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Remote entanglement of ions in parabolic mirror traps CHEN-KUAN CHOU, THOMAS NOEL, CAROLYN AUCHTER, BORIS BLINOV, U of Washington — We study ion-photon and remote ion entanglement protocols in application to quantum computation and information. One of the challenges is the efficient coupling between ions and resonant photons. We describe operation of an RF ion trap, which uses a reflective parabolic surface as one of the trap electrodes. This parabolic mirror covers a solid angle of 2-pi sr. around the trapped ion, and the ion can be placed precisely at the focus of the parabola. We measure approximately 40% fluorescence collection from a single barium ion with this setup, with the image spot size of about twice the diffraction limit. Using a reflective fiber collimator for the collected photos, we achieve a single mode fiber coupling efficiency of 10%. Thus, we demonstrate overall efficiency of single ion to single mode fiber fluorescence at 4%. Recently, we built an updated version with an improved control of the ion position, where piezoelectric actuators applied to a movable electrode. In this setup we can fully compensate the ion micromotion while placing the ion in the focus of the mirror. We demonstrated entanglement between a single barium ion and a single emitted photon [1]. Our goal now is to entangle two ions in separate parabolic mirror traps, eventually to be separated by a kilometer or more.

Chen-Kuan Chou
U of Washington

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