High-Energy Behavior of the Nuclear Symmetry Potential in Asymmetric Nuclear Matter

L.W. Chen,[1] C.M. Ko, and Bao-An Li[2]

[1]*Institute of Theoretical Physics, Shanghai Jiao Tong University, Shanghai 200030, China*

[2]*Department of Chemistry and Physics, Arkansas State University, Jonesboro, AR 72467*

Using the relativistic impulse approximation with empirical NN scattering amplitude and the nuclear scalar and vector densities from the relativistic mean-field theory, we have evaluated the Dirac optical potential for neutrons and protons in asymmetric nuclear matter for different parameter sets NL3, Z27v, and HA [1]. From the resulting Schrodinger-equivalent potential, the high energy behavior of the nuclear symmetry potential has been studied. We find that the symmetry potential at fixed baryon density is essentially constant once the nucleon kinetic energy is greater than about 500 MeV. Moreover, for such high energy nucleon, the symmetry potential is slightly negative below a baryon density of about ρ=0.22 fm^{-3} and then increases almost linearly to positive values at high densities as shown in Fig.1, where results from the non-relativistic momentum-dependent (MDI) interaction are also given. Our results provide an important constraint on the energy and density dependence of nuclear symmetry potential in asymmetric nuclear matter.

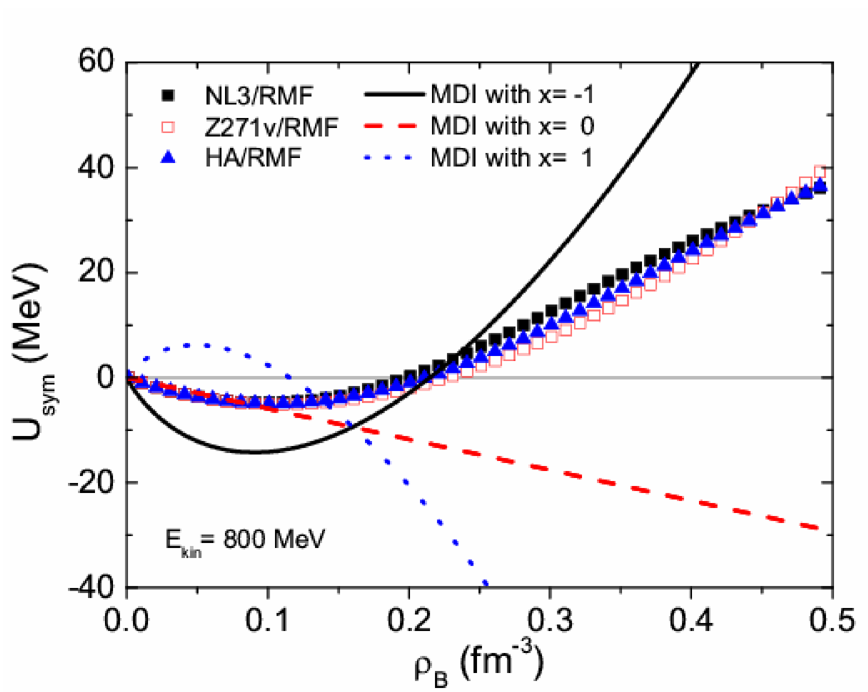

Figure 1. Density dependence of the nuclear symmetry potential using the parameter sets NL3, Z271v, and HA as well as from the MDI interaction with x=1, 0, and 1 at a fixed nucleon kinetic energy of 800 MeV.

[1] L.W. Chen, C.M. Ko, and B.A. Li, Phys. Rev. C **72**, 064606 (2005).