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Quantum interface between an electrical circuit and a single atom DAVID KIELPINSKI, Griffith University, D. KAFRI, Joint Quantum Institute/NIST, M.J. WOOLLEY, G.J. MILBURN, Centre for Engineered Quantum Systems, University of Queensland, J.M. TAYLOR, Joint Quantum Institute/NIST
— We show how to bridge the divide between atomic systems and electronic devices by engineering a coupling between the motion of a single ion and the quantised electric field of a resonant circuit. The coupling uses parametric modulation of the circuit capacitance by a MEMS device to bridge the gap in timescales between the ion motion and circuit frequency. Our method can be used to couple the internal state of an ion to the quantised circuit with the same speed as the internal-state coupling between two ions. The parametric driving of the coupling adds negligible decoherence to the system. All the well-known quantum information protocols linking ion internal and motional states can be converted to protocols between circuit photons and ion internal states. Our results enable quantum interfaces between solid state qubits, atomic qubits, and light, and lay the groundwork for a direct quantum connection between electrical and atomic metrology standards.

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