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Optical lattice-based addressing and control of long-lived neutral-atom qubits NATHAN LUNDBLAD, IAN SPIELMAN, WILLIAM PHILLIPS, TREY PORTO, NIST/JQI — Quantum computational platforms are driven by competing needs: the isolation of the quantum system from the environment to prevent decoherence, and the ability to control the system with external fields. For example, neutral-atom optical-lattice architectures provide environmental isolation through the use of "clock" states that are robust against changing external fields, yet those same external fields are inherently useful for qubit addressing. Here we demonstrate a technique to address a spatially dense field-insensitive qubit register. A subwavelength-scale effective magnetic-field gradient permits the addressing of selected elements of the qubit register, leaving unmarked qubits unaffected, with little crosstalk or leakage. We demonstrate this technique with rubidium atoms, and show that we can robustly perform single-qubit rotations on qubits located at selected lattice sites.

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