Study of the transverse momentum distribution of jet constituents in p-Pb collisions at ALICE

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Abstract: Jet properties are influenced by both perturbative and non-perturbative processes that take place during the jet fragmentation. Transverse momentum distributions in jets provide insight into the gluon radiation patterns in jet fragmentation. In this poster we present spectra of the momentum component perpendicular to the jet axis (j_T) of charged jet constituents from the analysis of fully reconstructed jets in p-Pb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV measured by the ALICE experiment.

ALICE

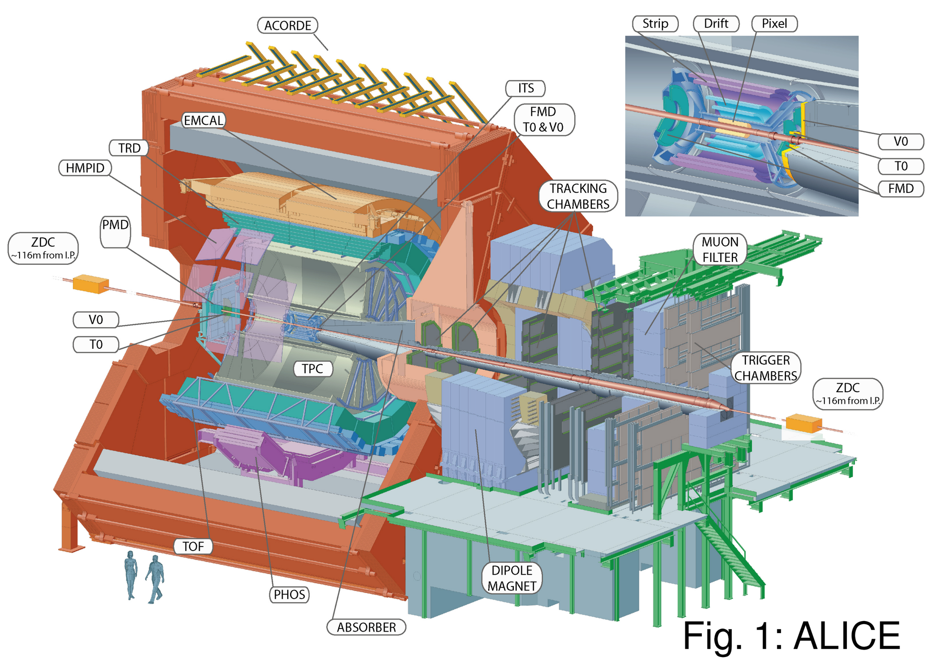

Fig. 1: ALICE

ALICE is a dedicated heavy ion experiment at the CERN LHC accelerator. Precision tracking is provided by the Time Projection Chamber (TPC) and enhanced by six layers of the silicon Inner Tracking System (ITS). Charged tracks used in jet reconstruction are measured in pseudo-rapidity $|\eta| < 0.9$ and with transverse momentum $p_T > 150$ MeV/c.

Photons and electrons are detected by the sampling lead scintillator calorimeter EMCal, with coverage of 100 degrees in azimuth and $|\eta| < 0.7$. Clusters with $E_T > 300$ MeV are used for the jet reconstruction.

Jet reconstruction

Track matching with clusters is implemented to avoid double counting of energy. Jets are reconstructed with anti-k_T algorithm and resolution parameter R = 0.4, from charged tracks and calorimeter clusters. Acceptance is limited by the calorimetry and fiducial cut to $|\eta| < 0.25$ and $1.455 < \varphi < 3.085$.

The analysis is conducted in several jet p_T bins in the range 20-150 GeV/c. The jet p_T is corrected for the Underlying Event (UE) contribution. The UE background density (ρ) is estimated by evaluating charged track deposits in the full tracking acceptance (Fig. 2) and then scaled up by the average charged/full ratio, to contain bkg of full jets.

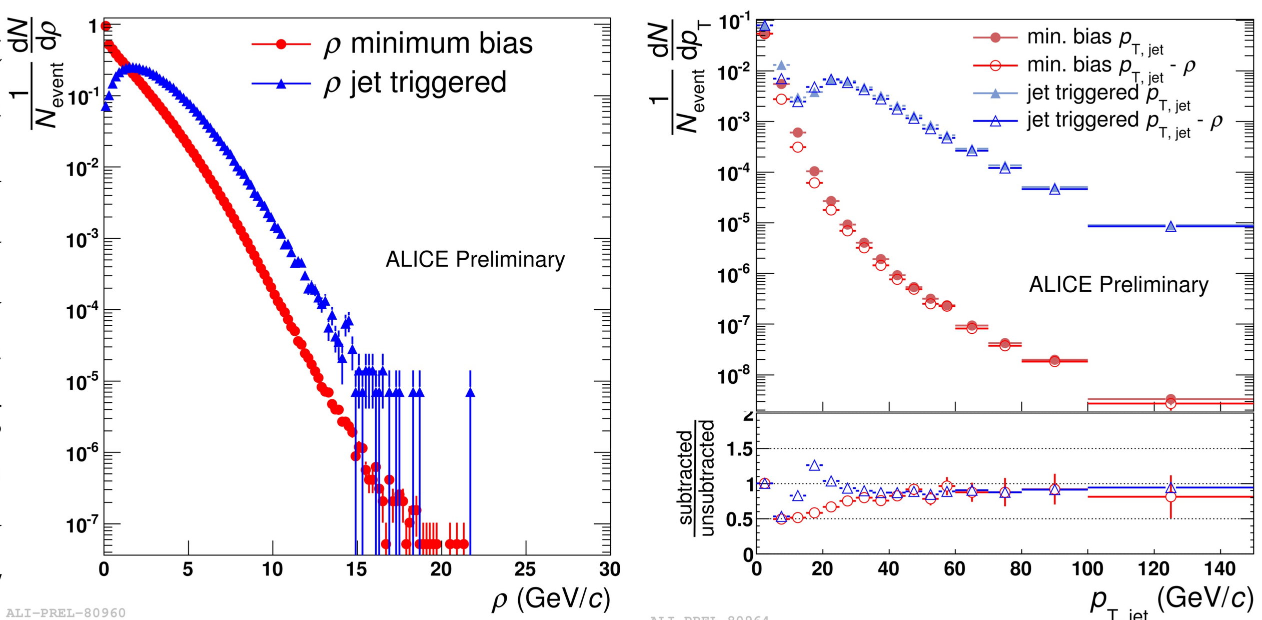

Fig .2: Left: ρ distribution for minimum bias and triggered events. Right: Raw jet spectra before and after the ρ subtraction.

j_T analysis method

Charged track constituents are used to calculate the distribution of the momentum component perpendicular to the jet axis, j_T (see Fig. 3).

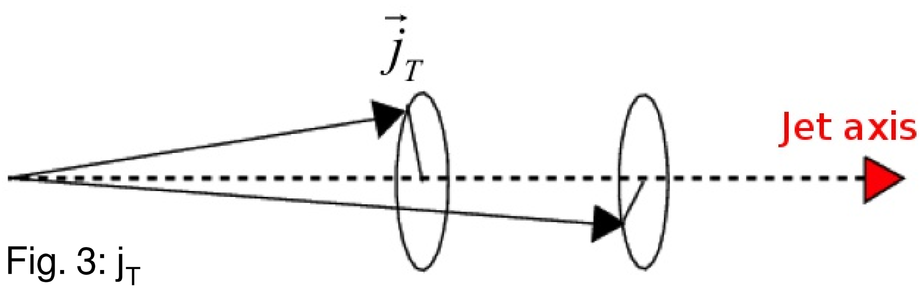

Fig. 3: j_T

The background contribution to the j_T spectrum is subtracted via 90° rotated cone method. The rotated cone size is adapted to the signal jet area (Fig. 4).

The raw spectrum is corrected using a bin-by-bin (in jet bins) correction obtained from full Monte-Carlo simulation.

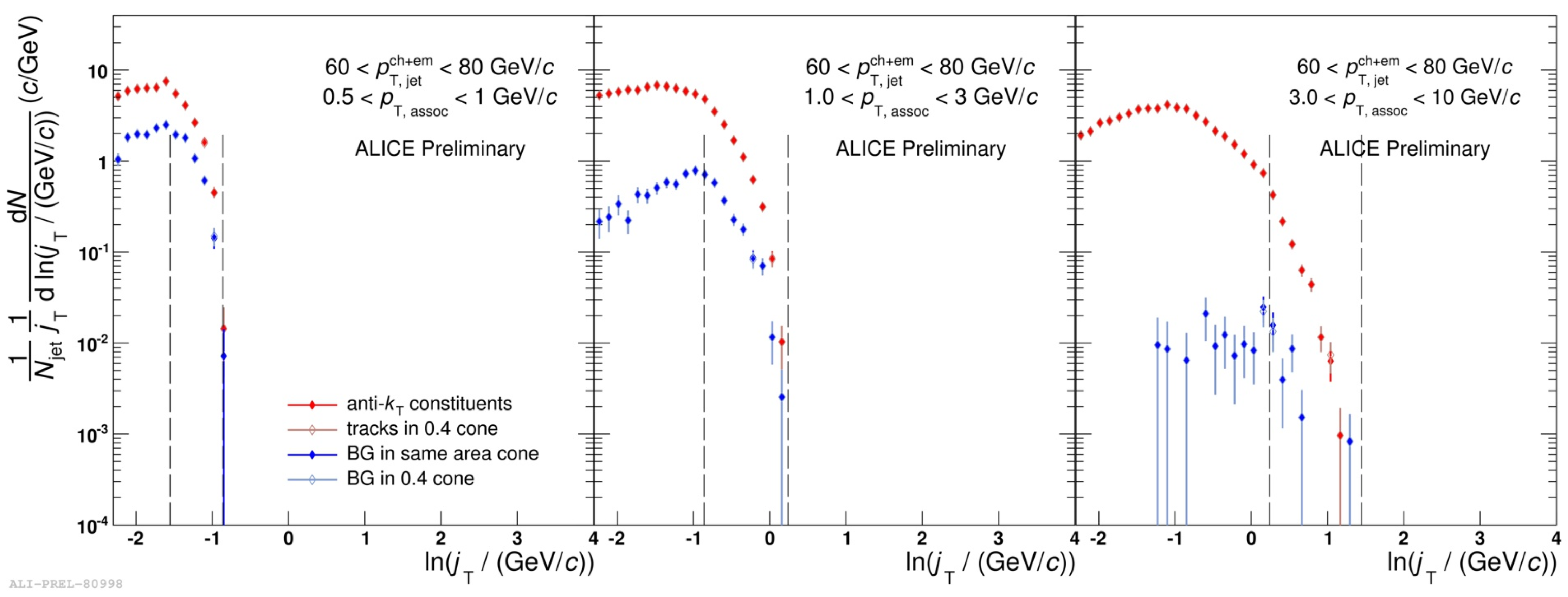

Fig. 4: Uncorrected j_T distribution (red) and corresponding UE distribution (blue) for various p_T of the associated tracks.

[1] F. Arleo, R. Perez Ramos, and B. Machet. Hadronic single inclusive k-perpendicular distributions inside one jet beyond MLLA. Phys.Rev. Lett., 100:052002, 2008.

[2] T. Aaltonen et al. Measurement of the kT Distribution of Particles in Jets Produced in pp Collisions at $\sqrt{s}$= 1.96 TeV. Phys.Rev.Lett., 102:232002, 2009

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j_T spectrum

The fully corrected charged j_T spectra are presented in jet p_T bins (Fig. 5). Comparison is made to the PYTHIA 6.4 CDF A tune with and without Angular Ordering (AO). AO provides better agreement with data.

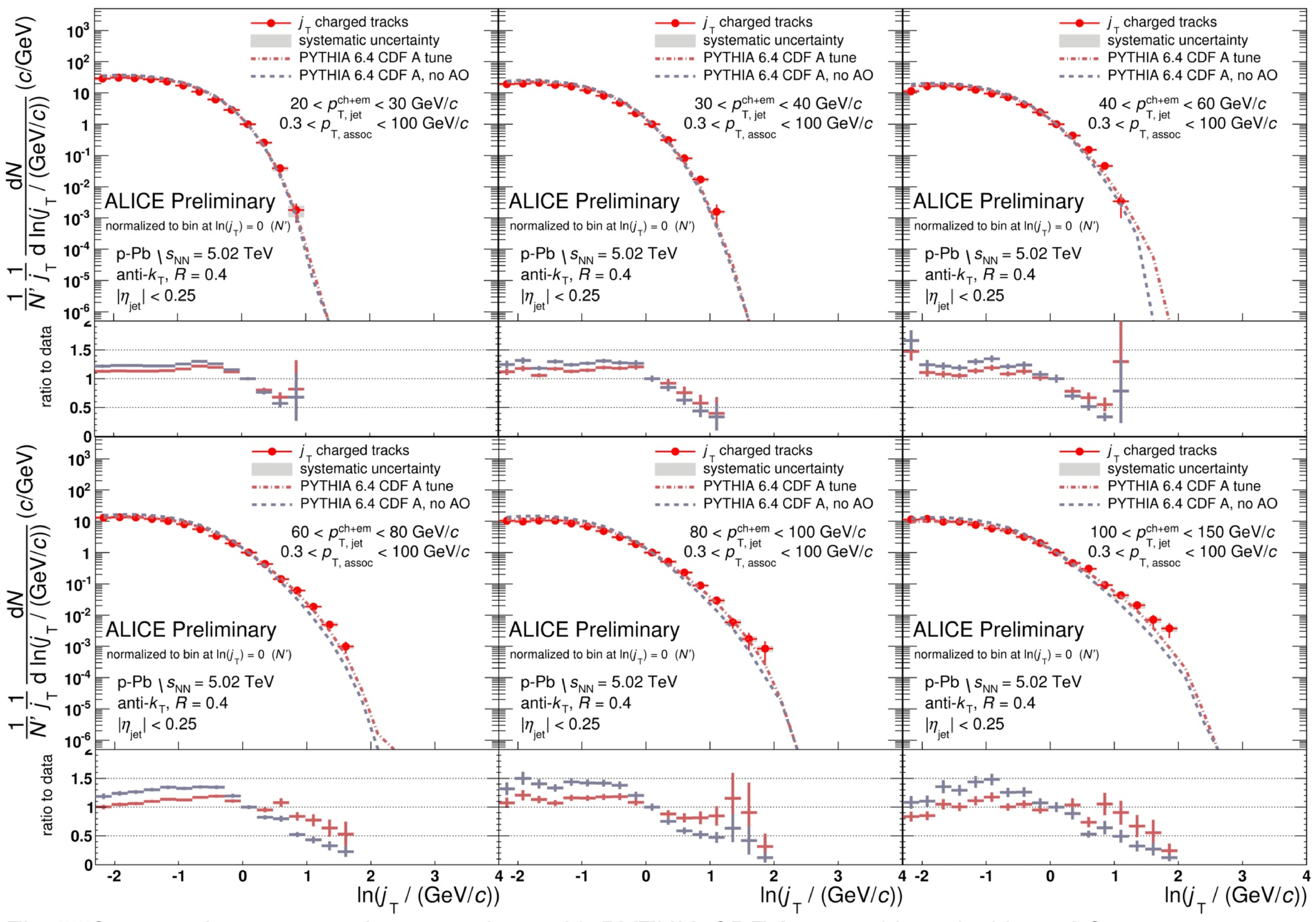

Fig. 5: Corrected j_T spectrum in comparison with PYTHIA CDF A tune with and without AO.

Comparison to NMLLA

We compare our data to a Next-to-Modified Leading Log Approximation (NMLLA) calculation [1] with different quark (q) and gluon (g) contributions (Fig. 6 - see legend), which was found to agree well with the CDF data [2].

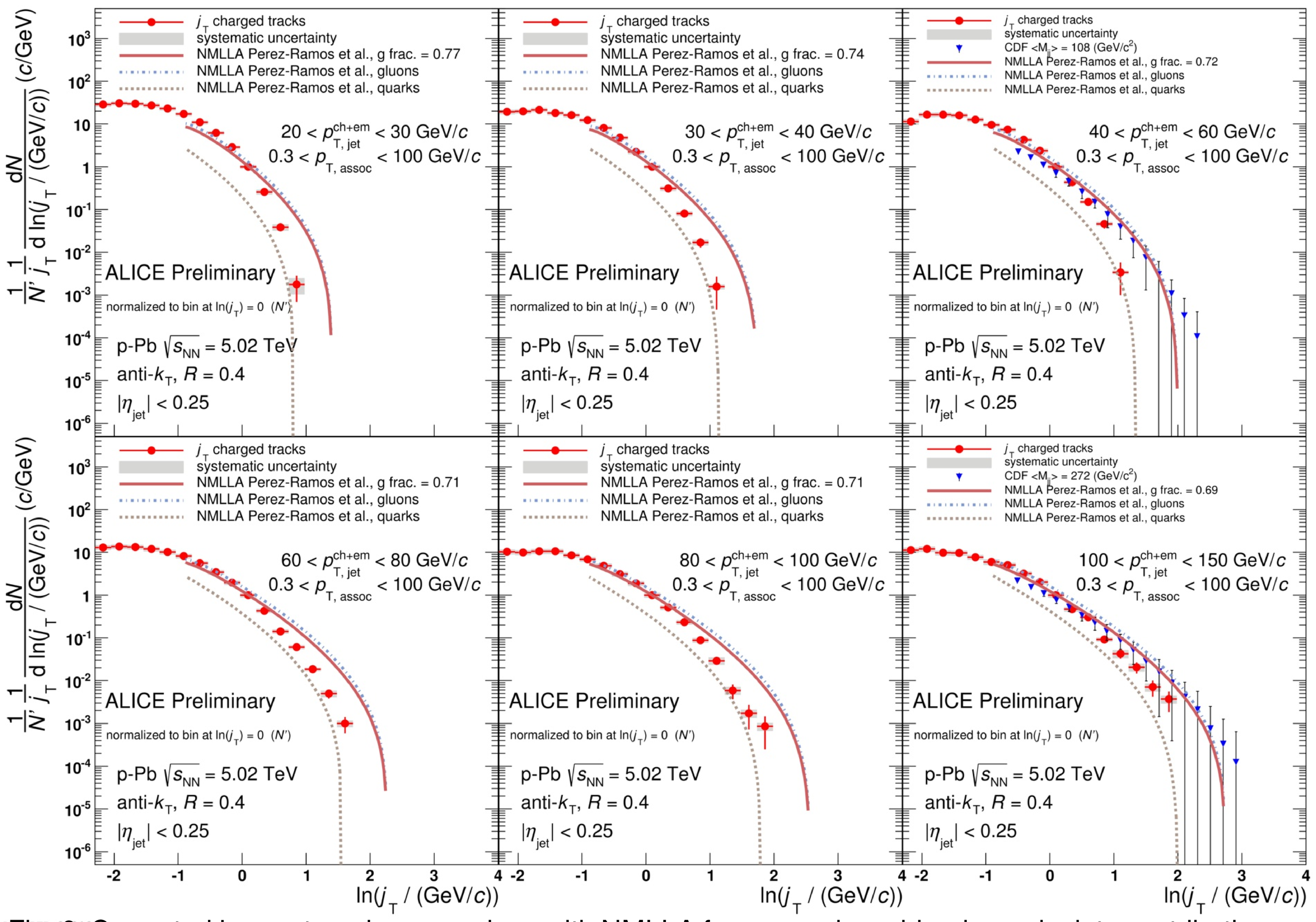

Fig. 6: Corrected j_T spectrum in comparison with NMLLA for g, q and combined q and g jets contributions.

The NMLLA is found to have different slope than the ALICE data. In addition, for lower jet p_T, higher order corrections which improve the description of energy momentum conservation may be important to not overestimate hard hadron production.

To gain insight into origin of the different slope of j_T distributions, PYTHIA was used with both ALICE and CDF jet finding settings. The j_T distributions inside an R = 0.5 cone around the jet axis found with different R jet finders are compared in Fig. 7. This comparison shows a negligible dependence on the jet finder algorithm, but a clear dependence of the j_T distribution on R.

As a conclusion we find better agreement with NMLLA for higher jet p_T bins, which is compatible with the expected theory limitations. Additionally we see that making a link in between jets reconstructed with specific R and theory predictions is untrivial.

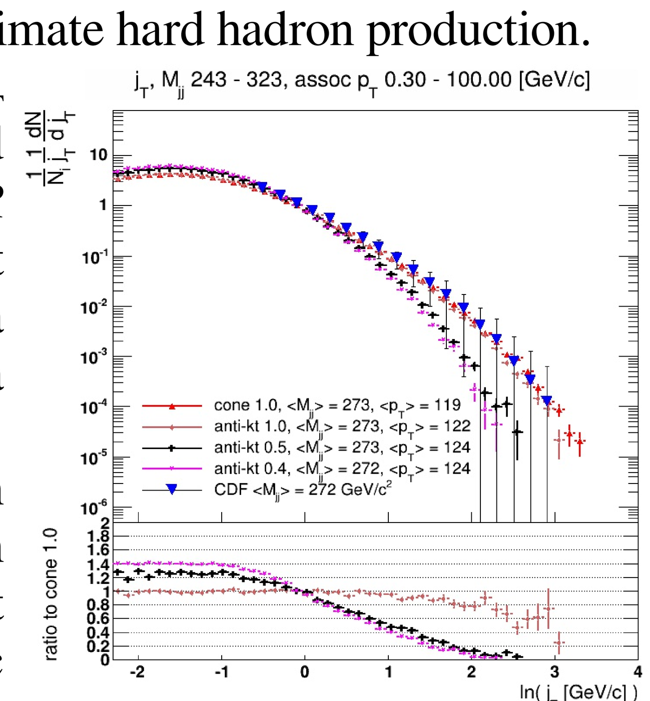

Fig. 7: PYTHIA study of j_T spectrum