

Study of a New Liquid Scintillator Array for Neutron Scattering Cross Section Measurements at NCSR "Demokritos"

L. Amanatidis¹, T. Zafeiris¹, M. Diakaki¹, M. Kokkoris¹,
V. Michalopoulou¹, I. Mitropoulos¹, K. Kaperoni¹, R. Vlastou¹

¹*Department of Physics, National Technical University of Athens, GR-15780 Athens, Greece*

Presenting author email: amanatidisl@mail.ntua.gr

In this work, three novel EJ-309-type liquid organic scintillators and one BC-501A scintillator were optimized for measurements of neutron elastic scattering (n, el) and inelastic scattering (n, inl) at NCSR "Demokritos." These four liquid scintillators were put in a new device arrangement at eight typical Legendre angles, specifically at 16.2°, 37.2°, 58.3°, 79.4°, 100.6°, 121.7°, 142.8° and 163.8°. The overall elastic cross section can be precisely calculated by measuring the differential elastic cross section at these angles. The array was designed taking into account detector shielding requirements, minimization of detector cross-talk, and reduction of the scattering angle uncertainty, while ensuring the maximum possible statistics. For accurate elastic cross-section measurements, pulse shape analysis (PSA) was initially performed to discriminate neutrons from gamma rays over a broad energy range. For this purpose, a semi-digital unit, MPD-4 from Mesytec, was used to carry out the PSA and to optimize the parameters for neutron–gamma (n– γ) discrimination, using an Am-Be n/ γ source, along with a set of ¹³⁷Cs, ⁵⁴Mn and ⁶⁰Co gamma-ray sources. To assess the detector's efficiency over a wide neutron energy range, particularly between 1 and 6 MeV, GEANT4 simulations are presently underway. In the upcoming months, the procedure's validity will be evaluated by replicating the established total cross-section value of ¹²C (n, el) scattering.