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Construction of density dependent α -nucleon interaction to describe α -nucleus scattering

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A microscopic description of the nucleus-nucleus reaction system has been attempted.

The double-folding model with effective nucleon-nucleon interaction is widely successful to describe nucleusnucleus scatterings.

However, we need a special prescription for the microscopic description of the α -nucleus scatterings, for example for the application of the strong renormalization factor or the change of the local density approximation.

Namely, α scattering and heavy-ion scattering are not described in the same framework. We consider the reason as follows.

Almost the effective nucleon-nucleon interactions reflect the property in the nuclear matter.

However, the α particle is far from the condition of the nuclear matter.

Then, we should reconsider describing the α scattering with such nucleon-nucleon interaction.

In this work, we provide a complex density-dependent α -nucleon (DD- αN) interaction to construct the α -nucleus potential in the wide ranges of the incident energy and the target nucleus.

The α -nucleus potential is obtained by folding the present DD- αN interaction with the point nucleon density obtained by the mean-field model (HF+BCS).

The present DD- αN interaction is based on the phenomenological optical potential to reproduce the p + ⁴He elastic scattering.

Namely, the $\alpha\text{-nucleon}$ system is considered to be an elementary process.

The real part of the p + ⁴He potential has a form of the double Woods-Saxon (WS) type.

The short-range WS potential has a role in repulsive behavior at high energy.

However, the present density dependence of the DD- αN interaction is phenomenologically fixed to reproduce the α -nucleus elastic scattering.

The α -nucleus potential with the present DD- αN interaction well reproduces the experimental data.

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