Delayed particle spectroscopy with Optical TPC

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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 efficiency. 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 together with the time distribution of light collected in the PMT allow to reconstruct the trajectory of the decay products [1]. 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 two-proton (2p) decay of ^{45}Fe and to study angular correlations between the protons [2].

The same methodology and detection set-up was successfully applied also to measure the 2p decay of ^{48}Ni [3], to discover the β-delayed 3 proton (β3p) emission decay branch in ^{45}Fe [4] and ^{43}Cr [5] at the NSCL, and in ^{31}Ar at GSI Darmstadt [6]. Moreover, it was applied to measure the energy distribution of β-delayed ^{2}H from the decay of ^{6}He at ISOLDE [7] and the B_{GT} distribution in the β-delayed ^{3}H emission from ^{8}He at the JINR in Dubna [8]. Recently it was used to study the most neutron-deficient Ge and Zn isotopes [9,10] at the NSCL, ^{27}S at the JINR in Dubna [11] and ^{22,23}Si at TAMU [12]. A review of the results and an outlook on future studies will be presented.

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