SINGLET-TRIPLET DOORWAY STATES OF ALUMINUM MONOFLUORIDE

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Aluminum monofluoride (AlF) possesses highly favorable properties for laser cooling, both via the $A^1\Pi$ and $a^3\Pi$ states. Determining efficient pathways between the singlet and the triplet manifold of electronic states will be advantageous for future experiments at ultralow temperatures. The lowest rotational levels of the $A^1\Pi, v = 6$ and $b^3\Sigma^+, v = 5$ states of AlF are nearly iso-energetic and interact via spin-orbit coupling. These levels thus have a strongly mixed spin-character and provide a singlet-triplet doorway. We present a hyperfine resolved spectroscopic study of the $A^1\Pi, v = 6$ // $b^3\Sigma^+, v = 5$ perturbed system in a jet-cooled, pulsed molecular beam. From a fit to the observed energies of the hyperfine levels, the fine and hyperfine structure parameters of the coupled states, their relative energies as well as the spin-orbit interaction parameter are determined. The radiative lifetimes of selected hyperfine levels are experimentally determined using time-delayed ionization, Lamb dip spectroscopy and accurate measurements of the transition lineshapes. The measured lifetimes range between 2 ns and 200 ns, determined by the degree of singlet-triplet mixing for each level.