

# High-resolution oscillator strength measurements of the $v' = 0,1$ bands of the $B - X$ , $C - X$ , and $E - X$ systems in five isotopologues of carbon monoxide

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The photochemistry of CO and its isotopologues affects the structure and evolution of many astronomical environments, including interstellar clouds, circumstellar disks around newly formed stars, and the envelopes surrounding highly evolved stars. When in the presence of a strong ultraviolet field, the primary destruction mechanism for interstellar and circumstellar CO is photodissociation, which is entirely governed by discrete line absorption into predissociating levels in the wavelength range 91.2 to 111.8 nm. Because the CO spectrum consists primarily of resolved line features, self-shielding effects in high-column density environments can lead to strong isotopic fractionation signatures in both CO and elemental oxygen and carbon; for example, CO self-shielding in the solar nebula has been invoked to explain the unusual oxygen isotope ratios observed in the earliest solar system condensates, viz. calcium-aluminum inclusions (CAIs) in primitive meteorites.

A complete database of line positions, oscillator strengths, and line widths for all relevant CO isotopologues is needed to assess models of CO isotopic fractionation in astrophysical environments. Despite considerable experimental and theoretical efforts, significant uncertainties and gaps remain in that spectroscopic database. We report oscillator strengths for six strong vibrational bands between 105.0 and 115.2 nm, associated with transitions from the  $v = 0$  level of the  $X^1\Sigma^+$  ground state to the  $v = 0$  and 1 levels of the  $B^1\Sigma^+$ ,  $C^1\Sigma^+$ , and  $E^1\Pi$  states, in  $^{12}\text{C}^{16}\text{O}$ ,  $^{12}\text{C}^{17}\text{O}$ ,  $^{12}\text{C}^{18}\text{O}$ ,  $^{13}\text{C}^{16}\text{O}$ , and  $^{13}\text{C}^{18}\text{O}$ . The resolving powers of the room-temperature measurements, undertaken on the VUV-FTS branch of the DESIRS beamline at Synchrotron SOLEIL, allow for the analysis of individual line strengths within bands; the measurements reveal J-dependences in the branch intensities of the  $C(v = 0,1) - X(0)$  and  $E(v = 0,1) - X(0)$  bands in all isotopologues. Minimal or no isotopologue-dependence was found in the  $f$ -values of the  $C(v = 0,1) - X(0)$  and  $E(v = 0,1) - X(0)$  bands at a 5 percent uncertainty level. Revised dissociation branching ratios for the  $C(v = 0,1)$  and  $E(v = 0,1)$  levels are computed based on these  $f$ -values. The weak isotopologue dependence of the  $f$ -values presented here eliminates this mechanism as an explanation for the large  $^{17}\text{O}$  enrichments seen in recent laboratory photolysis experiments on CO at wavelengths from 105 to 108 nm.