A systematic study: some insights into the low-energy incomplete fusion reactions[$]

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Heavy-ion fusion reactions play a crucial role in producing and investigating the exotic nuclei, thus understanding the reaction dynamics involved in these processes has always been a subject of significant research interest. The only reactions that are anticipated to contribute to the total fusion cross section, for medium mass-region nuclei and above barrier energies, are the complete fusion (CF) processes occur for l-window 0 to l_{crit}. However, for peripheral collisions and/or at higher incident energies, the fusion pocket vanishes for $l > l_{crit}$ in the effective potential-energy curve, and as a consequence the projectile breaks up into its constituent clusters to impart maintainable input angular-momentum to the system, which leads to the incomplete fusion reactions (ICF). Since the observation of ICF reactions [1], various models were proposed to explain these observables [2-3]. Most of these models are found to fit the experimental data at energies >10 MeV/nucleon to a large extent [2-4], however, at low-energies 4-7 MeV/nucleon, the mechanism of incomplete mass transfer is not well understood [5-7]. It is not out of place to mention that, presently, no theoretical model is available which could reproduce the low energy ICF data satisfactorily. Hence, in recent years, the study of low energy ICF reactions has triggered the resurgent interest to correlate the onset of ICF with entrance channel parameters and to look for the general systematics. Morgenstern *et al.* [4] correlated the ICF fraction with entrance channel mass asymmetry, however, dependency of low-energy incomplete fusion on various entrance channel parameters have been studied [5-8]. In one of our papers shows the dependence of F_{ICF} on the target mass or Z_PZ_T of interacting partners for a wide range of projectile-target combinations [5], however, the limitation of Z_PZ_T-systematics have been explained in one of our recent papers [7], in light of the α-Q-value systematics [6]. Further, an attempt has been made to explain the trends of incomplete fusion fractions through the total asymmetry parameter and the system parameter, where system parameter seems to explain the data more satisfactorily, as it incorporates the Coulomb-factor as well as the masses of the interacting partners [8]. Furthermore, the limitations of system parameter systematics and possible pathway for some universal systematic for ICF at low energies will be discussed during the conference.

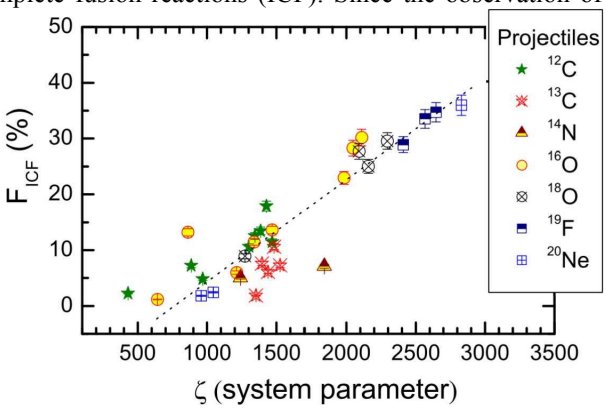

Fig.1: Comparison of F_{ICF} with the system parameter for different systems at constant E_{lab}/V_b energy.

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