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

Brooke Haag
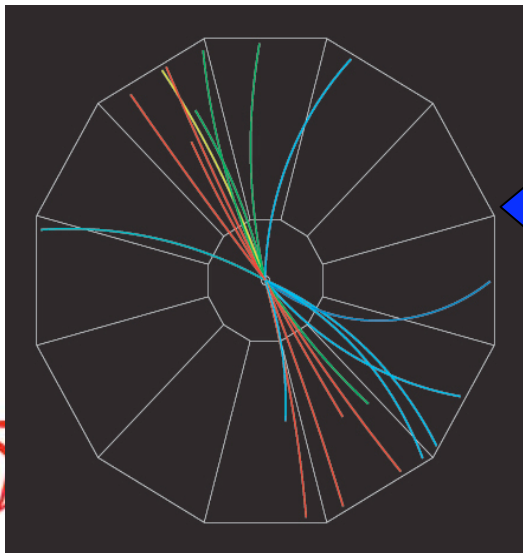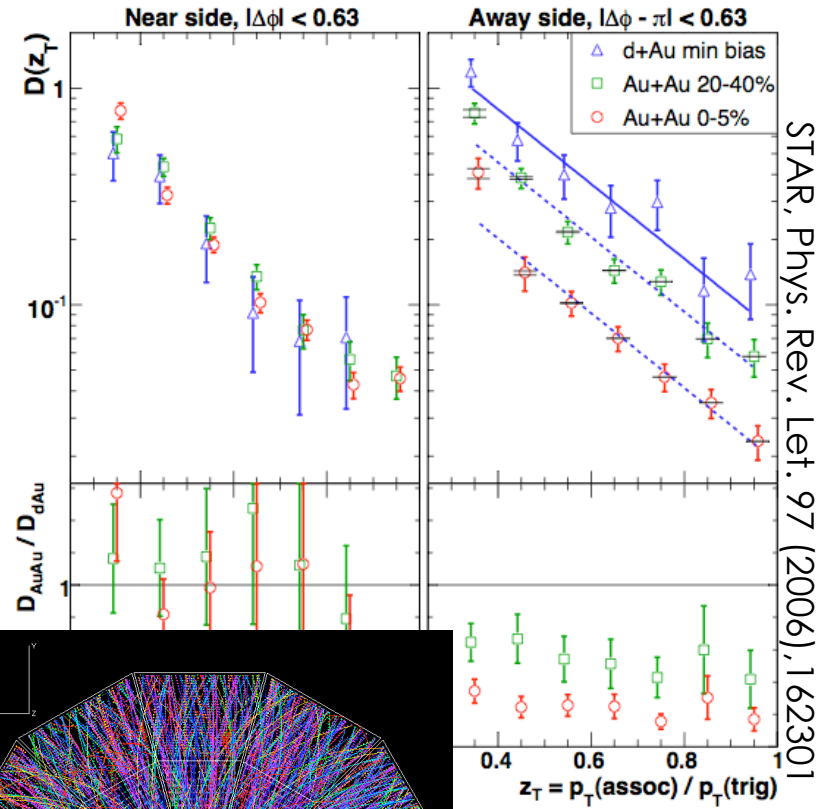
UC Davis

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,
    - 8 to 10 GeV and 12 to 15 GeV
  - Ratios of Cluster triggers to di-hadron triggers
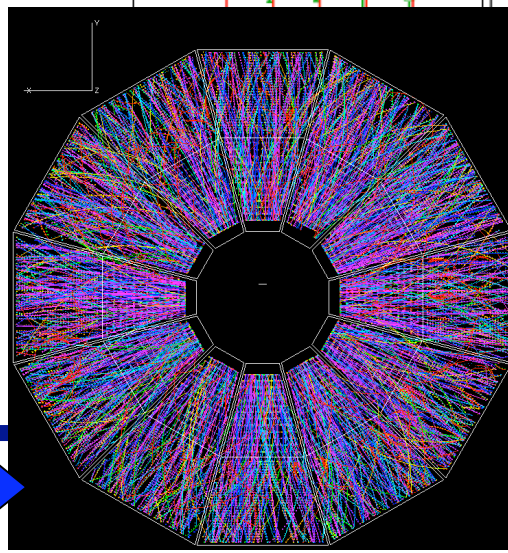- Conclusions and Outlook

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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

Find this

A daunting challenge:

In this Daunting

Near side, $|\Delta\phi| < 0.63$

Away side, $|\Delta\phi - \pi| < 0.63$

- d+Au min bias
- Au+Au 20-40%
- Au+Au 0-5%

$D(z_T)$

D_{AuAu}/D_{dAu}

$z_T = p_T(assoc) / p_T(trig)$

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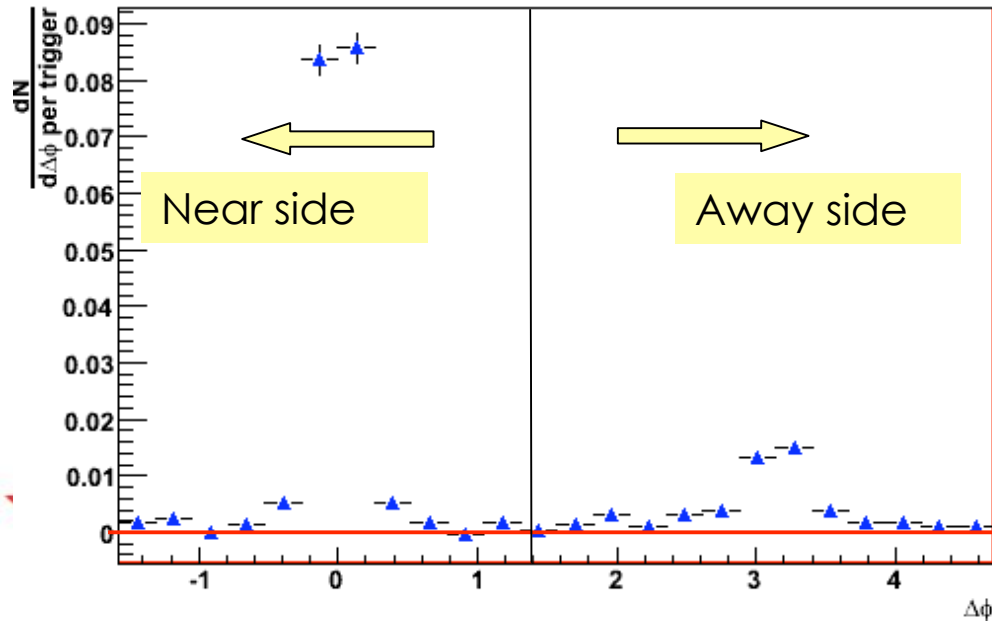 p_T (assoc) = 3 to 4, ... ,10 to 11 GeV
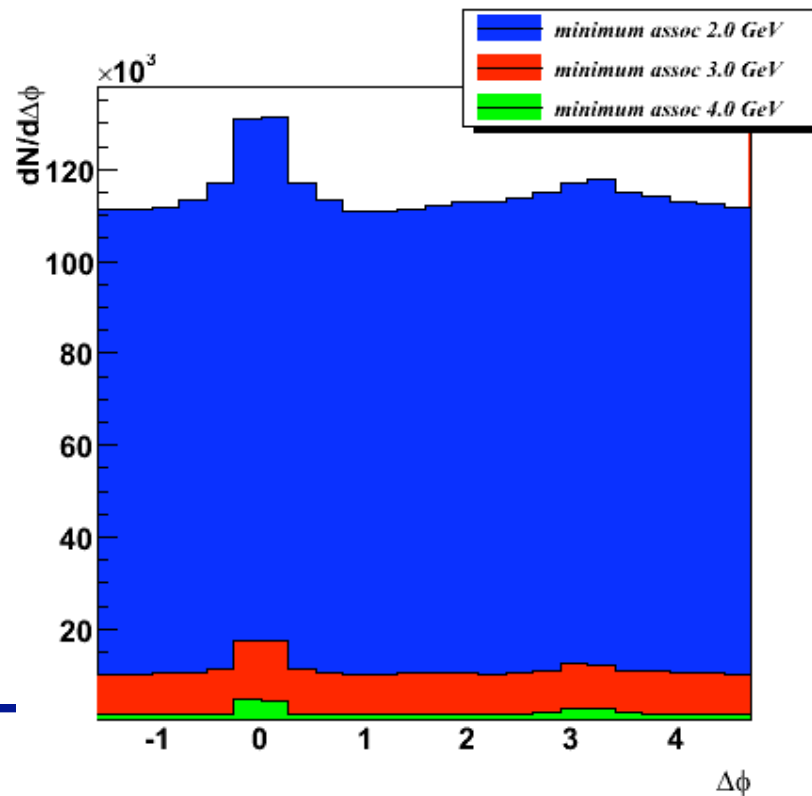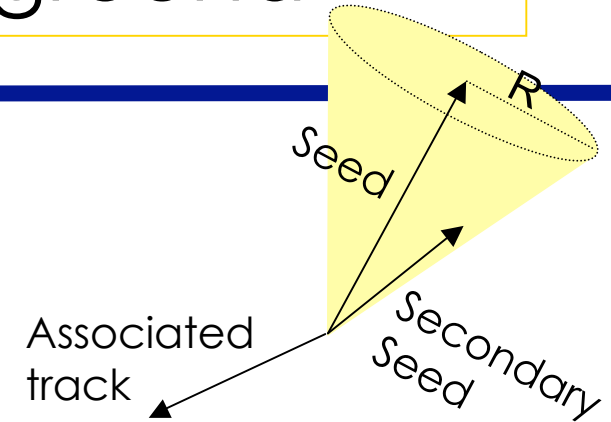

Di-hadron correlation

Multi-hadron trigger

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AuAu 0-12%
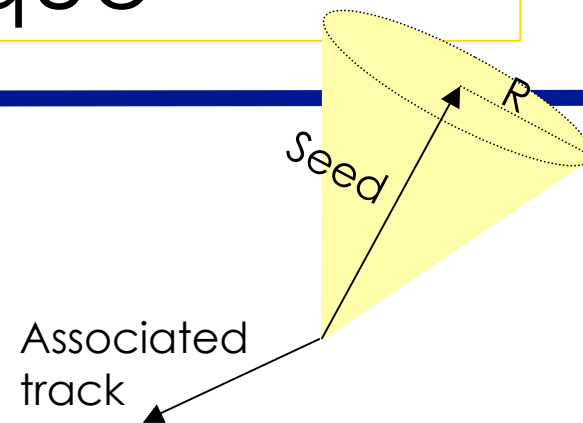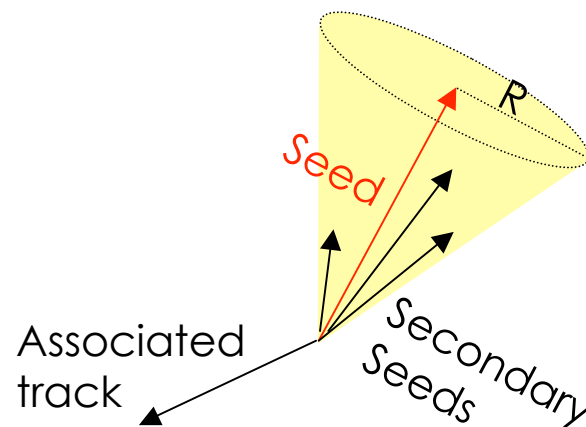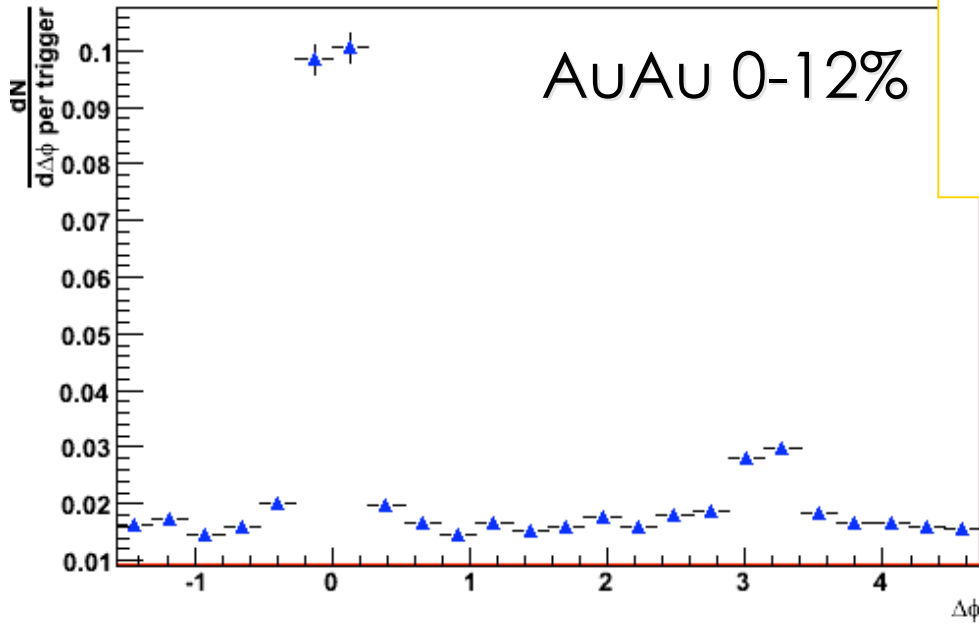
dN/dΔφ - jet p_T, 12 to 15 GeV, associated p_T, 3 to 4 GeV

Near side

Away side

- 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

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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

R

Seed

Secondary Seed

Associated track

minimum assoc 2.0 GeV
minimum assoc 3.0 GeV
minimum assoc 4.0 GeV

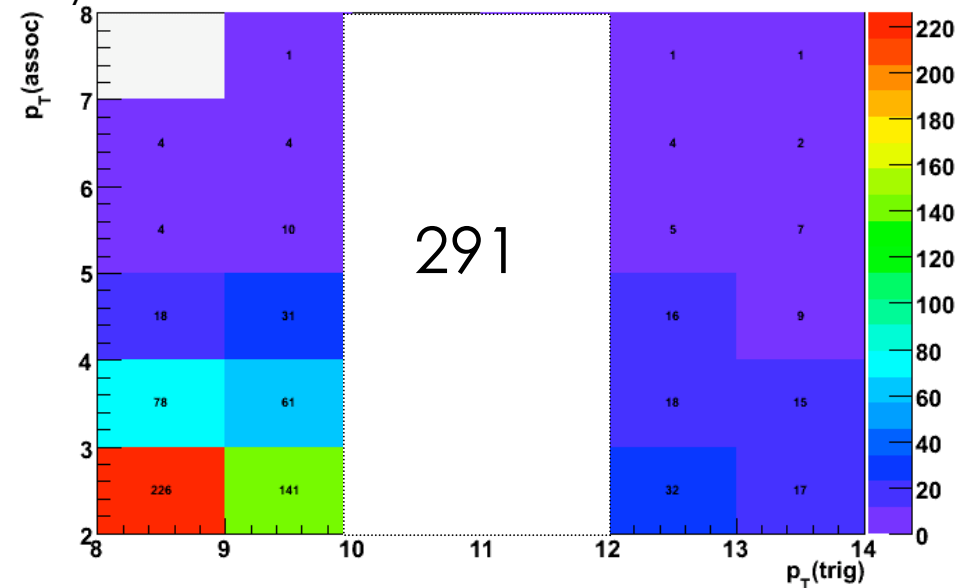$dN/d\Delta\phi$

$\Delta\phi$

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Comparison of single vs. cluster trigger statistics - d+Au
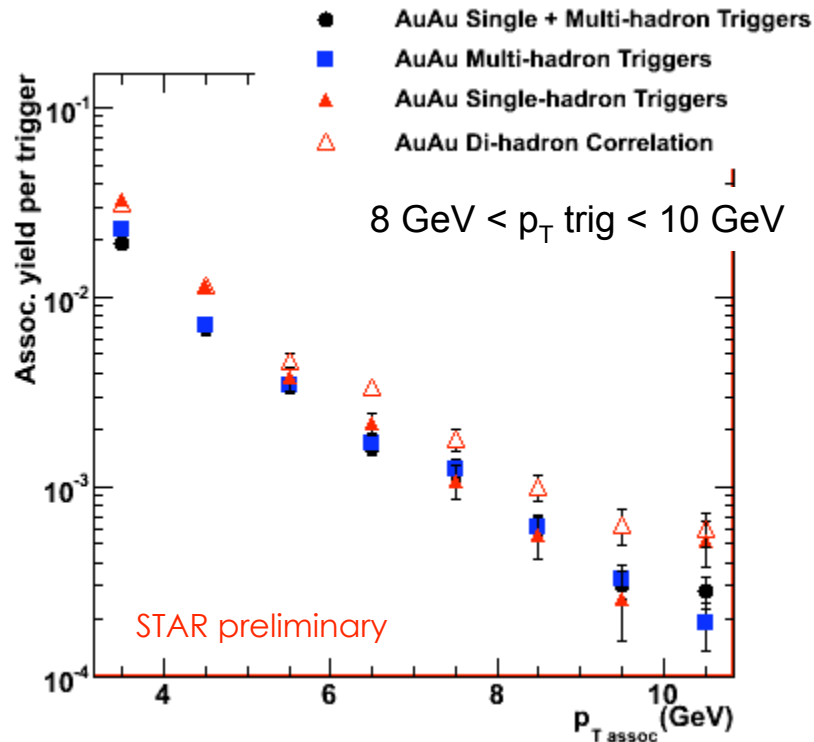
Minimum secondary seed cut = 2.0 GeV
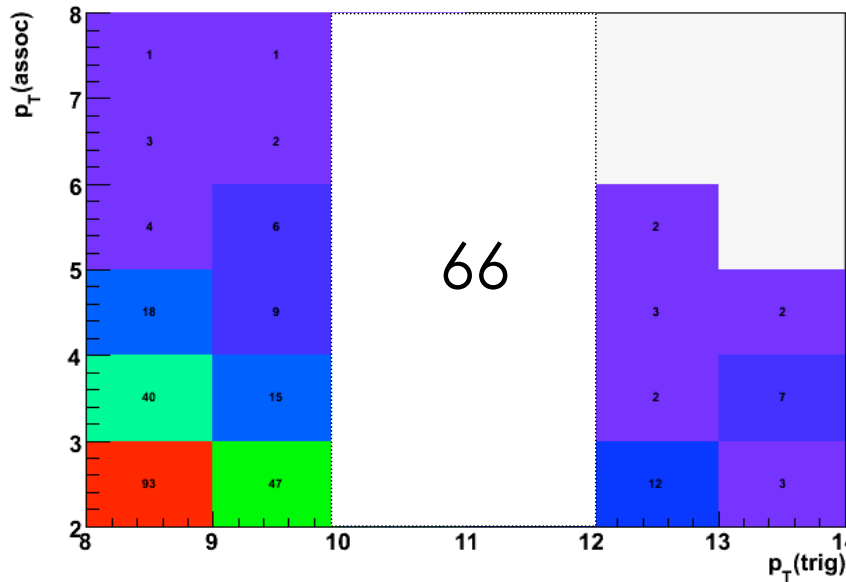
Di-hadron correlation

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

Legend (left plot):
- ● AuAu Single + Multi-hadron Triggers
- ■ AuAu Multi-hadron Triggers
- ▲ AuAu Single-hadron Triggers
- △ AuAu Di-hadron Correlation

$8\ \text{GeV} < p_T\ \text{trig} < 10\ \text{GeV}$

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Fraction of Multi-hadron triggers to Single+Multi triggers = 0.81

Legend (right plot):
- ● AuAu Single + Multi-hadron Triggers
- ■ AuAu Multi-hadron Triggers
- ▲ AuAu Single-hadron Triggers
- △ AuAu Di-hadron Correlation

$12\ \text{GeV} < p_T\ \text{trig} < 15\ \text{GeV}$

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Fraction of Multi-hadron triggers to Single+Multi triggers = 0.88
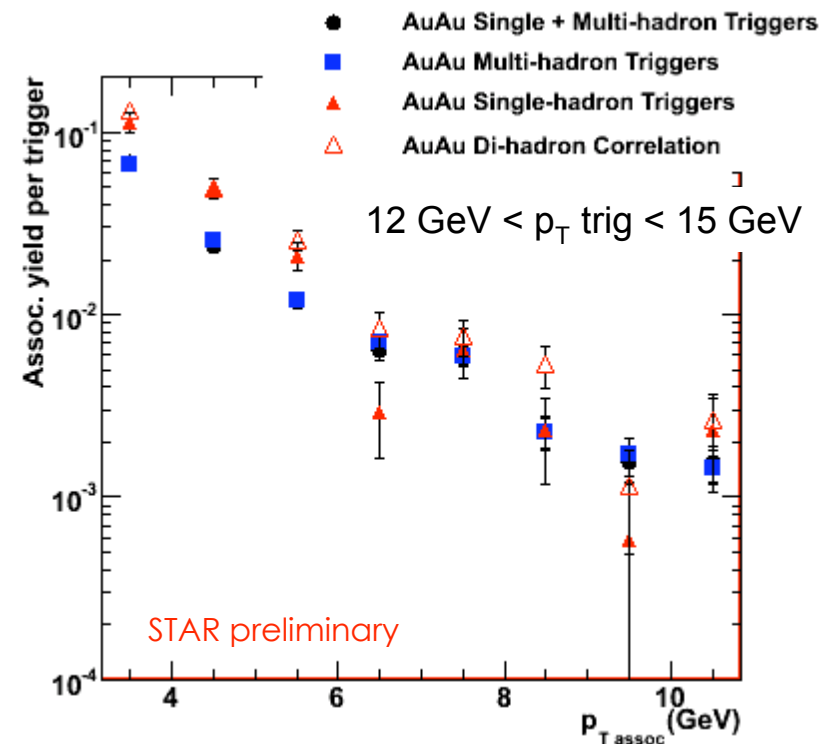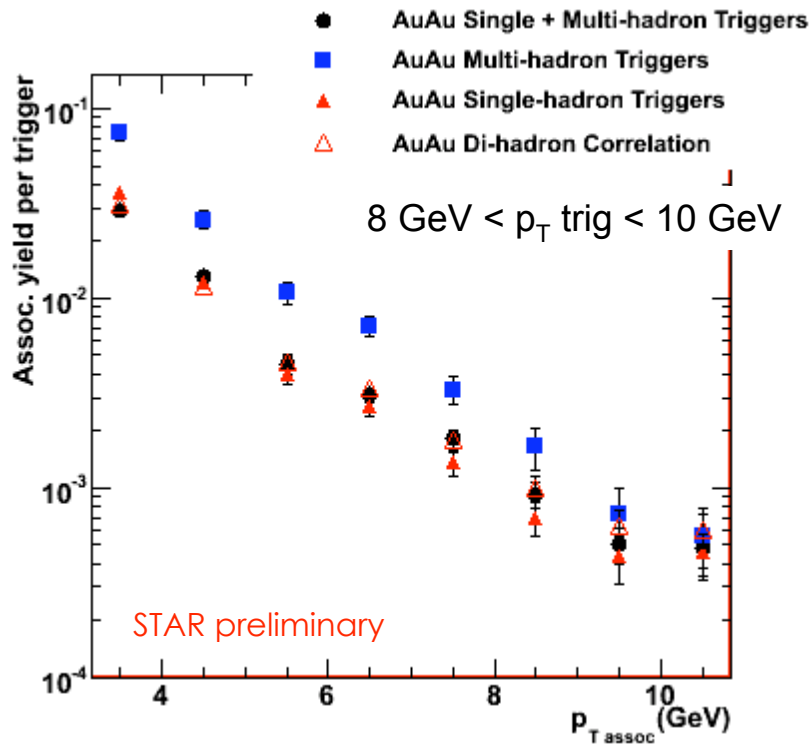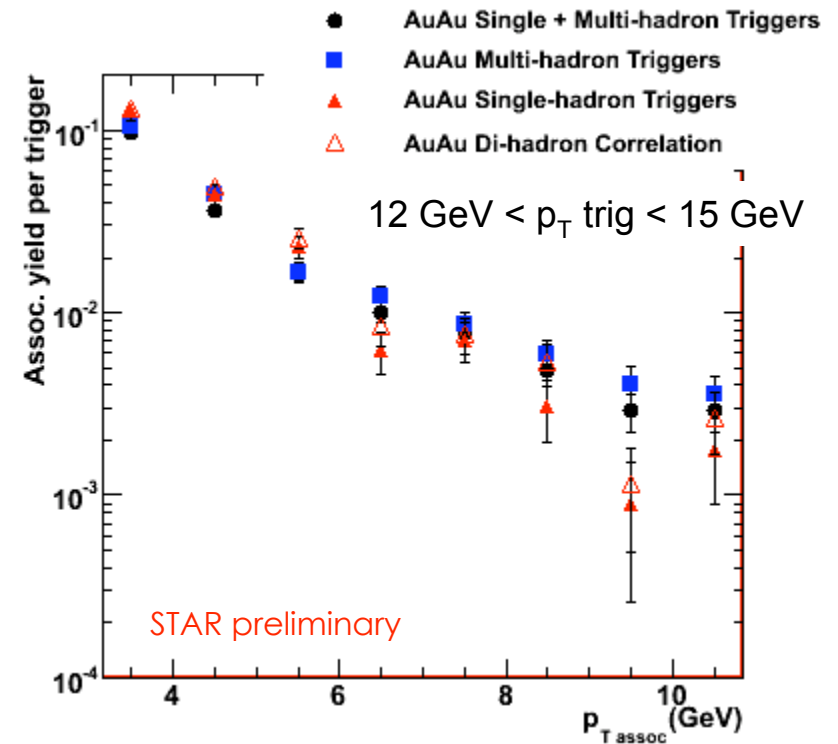
Away side yields

Minimum secondary seed cut = 3.0 GeV

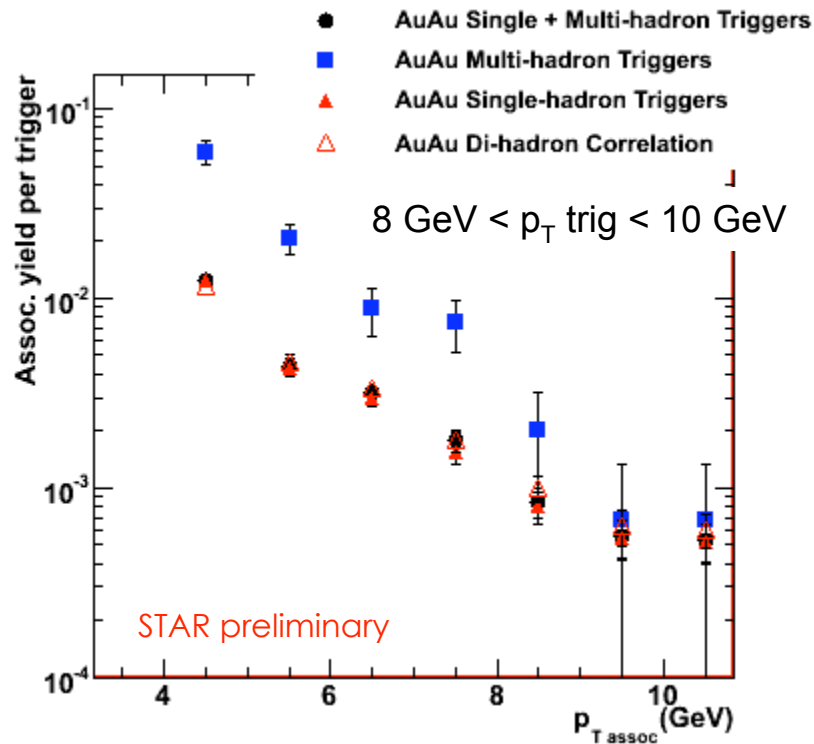Fraction of Multi-hadron triggers to Single+Multi triggers = 0.65

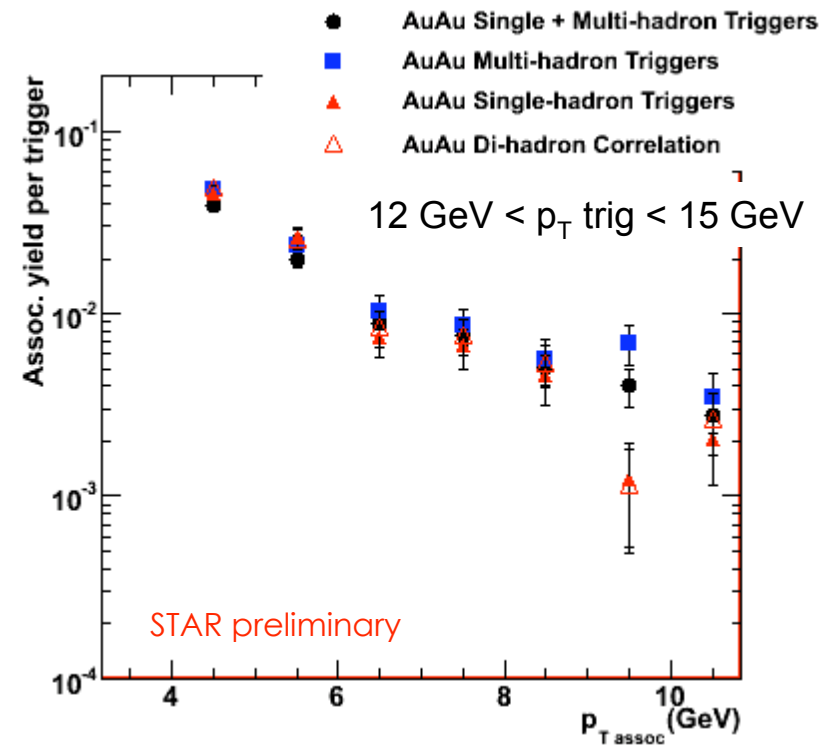Fraction of Multi-hadron triggers to Single+Multi triggers = 0.80

Away side yields

Minimum secondary seed cut = 4.0 GeV

8 GeV < p_T trig < 10 GeV

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Fraction of Multi-hadron triggers to Single+Multi triggers = 0.48

12 GeV < p_T trig < 15 GeV

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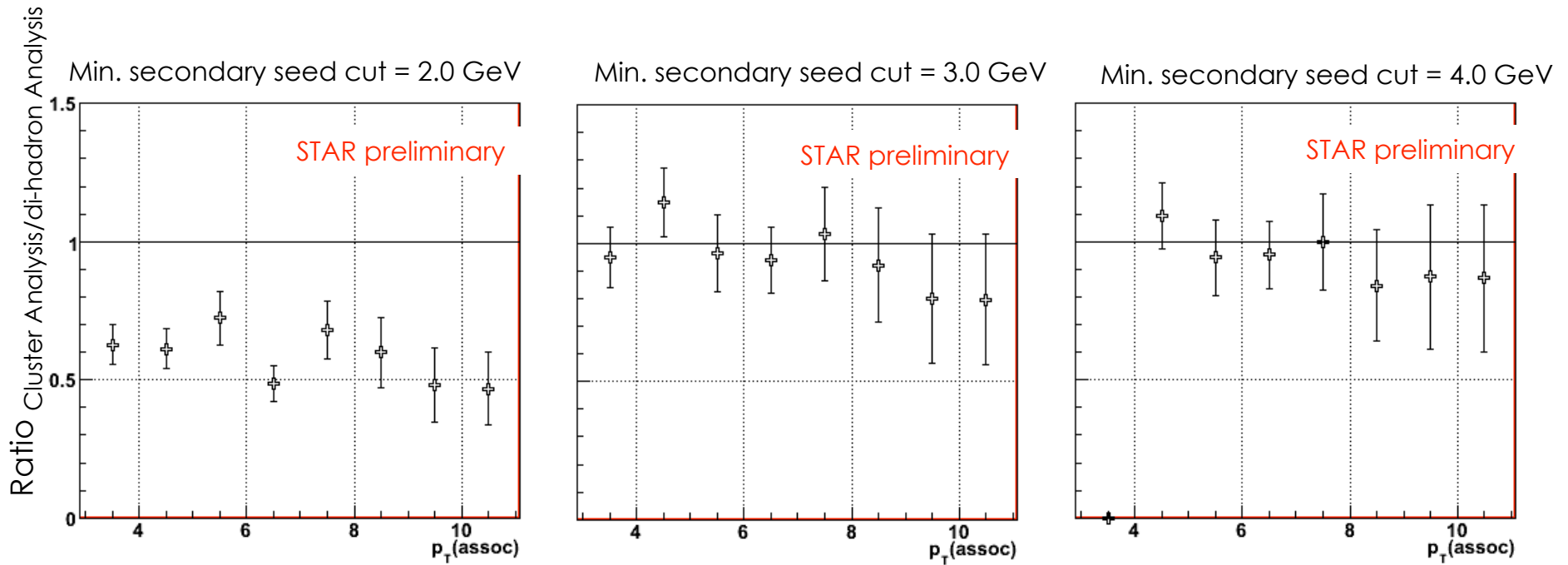
Fraction of Multi-hadron triggers to Single+Multi triggers = 0.85

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

$-$ 8 GeV < p_T trig < 10 GeV -

Min. secondary seed cut = 2.0 GeV   Min. secondary seed cut = 3.0 GeV   Min. secondary seed cut = 4.0 GeV

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

− 12 GeV < p_T trig < 15 GeV -

Min. secondary seed cut = 2.0 GeV   Min. secondary seed cut = 3.0 GeV   Min. secondary seed cut = 4.0 GeV
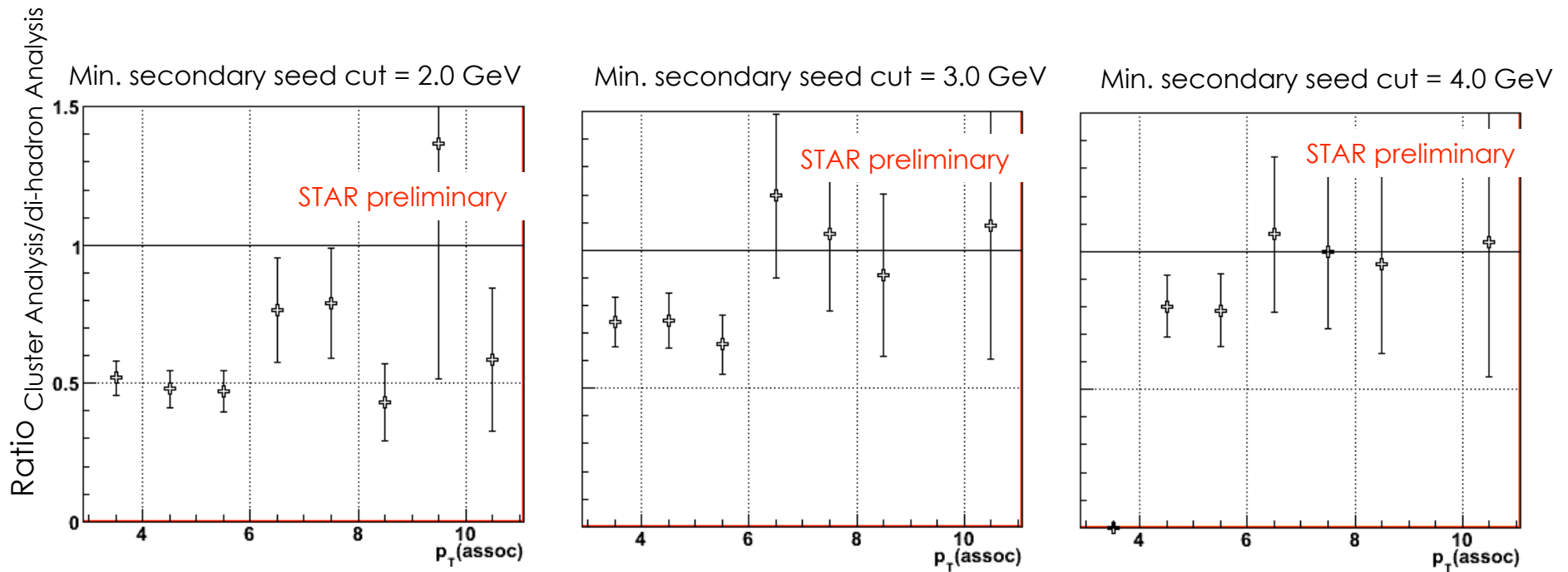
Conclusions and Outlook

- Investigated Multi-hadron triggers as a method of better approximating fragmentation functions
  - First ratios of Single+Multi-hadron trigger yields to di-hadron yields show slopes not different, kinematics not very different
  - Yields for Multi-hadron triggers show increase with increasing minimum secondary seed cuts in the case for 8 to 10 GeV p_T triggers
    - Need to investigate how random clusters are contributing to effect

Next Steps:
- Pythia simulations to understand expectations for multi-hadron trigger yields
- Study yields for different jet cone radii
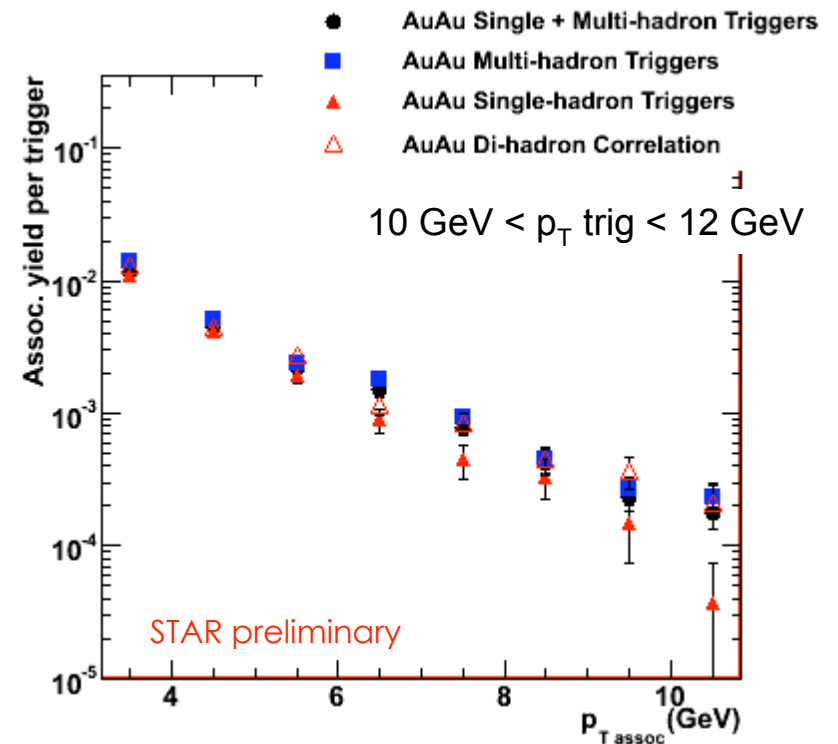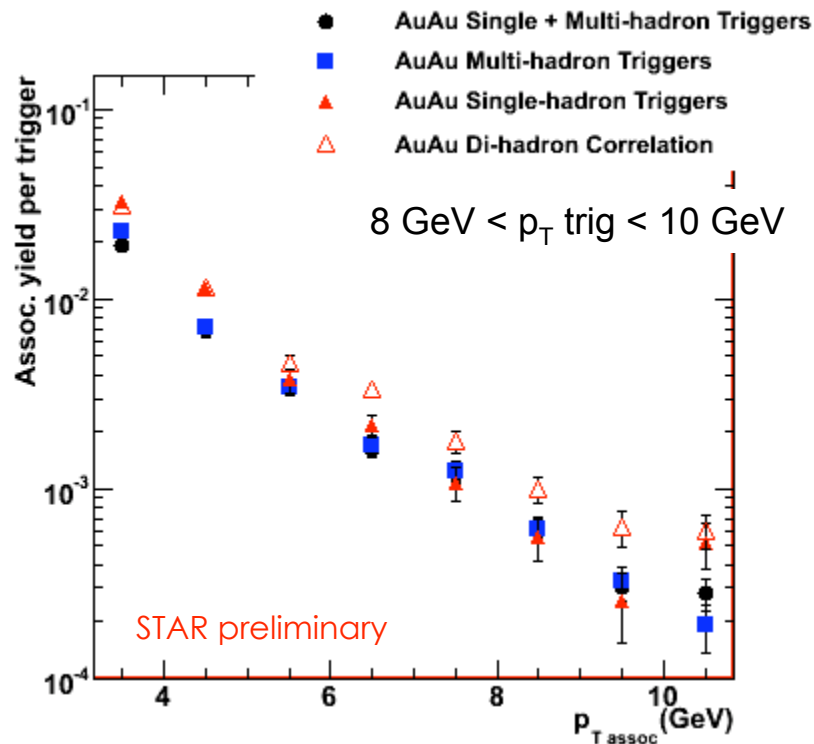- Look at higher p_T trigger > 15 GeV

Backup Slides

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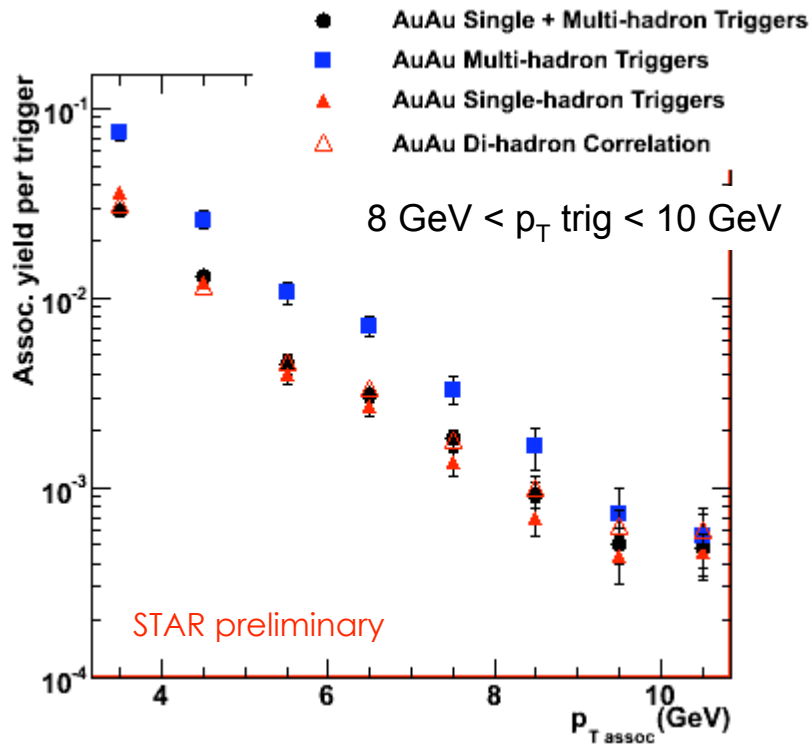# Away side yields

Minimum secondary seed cut = 2.0 GeV

Fraction of Multi-hadron triggers to Single+Multi triggers = 0.81

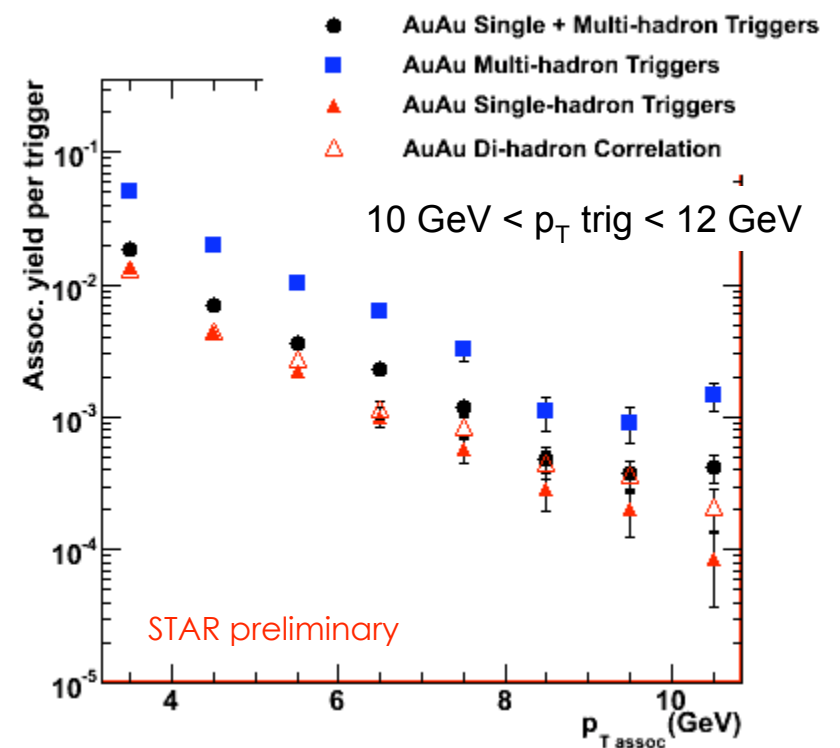Fraction of Multi-hadron triggers to Single+Multi triggers =

Away side yields

Minimum secondary seed cut = 3.0 GeV

Left plot legend:
- AuAu Single + Multi-hadron Triggers
- AuAu Multi-hadron Triggers
- AuAu Single-hadron Triggers
- AuAu Di-hadron Correlation

8 GeV < p_T trig < 10 GeV

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y-axis: Assoc. yield per trigger
x-axis: $p_{T\,assoc}$ (GeV)

Right plot legend:
- AuAu Single + Multi-hadron Triggers
- AuAu Multi-hadron Triggers
- AuAu Single-hadron Triggers
- AuAu Di-hadron Correlation

10 GeV < p_T trig < 12 GeV

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y-axis: Assoc. yield per trigger
x-axis: $p_{T\,assoc}$ (GeV)

Fraction of Multi-hadron triggers to Single+Multi triggers = 0.65
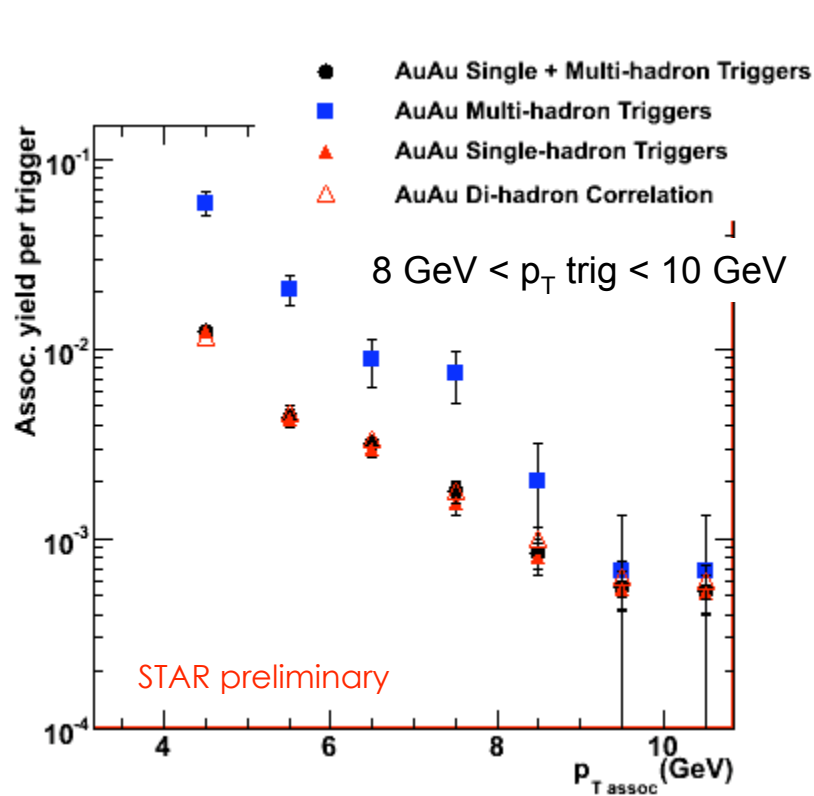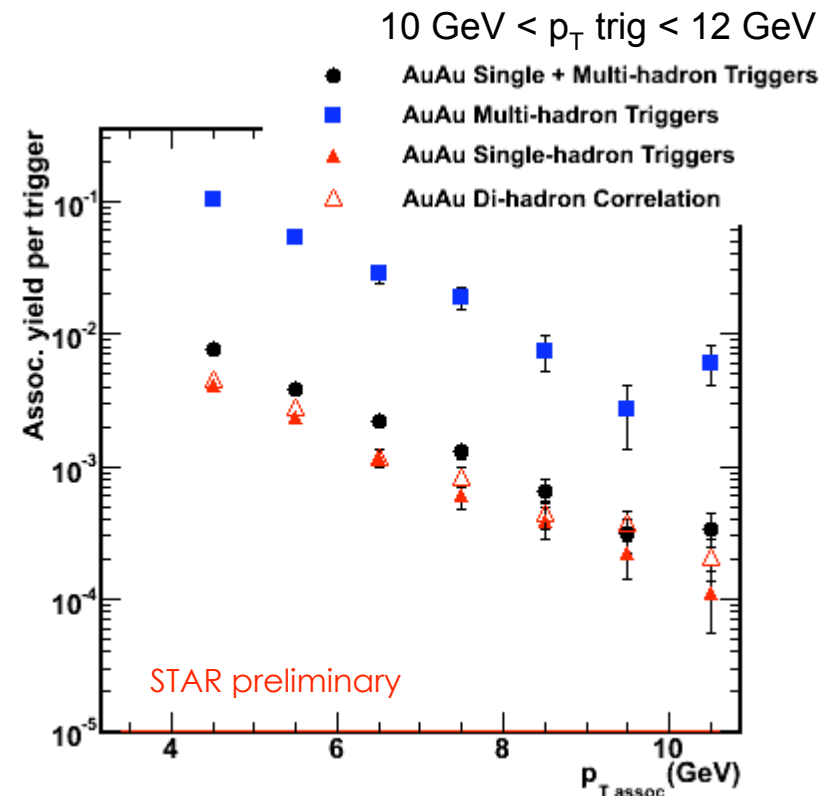
Fraction of Multi-hadron triggers to Single+Multi triggers = 0.77

Away side yields

Minimum secondary seed cut = 4.0 GeV

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

– 10 GeV < p_T trig < 12 GeV -