

A study of reactions mechanism in heavy ion at energies 5-7 MeV/A energies

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In recent years with the availability of heavy ion (HI) beams, the study of heavy ion reaction mechanism has become interesting due to possibility of a variety of reactions that may take place at moderate energies. Generally, the HI reactions are classified in term of the impact parameter. At higher values of impact parameter, direct reaction may take place leading to few nucleon transfer processes. However, at still smaller values of impact parameter the complete fusion (CF) and incomplete fusion (ICF) are important. Another way of classifying processes involved in HI induced reactions is through the degree of momentum transferred from the projectile to the target nucleus. In case of CF, the entire momentum is transferred to the target nucleus forming an excited composite system from which emission of particles may take place, while in case of ICF, only a part of the projectile fuses with the target nucleus and rest of it moves, as spectator, in the forward direction. This may lead to the fractional transfer of the incident momentum, which depends on the mass of the fused fragment. Some of the important characteristics of ICF reactions are; a) Incomplete momentum transfer, b) Forward peaked angular distribution of outgoing particles, c) Peaking of energy spectrum of outgoing particles at beam velocity and d) Higher production cross-sections for residues than predicted by fusion models. Pre-equilibrium (PE) emission of particles is also an important process at these energies.

In order to study CF, ICF and PE-emission in some reactions induced by oxygen ions on target nuclei ^{159}Tb and ^{169}Tm , we have measured the excitation functions (EFs) for several reactions in the energy range from 70 to 95 MeV measured, using activation technique. The experiments have been carried out at the Nuclear Science Centre (NSC), New Delhi, India. The measured excitation functions have been compared with theoretical calculations done using computer codes CASCADE, PACE2 and ALICE-91. The comparison of experimental data with theoretical ones has indicated significant contributions from PE-emission and ICF for some reaction channels. In order to separate out the relative contributions of complete and incomplete fusion channels, recoil range distributions of several residues produced in $^{16}\text{O}+^{159}\text{Tb}$ and $^{16}\text{O}+^{169}\text{Tm}$ systems have also been measured. Analysis of the recoil range distributions indicates that incomplete fusion in some cases may contribute more than 50% of the total reaction cross-section. Further details of the analysis will be presented.