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Note

Broadening of the $J = 3 \leftarrow 2$ spectral line of carbon monoxide by pressure of CO, N_2 and O_2

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Line shape studies for the investigation of collisional broadening and shift of spectral lines of molecules are of interest in astrophysics, planetary atmosphere studies, propagation of radiation in the Earth's atmosphere, quantum chemistry, etc. The employment of complementary experimental techniques and methods for such studies is very desirable since it may reveal possible sources of error and can yield very reliable line-shape parameters.

Here we compare results of our investigation on the collisional relaxation for the $J = 3 \leftarrow 2$ rotational line of CO in the ground vibrational state induced by nitrogen and oxygen using a spectrometer with radio acoustic detection of absorption (RAD—spectrometer) [1]. Comparison of our data with the results of Ref. [2], where a video-type sub-mm spectrometer was used for analogous investigations, is presented. The self-broadening study of the line is presented in this note as well.

The RAD spectrometer and method of the line shape investigation were described in detail in Ref. [3]. The length of the absorption cell was about 17 mm and the corresponding optical path-length is about 1.4×10^{-2} (the line intensity was taken from the HITRAN database [4]). All measurements were carried out at 297 ± 1 K. The Voigt profile was used for the line-shape parameter determination from the experimental data. Typical dependences of the collisional line half width at half maximum (HWHM) on pressure of CO, N_2, and O_2 are depicted in Fig. 1. The pressure broadening coefficient was obtained as a slope of the straight line fitted to the corresponding experimental dependence. The results of the measurements of the pressure broadening coefficient of the $J = 3 \leftarrow 2$ spectral line of carbon monoxide by pressure of N_2 and O_2 in comparison with data from Ref. [2] are presented in Table 1. The self-broadening coefficient of the line was measured as 3.135(10) MHz/Torr. Table 1 shows that our results are in good agreement within quoted experimental uncertainties. This agreement obtained by means of different techniques for the line-shape study increases the reliability of

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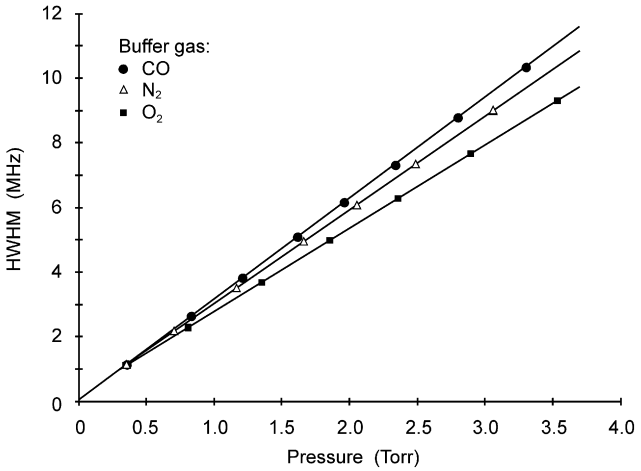

Fig. 1. Pressure dependence of the $J = 3 \leftarrow 2$ CO line half width for CO (●), N_2 (Δ) and O_2 (■) as buffer gasses. Solid lines are results of linear regression of the experimental data.

Table 1
Pressure broadening coefficient of the $J = 3 \leftarrow 2$ spectral line of carbon monoxide by pressure of N_2 and O_2 in comparison with data from Ref. [2].

Buffer gas	Broadening coefficient MHz/Torr	References
N_2	2.895(10)	This work
	2.885(6)	Ref. [2]
O_2	2.570(10)	This work
	2.516(37)	Ref. [2]

Errors in parentheses correspond to one standard uncertainty in unit of the last digit quoted.

the measured data. Our study did not reveal any noticeable shift of the line center within experimental uncertainty ± 5 kHz/Torr. The observed rest frequency of the line center is 345795.987(3) MHz, which is in good agreement with results of the Lamb-dip measurements [5] proving consistency of our data.

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