Study of p_T-Differential Radial Flow Fluctuations Using $v_0(p_T)$ in Au+Au Collisions at $\sqrt{s_{NN}} = 7.7$–200 GeV at RHIC

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Radial flow is conventionally studied through transverse-momentum (p_T) spectra and blast-wave model analyses, which provide information on the average collective expansion and kinetic freeze-out properties of the system. In contrast to the extensively studied anisotropic-flow coefficients v_2 and v_3, the p_T-differential fluctuations of radial flow remain largely unexplored. The recently proposed observable $v_0(p_T)$ provides direct sensitivity to p_T-differential radial-flow fluctuations [1, 2]. The RHIC Beam Energy Scan provides a unique opportunity to investigate how p_T-differential radial expansion and its event-by-event fluctuations evolve across a broad region of the QCD phase diagram.

In this work, we present measurements of $v_0(p_T)$ in Au+Au collisions at $\sqrt{s_{NN}} = 7.7$–200 GeV with the STAR experiment at RHIC. The beam-energy and centrality dependence of $v_0(p_T)$ is studied for charged hadrons as well as identified pions, kaons, and protons. Particular emphasis is placed on the slope of the p_T dependence of $v_0(p_T)$ and the characteristic p_T at which $v_0(p_T)$ changes sign, as these features are sensitive to the strength and fluctuations of radial flow [3]. A blast-wave model incorporating event-by-event fluctuations is simultaneously fitted to the proton, kaon, and pion $v_0(p_T)$ data to extract the radial-flow velocity, kinetic freeze-out temperature ($T_{\rm kin}$), and their event-by-event fluctuations. The extracted parameters provide a quantitative characterization of the beam-energy evolution of the average radial expansion and kinetic freeze-out conditions, as well as their fluctuations, thereby enabling us to assess the relative contributions of radial-flow and freeze-out fluctuations to the observed $v_0(p_T)$ behavior.

References

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