# Abstract

In this thesis I describe our method of simultaneously creating Bose-Einstein condensates of bosonic $^{87}$Rb and $^{133}$Cs atoms in two spatially separated optical dipole traps. The two condensates can be overlapped for quantum gas mixture experiments and for the production of ultracold samples of dipolar molecules.

We first load the Rb and Cs atoms into a two-color magneto-optical trap from Zeeman slowed atomic beams. The mixture is further cooled by applying two-color degenerate Raman sideband cooling, which also polarizes the atoms into their lowest spin states. We then load the Rb-Cs sample into a large-volume levitated dipole trap.

This is the starting point for a set of experiments, which are described in this thesis in detail: First, we search for interspecies Feshbach resonances in two different spin channels, Rb$|1,1\rangle$+Cs$|3,3\rangle$ and Rb$|2,-1\rangle$+ Cs$|3,3\rangle$, by performing inelastic loss spectroscopy. In total, we find 25 resonances in the accessible magnetic field range. Our results provide fundamental experimental input to determine the relevant parameters of a theoretical model describing the Rb-Cs scattering properties. Second, we examine inelastic heteronuclear three-body recombination processes in order to answer the question whether a subsequent combined cooling strategy is possible. For a collision of two Rb atoms and one Cs atom we measure a loss rate coefficient of $1.7(9) \times 10^{-24}$ cm$^6$/s. We perform this measurement at a magnetic field value far from any Feshbach resonance. Due to this comparatively large loss rate coefficient efficient evaporative cooling is very unlikely. We therefore spatially separate the two species. To do this, we selectively load the Rb and Cs atoms from the large-volume dipole trap into two spatially separated, more tightly confining dipole traps. After several seconds of simultaneous evaporative cooling, we obtain two pure condensates with $10^4 - 10^5$ atoms. The condensates are separated in space by about 400 $\mu$m.

Finally, we show that we are able to overlap the two condensates and to produce weakly bound RbCs Feshbach molecules by making use of a heteronuclear Feshbach resonance. This is a good starting point for the creation of dipolar ground state molecules using a coherent two-photon Raman transition.