Multi-hadron Triggered Azimuthal Correlations in Au+Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV from STAR

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Outline

- Introduction / Analysis Technique
  - Motivation for multi-hadron triggers
  - Explanation of a multi-hadron trigger
- Results
  - Away side yields for different p_T trigger bins,
    - 10 to 12 GeV and 12 to 15 GeV
  - Ratios of Cluster triggers to di-hadron triggers
- Conclusions and Outlook

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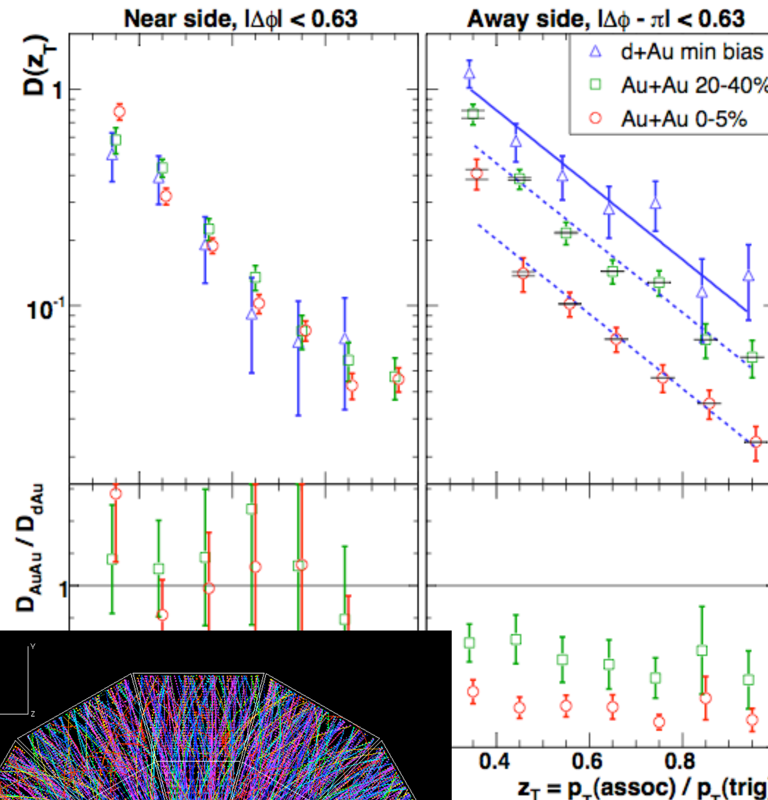
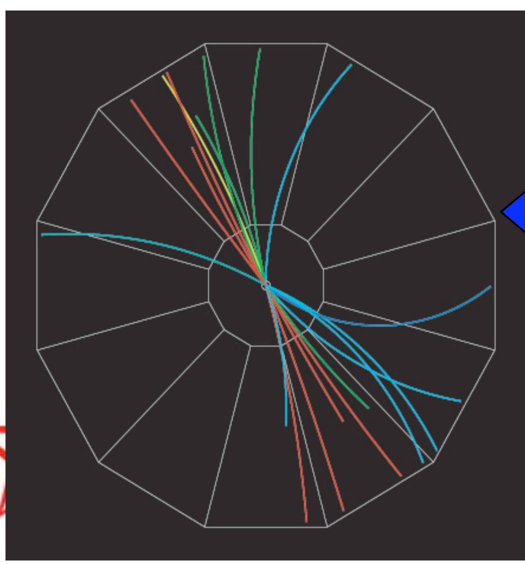
Introduction

- Fragmentation function D(z) depends on z defined as $p_T/E_{T,jet}$
- Current method of Di-hadron correlation is insensitive to true fragmentation functions
- Try multi-hadron (cluster) trigger
  - Better constrain $E_{T,jet} \sim p_T$(trig), better approximation of fragmentation function
  - Gain statistics



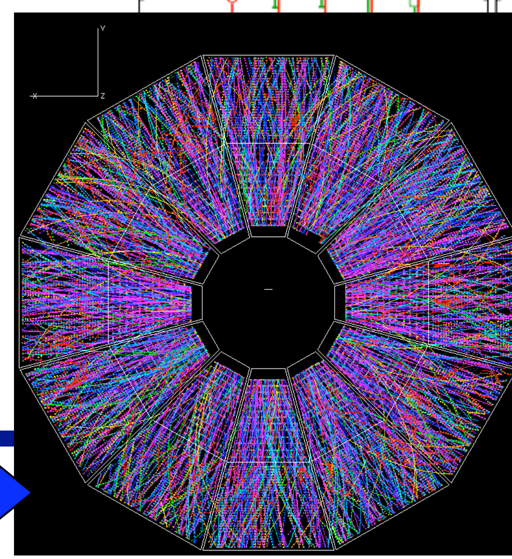
STAR, Phys. Rev. Let. 97 (2006),162301



Find this

A daunting challenge:

In this

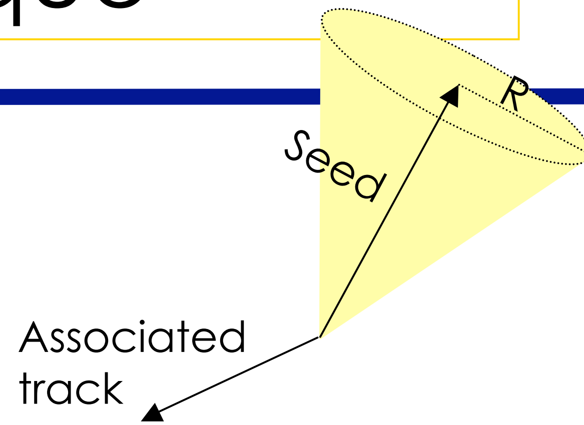


Analysis Technique

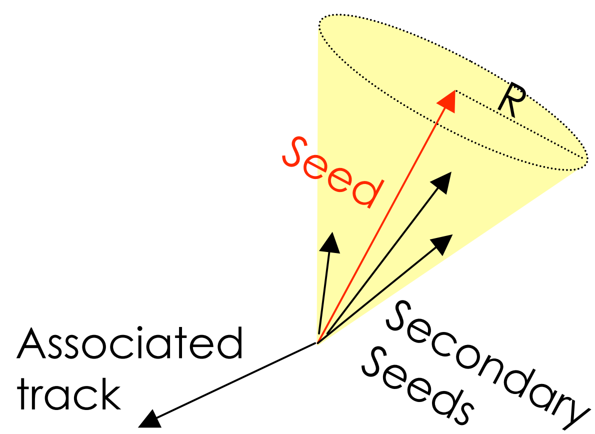
- Collect arrays of seed and associated tracks with a minimum seed p_T cut (5.0 GeV) and a minimum associated p_T cut
- Define a cone radius (R=0.3)
  - p_T trigger = p_T sum of all the associated tracks (secondary seeds) in that cone
- Plot $\Delta\phi$ between the highest p_T seed in the cone and associated tracks
  - Subtract flat background for Au+Au
  - Extract Yields:

p_T (trigger) = 8 to 10 GeV & 12 to 15 GeV

p_T (assoc) = 3 to 4, … ,10 to 11 GeV

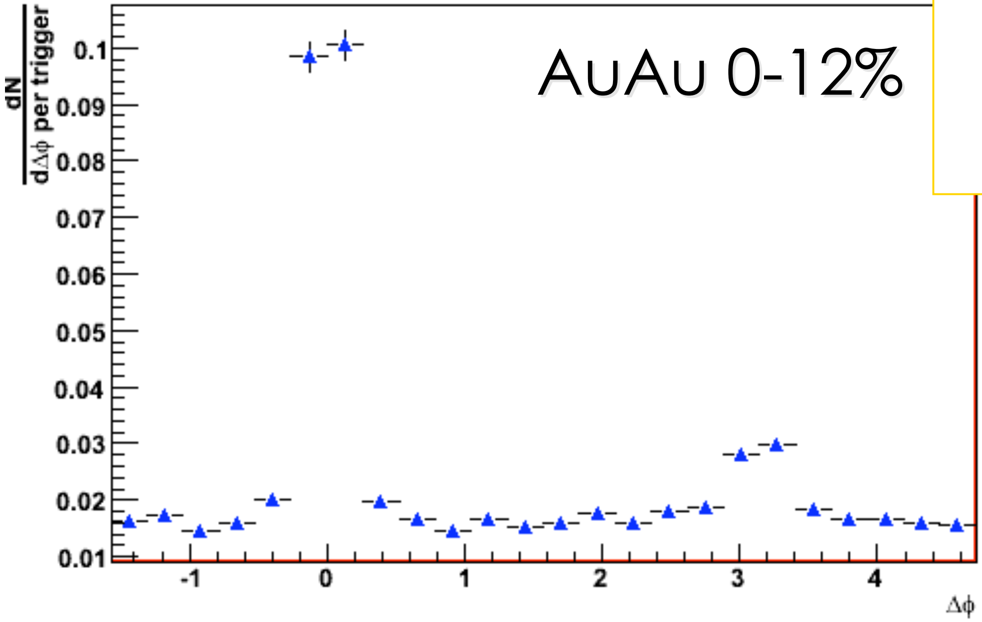


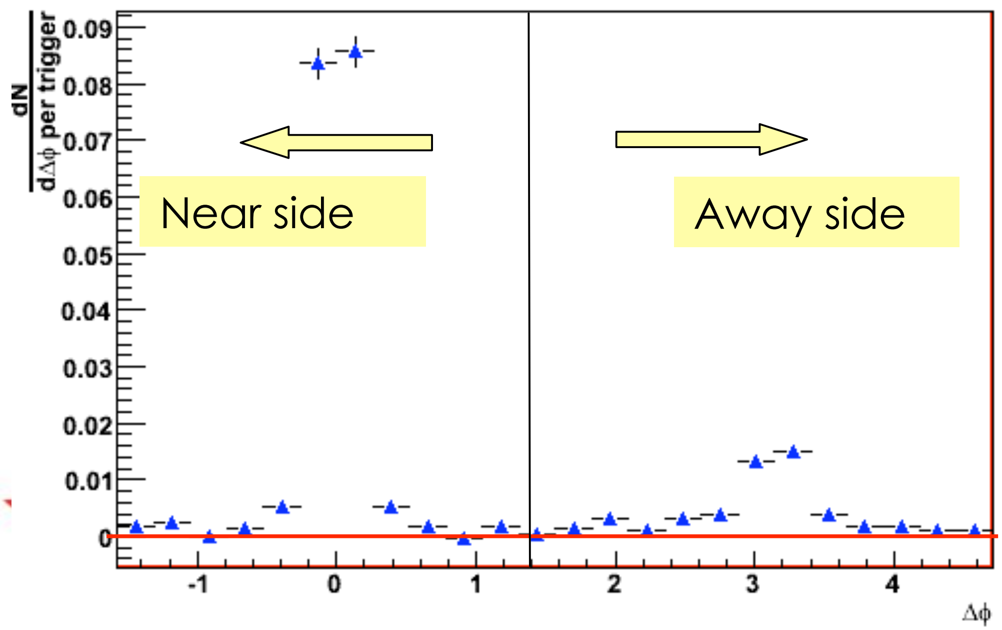
Di-hadron correlation



Multi-hadron trigger

dN/dΔϕ - jet p_T, 12 to 15 GeV, associated p_T, 3 to 4 GeV





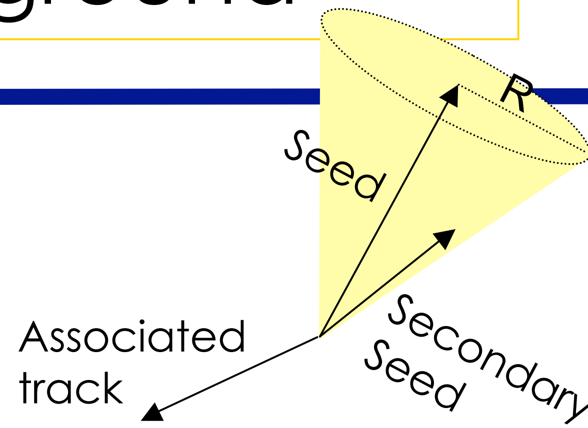
- Plot Δϕ between the highest p_T seed in the cone and associated tracks
  - Subtract flat background for Au+Au
  - Extract Yields:

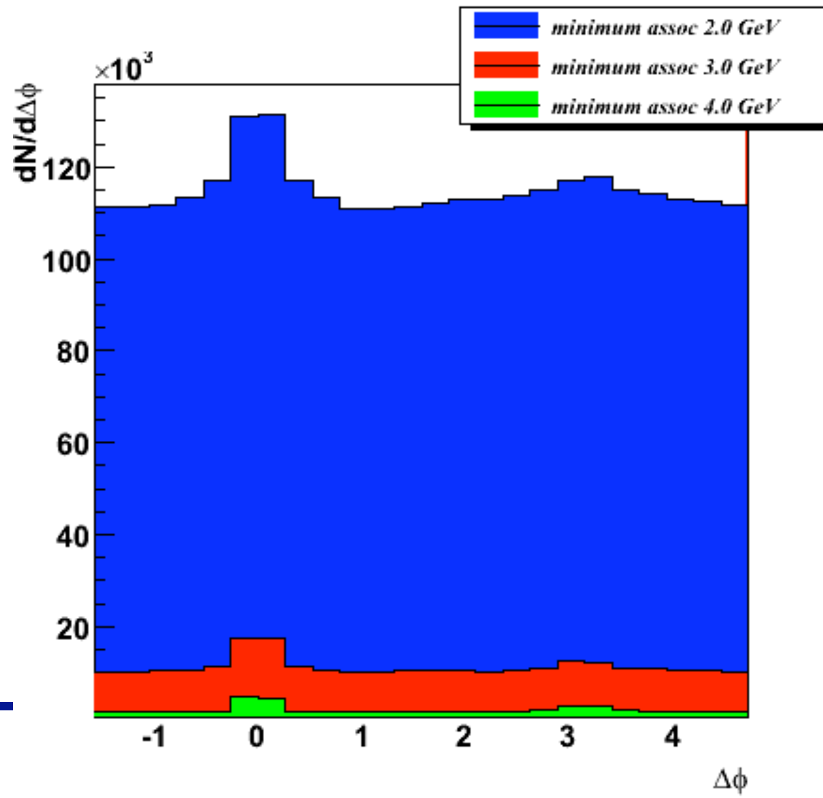
  p_T (trigger) = 8 to 10 GeV & 12 to 15 GeV

  p_T (assoc) = 3 to 4, … ,10 to 11 GeV

Combinatorial Background

- p_T seed > 5.0 GeV
  - Vary minimum secondary seed p_T to test effect of combinatorial background in AuAu
    - 2.0 GeV
    - 3.0 GeV
    - 4.0 GeV





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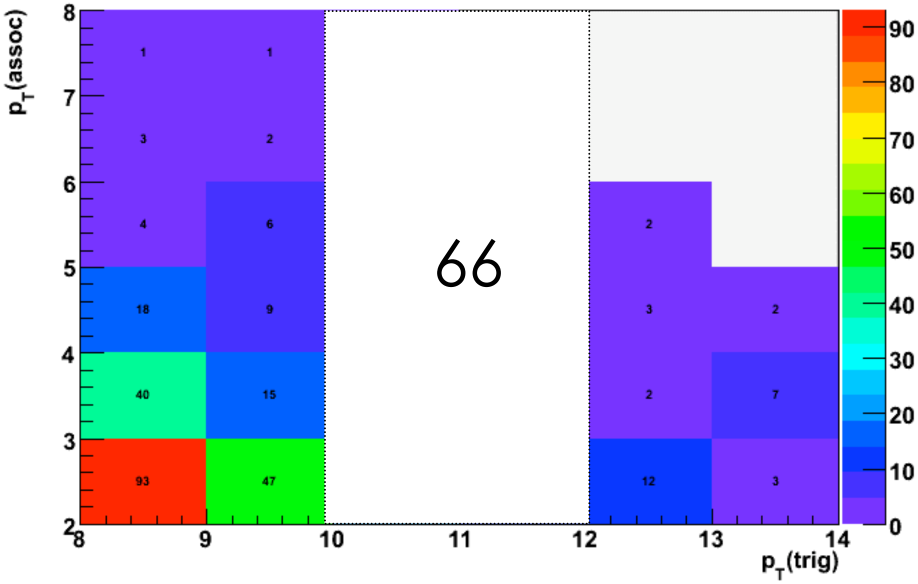
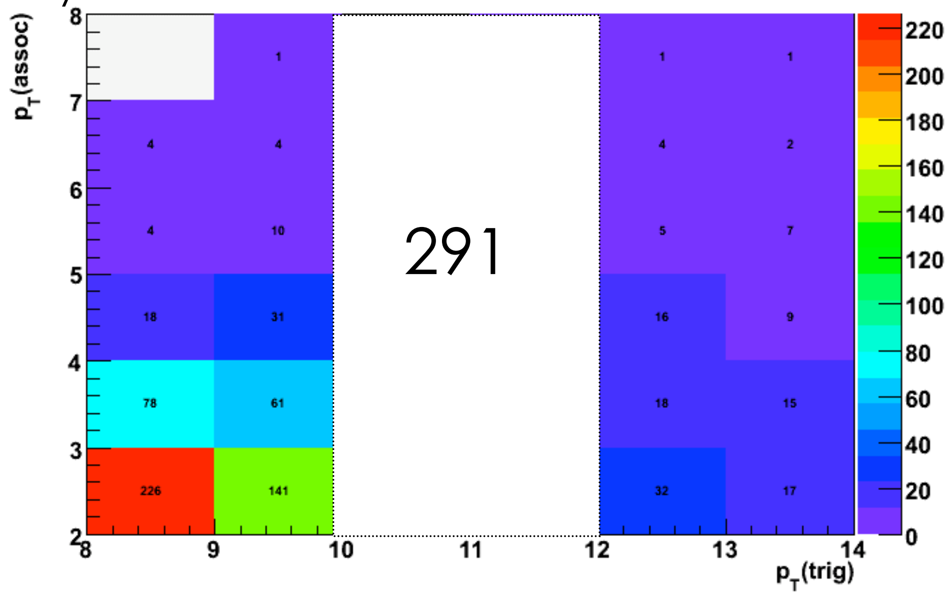
Comparison of single vs. cluster trigger statistics - d+Au

Minimum secondary seed cut = 2.0 GeV



Di-hadron correlation

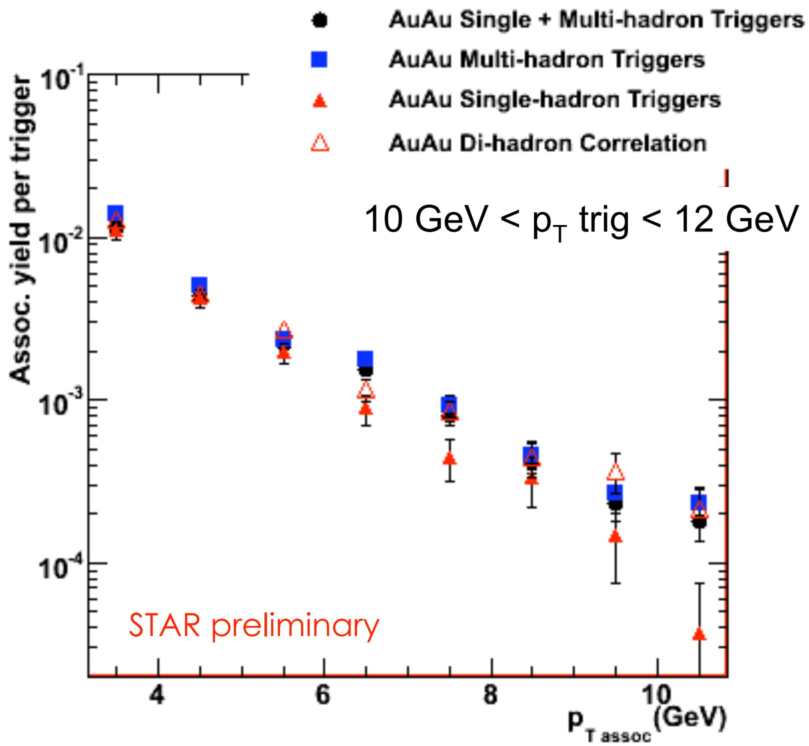


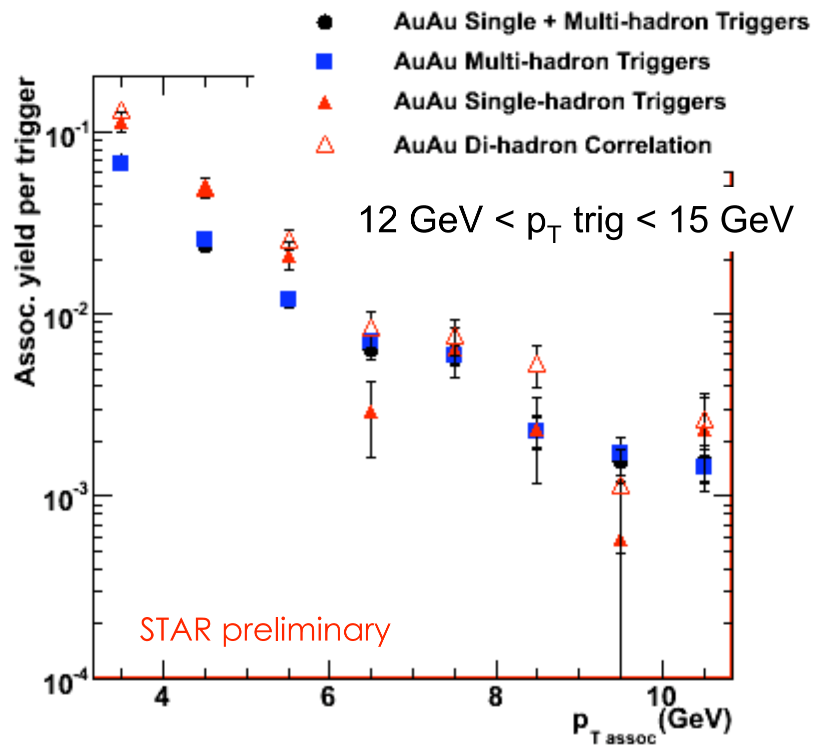
Multi-hadron triggers

- gain statistics by allowing clusters to add up to p_T(trig), not just requiring a single particle to carry p_T(trig)

Away side yields

Minimum secondary seed cut = 2.0 GeV





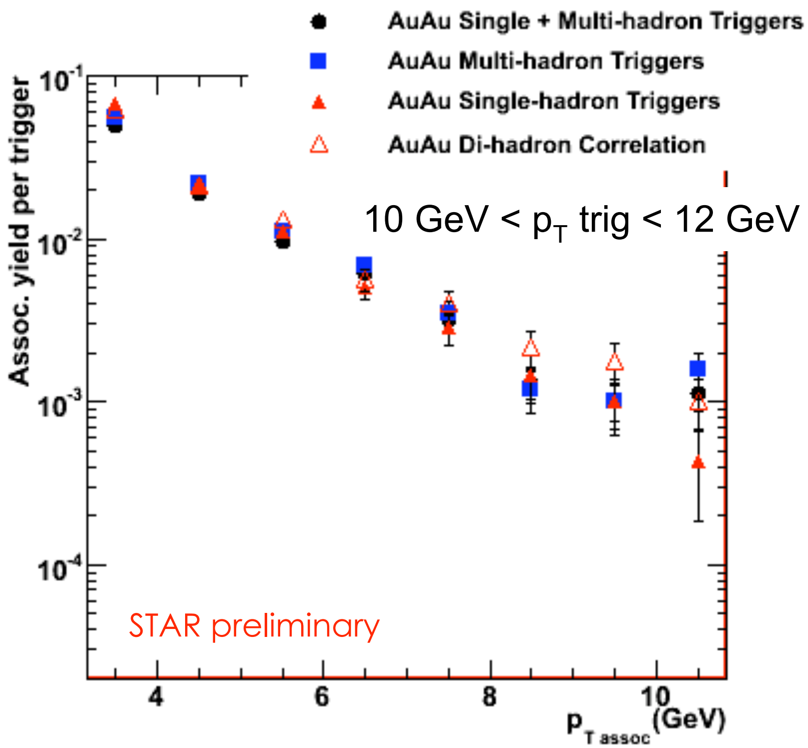
Fraction of Multi-hadron triggers to Single+Multi triggers = 0.83

Fraction of Multi-hadron triggers to Single+Multi triggers = 0.86

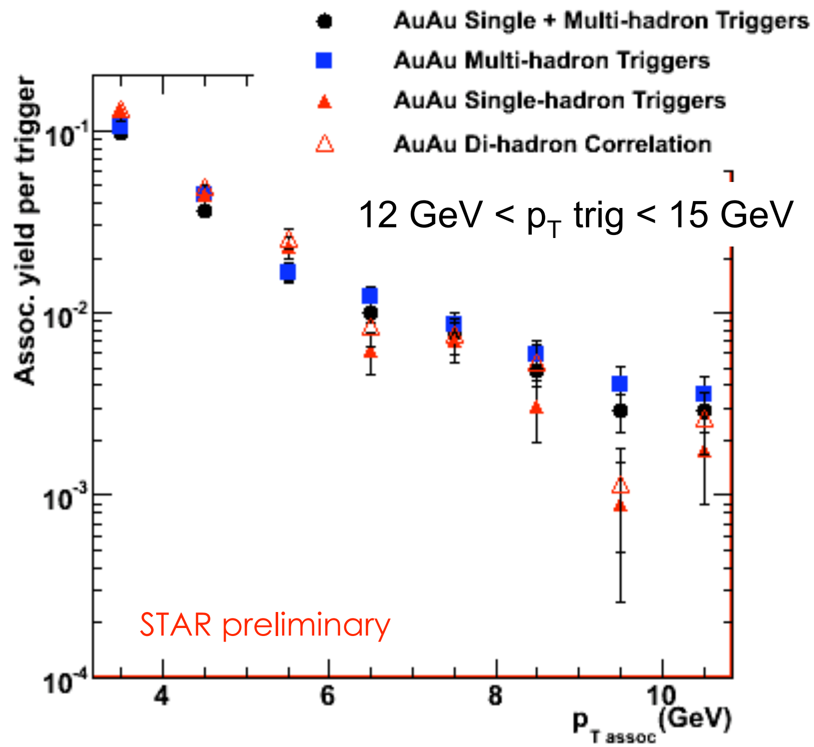
- Multi-hadron and Di-hadron curves match well for 10 < p_T trig <12 GeV
- Multi-hadron and Di-hadron curves match well for 12 < p_T trig <15 GeV, except at lower p_T assoc, likely effect of random clusters

Away side yields

Minimum secondary seed cut = 3.0 GeV



Fraction of Multi-hadron triggers to Single+Multi triggers = 0.59



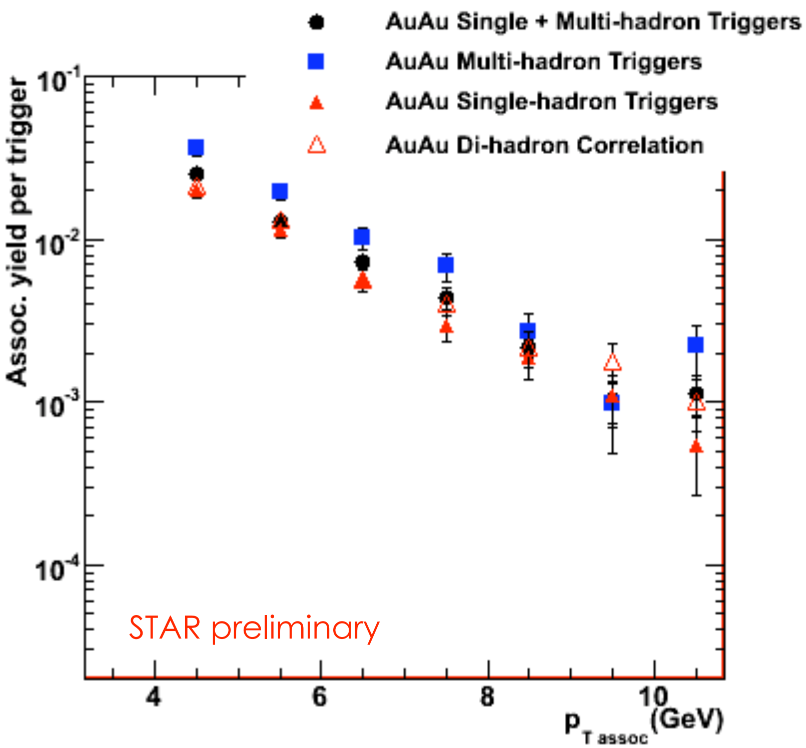
Fraction of Multi-hadron triggers to Single+Multi triggers = 0.64

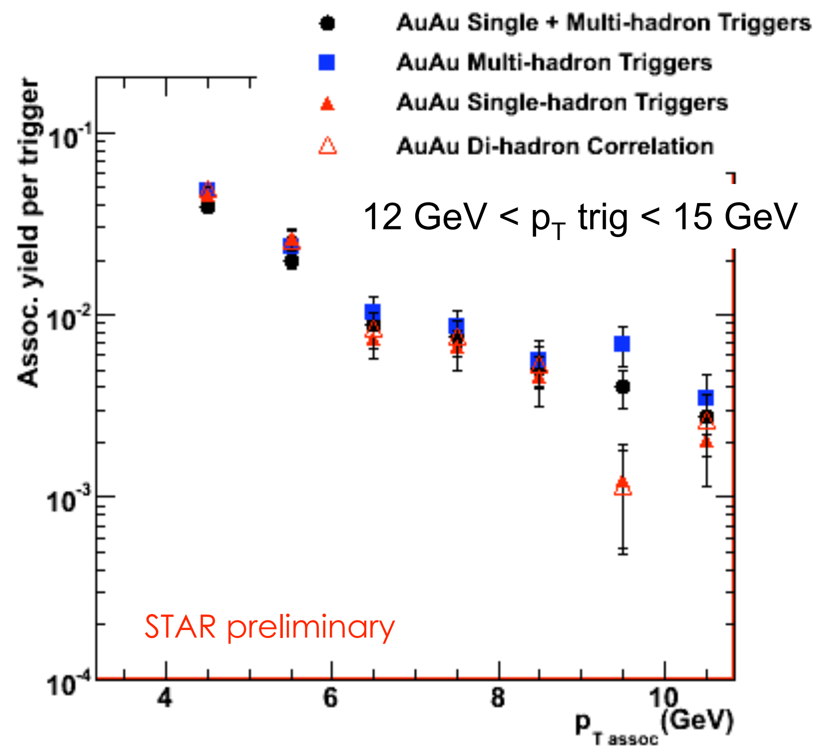
- Multi-hadron and Di-hadron curves match well in both p_T trigger bins
- Fraction of Multi-hadron triggers decreases as secondary seed cut increases

Away side yields

Minimum secondary seed cut = 4.0 GeV

10 GeV < p_T trig < 12 GeV





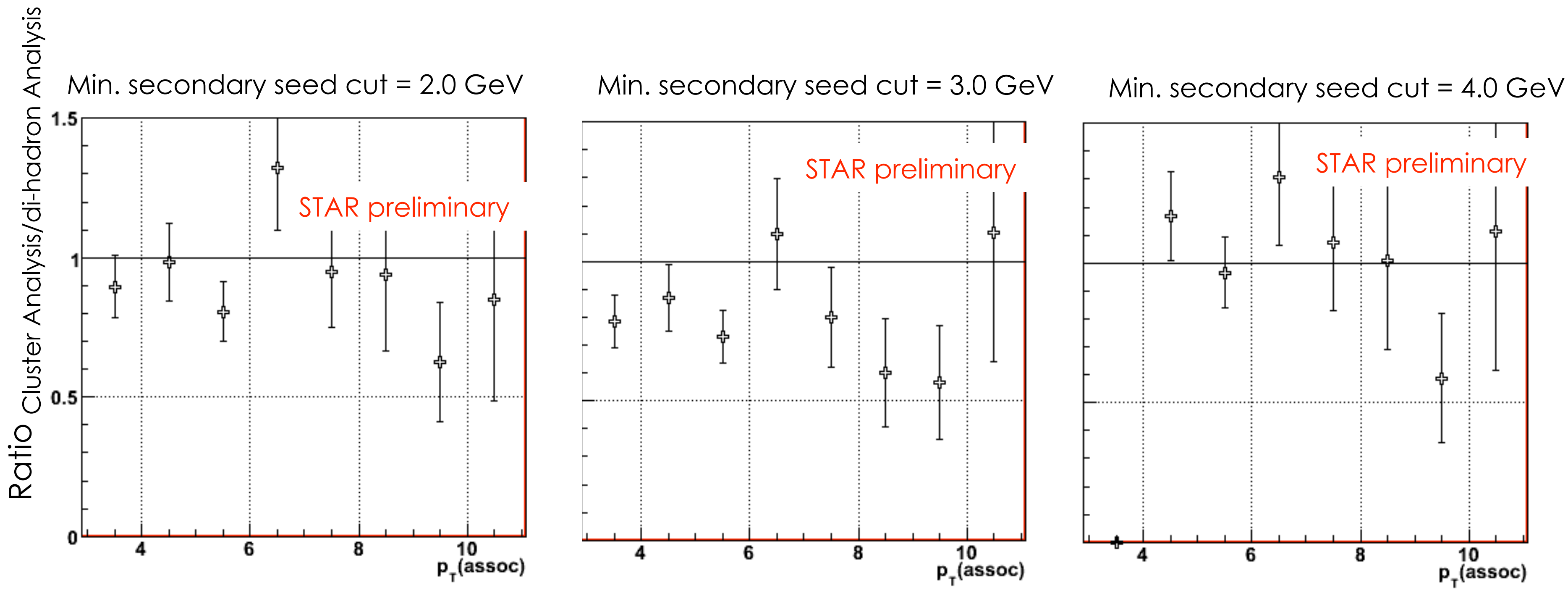
Fraction of Multi-hadron triggers to Single+Multi triggers = 0.36

Fraction of Multi-hadron triggers to Single+Multi triggers = 0.21

- Multi-hadron and Di-hadron curves match well for 12 < p_T trig < 15 GeV
- For 10 < p_T trig < 12 GeV, Multi-hadron triggers have slightly lower yield than Di-hadrons, possible effect of minimum seed/secondary seed cuts
- Fraction of Multi-hadron triggers decreases as secondary seed cut increases

Ratios: Single+Multi-hadron triggers to Di-hadrons

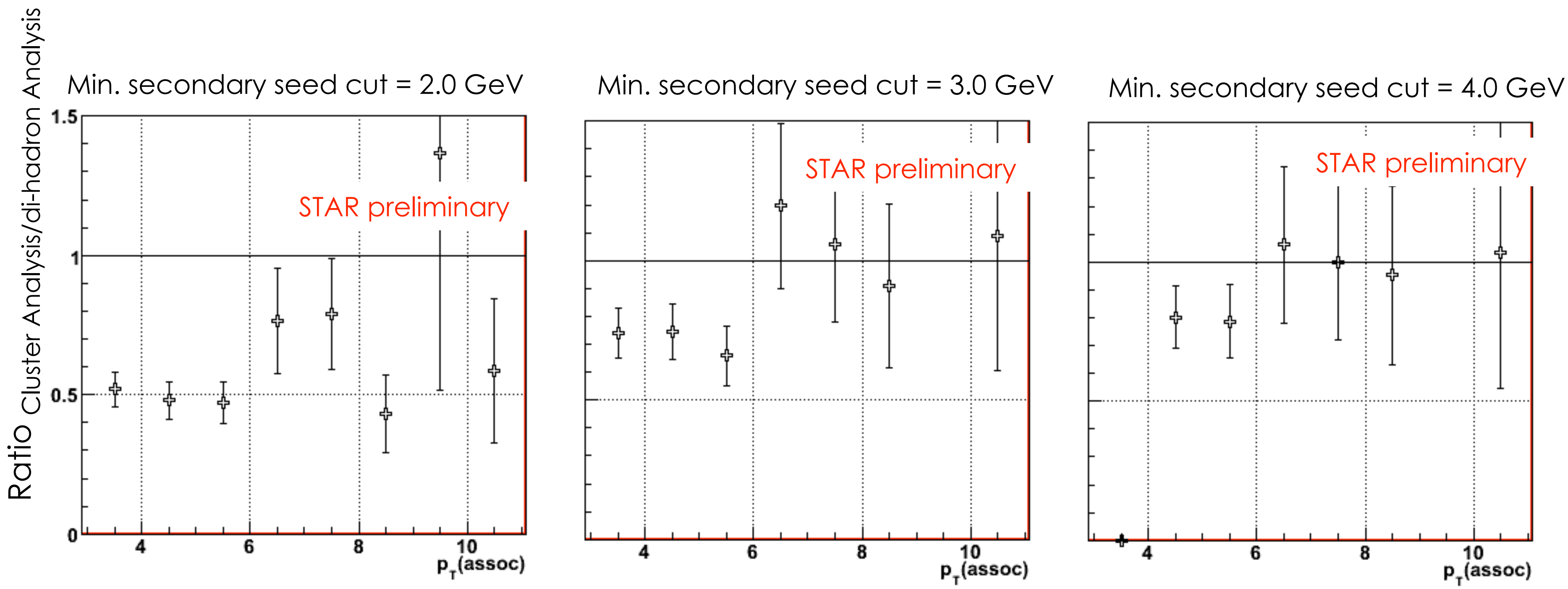
- 10 GeV < p_T trig < 12 GeV -



- Ratios (systematic errors only) fall around unity and are relatively flat. No significant variation with increasing secondary seed cut.
- The single+multi-hadron triggers sample same kinematics as di-hadron correlations.

Ratios: Single+Multi-hadron triggers to Di-hadrons

- 12 GeV < p_T trig < 15 GeV -



- Excluding lowest p_T associated bins affected by random clusters, ratios (systematic errors only) fall around unity and are relatively flat. No significant variation with increasing secondary seed cut.
- The single+multi-hadron triggers sample same kinematics as di-hadron correlations.

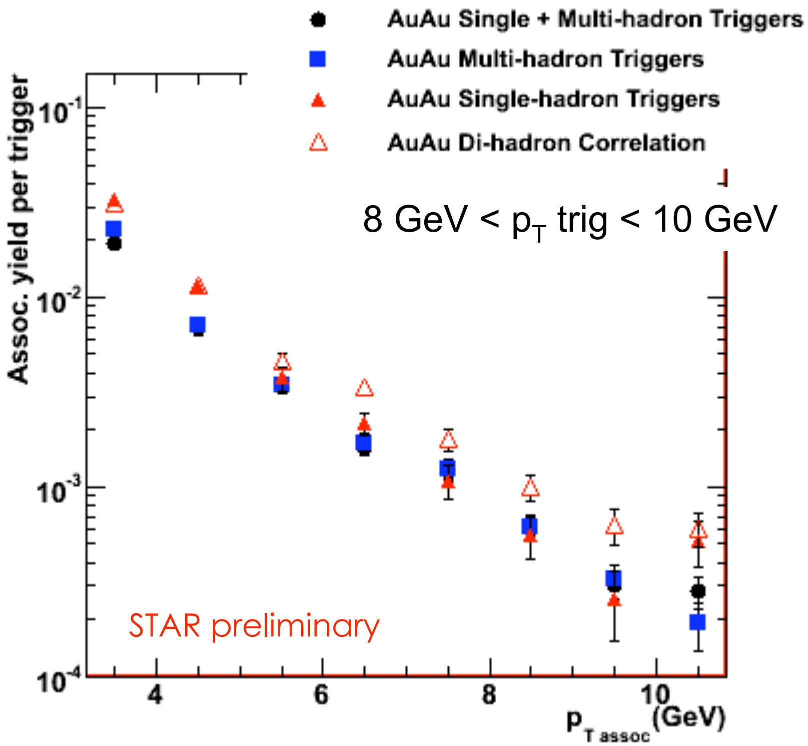
Conclusions and Outlook

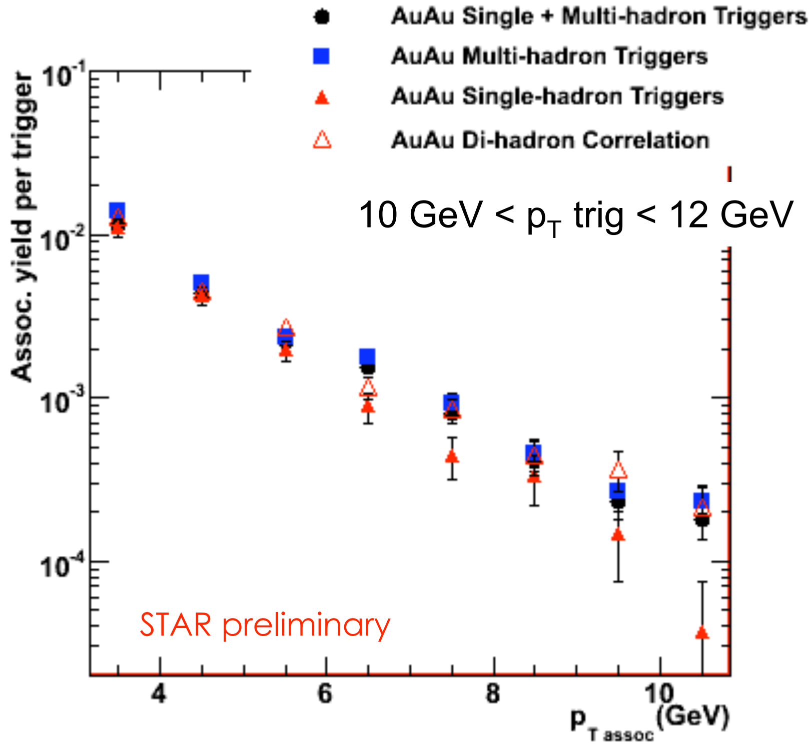
- Investigated Multi-hadron triggers as a method of better approximating fragmentation functions
  - Multi-hadron triggers and Di-hadron correlations mostly give very similar results
  - Also ratios of Single+Multi-hadron trigger yields to di-hadron yields show slopes not different, kinematics not very different
- Multi-hadron triggers yield the same physics as di-hadron correlations with improved statistics
  - Method is promising, more work is needed
    - Pythia simulations to understand expectations for multi-hadron trigger yields
    - Study yields for different jet cone radii
    - Look at higher p_T trigger > 15 GeV

Backup Slides

Away side yields

Minimum secondary seed cut = 2.0 GeV



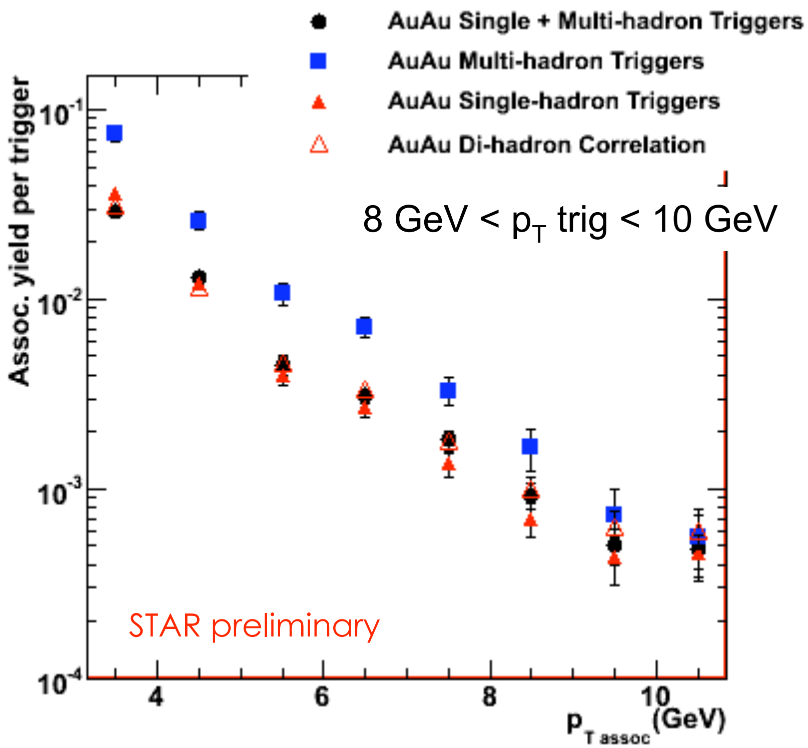


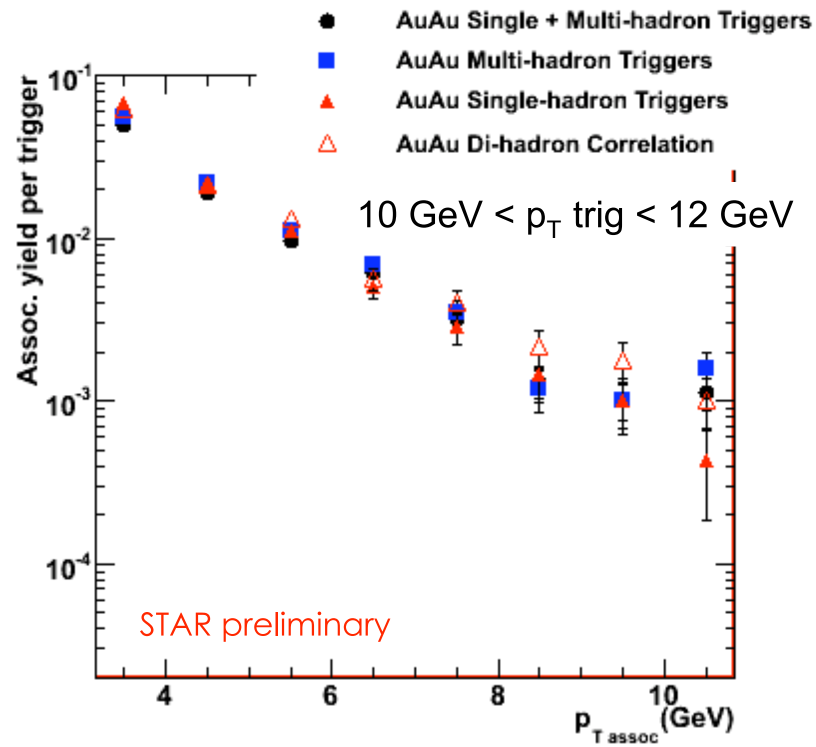
Fraction of Multi-hadron triggers to Single+Multi triggers = 0.72

Fraction of Multi-hadron triggers to Single+Multi triggers = 0.83

Away side yields

Minimum secondary seed cut = 3.0 GeV



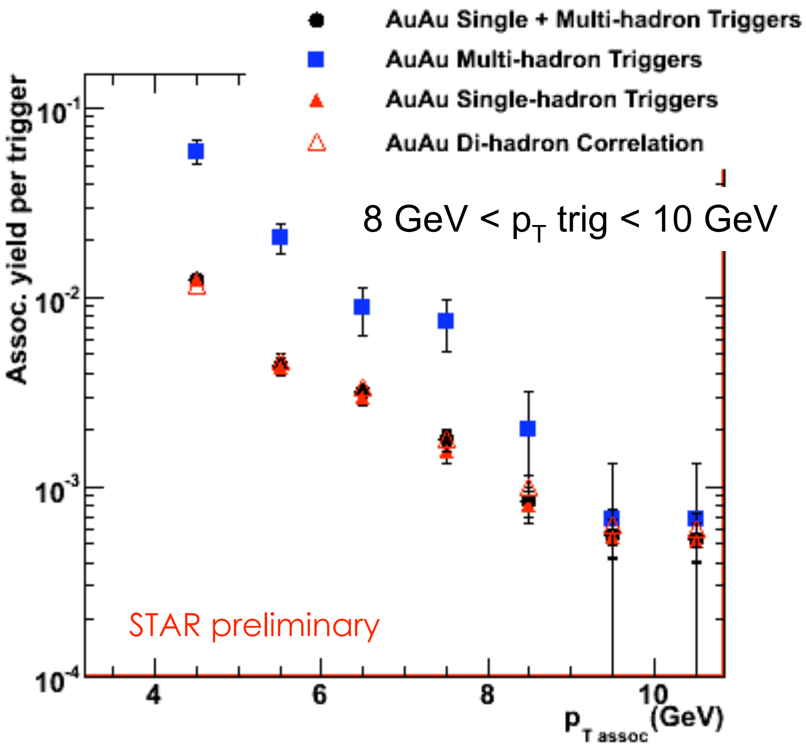


Fraction of Multi-hadron triggers to Single+Multi triggers = 0.24

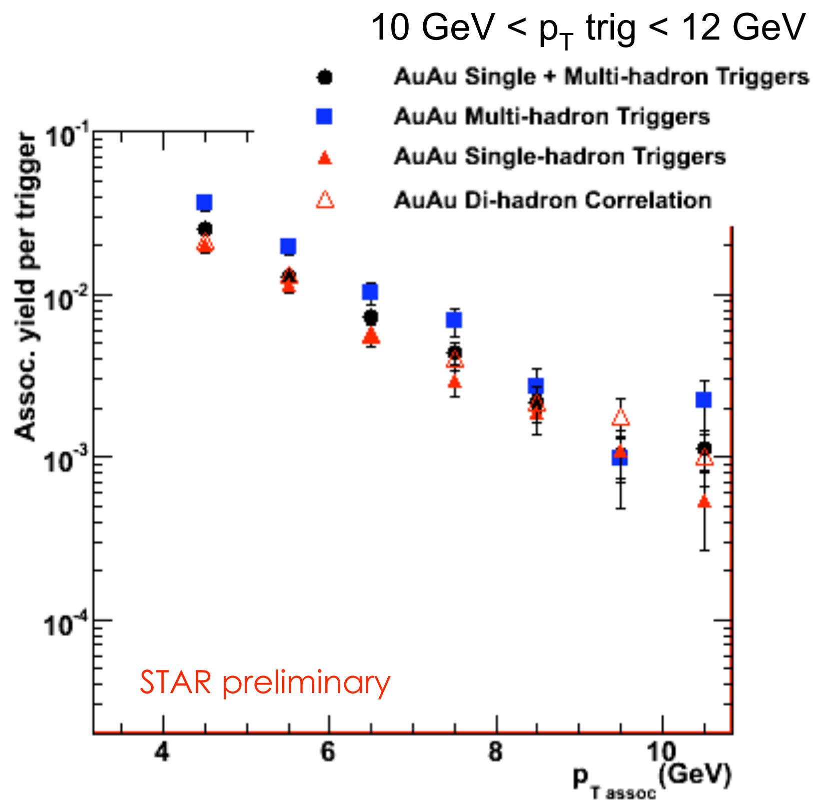
Fraction of Multi-hadron triggers to Single+Multi triggers = 0.59

Away side yields

Minimum secondary seed cut = 4.0 GeV



Fraction of Multi-hadron triggers to Single+Multi triggers = 0.04



Fraction of Multi-hadron triggers to Single+Multi triggers = 0.36

Ratios: Single+Multi-hadron triggers to Di-hadrons

- 8 GeV < p_T trig < 10 GeV -