Sympathetic cooling of ^{39}K in a hybrid potential

Lars J. Wacker[1], Nils Winter[1], Ridha Horchani[1], Jacob F. Sherson[1] and Jan Arlt[1]

[1]*Department of Physics and Astronomy, Aarhus University,*
Ny Munkegade 120, 8000 Aarhus C, Denmark
LWacker@phys.au.dk

Potassium-39 allows for precise tuning of the scattering length and enables the realization of noninteracting gases due to a broad Feshbach-resonance. It is thus a prime candidate for investigating e.g. interacting quantum systems and precision metrology. This contribution outlines our approach for sympathetic cooling of ^{39}K with ^{87}Rb in a hybrid trap and our progress towards the production of ^{39}K Bose-Einstein condensates (BECs).

At present our setup allows for the production ^{87}Rb BECs via microwave evaporation in a magnetic potential and further optical evaporation in a hybrid dipole and magnetic potential. This configuration has allowed e.g. the demonstration of a gravity compensated atom laser [1]. However ^{39}K BECs cannot be achieved in this configuration since ^{39}K has a negative background scattering length.

Therefore we start by sympathetically cooling ^{39}K with ^{87}Rb in a quadrupole trap via species selective evaporation of ^{87}Rb [2]. In addition we are developing a novel cooling strategy to continue sympathetic cooling below the limit imposed by the quadrupole potential. This cooling mechanism will be performed in a dipole trap with a superimposed magnetic field gradient. By using magnetically anti-trapped states for ^{87}Rb and trapped states for ^{39}K, species dependent evaporation will be possible. Finally ^{87}Rb will be removed before tuning the ^{39}K scattering length positive to produce stable BECs. So far our apparatus has shown a very reliable production of ^{87}Rb condensates and ^{39}K has been cooled in an optical molasses [3] and by the first sympathetic cooling [2] step.

References:

[1] G. Kleine Büning, J. Will, W. Ertmer, C. Klempt and J. Arlt, Appl. Phys. B, **100**, 117-123 (2010).
[2] G. Roati, M. Zaccanti, C. D'Errico, J. Catani, M. Modugno, A. Simoni, M. Inguscio and G. Modugno, Phys. Rev. Lett. **99**, 010403 (2007).
[3] M. Landini, S. Roy, L. Carcagn, D. Trypogeorgos, M. Fattori, M. Inguscio and G. Modugno, Phys. Rev. A **84**, 043432 (2011).