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A modular neutron spectrometer for studies with radioactive beams at ACCULINNA-2 fragment separator

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For the demanding of recent research with radioactive ion beams at the new fragment separator ACCULINNA-2 [1], a modular neutron spectrometer based on stilbene crystals and 3"ET-Enterprise 9822B photomultipliers has been routinely employed to study the properties of light exotic nuclei, for instance: 5-7H, 7,9He, 10Li [2-4] lying close to boundary of β-stability. Nonetheless, the detailed characteristics and properties of stilbene scintillator have not been completely studied and well-understood owing to its intricate response by light output anisotropy with reference to the crystalline structure itself. In this work, we determined the light output responses to electrons and charged ions (protons and alpha particles), having the same initial energy but generating different behaviors when they stop in the organic scintillator. In accordance with the detector performance, the energy and time resolution were evaluated at different energy ranges with several gamma sources. Monte Carlo simulations of neutron interactions with stilbene detector were performed to determine the fast neutron registration in the energy range of 3-30 MeV and compared with measured data by the use of 14-MeV "tagged" neutrons, ING-27 [5].

[1] http://aculina.jinr.ru/
[2] A.A. Bezbakh et al., "Study of 10Li low energy spectrum in the 2H(9Li,p) reaction", Bulletin of the Russian Academy of Sciences: Physics, 84 (2020) 491-494.
[3] A.A. Bezbakh et al., "Evidence for the First Excited State of 7H", Physical Review Letters, 124 (2022) 022502.
[4] M. S. Golovkov et al., "Observation of a positive-parity wave in the low-energy spectrum of 7He", Physical Review C, 109, L061602 (2024).
[5] I. N. Ruskov et al., "TANGRA-Setup for the Investigation of Nuclear Fission induced by 14.1 MeV neutrons", Physics Procedia, 64 (2015) 163-170.

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