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Cooling and long-lived single-site localization of an ion in an optical lattice[1] ALEXEI BYLINSKII, LEON KARPA, DORIAN GANGLOFF, Massachusetts Institute of Technology, MARKO CETINA, Institute of Quantum Optics and Quantum Information, Innsbruck, Austria, VLADAN VULETIC, Massachusetts Institute of Technology — We report on localization of a continuously cooled single ion by a one-dimensional optical lattice. The ion is confined in a hybrid trap formed by an optical dipole potential produced by the standing-wave field of an optical cavity and a two-dimensional radio-frequency Paul trap transverse to the cavity axis. A lattice-assisted resolved Raman sideband process cools the ion to energies 20 times lower than the depth of the lattice potential, close to the vibrational ground state. We observe ion localization by measuring its displacement in the presence of a periodically driven electric field parallel to the lattice. We demonstrate full suppression of the driven ion motion due to optical localization to a single lattice site on a time-scale of 100 μs, which is 100 times longer than the vibrational period of the ion in the lattice site. At a longer time scale of 1 ms, driven motion is suppressed to 50%. The presented system paves the way to the realization of novel experiments studying classical and quantum friction models, and many-body physics with long-range interactions in periodic potentials.

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