Searching the colliding energy and system size thresholds of QGP production in heavy-ion collisions with Ω/ϕ ratios

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Heavy-ion collisions provide a unique opportunity to study the properties of the QCD matter at varying temperatures, densities and system volumes. Ω and ϕ hadrons, composed merely of strange quarks, have relatively small hadronic interaction cross sections and can be utilized to study the matter properties at its early stage. In Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV and Pb+Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, significant Ω enhancement over ϕ have been observed at intermediate transverse momentum in central collisions, which can be explained by their productions through coalescence of strange quarks in Quark-Gluon Plasma (QGP). Hence the energy threshold of QGP production (or onset of deconfinement) in heavy ion collisions can be explored by measuring the colliding energy dependence of Ω/ϕ enhancement. It can also be expected that the measurement of Ω/ϕ ratios in different colliding systems may indicate the minimum colliding system size required to produce QGP.

In this talk, we will present measurements of new measurements of strange hadron production in Au+Au collisions at $\sqrt{s_{NN}} = 7.7$, 9.2, 11.5, 14.6, 17.3 and 19.6 GeV using high statistics STAR BES-II data. The transverse momentum (p_T) spectra, centrality dependence of yields, nuclear modification factor and the particles ratios (ϕ/K) will be presented. In particular, the energy and centrality dependence of Ω/ϕ ratios in BES-II energy range will be presented. Besides, the Ω/ϕ ratios in smaller colliding systems including O+O, d+Au, and isobar collisions at $\sqrt{s_{NN}} = 200$ GeV will also be shown and compared to the Au+Au data at the same colliding energy. These results will be compared to theoretical calculations and physics implications will be discussed.