

GROUP II MEETS GROUP I

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We are setting up an experiment for the study of mixtures of ultracold strontium, lithium and potassium gases. All three elements have fermionic isotopes in addition to the bosonic ones. This should allow us to study the BEC-BCS crossover of three different heteronuclear systems (LiK, SrLi and SrK).

Strontium as an alkaline-earth element brings novel properties to degenerate quantum gas mixtures. One important feature is its narrow intercombination line. This might allow to make use of optical Feshbach resonances. Compared to alkaline elements they are predicted to be accompanied by orders of magnitude less losses due to spontaneous emission from the excited state. Related two photon schemes can lead to the production of e.g. SrLi or SrK molecules in more deeply bound states than possible in alkaline mixtures with magnetic Feshbach resonances.

Optical dipole traps operating close to the intercombination line of strontium can selectively trap this element while having negligible influence on alkaline elements. This feature can be used for example to implement new cooling schemes for atoms in optical lattices.

^{88}Sr has no nuclear magnetic moment and very weak self-interaction. Because of this it should be well suited as sensitive probe to interaction effects in mixtures.

In addition to fermionic physics our machine gives us a new approach to reach quantum degeneracy of bosonic strontium by sympathetic cooling with lithium or potassium. If the metastable state would have a sufficiently long lifetime in such a mixture, it may even be possible to produce a degenerate quantum gas in that state.

We did trap $^{86,87,88}\text{Sr}$, $^{39,40,41}\text{K}$ and ^6Li in single or two species magneto-optical traps and transferred ^6Li to a high power crossed beam optical dipole trap. Currently we are working on the transfer of a Li-K mixture to the optical dipole trap and the detection of Feshbach resonances in that mixture.