

THE  $\tilde{A}(0, 8, 0)^1 \leftarrow \tilde{X}(0, 0, 0)^2$  AND  $\tilde{A}(0, 8, 0)^3 \leftarrow \tilde{X}(0, 0, 0)^2$  BANDS OF  $\text{CH}_2^+$

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The methylene ion,  $\text{CH}_2^+$ , is of special theoretical interest because it is both quasi-linear and exhibits a strong Renner-Teller interaction between its ground and first-excited electronic states. At linearity, the ground state is a  $^2\Pi_u$  state that splits into  $\tilde{X}^2A_1$  and  $\tilde{A}^2B_2$  states as the molecule bends. The  $\tilde{A}$  state is linear, while the  $\tilde{X}$  state is quasi-linear with a barrier to linearity of only  $1089 \text{ cm}^{-1}$ .

Recently, the spectrum of  $\text{CH}_2^+$  in the region  $10,700\text{--}11,000 \text{ cm}^{-1}$  has been recorded with our Ti:sapphire laser spectrometer. This spectrometer couples velocity modulation with heterodyne detection for near shot-noise-limited sensitivity. In this new spectrum we have assigned the  $\tilde{A}(0, 8, 0)^1 \leftarrow \tilde{X}(0, 0, 0)^2$  and  $\tilde{A}(0, 8, 0)^3 \leftarrow \tilde{X}(0, 0, 0)^2$  bands.<sup>a</sup> These bands are the first high-resolution detection of  $K_a = 2$  levels for the ground state. In addition, the  $\tilde{A}(0, 8, 0)^1 \leftarrow \tilde{X}(0, 0, 0)^2$  can be combined with the previously studied  $\tilde{A}(0, 8, 0)^1 \leftarrow \tilde{X}(0, 0, 0)^0$  band<sup>b</sup> to produce  $K_a = 2 - 0$  combination differences for the ground state. These combination differences provide the first high-resolution information about the ground state  $A$  rotational constant.

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<sup>a</sup>The  $\tilde{X}$  state is labeled using bent notation and the  $\tilde{A}$  state is labeled using linear notation.

<sup>b</sup>J. L. Gottfried and T. Oka, *J. Chem. Phys.* **121**, 11527 (2004).