SPECTROSCOPY ON ALUMINUM MONOCHLORIDE (ALCL) FOR LASER COOLING AND TRAPPING

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Cooling atoms to the ultracold regime has allowed for studies of physics, ranging from many-body physics of quantum degenerate gases, quantum computing, precision measurements and tests of fundamental symmetries. Extending these experiments to polar molecules has the prospect of enhancing the sensitivity of such tests and of enabling novel studies, such as cold controlled chemistry. However, applying traditional laser cooling techniques to molecules is rendered difficult due their additional degrees of freedom which result in a limited photon scattering budget. Here we study aluminum monochloride (AlCl) as a promising candidate for laser cooling and trapping. The cooling transition at 261 nm ($A^1\Pi - X^1\Sigma^+$) has a theoretical Franck-Condon factor of 99.88% which allows for scattering 800 photons with a single laser before the molecule enters an excited vibrational state. We use a frequency-tripled (SHG + SFG) Titanium-Sapphire laser and generate AlCl via laser ablation in a cryogenic helium buffer gas beam source. We will present our spectroscopy results on AlCl and the measured molecular constants of the $A^1\Pi$ state and compare them with ab-initio calculations. We will also discuss our estimates on the Franck-Condon factors.