GEMINI OBSERVATORY NEWSLETTER

June 2004

Issue 28

Gemini North "Transparent Dome" obtained by combining multiple digital images of rotating dome. Gemini photo by Kirk Pu'uohau-Pummill and Peter Michaud.

Inside This Issue

A STAR IS BORN

Celestial Beacon Sheds New Light on Stellar Nursery

Wide field view of region around McNeil Nebula by Jay McNeil using a 10-inch telescope (above). Gemini North close-up of McNeil Nebula obtained with GMOS (right). Jay McNeil standing with this 3" refractor used to make discovery (right).

A timely discovery by American amateur astronomer Jay McNeil, followed immediately by observations at the Gemini Observatory, has provided a rare glimpse into the slow, yet violent birth of a star about 1,500 light-years away. The resulting findings reveal some of the strongest stellar winds ever detected around an embryonic Sun-like star.

Jay McNeil (shown above with his 3-inch (8-centimeter) telescope) was surveying the sky in January from his backyard in rural Kentucky and taking electronic images through his 3-inch (8-centimeter) telescope (also shown above). When he examined his work, he noticed a small glowing smudge of light in the constellation of Orion that wasn't there before. "I knew this part of the sky very well and I couldn't believe what I was seeing," said McNeil. Astronomers were alerted almost immediately, via the Internet, and quickly realized that he had come across something special.

Gemini astronomer Dr. Colin Aspin and Dr. Bo Reipurth, (of the University of Hawaii's Institute for Astronomy), published the first paper on this object, now known as McNeil's Nebula. Their work, based on observations using GMOS on the Frederick C. Gillett Gemini North Telescope on Mauna Kea was published in The Astrophysical Journal Letters, Volume 606, May 10, 2004.

For more details and images see: http://www.gemini.edu/project/announcements/press/2004-6.html

GEMINI OBSERVATORY NEWSLETTER

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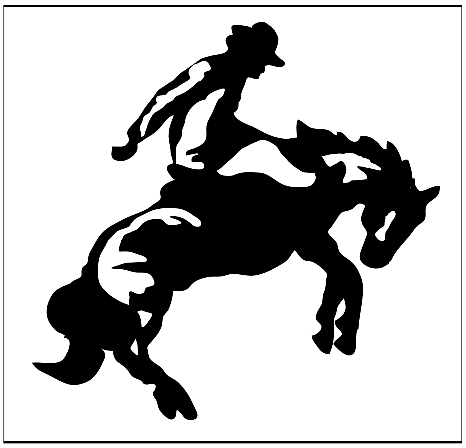
TO QUEUE OR NOT TO QUEUE

Matt Mountain

Seen through the multiple lenses of the many meetings interconnecting all aspects of the Gemini endeavor, it is easy to overlook the achievements of our staff and partnership communities. Almost without realizing it our user community and observatory staff together have wrought transformational changes that are diffusing through the field of ground-based optical/infrared astronomy.

This was brought home recently by a confluence of three e-mails I was reading one morning. The first was a list of papers being presented at Gemini's first Science Conference (Vancouver, May 23-25, 2004). With 60 oral presentations and 20 posters scheduled, there were complaints that we should have allowed time for more. The second e-mail noted that for 2004B we had a 40% increase in proposals over the same period last year—404 in all—with Gemini South showing the greatest increase. The third (more surprising) e-mail was an announcement by the Institute for Astronomy (IfA) at the University of Hawai'i that, for the first time, the majority of its proposals for Gemini North would be requesting queue scheduled observations. The IfA was joining an observational trend toward queue-scheduling that we have been seeing in all our national communities over the past few years.



Mastering the "cantankerous instrument"— is the Gemini classical observer an endangered species? [1]

The obvious realization from these e-mails is that Gemini now has an active scientific constituency enthusiastic enough to travel great distances to share its results. This same group is applying for even more time in 2004B, but is also intent on transforming the way we undertake our observational science by requesting queue-based observing almost exclusively.

Those three e-mails are a reminder to me that Gemini is a healthy 21st century observatory, but the growing expectations of our community of users don't come without challenges. To understand what we face, think back to 1995 when the Gemini Science Committee (GSC) hotly debated the heretical notion that—from the start—Gemini should plan for "queue based observing" (the ability to match observations to conditions, by using Gemini science staff rather than programs' principal investigators to undertake the actual observing). The need to make optimum use of telescope time during

1. Albert E. Whitford, an influential mid-century American astronomer, remarked that, in his time, using a large telescope required "high artistry" in doing it yourself and demanded "real mastery of a beautiful and cantankerous instrument". This quote is from an oral history interview - Albert E. Whitford interview, July 15, 1977, pg. 51; interviewed by David DeVorkin; Center for History of Physics/American Institute of Physics Collection (courtesy of Patrick McCray, UCSB)

Today, teams of scientists, engineers and specialists work together to make observations at Gemini and other large observatories. This image shows a team working to commission the Altair adaptive optics system on Gemini North.

changing conditions was hardly new. Back in 1930s during the planning of Palomar it was recognized that some things were beyond the control of the astronomers. In is 1995 book *The Perfect Machine*, Ronald Florence wrote:

"...weather and the general seeing conditions didn't always pay attention to the plans of astronomers and the allocation committee. In the brainstorming sessions [in 1931] the astronomers asked if the telescope could be switched from one focus point to another in minutes rather than hours, so the balance of the night could be put to profitable use."

Similarly, more than 50 years later, while planning the Keck telescope, Sandra Faber wrote in *Large Optical Telescopes: New Visions into Space and Time*:

"...both the designs and scheduling of large telescopes should be flexible enough to allow quick changeovers to programs that can benefit from good seeing. Adherence to this goal will, I believe, necessitate substantial changes in the operating philosophy in use at most observatories."

In our case, the new approach included actually incorporating changes to Gemini's operating philosophy from the outset. After much heated debate—some of it using terms like "garage attendant observing," or (my favorite) "queue observing is the work of the Devil"—the GSC agreed that the we should plan an operating model able to support 50% queue observing while maintaining at least 50% classical observing. The detailed quantitative arguments for the effectiveness of the queue approach on Gemini can be found at: http://www.gemini.edu/documentation/webdocs/rpt/rpt-ps-g0053.pdf.

Today, our communities are making their voices heard through the time allocation committees. The GSC recognized at its last meeting that in response to community pressure, as more science time becomes available, Gemini's model will be to support at least 75% queue, retaining only 25% of the science time for "classical" observing. This shift in community behavior is hardly surprising. The critical dependency on observing conditions, the increasing complexity of the observing process, and a rising level of community comfort with the concept of queue scheduling and "internet observing" has produced a significant shift in the whole sociology of observations using large ground-based facilities like Gemini. This is particularly true when one considers the inconvenience of missing teaching responsibilities and/or one's family for a few nights of variable conditions. Moreover, astronomers now have a significant "marketplace" of data products, ranging from space-based observatories like Hubble Space Telescope, Chandra X-ray Observatory, or Spitzer Space Telescope. In addition, there are many queued or classical observing options at large ground-based telescopes, as well as extensive online data archives available to the community.

From Gemini's perspective, the market has spoken. In 2004B, less than 5% of the time requested was for "classical" observing. Now, nine years after that heated GSC debate, classical time appears in danger of becoming extinct. Though this is a welcome testament to the confidence our communities have in the Gemini staff's ability to execute programs on their behalf, the appearance of classical observing on the "endangered list" is a problem for the observatory and our communities. While it is true that such an observing approach is inherently an inefficient use of complex telescopes like Gemini, and runs the risk (and cost) of a journey to Hawai'i and Chile being "weathered out," a classical observation is still an allocation that brings community astronomers to the telescopes. It allows them to experiment, innovate and even occasionally fail. The benefit of taking such a calculated risk by tightly coupling innovative users to complex machines like Gemini is difficult to quantify. But, keep in mind that the first use of the Gemini Multi-Object Spectrograph in its innovative "nod-and-shuffle" observing mode was as a classical observation. The challenge we as a community now face is to find a new model for observational ground-based optical/infrared astronomy that makes the best use of at least 25% of Gemini's science time in "a classical way."

PUBLIC INFORMATION & OUTREACH

DELIVERING A PUBLIC LEGACY

Peter Michaud

Gemini Observatory has come a long way from the days when the seeds of its creation were first planted by a visionary group of engineers and scientists in the mid-1980s. Today it is a world-class facility with a pre-eminent place among the world's great astronomical institutions. Such status demands a public information program to match the quality and caliber of our cutting-edge scientific research.

To meet this need, the Gemini Public Information and Outreach (PIO) effort began an expansion phase in early 1998, when the Gemini North mirror was still on its way across the Atlantic Ocean from France. My first duty as the newly hired PIO Manager was to help coordinate the video documentation of the mirror's arrival and subsequent 4-day "stroll" to the heights of Mauna Kea. Even from Oahu, some 300 miles away (where I was finishing out my previous job), I could sense the tempo of activity at Gemini was far ahead of the slow pace of the mirror's trek up Mauna Kea and I knew there were going be lots of exciting times ahead!

The Gemini PIO effort has undergone some dramatic changes in the past six years. To summarize where the Gemini PIO Office is today we should look at some of the events that led directly to our current status.

The Second Derivative of PIO Activity goes Positive (PIO Activity Accelerates)

There are many ways to build an effective PIO effort for a major observatory, but few formulas to follow. Every facility presents its own set of challenges and opportunities, and Gemini has had more than its share of both. Fortunately, everyone from management to the partnership recognized the importance of doing outreach and education in order to assure the long-term health of the organization.

The first to step up with funding was the U.S. National Science Foundation (NSF) in 1999. It provided additional money to support the creation of such media resources as animations and images, as well as the documentation of the Gemini South mirror move from France to Chile. This funding established a model and an order of magnitude for the finances necessary to support effective PIO activities at Gemini. Ultimately the model was adopted by the entire Gemini partnership.

About the time the supplemental NSF PIO funding was nearing the end of its cycle, a management review of Gemini in 2000 recommended a "substantial increase in the PIO level of effort…" to be funded by the entire partnership as part of the ongoing Gemini operating budget. A five-year PIO expansion proposal was developed and presented to the Gemini Board in 2000 and was met with broad support. This plan provided a significant increase in the level of staffing and infrastructure available at Gemini, and resulted in the establishment of many new initiatives—ranging from local outreach and education to the continuing production of new media resources.

Today the Gemini PIO Office is in the fourth year of this expansion and has reached what some might call its operational "steady-state" phase. During the past three and a half years, staff members have been hired and many new programs initiated. We have learned a great deal about what outreach methods are effective and necessary, and ultimately what PIO initiatives work best for Gemini.

Expanding to Fill a Void

In many ways, the expansion of the Gemini PIO effort was created to fill a void that existed not due to neglect, but because it had not yet been necessary. As the Gemini telescopes on Mauna Kea and Cerro Pachón matured from construction sites to an operating observatory, the public outreach activities needed to reflect Gemini's "coming of age." Broad goals were codified in the PIO mission statement, which says (in part) that the PIO effort would "…create a public legacy of Gemini science while meeting the media relations and education needs of the Gemini partnership as well as our local, international and global communities."

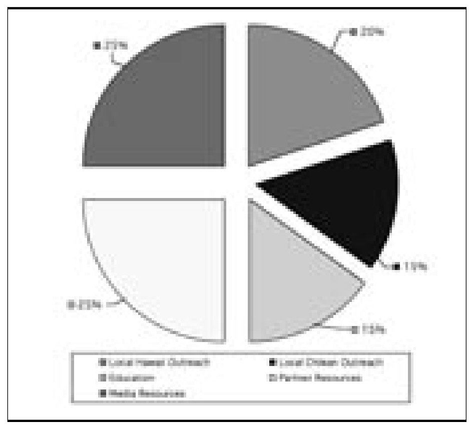


Figure 1: *Approximate allocation of Gemini PIO resources.*

To meet those goals, and to help develop an effective and appropriate PIO program for Gemini, four key areas of activity were identified: 1) local outreach; 2) education; 3) media relations and 4) partnership support. It was also necessary to define each of these categories as concisely and precisely as possible. Here is what emerged:

1) **Local Outreach:** sharing Gemini's science results and resources with our local communities (Chile and Hawai'i), while creating educational spin-offs;

2) **Education:** creating pedagogical knowledge, techniques and tools to more effectively share Gemini's science with all learners;

3) **Media Relations:** providing timely, accurate and relevant materials to all media, resulting in a public, long-term Gemini science legacy and;

4) **Partnership Support:** leveraging with the Gemini partnership to utilize our collective assets and provide necessary support materials.

While it is true that the distinctions between these categories may be blurry, these focal points have proved extremely useful for planning and evaluation.

In order to accomplish everything in the PIO's mandate, many milestones needed to be met. The single most important one was to define and hire the necessary qualified staff. Figure 2 shows the staffing ramp-up which is currently at our final target with the exception of the Writer/Editor position. This work is being performed (indefinitely) on a contracted

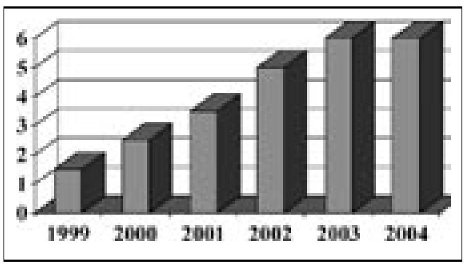


Figure 2: *Ramping up of PIO staff (FTE's) over the past 6 years of growth*

services basis for several reasons, including physical space limitations. The specific PIO positions currently funded and staffed include:

- PIO Manager/Press Officer
  1.0 FTE
- Local Outreach/Education Specialists
  2.0 FTE
- Graphic Artist/Photographer
  1.0 FTE
- Writer/Editor (contracted)
  1.0 FTE
- Interns/Assistants
  1.0 FTE

In addition to staffing, the PIO expansion effort required a significant amount of infrastructure buildup. This included establishing appropriate office accommodations at both sites, securing key outreach equipment like several portable StarLab planetaria, and completing a graphic arts/video studio.

Concurrent with the establishment of the PIO staff and infrastructure was an extensive increase in activity in the public outreach program. This was critical to our success because it provided the foundation for our subsequent steady-state operations as well as continued growth beyond the first expansion phase.

Ramping Up PIO:
Defining Outreach at Gemini

The formative years of Gemini PIO included multitudes of events and activities which are beyond the scope of this article (or the page limit of this newsletter!) To illustrate some of the key programs, milestones and initiatives which have highlighted the ramp-up period of Gemini's PIO expansion, see the montage on the opposite page.

In addition to these program highlights, other ongoing activities contribute to the overall PIO efforts, such as the editing and production of this newsletter, press release development, World-Wide-Web content, community and classroom events, and the creation of various media resources.

Ramping Up Gemini's PIO Activities

Images on the adjacent page correspond to past & current programs and initiatives described below:

*a. **Virtual Tour** – Interactive educational CD-ROM highlights many aspects of Gemini science and technology. The kiosk version is currently installed in ten locations in Hawai'i and one in Canada.*

*b & c. **StarTeachers Exchange** – Initiated in 2003, this program provides an opportunity for local teachers in Gemini host communities to visit and teach in Chile and Hawai'i–another exchange is planned for 2005. (more details on pg. 8)*

*d. **Gemini South Mirror Move** – Documentation of the Gemini South mirror move from France to Chile included extensive video and still images for media and archival purposes.*

*e & k. **StarLab Portable Planetarium** – This Gemini "Flagship" outreach program at both Gemini North and South provides school programming and educator loan opportunity with innovative portable planetarium. (see more details on pg. 8)*

*f. **Time-lapse Documentation and Video Production** – Time-lapse photography is used to document key events like mirror coating and produce broadcast quality (including HDTV quality) video of nighttime telescope operations.*

*g. **Mauna Kea Tabloid** – With over 35,000 copies printed and distributed in a Sunday edition of the Hawai'i Tribune-Herald, this 48-page tabloid was widely acclaimed. A similar publication is being planned for Chile.*

*h. **PIO Liaison Network** – An annual meeting of Gemini partner PIO staff (one from each country) brings together to discuss issues, coordinate planning and do a little brainstorming.*

*i. **Animation Development and Production** – Custom broadcast quality animations illustrates technology like adaptive optics and astronomical phenomena such as planetary/stellar formation.*

*j. **Image Resources** – Multi-faceted initiative to produce striking images of Gemini for media/education and outreach purposes is producing large format images for a "Tools of Vision" photo show, and establishing infrastructure for the production of color astronomical images.*

*l. **Canadian Essay Contest** – Joint program (2002 & 2003) with Canadian Partner Office selected winning essays that prompted observations (imaging) by Gemini.*

*m. **Dedications/Events** – Coordination, documentation and providing public relations support for events such as both Gemini dedications and the naming of the Frederick C. Gillett Gemini North Telescope.*

Ramping Up Gemini's PIO Activities

PIO Initiatives Under Development:

*a. **Annual Science Review** – Initiated with the 2004 Gemini Science Conference in late-May 2004, an annual Gemini Science Review publication will be published which will be aimed at the informed public, educators, leaders and funding agencies. Anticipated to be ~12 pages/year, this glossy, high production value publication is expected to play a major role in establishing Gemini's public scientific legacy.*

*b. **Newsletter Redesign and Expansion of Distribution** – Incorporating a new graphic design, editorial philosophy and the possibility of increasing the page-count and including all-color pages are all possibilities being explored for the Gemini Newsletter. In addition to this we continue to expand the mailing list distribution and a significant increase to the media, educators and universities is currently underway.*

*c. **Gemini South Media Resources** – A new part-time position has been created at Gemini South to facilitate the documentation of activities at Gemini South and provide video to local media and to support a new initiative program on local Chilean TV focusing on astronomy.*

*d & j.**Family Astro** – This NSF/Astronomical Society of the Pacific program is currently being integrated into the Gemini local outreach program in Hilo Hawai'i. The local Hawai'i Department of Education has also adopted this program (in a partnership with Gemini) for local school community engagement activities. A Spanish version is being explored for adaptation to the Gemini Chilean communities.*

*e. **New Animations/Video Production** – Continuing the legacy of animation production that created the highly successful adaptive Optics animation, future animations are planned and an animation highlighting the Gemini Laser Guide Star system is currently nearing completion. In addition, HDTV video time-lapse sequences are currently under production using a technique developed by Gemini PIO staff.*

*f. **Virtual Tour Translations** – With over 3 years of development and testing completed, the highly successful Gemini Virtual Tour is moving into the translation phase where it will be translated in to the primary Gemini languages (including Hawaiian) and integrated into national educational networks. Spanish translation is already well underway, see image "g".*

*g. **Internships** – The expansion and formalization of internship opportunities at Gemini is being actively pursued and partnerships with local universities and institutions like the Center for Adaptive Optics are being engaged.*

*h. **WWW Resources (redesign)** – The delivery of Gemini media and education resources via the WWW is being re-examined and a redesign is planned to ease navigation to all resources which could expand to include broadcast quality video and WWW adaptation of the Virtual Tour.*

*i. **Partner Resources** – In addition to the continuation of the production of partner resources such as press releases, images and illustrations, new products such as conference display graphics and technology (HDTV video content, Virtual Tour kiosks etc.) are currently being assembled for use by the partnership at conferences, meetings and public spaces throughout the partnership.*

*k. **PR Imaging Initiative** – While this has been under development for the past two years, we are developing plans to expand the effort, using contracted services to assure a continuous and greater level of activity in Gemini's astronomical PR imaging.*

*l. **Journey Through the Universe** – Joint Gemini/Keck/NASA(Challenger Center)/Hawai'i Department of Education partnership which will involve 130 local Hawai'i teachers in training, workshops, one week of extensive community programming, and a long-term 5-year teacher commitment to the program. Only 4 new communities are selected each year.*

The combination of these efforts and the programs described on pg. 4 brings us to where we are today and will take us into the future.

Looking to the Future

The five-year ramp-up of the Gemini PIO effort is currently midway through its fourth year, with one more year to go before the official end of this phase. We are in an experimental stage of testing, evaluating, and assessing programs for possible integrating into the long-term Gemini PIO program. This will continue into 2005, when we will determine which efforts should continue, undergo modification, or be dropped. Key programmatic elements and categories of effort will undergo a thorough review at the end of year five as we exit this phase of growth and move on to the next, and all of the PIO activities (current and planned) will be subject to ongoing review.

The current expansion of the Gemini PIO effort is not designed to simply establish a "steady-state" status at the end of 2005. As in astronomy, such a model is not a viable way to operate in the rapidly changing confluence of astronomy, education and the media. Instead, we anticipate the end of our current expansion will begin a continuous evaluation of our needs and exploration of opportunities for the future.

Seeking the continued extension of resources and funding options will be an ongoing part of our efforts. We anticipate that a long-term expansion of outreach capabilities at Gemini South will be an important part of the Gemini PIO effort to better match the level of activity currently established at Gemini North. Expansion at Gemini South will undoubtedly present different needs and influences than the Gemini North effort. However, the staggered approach of developing key programs at Gemini North first will result in a smoother integration at Gemini South during the next phase of the outreach/education expansion.

As we look toward the future for Gemini PIO, the following principles will help to steer our work:

1) to utilize appropriate technologies to disseminate resources effectively and globally;

PIO Initiatives Under Development

2) to network with a broad base of professional communities and participate in local, national and international conferences and meetings;

3) to share resources and knowledge freely;

4) to be prepared for opportunities, new partnerships and change.

In moving beyond the initial PIO expansion period, it is important to understand that our ultimate goal is to establish a legacy of Gemini's scientific impact by promoting our results within the broad international community. This is a long-term commitment and most of the effort we've made until now has served to lay the foundation. The work of creating a global legacy is just beginning for the Gemini PIO program.

Focus on Local Outreach

StarLab and StarTeachers Programs

Two of Gemini's flagship local outreach programs are the StarLab portable planetaria and the StarTeachers exchange program. Both of these programs have been extremely successful on many levels as indicated by the highlights that follow:

StarLab – Taking Gemini's Science to our Communities and Classrooms

Utilizing the popular StarLab portable planetarium system, Gemini has successfully delivered the science and excitement of astronomy to local classrooms in our host communities. The success of this program has resulted in significant growth and outside support for this program and allowed us to increase the variety of programming offered.

As a key local outreach program that is mirrored both in Hawai‘i and Chile, Gemini's StarLab program operates differently in each location due to differences in geography, educational systems and outside partnerships.

StarLab – Chile

- Partnership with CTIO RedLaser for effective leveraging and staffing
- Focus on La Serena region
- Includes well-developed teacher training/loan program
- "StarLab II" donated by US StarLab manufacturer (Learning Technologies, Inc.) for remote rural programs in communities surrounding Cerro Tololo/Pachón

StarLab Chile
2003 Attendance: 17,562

StarLab – Hawai‘i

- Staffed by Gemini outreach staff/interns
- Focus on East Hawai‘i (Big Island)
- Teacher training/loan program initiated in 2003
  - 53 teachers trained by end of 2003
- 2003 expansion of program to include W.M. Keck Observatory and University of Hawai‘i at Hilo to broaden programmatic and geographical reach

StarLab Hawai‘i
2003 Attendance: 6,116

StarTeachers – Taking our Community's Teachers to New Heights!

The StarTeachers exchange program was initiated in 2003 as a pilot project to explore the pedagogical impact of videoconferencing technology on students and educators. The program's success has prompted a second exchange of teachers between Chile and Hawai‘i planned for 2005. See the Gemini Newsletter #27 for more details on this program.

Highlights from the 2003 StarTeachers program:

- 6 participating teachers (3 from Hawai‘i, 3 from Chile)
- Over 7,900 students visited
- 30% increase in school astronomy club attendance (Chile)
- Gabriela Mistral Medal Awarded
- Teacher workshops involving 420 Chile/Hawai‘i teachers
- 1,700 lei made by students and delivered to Chile
- Over 50 lesson plans delivered to Chile
- Multiple follow-up workshops
- Successful experimental tests demonstrating the educational use of videoconferencing
- Positive community involvement

Chile's Gabriela Mistral Medal (above right) awarded on behalf of the Gemini StarTeachers from the Chilean Ministry of Education. This is the first time it has been presented outside of Chile. StarTeachers and staff prior to visiting Mauna Kea (above left).

RECENT SCIENTIFIC HIGHLIGHTS

Jean-René Roy & Phil Puxley

On 23-26 May 2004, about one hundred Gemini users will gather in Vancouver, Canada for the first Gemini science conference. This will be a unique moment in the young life of the Gemini Observatory. About 75 science papers have been published based on Gemini North and South Telescopes use so far, and the Vancouver participants will provide an exciting outlook on fresh results and on the crop of papers in preparation.

The most important event of the last semester has been the coming on line of the full set of facility instruments on the instrument support structure of the Gemini South Telescope. These have been Gemini Multi-Object Spectrograph-South (with its integral field unit), T-ReCS the mid-infrared imager and the Gemini Near Infrared Spectrograph (GNIRS).

The recent science highlights include exploring the surface composition of the newly discovered planetoid Sedna, the unique recovery of a type II supernova progenitor star in NGC 628, the identification of the nature of the galaxies in the redshift desert and the identification of possible large structure at z ~ 6 in the Hubble Space Telescope Ultra Deep Field (UDF).

Sedna: The Most Distant Minor Planet is Probed With NIRI

On November 14, 2003 UT, Chad Trujillo (Gemini Observatory) and Michael Brown (CalTech) found the new minor planet 2003VB12, using the Palomar 48-inch Telescope. Also known as Sedna, it is located much further out than Pluto. With a heliocentric distance of close to 90 astronomical units, it is the most distant known body bound to the Sun by a factor of two. The orbit of Sedna takes it from perihelion (near its current location) to about 1000 AU. It is most likely that the object represents an intermediate population between the Kuiper belt and the Oort cloud. Due to its extreme distance from the Sun, Sedna may have a more pristine surface than closer objects, more prone to solar heating and collisions. First-look low-resolution K band spectra of Sedna obtained with NIRI on the Gemini North telescope appear largely featureless, suggesting a surface to be highly processed by cosmic rays. For example the spectrum of Sedna is very different from those of Pluto and Charon which show deep methane ice and water ice absorptions respectively. No evidence of a companion to Sedna is apparent in the 0.31" images collected by NIRI, a result that has been confirmed by HST images. It is the reddest known minor planet. These observations emphasize the extremely unusual nature of Sedna.

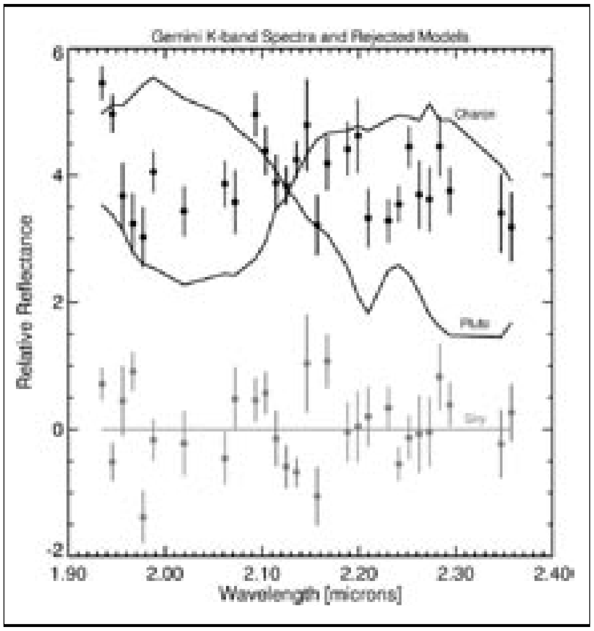


***Figure 1:** The largely featureless near-infrared spectrum of Sedna obtained with NIRI indicates a surface highly processed by billions of years of bombardment by cosmic rays. Pluto and Charon spectra are very different with their deep methane and water absorption.*

An Intergalactic Nursery of Young Stellar Clusters

A team of Brazilian and French astronomers led by C. Mendes de Oliveira has discovered four intergalactic HII regions located more than 80,000 light-years away from the center of the nearest group of galaxy and with no apparent connection to it. The gas of the HII regions appears surprisingly rich in metals and the exciting young stellar clusters are only about 5 million years old. The group of galaxies, known as Stephan's Quintet, lies about 280 million light-years away. It is an association of five galaxies that are probably undergoing a merger.

The team used the Gemini Multi-Object Spectrograph on the Gemini North Telescope to image Stephan's Quintet and to obtain spectra of several objects in the field. The HII regions have heliocentric velocities, measured with GMOS, that clearly support their spatial association with the Stephan's Quintet compact. The four young stellar clusters corresponding to the intergalactic HII regions are located on Figure 2. The intergalactic HII regions are found within a large neutral hydrogen plume that runs across the field.

The clusters of young stars exciting the intergalactic HII regions have masses similar to the proto-globular clusters found in several mergers and in the Stephan's Quintet. What is so unusual about the objects are their youth and location away from any of the normal locations of star forming regions. The intergalactic material, seen as the large HI tail, corresponds likely to the remnant of recent interactions in Stephan's Quintet. Oxygen abundances derived from the

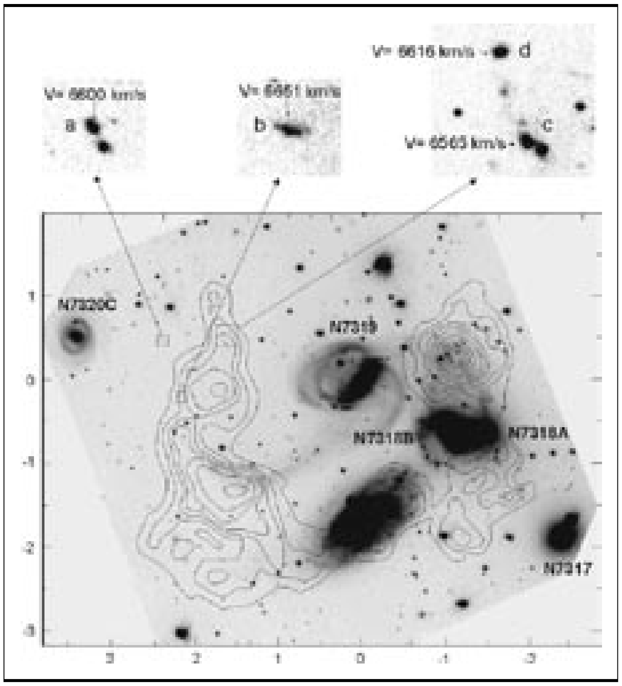


Figure 2: Image of the galaxy compact group Stephan's Quintet in the r band from GMOS. Over-plotted are the neutral hydrogen (HI) column gas density contours. The three boxes in the upper left corner indicate the areas where the new intergalactic HII regions were found. The top panels feature zoomed views of these regions. Note that they lie well within the HI tail.

optical nebular emission lines measured with GMOS indicate levels close to solar. Hence the intergalactic matter from which the young clusters formed had already been well pre-enriched by earlier generations of massive stars (a process that most likely took place when the gas was still part of the galaxies we see today as Stephan's Quintet).

Probing Galaxy Evolution One Billion Years After the Big Bang

The GLARE (Gemini Lyman Alpha at Reionisation Era) team, an international group of astronomers using the Gemini South telescope to study the early universe, discovered three very high redshift galaxies (z = 5.83, 5.79 and 5.94) in the same region of the southern GOODS field. Two of the Lyman-alpha emitters measured are the faintest of any previous spectroscopic study. The objects are red (i' - z') > 1.3 and the faintest one has a z' magnitude of 27.15. This finding suggests the existence of large-scale structure at this redshift.

This field is very close to the Hubble Ultra-Deep Field (UDF), a small portion of sky in the southern hemisphere recently imaged by the Hubble Space Telescope. The UDF is the deepest imaging ever done of a region in the sky. The UDF will be a unique dataset for astronomers during the decade to come. The GLARE team started taking spectra of objects in this region with the Gemini South Telescope last November.

Spectacular progress has been made lately on the population of galaxies at greater than 90% look-back time in cosmic history. The standard approach when identifying very distant galaxies is to obtain deep imaging in several color bands and to look for the "drop-out" objects. Young galaxy spectra are generally dominated by the emission line of hydrogen Lyman alpha (1216 angstroms). The flux on the blue side of Lyman alpha is highly depressed because of absorption in the intervening intergalactic medium, while the red side has a weak stellar continuum. The latter may be detected with only very deep spectroscopic exposures like those done with GMOS-N&S using the nod and shuffle technique. For high redshift objects, the drop-out effect translates into a non-detection in optical colors such as r, i, but detection in the z, or J and H band in the near infrared.

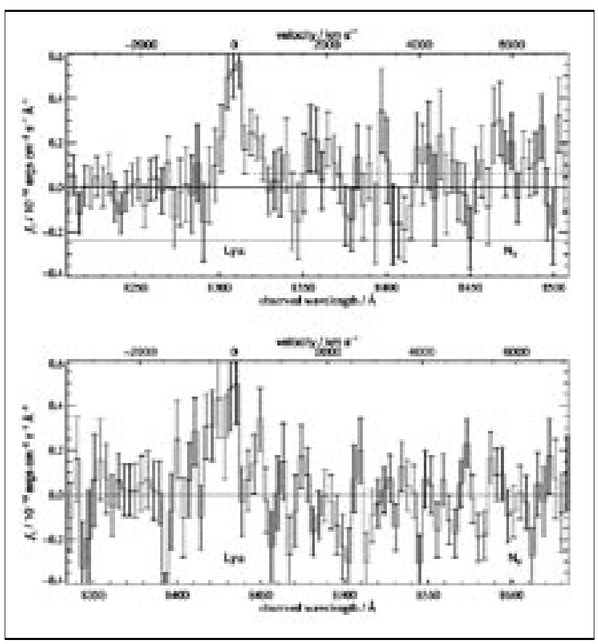


Figure 3: Unbinned GMOS-South spectra of the GLARE objects. The top frame shows GLARE#1042 with a weak continuum (dotted line). The observations were conducted during conditions of half arcsec seeing or better and high transparency. The bottom spectrum corresponds to the faintest ever detected (z'_{AB} = 27.15) Lyman Break Galaxy ever detected.

The Gemini Lyman Alpha at Reionisation Era (GLARE) survey aims to obtain extremely deep spectra of very faint high-redshift star-forming galaxies, selected via i - z color from the HST/UDF survey. The present discovery was from the first 7 hours of spectroscopy obtained with GMOS-S at Gemini South. The total exposure time, when completed, will be 125 hours, producing extremely deep spectra (see Figure 3).

The first GLARE objects show narrow Lyman-alpha lines characteristic of star-forming galaxies and do not show Active Galaxy Nuclei emission. The rest-frame ultraviolet spectra of the objects are likely to be dominated by star forming. This means that these are "normal" distant star-forming galaxies known as Lyman Break Galaxies.

Massive Old Star Reveals Secret on Deathbed

Like a doctor trying to understand an elderly patient's sudden demise, astronomers have obtained the most detailed observations ever of an old but otherwise normal massive star just before and after its life ended in a spectacular supernova explosion.

The star was imaged by the Gemini Observatory and the Hubble Space Telescope less than a year prior to the gigantic explosion, and is located in the nearby galaxy NGC 628 (Messier 74) in the constellation of Pisces. These observations allowed a team of European astronomers led by Dr. Stephen Smartt of the University of Cambridge, England, to verify theoretical models showing how a star like this can meet such a violent fate. This work provides the first confirmation of the long-held theory that some of the most massive (yet normal) old stars in the Universe end their lives in violent supernova explosions.

In this case, the renowned Australian amateur supernova hunter, Reverend Robert Evans, made the initial discovery of the explosion (identified as SN203gd) while scanning galaxies with a 12-inch (31-cm) backyard telescope from his home in New South Wales, Australia in June 2003.

Following Evans' discovery, Dr. Smartt's team quickly followed up with detailed observations using the Hubble Space Telescope. These observations verified the exact position of the original or "progenitor" star. Using this positional data, Smartt and his team dug through data archives and discovered that observations by the Gemini Observatory and HST contained the combination of data necessary to reveal the nature of the progenitor.

Armed with the earlier Gemini and HST observations Smartt's team was able to demonstrate that the progenitor star was what astronomers classify as a normal red supergiant. Prior to exploding, this star appeared to have a mass about 10 times greater, and a diameter about 500 times greater, than that of our Sun.

After SN2003gd exploded, the team observed its gradually fading light for several months using the Isaac Newton Group of telescopes on La Palma. These observations demonstrated that this was a normal Type II supernova, which means that the ejected material from the explosion is rich in hydrogen. Computer models developed by astronomers have long predicted that red supergiants with extended, thick atmospheres of hydrogen would produce these Type II supernovae but until now have not had the observational evidence to back up their theories. However, the resolution and depth of the Gemini and HST images allowed the Smartt team to estimate the temperature, luminosity, radius and mass of this progenitor star and reveal that it was a normal large, old star.

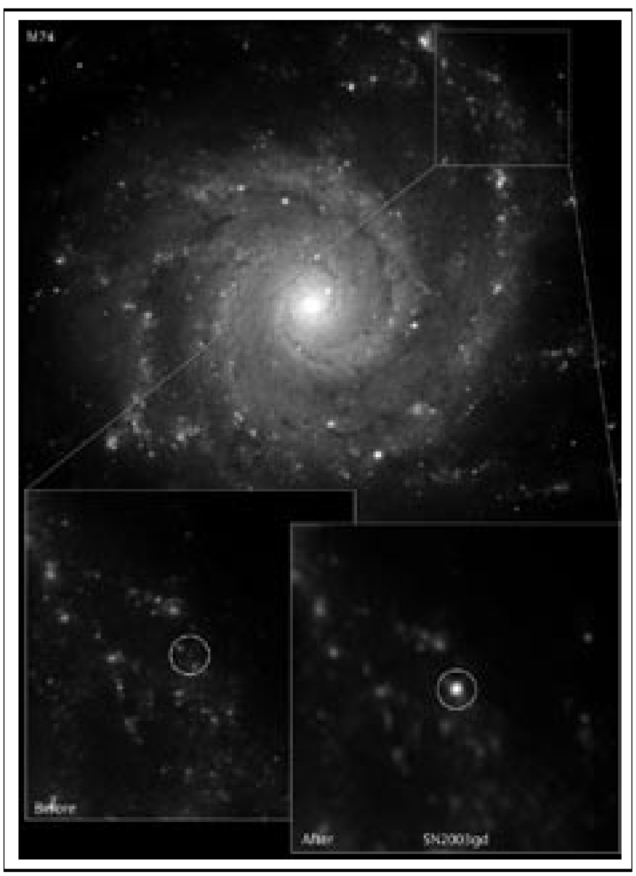


Figure 4: *Gemini GMOS image of M-74 (NGC 628) with inset (left) showing pre-explosion star (enhanced) from Gemini image and (right) SN2003gd after it exploded when the supernova was 6 months old (Isaac Newton Telescope).*

This is only the third time astronomers have actually seen the progenitor of a confirmed supernova explosion. The others were peculiar Type II supernovae: SN 1987A, which had a blue supergiant progenitor, and SN 1993J, which emerged from a massive interacting binary star system.

Old Massive Galaxies in the Early Universe

Until now, astronomers have been nearly blind when looking back in time to survey an era when most stars in the Universe were expected to have formed. This critical cosmological blind-spot has been removed by a team using the Frederick C. Gillett Gemini North Telescope, showing that many galaxies in the young Universe are not behaving as expected some 8-11 billion years ago. The surprise: these galaxies appear to be more fully formed and mature than expected at this early stage in the evolution of the universe.

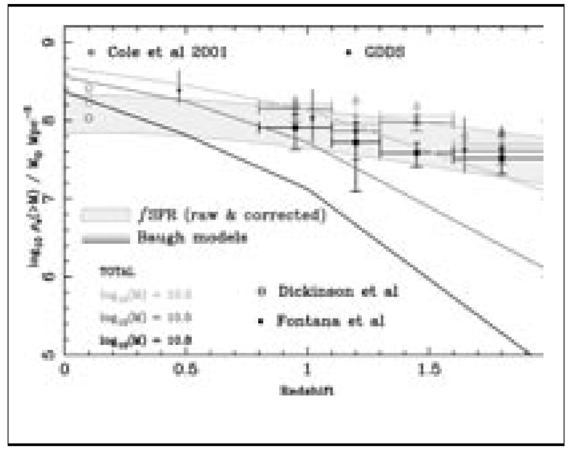


Figure 5: *The most surprising finding from the GDDS is that the ratio of small to massive galaxies remains surprisingly constant up to z ~ 2. A large fraction of the most massive field galaxies are already in place at z = 1.6-2.0.*

Theory tells us that this epoch should be dominated by little galaxies crashing together. We are seeing that a large fraction of the stars in the universe are already in place when the universe was quite young, which should not be the case. This glimpse back in time shows pretty clearly that we need to re-think what happened during this early epoch in galactic evolution.

These observations are from a multinational investigation, called the Gemini Deep Deep Survey (GDDS), which used a special technique to capture the faintest galactic light ever dissected into the rainbow of colors called a spectrum. In all, spectra from over 300 galaxies were collected, most of which are within what is called the "Redshift Desert," a relatively unexplored period of the universe seen by telescopes looking back to an era when the universe was only 3-6 billion years old. Previous studies in the Redshift Desert have concentrated on galaxies that were not necessarily representative of mainstream systems. For this study, galaxies were carefully selected based upon data from the Las Campanas Infrared Survey in order to assure that strong ultraviolet emitting starburst galaxies were not oversampled. The GDDS spectra represent the most complete sample ever obtained of galaxies in the Redshift Desert. By obtaining large amounts of data from four widely separated fields, this survey provides the statistical basis for drawing conclusions that have been suspected by past observations done by the Hubble Space Telescope, Keck Observatory, Subaru Telescope and the Very Large Telescope over the past decade.

Studying the faint galaxies at this epoch when the Universe was only 20-40% of its current age presents a daunting challenge to astronomers, even when using the light-gathering capacity of a very large telescope like Gemini North with its 8-meter mirror. All previous galaxy surveys in this realm have focused on galaxies where intense star formation is occurring, which makes it easier to obtain spectra but produces a biased sample. The GDDS was able to select a more representative sample including those galaxies which hold the most stars—normal, dimmer, and more massive galaxies—that demand special techniques to coax a spectrum from their dim light.

It is quite obvious from the Gemini spectra that these are indeed very mature galaxies, and we are not seeing the effects of obscuring dust. Obviously there are some major aspects about the early lives of galaxies that we just don't understand. It is even possible that black holes might have been much more ubiquitous than we thought in the early universe and played a larger role in seeding early galaxy formation.

What is arguably the dominant galactic evolution theory postulates that the population of galaxies at this early stage should have been dominated by evolutionary building blocks. Aptly called the Hierarchical Model, it predicts that normal to large galaxies, like those studied in this work, would not yet exist and would instead be forming from local beehives of activity where big galaxies grew. The GDDS reveals that this might not be the case.

Our Nearest Brown Dwarf Neighbor

Verne Smith of the University of Texas El Paso led an international team of American, Canadian, Brazilian and Japanese astronomers to a detailed study of the physical properties of the recently discovered nearby brown dwarf companion to Epsilon Indi, the fifth brightest star of the southern hemisphere constellation Indus.

This T-dwarf star was discovered at Gemini South by Kevin Volk *et al.* (2003) to be a close optical double consisting of an early T dwarf (Epsilon Indi Ba) and a late T dwarf (Epsilon Indi Bb) separated by 0.6". With an accurately known distance of 3.626 +/- 0.009 parsec, Epsilon Indi Ba and Bb are the nearest known brown dwarfs (see Figure 6).

High-resolution infrared spectra were obtained on Epsilon Indi Ba using the Gemini South Telescope and the NOAO PHOENIX spectrometer.

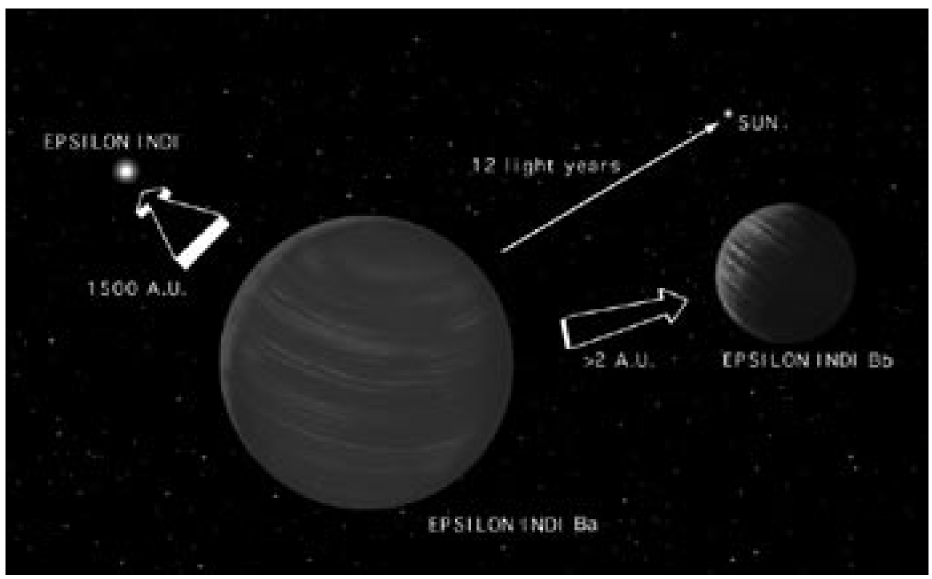


Figure 6: *An artist's conception of the Epsilon Indi system showing Epsilon Indi and the brown-dwarf binary companions. Due to the perspective of the brown dwarf companions, the relative sizes are not represented in this illustration. Artwork by Jon Lomberg.*

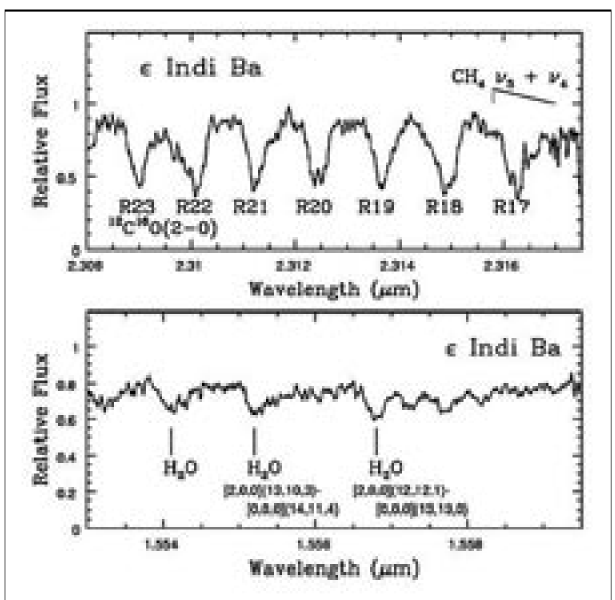


Figure 7: *PHOENIX spectra of the 2.308-2.317 μm and 1.553-1.559 μm region Epsilon Indi B. The former interval is dominated by strong* $^{12}C^{16}O(2\text{-}0)$ *lines that are rotationally broadened.*

The properties of Epsilon Indi Ba were explored by comparing the PHOENIX spectra (Figure 7) to the computer generated synthetic spectra from model atmospheres. These models are so called "unified cloudy models" in which dust is allowed to exist in the atmosphere of the brown dwarf over a limited range defined by a condensation temperature and a critical temperature. This technique reproduces the complex physical state of the atmospheres of brown dwarfs; they have "weather" driven by dust condensation and a complex circulation pattern. By matching the shape and the depth of the absorption lines of $^{12}C^{16}O$ and H_2O, the researchers derived an effective temperature of 1,500K, a surface gravity of log g = 5.2 (almost 6 times the surface gravity of the Sun). From the luminosity derived by Scholz *et al.* (2003) of log (L/L_{sun}) = -4.71 (i.e. 30,000 times fainter than the Sun), Smith *et al.* were able to determine that the mass of Epsilon Indi Ba is 32 times that of Jupiter.

Numerical fits to the line profiles (primarily the strong CO lines) yield the projected rotational velocity of 28 kilometers/second. This implies a maximum rotational period for Epsilon Indi Ba of 3.0 hours, more than three times that of Jupiter (which has the fastest rotation rate of any planet in our solar system with a period of 9h 50m). Jupiter and Epsilon Indi Ba probably have similar diameters, hence Epsilon Indi Ba must be significantly flattened by its fast rotation.

OSCIR Goes to Mickey!

Gemini South mid-infrared observations of young massive stars in our galaxy bares a striking resemblance to a famous mouse...

by Cassio Barbosa

Massive stars are rare and peculiar: they are born deeply embedded in their dust cocoons, they have short lives and die in spectacular and powerful explosions as supernovae, enriching the interstellar medium with heavy elements and triggering the star formation in their vicinity. Massive stars play fundamental roles in the galaxy at both local and global scales. Despite their impact on the Galactic medium, the formation process of massive stars is still very uncertain due to the huge extinction toward their birth places and their short lifetimes.

The galactic giant HII (GHII) region NGC 3576 harbors a set of very young stellar objects, heavily obscured at optical wavelengths, but very bright at near infrared, as seen in Figure 1 (Figuerêdo *et al.* 2002, AJ, 124, 2739). Even though the extinction in the K band is only $0.1A_V$, the photosphere of these objects still remains blocked by hot dust at ~2 μm and no further information, such as their spectral types, could be obtained. However, their positions in the color-magnitude diagram suggest that they are luminous massive objects, still embedded in their cocoons of gas and dust. The study of these intriguing objects is an ideal case for Gemini, since high-resolution images at longer wavelengths, such as mid-infrared (MIR), are needed to unveil their nature.

This paper was published in the Astronomical Journal, Vol. 126, Issue 5, pp. 2411-2420 and authored by: C. L. Barbosa & A. Damineli (Instituto de Astronomia, Geofísica e Ciências Atmosféricas, Universidade de São Paulo, Brazil); R. D. Blum (Cerro Tololo Interamerican Observatory, NOAO, Chile) and P. S. Conti (JILA, University of Colorado, USA)

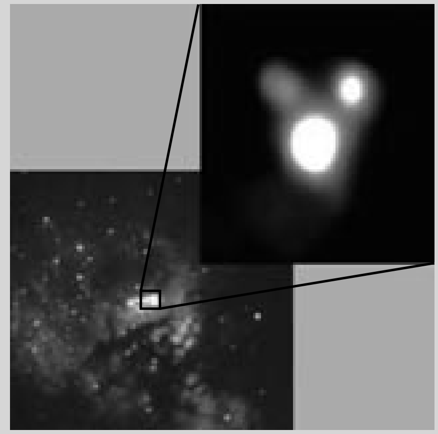


Figure 1: *The Galactic giant HII region NGC 3576 in the K band (~2'x2'; courtesy of R. Blum-CTIO). The inset shows the source IRS 1 in the N band (~11"x11"). The MIR camera OSCIR was used to observe the bright MIR source IRS 1 in NGC 3576. This source was discovered by Frogel and Person (1974, ApJ, 192, 351) along with other 4 sources in this cluster. The images with unprecedented resolution delivered by OSCIR at the Gemini South telescope revealed the multiple nature of IRS 1 (see Figure 2); within ~2 arcsec we found 4 sources (Barbosa et al. 2003, AJ, 126, 2411). The fluxes in 7.9, 9.8, 12.5 and 18.2 μm have been used to estimate the bolometric luminosity of each source and hence an estimate of their spectral types. The brightest sources, named #48 and #50, are in fact massive stars (B1 and O8 respectively) still enshrouded by their natal gas and dust.*

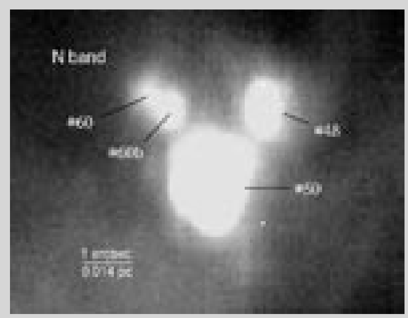


Figure 2: *Source IRS 1 resolved into 4 sources, for the first time, in MIR wavelengths. The initial results obtained for NGC 3576/IRS 1 are very promising, for they indicate that the nature of these deeply embedded objects can be revealed and the theories of formation and early evolution of massive stars can be constrained by combining observations in the NIR and MIR. The growing number of massive young stellar objects discovered in many Galactic GHII regions (at least a dozen in NGC 3576, for example) demands mid-infrared imaging cameras and spectrographs capable of delivering images with both high resolution and large field-of-view in order to give efficient answers to long standing questions. MICHELLE at Gemini North and T-ReCS at Gemini South are excellent tools to provide these answers.*

ENGINEERING REPORT

Kristin Brantzeg

As an engineering administrative assistant at Gemini North, I am privileged to work with very talented engineers and technicians. Day in and day out, our group remains focused on designing and maintaining the systems and subsystems for the observatory. Now that the last remaining construction, final commissioning tasks and debugging activities of the telescopes are nearing completion, the engineering department's primary goal for 2004 has shifted towards supporting science operations. By maintaining and enhancing the existing telescope and instrumentation systems, we are ensuring high reliability and optimum performance for science output. One of the department's specific goals is to achieve a science availability time of better than 80%. We are accomplishing this by carefully prioritizing new features and engineering tests that require telescope availability or observing time to ensure they offer net benefit while keeping science operations moving. As a team our group spans the four Gemini sites, but we work together to exemplify the concept of "Two Telescopes—One Engineering Team." Each site has group leaders and senior managers to offer leadership and support. Also, the group leaders, senior managers and engineers make frequent trips between sites to ensure good coordination.

In 2004, the engineering department is working on projects initiated with the intent to organize and improve engineering functions for the present and the future.

In January, software engineer Peter Groszowski began construction of the Gemini Engineering Archive (GEA). Under the supervision and guidance of Matthieu Bec, Gemini North Software Group Leader, Peter has created a software program to archive key technical data from the telescope and instruments. This system, which will be utilized by the engineering and science staff to monitor and visualize the long-term performance

Figure 1: *Technicians work on MICHELLE in the new Gemini North clean room at the Hilo Base Facility.*

of all the telescope components, will be a robust and easy-to-use package. It will monitor each instrument and system, routing important data for each 24-hour period to a "Daily" report page that will also have tools to help engineers create graphs and other data analysis reports for the systems and subsystems. The majority of the GEA library code is ready and operational in beta-testing mode. The general layout and structure of the GEA website is ready, but many of the implementation details have yet to be worked out. Please stay tuned for more information on GEA's development.

In late March, we held a meeting to discuss improvements and modifications to observatory utilities to increase operational robustness, and to communicate ways to modify and enhance our current systems. The goal is to make the observatory systems the best we can in order to deliver the maximum science time and the minimum time loss, and to suggest possible upgrades. The main utilities include the helium system, power system, cooling system and the air system. Rolando Rogers, head of the Electronics & Instrumentation Group suggested that one group leader from each site be assigned a specific utility system. Engineering will continue meeting with group leaders to update the progress of the improvements and modifications.

Figure 2: *Hilo Base Facility Instrumentation Laboratory*

A major focus in 2004 is the MICHELLE instrument—the mid-infrared imaging spectrograph, which has been previously shared between the UK Infrared Telescope and Gemini North, is being transferred at the end April for an extended period to Gemini. During May and June an intensive period of overhaul and preparation will be undertaken by a joint team of engineers and technicians from Gemini and the ATC in Edinburgh, Scotland. This work includes realigning the detector and optics, as well as improvements to the thermal performance. In July MICHELLE will undergo final commissioning, and engineers will work to optimize the detector noise and performance. The two month period for this work means that the team will have to plan and execute some difficult tasks in a relatively short time. To assist in this the Hilo Base Facility lab, which has been recently finished and equipped, will be used for the first time. MICHELLE will be transported from Mauna Kea to Hilo courtesy of the Subaru soft-ride truck.

The Hilo Base Facility Instrumentation Laboratory has undergone recent renovations to prepare the lab for Gemini instrumentation projects. These renovations include construction of Gemini North's flexure rig, which, is used to simulate the "on telescope environment" and to determine what deformation will occur to an instrument's optical light path as it travels on the telescope. The laboratory also contains a class 10,000 clean room setup for critical environment work related to optics and mechanisms. The room is operated under a strict protocol to maintain the contamination free space and it has already supported 3 major projects at Gemini: the Adaptive Optics group laser guide star, GMOS grating repair and MICHELLE engineering. The Instrument Lab itself is also now maintained as a "neat area." This means that the actions of personnel in the lab, the materials used in the lab and what construction materials are present in the room are controlled in order to reduce contamination levels to the benefit of delicate instruments. There is now only one commonly used entrance to the room to reduce human traffic through the space. This helps greatly in maintaining the clean area. Additional renovations are ongoing to upgrade the lab facility area where pumps, water chillers and support equipment resides. This will include installation of an enclosure for the facility pad and introduction of new helium refrigeration compressors. A lab scheduler has been established to inform personnel of project status in the lab and to help forecast facility use by various groups. During the 2004 calendar year the Instrument Lab will host 4 major projects and is expected to be used for many more.

Figure 3: *An image showing one of the Gemini Engineering Archive web pages. http://internal.gemini.edu/general/library/GEA/gea-present-feb27/img11.html*

On March 16th, the Gemini South secondary mirror (M2) was successfully recoated with only two days and one night of telescope down time. The mirror was coated with a four-layer protected Ag (silver) recipe (NiCr + Ag + NiCr + Si). Reflectivity at 2.2 µm is 98.6%. This 4-layer silver coating is a first. The Gemini South primary mirror (M1) will receive its 4-layer Ag coating at the end of May 2004. As for Gemini North, the secondary mirror (M2) will receive its coating in July 2004. And the primary mirror (M1) is scheduled for the end of 2004, depending on science availability.

New Faces in Engineering - 2004

The Gemini Engineering Department continues to grow, with the addition of the following new team members so far this year:

- Angelic Ebbers, Software Engineer
- Peter Groskowski, Software Engineer
- Daniel O'Connor, Senior Optical Engineer
- Eduardo Tapia, Mechanical Assistant
- Tomislav Vucina, Optics Engineer
- Chris Yamasaki, Senior Electronics Technician

Now that Gemini has completed all construction/commissioning activities, it is our goal for engineering at Gemini to become more transparent to our user community. In other words, that the telescopes and instruments will deliver the required performance and reliability to achieve the science goals of the Gemini Observatory.

With this in mind, this will be the final all encompassing "Engineering Report" as such. Future newsletter reports on engineering topics will focus on new initiatives, milestones and other key events as they occur.

Peter Gray,
Associate Director of Engineering

GEMINI LEADS SOLID STATE LASER DEVELOPMENT

Celine d'Orgeville & Peter Michaud

What is a sum-frequency diode-pumped solid-state laser?

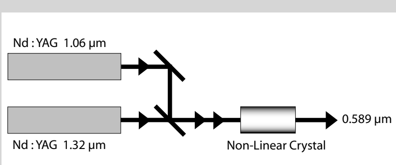
The technology adopted for the next-generation adaptive optics lasers being developed at Gemini utilize two diode-pumped solid-state Nd:YAG lasers (one operating at 1.06 µm and the other at 1.32 µm). The light is combined to produce a single laser beam at 0.589 µm, which is the same wavelength as the first electron energy excitation level for neutral sodium atoms giving it the same color as low-pressure sodium streetlights. The light is combined in a technique called sum-frequency generation. In essence, it is merged inside a non-linear crystal that adds the frequency of the two sources to produce a coherent beam with a frequency equaling the sum of the two light source frequencies (1/ λ).

In terms of wavelength (λ), the formula for the sum-frequency is:

$1/\lambda_1 + 1/\lambda_2 = 1/\lambda_3$

For the Gemini laser this translates to:

1/1.06 µm + 1/1.32 µm = 1/0.589 µm where $\lambda_3 = 0.589$ *µm which is the desired wavelength for a sodium laser.*



Schematic of a sum-frequency laser.

In the quest to provide Gemini and the entire astronomical community with a reliable and robust solution for the production of sodium laser guide stars (LGS) for adaptive optics systems, the Gemini Adaptive Optics (AO) team has made significant progress on the development of a solid-state laser to be used with Altair AO system on Gemini North.

Figure 1: *A view of the dye laser used in experimental tests on Cerro Tololo in 2001-2002. Photo by Maxime Boccas*

In November 2002, the observatory entered into a contract with Coherent Technologies, Inc. (CTI) located in Louisville Colorado, to produce the most powerful solid-state sodium laser ever built for astronomical-based adaptive optics. The specifications require a total light output of 14 watts using two Nd: YAG diode-pumped solid-state (DPSS) lasers and a non-linear crystal to perform a sum-frequency combining of light, which will result in output of light at a wavelength of 0.589 µm (see sidebar for more details on DPSS lasers and sum-frequency generation of light).

The current schedule calls for delivery of the laser by the fall of 2004, with commissioning activity beginning in late 2004 and AO laser science commencing by the end of 2005. "This continues to be an aggressive timeline, but if any team can do this, it is ours at Gemini," said AO Program Manager Mike Sheehan. Mike assumed management of the AO group in May 2003 and has been responsible for all AO program activities at both Gemini sites as well as Altair upgrades necessary to utilize a laser guide star.

"The laser system has significant implications that go way beyond just strapping a laser on the side of the telescope," says Sheehan, pointing out that the laser is only part of the process. From a positive-pressure clean room surrounding the laser system the beam transfer optics direct the light to the laser launch telescope mounted at the top of Gemini's secondary support structure. Finally, safety systems need to address everything from satellite/aircraft avoidance to a laser traffic control system to avoid disrupting observations at neighboring observatories sensitive to the laser light scattered by the atmosphere.

The development of the Gemini AO laser will be a significant boon to all astronomical observatories since it will provide the first facility-class solid-state laser system at an astronomical observatory. "Previous laser guide star

The Starmakers – Making Artificial Guide Stars With Lasers

The problem with adaptive optics systems using natural guide stars is that often targets of sufficient brightness and proximity are not available to sample the impact of atmospheric turbulence on starlight for adaptive optics corrections. This problem can be significantly reduced through the use of an artificial guide star created by a sodium laser fired along the axis of the telescope.

Producing a laser guide star is simple in theory: just shine a laser of the correct color of light into a layer 90 kilometers up in the atmosphere and excite the sodium atoms in this layer (this is why it's called the sodium layer) so they shine and produce an artificial "star" in the sky that can be used to sample the state of our turbulent atmosphere.

In practice it's not quite that simple, but the principles behind the process are well understood and have been demonstrated by experiments done at other institutions like the W.M. Keck and Lick observatories. The challenge has been to provide reliable and powerful laser light at the correct wavelength to excite the sodium atoms and keep the laser beam aligned with the telescope.

When Gemini completes the installation of the solid-state sodium laser on Gemini, it will be the first facility-class solid-state laser system installed at an astronomical observatory.

Laser guide star tests from Cerro Tololo in 2001 using the laser shown in Figure 1. Photo by Maxime Boccas

systems have been dye lasers, which are massive, require high maintenance and consume tens of kilowatts to produce tens of watts of usable light. Solid state lasers can be much smaller and will have efficiencies more than an order of magnitude better." said Fred Chaffee at the W.M. Keck Observatory. "At Keck we are very anxious for this to succeed since we are currently using a dye laser and solid state technology makes it much simpler and more practical for observatories to implement laser guide star systems."

As this newsletter went to press the latest reports from CTI indicate that work with the non-linear crystal PPKPT looks promising. According to Deputy Adaptive Optics Program Manager Celine d'Orgeville, the sodium laser project is no mean feat. "The greatest challenge is getting 14 watts of power out of the PPKPT non-linear crystal", she said. "It has just never been done at these wavelengths and power levels in this configuration."

Project Scientist for the Gemini laser work at CTI is Iain McKinnie, who has an extensive background in the development of DPSS sum-frequency lasers for industrial and military applications. He reports: "The Gemini laser is a unique challenge and it has been interesting working in the environment of a modern observatory like Gemini. The technology is progressing exceptionally well at this point and I'm confident that we are going to be able to meet or even exceed the design specifications for this laser."

Along with its expected significance for all observatories, development of the Gemini laser will have a very profound impact on the future of adaptive optics. The planned Multi-Conjugate Adaptive Optics (MCAO) system slated for Gemini South in the next few years will require five individual laser guide stars each of approximately the same power as the one being developed for Altair. François Rigaut, Gemini's Associate Project Scientist for Adaptive Optics, plays a leadership role in the MCAO development effort and has great expectations for the system. "Extending our laser development to MCAO is going to take astronomical lasers to a whole new level," he said. "MCAO on Gemini is going to provide us with a glimpse of the future for ground-based high-resolution imaging."

Research into the production of a solid-state sodium laser has been supported by the entire Gemini partnership along with funding from the National Science Foundation and US Air Force. It is hoped that this work will provide all large astronomical observatories with the technology necessary to routinely produce artificial guide stars for AO systems, and will be critical for the development of the next generation of large 30- to 50-meter telescopes in the next two decades.

SOAR'S MIRROR VISITS THE GEMINI SOUTH COATING FACILITY

Carolyn Collins Petersen

After months of preparation and hard work by a team of dedicated engineers, contractors, and mirror wranglers, the 4.3-meter primary mirror from the Southern Astrophysical Research Telescope (SOAR) took a successful foray into the Gemini South mirror-coating facility at Cerro Pachón on January 28, 2004. A scant 43 minutes later, it emerged with a shiny new aluminum surface. On February 11, the newly coated mirror journeyed the 300 meters to its new home, another milestone in the construction of Gemini South's newest (and only) neighbor on Cerro Pachón.

Figure 1: *The SOAR primary mirror is meticulously cleaned at Gemini South prior to placement in the coating chamber.*

The 4.3-meter SOAR primary mirror was first delivered to Cerro Pachón on January 9, 2004. It's only 10 centimeters thick, weighs 7,000 pounds, and is made of ULE glass, a special, low-expansion glass produced by Corning Inc. and the same type of glass used to make the Gemini mirrors. After its manufacture, the mirror was polished to a precise aspheric shape by the Electro Optical Systems Division of the Goodrich Corporation in Danbury, Connecticut.

The polished glass, which is not very shiny in its "native" state, needs a reflective coating that will maximize the capture of optical and infrared light. An aluminum coating fills the bill, since it gives good reflectivity over the entire optical and near-IR wavelength region. The thickness of this film must be precisely controlled (it needs to be about 90 nanometers or 0.000003 inch thick), and must be uniform over the entire surface of the mirror so as not to degrade its precise figure.

This is a very exacting requirement, so the preparations to achieve it were equally precise. SOAR's coating process was the culmination of work from two teams where Gemini played a major role in the procedure, assisting the SOAR staff in readying the mirror and preparing the coating facility to receive the "visitor." First, the mirror was carefully washed, since even the tiniest traces of grease or dust would interfere with the coating's ability to adhere properly to the mirror surface. Then the mirror was installed on the giant turntable enclosed within the large vacuum chamber. During the aluminizing process the mirror rotated slowly on the turntable while a magnetron created a plasma of argon ions that stripped aluminum atoms off a target (by bombardment), and deposited them (through a process called "sputtering") onto the surface of the glass at a carefully controlled rate. The aluminum was sputtered along a narrow radial strip across the mirror as it rotated on the turntable until the whole surface was coated. The result was a surface with a reflectivity in excess of 91% at 470 nanometers, which is very close to the theoretical limit for an aluminized surface.

Why was this done at Gemini South? As anyone at Gemini knows, a coating chamber is a necessary, but seldom-used big-ticket item, since telescope mirrors typically only need to be coated every one or two years. Fortunately Gemini South already has a state-of-the-art coating facility designed to hold our 8.1-meter mirrors (with aluminum as well as protected silver). SOAR personnel, working with Gemini South staffers, were able to design special fixtures to position their smaller mirror in the Gemini facility and allow us to share this resource.

Gemini is pleased that we were able to help SOAR to meet the stringent criteria set for their primary mirror and we look forward to a long relationship with our new neighbor on the mountain.

Figure 2: *The freshly coated SOAR primary mirror seen inside the coating chamber at Gemini South.*

GEMINI-SOUTH'S NEAR-INFRARED SPECTROGRAPH GETS "3-D VISION"

Bernadette Rodgers & Jeremy Allington-Smith

The new GNIRS[1] integral field unit (IFU) arrived on Cerro Pachón (Gemini South) in February in a deceptively small package. The IFU is about the size of a large paperback, but contains 66 miniature optical elements. Designed and built by the University of Durham (UK), the IFU fits in the GNIRS slit slide mechanism, providing an alternative input "aperture" to the variety of traditional slit masks that feed the long-slit and cross-dispersed configurations of the instrument. With the IFU in the optical path, a 2-dimensional input field of roughly 3" x 5" is divided into 21 slices of 0.15" x 4.9" each. Then these are arranged end-to-end to form a pseudo-slit that is dispersed by one of the spectrograph's three gratings as if it was a normal long-slit. This gives GNIRS the ability to form spectra of each 0.15" x 0.15" sample over the entire field without gaps.

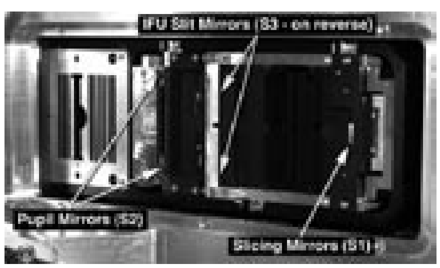


Figure 1: *The GNIRS IFU installed showing elements referenced in Figure 2 and the accompanying text.*

Unlike the IFUs built for both Gemini Multi-Object Spectrographs by the same Durham group, the GNIRS IFU dispenses with optical fibers (each GMOS IFU has 1,500 fibers)[2], in favor of a complex set of multifaceted optics which split the field into 21 slices. Each slice requires a chain of three mirror facets (see illustration):

1) the slicing mirror itself (S1) which sends the light from each piece of sky off at a different angle;

2) a pupil mirror (S2) which re-images the slice onto the pseudo-slit;

3) and a slit mirror (S3) which re-images the pupil (itself re-imaged by S1 onto S2) onto the spectrograph pupil stop.

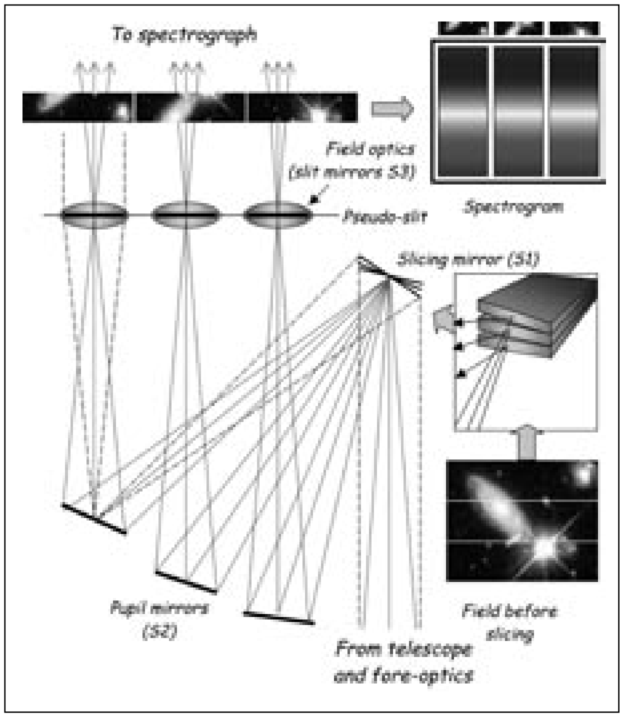


Figure 2: *Schematic of the GNIRS IFU showing key elements highlighted in the accompanying text.*

The ability of each mirror to form images makes it possible to adapt the system to an existing beam-fed spectrograph design, unlike its pioneering predecessor — the 3-D instrument devised by the Max-Planck-Institute for Extraterrestrial Physics (MPE, Munich)—which uses flat optics. The versatility, compact size and high performance of the Advanced Image Slicer[3] comes at the price of requiring tiny, close-packed optics with precisely shaped, ultra-smooth surfaces. This complexity was the major challenge facing the Durham team. Their solution was to diamond-turn each of the 21 optical surfaces required in every stage on the same aluminum substrate. This technique greatly reduced the problem of alignment since the special process places each facet correctly relative to its neighbors. Furthermore, the all-metal, monolithic construction means that the system remains aligned at the cryogenic temperatures inside the GNIRS cryostat where it is located. For extra efficiency, the optics are also gold-coated.

The GNIRS IFU was installed in GNIRS while it was in the instrument lab on Cerro Pachón in mid-March by a joint team from Durham (Marc Dubbeldam and David Robertson) and NOAO-Tucson (Jay Elias and Ron George) together with Gemini engineers and scientists. It was immediately clear that all of the fabrication team's hard work had paid off when the installation went very smoothly and the IFU fit perfectly on the first try. Proper alignment and co-focality with the slit mask were confirmed while the instrument was still in the lab.

The newly enhanced GNIRS was returned to the telescope in early April and was ready for its first commissioning run on April 6-11, 2004. Gemini staff James Turner and Durham IFU project scientist Jeremy Allington-Smith, with help from Jay Elias, conducted a variety of experiments both on the sky and using the Gemini Calibration unit (GCAL) to characterize the performance of the IFU.

Initial estimates of the throughput of the IFU relative to that of a matched long-slit were 66% at 1.06 μm, 82% at 1.65 μm, 87% at 1.93 μm and 93% at 2.45 μm confirming the theoretical expectation based on the optical surface quality measured in the lab. The wavelength dependency is expected since surface scattering is the dominant loss mechanism. (A complex series of baffles ensures that the scattered light does not reach the detector).

Data for longer wavelengths should confirm even higher throughput at > 2.5 μm, even though the optical design was optimized for 1-2.5 μm. Indeed, it is theoretically possible for the IFU relative throughput to exceed 100% since the design cleverly reduces the effect of diffraction relative to that of a slit of the same width through the use of anamorphism (which underfills the spectrograph pupil). Another unusual feature is the ability of the pseudo-slit length to exceed that of a normal long-slit by angling the beams emerging from the outer slit/slices to pass through the spectrograph stop. Even in this mode vignetting is minimal and it has been possible to expand the field from 17 to 21 slices with only partial vignetting of the outermost slices. (The extra slices have not been included in the throughput calculations; nor has part of one slice that was damaged during final assembly).

Scientific commissioning to establish the limiting performance included diverse targets such as the galactic center, bipolar planetary nebulae and ultra-luminous infrared galaxies implicated in recent mergers. While these observations included nominal flat-field and background subtraction, even without data reduction, the results look impressive. An excellent example of the combination of GNIRS with the IFU is illustrated in Figure 3 showing R~6000 IFU spectra of the galactic center. This data clearly shows a strong velocity shear in Brackett gamma due to the supermassive black hole at the center of our galaxy.

The GNIRS IFU will be offered to the Gemini user community in semester 2005A.

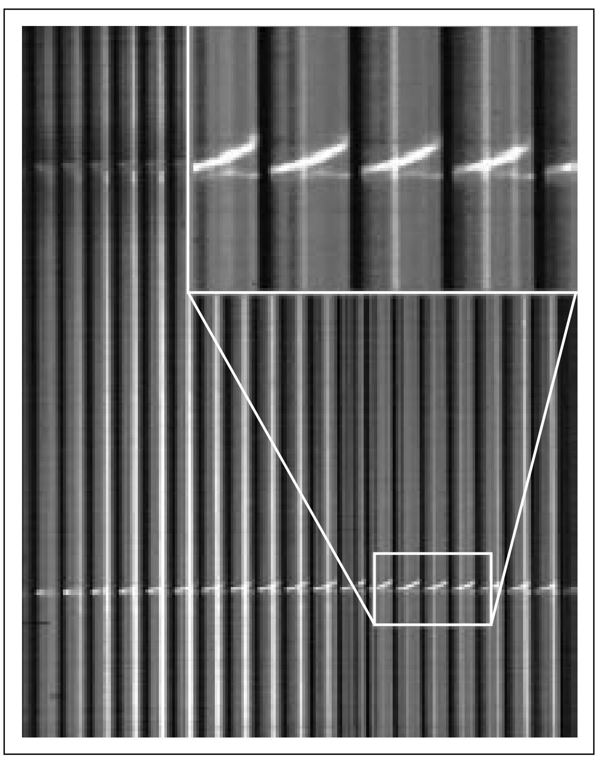


Figure 3: *GNIRS K-band IFU spectra showing strong velocity gradients (as indicated by the curved emission spectral lines in the enlarged section), surrounding the central massive black hole at the Milky Way's center. Each vertical stripe is a spectrum from one of the 21 slices of the IFU. This is a GNIRS-IFU commissioning image.*

1. GNIRS is the Gemini Near-infrared Spectrograph built by the National Optical Astronomy Observatory (NOAO) in Tucson.

2. Allington-Smith et al. 2002, PASP, 114, 892

3. Content, R., 1997. Proc. SPIE, 2871, 1295

STAFF PROFILE: MARIE-CLAIRE HAINAUT-ROUELLE

Carolyn Collins Petersen

In July 1998, the French astronomy magazine Ciel et Espace published a feature article called "Pilote de nuit à Hawai'i" about Gemini Observatory's Marie-Claire Hainaut-Rouelle. "Pilot of the night" is an apt description for her and the job she does as lead system support assistant at Gemini South. Marie-Claire is expert at piloting a complex facility and a diverse group of people through the intricacies of an observation run. Hers is a challenging job, she admits, but one that she loves. "It's the work of optimization to get the best data, the best photons that I really enjoy," she said. "We work very hard from night to night to get the best performance out of the equipment."

Marie-Claire while visiting Florence, Italy in September 1989.

Marie-Claire is responsible for doing whatever it takes to make observations run smoothly. On any given day (or night), she can be found organizing schedules for the group and working to make sure that everyone from astronomers to engineers and technicians has what they need to do the complex job of getting data from the observatory's instruments and active optics systems.

There's no problem—mechanical or otherwise—that she is not willing to tackle and ultimately solve. "My goal is to make sure that everyone's wishes are met and that we accommodate all the various needs to get a successful observation," she said.

Her work and personality have won her high praise from observers who have worked with her. Charles Telesco, of the University of Florida and principal investigator for OSCIR (a Gemini visitor instrument) and TReCS (a Gemini facility instrument) sees Marie-Claire as a strong inspiration to the Gemini South group.

"She's a guiding hand," he said. "She's like a catalyst to help solve problems that all these good people face from time to time. I've seen her come in and people are lost or confused by some glitch or problem, or couldn't get something to work, and she'd come up with a way forward, another solution. She's never dead in the water, she's always got another option to try out."

Because the Gemini facilities are relatively new, there are always technical bugs to be worked out, and part of Marie-Claire's job is to focus on making each system function more smoothly. "That's what seems to fascinate her most," Telesco said. "She has to be able to debug the system and she understands a great deal about the individual parts. She has a clear feel for working with engineers and science staff at Gemini to find out and diagnose problems."

As an example, when the science staff and software engineers at Gemini South were trying to integrate the secondary mirror system with the OSCIR and TReCs systems, Telesco said she worked very closely with the team to solve the problems. "They were able to look at a symptom like a weird image and come up with tests that would allow them to determine what was causing the images," he said. "They would isolate where in the loop something was going wrong and would go through the scientific method to figure it out. She was always focused and I was impressed at her being on-target."

When Marie-Claire is on the job, she's all business, completely focused on the work. On cloudy nights, she can be found checking out the system, tuning it up. Off the job, another Marie-Claire emerges: a savvy traveler fluent in several languages, who knows all the best restaurants, and confesses to a love of good food, cooking, fine clothes, and beautiful objects.

The eye for beauty and harmony Marie-Claire uses on the job to mesh technical and astronomical challenges extends to a love of art and design. She particularly likes modern art but shrugs off an interest in creating art herself. "I would like to make the time to paint or draw again," she says, "But that's been wishful thinking for the past couple years."

Marie-Claire's interests in art and science merged when she was first planning her university studies. She faced a tough choice: study art or study science. She wanted to pursue painting and drawing, but she thought to herself, "I can always open a book about art and read it. But I will never again open a physics book if I don't do it now."

Not wanting to forsake one for the other, Marie-Claire studied atomic physics at Belgium's University of Liége and found a way to connect this to her interest in the mediums of art. As an undergraduate, she worked on a project using a Van de Graaff accelerator to "bomb" old pieces of marble in order to improve art sample analysis to better understand their chemical structures and reactions. This formative work set into motion a series of career moves that ultimately led her to Chile and her present job.

She found this "applied science" far more interesting than working on theoretical models. Much like the job she does today, her efforts in the lab were aimed at optimizing the setups to collect the best data and designing hardware. "I was motivated to work "hands-on" in the laboratory," Marie-Claire said.

After leaving there, she traveled in Chile, exploring the nooks and crannies of the country and learning about the people and culture. While in Germany with her husband, European Southern Observatory astronomer Olivier Hainaut, she inherited a small observing program surveying asteroids with the European Southern Observatory's 50-centimeter telescope.

Marie-Claire arrived in Hawai'i at the end of 1993 and applied to many of the observatories at Mauna Kea. While waiting to hear about possible jobs, she began selling clothes at a pair of dress shops on Oahu. Eventually she was hired to work at the Infrared Telescope Facility on Mauna Kea, assisting with observations of Comet Hyakutake in 1996. She described it as a very intense experience. "I had two nights training and then it was straight to the sky!"

According to Charles Telesco, who was at the facility commissioning his OSCIR mid-infrared camera and spectrometer, Marie-Claire came in without a lot of experience, but she learned very quickly. "She just seemed to be hungry to learn and she learned a whole observatory facility," he said. When her time at IRTF ended, she worked for the University of Hawai'i intermittently until Telesco recommended her for a similar position at the Canada-France-Hawai'i Telescope.

There Marie-Claire worked on a variety of systems and began learning about adaptive optics. After her success at CFHT as a night assistant, she went straight to work at Gemini Observatory. She spent eight months at Gemini North before moving to Chile and her current job at Gemini South. She loves living and working in the Andes and has been there since the observatory was built. Marie-Claire talked about being on the mountain for first light when the secondary mirror was integrated. "I saw every piece being integrated into the telescope to make it work," she said. "Each observation is a challenge and I love that here at Gemini they let me work and get involved in all stages of a project. I like new challenges, especially the struggle and fight to make something work in harmony."

The next challenge on Marie-Claire's horizon is the implementation of adaptive optics at Gemini South. In the meantime, she continues to meet the goals of doing good science at Gemini. "My job is to contribute to a successful outcome," she says. "The challenges are huge and the good quality data that comes out of the Telescope can only be achieved with everyone's contribution and efforts."

HUMAN RESOURCES

Melissa Welborn

To know Gemini's history is to realize that only eight years ago, we had a total of 33 employees. Back in 1996, we had a handful of engineers and three scientists. At the time, much of our work was focused on building Gemini North. Just a few short years later, we were building the Gemini South facility in earnest and adding steadily to our Chilean employee roster. By 2000 we had an employee population of 86 and today, we are hovering at about 154. Testing, commissioning and integrating instruments have been major activities in the last few years. Today our telescopes are paying off with a plethora of new scientific discoveries and wonderful images of the universe. From Claudio Araya to Claudia Winge, and Craig Allen to Xiaoyu Zang, everyone plays an important role.

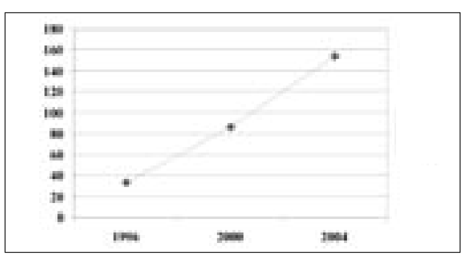


Figure 1: *Staffing levels at Gemini from 1996 to present.*

The story of Gemini Observatory is like a good novel. All good stories have struggles, unexpected challenges, triumphs, routine days that seem to quell the regular agitation of undertaking a monumental task: that of building two world class 8-meter telescopes. Our huge dreams created huge obstacles. We learned a lot along the way about building telescopes and about ourselves. Now we have prevailed, thanks to the hard work of our employees and others who have contributed to our success.

Every department has expanded to meet the needs and desires of the astronomical community. The challenge for Human Resources (HR) is to continue to lead Gemini Observatory in the acquisition of the necessary talent to operate two state-of-the-art ground-based telescopes and to ensure the Gemini Observatory benefits package provides a security core of medical, dental, life, retirement and disability coverage. In addition, HR responsible for our safety program and all observatory immigration issues.

Because of the increasing demands on our service-oriented activities, we needed to expand the Human Resources Department. This year, we added Jeracah Holland to our staff. She has been instrumental in our recruitment efforts and jumped right in when we were in a heavy recruiting period. "I never imagined that scheduling interviews could be so complicated!" she says. Jeracah is also responsible for our relocations around the world. She enjoys educating people about the joys of living in Hawai'i and Chile and hopes to soon go to Chile to see Gemini South operations first-hand. In the near future, we will add another HR Assistant to the Department, who will be located at Gemini South and will support our employees with HR issues, provide advice, and assist in the consistent local delivery of high-quality HR services.

Tumua Rosen, our Human Resources Representative, works mainly in the areas of compensation and benefits. She is also a key player in helping us assist employees with their immigration needs. Tumua has become a real expert in the area of *J visas*. She works closely with all three of our sites and ensures questions and problems are resolved in a professional and friendly manner.

One of the realities of Human Resources is that much of what we do is not public and must remain confidential. A typical day for us includes taking care of paperwork, getting people signed up on their benefits, writing offer letters, conducting orientations, consulting with managers and/or employees about employee issues, preparing advertising, reviewing resumes, revising policies, researching, answering questions, giving advice, providing information, checking special circumstances with our benefits carriers, posting recruitment notices, developing reports, initiating new projects and much more. All of this happens behind the scenes and unfortunately, there are no back-stage passes to give a bird's-eye view.

Working in Human Resources is a privilege and comes with a large dose of satisfaction from helping others. We are challenged every day to perform to high standards and to provide a consistently high level of service. As Tumua says, "We never have a dull day!"

In this newsletter, we are proud to announce the following staff awards/ honors:

Jim Kennedy: President of the Hawai'i Island Chamber of Commerce July 2003-June 2004.

Larry Stepp: NOAO Excellence Award, March 16, 2004

The following received their 5-Year Service Award:

Gustavo Alarcon • Corinne Boyer • Tamara Brown • Chris Carter • Simon Chan • Paul Collins • Pattie Dawson • Alice Dakujaku • Celine d'Orgeville • Tom Geballe • Alan Hatakeyama • Inger Jorgensen • Joe LeBlanc • Diego Maltes • Peter Michaud • James Patao • Francois Rigaut • Harlan Uehara

Congratulations to everyone for your hard work and dedication. Your teamwork, professionalism and willingness to embrace Gemini's vision are what will keep us at the forefront of astronomical research for decades to come.

Claudio Anguita Commemoration at Gemini South

On April 16th, 2004 a special ceremony was held at the Gemini South Telescope to commemorate Chilean astronomer Claudio Anguita. Anguita played a central role in the development of astronomical facilities in Chile such as Gemini, CTIO and the VLT. His legacy of astronomical research covers a diverse range of topics that he pursued during his career that included serving as the Dean of Physics and Mathematics at the University of Chile from 1976-1984.

The AURA sponsored event was attended by approximately 100 people including family, astronomers and dignitaries. A commemorative plaque was presented for display at Gemini South on Cerro Pachón.

UNITED STATES

Taft Armandroff

The NOAO Gemini Science Center (NGSC) saw a strong response from the U.S. community to the Gemini Call for Proposals for semester 2004B. Eighty-four proposals were received for Gemini North: 45 for GMOS North, 18 for NIRI alone, 5 for NIRI with the Altair adaptive optics system, and 17 for MICHELLE. There were 93 U.S. proposals that requested Gemini South: 29 for GNIRS, 28 for T-ReCS, 28 for GMOS South, 9 for Phoenix, and 2 for the Acquisition Camera. In total, 161 U.S. proposals sought 371 nights on the two Gemini telescopes.

NGSC organized a booth for the Atlanta meeting of the American Astronomical Society in January 2004. Many community members visited the booth and viewed displays on how to propose for Gemini observing opportunities, picked up brochures on available Gemini instruments, and received tutorials on preparing Phase II programs. On March 16, 2004 NGSC conducted a Webcast for the U.S. community, discussing the availability of GNIRS for proposals during the 2004B semester.

GNIRS

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

GNIRS has been commissioned in its basic modes (long-slit and cross-dispersed spectroscopy), and system verification observations have been carried out in these modes. The instrument has passed its final acceptance testing. NOAO scientists Jay Elias and Rachel Mason have supported GNIRS commissioning and system verification at Cerro Pachón. Elias also participated in the successful installation of the GNIRS integral field unit (IFU) (which was provided by the University of Durham).

Figure 1: *NICI's main optical bench is lowered into the NICI dewar prior to the March 2004 cold test.*

NICI

The Near Infrared Coronagraphic Imager (NICI) will provide a 1 - 5 micron dual-beam coronagraphic imaging capability for the Gemini South telescope. Mauna Kea Infrared (MKIR) in Hilo is building NICI, under the leadership of Doug Toomey. All of the dewar parts have been cleaned and assembled, and NICI was successfully vacuum tested in January 2004. NICI reached its desired operating temperature on its first cold test in March 2004. During this first cooldown, the mechanisms were tested manually for proper operation. MKIR reports that 75 percent of the work to NICI final acceptance by Gemini (planned for December 2004) has been completed.

FLAMINGOS-2

FLAMINGOS-2 is a near-infrared multi-object spectrograph and imager for the Gemini South Telescope being built by the University of Florida. It will cover a 6.1-arcminute-diameter field at the standard Gemini f/16 focus in imaging mode, and will provide multi-object spectra over a 6.1x2-arcminute field. It will also give Gemini South's multi-conjugate adaptive optics system a multi-object spectroscopic capability.

FLAMINGOS-2 is in the procurement and fabrication phase of the project. Essentially all of the FLAMINGOS-2 optics have been ordered, and mechanical fabrication is underway in the University of Florida shops and at a few key subcontractors. In addition, fabrication of the detector control and motor control electronics is ongoing at Florida. A Gemini/NGSC review of the FLAMINGOS-2 software was completed in March 2004. As of the end of March, 36 percent of the work to FLAMINGOS-2 final acceptance by Gemini had been completed.

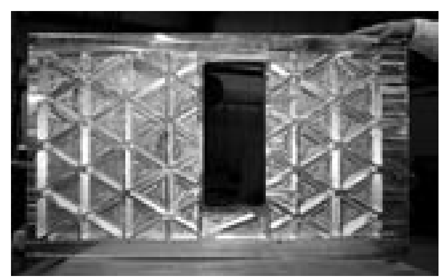


Figure 2: *The cold plate of FLAMINGOS-2 provides a glimpse of the progress in mechanical fabrication.*

Dr. Richard Elston conceived the FLAMINGOS and FLAMINGOS-2 concepts and served as FLAMINGOS-2 Project Scientist and Principal Investigator. Tragically, Richard died on 26 January 2004 (see tribute on next page). Steve Eikenberry, who was Co-Principal Investigator, has assumed the responsibilities of Project Scientist and Principal Investigator.

Dr. Richard Elston, Professor of Astronomy at the University of Florida and valued contributor to Gemini's instrumentation program, died on January 26, 2004 in Gainesville, Florida. He is survived by his spouse Elizabeth Lada and his son Joseph Lada Elston.

Dr. Elston was passionate about observational extragalactic astronomy and innovative astronomical instrumentation and was a prominent member of the Gemini community. Besides pursuing observational programs with the Gemini telescopes, he made far-reaching contributions to Gemini's instrumentation program. Elston conceived and led the development of the FLoridA Multi-object Imaging Near-IR Grism Observational Spectrometer (FLAMINGOS). Designed and constructed by Elston and a team of coworkers at the University of Florida, FLAMINGOS functions as both a wide-field infrared imager and multi-object spectrograph. FLAMINGOS was the first fully cryogenic wide-field multi-object infrared spectrograph and was used successfully at Gemini South for community science observations. Its spectacular images were a notable highlight of the Gemini South dedication.

Spurred by the success of FLAMINGOS, Gemini and the U.S. National Gemini Office contracted with Richard Elston and his team to design and construct a new facility-class infrared multi-object spectrometer optimized for Gemini, FLAMINGOS-2. Elston envisioned this instrument, which is well into the fabrication phase at the University of Florida, making breakthrough contributions to the study of high-redshift objects, galaxy clusters, and Galactic star-forming regions. The Gemini Partnership shares Richard's vision and looks forward to the completion of FLAMINGOS-2 next year.

The Gemini Partnership gratefully acknowledges Richard Elston's lasting contributions to enabling scientific research at Gemini. Our deepest condolences go out to Richard's family. A scholarship fund has been set up for Richard's son, Joseph Lada Elston's education. More information can be found at: http://www.astro.ufl.edu/%7Ehon/J.%20Elston%20College/

UNITED KINGDOM

Isobel Hook

The 2004B Call for Proposals for Gemini Observatory was met with a healthy response, resulting in a total of 76 requests for time. This is a significant increase over the 65 applications received in 2004A. The over-subscription rates are 2.5 and 2.6 for Gemini North and Gemini South respectively, and the two GMOS instruments continue to be the most-requested instruments by UK users.

Reflecting the increased interest in Gemini, a large delegation of our users will be present at the first Gemini Science conference in Vancouver (scheduled for May 22-26, 2004). About 20 people are scheduled to attend from the UK, and 15 will discuss their results in talks or posters.

The UK Gemini Users Committee has joined with UK representatives of the Very Large Telescope (VLT) user community to form a UK 8-meter group. The first meeting of this joint committee was held in March 2004, chaired by Malcolm Bremer of Bristol University. UK Gemini Users Committee members provided useful and constructive feedback in advance of the joint meeting via an e-mail questionnaire. Feedback on Gemini will be combined with comments raised by user committee members and forwarded to the observatory for consideration. This process proved valuable in the past when Gemini staff provided progress reports in response to UK Users' comments from the previous meeting in September 2003. Reports on the user group meetings are available at http://gemini.physics.ox.ac.uk/Users/Users_Committee.html

The UK's contributions to the Gemini instrumentation suite continue to progress well. Two new Integral Field Units, both built at the University of Durham, were recently delivered to Gemini South for use in GMOS-South and GNIRS. Initial commissioning showed that the GMOS-South IFU performs well optically but was in need of some mechanical rework. This was carried out at Durham, and the component is now in use at Gemini South. The GNIRS IFU safely arrived at Gemini South in March and had successful first light in early April. The instrument team is delighted with the early results (which are reported elsewhere in this newsletter). At Gemini North, the mid-IR spectrograph and imager, MICHELLE (built at the UK Astronomy Technology Centre (UKATC)), was used successfully for queue imaging programs at the end of 2004. The instrument is currently on UK Infrared Telescope (UKIRT) and is due back at Gemini North in May. It will undergo some reworking in the Gemini labs followed by recommissioning on the telescope. MICHELLE is due to be available for community use on Gemini in October.

We are pleased to report that Rachel Johnson (currently based at ESO in Chile) will be joining the UK Gemini Support Group in June, will take over from Isobel Hook as head of the group after a transitional period. Rachel obtained her Ph.D. from the University of London in 1997 and went on to work in the UK Hubble Space Telescope Support Facility in Cambridge. She then worked as Cambridge Infrared Panoramic Survey Spectrograph (CIRPASS) Project Scientist from 1999-2001 before joining the European Southern Observatory in 2001 to work as a staff astronomer at the VLT, with responsibility for the Infrared Spectrometer and Array Camera (ISAAC). Her research interests focus on nearby galaxies, in particular the ages and metallicities of their stellar populations derived from color-magnitude diagrams of resolved stars. We also welcome Deborah Baines (a recent Ph.D. graduate from Leeds University) as a temporary member of the group. She is currently responsible for support of Mid-IR instruments and providing additional support for GMOS.

CANADA

Dennis Crabtree

The Canada National Gemini Office received a record 50 proposals for Semester 2004B on Gemini! The details are shown in the table below. While this is a large number, the average time per request remains modest—at under 16 hours—and leaves the Canadian subscription rate at 2.4 for both telescopes with very little difference between Gemini North and Gemini South.

Instrument	Acq. Camera	Altair +NIRI	GMOS-N	GMOS-S	GNIRS	Michelle	NIRI	Phoenix	T-ReCS
# of props	1	4	16	13	5	1	5	2	3
Hours requested	6	116.6	209.28	219.65	93.87	13.5	56.45	23.7	48.83

Canada submitted a one-hour GMOS proposal for a contest we plan to run in Fall 2004. The competition will be open to members of the Royal Astronomical Society of Canada—a nationwide amateur astronomy group. Applicants will be asked for proposals on how they would use Gemini time, and a small committee will select the best one.

The National Research Council-Herzberg Institute of Astrophysics, Victoria, is hosting a meeting of representatives from Gemini and the National Gemini Offices on May 27th, the day after the Gemini Science 2004 meeting in Vancouver. This time will be used to train NGO staff on aspects of the latest Gemini instrumentation and for a collective discussion of how the user support process can be improved in the future.

Canada's Long Range Plan for Astronomy was a very successful community-wide planning exercise that prioritized upcoming projects and made several other recommendations. The plan was instrumental in leveraging the funds for Canadian involvement in the Atacama Large Millimeter Array (ALMA), and studies related to next generation optical and radio telescope studies and initiating virtual observatory activities. (More information on the Long-Range Plan can be found at: http://www.casca.ca/lrp/front-back/en-index.html)

The LRP mid-term review occurred in mid-April 2004 and we hope this mechanism will help us obtain a strong endorsement of the Aspen instrumentation plan. This will be a key element in identifying resources for the Canadian contribution to Aspen instruments.

AUSTRALIA

Warrick Couch

The deadline for proposals for use of Australian time on the Gemini telescopes in semester 2004B has just passed, and we had the best response that we have ever had from our community. A total of 30 proposals were received, 13 for Gemini North, and 17 for Gemini South. The demand for time on Gemini South was exceptionally high, with a total of 252 hours being requested. This represents a factor of 5.4 oversubscription of the 47 hours available. Sixty percent of the time requested was for GMOS-S, but there was also strong interest in GNIRS (30% of time requested). There was also a very healthy demand for time on Gemini North, with a total of 180 hours being requested, representing an oversubscription factor of 2.9. Most (86%) of the time requested was for GMOS North. Our NTAC will have a very challenging job considering and ranking the many excellent proposals we received.

Construction of the Near-infrared Integral Field Spectrograph (NIFS) and the Gemini South Adaptive Optics Imager (GSAOI) by Peter McGregor and his team at the Research School of Astronomy and Astrophysics at the Australian National University in Canberra, continues to make good progress and remains close to schedule. NIFS, which is being rebuilt after the original was destroyed in the Mt. Stromlo fires, underwent its "zeroeth" cool-down in January, and the cooling and temperature control of its new cryostat worked as expected. Its mechanisms have been assembled, tested, and debugged at both ambient temperature and at 120K in a test chamber. During its first cool-down during April 2004, the mechanisms will be tested at working temperature and the initial phase of the on-instrument wavefront sensor's optical alignment will be verified. NIFS is still on schedule for completion by the end of 2004 and should be commissioned on Gemini North in semester 2005A.

GSAOI passed its Critical Design Review in October, two months ahead of schedule. A separate software review was completed in January. The GSAOI cryostat underwent its "zeroeth" cool-down in February. Production drawings for the imager modules have been completed and fabrication work is in full swing in the recently completed temporary workshop at Mount Stromlo Observatory and at several local commercial workshops. All optical elements have been ordered and the first lenses delivered. The focal plane module has been delivered by GL Scientific and one of the four science-grade detectors has arrived. A test cryostat and engineering detector system have been assembled, while the final system is being completed.

In late February, one of our technical support scientists—Dr. Stuart Ryder from the Anglo-Australian Observatory —visited Gemini North to assist with a NIRI run and gain valuable experience in the use and operation of this instrument. His arrival at the summit of Mauna Kea was marked by a massive snowstorm that cut off power to the mountain and threatened to end the run before it even started because NIRI began to warm up. Fortunately the situation improved and NIRI remained operable, allowing Stuart and the Gemini staff to obtain several nights of good data. In March, Gemini North had another Australian visitor when Professor Rachel Webster from the University of Melbourne went to Hilo to attend and chair the first meeting of the Gemini Visiting Committee.

We look forward to participating in the Gemini Science 2004, Gemini Users Group, National Gemini Office, and Public Information Office meetings in Vancouver and Victoria in May. Ten people from our community will be attending and five will be giving talks on their Gemini results at the science meeting.

CHILE

Luis Campusano & Sebastián López

The Call for Proposals for semester 2004B resulted in the submission of 16 research projects requesting a total of 383 hours of Gemini South telescope time. This is in contrast to the small number of proposals (5) received for the previous semester.

By far the most requested instrument for 2004B was GMOS South with requests for 282 hours (74% of the total), followed by GNIRS (23 %) and T-ReCS (3%). This resulting subscription rate of 3.22 is very healthy for a community that is still small in relation to its large telescope access, and we would like to see it stabilized at that level. We believe that the increased demand was partly a result of presentations at the Chilean Astronomical Society (SOCHIAS) held in Santiago in January 2004. At this meeting, the capabilities of Gemini South were illustrated, notably by Felipe Barrientos (PUC) and Luis Campusano, and the low subscription rates in the past semesters were discussed. These discussions prompted the Chair of the Chilean Gemini TAC, Jose Maza (Universidad de Chile) to send a message to the Chilean astronomy community urging members to apply for Gemini time.

One critical aspect our small office has to deal with is Phase II support as outlined in the "Gemini User Support by the National Gemini Offices under the Gemini Agreement." Currently, this task is being performed by Sebastián López and we are exploring ways to increase our capabilities as a National Gemini Office. We need to increase our staffing levels at least on a part-time basis during Phase II, particularly when the user demand and the amount of telescope time available result in a large number of approved proposals.

Starting in 2003A two new members were welcomed into the Chilean TAC. They are Guido Garay of the Universidad de Chile and Nicholas Suntzeff from the Cerro Tololo Inter-American Observatory. They replace outgoing members Leonardo Bronfman (Universidad de Chile) and Mark Phillips (the Carnegie Observatories).

The PPARC Gemini fellowship 2004, available to Chilean students and administered in Chile by the Fundación Andes, was awarded to Francisco Forster, a B.SC. graduate in astronomy from the University of Chile, who was accepted in the Ph.D program at Oxford University. We wish Francisco a very successful research experience in Oxford, and a happy return to Chile in a few years.

BRAZIL

Max Faúndez-Abans

The Brazilian Astronomical Community organized a workshop entitled Optical and Infrared Astronomical Instrumentation for Modern Telescopes, where special attention was given to issues concerning both Gemini Observatory and the Southern Astrophysical Research (SOAR) telescope. It took place in the city of Angra dos Reis, Rio de Janeiro, Brazil, on November 16-20, 2003. The meeting focused on optical and infrared instruments for large and medium-class telescopes, with special attention to projects in which the Brazilian community is involved today. Together with the instrumentation presentations, the workshop had oral and poster contributions on the science that these telescopes and the new generation of instruments will provide. This allowed the participants, instrumentation groups and the astronomers to interact and set the direction for the new developments needed to achieve the high quality data necessary to answer important open questions in many astronomical fields.

Our colleague Alberto Ardila participated in the commissioning activities of GNIRS at Gemini South from December 2003 through February 2004. He points out that it was a unique experience to work with that instrument. He adds that during the commissioning period he gained a deep understanding of the different modes in which GNIRS operates and became much more aware of the telescope and queue operations. This certainly will benefit the Brazilian astronomical community due to the better support that the LNA is now able to offer. Finally, Alberto extends his thanks for the warm welcome and hospitality provided by Gemini during his stay and the professionalism of the GNIRS team.

As for the proposals for Semester 2004B, a total of 31.8 hours at Gemini North have been requested, representing a subscription factor of 1.54. For Gemini South, 39.83 hours have been requested, resulting in a subscription factor of 1.99. In total, we received 17 proposals for Gemini.

The Brazilian community has started to produce Gemini scientific results, and one of the first science contributions appears on page 13 of this newsletter. In addition, the Brazilian Gemini PIO liaison, Mariângela de Oliveira-Abans, working closely with Peter Michaud and Steve Heathcote, Director of the Southern Astrophysical Research (SOAR) telescope, produced an article about the SOAR Telescope's mirror aluminizing at the Gemini South facility for this issue of the Gemini Newsletter. This article can be found on page 18. We appreciate his kind contribution and are pleased with the healthy interaction between Gemini and SOAR. Mariângela is also the Brazilian liaison at the SOAR Public Affairs and Educational Outreach Network—PAEO.

ARGENTINA

Guillermo Bosch

In a happy coincidence, Gemini Argentina received confirmation that it had regained observing status on the very same day that the Call for Proposals for 2004 came out. The response from the local community has been very good: time requested at Gemini North is the same as for 2003 and requested time at Gemini South has increased by a factor of three. The availability of GMOS South was the main reason for this sharp rise in observing requests, and we expect an even larger increase in time requests when bHROS comes online.

Nidia Morrell has stepped down as Argentinian Project Manager. We are very grateful for her commitment and valuable contributions and wish her all the best in her new position at Las Campanas Observatory. I will also step down as Argentinian Project Scientist, but will remain on duty until a GSC representative to replace me has been found.

Other Gemini activities are spurring a great deal of interest here, including a good response by applicants for the U.S. Gemini Fellowship, Phase II training at Gemini South, and a job opening for an assistant observer at Gemini North. In addition, the Argentinian Gemini web page is frequently updated as part of our outreach effort, including a Spanish language version of the Gemini Home Page news releases.

IRREGULAR SATELLITES REVEAL "FAMILY" TIES

An artist's rendition shows irregular satellites around Jupiter after a collision. Jupiter's four large moons are shown for orbital scale. Gemini artwork by Jon Lomberg.

Observations using the Gemini Near Infrared Imager (NIRI) have provided key evidence that many of the "irregular" satellites around Jupiter and Saturn share a common ancestry. The infrared surface color observations of the satellites reveal that, of the 14 objects observed by Gemini, all appear to have a common ancestry. It is suspected that these moons, now in relatively stable (but exceptional) orbits around the giant planets, were once part of Sun-orbiting asteroids that were fragmented by collisions and eventually captured by Jupiter and Saturn.

Often described as "families," groups of irregular satellites have common dynamical properties, like swarms of bees flying together. Recent studies have found that the optical colors of these satellite share a common family likeness. Different families (or swarms) have different colors, betraying different surface properties and bodies of origin.

Gemini observations in the infrared have provided an even better way to distinguish surface types. The advantage of using infrared radiation is that it can reveal color differences that are unseen in the optical. Optical observations can "trick" researchers into thinking unrelated objects are in the same family when in reality the objects could have different origins.

The Gemini NIRI infrared observations allowed astronomers Tommy Grav and Matthew J. Holman of the Harvard-Smithsonian Center for Astrophysics to confirm that the satellites selected for this study were indeed from the same family.

This result appeared in the April 20, 2004 issue of The Astrophysical Journal. More details can also be found at:
http://www.gemini.edu/project/announcements/press/2004-9.html

GEMINI OBSERVATORY NEWSLETTER

THE GEMINI OBSERVATORY
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A lenticular cloud, technically known as altocumulus standing lenticularus, hovers over the Gemini North Base Facility in Hilo, Hawai'i in late November 2003.