ESR7: Formation and reactions of cold $(BaRb)^+$ and Rb_2^+ molecules

Supervisor: Johannes Hecker Denschlag

Host Institution:
Ulm University

Duration: 36 months

Planned secondment: University of Bonn, Aarhus University, University of Basel

Description:

In our BaRbIe experiment we immerse a single cold trapped Barium (Ba) [or Rubidium (Rb)] ion in an ultracold gas of neutral Rb atoms. In this very unique and novel set-up we can study for the first time interactions of ions and atoms at ultralow temperatures.

Compared to the short ranged van der Waals interactions between neutral particles, atom ion interactions are long range due to the $1/r^4$ polarization potential. We investigate how ions and atoms collide and react in the cold regime.

An important goal is to transfer quantum control techniques that have in recent years been developed for ultracold neutral quantum gases to atoms and ions. For example, we want to demonstrate Feshbach resonances in collisions between ions and atoms, which can be used to control the interactions of the particles and to form cold ionic molecules. We then want to study the properties of these molecules and measure how quickly they relax to more deeply bound states when they collide with cold atoms. The applicant will join these efforts to move forward the frontier of ultracold chemistry between atoms and ions.

Literature:

- Population distribution of product states following three-body recombination in an ultracold atomic gas. A. Härter, A. Krükow, M. Deiß, B. Drews, E. Tiemann, and J. Hecker Denschlag, Nature Physics 9, 512 (2013)
- A single ion as a three-body reaction center in an ultracold atomic gas , A. Härter, A. Krükow, A. Brunner, W. Schnitzler, S. Schmid, and J. Hecker Denschlag, Phys. Rev. Lett. 109, 123201 (2012)
- Dynamics of a cold trapped ion in a Bose-Einstein condensate, Stefan Schmid, Arne Härter, Johannes Hecker Denschlag, Phys. Rev. Lett. 105, 133202 (2010)

Contact: johannes.denschlag@uni-ulm.de

Links: http://www.uni-ulm.de/nawi/qm.html