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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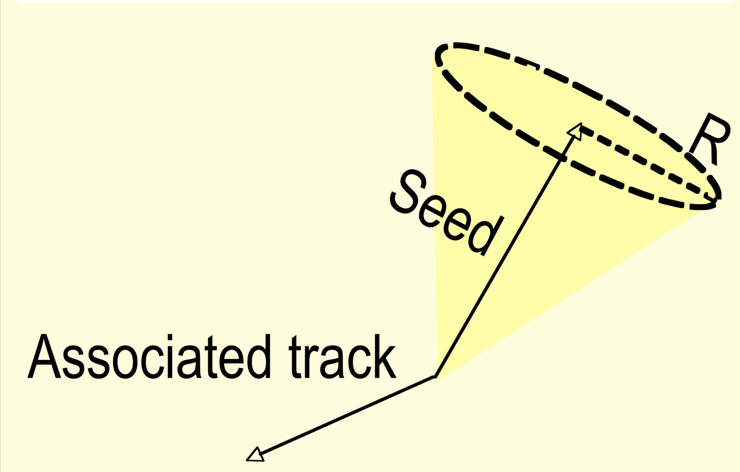
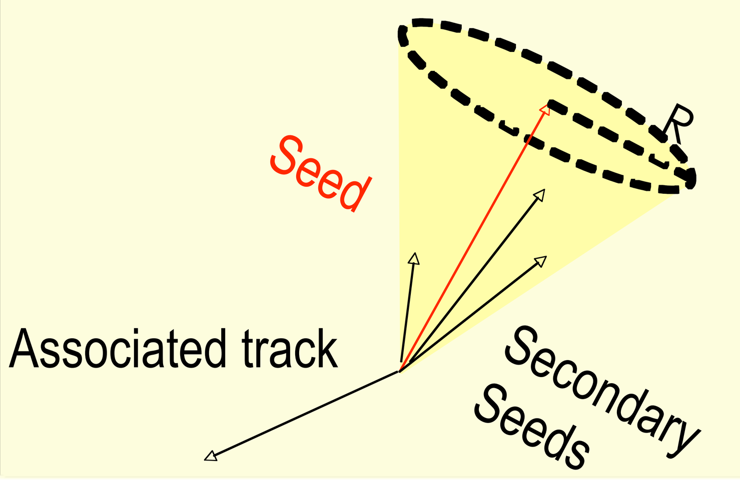
Di-hadron correlation



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 arrays of "seed" and associated tracks with a minimum seed p_T cut (5.0 GeV) and a minimum associated p_T cut
- Define a cone radius ($R = \sqrt{(\Delta\eta^2 + \Delta\varphi^2)}$, for this analysis we choose 0.3)
  - p_T trigger = p_T sum of all the associated tracks (secondary seeds) in that cone
- Plot $\Delta\varphi$ between the highest p_T seed in the cone and associated tracks
  - Subtract a flat background as a first approximation
  - Extract Away Side Yields:
  - p_T (trigger) = 10 to 12 GeV & 12 to 15 GeV
  - p_T (assoc) = 3 to 4, … ,10 to 11 GeV

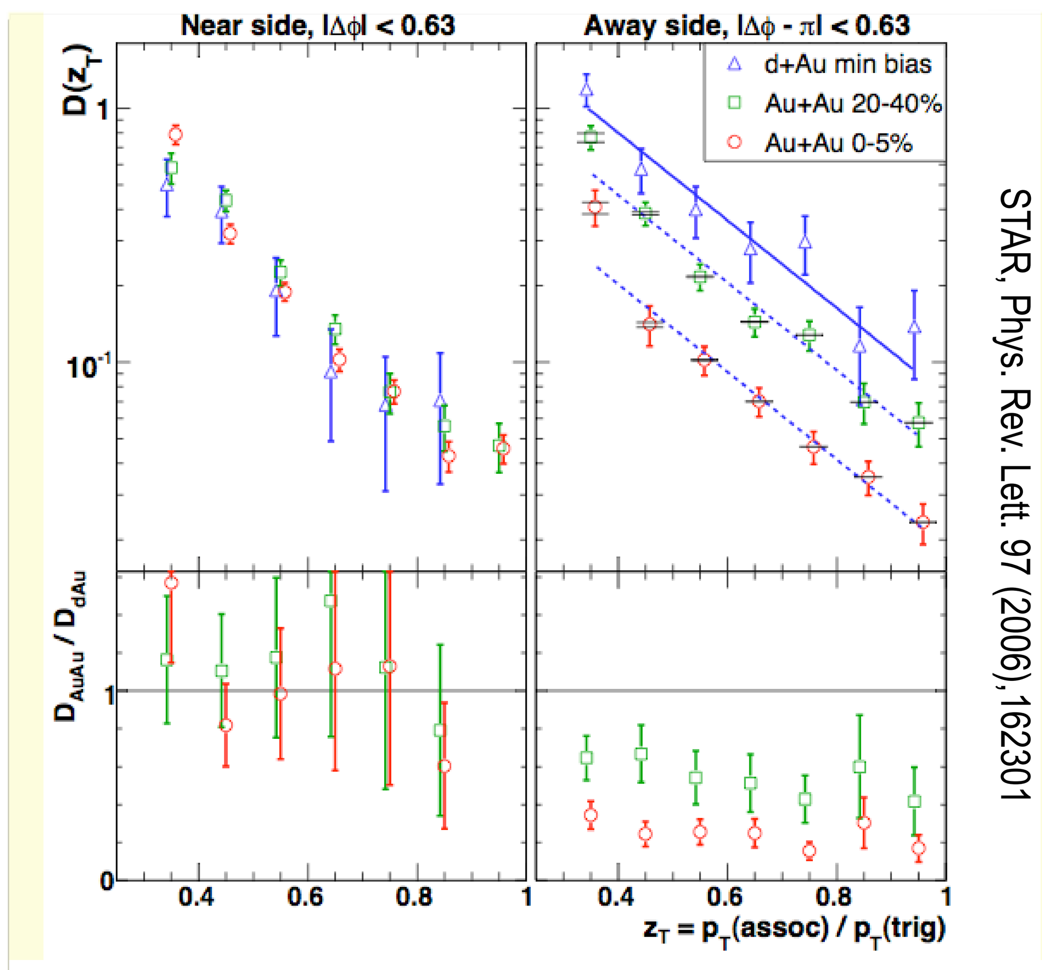
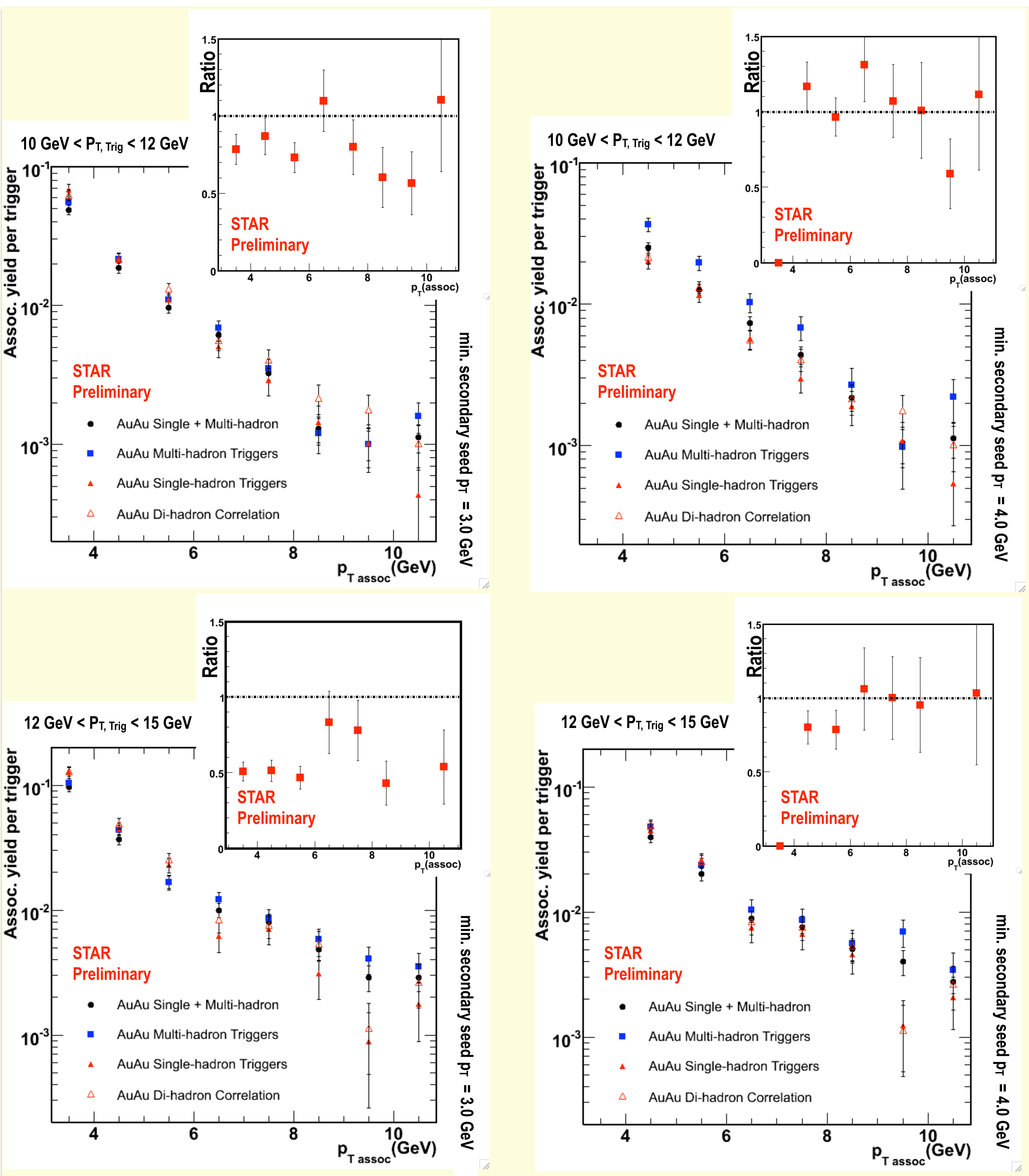


Figure 1: The fragmentation function, D(z), depends on z defined as $p_T/E_{T,jet}$, the fraction of momentum carried by a fragmented hadron from a jet. The current method of di-hadron correlations is insensitive to true fragmentation functions as it approximates $E_{T,jet}$ from the leading hadron in a jet. We implement the multi-hadron trigger as a better approximation to $E_{T,jet}$ and subsequently to fragmentation functions.



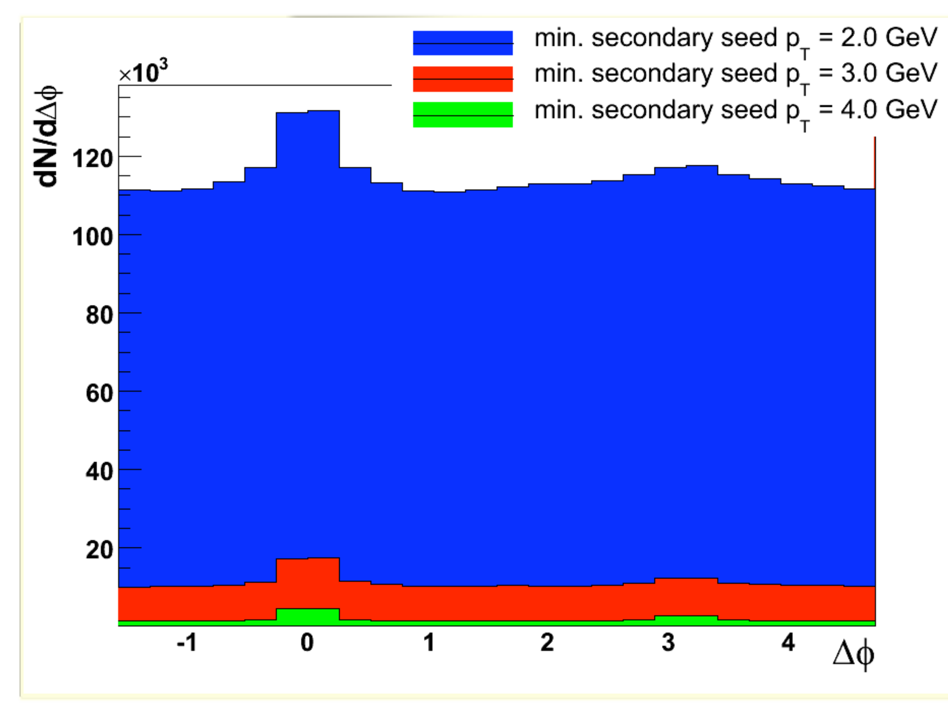
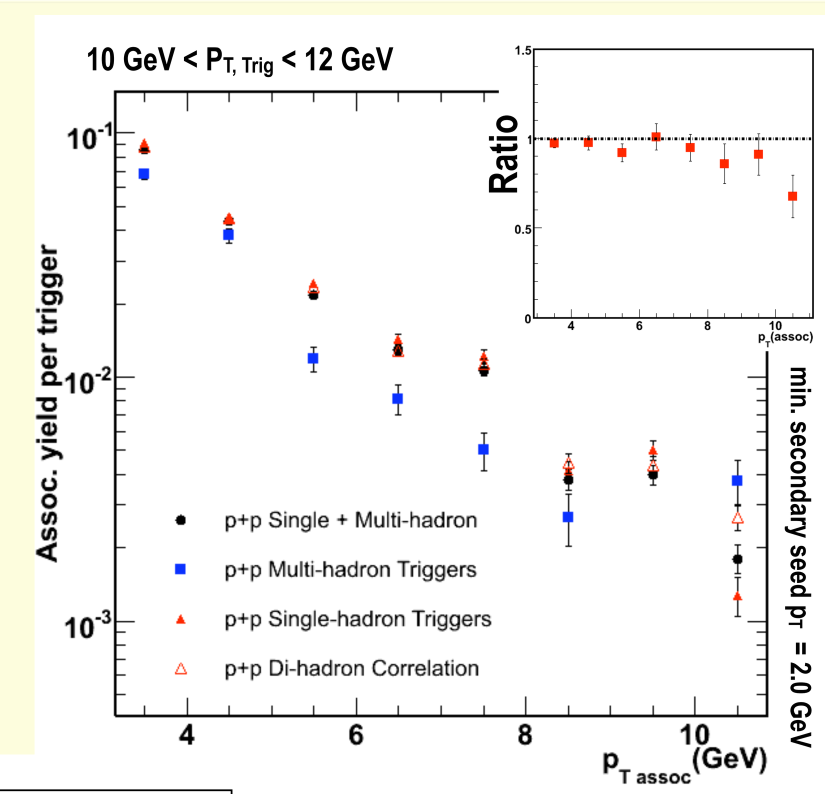


Figure 2: Sample azimuthal correlation as a function of minimum secondary seed p_T. As secondary seed p_T increases, random background decreases.



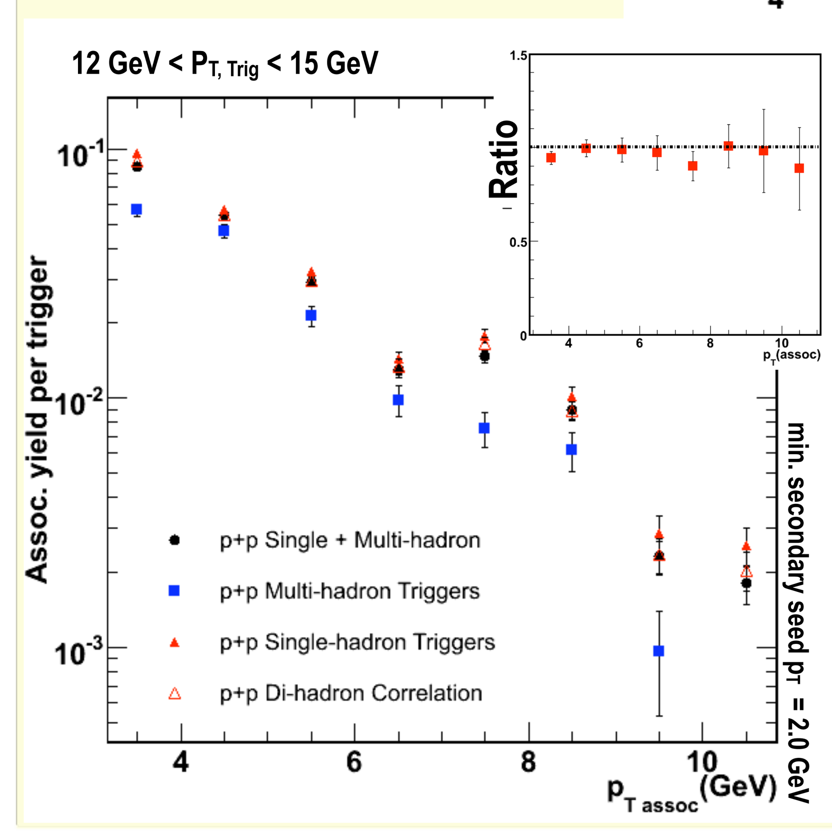


Figure 3 & 4: Pythia predictions for away-side yields per trigger for 10 GeV < $p_{T,Trig}$ < 12 GeV (above) and 12 GeV < $p_{T,Trig}$ < 15 GeV (left). Inlaid plots show ratio of single +multi-hadron yields to di-hadron correlations. More statistics will be required for a thorough study of multi-hadron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

The plots above (statistical errors only) compare away-side yields per trigger for multi-hadron triggers and di-hadron correlations for two different trigger bins: **10 GeV < $p_{T,Trig}$ < 12 GeV** and **12 GeV < $p_{T,Trig}$ < 15 GeV**, and two different minimum secondary seed cuts of **3.0 GeV and 4.0 GeV**. Black filled circles represent all triggers collected in the multi-hadron algorithm. This includes triggers with only a primary seed within the jet cone radius (Single), and those with a primary and 1 or more secondary seeds (Multi-hadron). Blue filled squares represent Multi-hadron triggers sorted out from Single triggers (filled red triangles). The inset plots show the ratio of Single+Multi-hadron triggers to Di-hadron Correlations. The dotted line shows where the ratio is equal to 1. The ratios fall around unity and are relatively flat. We observe no significant variation with increasing secondary seed cut.

The Multi-hadron and Di-hadron curves match well for all plots with a slight deviation in the case of 10 GeV < $p_{T,Trig}$ < 12 GeV, and minimum secondary seed cut of 4.0 GeV. This may be due to the multi-hadron trigger algorithm in this case which requires a minimum primary seed of 5 GeV and minimum secondary seed of 4GeV. A decline in the number of multi-hadron triggers due to these requirements could be the source of the difference. A similar effect might be at work in the ratio plots where the first few points fall closer to 0.5 than to 1. Further studies are underway to understand these effects.

SUMMARY AND CONCLUSIONS:

We have investigated multi-hadron triggers as a method of better approximating fragmentation functions. So far we conclude that multi-hadron triggers and di-hadron correlations mostly give very similar results. Ratios of single+multi-hadron trigger yields to di-hadron correlation yields are close to one, implying that the kinematics are not very different in either case. A 10 GeV leading hadron delivers approximately the same result as two hadrons of 7 and 3 GeV adding up to a trigger p_T of 10 GeV. We conclude multi-hadron triggers yield the same physics as di-hadron correlations with the benefit of improved statistics.

Moreover, we have presented initial results of Pythia simulations to understand the expectations for multi-hadron trigger yields. Though more statistics are needed, preliminary results appear to support conclusions from the data.