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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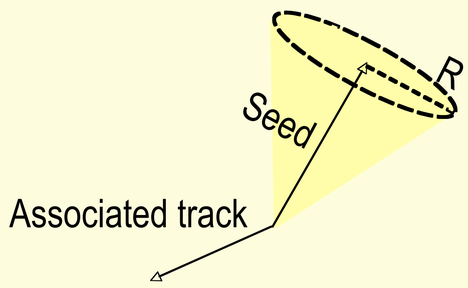
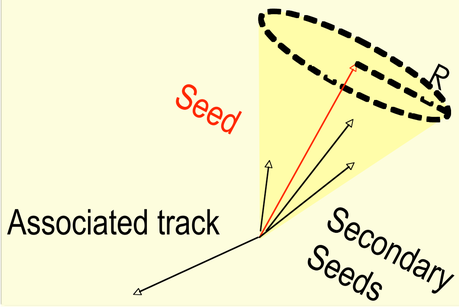
Abstract: Di-hadron correlation measurements have been used to probe di-jet production in heavy-ion collisions at RHIC. A strong suppression of the away-side high-pt yield in these measurements is direct evidence that high-pt partons lose energy as they traverse the strongly interacting medium. However, 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.

Di-hadron correlation



Multi-hadron correlation



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

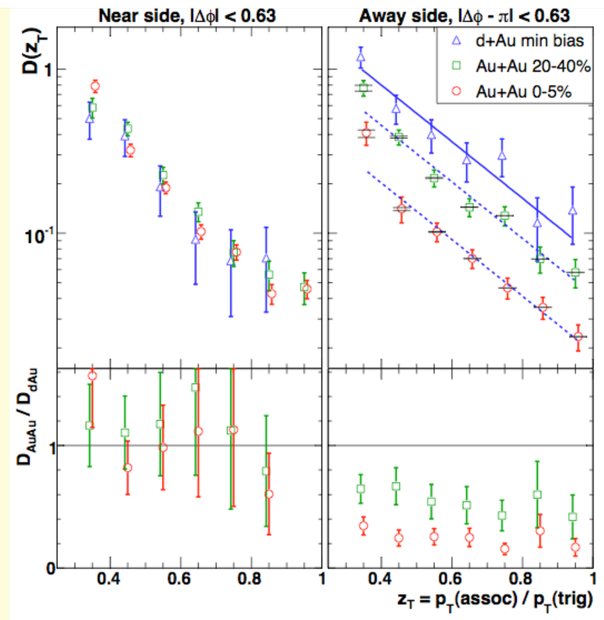


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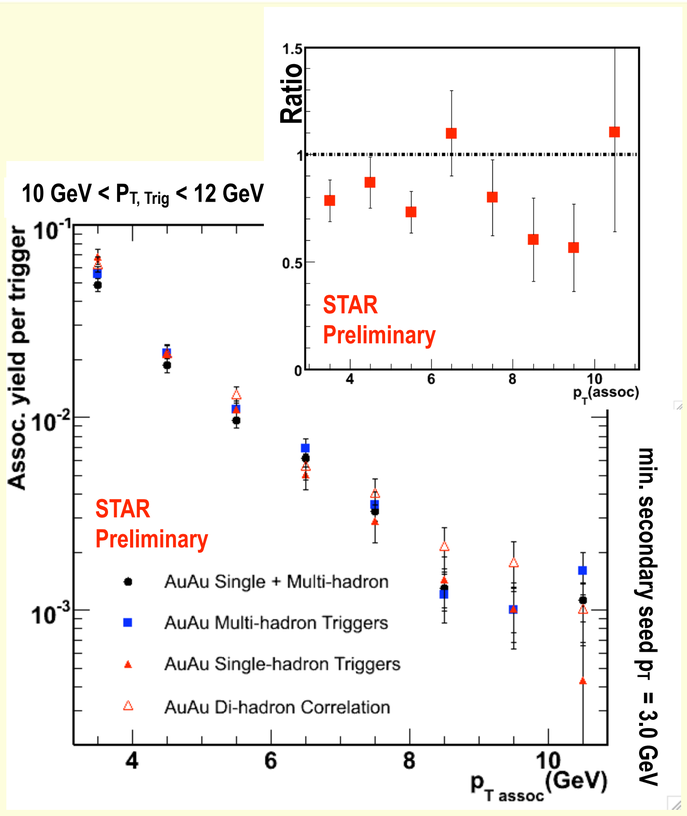
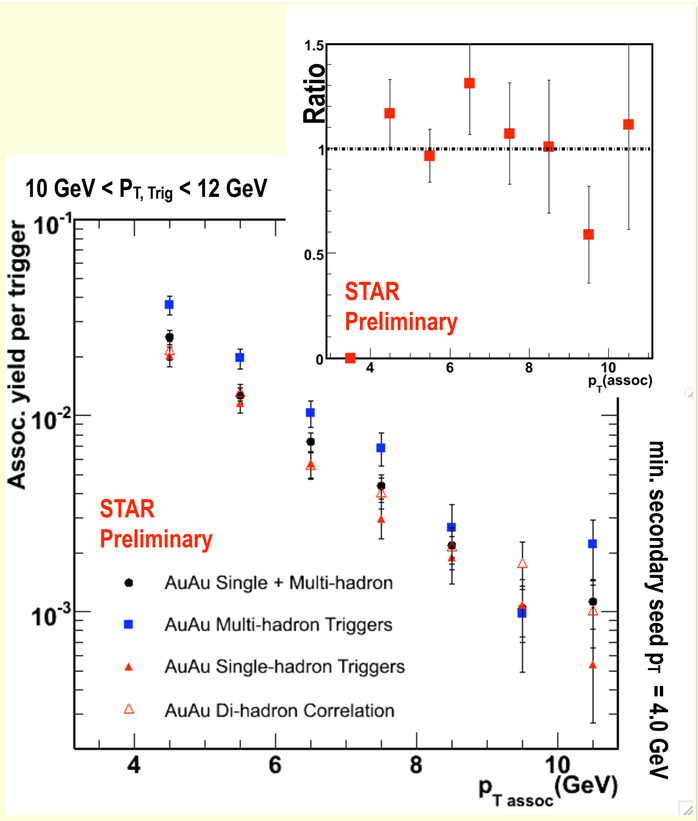
Figure 1: Published di-hadron fragmentation function D(z): ratio of recoil associated yield in Au+Au relative to d+Au measurements, as function of $z=p_T(assoc)/p_T(trigger)$.





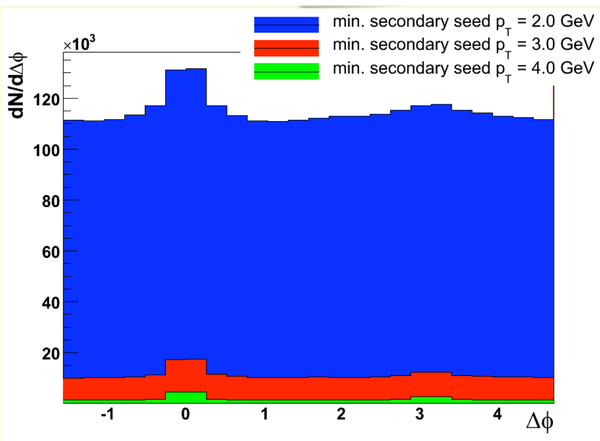
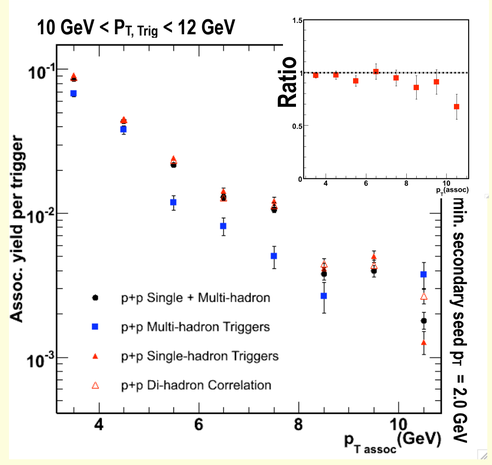
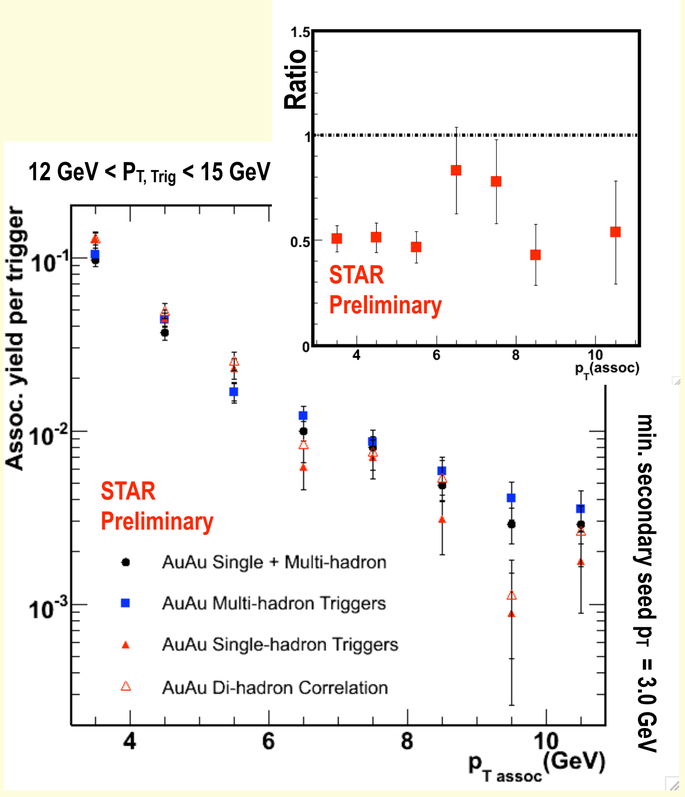
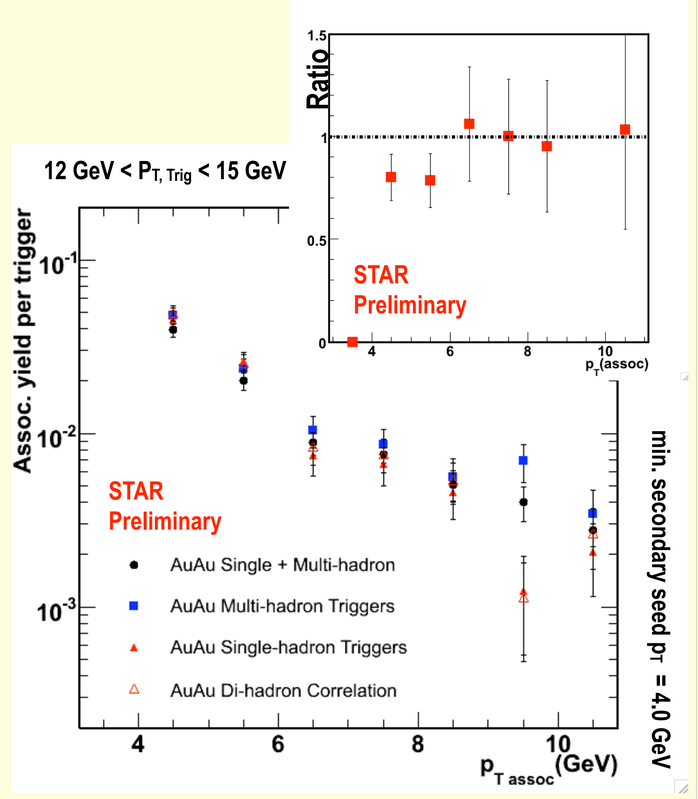


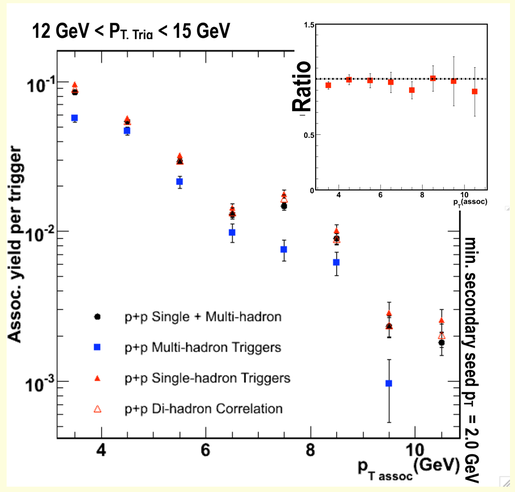
Figure 2: Sample azimuthal correlation as a function of minimum secondary seed p_T. As secondary seed p_T increases, random background decreases.

Figure 3 & 4: Pythia predictions for away-side yields per trigger for 10 GeV < $p_{T,Trig}$ < 12 GeV (above) and 12 GeV < $p_{T,Trig}$ < 15 GeV (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.









- 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.

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.
- **Invariance of the recoil population with trigger multiplicity for fixed trigger p_T is necessary if the triggers are dominated by jet fragmentation in vacuum. Experimental observation of such invariance is reported in this poster for the first time. It will be important to quantify recoil distributions for fully reconstructed jets in pythia to fully understand the implications of this invariance.**