

First detection of Io's atmosphere at 4.0 μm

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Abstract

Io's tenuous SO_2 atmosphere has been the subject of numerous investigations since the 1990s, mostly in the millimetre-wave and UV ranges (e.g. [1] for a review). However, except for the original detection of SO_2 gas in its ν_3 7.3 μm band by Voyager/IRIS above Loki [2], it was not until 2001-2004 that this atmosphere could be observed in the infrared, using the ν_2 band of SO_2 at 19 μm [3]. This detection opened a new window for studying Io's atmosphere, but with considerable complications associated with non-LTE effects.

We report here the first observation of the $\nu_1 + \nu_3$ band of SO_2 gas at 4.0 μm in Io's atmosphere. Observations were conducted with the CRIRES (Cryogenic high-resolution infrared echelle spectrograph) instrument on UT1 of ESO/VLT. Io was observed on July 24 and 29, 2008. The sampled central meridian longitudes were 197-241 (trailing side) and 124-166 (leading), respectively. The covered spectral range was 3.95-4.05 micron. CRIRES was used in conjunction with adaptive optics, providing a spatial resolution of about 0.2" along the slit. The slit (0.5" or 0.8" width, affording a spectral resolution of 40.000-25.000) was positioned either along the Equator or along the polar axis, to search for variations with longitude and latitude.

A first analysis indicates that, although the spectral region is heavily crowded with telluric and solar lines, the spectra clearly show the signature of SO_2 gas (Figure 1). A preliminary modelling of the data on the trailing side indicates a SO_2 column density of about 1.5×10^{17} mol cm^{-2} . Thermal emission from a volcanic hot spot is seen superimposed onto the dominant reflected solar

light, which may offer the possibility to separately measure SO_2 in the two components.

Results will be presented at the meeting.

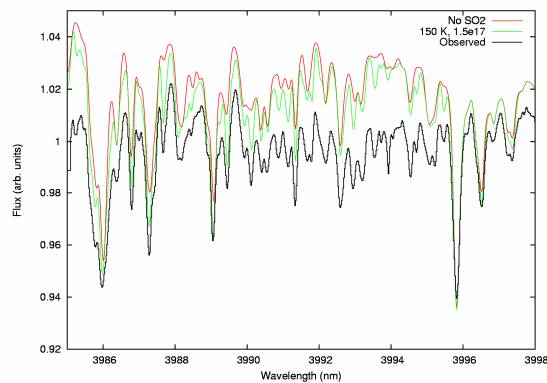


Figure 1: Io's spectrum at 3.985-3.998 μm observed on the trailing side (black). The observed spectrum is compared with models including telluric and solar lines, with and without SO_2 . Comparison suggests a SO_2 column density of $\sim 1.5 \times 10^{17}$ cm^{-2} .

References

- [1] Mc Grath, M.A., et al. (2004) Satellite atmospheres. In "Jupiter: The planet, satellites and magnetosphere", CUP, 2004, p. 457.
- [2] Pearl, J. et al. (1979) *Nature*, 280, 755
- [3] Spencer, J. et al. (2005) *Icarus*, 176, 283