Collisional-broadening line-shape parameters of rovibronic transitions in the $^{12}C^{16}O$ $a^3\Pi - X^1\Sigma^+(1, 0)$ band

Rafal Hakalla[1], Wim Ubachs[2], Aleksandra Stasik[1,3], Nelson de Oliveira[4], Jeanna Buldyreva[5]

[1] Materials Spectroscopy Laboratory, Institute of Physics, University of Rzeszow, Poland
[2] Department of Physics and Astronomy, and LaserLaB, Vrije Universiteit, Amsterdam, Netherlands
[3] Doctoral School of the University of Rzeszow, University of Rzeszow, Poland
[4] Synchrotron SOLEIL, Orme de Merisiers, St. Aubin, France
[5] Institut UTINAM UMR CNRS 6213, Université Marie et Louis Pasteur, 16 Route de Gray, 25030 Besançon cedex, France

Line-shape parameters of rovibronic transitions have become a subject of increasing study since they are needed for modeling of visible and ultraviolet radiation transport in exoplanetary atmospheres. Getting their experimental values represents however a formidable task, so that a very limited number of measurements is available in the literature for NO, CO and OH self-perturbed and perturbed by N_2, CO_2, H_2O and Ar.

In the present work we analyse transitions in the $a^3\Pi - X^1\Sigma^+(1, 0)$ band of $^{12}C^{16}O$ recorded in SOLEIL Synchrotron at 300 K [1]. The broadening and shift coefficients obtained for different values of the rotational quantum number J are compared to CO-CO measurements of Q-branch transitions in the B - X(0,0) band by DiRosa et al. [2] who reported no observed dependence on rotational quantum state.

Our measurements represent an alternative way to obtaining rovibronic line-shape parameters at room and elevated temperatures (above 1000K) needed for exoplanets. They enable also probing of various buffer gases. The J-dependence of broadening and shift coefficients opens a prospective of more advanced theoretical calculations going beyond the traditional "phase-shift" theory previously applied to NO and OH [3].

[1] S. Mahmoud et al. (in preparation).

[2] M.D. Di Rosa, R.L. Farrow, JQSRT 68, 363-375 (2001).

[3] J. Buldyreva, R.P. Brady, S.N. Yurchenko, J. Tennyson, JQSRT 313, 108843 (2024).