Measurements of generalized jet angularities in pp collisions at $\sqrt{s}$ = 5.02 TeV with ALICE

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References

[1] Z. Kang, K. Lee, F. Ringer, JHEP 1804 (2018) 110

[2] G. D'Agostini, arXiv:1010.0632

ALICE Collaboration:

[3] Int. J. Mod. Phys. A 29 (2014) 14300440

[4] JHEP 10 (2018) 139

[5] Phys. Lett. B776(2018) 249-264

Physics Motivation

- **Jets** are formed from initial hard-scattered q or g in nucleon and are sensitive to higher-order effects after initial scattering
- Provide direct probe of perturbative & non-perturbative QCD
- The generalized angularities λ_β^κ are a class of **jet substructure** observables dependent on p_T and angular distributions of tracks within jets

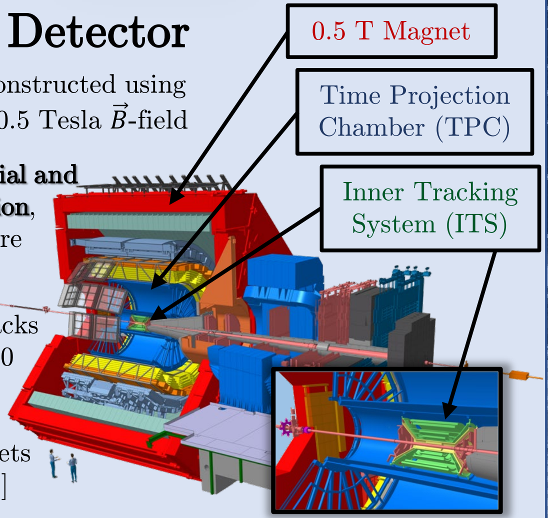
$$\lambda_\beta^\kappa \equiv \sum_{i\in\mathrm{jet}} \left(\frac{p_{\mathrm{T},i}}{p_{\mathrm{T,jet}}}\right)^{\kappa} \left(\frac{\Delta R_{\mathrm{jet},i}}{R}\right)^{\beta}$$

Continuous, tunable parameters

- **IRC-safe** observable for $\kappa = 1$, $\beta > 0$ → can directly compare shapes to theoretical predictions for different jet radius R [1]

The ALICE Detector

- Charged tracks reconstructed using ITS and TPC in a 0.5 Tesla $\vec{B}$-field
- **High-precision spatial and momentum resolution**, ideal for substructure measurements
- Measurement of tracks with p_T down to 150 MeV/c → unique ability to study low-p_T tracks and jets at LHC energies [3]

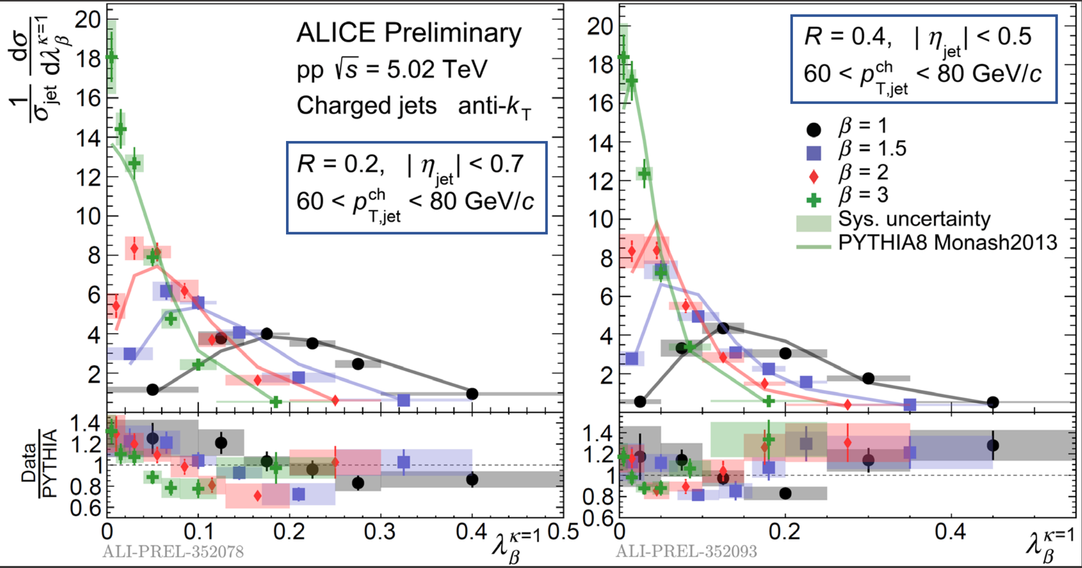


Analysis Method

- Reconstruct charged particle jets using the anti-k_T algorithm with radius $\boldsymbol{R}$ **= 0.2, 0.4** in the E recombination scheme
- Choose observables to be $\boldsymbol{\kappa = 1}$ **and** $\boldsymbol{\beta \in \{1, 1.5, 2, 3\}}$
  - $\beta = 1$ → λ_β = jet girth g;
  - $\beta = 2$ → λ_β = (jet mass)^2 / $(p_{\mathrm{T,jet}}^{\mathrm{ch}})^2$
- Create 4D response matrix $(p_{\mathrm{T,jet,det}}^{\mathrm{ch}}, p_{\mathrm{T,jet,tru}}^{\mathrm{ch}}, \lambda_{\beta,\mathrm{det}}, \lambda_{\beta,\mathrm{tru}})$ using PYTHIA 8 Monash 2013 through GEANT 3 simulation
- **Unfold measured distributions** with 2D iterative Bayesian procedure [2] to account for finite tracking efficiency, particle-detector interactions, and track p_T resolution

Results

- Results measured in three p_T bins: 20-40, 40-60, and 60-80 GeV/c (all figures: link)
- **Distributions are strongly peaked at lower** $\boldsymbol{\lambda_\beta}$ **for larger values of** $\boldsymbol{\beta}$ **and jet radius** $\boldsymbol{R}$
- Slight deviations from PYTHIA, with non-negligible systematic uncertainty
- **Data slightly enhanced in tails** with respect to the central values (distributions are self-normalized by area)
  - → data has more high-/low-λ_β jets than PYTHIA, meaning **more jets with constituent** $\boldsymbol{p_\mathrm{T}}$ **collimated or at edges**



Outlook

- **Compare theory predictions** from Soft Collinear Effective Theory (SCET) to these measurements
  - Test perturbative accuracy
  - Different values of β test of the universality of non-perturbative functions fit from data
- Reference for **quenched jet measurements** in heavy-ion collisions
  - Probe how the QCD medium affects these jet shapes
  - Statistically significant modifications were seen in ALICE heavy-ion collisions for $\beta = 1$ [4] but not for $\beta = 2$ [5]
  - Provide a wider set of tests for comparison to existing phenomenological models of the quark-gluon plasma