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MAX-PLANCK-INSTITUT
FÜR QUANTENOPTIK

Master’s student project
Development of high-power laser

Hydrogen is the simplest of all atoms. Its energy levels can be computed from first principles. At MPQ labs, we operate the only cryogenic atomic hydrogen beam in the world. We create the beam by using a nozzle in vacuum that is held at a temperature of 5 Kelvin. This is the first step towards trapping atomic hydrogen in an optical lattice and probing the 1S-2S transition, which is extremely sharp. To trap hydrogen in an optical lattice, we require a magic wavelength of 515nm. This wavelength is easily accessible with frequency doubled lasers that can generate large power levels.

Optical lattice clocks have become the most accurate instruments. They are used in fundamental research, such as testing general relativity and tightening limits on suspected slow temporal variation of fundamental constants. Their superior accuracy is expected to lead to a redefinition of the SI second, which is currently bound to a radio frequency transition. Performing laser spectroscopy on atomic hydrogen is similar to running an optical clock, except that atomic hydrogen is challenging to handle. However, defining the SI second in terms of hydrogen would yield a "computable second" and remove the Cs atom from the SI system. All units would then be given by fixing the values of physical constants.

The hydrogen lattice clock uses the 1S-2S two-photon transition in hydrogen for both spectroscopy and manipulation of atoms. **We are seeking a master student to develop a new high-power 972 nm laser.** This laser will be used as a building block for the deflection and manipulation of atomic hydrogen into the dipole trap.

If you are interested, please send your application to

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