Oscillator Strengths and Predissociation Widths for Rydberg Transitions in Carbon Monoxide

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February 3, 2006

Abstract

CO is used as a probe of astronomical environments ranging from planetary atmospheres and comets to interstellar clouds and the envelopes surrounding stars near the end of their lives. One of the processes controlling the CO abundance and the ratio of its isotopomers is photodissociation. Accurate oscillator strengths for Rydberg transitions are needed for modeling this process. We present results of recent analyses on absorption from the $E - X$ (1-0), $B - X$ (6-0), $K - X$ (0-0), $L' - X$ (1-0), $L - X$ (0-0), and $W - X$ (ν'-0, $\nu' = 0$ to 3) bands acquired at the high resolution (R $\approx$ 30,000) SU5 beam line at the SuperACO Synchrotron (Orsay, France). Spectra were obtained for the $^{12}C^{16}O$, $^{13}C^{16}O$, and $^{13}C^{18}O$ isotopomers. Absorption bands were analyzed by synthesizing the profiles with codes developed independently in Meudon and Toledo. Each synthetic spectrum was adjusted to match the experimental one in a nonlinear least-squares fitting procedure with the band oscillator strength, the line width (instrumental and predissociation), and the wavelength offset as free parameters. In order to perform the synthesis, the CO column density was required. Because a differentially pumped cell was used, the measured CO pressure had to be corrected to determine the CO column density. This was accomplished by fitting absorption obtained at the same pressure from the $E - X$ (0-0) band, whose oscillator strength is well known. For the $K - X$, $L' - X$, and $L - X$ bands, the substantial amount of mixing among the upper states was considered in detail. Predissociation widths determined for the $B - X$ band varied widely among isotopomers. For the $W - X$ bands, when possible, J-dependent widths and widths for both e and f parities were extracted from the data. Our results will be compared with earlier determinations.

This work was funded in part by NASA through grant NAG5-11440 and the CNRS-PCMI program.

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