

Ultra-high Resolution Spectroscopy

A new heterodyne spectrometer operating at 12 microns was successfully installed and tested at Cassegrain focus of the IRTF during Dec. 2000. This instrument was built at the Goddard Space Flight Center is named "Heterodyne Instrument for Planetary Wind And Composition (HIPWAC)". Its commissioning run coincided with the Jupiter flyby of the Cassini spacecraft. The spectral resolution obtained is approximately 1,000,000. This is the highest spectral resolution currently obtained by any ground-based telescope. The previous generation of this instrument was located in the coudé and was the size of a small automobile.

The attached figure shows the instrument at the IRTF and sample spectra obtained on Jupiter. The ethane (C₂H₆) emission lines originate from the stratosphere of Jupiter and the intensity is a function of the abundance and temperature of the gas. The observations are part of a long-term program to understand the interaction of the solar wind with the stratosphere of Jupiter.

Specifications:

- Wavelength Coverage: 9 – 12 μm .
- Spectral Resolving Power = 10^6 , orders of magnitude greater than conventional spectrometers.
- Field of View on Sky Diffraction limited; 1 arcsec on a 3-m telescope.
- Can measure gas velocities (winds) to ~ 1 m/sec from Doppler shifts of emitted spectral lines.
- Can retrieve atmospheric temperature and molecular abundance from true line shapes.
- Carbon composite optical bench and laser: Low mass and high thermal and mechanical stability.

This is an excellent illustration of the use of the IRTF for mission support, a platform for testing innovative instruments, and a resource for NASA scientists for astronomical research.

Figures and text courtesy of T. Kostiuk.

