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Magnetic Moment Measurement of 11Be with ppm Accuracy

β detected NMR is a method that allows investigations of short-lived isotopes with a precision inaccessible to conventional NMR. This increased sensitivity is gained by combining hyperpolarisation of the nuclear spin generated through optical pumping with an efficient detection of the asymmetrically emitted β-particles from the decaying isotopes. One of the isotopes scheduled to be investigated with β detected NMR at VITO is ^{11}Be. It is of interest because it is a single neutron halo nucleus. Measuring the magnetic moment of ^{11}Be with greater accuracy will help to give insights into the nuclear magnetisation distribution of ^{11}Be and thus directly confirm its halo structure.

To enable such measurements, the VITO beamline has undergone multiple major upgrades and extensions in the past, such as, the installation of a superconducting solenoidal magnet with sub-ppm homogeneity and the ability to measure in liquid samples [1]. The beta detectors are a critical aspect; their purpose is to detect the asymmetrically emitted β-particles from the hyperpolarized decaying isotopes. A new detector setup is currently being developed it will consist of two plastic scintillators light guides and silicon photomultipliers. It will be able to measure the energies of the detected β-particles. This is useful because in ^{11}Be the two most intense transitions, the transition to the ground state and the first excited state have opposite beta asymmetry parameters and cancel each other out [2]. Including only the higher energy decay to the ground state will result in an increased observed β-decay asymmetry and thus enable the measurement of ^{11}Be.

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[2] Levy, C. D. & Pearson, M. & Morris, Gerald & Chow, Kai Hang & Hossain, M. & Kiefl, Robert & Labbé, R. & Lassen, Jens & MacFarlane, W. & Parolin, T. & Saadaoui, Hassan & Smadella, M. & Song, Q. & Wang, Shuangshuang. (2010). Development of the collinear laser beam line at TRIUMF. Hyperfine Interactions. 196. 287-294. 10.1007/s10751-009-0148-9

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Author: PAULITSCH, Daniel (University of Innsbruck (Universität Innsbruck))

Co-authors: SPARKS, Amy; NAGPAL, Anu (University of York (GB)); HAVRANEK, Daniel (Brno University of Technology (CZ)); MICHELON, Ilaria (Universite de Geneve (CH)); KOWALSKA, Magdalena (CERN); JANKOWSKI,

Marcus (Technische Universitaet Darmstadt (DE)); BISSELL, Mark (CERN); CHOJNACKI, Mateusz Jerzy (Universite de Geneve (CH)); Dr PESEK, Michael (Charles University (CZ)); PIERSA-SILKOWSKA, Monika (CERN); AZARYAN, Nikolay (Adam Mickiewicz University in Poznan (PL))

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