

## BRIDGING THE GAP - NEWLY OBSERVED VIBRATIONAL LEVELS OF A AND B STATES OF CaH

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The electronic spectrum of CaH has been studied for over 90 years. The first laboratory spectroscopy of CaH was carried out in 1925 on  $C^2\Sigma^+ - X^2\Sigma^+$  transitions in the near-UV region<sup>a</sup>. Our primary interest is the B state and how it is affected by other nearby states. The B state has a double-minimum potential energy function. For this state we can identify three energy regimes. The lowest is the energy range between the minimum of the inner well and the minimum of the higher lying outer well. In this lower energy region the B-X and A-X spectra were recently investigated by Shayesteh *et al.*<sup>b</sup>. The high energy range is that lying above the potential energy barrier between the two wells. Our previous laser induced fluorescence report was on the vibrational states in this higher energy range.<sup>c</sup> In that previous report we were able to confirm a strong irregularity in the vibrational energy spacings that had been previously predicted by the *ab initio* study of Carlsund-Levin *et al.*. This irregularity is due to interaction between the B and D states.<sup>d</sup>

In the current study we have investigated the intermediate energy regime. These are energies starting from somewhat below the minimum of the higher lying outer well and continuing up to somewhat above the potential energy barrier between the two wells. In this intermediate energy range we have identified the A-X(4,0) and B-X(3 or 5, 0) bands. We present evidence for possible interactions between these vibrational levels. We will report on the current status of our work as we continue our program of delineating the vibrational levels of the B state over a full energy range: starting at the energy of the minimum of the inner well, progressing through the energy of the minimum of the outer well, the energy of the barrier, and on towards the dissociation limit.

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<sup>a</sup>R. S. Mulliken, *Phys. Rev.* **25**, 509 (1925).

<sup>b</sup>A. Shayesteh, R.S. Ram, P.F. Bernath, *J. Mol. Spectrosc.* **288**, 46 (2013).

<sup>c</sup>K. Watanabe, N. Yoneyama, K. Uchida, K. Kobayashi, F. Matsushima, Y. Moriwaki, S. C. Ross, *Chem. Phys. Lett.* **657**, 1 (2016).

<sup>d</sup>C. Carlsund-Levin, N. Elander, A. Nunez, A. Scrinzi, *Phys. Scripta* **65**, 306 (2002).