

## First detection of Io's atmosphere at 4.0 $\mu\text{m}$

**E. Lellouch** (1), K.L. Jessup (2), H.-U. Käufl (3), and F. Marchis (4)

(1) Observatoire de Paris, F-92195 Meudon, France ([emmanuel.lellouch@obspm.fr](mailto:emmanuel.lellouch@obspm.fr), fax 33-1-45077144)

(2) SWRI, Boulder, USA

(3) ESO, Garching, Germany

(4) U. Berkeley & SETI

### Abstract

Io's tenuous  $\text{SO}_2$  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  $\text{SO}_2$  gas in its  $\nu_3$  7.3  $\mu\text{m}$  band by Voyager/IRIS above Loki [2], it was not until 2001-2004 that this atmosphere could be observed in the infrared, using the  $\nu_2$  band of  $\text{SO}_2$  at 19  $\mu\text{m}$  [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  $\text{SO}_2$  gas at 4.0  $\mu\text{m}$  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  $\text{SO}_2$  gas (Figure 1). A preliminary modelling of the data on the trailing side indicates a  $\text{SO}_2$  column density of about  $1.5 \times 10^{17}$  mol  $\text{cm}^{-2}$ . Thermal emission from a volcanic hot spot is seen superimposed onto the dominant reflected solar

light, which may offer the possibility to separately measure  $\text{SO}_2$  in the two components.

Results will be presented at the meeting.

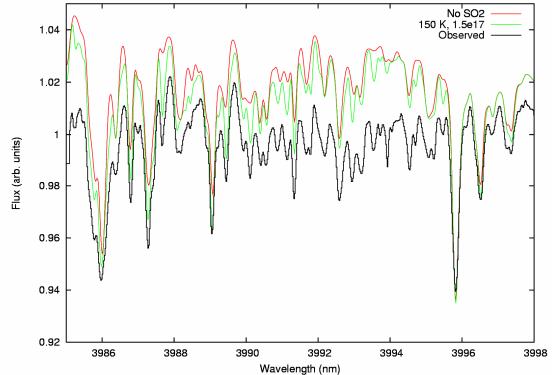


Figure 1: Io's spectrum at 3.985-3.998  $\mu\text{m}$  observed on the trailing side (black). The observed spectrum is compared with models including telluric and solar lines, with and without  $\text{SO}_2$ . Comparison suggests a  $\text{SO}_2$  column density of  $\sim 1.5 \times 10^{17} \text{ cm}^{-2}$ .

### 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