Cross Section Measurements of (n,x) Reactions In the Energy Range Between 16.4 and 18.9 MeV Using Highly Enriched Ge Isotopes

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Neutron induced reactions on Ge isotopes are of major importance for both practical applications, as well as fundamental research in the Nuclear Physics field. Practical applications include fields such as dosimetry, nuclear medicine, astrophysical projects, reactor and detector technology. As far as fundamental research is concerned, some (n,x) reactions produce residual nuclei in high spin isomeric states, whose decay is governed by the spin distribution of the continuum phase space and the spins of the discrete levels involved. The five isotopes of natural Ge can reveal very interesting systematics, on many different reaction channels, the accurate experimental measurement of which, can act as a very firm constraint for the optimization of input parameters in statistical model calculations.

Cross sections of (n,x) reactions on a natural Ge target have been studied in the past by our group [1-2], at NCSR "Demokritos" using the ^{3}H(d,n)^{4}He reaction for the production of the neutron beam. In the case of ^{nat}Ge targets, the inevitable existence of neighboring isotopes (with their respective natural abundances) in the natural target, could lead to the production of the same residual nucleus as the one produced from the measured reaction, acting as a contamination in the measured yield. In this case, theoretical corrections based on Hauser-Feshbach calculations must be performed, to compensate for the contribution of these reactions. These corrections however, inevitably insert their own uncertainties in the analysis. On the other hand, the implementation of isotopically enriched targets, do not suffer from the aforementioned contaminations (theoretical corrections are no longer needed) and more accurate experimental results are produced. In this scope, five mono-isotopic Ge pellets of ~2 g each that have become available from CERN have been used in this work, with enrichment levels reaching up to ~97.71%. The irradiations were carried out at the 5.5 MV Tandem Accelerator Laboratory of NCSR "Demokritos" utilizing the ^{3}H(d,n)^{4}He reaction for the production of the quasi monoenergetic neutron beam. The Ge samples were placed between two high purity Al reference foils during each irradiation. The cross section results produced from highly enriched Ge targets, are more accurate and could also improve the existing theoretical models.

[1] Gkatis, G., *et al*. (2020). Cross Section Measurements of (n,p) Reactions on Ge Isotopes. *HNPS Advances in Nuclear Physics, 27*, 185-188. doi:http://dx.doi.org/10.12681/hnps.2998
[2] R. Vlastou, *et. al* (2020). Isomeric cross section study of neutron induced reactions on Ge isotopes. *EPJ Web Conf.* 239 01028, doi: https://doi.org/10.1051/epjconf/202023901028