Initial studies on

LHC combination of inclusive jet data

for the LHC Electroweak Working Group

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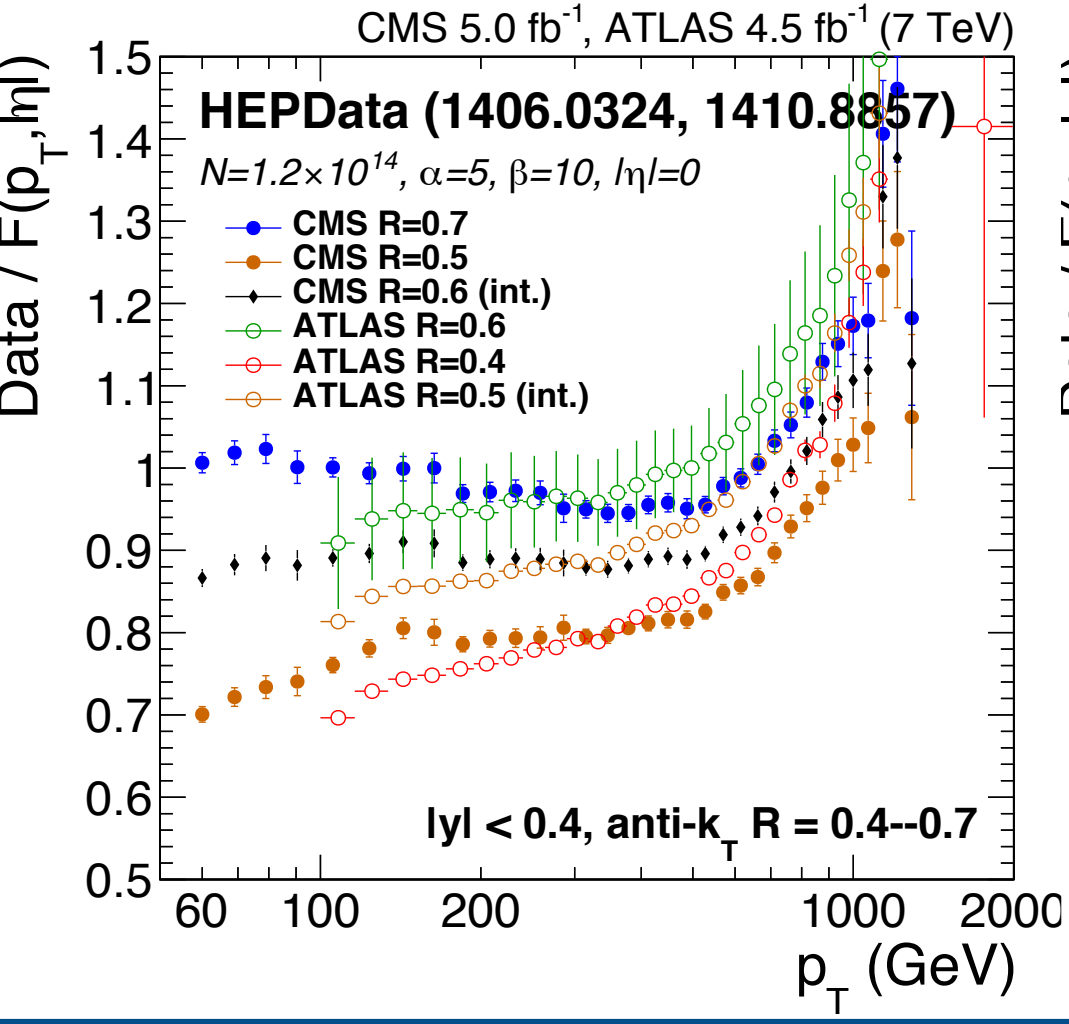
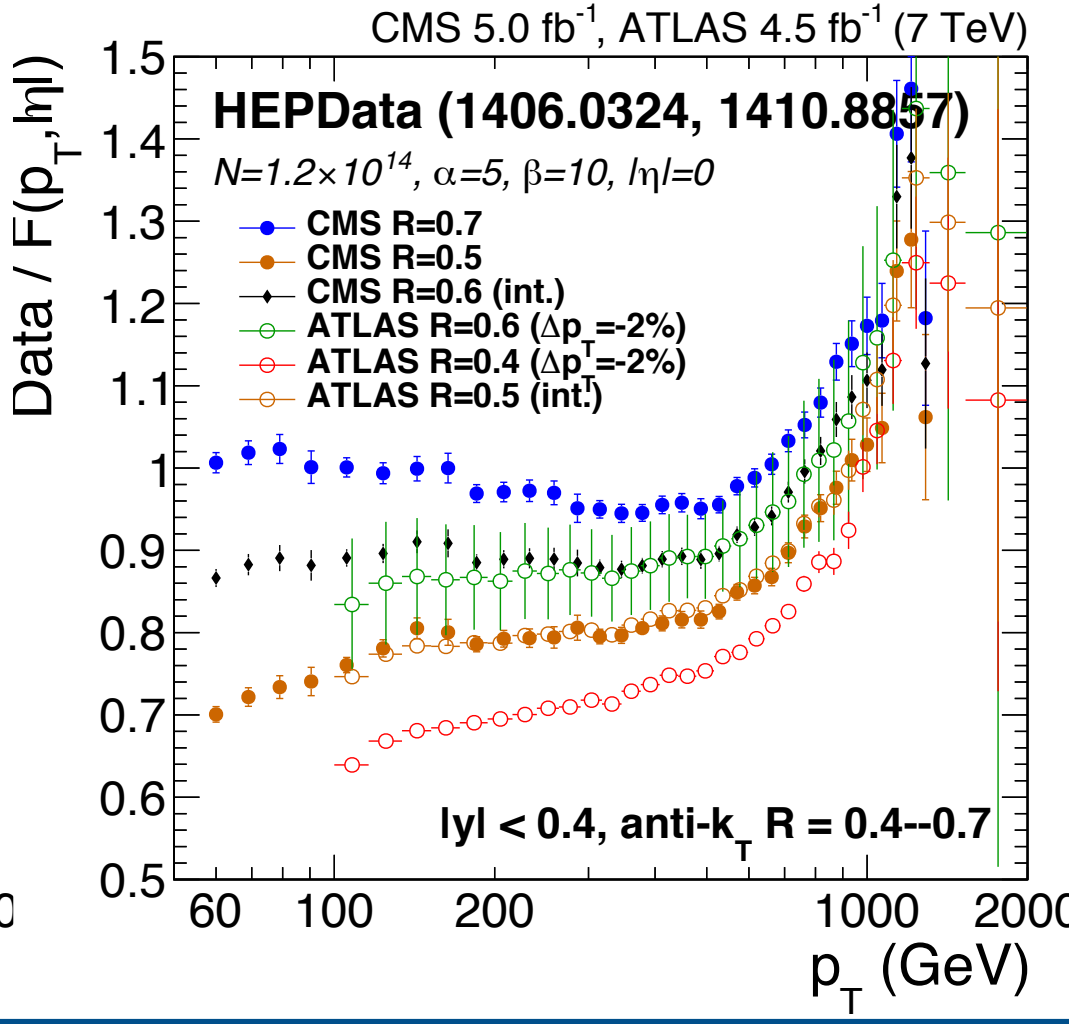
Introduction

- CMS and ATLAS have high quality jet data with R=0.4, 0.5, 0.6, 0.7 from 2.76, 7, 8, 13 TeV
- Combining data would reduce uncertainties and provide theorists a coherent reference set
- Benefit **global PDF** fits, understanding of **NNLO** predictions and **R dependence**

nominal

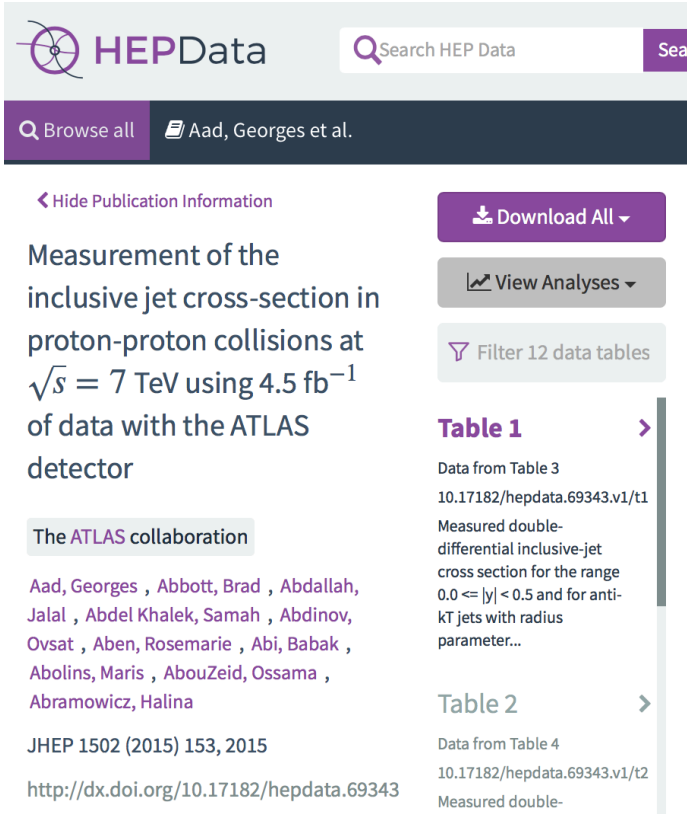


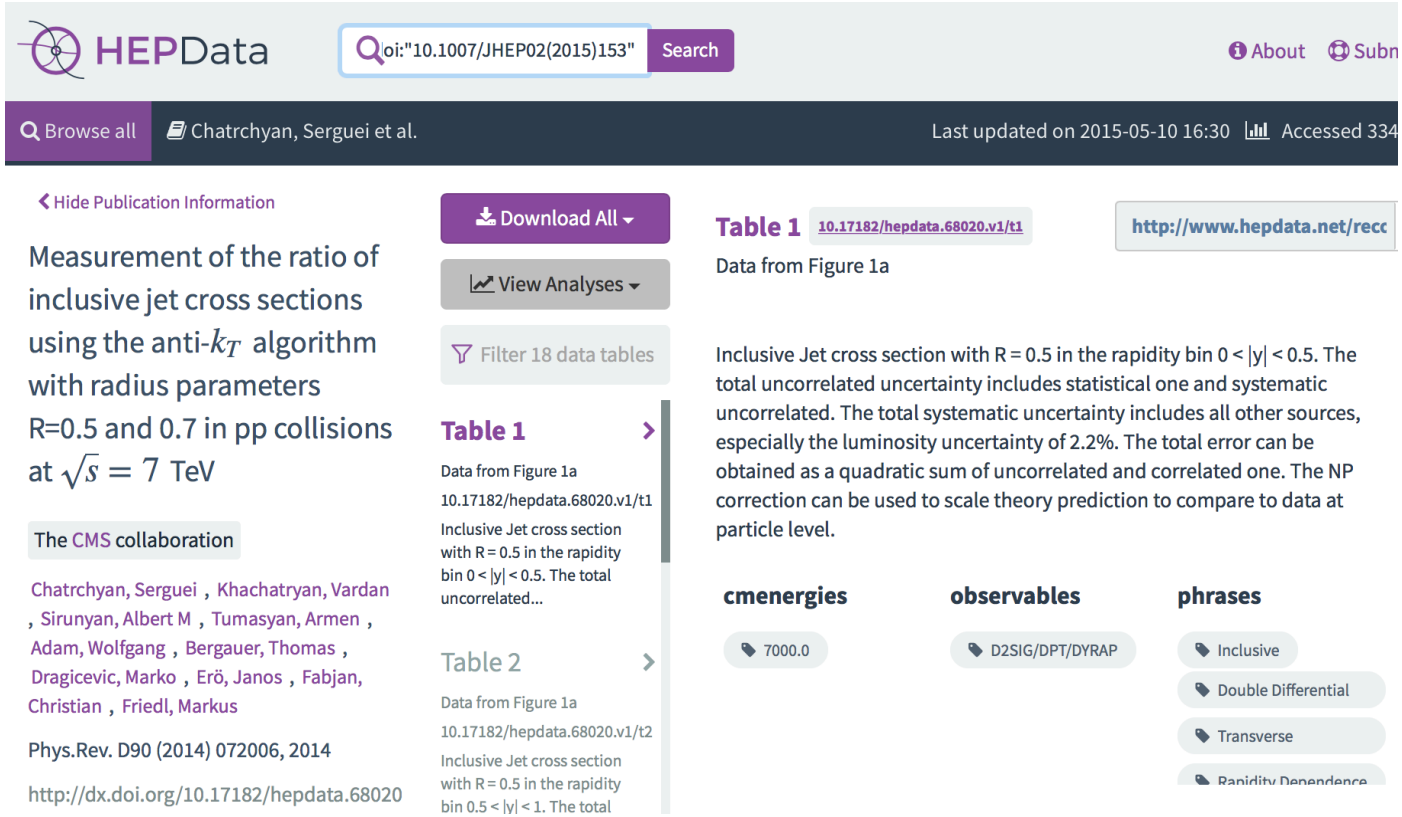
JEC shifted 2%



Work so far

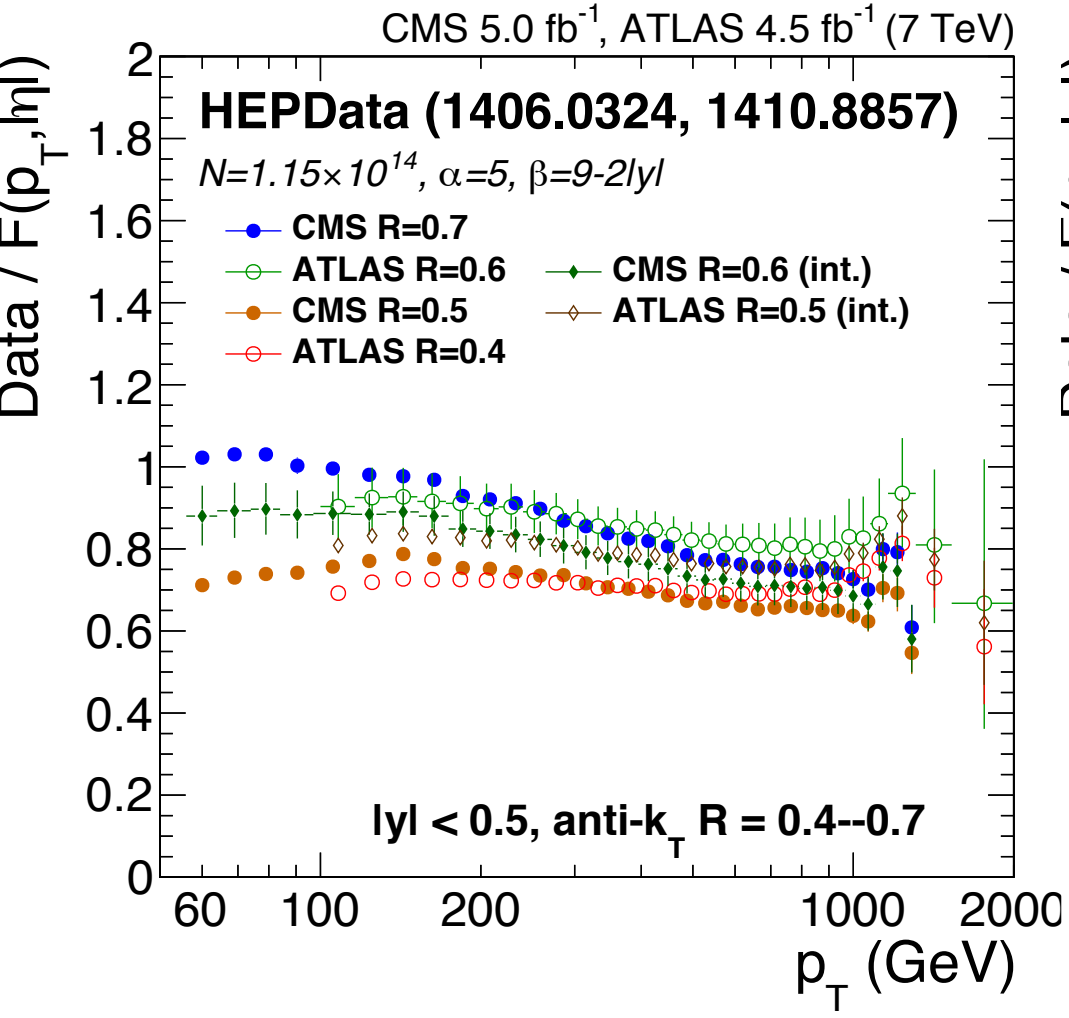
- Retrieved CMS and ATLAS 7 TeV (2011) data from HEPDATA, with stat and stat⊕syst
  - uncertainty sources available, but provided a bit differently => adapt to common format
- Interpolated R=0.4/R=0.6 and R=0.5/0.8 to 0.4-0.5-0.6-0.7 spectrum using **log(R)** scaling
  - spectra normalised by $\mathbf{F(p_T,\eta) = \iint N\, p_T^{\alpha}\,(1 - 2p_T \cosh(\eta)/\sqrt{s})^{\beta}\, dp_T d\eta}$ for plotting
- JEC uncertainty by far dominant => start by bracketing CMS/ATLAS difference as **ΔJEC**
  - known issues: FSR in p_T balance vs MPF, detector response vs p_T, Pythia6/8 vs Herwig++
  - can also check ΔJEC with published in-situ W mass constraints in ttbar

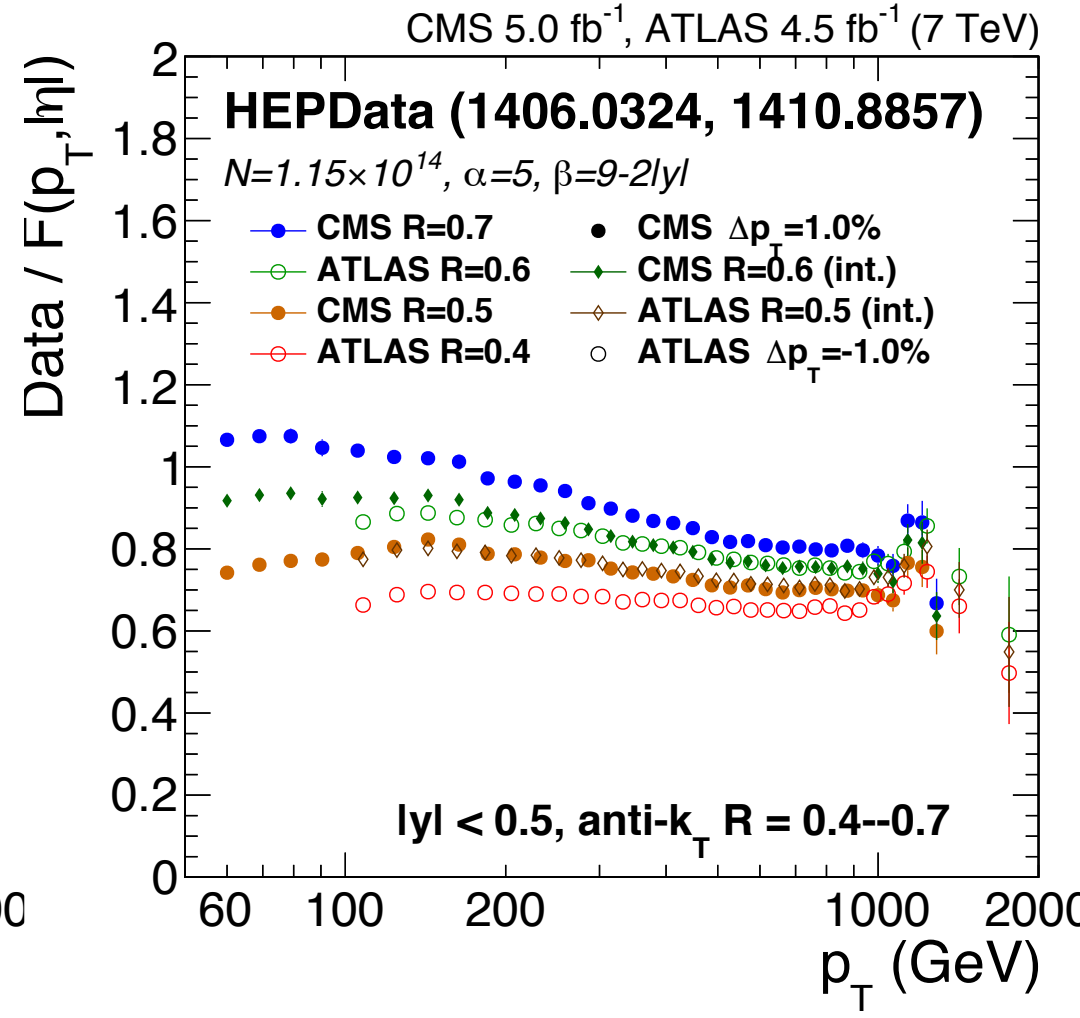




|y|<0.5

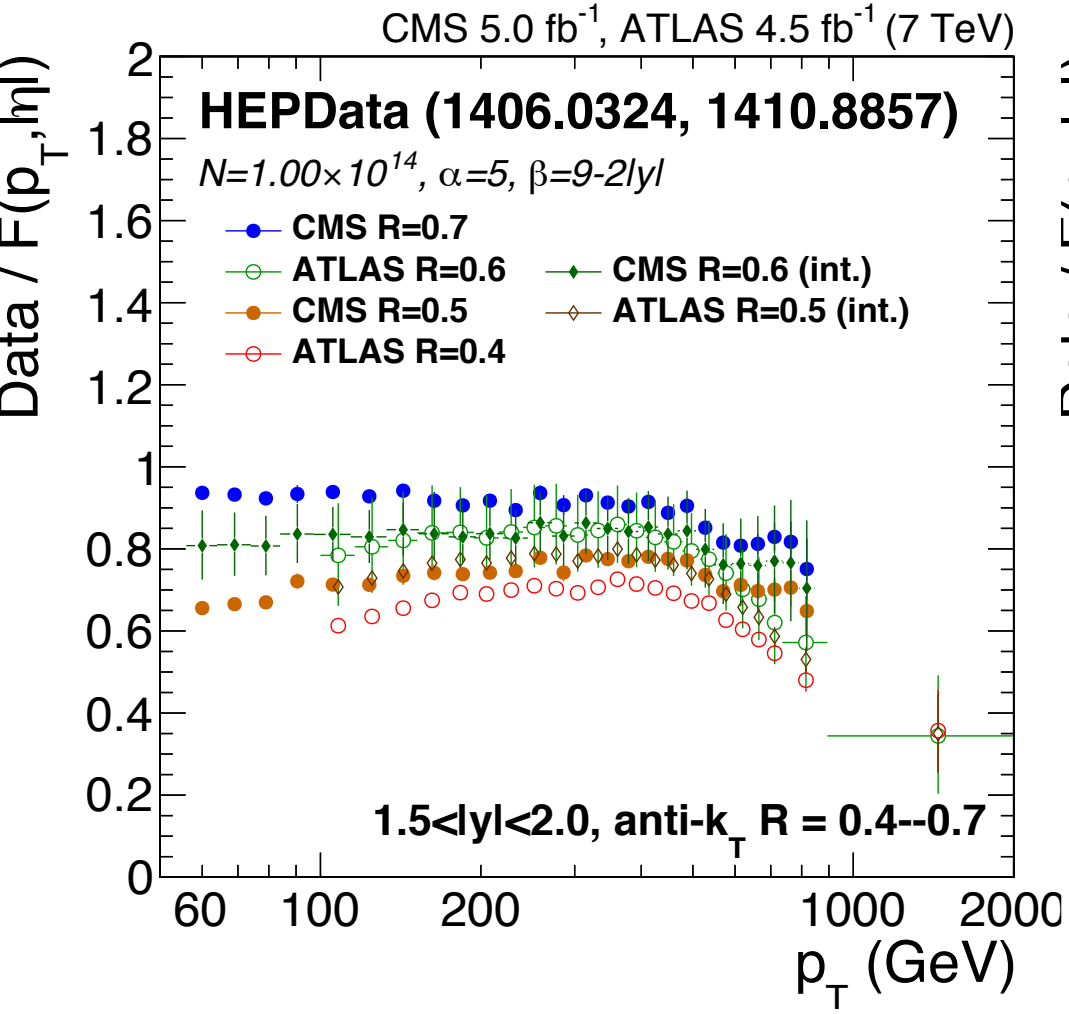
- Central rapidity in quite good agreement after CMS +1%, ATLAS -1%
- Possibly tracked down to:
  - ATLAS FSR bias (p_T balance method used instead of MPF)
  - CMS p_T dependence (const fit due to lack of multijet and γ+jet statistics)

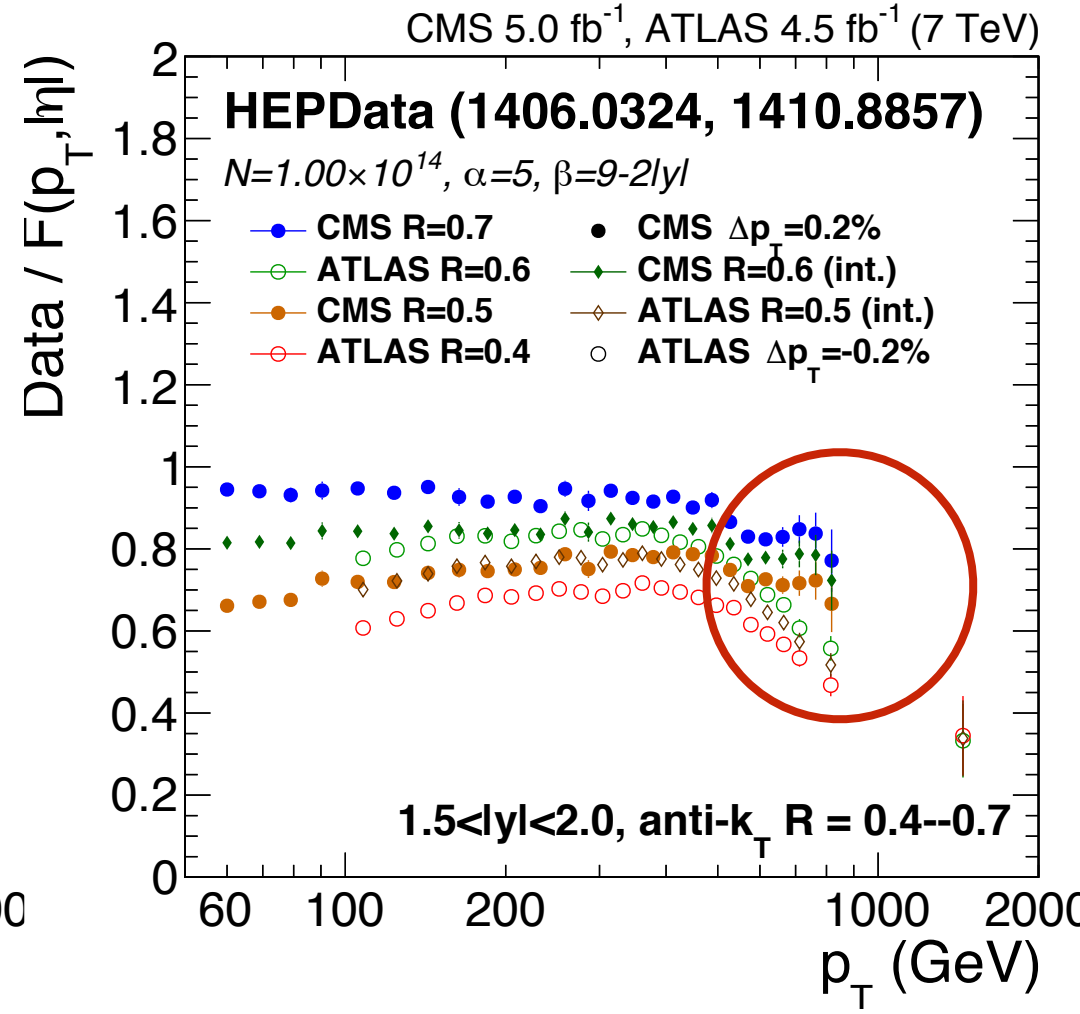




1.5<|y|<2.0

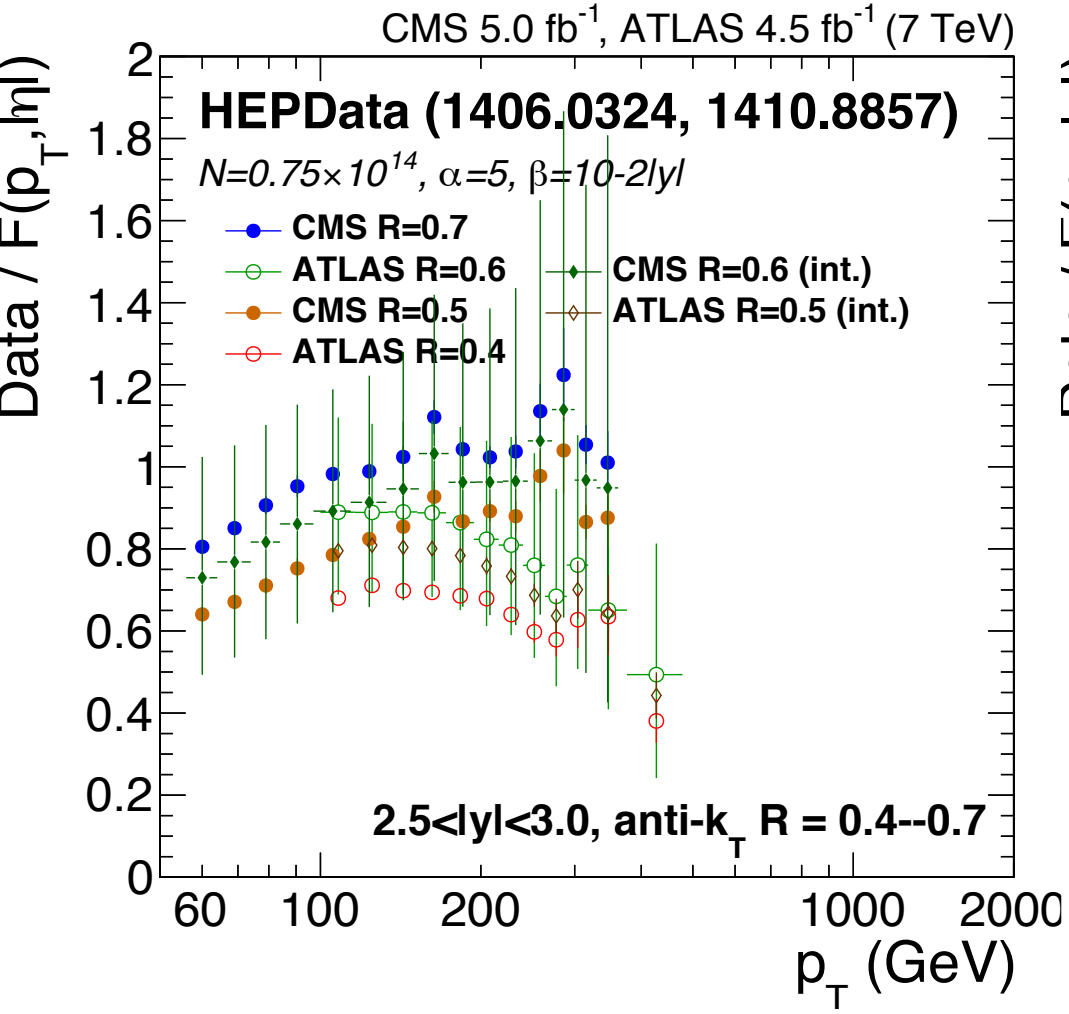
- Mid-rapidity 1.5<|y|<2.0 has big shape different at p_T>500 GeV
- Outside of direct Z/γ+jet reach, in barrel/endcap transition => detector effect (JEC/JER)?
- Global PDF fits have had large χ^2/NDF for ATLAS data, could this |y| bin be the reason?

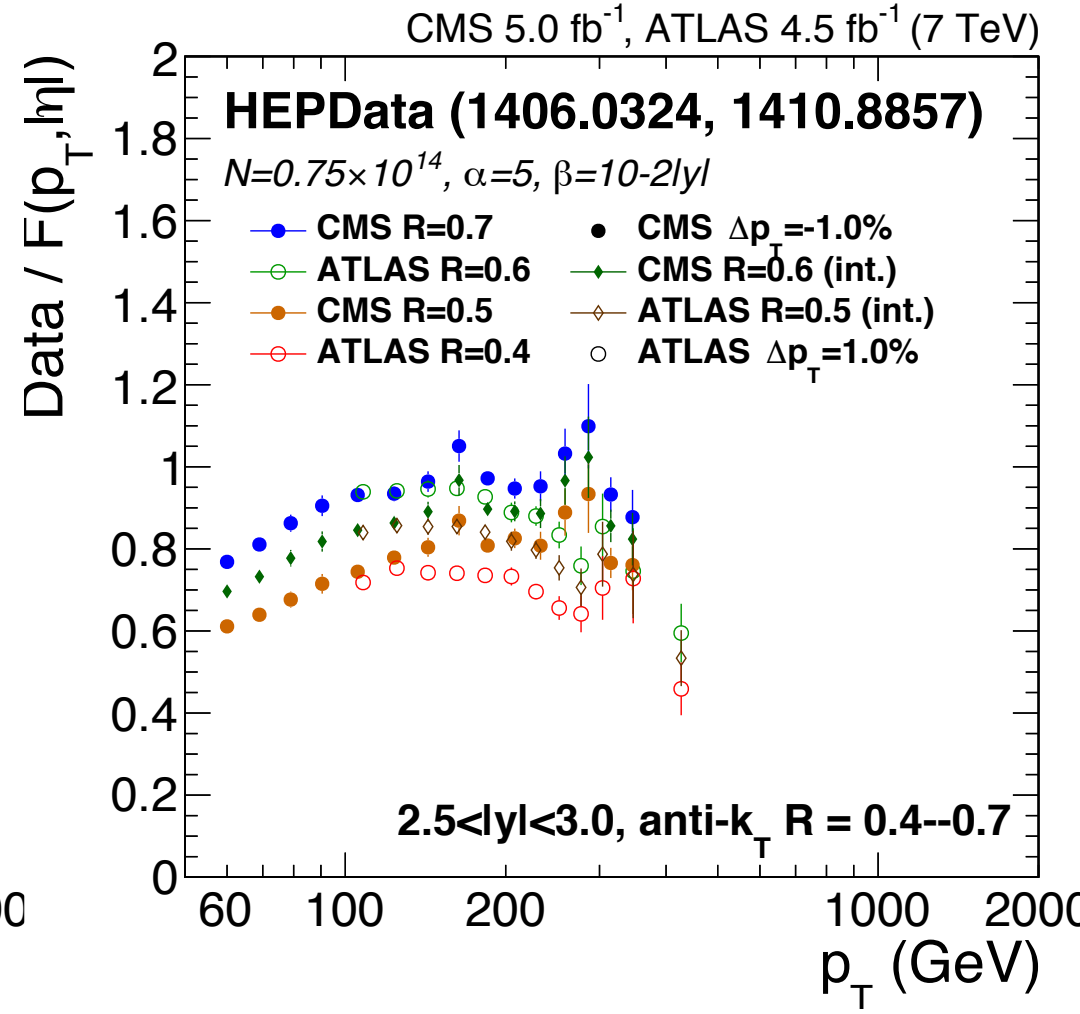




2.5<|y|<3.0

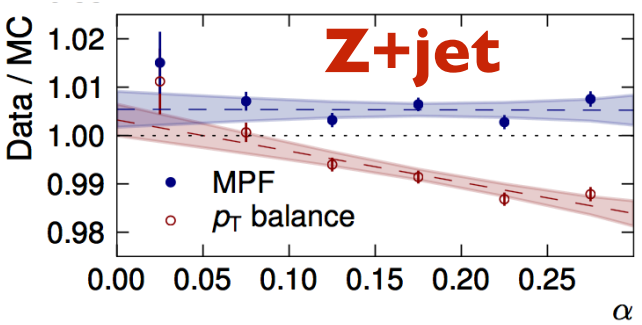
- Forward rapidity 2.5<|y|<3.0 in decent agreement, given large uncertainties
- p_T~200 GeV compatible with CMS -1%, ATLAS +1%

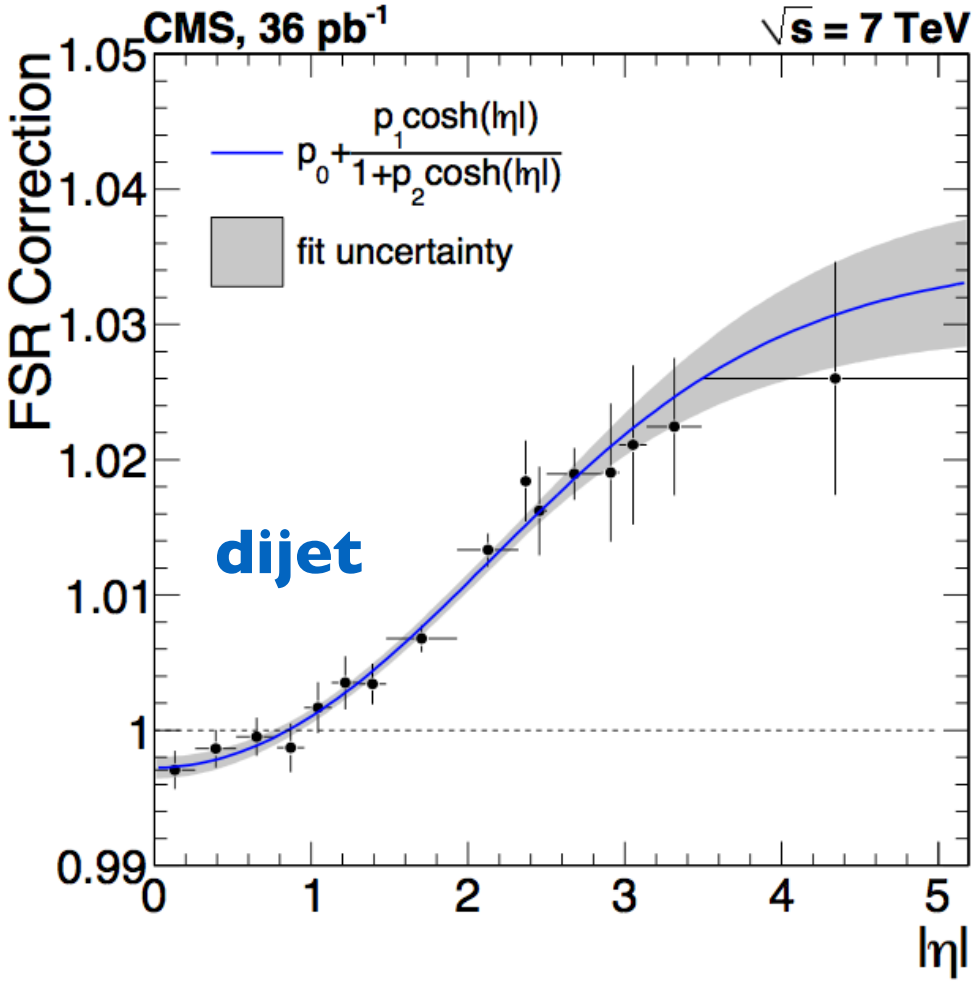


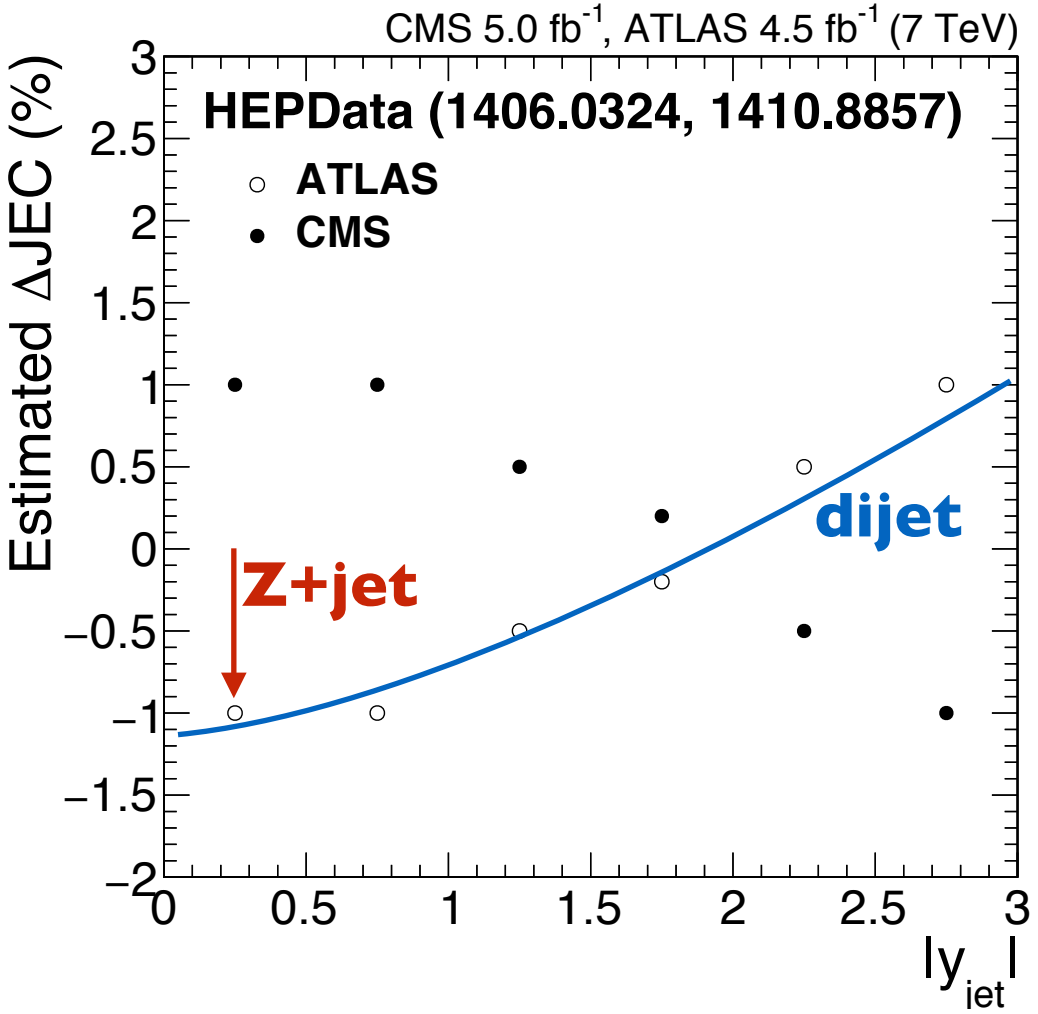


ΔJEC: ATLAS

- Estimated ΔJEC as symmetric between CMS and ATLAS
- ATLAS results fit hypothesis of residual FSR bias
  - CMS used MPF, while ATLAS used p_T balance at 7 TeV
  - -1% from Z+jet, +0% (|η|=0) to +2% (|η|=3) from dijet

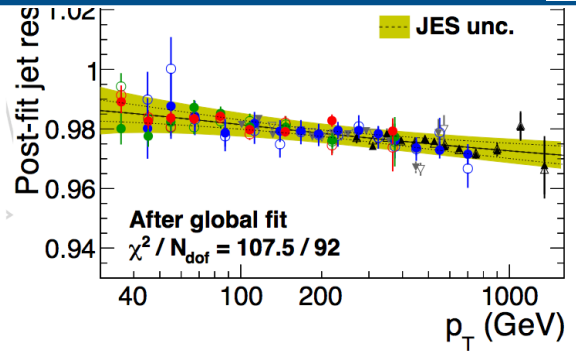


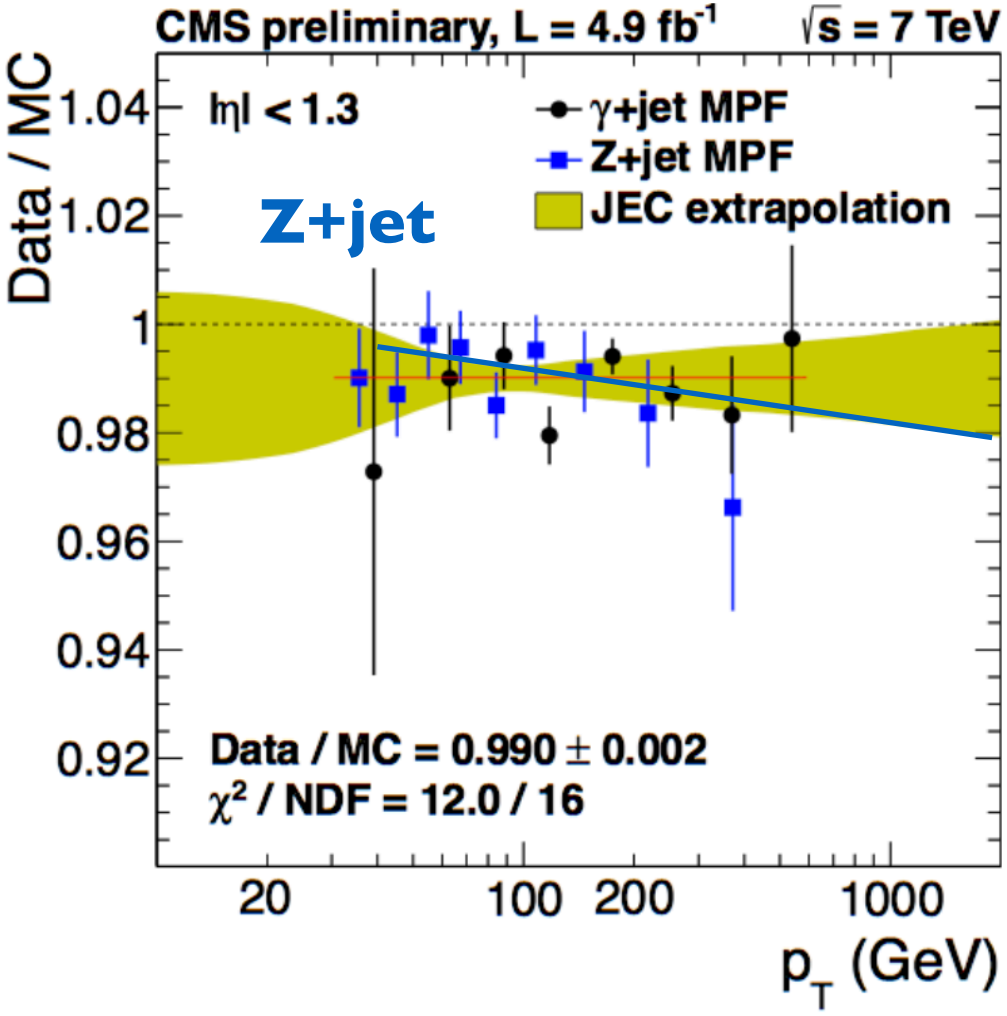


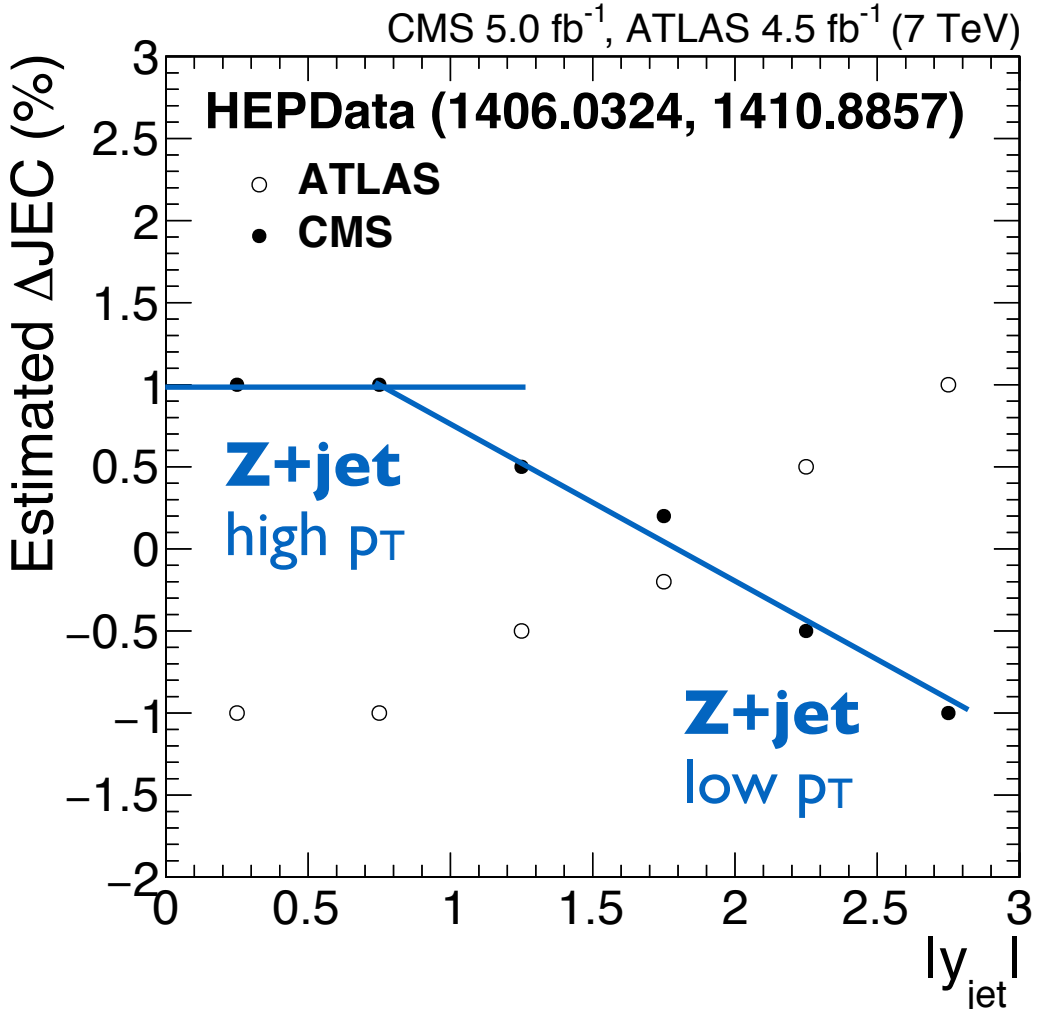


ΔJEC: CMS

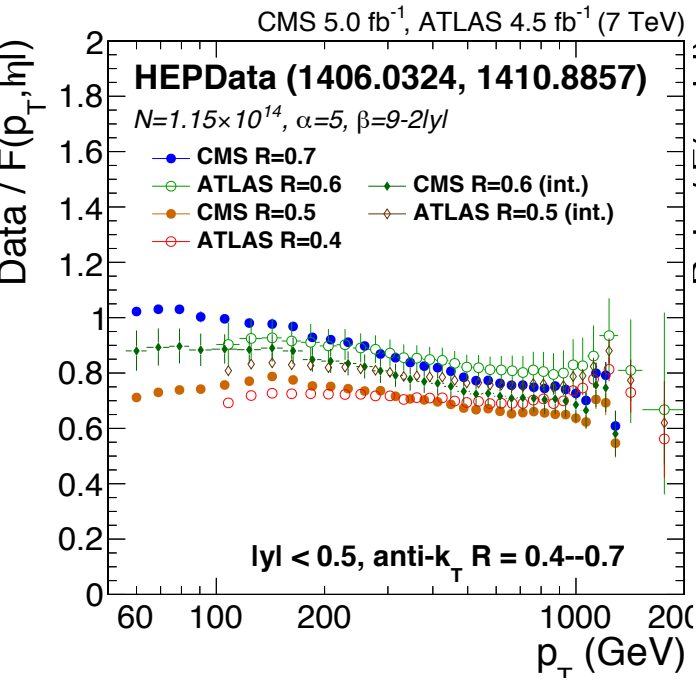
- Estimated ΔJEC as symmetric between CMS and ATLAS
- CMS results fit hypothesis of residual Z+jet p_T dependence
  - 8 TeV data showed slope vs p_T, not enough statistics at 7 TeV
  - dijet balance: low |y| <=> high p_T, high |y| <=> low p_T

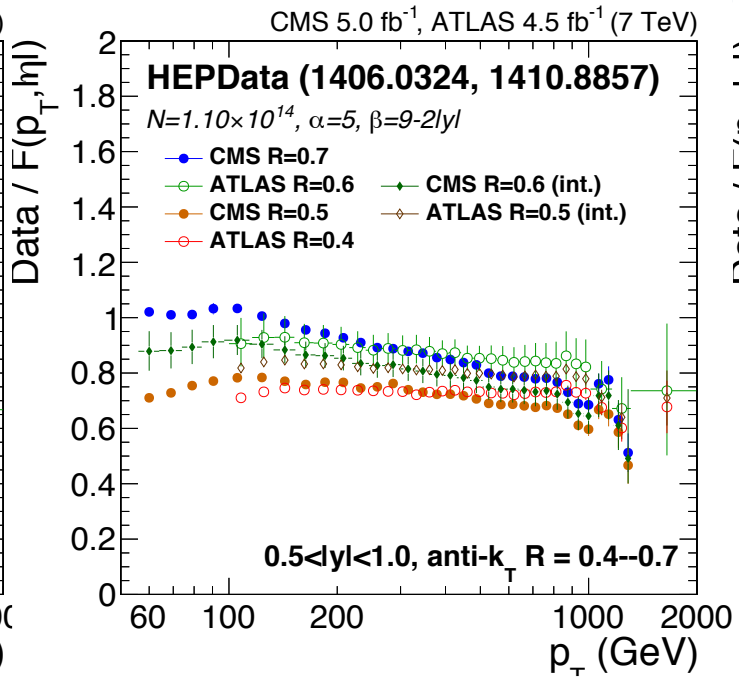


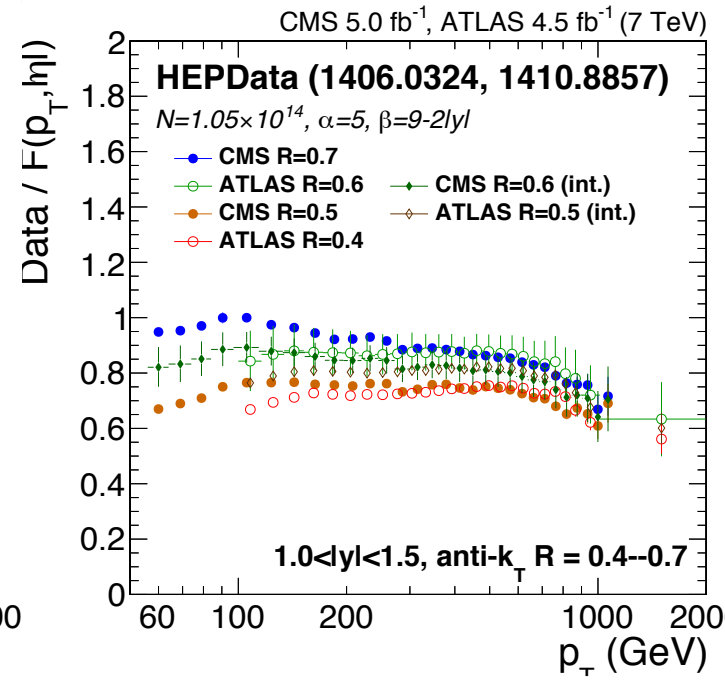


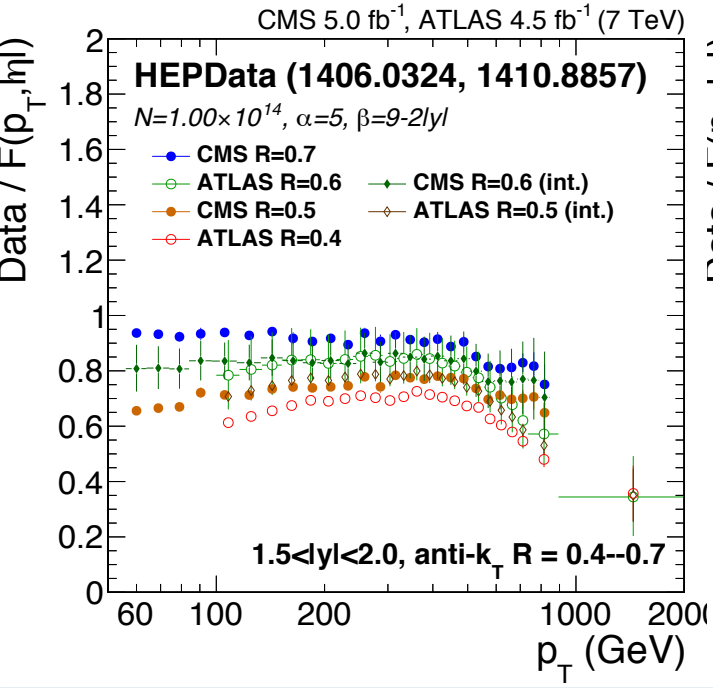


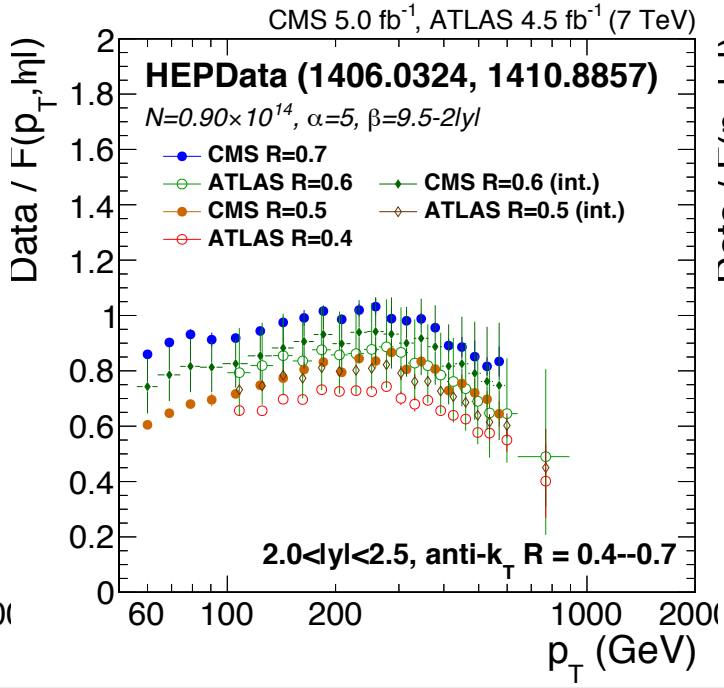
All |y| bins: before

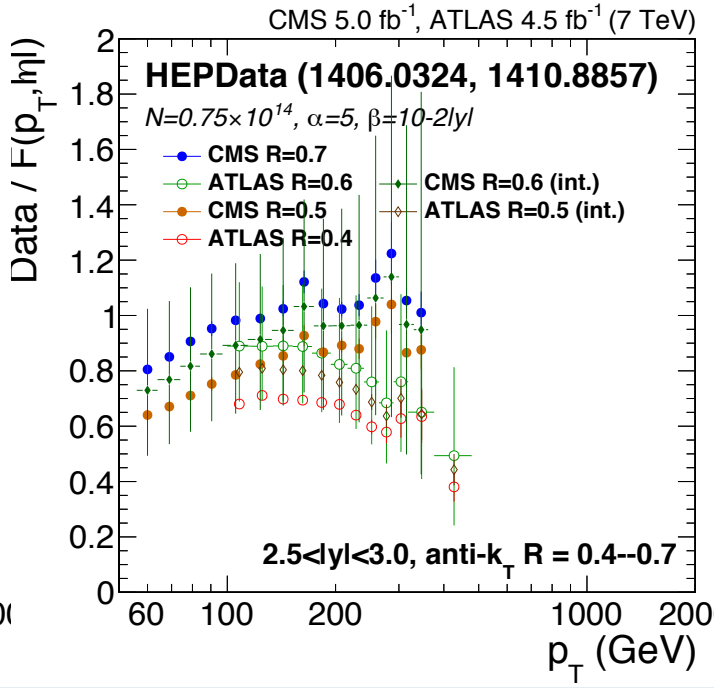




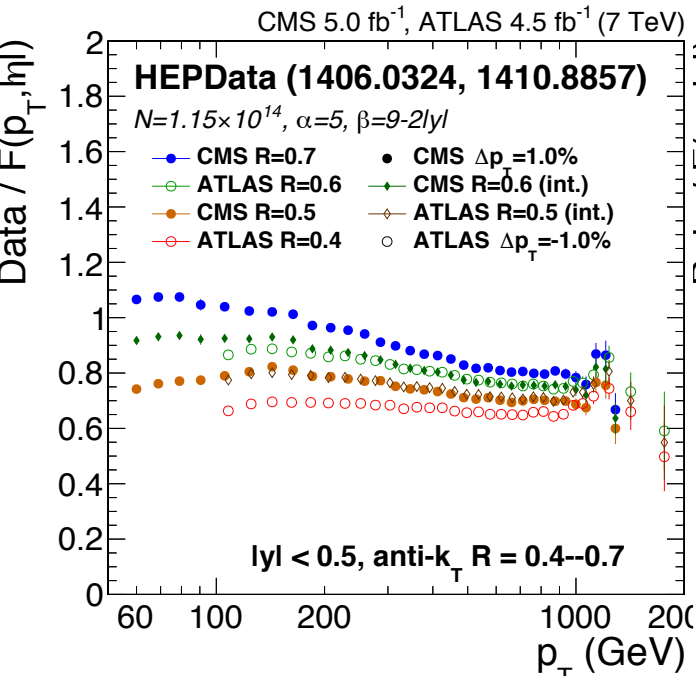


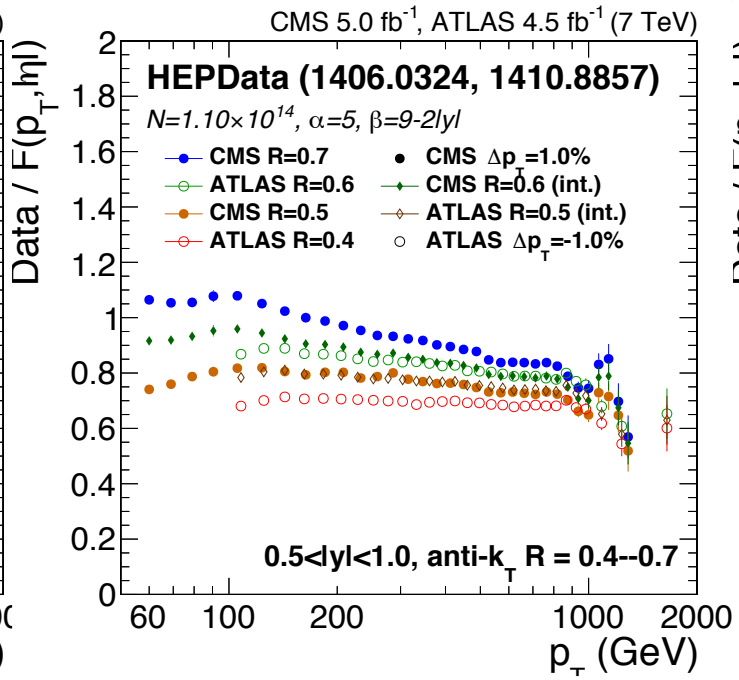


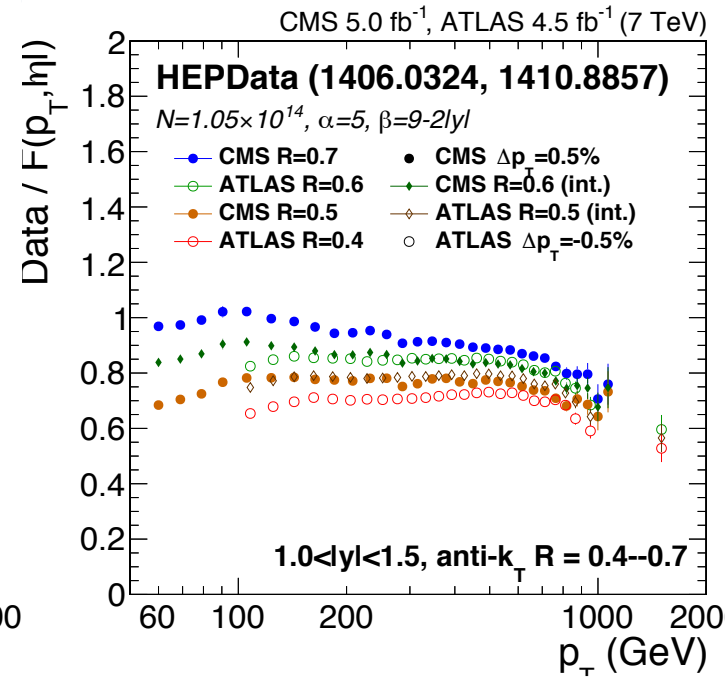


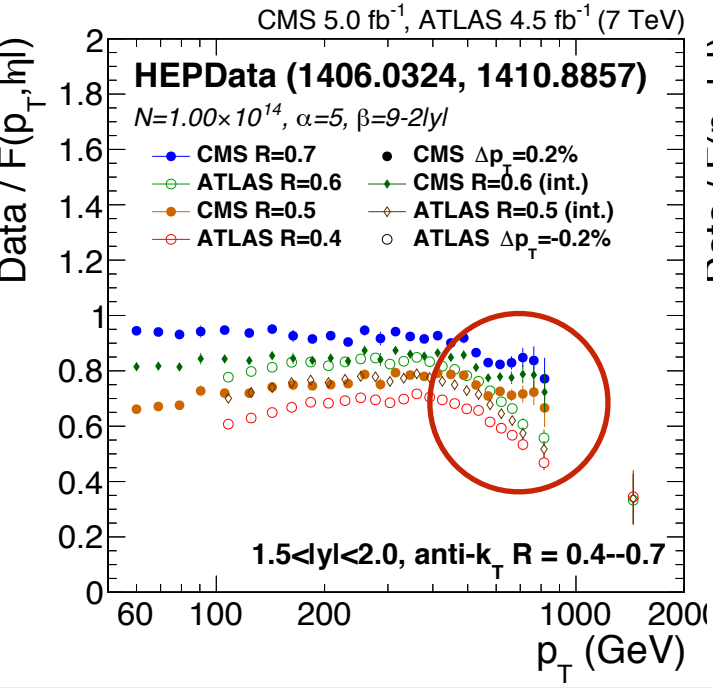


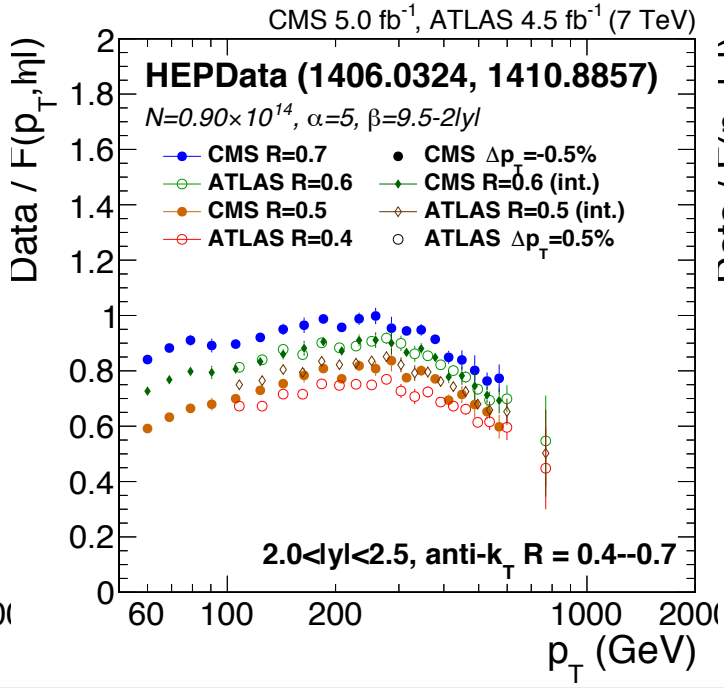
All |y| bins: after

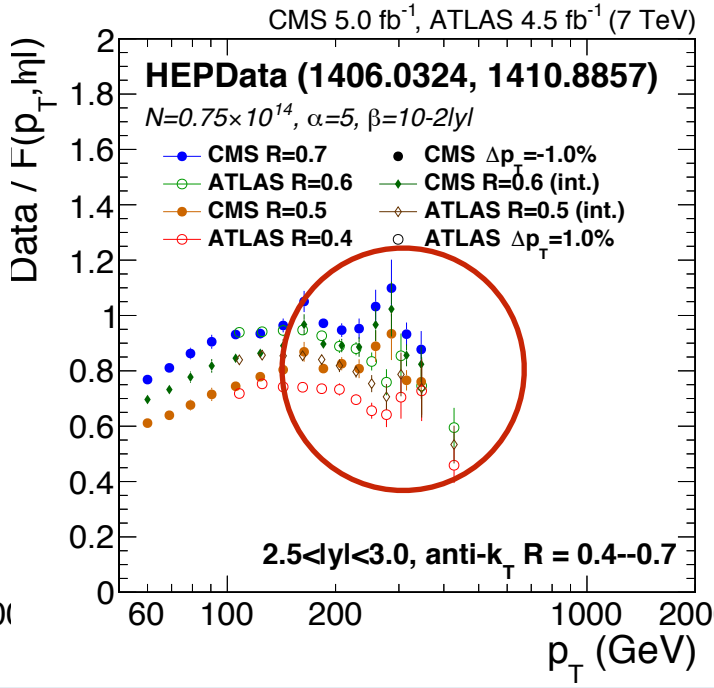






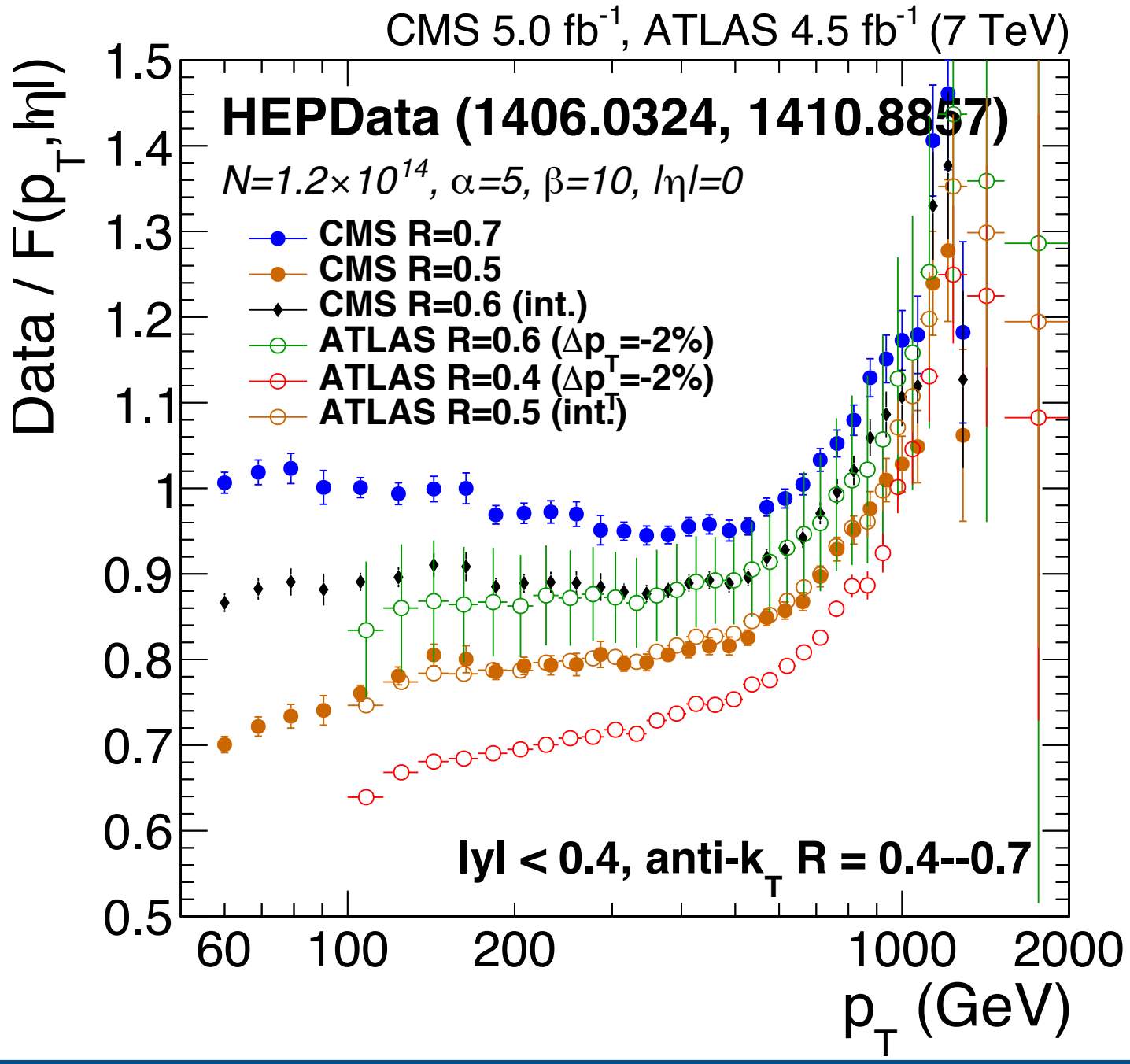






Conclusions

- Combination of 7 TeV data looks feasible
  - R difference by log(R) interpolation
  - p_T bin difference by $F(p_T,\eta)$ interpolation
  - $d\sigma/dp_T$ difference by "known" JEC biases
- Systematic uncertainties similar, uncorrelated case would be $1/\sqrt{2} = 70\%$
- Anti-correlation could reduce syst. even further
  - ATLAS limit FSR (?) (p_T balance vs MPF)
  - CMS limit JEC p_T dep. (PF vs Calo)



Outlook

- Next step is to add nuisances and do χ^2 fit
  - investigate also 8 TeV data as available
- FSR bias and JEC vs p_T possible differences
  - back-propagate lessons from 8 and 13 TeV?
  - derive joint CMS/ATLAS FSR corrections?