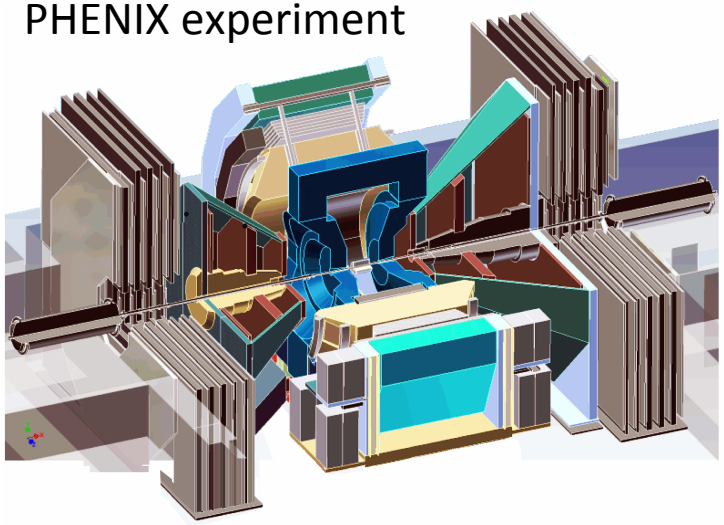
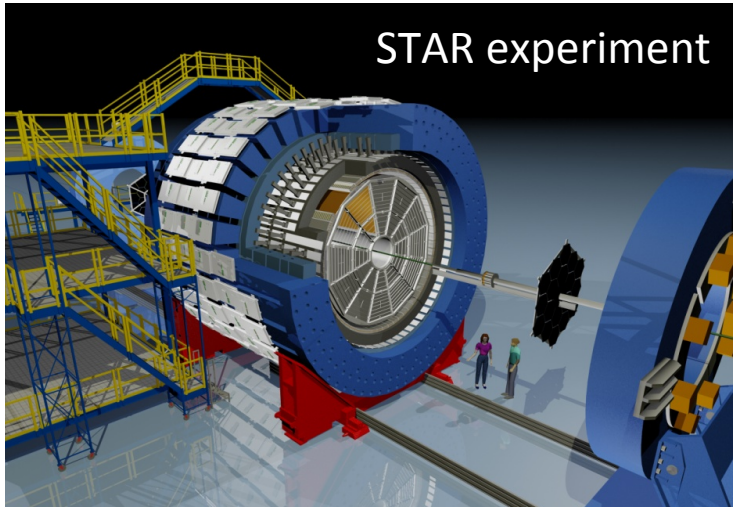
Experimental Results from RHIC

PHENIX experiment



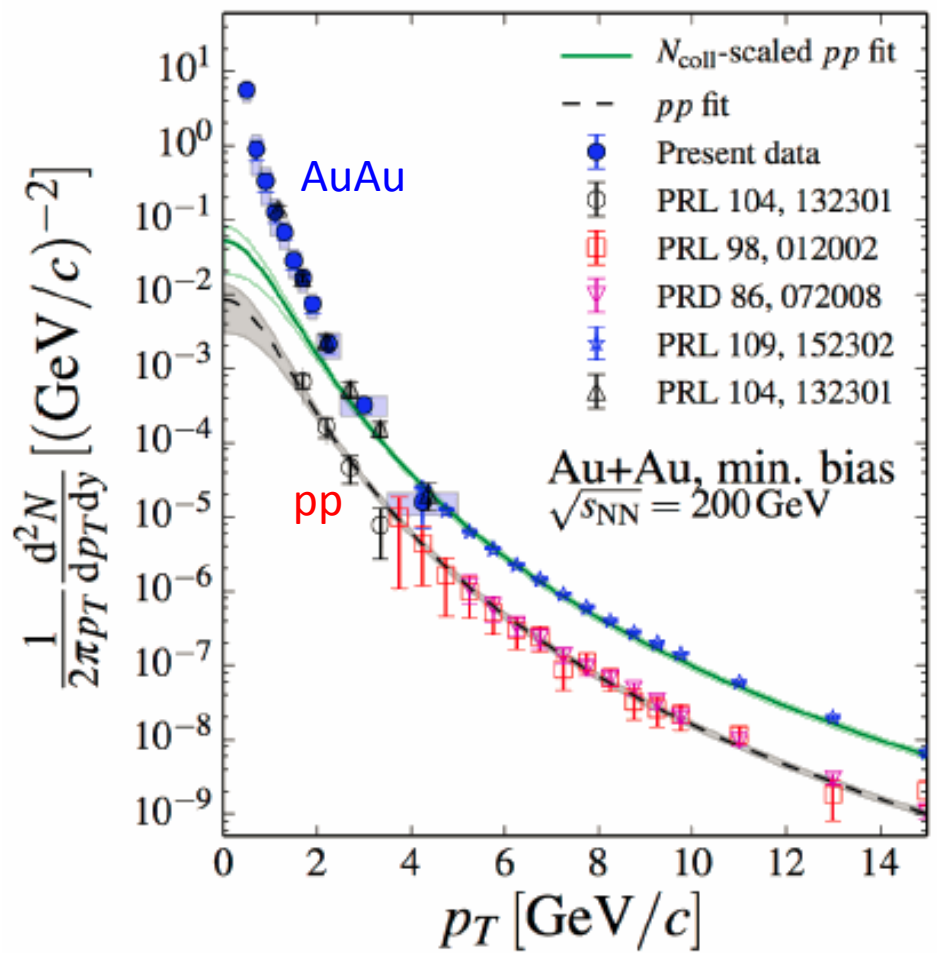
ShinIchi Esumi
Inst. of Physics, Univ. of Tsukuba



Contents

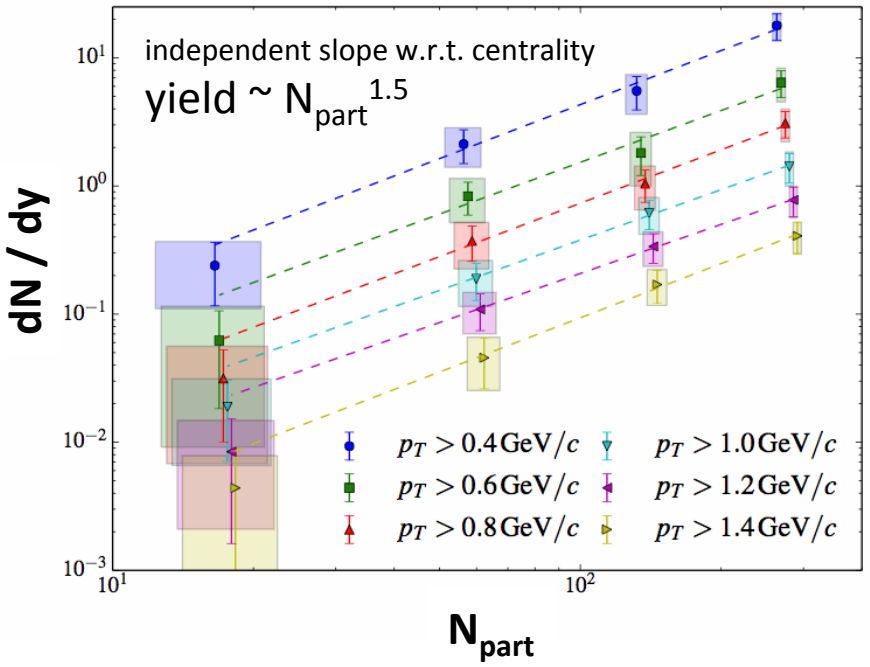
- Direct photons
- Jet quenching
- d-Au and ridge/flow
- Beam energy scan

Enhanced thermal photon production at low p_T

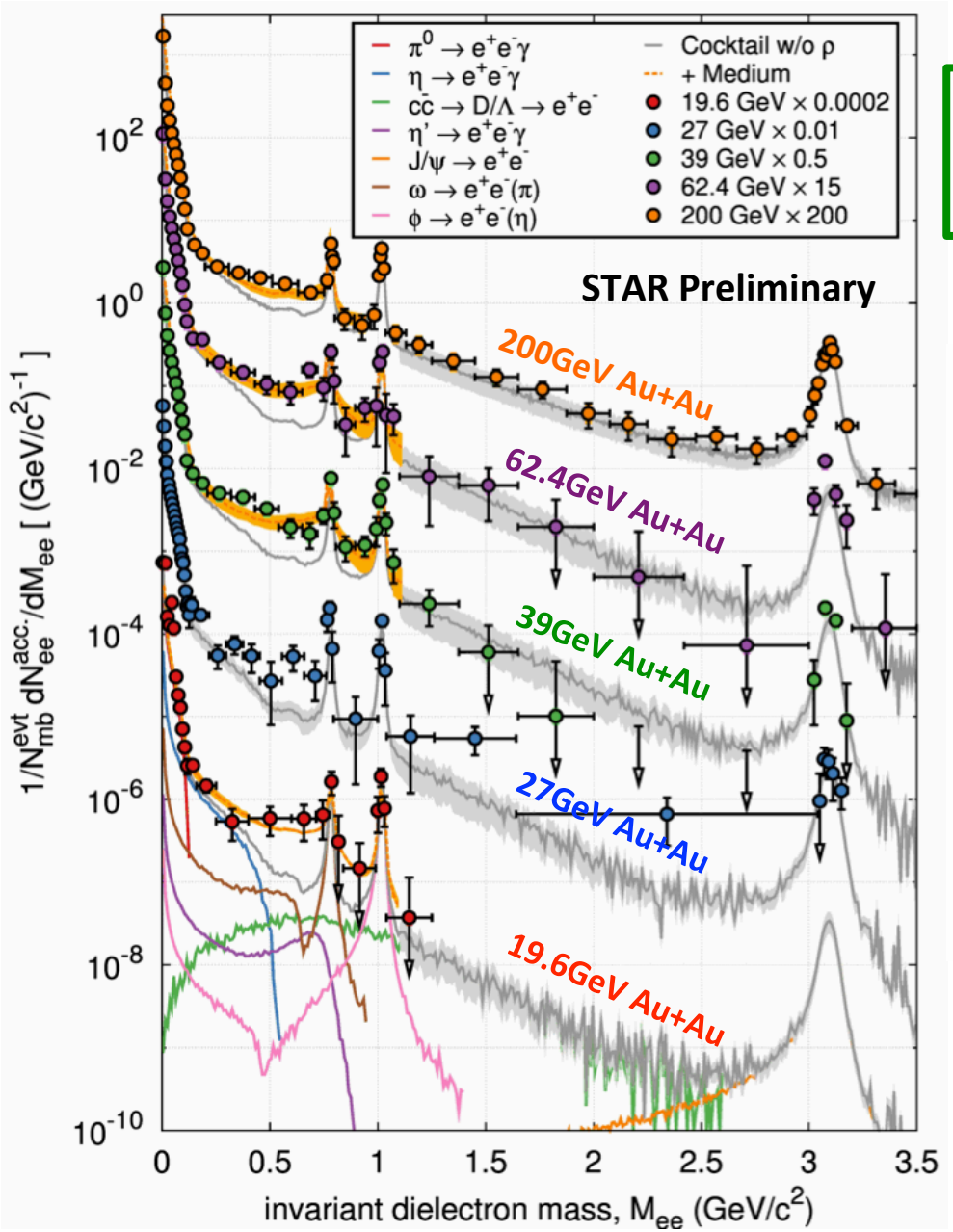


- Virtual and real photon measurements via internal and external conversion methods with electron pair measurements
- Real photon measurements with EM-cal

arXiv:1405.3940

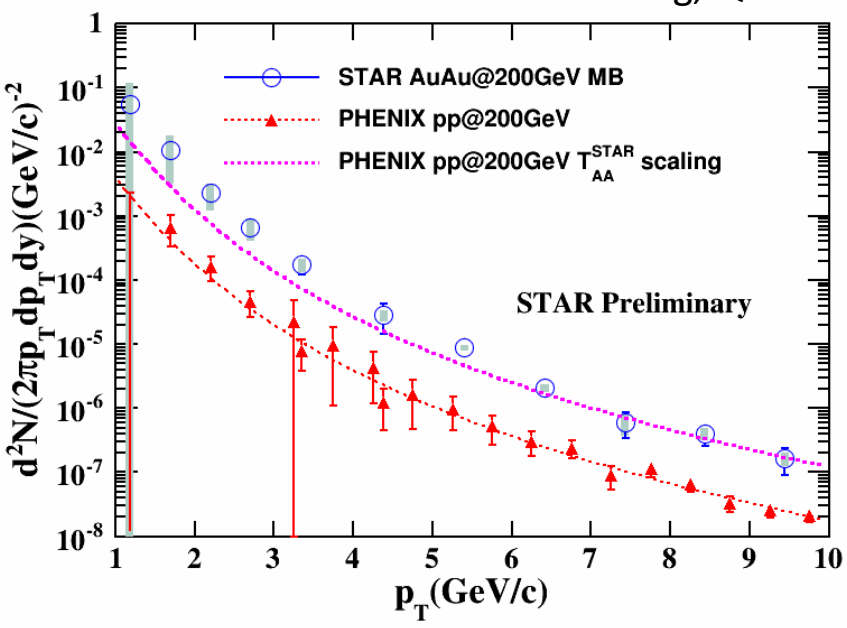


Patrick Huck, QM14



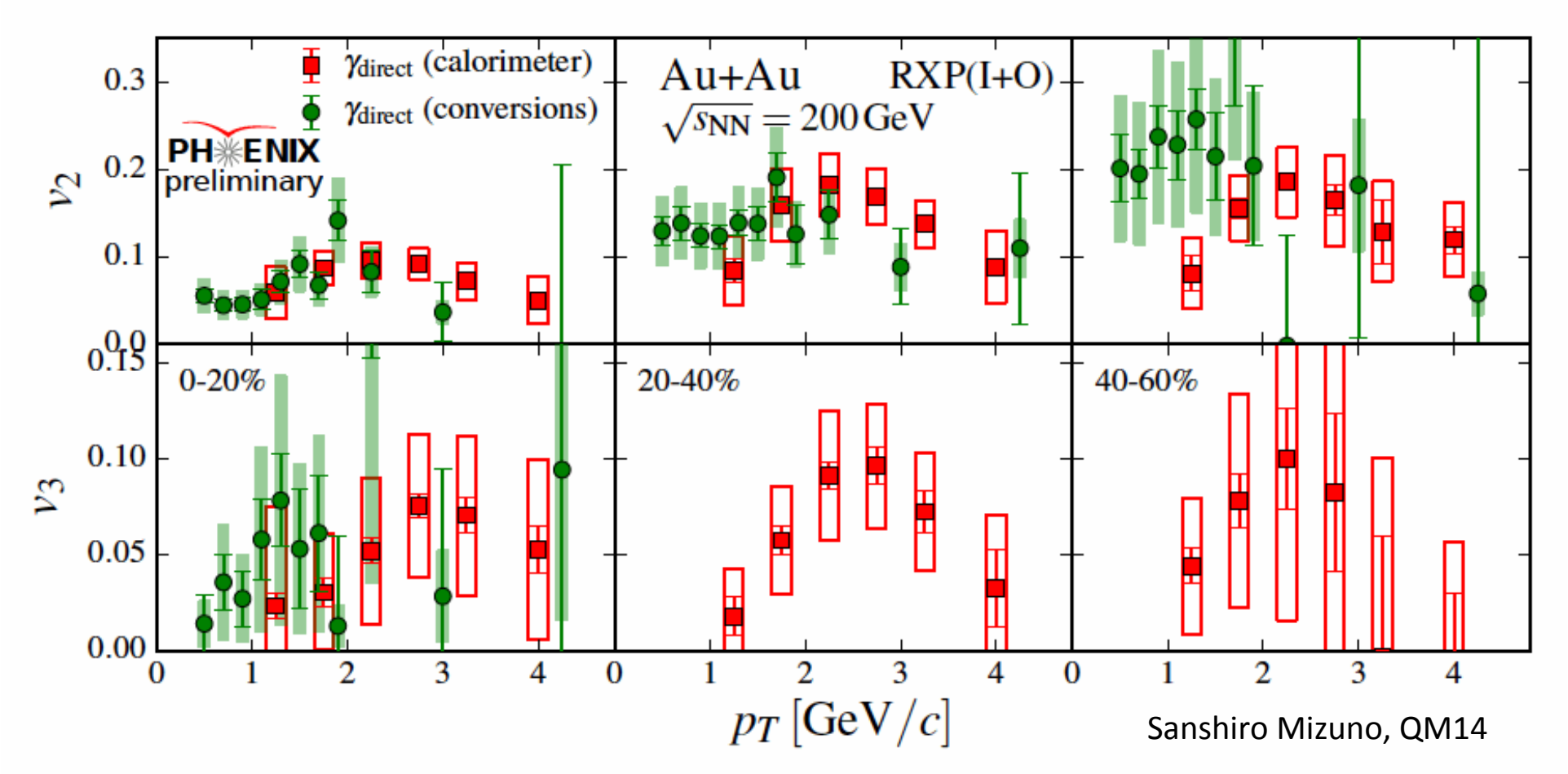
$M_{ee}^{inv.}$ spectra and Direct $\gamma^{thermal}$ from STAR experiment

Chi Yang, QM14



Low mass di-lepton yield :
almost consistent with CERES at ~20GeV
somewhat lower than PHENIX at ~200 GeV
thermal photon spectra : consistent with PHENIX

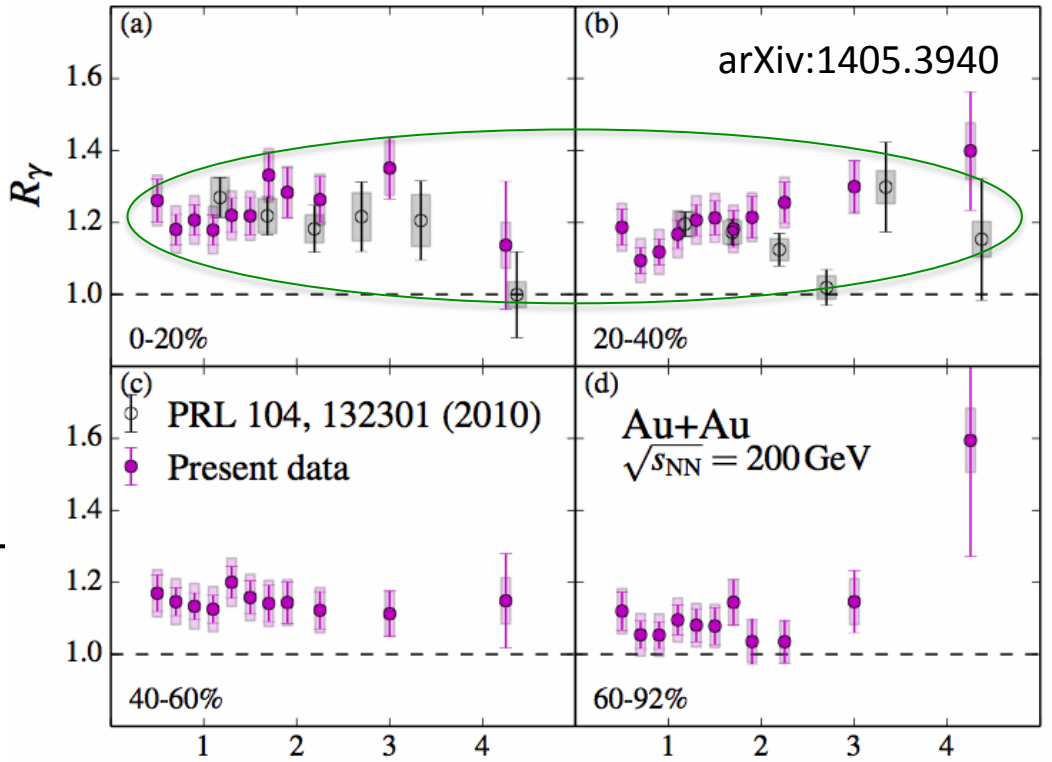
Direct (thermal) photon v_2 and v_3



- comparable to hadron for both v_2 and v_3 at 2~3GeV/c
- flatter p_T dependence of v_2 at low p_T
- significant contribution from photons from later stages

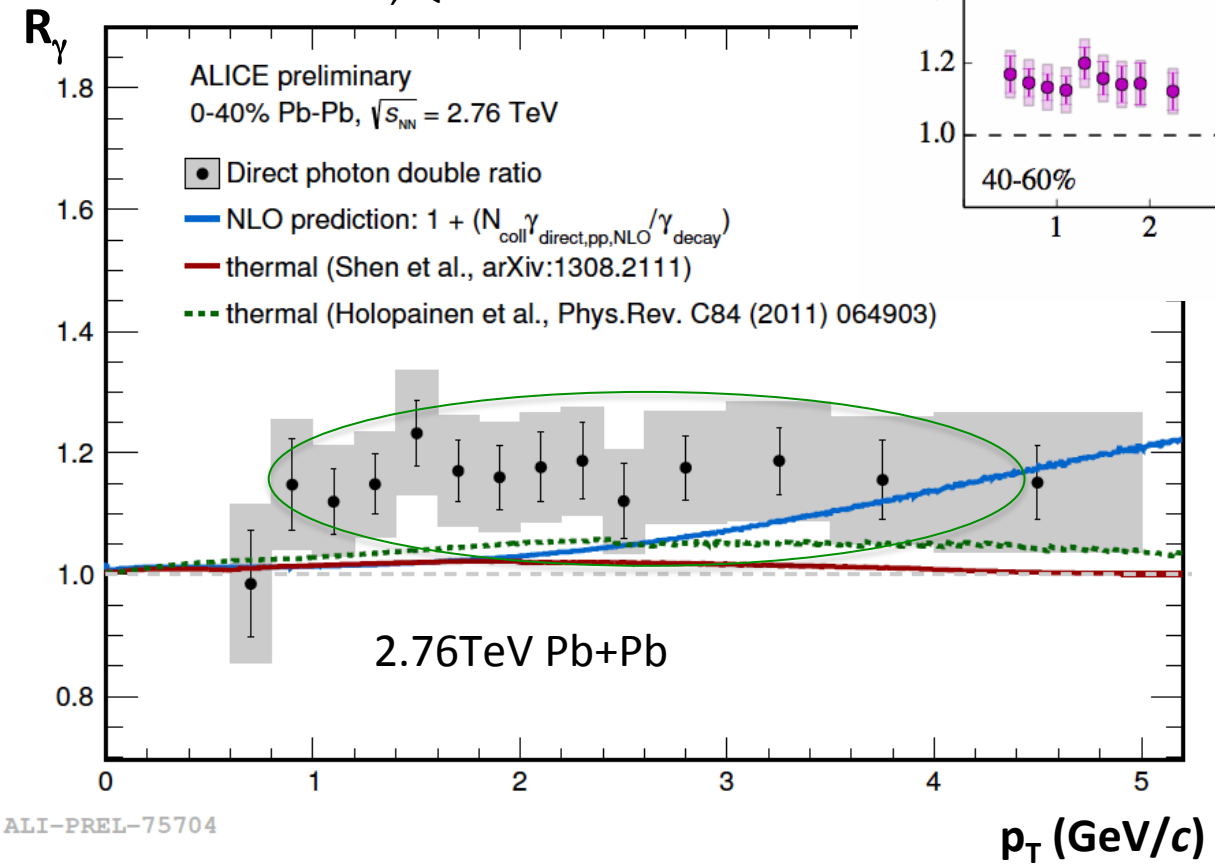
R_γ comparison between RHIC and LHC

Two main ingredients for direct γ v_n are :
(1) v_n of inclusive and decay photons
(2) relative fraction of signal photon R_γ



Benjamin Bannier, QM14

Friederike Bock, QM14



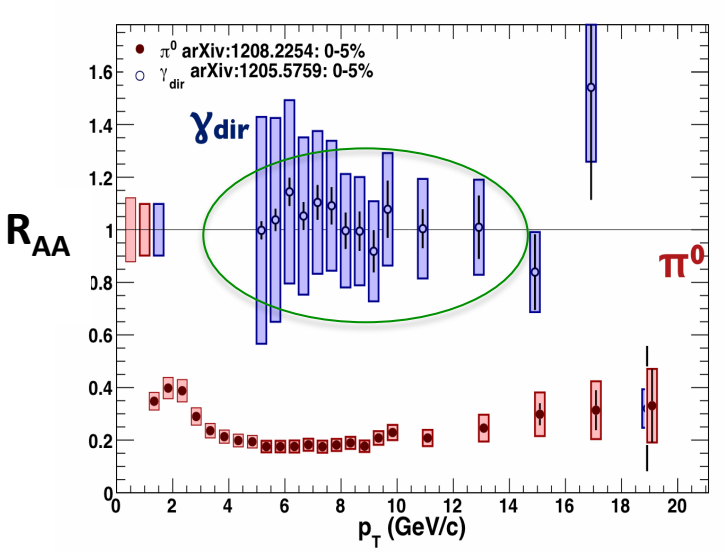
R_γ ~ 20% (+/- 5%) at RHIC
R_γ ~ 15% (+/- 10%) at LHC

- not enough significance at LHC yet
- inclusive γ v_n measurements are relatively good at both RHIC/LHC
- identified virtual photon v_n

High p_T direct photon as penetrating probe

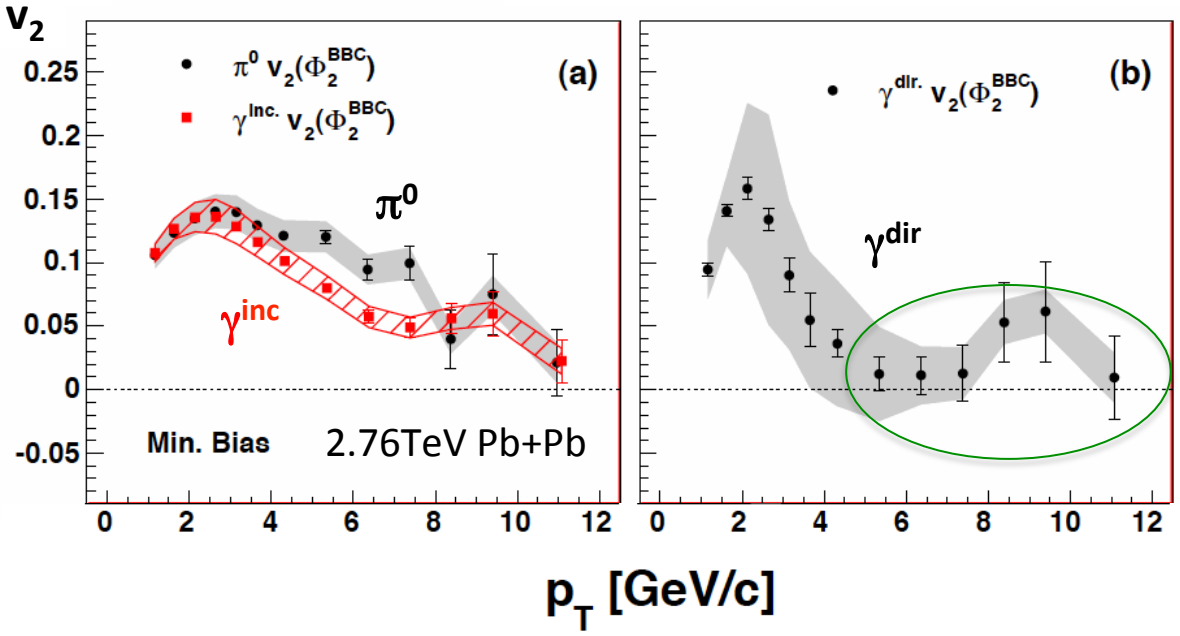
- R_{AA} (γ^{dir} at high p_T) ~ 1
- v_2 (γ^{dir} at high p_T) ~ 0
  (relatively easy, since R_γ is much larger than 1)

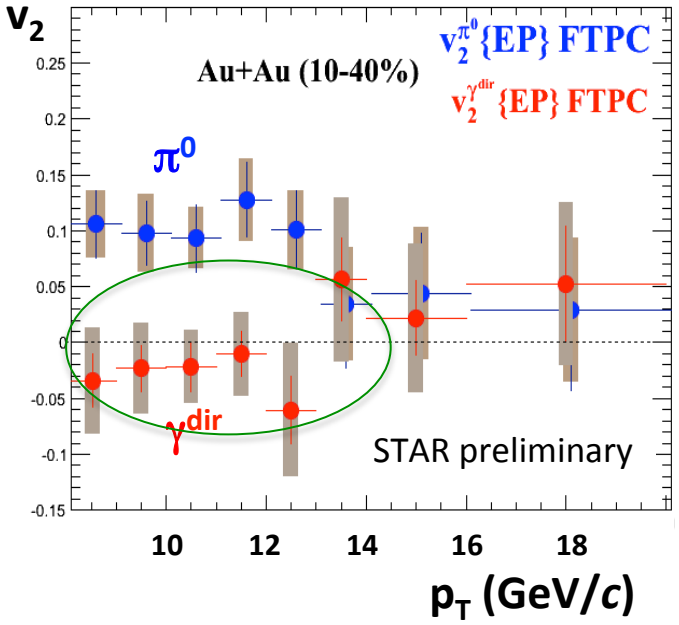
PRL 109 (2012) 152302



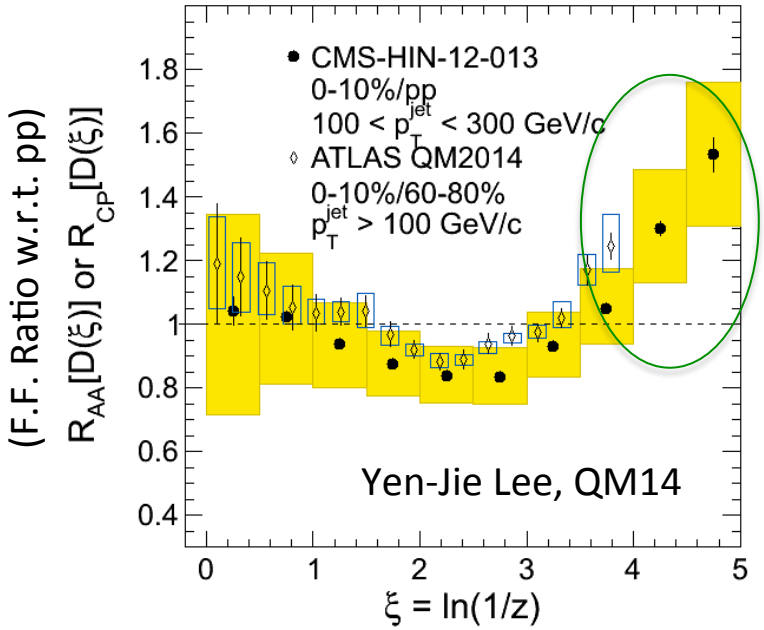
$\pi^0, \gamma^{inc.}, \gamma^{dir.}$ v_2

PRL 109 (2012) 122302

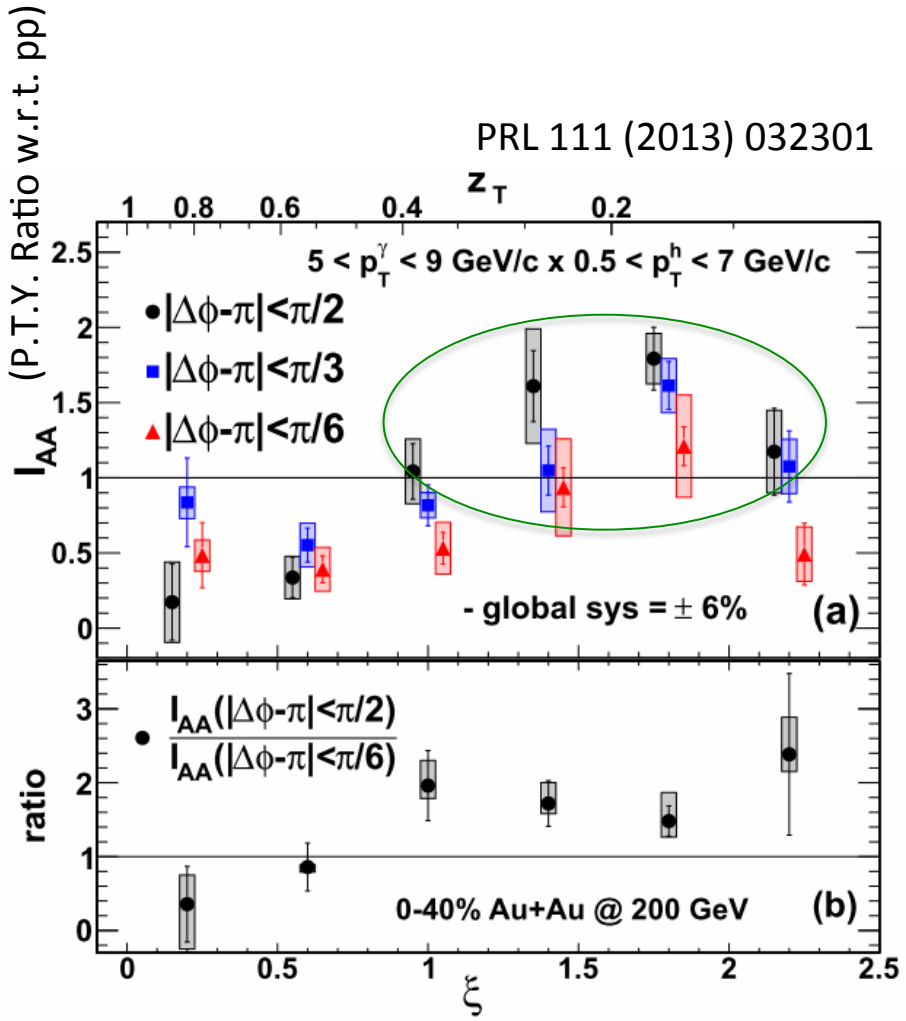




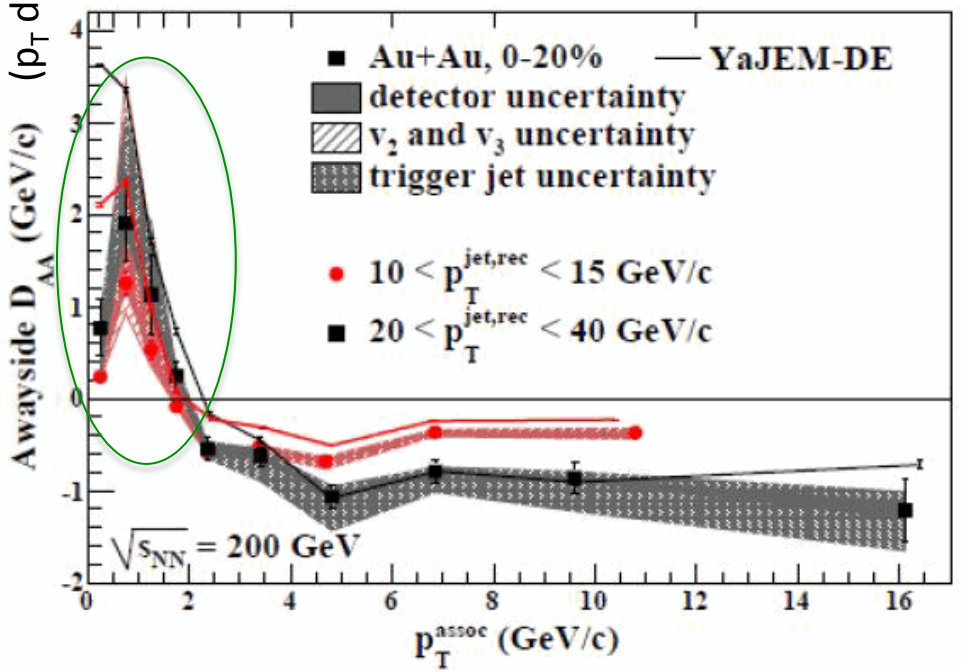
Energy loss at high pT and re-distribution of the lost-energy at low pT in A+A at RHIC and LHC



PRL 111 (2013) 032301

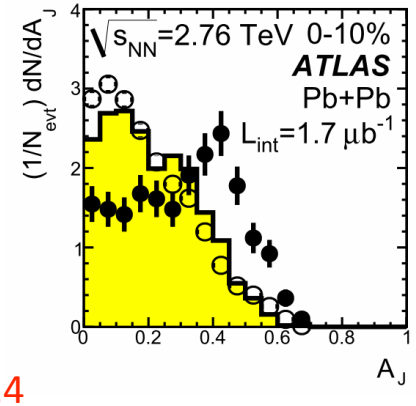


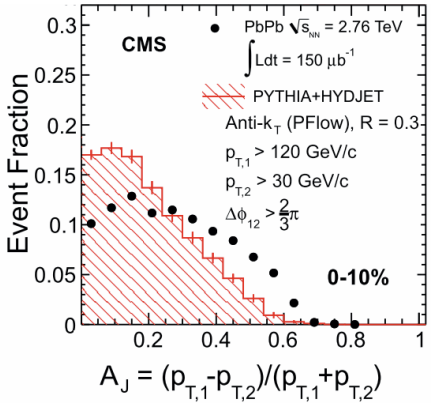
PRL 112 (2014) 122301

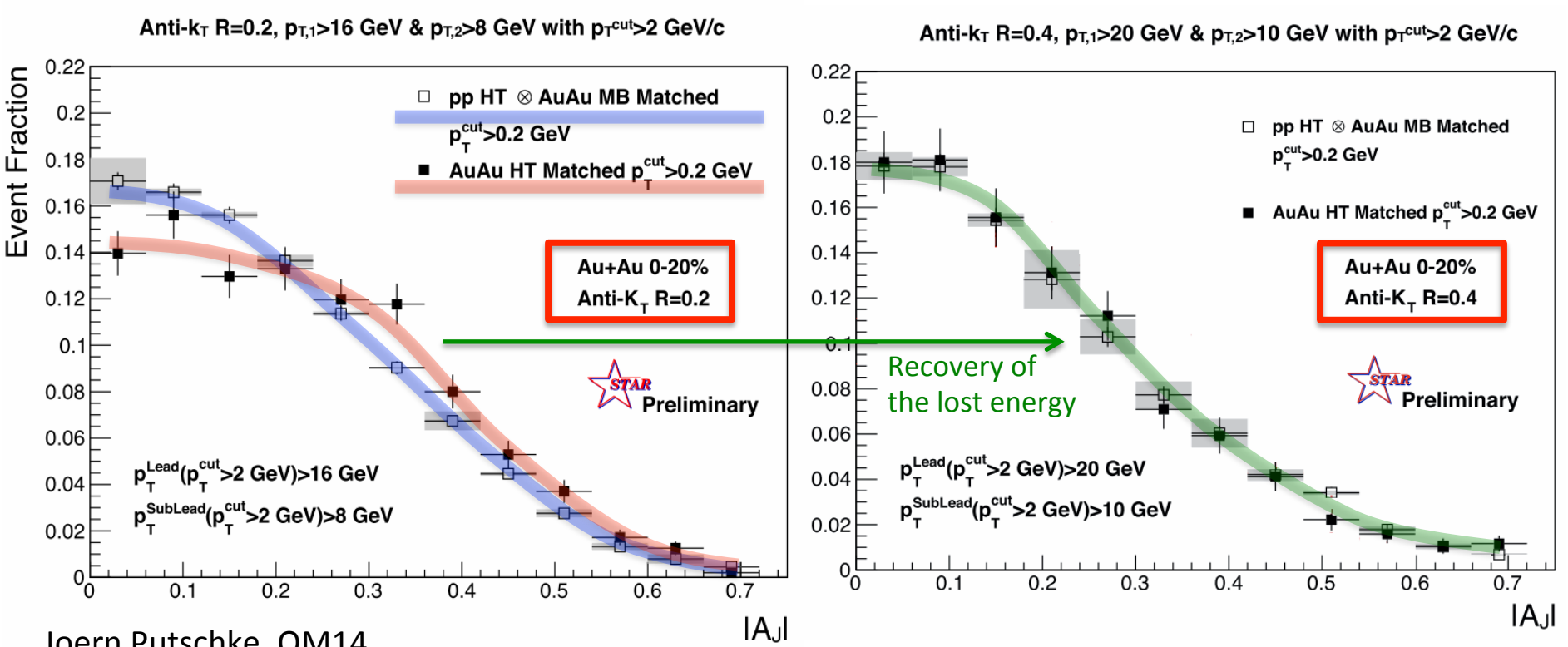


Jet quenching at RHIC (A_J distribution)

- lower jet energy than LHC
- smaller effect than LHC
- larger effect with smaller jet cone R~0.2
- recovered jet energy with larger jet cone R~0.4



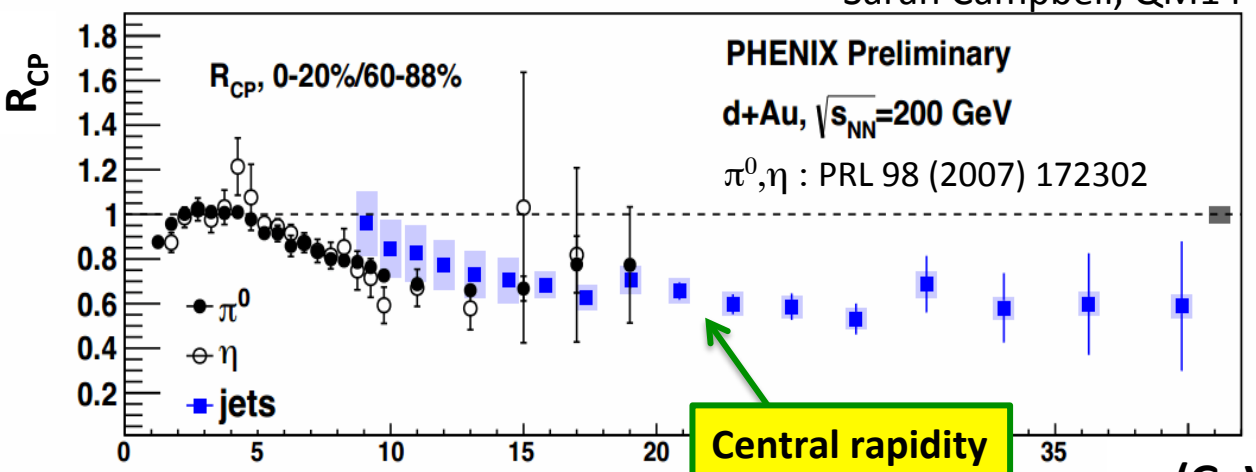




Joern Putschke, QM14

Jet suppression in central dAu? or peripheral enhancement?

Sarah Campbell, QM14

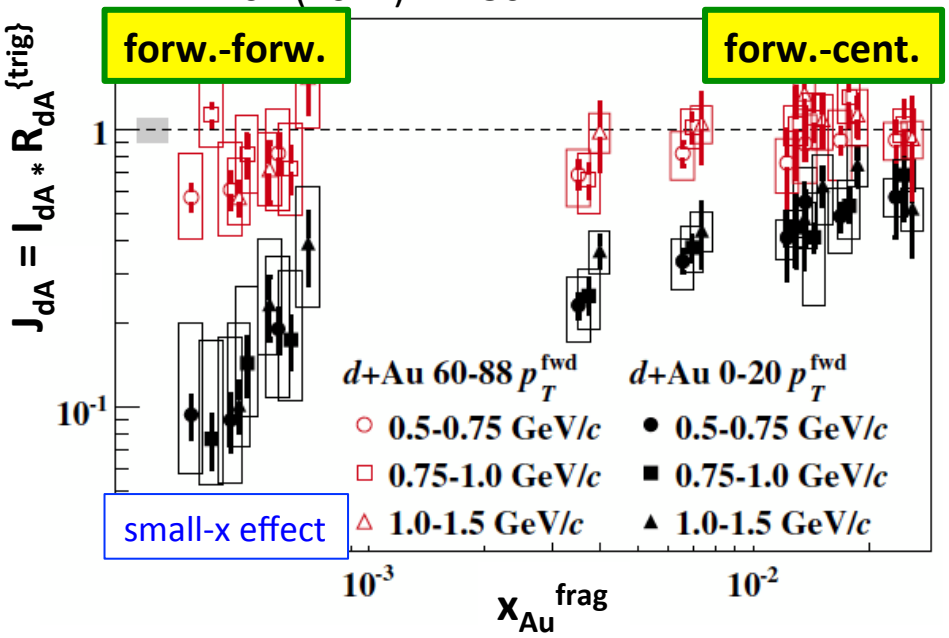


Central rapidity

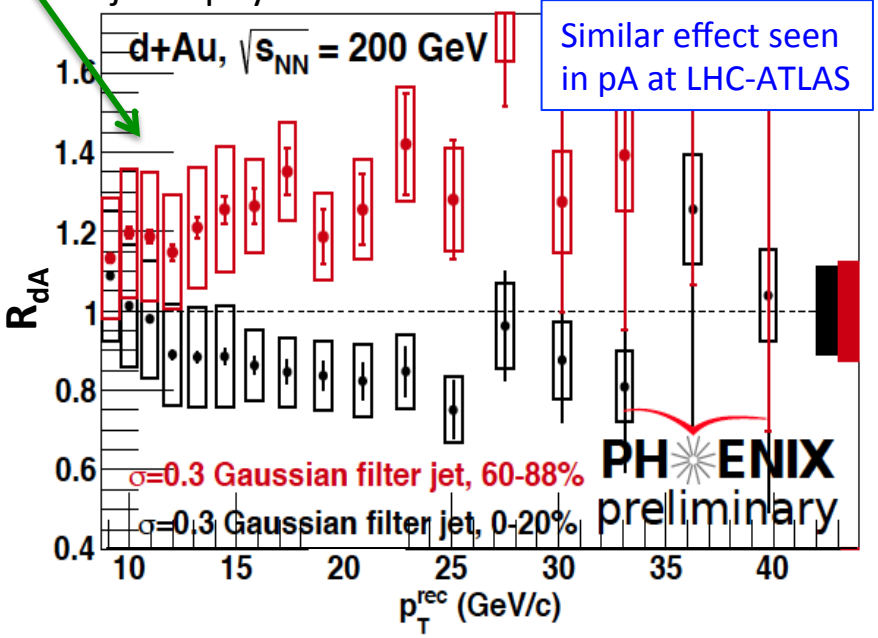
$R_{dA} \sim 1$ for min. bias d+Au

p_T (GeV/c)

PRL 107 (2011) 172301

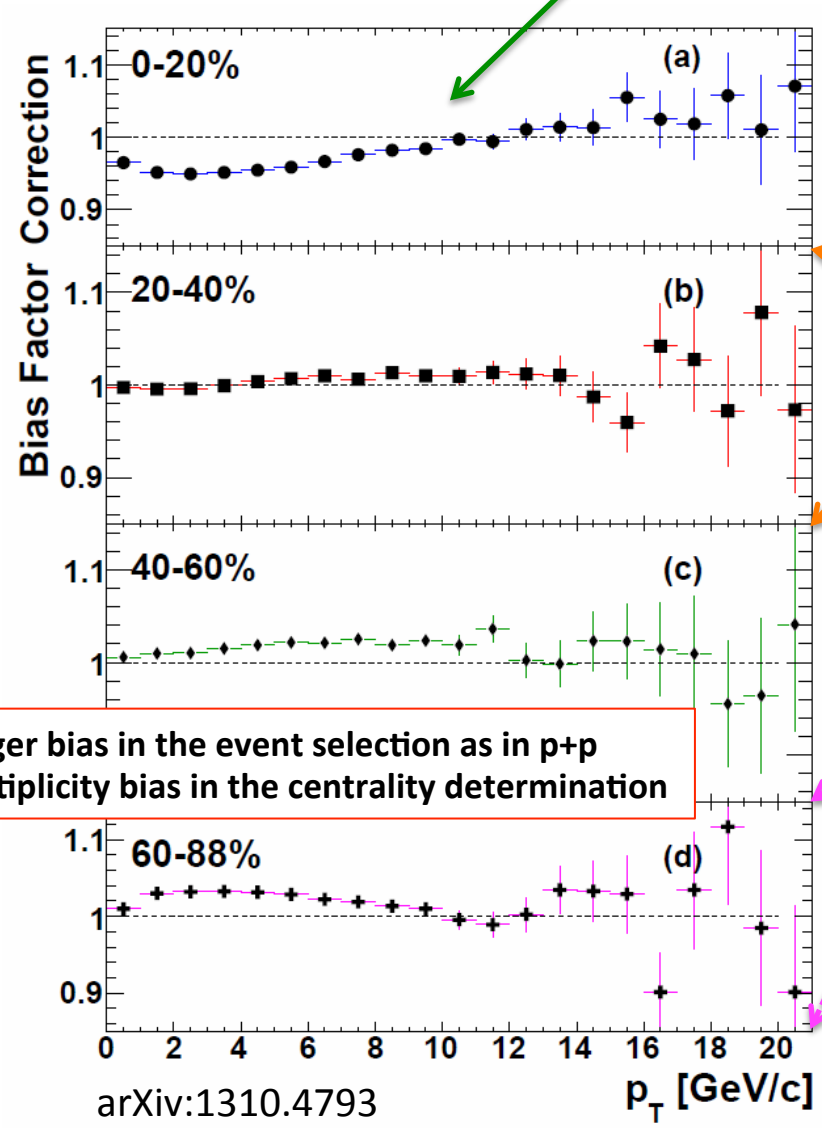


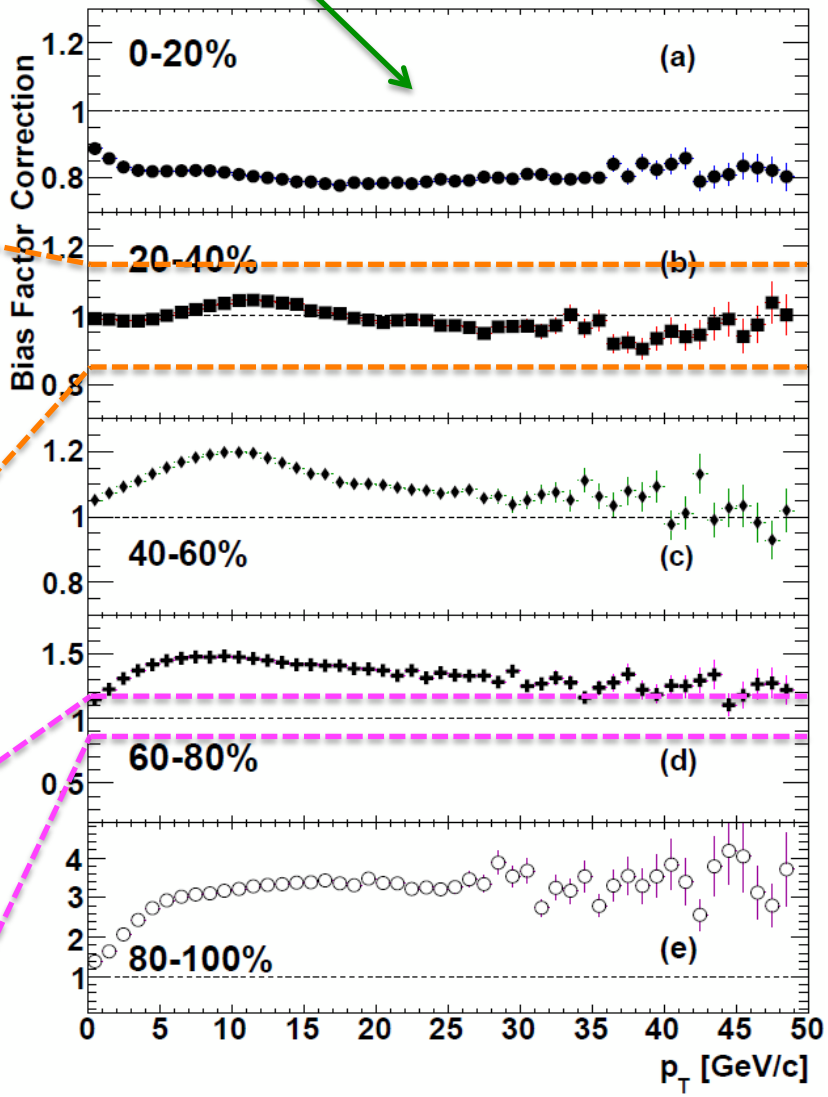
j.nuclphysa.2013.02.184



Similar effect seen in pA at LHC-ATLAS

Bias test at dAu (RHIC) and at pPb(LHC) with Hijing



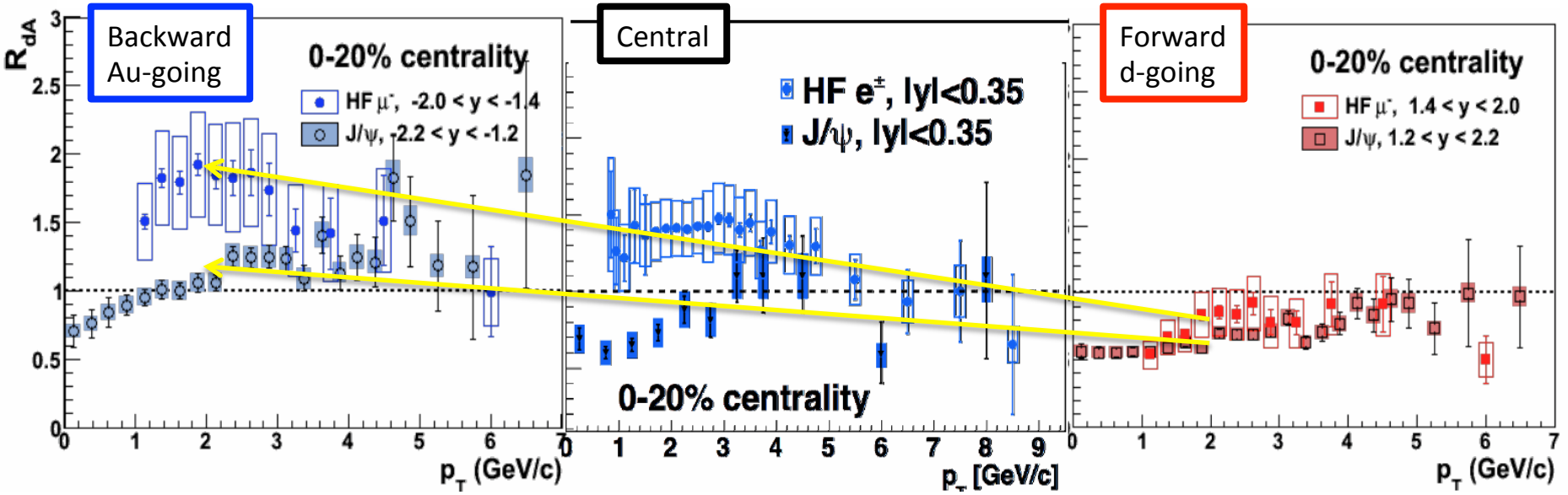


trigger bias in the event selection as in p+p
multiplicity bias in the centrality determination

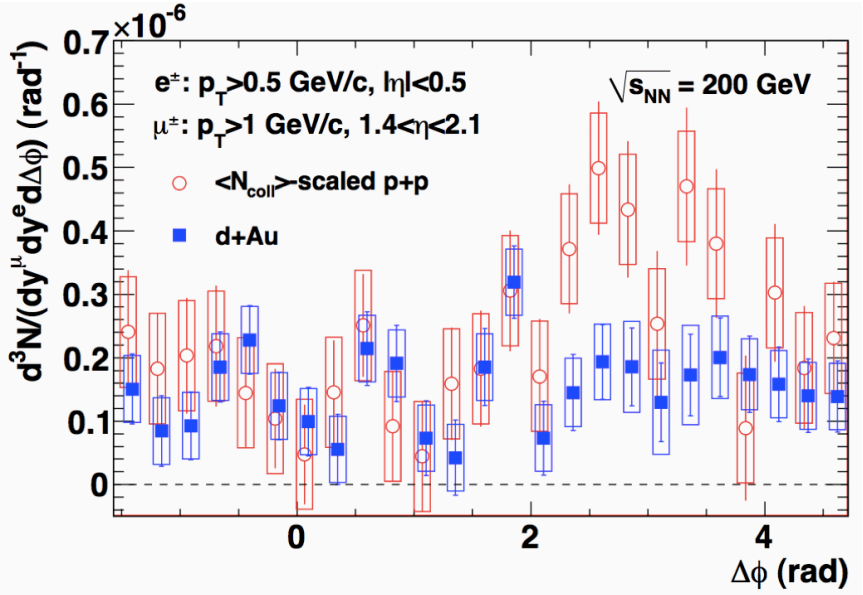
arXiv:1310.4793

Q_{pA} (ALICE), quark DoF in N_{coll} (ATLAS),,,

PRL 112 (2014) 252301, PRL 109 (2012) 242301, PRC 87 (2013) 034904



Higher particle density ← → **Lower-x gluon in Au**

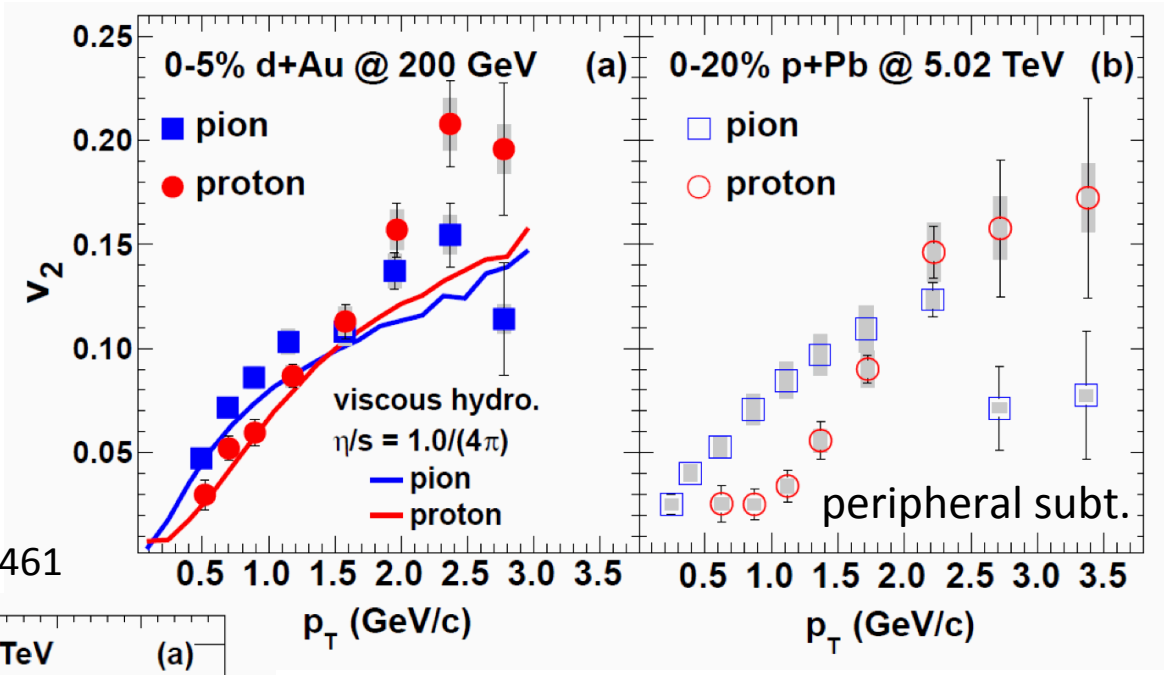


Heavy Flavor and J/psi in d-Au

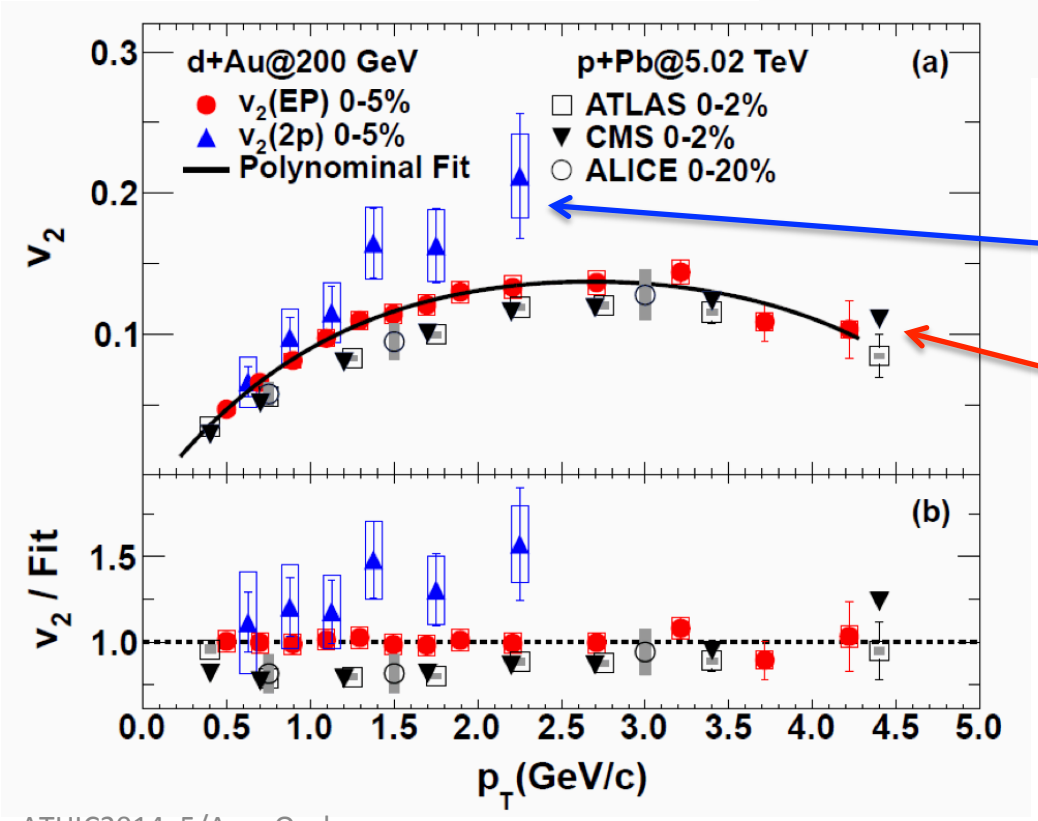
away-side suppression in dAu for
e(central) – μ(forward) correlation

PRC 89 (2014) 034915

Elliptic flow in 200GeV d + Au at RHIC-PHENIX



arXiv:1404.7461



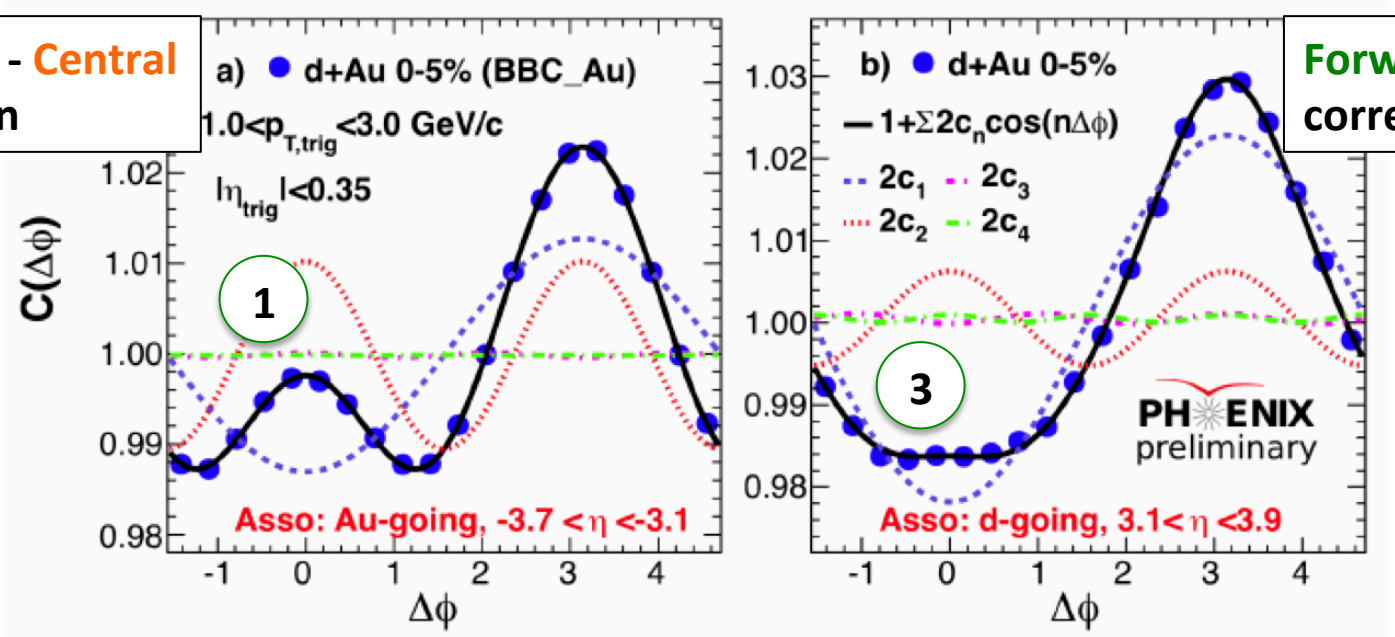
two PHENIX results

2P : two particle within $|\eta|<0.35$ and peripheral subtracted

EP_{MPC} : resolution is determined via 3-sub event correlations

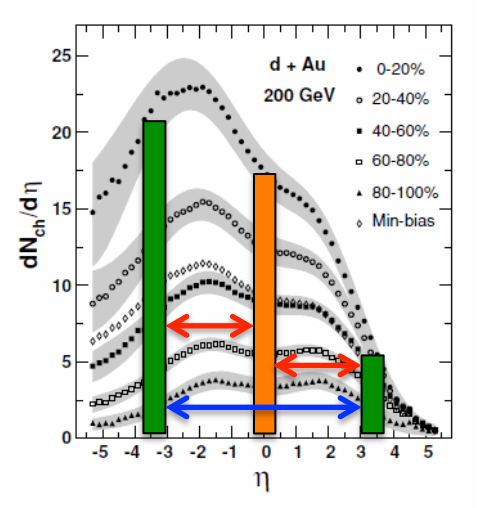
- Φ_2 central arm [$|\eta|<0.35$]
- Φ_2 Au-side MPC [$-4<\eta<-3$]
- Φ_1 Au-spectator ZDC [$\eta<-5$]

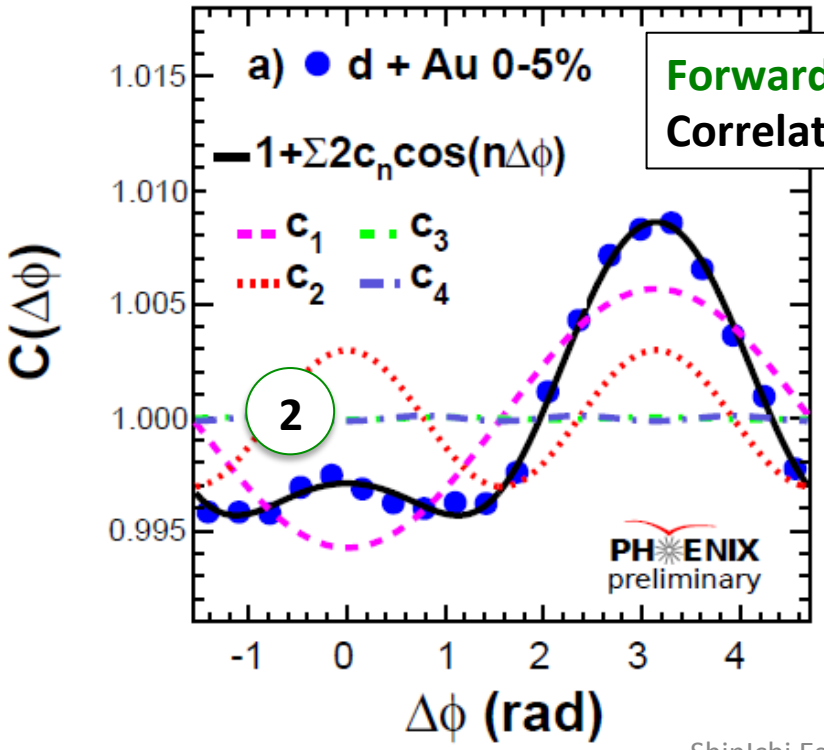
Backward - Central correlation



Forward - Central correlation

200GeV d + Au at RHIC-PHENIX

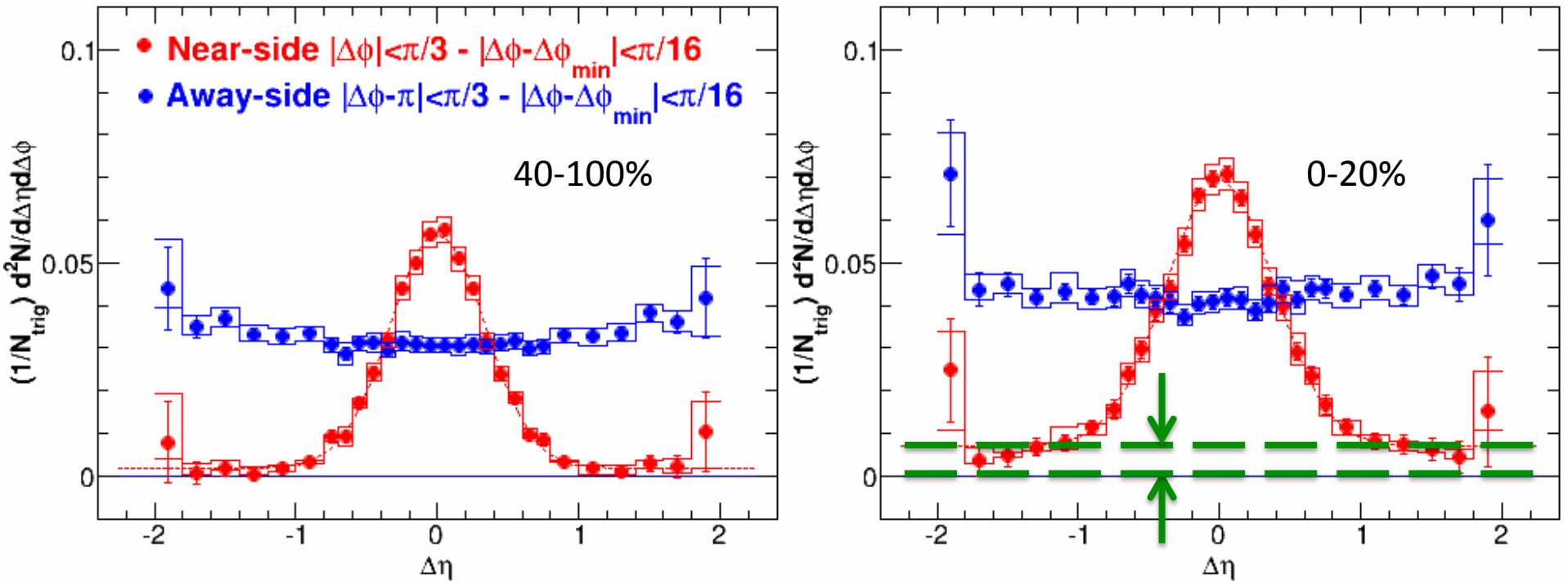




Forward - Backward Correlation with |Δη| > 6.0

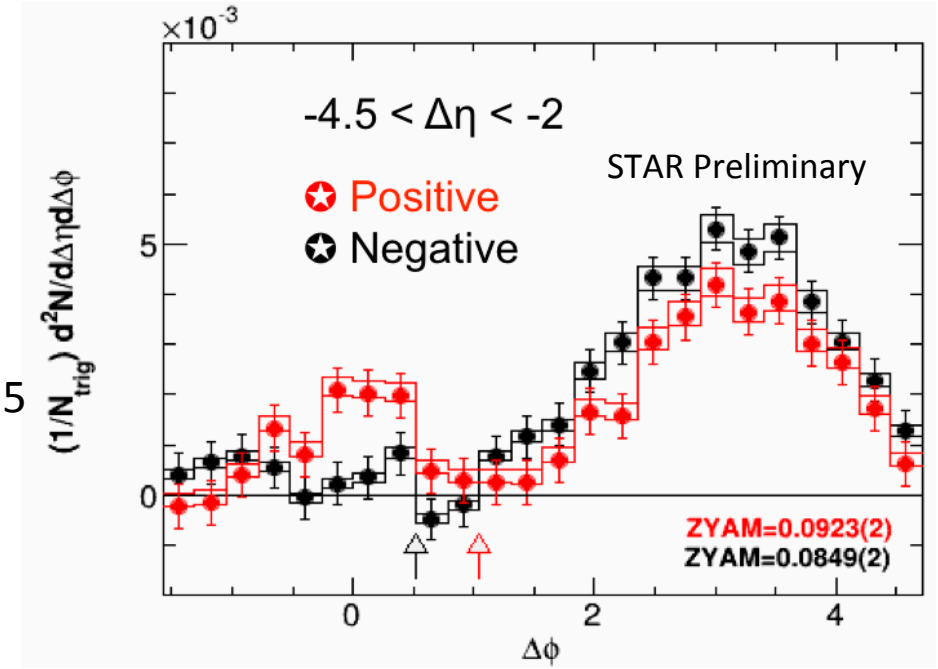
Au-going : -3.7 < η < -3.1
d-going : 3.1 < η < 3.9

Shengli Huang, QM14



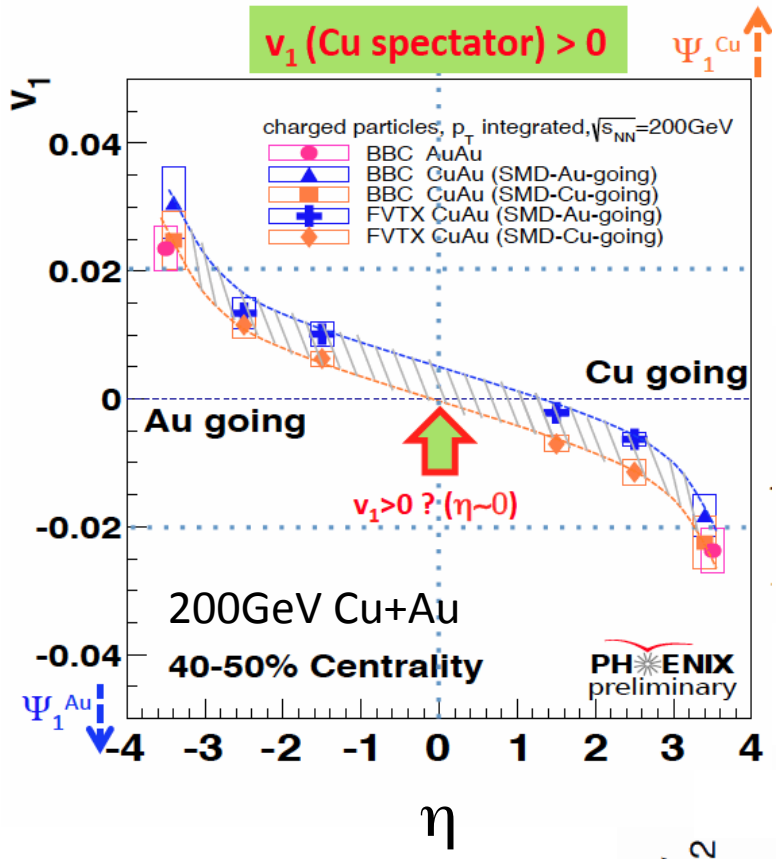
200GeV d + Au
at RHIC-STAR

clear ridge/v_2 signal at Δη~1.5
positive/negative difference



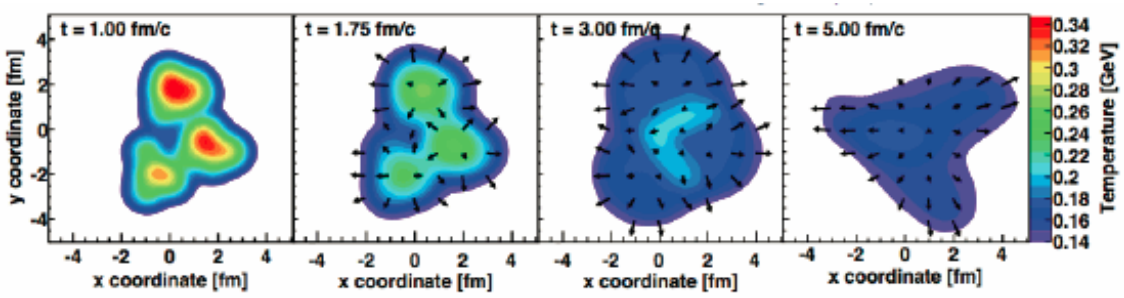
no flow effect
in dAu ?

Yi Li, QM14

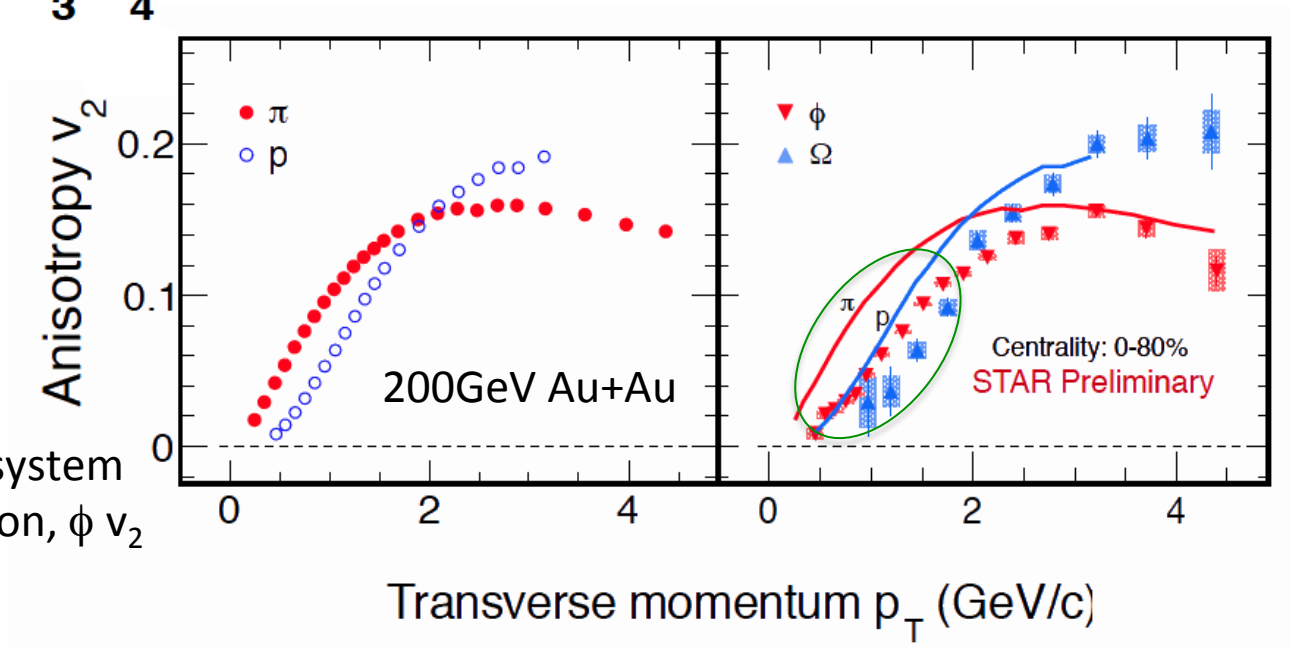


Hiroshi Nakagomi, QM14

^{3}He+Au collision data already on tape in RHIC-RUN14



Rihan Haque, QM14



Various flow tests at RHIC

$v_1 \neq 0$ at y ~ 0 in asymmetric system

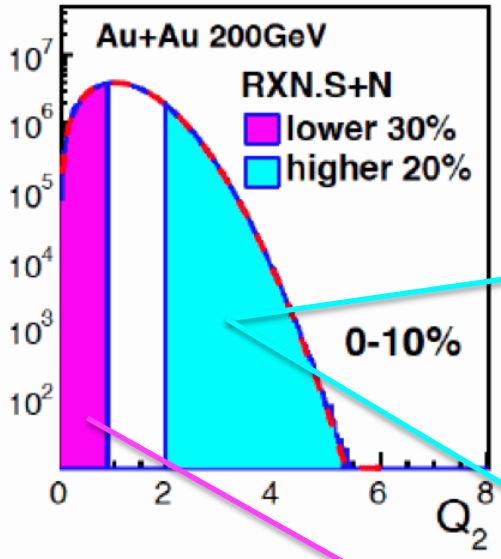
precision comparison of proton, ϕ v_2

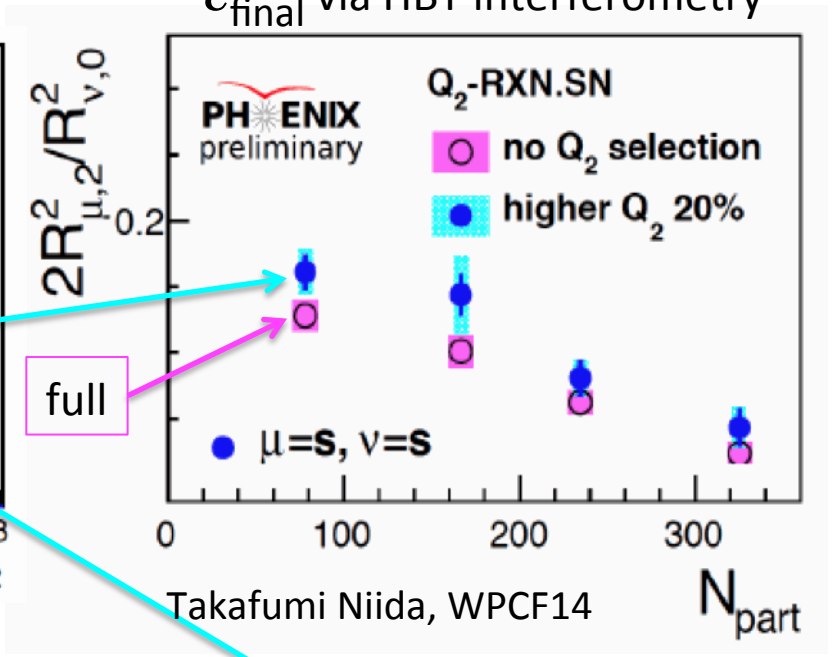
^{3}He-Au collision data

Event Shape Engineering by Flow-Vector Q_2 selection

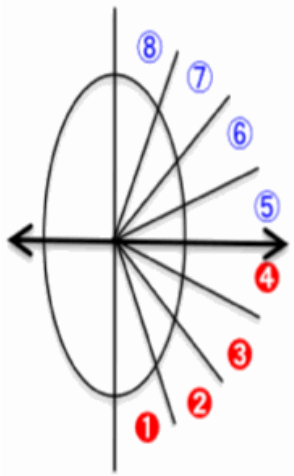
$\varepsilon_2^{\text{initial}} - v_2 - \varepsilon_2^{\text{final}}$

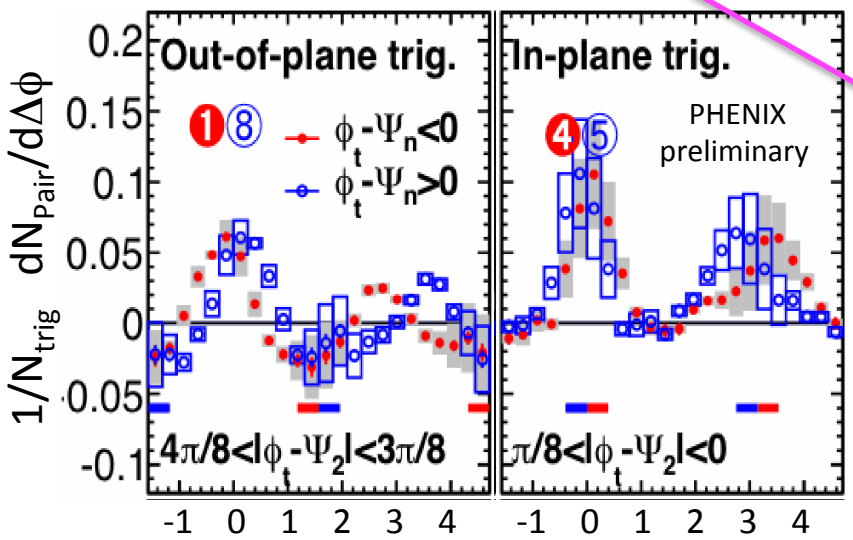
$\varepsilon_{\text{final}}$ via HBT interferometry



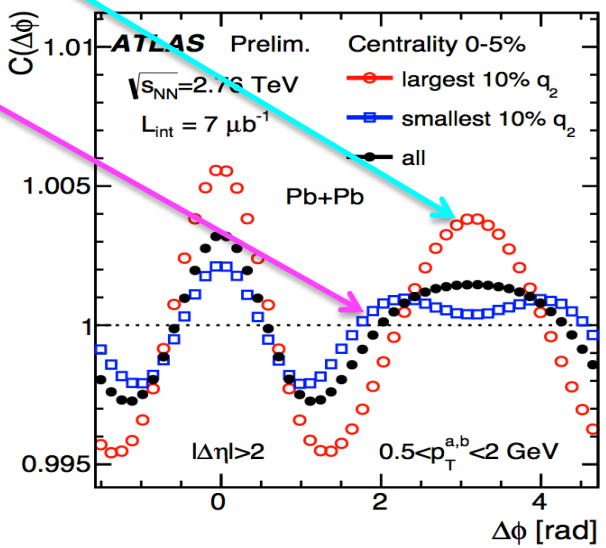


Takafumi Niida, WPCF14





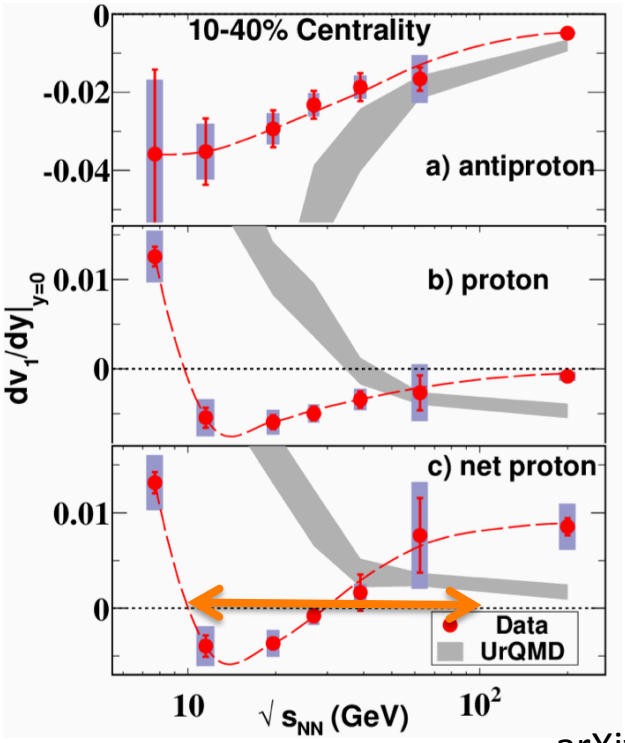
Takahito Todoroki, QM12



Soumya Mohapatra, QM14

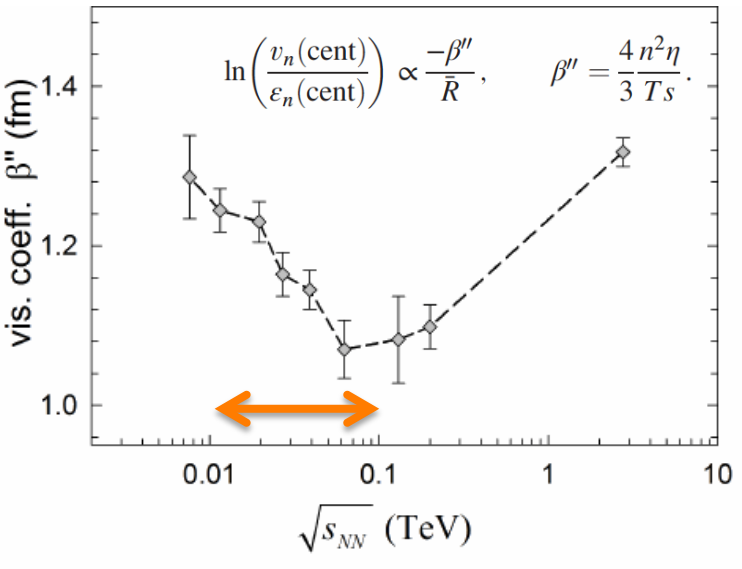
$\Delta\phi = \phi_{\text{Asso.}} - \phi_{\text{Trig.}}$

PRL112 (2014) 162301

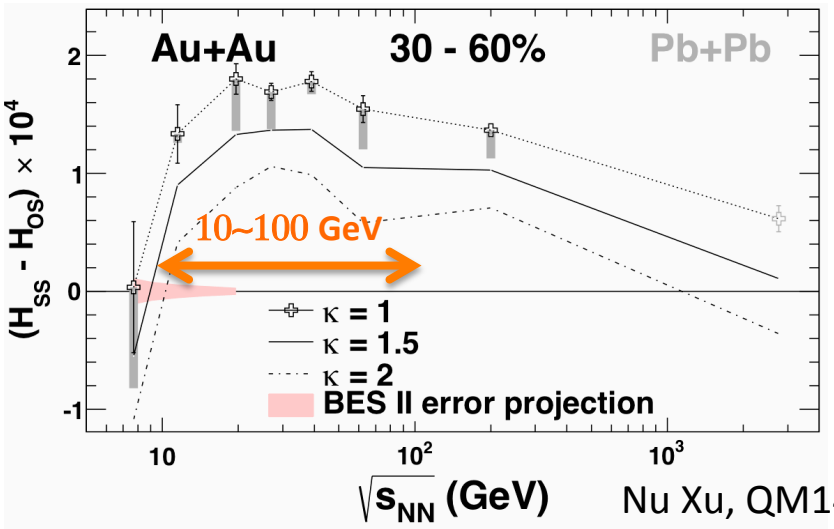


Beam energy dependence of v_1, v_2, HBT and charge asymmetry

PRL 112 (2014) 082302

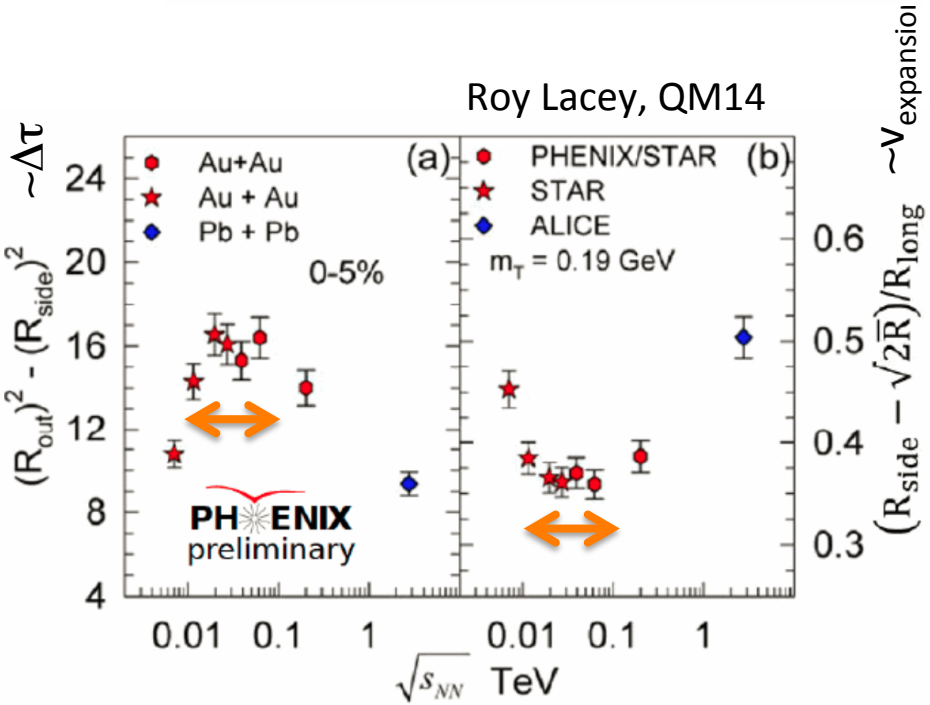


arXiv:1404.1433

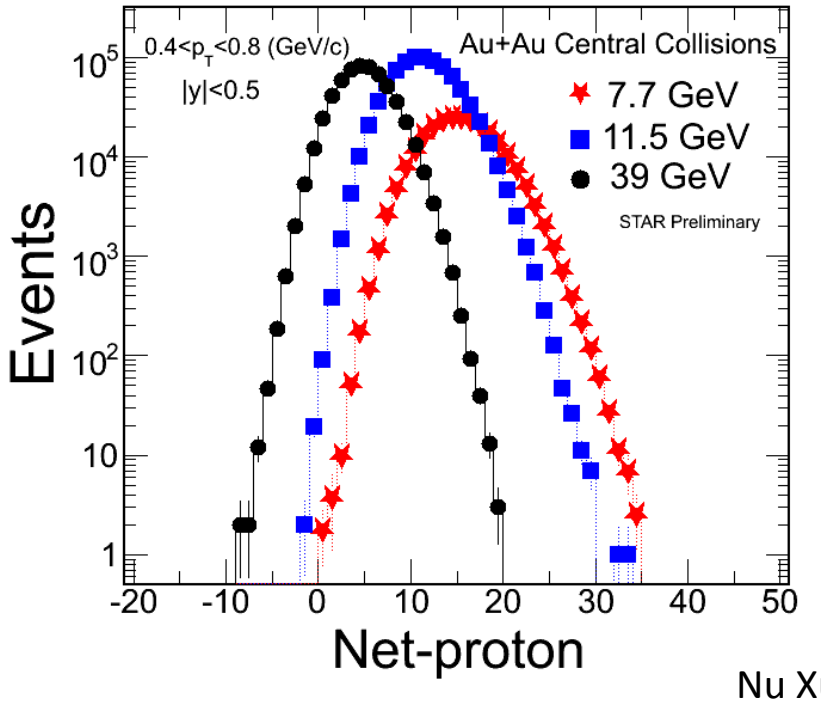


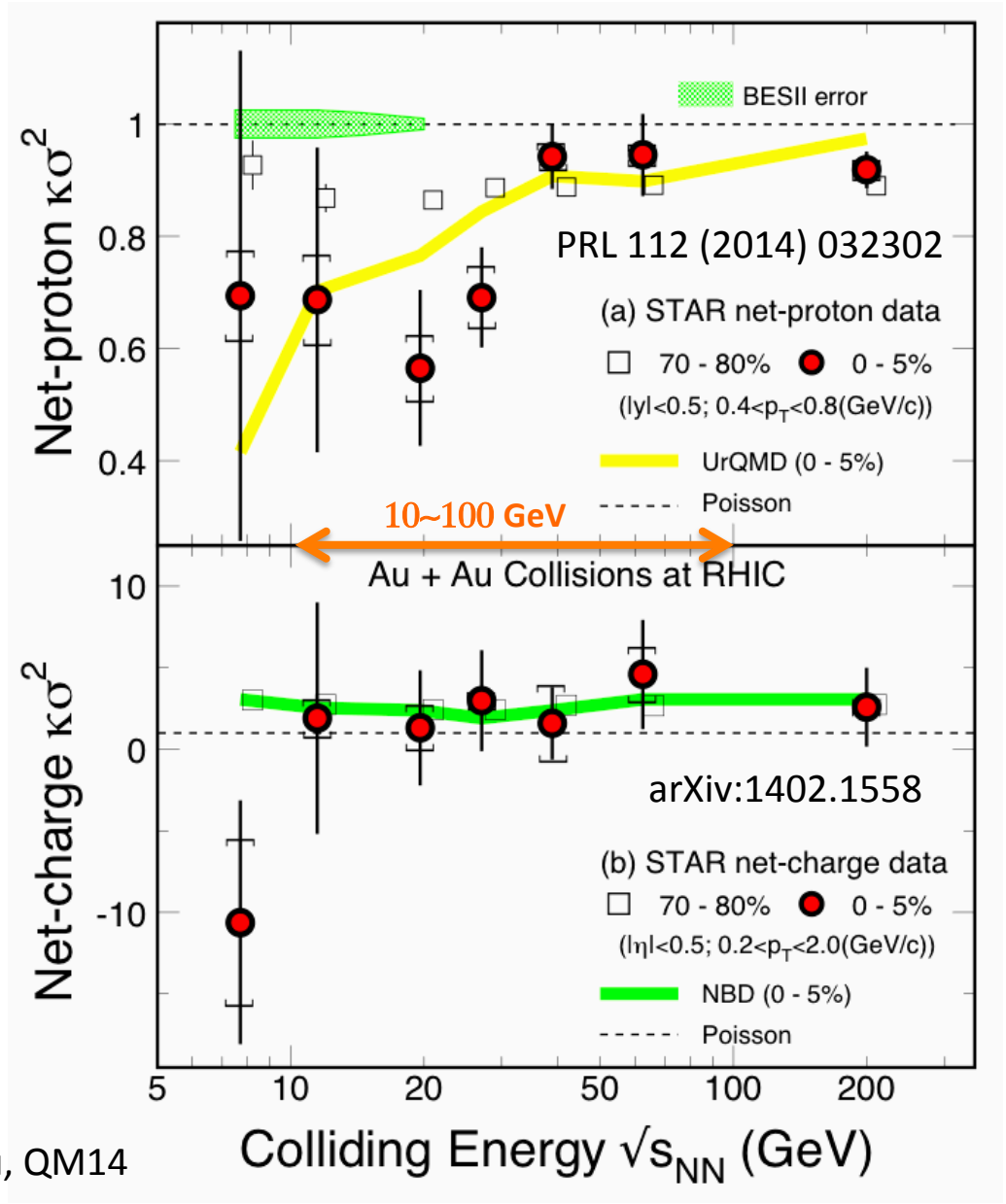
Nu Xu, QM14

Roy Lacey, QM14



Fluctuation of conserved quantities such as net-baryon, net-charge distribution





Nu Xu, QM14

Summary

- Direct photons
  - thermal photon signal
  - large v2,v3 of thermal photon
  - penetration of direct photon
- Jet quenching
  - energy loss of parton
  - Re-distribution of lost-energy
- d-Au and flow
  - suppression or enhancement
  - Ridge-like and v2-like structure
- Beam energy scan
  - various indicative signals of phase transition
  - including fluctuation of conserved quantities