UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES
Département de physique nucléaire et corpusculaire

Public oral presentation of Dr Magdalena KOWALSKA

Nomination « par appel » Professeur titulaire bénévole à 10%

Wednesday 14 September 2022
11h-12h00

Auditoire Stückelberg, Ecole de Physique
Connection by videoconference Zoom
https://unige.zoom.us/j/62497137018?pwd=enZaUThRd1hhTkVrbDJsMm5pbGJSUT09

Title:

From fundamental physics to biology and medicine with polarized unstable isotopes

Abstract:

When the nuclear spins of an ensemble of unstable nuclei are polarised, their decay radiation – be it beta or gamma decay – shows an asymmetry in space. This unique feature can be used in a variety of research fields, starting from fundamental physics, passing through nuclear physics, going all the way to chemistry, biology, and medicine.

In this presentation, I will present the techniques and science behind several research projects, in which we polarise and further use short- and long-lived unstable nuclei, most of which are produced at the ISOLDE facility at CERN. At the VITO-ISOLDE beamtime we use the asymmetry in beta decay of laser-polarised short-lived nuclei to contribute to the tests of the unitarity of the CMK quark-mixing matrix and searches for New Physics. We also use VITO to perform beta-decay detected nuclear resonance (beta-NMR), with up to a billion times higher sensitivity compared to conventional NMR. We have used the approach to push the limit in accuracy of magnetic moments on short-lived isotopes by two orders of magnitude. We now aim to use it to determine the distribution of nuclear magnetisation, and through it the elusive distribution of neutrons in many short-lived nuclei, relevant, e.g. for nuclear theory, neutron stars, and atomic parity violation studies. In chemistry and biology, we use beta-NMR on short-lived Na and K isotopes to investigate ionic liquids and prepare for studies of DNA G-quadruplex structures. Finally, within the gamma-MRI project, with several European partners, we work towards a novel molecular imaging modality, which aims at employing gamma-emitting long-lived Xe isotopes for improved lung and brain imaging.

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