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Preliminary Results from the JIRAM Observations of Jupiter Poles acquired during the first orbit of Juno

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Abstract

Throughout the first orbit of the NASA Juno mission around Jupiter, the Jupiter InfraRed Auroral Mapper (JIRAM - Adriani et al. 2014) observed the northern and southern polar regions several times. The observations have been carried out in nadir and slant viewing by the L filtered imager and the spectrometer, both part of the JIRAM instrument, producing a very high number of images and spectra. The observations of the Jovian North and South Pole auroras have enabled the identification of the emissions of H_3^+ (trihydrogen cation) and CH_4 (methane). The geographical coverage of the main ovals has been partial, but sufficient to determine different regions of temperature and abundance of the H_3^+ ion from its emission lines in the wavelength range of 3-4 μm. The observations of the southern aurora have been collected in daytime only, while the northern observations cover the full Jupiter day of about 10 hours. The direct comparison of the North/South auroras shows that the Southern hemisphere auroral emissions were always more powerful than the northern ones. In the southern hemisphere the average integrated radiance was (0.89±046)x10^{-4} W/m^2/sr with the highest values reaching 7.34x10^{-4} W/m^2/sr while in the North no values greater than 3.38x10^{-4} W/m^2/sr have been found with a mean value of (0.75±0.34)x10^{-4} W/m^2/sr. The analysis method, described by Dinelli et al. (2017), has enabled to obtain both column density (CD) and Temperature for the H_3^+ emission. The analysis of the high spatial resolution of JIRAM measurements has enabled to show that the aurora is asymmetric on both poles, with CD and temperature ovals not superimposed and not exactly located where models and previous observations suggested. On the North, the main oval averaged CDs of H_3^+ span between 1.8x10^{12} cm^{-2} and 2.8x10^{12} cm^{-2}, while the retrieved temperatures show values between 800 and 950 K. On the South, the averaged CDs assume values from 2.0 x10^{12} cm^{-2} and 3.5 x10^{12} cm^{-2}, and Temperatures from 850 and 1100 K. JIRAM indicates a complex relationship among H_3^+ CDs and Temperatures. The analysis method developed for the retrieval of H_3^+ temperature and abundances has also enabled to estimate the effective temperature of the methane peak emission (500 K in the North and 650 K in the South) and the distribution of its spectral contribution in the polar regions. The enhanced methane emission is located inside the auroral ovals in both the two hemispheres. The larger CH_4 temperature in the South would imply either higher emission altitudes or a warmer atmospheric structure than in the North. The location of the northern and southern methane enhancements appear located well inside the auroral ovals and in a narrow range of longitudes, although the limited coverage of the South Pole prevents a definite conclusion. If this pattern will

be confirmed from the next observations, it would suggests that the excitation leading to the infrared emission is linked to magnetospheric phenomena and in particular to the auroral particle precipitation in the polar caps.
The presence of C_2H_2 and C_2H_6, reported by Altieri et al. (2016), has been investigated with negative results. It is likely that the coverage of JIRAM of Jupiter's poles during the first Juno orbit has been insufficient to detect the emissions of these hydrocarbons or that the spectral region where C_2H_2 and C_2H_6 emit was contaminated by the scattered sunlight that may have masked the faint emissions of those molecules.

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