Isomeric cross section study of neutron induced reactions on Ge

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Studies of neutron induced reactions are of considerable significance, both for their importance to fundamental research in Nuclear Physics and Astrophysics and for practical applications in nuclear technology, medicine and industry. In the energy region up to 20 MeV, many reaction channels, which may proceed via different reaction mechanisms, are open and therefore can be simultaneously studied both experimentally and theoretically. Furthermore, (n,2n), (n,p) and (n,α) reactions, have attracted recently new interest for the investigation of isomeric to ground state cross section ratios in the formation of residual nuclei. The measurement of this ratio is of fundamental importance for studying spin distribution of the level density involved in the calculations for the formation of the compound nucleus, via its decay to isomeric and normal states.

In this work, cross section measurements of (n,2n) and (n,α) reactions on high purity natural Ge will be presented along with statistical model calculations. The measurements were performed in the energy range 8.5 -11.7 MeV, by using the activation method and in the cases where it was found possible, isomeric to ground state cross section ratios were determined. The irradiations were carried out at the 5 MV Tandem T11/25 accelerator laboratory of NCSR "Demokritos", in Athens. Quasi-monoenergetic neutron beams were produced via the $^{2}H(d,n)^{3}He$ reaction at a flux of the order of ~10^{6} n/(cm^{2} sec). The absolute flux of the beam was obtained with respect to the $^{27}Al(n,\alpha)^{24}Na$ reference reaction, while its variation was monitored by a BF_3 detector placed at a distance of 3 m from the neutron source. The induced activity of product radionuclides and reference foils was measured with a HPGe detectors of 56% efficiency. Statistical model calculations using the code EMPIRE and taking into account pre-equilibrium emission were performed on the data measured in this work as well as on data reported in literature. The effect of the level density parameters on the production of the isomeric cross sections will be discussed in detail.