π^0 production in $\sqrt{s_{NN}}$ = 200 GeV Cu+Au Collisions at PHENIX

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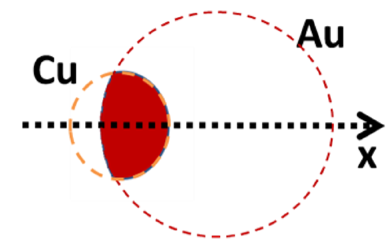
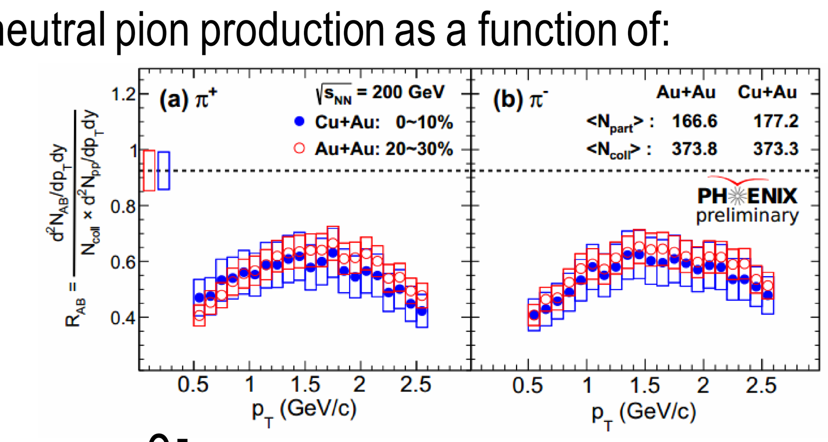
Cu+Au Collisions



Asymmetric Cu+Au collisions at RHIC provide a new environment to study path length and geometric effects on energy loss and flow. While charged pions show a similar suppression pattern in Cu+Au as is seen in Au+Au, neutral pion measurements will extend the comparison out to higher p_T where hard processes dominate and path length effects are more visible. This analysis is interested in the neutral pion production as a function of:

- Centrality
- Rapidity
- Reaction plane

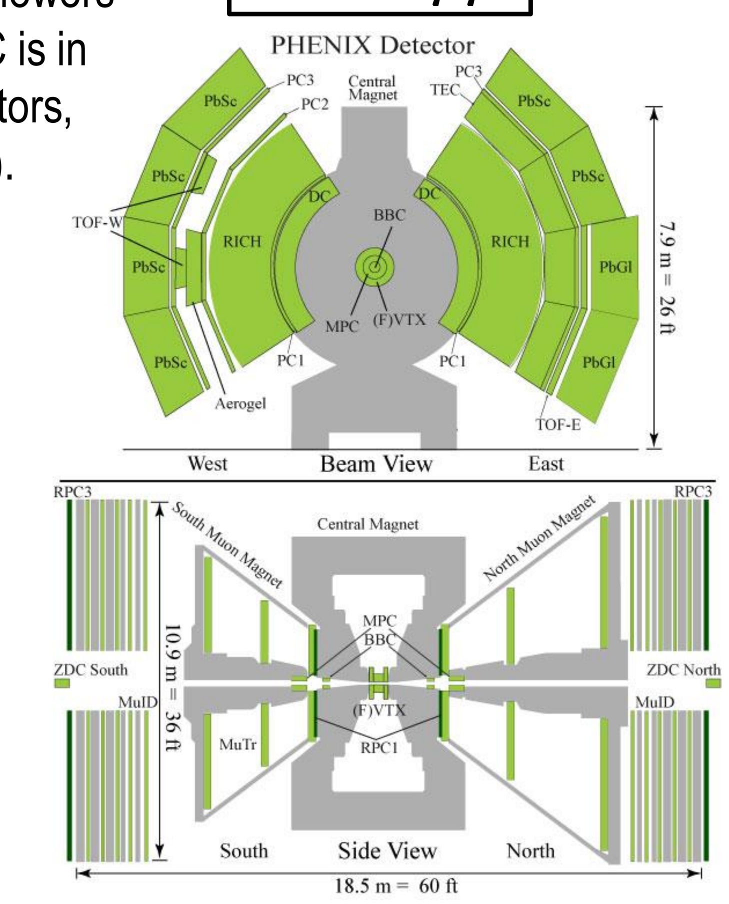


This poster focuses on measuring the pion yields in various centrality and rapidity bins.

Detecting π^0's

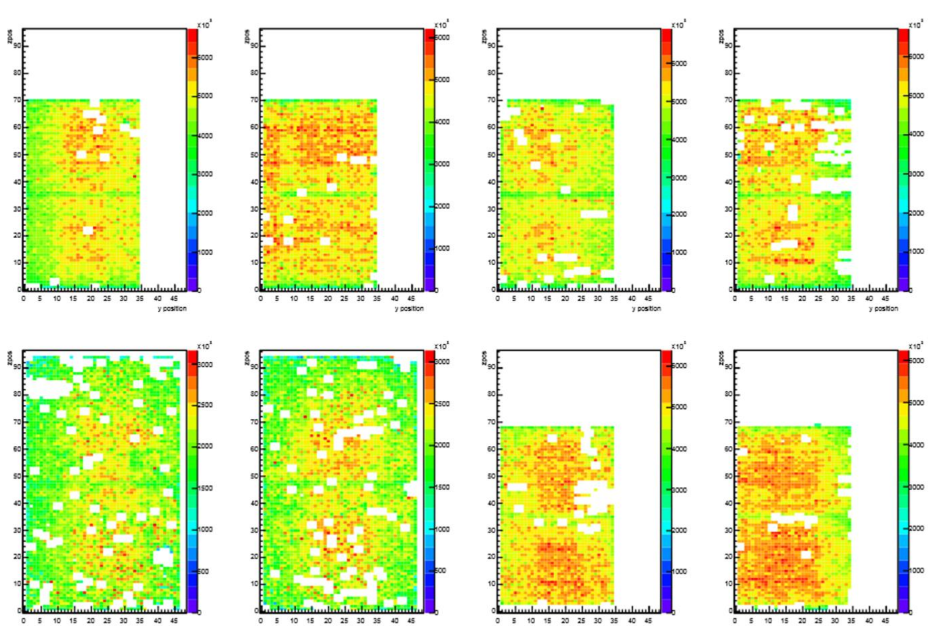
$$\pi^0 \rightarrow \gamma\gamma$$

π^0's are reconstructed from photon pairs identified by showers in the Electro-Magnetic Calorimeter (EMC). The EMC is in PHENIX's central arm, $|\eta| < 0.35$, and consists of 8 sectors, 6 PbSc (W0, W1, W2, W3, E2, E3) and 2 PbGl (E0, E1).



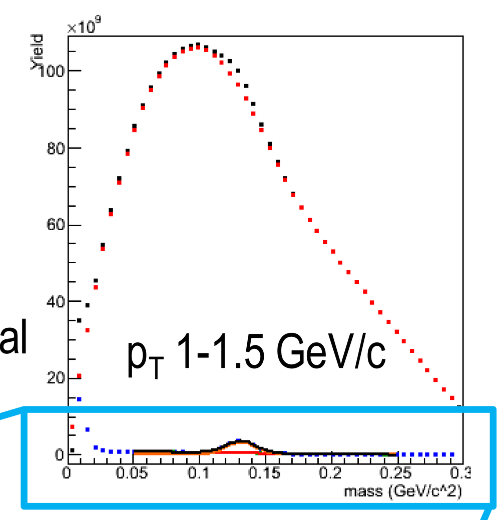
Photon ID:

- Energy > 400 MeV
- Shower shape cut, $\chi^2 < 3$
- Not in the EMC dead/warnmap

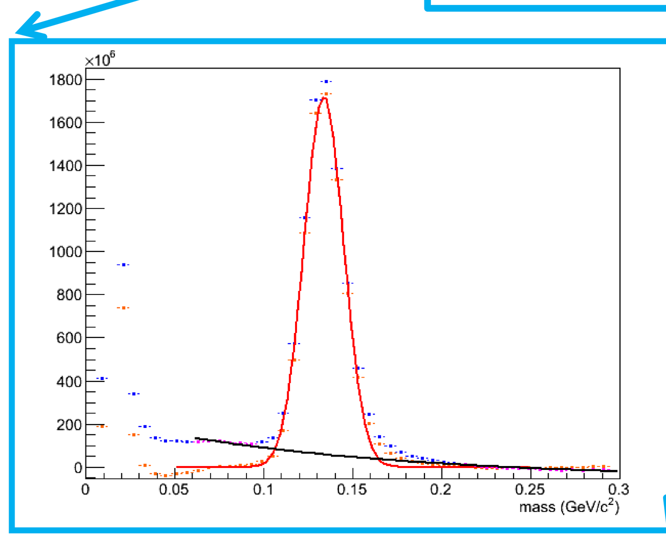


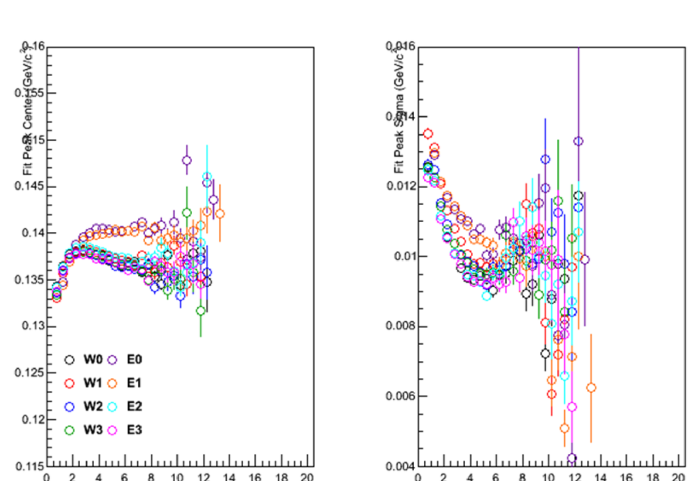
Yield extraction

At low p_T there is a significant background contribution from combinatorial pairs. The combinatorial background is generated using a mixed event method and normalized in the 0.2-0.3 GeV/c^2 mass region for each measured p_T.



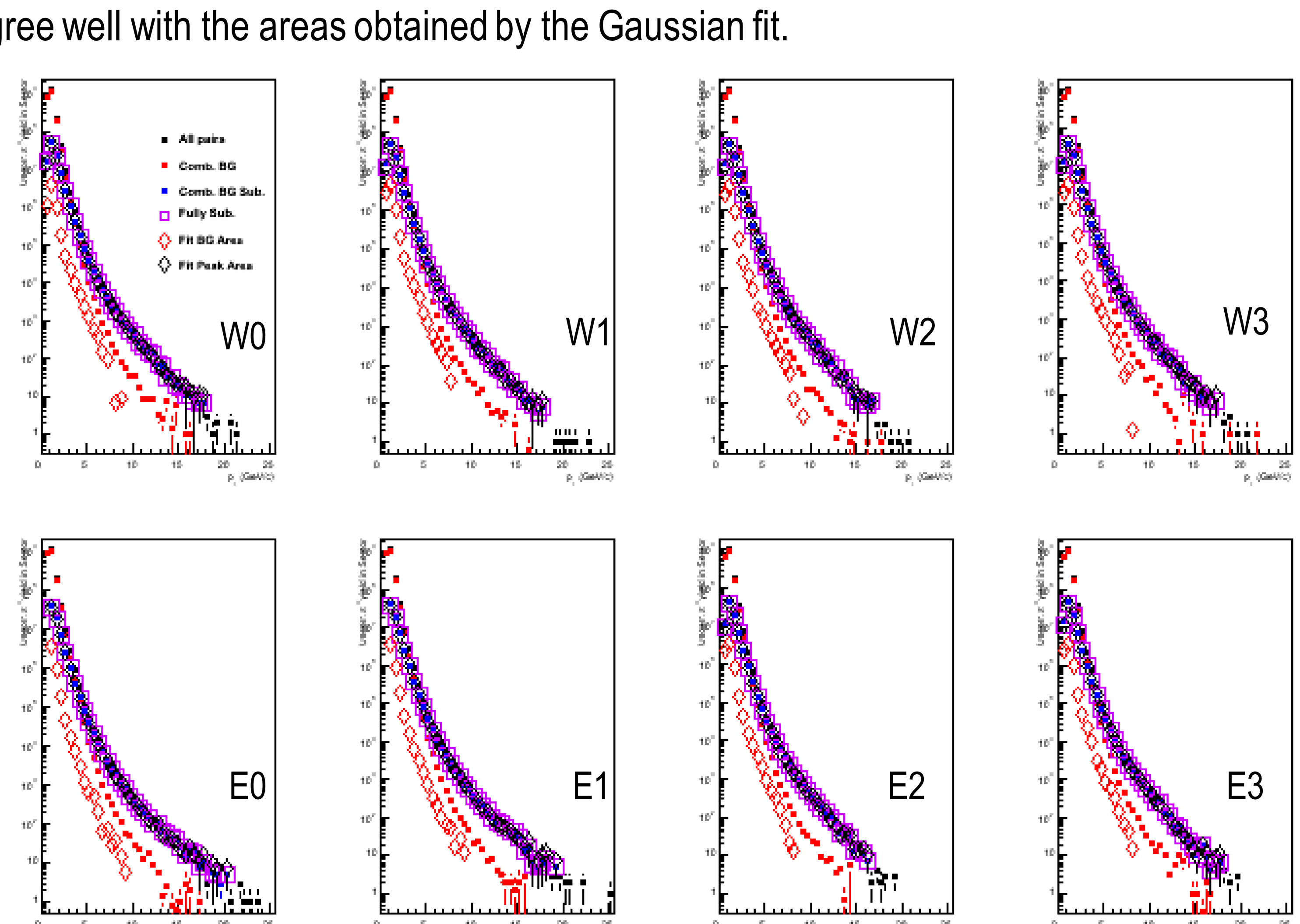
After the combinatorial background is removed, a residual background remains for pairs with $p_T < 8$ GeV/c. This background is fit with an exponential in the side band regions of 0.060-0.095 and 0.21-0.30 GeV/c^2. The fit quantifies the remaining background under the pion peak.



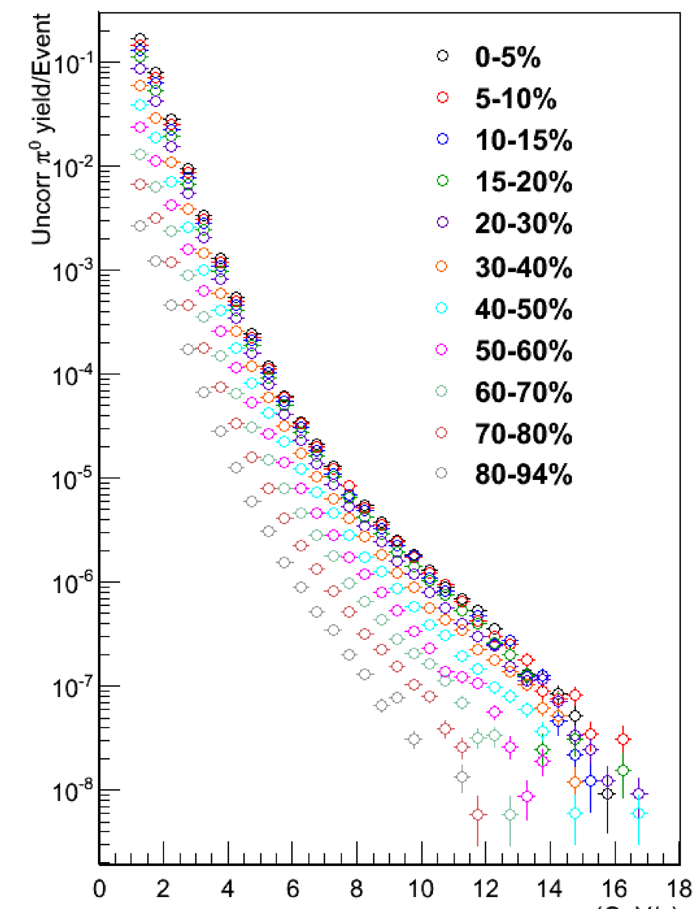


To characterize the performance of the detectors the pion peak is fit with a Gaussian after all background components are subtracted. The energy scale and resolution of each sector is characterized by the fit's center and sigma. The area of the fit is compared to the integrated yield.

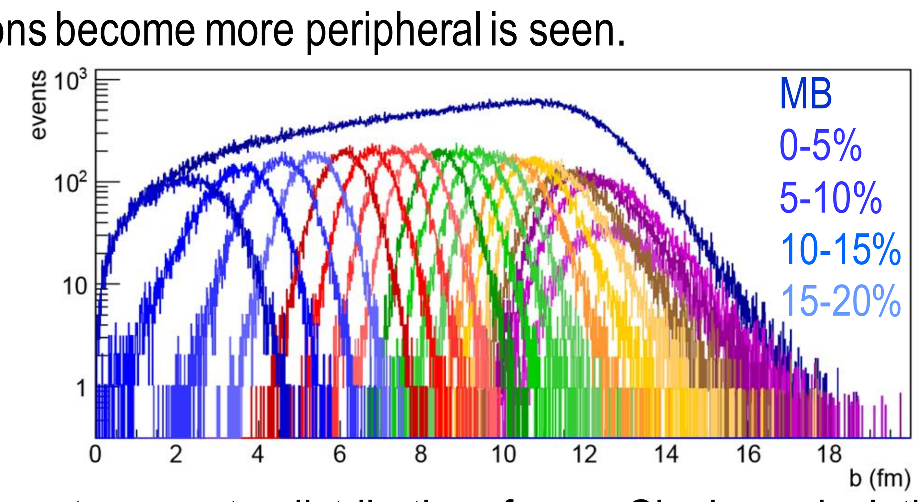
The uncorrected yields are found by integrating between 0.10-0.17 GeV/c^2 for each sector. All pairs, the combinatorial background, and the residual background yields are shown below. The combinatorial background ceases to be significant at around 5 GeV/c and the residual background is gone at around 8 GeV/c. The integrated fully subtracted yields agree well with the areas obtained by the Gaussian fit.



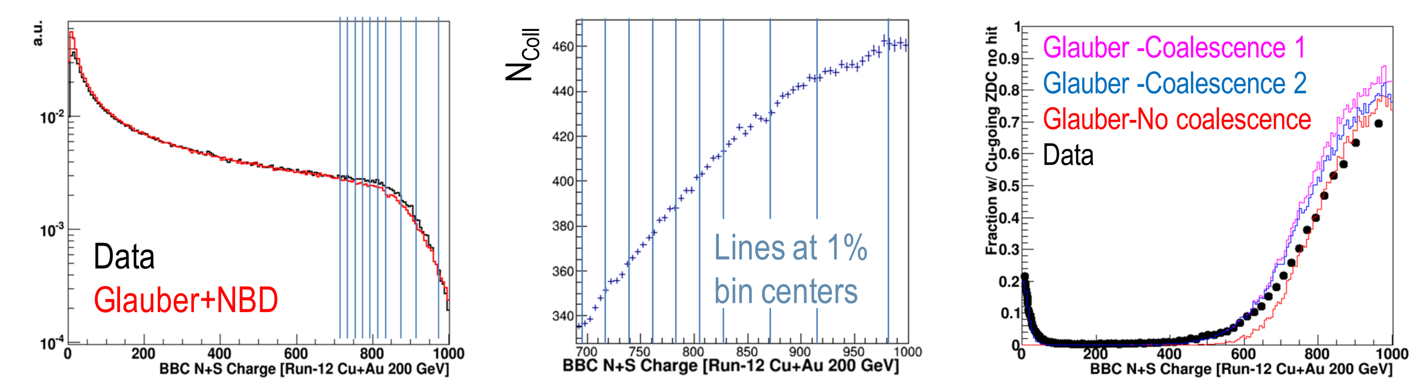
Centrality dependence

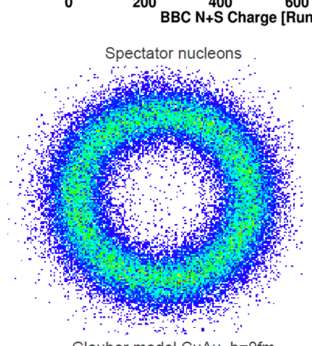


The raw yield/event in twelve centrality groups for 6.2 billion Min. Bias triggered events are presented. The yields are extracted separately in each sector and then summed. We expect to extend the p_T reach by improving the combinatorial background subtraction at high p_T and analyzing the ERT triggered data. A clear reduction in π^0 yield as collisions become more peripheral is seen.

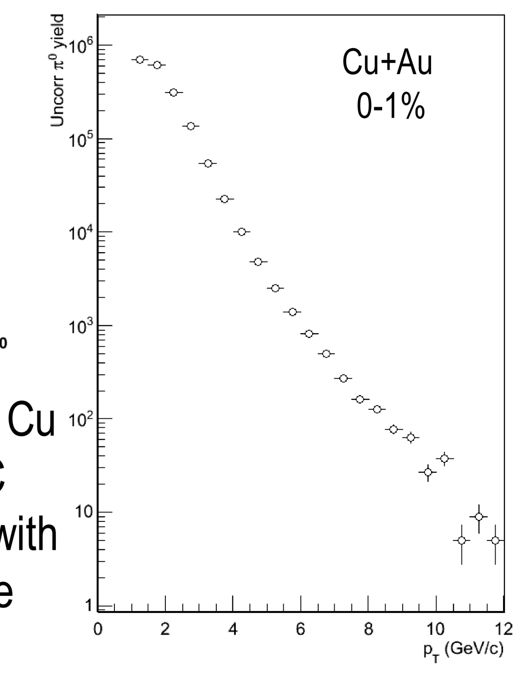


The impact parameter distributions from a Glauber calculation in 5% Cu+Au centrality bins are shown.

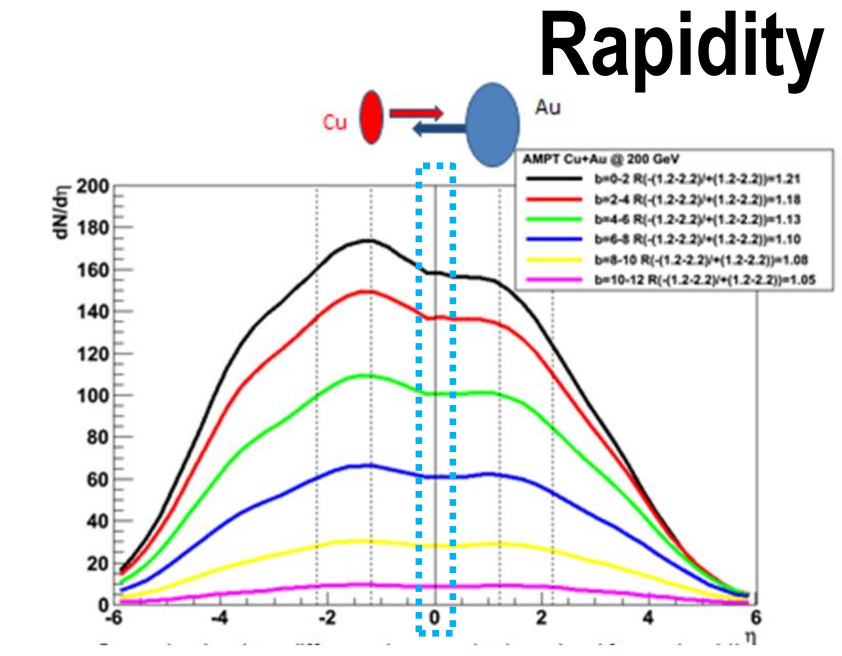




With finer 1% centrality bins, we can study the behavior as the Cu nucleus becomes occluded inside the Au nucleus. As the BBC charge increases the N_{Coll} increase and the fraction of events with no Cu-going ZDC hits increases, rising to a value of 70% at the center of the 0-1% bin.

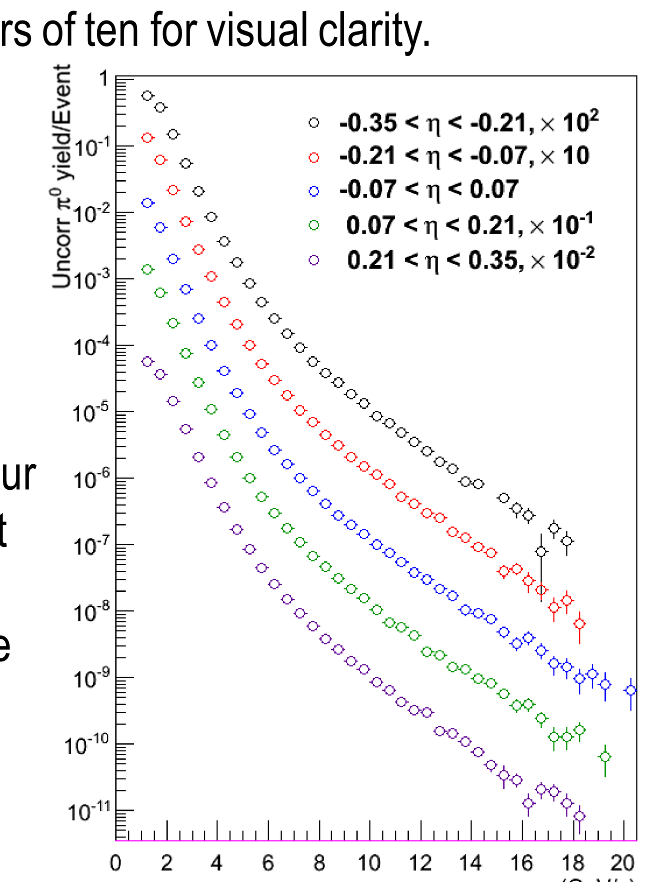


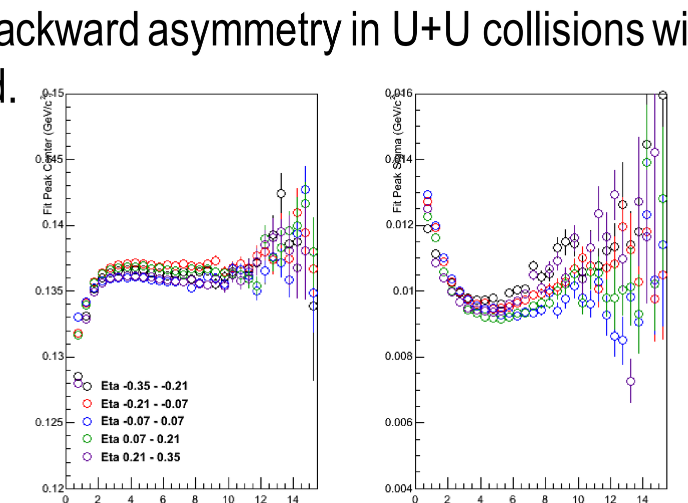
Rapidity dependence



It is unclear whether a forward-backward asymmetry due to the asymmetric nature of Cu+Au collisions will be measureable in our rapidity window, shown in light blue. AMPT calculations predict only a 3% increase in the dN/dη at the lowest available rapidity. To control for detector effects a comparison measurement of the forward-backward asymmetry in U+U collisions will also be performed.

The raw Minimum Bias yield/event in five rapidity bins are shown. The rapidity bins are scaled by powers of ten for visual clarity.

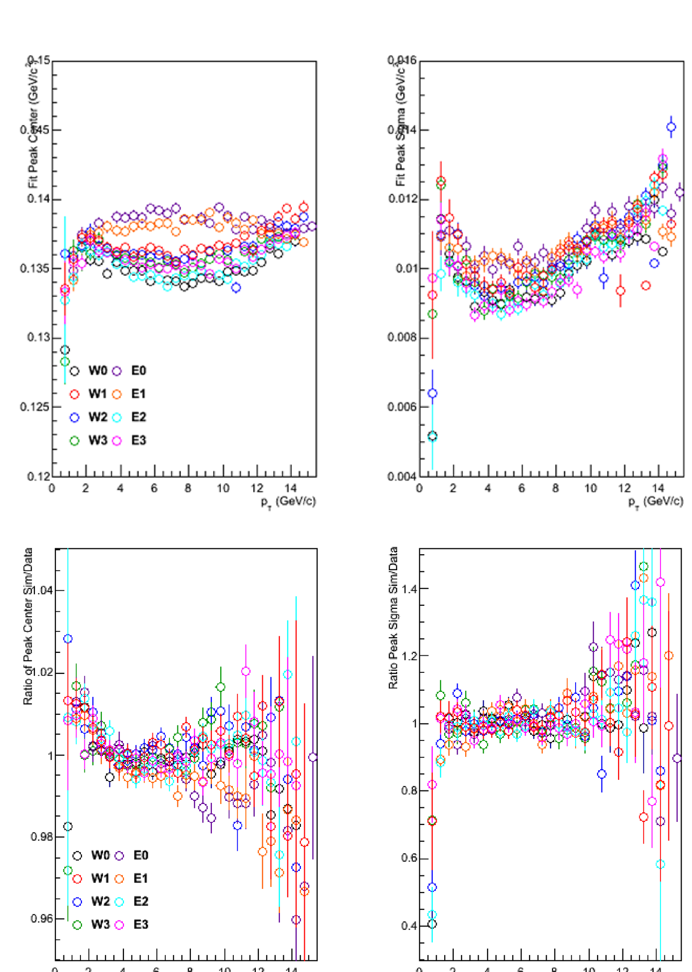




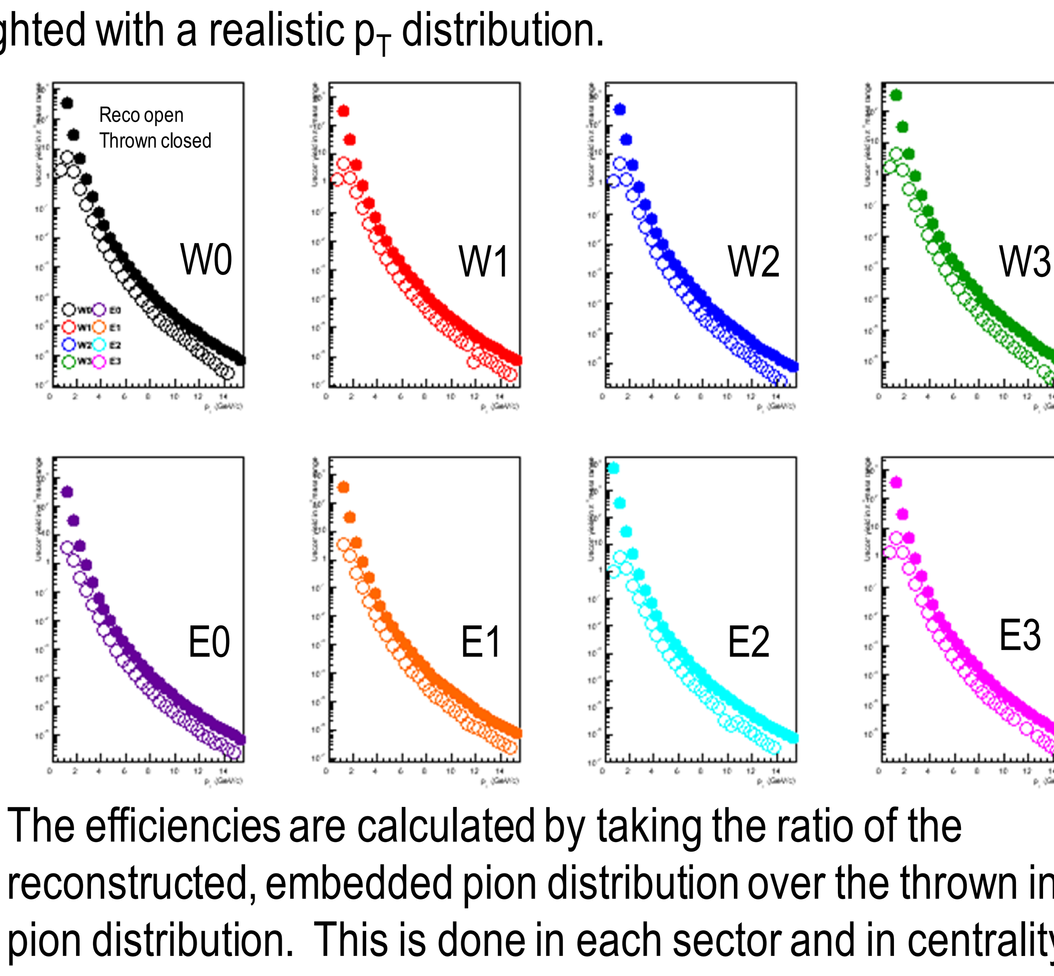
As a cross-check the pion peak centers and widths in the rapidity bins are found to ensure that the EMC's energy scale and resolution is uniform in each of the rapidity bins.

Simulation

Simulations are needed to correct for acceptance, efficiency and occupancy effects in the measurement. Pions are generated flat in p_T, eta and phi with the measured z-vertex distribution. They are run through a GEANT-based software, reconstructed, embedded in an underlying real event, analyzed and weighted with a realistic p_T distribution.



We ensure that the simulated pion peak centers and widths replicate the values seen in the data. This agreement is within 1% for all sectors.



The efficiencies are calculated by taking the ratio of the reconstructed, embedded pion distribution over the thrown input pion distribution. This is done in each sector and in centrality bins.