MAX PLANCK INSTITUTE
OF QUANTUM OPTICS

Master / PhD Project

Development of an ion trap for high precision spectroscopy of hydrogen-like helium

Since the emergence of the optical frequency comb, high precision laser spectroscopy in the vacuum and extreme ultraviolet (VUV, EUV/XUV) has become a field of cutting-edge research. The simplest atoms and ions of the periodic table all have ground state transitions in this spectral region so that a precise experimental determination of the transition frequencies can enable stringent tests of quantum electrodynamics (QED).
Our goal is to perform XUV frequency comb spectroscopy of the 1S-2S two-photon transition in trapped hydrogen-like helium (He^+) at a wavelength of 60.8 nm. For that purpose, we are working both on the development and improvement of different ion trap setups to store He^+ at low temperatures and on the generation and characterization of an XUV frequency comb source suitable for spectroscopy.

We are looking for a committed student of physics who wants to contribute to our ion trap experiments:

One possible project would involve the development of an ion trap that is suitable for sympathetic cooling of multiple ionic species. Since He^+ lacks a convenient cooling transition, direct laser cooling of He^+ is challenging. However, one can circumvent this challenge by using the technique of sympathetic cooling. Here, the target ions are simultaneously trapped with ions that have a cooling transition easily accessible with lasers. The Coulomb interaction of those "coolant ions" with the target ions can then result in cooling of the target ions and the creation of a mixed ion crystal.
The ultra-high-vacuum chamber required for the ion trap setup has to be connected to the vacuum chamber in which the XUV frequency comb is generated. Since higher pressures are inevitable in this chamber, the designated student will also have to design, build, and evaluate a differential pumping setup to connect those chambers.

If you are interested, please contact:

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