

Title: Measurement of projectile breakup cross-sections in ${}^6,{}^7\text{Li}+{}^{112}\text{Sn}$ reactions

This highlights results of one of the completed thesis work which deals with the understanding of breakup reactions of weakly bound stable projectiles ${}^6,{}^7\text{Li}$ by medium mass nuclei ${}^{112}\text{Sn}$. Since ${}^6,{}^7\text{Li}$ nuclei have very low breakup threshold, similar to some of the exotic nuclei near drip lines, the study of the reaction mechanism involving these nuclei will be very useful to understand some of the important features of the reactions involving exotic nuclei. From the present study, it is observed that ${}^6\text{Li}$ (${}^7\text{Li}$) not only breaks into its cluster constituents $\alpha+d$ ($\alpha+t$), but also exchange some nucleons with the target before forming the quasi-bound nuclei which subsequently break into $\alpha+y$ particles, where 'y' can be an α , d, p, etc. A schematic diagram representing different pathways of projectile breakup phenomena are shown in Fig. 1. In order to capture all the breakup fragments a large area silicon strip detector (telescope) array has been setup and used for the experiments at BARC-TIFR Pelletron-LINAC Facility, Mumbai. A Monte Carlo Simulation Code has been developed in C++ to find out the efficiency of the strip detector array. A simulation using GEANT4 has also been performed for the same purpose. Several kinematic correlation techniques are used to identify the breakup fragments in coincidence and compared with the simulation.

Exclusive measurements of all the dominant breakup modes producing light charged particles in the outgoing channels have been made. Several new and interesting results, like the breakup of ${}^6\text{Li}$ through its 1^+ resonant state, ${}^7\text{Li}$ via its $5/2^-$ resonant state and ${}^8\text{Be}$ via its 4^+ resonant state, have been observed for the first time. The identification of direct breakup of ${}^7\text{Li}$ into ${}^6\text{He}+p$ has also been observed for the first time suggesting the possibility of additional cluster structure of ${}^7\text{Li}$. Different breakup channels responsible for high inclusive α production have been disentangled. Coupled channels calculations using FRESKO have been performed to understand the experimental breakup cross-sections. The detailed study of resonant, direct and transfer induced breakup into fragments via different resonant states provides a good foundation towards understanding the reaction mechanisms of total α production, the sequential modes of projectile breakup and their impact on fusion cross sections.

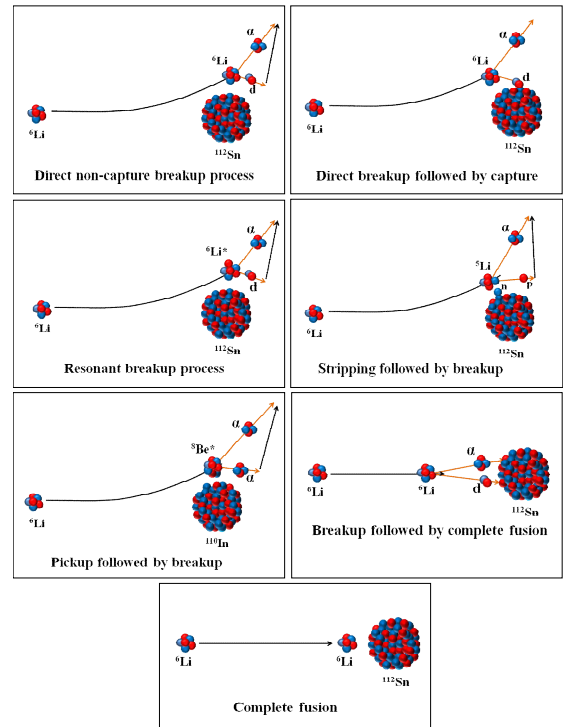


Figure 1. Different possible pathways when weakly bound nuclei like ${}^6\text{Li}$ is used as projectile

References:(1) "Resonant, direct, and transfer breakup of ${}^6\text{Li}$ by ${}^{112}\text{Sn}$ "- Phys. Rev. C **94**, 061602(R) (2016). (2) "Role of cluster structure in the breakup of ${}^7\text{Li}$ "-D. Chattopadhyay, Phys. Rev. C **97**, 051601(R) (2018). (3) "Resonant breakup of ${}^8\text{Be}$ in ${}^{112}\text{Sn}({}^7\text{Li}, {}^8\text{Be} \rightarrow 2\alpha)$ reaction"- Phys. Rev. C **98**, 014609 (2018).

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