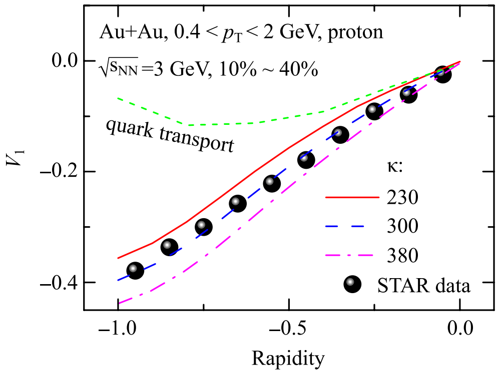

Fig. 1 (color online) Rapidity dependences of proton directed flow v_1 in 10% ~ 40% centrality for Au + Au collsions at $\sqrt{S_{NN}} = 3$ GeV given by the AMPT-HC mode with different EoSs and the quark transport AMPT-SM mode. The STAR data is taken from Ref. [2].

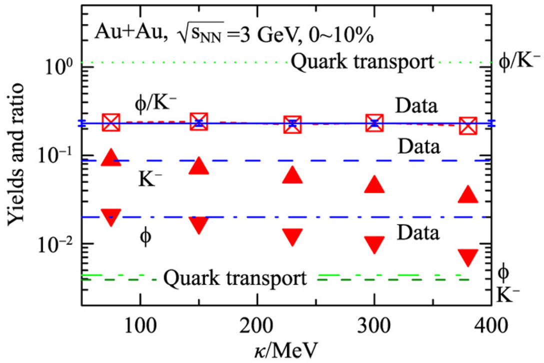

Fig. 2 (color online) Strange ϕ and K^- productions and their ratios ϕ/K^- in 0 ~ 10% centrality for Au + Au collisions at $\sqrt{S_{NN}} = 3$ GeV given by the AMPT-HC mode with different EoSs and the quark transport AMPT-SM mode. The data is taken from Ref. [3].

References

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1 - 4 Probing the Symmetry Energy with Strangeness Production*

Yong Gaochan

The EoS of dense matter plays an important role in understanding the later evolution of the universe, the physics associated with compact stars. Therefore, constraints on the equation of state (EoS) of dense nuclear matter has been a longstanding and common goal of both nuclear physics and astrophysics. Nowadays one of the main goals of relativistic heavy-ion collision program is to understand the properties of dense nuclear matter, i.e., EoS of nuclear matter under conditions of extreme energy and baryon density[1]. While among all the potential observables used to probe the EoS of dense nuclear matter, strange mesons or baryons are different from the rest. They are rarely absorbed by surrounding matter, thus frequently used to probe the EoS of dense matter. A lot of studies on probing the nuclear symmetry energy have been carried out for many years. Constraints on the high-density behavior of the symmetry energy can be highly relevant to a series of properties of neutron stars. To constrain the high-density symmetry energy, many terrestrial experiments are being carried out (or planned) using a wide variety of advanced facilities.

Based on the updated AMPT-HC model with the momentum-dependent single particle potential, the effects of the symmetry energy on the K^0_s/K^+ ratio and the Σ^-/Σ^+ ratio in the Au+Au collisions at RHIC-STAR energies are studied[2]. From Fig. 1, one sees that the effects of the symmetry energy on the K^0_s/K^+ ratio are not more than 6%. At lower kinetic energies, the effects of the symmetry energy on the Σ^-/Σ^+ ratio can be as high as 20%, but disappear at high kinetic energies (energetic $\pi^{-,+}$'s experience many re-scatterings in compression matter, further cause the produced $\Sigma^{-,+}$'s mostly lose the information of the symmetry energy, one sees the Σ^-/Σ^+ ratio shows no effects of the symmetry energy).

Figure 2 shows the effects of the symmetry energy on the Ξ^-/Ξ^0 ratio in the Au+Au reactions at $\sqrt{s_{NN}} = 3$ GeV [2]. It is seen that both the kinetic energy and the transverse momentum distributions of the Ξ^-/Ξ^0 ratio are particularly sensitive to the symmetry energy. The value of the Ξ^-/Ξ^0 ratio with the soft symmetry energy is higher than that with the stiff symmetry energy and the effects reach about 30%.

Recent studies show in the central Au+Au collisions at $\sqrt{s_{NN}} = 3$ GeV, the dense matter formed in the collisions is most likely dense hadronic matter. The baryonic density reached may be approximatively maximum compression baryonic density in terrestrial laboratory, far close to the phase boundary and onset of quark deconfinement. It is thus interesting to see the behavior of the symmetry energy at such extreme high baryonic density. Our study shows that the doubly strange Ξ^-/Ξ^0 ratio shows clear effects of the symmetry energy even at RHIC-STAR energies, thus provides a window to pry into the isospin dependence of the EoS of dense nuclear matter around the phase boundary and onset of quark deconfinement.

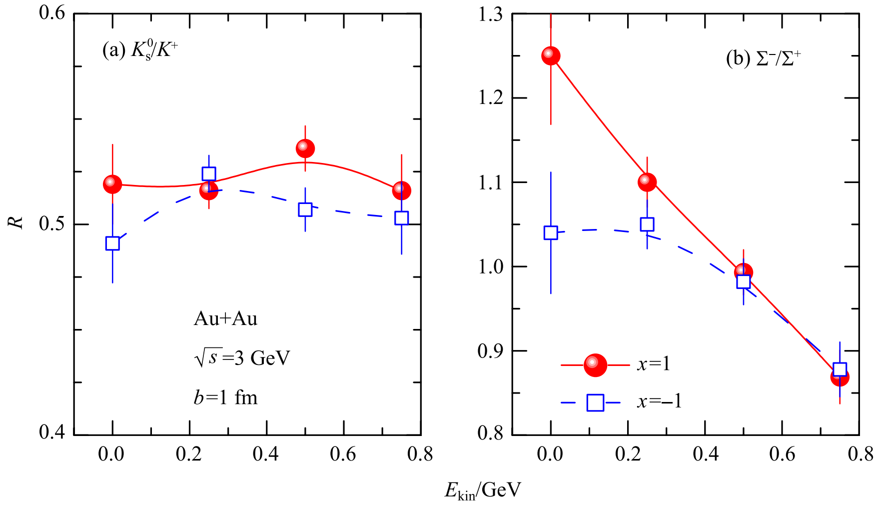

Fig. 1 (color online) Kinetic energy distributions of K_s^0/K^+ ratio (a) and Σ^-/Σ^+ ratio (b) in the central Au+Au reactions with stiff ($x=-1$) and soft ($x=1$) symmetry energies at $\sqrt{s_{NN}}$ = 3 GeV.

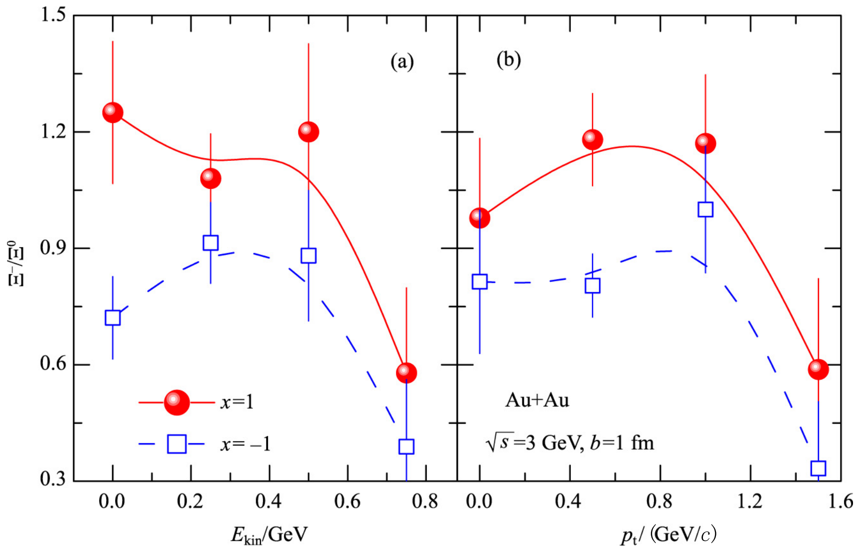

Fig. 2 (color online) Kinetic energy (a) and transverse momentum (b) distributions of the doubly strange baryon Ξ^-/Ξ^0 ratio in the central Au+Au reactions with stiff and soft symmetry energies at $\sqrt{s_{NN}}$ = 3 GeV.

References

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