Scattering process of ^{11}Be from ^{209}Bi at Coulomb barrier energies

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In our experiment we studied the scattering process of ^{11}Be from ^{209}Bi. The ^{11}Be secondary beam ($S_n = 0.504$ MeV) was obtained via fragmentation of a high energy ^{13}C primary beam impinging on a thick Be target at 100 A·MeV. The reaction products were separated with the RIPS facility at RIKEN and heavy reduced in energy by means of an aluminum degrader. The outcoming ^{11}Be beam had a Lorentzian shape centered at 43 MeV with a FWHM of 15 MeV, an overall intensity of 10^5 pps and a beam size at the target position of 27 mm (x axis) $\times$ 19 mm (y axis). The measurement of the scattering process with such a poor emittance and low intensity secondary beam was possible by tracking the incident beam with position sensitive detectors and by detecting the scattered particles with the high granularity EXODET array [1], which subtends $\sim 2\pi$ sr and allows for a position resolution of $\sim 1°$.

The scattering angular distributions were evaluated for 2-MeV energy bins in the energy range between 40 and 48 MeV and they turned out to be rather similar to those obtained for ^{9}Be ($S_n = 1.554$ MeV) nuclei interacting with a ^{209}Bi target. This similarity, also observed for the fusion cross sections of both systems [2], suggests moderate effects due to the low binding energy on the reaction dynamics at Coulomb barrier energies. A further comparison shows that for system ^{11}Be + ^{209}Bi the reaction cross section is much larger than the fusion one. Since in this energy range a few processes (namely fusion, inelastic excitations, breakup processes) are expected to exhaust the whole reaction cross section, this discrepancy could by solved by a strong breakup channel ^{11}Be $\rightarrow$ ^{10}Be + n. The deduced reaction cross section were also compared with those obtained for other weakly bound projectiles (^{9}Be, ^{6,8}Li and ^{6}He) interacting with high-Z target (^{208}Pb and ^{209}Bi), see Fig. 1. Among all of them, ^{6}He exhibits the highest "reactivity" at Coulomb barrier energies, even if its binding energy ($S_{2n} = 0.972$ MeV) is larger than for ^{11}Be. Theoretical analyses are going on to investigate the origin of this unexpected behavior.

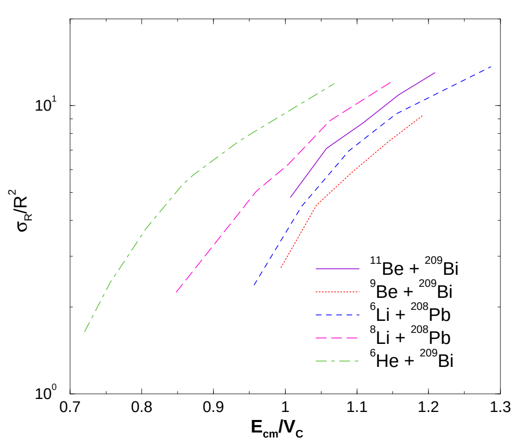

Figure 1: *Reaction cross sections for five similar mass systems at Coulomb barrier energies. Data are been divided by R^2, with R sum of the projectile and target radii, and plotted vs. E_{cm}/V_C.*

[1] M. Romoli et al., IEEE Transaction on Nuclear Science 52, 1860 (2005)

[2] C. Signorini et al., Nucl. Phys. A 735, 329 (2004)