Investigating incomplete fusion channels in ^{12}C+^{193}Ir system

Amanjot[1],* Malika Kaushik[1], Priyanka[1], Manoj Kumar Sharma[2], Rakesh Kumar[3], Yashraj Jangid[3], Ishtiaq Ahmed[3], Sushil Kumar[3], and Pushpendra P. Singh[1]
[1] *Department of Physics, Indian Institute of Technology Ropar, Rupnagar - 140 001, Punjab, India*
[2] *Department of Physics, University of Lucknow, Lucknow - 226 007, India and*
[3] *Inter-University Accelerator Center, Aruna Asaf Ali Marg, New Delhi - 110 067, India*

The heavy-ion-induced nuclear reactions at low incident energies have been one of the most intriguing topics of interest over the past few decades. Usually, at these energies, the total fusion cross-section is greatly influenced by complete fusion (CF) reactions. However, many experiments have been conducted to investigate incomplete fusion (ICF) reaction dynamics depending on various parameters of the entrance channels, in addition to Britt and Quinton's first observation of ICF reaction [1]. The present work focuses on measuring the cross-sections of the evaporation residues produced by CF and/or ICF in a reaction involving ^{12}C, an α cluster-structured projectile with ^{193}Ir target at energies 84 and 81 MeV, employing the stacked foil activation technique. The experiment has been carried out in General Purpose Scattering Chamber using a ^{12}C projectile beam from the 15UD Pelletron accelerator facility at Inter-University Accelerator Centre, New Delhi. After the bombardment, off-beam γ-ray spectroscopy was used to determine the activity of the residues produced in the Ir target. The residues have been identified using characteristic gamma rays and decay-curve analysis. The excitation functions for five reaction products viz., $^{205-x}$Bi (xn), x=4,5; $^{204-x}$Pb (pxn), x=3,4; and $^{201-x}$Tl (αxn), x=3 have been identified. A statistical reaction model code, PACE4, based on Hauser-Feshback's theory of compound nucleus decay, was employed to analyze experimental cross-sections that only consider the CF reaction's contribution [2]. An enhancement in the measured excitation functions has been observed as compared to PACE4 predictions. However, an enhancement in ^{201}Bi (4n) can be attributed to precompound emission, as shown in FIG. 1. It should be remarked that ^{200}Bi (5n) has both the metastable and ground states of 31 and 36.4 min half-lives, respectively. It has been observed that precursor decay contributes significantly to the decay of pxn channels. An advancement in ^{198}Tl (α3n) has been noticed (ref. FIG. 1), which signifies that ICF reactions are involved in the formation of α emitting channels. A detailed analysis of the present work will be presented during the conference.

FIG. 1: The excitation functions for (a) ^{201}Bi (4n), and (b) ^{198}Tl (α3n) populated in ^{12}C + ^{193}Ir system. Solid squares represent the experimental data, and solid lines correspond to theoretical predictions of PACE4 code for K=8, K=10 and K=12 level density parameters.

[1] H. C. Britt and A. R. Quinton, Phys. Rev. **124** (1961) 877-887.
[2] A. Gavron, Phys. Rev. C **21** (1980) 230-236.

*One of the authors, Amanjot, would like to thank the INSPIRE fellowship from the Department of Science & Technology (DST), Government of India.