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Microfabricated Surface Trap and Cavity Integration for High Fidelity State Detection and Photon Collection from Trapped Ions. ANDRE VAN RYNBACH, GEERT VRIJSEN, DAN GAULTNEY, JUNGSANG KIM, Department of Electrical and Computer Engineering, Duke University — Atomic ions trapped in microfabricated traps can provide a useful resource for quantum information processing. Traditional approaches to qubit state detection using state dependent fluorescence utilize refractive lenses or reflective optics to direct scattered photons to the detector. Here we show progress towards a new method which can drastically enhance the fidelity and speed of qubit state detection by using the interaction between a trapped ion and an optical field in a cavity. Our experiment uses a concentric cavity geometry with a surface trap fabricated on a mirror which is highly reflective at UV wavelengths for $^{171}Yb^{+}$ ions. Using this system, we show that it is feasible to reduce the qubit measurement time to that comparable to single qubit gate times (1μs), and the measurement errors down to the 10^{-5} range. Furthermore, this system can be used for enhanced photon collection and remote ion entanglement. We describe the design and fabrication of the traps used in the cavity system, and report the experimental progress towards the cavity realization.

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