Weak dipolar interactions in ion chains

Roee Ozeri

Weizmann Institute of Science

In this talk I will review two recent experiments in which weak, magnetic and electric, dipolar interactions were measured in between ultracold atoms at micrometer separation. In the first experiment, the magnetic spin-spin interaction between two trapped ions was observed to lead to the entanglement of their collective spin state. The measurement of this ultra-weak (mHz) interaction strength was made possible by restricting their spin evolution to a decoherence-free subspace. In the second experiment, resonant electric dipole-dipole interactions were measured during photon scattering on an allowed optical dipole transition in chains of up to eight ions. The resonance frequency of the transition was shown to slightly (10’ of kHz) shift whenever the separation between ions equaled an integer number of photon wavelength in what is known as collective Lamb shift. This shift is due to emission and re-absorption of virtual photons between different ions in the chain, and is closely related to superradiance.