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Understanding the fission dynamics in ^{12}C+^{193}Ir system

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Since the discovery of fission, heavy-ion induced reactions leading to fission of actinides have been extensively investigated both experimentally and theoretically. The experimental data in the pre-actinide region is limited due to very low fission probability leading to less statistics at low energies where the shell effects are more prominent. However, the unexpected onset of fission-like events at slightly above barrier energies needs to be investigated for better insight into the low-energy heavy-ion induced fission. An experiment has been performed in ^{12}C+^{193}Ir system at E_{lab} = 83.99, 80.99, 74.81 and 70.08 MeV using the 15UD Pelletron accelerator facilities at the Inter-University Accelerator Center, New Delhi. Prime objective of this study is to investigate various aspects of heavy-ion induced fission resulting from the evolution of a composite system via complete and/or incomplete fusion in the ^{12}C + ^{193}Ir system.

The production cross-sections of fission-like events were measured to draw mass distribution and analysed to obtain the dispersion parameters of fission fragments. In this work, a large number of fission-like events in the mass range 72≤A≤134 were identified at four studied energies. The resulting mass distribution of the fission-like residues was symmetric and fitted with a Gaussian function, peaking around the half mass of the compound nucleus, indicating their onset from the decay of the compound nucleus formed via complete and/or incomplete fusion [1]. Further, the mass variance (σ_m^2) of fission-like events increases with excitation energy above the Coulomb barrier, suggesting a broader distribution of fission fragment masses at higher energies. This trend in mass variance with excitation energy aligns with previous findings by Ghosh et al.[2], at energies above the Coulomb barrier. To gain further insights into the nature of mass distribution, the measured widths are compared with the statistical model calculations performed for fusion-fission channels. The role of the entrance-channel mass-asymmetry (α = (A_T-A_P)/(A_T+A_P)) on the mass distribution of fission-like fragments, and the effect of α on the mass variance (σ_m^2) has been studied. The results indicate that there is a linear increase in σ_m^2 with increasing mass α of the entrance channel. This suggests a broader mass distribution of fission-like residues for more mass-asymmetric systems. Detailed results and analysis will be presented during the conference.

[1] Rupinderjeet Kaur et. al, under review (2025); arXiv:2409.14520.

[2] T. K. Ghosh, S. Pal, K. S. Golda, and P.Bhattacharya, Phys. Lett. B 627, 26 (2005), and the references therein.

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