Back angle quasi-elastic scattering & Fusion Excitation function and studies for the $^{12,13}C+^{197}Au$ reaction.

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Hot rotating compound nuclei with N ~ 126 formed through heavy ion fusion reactions have moderate fission barriers and offer a sensitive but experimentally feasible region to explore the possible shell closure effects on fission survival probability near the N=126 shell closure

The measured cross sections for the Evaporation Residues (ER) in the neighborhood of ^{216}Th (Z=90) produced in heavy-ion fusion reactions with ^{40}Ar [1] and heavier projectiles [2] do not show any noticeable enhancement due to shell stabilization around N=126, although a strong shell correction of 5 MeV is observed for the ground-state Compound Nucleus (CN) masses. The lack of shell stabilization against fission observed near the N = 126 shell is expected to have consequences for the production cross-sections of spherical super-heavy nuclei around magic neutron number N =184.

This motivated us to carry out the decay study of compound nuclei formed with neutron number across N=126 shell closure, through sufficiently asymmetric combination, with asymmetry clearly more than the αBG for the CN, in order to ascertain pure CN process. This should permit a systematic and clear observation of any CELD effects on the fission survivability of nuclei across shell closure, which is supposed to play a vital role in the anticipated, stabilization against fission for spherical nuclei near N = 126 [3].

Measurements have been carried out using the recoil mass separator HIRA at IUAC [4] for near barrier heavy ion reactions involving the systems $^{12,13}C+^{197}Au$. The experimental details are summarized in Ref [5].

Data for the 180° quasi elastic back scattering cross sections for the two reactions $^{12,13}C + ^{197}Au$ are shown in Figure 1. The data have been corrected for the beam energy and reaction dependent HIRA efficiency.

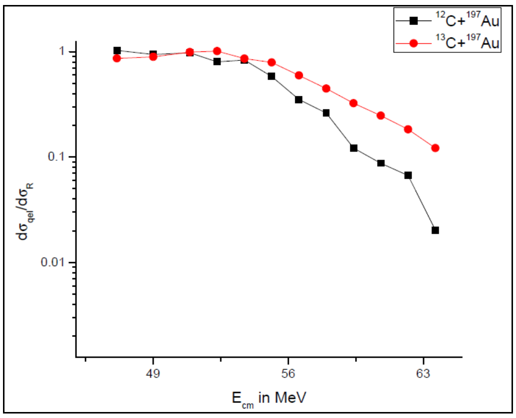

Fig. 1 The excitation function for quasi-elastic scattering at Θ_{cm} = 180° relative to Rutherford scattering.

The experiments yielded excitation functions for quasi-elastic reaction. The ratio of the measured cross section and the Rutherford scattering cross section was used to derive the L=0 partial wave transmission probability T_0 for $^{12,13}C+^{197}Au$ systems. The plots for T_0 vs E_{cm} are presented in Figure 2 for the $^{12,13}C+^{197}Au$ system.

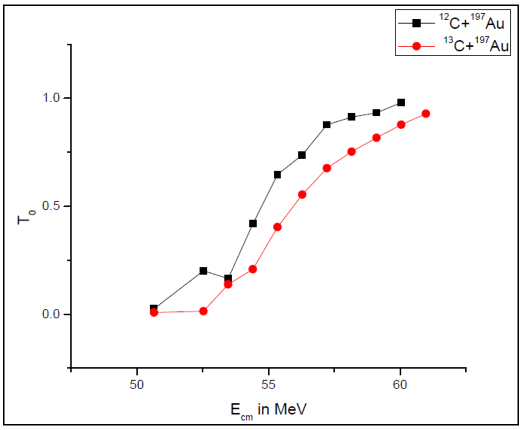

Fig. 2 Plot of Transmission Coefficient T_0 (for L=0) v/s E_{cm}

We obtain the Sigma-fusion at various beam energies by deriving transmission probabilities T_l for various L-values. Using a simple barrier penetration model, T_l at energy E may be taken as equal to T_0 at energy E-E_r where $E_r = L(L+1)\hbar^2/2\mu R_b^2$.

Following evaluation of sigma-fusion, the fission probability can be derived using the measured evaporation residue cross sections to compare with the models looking for possible CELD effects.

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