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Exotic decay modes studied by means of the Optical Time Projection Chamber

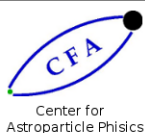
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At the proton drip-line, where large Q-values are available for β^+ decay, β -delayed multi-particle emission becomes an important phenomenon. Moreover, very exotic decay modes, like the recently discovered ground-state decay by emission of two protons, or two-proton radioactivity, become possible in so proton-rich nuclei. The study of these decay modes became possible thanks to the development of a Time-Projection Chamber with optical read-out (OTPC) at the University of Warsaw about a decade ago, opening the possibility to investigate a broad range of rare decay modes with very high efficiency. The detection of one decay event is in fact sufficient to unambiguously identify the decay mode and establish its branching ratio. The OTPC detector is a gaseous time-projection chamber with amplification stage formed by a stack of GEM foils and optical readout consisting of a CCD camera and a photomultiplier tube (PMT). The images recorded by the CCD camera together with the time distribution of light collected in the PMT allow to reconstruct the trajectory of the decay products. Such an approach is ideally suited to study the decay by (multi-) particle emission of very exotic isotopes. It was originally designed to obtain the first unambiguous proof of the two-proton (2p) decay of ^{45}Fe and to study the angular correlations between the protons. The same methodology and detection set-up was successfully applied also to measure the 2p decay of ^{48}Ni , to discover the beta-delayed 3 proton ($\beta 3p$) emission decay branch in ^{45}Fe , and ^{43}Cr at the NSCL, and in ^{31}Ar at GSI Darmstadt. Moreover, it was applied to measure the energy distribution of beta-delayed deuterons from the decay of ^6He at ISOLDE and the B_{GT} distribution in the beta-delayed tritium emission from ^8He at the JINR in Dubna. A review of the results and an outlook on future studies will be presented.

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