BROADBAND OPTICAL COOLING OF $AlH^+$ TO THE ROTATIONAL GROUND STATE

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We demonstrate that a single spectrally filtered femtosecond laser, tuned to the electronic A-X transition of trapped $AlH^+$, can efficiently cool rotations from room temperature to the ground state. The nearly diagonal Franck-Condon-Factors between the electronic X and A states create semi-closed cycling transitions between the vibrational ground states of the X and A states. Parity-preserving electronic cycling cools to the two lowest rotational levels with a 10 $\mu$s timescale set by repeated electronic relaxation, and collection into the lowest rotational level relies upon a slower vibrational relaxation event setting the overall cooling timescale to 140 ms. The population distribution among the rotational levels is detected by $(1 + 1')$ resonance-enhanced multiphoton dissociation (REMPD) and time-of-flight mass-spectrometry (TOFMS).