Investigation of (n,x) reactions with enriched Ge targets at 15.7 MeV at the upgraded facility of NCSR “Demokritos”

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Abstract: Studies of neutron induced reactions are of considerable interest, not only for their importance to fundamental research in Nuclear Physics and Astrophysics, but also for practical applications in nuclear technology, dosimetry, medicine and industry. These tasks require improved nuclear data and higher precision cross sections for neutron induced reactions.

The 5.5 MV Tandem T11/25 Accelerator of NCSR "Demokritos", has been recently upgraded to a pelletron charging system, with new ion sources, gas stripper and beam optics. Quasi-monoenergetic neutron beams are produced in the energy range ~ 16-19 MeV using a Ti-tritiated target of 373 GBq activity, consisting of 2.1 mg/cm2 Ti-T layer on a 1 mm thick Cu backing, by means of the ^{3}H(d,n)^{4}He reaction. The maximum flux has been determined to be of the order of 10^{5}-10^{6} n/cm^{2}s, implementing reference reactions, while the flux variation of the neutron beam is monitored by using a BF3 detector. An investigation of the energy dependence of the neutron fluence has been carried out via the multiple foil activation technique in combination with the SAND unfolding code as well as by means of MCNP5 Monte Carlo simulations. The 15.7 MeV neutron beam has been used for the measurement of the ^{70}Ge(n,2n)^{69}Ge, ^{76}Ge(n,2n)^{75}Ge, ^{73}Ge(n,p)^{73}Ga, ^{72}Ge(n,p)^{72}Ga, ^{73}Ge(n,np/d)^{72}Ga, ^{74}Ge(n,np/d)^{73}Ga, ^{74}Ge(n,α)^{71m}Zn, ^{72}Ge(n,α)^{69m}Zn, ^{73}Ge(n,nα)^{69m}Zn reaction cross sections with the activation technique, using monoisotopic Ge targets which significantly improve the accuracy of the results, in comparison with the ones derived from ^{nat}Ge targets. The preliminary results from these cross section measurements will be presented, along with the results from the neutron beam characterization.