UPDATING THE CARBON DIOXIDE LINE LIST FOR THE HITEMP DATABASE

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The HITEMP database[1] (www.hitran.org/hitemp) was established to model the radiative transfer of high temperature gaseous environments and provides accurate line-by-line molecular spectroscopic parameters for eight molecules: H_2O, CO_2, N_2O, CO, CH_4, NO, NO_2, and OH. The addition and update of HITEMP line lists relies on the accuracy and completeness of state-of-the-art *ab initio* works. To account for molecular absorption at high temperatures, it is often necessary for these works to consider billions of individual transitions per isotopologue. This makes implementing full *ab initio* line lists in line-by-line calculations impractical for applications such as calculating the radiative transfer of stellar, brown dwarf, and exoplanetary atmospheres. When adding methane to the HITEMP database, a methodology[2] was developed to convert the intensity contribution of numerous weak transitions into a relatively small number of "effective" lines, thereby substantially reducing the size of the line list while retaining the absorption contribution.

The recently-published AI-3000K infrared line list for hot carbon dioxide[3] contains over 36 billion transitions for the four most abundant CO_2 isotopologues, and has been shown to be accurate at high temperatures. AI-3000K provides an opportunity to extend the effective line approach developed for CH_4 in order to update the HITEMP line list of CO_2. This presentation will outline the development of the effective line methodology for CO_2, which reduces the total number of lines by 2 orders of magnitude. The CO_2 effective lines retain some quantum information that enables line broadening parameters to be applied to the HITEMP line list. The presentation will also include detailed validations against a series of high temperature experimental spectra.

[1] Rothman, et al. *JQSRT*, **111**, 2139 (2010), doi:10.1016/j.jqsrt.2010.05.001
[2] Hargreaves, et al. *ApJS*, **247**, 55 (2020), doi:10.3847/1538-4365/ab7a1a
[3] Huang, et al. *JQSRT*, **392**, 111748 (2023), doi:10.1016/j.jms.2023.111748

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