Abstract Submitted
for the DAMOP09 Meeting of
The American Physical Society

Trapped Ion Imaging with Integrated Spherical Mirror[1] GANG SHU, MATTHEW DIETRICH, NATHAN KURZ, BORIS BLINOV[2], University of Washington — Efficient fluorescence collection is essential for trapped ion quantum computation and information. High photon counting rate implies fast, high-fidelity qubit state readout, more efficient single-photon generation by trapped ions or neutral atoms, and reliable ion-photon and distant ion entanglement generation. In an effort to increase solid angle of ion fluorescence collection we built a linear ion trap with an integrated concave spherical mirror. Our integrated mirror has an estimated numerical aperture of 0.9, representing more than an order of magnitude increase in covered solid angle as compared to a typical lens system. We demonstrate robust ion trapping in the presence of the mirror, and obtain sharp images of single ions and resolve multiple ions with no additional optics but the spherical mirror. The preliminary result show a substantial boost in photon counting rate. To exploit the full potential of this spherical mirror, we developed an aspheric corrector plate to be placed outside the vacuum chamber which will eliminate the mirror's inherent spherical aberration. Our simulations show that with such corrector a near diffraction-limited imaging of ions is possible.

[1]Supported by the NSF, ARO, and the University of Washington Royalty Research Fund.
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Date submitted: 26 Jan 2009 Electronic form version 1.4