Measurement of radial flow fluctuations in the high baryon density region of QCD phase diagram

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July 2026

1 Abstract

A newly proposed observable, v_0, and its transverse-momentum-differential form, $v_0(p_T)$, is designed to quantify event-by-event variations in the spectral shape associated with radial-flow fluctuations [1–4]. This observable is sensitive to the equation of state (EoS) of the medium, and several phenomenological studies have identified it as a potential signature of partonic collectivity.

STAR measurements of elliptic flow at high baryon density, obtained in Au+Au fixed-target collisions at $\sqrt{s_{NN}}$=3.0–4.5 GeV, indicate that signatures of partonic collectivity weaken across this energy range, suggesting a transition in the EoS from partonic to hadronic dominance [5]. Measuring v_0 and $v_0(p_T)$ in this energy regime could therefore provide additional constraints on the EoS.

In this presentation, we report the first measurements of v_0 and $v_0(p_T)$ for identified hadrons in Au+Au fixed-target collisions at $\sqrt{s_{NN}}$ = 3.0–4.5 GeV using data recorded by the STAR experiment, and discuss the implications for partonic collectivity and the EoS at high baryon density. The results are compared to transport model calculations to gain further insight into the nature of the medium in this energy regime.

References

[1] B. Schenke, C. Shen, D. Teaney, Phys. Rev. C 102, 034905 (2020).

[2] T. Parida, R. Samanta, J.-Y. Ollitrault, Phys. Lett. B 857, 138985 (2024).

[3] ATLAS Collaboration, Phys. Rev. Lett. 136, 031901 (2026).

[4] ALICE Collaboration, Phys. Rev. Lett. 136, 032302 (2026).

[5] STAR Collaboration, Phys. Rev. Lett. 135, 072301 (2025).