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**Single trapped ions sympathetically cooled by ultracold atoms**
ARNE HAERTER, ANDREAS BRUNNER, ARTJOM KRUEKOW, STEFAN SCHMID, WOLFGANG SCHNITZLER, JOHANNES HECKER DENSCHLAG, Institute of Quantum Matter, Ulm University — We investigate the interaction of single trapped ions ($^{138}Ba^+$ or $^{87}Rb^+$) with an ultracold cloud of optically confined $^{87}$Rb atoms. In these experiments, the ion is held in a linear Paul trap and is immersed in the center of the atomic cloud. The atom-ion interaction gives rise to a strong and long-range $\frac{1}{r^4}$ polarization potential yielding novel and complex interaction dynamics. Charge transfer processes and elastic scattering have been observed at millikelvin collision energies [1,2], the energy scale being set by the trap-driven excess micromotion of the ion. Using improved field compensation techniques, we reduce the energy of the excess micromotion to the $Ba^+$ sub-Doppler regime ($\approx k_B 300\,\mu$K) and examine the influence of ion micromotion energy over a wide range. In performing these experiments on $^{87}Rb^+$ ions we show the applicability of this buffer-gas cooling method to ionic species not amenable to laser cooling. By decreasing the ion energy even further we are aiming at novel experiments, such as the production of ultracold, charged molecules in a well-defined quantum state.

[1] S. Schmid et al, Phys. Rev. Lett. **105**, 133202 (2010)
[2] C. Zipkes et al, Phys. Rev. Lett. **105**, 133201 (2010)

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