The Elliptic Flow of Multi-strange Hadrons in $\sqrt{s_{NN}} = 200$ GeV Au + Au Collisions at STAR

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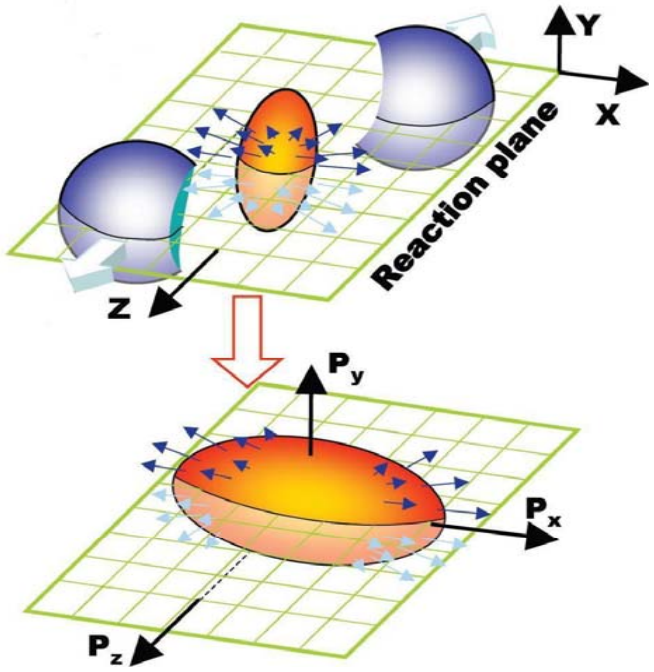
Outline

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

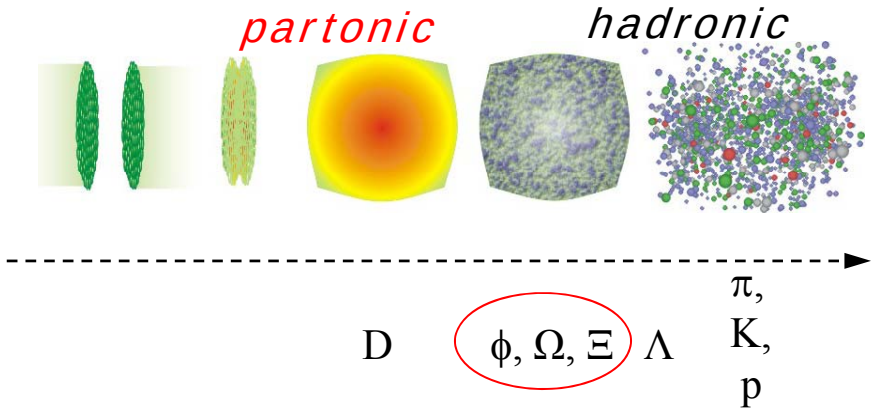
Elliptic Flow (v_2)



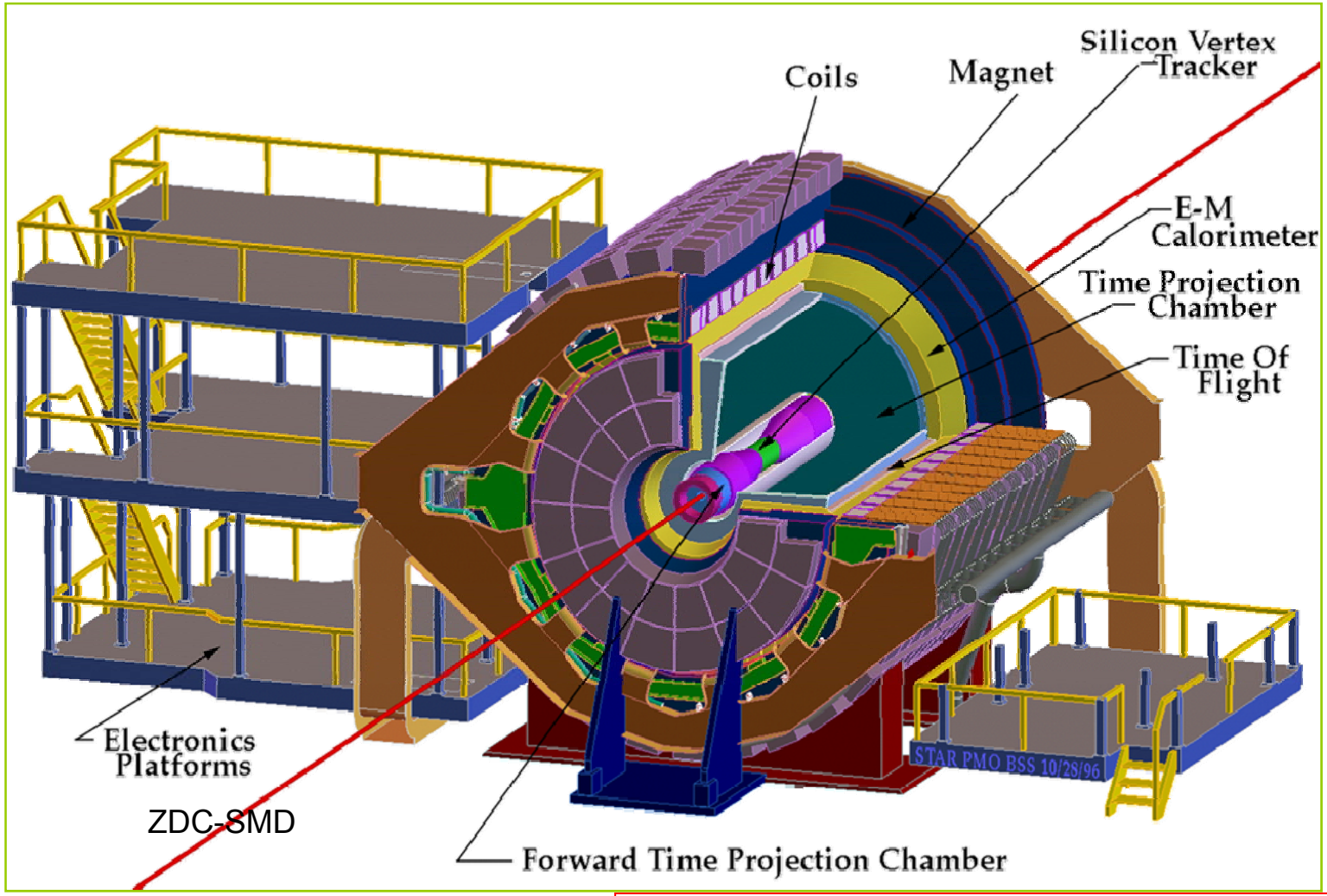
$$\varepsilon = \frac{< y^2 - x^2 >}{< y^2 + x^2 >} \Rightarrow v_2 = < \cos 2\varphi >, \quad \varphi = \tan^{-1}(\frac{p_y}{p_x})$$

- **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 =>**
  Less sensitive to late hadronic rescattering

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



STAR Detectors

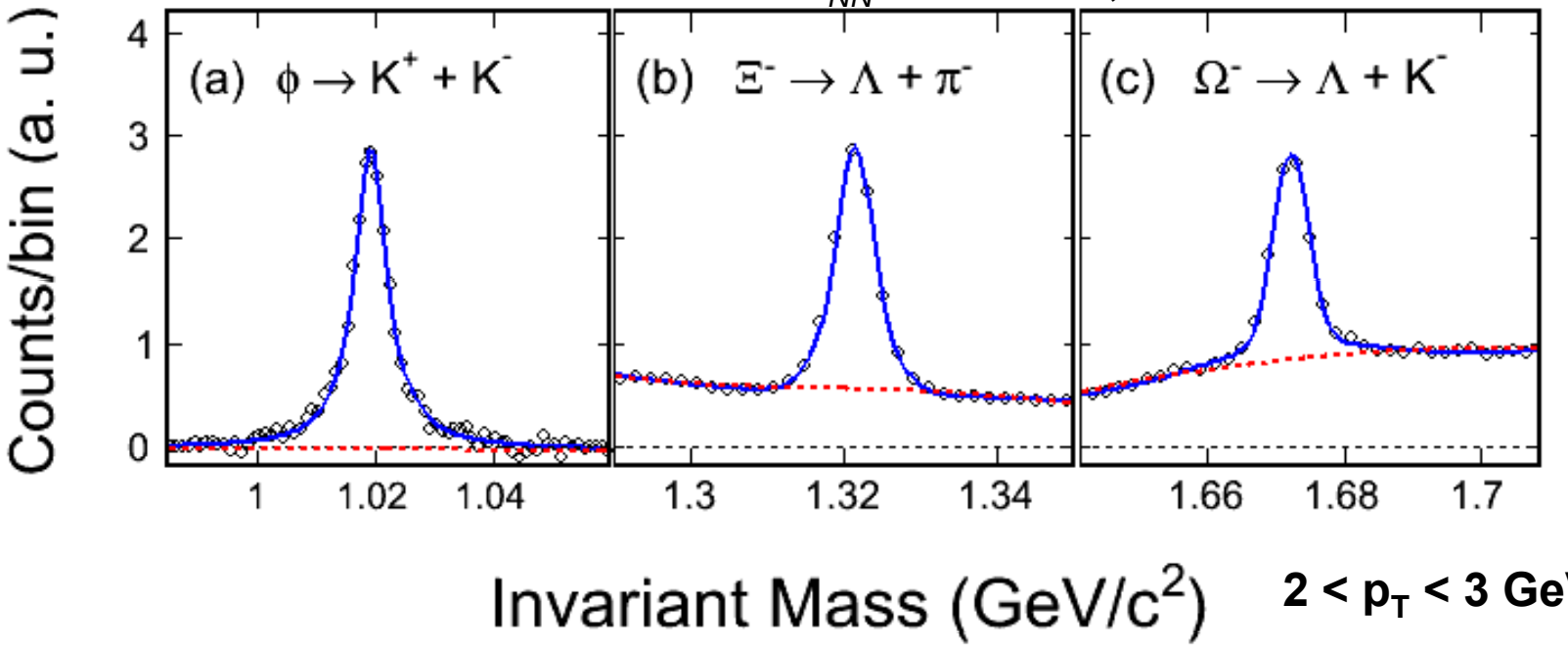


Large acceptance

TPC: Full azimuthal coverage, ($|\eta|<1.0$)

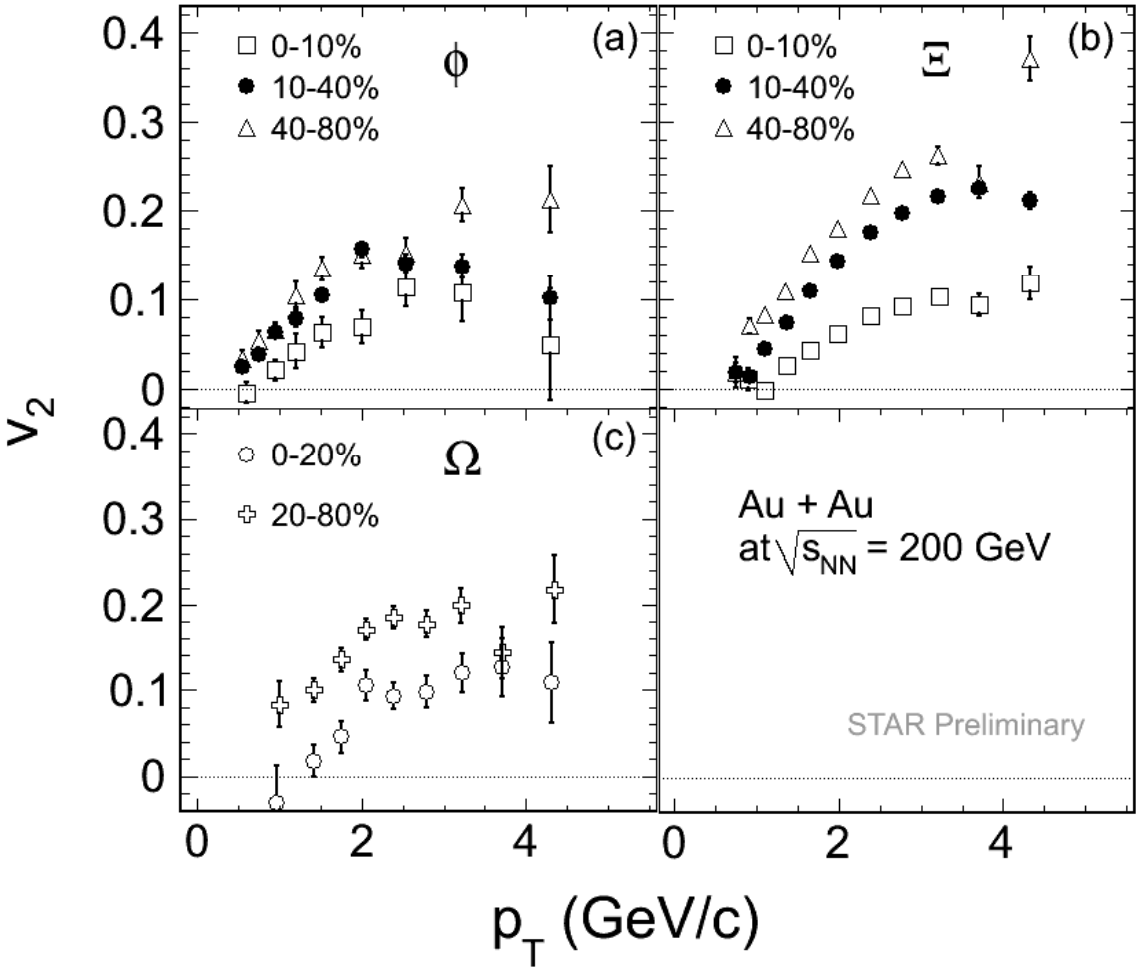
dE/dx PID: pion/kaon: $p_T \sim 0.6$ GeV/c; proton $p_T \sim 1.0$ GeV/c

Particle Identification



- Reconstructed by decay topology
- Clear signal for multi-strange hadrons
  - ϕ : Breit-Wigner + linear fit
    - after combinatorial background subtraction by event mixing
  - Ξ, Ω : Gaussian + 4th order polynomial fit
  - For clarity, ϕ, Ξ and Ω are scaled by 1/65000, 1/110000 and 1/4500, respectively

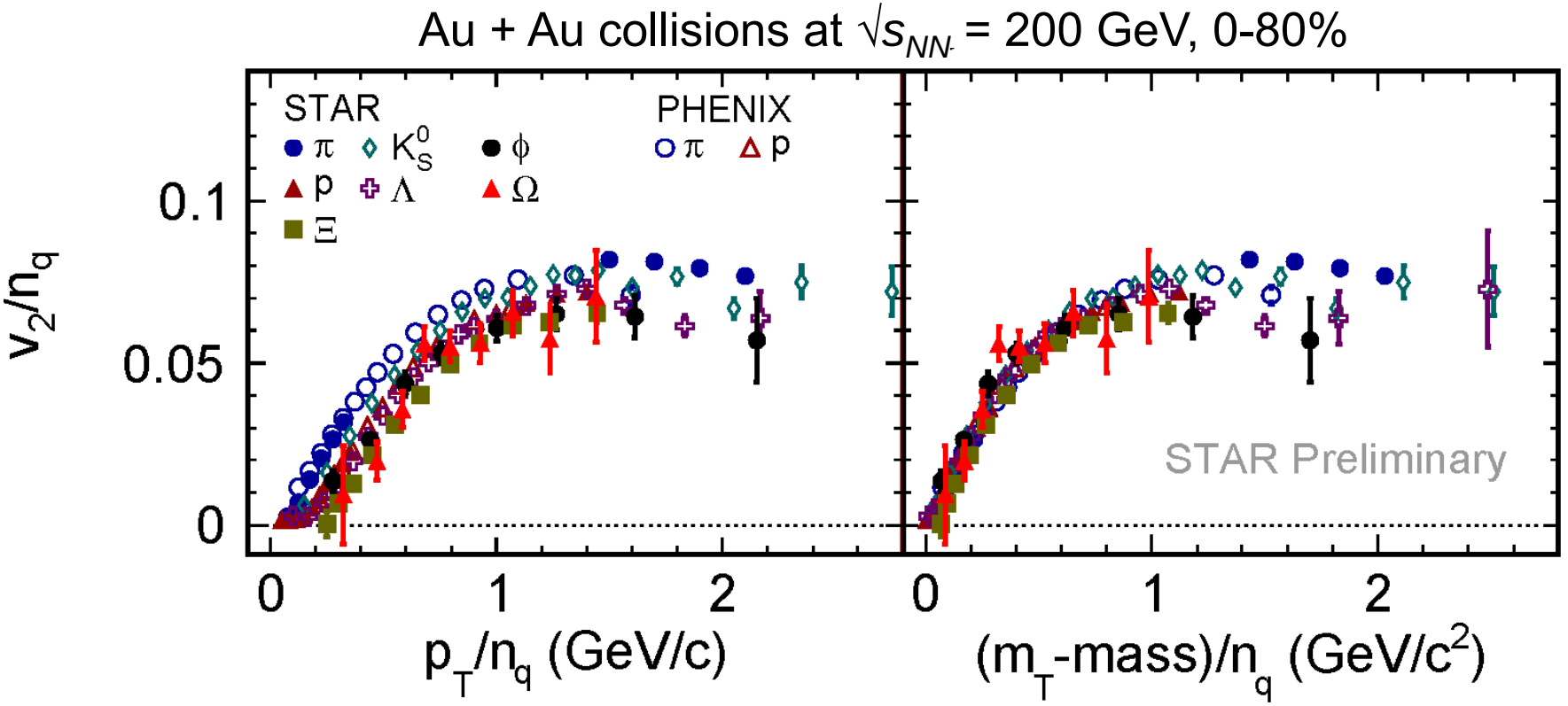
Centrality Dependence



- **Event Plane**
  - Determined by TPC tracks
- **Centrality dependence**
  - Driven by the initial collision geometry
  - v_2 as large as light hadrons
- **Systematic error**
  - Background estimation, cuts:

    5-10%

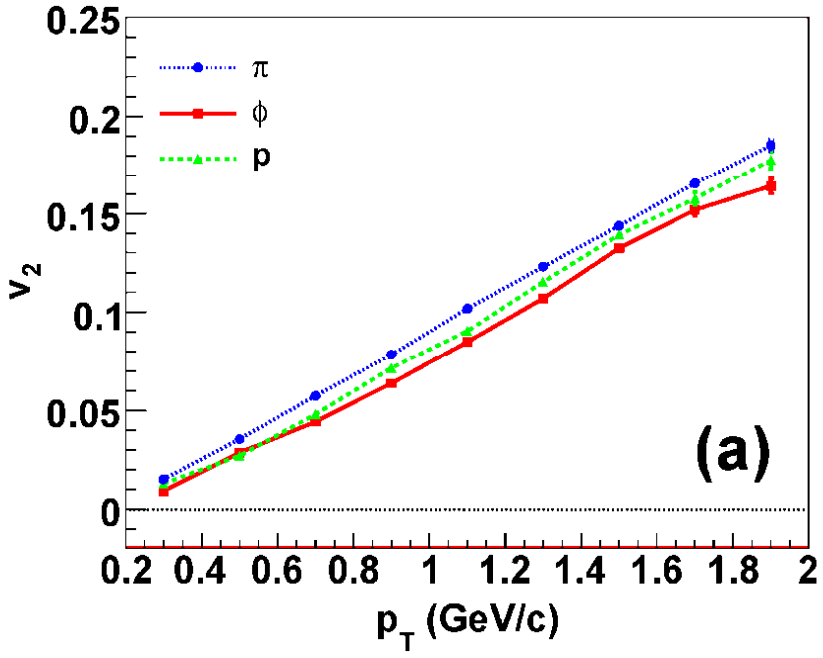
Partonic Collectivity



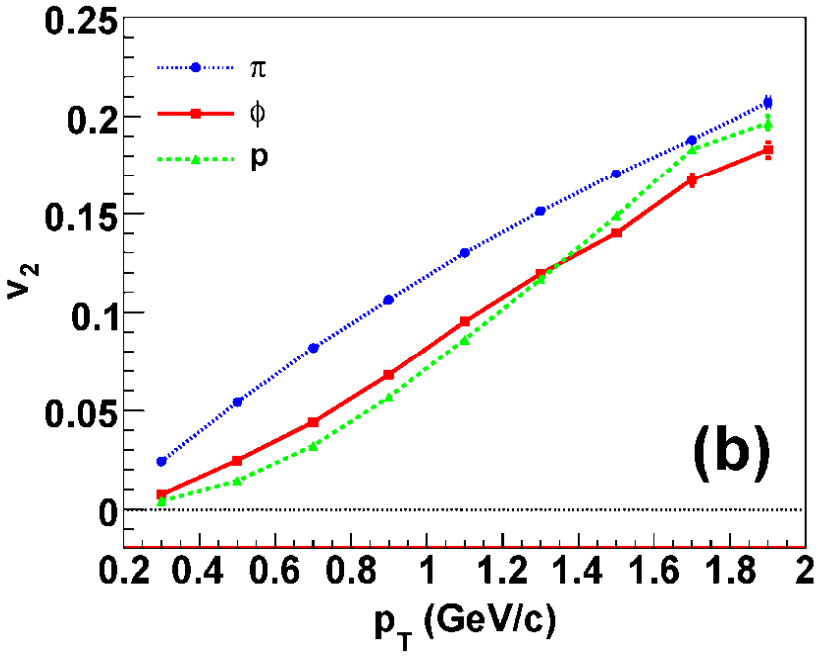
PHENIX; PRL98, 162301 (2007)

- **Number of Quark scaling works up to p_T/n_q ~ 1.5 GeV/c**
  Collectivity developed at partonic stage!

Mass Ordering for ϕ Mesons



Before hadronic rescattering

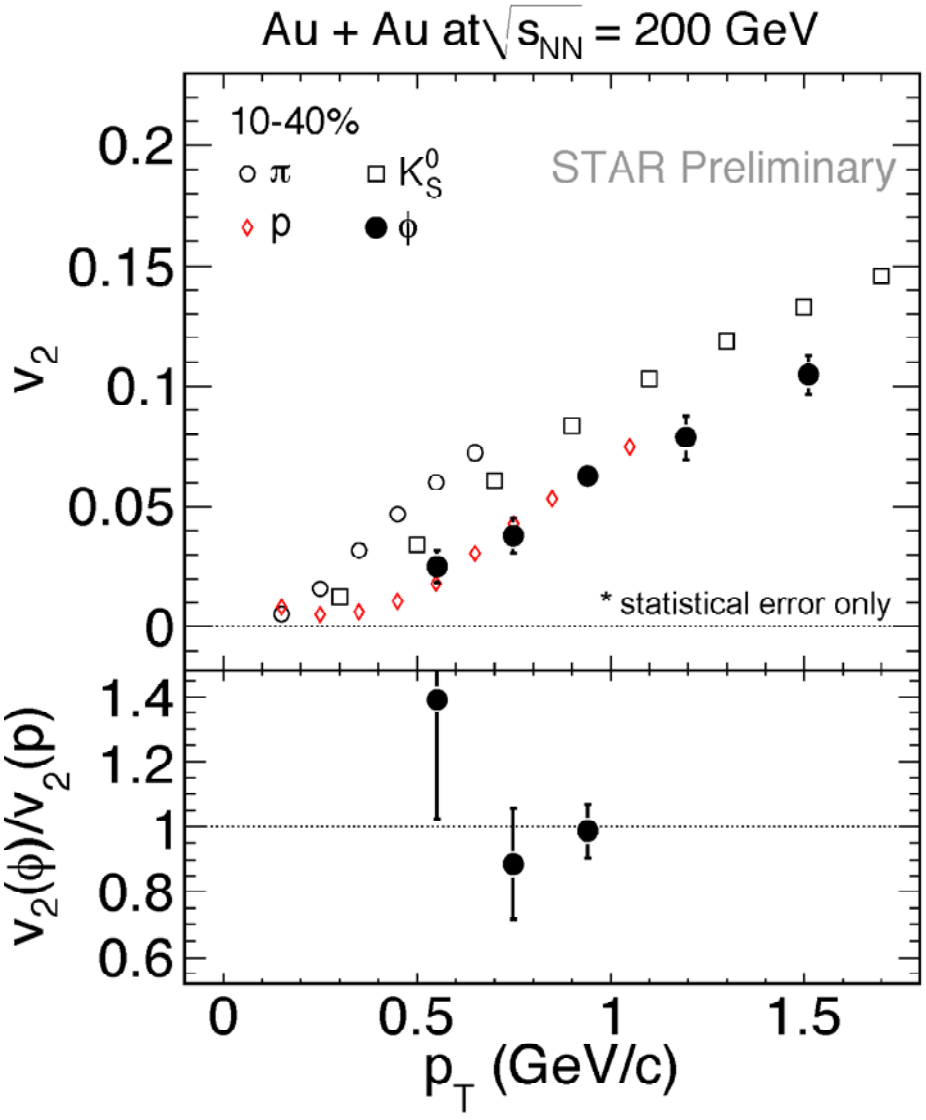


After hadronic rescattering

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

Low p_T v_2 of ϕ Mesons



- **Radial flow**
  - Driving force of mass ordering on v_2
- **Mass ordering from ideal hydrodynamics**
  - $v_2(\pi) > v_2(K) > v_2(p) > v_2(\phi)$
- **Data: $v_2(\phi) \sim v_2(p)$**
  - Effect of hadronic stage?

Summary

- STAR measured multi-strange hadrons v_2 up to Ω
  Large acceptance!

- Multi-strange hadrons v_2 of ϕ, Ξ and Ω
  v_2 increases from central to peripheral collisions

- Number of quark scaling
  Partonic collectivity!

- Mass ϕ > mass p, $v_2(\phi) \approx v_2(p)$ at $p_T < 1$ GeV/c
  More data are needed for studying ϕ v_2 at low p_T