Study of neutron cross-sections in (α, n) reactions

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Neutron production through α-induced reactions plays a crucial role in the creation and preservation of nuclear reactor fuel. The yield of (α, xn) reactions is highly sensitive to the energy of incident α-particles, necessitating careful consideration by safeguards in nuclear power and enrichment facilities. Neutron background influences the maximum attainable sensitivity in deep underground nuclear experiments. The underground neutron flux primarily originates from the spontaneous fission of uranium contained within the Earth's crust, as well as (α, n) reactions triggered by α-particles emitted naturally within cavernous environments or from the materials used in experimental setups itself. Different material used in detector construction and safeguard applications, for example ^{27}Al, ^{28,29,30}Si, ^{54}Fe, ^{60,62,64}Ni, ^{46,48}Ti, etc. (α, xn)-reactions represent the source of neutron background events, which should be properly estimated. Hence, we performed an experiment to study (α, n) reactions on ^{27}Al and ^{19}F in the energy range of 2.5-5.2 MeV and 3-6 MeV, respectively, using the ELIGANT-TN setup [1] of ELI-NP (Romania), at the 3 MV Tandetron accelerator of IFIN-HH (Romania). ELIGANT-TN is an array of 28 He-3 counters, arranged into 3 rings. Each ring is sensitive to the different energies of neutrons. The information on the average energy of the detected neutrons has been obtained from the ring-ratio technique [2], and the build-up of ^{13}C contamination on the target has also been investigated. More details regarding the work will be presented at the conference.

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