

NOAO Newsletter

Issue 70

June 2002

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On May 9, the National Science Foundation's governing body, the National Science Board (NSB), approved the foundation's recommendation to select AURA as the managing organization for the National Optical Astronomy Observatory and the National Solar Observatory.

This decision by the NSB is a crucial step in the process to compete the contract to manage and operate these two federally funded facilities for optical/infrared astronomy and solar astronomy, which began in early 2001.

Negotiations on administrative matters will be underway shortly toward the goal of having a new five-year cooperative agreement in place by 1 October 2002.

AURA's efforts to realize the major projects identified by the most recent Decadal Survey, plus its work to implement the Telescope System Instrumentation Program, and its leadership in the design and development of Advanced Technology Solar Telescope, were key aspects of the decision cited by NSF officials.

Notable Quotes

"The Administration's request for both civilian and defense research can be kindly described as disappointing. While the Administration's FY 2003 request for R&D overall is above last year's level, most of the requested funding almost exclusively falls on the 'D' side of the ledger. The 'R' side—especially funding for basic research in math, physical sciences and engineering—is flat or even declining. Shorter-term requirements seem to be winning out over long-term needs.

"Even a casual glance at the Administration's budget makes clear what the R&D priorities are—biomedical research and the fight against terrorism at home and abroad. These are reasonable—even self-evident—priorities and they deserve to be funded more generously than are other programs. That's what it means to be a budget priority.

"But I'm concerned that the proposed budget treats these items not just as priorities, but as panaceas. And that, I fear, is a mistake. I have long supported, and continue to support the doubling of the budget of the National Institutes of Health (NIH). But the NIH alone cannot undergird our economic health or even improve human health. Yet the NIH budget is now larger than that of the rest of the civilian science agencies put together, and just the increase in the NIH budget is larger than the research budget of National Science Foundation. Pretty soon, AFOSR's total budget will fall within the rounding error of the figure for the NIH."

-- House Science Committee Chairman Sherwood Boehlert (R-NY) addressing an April 2002 defense conference on the 50th anniversary of the US Air Force Office of Scientific Research (AFOSR)

Courtesy: The American Institute of Physics Bulletin of Science Policy News

Have you seen an interesting comment in the news or heard one during a NOAO-related meeting or workshop? Please share them with the Newsletter Editor, editor@noao.edu.

On the Cover

The Advanced Technology Solar Telescope (ATST) is a major solar community project being led by the National Solar Observatory with 22 participating institutions. The preliminary concept for the ATST, shown in lower left foreground, incorporates off-axis optics and two Coudé rooms as well as Nasmyth focus. For details about the ATST Project, visit atst.nso.edu.

High-order adaptive optics (AO) systems being developed by NSO will serve as proofs-of-concept for a scalable AO design for the ATST. The background images, clockwise from lower right, show the McMath-Pierce main telescope on Kitt Peak and the Dunn Solar Telescope (DST) on Sac Peak; and three images exhibiting small-scale magnetic elements from the DST using AO: 1) a narrowband image through the Universal Birefringent Filter (UBF) at 630.2 nm (18-sec exposure), 2) a line-of-sight magnetogram at the UBF, and 3) a G-band image (6-sec exposure).

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Staff

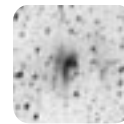
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Two's Company

Based on a contribution solicited from Laird Close (University of Arizona)

Laird Close and his student Nick Siegler (University of Arizona) used the Hokupa'a Adaptive Optics camera on the Gemini North telescope to search for binaries among the lowest-mass stars. Their discovery of several such systems offers insight into the formation of M and brown dwarf stars.

Close and Siegler capitalized on the high-photon counting sensitivity of Hokupa'a curvature wavefront sensor (WFS) to guide on extremely faint stars, allowing them to survey the lowest mass stars in the solar neighborhood. Very little was known about the binary frequency or separation distribution of the lowest mass stars (spectral types M8-M9), which have masses from 75–95 Jupiters.

Over 20 target M8-M9 stars (identified by Gizis et al. 2002 from the 2MASS survey) were imaged at ~ 0.1 arcsec resolutions at J, H and K' during two excellent nights on Gemini North (seeing ~ 0.5 arcsec at R). This was the largest survey of M8-M9 stars at these resolutions (see Close et al., *ApJ* 567, L53–L57, 2002). This is a significant feat since these objects are so cool (Teff ~ 2400 – 2600 K) that the WFS was only receiving ~ 4 photons per sample ($V \sim 18.5$ mag)—it was impressive that Hokupa'a was able to produce 0.1 arcsec images at K'.

Close and Siegler were surprised to find that four of their 20 objects were in fact binary systems. The companions to such low-mass stars are themselves either on or below the stellar brown dwarf boundary. Indeed, 2M2331B is certainly a brown dwarf companion, adding another rare example of a brown dwarf companion to a star.

Although the sample is too small to draw any strong conclusions, it is worth noting that no “wide” low-mass binaries were detected. All these systems had separations less than 5 AU (except 2M2331, which has the widest separation of a low-mass binary at 14.4 AU). This is in contrast to the separation distribution observed for more massive M and G binaries, which peak much further out at ~ 30 AU.

The binary frequency of the survey was 14–24% for systems with separations >3 AU. This is consistent with the observation that $23 \pm 5\%$ of M and G stars have companions with separations >3 AU. Therefore, it appears that low-mass binaries may have binary fraction similar to more massive stars. However, they seem to also form in much tighter systems with a peak

closer to 4 AU, as compared to 30 AU for more massive stars.

The conclusion that low-mass stars seem to agree with the binary fraction of more massive stars implies that very low-mass stars are not ejected from fragmenting disks. They may likely form from their own small cloud cores, which fragment into the tight binaries observed. It is also worth noting that these binary systems will pay a critical role in the calibration of the Mass-Luminosity-Age relation for low-mass stars and brown dwarfs. The typical periods for these systems is estimated to be 15–20 years.

Editor's Note: Another eight of these binaries were discussed at an IAU symposium on 21 May 2002.

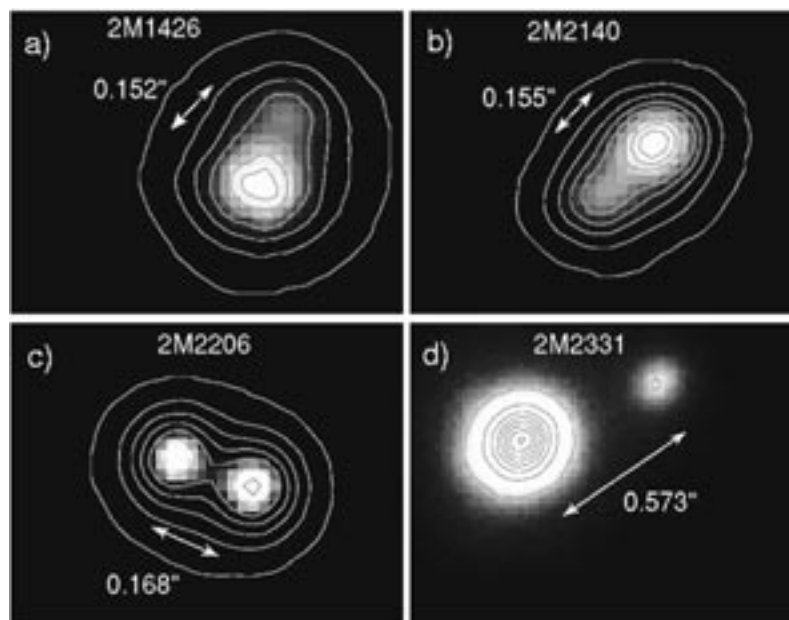
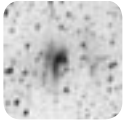


Fig. 1 (a) 12×10 arcsec K' image of the 2MASSJ 1426316+155701 binary discussed in Close et al. (2002) at a resolution of 0.131 arcsec. (b, c, d) K' images of the new binaries 2MASSW J2140293+162518, 2MASSWJ 2206228-204705, and 2MASSWJ 2331016-040618, respectively. The contours are linear at the 90%, 75%, 60%, 45%, 30%, 15%, and 1% levels. In each panel, north is up and east is left.



X-Rays from Far Away

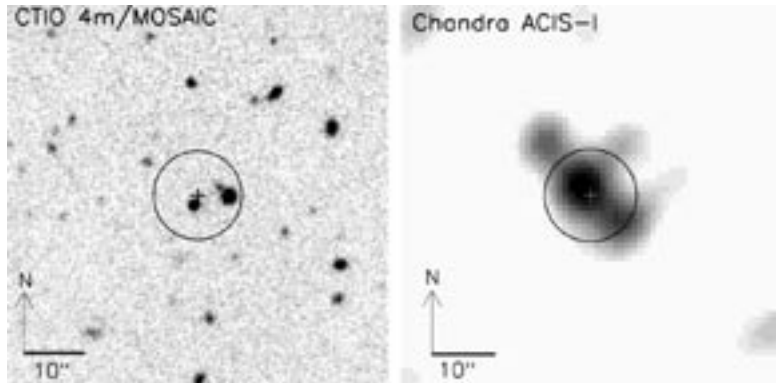
Based on a contribution solicited from J.D. Silverman (SAO)

J. D. Silverman (SAO) and Chris Smith (NOAO) used HYDRA on the CTIO 4-m telescope to identify what is now the most distant X-ray selected quasar known (CXOMP J213945.0-234655; Silverman et al., *ApJ* **569**, L1, 2002). The redshift observed is $z = 4.93$, based on detection of the Ly- α line. Only four $z > 4$ quasars have been discovered in X-ray surveys to date.

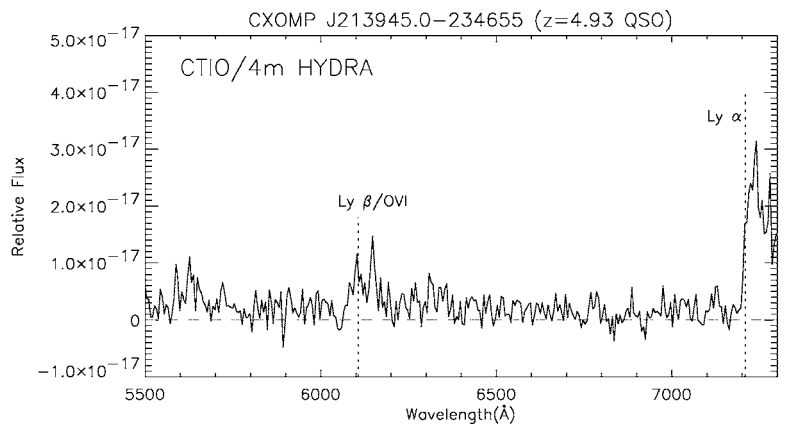
The QSO identified by Silverman and Smith was originally detected in a survey conducted with the Chandra X-ray Observatory. Chandra has begun to reveal the obscured Active Galactic Nuclei (AGN) whose glow dominates the cosmic X-ray background. With Chandra's exceptional sensitivity, quasars should be detected out to $z \sim 6$, thereby probing the accretion history from the early universe to the present.

Wide area surveys are crucial to investigate the global properties of AGN over a large range of redshift and luminosity. The Chandra Multiwavelength Project (ChaMP) is classifying serendipitous X-ray sources in archived high-galactic latitude Chandra fields at flux limits intermediate between past deep ROSAT (e.g., Lockman Hole) and current Chandra Deep Field (CDF-N, CDF-S) studies. Optical follow-up is underway at NOAO facilities under the direction of Paul Green and Belinda Wilkes (Chandra X-ray Center); via the ChaMP collaboration with scientists at the CXC; and, at a variety of institutions including NOAO, Michigan State, MMT0, and Texas. The $z = 4.93$ quasar was first located in the optical from a CTIO 4-m MOSAIC image of a 41-ksec Chandra field.

Silverman is currently working on a PhD thesis to measure the X-ray luminosity function of quasars out to



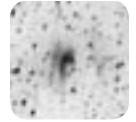
X-ray and optical images of CXOMP J213945.0-234655. The circle shows the region containing 50% of the encircled energy (radius = 7.3 arcsec) of the Chandra counts. The cross marks the centroid of the X-ray emission in both images. The optical counterpart is the source closest to the X-ray centroid position.



Optical spectrum of CXOMP J213945.0-234655. A followup spectrum (not shown) with the NTT 3.5-m confirmed the redshift by detecting the broad CIV]1549 Å emission line.

$z \sim 5$. ChaMP has begun to acquire a significant sample of quasars, with 11 at $z > 3$. This quantity already surpasses the number obtained in past combined ROSAT surveys. There should shortly be enough objects to show whether obscured quasars emerge in greater

numbers at higher redshifts, using sensitive X-ray selection. Such a trend has been suggested from population synthesis models of the X-ray background, and predicted by theories of quasar evolution, but only hinted at from ROSAT surveys.



High-Resolution Near-IR Measurement of Sunspot Magnetic Fields

Haosheng Lin (University of Hawaii, IFA)

The low-order adaptive optics (AO) system of the Dunn Solar Telescope (DST) was used for the first time with a near-infrared spectropolarimeter to study the magnetic field of sunspots during an observing run in April 2001. With the help of the AO system, the infrared (IR) observation achieved a resolution of 0.6 arcsec, near the diffraction-limit (0.5 arcsec at 1.6 μm) of the DST, and provided excellent sunspot vector magnetic field configuration data. In addition to the near-IR measurements, visible continuum intensity images with 0.16-arcsec resolution were acquired simultaneously to help with the interpretation of the magnetic field data.

While sunspots may be the most well-known feature on the surface of the Sun, currently they have no satisfactory and universally accepted theoretical explanation. For example, the darkness of a sunspot can be understood by simple energy and pressure equilibrium considerations. Nevertheless, the detailed structure of the magnetic fields inside the sunspots (particularly in the dark umbrae) are still not resolved. Fundamental questions like: "How are the sunspots formed?" and "What is the magnetic field structure of sunspots?" remain unanswered nearly a century after Hale's discovery of sunspot magnetic fields.

Obviously, the ultimate resolution of the sunspot problem depends on our ability to observationally resolve the detailed magnetic and thermodynamic structure of the sunspots. The experiment we conducted was specifically designed to address these questions.

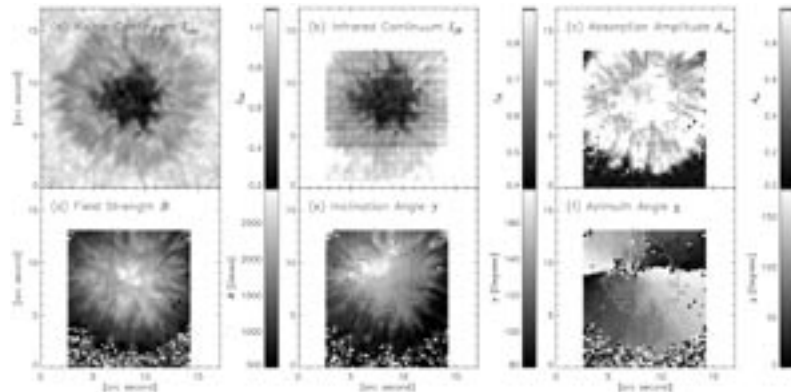


FIG 1

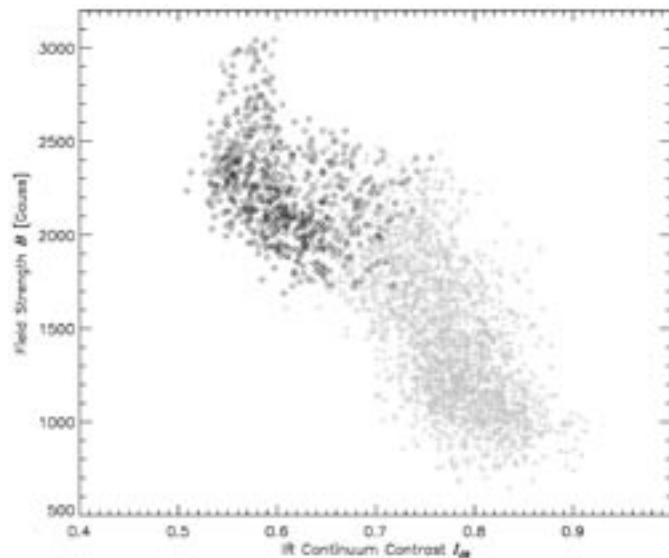
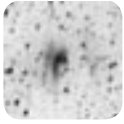


FIG 2

Figure 1 shows one of the high-resolution visible images, the IR continuum intensity map, the magnetized plasma absorption line amplitude A_m map, and the vector magnetic field maps of the sunspot derived from our IR

scan data. The most intriguing and important aspect of the magnetic field structure of the sunspot in figure 1 is the existence of several small-scale features concentrated near the center of the sunspot that display enhanced

continued



Sunspot Magnetic Fields continued

magnetic field strength and sharp boundaries with the surrounding area. Close inspection and comparison of the magnetic field and continuum intensity maps further revealed that these enhanced magnetic field features are cospatial with the dark umbral nuclei. This finding may appear to confirm the expectation that the darker features inside the sunspot correspond to regions of stronger magnetic field. Interestingly, however, we also found that the distribution of the magnetic field strength (B) in the dark nuclei ranges from 2500 G to 3000 G, while their continuum intensity remains at a

minimum constant value. That is, the continuum intensity in the dark umbral nuclei is *not* directly related to the magnetic field strength. The scattered plot between B and I_C of the sunspot in Figure 2 demonstrates the decoupling between B and I_C in the dark nuclei.

Although the enhanced magnetic field features were found to be closely associated with the darkest part of the umbra, the apparent decoupling between B and I_C is puzzling. Cooling of the plasma inside the sunspot has been considered the primary magnetic field intensification mechanism in cur-

rent sunspot theories. However, the decoupling between B and I_C suggests that a new, heretofore unknown, magnetic field mechanism is responsible for the intensification of the sunspot magnetic field in the dark nuclei. This mechanism, if proven to be true, will certainly enhance our understanding of the physics of sunspots, and help to eventually solve the sunspot mystery. Obviously, the improved capability of the Advanced Technology Solar Telescope (ATST) to observe the Sun with high magnetic field sensitivity and spatial resolution simultaneously will greatly benefit this endeavor.

Extreme Limb Observations with the McMath-Pierce FTS and Image Stabilization System

Tom Ayres (University of Colorado) & Claude Plymate (NSO)

On a recent McMath-Pierce observing run (13–18 April 2002), Tom Ayres (University of Colorado) and Claude Plymate (NSO) used the 1-m Fourier Transform Spectrometer (FTS) to record the center-to-limb behavior of the 5- μm rovibrational bands of carbon monoxide (CO). The goal was to better characterize the properties of thermal inhomogeneities at the top of the photosphere.

The CO bands are very sensitive “thermometers” for the high layers of the solar atmosphere where the strongest of the rovibrational transitions form, particularly at the extreme limb where the slanted sightline probes into the low chromosphere. In fact, the CO lines go into emission off the solar limb for an arcsecond or so as the high-altitude continuum fades away, but the optically thick line cores still radiate thermally (although at a surprisingly low temperature of 3600 K)—a phenomenon discovered by Bill Livingston (NSO) about ten years ago. The off-limb CO emissions are thought

to arise in “cool clouds” that inhabit the low chromosphere, although that interpretation remains controversial.

Most recent observations of the 5- μm CO bands have used Doug Rabin’s (formerly NSO, now GSFC) Near Infrared Magnetograph (NIM) to obtain long-slit stigmatic spectra, taking advantage of the spatial/spectral multiplex capability of NIM’s 256 \times 256 InSb camera. The 14-m main spectrograph that feeds NIM, however, suffers significant scattered light.

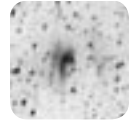
In the past, this has been removed by running in double pass with an intermediate slit, but the monochromatic output requires scanning the grating to build up a spectrum. The scattered light in NIM’s single-pass imaging spectroscopy mode reduces spectral resolution significantly—an important consideration for the narrow CO lines. On the other hand, the FTS has unsurpassed resolution and essentially zero scattered light, but can record only one spatial point at a time. Furthermore, the long integra-

tions to scan a single interferogram (4 minutes) render the FTS susceptible to seeing fluctuations and image motion. The latter consideration has prevented accurate observations of the extreme limb behavior of the CO bands, owing to the blurring effects of image shake, particularly during the windy conditions that often seem to follow observer Ayres to Kitt Peak.

Recently, however, Christoph Keller (NSO) and Plymate developed a tip-tilt image stabilization system for the all-reflecting 1.5-m telescope, which is the largest in the solar world (and thus best suited to the diffraction-challenged thermal IR). Ayres, a long-time “devotee” of CO, judged that the time was right to reexamine the center-to-limb behavior of the 5- μm bands using high-quality FTS scans, but now to extend the measurement very close to the limb.

On April 14, using the image stabilizer, Plymate and Ayres took a series of FTS scans quite close to the south limb. The

continued



Extreme Limb Observations continued

skies were clear and seeing was good, although it was somewhat breezy. Figure 1 compares four independent scans at $\mu = 0.107$ (5.5 arcsec inside limb) and four at $\mu = 0.076$ (2.8 arcsec inside limb). The repeatability was excellent. Previous FTS observations were limited to $\mu = 0.20$ (19 arcsec) owing to image shake. Similarly, an attempt to run open-loop (no stabilization) failed when the A+B intensity transiently ran out of bounds, a clear symptom of image shake. The new stabilized FTS observations represent a significant advance for probing the extreme limb behavior of the CO bands.

On April 15, the observers attempted to scan across the solar edge into the “translimb” regime. The sky was clear, but a cold front was due through later in the day and it was very windy. Seeing was relatively poor. The observation began at about 10 arcsec inside the limb and stepped across it. A 4-minute FTS scan was taken at each position, with the finest sampling (steps of 0.28 arcsec) in the immediate vicinity of the limb (determined from the half-power point in the roll-off of the A+B signal, contributed by the 3- to 5- μ m spectrum isolated by a prefilter). The diffraction limit of the McMath-Pierce main telescope at 5 μ m is about 0.8 arcsec; the slit width was 0.25 mm (0.6 arcsec), and the length was 10 mm parallel to the limb. Results are illustrated in figure 2.

The remarkable stability of the “low-order AO” correction is indicated by the systematic decline in the continuum intensity with translimb position. Even more remarkable is that in several of the off-limb scans (indicated by negative values of the displacements in arcsec) one clearly sees the CO lines in emission. This effect usually is recorded only in very short NIM exposures that “freeze” the seeing, or in scanned spectra taken during periods of excellent seeing and persistent image stability (as in Bill Livingston’s pioneering observations of the effect). The off-limb CO emissions were de-

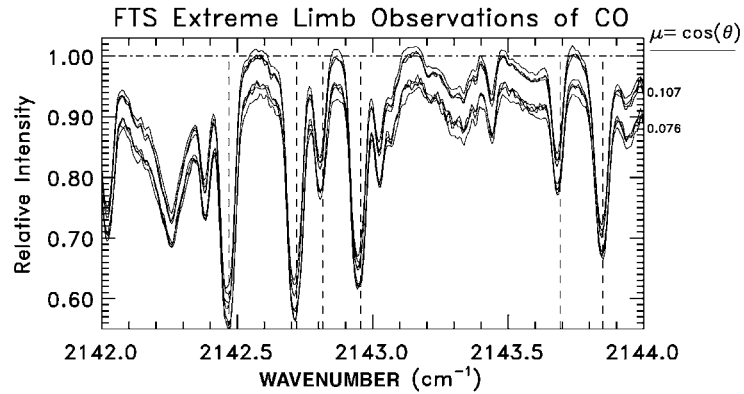


FIG 1

tectable with the image-stabilized FTS despite the long integrations during periods of poor seeing in the worst possible wind conditions (just below the shut-down limit).

Unfortunately, the S/N in the translimb spectra is lower than desirable, owing to the relatively broad 3- to 5- μ m prefilter, and the narrow slit. The noise (thermal and photon) could be suppressed significantly by using narrowband cold filters on the InSb detectors at the twin outputs of the FTS. Narrowing the passband also would have allowed running at a high alias and thereby would have shortened a single scan to about 40 seconds. Nevertheless, the translimb scans clearly demonstrated that the tip-tilt system

has the ability to transform the world’s highest-resolution solar spectrometer, long relegated mainly to a workhorse of laboratory atomic physics and atmospheric chemistry, back into a frontline instrument for solar studies. Of course, using the image stabilization on the NIM itself offers even greater promise, if the scattered light and resolution issues can be solved. Better yet, the tip-tilt corrector is only the first step; a breadboard version of a full AO unit for the McMath-Pierce is already being tested. Such a system would be extremely valuable, for example, in NIM magnetography using iron lines in the 1.6- μ m region, serving as a prelude to the potential capabilities of the next-generation large solar telescope, ATST.

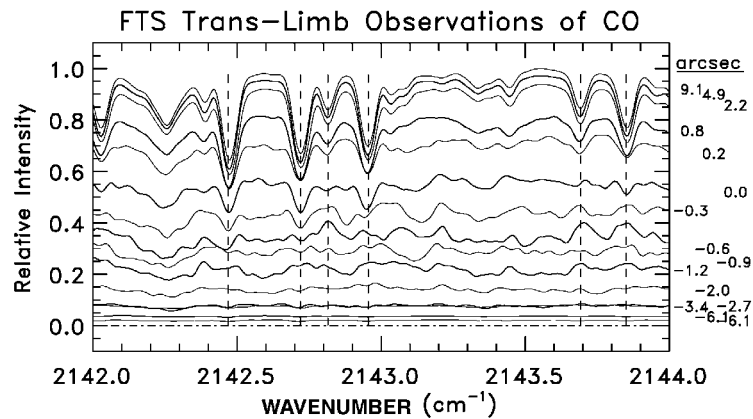
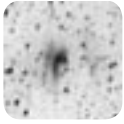


FIG 2



The High-Order Solar Adaptive Optics Program: Progress Report

Thomas Rimmele & the Adaptive Optics Team

NSO, in partnership with the New Jersey Institute of Technology (NJIT) and the Kiepenheuer Institute (KIS) in Germany, is developing high-order solar adaptive optics (AO). The development of high-order AO systems for use on the 65-cm telescope at Big Bear Solar Observatory (BBSO) and the 76-cm Dunn Solar Telescope (DST) at Sacramento Peak is well underway. The high-order AO system will upgrade each of these high-resolution solar telescopes and greatly improve the scientific output of each facility. The resulting systems will also serve as proof-of-concept for a scalable AO design for the much larger Advanced Technology Solar Telescope (ATST). The solar AO program is funded by the NSF Major Research Instrumentation Program and through substantial contributions by the partner institutions.

The overall system designs for both the DST and BBSO are complete. All subsystems are in hand and the major hardware components have been tested.

The two deformable mirror systems, one for BBSO and one for the DST, were delivered to Sac Peak by Xinetics, Inc. The deformable mirrors were tested using an interferometer, and they performed as expected, meeting all target specifications. Minor modifications of some of the drive-electronics components are currently being implemented by the manufacturer.

The interim Dalsa WFS camera, with a frame rate of 955 Hz, has been integrated with the processing unit. This camera will be used for the first-light AO system tests. A contract for the design and fabrication of a fast wavefront sensor camera, based on a CMOS device developed by JPL, has been issued to Baja Technologies in Tucson. A "smart" interface for this camera has been designed. This interface is flexible and can be reprogrammed to accommodate different formats. A 200×200 format can be implemented at sufficiently high rates of ~ 2500 Hz. The final design review is scheduled for May 2002, with delivery of a prototype camera due by October 2002.

The Digital Signal Processor (DSP) system, which performs all computations for sensing and reconstructing the wavefront, has been delivered by Bittware. Extensive tests of I/O and processing speeds were performed with this 80-proces-

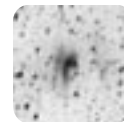
sor parallel system. The system passed all tests and the BBSO DSP system is now on order. The interface between DALSA camera and DSPs, and the interface between the DSPs and the deformable mirror drive electronics, both designed in-house, were integrated with the wavefront sensor processing unit and the deformable mirror system. The system passed all tests. The DSP system software design and implementation is expected to be complete in six months.

The optical design for integrating the high-order AO system into the DST has been finalized and all optical components have been ordered. All components are expected to be in hand by the end of May 2002. The optical bench for the high-order AO has been installed at the telescope. Design and manufacturing of mounts and optomechanical assembly are in progress. The high-order AO bench is integrated with the newly developed Diffraction Limited Spectro-Polarimeter (DLSP), which had its first (and very successful) engineering run in March 2002 at the DST.

At BBSO, a new observing room that will house the AO system and post-focus instrumentation was created by remodeling office space. The optical design for the BBSO AO system has been completed. The light is brought from the dome floor to the floor below, where the AO system and the two scientific benches reside. Visible and near-infrared narrowband Fabry Perot filter systems, in combination with polarization analyzers, will be used to measure magnetic fields.

Long-exposure PSF estimation is an important tool for post-processing AO-corrected data and PSF estimates will be provided as a standard product of the AO system. The long-exposure PSF can be estimated from the covariance matrix of the residual (closed-loop) wavefront sensor signals and knowledge of r_0 . This method was developed for wavefront curvature, sensor-based nighttime AO systems by J.P. Veran. Jose Marino, a graduate student at NJIT, is now working at Sac Peak on refining the method and applying it to solar data, such as narrowband images and spectra. He has carried out observing runs at the DST using software developed by another graduate student, Chun Yang, to record fast, high-order wavefront sensor data simultaneously with long-exposure images. Both closed-and open-loop data were recorded. Jose is also collaborating with ONERA

continued



Progress Report continued

in Paris and the Gemini Project on the development and application of the PSF estimation method. He is currently spending two months in Victoria, Canada with J.P. Veran to work on PSF estimation for the Gemini AO system, Altair. This collaboration is supported by the Center for Adaptive Optics.

Krishnakumar Venkateswaran left the AO project in January 2002 and is now working in the field of vision science AO in Houston. Maud Langlois has been hired to replace Krishna. She will join the project in September 2002. An expert in MCAO, Maud is currently working on MCAO laboratory experiments at the University of Durham, England. Prior to that, she worked on adaptive optics at the University of Arizona's Steward Observatory. Gil Morreto has been hired by NSO as an optical scientist and will spend part of his time supporting the solar AO effort.

New Results from the Low-Order AO System at the DST

Using the low-order AO system, T. Rimmele was able to observe direct evidence for "convective collapse." This is the process that has been invoked by theoretical models to explain why solar magnetic fields are concentrated in small flux elements of kilo Gauss (kG) field strength, sometimes called the building blocks of solar magnetic fields. It has long been recognized that "flux expulsion," the process by which the convective flows sweep "frozen in" magnetic field into the sites of downflows in intergranular lanes, can only produce fields of the order of kinematic equipartition field strength (400 G). An additional process is needed to explain kG fields. Convective collapse, initiated by radiative cooling at the surface, is the most promising process able to produce kG fields. However, thus far, direct observations that would provide evidence that this process actually occurs on the Sun have been missing. Adaptive optics has now made observations of this fundamental process possible.

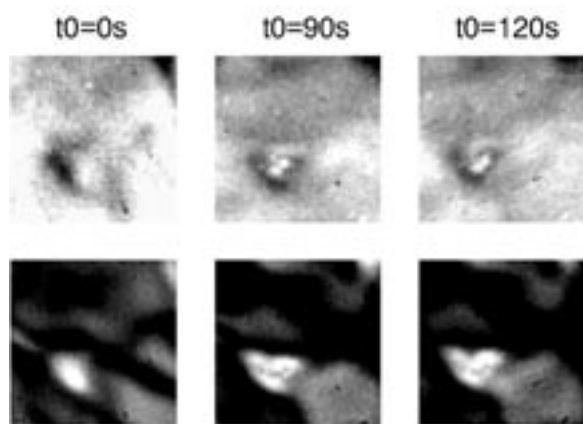


FIG 1

Figure 1 shows a short time sequence of line-of-sight magnetograms and corresponding narrowband intensity images taken with the Universal Birefringent Filter in the Fe I 6302 Å line. The effective exposure time was 10 seconds. We observe how a patch of diffuse magnetic field of about 1-arcsec size "collapses" into two distinct, concentrated flux elements of about 0.2-arcsec diameter.

The spatial scale can be inferred from figure 2, which shows the intensity image at 90 seconds with contours of the LOS-magnetogram overlaid. The diffraction limit of the 76-cm DST at 6302 Å is about 0.2 arcsec, and it is likely that the flux concentrations are actually significantly smaller. As the field is concentrated, we observe darkening at the location of the newly formed field concentrations while their edges become bright. This is likely the effect of radiative cooling in the center of the flux tube and the effect of radiative heating from the immediate, hot surroundings of the flux tube (hot wall effect), as predicted by theoretical models. The flux concentration occurs on a timescale of approximately one minute. This also compares well with predictions.

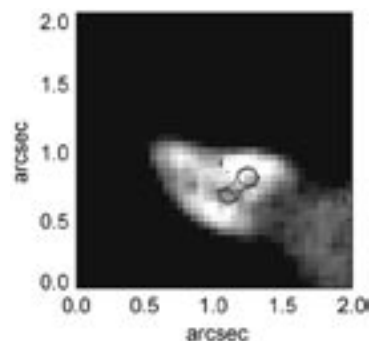
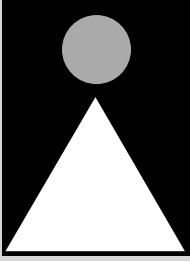


FIG 2

Although these new and exciting observations provide the first strong and direct evidence for convective collapse, a crucial piece of the puzzle is still missing. Measurements of the actual magnetic field strength before and after the field concentration occurred are needed to verify that a diffuse patch of weak magnetic field has been concentrated into small kG strength flux tubes. Such quantitative observations will soon be possible with the combination of high-order AO and diffraction-limited spectropolarimetry and/or NIR polarimetry.



Director's Office

A Science Working Group for GSMT

Jeremy Mould

Sometimes you can actually see progress being made toward the goals of the astronomy and astrophysics Decadal Survey. The NSF has taken another step along the way this spring by authorizing NOAO to form a Giant Segmented Mirror Telescope (GSMT) Science Working Group.

This working group is intended to be the community-based body that will develop the science case and justification for any federal investment by NSF or other agencies in GSMT. The Science Working Group (SWG) will represent the US community in assembling relevant partnerships for describing and advocating the appropriate federal role in this project. This guidance is intended to be a product of all public, private, and international groups that expect to play a role in the GSMT. SWG members are expected to actively participate in technical, observational, and theoretical astrophysical studies that will be useful in defining and focusing the scientific objectives for the GSMT.

Although not limited to these areas, the GSMT SWG has been assigned the following specific tasks:

1. Develop the science cases and scientific priorities for a GSMT, and refine the science goals outlined in earlier reports prepared by participating institutions. This includes evaluation of the likely impact that advances expected with existing and near-term studies will have on the science goals of GSMT, along with consideration of the costs and benefits of alternative approaches. It also includes working with the scientific community to ensure that the goals continue to be exciting, important, and representative of the highest scientific priorities for a general purpose optical/infrared observatory.
2. Develop a "flowdown" from key science to top-level engineering goals and requirements. Develop performance metrics for the GSMT telescope, instrumentation, software, operations, and other aspects of the program; and, assess performance against these metrics.
3. Identify the key instrumentation capabilities for a GSMT. Review currently proposed science instruments and propose alternate designs or complementary instrumentation that would enhance scientific usefulness, improve observing efficiency, or lead to potential cost reduction.
4. Establish the scientific relationship between GSMT and other major facilities (NGST, ALMA, SKA, TPF, etc.)
5. With specific reference to the adaptive optics (AO) roadmap, establish the relationship between specific AO capabilities and science outcomes.
6. Identify the priorities for key technology developments.
7. Provide scientific assessments of design concepts and implementation plans for their impact on the overall scientific performance.
8. Assemble appropriate community-wide partnerships for preparation of any proposals to NSF for funding activities related to GSMT.

If you wish to offer your services to the GSMT SWG, please send me a brief proposal outlining your expertise in any of the relevant areas.

As you can see from the charter, this is a serious effort that will measurably advance the GSMT, and help to shape the future. We anticipate that the SWG will accomplish most of its creative work off-line and via monthly telecons, but three physical meetings a year will be required. NOAO will meet the travel expenses of the SWG.

A number of invitations to join GSMT SWG have already been made, and I hope to announce the composition of the group toward the end of July. NOAO staff will not be members of GSMT SWG, but a small support group will be formed to assist and to ensure that assignments the SWG gives to NOAO engineers are kept on track.

What is most heartening about NSF's move to initiate a Science Working Group is that it is a clear sign of interest from the public side of the optical/infrared community in fulfilling the Decadal Survey's plan for the GSMT to be a public-private partnership.



Guest Column

Recycling Aging Telescopes

In a recent lecture to Caltech alumni on the merits of constructing the California Extremely Large Telescope (CELT), a 30-meter telescope proposed in partnership with UC colleagues, I contrasted a giant 30-meter segmented mirror telescope with the Mt. Wilson 2.5-meter, Palomar 5-meter, and Keck 10-meter telescopes on a single slide. Each telescope was pictorially scaled according to the aperture of their primaries. The slide conveys a simple point: astronomers have a continuing motivation to build ever more powerful facilities to explore the Universe in new ways.

However, the same slide could be viewed as illustrating a very different point: telescopes last for a very long time! Almost all of our historic telescopes are still in place and most are, to some extent, operational. During the next decade, many new telescopes with apertures greater than 2.5-meters will come into operation. These will join a large consort of existing telescopes still capable of productive research. What should be the future role of these aging telescopes?

New telescopes do not always follow the progression of ever-increasing aperture as simplified in my slide. Many are modest aperture, special-purpose facilities, equivalent to those built 30–40 years ago, but placed on better sites and tuned to deliver better performance. True, a few telescopes have been given a new lease on life via imaginative instrumental “upgrades,” but this seems to be the exception.

Consider the issue from a financial standpoint. The operating cost of a telescope is dominated by salaries, and the world can only sustain a modest growth in its operational workforce. Likewise, any telescope eventually stagnates without state-of-the-art instrumentation for which funds are certainly limited. Though this has already led to some pruning of old telescopes, it is likely to become a much larger issue in the future.

Well, what's the problem? We regularly replace computers and automobiles for newer, improved versions without any sentimental worries. If it's scientifically more productive to invest in a new telescope than upgrade an old one, surely this

is defensible? Indeed it is probably easier to raise resources for a new initiative than to persuade a funding agency or private donor of the need to transform an existing telescope. Yet there is something in the romance of observatories and our respect for their past accomplishments that restrains us from being so hard-nosed. So what are the most productive future roles for our “mature” telescopes?

Automation is an attractive route, both financially and scientifically. Synoptic studies have been neglected simply by the manner in which telescope time has been traditionally allocated. Time-variable studies represent a growth area of great promise and, provided existing facilities can be coordinated, this is an interesting option. Most telescopes built after 1965 can be automated with only modest capital investment, which may even be recouped via a reduction in the operational cost. However, acquisition and guiding facilities and instruments will also generally need improvement.

The most suitable telescopes in this category are those of modest aperture (1–2 meters) alongside larger, fully staffed, telescopes on reasonable sites.

Many telescopes built in the 1970s have embraced a new role as imaging or spectroscopic “survey

telescopes,” concentrating on exploiting one or two new instruments with large time allocations. However, it is important to note that this development has not prevented the construction of a series of dedicated new telescopes charged with similar, more ambitious goals. It seems we prefer to reinvent rather than refurbish. Can we justify a need here for both new and old? Panoramic optical and infrared cameras and multifiber spectrographs are expensive to construct and our instrumental workforce is sorely limited.

Sharing telescopes over enlarged academic and international partnerships has helped defray operational costs but, even though the number of astronomers worldwide is increasing, the associated administrative burdens of moving in this direction should not be ignored. Also it is increasingly hard for universities or nations gaining access to observing facilities for the first time to raise funds for

It is surely our responsibility as professionals to take the initiative in establishing a “recycling policy” for our aging telescopes.

continued



Aging Telescopes continued

old telescopes, unless there is some obviously competitive angle. No faculty wants to embark on its astronomical future by inheriting someone else's problems.

Can we get the public to invest instead? An interesting activity now commonplace on a number of sites involves training and enthusing school children of various ages via the remote control of telescopes. Success stories in this area are already numerous and one suspects there is a much greater demand. But again, the case is often made for new telescopes. Wouldn't it be more useful to channel this enthusiasm and investment into reequipping older telescopes wherever possible?

I think there is a wider issue here. It is surely our responsibility as professionals to take the initiative in establishing a "recycling policy" for our aging telescopes. In many parts of the world astronomers are no longer considered so environmentally friendly. If we are not careful, in 20 years time, an array of mothballed facilities around the world may hurt our reputation. Astronomers could be regarded as spoiled children with discarded toys. Such damage to the public appreciation of our subject must be avoided no matter how productive our new facilities might be.

Richard Ellis
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NOAO Science Archive Released

Dick Shaw & Todd Boroson

The NOAO Science Archive (NSA), a new service from the Data Products Program, was released in early April. The archive and associated tools are key elements in a new effort at NOAO to enable legacy science from ground-based, optical/infrared (IR) telescopes.

Initially, the archive is being populated with reduced images from coherent surveys, particularly those carried out as part of NOAO's Surveys Program, as these data become available. In some cases, the Archive team is collaborating with the survey project teams to generate additional, value-added data products that will benefit all archive users. Surveys are an excellent enabler of science, and also provide an impetus for the next generation of telescopes and instrumentation. By virtue of having developed the bulk of the instrumentation and data reduction software, NOAO is well-positioned to take on the long-term stewardship of the survey data products and their science pedigree.

In its first release, the archive is rather simple in functionality and sparse in data holdings, but this will soon change. New data products and functionality upgrades will be added regularly, and we anticipate the completion of the next major development phase in the fall of 2002. By that time, an archive mirror site will have been established at NOAO-South in La Serena, Chile. In later phases, the holdings will be supplemented with data products from other projects and other facilities. The ultimate aim is to construct an archive facility that can be scaled to meet the needs of the Large Synoptic Survey Telescope (LSST) data system.

A complementary technical capability now under development is the construction of automated calibration pipelines that will greatly simplify the process of data reduction and archive ingest. The first such pipeline will be optimized for survey data from the Mosaic cameras (and for the gen-

eration of time-domain data products), though the pipeline should be useful for most Mosaic observing programs if certain observing protocols and minimum calibrations are performed. In the longer term, the data management systems for survey-optimized instruments that are under development at NOAO (such as NEWFIRM) are being designed to support the automatic reduction and archiving of their data. Given the prodigious data rates expected from current and next-generation telescopes and instruments (including LSST), the NSA holdings are expected to exceed the current holdings of all other archives in only a few years.

The archive at present provides basic search capabilities to locate images that contain particular objects or regions surrounding user-provided coordinates, etc., as well as a tool for extracting subregions (or "cutouts") from images. New and more powerful tools are planned for the discovery, mining, visualization, and retrieval of

continued



Science Archive continued

complex data products. What form will these data products and services take? Standard products such as images and spectra will be supplemented with catalogs and, as appropriate, time series, light curves, etc. Compute services might be invoked in response to a user query to enable on-the-fly construction of colors, magnitudes, object

classifications, etc., transparently to the user. Most of these advanced services are likely to be implemented

in the context of the National Virtual Observatory project, which is just getting underway.

The NOAO Science Archive is an important new resource for ground-based optical/IR astronomy, and is a key element in realizing the vision of the Data Products Program to enable legacy science and to participate fully in the National Virtual Observatory. The archive search form can be found at archive.noao.edu/nsa or through its link on the new NOAO Data Products Program page: www.noao.edu/dpp.

Symposium Demonstrates Vivid Legacy of Infrared Pioneer

Steve Strom

More than 100 astronomers and planetary scientists gathered in Tucson from April 11–13 for a symposium honoring the memory of Fred Gillett. The focus of the conference was on the evolution and properties of circumstellar disks, from the accretion phase to debris disks, and the formation of planetary systems.

Participants agreed that there is overwhelming evidence that accretion disks form around stars of all mass ranges. For solar-type stars, the masses of these disks during the late accretion phase are comparable to or greater than the mass of all bodies in our own solar system, while their sizes range from a few tens to a few hundred astronomical units (AU). This suggests that the formation of solar system–like disks represents a natural outcome of the star formation process.

The duration of the accretion phase ranges from less than one million years to perhaps as long as 10 million years. This period most likely represents the range of times available for building gas giant planets, since the mass of available gas appears to drop precipitously following the termination of disk accretion.

Both the size and lifetimes of accretion disks can be influenced strongly by local radiation fields and stellar density—both photoevaporation and stellar encounters act to truncate disks and reduce the timescale available for planet

formation. A provocative contribution by David Hollenbach from NASA's Ames Research Center suggested that the apparent outer boundary of the Kuiper Belt might be linked to the effects of photoevaporation on the outer parts of the solar nebula—if, in fact, the Sun and its planets were formed in a region similar to the Orion Nebula cluster.

The application of a variety of powerful new instruments at optical, infrared, and millimeter wavelengths has enabled the imaging of disks surrounding both young stellar objects and their descendants: debris disks, which are populated by dust produced or liberated in collisions between planetesimals and cometesimals.

These disks are now observed in ever increasing numbers via optical and near-infrared light scattered by micron-size dust grains, and via thermal emission at mid-infrared and millimeter wavelengths. Resolved debris disks around nearby

stars show clear evidence of structures—inner holes, rings, warps, and nonaxysymmetric features—that are explained most naturally via the dynamical effects of one or more planets on planetesimals and cometesimals, and related dust produced via collisions. Several contributors presented dynamical models that produce features similar to those observed in extrasolar debris disk systems, as well as in our own solar system.

The symposium evoked lively dialogue among dynamicists, planetary scientists, and astronomers—ideal testimony to the growing richness and promise of a field that was opened by Fred Gillett's fundamental contributions...

continued



Gillett Symposium continued

Searches for gas during the debris disk phase have proven difficult and fraught with ambiguity. Relatively broad-beam observations by the ISO spacecraft suggest the presence of molecular hydrogen surrounding several relatively young debris disk systems. However, “pencil beam” searches for molecular hydrogen from the ground at 12 and 17 microns places limits on the gas content well below the ISO values. A similar result is reported from ultraviolet absorption line searches.

In no case is there evidence of gas present in quantity and concentration sufficient to build a Jovian-mass planet at ages much later than a 10–20 million years. Firmer constraints on the gas content of disks—and the possibility of significant addition of disk gas to forming planetary atmospheres—awaits both observations of molecular hydrogen by the Space Infrared Telescope Facility and more sensitive ground-based searches.

The outer regions of debris disks, beyond 20 AU, seem likely to be tracing regions analogous to our own Kuiper Belt. Alan Stern reviewed the status of current observations of the Kuiper Belt, and described a series of dynamical simulations aimed at assessing the initial mass of the Kuiper Belt and the fate of Kuiper Belt Objects (KBOs).

Stern's results suggest that the primordial Kuiper Belt was likely a thousandfold more massive than today's remnant. Large bodies analogous to Pluto were likely built during the first 100 million years of the Kuiper Belt's evolution. Collisions among these bodies and smaller ones produce not only dust similar to that observed in extrasolar debris disks, but also larger “ice chips” that enter the inner solar system.

Hal Levison provided a detailed discussion of the evolution of eccentricity and inclination among KBOs (a result of dynamical interaction with the gas giants), and made strong predictions about their dynamical properties waiting to be discovered at distances of 50 AU and beyond from the Sun. He also suggested that both Neptune and Uranus could have been formed between the orbits of Jupiter and Saturn, and then been scattered outward more than one billion years after the formation of the solar system.

Debra Fischer reviewed the status of observations of extra-solar planetary systems, along with observational selection effects and future prospects. Current radial velocity surveys favor discovery of relatively massive planets located within a few AU of their parent stars. Even so, it remains surprising that Jovian-mass planets are found between 0.1 and 3 AU of their parent stars in such a large fraction (roughly 10%) of the objects searched, and that the distribution of semimajor axes covers the detected range so broadly and uniformly. The presence of inner-system Jovian planets seems most naturally explained as a result of rapid formation and migration during the accretion phase.

Fisher also reviewed the evidence that appears to link the presence of inner Jovian planets with higher-than-usual surface metal abundances among their parent stars. If correct, this result seems to suggest that the outer convective layers of solar-like stars are contaminated by material that evaporates from massive planetary cores as they migrate inward during the disk accretion phase. Abundance analyses for a sample of ~1,000 solar type stars currently underway should answer the metallicity–Jovian planet connection definitively.

The symposium evoked lively dialogue among dynamicists, planetary scientists, and astronomers—ideal testimony to the growing richness and promise of a field that was opened by Fred Gillett's fundamental contributions to the pioneering IRAS satellite mission, the discovery of debris disks, and the advancement of many of the instruments and facilities that enabled the progress described at the conference.

During the symposium, Gemini Observatory Director Matt Mountain announced the pending renaming of the Gemini North telescope as the “Frederick C. Gillett Gemini Telescope,” a fitting memorial to a valued—and very much missed—colleague and person.

A more detailed wrap-up of the meeting is available at www.noao.edu/meetings/gillett/gillett_summary.



USGP

US GEMINI PROGRAM

Gemini Update

Taft Armandroff

The US Gemini Program (USGP) saw a strong community response to the Gemini Call for Proposals for semester 2002B. On Gemini North for 2002B: 57 US proposals were received, 36 requesting GMOS and 22 for NIRI. Forty-six US proposals requested Gemini South: 21 for Phoenix, 18 for T-ReCS, 6 for FLAMINGOS, and 4 for the Acquisition Camera (some proposals requested more than one instrument). In total, 103 US Gemini proposals sought 181 nights on the two Gemini telescopes. The resulting oversubscription factors were 3.0 for Gemini North and 4.0 for Gemini South. Based on Gemini Board actions, in semester 2002B the science fractions for Gemini North and South will be 50% and 35%, respectively.

We are in the midst of semester 2002A as this article goes to press. Science observations are ongoing at Gemini North with GMOS and NIRI, and at Gemini South with Phoenix and the Acquisition Camera. Approved T-ReCS proposals for semester 2002A will, unfortunately, not receive data because of the unavailability of the instrument at Gemini South in 2002A (see the USGP Instrumentation article below). One can follow progress on the approved Gemini science programs via the following URLs:

www.us-gemini.noao.edu/sciops/schedules/schedQueue2002A.html

www.us-gemini.noao.edu/sciops/schedules/schedLog2002A.html

Telescope, instrument, and software engineering activities continue as well. Some aspects of the current engineering activities that will be of tangible interest to Gemini users include: commissioning the integral-field-unit and polarimetry modes of GMOS; adding nod-shuffle capability to GMOS and commissioning it; working on secondary mirror chopping and nodding on Gemini South in preparation for T-ReCS; enhancing the efficiency of field acquisition and guide star setup; and fully integrating the high-level software with the real-time and data handling systems.

One noteworthy accomplishment that will pay scientific dividends is the exquisite delivered image quality at Gemini South. A careful analysis of delivered image quality was performed for the FLAMINGOS block of observations in October 2001. Median image FWHM was 0.37 arcsec in both the J and H bands. This excellent delivered image quality has continued in 2002A and has aided Phoenix observations by passing a large fraction of the light through Phoenix's narrow slit.

It is a pleasure to see scientific papers being published based on Gemini data. A partial list of US papers based on Gemini observations follows. It is clear that many of these results have been made possible by the exceptional image quality at Gemini, particularly as facilitated by the Hokupa'a adaptive optics system (provided by the University of Hawaii). Another enabler of new results is the availability of a mid-infrared capability at 8-meter aperture, courtesy of OSCIR (provided by the University of Florida). US Gemini users and proposers should benefit from the information in these papers.

Hokupa'a:

- "An Adaptive Optics Search for Companions to Stars with Planets," Luhman, K.L., Jayawardhana, R., *ApJ* **566**, 1132, 2002.
- "Discovery of a 0.15" Binary Brown Dwarf, 2MASS J1426316+155701, with Gemini/Hokupa'a Adaptive Optics," Close, L.M., Potter, D., Brandner, W., Lloyd-Hart, M., Liebert, J., Burrows, A., Siegler, N., *ApJ* **566**, 1095, 2002.
- "An Adaptive Optics Survey of M8-M9 Stars: Discovery of Four Very Low Mass Binaries with at Least One System Containing a Brown Dwarf Companion," Close, L.M., Siegler, N., Potter, D., Brandner, W., Liebert, J., *ApJ* **567**, L53, 2002. (See "Two's Company" in the Science Highlights of this issue of the *Newsletter*.)
- "Hokupa'a-Gemini Discovery of Two Ultracool Companions to the Young Star HD 130948," Potter, D., Martín, E.L., Cushing, M.C., Baudoz, P., Brandner, W., Guyon, O., Neuhäuser, R., *ApJ* **567**, L133, 2002.

continued



Gemini Update continued

OSCIR:

- “Deep 10 Micron Imaging of M87,” Perlman, E.S., Sparks, W.B., Radomski, J., Packham, C., Fisher, R.S., Piña, R., Biretta, J.A., *ApJ* **561**, L51, 2002.
- “Mid-Infrared Detection of a Hot Molecular Core in G29.96-0.02,” De Buizer, J.M., Watson, A.M., Radomski, J.T., Piña, R.K., Telesco, C.M., *ApJ* **564**, L101, 2002.
- “N-Band Observations of Henize 2-10: Unveiling the Dusty Engine of a Starburst Galaxy,” Vacca, W.D., Johnson, K.E., Conti, P.S., *AJ* **123**, 772, 2002.

Phoenix Demonstration Science at Gemini South

Ken Hinkle (NOAO) & Verne Smith (University of Texas at El Paso)

The first science run at Gemini South for Phoenix, NOAO’s high-resolution infrared spectrograph, took place 1–15 February 2002. In addition to the authors and the Gemini South SSA; Claudia Winge, Bernadette Rodgers, Tom Hayward, and Phil Puxley from the Gemini scientific staff; Nicole van der Blik and Bob Blum from the NOAO scientific staff; and Katia Cunha from the Demonstration Science team were present at the telescope at various times. For most of the nights, a member of the Gemini scientific staff also joined the observing from La Serena via the video conferencing link. The role of the additional Gemini staff member was to undertake real-time reduction of the data for quality control.

A large fraction of the February run was devoted to the Demonstration Science Program “Determining the Oxygen-to-Iron Abundance Ratio in the Large Magellanic Cloud.” K magnitudes as faint as 12.7 were successfully observed. The Demonstration Science spectra will be available on the NOAO Web site. Scientific results from these observations will appear in several papers that are now being written. The

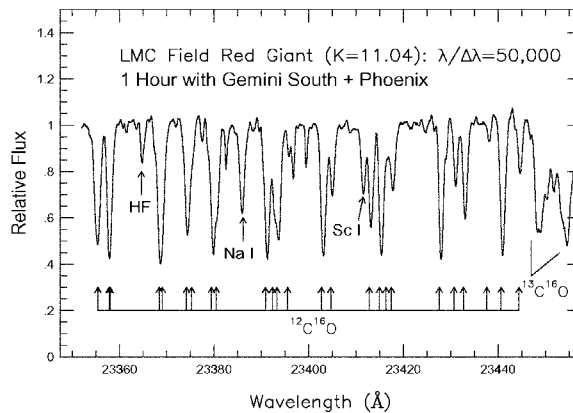
data are being made available for possible additional scientific analysis, as well as for use in planning future observations.

The main goal of the Demonstration Science Program was to determine the oxygen-to-iron abundance ratio (O/Fe) in the Large Magellanic Cloud. The

stars than in stars with comparable Fe abundance in our own galaxy. Because the relative abundances of oxygen and iron are sensitive to the chemical yields from two different types of supernovae (SN II and SN Ia, respectively), which arise from very different types of stellar systems with different evolutionary timescales, the O/Fe ratio can be used to measure different types and rates of star formation in separate galactic systems.

Field K- and M-giants in the LMC were observed in two wavelength regions containing samples of OH, CO, and CN lines, as well as atomic lines from Fe, Na, Si, Sc, Ti, and Ni. The molecular lines allow for C, N, and O abundances to be derived, and thus, any mixing-induced abundance changes in C, N, or O can be determined and accounted for, resulting in accurate oxygen-to-iron abundances being measured over a range in metallicity in the LMC.

Abundances have been derived for 12 LMC members spanning a metallicity range from [Fe/H] = -0.25 to -1.1. In

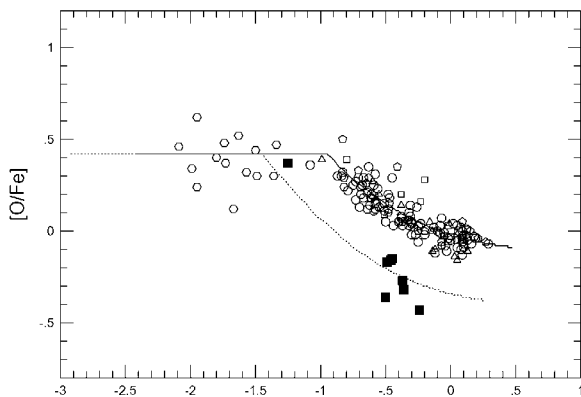


Sample Phoenix spectrum of a K = 11 mag field red giant in the Large Magellanic Cloud. This spectrum results from the combination of three 20-minute integrations with the 4-pixel slit. This spectral region is dominated by CO 2-0 vibration-rotation lines from both ¹²C and ¹³C. Two atomic lines are identified, as well as the R9 line from HF (1-0).

O/Fe ratio is a key parameter in understanding the chemical history of the LMC in comparison to the Milky Way. The few previous observations suggested that the O/Fe ratio is lower in LMC



Phoenix Demonstration continued



The demonstration science $[O/Fe]$ versus $[Fe/H]$ measurements for LMC field stars (filled squares) compared to results for the Milky Way from the literature (open symbols). The continuous curves are simple models.

the more metal-rich LMC stars, it is found that $[O/Fe]$ is indeed significantly lower than the same ratio in the Milky Way by about a factor of 2–3 at the same value of $[Fe/H]$. This result is perhaps easiest to explain by a combination of a lower star-formation rate (by about a factor of three), and a slightly larger ratio of Type Ia supernovae (SN Ia) to Type II supernovae (SN II) in the LMC relative to the Milky Way.

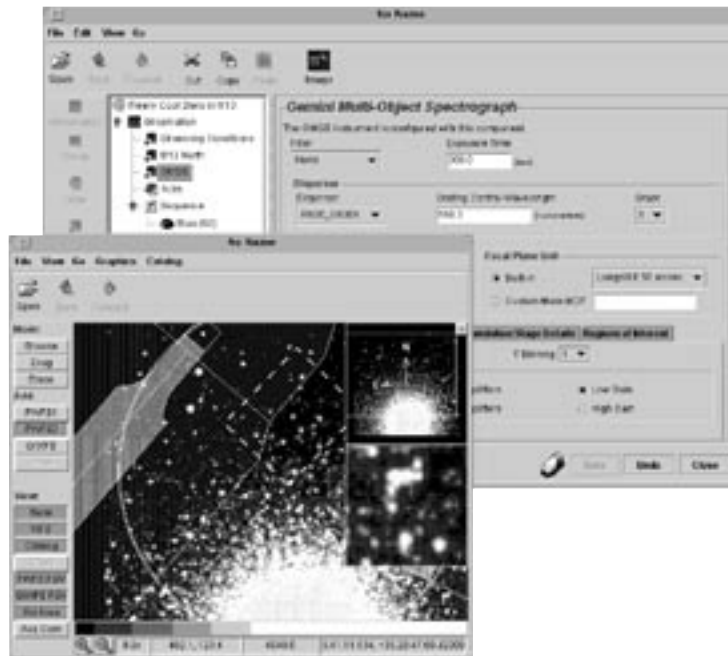
The observed red giants show clear evidence of first dredge-up, with lowered ^{12}C abundances and enhanced ^{14}N abundances; however, no evidence is found that the ^{16}O abundances have been lowered by some form of deep mixing. The combination of carbon and nitrogen abundances also indicates that these LMC stars have lower initial C/Fe and N/Fe ratios than found in most Galactic stars: all three of the astrophysically important elements C, N, and O appear underabundant relative to Fe in the LMC (in comparison to the Milky Way).

Gemini Phase II Process Using the Observing Tool

Taft Armandroff & Dave Bell

Successful US proposers for Gemini observing with facility instruments must go through a Phase II process. Gemini extracts information from accepted observing proposals and places this into a Phase II database. This includes targets, guide stars, and instrument resources, but the proposer must define specific setup and observing sequence details during Phase II. This is done using Gemini's Observing Tool (OT), which includes field visualization options to show slit placement, possible vignetting due to guide star probes, etc. US investigators are notified by e-mail from Gemini that their proposal has been prepared. Currently the Phase II skeleton is also e-mailed, but in the future it will be downloadable from the database through the OT. See www.us-gemini.noao.edu/sciops/ObsProcess/ObsProcPh2Overview.html for more information on the Phase II process.

The OT is available for Windows, Linux, and Solaris platforms. Instructions for downloading and installing the OT are available (see www.us-gemini.noao.edu/sciops/OThelp/otInstallation.html). A tutorial for Gemini's OT is also available (see www.us-gemini.noao.edu/sciops/OThelp/tutorials/otNewTutorial.html).



Representative display of the Observing Tool being used. Note the display of guide-probe vignetting of the cluster field.

USGP staff contacts are prepared to help with questions during the Phase II process. See www.noao.edu/usgp/noaosupport.html for a list of USGP contacts for each instrument.



Remembering Bob Schommer

Robert Schommer, former US Gemini Project Scientist and Associate Director of NOAO for USGP, died tragically on 12 December 2001.

At its meeting in March 2002, the US Gemini Science Advisory Committee passed the following resolution:

“The US Gemini SAC mourns the loss of Bob Schommer. His wise and energetic leadership of the US Gemini Program, his professionalism, his integrity, and his commitment to the success of the Gemini Observatory were exemplary. We miss his enthusiastic participation in Gemini meetings, and most especially, we mourn the loss of a friend. We extend our condolences to his family and to his NOAO/CTIO colleagues.”

Similarly, the following statement was written by Bob Joseph, Chair of the Gemini Science Committee, on behalf of that committee:

“Bob Schommer was an active member of the international Gemini Science Committee, which advises the Gemini Observatory Director on scientific policy issues. All of us are deeply shocked and saddened by the news of Bob’s death; what we know in our minds we cannot accept in our hearts. Bob combined acute understanding of the scientific priorities of astronomical observatory operation and instrumentation with wisdom about what goals are achievable in a real world. Bob had a major role in the GSC as the US Gemini Project Scientist, and was an effective voice in representing the considered views of his advisory committee. But a number of GSC members from other partner countries have commented on the way that Bob made them feel welcome and valued in the various Gemini meetings. Bob was not only an outstanding research astronomer, but also gifted in his role as an international scientific advisor and manager. I speak for all the Gemini Science Committee in offering our deepest sympathies to Bob’s family, and to his friends and colleagues at CTIO and NOAO.”

AURA has established the Schommer Children’s Fund to assist the Schommer family in meeting the future educational expenses of the children—Robert, Andrea, and Paulina. Friends and colleagues are invited to contribute to this fund. Contributions can be made payable to Iris Schommer/Schommer Children’s Fund and sent to:

Schommer Children’s Fund
c/o Wendy S. Goffe, Esq.
Graham & Dunn P.C.
1420 Fifth Avenue, 33rd Floor
Seattle, WA 98101



Bob Schommer
1946–2001

Contributions are not tax deductible, but will be tax-free gifts to the family.



US Gemini Instrumentation Program Update

Taft Armandroff & Mark Trueblood

The US Gemini Instrumentation Program continues its mission to provide highly capable instrumentation for the Gemini telescopes in support of their scientific success. This article gives an update on Gemini instrumentation being developed in the US, with status as of mid-April.

T-ReCS

T-ReCS, the Thermal Region Camera and Spectrograph, is a mid-infrared imager and spectrograph for the Gemini South telescope, under construction at the University of Florida by Charlie Telesco and his team.

T-ReCS has been completely assembled. The team has recently completed a series of tests and resulting adjustments. After the recent USGP Quarterly Review of T-ReCS on April 16, T-ReCS was being pumped down and then cooled. While the instrument is at cryogenic operating temperature, the T-ReCS Team will perform a series of tests to insure that the instrument meets its specifications. This will allow USGP, Gemini, and Florida to carry out the Pre-Ship Acceptance Test of T-ReCS.



After a USGP Quarterly Review of GNIRS on 24 January 2002, the GNIRS team took NSF program officer Dan Weedman to the clean room where the cleaned GNIRS slit-slide and filter-wheel mechanisms were visible.

GNIRS

The Gemini Near-Infrared Spectrograph is a long-slit spectrograph for the Gemini South telescope that will operate from 1 to 5 microns and will offer two plate scales and a range of dispersions. The project is being carried out at NOAO in Tucson under the leadership of Jay Elias (Project Scientist) and Neil Gaughan (Project Manager).

Cold mechanism testing continues. Mechanisms are adjusted, if needed, after cold testing and then retested. As of mid-April, all but two mechanisms had completed cold testing. The first cooldown of the assembled instrument is expected to take place in May. Two-axis flexure tests will be performed on GNIRS using a new Flexure Test Facility, which will contain a flexure test rig identical to the ones being installed at the Gemini laboratories. Overall, 90% of the work to GNIRS delivery has been completed; delivery is planned for autumn 2002.



Flexure Test Facility building under construction at the southeast corner of NOAO's facility in Tucson. This image shows progress as of 26 February 2002.

continued



Program Update continued

NICI

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

The NICI Team has made good progress in the areas of optical design, mechanical design, electronics design, systems engineering, and software. The NICI Preliminary Design Review (PDR) took place in Hilo on 2–3 April 2002. The NICI PDR Committee, chaired by Chick Woodward (University of Minnesota), endorsed NICI’s passage beyond the PDR gate; the Committee is preparing a detailed PDR report.



Christ Ftaclas of the NICI Team makes a point at the NICI Preliminary Design Review.

US Gemini SAC Meeting

Taft Armandroff

The US Gemini Program meets regularly with its community-based advisory council, the US Gemini Science Advisory Committee (US SAC), to discuss the US perspective on all matters that bear on the scientific quality and productivity of the Gemini telescopes. The US SAC met at Carnegie Observatories in Pasadena, CA, on March 22–23. US Gemini SAC members attending were Lori Allen (CfA), Taft Armandroff (acting Chair, NOAO), Bob Joseph (University of Hawaii), Mario Mateo (University of Michigan), Andy McWilliam (OCIW), and Chick Woodward (University of

Minnesota); SAC Members participating by teleconference were Caty Pilchowski (Indiana University) and Bob Williams (STScI). US Gemini Board member Gus Oemler (OCIW) kindly hosted the meeting and participated.

The US SAC discussed the current state of observing capabilities on Gemini, future opportunities, and how the priorities of the US Gemini community should be enunciated at the Gemini Science Committee meeting in Vancouver on April 8–9. Two NOAO staff members made presentations on potential future instrumental

direction for Gemini. Sam Barden described an innovative wide-field multifiber spectroscopy system, and Ken Hinkle outlined a cross-dispersed, high-resolution infrared spectrograph that capitalizes on advances in detector technology.

The meeting was highly successful with much lively discussion. US community astronomers are encouraged to contact the author (armand@noao.edu) or any US SAC member (see www.noao.edu/usgp/staff.html for a full list) to express their views and aspirations for US use of the Gemini telescopes.



Two US Gemini Fellowships

Taft Armandroff

The USGP is pleased to announce two awards for advanced research using the Gemini telescopes—one to Silvia Alencar, recipient of the US Gemini Fellowship for the 2002–2003 cycle, and the other to Marcel Bergmann, recipient of the USGP Postdoctoral Research Associate position.

The US Gemini Fellowships provide South American students and educators from Argentina, Brazil, and Chile with opportunities to study, conduct independent research, work, and teach in the United States at universities and similar research institutions of their choice. Silvia Alencar, the recipient of the US Gemini Fellowship for the 2002–2003 cycle, is currently a postdoctoral research fellow at the Universidade de Sao Paulo. Dr. Alencar will take her US Gemini Fellowship to

the Harvard-Smithsonian Center for Astrophysics (CfA). Her research plan addresses the formation and early evolution of solar-type stars via studies of T Tauri stars. Alencar will collaborate with Nuria Calvet and Lee Hartmann at the CfA, and plans to use the Gemini telescopes in her research.

The US Gemini Fellowship is carried out as a partnership between AURA and USGP, with funding from the National Science Foundation, and provides research support for up to two years. The 2002 award was made after thorough evaluation by the partner countries and an independent review by a specially appointed Selection Committee chaired by the author, and including Mario Mateo (University of Michigan) and Chick Woodward (University of Minnesota). Please see www.aura-astronomy.org/f/usgfp.asp

for more information about the US Gemini Fellowships.

Marcel Bergmann of the University of Texas at Austin will be joining the USGP–La Serena staff later this year as a Postdoctoral Research Associate. Bergmann's experience in the study of elliptical galaxies, which is the topic of his PhD dissertation, as well as his accomplishments in the commissioning and early use of the Hobby-Eberly Telescope's Low-Resolution Spectrograph, will mesh well with the requirements of this position for research and USGP service. The USGP eagerly awaits his arrival in October. Some of the areas where Bergmann will make a contribution to USGP endeavors include GMOS user support, GMOS data reduction software development, and Gemini South visitor instrument support.

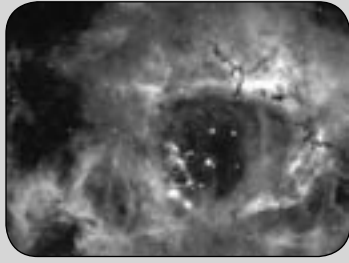
Notable Quotes

Senate Appropriations Subcommittee Chairwoman Barbara Mikulski (D-Maryland) urged NASA to look at contingency plans to extend the life of the Hubble Space Telescope beyond 2010 in case the Next Generation Space Telescope project was delayed.

NASA Administrator Sean O'Keefe reported that he was beginning to explore such possibilities.

-- 1 May 2002 hearing of the Senate Appropriations VA/HUD Subcommittee on NASA's FY 2003 budget

Courtesy: AIP



Observational Programs

2002B Proposal Process Update

Dave Bell

NOAO received 345 observing proposals for telescope time during the 2002B semester, plus an additional 14 proposals on behalf of the Chilean National TAC for time at CTIO. Of those sent to the NOAO TAC: 134 proposals requested time at KPNO, 131 requested time at CTIO, 103 requested time with the Gemini telescopes, 13 requested public-access time at MMT, and 9 proposals requested public-access observations with the Hobby-Eberly Telescope. Thesis projects accounted for 22% of those received, or 77 proposals. NOAO received 15 new requests for Survey programs, and 19 standard proposals requested long-term status. Detailed time-request statistics will be published in the September issue of the *Newsletter*.

As of this writing, the proposals are being reviewed by members of the NOAO TAC. After their deliberations, the KPNO and CTIO

schedules will be completed by mid-June, and e-mail notifications will be sent promptly to principal investigators. Investigators who've submitted HET and MMT requests will also be notified at this time. Investigators who've requested time at Gemini will be notified in late June, after the meeting of the the Gemini International TAC and final approval by the Gemini Director. Mailed information packets will follow the e-mail notifications by about two weeks.

Looking ahead to 2003A, Web-proposal materials for most facilities should go on-line around August 31. The September issue of the *Newsletter* will contain updated instrument and proposal information. The deadline for submitting 2003A observing proposals will be Monday, 30 September 2002.

A Status Report on the NOAO Telescope Time Allocation Process

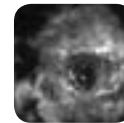
Dave De Young

The NOAO telescope time allocation process is one of the most critical functions carried out by the Observatory. It is here that telescope developments, instrumentation initiatives, and site operations are merged with peer review procedures to enable the observing process and produce the NOAO's "end product:" good science. Any successful allocation process must have the support of the astronomical community and, in order for this to happen, the process must be clearly understood and seen to be without bias. This is not always a trivial task, but over time many refinements have been made to the NOAO allocation process to make it as efficient and fair as possible.

The central element of the process is the peer review of observing time proposals that is carried out by the Time Allocation Committees (TACs). There are currently seven primary allocation committees, whose members are listed below, and an additional committee to evaluate proposals for the NOAO Survey Program. The primary committees review and rank proposals for all NOAO telescopes, for the US share of the Gemini telescopes, and for national center time at independent observatories. TAC members are recruited from the astronomical community at large, and the term of service on the primary committees is nominally five semesters, since continuity is considered an essential part of an effective evaluation process. There is no direct compensation for service on a TAC, and NOAO is very indebted to the many astronomers who have contributed their time and expertise that are so essential to the success of the proposal review procedure.

The TAC process has a relatively low profile, but there is a great deal of "behind the scenes" effort involved in the processing of about 360 proposals each semester. Incoming proposals need to be sorted, checked (and sometimes corrected), and assigned to lead reviewers. Proposals are given initial grades prior to the meeting, and these need to be assembled and placed into the database. In addition, the logistics of a total of nine committee meetings over a period of approximately two weeks must be arranged in a seamless manner. The entire process is very complex, and it is efficiently organized and coordinated every semester by Mia Hartman, the TAC Proposal Process Coordinator. The software used in the TAC process is also complex and becoming more so. The old software is now being upgraded by Dave Bell and David Gasson, and at present, the new Web-based system allows all grading, reviewing, allocation, and scheduling functions to be performed through

continued



Status Report continued

password-protected Web pages. Each TAC member can now use a laptop during the meeting to access on-line information about proposals, technical reviews, observatory statistics, and historical data.

The TAC process is a vital part of NOAO's mandate as a national observatory, and it is a complex and evolving operation. We are continually seeking ways to improve its effectiveness, and we welcome any suggestions.

2002B TAC Members

Galactic 1

Sidney Wolff, Chair
Lori Allen
Michael Briley
Ken Sembach
David Soderblom
Jeff Valenti

Galactic 2

Abi Saha, Chair
John Gizis
Marc Pinsonneault
Kim Venn
Stefanie Wachter
Rene Walterbos

Galactic 3

Chris Sneden, Chair
Suzanne Hawley
Michael Jura
Julie Lutz
Knut Olsen
Steve Ridgway

Extragalactic 1

Dave DeYoung, Chair
Stefi Baum
Julianne Dalcanton
Puragra Guhathakurta
Rogier Windhorst
Howard Yee

Extragalactic 2

Tod Lauer, Chair
Erica Ellingson
Fred Hamann
David Hogg
Brain McNamara
Steve Zepf

Extragalactic 3

Pat McCarthy, Chair
Paul Green
Bill Keel
John Mulchaey
Marc Postman
Nick Suntzeff

Survey

Tod Lauer, Chair
John Gardner
Mauro Giavalasco
Mario Mateo
Steve Strom
Scott Trager
Michael Vogely

Solar System

Dave DeYoung, Chair
William Hubbard
Robert Millis
Susan Wyckoff

Joint HST-NOAO Observing Proposals

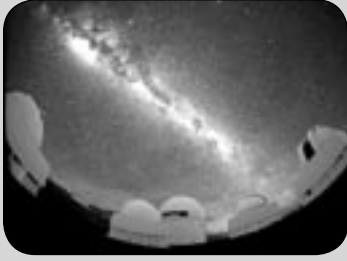
Jeremy Mould

NOAO is again collaborating with the Space Telescope Science Institute to award observing time on NOAO facilities for highly ranked Cycle 12 HST proposals that request time on both HST and NOAO telescopes. The award of time on NOAO facilities will be subject to approval by the NOAO Director, after nominal review by the NOAO TAC to avoid duplication of programs. The important additional criterion for the award of NOAO time is that both the HST and the ground-based data are required to meet the science goals of the project.

Up to 5% of NOAO's available observing time may be allocated to proposals meeting the stated criteria. NOAO observing time will be scheduled during the two semesters from August 2003 through July 2004. Under this agreement, approximately 15 nights per telescope will be available on most telescopes, with the following exceptions: only 1-2 nights will be available on the MMT and HET, and no time will be available on Gemini. In addition, time on the heavily-subscribed Mosaic cameras may be limited by the NOAO Director. Detailed information on available facilities is given on the NOAO/NASA Collaboration Web page (www.naoa.edu/gateway/nasa).

The following four programs were granted NOAO time through this agreement in Cycle 11, and will be executed during the August 2002 through July 2003 observing period:

- *The Origin of Gamma-Ray Bursts* (PI: Andrew Fruchter, STScI)
- *Understanding Irradiation and Dipping Behavior in Low Mass X-ray Binaries* (PI: Robert Hynes, University of Southampton)
- *Do the Most Powerful Radio Galaxies Host the Most Massive Black Holes?* (PI: André Martel, JHU)
- *UV Observations of Hubble Flow Type Ia Supernovae* (PI: Peter Nugent, LBNL)



CTIO

OPERATIONS

The Role of CTIO in the Development of the GSMT

Brooke Gregory

The Decadal Survey encouraged NOAO to increase its focus on unique capabilities that we can develop and offer to the community. The New Initiatives Office (NIO), a collaboration between NOAO and Gemini, houses the effort working on the most distant horizon; specifically an effort to enable the development of a Giant Segmented Mirror Telescope, tentatively 30 meters in diameter. The main offices of the NIO are in Tucson, but all parts of NOAO have been involved in working on studies to advance the goal of a GSMT, including significant involvement of CTIO staff. During the first year of the NIO, scientific and technical staff from CTIO have been active in the following areas of the NIO program:

Science Case

Bob Blum and Knut Olsen have collaborated with Francois Rigaut of Gemini in the analysis of simulated images from a 30-meter GSMT, which test its capabilities for doing stellar population studies in external galaxies.

Sites

CTIO's deputy director, Alistair Walker, is leading the investigation of potential sites for a GSMT, a search that extends from Hawaii through the southwest of the continental US to northern Chile. He is coordinating a collaborative effort involving other organizations—ESO, CELT, Cornell, and groups from Mexico and Japan—which is proceeding on several fronts:

- Purchase and analysis of extensive satellite data for assessment of cloud cover and water vapor at all sites under consideration
- Development of a robotized Differential Image Motion Monitor (DIMM)
- Development of a compact, transportable Multiple Aperture Scintillation Scanner for measuring the vertical profile of seeing above a site
- Weather monitoring equipment
- On-the-ground site evaluations in northern Chile
- Participation, with Gemini and others, in measurements of the sodium layer conditions over Cerro Tololo. The short term motivation for these studies is to help specify the laser guide star system for the Gemini multi-conjugate Adaptive Optics (AO) system to be built on Cerro Pachón. Longer term, this data will be useful to design AO systems for the GSMT.

Systems Engineering

Brooke Gregory is serving as Systems Scientist in the NIO effort. In that role he has helped to define the science requirements, and the engineering specifications that flow down from them, for a Point Design GSMT.

“Enabling A Giant Segmented Mirror Telescope for the Astronomical Community,” a comprehensive progress report on the efforts of the New Initiatives Office, has recently been published on the Web at www.aura-nio.noao.edu/book/index.html.

Also known as the GSMT Book, this document presents an overview of initial GSMT science requirements and an illustrative analysis of a conceptual point design for a 30-meter telescope, including its initial scientific instrumentation.



SOAR Dome and Telescope Mount Come Together on Cerro Pachón

Steve Heathcote

After an unfortunate series of delays during assembly and testing, and following a highly eventful journey from Brazil to Chile, the SOAR dome was finally delivered to Cerro Pachón in mid-December. Since then, the SOAR Team has raced to erect the structural steel, and clad it with composite fiberglass panels before the onset of winter. At the time of this writing (late April), the last few panels are being installed and we hope to have the dome complete and weathertight by early June. Meanwhile, the telescope mount took a much more tranquil ocean cruise from Houston, Texas, arriving on site in early March. Installation is now proceeding in parallel with the dome work, and we expect to have the mount assembled and fully operational by September.

The work to fabricate the SOAR primary mirror also recently passed a very important milestone when the surface became sufficiently smooth to allow quality assessment of its



The base cone, which carries the azimuth bearing for the telescope, is gingerly lifted into the building, marking the first step in assembly of the SOAR mount.



Installation of one of the 153 fiberglass composite panels that comprise the skin of the SOAR dome, a sphere 20 meters in diameter.

figure using optical interferometry. Nonetheless, the accumulated fabrication delay is now such that we do not expect the completed optical system to arrive in Chile until early 2003. However, we plan to make good use of the interlude between completion of the mount and arrival of the optics to ensure that everything else, both hardware and software, is completed and fully tested. This will allow us to get to first light, and then to first science, as quickly as possible once the optics do arrive.

Our ambitious but obtainable goal is to achieve first light two months after delivery of the optics, to have the telescope in use for science 50% of the time only three months later, and to reach full science capability within six months of first light, even though we will not finish commissioning all of the new science instruments until somewhat later. We thus anticipate that general observer time on SOAR will become available to the NOAO community, on a shared risk basis, starting in the 2003B semester.



Highlights of Conference on Controlling Light Pollution

Hugo Schwarz & Malcolm Smith

In early March, a highly successful, interdisciplinary, international, bilingual conference was hosted by NOAO/CTIO and several other organizations in La Serena in response to a 1999 resolution by the IAU Working Group on “Controlling Light Pollution” (see www.opcc.cl/congreso_internacional/ingles.htm). It was attended by 132 registered participants from 12 countries in four continents, with 13 guests—making it a much larger gathering than we had expected for such a specialized topic.

Twenty invited talks were given, as well as several oral and poster contributions. Topics included: visible (optical) light pollution, radio frequency interference with radio and (sub)millimeter-wave astronomy, space advertising, and aircraft contrail pollution. Some highlights were:

- P. Daud—CONAMA representative speech
- F. Falchi—First world map of true light pollution (LP)
- L. Alvarez—Report on International Dark-Sky Association activities
- J. Diaz, P. Sanhueza, R. Wainscoat—Reports on the activities on LP control in Spain, Chile, and Hawaii, respectively
- J. Cohen, E. Hardy, T. Hasegawa, G. Delgado, L. Nyman—Reports on radio frequency work
- M. Metaxa—Report on educational activities in Greece and Europe
- N. Zeitlinger—Report on an experiment that raised public awareness of LP
- E. Piraino—Report on the work of the photometric lab in Valparaiso, Chile
- A. Heck—Space advertising
- H. Pedersen—Aircraft contrails

(All talks are available in MS Powerpoint at www.ctio.noao.edu/~emond/lpc/lpc-presentation.html).

Many companies from both Chile and abroad displayed their light fixtures and other products. Several important local and national authorities attended and, during the opening session, we had both the present- and ex-Intendente of the fourth region present. The ex-Intendente, Don Renan Fuentealba, has always supported our light pollution cause and we are happy that the new Intendente, Don Felipe del Rio, has shown strong interest in astro-tourism and the associated control of light pollution (see, e.g., www.ctio.noao.edu/news/President.html).

Another highlight of the conference was the founding of the Chilean section of the International Dark-Sky Association (IDA). During a side meeting, the main points

of the agreement between the Chilean IDA members and the US IDA representatives for the establishment of the Chilean section were settled. Chile now has an official IDA section, see www.darksky.org/ida/sections.html. For more information, you can visit www.polucionluminica.cjb.net or www.redastro.cjb.net (both in Spanish). The entire conference proceedings will be published and available in hard copy.

The general worry about what conversion to “good” public lighting involves is clearly on the retreat among the public, and there is more awareness that “good” also means saving money and providing more security for pedestrians and drivers, in addition to saving the night sky for generations to come.

We had positive media coverage: national TV, local TV and radio, and cable TV covered our press conference and broadcast several interviews; we had full-page spreads on all three days of the conference in regional papers (one day a double page), and a full page of coverage in the biggest national paper, *El Mercurio*. Weeklies also published articles and photos of the various events. The general worry about what conversion to “good” public lighting involves is clearly on the retreat among the public, and there is more awareness that “good” also means saving money and providing more security for pedestrians and drivers, in addition to saving the night sky for generations to come. We feel that our message: “We will all be winners!” when light pollution is controlled, has now reached many people in Chile. Its importance to siting Extremely Large Telescopes of the future is obvious.

The roundtable at the end of the conference and a meeting of members of IAU Commission 50’s Working Group on Controlling Light Pollution came to the following conclusions and recommendations:

- Organize help in securing funding for a second World Atlas of Light Pollution (for the first atlas, see Cinzano et al., *MNRAS* **328**, 689–707), 2001.
- Help the International Telecommunications Union extend its brief to include infrared and optical frequencies.

continued



Light Pollution continued

- Develop international educational networking to stimulate initiatives for international LP awareness, involving teachers, videocons, Internet, etc. The excellent work of M. Metaxa was specifically noted.
- Stimulate the monitoring of light pollution from ground-based observatories worldwide. The All-Sky Cameras initiative at NOAO/CTIO was specifically cited.

In the near future, the Chilean DS686 law on light pollution will need some revision. Advances in the technology of lamps has made certain sections of the law ineffective and some additions and refinements to put the law more in line with internationally agreed upon standards are desirable. The inclusion of radio frequency interference may need to be considered.

We look forward to a bright—but unpolluted—future on a worldwide scale!



Many of the 132 attendees at the March 2002 international conference on light pollution held in La Serena, Chile, visited the Cross of the Third Millennium in nearby Coquimbo. Efficient, dark sky-friendly lighting was designed for this impressive 93-meter tall monument by Enrique Piraino of the photometric laboratory of the University of Valparaiso. Conference attendees were welcomed to the site by Mayor Don Pedro Velásquez Seguel, who stands third from the left in the first row.



Highlights of the IAOC Workshop “Galactic Star Formation Across the Stellar Mass Spectrum” 10–15 March 2002, La Serena, Chile

James De Buizer

More than 120 star formation experts and students from more than 15 countries gathered in La Serena, Chile, this March to attend a workshop about star formation and exchange ideas and perspectives. The workshop, *Galactic Star Formation Across the Stellar Mass Spectrum*, was the first to bring together experts from the specialized fields of low-, intermediate-, and high-mass star formation.

The highly successful workshop presented cutting-edge science in a wide range of topics within star formation. Topics included: structure and initial conditions of the interstellar medium and molecular clouds; circumstellar disk and planet formation around stars of different mass; and effects of high-mass stars on low-mass star formation. Each day of the workshop ended in a lively and informative debate, often resulting in a fresh insight about our present-day understanding of the star formation process.

Until recently, observation and theory of star formation was focused on stars similar to the mass of our Sun or smaller. However, in the last decade there has been increased interest and work in intermediate-mass star formation (two to eight times the mass of our Sun), and high-mass star formation (greater than eight times the mass of our Sun). These studies have cast doubt on long-held beliefs of how stars form and has led to the idea that stars of different masses may form in different ways. The aim of the workshop was to join together the most recent observational and theoretical results of star formation into a cogent picture of star formation across the entire mass spectrum.

Some of the scientific highlights included: Dr. Matthew Bate’s (University of Exeter) presentation of the highest-resolution computer simulation of star formation to date; Dr. Jorick Vink’s (Imperial College) observations showing that there is an apparent difference in the timescales of possible planet formation between lower and higher mass stars; and Dr. Jonathan Tan’s (Princeton University) models of star formation showing that theoretically stars of all masses can be formed in the same way.

A special star party was held for those unlucky astronomers who had never observed the nighttime skies from the southern hemisphere.

The International Astronomical Observatories in Chile (IAOC) have worked together for more than 15 years to present biennial international workshops such as this one. The IAOC is a cooperation of observatories that includes the AURA-operated Cerro Tololo Inter-American Observatory (CTIO) and Gemini Observatory, the European Southern Observatory (ESO), Las Campanas Observatory (LCO), and the National Radio Astronomy Observatory (NRAO). This year’s workshop organization was lead by CTIO.

The results and debates from *Galactic Star Formation Across the Stellar Mass Spectrum* will be collected in a volume of proceedings to be published in early 2003 in the Astronomical Society of the Pacific Conference Series. For more information about the workshop or proceedings, please contact the chair, Dr. James M. De Buizer, CTIO, Casilla 603, La Serena, Chile, jdebuizer@ctio.noao.edu.



The NSF's Astronomy and Astrophysics Postdoctoral Fellowship: Putting the Fun Back in Funding

Dara Norman

Let's face it, astronomy is just plain fun. It's fun to look up into a dark sky full of stars; to see a bright shooting star flash across the sky; to notice that stars are different colors; to watch an eclipse. It's especially fun to try and understand where it all comes from and how it's all put together. Sure, it's not so great to be an astronomer when those proposal writing seasons come around, but in fact we've all become astronomers because, well . . . it's fun.

If you are like me, you have spent time sharing your interest in astronomy with children, students, parents, and teachers, and basically anyone else who is interested. And that's fun too. However, anyone who has volunteered to organize or participate in educational and public outreach (EPO) projects knows that they require plenty of time and effort to be successful, taking up energy that could be spent pursuing research, classroom teaching, or supporting instruments... the things that most astronomers are actually paid to do.

The rewards of volunteering for EPO projects are generally personal: hearing delighted gasps from children when you turn up the stars for the first time during a planetarium presentation; getting really good questions from the audience after a public talk; receiving 25 thank-you cards unexpectedly from a third grade class. Those rewards make volunteering worthwhile, but often even those great personal rewards are unable to compete with paid responsibilities. Furthermore, too often these volunteer efforts, which help to keep money flowing to astronomy, go unrecognized by bosses, managers, advisors, and peers. Since there just aren't enough hours in the day to do everything, often it is the EPO activities that are dropped.

However, projects that include some EPO component are becoming the norm in the astronomical community. Organizations like NOAO and STScI have whole departments to develop and carry out EPO activities. More and more, researchers seeking "big money" grants are advised (and often required) to include some EPO section in proposals. NASA even has an Office of Space Science Education and Outreach Broker/Facilitator Program to help astronomers develop ideas for the EPO components of proposals. Thus, experience in matters of EPO is becoming an asset in the astronomical community.

A year and a half ago, the NSF began its Astronomy and Astrophysics Postdoctoral Fellowship (AAPF) to encourage and develop EPO skills in researchers at an early stage in their careers. The fellowship is a unique opportunity for postdocs who are interested in more than just research to pursue

significant education and outreach projects of their own design. Applicants are expected to submit proposals in which 20–25% of their time is devoted to EPO activities. This is a fellowship for people really committed to outreach and education. Furthermore, the fellowship award is an excellent deal, with a total award of \$60,000 annually for three years. Fellowship awardees receive a stipend and a travel budget, and can take the fellowship to the US institution of their choice, including those like CTIO and Gemini South in foreign countries. The host institution also receives a mon-

etary allowance. Details can be found at www.nsf.gov/pubs/2000/nsf00136/nsf00136.html.

When I became aware of this fellowship, I was truly excited. I have always had a strong sense that I would like to give back to the community from which I was inspired. I spent much of my time in graduate school giving planetarium shows, talking to students at local elementary and high schools, and, of course, TA-ing undergraduate classes. However, I wished to pursue a research career, and I wanted to move to La Serena, Chile. This fellowship was perfect for me. The only problem was that I am not fluent in Spanish. This wouldn't really be a problem for a researcher, but it was potentially a big one for being involved in EPO. As I investigated the

EPO activities at CTIO and NOAO, I discovered many activities that I could be involved in without the benefit of fluency.

CTIO has an established Research Experienc-

es for Undergraduates (REU) program, and I got my first chance to work with a student this past Chilean summer. The observatory also helps to support astronomy and science education at local schools through a number of different programs. I have become involved at the International School, helping to set up an astronomy club for high school students. Many of us at CTIO have been helping to build the structure that will house a donated Celestron telescope, and I'll be giving astronomy talks in English. There are also efforts under-

Sure, it's not so great to be an astronomer when those proposal writing seasons come around, but in fact we've all become astronomers because, well . . . it's fun.

continued



Postdoctoral Fellowship continued

way through CTIO and NOAO-Tucson to connect the already successful Red-laser group in Chile with local Spanish-speaking teachers in Tucson to develop ideas and resources for a mentoring program similar to the Astronomical Society of the Pacific's Project ASTRO. Also, I have begun to collect data on bright transients in the Deep Lens Survey (DLS) that I hope to develop as a project unit for NOAO's Teacher Leaders in Research Based Science Education (TLRBSE) program.

As my Spanish improves, there are even more activities I can become involved

in. One advantage of doing this work at an international facility is that I have been able to meet people from all over the world who also enjoy being involved in EPO. As for my research, I am now working with the DLS team. I plan to use the survey data for an original project on gravitational lensing of quasars, and I am involved in interesting follow-up projects with the team.

Two classes of postdocs are currently funded or soon to be funded by the NSF's AAPF, with a varied set of scientific and EPO interests. The scientific research spans topics from studies of the cosmic microwave background, to large and small-scale jets, to infrared studies

of clusters of massive stars, to tidal interactions in stars and planets. The list of EPO activities is even more diverse, reflecting the broad experiences, understanding, and interests of the fellows.

Of course three years is not a lot of time to develop, implement, and establish many of the proposed EPO activities, therefore, it is essential that fellows be encouraged and incorporated into on-

going activities at their host institutions in order to be successful.

As part of their EPO activities, a number of fellows have

undertaken to develop and teach classes for graduate students, undergraduates, and/or local teachers. These classes are generally astronomical in their scope, but with a variety of instructional methods; some are labs, others are workshops, and a few are the more traditional lecture series type of classes.

Like me, many recipients are working with undergraduates on research projects related to their own scientific proposals through programs such as REU or the Undergraduate Research Opportunities Program. Several are involved with elementary and high school teachers and students with the help of established programs like Project ASTRO and TLRBSE.

Many fellows have designed activities to target women, minorities, and underprivileged groups in local communities. Fellows are building telescopes with student groups, organizing public seminar series, designing and building museum exhibits, designing and writing bilingual Web sites, and publishing magazine articles. As the AAPF program continues, ideas for activities are likely to become even more innovative as "big money" projects looking for postdoctoral researchers will also be involved in EPO programs.

As a recipient of the AAPF, I am happy to see a funding agency that recognizes the role researchers have in educating the public about astronomy and science in general. Even more significantly, I admire an agency that is willing to commit resources to develop these skills among an upcoming generation of researchers. I am pleased to be able to pursue both my interest in research and in EPO on equal footing, and not feel that I must sacrifice one for the other.

I would encourage anyone who knows of a graduate student or early postdoc interested in education and outreach to inform them about this fellowship. My ability to pursue outreach activities along with my research has made a world of difference in my career satisfaction. And I hope this fellowship will make a difference in the lives of a few other people who share an interest in looking up into a dark sky full of stars.

I am pleased to be able to pursue both my interest in research and in EPO on equal footing, and not feel that I must sacrifice one for the other.



Staff Comings

Malcolm G. Smith

On 1 March 2002 Timothy Abbott joined the CTIO Scientific Staff as Telescope Manager and Instrument Scientist. His main responsibility is serving as the instrument scientist for the Blanco 4-meter telescope, where he will explore the possibilities of improving operations and upgrading instrumentation. He is also pursuing the identification and removal of sources of human-related seeing degradation.

Tim is also well-known as the moderator of the highly successful “CCD-world” forum, and he has much expertise with CCD detectors and astronomical instrumentation in general. His main research interests are the late stages of binary star evolution, interacting stars, and cataclysmic variables.

Tim comes to us from the Nordic Optical Telescope, where he was the Astronomer in Charge. Before taking up the position in the Canary Islands, Tim was resident astronomer at the Canada-France-Hawaii Telescope in Hawaii, and a fellow at the European Southern Observatory in La Silla.

The Abbott family consists of Tim, Jackie (who is a native Texan and professional actress), and their six-year-old son, Alex.

Notable Quotes

A new bipartisan effort has been launched to increase the National Science Foundation’s budget next year by \$720 million to \$5.5 billion. The initiative, in the form of a letter to two key House appropriators, is being led by Reps. Vernon Ehlers (R-Michigan) and Sherwood Boehlert (R-New York), Ralph Hall (D-Texas), Constance Morella (R-Maryland), Rush Holt (D-New Jersey) and Eddie Bernice Johnson (D-Texas). The \$720 million increase sought by Ehlers and his colleagues would give NSF an increase of 15% in their FY 2003 budget. The Bush Administration requested an increase of 5%, which reduces to 3.3% after adjusting for requested program transfers.

Rep. Nick Smith (R-Michigan) later introduced a bill (H.R. 4664), called the “Investing in America’s Future Act,” to authorize a 15% increase for the NSF in each of the next three years, leading toward a doubling of the foundation’s budget.

Courtesy: AIP



K P N O

Operations

WIYN Tip-Tilt Module Success in Early Commissioning

C. F. Claver & A. Saha, for the WTTM team

The WIYN Tip-Tilt Module (WTTM) saw first light on 27 February 2002 at the WIYN 3.5-meter telescope. It is currently in intensive commissioning. This instrument, which mounts as an extension of the WIYN Nasmyth imaging port, provides high-speed, tilt-compensated imaging. It is being tested with a CCD, which is likely to be its primary mode, but it is also capable of feeding other detectors or instruments, e.g., an infrared camera, or an integral field unit (IFU) feed to a spectrograph. With its current EEV-80 CCD, the WTTM has a field of view of 4.6×3.8 arcmin with 0.11 arcsec square pixels (2430×2048 , 13.5 micron pixels). Figure 1 illustrates the field of view with an image of NGC 2841.

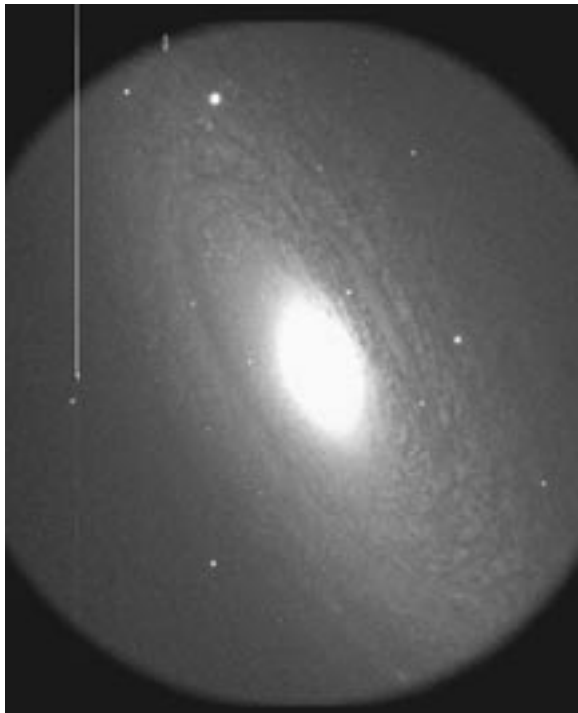


FIG 1

Early commissioning tests have been most encouraging. In ambient seeing of 0.7 arcsec FWHM (the median seeing at the WIYN telescope), WTTM produced an improved stellar profile with

FWHM of 0.56 arcsec. The correction signal at 100 hertz was generated using a reference star of about 13th magnitude, and the profile improvement quoted above was measured on another star about 1 arcmin away. Figure 2 shows the ambient and corrected radial profiles. Thus far, we find that improvements in the FWHM of

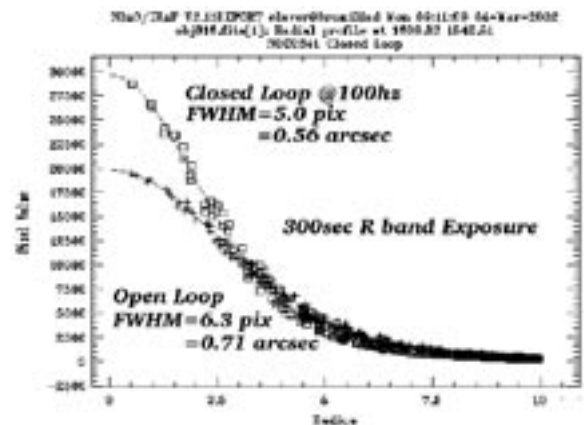


FIG 2

stellar profiles by 0.15 to 0.25 arcsec are typical. As part of the commissioning, we are evaluating how the improvement depends on native seeing, wavelength, and distance from the reference star. To date, the best delivered image quality from WTTM has been 0.27 arcsec on short exposures, and 0.30 arcsec FWHM on extended (300-second) exposures, as demonstrated in figure 3 by the image of the Ring nebula in H-alpha.

We are working on an empirical prescription for setting the loop gain and optimal sampling and correction frequency. This will contribute toward robustness and ease of operation. We are also tuning the algorithms and signals that are issued to actively control the telescope focus and tracking. We have every expectation that these additional functions will produce further gains in image quality from the WTTM.

At present, we are commissioning the WTTM with an interim beamsplitter that has a thin layer of aluminum, which transmits 20% of the light to the error sensor, and reflects 60% to the

continued



WIYN Tip-Tilt continued

science detector (20% is lost to the metallic coating). With this configuration, we find that for a reference star with $V = 15.5$ magnitude, we can correct comfortably at 400 hertz. We shall be procuring a variety of nearly loss-less dichroic beamsplitters aimed at optimizing the efficiency for a wide range of applications and situations.

Further commissioning is scheduled through the summer. We expect to be able to offer the instrument in shared-risk mode sometime in the fall of this year.

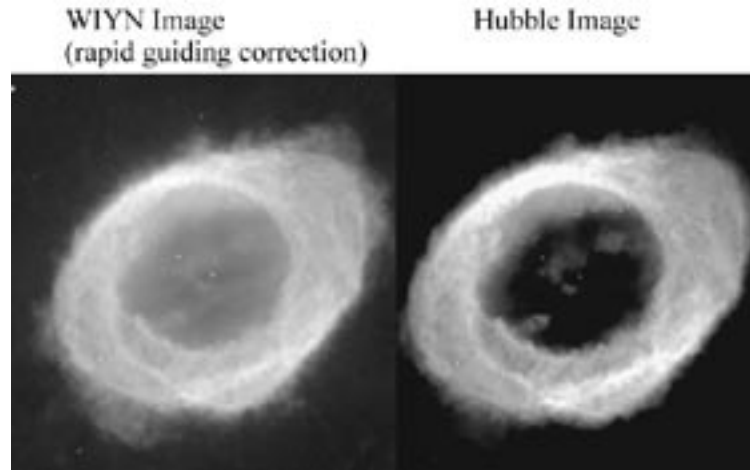


FIG 3

Observatories on Kitt Peak Plan for the Future

Richard Green

KPNO sponsored a meeting in Tucson on April 22 for all the observatories on Kitt Peak. The purpose of the well-attended, day-long session was to discuss issues related to shared infrastructure and services on the mountain.

The group approved an upgrade to the telephone switching system to bring it up to modern, maintainable standards. We addressed questions of facility security, in part because spring usually has an increase of undocumented workers migrating through the area, and also because of an increase in the transshipment of contraband materials.

We heard descriptions of new or revised operations plans since our last meeting in 1998. New operations of facilities include the WIYN 0.9-meter, the RCT 1.3-meter, the University of Arizona/University of Massachusetts operation of the former NRAO 12-meter, and the imminent deployment of the SOLIS synoptic solar monitoring system that will upgrade and replace the capabilities of the solar vacuum telescope.

Important reminders were given that affect us as observers as well as observatory operators. We must keep vigilant to maintain the observatory area as a radio-protected and low-light zone. These include reminders to turn off cell phones and use them only in emergencies, and to not plan for wireless LANs in system architectures.

Special public relations events that would otherwise be handled by a live uplink must be rare and coordinated well in advance, since they require the shutting down of sensitive radio receivers.

It's also easy for us to forget that local sources of stray light are a much more powerful pollutant than the distant city glow. Please draw the shades for rooms lighted at night! Many rental cars now have headlamps that cannot be turned off and this should be taken into consideration when traveling to and around the observatories. Also, particular care must be taken to avoid illuminating the working area of the

domes since many of them have very open structures for air venting.

A key change in the relationship between KPNO and the other observatory organizations was reflected in the offering of KPNO support services for purchase, beyond those contained in the basic Joint Use Agreement. A full range of skills are available, from custodial and facilities maintenance through electronics and engineering services. The terms of offer and level of interest are under consideration, and are expected to develop positively with time.

The overall conclusion was that a large group of major astronomy institutions share a strong interest in the continuing good health of the operation, and are willing to use their combined influence to appropriate advantage. Based on the success of this event, we intend to meet more frequently, particularly as the need for joint planning continues to grow.



Calypso Telescope Exploits Good Image Quality

Don Neill (Columbia University)

The 1.3-meter Calypso Telescope completed a project last fall to monitor the dwarf nova V101 in the globular cluster M5. During this project the observatory manager, Adeline Caulet, acquired over 400 images in the I-band with the High Resolution Camera (HRCAM). Of these, 381 images covering 12 nights were measured photometrically and for their seeing performance. More than two-thirds of these (270) were 10-minute exposures taken with tip-tilt adaptive optics correction using a $V = 13.62$ magnitude guide star. The seeing histogram of these images has a median of 0.65 arcsec, and a best seeing of 0.45 arcsec. More than 125 of these images had a seeing equal to or better than 0.7 arcsec. All the images were analyzed by Don Neill, and an orbital period for V101 was determined—the first for a dwarf nova in a globular cluster. These results will be published shortly.

A long-term novae survey of the nearby galaxy M81 was initiated by Don Neill and Mike Shara on the Calypso Telescope at the end of October. By observing this galaxy every clear night for eight months, the novae population in M81 will be characterized with unprecedented accuracy. This ambitious project is made possible by the observing talents of Adeline Caulet and Elaine Halbedel.

KPNO Tucson Support Offices Relocated

Richard Green for the Kitt Peak Support Office

As part of the continuing changes within NOAO, the KPNO offices have been moved into the heart of the NOAO-Tucson building. We now occupy offices 170, 172, 173, and 174, which are located in the N-S corridor just before the stairs to the service yard and mountain shuttle vehicles. As always, Judy Prosser and Jane Price are available to help you with logistics and other questions while you're here in Tucson. If you're in the building on your way to or from observing, please stop in to say hello—we'll be glad to see you in our new location.

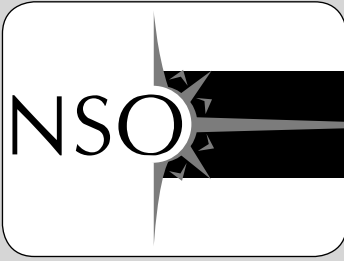
Tohono O'odham Night on Kitt Peak

Richard Green

Saturday, April 20 offered more than 300 members of the Tohono O'odham Nation the chance to see for themselves the power of the telescopes that dominate their skyline. The clear, calm day and evening provided excellent images of the sun through the Visitor Center and McMath-Pierce telescopes, and stunning views of the Moon and Jupiter through the wide-angle eyepiece at WIYN. The 2.1-meter was open for viewing as well, and the visitors kept the mountain shuttles busy on trips to marvel at the 4-meter and its on-line image gallery. Those of us at the telescopes noted a gratifying number of curious children clearly eager to understand what they were seeing and how they could learn more.

Visitors and volunteers were treated to performances by a traditional dance troupe and ensemble of drummers. Several vendor stands with traditional fry-bread and other native foods were kept busy from early afternoon until well after dark. NOAO volunteers from both the mountain and downtown worked hard to provide support. The appreciative and large turnout from the Nation, and the smooth logistics of this specialty night on Kitt Peak, made it particularly worthwhile.





National Solar Observatory

From the NSO Director's Office

Steve Keil

The past quarter witnessed a rapid growth in the Advanced Technology Solar Telescope (ATST) project at the National Solar Observatory and within several of our partner institutions. It also saw the arrival of the Rockwell cameras for SOLIS, which is now scheduled for deployment this fall. Our users are continuing the scientific exploitation of adaptive optics (AO) at the Dunn Solar Telescope (DST), and now in the infrared at the McMath-Pierce Telescope. Phase I of the joint High Altitude Observatory/NSO Diffraction Limited Spectro-Polarimeter (DLSP) project—the upgrade of the Advanced Stokes Polarimeter to obtain polarimetric observations at the diffraction limit of the DST—obtained first light.



The ATST project team is now looking at conceptual designs for key components of the telescope (optics, heat control, mechanical, software) and agreements have been established with partner organizations to investigate other design issues and instrumentation. In March, NSO held both a scientific workshop on the high-resolution science that will be enabled by the ATST, “Current Theoretical Models and Future High Resolution Solar Observations: Preparing for the ATST,” and a meeting of the ATST Science Working Group. The workshop—sponsored by the NSF, the US Air Force, and NASA—attracted more than 60 participants from 12 countries.

There will be a topical session on solar magnetism and the role of the ATST during the June AAS/SPD meeting in Albuquerque. This will provide an opportunity for members of the solar community to hear about ATST plans and science and to have input into the developing project.



We welcome two new members to the ATST project team: Ruth Kneale and Jennifer Purcell have recently transitioned from the Gemini Project and New Initiatives Office. Ruth is the ATST librarian and documentation specialist, and Jennifer is the ATST administrative coordinator. In March, Mark Warner transferred from the SOLIS project to become the ATST principal mechanical engineer.



At the same time that the ATST project is gearing up, NSO faces a year of flat funding for its base program and operations, given the President's FY03 budget request released in February. Because of inflationary pressures, NSO had to eliminate some positions to reduce its payroll costs. These reductions were made with an eye toward maintaining strong user support for observations and projects. Unfortunately, they will impact our facilities maintenance and our ability to support photographic work.



On a more positive note, we held our annual award ceremonies in April. Claude Plymate received an AURA Award for Technical Achievement and Priscilla Piano received a Service Award. Any of you who have used the McMath-Pierce facility or have interacted with NSO over the last few years know that both awards are richly deserved.

Priscilla's work for, and dedication to, NSO and its user community is nothing short of remarkable. She has certainly become one of the cornerstones of the NSO program. Her skillful and dedicated efforts support virtually every aspect of our scientific, educational, and user communities, as well as the project activities of the Observatory.

Claude Plymate leads our observing group on Kitt Peak and also provides technical support for the infrared AO and Near-Earth Objects (NEO) programs at the McMath-Pierce telescope facility. Since he joined the Observatory over 15 years ago, he has contributed significantly to its success. Claude's skills and dedication as an observer resulted in the success of countless observing programs, which have produced invaluable data products for the astronomical community. These include programs in solar, stellar, and planetary astrophysics, as well as programs in atmospheric and laboratory physics. His efforts on projects such as the McMath-Pierce east auxiliary telescope upgrade, were instrumental in obtaining significant external funding.

continued

NSO Director's Office continued

For their outstanding efforts in fielding the upgraded GONG camera systems in a seamless fashion that allowed the transition to occur with minimal downtime, the GONG+ Team received the new AURA Award for Team Achievement.



We are looking forward to another very strong student program this summer. Both Research Experiences for Undergraduates (REU) students and graduate students will be working with NSO and partner staffs in Sunspot and Tucson. In addition, four teachers will participate in the NSO summer Research Experiences for Teachers (RET) program and take part in activities of the Teacher Leaders in Research Based Science Education (TLRBSE) program with NOAO. These programs should contribute to a dynamic and fruitful summer at the Observatory.



Steve Keil (*left*) with the GONG+ Team, recipients of the AURA Team Award. Team members (*left to right*): Bert Villegas, Jean Goodrich, Jack Harvey, Guillermo Montijo, Ron Kroll, Sang Nguyen, Roy Tucker, Roberta Toussaint. Missing from photo: Lana Britanik.

KAREN L. HARVEY
1942–2002

It is with deep sadness that the National Solar Observatory reports the passing of our friend and colleague, Dr. Karen Harvey. A leading expert in the study of solar activity, beloved wife of Jack Harvey and loving mother of David Harvey, Karen passed away peacefully on 30 April 2002.

Karen was renowned for her studies of the emergence and evolution of magnetic structures on the Sun, and the connection of these surface manifestations of activity with the interior dynamo that is at the heart of the origin of the solar cycle. She was particularly noted for her work on the properties and emergence patterns of bipolar active regions, including ephemeral regions, the relationship between He I 10830 dark and bright points and the solar corona, and the general properties of the solar cycle.

Karen was an active member of the solar community and a vital participant in the scientific life of the NSO as a long-term visitor. Karen's scientific work will remain a lasting memorial to her life investigating the Sun. All of us at the NSO will deeply miss her. More about Karen's contributions to understanding the Sun can be found at www.nso.edu.

ATST Site Survey Status

Frank Hill

The site survey for the Advanced Technology Solar Telescope (ATST) is accelerating. By the time you read this we will have three instruments up and running, and construction will be underway for the test stand foundations at the other three sites. Data are now arriving on a weekly basis, and the reduction package is partially complete.

The three operating sites are at Mees Solar Observatory (Haleakala, HI), Big Bear Solar Observatory (CA), and Sacramento Peak (NM). We expect that operations will be underway at Observatorio Roque de Los Muchaos (La Palma, Canary Islands, Spain), Observatorio Astronómico Nacional (San Pedro Mártir, Baja California, Mexico), and Panguitch Lake (UT) by the end of this summer. This will allow us to gather data for about one year prior to producing the ranked site list. Scott Gregory, Robert Rentschler, John Briggs, Mark Warner, Steve Hegwer, and Rex Hunter have all made substantial contributions to the progress of the deployment so far.

Frank Hill and Mark Warner recently visited San Pedro Mártir (SPM) to select a location for the site survey instrument. They found that SPM appears to have good potential as an ATST site, with clear skies, good



Installing the test stand at Haleakala.

coronal conditions, two possible locations for the telescope, and a stellar DIMM that can be used for comparisons. The process for permits at SPM is now underway, as well as at Panguitch Lake and La Palma.

Data are now being received regularly, and an initial quick-look and statistics reduction package has been developed. Work is underway on the development of the more involved analysis steps, in particular the analysis to extract the index of refraction structure as a function of height. Richard Radick and Frank Hill are developing two

additional approaches to supplement the original method of Jacques Beckers. Other tasks under development are the procedures to measure the clear-time fraction and to combine the measurements into a score for the final ranking.

The Sky Brightness Monitor instrument is under construction at the Institute for Astronomy in Hawaii under the leadership of Haosheng Lin. This device, which includes a water vapor measurement and a dust monitor, will be retrofitted at the sites when it is available in midsummer.

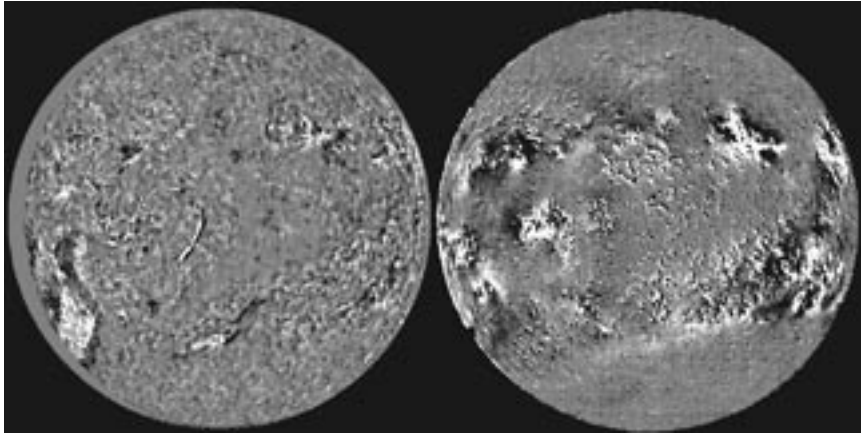
SOLIS

Jack Harvey

Our brightest highlight for the first quarter of 2002 was receiving the hybrid sensor/readout multiplexer cameras built by Rockwell Science Center. These cameras are crucial parts of the Vector Spectromagnetograph (VSM). The cameras produce 92 frames per second, have a 14-bit dynamic range, superb quantum efficiency, and a well depth of close to 3 million electrons per pixel. Tests

are in progress to determine if the wavelength-dependent, frame-to-frame image lag is larger than desirable. The cameras are being tested using the VSM data acquisition system and have produced test images in our lab. The SOLIS project was seriously delayed by the failure of a previous vendor to produce the required CCDs and cameras, and the project is relieved to be back on track.

continued

NSO Director's Office continued

NSO/KPVT images of the Sun on 3 March 2002, experimentally processed to indicate a tiny fraction of the capabilities that SOLIS will provide. Both images are aspects of the solar chromosphere, where much space weather originates. On the left, the change in the strength of the 1083 nm He I line from the previous day is shown. In light places the line weakened, and in dark places it strengthened. Note the strange pattern near the lower left limb. This is the location of a large coronal mass ejection (CME) event. The right image is the difference between the line-of-sight component of the magnetic field measured in the chromosphere and the photosphere about two hours earlier. Large-scale "smudgy" patterns are present only in the chromosphere and are usually associated with so-called filament channels. These channels are often the birthplaces of CMEs. SOLIS will produce far better and more frequent data of this sort.

VSM optics are carefully being centered and mounted in their mechanical cells, and the VSM instrument housing has been pressurized with air for leak checking (operationally, the VSM will be filled with helium). The liquid cooling system is working well and delivering a good flow rate. Accuracy of the quick-look vector magnetic field reduction algorithm was greatly improved, without any throughput reduction, by changing which parts of the spectrum lines are used.

The SOLIS mounting is located at the GONG prototype site and has been fitted with a telescope and CCD camera to do nighttime stellar alignment and tracking tests. Using numerous stars allows determination of a pointing error map far more rapidly than using just the Sun.

A crucial part of the Integrated Sunlight Spectrometer (ISS) is a method for creating accurate and precise flat fields. The basis of the approach selected is the so-called Kuhn-Lin-Lorantz method, wherein an image is assumed to have intrinsic structure that is constant and is moved around on a CCD detector between exposures. The multiple images are then used to extract both the pixel-to-pixel gain sensitivities and the original image. This method works well in

numerous solar applications, but has been computationally expensive. Test data from the ISS has been used to speed up the algorithm by nearly two orders of magnitude and, at the same time, improve its accuracy. Because of these improvements, it is now feasible to consider using this algorithm to help calibrate Full Disk Patrol (FDP) observations.

The FDP housing was powered "on" for the first time. The two FDP $2K \times 2K$ CCD cameras are now being read out at the expected cadence. Adjustable mountings for the FDP cameras turned out to be too difficult to use and are being modified. There are two narrowband filters in the FDP, one for 1083 nanometers and a tunable one covering 380 to 660 nanometers. The former filter was fitted with its final heater electronics and its temperature

servo loop was tuned. The latter filter awaits gluing of some polarizers and wave plates before it can be assembled.

An essential part of SOLIS is rapid delivery of data to the community. Therefore, SOLIS enthusiastically participated in a successful proposal to the NSF for installation and five years of partial operational funding of a 45 Mb/s (DS-3) data line between Kitt Peak and Tucson. The SOLIS project is very grateful to Steve Grandi for leading this forward-looking project through many adversities to a successful "first-byte" on 20 March 2002. SOLIS expects to use up to half of the total 24-hour capacity of this circuit in clear weather. Procurement of the final data handling system and data archiving hardware for use at the two ends of the DS-3 line is now underway.

Work on the Observation Control System and Data Handling System software has been completed for the laboratory setup and is awaiting actual data from the instruments. Software work continues on the instrument data control systems associated with the VSM cameras. The software that monitors the safety interlock system has been completed.

New Diffraction-Limited Spectro-Polarimeter (DLSP) Sees First Light

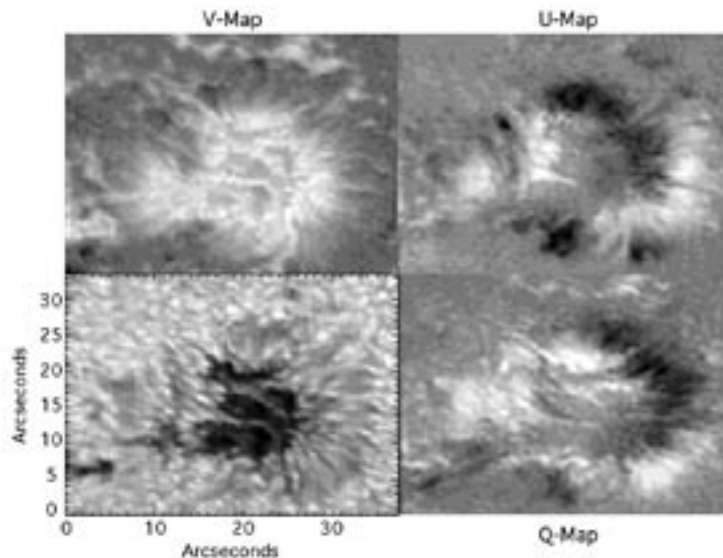
K. S. Sankarasubramanian

NSO, in collaboration with the High Altitude Observatory, is building a new Spectro-Polarimeter that will measure vector magnetic fields down to the diffraction-limited image delivered by the adaptive optics (AO) system at the Dunn Solar Telescope (DST). Building the spectrograph—Phase I of this project—has been completed recently. The spectrograph, combined with the existing Advanced Stokes Polarimeter's (ASP's) modulator and demodulator and with the low-order AO system, will be used to measure vector fields. During Phase II, a new modulation and demodulation unit and a new CCD will be installed. This instrument will be used with the high-order AO system currently under development at NSO.

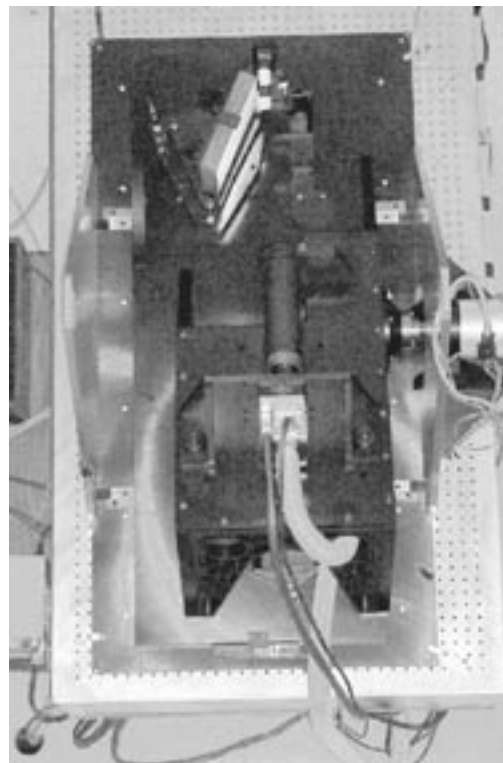
The Phase I instrument saw first light on 13 March 2002. It now uses the ASP-CHILL camera to obtain Stokes profiles. Therefore, the spatial sampling is limited to 0.15 arcsec per pixel. In combination with the low-order AO system, the performance looks better than the current ASP. The accompanying figure shows the I, Q, U, and V map of a sunspot taken with this new instrument.

The current capability of this (Phase I) instrument is: (i) spatial sampling of 0.15 arcsec per pixel (this will be 0.09 arcsec per pixel for the final phase with a new CCD camera); (ii) spectral sampling of 15 milliangstroms per pixel; (iii) flexible image scale from 0.15 arcsec per pixel in the high-resolution small FOV (35 arcsec) mode to 0.25 arcsec per pixel in the low-resolution, large-field-of-view (58 arcsec) mode. This FOV will be improved, during Phase II, to 58 arcsec for high-resolution mode and 163 arcsec in low-resolution mode. Note that the field-stop at the DST is 170 arcsec.

We'd like to thank Rick Dunbar, Doug Gilliam, Joe Elrod, and Mike Bradford for helping with this successful run.



The I, Q, U, and V map of a sunspot taken on 31 March 2002 using the DLSP Phase I instrument.



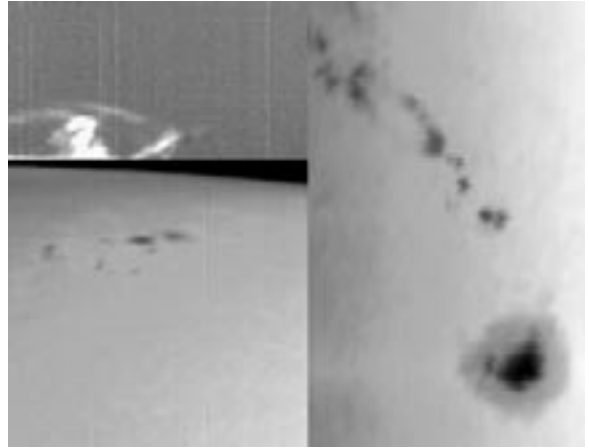
Top view of the DLSP engineering setup.

Spectra and Spectropolarimetry with the CSUN-NSO IR Camera

Matt Penn (NSO) & Stephen Walton (California State University, Northridge)

The California State University, Northridge (CSUN)-NSO infrared camera, featuring a 256×256 HgCdTe array, was tested during a two-week observing run at the McMath-Pierce Telescope. Spectroscopy was performed using the photoelectric exit port of the main spectrograph at a variety of wavelengths from 1026 to 1565 nanometers. On 22 March 2002, an erupting limb prominence was observed in He I 1083 nanometers. Spectra off the limb showed large Doppler-shifted emission with velocities about ± 100 kilometers per second as the prominence material whips around in the solar atmosphere.

A Meadowlark optics liquid crystal retarder was integrated with the system during the second week, and spectropolarimetry of the $g = 3$ 1565-nanometer Fe I line was performed in several active regions. On March 29 and April 1, the new image stabilizer was used on a sunspot while the camera took spectropolarimetric observations that showed umbral oscillations in molecular lines in the sunspot.



Left: Limb spots and prominence at 1083 nm.
Right: A sunspot group at 1565 nm.



Left: Spectral frame at He I 1083 nm, showing Doppler shifts.
Right: Stokes Q spectra at 1565 nm.



G O N G

Global Oscillation Network Group

GONG

John Leibacher

The Global Oscillation Network Group (GONG) Project is a community-based activity to operate a six-site helioseismic-observing network, to do the basic data reduction and provide the data and software tools to the community, and to coordinate analysis of the resulting rich data set. Information on the status of the project, the scientific investigations, as well as access to the data, is available at www.gong.nso.edu.

The second quarter of 2002 saw all of the network sites operating, duty cycles on the rise, and an increase in user community data distributions—over 100 GB of data per month! We anticipate that many works-in-progress, including several from GONGsters using the new and improved GONG+ data, will debut at the upcoming AAS meeting in June.

The Scientific and Local Organizing Committees have been selected for the GONG 2002 – SOHO 12 Workshop, which will be held at the Big Bear Solar Observatory in October. For meeting announcements see www.bbsso.njit.edu/gong02.

Network Operations and the GONG+ Deployment

The New Year began with the Mauna Loa instrument inoperative due to leakage of water into the turret, which caused an electrical short. A repair team was on site during the first two weeks of January replacing the turret, realigning the optics, troubleshooting residual electronics problems, and performing standard preventive maintenance tasks. In spite of a stretch of bad weather that prolonged the trip and prevented a definitive determination of proper functioning before returning to Tucson, verification of problem-free operation was made with the first usable data several weeks later.

The El Teide instrument suffered an occasional glitch during the last few months of 2001, which caused errors with integrating the images. As an attempt at a fix, one of the DAS boards was replaced. Since that time, no further glitches have been observed.

The approximately once-per-day resyncs, which had been appearing at the Learmonth site and had been previously occurring at CTIO, have disappeared. Because they were believed to be

related to the GPS constellation and/or our GPS receivers, it was thought that they might reappear at CTIO by this time, but this has not happened. So, while we are still in a bit of a quandary, we aren't losing any data.

The Udaipur camera was suffering noise in one of the four channels, which causes the apparent light level of the channel to vary. The noise occurred infrequently and the most recent evidence indicates that the channel is no longer noisy, and is steady at a level higher than the other three channels. This is a better situation because the images can be corrected systematically.

We have begun to see some problems in the Digital Linear Tape operation. In all but one case, the problem could be corrected remotely or with a tape change and cleaning. At Big Bear however, it was necessary to enlist the local staff to replace the drive.

Data Management and Analysis

During the past quarter, the DMAC produced month-long (36-day) velocity, time series, and power spectra for GONG+ months 63, 64, and 65 (ending 1 October 2001) with fill factors of 0.58, 0.74, and 0.68, respectively. The low fill factors resulted from the upgrade of several of the observing sites to GONG+, the absence of the Udaipur site due to the seasonal monsoon, and various instrument problems at a few of the upgraded sites.

The GONG Classic month-62 images and the GONG+ month-62 images were processed separately, producing month-long time series and ℓ - v spectra. They were also used to produce a blended version of these time series. A similar procedure has been applied to months 61 and 63 to improve the fill factors of all three months. These results (in particular, the mode frequencies from the three-month-long time series) are being evaluated. It has not yet been decided what products will be archived and made available for distribution.

The campaign to repick the mode frequencies from the entire GONG Classic data set, after the application of multiple optimized tapers, has been completed and has resulted in a second set of mode frequencies using all the time series from months 1–61.

continued



GONG continued

A campaign was launched to extract mode frequencies from multitapered three-year-long time series (30 GONG months). Four such sets can be extracted from the GONG Classic data set. This effort supercedes a previous campaign that used 10-month-long time series.

A GONG network day (with a fill factor of 0.99) was assembled from the daytime series from four sites for all spherical harmonic degrees ≤ 1200 . The ℓ - v spectra and selected m - v spectra were produced and inspected. These spectra demonstrate the spatial frequency range and the signal-to-noise ratio that is expected to be routinely provided by GONG++ applications. The results indicate that the GONG+ data will easily support global p -mode analysis at ℓ s that are much higher than those currently used ($\ell < 150$).

A comparison of synoptic maps from GONG+ magnetograms with those from MDI/SOI, KPVT, and Mt. Wilson confirms that the GONG+ magnetograms should prove to be a high-quality product. The geometric control over the image registration process appears to be very precise. An effort is currently underway to correct minor scale deficiencies in the project's magnetograms by applying a simple calibration correction.

The software functional and performance requirements for GONG++ have been refined, and in February the project conducted a conceptual design review to help firm up the software strategy for the data handling system. The data processing pipeline system developed and used by the Space Telescope Science Institute (STScI) for processing Hubble data, OPUS, has been selected for the GONG++ pipeline architecture. We are proceeding with its implementation. The opportunity to leverage effort at STScI for use by NSO is an excellent example of interaction between AURA's centers. Samples of GONG+ merged image products are currently being evaluated by external experts with the expectation that routine production will commence in the near future. The development of GONG++ applications is also continuing.

Data Algorithm Developments (and some science)

Cliff Toner and Thierry Corbard are creating ring diagrams using Cliff's merged data and Thierry's new tracking and remapping code. The ring diagrams look very good, and Deborah Haber (University of Colorado) is working on fitting the rings.

Simon Kras, Rudi Komm, and Rachel Howe have completed the multitaper analysis of all of the GONG Classic time series. The resulting picture of the internal dynamics has consequently gotten sharper, but has not changed its fundamental character. Simon is preparing a poster on the result for the June AAS/SPD meeting, and is now producing a consistent set of frequency splittings using Rachel's latest code. This will become the standard GONG splitting set.

Rachel is also working on the long-awaited leakage matrix computation. She uncovered a bug that was preventing the correct calculation of the low- ℓ modes. This was traced to a mismatch in the grids used to compute the spatial mask and the spherical harmonics. She is currently generating a set of leaks for selected degrees and times and comparing the results with the data. The next major step will be the incorporation of the modulation transfer function.

Caroline Barban continues to work on the complex new method of fitting the spectra using the power spectrum in velocity (V), the power spectrum in total intensity (I), the phase difference between V and I, and the coherence between V and I. She has detailed the functions of the model and verified that they reproduce previous results. Now we "just" have to fit four data sets with four functions that involve 12 equations, 14 parameters, and three statistical distributions to a single peak.

Richard Clark has a preliminary, automated bad-image-rejection program operating. He is currently working with Jack Harvey to develop a zero-point correction for the GONG+ magnetograms. The current procedure captures the inhomogeneities in the modulator by creating a magnetic calibration image at the eastern and western limbs. This image is then used as a first-order magnetic flat-field correction. Preliminary indications suggest that though this approach helps, it may not be sufficient.

Jeff Sudol is pursuing all of the mathematical and numerical details needed to measure the residual optical distortion in the GONG+ images. The next step is to design and fabricate the target, and test it.

Jean Goodrich has drafted a thorough development path and analysis that could be used to develop a near-real-time farside imaging capability for GONG++. This would ensure the continued availability of this valuable space weather product.

The opportunity to leverage effort at STScI for use by NSO is an excellent example of interaction between AURA's centers.



Public Affairs & Educational Outreach

Educational Outreach Update

Dr. Stephen Pompea began work in February as the new Manager of Science Education at NOAO (see photo). Stephen has a PhD in astronomy from the University of Arizona and a Master's in physics teaching from Colorado State. He has the dual title of Manager of Science Education/Astronomer to reflect the full range of his duties and experience. His contact information is spompea@noao.edu, 520/318-8285.

For the last eight years, Stephen has been a consultant in science education to a wide variety of national and international science education projects that are developing new multimedia and inquiry-based curriculum materials, exhibits for hands-on science centers, teacher's guides, and professional development materials for teachers.

Stephen replaces Suzanne Jacoby, who left NOAO in early April to pursue an advanced degree in teaching, after making valuable contributions to numerous offices in the organization over the past 21 years. Very best wishes, Suzanne.



Stephen Pompea, Connie Walker, and Robert Wilson attended the 2002 Project ASTRO Site Leaders Meeting at the National Solar Observatory on Sacramento Peak from April 25–27 as representatives of Project ASTRO-Tucson. They reported on

the past year's activities, highlighting local accomplishments, staff changes, coalition changes, site statistics, new initiatives, fundraising, and publicity.

More than 245 astronomer and teacher partners have been trained at NOAO-based ASTRO workshops, benefiting an estimated 13,000 students in the classroom. Eighty-two of the 144 partnerships

created in Tucson over the last six years remain active. At the Site Leaders Meeting, NOAO presented several initiatives designed to extend Project ASTRO-Tucson in a variety of new directions, including work with a bilingual school in a Mexican border town, the handicapped community, the Girl Scouts of America, a regional science and engineering fair, and the involvement of teachers from Indian Nations. A second oral presentation was given on the Math and Science Partnership Initiative, a new NSF-funded educational program, which spurred discussion on the appropriateness of the Project ASTRO National Network's involvement in such proposals. Samples of Project ASTRO-Tucson workshop agendas, giveaway materials, poster presentations, and CDs were also supplied to participants of the Site Leaders Meeting.

continued



Outreach continued



NOAO's Teacher Leaders in Research Based Science Education (TLRBSE) program had a strong presence at the National Science Teachers Association national meeting in San Diego, offering an exhibitor's booth, an exhibitor's workshop for potential recruits, and a business meeting for Teacher Leaders and Learning Colleagues who participated in the program in 2001.

NOAO posters on careers in astronomy and the Rosette Nebula were among the most popular materials distributed at the booth. Other exhibit posters, free CDs, a Power Point presentation at the booth, and workshop presentations by TLRBSE staff and teachers all expounded upon the benefits of being part of the TLRBSE program. Two different sets of curricula, *Jewels of the Night* and an analog version of the

Nova Search Project, were given out to prospective recruits. Progress reports presented at the business meeting by the TLRBSE teachers overflowed with enthusiasm and impressive accomplishments.

Three one-hour teacher workshops on teaching about light and color were presented at the meeting with the sponsorship of the Optical Society of America, the Lawrence Hall of Science, and the University of Arizona Gamma Ray Spectrometer project, all of whom provided workshop materials. NOAO Educational Outreach staff organized the workshops, which included sessions on "color analyzers," ultraviolet light and fluorescence, spectroscopy, and light wave communication. An additional workshop was presented at a local high school one evening during the meeting. Presenters at the workshops included optics education experts from the UC Berkeley Lawrence Hall of Science and the UA Optical Sciences Center. The workshops were "Standing Room Only" and were met with great enthusiasm by the teachers (see "NOAO at NSTA Workshops," following).

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NOAO at the NSTA Workshops

The Optical Society of America (OSA) sponsored four optics workshops for teachers, held in conjunction with the NSTA meeting. The OSA provided an extensive array of teaching kits and materials for the participants. This allowed each teacher to return to his or her school with equipment that could be immediately used to teach basic concepts in optics. Stephen Pompea and Connie Walker from NOAO played key roles in organizing the workshop, in conjunction with OSA Education Specialist Jason Briggs.

The workshop had several goals. First, we wanted to provide teachers with well-tested curriculum materials that would work well in the classroom. Second, we wanted to provide the teachers with equipment, such as ultraviolet lights and spectrometers, that could be immediately used in the classroom. Finally, we wanted to challenge the teachers to explore light and color in an inquiry-oriented way. Inspiring confidence in a teacher's ability to explore optics is preferable to trying to instill extensive content knowledge in such a short time.

The NOAO-led NSTA workshops were so popular that many teachers "camped out" in the workshop room in order to attend all three workshops (held during one long afternoon), since attendance was limited and they were

afraid of losing their seats. In one workshop, 90 teachers attended even though we had decided to cap attendance at 50 (we were naively hoping to have at least 20 teachers)!

Our workshop topics were accessible to teachers at all grade levels:

Curriculum Activities on Light and Color from the Great Explorations in Math and Science (GEMS) Program

Alan Gould from the Lawrence Hall of Science led activities from *Color Analyzers*, the GEMS book he coauthored. The activities involved creating colored patterns and puzzles and looking at them through colored filters. These simple and powerful activities are fully suitable and engaging for students of nearly any age. Each teacher received a GEMS book and many received the OSA Optics Discovery kit, which has filters and a large variety of experiments.

Teaching About Ultraviolet Light

Fluorescent UV-A black lights with blue-blocking filters were used to explore the fluorescence of paper money, clothing, credit cards, and jewelry. Other common materials, such as glass and plastic, were used in experiments to see if they could block ultraviolet light. We also played with special beads that change color when exposed to ultraviolet light. The beads were used as detectors to test the blocking power

continued



NSTA Workshops continued

of sunscreens by measuring the time for the beads to change color. Teachers received a compact ultraviolet fluorescent light and ultraviolet-sensitive, bead-based detectors.

Neon Magic—Building/Using a Spectrometer

Connie Walker from NOAO Educational Outreach led a session where teachers built high-quality spectrometers (high-quality grating and slit with nanometer scale) that can be used to analyze such common light sources as fluorescent, incandescent, small LEDs, and black lights. The teachers took home the spectrometers that they built and information on how to obtain a classroom set of spectrometers (from Learning Technologies, Inc.) for students to assemble and use.

Talking Over a Beam of Light

Mike Nofziger from the University of Arizona Optical Sciences Center helped teachers use electronic circuits to transmit the human voice over a beam of light or optical fiber. "Send and receive" units that were preassembled were used to experiment with transmission distance. When finished, the teachers took away complete kits to build identical units in their own classrooms to continue their experiments. This workshop gave participants the confidence to use, optimize, and experiment with electronic assemblies. The teachers had fun competing with each other to send the beam across tables.

We came away from the workshop with three thoughts heavily reinforced:

1. Teachers at all grade levels like to teach about light and color and want to incorporate more optics education into their classrooms.
2. Teachers are hungry for curriculum materials and activities in optics.

3. Teachers greatly appreciate being given useful classroom equipment and materials in addition to activity sheets.

To amplify this third point, the average science teacher's budget for materials ranges from zero (common) to a few hundred dollars per year (rare), and this sum must be used to replace glassware and buy chemicals and supplies for all classes. Teachers were incredibly grateful to the OSA and the other sponsors for supplying them with equipment. They left the workshops with an enhanced knowledge of how to teach about light and color, but also with equipment that could be used in an inquiry-oriented classroom setting. We also distributed copies of Doug Goodman's book *Optics Demonstrations with the Overhead Projector* to high school physics teachers.

We had planned on doing special demonstrations from the book between the workshops, but we realized that the teachers wanted to continue the workshop discussions during the breaks. In essence, we gave one long workshop with nearly continuous discussions on optics and pedagogy.

Follow-up activities to the workshops included posting background and reference material on a Web site. Teachers provided their contact information and e-mail addresses so that we can inform them about additional educational resources in optics education, such as the public release of the Optics for Kids Web site.

The San Diego OSA chapter, led by James Menders, was incredibly helpful in organizing the workshops, and a number of its members took a day off from their jobs to assist with them. We are grateful for their knowledge, dedication, and energy.

Notable Quotes

The Coalition for National Science Funding issued a statement calling for a 15% increase in the FY 2003 budget for the National Science Foundation (see www.cnsfweb.org). This statement was endorsed by the American Institute of Physics and three of its member societies: the American Astronomical Society, the American Geophysical Union, and the American Physical Society.



Undergraduate Astronomy Students Reach for the Southern Stars at CTIO

Nicole van der Blik, Chris Smith, Alan Whiting, & Amber Young

CTIO's summer student program continues to grow, this year bringing even more students together to explore the mysteries of the southern skies. This southern summer, between January and March 2002, CTIO hosted a group of eight undergraduate students, including four participants of the NSF-funded Research Experiences for Undergraduates (REU) program, three participants of the CTIO-funded *Prácticas de Investigación en Astronomía* (PIA) program, and one foreign exchange student.

As part of this year's program, the students had various opportunities to observe on Cerro Tololo, including six nights at the 0.9-meter telescope specifically for REU projects. They also attended student seminars on astronomy, including talks by guests such as Bill Smith (AURA), Eileen Friel (NSF), and Jeremy Mould (NOAO). In addition, they participated in "classes" on topics related to astronomical research and a career in astronomy, such as how to write proposals, how to apply for graduate school, and various other topics. The students had the opportunity to learn about and write their own observing proposals, which were then discussed over pizza in a simulated TAC meeting.

Other highlights of the summer program were a trip to Cerro Pachón to tour the Gemini South telescope, and the opportunity to participate in two international conferences held in La Serena: the *International Conference on Light Pollution*, and the IAOC workshop on *Galactic Star Formation across the Stellar Mass Spectrum*.

During their stay, the students all prepared Web pages in which they presented their work, and the 10-week program culminated in the oral presentations. They will also present their work at the January 2003 meeting of the AAS.



Summer students evaluate each others' observing proposals in a (not so) intense TAC meeting.



This year's CTIO REU and PIA participants included (left to right): Miguel Verdugo (PIA), Universidad Católica de Chile; Pamela Baca (REU), University of Colorado, Denver; Marcelo Mora (PIA), Universidad Católica de Chile; Amber Young (Exchange Student), Middlebury College; Sergio Vera (PIA), Universidad Católica de Chile; Colette Salyk (REU), Massachusetts Institute of Technology; Thomas Freismuth (REU), College of Charleston; Jeff Carlin (REU), San Francisco State University.

For more information on the CTIO REU and PIA programs, see www.ctio.noao.edu/students/REU and www.ctio.noao.edu/students/PIA. Specific information on the 2002 program, the students, their projects, and their Web pages can be found at www.ctio.noao.edu/students/REU/ctioreu2002/REU2002.html.



Hands-On-Universe Video Conference with CTIO

Dara Norman

On 12 April 2002, CTIO participated in a Hands-on-Universe (HOU) teacher training workshop via video conferencing. HOU is a project run by The Lawrence Hall of Science at the University of California, Berkeley. The program is designed to enable students to investigate astronomical topics by applying concepts from science, math, and technology. Students access large data sets in order to look for moving solar system objects, such as asteroids and Kuiper Belt Objects. More details can be found at hou.lbl.gov.

Currently, the Deep Lens Survey (DLS), one of the NOAO Survey Programs, is supplying survey data to HOU in order to look for these objects (see dls.bell-labs.com). During the most recent DLS observing run, team astronomers video-linked into a teacher training workshop held at the Shasta County Office of Education, along with astronomers from Lawrence Berkeley National Laboratory, both in California. Teachers were able to view the 4-meter Blanco Telescope, see it move, and get a look at the mirror as the telescope winked.

As a member of the DLS team, I gave a short presentation covering the telescope, gravitational lensing, and the chief goals of the DLS. I also answered questions from the audience of K-12 Shasta County teachers. Reactions to the inclusion of video from CTIO were extremely positive with email messages of thanks received from several in attendance including Shasta County education officials. As of this writing, we plan to do a similar video conference with 250 Illinois teachers in May 2002.

The workshop successfully combined many technological elements, including video conferencing between several centers, video presentations, and simultaneous Web-casting. Eventually, searchable video of the workshop will be available at www-library.lbl.gov/teid/tmVideo/aboutus/VideoDefault.htm.

On the CTIO end of the video conferencing, thanks goes to Ron Lambert, Daniel Maturana, and Hernan Tirado, and special thanks to Eduardo Toro and Ricardo Venegas for making it all possible.

In Brief

The **National Solar Observatory is prominently featured** in a new exhibit on space weather produced by **the American Museum of Natural History**. Spectacular footage of the Vacuum Telescope and time-lapse shots of sunrise over Kitt Peak are the backdrop for an engaging segment on the nature and importance of space weather. Illustrating the point are dramatic images of the Sun and slick graphics about its affect on Earth's magnetic field and atmosphere. The video is available for review in NOAO Public Outreach, and it will air regularly in the Kitt Peak Visitor Center during the Space Weather Mini-Exhibit coming in September.

A **CNN-TV crew visited Kitt Peak** on March 5 to obtain video related to **dark skies** and to interview Kitt Peak Director Richard Green for a piece that aired on March 30-31.

The **Kitt Peak Nightly Observing Program** for the public was the subject of a very positive feature story on the **Space.com** Web site.



A second series of colorful astronomy posters has been created by the NOAO Office of Public Affairs & Educational Outreach for sale at the Kitt Peak Visitor Center.

The three latest posters are based on data acquired and processed by Travis Rector; the poster of the Triangulum galaxy (M33), which combines optical data from the WIYN 0.9-meter telescope on Kitt Peak and data from several radio telescopes, is being distributed jointly by NOAO and the National Radio Astronomy Observatory (NRAO) at the June 2002 meeting of the American Astronomical Society.