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Laser-cooled atomic ions as tools for molecular ion spectroscopy

KENNETH BROWN, Georgia Tech

Laser cooled ions in linear Paul traps are an ideal tool for studying gas phase atomic and molecular ions at very low temperatures. The large trapping depth and the wide mass acceptance range allows the simultaneous trapping of different ion species for long times. The laser cooled ions sympathetically cool other ion species in the trap through the Coulombic interaction. At cold temperatures the ions will form an ordered structure, a Coulomb crystal. This presents an opportunity to heat the crystal with one ion and detect that heating with another. Our work is focused on using this effect to non-destructively detect molecular spectra by changes in the laser-cooled atomic fluorescence. We will compare our technique to two similar procedures: resonance enhanced multi-photon dissociation in Coulomb crystals and quantum logic spectroscopy.