Anisotropic flows of ϕ-meson in Au+Au collisions at 7.2 GeV from STAR

Ding Chen, for the STAR Collaboration

University of California, Riverside

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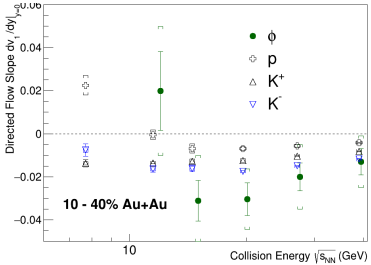
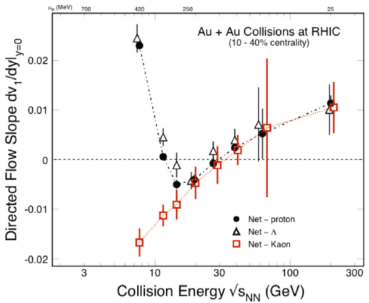
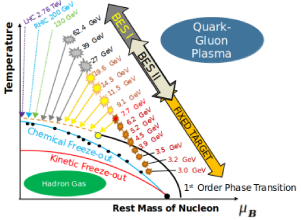
Supported in part by

Motivation





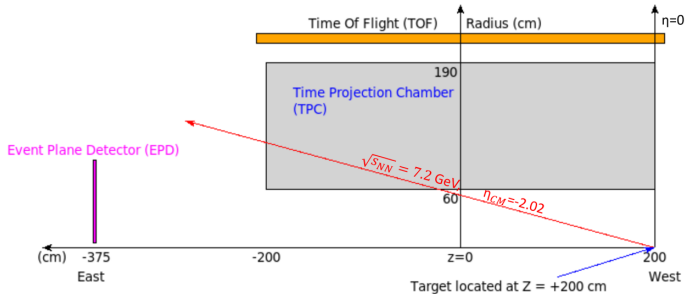


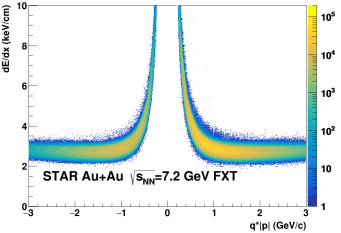
- The ϕ-meson has small hadronic cross-section - sensitive to early stage of collisions.
- BES-I shows hint of sign change of ϕ-meson dv_1/dy around 11.5 GeV, with large uncertainties.
- The minimum of net-proton and net-Λ dv_1/dy may indicate the softest point of Equation of State (EoS)[1]. How are the ϕ-meson?
- Fixed-target (FXT) program at STAR enables us to scan a range of low collision energies that collider mode (COL) cannot reach ($\sqrt{s_{NN}} < 7.7$ GeV down to a minimum of 3 GeV).

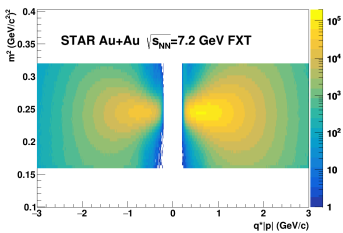
[1] L. Adamczyk et al. (STAR). *Phys. Rev. Lett. 120 062301.*

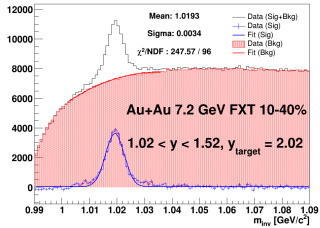
[3] K. C. Meehan for the STAR Collaboration. *Nuclear Physics A. 956(2016) 878-881.*

The ϕ-meson Reconstruction





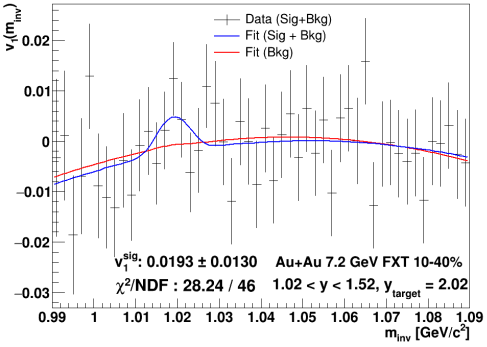


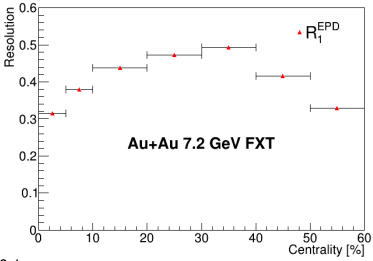


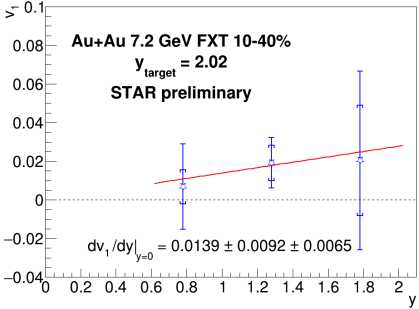
- ϕ-mesons are reconstructed by K^+K^- pairs.
- Kaons identifed by dE/dx from TPC and $mass^2$ from TOF.
- Combinatorial background (Bkg) are from mixed-events and subtracted.
- Convention used in this analysis: $y = y_{Lab} - y_{mid}$, $y_{mid} = -2.02$.
- Fitting Function:
  - Sig : Gaussian + Constant
  - Bkg : 2^{nd} order polynomial

Flow Extraction: Invariant Mass Method

- ϕ-meson v_1 is measured with respect to the first-order event plane (EP) from EPD ($-5.1 < \eta < -2.1$), corrected for the EP resolution R_1.
- Fitting Function:
  - Sig + Bkg: $Y_R v_1^{Sig}(m_{inv}) + (1 - Y_R) v_1^{Bkg}(m_{inv})$
  - $Y_R = \frac{Yields(Sig)}{Yields(Sig)+Yields(Bkg)}$
  - v_1^{Bkg}: Modeled by 2^{nd} order polynomial

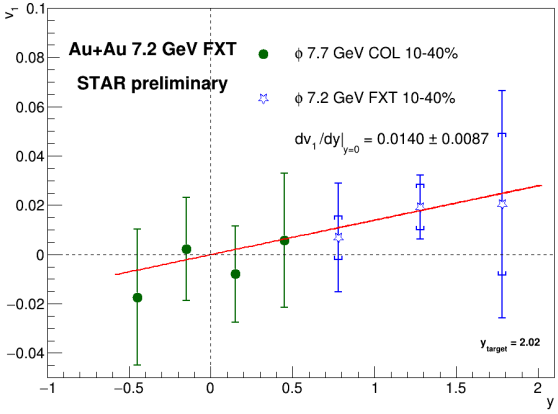


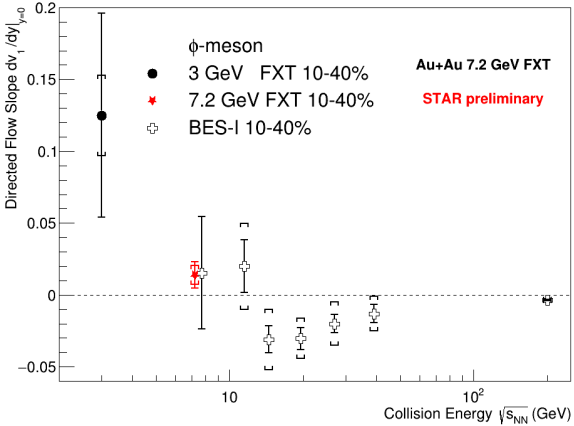




Note: Fit for slope is required to go through origin.

Results and Summary





- FXT and COL modes follow similar trend. Combining FXT and COL data for higher statistics and greater coverage will improve the flow measurements.
- With decreasing $\sqrt{s_{NN}}$, the $dv_1/dy|_{y=0}$ of the ϕ-meson shows a trend of turning from negative to positive.
- This may indicate a softest point of EoS[3] for the ϕ-meson - call for theory/model calculations.

[3] M.S. Abdallah et al. (STAR). *Physics Letter B. 827(2022) 137003.*