Role of cluster structure of $^7$Li in the dynamics of fragment capture


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In weakly bound nuclear systems, correlation among nucleons and pairing are manifested, among others, as an emergence of strong clustering and exotic shapes [1]. Lithium isotopes present a unique example of nuclear clustering, with lighter isotopes ($^6$, $^7$Li) having a well-known $\alpha + x$ cluster structure and the heaviest bound isotope ($^{11}$Li) exhibiting a two neutron Borromean structure. $^9$Li has been described as $^6$He + $t$ in a recent work. $^7$Li is an equally interesting case with its well-known weakly bound $\alpha + t$ structure as well as less studied more strongly bound clusters, $^6$He + $p$ and $^5$He + $d$. Recent studies with weakly bound nuclei have also focused on the understanding of the role of novel structures in the reaction dynamics [2]. Dominant reaction modes in nuclei with low binding energies, involve inelastic excitation to low lying states in the continuum or transfer/capture of one of the cluster fragments from their bound/unbound states to the colliding partner nucleus [3].

We have performed exclusive particle-gamma coincidence measurements in the $^7$Li + $^{198}$Pt system to study the dynamics of the process of fragment capture for the various cluster structures ($\alpha + t$, $^6$He + $p$ and $^5$He + $d$) of $^7$Li, at energy near the Coulomb barrier. Recent dynamic classical trajectory calculations [3], constrained by the measured fusion, $\alpha$ and $t$ capture cross-sections have been used to explain the excitation energy dependence of the residue cross-sections. Comparison of results from the calculations with the measured data, illustrating the role played by the cluster structures of $^7$Li in understanding the reaction dynamics will be presented.