

Abstract Submitted  
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**Toward Quantum Logic Spectroscopy of Molecular Ions<sup>1</sup>**

CHRISTOPHER SECK, MATTHEW DIETRICH, MARK KOKISH, BRIAN ODOM, Northwestern University — Quantum logic spectroscopy (QLS) demands reliable state preparation of the subject's external and internal quantum numbers, a challenging task for molecules owing to their numerous internal degrees of freedom. Having recently achieved rapid rotational ground state cooling with the aluminum monohydride cation ( $\text{AlH}^+$ )<sup>2</sup>, we now present progress toward demonstrating QLS with  $\text{AlH}^+$ . We have implemented a new, efficient source for  $\text{AlH}^+$  production via resonance enhanced multiphoton ionization (REMPI) of neutral aluminum monohydride ( $\text{AlH}$ ).  $\text{AlH}$  is formed by ablation of aluminum in the presence of hydrogen gas. Following production, we then prepare the  $\text{AlH}^+$  ions in a well-defined internal state. In addition, we demonstrate progress toward ground state cooling  $\text{AlH}^+$  through sympathetic cooling with atomic barium ions ( $\text{Ba}^+$ ).  $\text{Ba}^+$  will then serve as our readout qubit in QLS.

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

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