Examining the relationship between charged particle momentum spectra and centrality estimates

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Abstract

High energy collisions of heavy ions form a relativistic hydrodynamic fluid called Quark Gluon Plasma (QGP). Central collisions, collisions that have a small impact parameter, produce higher volumes of QGP than peripheral collisions with a large impact parameter. One way of studying QGP is by comparing the momentum spectra of charged particles in central and peripheral collisions. Traditionally at the Solenoidal Tracker at RHIC (STAR) experiment, centrality is determined via the multiplicity of reconstructed charged particles within the Time Projection Chamber (TPC). This measure of centrality can be used to calculate a ratio of momentum distributions in central and peripheral events. However, centrality can also be estimated using the charged-particle multiplicity from the Event Plane Detector (EPD), which measures charged-particle multiplicity in a different rapidity region. This poster will compare the charged-particle momentum distribution ratio curves obtained by using the two different methods of estimating collision centrality in oxygen-oxygen collisions at a center-of-mass collision energy of 200 GeV per nucleon pair. Such a comparison will allow us to observe the differences between using the TPC or EPD to create a centrality estimate.

Introduction

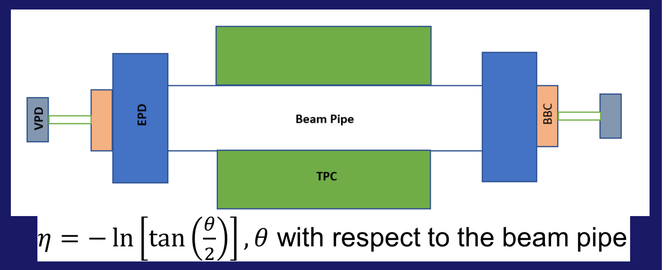


Figure 1: A Schematic of the Solenoidal Tracker at RHIC (STAR), RefMult is created from the TPC, $|\eta|<1$ EPDMult is created from the EPD, $2.1<|\eta|<5.1$

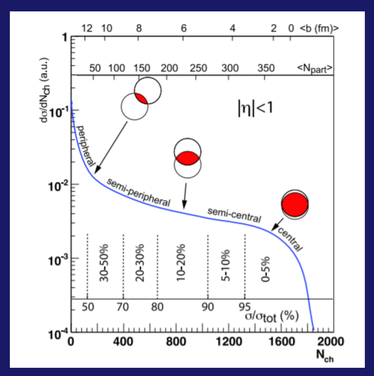
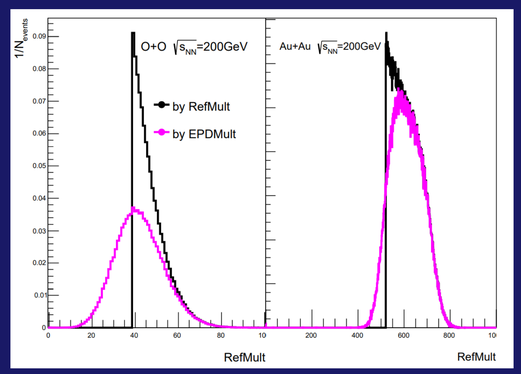


Figure 2: The relation between charged particle multiplicity and impact parameter.[1]

EPD Resolution

Figure 6: EPD and new measure of centrality resolution. The Au+Au data have much higher resolution in the EPD, which could explain the similar momentum ratio plots



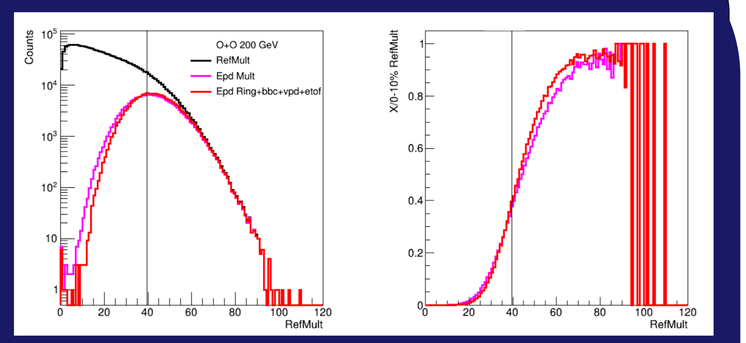


Figure 7:Comparison of RefMult to other measures of centrality at forward rapidity. The linear weighting and sum of forward detectors provides the highest resolution

Momentum Distribution Ratio

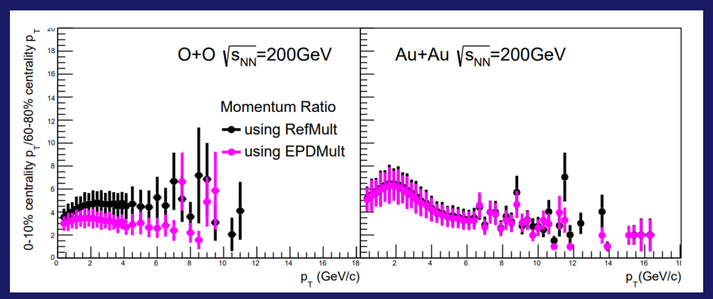


Figure 3: Momentum Ratio Plots. Note the separation between the plots for O+O that does not appear for Au+Au, indicating this is a small systems effect

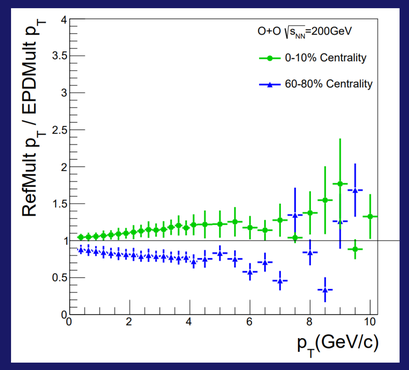


Figure 4: Comparing momentum distributions selected by RefMult to those selected by EPDMult

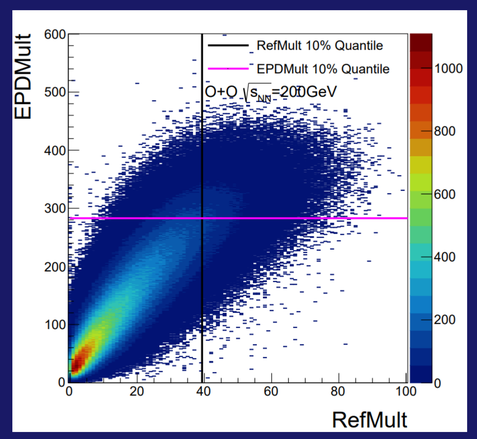


Figure 5: RefMult from the TPC vs EPDMult from the EPD

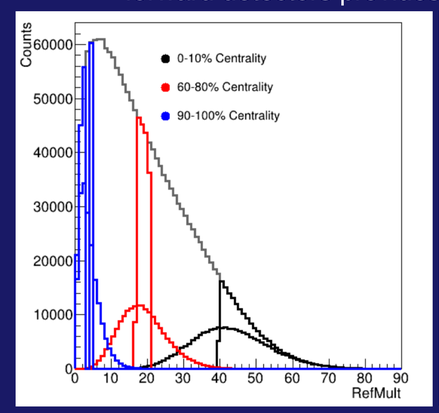


Figure 8: RefMult for each centrality class of the different centrality measures

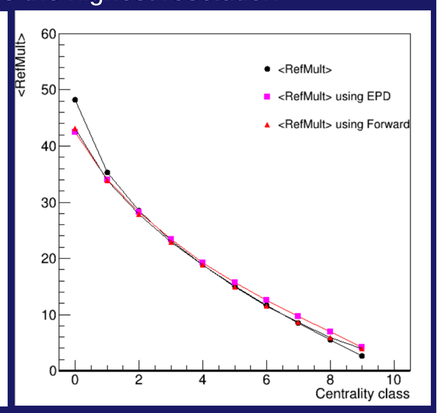


Figure 9: The Resolution of the new forward centrality measure for different classes

[1]Michael L. Miller et al. “Glauber Modeling in High-Energy Nuclear Collisions”. In:Annual Review of Nu-clear and Particle Science57.1 (Nov. 2007), pp. 205–243.ISSN: 1545-4134.

Acknowledgement(s):

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