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## Laser-polarisation assisted beta-decay spectroscopy at VITO

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Experimental  $\beta$ -decay studies contribute significantly to improving our understanding of exciting nuclear phenomena emerging far from stability, such as  $\beta$ -delayed multiple-particle emission [1–3], evolution of the shell structure [4], and the appearance of so-called “islands of inversion” [5]. The great success of  $\beta$ -decay experiments in probing ground- and excited-state properties is due to the high angular-momentum selectivity of the  $\beta$  decay that populates states with particular “allowed” configurations in the daughter nuclei.

$\beta$ -decay spectroscopy becomes even more powerful when spin-polarised nuclei are utilised, i.e. when the nuclear spin of the  $\beta$ -decay emitter has a directional orientation with respect to the axis of an applied magnetic field. In this way, one can benefit from the parity non-conserving nature of the weak interaction and exploit the anisotropy of the  $\beta$ -particle emission from spin-oriented nuclei to unambiguously assign spins and parities of states populated in daughter nuclei via allowed transitions [6, 7].

This novel approach to  $\beta$ -decay measurements, pioneered by a group from the University of Osaka [8–11], has recently been adopted at the VITO beamline [12], which is a permanent setup at the ISOLDE facility devoted to versatile studies with laser-polarised radioactive beams. In this contribution, a new experimental station that accommodates  $\beta$ -particle,  $\gamma$ -ray, and neutron detection following the  $\beta$  decay of laser-polarised nuclei will be presented. The research program focused on strong  $\beta$ -delayed neutron ( $\beta n$ ) emitters will be discussed.  $\beta$ -decay studies with spin-polarised beams can provide a robust experimental dataset to test  $\beta n$  emission models and answer critical questions about the mechanism of  $\beta n$  decay, being a prevalent decay branch of exotic nuclides, with great relevance to the  $r$ -process nucleosynthesis. Preliminary results from the commissioning experiment with laser-polarised beams of neutron-rich potassium isotopes will be presented [13].

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