Centrality dependence of elliptic flow of multi-strange hadrons in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV

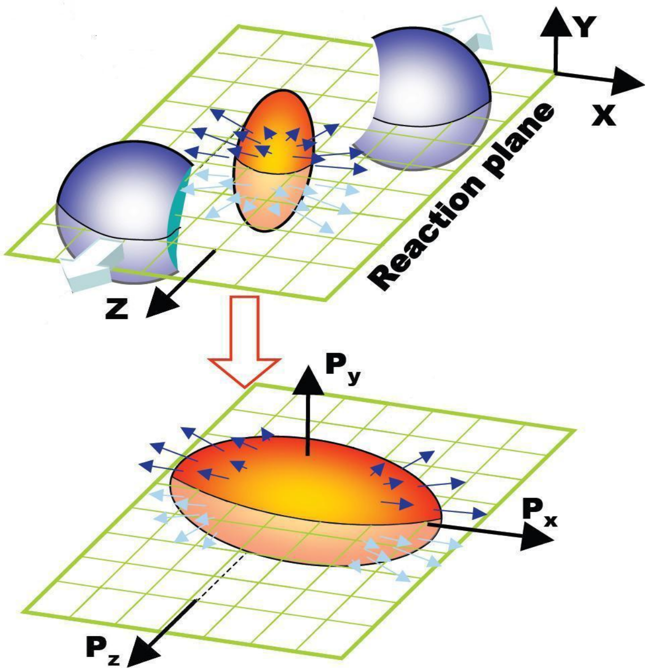
Shusu Shi
for the STAR collaboration

Central China Normal University

Outline

- **Introduction**
- **Analysis Method**
- **Results and Discussions**
  - Centrality dependence
  - Partonic collectivity
  - ϕ and proton v_2 at low p_T
- **Summary**

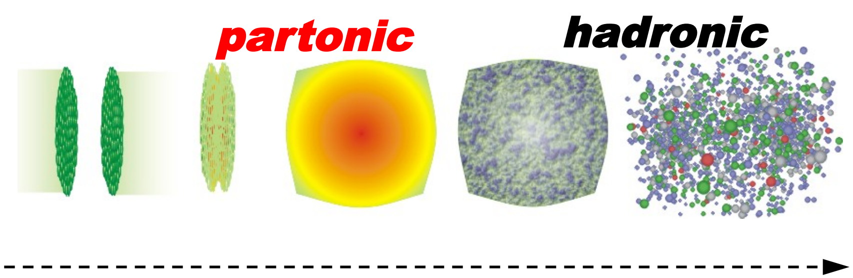
Elliptic Flow (v_2)



$$\varepsilon = \frac{< y^2 - x^2 >}{< y^2 + x^2 >} \Rightarrow v_2 = < \cos 2\varphi >, \quad \varphi = \tan^{-1}\left(\frac{p_y}{p_x}\right)$$

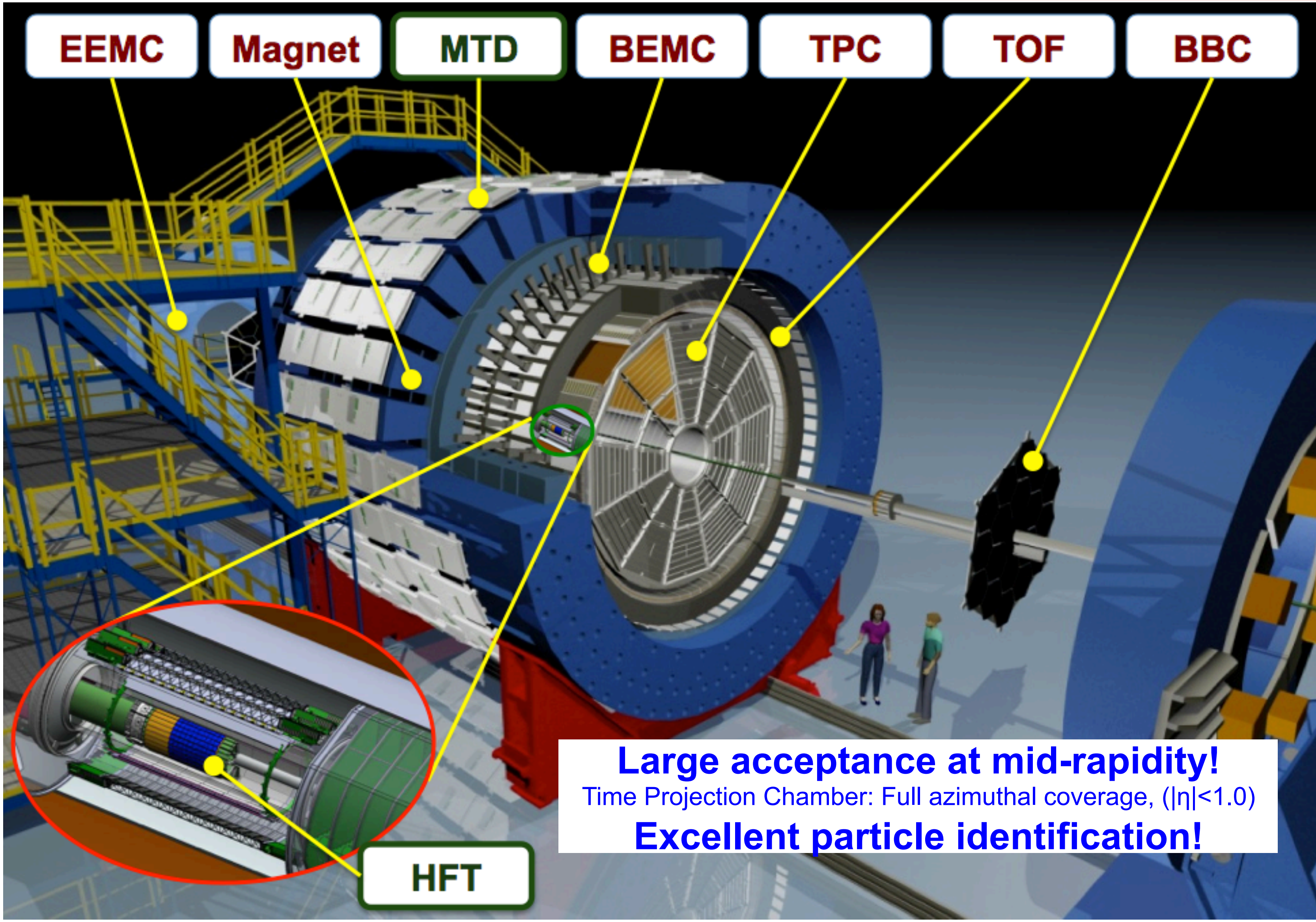
- **Elliptic flow =>**
- Initial spatial anisotropy (eccentricity ε)
  - ->Final momentum anisotropy v_2
    - ➔ Interactions among constituents
    - Sensitive to degree of thermalization
- Self-quenching with time
  - Sensitive to the early stages of the system evolution
- **Multi-strange hadrons and ϕ meson =>**
  - Less sensitive to late hadronic rescattering

Probe of the early (partonic) stage of the collision.



D ϕ, Ω, Ξ Λ π, K, p

STAR Detectors

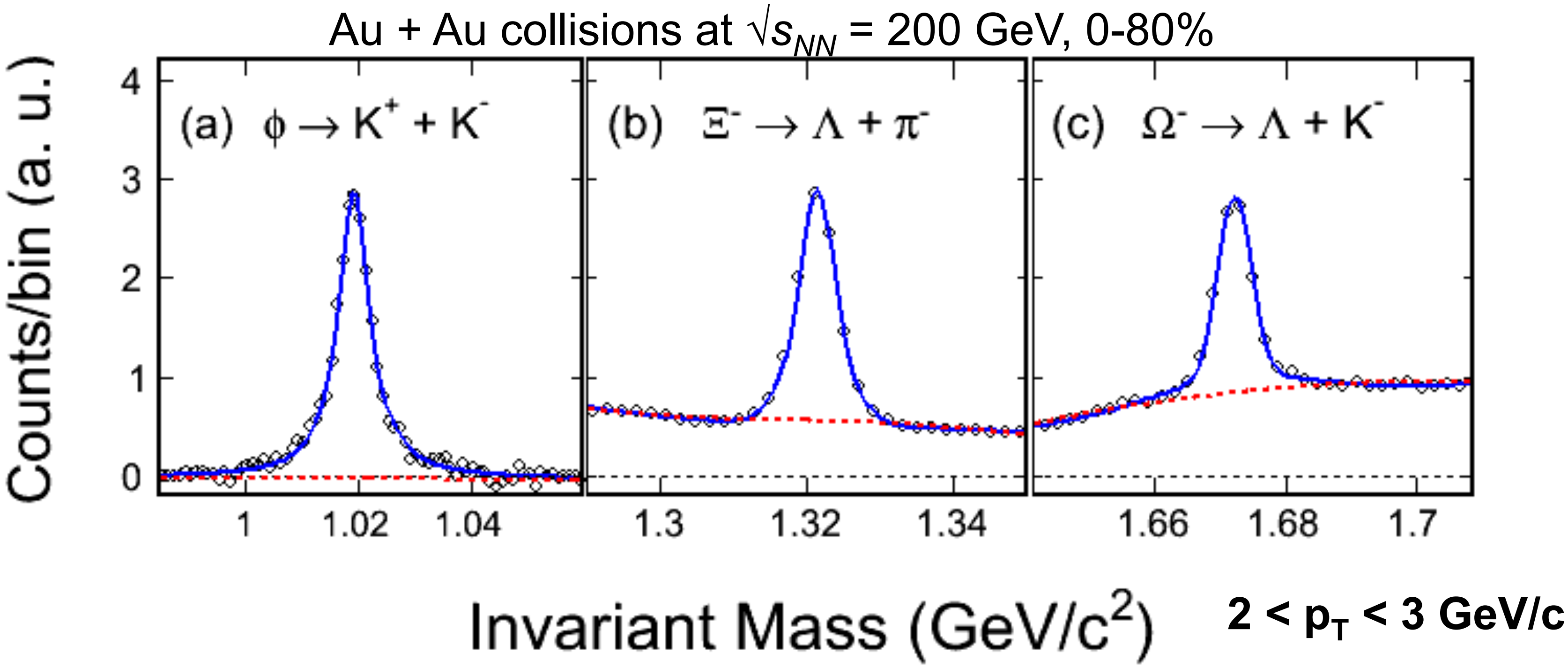


Large acceptance at mid-rapidity!

Time Projection Chamber: Full azimuthal coverage, ($|\eta|<1.0$)

Excellent particle identification!

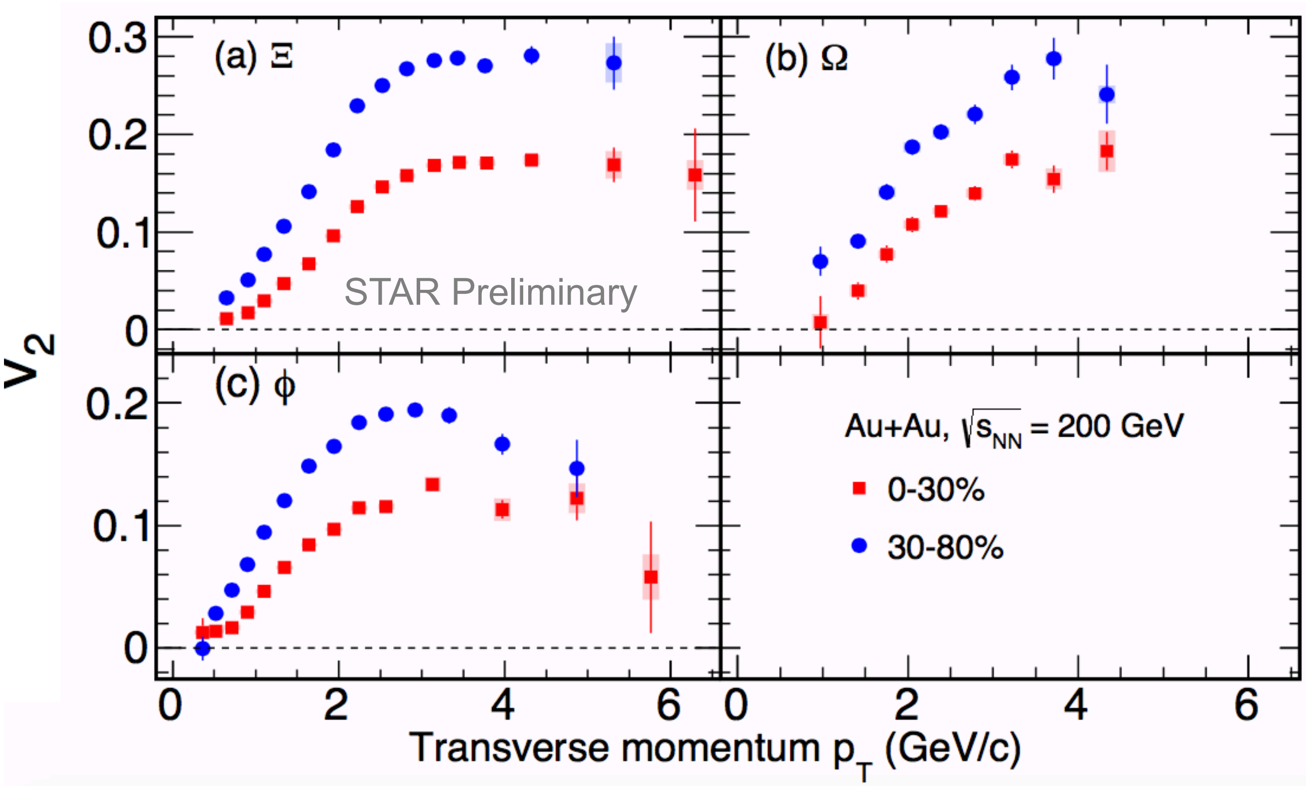
Particle Identification



- Clear signal for multi-strange hadrons and ϕ meson
  - ϕ : after combinatorial background subtraction by event mixing Breit-Wigner + linear fit
  - Ξ, Ω : topological cuts

    Gaussian + 4th order polynomial fit

Centrality Dependence

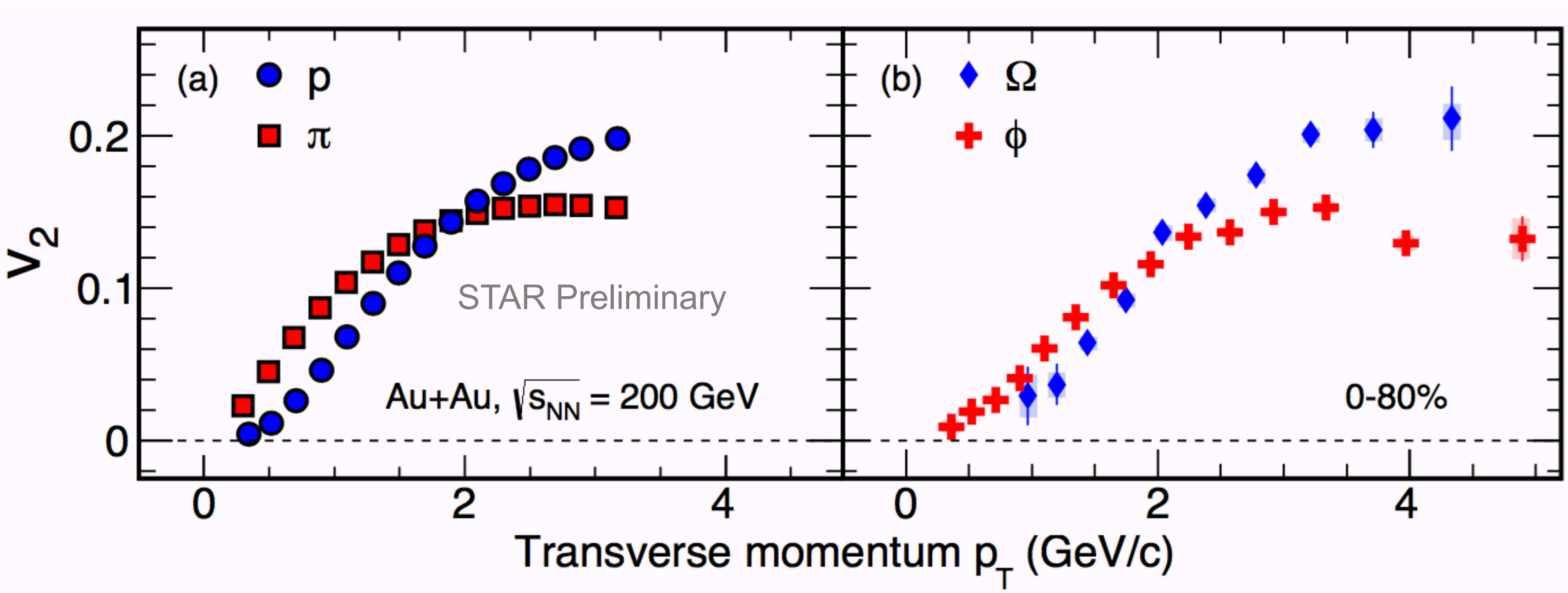


Event Plane determined by TPC tracks

- **Run10 + Run11: 730 M events.**
- **Larger v_2 in more peripheral collisions -> final momentum anisotropy is driven by the initial spatial anisotropy**

High precision data!

Partonic Collectivity

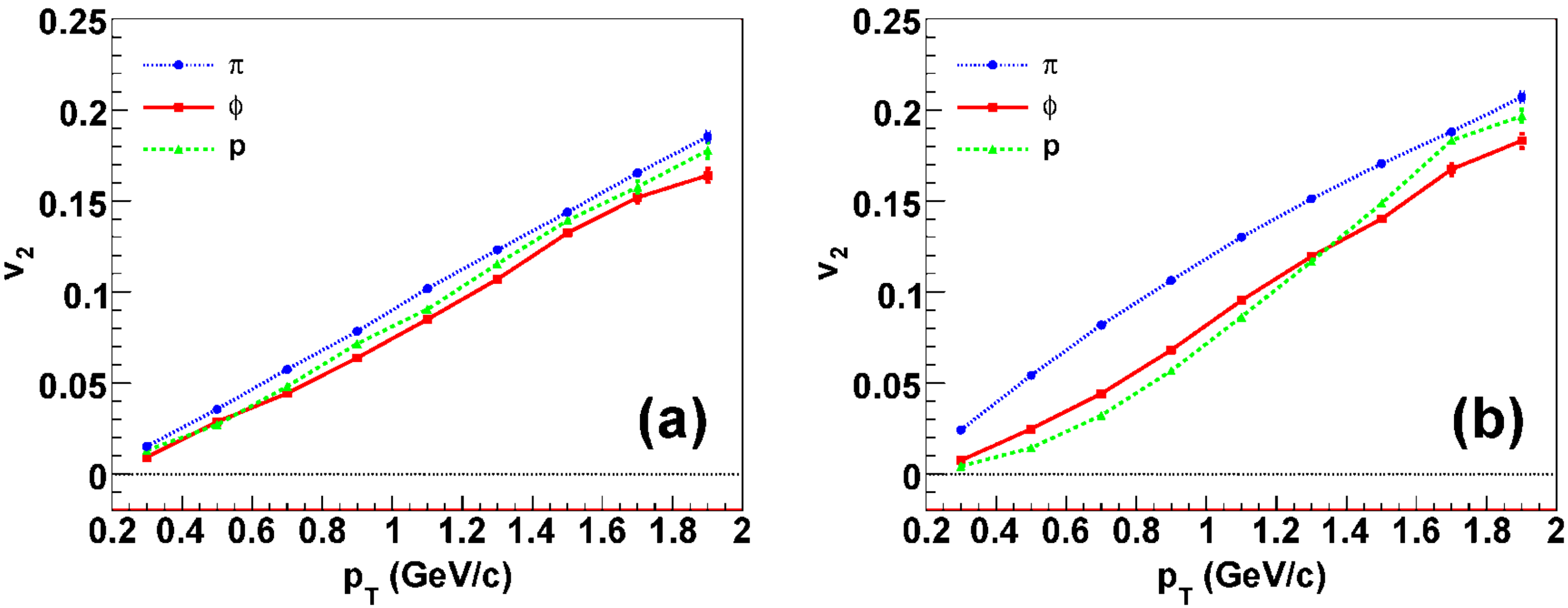


- Mass ordering when $p_T < 2$ GeV/c
- Baryon/meson splitting when $2 < p_T < 5$ GeV/c

High precision data prove that Ω follows the baryon/meson splitting.

First time!

Mass Ordering for ϕ-mesons



Before hadronic rescattering

After hadronic rescattering

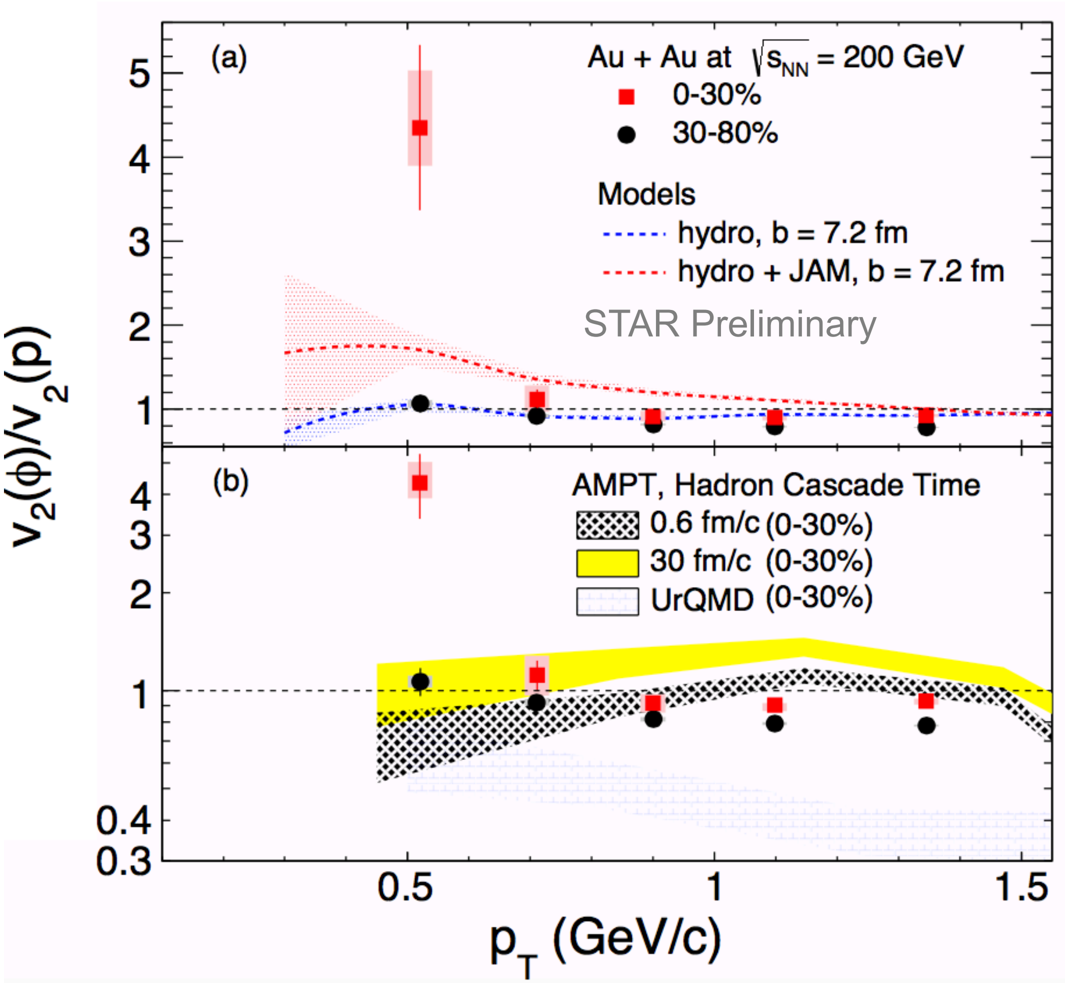
T. Hirano et al., ; PRC77, 044909 (2008)

- **Ideal hydro + hadron cascade**
- **Small hadron cross section + hadronic rescattering effect on v_2**

  Mass ϕ > mass p ➔ $v_2(\phi) > v_2(p)$

  ➔ ***Break mass ordering for ϕ meson***

$v_2(\phi)/v_2(p)$



- **Model study indicates with increasing hadronic cascade time (more hadronic re-scattering), the $v_2(\phi)/v_2(p)$ ratio increases**

- **The ratio $v_2(\phi)/v_2(p)$ Is $4.35 \pm 0.98 \pm^{0.66}_{0.45}$ at p_T = 0.52 GeV/c in 0-30% ->**
  Possibly due to the effect of late hadronic interactions on the proton v_2

Summary

- **The v_2 of Ω baryon follows baryon/meson splitting in the intermediate p_T range ->** ***Partonic collectivity***

- **There is a *possible* violation of hydrodynamics inspired mass ordering between ϕ and *p*->** ***The effect of late-stage hadronic re-scattering on the proton v_2***