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Jupiter's Mid-Infrared Aurora: Solar Connection and Minor Constituents

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Abstract

High spectral resolution measurements in the 12 µm region of the polar regions of Jupiter reveal unique information on auroral phenomena and upper stratospheric composition. Polar aurorae in Jupiter's atmosphere radiate throughout the electromagnetic spectrum from X-ray through mid-infrared (mid-IR, 5 - 20 µm wavelength). Voyager IRIS data and ground-based spectroscopic measurements of Jupiter's northern mid-IR aurora, acquired since 1982, reveal a correlation between auroral brightness and solar activity that has not been observed in Jovian aurora at other wavelengths. Over nearly three solar cycles, Jupiter auroral ethane emission brightness and solar 10.7~cm radio flux and sunspot number are positively correlated with high confidence. Ethane line emission intensity varies over tenfold between low and high solar activity periods. Detailed measurements have been made using the GSFC HIPWAC spectrometer at the NASA IRTF since the last solar maximum, following the mid-IR emission through the declining phase toward solar minimum. An even more convincing correlation with solar activity is evident in these data.
The spectra measured contain features that cannot be attributed to ethane and are most likely spectra of minor constituents whose molecular bands overlap the ν_9 band of ethane. Possible candidates are allene, propane, and other higher order hydrocarbons. These features appear to be enhanced in the active polar regions. Laboratory measurements at comparable spectral resolution of spectra of candidate molecules will be used to identify the constituents.
Current analyses of these results will be described, including planned measurements on polar ethane line emission scheduled through the rise of the next solar maximum beginning in 2009, with a steep gradient to a maximum in 2012. This work is relevant to the Juno mission and to the development of the NASA/ESA Europa Jupiter System Mission.

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