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Note

# Broadening and shifting studies of $J = 5 \leftarrow 4$ carbon monoxide line perturbed by Ne, Ar, and Kr

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A growing interest in determination of molecular line parameters—such as pressure broadening, pressure shift, and lineshape makes development of accurate methods of measurements very desirable. Recently, few works were published concerning this problem in the mm and submm region [1–3].

This paper continues our previous lineshift and line broadening studies of carbon monoxide molecule induced by collision with different types of gases [4–7]. Since carbon monoxide (CO) is a simple diatomic molecule, the choice of the rare gases (Ne, Ar, and Kr) was motivated by the development of theories describing collisional line broadening and shifting phenomena, the experimental data are useful for deducing intermolecular potential parameters.

We also desire to compare our data with data [3], where analogous investigation was performed but by using a different method.

All investigations were made at room temperature $(295 \pm 1)$ K. A detailed description of the experimental technique and general methods of determination of halfwidth and linecenter frequency is presented [4].

Shortly, for this study the submillimeter RAD spectrometer with backward wave oscillator (BWO) and acoustic cell was used [8]. The BWO frequency was phase stabilized and controlled by a computer via GPIB. The amplitude modulation of submm radiation was used for this investigation. The lineshape experimental data were fitted to the Voigt model function including baseline influence [4].

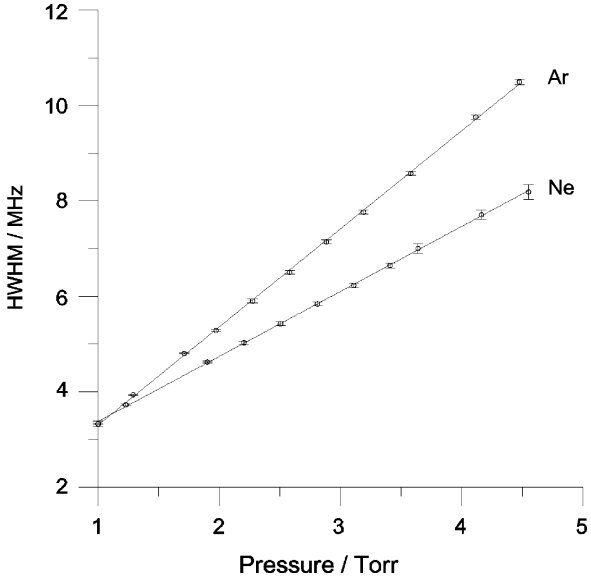


Fig. 1. Experimental dependence of HWHM of $J = 5 \leftarrow 4$ CO line broadened by Ar and Ne gases.

The example pressure dependence of HWHM of $J = 5 \leftarrow 4$ CO line on the pressure of Ar and Ne gases is depicted in Fig. 1. The dependences of the center frequency of the $J = 5 \leftarrow 4$ CO line on the pressure of rare gases (Ne, Ar, and Kr) are presented in Fig. 2. Comparison of our experimental results with data [3] is presented in Table 1.

As we can see our data have a good coincidence with results in the paper [3], but the accuracy of determination of pressure shift coefficients is much high in our work.

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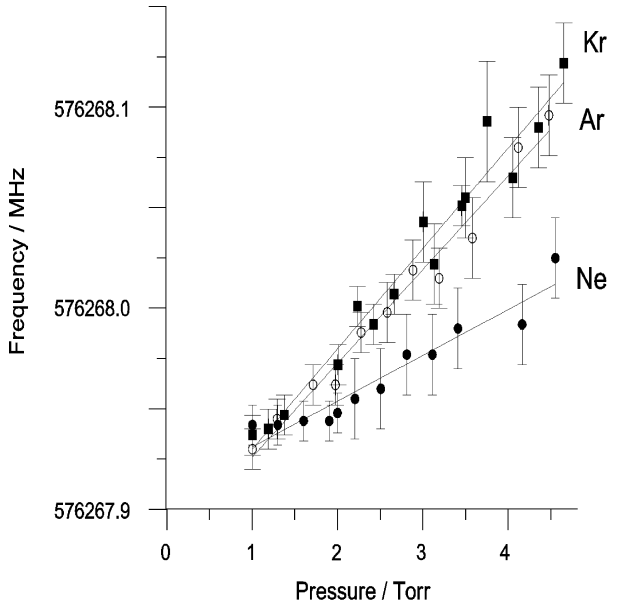


Fig. 2. Dependences of center frequency of $J = 5 \leftarrow 4$ CO line on the pressure buffer gases Ne (●), Ar (○), and Kr (■).

Table 1
Pressure broadening coefficient $\delta$ and shift coefficient of $J = 5$–4 spectral line CO molecule for Ne, Ar, and Kr

| Perturbed gas | $\gamma$ (MHz/Torr) | $\delta$ (kHz/Torr) | Reference |
|---|---|---|---|
| Ne | 1.33(2) | 23(4) | This work |
| | 1.383(47) | 24.8(123) | [3] |
| Ar | 2.04(2) | 45(5) | This work |
| | 1.917(31) | 54.8(136) | [3] |
| Kr | 2.08(2) | 49(5) | This work |
| | 1.935(31) | 64.5(165) | [3] |

Numbers in parentheses are one standard deviation obtained from least-squares analysis.

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