The Swings Effects of the A-X System and v″ = 1-0 Band of CO in Comets

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We have constructed a model of the A-X system of CO in order to analyze the CO bands appearing in the UV spectra of comet P/Halley obtained with the IUE. The major bands of the A-X system occur in the 1200 - 1800Å range where the temporal variation of solar irradiation is significant. The model includes electronic, rotational, vibrational transitions, excitations by solar UV radiation, and effects of neutral and electron collisions. The solar spectrum in this spectral range shows many emission lines, which cause a significant Swings effect. We derived fluorescence efficiencies of the bands as functions of heliocentric velocity and cometrocentric distance using a high resolution spectrum of the sun, and estimated that the UV Swings effects are less than 20% of the fluorescence efficiencies for the most bands of the A-X system. We discuss the temporal variation of solar UV irradiation and its effects on the fluorescence efficiencies. The study of the A-X system also requires knowledge of vibrational and rotational fluorescent processes in the infrared and radio regions because the majority of CO molecules in the coma is in the ground rotational states. The solar infrared spectrum around 5 microns, where the fundamental band of CO occurs, contains strong absorption lines of the fundamental band and hot bands of CO and its isotopes. We derived fluorescence efficiencies of the infrared band as functions of heliocentric velocity and cometrocentric distance. The solar absorption lines around 5 microns cause a 20% reduction of the g-factor of the fundamental band at heliocentric velocities close to 0 km/sec^{-1}. We discuss the effects of neutral and electron collisions on the fluorescence efficiencies of the infrared and UV bands.