

Non-monotonicity of transverse momentum correlations in Au + Au collisions at RHIC

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We report the first measurements of two-particle transverse-momentum correlations (variance) for midrapidity charged particles in fixed-target Au+Au collisions at $\sqrt{s_{\text{NN}}} = 3.0\text{--}7.7$ GeV using data collected by STAR during the Beam Energy Scan Phase II program [1]. Combined with previous BES-I measurements at $\sqrt{s_{\text{NN}}} = 7.7\text{--}200$ GeV [2], the relative dynamical correlator approximately follows the $1/\sqrt{N_{\text{part}}}$ scaling expected from independent particle-emitting sources at most energies. The scaling breaks down at the lowest collision energy, while additional deviations emerge in central collisions. For 0–5% central collisions, the combined data exhibit a non-monotonic beam-energy dependence with a significance of approximately 5σ relative to a monotonic baseline. In comparison, the mid-central data and AMPT calculations yield deviations of only approximately 2σ and 1.4σ , respectively. Possible connections to temperature fluctuations and QCD critical dynamics are discussed using recent 2 + 1-flavor LEFT-fRG and PNJL model calculations [3, 4]. The observations provide valuable input to understand the critical fluctuations and new constraints on the equation of state at high baryon density.

References

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