Jet measurements in proton-proton collisions with the ALICE experiment

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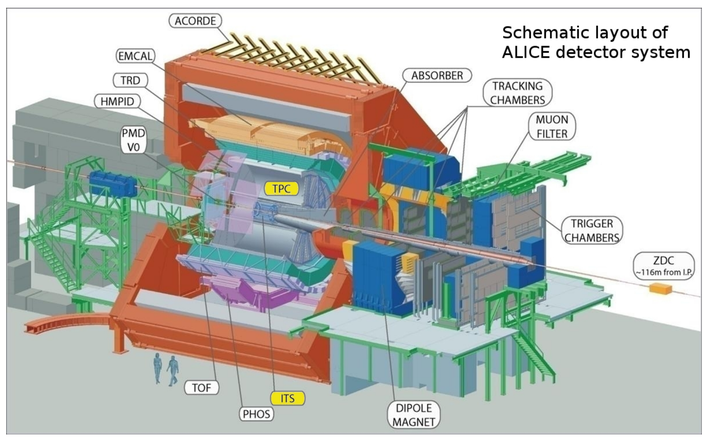
1. Motivation

Jets, collimated sprays of particles associated with hard partons, are an important tool in testing QCD and probing hot and dense nuclear matter created in high energy heavy-ion collisions. Jets enable study the evolution from hard-scattering through fragmentation to hadronisation and test modification of these processes in presence of nuclear medium with respect to measurements in vacuum. The unmodified baseline can be acquired from jet measurements in proton-proton collisions. Here we focus on deconvoluting detector effects in measured jet spectra obtained from charged particle tracks in proton-proton collisions measured by the ALICE detector system at the CERN LHC.

2. ALICE

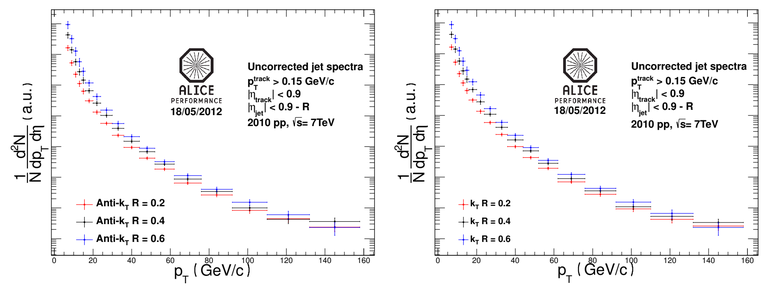


3. Selection

Data	minimum bias pp collisions 2010 $\sqrt{s} = 7$ TeV
Global tracks	from ITS and TPC $p_T > 0.15$ GeV/c $\|\eta\| < 0.9$
Jet reconstruction	Anti-k_T and k_T algorithms [1] R = 0.2, 0.4 or 0.6 $\|\eta\| < 0.9 - R$
Simulation	Pythia6 Perugia-0 tune full GEANT detector simulation

4. Raw jet spectra

- charged jet yields from 7 TeV proton-proton collisions



5. Deconvolution algorithms

Bin-by-bin correction

- compares simulated spectra on the level of Monte Carlo generator and detector
- bins without signal cannot gain signal
- depends on shape of simulated jet spectra

$$\frac{d^2N^{unf}}{dp_T d\eta} = \frac{d^2N^{raw}}{dp_T d\eta} \cdot \frac{d^2\sigma}{dp_T d\eta}\Big|^{MC}_{gene} \Big/ \frac{d^2\sigma}{dp_T d\eta}\Big|^{MC}_{reco}$$

Bayesian unfolding [2]

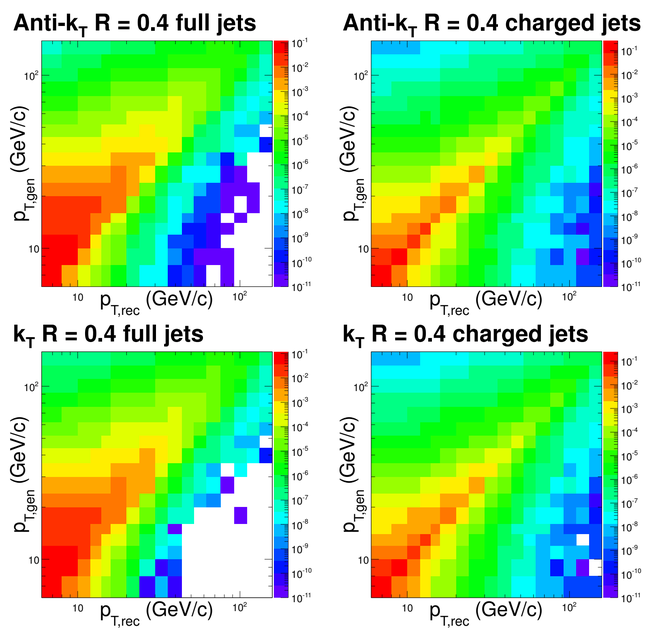
- utilizes Bayes' theorem to invert response matrix obtained from simulation
- independent of shape of simulated jet spectra
- bins without signal can gain signal

$$P(C_j|E_i) = \frac{P(E_i|C_j)\,P_0(C_j)}{\sum_j P(E_i|C_j)\,P_0(C_j)}$$

Singular value decomposition (SVD) [3]

- of response matrix to orthogonal and diagonal matrices
- transformed to system of linear equations

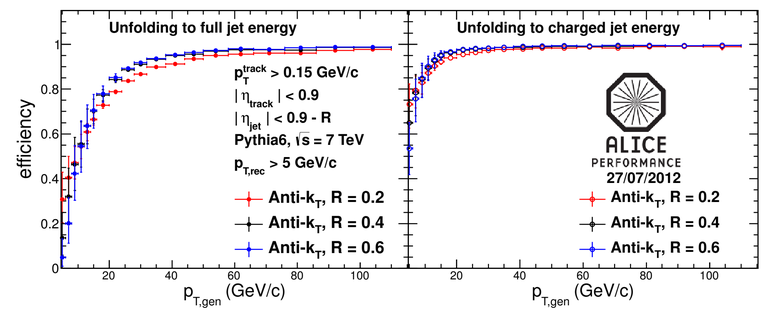
6. Detector response matrix



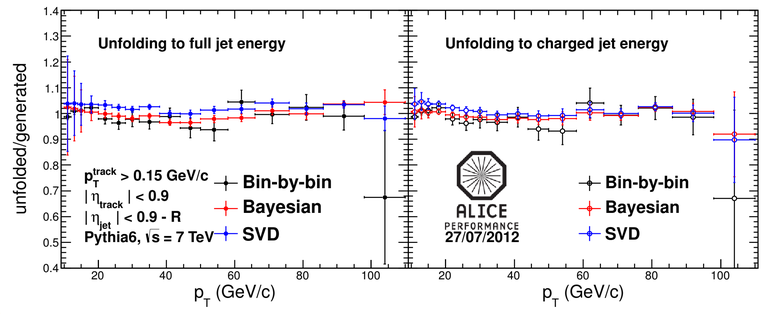
- distribution of reconstructed against matched generated jet momenta
- obtained from a Pythia+Geant simulation of the ALICE detector
- geometrical matching, i.e. jets close in $\eta - \varphi$
- matching jets on detector level to jets on level of Monte Carlo

7. Unfolding performance

- efficiencies of matched simulated jets in acceptance to reconstructed jets
- inefficiency at low p_T is mainly caused by requirement of $p_T^{rec} > 5$ GeV/c

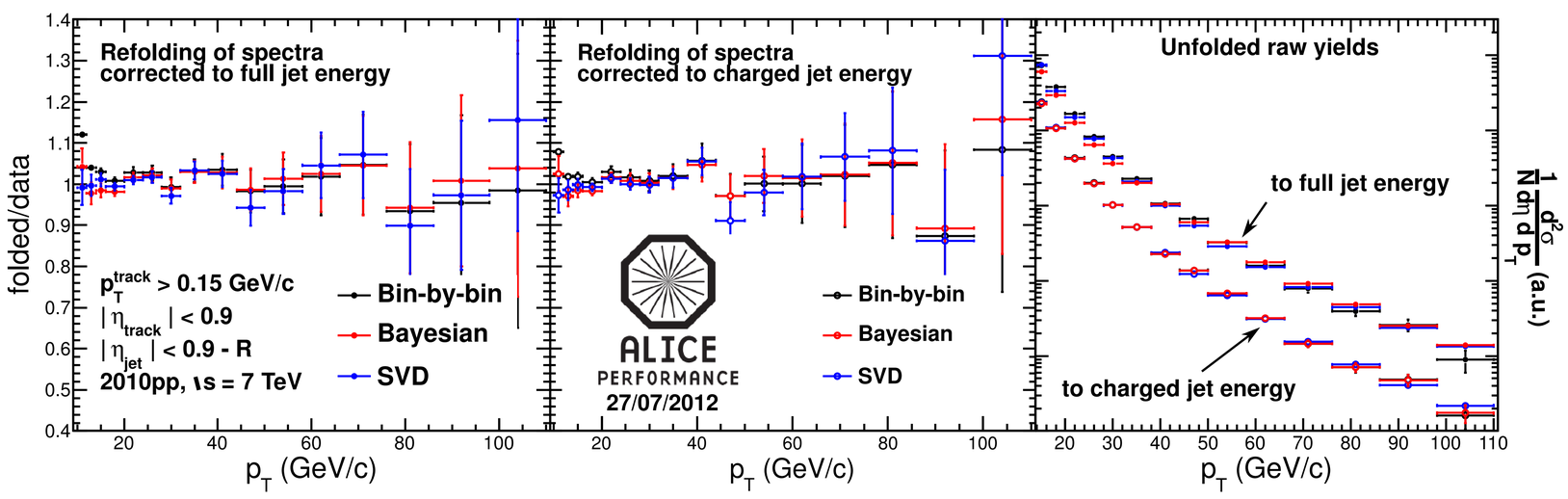


- comparing unfolded and generated yields of simulated data



8. Unfolding of raw yields

- we unfold raw yields using Bayesian and SVD methods, and correct using factors obtained on bin-by-bin basis, and refolding shows that we are within 10% from raw yields



- for R equal to 0.2, 0.4 and 0.6, and both algorithms, Anti-k_T and k_T, unfolding methods produced consistent results

9. Conclusion

We reconstructed raw spectra of charged jets in 7 TeV pp collisions in the ALICE detector system and observed that bin-by-bin corrections, SVD and Bayesian unfolding produce consistent spectra deconvoluted to both charged and full jet spectra for ll cases.

10. References

[1] M. Cacciari, G.P. Salam and G. Soyez, Eur.Phys.J. C72 (2012) 1896 [arXiv:1111.6097].

[2] G. D'Agostini, A multidimensional unfolding method based on Bayes theorem, NIM A 362 (1995) 487.

[3] A. Höcker and V. Kartvelishvili, SVD Approach to Data Unfolding, NIM A 372 (1996) 469.

11. Acknowledgment

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