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 (C¹Σ⁺ − X¹Σ⁺) 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 ≈ 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 λ1031.9, 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 B¹Σ⁺ − X¹Σ⁺ (0,0) band at 1151 Å.

Acknowledgements

Financial support was provided by NASA contract NAS5-32985 and NASA grant NAG5-12963.

References