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Studies of β-delayed particle emission by means of the Optical Time Projection Chamber

The development of an Optical Time Projection Chamber (OTPC) at the University of Warsaw about a decade ago opened the possibility to investigate a broad range of rare decay modes with very high sensitivity. The detection of one decay event is sufficient to unambiguously identify the decay mode and establish its branching ratio.
The detector is a TPC 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 [1,2]. 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 45Fe and to study the angular correlations between the protons [3].
The same methodology and detection set-up was successfully applied also to measure the 2p decay of 48Ni [2,4], to discover the beta-delayed 3 proton (β3p) emission decay branch in 45Fe [5], and 43Cr [6] at the NSCL, and in 31Ar at GSI Darmstadt [7,8]. Moreover, it was applied to measure the energy distribution of beta-delayed deuterons from the decay of 6He at ISOLDE [9] and to study the beta-delayed tritium-alpha-neutron decay of 8He at the JINR in Dubna [10]. A review of the results, preliminary results of the β-delayed particle emission from the decay of 27S branch and an outlook on future studies will be presented.

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