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Low-energy incomplete fusion: A systematic study of entrance channel parameters

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Research into heavy-ion (HI) fusion, a key area of modern nuclear reaction physics, has flourished in recent decades pursuant to developments in accelerator technology. The primary goal of studying HI reactions is to gain knowledge about the underlying processes and how they are affected by entrance channel parameters, such as beam energy, angular momentum, and mass asymmetry. The fusion mechanism of non-α-cluster projectiles, such 14N and 19F, has been studied in the low-energy zone. It has been challenging to analyze the contributing degrees of freedom in such reactions due to the absence of experimental data. The present study reports the measurement of residual cross sections from the 19F induced reaction on 93Nb within the energy range of 3-7 MeV/A. The stack foil activation technique followed by offline γ spectroscopy was employed to measure the cross sections of residues populated in the reaction. The experimental data were compared with theoretical predictions from statistical model code PACE4 to probe the underlying reaction dynamics. The imitation of xn and pxn channel data grossly by model code suggests the production of residues via the complete fusion (CF) mode, while the enhancement observation in α-channel cross sections hints at the signatures of incomplete fusion in addition to the dominant CF. Thus, the ICF strength fraction (FICF) was calculated. Moreover, the estimated incomplete fusion fraction has been used to study the effect of several entrance channel parameters on incomplete fusion reaction dynamics. The present analysis shows the presence of strong clustering in the 19F projectile as α and 15N.

Section

Heavy ion collisions at Intermediate and high energies

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