Proton scattering from Halo nuclei ^{6}He and ^{11}Li in BHF

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Introduction

Reactions of unstable neutron-rich nuclei with a proton (hydrogen) target is a field of current interest [1] as in the absence of electron scattering it is the only means to probe the matter and/or neutron distribution of exotic nuclei. One of the most exciting events in nuclear physics of recent years was the discovery of halo nuclei (^{11}Li the most celebrated example) having large extended neutron distribution. A nuclear halo is a structure with dilute matter distribution far beyond the core of the nucleus. The neutron rich ^{6}He nucleus is one of the typical nuclides with an extended neutron distribution. Since the extended neutron distribution is prominent at the nuclear surface and the spin-orbit coupling is, in nature, a surface phenomenon, it would be interesting to see how the extended neutron distributions affect the spin asymmetry (i.e., vector analyzing power) in proton elastic scattering.

We report the results of differential cross section and analyzing power for the p-^{6}He [2] and p-^{11}Li elastic scattering at 60MeV/nucleon[3], obtained by using Reid93[4], Argonne v18 [5] and v14 [6] nucleon - nucleon interactions in the Brueckner Hartee Fock (BHF) formalism. The nucleon density distributions required in the folding procedure to generate the microscopic nucleon (p) – nucleus optical potential are taken from earlier work [7]. The forms of these distributions correctly incorporate the asymptotic behavior and the behavior near the origin.

Results and Discussion

The calculated differential cross section and analyzing power for p-^{6}He is presented in Figs. 1(a and b) and for p - ^{11}Li the differential cross section is presented in Figure 2 along with the corresponding experimental data taken from [2,3]). Clearly, the calculations reproduce the experiment well. The calculated analyzing power A_y for the p-^{6}He is shown in Fig. 1(b). The corresponding experimental data included in the same figure has large errors and is very small in magnitude. The qualitative trend is reproduced. It is difficult to draw a definite conclusion. Therefore, we advocate the need for additional and more accurate data.

It is expected that the analyzing power may provide new information on the reaction mechanism and also on the nuclear structure. The nuclear structure effects on Ay may originate from the spatial distribution of the α core in ^{6}He, which is closely connected to the valence neutron distribution. This can be a possible key for understanding spin-orbit coupling in a neutron-rich ^{6}He nucleus. The work on these lines is in progress.

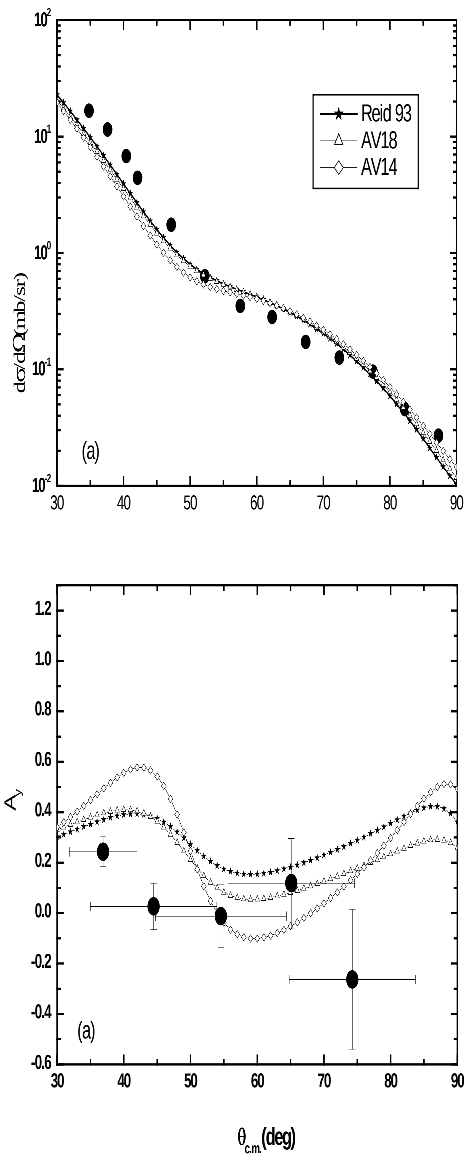

FIG.1. Calculated (best fit) and the corresponding experimental values of (a) differential cross sections and (b) analyzing power for scattering of protons from ^{6}He isotopes using Reid93, Argonne v-18, and Argonne v-14 inter nucleon potentials in the BHF framework

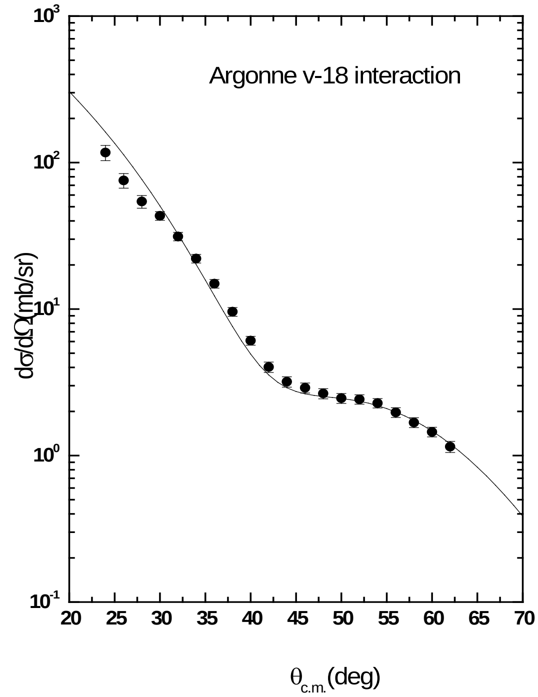

FIG.2. Calculated (best fit) and the corresponding experimental values of (a) differential cross sections for scattering of protons from ^{11}Li isotopes using Argonne v-18 inter nucleon potential in BHF..

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