Azimuthal Correlations with High-p_T Multi-Hadron Cluster Triggers in Au+Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV from STAR

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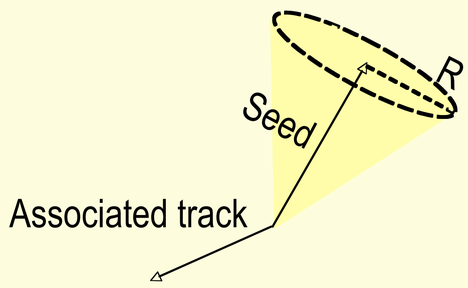
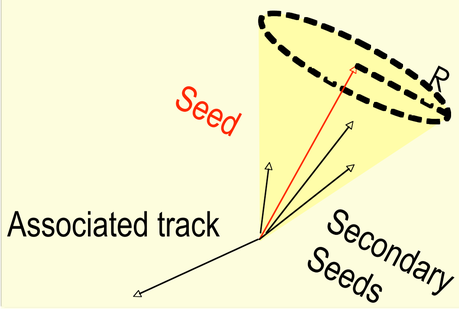
Di-hadron correlation



Multi-hadron correlation



Abstract: Di-hadron correlation measurements have been used to probe di-jet production in heavy-ion collisions at RHIC. A strong suppression of the away-side high-pt yield in these measurements is direct evidence that high-pt partons lose energy as they traverse the strongly interacting medium. However, since the momentum of the trigger particle is not a good measure of the jet energy, azimuthal di-hadron correlations have limited sensitivity to the shape of the fragmentation function. We explore the possibility to better constrain the initial parton energy by using clusters of multiple high-pt hadrons in a narrow cone as the 'trigger particle' in the azimuthal correlation analysis. We present first results from this analysis of multi-hadron triggered correlated yields in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV from STAR. The results are compared to Pythia calculations.

ANALYSIS TECHNIQUE

- Collect all seed tracks p_T > 5.0 GeV/c
- Collect all "secondary seeds" with p_T > 2, 3, 4 GeV/c
- Cone R = $\sqrt{(\Delta\eta^2 + \Delta\varphi^2)}$ =0.3 centered on each seed track
- Trigger p_T = vector sum of all associated tracks and secondary seeds in cone
- Study recoil (away-side) associated yield relative to highest trigger cluster in event
- Background estimate: uniform in $\Delta\varphi$, normalize with ZYAM

Trigger classes:

- Single+Multi-hadron: all trigger clusters
- Multi-hadron: exclude single-hadron clusters
- Single hadron: single hadron clusters only
- Di-hadron: conventional di-hadron analysis with same p_T(trigger)

Kinematic cuts:

- p_T (trigger) = 10 -12, 12-15 GeV/c
- p_T (assoc) = 3-4, … ,10-11 GeV/c

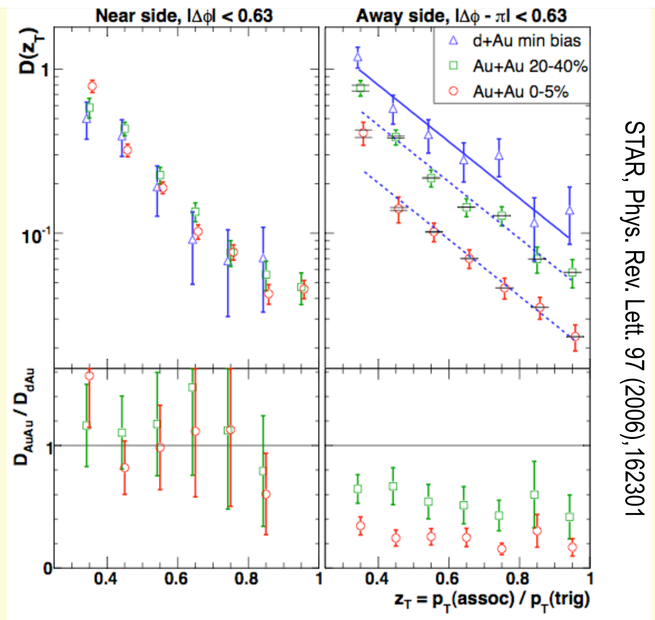
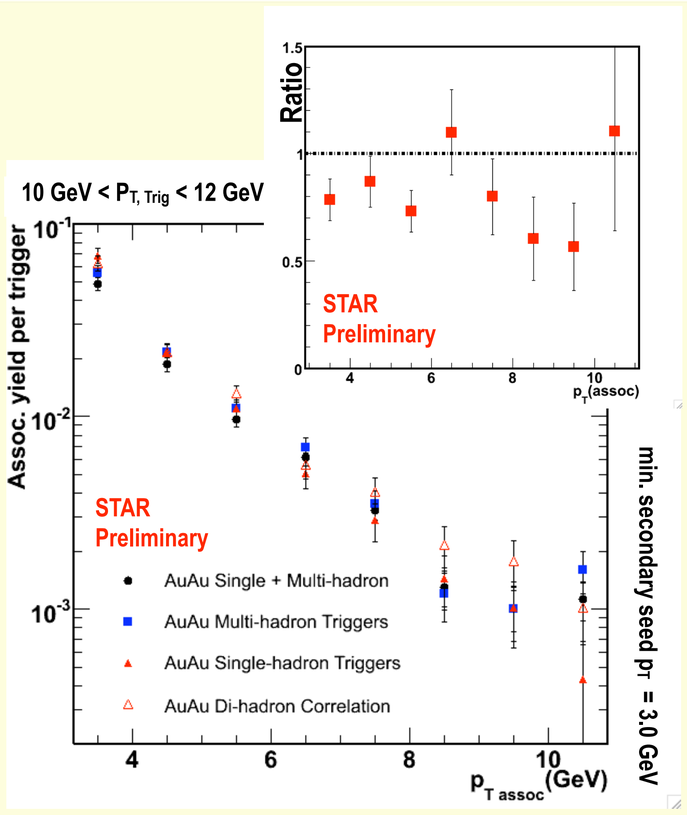
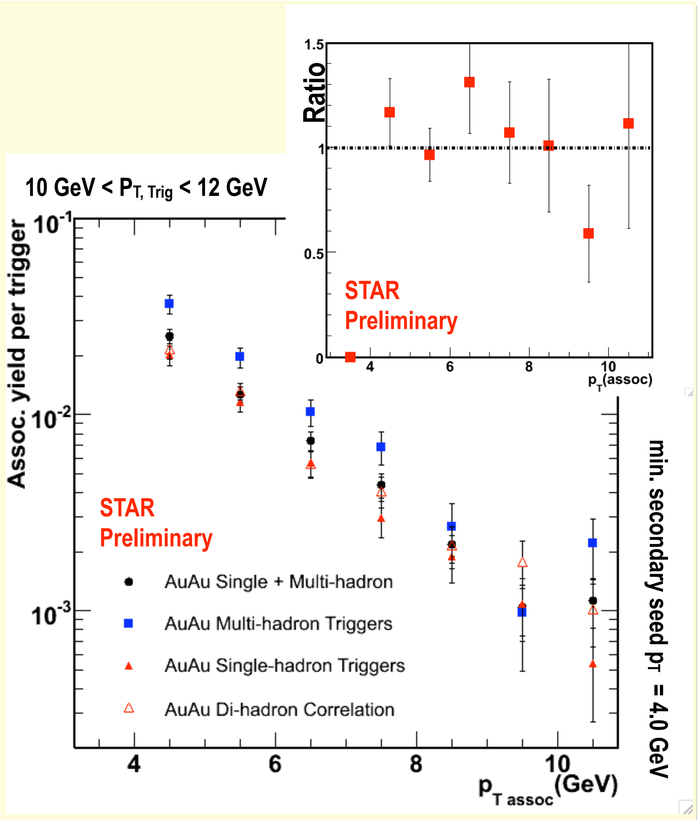


Figure 1: Published di-hadron fragmentation function D(z): ratio of recoil associated yield in Au+Au relative to d+Au measurements, as function of $z=p_T(assoc)/p_T(trigger)$.





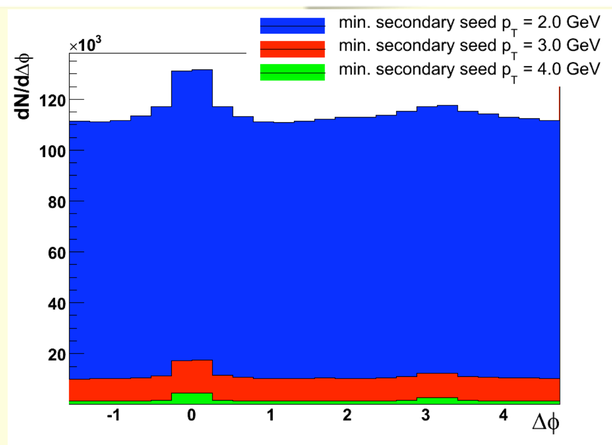
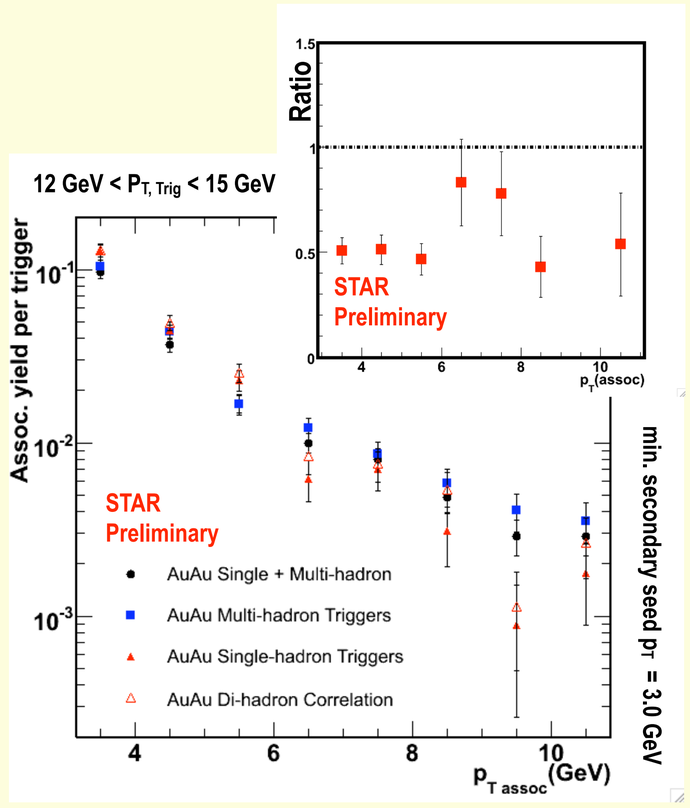
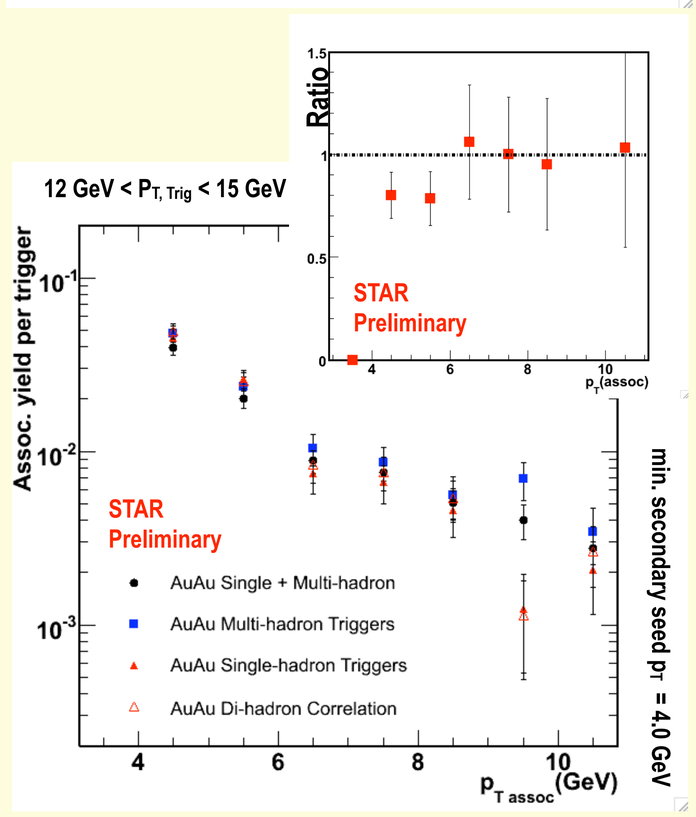


Figure 2: Sample azimuthal correlation as a function of minimum secondary seed p_T. As secondary seed p_T increases, random background decreases.



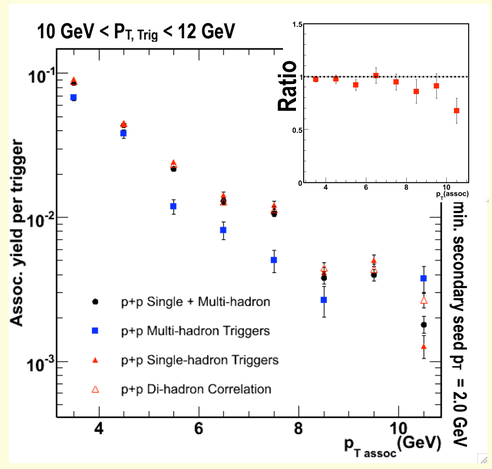


- Associated yield per trigger vs. p_T (assoc) comparing the four trigger classes defined above for a common p_T(trig) interval (10-12, 12-15 GeV/c), for secondary seed p_T >3, 4 GeV/c.
- Insets: ratio of recoil associated yield for Single+Multi-hadron trigger clusters relative to conventional to Di-hadron correlation analysis vs p_T(assoc).
- Ratios are uniform and consistent with unity for min. seed cut = 4 GeV/c.
- Ratios are suppressed for min. seed cut = 3 GeV/c. Random (combinatoric) seeds are more likely in this case, resulting in an overestimate of the jet energy and corresponding deficit in recoil yield relative to (harder) di-hadron correlations. Quantitative study of this effect is in progress.

To better explain the triggers used in this study, we take three illustrative cases:

a) two hadrons of 7 & 3 GeV/c
b) a single 10 GeV/c hadron
c) two hadrons of 10 & 3 GeV/c

In a p_T trigger bin of 10 to 12 GeV/c, The di-hadron analysis would include b) and c). The single-hadron trigger would only include b). The multi-hadron trigger would only include a).



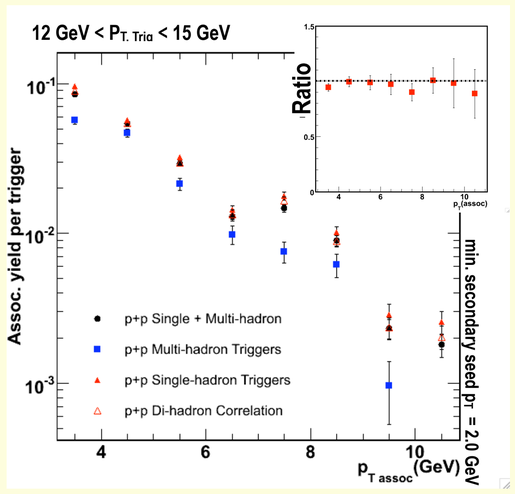


Figure 3 & 4: Pythia predictions for away-side yields per trigger for 10 GeV/c < $p_{T,Trig}$ < 12 GeV/c (above) and 12 GeV/c < $p_{T,Trig}$ < 15 GeV/c (left). Inlaid plots show ratio of single +multi-hadron yields to di-hadron correlations. More statistics will be required for a thorough study of multi-hadron triggers.

SUMMARY AND CONCLUSIONS:

- We have investigated multi-hadron triggers as a method of reducing leading trigger bias and better approximating measured fragmentation functions.
- Ratios of single+multi-hadron trigger recoil yields to di-hadron correlation recoil yields are close to unity, i.e. a 12 GeV/c leading hadron generates same (suppressed) recoil distribution as two hadrons of 8 and 4 GeV/c adding up to a trigger p_T of 12 GeV/c.
- We have also performed a preliminary analysis on Pythia events and a similar result was found: the recoil spectra are similar in the cluster-based analysis and in the di-hadron analysis. In Pythia events, however, the recoil yield for multi-hadron clusters is found to be different than for single-hadron clusters. This effect is not seen in data and warrants further study.