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Laser-polarisation assisted beta-decay spectroscopy at VITO

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Experimental β-decay studies contribute significantly to improving our understanding of exciting nuclear phenomena emerging far from stability, such as β-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 β-decay experiments in probing ground- and excited-state properties is due to the high angular-momentum selectivity of the β decay that populates states with particular "allowed" configurations in the daughter nuclei.

β-decay spectroscopy becomes even more powerful when spin-polarised nuclei are utilised, i.e. when the nuclear spin of the β-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 β-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 β-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 β-particle, γ-ray, and neutron detection following the β decay of laser-polarised nuclei will be presented. The research program focused on strong β-delayed neutron (βn) emitters will be discussed. β-decay studies with spin-polarised beams can provide a robust experimental dataset to test βn emission models and answer critical questions about the mechanism of βn 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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