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A Systematic Study of Excitation Functions of Various Evaporation Residues in Heavy Ion Reactions at Moderate Excitation Energy: Incomplete Fusion Vs Complete Fusion

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Study of heavy ion induced reactions with special reference incomplete fusion (ICF) and complete fusion (CF) process has been a subject of paramount interest of nuclear physicists working on heavy ion (HI) nuclear reactions at low and intermediate energies [1–4]. Measurement and analysis of excitation functions of various evaporation residues populated in nuclear reactions induced by heavy ions (HIs) occurring at near and above barrier energies provides inimitably sensitive probes of the actual reaction dynamics mostly associated in heavy ion interactions. Present work is an attempt to exclusively measure and study the excitation functions (EFs) of evaporation residues populated in 12C+159Tb system at energies ≈ 4.5 –6.5 MeV/nucleon. The stacked foil activation technique followed by offline γ –ray spectroscopy
with a high-resolution HPGe detector has been employed. The experimentally measured excitation functions are compared with the theoretical predictions obtained from statistical model code PACE- 4 [5]. For xn and/or pxn channels, the experimentally measured excitation functions are found to be in good agreement with theoretical predications. However, in case of α emitting-channels, the measured EFs had significantly more production cross-section values than PACE-4 predicated values, which may be credited to the incomplete fusion (ICF) of the projectile with the target nucleus.
The coupled channel (CC) calculations are also performed using a modified version of the code CCFULL [6] for the present system. CC calculation performed using the code CCFULL do not take into account the coupling to unbound or continuum state and hence the breakup of the incident projectile is not considered into account. The experimental data have been compared to the result of CC calculation. A good description of the experimentally measured CF cross section data can be obtained by multiplying the CC calculation, by a factor of 0.89. Thus, it can be concluded that experimentally measured CF cross sections for 12C+159Tb system have been suppressed by 11% in comparison to value predicted by CC calculations performed by using the code CCFULL.

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