

The Evolution of Correlation Functions from Low to High p_T : From HBT to Jets

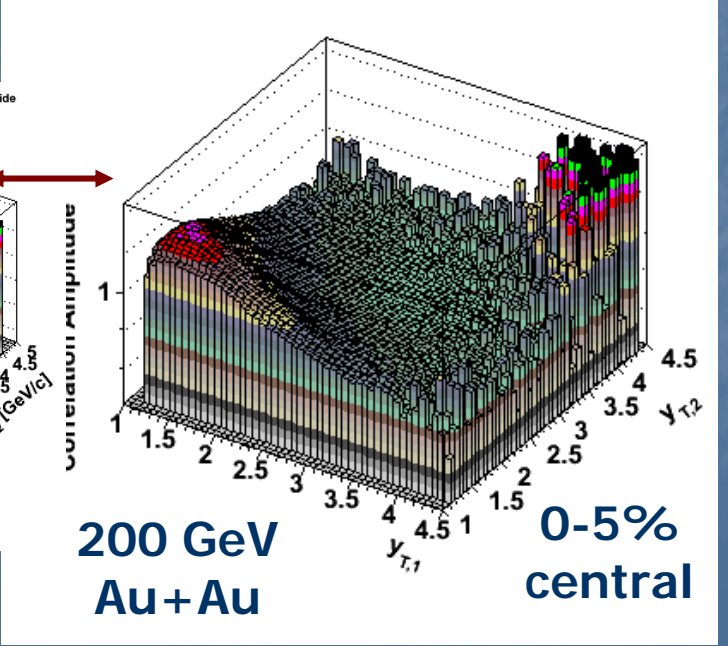
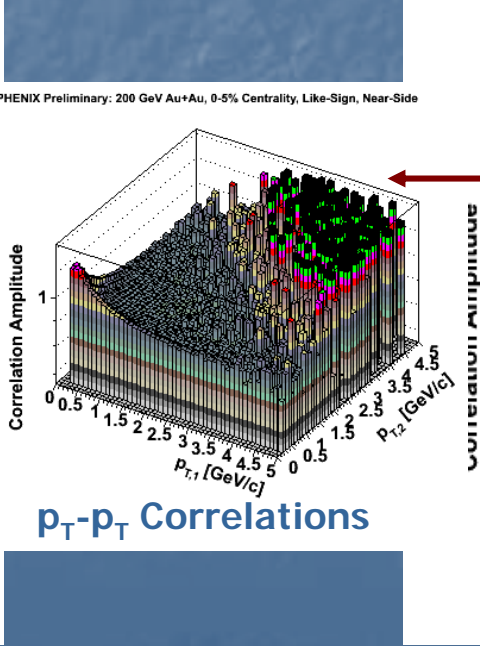
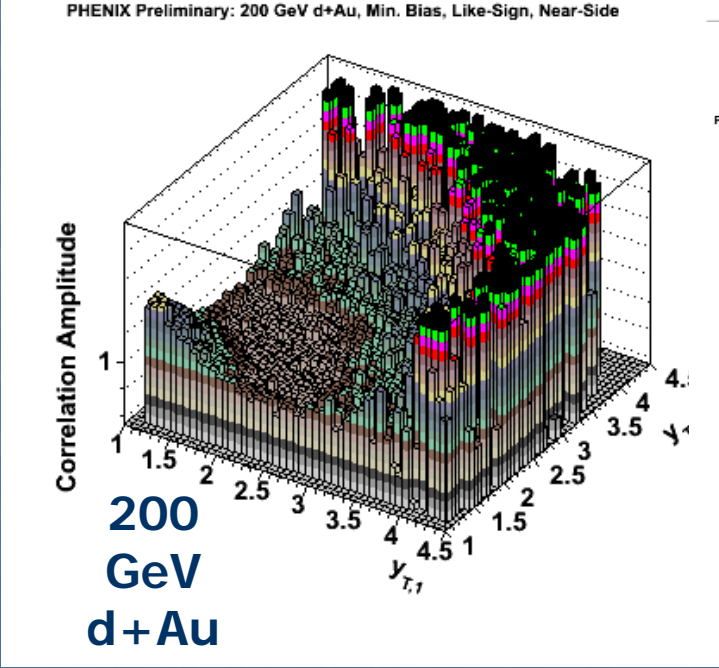
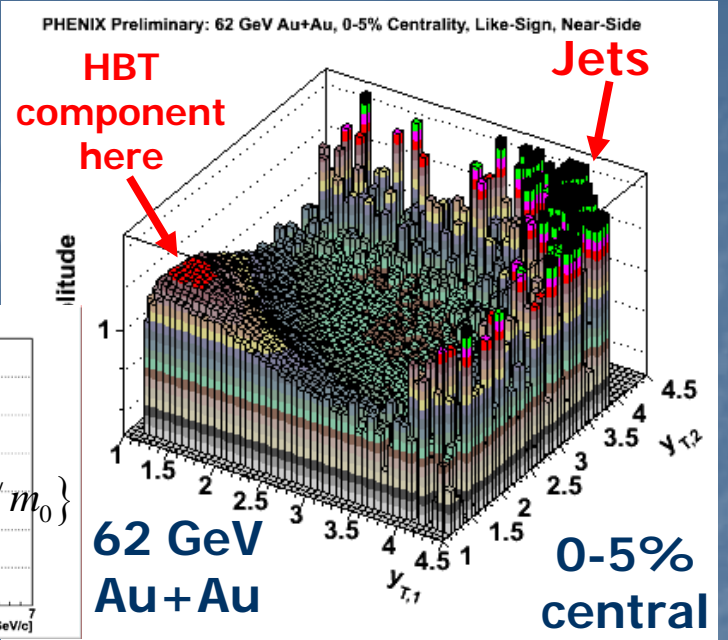
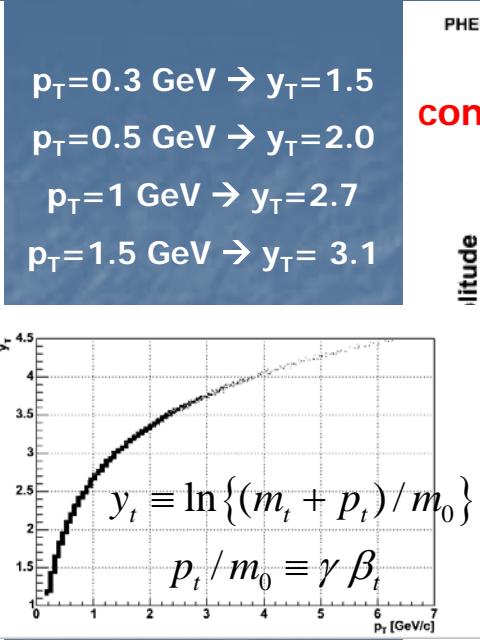
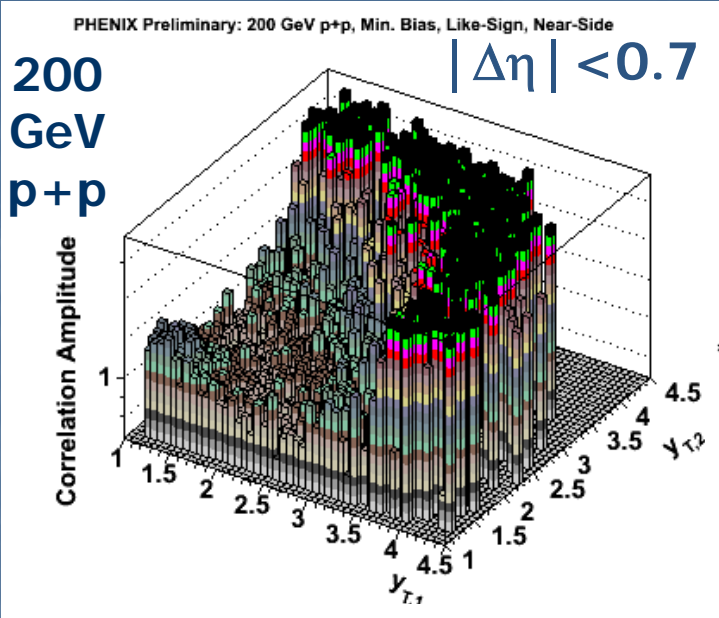
Quark Matter 2005
Jeffery T. Mitchell
(Brookhaven National Laboratory)
for the PHENIX Collaboration

OUTLINE

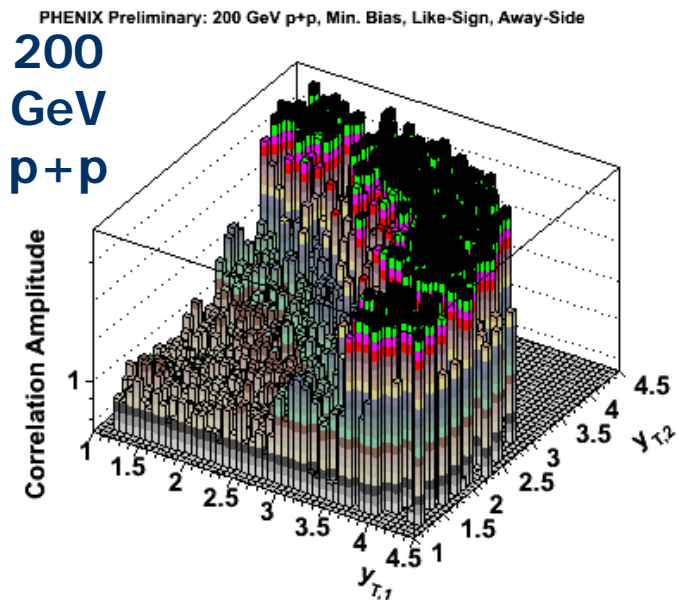
- A survey of correlations in y_T - y_T (p_T - p_T)
- Charge difference correlations in y_T - y_T (p_T - p_T)
- Like-sign near-side peak amplitudes and widths vs. centrality and p_T . Can any hard scattering contributions be observed for $p_T=0.5-1.0$ GeV/c?
- Correlation Amplitude Normalization:

$$C(p_T) = (N_{\text{data}}/N_{\text{events,data}}) \times (N_{\text{events,mixed}}/N_{\text{mixed}})$$

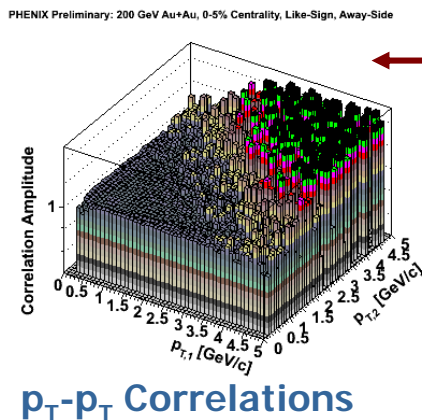
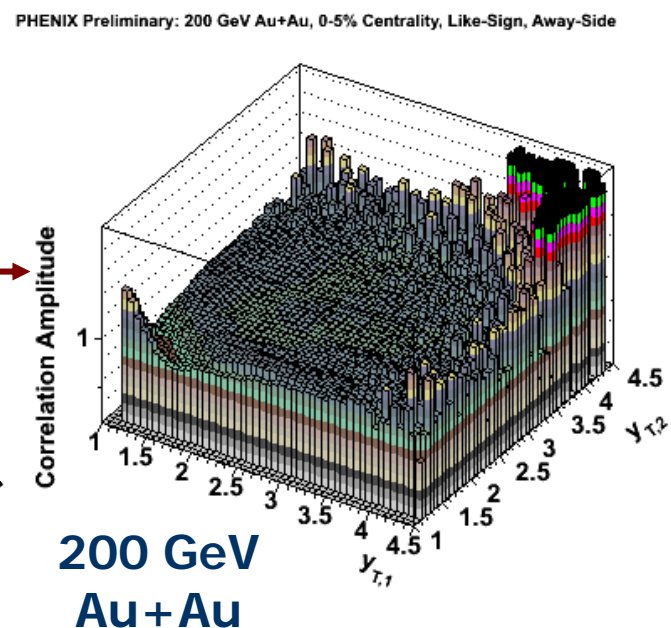
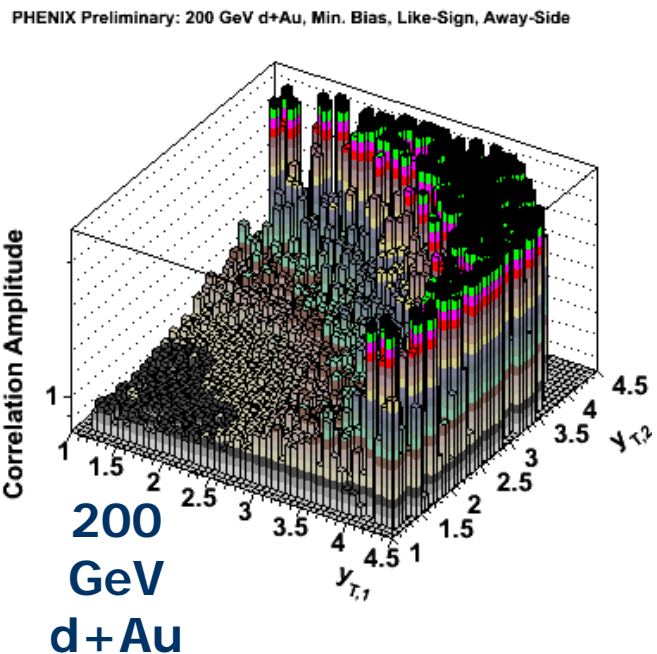
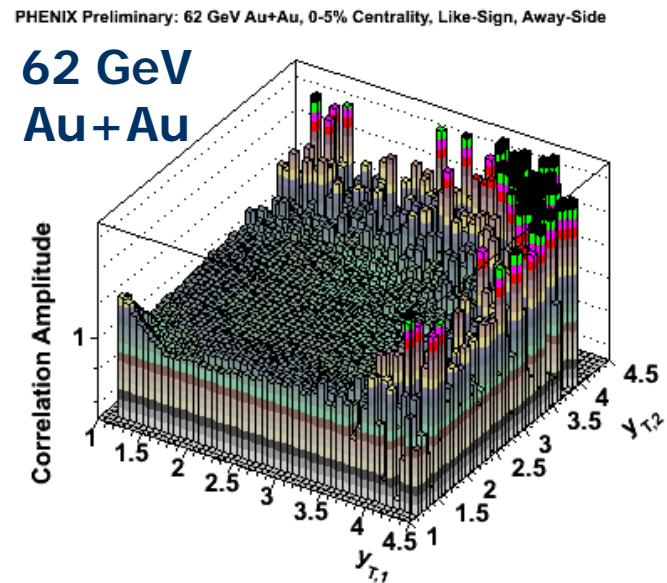
Like-sign Near-side ($\Delta\phi < 60^\circ$) Correlations in Transverse Rapidity



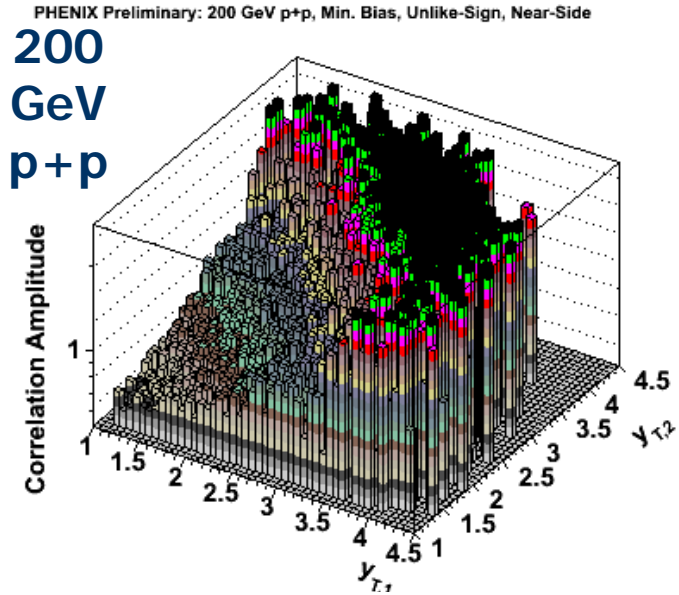
Like-sign Away-side ($\Delta\phi > 120^\circ$) y_T Correlations



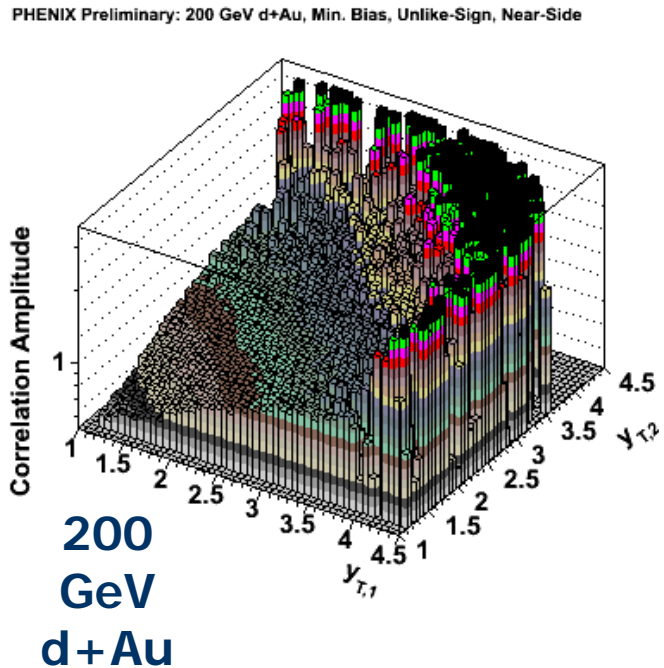
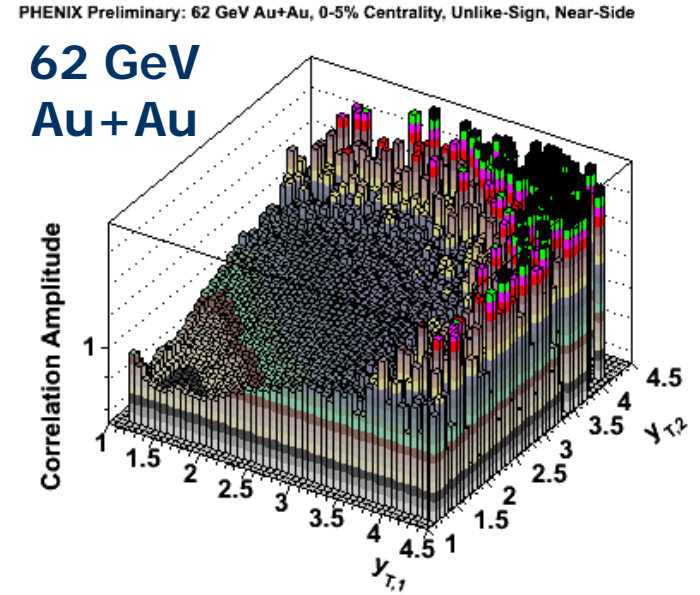
The jet structure persists, the peak with the HBT component does not. A low p_T correlation is observed in Au+Au collisions only for $p_T < 300$ MeV/c. It's source is under investigation.



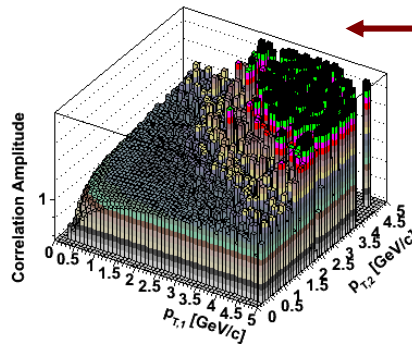
Unlike-sign Near-side ($\Delta\phi < 60^\circ$) y_T Correlations



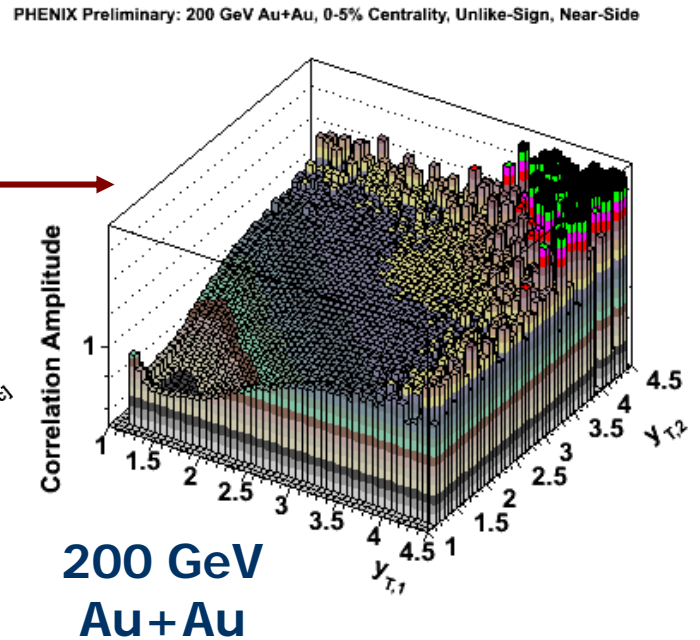
The jet structure persists, the broad peak with the HBT component on the near side does not.



PHENIX Preliminary: 200 GeV Au+Au, 0-5% Centrality, Unlike-Sign, Near-Side



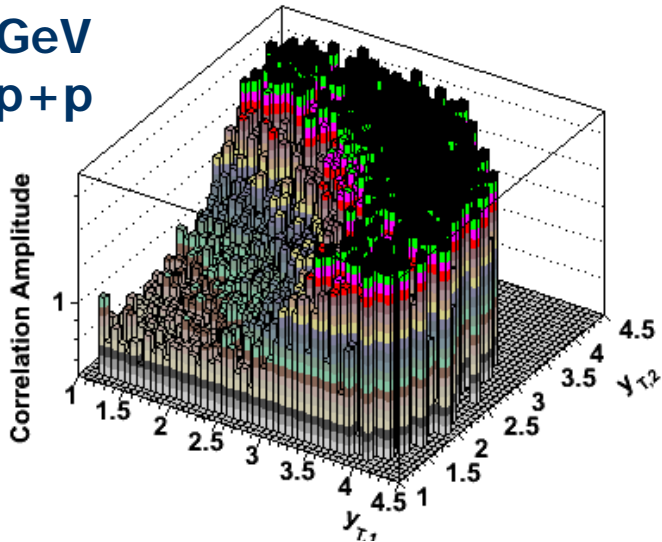
p_T - p_T Correlations



Unlike-sign Away-side ($\Delta\phi > 120^\circ$) y_T Correlations

PHENIX Preliminary: 200 GeV p+p, Min. Bias, Unlike-Sign, Away-Side

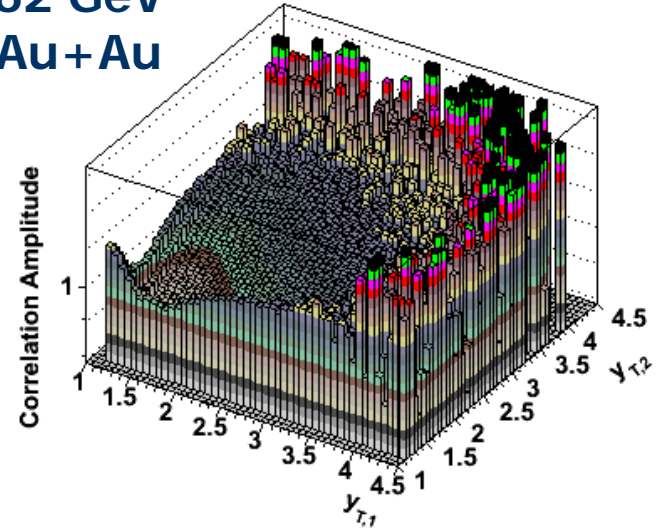
200 GeV p+p



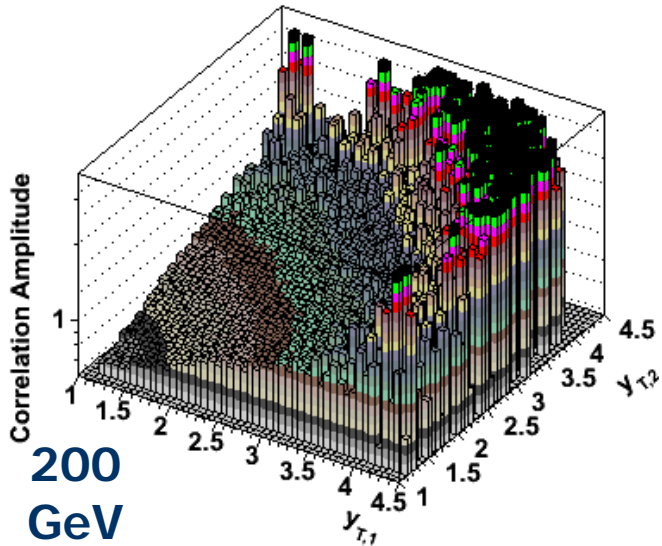
The jet structure persists, the broad peak with the HBT component from like-sign near-side pairs does not.

PHENIX Preliminary: 62 GeV Au+Au, 0-5% Centrality, Unlike-Sign, Away-Side

62 GeV Au+Au

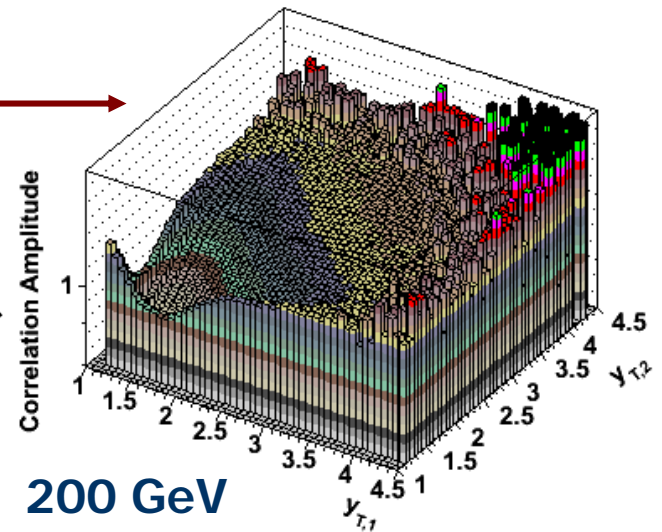


PHENIX Preliminary: 200 GeV d+Au, Min. Bias, Unlike-Sign, Away-Side



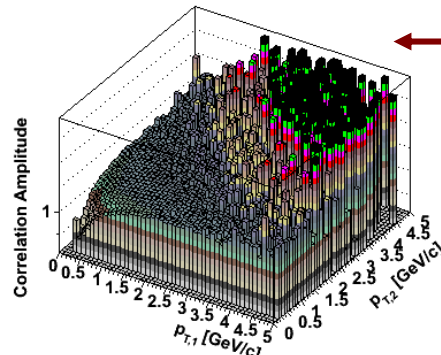
200 GeV d+Au

PHENIX Preliminary: 200 GeV Au+Au, 0-5% Centrality, Unlike-Sign, Away-Side



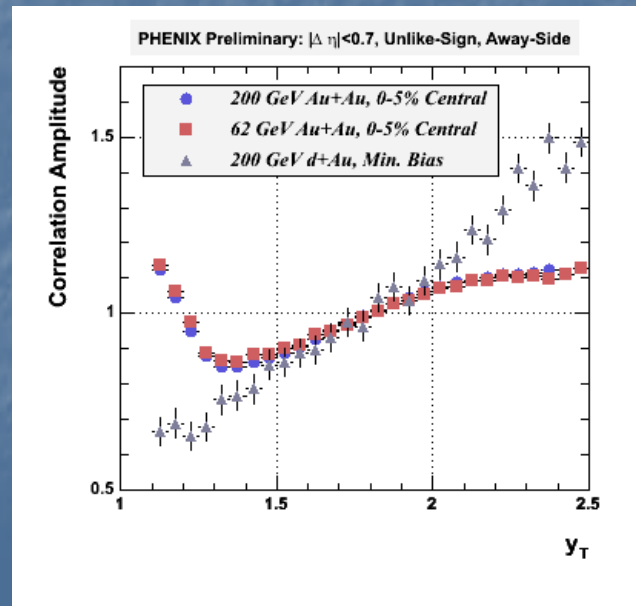
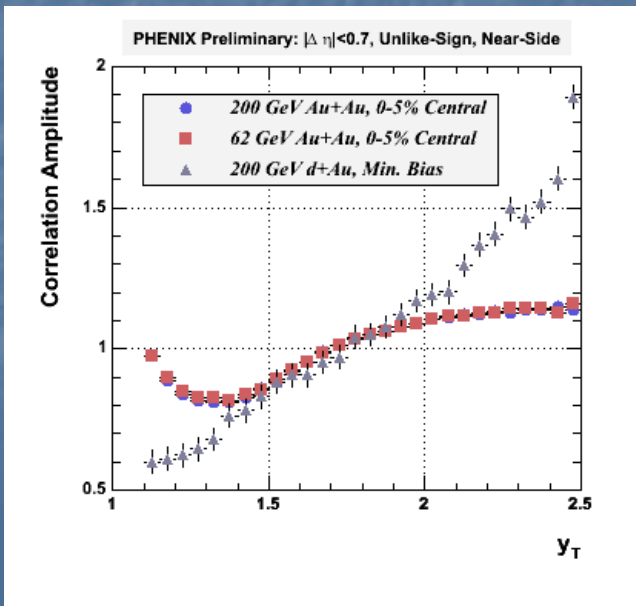
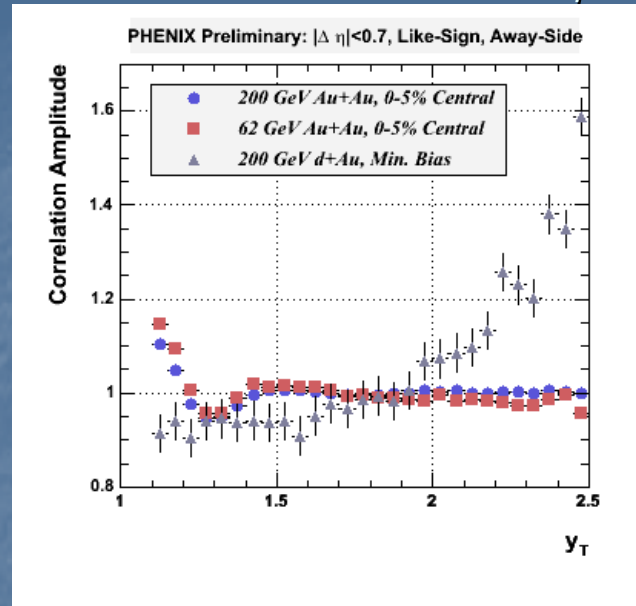
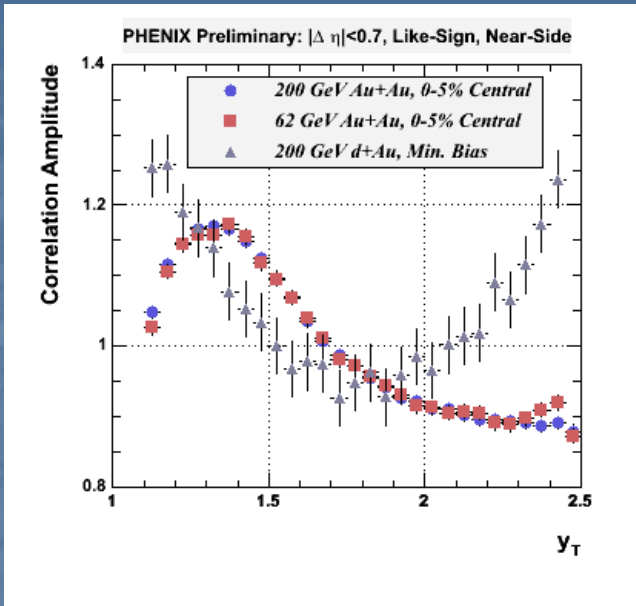
200 GeV Au+Au

PHENIX Preliminary: 200 GeV Au+Au, 0-5% Centrality, Unlike-Sign, Away-Side



p_T - p_T Correlations

Correlations Comparisons along a $y_{T,1}=y_{T,2}$ bin slice



$p_T=0.25$ GeV $\rightarrow y_T=1.34$

$p_T=0.3$ GeV $\rightarrow y_T=1.5$

$p_T=0.5$ GeV $\rightarrow y_T=2.0$

$p_T=0.9$ GeV $\rightarrow y_T=2.56$

$p_T=1.5$ GeV $\rightarrow y_T=3.1$

- The 62 GeV and 200 GeV Au+Au distributions are similar.

- The behavior at low p_T between Au+Au and d+Au collisions is different in all 4 cases.

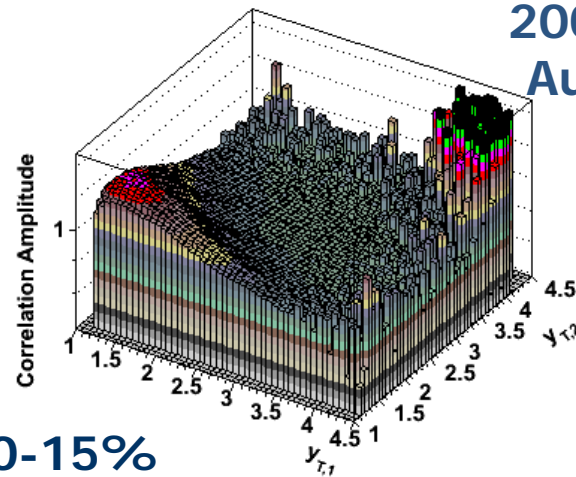
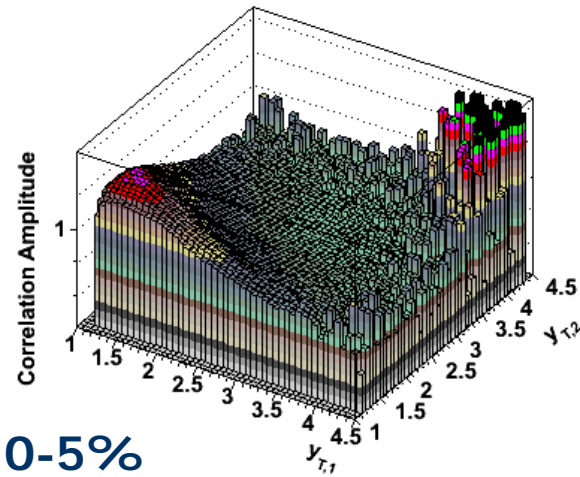
- The influence of resonance and conversion contributions is under investigation.

Like-sign Near-side ($\Delta\phi < 60^\circ$) y_T Correlations

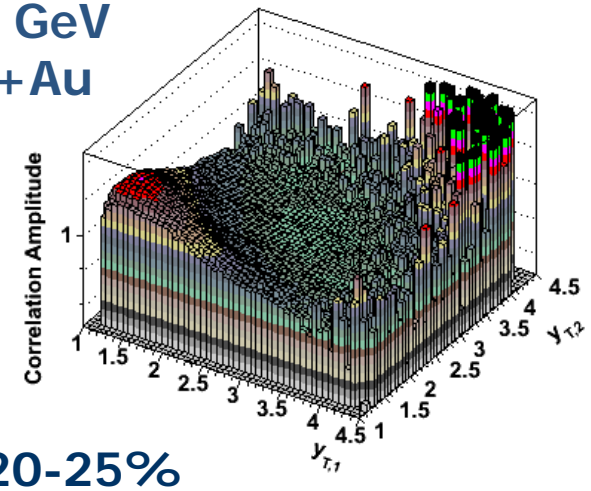
PHENIX Preliminary: 200 GeV Au+Au, 0-5% Centrality, Like-Sign, Near-Side

PHENIX Preliminary: 200 GeV Au+Au, 10-15% Centrality, Like-Sign, Near-Side

PHENIX Preliminary: 200 GeV Au+Au, 20-25% Centrality, Like-Sign, Near-Side



200 GeV
Au+Au

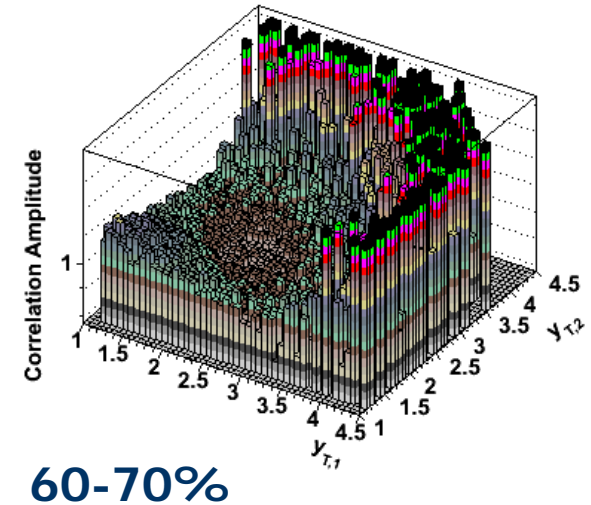
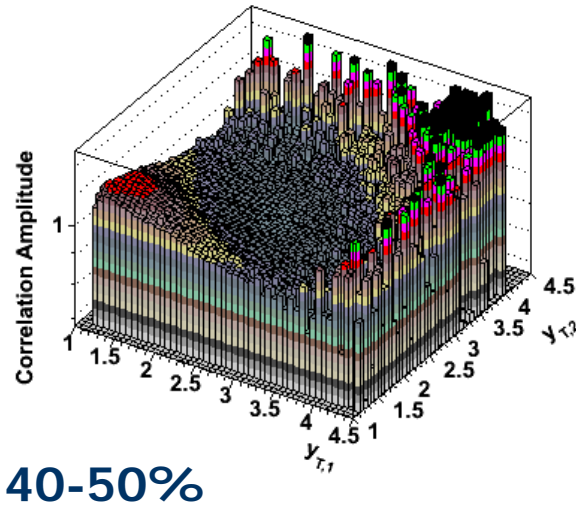
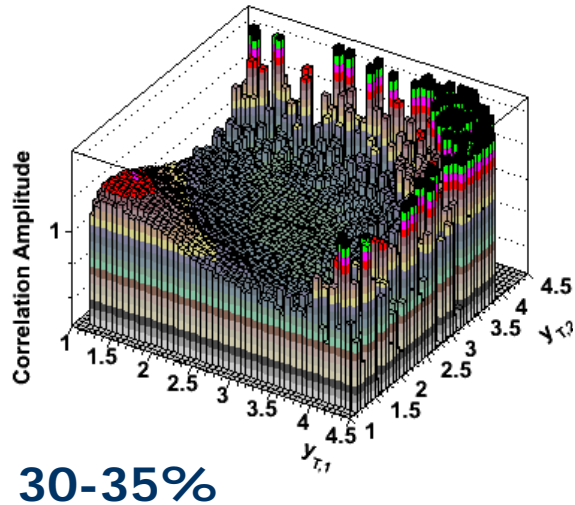


The primary features persist from central to peripheral collisions. Correlations for the most peripheral collisions are similar to d+Au collisions. This statement is true for all 4 cases.

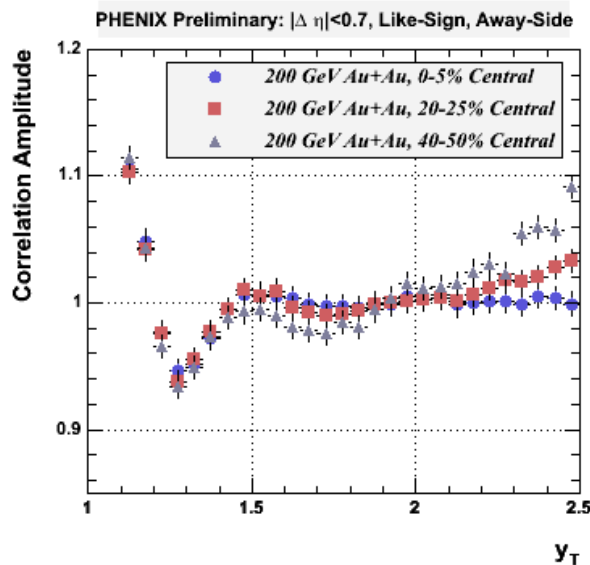
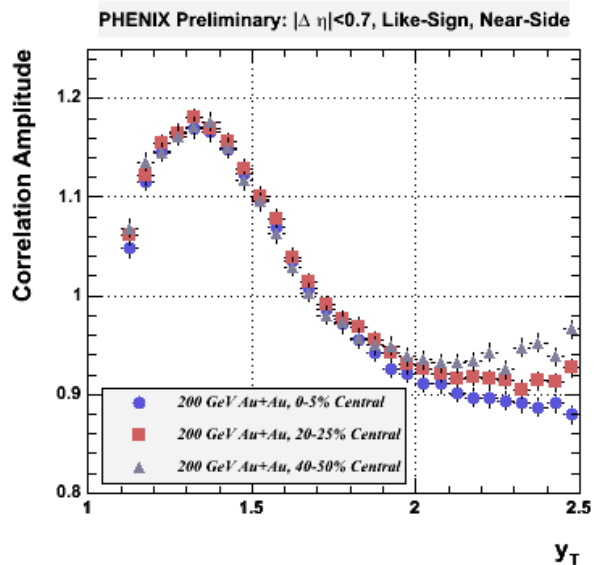
PHENIX Preliminary: 200 GeV Au+Au, 30-35% Centrality, Like-Sign, Near-Side

PHENIX Preliminary: 200 GeV Au+Au, 40-50% Centrality, Like-Sign, Near-Side

PHENIX Preliminary: 200 GeV Au+Au, 60-70% Centrality, Like-Sign, Near-Side



Correlations Comparisons along a $y_{T,1}=y_{T,2}$ bin slice



$$p_T = 0.25 \text{ GeV} \rightarrow y_T = 1.34$$

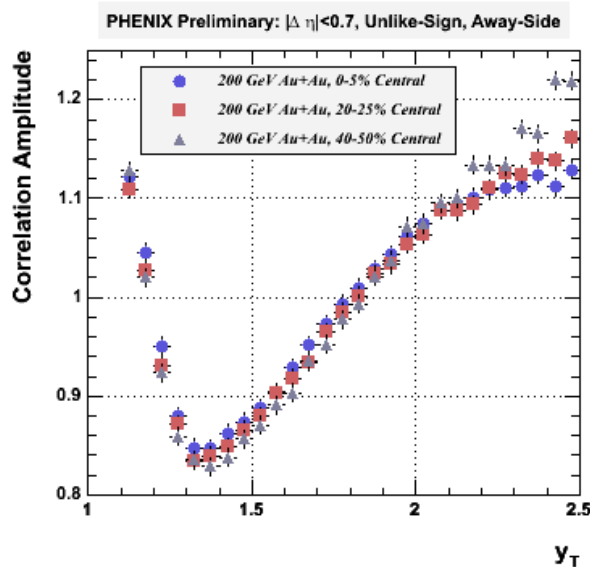
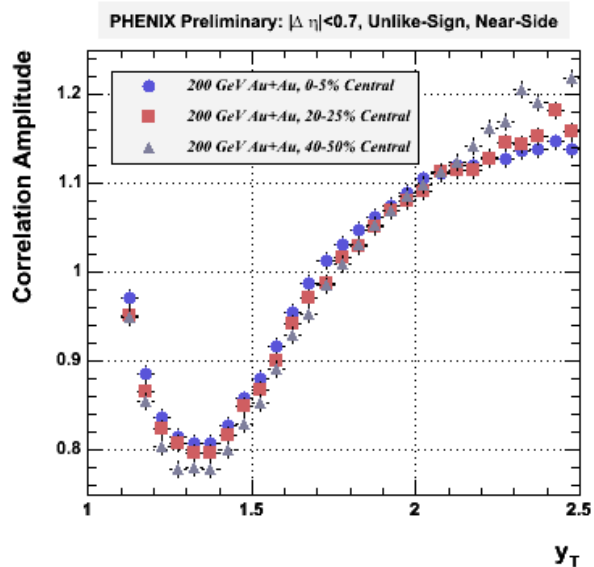
$$p_T = 0.3 \text{ GeV} \rightarrow y_T = 1.5$$

$$p_T = 0.5 \text{ GeV} \rightarrow y_T = 2.0$$

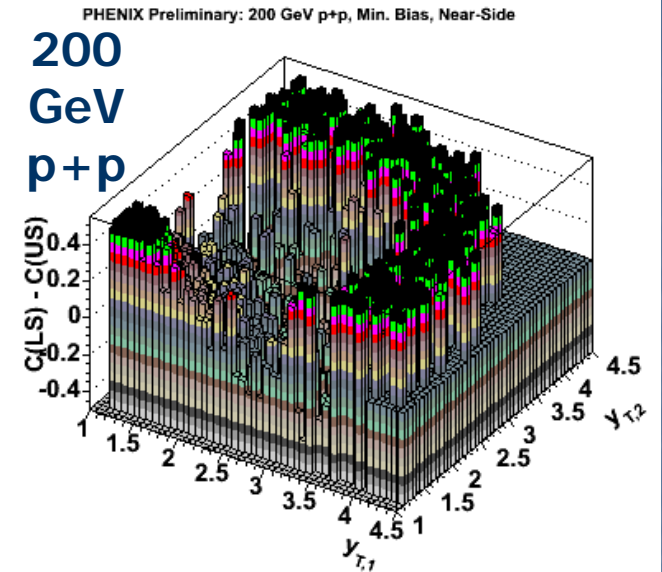
$$p_T = 0.9 \text{ GeV} \rightarrow y_T = 2.56$$

$$p_T = 1.5 \text{ GeV} \rightarrow y_T = 3.1$$

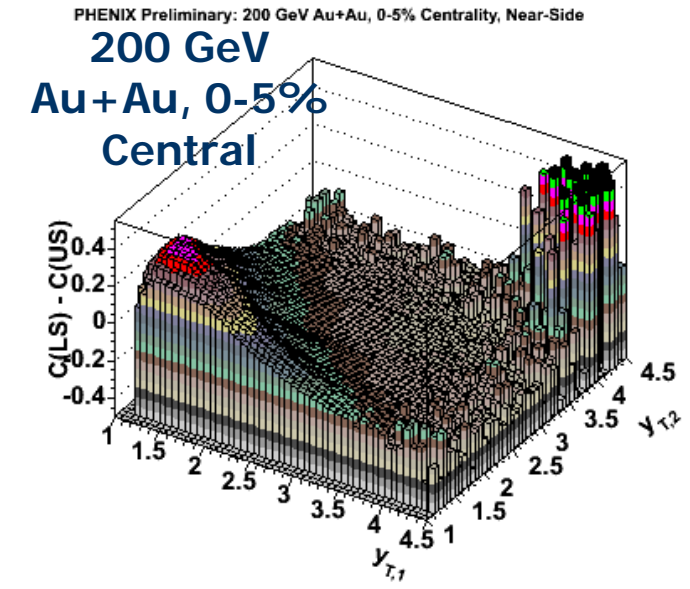
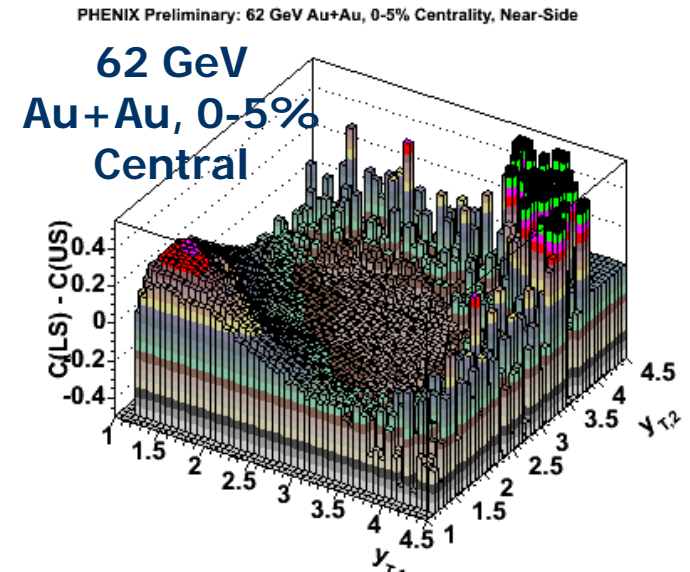
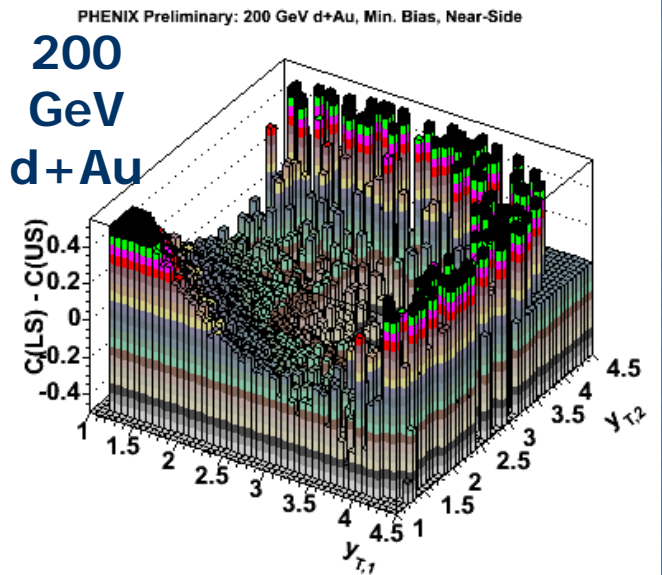
The integrated correlation amplitudes vary little over a wide range of centralities (and pair occupancies). Later, background and flow-subtracted peak amplitudes will be measured.



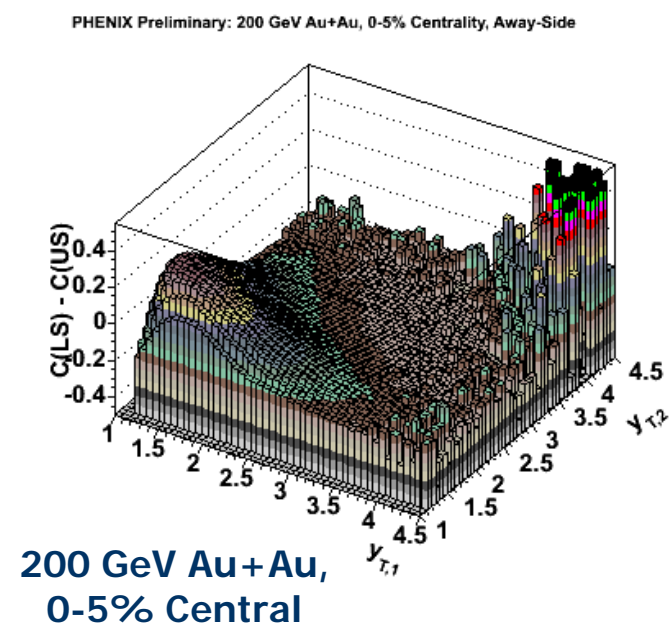
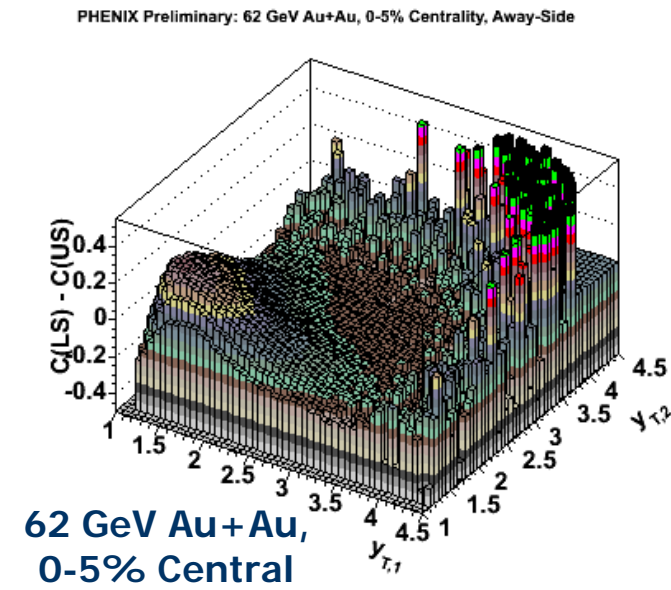
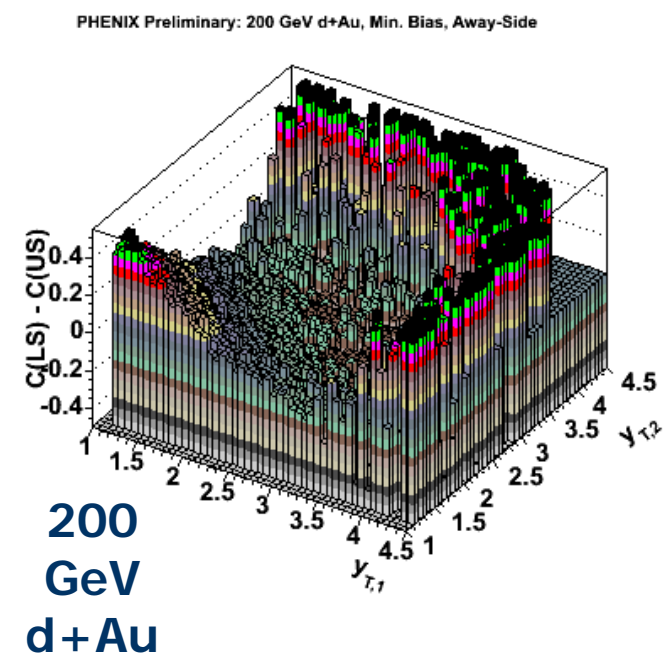
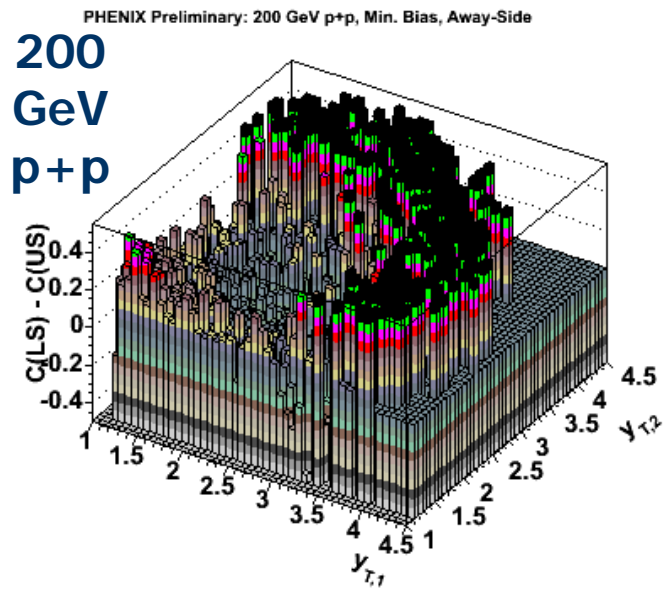
Charge Difference Correlations: C(LS)-C(US): Near Side



Calculated by subtracting the correlation amplitude of unlike-sign pairs from that of like-sign pairs. It is expected that primarily HBT remains in this case at low y_T . The remaining peak is much broader in Au+Au collisions and shifted in y_T compared to p+p and d+Au collisions. The location of the peaks in y_T agree with STAR results.

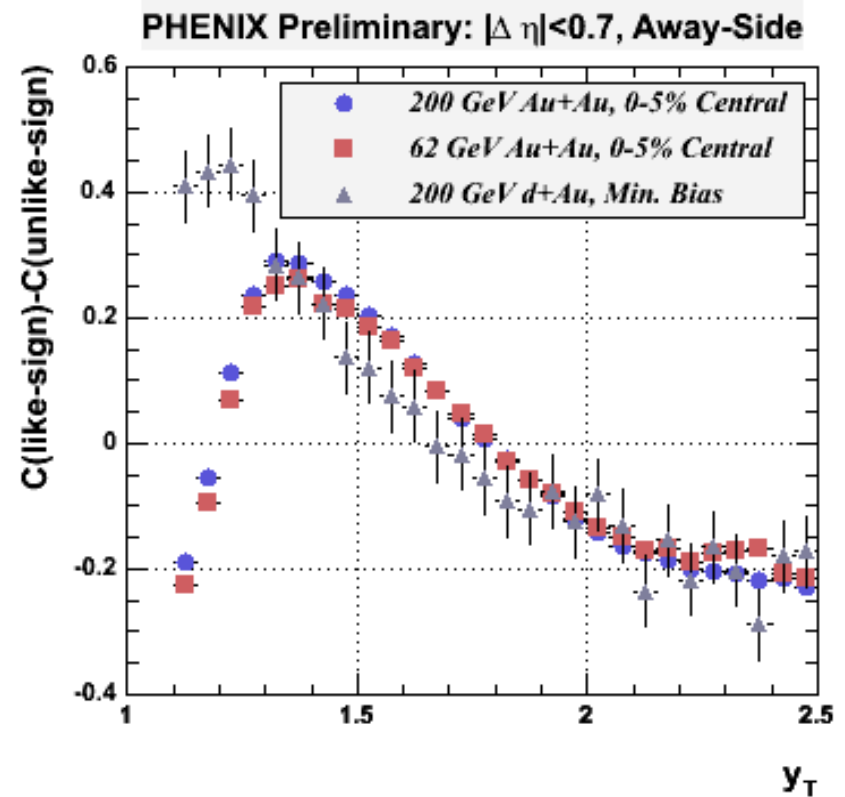
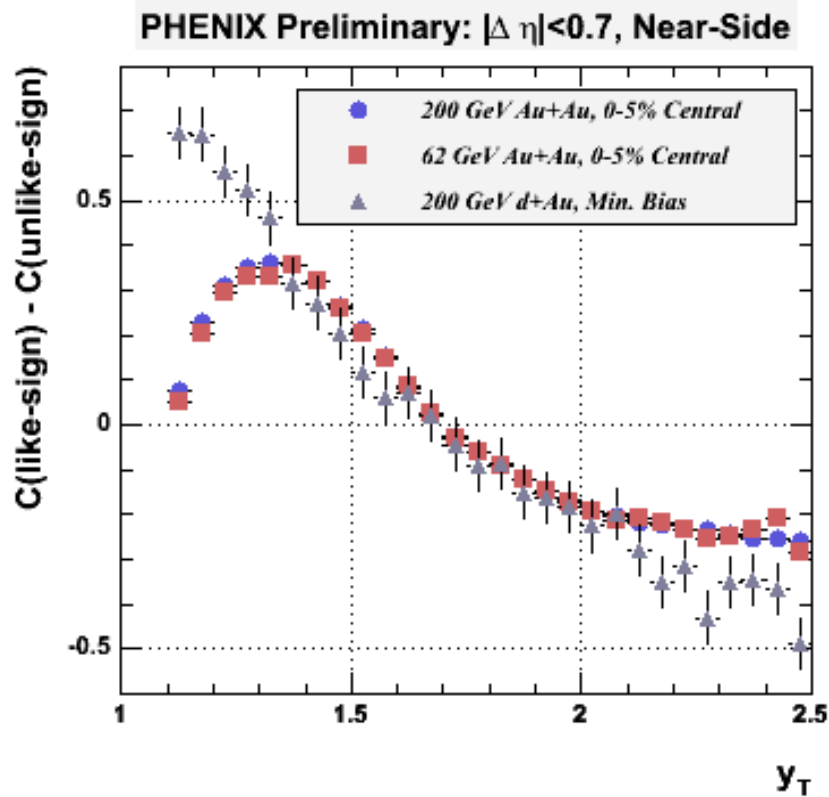


Charge Difference Correlations: C(LS)-C(US): Away Side



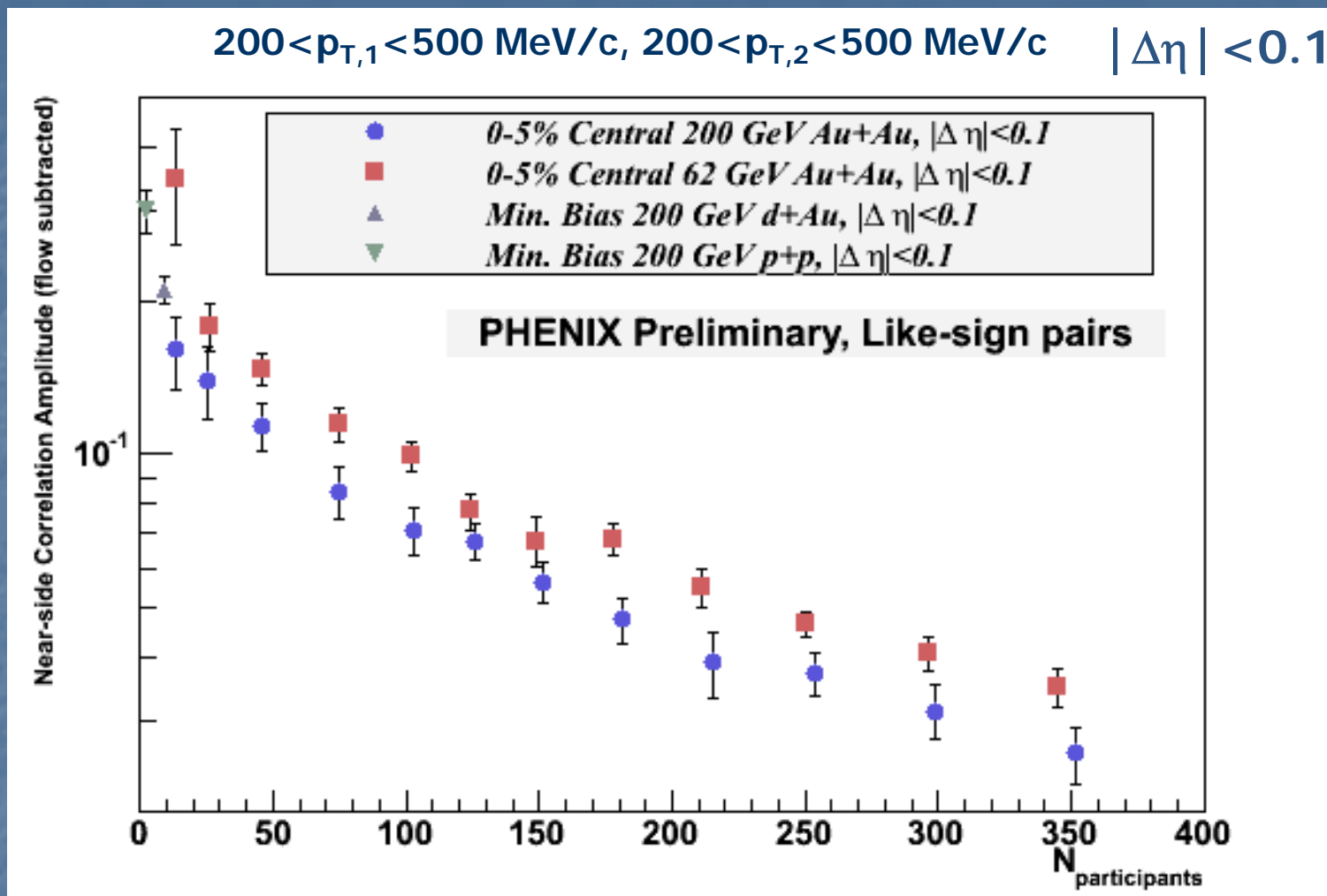
A similar peak with similar properties compared to the near-side is seen on the away-side, but with a lower integrated correlation amplitude.

Charge Difference Correlations Comparisons along a $y_{T,1}=y_{T,2}$ bin slice



The near and away side charge difference correlations are qualitatively similar. The p+p and d+Au charge difference correlations do not decrease significantly at low y_T .

Near-Side Peak Amplitude vs. Centrality

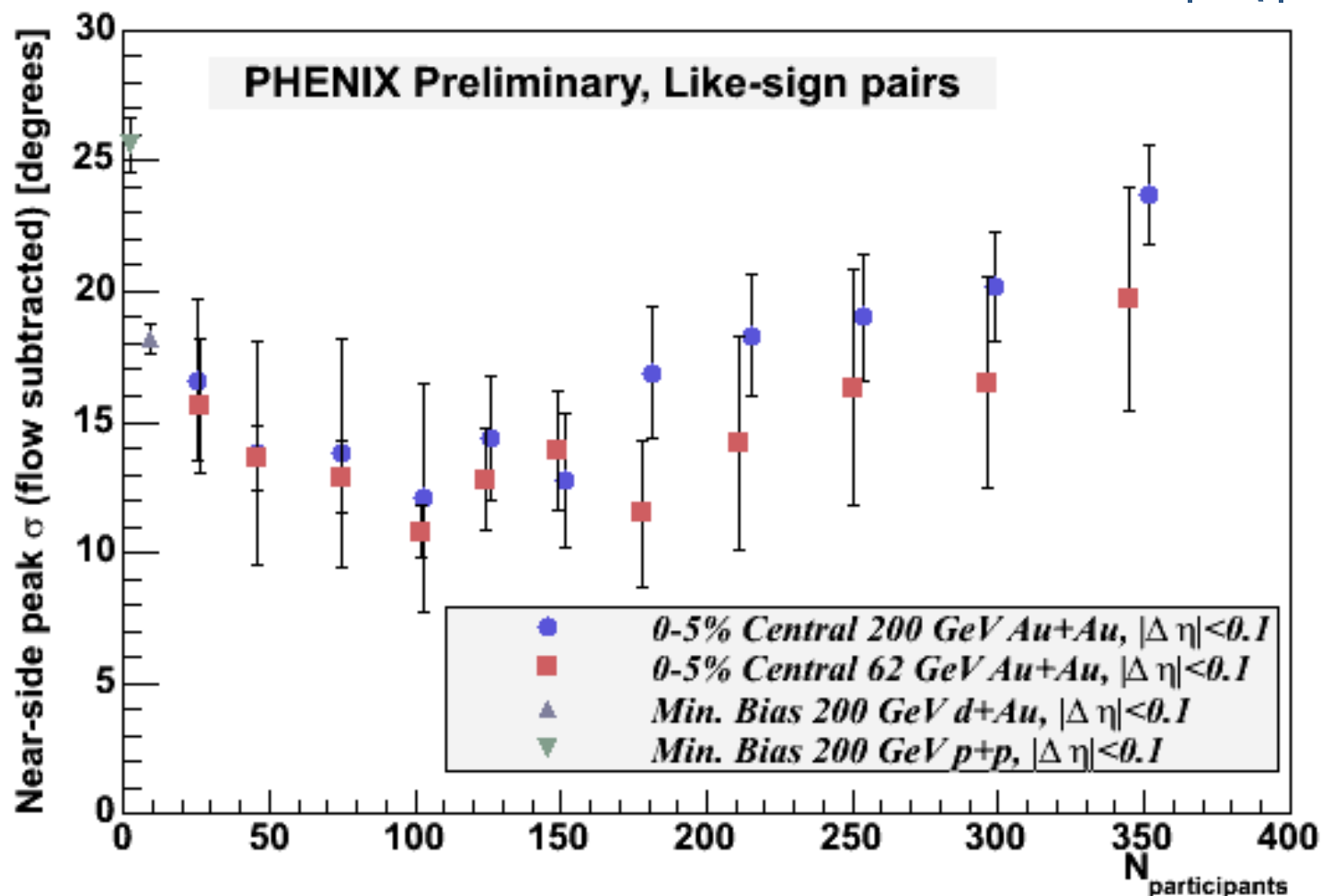


Azimuthal correlation functions were measured for all like-sign pairs with both pairs in the p_T range from 200-500 MeV ($y_T < 2$). The near-side peak was fit to a Gaussian convoluted with a $\text{Background} \cdot \cos(2\Delta\phi)$ flow term (Au+Au only). For $|\Delta\eta| < 0.1$, the like-sign pairs are correlated in $Q_{\text{invariant}}$ space, the unlike-sign pairs are not.

Near-Side Peak Width vs. Centrality

$200 < p_{T,1} < 500 \text{ MeV}/c, 200 < p_{T,2} < 500 \text{ MeV}/c$

$|\Delta\eta| < 0.1$



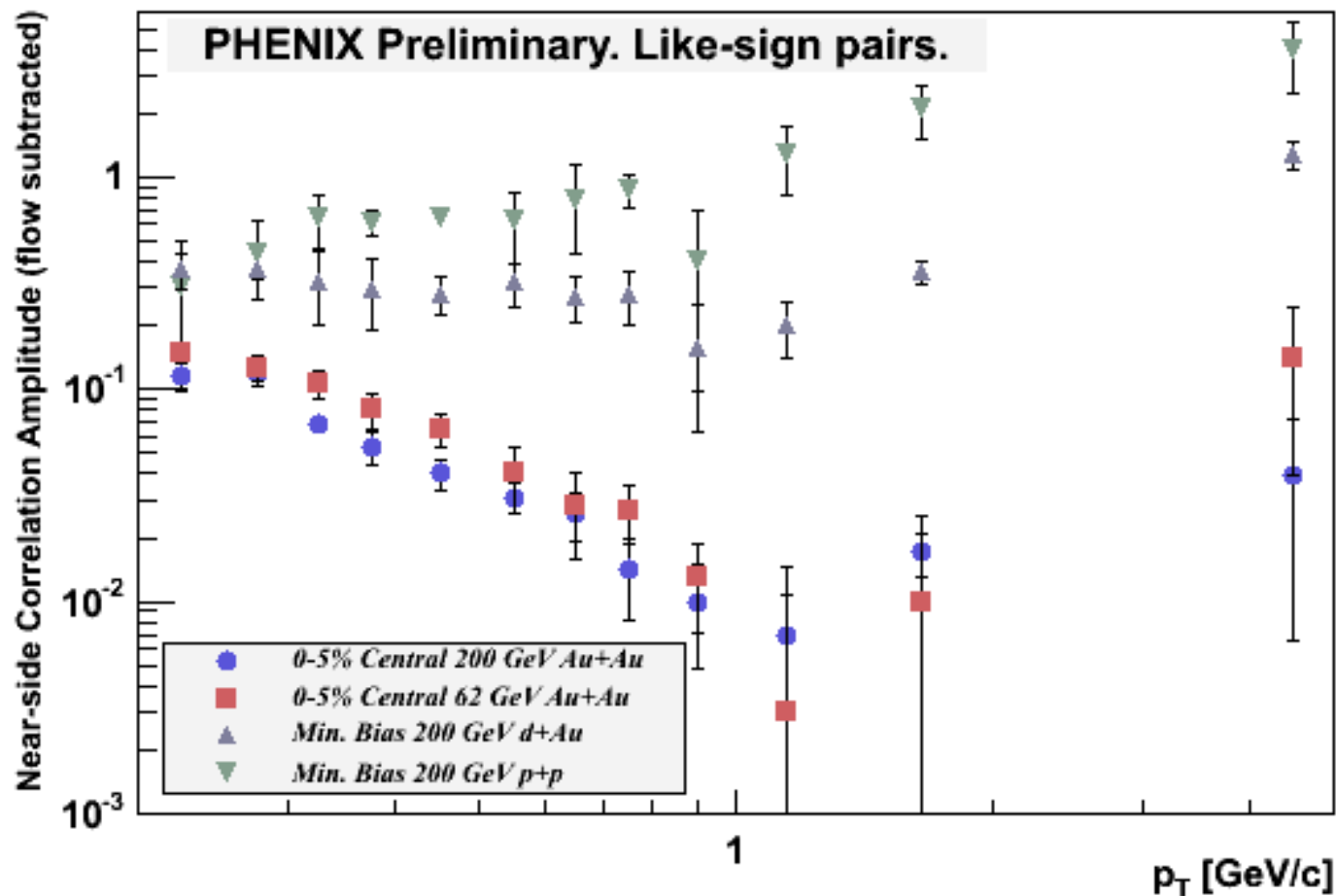
The standard deviation of the Gaussian fit to the flow- and background-subtracted near-side peaks for all like-sign pairs within the p_T range 200-500 MeV/c. The 200 GeV Au+Au peaks broaden significantly towards the most central collisions. The d+Au peak is much more narrow than the p+p peak.

Near-Side Peak Amplitude vs. p_T

$p_{T,\min} < p_{T,1} < p_{T,\max}, p_{T,\min} < p_{T,2} < p_{T,\max}$

Points plotted in the center of each p_T bin.

$|\Delta\eta| < 0.1$



Central Au+Au flow- and background-subtracted amplitudes decrease exponentially with p_T while the p+p and d+Au amplitudes remain flat. The amplitude increase above 1 GeV is due to the contribution of hard processes. No evidence for excess contributions from hard processes is seen in Au+Au collisions in the $p_T=0.5-1.0$ GeV/c range.

Conclusions

- A survey of integrated correlations in transverse momentum (transverse rapidity) is presented for like-sign and near-sign pairs on the near-side and the away-side. The survey covers 200 GeV p+p and d+Au collisions along with 62 and 200 GeV Au+Au collisions.
- Two primary features are seen in the y_T - y_T correlations: a peak attributed with a large HBT component, and a region dominated by large correlation amplitudes due to hard scattering processes. Contributions from resonance decays are under investigation.
- Charge difference correlations (like-sign minus unlike-sign) yield a decrease in correlation amplitude that persists on both the near and away sides for Au+Au collisions for $p_T < 275$ MeV/c. This decrease is not present in p+p or d+Au collisions.
- Measurements of the flow- and background-subtracted like-sign near-side peak amplitudes as a function of correlations in a given p_T range show that the amplitude drops exponentially with p_T up to $p_T = 1.0$ GeV/c. There is no evidence of excess correlations due to hard processes in this region.