Cavity optomechanics of single ions and ion coulomb crystals

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Cavity cooling is a relatively new laser-cooling paradigm, which relies on the coupling of atomic or molecular optical transitions to the light field of optical resonators. In case of sufficiently strong coupling it should be feasible to cool atomic as well as molecular species, which due to lack of closed optical transitions normally needed in traditional laser cooling schemes are not easily cooled. Furthermore, cavity cooling can be applied as an additional cooling tool to reach temperatures below those normally dictated by the free space decay rates of the cooled species. So far, the cooling scheme has, however, only been demonstrated with neutral atoms.

I will present resolved sideband cavity cooling of single ions to a temperature below the Doppler limit as well as novel techniques for measuring the temperature of ions in a cavity. I will also present a project under construction on cavity optomechanics with ion coulomb crystals, concerning investigations of the mechanical effects of light on very dilute and cold crystals of ions (Coulomb crystals) placed in an optical cavity. As a particular research goal, we will investigate cavity cooling of the vibrational eigenmodes of such crystals.