Interactions of Lithium Atoms in a Resonator-Enhanced Dipole Trap

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In order to study the interaction in an ultracold lithium gas, we have developed a novel dipole trap based on the resonant enhancement of a far detuned standing wave in an optical resonator. Light from an ultrastable 2 Watt Nd:YAG laser is coupled into the resonator and enhanced 130-fold, thus creating a trap depth of approximately 1 mK for the lithium atoms. It enables us to trap roughly 10^5 to 10^6 laser-cooled atoms in about 1000 wells of the standing wave[1].

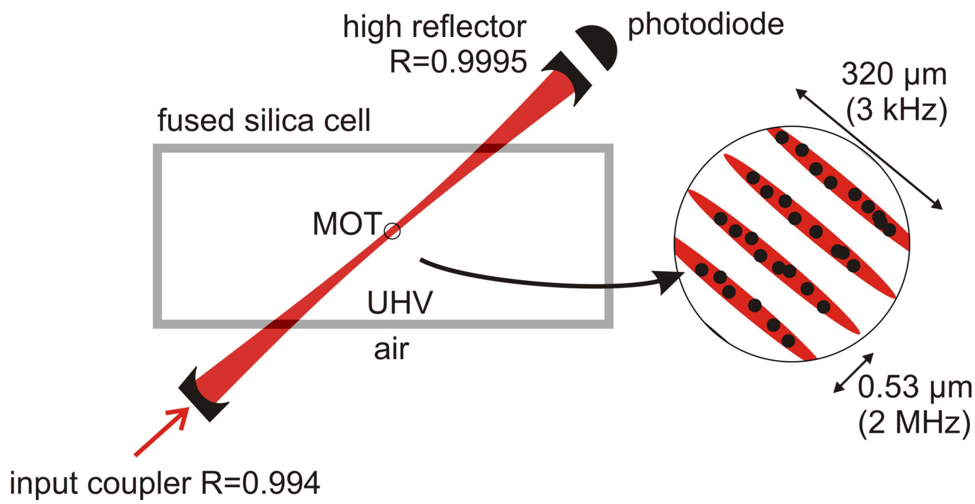

Figure 1: Schematic of the resonator trap.

Current experimental work is being performed with the fermionic isotope, ^{6}Li. The goal is to explore a Feshbach resonance that is predicted at a magnetic field of 800 G[2]. In following experiments, the tunability of the interactions in the vicinity of this resonance will be essential to accelerate thermalization of the trapped gas, which is essential for a variety of cooling techniques[3]. Also, a strongly attractive interaction will be necessary to observe a phase transition to a BCS phase at an experimentally feasible temperature.

The diode laser system used for the magneto-optical trap can be easily adapted to trap the bosonic isotope, ^{7}Li. With the bosons we plan to explore combinations with magnetic traps[4], a novel collision-assisted cooling scheme[5], and the production of a stable array of small attractively interacting Bose-Einstein condensates.

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