AIR-BROADENING AND SHIFT COEFFICIENTS AND LINE MIXING IN THE $\nu_3$ BAND OF $^{12}$CH$_3$D

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A multispectrum nonlinear least squares fitting technique has been used to determine Lorentz air-broadening coefficients and air-induced shift coefficients for transitions in the $\nu_3$ fundamental band of $^{12}$CH$_3$D in the spectral region between 1154 and 1430 cm$^{-1}$. Eleven high-resolution (0.005 cm$^{-1}$) room-temperature absorption spectra, recorded using the 1-m Fourier transform spectrometer (FTS) at the McMath-Pierce facility of the National Solar Observatory at Kitt Peak, were simultaneously analyzed. The data set included both low-pressure (1 to 3 Torr) spectra of 98% pure CH$_3$D and spectra of lean mixtures ($\approx$ 1%) of CH$_3$D in dry air at total pressures from about 100 Torr to 400 Torr. Cell path lengths of 25 and 150 cm were used.

Air-broadening coefficients were determined for more than 360 $\nu_3$ transitions with rotational quantum numbers as high as $J^u = 17$ and $K^u = 17$. Air-induced shift coefficients were also determined for most of these transitions. The measured broadening coefficients range from 0.016 to 0.073 cm$^{-1}$ atm$^{-1}$ at 296K, and the shift coefficients range from about -0.0086 to +0.0058 cm$^{-1}$ atm$^{-1}$. The majority of the shifts are negative, and the positive shifts often involve transitions with $J^u = K^u$. The $QQ$ sub-band $J'' = K''$ transitions are also associated with the smallest broadening coefficients. Weak line mixing effects have been observed in a few high-$J$ transitions with $K'' = 3$, and we have determined off-diagonal relaxation matrix element coefficients for several $A^+A^-(A1A2)$ split components. At low to medium values of $J''$, the $A^+A^-$ splittings are very small, and the two components are practically unresolved. Variations of the measured parameters with rotational quantum numbers and differences between the $A$ and $E$ symmetry species will be discussed. We will also compare our measurements with the values on the current HITRAN compilation and with other available measurements.

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