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Efficient Sympathetic Cooling of Trapped Atomic Ions GRAHAME VITTORINI, CRAIG CLARK, KENNETH BROWN, Georgia Institute of Technology — A challenge of performing ion trap quantum computation with chains of ions is the heating of the trap vibrational modes. Trap heating can result in unwanted occupation of vibrational modes and a reduced fidelity for two ion gates. To combat this, specific ions within the chain can be tasked with cooling the entire chain via sympathetic cooling. The strength of the interaction between the cooling laser and cooling ions may have a significant effect on how efficiently the chain is sympathetically cooled. This interaction can be controlled via the intensity and detuning of the cooling beam as well as the time the cooling ions spend interacting with the cooling laser versus thermalizing with the ion chain. By using separate isotopes of Ca+, we can construct a chain of cooling and information ions with each isotope interacting with its resonant cooling laser independently. By adjusting the aforementioned interaction parameters and measuring the sideband spectrum of the information ions, we will be able to find the most efficient sympathetic cooling parameters. We will describe the experimental results so far as well as future related investigations.

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