Elastic scattering of deuterons from ^{27}Al target

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Introduction

Nuclear physics research always focus to understand nature of nuclear interactions as well as structure of nuclei. Several works to understand the nature of the nuclear potentials which are responsible for the nuclear reaction to occur have been parformed in past decades. For this purpose, it is necessary to know the nature of the parameters of the phenomenological optical model potential. Optical model parameters plays important role in the study of direct reactions. These parameters are required to extract spectroscopic factors in transfer reactions, which measures the degree to which a state populated in transfer reaction is a pure single-particle state; this allows us to test the predictions of shell model. The phenomenological optical model potential parameters are extracted from the elastic angular distributions and several sets of optical model potential parameters can be extracted for a particular projectile-target combination and the extracted spectroscopic factors may not be same. Spectroscopic factor is a property of the nucleus itself and should be independent of the reactions involved and beam energies. Hence, a systematic study of the optical model parameters is necessary over a range of energies and reaction channels. As optical model potential parameters depend on projectile-target combination as well as the energy involved in the reaction, so systematic study of optical potentials will provide opportunity to extract reliable information about the nature of nuclear interactions as well as structure of nuclei. Optical model parameters also plays important role in the calculation of reaction rates at astrophysically relevant energies and are responsible for estimated uncertainties. Wood-Saxon and Sao-Paulo potential types are very frequently used to extract optical model parameters.

In this paper, we plan to present the energy dependence of the optical model parameters for ^{27}Al(d, d)^{27}Al reaction at several incident energies of deuteron beams using Sao-Paulo potential [1, 2].

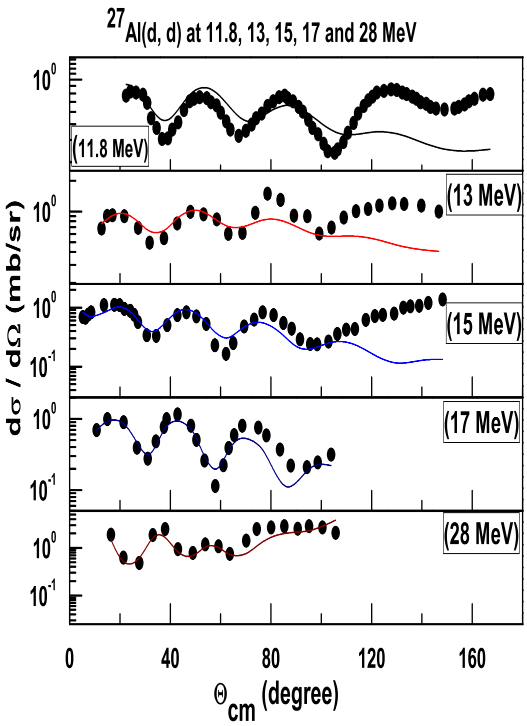

FIG. 1: Fitted elastic angular distributions for the reaction ^{27}Al(d,d)^{27}Al at 11.8, 13, 15, 17 and 28 MeV using Sao-Paulo Potential.

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1. Analysis and Results

Experimental elastic scatering data using deuteron beams of 11.8, 13, 15[†], 17 and 28 MeV on ^{27}Al have been taken from [3–6](references are in increasing energy sequence, [†] [4]). The angular distributions of elastically scattered deuterons have been shown in Fig.1 by filled circles. We can easily find from Fig. 1 that there exists a significant peak shifts among the elastic angular distributions with energy change; which is the indication of energy dependence. These angular distributions have been compared with the predictions from the computer code S-FRESCO [7] using Sao-Paulo potential [1, 2] by solid lines. Details about the Sao-Paulo potential and its parametrization can be found in [1, 2]. Preliminary fitted elastic angular distributions have been shown in Fig. 1 in which minimum χ^2 condition has been opted for best fit and to extract values of the optical model parameters.

From the present preliminary analysis, it has been found that for low energy (11.8 to 15 MeV), theoretical predictions from S-FRESCO has explained the lower angle data while the data at higher angle is not in agreement with theoretical predictions. It can also be concluded from Fig. 1 that for the higher energy [17 and 28 MeV], the shapes of both experimental data and theoretical predictions have been found to be in agreement. Elastic scattering data shown in Fig. 1 are not sufficient to study the energy dependence of the optical potentials for d $+^{27}$Al, we need more data at different energies to examine the energy dependence more accurately. Very recently, Vishal Srivastava *et al.,*[8] has fitted elastic scattering data for ^{27}Al(d,d) at 25MeV and they also used the elastic scattering data at 23 MeV to examin the energy dependence of optical model parameters using Wood-Saxon potential. These two energy points will also be included in the final analysis to understand the energy dependence of the optical model potential parameters for the d $+^{27}$Al system. It will also be helpful for better examination of optical potential by comparing the results obtained using Sao-paulo and Wood-Saxon potentials. Further analysis is in progress. Detail calculation and results will be presented during the conference.

References

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