Evaporative cooling of metastable helium atoms

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BEC of metastable helium has been a goal for many years and was realized by two groups in France [1, 2], demonstrating the feasibility of Bose-condensing metastable helium. In Amsterdam we are close to reaching runaway evaporation in metastable helium. However, it is unclear if we can realize BEC with our present-day experimental setup. Especially our background pressure is relatively high and limits the lifetime of atoms in our cloverleaf trap to 15 s, hampering efficient runaway evaporative cooling.

We have optimized the loading of our cloverleaf trap applying molasses and optical pumping and magnetically trap now up to 6×10^8 atoms, starting from a MOT with 1.5×10^9 atoms. Our magnetic field configuration does not allow for strong compression, so the density ($1 \times 10^9 cm^{-3}$) at the beginning of evaporative cooling stage is not high. After 18 s of rf ramp we detect time-of-flight signal with MCP detector. About $\sim 5 \times 10^5$ atoms are left in the trap at a temperature of a few microkelvin. Up till now, we do not observe increase in density and collision rate which would be the evidence of runaway evaporation.

In the mean time we have designed a new vacuum chamber that should bring better vacuum and stronger confinement. This chamber has all the magnetic field coils outside the vacuum and uses a novel four-coil Quic-trap configuration.

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