

Isospin-dependent pion in-medium effects on charged pion ratio in heavy ion collisions

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The spectral functions of pions in asymmetric nuclear matter become dependent on their charges. Using those determined from the couplings of pions to the delta-resonance nucleon-hole excitations in nuclear matter, we have studied in a thermal model their effects on the ratio of negatively charged to positively charged pions [1]. In the neutron-rich matter formed in heavy ion collisions, this ratio is enhanced by the isospin-dependent pion in-medium effects, and the effect is comparable to that due to the uncertainties in the theoretically predicted stiffness of the nuclear symmetry energy at high densities. As shown in Fig.1, the measured π^-/π^+ ratio of about 3 with a large error bar by the FOPI Collaboration [2], shown by the dash-dotted line, which without the pion in-medium effects favors a nuclear symmetry energy softer than the one given by $x=1$, is now best described by the latter. Therefore, it is of great interest to include the pion in-medium effects in the transport model [3], which takes into account possible non-thermal effects, to extract more reliably the nuclear symmetry energy at high density from the measured π^-/π^+ ratio in high energy heavy ion collisions.

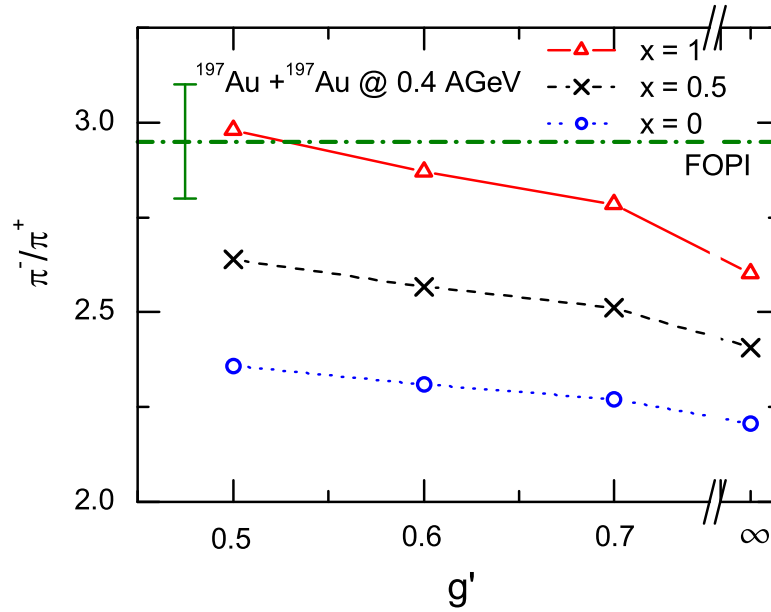


FIG. 1. The π^-/π^+ ratio in Au+Au collisions at the beam energy of 0.4 AGeV for different values of nuclear symmetry energy ($x=0, 0.5$, and 1) and the Migdal parameter $g=0.5, 0.6$, and 0.7. Results for $g = \infty$ correspond to the case without the pion in-medium effects.

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- [2] W. Reisdorf *et al.* (FOPI Collaboration), Nucl. Phys. **A781**, 459 (2007).
- [3] Z. G. Xiao, B. A. Li, L. W. Chen, G. C. Yang, and M. Zhang, Phys. Rev. Lett. **102**, 062502 (2009).