Vibrational State Transfer in Ultracold NaCs

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Ultracold polar NaCs molecules are formed via photoassociation through a resonance 23 GHz detuned from the Cs $^2\text{P}_{3/2}$ asymptote from overlapped dark-spot Magneto-Optical Traps. Using a vibrational state selective detection method, we have determined the sample consists of $\nu=4-19$ in the $X^1\Sigma^+$ electronic ground state. We will report on an optical pumping method designed to transfer this initial distribution of vibrational levels to maximize the $\nu=0$ population. A simple model of optical pumping using the $A^1\Sigma^+-b^3\Pi$ complex is used to predict that the population will accumulate in the $\nu=0$ state if the sample is illuminated with light at roughly 1 micron with a 10 nm spectral range. Most importantly, the pulse frequency must be shaped to exclude transitions out of the $\nu=0$ level in order to create a dark state where the population will accumulate [1].