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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 nucleus-nucleus 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 + ^{4}He elastic scattering.
Namely, the α-nucleon system is considered to be an elementary process.
The real part of the p + ^{4}He 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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