

Probing the system-size dependence of radial flow fluctuations in Au+Au and O+O collisions at RHIC

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The expansion dynamics and transport properties of the quark-gluon plasma (QGP) are essential for understanding the evolution of matter created in relativistic heavy-ion collisions [1, 2, 3, 4, 5]. In particular, comparisons between different collision systems provide a powerful way to isolate the system-size dependence of collective expansion and its fluctuations, thereby improving sensitivity to the transport properties of the medium. We present STAR measurements of the p_T -differential radial-flow fluctuation observable $v_0(p_T)$, which quantifies long-range correlations between particle-yield fluctuations in a given p_T interval and mean- p_T fluctuations, in Au+Au and O+O collisions at $\sqrt{s_{NN}} = 200$ GeV, with Au+Au serving as the large-system reference. Using a two-particle correlation method with separated pseudorapidity subevents, we measure inclusive charged particles over $0.2 < p_T < 10.0$ GeV/ c , identified pions and kaons over $0.2 < p_T < 2.0$ GeV/ c , and protons over $0.5 < p_T < 3.0$ GeV/ c . Both systems show a characteristic sign change and rise in $v_0(p_T)$. Identified-particle results exhibit mass ordering at low p_T . The normalized differential response $v_0(p_T)/v_0$, where v_0 denotes the p_T -integrated fluctuation magnitude, provides a way to investigate centrality dependence at low-to-intermediate p_T , while its extension to high p_T provides sensitivity to possible jet-quenching contributions. A comparison of O+O and Au+Au collisions at similar multiplicity provides sensitivity to the system-size dependence of radial-flow fluctuations. Model variations indicate strong sensitivity to bulk viscosity, especially for light hadrons, while weak sensitivity to shear viscosity. These results demonstrate the potential of $v_0(p_T)$ as a differential probe of radial flow fluctuations, providing constraints on the system-size dependence of radial-flow fluctuations and on the properties of the QGP medium.

References

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