Dependence of low energy in-complete fusion on projectile's α-Q-value

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During the last couple of decades, with the observation of incomplete fusion (ICF) reactions at low energies ≈ 4-7 MeV/nucleon, considerable efforts are being employed to look for the systematics of ICF reactions at these energies, where complete fusion (CF) is supposed to be the sole contributor to the total fusion cross section [1-4]. Presently, no theoretical model is available which could reproduce the low energy ICF data satisfactorily [4-7]. Hence, in recent years, study of ICF at near barrier energies triggered the resurgent interest to correlate the onset of ICF with entrance channel parameters and to look for the general systematics.

In ICF reactions, the incident projectile is breaks up into its fragments as a consequence of excess input angular momentum, and one of the breakup fragments fuses with the target nucleus [3]. The onset of ICF at slightly above barrier energies has been emphasized in the excitation function (EFs) measurements [6], however, a clear existence of ICF at low incident energies has been demonstrated by measuring more than one linear momentum transfer components in the forward recoil ranges [5]. In addition to this, the unclear or ambiguous dependences of ICF on various entrance channel parameters have also been explored and contradicting dependences of the fraction of incomplete fusion have been reported [1,7]. Morgenstern et al. [2] correlated the ICF fraction with entrance channel mass asymmetry (μA). Recently, Singh et al. [4] introduced the importance of projectile structure in ProMass-systematics. Hence, in order to explore the above aspects and to find a consistent general systematics for low energy ICF reactions, several experiments have been performed [5-7]. The measurements of EFs for $^{12,13}C+^{159}Tb$ systems have been performed, where significant contribution of ICF reactions have been observed. Here, the break-up probability for ^{13}C projectile is found to be noticeably smaller than for ^{12}C projectile, which has been explained on the basis of the proposed '*alpha-Q-value systematics*'. Further, details regarding the experiment and analysis of data in light of the effect of projectile structure, particularly, the α-Q-value of the projectile on the ICF strength function will be presented.

References:

1. M. DasGupta et al., Phys. Rev. C 66, 041602(R) (2002).
2. H. Morgenstern et al., Phys. Rev. Lett. 52, 1104 (1984).
3. Pushpendra P. Singh et al., Phys. Lett. B 671, 20 (2009).
4. Pushpendra P. Singh et al., Phys. Rev. C 77, 014607 (2008).
5. Abhishek Yadav et al., Phys. Rev. C 85, 064617 (2012).
6. Abhishek Yadav et al., Phys. Rev. C 85, 034614 (2012).
7. Abhishek Yadav et al., Phys. Rev. C 86, 014603 (2012).