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Probing Nuclear Collective Motion at Finite Temperature and Angular Momentum: The fusion-fission Route

I. Mazumdar[1]

[1]Tata Institute of Fundamental Research, Mumbai 400 005, India

Abstract. Studies in heavy-ion induced fusion-fission process has established itself as one of the major branches of low and medium energy nuclear structure and reaction physics. A plethora of dynamical processes manifest through the fusion-fission of two atomic nuclei over a wide range of projectile energy. The process of fission followed by fusion of two heavy nuclei or survival of the Compound Nucleus (CN) against fission and formation of Evaporation Residues (ER) are deeply connected with various factors like, nuclear shell structure, target-projectile mass asymmetry, projectile energy, angular momentum distribution in the CN etc. Other than studying the dynamical effect associated with fusion and subsequent fission (or survival against fission) of heavy CN, there is also the long-standing desire to understand formation of very heavy or Super Heavy Elements (SHE). In this talk we plan to review the present status of heavy-ion induced fusion-fission processes at energies above the Coulomb Barrier. We would like to touch upon aspects of fission followed by complete and incomplete fusion and processes like fast and quasi-fission. We will be primarily drawing from our measurements carried out at Inter University Accelerator Centre, New Delhi using the Hybrid Recoil mass Analyser (HYRA) coupled with the TIFR 4π Sum-Spin spectrometer. We will summarise what we have learnt so far and what are the unresolved problems. Detailed analyses using both Statistical and Dynamical Model formalisms will be presented. We will also discuss the very important role of dissipative mechanism or nuclear viscosity in the survival of the CN against fission. It is worth noting that the Giant Dipole Resonance (GDR) is another fascinating mode of nuclear collective motion. In this talk, we will make an effort to discuss the underlying fundamental aspects of correlated nuclear motion at finite temperature and angular momentum through two different but most prominent collective motions, fission and GDR. We will address the common link of viscosity and how far the collectivity exists, an evergreen question in GDR, but can also be invoked in fission physics.