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Status of MIRACLS'proof-of-principle experiment

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Collinear laser spectroscopy (CLS) is a very effective tool to measure nuclear spins, magnetic moments, quadrupole moments and mean-square charge radii of short-lived isotopes far from stability with high precision and accuracy [1]. Conventional CLS relies on the optical detection of fluorescence photons from laser-excited ions or atoms. Depending on the specific case and spectroscopic transition, it is limited to radioactive ion beams (RIB) with yields of more than 100 to 10,000 ions/s. As a consequence, it is essential to develop more sensitive experimental methods for the study of more exotic nuclei.

Complementary to Collinear Resonance Ionization Spectroscopy (CRIS) technique [2], the MIRACLS project at ISOLDE/CERN aims to preserve the high resolution of conventional CLS and at the same time to enhance its sensitivity by a factor of 20 to 600. This will be achieved by extending the effective observation time, depending on the specific nuclides'mass and lifetime. The novel MIRACLS concept is based on an Electrostatic Ion Beam Trap/Multi-Reflection Time-of-Flight (MR-ToF) device which confines a 30keV ion beam in between two electrostatics mirrors [3].

In order to demonstrate the potential of this novel approach, a proof-of-principle
experiment for MIRACLS is being set up around an existing MR-ToF device [4] which is modified for the purpose of CLS. Mg ions are extracted from an offline electron-impact ionization source , are subsequently accelerated by a 250 V voltage gradient and injected into a linear Paul trap which allows for beam accumulation, bunching and cooling. After extraction from this buncher, the ions are accelerated at 2 keV and then they are trapped in the MR-ToF device which hosts an optical detection region to register fluorescence photons from laser excited Mg ions.
This poster contribution will introduce the MIRACLS proof-of-principle experiment and will present the first observation of photons in the MR-ToF device.

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Authors: LAGAKI, Varvara (Ernst Moritz Arndt Universitaet (DE)); MALBRUNOT, Stephan (CERN); HEYLEN, Hanne (CERN); LECHNER, Simon (University of Vienna (AT)); MAIER, Franziska Maria; Prof. NÖRTERSHÄUSER, Wilfried (Institut für Kernphysik, TU Darmstadt); SCHWEIKHARD, Lutz Christian (Ernst Moritz Arndt Universitaet (DE)); ROSENBUSCH, Marco (Ernst-Moritz-Arndt-Universitaet (DE)); WIENHOLTZ, Frank (CERN); WOLF, Robert (Ernst-Moritz-Arndt-Universitaet (DE))

Presenter: LAGAKI, Varvara (Ernst Moritz Arndt Universitaet (DE))

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