

Neutron production yield in alpha induced reactions on CaF2 and 27Al

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Low energy (α,n) reactions are important for reactor applications and low background experiments. In both cases α -particles, typically of a few MeV, originated from actinides decay present either in reactor fuel and/or in surrounding materials due to the elemental natural abundance. The emitted thus α -particles can induce nuclear reactions on nuclei of wide range of materials introduced in the given experimental environment such as ^{13}C , ^{19}F , ^{16}O , ^{18}O , ^{27}Al , ^{29}Si , ^{30}Si , etc. Because of the considerable cross-sections in the indicated energy range, up to barns, the resulted neutron yield is significant and should be properly taken in the consideration. Neutron detector systems based on proportional ^3He counters provide high efficiency and almost full angular coverage which makes it the ideal candidate for reaction cross-section measurements, including (α,n) reactions. The ELIGANT-TN [1] array constructed at Extreme Light Infrastructure-Nuclear Physics (ELI-NP), Măgurele, Romania was originally aimed at (γ, n) cross-section studies. It consists of 28 ^3He counters arranged in three rings in the high-density polyethylene matrix, shielded by a cadmium layer from background neutrons, in a way to reach a flat efficiency of $\sim 37\%$ up to ~ 5 MeV neutron energy. One more advantage of such a detector is the possibility to measure the average neutron energy by the ring ratio technique.

Lately, ELIGANT-TN was installed at the experimental hall of the 3 MV Tandetron facility of Horia Hulubei National Institute of Physics and Nuclear Engineering (IFIN-HH) Măgurele, Romania [2]. The accelerator provides intense low-energetic charged particles beams. In our first experiments the cross-sections of $^{19}\text{F}(\alpha,n)$, $^{13}\text{C}(\alpha,n)$ and $^{27}\text{Al}(\alpha,n)$ in the $\sim 3\text{--}7$ MeV energy range were investigated. Moreover, recently, in November 2023, an experiment to measure the $^{19}\text{F}(\alpha,n)$ and $^{13}\text{C}(\alpha,n)$ cross-sections up to 17 MeV was undertaken. α -beam was delivered by the 9 MV Pelletron Tandem Accelerator (IFIN-HH) [3].

In the talk it will be presented the design and performance of the ELIGANT-TN array. The preliminary experimental results/questions of our experiments and future perspectives will be discussed.

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