Elastic scattering and heavy residue production in the collisions ^{6,7}Li+^{64}Zn around the Coulomb barrier

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The study of nuclear collisions involving halo or, more in general, weakly bound nuclei at energies around the Coulomb barrier had a considerable interest in the last decade, since the peculiar structure of the colliding nuclei can deeply affect the reaction mechanisms (see e.g. [1–3] and refs. therein). We measured elastic scattering angular distributions and heavy residue production cross sections at several energies around the Coulomb barrier in the collisions ^{6,7}Li+^{64}Zn. Elastic scattering angular distributions have been reproduced within the Optical Model using renormalized double folding potentials for the real and imaginary part. The extracted energy dependence of the renormalization factors clearly show absence of the usual threshold anomaly in the optical potential, as already observed in other systems involving weakly bound nuclei.

The heavy residue production cross sections have been measured by using an activation technique, detecting off line the atomic X rays following the E.C. decay of the residues, allowing their mass and charge identification. The heavy residue excitation function ratio $\sigma(^{6}\mathrm{Li}+^{64}\mathrm{Zn})/\sigma(^{7}\mathrm{Li}+^{64}\mathrm{Zn})$ shows an increasing trend as the energy is decreased below the barrier as already observed by other authors for different similar systems (see e.g. [4] and refs. therein). The experimental relative yields of the heavy residues have been compared with the predictions of the statistical model code CASCADE. Such comparison suggests that heavy residue production is dominated by complete fusion (CF) at above barrier energies whereas, in the region below the barrier, other mechanisms such as incomplete fusion (ICF) are dominating. The large yield of ^{65}Zn observed in the low energy region suggests that, together with ICF, an important n-transfer contribution could also be present. This would be in agreement with the results of [5, 6], showing that in ^{6,7}Li induced collisions breakup triggered by n transfer is an important channel. Results confirm, to our opinion, that the study of fusion reactions induced by light weakly bound nuclei on medium mass targets presents a number of experimental challenges. Although the experimental problems related with the low energy of the produced evaporation residues can be overcome by using activation or on–line gamma ray techniques, a clear separation of CF, ICF and transfer cannot be easily achieved and transfer processes might contaminate what are believed to be total fusion excitation functions.

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