

EXPERT SETUP TO STUDY EXOTIC RADIOACTIVITY

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The proposal EXPERT (EXotic Particle Emission and Radioactivity by Tracking) suggests a compact modular setup for conducting studies of extremely exotic nuclei using fragment separators Acculinn-2 in Dubna [1] and SuperFRS in Darmstadt [2]. In addition to the standard detectors for beam monitoring, the specific movable instruments are foreseen to be used: i) radiation-hard silicon strip detectors [3, 6]; ii) micro-strip silicon tracking detectors [4, 5]; iii) the NeuRad (Neutron Radioactivity) fine-resolution detector of neutrons [5]; iv) the GADAST (Gamma-ray Detectors Around Secondary Target) array [6] and v) the OTPC detector (Optical Time Projection Chamber) [7].

The setup aims at studies of the nuclear landscape beyond the proton and neutron drip-lines and intends to push researches up to limits of nuclear existence. By combining the EXPERT instrumentation in different scenarios, phenomena of radioactivity, resonance decays, beta-delayed decays and exotic excitation modes can be studied via observations of particle emissions: i) exotic 2p radioactivity studies and search for unknown types of radioactive decays - 4p, 2n, 4n. Studies of p, 2p, 4p, n, 2n, 4n resonance decays and continuum spectroscopy; ii) quest to discover the limits of existence of nuclear structure. Search for systems located far beyond the drip-lines aimed to answer for the question: “Where is the border line between a resonant behavior and continuum response of nuclear matter?”; iii) studies of beta-delayed particle (multi-particle) emission from exotic isotopes near and beyond the drip-lines.

Feasibility of several such scenarios is confirmed by the recent works [4-7]. For the systems which ground states decay by (multi-) nucleon emission the proposed setup covers two important lifetime ranges of 1 s - 100 ns, and 1 ps-100 ns by applying the implantation-decay and decay-in-flight techniques, respectively. For the short-lived systems, the resonance properties and information about continuum dynamics is extracted on the basis of the angular correlations between the products. The suggested measurements are augmented with information about γ de-excitations and β -delayed particle emissions of the decay products.

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