NOTE

PRESSURE BROADENING OF FAR INFRARED ROTATIONAL TRANSITIONS: 88.65 CM\(^{-1}\) H\(_2\)O AND 114.47 CM\(^{-1}\) O\(_3\)

K. V. CHANCE, K. PARK, and K. M. EVENSON

*Harvard-Smithsonian Center for Astrophysics, Cambridge, MA 02138, U.S.A., 'Department of Physics, University of Oregon, Eugene, OR 97403, U.S.A. and National Institute of Standards and Technology, Boulder, CO 80303, U.S.A.

(Received 25 April 1997)

Abstract—We measured N\(_2\) and O\(_2\) pressure broadening coefficients for the 88.65 cm\(^{-1}\) line of H\(_2\)O 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\(_2\)O 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\(_2\)O 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\(_2\)O line, 8.19 \times 10^-7 cm\(^{-1}\) Pa\(^{-1}\), agrees to well within the error bars with the value in the Hitran92 line listing,\(^4\) 8.00 \times 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\(_2\)O transition (44,1\(\rightarrow\)51,4) is 2 657 665.79(5) MHz, and for the O\(_3\) transition (3113,1\(\rightarrow\)3014,1) is 3 431 692.02(3) MHz. The digits given in the parentheses are 2\(\sigma\) uncertainties for the respective positions.

<table>
<thead>
<tr>
<th>Broadening gas</th>
<th>88.65 cm(^{-1}) H(_2)O 290 ± 3 K</th>
<th>114.47 cm(^{-1}) O(_3) 290 ± 3 K</th>
<th>114.47 cm(^{-1}) O(_3) 210 ± 3 K</th>
</tr>
</thead>
<tbody>
<tr>
<td>N(_2)</td>
<td>9.07(82)</td>
<td>7.36(20)</td>
<td>9.19(32)</td>
</tr>
<tr>
<td>O(_2)</td>
<td>4.90(64)</td>
<td>6.53(22)</td>
<td>7.98(23)</td>
</tr>
<tr>
<td>Self</td>
<td>40.53(1.02)</td>
<td>8.40(29)</td>
<td>19.29(39)</td>
</tr>
<tr>
<td>Air(^a)</td>
<td>8.19(65)</td>
<td>7.19(16)</td>
<td>8.94(25)</td>
</tr>
</tbody>
</table>

\(^a\)Half-width at half maximum; 2\(\sigma\) uncertainty given.
\(^b\)\(\gamma_{air} = 0.79\gamma_{N_2} + 0.21\gamma_{O_2}\).
H\(_2\)O 44,1\(\rightarrow\)51,4 line position = 2 657 665.79(5) MHz.
O\(_3\) 3113,1\(\rightarrow\)3014,1 line position (average) = 3 431 692.02(3) MHz.

Acknowledgements—The research at the Smithsonian Astrophysical Observatory and the University of Oregon was supported by NASA (NAGW 1292, NAG 1 1650). Research at the National Institute of Standards and Technology was partially supported by NASA (W-18,913).

\(^\dagger\)To whom all correspondence should be addressed.
REFERENCES