

Quality assurance for High P_T particles

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ALICE is one of the three main detectors at CERN, focused to study the properties Quark Gluon Plasma (QGP), High Momentum particles for ALICE are particles beyond 5 GeV/c, these are a main component in the JETS usually the leading particle, so the correct determination of the P_T , and the source of background need to be quantified, in the present poster we address this questions.

I INTRODUCTION

High Transverse Momentum particles (HPT) are for the large Ion collider detector (ALICE), those with a $P_T > 5$ GeV/c the decay of a typical transverse-momentum (P_T) distribution, of course it depends of the energy of the interaction, the Large hadron collider (LHC) is expected to have a maximum of 14 TeV at center of mass interaction, and 900 GeV at initial operation.

HPT particles are rare probes to a energy scale still not well understood. In the Standard Model (SM) their production and correlations can give hints of new physics, also this particles may be part of JETS usually being the leading particles. An incorrect determination in the P_T might not only affect the energy but also the direction of the JET.

The way to detect HPT particles in ALICE depends on the nature of the particle. In this work we only are interested in charged particles, detected as the trajectory through the detector.

II THE ALICE DETECTOR

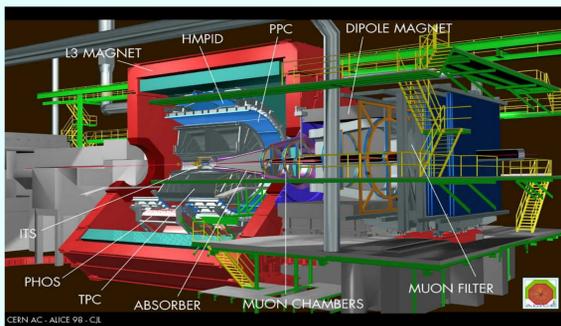


Figure 1 ALICE is a common central detectors, from center to outside: the inner tracking System (ITS), consisting of six layers of silicon detectors, after this, is the time Projection Chamber (TPC) the biggest gas chamber detector in the world allow us to go up to 8k particles per rapidity unity, the Transition Radiation detector (TRD) and the Time of Flight (TOF), also other subdetectors as V0 for luminosity and a muon arm in the forward region, in the top of the magnet is the ACORDE detector.

III ALICE TRACKING

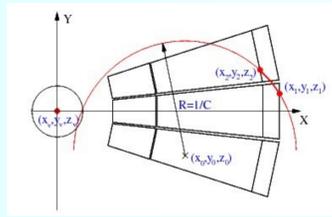


Figure 2 Local coordinates for the TPC.

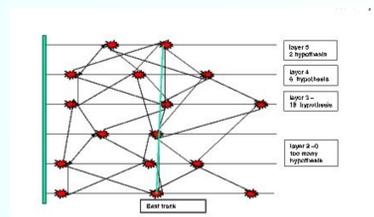


Figure 3 Local tracking in the ITS

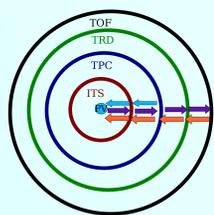


Figure 4 Drawing of the global tracking

The ALICE tracking is based in cluster finding for each subdetector, and Kalman filtering.

- Incremental Process:
- First seed outer layer of TPC Forward propagation toward primary vertex TPC \Rightarrow ITS
 - Back propagation: ITS \Rightarrow TPC \Rightarrow TRD \Rightarrow TOF
 - Refit inward: TOF \Rightarrow TRD \Rightarrow TPC \Rightarrow ITS
 - Continuous seeding: Track segment finding in all detectors

Secondary vertex and kinks are found in the tracking process.

IV MONTECARLO SAMPLE

The Montecarlo (MC) samples were generated using AliRoot, the standard framework in ALICE, in total four samples were generated. The samples were generated with a flat distribution in total momentum, suppressing the secondary decays at Pythia level, with the same amount of kaons, pions, and protons, primary vertex at (0,0,0), the sample was passed through the detector using only the ITS and the TPC to save time and a first approximation to simulate a more realistic distribution also p_T^{-5} weight was applied at Generation level see Fig 5 and 6.

Sample	# of particles	P range	pseudorapidity(η)	Polar angle (ϕ)
S900	900	0-100 GeV/c	(-0.9, 0.9)	(0, 2 π)
S3000	3000	0-100 GeV/c	(-0.9, 0.9)	(0, 2 π)
S4500	4500	0-100 GeV/c	(-0.9, 0.9)	(0, 2 π)
S5000	6000	0-100 GeV/c	(-0.9, 0.9)	(0, 2 π)

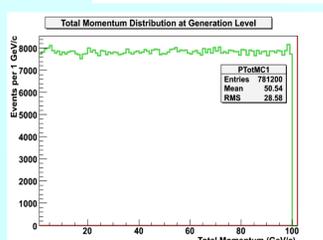


Figure 5 Total momentum at generation level

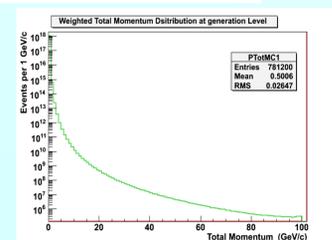


Figure 6 Total weighted momentum at generation level

V VARIABLES INVESTIGATED

The basic problem is that the P_T reconstructed differs from the P_T generated. We want to quantify and minimize this quantity. In order to do this we can use the correlation of this "Badly reconstructed track" with other variables. The definition of a bad track is the one that have a pull beyond 5 sigmas where the pull is defined in $1/P_T$ since that is the parameter measured:

$$\text{Pull} (1/P_T) = \frac{1/P_T(\text{Generated}) - 1/P_T(\text{Reconstructed})}{\text{Error } 1/P_T(\text{Reconstructed})}$$

We have investigated the following variables the Eta, phi, the other 4 parameter of the tracks: y, z, tan(λ), and sin(ϕ), the error in them, the number of clusters for the ITS and the TPC, the significance in the variable, where the significance is the valor divided by the error, and finally the DCA in xy and its significance.

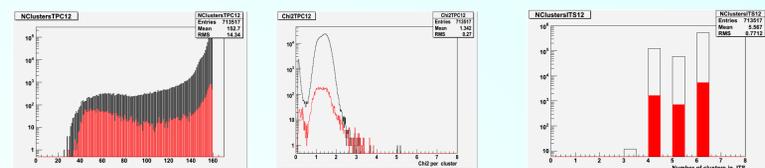


Figure 7 From left to right, TPC clusters, Chi2 per clusters in TPC, Number of clusters in the ITS, In Red tracks with pull greater than 5, black otherwise.

VI RESOLUTION AND EFFICIENCY

We found the resolution depends mainly of the number of detectors used. We do not observe a change in the resolution changing the cuts, this one is showed in Figure 8, the efficiency is also showed there.

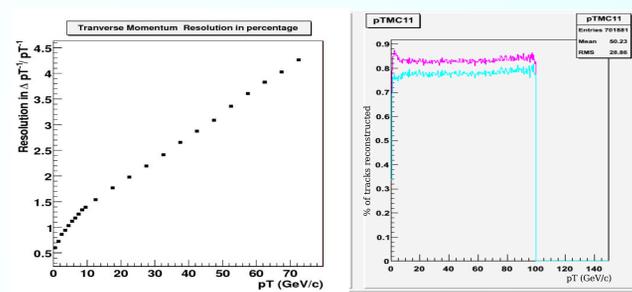


Figure 8 In the left resolution as function of the P_T , In the Right the Efficiency, the magenta is the optimal and the Blue excluding the outer part of the TPC sectors.

VII MIGRATIONS FROM LOW TO HIGH P_T

The migrations for the unweighted sample were almost constant. As for the weighted sample the migrations from low to high momenta are more frequent, To calculate the percentage of "badly tracks" we use bins of 1 GeV until 10 and from 10 GeV up to 100.

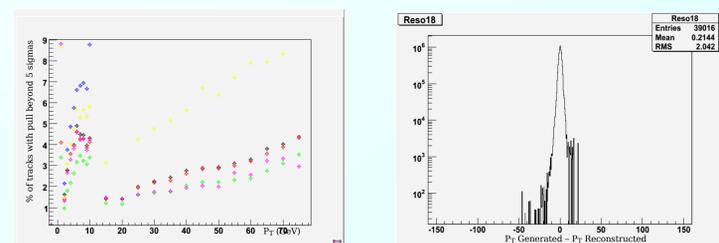


Figure 9 In the left graph the percentage of tracks above 5 sigmas. The colors are for different cuts the yellow is excluding the DCA significance and the magenta is the most efficient, the peak in the low momentum is not well understood. In the left one of this points is shown.

VIII RESULTS AND CONCLUSIONS

Removing Kink hypothesis, applying ITS and TPC refit, we found that the optimal number of TPC clusters is 100, the significance in the DCA of 3 and no important correlation for the other variables. It was show that the ITS and TPC are necessary to have a well reconstructed track so the high P_T physics can only be done after all detectors are aligned. We do not found significant differences as function of multiplicity.

We also found a problem in the reconstruction of the laterals of the TPC sectors(see Fig 2), the exclusion of them will result in a increase in the quality of the data.

Currently we are trying to reproduce this analysis using pp MC data. The amount of data requires using parallel processing, there is a facility in CERN, but the code is very basic and the bandwidth is not optimal, a site is being deployed at ICN-UNAM.

I want to thank the HELEN project for the help in the progress of this work.