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Phonon-Mediated Detection of Trapped Atomic Ions¹ DAVID HUME, NIST and University of Colorado, TILL ROSEN BAND, DAVID WINELAND, NIST — Both quantum information processing and quantum-limited metrology require sensitive detection of quantum states. Using trapped atomic ions, we investigate quantum non-demolition measurements in a two-species ion chain composed of Al^+ and Be^+ . By mapping information from Al^+ to a shared phonon-mode then to Be^+ and detecting repetitively we have experimentally demonstrated a fidelity for state initialization and detection of 0.9994. We have also shown an increase in measurement efficiency through an adaptive procedure. Here we apply these ideas to the detection of states of multiple Al^+ using a single Be^+ ion, and describe the preparation of entangled states through measurement.

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David Hume
NIST and University of Colorado

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