^{6}He+^{64}Zn around the Coulomb barrier

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Effects on the fusion cross-section are predicted by theoretical models in reaction induced by halo nuclei below and around the Coulomb barrier [e.g. 1]. Different models disagree about the role played by the break-up of the loosely bound halo nucleon. The reaction studied experimentally so far are not yet sufficient to clarify this physics[2-4]. No data for fusion evaporation reactions induced by halo nuclei on medium mass targets below the barrier are available so far owing to the low beam current, small cross-section and low evaporation residue (E.R.) energies. Moreover indirect E.R. detection, via on-line or off-line gamma spectroscopy, would also be very difficult due to the combination of low E.R. yield with low detector efficiency.

The reaction ^{6}He+^{64}Zn was investigated in order to study the effect of the ^{6}He structure on the fusion cross section around the Coulomb barrier. An excitation function for fusion reaction was performed by using the activation thecnique. The E.R. produced by fusion decay by Electron Capture (E.C.) so they are detected and identified by measuring the X-ray emitted after E.C. decay using a Si-Li detector. The clear advantage of the off-line X-ray technique is the 100% intrinsic detection efficiency and the low background for X-ray detection. We clearly identified five E.R. previously predicted by statistical model calculations (^{68}Ge, ^{66,67,68}Ga and ^{65}Zn) with half-lifes ranging from 1 hour to 300 days. Different isotopes of the same element which cannot be distinguished by atomic X-ray spectroscopy can be identified following the activity curve as a function of time. An activation run using a ^{4}He beam was performed in order to check the absolute normalisation by comparing our results with previously measured excitation function for ^{4}He+^{64}Zn using radiochemical method [5]. Along with the fusion excitation function, elastic scattering and transfer reactions were measured. The contribution of the transfer channel has been clearly identified for the first time in such kind of studies.

[1] C.Signorini et al. Nucl.Phys. A616(1997)262c
[2] J.J.Kolata et al. Phys.Rev.Lett. 81(1998)4580
[3] M.Trotta et al. Phys.Rev.Lett. 84(2000)5058
[4] C.Signorini et al. Eur.Phys.J. A2(1998)227
[5] F.H.Ruddy and b.d.Pate Nucl.Phys. A127(1969)305