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First detection of the polarisation of H3+ infrared emission in Jupiter's aurora.

Mathieu Barthelemy (1), Makenzie Lystrup (3), Helene Menager (1), Steve Miller (2), and Jean Lilensten (1)
(1) CNRS/UJF, Laboratoire de Planétologie de Grenoble, Saint Martin d hères, France
(mathieu.barthelemy@obs.ujf-grenoble.fr), (2) University College London, UK, (3) University of Colorado, Boulder

- Observation

We observed the emissions from the aurora of Jupiter with the UIST/IRPOL spectro-polarimeter at the United Kingdom Infrared Telescope (Hawaii) in the 3.620-4.232μm range. This wavelength range contains bright H3+ fundamental Q-branch transition emissions. On August 4, 2008 we had a clear sky and observed the south auroral oval. The field of view was 0.24 x 20 arcsec with 0.12 arcsec pixel-1. At the latitude of the auroral oval, a 20 arcsec slit cuts across the entire the entire auroral region. The slit was rotated to be perpendicular to Jupiter's rotational axis. We used H Bracket filter images to position the slit across the oval. We did 16 series of exposures, each series containing 2 exposures at each of the 8 waveplate angles required for polarimetry measurements. We did not co-add the images because the planet had rotated of 6° between two series.

- Data reduction and results

We divided the length of the slit into 24 bins and summed the intensity in these bins to obtain a spectrum for each box. We fitted the 3.953 μm line by a Gaussian profile. The fit gave us the intensity of the line. Then we calculated the polarisation rate and angle with the ratio method (We checked the difference method give similar results. We also checked that we got similar results by adding the intensity of the individual pixels composing the line instead of fitting it by a Gaussian.). Propagation of the variance estimates from the raw data provided uncertainty on the final results. We then corrected the bias which exists in such polarization degree measurements. Due to the threshold of the debias procedure, most of the boxes show polarization degree equal to zero. However we can identify polarization rates up to 9%. Considering the error bars, we detected polarization with more than 3 confidence for some boxes.
This discovery is of great importance for the study of the jovian upper atmosphere. It validates the polarization as an observable quantity. In a first step, it can be interpreted as the effect of any anisotropy in the medium of emission, i.e. a magnetic or an electric field. However, the quantitative interpretation of the data will need further observation with better signal to noise ratio and a strong effort on both modelisation and laboratory experiment. H3+ is the simplest polyatomic molecule and this will constitute a challenge for molecular physicists. This result is part of a large program called SEPAGE trying to investigate the polarization of the planetary upper atmospheres emissions.