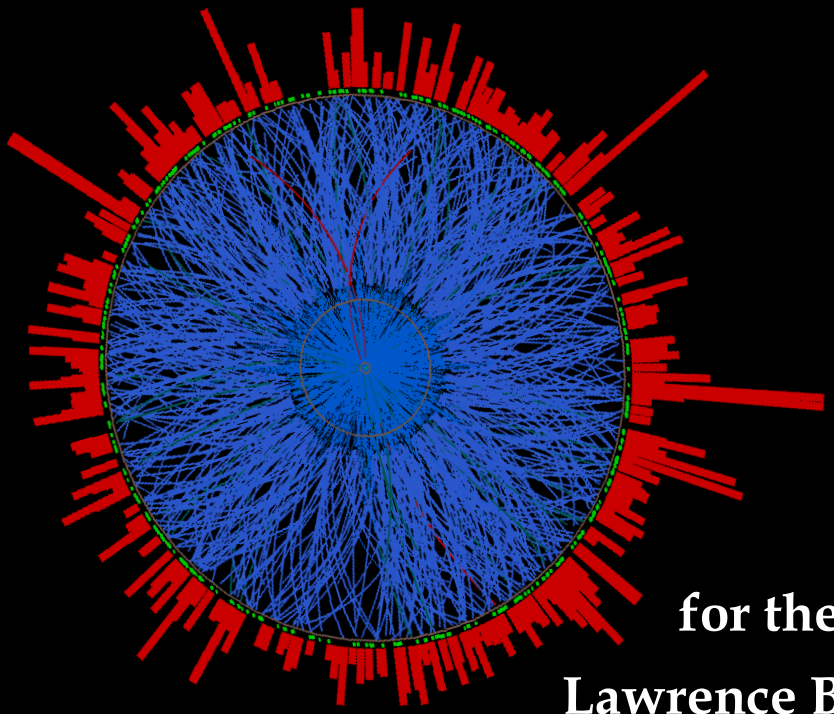
# Highlights from STAR



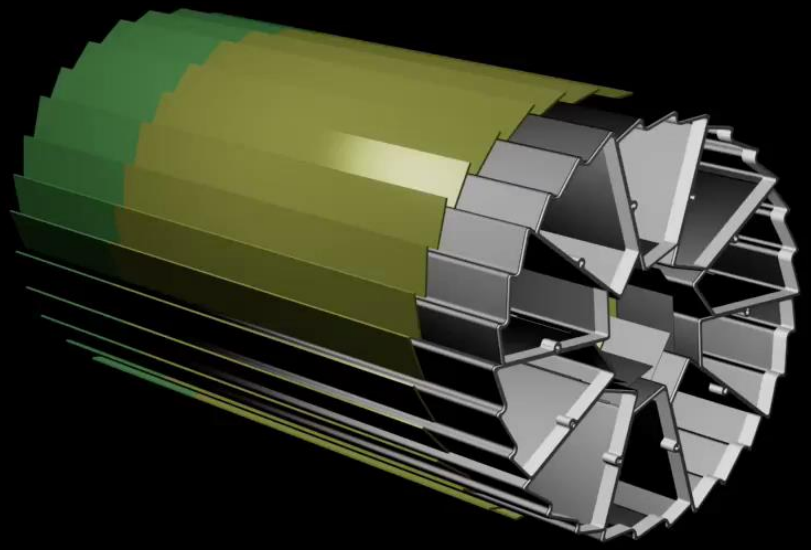

**Alexander Schmah**

**for the STAR Collaboration**

**Lawrence Berkeley National Lab**


**Quark Matter 2017 in Chicago**

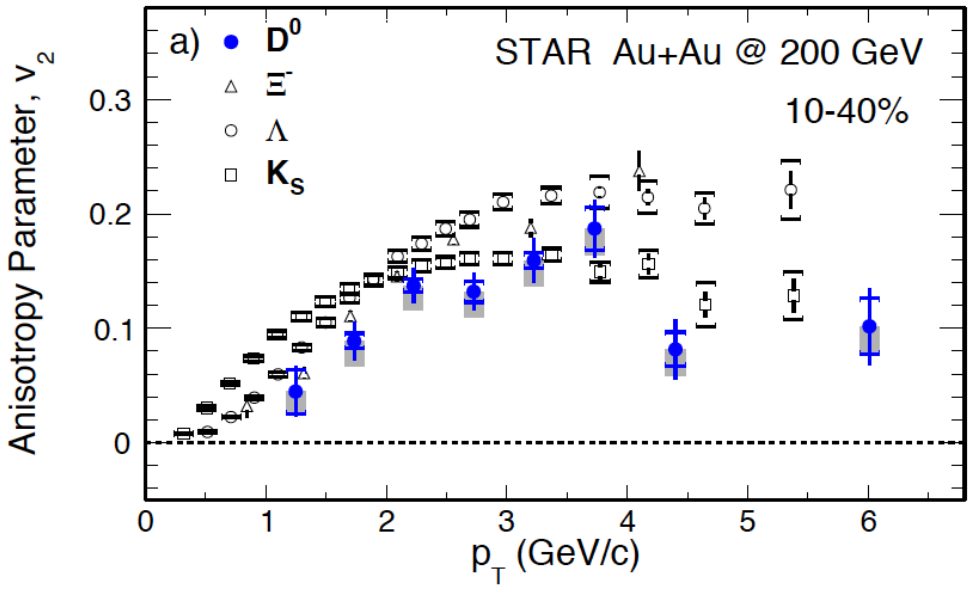

U.S. DEPARTMENT OF ENERGY | Office of Science



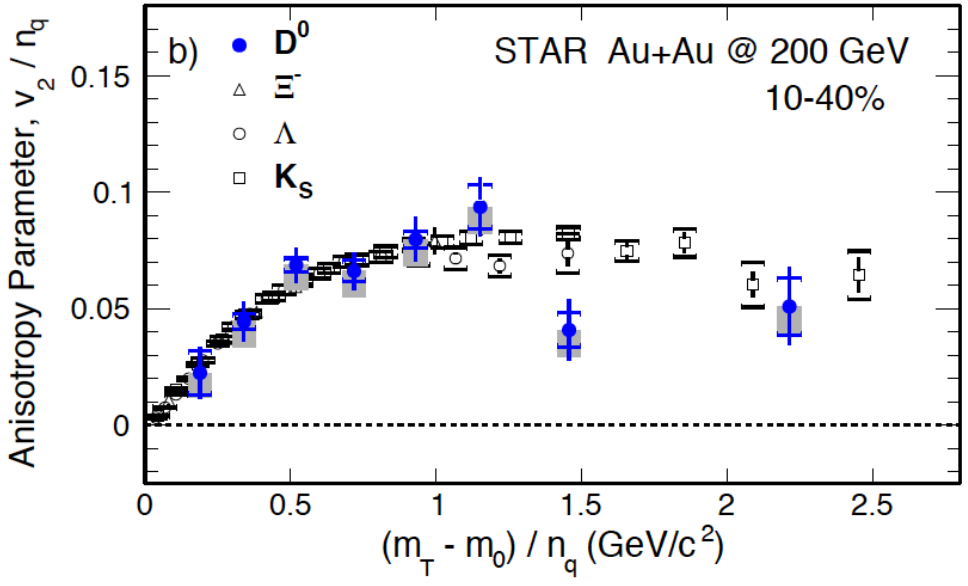
# Elliptic Flow of $D^0$ in 10-40%

**Liang He, Tue 17:10**

## Mass ordering




## NCQ scaling




- $D^0$ $v_2$ for 10-40% follows mass ordering and NCQ scaling of other hadrons
  → Evidence for thermalization of charmed mesons

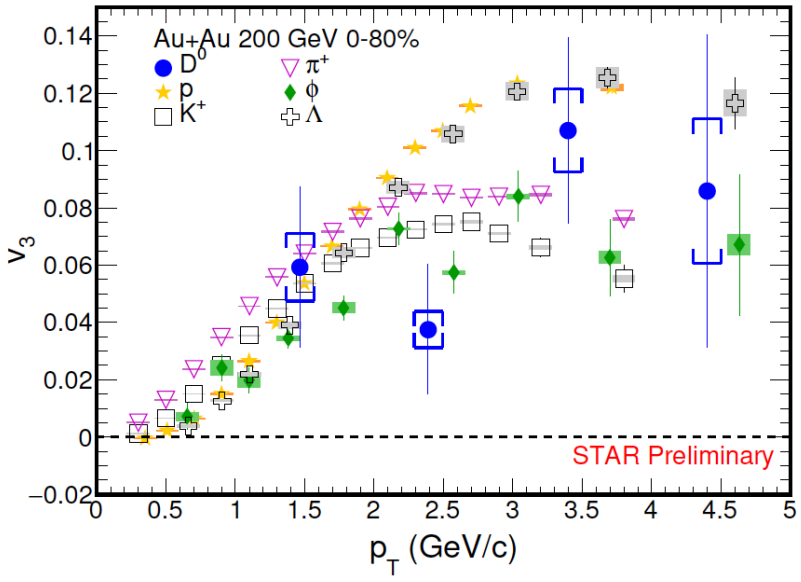
**Submitted**
**arXiv:1701.06060**

* Whole 2014 HFT data from second pass of production

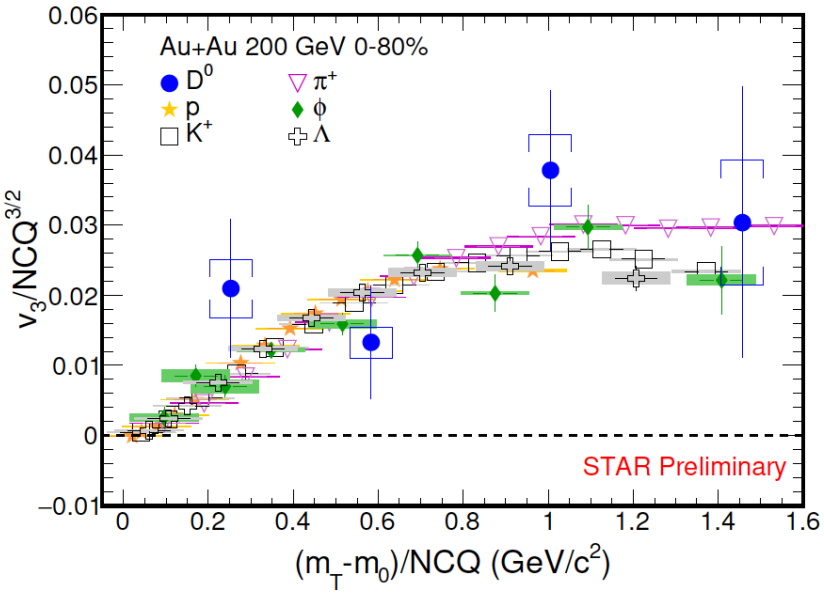
# Triangular Flow of $D^0$ in 0-80%

**Liang He, Tue 17:10**

## Mass ordering



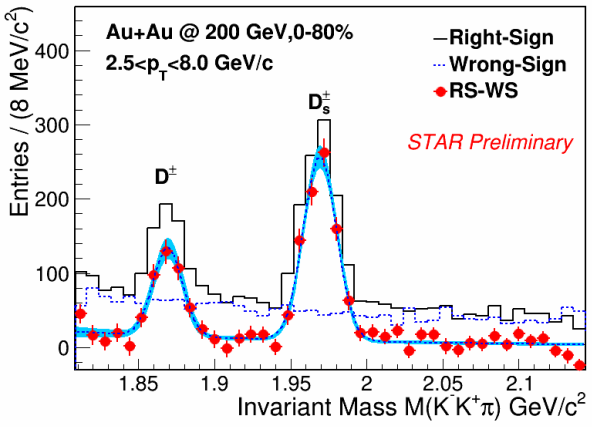

## NCQ scaling

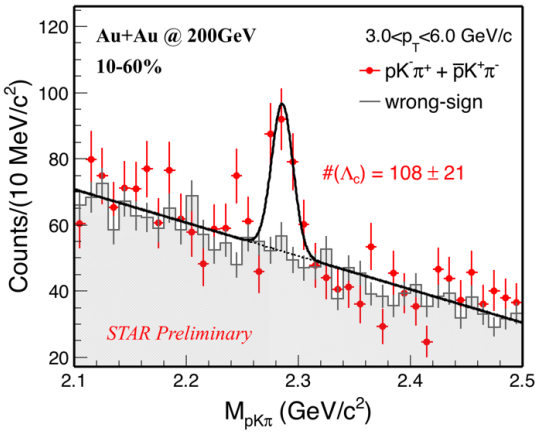


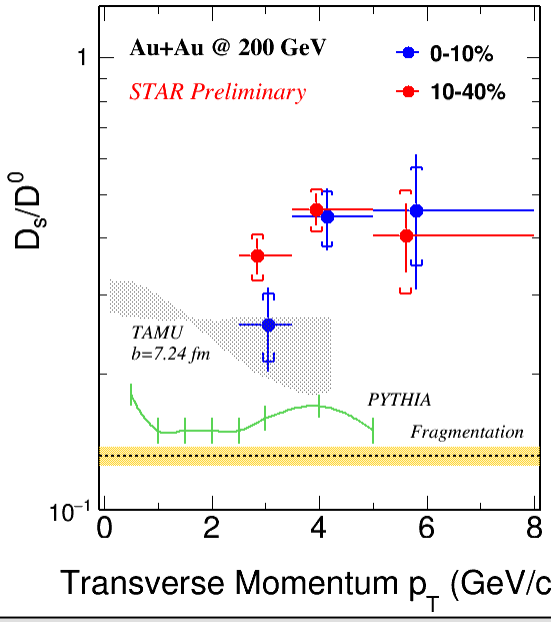

- First $D^0$ $v_3$ measurement
  → non-zero at RHIC
  → NCQ scales with other hadrons

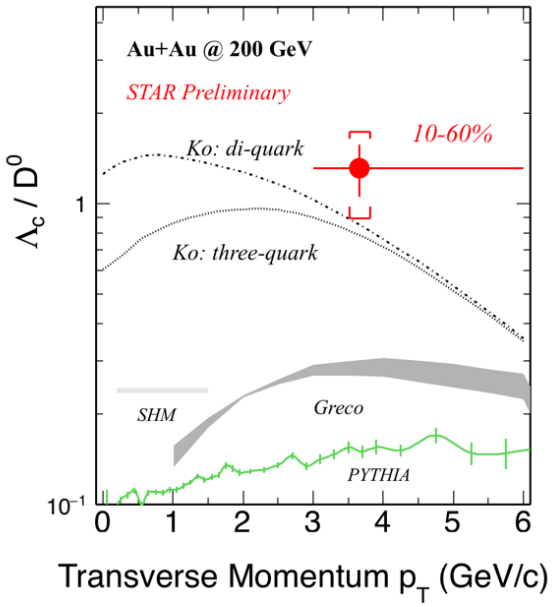
# D-Meson and $\Lambda_c$ Production

**Long Zhou, Tue 17:30**



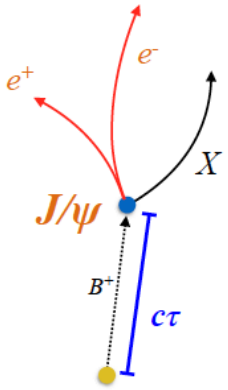



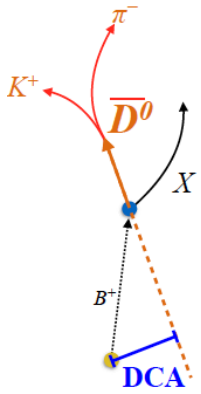



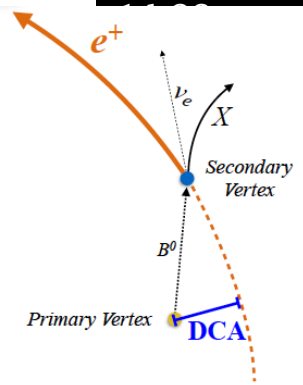

- **First $\Lambda_c$ reconstruction in A+A collisions**
- Strong enhancement observed over PYTHIA
  → consistent with coalescence model and thermalized charm quarks

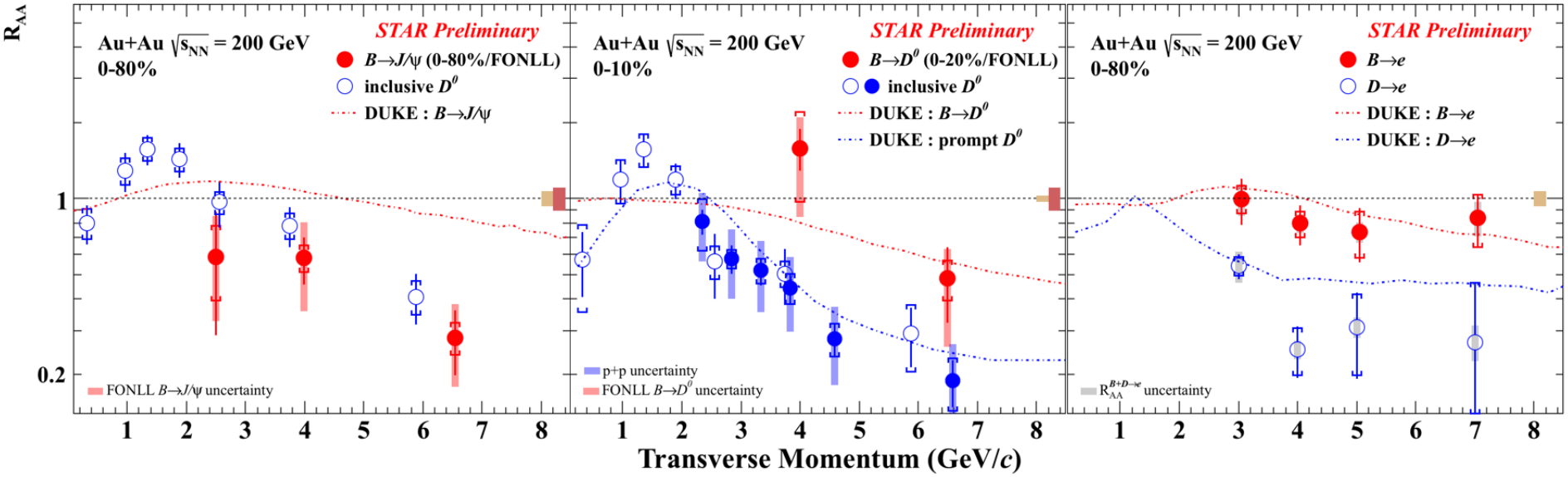
# B Production

Kunsu Oh, Wed



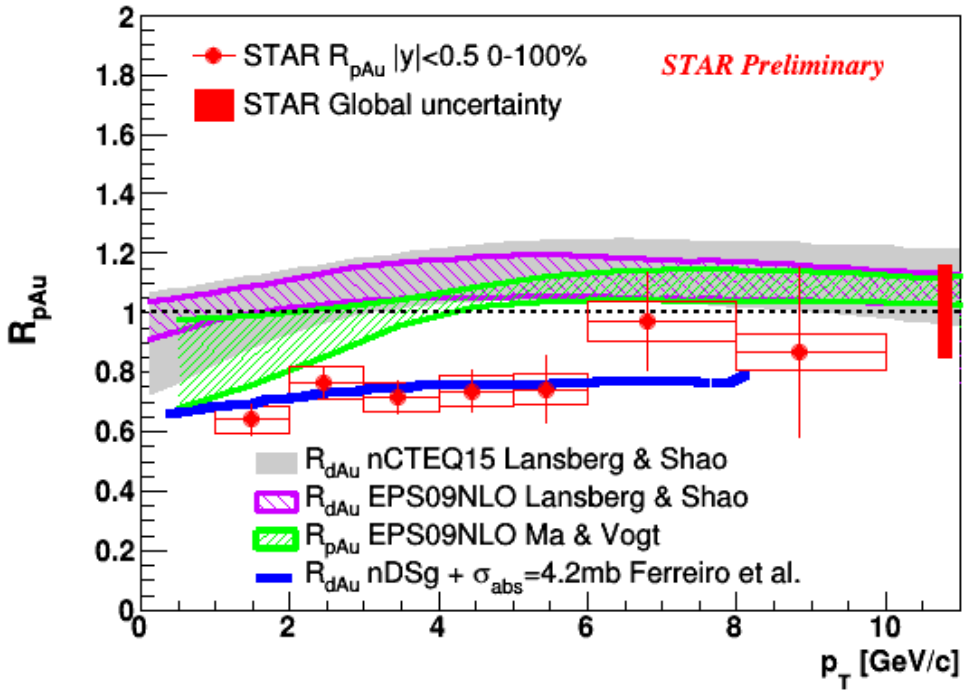




- Three ways of measuring B production
- Suppression observed for all three channels at high $p_T$
- B→ e is less suppressed than D→ e (2 σ effect)

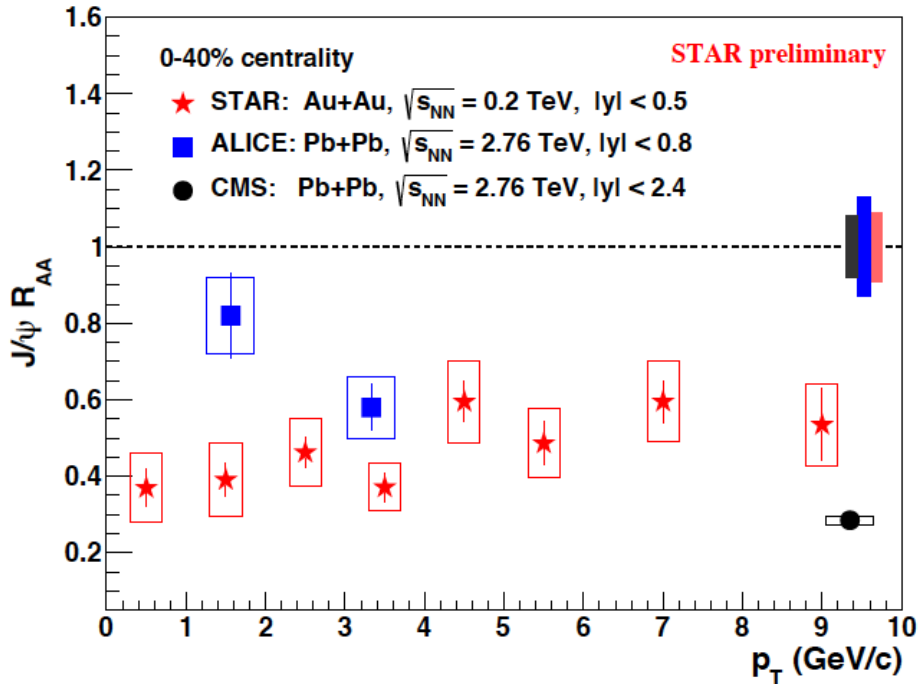
# Charmonium Production

**Takahito Todoroki, Tue 14:00**

## p+Au



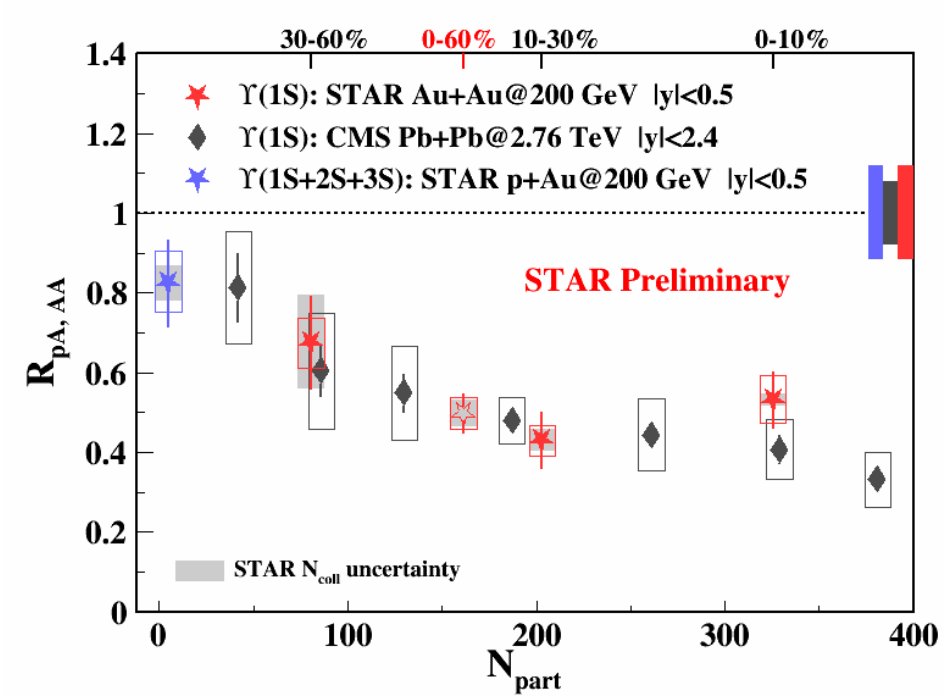

## Au+Au

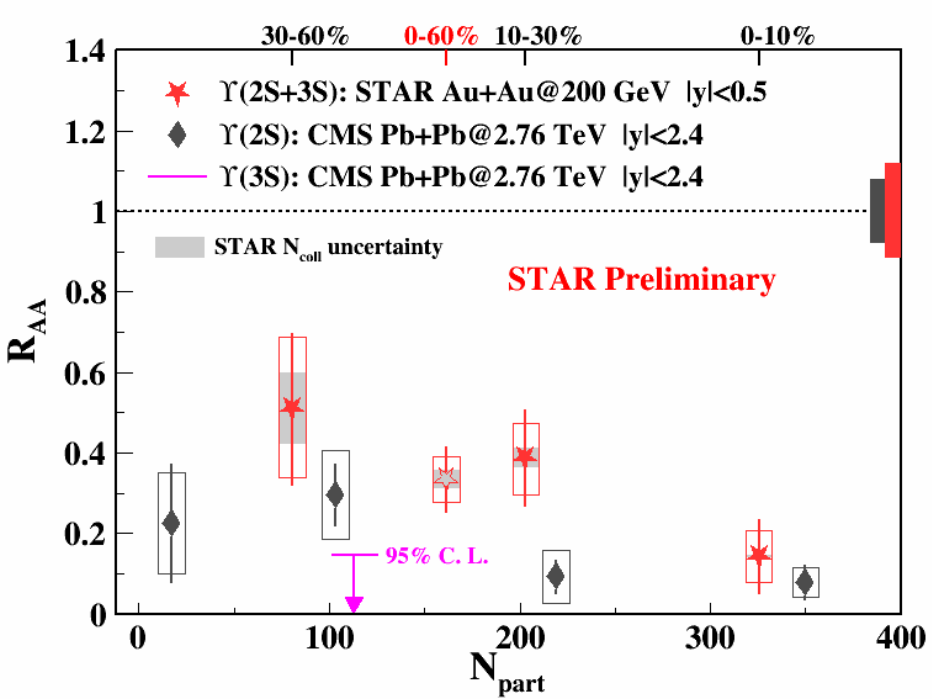



- Models with shadowing effects are close to p+Au data, but data favor additional nuclear absorption effects
- J/ψ in A+A more suppressed at low $p_T$ compared to LHC
  → smaller regeneration due to lower charm cross section
- Less suppressed at high $p_T$ compared to LHC
  → less dissociation due to lower medium temperature

# Upsilon Production

**Zaochen Ye,Tue 17:50**



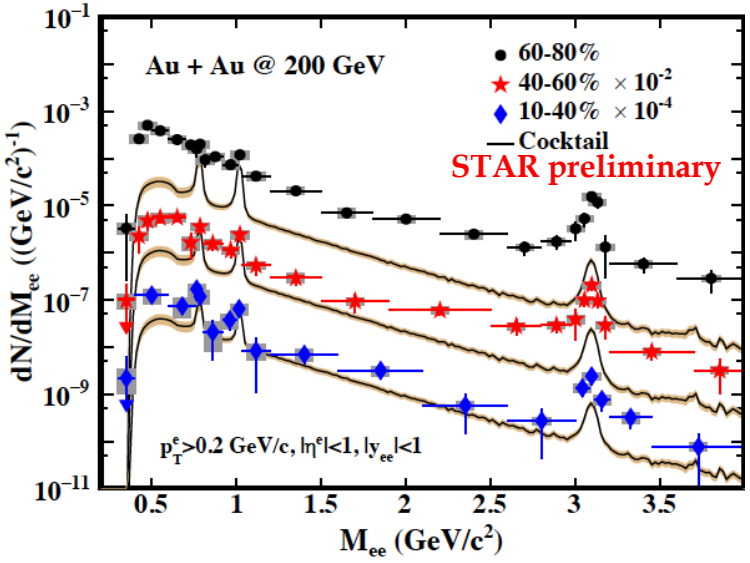




- Indication for more suppression towards more central collisions
- In central collisions Y(2S+3S) is more suppressed than Y(1S)
  → sequential melting
- Indication for less suppression than at LHC for Y(2S+3S)

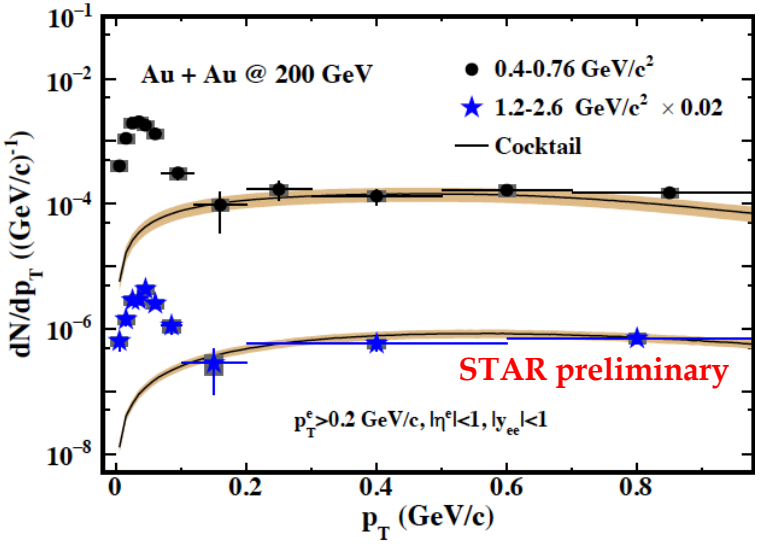
# Dilepton Production

**James Brandenburg, Tue 8:30**

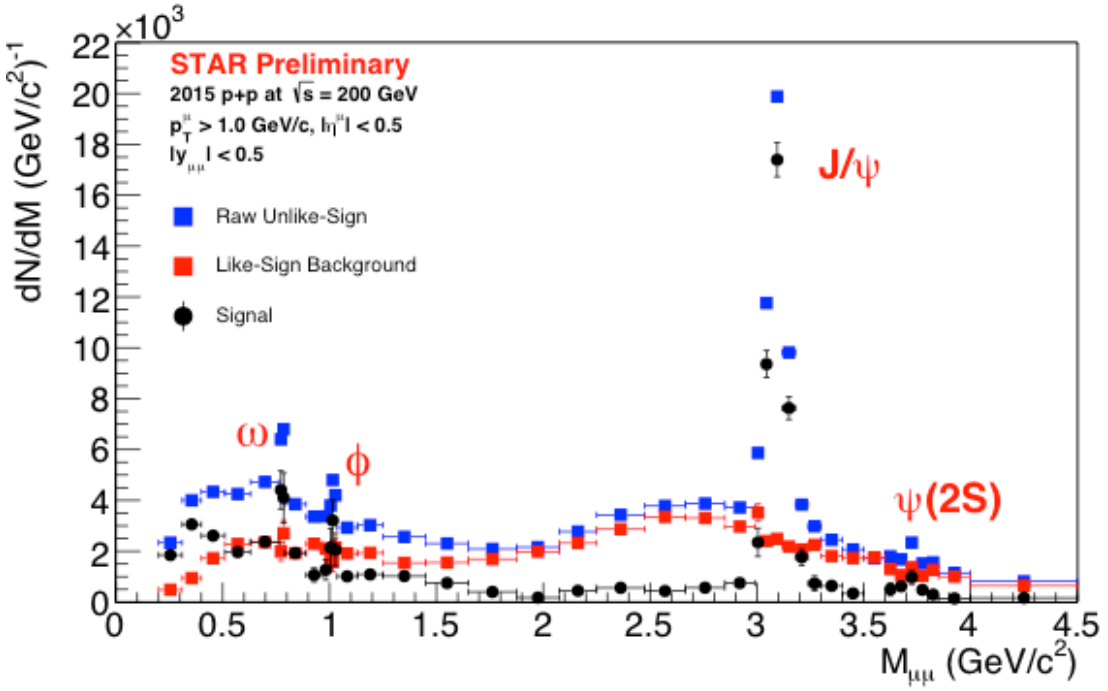
## Au+Au, $0<p_T<0.15$ GeV/c




## di-electron



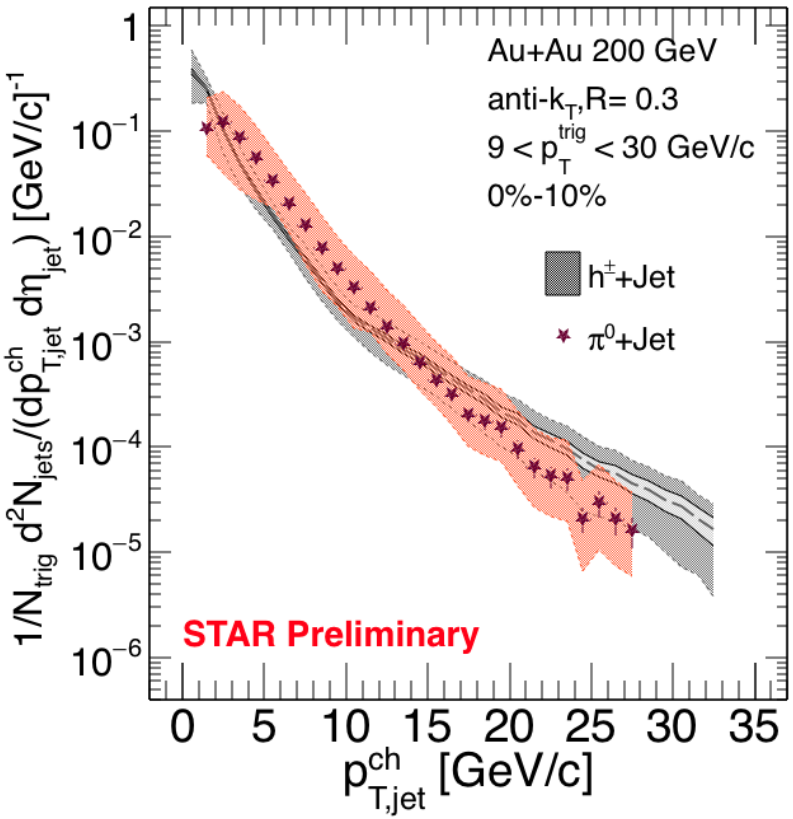

## p+p, dimuon

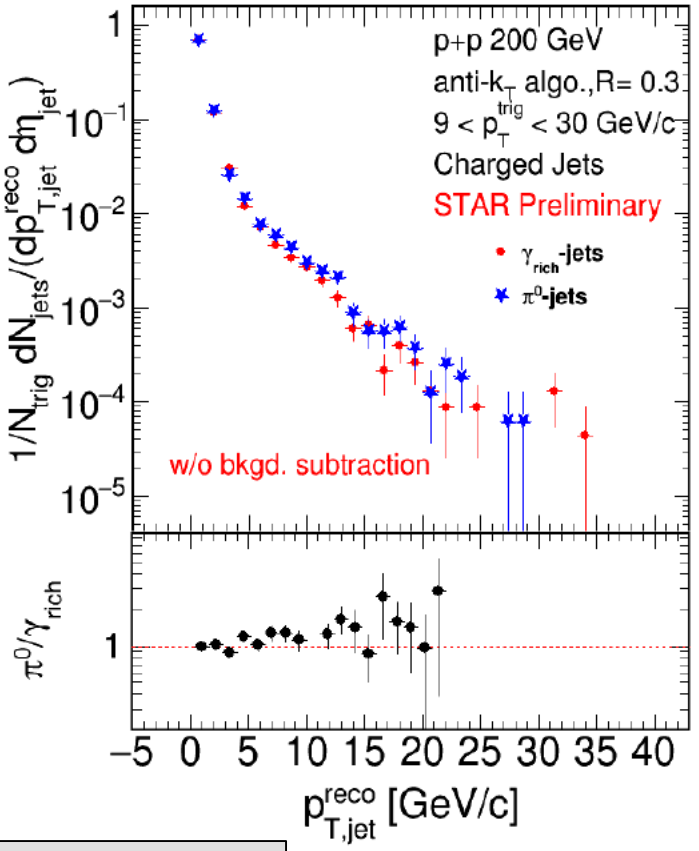



- In e+e-: large enhancement over cocktail in peripheral data at very low $p_T$
  → evidence for coherent photoproduction in the dielectron channel
- First look at μμ spectrum in p+p and Au+Au

# h/γ-Triggered Recoil Jets

**Nihar Sahoo, Tue 08:50**



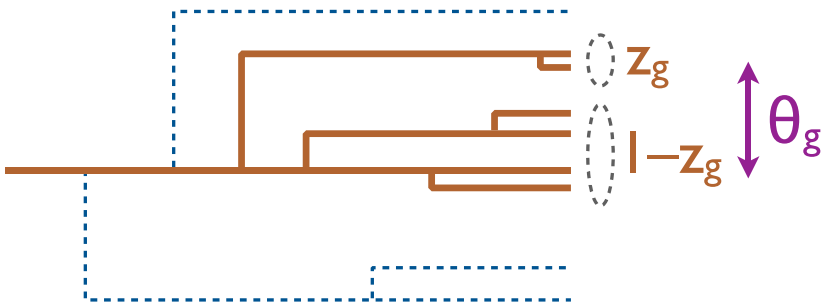

- π$^0$ and h$^{+/-}$ triggered recoil jets are in agreement in central Au+Au
- Modest difference observed between π$^0$ and γ triggers for p+p
  → A+A measurement on the way

**h-jet Submitted**

**arXiv:1702.01108**

# Shared momentum fraction

**Kolja Kauder, Tue 14:20**

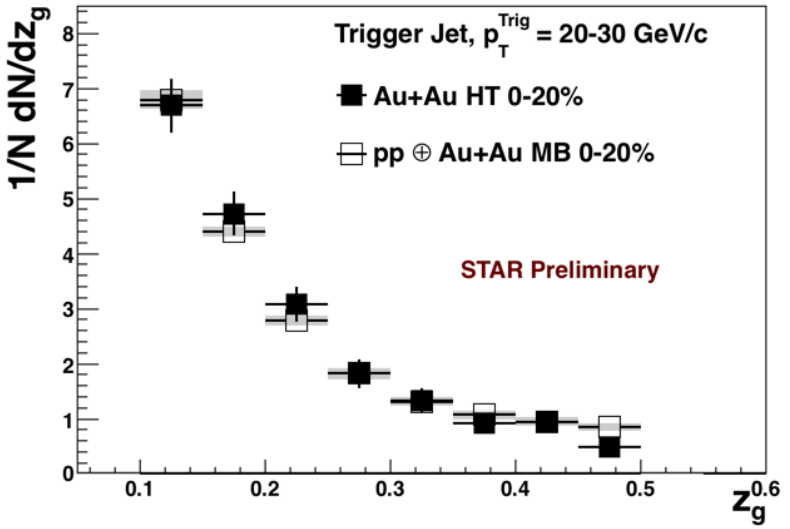


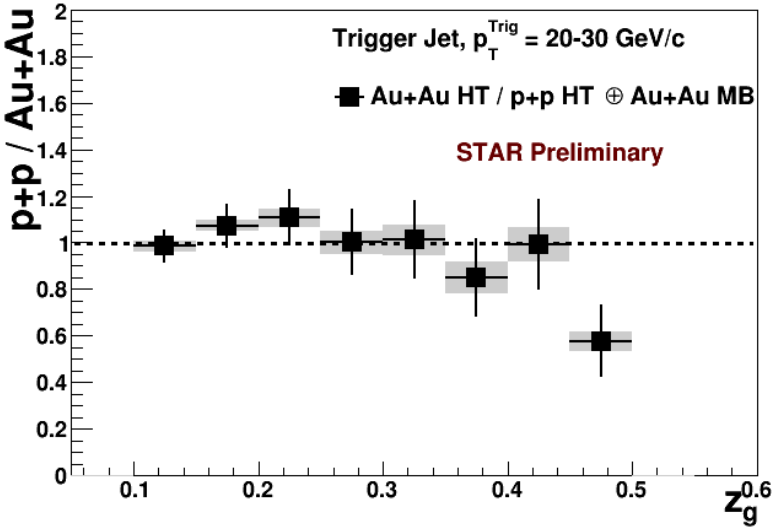

Based on declustering an angular-ordered tree

Di-jet Selection:
- Jet $p_T^{\text{Trig}} > 20$ GeV/c
- Jet $p_T^{\text{Recoil}} > 10$ GeV/$c$
- $|\Delta\Phi-\pi| < 0.4$

$p_T^{\text{Trig,Recoil}}$: Calculated with $p_{T,\text{cut}} > 2$ GeV/c
$z_g$: on matched jets with $p_{T,\text{cut}} > 0.2$ GeV/c

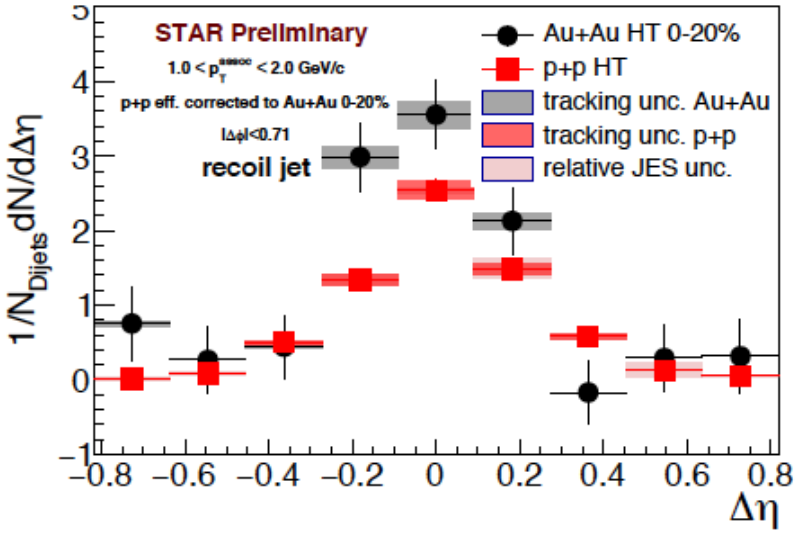
**Hard core di-jets:**
- As measured with $z_g$:
  No significant splitting modification on near- or away-side
- Discussion with theory ongoing!



# Jet-Hadron Correlations

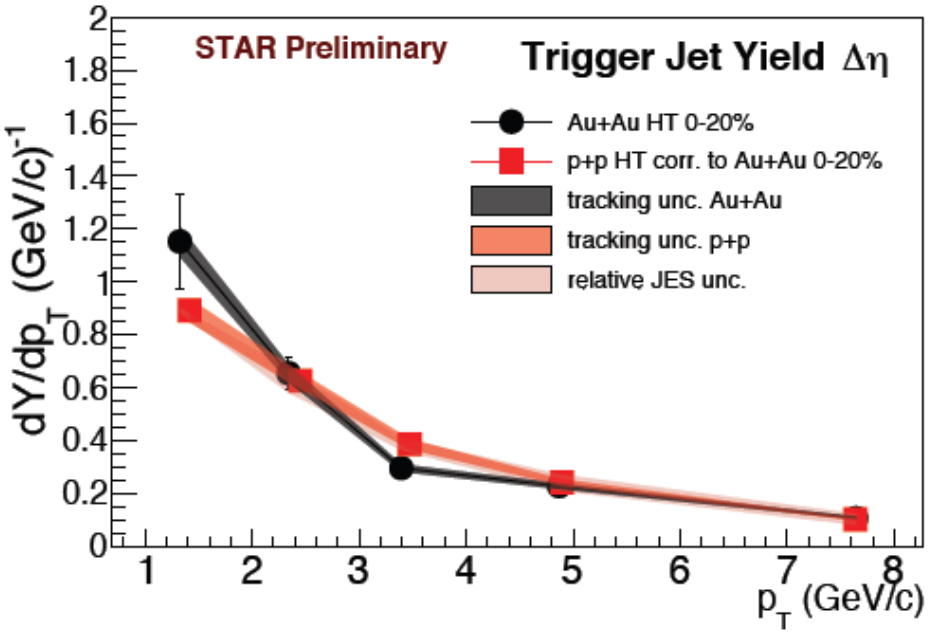
**Nihar Sahoo, Tue 08:50**

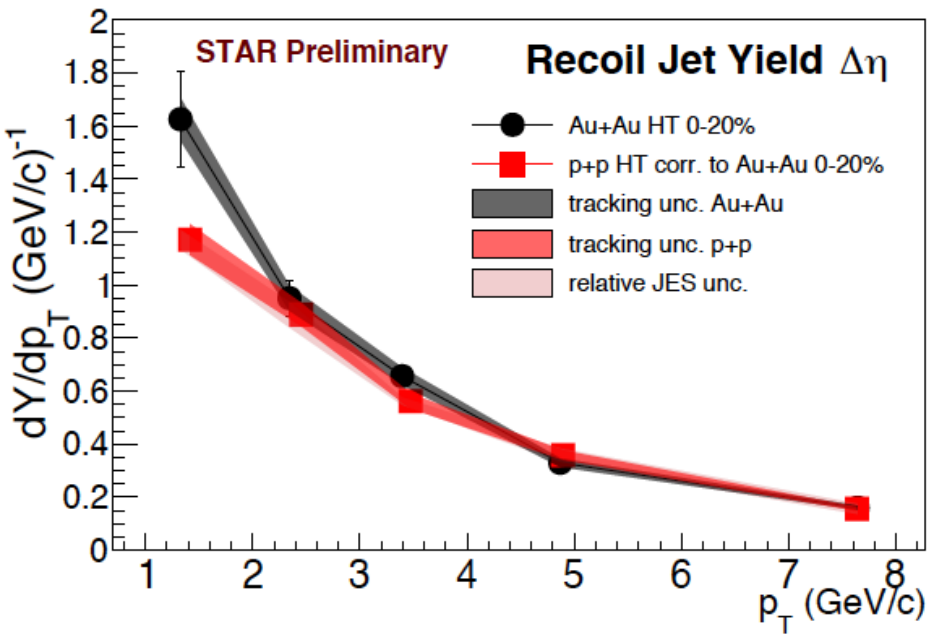



- Extension to $A_j$ measurement
- No modification relative to p+p on the trigger side
- Hints of excess on the recoil side at low $p_T$

**$A_j$ Submitted**

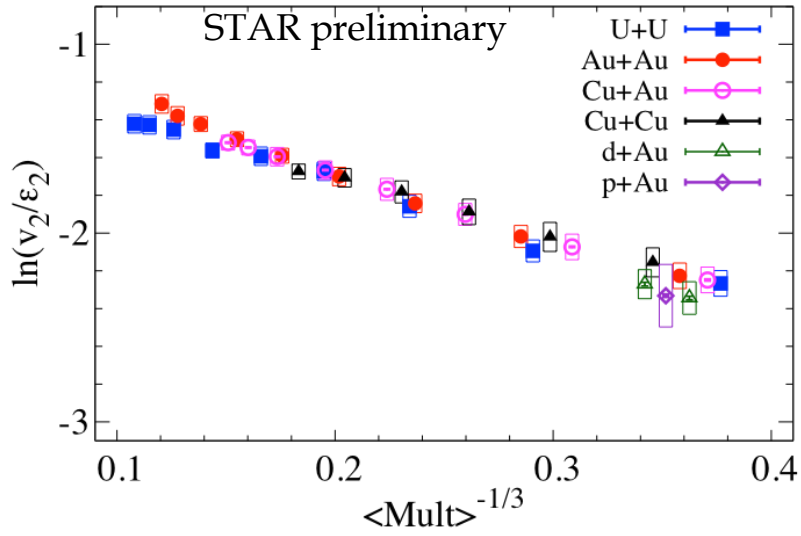
**arXiv:1609.03878**



# Flow and Three Particle Correlation Measurements

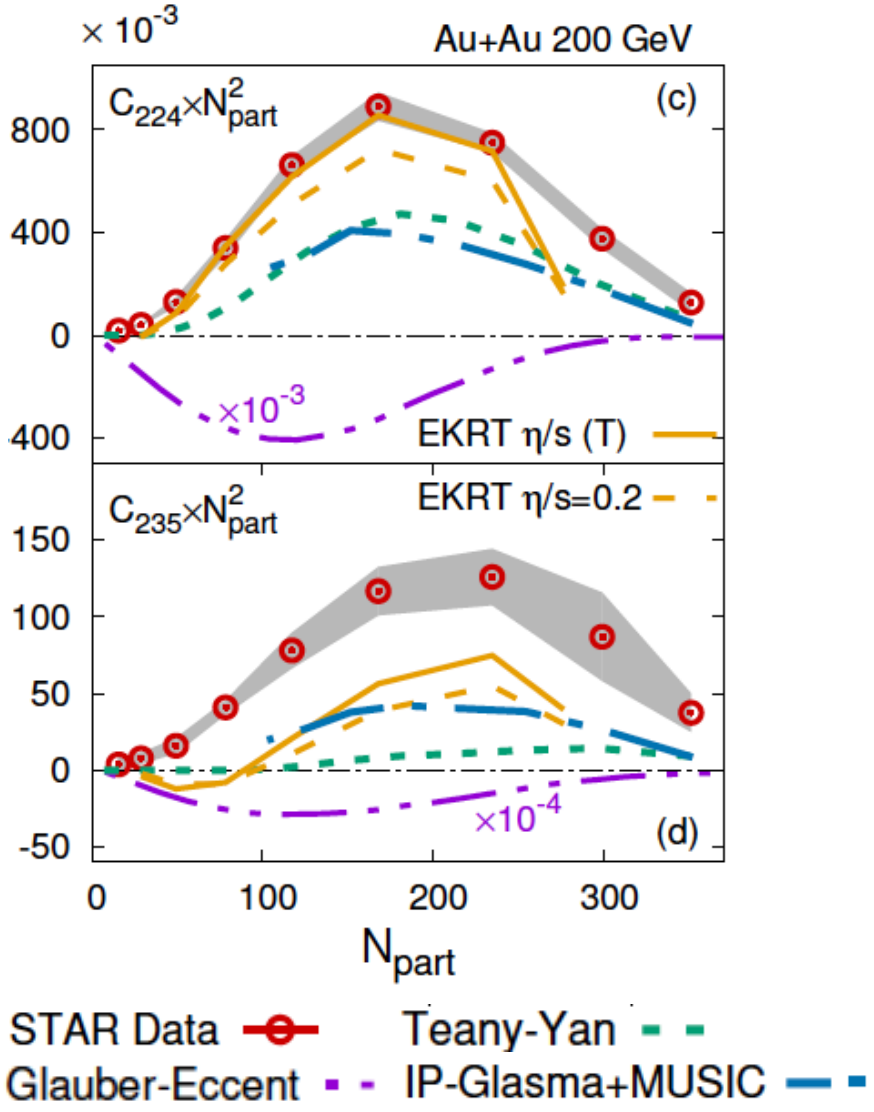
**Niseem Magdy, poster 363**




- Scaled $v_2$ shows similar features for all systems
  → same final state collective effects?
- $C_{m,n,m+n}$ : New way of constraining fluid-like properties and η/s(T)
  → 3D structure of initial state

**Corr. Submitted**
**arXiv:1701.06496**
**arXiv:1701.06497**

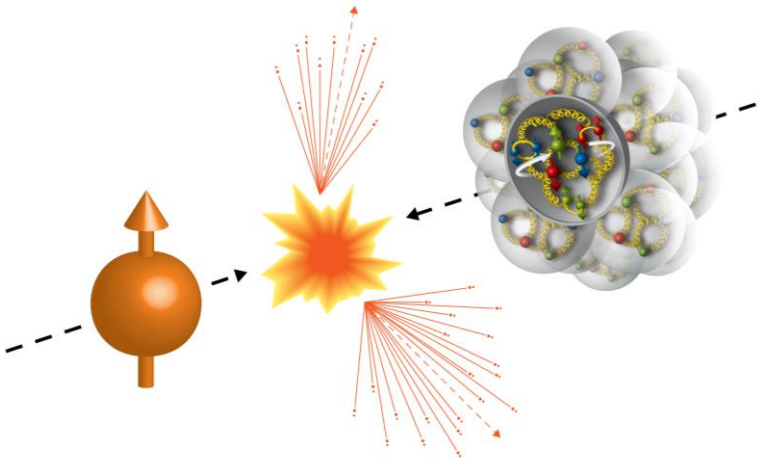
$$C_{m,n,m+n} = \langle\langle \cos(m\phi_1 + n\phi_2 - (m+n)\phi_3) \rangle\rangle$$



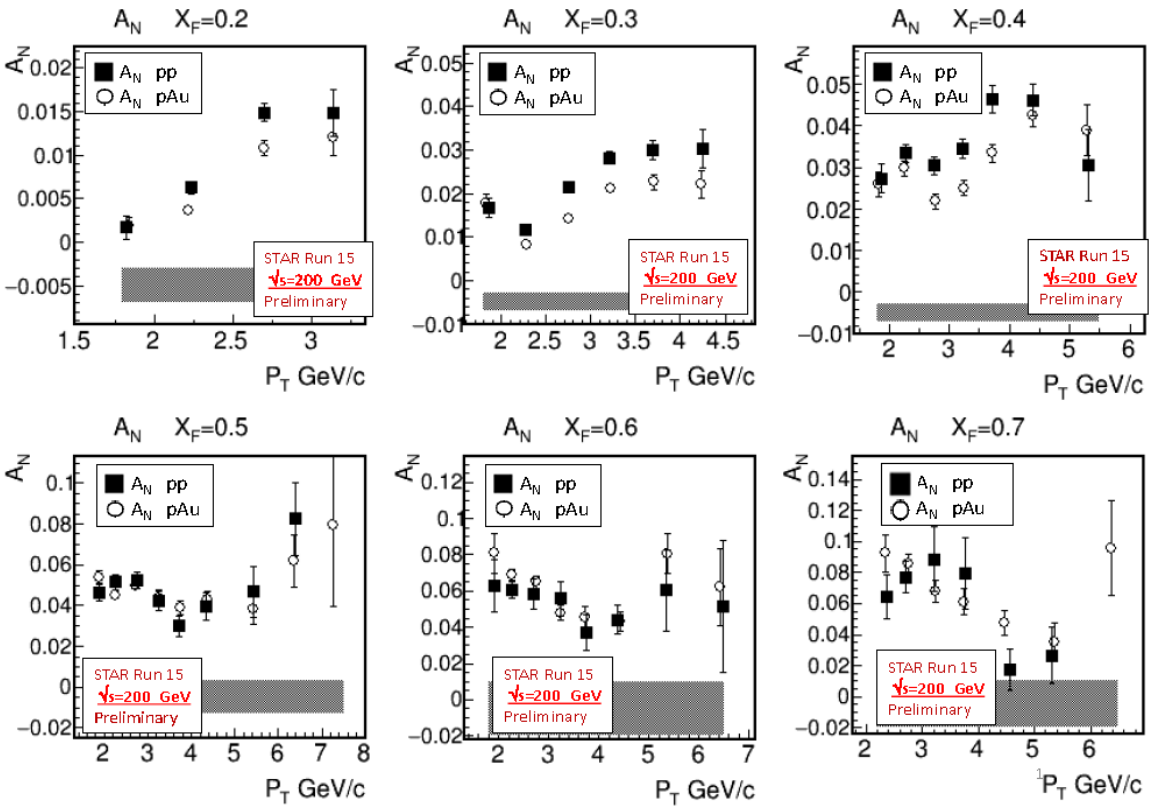
# $A_N$ from Polarized p+Au

**Akio Ogawa, Wed 09:10**

**$A_N$: Single Spin Asymmetry in Forward $\pi^0$ (low $x$) in p+p and p+Au**



Kang, PRD 84 (2011) 034019
Kovchegov, PRD 86 (2012) 034028

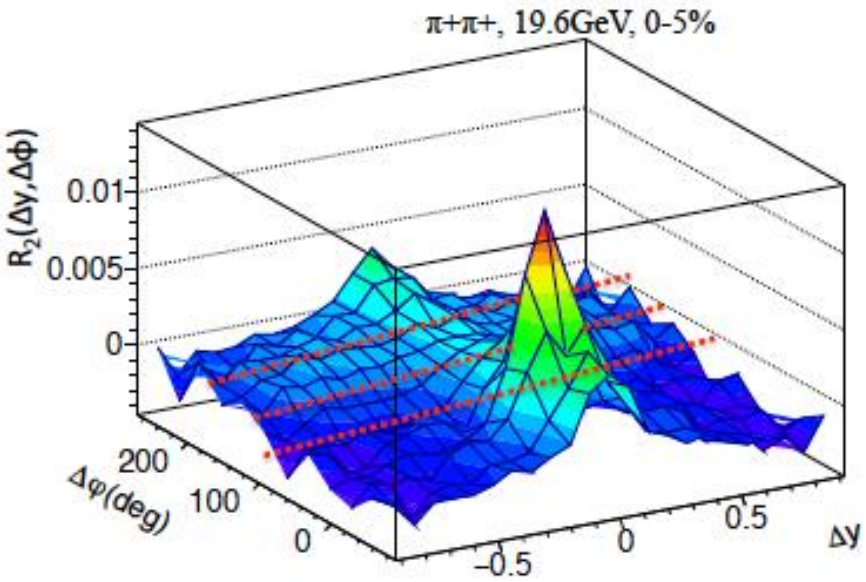



- Unique measurements of $A_N$ in p+Au vs. p+p: small to no reduction is observed
  → counter to initial expectations

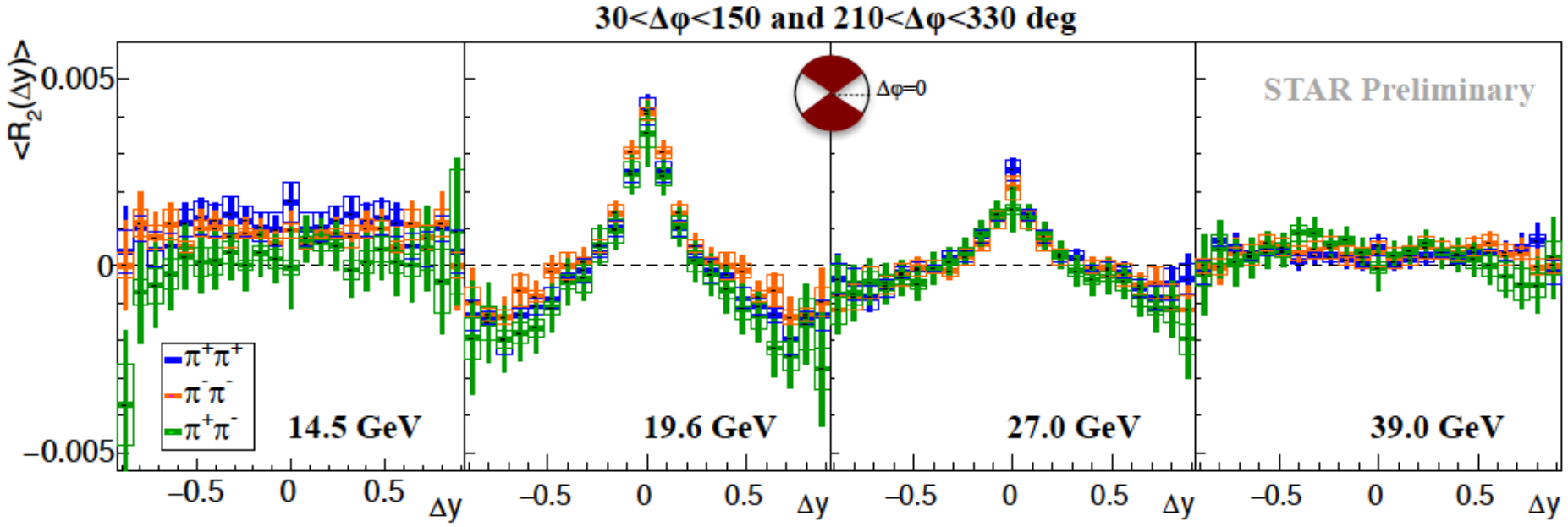
Shaded bands represent systematic uncertainty, dominated by dependence of $A_N$ on observed BBC multiplicity → central vs. peripheral collisions

# Rapidity Correlations in BES

**Sedigheh Jowzaee, Tue 17:30**

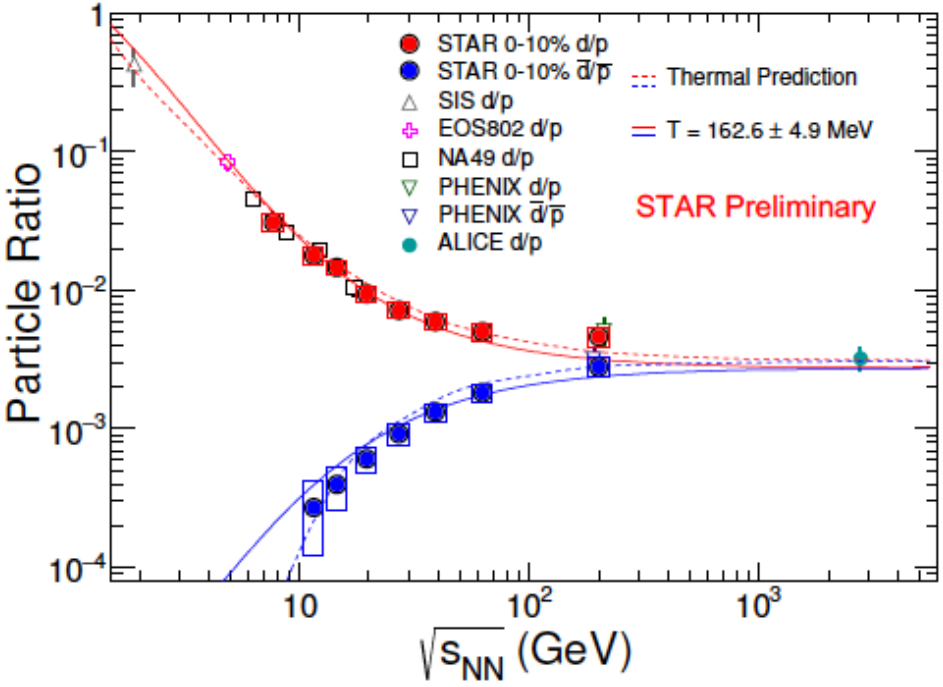



- Two-particle correlation of pion pairs
- Charge independent new ridge structure observed at around $\sqrt{s_{NN}}$ = 19.6 and 27 GeV
  → no ridge at higher/lower energies



# Light nucleus production in BES

**Ning Yu, Tue 17:10**

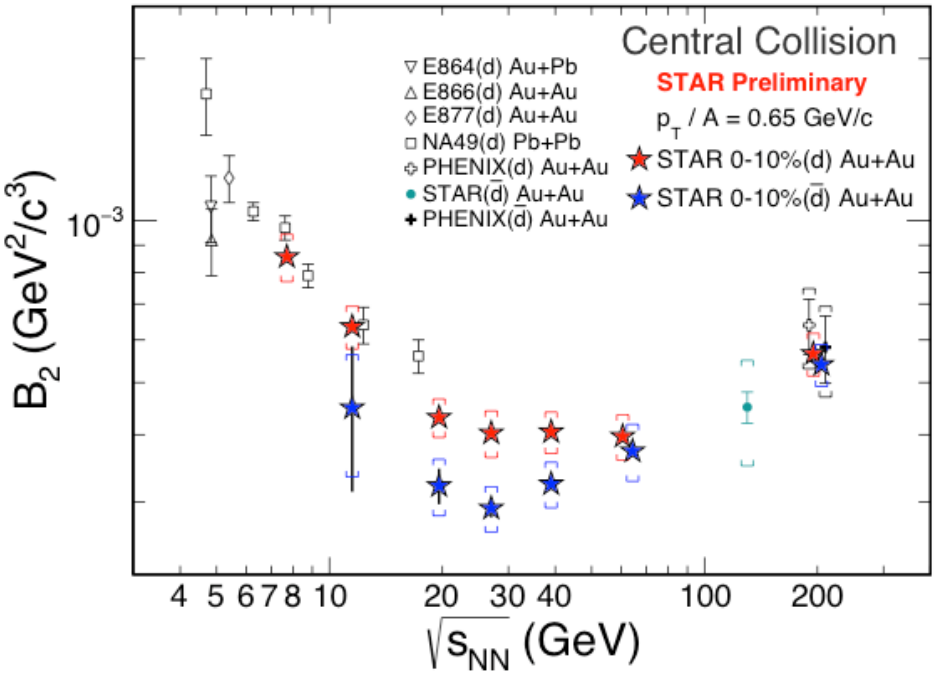



- Thermal model can correctly describe the d/p ratio at all energies

**BES spectra**

**arXiv:1701.07065**

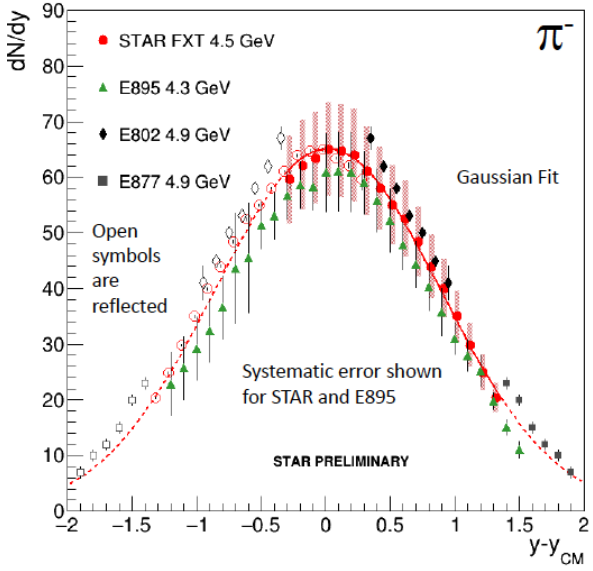
**Submitted**

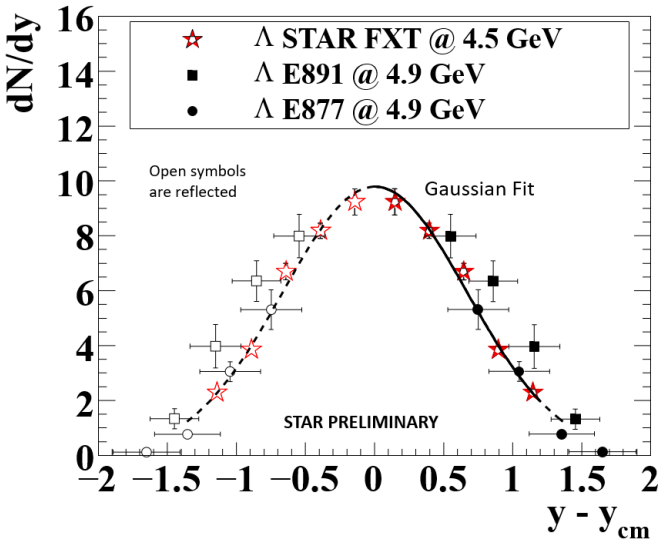


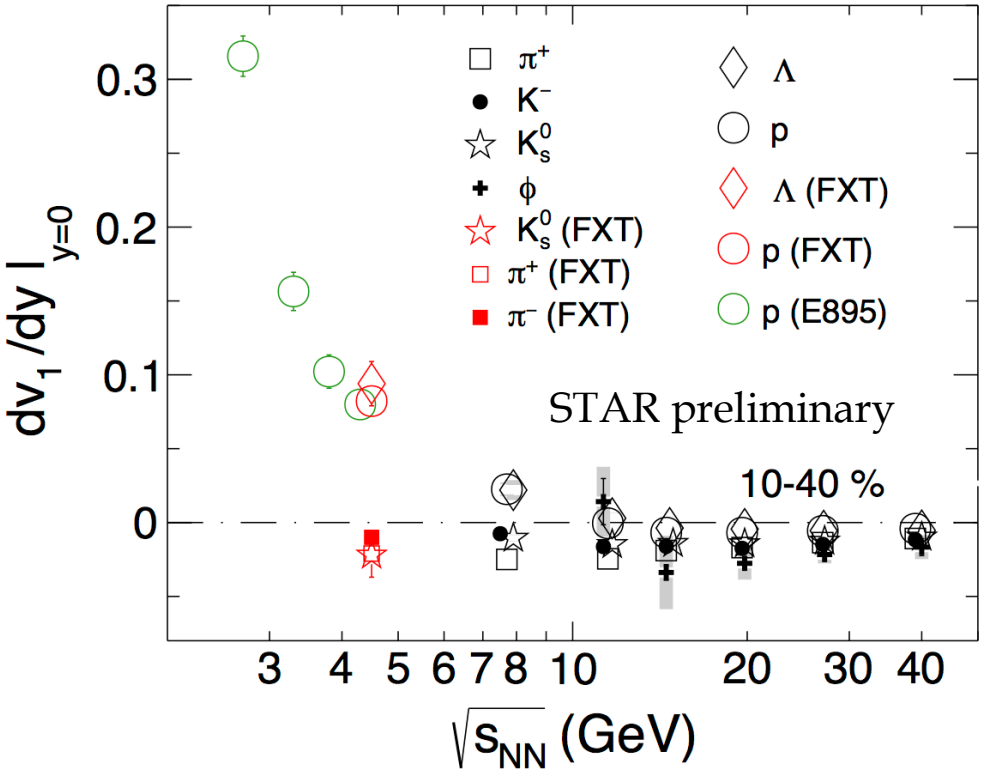

- The coalescence parameter $B_2$ is decreasing with energy and flattening out at about 20 GeV → change in EOS?

# Spectra and flow from Fixed Target

**Kathryn Meehan, Wed 14:20**



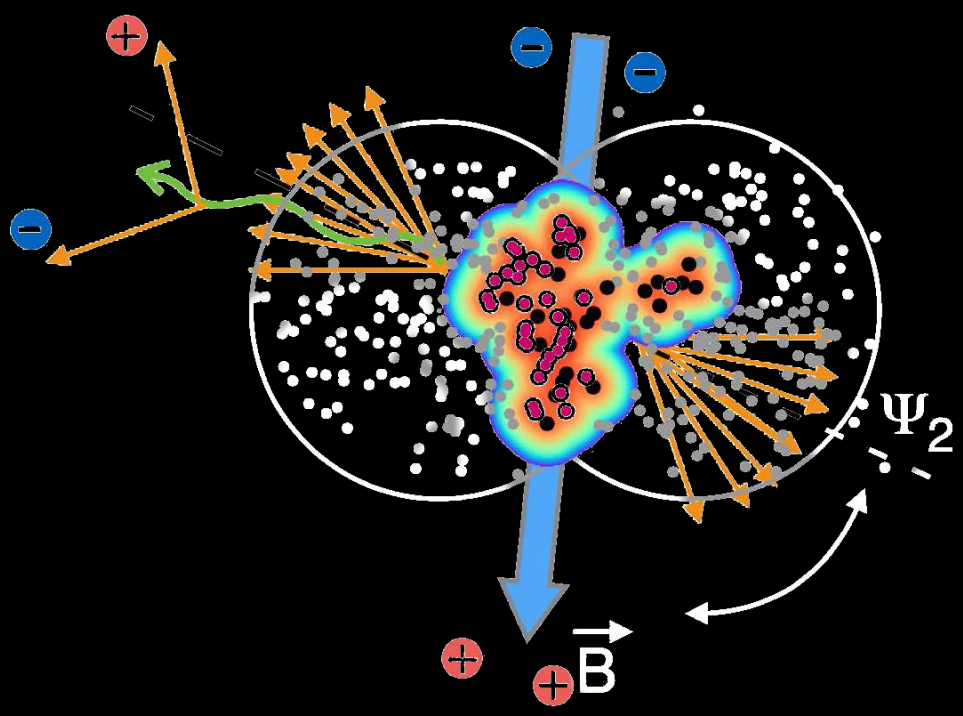



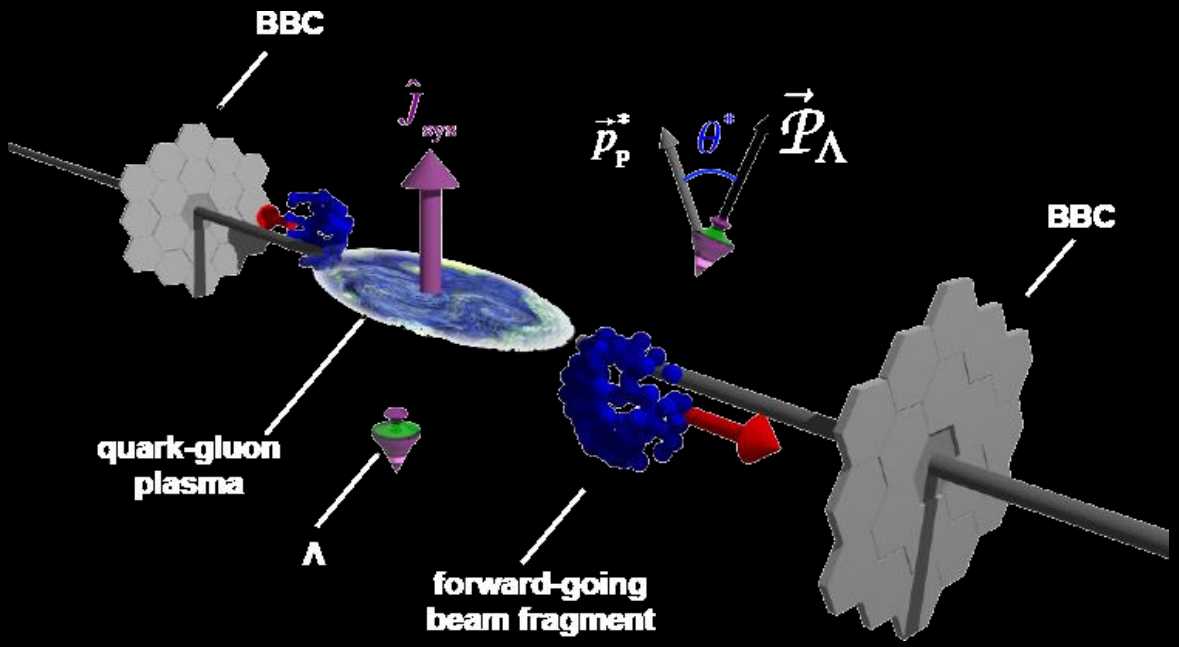

Dedicated fixed-target run in 2015: $\sqrt{s_{NN}}$ = 4.5 GeV
- 1 M events in 30 minutes!
- Excellent PID using dE/dx and ToF
- dN/dy and $v_1$ for charged particles and $V^0$s are in good agreement with published results

Non-central HI collision
→ Initial angular momentum (vorticity) + B-field

**Chiral Magnetic Effect (CME):**
→ Separation of charges along B-field (spin-momentum alignment)

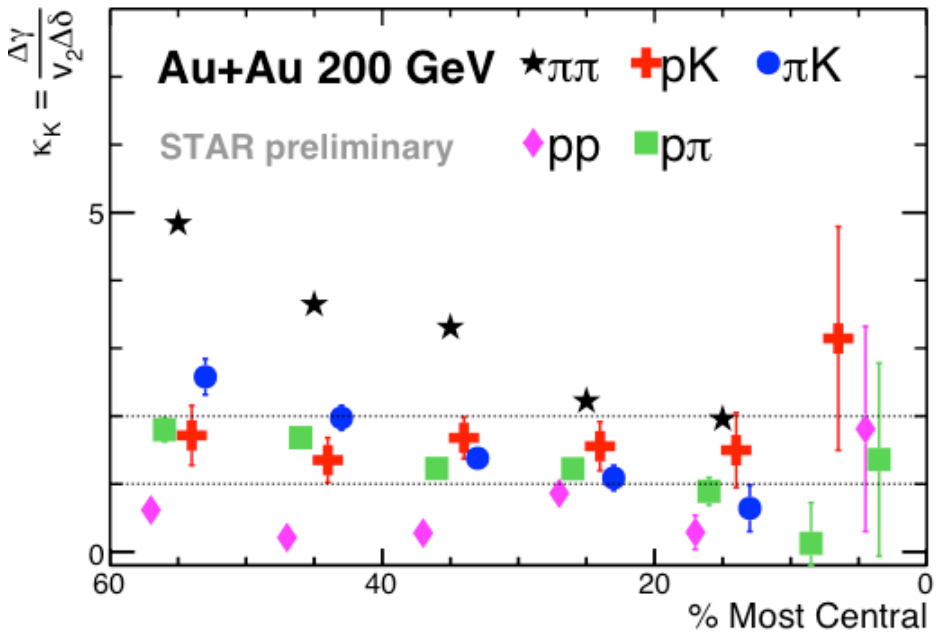
**Vortical or spin-orbit coupling:**
→ Spin alignment with global angular momentum

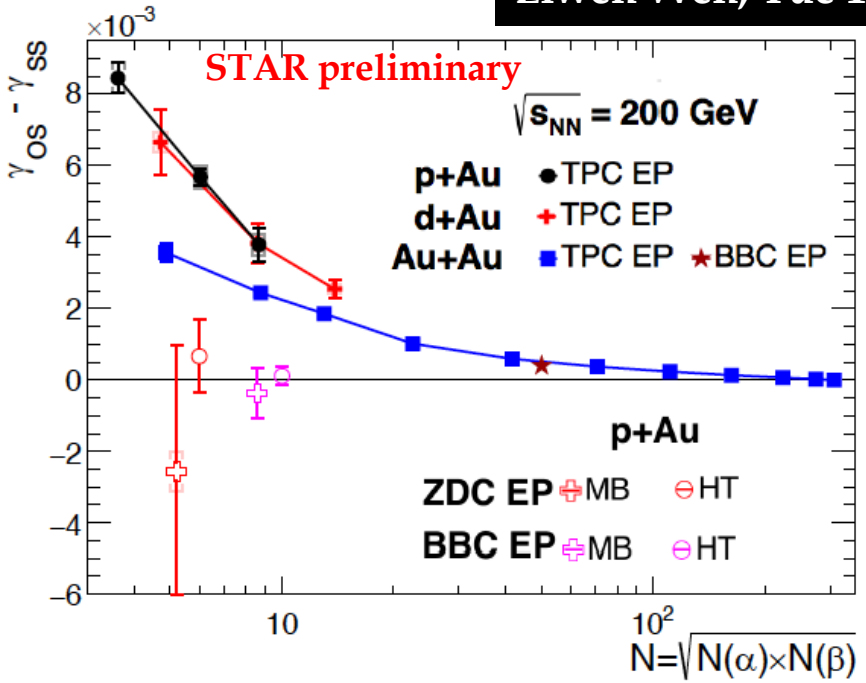


# Chiral Magnetic Effect

Liwen Wen, Tue 16:30



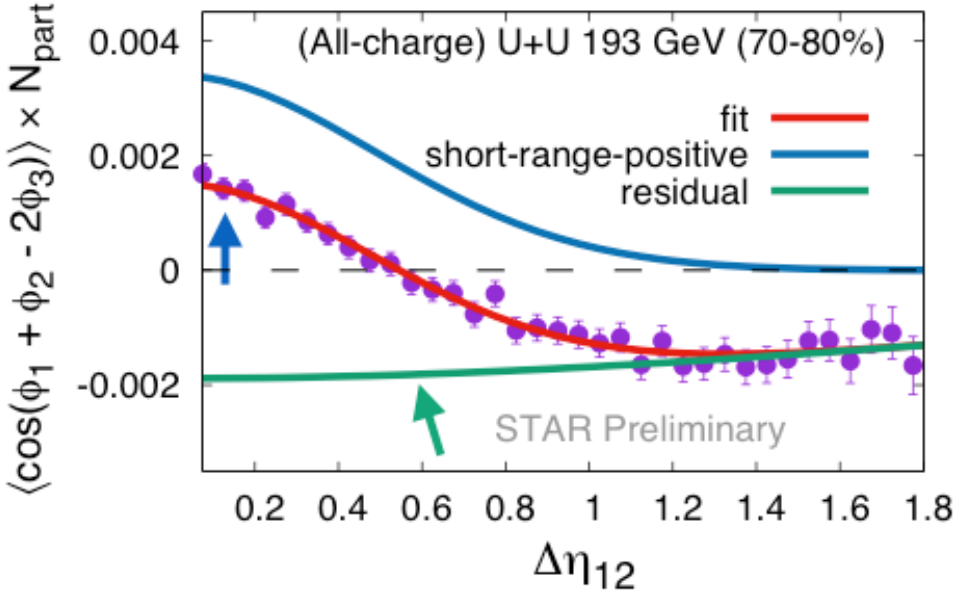



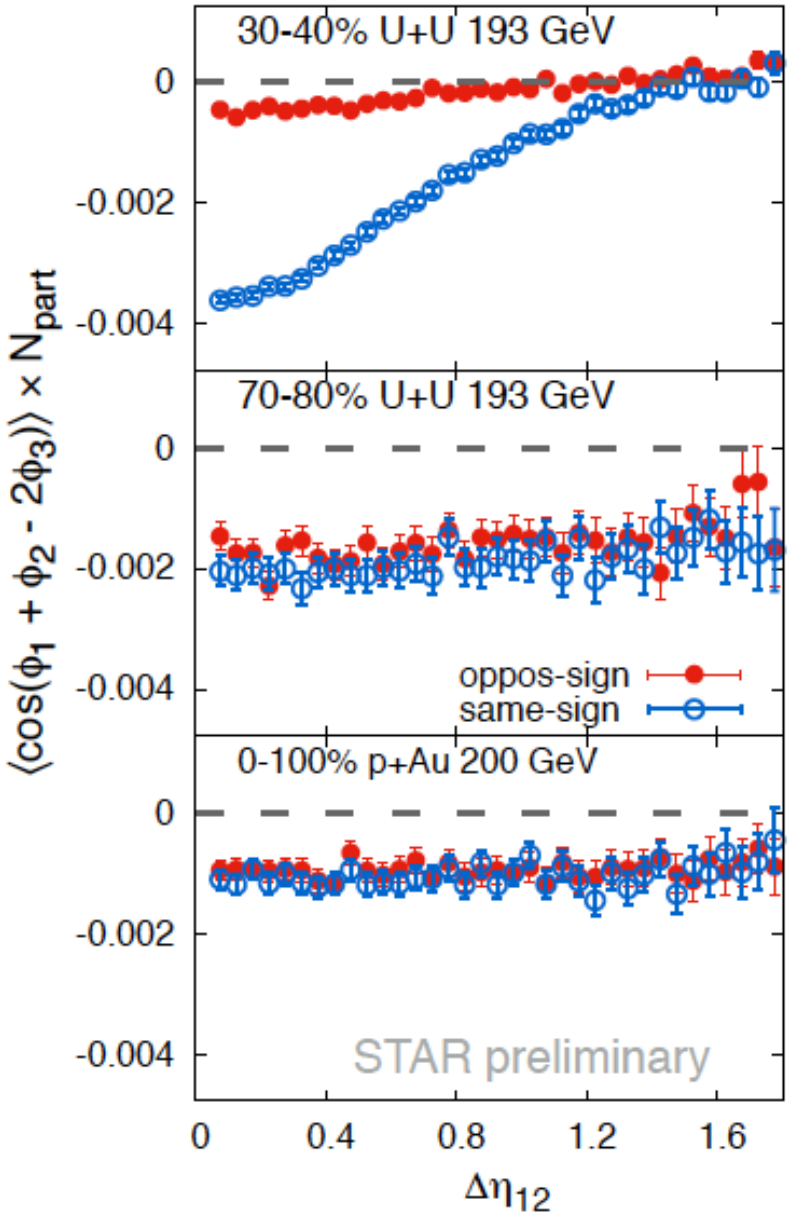

Time Projection Chamber: $|\eta| < 1$
Beam-Beam Counter: $3.8 < |\eta| < 5.2$
Zero Degree Calorimeter: $6 < |\eta|$

- Large charge separation signal in p+Au compared to Au+Au
- p+Au signal disappears for EP with large η gap
- $\kappa_K$: an estimator of signal excess over background, background level assumed to be around 1-2 in ideal cases
- ππ charge separation signal similar to hh, other PID combinations show smaller effects

# Background and Signals of Chiral Magnetic Effects

**Prithwish Tribedy, Tue 14:40**



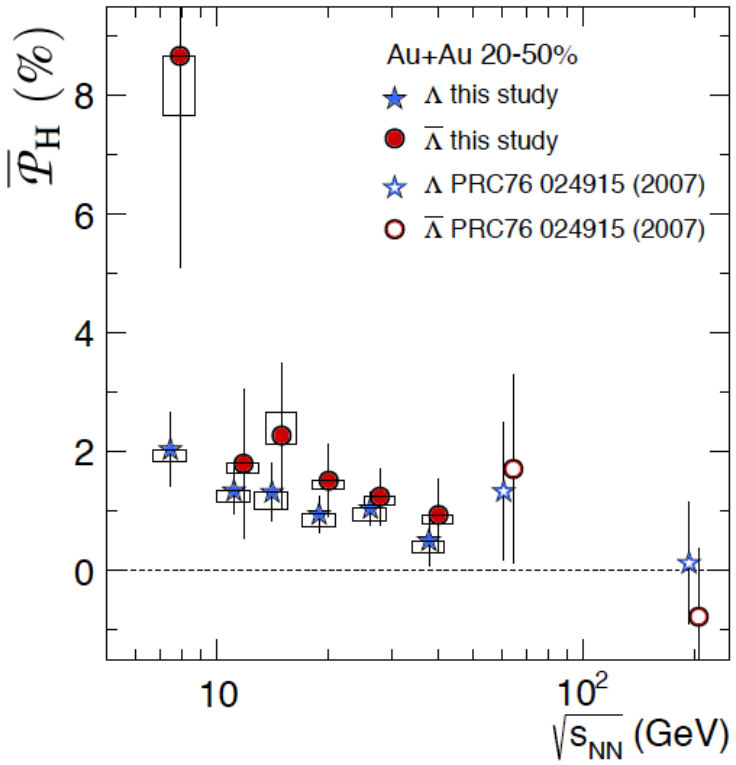

- Decompose correlations into three components
- Short range subtracted charge separation vanishes in most central and peripheral A+A and all p+A
- Isobar collisions will further clarify the origin of the remaining charge separation in middle centralities

# Global Λ Polarization and ϕ Spin Alignment

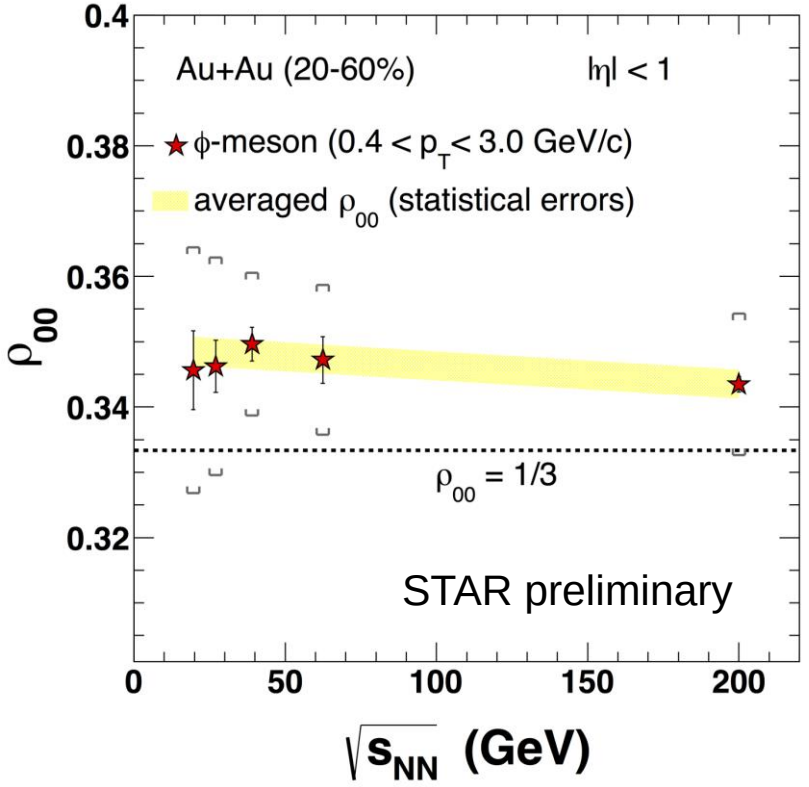
**Isaac Upsal, Tue 16:50**

**Xu Sun, poster 305**

$\Lambda \rightarrow p\pi$




$\phi \rightarrow KK$



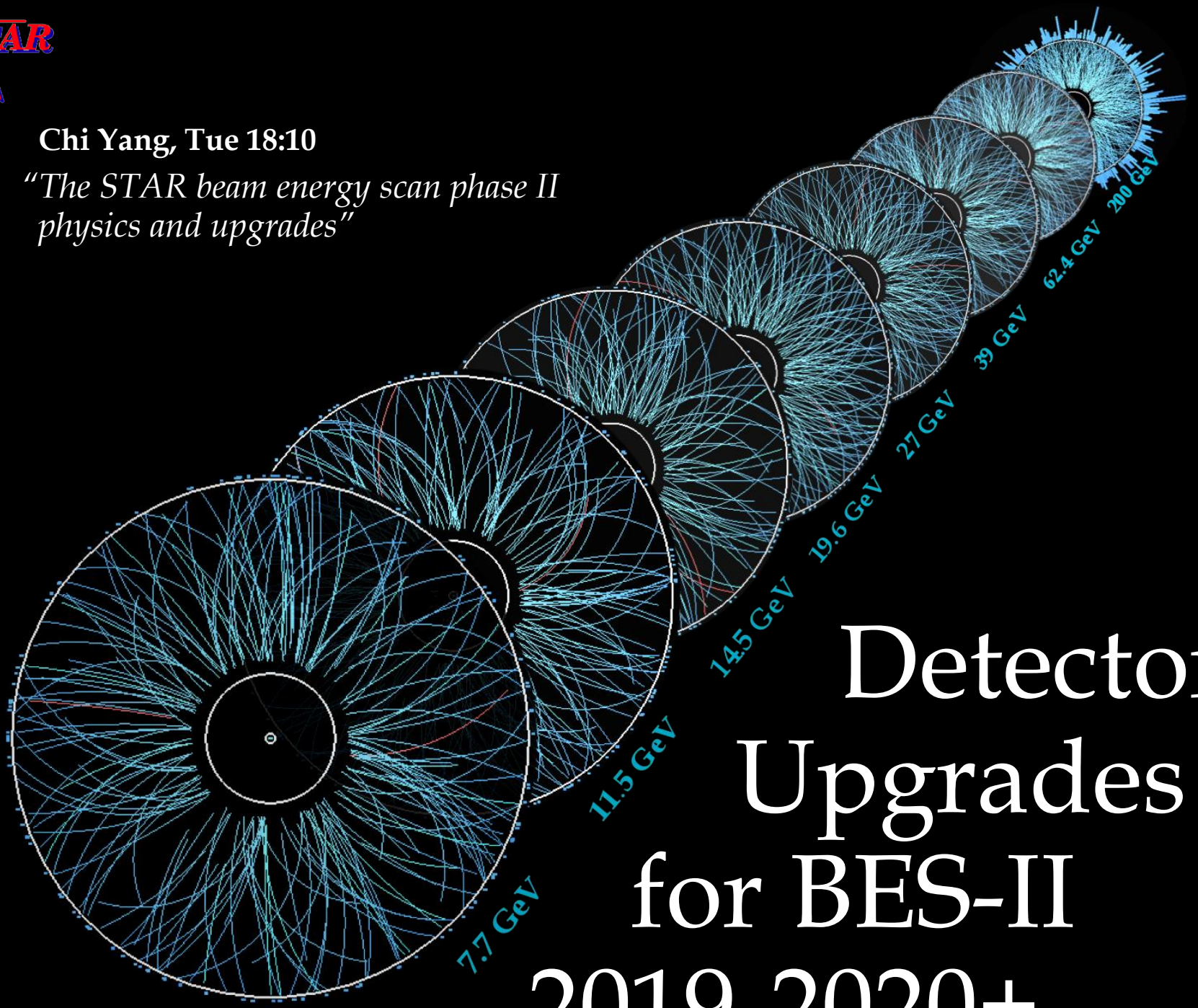

- Positive Λ signal → positive vorticity
- **First time non-zero signal observed!**
- $\bar{\Lambda}$ > Λ (?) → magnetic coupling
- First measurement on ϕ meson spin alignment

**Λ Submitted**

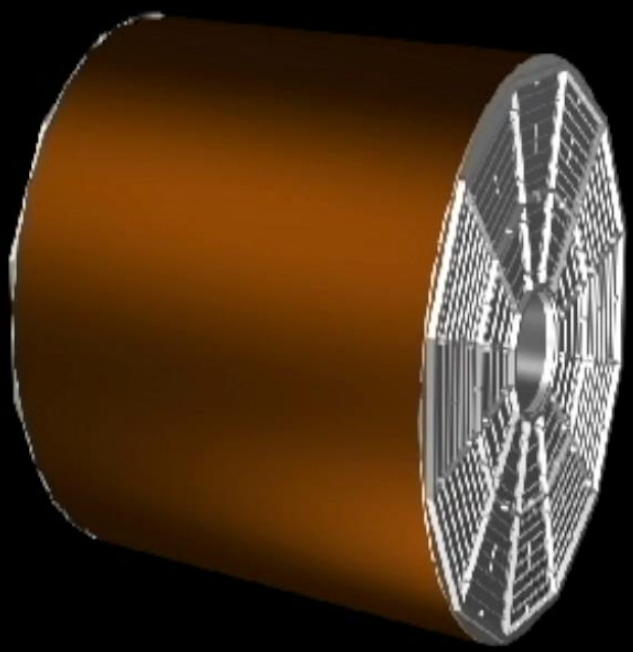
**arXiv:1701.06657**

**Chi Yang, Tue 18:10**

*"The STAR beam energy scan phase II physics and upgrades"*




# Detector Upgrades for BES-II 2019-2020+



# Posters from STAR I

**Baryon-rich QCD Matter**

**127. Tetsuo Sugiura:** Δη dependence of net-charge fluctuations in Au+Au collisions from the Beam Energy Scan at the STAR experiment
**522. Subhash Singha:** Beam energy dependence of bulk properties via $K^{*0}$ and φ resonances in Au+Au collisions at RHIC
**745. David Tlusty:** Strange hadron spectra and directed flow in STAR Fixed Target experiment

**Collective Dynamics**

**121. Md Nasim:** Probing QCD medium with the measurements of symmetric 2- harmonics 4-particle cumulant and moments of flow distributions in heavy-ion collisions in STAR.
**344. N.N. Ajitanand:** Charge asymmetry measurements in Au+Au collisions by STAR in search of the Chiral Magnetic Effect
**363. Naseem Magdy:** Beam energy and system size dependence of the viscous damping of anisotropic flow
**423. Michael Lomnitz:** Centrality and $p_T$ dependence of $D^0$ triangular flow in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV
**482. Takafumi Niida:** The dipole flow in Cu+Au and Au+Au collisions at $\sqrt{s_{NN}}$=200GeV with the STAR detectors
**619. Anjali Attri:** Event-by-event charge separation in Au+Au collisions at $\sqrt{s_{NN}}$=200 GeV with the STAR detector at RHIC

**Correlations & Fluctuations**

**152. Jie Zhao:** Separate measurements of physics background and the possible Chiral Magnetic Effect in p+Au and d+Au collisions at RHIC
**239. Toshihiro Nonaka:** Measurement of the sixth order cumulant of net-proton multiplicity distribution in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV from the STAR experiment
**293. Arghya Chatterjee:** Measurements of off-diagonal cumulants of net-charge, net-proton and net-kaon distributions at STAR
**305. Xu Sun:** Collision energy and centrality dependence of ϕ-meson spin alignment
**327. Jindrich Lidrych:** Kaon femtoscopy in Au+Au collisions at the energy from 7.7 to 200 GeV with the STAR experiment

**Electroweak Probes**

**340. Shuai Yang:** Coherent very low transverse momentum e+e- pair production in hadronic Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV and U+U collisions at $\sqrt{s_{NN}}$ = 193 GeV at STAR

**Heavy Flavor & Quarkonia**

**105. Qian Yang:** J/ψ production in p+p collisions at √s = 500 GeV at the STAR experiment
**176. Siwei Luo:** Measurements of J/ψ polarization in p+p, p+Au and Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV by the STAR experiment
**186. Alena Harlenderova:** Measurement of J/ψ azimuthal anisotropy in U+U collisions at $\sqrt{s_{NN}}$ =193 GeV by the STAR experiment
**241. Xiaoloong Chen:** Non-prompt $D^0$-meson production in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in STAR

# Posters from STAR II

**Heavy Flavor & Quarkonia**

**242. Zach Miller:** Measurements of electron production from heavy flavor decays in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV by the STAR experiment

**258. Wangmei Zha:** Excess of J/ψ yield at very low $p_T$ in Au+Au collisions at $\sqrt{s_{NN}}$= 200 GeV and U+U collisions at $\sqrt{s_{NN}}$ = 193 GeV measured with the STAR experiment

**263. Xinjie Huang:** Upsilon measurements via the dimuon channel in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV with the STAR experiment

**277. Jakub Kvapil:** D± meson production in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV measured by the STAR experiment

**356. Xiaozhi Bai:** Measurements of charm and bottom production via semi-leptonic decays in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV by the STAR experiment

**409. Miroslav Saur:** D0 meson production in Cu+Au collisions at $\sqrt{s_{NN}}$=200 GeV measured by the STAR experiment

**550. Guannan Xie:** $\Lambda_c$ production in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV at the STAR experiment

**Initial State Physics**

**402. Maowu Nie:** Event-by-event distributions of flow harmonics in U+U Collisions at $\sqrt{s_{NN}}$ = 193 GeV

**481. Zach Miller:** Cold nuclear matter effects on non-photonic electron production measured in p+Au collisions by the STAR experiment

**Jets & Jet Quenching**

**173. Derek Anderson:** Reconstruction of neutral-triggered full recoil jets in √s=200GeV p+p collisions at the STAR experiment

**254. Kun Jiang:** Characterizing the away-side jet correlation with robust flow background subtraction in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in STAR

**333. Ryo Aoyama:** Event plane dependent dihadron azimuthal correlations with event shape engineering in Au+Au collisions at $\sqrt{s_{NN}}$=200GeV

**419. Alex Jentsch:** $D^0$-hadron correlations in azimuth and pseudorapidity in Au+Au collisions at $\sqrt{s_{NN}}$ =200 GeV

**561. Li Yi:** Underlying-event activity studies at $\sqrt{s_{NN}}$ =200 GeV by STAR

**571. Nick Elsey:** Di-jet hadron correlations in central Au+Au collisions at $\sqrt{s_{NN}}$=200 GeV at STAR

**QGP in Small Systems**

**553. Yanfang Liu:** Centrality determination for p+Au Collisions at $\sqrt{s_{NN}}$=200GeV by the STAR experiment

**Future**

**428. Justin Ewigleben:** An improved Event Plane Detector for the STAR experiment

**450. Daniel Brown:** Forward calorimetry for heavy-ion physics at the STAR experiment

**463. Frank Geurts:** The STAR eTOF upgrade

**682. Yaping Wang:** A faster pixel detector for open bottom hadron measurements at RHIC


Thanks!