Slowing and cooling of AlF molecules

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The realization of ultracold molecules is fundamental for the study of ultracold chemistry, for precision measurements to test fundamental symmetries and for quantum information and simulation. Most of the theoretical and experimental efforts have been devoted to bi-alkali molecules via photo-association of two ultracold atoms. However, ultracold molecules can also be produced by trapping and cooling molecules from a molecular beam. Here, we present a joint theoretical-experimental study about slowing and trapping of AlF down to temperatures $\sim 100\mu$K. In particular, the measured and available spectroscopy information for the $X^1\Sigma$, $a^3\Pi$ and $A^1\Pi$ electronic states is inverted to get the pertinent potentials, and realistic Franck-Condon factors. The results obtained are shown in Fig.1 and indicate that only a single re-pump laser will be required for the cooling of AlF. The Spectroscopy characterisation of the relevant ro-vibrational and electronic states allows us to explore the slowing of the molecules as a function of the detuning and intensity of the applied laser field, which is theoretically modelled by means of the optical Bloch equations between the 36 ground and 36 excited states.

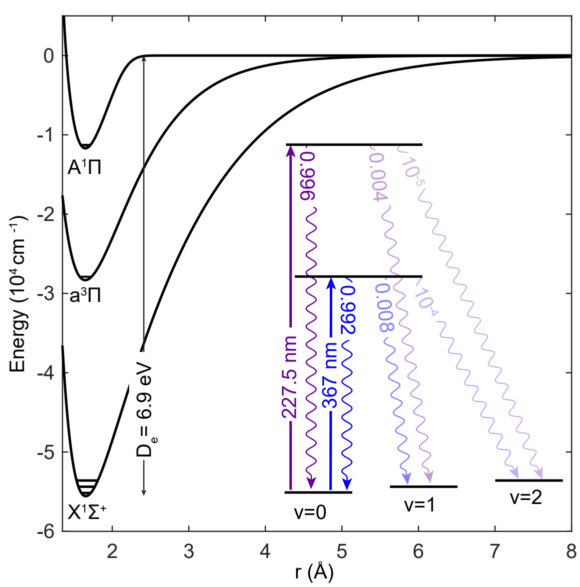

Figure 1: Calculated potential energy curves and Franck-Condon factors relevant for cooling and slowing of AlF.