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Investigation of an ultracold mixture of Yb and Rb atoms

Studies on mixtures of ultracold atoms are currently attracting significant attention. Among the most prominent results achieved so far are the creation of two-species quantum gases, the discovery of interspecies Feshbach resonances and the production of heteronuclear molecules in the vibrational ground state. In our experiment, we investigate a mixture of paramagnetic rubidium (Rb) and diamagnetic ytterbium (Yb). The different magnetic and electronic properties make it possible to design a combined trap, in which the two species can be manipulated independently. The trap consists of a Ioffe-Pritchard type magnetic trap for Rb and a bichromatic optical dipole trap for Yb employing. In this novel type of combined trap, we have successfully trapped mixtures of ^{87}Rb and five different Yb isotopes and realized sympathetic cooling of Yb by evaporatively cooled Rb. We have determined the interspecies elastic scattering cross sections and observed a strong dependence of the scattering corss section on the mass of the Yb isotope. In a second line of experiments, we investigate the possibilities to create RbYb molecules by photoassociation. The first step towards this goal is the investigation of one-photon spectroscopy from the atomic ground state of the two atomic species to an electronically excited state of the heteronuclear RbYb molecule. Here, we report on recent results of photoassociation spectroscopy close to the Rb D1-transition at 795 nm in a combined magneto-optical trap. By detecting the Yb trap loss as a function of the frequency of the photoassociation laser, we are able to observe spectral lines corresponding to several vibrational states and resolve the rotational sub-structure of the excited RbYb molecule. The next steps will be photoassociation spectroscopy of conservatively trapped RbYb mixtures and the extension to two-photon photoassociation in order to produce ultracold ground state molecules.

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