

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

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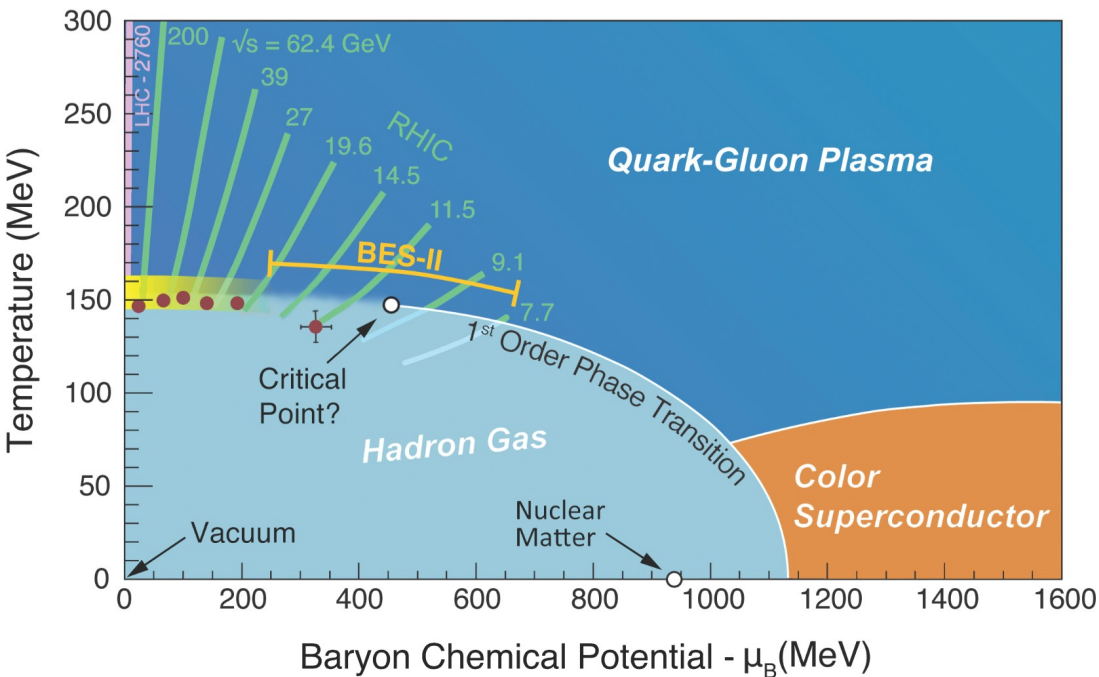
(for the STAR collaboration)

Indian Institute of Science Education and Research (IISER) Berhampur

10th Asian Triangle Heavy-Ion Conference - ATHIC 2025



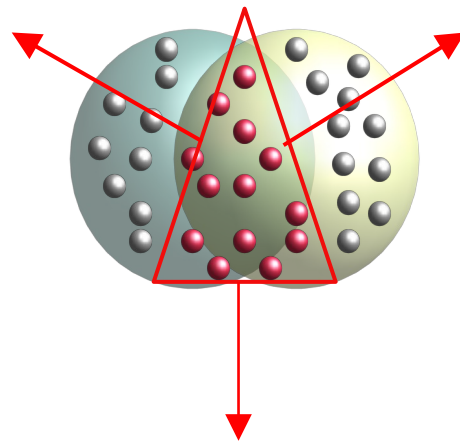
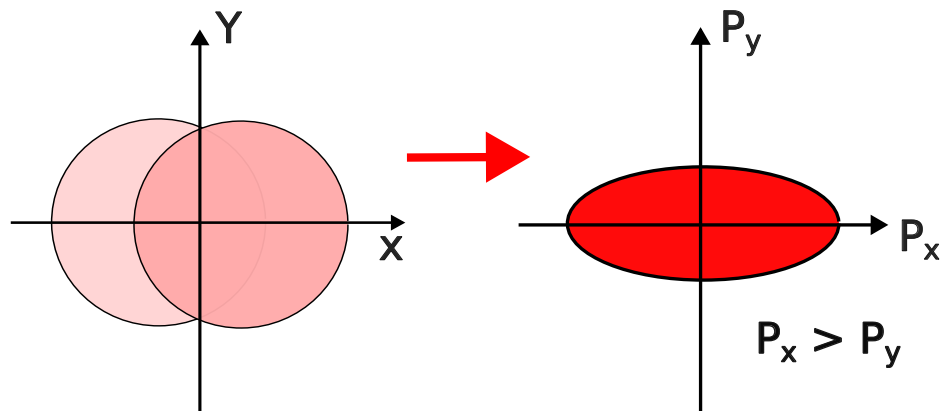
QCD phase diagram



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.
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- Study the disappearance of partonic collectivity via flow measurements at various beam energies (proxy for baryon chemical potential)

Collective expansion of the medium: **Flow**



Elliptic flow: Driven by initial spatial anisotropy.

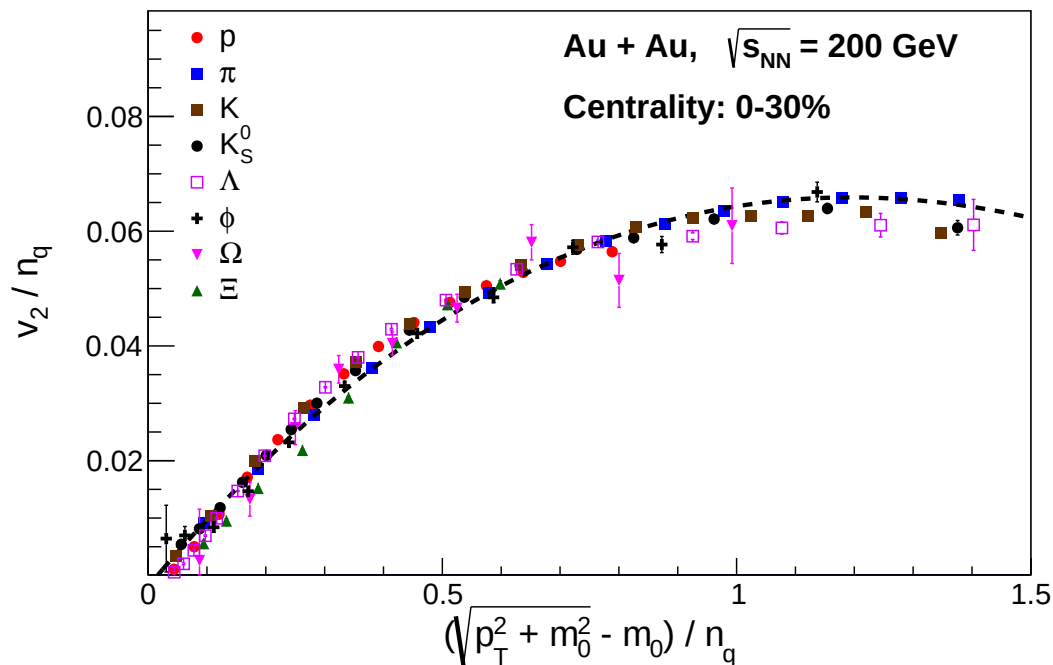
Triangular flow: Driven by the fluctuation in the position of the participant nucleons.

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

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Constituent quark scaling in v_2 : Signature of partonic collectivity

Phys. Rev. Lett. 116 (2016) 62301

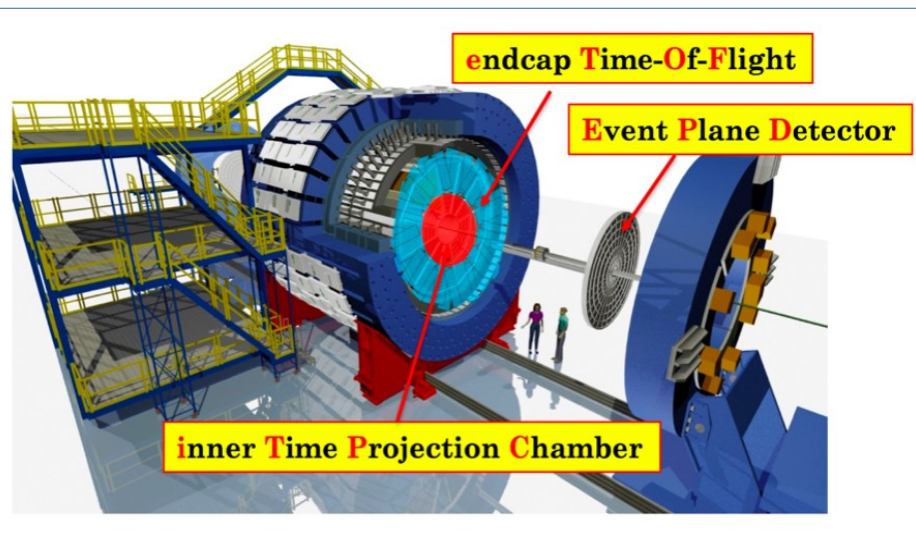


$$v_2^H(p_T) = n_q \times v_2^q(p_T/n_q)$$

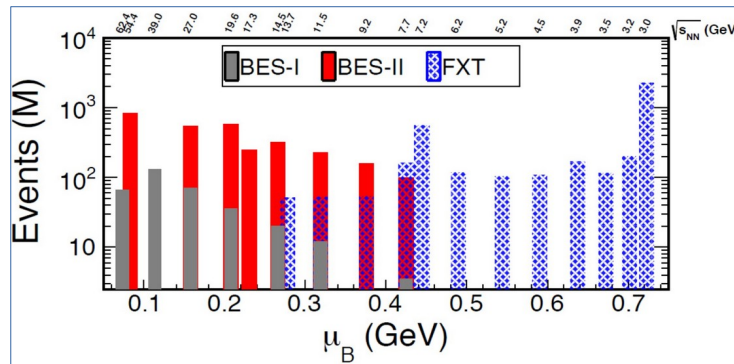
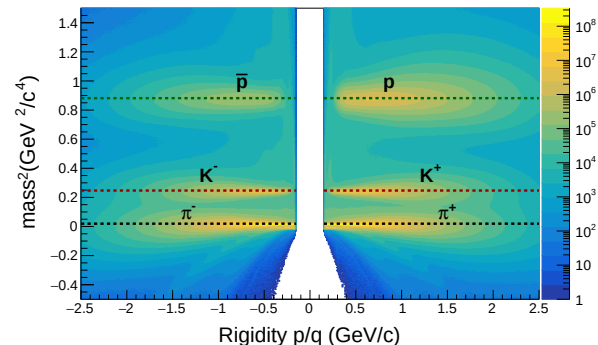
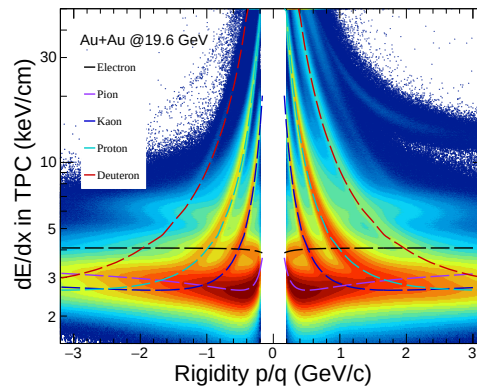
NCQ scaling at 200 GeV:

- Signature of 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?

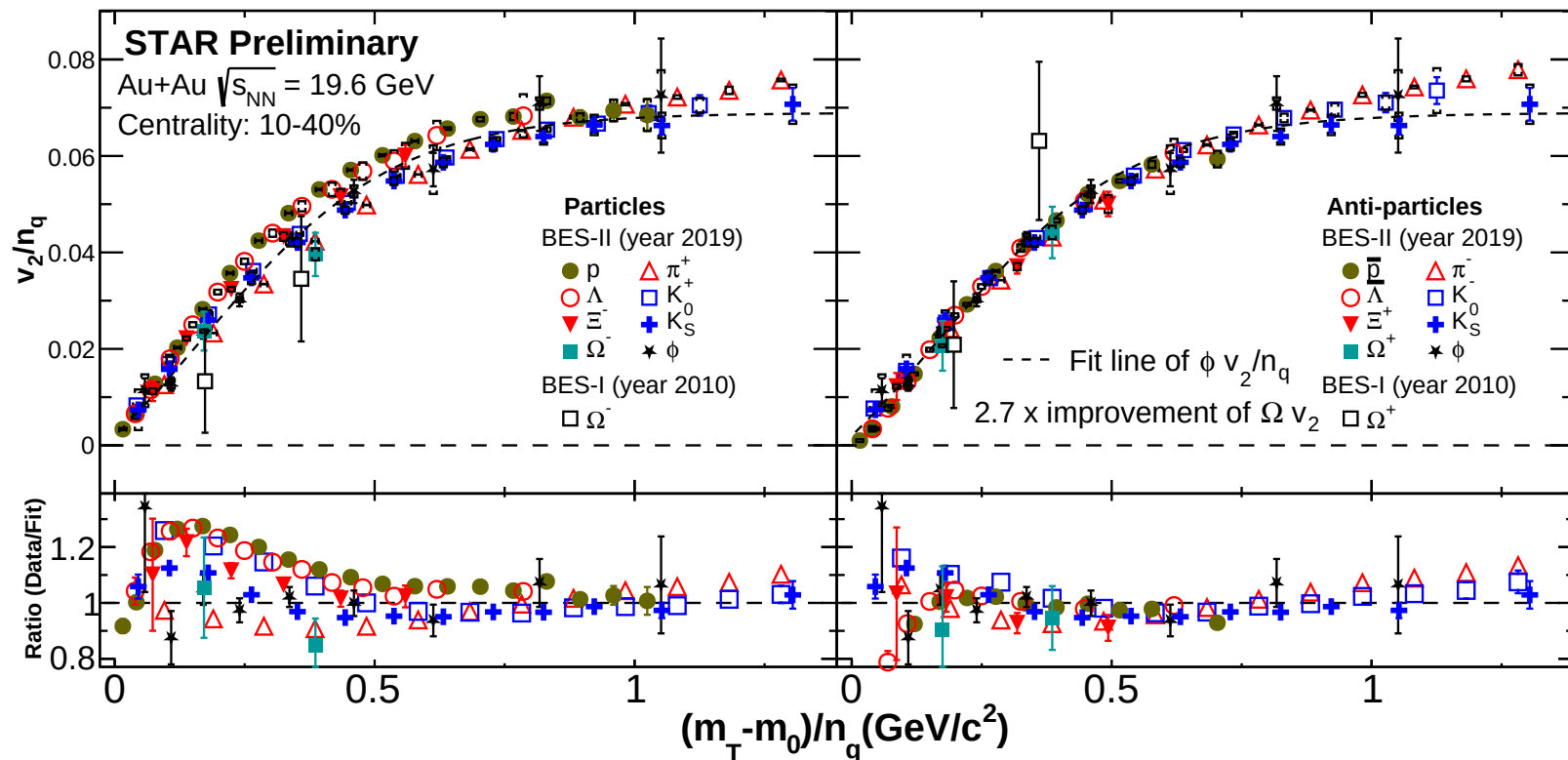


Particle identification

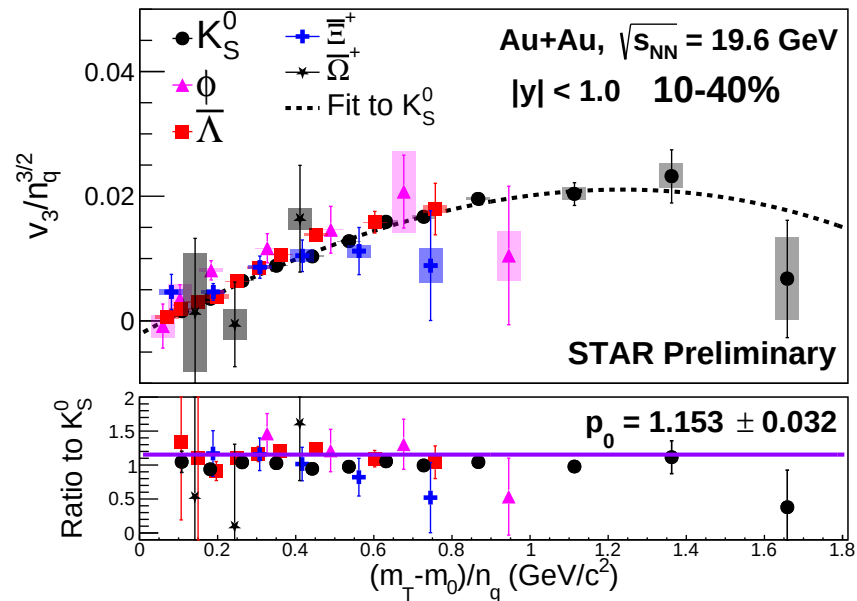
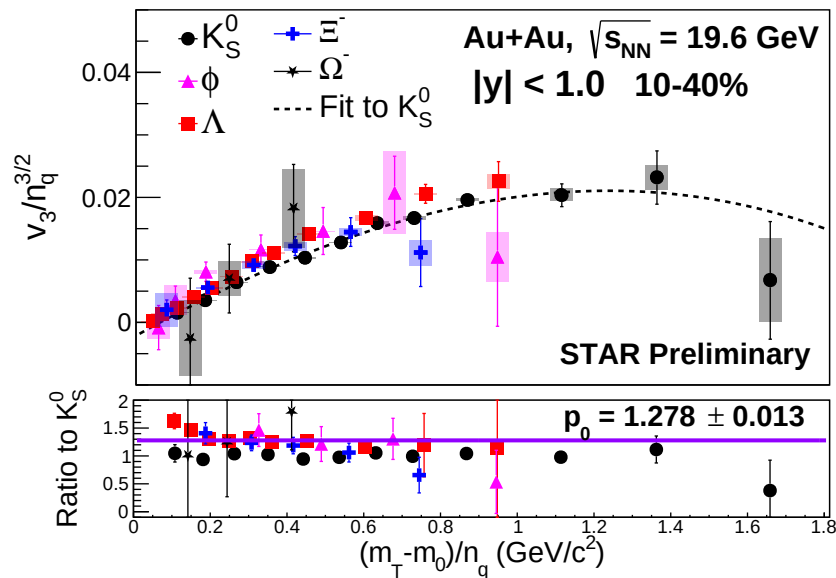


Major upgrades in BES-II:

- **iTPC upgrade:** Larger η coverage ($-1.5 < |\eta| < 1.5$) and better dE/dx and momentum resolution.
- Dedicated Event Plane Detector (EPD) ($2.1 < |\eta| < 5.1$)
- eToF: PID at larger rapidity ($1.1 < \eta < 1.5$)

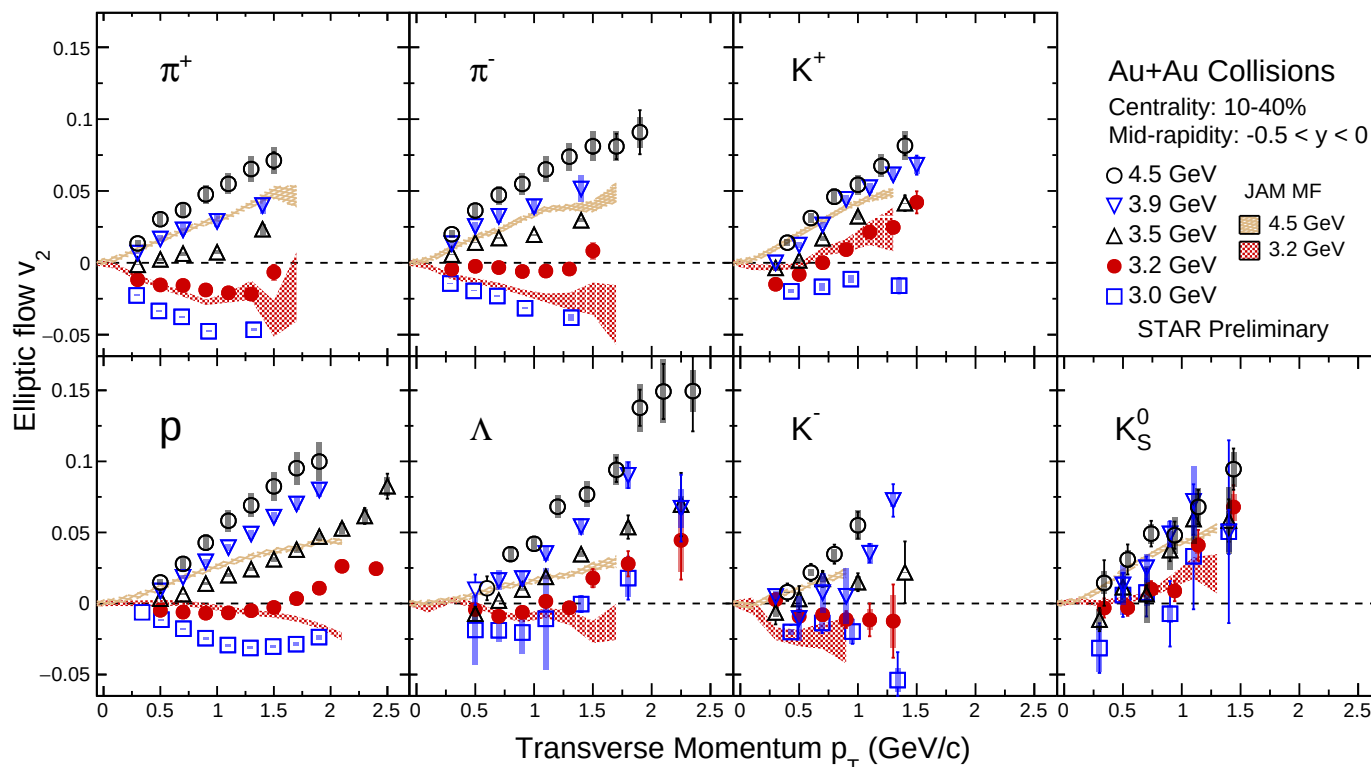


The NCQ scaling holds within 20% for particles and within 10% for antiparticles
Better scaling for antiparticles: might be the effect of transported quarks in particles.
Signature of partonic degrees of freedom in the produced medium.



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 $\sqrt{s_{NN}} = 3.0 - 4.5$ GeV

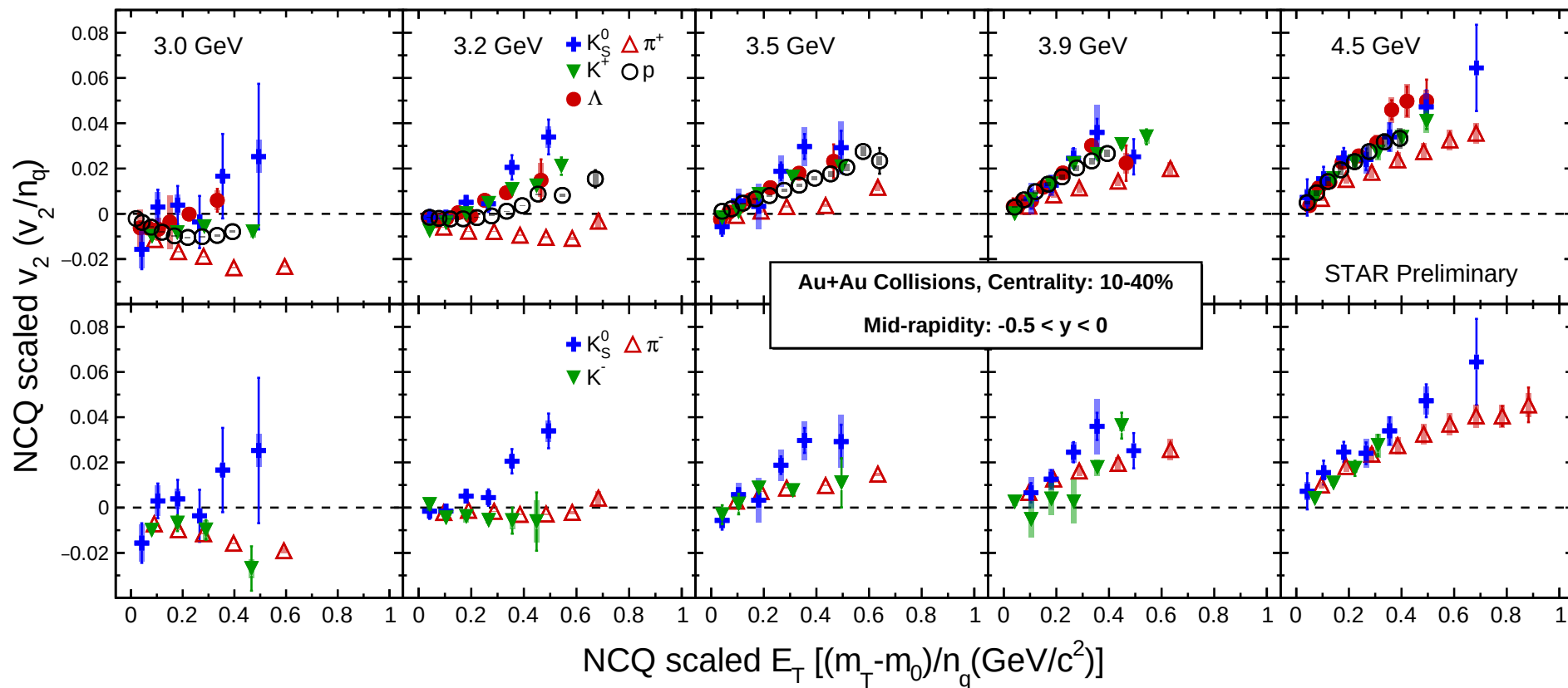


- Change of sign of v_2 from positive to negative below $\sqrt{s_{NN}} < 3.5$ GeV: **spectator shadowing effect**
- JAM + baryonic mean field describe the 3.2 GeV data while underestimate 4.5 GeV data.



Results: Energy dependence of NCQ scaling at $\sqrt{s_{NN}} = 3.0 - 4.5$ GeV

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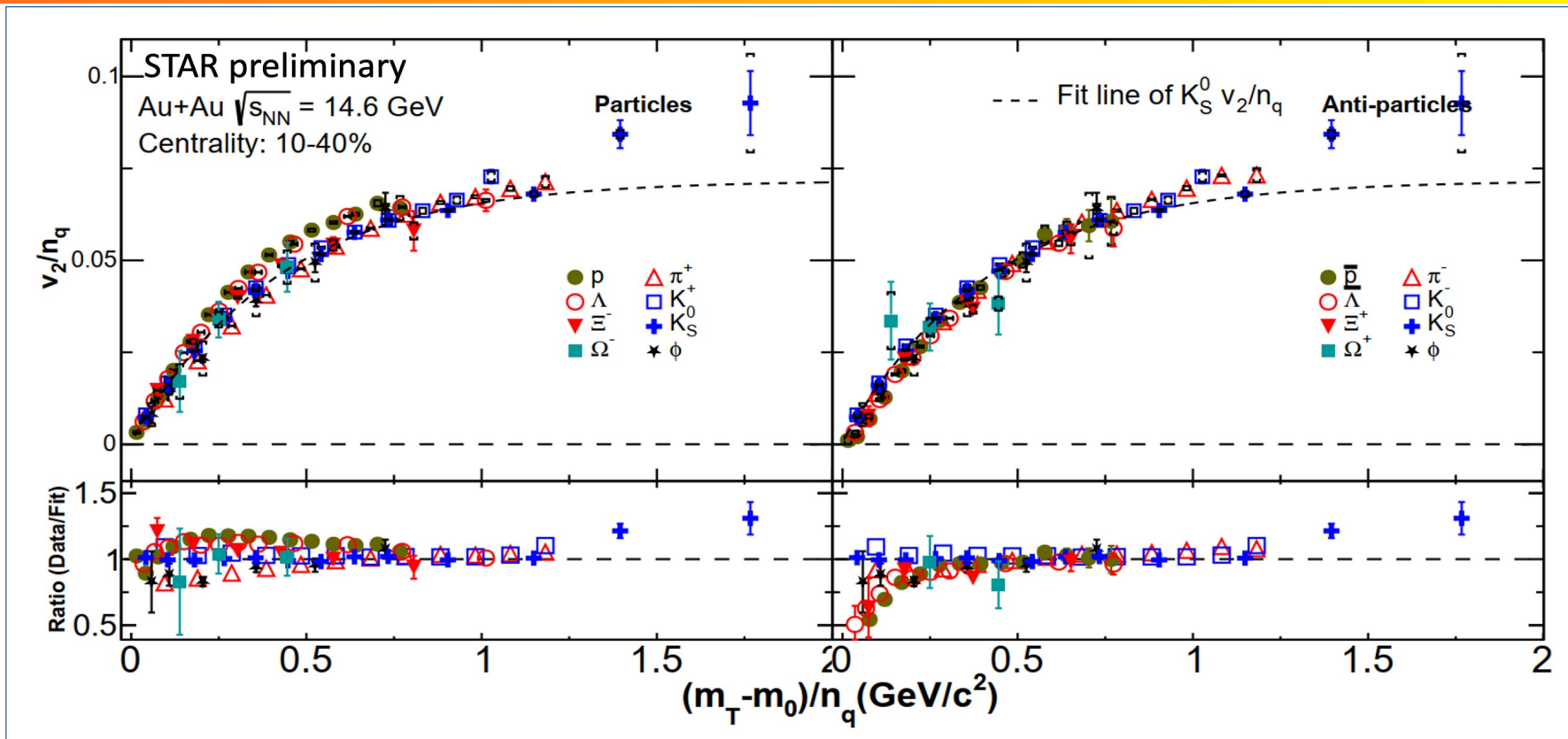


NCQ scaling is broken completely below $\sqrt{s_{NN}} < 3.5$ GeV : **hadronic dominance of the produced medium.**

- 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...

Back up



The NCQ scaling holds within 25% for particles and within 15% for antiparticles.