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Scattering of 15C on 208Pb at energies near the Coulomb barrier

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Nuclear systems such as 6He, 11Li, 11Be, 14Be are known to have extended neutron distributions: the so-called neutron halos [1, 2]. This feature occurs when the separation energy of valence neutrons is much smaller than the average binding energy per nucleon in a nucleus, so they can tunnel out of the nuclear potential to large distances with sizable probability. It has been an intense experimental and theoretical activity dedicated to study the existence of halos and their dynamics in reaction processes. The neutron halo produces a pronounced maxima at low excitation energies in the Coulomb dipole strength B(E1), very narrow transverse momentum distributions and large interaction cross-sections when measured at high energies [3].
The dynamics of the halo nuclei scattering at low energies, around the Coulomb barrier, is dominated by the coupling between the elastic channel and collective excitations, neutron transfer and breakup. The angular distributions of the elastic cross section and the core fragments present large sensitivity to these coupling effects, which are due to the halo configuration. This has been demonstrated by us in previous studies with light exotic beams of 6He, 11Li and 11Be scattered on heavy targets [4, 5, 6]. The angular distribution of the elastic channels shows strong absorption patterns where the nuclear and Coulomb interference completely disappears. The 15C nucleus (T1/2 =2.449(5) s) has a low single- neutron separation energy Sn=1218.1(8) keV in comparison with the two-neutron separation energy S2n=9394.5(8) keV [7]. The spins and parities of the ground and first excited state at E=740 keV are known to be Iπ=1/2+, 5/2+, respectively.
The halo structure of 15C has been investigated at relatively high energies in several experiments. The reaction cross section at high energy (83 MeV/u) shows an enhancement respect to the neighboring 14,16C isotopes and the longitudinal momenta of the 14C fragments after 1n-breakup present a FWHM distribution between 64-70 MeV/c depending of the target [8, 9, 10] that it is narrower than that of the neighbour 14,16C isotopes, ≈ 200 MeV/c, but wider than the ≈ 40-50 MeV/c found for the archetype cases [3]. These properties have hinted the presence of a halo configuration in the 15C nucleus that would be unique in the sense that it can be described with an almost pure s1/2 ground state wavefunction.
To complete our understanding of the role of the halo in 15C, we have studied its dynamical response at energies close to the Coulomb barrier that has not been yet probed until this work. We studied the scattering of 4.37 MeV/u 15C beam on a lead target at HIE-ISOLDE, CERN using the GLORIA setup [10]. We've also measured a stable beam of 12C under the same conditions. In this contribution, we will present the angular distribution of the elastic cross section of 15C + 208Pb relative to 12C in order to avoid solid angle uncertainties. Optical Model calculations properly describe the angular distribution of the elastic channel and indicate an enhancement of the total reaction cross section.

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