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Topical plan for JINR research and international cooperation:

Synthesis and properties of nuclei at the stability limits

Project: Neutron spectrometer for experiments with radioactive beams on the ACCULINNA-2 fragment separator. Project is addressed to 2 students.

Project description: One of the topical problems of nuclear physics is the study of the properties of exotic nuclei. Experiments with Radioactive Ion Beams (RIBs) are one of the most effective tools to study the properties of light exotic nuclei. In Flerov Laboratory of Nuclear Reactions at Joint Institute for Nuclear Research (JINR, Dubna) RIBs of light nuclei ($A < 40$) in the energy range 20-60 MeV/A are obtained with ACCULINNA-2 in-flight fragment separator. One of the characteristics of such beams is the low intensity in comparison with the beams of stable nuclei. The only method of increasing luminosity in the experiment is to use thick targets. In consequence this method leads to a deterioration of the energy resolution due to ionization losses of charged particles and reaction products. The only exception are neutrons, coming from the area of the nuclear interaction, which, with high probability, can reach the detector. The registration of neutrons is especially important in the study of nuclei near the neutron drip lines, where neutron decay is often dominant process.

Most of the experiments at ACCULINNA-2 facility are focused on the studies of the neutron-rich nuclei. Thus, in such experiments it is often necessary to register neutrons along with other charged decay products to increase the accuracy of the experiment and obtain unique information about the structure and properties of exotic nuclei. For such investigations at ACCULINNA-2 an array of stilbene based neutron detectors is used.

The main goal of the practice is to become familiar with stilbene based neutron detectors for the experiments with radioactive beams on the ACCULINNA-2 fragment separator.

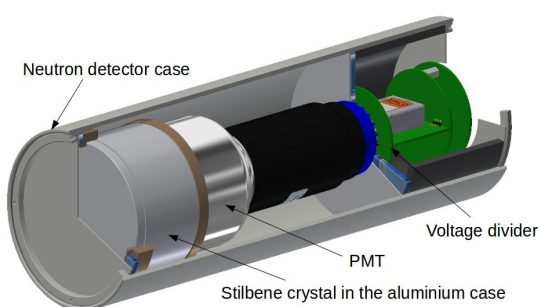


Figure 1: Neutron module in sectional view.



Figure 2: Array of neutron detectors.

Students will get introduction of the principle of work and construction of neutron detectors and of the basic nuclear electronics used in the neutron measurements. Students will get basic knowledge about the main characteristics of a stilbene based neutron detector, such as: threshold of the n- γ discrimination, time resolution and neutron detection efficiency. Practical work with neutron detectors (amplitude calibration by gamma sources, measurement of the detector time resolution, determination of the n- γ discrimination threshold) is planned. Students will learn procedures for obtaining experimental data using ROOT software.

Additionally, in the period of summer training students will get introduction on the principle of operation and the design of the in-flight separator ACCULINNA-2. Students will get familiar with detectors and introduction to techniques used in experimental nuclear physics at ACCULINNA -2.

Requirements: The projects is related to students interested in nuclear physics, experimental physics and particle detection techniques. Basics knowledge in nuclear physics and C++ programming skills are welcome.