7th European Conference on Trapped Ions

Contribution ID: **71** Type: **Invited Speaker**

Towards High-Precision Spectroscopy of the 1S−2S Transition in He+

Wednesday, 27 September 2023 11:45 (30 minutes)

The energy levels of hydrogen-like atoms can be precisely described by bound-state quantum electrodynamics (QED). The frequency of the narrow 1s-2s transition of atomic hydrogen has been measured with a relative uncertainty below 10^{-14}. When combined with other spectroscopic measurements of hydrogen and hydrogen-like atoms, the Rydberg constant and the proton charge radius can be determined. Comparing the physical constants extracted from different combinations of measurements serves as a consistency check for the theory. Hydrogen-like He+ ion is yet another interesting spectroscopy target for testing QED. Due to their charge, He+ ions can be held near-motionless in the field-free environment of a Paul trap, providing ideal conditions for high precision measurement. Interesting higher-order QED corrections scale with large exponents of the nuclear charge, which makes this measurement much more sensitive to these corrections compared to the hydrogen case. We are currently setting up an experiment to perform precise spectroscopy of the He+ 1S−2S transition. The main challenge of the experiment is that driving the 1S−2S transition in He+ requires narrow-band radiation at 61 nm. This lies in the extreme ultraviolet (XUV) spectral range where no continuous wave laser sources exist. Our approach is to use two-photon direct frequency comb spectroscopy with an XUV frequency comb. The XUV comb is generated from an infrared high power frequency comb using intracavity high harmonic generation. The spectroscopy target will be a small number of He+ ions, which are trapped in a linear Paul trap and sympathetically cooled by co-trapped Be+ ions. In this talk, we will present our recent progress in developing XUV frequency comb and Paul-trap for high-precision spectroscopy of He+ 1S−2S transition.

Primary author: OZAWA, Akira (MPQ)

Co-authors: Mr MORENO, Jorge (Max Planck Institute of Quantum Optics); WEITENBERG, Johannes (Max Planck Institute of Quantum Optics); Dr SCHMID, Fabian (Max Planck Institute of Quantum Optics); W. HÄNSCH, Theodor (Max Planck Institute of Quantum Optics); Prof. UDEM, Thomas (Max Planck Institute of Quantum Optics)

Presenter: OZAWA, Akira (MPQ)

Session Classification: Wednesday