The Composite Infrared Spectrometer on Cassini: 15 years in Flight.

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and the CIRS Team
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October 10, 2012
CIRS Development Team
Location of CIRS on Cassini
Description of Investigation

- Infrared spectroscopy of thermal emission from atmospheres, rings, and surfaces in 10–1450 cm\(^{-1}\) (1000–7 micron) region.

- Global mapping in atmospheres of the three dimensional and temporal variation of:
  - Gas composition.
  - Temperatures.
  - Dynamics.
  - Aerosols, clouds.

- Mapping of rings and icy satellite surfaces for:
  - Composition.
  - Thermal properties.
## Instrument Description

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telescope Diameter(cm)</td>
<td>50.8</td>
</tr>
<tr>
<td>Interferometers:</td>
<td>FAR-IR, MID-IR</td>
</tr>
<tr>
<td>Type:</td>
<td>Polarizing, Michelson</td>
</tr>
<tr>
<td>Spectral range(cm⁻¹):</td>
<td>10 - 650, 600 - 1450</td>
</tr>
<tr>
<td>Spectral range(microns):</td>
<td>15.4 - 1000, 6.9 - 16.6</td>
</tr>
<tr>
<td>Spectral resolution(cm⁻¹):</td>
<td>0.5 to 20, 0.5 to 20</td>
</tr>
<tr>
<td>Integration time(sec):</td>
<td>2 to 50, 2 to 50</td>
</tr>
</tbody>
</table>

### FOCAL PLANES:

<table>
<thead>
<tr>
<th>Focal Plane</th>
<th>Spectral range(cm⁻¹)</th>
<th>Detectors</th>
<th>Pixels</th>
<th>Pixel FOV(mrad)</th>
<th>Peak D*(cm hz¹/² W⁻¹)</th>
<th>Data Telemetry Rate(kbs)</th>
<th>Instrument Temperature(K)</th>
<th>Focal Planes 3 &amp; 4 Temperature(K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP1</td>
<td>10 - 650</td>
<td>Thermopile</td>
<td>2</td>
<td>3.9</td>
<td>4 x 10⁹</td>
<td>2, 4</td>
<td>170</td>
<td>75 - 90</td>
</tr>
<tr>
<td>FP3</td>
<td>600 - 1125</td>
<td>PC HgCdTe</td>
<td>1 x 10</td>
<td>0.273</td>
<td>2 x 10¹⁰</td>
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<td></td>
<td></td>
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<tr>
<td>FP4</td>
<td>1100 - 1450</td>
<td>PV HgCdTe</td>
<td>1 X 10</td>
<td>0.273</td>
<td>5 x 10¹¹</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Voyager IRIS
CIRS EM and FM
80 K Cooler for Mid-IR Detectors

Cooler supplied by Oxford
Far-IR & Mid-IR Focal Plane Assemblies

FP1 Thermocouples
Supplied by Univ. Karlsruhe
FIR FP supplied by GSFC

FP3 & FP4 HgCdTe Arrays
GSFC & CEA Astrophysique
MIR FP supplied by Oxford
CIRS Fields of Views
CIRS
Mechanical Layout
Optical Layout

Telescope

Far-Infrared Interferometer

Coupled Moving Retroreflectors

Near-Infrared Interferometer
Optical Layout
As Proposed and As Built
CIRS Interferogram

~ 46 Scans Averaged for Each Detector

Ifms Filtered for Length

Amplitude (Digital Counts)

Sample Number

Jupiter: SCET 979067816 to 979117902
Latitude -5.0 to +5.0 Degrees Emission Angle 0.0 to 45.0 Degrees
All Longitudes
Jupiter from Cassini ISS
flyby 2000-2001
Jupiter Brightness Temperature Spectrum
Jupiter Thermal Image from CIRS

Blue: Acetylene
Green: Methane
Red: Hydrogen Continuum
Saturn from Cassini ISS
arrival 2004
Saturn Brightness Temperature Spectrum
Titan from Cassini ISS
Titan Brightness Temperature Spectrum
Enceladus Thermal Stripes
CIRS used as a High-Speed Radiometer

Enceladus Close Fly-by 14 April 2012

Three 50-second Interferograms 400 rti

Same, With Deep Space Subtracted

thermal vent

zpd

expanded
CIRS Telescope Upgraded from MIRIS
CIRS Technology: Scan Mechanism

In CIRS

Vibration Testing

In CIRS

In CLARREO CDS
CIRS Technology: Reference Interferometer
diode laser, LED, cube corners
Substrate wire-grid polarizer supplied by QMWC, London
CIRS Technology: Retroreflectors

Mid-IR Cube-Corner

Reference interferometer Cube-Corner
CASSINI CIRS
COMPOSITE INFRARED SPECTROMETER
NASA/GSFC
OBS. PARIS-MEUDON QMW-LONDON UNIV. OF OXFORD CEA/ASTROPHYSIQUE