Abstract Submitted
for the DAMOP19 Meeting of
The American Physical Society

Optical Pumping of $^{27}AlD^+$ Molecules to their Rovibrational Hyperfine Ground State[1] PANPAN HUANG, SCHUYLER KAIN, BRIAN ODOM, Northwestern University — Control of the internal degrees of freedom of molecules has important applications in quantum computing, precision spectroscopy, and ultracold chemistry. Molecules can have large electric dipoles compared to atoms. These dipoles can enable the coherent transfer of information within and between molecules, operations relevant to quantum computing. In addition, molecular quantum state control in precision spectroscopy offers one approach to measuring variations of m_p/m_e and intrinsic moments of fundamental particles. Molecular state control also offers the potential for insights into chemical phenomena such as the interplay between molecular structure and reaction dynamics. The aforementioned applications require the precise preparation and manipulation of quantum states. Building on previous work on the rovibrational cooling of $^{27}AlH^+$, we propose a method to drive $^{27}AlD^+$ to a specific hyperfine state within the rovibrational ground state using circularly-polarized pulse-shaped UV light. After driving the molecules to the targeted state, the rotational spectrum of the molecule will be acquired and accurate values of its rotational and hyperfine coupling constants will be measured.

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Date submitted: 01 Feb 2019 Electronic form version 1.4