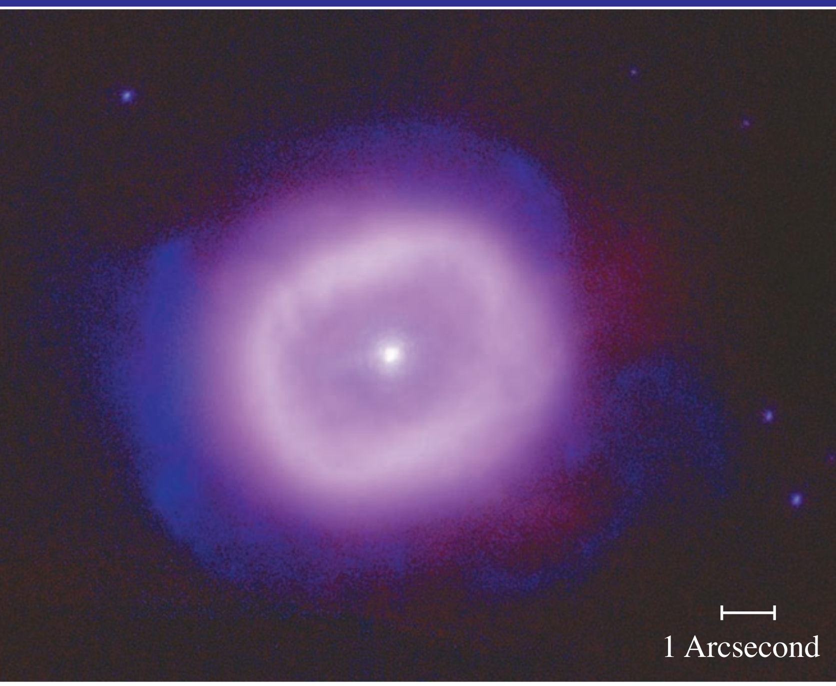
GEMINI OBSERVATORY NEWSLETTER

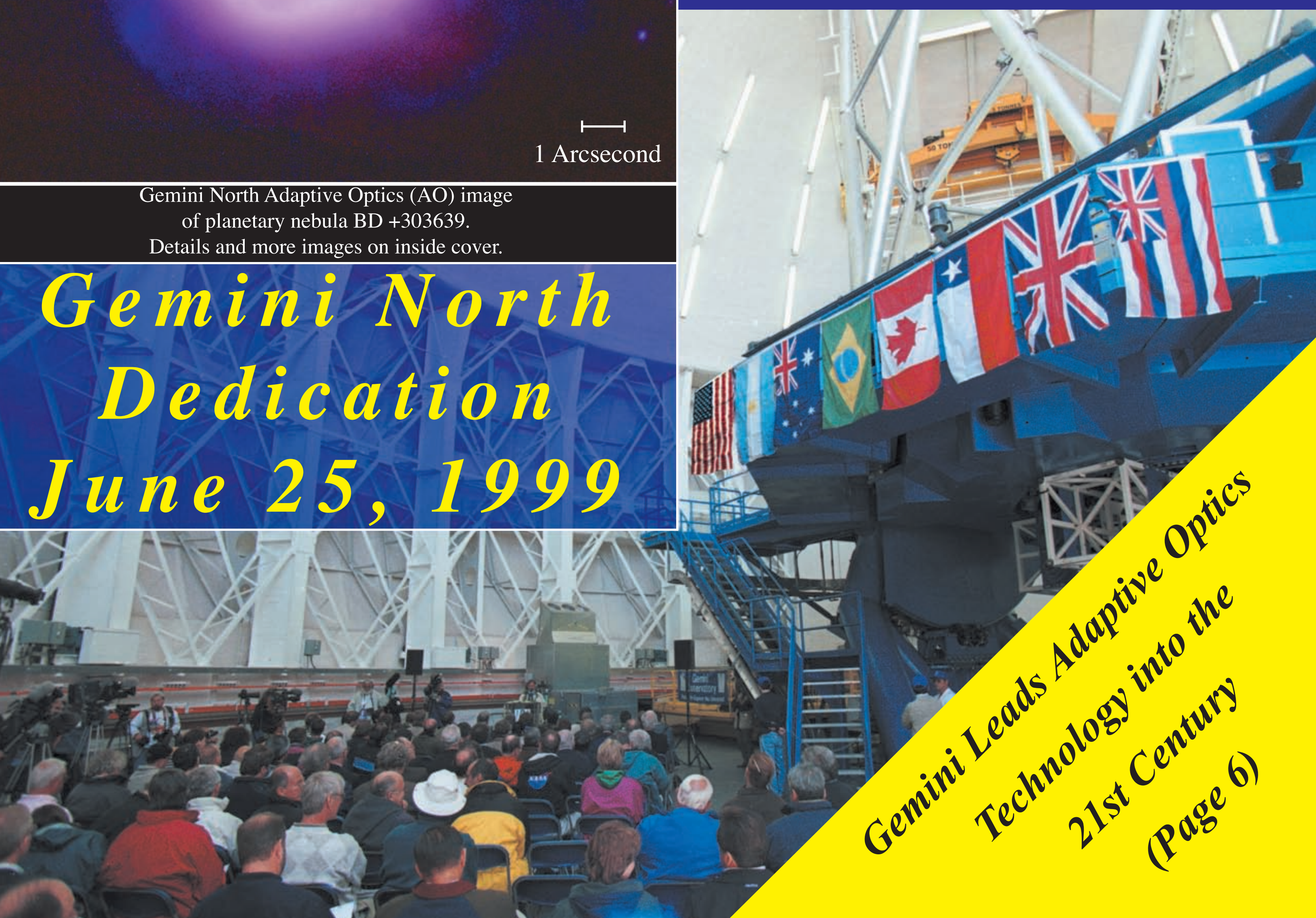
Issue 19 December 1999

In This Issue:



Gemini North Adaptive Optics (AO) image of planetary nebula BD +303639. Details and more images on inside cover.

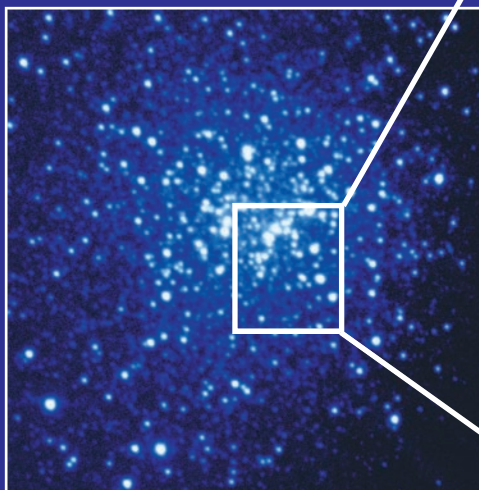
Gemini North Dedication June 25, 1999

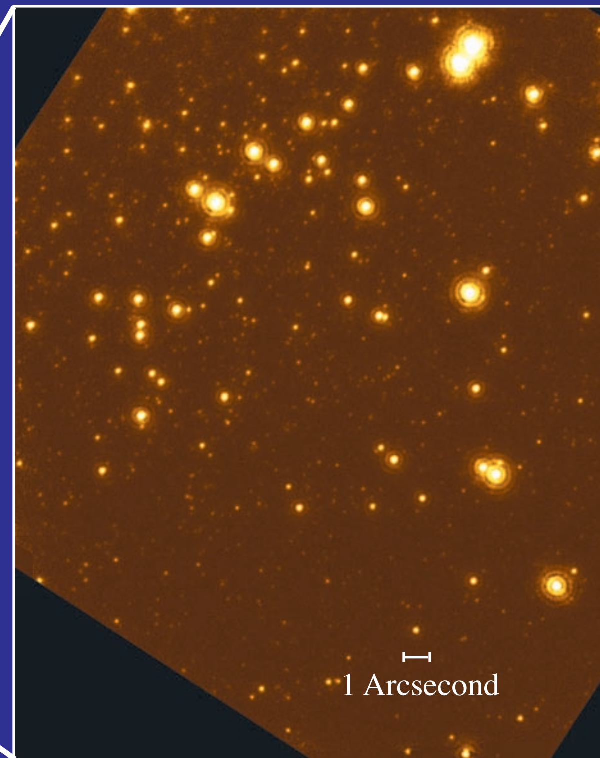


Gemini Leads Adaptive Optics Technology into the 21st Century (Page 6)

Looking Up With Gemini North...

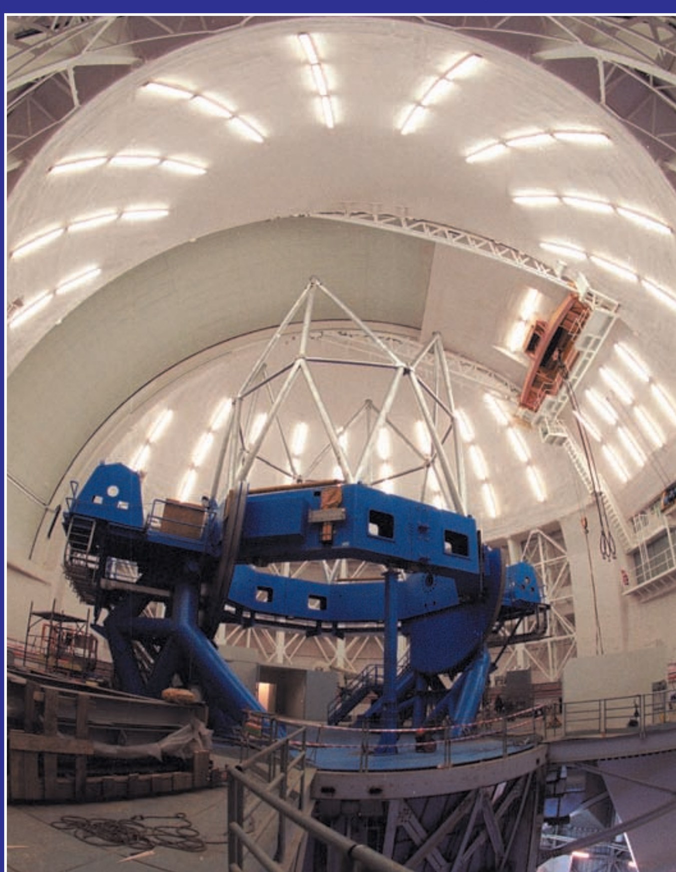
These images of the Globular Cluster NGC 6934 were both taken through Gemini North. The (left) image was taken at optical wavelengths WITHOUT Adaptive Optics and has a FWHM resolution of about 0.6 arcsec. The "blow-up" of the central portion (right) was taken using the NSF funded, University of Hawaii's Hokupa'a Adaptive Optics (AO) system with an imager called QUIRC. The infrared Adaptive Optics image has a FWHM of 0.09 arcsec, or about the separation of a pair of automobile headlights at about 2500 miles!





Building Up At Gemini South

These images of Gemini South were taken by Gustavo Arriagada in late October, 1999. As can be seen in these images, the telescope structure is progressing well and it is expected that the primary mirror will be shipped in the Spring of 2000. If you want to monitor the progress of the telescope, access www.gemini.edu/gallery/daily_cp.html



Cover (inset) Photo: The photograph of the planetary nebula BD+303639 was obtained with Gemni North using the NSF funded, University of Hawaii's Adaptive Optics system named hokupa'a. This infrared image was obtained with the QUIRC imager and has a FWHM of 0.083 arcseconds.

The Gemini Observatory Newsletter

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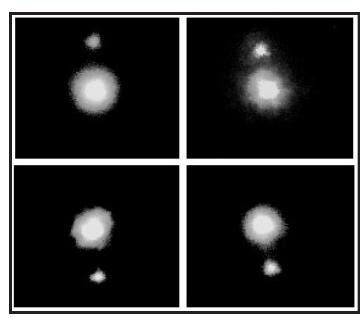
Edited by Peter Michaud
pmichaud@gemini.edu

MESSAGE FROM THE DIRECTOR

Matt Mountain

Walking into our Northern Operations Center in Hilo late one night in June was an exhilarating experience. In the darkened Operations Room, a group of approximately ten people were either surrounding one of the many computer monitors or watching the crew at the summit control room over the videoconferencing system. Sitting at his own terminal in Hilo, Project Manger Jim Oschmann was being urged to try one more tweak of the primary mirror figure when there was a sudden cry of "got it!" Simultaneously, everyone's attention turned to the University of Hawaii Adaptive Optics (UHAO) team and the infrared camera displays showing a remarkable two-micron image of Pluto and its moon Charon. "Image quality is zero-point-one arc-seconds" came a voice from Mauna Kea, "it'll do, let's go" replied the Project Manager. "Jim, hold it…" said Buzz Graves looking at the AO control screen from over the shoulder of UHAO collegue Malcolm Northcotes, "…we've got large amplitude, low frequency, low order errors in the control loop -- we seem to have dome seeing." Immediately, Jim looked up at videoconference screen and asked, "Simon, are the vents open?" Simon Chan, our system support associate up on Mauna Kea realizing that the vents are closed replied, "Good point, hold-on, vents opening…" Several seconds later Malcolm's voice returns, "Low frequency errors now zero, dome seeing gone." "Okay, can we go on now?" said Jim, looking at his watch, "we've got a lot to do tonight guys…" And so began another night of adaptive optics work on Gemini North.



Gemini AO images of Pluto and Charon between June 14-17. Pluto was used as a test object during AO imaging prior to the dedication.

Watching all this back in June, two things stuck me. First, although we have a long way to go before we are ready for operational hand-over, we clearly have developed a nascent "operations team" working hard to do first-class observations with an 8m telescope on Mauna Kea. Secondly, looking at the nighttime state of operations and summit control rooms, with lab books, lap-tops, cookie packets and coffee cups scattered on every surface, the telescope is clearly moving into an operational state!

By early November we were ready to hold our first “Operations Preparedness” Review. The Review Panel, Chaired by Fred Chaffee (Director of the Keck Observatory) looked at whether the Gemini North Telescope, its first facility instrument (NIRI), the Science Operations Team and the National Gemini Offices (NGOs) would be ready for our first “call for proposals”. Their conclusions were instructive.

They were “enormously impressed by the state of readiness of the telescope and of the NGOs to receive proposals, manage the TAC process and forward the proposals to Gemini in a uniform way so they can be assembled into a combined classical and queue schedule. Similarly, [they] were impressed with the results of the immense amount of work that has gone into the web-based proposal planning and submittal process, and the training program at Gemini HQ for those charged with disseminating this information to potential users in the partner countries.” The Review Panel however were concerned that “Gemini is attempting to break new ground on many levels—[for example] its use of queue scheduling, its serving of a global users community, [and] its eventual operation of two telescopes with a single team of engineers. We feel strongly that such an ambitious program requires a much higher level of readiness than ever before and believe that it would be essential to have a first-class NIRI [Near Infrared Imager] to offer its users at the beginning of Gemini Science operations”. The Panel is concerned that NIRI and its associated detector systems do not yet meet the “higher level of readiness” required. NIRI has completed a very successful first cool down as a fully assembled instrument, however it will not be until the next cool down that we anticipate a demonstration of its scientific performance.

Therefore, before issuing our first call proposals and setting a proposal deadline, Gemini will undertake a further in-depth review of NIRI’s performance and its associated systems after its next cool down in January 2000. Despite today’s uncertainty in the actual date NIRI may be come available to the Gemini Observatory, we are planning to hold our final “Operational Preparedness Review” of the Gemini North Telescope in May of 2000.

In the meantime the part of the team already in Chile hasn’t been idle either. As can be seen on our “live” Web pictures from Cerro Pachón (http://www.gemini.edu/gallery/daily_cp.html), our giant parts kit is now becoming the second Gemini telescope. The E-mail, telephone and video-conference lines are regularly abuzz with traffic between Hilo and La Serena. Nor are our transfers purely “electronic”. Several Observatory staff have recently moved from Hilo to La Serena, and some are returning home to Chile after two years in Hawaii. In addition, there are several familiar faces who are now “commuting” between our two sites, ensuring that our “Mauna Kea lessons learned” will be effectively applied to the Cerro Pachón telescope.

This feeling of exhilaration is not just being generated by the progress of our telescopes. We our on the verge of an exciting change in the direction of our adaptive optics (AO) program. Led by Dr. François Rigault as Program Scientist and Dr. Brent Ellerbroek as Program Manager, the new Gemini AO Group is developing what could be called the “Next Generation” of AO technology. After consultation with the Gemini AO and science communities at an AO workshop held in Hilo in April ’99, this new and revolutionary concept for the Cerro Pachón AO facility has begun to take shape. Motivated by 1) the requirements of the science programs as laid out in the 1997 Abingdon Workshop, 2) very strong competition with other observatories, and 3) longer term issues such as competitiveness of Gemini in the NGST era, a multi-conjugate adaptive optics system (MCAO) has been proposed for Cerro Pachón. As the key element in our AO program, this system which is described in this Newsletter by François and Brent, will deliver a uniform AO compensated image quality over a nearly 2 arc-minute field of view. In conjunction with a well thought out instrumentation suite, this system will be a powerful tool for deep infrared imaging and multi-object IR spectroscopy. The Hilo AO workshop concluded: “We believe that the proposed program addresses most of the requirements of the Gemini science mission, as defined in the top science requirements and the Abingdon science programs. It will put the Gemini science community at the very forefront for several years, and will still be competitive (in near IR spectroscopy) in the NGST era.”

These are indeed exciting times for the Gemini partnership!

GEMINI PROJECT UPDATE

Jim Oschmann

Since the last newsletter was published 6 months ago, the Gemini project has experienced much excitement, progress and ceremony. The most visible event was the very successful dedication of the Gemini North telescope on June 25-26 (see article/pictorial on the inside back cover of this issue). In preparation for the dedication, fantastic images were produced that demonstrate the capabilities of these state of the art facilities (see front cover). These imaging efforts involved significant work by the entire Gemini staff as well as our partners at the University of Hawaii. The University of Hawaii also provided the adaptive optics system (Hokupa'a) along with the extra assistance necessary to produce these results in time for the dedication.

Gemini North

Immediately following the dedication, work resumed at both Gemini North and South, with commissioning activities on Mauna Kea advancing the telescope toward scientific handover to the operations team in the summer of 2000. These activities include continued improvements on the M1 support system, clean-up of M2 assembly functions, improvements in the acquisition and guiding system, preparations for closed loop active optics, and the initiation of regular maintenance programs for much of the equipment on Mauna Kea.

Larry Stepp and others supporting the Optics Group kept the mirror cell assembly work progressing with a successful series of measurements at prime focus shortly after dedication. Analysis of these measurements by Myung Cho combined with improvements on the support system actuators by John Maclean have realized open loop active control of the primary mirror that is very close to the expected closed loop performance. These efforts resulted in wavefronts that meet the closed loop error budget for the telescope and these long-term wavefronts are consistent with 0.07 arcsec images. Recall that the telescope error budget, excluding atmosphere, is 0.1 arcseconds at 2.2 microns - so we are right on track for meeting the highest priority error budget target.

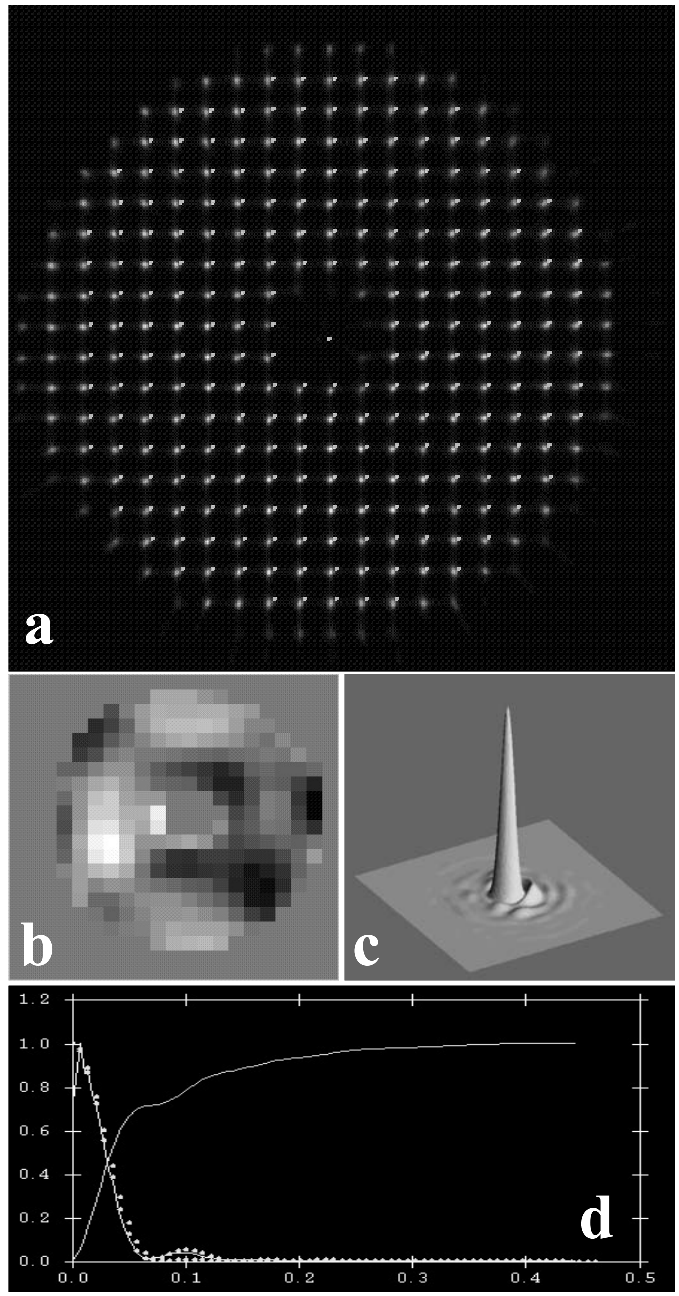


Figure1 (a-d): *Prime focus wavefront sensor image (a) and data reduction (b-d). Image (a) shows the Shack-Hartman spot pattern of a star with (smaller) reference spots, (b) is an optical path difference map, (c) shows a 3-D point spread function (psf), and (d) is a plot of encircled energy vs. diameter in arcseconds.*

To consistently obtain the type of telescope performance described above has required the continuation of some commissioning activities on the other real-time systems. Control system improvements for the secondary mirror control have been completed and are being tested as this newsletter goes to press. Also, the acquisition and guiding (A&G) system was found to need major rewiring work in order to improve both reliability and serviceability. This work has been completed under the leadership of John Wilkes of our Electronics Group and based on this work, Zeiss Optical in Germany is making similar improvements on the Cerro Pachón unit that is near acceptance.

Related to the A&G work, Corrine Boyer is leading efforts on the wavefront sensing system with modifications to hardware and software that will improve both speed and reliability of this system.

All of the systems mentioned above are preparing us for the imminent (as of this writing, October, 1999) implementation of closed loop active control of the primary mirror and secondary alignment. Working together, these systems will ensure that the telescope will meet our performance goals on a consistent basis. Also, commissioning of the thermal control systems to further improve overall telescope performance is a major task that will begin next year.

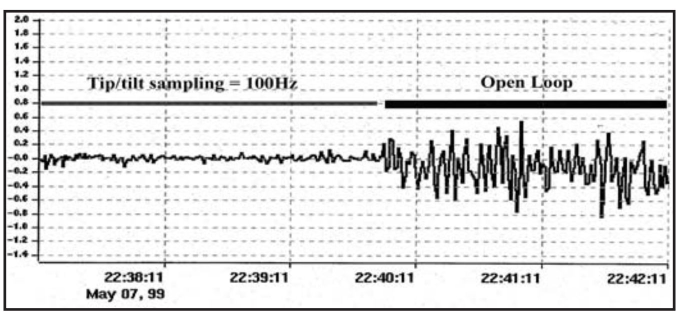


Figure 2: *Tilt loop performance graph*

Another commissioning activity that has improved telescope operational performance is the recent progress on the mount drive tape encoder system. Earlier in the year, we used backup friction encoders and while these worked better than expected and often delivered pointing near our overall specifications, they were susceptible to slippage. The first test of the tape encoding system, implemented by John Wilkes and Andy Foster was successful in meeting our requirements of pointing to better than 3 arcseconds rms (see Figure 3).

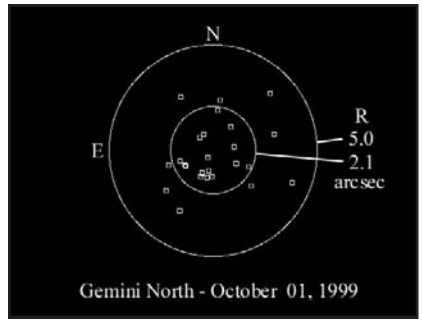


Figure 3: *Pointing results revealing better than 3 arcseconds rms.*

Other systems now completed include the Enclosure Control System and the control console that has been installed both at the summit and the Hilo Base Facility. A solution to eliminate leaks in the mirror support system has been implemented. Work on the higher level software has also progressed well and Kim Gillies and his team will be working to implement various parts of this as we enter Y2K**.**

Gemini South

With completion of the Cerro Pachón enclosure and support building, the Gemini South telescope structure began assembly this summer under the leadership of Mike Sheehan (who has now relocated to Chile) and Paul Gillett. Mike and Paul have taken over management of this work after the departure of Keith Raybould in July. The project wishes to thank Keith for his years of hard work and devotion, allowing Mike and Paul to follow-on flawlessly. The main steel telescope structure was erected from July through October, one month ahead of schedule (see inside cover photo and www.gemini.edu/gallery/daily_cp.html). Work has also accelerated in outfitting the many systems and services in the enclosure and support building.

After spending two years helping complete Gemini North installation, several of our early Chilean hires have returned to Chile to help lead the integration/commissioning efforts at Gemini South. This includes Gustavo Arriagada, Manuel Lazo (both in our Electronics Group), and Luis Godoy in our Mechanical Systems Group. We have begun increasing our hiring efforts in Chile as existing staff return and Gemini South integration ramps up.

We already have many systems that are ready to be integrated in Chile that include:

- Primary mirror (in storage in France)
- Primary mirror assembly (in Chile)
- Secondary mirror (in Chile)
- Secondary assembly (being integrated in Hilo)
- Cassegrain Rotator (in Chile)
- Instrument Support Structure (in Chile)
- Acquisition and Guiding (in final stages at Zeiss)
- Services being installed
- Telescope structure (mostly installed!)

Instrumentation

Much of the partnership efforts are concentrating on instrumentation and Adaptive Optics. Our first facility instrument, NIRI, from the University of Hawaii will be on the telescope early in the year 2000. GMOS integration is well underway in the UK and Canada. GNIRS work at NOAO has been restarted with the new team doing an excellent job at a restart review held in July. A totally new layout was developed that addresses previous technical concerns and the management is well in hand.

The Adaptive Optics (AO) program has expanded into the exciting potential of wider field correction using Multi Conjugate AO (MCAO) methods for Gemini South. The overall AO program is being led by François Rigaut and Brent Ellerbroek who were hired this year. A feasibility study was just completed which shows how this exiting technique can be realized with mostly existing technology in a straightforward manner. More details on this initiative can be found in François' and Brent's article in this newsletter.

Summary

We look forward to the continuation of the successful commissioning work that is ongoing on Mauna Kea. This is well underway with lots of progress on several fronts. The first phase of Chile integration is going extremely well using experiences gained on Mauna Kea. Though MK commissioning is our priority, the work in Chile is ahead of schedule.

HUMAN RESOURCES UPDATE

Melissa Welborn

As we gear up for scientific hand-over, Gemini has made some important staffing changes to our scientific team. Dr. Phil Puxley has been appointed Interim Associate Director for Gemini North and as such, Dr. Puxley is leading the Gemini North Scientific Operations Team.

We recently began the search for a full-time Gemini North Associate Director and our recruiting for other scientific, mechanical design, instrumentation engineering, and software staff continues. We have filled key positions with the following additions to our scientific staff: Dr. Tom Hayward, from Cornell University and Dr. Bryan Miller from Leiden University will come on board in January 2000. After a period in Hawaii, both Dr. Hayward and Dr. Miller will relocate to Gemini South. In addition, we are pleased to announce that Dr. Brent Ellerbroek, formerly of the US Air Force Research Lab, has joined the Gemini team as the Adaptive Optics Program Manager. In August, Dr. Paul Gillett was promoted to Site Manager for Cerro Pachón, and Mike Sheehan assumed duties as Manager of Mechanical Systems as we transition many of our construction team to Gemini South.

Due to the movement of some of our staff to Chile, the Human Resources Department has put together information of general interest about Chile on the new HR Internal Web Site and has created a binder for relocating employees. We invite our readers to take a look at the links to information about Hawaii and Chile on our Gemini Job Opportunities page at *www.gemini.edu/project/announcements/jobs.html.*

GEMINI TAKES THE LEAD IN HIGH ANGULAR RESOLUTION ASTRONOMY

François Rigaut and Brent Ellerbroek

Gemini has just received approval from the Gemini Instrument Forum and the Gemini Science Committee to embark in a Conceptual Design Study for the construction of a Multi-Conjugate Adaptive Optics (MCAO) system. This system is designed to deliver diffraction limited images over a field of view of up to 2 arc minutes in diameter, with nearly uniform image quality. These goals will be achieved by the use of multiple deformable mirrors, guide stars and wavefront sensors. This represents a major upgrade with respect to traditional Adaptive Optics (AO) systems in which the image quality degrades steadily when looking away from the AO guide star. This is a major endeavor and if the Conceptual Design Study is approved in May 2000, it will lead to four years of development before being installed at Cerro Pachón in mid 2004.

> ***"This system is designed to deliver diffraction limited images over a field of view of up to 2 arc minutes in diameter, with nearly uniform image quality."***

A Short Overview of the Gemini AO Program

Altair

The current AO program at Gemini consists of Altair, a Natural Guide Star (NGS)/Laser Guide Star (LGS) adaptive optics system for use on Gemini North. The construction of Altair is underway and proceeding well at the Hertzberg Institute for Astrophysics in Victoria, Canada. A Request for Proposals was released in early October 1999 to provide a 10-20 watt sodium laser that will be used to produce a LGS for Altair on Mauna Kea.

Hokupa'a North

In 1998, the possibility arose that would allow Gemini to use the University of Hawaii's (UH) NGS AO system called Hokupa'a* soon after first light on Gemini North. Hokupa'a went through some modifications earlier this year to make it compatible with the Gemini F/16 input beam and the mechanical interface with the Instrument Support Structure. A new deformable mirror was also retrofitted. Hokupa'a was installed in late May, and obtained nearly diffraction limited images only days later, just in time for the dedication (see cover of this issue.) During the pre-dedication run when seeing was generally between 0.7 – 1 arcsec, AO compensated images with Strehl Ratios of 15-30% and Full Width at Half Maximum values of 70 to 100 milliarcsec were regularly obtained. (See box: "An Adaptive Optics Dictionary" for a definition of Strehl Ratio). The performance matches the expectations that were derived from numerical simulation codes at both UH and Gemini.

Hokupa'a is going to be upgraded next year to accommodate an 85 actuator deformable mirror and an 85 sub-aperture sensor that will be called Hokupa'a-85. The expected performance of Hokupa'a-85 is given in the Table 1. The quoted Strehl Ratios include only the atmospheric turbulence contribution as compensated by the AO system. It does not include residual static aberrations from the telescope or the instru-

** Hokupa'a is the Hawaiian name for Polaris, the "north" or "stationary" star.*

ment, (e.g. the QUIRC* static aberrations currently reduce the Strehl ratio by about 40% in K band). Hokupa‘a-85, with QUIRC, will be available for use by the Gemini communities during early operational use of Gemini North and prior to the arrival of Altair.

Seeing	J band Strehl Ratio	K band Strehl Ratio
0.45”	50%	80%
0.65”	25%	62%

Table 1: *Expected performance of Hokupa‘a-85 (AO only)*

Hokupa‘a South

Following the success of Hokupa‘a at Gemini North, its upgraded version, Hokupa‘a-85 is going to be replicated for use at Gemini South during the period from operational hand-over until the availability of the MCAO system in early 2004. Hokupa‘a-85 at Cerro Pachón will be coupled with a commercially available low-power sodium laser which will provide the Gemini science community with a 2 to 3 year window of unchallenged capability in the southern hemisphere. Hokupa‘a-85 on Gemini South will be a visitor instrument. The duplication of Hokupa‘a-85 is dependent on the funding of a NSF proposal that was submitted by the UH-AO group in late August 1999.

The Next Step in the Gemini AO Program

In response to the very strong competition (see “Other Planned and Existing AO Systems” box in this article) that includes future NGST capabilities and the need to better address the science requirements laid out in the Abingdon Report*, the Gemini AO and instrumentation groups have developed the aggressive plan outlined in this article. After consultation with the Gemini AO and science communities at a workshop held in Hilo in April ’99, a multi-conjugate adaptive optics system was proposed that would serve as the key element in the Gemini South AO program. This system will deliver uniform AO compensated image quality over a field of view nearly 2 arcmin in diameter, with on-axis performance that is on the order of, or better than *Altair*’s. It is expected that this system, in conjunction with a well thought out instrumenta-

** QUIRC is a 1 – 2.5 μ IR camera on loan to Gemini from the University of Hawaii*

** The Abingdon Report is from a 1997 meeting (held in Abingdon) that defines the top science objectives for Gemini. A copy of the report*

Other Planned and Existing AO Systems

High spatial resolution has been identified by most of the leading observatories as one of the master keys needed to unlock the most important astrophysical questions in the next few decades.

The European VLT has made major investments in AO, working in this field for more than 10 years (the instrument COME-ON has been in operation since 1989 at the ESO-La Silla 3.6-m telescope). A 14x14 sub-apertures Shack-Hartmann system, the VLT-NAOS AO system is planned for commissioning on VLT-UT1 in mid 2001. An integral field unit, with an integrated AO curvature system, is also planned for 2001, and major efforts are being devoted to medium order, interferometry-dedicated AO systems.

The Keck observatory has also adopted a rather aggressive approach to AO. Keck’s AO program began in 1994 and within the first night of operation in December ’98, Keck has had a working 20x20 sub-apertures, Shack-Hartmann AO system on Keck-II. Funding has also been secured for a second system to be installed on Keck-I. Although not yet fully optimized for automated nighttime use atop Mauna Kea, a laser has been at Keck for almost a year now. This laser could be used on the telescope in conjunction with their AO system within several months.

Subaru also has an AO program, although more modest that VLT’s or Keck’s. The Subaru AO system, a 37-actuator curvature-based system, has already been tested on a telescope in Japan and installation on the 8-m telescope is planned for the end of this year. Subaru’s plans include the retrofit of a low power sodium guide star to increase sky coverage.

On the laser side, the Lick and the Calar Alto observatories have been experimenting with LGS AO for the past three years, showing fast and steady progress. Calar Alto, for instance, uses an 18 mode AO system with approximately 3W of sodium laser light projected into the sky which has improved performance by nearly a factor of 10 in the last two years. Recently, Calar Alto has obtained a Strehl ratio of 0.23 in the K band, tion suite, will address a significant fraction of the NGST science programs 4 years prior to the NGST launch. As a result of the April workshop and at the request of the Gemini Board of Directors, a feasibility study of the MCAO system was carried out. This study addressed the science drivers of such an instrument; assessed performance with theoretical analysis and numerical simulations; looked at computing and control issues and includes an opto-mechanical proof-of-concept design and an early management plan.

The proposed program, including the facility systems at Mauna Kea and Cerro Pachón, addresses most of the requirements of the Gemini science mission, as defined in the Gemini top science requirements and the Abingdon science programs. It will put the Gemini science community at the very forefront of high angular resolution astronomy for several years, and will still be competitive (for near IR spectroscopy) with the NGST.

What is MCAO?

The major fundamental limitation of traditional NGS AO systems is sky coverage, which results from a combination of the finite *limiting magnitude* of the guide star and the *isoplanatic patch*. Typical values of *sky coverage*, for adequate compensation in the near IR, are of the order of 0.1 to 1%. (See box: "An Adaptive Optics Dictionary" for a definition of *limiting magnitude, isoplanatic patch and sky coverage).* Because the sky coverage is so low with NGSs, the use of Laser Guide Stars (LGSs) was pro-

An Adaptive Optics (AO) Dictionary:

Strehl Ratio: A measure of image quality for close to diffraction limited images. It is the ratio of the maximum intensity of the actual image to the maximum intensity of the fully diffraction limited image, both of them being normalized to the same integrated flux.

Limiting Magnitude: Because the phase aberrations have to be measured over a finite spatial scale ($r_0(\lambda)$) and time scale ($\tau_0(\lambda)$), and with a useful SNR, only stars brighter than a given *limiting magnitude* can be used for NGS-AO systems (typically m_R=13-15).

Sky Coverage: Fraction of the sky in which a targeted performance can be achieved.

Isoplanatic Patch: Because the turbulence is vertically distributed over several kilometers, and not all located in a single layer at the ground, the phase corrugation is not isoplanatic. This means that it changes according to the direction in which the telescope is pointing. Practically, for typical vertical distributions of turbulence and typical seeing, the phase angular decorrelation is such that the isoplanatic patch (defined here as the radius of the field over which the Strehl loss is lower or equal to 50%) is typically equal to 40'' in K band. This angle scales as $\lambda^{1.2}$, which then translates into 25'' at H band and 20'' at J band.

Cone Effect: Because a LGS is at finite altitude (90km), the beam propagating back to the telescope aperture does not follow the same path as the beam from a celestial object, located at infinity. Therefore, there is an estimation error, which results in a phase error, and in a degradation of the performance. Its amplitude depends on the vertical profile of turbulence and on D/r_0 in the telescope aperture, which means that it becomes more critical toward shorter wavelengths, for larger telescope apertures, or for worse seeing. In an average astronomical site and for an 8-m telescope, the Strehl ratio attenuation due to the cone effect is typically 50% at about 1μm, and reduces the performance further to almost zero at visible wavelengths.

Tip-tilt Problem: A LGS is not fixed in the sky. Indeed the laser is shot from ground level, and before it hits the sodium layer and is back scattered, it crosses some turbulence. This induces a wander of the spot at 90km, which in turn make its position unpredictable. The LGS still provides useful information on relative phase excursion across the telescope aperture, but the overall tilt cannot be unequivocally extracted from the LGS information. In addition to the LGS, one therefore needs a NGS that will provide the image motion information. Because the whole telescope aperture is used in Tip-tilt sensors, a NGS significantly fainter than the one required for NGS-only systems can be used. Typical limiting magnitude for Tip-tilt NGS on an 8-meter telescope are m_R=18. Such systems lead to approximately 30-50% sky coverage in the near IR, which is a vast improvement with respect to NGS systems.

posed in 1985 (Foy and Labeyrie). The idea is to create an artificial beacon, or artificial star, by resonant scattering of the Sodium atoms located in the 10km thick, 90km high Sodium layer of our atmosphere. Projected from an auxiliary telescope mounted on the observing telescope, this beacon can be created wherever it is needed and in particular where no NGS is available. Unfortunately, a LGS does not provide a full solution. Two fundamental problems are associated with the use of LGS's: The cone effect and the tip-tilt problem (see "An Adaptive Optics Dictionary" box). Compared to NGS AO, LGS AO vastly improves the sky coverage, but the cone effect reduces their performance (Strehl Ratio) by about 50% at 1 micron (and more at shorter wavelengths). Sky coverage is still somewhat limited by the need for a natural guide star to make tip-tilt corrections, but Tip-tilt NGSs can use the entire light collecting power of the telescope and allow for the use of dimmer, more plentiful stars.

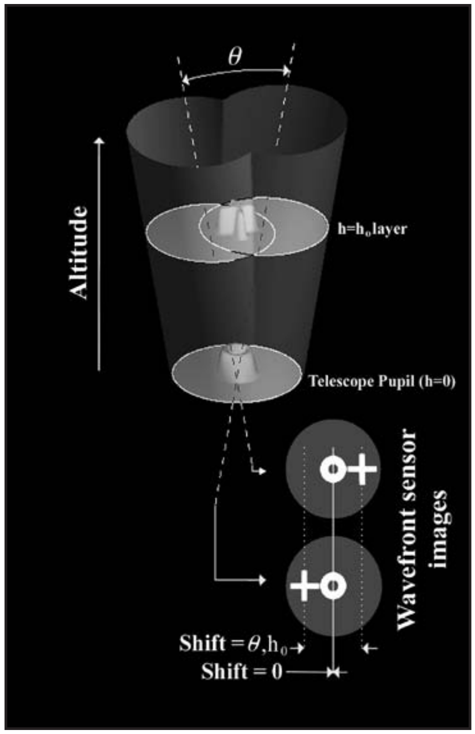


Figure 1: *Principle of MCAO. The shift of a phase feature signature in the 2-D wave-front sensors is proportional to the altitude of the atmospheric layer which created it. Once reconstructed, the 3-dimensional phase volume is then compensated in a 3-D fashion by using several deformable mirrors conjugated at a range of altitude.*

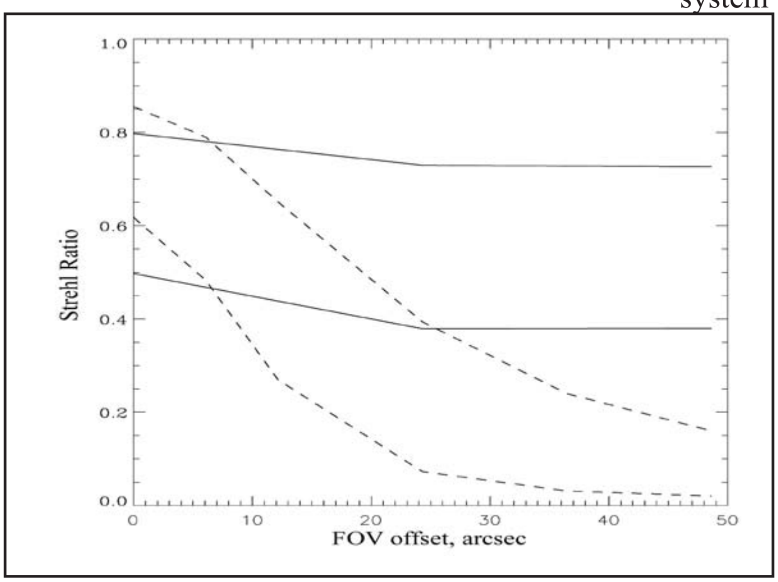


Figure 2: *J (lower curves) and K (upper curves) Strehl ratio versus off-axis angle for Natural Guide Star systems (dashed line) and for a MCAO system using 5 LGSs, 4 NGSs and 3 deformable mirrors (solid line). Both are 12x12 subapertures Shack-Hartmann systems. This case was run for a zero degree zenith angle, under median seeing conditions, for a typical Cerro Pachón turbulence profile.*

A concept called Multi-Conjugate Adaptive Optics was proposed by Beckers in 1988 and developed by Ellerbroek in 1994. MCAO provides a solution for the cone effect and delivers nearly uniform image quality over a larger compensated field of view. MCAO is based on what is called "tomographic" analysis and compensation. The tomographic analysis is similar in principle to the SCIDAR* principle used in atmospheric characterization in which several 2-D sensor measurements are combined to reconstruct 3-D information. In a MCAO system, the actual process looks much like simple stereoscopy. Two sensors look at two different guide stars, separated by an angle (see Figure 1). The two beams have an increasing shear with altitude, the shear being $\theta.\boldsymbol{h}$. A phase feature, e.g. a phase bump, seen by the two sensors with a spatial shift $\theta.\boldsymbol{h_0}$ can then be traced to a layer at altitude $\boldsymbol{h_0}$. The reconstructed 3-D phase volume is then compensated by several deformable mirrors (2 to 3 in our current plans), that are optically conjugated to several well-chosen altitudes that encompass a major fraction of the turbulent volume. In our current design, the deformable mirrors are conjugated to 0, 4 and 8km above the telescope.

The basic advantages of an MCAO system with respect to more conventional NGS or LGS systems are:

- Increased sky coverage compared to a NGS system (50-500 times)
- Increased performance on axis compared to a LGS system because the cone effect is corrected
- Increased field of view compared to both NGS and conventional LGS systems
- Nearly uniform Point Spread Function (PSF)

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* *SCIDAR is an acronym for Scintillation Detecting and Ranging: A technique used to measure the turbulence profile versus altitude.*

across the field of view, which renders the data reduction much easier, accurate and stable

The design of a MCAO system is obviously more complex than a traditional AO system. The AO group at Gemini has been investigating several control schemes that have led to encouraging results. A number of parameters have to be optimized to get the best results, and trade-offs have to be made. For instance, uniformity can be traded with maximum performance on-axis, average Strehl Ratio can be traded with field of view, etc. Figure 2 gives an example of Strehl Ratio versus off-axis angle for a system with 5 LGSs, 4 NGSs and 3 deformable mirrors conjugated at 0,4 and 8km. Four of the LGSs are located 48" from the center of the field of view, in a square configuration. The fifth LGS is at the field center. In this example, on-axis performance has been traded for better Strehl Ratio uniformity across the field. The Strehl Ratio improvement at the edge of the field is approximately 4.5 in K band and 17 in J band.

Current Proof of Concept Design

Part of the just-completed MCAO feasibility study was the development of a "proof of concept" design to illustrate what the key features of such an AO system might resemble. This effort resulted in: (1) basic requirements for the LGS laser sources; (2) design concepts for the beam transfer optics and laser launch telescope which project the laser beams into the sky; (3) basic requirements for the wave front sensors, deformable mirrors, and signal processing electronics which comprise the AO control loop; and (4) an initial opto-mechanical layout for the AO instrument package. Figure 4 illustrates the AO instrument package mounted to a side port of the Gemini instrument support structure (ISS), as well as the optical path for the science beam. The path begins at the AO fold mirror in the upper right hand corner (inside of ISS), out through the MCAO, back to the science fold mirror and directed to an up-looking instrument. It includes 2 fold mirrors, an off-axis parabola to collimate the beam, three DM's at 8, 4, and 0 kilometer conjugates, and an off-axis parabola as a final camera optic. The output f/30 beam is fed back into the ISS. The AO instrument package will also contain wave front sensors (not shown) for each natural- and laser guide star. The LGS optical path includes a faceted prism to direct the light from all guide stars onto a single wave front sensing camera.

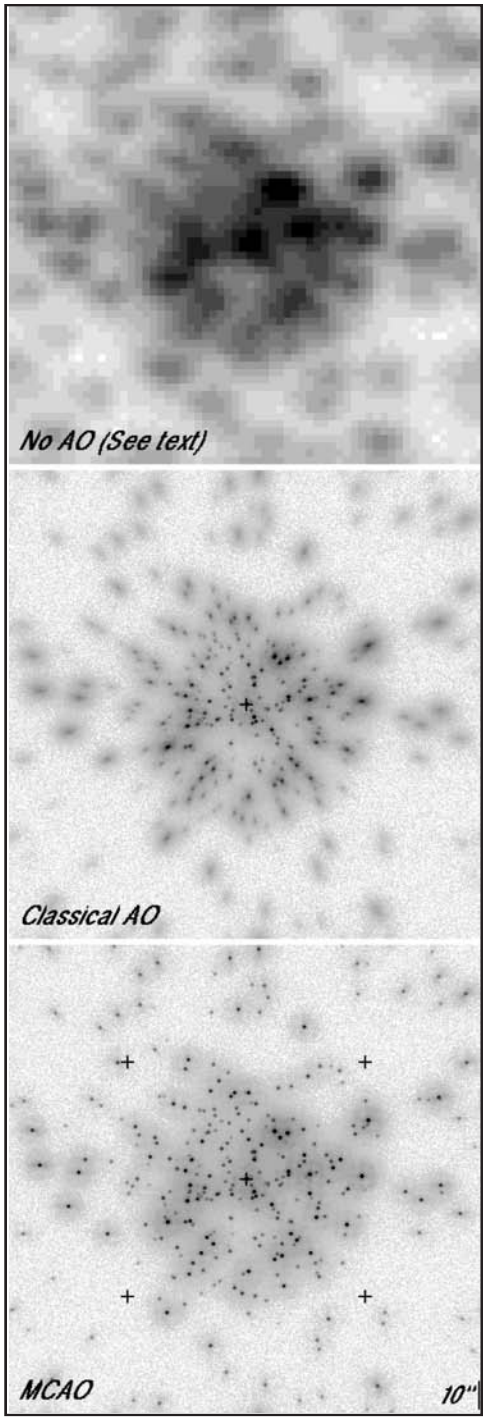


Figure 3: *An example of NGS MCAO capability. Simulated stellar field with 320 stars, showed without AO, with a classical single guide star/deformable mirror AO and with a 2 deformable mirror/5 guide star MCAO. The wavefront sensors have 8x8 subapertures. The field of view is 165 arcsec on the side, the wavelength is 2.1 micron. The telescope aperture is 8-m. The natural seeing is 0.7 arcsec at 550 nm. Note that each star has been blown up by 15x to be able to better see the PSF variations. Because of this, the crowding looks worse than it actually is (especially on the No-AO image). The guide stars are not shown on these images, but their positions are marked by crosses.*

The opto-mechanical packaging of the MCAO concept for Gemini appears feasible, and many of the basic requirements for the AO hardware components have already been demonstrated in other systems. Some of these include: (1) 128 by 128 pixel CCD arrays with high quantum efficiency and low read noise at kilo-Hertz frame rates; (2) deformable mirrors with up to 21 actuators across the diameter of the mirror; and (3) wave front reconstructor signal processors able to compute 1000 actuator commands from 2000 sensor measurements in under a millisecond. An important exception where MCAO requirements exceed current hardware capabilities are the LGS laser sources. However, these requirements are no different from Altair when described on a per guide star basis. The more fundamental extension of current capabilities required for MCAO is the integration of multiple guide stars, wave front sensors, and deformable mirrors into a single instrument and AO control loop.

"By developing this technology, Gemini will provide a powerful new tool for our communities that will keep us competitive with other ground and space-based telescopes well into the 21st century."

Conclusion

In the 1997 "Future Gemini Instrumentation" Abingdon Report, astronomers have identified laser guide star adaptive optics to be "of paramount importance in effectively addressing key [Gemini's] scientific issues […]". The science applications include stars and planetary systems, star formation, galactic structure and formation and evolution of galaxies. The MCAO system will be a very effective instrument to tackle these problems. The instrumentation suite is under review, but it is likely that the instruments of preference will be: (1) a infrared multi-object spectrograph, providing a 1 to 2 arcmin field at this resolution; (2) a well sampled infrared imager, for medium to high SNR applications; and (3) a deployable integral field unit.

Finally, when compared to other existing and planned AO systems, the MCAO system described in this article provides advantages that are unparalleled. By developing this technology, Gemini will provide a powerful new tool for our communities that will keep us competitive with other ground and space-based telescopes well into the 21st century.

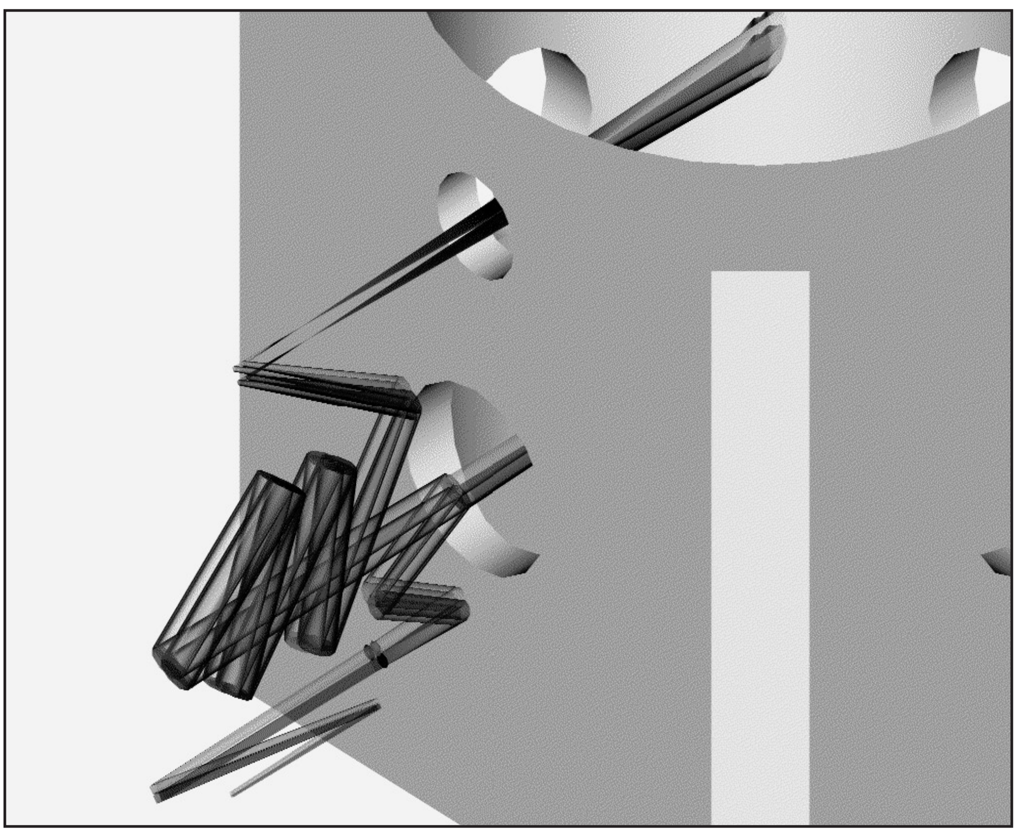


Figure 4: *3-D solid model of the MCAO science path*

GEMINI PROPOSAL PROCESS

Phil Puxley

The proposal deadline for shared-risks observations in the first semester of science operations on Gemini North (semester 2000-B) is fast approaching with the publication of this newsletter. This article presents an overview of the proposal process independent of NGO procedures that will vary from partner to partner.

The Gemini proposal process is comprised of two phases. In Phase I, an application for time is submitted to National Time Allocation Committees (NTACs) which is supported by a scientific and technical justification. In Phase II, observations are prepared with the Gemini Observing Tool (OT) software.

> ***"The process has been separated into two phases so that only those science programs which have been awarded time need be defined in precise detail."***

The process has been separated into two phases so that only those science programs which have been awarded time need be defined in precise detail. In general, only proposals for the facility-class instruments which interface fully with the Observatory Control System will go through both phases so that full advantage will be realized from observation preplanning (e.g. telescope and instrument configuration and sequencing) and data processing pipelines. Proposals for visiting instruments, which are essentially standalone, will generally be adequately defined in Phase I.

Applications for time on Gemini are made through National Time Allocation Committees (NTAC) with each NTAC responsible for scientific and technical assessment and recommending to the Gemini Observatory which proposals should be awarded time. Details of the submission and review process vary throughout the partnership and partner-specific information (if available prior to this newsletter printing), is contained in the Partner Updates section of this newsletter. WWW links on the partner country proposal submission process will also be available at the science operations www site: www.gemini.edu/sciops/sciOpsContents.html

In steady-state operations, Gemini will solicit proposals every 6 months. Individual partners may solicit proposals more frequently for placement in pre-reserved classical or queue slots when the quick-response mechanism is in effect, again see the links on the science operations WWW page for more details.

The Phase I process is supported by staff in the National Gemini Offices (NGOs), and the Gemini Help Desk (when available) is the preferred method for contacting NGO staff to make queries and request information etc. Proposals from outside of the Gemini community must be submitted through one of the NTACs and international collaborations must be submitted to the relevant multiple NTACs.

Applications may be made for either classical or queue mode observations. Classical mode observations are scheduled on specific dates, similar to most ground-based observatories, and are carried out by the investigators visiting the telescopes. (Remote observing from sea level or other sites will be available at a future date). Queue mode observations are defined in detail by the applicants and executed on their behalf by the Gemini staff. This mode offers the potential of better matching observations to the prevailing conditions (e.g. image quality, sky back-

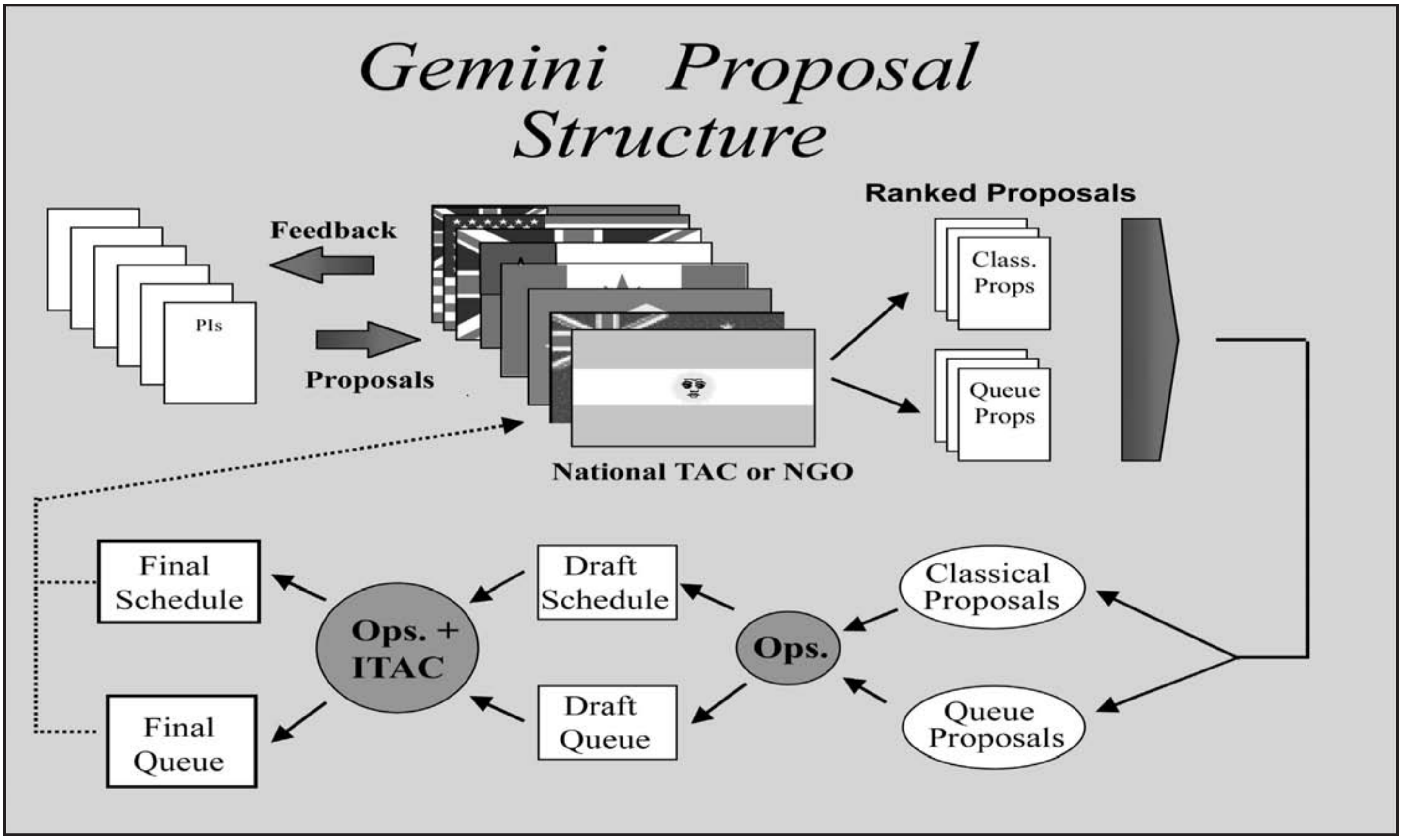


Figure 1

ground, cloud cover) and of more rapid response.

The following schematic view of the Phase I process (Figure 1, above) illustrates some of the aspects that differ from many other telescopes.

The NTACs will rank queue and classical proposals separately. The NTAC outputs, consisting of the rankings, recommended time awards and the full proposals, will be sent electronically to the Gemini Observatory and merged to produce a draft schedule and preliminary queue. (For more details on the merging process look at www.gemini.edu/sciops/ObsProcess/ObsProcIndex.html) For effective merging, the set of top-rated proposals from each partner's share of the time available should contain a reasonable balance that considers the observing constraints requested. For example, not all proposals can request optimal image quality conditions or dark time. In fact, more proposals than the minimum will be transmitted to provide flexibility during merging.

The draft schedule and preliminary queue, along with notification of any target or scheduling conflicts identified during the merging process, will then be sent to the International Time Allocation Committee (ITAC). The ITAC consists of representatives from each NTAC and from the Gemini Observatory. After resolution of any conflicts, the recommended schedule and queue are forwarded to the Gemini Director for final approval.

Scientific and technical feedback to the investigators about their proposal will be generated by each NGO/NTAC (if supported). Notification of the award of time (or queue position) will be produced by the Gemini Observatory and sent to the investigators and copied to each NGO/NTAC. The formal hand-over of responsibility for supporting the investigators, from the NGO to the Gemini Observatory, takes place upon publication of the schedule (for classical investigators), or upon transmission to Gemini of the detailed Phase II program (for queue investigators).

The two phases of the proposal process as seen from the applicant's perspective, are shown schematically in the generic Figure 2. (Precise details of the Phase I process which vary between partners, lie outside the dark dashed lines.)

Each proposal recommended for time will be sent to Gemini by the NTACs/NGOs as an XML (eXtensible Markup Language) document consisting of attribute/value pairs that encode the proposal information (e.g. PI name, target co-ordinates, instrument resources, scientific case) and, if required, associated files with figures etc. The Gemini Phase I Tool automatically generates the XML file. Partners who have chosen to use their own web-based or other proposal systems must translate their internal formats into the correct XML structures. The XML format is described in a document package (see www.gemini.edu/sciops/OThelp/otIndex.html to download) and has been designed to be of generic use for observatories other than Gemini.

Phase I queue proposals require the specification of observing condition constraints which define the poorest acceptable conditions under which the observations can be executed. In addition, both queue and classical observations require the use of one or more wavefront sensor (WFS) guide stars. As the technical feasibility of a proposal relies in part on the availability of guide stars, all proposals sent by the NTACs/NGOs to Gemini must identify WFS stars in the XML document. The Gemini Phase I software contains a tool that will automatically apply the relevant brightness and field-of-view constraints and select guide stars given the science target co-ordinates. The alternative proposal systems used by some partners have other provisions for selecting guide stars (in some cases these are added by NGO staff after submission of the proposal).

Finally, the first semester of observations on Gemini North will be a learning experience for both users and staff. While we have tried to anticipate most problems and potential issues, we appreciate your patience as we perfect the Gemini proposal process and make Gemini Observatory a model for innovative and effective scheduling.

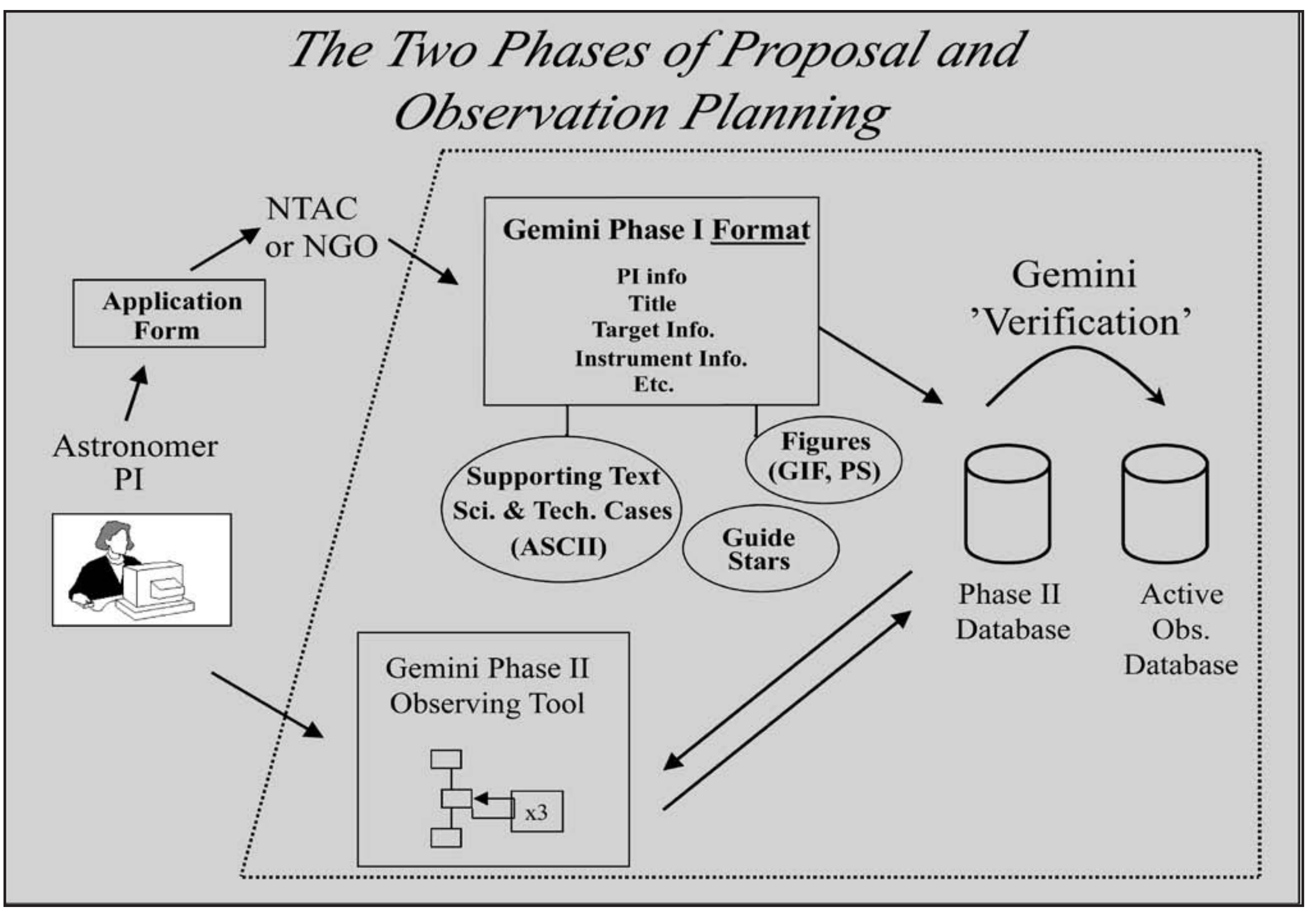


Figure 2

GEMINI COMMUNITY TO HAVE ACCESS TO INFRARED SPECTOMETER AT KECK

Tom Geballe

In return for the use of one of Gemini's Aladdin InSb arrays, the WM Keck Observatory has agreed to provide limited access by the Gemini Community to NIRSPEC a 1-5um infrared spectrograph on the 10-m Keck II telescope on Mauna Kea. The Gemini community will be allocated a total of twelve nights of NIRSPEC time over the next two years beginning in Semester 2000-A (February-July, 2000). The NIRSPEC observations will be organized and undertaken as a "Service" program by Gemini staff.

NIRSPEC is a near-infrared cross-dispersed echelle and grating spectrometer operating at the Nasmyth focus on Keck II. It features a 1024-squared InSb detector array (on loan from Gemini) and provides spectroscopy at resolving powers of R=2,000 or 25,000 over the 1-5 um wavelength range. Commissioning of the instrument, which was built at UCLA under the direction of Professor Ian S. McLean, has been completed at Keck II. Information on NIRSPEC is available at http://www2.keck.hawaii.edu:3636/realpublic/inst/nirspec/nirspec.html.

"NIRSPEC is a near-infrared cross-dispersed echelle and grating spectrometer operating at the Nasmyth focus on Keck II. It features a 1024-squared InSb detector array (on loan from Gemini) and provides spectroscopy at resolving powers of R=2,000 or 25,000 over the 1-5 um wavelength range."

The Gemini/NIRSPEC observing program will be led by Gemini scientific staff members Tom Geballe and Marianne Takamiya. Use of Gemini/NIRSPEC time will be organized as a "Service" program, along the lines of the Service Observing programs at the United Kingdom Infrared Telescope and the NASA Infrared Telescope Facility. Observing time will be allocated based on proposals electronically submitted to Gemini, with proposals being reviewed by external referees and Gemini staff providing technical support. Management of the program will be handled directly between Gemini and the Gemini user communities via the web/E-mail and will not involve the Keck Observatory or any of the Gemini National Project Offices.

The primary selection criteria for the proposals will be scientific quality, technical feasibility, and observing time requirements. Balanced partner shares will not be a requirement, but results will be reported to the GSC. The actual observing, distribution of the resulting data, and provision of necessary support for users will be done by Tom Geballe and Marianne Takamiya.

The program will formally begin early in the year 2000 with the publication/distribution of an application form and details on the instrument's capabilities, contact information, application rules and deadlines, and observing dates.

NSF FUNDS INTERNET UPGRADE FOR GEMINI SOUTH

Tod Fujioka

It is hard to argue the value that the Internet provides in our lives today. E-mail, file transfers, video and voice applications are just some of the benefits of the Internet. Many of these applications require high speed, low latency, and minimal jitter packet transfers. This technology has brought the world closer together with communications and information to homes, businesses, libraries and even Internet café's! Regardless of where it ends up, the information packets are switched and routed through the core of the Internet at rates of millions or billions of packets per seconds.

The Gemini project has a myriad of applications that drive the need for reliable, high-speed bandwidth in its core network. The Gemini North Observatory on Hawaii's Mauna Kea has been successful in meeting its Internet goals and is nearly ready for operational hand-over in the summer of 2000. Much of this success is due to the reliable, high-speed network between Mauna Kea and the Gemini base facility in Hilo Hawaii. This network provides connections to all vital functions of the telescope and makes the operation of the telescope much more productive (and comfortable). In a sense, the network is the telescope!

The Gemini South Observatory that is currently being built on Chile's Cerro Pachón, like its northern twin, will rely heavily upon high-speed and reliable Internet communications between the summit and its planned base facility in La Serena, Chile. However, unlike its northern twin, Gemini South is faced with the challenge of having no existing communications infrastructure connecting the remote Cerro Pachón site.

> ***"However, unlike its northern twin, Gemini South is faced with the challenge of having no existing communications infrastructure connecting the remote Cerro Pachón site."***

Due to remote location and costs, the observatories in this region have never been able to achieve very high speed, wide area communications between the mountaintop observatories and their base facilities. Fortunately, by partnering with the existing local observatory community, we have been able to design a system that is affordable for all participants and will have a profound impact on the way that research is done at all of these facilities.

To accomplish this goal, a partnership has been established between Gemini and the Cerro Tololo Inter-American Observatory (CTIO) which operates a telescope facility on the neighboring mountain peak of Cerro Tololo. The partnership presented a proposal to the United State's National Science Foundation (NSF) for high speed connectivity between the base facility in La Serena and the remote mountain tops of Cerro Tololo and Cerro Pachón. Approved in August, 1999, this proposal will construct a OC3/STM-1 155Mbps transport backbone between each of the three locations. The observatories on Cerro Tololo, the Gemini South Observatory, the future SOAR observatory on Cerro Pachón and their respective base stations in La Serena will benefit directly from this high speed infrastructure.

In evaluating the requirements and the uniqueness of these locations, we compared the possibility of installing either fiber optic cable or a OC3/OC12 microwave system. Although fiber optic cable presents a very attractive transport media, when we explored the possible cable routes the situation became less desirable. As the crow flies, the distance between Cerro Tololo and Cerro Pachón is only 15km but the cable would have to traverse a steep slope on Cerro Tololo, meander through the rough valleys and then span the steep slope of Cerro Pachón. In the final analysis, running a cable between La Serena and Cerro Tololo would span more than 65km and given our selected transport equipment, would require regeneration of the signal. For these reasons, and because of an additional risk of flooding in the valleys, it was determined that a microwave system would be more reliable, quicker to install and have easier access to all components during troubleshooting.

Even with the microwave system, a short 5km fiber span in La Serena will still be necessary. It is expected that this microwave system combined with a short fiber run will meet our goals by providing transport speeds at OC3 155Mbps with the ability to upgrade to OC12 622Mbps capacity. To fully appreciate the capability of these links, an OC3 link could provide over 2400 simultaneous uncompressed phone calls while an OC12 could support over 9700! Furthermore, should the need arise for an upgrade to higher bandwidth, the only changes to the microwave system will be the addition of digital components.

Microwave systems also have an extra level of reliability by providing a "hot standby" feature. In the event of a component failure the system switches over to the hot standby mode and data continues to flow until the failed component can be repaired.

Due to our positive experiences with the Cisco LightStream1010 Asynchonous Transfer Mode (ATM) switches, we will use them to tie together each of the network nodes. With an ATM switch in La Serena, Cerro Tololo, and Cerro Pachón, a Virtual Circuit (VC) to any of the locations can be created in a matter of minutes. A Permanent Virtual Path (PVP) can also be configured that will allow each of the organizations to manage their own VCs within the PVP. Quality of Service (QoS) will allow an equal share of the bandwidth as well as the protections of services.

At the edge of the ATM network, Cisco 7200 and 7200VXR routers will be interconnected with either a Switch Virtual Circuit (SVC), permanent virtual circuit (PVC), or soft PVC via a physical interface. With a high-speed network in place, control of the network equipment video over Internet Protocol (IP) and voice over IP can be achieved easily. The router's enhanced ATM interface port adapters allow Class of Service techniques that provide better protection of voice and video streams. Weighted Fair Queuing (WFQ) and Random Early Discard (RED) are two of the favored methods for protecting the particular packet streams on the ethernet segments. The backbone will support the integration of voice, video, and data in various ways: 1) Circuit Emulation - will provide a telco standard interface between end points; 2) Native ATM devices - using ATM standards, interfaces, and protocols and 3) TCP/IP – using the TCP/IP protocol to transmit and receive voice, video, and data.

Finally, it is expected that this system could be operational by March of 2000 and will provide Gemini South with a level of service and expandability that will keep the network viable for many years. The next challenge will be to tie the twin Gemini telescopes together with high-speed connections that overcome the obvious financial challenges as well as the propagation delays inherent over such great distances. Stay tuned!

PARTNER COUNTRY REPORTS

US Gemini Project Office

Preparations are under way to support the U.S. community and their access to Gemini during the first semester of operations at Gemini North. A proposal form, much like the standard NOAO form, will be available on the Web (http:www.noao.edu/noaoprop/noaoprop.html) for the upcoming call for proposals. Information can be entered and the proposal submitted through a web form or alternately proposers can request that the LaTeX template be E-mailed to them. In the latter case, the completed form can be e-mailed to NOAO for processing. All the tools needed for supplying the additional information for Gemini applications will be integrated into the Web interface.

After the first semester, the proposal process for time on the Gemini telescopes will be combined with that for all the telescopes to which NOAO provides access: those at CTIO, KPNO, and the national access time on telescopes such as the Hobby-Eberly Telescope and the MMT. The goal of this integration is to allow U.S. astronomers to write a single proposal for all of the capabilities that are needed to undertake a scientific program. Proposals are reviewed against others that address the same scientific problems and dividing into broad subject areas for consideration by separate panels. The individual panel recommendations are then brought together in a "Merging TAC" that looks at a merged, ranked list of proposals for each telescope.

User support is another area in which activity is increasing as the call for proposals approaches. The USGP has assigned NOAO astronomers Patrice Bouchet (OSCIR), Tod Lauer (Hokupa'a/QUIRC), and Mike Merrill (NIRI) responsibility for being the first tier of support for these instruments. Patrice supported OSCIR on the Blanco 4-m telescope when it was a visitor instrument at CTIO. Tod has extensive experience with high-resolution imaging data, and Mike has played a major role in the detector and controller development for NIRI as well as a number of NOAO instruments. These scientists will maintain familiarity with the instruments, work with the international Gemini staff on the development of data reduction tools, and answer questions from the U.S. community using the Gemini electronic help desk.

Through USGP efforts, the IRAF group has been working with NOAO and Gemini scientific staff to understand what data reduction software is needed to support all of the Gemini instruments. The goals have been: 1) to identify specific data reduction requirements with emphasis on the instruments that will be available in the first semester, 2) to understand which of these needs cannot be addressed using extant routines in IRAF, and 3) to evaluate the level of effort needed to provide the new software. This work will then be executed as a joint project involving NOAO and Gemini staff and a new IRAF package called "gemini" will be created and supplied to the scientific communities of the entire partnership.

The increase in activity associated with operations has not resulted in any less activity in areas connected with instrumentation. NIRI, the near-IR imager being built at the Institute for Astronomy of the University of Hawaii has been integrated and is going through a series of diagnostic cool-downs. The near-IR spectrograph, GNIRS, has passed a restart review and work is now underway at NOAO to finalize designs and drawings so we can begin fabrication. T-ReCS, the mid-IR imager and spectrograph successfully completed its conceptual design phase at the University of Florida, and work is now beginning on fabrication. The array and controller work for both IR and optical instruments is nearing completion. One area of outstanding success has been the foundry run of 1024 X 1024 InSb arrays at SBRC, now a division of Raytheon. An unprecedented high yield for the 12 hybridized devices produced has resulted in a surplus of science grade detectors for Gemini.

Work is just beginning in other areas, including the near-IR coronagraph. This instrument will be funded by NASA with a goal of providing ground-based support for science and missions within their origins theme. The conceptual design work has begun in Hawaii by a team led by Doug Toomey of Mauna Kea Infrared.

The USGP is also in a period of transition. As of February 1, 2000, Bob Schommer will take over the leadership of USGP from Todd Boroson. Bob will be based in La Serena and will be assisted in Tucson by Deputy Project Scientist Caty Pilachowski. The group providing support to U.S. users of Gemini will be split between Tucson and La Serena. We believe that the international nature of Gemini and the two base locations of the Gemini Observatory will inherently make this distributed support approach effective.

Todd Boroson

UK Gemini Project Office

UK Gemini Support Group:

Dr. Eline Tolstoy, currently a research fellow at the VLT, will be returning to the UK to join the UK support group in Oxford in 2000. Eline's research interests are in stellar populations in galaxies and she has substantial experience with many front-line facilities including the VLT and HST

UK Gemini Proposal Process:

The U.K. has adopted the Gemini Observatory Phase I Submission Tool, the PIT, as the method for submission of Gemini observing proposals. This will be the first time in the U.K. that a Principal Investigator (PI) will use such a tool to prepare and submit proposals.

The latest version of the Gemini PIT allows the definition of all aspects of a Gemini observing proposal e.g. PI information, scientific justification, observation details, etc., and the subsequent storage of the proposal in XML format, the language adopted by Gemini for proposal submission. One specific page of the PIT allows the PI to define the partner country to which the proposal is submitted and includes a "Submit" button for transfer of the proposal, using http protocol, to the selected national office.

The submitted proposal will be received by a back-end software package. In the U.K. this will be a modified version of the back-end currently operating for the AAO and UKIRT telescopes. This back-end is written in Perl and is being modified by its author, Stuart Lumsden of Leeds University, for U.K. Gemini use. The back-end will check the submitted proposal for completeness (in terms of containing all necessary information), notify the PI of a successful (or otherwise) submission and issue a proposal reference number, file the proposal on the national Gemini office (in our case Oxford University) computers and notify U.K. Gemini Support Group (UKGSG) staff of the reception of an accepted proposal.

Off-line, UKGSG will process the XML file and produce a LaTeX form, in a style similar to the current optical/IR proposal submission forms. Then, after the proposal deadline has passed, the received proposals will be transmitted to the U.K. PPARC Panel for the Allocation of Telescope Time (PATT) committee for assessment and grading. Programs accepted by the PATT panel will be transmitted to the Gemini Observatory (in XML format) for integration into the Gemini observing schedule. Once notified, PIs of accepted proposals will be required to complete a Phase II submission using the Gemini Observatory Observing Tool (OT). The OT details the observations to be made in a form that can be executed directly at the telescope. More details on the submission of Gemini observing proposals can be found on the UKGSG homepage at URL http://gemini.physics.ox.ac.uk.

Colin Aspin
Alison Toni

Editor's Note: *See Pages 24-27 for a UK Instruments Update.*

Andy Woodsworth left the Canadian Gemini Office in July to head the National Research Council's Institute of Information technology. Andy served as Canadian Gemini Project Manager for 8 years. Andy's contributions to Gemini are summarized by a quote from a September 1999 Committee of Gemini Offices resolution. "Andy played a unique and brilliant role in the management of many important steps during the construction of the Gemini Observatory and in the development of the National Gemini Offices". Dennis Crabtree is the new Canadian Gemini Project Manager and head of the Canadian Gemini Office (CGO). Dennis is a former head of the Canadian Astronomy Data Centre and was most recently the Senior Resident Astronomer at CFHT. The CGO staff now includes Dennis, Stéphanie Côté and Tim Davidge.

The CGO is busy preparing for the first Call for Proposals expected on December 1st. As part of our efforts to communicate the exciting scientific potential of Gemini, Tim and Stéphanie led a workshop on Gemini for graduate students at the June Canadian Astronomical Society meeting in Halifax. We have scheduled a series of townhall meetings in late November and early December at universities across Canada. We will use these meetings to inform our community of Gemini capabilities available for the first semester, the proposal process and support provided by the CGO.

Canadians proposing for Gemini time will use the Gemini Observatory Phase I Tool (PIT) to develop and submit their proposals. Gemini requires more detailed information than CFHT and the changes needed to POOPSY (used for CFHT proposals) are significant. PIT will be used by all of the Gemini partners except for the US, during the first semester. We will compare the use of PIT and POOPSY and decide on a single proposal system for both Gemini and CFHT proposals. An expanded Canadian Time Allocation Committee (CTAC), that currently handles CFHT proposals, will handle Gemini proposals. CTAC incorporates external referee reports into the review process. Canada hopes to align the deadline for Gemini and CFHT proposal deadlines for future semesters so that only one CTAC meeting is required.

The CGO will provide Canadians with the first level of support (Tier-1) on all aspects of Gemini. A table showing the assignment of support duties within the CGO can be found at http://gemini.hia.nrc.ca/cgo/Tier1.html. The CGO staff attended the Gemini Readiness Review and National Gemini Office training during the first week of November in Hilo. Information on Gemini and support from the CGO can be found on the CGO Web site (http://gemini.hia.nrc.ca).

Integration and testing of the first GMOS is now underway at the ATC in Edinburgh. The GMOS optical system is extremely large and complex and has a very high image quality requirement that must be maintained for all orientations. The NRC staff did an outstanding job in the design, analysis, precision fabrication of mounting components, maintenance of the external contracts, performing the coating work, mounting and alignment of the components, for the system to meet the difficult specifications.

Work is proceeding well on Altair, with fabrication of components underway in the machine shop in Victoria. Fabrication of the optics is also on schedule and a vendor has been chosen for the deformable mirror.

The CADC is in the final stages of negotiating a Work Scope for Phase 1 work on the Gemini Science Archive (GSA). Phase 1 will produce a Conceptual Design, a working prototype and an estimate of the costs to operate the archive system. Gemini will make a decision on whether to proceed with Phase 2, the implementation of operational system, after reviewing the outcome of the Phase 1 work. The GSA will consist of a copy of all of the scientific and ancillary data obtained by Gemini, together with a catalog of the data. This will be located at one or more physically secure sites that will be accessible by the Gemini user community through a high-speed Internet link.

Dennis Crabtree, Tim Davidge, Stéphanie Côté

At the time of writing this report (Oct 17, 1999) it is possible to provide only a basic outline of the proposal submission process to be followed by those seeking Australian Gemini time. More up-to-date information will be found on the local Australian mirror (www.gemini.anu.edu.au) of the Gemini web site and on the information page for the Australian community (www.gemini.anu.edu.au/aus_office).

It is intended however, that proposers for Australian Gemini time will use the Gemini Phase-I proposal tool and submit their proposals via the web to the Anglo-Australian Observatory - much as is currently done for proposals to use Australian time on the Anglo-Australian Telescope. The proposal deadline will be announced in the Call for Proposals. Proposals will be accepted for queue and classically scheduled programs, though the expectation is that most proposals will request queue scheduled time. The proposals will be technically reviewed and submitted for scientific evaluation by ATAC, the Australian Time Allocation Committee. After the ATAC meeting, the proposal rankings will be forwarded to Gemini for incorporation into the draft queue and classical schedules that are then considered by the International Time Allocation Committee (ITAC). Australia's representative on the ITAC will be the ATAC Chair.

It is important to remember two things about this process (1) there will be no feedback from the ATAC to individual proposers until after the ITAC has met and the queue and classical schedule has been issued by Gemini and (2) an efficient and flexible queue scheduled process requires an over-allocation of programs in all queue categories. Consequently, proposers cannot assume that because their program is "in the queue" that it will necessarily be carried out.

After checking the information available on the Web, requests for information regarding the Australian Gemini time proposal process should be directed to the Project Scientist, Dr. Gary S. Da Costa, at the Research School of Astronomy & Astrophysics, Australian National University (gdc@mso.anu.edu.au). Specific questions related to ATAC procedures should be addressed to the ATAC Secretary, Ms. Helen Woods, at the Anglo-Australian Observatory (hmw@aaoepp.aao.gov.au).

Other Recent Highlights

• During mid-September a successful set of Instrument Forum and Committee of Gemini Offices meetings were held at Mt. Stromlo Observatory outside Canberra, Australia.

• AURA and the Australian National University have signed a workscope covering the concept design study for NIFS (Near-infrared Integral Field Spectrograph). NIFS is an instrument intended for use with ALTAIR on the Gemini North telescope and will produce spectra at each point across its 3.1" x 3.3" field-of-view with ~0.1" spatial resolution and R ~ 5400 spectral resolution in any one of the J1, J2, H and K bands. The concept design study will be completed by the end of March 2000. The NIFS project scientist is Dr. Peter McGregor and more information on the instrument concept can be found at the NIFS Home Page (www.mso.anu.edu.au/nifs/).

• The relationship between the Anglo-Australian Observatory (AAO) and Gemini has been clarified. Responsibility for AAO involvement with Gemini instrumentation projects will rest with the Anglo-Australian Telescope Board and not with either the UK or the Australian Gemini offices. The UK and Australian Gemini offices will be kept informed of AAO instrumentation proposals to Gemini but will not have any direct oversight or input roles. Any Gemini Instrumentation Development Fund (IDF) contracts that are awarded to the AAO will count equally (50/50) to the UK and Australian IDF shares. Currently, the AAO is carrying out a development study for the Gemini near-IR multi-object spectrograph instruments focusing on the testing of near-IR fibers and their use in fiber-based deployable integral field units. This study will be completed by August 2000. The AAO is also carrying a concept design study of IRIS2-g, a development of an AAT instrument (IRIS2-a) which could provide near-IR imaging and multi-object slit spectroscopy capabilities on the Gemini telescopes. This design study will be completed by the end of April, 2000.

Gary Da Costa

The efforts of the office in the recent months have been centered on the preparation for the Call for Proposals and the Gemini Science Archive Workpackage, which will be done by NRC (Canada) and CONICYT.

Call for Proposals:

A big step forward in the preparation for the Gemini Call for Proposals, was the incorporation of Sebastian Lopez to the Chilean Office in September. Sebastian has a PhD from the University of Hamburg and his main scientific interests are the study of quasar absorption lines and gravitational lensing. He has a postdoc position at the University of Chile, and a partial dedication to CONICYT as Support Astronomer for Gemini-Chile.

The status of the preparation for the call for proposals is as follows:

1. The Phase I Tool (PIT) has been tested with positive initial results. It creates an appropriate .XML file expected by the Gemini Observatory, and an appropriate .HTML file suitable for printing via a web browser. It runs fine in a Solaris machine - though not yet under Linux. A separate build for running PIT under Linux is in preparation at Gemini International. Notice that the PIT must be installed by each astronomical institute in Chile.

2. The submission process must still be checked. PIT will allow automatic submission from its interface (this is under development). There will be a software (offered by the UK Project Office) running at CONICYT which will receive proposals automatically; however, the alternative of simply sending the XML and PostScript files via ftp to the Chilean TAC has not yet been ruled out.

3. At the time of this writing The Chilean Gemini site (www.conicyt.cl/Gemini/) will soon have a link to mirror of the site of Gemini International, including online documentation. This will provide an enormous time savings for the entire Chilean astronomical community.

4. A number of consultations with respect to the composition and guidelines for the Chilean Gemini TAC are being conducted. The members of the Chilean TAC will be announced soon.

Meetings and Contracts:

1. David Schade (CADC, Canada) visited CONICYT in September and gave a talk about Astronomical Data Centers, many faculty from Astronomy and Computing Science Departments from the main universities in Santiago were in attendance. As of this writing, the workpackage has not been yet been signed. A job advertisement for a Chilean software engineer was posted by mid-October. We are working on a preliminary contract with AURA to develop the Gemini Archives in collaboration with Canada. We expect to sign the contract before the end of this year.

2. At the Instrument Forum, held at Mount Stromlo Observatory in Camberra, it was agreed that the Chilean Office will host the next Instrument Forum in La Serena during September 2000. Chile is interested in getting young engineers involved in the construction of Gemini instruments by other partners, and looking for ways that may be attractive to the parties involved. V. Pesce will be soon leaving to work on the coating chamber and IR MOS design study.

3. In July a Chilean firm called REUNA signed a contract with AURA to conduct a study on the Communication requirements for Gemini South. It is expected that this study will be finished by mid-November. The study also permitted visits to the relevant sites at Hawaii, La Serena and Tucson. REUNA was also involved in the preliminary design study of the communication network for Gemini North. REUNA is a private firm which was formed by 19 Chilean universities (providing a national high band width network to them) and provides services such as high-quality video conference services to some of the universities of the consortium.

4. A national standard for light pollution in northern Chile has been in place since October 1st. This standard was initiated by our National Environmental Agency (CONAMA) and will protect all the observatories in Chile, but in particular the Gemini Observatory.

Sebastian Lopez
Luis Campusano
Oscar Riveros

Brasilian Gemini Project Office

Brazilian astronomers are getting organized to submit many proposals to the NTAC in order to optimize the use of our 3 nights in the upcoming first semester, the Brazilian Gemini Committee, with support from the members of the NTAC, has decided to recommend that the Brazilian community submit only proposals for the queue schedule mode during this first semester. In this way, we believe we will be able to accommodate a larger number of potential users in a more efficient way.

The LNA - Laboratorio Nacional de Astrofisica, which is the Gemini Project Office for Brazil, will concentrate the efforts in supporting the use of the software necessary for the preparation of proposals for Gemini in Brazil. In the future, we hope that other home Institutions of the Brazilian astronomers will have also the relevant software installed and running in their local machines.

Dr. Albert Bruch (albert@lna.br), from LNA, will be the main initial contact for proposal-related subjects in Brazil. He will be in charge at LNA of the necessary initial support activities for the preparation and submission of proposals, such as keeping updated versions of all the software, as well as of testing its installation and use.

Thaisa Storchi Bergmann

Argentine Gemini Project Office

As this newsletter went to press, the Argentine Gemini Office had only recently appointed a NTAC (see below), so many details on the Argentine proposal submission process were still pending. However, it is known, that proposals will need to be sent to the Argentine Gemini Office at the Faculty of Astronomical and Geophysical Sciences, National University of La Plata, to the E-mail address: gemini@fcaglp.fcaglp.unlp.edu.ar. The person who will be in charge of sending the Argentine proposals to Gemini will be Ruben Martinez (ruben@fcaglp.fcaglp.unlp.edu.ar) and he will have the support of a few additional astronomers. Proposals guidelines will follow closely those adopted by the U.K.

Following are additional news items from Argentina:

• The workshop that was announced in the last issue of this Newsletter took place as scheduled, on May 27 and 28, at the Astronomical and Geophysical Sciences Department, National University of La Plata. This workshop included the participation of Prof. Dr. Beatriz Barbuy from Brazil as well as astronomers from the various Argentine astronomical institutions. The list of papers presented, their abstracts and (when available) full texts, can be found on the La Plata home page (in Spanish) at: http://www.fcaglp.unlp.edu.ar/~gemini/taller99.html. The meeting was made possible through the support of the Faculty of Astronomical and Geophysical Sciences, National University of La Plata, and the Argentine Astronomical Association.

• During the last meeting of the Agentine Astronomical Association that took place in Rosario, a good part of the morning session on September 23 was devoted to the Gemini Project. Included in the discussions was an update on the status of the Project as well as the question of observing proposal presentation.

• At the last meeting of the Argentine Gemini Committee, the local TAC was appointed, with the names proposed by different Argentine astronomical organizations taken into consideration. The list is as follows:
Juan Carlos Forte (Coordinator),
Rodolfo Barbá,
Juan José Clariá,
Alejandro Clocchiati,
Diego García Lambas,
Dante Minniti.
As substitutes: Mercedes Gómez and
Raúl Mariano Méndez

Jorge Sahade

UK INSTRUMENTS UPDATE

HROS Update

The High-Resolution Optical Spectrograph (HROS) held its Preliminary Design Review (PDR), chaired by Dr. Gordon Walker of the University of British Colombia, at University College London on 5 and 6 of August 1999.

At the Review the HROS team presented the final optical design of the instrument, which meets essentially all of the top-level science requirements for the instrument (summarised in Table 1). The review panel endorsed this optical design, which now moves onto to the detailed mechanical design phase, in preparation for the Critical Design Review to be held in mid-2000. In particular, the panel endorsed the key concept of active flexure compensation (AFC), which lies at the core of our strategy to meet the very demanding specification on image stability (Table 1).

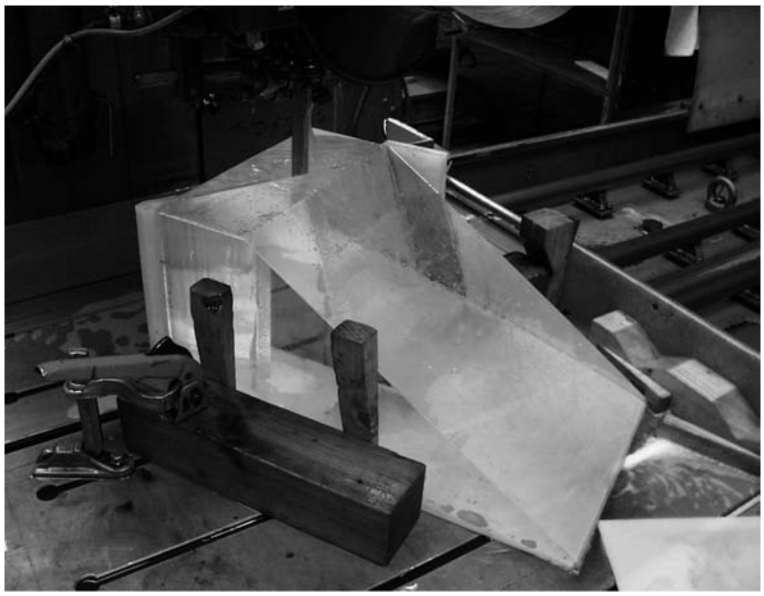


Figure 1: *Cutting of the large fused silica prism ("immersion prism") at Heraeus. The prism was cut out of a single large rectangular block 612x375x370mm in size and is made out of the highest homogeneity fused silica commercially available (less than 1 part per million variation in the refractive index).*

Many of the large optical components of the spectrograph are now in the manufacturing phase. In particular the fused silica blanks for the immersion and cross-dispersing prisms have been manufactured by Heraeus Quarzglas GmbH in Hanau, Germany (Figure 1). In addition, both the collimator mirror and the camera lenses are in the process of being manufactured by Optical Surfaces Ltd. in the UK. Contracts for the optical polishing of the large prisms will be placed shortly.

As a result of all this activity, it is now possible to give a more realistic date for the completion of the project, and the PDR panel endorsed a revised management plan which calls for commissioning at Cerro Pachón in mid-2002.

Ian Crawford and
Paolo D'Arrigo, UCL

TABLE 1

COMPARISON OF ORIGINAL HROS SCIENCE REQUIREMENTS WITH PDR VALUES

	REQUIREMENT	PDR VALUE
RESOLVING POWER (R):	50,000 (+/- 10%)	45,000 to 52,000(dependent on camera field position)
SLIT WIDTH:	0.6 arcsec	0.6 arcsec
PSF SAMPLING:	3.0 pixels	3.1 pixels
MAX SLIT LENFTH:	60 arcsec	60 arcsec
MIN. ORDER SEPARATION:	7.0 arcsec	7.65 arcsec
TOTAL WAVELENGTH RANGE:	300 to 1000 nm	300 to 1000 nm
SIMULTANEOUS WAVELENGTH COVERAGE (goal):	325 to 830 nm	324 to 885 nm
THROUGHPUT:	>20% at 500nm	28% at 500nm
IMAGE STABILITY (spectral):	<2.03 microns/hour	TBC (depending on AFC performance)

CIRPASS Update

CIRPASS (Cambridge IR Panoramic Survey Spectrograph) is a fibre-fed, near-infrared, integral field spectrograph that is being built at the Institute of Astronomy, Cambridge, UK and is intended for use as a common user instrument during the first semester of Gemini operations (and beyond).

The expected performance of CIRPASS is summarized below:

- 499 element integral field unit (IFU) with a maxi mum field of view of 13.3≤x5.5≤ :
- operation in the wavelength range 0.85-1.8 mm
- spectral resolution of R~3100 (higher resolutions of R~11000 and R~26000 may be available)
- 2048 detector allowing a large wavelength cover age of ~4300 A at R~3100 resolution
- dark current >0.1 e/s/pix
- read noise 7e
- limiting magnitudes of J~23 and H~22 in 3 hours

Science

There are many science areas where observations with CIRPASS could make a significant contribution, from searches for brown dwarfs and giant planets to observations of AGN. Of particular interest is the study of galaxies at redshifts 1<z<2.5. This redshift range is crucially important, as recent work suggests that it is where the bulk of galaxy formation occurred (Madau et. al., 1999). However, no significant spectroscopically confirmed sample of galaxies in this redshift range exists, because the strong spectral features (e.g. [OII] l3727, Ha l6563) have been shifted into the near-infrared, making the identification of these galaxies using optical spectra very difficult. The star formation history of galaxies at these redshifts has been estimated from the spatially resolved images produced by HST (Abraham et. al., 1998). The IFU capability of CIRPASS will allow a more detailed investigation of their star formation rates and dust extinctions and also of their internal dynamics.

At redshifts z > 2 the major observable baryonic component in the Universe resides in the ubiquitous damped Lyman-alpha absorption line systems. These high column density (N(HI)>2x1024 m-2) HI systems are detected via their imprint on the spectra of background quasars. Measuring the star formation rates, kinematics and metal content of these systems is crucial to our understanding of how galaxies form and evolve. In the optical the star formation rate can be measured using Lyman a for z>2. Attempts to do this have met with only limited success, and even if Lyman a can be measured, estimating a star formation rate is highly uncertain. A more robust method is to use the Ha line, which requires near-infrared observations. The CIRPASS IFU will not only allow us to detect Ha in these galaxies, but also to get a full 2-D Ha velocity map and hence determine rotation curves for this important galaxy population.

Design

The CIRPASS design consists of a 499-element integral field unit (IFU) feeding a cooled spectrograph. The spectrograph contains a mask to hardware suppress the bright and variable OH skylines, therefore reducing the scattered light component of the interline sky background. It is intended to add a multi-object mode to CIRPASS in the future but this will not be available for the first semester. A prototype of CIRPASS is currently working on the Schmidt telescope at the IoA. Using the Schmidt, we will be able to test both the new instrument systems and the instrument control and data reduction software, before shipping to Gemini.

The CIRPASS IFU is very similar in design to the previous 100-element IFU built at the IoA for the CIRPASS predecessor, COHSI. The IFU has four possible lens scales and fields of view as listed in the Table 2 below.

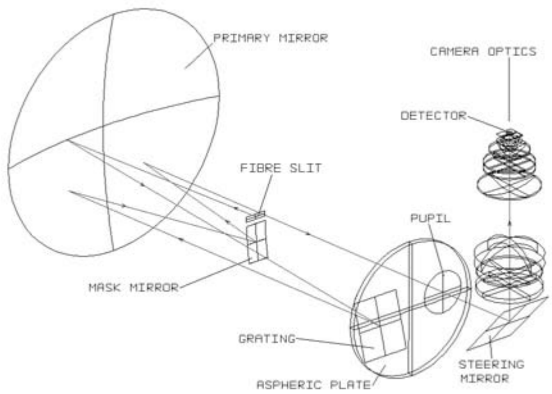
Changes between these different scales can be made remotely. The smallest lens scale is intended for use-

Lenslet Scale (arcsecs/lenslet)	Field size (arcsecs)	Scale (arcsecs/mm)
0.36	13.3X5.5	0.138
0.25	9.3X3.5	0.096
0.12	4.4X1.7	0.046
0.05	1.8X0.7	0.019

Table 2

with the adaptive optics system Hokupa‘a.

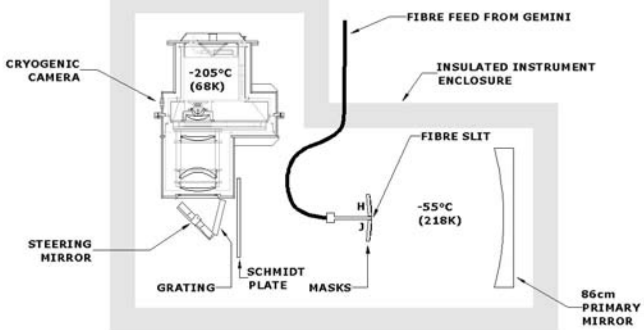
The light from the telescope is imaged onto the IFU-lenslets, each of which is aligned to a ~20m long optical fibre. At the entrance to the cooled OH suppressor, the fibres are arranged into a linear structure (the fibre slit).



Inside the suppressor the light is dispersed and this dispersed light is reflected off the mask mirror which blocks out the light from the OH lines. If this hardware OH suppression is not required the mask can be replaced by a plain mirror. The cryogenic camera then images the output light from the mask onto the detector.

Our aim is to use one of the new generation 2048x2048 pixel Rockwell HAWAII-2 detectors. A 1024x1024 pixel HAWAII-1 detector is available as a backup. The field of view is the same for either detector as the 499-element IFU projects to ~1000 pixels on the detector. However the larger detector provides double the wavelength coverage. The output from the detector consists of 499 spectra, one for each IFU lens. This output can then be reconstituted to give a spatial image of the observed source at each wavelength.

The entire spectrograph is inside a cooled box at ~-55C in order to reduce the thermal background from the instrument to a negligible amount. The camera and detector are cryogenically cooled to 68K. The cool box technology is already widely used, for instance in building small refrigerated rooms in life science laboratories. The box has panels of foamed insulation clad with thin zinc plated steel sheeting. The air inside the box is required to be very dry indeed to prevent condensation. To prevent leaks of damp air into the box the interior pressure will be higher than atmospheric ambient pressure. The required 500 watts of cooling power to maintain the suppressor temperature will be provided by a single stage refrigerator. If the large optics are not cooled, then the thermal background in z and J is still small.

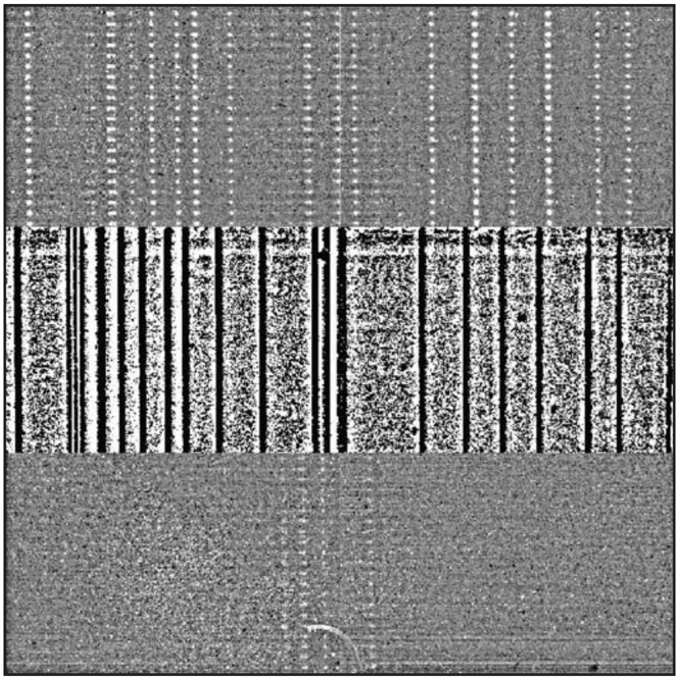


Suppression

The hardware suppression option is intended for observations of faint targets with the R~3100 grating. The expectation is that suppressing the bright and variable OH lines will reduce the scattered light background and hence enable fainter objects to be detected in the inter-line regions. This scattered light reduction offsets the slightly reduced throughput due to the suppressor optics, as summarized below.

	CIRPASS with mask	Theoretical spectrograph no suppression optics	CIRPASS without mask
	0% scattering 15.7% throughput	2% scattering 19.9% throughput	2% scattering 15.7% throughput
Limiting mag. in H S/N = 5	22.26	22.20	22.02
Scattered background (e/s/pixel)	0.0	0.053	0.042
Sky (e/s/pixel)	0.026	0.033	0.026
Object (e/s/pixel)	0.009	0.013	0.012
Brightest OH line	0.4	107	85

The suppression mask mirror has a surface pattern that very accurately matches the OH spectrum. In the regions where the OH light hits the mask the surface coating is a multi-layer anti-reflection coating with a reflectivity of <0.5%.. The other, non-OH, regions are coated with gold with a reflectivity of ~98%. Techniques for making these masks have been developed at the IoA for COHSI, and the masks have been used successfully to block the OH lines.



This mosaic of 3 COHSI exposures shows: Top - the spectra of the Mauna Kea night sky with the grating offset so that the OH lines are not blocked at the mask. Middle - the mask illuminated directly (not through the fibres). The AR coated mask features are clearly seen. Bottom - the suppressed night sky. Some weak oxygen lines which have no mask features are clearly seen.

Software

The CIRPASS system will stand alone on Gemini, with the instrument control and data acquisition and reduction being carried out on dedicated computers. The instrument control software (ICS) being written at the IoA provides an easy to use graphical user interface for the observer. Simple ICS commands issued by the observer (e.g. change lens scale) are translated by the ICS into the required actions (e.g. move appropriate magnifying lens into position and also move the fibre head to the correct position). The ICS also controls the detector by sending commands to the detector software, PixCel, using a TCP/IP socket. At the end of an observation PixCel saves a FITS file directly onto the data reduction machine (a PC running LINUX) over a fast ethernet link. Development of the data reduction software is currently in the early stages but it is likely that the routines will be written as IRAF tasks. It is envisaged that as an integration finishes the data will undergo some initial processing (e.g. removal of dark and sky backgrounds) before being displayed in both tramline spectra and reconstituted data cube formats.

References:
R.G.Abraham, R.S.Ellis, A.C.Fabian, N.R.Tanvir, K.Glazebrook, 1999 MNRAS 303, 641
P.Madau, L.Pozzetti, M.Dickinson, 1998 ApJ 498, 106

Rachel Johnson, Andrew Dean, Dave King, Craig Mackay, Steve Medlen, Ian Parry (PI), Jim Pritchard, Anamparambu Ramaprakash

Institute of Astronomy, Cambridge, UK

GEMINI NORTH

On June 25, 1999, two distinguished groups of people gathered in two very different places to celebrate the dedication of the Gemini North telescope on Mauna Kea, HI. One group of about 150 individuals (including a prince) woke up early so that they could travel for several hours into the thin, chilly air that marks the highest point in the Pacific Basin. Almost 3 vertical miles below, 250 people took a more leisurely pace and gathered just before lunch outside the modern Gemini Observatory Headquarters that overlooks the Pacific Ocean from the tropical town of Hilo.

The smaller group, located on the observing floor of the Gemini North telescope, was breathless, both with anticipation and altitude, when fiber-optics videoconferencing technology joined them with their counterparts in Hilo. From under a large tent, the Hilo group watched the mid-day ceremony unfold on a large projected video image that was literally "larger than life."

After years of anticipation, the time had come to dedicate the first of the twin Gemini telescopes. The excitement and emotion of the event was not lost on anyone in attendance. Before introducing the dignitaries from across the Gemini partnership, NSF Director Dr. Rita Colwell was able to capture the spirit of the event in her opening statement. "This is a very special place and a very special time… It's not just the altitude, but the occasion that takes our breath away. We stand here on the brink of discovery that we cannot even imagine. We can only be sure that these discoveries will enlarge our vision and make our spirits soar in this thin air and far beyond."

For the next hour the ceremony did what every good dedication should, it celebrated the successes and dreams of Gemini, while acknowledging the personal sacrifices we all have made to get where we are today. Recognizing the tremendous efforts of staff around the world, His Royal Highness, Prince Andrew, Duke of York suggested that, "We should look around us and thank everybody who has been involved and what they have achieved. They have created a masterpiece and I wish it every success." Gemini Chairman Jean-Renél Roy continued this sentiment with his heartfelt (multilingual) appreciation to all and a special thanks to the "...spouses down in Hilo!"

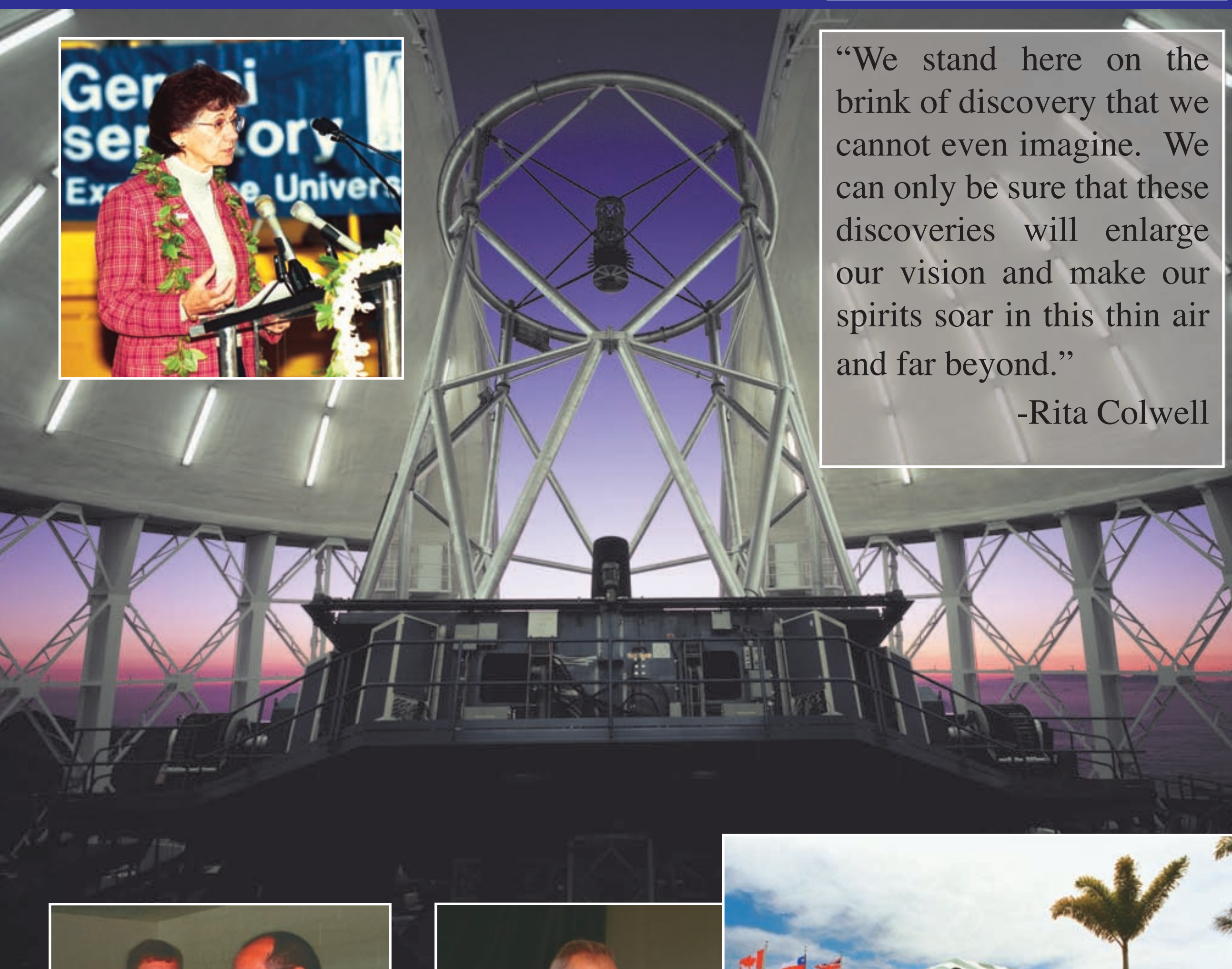
In addition to the dedication ceremony, other events provided guests and staff with very little time for lounging at the beaches that surround the beautiful Waikaloa hotels where most of us stayed. First, there was the pre-dedication visit to the Gemini Headquarters by His Royal Highness, Prince Andrew and then the post dedication banquet with keynote speaker, Dr. Robert Kirshner. If you want to try to capture Dr. Kirshner's most entertaining presentation, take a look at: http://www.noao.edu/usgp/outreach/speech_kirshner.html

Also at the banquet, Gemini Director Dr. Matt Mountain, presented a very impressive overview of the milestones that Gemini has met, and wowed everyone with the Gemini Adaptive Optics images that were obtained only days before the dedication event. These images can be found on the cover of this newsletter and at: www.gemini.edu/dedication/dedication.html

Finally, for those who couldn't make it to the Gemini North dedication, its not too early to start planning for the Gemini South dedication in 2001! In the meantime, we hope this pictorial will help to share this special event and preserve the gratitude and sense of accomplishment that this dedication celebrated.

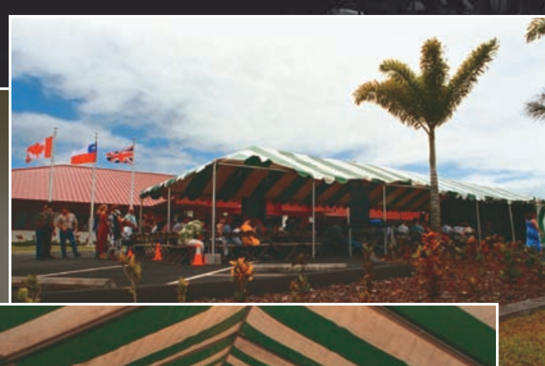
- Peter Michaud

DEDICATION



"We stand here on the brink of discovery that we cannot even imagine. We can only be sure that these discoveries will enlarge our vision and make our spirits soar in this thin air and far beyond."

-Rita Colwell



Composite photo of Gemini North and southern star field as seen from the Canada-France-Hawaii Telescope catwalk on Mauna Kea. Crux is to the left of the dome.

The Gemini 8m Telescopes Project
950 N. Cherry Ave., P.O. Box 26732
Tucson, Arizona 85762-6732, USA
Phone: (520) 318-8545 / Fax: (520) 318-8590

The Gemini Observatory
670 North A'ohoku Place
Hilo, Hawai'i 96720, USA
Phone (808) 974-2500 / Fax: (808) 935-9235

e-mail: gemini@gemini.edu
WWW: http://www.gemini.edu

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