Contribution ID: **160** Type: **Poster**

Reaction processes at near barrier energies: the case of 9Be+197Au

Monday, 20 September 2021 15:45 (2 hours)

Recent studies of nuclear reactions involving weakly bound stable nuclei, ^{6,7}Li and ^{9}Be have revealed several interesting phenomena [1]. The low breakup threshold, small binding energy, and cluster structure are some of the unique features of these nuclei, which strongly influence the reaction dynamics at near barrier energies. The simultaneous measurement of complete/ incomplete fusion and direct reactions (e.g. neutron transfer) can provide insight into the underlying mechanism. With this motivation, the excitation functions for complete fusion (CF), incomplete fusion (ICF), and transfer channels have been measured in ^{9}Be+^{197}Au system, over the energy range $0.76 \leq E_{c.m.}/V_B \leq 1.16$ (V_B = 38.4 MeV). The experiment was carried out at the BARC-TIFR Pelletron-Linac Facility, Mumbai, India, by employing the stack-foil technique followed by offline gamma spectroscopy with two HPGe detectors. Theoretical model calculations using CCFULL and FRESCO codes are employed to interpret the measured cross-section data. The coupled channel calculations (CCFULL) successfully describe the data at sub-barrier energies and indicate $\sim 40\%$ fusion suppression at above barrier energies [2]. Further, it is observed that amongst x+^{197}Au systems, where x represents stable projectiles with Z = 2-5, the enhancement in sub barrier fusion is largest for ^{9}Be. The ground state deformation of ^{9}Be is shown to play an important role in sub barrier fusion along with the weak binding.
At sub barrier energies, the transfer process has been found to be dominant [3] in ^{9}Be+^{197}Au, and the ratio of transfer to CF cross-sections is considerably higher in comparison to ^{6,7}Li+^{197}Au systems. The CRC calculations for $1n$-stripping (^{198}Au) highlight the role of 2+ resonance state of ^{8}Be, as it provides better matching with the Q-value (4.85 MeV) of the reaction. The present studies indicate that observed differences amongst reactions with ^{6,7}Li, ^{9}Be can be attributed to the structural differences in these projectiles, and have also highlighted the impact of the large deformation as well as a spatial extension of ^{9}Be nucleus. Details will be presented.

References

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Session Classification: Poster Session 1

Track Classification: Nuclear Structure, Reactions and Dynamics