THE 4s ← 3p ELECTRONIC TRANSITION IN ALUMINUM ATOM-MOLECULE COMPLEXES: BOUND AND REPULSIVE EXCITED STATES

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An investigation of the 4s ← 3p electronic transition in weakly bound binary complexes of the Al atom with Ne and several molecules (H_2, D_2, N_2, CH_4) is reported. In contrast with the higher excited Al atomic states where the interactions are all attractive, the observed spectra are indicative of both attractive and repulsive interactions of Al(4s) with these partners. No fluorescence was detected upon laser excitation of this electronic transition in the Al-N_2 and Al-CH_4 complexes. Fluorescence depletion spectroscopy, using the 3d ← 3p electronic transition as the probe transition, was employed to observe these transitions. The 4s ← 3p transitions in Al-N_2 and Al-CH_4 show vibrational structure, assigned as an excited-state progression in the van der Waals stretch mode. An unstructured feature to the blue of the Al 4s ← 3p atomic transition was observed in the laser fluorescence excitation spectra of the AlNe, Al-H_2, and Al-D_2 complexes. These spectra are a consequence of the repulsive nature of the interaction of Al(4s) with these partners, as in the corresponding isovalent complexes involving boron. With the availability of an *ab initio* potential energy curve for the ground state, a potential energy curve for the excited AlNe($B^2\Sigma^+$) electronic state was derived by a fit to the observed AlNe excitation spectrum.