THE DOPPLER-FREE TWO-PHOTON ABSORPTION SPECTROSCOPY OF NAPHTHALENE AND THE ZEEMAN EFFECTS

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The Doppler-free spectrum and the Zeeman effect of the $A\ ^1B_{1u}(v_4 = 1 : b_{1u}) \leftarrow X\ ^1A_g(v = 0)$ transition of naphthalene in the 33576.4-33578.0 cm^{-1} range has been measured by means of two-photon absorption spectroscopy with counter propagating light beams of identical wavelength within an external cavity. Rotational lines were fully resolved, and 1098 $^{Q(K)}Q(J)$ lines of $J = 0 - 42, K = 0 - 24$ were assigned. The molecular constants of the $A\ ^1B_{1u}(v_4 = 1 : b_{1u})$ state were determined. Deviations from the line positions calculated using the molecular constants were observed for several lines. Perturbations were not observed for K=0 but were observed to increase with increasing values of K. The perturbations were therefore identified as originating from a parallel Coriolis interaction. The Zeeman splittings for lines of a given J were observed to be maximum at $K = 0$ and to decrease with increasing K. Analysis of these results indicate that the magnetic moment lies along the c axis (perpendicular to the molecular plane). Any lines broader than our instrumental resolution (5 MHz) were not observed at $H = 0$ T. The J and K dependence of the Zeeman splittings of the $A\ ^1B_{1u}(v_4 = 1 : b_{1u}) \leftarrow X\ ^1A_g(v = 0)$ transitions were observed to be regular. This observation and the small number of perturbed lines, leads to the conclusion that the resonance interaction of the $A\ ^1B_{1u}$ state with the $T_1\ ^3B_{3u}$ and $T_2\ ^3B_{1u}$ states are small and negligible in the observed region.