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ELIGANT 3He long neutron counter for (a, xn) and (a, xp) reaction studies

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α-induced neutron reactions can result in a neutron yield important for fabrication/storage of nuclear reactor fuel and low background neutron applications. α-emitters in the actinide mass region have different half-lives and thus represent a steady and long-term α-flux [1, 2]. The neutron production yield of (α,xn) reactions vary rapidly in response to the incident α energy and should be accordingly considered by safeguards at nuclear power/enrichment plants; for low background measurements (α,xn) reactions is the source of background events. The underlying experimental cross-section of these (α,xn) reactions become one the main source of uncertainty in the safeguard calculations and the background estimations. Since F compounds of U and Pu are ubiquitous in the nuclear fuel cycle in the project it is proposed to study the 19F(α,xn) reaction to resolve the discrepancy in the available cross section tables. Additional to neutron rates, data on neutron spectra and neutron angular distributions are the important observable. Thus, the mean neutron energy from (α, n) is necessary to estimate a proper shielding for storage/production of reactor fuel. Using the neutron angular anisotropy information it is possible to determine dynamically the ratio of (α, n) rate to spontaneous fission for coincidence counting applications.
This kind of experiments can be fulfilled by using a long (3He) neutron counter such as the ELIGANT-TN (ELI-NP) array [3]. Beside high efficiency it provides an opportunity to measure neutron angular correlations and also can give a hint on the energy of the incident neutron beams (using the ring-to-ring technique). If the response of ELIGANT to mono-energetic neutrons is calibrated the mean energy of the detected neutrons can be derived.
In the talk it is presented the ELIGANucl. Data Sheets 139 (2017) 190
[2] S. Croft, et al., Nucl. Inst. & Meth. A 954 (2020) 161608
[3] H. Utsunomiya et al., Nucl. Inst. & Meth. A 871 (2017) 135 T detector and constructed to measure parameters (α, xn), (p, xn) and (γ, n) reactions. The project to calibrate ELIGANT using isotropic mono-energetic sources produced in resonant and non-resonant (α, n), (p, n) reactions is discussed. Future experiments, in the astrophysics interest, using a gamma to be provided at ELI-NP are highlighted.

[1] S.P. Simakov and Q.Y. van den Berg,Nucl. Data Sheets 139 (2017) 190
[2] S. Croft, et al., Nucl. Inst. & Meth. A 954 (2020) 161608
[3] H. Utsunomiya et al., Nucl. Inst. & Meth. A 871 (2017) 135

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