Three-Particle Azimuthal Correlations with an Intermediate-$p_{\rm T}$ Trigger Particle in ALICE*

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Introduction

Lead ions are collided at energies up to 2.76 TeV per nucleon pair in the ALICE detectors at the Large Hadron Collider. These collisions produce hot and dense matter, possibly a deconfined state of quarks and gluons called a Quark Gluon Plasma. A method of studying this matter is by examining correlations of particles with a trigger particle. An intermediate $p_{\rm T}$ trigger particle is chosen to preferentially select jets. This can be used to study how jets and the produced medium interact. Three-particle correlations provide us with different insights and systematics than two-particle correlations and the technique was designed to look for conical emission in heavy-ion collisions[1], which could come from Mach Cones[2] or Čerenkov Gluon radiation[3].

Analysis

Correlations between the differences in azimuthal angle between a 3< $p_{\rm T,Trigger}$ <4 GeV/c and two 1< $p_{\rm T,Associated}$ <2 GeV/c associated particles are studied. Before background subtraction the three-particle correlations contains backgrounds from two-particle correlations and three-particle flow. To subtract the two-particle correlations one particle is taken from a mixed event while the other two are taken from the same event. To remove the three-particle flow background the measured flow values of orders v_2, v_3, and v_4 were used. An additional background exists from the correlation of the flow of the jet with the other particle. Background subtracted two-particle correlations and the measured flow values were used to subtract this background. Backgrounds were normalized assuming the background subtracted two- and three-particle correlations have Zero Yield At Minimum.

Results

Background subtracted three-particle correlations are shown for two different centrality selections in Fig. 1. Both associated particles in peak at $(\Delta\phi, \Delta\phi)$ =(0,0) are near the trigger particle. In the peak at (π, π) is from both are on the away side. This peak is elongated along the diagonal consistent with k_T broadening. The peaks at $(0, \pi)$ and $(\pi, 0)$ are from where one associated particle is near the trigger and the other is opposite in azimuth. In addition, there are peaks in central collisions at about $(\pi \pm 1.5, \pi \mp 1.5)$. These peaks are a non-dijet signal. In the projections, these peaks show up as the two side peaks and it can be seen that these peaks are significant in the 0-5% collisions but not in 40-50%. The dominant contributions to these systematic errors are the uncertainty in the measured flow values from different methods used to obtain them and from the jet flow cross term.

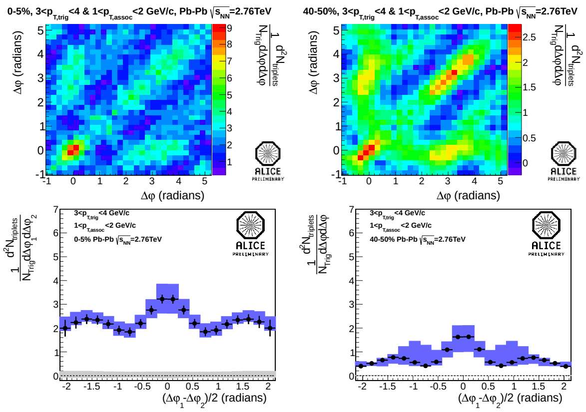

Figure 1: Three-particle correlation for $2.5 < p_{\rm T,Trigger} <$ 4 GeV/c and $1 < p_{\rm T,Associated} < 2$ GeV/c in 0-5%, left, and 40-50%, right, most central Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV. Bottom panels show the away-side projection along the $\Delta\phi_1 + \Delta\phi_2 = 2\pi$ axis along with systematic errors. Uncorrelated systematic errors are shown in blue around the points and correlated systematic errors are shown in grey about 0.

Summary

In conclusion, significant off-diagonal peaks are seen in central Pb-Pb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV. These peaks are a non-dijet signal. Broadening consistent with k_T broadening is also seen along the diagonal.

References

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[3] I.M. Dremin, *Ring-like events: Cerenkov Gluons or Mach Waves?*, *Nucl. Phys.* **A767** 233 (2006).

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