Scattering studies of the halo nucleus ^{11}Li and its core ^{9}Li on ^{208}Pb near the Coulomb barrier, Scattering and Reaction dynamics

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The scattering of ^{11}Li on a high-Z target at energies near and below the Coulomb barrier can unveil new features of halo nuclei. The nucleus ^{11}Li has a halo structure of two neutrons with very low binding energy due to its loosely bound structure (S_{2n}=369.15 (65) keV[1]), one expects that collisions with heavy targets at energies around the Coulomb barrier will depart from Rutherford. And this deviation can shed light on the nuclear halo as well as on the scattering process and how this process depends on coupling to the continuum. In particular, the effect of dipole polarizability is known to affect strongly the elastic scattering of halo nuclei on heavy targets, even at energies below the Coulomb barrier, where nuclear forces should not be dominant. Two effects are noticeable: First, Coulomb break-up reduces the elastic cross sections. Second, the distortion of the wave function generated by the displacement of the charged core with respect to the center of mass of the nucleus reduces the Coulomb repulsion, and with it the elastic cross sections.

We report here on the experiment, performed in 2008 at the ISAC-II facility at TRIUMF, where the break-up and elastic differential cross section of ^{11}Li on ^{208}Pb at laboratory energies of 2.2 and 2.7 MeV/u was measured. For comparison and in order to decouple the behaviour of the core, ^{9}Li, from the system, ^{11}Li, the scattering of its core ^{9}Li at the same CM energies was also measured. Furthermore to characterize the Optical Potential (OP) for the ^{9}Li+^{208}Pb system, scattering of ^{9}Li at 3.67 MeV/u was also measured. We used a set of four telescopes with DSSSD, SSSD and PAD silicon detectors in order to clearly identify all fragments in the angular range relevant for this study, from 10 to 140 degrees.

It has been found that the measured ^{11}Li+^{208}Pb elastic cross sections show significant deviations from Rutherford even at energies below the Coulomb barrier. The ratio between the breakup and elastic cross section of ^{11}Li on ^{208}Pb at 24 and 29 MeV as well as the experimental energy distribution of the breakup products from ^{11}Li scattering at forward angles are according with CDCC energy calculations of di-neutron model assuming direct breakup.

In this contribution we will present the preliminary results, the optimum OP parameterization able to describe the elastic cross section, the comparison with different models and the main conclusions achieved.

[1] M. et al., Phys. Rev. Lett. 101, 202501 (2008).