

# NOAOGEMINI SCIENCE CENTER

TUCSON, ARIZONA • LA SERENA, CHILE

## Gemini Update

*Taft Armandroff*

The majority of the time on the Gemini telescopes is being used for scientific observations for the Gemini user community. For semester 2004B, science time will represent at least 70 percent of the total time. Instrument commissioning and system verification activities are underway at Gemini as described below. System verification is the final step in readying an instrument for TAC-approved science observing.

### **GNIRS**

The Gemini Near InfraRed Spectrograph (GNIRS) has been commissioned and verified in its primary modes. During semester 2004B, system verification of the GNIRS integral field unit (IFU) and GNIRS's high spectral resolution mode ( $R = 18,000$ ) is occurring.

### **Michelle**

The mid-infrared imager and spectrograph Michelle is undergoing system verification in its spectroscopic mode during semester 2004B at Gemini North.

### **Hokupa'a-85**

A new visitor instrument, Hokupa'a-85, is being commissioned at Gemini South during semester 2004B. Hokupa'a-85 is an 85-element curvature-sensing adaptive optics system. It was developed by the University of Hawaii, under the leadership of Mark Chun and Christ Ftaclas. Hokupa'a-85 is used in tandem with NOAO's ABU infrared imager. Among its benefits, Hokupa'a-85

provides demonstration, testing, and experience with the adaptive optics technology and methodology also used in the Near Infrared Coronagraphic Imager (NICI), a future facility instrument for Gemini South.

### **Semester 2005A Proposal Statistics**

The NOAO Gemini Science Center (NGSC) saw enthusiastic demand from the US community for Gemini observing time for semester 2005A. One hundred twenty proposals were received for Gemini North: 60 for GMOS-North, 35 for NIRI alone, 12 for NIRI with the Altair adaptive optics system, and 22 for Michelle. One hundred fourteen US proposals requested Gemini South: 39 for GNIRS, 34 for GMOS-South, 24 for Phoenix, 23 for T-ReCS, and 1 for the Acquisition Camera. In total, 217 US Gemini proposals sought 475 nights on the two Gemini telescopes. The numbers of US Gemini proposals and nights requested represent record highs. The oversubscription factors of 5.1 at Gemini North and 4.2 at Gemini South demonstrate healthy community engagement.

## Opportunities to Use the Gemini Telescopes to Observe the Deep Impact Comet Encounter

*Verne Smith*

Deep Impact is a NASA Discovery Program mission designed to intercept and study Comet Tempel 1 in July 2005, centered on an ambitious plan to strike the comet with a 370-kilogram copper projectile that will impact at a relative velocity of 10.2 kilometers per second. This event will take place when Comet Tempel 1 is about 0.9 astronomical units from Earth. The current nominal mission timeline calls for a Delta II launch in December 2004, followed by a six-month cruise to comet encounter. The planned encounter will take place on, or near, 4-5 July 2005, with the impactor being released from the flyby spacecraft about 24 hours before the Tempel 1 encounter. The flyby spacecraft will

maneuver so as to observe the impact from a distance of about 500-700 kilometers. Instruments on the flyby spacecraft include high-resolution and medium-resolution optical CCD imagers (with respective scales of 1.4 meters per pixel and 7 meters per pixel at 700 kilometers). In addition, the flyby spacecraft has an infrared spectrometer with an HgCdTe array, having spectral sensitivity from 1.05 to 4.8 microns, and a spectral resolution of  $R = 216$ . The impactor itself carries a targeting optical CCD camera that will guide it to the comet. This camera will return images up to a few seconds before impact and provides a scale of 0.2 meters per pixel at 20 kilometers.

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### *Opportunities to Observe the Deep Impact Comet Encounter continued*

Observers should be aware that the Gemini telescopes, and their deployed suite of instruments, will support the Deep Impact mission by reserving three nights on each telescope. These nights will be immediately before, during, and after the day of the impact. During the dates of the Tempel 1 encounter, the approximate positions of the comet will be from about 13 hours 35 minutes to 13 hours 40 minutes in right ascension and -9 to -10 degrees in declination. Observations on those nights

will be coordinated with other national and international observatories, and access to them made available in a separate Call for Proposals to be released in early 2005. Keep an eye on the Gemini Observatory Web site ([www.gemini.edu](http://www.gemini.edu)) for the proposal call.

More information on the Deep Impact mission can be found at [deepimpact.jpl.nasa.gov](http://deepimpact.jpl.nasa.gov) and [deepimpact.umd.edu](http://deepimpact.umd.edu).

## Following the Aspen Process: Extreme Adaptive Optics Coronagraph

*Jay Elias*

The March 2004 *NOAO-NSO Newsletter* reported the results of the Aspen Workshop, which was convened for the purpose of outlining future research paths for the Gemini telescopes and identifying instrumentation essential to the pursuit of this research. Gemini has funded concept design or feasibility studies for four instruments identified as highest priority. In the September 2004 *NOAO-NSO Newsletter*, Ken Hinkle briefly described the high-resolution near-infrared spectrograph (HRNIRS), one of the two instruments for which concept designs are being developed. The second instrument for which concept designs are being developed is the Extreme Adaptive Optics Coronagraph (ExAOC).

One of the key research topics identified by the Aspen Workshop is the identification and study of planets orbiting around other stars. Studying these planets includes direct imaging and low-resolution spectroscopy, which, needless to say, is quite difficult, since even planets significantly larger than Jupiter are still much fainter than the star around which they orbit. The performance goal for the coronagraph is detection of planets  $10^7$  times fainter than the central star, inside a 1.5 arcsec radius of the star. For a star at 50 parsecs distance, a separation of 0.1 arcsec corresponds to the orbit of Jupiter. For a 5<sup>th</sup> magnitude star, one must detect an object fainter than magnitude 22 at this separation.

In order to accomplish this difficult task, the instrument must rely on a combination of high-order adaptive optics, a coronagraphic capability, and excellent control of scattered light. This is best done in the near-infrared, where in addition giant planets should show maximum contrast with the star and where the planetary atmospheres should show strong methane bands.

ExAOC differs from other present and proposed Gemini instruments in that it is very much a special-purpose instrument. Although it may possibly prove useful for other projects, such as observations of active galactic nuclei or dust disks around young stars, this science is definitely secondary to the primary purpose of planet detection. It differs specifically from NICI, the coronagraphic imager now under construction (see the "NGSC Instrumentation Program Update" article that follows) in that it sacrifices versatility for maximum contrast at minimum separation.

As with HRNIRS, Gemini has selected two teams to carry out competitive design studies and will review the concepts early next year. One of the teams is led by Laird Close (Center for Astronomical Adaptive Optics, University of Arizona), with participants from other institutions within the Gemini partnership, including NOAO. The second team is led by Bruce Macintosh (Center for Adaptive Optics, University of California) and also involves several other institutions.



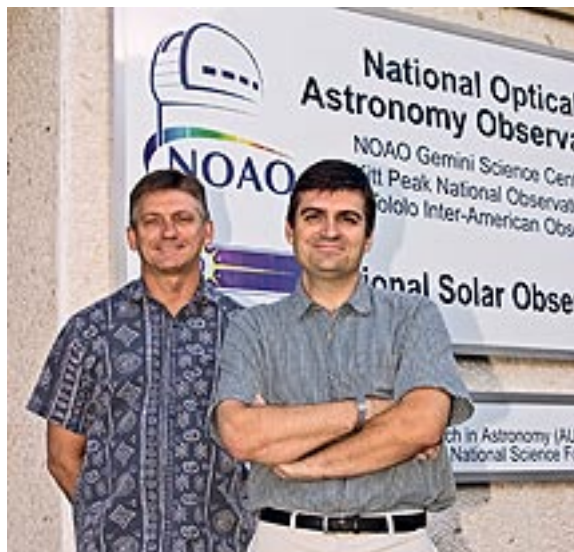
## Two New NGSC Staff Members

*Taft Armandroff*

The NOAO Gemini Science Center (NGSC) is delighted to announce the arrival of two new scientific staff members who will contribute to supporting the US astronomical community in its use of the twin Gemini 8-meter telescopes. Please join us in welcoming Verne Smith and Tom Matheson to NGSC and NOAO.

Verne Smith assumed the duties of NGSC Deputy Director on August 1; he also holds an appointment as tenured astronomer. Verne is well recognized for his studies of stellar abundances and Galactic chemical evolution. An experienced user of Phoenix and Gemini, Verne is the author of three publications from Gemini observations. He is initially based in Tucson but will relocate to NOAO South in 2005. Verne will provide leadership for NGSC activities at NOAO South and will be active in supporting US users of Phoenix and GMOS. Among his current activities, Smith is exploring how stellar populations and chemical abundances research is enabled by the HRNIRS and WFMOs instrument concepts for Gemini.

Tom Matheson joined NOAO on September 1 as NGSC Assistant Astronomer. Tom moved to Tucson from the Harvard-Smithsonian Center for Astrophysics, where he was a postdoctoral fellow. He received his PhD from the University of California, Berkeley, in 2000. His PhD thesis topic was "The Spectral Characteristics of Stripped-Envelope Supernovae." Tom's main research interests are supernovae, supernova cosmology, and the relation between gamma ray bursts and supernovae. One of his NGSC duties will be to serve as instrument support scientist for



*New NGSC staff members Verne Smith, NGSC Deputy Director (left) and Tom Matheson, Assistant Astronomer (right) in front of the NOAO Headquarters building in Tucson.*

GMOS, which he has been using to obtain spectroscopy of cosmologically interesting supernovae.

NGSC is currently recruiting two additional scientific staff members. Please see the NOAO Web pages for a description of these opportunities ([www.nao.edu/cas/hr/jobs/jobs\\_list.html](http://www.nao.edu/cas/hr/jobs/jobs_list.html)).



## NGSC Instrumentation Program Update

*Taft Armandroff & Mark Trueblood*

The NGSC Instrumentation Program continues its mission to provide innovative and capable instrumentation for the Gemini telescopes in support of frontline science programs. This article gives a status update on Gemini instrumentation being developed in the United States, with progress since the September 2004 *NOAO-NSO Newsletter*.

### NICI

The Near Infrared Coronagraphic Imager (NICI) will provide a 1- to 5-micron dual-beam coronagraphic imaging capability on the Gemini South telescope. Mauna Kea Infrared (MKIR) in Hilo is building NICI, under the leadership of Doug Toomey.

MKIR integrated all of the NICI components into the NICI dewar and carried out the second NICI cold test. This test demonstrated that all the NICI mechanisms and Hall-effect sensors are performing correctly at NICI's operating temperature. Proper thermal performance of the dewar was also proven. Good progress has been made on the NICI documentation deliverables.

As of the end of September, MKIR reports that 93 percent of the work to NICI final acceptance by Gemini has been completed. NICI is expected to be deployed on Gemini South in 2005.



*The NICI filter wheel assembly is shown being inserted into the NICI dewar, in preparation for the second cold test.*

### FLAMINGOS-2

FLAMINGOS-2 is a near-infrared multi-object spectrograph and imager for the Gemini telescopes; it will be commissioned at Gemini North and used there for some period before being relocated to Gemini South. It will cover a 6.1-arcmin-diameter field at the standard Gemini *f*/16 focus in imaging mode, and will provide multi-object spectra over a 6.1x2-arcmin field. It will also provide a multi-object spectroscopic capability for Gemini South's multiconjugate adaptive optics system. The University of Florida is building FLAMINGOS-2, under the leadership of Principal Investigator Steve Eikenberry.

FLAMINGOS-2 is transitioning from the late fabrication phase of the project to the early part of the integration phase. Recent achievements include fabrication of the filter wheel and integration of the camera dewar components. As of September, 59 percent of the work to FLAMINGOS-2 final acceptance by Gemini has been completed.



*The FLAMINGOS-2 MOS dewar that contains the masks for multi-object spectroscopy and the spacer.*

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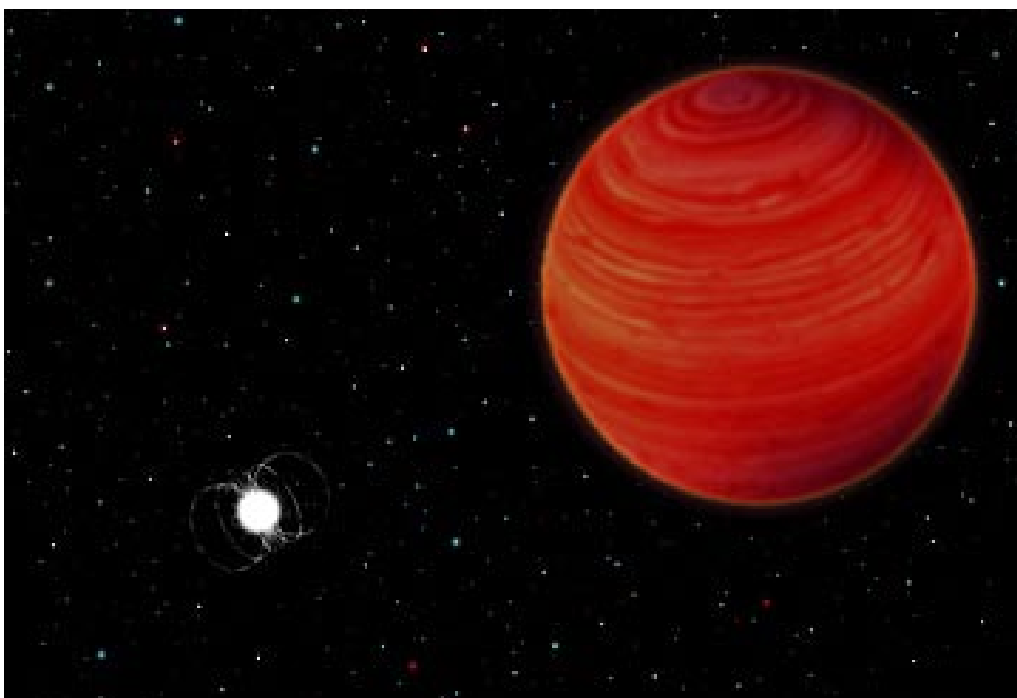


## *NGSC Instrumentation Program Update continued*

### **Future Gemini Instrumentation**

The next generation of instrumentation at Gemini will be the result of the community planning process that culminated in the Gemini workshop in Aspen, Colorado, in June 2003. Design studies are underway for a very capable high-resolution near-infrared spectrograph (HRNIRS) and an ambitious high-contrast adaptive optics system and associated imager/spectrograph capable of imaging warm planets around nearby stars (ExAOC). Gemini has funded two competing design studies for each of these two concepts. Gemini is also conducting feasibility studies for a very powerful wide-field multi-object spectrograph (WF MOS) and for a ground-layer adaptive optics (GLAO) program.

Groups in the United States are participating strongly in both the design and feasibility studies. NOAO and the University of Florida form one HRNIRS design-study team, while the United Kingdom Astronomy Technology Centre and the University of Hawaii make up the other HRNIRS team. The University of Arizona and the Center for Adaptive Optics at the University of California are each leading independent design-study teams for ExAOC. Johns Hopkins University and NOAO are collaborators on the Anglo-Australian-Observatory-led WF MOS feasibility study. The University of Arizona is one of three institutions collaborating on the international GLAO feasibility study.



*A joint Gemini Observatory-NOAO press release on 5 October 2004 highlighted observations by a team including Steve Howell of NOAO-WIYN and Thomas E. Harrison of New Mexico State University, who used the Gemini North and Keck II telescopes to peer inside the violent binary star system EF Eridanus. The team found that that one of the interacting stars has lost so much mass to its partner that it has regressed to a strange, inert body resembling no known star type. The unusual result was reported widely, including a story by Reuters wire service that appeared on CNN.com and ABCNews.com, plus other stories by Space.com, the New Zealand Herald, SkyandTelescope.com, and numerous Hawaiian newspapers.*

*Artwork: Gemini Observatory and Jon Lomberg.*