

THE FAR ULTRAVIOLET SPECTRAL SIGNATURES OF FORMALDEHYDE AND CARBON DIOXIDE IN COMETS. Paul D. Feldman¹, Roxana E. Lupu¹, Stephan R. McCandliss¹, and Harold A. Weaver², ¹Department of Physics and Astronomy, The Johns Hopkins University, 3400 N. Charles Street, Baltimore, MD 21218-2686 (pdf@pha.jhu.edu), ²Johns Hopkins University Applied Physics Laboratory, Laurel, MD

Abstract

Observations of four comets made with the *Far Ultraviolet Spectroscopic Explorer* show the rotational envelope of the (0,0) band of the CO Hopfield-Birge system ($C^1\Sigma^+ - X^1\Sigma^+$) at 1088 Å to consist of both “cold” and “hot” components, the “cold” component accounting for ~75% of the flux and with a rotational temperature in the range 55–75 K [1]. We identify the rotationally “hot” component ($T \sim 500$ K) as coming from the dissociation of CO₂ into CO, with electron impact dissociation and photodissociation contributing roughly equally. An additional weak, broad satellite band is seen in two of the comets observed by *FUSE* (C/2001 A2 (LINEAR), Fig. 1, and C/2001 Q4 (NEAT)), centered near the position of the P(40) line that we attribute to CO fluorescence from a non-thermal hot rotational population produced by photodissociation of formaldehyde into CO and H₂. This process has been well studied in the laboratory. The dissociation products are characterized by a CO molecule whose rotational distribution can be represented by a gaussian centered near $J = 40$ with a half-width in J of about 20, and a vibrationally excited H₂ molecule [2]. Fluorescence from the high J levels of CO in the P-branch, together with vibrationally excited H₂, detected by fluorescent H₂ emission pumped by solar O VI $\lambda 1031.9$, constitute an unambiguous signature of H₂CO in a cometary coma. Formaldehyde has been observed in several recent comets in both the infrared and millimeter spectral regions [3, 4]. The capability of high resolution far-ultraviolet spectroscopy to identify H₂CO in a cometary coma provides a new means to determine its production rate relative to that of water and to compare these results with ground-based observations. From our analysis, we also find that electron impact excitation of CO, rather than resonance fluorescence, is the primary source of the observed $B^1\Sigma^+ - X^1\Sigma^+$ (0,0) band at 1151 Å.

Acknowledgements

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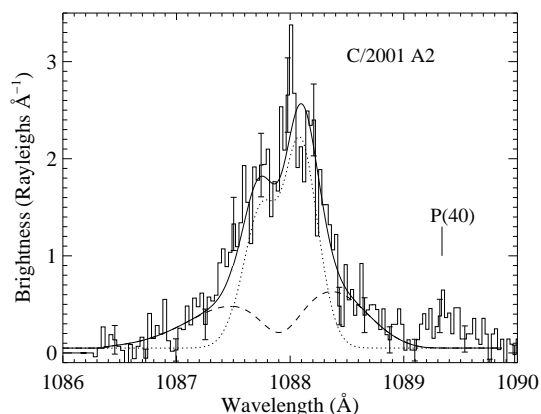


Figure 1: *FUSE* spectrum of the CO $C - X$ (0,0) band in comet C/2001 A2 (LINEAR) taken with the $30'' \times 30''$ aperture. The model fit is shown together with the “cold” (dotted) and “hot” (dashed) components. P(40) indicates the position of the P-branch transitions originating from J levels near the peak of the hot, non-thermal rotational distribution seen in laboratory photodissociation experiments [2]. The corresponding R-branch lines lie below the short wavelength cut-off of the LiF2a detector.

References

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