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Sideband cooling and anomalous heating of trapped Sr^+ ion.
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Center for Ultracold Atoms, MIT — Many schemes for entangling and quantum processing with trapped ions require cooling the ions close to motional ground state, and the anomalous heating of the ion can be the limiting factor in gate fidelity. We developed a simple laser system, based on external cavity diode lasers with optical feedback to a running-wave cavity to investigate this heating. Without the use of a high finesse cavity, or fast active feedback, we have achieved < 30 kHz linewidths and ≈ 1 MHz long term stability. This system was used to sideband cool a single Sr^+ ion to a motional ground state with $> 90\%$ probability and observe Rabi oscillations on the $5S_{1/2} \rightarrow 4D_{5/2}$ transition. We present our results on heating and cooling rates of the ion in room temperature and cryogenic ion traps.

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