Projectile – Mass asymmetry systematics for low energy incomplete fusion

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Incomplete fusion (ICF), in which only a fraction of incident projectile amalgamates with target nucleus, has got resurgent interest in recent years. A variety of inclusive experiments has been performed at the Inter-University Accelerator Centre (IUAC), New Delhi to better understand ICF dynamics [1-7]. In our intense investigations, ICF has been found to be a process of greater importance at energies as low as ≈ 3.5 – 7 MeV/nucleon with an unexpected onset at slightly above barrier energies [2]. The very existence of ICF at these energies has been demonstrated in the measurement of forward recoil ranges, where multiple linear momentum transfer components have been clearly disentangled [3,5]. The onset of ICF at slightly above barrier energies has been emphasized in the spin-distribution measurements [4]. The low energy ICF has been correlated with the driving input-angular-momenta imparted into the system in peripheral interactions. It has been found that the ICF sets in due to the intricate interplay of input angular momenta associated with the increased range of impact parameters [6].

One of the outstanding findings of the IUAC data reconciles famous mass-asymmetry systematics [8] for ICF as a projectile dependent mass-asymmetry (ProMass) systematics [7]. According to Morgenstern et al. [8], the ICF is supposed to onset above relative velocity $\beta = 0.06$ (*i.e.,* 6 % of c) with increasing probability for more mass-asymmetric systems. Recently [1-7], it has been found that the ICF starts competing with complete fusion at noticeably lower β-values (*i.e.,* 0.025 or 2.5 % of c) and displays strong projectile dependence. The percentage fraction of ICF increases with entrance channel mass-asymmetry for individual projectiles. The ProMass - systematics has withstood all tests that have been done for fairly large number of systems to verify its validness. Recent experimental results on ICF will be discussed in light of the ProMass – systematics during the conference.

References:

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