Jet Studies in STAR via Di-jet Triggered (2+1) Multi-hadron Correlations

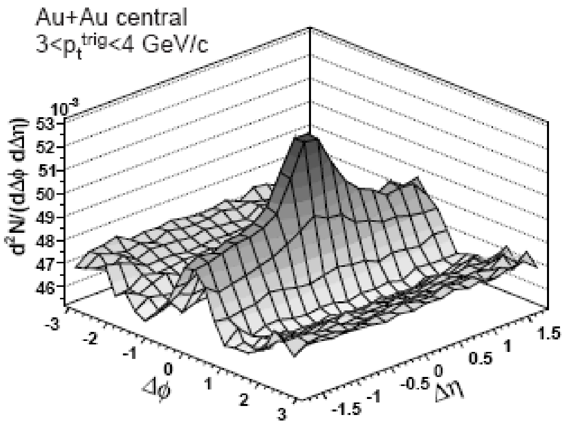
Hua Pei for the STAR collaboration

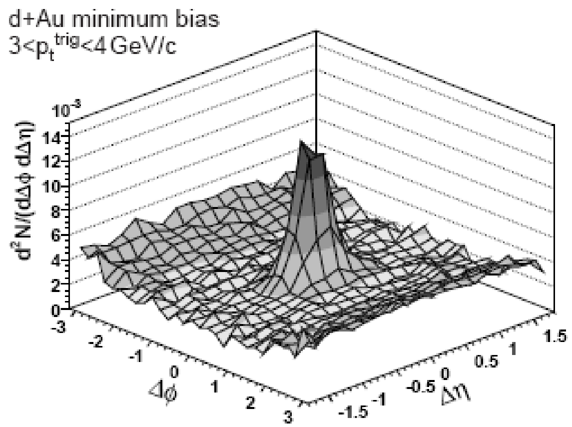
- Jet quenching in heavy ion collisions
- Statistical studies of di-jets: 2+1 correlation technique
  - Analysis technique
  - High-energy photon and charged hadron triggered data
  - Jet shapes, Spectra, and Compare between
    - d+Au analysis
    - Au+Au analysis
- Outlook

Observed jet-medium interaction

Near-side Ridge

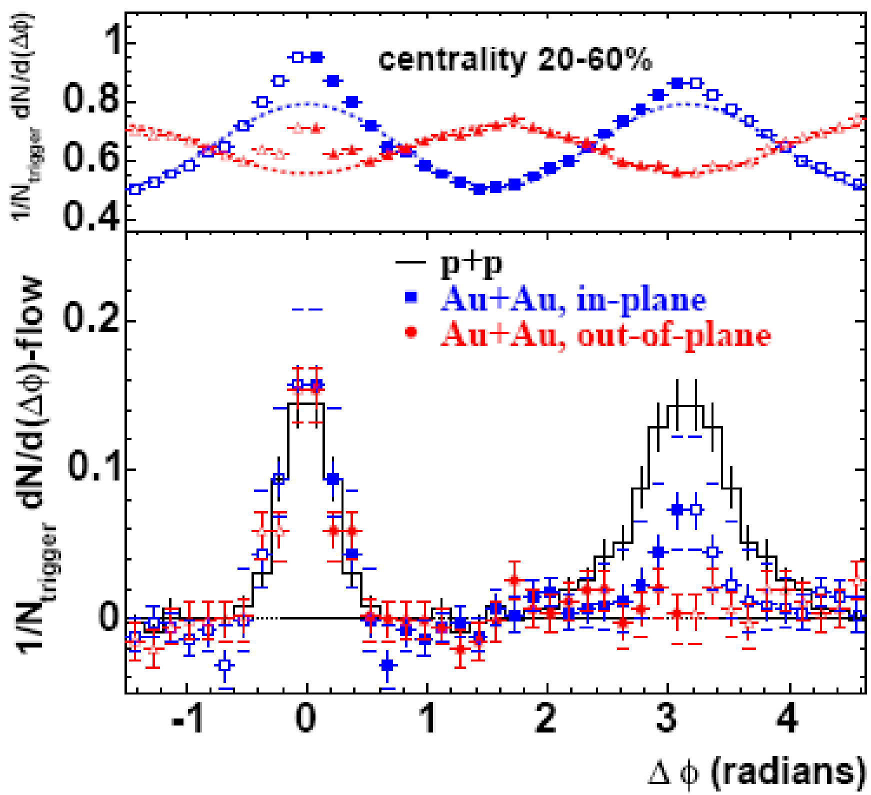
arxiv.org:0909.0191





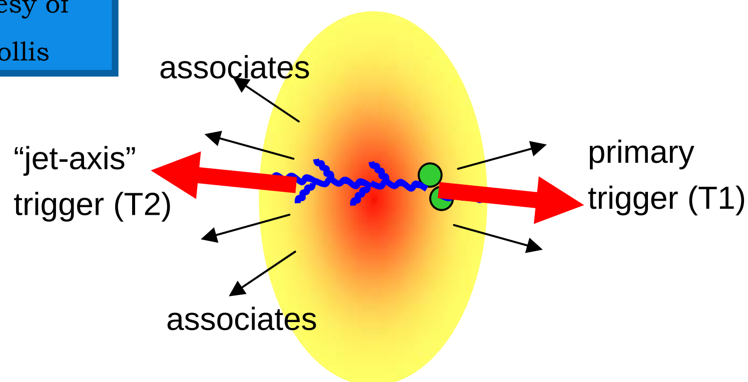
Away-side suppression (flow subtracted)

Phys. Rev. Lett. 93, 252301 (2004)

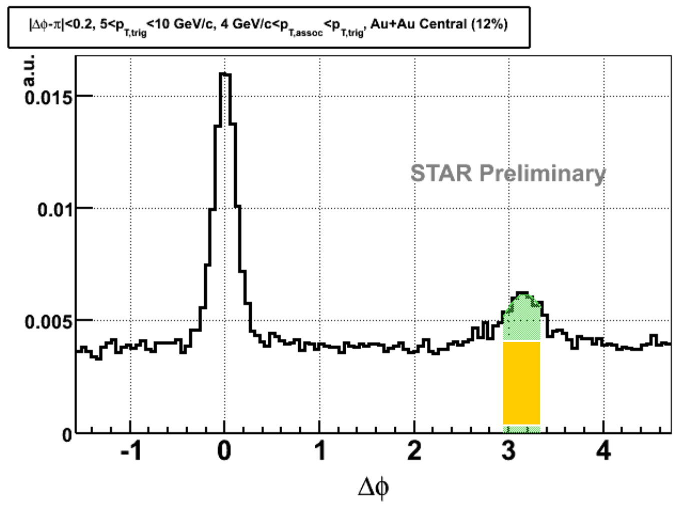


You see the ending, but where it begins?

Courtesy of R .Hollis



Trigger-trigger correlation



- **Use 'di-jets' to study jet-medium effects**
  - **"pin" the 'jet axis' selecting back-to-back triggers**
  - **study correlation w.r.t. this axis**

$|\Delta\phi-\pi| < 0.2$ radian

Sample: Au+Au Central (12%)
T1: 5 GeV/*c* < p_T < 10 GeV/*c*
T2: 4 GeV/*c* < p_T < p_T of T1

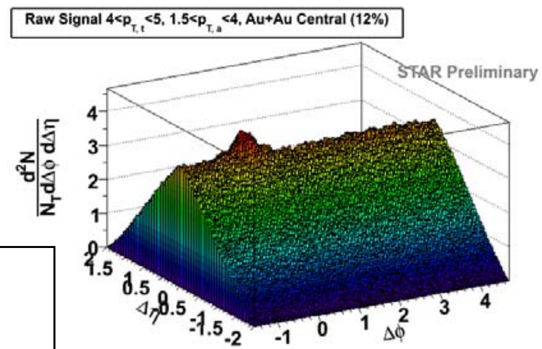
Signal reconstruction

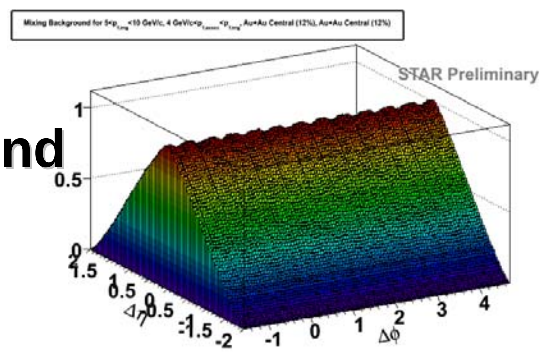
Raw

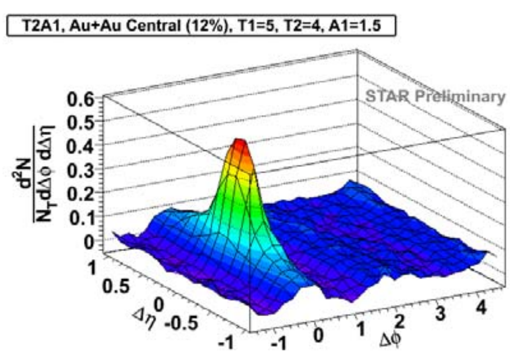
corrected by

Mixing Background

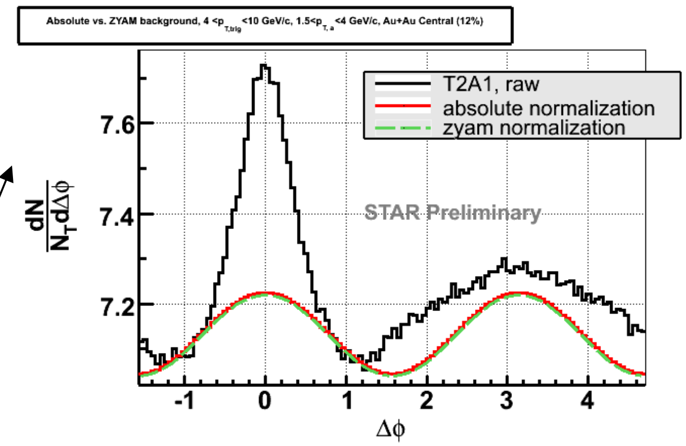
Primary signal



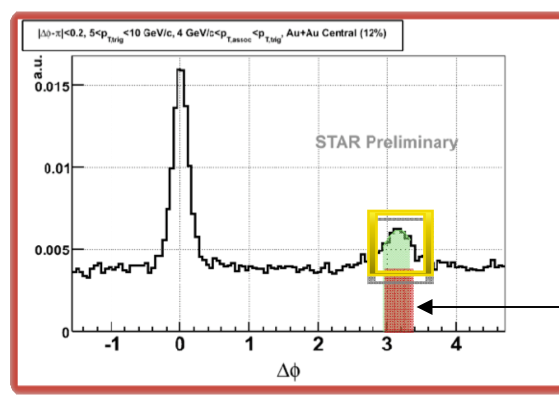




Subtract the flow contribution through ZYAM (mixed-event without ZYAM used as cross-check)



Correlated background estimated by di-hadron correlations



Kolja Kauder

QM09

Symmetric triggers

The leading triggers are selected from the highest-pT charged hadrons.

The second trigger are the highest-pT charged in the back-side cone.

$$2003 \text{ d+Au } \sqrt{s_{NN}} = 200GeV$$

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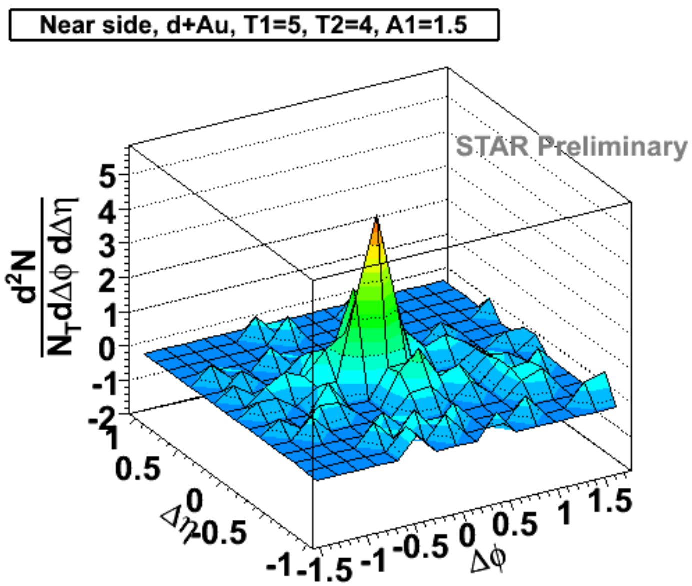

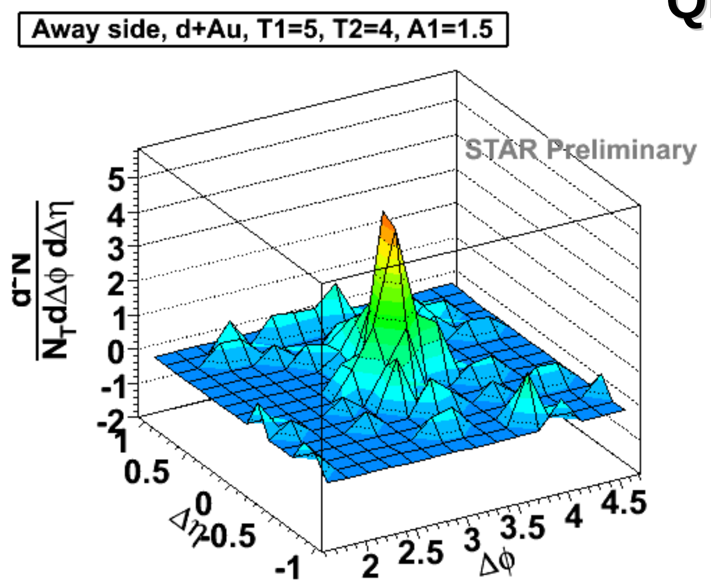

d+Au	T1 (charged):	5 GeV/*c* < p_T < 10 GeV/*c*
	T2 (charged):	4 GeV/*c* < p_T < p_T of T1
	Assoc (charged):	1.5 GeV/c < p_T < 10GeV/c

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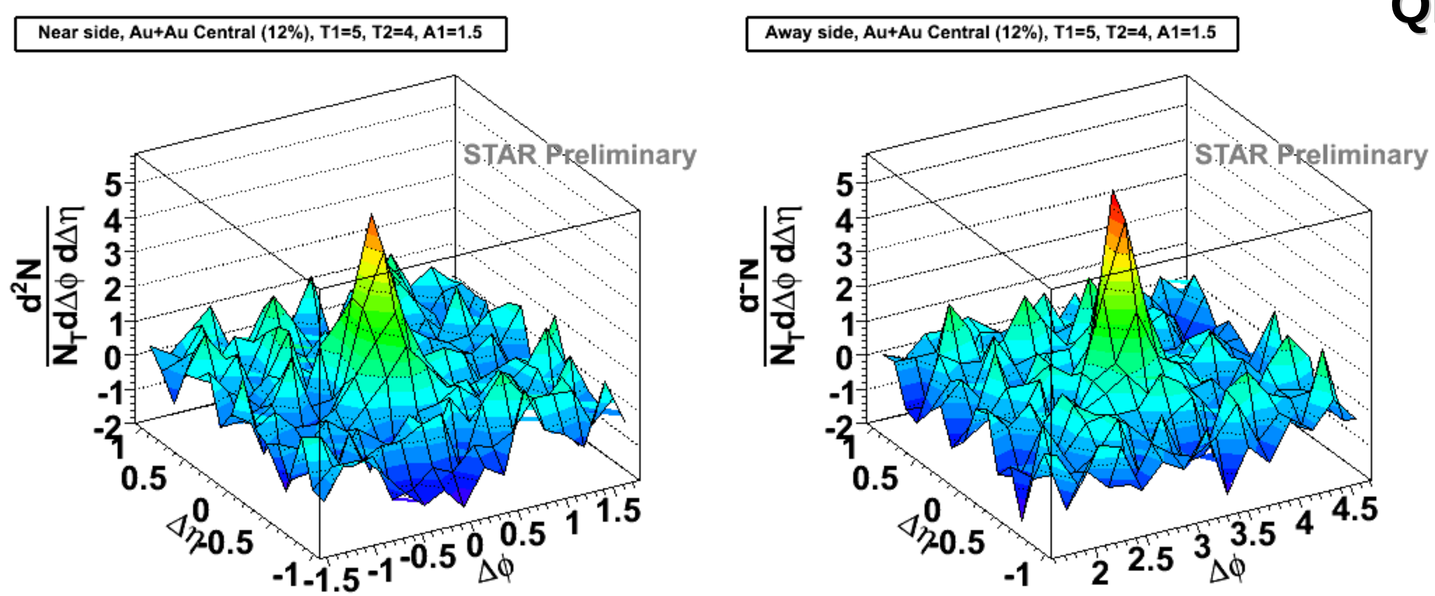


Au+Au (Central 12%)	T1 (charged):	5 GeV/*c* < p_T < 10 GeV/*c*
	T2 (charged):	4 GeV/*c* < p_T < p_T of T1
	Assoc (charged):	1.5 GeV/c < p_T < 10GeV/c

Asymmetric triggers

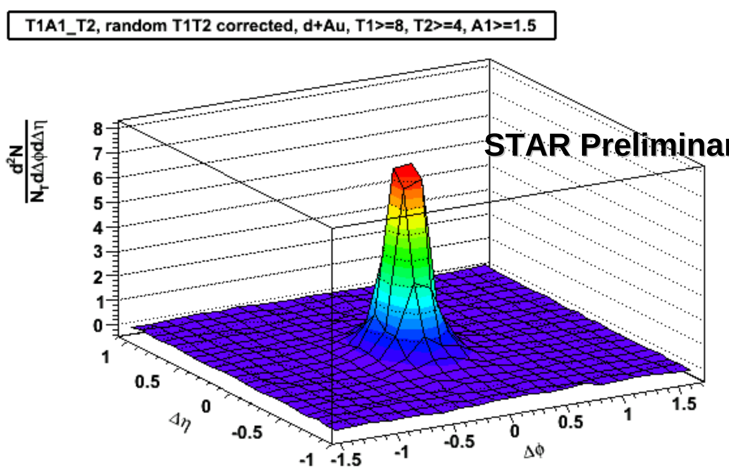
The leading triggers are now high-energy clusters from electro-magnetic calorimeter (EMCal), so that we can push trigger energy to a much higher level than those charged particle triggers.

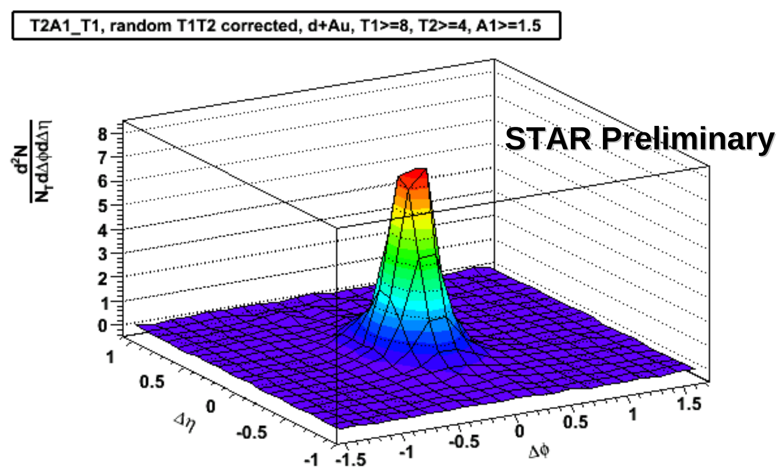
The second trigger are the highest-pT charged in the away-side cone.

We use those efficiency of 2003 d+Au data for our 2008 d+Au analysis.

$$2008\ \mathrm{d+Au}\ \sqrt{s_{NN}} = 200GeV$$

New work





d+Au

T1 (EMCal tower): 8 GeV < E_T < 15 GeV

T2 (charged): 4 GeV/*c* < p_T < 10 GeV/c

Assoc (charged): 1.5 GeV/c < p_T < 10GeV/c

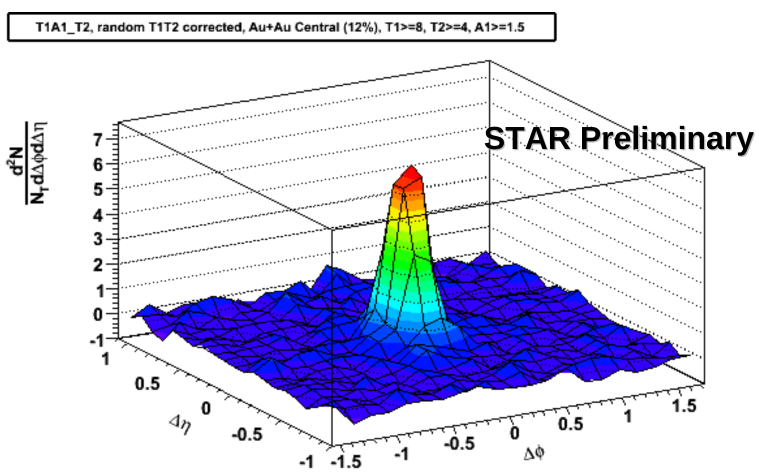
Asymmetric triggers

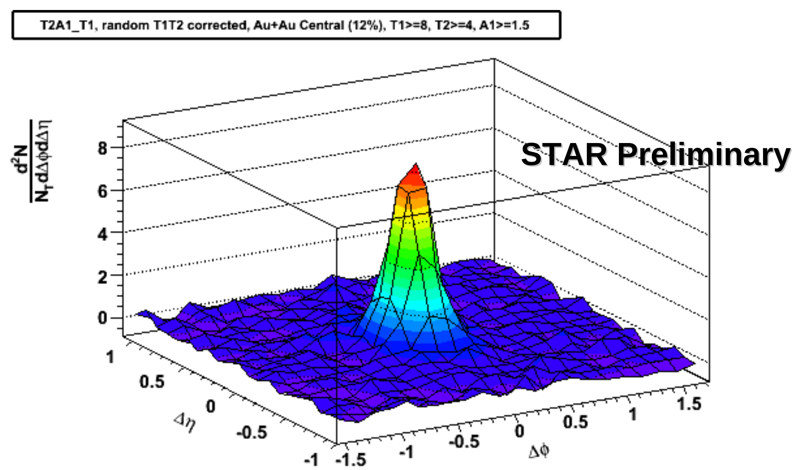
The leading triggers are high-energy clusters from electro-magnetic calorimeter (EMCal).

The second trigger are the highest-pT charged in the away-side cone.

We use those efficiency / flow (centrality, pT) of 2004 Au+Au data for our 2007 Au+Au analysis.

$$2007\ \mathrm{Au+Au}\ \sqrt{s_{NN}} = 200GeV$$





Au+Au	T1 (EMCal tower):	8 GeV < E_T < 15 GeV
	T2 (charged):	4 GeV/*c* < p_T < 10 GeV/c
	Assoc (charged):	1.5 GeV/c < p_T < 10GeV/c

Compare the correlation functions

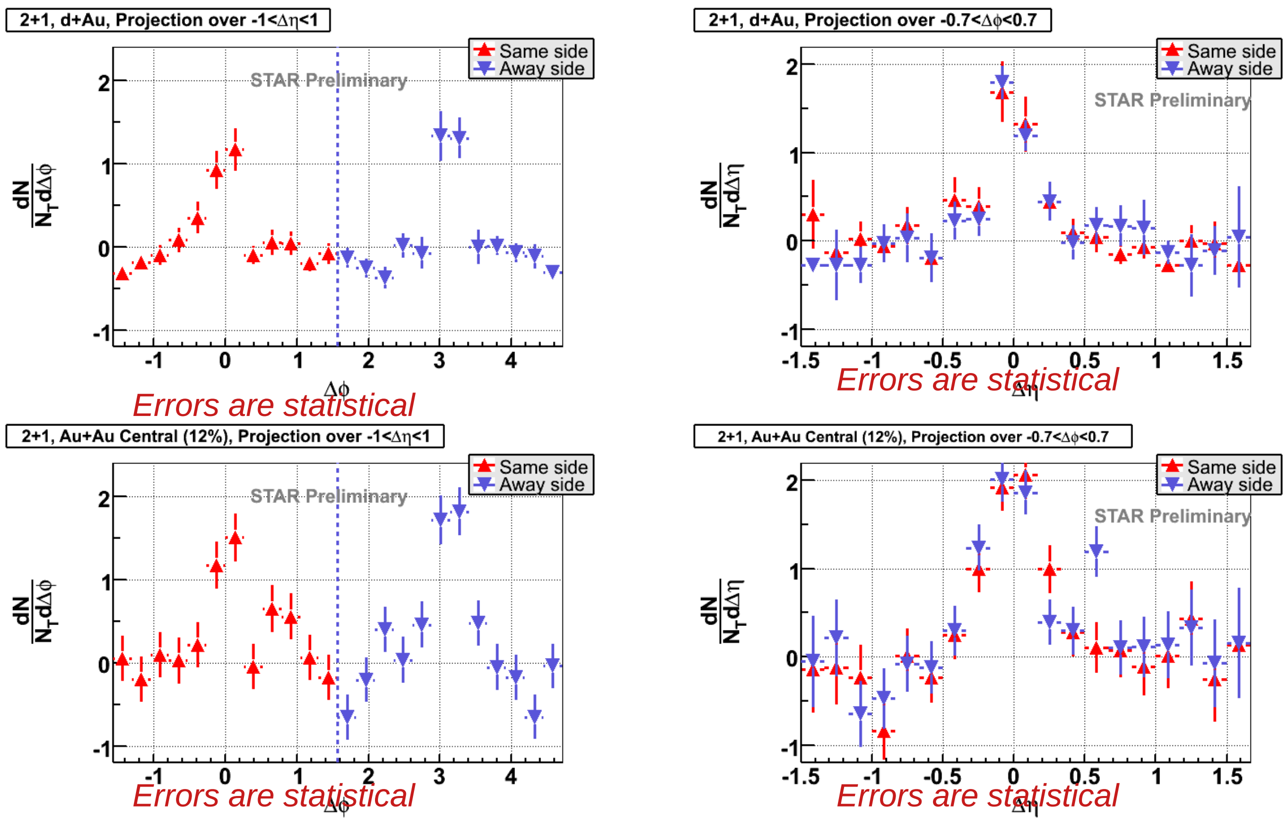
--- *Symmetric triggers*

Kolja Kauder, QM09

d+Au

Vs.

Au+Au



Projection at Δφ (radian) and Δη plane

d+Au vs. Au+Au (Central 12%)

T1 (charged):	5 GeV/*c* < p_T < 10 GeV/*c*
T2 (charged):	4 GeV/*c* < p_T < p_T of T1
Assoc (charged):	1.5 GeV/c < p_T < 10GeV/c

Compare the correlation functions

--- *Asymmetric triggers*

New work

d+Au

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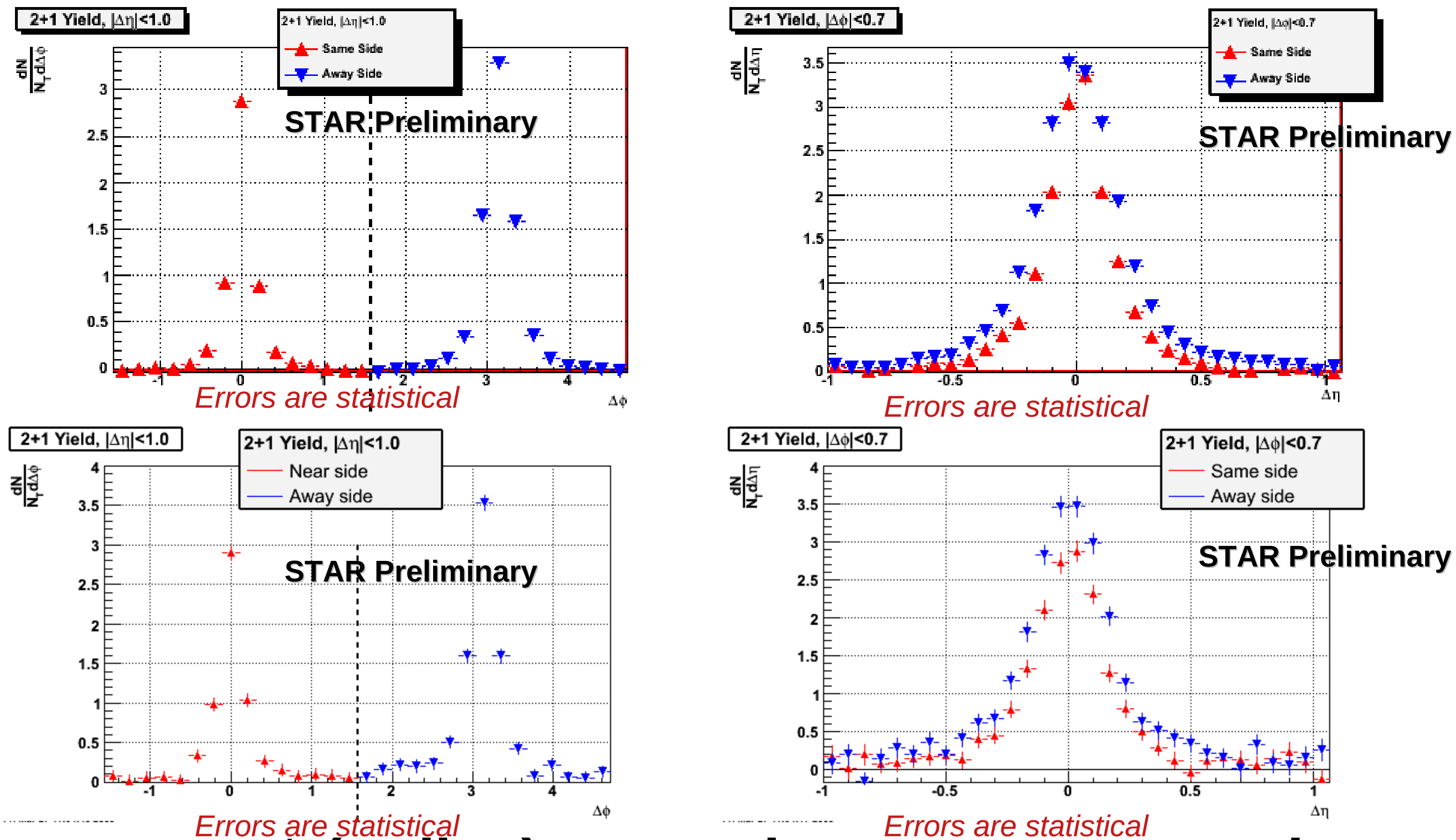


Projection at Δφ (radian) and Δη plane

d+Au vs. Au+Au

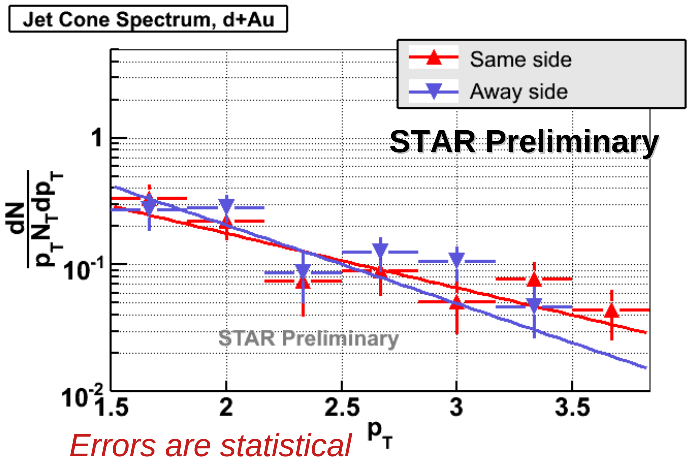
T1 (charged): 8 GeV < E_T < 15 GeV

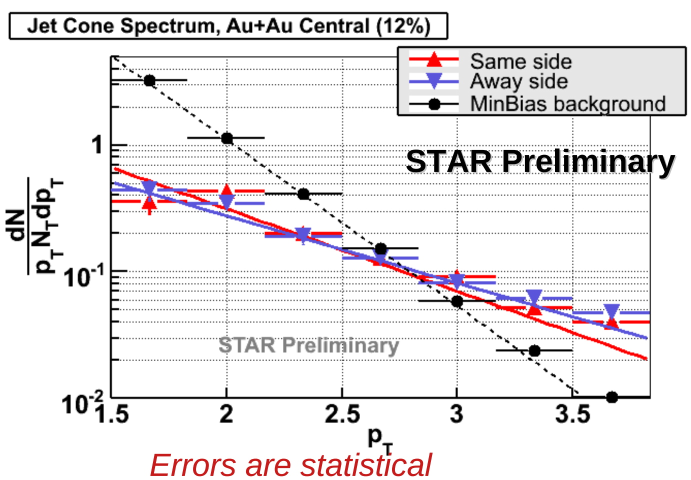
T2 (charged): 4 GeV/*c* < p_T < 10 GeV/c

Assoc (charged): 1.5 GeV/c < p_T < 10GeV/c

Compare the p_T spectra

Symmetric triggers
(Kolja Kauder, QM09)



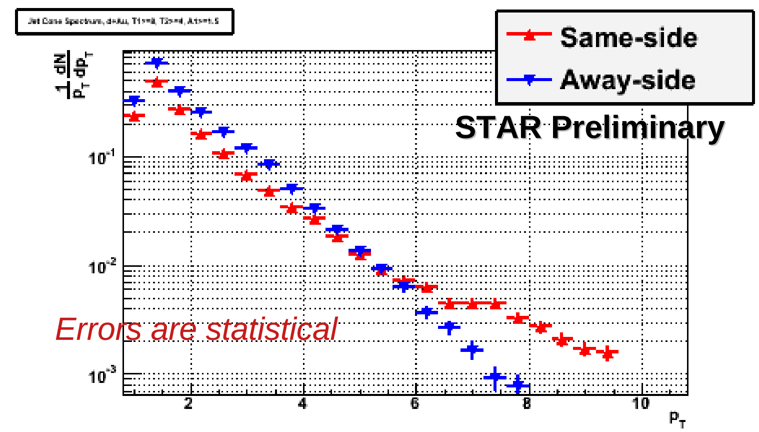


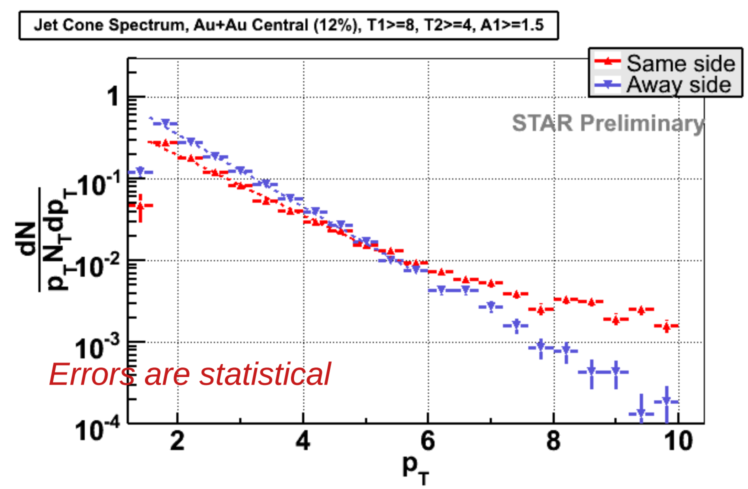
d+Au

and

Au+Au

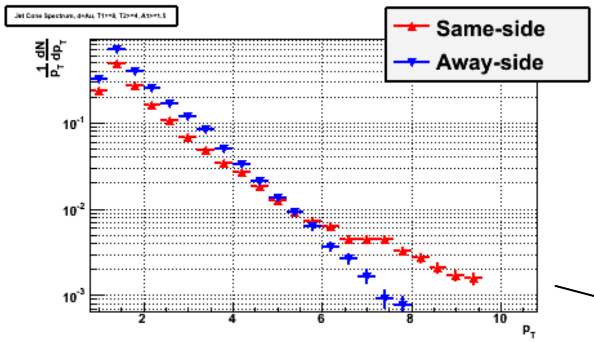
Asymmetric triggers
(New work)



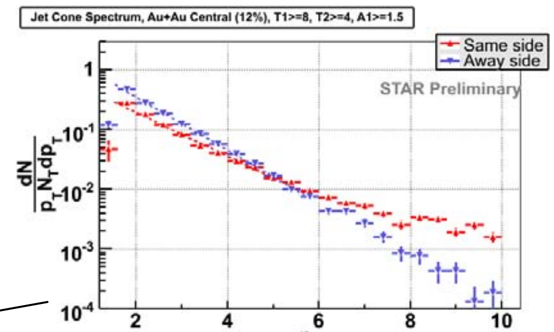


Ratios of spectra: Au+Au / d+Au

(Only asymmetric triggers case is shown here due to statistics)



Errors are statistical



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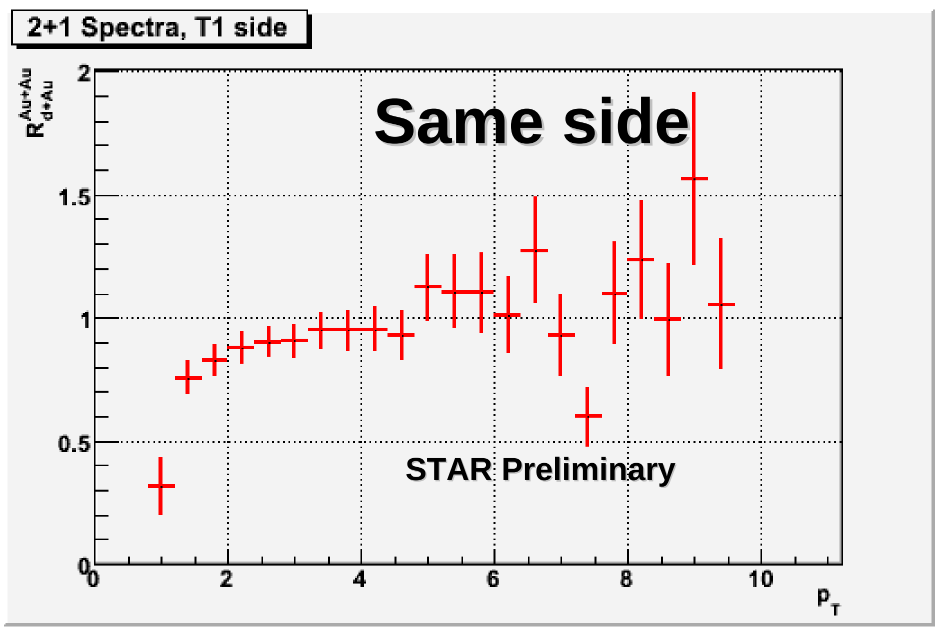

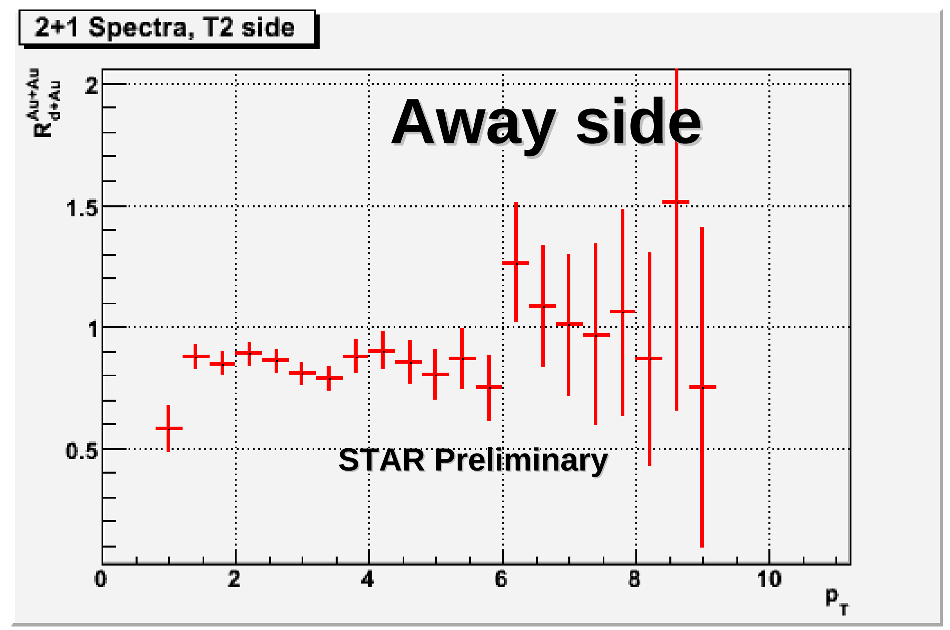

Summary

- ✓ **Studied dijet properties using 2+1 correlation technique**
  - ✓**Symmetric trigger pairs:**
    - ✓**Similar spectra for same and away side**
    - ✓**No measurable modifications in correlations and pT spectra side from d+Au to central Au+Au collisions**
  - ✓**Asymmetric trigger pairs:**
    - ✓**Softer spectra on the away side**
    - ✓ **The correlations and pT spectra are of close shape/level from d+Au to central Au+Au collisions**
  - ✓**Next work: Compare the relative energy loss in both cases by the near/away-side integrated p_T/E_T.**

Backup

Trigger and Associated Cuts

- For symmetric triggers:
  - T1 5< p_T <10GeV/c, T2 4< p_T < p_T(T1) <10GeV/c,
  - Between T1 and T2, $|\Delta\phi - \pi|<0.2$
  - Assoc 1.5< p_T <10GeV/c
- For asymmetric triggers:
  - T1 8< E_T <15GeV, T2 4< p_T < E_T(T1) <10GeV/c,
  - Between T1 and T2, $|\Delta\phi - \pi|<0.2$
  - Assoc 1.5< p_T <10GeV/c