N(N)LO, Multi-legs SM group
experimental summary

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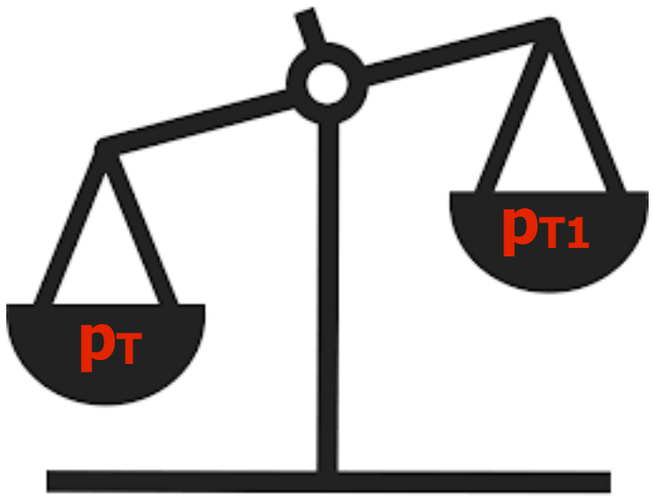
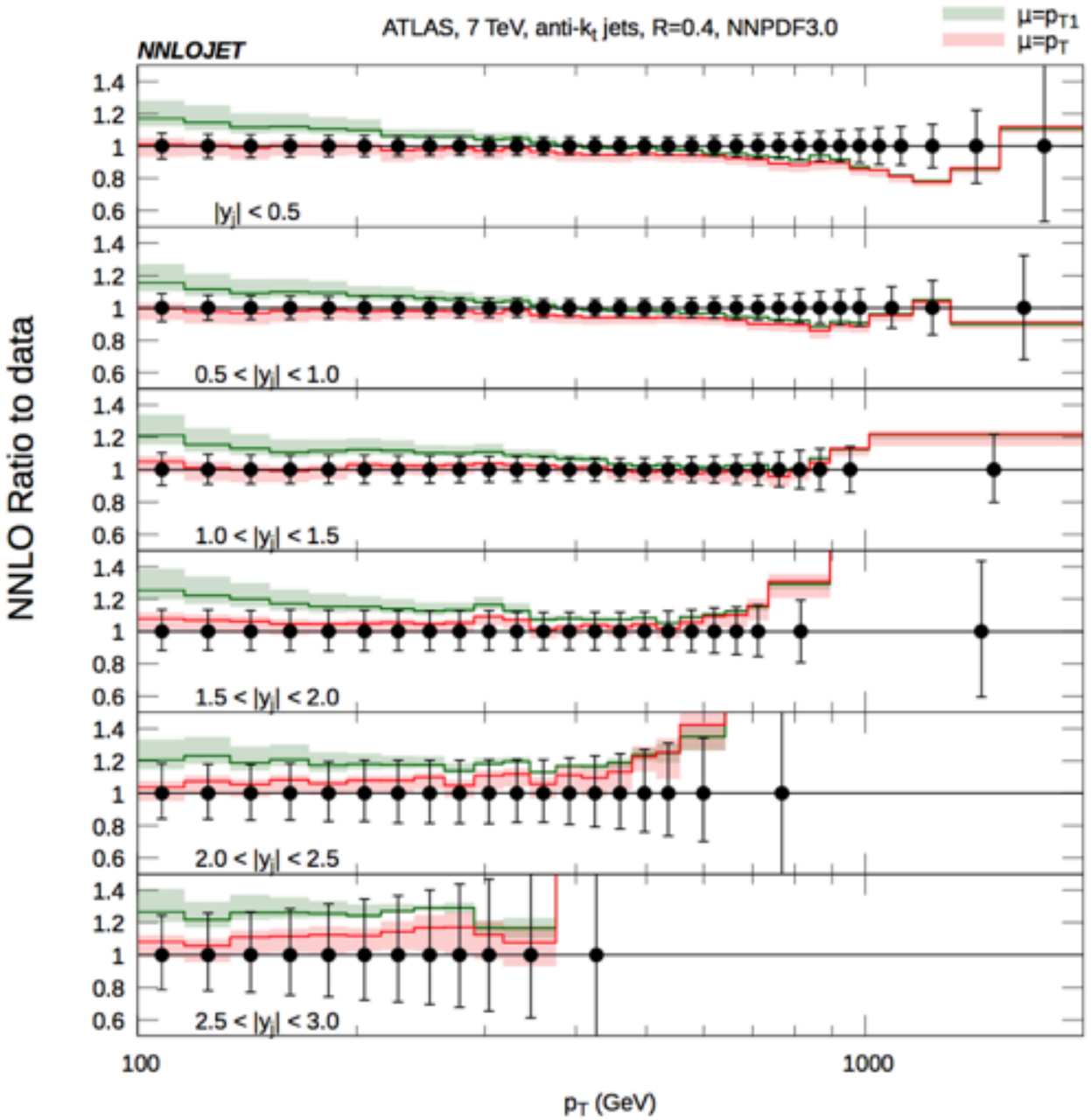
ETH zürich

Les Houches
14 June 2017

From questions arising from the



NNLO scale ?



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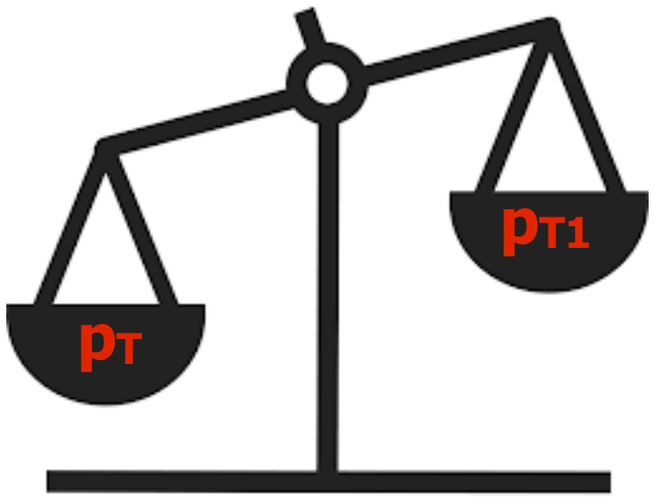

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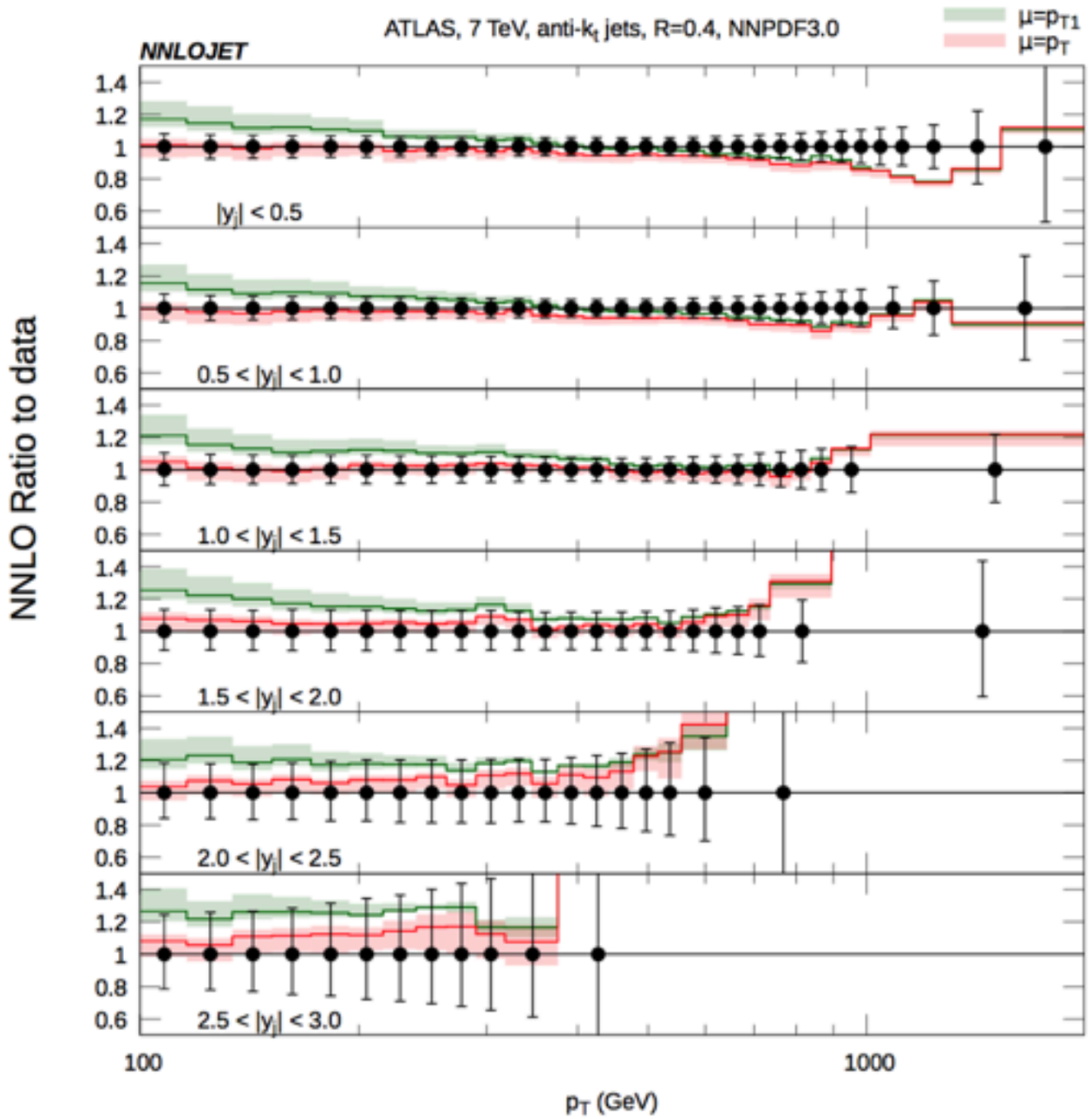
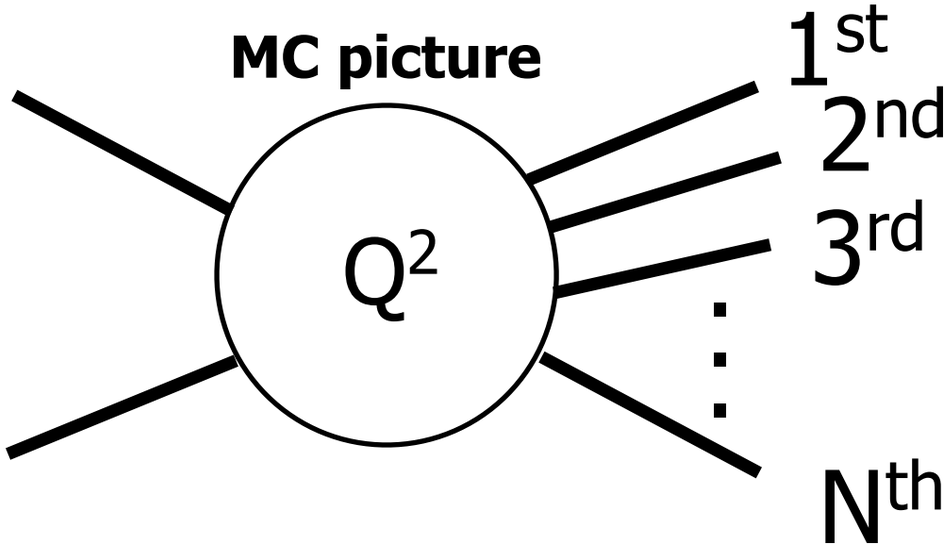
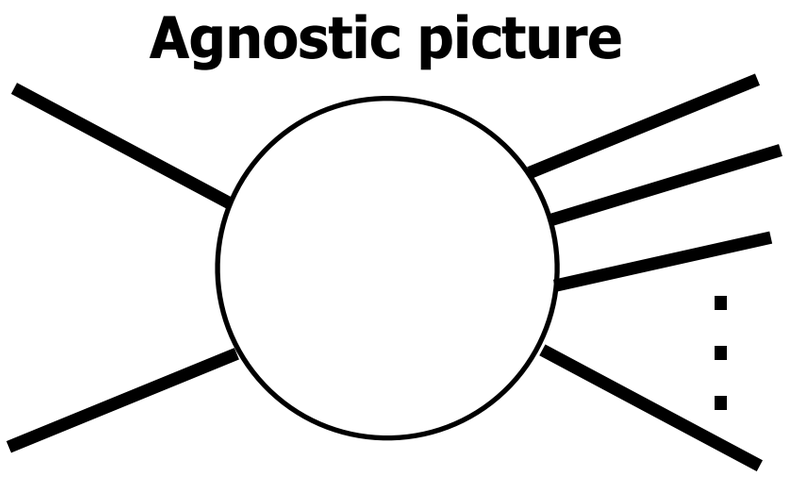


to wondering if AK04 is sufficiently wide enough and if the inclusive jet observable makes sense to start with ...

Two pictures



<u>each event</u> has a specific scale Q^2

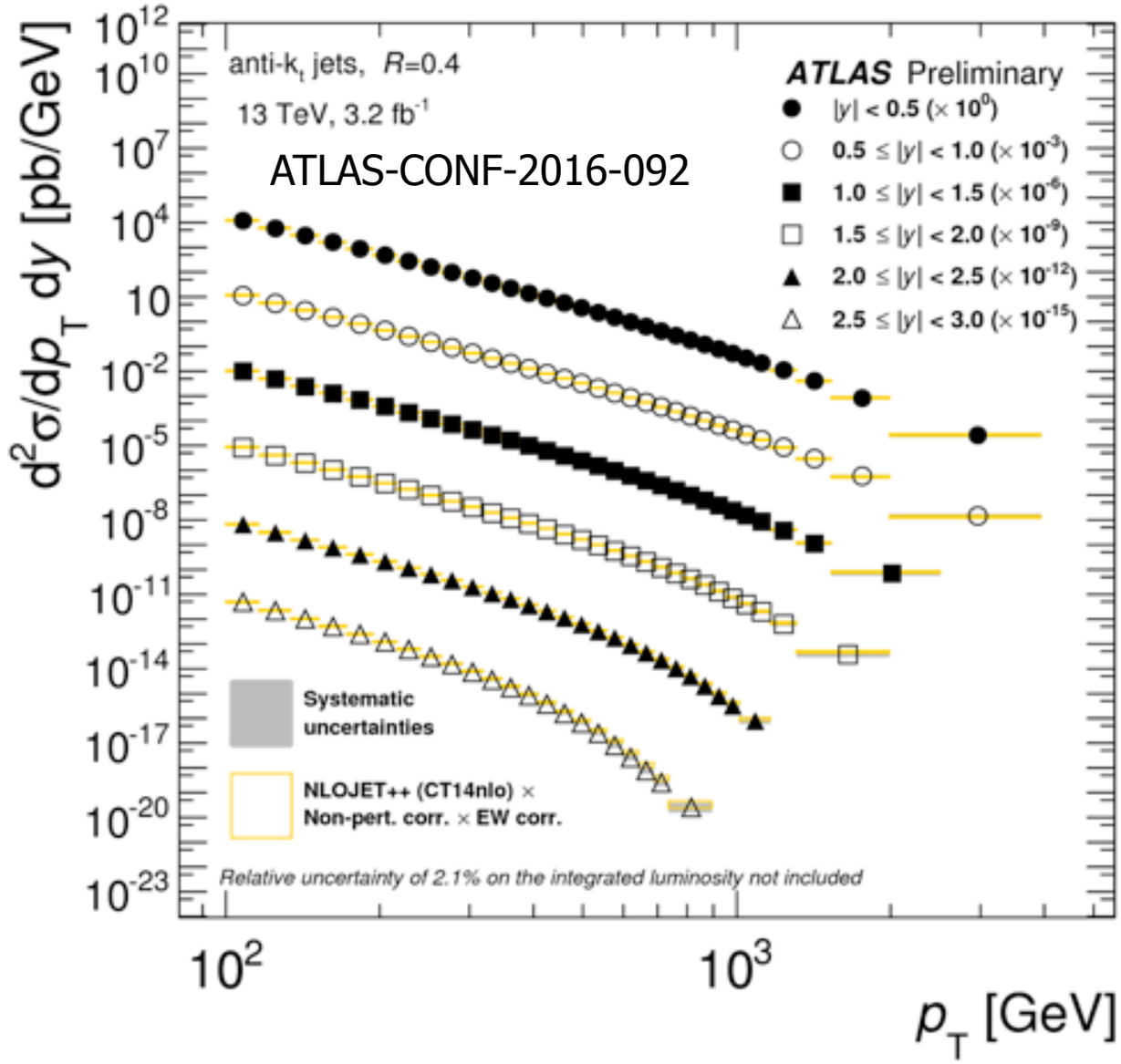


$Q^2 = p_T^2$

<u>each jet</u> is agnostic what happens elsewhere, it only knows its very own p_T

Inclusive jet cross section

- A N-jet event will contribute N-times in the same distribution (histogram)
- Alternative would be: order them and use each event once, e.g., a 4-jet event will just go in the 4-jet distribution



a bet has been placed that peculiarities of the different scale differences will reside on high N_{jet} that gets a soft scale for $\mu=p_T$

Inclusive jet cross section

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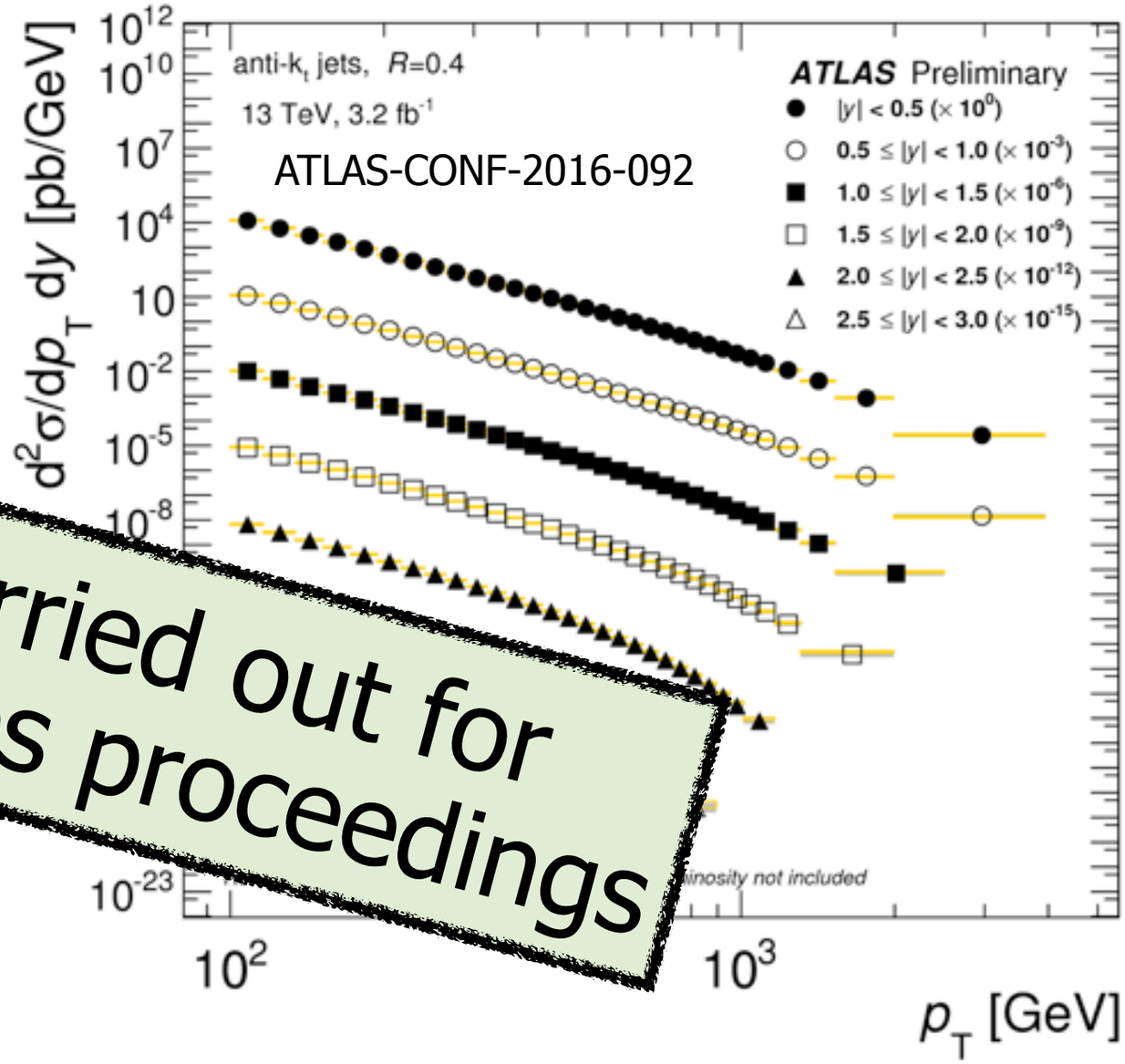
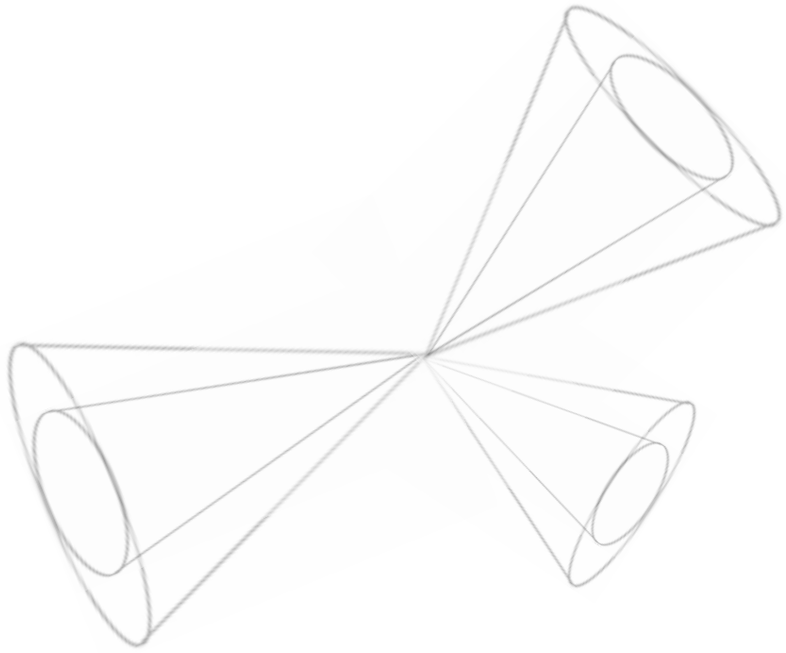


Study to be carried out for the Les Houches proceedings

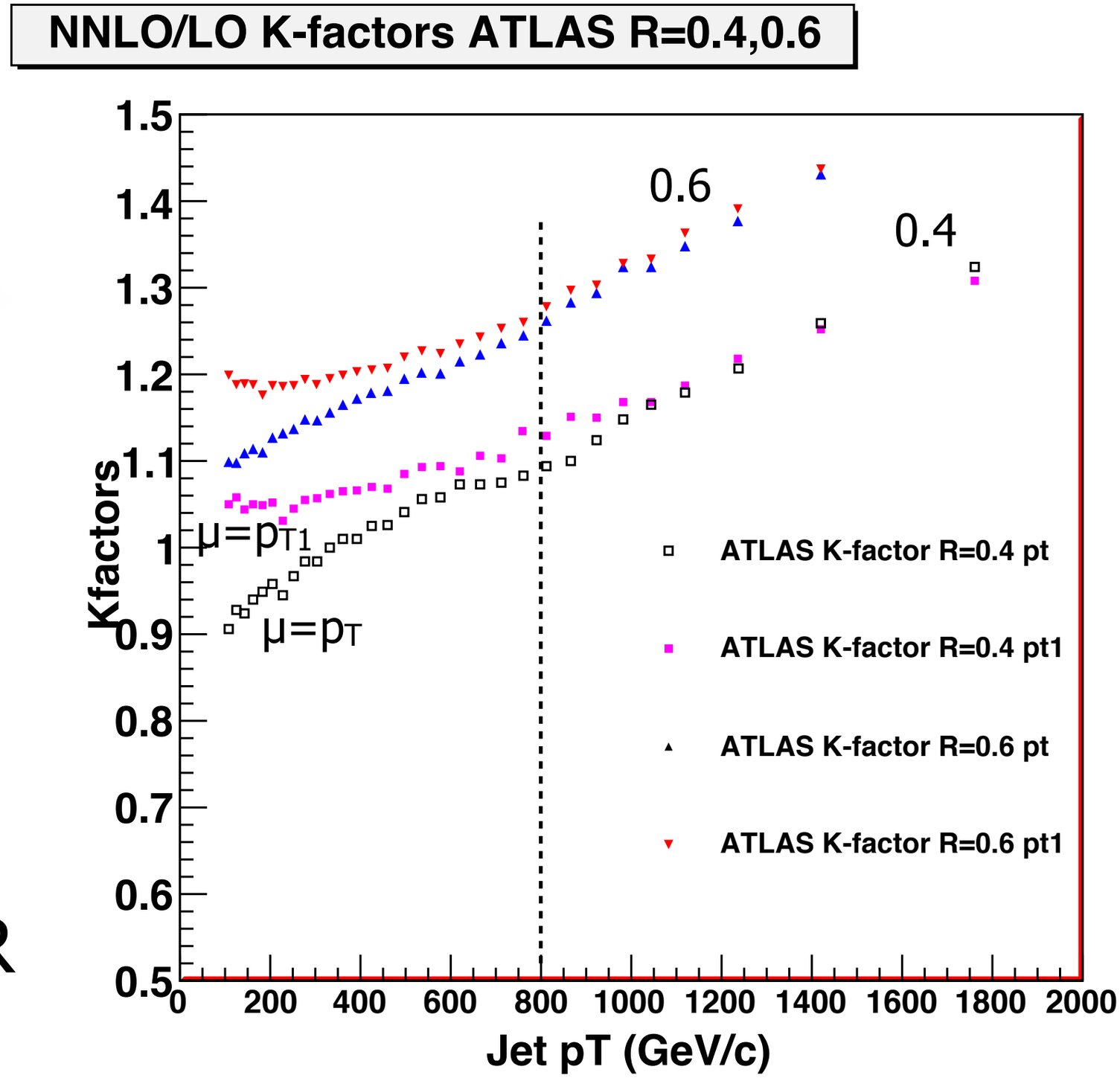
a bet has been placed that peculiarities of the different scale differences will reside on high N_{jet} that gets a soft scale for $\mu=p_T$

But is this discussion

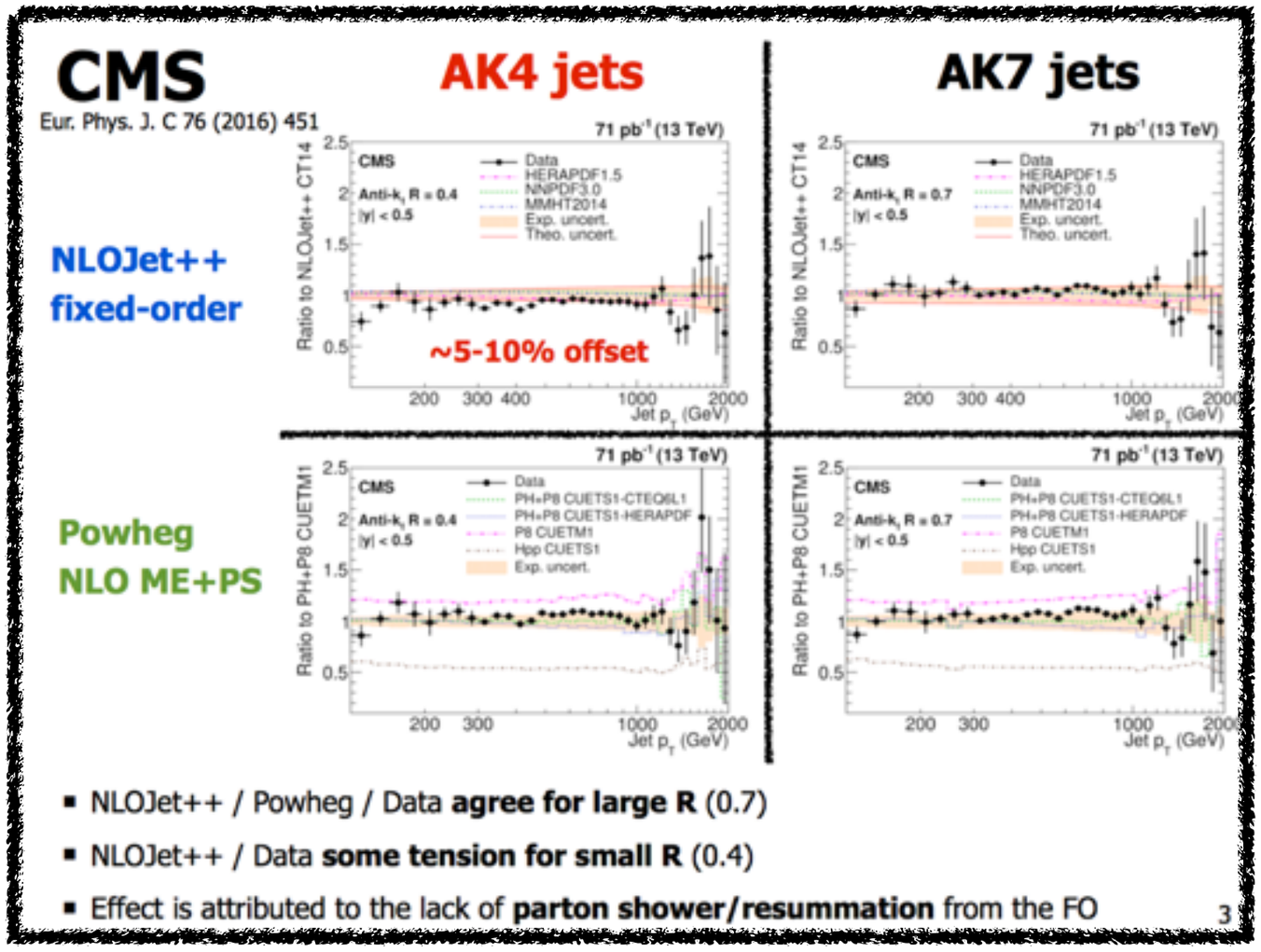
independent of the cone size ?



scale choice differences get larger for smaller R



partonic vs hadronic x-sections



NLO ME+PS vs Fixed Order agree for large R but not for small, data always good with NLO ME+PS

quantify resummation/shower effects affecting small cones for FO predictions comparing ME with ME+PS for (N)LO using MCs

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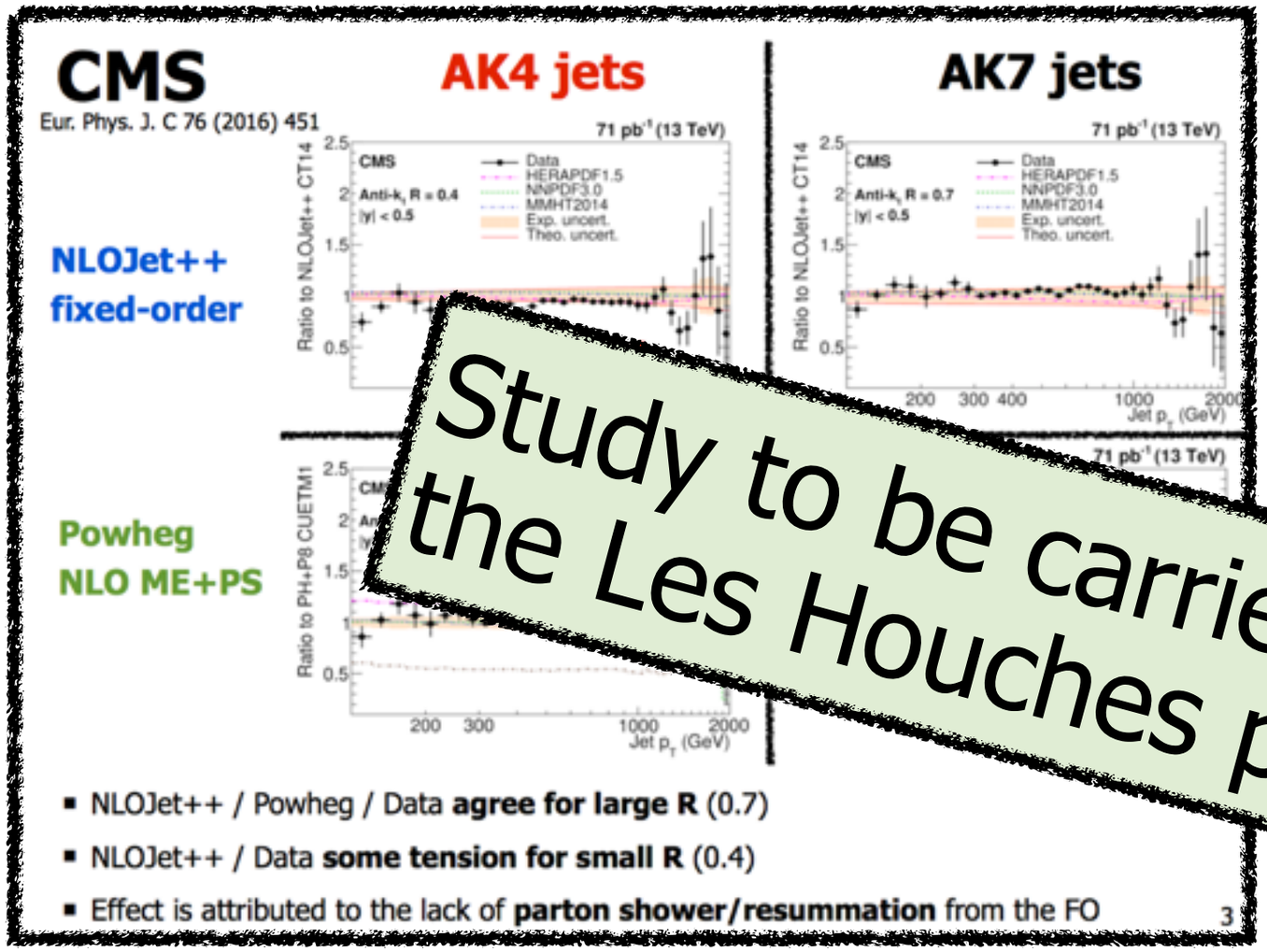

Study to be carried out for the Les Houches proceedings

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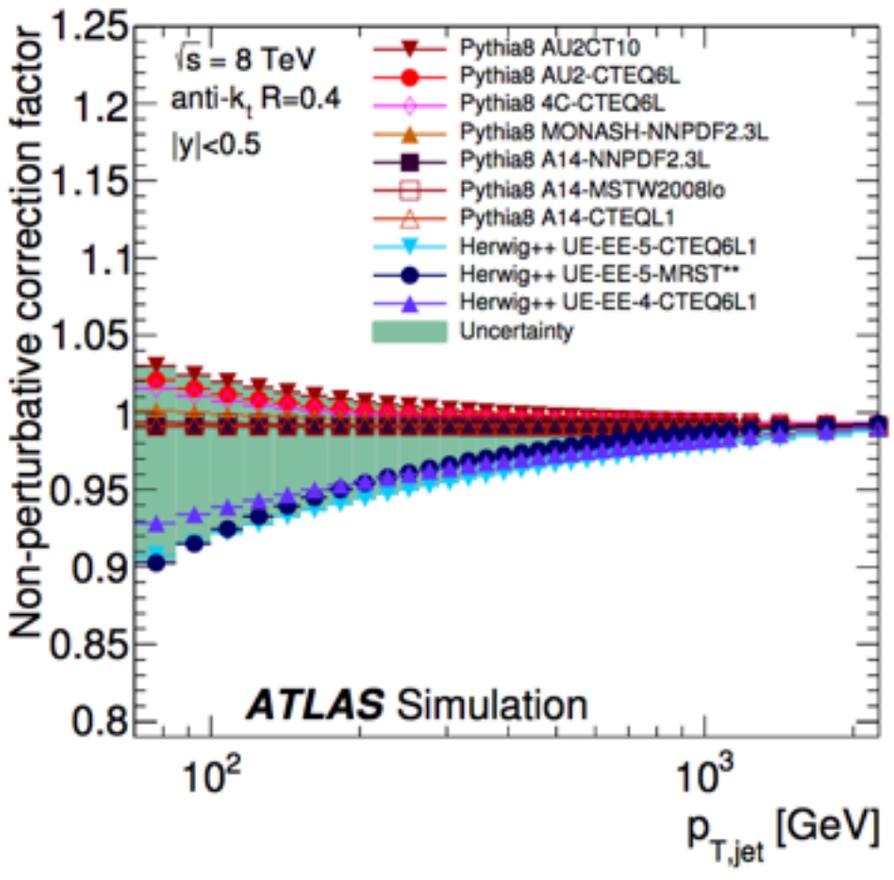
quantify resummation/shower effects affecting small cones

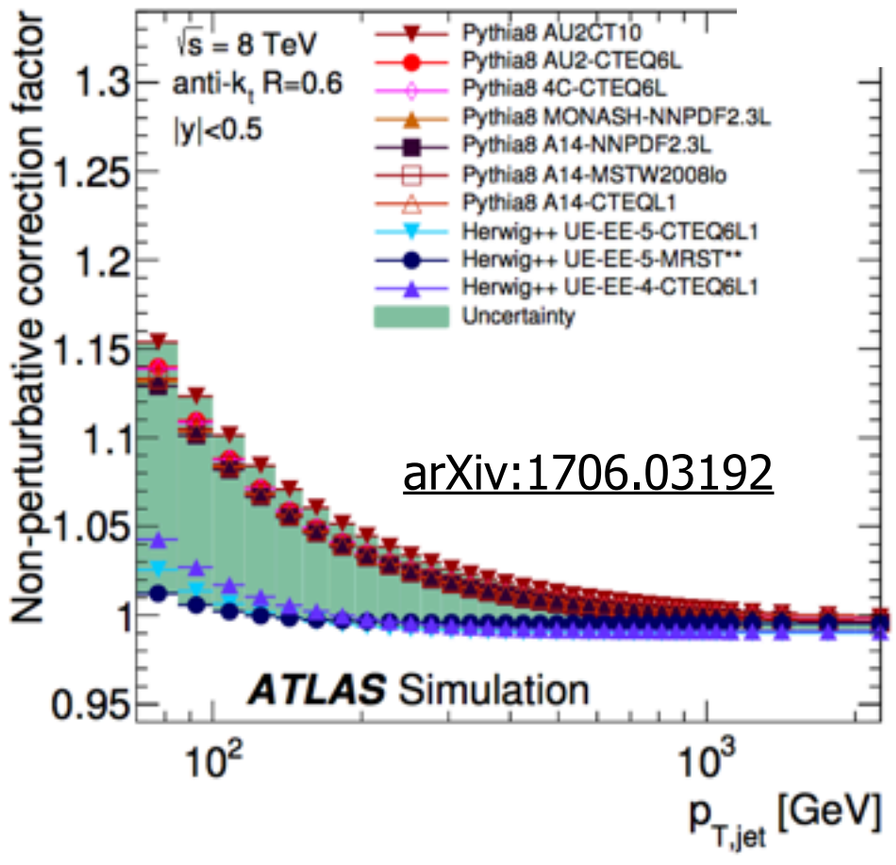
for (N

Ideally we would like Pythia, Herwig, Powheg, Sherpa, aMC@NLO people subscribing if not done that already, Rivet routines from CMS are waiting in the wiki

Unboxing NP effects

$$C_{\mathrm{NP}} = \frac{d\sigma^{\mathrm{ME+PS+HAD+MPI}}/dp_{\mathrm{T}}}{d\sigma^{\mathrm{ME+PS}}/dp_{\mathrm{T}}}$$

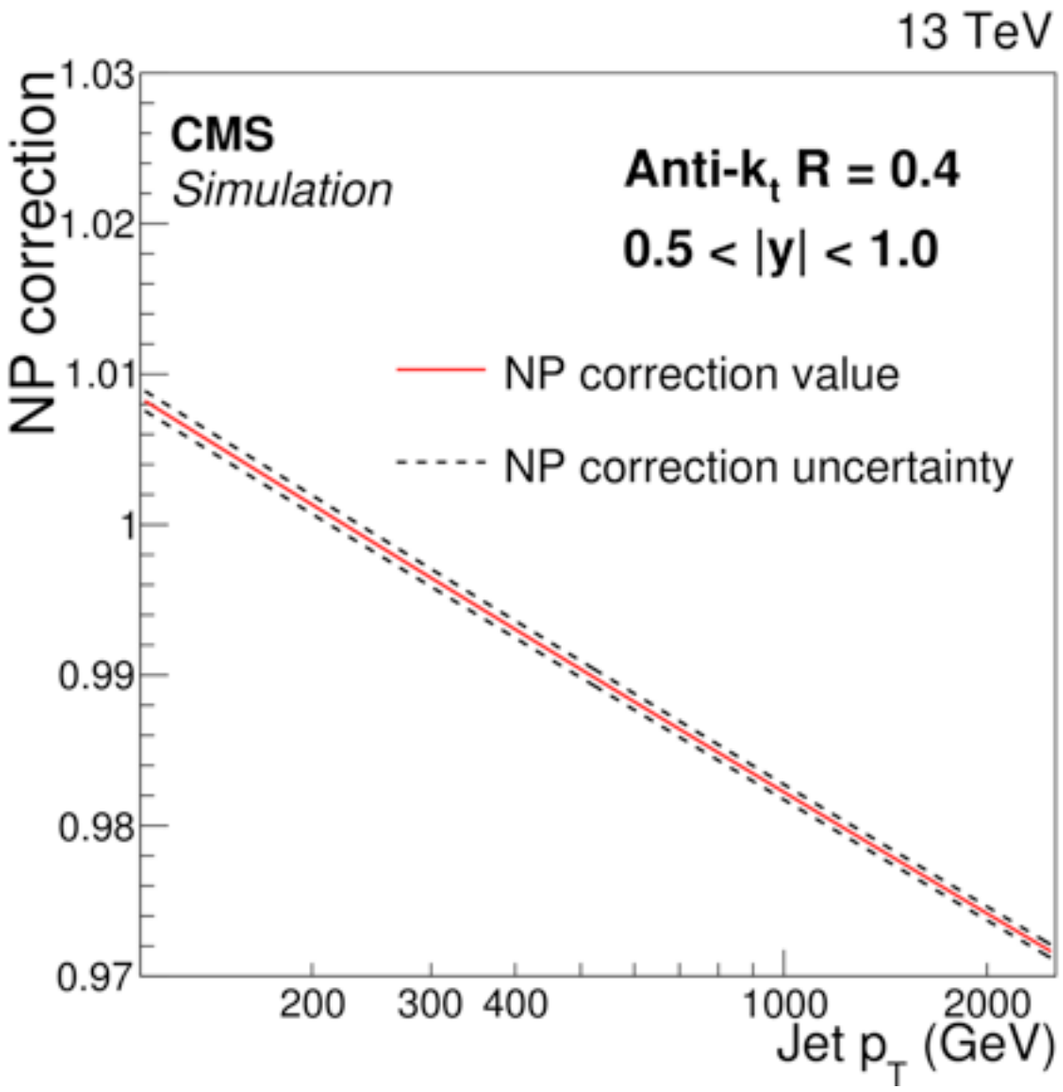


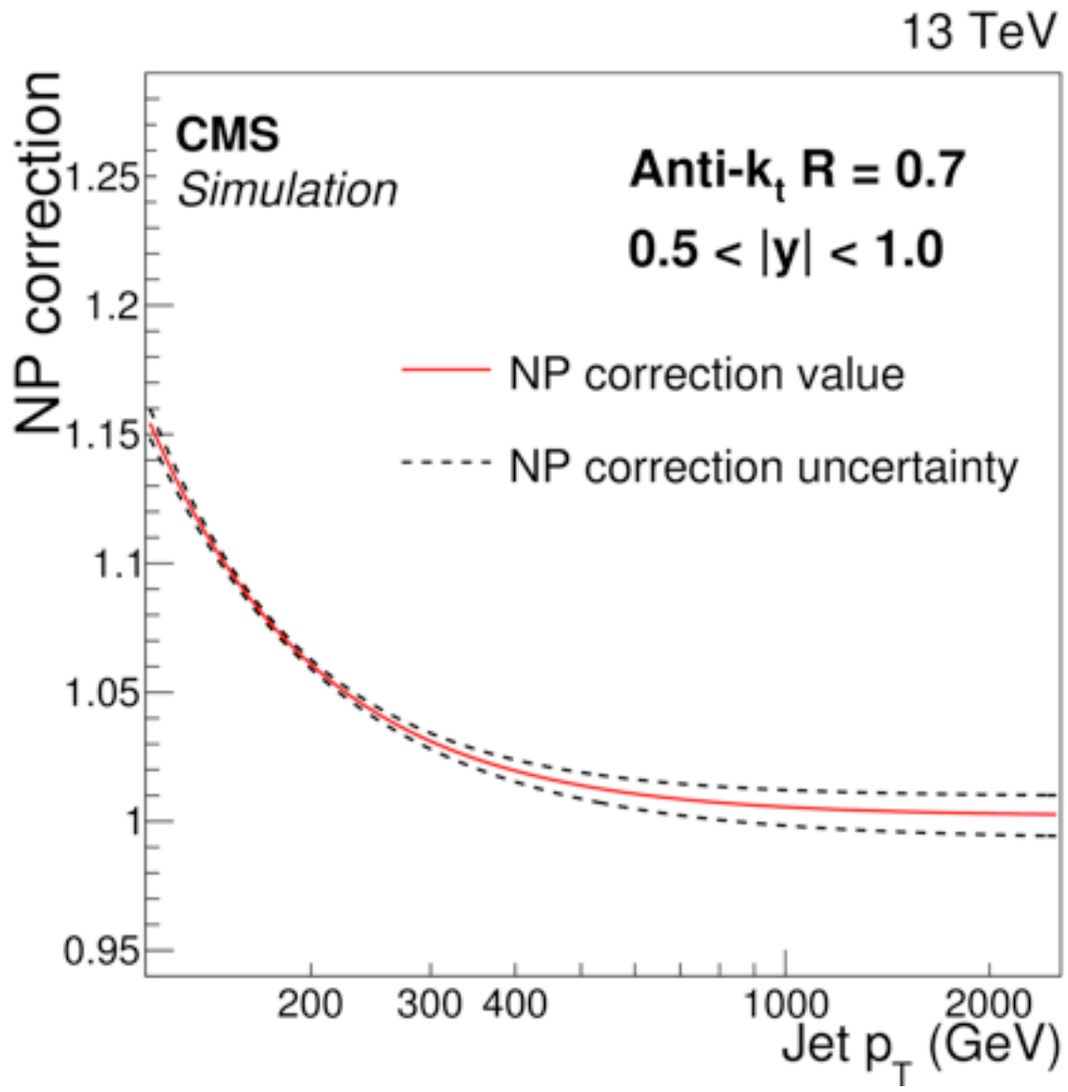


arXiv:1706.03192

- Herwig alone predicts **small δC_{NP}** when varying its tunes
- Pythia alone predicts **small δC_{NP}** when varying its tunes
- But Pythia/Herwig **disagree on C_{NP}**

NP at CMS





- Herwig/Pythia and Powheg+Pythia used for envelopes
- Uncertainties become larger (a bit) at high P_T for R=0.7

Philosophical (?) questions

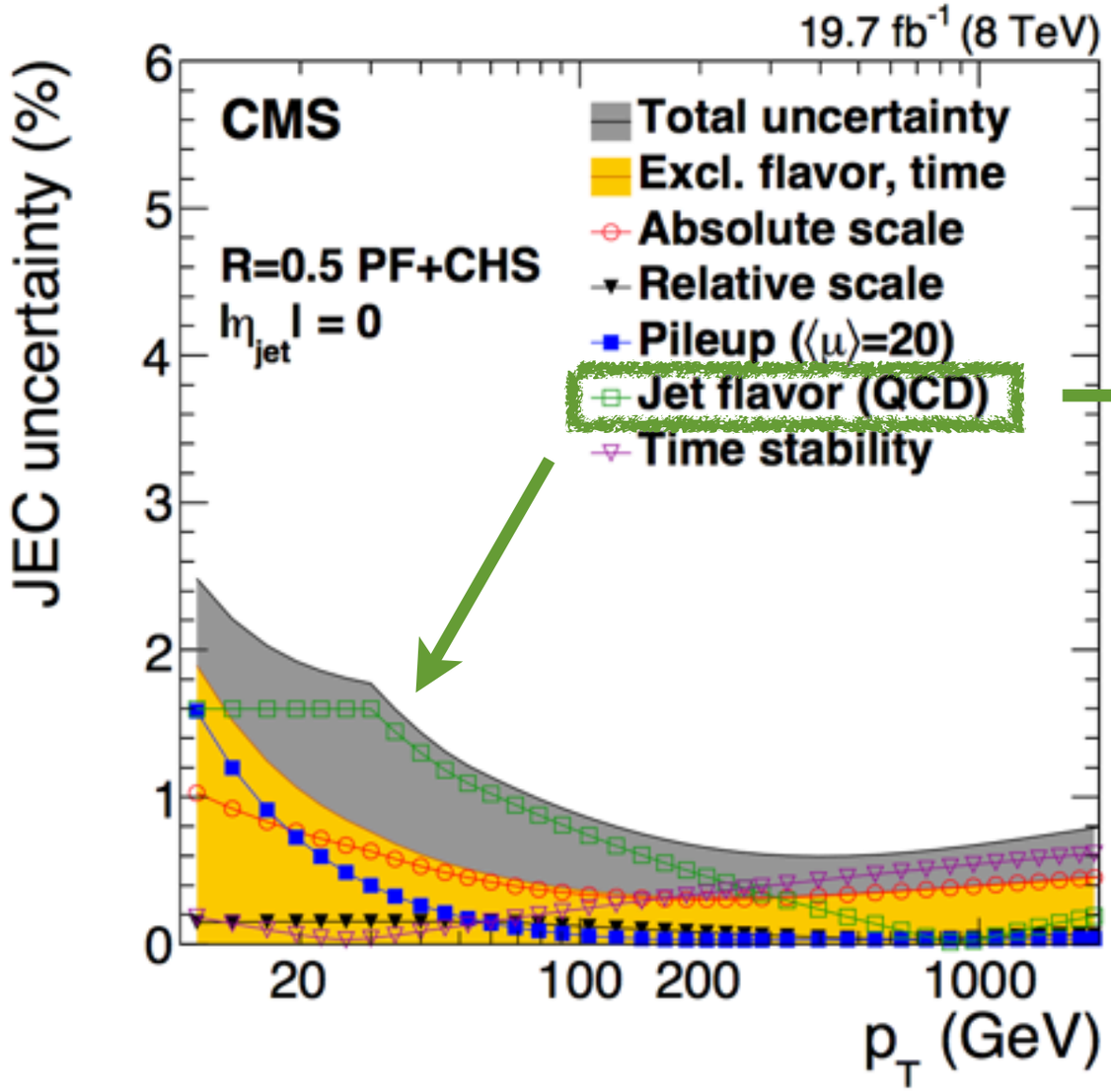
- Why the procedure of assessing $\mathbf{C_{NP}}$, $\mathbf{\delta C_{NP}}$ can't be made ~identical between ATLAS/CMS

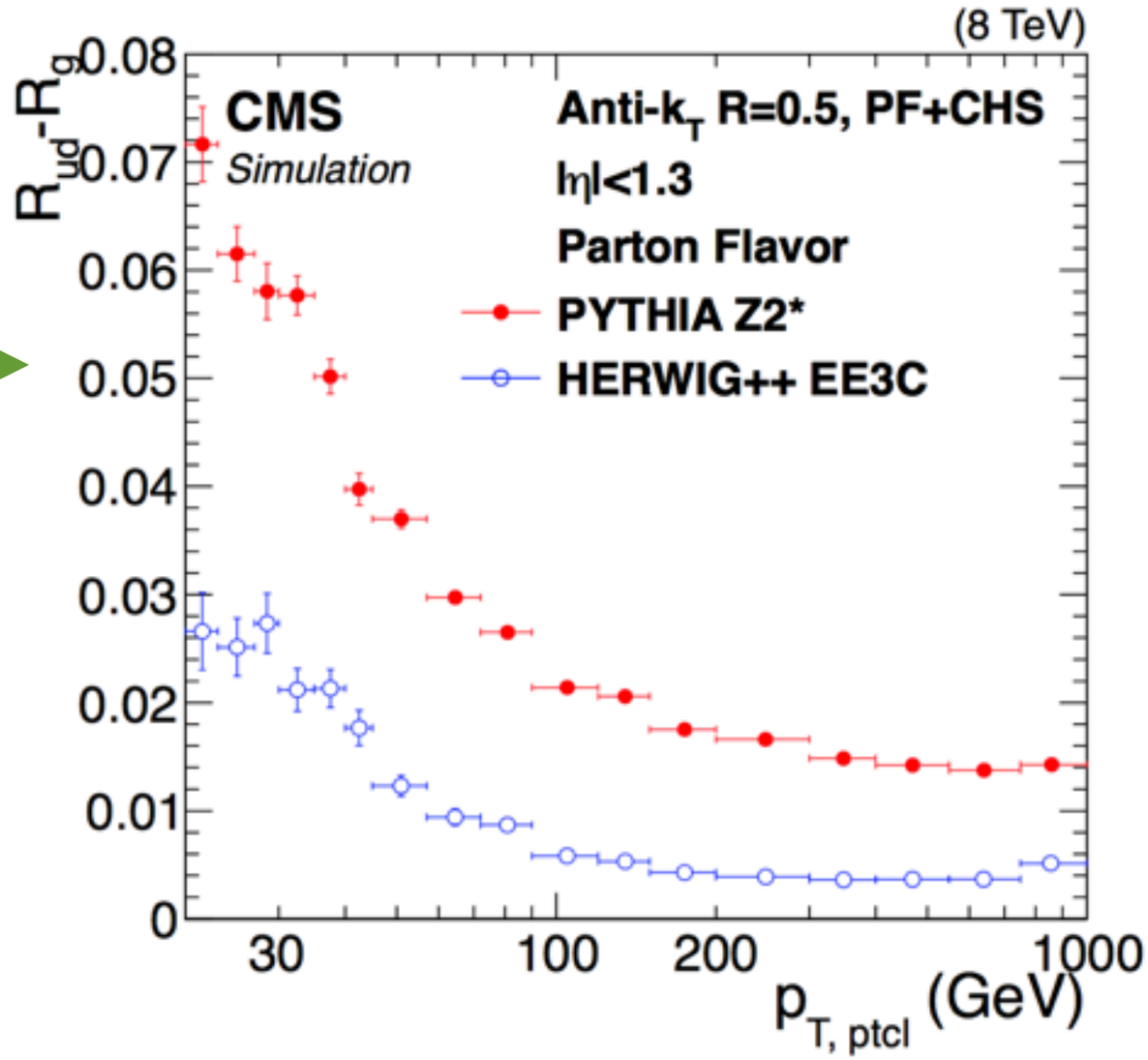
- Why Pythia and Herwig predict so much different C_{NP} ? What about Sherpa ?

- What is the best cone size, interplay for NP and soft pertubative effects (resummation)

- Are these purely theoretical aspects on the interpretation having nothing to do with the experimental-measurements@hadron-level?

Interplay with the jet group





Pythia vs Herwig gluon response is a dominant experimental uncertainty

What about UE/PU area subtraction (offset JEC) ?

Les Houches accord on NP/cone?

- Les Houches accord on MPI+HAD assessment (C_{NP}, δC_{NP})
- Understand why Pythia vs Herwig predict different C_{NP}
  - Can we get Sherpa also ? Yes we can
  - "jet flavor uncertainties" upon calibrating the jets ? (dominant experimental uncertainties on the cross section)
- Rivet routines for tuning observables **jet mass, width and LH angularities** have been provided in the LH wiki (interplay with jet group) -- can these be also measured by ATLAS/CMS for **Les Houches 2019** ?
- **3-rd dimension of the problem**, evaluate these for different cone sizes, suggested R=0.3, 0.4, 0.6, 0.7, 1.0

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Study to be carried out for the Les Houches proceedings

https://phystev.cnrs.fr/wiki/2017:working_groups:incljets

~TeV Z's are useful

for QCD resummation studies

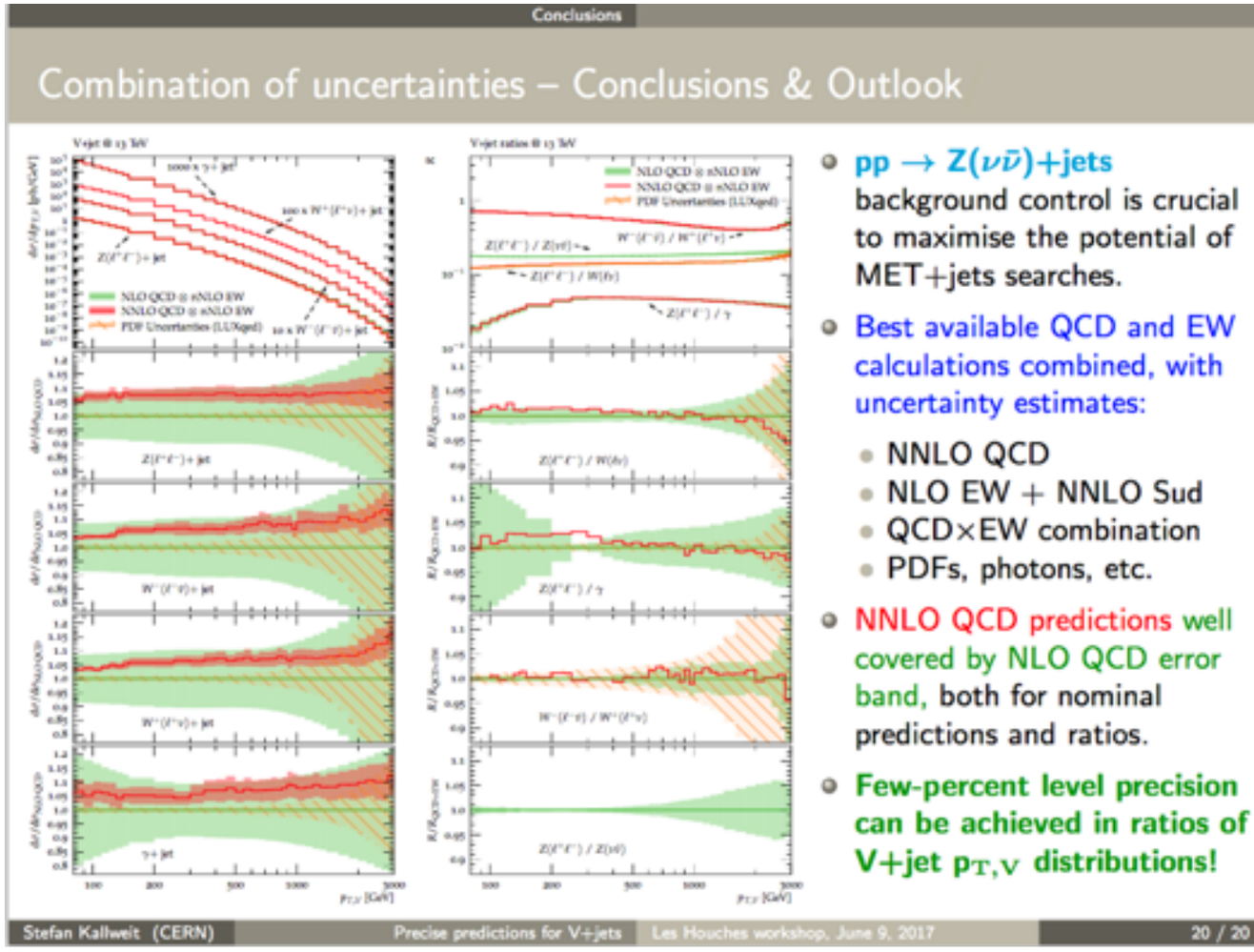
Idea behind this exercise:

- **mZ'** sets high scale the scale of **Z' + jets**
- check down to which $\mathbf{p_{T1}^{min}}$ the FO predictions are alone sufficient to describe the leading jet $\mathbf{p_T}$ spectrum by contrasting them with resummed predictions

- project to be added soon in the wiki, would be nice to compare predictions with some real Z' data ;-)

Uncertainties in ratios

- scale choices in ratios e.g., W+>=1 jet/Z+>=1 jet, H+>=1 jet/Z+>=1 jet at NLO and at NNLO
- paradigm from V+jets background for DM searches was discussed (W/Z, Z/γ)
- :-(from discussion at LH not easy to do similar tricks for VV, VV+2j VBSs



Summary of the summary

unknotting the knot (reducing uncertainties)

subscribe to the wiki and become a contributor to the SM studies !