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State Transfer between a Mechanical Oscillator and Itinerant Microwave Fields TAUNO PALOMAKI, JENNIFER HARLOW, JILA, National Institute of Standards and Technology and the University of Colorado, JOHN JOHN TEUFEL, RAYMOND SIMMONDS, National Institute of Standards and Technology, Boulder, KONRAD LEHNERT, JILA, National Institute of Standards and Technology and the University of Colorado — We demonstrate that the state of an itinerant microwave field can be coherently transferred into, stored in, and retrieved from a mechanical oscillator. The mechanical oscillator is coupled to a microwave resonator such that the coupling Hamiltonian is capable of exchanging microwave photons and mechanical phonons by applying a detuned microwave pulse. By shaping the envelope of the detuned microwave pulse, we can ideally capture and release itinerant microwave fields with a particular temporal mode. Crucially, the time to capture and to retrieve the microwave state is shorter than the quantum state lifetime of the mechanical oscillator. Here we demonstrate protocols for optimal transfer and measure their efficiency using coherent states with energy at the single quantum level.

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