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Coherent and simultaneous addressing of individual atoms in a 1D Optical Lattice HYOK SANG HAN, HYUN GYUNG LEE, SEOKCHAN YOON, D. CHO, Korea Univ — Coherent addressing and independent control of individual atoms are key elements for the lattice-based quantum computing. While recent approaches using a focused addressing laser beam enables a fast and high-fidelity addressing of individual atoms, the process is inevitably sequential for independent control of multiple qubits. On the other hand, when individual atoms are addressed by a position-dependent Zeeman shift, a simultaneous addressing is possible because each atom has a distinct identity. In previous experiments, however, use of large B-gradient to overcome an inhomogeneous broadening due to differential ac-Stark shift complicated the noise control and hindered the coherent addressing. Instead of using a large B-gradient, we reduce the linewidth down to the Fourier limit by using "magic polarization" that removes the trap-induced differential shift. In our demonstration, single 7Li atoms in a 1D lattice with 532-nm spacing are resolved in RF domain with the nearest-site resolution preserving long coherence. Moreover, two adjacent atoms are simultaneously addressed and controlled independently, paving the way for a more generalized parallel processing of multiple qubits.

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