

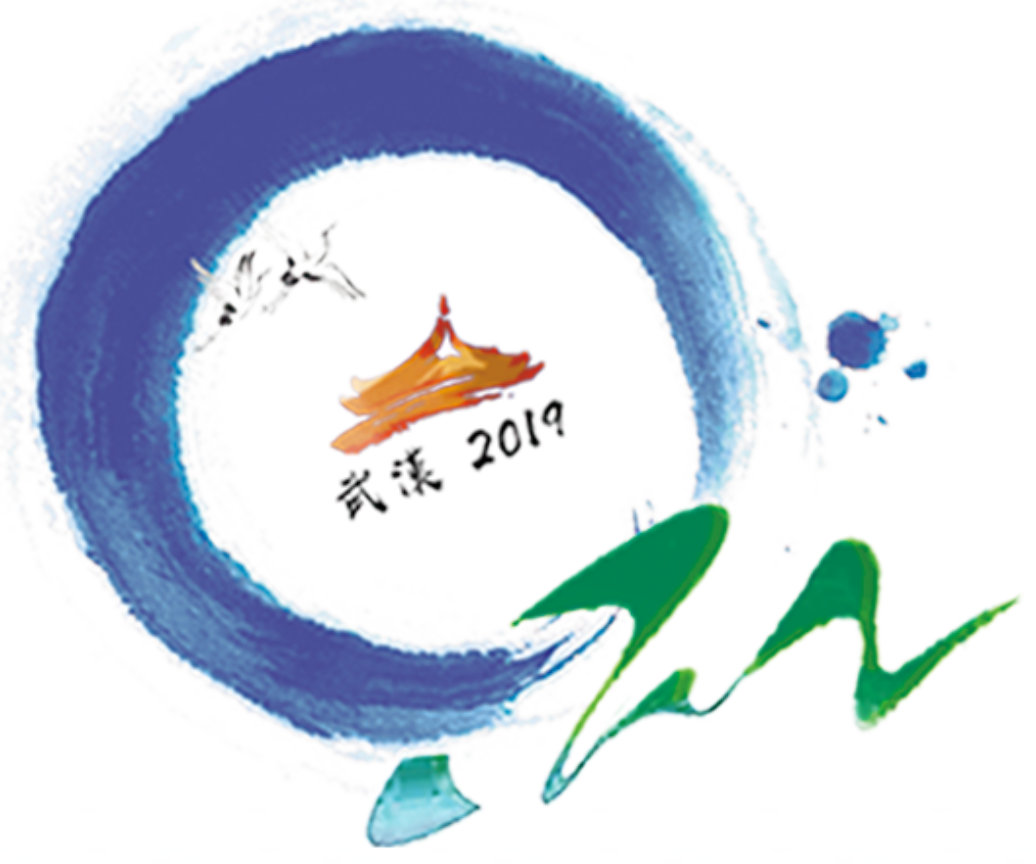


Event anisotropy v_2 in Au+Au collisions at

$\sqrt{s_{NN}} = 27$ and 54.4 GeV with STAR

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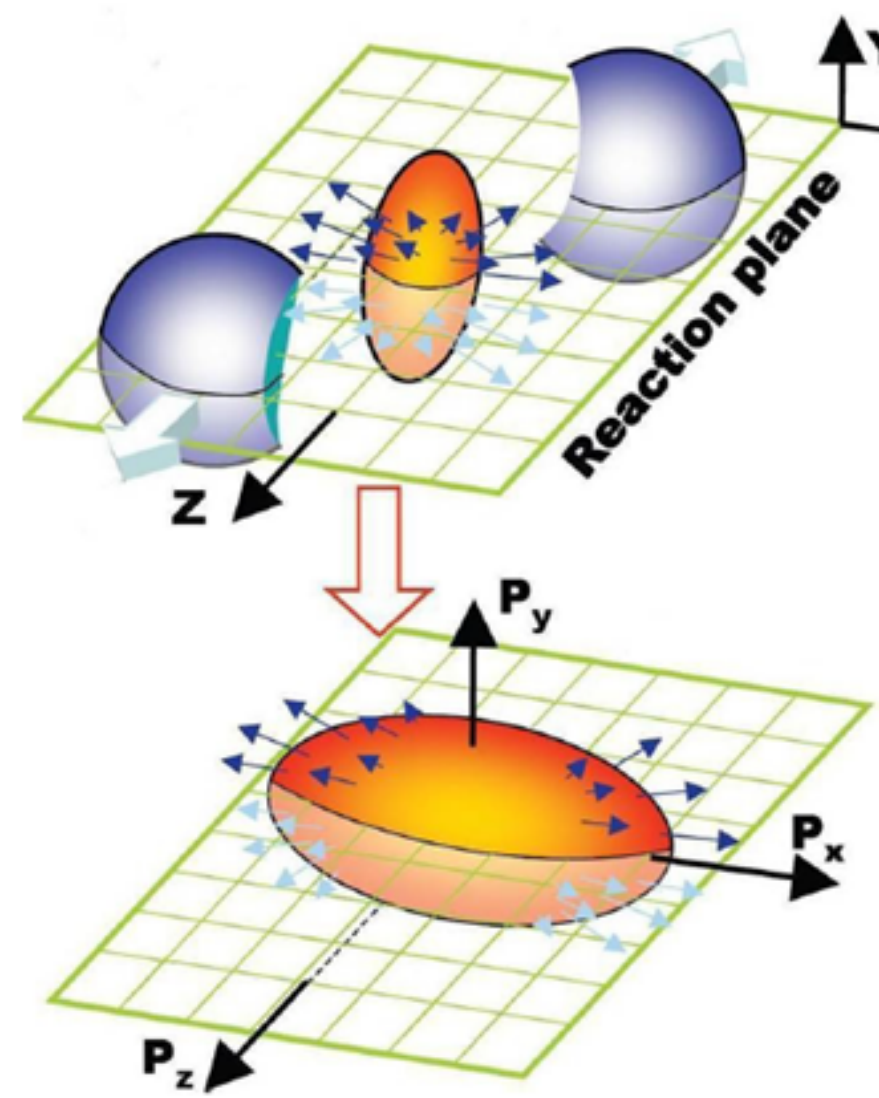
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Abstract:

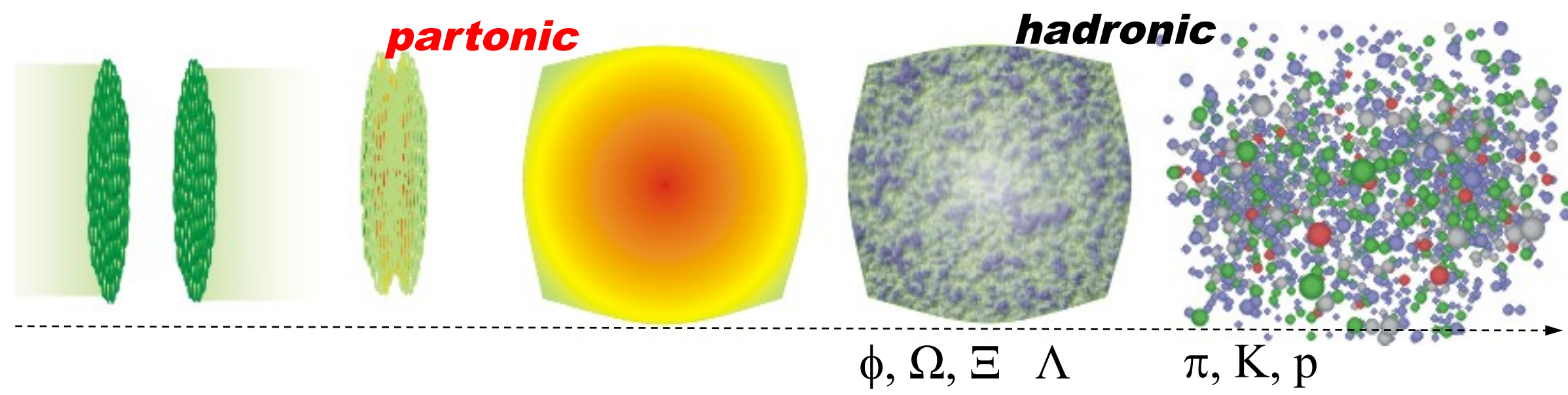
Elliptic flow is one of the most important observables in the relativistic heavy-ion collisions. It can provide us opportunities to study the evolution of the expanding system. In this poster, we will present elliptic flow of identified particles (π^\pm , K^\pm , $p(\bar{p})$, K_S^0 , $\Lambda(\bar{\Lambda})$, ϕ , $\Xi^- (\bar{\Xi}^+)$, $\Omega^- (\bar{\Omega}^+)$) at midrapidity ($\eta < 1$) as a function of transverse momentum in Au+Au collisions at $\sqrt{s_{NN}} = 27$ and 54.4 GeV. The ϕ -meson and multistrange hadrons have small hadronic cross sections and freeze-out early from the medium, therefore can be used to study the energy dependence of partonic and hadronic interactions. Furthermore, the mass ordering of v_2 is expected to be violated between proton and ϕ -meson in the low p_T range ($p_T < 1.5$ GeV/c) [1, 2] due to their different sensitivity to hadronic phase. These results provide us an opportunity to study the hadronic contributions on v_2 measurements as a function of collision energy and centrality.

Motivation:



- Initial spatial anisotropy in coordinate space exists in non-central heavy-ion collisions.
- Density gradients and interactions among constituents lead to conversion from initial spatial anisotropy to final momentum-space anisotropy.

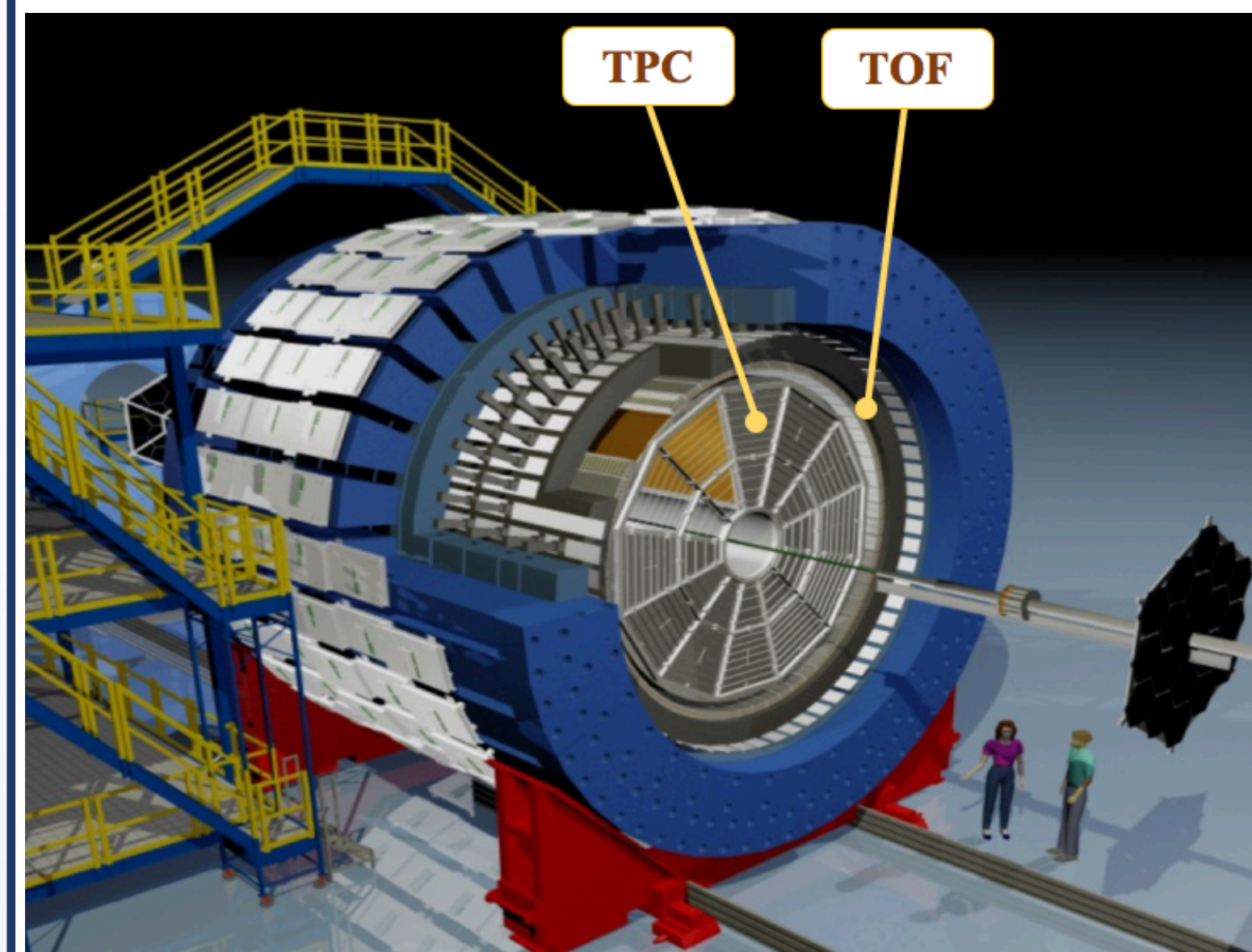
$$E \frac{d^3N}{d^3p} = \frac{1}{2\pi} \frac{d^2N}{p_T dp_T dy} \left(1 + \sum_{n=1}^{\infty} 2v_n \cos(n(\phi - \Psi_{RP})) \right) \quad v_2 = \langle \cos(2(\phi - \Psi_{RP})) \rangle$$



Multistrange Hadrons and ϕ -meson

- Less sensitive to late hadronic rescatterings.
- Freeze-out earlier than other light hadrons.

Experimental Setup:



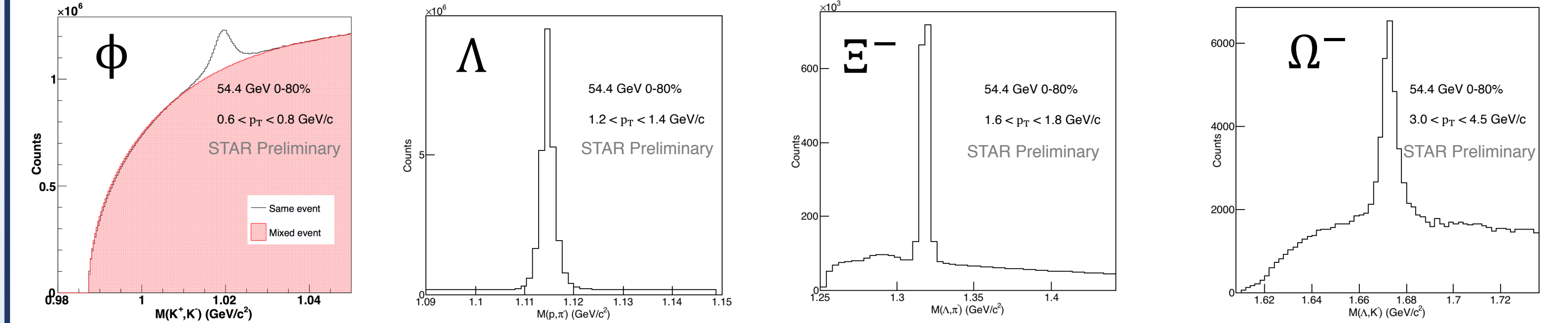
The STAR Detector

- Excellent particle identification.
- Large acceptance at midrapidity.
- Full azimuthal coverage.

Data Sets

$\sqrt{s_{NN}}$ (GeV)	Events (10^6)	Year
27	1000	2018
54.4	1200	2017

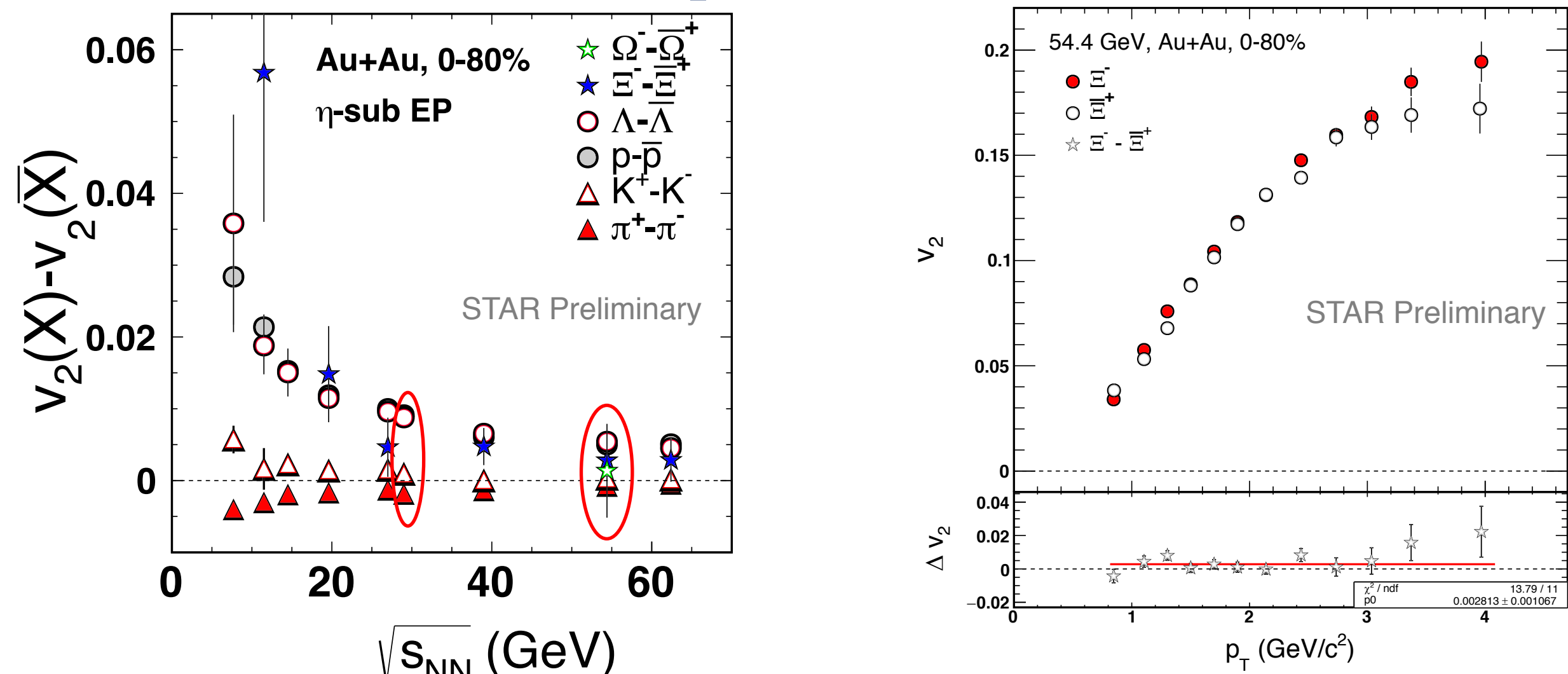
Particle Identification



v_2 Extraction

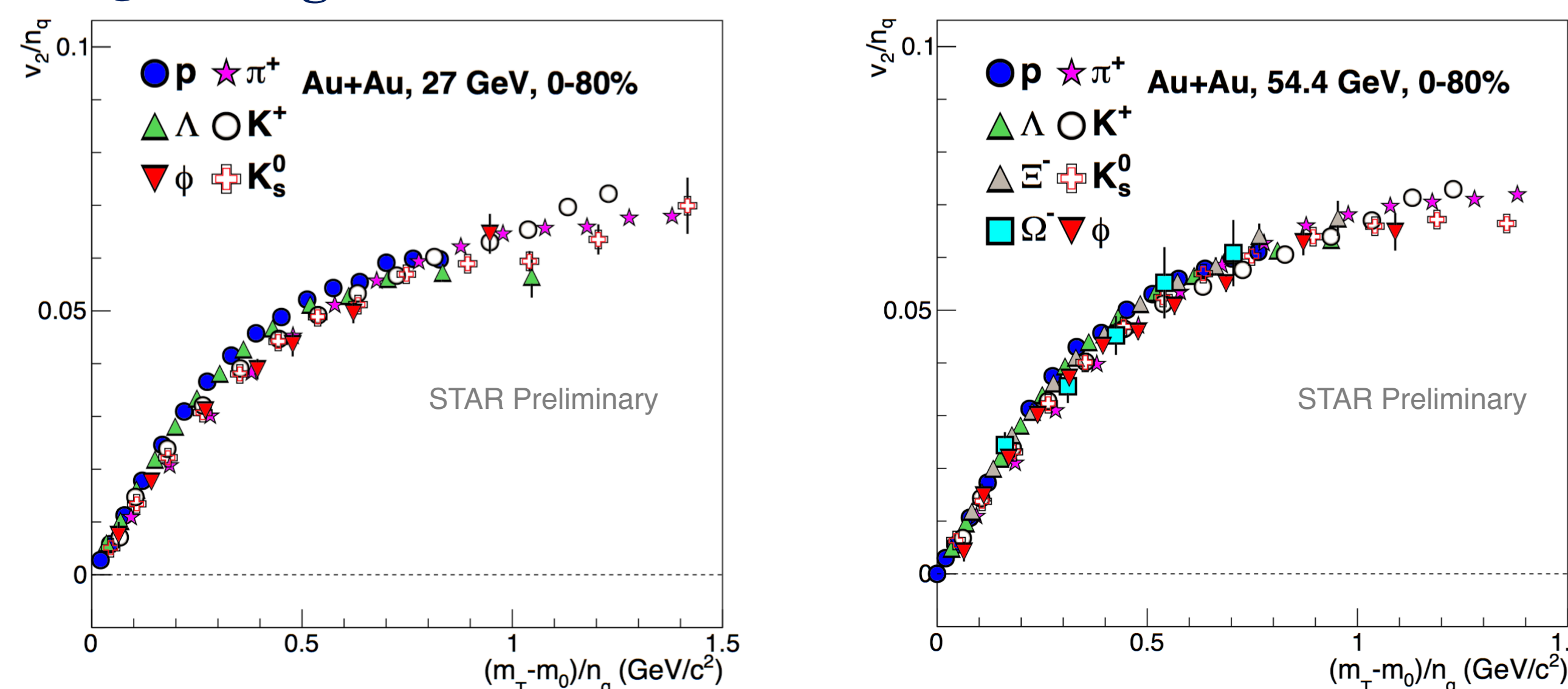
- π , K , p , ϕ -meson: event plane method.
- Weak decay particles (K_S^0 , Λ , Ξ , Ω): invariant mass method.

Particle vs. Antiparticle v_2 :



- Significant difference of baryon and antibaryon v_2 observed at low energy [3].
- New data from 27 GeV and 54.4 GeV are consistent with the energy dependence curve.

NCQ Scaling Test:

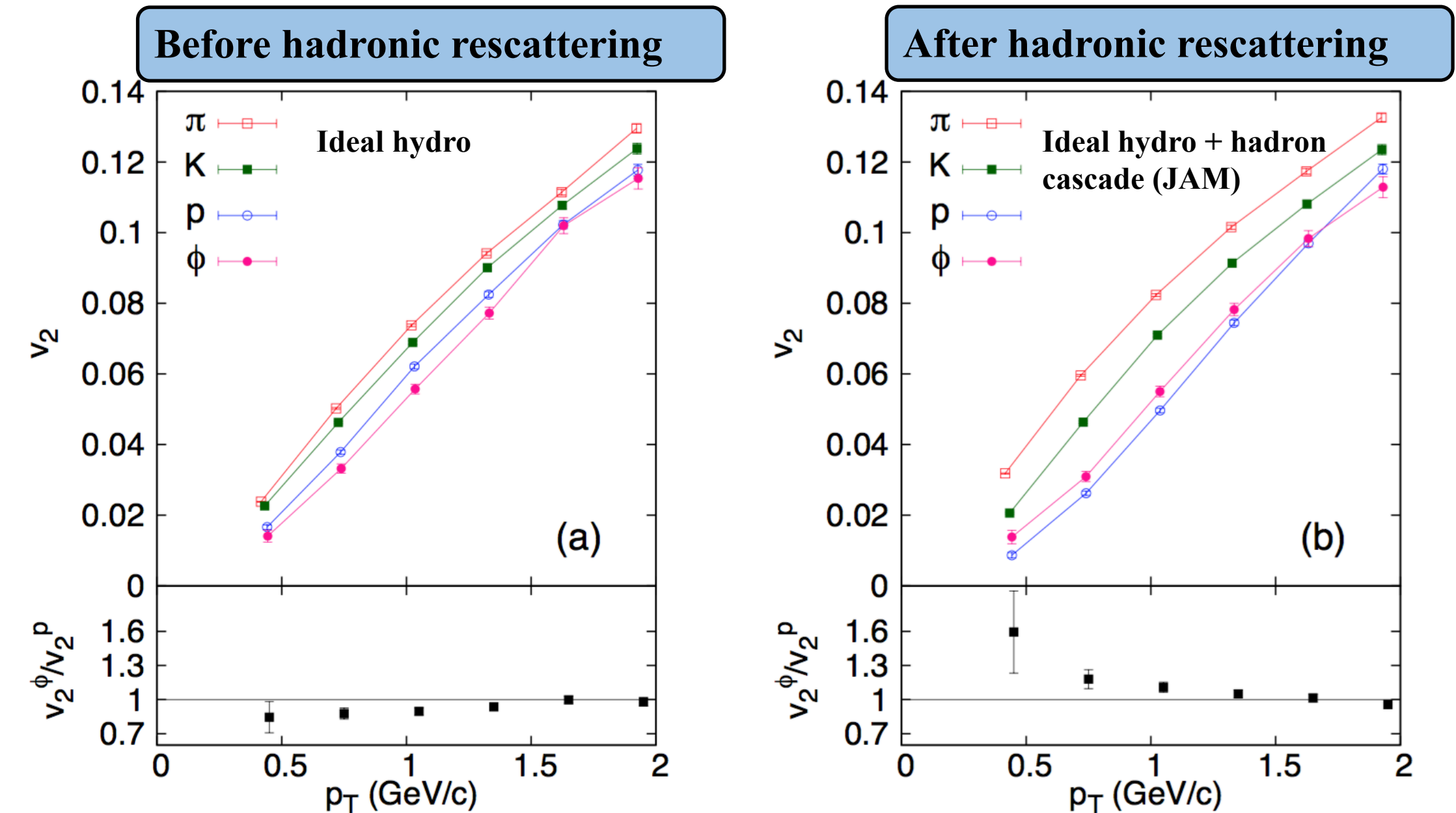


- NCQ scaling for measured identified particles at 27 and 54.4 GeV.

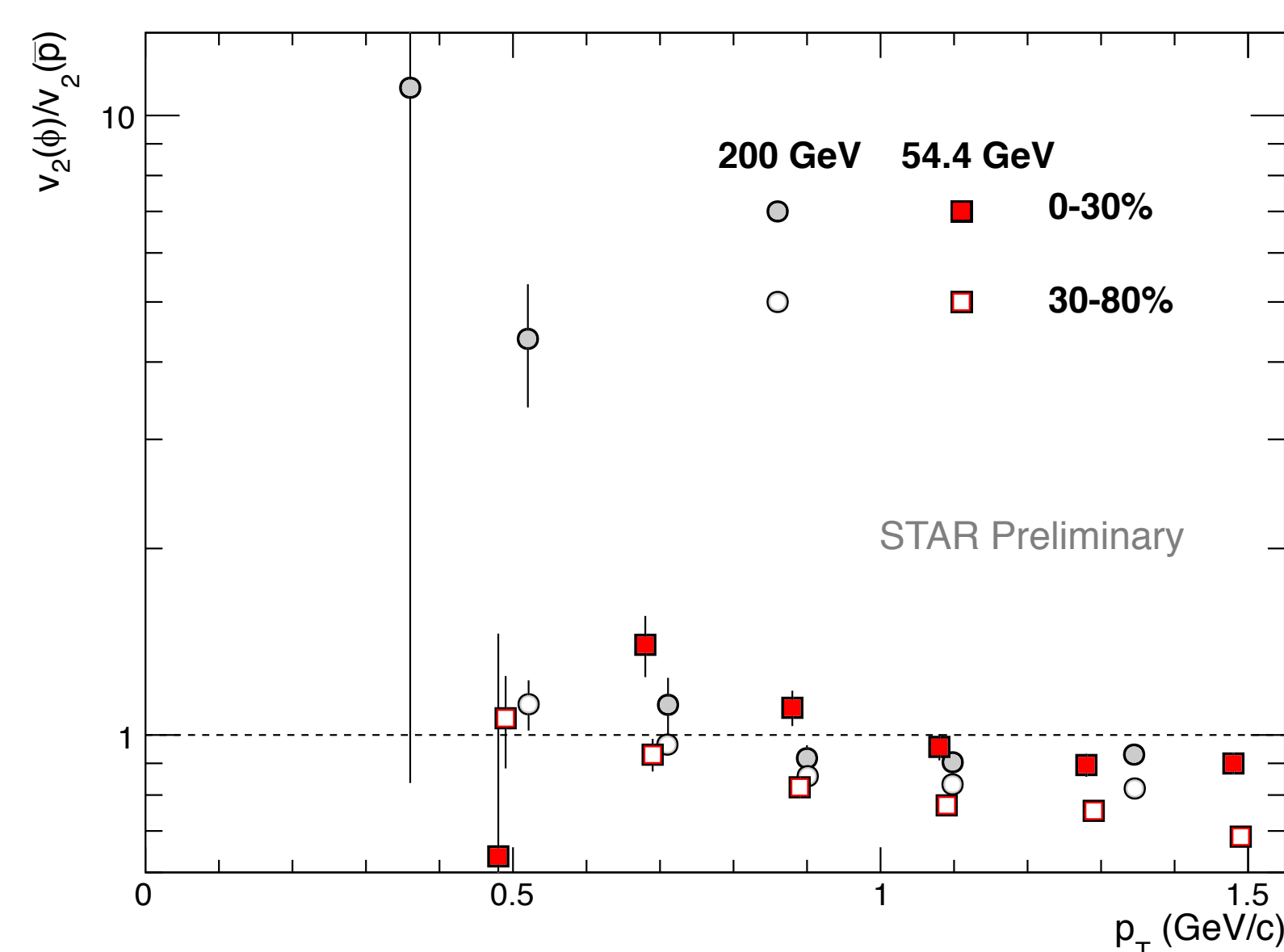
Summary:

- We have measured the v_2 of identified particles at 27 and 54.4 GeV.
- The difference between particle and antiparticle v_2 at 27 and 54.4 GeV is consistent with the energy dependence curve.
- Mass ordering violation between proton and ϕ -meson v_2 and its centrality dependence are observed at 54.4 GeV.

Mass Ordering Violation:



- Ideal hydrodynamics + hadron cascade (JAM model) calculation [1, 2] suggests mass ordering violation between proton and ϕ -meson v_2 at low p_T region.
- The effect of late hadronic interactions on the proton v_2 .



- Mass ordering violation between proton and ϕ -meson v_2 at 54.4 GeV is observed.
- Clear centrality dependence for both 54.4 and 200 GeV [4].
- \bar{p} v_2 values are used at lower energy as they are all produced.

References:

- [1] S. Takeuchi, T. Hirano et al., Phys. Rev. C **92**, 044907 (2015)
- [2] T. Hirano, U. Heinz et al., Phys. Rev. C **77**, 044909 (2008)
- [3] L. Adamczyk et al. (STAR Collaboration), Phys. Rev. Lett. **110**, 142301 (2013)
- [4] L. Adamczyk et al. (STAR Collaboration), Phys. Rev. Lett. **116**, 062301 (2016)