Levitated Cesium atoms in a CO_2 Laser Trap: Towards a BEC of Cesium

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We present the progress of an experiment in which a novel trap design is applied using both light and magnetic forces to trap and cool Cesium (Cs) in order to reach BEC.

The atoms are confined within an optical dipole trap consisting of two crossed 100W CO_2 laser beams. With a focus of $w_0 = 600\,\mu$m the resulting trapping potential is wide and shallow. In order to compensate the much stronger gravitational force, a magnetic field gradient of 31 G/cm along the vertical axis is applied. This counterbalances gravitation for only the atomic ground state of Cs ($F = 3, m_F = 3$) and effectively levitates those atoms. The atomic ground state cannot be trapped in standard magnetic traps but offers the advantage that 2-body loss processes are suppressed. This advantage allows storage times in the order of minutes in our trap. Other spin states remain untrapped and are thus expelled from the trap, opening up a path for rf evaporation. This combination of a wide and shallow optical dipole trap and the magnetic leviation defines our LEVitated Trap (LEVT).

The freedom to apply an additional homogeneous magnetic field provides the possibility to vary the scattering lenght due to a Feshbach resonance at low fields (50G). The resulting Cs BEC in this trap would constitute a tunable quantum gas. This setup enables us also to measure the scattering properties of pure spin polarized samples with a widely tunable interaction.

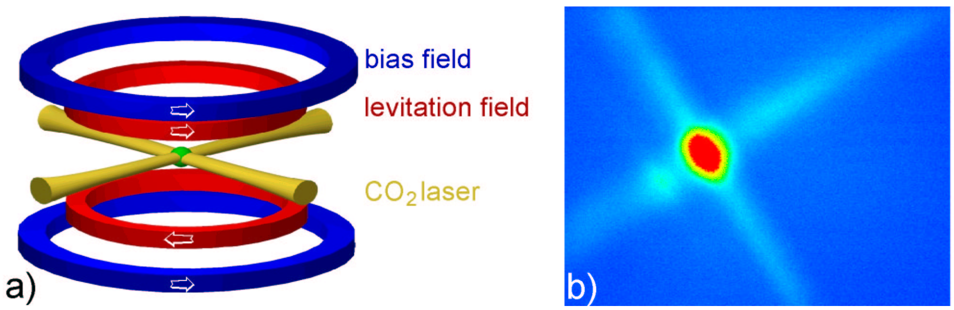

Figure 1: a) Setup of the LEVitated Trap, b) Fluorescence image after 100ms storage time.

In a first step, more than 10^8 Cs atoms were captured in a MOT and precooled with sub-Doppler techniques to below 10μK. We show levitation of the atoms after optically pumping them into the internal ground state and we demonstrate successful storage in the LEVT. We will discuss the trap properties and present first measurements on storage times.