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Recent upgrade of the VITO beamline for beta-decay spectroscopy with laser-polarised beams

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The new research programme at VITO combines the strengths of β-decay spectroscopy and collinear laser spectroscopy. The design of an experimental station for studying the asymmetry of beta particle emission in coincidence with delayed radiation emitted from laser-polarised beams of neutron-rich nuclei involved technical solutions that balance the requirements of these two powerful techniques. The central part of the new setup at VITO is a magnet built at CERN, made of a hollow conductor cooled by water, which provides a magnetic field up to 0.1 T to decouple the atomic and nuclear spins and to maintain the nuclear spin polarisation following the beam implantation into a crystal. A significant challenge in the magnet development was to ensure its compact size so that gamma-ray and neutron detectors could be placed around it to allow spectroscopy studies. The measurement of neutron energy by the time-of-flight technique imposes the demand to minimise the amount of material used in constructing the mechanical structure holding the magnet and detector frame. The new magnet hosts the main chamber with two SiPM-based plastic scintillators with a central hole, allowing the laser-polarised beam to be implanted into the centre of the chamber. In this contribution, I will discuss the technical details of the key components of the new spectroscopy station - magnet, beta detectors and implantation system, which were successfully commissioned in July 2023 with laser-polarised beams of neutron-rich potassium isotopes.

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