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Investigation of a quantum memory created by diffraction of laser light at an array of pinholes KATHARINA GILLEN-CHRISTANDL, BERT COPSEY, GLEN D. GILLEN, California Polytechnic State University, San Luis Obispo — We present computational results of the investigation of an array of pinholes as basis for a quantum memory. Our previous calculations [1] showed that the diffraction pattern of laser light behind a pinhole exhibits localized intensity maxima and minima that, for moderate laser intensities and commercially available pinholes, can serve as single atom traps for quantum computing. We also found that the traps stay intact for laser light incident on the pinhole at an angle. Thus, two laser beams incident at an angle can trap two atoms in separate wells. By exploiting the polarization-dependence of the atom trapping potential on the light polarization and the magnetic substate of the atom [2], we can controllably bring a pair of atoms together and apart for quantum operations. This is achieved by using two tilted laser beams with opposite circular polarizations to trap two atoms in different magnetic substates, and then moving the atoms arbitrarily close to each other by tilting the beams to normal incidence. We are currently exploring the scaling up of this approach to many pinholes to create an addressable 2D array of atoms for use as a quantum memory. [1] G. D. Gillen, et al., Phys. Rev. A 73, 013409 (2006); [2] I. H. Deutsch, et al., Phys. Rev. A, 57 (3), 1972-1986 (1998).

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