GAMMA RAY EMISSION IN HEAVY ION REACTIONS - EXPERIMENTAL SEARCH FOR ENTRANCE CHANNEL EFFECTS

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Recent experiments [1,2] on gamma ray spectra in the energy region 8-12 MeV and neutron multiplicities in heavy ion induced fission reactions indicate an enhanced emission of GDR gamma rays from the fused composite nucleus and prefission neutrons over the predictions of the standard statistical model of the decay of excited compound nuclei. These have been interpreted in terms of a retardation of the fission process in relation to the other competing decay modes of the compound nucleus. Weidenmuller and collaborators[3] have shown that the presence of friction in the nuclear collective dynamics during the passage over the fission barrier results in an apparent retardation of fission decay. On the otherhand, Ramamurthy[4] has recently argued that, in heavy ion fusion reactions, since there is a long dynamical path between capture of the projectile by the target and compound nucleus formation, the enhanced GDR gamma ray emission from the fused composite system and prefission neutron emission could indeed be signatures of the entrance channel dynamical details of the fusion process. It would therefore be very interesting and important to establish experimentally whether these enhanced emissions of GDR gamma rays and prefission neutrons arise due to the post-compound nucleus or the pre-compound nucleus dynamics. Ramamurthy has also proposed that for a direct experimental test of whether a measurement carries a signature of the entrance channel dynamics, one should make a study of its dependence on the entrance channel mass/charge asymmetry across the Businaro-Gallone critical asymmetry since the fusion dynamics is expected to change abruptly across this point. The importance of entrance channel dynamics on the fragment angular distributions in heavy ion induced fission reactions has already been established recently[5]. We have therefore

carried out a measurement of the gamma ray energy spectra in fission induced by ^{12}C and ^{16}O on ^{209}Bi target.

Carbon and Oxygen beams from the 15UD Pelletron accelerator of the Nuclear Science Centre, NewDelhi was used to bombard self-supporting bismuth targets.Gamma rays in the energy interval 3-20 MeV were detected using a 5"x5" **NaI(Tl)** detector placed at distance of about 80 cm from the target. Time of flight method was used to eliminate neutrons with the zero time obtained from the RF pick up of the beam pulsing system. Unlike the earlier measurements, no fission detection was included since fission is the predominant decay channel in the reactions studied here. Electronic pileup rejection was also incorporated in the experiment. The measured spectra exhibit the well known exponential fall off characteristic of statistical gamma rays below 8 MeV and the GDR bump from fragment emission around 14 MeV. Deviation from an exponential around 8MeV is also visible in the spectra. Detailed analysis of the spectra are in progress to extablish whether there is an entrance channel dependence as expected around 8-12 MeV characteristic of GDR emission from the fused composite system.

References

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