Highlight of PHENIX Results

Shengli Huang

Vanderbilt University

Initial Stages 2014

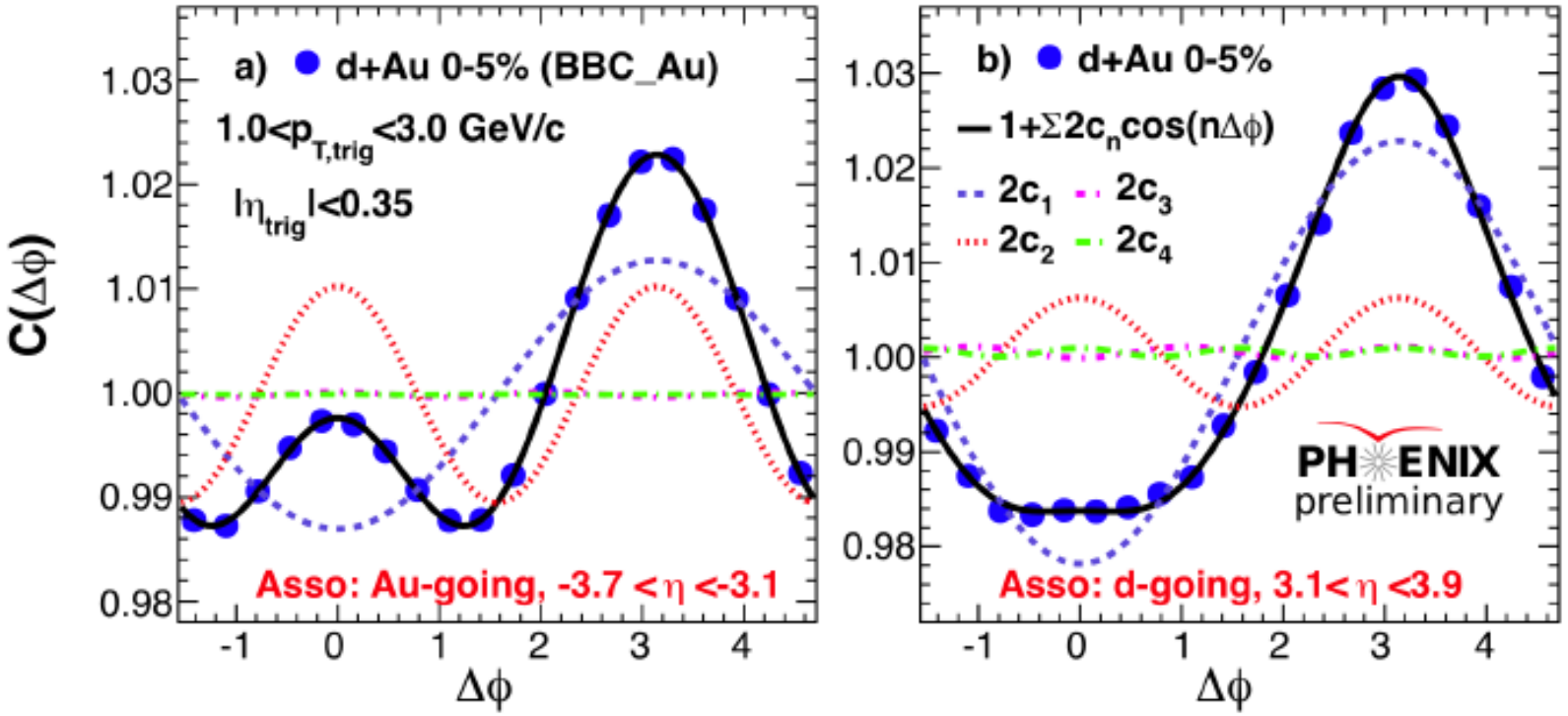
Outline

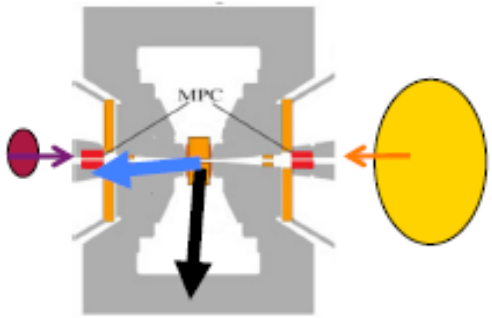
- Long-range correlation, v_n and HBT in d+Au and **^{3}He+Au** at 200GeV
- Photon measurements in 200GeV Au+Au
- Beam energy scan results
- Heavy quark and quarkonia
- Summary

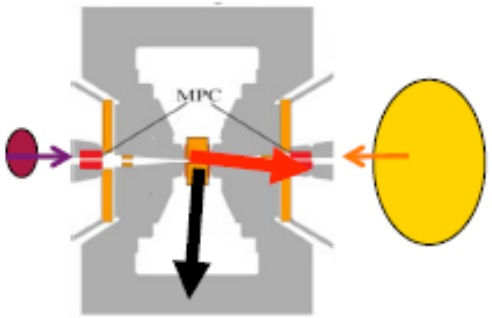
Long range correlation in d+Au

arXiv:1404.7461

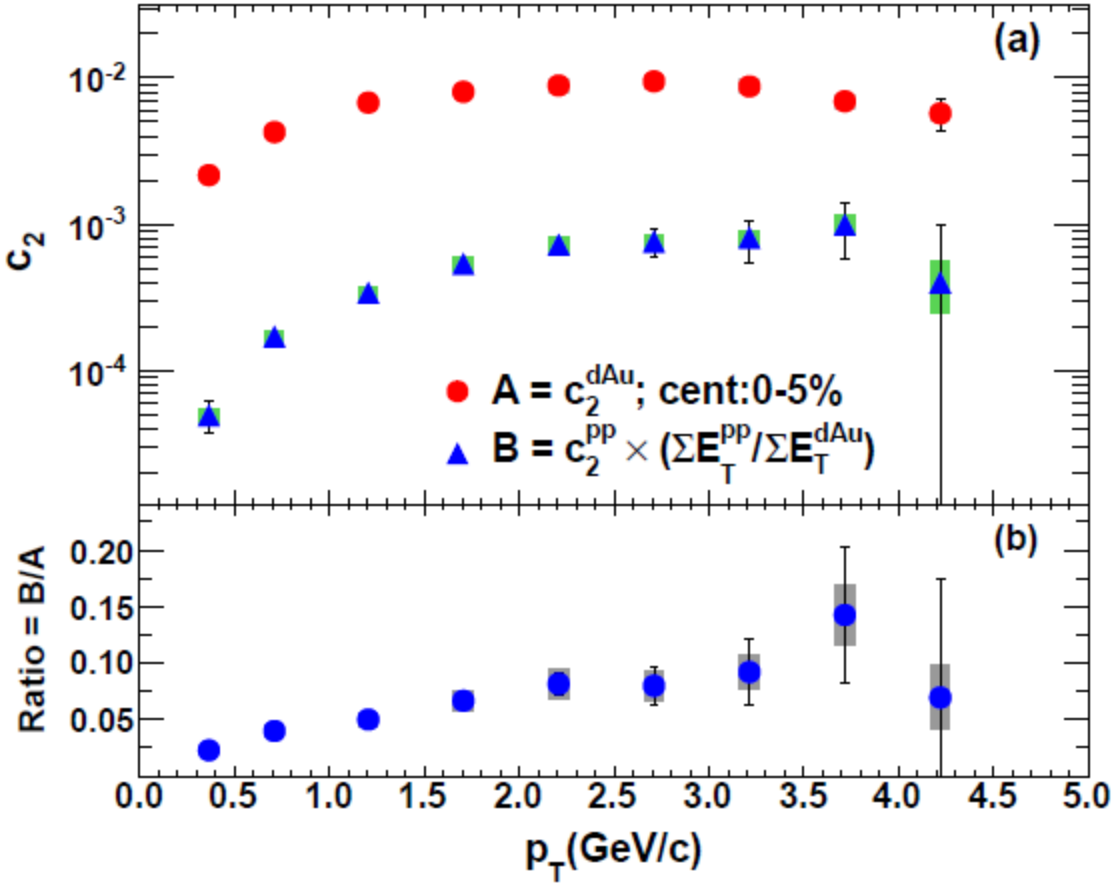
"Au-going" vs "d-going"







C_2 in 0-5% d+Au collision

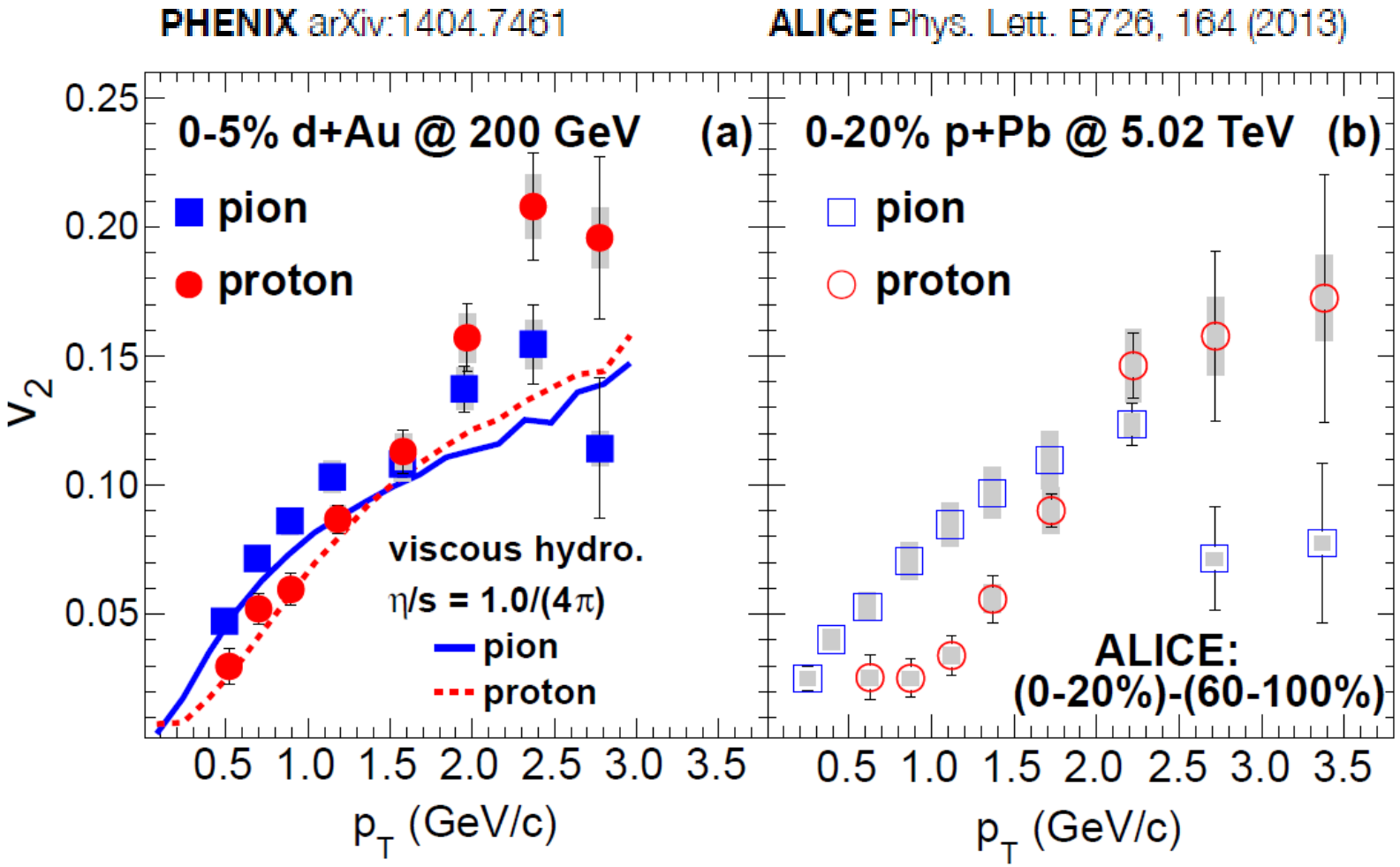


arXiv:1404.7461

Large η gap(|Δη|>2.75).

- In d+Au, the contribution from elementary processes estimated by pp is small
- Estimation is less sensitive to the final state interactions on jets

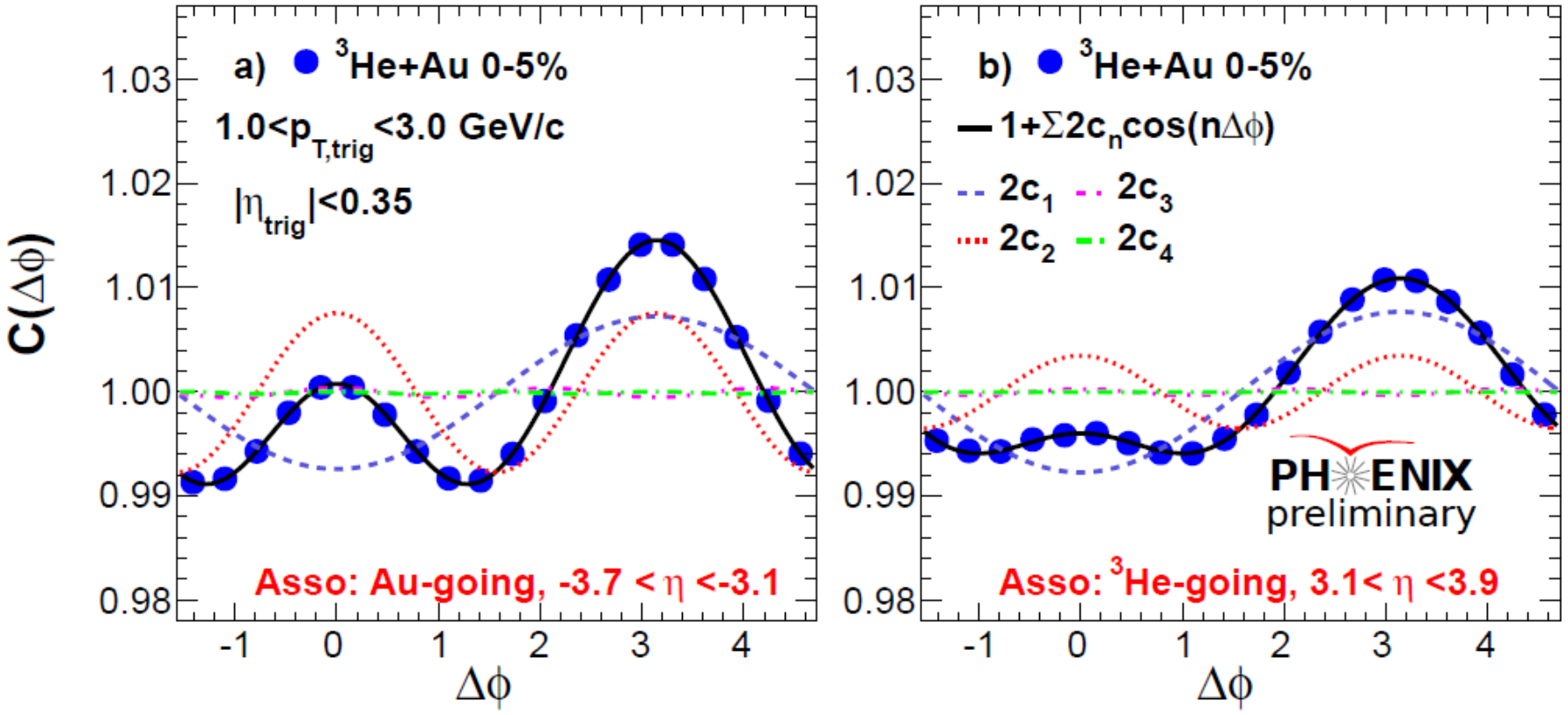
The v_2 of π and p in d+Au



Mass ordering for identified hadron is observed in both d+Au and p+Pb ---- consistent with hydrodynamic flow

Long range correlation in ^{3}He+Au

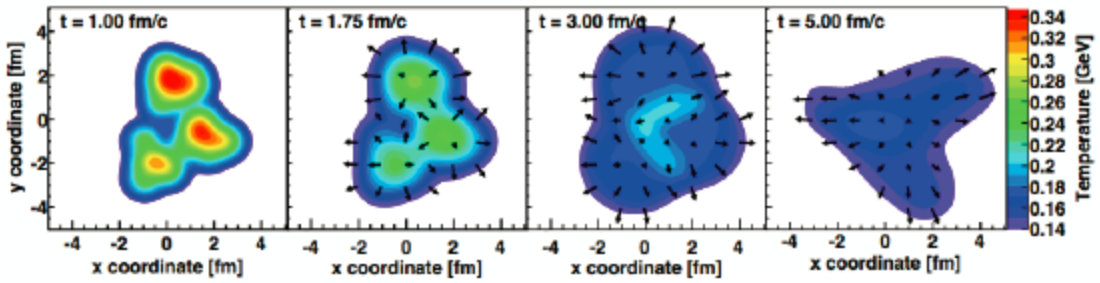
"Au-going" vs "^{3}He-going"



Ridges are seen on both Au-going and ^{3}He-going sides

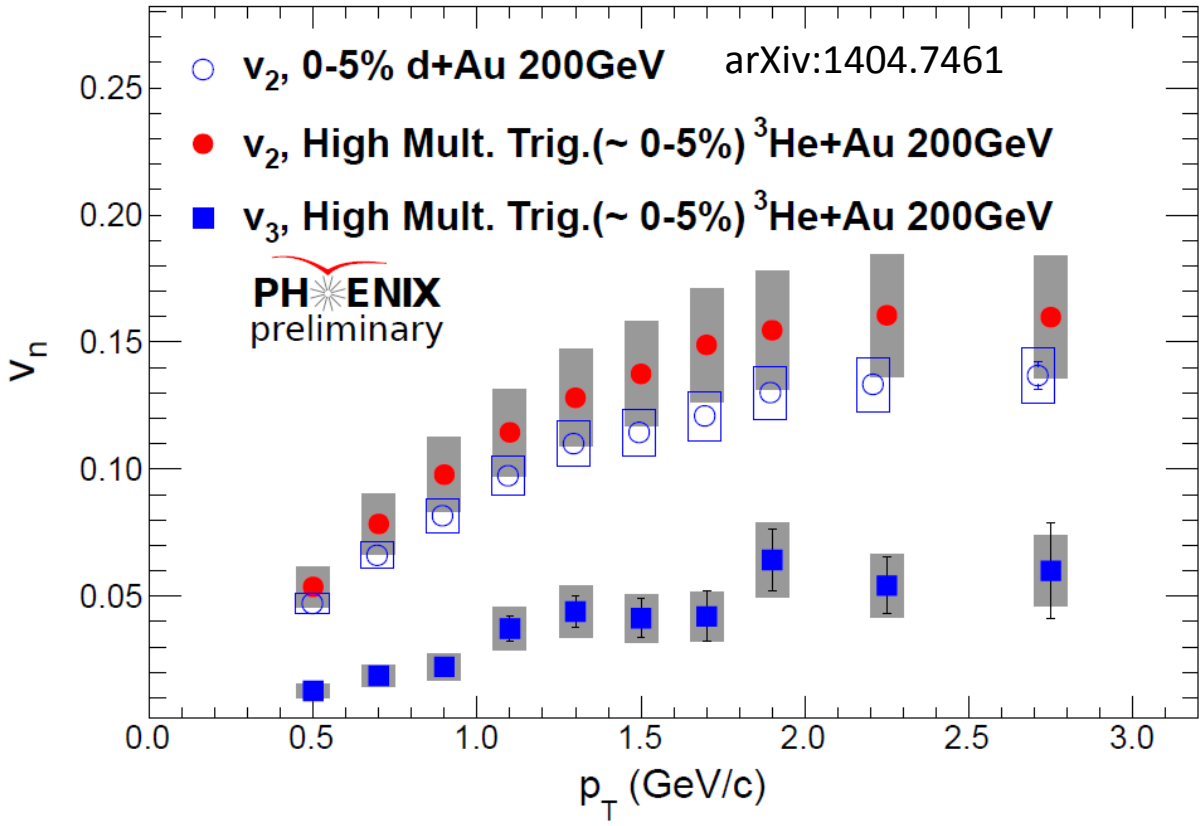
The v_2 and v_3 in ^{3}He+Au

J.Nagle et al, Phys. Rev. Lett. 113, 112301 (2014)



^{3}He+Au (0-5%) N_{part}=25.0
ε_2=0.504 ε_3=0.283

d+Au (0-5%) N_{part}=17.8
ε_2=0.540 ε_3=0.190

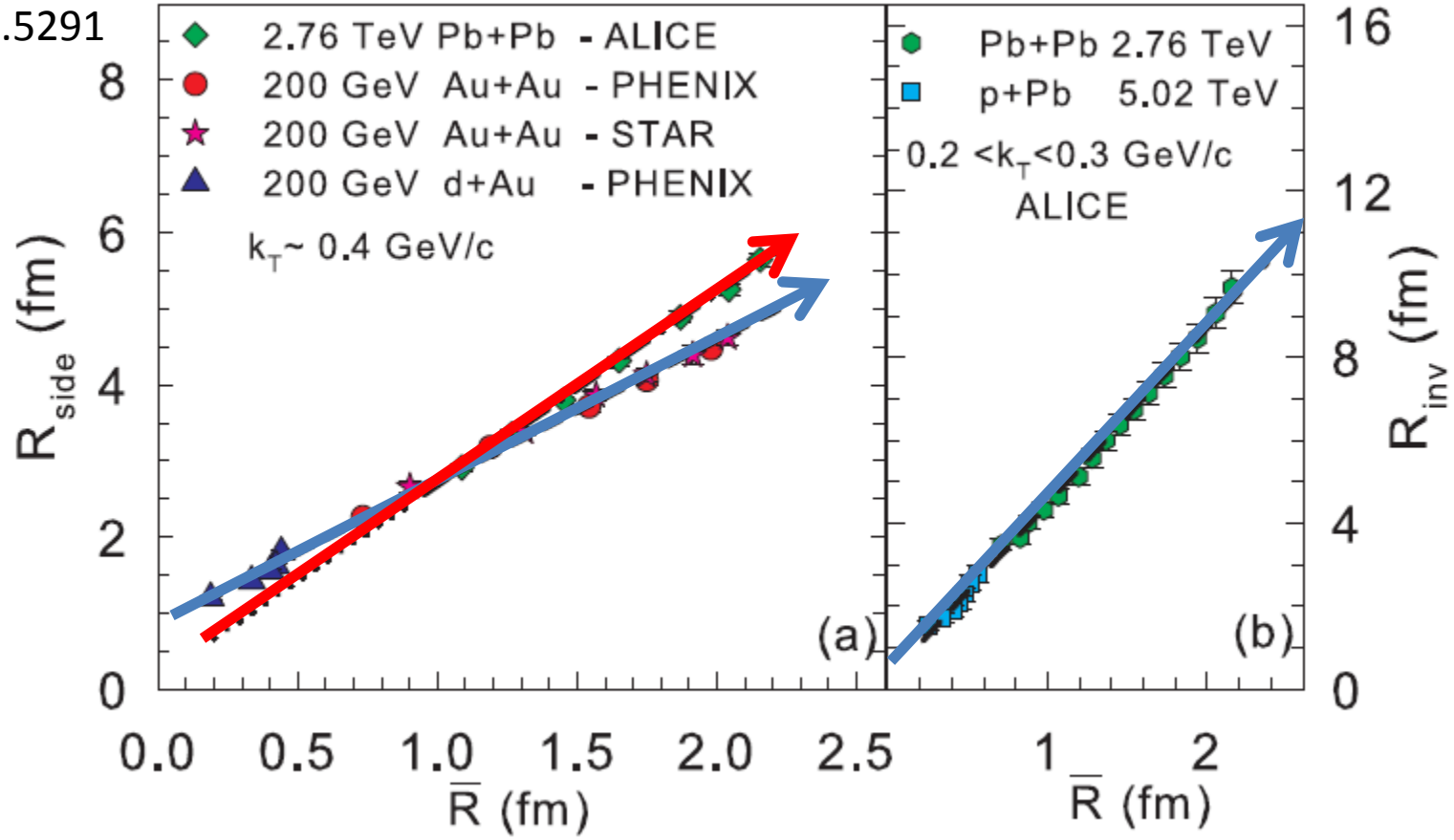


The v_2 of **^{3}He+Au** is similar to that of **d+Au**

A clear ***v_3*** signal is observed in 0-5% **^{3}He+Au** collisions

The HBT radii in d+Au

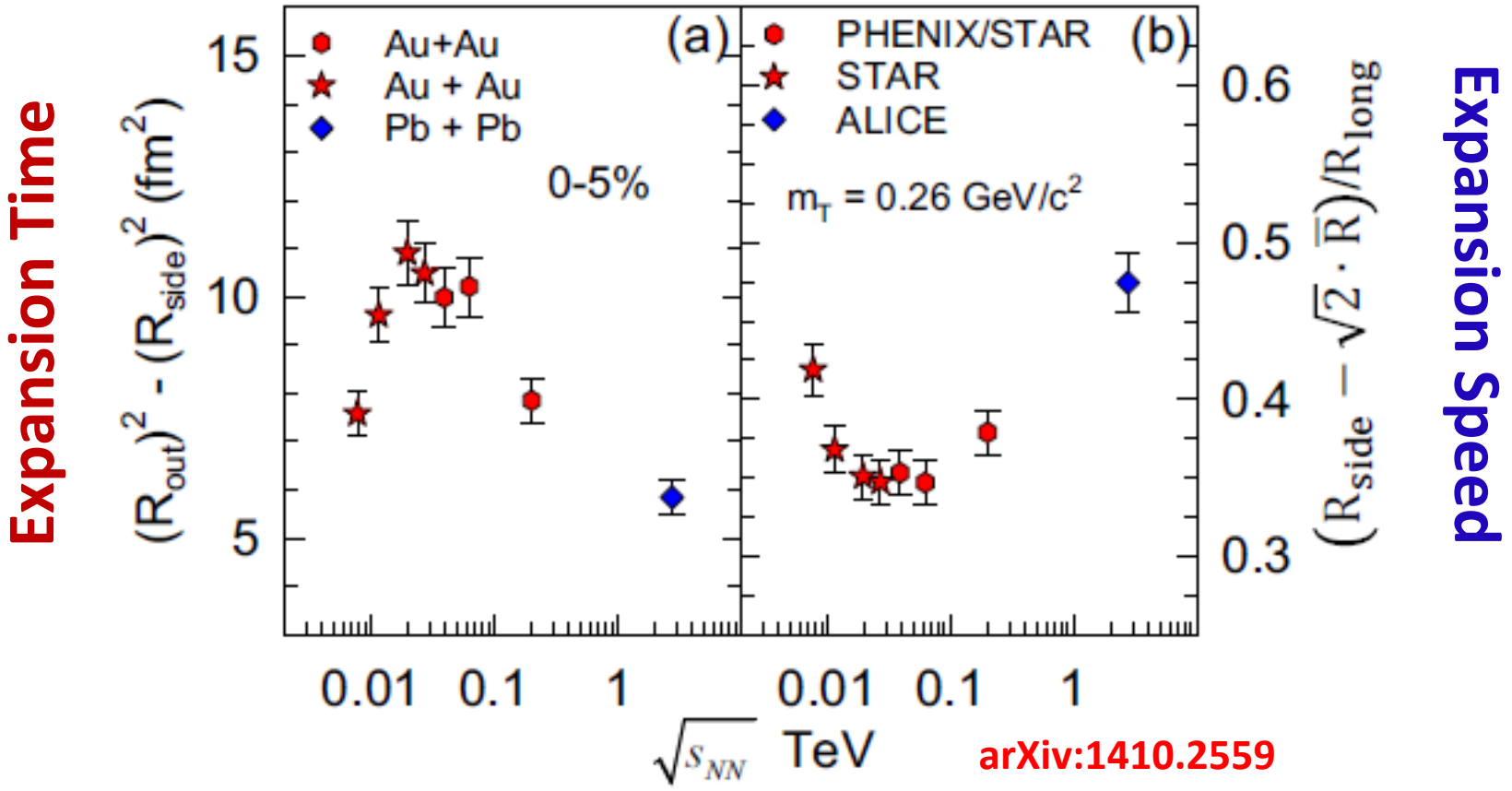
arXiv:1410.5291



Rbar(initial transverse size): $1/Rbar=sqrt(1/\sigma_x^2+ 1/\sigma_y^2)$

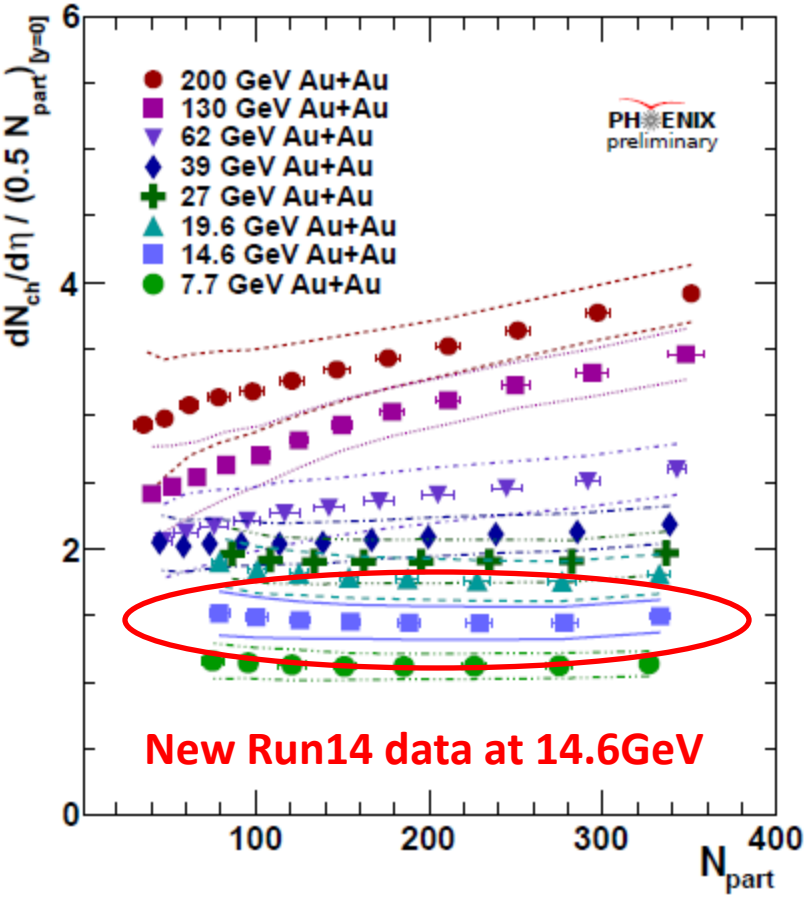
- Linear dependence and good scaling from small (p/d+A) to bigger(A+A) collision systems, implying radial expansion in p/d+A collisions
- The different slopes between RHIC and LHC imply different expansion rates

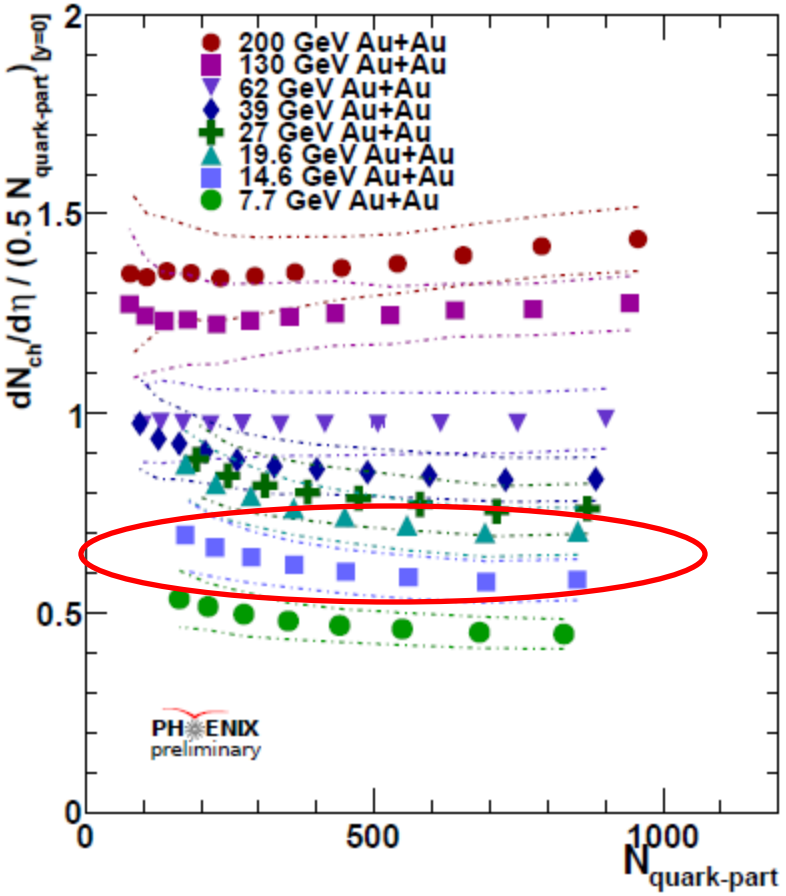
Emission duration vs. collision energy



- A medium produced near CEP will show a stalling of expansion speed ~$(R_{side}-\sqrt{2}R_{bar})/R_{long}$ as well as a longer expansion time $\Delta\tau^2 \propto R_{out}^2 - R_{side}^2$
- Non-monotonic behaviors are found for expansion time and expansion speed

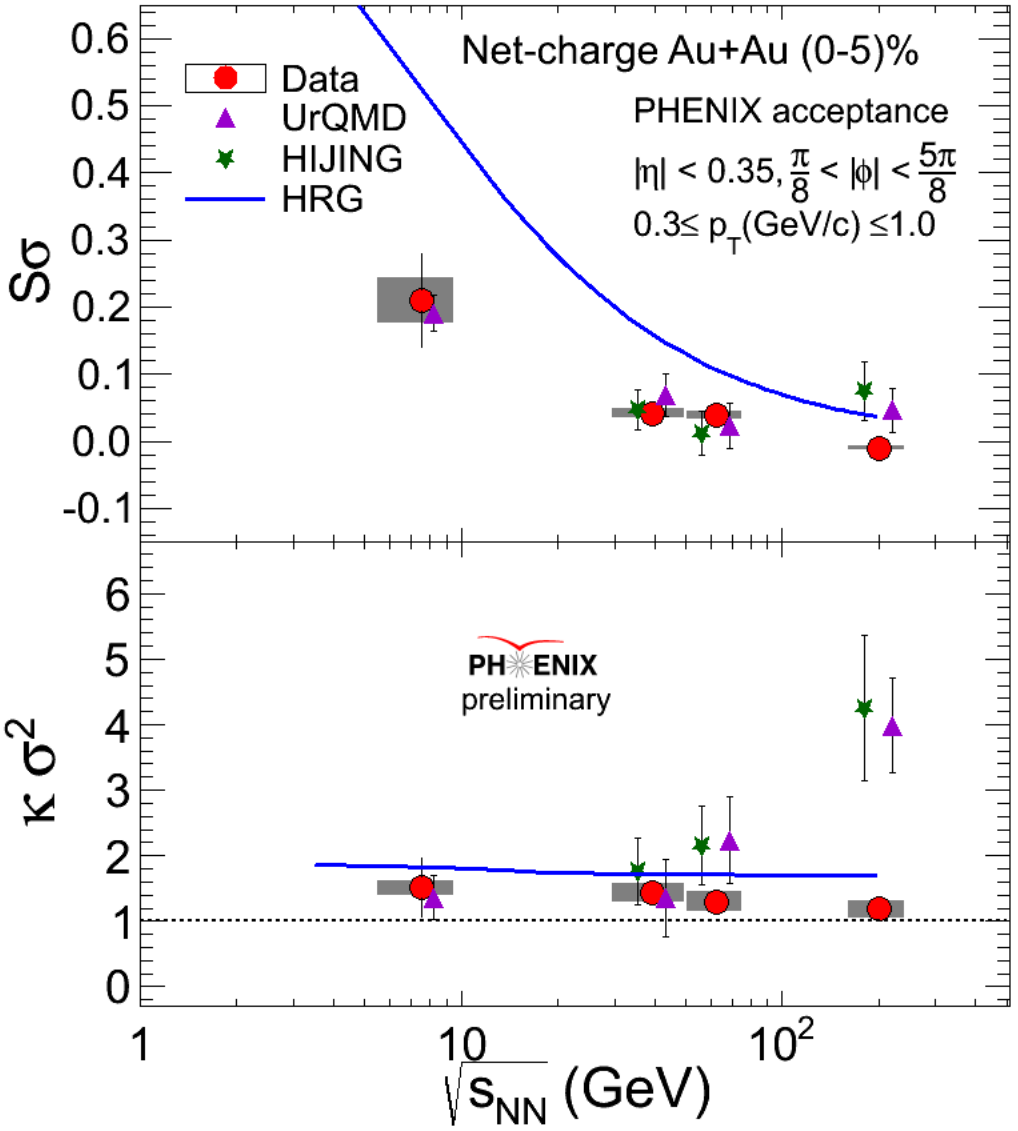
N_{part} and N_{quark} Scaling





- Below 39 GeV, the dN/dη scales well with participant nucleons
- Above 39 GeV, participant quark scaling describes the data well.

Higher moments of net charge fluctuation



The correlation length (ξ) is related to various moments of conserved quantities:

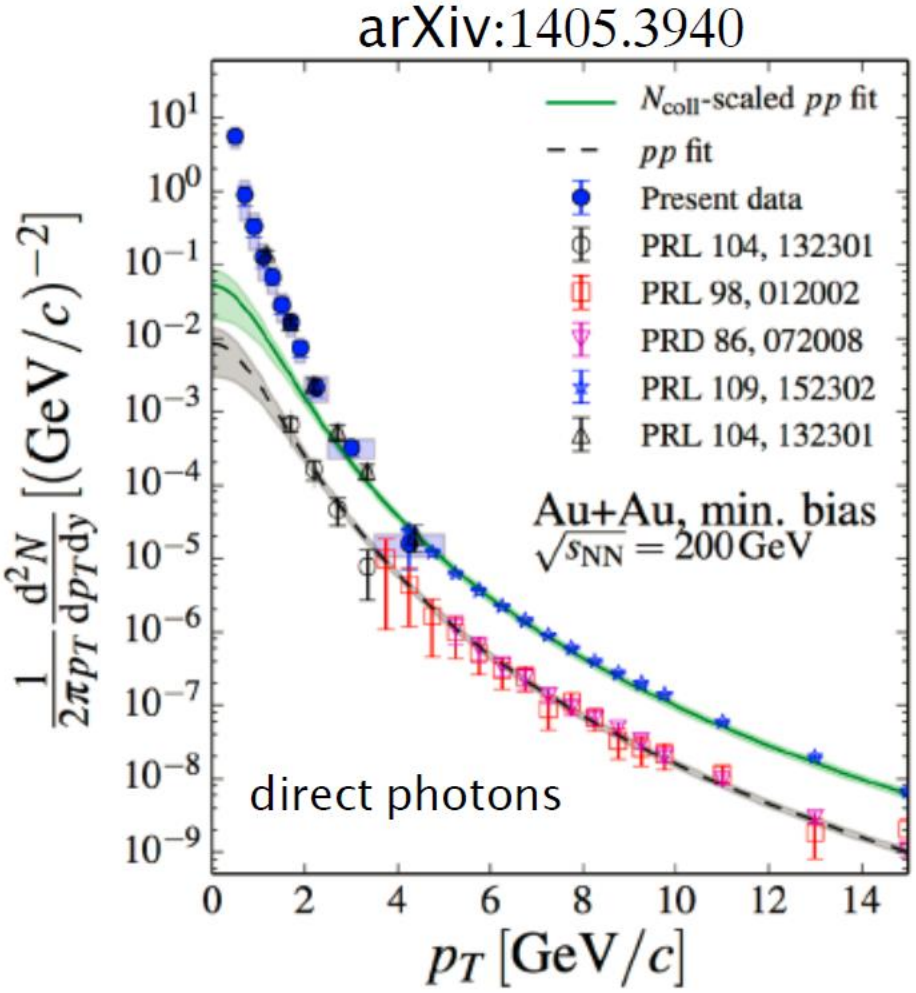
Variance: $\sigma^2 = \langle (N-\langle N\rangle)^2\rangle \sim \xi^2$

Skewness: $S = \langle (N-\langle N\rangle)^3\rangle/\sigma^3 \sim \xi^{4.5}$

Kurtosis: $\kappa = \langle (N-\langle N\rangle)^4\rangle/\sigma^4 - 3 \sim \xi^7$

The products of the net charge moments show no significant increase above URQMD, HIJING, or Hadron Resonance Gas predictions.

Direct photon at low p_T

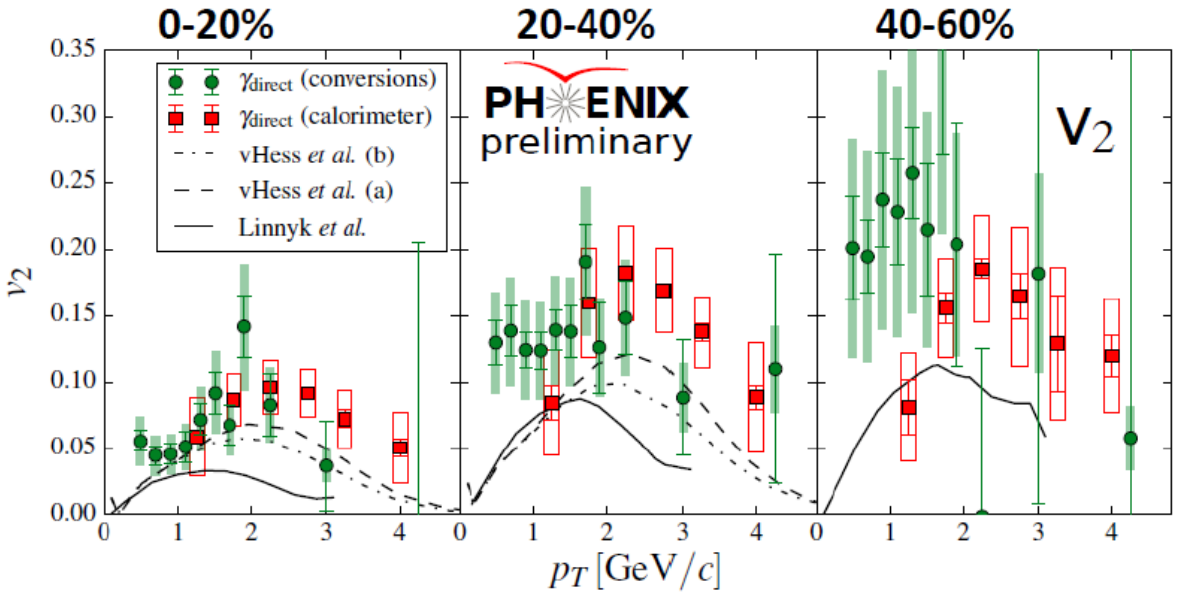


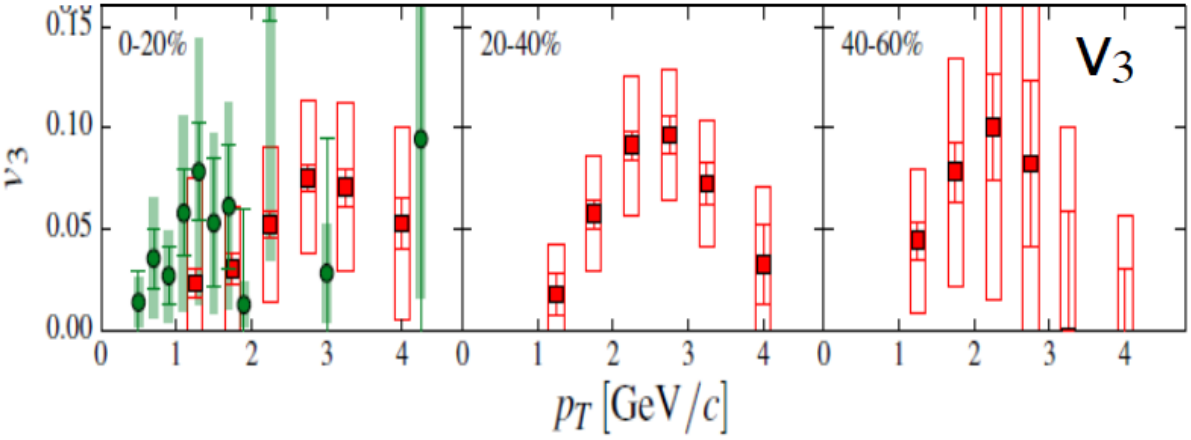
New analysis using external conversion of real photon

Consistent with previous results from virtual photon

Extension to lower p_T

V_2 and v_3 of direct photon in 200GeV Au+Au



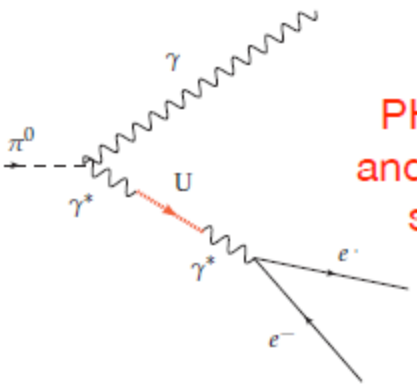


The direct photon v_2 has been measured with new external conversions methods

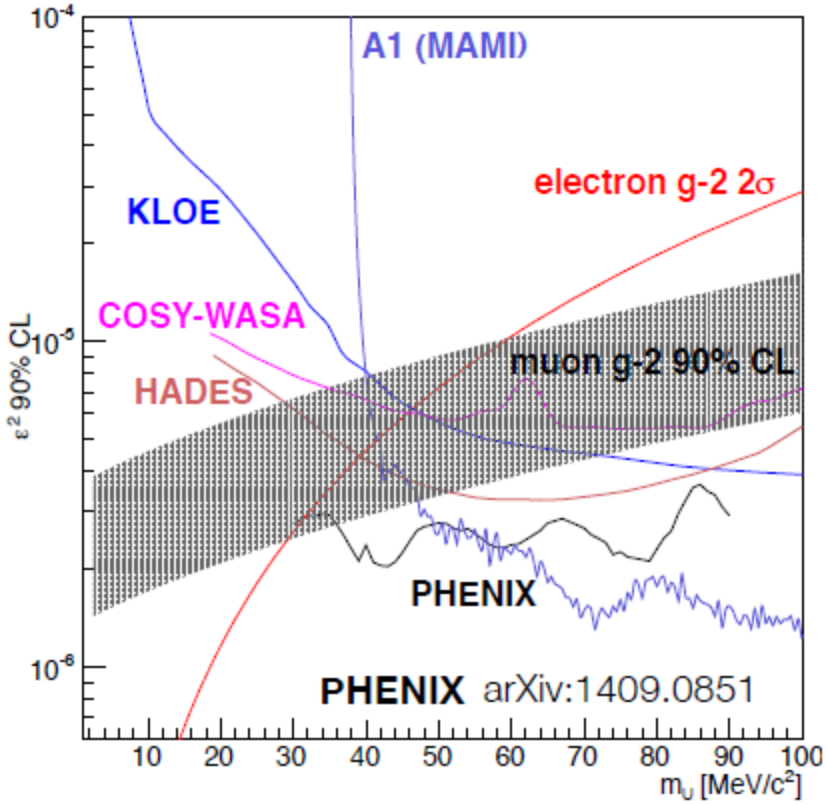
The model calculations under-predict our measurements

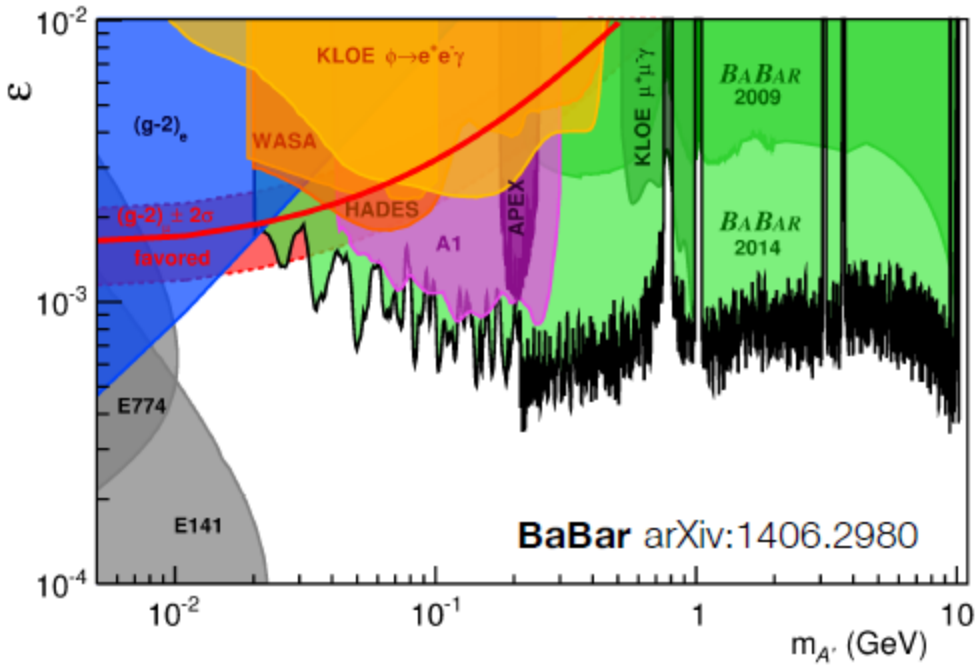
The new v_3 measurement will bring more challenges to theorists

Dark photons



PHENIX: excellent electron ID and e^+e^- mass resolution – huge sample of π^0 Dalitz decays

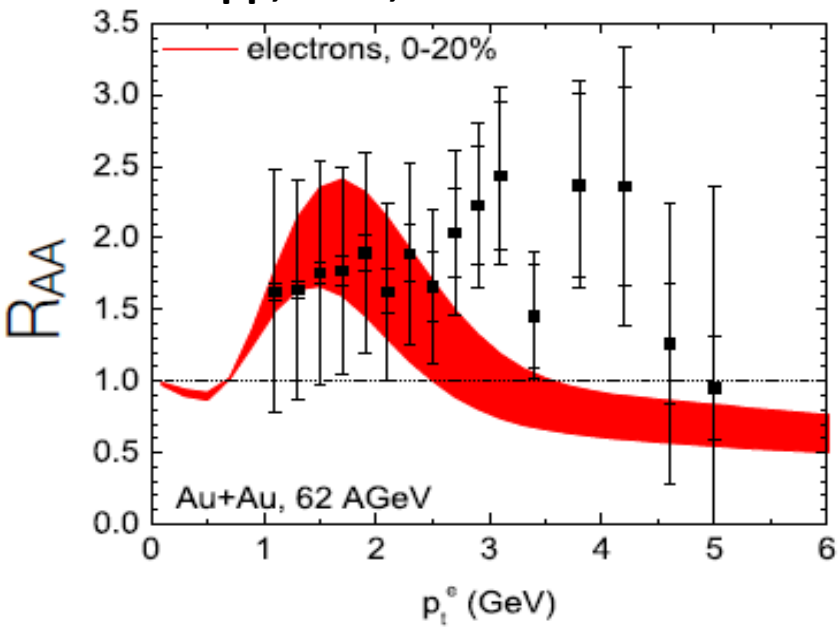


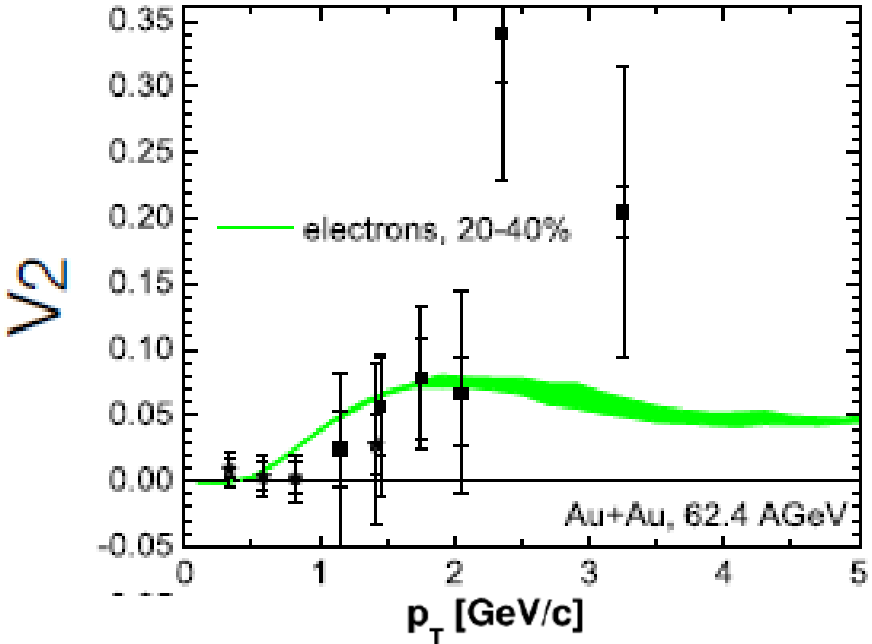


With recent combined limits – WASA, HADES, A1, BaBar, PHENIX, NA48/2 – essentially all parameter space for the minimal version of a dark photon to explain $(g\text{-}2)_\mu$ anomaly has been ruled out

HF e in 62.4 GeV Au+Au

Rapp, Fries, He arXiv:1409.4539





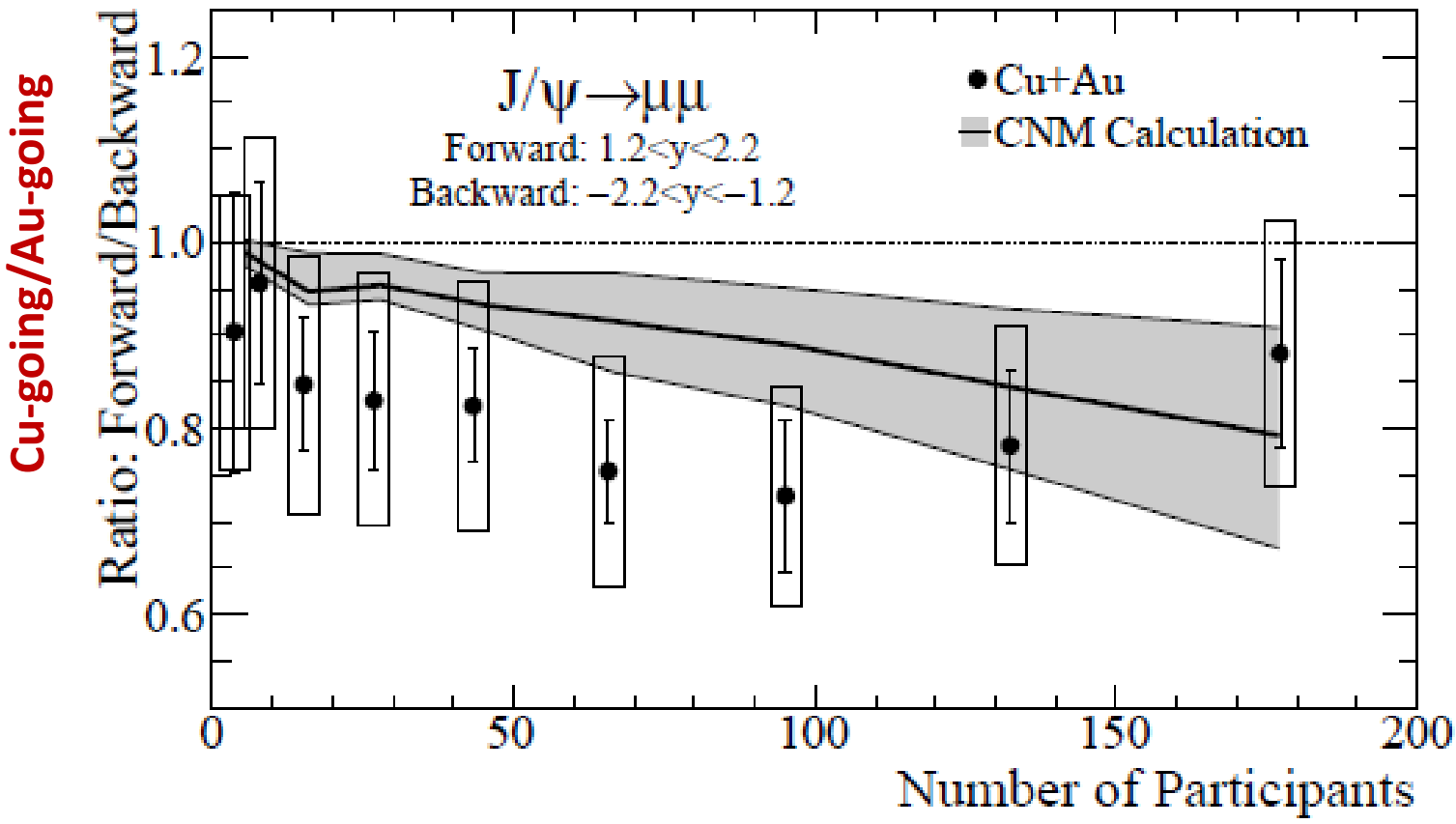
HF electron R_{AA} >1 && v_2>0 in 62.4GeV Au+Au collisions. The systematic uncertainties of R_{AA} are mainly from pp reference

HF e in 62.4 GeV Au+Au will help to understand how the HF coupling to the medium
i)Temperature
ii)Pseudo-critical region

Possible strong coupling nearer T_c drives interest in Au+Au and p+p at $\sqrt{s_{NN}}$ = 62.4 GeV for 2016 Run.

J/psi in Cu+Au collisions

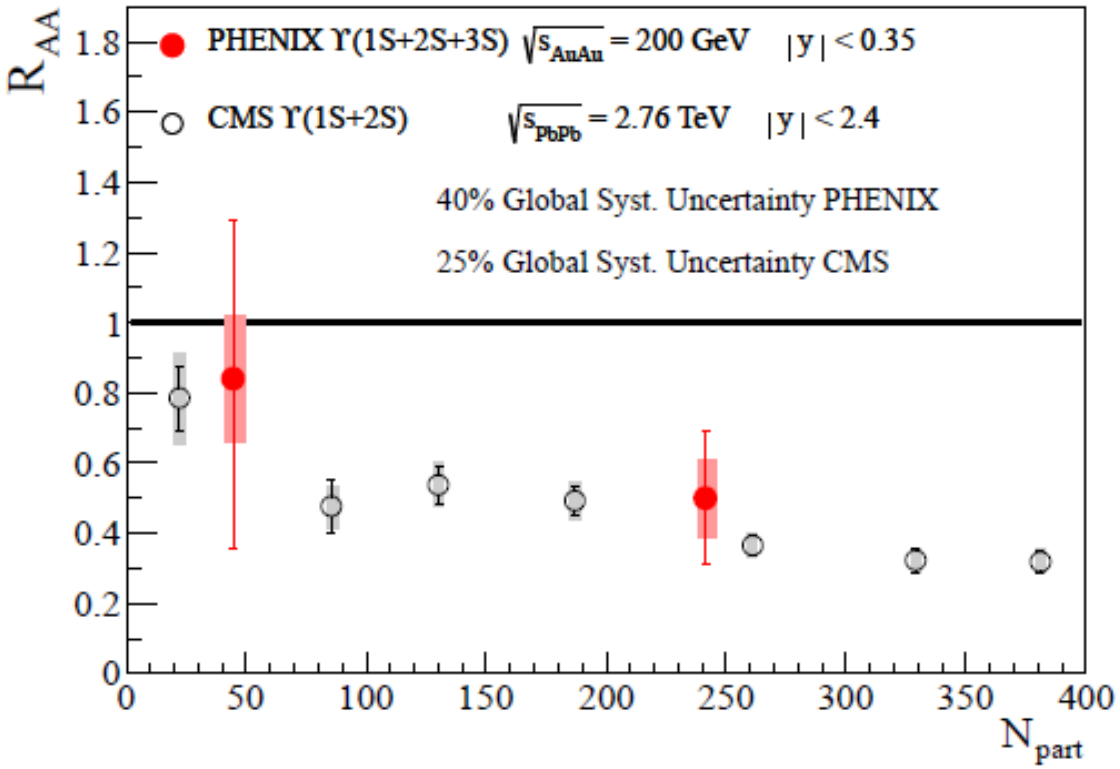
arXiv:1404.1873

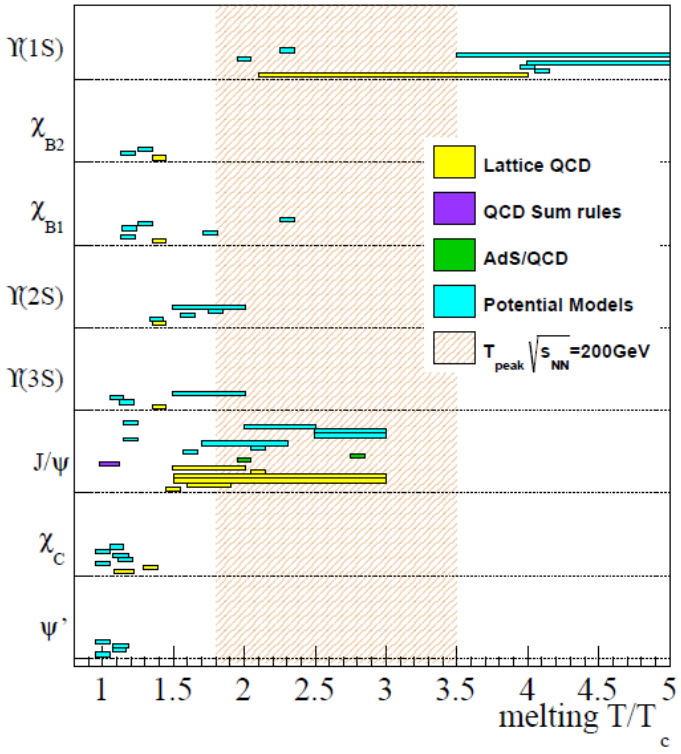


- J/psi is more suppressed in Cu-going direction
- Trend is comparable with the calculations using EPS09

Upsilon in 200GeV Au+Au

arXiv:1404.2246





Suppression of Upsilons at RHIC observed!

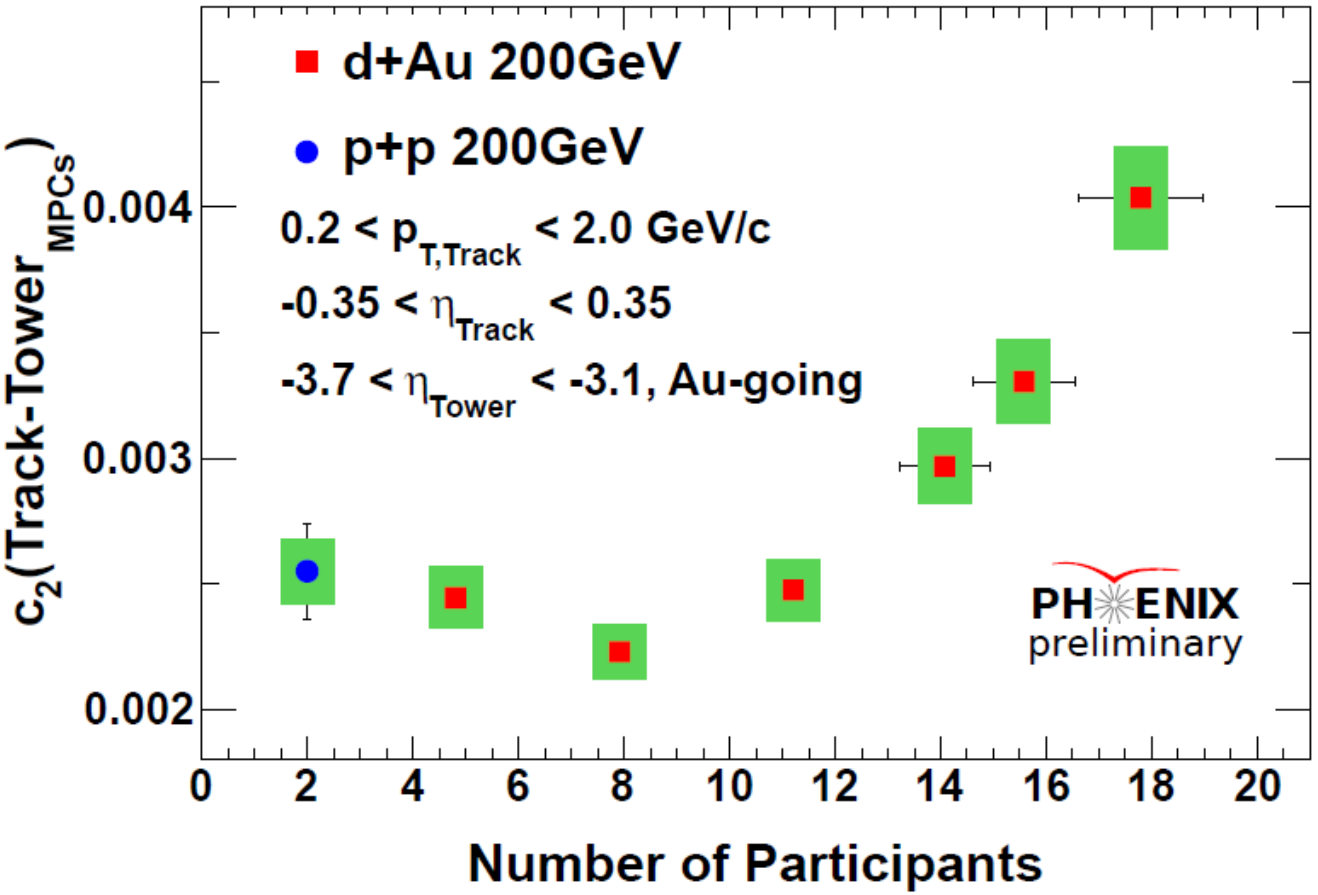
Consistent with disappearance of **2s** and **3s** contributions!

Within uncertainties similar to the suppression in Pb+Pb@CMS

Summary

- The ridge is observed in d+Au and ^{3}He+Au. There is a clear v_3 signal in ^{3}He+Au
- The v_3 of direct photon is seen in AuAu@200GeV
- Non-monotonic behaviors are found for expansion speed and time by HBT@collision energies
- The HF e R_{AA}>1 and v_2>0 in 62.4GeV Au+Au collision. Improved measurements in the future will help us to address “possible strong coupling near T_c”

Backup


d+Au 200GeV
p+p 200GeV
0.2 < p_T,Track < 2.0 GeV/c
-0.35 < η_Track < 0.35
-3.7 < η_Tower < -3.1, Au-going
PHENIX
preliminary
c2(Track-Tower_MPCs)
0.002
0.003
0.004
0
2
4
6
8
10
12
14
16
18
20
Number of Participants