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Sideband Cooling of Ytterbium BRANDON RUZIC, MELISSA REVELLE, PETER MAUNZ, Sandia National Laboratories — Trapped ions continue to be at the forefront of experimental platforms for precisely controlled quantum systems. In particular, linear chains of Yb ions are now counted among the most promising architectures for quantum computing. However, the high-fidelity entangling gates required for quantum information processing require that the motional degrees of freedom be kept at ultracold temperatures. Although these temperatures have been reached before, we have devised a novel sideband-cooling technique for Yb ions with a few advantages. By using the D3/2 state, this technique requires a simple laser system that is separate from the qubit lasers. It also avoids decay into the F7/2 state, which is a known complication when using the D5/2 state. We have experimentally demonstrated this technique on a single Yb-171 ion, and the resulting cooling rate is comparable to using the qubit lasers for cooling. The rate also shows good agreement with our theoretical model. These results suggest that this technique can be used to cool a chain of Yb ions and enable high-quality quantum gates. This research was funded, in part, by the Office of the Director of National Intelligence (ODNI), Intelligence Advanced Research Projects Activity (IARPA). Sandia National Laboratories is operated by NTESS, a wholly owned subsidiary of Honeywell International, for the US Department of Energy's NNSA under contract DE-NA0003525.

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