



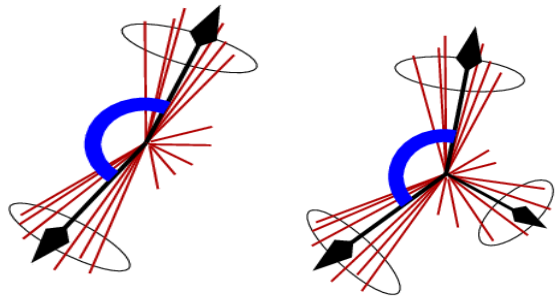
# DETERMINATION OF THE STRONG COUPLING CONSTANT IN MULTIJET PRODUCTION WITH THE ATLAS DETECTOR

Transverse energy-energy correlation function (TEEC) and its asymmetry (ATEEC)

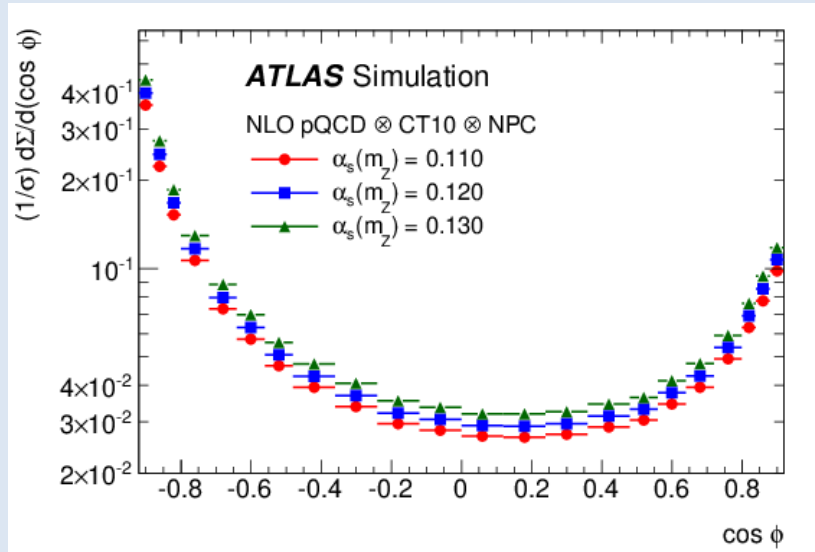
Weighted distribution of azimuth differences for all jet pairs (i,j) in a multijet event A

$$\text{TEEC Function} \quad \frac{1}{\sigma} \frac{d\Sigma}{d \cos \phi} \equiv \frac{1}{N} \sum_{A=1}^N \sum_{ij} \frac{E_{Ti}^A E_{Tj}^A}{\left(\sum_k E_{Tk}^A\right)^2} \delta(\cos \phi - \cos \phi_{ij})$$

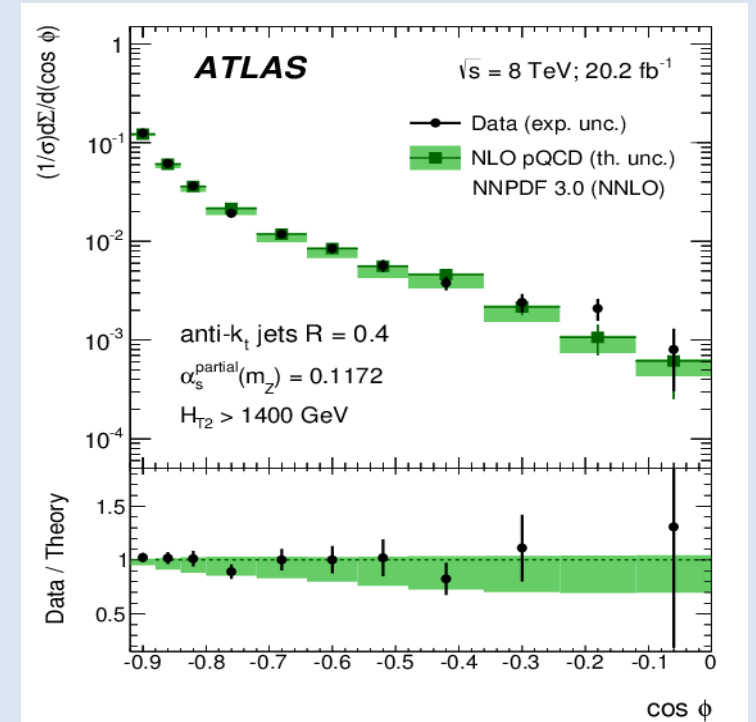
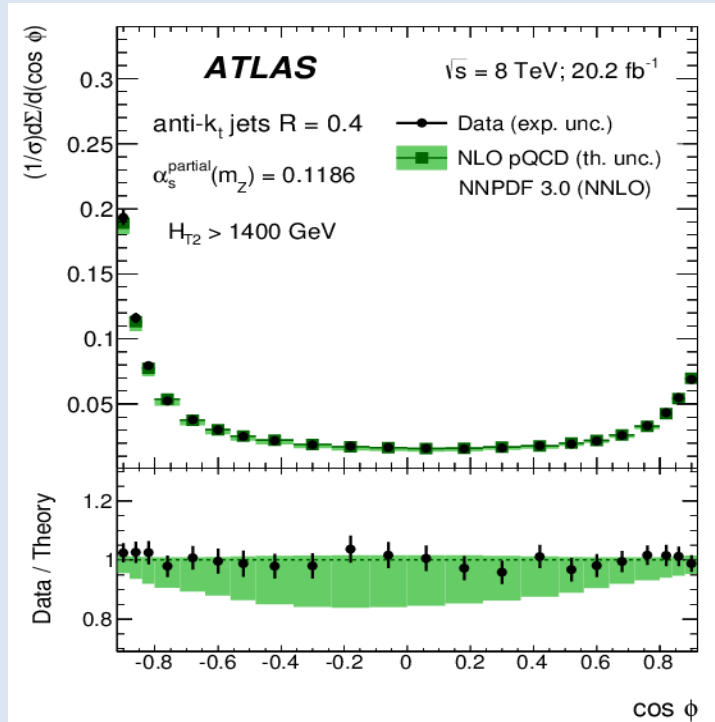
$$\text{ATEEC Function} \quad \frac{1}{\sigma} \frac{d\Sigma^{\text{asym}}}{d \cos \phi} \equiv \frac{1}{\sigma} \frac{d\Sigma}{d \cos \phi} \Big|_{\phi} - \frac{1}{\sigma} \frac{d\Sigma}{d \cos \phi} \Big|_{\pi-\phi}$$



## Dependence with $\alpha_s(m_Z)$



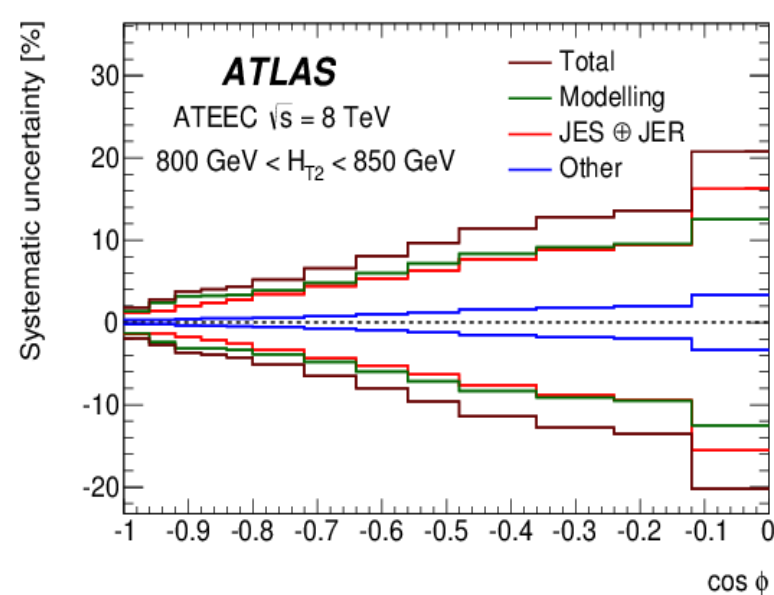
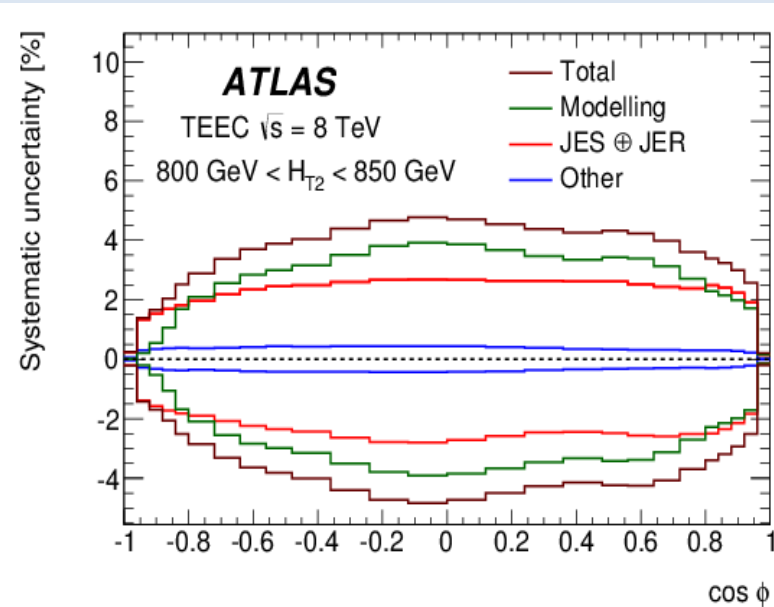
## Measured distributions as a function of $H_{T2} = p_{T1} + p_{T2}$ and $\cos \phi$



Three regions are distinguished in the TEEC distributions

- Back-to-back dijet configuration ( $\cos \phi \sim -1$ )
- Three-jet events (central  $\cos \phi$  plateau)
- Self-correlations ( $\cos \phi \sim +1$ )

## Systematic uncertainties



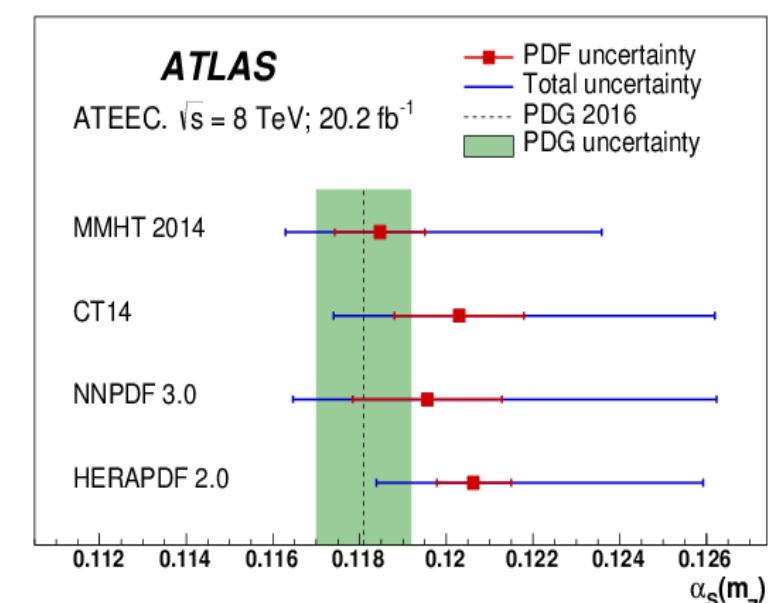
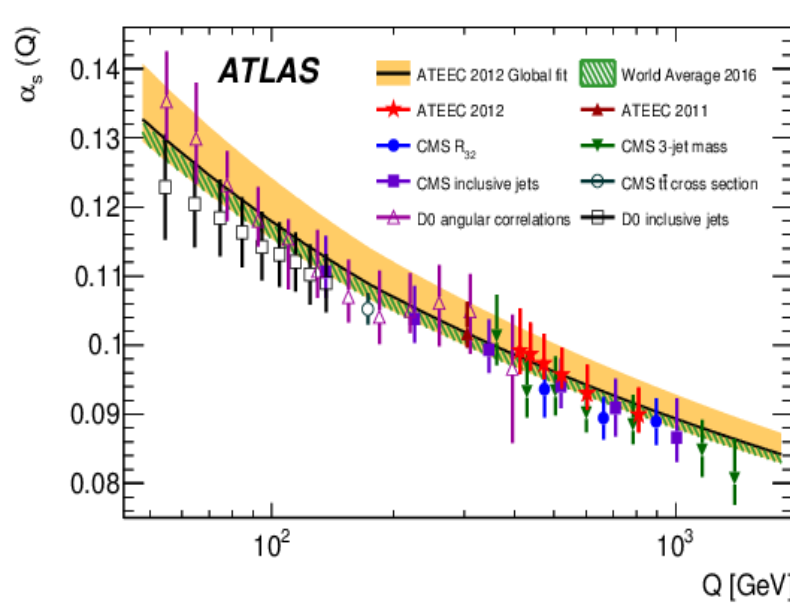
- Modelling: Parton shower unfolding
- Jet Energy Scale and Resolution
- Other: Angular resolution, unfolding

## Determination of the strong coupling

$\chi^2$  fits (including nuisance parameters for systematics) performed to TEEC and ATEEC

$$\chi^2(\alpha_s, \vec{\lambda}) = \sum_{\text{bins}} \frac{(x_i - F_i(\alpha_s, \vec{\lambda}))^2}{\Delta x_i^2 + \Delta \xi_i^2} + \sum_k \lambda_k^2$$

$$F_i(\alpha_s, \vec{\lambda}) = \psi_i(\alpha_s) \left( 1 + \sum_k \lambda_k \sigma_k^{(i)} \right)$$



ATEEC fits yield the most precise values (smaller scale uncertainties)

PDF	$\alpha_s(m_Z)$ value	$\chi^2/N_{\text{dof}}$
MMHT 2014	$0.1185 \pm 0.0012$ (exp.) $^{+0.0047}_{-0.0010}$ (scale) $\pm 0.0010$ (PDF) $\pm 0.0004$ (NP)	57.0 / 65
CT14	$0.1203 \pm 0.0013$ (exp.) $^{+0.0053}_{-0.0014}$ (scale) $\pm 0.0015$ (PDF) $\pm 0.0004$ (NP)	55.4 / 65
NNPDF 3.0	$0.1196 \pm 0.0013$ (exp.) $^{+0.0061}_{-0.0013}$ (scale) $\pm 0.0017$ (PDF) $\pm 0.0004$ (NP)	60.3 / 65
HERAPDF 2.0	$0.1206 \pm 0.0012$ (exp.) $^{+0.0050}_{-0.0014}$ (scale) $\pm 0.0005$ (PDF) $\pm 0.0002$ (NP) $\pm 0.0007$ (mod)	54.2 / 65

## References:

- 7 TeV result: PLB 750, 427 (2015)
- 8 TeV result: arXiv:1707.02562 [hep-ex]