

Exploring Nuclear Reaction Dynamics using Radioactive Ion Beams through α and β -Decay Spectroscopy

The investigation of nuclear reaction cross-sections for the creation of isotopes using radioactive ion beams (RIB) and studying their decay modes has been a critical source of understanding for nuclear reaction dynamics. While much of the experimental research on nuclear properties has focused on nuclei near the valley of stability, however, with the availability of RIBs, recent attention has turned to studying nuclei far from stability. Measuring systems at the limits may provide important information that, when contrasted with more stable systems, can shed light on the underlying physics and improve our understanding of the reaction dynamics. Some of the recent significant advancements include the discovery of additional heavy chemical elements, the observation of neutron halos in highly neutron-rich nuclei, and the experimental mapping of nuclear shell structures far from stability. We are an established group and have made significant contribution to the study of pre-compound emission and complete fusion (CF) / breakup fusion (BUF) reaction dynamics using stable beams obtained from the Variable Energy Cyclotron Centre (VECC), Kolkata and Pelletron Accelerator of the Inter University accelerator Centre (IUAC), New Delhi, India, respectively. With the availability of the ANURIB facility at VECC, it would be possible to produce exotic nuclei and study their properties, that are generally, not accessible using stable beams, by measuring their cross-sections over a range of energies through α and/or β -decay spectroscopy. However, conducting experiments using RIBs requires special beam and detector technology development, crucial for these studies. Many neutron halos, of one neutron or two-neutron character, have been identified in the nuclear chart e.g., ^{11}Be , ^{15}C , and ^{19}C for the former and ^6He , ^{11}Li , and ^{14}Be for the latter. Some useful beams for the measurements from the point of view of reaction dynamics studies may also include ^9Be , ^{14}C , ^{15}O , ^{18}F , and many more. As soon as some of these beams are developed, the reaction dynamics studies using RIB's may be initiated. Comparing the cross-sections of populated residues with stable and unstable beams over a range of energies, may provide important information on the reaction dynamics that can help in developing and/or extending the systematics on BUF contributions as well. Further, the proposed proton and neutron beamlines at the facility may give additional advantage of studying the nuclear reactions and measuring cross-sections with better accuracies. This talk will present the details of some proposed experiments using radioactive ion beams.

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