Investigation of the ^{6,7}Li+^{119}Sn reactions at energies near the Coulomb barrier

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Abstract

Nuclei considered “regular” are tightly bound, with binding energies of approximately 7.5 MeV per nucleon. In contrast, weakly bound nuclei present significantly lower breakup thresholds, which makes reactions involving them particularly complex. The breakup channel can strongly influence elastic, inelastic, and transfer processes. In addition, many weakly bound systems exhibit cluster structures, posing both experimental and theoretical challenges.

This work is part of a systematic investigation of reactions induced by weakly bound nuclei at the Open Laboratory of Nuclear Physics and Applications (LAFNA). We report the determination of experimental cross sections for different reaction channels in the ^{6,7}Li+^{119}Sn systems. Measurements were performed at three bombarding energies for each system, selected such that they correspond pairwise to the same reduced energy ($E_{\mathrm{red}} = E_{cm} - V_b$), allowing a direct comparison between the systems. Angular distributions for elastic scattering, inelastic excitation, and nucleon transfer were obtained at energies near and above the Coulomb barrier. The theoretical analysis was carried out within a coupled-reaction channels (CRC) framework. The nuclear interaction was described using the São Paulo Potential version 2 (SPP2). Owing to the weakly bound nature of the projectiles, continuum effects were incorporated effectively through a J- independent weighted-mean local polarization potential (PP) extracted from CDCC calculations and included in the CRC scheme. This approach enables a simultaneous description of the different reaction mechanisms.

Keywords: weakly bound nuclei; elastic scattering; inelastic scattering; transfer process; breakup process.