



Investigation of neutron-gamma separation threshold in BC-404 scintillator

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Investigation of nuclear matter close to limits of its existence discovered a number of unusual phenomena, such as so-called Borromean nuclei, neutron halo and multiple nucleon decay. Near the neutron drip-line this multiple nucleon decay is manifested as emission of several neutrons. The investigation of this phenomena is a non-trivial task due to limitations of previously developed techniques of neutron registration.

One of the current tasks at the ACCULINNA-2 fragment separator is development of a new time-of-flight neutron spectrometer with efficiency high enough for registration of several neutrons emitted in a singular event.

For Summer practice 2025 students are invited to participate in this development by investigation of limits of neutron-gamma separation in plastic scintillator BC-404. A number of pulse-shape analysis techniques are to be evaluated to find the lowest possible energy threshold on neutron-gamma separation. During the practice the students will be involved in measurement of detector response to a gamma and a neutron source, and waveforms of the response will be recorded and analysed. The analysis of the waveforms will be performed by means of the CERN ROOT framework [<https://root.cern/>]. The practice is organised for participation of up to three students and is planned to take three weeks in June–July 2025.

The tasks set a certain conditions on the skills of the students, which could participate in this summer practice. The major requirements are:

- Introductory level of understanding of interaction of charged particles with matter,
- Basic knowledge in handling of scintillator-based detectors and
- Intermediate level of skills in programming.

Also, a basic familiarity with CERN ROOT framework would be very welcomed.

The outcome of this summer practice will be practical skills in making and handling of scintillator detectors, basic familiarity with contemporary systems of data acquisition and ability to perform data analysis with CERN ROOT framework, using techniques common in subatomic physics.