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CH_4 emission variability on the Jupiter southern aurora as observed by the Juno/JIRAM spectrometer

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Abstract

JIRAM (InfraRed Auroral Mapper) is the imaging spectrometer on board the NASA Juno mission. Data collected since August 2016 on both Jupiter Northern and Southern aurora have an unprecedented spatial resolution [1,2,3]. The analyses of the acquired images and spectra confirmed the presence of methane (CH_4) on both auroras through its emission at 3.31 μm that overlap an H_3^+ signature [4].
Here we compare CH_4 emissions from the first and fourth Juno Perijove (PJ) passage on the southern aurora (period JM0003 and JM0041 respectively). Methane column densities have been retrieved for the first time. In the inner part of the main oval we observe column densities varying between 1×10^{12} cm^{-2} and 4×10^{12} cm^{-2} for JM0003, while during PJ4 the intensity is significantly lower with column densities $\leq 1 \times 10^{12}$ cm^{-2}. For PJ4 the more uniform coverage in time has allowed to derive the CH_4 column density behavior as a function of Jovian local time. We have found that the mean of the CH_4 column density in the dayside is 60% higher than the mean value in the night side.

1. Data set and Method

In this study, JIRAM spectra from both JM0003 and JM0041, with CH_4 spectral evidence on the southern aurora, have been fitted to retrieve the methane column density. Starting from the assumption that the observed methane emission is optically thin, we have applied a forward model described in [1] to simulate the spectrum in the 3100-3800 nm spectral range.
RGB maps have been obtained by considering the emissions around 3315, 3414 and 3531 nm for the B, G and R channel, respectively (Figure 1).
In Figure 2, the RGB image of the mosaic obtained from the data from JM0003 is reported. Bluish regions on the map highlight the presence of CH_4, mainly in the internal part of the main oval [4].

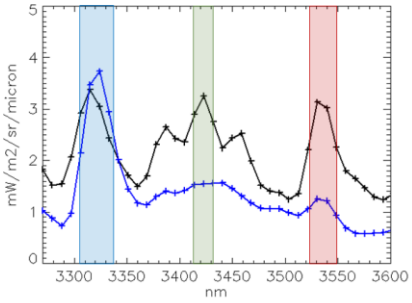

Figure 1: Comparison of a spectrum dominated by the H_3^+ emission (black) with a one where CH_4 (blue) is mainly present. Spectral ranges used for RGB images are indicated by the corresponding colors.

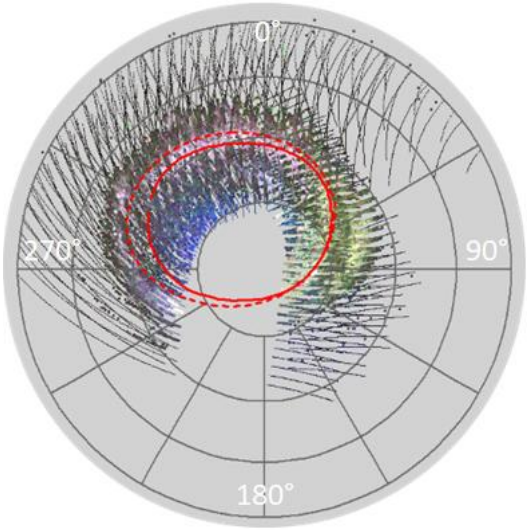

Figure 2: RGB image obtained mosaicking the JIRAM spectrometer footprints from JM0003 , southern aurora. The continuum curve shows the auroral main oval location according to VIP4 [5], while the dashed curve is the UV statistical oval from Hubble data [6]. Latitudes lines are spaced by 10°; the orthographic projection is centered on -90°S.

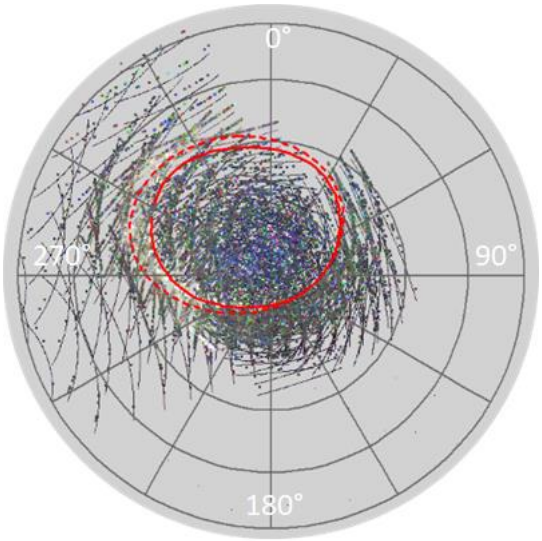

Figure 3: RGB image obtained mosaicking the JIRAM spectrometer footprints from JM0041 southern aurora. Latitudes lines are spaced by 10°; the orthographic projection is centered on -90°S.

Figure 3 shows the RGB image derived by mosaicking the spectral footprints from JM0041. In this case, although the overall aurora emissions appear less intense, there is a better coverage of the polar region.

2. Results

We have run a first retrieval by fitting both temperature and column densities (CD) of methane This revealed that methane temperature is fairly constant both spatially and temporally, and that a value of 600 K is compatible with the spectral retrieval. Then the analysis has been repeated fitting just the methane CD.

For JM0003 we observe CD varying between 1×10^{12} cm^{-2} and 4 10^{12} cm^{-2} in the inner part of the main oval, while a spot outside the main oval with a mean CD around 0.8×10^{12} cm^{-2} has been found for longitudes ranging in the interval 90°-150°.

During JM0041 the CH_4 emission intensity has been significantly lower with CDs $\leq 1 \times 10^{12}$ cm^{-2}. For PJ4, thanks to a better time coverage over the polar region, it has been possible to study the CH_4 CD behavior as a function of the Jovian local time (Figure 4).

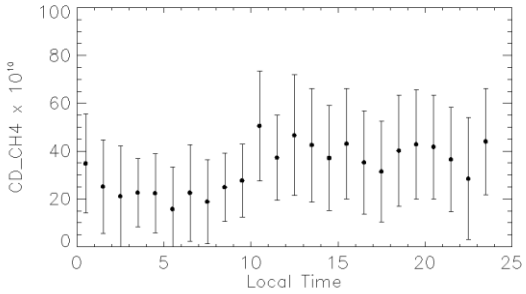

Figure 4: CH_4 column density as a function of the Jovian Local Time. Data are from JM0041 on the bluish polar emission of Figure 3.

In the night side a mean CD of about 0.25×10^{12} cm^{-2} is found, while in the day side it is of about 0.40×10^{12} cm^{-2}.

Acknowledgements

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References

[1] Dinelli, B. M., et al.: Preliminary JIRAM results from Juno polar observations: 1. Methodology and analysis applied to the Jovian northern polar region, Geophys. Res. Lett., 44, doi: 10.1002/2017GL072929, 2017.

[2] Adriani, A., et al.: Preliminary JIRAM results from Juno polar observations: 2. Analysis of the Jupiter southern $H3^+$ emissions and comparison with the north aurora, Geophys. Res. Lett., 44, 4633 – 4640, doi:10.1002/ 2017GL072905, 2017.

[3] Mura, A., et al.: Infrared observations of Jovian aurora from Juno's first orbits: Main oval and satellite footprints, Geophys. Res. Lett., doi:10.1002/2017 GL072954, 2017.

[4] Moriconi, M.L., et al.: Preliminary JIRAM results from Juno polar observations: 3. Evidence of diffuse methane presence in the Jupiter Auroral regions, Geophys. Res. Lett., doi:10.1002/2017GL073592, 2017.

[5] Connerney, J. E. P., M. H. Acuña, N. F. Ness, and T. Satoh: New models of Jupiter's magnetic field constrained by the Io flux tube footprint, J. Geophys. Res., 103(A6), 11,929–11,939, doi:10.1029 /97JA03726, 1998.

[6] Grodent, D., J. H. Waite Jr., and J. C. Gerard: A self-consistent model of the Jovian auroral thermal structure, J. Geophys. Res., 106(A7), 12,933–12,952, doi:10.1029/2000JA900129, 2003.