Probing QCD critical fluctuations from the yield ratio of strange hadrons in relativistic heavy-ion collisions

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By analyzing the available data on strange hadrons in central Pb+Pb collisions from the NA49 Collaboration at the Super Proton Synchrotron (SPS) [1] and in central Au+Au collisions from the STAR Collaboration at the Relativistic Heavy-Ion Collider (RHIC) [2] in a wide collision energy range from $\sqrt{s_{NN}}$ = 6.3 GeV to 200 GeV, we have found a possible non-monotonic behavior in the ratio $[N(K^+)N(\Xi^-)]/[N(\phi)N(\Lambda)]$ of K+, Ξ−, φ, and Λ yields as a function of $\sqrt{s_{NN}}$ [3] as shown by open and filled circles in Fig.1. Based on the quark coalescence model with the inclusion of the effect of quark density fluctuations on hadron production, a possible non-monotonic behavior in the dependence of the

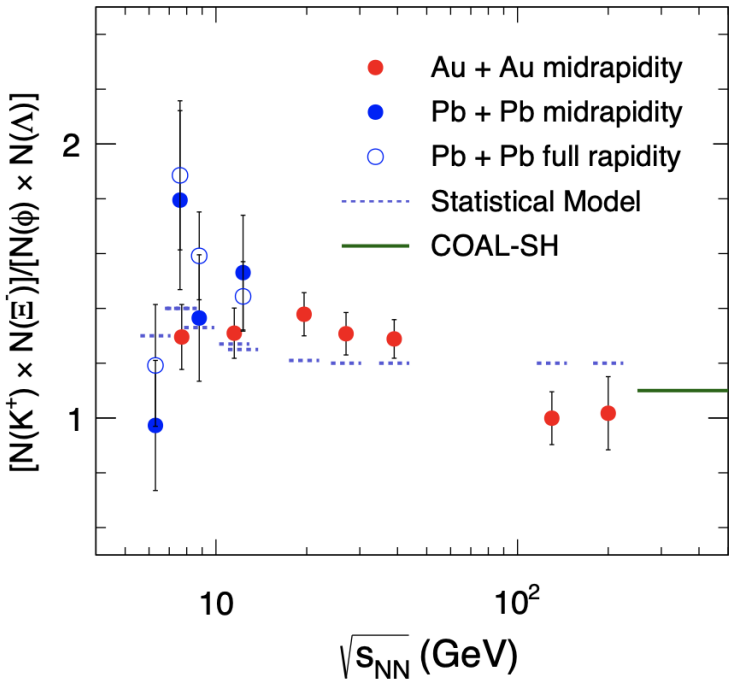

Fig. 1. Collision energy dependence of the ratio $[N(K^+)N(\Xi^-)]/[N(\phi)N(\Lambda)]$ in central Pb+Pb collisions at SPS energies and in central Au+Au collisions at RHIC energies from experimental data from Ref.[1] and Ref.[2], respectively. Filled and open circles denote, respectively, the ratio obtained from midrapidity and in full rapidity space. Error bars represent the statistical uncertainties. The horizontal line on the right side of the figure show the ratio calculated from the coalescence model without quark density fluctuations [4]. The dash lines are the ratio calculated from the statistical model [5].

strange quark density fluctuation on $\sqrt{s_{NN}}$ is obtained. This is in contrast to the coalescence model that does not include quark density fluctuations [4] and also to the statistical hadronization model [5], shown by short solid and dashed lines, respectively, in Fig.1, as both fail to describe even qualitatively the collision energy dependence of the ratio $[N(K^+)N(\Xi^-)]/[N(\phi)N(\Lambda)]$. Our finding thus confirms the suggestion in Refs.[6-8] that the signal and location of a possible critical endpoint in the QCD phase diagram, which is expected to result in large quark density fluctuations, can be found in the on-going Bean Energy Scan program at RHIC.

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