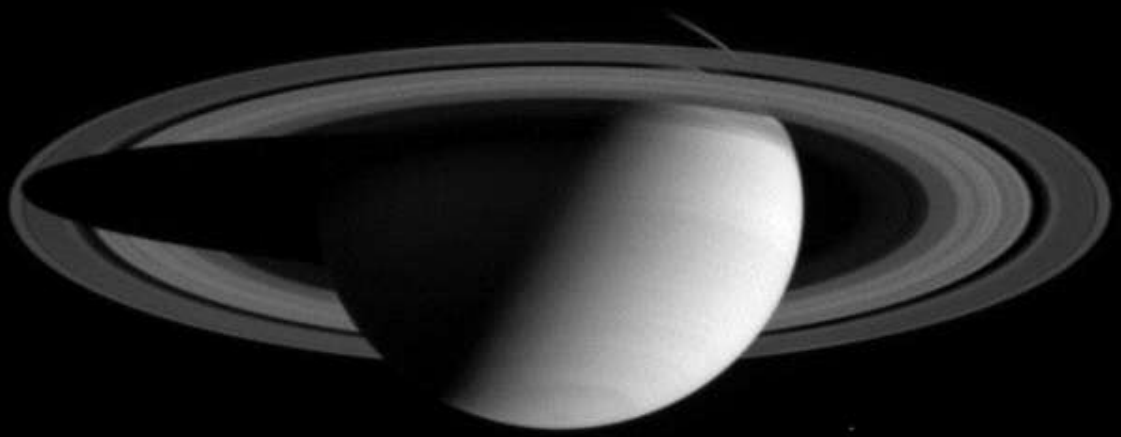
# The Composite Infrared Spectrometer on Cassini: 15 years in Flight.

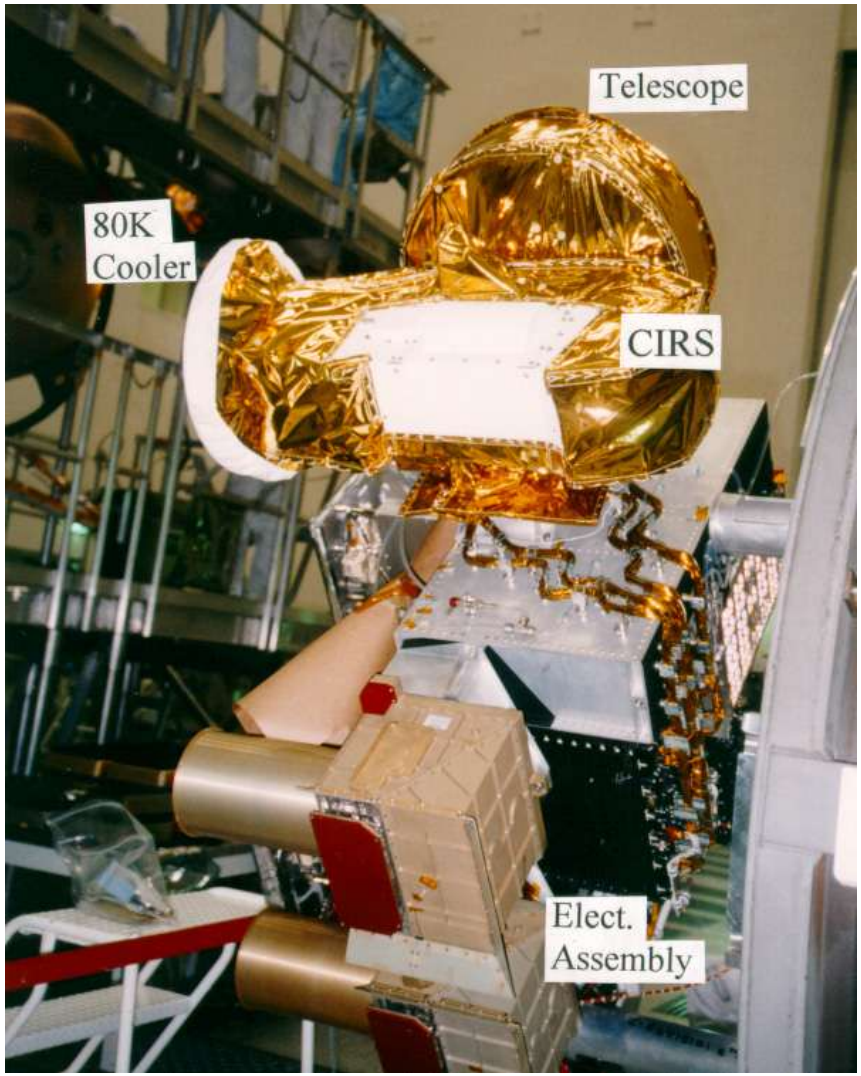


D. E. Jennings, V. G. Kunde, F. M. Flasar
and the CIRS Team

presented at the
International Workshop on Instrumentation for Planetary Missions
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.

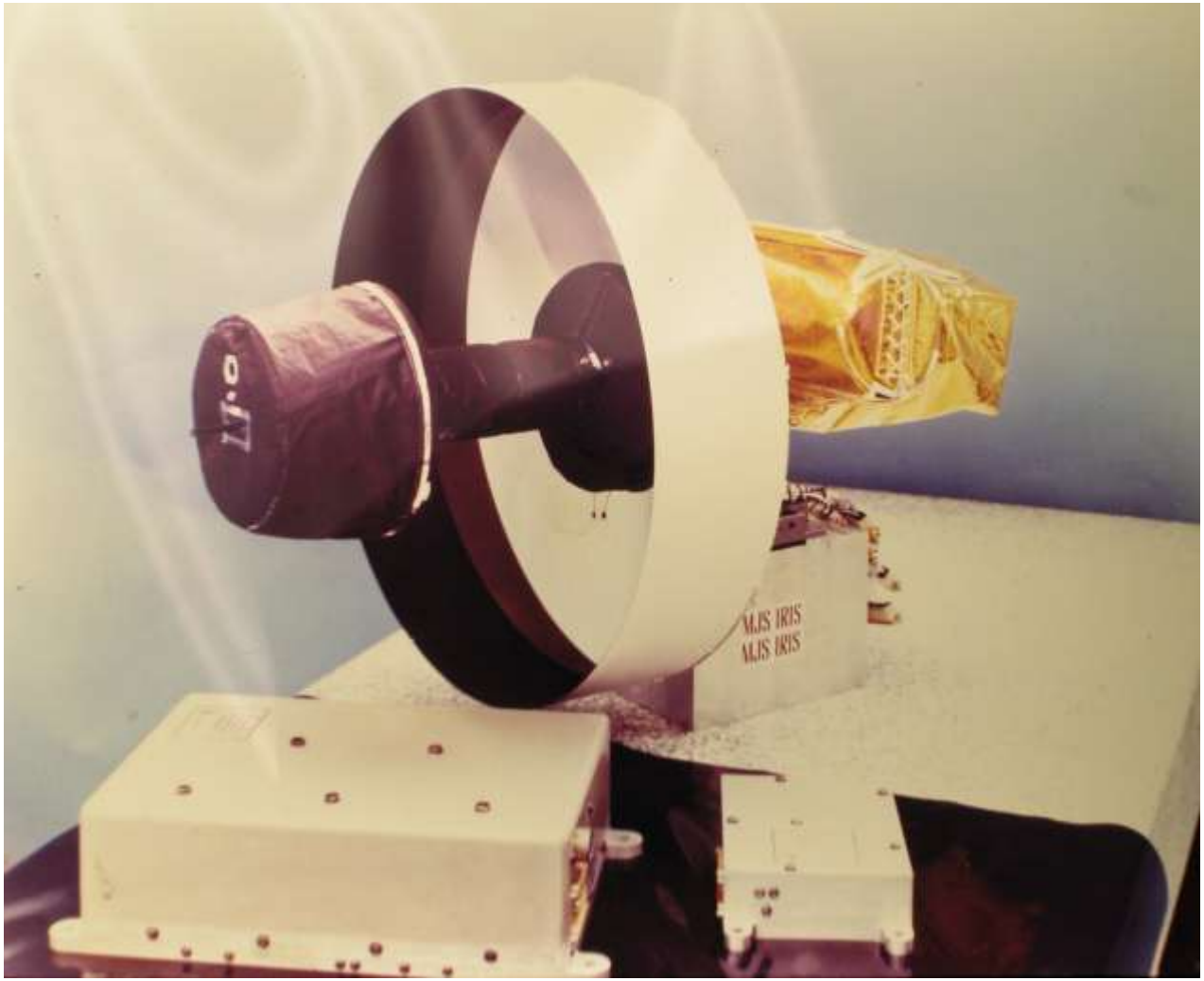
# Instrument Description

| | | |
|---|---|---|
| **Telescope Diameter(cm):** | **50.8** | |
| **Interferometers:** | **FAR-IR** | **MID-IR** |
| **Type:** | **Polarizing** | **Michelson** |
| **Spectral range($cm^{-1}$):** | **10 - 650** | **600 -1450** |
| **Spectral range(microns):** | **15.4 - 1000** | **6.9 -16.6** |
| **Spectral resolution($cm^{-1}$):** | **0.5 to 20** | **0.5 to 20** |
| **Integration time(sec):** | **2 to 50** | **2 to 50** |

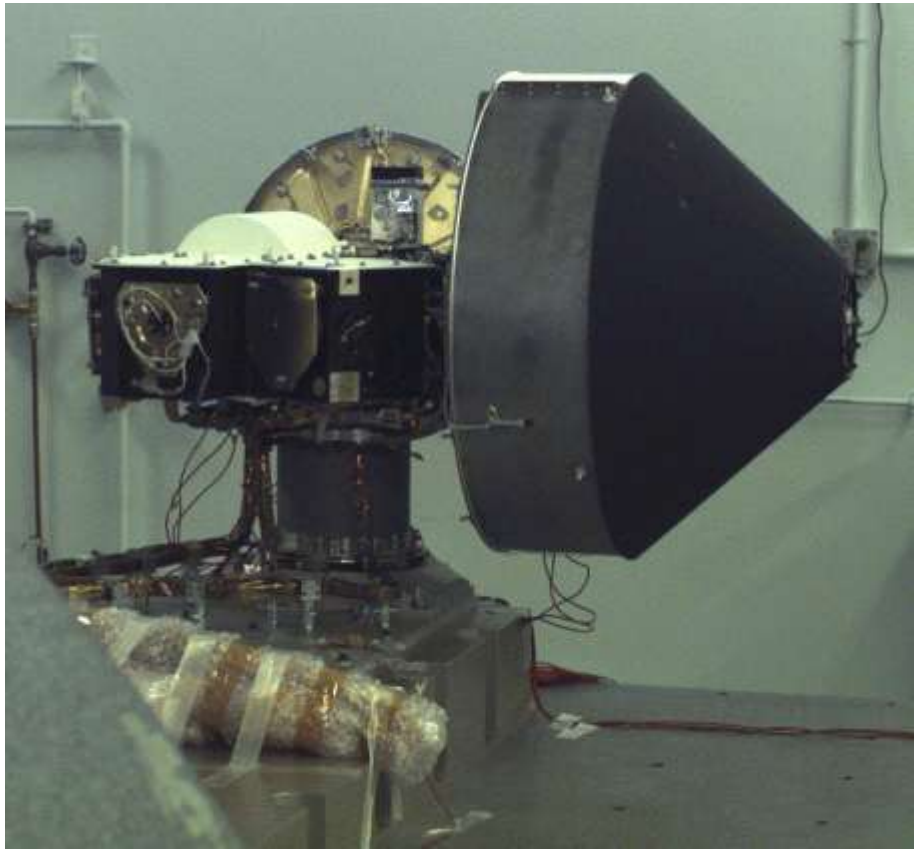
| | | | |
|---|---|---|---|
| **FOCAL PLANES:** | **FP1** | **FP3** | **FP4** |
| **Spectral range($cm^{-1}$)** | **10 - 650** | **600 - 1125** | **1100 - 1450** |
| **Detectors** | **Thermopile** | **PC HgCdTe** | **PV HgCdTe** |
| **Pixels** | **2** | **1 x 10** | **1 X 10** |
| **Pixel FOV(mrad)** | **3.9** | **0.273** | **0.273** |
| **Peak D*(cm $hz^{1/2}$ $W^{-1}$)** | **4 x $10^{9}$** | **2 x $10^{10}$** | **5 x $10^{11}$** |

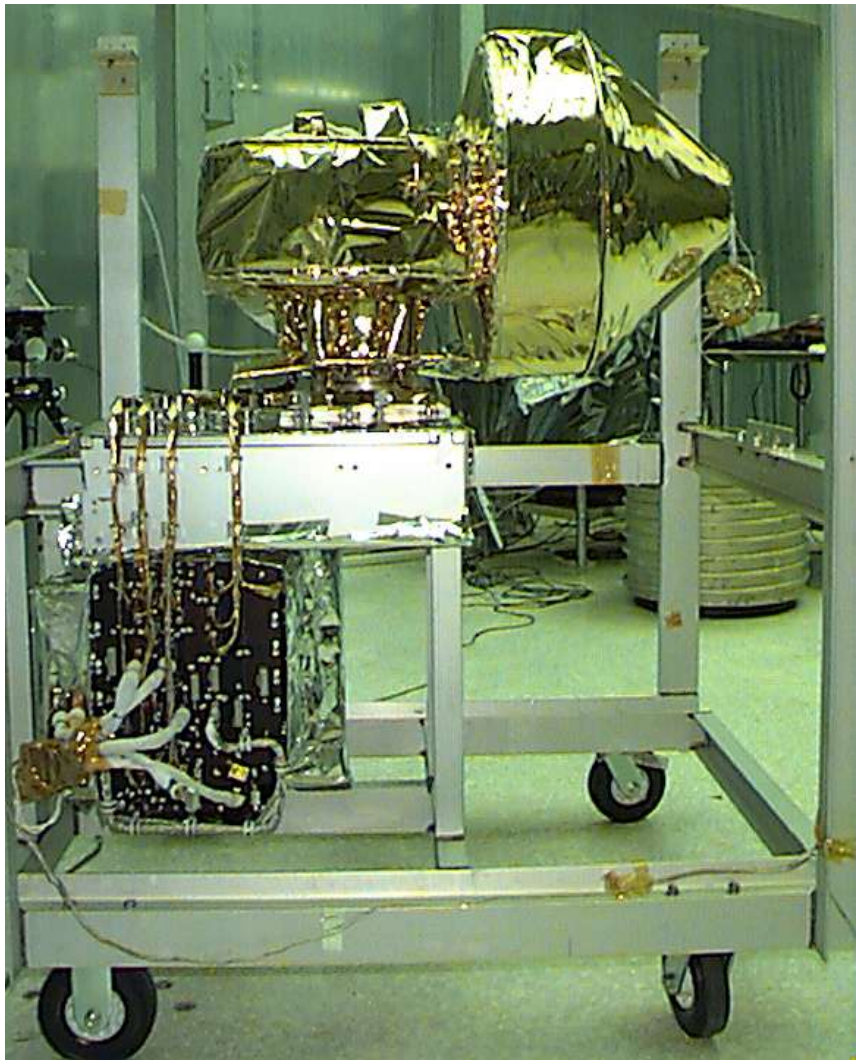
| | |
|---|---|
| **Data Telemetry Rate(kbs)** | **2, 4** |
| **Instrument Temperature(K)** | **170** |
| **Focal Planes 3 & 4 Temperature(K)** | **75 - 90** |

# Voyager IRIS



# CIRS EM and FM





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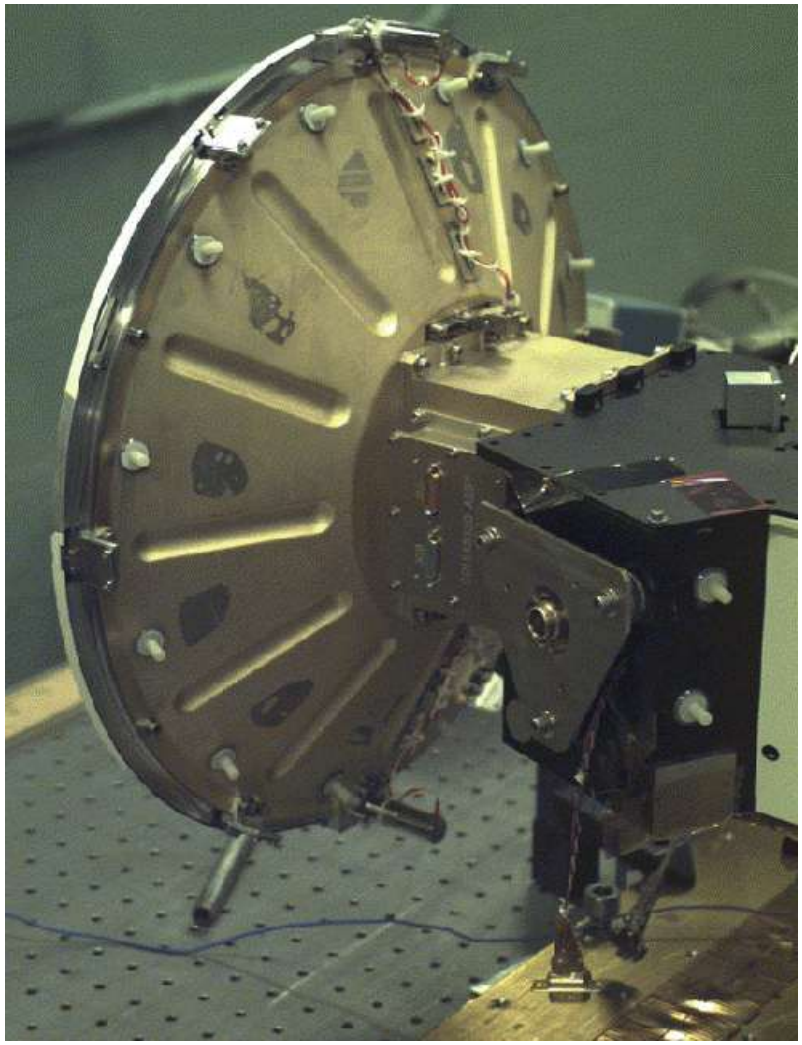
# 80 K Cooler for Mid-IR Detectors



Cooler supplied by Oxford

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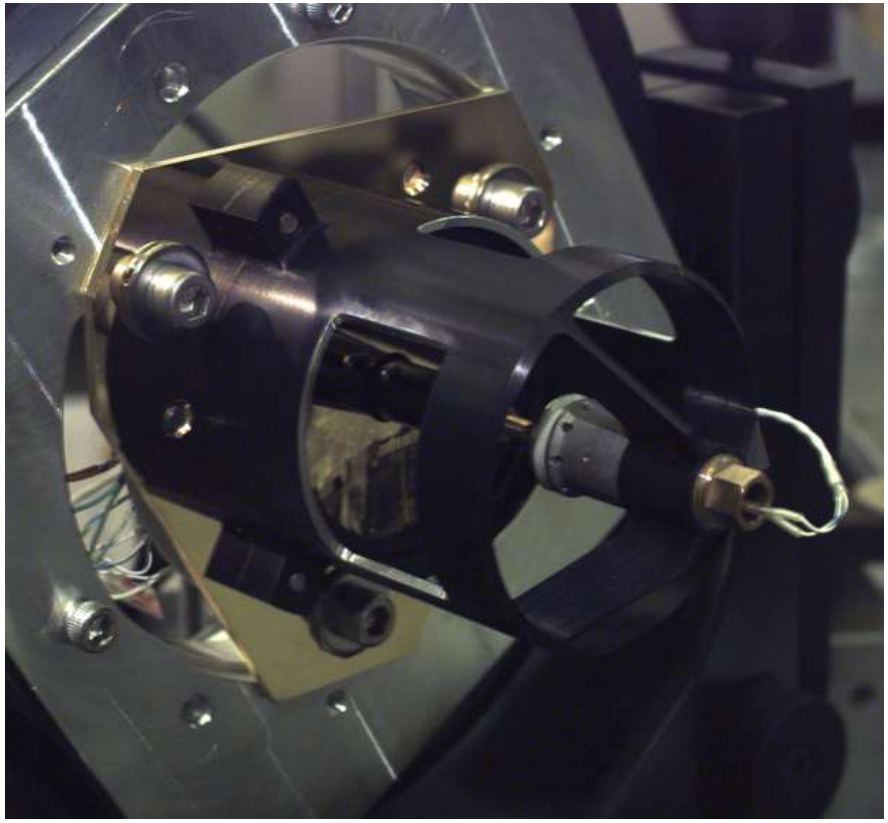
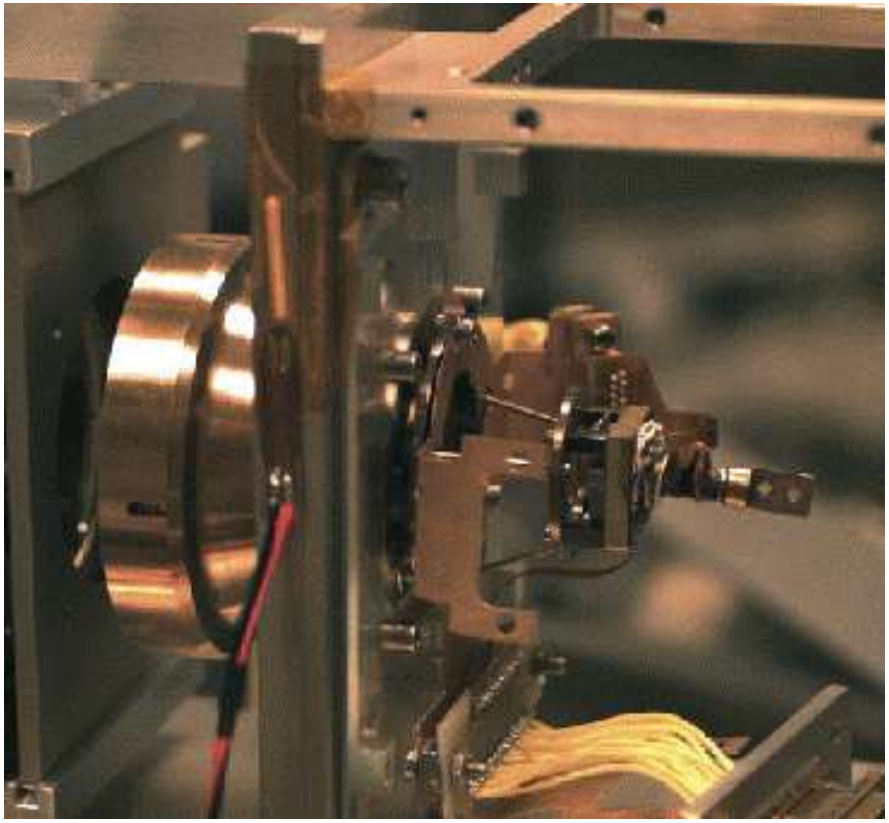
# Far-IR & Mid-IR Focal Plane Assemblies

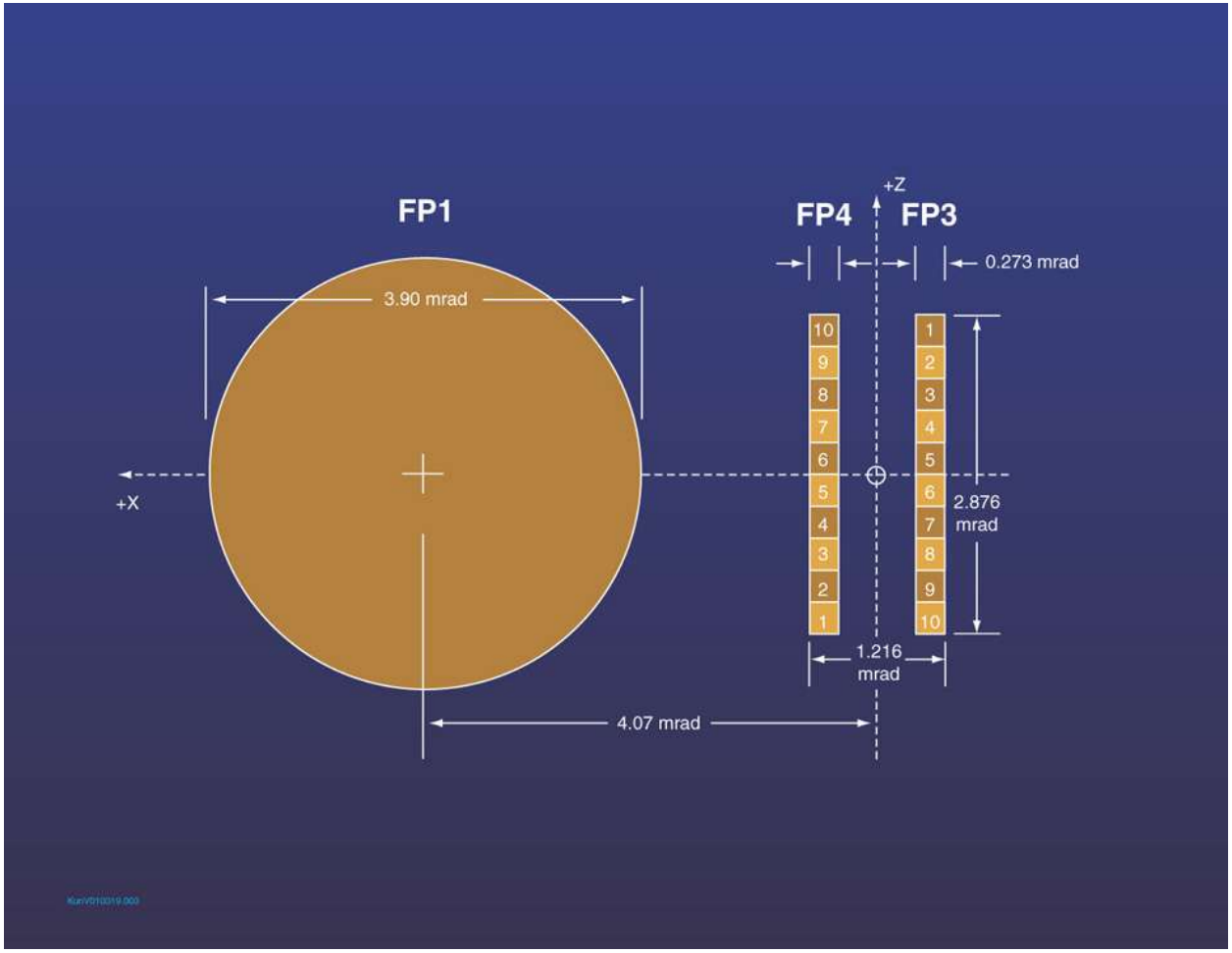


FP1 Thermocouples
Supplied by Univ. Karlsruhe
FIR FP supplied by GSFC

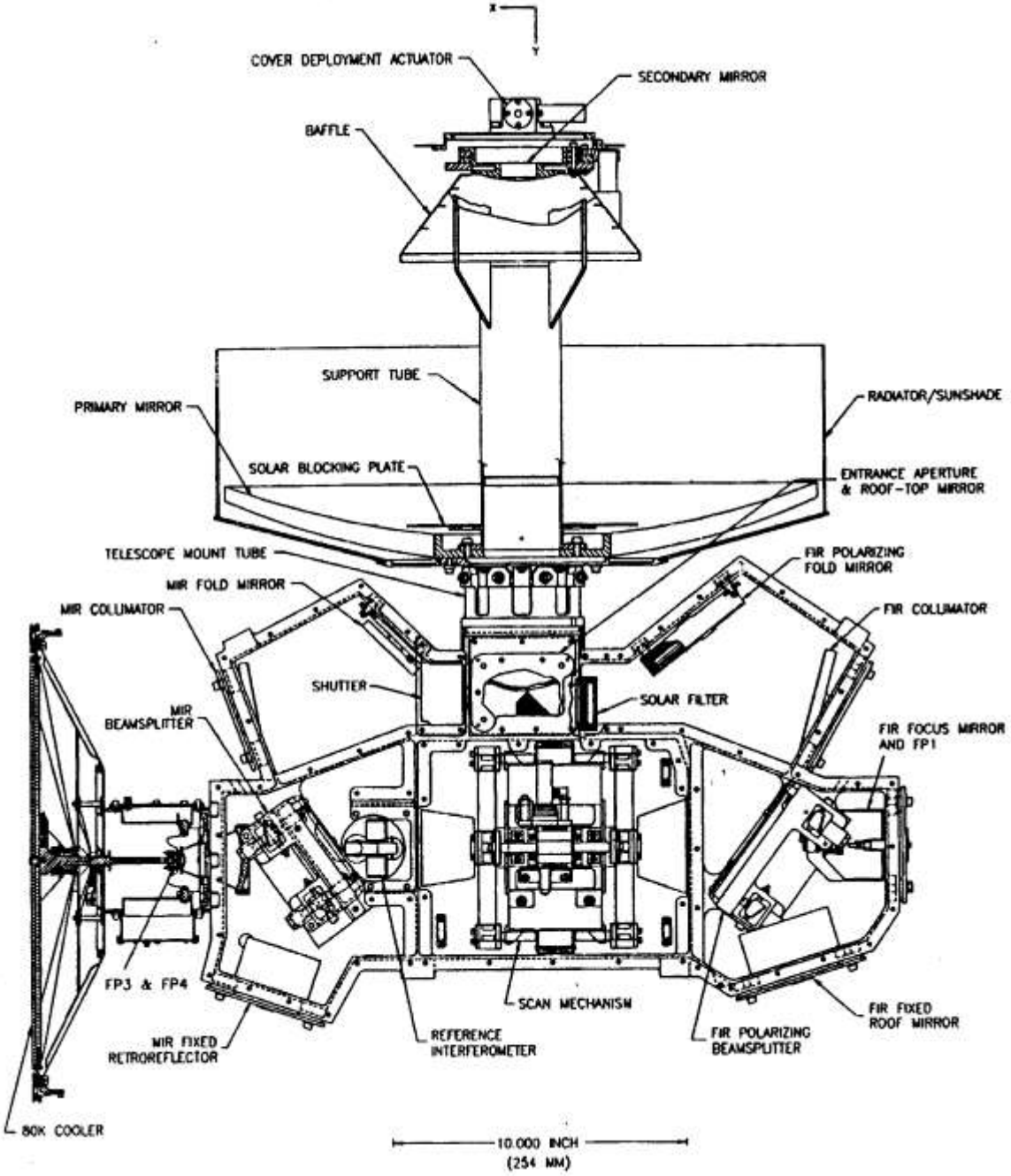


FP3 & FP4 HgCdTe Arrays
GSFC & CEA Astrophysique
MIR FP supplied by Oxford

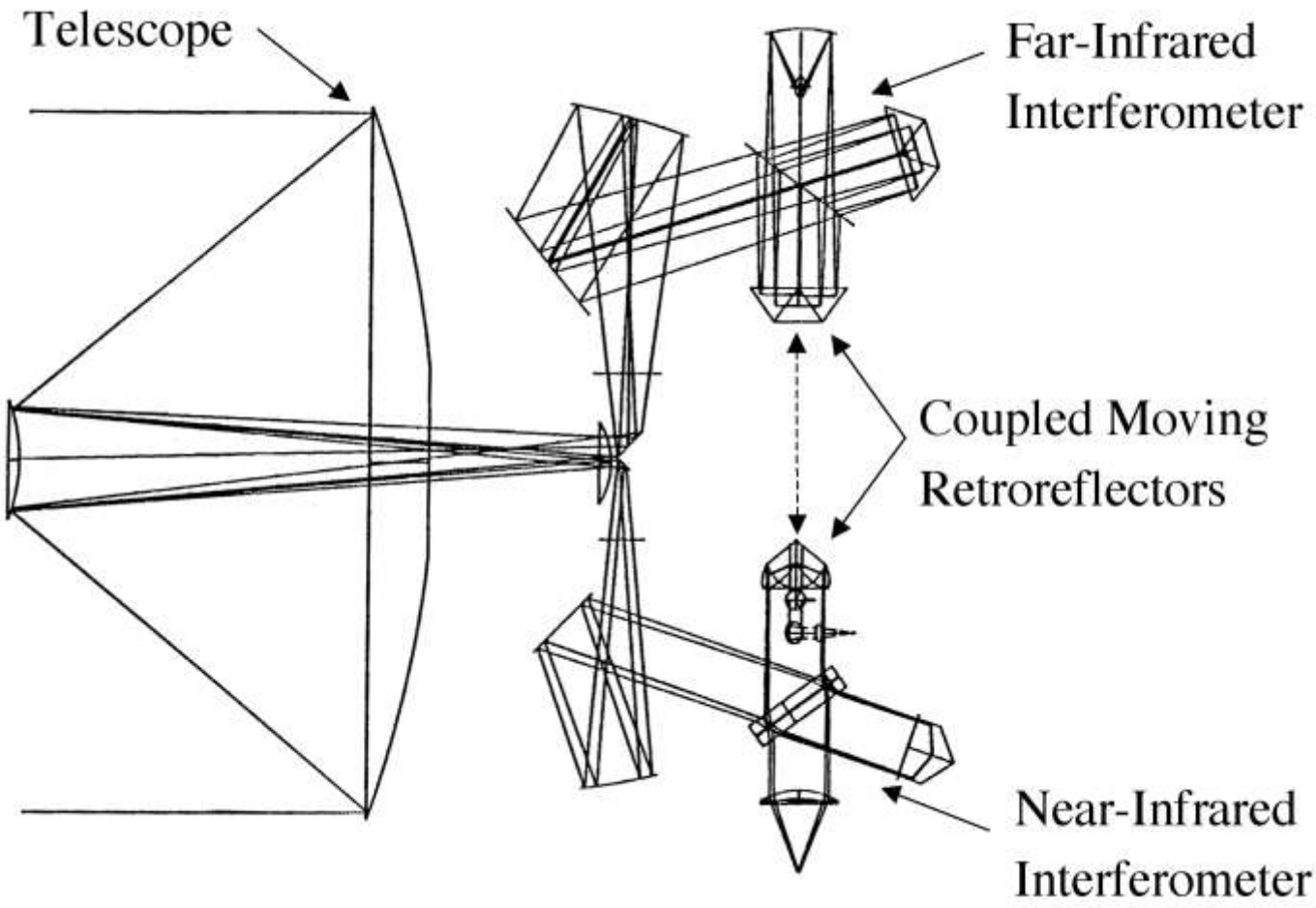
# CIRS Fields of Views



CIRS
Mechanical
Layout

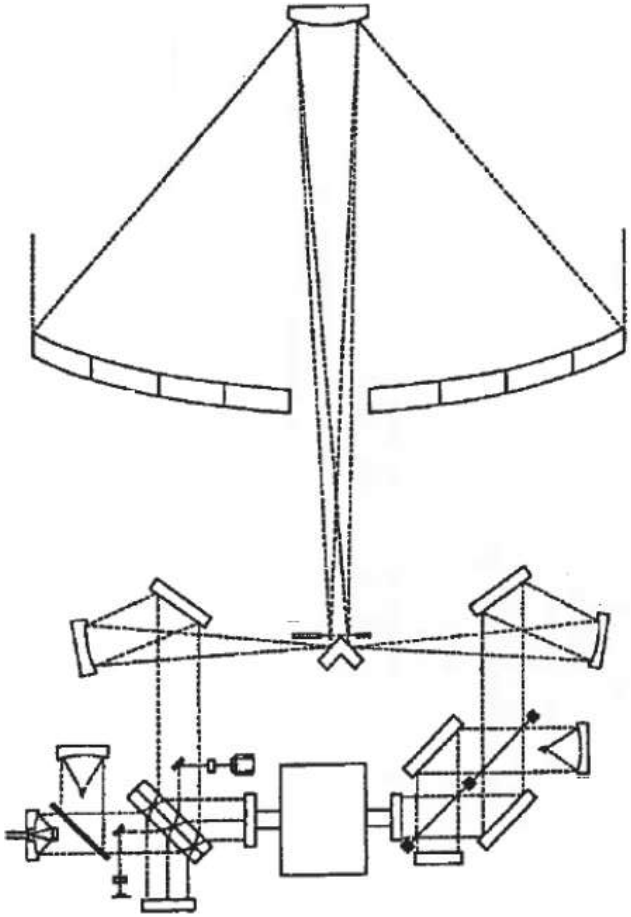


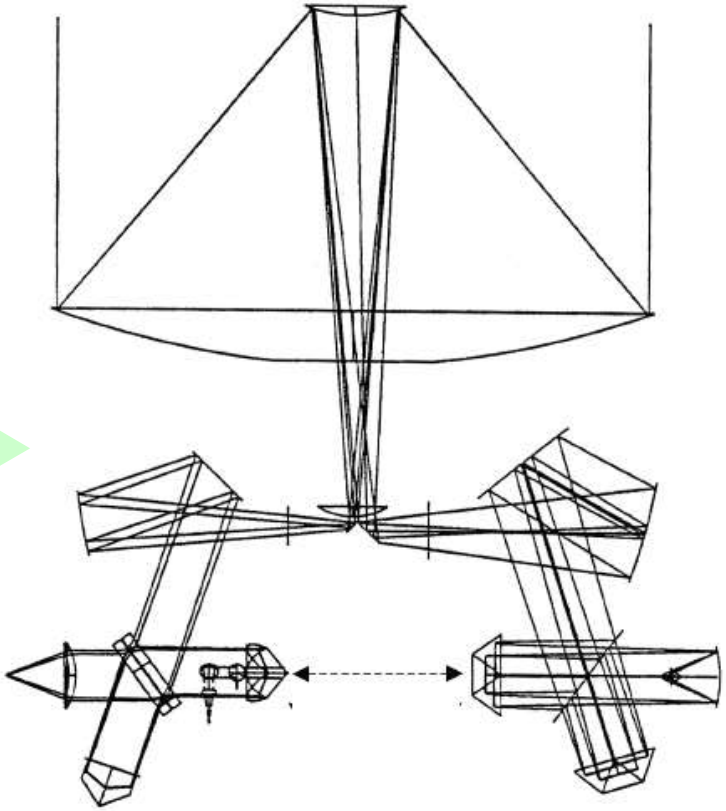
# Optical Layout



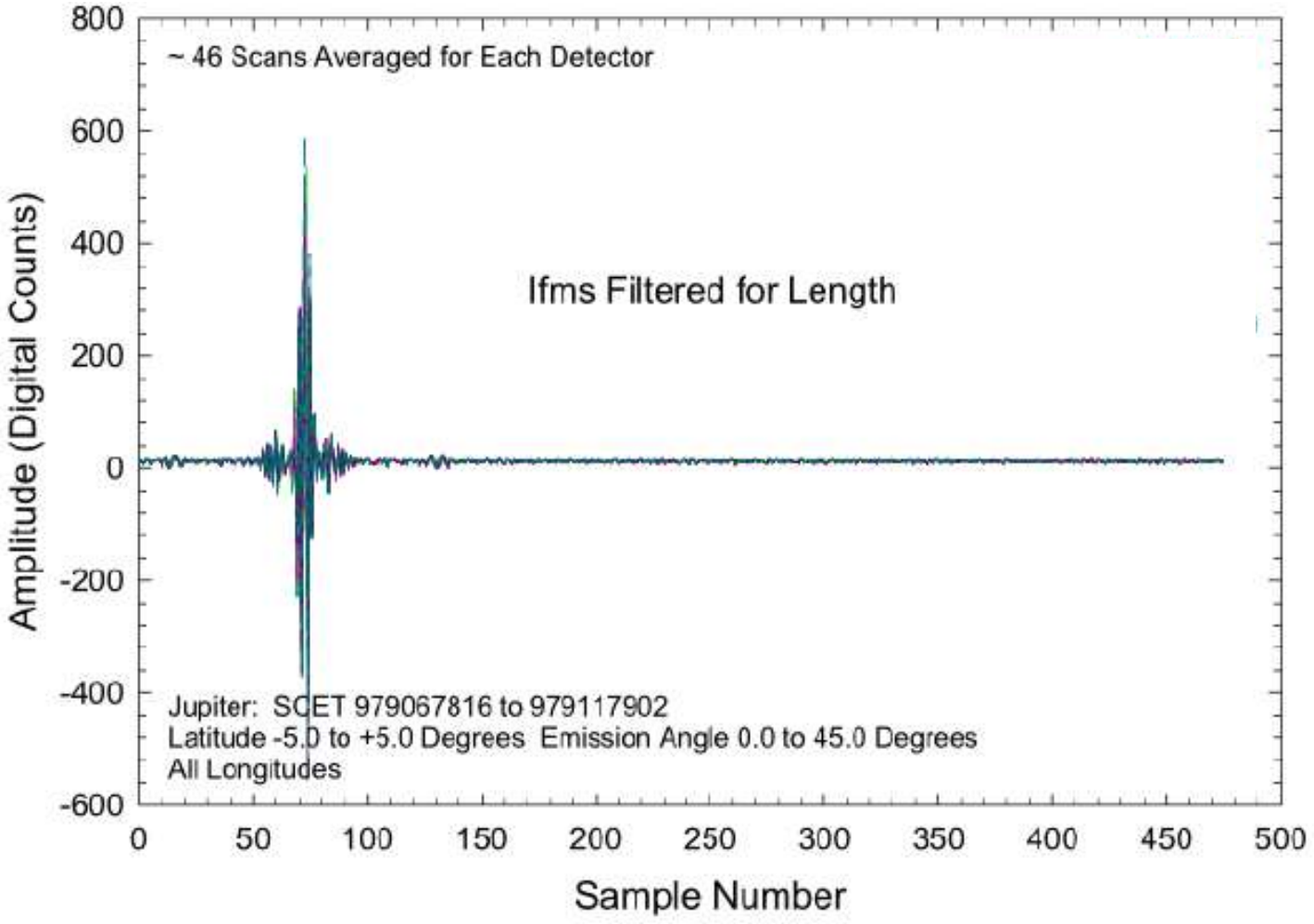
# Optical Layout
# As Proposed and As Built







# CIRS Interferogram



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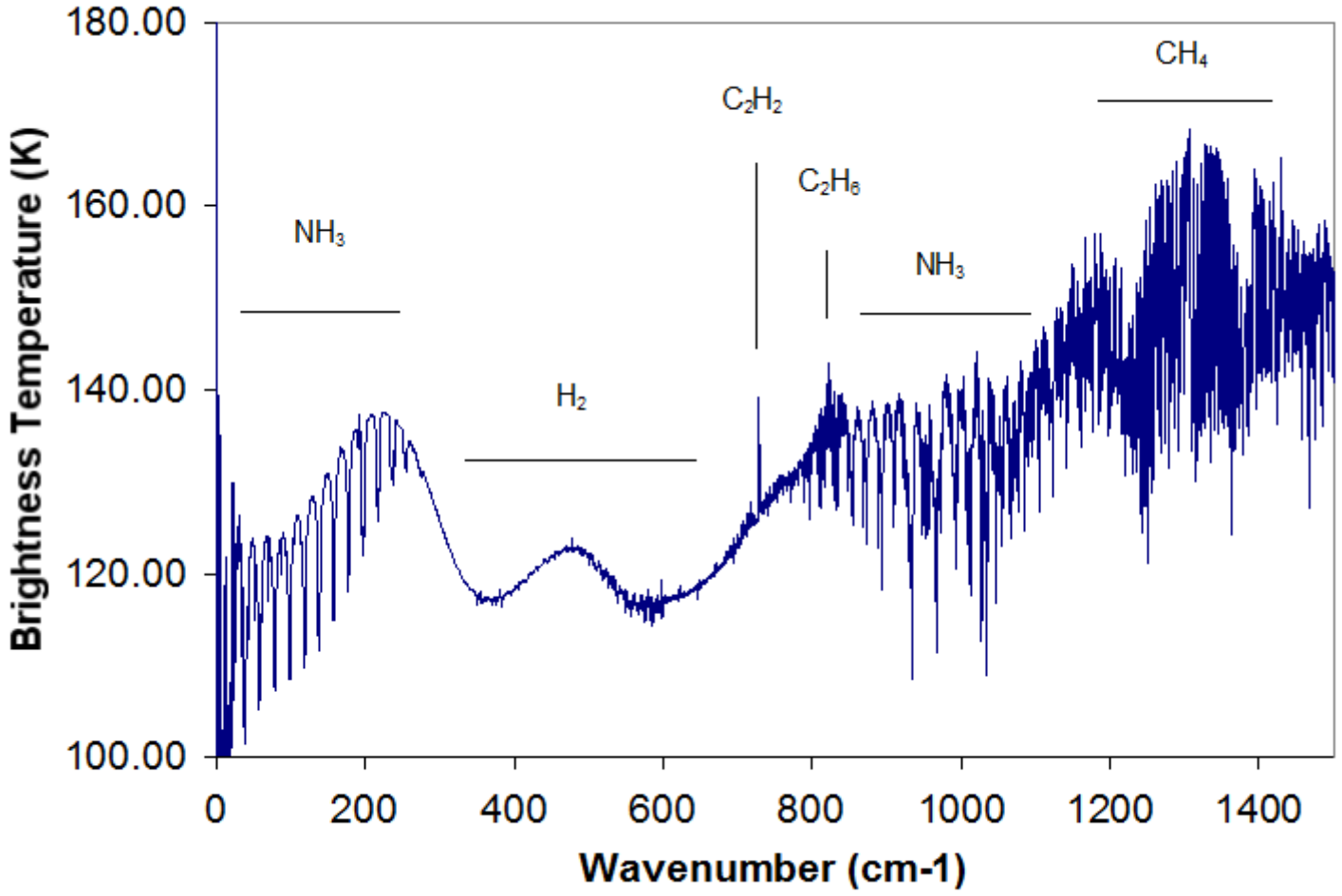
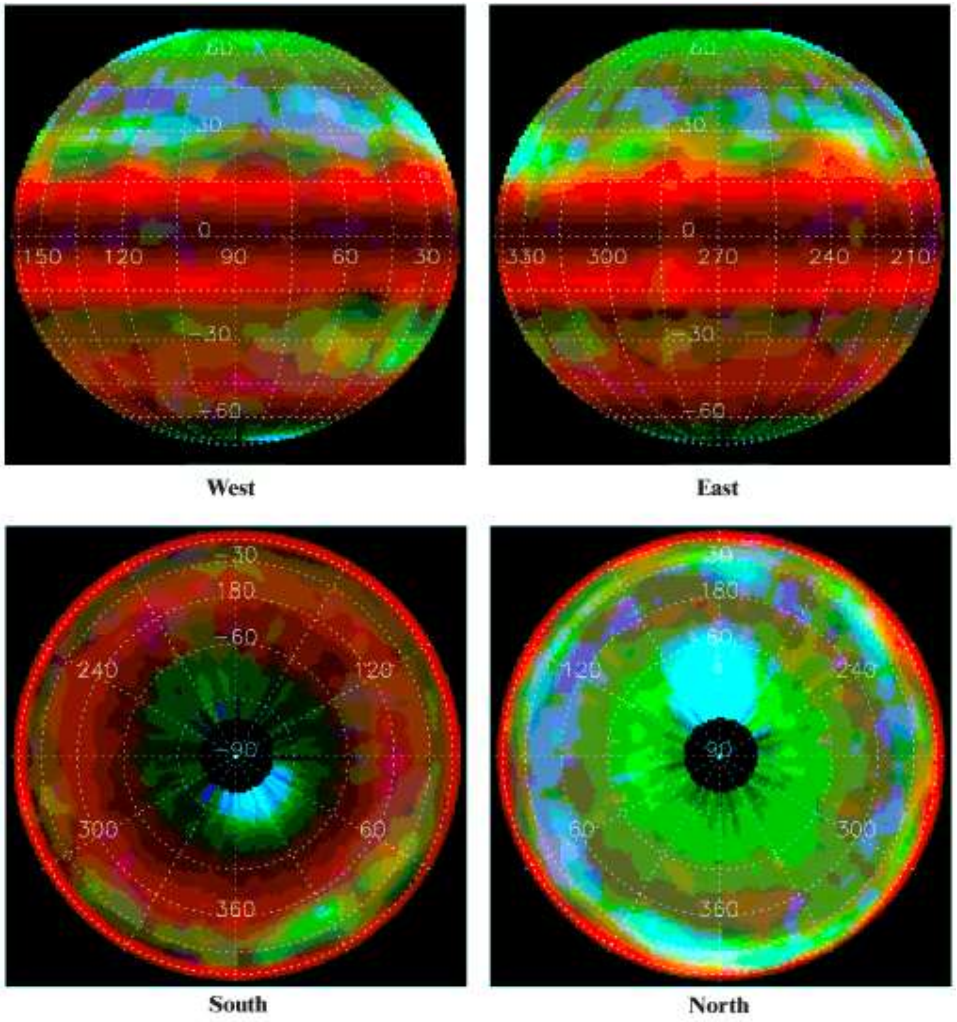
# Jupiter from Cassini ISS
## flyby 2000-2001

# Jupiter Brightness Temperature Spectrum



# Jupiter Thermal Image from CIRS




Blue: Acetylene

Green: Methane

Red: Hydrogen Continuum

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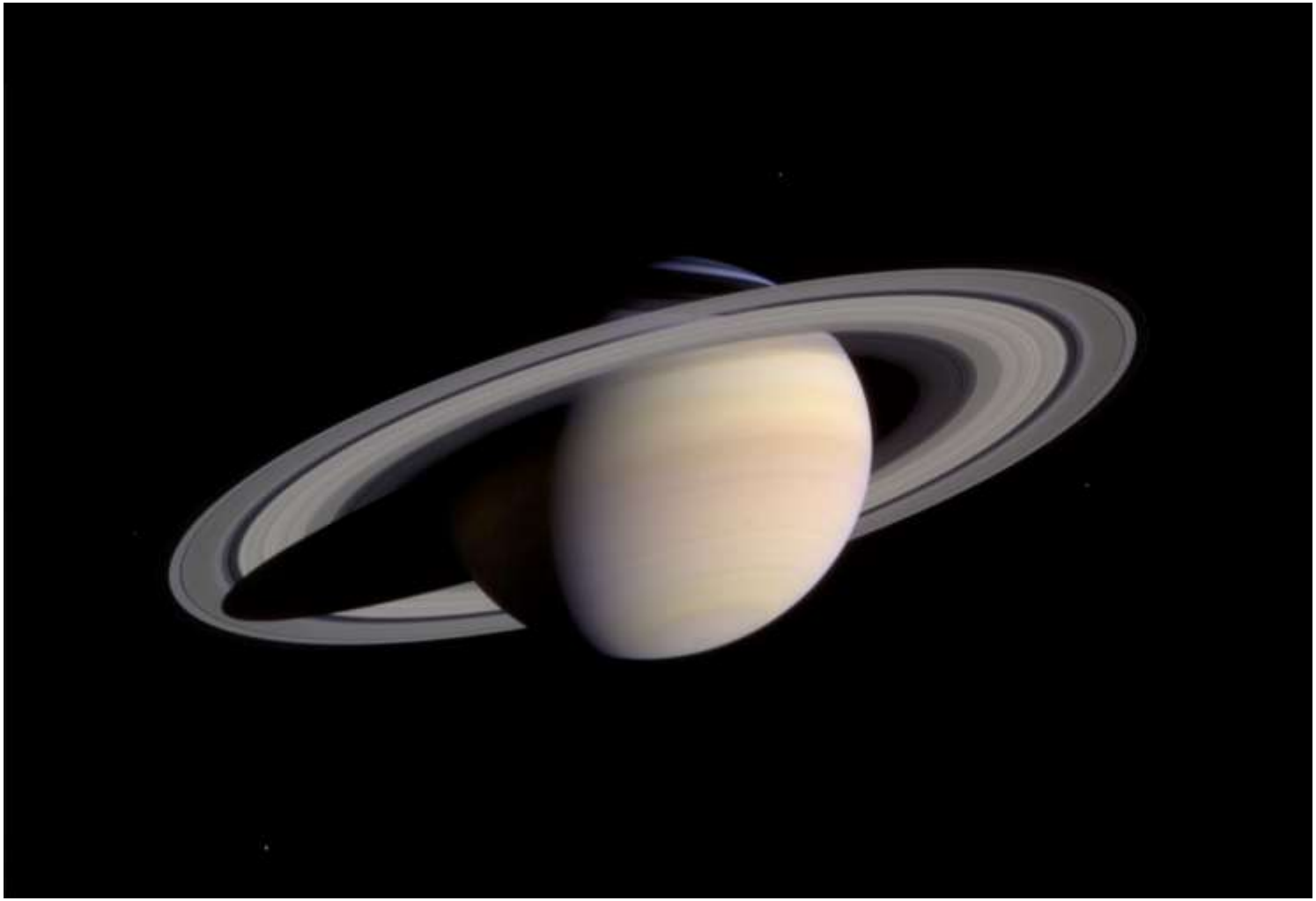
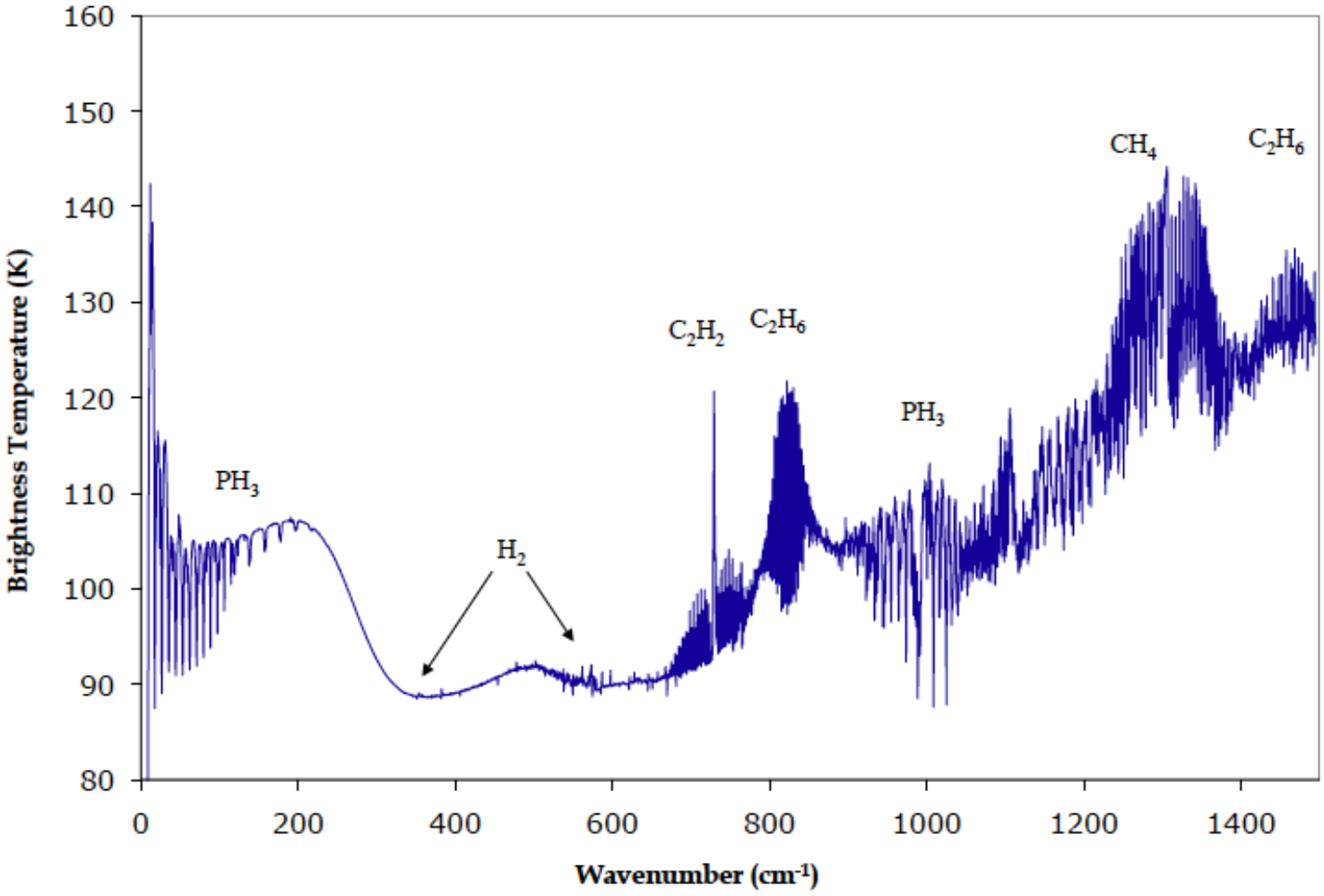
# Saturn from Cassini ISS

arrival 2004

CIRS



# Saturn Brightness Temperature Spectrum



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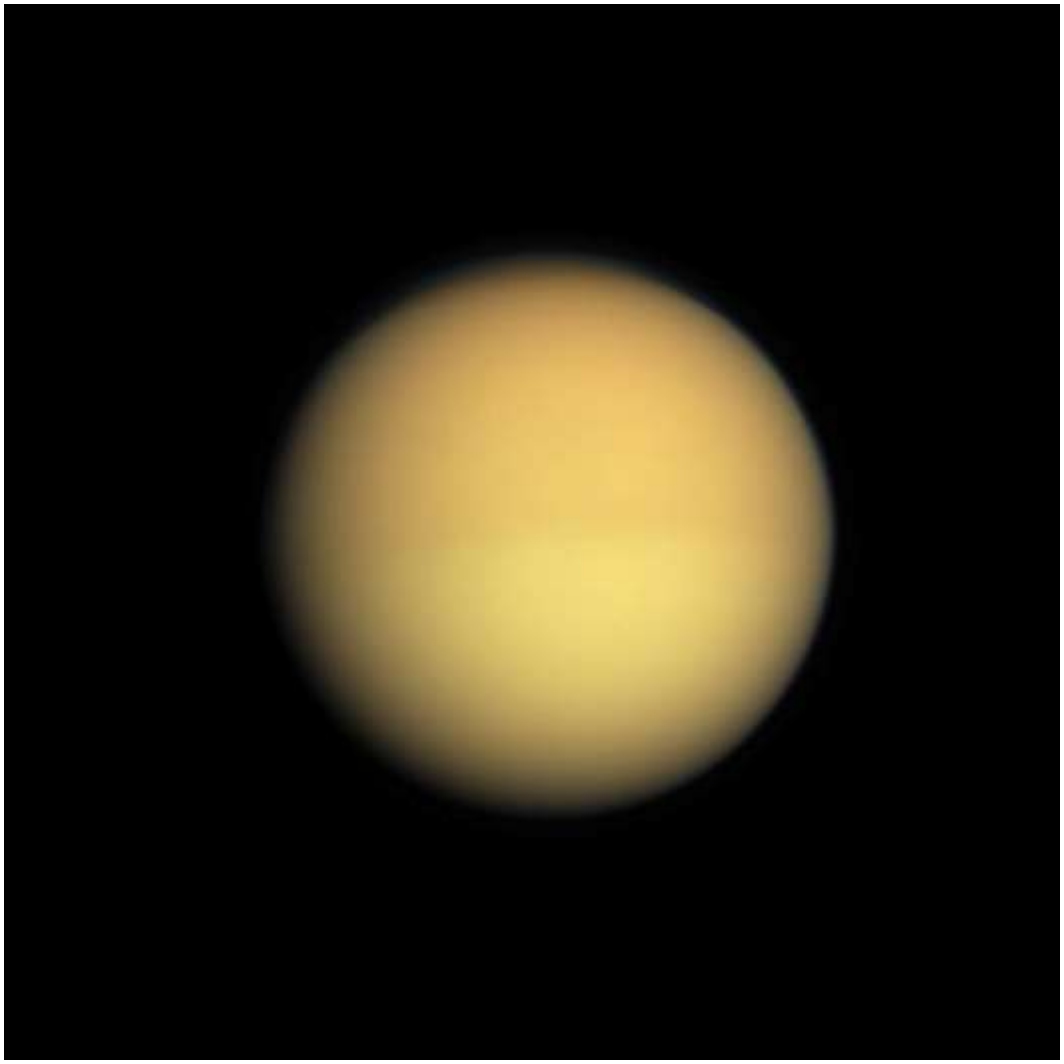
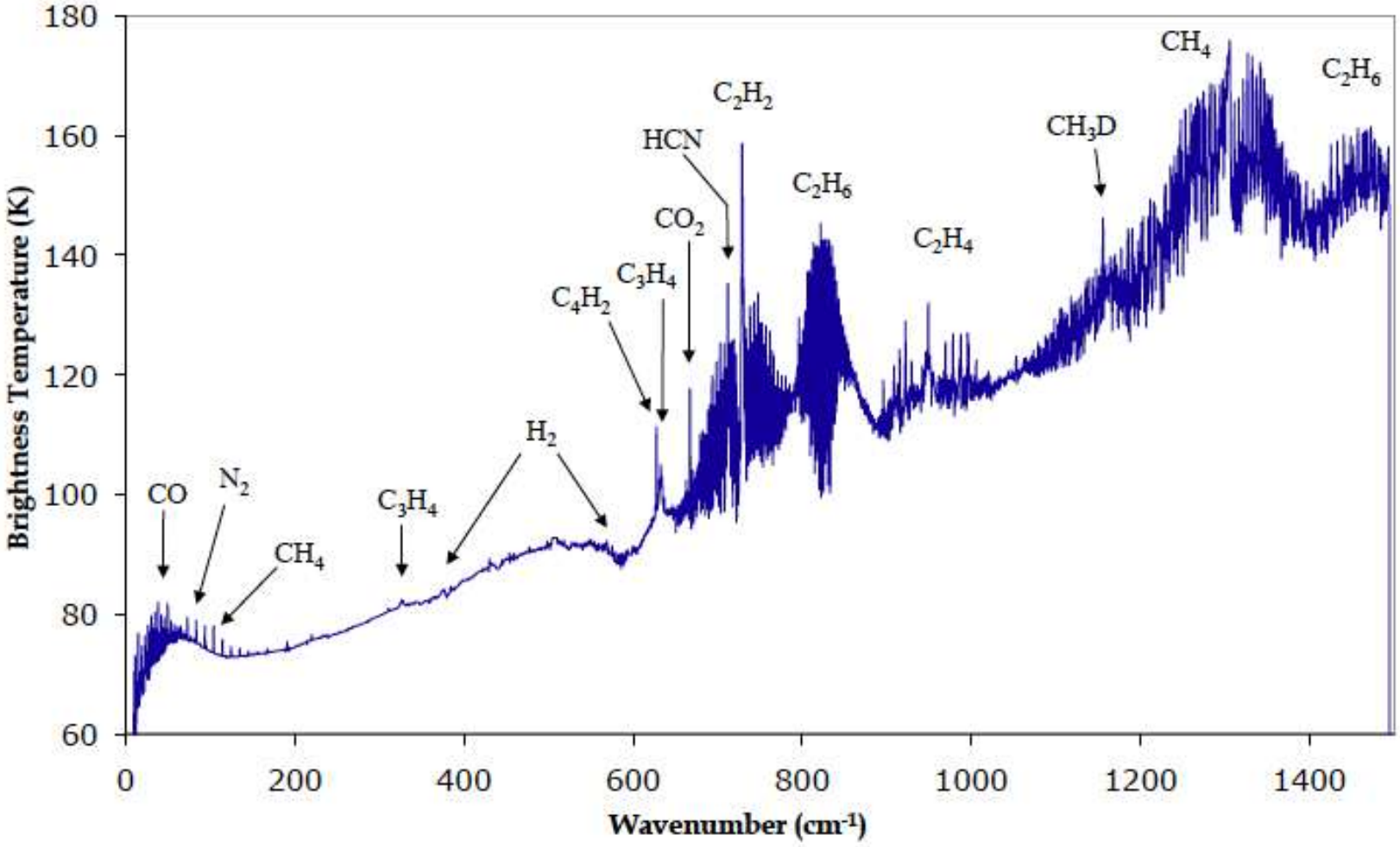
# Titan from Cassini ISS



# Titan Brightness Temperature Spectrum



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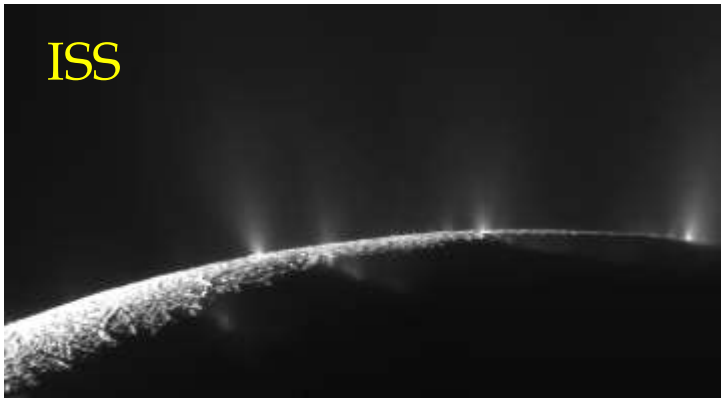
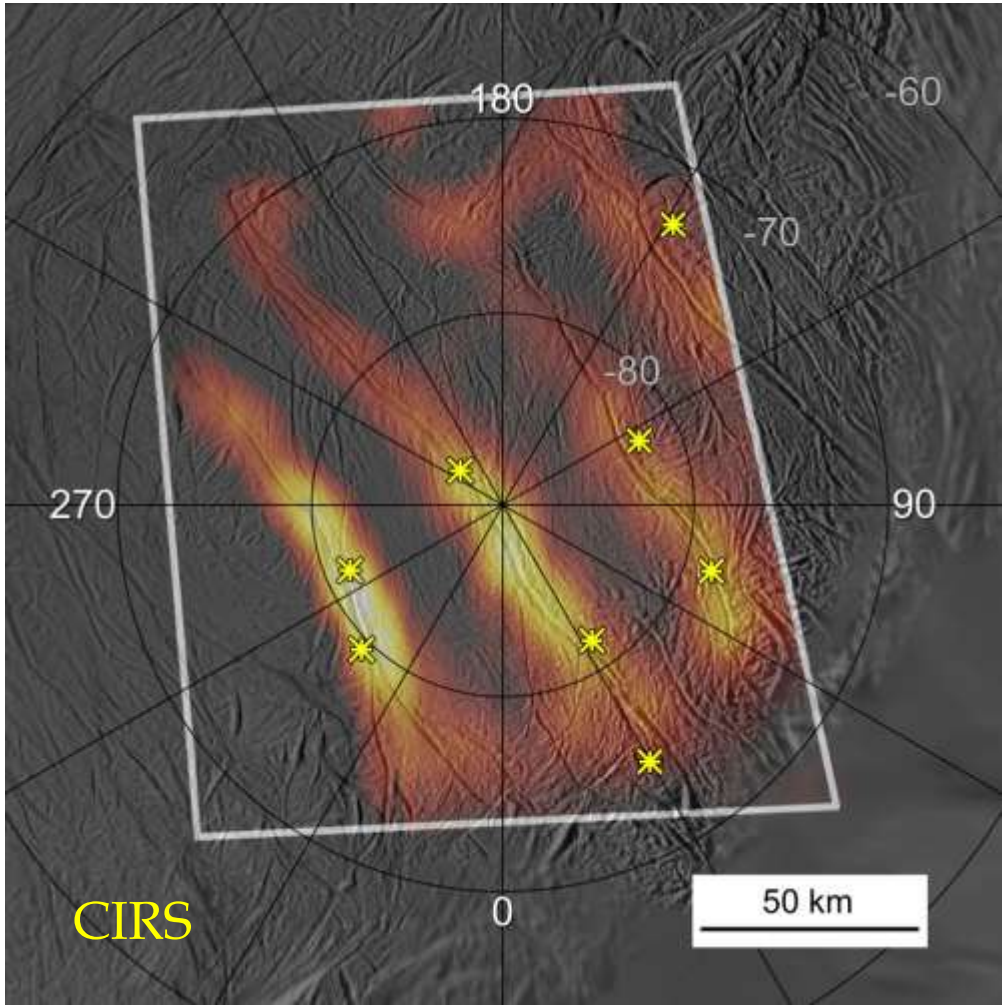
# Enceladus Thermal Stripes







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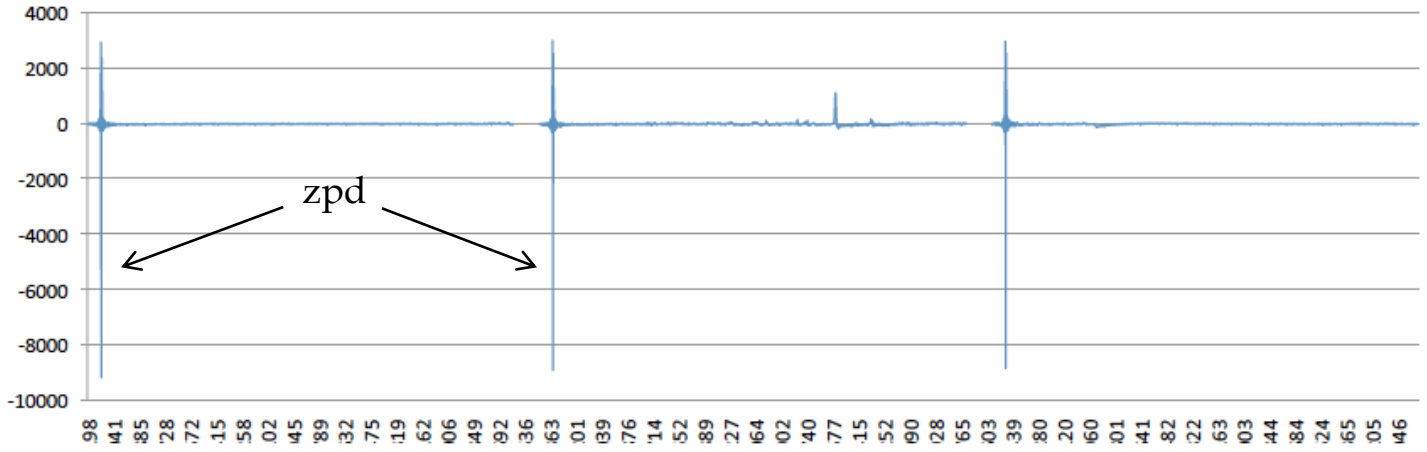
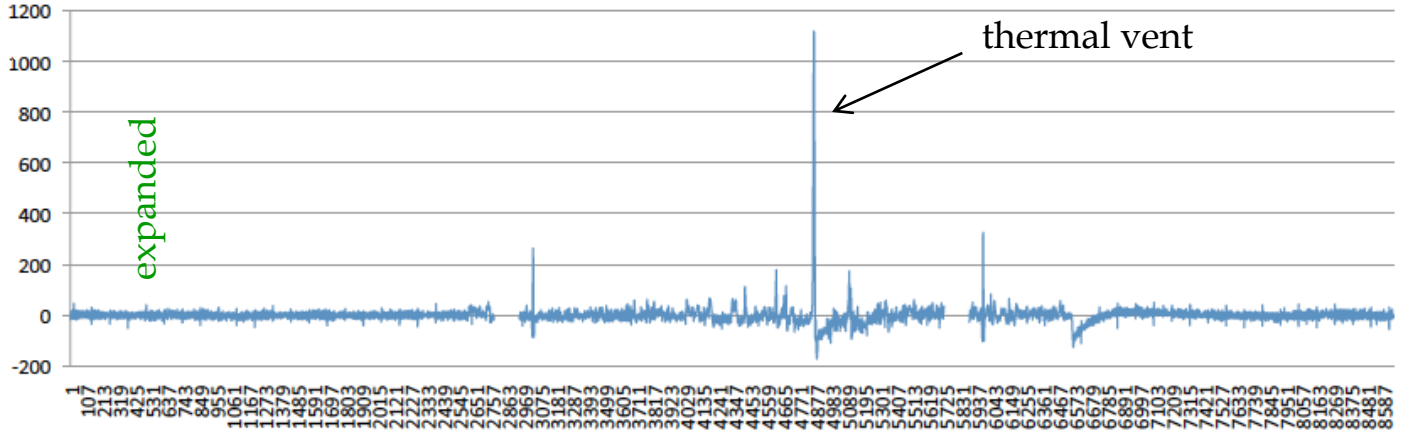
# CIRS used as a High-Speed Radiometer

Enceladus Close Fly-by 14 April 2012

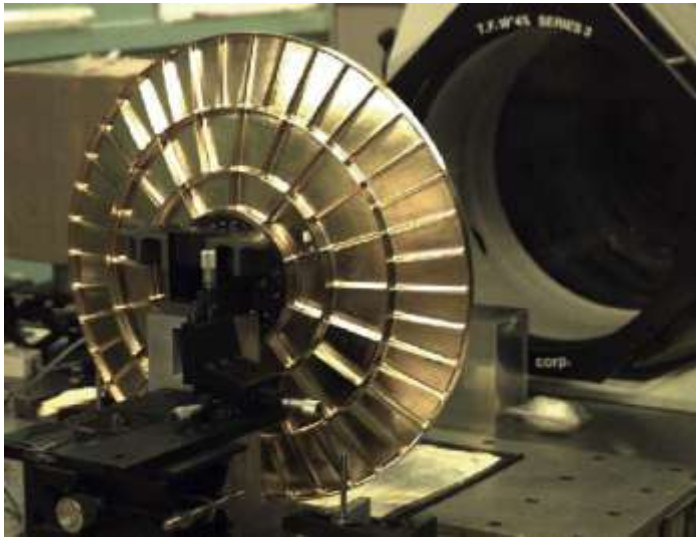
Three 50-second Interferograms 400 rti



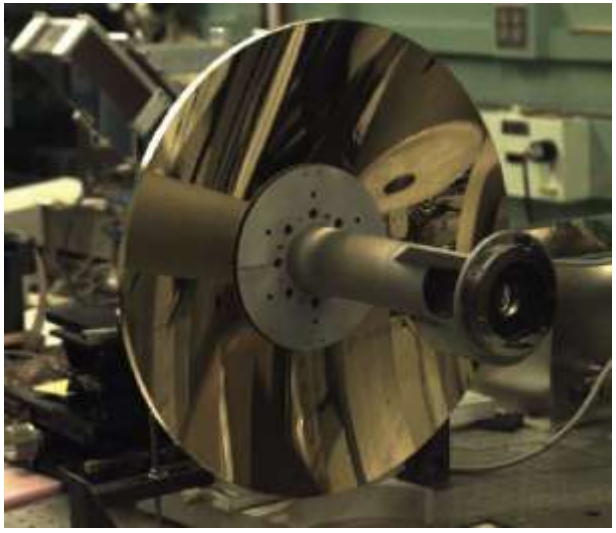

Same, With Deep Space Subtracted



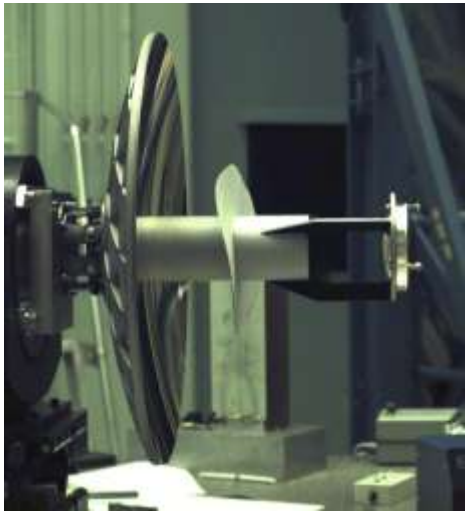
# CIRS Telescope Upgraded from MIRIS



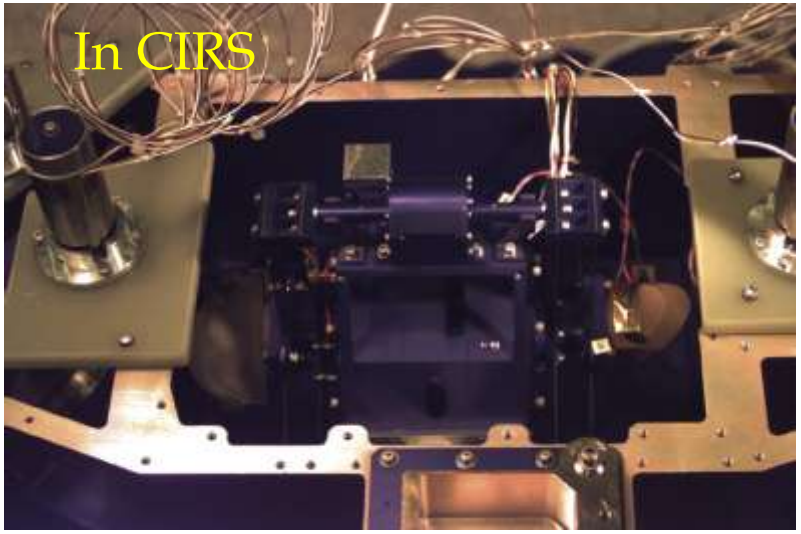
MIRIS

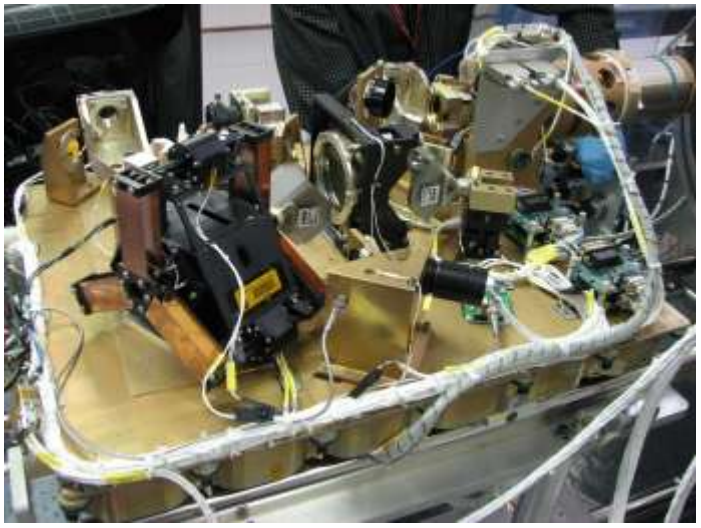


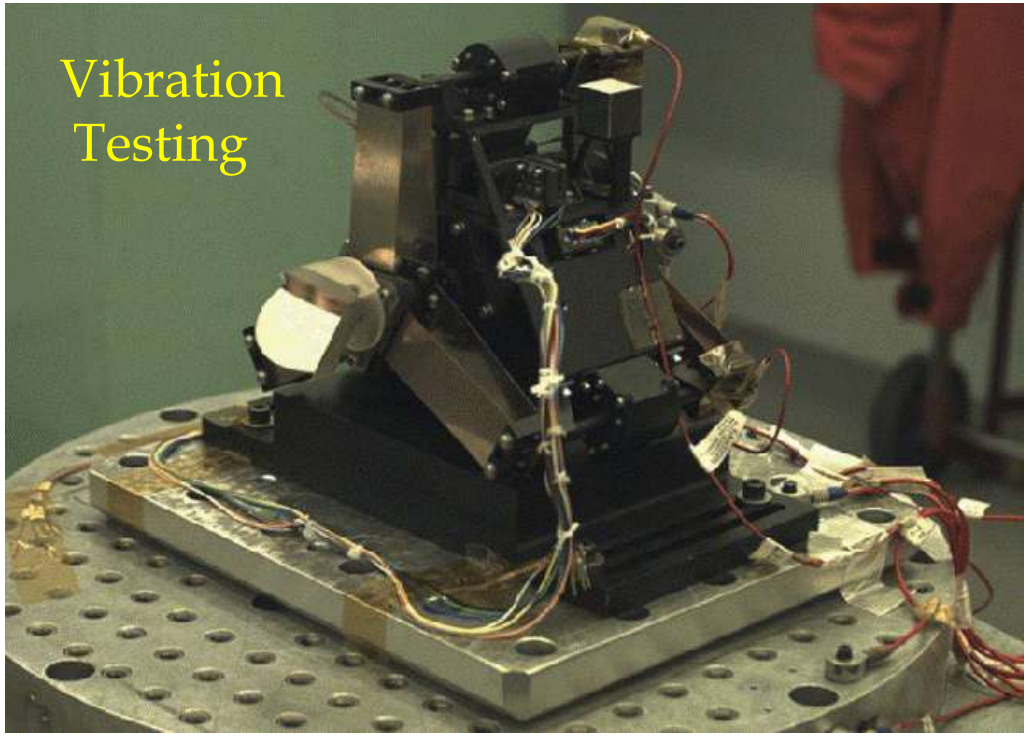
CIRS



# CIRS Technology: Scan Mechanism



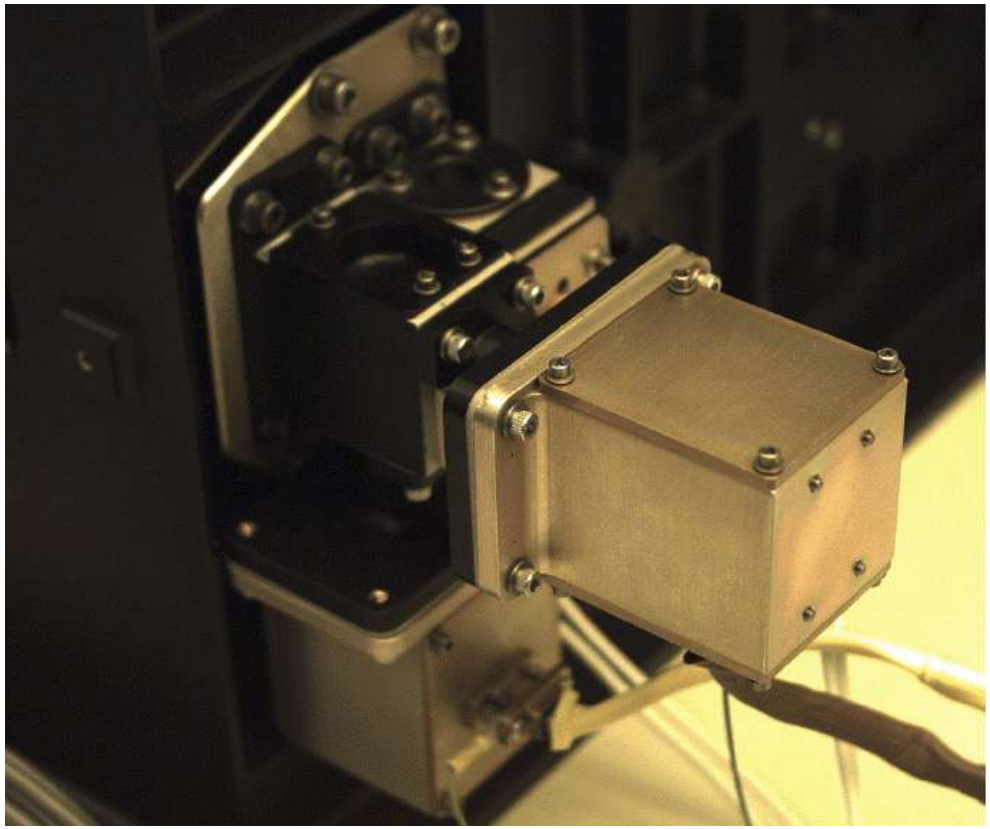



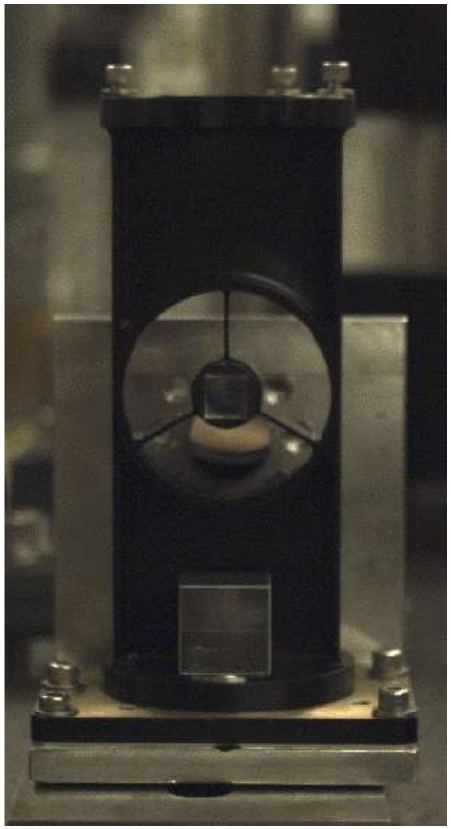



In CLARREO CDS

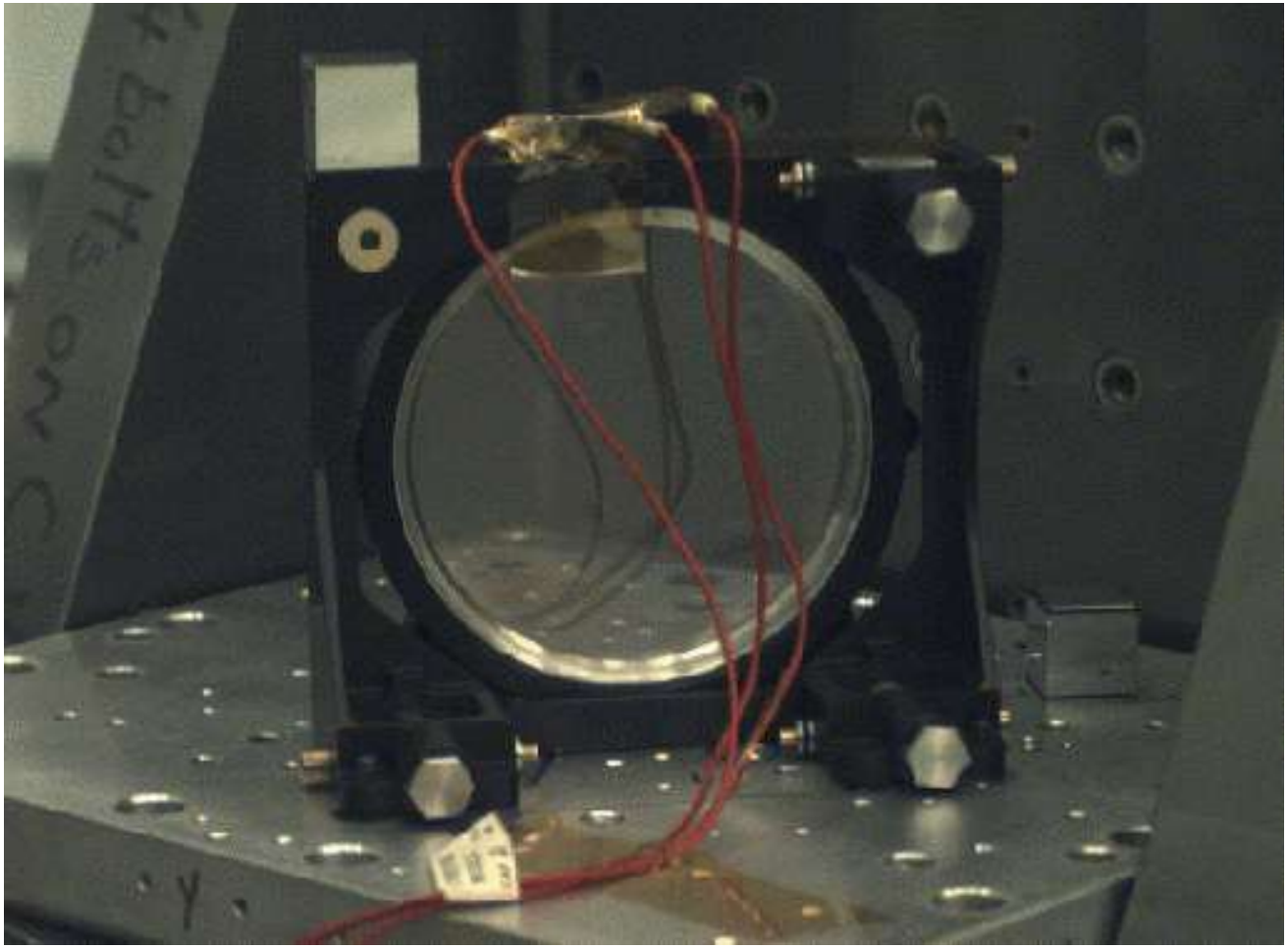
# CIRS Technology: Reference Interferometer diode laser, LED, cube corners







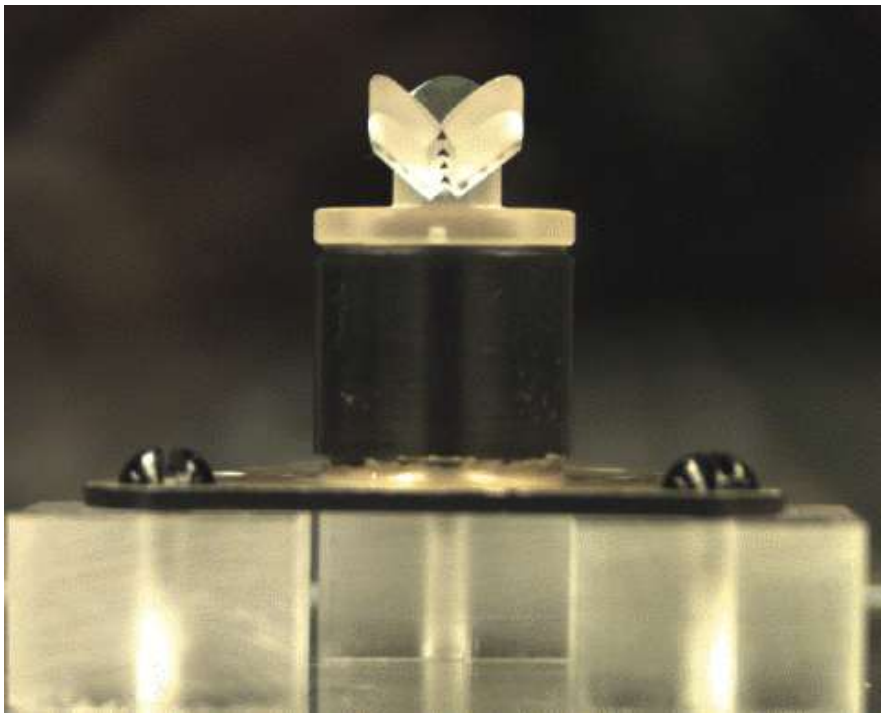
# CIRS Technology: Polarization Beamsplitter



Substrate wire-grid polarizer supplied by QMWC, London

# CIRS Technology: Retroreflectors

Mid-IR Cube-Corner



Reference interferometer
Cube-Corner


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