Tests of new-generation tracking detectors for studies of multi-proton emitters*

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Most of the proton-unbound nuclear isotopes have not been observed so far. The previous experiments aimed at nuclei located far beyond the proton dripline have demonstrated that the most-remote isotopes decay by emission of three or four protons, and even more exotic multi-proton emitters are foreseen.

In detection of multi-proton decays at high energy, detectors with high granularity and fine spatial resolution are needed. Such detectors allow for precise tracking of trajectories of all decay products, which is important for identification of ground and excited states of multi-proton precursors and their half-lives and decay modes. We present the results of the recent tests of new-generation tracking detectors of two types, namely (i) the micro-strip detectors FOOT which have been successfully deployed at s522/s509 short-range correlation and equation-of-state experiments at GSI by the R^3B collaboration in 2022. They were used to track heavy fragments in-beam and knocked-out protons at an angle showing improved performance in both rate capabilities, multi-hit resolving and resolution compared to the previous AMS detectors. (ii) the Monolithic Active Pixel detectors ALPIDE which were tested in a six detector telescope array in 2022 at the SPS accelerator at CERN together with the AMBER collaboration. These detectors have been shown to withstand high intensity particle beam with remarkable tracking and efficiency. Both detector types will be used for vertex reconstruction of nuclear decays in-flight and tracking of charged decay products in future experiments at the fragment separator FRS at GSI (Darmstadt, Germany).

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