

## GATEWAY STATES OF THE $1^2\Delta$ STATE OF CaH.

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Calcium monohydride CaH is found in the Sun and other stars. Indeed, its A-X electronic spectrum has been a useful probe for stellar classification.<sup>a</sup> We have been working on this molecule in the visible and ultraviolet regions. Using Laser Induced Fluorescence (LIF) we have identified many new vibrational levels of the A, B/B', and  $1^2\Delta$  states. Our primary interest has been the detailed investigation of the B/B' state which has a double-minimum potential energy function. We have previously studied vibrational levels lying both below and above the potential energy barrier between the two wells.<sup>b,c</sup> In that work, we were able to confirm the strong irregularity in the vibrational energy spacings that had been predicted by the quantum chemical study of Carlsund-Levin *et al.*<sup>d</sup>

We previously reported the first experimental observation of the direct, but forbidden, excitation  $1^2\Delta \leftarrow X^2\Sigma$ .<sup>e</sup> This was done using LIF. This excitation is possible due to interaction of levels of the  $1^2\Delta$  state with nearby levels of states for which excitation from the ground state is not forbidden, so called “gateway” states. By studying the ensuing relaxation from the  $1^2\Delta$  state we have now identified some of the gateway levels involved.

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<sup>a</sup>For example, J.E. Gizis, *Astron. J.* **113**, 806 (1997).

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

<sup>c</sup>K. Watanabe, I. Tani, K. Kobayashi, Y. Moriwaki, S. C. Ross, *Chem. Phys. Lett.* **710**, 11 (2018).

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

<sup>e</sup>J. Furuta, K. Watanabe, I. Tani, K. Kobayashi, Y. Moriwaki, S. C. Ross, *74th International Symposium on Molecular Spectroscopy*, **TI06**, (2019).