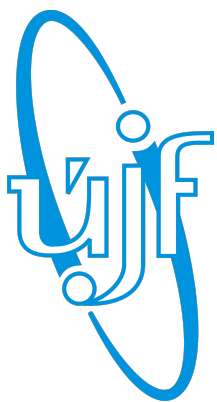


Charged jet spectra in proton-proton collisions with ALICE at LHC



**Michal Vajzer,
Nuclear Physics Institute,
on behalf of the ALICE collaboration**

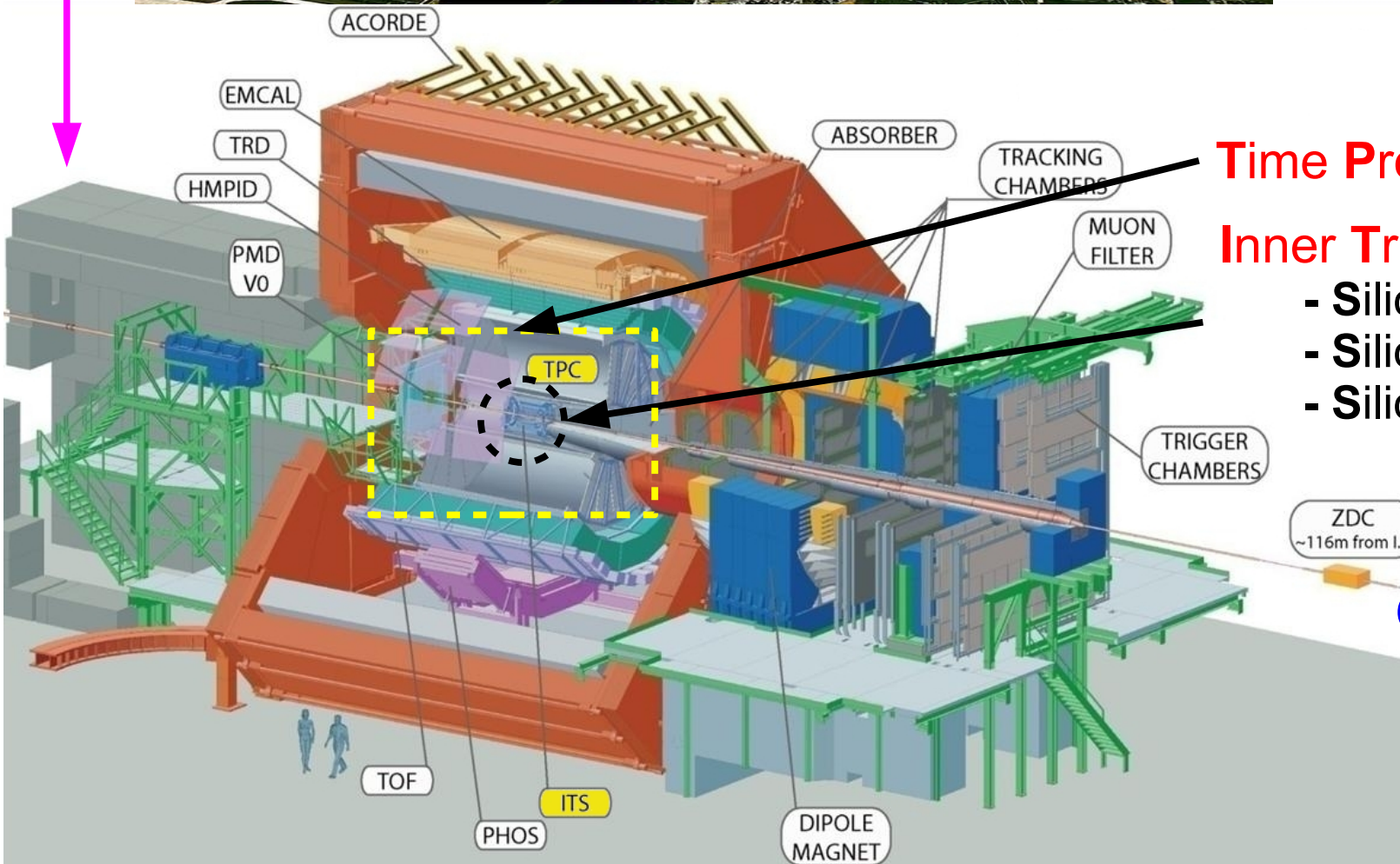


Motivation



- **Jets** originate from hard scattered partons (large Q^2)
- Test of **QCD**
 - non-perturbative: PDFs and fragmentation
 - perturbative: hard scattering
- Partons are important probes for **nuclear medium effects**
 - pp reactions form baseline

The ALICE detector system



Time Projection Chamber

Inner Tracking System

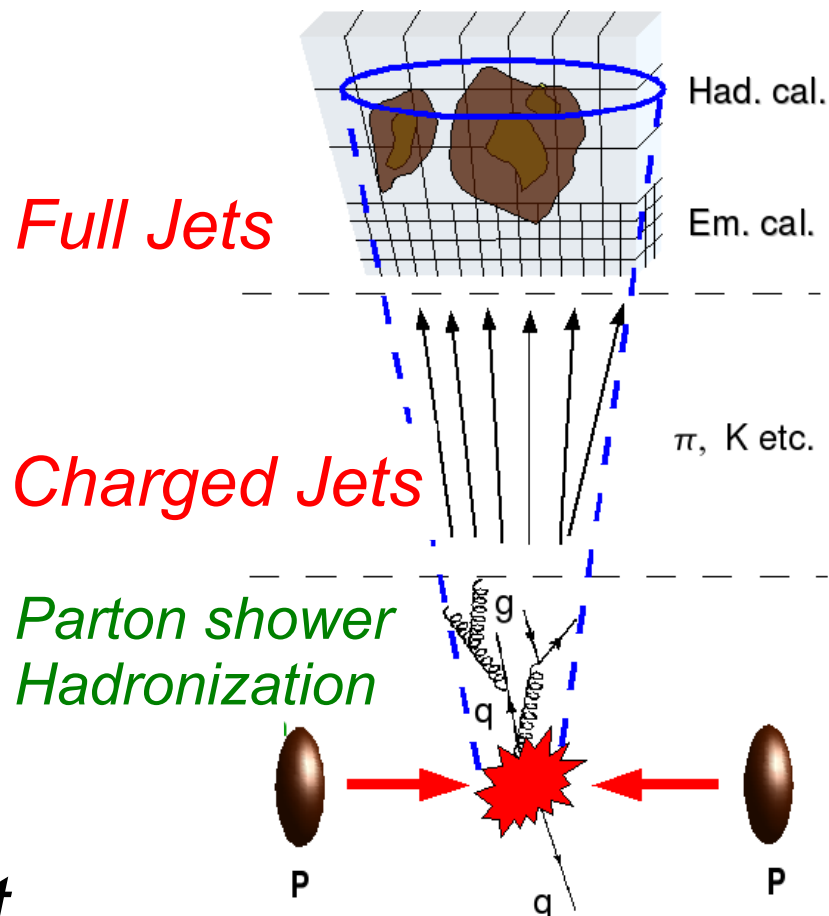
- Silicon Pixel Detectors
- Silicon Drift Detectors
- Silicon Strip Detector

Charged tracks

$$-0.9 < \eta < 0.9$$
$$p_T > 150 \text{ MeV}/c$$

Charged jets

- *theory: final state of hard parton*
- *experiment: spray of particles*
- *reconstruction:*
 - from charged particles
 - **FastJet*** anti- k_T algorithm
 - various resolution parameters R
 - $|\eta_{jet}| < 0.9 - R$
- *subtraction of Underlying Event*
- *deconvolution of detector effects*



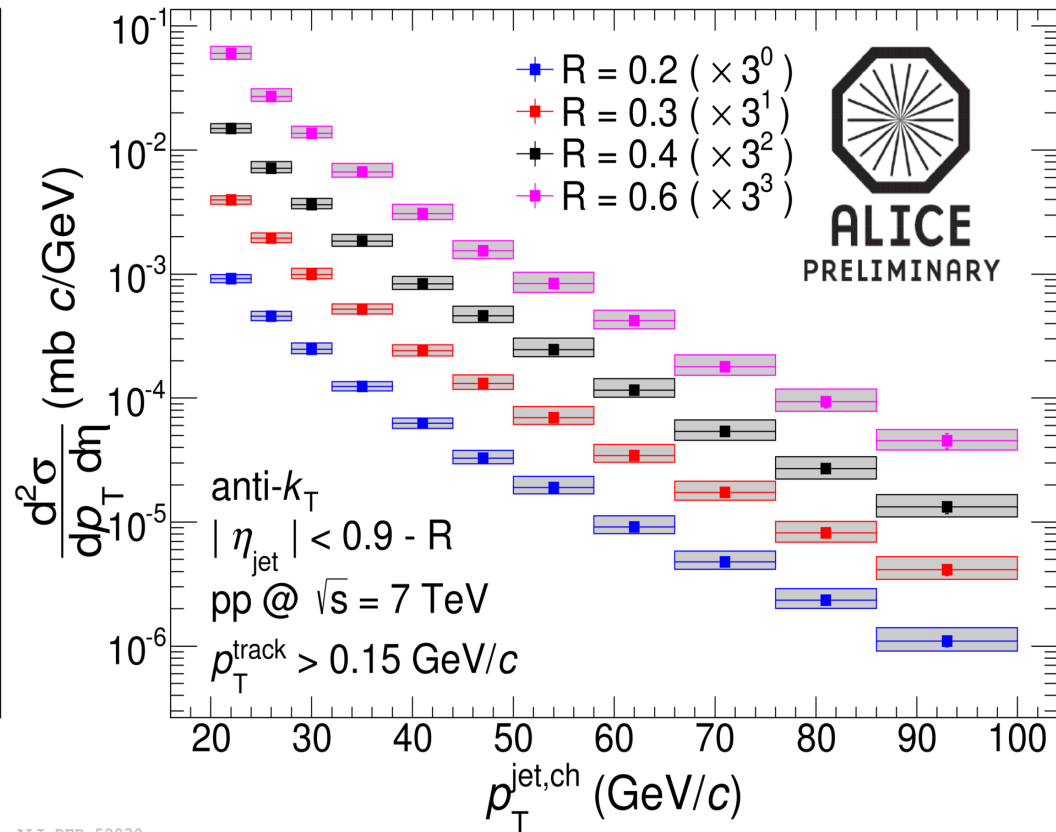
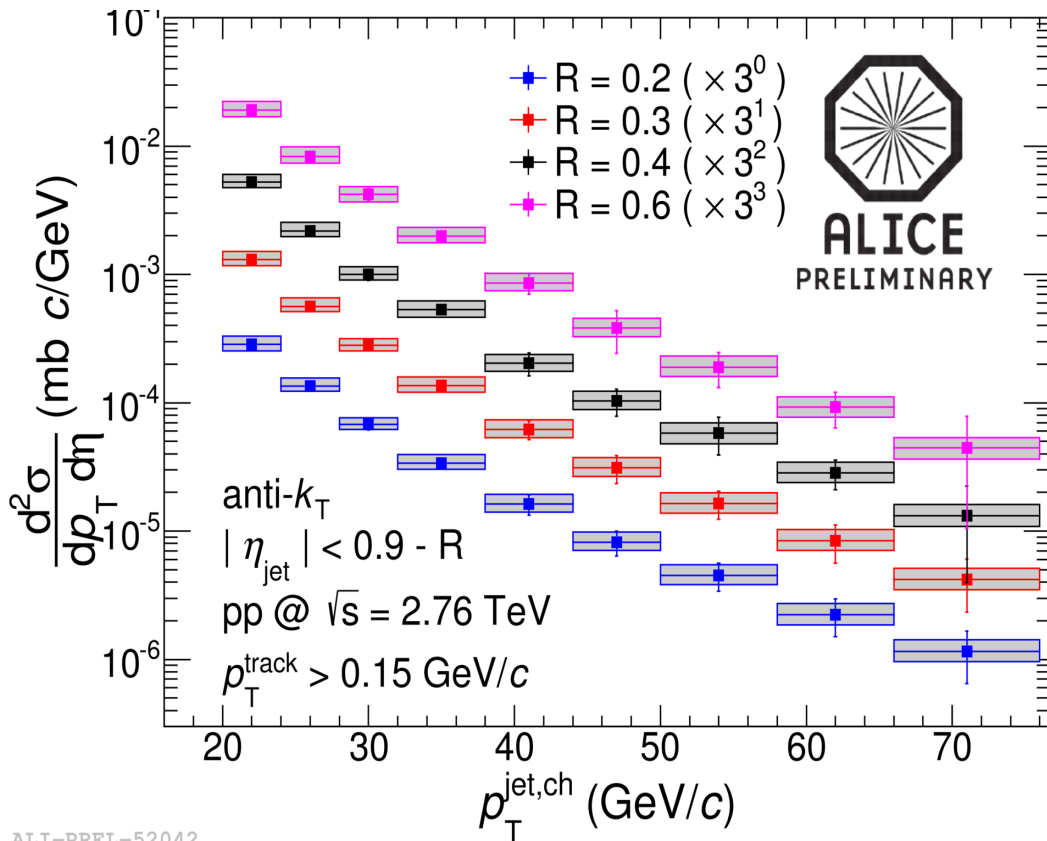
* M. Cacciari, G. P. Salam, Phys. Lett. B 641, 57 (2006).

Jet cross section



pp: **2.76 TeV**
min. bias: **66 M**

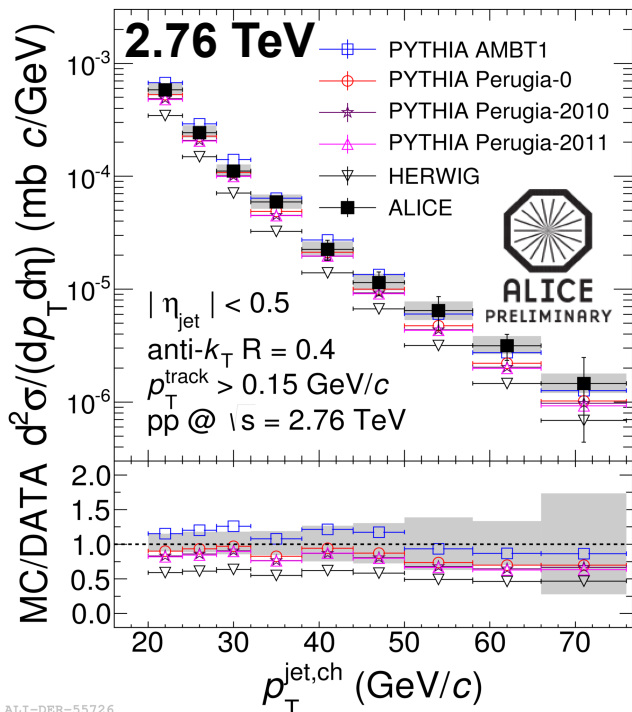
7 TeV
190 M



ALI-PREL-52042

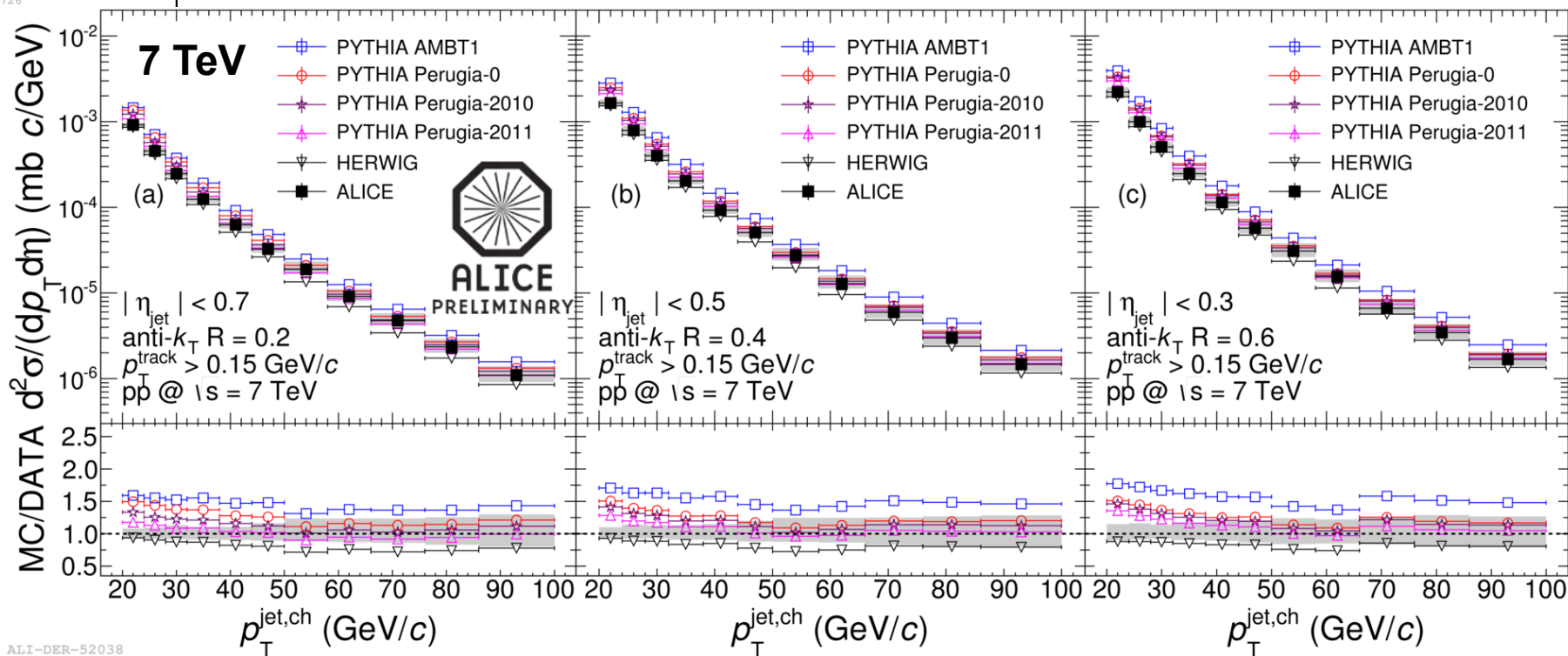
ALI-DER-52030

Comparison with MC generators



- no generator provides satisfactory description at both energies
- description of p_T evolution gets better for high p_T

ALI-DER-55726

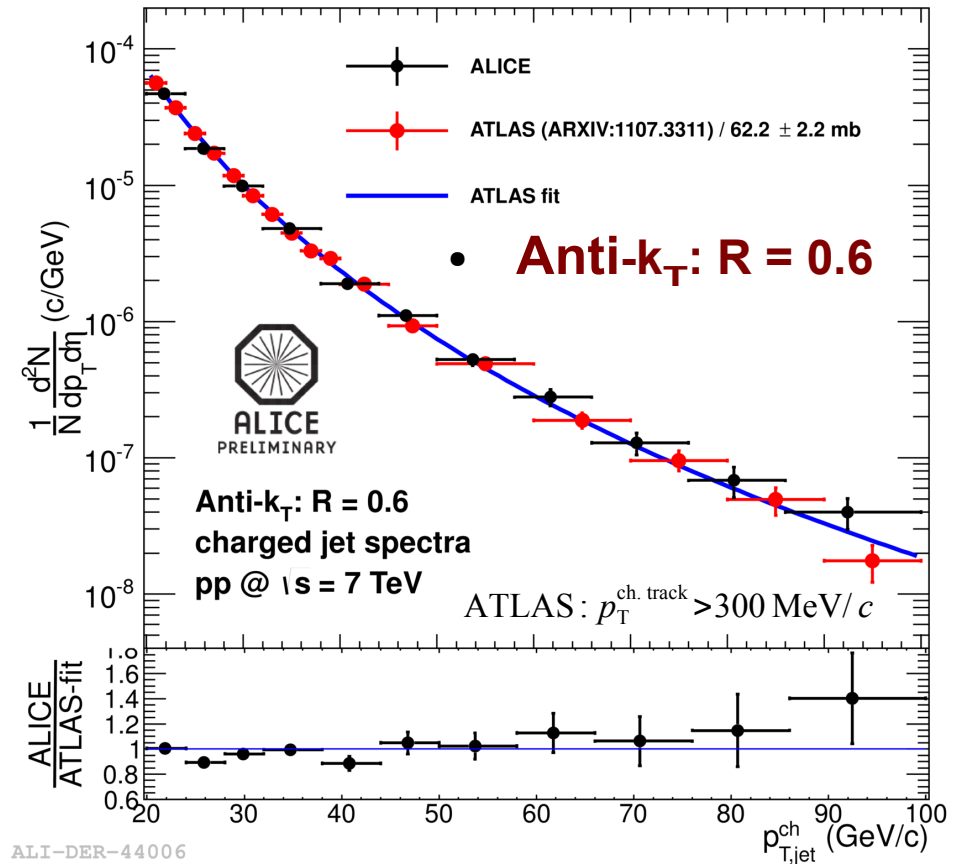
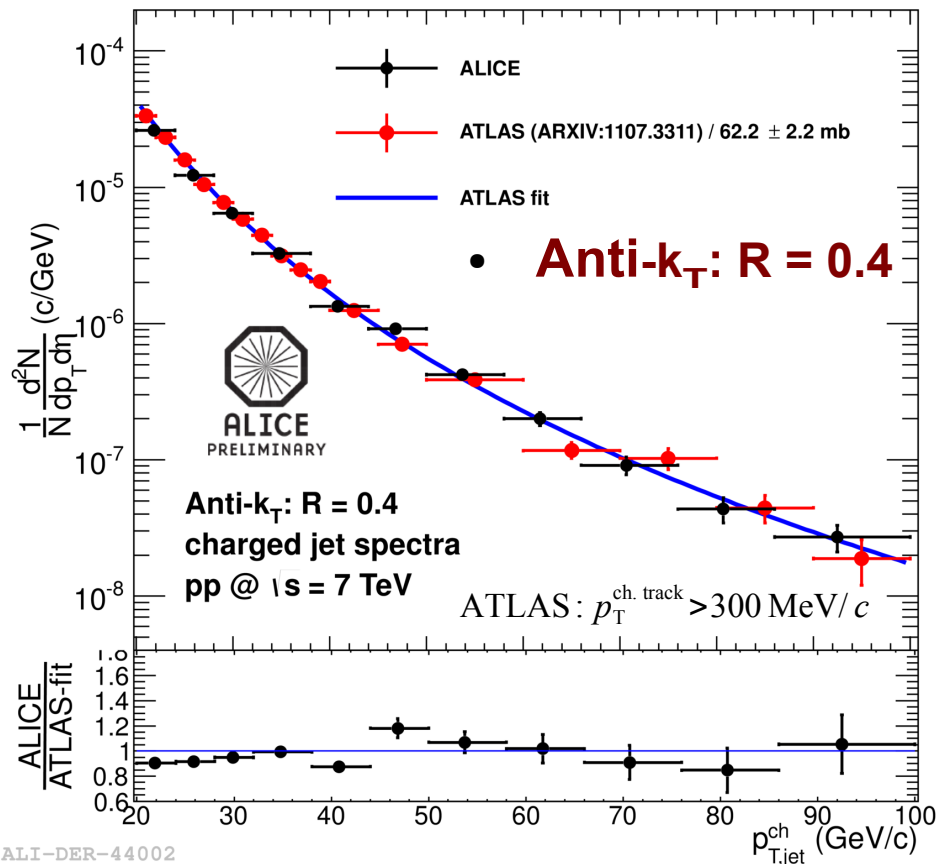


ALI-DER-52038

Yield comparison with ATLAS experiment

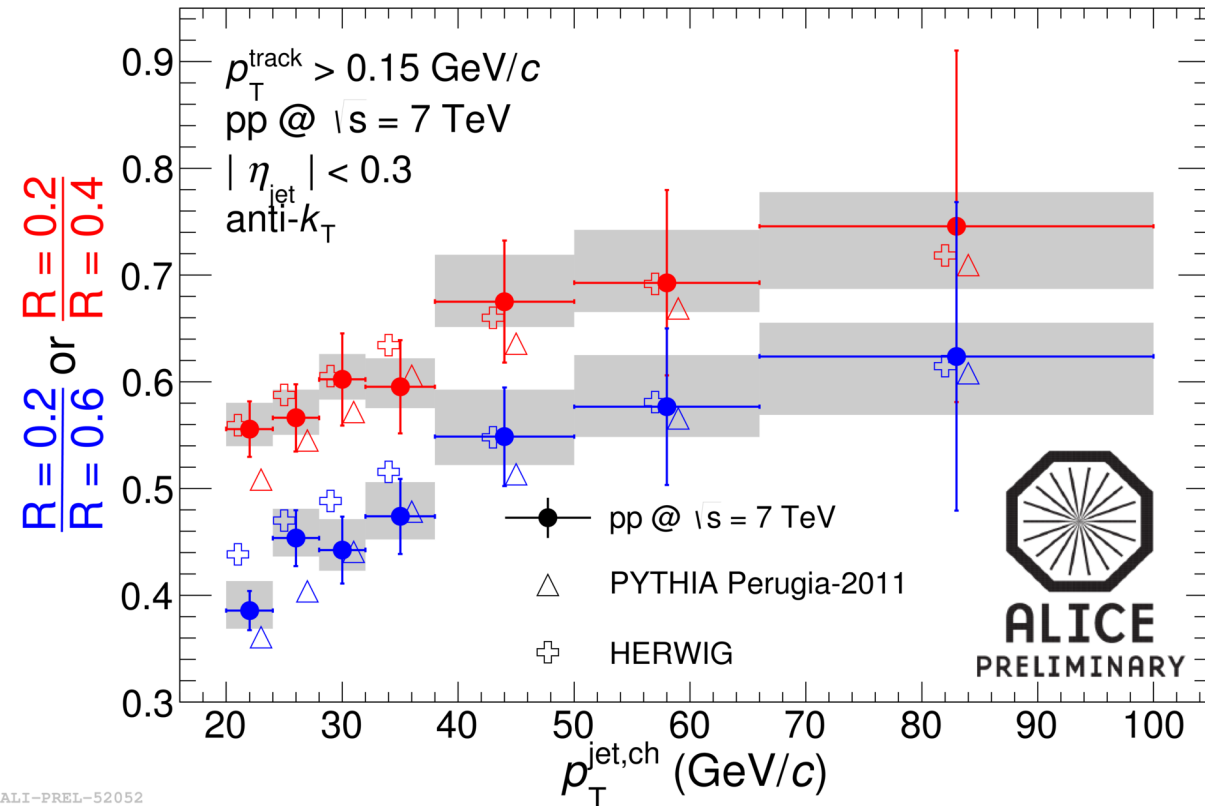
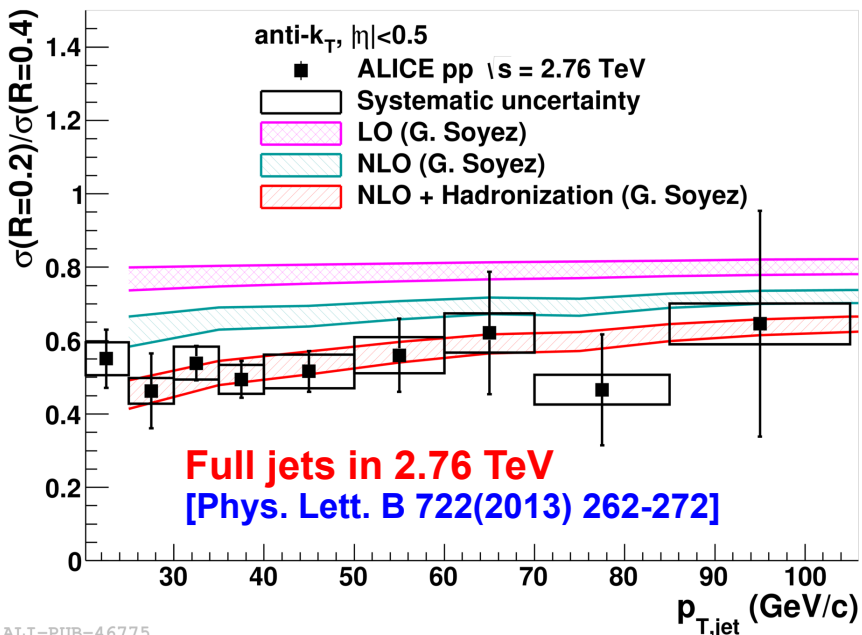


- observed good agreement
G. Aad et al., Phys. Rev. D 84 (2011) 054001



Cross section ratio

- ratio of jet spectra reconstructed with different R
- indirect measurement of radial properties
- applicable in HIC



- *collimation increases with jet p_T*

Jet properties



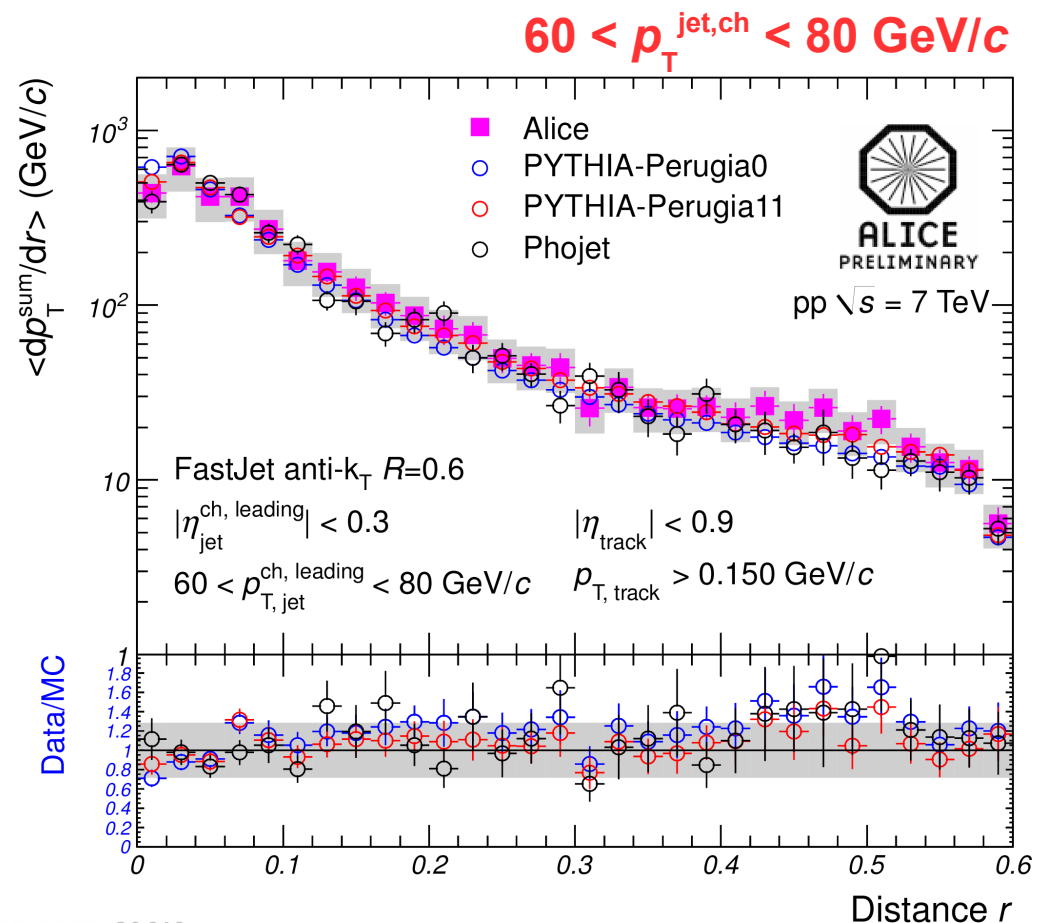
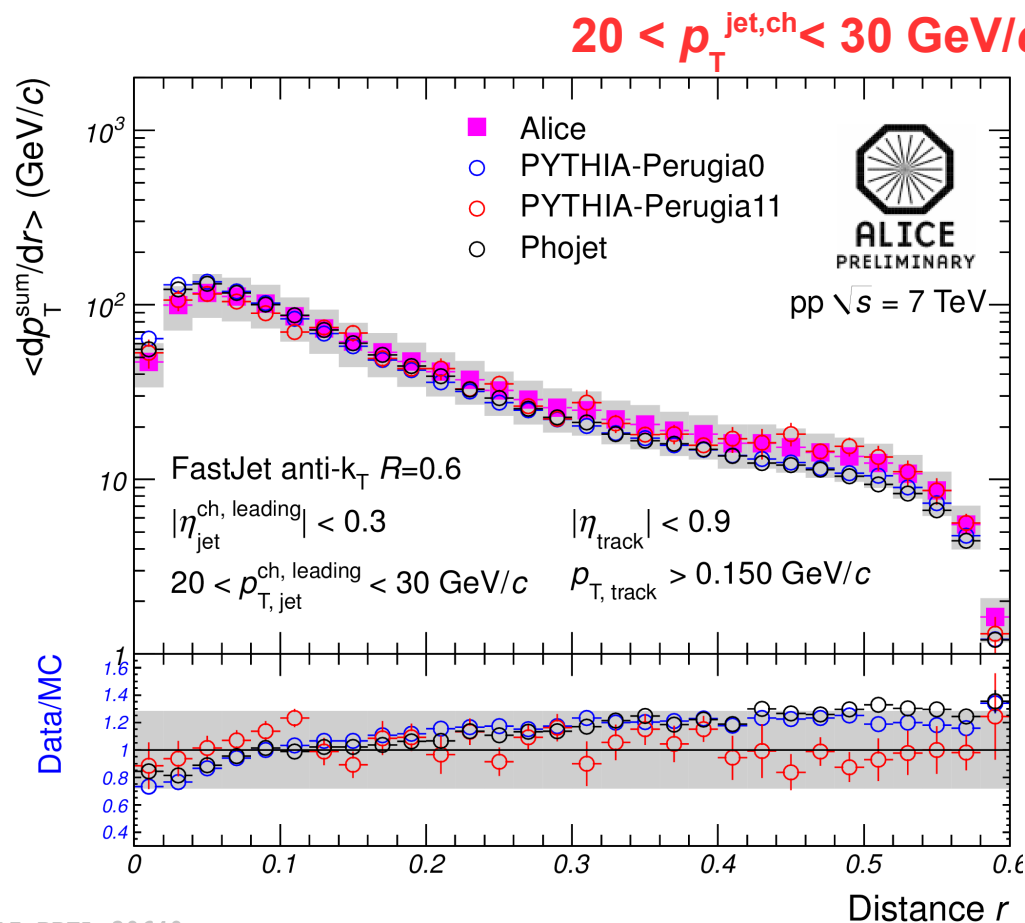
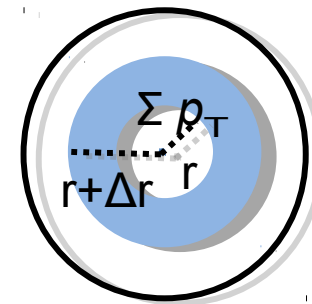
- study of *jet structure*
- focus on individual constituents of jet

→ in order to obtain details
on **evolution of parton shower**

Radial jet momentum distribution

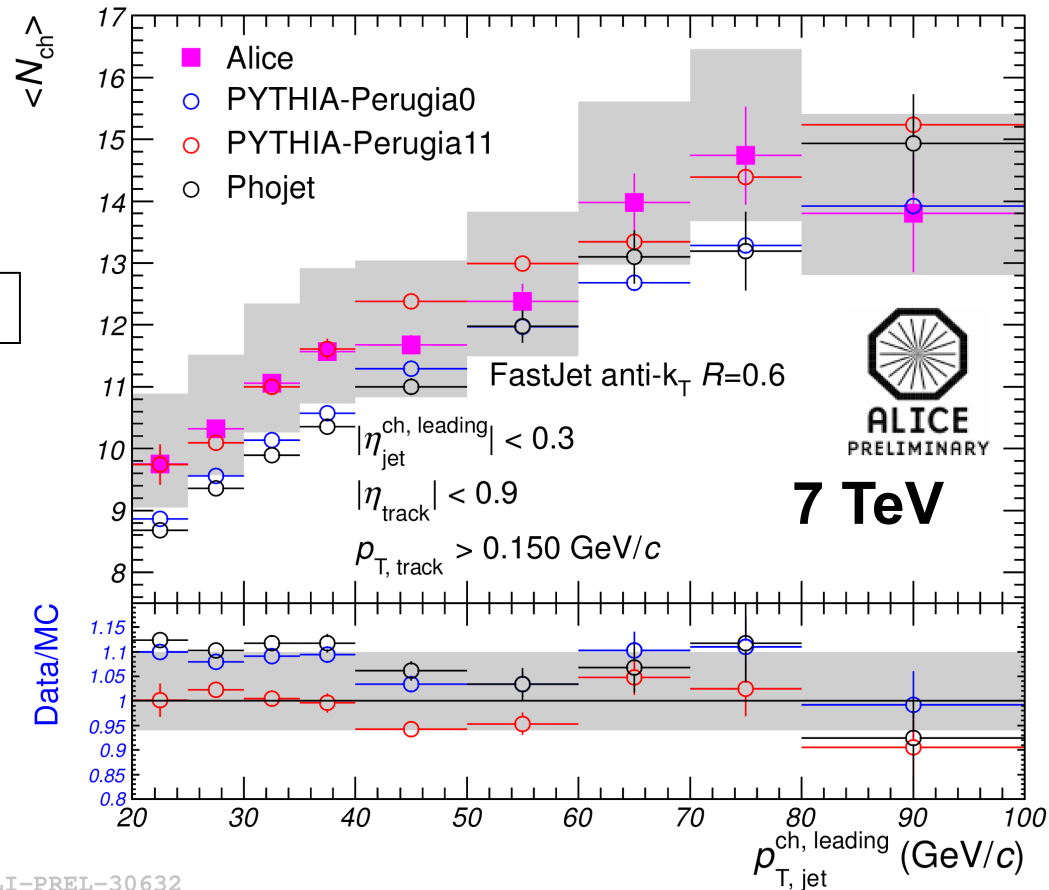
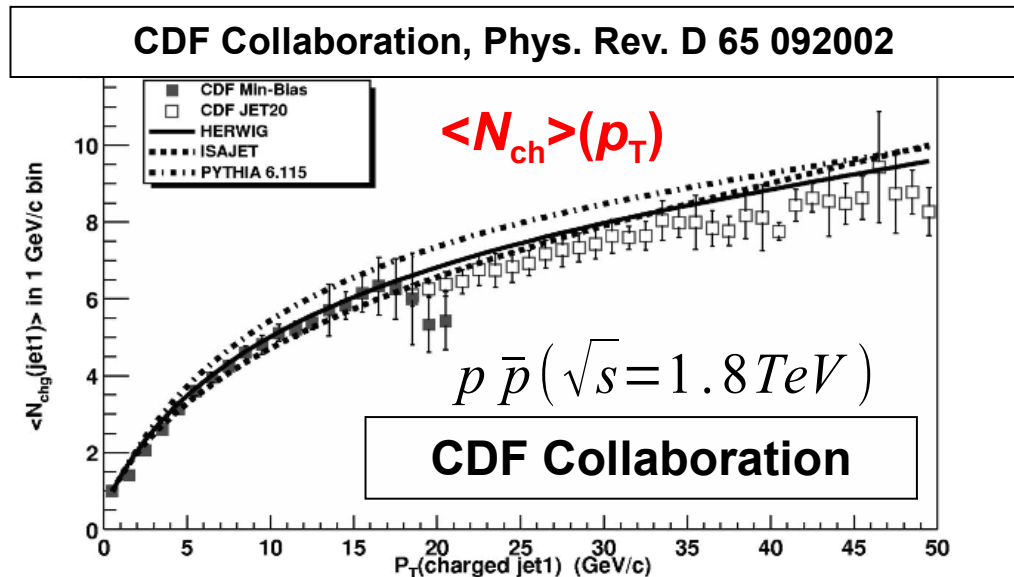


- momentum sum in radial slices
- jet collimation increases with $p_{T, \text{jet, ch}}$
- good description by all MC generators



Average charged track multiplicity in leading jet

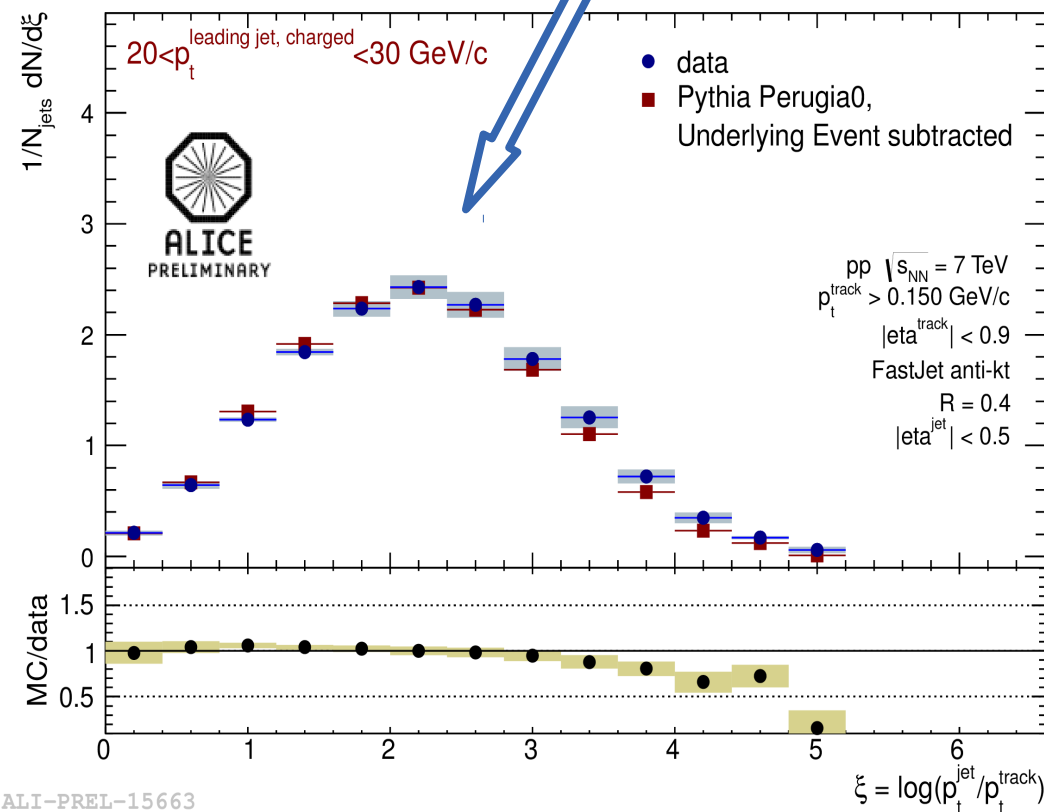
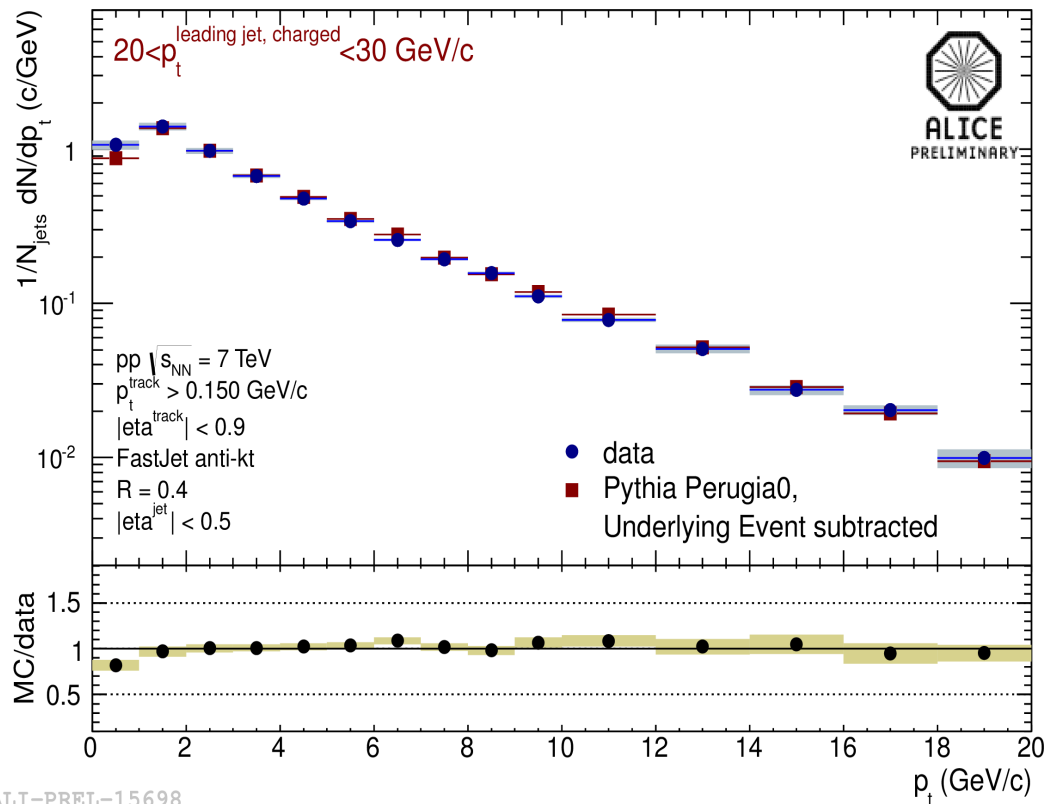
- increasing with jet p_T
- consistent with
PYTHIA and PHOJET



ALI-PREL-30632

Particle distributions

- particle momentum spectra in jets
 - less dependent on jet energy scale
 - scaled distribution to jet momentum $\xi^{ch} = \ln(p_T^{\text{jet,ch}}/p_T^{\text{particle}})$
 - low-momentum constituents
- Hump-backed plateau**



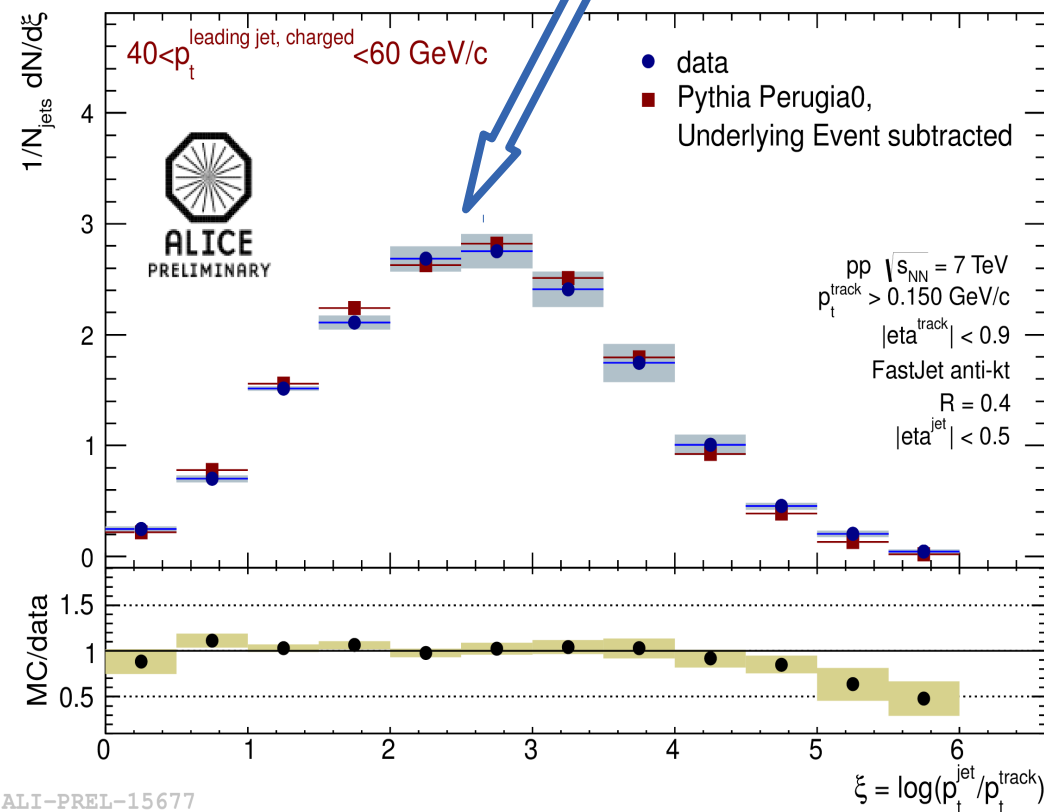
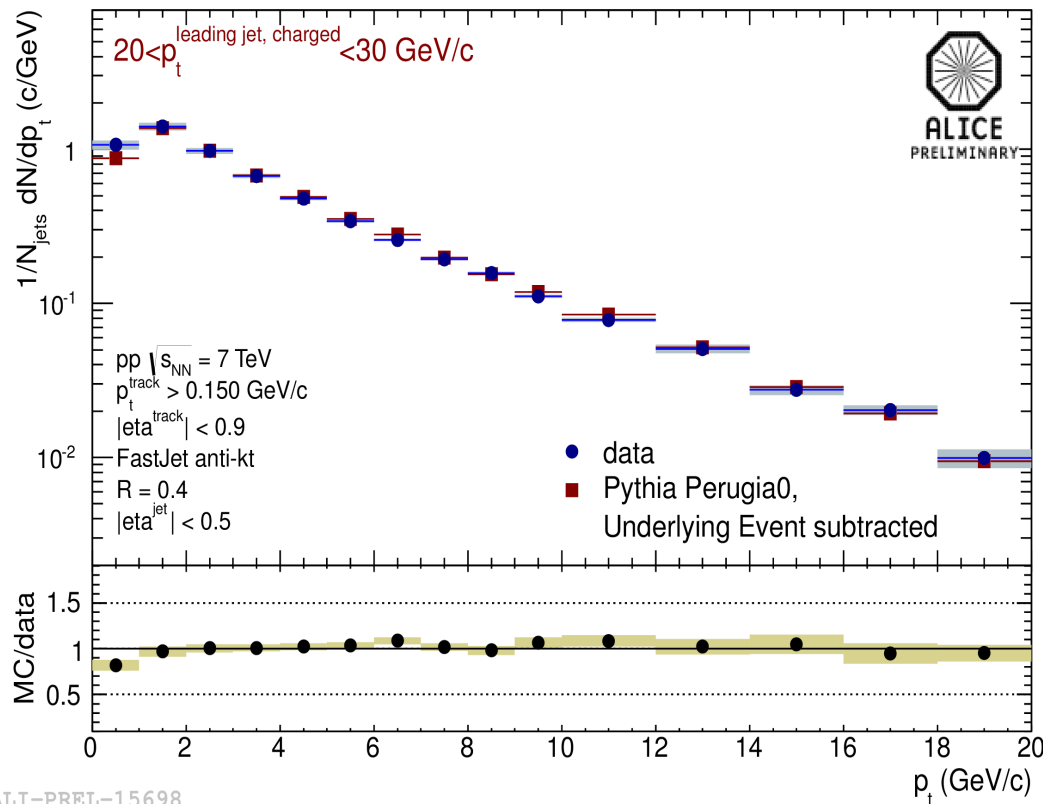
ALI-PREL-15698

ALI-PREL-15663

Particle distributions

- particle momentum spectra in jets
 - less dependent on jet energy scale
- scaled distribution to jet momentum $\xi^{ch} = \ln(p_T^{\text{jet,ch}}/p_T^{\text{particle}})$
 - low-momentum constituents

Hump-backed plateau



Summary



- reconstructed charged jets in proton-proton collisions at 2.76 and 7 TeV
 - large variations in descriptions provided by MC
 - good agreement with results of ATLAS experiment at 7 TeV
- study of fragmentation functions and jet shapes in proton-proton collisions at 7 TeV
 - '*hump-backed plateau*' in ξ distribution indicate QCD coherence
 - increased collimation with increasing jet p_T
 - consistent with predictions from MC and QCD expectations

**Thank You
for Your attention**

Backup

Jet algorithm

- FastJet package
- Sequential recombination of tracks according to
 - minimum of inverse transverse momenta squares
 - clusters high momenta particles first
 - displacement in $\varphi - \eta$ space
 - close tracks are processed sooner than pair of similar displaced tracks
- p_T recombination scheme
boost invariant

Analysis procedure

- *Raw jets*
 - minimum bias proton-proton collisions
 - underlying event subtraction (event-by-event)
- *UE subtracted jets*
 - unfolding to correct for detector effects
 - response matrix from *PYTHIA* + *GEANT*
- *Corrected jets*

Underlying event

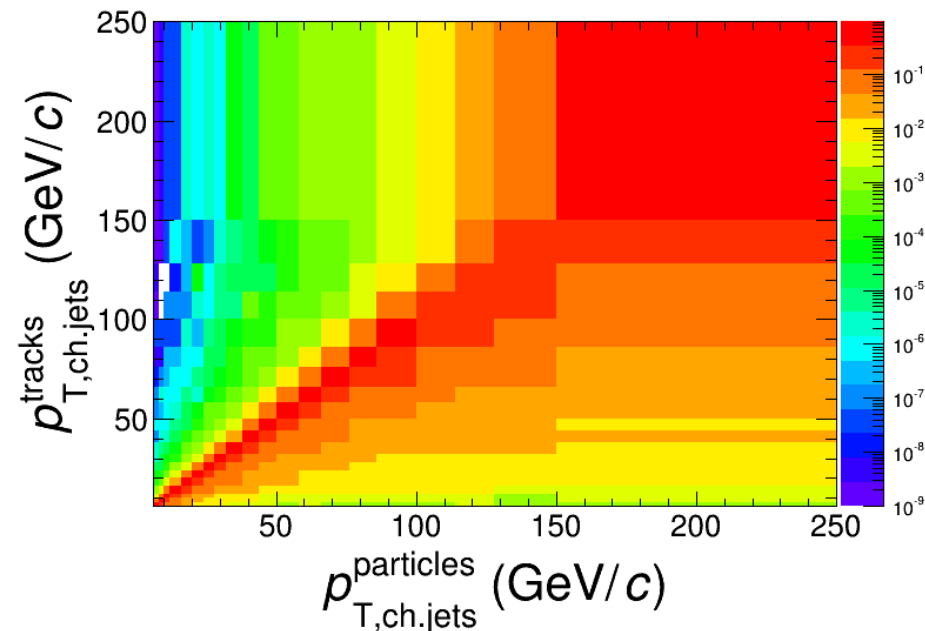
- *proton* is composite
 - many processes in one collision
 - usually soft processes
- *UE energy density* determination
 - at same η
 - φ is shifted by $\pm 90^\circ$
 - charged tracks are summed
 - in cone with radius R
- event-by-event subtraction

Unfolding

- Bayesian unfolding
 - based on Bayes' theorem
- SVD of Response Matrix (RM)
 - decomposition of RM to singular values
- Bin-by-bin correction
 - correction from corrected & uncorrected simulated spectra applied to data

* G. D'Agostini,
NIM A 362 (1995) 487.

* A. Höcker and V. Kartvelishvili,
NIM A 372 (1996) 469



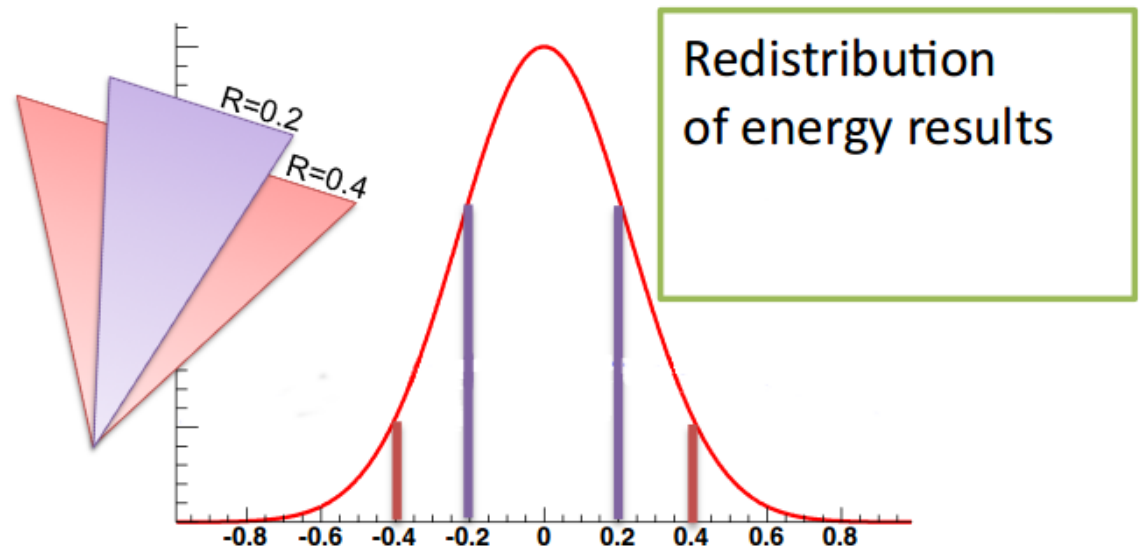
Ratio of jet spectra

- Study of jet profile

- 2 different sizes

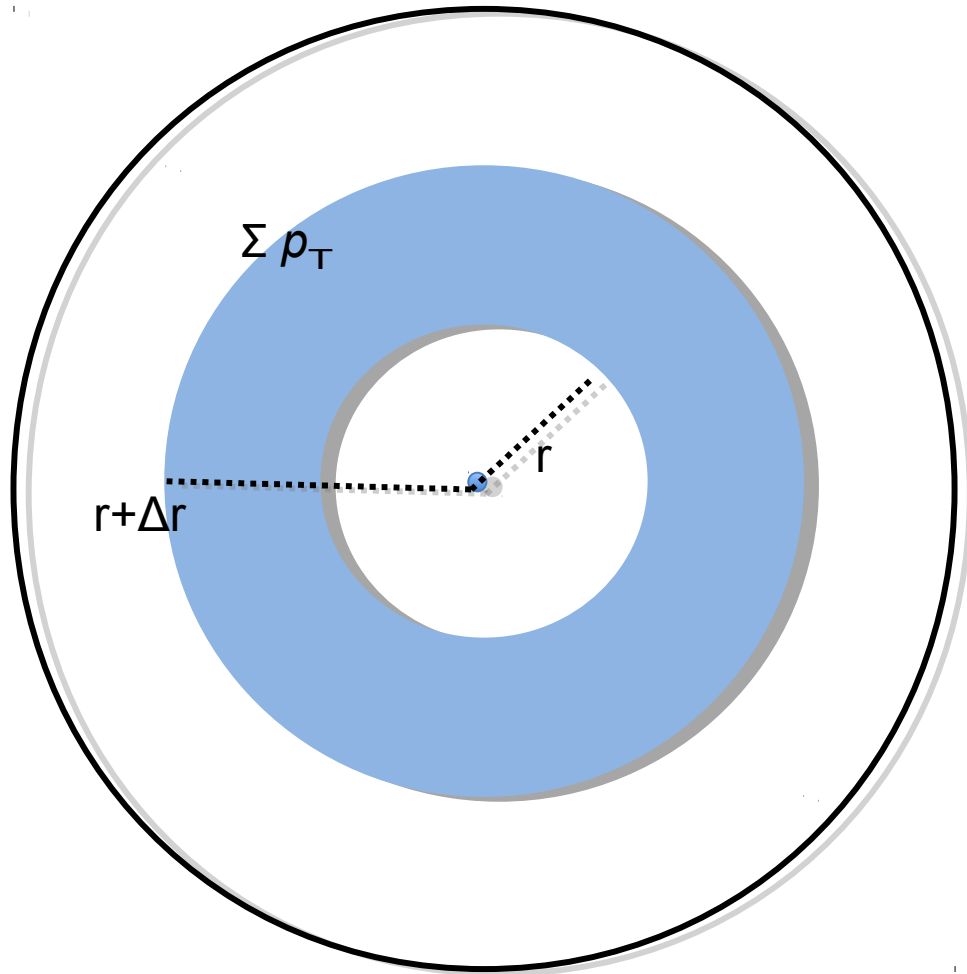
- $\text{ratio} = \frac{\text{jet core}}{\text{whole jet}}$

Illustration: Gaussian 1D profile



ratio $\rightarrow 1 \Rightarrow$ 'whole jet – jet core' $\rightarrow 0$

Radial momentum distribution



$$\langle p_T^{\text{sum}} \rangle(r) = \frac{1}{N_{\text{jet}}} \sum_{\text{jet}} \sum_{k=r}^{r+\Delta r} p_T^{\text{track}}(\mathbf{k})$$