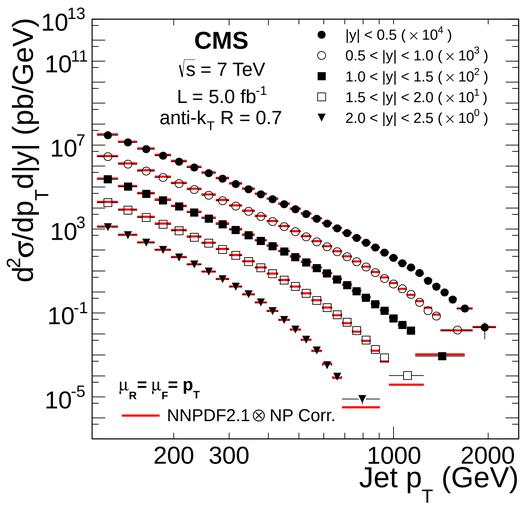
PDF constraints and extraction of the strong coupling from the inclusive jet cross section at 7 TeV

CMS-PAS-12-028

Karlsruhe Institute of Technology

CMS Inclusive Jet Measurement



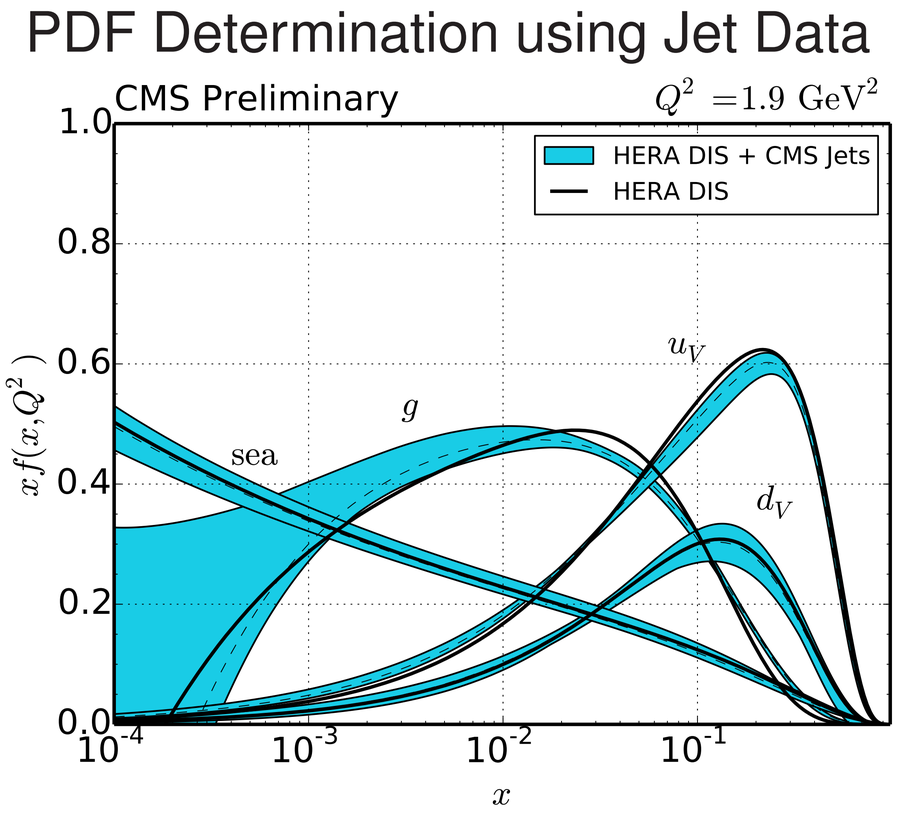
- **Double differential inclusive jet cross section**
- ➜ $\sqrt{s} = 7\,TeV$
- ➜ Data sample corresponding to $\mathcal{L}_{\text{int}} = 5.0\,\text{fb}^{-1}$
- ➜ $114\,\text{GeV} < p_{\text{T}} < 2116\,\text{GeV}$
- ➜ $0.0 < |y| < 2.5$
- ➜ published and available on HEPDATA

$$\frac{\mathrm{d}^2\sigma}{\mathrm{d}p_{\text{T}}\,\mathrm{d}y} = \frac{1}{\epsilon \cdot \mathcal{L}_{\text{int}}} \cdot \frac{N_{\text{jets}}}{\Delta p_{\text{T}}\,(2\,\Delta\,|y|)}$$

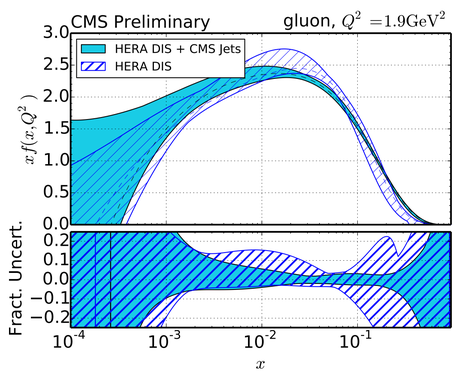
Reference: Phys. Rev. D 87 (2013) 112002

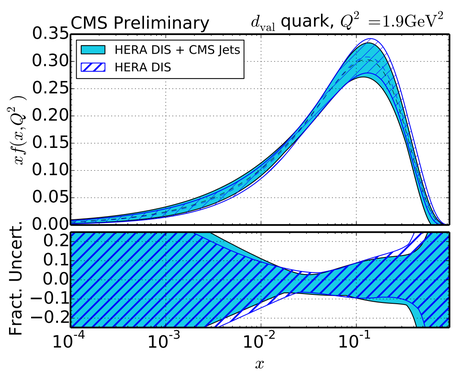
Constraints on PDFs

- Full PDF fits performed within the HERAFitter framework
- Comparison between fits performed with HERA-I DIS data alone and in combination with CMS inclusive jet data
- HERA DIS and CMS inclusive jet data perfectly compatible in combined fit



- PDF uncertainties studied using Hessian method
- Model-dependent input parameters and more flexible parametrizations studied as well

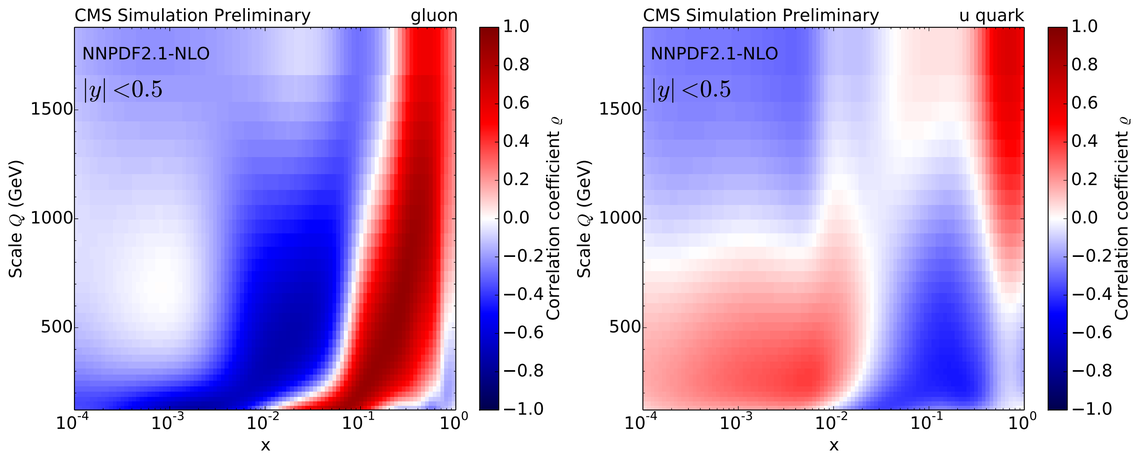




- ➜ **Inclusive jet data prefer harder gluon**
- ➜ **Gluon PDF uncertainties in high-x region are greatly reduced**
- ➜ **Impact on light quark distributions observed as well**

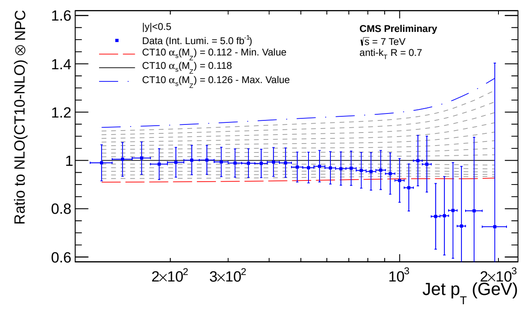
Sensitivity of PDFs to CMS inclusive Jet Data

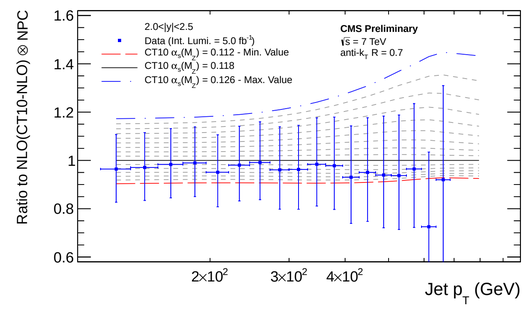
- **Correlations between PDFs and inclusive jet cross section**
- ➜ Observed high correlation between gluon PDF and σ_{jet} at high x
- ➜ Also some correlations between quark PDFs and σ_{jet}
- ➜ Constraints on PDFs expected in these kinematic regions.



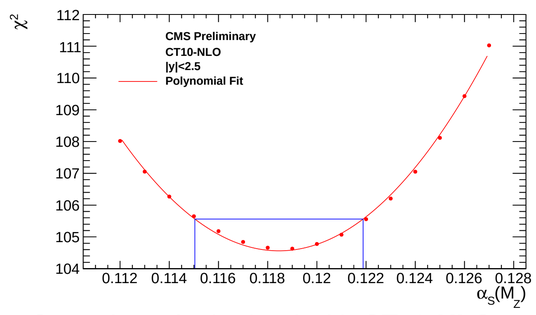
Sensitivity of $\alpha_S(M_Z)$ to Inclusive Jet Data

- Measurement compared to NLO prediction using fastNLO and NLOJet++
- Ratio of predicted cross section with different values of $\alpha_S(M_Z)$ to the central PDF prediction
- Ratio is flat over wide range of p_{T} and well described within a small $\alpha_S(M_Z)$ range
- ➜ Suitable for extraction of $\alpha_S(M_Z)$





Extraction of $\alpha_S(M_Z)$

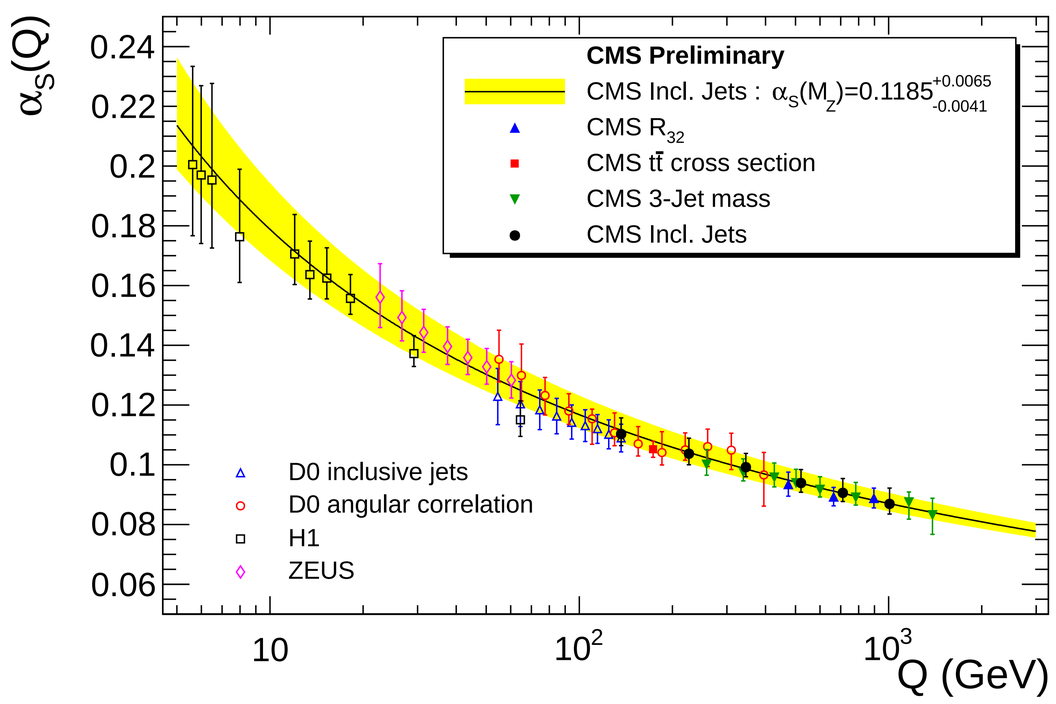


- χ^2 scan of full range of $\alpha_S(M_Z)$ PDFs performed
- Experimental and PDF, NP uncertainties extracted using $\Delta\chi^2 = 1$ tolerance
- Independent variation of scale choices μ_{R} and μ_{F} to estimate scale uncertainties
- Central result obtained with **CT10-NLO**
- PDF and scale uncertainties dominant
- Perfectly compatible with world average of $\alpha_S(M_Z)$
- Consistent results using other PDF sets within uncertainties

$$\alpha_S(M_Z) = 0.1185 \pm 0.0019(\text{exp}) \pm 0.0028(\text{PDF}) \pm 0.0004(\text{NP})^{+0.0055}_{-0.0022}(\text{scale})$$

Running of the Strong Coupling

- Fitted region is split intio six p_{T} intervals and $\alpha_S(M_Z)$ determined indedepently for each region.
- Using 2-loop RGE, the values are evolved to the corresponding $\alpha_S(Q)$

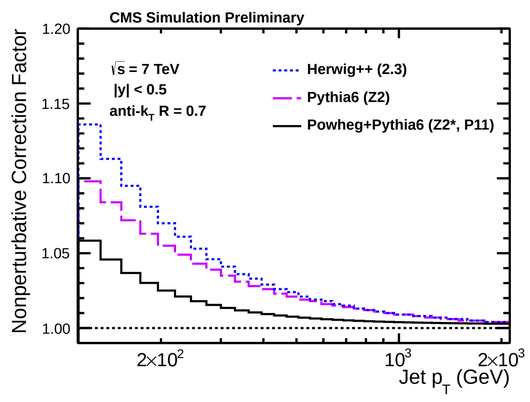


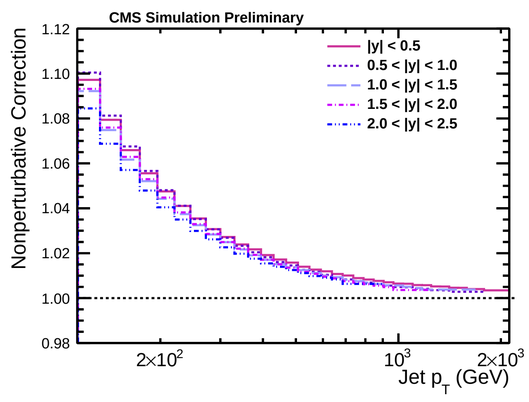
- **Agreement with the energy dependence predicted by the RGE**
- **New CMS results are consistent with previous measurements**

Non-Perturbative Corrections

- For the first time NP corrections from matched NLO MC generator were compared to PYTHIA6 and HERWIG++ predictions
- Central result on correction factor and uncertainty defined by mean and envelope of all three predictions.

$$C^{\text{NP}} = \frac{\sigma(\text{N})\text{LO+PS+HAD+MPI}}{\sigma(\text{N})\text{LO+PS}}$$





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