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Erratum: Measurement of hadronic event shapes in high-p_{T} multijet final states at $\sqrt{s} = 13$ TeV with the ATLAS detector

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Abstract: An error in the normalization of the Aplanarity and D-parameter has been found. Insufficient precision on the eigenvalue calculation can cause λ_3 to be negative, exclusively in two-jet events, yielding an underestimation of the inclusive two-jet cross section.

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H_{T2} range [TeV]	Value
1.0–1.5	1.376
1.5–2.0	1.334
2.0–$\sqrt{s}$	1.311

Table 1. Normalization factors to be applied to the A and D distributions in each H_{T2} bin.

An error in the normalization of the Aplanarity and the D-parameter is corrected in the present document. All event shapes in the paper are normalized to the inclusive two-jet cross section $\sigma(n^{\text{jet}} \geq 2)$. For event shape X, the two jet cross-section is calculated as

$$\sigma(n^{\text{jet}} \geq 2) = \int_0^\infty \frac{\mathrm{d}\sigma}{\mathrm{d}X}\mathrm{d}X \tag{1}$$

The Aplanarity $A = \frac{3}{2}\lambda_3$ and D-parameter $D = 27\lambda_1\lambda_2\lambda_3$ are proportional to the third eigenvalue, λ_3, of the Sphericity tensor $\mathcal{M}$, defined in terms of the three-momenta of all selected jets, $\vec{p}_i$, as

$$\mathcal{M}_{xyz} = \frac{1}{\sum_i |\vec{p}_i|} \sum_i \frac{1}{|\vec{p}_i|} \begin{pmatrix} p_{\mathrm{x},i}^2 & p_{\mathrm{x},i}p_{\mathrm{y},i} & p_{\mathrm{x},i}p_{\mathrm{z},i} \\ p_{\mathrm{y},i}p_{\mathrm{x},i} & p_{\mathrm{y},i}^2 & p_{\mathrm{y},i}p_{\mathrm{z},i} \\ p_{\mathrm{z},i}p_{\mathrm{x},i} & p_{\mathrm{z},i}p_{\mathrm{y},i} & p_{\mathrm{z},i}^2 \end{pmatrix}$$

By construction, two-jet events have $\lambda_3 = 0$. However, insufficient floating-point precision in the eigenvalue calculation can cause λ_3 to take negative values. Although very small in absolute value, typically $\lambda_3 = \mathcal{O}(-10^{-18})$, these negative values can cause the normalisation factors for these distributions to be underestimated if not correctly taken into account in the two-jet cross section calculation in eq. 1. The correction factors to be applied to both A and D distributions are different depending on the H_{T2} bin and are summarized in table 1

A few comments are in order

- The correction changes the normalization but not the shape of the distribution, since the values of λ_3 can be negative only in exclusive two-jet events. The distributions presented in the paper are for regions of the phase space with three or more jets, although their normalization includes the two-jet cross section.
- The error occurs both in data and Monte Carlo predictions similarly. Thus, the agreement between data and MC remains unchanged and, with it, the main conclusions of the paper.
- Similarly, the error affects in the same way all the experimental systematics variations, which are normalized by the same factor. Thus, the relative uncertainties remain the same.

Figures 1 and 2 show the corrected distributions for the Aplanarity A and the D-parameter, respectively. These figures replace figures 8 and 10 in the original paper.

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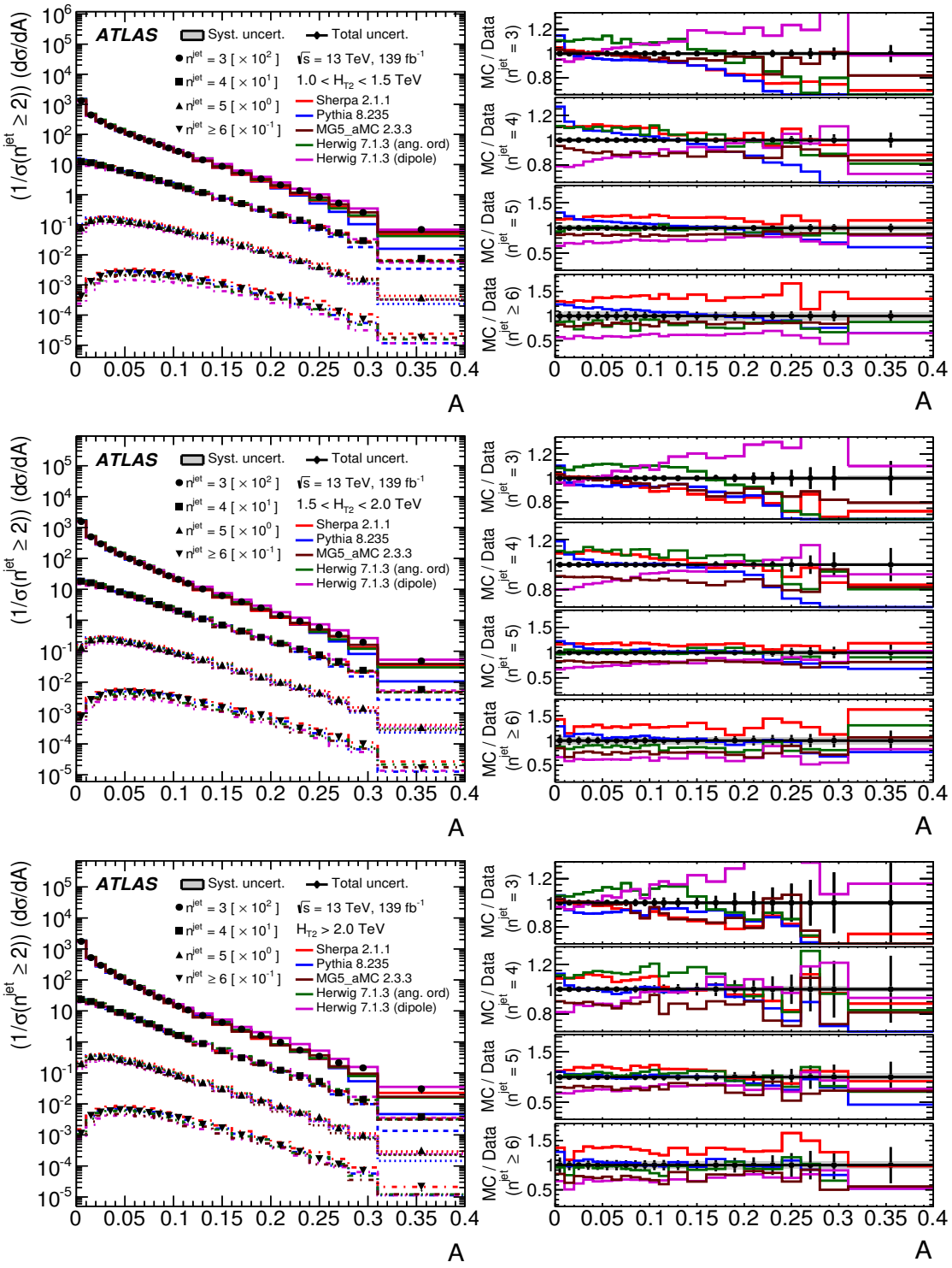

Figure 1. Comparison between data and MC predictions as a function of the aplanarity A for different jet multiplicities and energy scales. For illustration purposes, the corresponding differential cross section for each jet multiplicity is multiplied by 10^2 ($n^{\text{jet}} = 3$), 10^1 ($n^{\text{jet}} = 4$), 10^0 ($n^{\text{jet}} = 5$), 10^{-1} ($n^{\text{jet}} \geq 6$). The right panels show the ratios between the MC and the data distributions. The error bars show the total uncertainty (statistical and systematic added in quadrature) and the grey bands in the right panels show the systematic uncertainty.

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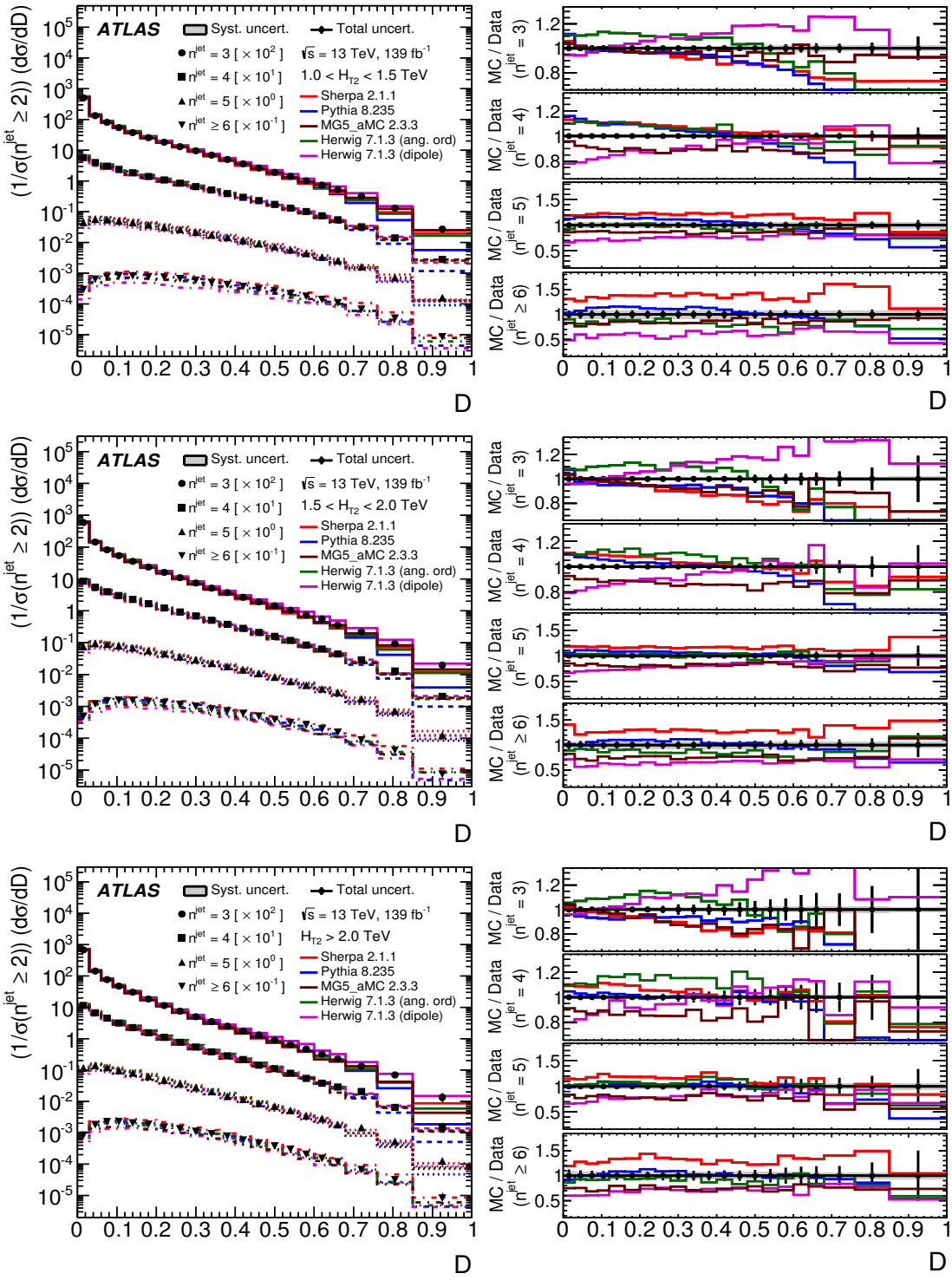

Figure 2. Comparison between data and MC predictions as a function of D for different jet multiplicities and energy scales. For illustration purposes, the corresponding differential cross section for each jet multiplicity is multiplied by 10^2 ($n^{\text{jet}} = 3$), 10^1 ($n^{\text{jet}} = 4$), 10^0 ($n^{\text{jet}} = 5$), 10^{-1} ($n^{\text{jet}} \geq 6$). The right panels show the ratios between the MC and the data distributions. The error bars show the total uncertainty (statistical and systematic added in quadrature) and the grey bands in the right panels show the systematic uncertainty.

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