SPECTROSCOPY OF CARBON MONOXIDE (7–0) BAND

S. WÓJTEWICZ, A. A. BALASHOV, K. BIELSKA, J. DOMYSŁAWSKA, R. CIURYŁO, D. LISAK, *Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University in Toruń, Grudziadzka 5, 87-100 Toruń, Poland*; **G. LI**, *PTB (Physikalisch-Technische Bundesanstalt), Bundesallee 100, 38116 Braunschweig, Germany*; **A. A. KYUBERIS**, *Van Swinderen Institute for Particle Physics and Gravity, University of Groningen, Nijenborgh 4, 9747AG Groningen, The Netherlands*; **N. F. ZOBOV, J. TENNYSON, O. L. POLYANSKY**, *Department of Physics and Astronomy, University College London, Gower Street, London WC1E 6BT, United Kingdom*

Carbon monoxide, the second most abundant molecule in the universe, plays a key role in astrophysical research. Knowledge of its spectroscopic data is very important in the analysis of the composition of the atmospheres of planets in the Solar System and exoplanets. Carbon monoxide is important in monitoring pollution in the Earth's atmosphere, e.g. from burning fossil fuels. CO molecule is also an important reference point for very accurate, both experimental and theoretical, studies of spectral line intensities[1].

Here we present the results of line-shape measurements of the CO (7–0) band in the visible range (around 695 nm). The results were obtained using the cavity ring-down spectroscopy (CRDS) technique, which is characterized by high sensitivity and stability of the frequency axis[2].

This is the first experimental observation of such high (7–0) and weak (intensities below 2×10^{-29} cm/molecule) overtone spectrum of CO. In the data analysis we took into account the effects that go beyond the commonly used Voigt model, in particular the speed-dependent effects. The obtained line-shape parameters are mostly characterized by uncertainties of several MHz for the line position and a few percent for the remaining parameters. The line intensities were compared with the results of *ab initio* calculations based on accurate dipole moment curves and semi-empirical potential energy curves. Agreement between theory and experiment was obtained at the level of several percent, which is comparable to the obtained experimental uncertainties[3].

[1] doi:10.1103/PhysRevLett.129.043002, K. Bielska, A. A. Kyuberis, Z. D. Reed, G. Li, A. Cygan, R. Ciuryło, E. M. Adkins, L. Lodi, N. F. Zobov, V. Ebert, D. Lisak, J. T. Hodges, J. Tennyson, O. L. Polyansky, Phys. Rev. Lett. **129**, 043002, (2022).

[2] doi:10.1016/j.jqsrt.2021.107927, K. Bielska, J. Domysławska, S. Wójtewicz, A. Balashov, M. Słowiński, M. Piwiński, A. Cygan, R. Ciuryłlo, D. Lisak, J. Quant. Spectrosc. Radiat. Transfer **276**, 107927 (2021).

[3] A. A. Balashov, K. Bielska, G. Li, A. A. Kyuberis, S. Wójtewicz, J. Domysławska, R. Ciuryło, N. F. Zobov, D. Lisak, J. Tennyson, O. L. Polyansky, "Measurement and calculation of CO (7–0) overtone line intensities", submitted to J. Chem. Phys.