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Experimental Progress Towards the Development of Neutral Atom Quantum Computing Architecture Based on 2D Optical Lattices on a Chip RAJANI AYACHITULA, ANDREW MORSS, GREG LAFYATIS, Ohio State University, KATHARINA GILLEN-CHRISTANDL, California Polytechnic State University, San Luis Obispo — Previously, we showed, theoretically, that optical lattices can be created above an optical waveguide by destructively interfering laser light in two different waveguide modes. [1] Single atoms can be tightly trapped at the nodes of a lattice and can serve as individually addressable qubits of a quantum memory. We have also examined moving the atoms within the lattice. We have studied ways to realize one- and two-qubit gates. On the experimental side, we have developed and characterized optical waveguides suitable for making these optical lattices. We measure losses $\lesssim$1db/cm for TE0 and TE1 modes. To address individual modes we couple light into the waveguide modes using gratings fabricated on the waveguide surface. We have observed >15% coupling efficiency. Our initial scientific studies will characterize samples of cold atoms dropped onto the waveguide. We will discuss recent experimental progress. 1. Phys. Rev. A 70 032302 (2004)

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