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Accurate Hydrogen Continua for Spitzer Uranus and Neptune Spectra Using New Ab Initio Models for Molecular Hydrogen Collision-Induced Absorption at Low Temperatures

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Considerable difficulty has been encountered in finding a good model of the temperature structure and bulk composition of Uranus and Neptune which provide a good match to recent thermal infrared spectra of both planets between approximately 600 and 1100 cm^{-1} (wavelengths of 9 and 17 μm). In this range, the spectral "continuum" is provided by the collision-induced absorption of molecular hydrogen. The relatively smooth collision-induced absorption spectrum is particularly prominent in the spectrum of Uranus which has fewer features arising from stratospheric hydrocarbon emission than Neptune. Radiative-transfer simulations of the spectra to date have used models of the hydrogen-hydrogen and hydrogen-helium absorption published originally by Borysow et al. (1985, Astrophys. J. 296, 644). More recent models (Gustafsson et al. 2003, J. Chem. Phys. 199, 12264) have updated the original models by including close-coupled ab initio equations describing H_2-H_2 scattering in the presence of a weak electromagnetic radiation field, accounting for the anisotropy of the interaction, and considering recent work on the H_2-H_2 dipole model. These improvements provide considerably better fits to the data