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Study of Proton-9,11Li Elastic Scattering at 60~75 MeV/Nucleon

Authors : Arafa A. Alholaisi, Jamal H. Madani, M. A. Alvi

Abstract : The radial form of nuclear matter distribution, charge and the shape of nuclei are essential properties of nuclei, and hence, are of great attention for several areas of research in nuclear physics. More than last three decades have witnessed a range of experimental means employing leptonic probes (such as muons, electrons etc.) for exploring nuclear charge distributions, whereas the hadronic probes (for example alpha particles, protons, etc.) have been used to investigate the nuclear matter distributions. In this paper, p-^{9,11}Li elastic scattering differential cross sections in the energy range to MeV have been studied by means of Coulomb modified Glauber scattering formalism. By applying the semi-phenomenological Bhagwat-Gambhir-Patil [BGP] nuclear density for loosely bound neutron rich ¹¹Li nucleus, the estimated matter radius is found to be 3.446 fm which is quite large as compared to so known experimental value 3.12 fm. The results of microscopic optical model based calculation by applying Bethe-Brueckner–Hartree–Fock formalism (BHF) have also been compared. It should be noted that in most of phenomenological density model used to reproduce the p-¹¹Li differential elastic scattering cross sections data, the calculated matter radius lies between 2.964 and 3.55 fm. The calculated results with phenomenological BGP model density and with nucleon density calculated in the relativistic mean-field (RMF) reproduces p-⁹Li and p-¹¹Li experimental data quite nicely as compared to Gaussian- Gaussian or Gaussian-Oscillator densities at all energies under consideration. In the approach described here, no free/adjustable parameter has been employed to reproduce the elastic scattering data as against the well-known optical model based studies that involve at least four to six adjustable parameters to match the experimental data. Calculated reaction cross sections σ_R for p-¹¹Li at these energies are quite large as compared to estimated values reported by earlier works though so far no experimental studies have been performed to measure it.

Keywords : Bhagwat-Gambhir-Patil density, Coulomb modified Glauber model, halo nucleus, optical limit approximation
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