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A single ion anharmonic mechanical oscillator with nonlinear dissipation NITZAN AKERMAN, SHLOMI KOTLER, YINNON GLICKMAN, ANNA KESELMAN, YEHONATAN DALLAL, ROEE OZERI, Weizmann Institute of Science — A driven, damped, nearly harmonic oscillator with a small cubic term in the force, is known as the Duffing oscillator. The Duffing oscillator shows various interesting features of non-linear response such as bistability and hysteresis. Several features of the Duffing instability have been recently measured using superconducting qubits and nano-mechanical resonators. Linear Paul traps can be well approximated as harmonic but have a small an-harmonicity due to their deviation from an ideal quadruple geometry. We study the steady state motion of a single trapped Sr^+ ion, subject to a near-resonance drive and dissipation in a linear Paul trap with a small anharmonicity. The driving force is applied by an oscillating voltage on the trap end-caps. Dissipation is the result of laser Doppler cooling. We measure both the amplitude and phase of the driven oscillations and find a good agreement with the Duffing oscillator model. When the cooling laser is close to resonance the standard Duffing model has to be extended to account for non-linearity in the dissipative force. Both the linear and the nonlinear terms of the dissipative force for various cooling laser detunings are determined by the line-shape of the -cooling transition and the cooling laser intensity and can therefore be conveniently controlled.

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