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

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Measurements have been carried out using the recoil mass separator HIRA at IUAC [1] for near barrier heavy ion reactions involving the systems $^{12,13}C+^{197}Au$. The reactions chosen form part of the reactions selected for the study of the fission survivability of hot rotating compound nuclei formed with increasing neutron number so as to cross N=126 shell closure while keeping the number of protons unchanged. The mass asymmetry of the selected reactions is chosen so as to be more than the α_{BG} to avoid extraneous effects due to contributions from possible non-compound processes while studying the fission survivability of hot rotating nuclei near neutron shell closure. This is in contrast with studies reported so far for the shell closure effects across N=126 shell on fission survivability which have their mass asymmetries lesser than the values of the corresponding α_{BG}.

The α_{BG} for the CN in the reaction $^{13}C+^{197}Au$ is 0.821 while the entrance channel has a higher value of asymmetry of 0.876. This condition is also true for the $^{12}C+^{197}Au$ reaction. This should ensure absence of non-compound processes as opposed to the reactions used earlier. The shell correction to the GS mass for the CN in the $^{13}C+^{197}Au$ reaction is -9.14 MeV and should provide for a good test for the so called Collective Enhancement in nuclear Level Density (CELD) effect [2-6].

The 180° back scattering measurements have been made for the $^{12,13}C+^{197}Au$ for the first time and are possible due to excellent beam rejection capability of the recoil separator HIRA. The data will be used to extract the fusion (capture) barrier distribution to determine the fusion cross sections. In the same experimental beam time, HIRA was also set for the Fusion Evaporation Residues (ER) and measurement of the ER Cross section has been carried out. There are earlier measurements on the fusion-ER cross section and fusion-fission cross section data for the $^{12}C+^{197}Au$ while data for back scattering and fusion-ER cross section for the $^{13}C+^{197}Au$ are obtained for the first time. The measurements leading to determination of the total fusion cross section and the fusion ER cross sections will enable the study of the fission survivability as one approaches N=126 shell closure.

Preliminary data for the 180° quasi elastic back scattering cross section for the two reactions $^{12,13}C$ + ^{197}Au are shown in Figure 1. The ^{197}Au like recoils following 180° back scattering of the projectiles ^{12}C,^{13}C move forward around zero degree along with the beam through the mass separator HIRA which efficiently rejects the beam and carries the recoils to its focal plane having a large area position sensitive MWPC. The HIRA was operated at 0◦ with respect to the beam with full acceptance (10 msr). In the target chamber of

HIRA, two silicon surface barrier detectors were placed at ±15.5º to measure Rutherford-scattered beam particles. In addition to being used for absolute normalization of ER cross sections, these two detectors were useful for relative normalization among different runs and correction caused by small changes of the beam position on the target. Also a silicon surface barrier detector was placed at 161º w.r.t beam direction in the target chamber to measure back angle scattering. Pulsed beams of ^{12,13}C (2 µs & 4 µs pulse separation) were employed during the experiment as provided by the 15UD Pelletron Facility at IUAC, New Delhi. For back angle elastic scattering measurements, the ^{197}Au target had a thickness of ~ 200 µg/cm^2 and a 100 µg/cm^2 target (wherein we expect a maximum energy loss of 0.1 MeV for the incident beam) was used for the ER cross section measurement.

The data shown is not corrected for possible HIRA efficiency variation etc and possible small beam like contamination reaching the focal plane of HIRA. The beam like contamination was tested by using a lighter target of Aluminum and was found to be quite small.

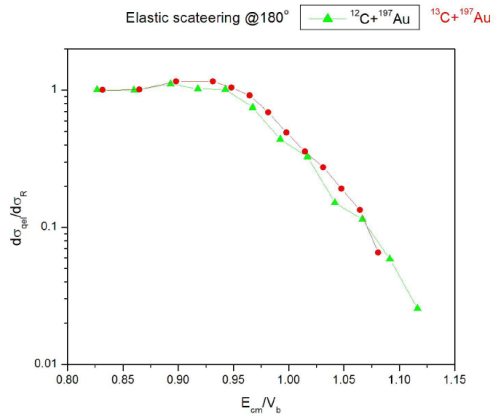

Fig. 1 Preliminary results from 180º back scattering measurements

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