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MIRACLS: From Proof of Principle Towards First Online Operation

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The Multi Ion Reflection Apparatus for Collinear Laser Spectroscopy (MIRACLS) is a novel approach for Collinear Laser Spectroscopy (CLS) in order to probe the most 'exotic'nuclides with very low production yields [1]. This is achieved by trapping an ion bunch in an electrostatic ion beam trap, also known as Multi-Reflection Time-of-Flight (MR-ToF) device in precision mass spectrometry [2], in which the ion bunch can interact with the laser beam during each revolution. Due to this extension of the observation time, the experimental sensitivity will be increased by a factor of 30-600 compared to traditional CLS.
During the last year, major efforts have been dedicated to a proof-of-principle experiment. We have successfully demonstrated the functionality of MIRACLS when performed in a low-energy (≈1.5 keV) MR-ToF device [3] adapted for CLS. The isotope shift in the D1 transitions of 24,26Mg+ has been carefully studied under varying operation modes to evaluate systematic CLS uncertainties in the MIRACLS approach. Moreover, the boost in experimental sensitivity has been estimated by comparing the signal strength in the MIRACLS data to conventional, single-pass CLS in the same device.
Building upon the experience gained in MIRACLS' proof-of-principle experiment, a new electrostatic ion beam trap is currently being developed. It will operate at a beam energy of 30 keV which minimises the Doppler broadening and, thus, enables high resolution CLS. In a first step, this 30-keV device will be coupled to the LA2 beamline at ISOLDE. There, we will address either neutron-rich magnesium isotopes in the island of inversion or cadmium isotopes at and beyond the N=50 and N=82 neutron shell closures as the first science cases.
In this talk, the results of the MIRACLS' proof-of-principle experiment will be presented along with the design, layout and expected performance of the new 30-keV apparatus currently in preparation for MIRACLS' first online operation at ISOLDE.

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