EXTENSIVE HIGH-RESOLUTION PHOTOASSOCIATION SPECTRA AND PERTURBATION ANALYSIS OF $2(0^-)$ LONG-RANGE STATE OF ULTRACOLD RbCs MOLECULES

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We report high-resolution photoassociation (PA) spectra of RbCs in the $2(0^-)$ long-range state. Transitions to more than fifty vibrational levels were recorded with the largest binding energy being 507.5 cm^{-1}. By fitting the experimental transition frequencies to the improved LeRoy-Bernstein formula, the C_6 coefficient for the potential energy curve of the $2(0^-)$ state was determined to be -1509$\pm$97 a.u.. Perturbation-induced energy level shift and state mixing of the long-range $2(0^-)$ and $3(1)$ states have been analyzed using an effective Hamiltonian that may be applied to mixing between other excited states of RbCs, as well as other heteronuclear diatomic molecules. Experimentally observed PA transitions to the $v = 190$ vibrational level of the $2(0^-)$ state and a vibrational perturbing level in the $3(1)$ state have been fit using the effective Hamiltonian, which provides the accurate value of the perturbation coefficient β_0. The experimentally determined rovibronic structure and the deperturbation analysis provide critical information for the search of new schemes for efficient production of ultracold RbCs molecules in the ground state.