Inclusive Jets and POWHEG

Small-x QCD meeting

- POWHEG input for inclusive jets
- Comparison to 2010 and 2011 inclusive jets analysis

  Rivet routines: CMS_2011_S908618, CMS_QCD_11_004
- Non-perturbative correction factor
- Comparison to PYTHIA

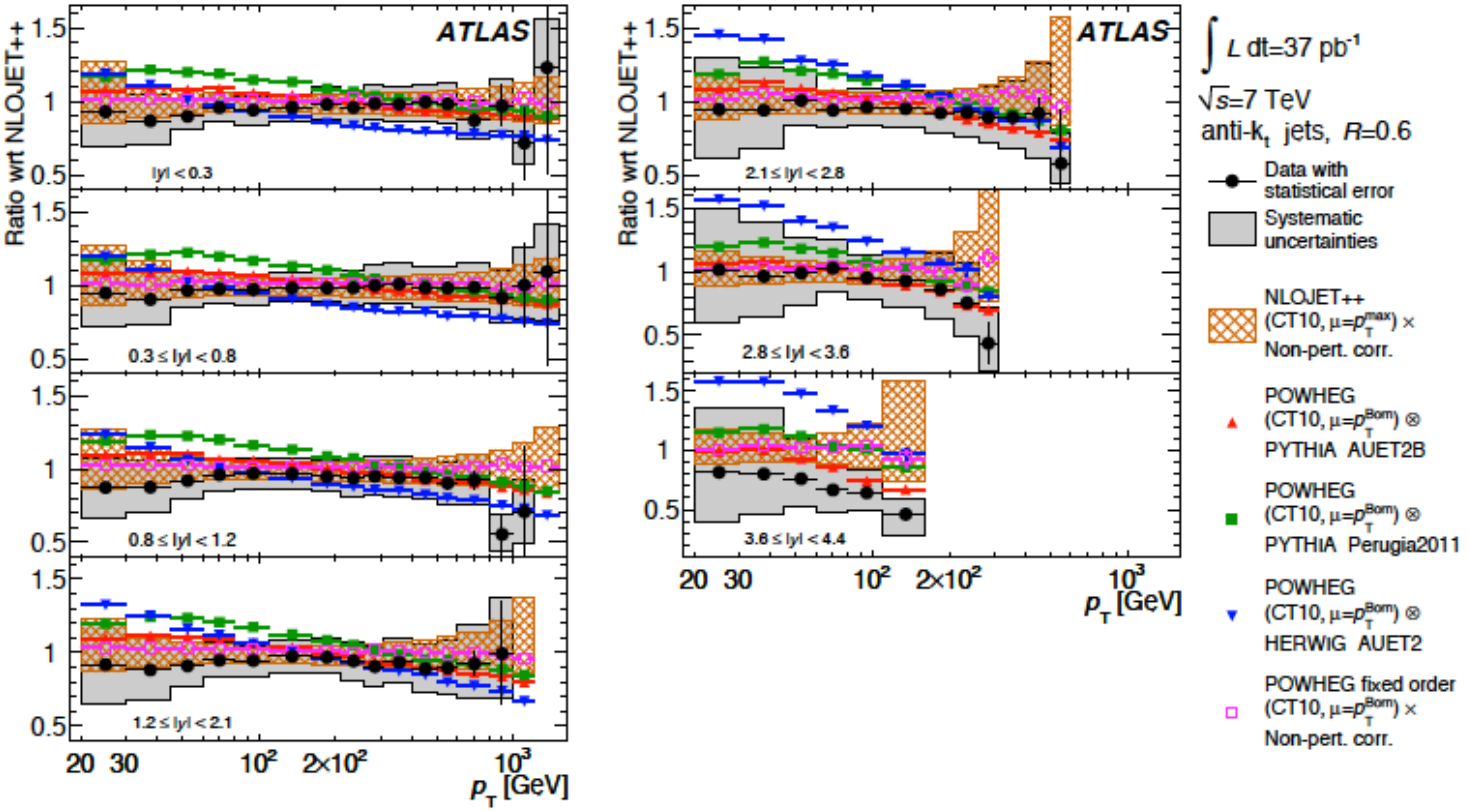
Motivation

Theoretical predictions for inclusive jet cross sections contain NLO QCD calculations. NLO calculation can be done with NLOJet++ program or the POWHEG method.

NLO predictions have to be corrected for non-perturbative effects.

Good agreement between NLO fixed-order calculations based on NLOJet++ and POWHEG

Significant differences if POWHEG is interfaced to showering and different soft models



ATLAS Measurement of inclusive jet and dijet production in pp collisions at sqrt s = 7TeV using the ATLAS detector, hep-ex/1112.6297

POWHEG BOX

- Implementing NLO calculations to shower Monte Carlo program (PYTHIA6.4)
- Events are generated independently from CMSSW and the MC generator in the dijet module
- To generate the NLO calculations and the hardest emission events appropriate for the inclusivie jets use (powheg.input)

bornktmin 5d0	kt cut on the final state partons for the generation of the underlying born configuration
bornsuppfact 250d0 (2d0, 400d0)	activate the weighted event mode to gain an uniformly distributed pt spectrum
foldcsi 5 foldy 10 foldphi 2	to reduce the fraction of negative weighted events, but high cost in computing time

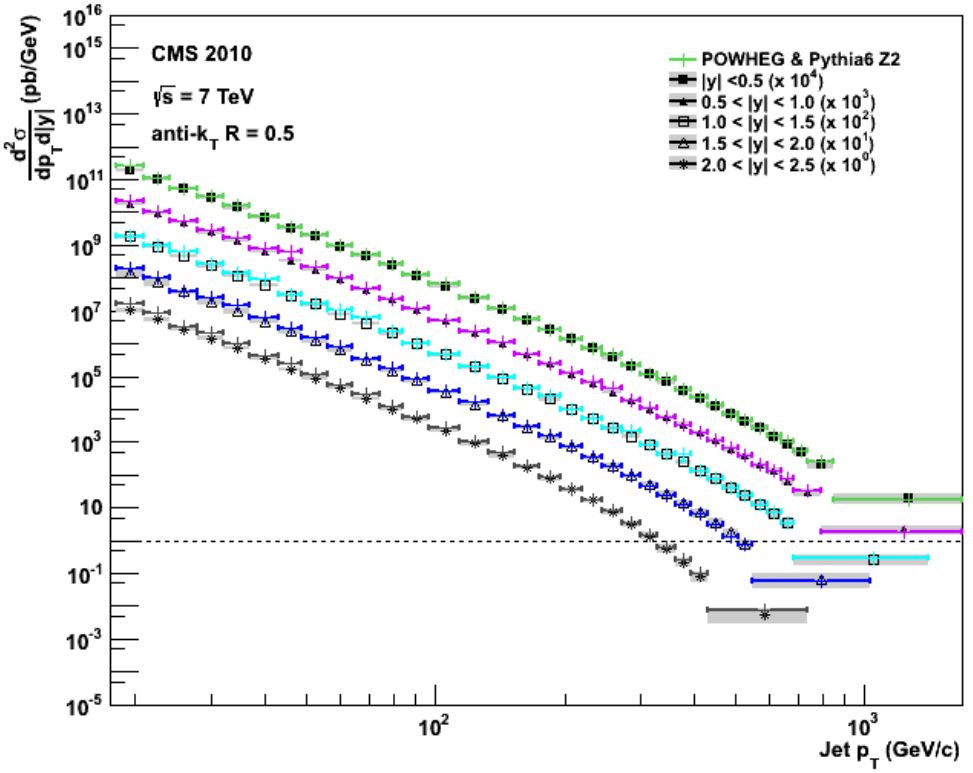
ATLAS Measurement of inclusive jet and dijet production in pp collisions at sqrt s = 7TeV using the ATLAS detector, hep-ex/1112.6297

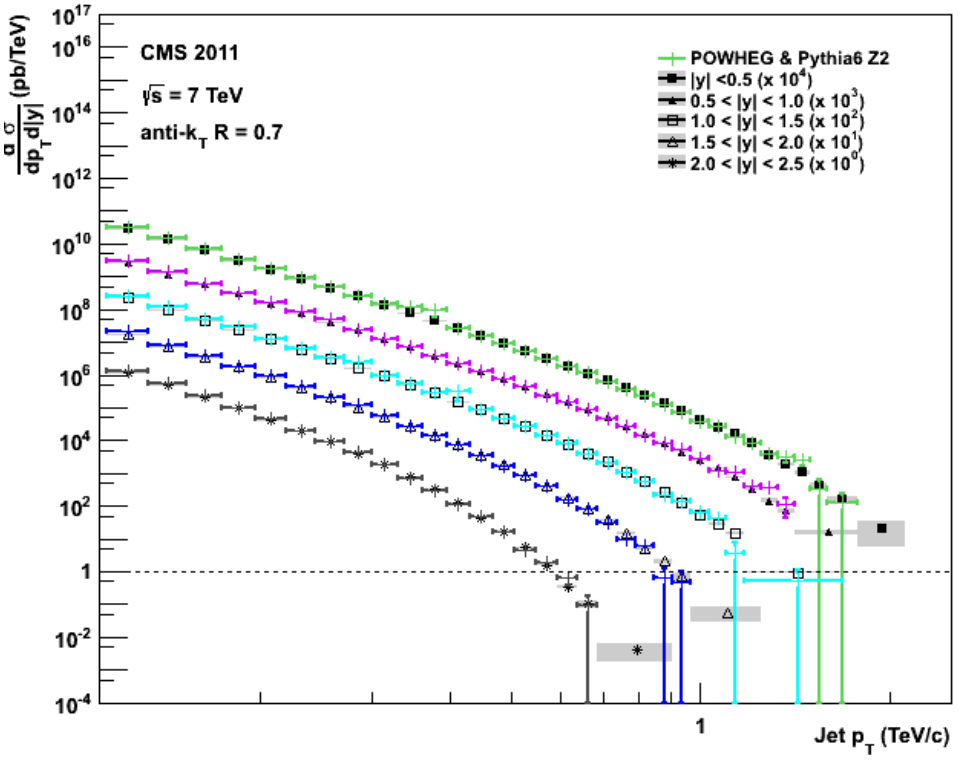
- Interface the LHE file with Shower Monte Carlo program including MPI

MSTP(86) = 1

MPI scale is limited to the hardness of the primary process, this corresponds to the momentum of the jets

Comparison to 2010 and 2011 data



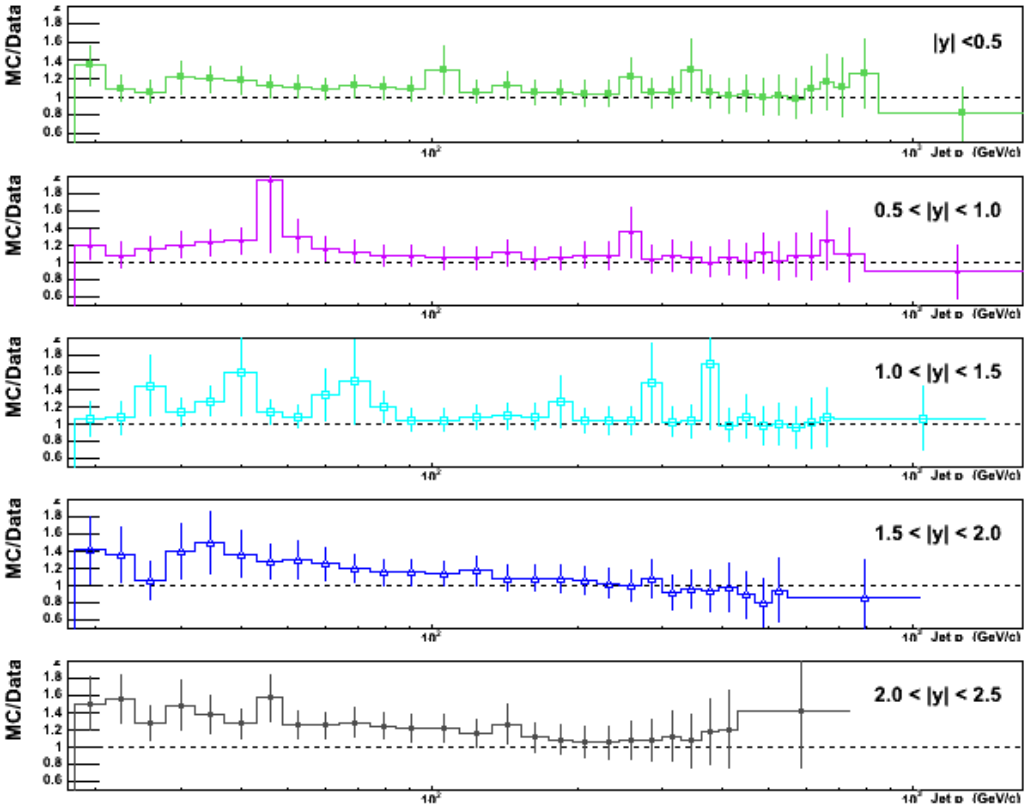


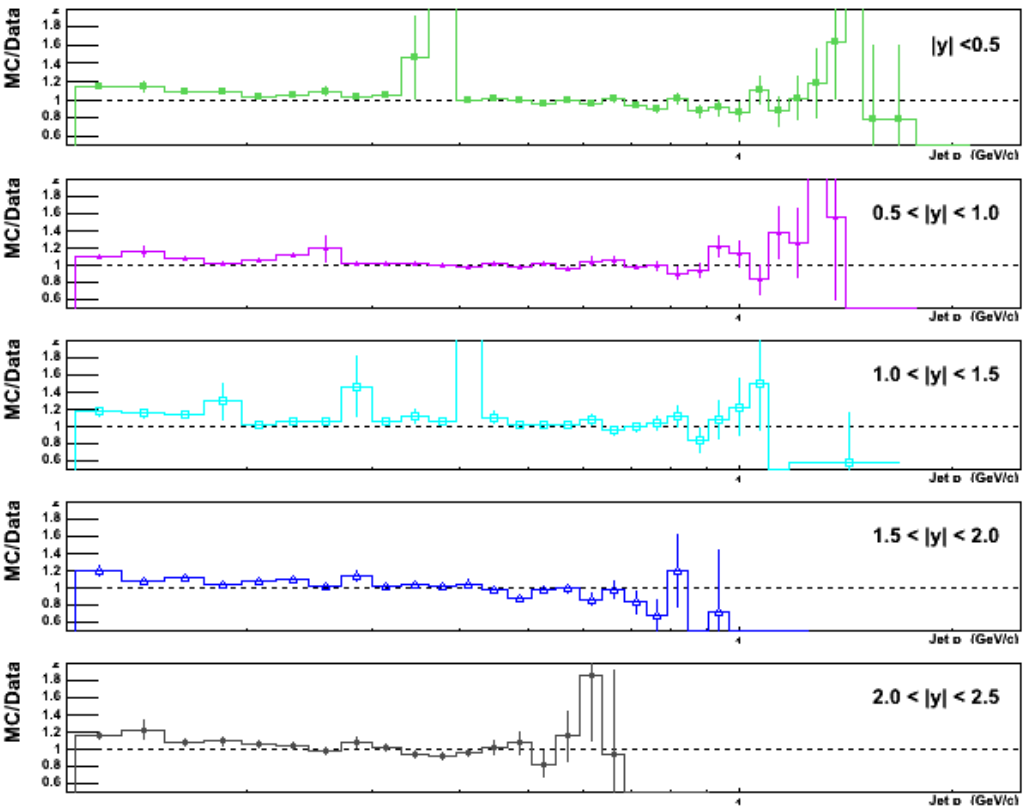
Double differential cross section for inclusive jets in different bins of rapidity going from the central region $|y| < 0.5$ to the forward region $2.0 < |y| < 2.5$

POWHEG uses for the NLO calculation the central value of the PDF set CT10 and is interfaced with PYTHIA with the tune Z2

Comparison to 2010 and 2011 data

Monte Carlo / Data Ratio for 2010 and 2011 jet analysis





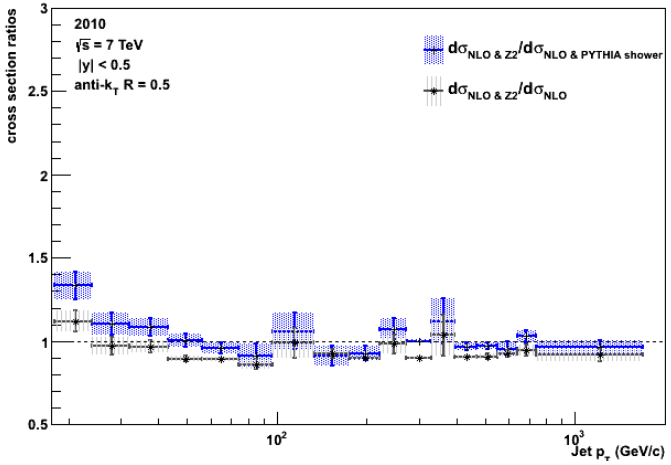
POWHEG (CT10 central value) interfaced with PYTHIA Z2 tune describes the data in a good agreement for 2011

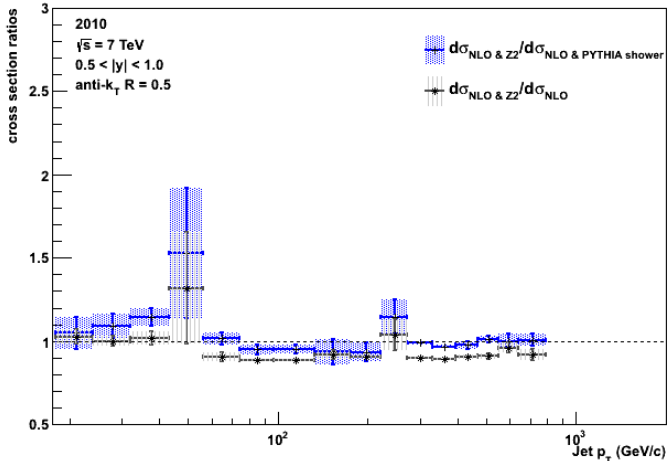
Discrepancy in 2010 comparison increases going to the forward region

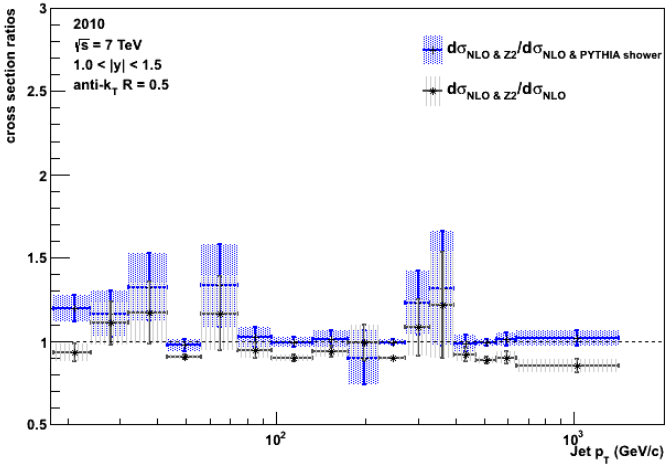
Dependence on the jet size and the interplay of hadronisation and the underlying event has to be investigated

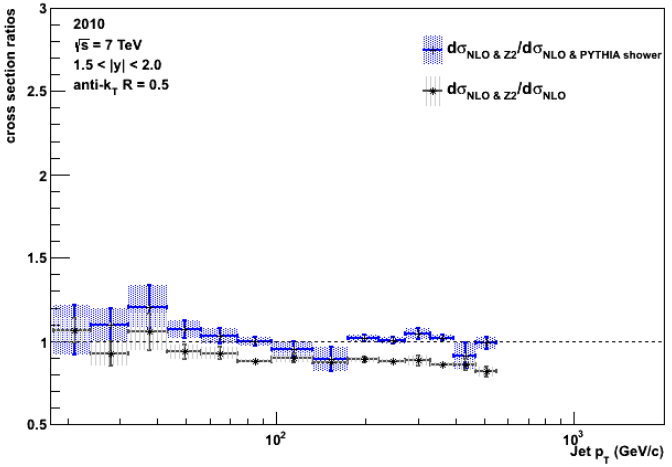
Non-perturbative correction factor for 2010

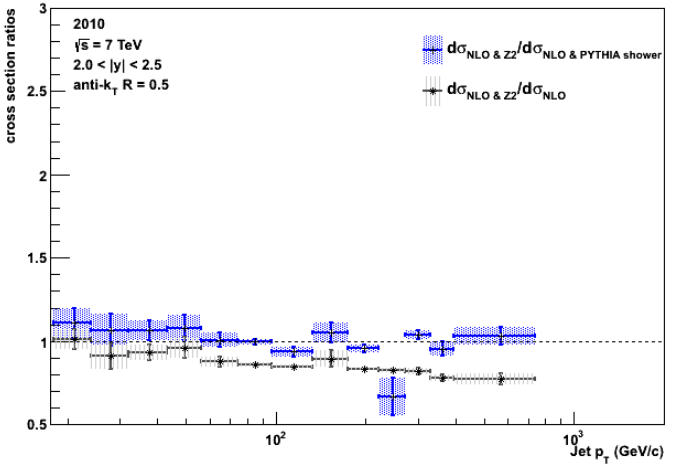
Ratio between POWHEG NLO interfaced with PYTHIA Z2 Tune and
POWHEG NLO interfaced with PYTHIA shower (MPI and hadronisation is turned off) and
POWHEG fixed order calculation (without hadronisation, shower or MPI)











Difference in large pt with PS and without PS around O(30%) emerges from radiation of the original parton at large angle

Interplay of two effects:
Reduction of jet energy from PS, since the radiation can go outside the cone and
increase of jet energy because of MPI and hadronisation

Non-perturbative correction factor for 2011

Ratio between POWHEG NLO interfaced with PYTHIA Z2 Tune and
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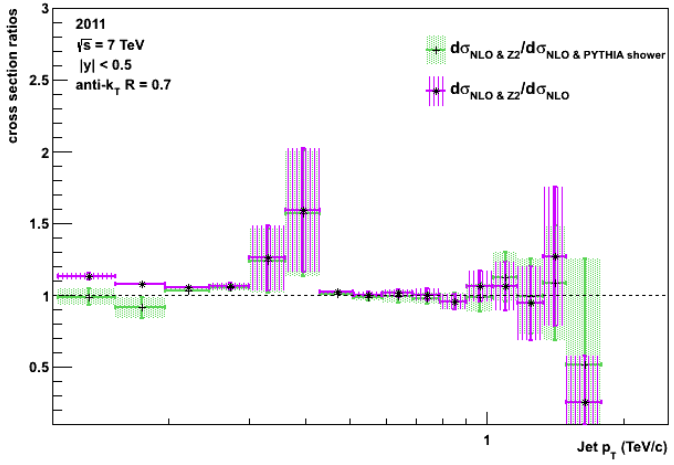
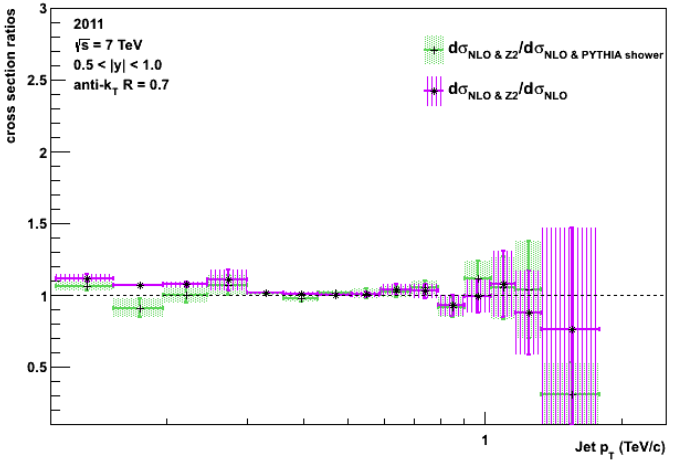


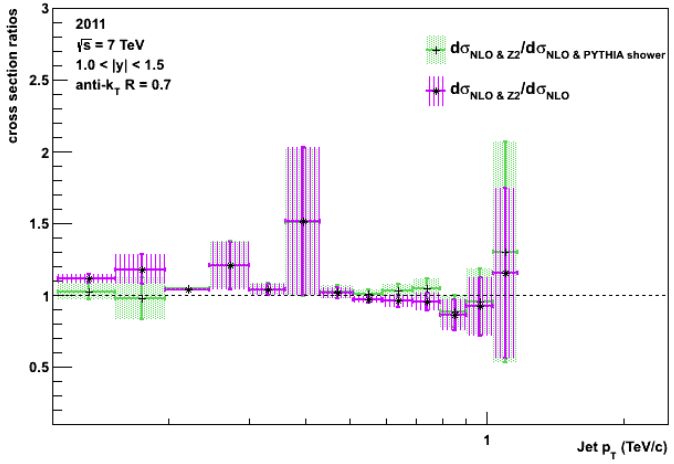


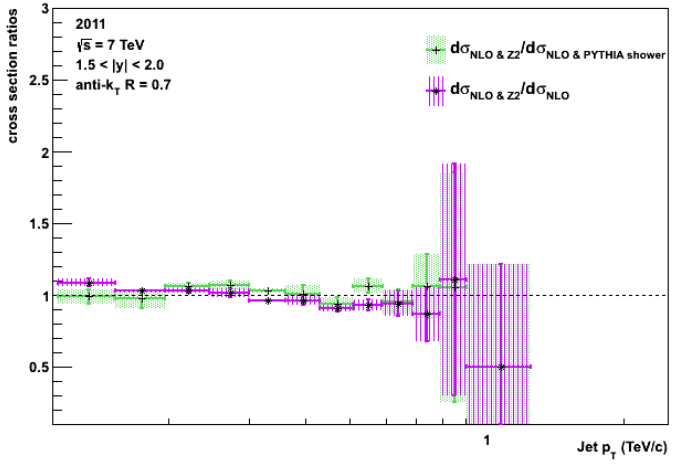
For large pt corrections are around 1

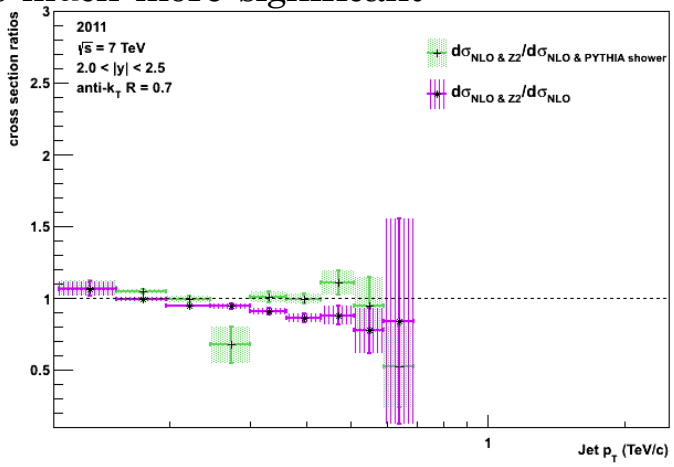
Difference in PS on and PS off is little (< 10%) compared to 2010

The difference in the jet radius has an effect on the non-perturbative corrections

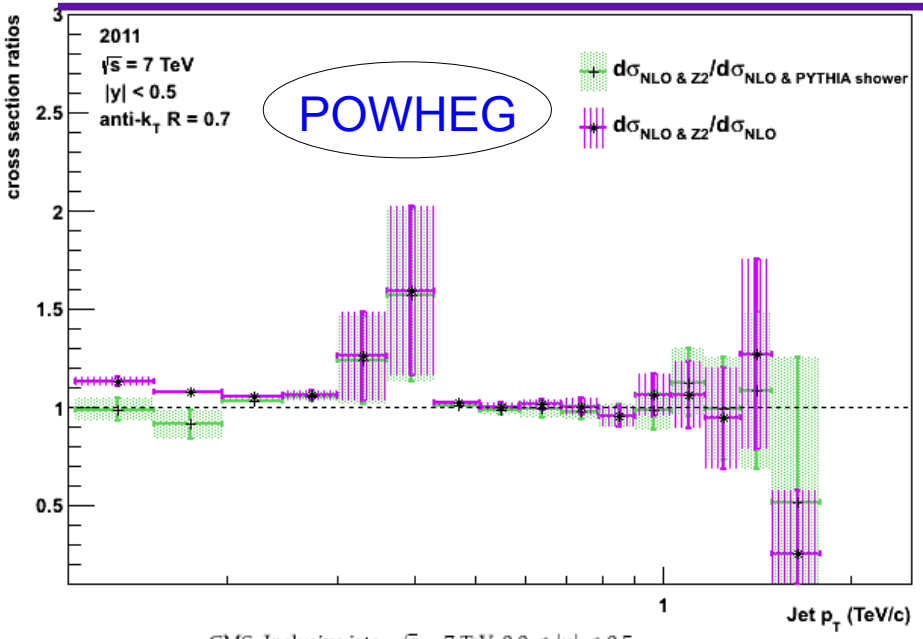
With a smaller radius the effect of PS is much more significant





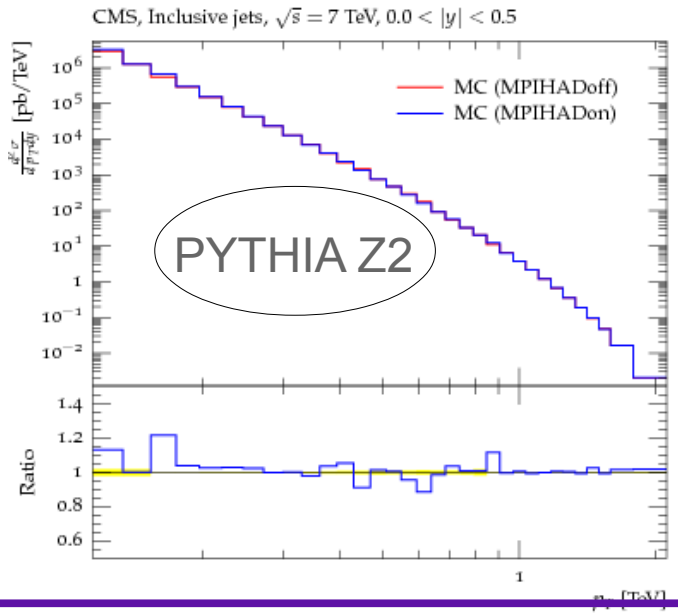


Comparison to PYTHIA 2011

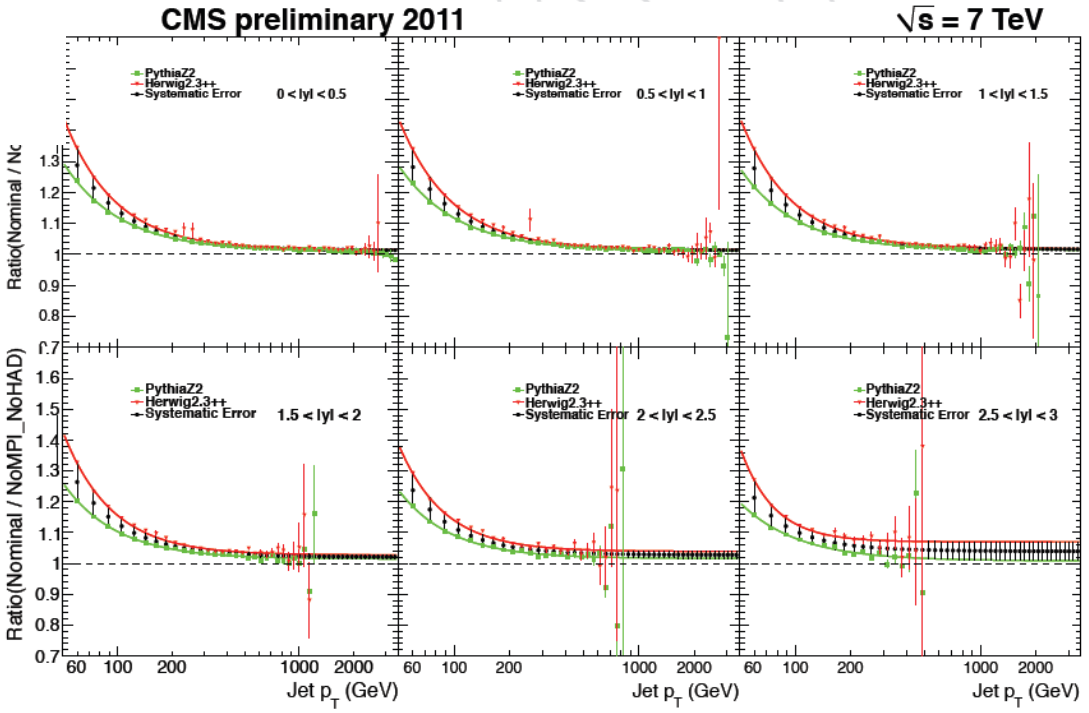


Np corrections in the central region

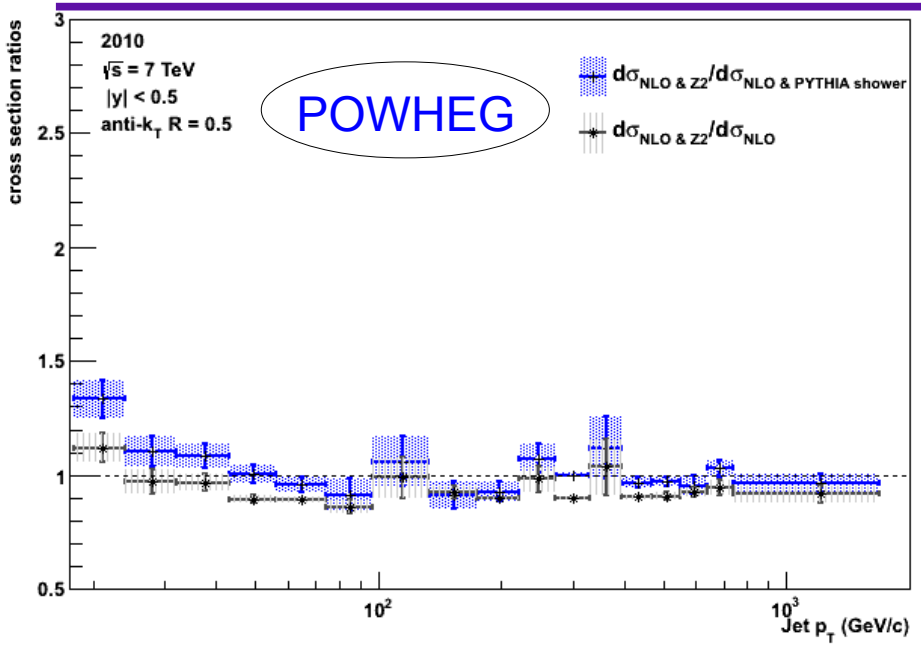
Comparison between POWHEG & PYTHIA and PYTHIA to the results from the Analysis note shows an consistent picture

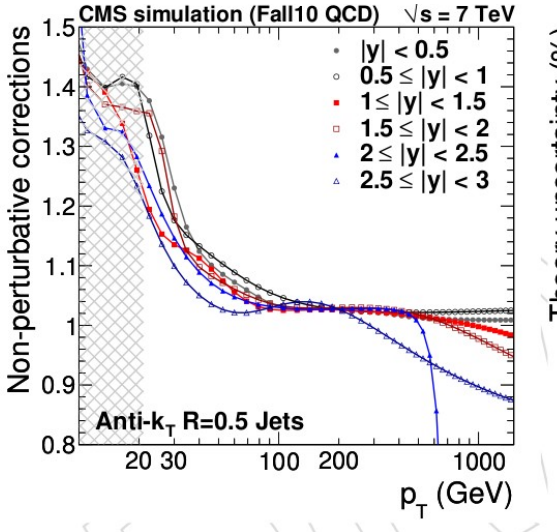


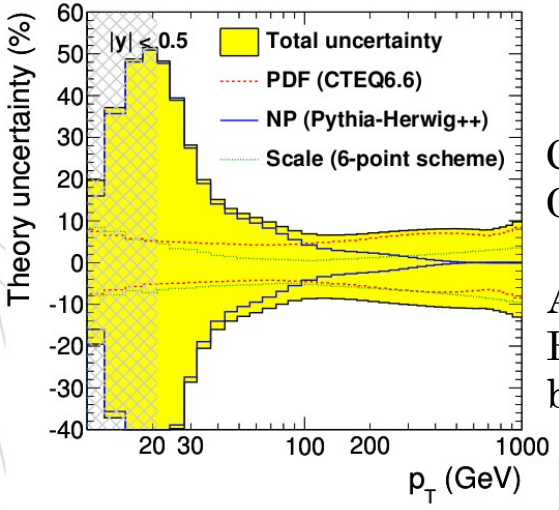
Measurement of the Inclusive Jet Cross Section at sqrt s = 7TeV CMS AN AN-11-462

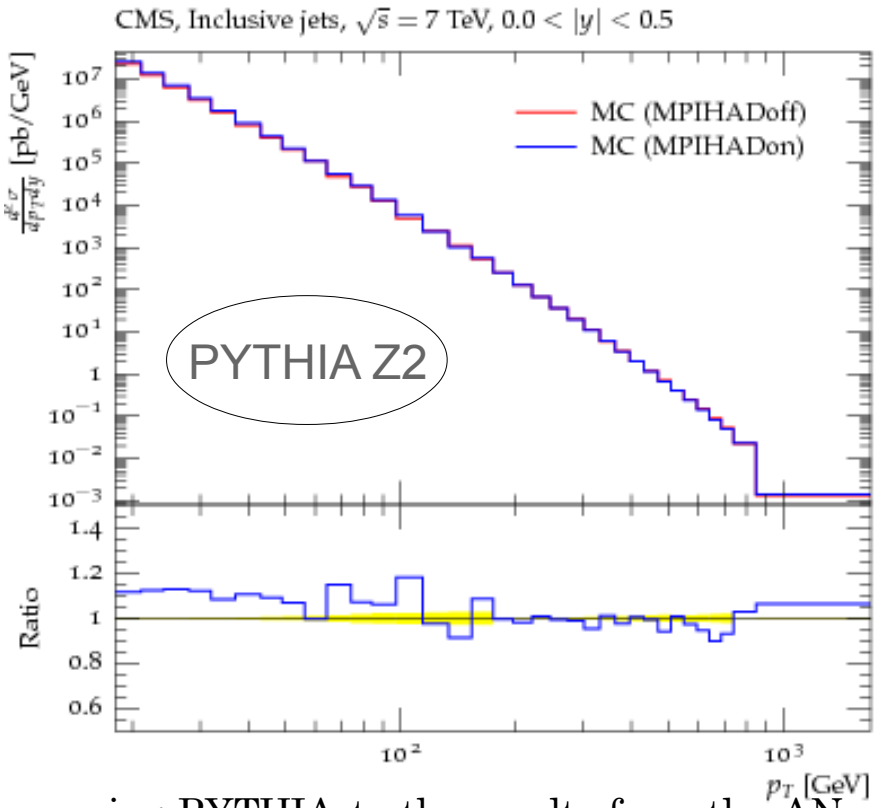


Comparison to PYTHIA 2010









Comparing PYTHIA to the results from the AN
One can see differences in the np correction factor

AN uses a different PDF set than PYTHIA
FastNLO from AN and POWHEG use CT10 here
behavior is consistent

Measurement of the Inclusive Jet Cross Section in pp Collisions at sqrt s =7 TeV AN 2010 439

Investigations and further studies

- Good agreement of data and POWHEG with PYTHIA
- The jet radius has a significant influence on the non-perturbative correction factors

  jets with R = 0.5 have larger correction factors for low pt than jets with R = 0.7

  at high pt both corrections factors converge to 1 but for the 2010 analysis parton shower show a significant effect due to the smaller jet cone radius

- higher statistics for POWHEG → running
- comparison with HERWIG → end of this week
- cross section comparison of inclusive jets and dijets with PYTHIA and Herwig
- NP corrections with more statistics
- scale variation for POWHEG