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New Line Lists for planetological applications: HC3N and C4H2

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The Composite Infrared Spectrometer (CIRS) on-board Cassini, after four years of operation in Saturnian orbit with over thirty close fly-bys of Titan, has obtained spectra in the far and mid-infrared with a spectral resolution of 0.5 cm-1. Mismatch between observed spectra and model spectra obtained from the available line lists has led us to study the bending bands of HC3N and C4H2, the longest carbon chains observed on Titan. Our experimental study for HC3N (Jolly et al. 2007, J.Mol.Spec) has shown that band intensities had to be revised and that including hot bands with lower level as high as 1300 cm-1 was necessary to model our experimental spectra at 0.5 cm-1 resolution. A new extended line list could be obtained by fitting high resolution data with the help of a global analysis. This line list was made available to the astronomers of the CIRS team and will be included in the next version of the GEISA data base. Thanks to the precision of the new spectroscopic data, 13C isotopologues of HC3N have been detected and quantified for the first time in the atmosphere of Titan (Jennings et al. 2008, ApJL). Search for the 15N isotopologues of HC3N will also be presented.
The proportion of hot bands is even more important for C4H2 than for HC3N and a new extended line list was absolutely necessary to improve the CIRS spectral analysis. We will present a new line list and show comparison between synthetic spectra and experimental spectra of C4H2 obtained between 193 and 296 K at 0.1 and 0.5 cm-1 resolution. Comparison of model spectra to CIRS observations of C4H2 at 220 and 630 cm-1 will also be presented.
Detections of hot bands and isotopes in cold environments such as Titan will be emphasized.