

Abstract Submitted  
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**Raman sideband cooling of  $^{138}\text{Ba}^+$  on a Zeeman transition<sup>1</sup>**

CHRISTOPHER SECK, MARK KOKISH, Northwestern University, MATTHEW DIETRICH, Northwestern University/Argonne National Laboratory, BRIAN ODOM, Northwestern University — Here, we report motional ground state preparation of a single  $^{138}\text{Ba}^+$  ion using Raman sideband cooling with the two  $S_{1/2}$  Zeeman sublevels. Owing to the small Zeeman splitting, Raman sideband cooling of  $^{138}\text{Ba}^+$  requires only two AOMs and the Doppler cooling lasers. Additionally, we demonstrate coherent operations using a second, far-off-resonant laser driving Raman  $\pi$ -pulses between the two Zeeman sublevels to characterize our mean motional occupation number, Raman sideband cooling frequency resonance, Raman sideband cooling rate, and ion trap motional heating rate. Motional ground state cooling and molecular internal state preparation, both realized in our group<sup>2</sup>, are important elements for molecular quantum logic spectroscopy (mQLS). We are now working towards motional ground state preparation of a  $^{138}\text{Ba}^+$  and  $\text{AlH}^+$  ion pair for mQLS.

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<sup>2</sup>C.-Y. Lien, C. M. Seck, Y.-W. Lin, J. H. V. Nguyen, D. A. Tabor, and B. C. Odom, *Nature Communications* **5**, 4783 (2014)

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