Gemini Update

Taft Armandroff

The NOAO Gemini Science Center (NGSC) is pleased to report several areas of noteworthy progress at Gemini Observatory. In addition to regular science observing for the Gemini communities, progress is being made on commissioning and optimizing several observing capabilities. These newly available instruments or instrumental modes represent opportunities for the US community to attack challenging science questions using Gemini.

GNIRS
The Gemini Near-Infrared Spectrograph (GNIRS) has been commissioned in its basic modes and is performing well. Gemini is on track to execute community queue observing programs with GNIRS in semester 2004B. The GNIRS integral field unit (IFU) has been successfully installed and commissioned, and Gemini expects to offer the GNIRS IFU for science observations in semester 2005A. Please see the subsequent GNIRS article by Jay Elias for more exciting details.

Michelle
The mid-infrared imager and spectrometer Michelle will be returning to Gemini from the United Kingdom Infra-Red Telescope (UKIRT) in May. Michelle will undergo work at Gemini's Hilo Base Facility during May and June to adapt it for optimal use at Gemini. Michelle will then return to the Gemini North telescope for additional commissioning. It is planned that Michelle will carry out scientific observations during semester 2004B and will remain at Gemini for the long term.

GMOS-South IFU
The integral field unit for GMOS-South has been commissioned and will be used for community science observing programs in semester 2004B. Thus, both southern and northern targets are observable with the twin GMOS IFUs.

T-ReCS
The Thermal-Region Camera and Spectrograph (T-ReCS) is performing well. Gemini South with T-ReCS provides the greatest sensitivity for mid-infrared imaging of any ground-based telescope and instrument combination.

2004B Proposals
NGSC saw a strong response from the US community to the Gemini Call for Proposals for semester 2004B. Eighty-four proposals were received for Gemini North: 45 for GMOS-North, 18 for NIRI alone, 5 for NIRI with the Altair adaptive optics system, and 17 for Michelle. Ninety-three US proposals requested Gemini South: 29 for GNIRS, 28 for T-ReCS, 28 for GMOS-South, 9 for Phoenix, and 2 for the Acquisition Camera. In total, 161 US Gemini proposals sought 371 nights on the two Gemini telescopes (note that some proposals requested more than one instrument).

The numbers of US Gemini proposals and nights requested represent all-time highs. The oversubscription factors of 3.1 at Gemini North and 4.8 at Gemini South demonstrate healthy community demand. The large number of US proposals for GNIRS (29) during its first semester of availability indicates wide community interest in this excellent instrument.

Gemini Data Comes Online

Marcel Bergmann

The Gemini Science Archive (GSA) prototype was publicly released in November 2003 and is now operating in a "shared risk" phase. The GSA prototype (see *www.us-gemini.noao.edu/sciops/data/dataArchive.html*) provides searchable access to every bit of science data taken with any of the instruments on either of the two 8-meter Gemini telescopes. Raw data that have reached the end of their proprietary periods (typically 18 months) may be downloaded directly from the archive, along with all the relevant calibration exposures and information. The GSA prototype precedes the release of the "basic" science archive, scheduled for release this summer, which will bring added functionality to the archive.

While most Gemini data has some proprietary period, the header information is considered to be public immediately upon ingestion into the archive. The headers can be searched to determine whether observations have been made of your favorite target, and if so, to determine when the data will become public. Calibration exposures including arc lamps, flat fields,

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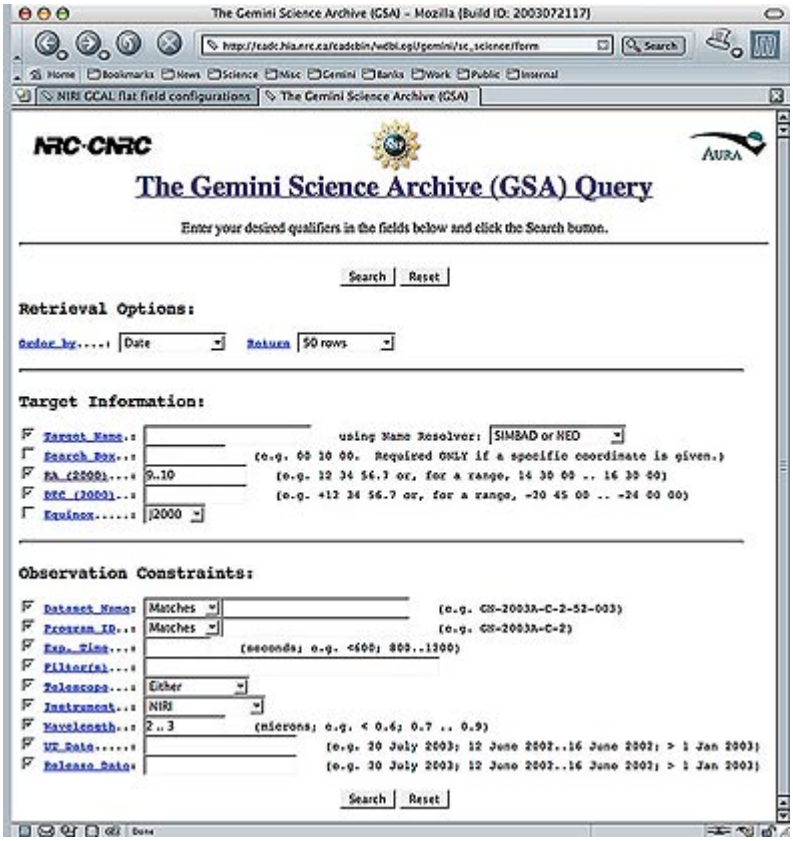
Gemini Data Comes Online continued

and (spectro)photometric standards have no proprietary period, and can be searched for and downloaded from the archive immediately.

There are two principal search features included in the GSA prototype. These are the *science query* and the *exposure query.* In a science query, users may search for observations taken near a particular object or location on the sky for objects whose name matches a particular pattern (or all objects). The search can be further constrained by limiting the results to one telescope, one instrument, a particular wavelength or filter, and a particular date range. The results returned will include only science data, not calibration data, though the search results do include links that lead to the nightly calibration data as well. An exposure query can be used to search for both science and calibration data at the same time, by matching on a data set name (or name fragment). The parameters for executing an exposure query are more limited: a user can constrain the telescope, instrument, and date range of the observations, but little else. In practice, a user would probably use a science query to find the list of programs that observed a particular target or set of targets, and then use an exposure query to find all the data (including calibrations) associated with those program identification numbers.

A special case of a science query is the *UDF query* (Ultra Deep Field). During semester 2003B, the GLARE team (PI K. Glazebrook; program GS-2003B-Q-7) proposed to use GMOS to obtain 75 hours of nod-and-shuffle multi-object spectroscopy on faint targets in the Hubble/ACS Ultra Deep Field region. The GLARE team waived the proprietary period for the observations, and all data are being made public immediately through the GSA. So far, 15 hours of integration have been obtained. The top-level GSA page has a link to this UDF data.



Science query form for accessing the Gemini Science Archive.

These searches using the GSA prototype allow users to find and download raw Gemini data. Data taken with ground-based telescopes are subject to more systematic variabilities than observations from space-based telescopes. A useful archive must do much more than simply storing the raw images and spectra from the telescopes. To enable a proper reduction and calibration of the data, it must provide all the information needed to understand the conditions under which the observations were executed. These so-called "meta-data" include things like observing logs, logs of the instrument set-ups, the xml files used to define and execute the observations, as well as environmental data and satellite weather maps. The plan to archive Gemini data was already in place before first light occurred at either telescope, and the whole data-taking infrastructure was designed to facilitate the production and tracking of all these meta-data. The full "basic" GSA will include a search function to access these meta-data.

The basic archive will also include improved linkage between science data sets and the most appropriate calibration files. It will also have a batch interface for large queries. Many other "behind the scenes" improvements that don't yet exist in the GSA prototype will be implemented in the basic archive.

While the basic GSA is scheduled to come on line this summer, there are already plans for an advanced archive with new features useful to both users and Gemini operations. The advanced

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Gemini Data Comes Online continued

capabilities being contemplated include an implementation of On-Line Data Processing (OLDP), which will produce fully reduced data within the archive. The OLDP could even be user configurable, so that users could have data reduced in the way they want, with the calibration files they choose, but with all the processing done on the high-performance archive computers rather than a user's home machine. The advanced archive may include data associations with the archived data from other observatories to facilitate multiwavelength and multitechnique (e.g., imaging and spectroscopy) archival analysis. Further proposed features include source catalog extraction, in which archived Gemini data are both automatically reduced and have automated measurements (such as object detection and photometry in imaging data, or emission line identification and strength measurements in spectroscopy) extracted and delivered to the user. These enhancements to the basic archive are fundamental to the inclusion of Gemini data in projects such as the National Virtual Observatory.

The GSA prototype is up and running. Several years of Gemini data have already become public. The basic archive will come on line this summer, improving access to these data sets. The advanced archive is still a year or more away, but is well into the planning stages. NOAO and Gemini encourage our user community to try out the archive tools now, and let us know what features you would most like to see implemented (*ngsc@noao.edu*).

GNIRS Commissioning and System Verification Go Well

Jay Elias

Since the last *NOAO/NSO Newsletter*, the Gemini Near-Infrared Spectrograph (GNIRS) has completed its first stage of commissioning, with runs in January, February, and April. Commissioning has been led by Bernadette Rodgers, the Gemini Instrument Scientist for GNIRS, with participation by other Gemini and NOAO staff members. The last run was used to commission the integral field unit (IFU), which was delivered from the University of Durham Astronomical Instrumentation Group (AIG) in March and installed jointly by NOAO, AIG, and Gemini. (See the figure for an illustration of the IFU in action, as well as the related article in the upcoming June issue of the *Gemini Newsletter*). GNIRS has now formally passed all of its acceptance tests.

With the April run, most of the key GNIRS modes have been commissioned and will be available to users for the 2005A semester. These modes include long-slit spectroscopy with resolutions R=2000 and R=6000 over the full wavelength range and cross-dispersed spectroscopy at R=2000 with continuous coverage from 1 to 2.5 microns. The highest spectral resolution mode (R~18,000 with 0.1 arcsec slit) has not been commissioned, though this is likely to occur early in 2004B, in which case it too will be available in 2005. GNIRS is also equipped with a Wollaston prism to permit its use with the Gemini Polarimeter (GPOL) for spectropolarimetry. Operation with GPOL requires installation on the up-looking port on the instrument support structure. No date has been set for commissioning this capability.

Part of the process of making GNIRS capabilities available to users is system verification (SV), where actual science observations are carried out in order to test the instrument with a variety of competitively selected programs. The first group of SV programs was selected from proposals submitted at the end of January, and observations were carried out in March and April. Data were obtained for all the top-ranked SV programs (see *www.us-gemini.noao.edu sciops/instruments/nirs/nirsSVPlan.html* for summaries), though most programs were not completed. The SV programs comprise a diverse selection that takes advantage of the versatility of the instrument, including

- cross-dispersed R=2000 spectra of objects ranging from red quasars to candidate brown dwarfs,
- R=6000 long-slit spectra of faint z=1.5 galaxies, galactic cores, and a Herbig-Haro object, and
- L and M band long-slit spectra of embedded and young stellar objects.

These observations are also being used to test the Gemini "quick look" data pipeline for GNIRS, which is used for quality assurance and to provide initial reductions for users.

A second round of SV will likely take place later in the year, with the focus on testing the IFU. Check the Gemini Web pages for an announcement of this opportunity.

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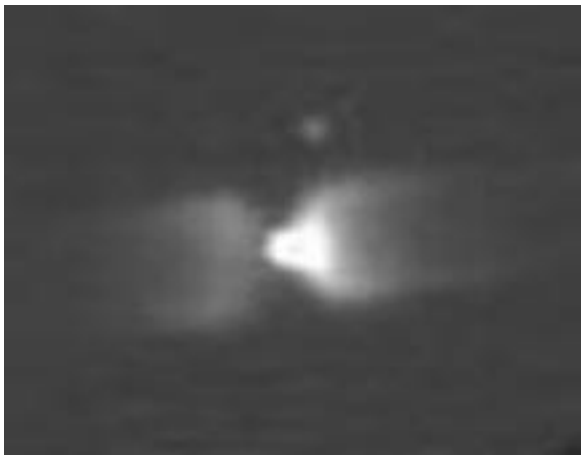
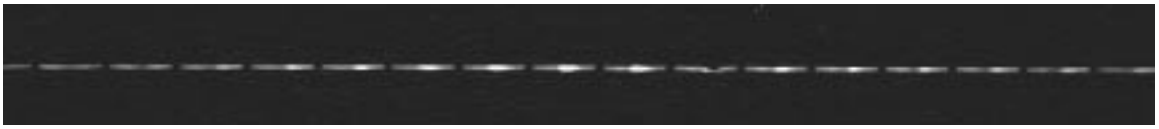
GNIRS Commissioning and System Verification continued

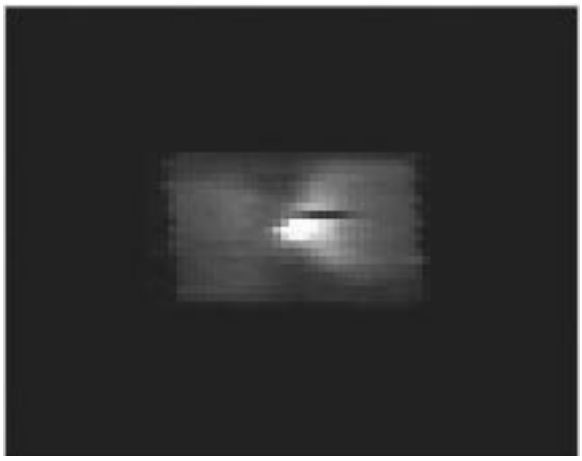
Observing with the GNIRS IFU. Start by taking an image of the field (in this case, of the protoplanetary nebula IRAS 10178-5958; only a magnified portion of the acquisition field is shown).



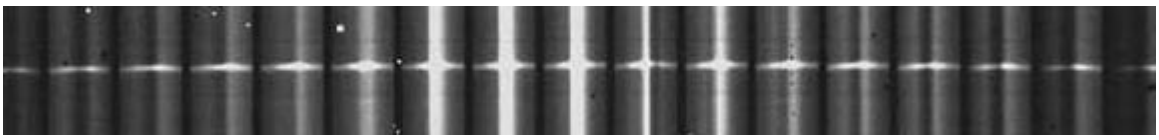
Then insert the IFU and take another image through the IFU. The field is sliced up (not all slices are shown here).



The slices can be assembled into an image using an IRAF script. This verifies centering on the IFU. The reconstructed image is ~3.2×4.8 arcsec. The width of the image corresponds to one of the slices above.



Now configure for spectroscopy. The image below shows a portion of a sky-subtracted spectrum of the object. The emission line is Brγ (2.166 microns); one also sees a fair amount of continuum due to light scattered by dust associated with the protoplanetary nebula.



NGSC Instrumentation Program Update

Taft Armandroff & Mark Trueblood

The NGSC Instrumentation Program continues its efforts 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 March 2004 *NOAO/NSO Newsletter.*

GNIRS

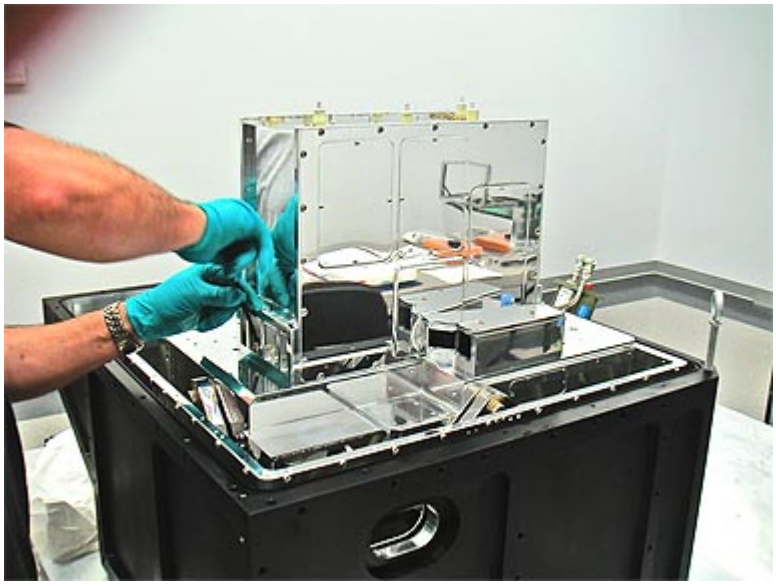
The Gemini Near-Infrared Spectrograph (GNIRS) is an infrared spectrograph for the Gemini South telescope that operates from 1 to 5 microns and offers two plate scales, a range of dispersions, as well as long-slit, cross-dispersed, and integral-field modes. This project has been carried out at NOAO in Tucson under the leadership of Neil Gaughan (Project Manager), Jay Elias (Project Scientist), and Dick Joyce (Co-Project Scientist).

GNIRS was commissioned in its basic modes, long-slit and cross-dispersed spectroscopy. GNIRS also successfully passed its final acceptance testing by Gemini. System verification observations have been carried out in the two basic GNIRS modes. For more details, see the previous article by Jay Elias.

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.

All of the NICI dewar parts have been cleaned, painted (where appropriate), and assembled. NICI was successfully vacuum tested in January 2004. Subsequently, NICI had its first cold test in March 2004, reaching the desired operating temperature. During this first cooldown, the NICI cold mechanisms were tested manually for proper operation. The filters and dichroics for optimal differential imaging of a low-mass companion relative to its primary star have been defined and are being procured. MKIR reports that 75 percent of the work to NICI final acceptance by Gemini, which is planned for December 2004, has been completed.



NICI's filter and dichroic wheel assembly is lowered into the NICI dewar prior to the successful cold test.

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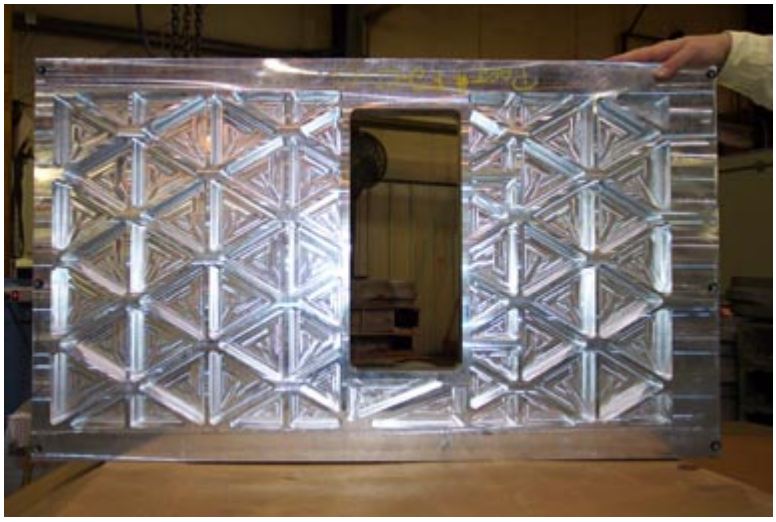
NGSC Instrumentation Program Update continued

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 6.1×2-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.



This image of the cold plate of FLAMINGOS-2 gives a glimpse of progress in mechanical fabrication.

Richard Elston conceived the FLAMINGOS and FLAMINGOS-2 concepts and served as FLAMINGOS-2 Project Scientist and Principal Investigator. Following Richard's tragic death on January 26 (see article in the March *NOAO/NSO Newsletter*), Steve Eikenberry, who was Co-Principal Investigator, has assumed the responsibilities of Project Scientist and Principal Investigator.

FLAMINGOS-2 is in the procurement and fabrication phase of the project. Essentially all of the FLAMINGOS-2 optics have been ordered. Mechanical fabrication is proceeding well at the University of Florida shops and at a few subcontractors. Fabrication of the detector control electronics is ongoing at Florida, with the analog-to-digital converter boards complete. A Gemini/NGSC review of the FLAMINGOS-2 software was completed successfully in March 2004. As of the end of March, 38 percent of the work to FLAMINGOS-2 final acceptance by Gemini had been completed.