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Polarization-dependent atomic dipole traps behind a pinhole for controllable manipulation of qubit locations in a quantum memory KATHARINA GILLEN-CHRISTANDL, BERT COPSEY, GLEN GILLEN, California Polytechnic State University, San Luis Obispo — We present computational results for the polarization-dependent trapping potentials of atom traps behind a pinhole that are suitable for a quantum memory. We previously calculated the trapping properties of localized bright and dark spots formed directly behind a pinhole for a laser beam at normal incidence [1]. In our recent computational research we found that the traps remain intact upon tilting the laser beam. Exploiting the polarization-dependence of atomic dipole traps [2], we have explored the use of tilted, circularly polarized laser beams to store Rb atoms in specific magnetic substates. We found that two laser beams of opposite circular polarization incident on a pinhole at an angle allow the storage of two atoms in two different magnetic substates in two separate locations. Further, our results show that physically tilting the laser beams allows us to bring the two atoms together and apart controllably. In this fashion, we hope to use an array of pinholes as a quantum memory with the ability of bringing pairs of qubits together and apart for 2-qubit quantum operations. [1] G. D. Gillen, et al., Phys. Rev. A 73 (2006), 013409, [2] I. Deutsch, et al., Phys. Rev. A, 57 (3), 1972-1986 (1998).

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