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Commissioning of a beta-decay spectroscopy station at VITO

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Beta-decay spectroscopy is a powerful technique for studying the properties of exotic nuclei. Thanks to the high angular momentum selectivity of the process, beta decay offers unique access to states in daughter nuclei having configurations similar to the decaying precursors. However, the one major drawback of conventional beta-decay experiments is the limited ability to firmly assign spins and parities of states involved in the decay [1]. This difficulty can be overcome by employing beams of spin-oriented nuclei decaying with the asymmetric emission of beta particles. The degree of experimental beta-asymmetry reveals spins and parities of nuclear states involved in allowed transitions, yielding a particular value and not just a tentative range of spin values, as inferred from experimental logft.

A novel approach to beta-decay spectroscopy, developed by a group from the University of Osaka [2,3], has been recently adopted at the VITO beamline at ISOLDE [4]. A new experimental station has been here developed and integrated with the existing setup for spin polarisation. The recent upgrades at VITO include the installation of a new, compact magnet that provides a field strong enough to maintain beam polarisation and to decouple atomic and nuclear spins, and, at the same time, it enables easy access for detectors around the chamber located inside and hosting implantation crystals or foils.

The new decay station at VITO (DeVITO) accommodates three Clovers, a set of neutron time-of-flight detectors –the VANDLE array from the University of Tennessee [5], as well as beta-particle detectors with SiPM readout. The chosen configuration allows for the coincident measurements of beta-delayed radiation emitted from laser-polarised nuclei and, thus, for the selection of the levels of interest for unambiguous assignment of spins and parities from measured beta-decay asymmetry in coincidence with gamma rays or neutrons. The recently built DeVITO station was commissioned in July 2023, with polarised beams of 47K and 49K [6]. Details on the commissioning set-up and preliminary results from online tests will be presented. The feasibility of the method and its possible extensions will also be discussed.

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