


Jim's Mentorship through Instrument Building: the example of CorMASS



John C. Wilson
Univ of Virginia

men·tor·ship

/ˈmentôrSHɪp, ˈmentərSHɪp/ 

noun

the guidance provided by a mentor, especially an experienced person in a company or educational institution.

"he is revered by his employees for his mentorship and problem-solving qualities"

- a period of time during which a person receives guidance from a mentor.
"a two-year mentorship with an entrepreneur in a tech start-up"

Mentorship in Astronomy Instrumentation

- Particularly necessary for the transfer of the `tacit knowledge` --- a large part of instrument building
- Includes transfer of knowledge from expert staff in the various trades of instrument building --- mechanics, optics, cryogenics, vacuum, electronics, computers, control systems, etc.
- An apprentice period in which students get comprehensive hands-on experience building instruments and use them at the telescope to do science
 - Jim provided many of these experiences for his students, often giving them plenty of `rope to hang themselves`



[International Journal of Infrared and Millimeter Waves](#)

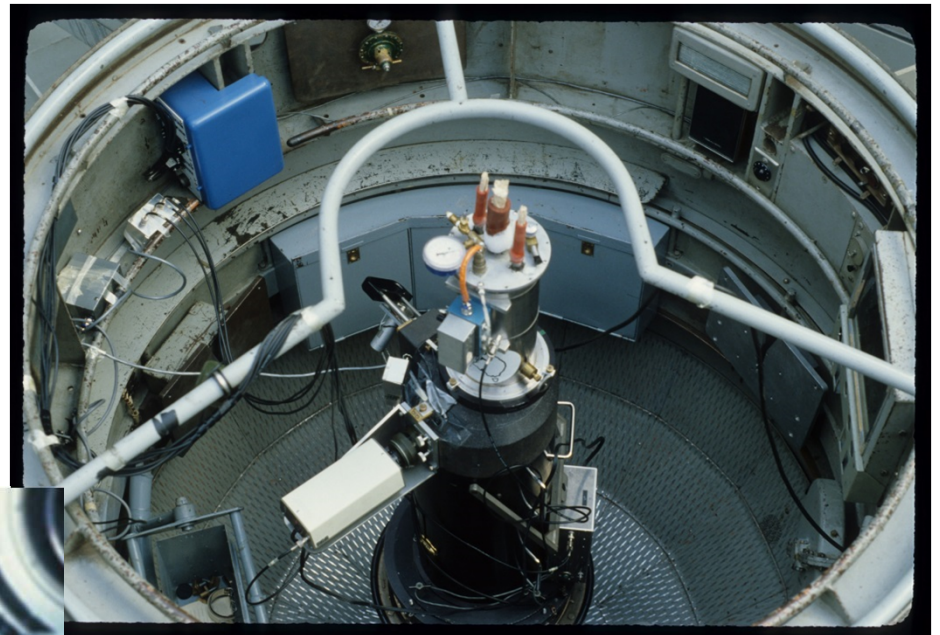
May 1983, Volume 4, [Issue 3](#), pp 299-309

A helium-3 cooled bolometer system for one millimeter continuum observations

Authors

[Authors and affiliations](#)

Thomas P. L. Roellig, James R. Houck



Photos Courtesy of T. Roellig

“I decided to try putting the airborne spectrometer HIRES on the Hale Telescope to measure fine structure lines in AGN ... After some initial discussions, he pretty much left me alone to design and implement it. Looking back I realize that Jim was very good at walking the fine line between allowing a student to learn from their mistakes yet intervening in time to allow the project to succeed.”

“I had designed (and machined myself) this Rube Goldberg like mounting for the instrument ... So I was surprised to find that Jim had realized the mount wasn't going to keep the instrument aligned as the telescope attitude changed. He quietly went and found some angle irons, cut them to length and fixed my mount thereby saving the observing run.”

Neil Rowlands
HIRES on Hale Telescope



Photo Courtesy of N. Rowlands

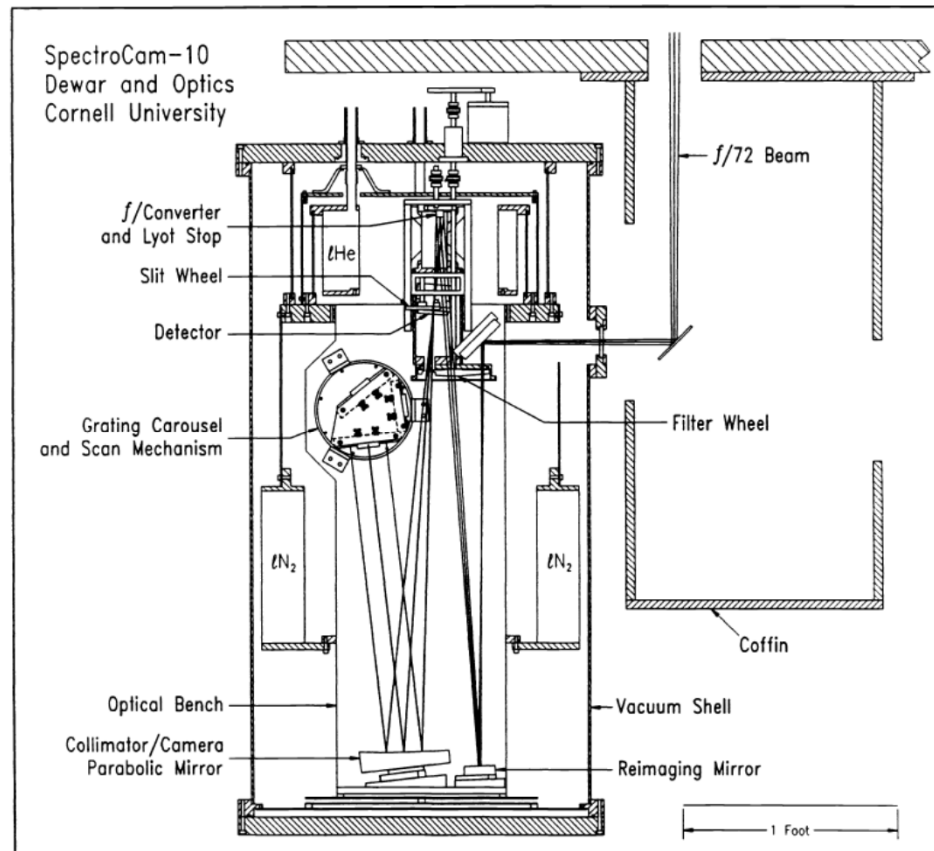
SpectroCam-10: A 10 micron spectrograph/camera for the Hale telescope

T.L. Hayward, J.W. Miles, J.R. Houck,
G.E. Gull, and J. Schoenwald

Center for Radiophysics and Space Research
Cornell University, Ithaca, NY 14853

ABSTRACT

SpectroCam-10 is a 10 μm spectrograph and camera built at Cornell University as a facility instrument for the 200 inch Hale telescope. The instrument is optimized for operation from $\lambda = 8$ to 13 μm in three modes: a medium-resolution spectrograph ($R \equiv \lambda/\Delta\lambda \approx 2000$), a low-resolution spectrograph ($R \approx 100$), and a camera with diffraction limited (0.5 arcsec) spatial resolution. An optical flat and two reflection gratings mounted on a cryogenic rotating mechanism allow rapid switching between modes. The detector is a Rockwell 128 \times 128 Si:As Back Illuminated Blocked Impurity Band array. We discuss the design and operation of the instrument, and present some scientific results from our early observing runs at Palomar.



Hayward et al.
1993, SPIE, 1946,
334

SCORE: A Mid-Infrared Echelle Format Spectrograph with No Moving Parts

JEFFREY VAN CLEVE, G. E. GULL, S. A. RINEHART, J. D. SMITH, J. C. WILSON, J. R. HOUCK, AND MIKE COLONNO

Space Sciences, Cornell University, Ithaca, NY 14853

AND

R. BROWN AND W. BLALOCK

Ball Aerospace and Technologies Corporation, AR 1, 1600 Commerce Street, Boulder, CO 80306

Received 1998 February 2; accepted 1998 September 15

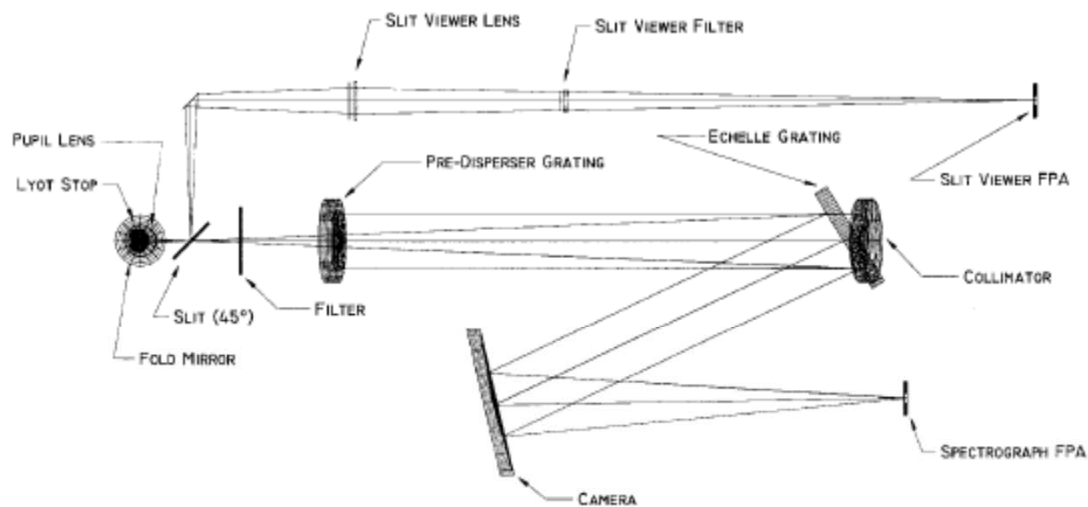


Fig. 2b

FIG. 2.—Optical ray-trace drawings of SCORE from two orthogonal views, the “top” view (a) and the “side” view (b). The telescope’s $f/72$ beam is converted to $f/10$ by a pair of lenses not shown here. These traces begin at the pupil produced by the f -converter.



Photos Courtesy of G. Gull

**PHARO (Palomar High Angular Resolution Observer):
A dedicated NIR camera for the Palomar adaptive optics system**

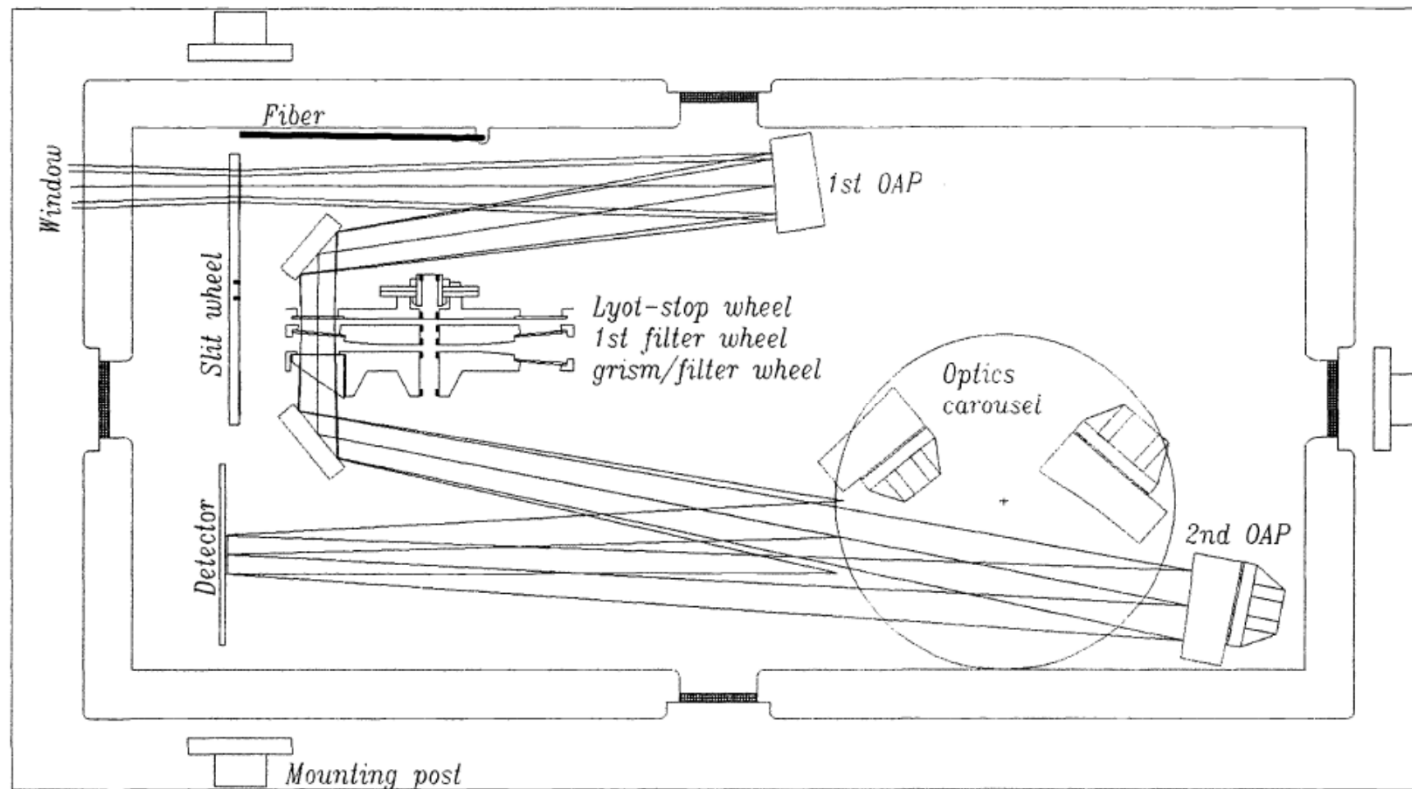
B. Brandl, T. L. Hayward, J. R. Houck, G.E. Gull, B. Pirger, & J. Schoenwald

Center for Radiophysics and Space Research
Cornell University

ABSTRACT

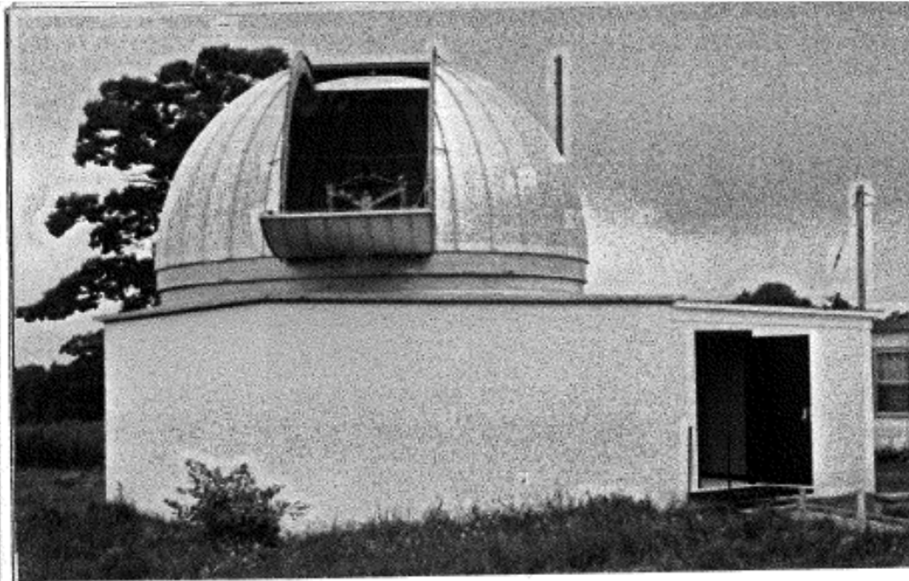
We describe Cornell's NIR camera system for the Hale 200" telescope adaptive optics system at Palomar Observatory. The instrument is under construction at this time, and we expect first light at the telescope in December 1997. Here we summarize the camera's design as well as its expected performance.

Keywords: Adaptive Optics, Instrumentation, NIR camera, grism spectroscopy, coronagraphy, HAWAII array



Cornell's 25-inch Training Telescope

J. R. HOUCK and G. E. GULL
Cornell University

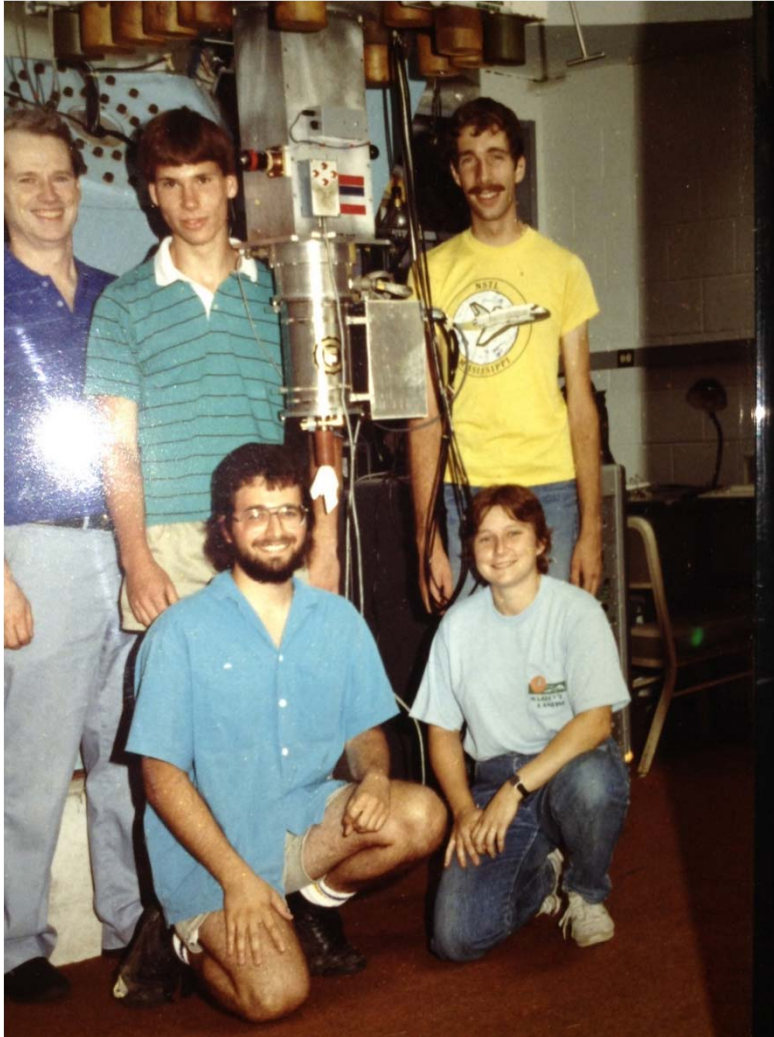


A view of Hartung-Boothroyd Observatory in mid-August, 1977, with the new 12-by-20-foot warm room at the right. The building was designed by S. M. Colbert to accommodate a 20-foot dome and the 25-inch reflector seen below. The guide scope at lower right on the box-girder tube has a three-degree field. For a close-up of the spectrometer at the Cassegrain focus, see page 266. All photographs are by G. E. Gull for Cornell University.

MOST MODERN observations with large telescopes are made not by an astronomer visually, but by complex instruments mounted at the focus. While the observer usually looks into an eyepiece in order to recognize the star field and to guide the telescope, it is a photometer, spectrometer, photographic plate, or other accessory device that collects the informa-

tion about the object under study. If a large telescope is to be used at maximum efficiency, then the accessory must perform at peak sensitivity and the observer must be skilled in its operation. Both of these criteria demand testing and training time.

Jim's "Camera Kids": built the first CCD for HBO between Sept 1987 and June 1988.



(Top Row, L-R): Jim, Eric Weisstein, Brian McLeod
(Bottom Row, L-R): Rob ?, Kim (Katriss) McLeod

Photo Courtesy of Kim (Katriss) McLeod

Hi John,

In the fall of 1983, Jim put together a group of 4 undergrads, (me, Kim Katris (McLeod), Rob Viens, and Kathy ____). Our mission was to build and deploy HBO's first CCD camera. We started with 4 empty boards and a PASP paper from Jim's Caltech's pals. By the spring, Jim, along with Terry and George, had taught us how to order parts, wire wrap, solder, write instrument control software, debug electronics, what a 9/64 ball driver is, how to pump out a dewar, use liquid nitrogen, wash and collimate a telescope, cement optical filters, how to observe, be sure to "ground yourself, Gridley!", and other ways to stay out of "deep yogurt". We still use those two Jim-isms at home.

It was a comprehensive experience, and for me personally it was transformative. It launched me on a career in instrumentation, and I am forever grateful for that unique opportunity Jim gave us that year.

Brian

What we learned along the way:

- Don't Waste Photons: "It's Bluuuuueeee ... !%#"
- Expensifying = Lightweighting (or was it anodizing?)
- Simple, straightforward design
- Minimize moving parts – "bolt & go"
- Importance of a good physical optics understanding
- Zero'th order outgassing test – does it smell?

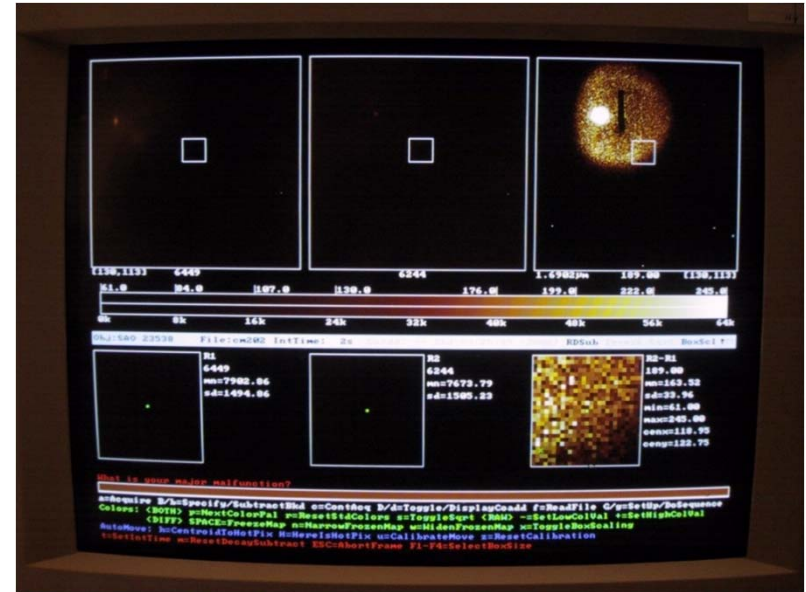
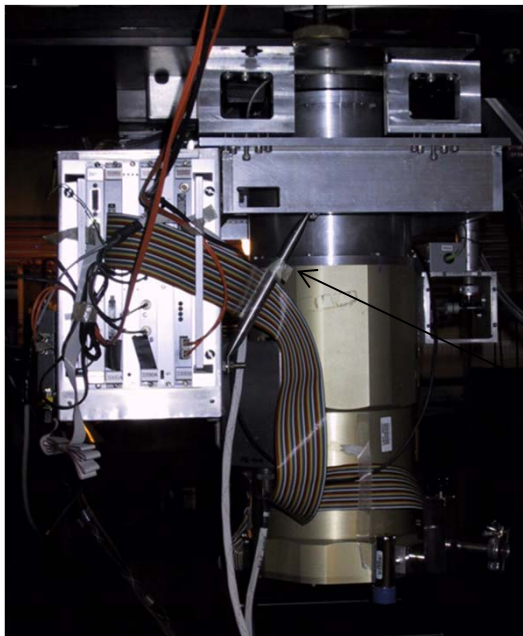
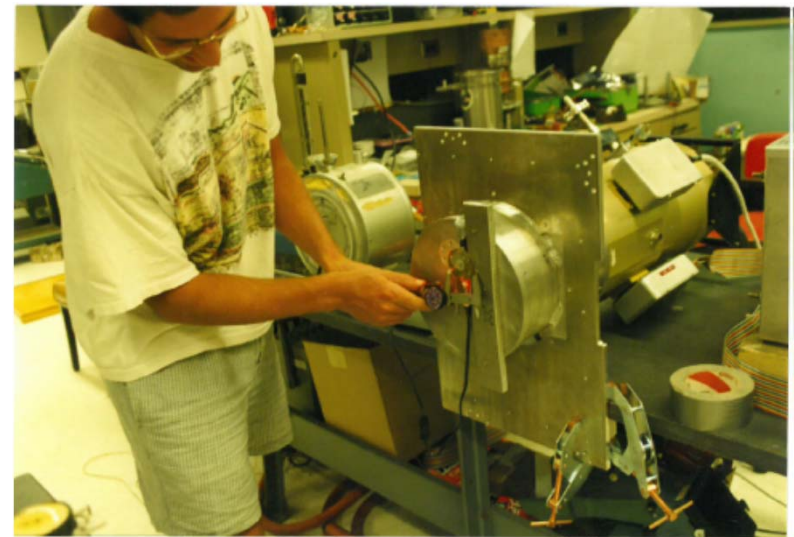


Photo courtesy D. Barry



Bar made by Jim the day instrument shipped

Photo courtesy D. Barry



Mentorship:

Craftsman on staff to help transfer the tacit knowledge of instrument building



George Gull

Cornell Univ Photo



Cornell Univ Photo

Justin Schoenwald



Chuck Henderson

& Bruce Pirger !

Start of CorMASS

UNIVERSITY OF MASSACHUSETTS
Department of Physics and Astronomy

517G Graduate Tower
Amherst, Massachusetts 01003-4525
email: skrutski@phast.umass.edu
(413) 545-2456 : FAX (413) 545-2117

August 18, 1998

Jim Houck
Department of Astronomy
Cornell University
Ithaca, NY 14853

Dear Jim,

Thanks for inviting me up to Cornell to give a talk. It was
I've enclosed my expenses and receipts with this note.

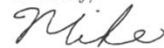
I lobbied a number of 2MASS science team members con-
SIRTF at our July meeting – Davy Kirkpatrick, Jim Liebert, and Roc Cutri in particular.
All expressed interest, but not at the level where they would actively seek out SIRTF
people and get something started. This reaction is probably quite natural considering the
intensive 2MASS activity that has everyone more than preoccupied at present. On the
other hand, I expect these three individuals would be quite receptive if SIRTF sought
them out and tried to start up a collaboration.

On a slightly different note, I believe that the 2MASS brown d-
lacks a means (better yet lacks the internal motivation) to sort the list
to the small fraction of very cool and interesting objects. The group se-
Keck and look at a bunch only to find a few real winners. Just a little clever narrowband
imaging (tuned to the broad spectral features of the L8 dwarfs and/or to methane) could
quickly pare down candidate lists. Such triage will be essential if we are to search effectively
for methane dwarfs since their IR colors will not be distinctive. I am trying to push John
Gizis (2MASS postdoc here in Amherst) to think about this issue. Access to Palomar may
be just the ticket to carry out an aggressive program (there will be thousands of potential
targets), so maybe there is the seed of a collaboration with John supplying the manpower
to make it happen. Such a follow-up might work with existing instrumentation, or my
NICMASS camera could be customized for the effort. Just a thought.

Just a little clever narrowband
imaging (tuned to the broad spectral features of the L8 dwarfs and/or to methane) could
quickly pare down candidate lists. Such triage will be essential if we are to search effectively
for methane dwarfs since their IR colors will not be distinctive.

Such a follow-up might work with existing instrumentation, or my
NICMASS camera could be customized for the effort. Just a thought.

Sincerely,

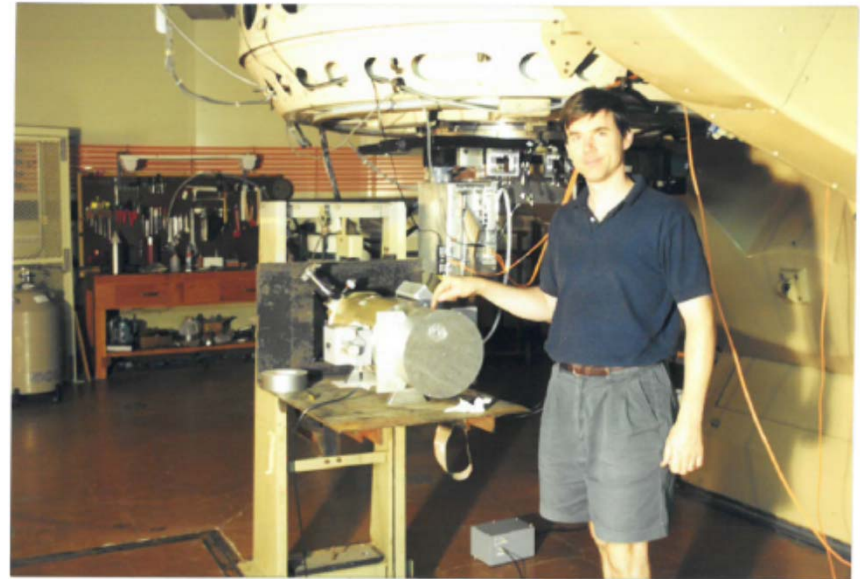


Michael F. Skrutskie

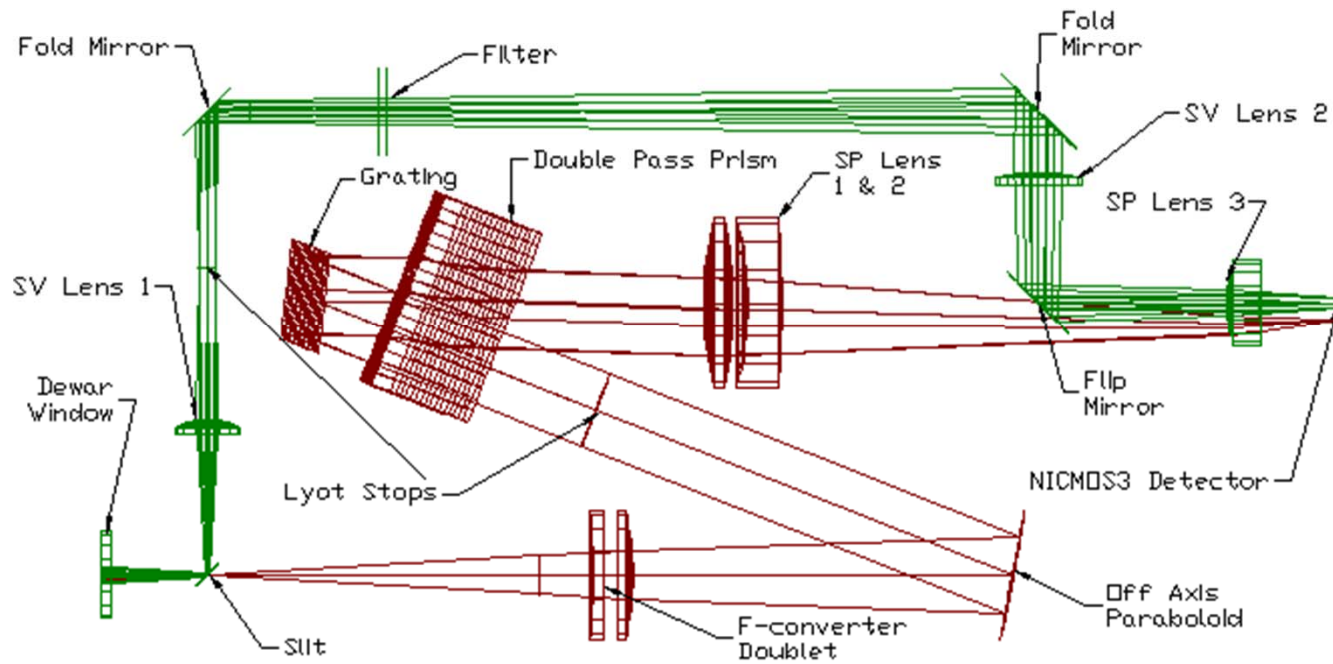
Team & Timeline

Alan Enos
Mike Colonno
JD Smith
Chuck Henderson
Mike Skrutskie
Jim Houck
John Wilson

- Letter M. Skrutskie to J. Houck
[Aug 18, 1998](#)
- First Light on Palomar 60 - inch
[Aug 22, 1999](#)



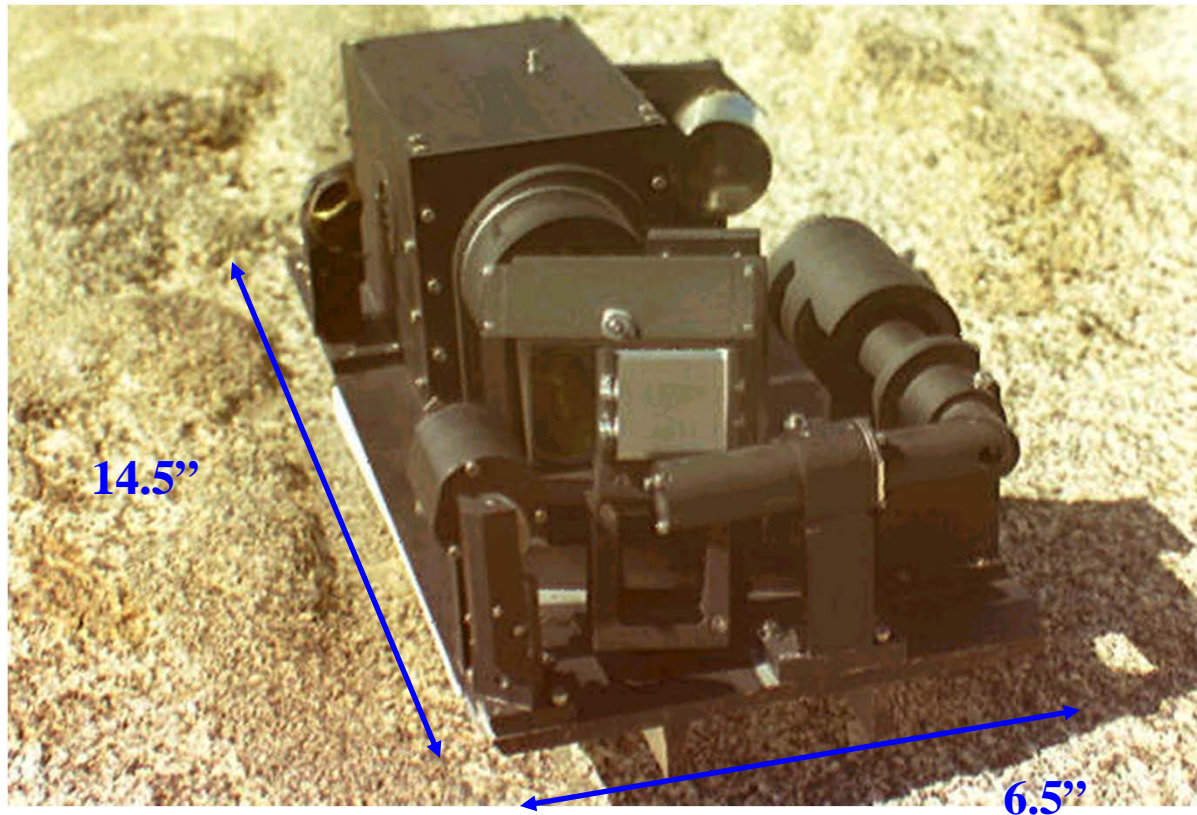
Light Paths



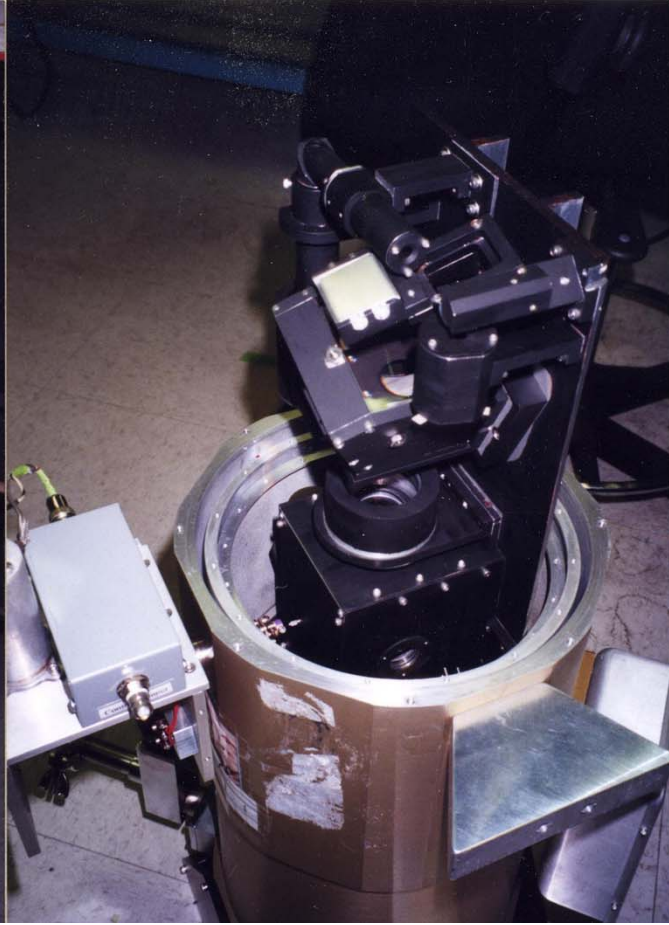
Externally driven flip mirror selects between [spectrograph](#) and [slit viewing](#) mode.

- Both modes use the same NICMOS 3 Detector

Optical Bench

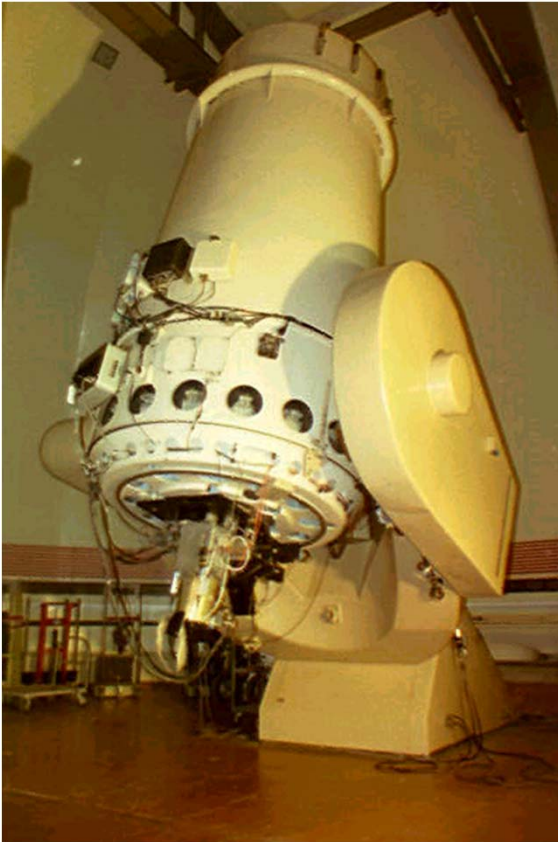


Double-Pass Prism Design keeps optical elements 'in-plane'
→ allows placement within existing Dewar cold volume

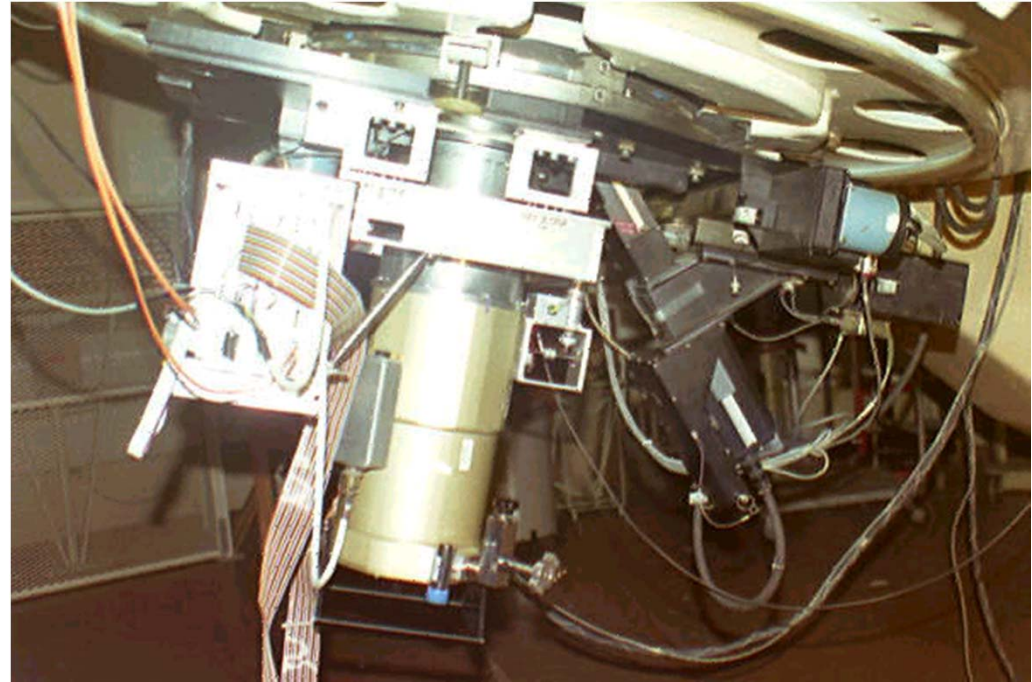


CorMASS

Cornell Massachusetts Slit Spectrograph



Palomar 60-inch f/ 8.75
Cassegrain Focus



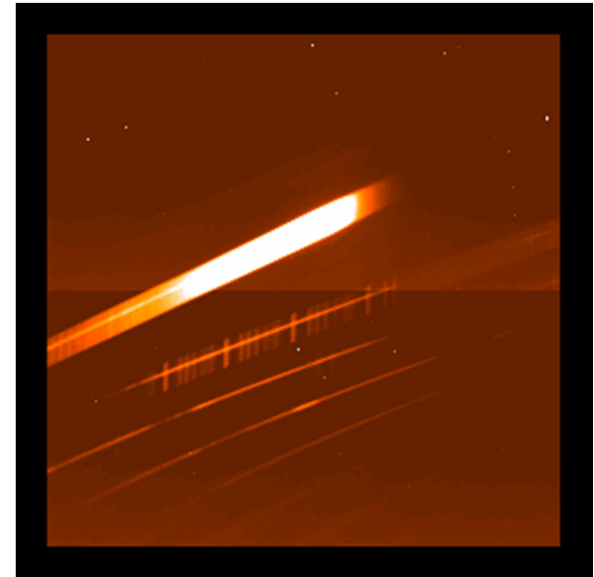
New role for the 2MASS Camera
Test Dewar + Electronics

Spectrograph

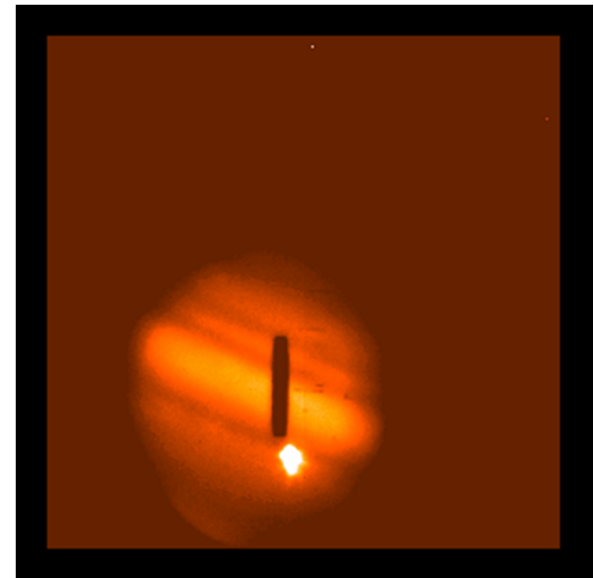
| | |
|-------------|---|
| Resolution | R ~300 |
| Wavelength | 0.8 - 2.3 microns (z'JHK) |
| Detector | NICMOS 3 |
| Plate Scale | 1 arcsec / pixel |
| Slit Size | 2 x 15 arcsec |
| Sensitivity | J=14.6, H=14.9, K=14.0 3600 sec, S/N=5 |
| Throughput | z=0.05, J=0.07, H=0.13 K=0.10 |

Slit Viewer

| | |
|-----------------------|-------------------------|
| Wavelength | Ks filter |
| Detector | same detector |
| Plate Scale | ~0.25 arcsec / pixel |
| FOV | 35 arcsec dia. |
| Sensitivity | K=13 in 2 sec for S/N=5 |
| Throughput | 0.2 |
| Flip Mirror Move Time | 10 sec |

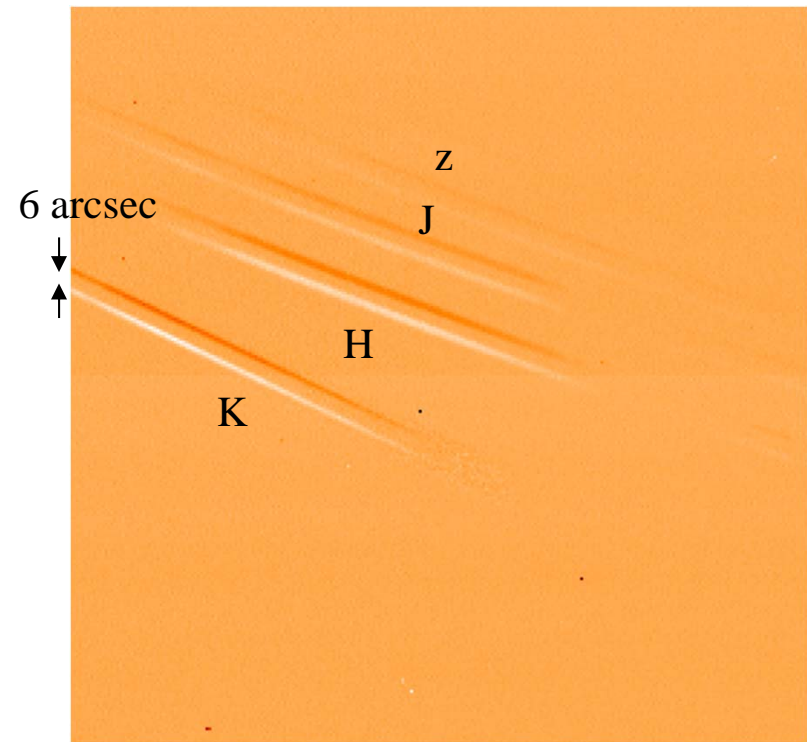
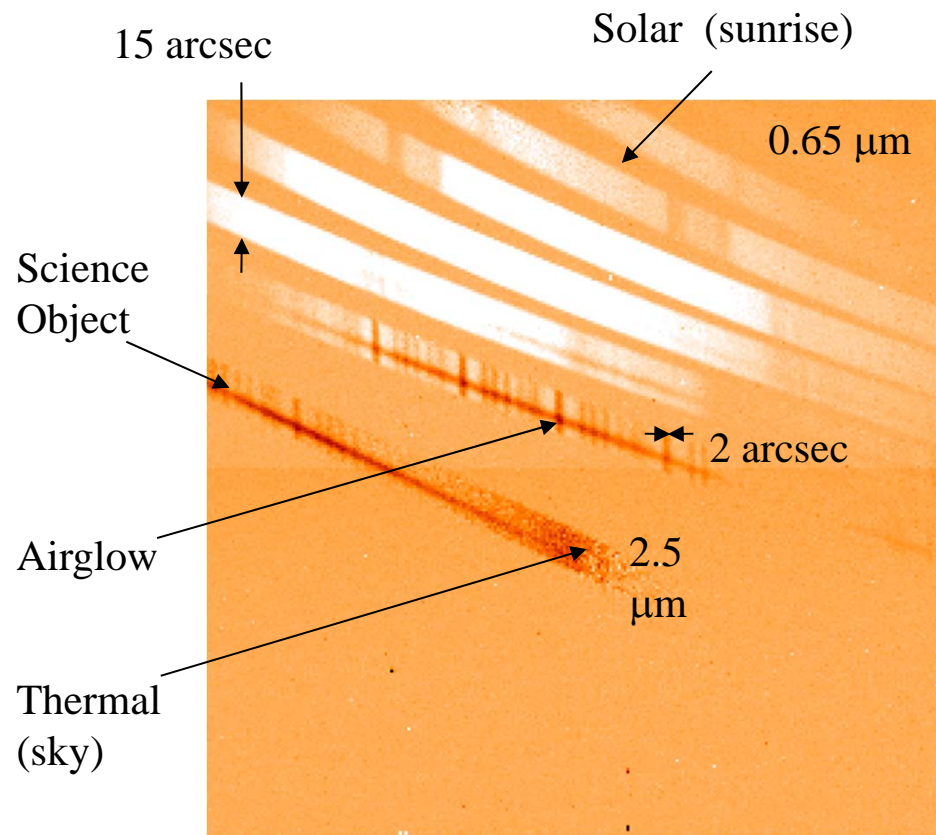


Wolf-Rayet in Spectrograph



Jupiter and Satellite in Slit Viewer

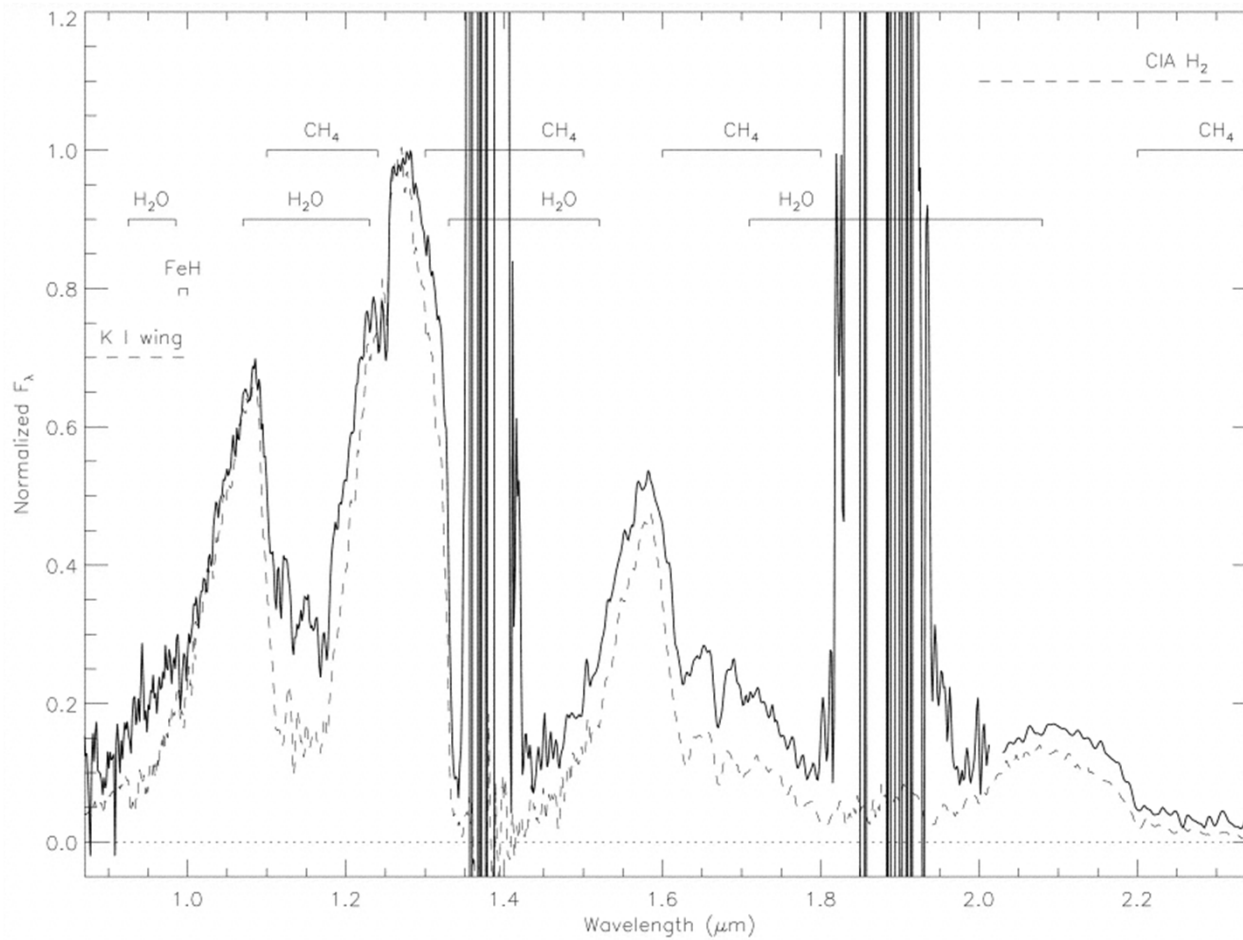
Cross-Dispersed Format



DISCOVERY OF A BRIGHT FIELD METHANE (T-TYPE) BROWN DWARF BY 2MASS

ADAM J. BURGASSER,¹ JOHN C. WILSON,² J. DAVY KIRKPATRICK,³ MICHAEL F. SKRUTSKIE,⁴ MICHAEL R. COLONNO,²
ALAN T. ENOS,² J. D. SMITH,² CHARLES P. HENDERSON,² JOHN E. GIZIS,³
MICHAEL E. BROWN,^{5,6} AND JAMES R. HOUCK²

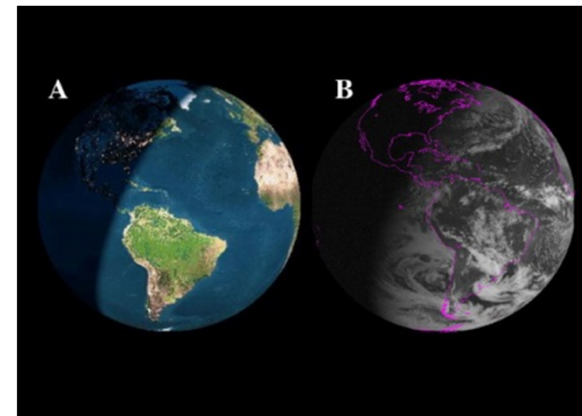
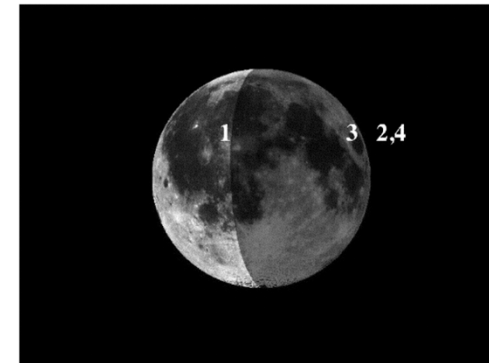
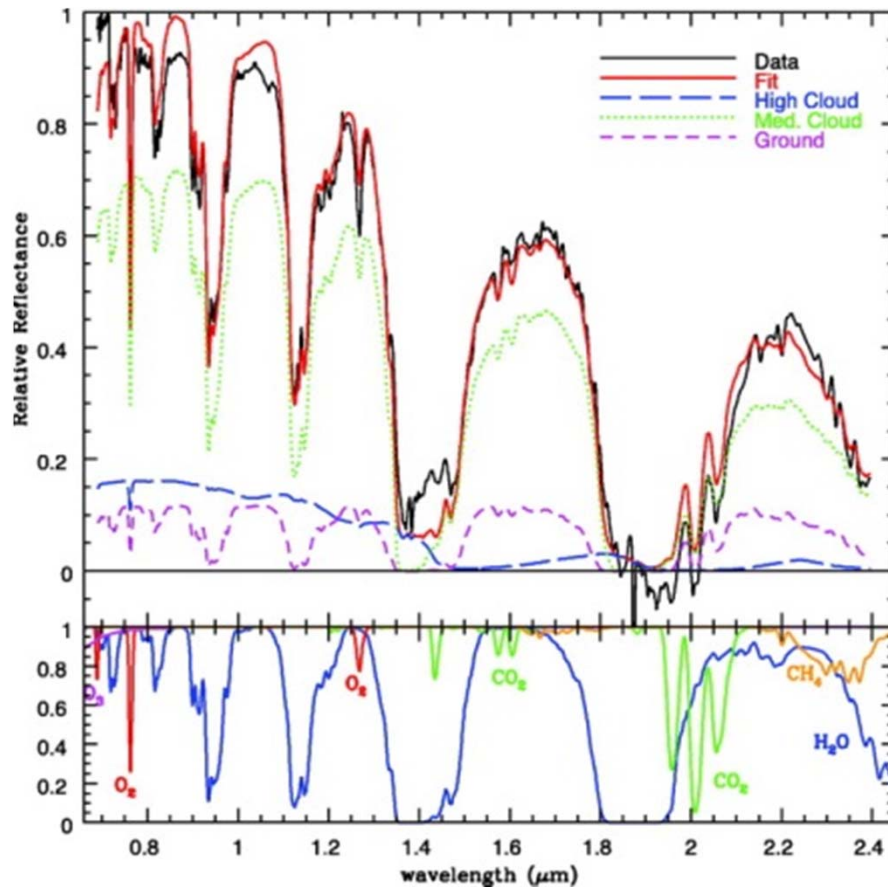
Received 2000 March 27; accepted 2000 April 17



SPECTRUM OF A HABITABLE WORLD: EARTHSHINE IN THE NEAR-INFRARED

MARGARET C. TURNBULL,^{1,2} WESLEY A. TRAUB,^{3,4} KENNETH W. JUCKS,⁴ NEVILLE J. WOOLF,^{2,5}
MICHAEL R. MEYER,^{2,5} NADYA GORLOVA,^{2,5} MICHAEL F. SKRUTSKIE,⁶ AND JOHN C. WILSON⁶

Received 2005 November 11; accepted 2006 January 25

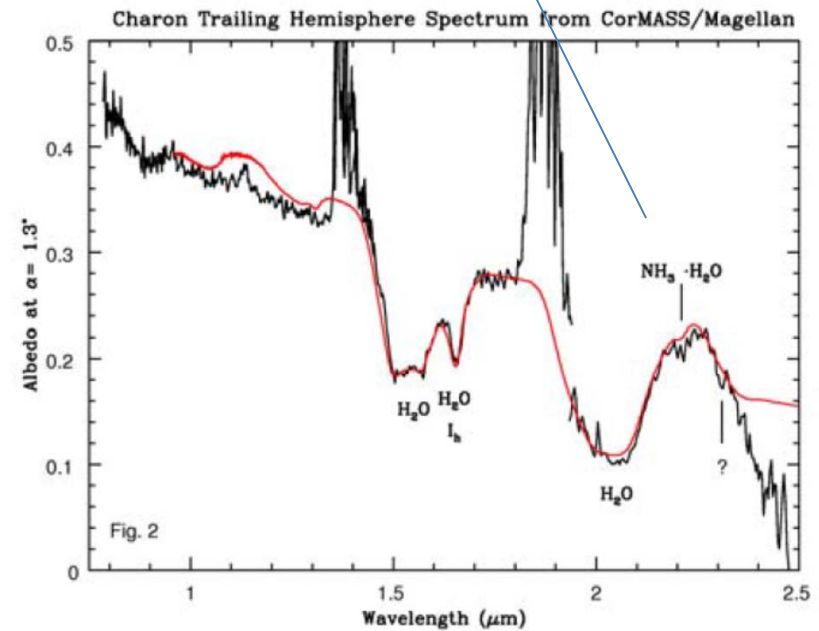
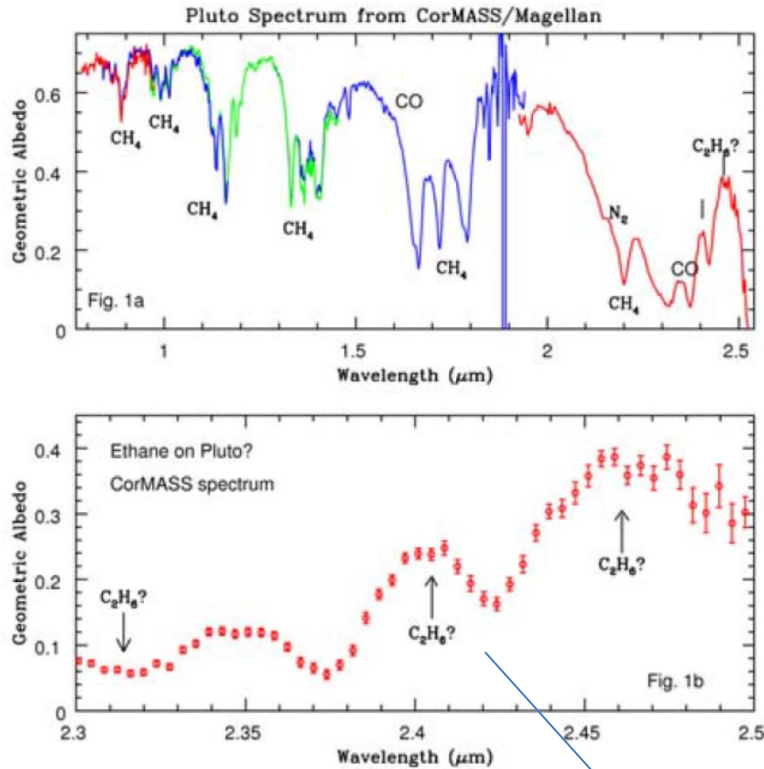


“Interpreted as a spectrum of an extrasolar planet, we would confidently conclude that this is a habitable planet, based on the presence of strong water bands. Furthermore, the simultaneous presence of oxygen and methane is a strong indicator of biological activity.”

SIMULTANEOUS SPATIALLY-RESOLVED NEAR-INFRARED SPECTRA OF PLUTO AND CHARON.

A. J. Verbiscer¹, D. E. Peterson¹, M. F. Skrutskie¹, M. Cushing¹, M. J. Nelson¹, J. D. Smith², and J. C. Wilson¹ ¹University of Virginia, P.O. Box 400325, Charlottesville VA 22904 (verbiscer@virginia.edu), ²Steward Observatory, University of Arizona, Tucson AZ 87512.

Amonia hydrate



ethane

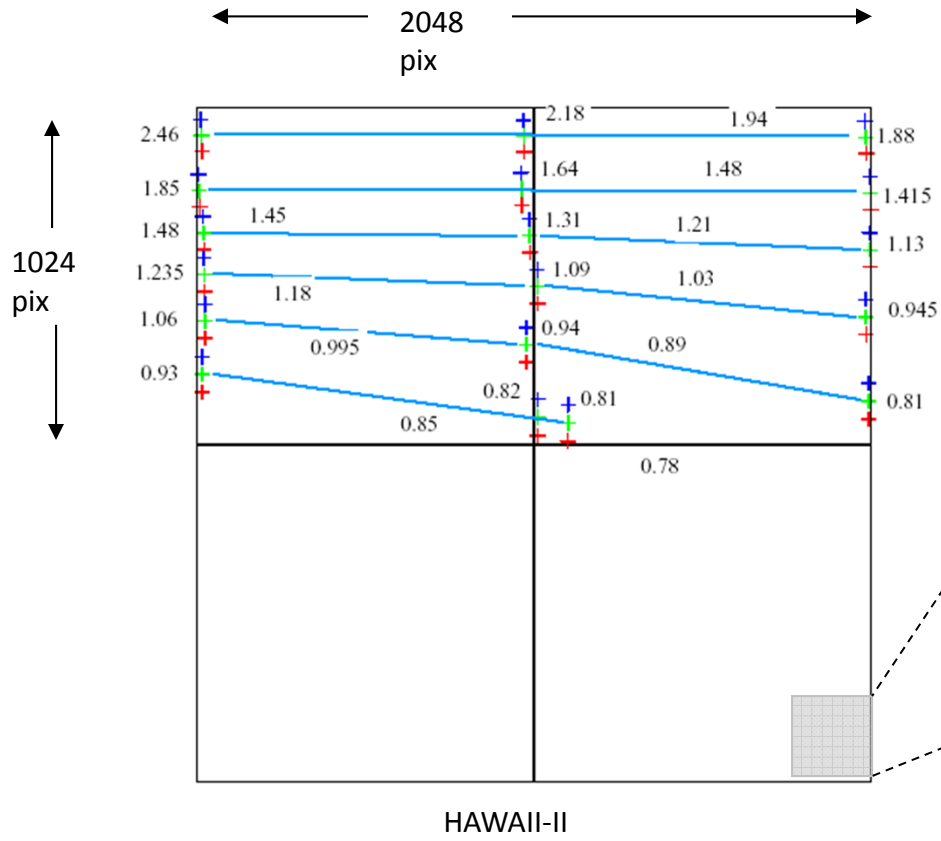
CorMASS → led to the suggestion of a TripleSpec like instrument ...

Subject: CorMASS & the BigEye
Date: Wed, 05 Dec 2001 15:43:35 -0800
From: Tom Jarrett <jarrett@ipac.caltech.edu>
Organization: CALTECH
To: jcw14@cornell.edu (John Wilson)

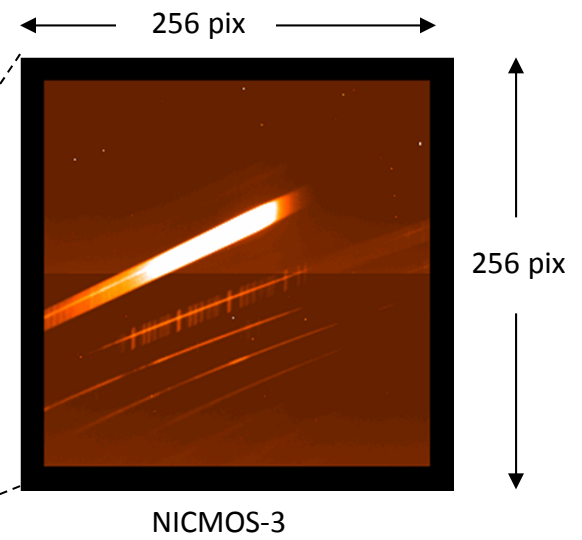
John,

As a satisfied user of CorMass, I have often wondered why the 200" does not have an instrument like this. Has the Cornell group (and you in particular) considered building an updated clone of CorMass for the 200? My group (IPAC and JPL) is now considering building an IR spectrograph for the 200", and I'm pushing for something that approaches CorMASS (efficient, covering the JHK windows and moderate resolution). Now we do want higher resolution than CorMASS (some of us are clamoring for a spectral resolution ~3000), so my question to you is this: can a CorMASS-like system be built with a low and high resolution mode (say 300 and 3000) using a larger array like a 2048? We don't actually want to build the instrument, but instead help design it and work on the software interfaces. So we are looking for hardware builders (such as yourself). I'm going to ping Mike Skrutskie on this stuff as well and see what his thoughts are on this stuff. We really need an efficient (and user friendly) NIR spectrograph for the Big Eye. Thanks for any info you may have.
Cheers, -tom jarrett

Triplspec (R=3600)

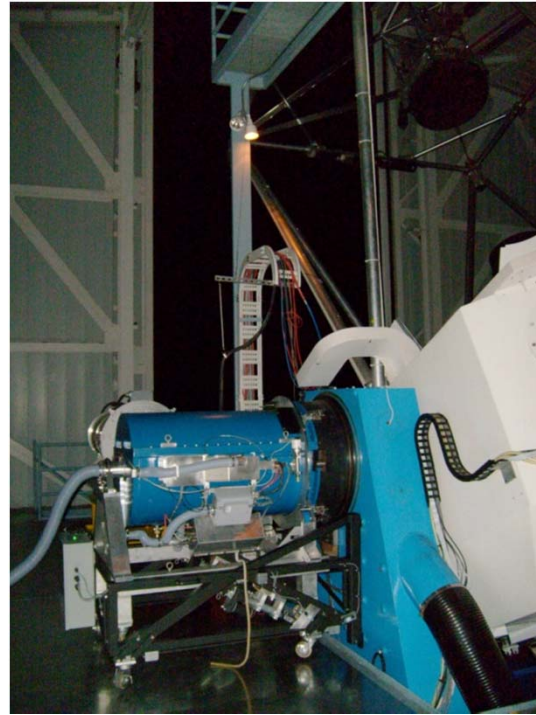


CorMass (R=300)

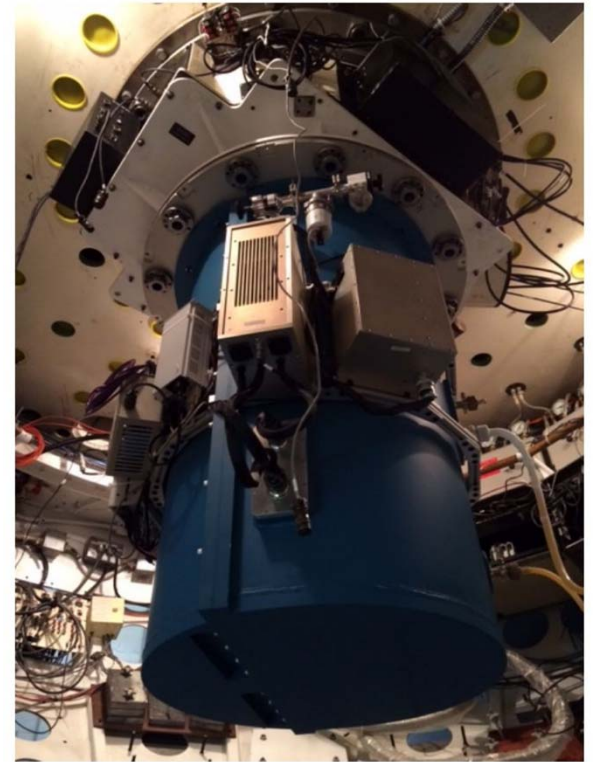




Palomar



APO

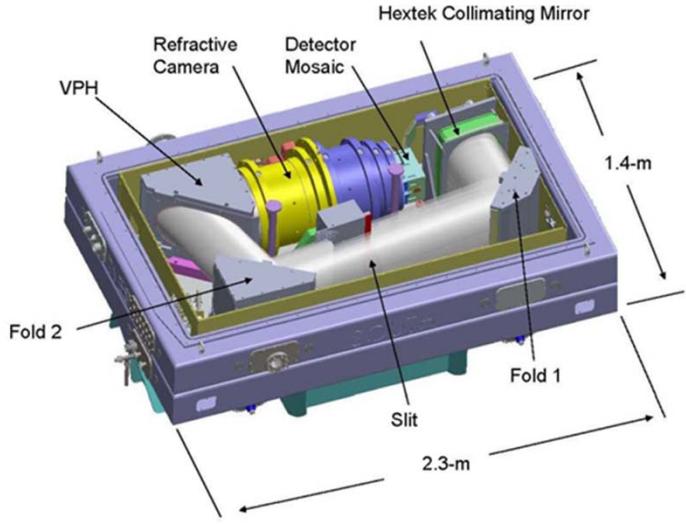


Blanco



Keck

CorMASS & TripleSpec at APO led to UVA's involvement in SDSS with the APOGEE spectrographs ...



Mentorship: Heritage

| PhD Students | |
|----------------------------|--|
| 2008 Shannon L. Gutenkunst | |
| 2008 Yanling Wu | |
| 2005 Joseph C. Carson | Assoc. Professor, Physics & Astronomy, College of Charleston |
| 2004 Dae-Sik Moon | Assoc. Professor, Astronomy & Astrophysics, Univ of Toronto |
| 2002 John C Wilson | Senior Scientist, UVA Astronomy |
| 2001 J.D. T Smith | Assoc. Professor, Astronomy, Univ of Toledo |
| 1999 Stephen Rinehart | Associate Chief, Laboratory for Observational Cosmology, NASA Goddard |
| 1995 Matthew L.N. Ashby | Astrophysicist, Harvard-Smithsonian CfA |
| 1994 John W. Miles | Integration and Test Lead, Giant Magellan Telescope |
| 1991 Neil Rowlands | JWST Industrial FGS Project Scientist Staff Scientist, COM DEV |
| 1988 Paul H. Graf | President, Aerospace Solutions |
| 1987 Perry B. Hacking | Professor, El Camino College |
| 1985 Mark Shure | Senior Staff Engineer, Harris Corp. |
| 1982 Bruce Thompson | Assoc. Professor & Chair, Physics & Astronomy, Ithaca College |
| 1981 Thomas L. Roellig | Deputy Project Scientist, SOFIA Astrophysicist, NASA Ames |
| 1980 John McCarthy | |
| 1977 Robert Reed | |
| 1975 Daniel A. Briotta Jr. | Assoc. Professor, Physics & Astronomy, Ithaca College |
| 1975 David Schaack | |
| 1972 Baruch Thomas Soifer | Harold Brown Professor of Physics, Caltech Director, Spitzer Science Center |

| Post-Docs / Staff Scientists | |
|----------------------------------|---|
| 2003-2011 Henrik Spoon | Senior Research Assoc., Cornell Univ. |
| 2003-2010 Jeronimo Bernard-Salas | Research Staff, School of Physical Sciences, Open Univ. |
| 2005-2010 Vianney Lebouteiller | CEA, Saclay, France |
| 2003-2008 Daniel Devost | Director of Science Operations, CFHT |
| 2004-2007 Lei Hao | Professor, Shanghai Astronomical Observatory |
| Don Barry | |
| Peter Hall | |
| Jim Higdon | Assoc. Professor, Dept of Physics, Georgia Southern University |
| Sarah Higdon | Asst. Professor, Dept of Physics, Georgia Southern University |
| Greg Sloan | |
| 1999-2007 Keven Uchida | JPL |
| 1999-2005 Vassillis Charmandaris | Professor & Director of IAASARS, National Observatory of Athens |
| 1991-2001 Jeffrey Van Cleve | SOFIA, USRA |
| 1996-2000 Bernhard Brandl | Professor, Leiden University |
| mid-late 90's Tom Hayward | Scientist, Gemini-South |

| Undergrads | |
|-----------------------------|--|
| 2005 Mansi M. Kasliwal | Assistant Professor, Caltech Astronomy |
| late 90's Michael Colonno | |
| late 90's Alan Enos | |
| 1993-1997 Chris Groppi | Assoc. Professor, School of Earth and Space Exploration, ASU |
| late 80's Brian McLeod | Astrophysicist, Harvard-Smithsonian CfA |
| late 80's Kim Katris McLeod | Professor of Astronomy, Wellesley College |
| late 80's Jeff Regester | Instructor of Physics & Astronomy, High Point Univ. |
| late 80's Eric Weisstein | Wolfram Research, Creator of <i>MathWorld</i> |
| late 80's Rob Vein | |
| 80's Mike Skrutskie | Professor and Chair, UVA Astronomy |
| 1981-1985 Bill Reach | SOFIA Deputy Director, Science |
| 1972 George Gull | Research Support Specialist, Cornell Astronomy |