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PASCAL - Planetary Atmospheres Spectral Catalog

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Spectroscopic observation of planetary atmospheres, stellar atmospheres, comets, and the interstellar medium is the most powerful tool for extracting detailed information concerning the properties of these objects. The $HITRAN$ molecular spectroscopic database[1] has traditionally served researchers involved with terrestrial atmospheric problems, such as remote-sensing of constituents in the atmosphere, pollution monitoring at the surface, identification of sources seen through the atmosphere, and numerous environmental issues. A new thrust of the $HITRAN$ program is to extend this longstanding database to have capabilities for studying the above-mentioned planetary and astronomical systems.

The new extension is called $PASCAL$ (Planetary Atmospheres Spectral Catalog). The methodology and structure are basically identical to the construction of the $HITRAN$ and $HITEMP$ databases. We will acquire and assemble spectroscopic parameters for gases and spectral bands of molecules that are germane to the studies of planetary atmospheres. These parameters include the types of data that have already been considered for transmission and radiance algorithms, such as line position, intensity, broadening coefficients, lower-state energies, and temperature dependence values. Additional parameters beyond what is currently considered for the terrestrial atmosphere will be archived. Examples are collision-broadened halfwidths due to various foreign partners, collision-induced absorption, and temperature dependence factors. New molecules (and their isotopic variants), not currently included in the $HITRAN$ database, will be incorporated. That includes hydrocarbons found on Titan but not archived in $HITRAN$ (such as C_3H_4, C_4H_2, C_3H_8). Other examples include sulfur-bearing molecules such as SO and CS. A further consideration will be spectral bands that arise as opportunities to study exosolar planets.

The task involves acquiring the best high-resolution data, both experimental and theoretical, covering a wide spectral range from the microwave through ultraviolet. The data are frequently from multiple sources and must be merged, with special attention to the unique quantum identification of each transition. The resultant line lists are then validated and incorporated into a structured database that is easily employed by modelers. Partition sums that are necessary for applications at a wide range of temperature will also be generated. For molecules with dense spectra, especially molecules with many low-lying fundamental vibrations, the approach is to cast them into sets of pressure-temperature absorption cross-section files. In this case, we will acquire the best laboratory measurements of these gases and transform them into the standard reference files for use in the radiative-transfer codes.

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[1]L.S. Rothman, I.E. Gordon, A. Barbe, D.Chris Benner, P.F. Bernath, et al, "The HITRAN 2008 Molecular Spectroscopic Database," $JQSRT$ **110**, 533-572 (2009).