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Magnetic moments of 47K, 49K, and 51K and new horizons for β-NMR at VITO

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β-NMR is a powerful method that exploits the asymmetry in the emission of β particles from spin-polarised, unstable nuclei. Combining a high degree of nuclear spin polarisation achieved through laser-induced optical pumping with an efficient detection yields a sensitivity up to ten orders of magnitude greater than conventional NMR. Its applications range from biochemistry to solid-state, atomic, and nuclear physics.

One major forerunner of this technique is the VITO beamline. Recent upgrades pushed the boundaries of this setup, including installing a superconducting magnet to improve the resolution and a state-of-the-art data acquisition system. This was followed by commissioning experiments with the implantation of ^{47}K, ^{49}K, and ^{51}K in liquid samples.

These studies yielded improved nuclear magnetic moments that are, in fact, precise enough to calculate the Bohr-Weisskopf effect for these isotopes, which describes a perturbation of the hyperfine structure due to the finite size of the nucleus. As such, the effect provides information on the distribution of nuclear magnetisation and, in return, the distribution of neutrons. The results of these measurements are presented in this poster.

They will also benefit the next major project at VITO. Several upgrades to the experimental setup are currently in preparation to measure magnetic moments and hyperfine A factors with greater precision to determine the Bohr-Weisskopf effect and, thus, the nuclear magnetisation distribution for a broader range of isotopes.

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