LINE MIXING STUDY OF CARBON MONOXIDE BROADENED BY NITROGEN, HELIUM, AND HYDROGEN

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Upcoming exoplanet infrared imaging will likely include carbon monoxide (CO) absorption from deeper, higher-pressure regions of larger Jupiter-like exoplanets, with compositions of majority hydrogen (H_2) and helium (He). However, there have been limited experimental CO spectroscopy studies in H_2 and He at elevated pressure conditions. We present quantitative, broadband absorbance measurements of the fundamental ro-vibrational band of CO between 1965 and 2235 cm^{-1}, in bath gases of nitrogen (N_2), He, and H_2. Then, we demonstrate a modeling approach that accurately reflects the effects of line mixing that we observe in the results, utilizing the modified exponential gap (MEG) law with a fitted inter-branch factor. The room-temperature static cell measurements were taken using a narrow-linewidth, broad-scan external-cavity quantum-cascade laser at pressures of 15–35 atm. For CO in H_2 and He, minor adjustments to the MEG Law were necessary to reproduce the weaker J″-dependence of the broadening coefficients relative to that of CO in N_2. The resulting MEG line mixing model shows improved agreement with the measured spectra across different pressures and broadening partners. Further reduction of the residuals to within approximately 1% (CO/H_2, 35 atm) is shown through the fitting of MEG coefficients directly to measured spectra, resulting in relatively small adjustments to each of the coefficients.