

Abstract

Ultracold quantum gases are ideal to explore few-body physics because of the tunable two-body interaction. The focus of our research is the exploration of quantum mechanical three-body and four-body systems. For this we investigate inelastic collisions between ultracold Cs atoms and Cs₂ molecules. The preparation of the cold atomic sample takes place in an optical dipole trap. We associate the molecules from an ultracold atomic sample by magnetically tunable Feshbach resonances.

In this work I report on the implementation of a new dipole trap. The new trap allows us to tune the position and the shape of the dipole potential during the running experiment and to prepare atomic and molecular samples at low temperatures in a convenient way. This new trap opens up a way to many exciting novel experiments.

In this thesis I describe the experimental setup focusing on the new system. I also discuss the creation and preparation of Cs₂ dimers by Feshbach association from an ultracold atomic sample. The obtained ultracold atomic and molecular sample serves as a starting point to study inelastic atom-dimer and dimer-dimer collisions. Here I will discuss a measurement in which the atom-dimer collision loss coefficient is determined for different external magnetic fields.

Future experimental directions will be the research of three-body and four-body physics at high magnetic fields, in particular the investigation of Efimov physics in the ultracold regime.