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NOTE

PRESSURE BROADENING OF FAR INFRARED ROTATIONAL TRANSITIONS: 88.65 CM^{-1} H_20 AND 114.47 CM^{-1} O_3

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Abstract—We measured N_2 and O_2 pressure broadening coefficients for the 88.65 cm^{-1} line of H_20 at 290 K and the 114.47 cm^{-1} line of O_3 at 290 and 210 K. Broadening measurements of these lines also include determinations of the self broadening and a frequency measurements of the transitions. Published by Elsevier Science Ltd

We report measurements of pressure-broadening coefficients of the 88.65 cm^{-1} line of H_2O at 290 ± 3 K and the 114.47 cm^{-1} line of O_3 at 290 and 210 ± 3 K by N_2 and O_2. These measurements are part of our ongoing program of spectroscopic measurements in support of atmospheric spectroscopy. The measurements were made using the TuFIR[1] method of laser mixing spectroscopy. The lines are among a set selected because they are of intermediate intensity for stratospheric spectral measurement of H_2O and O_3 and are near optimum in the balance between measurement signal-to-noise ratios and the influence of line broadening on resultant retrieved concentration profiles. The method for generation of far i.r. radiation, the details of the measurement technique, and the fitting and regression procedures have all been presented previously.[2,3] The results of the investigation are presented in Table 1. The air-broadening coefficient for the H_2O line, 8.19×10^{-7} cm^{-1} Pa^{-1}, agrees to well within the error bars with the value in the Hitran92 line listing,[4] 8.00×10^{-7} cm^{-1} Pa^{-1}. This latter value is based on theoretical calculations of N_2 broadening using quantum Fourier transform theory,[5,6] scaling the air broadening as 0.9 times the N_2 broadening. The line position for the H_2O transition ($4_{4,1} \leftarrow 5_{1,4}$) is 2 657 665.79(5) MHz, and for the O_3 transition ($31_{13,17} \leftarrow 30_{14,16}$) is 3 431 692.02(3) MHz. The digits given in the parentheses are 2σ uncertainties for the respective positions.

Table 1. Pressure-broadening coefficients[a] (10^{-7} cm^{-1} Pa^{-1})

Broadening gas	88.65 cm^{-1} H_2O 290 ± 3 K	114.47 cm^{-1} O_3 290 ± 3 K	114.47 cm^{-1} O_3 210 ± 3 K
N_2	9.07(82)	7.36(20)	9.19(32)
O_2	4.90(64)	6.53(22)	7.98(23)
Self	40.53(1.02)	8.40(29)	19.29(39)
Air[b]	8.19(66)	7.19(16)	8.94(25)

[a]Half-width at half maximum; 2σ uncertainty given.
[b]$\gamma_{air} = 0.79\gamma_{N_2} + 0.21\gamma_{O_2}$.
H_2O $4_{4,1} \leftarrow 5_{1,4}$ line position = 2 657 665.79(5) MHz.
O_3 $31_{13,17} \leftarrow 30_{14,16}$ line position (average) = 3 431 692.02(3) MHz.

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