Interactions of 14-MeV Neutrons with ^{40}Ca

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Two novel experimental setups have been commissioned to explore 14-MeV neutron-induced scattering and activation nuclear reactions on various isotopes and elements as part of the TANGRA (TAgged Neutrons & Gamma RAys) project conducted at FLNP JINR (Dubna, Russia) [1]. Such investigations are crucial for advancing both fundamental and applied neutron-nuclear physics research. The TANGRA-GeLa system comprises a portable 14.1 MeV neutron generator (ING-27, VNIIA, Moscow) and an array featuring two HPGe and four $LaBr_3$(Ce) gamma-ray spectrometers. The TANGRA-PSA experimental setup is equipped with a plastic scintillator array (PSA) to distinguish the contributions of reaction products (scattered neutrons and gamma-quanta), using time-of-flight (TOF) and pulse-shape discrimination (PSD) techniques in addition to the tagged-neutron method (TNM). This study aims to utilize both setups to conduct a feasibility study on the differential and angle-integrated cross-sections of 14-MeV neutron-induced reactions and the angular distributions of gamma rays for ^{40}Ca nuclei [2]. Calcium, along with fluorine and chlorine, is one of the most important materials in the molten salt reactor (MSR), a Generation IV nuclear power reactor that intends to use molten fluorides or chlorides as fuel mixtures or coolants. Our measurements can improve the quality of experimental and evaluated nuclear data for ^{40}Ca [3], whose reactions with 14-MeV neutrons remain among the most extensively studied due to the variety of reactions and decays.

References

1. TANGRA project, https://flnp.jinr.int/en-us/main/facilities/tangra-project-en
2. Ophoven, N., Ilic, Z., Mauerhofer, E. et al., Fast neutron induced gamma rays from (n,n'), (n,p) and (n,α) reactions on $CaCO_3$, J. Radioanal. Nucl. Chem. **331**, 5729–5740(2022). https://doi.org/10.1007/s10967-022-08594-6.
3. Jun Chen, Nuclear Data Sheets for A=40, Nuclear Data Sheets, Volume 140, 2017,Pages 1–376, https://doi.org/10.1016/j.nds.2017.02.001.