Coupled-channels calculations of heavy ion fusion reactions with a double-folding potential

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A Woods-Saxon potential is used in most of the coupled-channels calculations for heavy ion fusion reactions. The depth, range and surface diffuseness parameters are determined by fitting the experimental data at high energies, where channel coupling effects are supposed to be small. It is desirable to have a reliable potential which has less phenomenological parameters. One can then calculate the fusion cross section prior to the experimental data. This is important especially in predicting the cross section of the synthesis of super heavy elements.

In this contribution, we discuss the coupled channels calculations based on the double-folding potential as one possibility. We determine the double-folding potential by convoluting the M3Y interaction with the densities of the projectile and target nuclei. We apply the method to the ^{16}O+^{144,154}Sm fusion reactions. We show that the full order coupled channels calculations reproduce the experimental data in the same quality as the phenomenological approach using the Woods-Saxon parameterization by reducing the strength of the nuclear potential given by the double folding procedure by the same amount as that is known to be needed to describe elastic scattering.

We also apply the method to the ^{60}Ni+^{154}Sm and ^{76}Ge+^{150}Nd reactions. We show that the barrier transmission cross section thus obtained for the ^{60}Ni+^{154}Sm reaction well agrees with the sum of the experimental cross sections of the quasi fission and of the fusion reactions at low energies.