Identification of electron tracks using the correlation between PMD and FTPC in the STAR experiment at RHIC

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Introduction

We present a method based on correlating the clusters from the Photon Multiplicity detector (PMD) and the tracks from the Forward Time Projection Chamber (FTPC) for identifying electron tracks. PMD is a preshower detector covering forward region at STAR which has overlap with East FTPC(common η = -2.8 to -3.7) and generates clusters with higher energy deposition for electrons compared to charged hadrons [1]. We have utilized this property by constructing a 2D correlation function $(\eta - \phi)$ between PMD clusters and FTPC tracks. The application of a large threshold on PMD clusters correlated to FTPC tracks helps removing charged hadron candidates and an enriched sample of electron can be obtained.

Method and Results

A 2-d correlation plot shown in Fig.1 is obtained by measuring $\Delta\eta$ $(\eta_{track} - \eta_{pmd-cluster})$ and $\Delta\phi$ between FTPC tracks and PMD clusters. The quality criteria used for FTPC tracks are, DCA<3cm, 0.1< p_T <1.5 GeV/c, and no. of fit points >5. A clear peak is seen around $\Delta\eta$=0, and $\Delta\phi$=0 showing FTPC tracks correlated to PMD clusters. Other than electron tracks and matching clusters the possibilities of origin of the peak could be from (a) jets (b) low p_T particles originating from the domains of Disoriented Chiral Condensate (DCC) and (c) charged-hadrons forming clusters in the PMD after interaction. The first possibility can be eliminated due to narrow width of the peak and absence of away-side peak. For DCC, p_T should be even lower.

In order to eliminate the charged hadrons, we apply a threshold on PMD clusters of $n\times$MIP(Minimum ionizing particle) where we chose n >3 and varied n to study the effect.

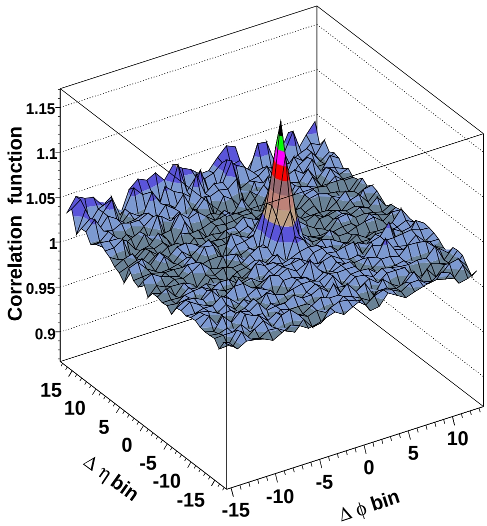

FIG. 1: 2-D plots of correlation function between PMD clusters and FTPC tracks for STAR CuCu $\sqrt{s_{NN}}$=200 GeV data. $\Delta(\eta)$ bins=0.023, $\Delta(\phi)$ bins=0.15 rad.

We have performed a detailed analysis of the one-dimensional correlation function (ϕ-plane). The *signal strength* is defined as the area under the background subtracted peak(≡(Sig-Bkg)/Bkg). We have studied the variation of the *signal strength* with MIP-cut. It is expected that for tracks from charged hadrons correlated to PMD-clusters, *signal strength* should decrease with increasing MIP cut.

Fig.2 shows the variation of the *signal strength* with n($\times$MIP cut). We find an

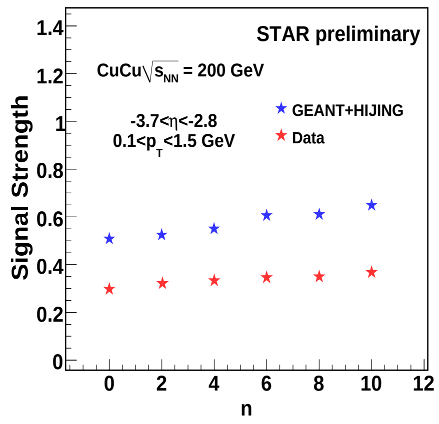

FIG. 2: Variation of *signal strength* with MIP cut

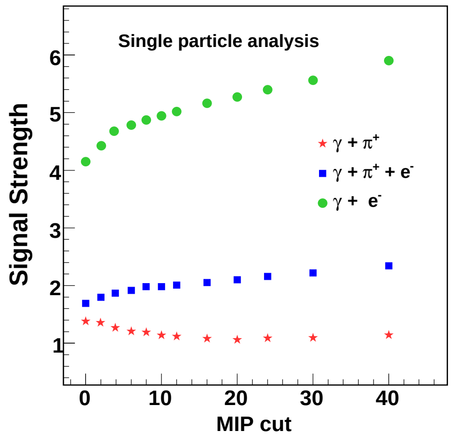

FIG. 3: Variation of the *signal strength* for single particle GEANT simulation

increasing trend contrary to expectation for charged hadrons. This suggests that the candidates might be rich with electrons or positrons.

We have performed simulation to pinpoint the origin and found a similar peak from HIJING[2] ruling out the possibilities of DCC. We have done single particle GEANT simulation for e^{+-} and π^{+-} separately and studied the variation of the *signal strength* with MIP. While for π^{+-} the *signal strength* decreases (Fig.3), electron sample shows an increasing

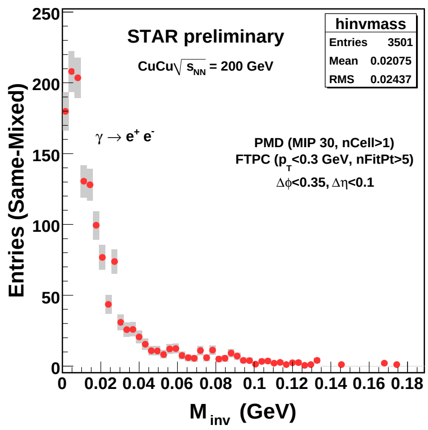

FIG. 4: Mixed-event background subtracted invariant mass(in GeV) spectra of $e^- - e^+$ pairs coming from conversion photons

behaviour similar to the data suggesting the correlation is due to electrons.

As a final step , we calculate the invariant mass of pairs of $e^- - e^+$ candidates. These candidates are chosen from the peak region applying criteria of detection of electrons as correlated track and cluster with $\Delta\eta$ <0.1, $\Delta\phi$ <0.35 rad, PMD MIP cut>20, PMD nCell >1 and FTPC 0.1< p_T <1.5GeV. The invariant mass analysis was done for both real and mixed events for the CuCu $\sqrt{s_{NN}}$=200GeV data set.

Conclusion

For CuCu collisions data at $\sqrt{s_{NN}}$=200 GeV from STAR we find that the invariant mass(M_{inv}) distribution (Fig.4) for such electron-positron pairs(with p_T <0.3 GeV for each particle) peaks at ∼2 MeV with an width of ∼20 MeV confirming that they are indeed coming from conversion of photons. Using this technique of electron identification we can also calculate invariant mass for e^+e^- pairs which are decay product of mesons.

References

[1] M. M. Aggarwal et al., Nucl. Instr. Meth. A 488 (2002) 131.

[2] X. N. Wang and M. Gyulassy, Phys. Rev. D 44 (1991) 3501.