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Cross-Section Measurements Using Enriched Ge samples at the IRSN AMANDE facility

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Cross-section measurements of neutron induced reactions on Ge isotopes are very important for practical applications including dosimetry, nuclear medicine, astrophysical projects and reactor technology, but also from a fundamental research point of view. Some neutron-induced reactions produce residual nuclei in high-spin isomeric states, the de-excitation of which is heavily dependent on the spin distribution of the continuum phase space and the spins of the involved discrete levels. The study of such reactions can play a very important role in the study of the residual nucleus. Furthermore, the several available reaction channels that can be studied via the activation technique can reveal interesting systematics, while the simultaneous reproduction of all reaction channels with the same set of input parameters acts as a very important constraint in statistical model calculations. In this work, experimental cross-section values were calculated for a total of nine reaction channels on the five natural occurring isotopes of Ge ($^{70,72,73,74,76}Ge$) via the activation technique. Quasi-monoenergetic neutron beams were produced via the $^{3}H(d,n)^{4}He$ (D-T) reaction at the neutron beam facility of AMANDE, IRSN (France) at 14 MeV by placing the targets at a 100 degree angle with respect to the axis of the neutron beam, completing a set of cross-section measurements performed at NCSR "Demokritos"(Athens, Greece), where quasi-monoenergetic neutron beams were produced via the D-T reaction in the energy range between 15-20 MeV. Monte-Carlo simulations were performed for the neutron flux determination via the combined use of MCNP6 and NeuSDesc codes. Five isotopically enriched samples were used for the cross-section measurements, provided by the n_TOF collaboration (CERN). Enriched samples produce more accurate cross-section results, because when natural targets are used, the studied residual nuclei can be produced not only from the measured reaction, but also from other reaction channels on neighboring isotopes found in the target, acting as contaminants. Theoretical corrections are then needed that suffer from their own uncertainties. Following the experimental measurements, a theoretical study was performed via the EMPIRE 3.2.3 code, reproducing all the experimental results, implementing the same set of input parameters.

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