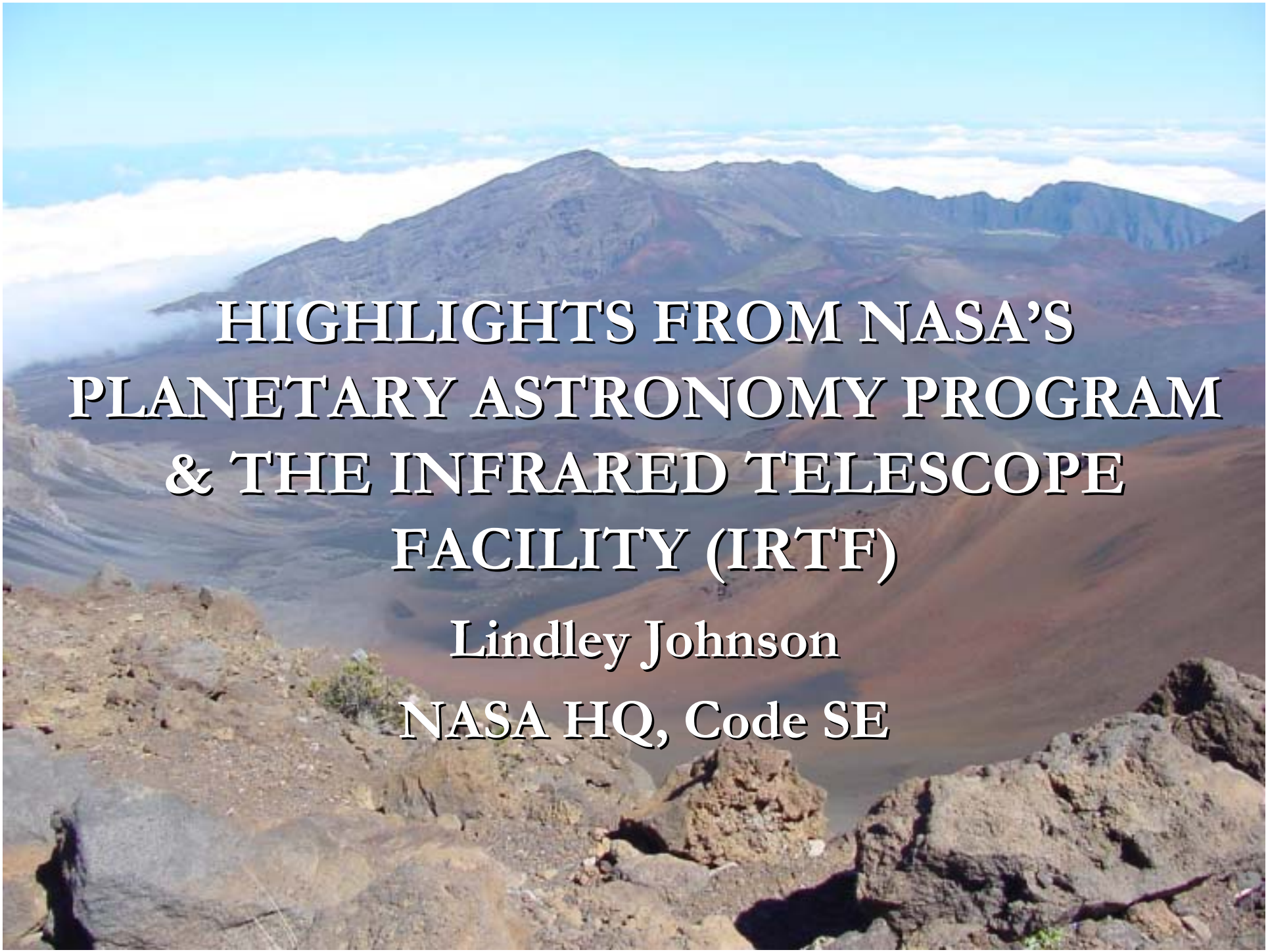


HIGHLIGHTS FROM NASA'S PLANETARY ASTRONOMY PROGRAM & THE INFRARED TELESCOPE FACILITY (IRTF)

Lindley Johnson

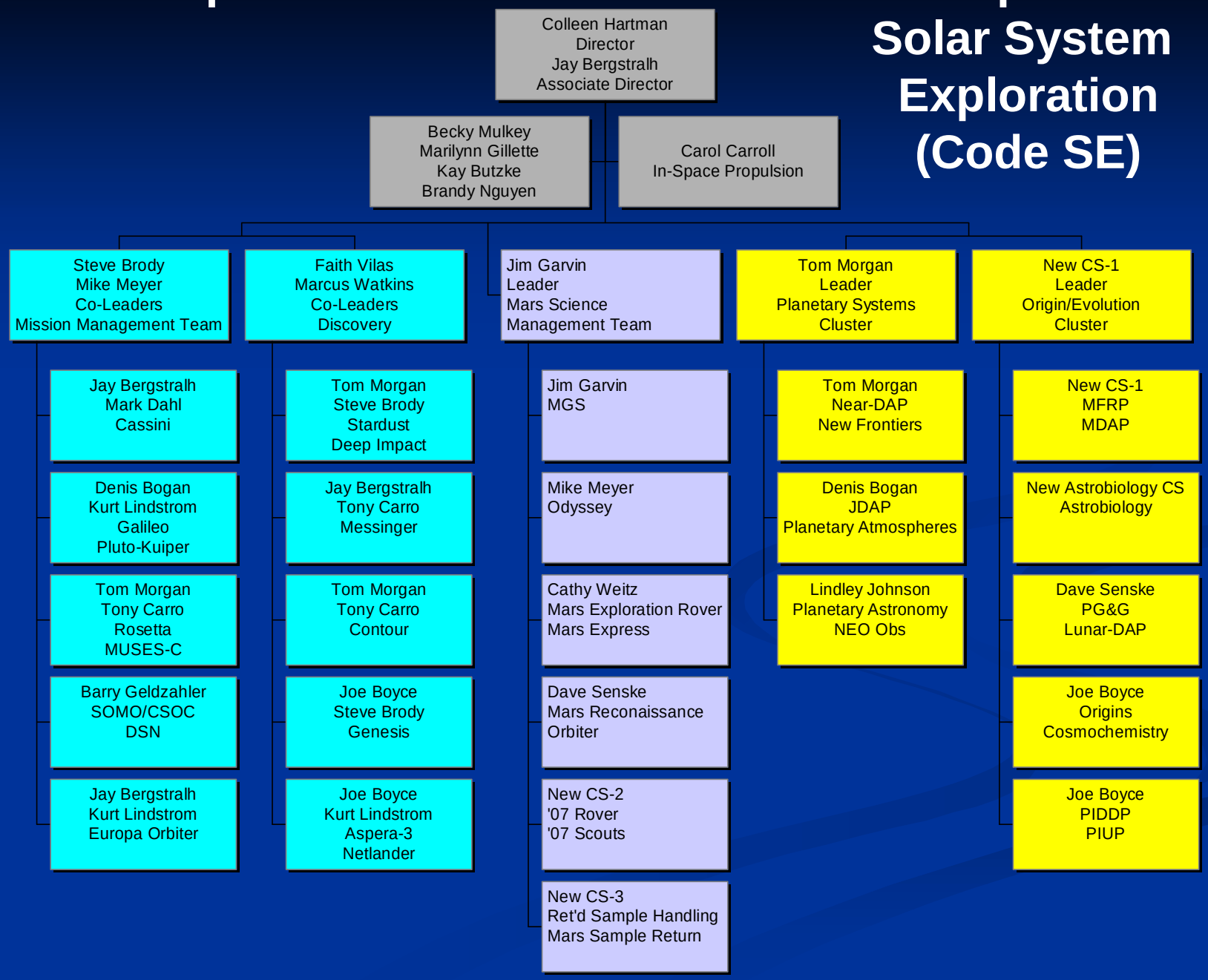
NASA HQ, Code SE

OUTLINE

- Description of the Programs
- NASA's Infra-Red Telescope Facility (IRTF)
  - Instrumentation
  - Recent Scientific results

NASA Headquarters

Office of Space Science Solar System Exploration (Code SE)



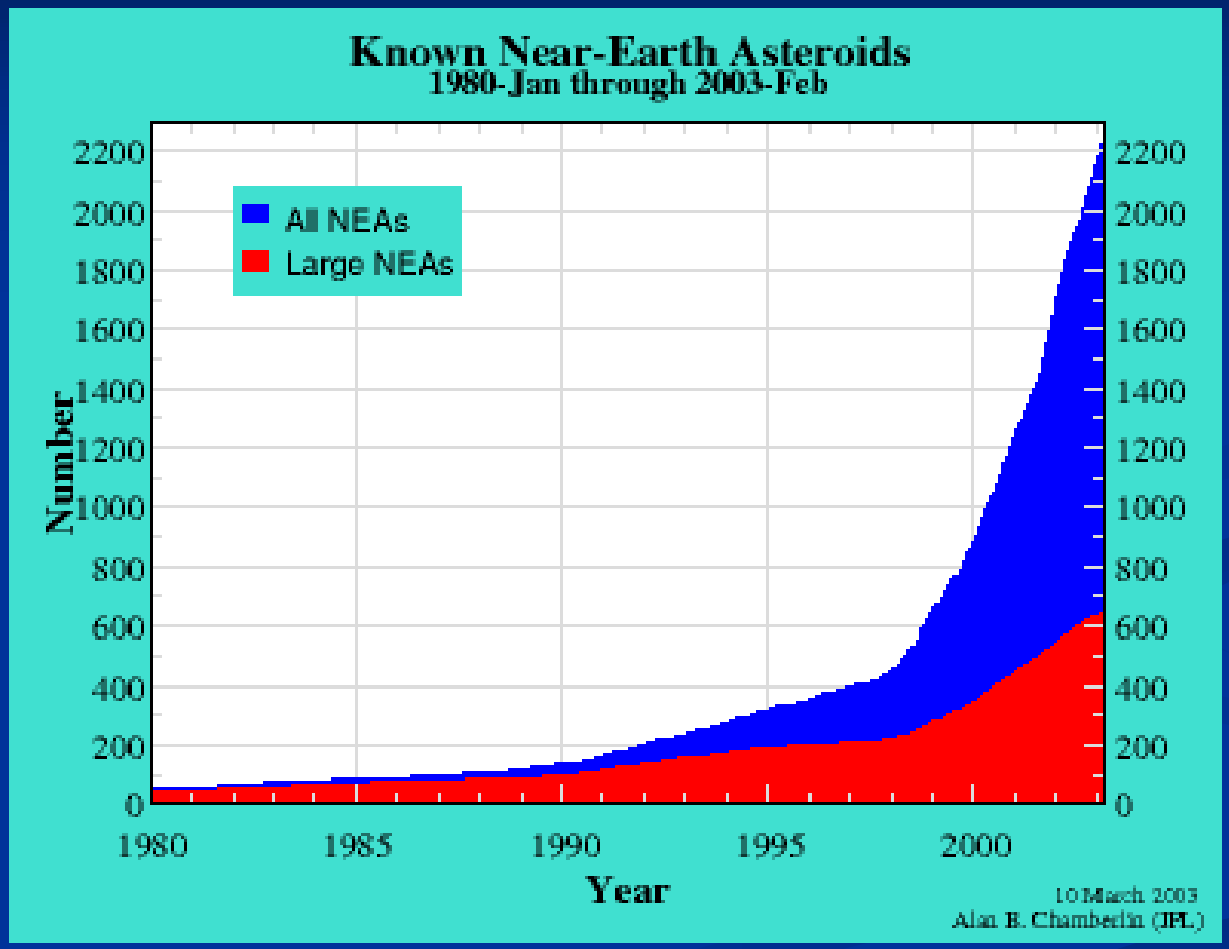
THE PROGRAMS

Within NASA's Solar System Exploration Division

- Near Earth Object Observation (NEOO) Program
  - $3.4M/yr across 15 mostly three year grants
  - 4 – 6 new grants per year (proposals due 6/20/03)
  - Focused on detection of >1km NEOs, some characterization
- Planetary Astronomy (PAST) Program
  - ~$5M/yr across 42 mostly three year grants
  - 15 – 20 new grants per year (proposals due 6/27/03)
  - From Mercury to the Kuiper Belt and everything between
    - Emphasis on support to NASA interplanetary missions
  - Infrared Telescope Facility (IRTF)

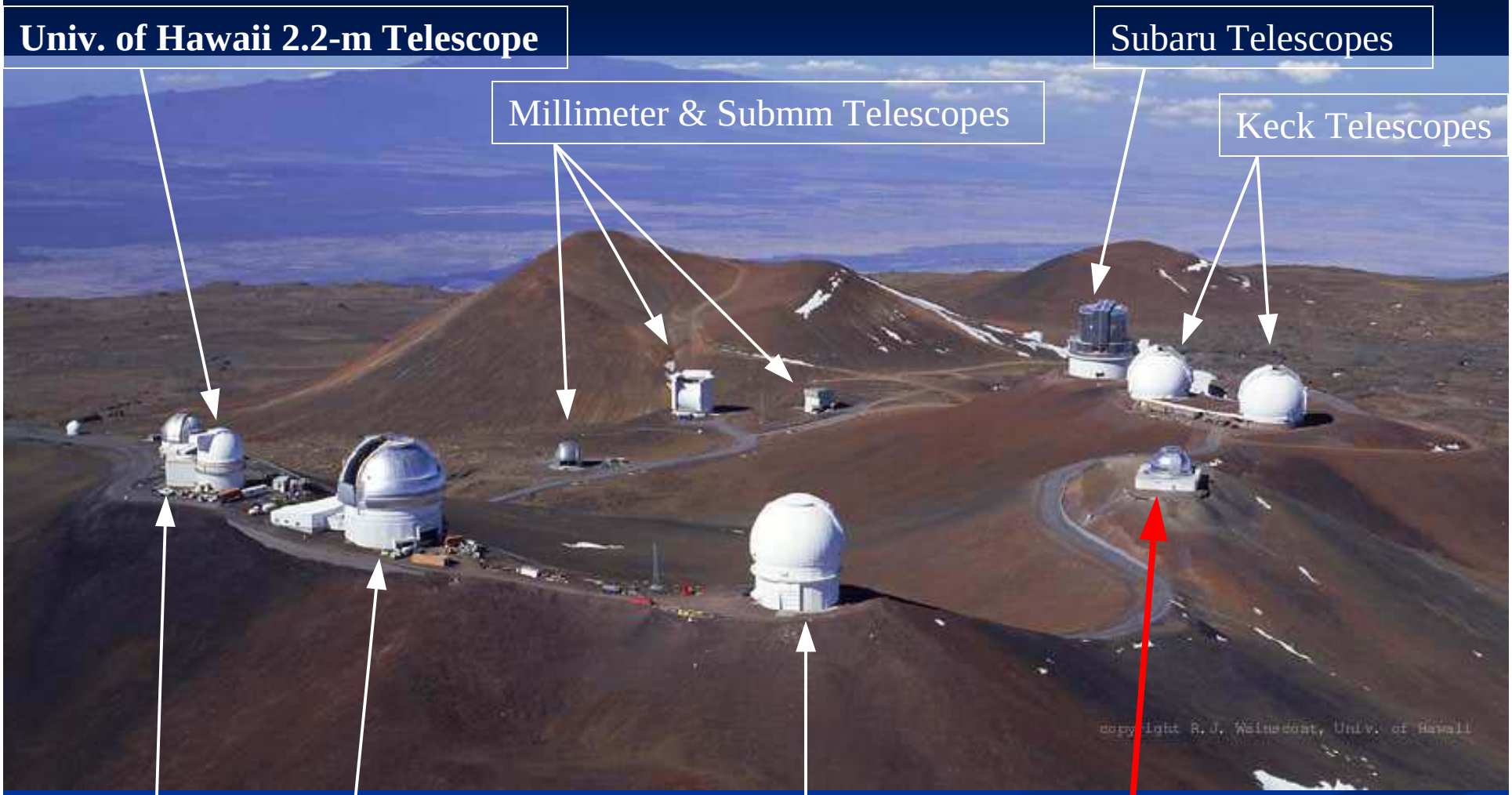
Near Earth Object Observation

- Discover 90% of 1 km or larger NEOs by Dec 2008

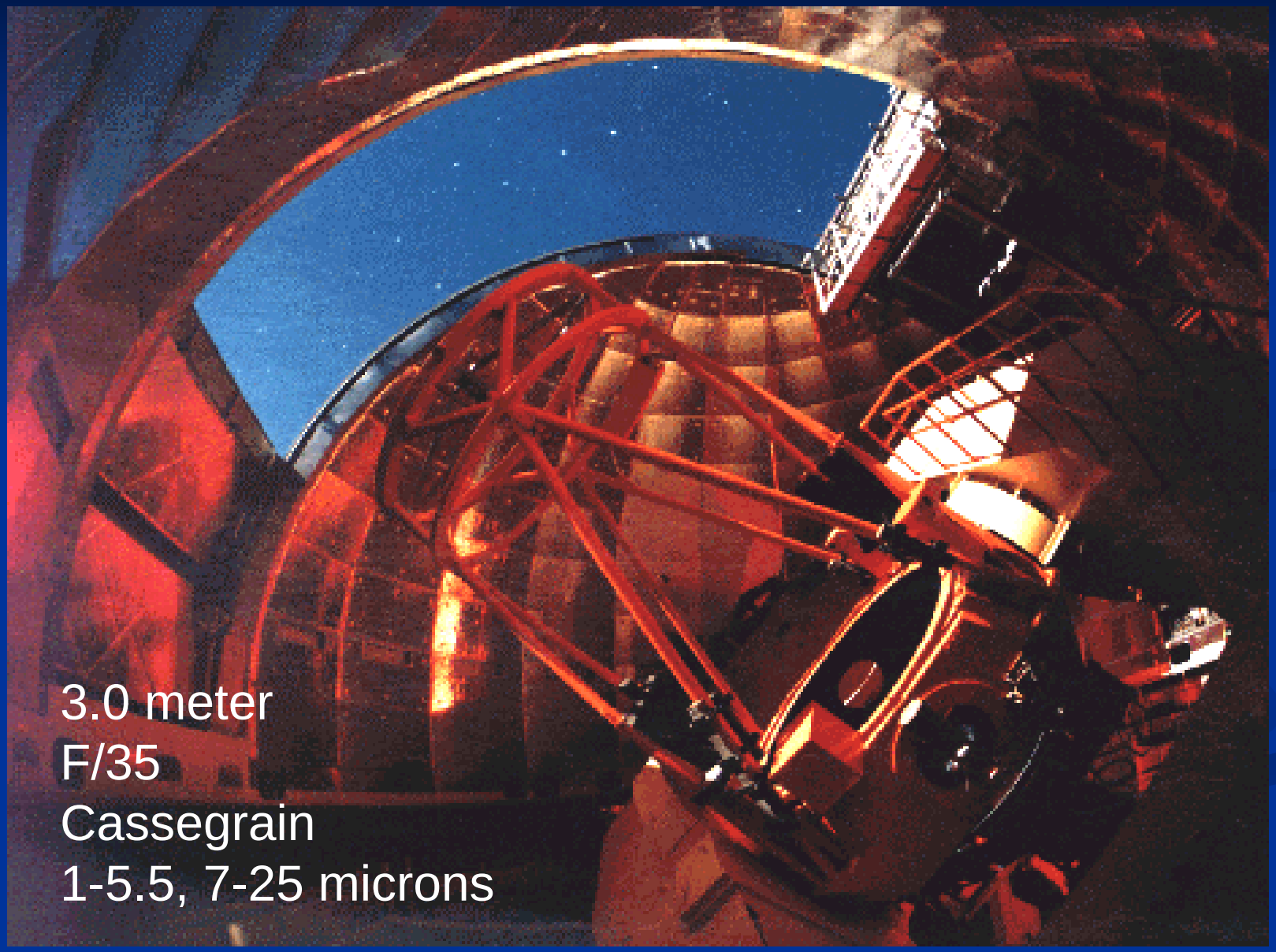


- To date (Jun 2003), 653 objects > 1 km detected, 1723 of smaller size

Overview of Mauna Kea



Infra-Red Telescope Facility



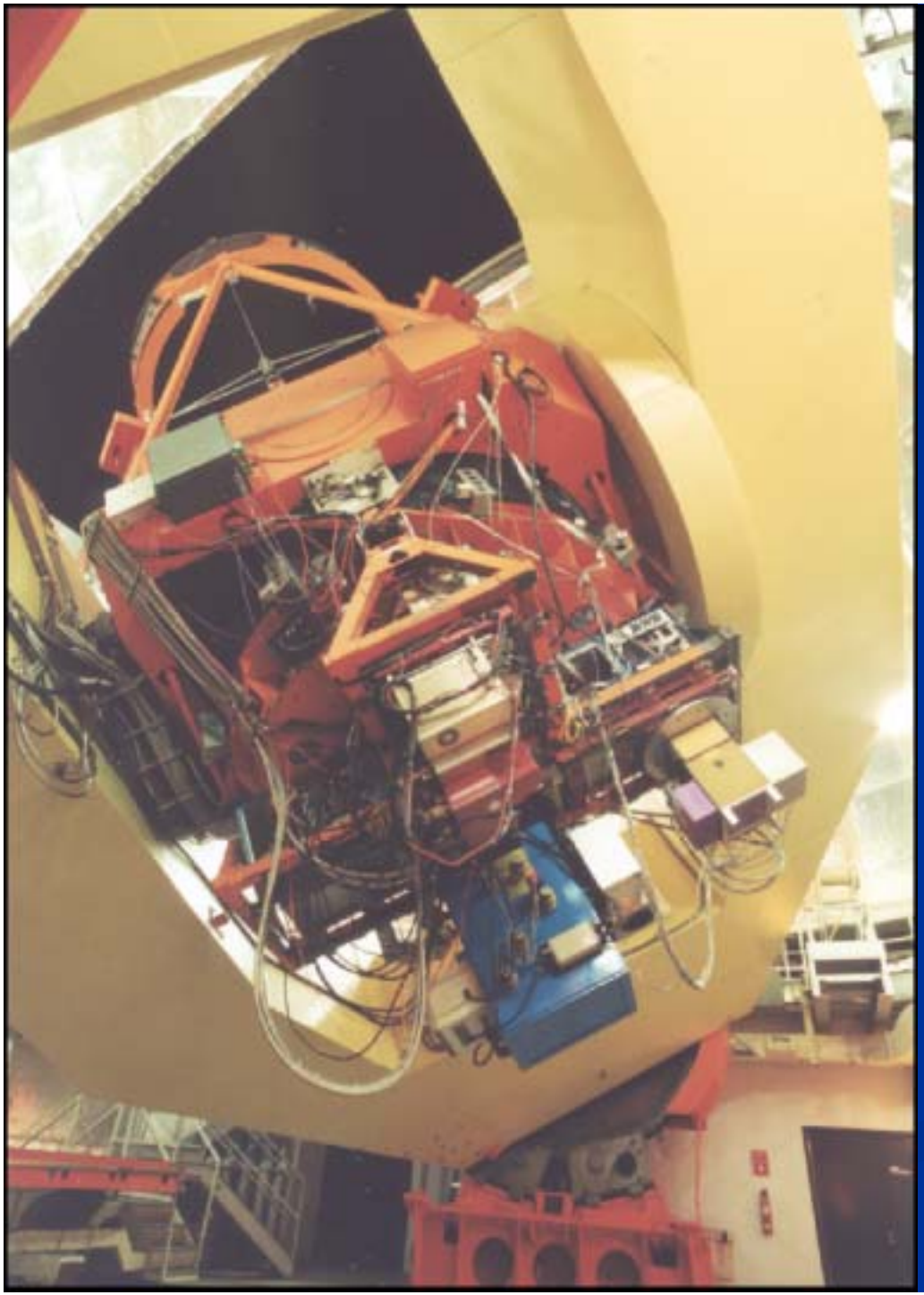
About the IRTF

- Completed in 1979. Operated by the Institute for Astronomy, Univ. of Hawaii, under a Cooperative Agreement with NASA.

- Operated as a national facility for the planetary and infrared astronomy communities in the US.

- Dedicated to planetary astronomy. 50% of telescope time allocated to solar system research. Provides basic research in planetary science and mission support.

- Recent instrumentation upgrades allow physical studies of asteroids and rapid follow-up of newly discovered NEOs.



IRTF Planetary Research

- Determine sizes of NEOs and asteroids.
- Determine the surface composition of NEOs and asteroids.
- Determine the composition of comets.
- Observe composition of the atmospheres of Mars, Jupiter, and Saturn.
- Measure the energy output of the volcanoes of Io, a satellite of Jupiter.
- Study the surface composition and clouds of Titan, a satellite of Saturn.
- Observe auroral processes in the outer planets.
- Search for spectral signatures from extrasolar planets.

Heat Removal & Electronics Relocation

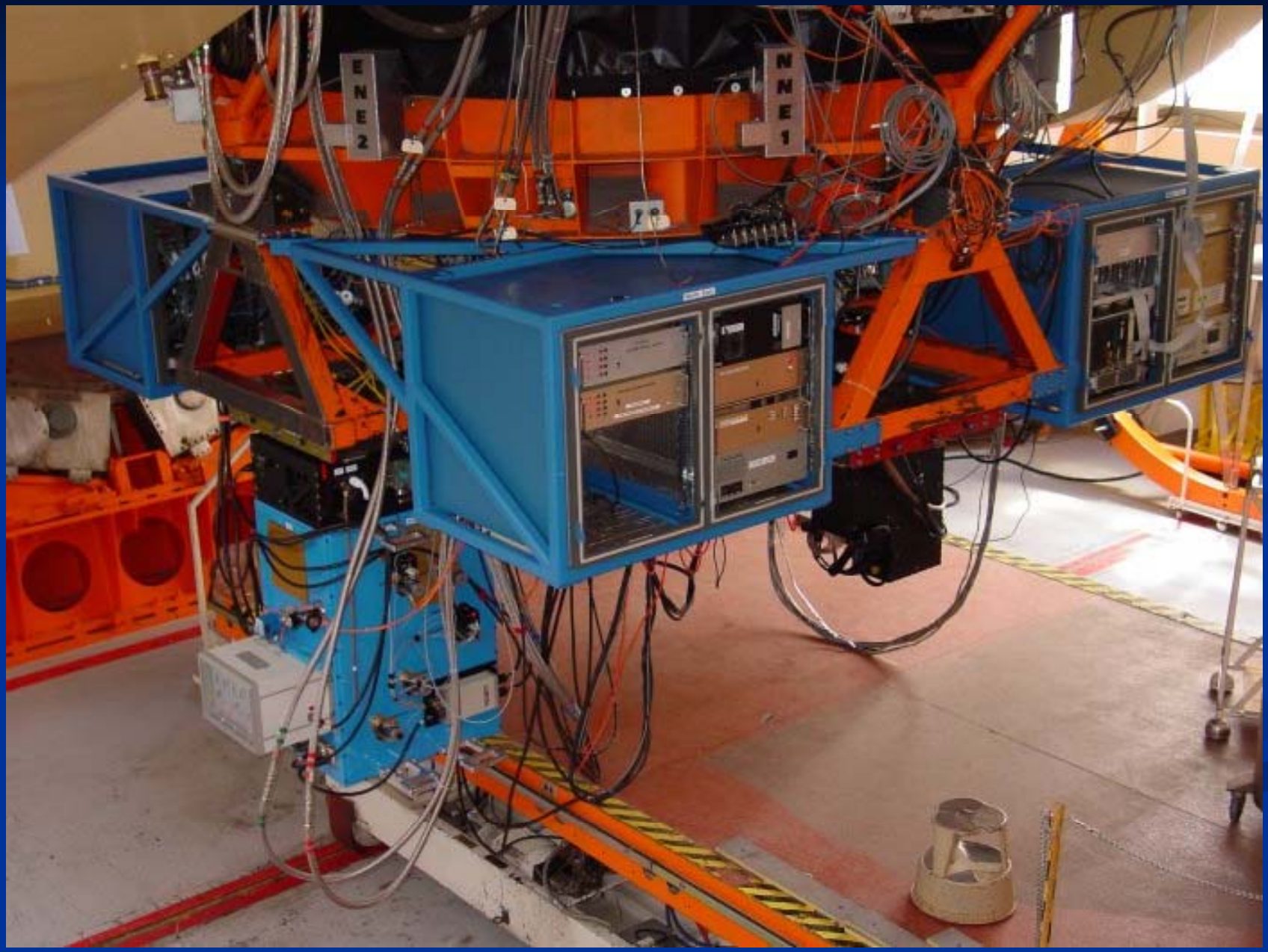
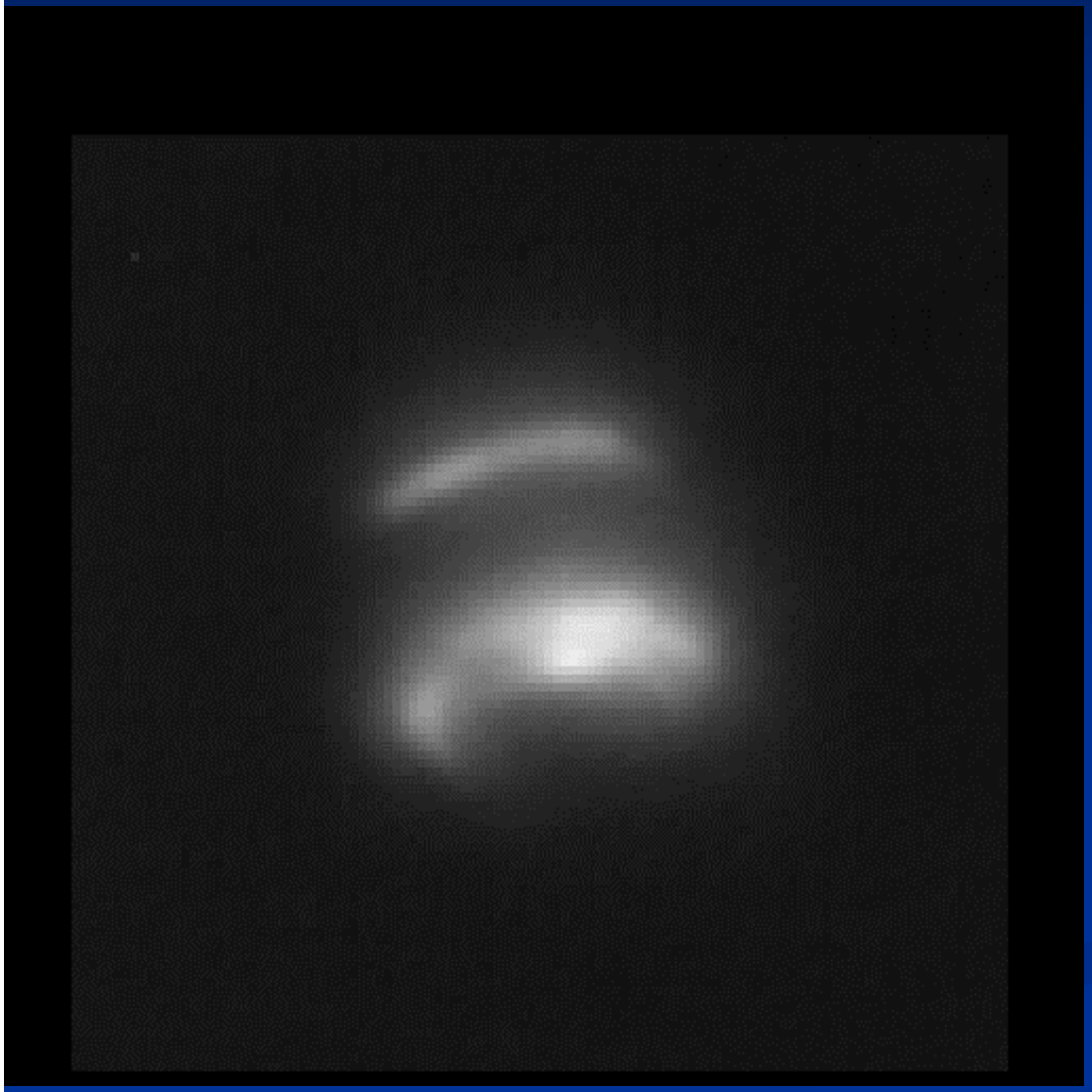


Image Quality Improvement

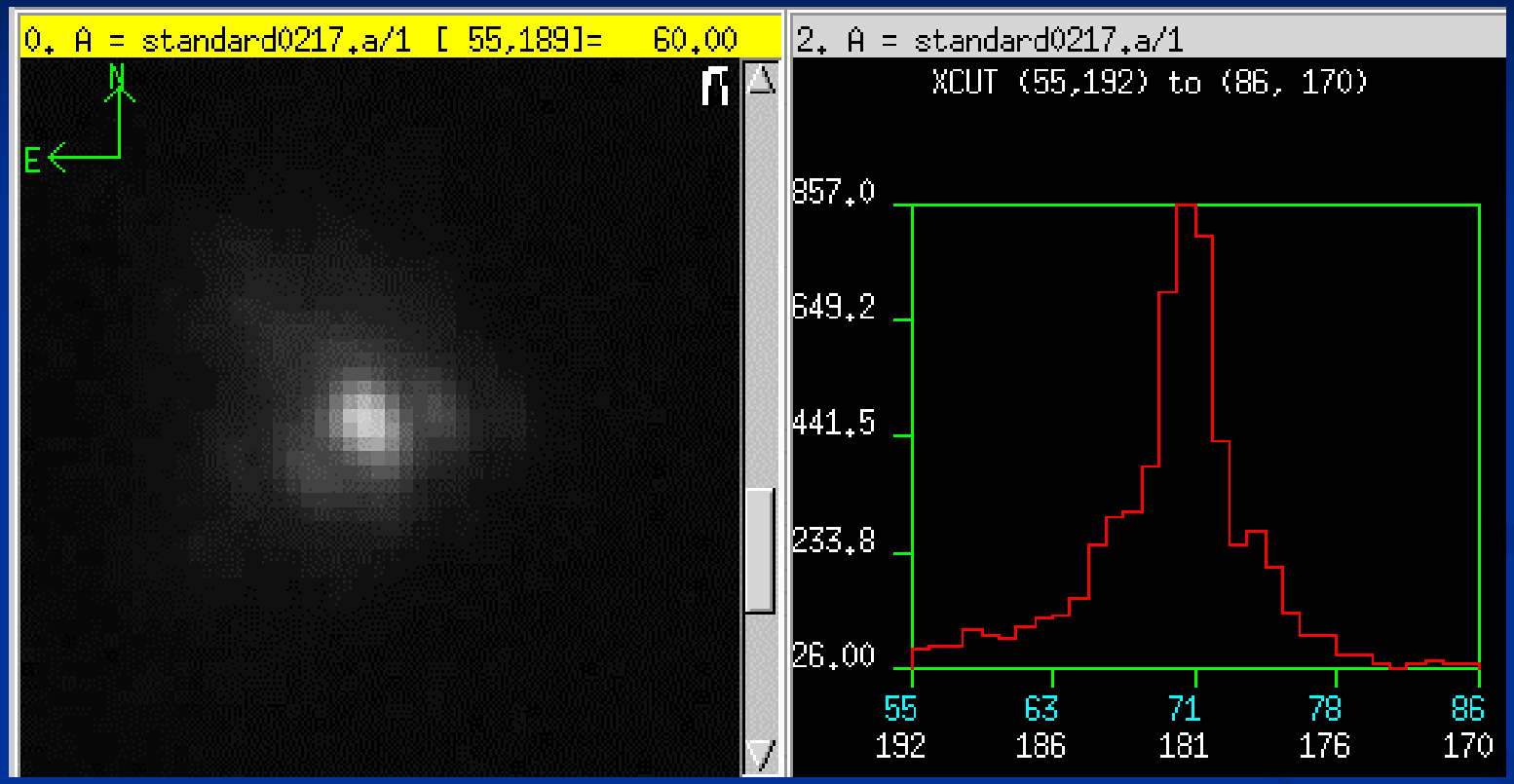


Data obtained on Neptune during July 2002 engineering Run by Toomey.

K' at 0.056"/pix, <u>without AO</u>

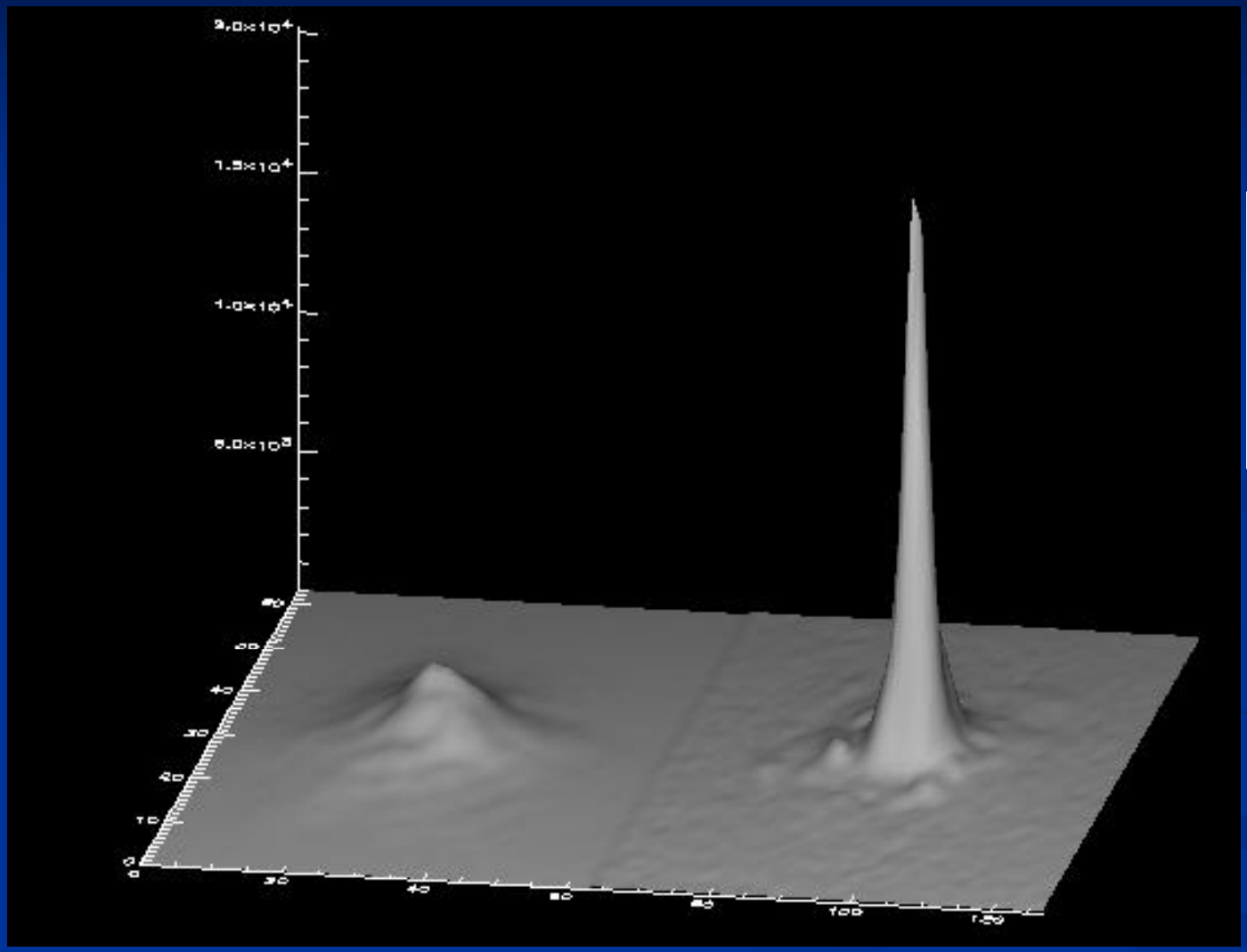
The FWHM of the northern (top) cloud ring is 0.25"

Image Quality Improvement



K' at 0.056"/pix, <u>without AO.</u> FWHM of the core is about 3-4 pixels, i.e. 0.2". (λ/D=0.15" at 2.2 microns).

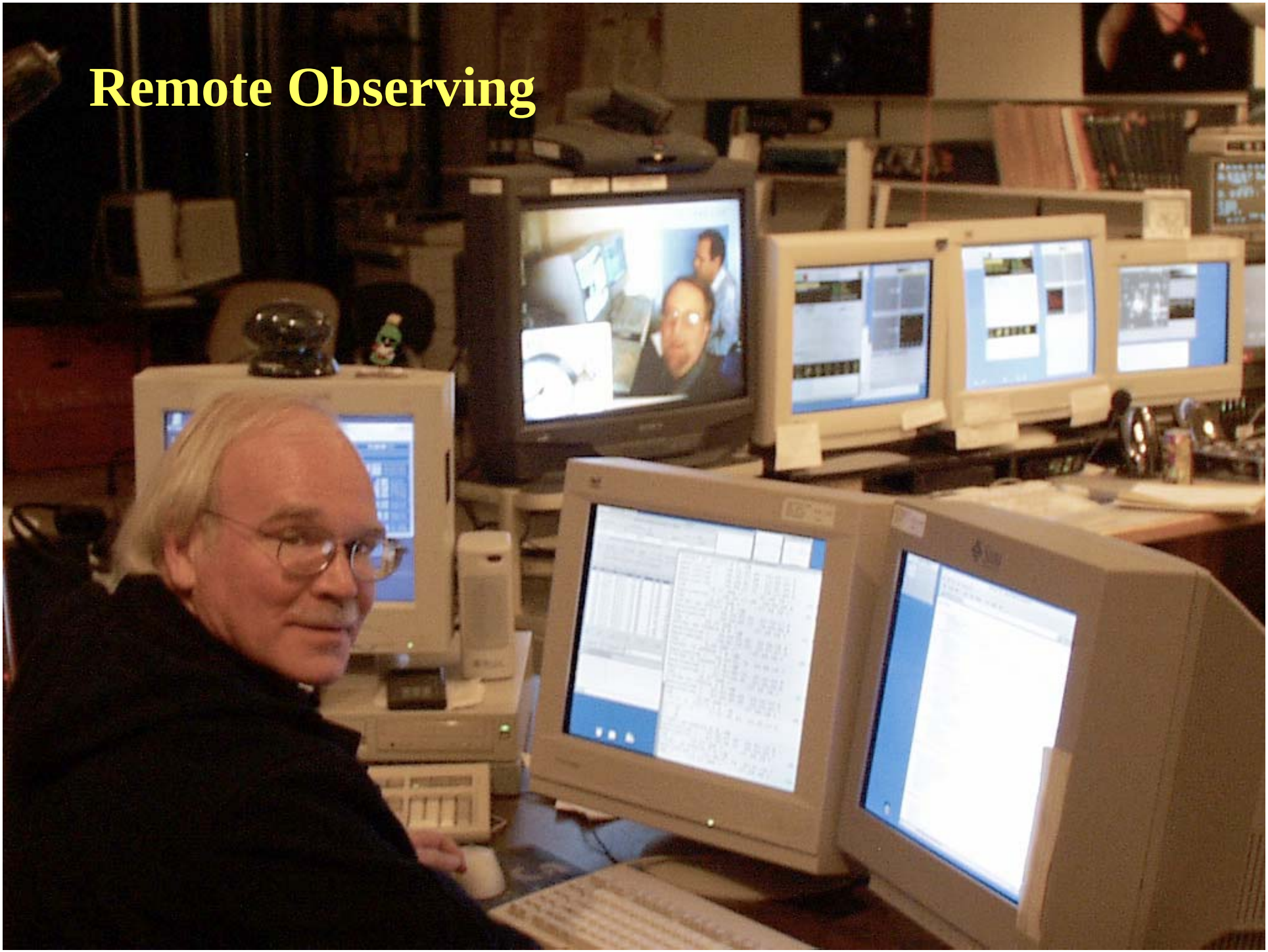
Instrument Status - Adaptive Optics



30 second integration
At K (2.2 microns).

FWHM=0.18 arcsec
0.056 arcsec/pixel

Remote Observing



Remote Observing Sites
(as of August 2002)

- Manoa
  Hilo
  HP

- Paris

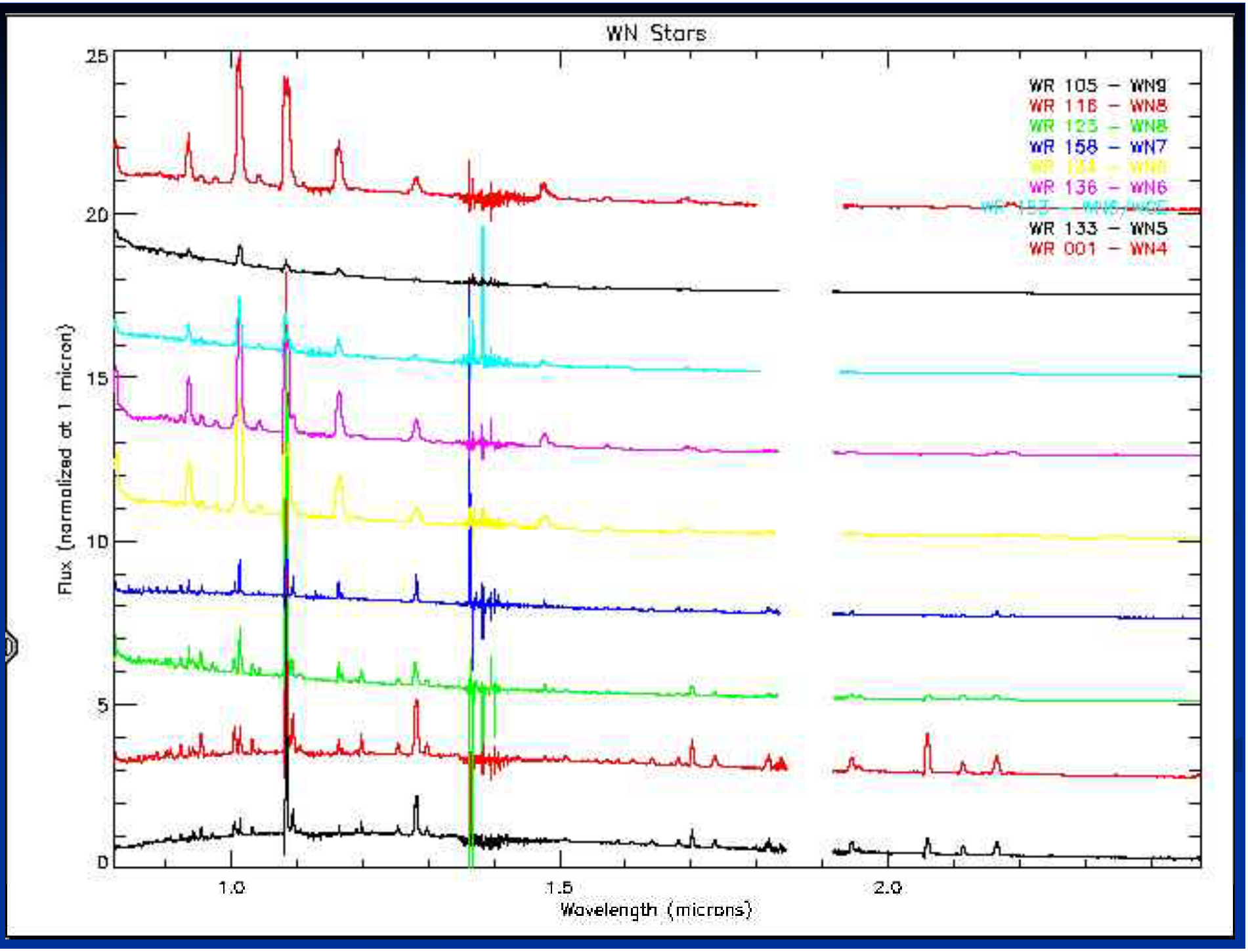
Instrumentation & Recent Science Highlights

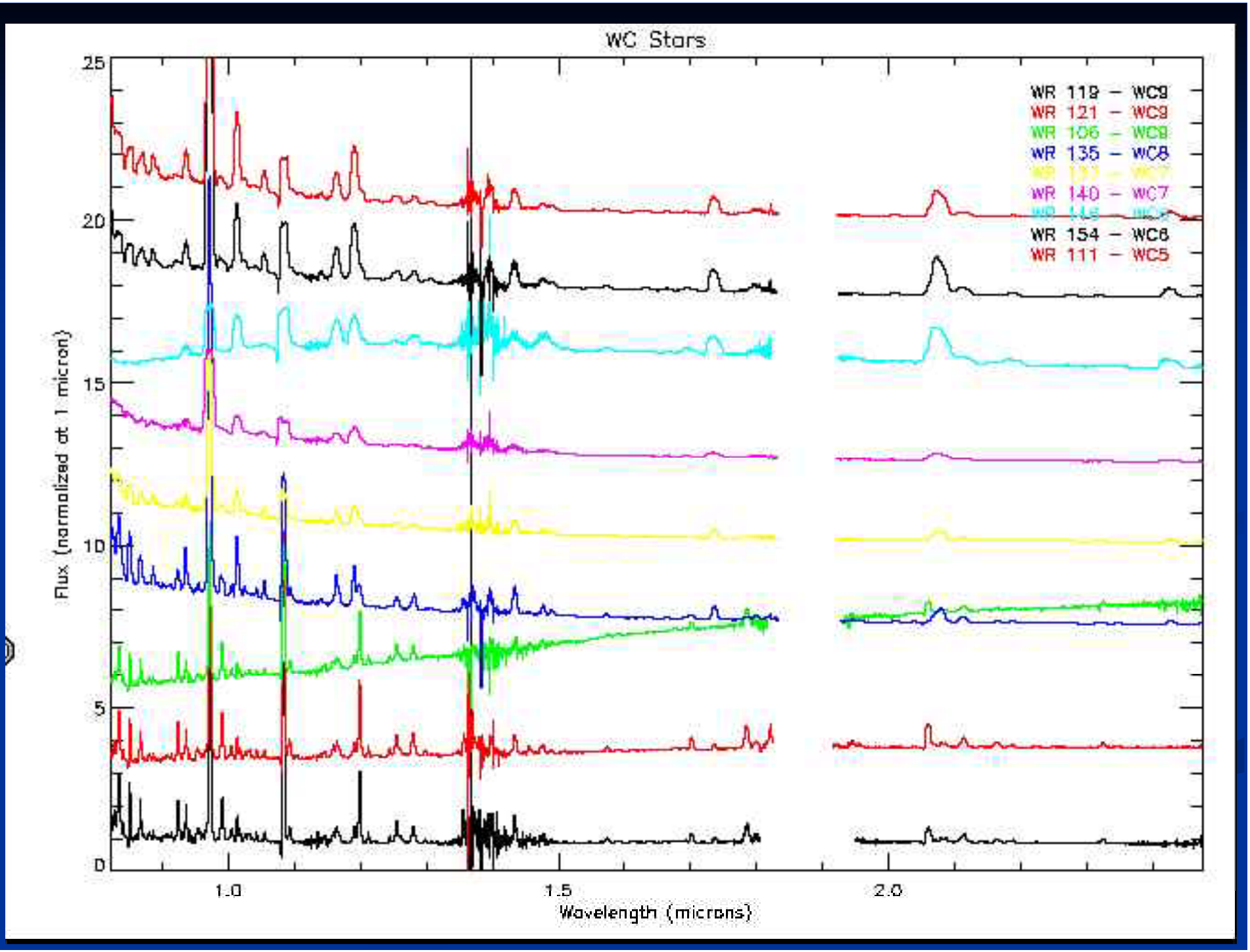
SpeX

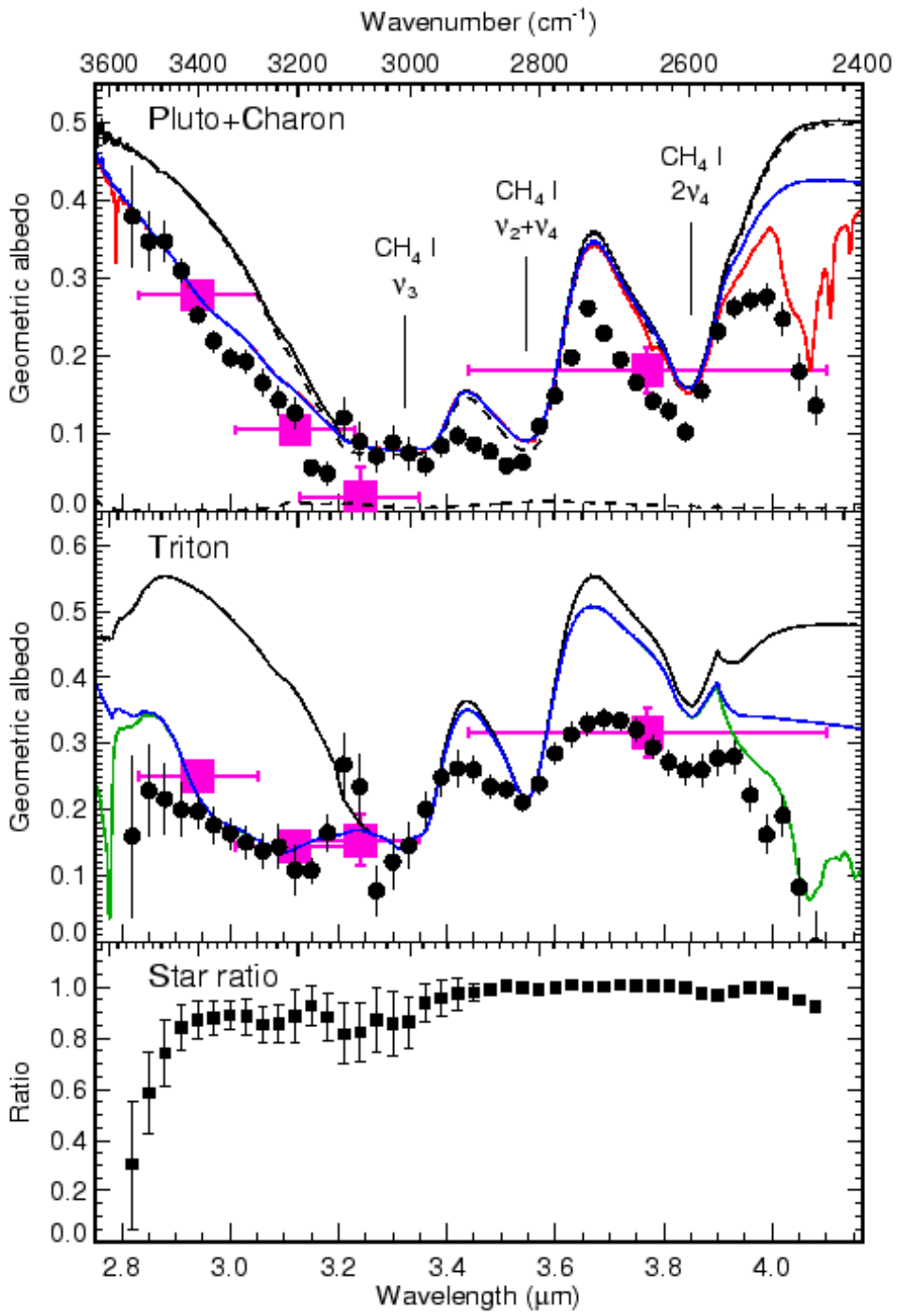
0.8-5.4 Micron Medium-Resolution Spectrograph and Imager

IRTF Near-Infrared Spectral Atlas. I. Wolf-Rayet Stars

William D. Vacca, John T. Rayner, and Michael C. Cushing


WN Stars
WR 105 – WN9
WR 116 – WN8
WR 123 – WN8
WR 158 – WN7
WR 136 – WN6
WR 133 – WN5
WR 001 – WN4
Flux (normalized at 1 micron)
Wavelength (microns)
0
5
10
15
20
25
1.0
1.5
2.0


WC Stars
WR 119 – WC9
WR 121 – WC9
WR 106 – WC9
WR 135 – WC8
WR 140 – WC7
WR 154 – WC6
WR 111 – WC5
Flux (normalized at 1 micron)
Wavelength (microns)
0
5
10
15
20
25
1.0
1.5
2.0



IR Spectroscopic Monitoring of Pluto

W. Grundy and W. Buie

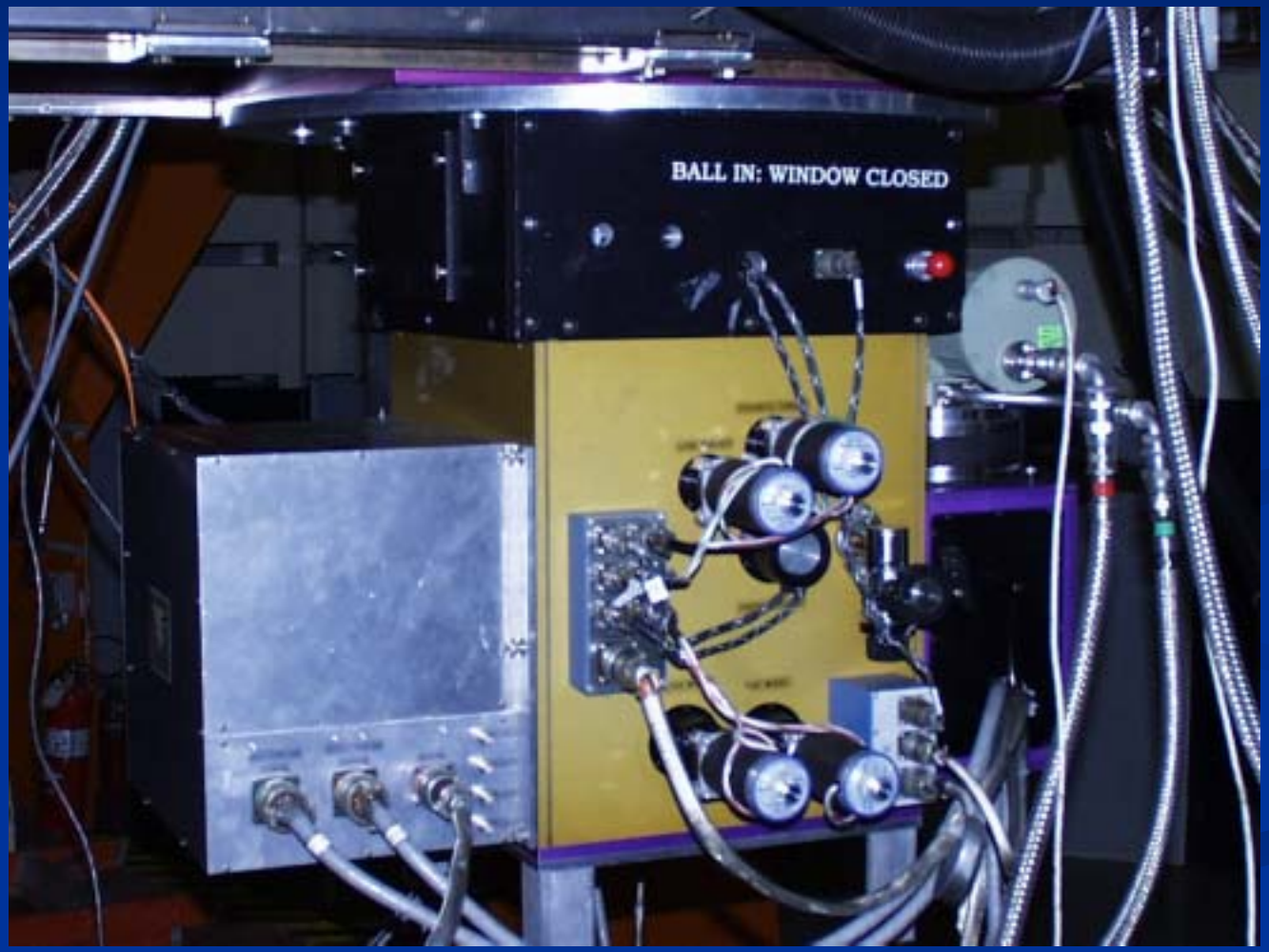
Black curve: published models, showing too much reflectance near 3.0 and 4.0 microns.

Blue curve: models having additional water ice added.

Red curve: add SO_2 ice (Pluto only).

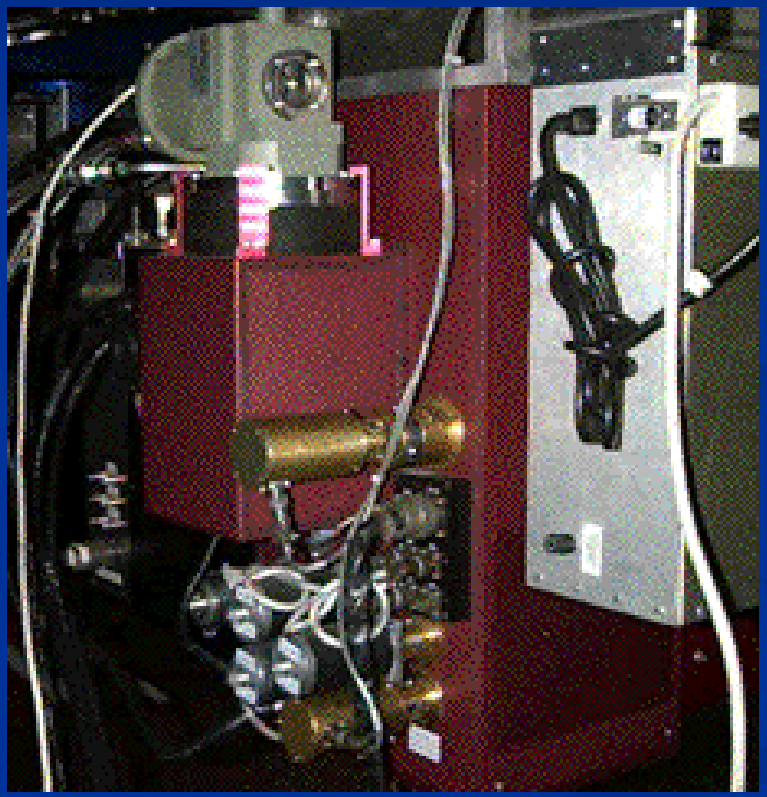
Green curve: add CO_2 ice (Triton only).

NSFCAM, a 1-5.5 micron Camera

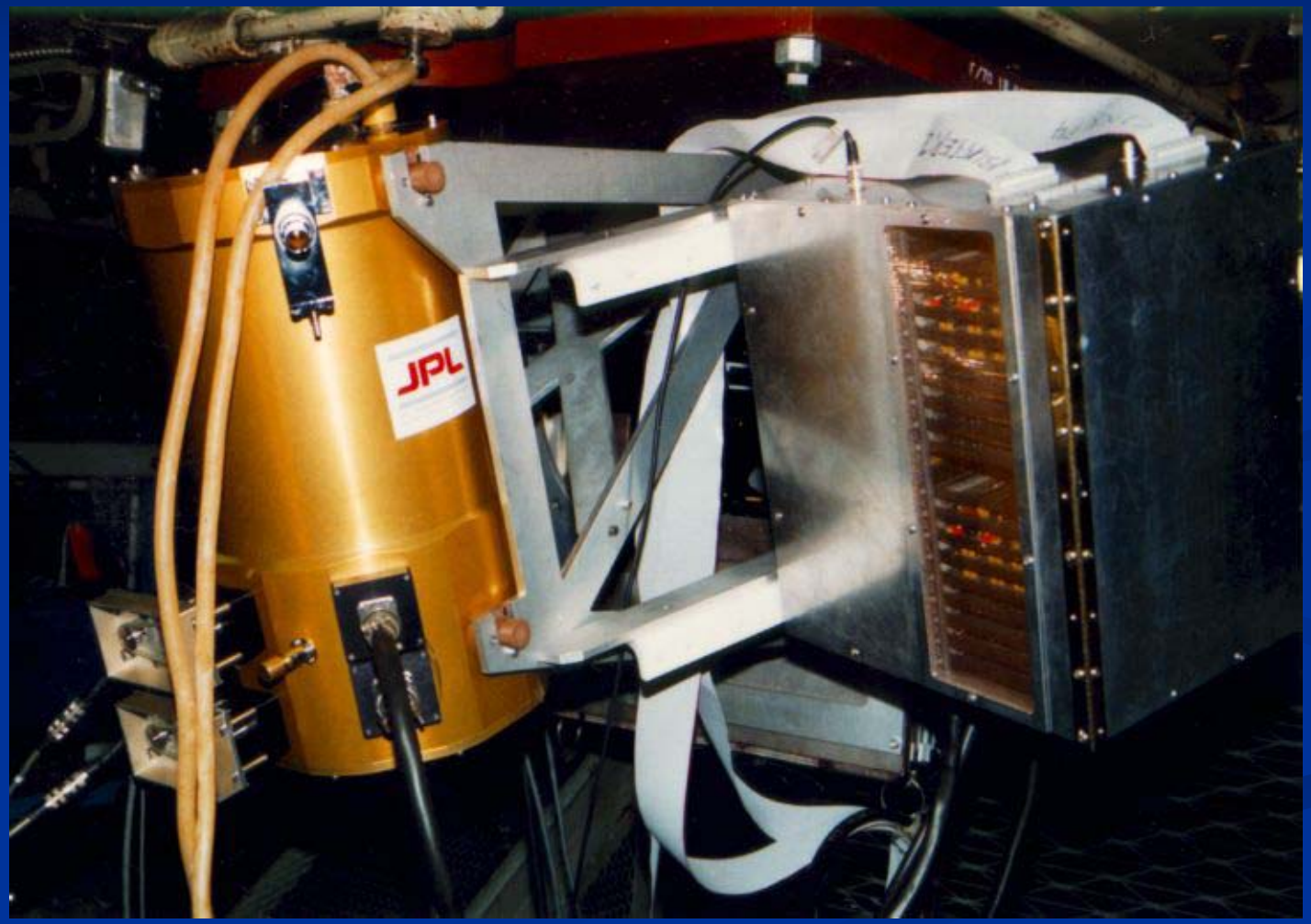


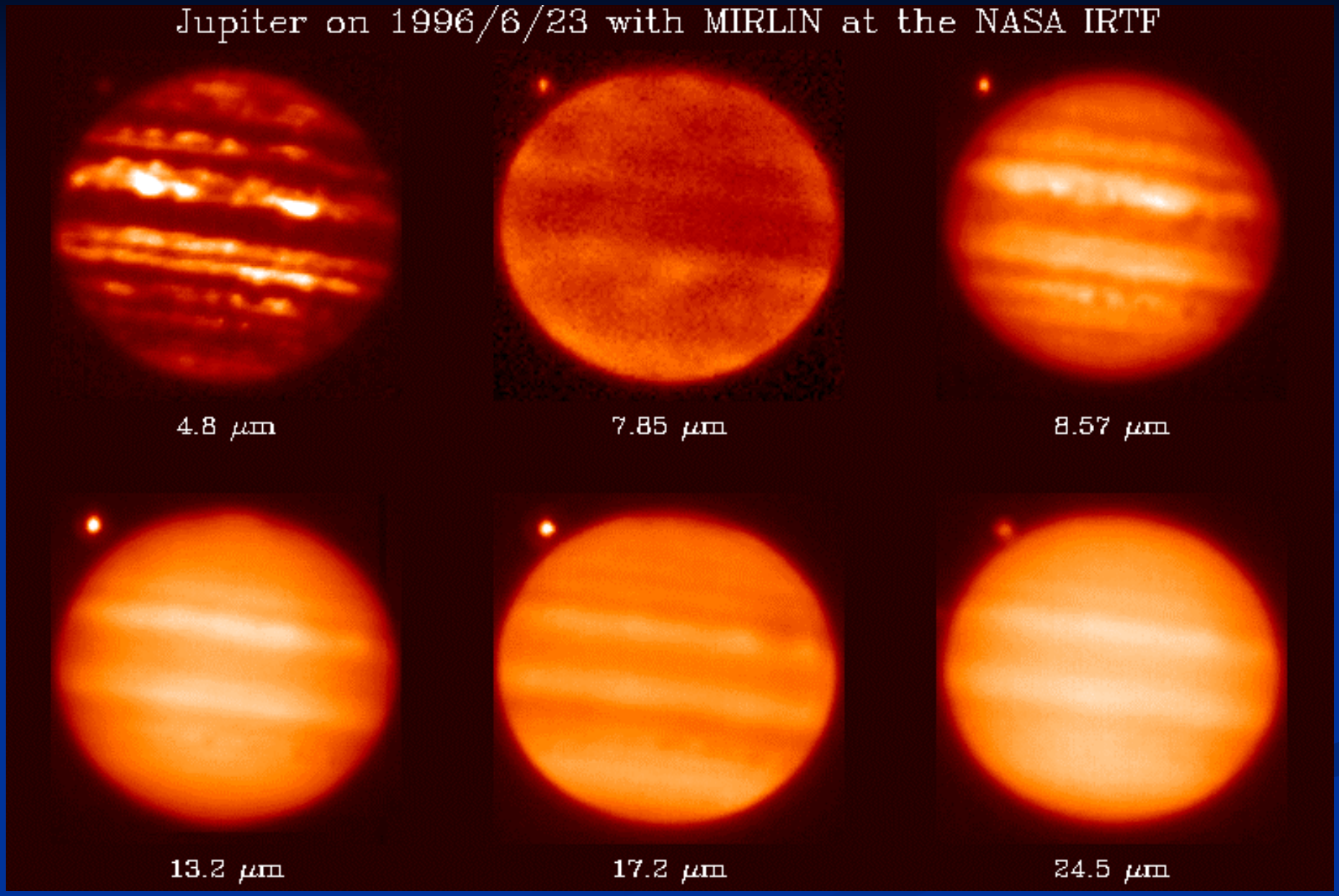
CSHELL

Cryogenic Near-IR Facility 1.5 – 5.5 micron Spectrograph



Mid-InfraRed Large-well Imager MIRLIN




Jupiter on 1996/6/23 with MIRLIN at the NASA IRTF
4.8 μm
7.85 μm
8.57 μm
13.2 μm
17.2 μm
24.5 μm

Saturn

July, 1995
(12.5, 17.9, 24.5 μm)

November, 1997
(12.5, 18.7, 24.5 μm)

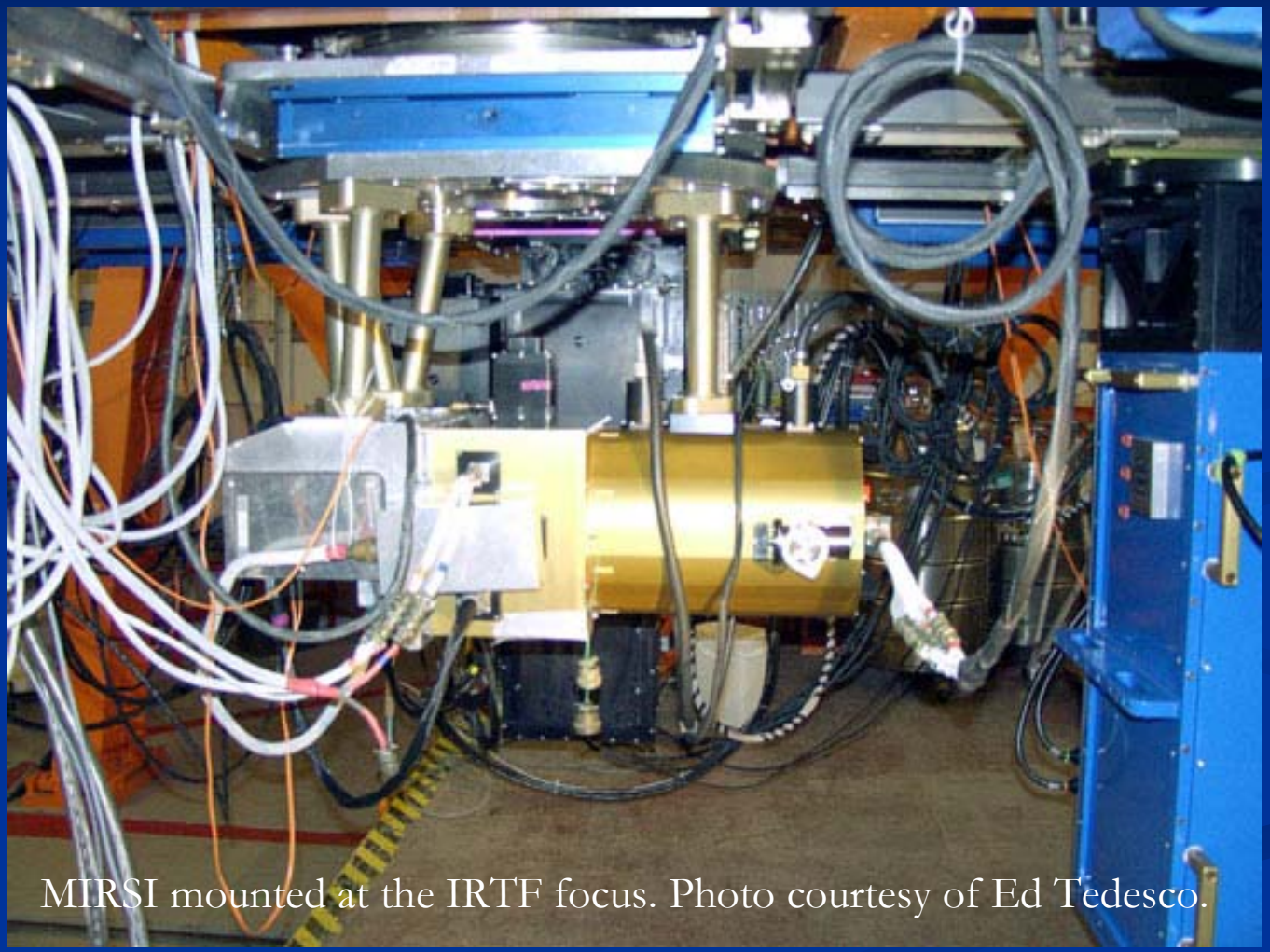
JPL

MIRLIN

Mid-Infrared Observations of the Orion Bar

MIRSI instrument team:
PI L. Deutsch, Co-I J. Hora, J. Adams, M. Kassis

Mid-InfraRed Spectrometer and Imager (MIRSI)



MIRSI mounted at the IRTF focus. Photo courtesy of Ed Tedesco.

MIRSI website: http://mirador.bu.edu/mirsi/mirsi.html

Figure 1.

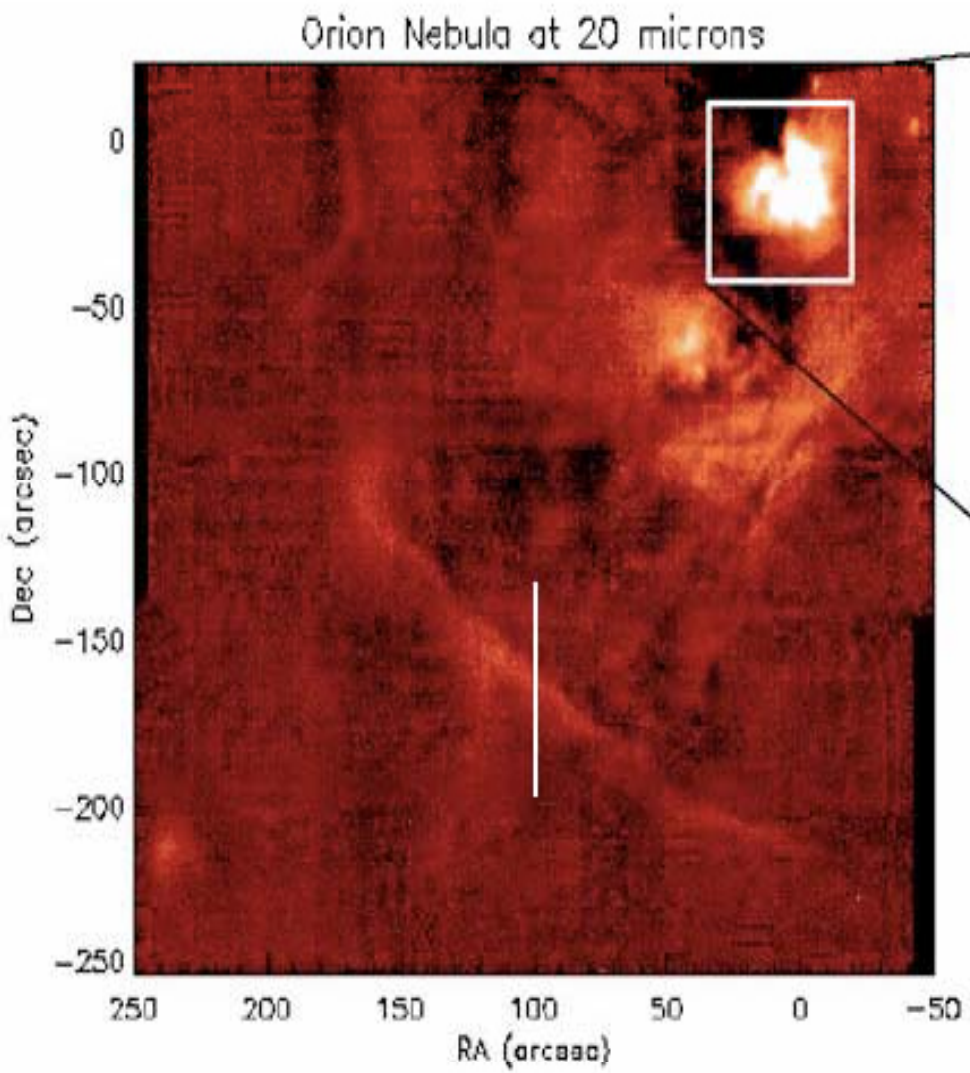


Figure 2.

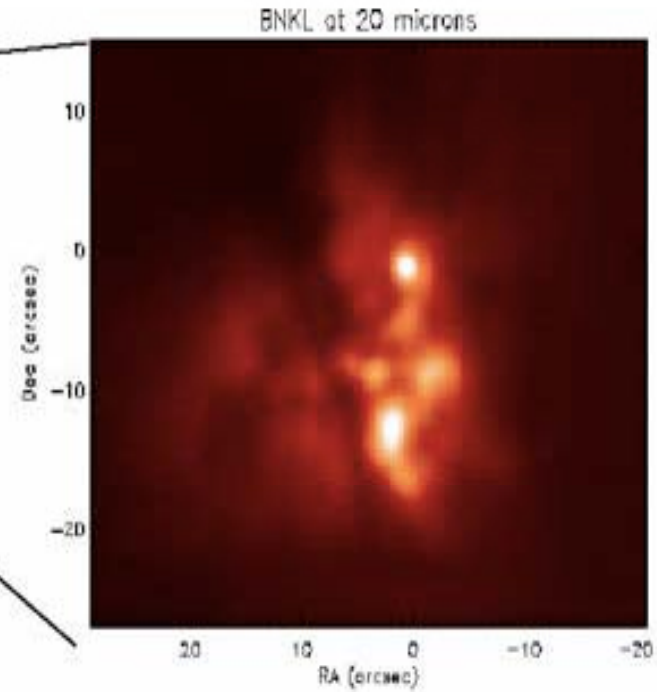
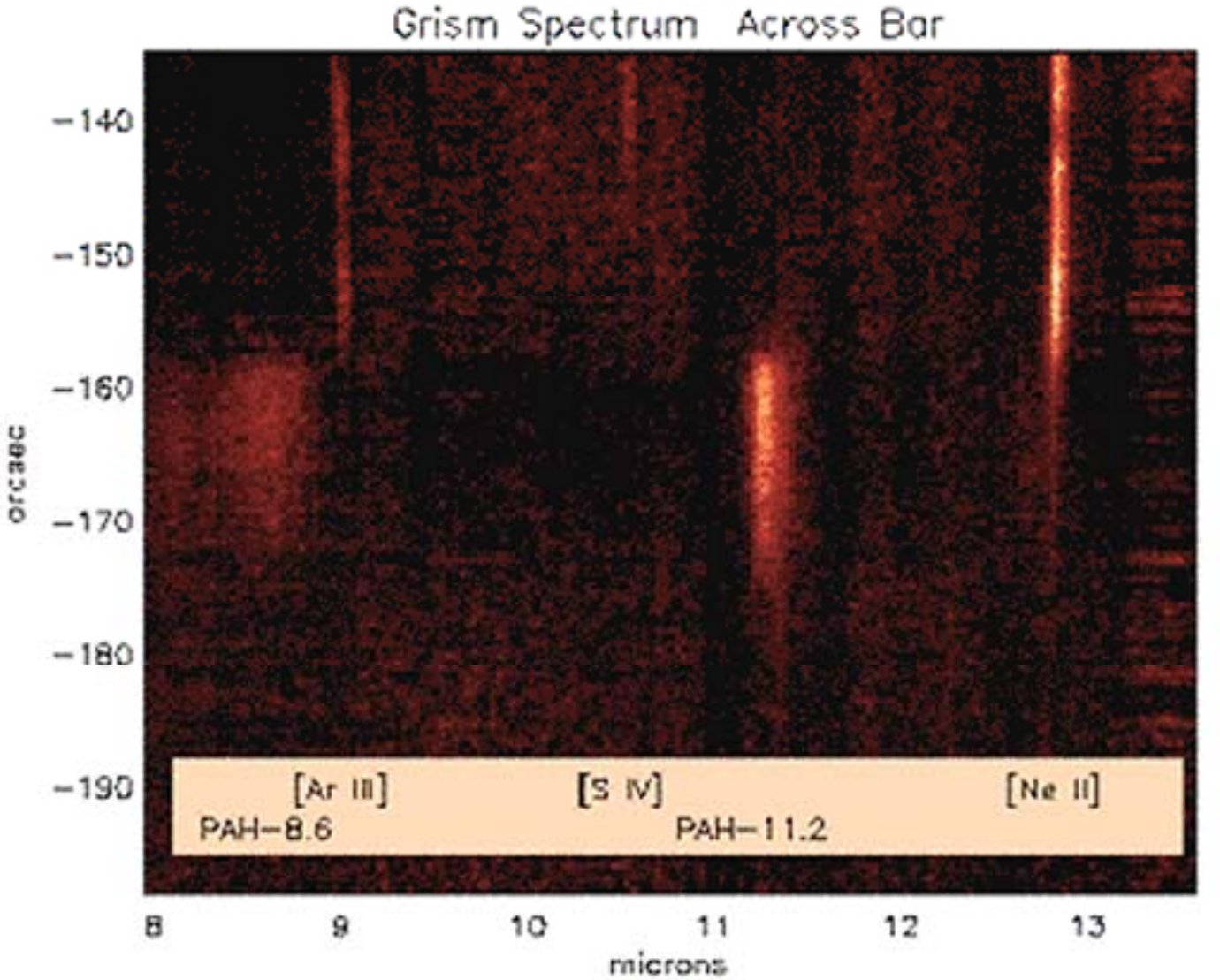


Figure 3.

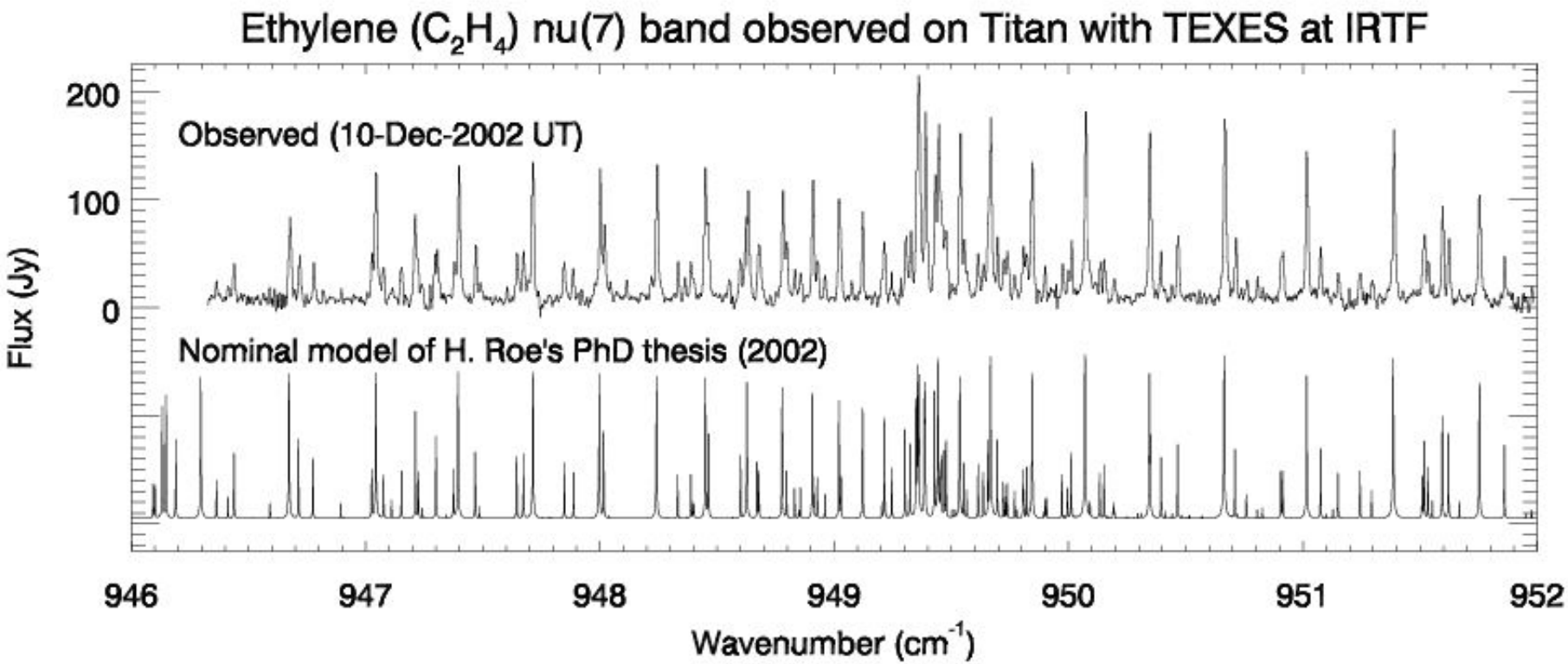

Grism Spectrum Across Bar
−140
−150
−160
−170
−180
−190
arcsec
[Ar III]
PAH−8.6
[S IV]
PAH−11.2
[Ne II]
8
9
10
11
12
13
microns

Spectroscopy of Titan's Atmosphere with Texas Echelon Cross Echelle Spectrograph (TEXES)

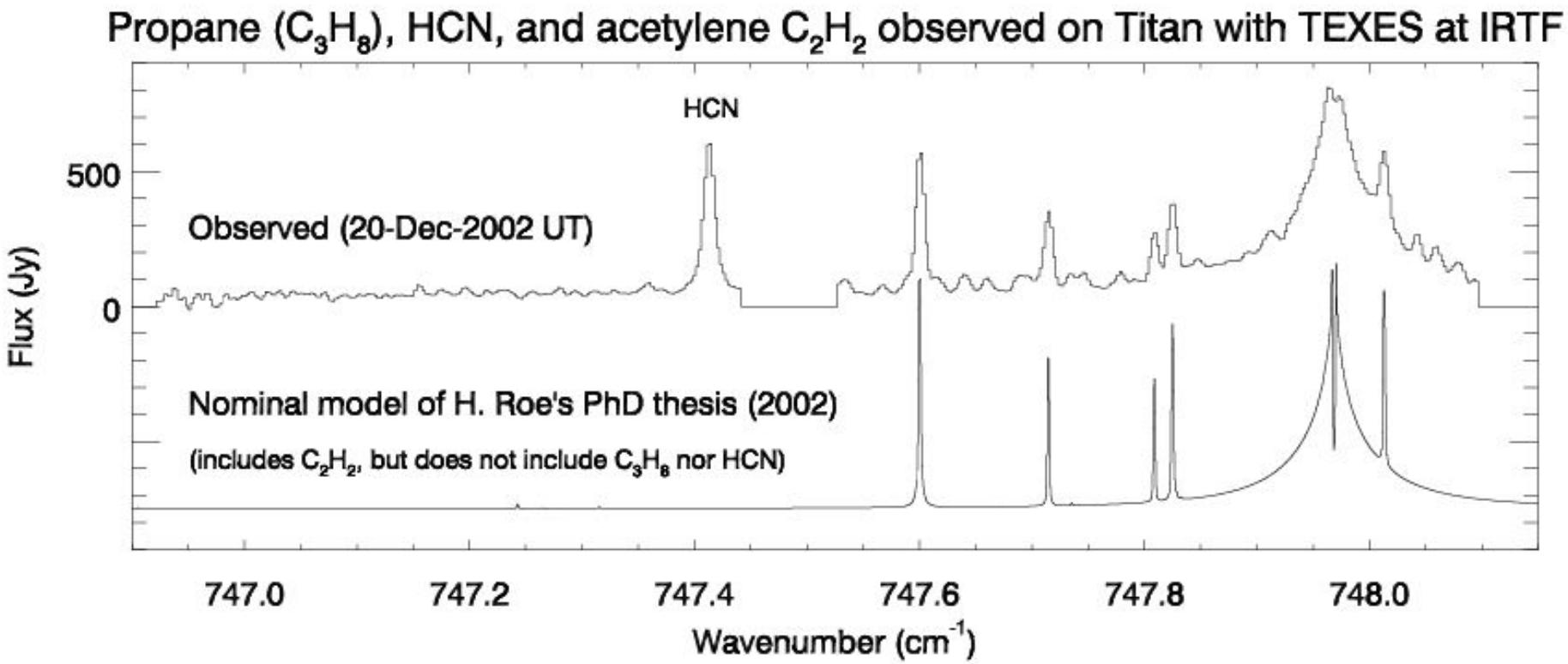
H. Roe (CalTech), T.Greathouse (Univ. of Texas),

M.Richter (UC Davis), J.Lacy (Univ. of Texas)

Titan's Atmosphere

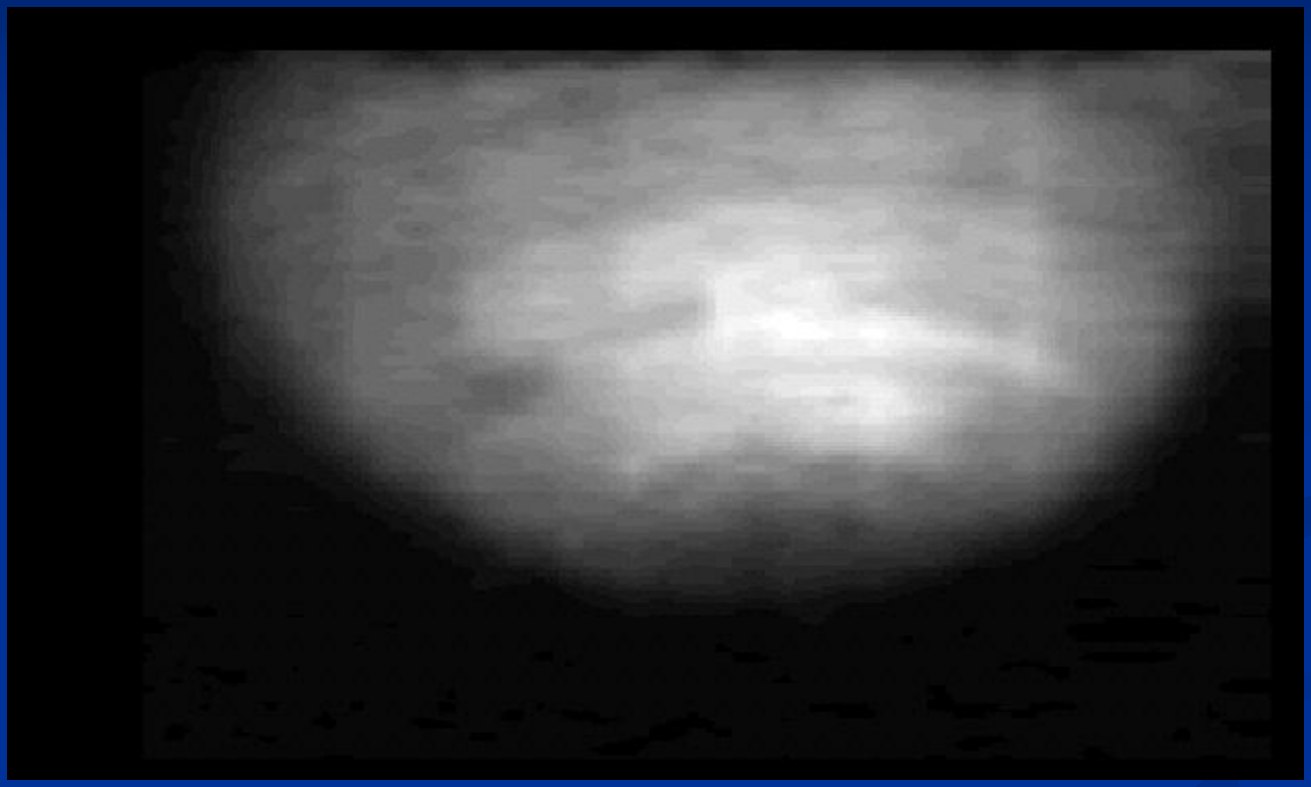


Titan's Atmosphere



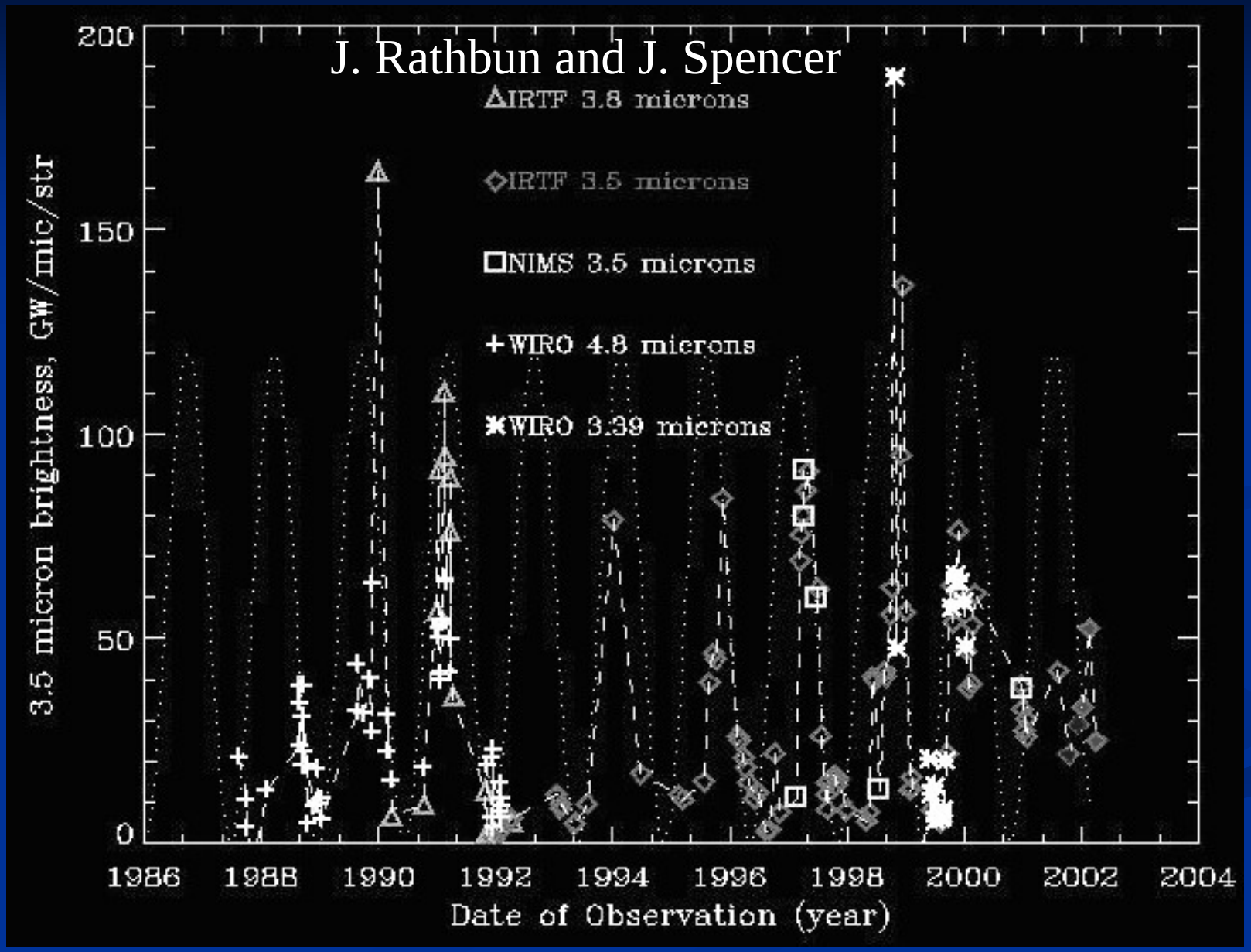
Cold Spots on Saturn

P. Yanamandra-Fisher, G. Orton, J. Rayner



5.20 microns, PH_3 absorption

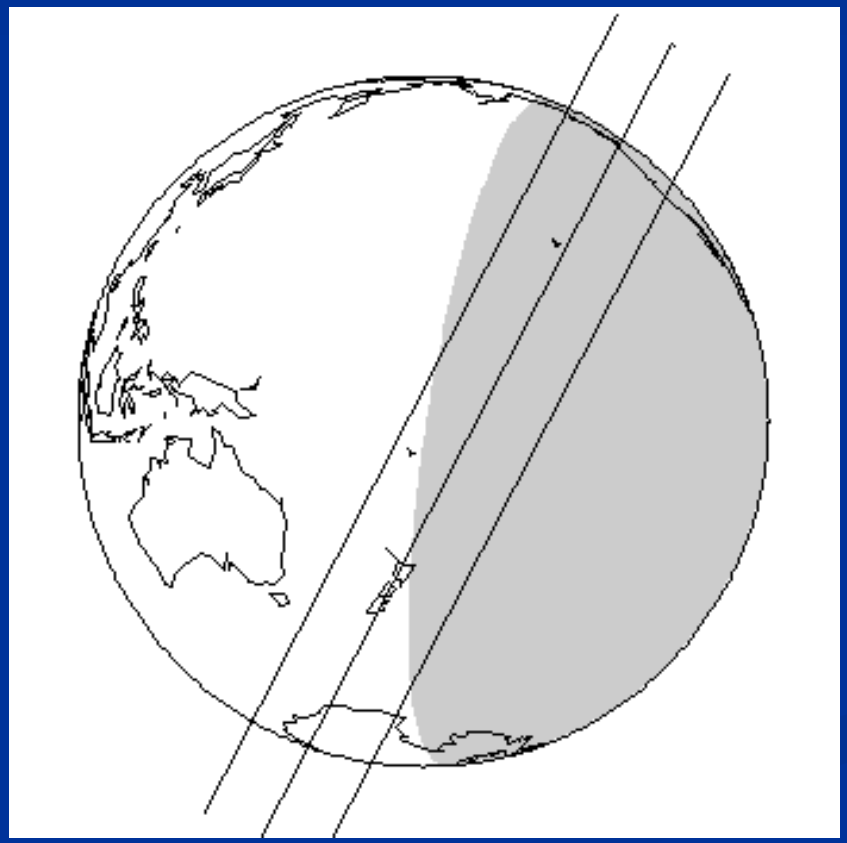
Lava Lakes on Io



PLUTO'S ATMOSPHERE, FOURTEEN YEARS LATER

(SpeX Observations of Pluto Occultation 2002 Aug. 21 UT)

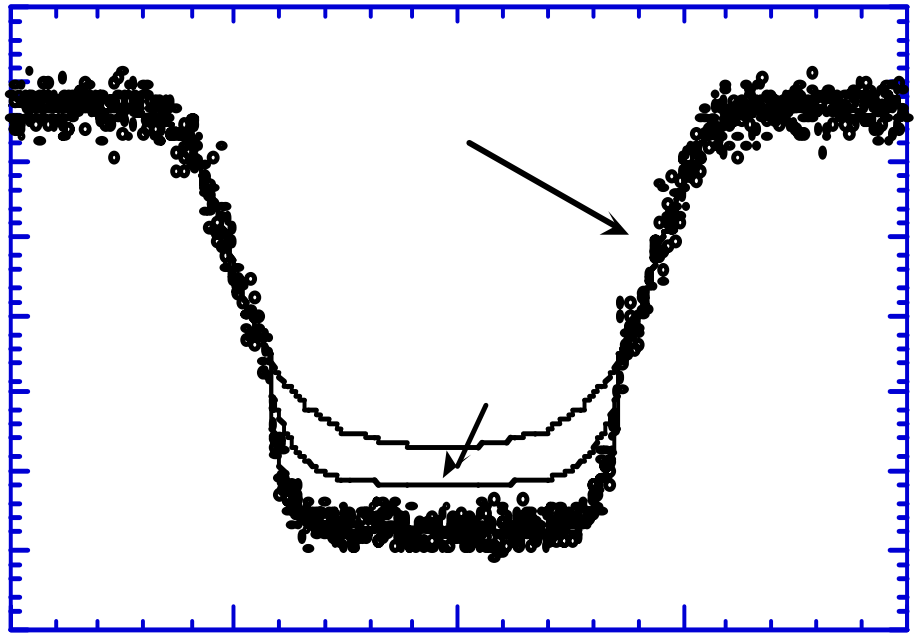
Jim Elliot, Dave Tholen, Mike Person, John Rayner



2002 08 21 06:59:41 UT

Globe of the Earth depicting the path of Pluto's shadow for the occultation of the K = 13.3 magnitude star on 2002 August 21. The three lines indicate the path of Pluto's shadow (moving from the upper right to lower left of the figure).

Pluto Occultation of P131.1

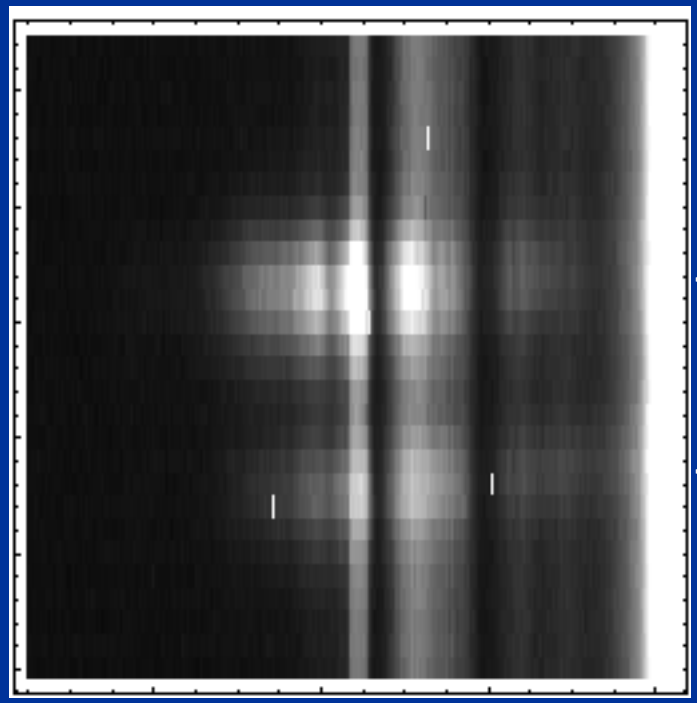


SPECTRA OF PLUTO-CHARON AND P131.1
(SpeX in Single-Prism Mode at IRTF; ~0.5" seeing)

(a) PRIOR TO OCCULATION
(separation about 1.5 arc sec)

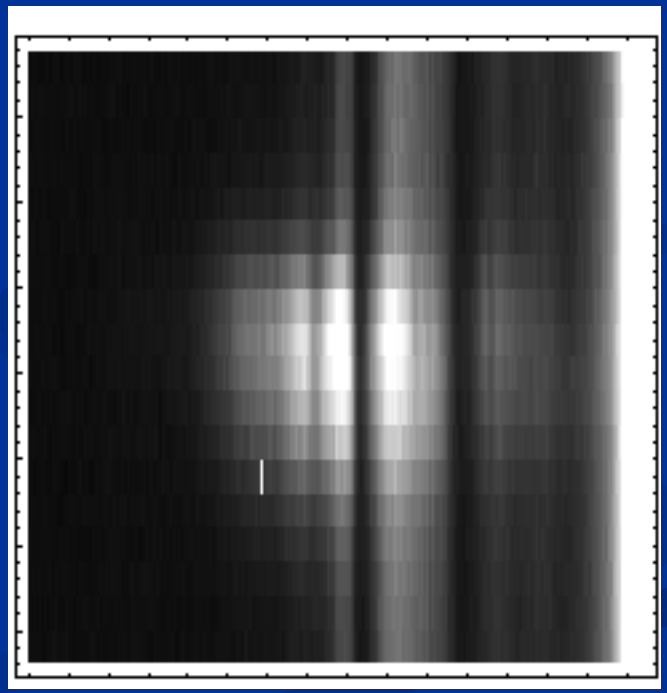
(b) SPECTRA MERGED

Distance along Slit —>



<—Pluto-Charon

<—Star (P131.1)



Distance along Slit —>

Wavelength Increasing —>
(0.8 to 2.5 µm)

Wavelength Increasing —>
(0.8 to 2.5 µm)

Alan Tokunaga <tokunaga@IfA.Hawaii.Edu>