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Charged-particle Spectroscopy with the Optical TPC

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Nuclei far from stability with a large imbalance between the number of protons and neutrons exhibit characteristic decay modes which are still far from being fully explored, both experimentally and theoretically [1]. One of them is emission of beta-delayed charged particles, which occurs for nuclei close to the proton drip-line. In addition to single (beta p) and double (beta 2p) delayed protons known since long, other channels, like the recently observed delayed emission of three protons (beta3p) become important. Delayed emission of charged particles has been also observed for very neutron-rich nuclei. Good understanding of such decays is necessary when the correct knowledge of beta strength distribution is demanded.
Experimental investigations of exotic and rare decay channels require special instrumentation offering efficiency and sensitivity. An example of such an approach is the Optical Time Projection Chamber (OTPC) developed at the University of Warsaw. Designed with the specific goal to study two-proton radioactivity (2p), it proved to be an excellent tool for investigation of other decay channels accompanied by emission of charged particles. Among interesting results obtained with help of the OTPC, in addition to 2p spectroscopy [2,3], are the first observation of the beta 3p decay mode in three nuclei [4,5,6], a study of 6He decay into the alpha + d continuum [7], and a measurement of beta-delayed tritons from 8He [8]. In the talk I will give a short overview of the charged-particle spectroscopy of exotic and rare decay channels investigated with help of the OTPC detector. In more detail I will discuss the decays of 6He and 8He, as well as the most recent results obtained for decays of 26P and 27S. At the end I will sketch some ideas for future studies, including an ambitious search for beta-delayed protons emitted by 11Be.
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