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The commissioning of a Paul trap for laser spectroscopy of exotic radionuclides in an MR-ToF device

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The Multi Ion Reflection Apparatus for Collinear Laser Spectroscopy (MIRACLS) represents a new approach for precision measurements of nuclear ground-state properties in short-lived radionuclides. Conventional Collinear Laser Spectroscopy (CLS) [1-3] requires ion yields of more than 100-10000 ions per second, depending on the element, delivered from a radioactive ion beam (RIB) facility to distinguish the fluorescence signal from background and, thus, to perform a successful measurement of radionuclides'electromagnetic moments or charge radii. Due to their low RIB production yields, the 'most exotic' radio-isotopes are often out of reach of traditional fluorescence-based CLS which is limited in observation time to a few microseconds while ions are passing once through a laser-ion interaction region. In the MIRACLS approach, however, the ion beam is stored in a Multi-Reflection Time-of-Flight (MR-ToF) device and probed repeatedly to increase the collected CLS signal with each ion revolution inside the trap.

After the successful completion of a MIRACLS proof-of-principle experiment [4-6], a new high-resolution apparatus is presently under construction at ISOLDE, CERN.
To accommodate the requirements on the ion beam properties of a small energy spread for CLS and a small temporal width for the MR-ToF operation, a linear Paul trap acting as radiofrequency cooler and buncher was constructed. In this talk, the design, simulation study of the operation, and commissioning of the Paul trap will be presented, together with an outlook on future studies of very exotic nuclei with MIRACLS.

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