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High fidelity lossless neutral atom qubit state detection in a state-dependent optical lattice[1] TSUNG-YAO WU, AISHWARYA KUMAR, FELIPE GIRALDO, DAVID S. WEISS, The Pennsylvania State University — Accurate qubit state detection is essential to a quantum computer. We demonstrate a lossless state measurement of ˜160 neutral atom qubits in a 3D optical lattice with a fidelity of 0.9994, ˜20 times lower error than in any previous lossless measurement in a neutral atom array. The atoms' wavefunction is coherently split by state-dependent motion, transferred into an optical lattice with an order of magnitude shorter lattice spacing and then imaged. In mapping the internal states to spatial positions, this technique is reminiscent of the Stern-Gerlach experiment. Since the measurement causes essentially no loss, we can reuse the atoms. We also demonstrate that we can replace atoms that are lost to background gas collisions during the experiment.

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