Gemini Observing Opportunities for Semester 2005A

Taft Armandroff

The NOAO Gemini Science Center (NGSC) invites and encourages the US community to submit proposals for Gemini observing opportunities during semester 2005A. Gemini observing proposals are submitted and evaluated via the standard NOAO proposal form and Time Allocation Committee (TAC) process. The following are our expectations of what will be offered in semester 2005A in the Gemini Call for Proposals, with a US proposal deadline of September 30. Please watch the NGSC Web page (*www.noao.edu/usgp*) for the Call for Proposals for Gemini observing; this will unambiguously establish the capabilities that one can request.

NGSC is pleased to report that a suite of scientifically vital instrumental capabilities will be offered in semester 2005A.

Gemini North

- The GMOS-North optical multi-object spectrograph and imager will be offered in 2005A. Multi-object spectroscopy and long-slit spectroscopy (both optionally with nod-and-shuffle mode), integral-field unit (IFU) spectroscopy, and imaging modes will be available.
- The NIRI infrared imager/spectrograph will be offered in 2005A. Both imaging mode and grism spectroscopy mode will be available.
- The Altair adaptive optics (AO) system will be offered in natural-guide-star mode in 2005A. The following capabilities of Altair are expected to be offered in 2005A: AO-enhanced infrared imaging and spectroscopy using NIRI.
- Michelle is a mid-infrared (8–25 micron) imager and spectrograph. Michelle is expected to be offered for imaging and for spectroscopy (resolutions of R=200 and R=3000, and possibly echelle spectroscopy at R=30,000 pending commissioning).
- Classical observing will only be offered to programs with a length of three nights or longer. All instruments and modes are available for classical observing, except for Michelle spectroscopy.

Gemini South

- The GMOS-South optical multi-object spectrograph and imager will be offered during semester 2005A. Multi-object spectroscopy, long-slit spectroscopy, IFU spectroscopy (all optionally with nod-and-shuffle mode), and imaging modes will be available.
- The T-ReCS mid-infrared imager and spectrograph will be available in semester 2005A. Both the imaging and spectroscopic modes of T-ReCS will be available in 2005A.
- The GNIRS facility infrared spectrograph will be offered in semester 2005A. Four GNIRS observing modes are expected to be available in 2005A: long-slit spectroscopy with resolutions R=2000 and R=6000; cross-dispersed spectroscopy at R=2000 (with continuous coverage from 1 to 2.5 microns) and R=6000 (noncontinuous coverage); higher-resolution mode with R=18,000; and IFU spectroscopy (pending commissioning report).
- The Phoenix infrared high-resolution spectrograph will be offered in semester 2005A. Phoenix will be offered only for classical observing with an integer-night run length (1, 2, 3...).
- The Acquisition Camera will be available for time-series photometry in 2005A.
- A new visitor instrument, Hokupa'a-85, may be available in semester 2005A. 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 would be offered for high-resolution infrared imaging, coupled to NOAO's ABU infrared imager. Please check the 2005A Call for Proposals.
- Classical observing will only be offered to programs with a length of three nights or longer, except for Phoenix as described above.

Detailed information on all of the above instrumental capabilities is available at *www.us-gemini.noao.edu/sciops/instruments/instrumentIndex.html*.

The percentage of time devoted to observations for science programs in semester 2005A is planned to be 70 percent at Gemini North and 75 percent at Gemini South. The primary use of the remainder of the time will be instrument commissioning (and system verification, if required) of NIFS and the Laser Guide Star System at Gemini North, and NICI and bHROS at Gemini South.

We remind the community that US Gemini proposals can be submitted jointly with collaborators in another Gemini partner. An observing team requests time from each relevant partner country. Such multipartner proposals are encouraged because they access a larger fraction of the available Gemini time, thus enabling larger programs that are likely to have substantial scientific impact. In order to facilitate multipartner proposals, the NGSC accepts Gemini proposals through both the standard NOAO proposal form and the Gemini Phase I Tool (PIT).

GNIRS Key Science Opportunity in Semester 2005A

Taft Armandroff, Jeremy Mould & Steve Strom

The Gemini Near-Infrared Spectrograph (GNIRS) has been commissioned in its primary modes and will be used for community science programs starting in semester 2004B. NOAO is eager to see the powerful capabilities of GNIRS exploited for major scientific initiatives.

As announced in the December 2003 and March 2004 issues of the *NOAO/NSO Newsletter*, NOAO is conducting a program to enable observations with high scientific potential that require significant blocks of time with GNIRS on Gemini South (15 to 20 nights over the next two to three years). Proposers must agree to make all Gemini data and ancillary information available publicly following a minimal proprietary period (less than six months). Please submit such proposals using the normal NOAO Time Allocation Committee (TAC) process, but indicate in the Abstract that your proposal is to be considered for the "GNIRS Key Science Opportunity." The TAC will evaluate the scientific merit of these proposals. In addition, because discretionary time from the NOAO Director will be used for this program, the Director will employ the following criteria in evaluating proposals:

- Intrinsic scientific merit as evaluated by the TAC
- Breadth and quality of the scientific team and its demonstrated track record
- Enhancement of undergraduate education through involvement in research
- Potential value of the archival database to other users
- Plans to manage data reduction and archiving, and deliver data products, in a timely fashion.

We recommend that you address the last three bullets explicitly in your proposal.

During the proposal review process for semester 2004B, NOAO selected the first program for GNIRS Key Science: "*A Near-Infrared Kinematic Survey of Nearby Galaxies: Black Holes, Bulges, and the Fundamental Plane*" by Karl Gebhardt (University of Texas) and colleagues. We wish this team every success in their pioneering work with GNIRS, and we look forward to other ambitious GNIRS Key Science submissions for semester 2005A.

Following the Aspen Process: A High-Resolution Near-Infrared Spectrograph

Ken Hinkle

As reported in the March 2004 *NOAO/NSO Newsletter*, the June 2003 Aspen workshop produced a report on the research ambitions of Gemini (*www.us-gemini.noao.edu/project/announcements/press/aspen_report/aspen_report.pdf*). A derivative of this report was a draft list of instrumental capabilities required to pursue those ambitions. Vetting by the Gemini Science Committee and the Gemini Board resulted in four announcements of opportunity for either design or feasibility studies.

One of the instruments for which Gemini has now contracted a design study is a high-resolution near-infrared spectrograph, HRNIRS. In May, Gemini funded two groups to produce concepts for HRNIRS. While Gemini cannot formally disclose the teams until contracts have been finalized, the size of the effort has required that both groups be partnerships between major instrument building teams. The process is competitive and Gemini will review the proposals in early 2005.

One group that is preparing a concept is a team made up of the University of Florida (UF) and NOAO, with Steve Eikenberry at UF as the overall principal investigator and Ken Hinkle at NOAO as the project scientist. Additional scientific staff with major commitments are Jian Ge at UF and Dick Joyce at NOAO. The engineering groups at both UF and NOAO are engaged. The NOAO-UF team brings considerable experience with Gemini instrumentation and high-resolution spectroscopy, gained from the construction and use of Phoenix, T-ReCS, and GNIRS at Gemini.

The basic instrument concept requested by Gemini features two modes, both of which operate over the 1–5 micron range. One mode is an R=70,000 spectrograph capable of observing either the entire J-H-K region or the entire L-M region in a single integration. The R=70,000 mode would be fed by the standard *f*/16 Gemini tip-tilt secondary. The

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Following the Aspen Process continued

second mode of the instrument is an R=30,000 spectrograph with multi-object input fed by the Gemini multiple conjugate adaptive optics system. With 15 to 30 multiple object probes, the spectrograph would cover at least about one third of either the J, H, or K band. In both modes, significant sensitivity improvements are expected over existing high-resolution infrared spectrographs.

The scientific case for HRNIRS extends from solar system to extragalactic topics. For instance, the capability to record comet spectra over a very broad wavelength interval will allow detailed analysis of numerous molecular species, including symmetric molecules and light organic molecules critical in the chemistry of the young solar nebula. Broad spectral coverage will allow the masses and luminosities of protoplanets to be estimated from a single observation with high spectral resolution, allowing line profile analysis to track angular momentum evolution. Many interesting objects, including massive stars that are highly reddened, for example, in the Galactic Center, can be studied only in the infrared. Large wavelength coverage will permit a single exposure to determine temperature, gravity, and abundances. Routine determination of $CO/H_2/H_3^+$ ratios along a line of sight in the interstellar medium will be possible with a single exposure. Spectroscopy of sets of individual giant stars in the Local Group galaxies, including cluster giants, will be possible in a single exposure, allowing CNO group and metal abundances to be determined quickly for a large number of targets.

A keystone of the Gemini scientific case for several of the planned instruments is the detection of extrasolar planets. Spectroscopy of a broad range of cool dwarfs will be possible with HRNIRS. The design of the spectrograph is intended to facilitate radial velocity precision to a few meters per second. This will allow the detection of low-mass planets around low-mass stars using the Doppler shift technique.

The NOAO-UF team welcomes input from the potential users. A small scientific team has been formed to evaluate key science issues. Ultimately, a very strong and broad scientific case must be made as a basis for funding this promising instrument. Interested and motivated spectroscopists are encouraged to contact Steve Eikenberry at *eikenberry@astro.ufl.edu*.

Gemini/IRAF Project Update

Mike Fitzpatrick for the Gemini/IRAF Team

NOAO and the Gemini Observatory are engaged in a collaborative project with the twin goals of improving and enhancing both the GEMINI reduction software and the underlying IRAF system it uses.

The Gemini/IRAF Project Team celebrated the first anniversary of the collaboration with a June meeting in Hilo to begin planning the second year and to review progress. The already busy agenda for the week was complemented by presentations to the Gemini scientific staff giving an overview and status of the project goals, discussion of GNIRS package development led by Andrew Cooke, and a tutorial on best-practices for CL scripting by Rob Seaman, which was received with great interest. The trip also included a visit to the Mauna Kea summit to see GMOS queue observing in action, providing the visiting programmers with a better understanding of how the GEMINI package is integrated in the observing environment and initiating several new ideas for enhancements to existing products.

One outcome of the Hilo meeting is that the Gemini/IRAF Team is holding biweekly videoconferences between the Hilo/Tucson/Chile sites that include both software experts and instrument scientists. The coordination of work being done at the three sites produced some recent accomplishments, which are outlined below.

An IRAF V2.12.2a patch release was made public in mid-July ahead of the recent GEMINI V1.7 release. V2.12.2a contained a number of system bug fixes needed for the newly released GNIRS package, as well as several new tasks that came out of discussions in Hilo. These include changes to the LONGSLIT package to support bad pixel masks and a new LSCOMBINE task for combining long-slit images. Additionally, there is a new ODCOMBINE task in the ONEDSPEC package for combining spectra with masks and supporting features previously only found in IMCOMBINE. The AUTOIDENTIFY task changes made earlier this year have greatly improved the automatic

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Gemini/IRAF Project Update continued

wavelength calibration processing of data; however, fine tuning of the algorithms and instrument parameter defaults continues.

The V1.7 release of the GEMINI package should be available in early September, and is the third major release of the package under this collaboration. Highlights of V1.7 include:

- First release of the GNIRS reduction package
  - —Supports NIRI as well as GNIRS data
  - —Handles long-slit, cross-dispersed and (preliminary support for) IFU data
  - —Includes steps toward support of T-ReCS/ Michelle spectra with same package
- Initial round of task modifications to use a new, generalized task logging facility
- Release of new GEMARITH/GEMEXPR tasks for doing arithmetic on MEF image extensions automatically

Additionally, several tasks that had previously lived in other external packages have been incorporated under GEMTOOLS to provide needed features and simplify the dependencies for installing the package. Future versions of the package will see the addition of more new tasks as well as another round of task changes to implement scripting improvements and new reduction capabilities.

New releases of software will be announced on the Gemini and IRAF homepages as they become available. For more information and progress reports, see *iraf.noao.edu* and *www.gemini.edu/sciops/data/dataSoftwareReleases.html*.

The Gemini/IRAF team in front of the Gemini North dome at Mauna Kea. From left to right: Andrew Cooke, Frank Valdes, Kathleen Labrie, Craig Allen, Nelson Zarate, Inger Jørgensen, Mike Fitzpatrick, and Rob Seaman.

Gemini Science 2004 Meeting

Taft Armandroff

The first conference on Gemini science results, "Gemini Science 2004," took place on May 23–25 in Vancouver. This conference highlighted the first four years of Gemini science. Gemini Observatory and the National Gemini Offices, including the NOAO Gemini Science Center (NGSC), organized the conference. A total of 128 participants from the Gemini partner countries and Gemini Observatory attended.

Thirty-nine US community members registered for Gemini Science 2004. There were 26 US oral presentations and four US poster presentations. In addition, NGSC displayed posters on "GNIRS Update" and "How to Apply for US Time on Gemini."

The following are representative examples of the results presented at Gemini Science 2004:

- Karl Glazebrook and Sandra Savaglio (Johns Hopkins University) presented results from the Gemini Deep-Deep Survey (GDDS), an infrared-selected ultra-deep spectroscopic program to investigate galaxies in the redshift interval 1<z<2. This interval, known as the "redshift desert" for lack of previous discoveries, is particularly interesting because it is when the Universe experienced its peak star formation activity. Using GMOS at the Gemini North telescope, with its nod-and-shuffle mode, the

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Gemini Science 2004 Meeting continued

GDDS Team detected 150 galaxies at 0.8<z<2 and derived properties, including metallicities, ages, morphologies, and masses. Glazebrook described GDDS finding a great abundance of massive, old galaxies at z significantly above 1. In contrast to the paradigm of standard hierarchical formation models, a large fraction of the stellar mass in large galaxies was assembled at high redshifts rather than recently.

- Chad Trujillo (Gemini Observatory) discussed the discovery of the minor planet Sedna (officially called 2003 VB12), the most distant object ever seen in our solar system. Pre-discovery images allowed refinement of the orbit sufficiently to conclude that Sedna has a highly eccentric orbit, permanently residing well beyond the Kuiper belt with a semimajor axis of 509 astronomical units. Such an orbit is unexpected in our current understanding of the solar system. Sedna is one of the reddest objects in the solar system, almost as red as Mars. Spectroscopy of Sedna with NIRI at Gemini North revealed that Sedna's surface composition is very different from that of both Pluto and Charon.
- Chris Smith (NOAO), Chris Pritchet (University of Victoria), and Isobel Hook (Oxford University) each discussed the use of Gemini for supernova cosmology. Two major observational programs seek to constrain the characteristics of the dark energy that is driving the accelerated expansion of the Universe. Gemini GMOS spectroscopy is used to determine the redshifts and types of the supernova candidates. The nod-and-shuffle capability of GMOS on Gemini, combined with queue scheduling, makes Gemini critical to the success of these two groups, which also have access to Keck and ESO's Very Large Telescope. In fact, both groups use Gemini for their most challenging targets.
- Charlie Telesco (University of Florida) presented observations from T-ReCS at Gemini South of the circumstellar environments of pre-main-sequence and younger main-sequence stars. He showed extensive new multiband mid-infrared images of the Beta Pictoris circumstellar disk and discussed marked trends in the disk structure with wavelength. Based on modeling, Telesco hypothesized that the orbits of protoplanets cause the observed structure in the disk.
- Karl Gebhardt (University of Texas) spoke about using Gemini to study central black holes in the most massive galaxies to constrain the high-mass end of the black hole correlations. However, such black holes are difficult to detect due to the low surface brightness of their galaxy hosts. The Gemini GMOS Integral Field Unit (IFU) is the ideal instrument to measure the central kinematics. Gebhardt et al. targeted eight cD and central galaxies in clusters. In particular, they measured the black hole mass in NGC 4472, accurate to 15 percent. Gebhardt emphasized that Gemini's new instrumentation is poised to play a unique role in understanding the relation of central black hole formation to the formation and evolution of galaxies. With the advent of GNIRS, and its IFU, followed by the NIFS IFU spectrograph coupled to the Altair adaptive optics system, Gebhardt predicted that Gemini would inherit Hubble Space Telescope's renown for studying black holes in the centers of galaxies.

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Presentations at Gemini Science 2004 meeting (clockwise from upper left): Wayne Van Citters (NSF), Keivan Stassun (Vanderbilt University), Julianne Dalcanton (University of Washington), Charlie Telesco (University of Florida), Sandra Savaglio (Johns Hopkins University), Craig Kulesa (University of Arizona), and Karl Gebhardt (University of Texas). Photos courtesy of Gemini Observatory.

Gemini Science 2004 Meeting continued

- In a previous observational program, Julianne Dalcanton (University of Washington) and colleagues found that late-type disk galaxies all host a substantial thick-disk component. As part of an extensive follow-up campaign to constrain the origin of the thick-disk population, Dalcanton et al. have been using Gemini and GMOS to measure the kinematics of thick disks in external galaxies. Their preliminary results indicate kinematics that are comparable to those of the Milky Way's thick disk. However, the degree to which the rotation of the thick disk lags that of the thin disk has been found to vary from galaxy to galaxy. Dalcanton argued that her Gemini data favor an accretion scenario for the formation of thick disks.

For the final program of the Gemini Science 2004 meeting, see *www.us-gemini.noao.edu/science/gem_conf/sched.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 June 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.

Work continues on the integration and testing of the NICI dewar and its contents. Following the first NICI cold test in March, the NICI cryogenic optics have been integrated into the dewar in preparation for a second cold test (planned for August). All electronics boards and components have been integrated into the array controller cabinet, which has passed subsystem testing.

In addition, work on the components of the NICI adaptive optics (AO) system has advanced. The University of Hawaii Institute for Astronomy, which is providing the components for the AO system, has produced a batch of 85-element deformable mirrors that meet the stringent NICI requirements. The AO electronics for NICI have been integrated and tested.

MKIR reports that 81 percent of the work to NICI final acceptance by Gemini has been completed. NICI is expected to be deployed on Gemini South in 2005.

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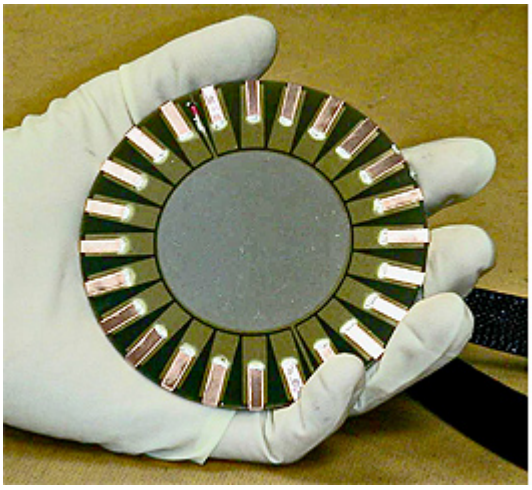

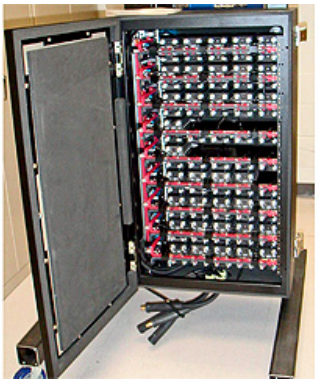

Progress on the NICI adaptive optics system is shown via images of a deformable mirror (top), the enclosure containing the avalanche photodiodes (APDs) for the NICI AO system (lower left), and the populated enclosure for the other NICI AO electronics (lower right).

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, under the leadership of Principal Investigator Steve Eikenberry.

FLAMINGOS-2 is in the late fabrication phase of the project. Recent achievements include the completed fabrication of major dewar components. Both the main camera dewar and the smaller (MOS) dewar that contains the masks for multi-object spectroscopy have been fabricated, test fitted, and vacuum tested. The FLAMINGOS-2 lenses are undergoing fabrication. Wiring of major electronics subassemblies is underway, and the first software Beta release occurred in July.

As of 7 July 2004, 45 percent of the work to FLAMINGOS-2 final acceptance by Gemini had been completed.

View of the FLAMINGOS-2 camera workbench (top), G-10 spacer, and dewar spacer ring, alongside FLAMINGOS-2 mechanical engineer Jeff Julian.