Searching for the Turn-Off Signature of the QGP via Anisotropic Flow Measurements at RHIC

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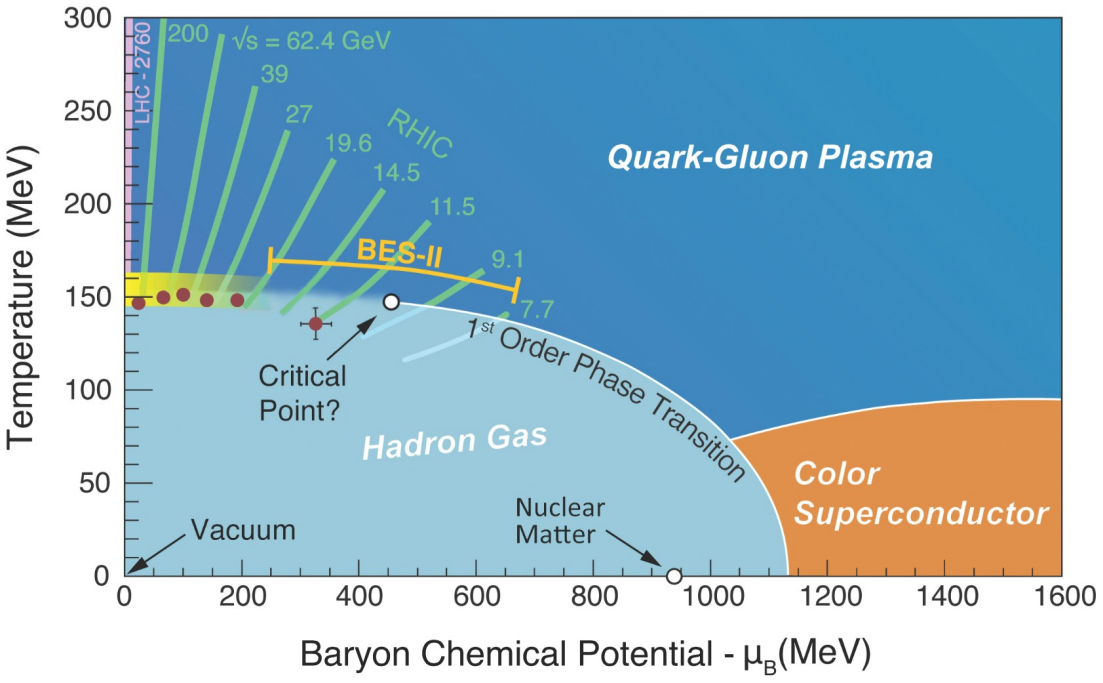
Introduction

Phase diagram of hadron-QGP phase transition



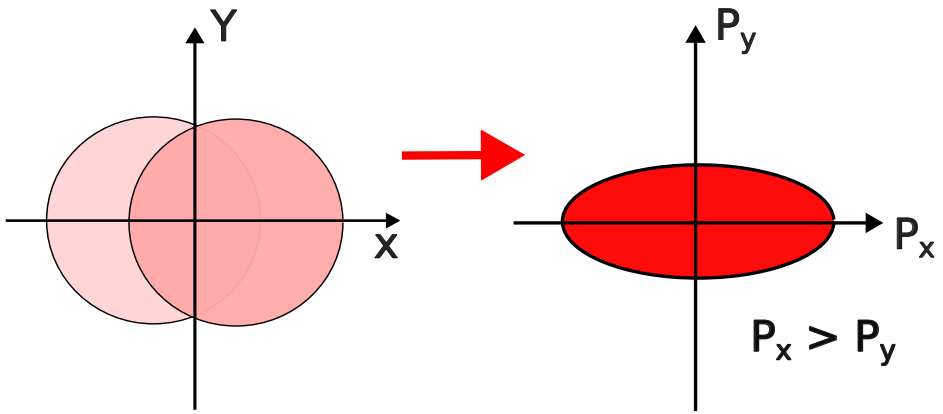
Goals of the STAR experiment

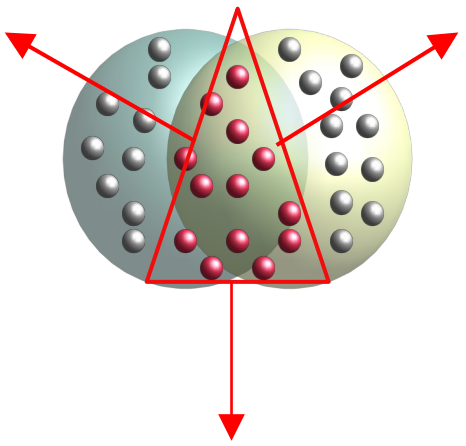
- **Search for the critical point.**
- **Search for the 1st order phase transition.**
- **Search for the turn-off signature of QGP.**

- **Scan the QCD phase diagram in the context of partonic collectivity by measuring v_2 and v_3 of identified hadrons.**

Introduction

Collective expansion of the medium: **Flow**





Elliptic flow: Initial spatial spatial anisotropy is the main reason.
Triangular flow: Geometry fluctuation due to fluctuation in the position of the participant nucleons.

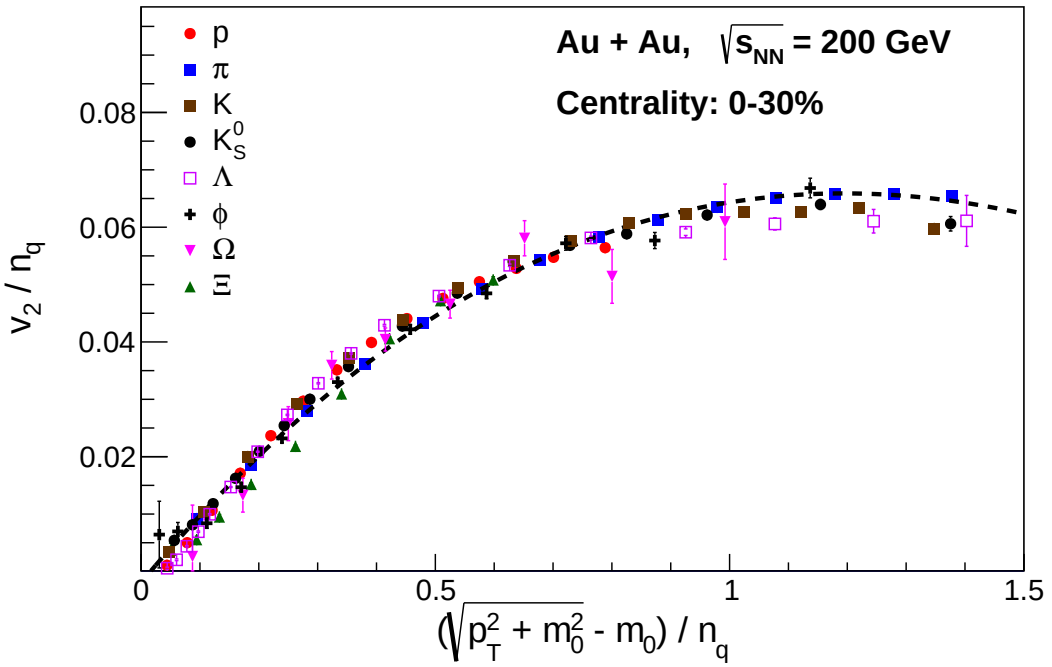
$$\frac{dN}{d\phi} = \frac{N_0}{2\pi}\left[1 + 2v_1\cos(\phi - \Psi_1) + 2v_2\cos(\phi - \Psi_2) + 2v_3\cos(\phi - \Psi_3) + ...\right]$$

Phys. Rev. C 58, 1671 (1998)

Introduction

Constituent quark scaling in v_2 : **Signature of collectivity**

Phys. Rev. Lett. 116 (2016) 62301



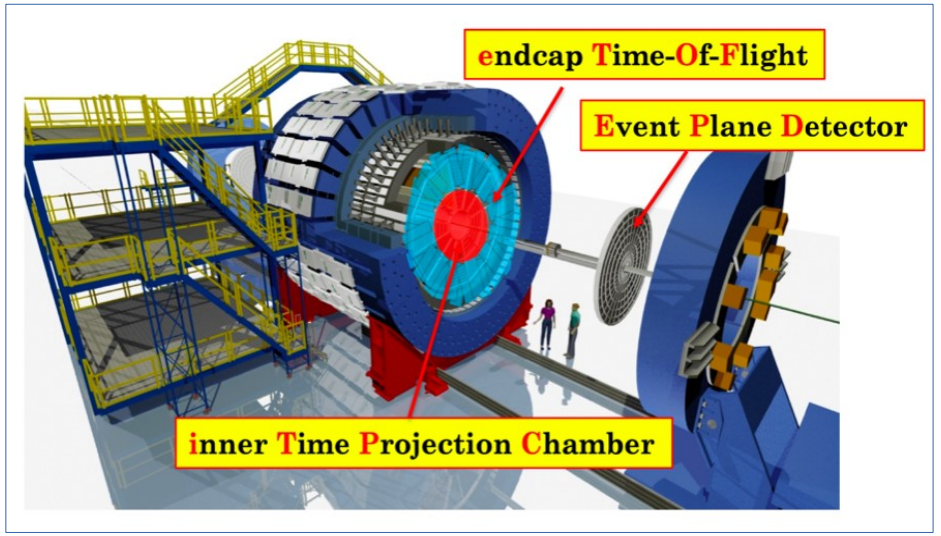
$$v_2^H(p_T) = n_q \times v_2^q(p_T/n_q)$$

NCQ scaling at 200 GeV:

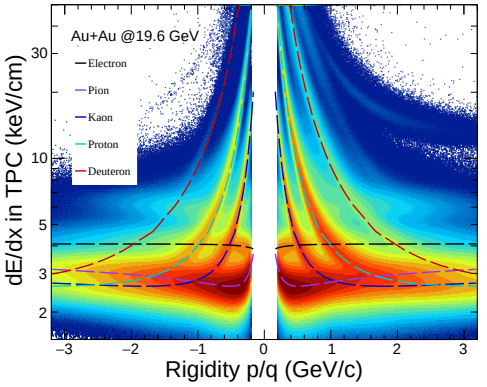
- Partonic collectivity in the produced medium.
- Quark recombination model of hadronization.

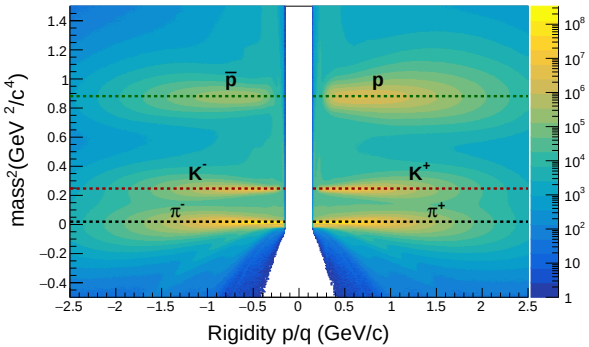
Does this scaling persist at lower collision energies? If so, up to what minimum energy does it remain valid?

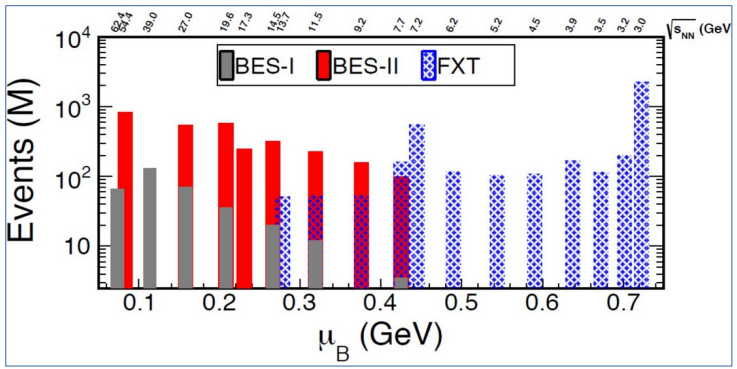
STAR detectors and BES-II upgrades



Particle identification



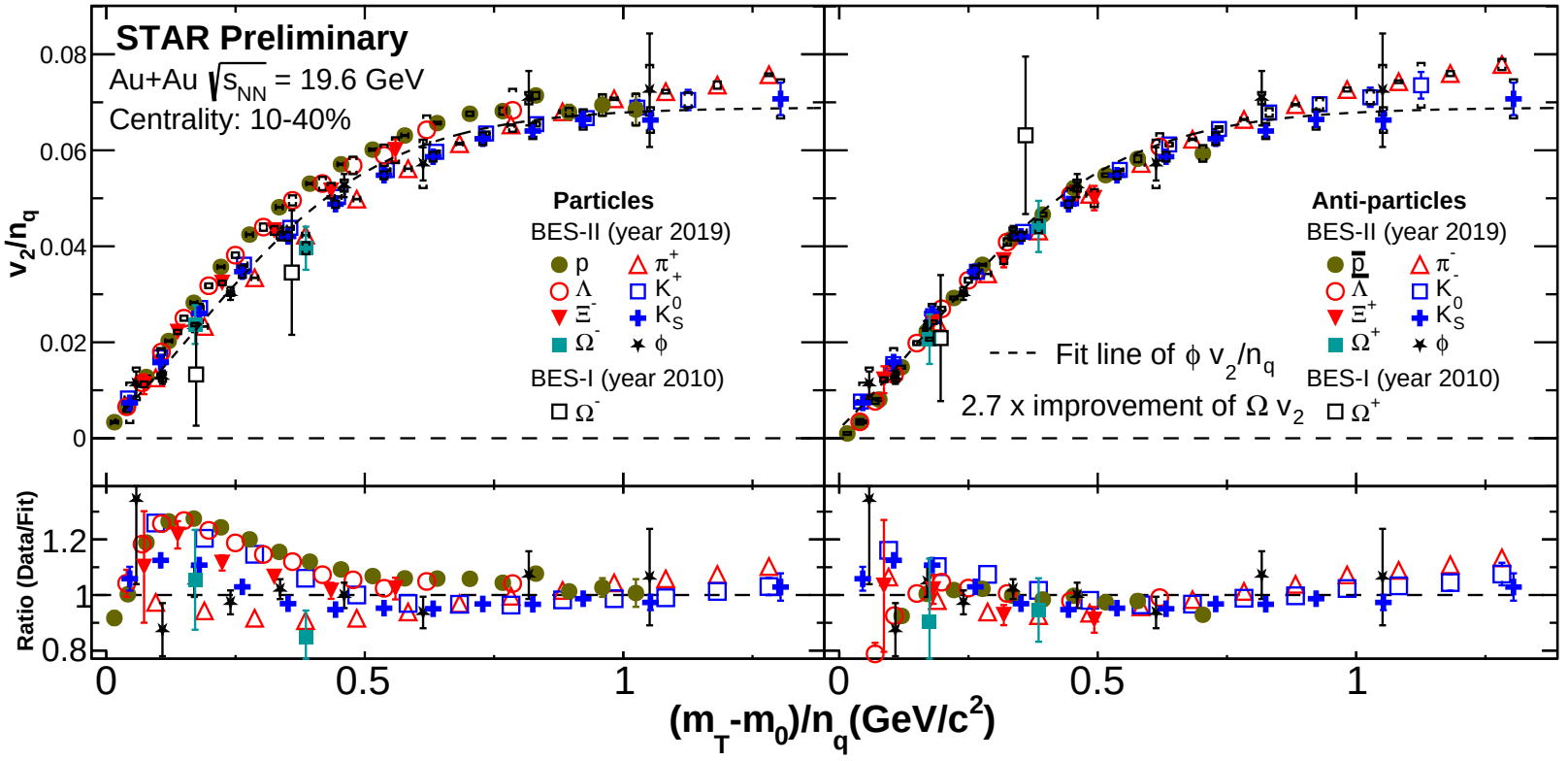




Major upgrades in BES-II:

- **iTPC upgrade:** Larger η coverage (-1.5 < η < 1.5) and better dE/dx and momentum resolution.
- Dedicated Event Plane Detector (EPD) (2.1 < |η| < 5.1)
- eToF: PID at larger rapidity

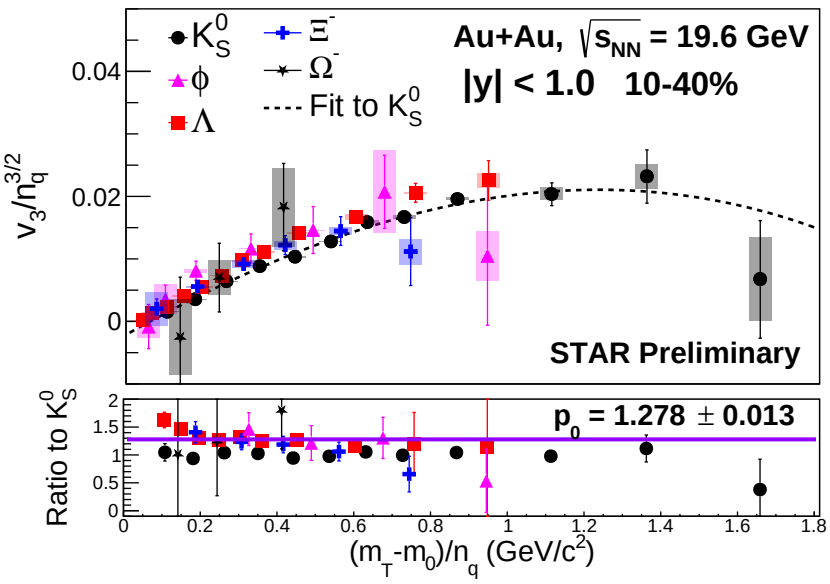
Results: NCQ scaling in v_2 at 19.6 GeV

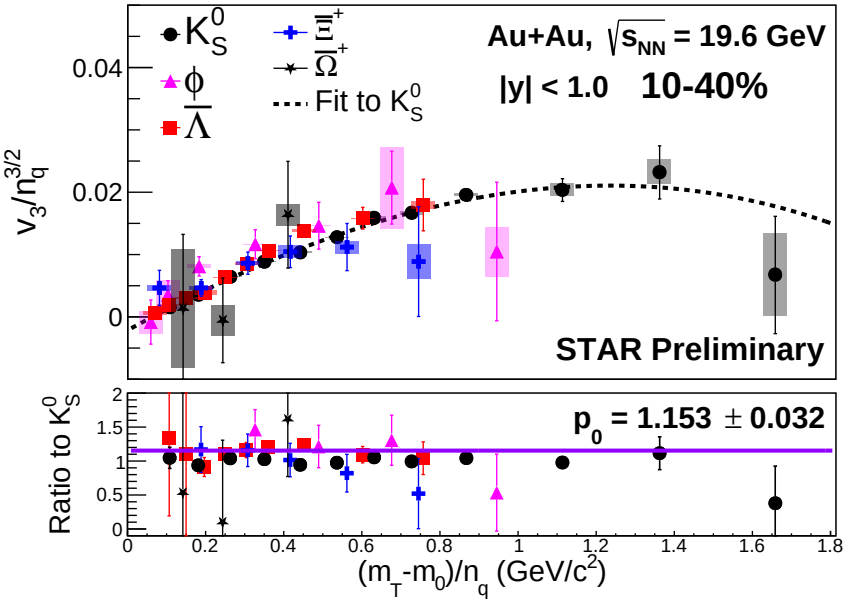


The NCQ scaling holds within 20% for particles and within 10% for antiparticles
Better scaling for antiparticles: might be the effect of transported quarks in particles.

Signature of partonic degrees of freedom in the produced medium.

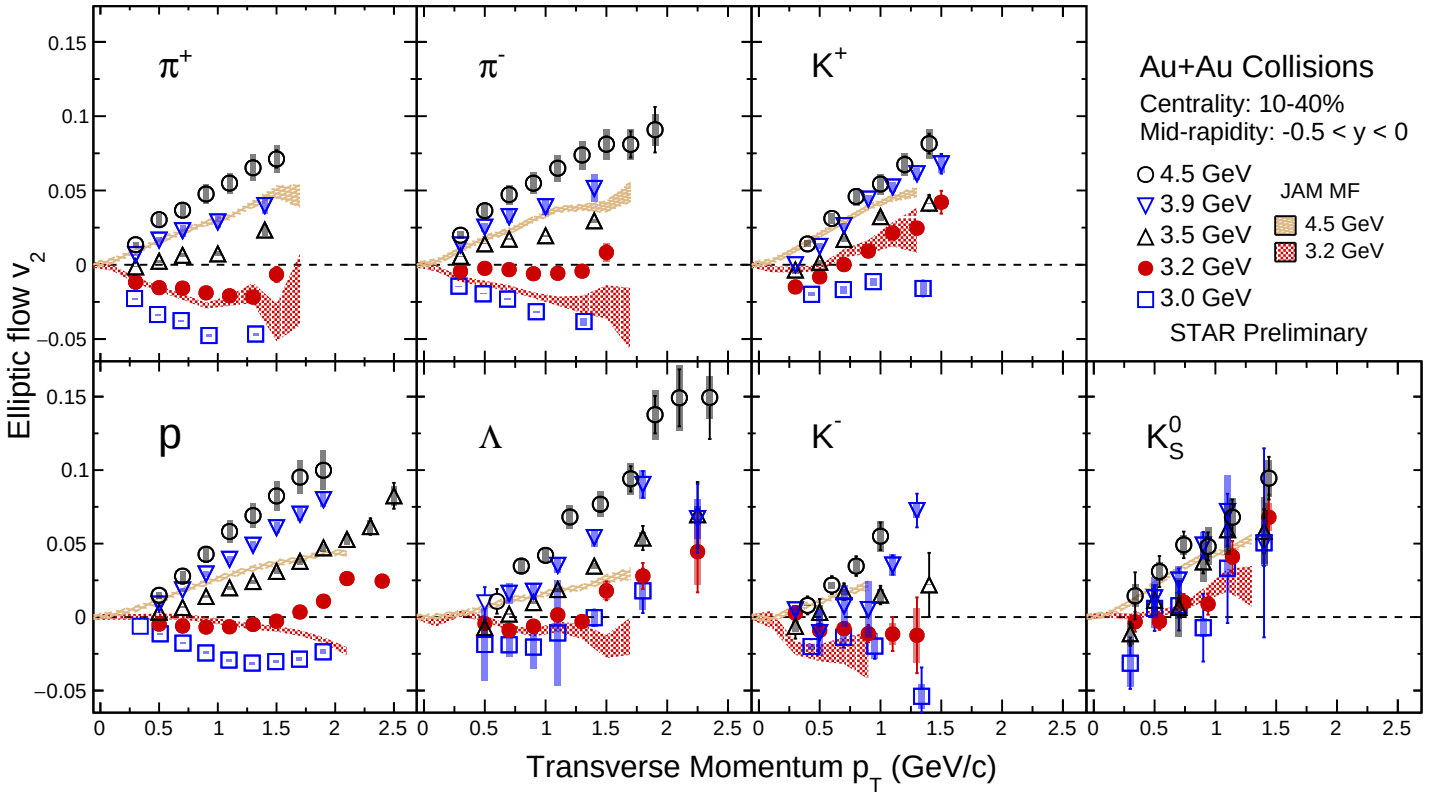
Results: NCQ scaling in v_3 at 19.6 GeV





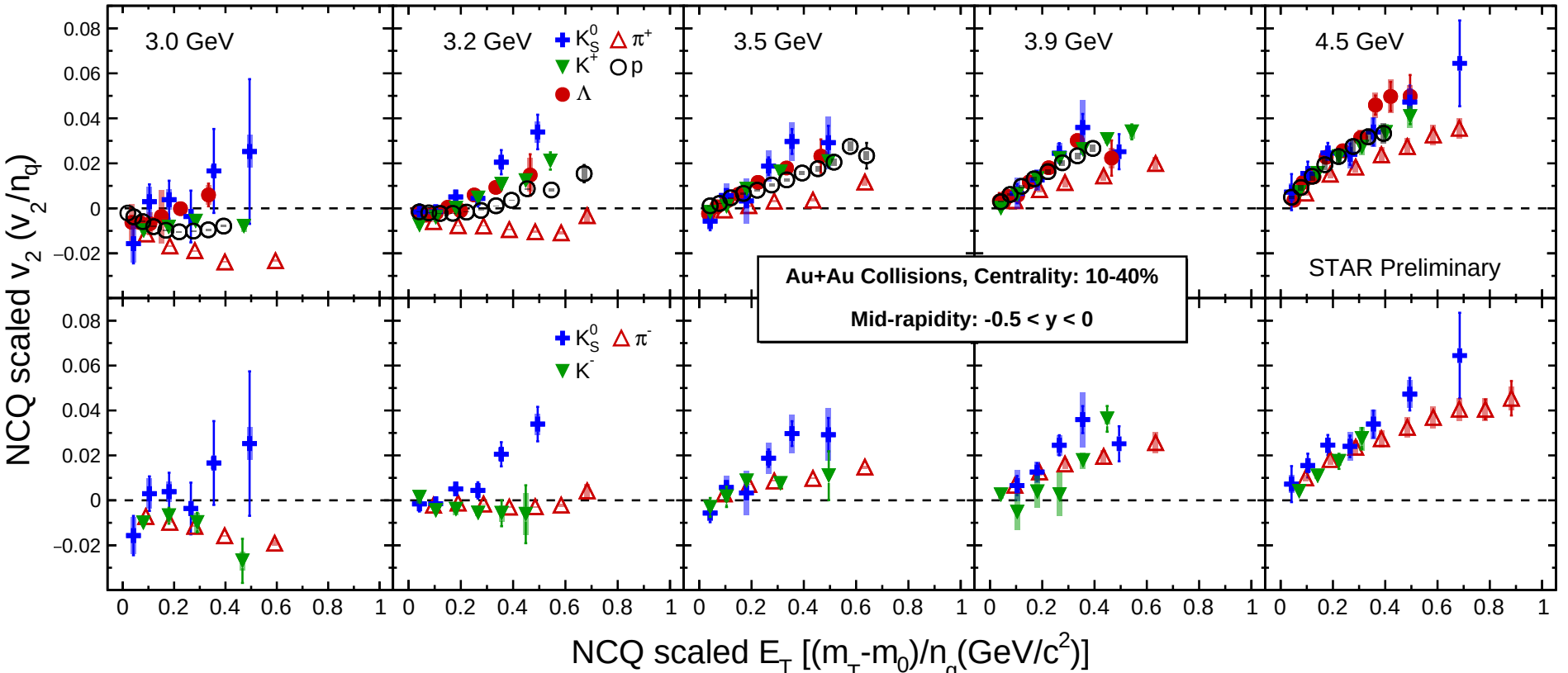
The NCQ scaling for v_3 holds within 30% for particles and within 15% for antiparticles
Better scaling for antiparticles.

Results: Energy dependence of v_2 at FXT experiments



- Change of sign of v_2 from positive to negative below $\sqrt{s_{NN}} < 3.5$ GeV: **spectator shadowing effect**
- JAM + baryonic mean field describe the 3.2 GeV data while underestimate 4.5 GeV data.

Results: Energy dependence of NCQ scaling at FXT experiments



NCQ scaling is broken completely below $\sqrt{s_{NN}}$ < 3.5 GeV : **hadronic dominance of the produced medium.**

Summary

- Measurements of v_2 and v_3 for identified hadrons are presented in Au+Au collisions at $\sqrt{s_{NN}}$ = 19.6 GeV. Additionally, these measurements are extended to baryon density region in Au+Au collisions using fixed target experiments at $\sqrt{s_{NN}}$ = 3.0-4.5 GeV.
- NCQ scaling holds for v_2 and v_3 at $\sqrt{s_{NN}}$ = 19.6 GeV indicating the presence of partonic degrees of freedom.
- NCQ scaling completely disappears at $\sqrt{s_{NN}}$ < 3.5 GeV indicating the presence of hadronic dominance in the produced medium at these lower energy regimes.

Thank you...