Towards a metastable helium BEC for atom interferometry

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We plan to precisely measure the recoil velocity of a helium-4 atom in the triplet metastable state (He*) when it absorbs a photon. A Ramsey-Bordé atom interferometry scheme will be used for sensitive velocity measurements, leading to a measurement of the ratio h/M for helium. Combined with the well known values of the proton-to-electron mass ratio, the Rydberg constant and the mass of the helium atom, the fine-structure constant (α) may be deduced.
With this experiment we aim for a competitive accuracy on α compared to values deduced from similar experiments in rubidium and cesium. Alternatively, α can also be derived from electron g-factor data combined with QED theory. Since atom interferometry provides a different route of arriving at a value for α, comparison of both techniques to get α provides a stringent test of QED.
Currently, a metastable helium BEC setup is being built. Here, we report on the progress of achieving an ultracold sample of He* atoms by means of various cooling stages. We plan to trap the BEC in an optical lattice, in which we will be able to move the atoms back and forth in a controlled manner. This will induce Bloch oscillations, which will be an important tool for accelerating atoms in the interferometry scheme. We show the expected behaviour of the atoms in the lattice and the prospects for He* for interferometry.