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## From magnetic moments and biochemistry to future $\beta$ -NMR studies at VITO

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While NMR is an indispensable technique in physics, chemistry, and biology, it bears constraints of low sensitivity, which make it challenging or unsuitable to study a variety of common elements. These limitations are widely overcome by  $\beta$ -particle-detecting NMR. It benefits from combining a hyperpolarisation of the nuclear spin generated through optical pumping, and an efficient detection of the  $\beta$  particles emitted asymmetrically from the decaying hyperpolarised isotopes. Among the established use cases of  $\beta$ -NMR are solid-state, atomic, and nuclear physics. One novel field of interest lies in biochemistry, aiming for a better understanding of molecular structures, dynamics, and chemical reactions.

A forerunner in  $\beta$ -NMR is the VITO beamline at ISOLDE. This setup has recently undergone major upgrades, including the installation of a superconducting magnet, a new detector array and a new data acquisition system to push boundaries towards  $\beta$ -NMR with biological samples. After re-commissioning the setup in 2021, the first such measurement campaign (IS666) was conducted this year, studying the interaction of 47K and 49K with DNA G-quadruplex structures.

Furthermore, two new research programmes have recently been launched at VITO. The key project's objective is to measure the distribution of the magnetization inside the nucleus. Another project aims for recording the  $\beta$  decay asymmetries in coincidence with emitted  $\gamma$  rays and neutrons to firmly establish spins and parities of excited states populated in daughter nuclei.

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