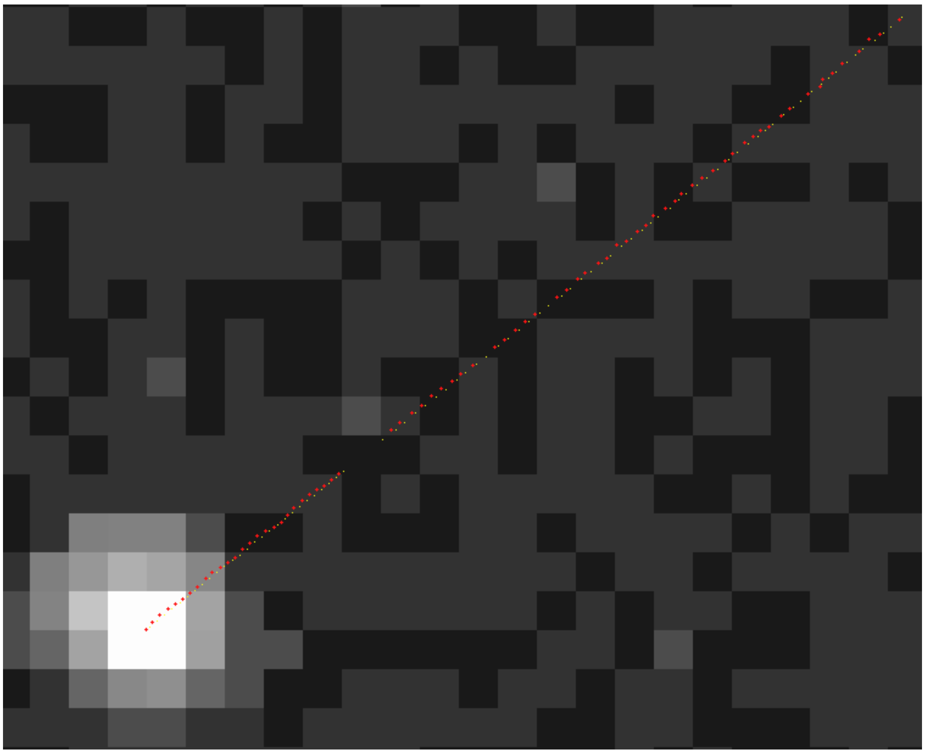


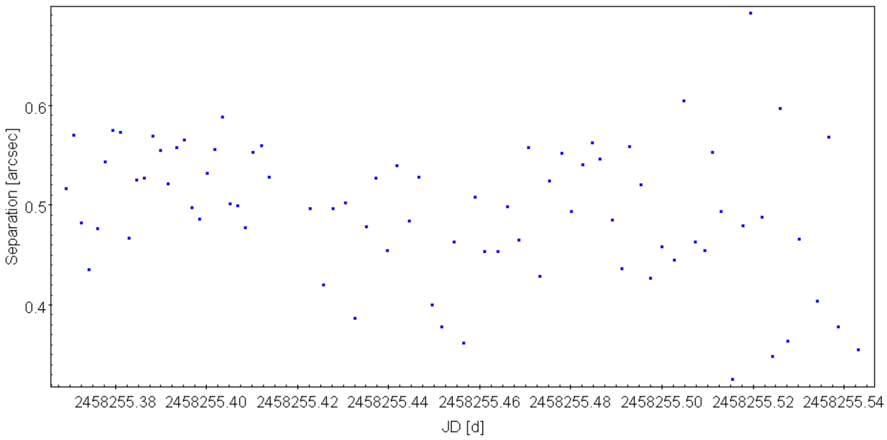
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
838	Seraphina	MB>Outer	14.9	158	152	0.50	0.06	Sc Vi	AAA






14.68
14.66
14.64
14.62
14.60
14.58
MAG_ISOCOR_CALIBRATED [mag]
2458254.38
2458254.40
2458254.42
2458254.44
2458254.46
2458254.48
2458254.50
2458254.52
2458254.54
JD [d]




Separation [arcsec]
0.6
0.5
0.4
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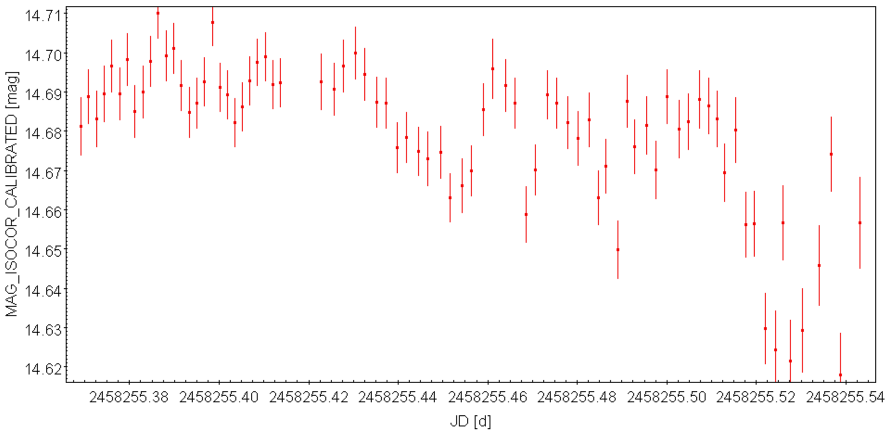
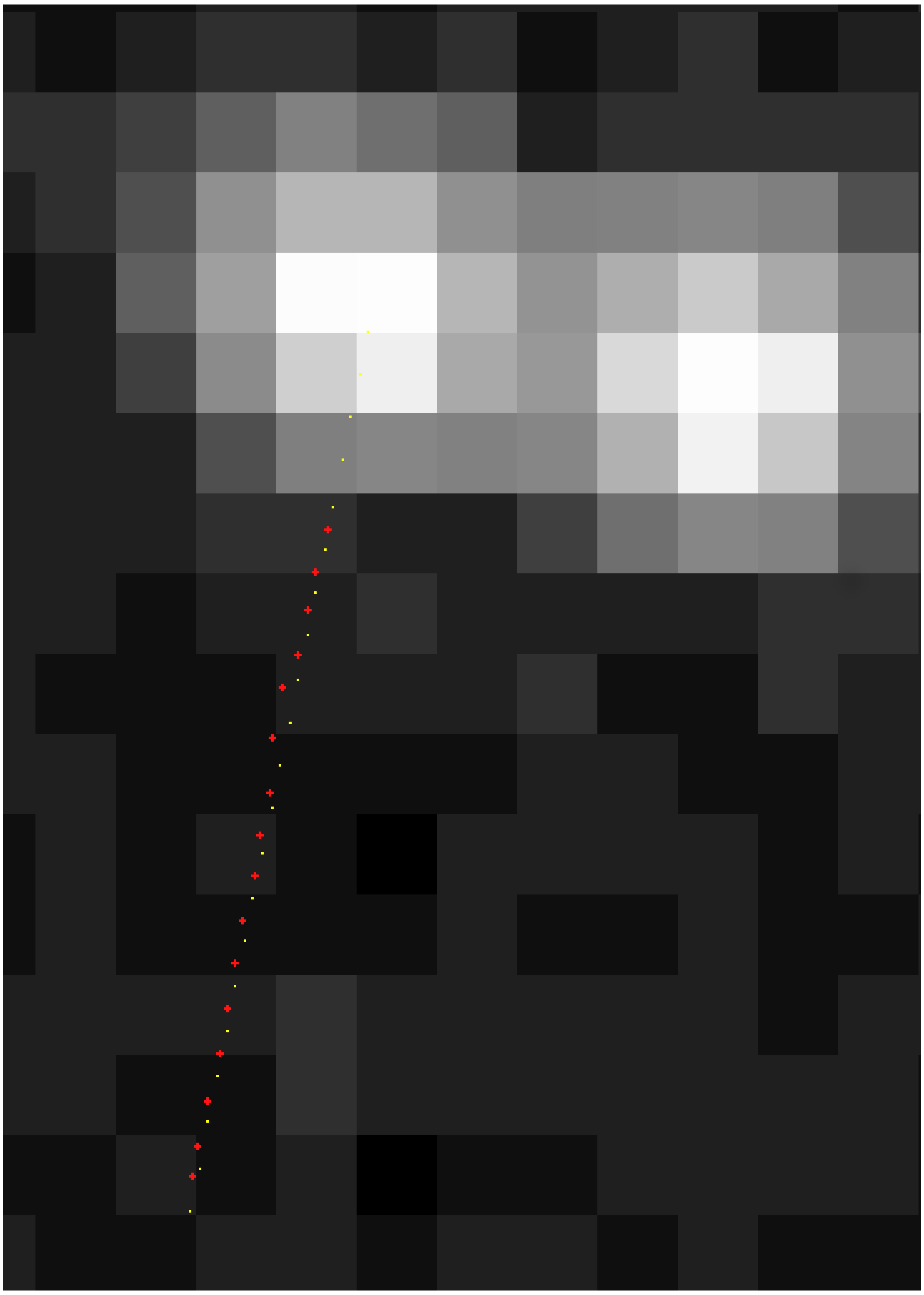
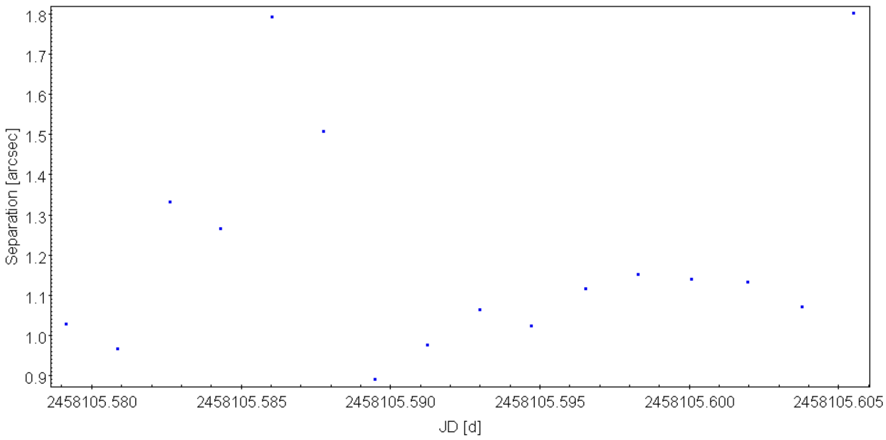
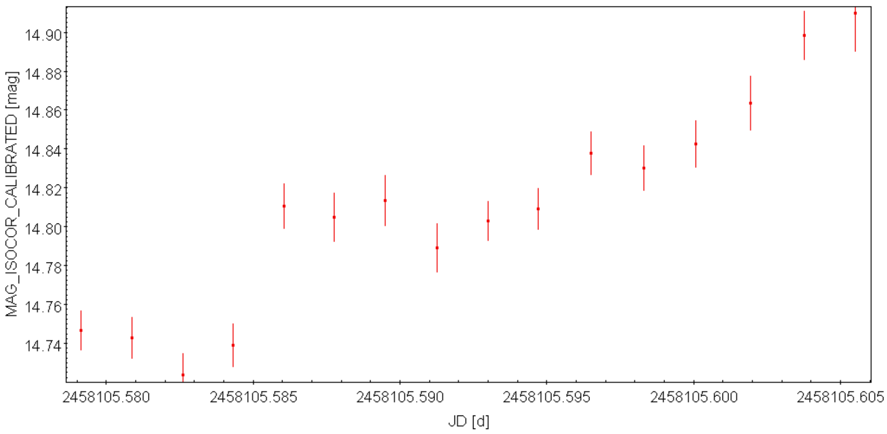
JD [d]


MAG_ISOCOR_CALIBRATED [mag]
14.71
14.70
14.69
14.68
14.67
14.66
14.65
14.64
14.63
14.62
2458255.38 2458255.40 2458255.42 2458255.44 2458255.46 2458255.48 2458255.50 2458255.52 2458255.54
JD [d]

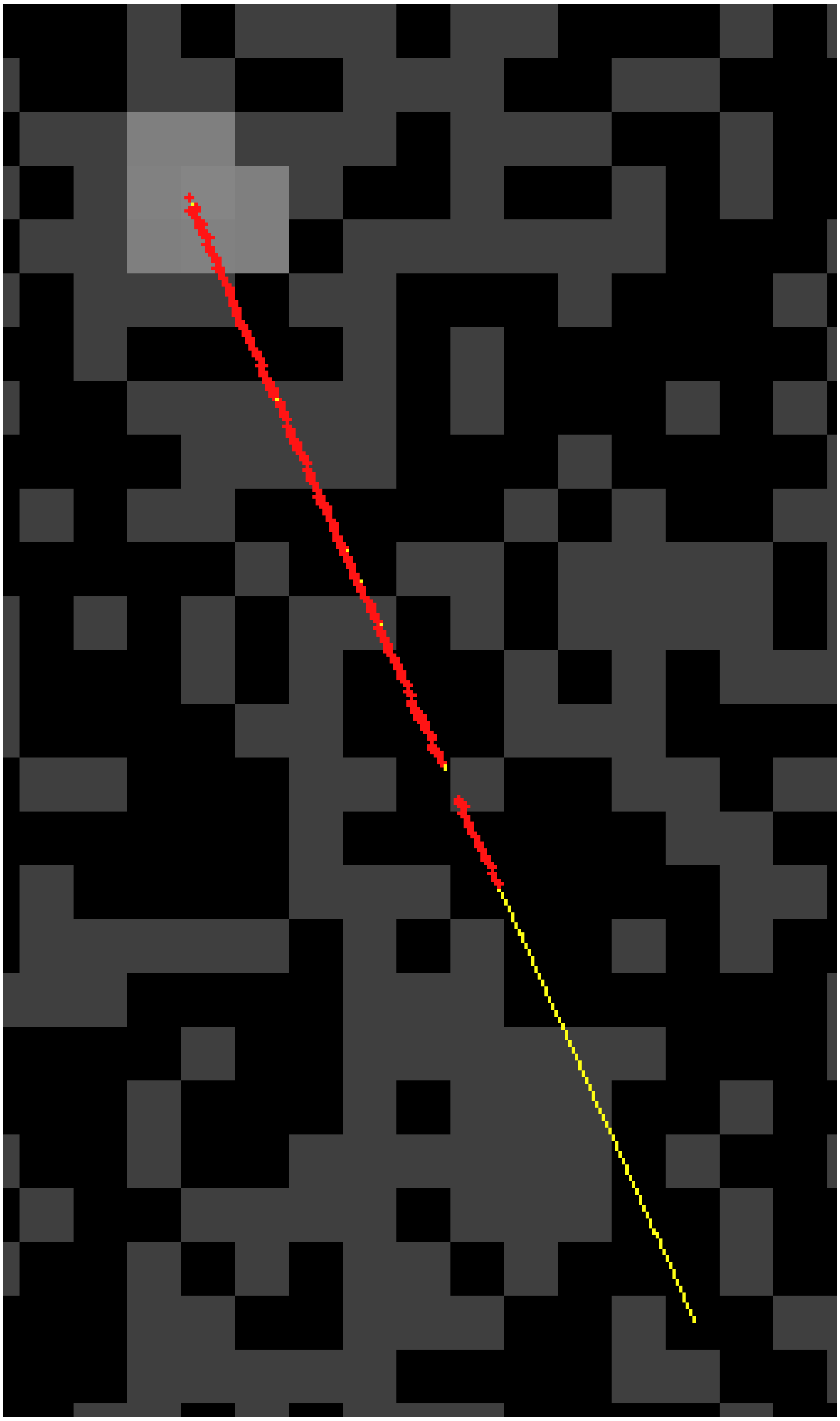
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
1626	Sadeya	MB>Inner	14.9	21	14	1.20	0.26	St	AAA

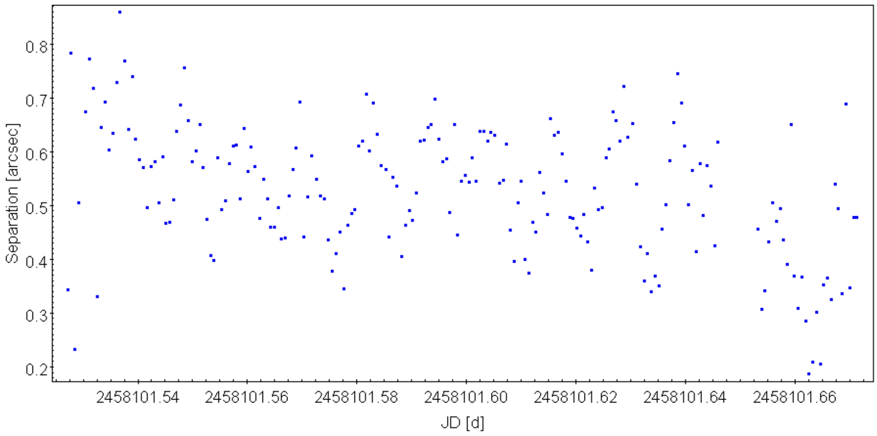



Separation [arcsec]
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
2458105.580
2458105.585
2458105.590
2458105.595
2458105.600
2458105.605
JD [d]

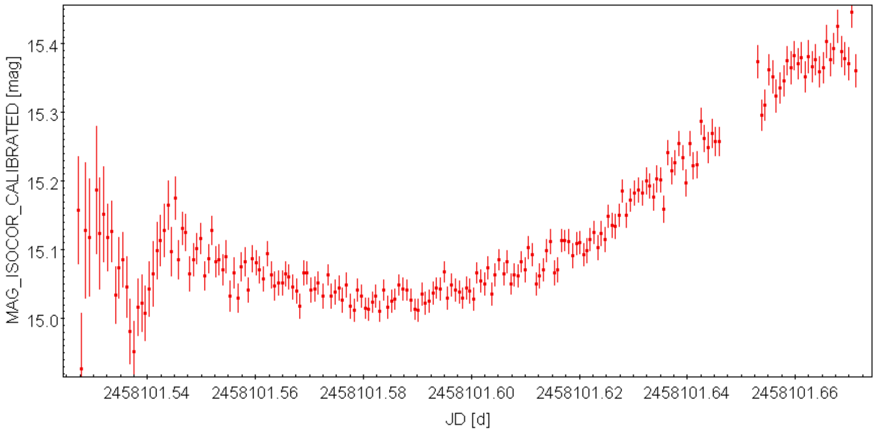

MAG_ISOCOR_CALIBRATED [mag]
14.90
14.88
14.86
14.84
14.82
14.80
14.78
14.76
14.74
2458105.580
2458105.585
2458105.590
2458105.595
2458105.600
2458105.605
JD [d]

ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
4628	Laplace	MB>Middle	15.1	334	201	0.53	0.12	St	AAA



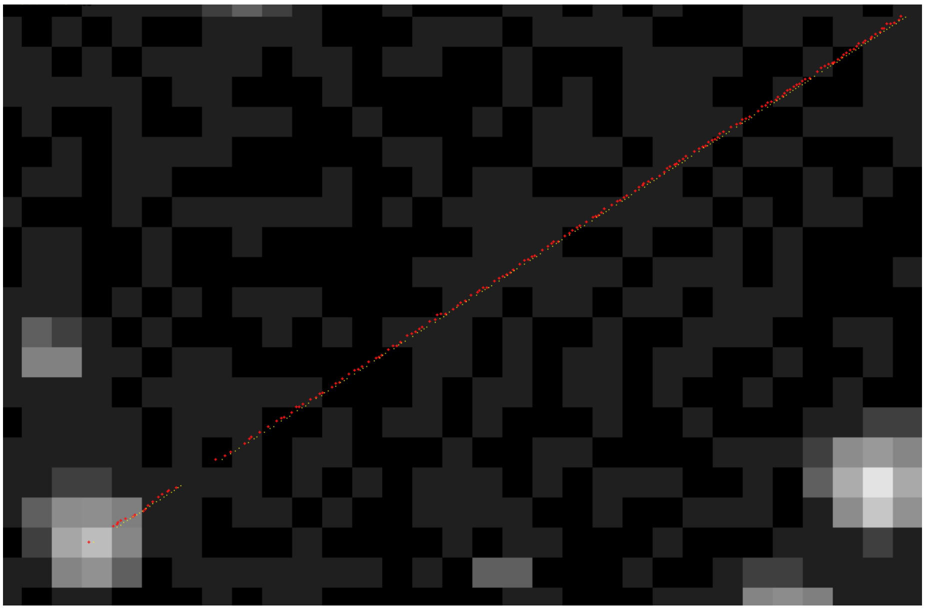


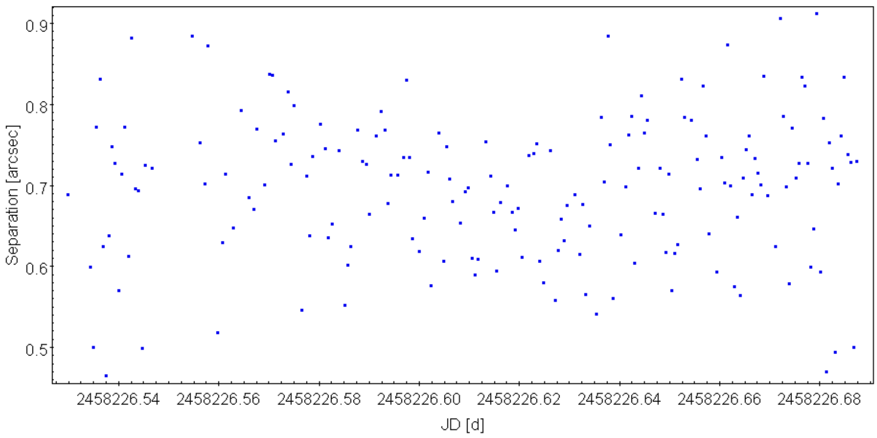
Separation [arcsec]
0.2
0.3
0.4
0.5
0.6
0.7
0.8
2458101.54
2458101.56
2458101.58
2458101.60
2458101.62
2458101.64
2458101.66
JD [d]

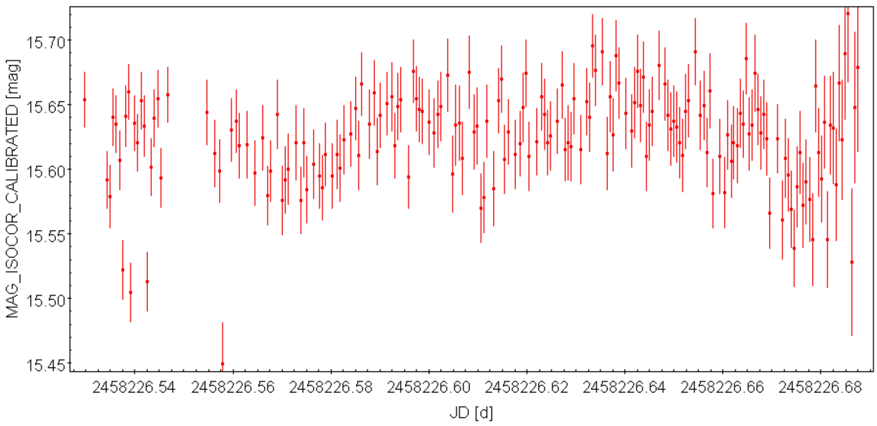


MAG_ISOCOR_CALIBRATED [mag]
15.0
15.1
15.2
15.3
15.4
2458101.54
2458101.56
2458101.58
2458101.60
2458101.62
2458101.64
2458101.66
JD [d]

ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
9659	1996 Ej	MB>Middle	15.8	327	316	0.67	0.10	Sc Vi	AAA






MAG_ISOCOR_CALIBRATED [mag]
15.70
15.65
15.60
15.55
15.50
15.45
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2458226.56
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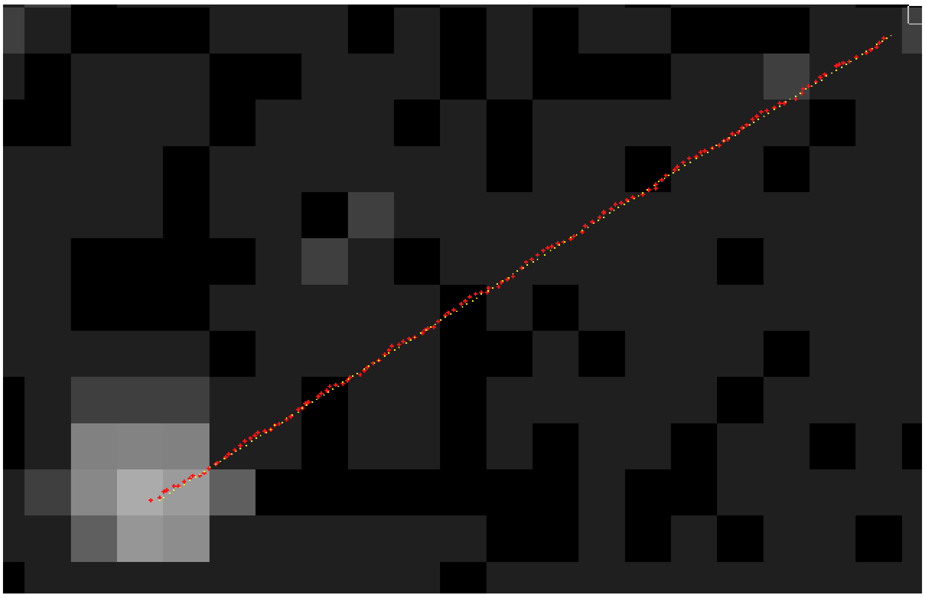
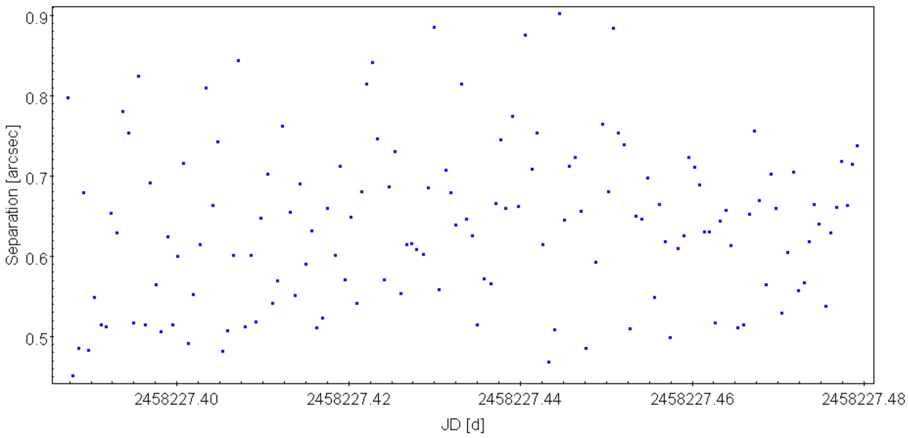
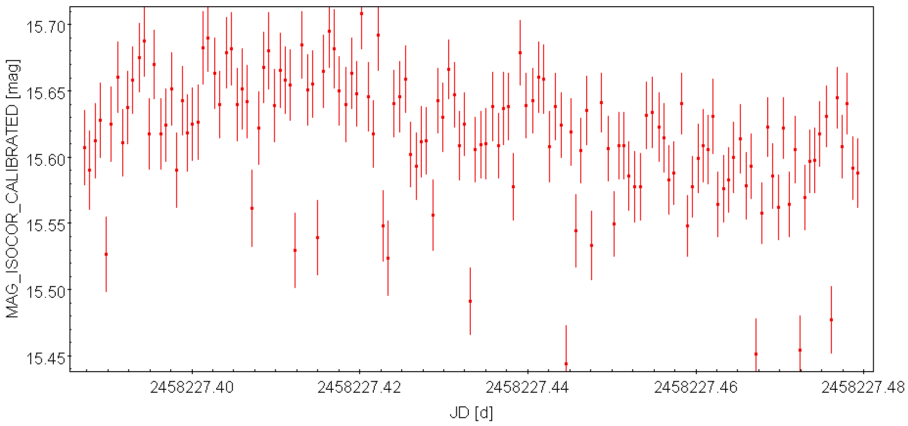
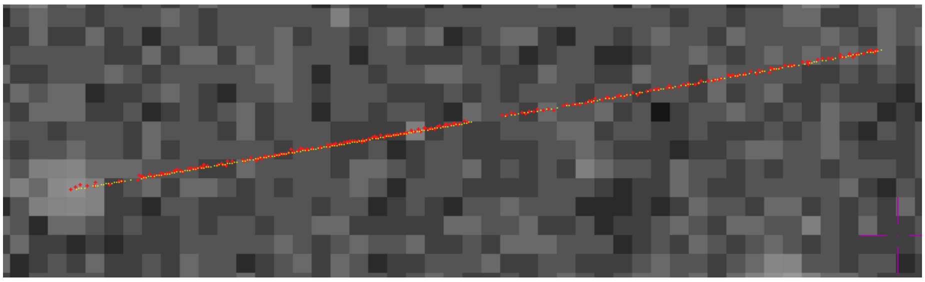
2458226.68
JD [d]

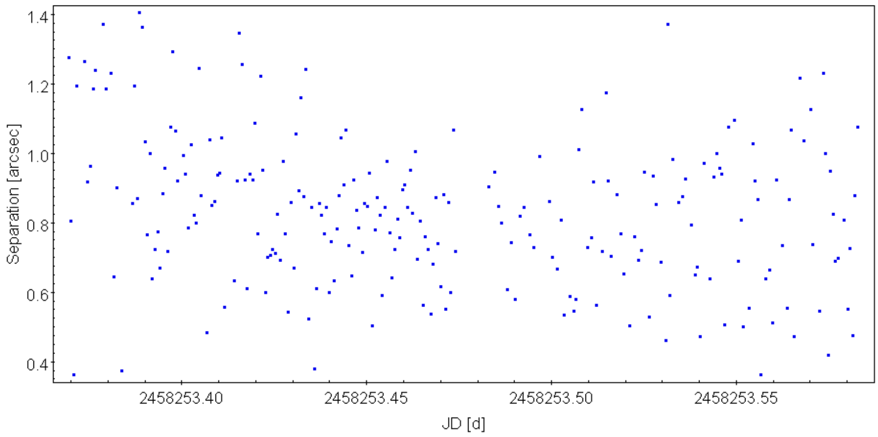


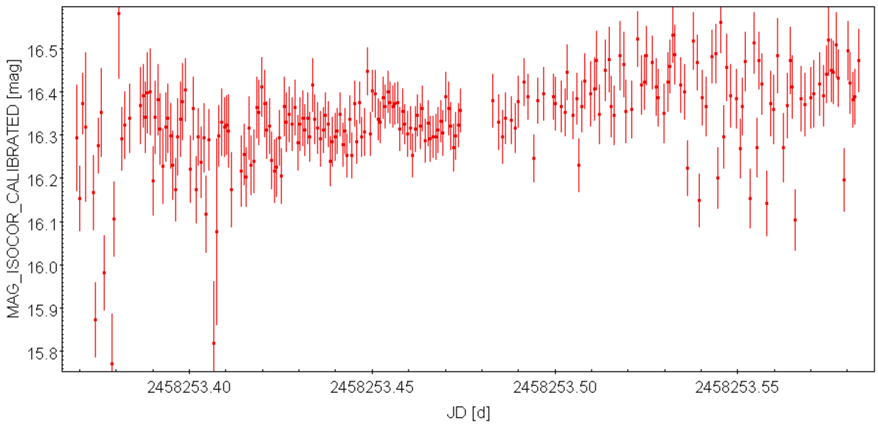

Separation [arcsec]
0.9
0.8
0.7
0.6
0.5
2458227.40
2458227.42
2458227.44
2458227.46
2458227.48
JD [d]


MAG_ISOCOR_CALIBRATED [mag]
15.70
15.65
15.60
15.55
15.50
15.45
2458227.40
2458227.42
2458227.44
2458227.46
2458227.48
JD [d]

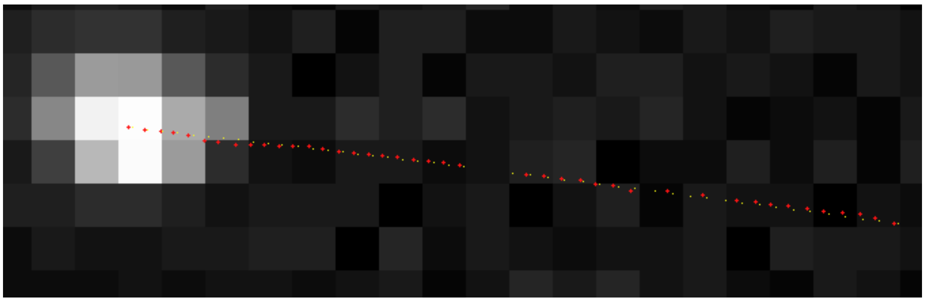
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
1501	Baade	MB>Middle	16.3	242	224	0.83	0.21	Sc Vi	AAA

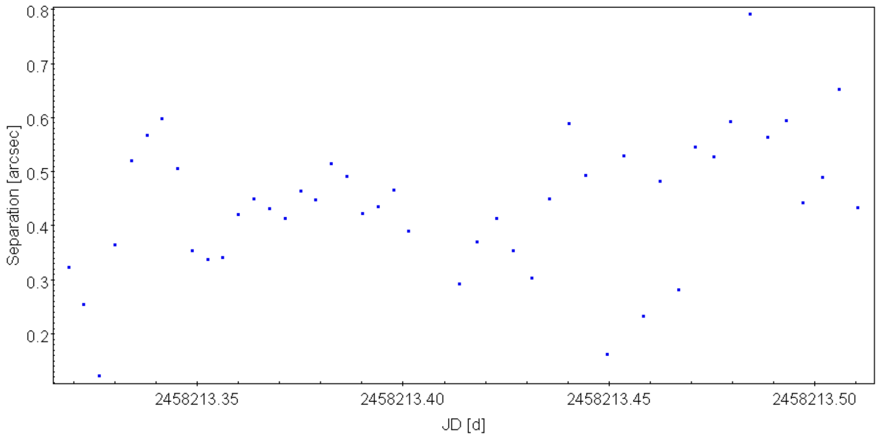


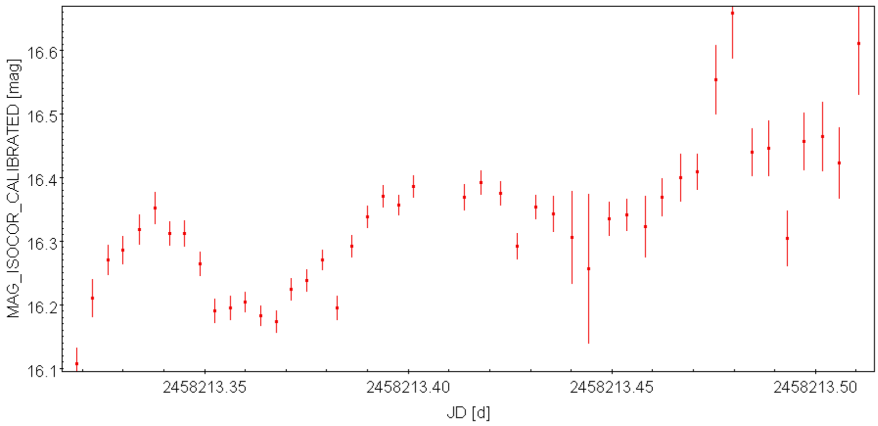


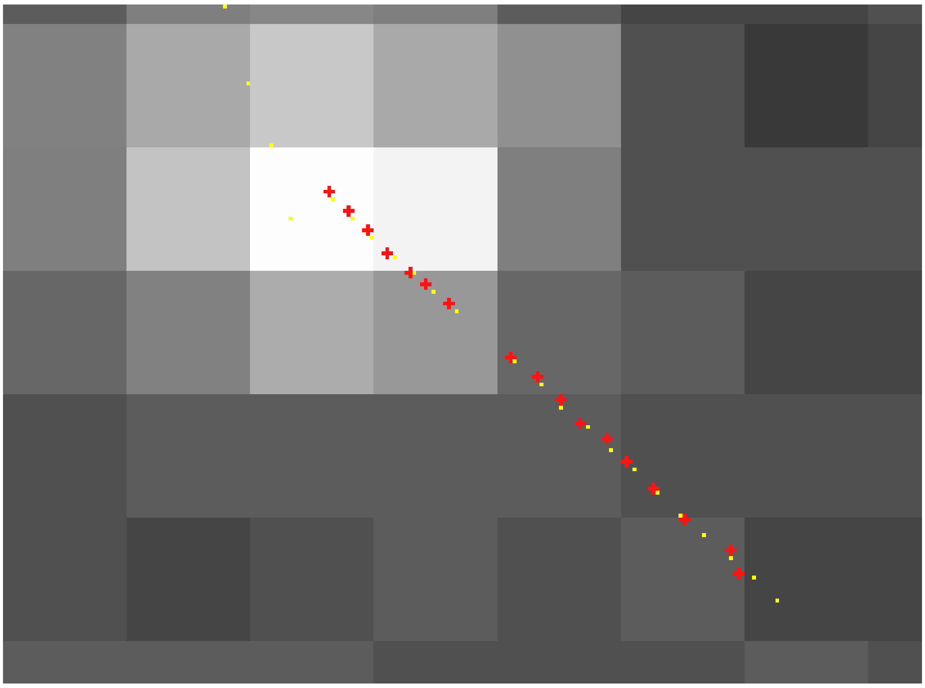


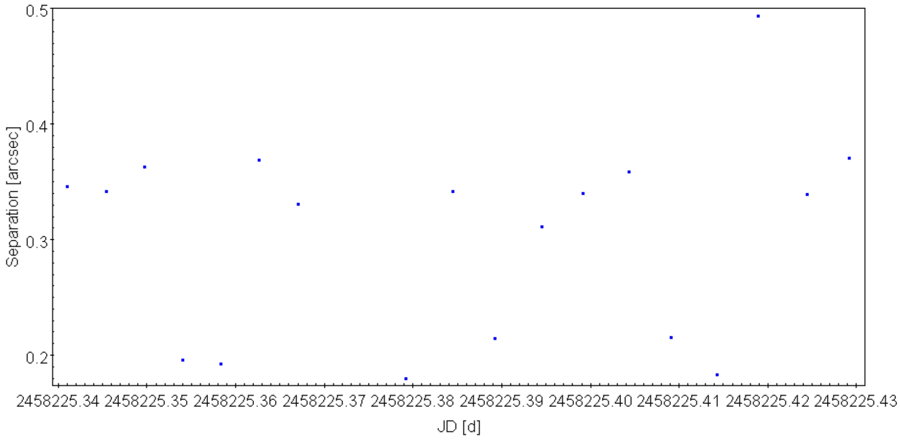
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
1427	Ruvuma	MB>Middle	16.4	65	59	0.40	0.13	Vi	AAA

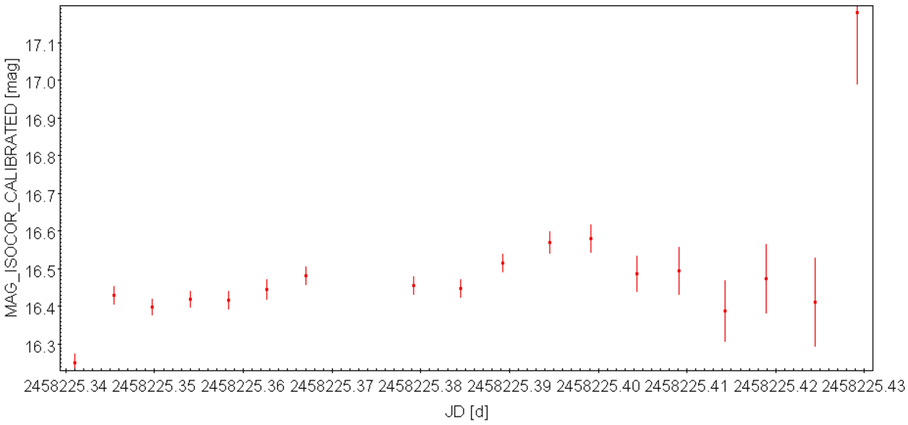




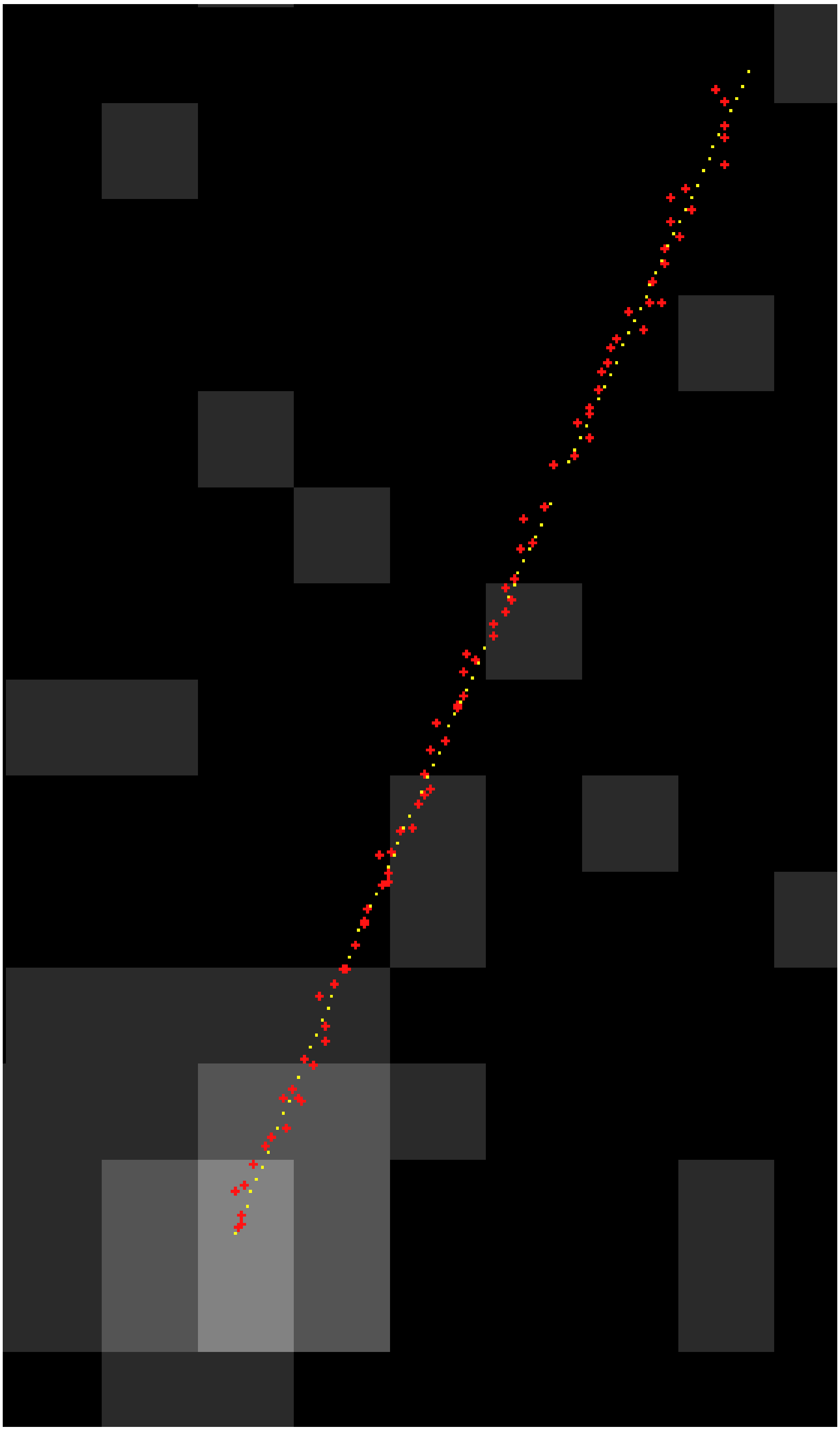


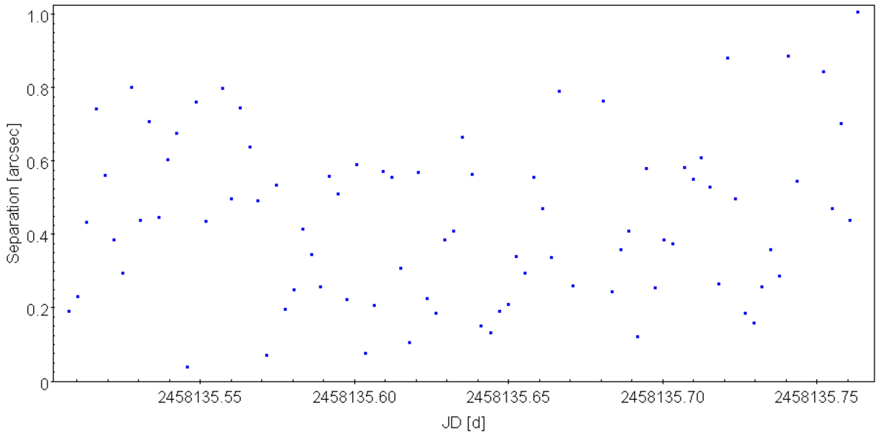



Separation [arcsec]
0.5
0.4
0.3
0.2
2458225.34 2458225.35 2458225.36 2458225.37 2458225.38 2458225.39 2458225.40 2458225.41 2458225.42 2458225.43
JD [d]

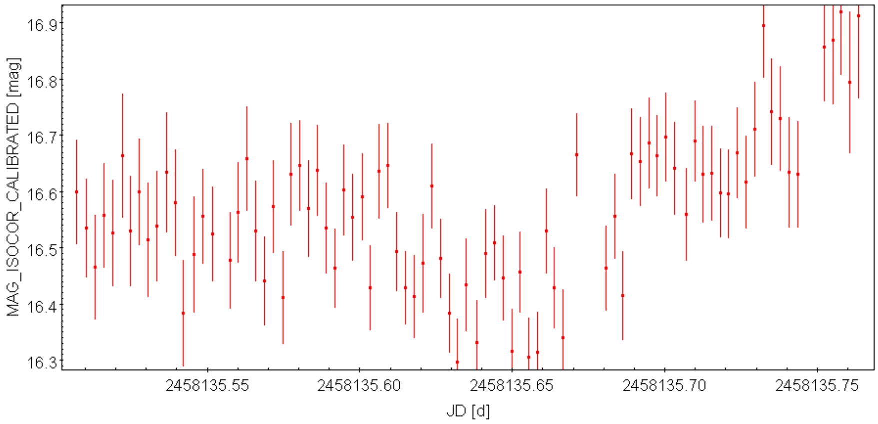

MAG_ISOCOR_CALIBRATED [mag]
17.1
17.0
16.9
16.8
16.7
16.6
16.5
16.4
16.3
2458225.34 2458225.35 2458225.36 2458225.37 2458225.38 2458225.39 2458225.40 2458225.41 2458225.42 2458225.43
JD [d]

ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
2219	Mannucci	MB>Outer	16.8	89	84	0.44	0.22	SNR Sc	AAA



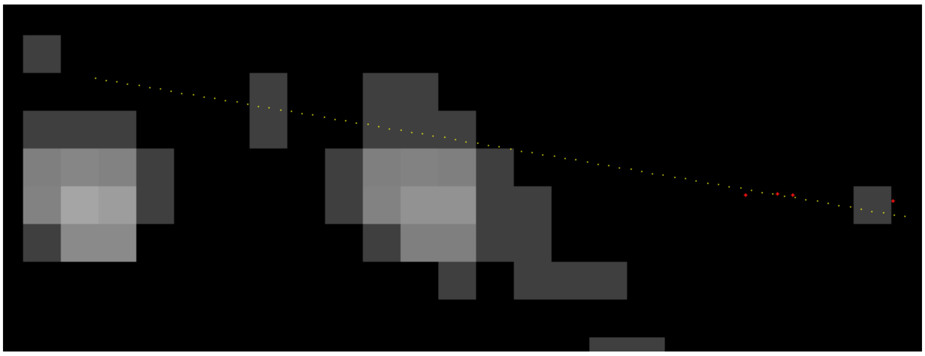


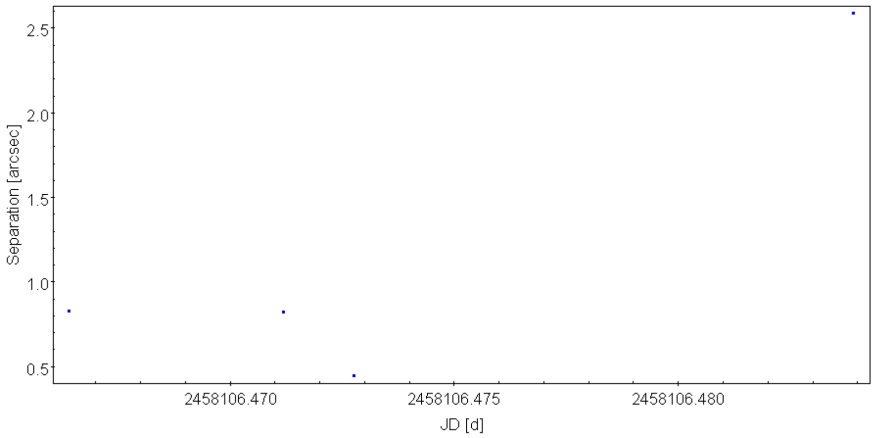
1.0
0.8
0.6
0.4
0.2
0
Separation [arcsec]
2458135.55
2458135.60
2458135.65
2458135.70
2458135.75
JD [d]

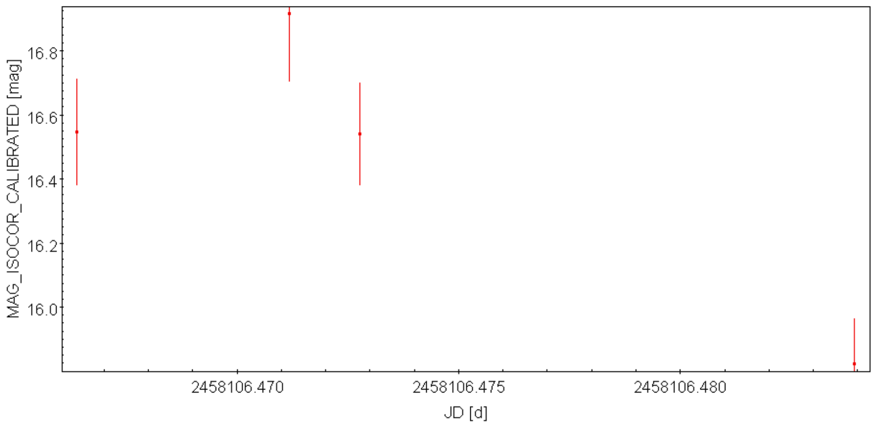


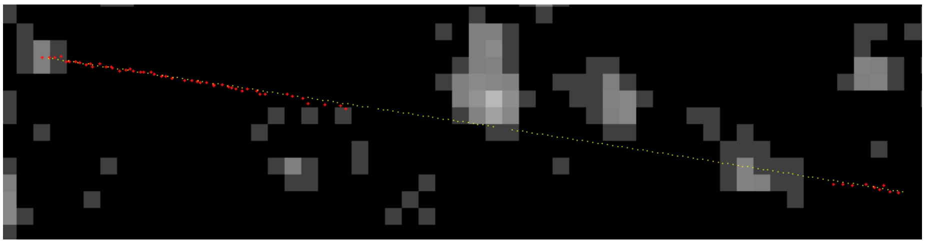
16.9
16.8
16.7
16.6
16.5
16.4
16.3
MAG_ISOCOR_CALIBRATED [mag]
2458135.55
2458135.60
2458135.65
2458135.70
2458135.75
JD [d]

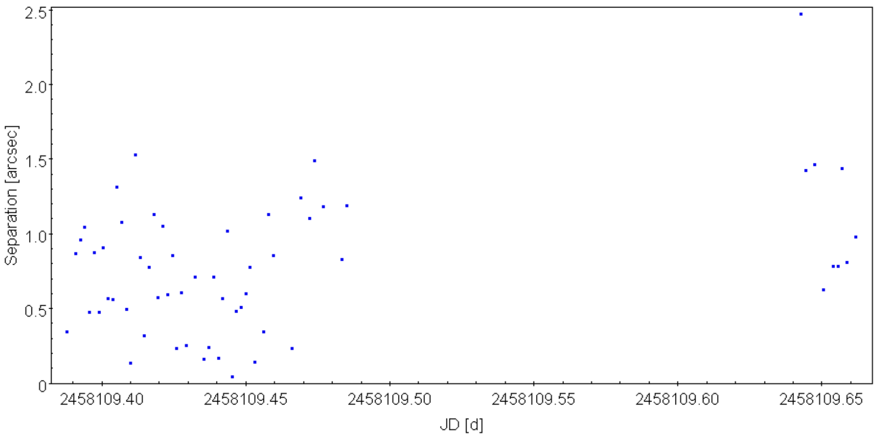
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
4745	Nancymarie	MB>Outer	16.8	244	53	0.68	0.31	St Sc Vi	AAA BBB

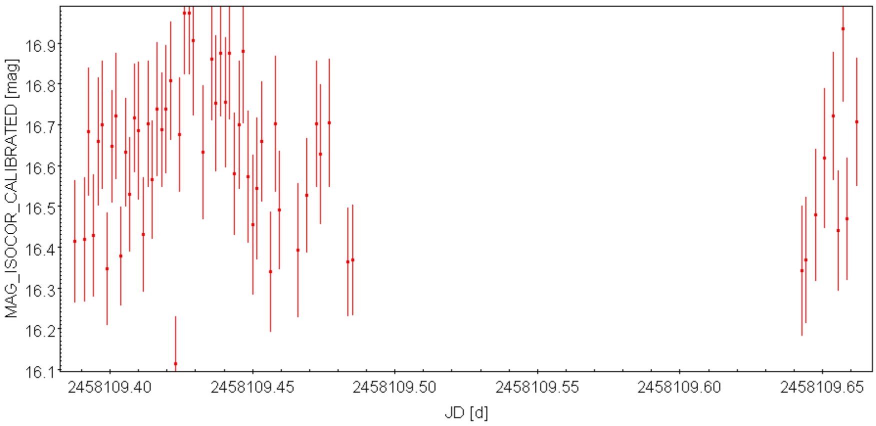




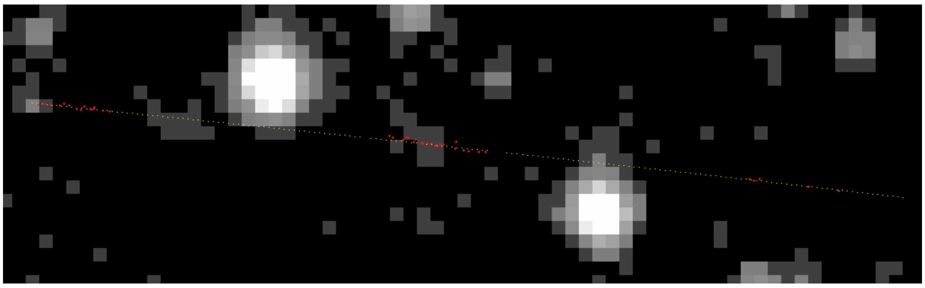


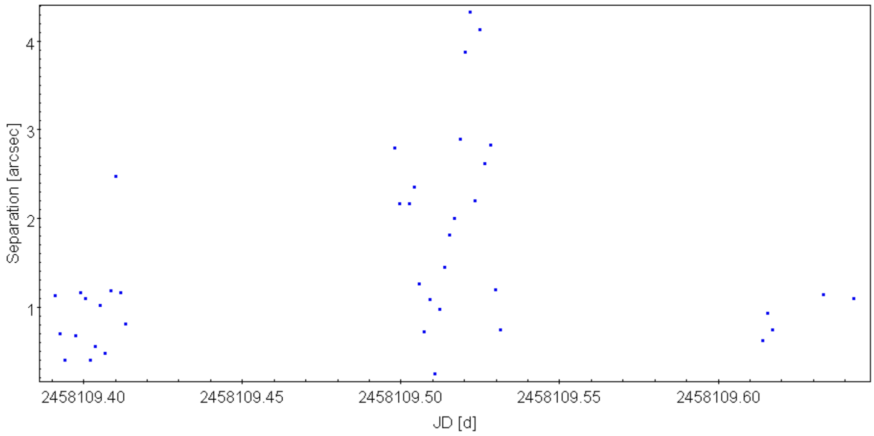


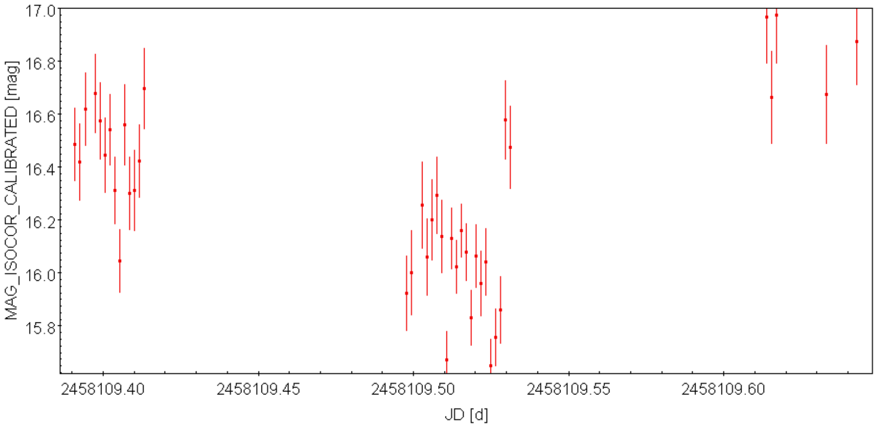

Separation [arcsec]
JD [d]
2458109.40
2458109.45
2458109.50
2458109.55
2458109.60
2458109.65


MAG_ISOCOR_CALIBRATED [mag]
JD [d]
2458109.40
2458109.45
2458109.50
2458109.55
2458109.60
2458109.65

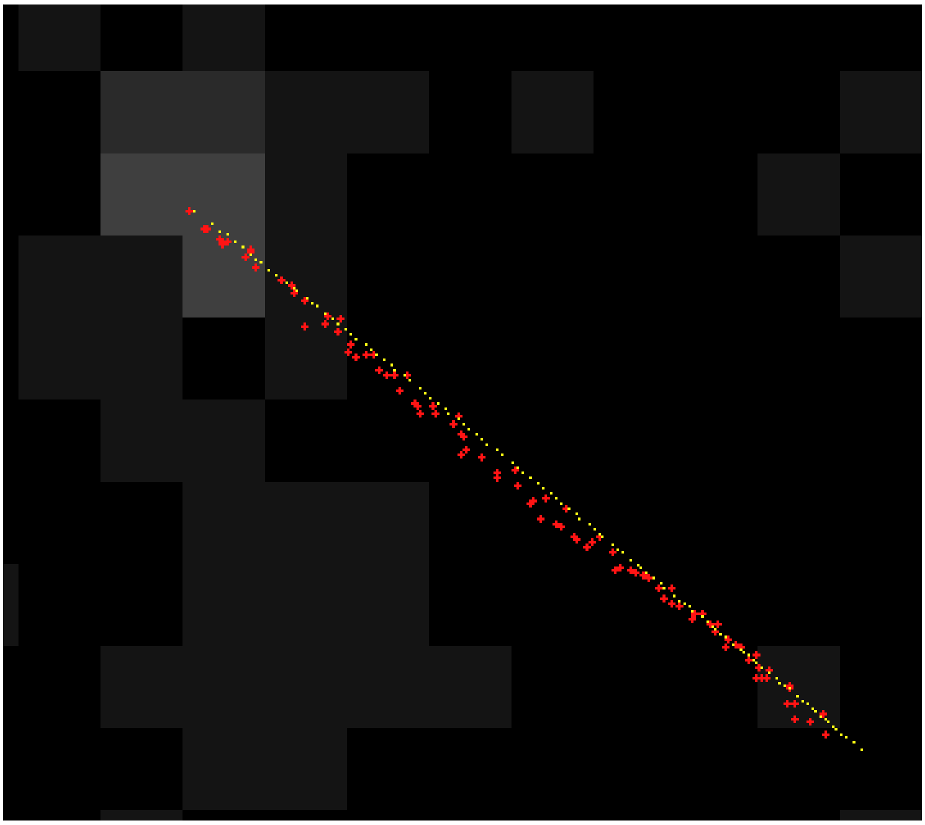
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
24837	Msecke Zehrovice	MB>Inner	17.1	244	26	0.88	0.31	SNR St Vi	AAA

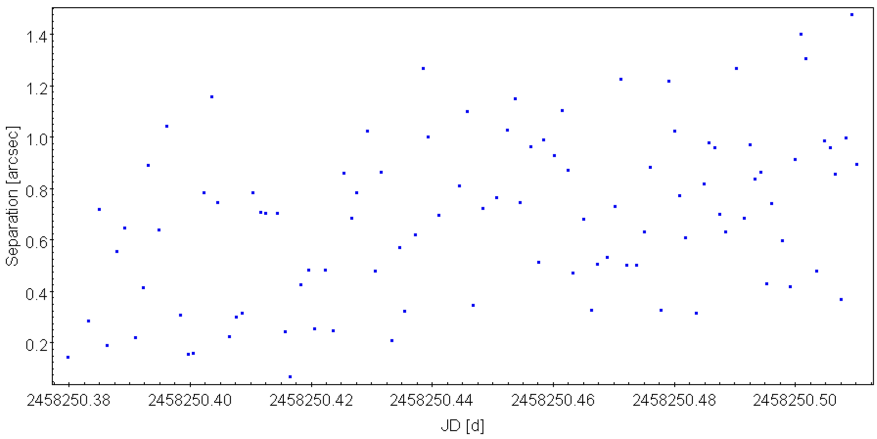


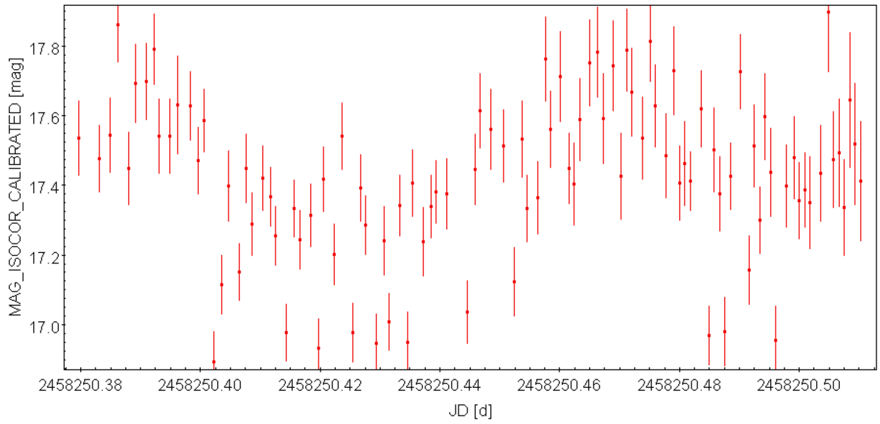




ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
10142	Sakka	MB>Middle	17.6	258	227	0.60	0.27	SNR Sc Vi	AAA






MAG_ISOCOR_CALIBRATED [mag]
17.8
17.6
17.4
17.2
17.0
2458250.38
2458250.40
2458250.42
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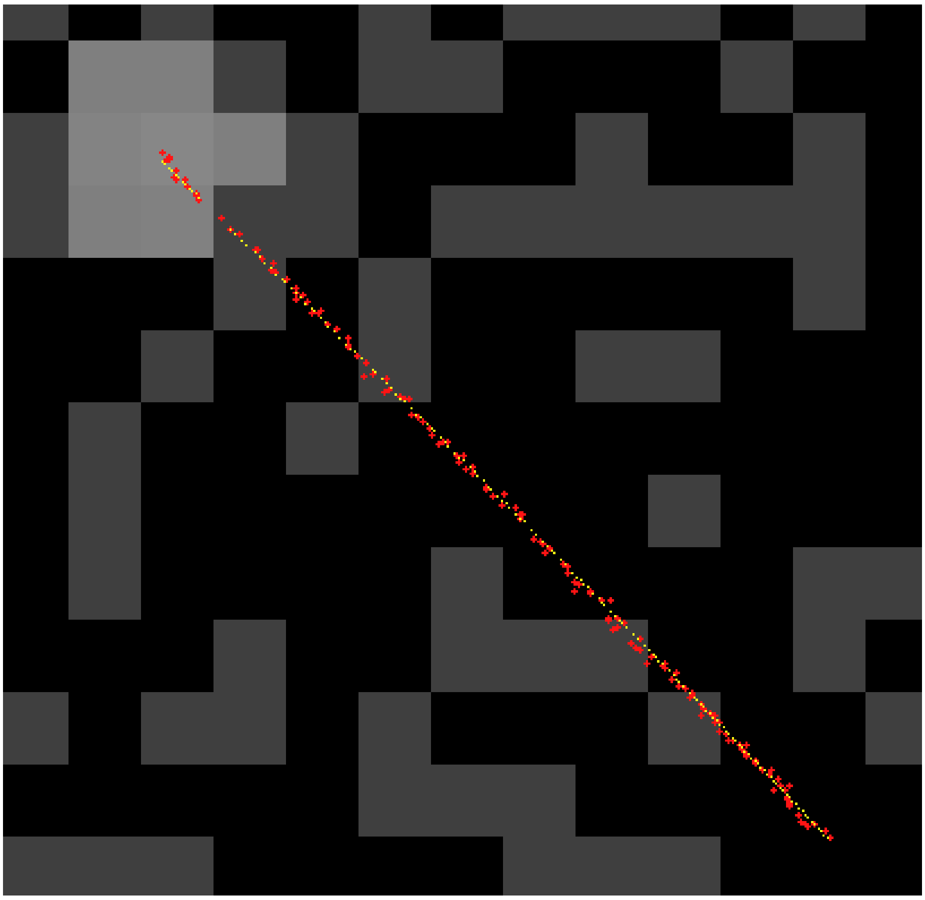
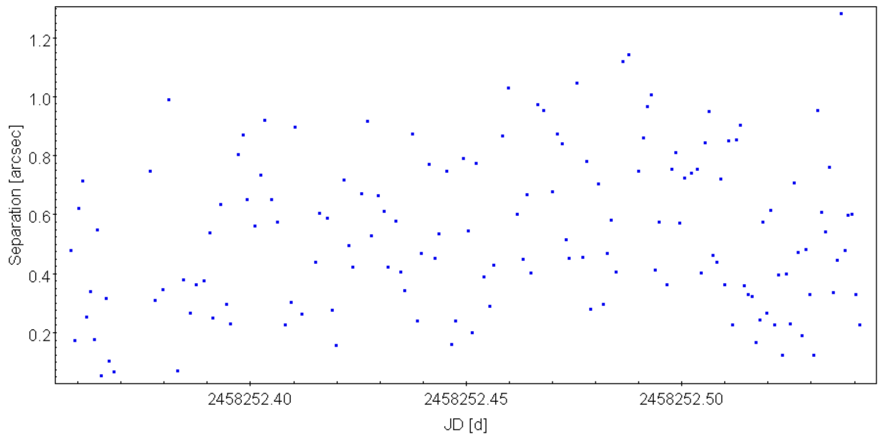
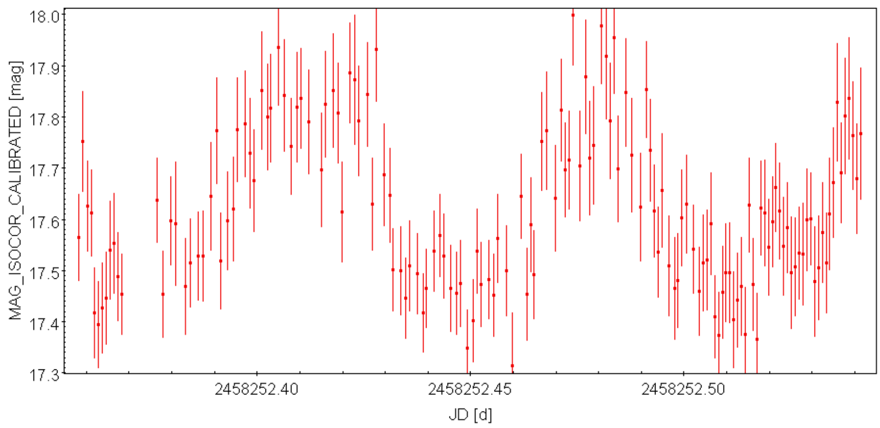
2458250.50
JD [d]



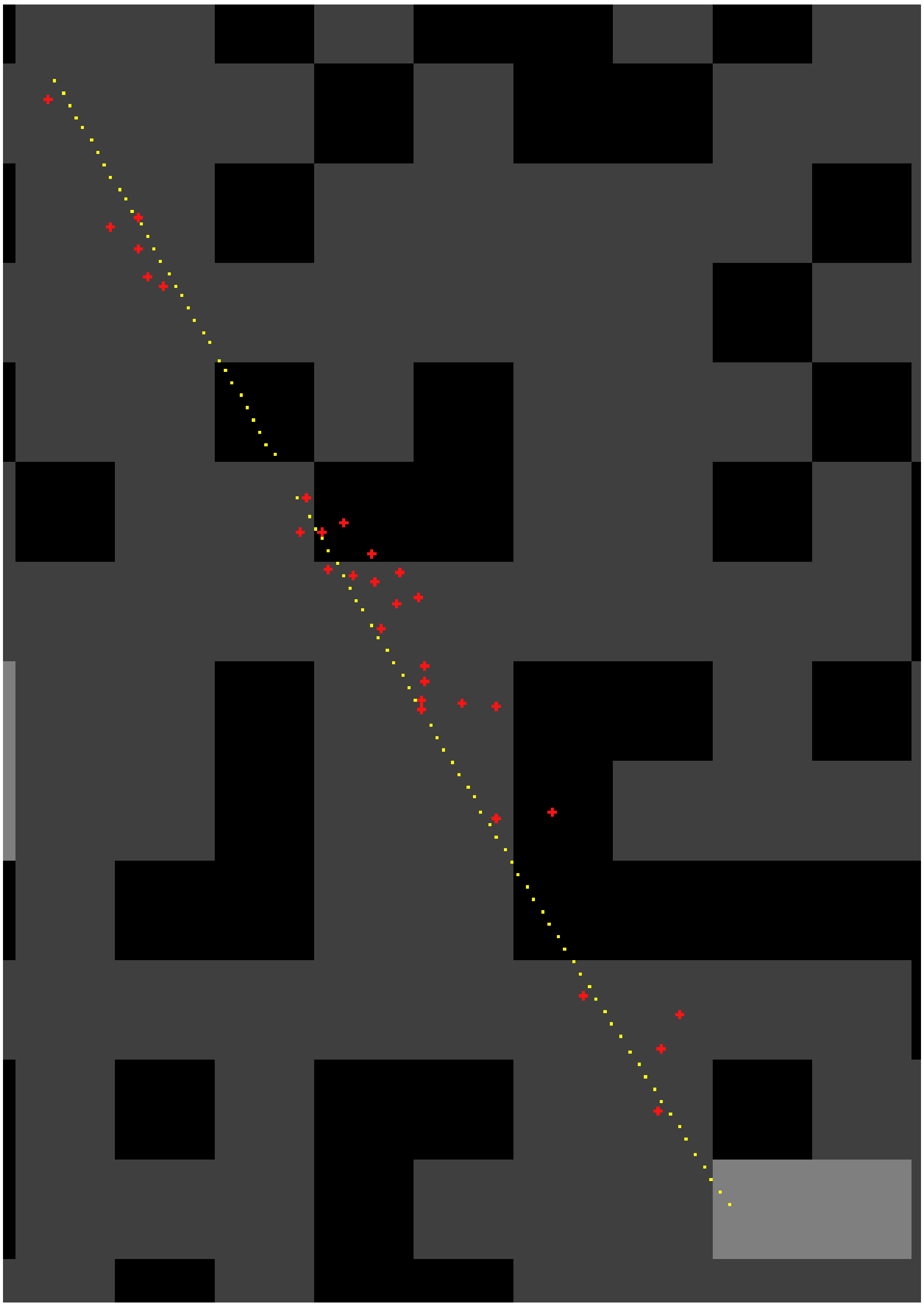


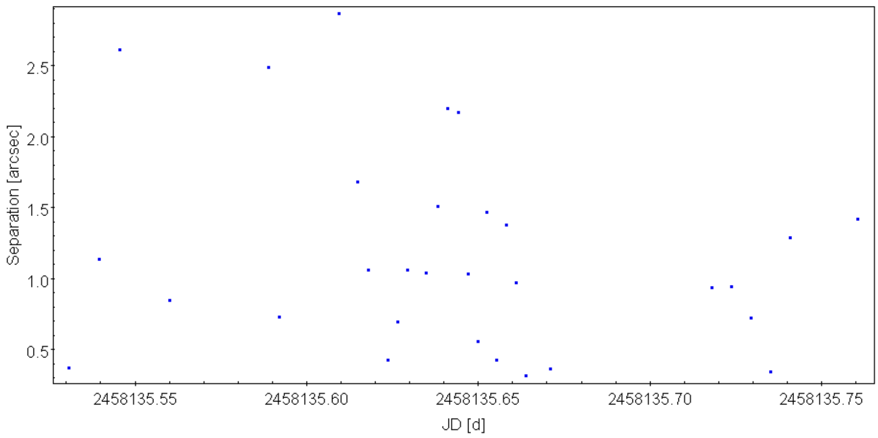
Separation [arcsec]
1.2
1.0
0.8
0.6
0.4
0.2
2458252.40
2458252.45
2458252.50
JD [d]



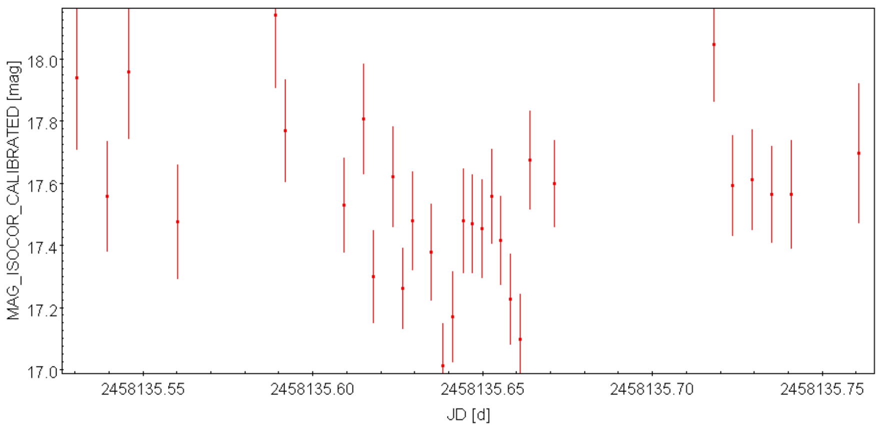
MAG_ISOCOR_CALIBRATED [mag]
18.0
17.9
17.8
17.7
17.6
17.5
17.4
17.3
2458252.40
2458252.45
2458252.50
JD [d]

ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
11922	1992 UT3	MB>Inner	17.7	89	30	0.76	0.32	SNR	AAA



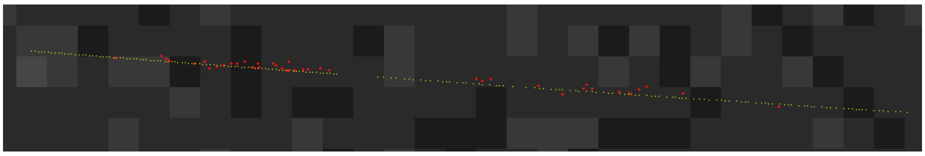


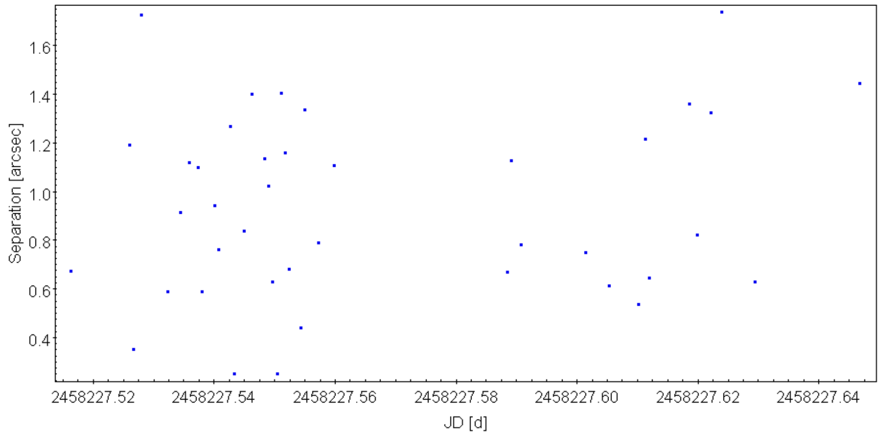
Separation [arcsec]
2.5
2.0
1.5
1.0
0.5
2458135.55
2458135.60
2458135.65
2458135.70
2458135.75
JD [d]

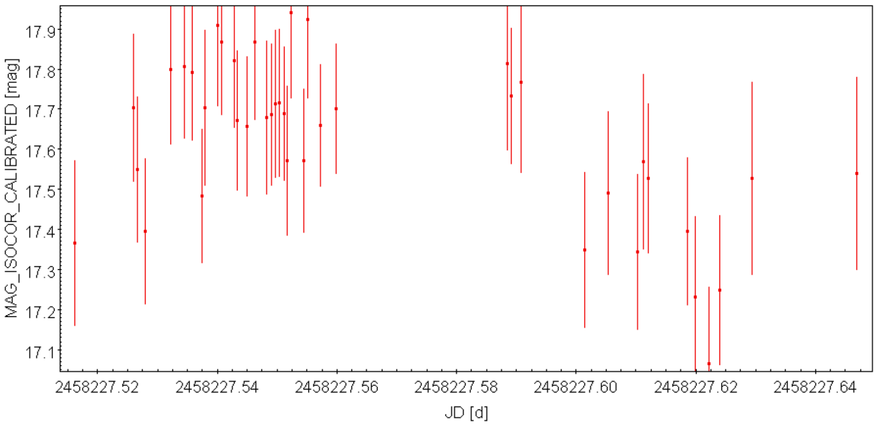


MAG_ISOCOR_CALIBRATED [mag]
18.0
17.8
17.6
17.4
17.2
17.0
2458135.55
2458135.60
2458135.65
2458135.70
2458135.75
JD [d]

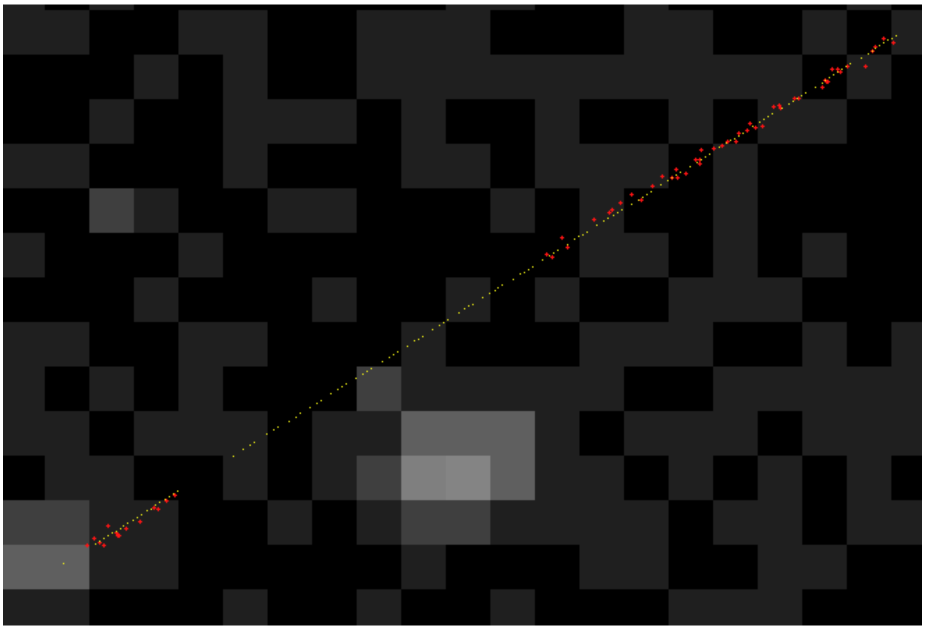
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
39539	Emmadesmet	MB>Outer	17.9	192	34	0.93	0.28	SNR Vi	BAA

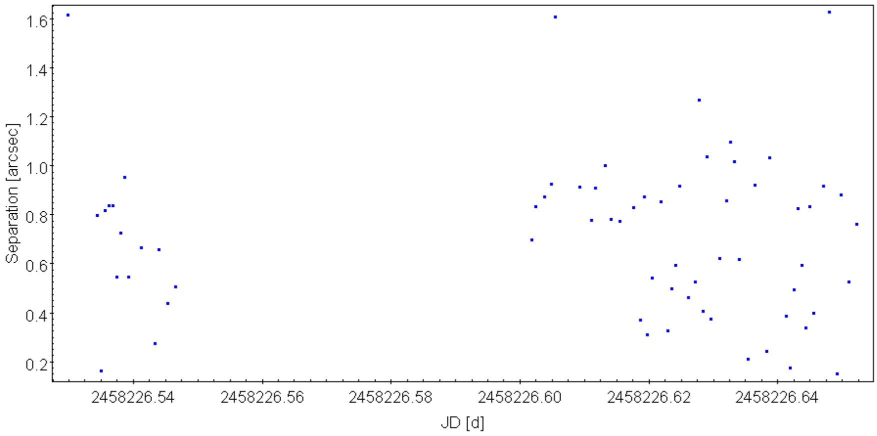


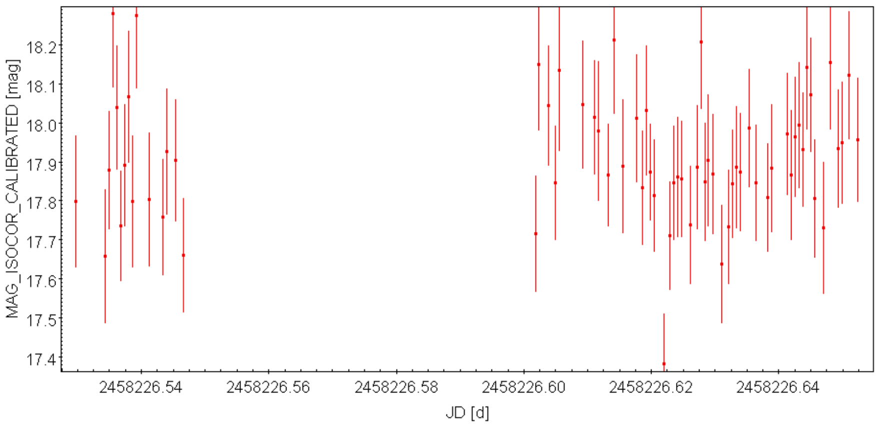




ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
43227	2000 AR166	MB>Outer	18.0	276	79	0.69	0.22	SNR St Sc Vi	AAA






MAG_ISOCOR_CALIBRATED [mag]
18.2
18.1
18.0
17.9
17.8
17.7
17.6
17.5
17.4
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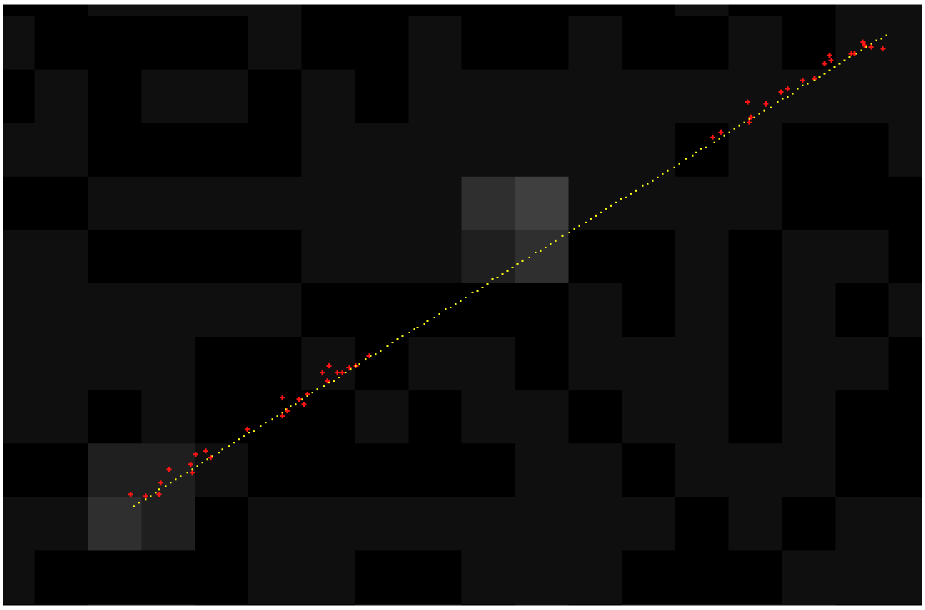
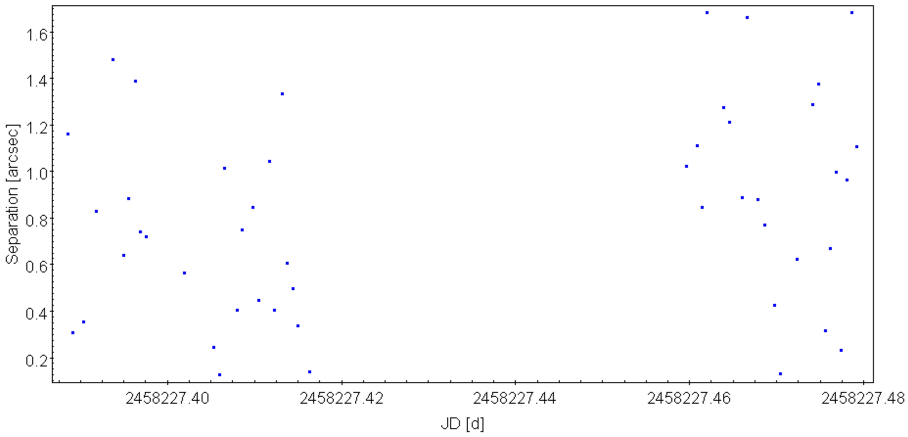
2458226.64
JD [d]




Separation [arcsec]
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
2458227.40
2458227.42
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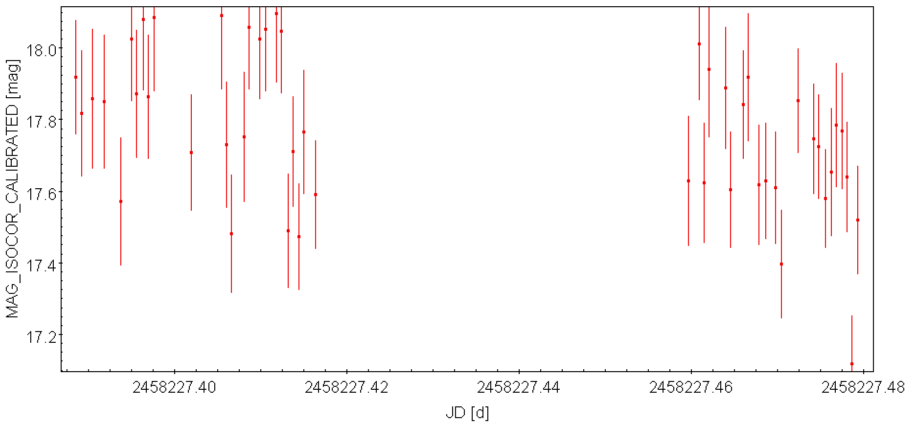
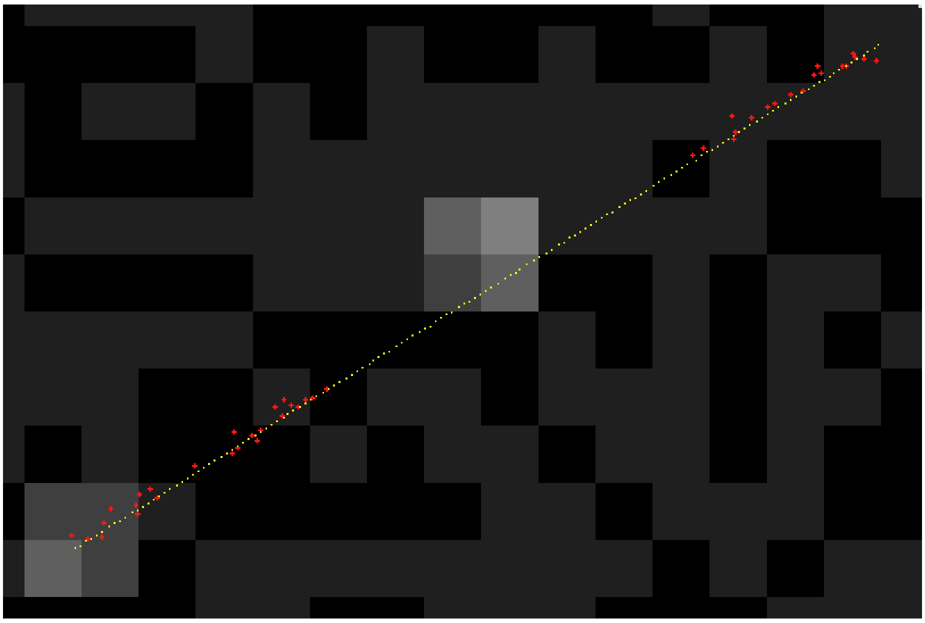
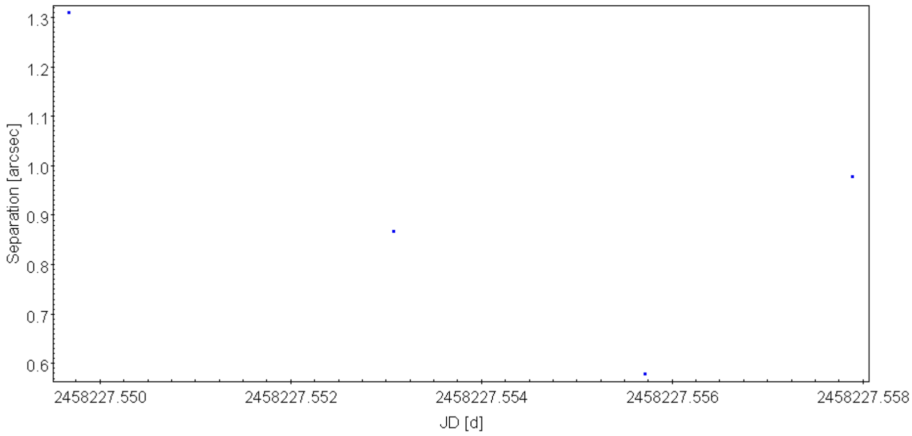
2458227.46
2458227.48
JD [d]

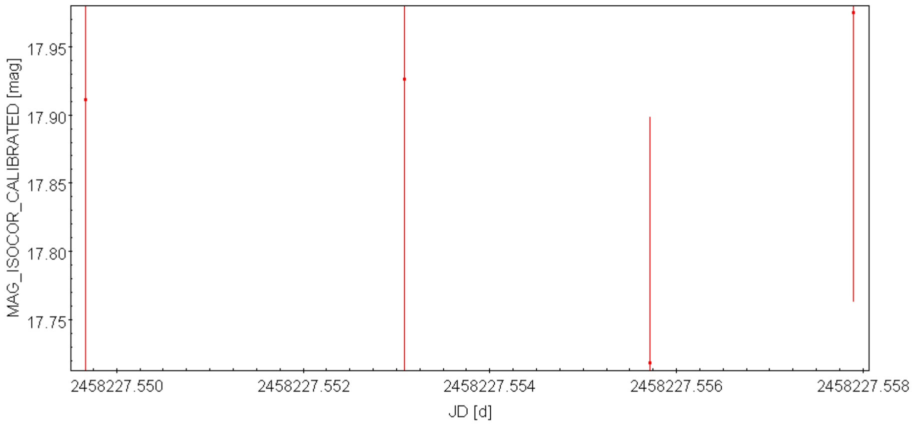


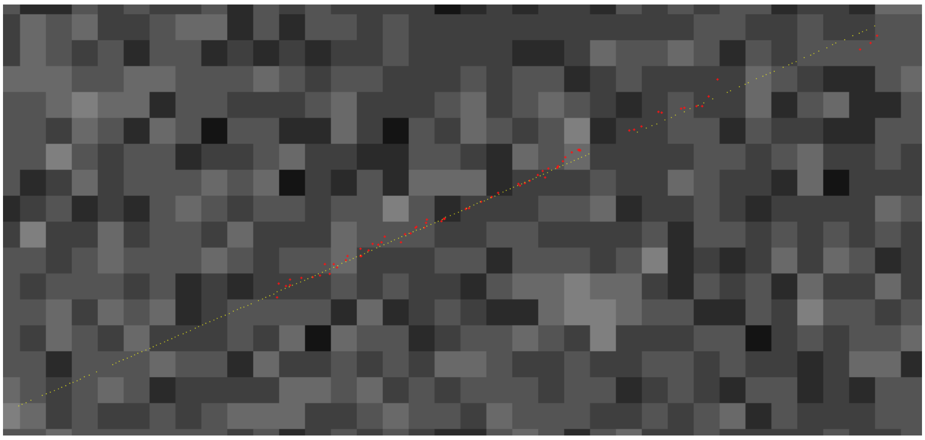
MAG_ISOCOR_CALIBRATED [mag]
18.0
17.8
17.6
17.4
17.2
2458227.40
2458227.42
2458227.44
2458227.46
2458227.48
JD [d]

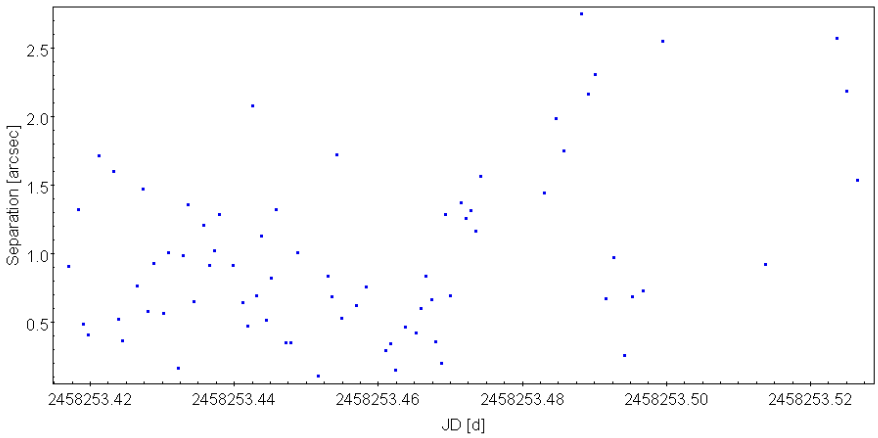
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
54041	2000 GQ113	MB>Inner	18.1	376	46	0.79	0.27	SNR Sc Vi	AAA BBA

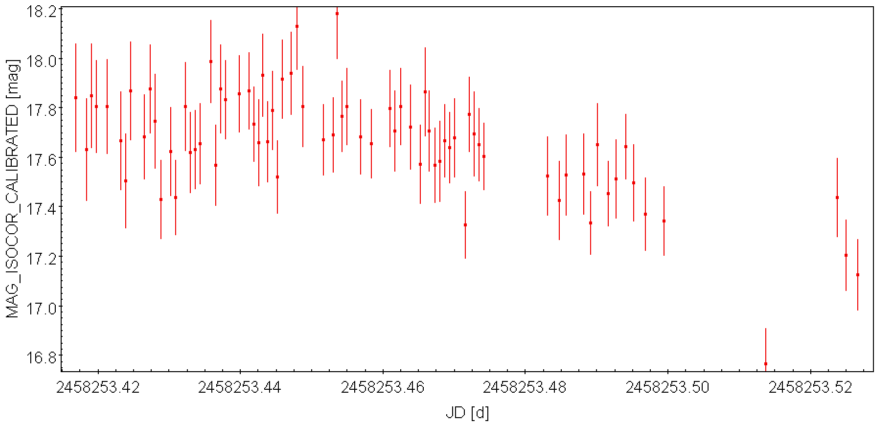




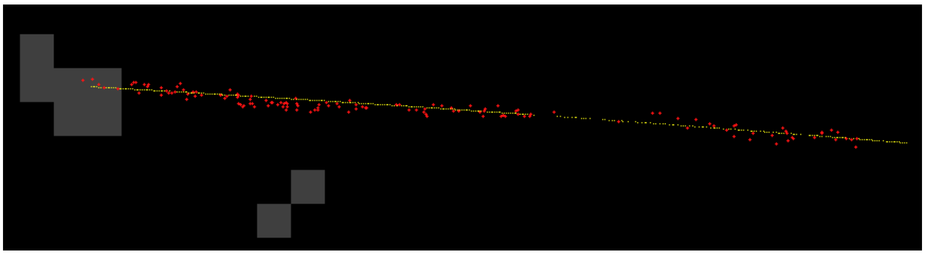

MAG_ISOCOR_CALIBRATED [mag]
17.95
17.90
17.85
17.80
17.75
2458227.550
2458227.552
2458227.554
2458227.556
2458227.558
JD [d]

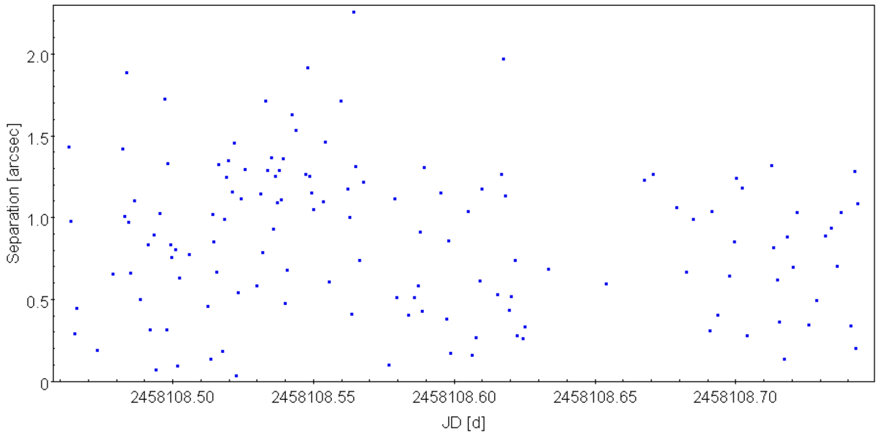


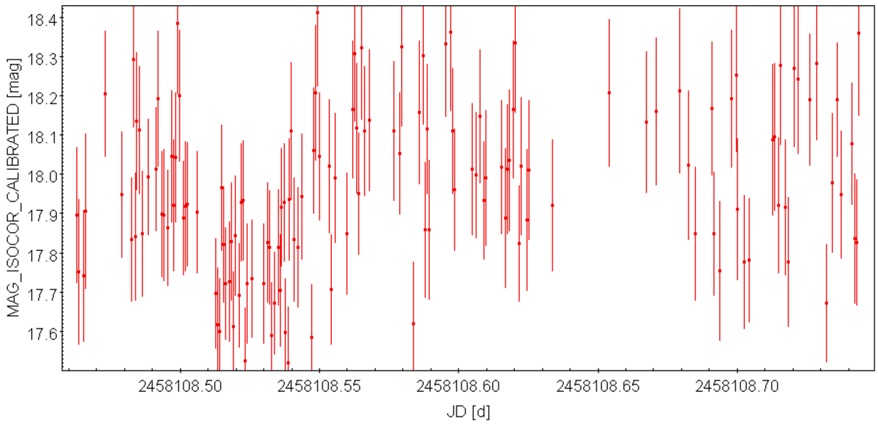

Separation [arcsec]
2.5
2.0
1.5
1.0
0.5
2458253.42
2458253.44
2458253.46
2458253.48
2458253.50
2458253.52
JD [d]

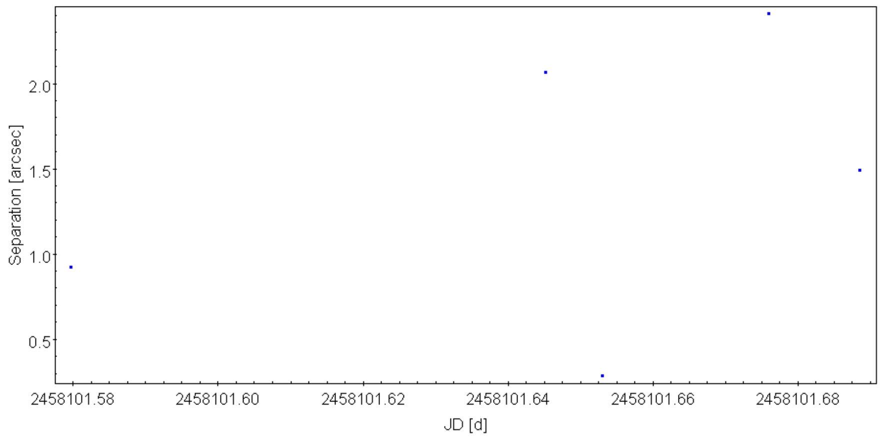

MAG_ISOCOR_CALIBRATED [mag]
JD [d]
18.2
18.0
17.8
17.6
17.4
17.2
17.0
16.8
2458253.42
2458253.44
2458253.46
2458253.48
2458253.50
2458253.52

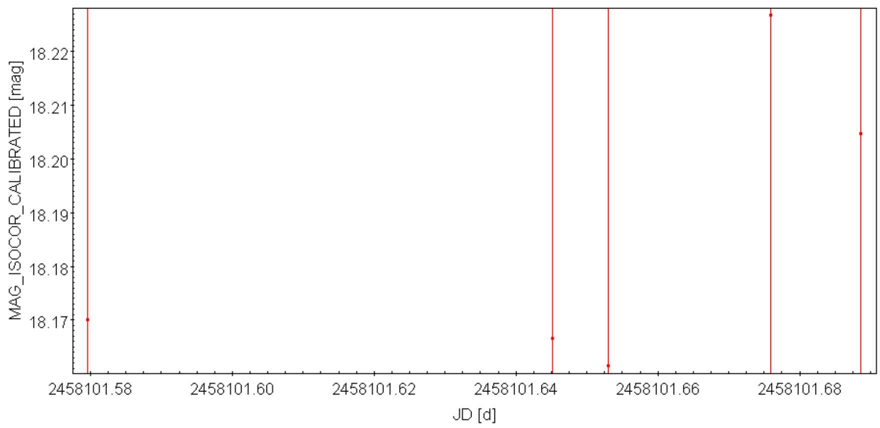
ID	Name	Class	M.v.	Pos.	Det.	Mean	St.Dev.	Filters	Behavior
41841	2000 WF60	MB>Middle	18.3	694	106	0.84	0.31	SNR St Sc Vi	AAA BAA








2.0
1.5
1.0
0.5
Separation [arcsec]
2458101.58
2458101.60
2458101.62
2458101.64
2458101.66
2458101.68
JD [d]


18.22
18.21
18.20
18.19
18.18
18.17
MAG_ISOCOR_CALIBRATED [mag]
2458101.58
2458101.60
2458101.62
2458101.64
2458101.66
2458101.68
JD [d]

Pipeline Code

```
IDL> .run index.pro
% Compiled module: $MAIN$.
```

```
              >>> WELCOME TO THE ASTEROID DETECTION PIPELINE <<<
          Developed by: Cédric Pereira; Miriam Cortes; Enrique Solano
              2018, CAB (CSIC-INTA) & ESAC (ESA), Madrid - Spain

[MENU]
1: Start.

7: Change configuration parameters.
8: Information about the methodology.
9: Requirements to use this pipeline.

0: Exit.

Enter Menu Option:
```

```
Enter Menu Option: 7

Change configuration parameters:
> To change the configuration parameters used in some scripts, go to the main folder of this software, open the file "con
figurations.txt" and edit the values that you want. Please keep the structure of the file.
```

```
Enter Menu Option: 8

Information about the methodology:
> run 1st script to map the pics [map_pics.pro];
> run 2nd script to check image quality [quality.pro]
> run 3rd script to compute the astrometric calibration [astrometric.pro]
> run 4th script to extract sources [sextractor.pro]
> run 5th script to choose the best SNR images and compute the sigma value [sigma.pro]
> run 6th script to compute the non-moving and moving catalogues [star.pro]
> run 7th script to calibrate the star magnitude and compute the magnitude limit of each image [mag.pro]
> run 8th script to identify known asteroid with skybot service [asteroid.pro]
> run 9th script to prepare stars catalogues, to be used in the next script [starcatg.pro]
> run 10th script to concatenate the results and flag nearby stars [conct.pro]
> run 11th script to concatenate the results from skybot [conct_skybot.pro]
> run 12th script to concatenate the results from sextractor [conct_sex.pro]
> run 13th script to create a table with the 1st results [resume.pro]
> run 14th script to filter and flag the results [fit.pro]
> run 15th script to concatenate the results from the same asteroid but different datasets and place the final file in th
e pathroot_resuls directory [collect.pro]
> run 16th script to display message to visual inspection [info.pro]
> run 17th script to filter and flag all the results [fit_collect.pro]
> run 18th script to resume the results [resume_end.pro]
```

```
Enter Menu Option: 9

Requirements to use this pipeline:
> You will need a very powerfull computer. Probabily your computer is not suitable for this extreme a very well designed
software. Please ask your organisation for a new computer and for a raise in your salary :)
> Linux based software;
> Internet connection;
> IDL;
> SExtractor;
> SCAMP;
> STILTS;
> VizieR;
```

```
Enter Menu Option: 1
IDL Version 8.4.1 (linux x86_64 m64). (c) 2015, Exelis Visual Information Solutions, Inc.
Installation number: 19939.
Licensed for use by: INTA - LAEFF

% Compiled module: $MAIN$.

###################################################################################
························· BEGIN: MAP_FOLDERS.PRO SCRIPT ·························
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

% Compiled module: READCOL.
% Compiled module: REMCHAR.
% Compiled module: GETTOK.
% READCOL: Skipping Line (strlen) 7
% READCOL: Skipping Line (strlen) 11
% READCOL: Skipping Line (strlen) 13
% READCOL: Skipping Line (strlen) 17
% READCOL: Skipping Line (strlen) 20
% READCOL: 22 valid lines read

···································································································
>>>> Folders Founded:
/pcdisk/stark/astrofisica3/Research/Software/pics/Sample/Palma/
/pcdisk/stark/astrofisica3/Research/Software/pics/Sample/Polyxo/
···································································································


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
························· END: MAP_FOLDERS.PRO SCRIPT ·························
###################################################################################


Please verify if you want to compute the data inside of all of these folder. If not, remove the folders from the pics_paths.

Enter Y to confirm or N to map the pics folders again (after change some folders). Enter 0 to return to the menu: Y

[OPERATING MODE]
1: Continuous - run all scripts for the first dataset and then proceed to the next dataset.
2: Continuous - run first script for all dataset and then proceed to the next script.
3: Step/Debug - run first script for all dataset and then proceed to the next script. Between each script, the software request permission to continue.

0: Cancel and return to the menu.

Enter Operating Mode Option: █
```

```
[OPTION 1: CONTINUOUS MODE]

% Compiled module: READCOL.
% Compiled module: REMCHAR.
% Compiled module: GETTOK.
% READCOL: Skipping Line (strlen) 7
% READCOL: Skipping Line (strlen) 11
% READCOL: Skipping Line (strlen) 13
% READCOL: Skipping Line (strlen) 17
% READCOL: Skipping Line (strlen) 20
% READCOL: 22 valid lines read
% READCOL: 2 valid lines read
IDL Version 8.4.1 (linux x86_64 m64). (c) 2015, Exelis Visual Information Solutions, Inc.
Installation number: 19939.
Licensed for use by: INTA - LAEFF

% Compiled module: $MAIN$.

###################################################################################
························· BEGIN: MAP_PICS.PRO SCRIPT ·························
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

% Compiled module: READCOL.
% Compiled module: REMCHAR.
% Compiled module: GETTOK.
% READCOL: Skipping Line (strlen) 7
% READCOL: Skipping Line (strlen) 11
% READCOL: Skipping Line (strlen) 13
% READCOL: Skipping Line (strlen) 17
% READCOL: Skipping Line (strlen) 20
% READCOL: 22 valid lines read
% READCOL: 1 valid lines read
/pcdisk/stark/astrofisica3/Research/Software/pics/Sample/Palma/

···································································································
>>>> Working Folder:
/pcdisk/stark/astrofisica3/Research/Software/pics/Sample/Palma/
···································································································



···································································································
>>>> Data Founded:
```

```
;########################################################################################
;# File Name:            reduce                                                        #
;# Description:          Script to run inside IRAF to reduce astronomical images.      #
;#                                                                                     #
;# Last revision:        04/07/2018                                                    #
;#                                                                                     #
;# Author:               Cédric Pereira, Miriam Cortes, Enrique Solano                 #
;# Affiliation:          CAB (CSIC-INTA) & ESA                                         #
;#                                                                                     #
;#                                                                                     #
;########################################################################################

files *.fts > raw.list
hselect @raw.list $I "FLIPSTAT!='Flip/Mirror'" > normal.list
hselect @raw.list $I "FLIPSTAT?='Flip/Mirror'" > flip.list
rotate masterbias2x2.fits masterbias2x2_rot.fits 180
rotate masterflat2x2.fits masterflat2x2_rot.fits 180

ccdmask ("masterbias2x2.fits",
"badpix_biasmask.pl", ncmed=7, nlmed=7, ncsig=15, nlsig=15, lsigma=6.,
hsigma=6., ngood=5, linterp=2, cinterp=3, eqinterp=2)

ccdmask ("masterbias2x2_rot.fits",
"badpix_biasmask_rot.pl", ncmed=7, nlmed=7, ncsig=15, nlsig=15, lsigma=6.,
hsigma=6., ngood=5, linterp=2, cinterp=3, eqinterp=2)

setinstrument ("direct",
"direct", site="kpno", directory="ccddb$", review=yes)

ccdproc ("@normal.list",
output="", ccdtype="", max_cache=0, noproc=no, fixpix=no, overscan=no,
trim=no, zerocor=yes, darkcor=no, flatcor=no, illumcor=no, fringecor=no,
readcor=no, scancor=no, readaxis="line", fixfile="", biassec="image",
trimsec="image", zero="masterbias2x2.fits", dark="", flat="", illum="",
fringe="", minreplace=1., scantype="shortscan", nscan=1, interactive=yes,
function="chebyshev", order=1, sample="*", naverage=1, niterate=1,
low_reject=3., high_reject=3., grow=0.)

ccdproc ("@normal.list",
output="", ccdtype="", max_cache=0, noproc=no, fixpix=no, overscan=no,
trim=no, zerocor=no, darkcor=no, flatcor=yes, illumcor=no, fringecor=no,
readcor=no, scancor=no, readaxis="line", fixfile="", biassec="image",
trimsec="image", zero=" ", dark="", flat="masterflat2x2.fits", illum="",
fringe="", minreplace=1., scantype="shortscan", nscan=1, interactive=yes,
function="chebyshev", order=1, sample="*", naverage=1, niterate=1,
low_reject=3., high_reject=3., grow=0.)

ccdproc ("@normal.list",
output="", ccdtype="", max_cache=0, noproc=no, fixpix=yes, overscan=no,
trim=no, zerocor=no, darkcor=no, flatcor=no, illumcor=no, fringecor=no,
readcor=no, scancor=no, readaxis="line", fixfile="badpix_biasmask.pl",
biassec="image", trimsec="image", zero="", dark="", flat="", illum="",
fringe="", minreplace=1., scantype="shortscan", nscan=1, interactive=yes,
function="chebyshev", order=1, sample="*", naverage=1, niterate=1,
low_reject=3., high_reject=3., grow=0.)

ccdproc ("@flip.list",
output="", ccdtype="", max_cache=0, noproc=no, fixpix=no, overscan=no,
trim=no, zerocor=yes, darkcor=no, flatcor=no, illumcor=no, fringecor=no,
readcor=no, scancor=no, readaxis="line", fixfile="", biassec="image",
trimsec="image", zero="masterbias2x2_rot.fits", dark="", flat=" ", illum="",
fringe="", minreplace=1., scantype="shortscan", nscan=1, interactive=yes,
function="chebyshev", order=1, sample="*", naverage=1, niterate=1,
low_reject=3., high_reject=3., grow=0.)

ccdproc ("@flip.list",
output="", ccdtype="", max_cache=0, noproc=no, fixpix=no, overscan=no,
trim=no, zerocor=no, darkcor=no, flatcor=yes, illumcor=no, fringecor=no,
readcor=no, scancor=no, readaxis="line", fixfile="", biassec="image",
trimsec="image", zero=" ", dark="", flat="masterflat2x2_rot.fits", illum="",
fringe="", minreplace=1., scantype="shortscan", nscan=1, interactive=yes,
function="chebyshev", order=1, sample="*", naverage=1, niterate=1,
low_reject=3., high_reject=3., grow=0.)

ccdproc ("@flip.list",
output="", ccdtype="", max_cache=0, noproc=no, fixpix=yes, overscan=no,
trim=no, zerocor=no, darkcor=no, flatcor=no, illumcor=no, fringecor=no,
readcor=no, scancor=no, readaxis="line", fixfile="badpix_biasmask_rot.pl",
biassec="image", trimsec="image", zero="", dark="", flat="", illum="",
fringe="", minreplace=1., scantype="shortscan", nscan=1, interactive=yes,
function="chebyshev", order=1, sample="*", naverage=1, niterate=1,
low_reject=3., high_reject=3., grow=0.)
```

```
;#####################################################################################
;# File Name:           index.pro                                                   #
;# Description:         Main file to run the "Asteroid Detection Pipeline".         #
;#                      This script contains the instructions to navigate inside    #
;#                      this software, to select different option and run external  #
;#                      script to process the data.                                 #
;# Last revision:       04/07/2018                                                  #
;#                                                                                  #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano               #
;# Affiliation:         CAB (CSIC-INTA) & ESA                                       #
;#                                                                                  #
;# Inputs               configurations.txt                                          #
;#                      folders_paths.txt   (secundary)                             #
;#                                                                                  #
;# Outputs:             working_path.txt                                            #
;#                                                                                  #
;#####################################################################################



;welcome mensage:
print, ''
print,'          _                 _     _    _____       _            _   _                _____ _             _
_           '
print,'     /\       | |               (_)   | |  |  __ \     | |          | | (_)              |  __ (_)           |
(_)         '
print,'    /  \   ___| |_ ___ _ __ ___  _  __| |  | |  | | ___| |_ ___  ___| |_ _  ___  _ __    | |__) | _ __   ___| |_ _
__   ___  '
print,'   / /\ \ / __| __/ _ \  __/ _ \| |/ _` |  | |  | |/ _ \ __/ _ \/ __| __| |/ _ \| |_ \   |  ___/ |  _ \ / _ \ | |  _ \
/ _ \'
print,'  / ____ \\__ \ ||  __/ | | (_) | | (_| |  | |__| |  __/ ||  __/ (__| |_| | (_) | | | |  | |   | | |_) |  __/ | | | |
|  __/'
print,' /_/    \_\___/\__\___|_|  \___/|_|\__,_|  |_____/ \___|\__\___|\___|\__|_|\___/|_| |_|  |_|   |_| .__/ \___|_|_|_|
|_|\___|'
print,'                                                                                                    |
|                        '
print,'                                _____          ____             ______  _____         _____
|_|                           '
print,'                               / ____|   /\   |  _ \           |  ____|/ ____|  /\   /
____|                        '
print,'                              | |       /  \  | |_) |  ______  | |__  | (___   /  \ |
|                             '
print,'                              | |      / /\ \ |  _ <  |______| |  __|  \___ \ / /\ \|
|                             '
print,'                              | |____ / ____ \| |_) |          | |____ ____) / ____ \
|____                         '
print,'                               \_____/_/    \_\____/           |______|_____/_/
\_\_____|                         '
print,''
print,'                                    >>> WELCOME TO THE ASTEROID DETECTION PIPELINE
<<<                                      '
print,'                               Developed by: Cédric Pereira; Miriam Cortes; Enrique
Solano                                 '
print,'                                    2018, CAB (CSIC-INTA) & ESAC (ESA), Madrid -
Spain                                        '

;_____________________________________________________________

;close files:
close, 1, 2, 3

;options menu:
menu:
option = ''
print, ''
print, '[MENU]'
print, '1: Start.'
print, ''
print, '7: Change configuration parameters.'
print, '8: Information about the methodology.'
print, '9: Requirements to use this pipeline.'
print, ''
print, '0: Exit.'
again_menu:
print, ''

;read menu option:
READ, option, PROMPT='Enter Menu Option: '

;option 7 - Configurations:
if option eq '7' then begin
    print,''
    print, 'Change configuration parameters:'
    print, '> To change the configuration parameters used in some scripts, go to the main folder of this software, open the
    file "configurations.txt" and edit the values that you want. Please keep the structure of the file.'
    print,''

    ;proceed to menu:
        done = ''
        READ, done, PROMPT='Press Enter to return to the menu:'
        goto, menu
endif

;option 8 - Informations:
if option eq '8' then begin
    print,''
    print,'Information about the methodology:'
    print,'> run 1st script to map the pics [map_pics.pro];'
    print,'> run 2nd script to check image quality [quality.pro]'
    print,'> run 3rd script to compute the astrometric calibration [astrometric.pro]'
    print,'> run 4th script to extract sources [sextractor.pro]'
    print,'> run 5th script to choose the best SNR images and compute the sigma value [sigma.pro]'
    print,'> run 6th script to compute the non-moving and moving catalogues [star.pro]'
    print,'> run 7th script to calibrate the star magnitude and compute the magnitude limit of each image [mag.pro]'
    print,'> run 8th script to identify known asteroid with skybot service [asteroid.pro]'
```

```
    print,'> run 9th script to prepare stars catalogues, to be used in the next script [starcatg.pro]'
    print,'> run 10th script to concatenate the results and flag nearby stars [conct.pro]'
    print,'> run 11th script to concatenate the results from skybot [conct_skybot.pro]'
    print,'> run 12th script to concatenate the results from sextractor [conct_sex.pro]'
    print,'> run 13th script to create a table with the 1st results [resume.pro]'
    print,'> run 14th script to filter and flag the results [fit.pro]'
    print,'> run 15th script to concatenate the results from the same asteroid but different datasets and place the final file in the pathroot_resuls directory [collect.pro]'
    print,'> run 16th script to display message to visual inspection [info.pro]'
    print,'> run 17th script to filter and flag all the results [fit_collect.pro]'
    print,'> run 18th script to resume the results [resume_end.pro]'
    print,''

    ;proceed to menu:
    done = ''
    READ, done, PROMPT='Press Enter to return to the menu:'
    goto, menu
endif

;option 9 - Requirements:
if option eq '9' then begin
    print,''
    print, 'Requirements to use this pipeline:'
    print, '> You will need a very powerfull computer. Probabily your computer is not suitable for this extreme a very well designed software. Please ask your organisation for a new computer and for a raise in your salary :)'
    print, '> Linux based software;'
    print, '> Internet connection;'
    print, '> IDL;'
    print, '> SExtractor;'
    print, '> SCAMP;'
    print, '> STILTS;'
    print, '> VizieR;'
    print,''

    ;proceed to menu:
    done = ''
    READ, done, PROMPT='Press Enter to return to the menu:'
    goto, menu
endif

;option 0 - Exit:
if option eq '0' then begin
    print,''
    print, 'Hasta la vista!'
    print,''
    goto, exit_end
endif

;option not valid:
if (option ne '1') and (option ne '7') and (option ne '8') and (option ne '9') and (option ne '0') then begin
    print, 'Option not valid!'
    goto, again_menu
endif

;option 1 - Start
if option eq '1' then begin
    map:

    ;run function to map the folders with images to process:
    spawn, 'idl -e ".run map_folders.pro"'

    ;verify if user wants to proceed:
    print, ''
    print, 'Please verify if you want to compute the data inside of all of these folder. If not, remove the folders from the pics_paths.'

    again:
    print,''

    confirm_folders = ''
    READ, confirm_folders, PROMPT='Enter Y to confirm or N to map the pics folders again (after change some folders). Enter 0 to return to the menu: '

    ;option Y - Proceed
    if confirm_folders eq 'Y' then begin
        goto, mode
    endif

    ;option N - Remap
    if confirm_folders eq 'N' then begin
        goto, map
    endif

    ;option 0 - Return to menu
    if confirm_folders eq '0' then begin
        goto, menu
    endif

    ;option not valid:
    if (confirm_folders ne 'Y') and (confirm_folders ne 'N') and (confirm_folders ne '0') then begin
        print, 'Option not valid!'
        goto, again
    endif
endif


;____________________________________________________________

;mode menu:
mode:
mode_option = ''
print, ''
print, '[OPERATING MODE]'
print, '1: Continuous - run all scripts for the first dataset and then proceed to the next dataset.'
print, '2: Continuous - run first script for all dataset and then proceed to the next script.'
```

```
print, '3: Step/Debug - run first script for all dataset and then proceed to the next script. Between each script, the software request permission to continue.'
print, ''
print, '0: Cancel and return to the menu.'
again_mode:
print, ''

;read menu option:
READ, mode_option, PROMPT='Enter Operating Mode Option: '

;option 1 - Continuous_1:
if mode_option eq '1' then begin
    goto, continuous_1
endif

;option 2 - Continuous_2:
if mode_option eq '2' then begin
    goto, continuous_2
endif

;option 3 - Step_1:
if mode_option eq '3' then begin
    goto, step_1
endif

;option 0 - Cancel and return to menu:
if mode_option eq '0' then begin
    goto, menu
endif

;option not valid:
if (mode_option ne '1') and (mode_option ne '2') and (mode_option ne '3') and (mode_option ne '0') then begin
    print, 'Option not valid!'
    goto, again_mode
endif

;____________________________________________________________

;continuous mode 1:
continuous_1:

print, ''
print, '[OPTION 1: CONTINUOUS MODE]'
print, ''

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))

;read folders paths:
readcol,pathroot+'folders_paths.txt',f='a', folders_paths, delimiter = ','

;write working path:
for i = 0, n_elements(folders_paths)-1 do begin

    ;create a file with the current working path:
    openw, 1, pathroot +'working_path.txt'
    printf, 1, folders_paths(i)
    close, 1

    ;run 1st script to map the pics:
    spawn, 'idl -e ".run map_pics.pro"'

    ;run 2nd script to check image quality:
    spawn, 'idl -e ".run quality.pro"'

    ;run 3rd script to compute the astrometric calibration:
    spawn, 'idl -e ".run astrometric.pro"'

    ;run 4th script to extract sources:
    spawn, 'idl -e ".run sextractor.pro"'

    ;run 5th script to choose the best SNR images and compute the sigma value:
    spawn, 'idl -e ".run sigma.pro"'

    ;run 6th script to compute the non-moving and moving catalogues:
    spawn, 'idl -e ".run star.pro"'

    ;run 7th script to calibrate the star magnitude and compute the magnitude limit of each image:
    spawn, 'idl -e ".run mag.pro"'

    ;run 8th script to identify known asteroid with skybot service:
    spawn, 'idl -e ".run asteroid.pro"'

    ;run 9th script to prepare stars catalogues, to be used in the next script:
    spawn, 'idl -e ".run starcatg.pro"'

    ;run 10th script to concatenate the results and flag nearby stars:
    spawn, 'idl -e ".run conct.pro"'

    ;run 11th script to concatenate the results from skybot:
    spawn, 'idl -e ".run conct_skybot.pro"'

    ;run 12th script to concatenate the results from sextractor:
    spawn, 'idl -e ".run conct_sex.pro"'

    ;run 13th script to create a table with the 1st results:
    spawn, 'idl -e ".run resume.pro"'

    ;run 14th script to filter and flag the results:
    spawn, 'idl -e ".run fit.pro"'

endfor
```

```
;read folders paths:
readcol,pathroot+'folders_paths.txt',f='a', folders_paths, delimiter = ','

;create a file with the current working path:
openw, 3, pathroot +'working_path.txt'
printf, 3, folders_paths
close, 3

;run 15th script to concatenate the results from the same asteroid but different datasets and place the final file in the pathroot_resuls directory:
spawn, 'idl -e ".run collect.pro"'

;run 16th script to display message to visual inspection:
spawn, 'idl -e ".run info.pro"'

;run 17th script to filter and flag all the results:
spawn, 'idl -e ".run fit_collect.pro"'

;run 18th script to resume the results:
spawn, 'idl -e ".run resume_end.pro"'

;end of the pipeline:
print,''
print, 'The process is finished. There is no logfile, so scroll up to look to the terminal and check if everything is correct (probably your terminal do not has enought memory to save every detail, sorry...) :)'

finish = ''
READ, finish, PROMPT='Press Enter to return to the menu:'
goto, menu

;__________________________

continuous_2:

print, ''
print, '[OPTION 2: CONTINUOUS MODE]'
print, ''

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))

;read folders paths:
readcol,pathroot+'folders_paths.txt',f='a', folders_paths, delimiter = ','

;create a file with the current working path:
openw, 2, pathroot +'working_path.txt'
printf, 2, folders_paths
close, 2

;run 1st script to map the pics:
spawn, 'idl -e ".run map_pics.pro"'

;run 2nd script to check image quality:
spawn, 'idl -e ".run quality.pro"'

;run 3rd script to compute the astrometric calibration:
spawn, 'idl -e ".run astrometric.pro"'

;run 4th script to extract sources:
spawn, 'idl -e ".run sextractor.pro"'

;run 5th script to choose the best SNR images and compute the sigma value:
spawn, 'idl -e ".run sigma.pro"'

;run 6th script to compute the non-moving and moving catalogues:
spawn, 'idl -e ".run star.pro"'

;run 7th script to calibrate the star magnitude and compute the magnitude limit of each image:
spawn, 'idl -e ".run mag.pro"'

;run 8th script to identify known asteroid with skybot service:
spawn, 'idl -e ".run asteroid.pro"'

;run 9th script to prepare stars catalogues, to be used in the next script:
spawn, 'idl -e ".run starcatg.pro"'

;run 10th script to concatenate the results and flag nearby stars:
spawn, 'idl -e ".run conct.pro"'

;run 11th script to concatenate the results from skybot:
spawn, 'idl -e ".run conct_skybot.pro"'

;run 12th script to concatenate the results from sextractor:
spawn, 'idl -e ".run conct_sex.pro"'

;run 13th script to create a table with the 1st results:
spawn, 'idl -e ".run resume.pro"'

;run 14th script to filter and flag the results:
spawn, 'idl -e ".run fit.pro"'

;run 15th script to concatenate the results from the same asteroid but different datasets and place the final file in the pathroot_resuls directory:
spawn, 'idl -e ".run collect.pro"'

;run 16th script to display message to visual inspection:
spawn, 'idl -e ".run info.pro"'

;run 17th script to filter and flag all the results:
spawn, 'idl -e ".run fit_collect.pro"'
```

```
;run 18th script to resume the results:
spawn, 'idl -e ".run resume_end.pro"'

;end of the pipeline:
print,''
print, 'The process is finished. There is no logfile, so scroll up to look to the terminal and check if everything is correct (probably your terminal do not has enought memory to save every detail, sorry...) :)'

finish = ''
READ, finish, PROMPT='Press Enter to return to the menu:'
goto, menu

;____________________________

step_1:
print, ''
print, '[OPTION 3: STEP MODE]'
print, ''

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))

;read folders paths:
readcol,pathroot+'folders_paths.txt',f='a', folders_paths, delimiter = ','

;create a file with the current working path:
openw, 2, pathroot +'working_path.txt'
printf, 2, folders_paths
close, 2

;-------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;-------------------------------------------------------------------------

;run 1st script to map the pics:
spawn, 'idl -e ".run map_pics.pro"'

;-------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;-------------------------------------------------------------------------

;run 2nd script to check image quality:
spawn, 'idl -e ".run quality.pro"'

;-------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;-------------------------------------------------------------------------

;run 3rd script to compute the astrometric calibration:
spawn, 'idl -e ".run astrometric.pro"'

;-------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;-------------------------------------------------------------------------

;run 4th script to extract sources:
spawn, 'idl -e ".run sextractor.pro"'

;-------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;-------------------------------------------------------------------------

;run 5th script to choose the best SNR images and compute the sigma value:
spawn, 'idl -e ".run sigma.pro"'

;-------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;-------------------------------------------------------------------------

;run 6th script to compute the non-moving and moving catalogues:
spawn, 'idl -e ".run star.pro"'

;-------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;-------------------------------------------------------------------------

;run 7th script to calibrate the star magnitude and compute the magnitude limit of each image:
spawn, 'idl -e ".run mag.pro"'

;-------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;-------------------------------------------------------------------------

;run 8th script to identify known asteroid with skybot service:
spawn, 'idl -e ".run asteroid.pro"'

;-------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;-------------------------------------------------------------------------

;run 9th script to prepare stars catalogues, to be used in the next script:
spawn, 'idl -e ".run starcatg.pro"'
```

```
;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;run 10th script to concatenate the results and flag nearby stars:
spawn, 'idl -e ".run conct.pro"'

;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;run 11th script to concatenate the results from skybot:
spawn, 'idl -e ".run conct_skybot.pro"'

;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;run 12th script to concatenate the results from sextractor:
spawn, 'idl -e ".run conct_sex.pro"'

;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;run 13th script to create a table with the 1st results:
spawn, 'idl -e ".run resume.pro"'

;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;run 14th script to filter and flag the results:
spawn, 'idl -e ".run fit.pro"'

;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;run 15th script to concatenate the results from the same asteroid but different datasets and place the final file in the pathroot_resuls directory:
spawn, 'idl -e ".run collect.pro"'

;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;run 16th script to display message to visual inspection:
spawn, 'idl -e ".run info.pro"'

;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;run 17th script to filter and flag all the results:
spawn, 'idl -e ".run fit_collect.pro"'

;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;run 18th script to resume the results:
spawn, 'idl -e ".run resume_end.pro"'

;--------------------------------------------------------------------------
okay = ''
READ, okay, PROMPT='Press Enter to continue:'
;--------------------------------------------------------------------------

;end of the pipeline:
print,''
print, 'The process is finished. There is no logfile, so scroll up to look to the terminal and check if everything is correct (probably your terminal do not has enought memory to save every detail, sorry...) :)'

finish = ''
READ, finish, PROMPT='Press Enter to return to the menu:'
goto, menu

exit_end:
end
```

```
;########################################################################################
;# File Name:       map_folders.pro                                                     #
;# Description:     Map the folders inside the data folder defined in the               #
;#                  "configurations.txt" file with the keyword "PATHROOT_PICS".         #
;# Last revision:   04/07/2018                                                          #
;#                                                                                      #
;# Author:          Cédric Pereira, Miriam Cortes, Enrique Solano                       #
;# Affiliation:     CAB (CSIC-INTA) & ESA - 2018                                        #
;#                                                                                      #
;# Inputs           configurations.txt                                                  #
;#                                                                                      #
;# Outputs:         folders_paths.txt                                                   #
;#                                                                                      #
;########################################################################################

print,''
print, '##################################################################################'
print, '························· BEGIN: MAP_FOLDERS.PRO SCRIPT ·························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
pathroot_pics = values(WHERE(STRMATCH(keywords, 'PATHROOT_PICS', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))

;folders paths:
folders_paths = FILE_SEARCH(pathroot_pics,'*',/TEST_DIRECTORY)+'/'

;pics paths array:
pics_paths = []

;write to the "pics_paths" array, which paths have images:
for i = 0,n_elements(folders_paths)-1 do begin

    if (FILE_TEST(folders_paths(i)+'*'+image_ext) EQ 1) then begin
            pics_paths = [[pics_paths],[folders_paths(i)]]
        endif

endfor

;remove first empty element of the "pics_paths" array:
;pics_paths = pics_paths[0,1:*]

print,''
print, '··································································································'
print, '>>>> Folders Founded: '
print, pics_paths
print, '··································································································'
print,''

;create a file with folders paths:
openw, 1, pathroot+'folders_paths.txt'
printf, 1, pics_paths
close, 1

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '·························· END: MAP_FOLDERS.PRO SCRIPT ··························'
print, '##################################################################################'
print,''

end
```

```
;#########################################################################################
;# File Name:           map_pics.pro                                                    #
;# Description:         Map the pictures for each dataset inside the data folder        #
;#                      defined in the "configurations.txt" file with the keyword       #
;#                      "PATHROOT_PICS".                                                #
;# Last revision:       04/07/2018                                                      #
;#                                                                                      #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                   #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                    #
;#                                                                                      #
;# Inputs               configurations.txt                                              #
;#                      working_path.txt                                                #
;#                                                                                      #
;# Outputs:             raw.list (one file per dataset)                                 #
;#                                                                                      #
;#########################################################################################

print,''
print, '#################################################################################'
print, '··························· BEGIN: MAP_PICS.PRO SCRIPT ····························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

print, working_path

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
    print, '·································································································'
    print, '>>>> Working Folder: '
    print, working_path(i)
    print, '·································································································'
    print,''

    ;map pics:
    pics = FILE_SEARCH(working_path(i)+'*'+image_ext)

    ;subtract path from pic name:
    pics_sub = []
    for k = 0, n_elements(pics)-1 do begin
        pics_sub = [[pics_sub],[STRMID(pics(k),(STRLEN(working_path(i))),(STRLEN(pics(k))-STRLEN(working_path(i))))]]
    endfor

        print,''
        print, '·································································································'
        print, '>>>> Data Founded: '
        print, pics_sub
        print, '·································································································'
        print,''

    ;create a file with folders paths:
    openw, 1, working_path(i) +'raw.list'
    printf, 1, pics_sub
    close, 1
endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '···························· END: MAP_PICS.PRO SCRIPT ·····························'
print, '#################################################################################'
print,''

end
```

```
;#################################################################################
;# File Name:           quality.pro                                              #
;# Description:         Quality control of the datasets to find a remove images with    #
;#                      excess of noise, trails, etc.                            #
;# Last revision:       20/08/2018                                               #
;#                                                                               #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano            #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                             #
;#                                                                               #
;# Inputs               configurations.txt                                       #
;#                      working_path.txt                                         #
;#                      raw.list    (one file per dataset)                       #
;#                      *.cat       (one file per image/data)                    #
;#                                                                               #
;# Outputs:             checked.list                                             #
;#                                                                               #
;#                                                                               #
;#################################################################################

print,''
print, '################################################################################'
print, '························· BEGIN: QUALITY.PRO SCRIPT ·····························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1, 2

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))
perc_sources = values(WHERE(STRMATCH(keywords, 'PERC_SOURCES', /FOLD_CASE) EQ 1))
perc_snr = values(WHERE(STRMATCH(keywords, 'PERC_SNR', /FOLD_CASE) EQ 1))
perc_ratio = values(WHERE(STRMATCH(keywords, 'PERC_RATIO', /FOLD_CASE) EQ 1))

perc_sources = float(perc_sources[0])
perc_snr = float(perc_snr[0])
perc_ratio = float(perc_ratio[0])

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;array to save final info:
alert = []
alarm = 0

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
        print, '································································································'
        print, '>>>> Working Folder: '
        print, working_path(i)
        print, '································································································'
        print,''

    ;read raw list with images/data name:
        readcol,working_path(i)+'raw.list',f='a', raw_list, delimiter = ','

    ;array to save values of each image:
        info = []

    ;Using Sextractor to extract sources:
        for k = 0,n_elements(raw_list)-1 do begin
        pic_name = STRMID(raw_list(k),0,(STRLEN(raw_list(k))-(STRLEN(image_ext))))
            spawn, 'sex '+working_path(i)+raw_list(k)+' -c settings_quality.sex'
            spawn, 'mv sex.cat '+working_path(i)+pic_name+'.cat'
        endfor

    ;working image loop:
        for k = 0,n_elements(raw_list)-1 do begin

                print,''
                print, '································································································'
                print, '>>>> Working Image: '
                print, raw_list(k)
                print, '································································································'
                print,''

        ;extract the name from raw.list without extension:
        pic_name = STRMID(raw_list(k),0,(STRLEN(raw_list(k))-(STRLEN(image_ext))))

        ;convert sextractor file *.cat to *.csv
                spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+working_path(i)+pic_name+'.cat
                out='+working_path(i)+pic_name+'.csv'

        ;read the sextractor file *.csv
                readcol,working_path(i)+pic_name+'.csv',f='f,f,f,f,f,d,d,d,d,f,f,f,f,f,i,i', MAG_ISOCOR , MAGERR_ISOCOR ,
                FLUX_AUTO , FLUXERR_AUTO , SNR_WIN  , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY , DELTAWIN_SKY, AWIN_IMAGE ,
                BWIN_IMAGE , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE, FLAGS , FLAGS_WEIGHT, delimiter=','

        ;compute the mean AWIN_IMAGE and BWIN_IMAGE value of each image:
                mean_A = mean(AWIN_IMAGE)
        mean_B = mean(BWIN_IMAGE)
        ratio = mean_B/mean_A

        m_SNR = 0
        n_SNR = 0
        for m = 0, n_elements(SNR_WIN)-1 do begin
            if SNR_WIN(m) lt 10000 then begin
                m_SNR = m_SNR + SNR_WIN(m)
```

```
                n_SNR = n_SNR + 1
            endif
        endfor
        mean_SNR = m_SNR/n_SNR

        num = n_elements(SNR_WIN)

        info = [[info],[string(raw_list(k)),string(num),string(mean_SNR),string(ratio)]]

        endfor

    num_max = max(info[1,*])
    SNR_max = max(info[2,*])
    ratio_max = max(info[3,*])

    ;create output file with the best images to process:
        openw,1, working_path(i)+'checked.list'
    openw,2, working_path(i)+'removed.list'
    printf,2,' Image_Name , Num_Sources , SNR , Aspect_Ratio '
    word_max='MAX. VALUES'
    printf,2, word_max , num_max , SNR_max , ratio_max, f='(a,",",d,",",d,",",d)'

    counter = 0
    trigger = 0
    for j = 0,n_elements(info[0,*])-1 do begin
        if (info[1,j] gt ((1-perc_sources)*num_max)) and (info[2,j] gt ((1-perc_snr)*SNR_max)) and (info[3,j] gt
        ((1-perc_ratio)*ratio_max))  then begin
            printf,1, info[0,j] , f='(a)'
        endif else begin
            trigger = 1
            counter = counter + 1
            printf,2, info[0,j] , info[1,j] , info[2,j] , info[3,j] , f='(a,",",d,",",d,",",d)'
        endelse
    endfor
    close, 1, 2

    if trigger eq 1 then begin
        alarm = 1
        alert = [[alert],[string(working_path(i)),string(counter)]]
    endif

endfor

if alarm eq 1 then begin
    print,''
    print, '·································································································'
    print, '>>>> SOME IMAGES WERE REMOVED. Please take a look at the following directories: '
    print, alert[0,*]+' # images: '+alert[1,*]
    print, '·································································································'
    print,''
endif

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '··························· END: QUALITY.PRO SCRIPT ·····························'
print, '#################################################################################'
print,''

end
```

```
;########################################################################################
;# File Name:           astrometric.pro                                                #
;# Description:         Astrometric calibration of the data.                           #
;# Last revision:       24/07/2018                                                     #
;#                                                                                     #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                  #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                   #
;#                                                                                     #
;# Inputs               configurations.txt                                             #
;#                      working_path.txt                                               #
;#                      checked.list    (one file per dataset)                         #
;#                      settings_astrometric.sex                                       #
;#                      settings.scamp                                                 #
;#                      settings.miss                                                  #
;#                                                                                     #
;# Outputs:             (calibrated images)                                            #
;#                                                                                     #
;########################################################################################

print,''
print, '################################################################################'
print, '························ BEGIN: ASTROMETRIC.PRO SCRIPT ··························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1, 2

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
    print, '································································································'
    print, '>>>> Working Folder: '
    print, working_path(i)
    print, '································································································'
    print,''

    ;read checked list with images/data name:
    readcol,working_path(i)+'checked.list',f='a', checked_list, delimiter = ','

    ;working image loop:
    for k = 0,n_elements(checked_list)-1 do begin

        print,''
        print, '································································································'
        print, '>>>> Working Image: '
        print, checked_list(k)
        print, '································································································'
        print,''

        ;image header:
        hdr = headfits(working_path(i)+checked_list(k))

        ;calculate center xy coordinates:
        xaxis_cen = sxpar(hdr,'NAXIS1')/2
        yaxis_cen = sxpar(hdr,'NAXIS2')/2

        ;extract current RA/DEC coordinates:
        ra = sxpar(hdr,'OBJCTRA')
        dec = sxpar(hdr,'OBJCTDEC')

        ra_array = strsplit(ra,' ',/EXTRACT)
        dec_array = strsplit(dec,' ',/EXTRACT)

        ;convert RA/DEC coordinates to degrees:
        ra_deg = (double(ra_array[0]) + double(ra_array[1])/60.0 + double(ra_array[2])/3600.0)*15.0

        if dec_array[0] ge 0 then begin
            dec_deg = (double(dec_array[0]) + double(dec_array[1])/60.0 + double(dec_array[2])/3600.0)
        endif else begin
            dec_deg = (double(dec_array[0]) - double(dec_array[1])/60.0 - double(dec_array[2])/3600.0)
        endelse

        ;write the astrometric standard reference solution:
        sxaddpar,hdr,'HISTORY','Astrometric standard reference solution'
        sxaddpar,hdr,'EQUINOX', 2000, 'Mean equinox'
        sxaddpar,hdr,'CTYPE1', 'RA---TAN','WCS projection type for this axis'
        sxaddpar,hdr,'CTYPE2','DEC--TAN','WCS projection type for this axis'
        sxaddpar,hdr,'LONPOLE',180
        sxaddpar,hdr,'LATPOLE',0
        sxaddpar,hdr,'CUNIT1','deg     ','Axis unit'
        sxaddpar,hdr,'CUNIT2','deg     ','Axis unit'
        sxaddpar,hdr,'CRVAL1',ra_deg,'World coordinate on this axis'
        sxaddpar,hdr,'CRVAL2',dec_deg,'World coordinate on this axis'
        sxaddpar,hdr,'CRPIX1',xaxis_cen,'Reference pixel on this axis'
        sxaddpar,hdr,'CRPIX2',yaxis_cen,'Reference pixel on this axis'
        sxaddpar,hdr,'CD1_1',-0.001,'Linear projection matrix'
        sxaddpar,hdr,'CD1_2',0.00005,'Linear projection matrix'
        sxaddpar,hdr,'CD2_1',0.00005,'Linear projection matrix'
        sxaddpar,hdr,'CD2_2',0.001,'Linear projection matrix'

        modfits,working_path(i)+checked_list(k),0,hdr
        endfor
```

```
    ;Using Sextractor to extract sources:
    for k = 0,n_elements(checked_list)-1 do begin
        pic_name = STRMID(checked_list(k),0,(STRLEN(checked_list(k))-(STRLEN(image_ext))))
        spawn, 'sex '+working_path(i)+checked_list(k)+' -c settings_astrometric.sex'
        spawn, 'mv sex.cat '+working_path(i)+pic_name+'.cat'
    endfor

    ;Using Scamp to perform the astrometric calibration:
    for k = 0,n_elements(checked_list)-1 do begin
        pic_name = STRMID(checked_list(k),0,(STRLEN(checked_list(k))-(STRLEN(image_ext))))
        spawn, 'scamp '+working_path(i)+pic_name+'.cat -c settings.scamp'
    endfor

    ;Using MISSFITS to add the Scamp astrometric solution for all images:
    for k = 0,n_elements(checked_list)-1 do begin
        pic_name = STRMID(checked_list(k),0,(STRLEN(checked_list(k))-(STRLEN(image_ext))))
        spawn, 'missfits '+working_path(i)+checked_list(k)+' -c settings.miss'
    endfor

    spawn, 'rm -f '+working_path(i)+'*.head'
    spawn, 'rm -f '+working_path(i)+'*.fits'
    spawn, 'rm -f '+working_path(i)+'*.par'
    spawn, 'rm -f '+working_path(i)+'*.pl'


endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '························· END: ASTROMETRIC.PRO SCRIPT ···························'
print, '#################################################################################'
print,''

end
```

```
;#########################################################################################
;# File Name:           sextractor.pro                                                   #
;# Description:         Extract the sources contained in the images/data. Sextractor is #
;#                      an external software from Astromatic.net                         #
;# Last revision:       04/07/2018                                                       #
;#                                                                                       #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                    #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                     #
;#                                                                                       #
;# Inputs               configurations.txt                                               #
;#                      working_path.txt                                                 #
;#                      checked.list                                                     #
;#                                                                                       #
;# Outputs:             *.cat (one file per image/data)                                  #
;#                                                                                       #
;#########################################################################################

print,''
print, '##################################################################################'
print, '························· BEGIN: SEXTRACTOR.PRO SCRIPT ·························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
        print, '·································································'
        print, '>>>> Working Folder: '
        print, working_path(i)
        print, '·································································'
        print,''

    ;read checked.list with images/data name:
    readcol,working_path(i)+'checked.list',f='a', checked_list, delimiter = ','

    ;working image loop:
        for k = 0,n_elements(checked_list)-1 do begin

        print,''
            print, '·································································'
            print, '>>>> Working Image: '
            print, checked_list(k)
            print, '·································································'
            print,''

        ;extract the name from checked.list without extension:
                pic_name = STRMID(checked_list(k),0,(STRLEN(checked_list(k))-(STRLEN(image_ext))))

        ;using Sextractor to extract sources with new astrometric solution:
            spawn, 'sex '+working_path(i)+checked_list(k)+' -c settings.sex'
                spawn, 'mv sex.cat '+working_path(i)+pic_name+'.cat'
        endfor

endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '·························· END: SEXTRACTOR.PRO SCRIPT ··························'
print, '##################################################################################'
print,''

end
```

```
;#########################################################################################
;# File Name:           sigma.pro                                                        #
;# Description:         Choose the best SNR images from the dataset, but not             #
;#                      consecutive images. Interval between images defined in the       #
;#                      configurations file with the keyword "INTERVAL".                 #
;# Last revision:       05/07/2018                                                       #
;#                                                                                       #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                    #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                     #
;#                                                                                       #
;# Inputs               configurations.txt                                               #
;#                      working_path.txt                                                 #
;#                      checked.list    (one file per dataset)                           #
;#                      *.cat       (one file per image/data)                            #
;#                                                                                       #
;# Outputs:             best_SNR.list                                                    #
;#                      sigma.txt                                                        #
;#                                                                                       #
;#                      *.csv           (convert from *.cat input)                       #
;#                                                                                       #
;#########################################################################################

print,''
print, '##################################################################################'
print, '·························· BEGIN: SIGMA.PRO SCRIPT ·····························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1, 2

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
interval = values(WHERE(STRMATCH(keywords, 'INTERVAL', /FOLD_CASE) EQ 1))
;change from array to int scalar:
interval=fix(interval[0])

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
        print, '···································································'
        print, '>>>> Working Folder: '
        print, working_path(i)
        print, '···································································'
        print,''

    ;read checked list with images/data name:
        readcol,working_path(i)+'checked.list',f='a', checked_list, delimiter = ','

    ;array to save SNR values of each image:
        SNR = []

    ;working image loop:
        for k = 0,n_elements(checked_list)-1 do begin

                print,''
                print, '···································································'
                print, '>>>> Working Image: '
                print, checked_list(k)
                print, '···································································'
                print,''

        ;extract the name from checked.list without extension:
        pic_name = STRMID(checked_list(k),0,(STRLEN(checked_list(k))-(STRLEN(image_ext))))

        ;convert sextractor file *.cat to *.csv
                spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+working_path(i)+pic_name+'.cat out='+working_path(i)+pic_name+'.csv'

        ;read the sextractor file *.csv
                readcol,working_path(i)+pic_name+'.csv',f='f,f,f,f,f,d,d,d,d,f,f,f,i,i', MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN  , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY , DELTAWIN_SKY,ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE, FLAGS , FLAGS_WEIGHT, delimiter=','

        ;compute the mean SNR value of each image and save it if it's lower than 10.000:
        ;############# why 10.000?????????????????????????????????????????????????????????????????
                mean_SNR = mean(SNR_WIN)
                if (mean_SNR lt 10000) then begin
                    SNR = [[SNR],[mean_SNR,k]]
                endif

        endfor

    ;sort SNR array from the best SNR value image to the worst SNR image:
    SNR_sort_index = reverse(sort(SNR[0,*]))
        for j=0,1 DO SNR[j,*] = SNR[j, SNR_sort_index]

    ;choose the best SNR images, but not consecutive images. choose te best one and then remove the images before and after in a defined interval:
        for l=0,n_elements(SNR[1,*])-1 do begin

        ;define SNR value and image index variables:
        SNR_value = SNR((0),(l))
                SNR_index = SNR((1),(l))

        ;working only with SNR values greater than 0:
```

```
        ;############## why 10.000??????????????????????????????????????????????????????????????????????
                if SNR_value gt 0 then begin

            ;remove consecutive images after the selected image:
                        for m = SNR_index+1, SNR_index+interval, 1 do begin
                                rem_index=where(SNR[1,*] eq m)

                ;if image index is less than 0, means no pictures before:
                                if rem_index gt 0 then begin
                                        d_row = where(SNR[1,*] eq m)
                                        ;consecutive images defined with SNR=0:
                    SNR[[0],[d_row]]=0
                                endif

                        endfor

            ;remove consecutive images before the selected image:
                        for n = SNR_index-1, SNR_index-interval, -1 do begin
                                rem_index=where(SNR[1,*] eq n)

                ;if image index is less than 0, means no pictures before:
                                if rem_index gt 0 then begin
                                        d_row = where(SNR[1,*] eq n)
                                        ;consecutive images defined with SNR=0:
                    SNR[[0],[d_row]]=0
                                endif
                        endfor
                endif
        endfor

    ;sort SNR array from the best SNR value image to the worst SNR image:
    SNR_sort_index = reverse(sort(SNR[0,*]))
        for o=0,1 DO SNR[o,*] = SNR[o, SNR_sort_index]

    ;create output file with the best images to process:
        openw,1, working_path(i)+'best_SNR.list'

    ;to count number of selected images:
    count=0

        ;write to the output file:
        for p = 0,n_elements(SNR[1,*])-1 do begin

                pic_index = SNR((1),(p))

        ;write images only with SNR greater than 0:
                if SNR[0,p] gt 0 then begin
                count = count+1
                printf,1,checked_list(pic_index)
                endif
        endfor
        close, 1

    print,''
        print, '..........................................................................'
        print, '>>>> Number of Selected Images: '
        print, count
        print, '..........................................................................'
        print,''


    ;compute the best SNR image to extract the cross-match error for the next script:
    ;choose the best SNR image to process:
    pic_main = checked_list(SNR((1),(0)))

    ;extract the name of the image without extension:
    pic_main = STRMID(checked_list(SNR((1),(0))),0,(STRLEN(checked_list(SNR((1),(0))))-(STRLEN(image_ext))))

    ;cross-match the main image with Gaia Dr2:
    spawn,'java -jar -Xmx1200m '+pathstilts+' cdsskymatch ifmt=votable in='+working_path(i)+pic_main+'.cat ra="ALPHAWIN_SKY"
    dec="DELTAWIN_SKY" radius=2.5 cdstable=I/345/gaia2 find=best out='+working_path(i)+'sigma_cross.xml ofmt=votable'

    ;compute statistics of the cross-mathed result:
        spawn,'java -jar -Xmx1200m '+pathstilts+' tpipe ifmt=votable in='+working_path(i)+'sigma_cross.xml cmd='+"'"+ 'stats
        Name StDev'+"'"+' ofmt=csv-noheader out='+working_path(i)+'sigma_stats.csv'

    ;read the computed statistics (StDev):
        readcol,working_path(i)+'sigma_stats.csv',f='a,d', name, StDev, delimiter=','

    ;compute the sigma = 3*StDev:
        n_table=n_elements(name)-1
        sigma_error = StDev(n_table)*3

    ;create an output file with the sigma result:
        openw, 2, working_path(i)+'sigma.txt'
        printf, 2, sigma_error,f='(d)'
        close, 2

    print,''
        print, '..........................................................................'
        print, '>>>> Sigma Value: '
        print, name(n_table), StDev(n_table)
        print, sigma_error
        print, '..........................................................................'
        print,''

    ;remove unnecessary files:
    spawn,'rm '+working_path(i)+'sigma_cross.xml'
    spawn,'rm '+working_path(i)+'sigma_stats.csv'

endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '........................... END: SIGMA.PRO SCRIPT .............................'
```

```
print, '####################################################################################'
print,''

end
```

```
;#################################################################################
;# File Name:           star.pro                                                 #
;# Description:         Create 2 catalogues: one of non-moving sources (stars) and      #
;#                      another of moving sources (asteroids, single pixels)     #
;# Last revision:       05/07/2018                                               #
;#                                                                               #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano            #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                             #
;#                                                                               #
;# Inputs               configurations.txt                                       #
;#                      working_path.txt                                         #
;#                      checked.list                                             #
;#                      sigma.txt                                                #
;#                      best_SNR.txt                                             #
;#                      stars-ini.xml                                            #
;#                      single-ini.xml                                           #
;#                                                                               #
;# Outputs:             log-images.txt                                           #
;#                      stars.xml                                                #
;#                      single.xml                                               #
;#                                                                               #
;#################################################################################

print,''
print, '##################################################################################'
print, '····························· BEGIN: STAR.PRO SCRIPT ·····························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
        print, '··································································································'
        print, '>>>> Working Folder: '
        print, working_path(i)
        print, '··································································································'
        print,''

    ;read checked list with images/data name:
    readcol,working_path(i)+'checked.list',f='a', checked_list, delimiter = ','

    ;read sigma value:
        readcol, working_path(i)+'sigma.txt', f='a', sigma_error
        error = sigma_error(0)

    ;copy star initial tables for catalogues to the working path:
        spawn,'cp '+pathroot+'stars-ini.xml '+working_path(i)+'stars.xml'
        spawn,'cp '+pathroot+'single-ini.xml '+working_path(i)+'single.xml'

    ;read best_SNR.list with the images to compute and create the catalogues:
    readcol,working_path(i)+'best_SNR.list',f='a', best_SNR, delimiter = ','

    ;create a file (log-images.txt) with name, ra/dec center coordinates and JD_mid:
        openw, 1, working_path(i)+'log-images.txt'


    ;working image loop:
        for k = 0,n_elements(checked_list)-1 do begin

        print,''
            print, '··································································································'
            print, '>>>> Working Image: '
            print, checked_list(k)
            print, '··································································································'
            print,''

        ;extract the name from checked.list without extension:
                pic_name = STRMID(checked_list(k),0,(STRLEN(checked_list(k))-(STRLEN(image_ext))))

        ;read image header:
        hdr = headfits(working_path(i)+checked_list(k),exten=0)

        ;calculate JD_mid:
                date = fxpar(hdr,'DATE-OBS')
                date_obs = double(date_conv(fxpar(hdr,'DATE-OBS'),'R'))
                exptime = double(fxpar(hdr,'EXPTIME'))/24./60/60
                date_end = double(date_obs+exptime)
                mid_jd =
                strcompress(string(format='(f17.7)',double((double(date_conv(fxpar(hdr,'DATE-OBS'),'J'))+double(date_conv(date_
                end,'J')))/2)),/remove_all)

        ;calculate RA/DEC center coordinates:
                xaxis_cen = sxpar(hdr,'NAXIS1')/2
                yaxis_cen = sxpar(hdr,'NAXIS2')/2
                xyad,hdr,xaxis_cen,yaxis_cen,ra,dec
                ra_cen= strcompress(ra,/remove_all)
                dec_cen= strcompress(dec,/remove_all)

                ;write to log-images file:
                printf, 1, checked_list(k)+','+ra_cen+','+dec_cen+','+mid_jd
```

```
    print,''
            print, '................................................................................'
            print, '>>>> Calculated Values: '
            print, '>>>> Mid Julian DATE: ' + mid_jd
    print, '>>>> RA Center Coordinates: '+ ra_cen
            print, '>>>> DEC Center Coordinates: '+ dec_cen
    print, '................................................................................'
            print,''
endfor

;close log-images file:
close, 1

;working image loop for best_SNR.list:
    for l = 0,n_elements(best_SNR)-1 do begin

    print,''
            print, '................................................................................'
            print, '>>>> Working Image: '
            print, best_SNR(l)
            print, '................................................................................'
            print,''

    ;extract the name from best_SNR.list without extension:
            pic_name = STRMID(best_SNR(l),0,(STRLEN(best_SNR(l))-(STRLEN(image_ext))))

            ;read image header:
            hdr = headfits(working_path(i)+best_SNR(l),exten=0)

    ;cross-match sextractor catalog with stars.xml table to verify if sex.cat contain only stars:
            spawn,'java -jar -Xmx2400m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=votable ra1="ALPHAWIN_SKY"
            dec1="DELTAWIN_SKY" ra2="ALPHAWIN_SKY" dec2="DELTAWIN_SKY" error='+error+' join=1not2 find=best
            in1='+working_path(i)+pic_name+'.cat'+' in2='+working_path(i)+'stars.xml out='+working_path(i)+'single1.xml'

    ;verify if "single1" is empty > if yes, sex.cat only contains stars and proceed to next image:
            spawn,'grep -c "TR" '+working_path(i)+'single1.xml > '+working_path(i)+'lsingle1.txt'
            readcol, working_path(i)+'lsingle1.txt',f='f',nlines1,/silent
            spawn,'rm '+working_path(i)+'lsingle1.txt'
            if (nlines1(0) eq 0) then begin
        print,''
                print, '................................................................................'
                print, '>>>> Sex.cat only contains stars > next image.'
                print, '................................................................................'
                print,''

        ;remove unnecessary files:
        spawn,'rm '+working_path(i)+'single1.xml'

        ;jump to next image:
                    goto, next_image

            ;if not, there are other objects:
            endif else begin
        print,''
                    print, '................................................................................'
                    print, '>>>> Sex.cat containes different objects.'
                    print, '................................................................................'
                    print,''

            endelse

    ;cross-match single1 with single.xml table to verify if any source is repeated and can be a star:
            spawn,'java -jar -Xmx2400m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=votable ra1="ALPHAWIN_SKY"
            dec1="DELTAWIN_SKY" ra2="ALPHAWIN_SKY" dec2="DELTAWIN_SKY" error='+error+' join=1and2 find=best
            in1='+working_path(i)+'single1.xml in2='+working_path(i)+'single.xml out='+working_path(i)+'stars1.xml'

            ;verify if "stars1" is empty > if yes, only single sources:
            spawn,'grep -c "TR" '+working_path(i)+'stars1.xml > '+working_path(i)+'lstars1.txt'
            readcol,working_path(i)+'lstars1.txt',f='f',nlines1,/silent
            spawn,'rm '+working_path(i)+'lstars1.txt'
            if (nlines1(0) eq 0) then begin
                    print,''
                    print, '................................................................................'
                    print, '>>>> Only Singles.'
                    print, '................................................................................'
                    print,''

        ;concatenate tables:
            spawn,'java -jar -Xmx2400m '+pathstilts+' tcat in='+working_path(i)+'single.xml
            in='+working_path(i)+'single1.xml out='+working_path(i)+'single-new.xml'

        ;remove unnecessary files:
            spawn,'rm '+working_path(i)+'single1.xml'
                    spawn,'rm '+working_path(i)+'single.xml'

    ;if not, there are other objects:
            endif else begin
            print,''
                    print, '................................................................................'
                    print, '>>>> More than Singles. Add new Stars.'
                    print, '................................................................................'
                    print,''

        ;edit table:
                    spawn,'java -jar -Xmx2500m '+pathstilts+' tpipe ifmt=votable in='+working_path(i)+'stars1.xml
                    cmd='+"'"+ 'addcol MAG_ISOCOR '+'"'+'MAG_ISOCOR_1'+'"'+"'"+' cmd='+"'"+ 'addcol MAGERR_ISOCOR
                    '+'"'+'MAGERR_ISOCOR_1'+'"'+"'"+' cmd='+"'"+ 'addcol FLUX_AUTO '+'"'+'FLUX_AUTO_1'+'"'+"'"+'
                    cmd='+"'"+ 'addcol FLUXERR_AUTO '+'"'+'FLUXERR_AUTO_1'+'"'+"'"+' cmd='+"'"+ 'addcol SNR_WIN
                    '+'"'+'SNR_WIN_1'+'"'+"'"+' cmd='+"'"+ 'addcol XWIN_IMAGE '+'"'+'XWIN_IMAGE_1'+'"'+"'"+' cmd='+"'"+
                    'addcol YWIN_IMAGE '+'"'+'YWIN_IMAGE_1'+'"'+"'"+' cmd='+"'"+ 'addcol ALPHAWIN_SKY
                    '+'"'+'ALPHAWIN_SKY_1'+'"'+"'"+' cmd='+"'"+ 'addcol DELTAWIN_SKY '+'"'+'DELTAWIN_SKY_1'+'"'+"'"+'
                    cmd='+"'"+ 'addcol ERRAWIN_IMAGE '+'"'+'ERRAWIN_IMAGE_1'+'"'+"'"+' cmd='+"'"+ 'addcol ERRBWIN_IMAGE
                    '+'"'+'ERRBWIN_IMAGE_1'+'"'+"'"+' cmd='+"'"+ 'addcol ERRTHETAWIN_IMAGE
                    '+'"'+'ERRTHETAWIN_IMAGE_1'+'"'+"'"+' cmd='+"'"+ 'addcol FLAGS '+'"'+'FLAGS_1'+'"'+"'"+' cmd='+"'"+
```

```
                        'addcol FLAGS_WEIGHT '+'"'+'FLAGS_WEIGHT_1'+'"'+"'"+' cmd='+"'"+ 'keepcols '+'"'+'MAG_ISOCOR
                        MAGERR_ISOCOR FLUX_AUTO FLUXERR_AUTO SNR_WIN XWIN_IMAGE YWIN_IMAGE ALPHAWIN_SKY DELTAWIN_SKY
                        ERRAWIN_IMAGE ERRBWIN_IMAGE ERRTHETAWIN_IMAGE FLAGS FLAGS_WEIGHT'+'"'+"'"+'
                        out='+working_path(i)+'stars2.xml ofmt=votable'

            ;new stars catalog:
                        spawn,'rm '+working_path(i)+'stars1.xml'
                        spawn,'java -jar -Xmx2400m '+pathstilts+' tcat in='+working_path(i)+'stars.xml
                        in='+working_path(i)+'stars2.xml out='+working_path(i)+'stars-new.xml'
                        spawn,'rm '+working_path(i)+'stars2.xml'
                        spawn,'rm '+working_path(i)+'stars.xml'

            ;new singles catalog:
                        print,''
                        print, '·································································.'
                        print, '>>>> Add new Singles.'
                        print, '·································································.'
                        print,''

            ;skymatch tables:
                        spawn,'java -jar -Xmx2400m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=votable ra1="ALPHAWIN_SKY"
                        dec1="DELTAWIN_SKY" ra2="ALPHAWIN_SKY" dec2="DELTAWIN_SKY" error='+error+' join=1not2 find=best
                        in1='+working_path(i)+'single1.xml in2='+working_path(i)+'single.xml
                        out='+working_path(i)+'single2.xml'
                        spawn,'java -jar -Xmx2400m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=votable ra1="ALPHAWIN_SKY"
                        dec1="DELTAWIN_SKY" ra2="ALPHAWIN_SKY" dec2="DELTAWIN_SKY" error='+error+' join=2not1 find=best
                        in1='+working_path(i)+'single1.xml in2='+working_path(i)+'single.xml
                        out='+working_path(i)+'single3.xml'
                        spawn,'java -jar -Xmx2400m '+pathstilts+' tcat in='+working_path(i)+'single2.xml
                        in='+working_path(i)+'single3.xml out='+working_path(i)+'single4.xml'
                        spawn,'java -jar -Xmx2400m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=votable ra1="ALPHAWIN_SKY"
                        dec1="DELTAWIN_SKY" ra2="ALPHAWIN_SKY" dec2="DELTAWIN_SKY" error='+error+' join=1not2 find=all
                        in1='+working_path(i)+'single4.xml in2='+working_path(i)+'stars-new.xml
                        out='+working_path(i)+'single-new.xml'

            ;remove unnecessary files:
                        spawn,'rm '+working_path(i)+'single.xml'
                        spawn,'rm '+working_path(i)+'single1.xml'
                        spawn,'rm '+working_path(i)+'single2.xml'
                        spawn,'rm '+working_path(i)+'single3.xml'
                        spawn,'rm '+working_path(i)+'single4.xml'

                endelse

        ;verify repeated objects between single-new catalog and stars-new catalog:
                spawn,'java -jar -Xmx2400m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=votable ra1="ALPHAWIN_SKY"
                dec1="DELTAWIN_SKY" ra2="ALPHAWIN_SKY" dec2="DELTAWIN_SKY" error='+error+' join=1and2 find=best
                in1='+working_path(i)+'single-new.xml in2='+working_path(i)+'stars-new.xml out='+working_path(i)+'test.xml'

                ;verify if "test" is empty > if no, mistake:
                spawn,'grep -c "TR" '+working_path(i)+'test.xml > '+working_path(i)+'ltest.txt'
                readcol,working_path(i)+'ltest.txt',f='f',nlines1,/silent
                spawn,'rm '+working_path(i)+'ltest.txt'
                if (nlines1(0) ne 0) then begin
                    print,''
                        print, '·································································.'
                        print, '>>>> FATAL ERROR. Single and stars catalogues have repeated sources'
                        print, '·································································.'
                        print,''

            ;jump to mistake:
                        goto, mistake
                endif

        ;remove unnecessary files:
        spawn,'rm '+working_path(i)+'test.xml'

next_image:
                ;if yes, set new catalogues:
                spawn,'mv '+working_path(i)+'stars-new.xml '+working_path(i)+'stars.xml'
                spawn,'mv '+working_path(i)+'single-new.xml '+working_path(i)+'single.xml'
    endfor

endfor

mistake:

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '······························ END: STAR.PRO SCRIPT ·····························'
print, '################################################################################'
print,''

end
```

```
;########################################################################################
;# File Name:           mag.pro                                                       #
;# Description:         Calibrate the star magnitude with Gaia DR2 cataloque.          #
;#                      Create an output file with the magnitude limit of each image.  #
;# Last revision:       10/07/2018                                                     #
;#                                                                                     #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                  #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                   #
;#                                                                                     #
;# Inputs               configurations.txt                                             #
;#                      working_path.txt                                               #
;#                      log-images.txt                                                 #
;#                      *.cat       (one file per image/data)                          #
;#                                                                                     #
;# Outputs:             maglimit.txt                                                   #
;#                      *_sex-cal.csv   (one file per log-image)                       #
;#                                                                                     #
;########################################################################################

print,''
print, '################################################################################'
print, '····························· BEGIN: MAG.PRO SCRIPT ·····························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))
error_gaia = values(WHERE(STRMATCH(keywords, 'ERROR_GAIA', /FOLD_CASE) EQ 1))
mag_min = values(WHERE(STRMATCH(keywords, 'MAG_MIN', /FOLD_CASE) EQ 1))
mag_max = values(WHERE(STRMATCH(keywords, 'MAG_MAX', /FOLD_CASE) EQ 1))
;change from array to int scalar:
mag_min=fix(mag_min[0])
mag_max=fix(mag_max[0])

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

        print,''
        print, '·································································'
        print, '>>>> Working Folder: '
        print, working_path(i)
        print, '·································································'
        print,''

    ;read information inside log-images.txt:
        readcol, working_path(i)+'log-images.txt',f='a,a,a,a', log_pic, ra_cen, dec_cen, mid_jd, delimiter=','

    ;coordinates for the vizier service to get the Gaia DR2 catalogue:
    ra_cen_viz = string(ra_cen(0))
        dec_cen_viz = string(dec_cen(0))

    ;convert dec coordinates for a readable format by vizier:
    if dec_cen_viz lt 0 then begin
                coord_viz=ra_cen_viz+dec_cen_viz
        endif else begin
                coord_viz=ra_cen_viz+'+'+dec_cen_viz
        endelse

    ;ask vizier for the catalogue:
        spawn,'vizquery -mime=votable -source=I/345/gaia2 -c='+coord_viz+' -c.rd=1.5 -out.max=unlimited >
        '+working_path(i)+'gaia_cat.csv'

    ;change columns position to be more easy to work:
        spawn,'java -jar -Xmx2400m '+pathstilts+' tpipe ifmt=votable  in='+working_path(i)+'gaia_cat.csv cmd='+"'"+'addcol
        -before Source Gmag1 '+'"'+'Gmag'+'"'+"'"+' cmd='+"'"+'addcol -before Source e_Gmag1 '+'"'+'e_Gmag'+'"'+"'"+'
        cmd='+"'"+'delcols '+'"'+'Gmag'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'e_Gmag'+'"'+"'"+'
        out='+working_path(i)+'gaia_cat2.csv'

    ;create a file to write the magnitude limit of each image:
        openw,1,working_path(i)+'maglimit.txt'

        ;working image loop:
        for k = 0,n_elements(log_pic)-1 do begin

                print,''
                print, '·································································'
                print, '>>>> Working Image: '
                print, log_pic(k)
                print, '·································································'
                print,''

        ;extract the name from log list without extension:
                pic_name = STRMID(log_pic(k),0,(STRLEN(log_pic(k))-(STRLEN(image_ext))))

                ;cross sextractor catalog with Gaia DR2:
        spawn,'java -jar -Xmx7000m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=csv in1='+working_path(i)+pic_name+'.cat
        in2='+working_path(i)+'gaia_cat2.csv ra1="ALPHAWIN_SKY" dec1="DELTAWIN_SKY" ra2="RA_ICRS" dec2="DE_ICRS"
        error='+error_gaia+' join=1and2 find=best out='+working_path(i)+pic_name+'_gaia.csv ofmt=csv'

        ;read cross result file:

        readcol,working_path(i)+pic_name+'_gaia.csv',f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,f,d,f,f,f',mag_isocor,MAGERR_ISOCOR,FLUX_
        AUTO,FLUXERR_AUTO,SNR_WIN,XWIN_IMAGE,YWIN_IMAGE,ALPHAWIN_SKY,DELTAWIN_SKY,ERRAWIN_IMAGE,ERRBWIN_IMAGE,ERRTHETAWIN_IMAGE
        ,FLAGS,FLAGS_WEIGHT,RA_ICRS,e_RA_ICRS,DE_ICRS,e_DE_ICRS,mag,e_mag, delimiter=','
```

```
;filter flagged sources by SExtractor:
remove_array = []
for q = 0,n_elements(mag_isocor)-1 do begin
    if (FLAGS(q) eq 1) or (FLAGS(q) eq 2) or (FLAGS(q) eq 3) or (FLAGS(q) eq 4) or (FLAGS(q) eq 5) or (FLAGS(q) eq 6)
    or (FLAGS(q) eq 7) or (FLAGS(q) eq 8) or (FLAGS(q) eq 9) or (FLAGS(q) eq 10) or (FLAGS(q) eq 11) or (FLAGS(q) eq
    12) or (FLAGS(q) eq 13) or (FLAGS(q) eq 14) or (FLAGS(q) eq 15) or (FLAGS(q) eq 17) or (FLAGS(q) eq 18) or
    (FLAGS(q) eq 19) or (FLAGS(q) eq 20) or (FLAGS(q) eq 21) or (FLAGS(q) eq 22) or (FLAGS(q) eq 23) or (FLAGS(q) eq
    24) or (FLAGS(q) eq 25) or (FLAGS(q) eq 26) or (FLAGS(q) eq 27) or (FLAGS(q) eq 28) or (FLAGS(q) eq 29) or
    (FLAGS(q) eq 30) or (FLAGS(q) eq 31) then begin
        remove_array = [[remove_array],[q]]
    endif
endfor

remove, remove_array, mag_isocor , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE ,
ALPHAWIN_SKY , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , RA_ICRS ,
e_RA_ICRS , DE_ICRS , e_DE_ICRS , mag , e_mag

;arrays to compute values:
mag_f=[]
mag_isocor_f=[]
e_mag_f=[]

;set the magnitude range (linear region) to calibrate the stars magnitude:
for m = 0,n_elements(mag)-1 do begin
                if (mag(m) lt mag_max and mag(m) gt mag_min) then begin
                        mag_f=[[mag_f],[mag(m)]]
        mag_isocor_f=[[mag_isocor_f],[mag_isocor(m)]]
        e_mag_f=[[e_mag_f],[e_mag(m)]]
                endif
        endfor

;calibrate the magnitude:
whl=0 & mag1=mag_f & mag_isocor1=mag_isocor_f & e_mag1=e_mag_f
while (whl eq 0) do begin
        n_var=0 & n_stars=n_elements(mag1)
        fit=LINFIT(MAG_ISOCOR1,mag1,MEASURE_ERRORS=e_mag1,SIGMA=s)
        print,n_stars,fit(0),s(0),fit(1),s(1)
        mag_iso1=MAG_ISOCOR1*fit(1)+fit(0)
        diffmag=abs(mag_iso1-mag1)
        threshold=mean(diffmag)+3*stddev(diffmag)
        for ii=0,n_stars-1 do if (diffmag(ii) gt threshold) then n_var=n_var+1
        if (n_var ne 0) then begin
            mag_isocor2=fltarr(n_stars-n_var)
            mag2=fltarr(n_stars-n_var)
            e_mag2=fltarr(n_stars-n_var)
            jj=0
            for ii=0,n_stars-1 do begin
                    if (diffmag(ii) le threshold) then begin
                    mag_isocor2(jj)=mag_isocor1(ii)
                    mag2(jj)=mag1(ii)
                    e_mag2(jj)=e_mag1(ii)
                    jj=jj+1
                    endif
            endfor
            mag_isocor1=mag_isocor2
            mag1=mag2
            e_mag1=e_mag2
        endif else whl=1
endwhile

mag_iso=MAG_ISOCOR*fit(1)+fit(0)
er_mag_iso=sqrt((fit(1)*MAGERR_ISOCOR)^2+(MAG_ISOCOR*s(1))^2+s(0)^2)
diffmag=abs(mag_iso-mag)

mag_iso_str=strcompress(mag_iso,/remove_all)
er_mag_iso_str=strcompress(er_mag_iso,/remove_all)
mag_str=strcompress(mag,/remove_all)
e_mag_str=strcompress(e_mag,/remove_all)

pend=strcompress(fit(1),/remove_all) & erpend=strcompress(s(1),/remove_all)
ord=strcompress(fit(0),/remove_all) & erord=strcompress(s(0),/remove_all)

;add the calibrated magnitude to the sextractor catalogue:
spawn,'java -jar -Xmx2500m '+pathstilts+' tpipe ifmt=votable in='+working_path(i)+pic_name+'.cat cmd='+"'"+ 'addcol
MAG_ISOCOR_CALIBRATED '+'"'+'MAG_ISOCOR*'+pend+'+'+ord+'"'+"'"+'  cmd='+"'"+ 'addcol MAGERR_ISOCOR_CALIBRATED
'+'"'+'sqrt(pow('+pend+'*MAGERR_ISOCOR,2)+pow(MAGERR_ISOCOR*'+erpend+',2)+pow('+erord+',2))"'+"'"+'
out='+working_path(i)+pic_name+'_sex-cal.xml ofmt=votable'


;magnitude limit:
;change columns to be more easy to work:
spawn,'java -jar -Xmx2400m '+pathstilts+' tpipe ifmt=votable  in='+working_path(i)+pic_name+'_sex-cal.xml
cmd='+"'"+'delcols '+'"'+'MAG_ISOCOR'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'MAGERR_ISOCOR'+'"'+"'"+' cmd='+"'"+'delcols
'+'"'+'FLUX_AUTO'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'FLUXERR_AUTO'+'"'+"'"+' cmd='+"'"+'delcols
'+'"'+'SNR_WIN'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'XWIN_IMAGE'+'"'+"'"+' cmd='+"'"+'delcols
'+'"'+'YWIN_IMAGE'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'ALPHAWIN_SKY'+'"'+"'"+' cmd='+"'"+'delcols
'+'"'+'DELTAWIN_SKY'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'ERRAWIN_IMAGE'+'"'+"'"+' cmd='+"'"+'delcols
'+'"'+'ERRBWIN_IMAGE'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'ERRTHETAWIN_IMAGE'+'"'+"'"+' cmd='+"'"+'delcols
'+'"'+'FLAGS'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'FLAGS_WEIGHT'+'"'+"'"+' cmd='+"'"+'delcols
'+'"'+'MAGERR_ISOCOR_CALIBRATED'+'"'+"'"+' out='+working_path(i)+pic_name+'_sex-cal.csv'

;read last created file:
readcol,working_path(i)+pic_name+'_sex-cal.csv', f='d', MAG_L , delimiter=','

;compute statistics:
spawn,'java -jar -Xmx1200m '+pathstilts+' tpipe ifmt=csv in='+working_path(i)+pic_name+'_sex-cal.csv cmd='+"'"+
'stats Name Quartile3 Quartile1 NGood'+"'"+' ofmt=csv-noheader out='+working_path(i)+'stats.csv'

;read statistics:
readcol,working_path(i)+'stats.csv',f='a,f,f,i',namec,q3,q1,ngood

;compute magnitude limit:
bsize=(2*(q3-q1))/(ngood)^(0.3333333333333333)
    v=max(histogram(MAG_L,location=loc,binsize=bsize),mxpos)
```

```
            Jlimit=loc[mxpos]

        ;write the magnitude limit to the maglimit.txt file:
        printf,1, log_pic(k), Jlimit, f='(a,",",d)'
    endfor

    ;close file:
    close, 1

    ;remove unnecessary files:
    spawn,'rm '+working_path(i)+'gaia_cat2.csv'
    spawn,'rm '+working_path(i)+'*_gaia.csv'
    spawn,'rm '+working_path(i)+'stats.csv'
    spawn,'rm '+working_path(i)+'*_sex-cal.csv'

endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '······························ END: MAG.PRO SCRIPT ······························'
print, '#################################################################################'
print,''

end
```

```
;####################################################################################
;# File Name:           asteroid.pro                                                #
;# Description:         Compare the data with the Skybot service to identify know   #
;#                      asteroids.                                                  #
;# Last revision:       10/07/2018                                                  #
;#                                                                                  #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano               #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                #
;#                                                                                  #
;# Inputs               configurations.txt                                          #
;#                      working_path.txt                                            #
;#                      sigma.txt                                                   #
;#                      log-images.txt                                              #
;#                      *_sex-cal.xml                                               #
;#                                                                                  #
;# Outputs:             log-asteroid.txt                                            #
;#                      log-no-asteroid.txt                                         #
;#                      log-error.txt                                               #
;#                      log-asteroid-aftercross.txt                                 #
;#                      log-no-asteroid-aftercross.txt                              #
;#                      *_skybot.xml                                                #
;#                      *_sex-cal.xml                                               #
;#                      *_cross.xml                                                 #
;#                      *_candidates.xml                                            #
;#                      *_candidates-nostars.xml                                    #
;#                                                                                  #
;####################################################################################

print,''
print, '##################################################################################'
print, '·························· BEGIN: ASTEROID.PRO SCRIPT ··························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1, 2, 3, 4, 5, 6

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))
skybot_fov = values(WHERE(STRMATCH(keywords, 'SKYBOT_FOV', /FOLD_CASE) EQ 1))
skybot_obs = values(WHERE(STRMATCH(keywords, 'SKYBOT_OBS', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
    print, '·································································································'
    print, '>>>> Working Folder: '
    print, working_path(i)
    print, '·································································································'
    print,''

    ;read sigma value:
    readcol, working_path(i)+'sigma.txt', f='a', sigma_error
    error = sigma_error(0)

    ;read information inside log-images.txt:
    readcol, working_path(i)+'log-images.txt',f='a,a,a,a', log_pic, ra_cen, dec_cen, mid_jd, delimiter=','

    ;create output files:
    openw, 1, working_path(i)+'log-asteroid.txt'
    openw, 2, working_path(i)+'log-no-asteroid.txt'
    openw, 3, working_path(i)+'log-error.txt'
    openw, 4, working_path(i)+'log-asteroid-aftercross.txt'
    openw, 5, working_path(i)+'log-no-asteroid-aftercross.txt'

    ;working image loop:
    for k = 0,n_elements(log_pic)-1 do begin

        print,''
        print, '·································································································'
        print, '>>>> Working Image: '
        print, log_pic(k)
        print, '·································································································'
        print,''

        ;extract the name from raw.list without extension:
        pic_name = STRMID(log_pic(k),0,(STRLEN(log_pic(k))-(STRLEN(image_ext))))

        ;Skybot search to detect asteroids in the images:
        openw,6,working_path(i)+'kk.tex'

        printf,6,'http://vo.imcce.fr/webservices/skybot/conesearch?EPOCH='+mid_jd(k)+'&-loc='+skybot_obs+'&RA='+ra_cen(k)+'&DEC='+dec_cen(k)+'&-bm='+skybot_fov
        close,6
        spawn,'wget -i '+working_path(i)+'kk.tex -O '+working_path(i)+pic_name+'_skybot.xml'
        spawn,'rm '+working_path(i)+'kk.tex'

        ;check if Skybot search was succeeded:
        spawn,'grep -c "OK" '+working_path(i)+pic_name+'_skybot.xml > '+working_path(i)+'lines-skybot.txt'
        readcol,working_path(i)+'lines-skybot.txt',f='f',nlines,/silent
        spawn,'rm '+working_path(i)+'lines-skybot.txt'
        if (nlines(0) lt 1) then begin
            print,''
            print, '·································································································'
            print, '>>>> Skybot Search Error!!!'
            print, '·································································································'
```

```
        print,''
        printf, 3, log_pic(k),',',ra_cen(k),',',dec_cen(k),',',mid_jd(k)
        spawn,'rm '+working_path(i)+pic_name+'_skybot.xml'
        goto, skip
    endif

    ;check if there is any asteroid:
    spawn,'grep -c "TR" '+working_path(i)+pic_name+'_skybot.xml > '+working_path(i)+'lines-skybot-asteroids.txt'
    readcol,working_path(i)+'lines-skybot-asteroids.txt',f='f',nlines,/silent
    spawn,'rm '+working_path(i)+'lines-skybot-asteroids.txt'
    if (nlines(0) eq 0) then begin
        print,''
        print, '................................................................................'
        print, '>>>> No Asteroids in Image!!!'
        print, '................................................................................'
        print,''
        spawn,'rm '+working_path(i)+pic_name+'_skybot.xml'
        printf, 2, log_pic(k),',',ra_cen(k),',',dec_cen(k),',',mid_jd(k)
        goto,skip
    endif

    print,''
    print, '................................................................................'
    print, '>>>> Skybot Asteroids in Image.'
    print, '................................................................................'
    print,''

    ;log file with asteroid data:
    printf, 1, log_pic(k)+','+ra_cen(k)+','+dec_cen(k)+','+mid_jd(k)
skip:
endfor
close, 1, 2, 3, 6


;analyse asteroids info:
;working image loop:
for k = 0,n_elements(log_pic)-1 do begin

    print,''
    print, '................................................................................'
    print, '>>>> Working Image: '
    print, log_pic(k)
    print, '................................................................................'
    print,''

    ;extract the name from raw.list without extension:
    pic_name = STRMID(log_pic(k),0,(STRLEN(log_pic(k))-(STRLEN(image_ext))))

    ;add new column with error position:
    spawn,'java -jar -Xmx2500m '+pathstilts+' tpipe ifmt=votable in='+working_path(i)+pic_name+'_sex-cal.xml'+'
    cmd='+"'"+ 'addcol Poserr '+'"'+'0.0'+'"'+"'"+' ofmt=vot out='+working_path(i)+pic_name+'_sex-cal.xml'
    spawn,'java -jar -Xmx2500m '+pathstilts+' tpipe ifmt=votable in='+working_path(i)+pic_name+'_skybot.xml'+' cmd='+"'"+
    'addcol search_radius '+'"'+'3*sqrt(pow(ErrPos,2)+pow('+error+',2))'+'"'+"'"+' ofmt=votable
    out='+working_path(i)+pic_name+'_skybot.xml'

    ;match:
    spawn,'java -jar -Xmx1200m '+pathstilts+' tmatch2 matcher=skyerr values2="_RAJ2000 _DECJ2000 search_radius"
    in2='+working_path(i)+pic_name+'_skybot.xml values1="ALPHAWIN_SKY DELTAWIN_SKY Poserr"
    in1='+working_path(i)+pic_name+'_sex-cal.xml params=1 find=best out='+working_path(i)+pic_name+'_cross.xml
    ofmt=votable'

    ;add columns with image name and JD_mid:
    spawn,'java -jar -Xmx2500m '+pathstilts+' -disk tpipe in='+working_path(i)+pic_name+'_cross.xml cmd='+"'"+'addcol
    Image '+'\"'+log_pic(k)+'\"'+"'"+' cmd='+"'"+'addcol JD '+'"'+mid_jd(k)+'"'+"'"+'
    out='+working_path(i)+pic_name+'_candidates.xml'

    ;check asteroid cadidates:
    spawn,'grep -c "<TR>" '+working_path(i)+pic_name+'_candidates.xml > lines-detected.txt'
    readcol,'lines-detected.txt',f=f,n_astecand,/silent
    spawn,'rm lines-detected.txt'
    if (n_astecand(0) eq 0) then begin
        print,''
        print, '................................................................................'
        print, '>>>> Asteroid Candidate Not Detected.'
        print, '................................................................................'
        print,''
        printf, 5, log_pic(k),' ASTEROID CANDIDATE NO DETECTED '
        goto, skipcross
    endif

    ;if cross file is not empty, check if they can be stars:
    spawn,'java -jar -Xmx7000m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=votable
    in1='+working_path(i)+pic_name+'_candidates.xml in2='+working_path(i)+'stars.xml ra1="ALPHAWIN_SKY"
    dec1="DELTAWIN_SKY" ra2="ALPHAWIN_SKY" dec2="DELTAWIN_SKY" error='+error+' join=1not2 find=all
    out='+working_path(i)+pic_name+'_candidates-nostars.xml ofmt=votable'

    ;check asteroids candidates:
    spawn,'grep -c "<TR>" '+working_path(i)+pic_name+'_candidates-nostars.xml > lines-nostars.txt'
    readcol,'lines-nostars.txt',f=f,n_nostars,/silent
    spawn,'rm lines-nostars.txt'
    if (n_nostars(0) eq 0) then begin
        print,''
        print, '................................................................................'
        print, '>>>> Asteroid Candidates were Stars.'
        print, '................................................................................'
        print,''
        printf,5,log_pic(k),' ASTEROID CANDIDATES WERE STARS '
        goto, skipcross
    endif

    print,''
    print, '................................................................................'
    print, '>>>> Asteroids Founded.'
    print, '................................................................................'
    print,''
```

```
        printf, 4, log_pic(k),',',ra_cen(k),',',dec_cen(k),',',mid_jd(k)

    skipcross:

    endfor
    close, 4, 5

endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '··························· END: ASTEROID.PRO SCRIPT ···························'
print, '################################################################################'
print,''

end
```

```
;##########################################################################################
;# File Name:            starcatg.pro                                                     #
;# Description:          Prepare the stars catalogues for the next "conct" script, that   #
;#                       removes asteroid positions close to stars.                       #
;# Last revision:        10/07/2018                                                       #
;#                                                                                        #
;# Author:               Cédric Pereira, Miriam Cortes, Enrique Solano                    #
;# Affiliation:          CAB (CSIC-INTA) & ESA - 2018                                     #
;#                                                                                        #
;# Inputs                configurations.txt                                               #
;#                       working_path.txt                                                 #
;#                       stars.xml                                                        #
;#                       gaia_cat.csv                                                     #
;#                                                                                        #
;# Outputs:              stars_cat.txt                                                    #
;#                       *_gaia_cat.txt                                                   #
;#                                                                                        #
;##########################################################################################

print,''
print, '##########################################################################################'
print, '························· BEGIN: STARCATG.PRO SCRIPT ·························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))
gaia_error = values(WHERE(STRMATCH(keywords, 'GAIA_ERROR', /FOLD_CASE) EQ 1))
star_mag = values(WHERE(STRMATCH(keywords, 'STAR_MAG', /FOLD_CASE) EQ 1))
star_radius_big = values(WHERE(STRMATCH(keywords, 'STAR_RADIUS_BIG', /FOLD_CASE) EQ 1))
star_radius_small = values(WHERE(STRMATCH(keywords, 'STAR_RADIUS_SMALL', /FOLD_CASE) EQ 1))
gaia_mag = values(WHERE(STRMATCH(keywords, 'GAIA_MAG', /FOLD_CASE) EQ 1))
gaia_radius_big = values(WHERE(STRMATCH(keywords, 'GAIA_RADIUS_BIG', /FOLD_CASE) EQ 1))
gaia_radius_small = values(WHERE(STRMATCH(keywords, 'GAIA_RADIUS_SMALL', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

        print,''
        print, '·······························································································'
        print, '>>>> Working Folder: '
        print, working_path(i)
        print, '·······························································································'
        print,''

    ;cross-match star catalogue with Gaia DR2
    spawn,'java -jar -Xmx1200m '+pathstilts+' cdsskymatch ifmt=votable in='+working_path(i)+'stars.xml ra="ALPHAWIN_SKY"
    dec="DELTAWIN_SKY" radius='+gaia_error+' cdstable=I/345/gaia2 find=best out='+working_path(i)+'stars_gaia.xml ofmt=votable'

    ;manage columns:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tpipe ifmt=votable  in='+working_path(i)+'stars_gaia.xml cmd='+"'"+'delcols
    '+'"'+'ra_epoch2000'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'dec_epoch2000'+'"'+"'"+' cmd='+"'"+'delcols
    '+'"'+'errHalfMaj'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'errHalfMin'+'"'+"'"+' cmd='+"'"+'delcols
    '+'"'+'errPosAng'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'source_id'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'ra'+'"'+"'"+'
    cmd='+"'"+'delcols '+'"'+'ra_error'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'dec'+'"'+"'"+' cmd='+"'"+'delcols
    '+'"'+'dec_error'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'parallax'+'"'+"'"+' cmd='+"'"+'delcols
    '+'"'+'parallax_error'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'pmra'+'"'+"'"+' cmd='+"'"+'delcols
    '+'"'+'pmra_error'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'pmdec'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'pmdec_error'+'"'+"'"+'
    cmd='+"'"+'delcols '+'"'+'duplicated_source'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'phot_g_mean_flux'+'"'+"'"+'
    cmd='+"'"+'delcols '+'"'+'phot_g_mean_flux_error'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'phot_g_mean_mag'+'"'+"'"+'
    cmd='+"'"+'delcols '+'"'+'phot_bp_mean_flux'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'phot_bp_mean_flux_error'+'"'+"'"+'
    cmd='+"'"+'delcols '+'"'+'phot_bp_mean_mag'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'phot_rp_mean_flux'+'"'+"'"+'
    cmd='+"'"+'delcols '+'"'+'phot_rp_mean_flux_error'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'phot_rp_mean_mag'+'"'+"'"+'
    cmd='+"'"+'delcols '+'"'+'bp_rp'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'radial_velocity'+'"'+"'"+' cmd='+"'"+'delcols
    '+'"'+'radial_velocity_error'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'teff_val'+'"'+"'"+' cmd='+"'"+'delcols
    '+'"'+'a_g_val'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'e_bp_min_rp_val'+'"'+"'"+' cmd='+"'"+'delcols
    '+'"'+'radius_val'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'lum_val'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'angDist'+'"'+"'"+'
    out='+working_path(i)+'stars_cat.xml'

    ;convert from .xml to .csv:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+working_path(i)+'stars_cat.xml out='+working_path(i)+'stars_cat.csv'

    ;read the previous file:
    readcol,working_path(i)+'stars_cat.csv', f='f,f,f,f,f,d,d,d,d,f,f,f,i,i', MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO ,
    FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE ,
    ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , delimiter=','

    ;create the final catalogue:
        openw,1,working_path(i)+'stars_cat.txt'
        printf,1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY ,
        DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , star_radius'

        for m=0,n_elements(MAG_ISOCOR)-1 do begin
                if MAG_ISOCOR(m) lt star_mag then begin
            printf,1, MAG_ISOCOR(m) , MAGERR_ISOCOR(m) , FLUX_AUTO(m) , FLUXERR_AUTO(m) , SNR_WIN(m) , XWIN_IMAGE(m) ,
            YWIN_IMAGE(m) , ALPHAWIN_SKY(m) , DELTAWIN_SKY(m) , ERRAWIN_IMAGE(m) , ERRBWIN_IMAGE(m) , ERRTHETAWIN_IMAGE(m) ,
            FLAGS(m) , FLAGS_WEIGHT(m) , star_radius_big,
            f='(f,",",f,",",f,",",f,",",f,",",d,",",d,",",d,",",d,",",f,",",f,",",f,",",i,",",i,",",d)'
                endif   else begin
            printf,1, MAG_ISOCOR(m) , MAGERR_ISOCOR(m) , FLUX_AUTO(m) , FLUXERR_AUTO(m) , SNR_WIN(m) , XWIN_IMAGE(m) ,
            YWIN_IMAGE(m) , ALPHAWIN_SKY(m) , DELTAWIN_SKY(m) , ERRAWIN_IMAGE(m) , ERRBWIN_IMAGE(m) , ERRTHETAWIN_IMAGE(m) ,
            FLAGS(m) , FLAGS_WEIGHT(m) , star_radius_small,
            f='(f,",",f,",",f,",",f,",",f,",",d,",",d,",",d,",",d,",",f,",",f,",",f,",",i,",",i,",",d)'

```

```
                endelse
        endfor

    ;close file:
        close,1


    ;change columns position to be more easy to work:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tpipe ifmt=votable  in='+working_path(i)+'gaia_cat.csv cmd='+"'"+'addcol
    -before Source Gmag1 '+'"'+'Gmag'+'"'+"'"+' cmd='+"'"+'delcols '+'"'+'Gmag'+'"'+"'"+' out='+working_path(i)+'gaia_cat2.csv'

    ;read files:
    readcol,working_path(i)+'gaia_cat2.csv',f='d,f,d,f,f',RA_ICRS,e_RA_ICRS,DE_ICRS,e_DE_ICRS,Gmag,delimiter=','
    readcol, working_path(i)+'maglimit.txt',f='a,d', mag_pic, mag_limit , delimiter=','

    ;working image loop:
        for k = 0,n_elements(mag_pic)-1 do begin

                print,''
                print, '································································.'
                print, '>>>> Working Image: '
                print, mag_pic(k)
                print, '································································.'
                print,''

                ;extract the name from raw.list without extension:
                pic_name = STRMID(mag_pic(k),0,(STRLEN(mag_pic(k))-(STRLEN(image_ext))))

        ;create new file for each image with gaia stars until magnitude limit of the image:
        openw,2,working_path(i)+pic_name+'_gaia_cat.txt'
            printf,2,'RA_ICRS,e_RA_ICRS,DE_ICRS,e_DE_ICRS,Gmag,star_radius'

        print,''
                print, '································································.'
                print, '>>>> ', pic_name," > Mag. Limit = ",mag_limit(k)
                print, '································································.'
                print,''

        ;select gaia stars until magnitude limit:
            for l = 0,n_elements(Gmag)-1 do begin
                    if (Gmag(l) lt mag_limit(k)) then begin
                ;define the cross match error according with the star magnitude:
                if Gmag(m) lt gaia_mag then begin
                    printf,2, RA_ICRS(l) , e_RA_ICRS(l) , DE_ICRS(l) , e_DE_ICRS(l) , Gmag(l), gaia_radius_big,
                    f='(d,",",f,",",d,",",f,",",f,",",d)'
                endif   else begin
                    printf,2, RA_ICRS(l) , e_RA_ICRS(l) , DE_ICRS(l) , e_DE_ICRS(l) , Gmag(l), gaia_radius_small,
                    f='(d,",",f,",",d,",",f,",",f,",",d)'
                        endelse
            endif
            endfor

        ;close files:
        close, 2

    endfor

    ;remove unnecessary files:
    spawn,'rm '+working_path(i)+'stars_gaia.xml'
    spawn,'rm '+working_path(i)+'gaia_cat2.csv'
    spawn,'rm '+working_path(i)+'stars_cat.csv'
    spawn,'rm '+working_path(i)+'stars_cat.xml'

endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '···························· END: STARCATG.PRO SCRIPT ···························.'
print, '################################################################################'
print,''

end
```

```
;#################################################################################
;# File Name:            conct.pro                                               #
;# Description:          Concatenate all the results / asteroid positions.       #
;#                       Flag positions close to stars that can affect the centroid.     #
;# Last revision:        11/07/2018                                              #
;#                                                                               #
;# Author:               Cédric Pereira, Miriam Cortes, Enrique Solano           #
;# Affiliation:          CAB (CSIC-INTA) & ESA - 2018                            #
;#                                                                               #
;# Inputs                configurations.txt                                      #
;#                       working_path.txt                                        #
;#                       results-ini.xml                                         #
;#                       log-asteroid-aftercross.txt                             #
;#                       *_candidates-nostars.xml                                #
;#                       *_gaia_cat.txt                                          #
;#                       stars_cat.txt                                           #
;#                                                                               #
;# Outputs:              results_wo_nearby_stars.csv                             #
;#                       nearby_stars.csv                                        #
;#                       results.csv                                             #
;#                                                                               #
;#################################################################################

print,''
print, '################################################################################'
print, '···························· BEGIN: CONCT.PRO SCRIPT ····························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
    print, '·······································································'
    print, '>>>> Working Folder: '
    print, working_path(i)
    print, '·······································································'
    print,''

    ;copy initial empty catalogues:
    spawn,'cp '+pathroot+'results-ini.xml '+working_path(i)+'results_good.xml'
    spawn,'cp '+pathroot+'results-ini.xml '+working_path(i)+'results_stars.xml'

    ;read information inside log-images.txt:
    readcol, working_path(i)+'log-asteroid-aftercross.txt',f='a,a,a,a', log_ast_pic, ra_cen, dec_cen, mid_jd, delimiter=','

    ;working image loop:
    for k = 0,n_elements(log_ast_pic)-1 do begin

        print,''
        print, '·······································································'
        print, '>>>> Working Image: '
        print, log_ast_pic(k)
        print, '·······································································'
        print,''

        ;extract the name from raw.list without extension:
        pic_name = STRMID(log_ast_pic(k),0,(STRLEN(log_ast_pic(k))-(STRLEN(image_ext))))

        ;cross-match candidates-nostars.xml with gaia catalogue:
        spawn,'java -jar -Xmx1200m '+pathstilts+' tmatch2 ifmt1=votable ifmt2=csv matcher=skyerr values1="ALPHAWIN_SKY
        DELTAWIN_SKY Poserr" in1='+working_path(i)+pic_name+'_candidates-nostars.xml values2="RA_ICRS DE_ICRS star_radius"
        in2='+working_path(i)+pic_name+'_gaia_cat.txt params=1 join=1not2  find=all
        out='+working_path(i)+pic_name+'_candidates_wo_nearby_stars.xml ofmt=votable'

        ;concatenate the previous results:
        spawn,'java -jar -Xmx2400m '+pathstilts+' tcat in='+working_path(i)+pic_name+'_candidates_wo_nearby_stars.xml
        in='+working_path(i)+'results_good.xml out='+working_path(i)+'results_good.xml'

        ;cross-match candidates-nostars.xml with _candidates_wo_nearby_stars.xml to get a catalogue with bad
        positions:
        spawn,'java -jar -Xmx7000m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=votable
        in1='+working_path(i)+pic_name+'_candidates-nostars.xml
        in2='+working_path(i)+pic_name+'_candidates_wo_nearby_stars.xml ra1="ALPHAWIN_SKY" dec1="DELTAWIN_SKY"
        ra2="ALPHAWIN_SKY" dec2="DELTAWIN_SKY" error=0.01 join=1not2 find=all
        out='+working_path(i)+pic_name+'_candidates_nearby_stars.xml ofmt=votable'

        ;concatenate the previous results:
        spawn,'java -jar -Xmx2400m '+pathstilts+' tcat in='+working_path(i)+pic_name+'_candidates_nearby_stars.xml
        in='+working_path(i)+'results_stars.xml out='+working_path(i)+'results_stars.xml'

    endfor

    ;cross-match results_good.xml with star catalogue:
    spawn,'java -jar -Xmx1200m '+pathstilts+' tmatch2 ifmt1=votable ifmt2=csv matcher=skyerr values1="ALPHAWIN_SKY
    DELTAWIN_SKY Poserr" in1='+working_path(i)+'results_good.xml values2="ALPHAWIN_SKY DELTAWIN_SKY star_radius"
    in2='+working_path(i)+'stars_cat.txt params=1 join=1not2  find=all out='+working_path(i)+'results_wo_nearby_stars.xml
    ofmt=votable'

    ;flag nearby stars:
    spawn,'java -jar -Xmx2500m '+pathstilts+' tpipe ifmt=votable in='+working_path(i)+'results_stars.xml cmd='+"'"+ 'addcol
```

```
    FLAG_NEARBY '+'"'+'1'+'"'+"'"+' ofmt=vot out='+working_path(i)+'results_stars.xml'

    ;flag nearby stars:
    spawn,'java -jar -Xmx2500m '+pathstilts+' tpipe ifmt=votable in='+working_path(i)+'results_good.xml cmd='+"'"+ 'addcol
    FLAG_NEARBY '+'"'+'1'+'"'+"'"+' ofmt=vot out='+working_path(i)+'results_good.xml'

    ;flag good positions:
    spawn,'java -jar -Xmx2500m '+pathstilts+' tpipe ifmt=votable in='+working_path(i)+'results_wo_nearby_stars.xml cmd='+"'"+
    'addcol FLAG_NEARBY '+'"'+'0'+'"'+"'"+' ofmt=vot out='+working_path(i)+'results_wo_nearby_stars.xml'

    ;cross-match results_good.xml with results_wo_nearby_stars.xml:
    spawn,'java -jar -Xmx7000m '+pathstilts+' tskymatch2 ifmt1=votable ifmt2=votable in1='+working_path(i)+'results_good.xml
    in2='+working_path(i)+'results_wo_nearby_stars.xml ra1="ALPHAWIN_SKY" dec1="DELTAWIN_SKY" ra2="ALPHAWIN_SKY"
    dec2="DELTAWIN_SKY" error=0.01 join=1not2 find=all out='+working_path(i)+'nearby_stars.xml ofmt=votable'

    ;concatenate results_stars.xml with nearby_stars.xml:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcat in='+working_path(i)+'results_stars.xml
    in='+working_path(i)+'nearby_stars.xml out='+working_path(i)+'nearby_stars.xml'

    ;concatenate results_wo_nearby_stars.xml with nearby_stars.xml:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcat in='+working_path(i)+'results_wo_nearby_stars.xml
    in='+working_path(i)+'nearby_stars.xml out='+working_path(i)+'results.xml'

    ;convert results.xml to .csv:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+working_path(i)+'results.xml out='+working_path(i)+'results.csv'

    ;convert nearby_stars.xml to .csv:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+working_path(i)+'nearby_stars.xml
    out='+working_path(i)+'nearby_stars.csv'

    ;convert results_wo_nearby_stars.xml to .csv:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+working_path(i)+'results_wo_nearby_stars.xml
    out='+working_path(i)+'results_wo_nearby_stars.csv'


    ;remove unnecessary files:
    spawn,'rm '+working_path(i)+'results.xml'
    spawn,'rm '+working_path(i)+'nearby_stars.xml'
    spawn,'rm '+working_path(i)+'results_wo_nearby_stars.xml'
    spawn,'rm '+working_path(i)+'results_good.xml'
    spawn,'rm '+working_path(i)+'results_stars.xml'
    spawn,'rm '+working_path(i)+'*_candidates_wo_nearby_stars.xml'
    spawn,'rm '+working_path(i)+'*_candidates_nearby_stars.xml'


endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '······························· END: CONCT.PRO SCRIPT ·····························'
print, '##################################################################################'
print,''

end
```

```
;#####################################################################################
;# File Name:           conct_skybot.pro                                             #
;# Description:         Concatenate all the skybot results.                          #
;#                                                                                   #
;# Last revision:       11/07/2018                                                   #
;#                                                                                   #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                 #
;#                                                                                   #
;# Inputs               configurations.txt                                           #
;#                      working_path.txt                                             #
;#                      results_skybot-ini.xml                                       #
;#                      log-asteroid-aftercross.txt                                  #
;#                      *_skybot.xml                                                 #
;#                                                                                   #
;# Outputs:             results_skybot.csv                                           #
;#                                                                                   #
;#####################################################################################

print,''
print, '################################################################################'
print, '························ BEGIN: CONCT_SKYBOT.PRO SCRIPT ·························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
    print, '································································································'
    print, '>>>> Working Folder: '
    print, working_path(i)
    print, '································································································'
    print,''

    ;copy the initial empty catalogue:
    spawn,'cp '+pathroot+'results_skybot-ini.xml '+working_path(i)+'results_skybot.xml'

    ;read information inside log-images.txt:
    readcol, working_path(i)+'log-asteroid-aftercross.txt',f='a,a,a,a', log_ast_pic, ra_cen, dec_cen, mid_jd, delimiter=','

    ;working image loop:
    for k = 0,n_elements(log_ast_pic)-1 do begin

        print,''
        print, '································································································'
        print, '>>>> Working Image: '
        print, log_ast_pic(k)
        print, '································································································'
        print,''

        ;extract the name from raw.list without extension:
        pic_name = STRMID(log_ast_pic(k),0,(STRLEN(log_ast_pic(k))-(STRLEN(image_ext))))

        ;concatenate the skybot results:
        spawn,'java -jar -Xmx2400m '+pathstilts+' tcat in='+working_path(i)+pic_name+'_skybot.xml
        in='+working_path(i)+'results_skybot.xml out='+working_path(i)+'results_skybot.xml'

    endfor

    ;convert from results_skybot.xml to .csv:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+working_path(i)+'results_skybot.xml
    out='+working_path(i)+'results_skybot.csv'

    ;remove unnecessary files:
    spawn,'rm '+working_path(i)+'results_skybot.xml'

endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '·························· END: CONCT_SKYBOT.PRO SCRIPT ··························'
print, '################################################################################'
print,''

end
```

```
;##########################################################################################
;# File Name:           conct_sex.pro                                                     #
;# Description:         Concatenate all the sextractor results for debug.                 #
;#                                                                                        #
;# Last revision:       11/07/2018                                                        #
;#                                                                                        #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                     #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                      #
;#                                                                                        #
;# Inputs               configurations.txt                                                #
;#                      working_path.txt                                                  #
;#                      results_sex-ini.xml                                               #
;#                      checked.list                                                      #
;#                      *_sex-cal.xml                                                     #
;#                                                                                        #
;# Outputs:             results_sex.csv                                                   #
;#                                                                                        #
;##########################################################################################

print,''
print, '################################################################################'
print, '·························· BEGIN: CONCT_SEX.PRO SCRIPT ··························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
    print, '·······························································································'
    print, '>>>> Working Folder: '
    print, working_path(i)
    print, '·······························································································'
    print,''

    ;copy the initial empty catalogue:
    spawn,'cp '+pathroot+'results_sex-ini.xml '+working_path(i)+'results_sex.xml'

    ;convert results.xml to .fits to speed the process:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+working_path(i)+'results_sex.xml ofmt=colfits-plus out='+working_path(i)+'results_sex.fits'

    ;read checked list with images/data name:
    readcol,working_path(i)+'checked.list',f='a', checked_list, delimiter = ','

    ;working image loop:
    for k = 0,n_elements(checked_list)-1 do begin

        print,''
        print, '·······························································································'
        print, '>>>> Working Image: '
        print, checked_list(k)
        print, '·······························································································'
        print,''

        ;extract the name from checked.list without extension:
        pic_name = STRMID(checked_list(k),0,(STRLEN(checked_list(k))-(STRLEN(image_ext))))

        ;concatenate the sextractor results:
        spawn,'java -jar -Xmx2400m '+pathstilts+' tcat in='+working_path(i)+pic_name+'_sex-cal.xml in='+working_path(i)+'results_sex.fits out='+working_path(i)+'results_sex.fits'

    endfor

    ;convert results_sex.fits to .csv:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+working_path(i)+'results_sex.fits out='+working_path(i)+'results_sex.csv'

    ;remove unnecessary files:
    spawn,'rm '+working_path(i)+'results_sex.fits'
    spawn,'rm '+working_path(i)+'results_sex.xml'

endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '···························· END: CONCT_SEX.PRO SCRIPT ···························'
print, '################################################################################'
print,''

end
```

```
;########################################################################################
;# File Name:           resume.pro                                                     #
;# Description:         Resume the skybot results vs detected positions.               #
;# Last revision:       11/07/2018                                                     #
;#                                                                                     #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                  #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                   #
;#                                                                                     #
;# Inputs               configurations.txt                                             #
;#                      working_path.txt                                               #
;#                      results.csv                                                    #
;#                      results_skybot.csv                                             #
;#                                                                                     #
;# Outputs:             resume.txt                                                     #
;#                                                                                     #
;########################################################################################

print,''
print, '#################################################################################'
print, '···························· BEGIN: RESUME.PRO SCRIPT ·····························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

        print,''
        print, '·································································'
        print, '>>>> Working Folder: '
        print, working_path(i)
        print, '·································································'
        print,''

    ;read skybot results file:
    readcol,working_path(i)+'results_skybot.csv',f='a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d', Num , Name , RA , DEC , Class , Mv ,
    ErrPos , d , dRAcosDec , dDEC , Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , delimiter=','

    ;read detected asteroid results file:
    readcol,working_path(i)+'results.csv',f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,d,f,a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d,d,a,d,i',
    MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY , DELTAWIN_SKY ,
    ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
    MAGERR_ISOCOR_CALIBRATED , Poserr , Num2 , Name2 , RA2 , DEC2 , Class2 , Mv2 , ErrPos2 , d2 , dRAcosDec2 , dDEC2 , Dgeo2
    , Dhelio2 , _RAJ20002 , _DECJ20002 , ExternalLink2 , search_radius2 , Separation , Image , JD , FLAG_NEARBY , delimiter=','

    ;arrays to count how many different asteroids are in the data:
    Types = []
    Flag=0

    ;count how many different asteroids are in the data:
    for k = 0,n_elements(Name)-1 do begin
        for l = 0,n_elements(Types)-1 do begin
            if Name(k) eq Types(l) then begin
                Flag = 1
            endif
        endfor

        if Flag eq 0 then begin
            Types = [[Types],[Name(k)]]
        endif
        Flag = 0
    endfor

    ;create a file to resume everything;
    openw,1,working_path(i)+'resume.txt'
    printf,1,'Path,Name,Mv,Skybot_Detections,Number_Detections'

    ;count how many asteroid positions from skybot and from results:
    for m = 0,n_elements(Types)-1 do begin
                numb_count = 0
        for n = 0,n_elements(Name)-1 do begin
                        if Name(n) eq Types(m) then begin
                                numb_count = numb_count+1
                Mag = Mv(n)
                        endif
                endfor

        numb_count2 = 0
        for o = 0,n_elements(Name2)-1 do begin
            if Name2(o) eq Types(m) then begin
                numb_count2 = numb_count2+1
            endif
        endfor

        ;print data:
        printf,1,working_path(i),Types(m),Mag,numb_count,numb_count2,f='(a,",",a,",",f,",",i,",",i)'

        endfor

    ;close files:
    close,1

```

```
endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '···························· END: RESUME.PRO SCRIPT ···························'
print, '###############################################################################'
print,''

end
```

```
;########################################################################################
;# File Name:           fit.pro                                                        #
;# Description:         Filter the asteroid positions, flag behaviours and create an    #
;#                      outfile with the data for each asteroid.                        #
;# Last revision:       18/07/2018                                                      #
;#                                                                                      #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                   #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                    #
;#                                                                                      #
;# Inputs               configurations.txt                                              #
;#                      working_path.txt                                                #
;#                      results.csv                                                     #
;#                      sigma.txt                                                       #
;#                      results_wo_nearby_stars.csv                                     #
;#                                                                                      #
;# Outputs:             resume-fit.txt                                                  #
;#                      asteroid_*.txt                                                  #
;#                      asteroid_*-fit.txt                                              #
;#                                                                                      #
;########################################################################################

print,''
print, '################################################################################'
print, '····························· BEGIN: FIT.PRO SCRIPT ······························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 99

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
image_ext = values(WHERE(STRMATCH(keywords, 'IMAGE_EXT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
    print, '·······························································································'
    print, '>>>> Working Folder: '
    print, working_path(i)
    print, '·······························································································'
    print,''

    ;read sigma value:
    readcol, working_path(i)+'sigma.txt', f='a', sigma_error
    error = sigma_error(0)

    ;add "Poserr" column to results.csv:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tpipe ifmt=csv  in='+working_path(i)+'results.csv cmd='+"'"+'delcols
    '+'"'+'Poserr'+'"'+"'"+' cmd='+"'"+ 'addcol -before Num Poserr '+'"'+error+'"'+"'"+' out='+working_path(i)+'results2.csv'

    spawn,'rm '+working_path(i)+'results.csv'
    spawn,'cp '+working_path(i)+'results2.csv '+working_path(i)+'results.csv'
    spawn,'rm '+working_path(i)+'results2.csv'

    ;add "Poserr" column to results_wo_nearby_stars.csv:
    spawn,'java -jar -Xmx2400m '+pathstilts+' tpipe ifmt=csv  in='+working_path(i)+'results_wo_nearby_stars.csv
    cmd='+"'"+'delcols '+'"'+'Poserr'+'"'+"'"+' cmd='+"'"+ 'addcol -before Num Poserr '+'"'+error+'"'+"'"+'
    out='+working_path(i)+'results_wo_nearby_stars2.csv'

    spawn,'rm '+working_path(i)+'results_wo_nearby_stars.csv'
    spawn,'cp '+working_path(i)+'results_wo_nearby_stars2.csv '+working_path(i)+'results_wo_nearby_stars.csv'
    spawn,'rm '+working_path(i)+'results_wo_nearby_stars2.csv'

    ;read results_wo_nearby_stars.csv:
    readcol,
    working_path(i)+'results_wo_nearby_stars.csv',f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,d,f,a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d,d,a,d,i'
    , MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY , DELTAWIN_SKY
    , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
    MAGERR_ISOCOR_CALIBRATED , Poserr , Num , Name , RA , DEC , Class , Mv , ErrPos , d , dRAcosDec , dDEC , Dgeo , Dhelio ,
    _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image , JD , FLAG_NEARBY , delimiter=','

    ;count how many different asteroids are in the data:
    Types = []
    Flag=0

    for k = 0,n_elements(Name)-1 do begin
        for l = 0,n_elements(Types)-1 do begin
            if Name(k) eq Types(l) then begin
                Flag = 1
            endif
        endfor

        if Flag eq 0 then begin
            Types = [[Types],[Name(k)]]
        endif
        Flag = 0
    endfor


    ;split data in different txt files for each asteroid:
    for l = 0,n_elements(Types)-1 do begin
        openw,l+1,working_path(i)+'asteroid_'+Types(l)+'.txt'
        printf,l+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY
        , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
        MAGERR_ISOCOR_CALIBRATED , Poserr , Num , Name , RA , DEC , Class , Mv , ErrPos , d , dRAcosDec , dDEC , Dgeo ,
        Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image , JD , FLAG_NEARBY'
```

```
        for k = 0,n_elements(Name)-1 do begin
            if Name(k) eq Types(l) then begin
            printf,l+1, MAG_ISOCOR(k) , MAGERR_ISOCOR(k) , FLUX_AUTO(k) , FLUXERR_AUTO(k) , SNR_WIN(k) , XWIN_IMAGE(k) ,
            YWIN_IMAGE(k) , ALPHAWIN_SKY(k) , DELTAWIN_SKY(k) , ERRAWIN_IMAGE(k) , ERRBWIN_IMAGE(k) , ERRTHETAWIN_IMAGE(k) ,
            FLAGS(k) , FLAGS_WEIGHT(k) , MAG_ISOCOR_CALIBRATED(k) , MAGERR_ISOCOR_CALIBRATED(k) , Poserr(k) , Num(k) ,
            Name(k) , RA(k) , DEC(k) , Class(k) , Mv(k) , ErrPos(k) , d(k) , dRAcosDec(k) , dDEC(k) , Dgeo(k) , Dhelio(k) ,
            _RAJ2000(k) , _DECJ2000(k) , ExternalLink(k) , search_radius(k) , Separation(k) , Image(k) , JD(k) ,
            FLAG_NEARBY(k) ,
            f='(f,",",f,",",d,",",d,",",f,",",d,",",d,",",d,",",d,",",f,",",f,",",f,",",i,",",i,",",d,",",d,",",f,",",a,",",a,"
            ,",a,",",a,",",a,",",f,",",f,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",a,",",d,",",d,",",a,",",d,",",i)'

            endif
        endfor
        close,l+1
    endfor


;------------------------------------------------------------------------------

    l_array = []

    ;remove saturated positions:
    for l=0,n_elements(Types)-1 do begin

        readcol,working_path(i)+'asteroid_'+Types(l)+'.txt',
        f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,d,f,a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d,d,a,d,i', MAG_ISOCOR9 , MAGERR_ISOCOR9 ,
        FLUX_AUTO9 , FLUXERR_AUTO9 , SNR_WIN9 , XWIN_IMAGE9 , YWIN_IMAGE9 , ALPHAWIN_SKY9 , DELTAWIN_SKY9 , ERRAWIN_IMAGE9 ,
        ERRBWIN_IMAGE9 , ERRTHETAWIN_IMAGE9 , FLAGS9 , FLAGS_WEIGHT9 , MAG_ISOCOR_CALIBRATED9 , MAGERR_ISOCOR_CALIBRATED9 ,
        Poserr9 , Num9 , Name9 , RA9 , DEC9 , Class9 , Mv9 , ErrPos9 , d9 , dRAcosDec9 , dDEC9 , Dgeo9 , Dhelio9 , _RAJ20009
        , _DECJ20009 , ExternalLink9 , search_radius9 , Separation9 , Image9 , JD9 , FLAG_NEARBY9 , delimiter=','

        print,''
        print, '·································································'
        print, '>>>> Asteroid: '
        print, Name9(0)
        print, '·································································'
        print,''

        openw,l+1,working_path(i)+'asteroid_'+Types(l)+'-sat.txt'
        printf,l+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY
        , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
        MAGERR_ISOCOR_CALIBRATED , Poserr , Num , Name , RA , DEC , Class , Mv , ErrPos , d , dRAcosDec , dDEC , Dgeo ,
        Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image , JD , FLAG_NEARBY'


        ;filter satrurated sources by SExtractor:
        zero_counter = 0
        for q = 0,n_elements(MAG_ISOCOR9)-1 do begin
            if (FLAGS9(q) ne 4) and (FLAGS9(q) ne 5) and (FLAGS9(q) ne 6) and (FLAGS9(q) ne 7) and (FLAGS9(q) ne 12) and
            (FLAGS9(q) ne 13) and (FLAGS9(q) ne 14) and (FLAGS9(q) ne 15) and (FLAGS9(q) ne 20) and (FLAGS9(q) ne 21) and
            (FLAGS9(q) ne 22) and (FLAGS9(q) ne 23) and (FLAGS9(q) ne 28) and (FLAGS9(q) ne 29) and (FLAGS9(q) ne 30) and
            (FLAGS9(q) ne 31) then begin
                printf,l+1, MAG_ISOCOR9(q) , MAGERR_ISOCOR9(q) , FLUX_AUTO9(q) , FLUXERR_AUTO9(q) , SNR_WIN9(q) ,
                XWIN_IMAGE9(q) , YWIN_IMAGE9(q) , ALPHAWIN_SKY9(q) , DELTAWIN_SKY9(q) , ERRAWIN_IMAGE9(q) , ERRBWIN_IMAGE9(q)
                , ERRTHETAWIN_IMAGE9(q) , FLAGS9(q) , FLAGS_WEIGHT9(q) , MAG_ISOCOR_CALIBRATED9(q) ,
                MAGERR_ISOCOR_CALIBRATED9(q) , Poserr9(q) , Num9(q) , Name9(q) , RA9(q) , DEC9(q) , Class9(q) , Mv9(q) ,
                ErrPos9(q) , d9(q) , dRAcosDec9(q) , dDEC9(q) , Dgeo9(q) , Dhelio9(q) , _RAJ20009(q) , _DECJ20009(q) ,
                ExternalLink9(q) , search_radius9(q) , Separation9(q) , Image9(q) , JD9(q) , FLAG_NEARBY9(q) ,
                f='(f,",",f,",",d,",",d,",",f,",",d,",",d,",",d,",",d,",",f,",",f,",",f,",",i,",",i,",",d,",",d,",",f,",",a,","
                ,a,",",a,",",a,",",a,",",f,",",f,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",a,",",d,",",d,",",a,",",d,",",i)
                '
                zero_counter = zero_counter + 1
            endif
        endfor


        ;if all sources are saturated, the asteroid will be removed from the script:
        if zero_counter eq 0 then begin
            l_array = [[l_array],[l]]
        endif
        close,l+1
    endfor

    ;if all sources are saturated, the asteroid will be removed from the script:
    remove, l_array, Types

;------------------------------------------------------------------------------


    ;create new txt files with data inside defined tolerances:
    for l=0,n_elements(Types)-1 do begin
            readcol,working_path(i)+'asteroid_'+Types(l)+'-sat.txt',
            f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,d,f,a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d,d,a,d,i', MAG_ISOCOR2 , MAGERR_ISOCOR2 ,
            FLUX_AUTO2 , FLUXERR_AUTO2 , SNR_WIN2 , XWIN_IMAGE2 , YWIN_IMAGE2 , ALPHAWIN_SKY2 , DELTAWIN_SKY2 ,
            ERRAWIN_IMAGE2 , ERRBWIN_IMAGE2 , ERRTHETAWIN_IMAGE2 , FLAGS2 , FLAGS_WEIGHT2 , MAG_ISOCOR_CALIBRATED2 ,
            MAGERR_ISOCOR_CALIBRATED2 ,  Poserr2 , Num2 , Name2 , RA2 , DEC2 , Class2 , Mv2 , ErrPos2 , d2 , dRAcosDec2 ,
            dDEC2 , Dgeo2 , Dhelio2 , _RAJ20002 , _DECJ20002 , ExternalLink2 , search_radius2 , Separation2 , Image2 , JD2 ,
            FLAG_NEARBY2 , delimiter=','


        print,''
        print, '·································································'
        print, '>>>> Asteroid: '
        print, Name2(0)
        print, '·································································'
        print,''

        openw,l+1,working_path(i)+'asteroid_'+Types(l)+'-sepcrit.txt'
        printf,l+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY
        , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
        MAGERR_ISOCOR_CALIBRATED , Poserr , Num , Name , RA , DEC , Class , Mv , ErrPos , d , dRAcosDec , dDEC , Dgeo ,
        Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image , JD , FLAG_NEARBY'


        ;remove outlier positions:
```

```
        whl_total = n_elements(Separation2)-1
        whl_count = 0
        whl=0
        while (whl eq 0) do begin

            mean_sep = mean(Separation2)
                std_sep = stddev(Separation2)
            threshold_minus = Separation2-(mean_sep-3*std_sep)
                    threshold_plus = Separation2-(mean_sep+3*std_sep)
            remove_array=[]

            for k=0,n_elements(Separation2)-1 do begin
                if (threshold_minus(k) lt 0) or (threshold_plus(k) gt 0) then begin
                    remove_array = [[remove_array],[k]]
                endif
            endfor

            remove,remove_array, MAG_ISOCOR2 , MAGERR_ISOCOR2 , FLUX_AUTO2 , FLUXERR_AUTO2 , SNR_WIN2 , XWIN_IMAGE2 ,
            YWIN_IMAGE2 , ALPHAWIN_SKY2 , DELTAWIN_SKY2 , ERRAWIN_IMAGE2 , ERRBWIN_IMAGE2 , ERRTHETAWIN_IMAGE2 , FLAGS2 ,
            FLAGS_WEIGHT2 , MAG_ISOCOR_CALIBRATED2 , MAGERR_ISOCOR_CALIBRATED2 , Poserr2 , Num2 , Name2 , RA2 , DEC2 , Class2

            remove,remove_array, Mv2 , ErrPos2 , d2 , dRAcosDec2 , dDEC2 , Dgeo2 , Dhelio2 , _RAJ20002 , _DECJ20002 ,
            ExternalLink2 , search_radius2 , Separation2 , Image2 , JD2 , FLAG_NEARBY2

            whl_count = whl_count+1
            if (whl_count eq whl_total) then begin
                whl=1
            endif

            endwhile

        for k=0,n_elements(Separation2)-1 do begin
            printf,l+1, MAG_ISOCOR2(k) , MAGERR_ISOCOR2(k) , FLUX_AUTO2(k) , FLUXERR_AUTO2(k) , SNR_WIN2(k) , XWIN_IMAGE2(k)
            , YWIN_IMAGE2(k) , ALPHAWIN_SKY2(k) , DELTAWIN_SKY2(k) , ERRAWIN_IMAGE2(k) , ERRBWIN_IMAGE2(k) ,
            ERRTHETAWIN_IMAGE2(k) , FLAGS2(k) , FLAGS_WEIGHT2(k) , MAG_ISOCOR_CALIBRATED2(k) , MAGERR_ISOCOR_CALIBRATED2(k) ,
            Poserr2(k) , Num2(k) , Name2(k) , RA2(k) , DEC2(k) , Class2(k) , Mv2(k) , ErrPos2(k) , d2(k) , dRAcosDec2(k) ,
            dDEC2(k) , Dgeo2(k) , Dhelio2(k) , _RAJ20002(k) , _DECJ20002(k) , ExternalLink2(k) , search_radius2(k) ,
            Separation2(k) , Image2(k) , JD2(k) , FLAG_NEARBY2(k) ,
            f='(f,",",f,",",d,",",d,",",f,",",d,",",d,",",d,",",d,",",f,",",f,",",f,",",i,",",i,",",d,",",d,",",f,",",a,",",a,"
            ,",a,",",a,",",a,",",f,",",f,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",a,",",d,",",d,",",a,",",d,",",i)'
        endfor
        close,l+1
    endfor



;-----------------------------------------------------------------------------


    ;compute some asteroids parameters

    for l=0,n_elements(Types)-1 do begin
        readcol,working_path(i)+'asteroid_'+Types(l)+'-sepcrit.txt',
        f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,d,f,a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d,d,a,d,i', MAG_ISOCOR3 , MAGERR_ISOCOR3 ,
        FLUX_AUTO3 , FLUXERR_AUTO3 , SNR_WIN3 , XWIN_IMAGE3 , YWIN_IMAGE3 , ALPHAWIN_SKY3 , DELTAWIN_SKY3 , ERRAWIN_IMAGE3 ,
        ERRBWIN_IMAGE3 , ERRTHETAWIN_IMAGE3 , FLAGS3 , FLAGS_WEIGHT3 , MAG_ISOCOR_CALIBRATED3 , MAGERR_ISOCOR_CALIBRATED3 ,
        Poserr3 , Num3 , Name3 , RA3 , DEC3 , Class3 , Mv3 , ErrPos3 , d3 , dRAcosDec3 , dDEC3 , Dgeo3 , Dhelio3 , _RAJ20003
        , _DECJ20003 , ExternalLink3 , search_radius3 , Separation3 , Image3 , JD3 , FLAG_NEARBY3 , delimiter=','

        if (n_elements(Name3) gt 1) then begin


            print, Types(l)

            regpos =
            regress(ALPHAWIN_SKY3,DELTAWIN_SKY3,measure_errors=Poserr3,sigma=sigma_res,correlation=corr_pos,ftest=f_value_pos)
            print, regpos
            print, corr_pos
            print, f_value_pos


            jdpoints=minmax(JD3,subs)
                    jd1=jdpoints[0]
                jd2=jdpoints[1]
                djd=abs(jd2-jd1)

            lfit_ra=linfit(JD3,ALPHAWIN_SKY3,measure_errors=Poserr3)
                    beta_ra=(ALPHAWIN_SKY3-lfit_ra[0])/JD3
                factor=3600/24
                pmrasex=mean(beta_ra)*factor*cos(!dtor*mean(DELTAWIN_SKY3))
                    epmrasex=stddev(beta_ra)*factor*cos(!dtor*mean(DELTAWIN_SKY3))

                lfit_dec=linfit(JD3,DELTAWIN_SKY3,measure_errors=Poserr3)
                beta_dec=(DELTAWIN_SKY3-lfit_dec[0])/JD3
                pmdecsex=mean(beta_dec)*factor
                epmdecsex=stddev(beta_dec)*factor

                pmraskym=mean(dRAcosDEC3)
                pmraskystd=stdev(dRAcosDEC3)
                    pmdecskym=mean(dDEC3)
                pmdecskystd=stdev(dDEC3)
                GIDn=strcompress(k,/remove_all)


            dmura=abs((pmrasex-pmraskym)/pmraskym)
            dmudec=abs((pmdecsex-pmdecskym)/pmdecskym)

            if abs(corr_pos) ge 0.90 then begin
                flaglin="A"
            endif else begin
                flaglin="B"
            endelse


            if dmura le 0.20 then begin
```

```
                flagpmra="A"
            endif else begin
                flagpmra="B"
            endelse


            if dmudec le 0.20 then begin
                flagpmdec="A"
            endif else begin
                flagpmdec="B"
            endelse

            Final_Flag = flaglin+flagpmra+flagpmdec

            openw,l+1,working_path(i)+'asteroid_'+Types(l)+'-fit.txt'
                    printf,l+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE ,
                    ALPHAWIN_SKY , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT ,
                    MAG_ISOCOR_CALIBRATED , MAGERR_ISOCOR_CALIBRATED , Poserr , Num , Name , RA , DEC , Class , Mv , ErrPos ,
                    d , dRAcosDec , dDEC , Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation ,
                    Image , JD , FLAG_NEARBY, FLAG_FIT'

            for k=0,n_elements(Name3)-1 do begin
                            printf,l+1, MAG_ISOCOR3(k) , MAGERR_ISOCOR3(k) , FLUX_AUTO3(k) , FLUXERR_AUTO3(k) , SNR_WIN3(k) ,
                            XWIN_IMAGE3(k) , YWIN_IMAGE3(k) , ALPHAWIN_SKY3(k) , DELTAWIN_SKY3(k) , ERRAWIN_IMAGE3(k) ,
                            ERRBWIN_IMAGE3(k) , ERRTHETAWIN_IMAGE3(k) , FLAGS3(k) , FLAGS_WEIGHT3(k) ,
                            MAG_ISOCOR_CALIBRATED3(k) , MAGERR_ISOCOR_CALIBRATED3(k) , Poserr3(k) , Num3(k) , Name3(k) ,
                            RA3(k) , DEC3(k) , Class3(k) , Mv3(k) , ErrPos3(k) , d3(k) , dRAcosDec3(k) , dDEC3(k) , Dgeo3(k)
                            , Dhelio3(k) , _RAJ20003(k) , _DECJ20003(k) , ExternalLink3(k) , search_radius3(k) ,
                            Separation3(k) , Image3(k) , JD3(k) , FLAG_NEARBY3(k) , Final_Flag  ,
                            f='(f,",",f,",",d,",",d,",",f,",",d,",",d,",",d,",",d,",",f,",",f,",",f,",",i,",",i,",",d,",",d,","
                            ,f,",",a,",",a,",",a,",",a,",",a,",",f,",",f,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",a,",",d,
                            ",",d,",",a,",",d,",",i,",",a)'
                    endfor
                close,l+1
        endif else begin

            Final_Flag = 'null'

            openw,l+1,working_path(i)+'asteroid_'+Types(l)+'-fit.txt'
                        printf,l+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE ,
                        YWIN_IMAGE , ALPHAWIN_SKY , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS
                        , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED , MAGERR_ISOCOR_CALIBRATED , Poserr , Num , Name , RA , DEC ,
                        Class , Mv , ErrPos , d , dRAcosDec , dDEC , Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink ,
                        search_radius , Separation , Image , JD , FLAG_NEARBY, FLAG_FIT'
            for k=0,n_elements(Name3)-1 do begin
                                printf,l+1, MAG_ISOCOR3(k) , MAGERR_ISOCOR3(k) , FLUX_AUTO3(k) , FLUXERR_AUTO3(k) ,
                                SNR_WIN3(k) , XWIN_IMAGE3(k) , YWIN_IMAGE3(k) , ALPHAWIN_SKY3(k) , DELTAWIN_SKY3(k) ,
                                ERRAWIN_IMAGE3(k) , ERRBWIN_IMAGE3(k) , ERRTHETAWIN_IMAGE3(k) , FLAGS3(k) , FLAGS_WEIGHT3(k)
                                , MAG_ISOCOR_CALIBRATED3(k) , MAGERR_ISOCOR_CALIBRATED3(k) , Poserr3(k) , Num3(k) , Name3(k)
                                , RA3(k) , DEC3(k) , Class3(k) , Mv3(k) , ErrPos3(k) , d3(k) , dRAcosDec3(k) , dDEC3(k) ,
                                Dgeo3(k) , Dhelio3(k) , _RAJ20003(k) , _DECJ20003(k) , ExternalLink3(k) , search_radius3(k) ,
                                Separation3(k) , Image3(k) , JD3(k) , FLAG_NEARBY3(k) , Final_Flag  ,
                                f='(f,",",f,",",d,",",d,",",f,",",d,",",d,",",d,",",d,",",f,",",f,",",f,",",i,",",i,",",d,",",d
                                ,",",f,",",a,",",a,",",a,",",a,",",a,",",f,",",f,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",
                                a,",",d,",",d,",",a,",",d,",",i,",",a)'
                        endfor
                        close,l+1
        endelse
    endfor


    ;flag positions:
    ;read results.csv:
        readcol, working_path(i)+'results.csv',f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,d,f,a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d,d,a,d,i',
        MAG_ISOCOR6 , MAGERR_ISOCOR6 , FLUX_AUTO6 , FLUXERR_AUTO6 , SNR_WIN6 , XWIN_IMAGE6 , YWIN_IMAGE6 , ALPHAWIN_SKY6 ,
        DELTAWIN_SKY6 , ERRAWIN_IMAGE6 , ERRBWIN_IMAGE6 , ERRTHETAWIN_IMAGE6 , FLAGS6 , FLAGS_WEIGHT6 ,
        MAG_ISOCOR_CALIBRATED6 , MAGERR_ISOCOR_CALIBRATED6 , Poserr6 , Num6 , Name6 , RA6 , DEC6 , Class6 , Mv6 , ErrPos6 ,
        d6 , dRAcosDec6 , dDEC6 , Dgeo6 , Dhelio6 , _RAJ20006 , _DECJ20006 , ExternalLink6 , search_radius6 , Separation6 ,
        Image6 , JD6 , FLAG_NEARBY6 , delimiter=','


    ;create a second table with a new resume from the results of this script:
        readcol,working_path(i)+'resume.txt', f='a,a,f,i,i', Path5 , Name5 , Mv5  , Skybot_Detections5 , Number_Detections5 ,
        delimiter=','
    openw,99,working_path(i)+'resume-fit.txt'
    printf,99,'Path,Name,Mv,Skybot_Detections,Number_Detections,Final_Positions,Flag_Positions,Flag_Fit'

    for l=0,n_elements(Types)-1 do begin
        print,'-------------------------------------------------------------------------------------------'

        readcol,working_path(i)+'asteroid_'+Types(l)+'.txt',
        f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,d,f,a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d,d,a,d,i', MAG_ISOCOR8 , MAGERR_ISOCOR8 ,
        FLUX_AUTO8 , FLUXERR_AUTO8 , SNR_WIN8 , XWIN_IMAGE8 , YWIN_IMAGE8 , ALPHAWIN_SKY8 , DELTAWIN_SKY8 , ERRAWIN_IMAGE8 ,
        ERRBWIN_IMAGE8 , ERRTHETAWIN_IMAGE8 , FLAGS8 , FLAGS_WEIGHT8 , MAG_ISOCOR_CALIBRATED8 , MAGERR_ISOCOR_CALIBRATED8 ,
        Poserr8 , Num8 , Name8 , RA8 , DEC8 , Class8 , Mv8 , ErrPos8 , d8 , dRAcosDec8 , dDEC8 , Dgeo8 , Dhelio8 , _RAJ20008
        , _DECJ20008 , ExternalLink8 , search_radius8 , Separation8 , Image8 , JD8 , FLAG_NEARBY8 , delimiter=','

        readcol,working_path(i)+'asteroid_'+Types(l)+'-sat.txt',
        f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,d,f,a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d,d,a,d,i', MAG_ISOCOR7 , MAGERR_ISOCOR7 ,
        FLUX_AUTO7 , FLUXERR_AUTO7 , SNR_WIN7 , XWIN_IMAGE7 , YWIN_IMAGE7 , ALPHAWIN_SKY7 , DELTAWIN_SKY7 , ERRAWIN_IMAGE7 ,
        ERRBWIN_IMAGE7 , ERRTHETAWIN_IMAGE7 , FLAGS7 , FLAGS_WEIGHT7 , MAG_ISOCOR_CALIBRATED7 , MAGERR_ISOCOR_CALIBRATED7 ,
        Poserr7 , Num7 , Name7 , RA7 , DEC7 , Class7 , Mv7 , ErrPos7 , d7 , dRAcosDec7 , dDEC7 , Dgeo7 , Dhelio7 , _RAJ20007
        , _DECJ20007 , ExternalLink7 , search_radius7 , Separation7 , Image7 , JD7 , FLAG_NEARBY7 , delimiter=','

        readcol,working_path(i)+'asteroid_'+Types(l)+'-fit.txt',
        f='f,f,d,d,f,d,d,d,d,f,f,f,i,i,d,d,f,a,a,a,a,a,f,f,d,f,f,d,d,d,d,a,d,d,a,d,i,a', MAG_ISOCOR4 , MAGERR_ISOCOR4 ,
        FLUX_AUTO4 , FLUXERR_AUTO4 , SNR_WIN4 , XWIN_IMAGE4 , YWIN_IMAGE4 , ALPHAWIN_SKY4 , DELTAWIN_SKY4 , ERRAWIN_IMAGE4 ,
        ERRBWIN_IMAGE4 , ERRTHETAWIN_IMAGE4 , FLAGS4 , FLAGS_WEIGHT4 , MAG_ISOCOR_CALIBRATED4 , MAGERR_ISOCOR_CALIBRATED4 ,
        Poserr4 , Num4 , Name4 , RA4 , DEC4 , Class4 , Mv4 , ErrPos4 , d4 , dRAcosDec4 , dDEC4 , Dgeo4 , Dhelio4 , _RAJ20004
        , _DECJ20004 , ExternalLink4 , search_radius4 , Separation4 , Image4 , JD4 , FLAG_NEARBY4 , Final_Flag4 , delimiter=','

        flag_positions = 0
        numb_count = 0
            for k = 0,n_elements(Name4)-1 do begin
                    if Name4(k) eq Types(l) then begin
```

```
                                numb_count = numb_count+1
                        endif
                endfor

        numb_count2 = 0
                for p = 0,n_elements(Name7)-1 do begin
                        if Name7(p) eq Types(l) then begin
                                numb_count2 = numb_count2+1
                        endif
                endfor

        numb_count3 = 0
                for z = 0,n_elements(Name8)-1 do begin
                        if Name8(z) eq Types(l) then begin
                                numb_count3 = numb_count3+1
                        endif
                endfor

        for n =0,n_elements(Name6)-1 do begin
            if (Name6(n) eq Types(l) and FLAG_NEARBY6(n) eq 1) then begin
                flag_positions = 1
            endif
        endfor

        if numb_count2 gt numb_count then begin
            flag_positions = flag_positions+2
        endif

        if numb_count3 gt numb_count2 then begin
            flag_positions = flag_positions+4
        endif

        ;flag positions code:
        if flag_positions eq 0 then begin
                        flag_pos = 'null'
                endif
        if flag_positions eq 1 then begin
            flag_pos = 'St'
        endif
        if flag_positions eq 2 then begin
            flag_pos = 'Sc'
        endif
        if flag_positions eq 3 then begin
                        flag_pos = 'St Sc'
                endif
        if flag_positions eq 4 then begin
                        flag_pos = 'Sa'
                endif
        if flag_positions eq 5 then begin
                        flag_pos = 'St Sa'
                endif
        if flag_positions eq 6 then begin
                        flag_pos = 'Sc Sa'
                endif
        if flag_positions eq 7 then begin
                        flag_pos = 'St Sc Sa'
                endif

        ;print output:
        for m = 0,n_elements(Name5)-1 do begin
                        if Name5(m) eq Types(l) then begin
                                printf,99, Path5(m) , Name5(m) , Mv5(m)  , Skybot_Detections5(m) , Number_Detections5(m),
                                numb_count, flag_pos , Final_Flag4(0), f='(a,",",a,",",f,",",i,",",i,",",i,",",a,",",a)'
                        endif
                endfor

        openw,l+1,working_path(i)+'asteroid_'+Types(l)+'-fit.txt'
            printf,l+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE ,
            ALPHAWIN_SKY , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT ,
            MAG_ISOCOR_CALIBRATED , MAGERR_ISOCOR_CALIBRATED , Poserr , Num , Name , RA , DEC , Class , Mv , ErrPos , d ,
            dRAcosDec , dDEC , Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image , JD
            , FLAG_NEARBY, FLAG_FIT, FLAG_POSITIONS'

                for k=0,n_elements(Name4)-1 do begin
                    printf,l+1, MAG_ISOCOR4(k) , MAGERR_ISOCOR4(k) , FLUX_AUTO4(k) , FLUXERR_AUTO4(k) , SNR_WIN4(k) ,
                    XWIN_IMAGE4(k) , YWIN_IMAGE4(k) , ALPHAWIN_SKY4(k) , DELTAWIN_SKY4(k) , ERRAWIN_IMAGE4(k) ,
                    ERRBWIN_IMAGE4(k) , ERRTHETAWIN_IMAGE4(k) , FLAGS4(k) , FLAGS_WEIGHT4(k) , MAG_ISOCOR_CALIBRATED4(k) ,
                    MAGERR_ISOCOR_CALIBRATED4(k) , Poserr4(k) , Num4(k) , Name4(k) , RA4(k) , DEC4(k) , Class4(k) , Mv4(k) ,
                    ErrPos4(k) , d4(k) , dRAcosDec4(k) , dDEC4(k) , Dgeo4(k) , Dhelio4(k) , _RAJ20004(k) , _DECJ20004(k) ,
                    ExternalLink4(k) , search_radius4(k) , Separation4(k) , Image4(k) , JD4(k) , FLAG_NEARBY4(k) ,
                    Final_Flag4(k) , flag_pos  ,
                    f='(f,",",f,",",d,",",d,",",f,",",d,",",d,",",d,",",d,",",f,",",f,",",f,",",i,",",i,",",d,",",d,",",f,",",a
                    ,",",a,",",a,",",a,",",a,",",f,",",f,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",a,",",d,",",d,",",a,",",
                    d,",",i,",",a,",",a)'
                endfor
                close,l+1


    endfor
    close, 99

    ;remove unnecessary files:
        spawn,'rm '+working_path(i)+'*sepcrit.txt'
    spawn,'rm '+working_path(i)+'*sat.txt'
endfor

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '······························· END: FIT.PRO SCRIPT ·······························'
print, '#################################################################################'
print,''

end
```

```
;####################################################################################
;# File Name:       collect.pro                                                     #
;# Description:     Concatenate the data from the same asteroid but different       #
;#                  datasets. Place the results in the pathroot_results directory.  #
;# Last revision:   19/07/2018                                                      #
;#                                                                                  #
;# Author:          Cédric Pereira, Miriam Cortes, Enrique Solano                   #
;# Affiliation:     CAB (CSIC-INTA) & ESA - 2018                                    #
;#                                                                                  #
;# Inputs           configurations.txt                                              #
;#                  working_path.txt                                                #
;#                  asteroid_*-fit.txt                                              #
;#                                                                                  #
;# Outputs:         asteroid_*.txt  (results folder)                                #
;#                                                                                  #
;####################################################################################

print,''
print, '#################################################################################'
print, '···························· BEGIN: COLLECT.PRO SCRIPT ·····························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))
pathroot_results = values(WHERE(STRMATCH(keywords, 'PATHROOT_RESULTS', /FOLD_CASE) EQ 1))

;read working paths:
readcol,pathroot+'working_path.txt',f='a', working_path, delimiter = ','

;array to put directories:
asteroid_list = []
directory_list = []

;working path loop:
for i = 0, n_elements(working_path)-1 do begin

    print,''
    print, '·································································································'
    print, '>>>> Working Folder: '
    print, working_path(i)
    print, '·································································································'
    print,''

    ;map asteroid results files:
    asteroids = FILE_SEARCH(working_path(i)+'asteroid_*-fit.txt')

    ;join the directories in the array:
    for k=0, n_elements(asteroids)-1 do begin
        asteroid_list = [[asteroid_list],[asteroids[k]]]
        directory_list = [[directory_list],[working_path(i)]]
    endfor
endfor

;working asteroid path loop:
for l = 0, n_elements(asteroid_list)-1 do begin

    ;extract the file name:
    file_name = STRMID(asteroid_list(l), STRLEN(directory_list(l)) , STRLEN(asteroid_list(l)))

    ;add column with directory:
    spawn,'java -jar -Xmx2500m '+pathstilts+' -disk tpipe ifmt=csv ofmt=votable  in='+"'"+asteroid_list(l)+"'"+'
    cmd='+"'"+'addcol -before Num Directory '+'\"'+directory_list(l)+'\"'+"'"+' out='+"'"+asteroid_list(l)+"'"+'_collect'

endfor

;new array with the asteroid_list data:
asteroid_match=[asteroid_list]

;working asteroid path loop:
for l = 0, n_elements(asteroid_list)-1 do begin

    ;extract the file name:
    file_name = STRMID(asteroid_list(l), STRLEN(directory_list(l)) , STRLEN(asteroid_list(l)))

    ;copy the main file:
    if asteroid_match(l) ne 'null' then begin
        spawn,'cp '+"'"+asteroid_match(l)+"'"+'_collect'+' '+pathroot_results+"'"+file_name+"'"
    endif

    asteroid_match[l]='null'
    for m = 0, n_elements(asteroid_match)-1 do begin
        ;extract the file name:
        file_name2 = STRMID(asteroid_match(m), STRLEN(directory_list(m)) , STRLEN(asteroid_match(m)))

        ;concatenate same asteroid data:
        if file_name eq file_name2 then begin

            print,''
            print, '·································································································'
            print, '>>>> Concatenating: '
            print, asteroid_list(l)
            print, asteroid_match(m)
            print, '·································································································'
            print,''

            spawn,'java -jar -Xmx2400m '+pathstilts+' tcat ifmt=votable ofmt=votable
            in='+pathroot_results+"'"+file_name+"'"+' in='+"'"+asteroid_match(m)+"'"+'_collect'+'
            out='+pathroot_results+"'"+file_name+"'"

            asteroid_match[m]='null'
```

```

        endif
    endfor
endfor

;working path loop:
for i = 0, n_elements(working_path)-1 do begin
    ;remove unnecessary files:
    spawn,'rm '+working_path(i)+'*_collect'
endfor

;map asteroid results files:
asteroids_end = FILE_SEARCH(pathroot_results+'*')

for m = 0, n_elements(asteroids_end)-1 do begin

    ;convert files .xml to csv
    spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy ifmt=votable ofmt=csv in='+"'"+asteroids_end(m)+"'"+'
    out='+"'"+asteroids_end(m)+"'"

    ;extract the file name:
    file_name3 = STRMID(asteroids_end(m), STRLEN(pathroot_results) , STRLEN(asteroids_end(m))-STRLEN(pathroot_results)-8)

    ;modify the name:
    spawn, 'cp '+"'"+asteroids_end(m)+"'"+' '+"'"+pathroot_results+file_name3+"'"+'.txt'

endfor

;remove unnecessary files:
spawn,'rm '+pathroot_results+'*-fit.txt'

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '···························· END: COLLECT.PRO SCRIPT ·····························'
print, '##################################################################################'
print,''

end
```

```
;########################################################################################
;# File Name:       info.pro                                                            #
;# Description:     Display a message to inform to do a visual inspection.              #
;# Last revision:   19/07/2018                                                          #
;#                                                                                      #
;# Author:          Cédric Pereira, Miriam Cortes, Enrique Solano                       #
;# Affiliation:     CAB (CSIC-INTA) & ESA - 2018                                        #
;#                                                                                      #
;# Inputs                                                                               #
;#                                                                                      #
;# Outputs:                                                                             #
;#                                                                                      #
;########################################################################################

print,''
print, '#################################################################################'
print, '····························· BEGIN: INFO.PRO SCRIPT ····························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot_results = values(WHERE(STRMATCH(keywords, 'PATHROOT_RESULTS', /FOLD_CASE) EQ 1))

print,''
print, '·································································································'
print, '>>>> It is time to make a visual inspection of each result.'
print, '>>>> Please visualize the asteroid positions and exclude bad positions.'
print, '>>>> Take a look at the light curves and exclude bad points/outliers.'
print, '>>>> Dont change the name of the files. Open them, remove bad lines and save them with the same name.'

print,''
print, '>>>> You need to check the following results/files:'
print,''

;map asteroid results files:
asteroids_results = FILE_SEARCH(pathroot_results+'asteroid_*.txt')

print,''
print, '>>>> Result files:'
print, asteroids_results
print,''

print, '·································································································'

option = ''
again:
;read menu option:
READ, option, PROMPT='After the visual inspection, enter "Y" to proceed: '

;option Y - Proceed
if option eq 'Y' then begin
    goto, proceed
endif

;option not valid:
if option ne 'Y' then begin
    print, 'Option not valid!'
        goto, again
endif

proceed:

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '······························ END: INFO.PRO SCRIPT ·····························'
print, '#################################################################################'
print,''

end
```

```
;################################################################################
;# File Name:           fit_collect.pro                                        #
;# Description:         Filter the asteroid positions, flag behaviours and create an    #
;#                      outfile with the data for each asteroid. After filter data.     #
;# Last revision:       23/07/2018                                             #
;#                                                                             #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano          #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                           #
;#                                                                             #
;# Inputs               configurations.txt                                     #
;#                      asteroid_*.txt                                         #
;#                                                                             #
;# Outputs:             asteroid_*-end.txt                                     #
;#                                                                             #
;################################################################################

print,''
print, '################################################################################'
print, '························ BEGIN: FIT_COLLECT.PRO SCRIPT ························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
pathroot_results = values(WHERE(STRMATCH(keywords, 'PATHROOT_RESULTS', /FOLD_CASE) EQ 1))

;map asteroid results files:
asteroids = FILE_SEARCH(pathroot_results+'asteroid_*.txt')

;asteroids loop:
for i = 0, n_elements(asteroids)-1 do begin

        print,''
        print, '·······························································'
        print, '>>>> Working Asteroid: '
        print, asteroids(i)
        print, '·······························································'
        print,''

    ;extract the file name:
    file_name = STRMID(asteroids(i), STRLEN(pathroot_results) , STRLEN(asteroids(i))-STRLEN(pathroot_results)-4)

    ;read results_wo_nearby_stars.csv:
    readcol,asteroids(i), f='d,f,d,d,d,d,d,d,d,f,f,d,i,i,d,d,d,a,a,a,a,a,a,d,f,f,d,d,d,d,d,d,a,d,d,a,d,i,a,a', MAG_ISOCOR ,
    MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY , DELTAWIN_SKY ,
    ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
    MAGERR_ISOCOR_CALIBRATED ,  Poserr ,Directory  , Num , Name , RA , DEC , Class , Mv , ErrPos , d , dRAcosDec , dDEC ,
    Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image , JD , FLAG_NEARBY , FLAG_FIT ,
    FLAG_POSITIONS  ,delimiter=','

    ;read results files:
    openw,i+1,+pathroot_results+file_name+'-final.txt'
    printf,i+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY ,
    DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
    MAGERR_ISOCOR_CALIBRATED , Poserr , Directory  , Num , Name , RA , DEC , Class , Mv , ErrPos , d , dRAcosDec , dDEC ,
    Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image , JD , FLAG_NEARBY,
    FLAG_FIT,FLAG_POSITIONS'

    ;filter outlier points:
    whl_total = n_elements(Separation)-1
    whl_count = 0
    whl=0
    while (whl eq 0) do begin

            mean_sep = mean(Separation)
            std_sep = stddev(Separation)
            threshold_minus = Separation-(mean_sep-3*std_sep)
            threshold_plus = Separation-(mean_sep+3*std_sep)
            remove_array=[]

            for k=0,n_elements(Separation)-1 do begin
                    if (threshold_minus(k) lt 0) or (threshold_plus(k) gt 0) then begin
                            remove_array = [[remove_array],[k]]
                    endif
            endfor

            remove,remove_array, MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE ,
            ALPHAWIN_SKY , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT ,
            MAG_ISOCOR_CALIBRATED , MAGERR_ISOCOR_CALIBRATED , Poserr , Num , Name , RA , DEC , Class

            remove,remove_array, Mv , ErrPos , d , dRAcosDec , dDEC , Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink ,
            search_radius , Separation , Image , JD , FLAG_NEARBY , FLAG_FIT, Directory,FLAG_POSITIONS

            whl_count = whl_count+1
            if (whl_count eq whl_total) then begin
                    whl=1
            endif

    endwhile

    ;write a new file with the filtered results:
    for k=0,n_elements(Separation)-1 do begin
            printf,i+1, MAG_ISOCOR(k) , MAGERR_ISOCOR(k) , FLUX_AUTO(k) , FLUXERR_AUTO(k) , SNR_WIN(k) , XWIN_IMAGE(k) ,
            YWIN_IMAGE(k) , ALPHAWIN_SKY(k) , DELTAWIN_SKY(k) , ERRAWIN_IMAGE(k) , ERRBWIN_IMAGE(k) , ERRTHETAWIN_IMAGE(k) ,
            FLAGS(k) , FLAGS_WEIGHT(k) , MAG_ISOCOR_CALIBRATED(k) , MAGERR_ISOCOR_CALIBRATED(k) , Poserr(k) , Directory(k) ,
            Num(k) , Name(k) , RA(k) , DEC(k) , Class(k) , Mv(k) , ErrPos(k) , d(k) , dRAcosDec(k) , dDEC(k) , Dgeo(k) ,
            Dhelio(k) , _RAJ2000(k) , _DECJ2000(k) , ExternalLink(k) , search_radius(k) , Separation(k) , Image(k) , JD(k) ,
            FLAG_NEARBY(k) , FLAG_FIT(k), FLAG_POSITIONS(k) ,
            f='(d,",",f,",",d,",",d,",",d,",",d,",",d,",",d,",",d,",",f,",",f,",",d,",",i,",",i,",",d,",",d,",",d,",",a,",",a,"
            ,",a,",",a,",",a,",",a,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",d,",",d,",",a,",",d,",",d,",",a,",",d,",",i,",
            ",a,",",a)'
    endfor
```

```

    ;close the files:
    close,i+1

    ;read the filteres files:
    readcol,+pathroot_results+file_name+'-final.txt',
    f='d,d,d,d,d,d,d,d,d,d,d,d,i,i,d,d,d,a,a,a,a,a,a,d,d,d,d,d,d,d,d,a,d,d,a,d,i,a,a', MAG_ISOCOR2 , MAGERR_ISOCOR2 ,
    FLUX_AUTO2 , FLUXERR_AUTO2 , SNR_WIN2 , XWIN_IMAGE2 , YWIN_IMAGE2 , ALPHAWIN_SKY2 , DELTAWIN_SKY2 , ERRAWIN_IMAGE2 ,
    ERRBWIN_IMAGE2 , ERRTHETAWIN_IMAGE2 , FLAGS2 , FLAGS_WEIGHT2 , MAG_ISOCOR_CALIBRATED2 , MAGERR_ISOCOR_CALIBRATED2 ,
    Poserr2 , Directory2 , Num2 , Name2 , RA2 , DEC2 , Class2 , Mv2 , ErrPos2 , d2 , dRAcosDec2 , dDEC2 , Dgeo2 , Dhelio2 ,
    _RAJ20002 , _DECJ20002 , ExternalLink2 , search_radius2 , Separation2 , Image2 , JD2 , FLAG_NEARBY2 , FLAG_FIT2 ,
    FLAG_POSITIONS2,  delimiter=','

    ;flag proper motions:
    if (n_elements(Name2) gt 1) then begin

            regpos =
            regress(ALPHAWIN_SKY2,DELTAWIN_SKY2,measure_errors=Poserr2,sigma=sigma_res,correlation=corr_pos,ftest=f_value_pos)
            print, regpos
            print, corr_pos
            print, f_value_pos

            jdpoints=minmax(JD2,subs)
            jd1=jdpoints[0]
            jd9=jdpoints[1]
            djd=abs(jd9-jd1)

            lfit_ra=linfit(JD2,ALPHAWIN_SKY2,measure_errors=Poserr2)
            beta_ra=(ALPHAWIN_SKY2-lfit_ra[0])/JD2
            factor=3600/24
            pmrasex=mean(beta_ra)*factor*cos(!dtor*mean(DELTAWIN_SKY2))
            epmrasex=stddev(beta_ra)*factor*cos(!dtor*mean(DELTAWIN_SKY2))

            lfit_dec=linfit(JD2,DELTAWIN_SKY2,measure_errors=Poserr2)
            beta_dec=(DELTAWIN_SKY2-lfit_dec[0])/JD2
            pmdecsex=mean(beta_dec)*factor
            epmdecsex=stddev(beta_dec)*factor

            pmraskym=mean(dRAcosDEC2)
            pmraskystd=stdev(dRAcosDEC2)
            pmdecskym=mean(dDEC2)
            pmdecskystd=stdev(dDEC2)
            GIDn=strcompress(k,/remove_all)

            dmura=abs((pmrasex-pmraskym)/pmraskym)
            dmudec=abs((pmdecsex-pmdecskym)/pmdecskym)

        if abs(corr_pos) ge 0.90 then begin
                    flaglin="A"
            endif else begin
                    flaglin="B"
            endelse


            if dmura le 0.20 then begin
                    flagpmra="A"
            endif else begin
                    flagpmra="B"
            endelse


            if dmudec le 0.20 then begin
                    flagpmdec="A"
            endif else begin
                    flagpmdec="B"
            endelse

            Final_Flag = flaglin+flagpmra+flagpmdec

        ;create a new file with the final results:
        openw,i+1,+pathroot_results+file_name+'-end.txt'
            printf,i+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE ,
            ALPHAWIN_SKY , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT ,
            MAG_ISOCOR_CALIBRATED , MAGERR_ISOCOR_CALIBRATED , Poserr , Directory , Num , Name , RA , DEC , Class , Mv ,
            ErrPos , d , dRAcosDec , dDEC , Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation
            , Image , JD , FLAG_NEARBY, FLAG_FIT , FLAG_FIT_END , FLAG_POSITIONS'

        ;print results:
        for l=0,n_elements(Name2)-1 do begin
                    printf,i+1, MAG_ISOCOR2(l) , MAGERR_ISOCOR2(l) , FLUX_AUTO2(l) , FLUXERR_AUTO2(l) , SNR_WIN2(l) ,
                    XWIN_IMAGE2(l) , YWIN_IMAGE2(l) , ALPHAWIN_SKY2(l) , DELTAWIN_SKY2(l) , ERRAWIN_IMAGE2(l) ,
                    ERRBWIN_IMAGE2(l) , ERRTHETAWIN_IMAGE2(l) , FLAGS2(l) , FLAGS_WEIGHT2(l) , MAG_ISOCOR_CALIBRATED2(l) ,
                    MAGERR_ISOCOR_CALIBRATED2(l) , Poserr2(l) , Directory2(l) , Num2(l) , Name2(l) , RA2(l) , DEC2(l) ,
                    Class2(l) , Mv2(l) , ErrPos2(l) , d2(l) , dRAcosDec2(l) , dDEC2(l) , Dgeo2(l) , Dhelio2(l) , _RAJ20002(l)
                    , _DECJ20002(l) , ExternalLink2(l) , search_radius2(l) , Separation2(l) , Image2(l) , JD2(l) ,
                    FLAG_NEARBY2(l) , FLAG_FIT2(l) , Final_Flag , FLAG_POSITIONS(l) ,
                    f='(d,",",f,",",d,",",d,",",d,",",d,",",d,",",d,",",d,",",f,",",f,",",d,",",i,",",i,",",d,",",d,",",d,",",a
                    ,",",a,",",a,",",a,",",a,",",a,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",d,",",d,",",a,",",d,",",d,",",
                    a,",",d,",",i,",",a,",",a,",",a)'
            endfor

        ;close files:
        close,i+1
    endif else begin

        Final_Flag = 'null'

        ;create a new file with the final results:
                openw,i+1,+pathroot_results+file_name+'-end.txt'
                printf,i+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE ,
                ALPHAWIN_SKY , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT ,
                MAG_ISOCOR_CALIBRATED , MAGERR_ISOCOR_CALIBRATED , Poserr , Directory , Num , Name , RA , DEC , Class , Mv ,
                ErrPos , d , dRAcosDec , dDEC , Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius ,
                Separation , Image , JD , FLAG_NEARBY, FLAG_FIT , FLAG_FIT_END , FLAG_POSITIONS'

```

```
                ;print results:
                for l=0,n_elements(Name2)-1 do begin
                        printf,i+1, MAG_ISOCOR2(l) , MAGERR_ISOCOR2(l) , FLUX_AUTO2(l) , FLUXERR_AUTO2(l) , SNR_WIN2(l) ,
                        XWIN_IMAGE2(l) , YWIN_IMAGE2(l) , ALPHAWIN_SKY2(l) , DELTAWIN_SKY2(l) , ERRAWIN_IMAGE2(l) ,
                        ERRBWIN_IMAGE2(l) , ERRTHETAWIN_IMAGE2(l) , FLAGS2(l) , FLAGS_WEIGHT2(l) , MAG_ISOCOR_CALIBRATED2(l)
                        , MAGERR_ISOCOR_CALIBRATED2(l) , Poserr2(l) , Directory2(l) , Num2(l) , Name2(l) , RA2(l) , DEC2(l) ,
                        Class2(l) , Mv2(l) , ErrPos2(l) , d2(l) , dRAcosDec2(l) , dDEC2(l) , Dgeo2(l) , Dhelio2(l) ,
                        _RAJ20002(l) , _DECJ20002(l) , ExternalLink2(l) , search_radius2(l) , Separation2(l) , Image2(l) ,
                        JD2(l) , FLAG_NEARBY2(l) , FLAG_FIT2(l) , Final_Flag , FLAG_POSITIONS(l) ,
                        f='(d,",",f,",",d,",",d,",",d,",",d,",",d,",",d,",",d,",",f,",",f,",",d,",",i,",",i,",",d,",",d,",",d,"
                        ,",a,",",a,",",a,",",a,",",a,",",a,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",d,",",d,",",a,",",d,",
                        ",d,",",a,",",d,",",i,",",a,",",a,",",a)'
                endfor

                ;close files:
                close,i+1


        endelse


        readcol,asteroids(i), f='d,f,d,d,d,d,d,d,d,f,f,d,i,i,d,d,d,a,a,a,a,a,a,d,f,f,d,d,d,d,d,d,a,d,d,a,d,i,a,a', MAG_ISOCOR8 ,
        MAGERR_ISOCOR8 , FLUX_AUTO8 , FLUXERR_AUTO8 , SNR_WIN8 , XWIN_IMAGE8 , YWIN_IMAGE8 , ALPHAWIN_SKY8 , DELTAWIN_SKY8 ,
        ERRAWIN_IMAGE8 , ERRBWIN_IMAGE8 , ERRTHETAWIN_IMAGE8 , FLAGS8 , FLAGS_WEIGHT8 , MAG_ISOCOR_CALIBRATED8 ,
        MAGERR_ISOCOR_CALIBRATED8 ,  Poserr8 ,Directory8  , Num8 , Name8 , RA8 , DEC8 , Class8 , Mv8 , ErrPos8 , d8 , dRAcosDec8
        , dDEC8 , Dgeo8 , Dhelio8 , _RAJ20008 , _DECJ20008 , ExternalLink8 , search_radius8 , Separation8 , Image8 , JD8 ,
        FLAG_NEARBY8 , FLAG_FIT8 , FLAG_POSITIONS8  ,delimiter=','

            readcol,pathroot_results+file_name+'-end.txt',
            f='d,f,d,d,d,d,d,d,d,f,f,d,i,i,d,d,d,a,a,a,a,a,a,d,f,f,d,d,d,d,d,d,a,d,d,a,d,i,a,a,a', MAG_ISOCOR9 , MAGERR_ISOCOR9 ,
            FLUX_AUTO9 , FLUXERR_AUTO9 , SNR_WIN9 , XWIN_IMAGE9 , YWIN_IMAGE9 , ALPHAWIN_SKY9 , DELTAWIN_SKY9 , ERRAWIN_IMAGE9 ,
            ERRBWIN_IMAGE9 , ERRTHETAWIN_IMAGE9 , FLAGS9 , FLAGS_WEIGHT9 , MAG_ISOCOR_CALIBRATED9 , MAGERR_ISOCOR_CALIBRATED9 ,
            Poserr9 , Directory9 ,Num9 , Name9 , RA9 , DEC9 , Class9 , Mv9 , ErrPos9 , d9 , dRAcosDec9 , dDEC9 , Dgeo9 , Dhelio9
            , _RAJ20009 , _DECJ20009 , ExternalLink9 , search_radius9 , Separation9 , Image9 , JD9 , FLAG_NEARBY9 , FLAG_FIT9 ,
            Final_Flag9 , FLAG_POSITIONS9 , delimiter=','


        positions8=n_elements(Name8)
        positions9=n_elements(Name9)

        if positions8 eq positions9 then begin
            flag_pos = 0
        endif

        if positions8 ne positions9 then begin
                    flag_pos = 1
            endif


            ;flag positions code:
            if flag_pos eq 0 then begin
                flag_posi = 'null'
            endif
            if flag_pos eq 1 then begin
                flag_posi = 'Sc'
            endif

        openw,i+1,+pathroot_results+file_name+'-end.txt'
            printf,i+1,' MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY
            , DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
            MAGERR_ISOCOR_CALIBRATED , Poserr , Directory , Num , Name , RA , DEC , Class , Mv , ErrPos , d , dRAcosDec , dDEC ,
            Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image , JD , FLAG_NEARBY, FLAG_FIT
            , FLAG_FIT_END , FLAG_POSITIONS, FLAG_POSITIONS_END'

        ;print results:
            for l=0,n_elements(Name9)-1 do begin
                printf,i+1, MAG_ISOCOR9(l) , MAGERR_ISOCOR9(l) , FLUX_AUTO9(l) , FLUXERR_AUTO9(l) , SNR_WIN9(l) , XWIN_IMAGE9(l)
                , YWIN_IMAGE9(l) , ALPHAWIN_SKY9(l) , DELTAWIN_SKY9(l) , ERRAWIN_IMAGE9(l) , ERRBWIN_IMAGE9(l) ,
                ERRTHETAWIN_IMAGE9(l) , FLAGS9(l) , FLAGS_WEIGHT9(l) , MAG_ISOCOR_CALIBRATED9(l) , MAGERR_ISOCOR_CALIBRATED9(l) ,
                Poserr9(l) , Directory9(l) , Num9(l) , Name9(l) , RA9(l) , DEC9(l) , Class9(l) , Mv9(l) , ErrPos9(l) , d9(l) ,
                dRAcosDec9(l) , dDEC9(l) , Dgeo9(l) , Dhelio9(l) , _RAJ20009(l) , _DECJ20009(l) , ExternalLink9(l) ,
                search_radius9(l) , Separation9(l) , Image9(l) , JD9(l) , FLAG_NEARBY9(l) , FLAG_FIT9(l) , Final_Flag9(l) ,
                FLAG_POSITIONS9(l) , flag_posi ,
                f='(d,",",f,",",d,",",d,",",d,",",d,",",d,",",d,",",d,",",f,",",f,",",d,",",i,",",i,",",d,",",d,",",d,",",a,",",a,"
                ,",a,",",a,",",a,",",a,",",d,",",f,",",f,",",d,",",d,",",d,",",d,",",d,",",d,",",a,",",d,",",d,",",a,",",d,",",i,",
                ",a,",",a,",",a,",",a)'
            endfor
        close,i+1

    endfor

    ;remove unnecessary files:
    spawn,'rm '+pathroot_results+'*-final.txt'

    print,''
    print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
    print, '·························· END: FIT_COLLECT.PRO SCRIPT ·························'
    print, '##################################################################################'
    print,''

    end
```

```
;##########################################################################################
;# File Name:       resume_end.pro                                                        #
;# Description:     Resume all the results.                                               #
;# Last revision:   23/07/2018                                                            #
;#                                                                                        #
;# Author:          Cédric Pereira, Miriam Cortes, Enrique Solano                         #
;# Affiliation:     CAB (CSIC-INTA) & ESA - 2018                                          #
;#                                                                                        #
;# Inputs           configurations.txt                                                    #
;#                  asteroid_*-end.txt                                                    #
;#                                                                                        #
;# Outputs:         resume-end.txt                                                        #
;#                                                                                        #
;##########################################################################################

print,''
print, '###########################################################################'
print, '························ BEGIN: RESUME_END.PRO SCRIPT ·························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
pathroot_results = values(WHERE(STRMATCH(keywords, 'PATHROOT_RESULTS', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))

;map asteroid results files:
asteroids_end = FILE_SEARCH(pathroot_results+'asteroid_*-end.txt')

;create new file with the resume:
openw,1,pathroot_results+'resume-end.txt'
printf,1,' Num , Name , Mv , Skybot Positions , Final Positions , Mean , SD , Flag Fit , Flag Fit End , Flag Positions, Flag Positions End'

;asteroids loop:
for i = 0, n_elements(asteroids_end)-1 do begin

        print,''
        print, '·······································································'
        print, '>>>> Working Asteroid: '
        print, asteroids_end(i)
        print, '·······································································'
        print,''

        ;extract the file name:
        file_name = STRMID(asteroids_end(i), STRLEN(pathroot_results) , STRLEN(asteroids_end(i))-STRLEN(pathroot_results)-4)

        ;read results:
        readcol,asteroids_end(i), f='d,f,d,d,d,d,d,d,d,f,f,d,i,i,d,d,d,a,a,a,a,a,a,d,f,f,d,d,d,d,d,d,a,d,d,a,d,i,a,a,a,a',
        MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY ,
        DELTAWIN_SKY , ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE , FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
        MAGERR_ISOCOR_CALIBRATED ,  Poserr ,Directory  , Num , Name , RA , DEC , Class , Mv , ErrPos , d , dRAcosDec , dDEC ,
        Dgeo , Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image , JD , FLAG_NEARBY ,
        FLAG_FIT , FLAG_FIT_END , FLAG_POSITIONS , FLAG_POSITIONS_END  , delimiter=','

    ;detect different flag positions:
    thr = ''
    St = 0
    Sc = 0
    Sa = 0
    St_Sc = 0
    St_Sa = 0
    Sc_Sa = 0
    St_Sc_Sa = 0
    for k = 0, n_elements(FLAG_POSITIONS)-1 do begin
                if FLAG_POSITIONS(k) eq 'St' then begin
                        St = 1
                endif
        endfor
    for k = 0, n_elements(FLAG_POSITIONS)-1 do begin
                if FLAG_POSITIONS(k) eq 'Sc' then begin
                        Sc = 2
                endif
        endfor
    for k = 0, n_elements(FLAG_POSITIONS)-1 do begin
        if FLAG_POSITIONS(k) eq 'Sa' then begin
                        Sa = 4
                endif
    endfor
    for k = 0, n_elements(FLAG_POSITIONS)-1 do begin
                if FLAG_POSITIONS(k) eq 'St Sc' then begin
                        St_Sc = 8
                endif
        endfor
    for k = 0, n_elements(FLAG_POSITIONS)-1 do begin
                if FLAG_POSITIONS(k) eq 'St Sa' then begin
                        St_Sa = 16
                endif
        endfor
    for k = 0, n_elements(FLAG_POSITIONS)-1 do begin
                if FLAG_POSITIONS(k) eq 'Sc Sa' then begin
                        Sc_Sa = 32
                endif
        endfor
    for k = 0, n_elements(FLAG_POSITIONS)-1 do begin
                if FLAG_POSITIONS(k) eq 'St Sc Sa' then begin
                        St_Sc_Sa = 64
                endif
        endfor
```

```
thr_result = St + Sc + Sa + St_Sc + St_Sa + Sc_Sa + St_Sc_Sa

if thr_result eq 1 then begin
    thr = 'St'
endif
if thr_result eq 2 then begin
            thr = 'Sc'
    endif
if thr_result eq 4 then begin
            thr = 'Sa'
    endif
if thr_result eq 3 or thr_result eq 8 or thr_result eq 9 or thr_result eq 10 or thr_result eq 11 then begin
            thr = 'St Sc'
    endif
if thr_result eq 5 or thr_result eq 16 or thr_result eq 17 or thr_result eq 18 or thr_result eq 19 then begin
            thr = 'St Sa'
    endif
if thr_result eq 6 or thr_result eq 32 or thr_result eq 34 or thr_result eq 36 or thr_result eq 38 then begin
            thr = 'Sc Sa'
    endif
if thr_result eq 7 or thr_result eq 33 or thr_result eq 35 or thr_result eq 37 or thr_result eq 39 or (thr_result gt 11 and thr_result lt 16) or (thr_result gt 19 and thr_result lt 32) or thr_result gt 39 then begin
            thr = 'St Sc Sa'
    endif




;compute statistics:
    spawn,'java -jar -Xmx1200m '+pathstilts+' tpipe ifmt=csv in='+"'"+asteroids_end(i)+"'"+' cmd='+"'"+ 'stats Name StDev Mean NGood'+"'"+' ofmt=csv-noheader out='+pathroot_results+'stats.csv'

;read statistics:
    readcol,pathroot_results+'stats.csv',f='a,f,f,i',namec,sdl,meanl,ngood

for k = 0, n_elements(namec)-1 do begin
    if namec(k) eq "Separation" then begin
        meanl2=meanl(k)
        sdl2=sdl(k)
    endif
endfor

;detect different flag positions:
dFlag_Fit=0
    Fit_Types = []
    for k = 0,n_elements(FLAG_FIT)-1 do begin
            for l = 0,n_elements(Fit_Types)-1 do begin
                    if FLAG_FIT(k) eq Fit_Types(l) then begin
                            dFlag_Fit = 1
                    endif
            endfor

            if dFlag_Fit eq 0 then begin
                    Fit_Types = [[Fit_Types],[FLAG_FIT(k)]]
            endif
            dFlag_Fit = 0
    endfor

Fit_Total=''
for n = 0, n_elements(Fit_Types)-1 do begin
    Fit_Total = Fit_Total +' '+Fit_Types(n)
endfor


;clear word null:
if FLAG_POSITIONS_END(0) eq 'null' then begin
    FLAG_POSITIONS_END(0) = ''
endif

if FLAG_FIT_END(0) eq 'null' then begin
            FLAG_FIT_END(0) = ''
    endif

;count number of final positions:
Final_Positionsl = n_elements(Name)

;count number of skybot positions:
    dFlag=0
    dir = []
for k = 0,n_elements(Directory)-1 do begin
            for l = 0,n_elements(dir)-1 do begin
                    if Directory(k) eq dir(l) then begin
                            dFlag = 1
                    endif
            endfor

            if dFlag eq 0 then begin
                    dir = [[dir],[Directory(k)]]
            endif
            dFlag = 0
    endfor

skybot = 0
for j = 0,n_elements(dir)-1 do begin
    readcol,dir(j)+'resume-fit.txt', f='a,a,d,i,i,i,a,a', xPath , xName , xMv , xSkybot_Detections , xNumber_Detections , xFinal_Positions , XFlag_Positions , xFlag_Fit  , delimiter=','
    for m = 0,n_elements(xName)-1 do begin
        if Name(0) eq xName(m) then begin
            skybot = skybot + xSkybot_Detections(m)
        endif
    endfor
endfor
```

```
    ;print resume file:
    printf,1, Num(0) , Name(0) , Mv(0) , skybot  , Final_Positionsl , meanl2 , sdl2 , Fit_Total , FLAG_FIT_END(0) , thr ,
    FLAG_POSITIONS_END(0) , f='(a,",",a,",",d,",",i,",",i,",",d,",",d,",",a,",",a,",",a,",",a)'


endfor

;close files:
close,1

;remove unnecessary files:
spawn,'rm '+pathroot_results+'stats.csv'

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '·························· END: RESUME_END.PRO SCRIPT ···························'
print, '################################################################################'
print,''

end
```

```
;#####################################################################################
;# File Name:           mir.pro                                                      #
;# Description:         Phase angle calibration fo the light curves.                 #
;# Last revision:       30/07/2018                                                   #
;#                                                                                   #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                #
;# Affiliation:         CAB (CSIC-INTA) & ESA - 2018                                 #
;#                                                                                   #
;# Inputs               configurations.txt                                           #
;#                      asteroid_*-end.txt                                           #
;#                                                                                   #
;# Outputs:                                                                          #
;#                                                                                   #
;#####################################################################################

print,''
print, '####################################################################################'
print, '······························ BEGIN: MIR.PRO SCRIPT ······························'
print, '>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>'
print,''

;close files:
close, 1

;read configurations file:
readcol,'configurations.txt',f='a,a,a', keywords , values , comments , delimiter=' ,#'

;define configuration variables:
pathroot = values(WHERE(STRMATCH(keywords, 'PATHROOT', /FOLD_CASE) EQ 1))
pathroot_results = values(WHERE(STRMATCH(keywords, 'PATHROOT_RESULTS', /FOLD_CASE) EQ 1))
pathstilts = values(WHERE(STRMATCH(keywords, 'PATHSTILTS', /FOLD_CASE) EQ 1))

;map asteroid results files:
asteroids_end = FILE_SEARCH(pathroot_results+'asteroid_*-end.txt')

;asteroids loop:
for i = 0, n_elements(asteroids_end)-1 do begin

        print,''
        print, '····························································································'
        print, '>>>> Working Asteroid: '
        print, asteroids_end(i)
        print, '····························································································'
        print,''

    ;read final files
    readcol,asteroids_end(i),f='d,d,d,d,d,d,d,d,d,d,d,d,i,i,d,d,d,a,a,a,a,a,a,d,d,d,d,d,d,d,d,a,d,d,a,a,i,a,a,a,a',
    MAG_ISOCOR , MAGERR_ISOCOR , FLUX_AUTO , FLUXERR_AUTO , SNR_WIN , XWIN_IMAGE , YWIN_IMAGE , ALPHAWIN_SKY , DELTAWIN_SKY ,
    ERRAWIN_IMAGE , ERRBWIN_IMAGE , ERRTHETAWIN_IMAGE ,FLAGS , FLAGS_WEIGHT , MAG_ISOCOR_CALIBRATED ,
    MAGERR_ISOCOR_CALIBRATED , Poserr , Directory, Num , Name , RA , DEC , Class, Mv , ErrPos , d , dRAcosDec , dDEC , Dgeo ,
    Dhelio , _RAJ2000 , _DECJ2000 , ExternalLink , search_radius , Separation , Image, JD , FLAG_NEARBY , FLAG_FIT ,
    FLAG_FIT_END , FLAG_POSITIONS , FLAG_POSITIONS_END ,  delimiter=',' , skipline=1

    ;correct the name of the asteroid:
    name_correct=strjoin(strsplit(name(0), /EXTRACT), '_')

    ;extract the file name:
        file_name = STRMID(asteroids_end(i), STRLEN(pathroot_results) , STRLEN(asteroids_end(i))-STRLEN(pathroot_results)-4)

    ;open a new file to place the JD:
    openw,1,pathroot_results+'JD.txt'
    for k = 0,n_elements(JD)-1 do begin
        printf,1,JD(k)
    endfor
    close,1

    ;ask miriade service to return the parameters for the asteroid positions:
    spawn,'curl -F "epochs=@'+pathroot_results+'JD.txt"
    "http://vo.imcce.fr/webservices/miriade/ephemcc_query.php?-name=a:'+name_correct+'&-tscale=UTC&-observer=@J75&-theory=INPOP
    &-teph=1&-tcoor=5&-mime=votable&-output=--jd&-extrap=0&-from=MiriadeDoc" -o
    '+"'"+pathroot_results+file_name+"'"+'_miriade.txt'

    ;cross miriade result with asteroid positions:
    spawn,'java -jar -Xmx1200m '+pathstilts+' tmatch2 matcher=exact values1="JD" ifmt1=csv in1='+"'"+asteroids_end(i)+"'"+'
    values2="Date" ifmt2=votable in2='+"'"+pathroot_results+file_name+"'"+'_miriade.txt find=best
    out='+"'"+pathroot_results+file_name+"'"+'_cross.xml ofmt=votable'

    ;According with Carry et al. 2008 A&A 609, A113:
    spawn,'java -jar -Xmx1200m '+pathstilts+' tpipe ifmt=votable in='+"'"+pathroot_results+file_name+"'"+'_cross.xml
    cmd='+"'"+ 'addcol J_abs
    '+'"'+'MAG_ISOCOR_CALIBRATED+2.5*log10($55*$55*$56*$56)-2.5*log10((1-0.15)*exp(-3.33*tan(pow(degreesToRadians(Phase)/2,0.63
    )))+0.15*exp(-1.87*tan(pow(degreesToRadians(Phase)/2,1.22)))) "'+"'"+'
    out='+"'"+pathroot_results+file_name+"'"+'_crossmag.xml ofmt=votable'

    ;calculate statistics:
    spawn,'java -jar -Xmx1200m '+pathstilts+' tpipe ifmt=votable in='+"'"+pathroot_results+file_name+"'"+'_crossmag.xml
    cmd='+"'"+ 'stats Name Mean StDev'+"'"+' ofmt=csv out='+"'"+pathroot_results+file_name+"'"+'Jabs_stats.csv'

    ;read statistics:
    readcol,pathroot_results+file_name+'Jabs_stats.csv',f='a,f,f',colname,mean,std,delimiter=','
        for l=0,n_elements(colname)-1 do begin

                check=strmatch(colname(l),"J_abs")
                if (check eq 1) then begin
                        Jabs_mean=mean(l)
                        Jabs_std=std(l)
                endif
         endfor

    Jabsm=strcompress(Jabs_mean,/remove_all)
        Jabsstd=strcompress(Jabs_std,/remove_all)

    ;final table:
        spawn,'java -jar -Xmx1200m '+pathstilts+' tpipe ifmt=votable in='+"'"+pathroot_results+file_name+"'"+'_crossmag.xml
        cmd='+"'"+ 'addcol F '+'"'+'(1-pow(10,-(J_abs-'+Jabsm+')/2.512))*pow(10,6) "'+"'"+' cmd='+"'"+ 'addcol eF
```

```
        '+'"'+'(pow(10,-(J_abs-'+Jabsm+')/2.512))*pow(10,6)*ln(10)*sqrt(MAGERR_ISOCOR_CALIBRATED*MAGERR_ISOCOR_CALIBRATED+'+Jab
        sstd+'*'+Jabsstd+')/2.512 "'+"'"+' out='+"'"+pathroot_results+file_name+"'"+'_crossmagflux.xml ofmt=votable'

    ;convert final file to .csv:
        spawn,'java -jar -Xmx2400m '+pathstilts+' tcopy in='+"'"+pathroot_results+file_name+"'"+'_crossmagflux.xml
        out='+"'"+pathroot_results+file_name+"'"+'_final.csv'

    ;extract nasa exoplanet periodogram data file:
    spawn,'java -jar -Xmx1200m '+pathstilts+' tpipe ifmt=votable in='+"'"+pathroot_results+file_name+"'"+'_crossmagflux.xml
    cmd='+"'"+ 'keepcols  '+'"'+'JD J_abs'+'"'+"'"+'  cmd='+"'"+ 'sort JD'+"'"+'
    out='+"'"+pathroot_results+file_name+"'"+'_NASA.txt ofmt=csv'


endfor

;close files:
close,1

;remove unnecessary files:
spawn,'rm '+pathroot_results+'asteroid_*-end_cross.xml'
spawn,'rm '+pathroot_results+'asteroid_*-end_crossmag.xml'
spawn,'rm '+pathroot_results+'asteroid_*-end_crossmagflux.xml'
spawn,'rm '+pathroot_results+'asteroid_*-endJabs_stats.csv'
spawn,'rm '+pathroot_results+'JD.txt'
spawn,'rm '+pathroot_results+'asteroid_*-end_miriade.txt'

print,''
print, '<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<'
print, '······························ END: MIR.PRO SCRIPT ·····························'
print, '################################################################################'
print,''

end
```

```
;##########################################################################################
;# File Name:           configurations.txt                                              #
;# Description:         Configuration file with some parameters to run the software.    #
;#                      You can adjust some of the parameters to improve the pipeline.  #
;#                                                                                      #
;# Last revision:       04/07/2018                                                      #
;#                                                                                      #
;# Author:              Cédric Pereira, Miriam Cortes, Enrique Solano                   #
;# Affiliation:         CAB (CSIC-INTA) & ESA                                           #
;#                                                                                      #
;#                                                                                      #
;##########################################################################################

PATHROOT            /pcdisk/stark/astrofisica3/Research/Software/           #path to the folder with this software
PATHROOT_PICS       /pcdisk/stark/astrofisica3/Research/Software/pics/      #path to the folder with the data to process
PATHROOT_RESULTS    /pcdisk/stark/astrofisica3/Research/Software/results/   #path to the folder where to place the results
PATHSTILTS          /usr/local/stilts-3.0.9/stilts.jar                      #path to the software stilts
PATHSEX             /usr/bin/sex                                            #path to the software sex
IMAGE_EXT           .fts                                                    #image extension of the data to analyse

PERC_SOURCES        1       #quality factor of total number of sources [quality.pro]
PERC_SNR            1       #quality factor of SNR [quality.pro]
PERC_RATIO          1       #quality factor of shape [quality.pro]

INTERVAL            10      #interval between pictures [sigma.pro]

ERROR_GAIA          0.5     #cross-match radius [star.pro, asteroid.pro, ...]
MAG_MIN             12      #min magnitude (linear region) to calibrate the stars with gaia dr2 [mag.pro]
MAG_MAX             16      #max magnitude (linear region) to calibrate the stars with gaia dr2 [mag.pro]

SKYBOT_FOV          78x51   #FOV for skybot service return known asteroids [asteroid.pro]
SKYBOT_OBS          J75     #observatory for skybot service return known asteroids [asteroid.pro]

GAIA_ERROR          2.5     #cross-match radius [conct.pro???]
STAR_MAG            -8.77   #instrumental magnitude to define the nearby star filter [conct.pro???]
STAR_RADIUS_BIG     20      #big star radius to filter nearby stars above instrumental magnitude [conct.pro???]
STAR_RADIUS_SMALL   15      #small star radius to filter nearby stars under instrumental magnitude [conct.pro???]
GAIA_MAG            17.29   #gaia magnitude to define the nearby star filter [conct.pro???]
GAIA_RADIUS_BIG     20      #big star radius to filter nearby stars above gaia magnitude [conct.pro???]
GAIA_RADIUS_SMALL   15      #small star radius to filter nearby stars under gaia magnitude [conct.pro???]
```

```
# Default configuration file for SExtractor 2.5.0
# EB 2006-07-14
#

#-------------------------------- Catalog ------------------------------------

CATALOG_NAME     sex.cat        # name of the output catalog
CATALOG_TYPE     ASCII_VOTABLE  # NONE,ASCII,ASCII_HEAD, ASCII_SKYCAT,
                                # ASCII_VOTABLE, FITS_1.0 or FITS_LDAC
PARAMETERS_NAME  param.sex  # name of the file containing catalog contents

#------------------------------- Extraction ----------------------------------

DETECT_TYPE      CCD            # CCD (linear) or PHOTO (with gamma correction)
DETECT_MINAREA   5              # minimum number of pixels above threshold
DETECT_THRESH    2              # <sigmas> or <threshold>,<ZP> in mag.arcsec-2
ANALYSIS_THRESH  3              # <sigmas> or <threshold>,<ZP> in mag.arcsec-2

FILTER           Y              # apply filter for detection (Y or N)?
FILTER_NAME      conv.sex       # name of the file containing the filter

DEBLEND_NTHRESH  32             # Number of deblending sub-thresholds
DEBLEND_MINCONT  0.005          # Minimum contrast parameter for deblending

CLEAN            Y              # Clean spurious detections? (Y or N)?
CLEAN_PARAM      1.0            # Cleaning efficiency

MASK_TYPE        CORRECT        # type of detection MASKing: can be one of
                                # NONE, BLANK or CORRECT

#------------------------------ Photometry -----------------------------------

PHOT_APERTURES   12              # MAG_APER aperture diameter(s) in pixels
PHOT_AUTOPARAMS  2.5, 3.5       # MAG_AUTO parameters: <Kron_fact>,<min_radius>
PHOT_PETROPARAMS 2.0, 3.5       # MAG_PETRO parameters: <Petrosian_fact>,
                                # <min_radius>

SATUR_LEVEL      55000.0        # level (in ADUs) at which arises saturation

MAG_ZEROPOINT    0.0            # magnitude zero-point
MAG_GAMMA        4.0            # gamma of emulsion (for photographic scans)
GAIN             0.0            # detector gain in e-/ADU
PIXEL_SCALE      0.0            # size of pixel in arcsec (0=use FITS WCS info)

#------------------------- Star/Galaxy Separation ----------------------------

SEEING_FWHM      2.3            # stellar FWHM in arcsec
STARNNW_NAME     default.nnw    # Neural-Network_Weight table filename

#------------------------------ Background -----------------------------------

BACK_SIZE        64             # Background mesh: <size> or <width>,<height>
BACK_FILTERSIZE  3              # Background filter: <size> or <width>,<height>

BACKPHOTO_TYPE   GLOBAL         # can be GLOBAL or LOCAL

#------------------------------ Check Image ----------------------------------

CHECKIMAGE_TYPE  NONE           # can be NONE, BACKGROUND, BACKGROUND_RMS,
                                # MINIBACKGROUND, MINIBACK_RMS, -BACKGROUND,
                                # FILTERED, OBJECTS, -OBJECTS, SEGMENTATION,
                                # or APERTURES
CHECKIMAGE_NAME  check.fits     # Filename for the check-image

#--------------------- Memory (change with caution!) -------------------------

MEMORY_OBJSTACK  3000           # number of objects in stack
MEMORY_PIXSTACK  300000         # number of pixels in stack
MEMORY_BUFSIZE   1024           # number of lines in buffer

#----------------------------- Miscellaneous ---------------------------------

VERBOSE_TYPE     NORMAL         # can be QUIET, NORMAL or FULL
WRITE_XML        N              # Write XML file (Y/N)?
XML_NAME         sex.xml        # Filename for XML output
```

```
# Default configuration file for SCAMP 2.0.4
# EB 2015-06-19
#

#---------------------------- Field grouping ---------------------------------

FGROUP_RADIUS          1.0             # Max dist (deg) between field groups

#---------------------------- Reference catalogs ------------------------------

REF_SERVER         cocat1.u-strasbg.fr # Internet addresses of catalog servers
REF_PORT               80              # Ports to connect to catalog servers
CDSCLIENT_EXEC         aclient_cgi         # CDSclient executable
ASTREF_CATALOG          2MASS          # NONE, FILE, USNO-A1,USNO-A2,USNO-B1,
                                       # GSC-1.3,GSC-2.2,GSC-2.3,
                                       # TYCHO-2, UCAC-1,UCAC-2,UCAC-3,UCAC-4,
                                       # NOMAD-1, PPMX, CMC-14, 2MASS, DENIS-3,
                                       # SDSS-R3,SDSS-R5,SDSS-R6,SDSS-R7,
                                       # SDSS-R8, SDSS-R9
ASTREF_BAND            DEFAULT         # Photom. band for astr.ref.magnitudes
                                       # or DEFAULT, BLUEST, or REDDEST
ASTREFCAT_NAME         astrefcat.cat   # Local astrometric reference catalogs
ASTREFCENT_KEYS        X_WORLD,Y_WORLD # Local ref.cat. centroid parameters
ASTREFERR_KEYS         ERRA_WORLD, ERRB_WORLD, ERRTHETA_WORLD
                                       # Local ref.cat. err. ellipse params
ASTREFMAG_KEY          MAG             # Local ref.cat. magnitude parameter
ASTREFMAGERR_KEY       MAGERR          # Local ref.cat. mag. error parameter
ASTREFOBSDATE_KEY      OBSDATE         # Local ref.cat. obs. date parameter
ASTREFMAG_LIMITS       -99.0,99.0      # Select magnitude range in ASTREF_BAND
SAVE_REFCATALOG        N               # Save ref catalogs in FITS-LDAC format?
REFOUT_CATPATH         .               # Save path for reference catalogs

#--------------------------- Merged output catalogs ---------------------------

MERGEDOUTCAT_TYPE      NONE            # NONE, ASCII_HEAD, ASCII, FITS_LDAC
MERGEDOUTCAT_NAME      merged.cat      # Merged output catalog filename

#--------------------------- Full output catalogs ---------------------------

FULLOUTCAT_TYPE        NONE            # NONE, ASCII_HEAD, ASCII, FITS_LDAC
FULLOUTCAT_NAME        full.cat        # Full output catalog filename

#----------------------------- Pattern matching -------------------------------

MATCH                  Y               # Do pattern-matching (Y/N) ?
MATCH_NMAX             0               # Max.number of detections for MATCHing
                                       # (0=auto)
PIXSCALE_MAXERR        1.2             # Max scale-factor uncertainty
POSANGLE_MAXERR        20.0            # Max position-angle uncertainty (deg)
POSITION_MAXERR        20.0            # Max positional uncertainty (arcmin)
MATCH_RESOL            1.0             # Matching resolution (arcsec); 0=auto
MATCH_FLIPPED          N               # Allow matching with flipped axes?
MOSAIC_TYPE            UNCHANGED       # UNCHANGED, SAME_CRVAL, SHARE_PROJAXIS,
                                       # FIX_FOCALPLANE or LOOSE
FIXFOCALPLANE_NMIN     1               # Min number of dets for FIX_FOCALPLANE

#---------------------------- Cross-identification ----------------------------

CROSSID_RADIUS         1.0             # Cross-id initial radius (arcsec)

#---------------------------- Astrometric solution ----------------------------

SOLVE_ASTROM           Y               # Compute astrometric solution (Y/N) ?
PROJECTION_TYPE        SAME            # SAME, TPV or TAN
ASTRINSTRU_KEY         FILTER,QRUNID   # FITS keyword(s) defining the astrom
STABILITY_TYPE         EXPOSURE        # EXPOSURE, PRE-DISTORTED or INSTRUMENT
CENTROID_KEYS          XWIN_IMAGE,YWIN_IMAGE # Cat. parameters for centroiding
CENTROIDERR_KEYS       ERRAWIN_IMAGE,ERRBWIN_IMAGE,ERRTHETAWIN_IMAGE
                                       # Cat. params for centroid err ellipse
DISTORT_KEYS           XWIN_IMAGE,YWIN_IMAGE # Cat. parameters or FITS keywords
DISTORT_GROUPS         1,1             # Polynom group for each context key
DISTORT_DEGREES        3               # Polynom degree for each group
FOCDISTORT_DEGREE      1               # Polynom degree for focal plane coords
ASTREF_WEIGHT          1.0             # Relative weight of ref.astrom.cat.
ASTRACCURACY_TYPE      SIGMA-PIXEL     # SIGMA-PIXEL, SIGMA-ARCSEC,
                                       # or TURBULENCE-ARCSEC
ASTRACCURACY_KEY       ASTRACCU        # FITS keyword for ASTR_ACCURACY param.
ASTR_ACCURACY          0.01            # Astrom. uncertainty floor parameter
ASTRCLIP_NSIGMA        3.0             # Astrom. clipping threshold in sigmas
COMPUTE_PARALLAXES     N               # Compute trigonom. parallaxes (Y/N)?
COMPUTE_PROPERMOTIONS  Y               # Compute proper motions (Y/N)?
CORRECT_COLOURSHIFTS   N               # Correct for colour shifts (Y/N)?
INCLUDE_ASTREFCATALOG  Y               # Include ref.cat in prop.motions (Y/N)?
ASTR_FLAGSMASK         0x00fc          # Astrometry rejection mask on SEx FLAGS
ASTR_IMAFLAGSMASK      0x0             # Astrometry rejection mask on IMAFLAGS

#---------------------------- Photometric solution ----------------------------

SOLVE_PHOTOM           N               # Compute photometric solution (Y/N) ?
MAGZERO_OUT            0.0             # Magnitude zero-point(s) in output
MAGZERO_INTERR         0.01            # Internal mag.zero-point accuracy
MAGZERO_REFERR         0.03            # Photom.field mag.zero-point accuracy
PHOTINSTRU_KEY         FILTER          # FITS keyword(s) defining the photom.
MAGZERO_KEY            PHOT_C          # FITS keyword for the mag zero-point
EXPOTIME_KEY           EXPTIME         # FITS keyword for the exposure time (s)
AIRMASS_KEY            AIRMASS         # FITS keyword for the airmass
EXTINCT_KEY            PHOT_K          # FITS keyword for the extinction coeff
PHOTOMFLAG_KEY         PHOTFLAG        # FITS keyword for the photometry flag
PHOTFLUX_KEY           FLUX_AUTO       # Catalog param. for the flux measurement
PHOTFLUXERR_KEY        FLUXERR_AUTO    # Catalog parameter for the flux error
PHOTCLIP_NSIGMA        3.0             # Photom.clipping threshold in sigmas
PHOT_ACCURACY          1e-3            # Photometric uncertainty floor (frac.)
PHOT_FLAGSMASK         0x00fc          # Photometry rejection mask on SEx FLAGS
PHOT_IMAFLAGSMASK      0x0             # Photometry rejection mask on IMAFLAGS
```

```
#------------------------------- Check-plots ----------------------------------

CHECKPLOT_CKEY         SCAMPCOL        # FITS keyword for PLPLOT field colour
CHECKPLOT_DEV          NULL            # NULL, XWIN, TK, PS, PSC, XFIG, PNG,
                                       # JPEG, AQT, PDF or SVG
CHECKPLOT_RES          0               # Check-plot resolution (0 = default)
CHECKPLOT_ANTIALIAS    Y               # Anti-aliasing using convert (Y/N) ?
CHECKPLOT_TYPE
CHECKPLOT_NAME                     # Check-plot filename(s)

#------------------------------- Check-images ---------------------------------

CHECKIMAGE_TYPE        NONE            # NONE, AS_PAIR, AS_REFPAIR, or AS_XCORR
CHECKIMAGE_NAME        check.fits      # Check-image filename(s)

#------------------------------ Miscellaneous ---------------------------------

SN_THRESHOLDS          10.0,100.0      # S/N thresholds (in sigmas) for all and
                                       # high-SN sample
FWHM_THRESHOLDS        0.0,100.0       # FWHM thresholds (in pixels) for sources
ELLIPTICITY_MAX        0.5             # Max. source ellipticity
FLAGS_MASK             0x00f0          # Global rejection mask on SEx FLAGS
WEIGHTFLAGS_MASK       0x00ff          # Global rejec. mask on SEx FLAGS_WEIGHT
IMAFLAGS_MASK          0x0             # Global rejec. mask on SEx IMAFLAGS_ISO
AHEADER_GLOBAL         scamp.ahead     # Filename of the global INPUT header
AHEADER_SUFFIX         .ahead          # Filename extension for additional
                                       # INPUT headers
HEADER_SUFFIX          .head           # Filename extension for OUTPUT headers
HEADER_TYPE            NORMAL          # NORMAL or FOCAL_PLANE
VERBOSE_TYPE           NORMAL          # QUIET, NORMAL, LOG or FULL
WRITE_XML              N               # Write XML file (Y/N)?
XML_NAME               scamp.xml       # Filename for XML output
XSL_URL                file:///usr/share/scamp/scamp.xsl
                                       # Filename for XSL style-sheet
NTHREADS               0               # Number of simultaneous threads for
                                       # the SMP version of SCAMP
                                       # 0 = automatic
```

```
# Default configuration file for MissFITS 2.8.0
# EB CM 2016-08-23
#
#-------------------------------- FITS keywords --------------------------------
REMOVE_KEYWORD                          # Remove a FITS keyword from the headers
REPLACE_KEYWORD                         # Replace a FITS keyword with another
                                        # Syntax: OLD_KEY1:NEW_KEY1,
                                        #         OLD_KEY2:NEW_KEY2,...
SLICE_KEYWORD                           # Replace the keyword
                                        # SLICE_KEYWORD+SLICEKEY_FORMAT
                                        # with SLICE_KEYWORD for every slice
                                        # or viceversa building cubes
SLICEKEY_FORMAT        %03d             # format of slice referring keywords
DISPLAY_KEYWORD        OBJECT           # Display the following keywords while
                                        # processing the files

HEADER_SUFFIX          .head            # Filename extension for add. headers

#------------------------------ FITS properties -------------------------------

NEXTENSIONS_MIN        0                # Minimum number of extensions (warns
                                        # if less are found)
OUTFILE_TYPE           SAME             # Basic or Multi-FITS output:
                                        # "SAME", "MULTI", "SPLIT",
                                        # "SLICE", "CUBE" or "DIR"
SPLIT_SUFFIX           .%03d.fits       # Suffix expected for split FITS files
SLICE_SUFFIX           .%03d.fits       # Suffix expected for sliced FITS files

#-------------------------------- FITS data  ----------------------------------

PROCESS_TYPE           NONE             # Operations on FITS data:
                                        # "NONE", "TOBITPIX16", "COMPRESS" or "UNCOMPRESS"

CHECKSUM_TYPE          NONE             # Checksum operations:
                                        # "NONE", "COMPUTE", "VERIFY" or
                                        # "UPDATE"
#------------------------------ Output filename  -----------------------------

SAVE_TYPE              REPLACE          # Behaviour towards output filename:
                                        # "NONE", "BACKUP", "NEW" or "REPLACE"

NEW_SUFFIX             -miss            # suffix to add in SAVE_TYPE NEW mode

#------------------------------ Miscellaneous ---------------------------------

VERBOSE_TYPE           NORMAL           # "QUIET","NORMAL" or "FULL"
WRITE_XML              N                # Write XML file (Y/N)?
XML_NAME               missfits.xml     # Filename for XML output
NTHREADS               1                # 1 single thread

```