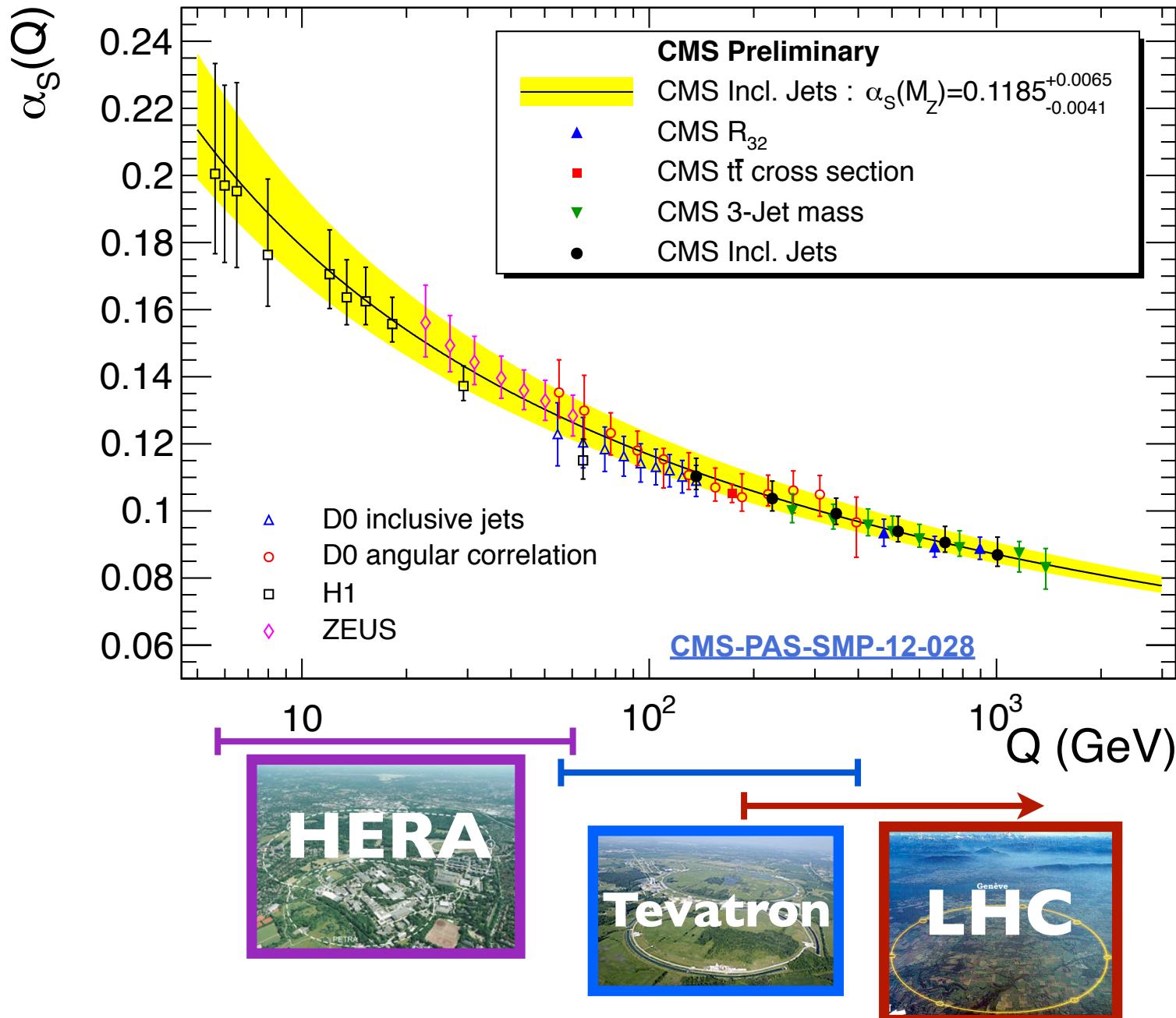


The strong coupling constant and PDFs

Esteban Fullana Torregrosa^(I)

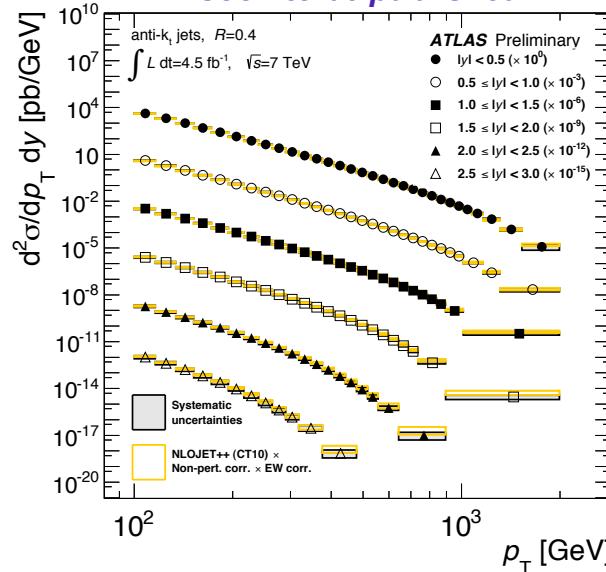
(I) on behalf of the CMS and ATLAS collaborations

The strong coupling constant



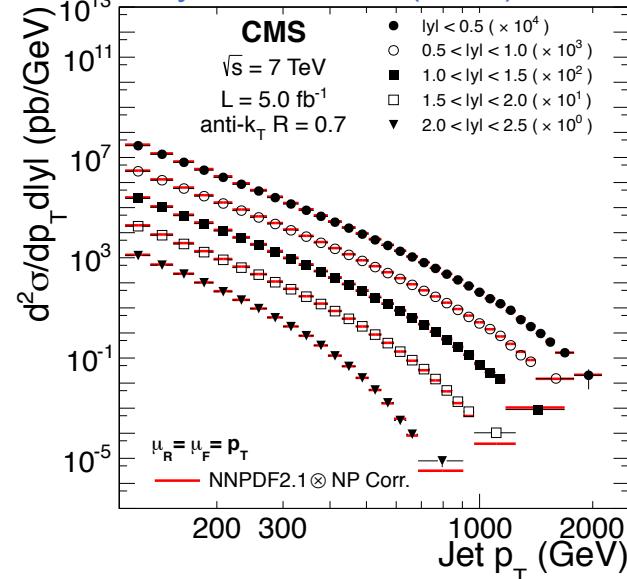
CMS and ATLAS 7TeV Jet measurements

*ATLAS Inclusive Jet 7 TeV
soon to be published*



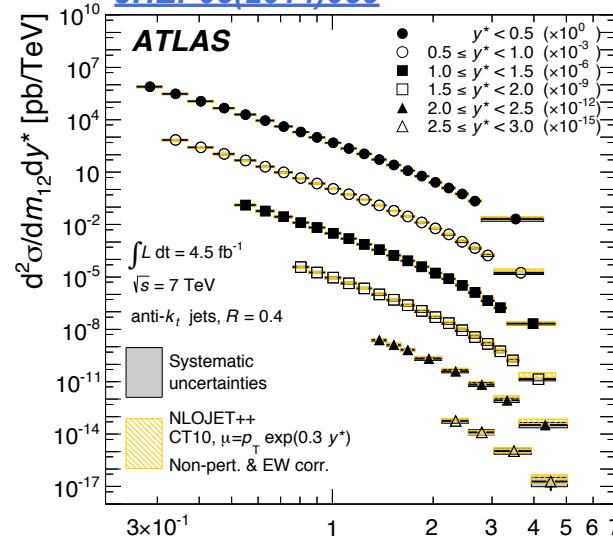
CMS Inclusive Jet 7 TeV

[Phys. Rev. D 87 \(2013\) 112002](#)



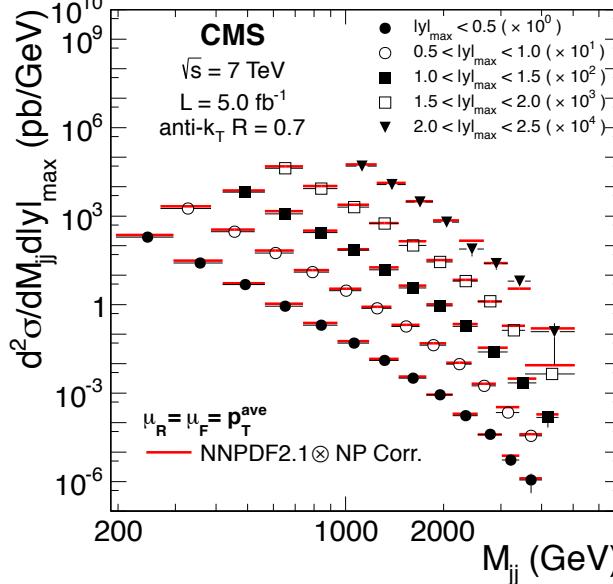
Physics at the LHC and beyond, Quy-Nhon, August 2014

*ATLAS Dijet 7 TeV
JHEP05(2014)059*

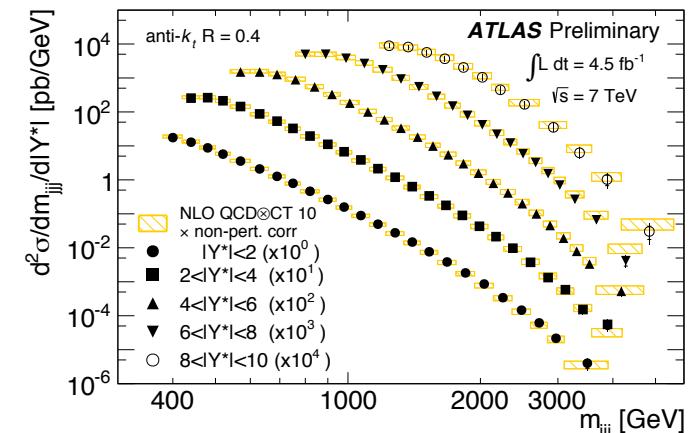


CMS Dijet 7 TeV

[Phys. Rev. D 87 \(2013\) 112002](#)

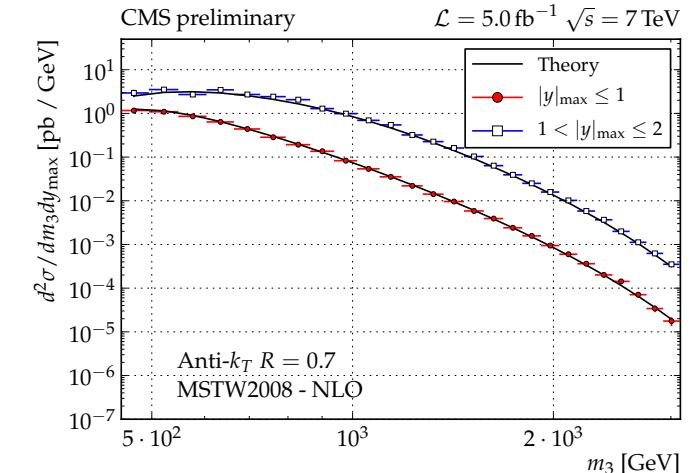


*ATLAS 3 Jet 7 TeV
ATLAS-CONF-2014-045*



CMS 3 Jet 7 TeV

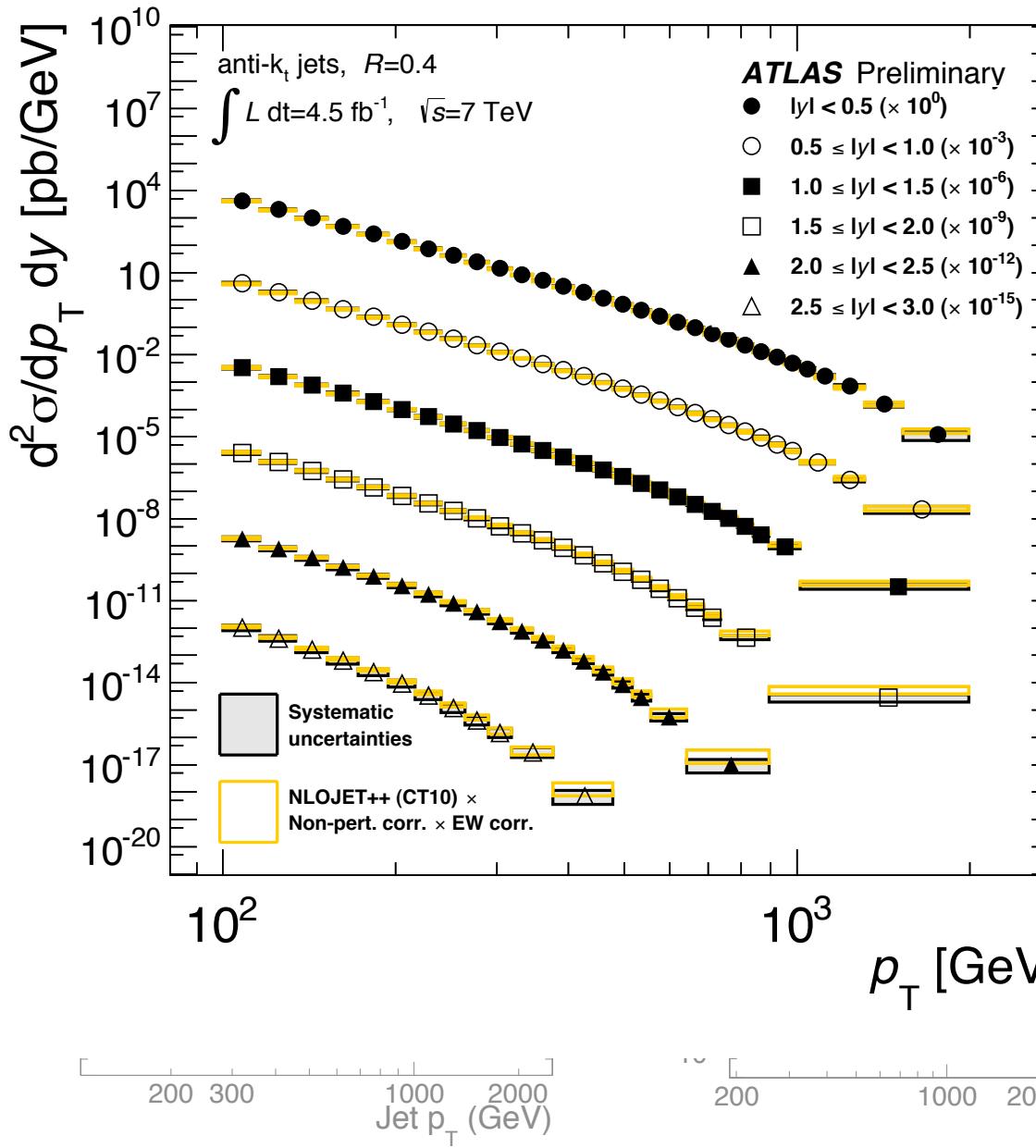
[SMP-12-027-pas](#)



Johannes Gutenberg-Universität Mainz

CMS and ATLAS 7TeV Jet measurements

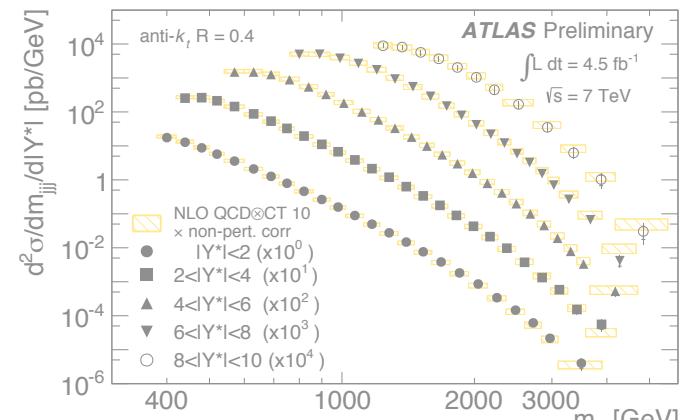
*ATLAS Inclusive Jet 7 TeV
soon to be published*



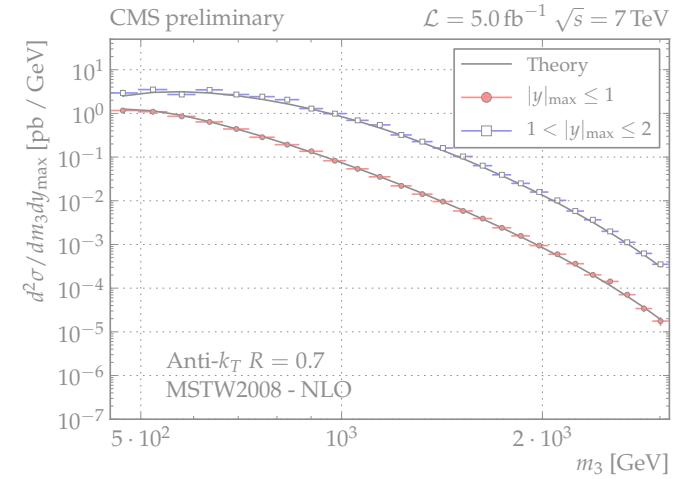
ATLAS Dijet 7 TeV



*ATLAS 3 Jet 7 TeV
ATLAS-CONF-2014-045*

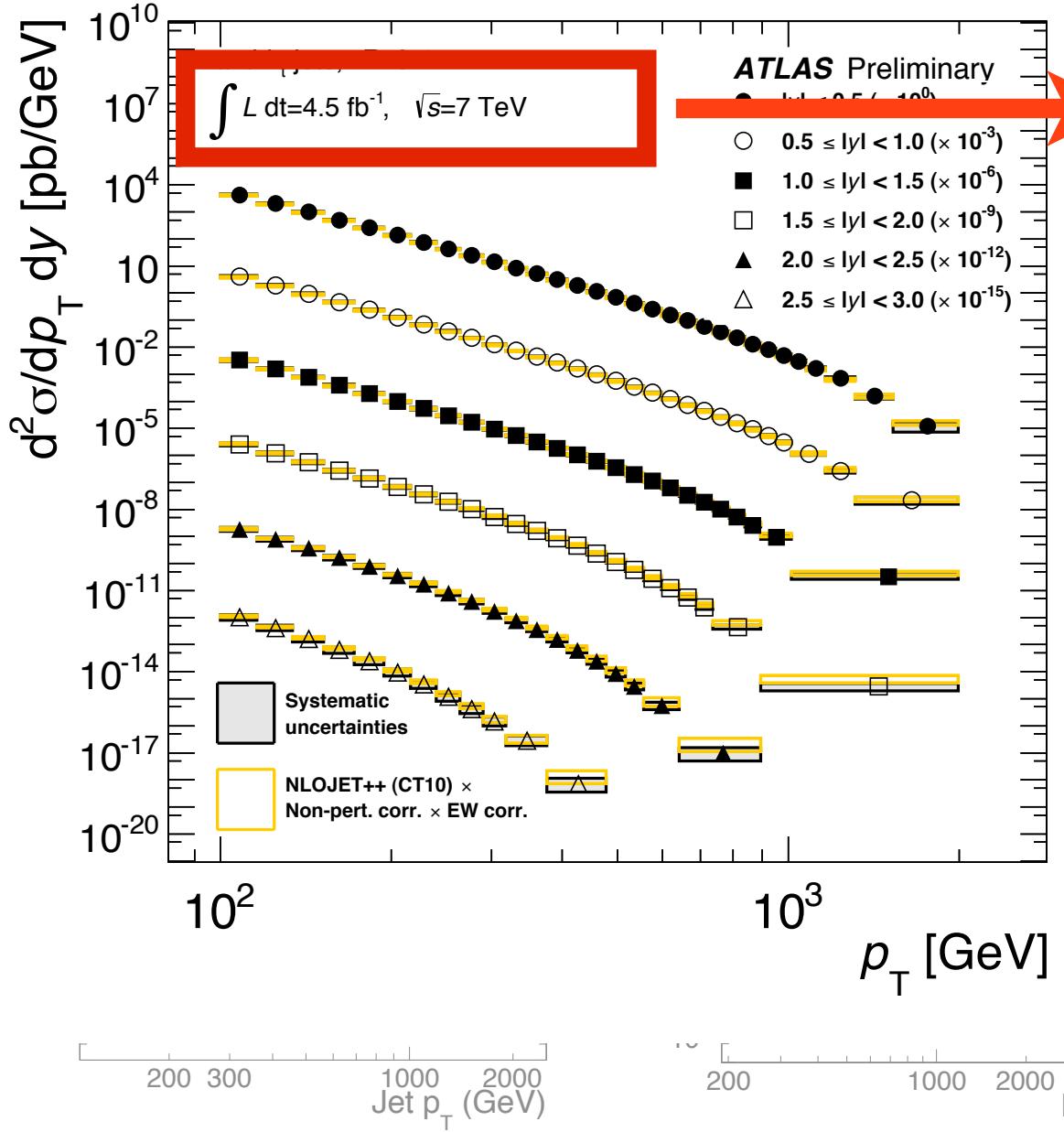


*CMS 3 Jet 7 TeV
SMP-12-027-pas*

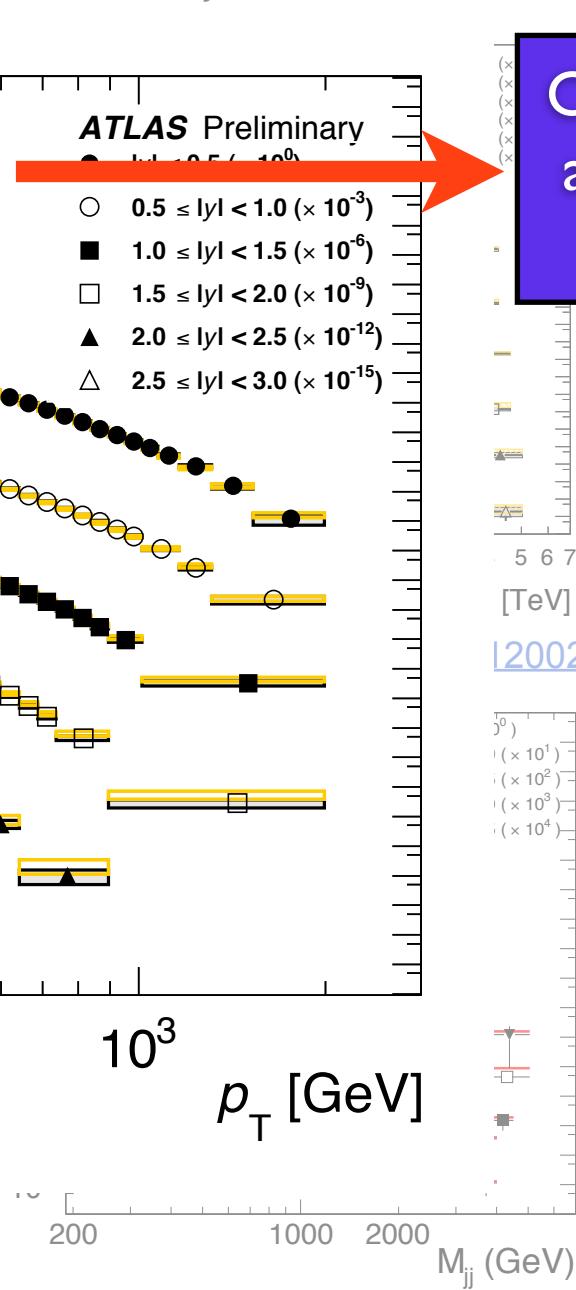


CMS and ATLAS 7TeV Jet measurements

ATLAS Inclusive Jet 7 TeV
soon to be published

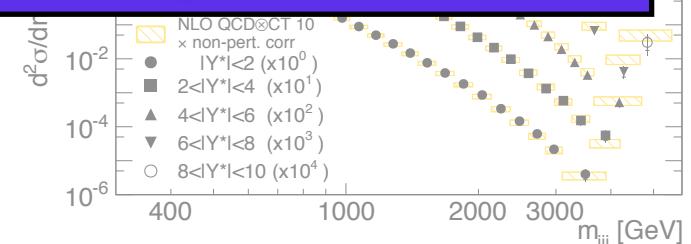


ATLAS Dijet 7 TeV



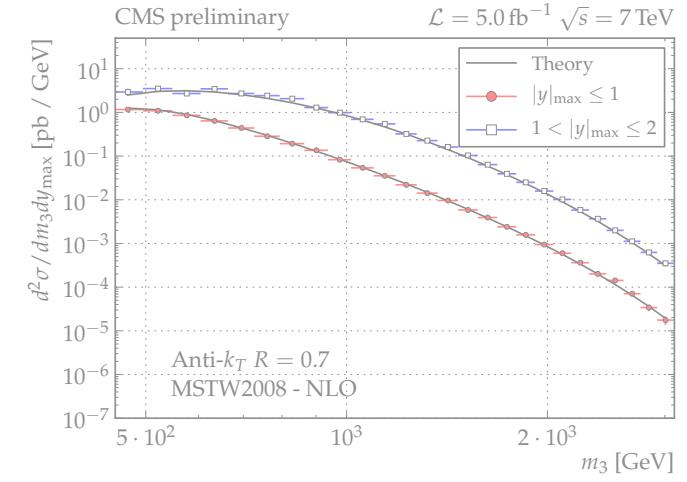
ATLAS 3 Jet 7 TeV

Outstanding work of both accelerator and detector operations



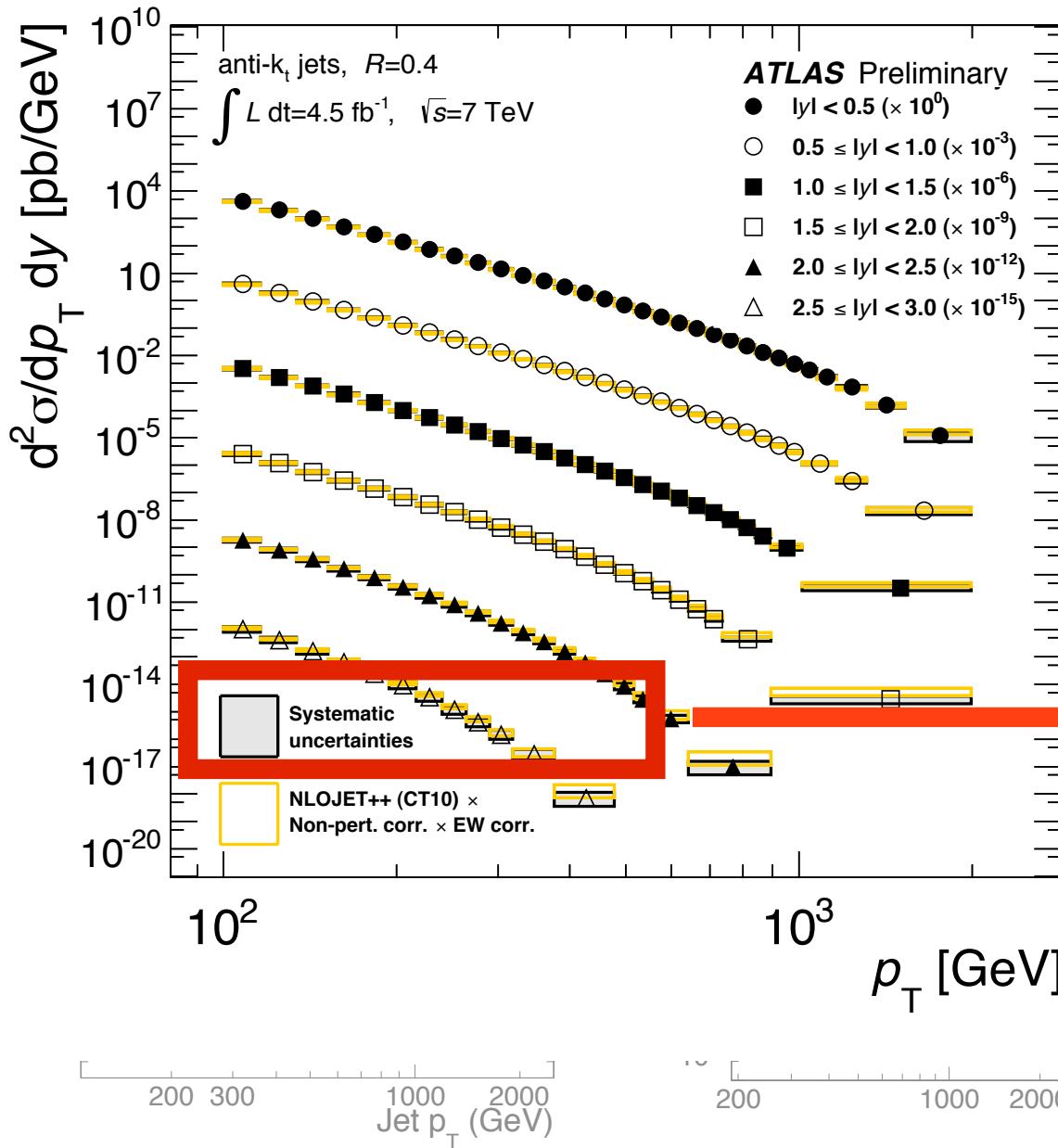
CMS 3 Jet 7 TeV

SMP-12-027-pas

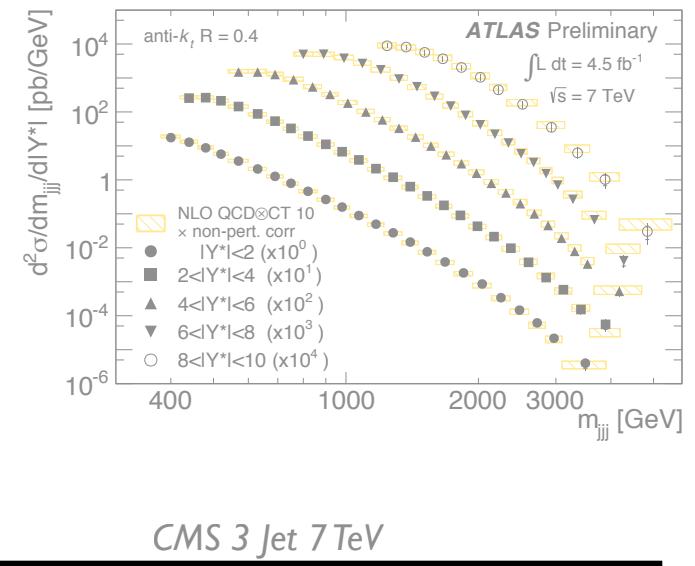


CMS and ATLAS 7TeV Jet measurements

ATLAS Inclusive Jet 7 TeV
soon to be published

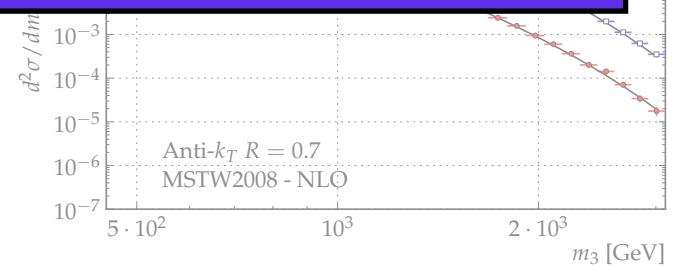


ATLAS 3 Jet 7 TeV
[ATLAS-CONF-2014-045](#)



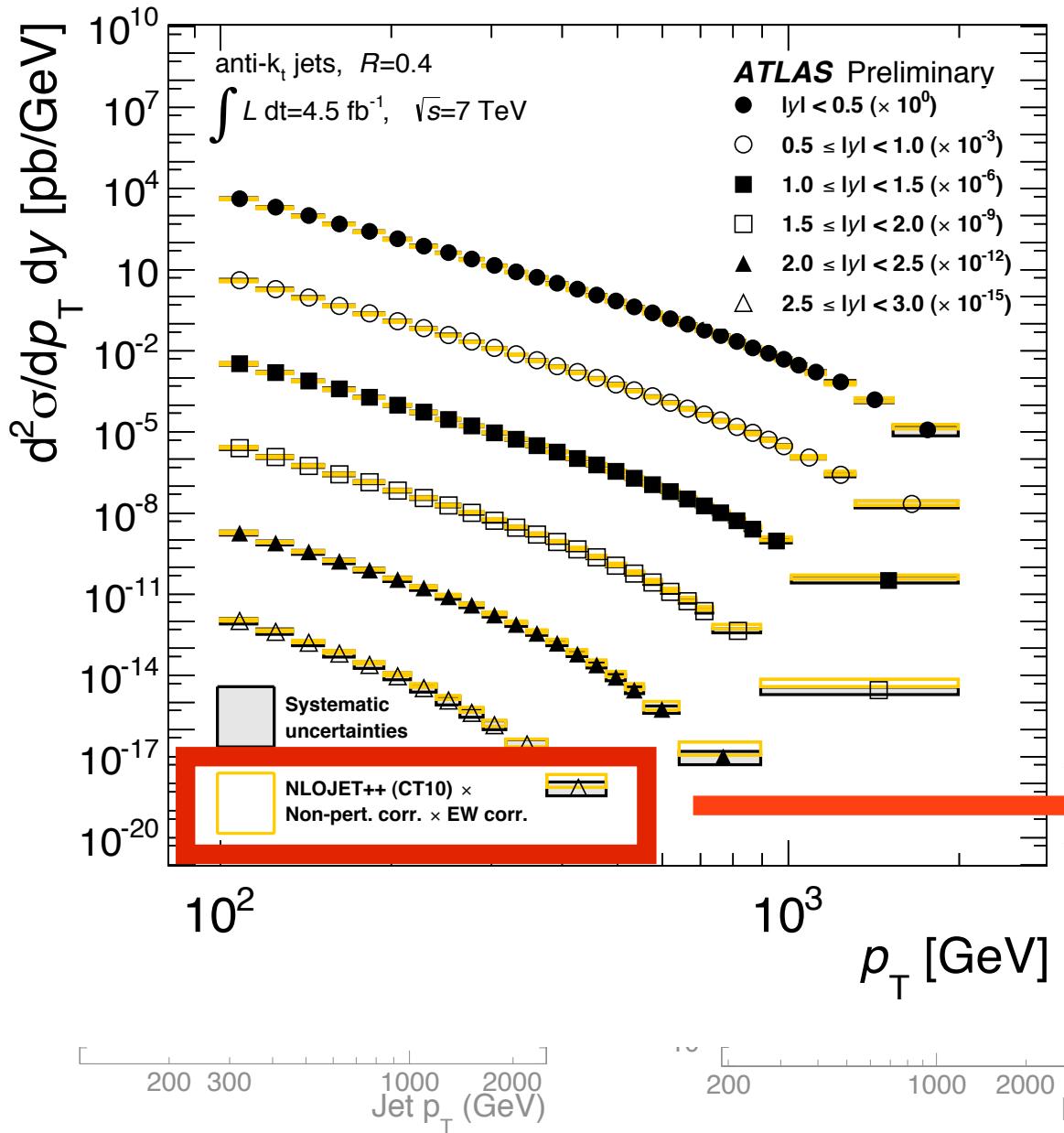
CMS 3 Jet 7 TeV

Small uncertainty due to
the dedicated effort of the
performance groups

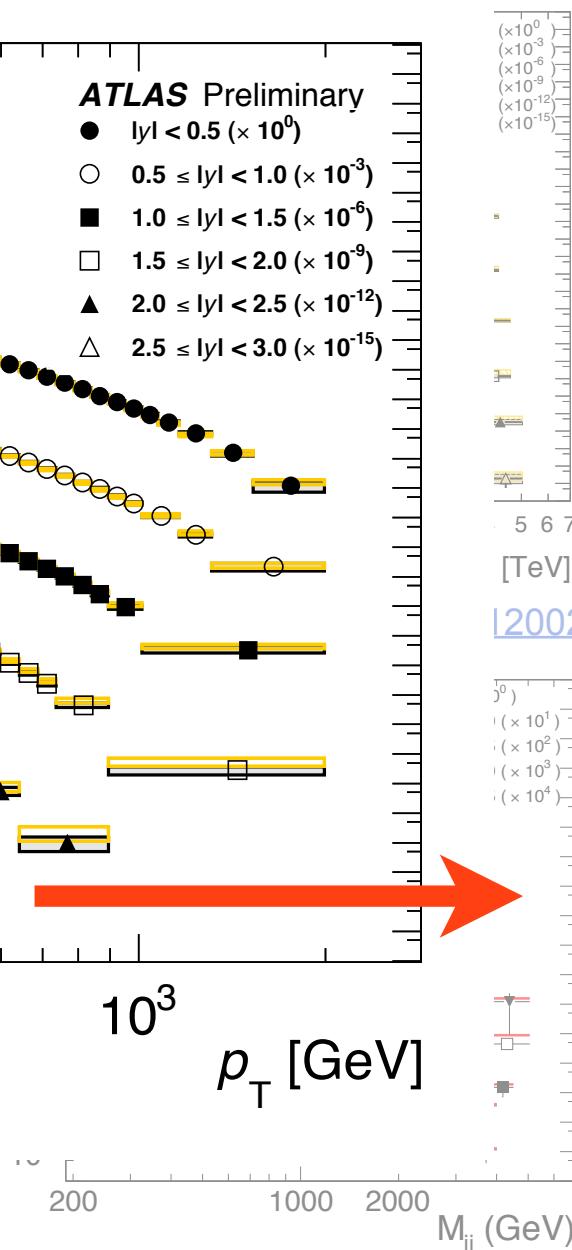


CMS and ATLAS 7TeV Jet measurements

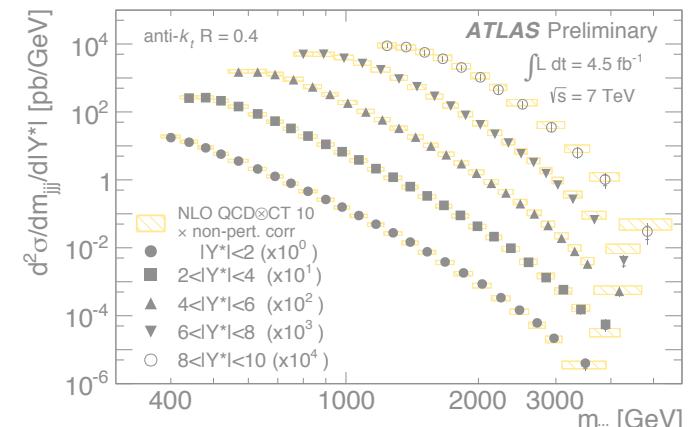
*ATLAS Inclusive Jet 7 TeV
soon to be published*



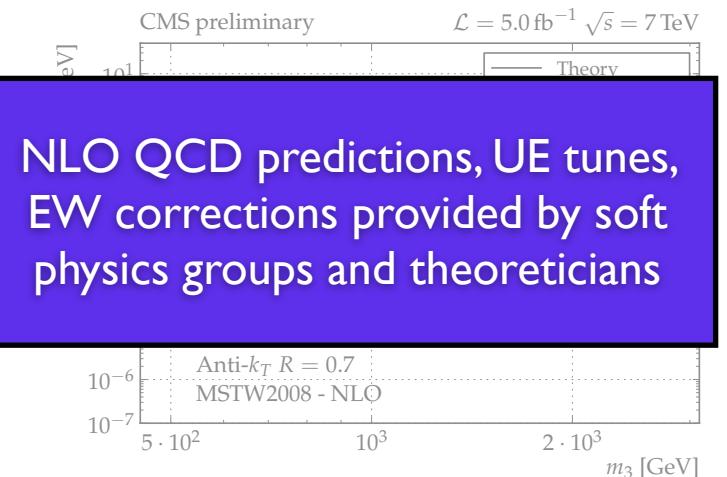
ATLAS Dijet 7 TeV



*ATLAS 3 Jet 7 TeV
ATLAS-CONF-2014-045*



*CMS 3 Jet 7 TeV
SMP-12-027-pas*



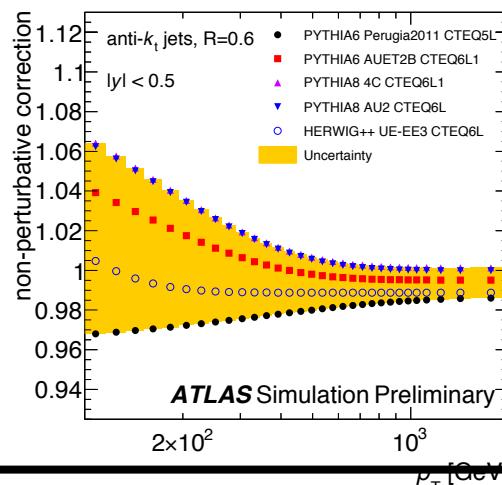
Jet measurements and their uncertainty

Theory:

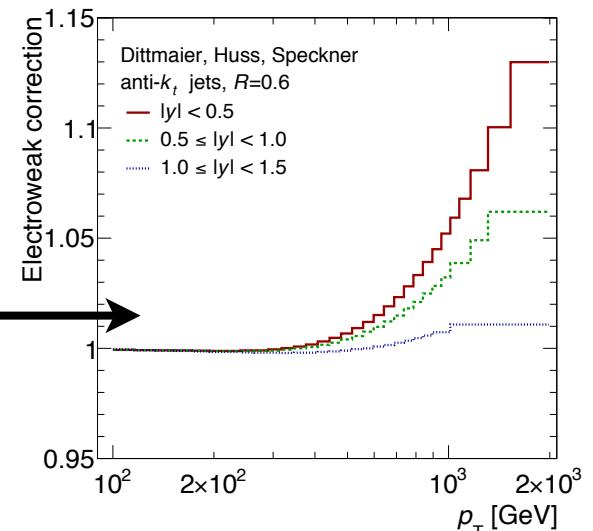
- QCD NLO : NLOJet++
- Interfaced to APPLGRID
- Corrected by non-perturbative effects (UE and Hadronization) →
- Electroweak corrections applied
- (although not used for PDF fits)

Data:

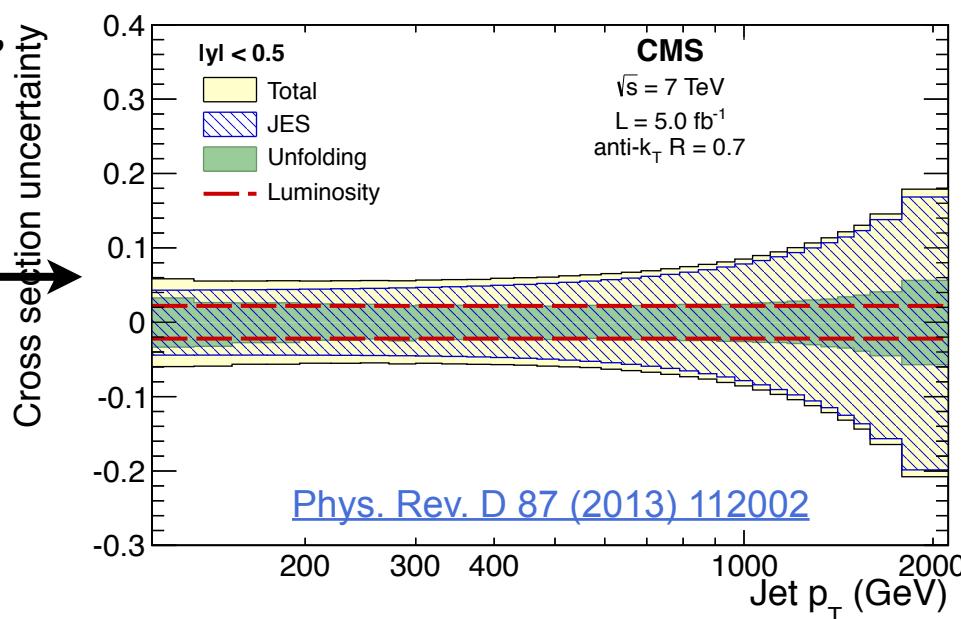
- Event and jet quality selection
- Several triggers in the full eff. range
- Unfolded using [IDS](#)
- Cross-checks on: PU, detector effects, quality criteria, unfolding bias
- Uncertainty dominated by the jet energy scale (see the CMS measurement example) →



ATLAS Inclusive Jet 7 TeV
soon to be published

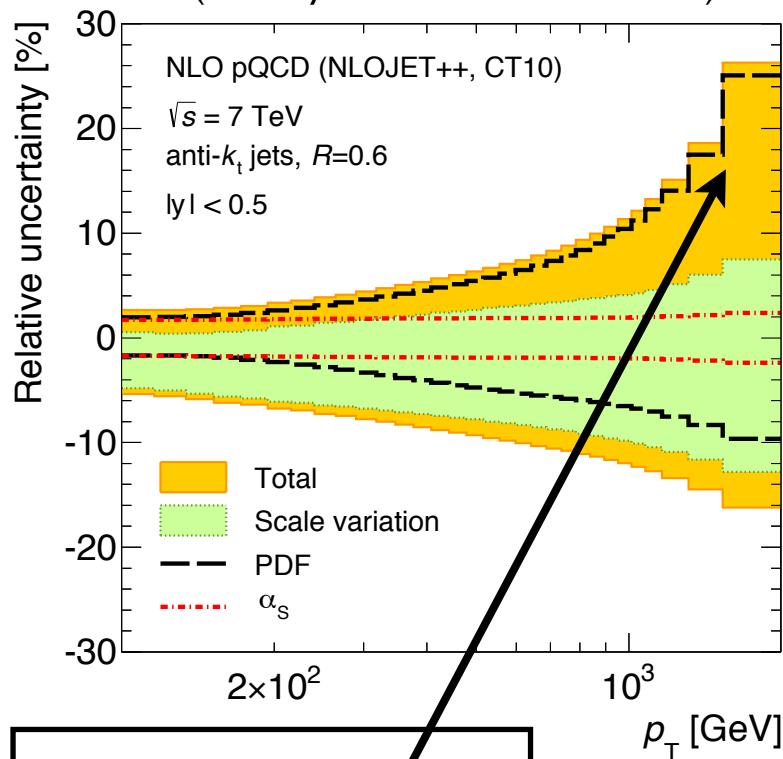


CMS Inclusive Jet 7 TeV



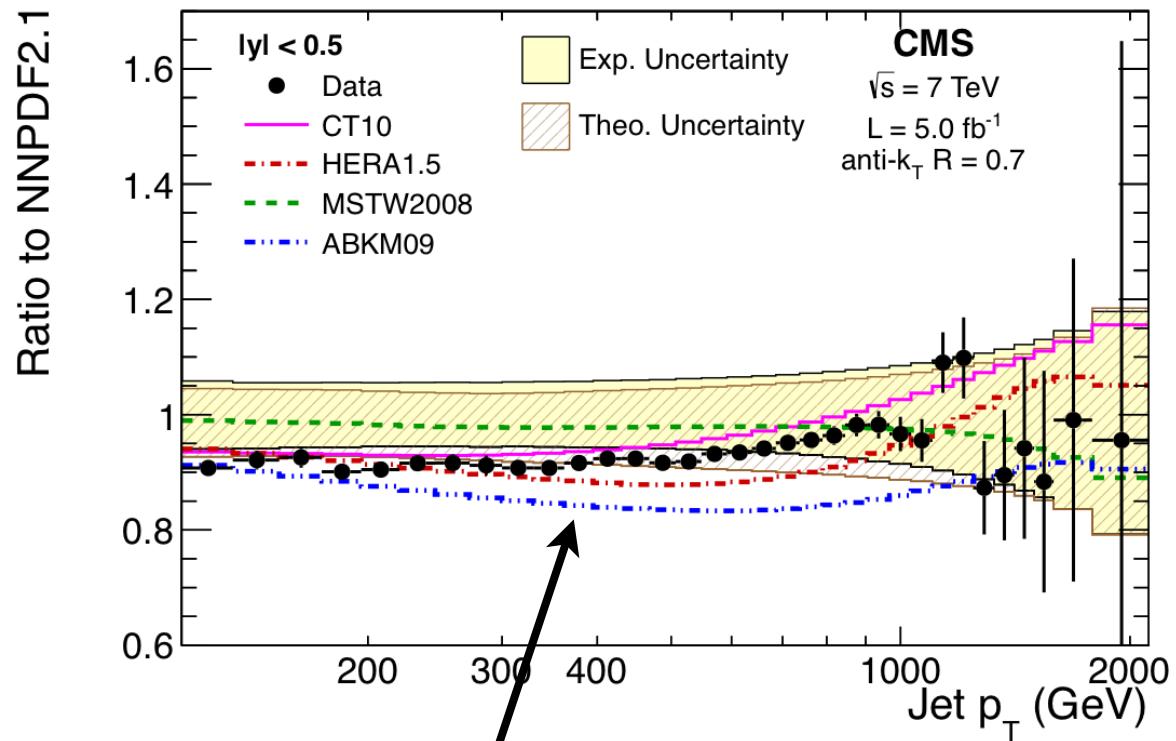
Sensitivity of Jet measurements to PDFs

Inclusive Jet Cross section
Theoretical Uncertainty
(done by the ATLAS collaboration)



PDF uncertainty dominates

CMS 7 TeV Inclusive full 2011 dataset
[Phys. Rev. D 87 \(2013\) 112002](#)



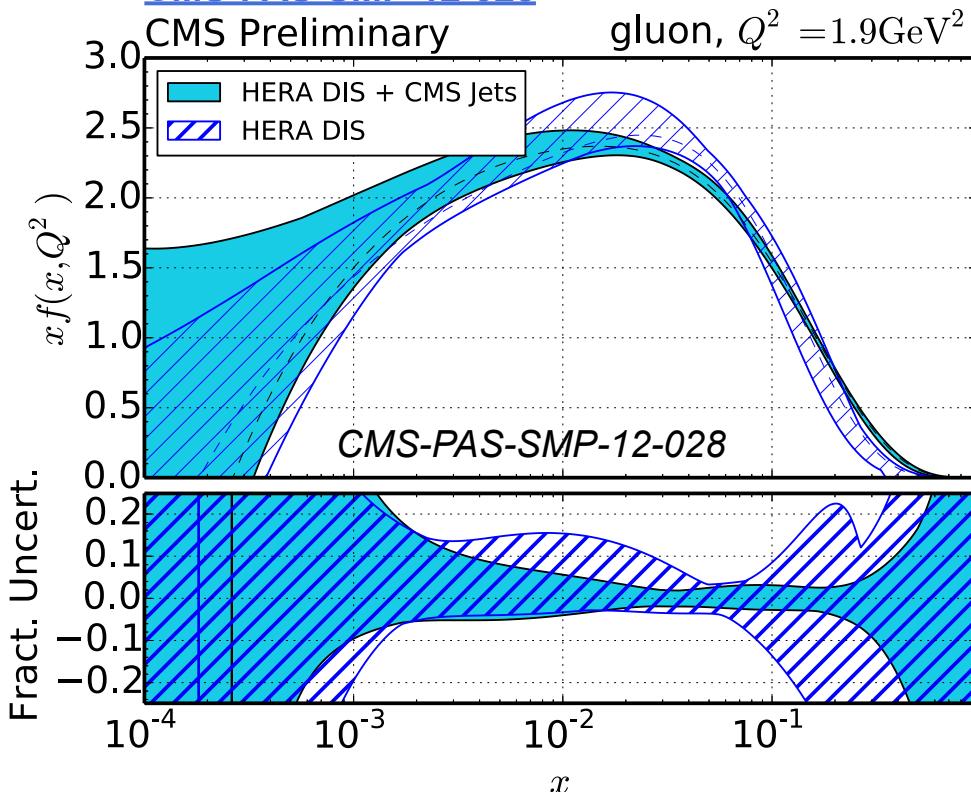
jet measurements are sensitive to PDFs

gluon quark PDF results

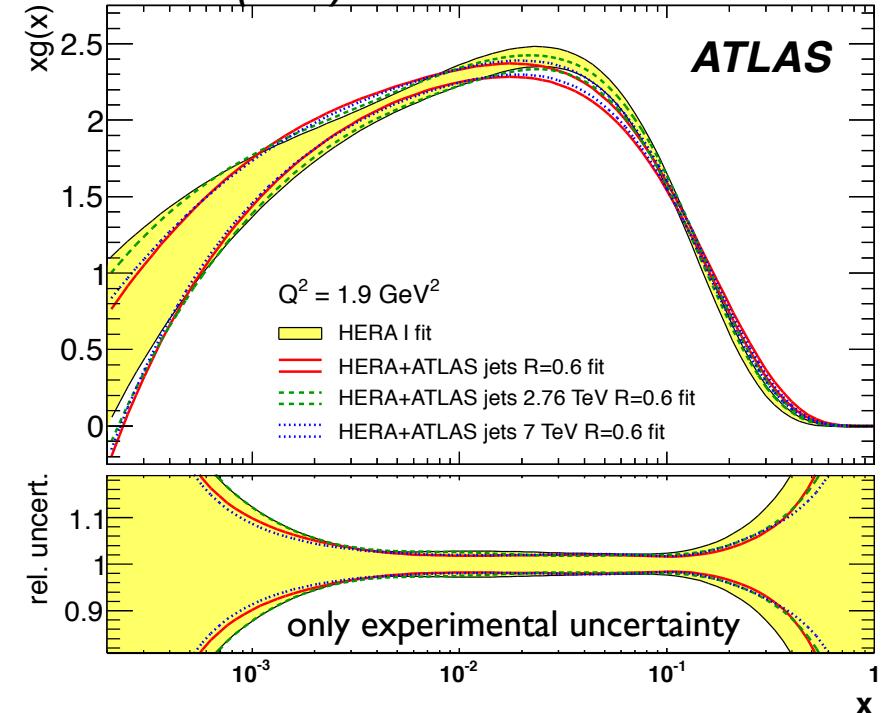
gluon pdf parametrization (HERA Fitter):

$$xg(x) = A_g x^{B_g} (1-x)^{C_g} - A'_g x^{B'_g} (1-x)^{C'_g}$$

[CMS-PAS-SMP-12-028](#)

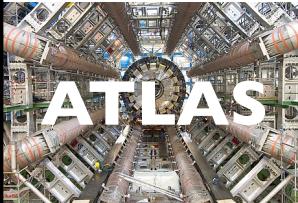


EPJC (2013) 73 2509



both ATLAS and CMS jets measurements
prefer harder gluon PDF

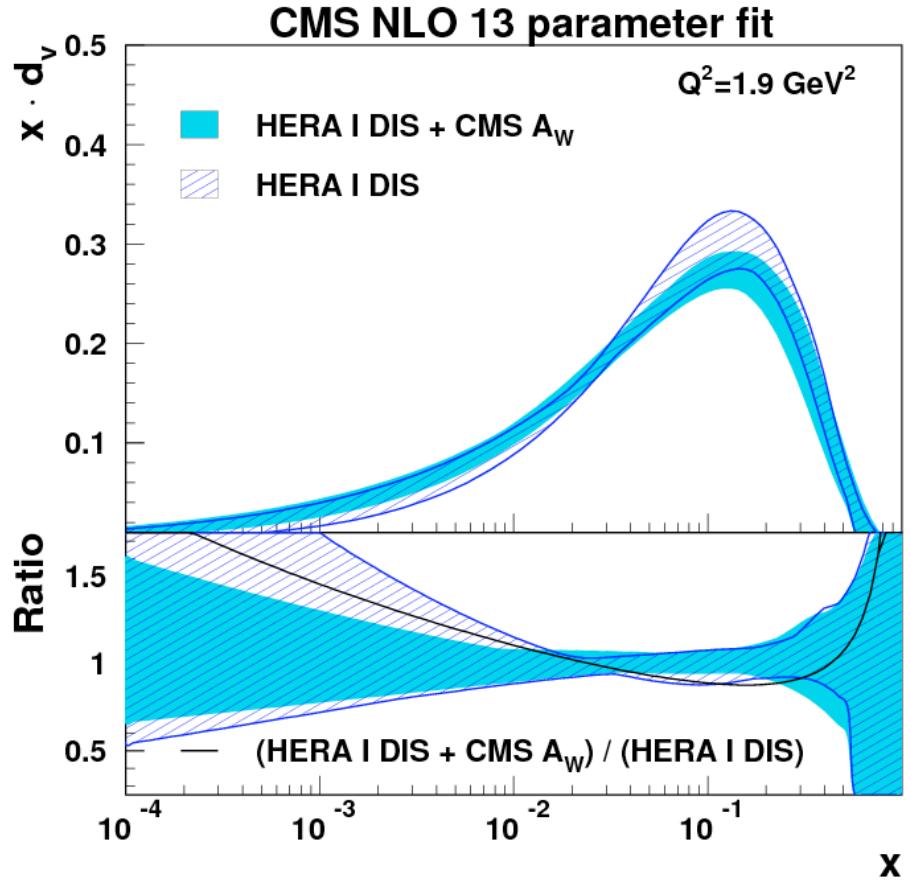
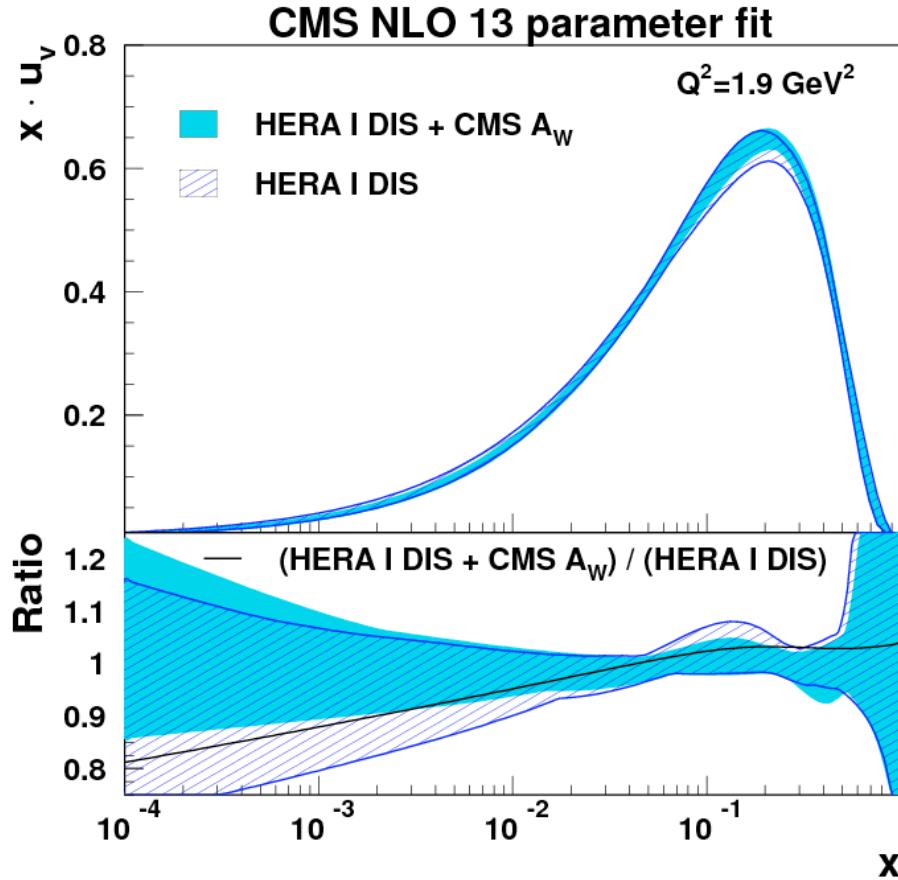
Measurements used for PDF fits

Observable:	Jets	$A_w(W \rightarrow \mu\nu)$	$W+c$	W,Z	High-Mass Drell Yan
Sensitivity:	g and u quark PDF	$(u_v - d_v) / (u_v + d + 2u_{sea})$	s PDF	s PDF	quarks at high Q^2
 ATLAS	7 TeV : inc. ^(*) , m_{jj} , $m_{3j}^{(*)}$		7 TeV	7 TeV (2010)	7 TeV
 CMS	7 TeV : inc., m_{jj} , m_{3j} 8 TeV ^(*) : inc., m_{jj} , m_{3j}	7 TeV hep-ex/ 1312.6283	7 TeV JHEP 02 (2014) 013		

(*) Still preliminary

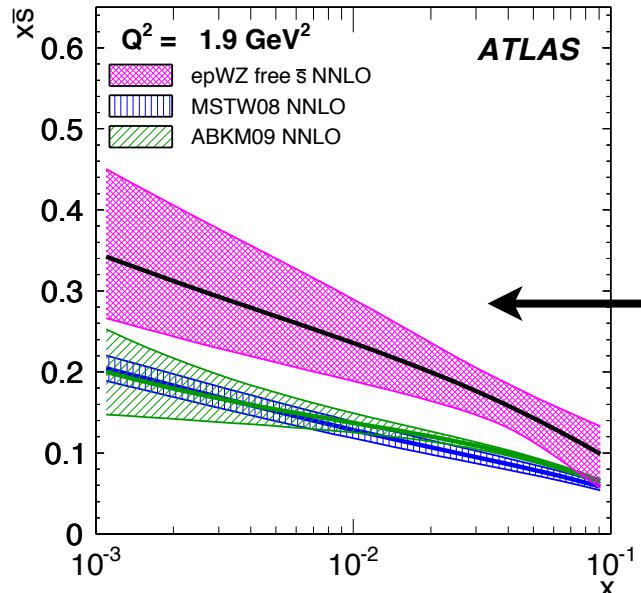
valence quark PDF results using W asymmetry

[hep-ex/1312.6283](https://arxiv.org/abs/hep-ex/1312.6283); (submitted to Phys. Rev. D)

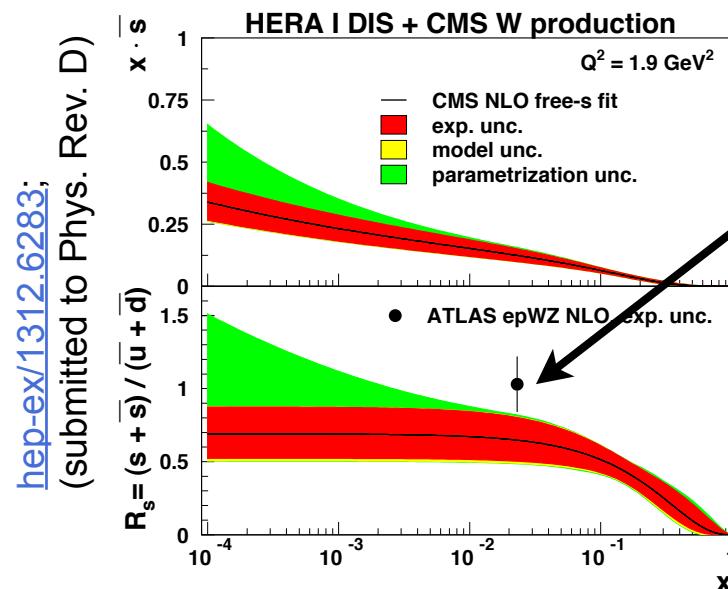
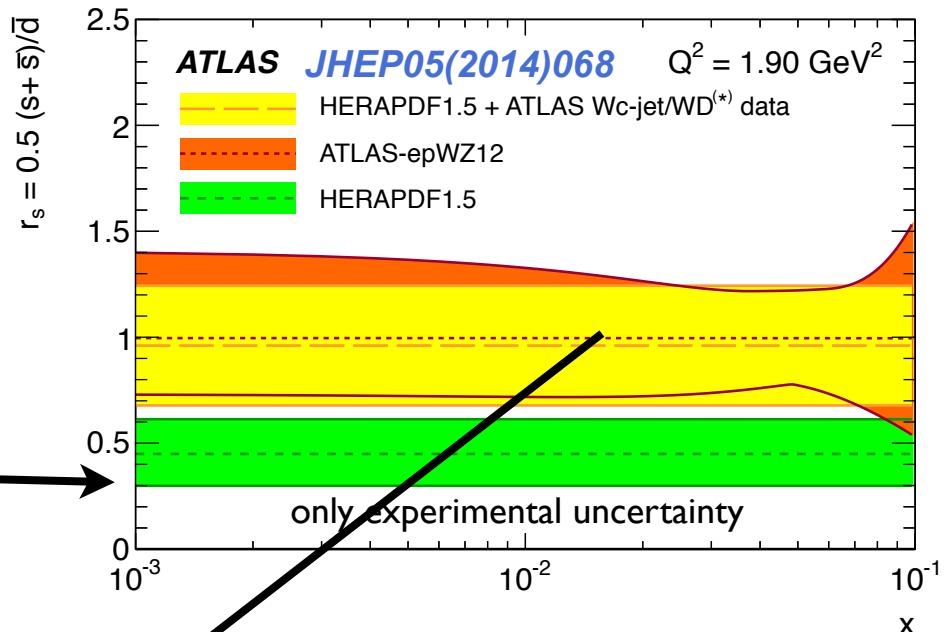


The muon charged asymmetry in W -boson production imposes strong constraints on the valence-quark distributions

strange-quark PDF results using W/Z and W+c

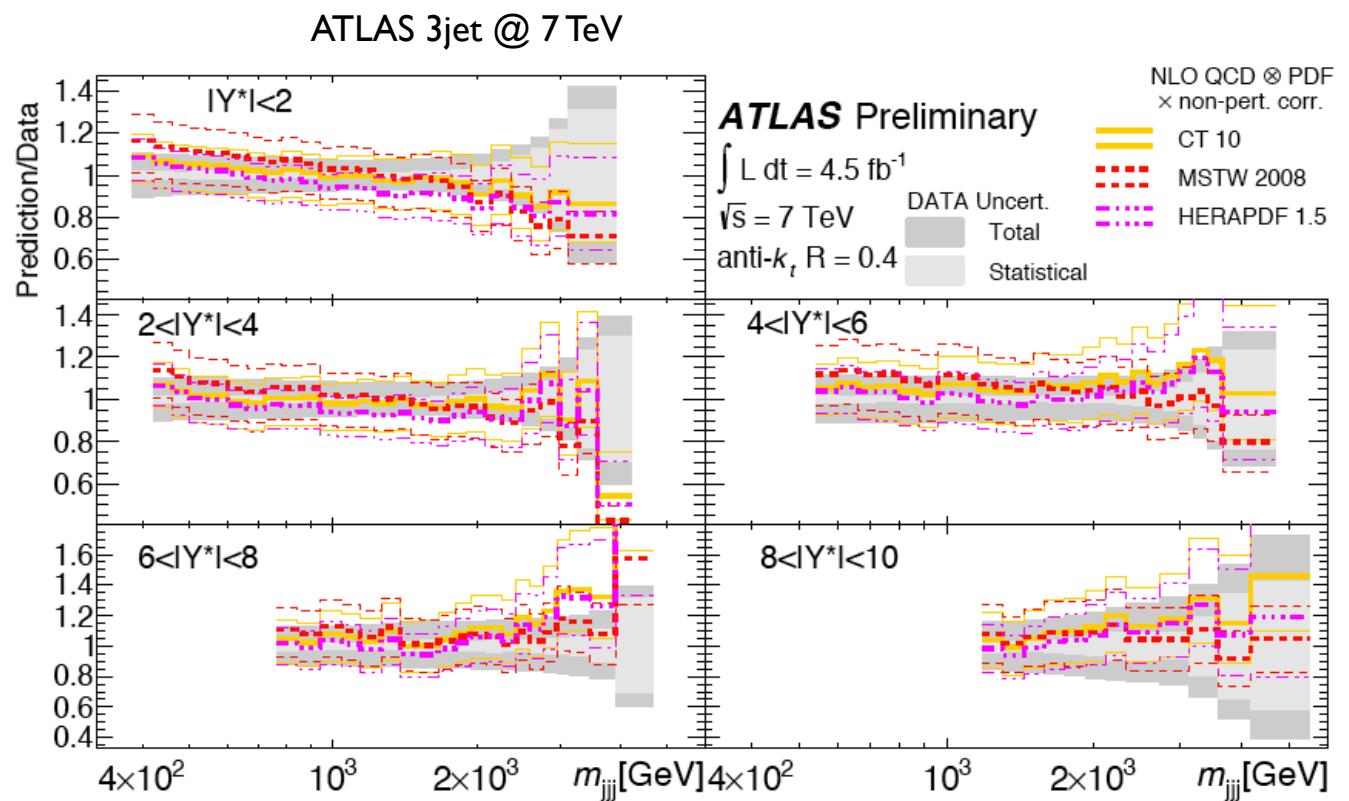
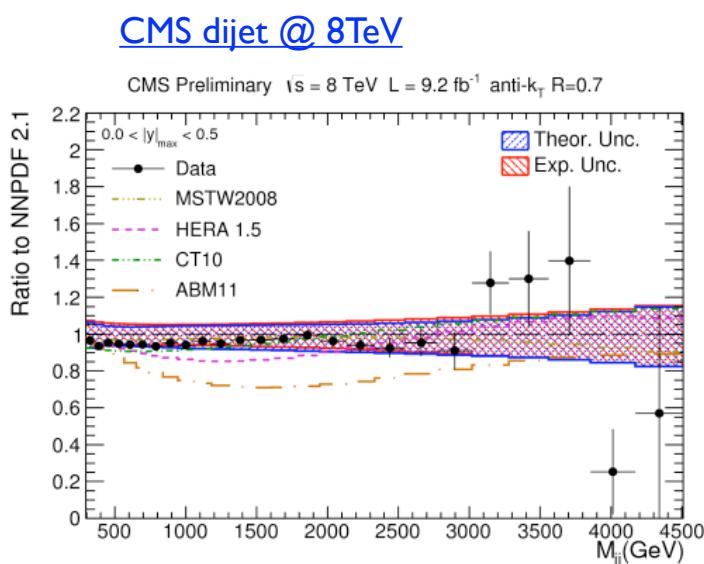
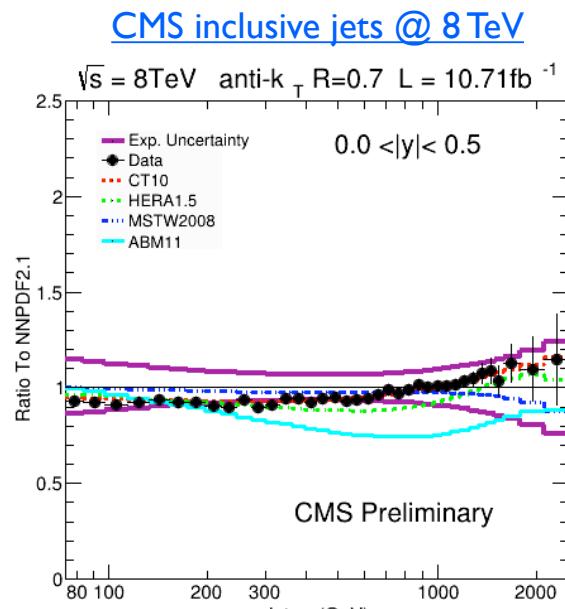


The strange-quark PDF has been determined by ATLAS indirectly with W/Z production and directly through W+c



CMS has done the same directly determination of sPDF the W+c channel

New inputs for PDFs



Once the new results get consolidated we will have a much better insight of the gluon PDF and α_s

in preparation for run 2

- Jet data is providing a deeper insight of the gluon PDF
 - the full 7 TeV analysis for CMS/ATLAS are or will be published soon, and the 8 TeV ones are coming
 - JES uncertainty dominates jet physics measurements uncertainty
 - Better JES requires less PU
 - Disentangle the role of EWC, NNLO and gluon pdf is a key in run 2
- Not mention in the talk but Photon analysis also show potential for PDF determination
 - A better insight of the theoretical calculations is needed
- Updates on measurements on W/Z measurements also have potential impact on PDFs

*Wanderer, your footsteps are
the road, and nothing more;
wanderer, there is no road,
the road is made by walking.
By walking one makes the road,
and upon glancing behind
one sees the path
that never will be trod again.
Wanderer, there is no road--
Only wakes upon the sea.*

A. Machado, Campos de Castilla



BU

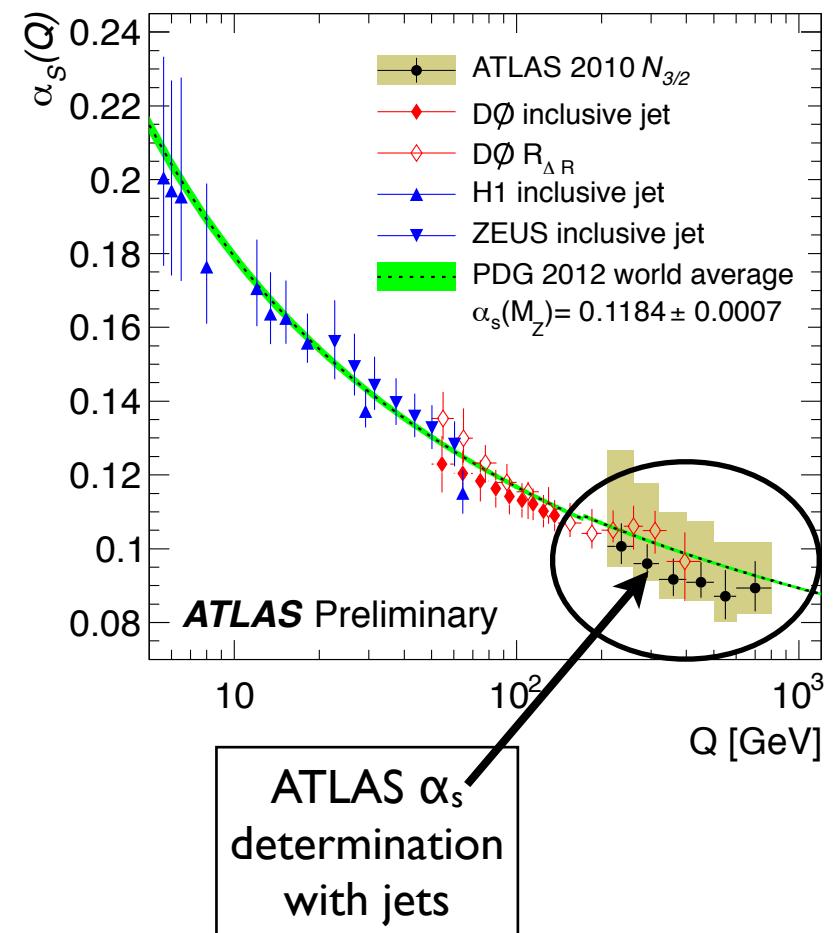
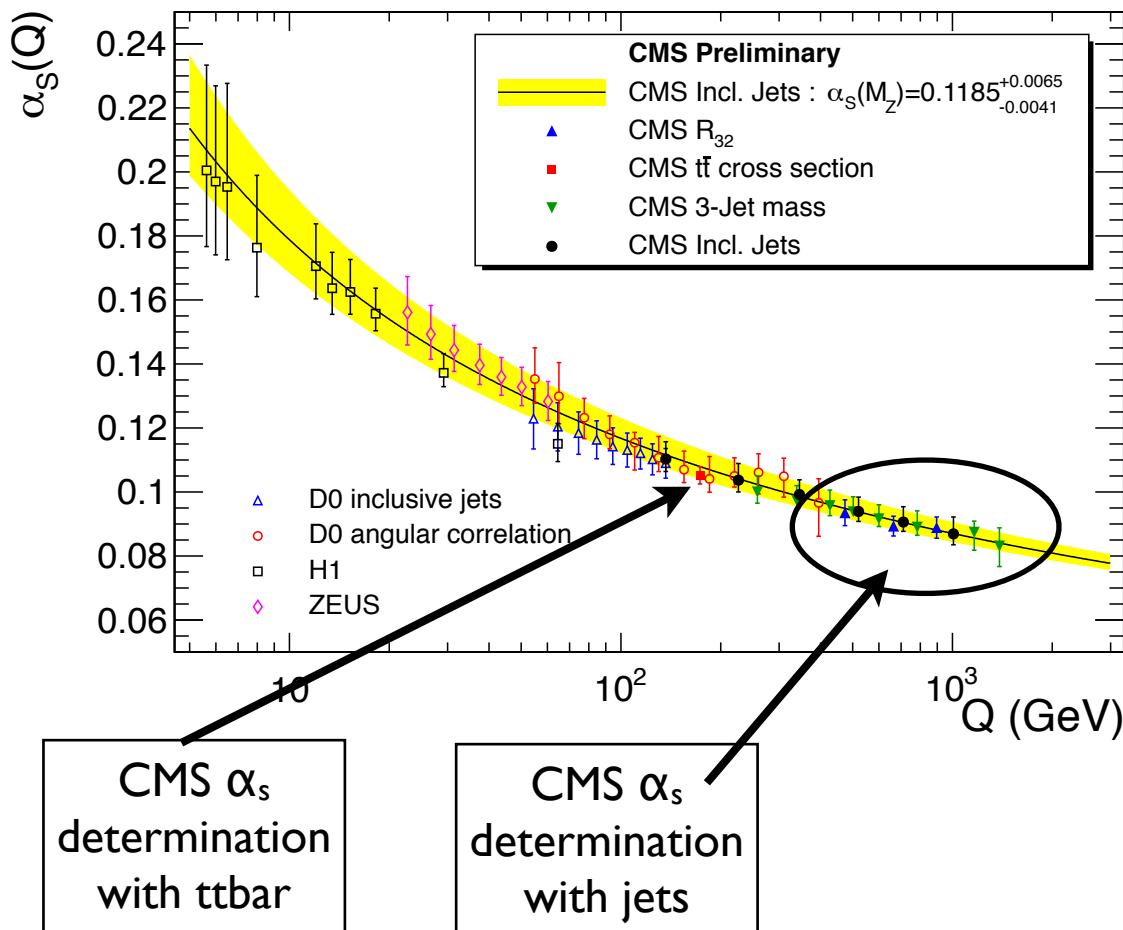
Outline

- ATLAS and CMS measurements relevant to PDFs and α_s
 - Jets, W/Z, W+c
- Newest α_s determinations
- Newest PDF extraction
- Future prospects

Sensitivity of Jet measurements to α_s

Both CMS and ATLAS jet measurements have been used to probe the running of α_s to the highest energy scales

no deviations from RGE is found



Sensitivity of Jet measurements to α_s determination

World average (2014)
 $\alpha_s(M_Z) = 0.1185 \pm 0.0006$ (0.5%)

CMS Most recent: inclusive jet (5%)

$$\alpha_s(M_Z) = 0.1185 \pm 0.0019(\text{exp}) \pm 0.0028(\text{PDF}) \\ \pm 0.0004(\text{NP}) \pm 0.0055(\text{scale})$$

H1 most recent α_s extraction from inclusive and multijet cross-section. Best precision is reached from fit to normalized multijet cross sections:

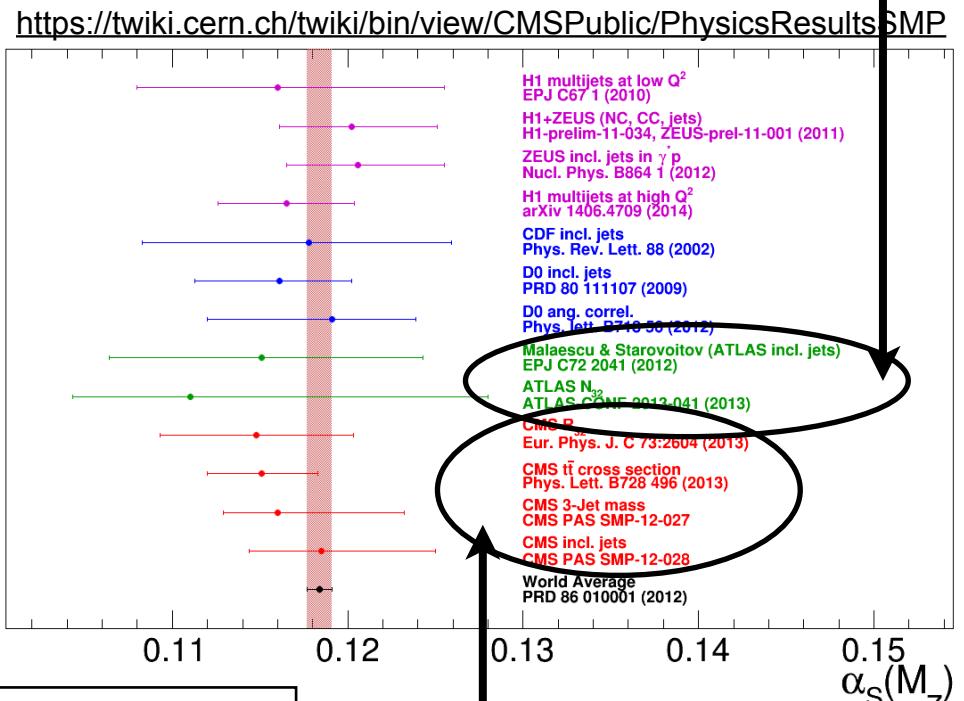
$$\alpha_s = 0.1165 \pm 0.0008(\text{exp}) \pm 0.0038(\text{PDF, theo})$$

The current Zeus one is:

Physics Letters B 649 (2007) 12–24

$$\alpha_s(M_Z) = 0.1207 \pm 0.0014(\text{stat.})^{+0.0035}_{-0.0033} (\text{exp.})^{+0.0022}_{-0.0023} (\text{th.})$$

2 determinations using ATLAS data



4 determinations using CMS data