Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

"Tack" ion trap for efficient photon collection.[1] CHEN-KUAN CHOU, GANG SHU, NATHAN KURZ, THOMAS NOEL, JOHN WRIGHT, BORIS BLINOV, University of Washington — Trapped, laser-cooled atoms and ions produce intense fluorescence of the order 10^7 – 10^8 photons per second. Detection of this fluorescence enables the efficient measurement of the quantum state of qubit based on the trapped atoms. Thus, it is desirable to collect a large fraction of the (isotropically emitted) photons to make the detection faster and more reliable. Additionally, efficient fluorescence collection can improve the speed and fidelity of remote ion entanglement and quantum gates. Refractive and reflective optics, as well as optical cavities, and, recently, bare multimode optical fibers have all been used to collect the trapped ion fluorescence with up to 10% efficiency. Here we show a novel ion trap design that incorporates a high numerical aperture metallic spherical mirror as the integral part of the trap itself (the RF electrode) which enables up to 35% solid angle collection of trapped ion fluorescence. The movable central needle-shaped electrode of this "tack" trap allows precise placement of the ion at the focus of the spherical mirror. We also study the properties of the images formed by the spherical mirror and comment on possible methods for aberration correction. Owning to the simplicity of its design, this trap structure can be adapted for mircofabrication and integration into more complex trap architectures.

[1]Supported by National Science Foundation and IARPA

Boris Blinov
University of Washington

Date submitted: 21 Nov 2010 Electronic form version 1.4