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Addendum: Measurement and QCD analysis of double-differential inclusive jet cross sections in proton-proton collisions at $\sqrt{s} = 13$ TeV

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The QCD analysis at NNLO is repeated by using the NNLO interpolation grids for the double-differential inclusive jet cross section [1], which were released after the journal publication of the original analysis. The NNLOJET calculation used to derive these grids is based on the leading-colour and leading-flavour-number approximation and does not include the most recent subleading colour contributions. However, these contributions were reported in ref. [2] to be very small in inclusive jet production, in particular for a jet size of $R = 0.7$. The grids also contain an estimate of the numerical integration uncertainty of around 1% or less. To account for point-to-point fluctuations, this uncertainty, after consultation with the authors of NNLOJET, has been increased by a factor of two; however, its impact in the fit is negligible. A comparison of the measurement with predictions using various PDFs is shown in figure 1. Although the PDF parametrisation remains identical, higher precision in PDF and QCD parameters is expected by using NNLO grids consistently in the QCD analysis. These new results supersede those obtained by using the k-factor technique.

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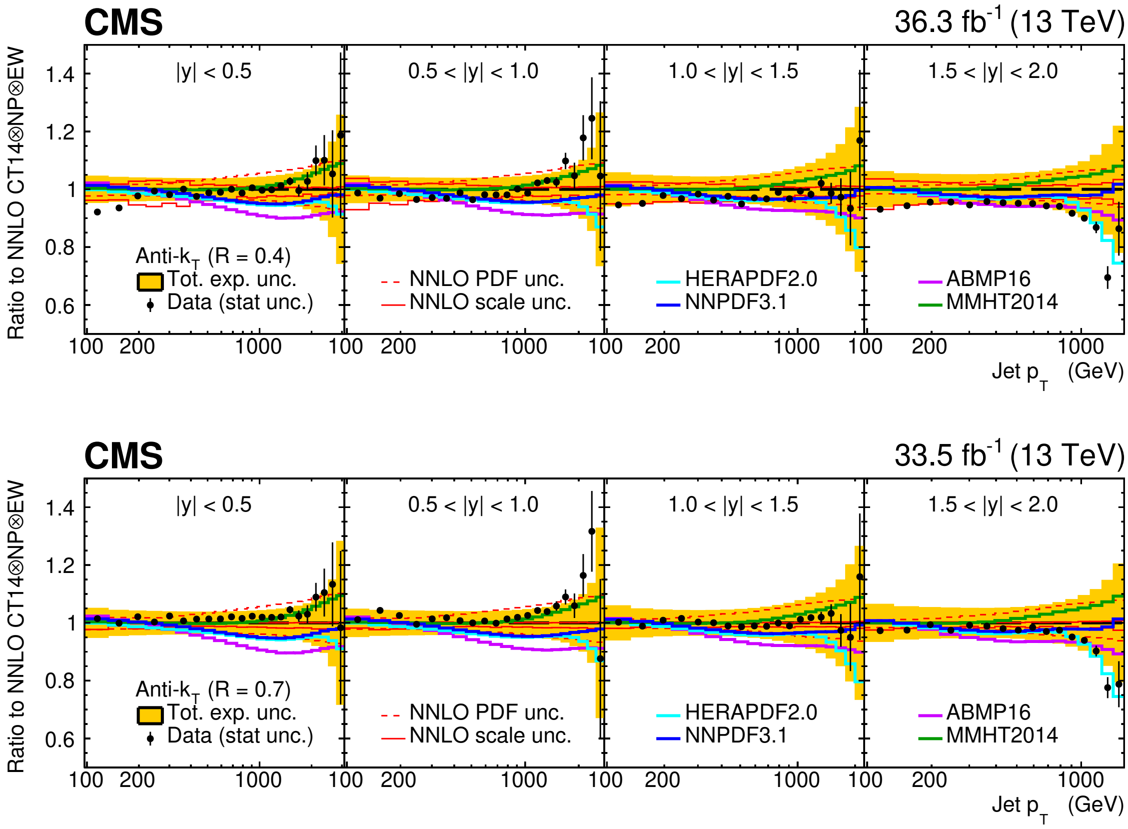

Figure 1. The double-differential cross section of inclusive jet production, as a function of p_T and $|y|$, for jets clustered using the anti-k_T algorithm with $R = 0.4$ (upper panel) and $R = 0.7$ (lower panel), presented as ratios to the QCD predictions. The data points are shown by filled circles, with statistical uncertainties shown by vertical error bars, while the total experimental uncertainty is centred at one and is presented by the orange band. The data are divided by the NNLO prediction corrected for NP and EW effects, using CT14nnlo PDF and choosing jet p_T as renormalisation and factorisation scale. NNLO predictions obtained with alternative PDF sets are displayed in different colours as a ratio to the central prediction using CT14nnlo.

The PDFs from the QCD analysis at NNLO of the CMS inclusive jet production and HERA DIS cross sections are shown in figure 2, illustrating the contributions of the fit, model, and parametrisation uncertainties.

The value of the strong coupling constant $\alpha_S(m_Z)$ is extracted simultaneously with the PDFs and corresponds to $\alpha_S(m_Z) = 0.1166 \pm 0.0014\,(\text{fit}) \pm 0.0007\,(\text{model}) \pm 0.0004\,(\text{scale}) \pm 0.0001\,(\text{param.})$, showing improved precision with respect to the NNLO result obtained using the k-factor technique. The global and partial χ^2 values for each data set in the NNLO fits using the interpolation grids are listed in table 1, where the χ^2 values illustrate a general agreement among all the data sets.

The impact of the CMS jet data in the QCD analysis (HERA+CMS fit) at NNLO is illustrated in figure 3, where the result is compared with the alternative fit using only the HERA DIS data (HERA-only fit).

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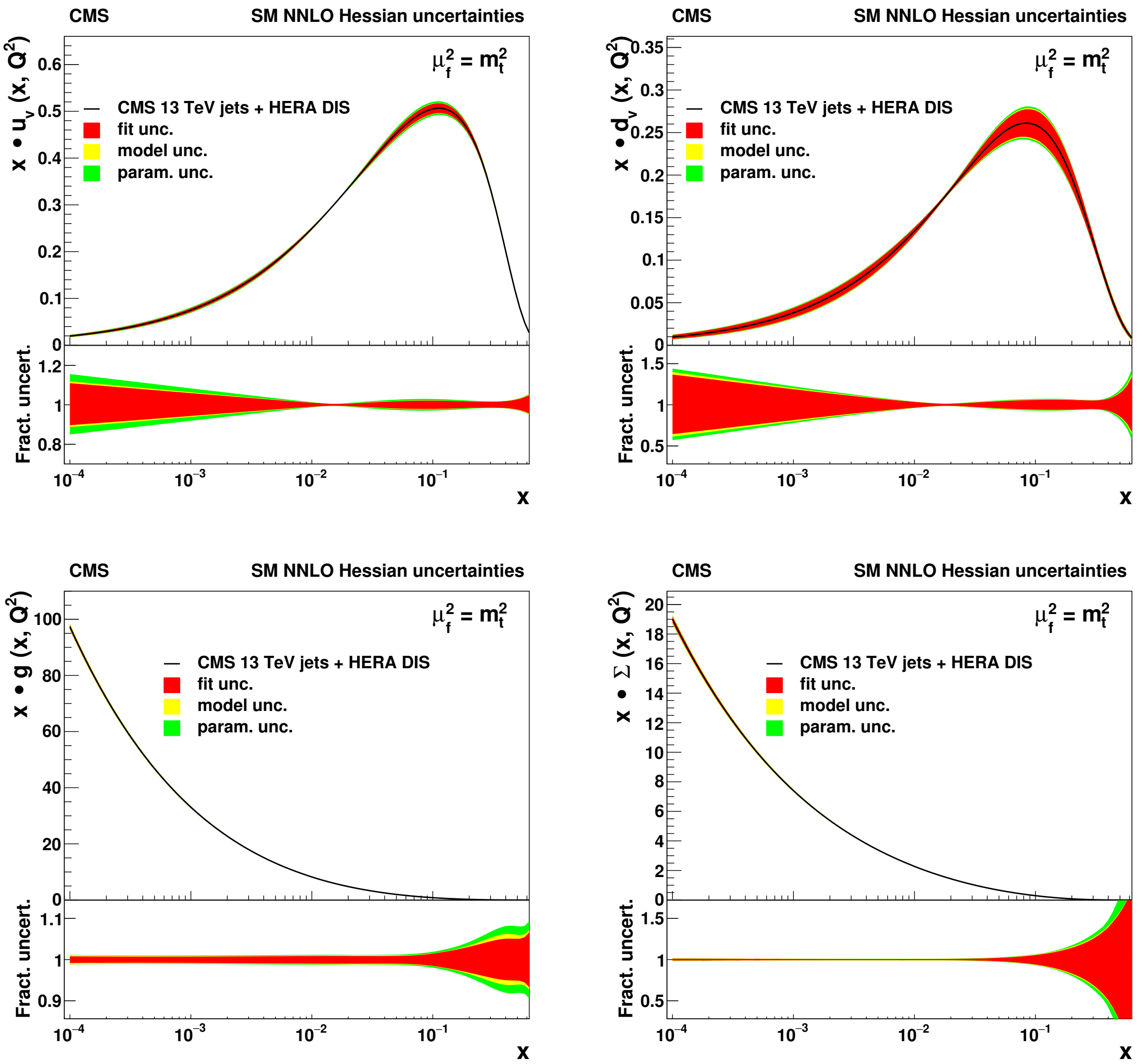

Figure 2. The u-valence (upper left), d-valence (upper right), gluon (lower left), and sea quark (lower right) distributions shown as a function of x at the scale $\mu_\mathrm{f} = m_\mathrm{t}$, resulting from the NNLO fit using HERA DIS data together with the CMS inclusive jet cross section at $\sqrt{s} = 13\,\mathrm{TeV}$. The prediction for the inclusive jet cross section is obtained using NNLO interpolation grids. Contributions of the fit, model, and parametrisation uncertainties for each PDF are shown. In the lower panels, the relative uncertainty contributions are presented.

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Data sets		HERA+CMS Partial χ^2/N_{dp}
HERA I+II neutral current	e^+p, $E_p = 920$ GeV	376/332
HERA I+II neutral current	e^+p, $E_p = 820$ GeV	60/63
HERA I+II neutral current	e^+p, $E_p = 575$ GeV	202/234
HERA I+II neutral current	e^+p, $E_p = 460$ GeV	209/187
HERA I+II neutral current	e^-p, $E_p = 920$ GeV	227/159
HERA I+II charged current	e^+p, $E_p = 920$ GeV	46/39
HERA I+II charged current	e^-p, $E_p = 920$ GeV	56/42
CMS inclusive jets 13 TeV	$0.0 < \|y\| < 0.5$	8.6/22
	$0.5 < \|y\| < 1.0$	23/21
	$1.0 < \|y\| < 1.5$	13/19
	$1.5 < \|y\| < 2.0$	14/16
Correlated χ^2		81
Global χ^2/N_{dof}		1302/1118

Table 1. Partial χ^2 per number of data points, N_{dp}, and the global χ^2 per degree of freedom, N_{dof}, as obtained in the QCD analysis at NNLO of HERA+CMS jet data, using NNLO interpolation grids for the 13 TeV inclusive jet cross section. In the DIS data, the proton beam energy is given as E_p and the electron energy is 27.5 GeV.

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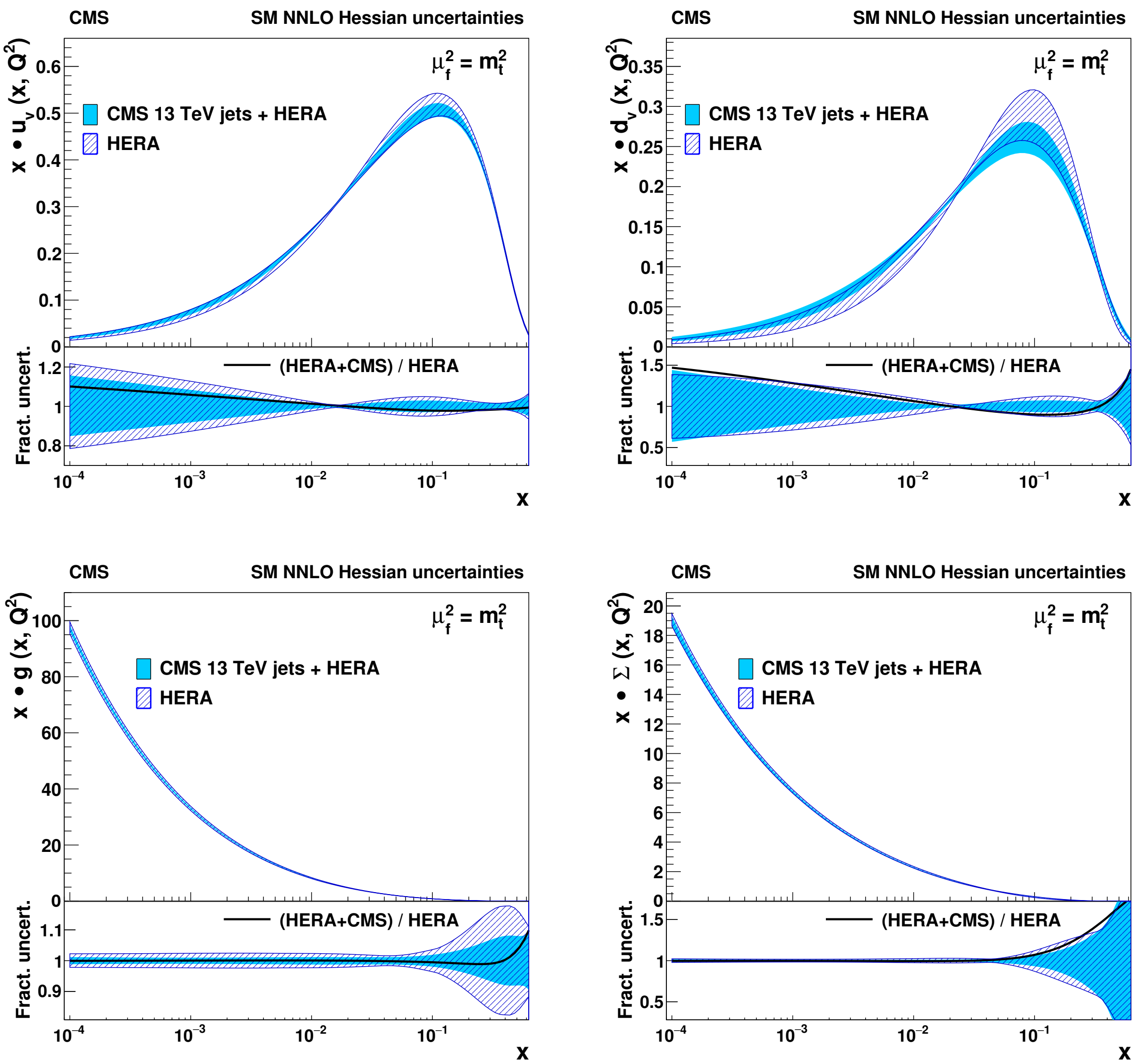

Figure 3. The u-valence (upper left), d-valence (upper right), gluon (lower left), and sea quark (lower right) distributions shown as a function of x at the scale $\mu_\mathrm{f} = m_\mathrm{t}$. The filled (hatched) band represents the results of the NNLO fit using HERA DIS and the CMS inclusive jet cross section at $\sqrt{s} = 13\,\mathrm{TeV}$ (using the HERA DIS data only). The PDFs are shown with their total uncertainty. The prediction for the inclusive jet cross section is obtained using NNLO interpolation grids. In the lower panels, the comparison of the relative PDF uncertainties is shown for each distribution. The line corresponds to the ratio of the central PDF values of the two variants of the fit.

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