Momentum-dependent nuclear potential and its applications

Yoritaka Iwata and Hans Feldmeier

GSI Helmholtz Centre for Heavy-Ion Research

Charge equilibration, which is a rapid process taking about 10^{-22} s, is decisive in determining the final products of heavy-ion collisions [1]. Indeed, fusion does not take place without attaining the charge equilibrium. Nowadays, three-dimensional time-dependent Hartree-Fock (TDHF) calculations are feasible equipped with full Skyrme interactions, where modern TDHF calculations have been shown to agree with experiments (e.g., see [2]), even in terms of the number of transferred nucleons [3]. In this paper, based on H. Feldmeier [4] and H. Feldmeier and P. Buck [5], we propose a rather accurate method of extracting nuclear potentials from the collision dynamics (TDHF calculations). This method is advantageous enough to allow us to obtain potentials microscopically and momentum-dependently. First, in the context of nuclear potential structure, we show that the spin-orbit force play a crucial role in charge equilibration. Next, the relation between spin-orbit force and spin-polarization is discussed (for the preceding studies on spin-polarization, e.g., see [6, 7, 8]). Eventually, momentum-dependence and the isovector dependence of spin-oribt/nuclear potential is clarified, and the mechanisms of charge equilibration, spin-polarization, and dissipation are understood in such a microscopic manner.

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