USING HOT EMISSION SPECTRA IN GENERATING LINE LISTS OF MOLECULES (NH_3, CH_4) FOR ASTROPHYSICAL APPLICATIONS

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Spectra of cool stars, brown dwarfs and extrasolar planets (exoplanets) contain a dense forest of lines from hot molecules. Examples include CH_4 and NH_3 in brown dwarfs and CH_4 in 'hot Jupiter' exoplanets. These observations present challenges to astronomers, who typically use databases such as HITRAN intended for room-temperature applications, to model the spectral energy distributions. We have used a novel technique to combine 'hot' emission spectra recorded for a range of sample temperatures (300 – 1400°C) in order to deduce empirical lower state energies of the emitted lines. We have applied this method to NH_3 in the 740 – 2100 cm^{-1} range[a] which includes the ν_2 and the ν_4 fundamental modes and in the 1650 – 4000 cm^{-1} range[b] which includes the ν_1 and ν_3 fundamental modes. We have estimated empirical lower state energies and our values have been incorporated into the line lists along with line positions and calibrated line intensities. This method is currently being extended to CH_4. Our results can be used directly for the simulation of astronomical spectra.

[a]Hargreaves, R. J., Li, G., and Bernath, P. F. *Astrophys. J.* **735** (2011) 111.

[b]Hargreaves, R. J., Li, G., and Bernath, P. F. *J. Quant. Spectrosc. Radiat. Transfer*, (2012) in press.