Geophysical Research Abstracts
Vol. 12, EGU2010-4392, 2010
EGU General Assembly 2010

ORbiter Terahertz-Infrared Sensor - ORTIS

Patrick G. J. Irwin (1), Brian N. Ellison (2), Simon B. Calcutt (1), Neil E. Bowles (1), Jane Hurley (1), Ranah Irshad (1), Nicholas Teanby (1), Brian Alderman (2), Simon Rae (2), and Remco de Kok (3)

(1) Atmospheric, Oceanic and Planetary Physics, Dept. of Physics, Oxford University, Oxford OX1 3PU, UK (irwin@atm.ox.ac.uk, 0044-1865-272901), (2) Rutherford Appleton Laboratory, Didcot, OX11 0QX, UK,, (3) SRON, Sorbonnelaan 2, 3584 CA Utrecht, Netherlands.

The sub-millimetre wave spectra of the outer planets are rich in absorption line features that can be measured with extremely high spectral resolution ($\sim 10^6$) with sub-millimetre wave heterodyne technology to determine temperature, winds and composition in the stratosphere. To measure stratospheric temperature requires the observation of the absorption of a well-mixed gas such as methane and while there is a methane absorption feature near 1.2 THz, this feature is relatively weak. Methane absorption lines become stronger at increasing frequency and the feature at 2.2 THz is particularly attractive as there is a strong water line lying $\sim$ 2 GHz from the main methane absorption line that could be measured simultaneously.

Sub-millimetre wave spectroscopy is advancing rapidly in the terahertz frequency range and we believe that observation of the required spectral features will be technically feasible from a highly compact in situ payload within the timeframe of EJSM. The advantages over lower frequency measurements include: 1) the methane absorption line is stronger, allowing sounding to higher altitudes; 2) the field-of-view is smaller for the same antenna size allowing easier near-limb-sounding; 3) the Doppler shifting of lines due to winds is larger; and 4) the instrument payload is more compact.

A sub-millimetre wave instrument would provide valuable information about Jupiter's stratosphere, but the radiance away from the line centres is governed by the temperature and also the ammonia abundance in the upper troposphere. Our instrument will combine the sub-millimetre wavelength device with an infrared spectrometer/radiometer, which will be able to measure the upper tropospheric temperatures in the H_2-H_2, H_2-He collision induced continuum (200 -– 650 cm^{-1}), not affected by ammonia, simply extending the vertical coverage of temperature of the combined instrument right down to the cloud tops and simultaneously allowing the determination of the upper tropospheric ammonia abundance and para-H_2 fraction. A feasibility study is currently under way to assess possible infrared component designs, ranging from a simple channel radiometer to a more ambitious spectrometer designs.

Since the ESA Jupiter Ganymede Orbiter will be in orbit about Ganymede our proposed instrument would spend much of its time viewing the surface of Ganymede rather than the atmosphere of Jupiter. Observing over a wide frequency range from far-IR to mid-IR wavelengths offers significant advantages over purely THz devices in determining surface temperature variations and provides complementary information on composition to the measurements made in the visible and near-IR. In particular, the inclusion of the thermal IR may allow measurements of 'hot spots' and help characterise any sources of endogenic heat flow at unprecedented spatial and temporal resolution.