Nucleon Optical Potentials for the CDCC analysis of Deuteron Elastic Scattering from ^{6,7}Li

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Recently, the development of fusion reactors attracts an interest in deuteron induced reactions, because the Li(d,xn) data up to 50MeV is requested in the design of the International Fusion Materials Irradiation Facility (IFMIF) [1] which is composed of an accelerator-driven deuteron-lithium neutron source for irradiation tests of fusion reactor candidate materials. In the Li(d,xn) reaction, the deuteron breakup process is expected to be important. The continuum discretized coupled channels (CDCC) method has so far been successfully applied to describe the breakup process [2]. The CDCC method deals with the deuteron breakup using a phenomenological three-body Hamiltonian in which the nucleon-nucleus interaction is represented by the optical model potential (OMP) at half the deuteron incident energy and an effective nucleon-nucleon potential is used for the p-n interaction. The nucleon-nucleus OMP is the most important physical quantity in the CDCC calculation. Thus, simultaneous analyses of both nucleon and deuteron elastic scatterings will provide us a capability of deriving more reliable nucleon OMPs.

A proper nucleon OMPs should be prepared by analyzing d-^{6,7}Li elastic scattering process up to 50MeV for our purpose. P. Chau Huu-Tai [3] has systematically studied the deuteron induced elastic and reaction cross section within the CDCC approach. However, the mass of the target nuclei in [3] is larger than A=16, and the nucleon OMPs used does not include the lithium. Therefore, we have decided to derive the proper nucleon-^{6,7}Li OMP for the CDCC analysis of d-^{6,7}Li at incident energies from 5 to 25MeV in our work.

There are many global nucleon OMPs for medium and heavy nuclei, but only a few phenomenological neutron OMPs are applicable to lithium [4-6]. We choose Chiba OMP [6] for ^{6}Li(n,el) and Dave-Gould OMP [5] for ^{6,7}Li(n,el). For CDCC calculations, we extend the neutron OMP to the proton OMP by using the Lane model, and extend the Chiba OMP to include ^{7}Li target by changing the Fermi energies. Comparisons between the calculation results of two OMPs and experimental data show that both OMPs reproduce neutron and proton angular distributions well. However, the Dave-Gould OMP cannot be used beyond the energy region from 7MeV to 15MeV because of its failure on neutron total cross sections. The Chiba OMP is better to describe nucleon elastic scattering from ^{6,7}Li for our purpose. Using the Chiba OMP as input, CDCC calculations for ^{6,7}Li(d,el) reproduces the measurement satisfactorily well to the same extent as a newly developed deuteron OMP[7].

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