Onset of Partonic Collectivity in Heavy-Ion Collisions at RHIC

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Partonic collectivity is one of the key signatures for the formation of quark-gluon-plasma in high-energy nuclear collisions. Scaling with the number of constituent quarks (NCQ) of elliptic flow (v_2) has been observed at top RHIC energy ($\sqrt{s_{\rm NN}}$ = 200 GeV) and at the LHC ($\sqrt{s_{\rm NN}}$ = 2.76 TeV), indicating the presence of partonic collectivity. Meanwhile, NCQ scaling is absent for identified particles at $\sqrt{s_{\rm NN}}$ = 3 GeV Au+Au collisions.

In this talk, we present a systematic analysis of v_2 for light, strange, multi-strange, and ϕ mesons in Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 3.0, 3.2, 3.5, 3.9, 4.5, 7.7, 9.2, 11.5, 14.5, 17.3, and 19.6 GeV, using data from the STAR experiment at RHIC. While NCQ scaling is clearly violated at $\sqrt{s_{\rm NN}} \leq 3.2$ GeV, implying a hadronic interaction-dominated equation of state, the scaling is gradually restored as the energy increases up to the 4.5 GeV Au+Au collisions, indicating the onset of the partonic interactions in these collisions. The v_2 results of multi-strange hadrons and ϕ mesons, with new high statistics data, will be shown for collision energies $\sqrt{s_{\rm NN}} \geq 7.7$ GeV. In addition, the energy dependence of the p_T-integrated v_2 for different particle species will be compared with predictions from transport model calculations. Finally, we will discuss the implications of these measurements on understanding of QCD phase structure.