Future plans for HITEMP and extensions to the HITRAN broadening molecules

Robert Hargreaves,[1] *S. Samuels, Y. Tan, R. V. Kochanov, L. S. Rothman, & I. E. Gordon, Harvard-Smithsonian Center for Astrophysics*

The high temperatures observed for some exoplanets significantly increases the amount of lines needed to model their atmospheres. The HITEMP database[2] was developed to be used for high temperature environments, and the current version of HITEMP contains line parameters for five molecules (i.e., H_2O, CO_2, CO, NO, and OH). Some molecules omitted, due to limited or inaccurate high temperature data, have now become important for the characterization of exoplanets, cool stars and brown dwarfs (e.g., CH_4). The next major update of HITEMP will be discussed, with a brief description of the aims and difficulties that will need to be addressed.

In addition, the line broadening effect in planetary atmospheres depends on their atmospheric composition. The HITRAN database contains self- and air-broadening parameters (and exponents of temperature dependence) for all of its molecules and their isotopologues. The most recent 2016 edition of HITRAN[3] has been extended to include H_2-, He- and CO_2-broadening parameters for a significant number of molecular species relevant to planetary atmospheres. Furthermore, the effect of H_2O-broadening in the Earth's atmosphere can be observed especially in the tropics. Interestingly, it is also predicted to be important for rocky exoplanets that may have suffered giant impacts, as these are expected to have "steamy" atmospheres. An empirical law has been obtained from H_2O-broadened O_2 measurements and will be implemented into the HITRAN database for CO_2, CH_4, CO, NH_3, N_2O, OCS, CH_3CN and H_2CO.

The HITRAN Application Programming Interface, HAPI,[4] has been developed to work directly with the HITRAN and HITEMP databases, and uses the latest available partition sums.[5] HAPI can be used to calculate cross-sections at user specified temperatures (up to 9000 K for some molecules), pressures and broadening gas mixtures. Work is currently underway to increase its capability of working with large datasets.

[1]robert.hargreaves@cfa.harvard.edu

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