# Radioactive Isotopologues of CO

The radioactive isotopologues of carbon monoxide, namely $^{14}C^{16}O$ (iso 7), $^{14}C^{18}O$ (iso 8) and $^{14}C^{17}O$ (iso 9) have been provided as part of the supplementary data of Ref. [1]. We also provide it here after additional corrections to the line positions, described in the HITRAN2016 article [2].

**Users should be aware that the line intensities of these radioactive isotopologues do not follow the standard HITRAN convention of being scaled by natural terrestrial isotopic abundance. Instead, they are provided at an abundance of 100% because of the large variation of $^{14}C$ in different environments. It is the responsibility of the user to account for this difference when comparing with the stable isotopologue intensities.**

The `CO_dV11_radioactive.data` file contains line lists of the three isotopologues of CO above. The format of each line follows the standard ".par" fixed-length HITRAN format to begin with (i.e., 160 characters described in Ref. [3]), followed by 6 more parameter fields:

1. $H_2$-broadened half-width, $\gamma_{H2}$ (F7.4)
2. Temperature dependence of $H_2$-broadened half-width, $n_{H2}$ (F6.4)
3. $H_2$-induced line shift, $\delta_{H2}$ (F9.6)
4. $CO_2$-broadened half-width, $\gamma_{CO2}$ (F7.4)
5. Temperature dependence of $CO_2$-broadened half-width, $n_{CO2}$ (F6.4)
6. $CO_2$-induced line shift, $\delta_{CO2}$ (F9.6)

The FORTRAN format is given in parentheses after each additional parameter.

To assist users familiar with the *HITRAN Application Programming Interface* (HAPI) [4], a header file (`CO_dV11_radioactive.header`) is also provided.


[1] G. Li, et al., "Rovibrational line lists for nine isotopologues of the CO molecule in the $X^1\Sigma^+$ ground electronic state", *Astrophys. J. Supp. Ser.* **216**, 15 (2015). doi: 10.1088/0067-0049/216/1/15

[2] I. E. Gordon, L. S. Rothman, C. Hill, R. V. Kochanov, Y. Tan, *et al.*, "The HITRAN2016 molecular spectroscopic database", *J. Quant. Spectrosc. Radiat. Transfer* **203**, 3-69 (2017). doi: 10.1016/j.jqsrt.2017.06.038

[3] L.S. Rothman, D. Jacquemart, A. Barbe, D. Chris Benner, M. Birk, *et al.*, The HITRAN 2004 molecular spectroscopic database, J. Quant. Spectrosc. Radiat. Transf. 96 (2005) 139–204. doi:10.1016/j.jqsrt.2004.10.008

[4] R.V. Kochanov, I.E. Gordon, L.S. Rothman, P. Wcislo, C. Hill, J.S. Wilzewski, "HITRAN Application Programming Interface (HAPI): A comprehensive approach to working with spectroscopic data", *J. Quant. Spectrosc. Radiat. Transfer* **177**, 15-30 (2016) doi: 10.1016/j.jqsrt.2016.03.005