Abstract Submitted
for the DAMOP07 Meeting of
The American Physical Society

Efficient qubit state detection using integrated optics in ion trap quantum computation.[1] JUNGSANG KIM, CHANGSOON KIM, CALEB KNOERNSCHILD, BIN LIU, KYLE MCKAY, FELIX LU, Duke University — Efficient and scalable detection of qubits in trapped ion systems is a major bottleneck in achieving scalable quantum information processor. High fidelity qubit detection is possible utilizing cycling transition, and monitoring the presence of scattered photons. The efficiency and speed of this detection process critically depends on the effectiveness of photon collection optics and the performance of the photon detectors used. In this study, we explore utilization of micro-optical components for effective collection of the scattered photons in a scalable manner. We also analyze the signal-to-noise ratio and corresponding bit-error-rate (BER) of the state detection based on different types of detectors available to date. The BER in the detection process critically depends on the quantum efficiency, internal gain, and the excess noise factor associated with the gain process. Based on this analysis, we propose an ideal photon detector based on visible light photon counter (VLPC) technology that provides the best BER performance. Combining the micro-optical collection and ideal photon detector is shown to improve the integration time required for the state detection by almost an order of magnitude at the same BER level as compared to current approaches using photomultiplier tubes.

[1]This work is supported by NSF.

Jungsang Kim
Duke University

Date submitted: 02 Feb 2007 Electronic form version 1.4