National Optical Astronomy Observatory

Cerro Tololo • Kitt Peak • U.S. Gemini Program

National Solar Observatory

GONG • Kitt Peak • Sacramento Peak

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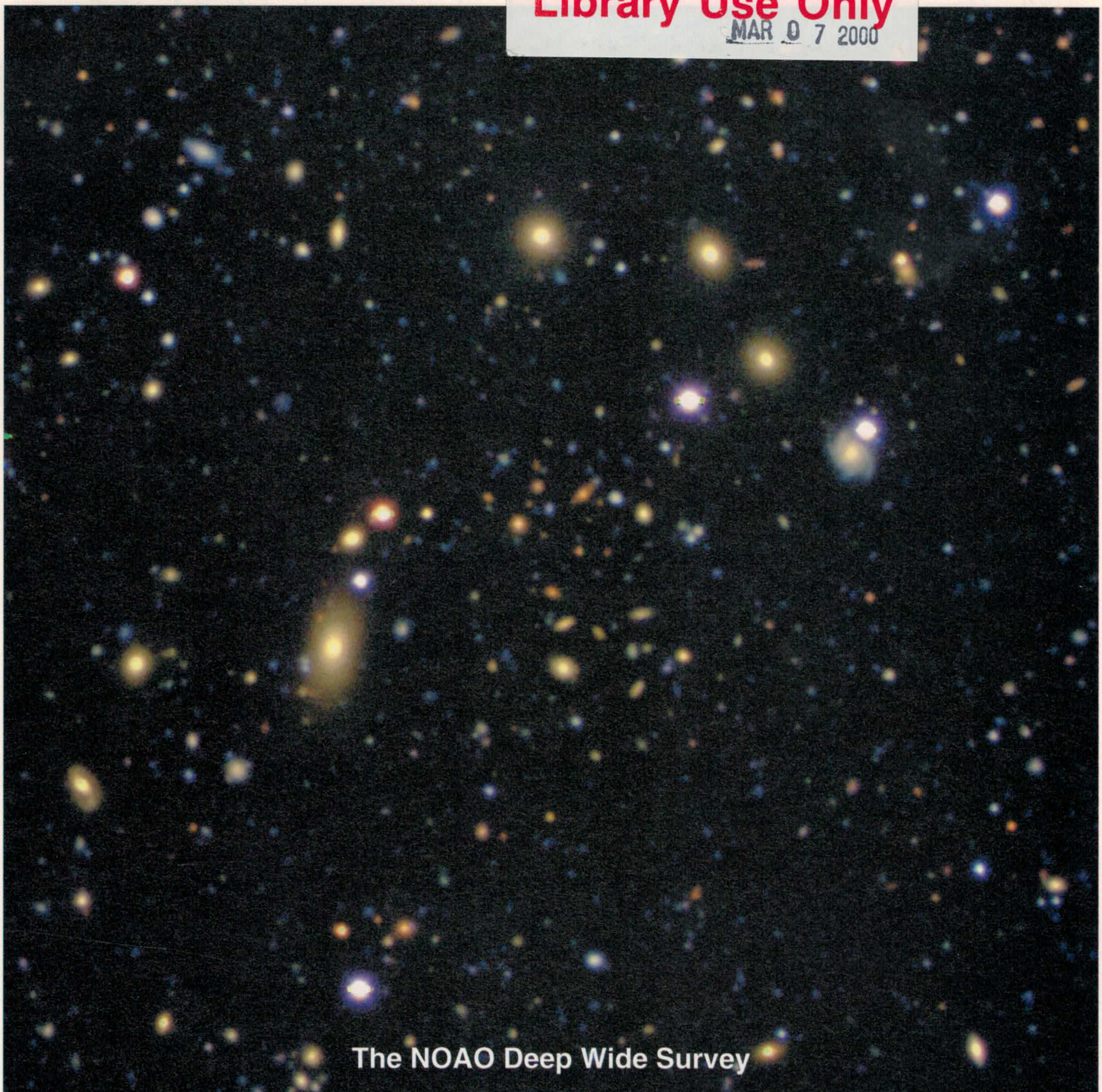

The NOAO Deep Wide Survey

Operated by the Association of Universities for Research in Astronomy (AURA), Inc. under cooperative agreement with the National Science Foundation

On the Cover: *The NOAO Deep-Wide Survey*

Wide-field imaging surveys provide a foundation for astronomical discovery and are an important exploratory step in our investigation of the Universe. NOAO's 4-m telescopes have long pioneered wide-field imaging. With a new generation of large CCD Mosaic cameras, the KPNO and CTIO 4-m telescopes now allow rapid mapping of large areas of sky to faint limiting magnitudes, an important enabling capability for follow-up deep spectroscopy with 8-m class telescopes such as Gemini.

The cover shows a 3.9′×3.9′ postage stamp from the 2° × 4.5° Cetus field of the NOAO Deep Wide-Field Survey. The Survey is an ongoing project led by Buell Jannuzi and Arjun Dey (NOAO) to map two 9-square-degree regions of sky, one in Boötes and one in Cetus, in B_W, R, I, J, H, and K. Primary science goals are investigation of the evolution of galaxies and large-scale structure. The multicolor data will produce photometric redshift estimates and enable the selection of brown dwarfs, faint halo stars, distant quasars and galaxies, and other inhabitants of the astronomical zoo for spectroscopic study.

The color image shown was constructed by Nigel Sharp and Mark Hanna from B_W, R, and I images obtained using the NOAO 8K×8K CCD MOSAIC Imager at the prime focus of the 4-m Mayall telescope of the Kitt Peak National Observatory. The seeing in the summed B_W, R, and I frames is 1.2″, 1.0″, and 1.0″, respectively. The R frame reaches a 5σ limiting AB magnitude of 25.7 in a 2″-diameter aperture.

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Tod R. Lauer, Editor-in-Chief

Division Editors

Jeannette Barnes, CCS
Bruce Bohannan, KPNO
Todd Boroson, OP
John Leibacher, NSO & GONG
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Priscilla Piano, NSO & GONG
Caty Pilachowski & Bob Schommer, USGP

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A Shear Way to Find Dark Matter—*and Transients, Too!*

Based on a Solicited Contribution from Tony Tyson and Ian Dell'Antonio

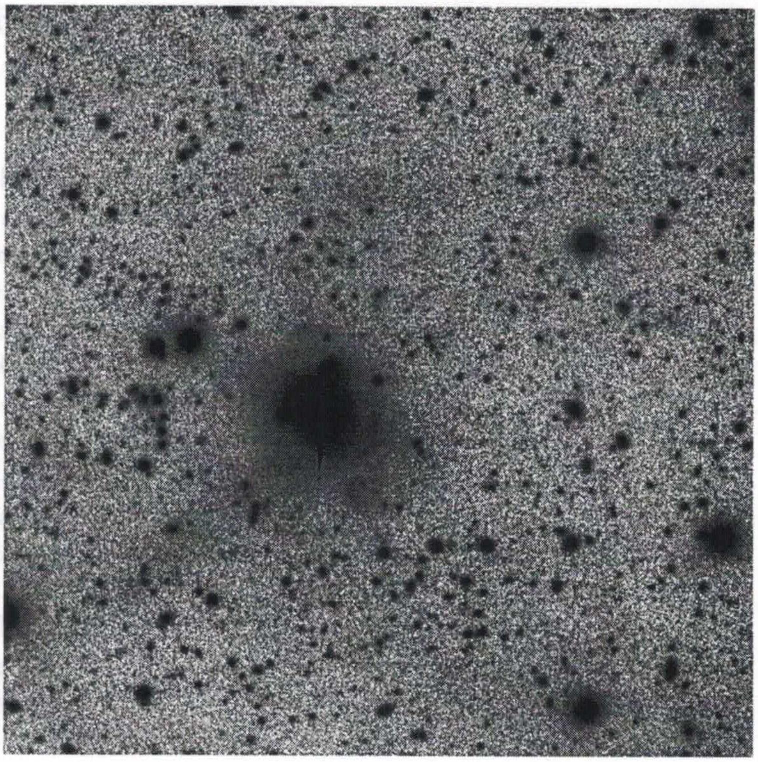
Tony Tyson, David Wittman (Lucent), and Ian Dell'Antonio (NOAO) are leading a team of some twenty CoIs worldwide to map the large-scale structure of the mass distribution beyond the local universe, using the Mosaic CCD imagers at the Blanco and Mayall telescopes to conduct an ultra-deep, multi-band optical survey. This "Deep Lens Survey" will run five years to completion and comprises deep multicolor imaging in four bands (B,V,R,z') over seven 2° fields. The shear of distant galaxies induced by the mass of foreground structures will be measured. These weak-lensing observations are sensitive to all forms of clumped mass and will yield unbiased mass maps with resolution of 1′ in the plane of the sky (~120 h^{-1} kpc at z=0.2), in multiple redshift ranges. These maps will measure for the first time the change in large-scale structure from z=1 to the present epoch and test the current theories of structure formation, which predict that mass in the low-redshift universe has a particular filamentary/sheetlike structure. These observations will constrain the clustering properties of matter, most notably Ω_{matter} and Ω_{Λ}, and when compared with the results from microwave background anisotropy missions, will test the basic theory of structure formation via gravitational instability. The deep combined data and catalogs for sub-fields will be released to the community as they are completed.

Although it will take some time before the survey can complete its statistical measures of the mass power spectrum, immediate returns may be provided by transient sources identified in the course of the observations. The survey group is sequencing the imaging to detect sources that vary over time scales from hours to months. This is done by spreading observations of individual subfields over four runs and two years. Optical transient events and supernova candidates will be released in real time (see the NOAO Web Page "Science Programs," "Deep Lens Survey Transient Events"). Moving-object lists (asteroids, KBOs, comets) will be listed separately as they are found.

Fast identification of transient events may allow for spectroscopic follow-up by the community while the events are still bright enough to be captured. March and April dark runs at CTIO will produce transient event listings in the 10h and 14h equatorial fields (see below); KPNO dark runs in November and December will target the two northern fields. Transients shorter than a day or so may be very interesting—the survey should provide the first glimpse of transient phenomena at the faint 20–25 mag attainable with this 4-meter survey. The results for the on-line transient search during the Nov/Dec KPNO runs may be seen by following the "Deep Lens Survey Transient Source Detections" link from ***http://www.noao.edu/sciprogs***. The individual exposures are 600–900s each, depending on the filter taken in blocks consisting of five pointings dithered by up to 8′ to shift all low-surface brightness features

continued

off themselves (to provide adequate sky-flatfielding) and cover 42′×42′ in one "subfield" (9 subfields = one 2°×2° field). This dither is repeated (with about a one arcminute offset) in each filter—and then off to another subfield within one of two fields. In the first two survey runs, the survey team observed five subfields in the 0053+12 field and four subfields in 0919+30 to roughly half of the final depth in B,R and z′. The survey observations go deepest in R (to a surface brightness limit of 29 mag/sq.arcsec) and concentrate on R in good seeing to obtain the best lensing signal possible. The other bands are imaged less deeply (approximately half of the exposure time of R) and mainly provide photometric redshift estimates. In Figure 1, a 5′×5′ section of one of the fields (imaged at half depth) is reproduced, showing the level of detail available in the data.



A sample 5′×5′ section from the *Deep Lens Survey* imaging data.

The survey team will integrate deeply in the same subfields on successive runs. Most runs will concentrate on two fields, and the runs come in pairs separated by one month (for SN finding). Two of the seven fields are chosen to lie within the existing NOAO Deep Wide-Field Survey fields to save as much telescope time as possible. Below is a listing of the DLS fields. Star density, extinction, two-field accessibility, and existing redshifts were factors in their choice. Much more information about the survey is available at ***http://dls.bell-labs.com***.

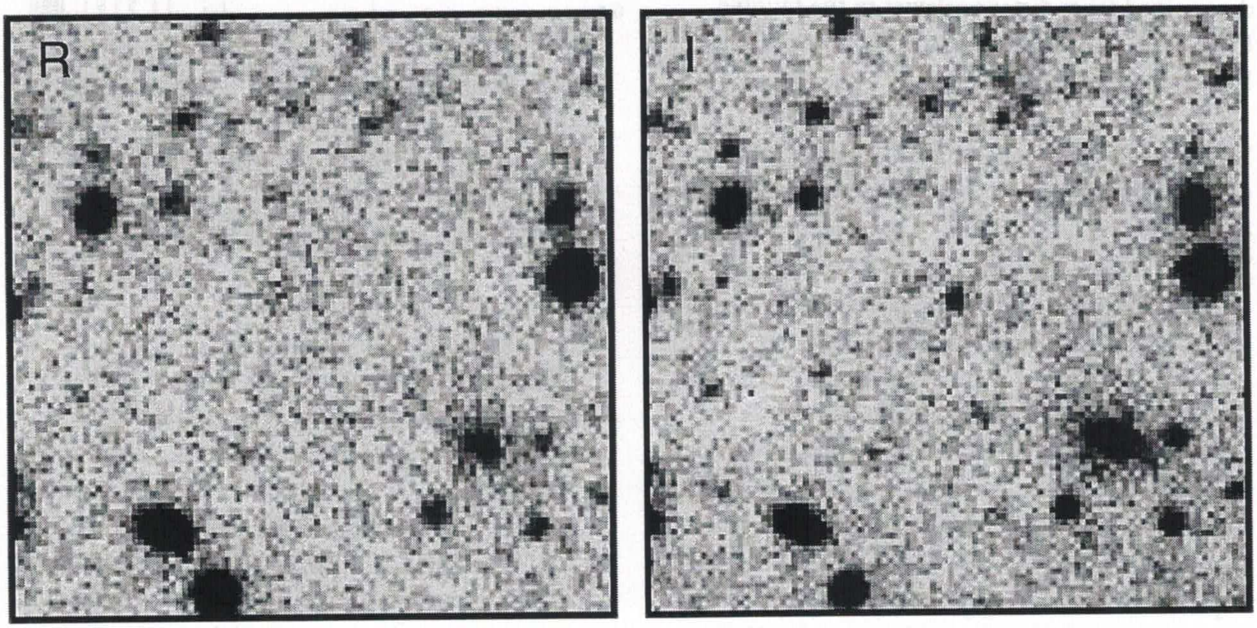
DLS Fields

	RA(J2000)	DEC	l,b	E(B-V)
North:	00 53 25.3	+12 33 55	125,-50	0.06
	09 19 32.4	+30 00 00	197, 44	0.02
South:	05 20 00	-49 00 00	255,-35	0.02
	10 52 00	-05 00 00	257,47	0.025
	13 55 00	-10 00 00	328,49	0.05
NOAO DWFS fields:	02 10 00	-04 30 00	166,-61	<0.04
	14 32 06	+34 16 48	57,63	0.015

The Most Distant Quasar Known

Based on a Solicited Contribution from Daniel Stern

A team of astronomers, led by Daniel Stern (JPL), has recently discovered a quasar at redshift z = 5.50, using the KPNO 4-m, Palomar 5-m, and Keck 10-m telescopes. The quasar, now the most distant known, was picked out as a high-redshift candidate from a deep, multicolor (RIz) imaging survey.



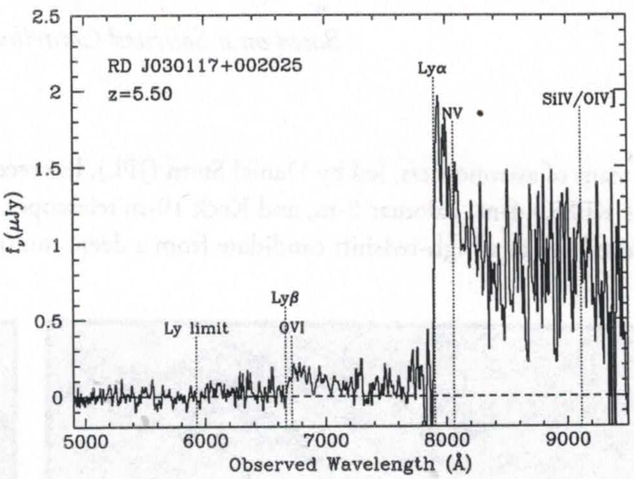
KPNO 4-m PFCCD images used to identify "Red-Dropout" objects. The left panel is an R-band exposure; the right panel is in I. The z=5.50 QSO, RD300, is only visible at the center of the right panel.

The team of astronomers, which also includes Hyron Spinrad (Berkeley), Peter Eisenhardt (JPL), Andrew Bunker (Cambridge), Steve Dawson (Berkeley), Adam Stanford (Davis, IGPP), and Richard Elston (Florida), has begun a deep imaging survey to probe the first Gyr of galaxy formation through rest-frame UV-dropout selection of z ~ 5 galaxies. Broad-band RIz images have been obtained using PFCCD on the KPNO 4-m and the COSMIC camera at the prime focus of the Palomar 5-m telescope. Targets are selected on the basis of the strong signature of the Lyman-α forest at z ~ 5, causing objects to disappear in the R-band. For z ~ 5, the Lyman break is inconsequential relative to the thick jungle of the Lyman-α forest. The aim of the survey is primarily to study high-redshift galaxies, but it is also sensitive to high-redshift quasars.

The newly discovered R-drop quasar, RD300, was the brightest candidate from the current sample, which covered 74 square arcminutes. The quasar is undetected in R (3-σ limit in 3″ diameter aperture is 26.3 mag) and has I = 23.8 and z = 23.4. Figure 1 shows the R and I images centered on the quasar.

continued

Slit-mask spectroscopy was obtained using LRIS on the Keck II telescope in January 2000, revealing RD300 to be an extremely high-redshift quasar. The spectrum shows broad Lyman-α/NV emission and sharp absorption decrements from the highly redshifted hydrogen forests. The fractional continuum depression due to the Lyman-α forest is $D_A = 0.9$, comparable to values determined from distant galaxies in the Hubble Deep Field and from models of evolution in the Lyman-α forest.



Keck II LRIS spectrum of RD300.

Imaging surveys provide one of our most robust tools for probing the evolution of galaxies and quasars. Wide-field, "shallow" surveys such as the Palomar Digital Sky Surveys and Sloan Digital Sky Survey have been very successful at identifying bright, high-redshift quasars at redshifts between z = 4 and z = 5 (e.g., Djorgovski et al. 1999; Fan et al. 1999). Such discoveries are useful for studying the conditions of the early Universe. In particular, distant quasars have shown that the IGM remains largely ionized out to z ~ 5. Deep, smaller field surveys have proved successful at probing star-forming galaxies at early cosmic epoch (e.g., Steidel et al. 1996; Hu et al. 1999), with interesting implications, for example, regarding the cosmic star formation history of the Universe and the morphological evolution of galaxies.

Potentially the most interesting aspect of the current discovery is its implications for the faint end of the quasar luminosity function at high redshift. RD300, at $M_B = -22.7$, is the faintest quasar known at z > 4. Its luminosity is comparable to the lower luminosity objects in local quasar samples. The expected surface density of such quasars is therefore uncertain, but extrapolating the z = 2 (Boyle et al. 1991) quasar luminosity function to high redshift, with the Schmidt, Schneider, and Gunn (1995) pure density evolution (quasar space density falls off by a factor of 2.7 per unit redshift beyond z = 3), would suggest that only ~ 0.15 R-drop ($4.3 \leq z \leq 5.8$), faint ($M_B < -22.5$) quasars should appear in this survey. Was the current record-breaking discovery yet another example of the infamous Spinradian luck (cf. McCarthy et al. 1988; Dey et al. 1998), or are faint, distant quasars more common than expected? The latter possibility could have important consequences for the early ionization of the IGM and bode well for future, moderately deep surveys for high-redshift quasars.

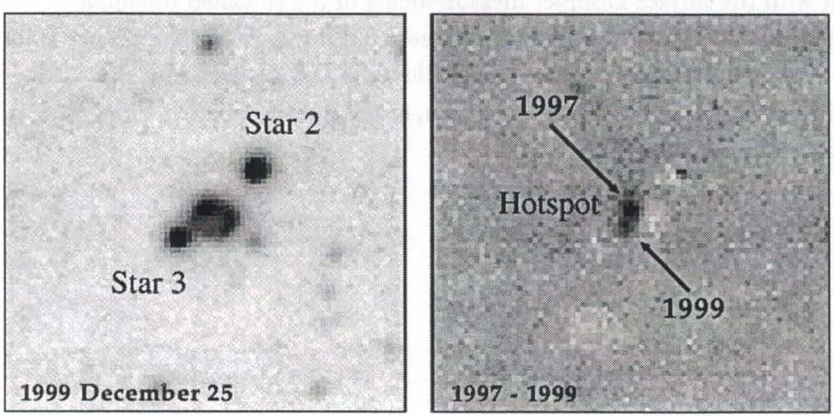
Supernova 1987A Dings the Ring

Bruce Bohannan

A team of astronomers led by Patrice Bouchet (CTIO), which includes Stephen Lawrence, Arlin Crotts, Ben Sugerman, Robert Uglesich (Columbia), and Stephen Heathcote (CTIO), used a new "tip/tilt" imaging camera at the CTIO 4-m Blanco telescope to discover a new brightening of the circumstellar ring around Supernova 1987A in the Large Magellanic Cloud. This activity indicates that supernova ejecta have finally begun to collide with the shell of gas puffed out by the star earlier in its lifetime—the beginning of a critical phase in the formation of a supernova remnant that has never before been witnessed.

A "hot spot" that appeared in the circumstellar ring around SN1987A in 1997 was believed to be the first impact of supernova ejecta. No other active sites had been observed until 25 December 1999, when the Bouchet et al. team first observed a new hot spot. The new hot spot is about the same brightness as the first was when it was originally found. Other, fainter impact sites are also present in their observations. They Bouchet team also found that the original hot spot had brightened significantly since their last observation over a year ago.

The basic spatial resolution of the images was enhanced by use of tip/tilt image motion compensation at the Blanco telescope. Maximum entropy deconvolutions conducted by the Bouchet et al. team clearly show the new hot spot and reveal fainter, possible new hot spots. The significance of the newly discovered hot spots is that they are not confined to a single location, but are distributed around the circumstellar ring. The distribution around the ring indicates that a large fraction of the material ejected from the supernova is finally colliding with the circumstellar ring, instead of a fast-moving "bullet" of ejecta making a single hot spot. If so, this is the beginning the long-awaited formation of a supernova remnant around SN1987A. Other teams making follow-up observations with the HST in late January and early February have confirmed the new hot spot (*IAU Circulars* 7359 and 7360, *New York Times* February 15 issue) and found a number of other fainter new impact sites, which are present in the CTIO data at a subtle level.

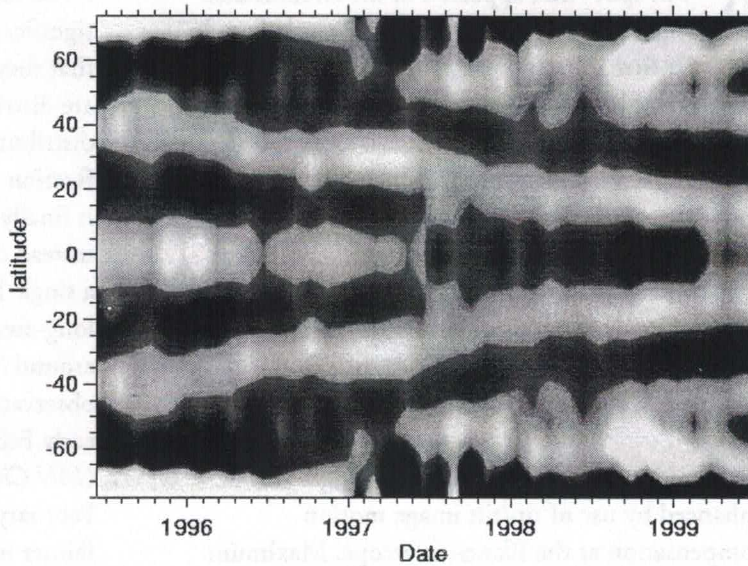


The increasing brightness of the hotspot in the ring around SN1987A discovered in 1997 and the new hot spot to the southeast are readily evident in the difference between the 1998 October and 1999 December observations of Bouchet et al. (left panel). The right-hand panel is the image made in HeI 10830A on 25 December 1999. Frames are ~16 arcsec square, with north up and east to the left.

Evolving Flows Inside the Sun Seen by GONG

Rachel Howe, Rudi Komm, and Frank Hill

GONG observations of the solar oscillations have yielded this image of solar rotation inside the Sun, showing regions of relatively fast (light) and slow (dark) flows 700 km below the solar surface, which migrate towards the solar equator as the surface magnetic activity level rises. These flows extend down to depths of 60,000 km and provide the first detailed look at solar cycle-related internal motions.



The figure shows the time variation of solar rotation, as derived from GONG data, with date horizontally and latitude vertically. Thirty-nine overlapping 108-day intervals, covering 1476 days from the end of the previous solar cycle to the rising phase of the current one, were analyzed using the usual GONG algorithms, and rotational splitting coefficients were fitted to the frequencies. The coefficients were then inverted to give a rotation profile for each interval. The mean rotation rate over the entire time span was found for each radius and latitude, and subtracted from the value for each point. The figure shows the residual rotation rate at 1% of the solar radius, 7 Mm below the surface. Bands of faster and slower rotation converging towards the equator are clearly visible, and they are consistent with the surface Doppler measurements of the so-called torsional oscillation. Magnetic activity appears along the poleward edge of the more rapid flows. There is evidence from the helioseismic data that these flow bands extend tens of megameters below the surface, well into the Convection Zone, and also that significant variations occur deeper down, at the interface between the Convection Zone and the rigidly-rotating interior of the Sun.

from the Director's Office

A Message from Bill Smith, the New AURA President

On February 11, the AURA Board of Directors announced my appointment as President of AURA. I have accepted this appointment with a great appreciation for AURA's past accomplishments and an even greater anticipation for what AURA can be in the future. I am committed to establishing a leadership role for AURA, not only within the US community, but also internationally.

Over the past two years, I have made a concerted effort to take stock of AURA's strengths, as well as its perceived weaknesses. One of the most consistent views of AURA—from its supporters, critics, funding agencies, and policy makers—is the high quality of its people. This view is uniform and widespread, which makes it all the more gratifying that I have been given the opportunity to lead AURA over the coming years.

There is no question that the coming years will be perhaps the most challenging in AURA's history. The Gemini Observatory will be entering its long awaited operational phase, the Space Telescope Science Institute will take on a new mission with the Next Generation Space Telescope, the National Solar Observatory will work to build community support and prepare for the Advanced Solar Telescope, and NOAO will take on new leadership roles as community needs evolve. I have every confidence that AURA can meet these challenges and even seek new opportunities that fit our mission.

The accompanying article announces the resignation of Dr. Sidney Wolff who has directed NOAO over the past 13 years. Her leadership in science and in management has positioned NOAO well to move into the new era we all know is coming. The Long Range Plan she has authored clearly points the way for NOAO for the future. As NOAO directs more of its resources towards getting to that future, the community must understand that the goal is to provide more capabilities, including more powerful telescopes, instruments, archives, and software to enable more science. This can only happen through a commitment to change, which can be a difficult thing to embrace. The NOAO staff needs the support of the community in order to put NOAO into a leadership position.

The strength of the US astronomy community today is directly attributable to the contributions that NOAO and its staff have made. The challenges for the future will be more complex and more difficult in every way—scientifically, technologically, and politically.

AURA is now in search of a new Director to take on these challenges. The new Director will need the cooperation and help of the NOAO staff in order to be successful. I am grateful that Todd Boroson has taken on the task of forming an NOAO Liaison Committee to assist in this search and with whatever tasks arise through the transition.

AURA is in the midst of change. Our management team is strong though, and the quality of our people will remain our most valuable and enduring resource. I look forward to serving as AURA's President.

Sidney Wolff Resigns as NOAO Director: Search for New Director Underway

Leonard V. Kuhi, Chair AURA Board of Directors

On November 18, 1999, Dr. Sidney Wolff announced to the AURA Board of Directors her desire to resign as Director of NOAO. The Board has accepted her resignation effective December 31, 1999, with the understanding that she will continue to serve until a successor is in place.

Sidney has served with distinction as Director of NOAO since 1987. During this time, the role of the National Observatories has changed in major ways. Sidney is responsible for the structuring of partnerships to develop major new facilities such as WIYN and SOAR that will increase public access to state-of-the-art telescopes. She led the community-based effort to develop the scientific, technical, and management proposal for the Gemini telescopes; served as the first director of the Gemini project; and was responsible for Gemini's early success. The GONG network to study solar helioseismology was deployed during her tenure, and construction was begun on the SOLIS facility, which will monitor solar activity. Recently, Sidney led in the development of a long-range plan for NOAO that includes major new survey capabilities and the possibility of a 50- to 100-m large aperture telescope. She has also pioneered efforts to develop collaborative scientific programs with Chandra and SIRTF that will leverage ground- and space-based astronomical capabilities.

Sidney intends to return to the Kitt Peak scientific staff when a new director is in place. Her hope is to use some of the outstanding facilities that she has helped to develop in her own astronomical research.

The search process, carried out by AURA's Observatories Council, has begun with the naming of the search committee, which will be chaired by John Huchra (CfA) and includes Martha Haynes (Cornell), Robert Kennicutt (Arizona), Joseph Miller (UCSC), Rolf Kudritzki (U. Munich), Nick Suntzeff (NOAO), and Ken Janes (Boston University).

The Board of Directors is very appreciative of Sidney's many years of service to AURA, first as Director of KPNO and then as Director of NOAO. She has managed to maintain a first-class institution, as well as launching many new projects within the confines of extremely constrained budgets. Her unselfish devotion to the national needs of astronomers has been exemplary, and the Board wishes her well in her return to a more normal astronomer's life.

Observing Time on the Gemini Telescopes

Sidney C. Wolff

The first deadline for proposals for the Gemini telescopes is likely to be 31 March 2000 (see article elsewhere in this *Newsletter*). It is therefore appropriate to announce now that we plan to implement the same policies for allocation of time on these telescopes as are used for allocating time on Kitt Peak and Cerro Tololo telescopes. Specifically, you will be able to use the same observing forms and procedures with which you are already familiar, and the TACs will operate in exactly the same manner. If current experience at CTIO and KPNO is a guide, we can expect that 80-90 percent of the US share of the observing time on the Gemini telescopes will go to astronomers outside NOAO.

NOAO is responsible for providing support to the US users of the Gemini telescopes, except when the observers are actually at the observatories in Hawaii or Chile. NOAO staff will be the first point of contact for questions about planning observing programs at Gemini, optimizing observing strategies, and reducing data—just as they now are for CTIO and KPNO telescopes. Therefore, NOAO staff will have to become knowledgeable about the Gemini instruments and their quirks and capabilities.

The best way for the staff to acquire the necessary depth of knowledge is to use the telescopes and instruments themselves. Recognizing this requirement, the AURA Board has established a set of policies relating to the allocation of observing time by NOAO. These policies state that the allocation of time is the responsibility of the Observatory Director, that the same procedure will be used to evaluate proposals from both NOAO staff and from the community, and that the Director may assign at his/her "discretion up to 25 percent of the time during which the telescopes are scheduled for observations for science, science verification tests of new instrumentation, for calibrating or testing the performance of old instrumentation, or for telescope maintenance. At least 60 percent of scheduled observing time shall be assigned to scientists who are not on the staff of NOAO."

In practice, I have never used the full allocation of discretionary time on the CTIO and KPNO telescopes. When I came to KPNO, I discovered that historically about 10 percent of the available time was used for commissioning new instruments, installing and testing upgrades to the telescopes, etc. Demand for engineering time continues at about this level, and I have scheduled it as part of the discretionary allotment. I have also used up to 10 percent of the total available time for discretionary allocations of nights for scientific observations. This science time has been allocated only to proposals that have been reviewed and evaluated by the TAC and has been used to:

- Ensure that NOAO scientific staff who must support a facility get observing time for their own science. This guarantees staff competence

continued

with, and knowledge of, the equipment. I have also used discretionary time to make sure that post-docs can conduct viable research programs.

- Provide guaranteed time for external scientists or groups who have made a significant resource contribution to NOAO, such as providing an instrument at a reduced cost.
- Compensate for obvious biases or inadequacies of the Time Allocation Committee, in cases where the TAC chair and Director believe that a good proposal was treated unfairly.

With the advent of the Gemini telescopes, some modification of the implementation of this policy is needed. While NOAO will not require any engineering time from the US allocation of Gemini observing time, the other three factors listed above are relevant. There will be NOAO (and perhaps external) scientists who are responsible for supporting US astronomers in writing observing proposals, planning observing runs using the Gemini software, and understanding and reducing data; these supporting scientists will need to have an opportunity to use the Gemini instruments. NOAO (with the permission of AURA, the NSF, and the Gemini Board) has offered "guaranteed time" to US instrument builders who can provide some funding for US-built instruments. And, occasionally, it will be important to accept proposals that did not make the cut recommended by the TAC.

The need to support these efforts with Gemini observing time has been discussed and endorsed by the US Gemini Science Advisory Committee, the NOAO Users' Committee, and the AURA Observatories Council, although a specific implementation plan had not been developed when these committees met.

What should the implementation plan be? At any given time, there might be one instrument team collecting guaranteed time on each telescope: a maximum of 5-6 nights per year per telescope might be allocated to the team. There might be an additional 5-7 nights per year per telescope for which discretionary allocation for support of science observations is desirable. This totals 10-13 nights, or up to about 10% of the annual US allotment on each telescope. I have indicated to the AURA Board that I would like to limit discretionary time on the Gemini telescopes (and on the independent telescopes to which NOAO provides access) to 10 percent. In all cases, I will continue my current practice of awarding discretionary time only to proposals, whether from staff or visitors, that have been evaluated by the TAC.

If you have any comments on this proposal, please feel free to send them to me (*swolff@noao.edu*) and I will forward them (unedited!) to the AURA Observatories Council and the AURA President.

Partnering Opportunities Sought for Wide-Field Infrared Imaging Capability

Ron Probst and Richard Green

Wide-field, moderate-resolution infrared imaging on 2-4 m class telescopes has been identified as a crucial need for the US community of Gemini users. Such a capability is also a natural extension of both advances in IR sensor technology and current research programs involving moderately deep survey-mode imaging. NOAO is enthusiastic about offering this capability to the US community. We have developed an instrument concept that provides one-quarter square degree of mosaiced field of view, at 1-2.4 µm, on the 4-m Mayall telescope (***http://www.noao.edu/ets/newfirm***). We are now seeking interested partners to bring this, or some similar concept, to reality.

We wish to put new instrumentation into the community's hands rapidly and have several candidates for development over the next few years. To achieve this goal with solely in-house technical resources would require that we focus on only one of these candidates. We also wish to develop major capabilities through community-based partnerships, a goal encouraged by the NOAO Users Committee. There appears to be real promise in the development of wide-field IR imaging through partnering because of demonstrated community expertise as well as shared scientific goals.

NOAO contributions to an instrumentation partnership could include an optical design, IR detectors, a multi-detector array controller, access to wide-field 4-m and 2.1-m telescopes at Kitt Peak, and timeshares in complementary instruments such as the wide-field, multi-slit spectrometer Next Generation Optical Spectrograph presently under development (***http://www.noao.edu/ets/optspect/***). Partner contributions might range from cash and technical resources as a buy-in to an NOAO instrument, to taking the lead in design and fabrication of a shared instrument, to substantial public access to a comparable instrument at some other facility, or to time trades between a wide-field IR imaging capability and NOAO instruments such as NGOS. NOAO's contribution will depend in part on partner wants and needs. We are open to creative ideas.

We intend to organize a short workshop in Tucson in April for seriously interested potential partners. We shall explore the science drivers behind this instrumental need, including the possibilities for large-scale collaborative programs, technical alternatives for wide-field IR imaging, and programmatic means for realizing this exciting capability. Our goal is to create a consortium that will move rapidly ahead to instrument construction.

The workshop will be limited to those who respond in a timely way to this solicitation. For further information and to indicate your interest, please contact Ron Probst (rprobst@noao.edu) or Richard Green (rgreen@noao.edu) by 15 March 2000.

New Staff Responsibilities

Sidney C. Wolff

In the last *Newsletter*, I described some of the new directions of the NOAO program. New directions mean new priorities and new assignments for the staff.

At its recent meeting in Chile, the AURA Observatories Council approved the appointment of **Robert Schommer** as the Associate Director of NOAO for Gemini. This is the position formerly held by **Todd Boroson**, who had the title of US Gemini Project Scientist. **Caty Pilachowski** will serve as Bob's deputy in Tucson. These changes are being made with the goal of providing the support that will be required by the US users of the Gemini facilities. NOAO staff will be the first point of contact for US observers who want to know how to apply for and use the Gemini instruments and telescopes. Bob and Caty are now working out the strategies for organizing and providing the necessary information to the community and for training the NOAO supporting staff. Bob will remain in Chile, where he will have direct access to Gemini South and can become thoroughly familiar with operational issues. Scientific support will be reassigned from the existing KPNO and CTIO staffs.

Taft Armandroff has accepted the position of, in Gemini terminology, US Gemini Project Manager. In US terms, he might better be described as US Gemini Instrument Scientist. In this capacity, he will be responsible for working with Bob and with the US community to provide input into the strategic planning for Gemini instruments and other development activities. He will also monitor, with the assistance of **Mark Trueblood**, the progress of all the Gemini instrument projects being carried out in the US, both at NOAO and within the community.

Todd Boroson will continue to serve as Deputy Director of NOAO and will also take on responsibility for overseeing the software efforts in data acquisition, reduction, archiving, and mining. We expect this area to be one that offers major opportunities and challenges over the next decade. Todd will also work with the teams currently conducting surveys with NOAO telescopes to make sure that the data are archived and made available to the community in a timely manner.

NOAO Preprint Series

861 *Bower, G.A., Green, R.F., Quillen, A.C., Danks, A., Malumuth, E.M., Gull, T., Woodgate,*B. Hutchings, J., Joseph, C., Kaiser, M.E., Weistrop, D., Nelson, C., "*The Ionization Source in the Nucleus of M84*"

862 *Samarasinha, N.H., "*Coma Morphology due to an Extended Active Region and Implications for the Spin State of "Comet Hale-Bopp*"

863 *Massey, P., Foltz, C.B., "*The Spectrum of the Night Sky over Mount Hopkins and Kitt Peak: Changes after a Decade*"

864 *Wolfe, T., Reed, R., Armandroff, T., Saha, A., Schommer, R., Walker, A.R., Smith, C., Smith, R.M., Blouke, M.M., "*CCD Detector Performance for NOAO's Wide-Field Mosaic Camera*"

865 *Cecil, G., Greenhill, L.J., DePree, C.G., Nagar, N., Wilson, A.S., Dopita, M.A., Perez-Fournon, I., Argon, A.L., , Moran, J.M., "*The Active Jet in NGC 4258 and its Associated Shocks*"

866 *Suntzeff, N.B., "*The Observations of Type Ia Supernovae*"

Other NOAO and NSO Papers

Almeida, J.S., Lites, B.W., "*Physical Properties of the Solar Magnetic Photosphere under the MISMA Hypothesis. II. Network and Internetwork Fields at the Disk Center*"

*Blum, R.D., Conti, P. S., Damineli, A., "*The Stellar Content of Obscured Galactic Giant HII Regions II: W42*"

Fleming, T.A., *Giampapa, M.S., Schmitt, J.H.M.M., "*An X-ray Flare Detected on the M8 Dwarf VB 10*"

Graff, D., Gould, A., *Suntzeff, N., Schommer, R.A., Hardy, E., "*The Velocity Dispersion of LMC Carbon Stars: Possible Detection of a Kinematically Distinct Population*"

Grossmann-Doerth, U., Schussler, M., *Sigwarth, M., Steiner, O., "*Strong Stokes V Asymmetries of Photospheric Spectral Lines: What Can They Tell Us About the Magnetic Field Structure?*"

continued

*Harvey, K.L., Jones, H.P., Schrijver, C.J., Penn, M.J., *"Does Magnetic Flux Submerge at Flux Cancellation Sites?"*

Hibbard, J.E., Vacca, W.D., Yun, M.S., "*The Distribution of Neutral Hydrogen in Merging Galaxies: Differences between Stellar and Gaseous Tidal Morphologies*"

*Howe, R., Christensen-Dalsgaard, J., Hill, F., *Komm, R.W., Larsen, R.M., Schou, J., Thompson, M.J., Toomre, J., *"Dynamic Variations at the Base of the Solar Convection Zone"*

Kaspi, S., Smith, P.S., Netzer, H., Maoz, D., *Jannuzi, B.T., Giveon, U., "*Reverberation Measurements for 17 Quasars and the Size-Mass-Luminosity Relations in Active Galactic Nuclei*"

Phillips, K.J., Read, P.D., Gallagher, P.T., Keenan, F.P., Rudawy, P., Rompolt, B., Berlicki, A., Buczylko, A., Diego, F., Barnsley, R., *Smartt, R.N., Pasachoff, J., *"SECIS: The Solar Eclipse Coronal Imaging System"*

Ramírez, S.V., Sellgren, K., Carr, J. S., Balachandran, S. C., *Blum, R. D., Terndrup, D. M., Steed, A. "*Stellar Iron Abundances in the Galactic Center*"

Schmitt, H.R., Kinney, A.L., "*Jet Directions in Seyfert Galaxies: B and I Imaging Data*"

Shine, R.A., *Simon, G.N., Hurlburt, N.E., *"Supergranule and Mesogranule Evolution"*

*Sigwarth, M., *"Dynamics of Solar Magnetic Fields: A Spectroscopic Investigation"*

Stenflo, J.O., Gandorfer, A., *Keller, C.U., *"Center-to-Limb Variation of the Enigmatic NaI* D_1 *and* D_2 *Polarization Profiles"*

Strous, L.H., Goode, P.R., *Rimmele, T.R., *"The Dynamics of the Excitation of Solar Oscillations"*

*Wachter, S., Smale, A.P., Bailyn, C., "*The Reappearance of the Transient Low Mass X-ray Binary X1658-298*"

*Wallace, L., Meyer, M.R., Hinkle, K., Edwards, S., "*Near-Infrared Classification Spectroscopy: J-Band Spectra of Fundamental MK Standards*"

Willson, R.C., Mordvinov, A., *"Time-Frequency Analysis of Total Solar Irradiance Variations"*

Observational Programs

Gemini Calls for Proposals—*Maybe*

Todd Boroson and Bob Schommer

As this *Newsletter* is in final preparation, the Gemini Observatory is considering whether to announce a Call for Proposals for the Gemini North Telescope, with observations starting sometime during the summer. The call would likely include early observations with two visiting instruments—the University of Hawaii's Adaptive Optics Camera and IR Camera (Hokupa'a and QUIRC) and the University of Florida's Mid-IR Spectrometer and Imager (OSCIR), with the likely possibility of observations beginning later in the Fall Semester with the facility-class Near Infra-Red Imager (NIRI) built by the University of Hawaii. The call might also include 2000B access to NIRSPEC on the Keck Telescope.

If the Call occurs, investigators may submit proposals for Gemini observations or observing time through the standard NOAO proposal process, with proposals due March 31. If the Call does not occur at this time, a later call sometime before June is likely. Interested observers should keep a close eye on the NOAO Web site in early March, and throughout the year, to find the latest information. The decision is likely to be made by early March and is dependent on the outcome of tests of the facility instrument NIRI. In anticipation of a Call for Proposals soon, NOAO has modified its proposal form and process to accommodate Gemini proposals. Users applying for time on other facilities will note some of these modifications as they prepare proposals.

For more information on the Gemini Observatory, see the US Gemini Program section of this *Newsletter*.

Call For HET Proposals

Tom Barnes and Caty Pilachowski

Beginning with the 2000B call for proposals, observers may request time on the 9.2-m effective aperture Hobby-Eberly Telescope (HET) at McDonald Observatory, under an agreement with the National Science Foundation. The HET is a unique, queue-scheduled, segmented-primary telescope optimized for spectroscopic observations. Access to HET through the

Public Access Program will begin in June 2000. Proposals should be submitted through NOAO using the standard NOAO proposal form. Proposals will be reviewed by the NOAO TAC, and those approved will be forwarded to the HET for queue-scheduling. For further details concerning the use of HET for observations and the preparation of observing proposals, see NOAO's mirror site for HET information at ***http://www.noao.edu/gateway/HET/***, and articles in the December issue of the NOAO *Newsletter*. All observations will be performed in a queue-scheduled mode by HET observers.

Current Status

The 9.2-m Hobby-Eberly Telescope is in routine science operation two weeks per month. The other two weeks are devoted to instrument commissioning and to engineering improvements to the telescope. This schedule will continue into Fall 2000. A month of shutdown is possible during Summer 2000, with the decision to be taken later. Performance of the HET was described in the December 1999 NOAO *Newsletter* and has improved somewhat since then. Electro-mechanical performance is excellent; optical performance of the 91-segment primary-mirror array in the 2000B semester is likely to be in the 2.0″–2.5″ range (encircled energy = 50% averaged over a 30-minute integration). Seventy percent of the clear, nighttime hours are used for science, with more than half of those hours being integration time. The fractional integration time is steadily improving as we gain experience with this unique telescope. The remaining 30% of the clear, nighttime is used for realignment of the primary mirror array (20%), lost to problems (8%), and 'other' (2%). The latter two categories are expected to decrease by Summer 2000; the realignment time will effectively go to zero upon installation of the edge sensor system on the primary mirror array in Spring 2001.

Instrumentation Status

Instrumentation available to researchers on the HET in the 2000B semester will be the Marcario Low Resolution Spectrometer (LRS) and the High Resolution Spectrometer (HRS). These are described in the December 1999 NOAO *Newsletter* and at ***http://www.noao.edu/gateway/het***. The LRS is a grism spectrometer with imaging and long-sit modes in operation now. The field of view is 4′ in diameter. The two grisms provide resolving powers of 600 and 1300 in wavelength regions 410–1000 nm and 430–740 nm, respectively. The LRS has achieved 1.6″ images on the HET, although imaging in the 2.0″–2.5″ range is more typical at this time. Researchers planning to use the LRS are asked to consult current performance measures documented at ***http://www.noao.edu/gateway/het***.

The HRS is under construction, with commissioning expected to begin in late April 2000. HRS is a fiber-fed spectrometer with resolving powers of 30,000, 60,000, and 120,000 by means of three slit widths. Spectral coverage is 420–1100 nm. Projected performance characteristics of the HRS are available at ***http://www.noao.edu/gateway/het*** and will be up-dated as commissioning proceeds.

Public Access Observing Time on the MMT

Caty Pilachowski and Jeannette Barnes

About 27 nights per year of observing time on the MMT Observatory 6.5-m telescope are available to the astronomical community through the NOAO proposal process, under an agreement with the National Science Foundation. The first Public Access visitors will be scheduled this spring for proposals that received time during the last proposal call. All observing will be carried out in classical mode. Proposals for the period from 1 August 2000 through 31 January 2001 are due on 31 March 2000 (note that the month of August is traditionally reserved for major telescope maintenance projects). Proposals should be submitted through NOAO using the standard NOAO proposal form. Proposals will be reviewed by the NOAO TAC, and those approved will be forwarded to the MMT for scheduling (approximately 20% more proposals will be forwarded than can be scheduled to allow for block scheduling, conflicts in dates, etc). Because of the limited support provided by the MMTO, access to the telescope will be restricted to experienced observers—check our MMT Web page for details (***http://www.noao.edu/gateway/mmt/***). See also accompanying articles in this *Newsletter* for information on how to apply for time on the MMT.

NOAO Nighttime Proposals Due for 2000B

The NOAO Proposal Team

Proposals for observing time for the 2000B observing semester (August 2000–January 2001) at Cerro Tololo Inter-American Observatory and Kitt Peak National Observatory, and for community access time at the Hobby–Eberly Telescope and the Multiple Mirror Telescope Observatory, are due in March 2000. A separate article appears elsewhere that discusses observing time options on Gemini North. (See accompanying articles in this section for information about capabilities available at the facilities available through this proposal process.) The deadline for Survey Proposals is Wednesday evening, 15 March 2000, Midnight MST. (Survey proposals are accepted only from those investigators who submitted survey letters of intent by January 31.) Regular or standard proposals are due Friday evening, 31 March 2000, Midnight MST.

Proposal materials and information are available on our Web page at ***http://www.noao.edu/noaoprop/*** (see accompanying articles in this section for changes to the proposal form and other important proposal information). Proposal materials are no longer available by FTP. Investigators are requested to use the Web form to initiate all proposals. Although the Web form is the starting point for all proposals, we do provide both e-mail and Web options for submission. Paper submissions are no longer an option.

Web submissions. The Web form may be used to complete and submit proposals. The information provided on the Web form is formatted and submitted as a LaTeX file, including figures that are "attached" to the Web proposal as Encapsulated PostScript files.

E-mail submissions. If you prefer to prepare your proposal locally as a LaTeX file and then submit it by e-mail, that option is still available. Investigators using the Web form are requested to fill out certain information on the general information, investigator information, and run information pages (what is required through the Web form varies with each facility, so read the instructions carefully). After these pages have been completed, a "customized" LaTeX file can be returned to you by e-mail or through a download for completion and submission by e-mail. Follow the instructions in the LaTeX template for submitting proposals and figures.

Several addresses are available to help with proposal preparation and submission:

http://www.noao.edu/noaoprop/ — Web proposal materials and information.

noaoprop-help@noao.edu — Request help for proposal preparation.

noaoprop-letter@noao.edu — Address for thesis and visitor instrument letters, as well as consent letters, for use of PI instruments on the MMT.

noaoprop-submit@noao.edu — Address for submitting LaTeX proposals by e-mail.

usgemini@noao.edu and *http://www.noao.edu/gateway/gemini/support.html* — Gemini-related questions relating to operations or instrumentation, or try the official Gemini HelpDesk at *http://helpdesk.gemini.edu/hdsupport/*.

ctio@noao.edu — CTIO-specific questions related to an observing run.

kpno@noao.edu — KPNO-specific questions related to an observing run.

mmt@noao.edu — MMT-specific questions related to an observing run.

het@noao.edu — HET-specific questions related to an observing run.

Once again we would like to thank the astronomical community for their continued cooperation with the electronic submission process.

What's New with the Proposal Process?

The NOAO Proposal Team

Some changes have been made to our proposal form for the next observing period, but they mostly affect requests for Gemini North time (see the accompanying article in this *Newsletter* about the availability of Gemini North telescope time). Please follow all instructions in the on-line help at ***http://www.noao.edu/noaoprop/noaoprop.html***.

We summarize here the major changes to the proposal form and process:

- ***Observing Time on Gemini North.*** Time may be available (the availability is uncertain at the time of this writing). If Gemini time is available, investigators should request observing time on Gemini North through the NOAO proposal process starting with this observing period. See our Web page at ***http://www.noao.edu/gateway/gemini/*** for the latest details.

- ***Community Access Time on the HET.*** Investigators may request community access time on the HET through the NOAO proposal process; proposals are being accepted for June 2000–January 2001 for the HET for this proposal round. See our Web page at ***http://www.noao.edu/gateway/het/*** for details.

- ***One Title, One Proposal.*** A single observing proposal may request up to six observing runs at any of the facilities available through NOAO, including Gemini North (if available) and community access time on the HET and MMT. For example, a single proposal may include requests for time on Gemini North, WIYN at Kitt Peak, the 4-meter at Cerro Tololo, the HET, and the MMT.

- ***Web-Based Proposal Form.*** The NOAO observing proposal form is available through our Web form only. Starting with the 1999B proposal period, we no longer support FTP retrievals. A partially completed proposal form may be completed over the Web or downloaded, completed, and submitted by e-mail.

- ***Long-Term and Survey Restrictions.*** Long-term and survey proposals are being accepted for all facilities available through NOAO, except for Gemini (when it becomes available).

- ***Changes to Proposal Form.*** We include here a summary of the major changes to the proposal form. Please read the instructions on our Web site carefully so you are aware of these and any other changes that have been made since the last time you submitted a proposal for observing time at any NOAO facility.

  – *We have added a keyword selection to the proposal form. One to five keywords are required for proposals requesting Gemini time and are optional for all other telescopes.*

continued

Keywords must be selected through the Web form.

– *Gemini proposers must indicate through the Web form if the same proposal is being submitted to another partner country.*

– *The number of nights from new moon used to depict moon phase for each observing run requested has been changed from a numeric entry to darkest (≤3), dark (≤7), gray (≤10), and bright (≤14).*

– *The run details page for Gemini observing runs has been customized, and Gemini runs must be specified through the Web form. Information for the run details section for Gemini runs will not appear in the LaTeX file unless a Gemini run has been identified through the Web form.*

– *Targets and guide stars are required for all Gemini runs. The guide stars are found automatically once the targets have been identified. Thus, it is required that all Gemini target tables be completed on the Web.*

– *Required target tables. Target tables are required for all WIYN-2hr, WIYN-SYN, YALO, and Gemini runs. Target tables are no longer required for standard WIYN observing programs, since these are now scheduled classically. Target tables are included on the run details pages for each run when the proposal form is printed. Target tables may be included with any run, but are optional for other telescopes. Target tables for Gemini runs have a different format than the other target tables.*

– *Target files can be imported into Web form. Targets may be uploaded to the Web form through a text file following a specified format (see our on-line help). The imported targets will be entered into the appropriate target table for further editing.*

- *Instrument Lists.* As with each semester, the instrument lists for CTIO and KPNO have undergone some modifications. See our instrument lists page at ***http://www.noao.edu/noaoprop/help/facilities.html*** for a complete list of instruments available for 2000B for all facilities including Gemini North (if available), HET, MMT, Kitt Peak, and Cerro Tololo.

  Observers should note that anyone who wishes to use a PI instrument on the MMT must consult with the PI and obtain a letter of approval and consent that should be submitted by the instrument PI to ***noaoprop-letter@noao.edu*** before the proposal deadline.

- ***CNTAC Proposals.*** Chilean National proposals for time at CTIO are being accepted through NOAO using the NOAO proposal form. Proposals received in Tucson will be checked for completeness and then forwarded to the Chilean National TAC for allocation of time. (This is new for the 1999B proposal period.) Requests for Chilean time on Gemini North may NOT be requested through the NOAO proposal process.

Details about the proposal process are available off the proposal home page (***http://www.noao.edu/noaoprop/noaoprop.html***). Questions may be directed to ***noaoprop-help@noao.edu.***

Keck/Nirspec Time Available to US Community

Todd Boroson and Bob Schommer

Observing time on the Keck II Telescope with the Near-IR Spectrograph is available to the US community (and other Gemini partners) through a trade of a Gemini InSb infrared array. Three nights will be available in each of the 2000A, 2000B, 2001A, and 2001B semesters; observations will be carried out in queue mode by Gemini Observatory staff.

While the deadline to propose for observations on April 8 has already passed, investigators now have a chance to apply for observations to be obtained on May 10 or 11. Investigators interested in applying for NIRSPEC time should obtain Web or ASCII application materials at ***http://www.us-gemini.noao.edu/sciops/instruments/nirspec/***.

NIRSPEC is a moderate/high resolution, near-infrared (1-5 μm), cross-dispersed, echelle, and grating spectrometer at the Keck Observatory on Mauna Kea. The instrument is equipped with a 1024×1024 Aladdin InSb array detector capable of resolving powers of R~1500–3,000 or R~15,000–75,000. At any single setting of its grating or echelle, NIRSPEC covers a wavelength range of approximately 0.18 × λ_{cen}. For example, with λ_{cen} set to 2.25 μm, the wavelength coverage is 2.05–2.45 μm. Further information on the instrument and on application procedures is available at ***http://www.us-gemini.noao.edu/project/announcements/nirspec.html***.

NOAO and NASA Work Together

Steve Strom

We are pleased to announce a collaboration with two NASA Great Observatories, Chandra and SIRTF, to provide investigators with complementary ground-based observations in support of their programs. Investigators will able to obtain time on NOAO facilities through proposals for SIRTF Legacy programs and through Chandra large programs. The goal of this collaboration is to allow proposers to avoid the double jeopardy inherent in having to pass through two separate TAC processes, and to provide access to facilities essential to obtaining complementary ground-based O/IR data without regard to institutional affiliation.

Investigators applying for Chandra large programs (>300 ks) will be able to apply for time at NOAO facilities in the same proposal, with a cap of approved time at 5% of the available time at NOAO, excluding Gemini. The key criterion in the award of NOAO time is that the X-ray and optical data form a coherent database such that both sets of data are required to meet the scientific goals of the proposal. The Chandra call for proposals is expected to be issued 15 February 2000; investigators may obtain further information at the Chandra web site, ***http://chandra.harvard.edu***.

Investigators on successful SIRTF Legacy Programs may also be allocated time at NOAO

continued

facilities. Legacy Programs are large, coherent science investigations, producing data of general and lasting importance to the broad astronomical community. Up to 10% of the time at NOAO facilities may be recommended by the SIRTF Legacy TAC. The SIRTF Legacy call for proposals is expected in June. For further information, see the SIRTF web site at ***http://sirtf.caltech.edu.***

Approved 1999 NOAO Survey Programs

Todd Boroson

Five programs were recommended for approval by the NOAO Survey Panel of the Telescope Allocation Panel and approved by the NOAO Director during the 1999 Survey Proposal round. Each program is to receive an average of about 100 nights total, typically spread over six semesters. Two to four different telescopes are utilized by each program. The successful 1999 NOAO Survey Programs are identified below. Further information about these programs, with links to the survey program web sites maintained by the survey groups, may be found at ***http://www.noao.edu/gateway/surveys/.***

Deep Imaging Survey of Nearby Star-Forming Clouds

John Bally (Colorado), Bo Reipurth (Colorado)

– Understanding local star formation through the properties of young stars, stellar outflows, and molecular clouds.

In Search of Nearby Stars: A Parallax Program at CTIO

Todd Henry (Johns Hopkins), Claudio Anguita (U. de Chile), Phil Ianna (Virginia), Rene Mendez (NOAO), Maria Teresa Ruiz (U. de Chile), Pat Seitzer (Michigan)

– Characterizing stars in the solar neighborhood and providing high-quality data for NASA's NStar project.

continued

The NOAO Deep Wide-Field Survey

Buell T. Jannuzi, Arjun Dey, and the NOAO Survey Team (NOAO)
– Studying the evolution of large-scale structure from z~1 to z~4, and detecting very distant star-forming galaxies and quasars.

Deep Lens Survey

J. Anthony Tyson (Bell Labs, Lucent Technologies); Gary Bernstein (Michigan); Ian Dell'Antonio (NOAO); David Wittman, David Kirkman, Greg Kochanski (Bell Labs, Lucent Technologies); Tod Lauer (NOAO); T. Broadhurst (UCB); R. Cen (Princeton); J. Cohen (Caltech); A. Gonzalez, R. Guhathakurta (UCSC); W. Hu (IAS); N. Kaiser (UH); J. Miralda-Escudé (Pennsylvania); R. Schommer (NOAO); D. Spergel (Princeton); G. Squires (Caltech); C. Stubbs (Washington)
– Testing the theory of structure formation using weak gravitational lensing.

A Fundamental Plane Peculiar Velocity Survey of Rich Clusters within 200 h^{-1} Mpc

Jeff Willick (Stanford), Mike Hudson (Waterloo), John Lucey (Durham), David Schade (CADC/HIA), Russell Smith (U. Catolica de Chile), Nick Suntzeff (CTIO), Gary Wegner (Dartmouth), Roger Davies (Durham)
– Surveying rich clusters of galaxies to probe the mass distribution on intermediate and large scales.

continued

Corrected Subscription Tables for 2000A Semester

Caty Pilachowski

Thanks to alert readers who noticed errors in the subscription tables for the CTIO and KPNO 4-m and 0.9-m telescopes for the 2000A semester, we here reprint the corrected tables. The error resulted from adding together the requested nights for both telescopes (4-meters at CTIO and KPNO) in the calculation of the oversubscription ratios. We apologize for the errors.

2000A CTIO Observing Request Statistics

February 2000 - July 2000

Summary

	4m	1.5m	YALO	0.9m	0.9mQ	SCHM
No. of requests	114	50	8	25	13	6
No. of nights requested	363.90	211.50	37.40	207.00	118.50	37.00
No. of nights available*	122	141	22	99	25	79
Oversubscription	2.98	1.50	1.70	2.09	4.74	0.47
Average request	3.19	4.23	4.67	8.28	9.12	6.17

*The number of nights available is approximate until engineering time assignments have been allocated.

2000A KPNO Observing Request Statistics

February 2000 - July 2000

Summary

	4m	WIYN	2.1m	CF	0.9m	W2HR
No. of requests	112	44	68	21	28	7
No. of nights requested	375.60	103.98	311.20	166.00	157.50	1.75
No. of nights available*	140	62	120	143	78**	
Oversubscription	2.68	1.68	2.59	1.16	2.02	
Average request	3.38	2.36	4.58	7.90	5.63	0.25

*The number of nights available is approximate until engineering time assignments have been allocated.
**The 0.9-m is only scheduled when the Mosaic camera is available.

CTIO Instruments Available

This lists common user instruments available. The last column gives volume number of *Newsletters* containing relevant articles. The most recent summary of specific CCD characteristics is in *NOAO Newsletter* 45; see also 51, 50, and 33.

SPECTROSCOPY			***Detector & Spectral Range***	***Resolution***	***Slit***	***Reference***
4-m Telescope	Hydra + Fiber Spectrograph		Loral 3K CCD, 3300-11000Å *or*	300-2000	Fiber*	[54,55,57]
		*1	SITe 2K CCD, 3300-11000Å		*120 + fibers, 1.3 or 2 arcsec aperture	
	R-C Spectrograph		Loral 3K CCD, 3100-11000Å	300-5000	5.5'	[40,41,42]
	Echelle Spectrograph + Blue Air Schmidt		Loral 3K CCD, 3100-11000Å	15000	5.2'	[40,41,42,50,51]
	Echelle Spectrograph + Long Cameras		SITe 2K CCD, 3100-11000Å	98000	5.2'	[50,51]
	CTIO IR Spectrometer	*2	InSb (256^2, 0.9-5 μm)	450-9800	0.3'	[41,45,49,51,53]
	OSIRIS IR Imager/Spectrometer		HgCdTe, (1024^2, 1.0-2.4 μm)	1200 or 2900	1.2'	[55,57]
1.5-m Telescope	Cass Spectrograph		Loral 1200x800 CD, 3100-11000 Å	<1300	7.7'	[43,45]
	Bench Echelle Spectrograph		SITe 2K CCD, 3100-8800 Å	15000-60000	Fiber	[42,50,51]
	OSIRIS IR Imager/Spectrometer		HgCdTe, (1024^2, 1.0-2.4 μm)	1200 or 2900	4'	[55,57]
Curtis Schmidt	Objective Prism Imaging		SITe 2K CCD, 3100-11000 Å	<900	NA	[42,47,50,51]
IMAGING			***Detector***	***Scale ("/pixel)***	***Field***	***Reference***
4-m Telescope	Mosaic II Imager		8K x 8K CCD Mosaic	0.27	36'	[57,59]
	OSIRIS IR Imager/Spectrometer		HgCdTe, (1024^2, 1.0-2.4 μm)	0.15 or 0.4	1.2' or 3'	[55,57]
	CTIO IR Imager	*2	HgCdTe (256^2, 1-2.5 μm)	0.4 or 0.22	1.7' or 0.9'	[40,41,53]
1.5-m Telescope	Cass Direct Imaging		SITe 1K/2K CCD	0.44/0.24	14.8'/8.2'	[50,51]
	CTIO IR Imager	*2	HgCdTe (256^2, 1-2.5 μm)	1.16/0.64	4.9'/2.8'	[40,41]
	ASCAP Optical Photometer					[43]
	OSIRIS IR Imager/Spectrometer		HgCdTe, (1024^2, 1.0-2.4 μm)	0.4 or 1.1	4' or 10'	[55,57]
0.9-m Telescope	Cass Direct Imaging		SITe 2K CCD	0.40	13.6'	[50,51]
Curtis Schmidt	Direct Imaging		SITe 2K CCD	2.3	79'	[47,50,51,54]
YALO Telescope	ANDICAM Optical/IR Camera		Loral 2K CCD	0.3	10'	[55,59]
			HgCdTe 1K IR	0.2	3.3'	

Notes

*1 SITe CCD plus new camera available for semester 2000B.

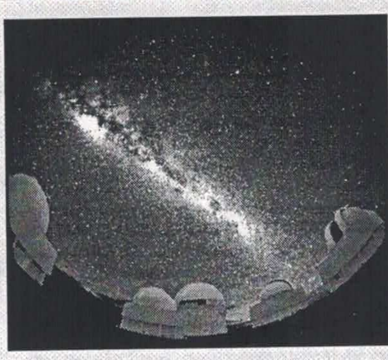
*2 OSIRIS is the prefered instrument for all IR imaging and spectroscopy. See article in this Newsletter.

KPNO Instruments Available

SPECTROSCOPY		Detector	Resolution	Slit	Multi-object
Mayall 4-m Telescope	R-C CCD Spectrograph	T2KB CCD	300-5000	5.4'	single/multi
	CCD Echelle Spectrograph	T2KB CCD	18000-65000	2.0'	
	IR Cryogenic Spectrograph *(1)*	InSb (256x256, 0.9-5.5 µm)	300-1500	0.8'	
	CryoCam Spectrograph	Loral CCD (800x1200)	400-600	5.4'	single/multi
WIYN 3.5-m Telescope	Hydra + Bench Spectrograph	T2KC CCD	700-22000	NA	~100 fibers
	DensePak *(2)*	T2KC CCD	700-22000	IFU	~90 fibers
2.1-m Telescope	GoldCam CCD Spectrograph	F3KA CCD	300-4500	5.2'	
Coudé Feed Telescope	Coudé CCD Spectrograph *(3)*	F3KB CCD	2200-250000	3.0'	

IMAGING		Detector	Spectral Range	Scale ("/pixel)	Field
Mayall 4-m Telescope	Prime Focus CCD Camera	T2KB CCD	3300-9700Å	0.42	14.2'
	IR Imager *(4)*	HgCdTe (256x256, 1-2.5 µm)	JHK + NB	0.60	2.5'
	CCD Mosaic	8Kx8K	3500-9700Å	0.26	35.4'
	SQIID	InSb (512x512x4, 0.9-2.5 µm)	JHK + L(NB)	0.39	3.3' circular
WIYN 3.5-m Telescope	Mini-Mosaic Imager	4Kx4K CCD	3300-9700Å	0.14	9.3'
2.1-m Telescope	CCD Imager	T2KA CCD	3300-9700Å	0.305	10.4'
	IR Imager *(4)*	HgCdTe (256x256, 1-2.5 µm)	JHK + NB	1.1	4.7'
	SQIID	InSb (512x512x4, 0.9-2.5 µm)	JHK + L(NB)	0.68	5.8' circular
0.9-m Telescope	CCD Mosaic *(3)*	8Kx8K	3300-9700Å	0.425	59.0'

(1) Possibly unavailable if temporarily redeployed at Gemini North.
(2) Integrated Field Unit: 30" x 45" field, 3" fibers, 4" fiber spacing.
(3) Completion of previously approved projects only.
(4) Proposals restricted to Narrow Band requirement. May be scheduled for broad band use to accommodate more imaging requests.



CTIO OPERATIONS

CTIO Instrumentation Update

Alistair Walker (awalker@noao.edu)

The CTIO La Serena-based Engineering and Technical Services (ETS) Division has the multiple functions of building new instrumentation, upgrading existing telescopes and their instruments, and providing support to the Tololo-based Telescope Operations Division (Telops). In addition, computer hardware and software support is provided to the systems in both La Serena and on Tololo. Both divisions are expected to provide some support for Gemini South, particularly for NOAO instruments such as Phoenix. The ETS division is managed by Brooke Gregory, while schedules, progress, and priorities are reviewed by a committee of scientists who meet at approximately monthly intervals. The program presently contains 25 projects, large and small; here I concentrate on the major instrumentation projects now underway.

The Hydra multi-object spectrograph entered regular operation on the Blanco 4-m telescope during 1999, using the Air Schmidt camera and a Loral 3K CCD as detector. The camera vignettes significantly when used with Hydra, and the CCD format is not large enough to allow use of all the fibers. A new camera has been built under the leadership of Tom Ingerson, while Roger Smith and Andrés Montané have implemented a SITe 2K×4K CCD in a sophisticated, low-profile mount. The combination is due to undergo tests during the next Hydra engineering run in March, and if successful will be offered to users immediately. We presently offer only 300-µm fibers with Hydra, but with the new camera observers who desire higher resolution will be able to install slit plates of width 100 or 200 µm. Watch *http://www.ctio.noao.edu/spectrographs/hydra*.

The Infrared Sideport IR Imager (ISPI) will fit at the Blanco *F*/8 focus on a sideport, with all transmissive optics (the Richard Elston Flamingos design) and a 2K HgCdTe detector, to give a 10′×10′ field with 0.3″ pixels. The instrument is making good progress, with most optics received and mechanical design proceeding apace. Like the SOAR Imager (below), ISPI will use a Leach controller with software written in the LabView environment, under LINUX. The instrument is scheduled to be completed by late 2001, but array acquisition is likely to be the pacing item. Ron Probst, now relocated back to Tucson, is the project manager.

The SOAR Optical Imager is the commissioning instrument for the SOAR 4-m, which has first light scheduled for September 2002. The instrument fits on a folded Cass port and incorporates a rotator, ADC (trombone-type as in VLT FORS), tip-tilt sensor, and a 4K×4K CCD mosaic, giving a 5.5′×5.5′ field with 0.08″

continued

pixels. This instrument is heading for preliminary design review and is on schedule. Alistair Walker is the project manager.

Finally, after some delays due to lack of resources, construction of an Integral Field Unit for the Blanco telescope is beginning. The IFU will insert at the *F*/8 RC focus and feed the Hydra bench spectrograph. This arrangement allows a great deal of flexibility and, in principle, could replace many of the functions presently provided by both RC and Echelle spectrographs. This project is led by Tom Ingerson.

The Blanco instruments described above (Hydra, ISPI, and IFU), together with the Mosaic II Imager, will be the only instruments offered on the Blanco telescope by the time the SOAR telescope enters operation in March 2003. This complement of fixed instrumentation will allow us to divert resources from Tololo to running SOAR. By that time, Gemini South will have been operating for approximately two years; the three telescopes together will offer a range of state-of-the-art instrumentation, with the wide-field Blanco and narrow-field high-resolution SOAR complementing the larger telescope.

OSIRIS Is the Primary Infrared Instrument at CTIO

Bob Blum (rblum@noao.edu)

The Ohio State InfraRed Imager/Spectrometer (OSIRIS) had its Rockwell HAWAII array replaced in December 1999. New parameters and performance information can be found in the OSIRIS web pages (***http://www.ctio.noao.edu/instruments/ir_instruments/osiris***). The new array is similar in most respects to the old, but does not exhibit the severe ramping at the quadrant boundaries that the old array did and appears to have a deeper full-well capacity.

OSIRIS is now the default IR imager/spectrometer at CTIO. Its combined imaging and spectroscopic modes allow CTIO to make fewer instrument changes over bright-time runs, an important consideration as we begin to prepare for the additional operational load of SOAR. Observers should propose to use OSIRIS instead of CIRIM or the IRS. The IRS may occasionally be scheduled for very highly rated science proposals that need long wavelength coverage (> 2.5 μm) or high resolution (R>5000). CIRIM may be scheduled if it is advantageous to have both IR imagers on two different telescopes at the same time.

The First Semester of the NOAO MOSAIC II Camera at CTIO

R.A.Schommer (rschommer@noao.edu), R.C. Smith (csmith@noao.edu), A. Walker (awalker@noao.edu), and K. Olsen (kolsen@noao.edu) for the Mosaic II Team

The Mosaic II camera was successfully commissioned at CTIO in July 1999. Shared-risk observing starting in August produced useful images from the first night, and observers have taken home some excellent data over the past five months. Guided images in red bandpassses have been obtained with FWHM< 0.7″ over >600 sec.

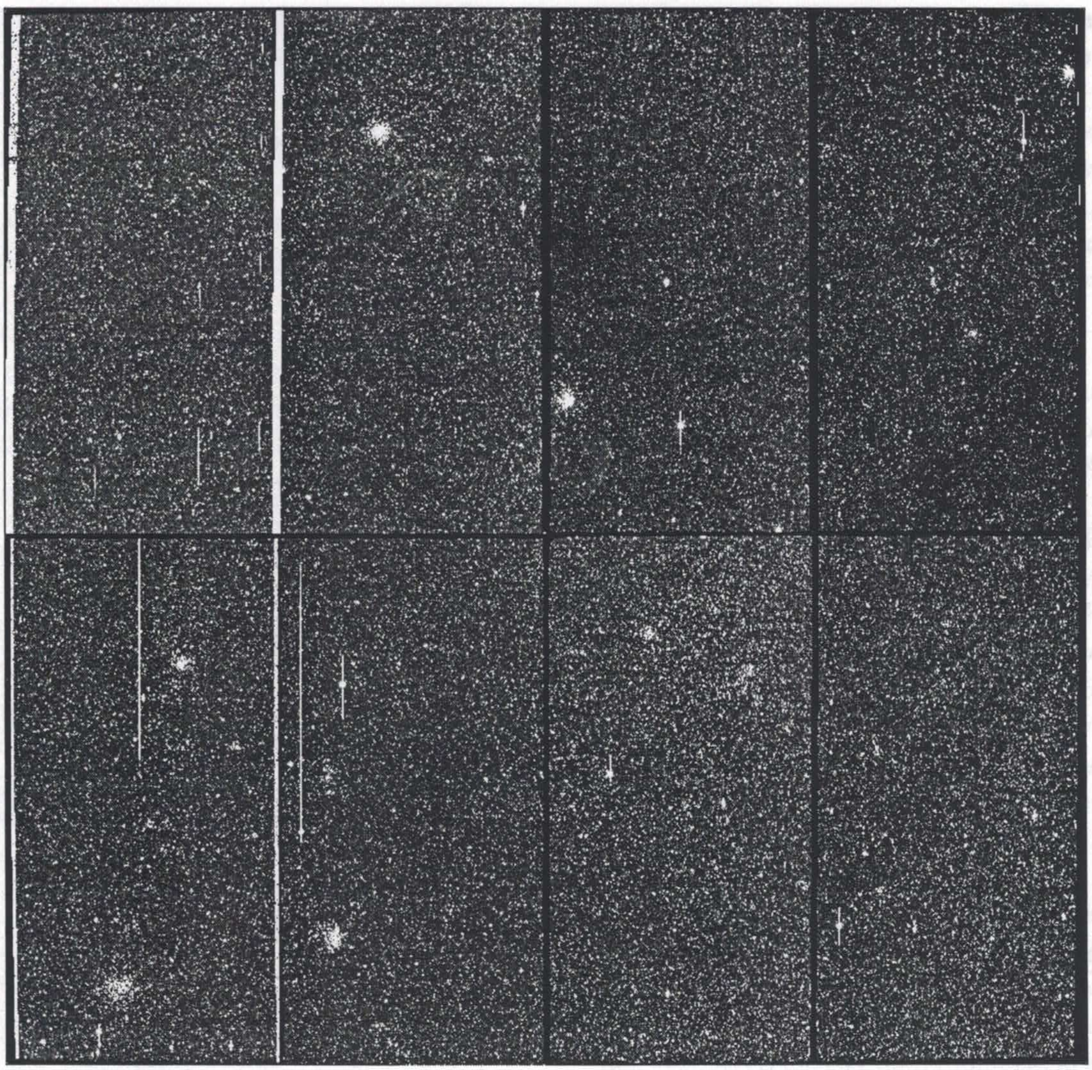


Photo credit: M. Shara (Am. Mus. of Nat. History), D. Zurek (STScI), and R. Schommer (NOAO)

continued

In summary, the Mosaic II offers a 36′×36′ field, with 0.27″/pixel in an 8K×8K mosaic of SITe 2K×4K CCDs, and is a clone of the Mosaic I camera, which has been in use at KPNO for 2.5 yrs.

Please check the web pages for details and updates (*http://www.ctio.noao.edu/mosaic*). The camera is currently in our La Serena labs for upgrades and maintenance between semesters, and is scheduled to be reinstalled at the Blanco prime focus at the end of February 2000. We hope to have dual-channel readout working at that time, so that 16 amplifiers will allow complete image readout and delivery time of less than 100 sec, about 1.5× faster than currently available.

Our experience with data reductions is still somewhat limited, but the advice is to get more disk space and a faster computer. Typical raw images from one night fill 5-10 gigabytes. Processing is very CPU and disk intensive (each image is, of course, 16× bigger than that of a 2K chip), so even overscan subtraction and median processes run at coffee-break rates. We have generally found that dome flats are useable to about 1-1.5% for large-scale flattening—to do much better probably requires careful creation of superflats from multiple sky exposures. CCD reductions and experience indicate that standards should be taken on every chip for careful (<1%) photometric reductions, as the chips have their own individual properties, such as slightly different sensitivities and color terms. Check our web pages and those of the KPNO mosaic for more comments about data reductions and camera characteristics.

We are collecting an image gallery for public viewing and access, so observers who have processed images should send us their final images if suitable. We currently are featuring multicolor images of Sculptor group galaxies (NGC 247 and NGC 300) as part of Cepheid and globular cluster searches, some deep R and I band imaging of high redshift SNe (z = 0.45–1.0) as part of a cosmology program, and a spectacular U-band image of an LMC field, showing some SNe remnants (OII emission), and giving 1" FWHM images in about 1 hour of stacked integration time (see attached figure, courtesy of Mike Shara, Am. Mus. of Nat. History and David Zurek, STScI).

HYDRA Soon to Have a New Camera

T. Ingerson (tingerson@noao.edu)

The new 400-mm Hydra camera and Site 2K×4K CCD combination is scheduled for final commissioning during the engineering run of March 23-24, 2000. Barring mishap, we expect that this combination will be ready for visitor use after that date and will replace the Air Schmidt/Loral system currently in use. When the new camera is ready, the efficiency, resolution, and number of fibers that can be used with Hydra will increase significantly. We can't promise anything until the new system is actually working, but things look good. Scheduled users of Hydra and proposers for future use should be sure to check the CTIO Hydra WWW page for the current status of the instrument before making plans.

"Stars, Gas, and Dust" Coming to La Serena

Knut Olsen (kolsen @noao.edu)

From March 15–18, more than 100 astronomers will meet in La Serena to attend the workshop "Stars, Gas, and Dust in Galaxies: Exploring the Links," organized jointly by CTIO, the European Southern Observatory, and the Las Campanas Observatory. For several years, the three observatories have held joint conferences roughly biannually. The last was held in 1997 and commemorated the 10th anniversary of the discovery of supernova 1987A in the Large Magellanic Cloud. This year's workshop seeks to develop a global view of the physics of galaxies. The workshop will open with a treatment of the interstellar medium in galaxies, starting with an inventory of its phases, with later discussion of the physics of interaction between the phases. Focus will then move to the stellar populations and their feedback to the ISM, first discussing single stars and their effect on their surroundings. Next, the star formation and chemical evolution histories of entire galaxies, including the important techniques used to derive these, will be discussed. Finally, the workshop will treat galaxy physics operating at large scales, including galaxy interactions and large-scale gas flows.

The workshop will be held at the newly built Caja de Compensación, which lies on La Serena's long and beautiful beach front. The astronomers will be working hard; however, registrants have been asked to provide and to come prepared to discuss one "burning" question that they would like addressed during the workshop. The last day will be devoted to discussions in small working groups, with programs previously prepared by appointed working group leaders. But, even astronomers have to play a little—in particular, everyone will be invited to test their salsa dancing skills following the workshop banquet. Hopefully there will be pictures!

Those interested in seeing the workshop program can link to the web page through CTIO's main page, ***http://www.ctio.noao.edu/***, or directly at ***http://www.eso.org/gen-fac/meetings/sgd2000***. For those not attending, the proceedings will be published in the ASP Conference Series following the meeting.

A Tip/Tilt System for the Blanco Telescope

P. Bouchet (CTIO, pbouchet@noao.edu), S. Lawrence (Columbia University), Crotts (Columbia University), and S. Heathcote (CTIO, sheathcote@noao.edu)

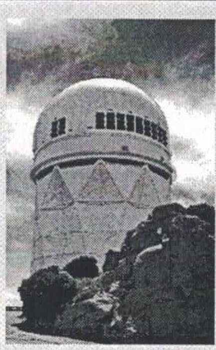
The Tip/Tilt System at the CTIO Blanco 4-m telescope offers first-order wavefront correction for high spatial resolution near-infrared imaging at the f/14 focus. The system is very user friendly, and doesn't require special technical skills from the observer to be operated efficiently. Advance preparation by the astronomer consists of identifying suitable guide stars at V = 8–16 magnitude within 2.5′ radius of the science target. The target itself can be used if it is pointlike and sufficiently bright at visible wavelengths. At the telescope, initial acquisition and setup is performed by the operator. The observer can interact with the guider and telescope to move the science FOV while guiding, disable guiding to go off to sky, move the guider to reacquire a guide star, etc.

The Tip/Tilt System is used in conjunction with CTIO's infrared instruments: CIRIM, OSIRIS, and IRS. It couples an optical sensor and active secondary to the instrument; a guider box ahead of the instrument provides guiding signals to the telescope at a slow rate (once every few seconds) and to the steerable f/14 secondary at a high rate (10-100 Hz).

The system can in principle operate under very poor seeing conditions; the maximum amplitude and frequency of the system are 3″ at 230 Hz. However, rarely are these limits pushed: typical displacements are <1″ at lower frequencies (the system is not designed for "chopping," or oscillations with amplitudes of many arcseconds). The optical quality of the mirror surfaces is the ultimate limit on system performance—this is currently being evaluated by wavefront curvature and Hartmann tests.

A complete description of the Tip/Tilt System, together with technical information, can be found in the Users Manual (P. Bouchet et al., 1999) included under the CTIO web page (*http://www.ctio/noao.edu/ctio/tiptilt/*).

As an example of the capabilities of the Tip/Tilt System, we present a series of near-infrared images taken during our campaign to monitor the evolution of SN 1987A as its ejecta impact with the circumstellar rings and give birth to a supernova remnant. For the observations reported here, we closed the loop on a nearby star, (Star 2, 3″ to the NW of SN 1987A, V ~ 14.5) with a frame rate of 50 ms. The resulting cutoff frequency for the uncorrected vs. Tip/Tilt corrected power spectra is ~ 1 Hz. This allowed us to obtain images with FWHM (prior to deconvolution) of 0.3″– 0.5″ with seeing of 0.6″–0.9″ (see the *Highlights Section* for further discussion of these observations).

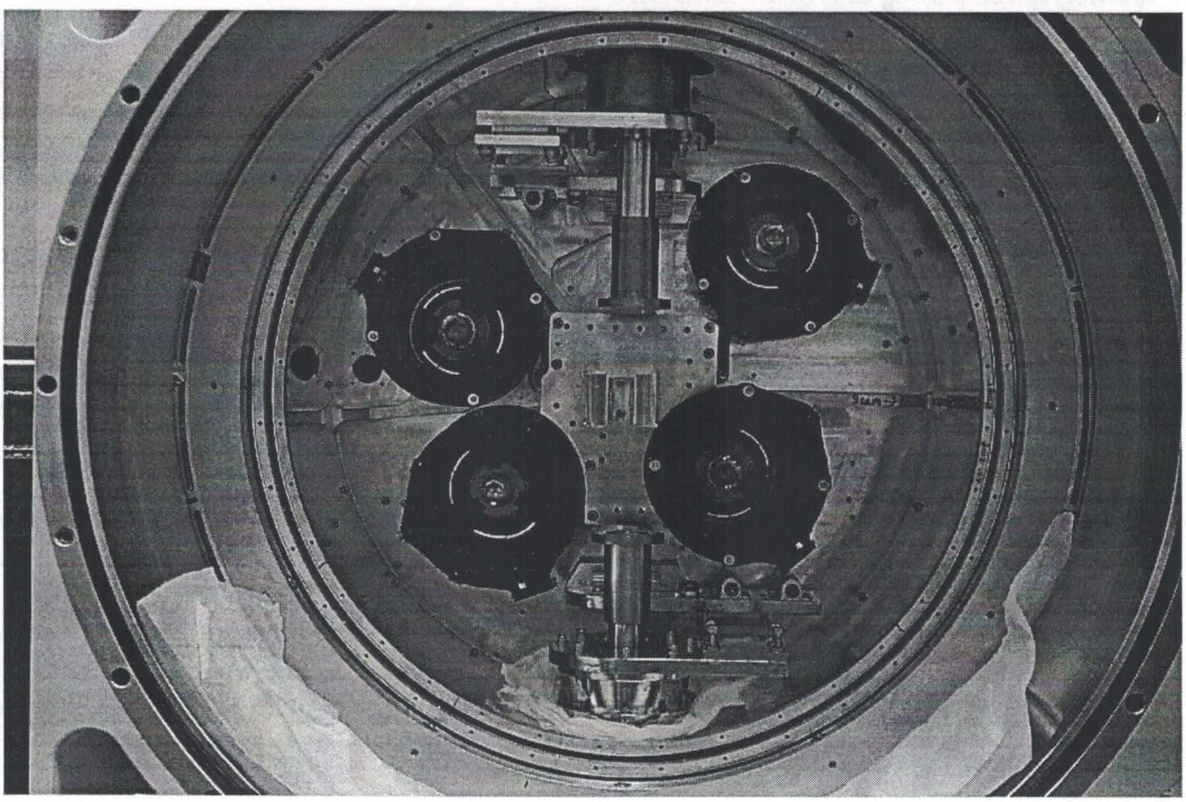


KPNO OPERATIONS

From the KPNO Director– Evolution of the IR Instrument Complement on Kitt Peak

Richard Green, for the KPNO Staff

As Gemini North is about to start its scientific operation, KPNO is beginning to deploy a new generation of IR instruments that exploit wide field of view. The first is the new incarnation of SQIID, the Simultaneous Quad Infrared Imaging Device, which has now been retrofitted with 4 InSb arrays from the ALADDIN development program. The optics will illuminate the inscribed circles of the 512 square quadrants. SQIID is now upgraded with science-grade arrays and is undergoing lab testing. Telescope testing is scheduled for late February.



SQIID, with new detectors to simultaneously image 3.3' of the sky in J, H, K, and L′, returns to KPNO in 2000B.

For Semester 2000B, SQIID will be the primary near-IR imager on both the 4-meter and 2.1-meter telescopes. It offers 0.39"/pixel on the 4-meter for a circular field of view of 3.3' diameter with broad-band J,H, and K filters, as well as a 3.28-μm narrow-band L filter. On the 2.1-meter, the scale is 0.68"/pixel with a circular field 5.8' in diameter.

You may propose for IRIM as your primary instrument only if your program requires narrow-band filters. Please do, however, state in your SQIID proposal whether IRIM is acceptable as a backup, in case we have opportunity to schedule IR imaging on two telescopes at once.

The advent of SQIID marks the completion of our arrangement with Ohio State University for the shared use of ONIS, their imager and spectrograph employing an NOAO ALADDIN InSb array. We feel that this agreement has worked strongly to the mutual benefit of NOAO and MDM users. The conscientious, capable, and cooperative support of the OSU staff has enabled us to offer a state-of-the-art instrument with good reliability and excellent technical backup.

A comparably large change in near-IR spectroscopic capabilities is underway. Phoenix will be moving South, either to Gemini or to CTIO, as recommended by the Users Committee. Its exact deployment is not currently settled, but it will be in transit and remodeling during Semester 2000B, and therefore unavailable for proposals. CRSP proposals will be accepted for the 4-meter only. There is a slight chance that CRSP will be wanted on an interim basis for early science with Gemini North. At this time, our best advice is to submit your CRSP proposal anyway, as the instrument will most likely be offered on the Kitt Peak 4-meter for Semester 2000B.

The exciting new prospect for imaging and spectroscopy is FLAMINGOS, the Florida Multi-Object Infrared Grism Observational Spectrometer. Richard Elston (Florida) reports that the mechanical and optical assembly is progressing well, easily on schedule for the first engineering run at Kitt Peak in July. The instrument design is based on a 2048^2 HgCdTe array from Rockwell, with a scale of 0.3"/pixel on the 4-meter at f/8. The dewar will contain three wheels, one with Lyot stops, one with filters for the J,H, and K bands, and one with grisms, planned for resolutions from 1000 to 4000. A small, separate dewar at the front of the instrument will accommodate 10 cold slit masks for multi-object spectroscopy.

FLAMINGOS will be available at the 2.1-meter as well, affording a field of view some 20' on a side. It will be shared with at least one other observatory besides KPNO, so its maximum availability will be somewhat under 50%. The pacing item for its deployment is the new detector array. KPNO is currently anticipating first scientific use in Semester 2001A. Watch the website and subsequent *Newsletters* for updates. Once FLAMINGOS is part of the instrument complement, IRIM is likely to be retired from service.

Finally, KPNO is exploring collaboration with the Space Telescope Science Institute and Goddard Space Flight Center for moderate resolution, multi-object spectroscopy. The goal is to produce a prototype operation of micro-mirror arrays as programmable multi-object masks. A preliminary design review is anticipated this spring.

Margaret Edmondson Graduate Student Fellowship

Sidney Wolff and Richard Green

*To enable graduate students to gain hands-on experience with astronomical instrumentation and observation, KPNO is pleased to announce the **Margaret Edmondson Fellowship** program, which will support extended visits to Kitt Peak to work on projects at the WIYN Observatory. Once each year we will fund travel and living expenses for a graduate student in astronomy, physics, optics, or engineering to spend a month working with NOAO and WIYN scientists and engineers. A diverse range of opportunities is possible, including observing and data analysis, instrument calibration, and technical and engineering projects. Participation in the program may lead to continuing scientific and technical collaborations.*

The fellowship was made possible by a generous gift from Dr. Frank K. Edmondson, Emeritus Professor of Astronomy at Indiana University. Frank served on the AURA Board for 26 years from its inception and, as its President, was active in the planning of the KPNO 4-meter telescope and the establishment of CTIO. The gift memorializes his wife, Margaret Russell Edmondson, his life's companion and daughter of the astronomer Henry Norris Russell.

The application should include a curriculum vitae, a description of the student's interests, and a statement about how this extended visit would benefit his or her graduate training. Please include the names and contact information for two references. Applicants will be selected based on their proposals and the match between student interests and available scientific and engineering supervisors.

Lodging and meals on Kitt Peak will be provided for students in the program. Applications for the coming year should be sent to:

Margaret Edmondson Fellowship Program

c/o Director's Office
Kitt Peak National Observatory
P.O. Box 26732
Tucson, Arizona 85726-6732

The application deadline is April 14, 2000.

Proposals for the 0.9-meter and Coudé Feed

Richard Green

Semester 2000B will be the last opportunity to propose through KPNO for observing time on the 0.9-meter and Coudé Feed telescopes. Proposals are limited to the completion of the scientific goals of programs for which time was allocated on the telescope in Semester 1999B or 2000A. Previously approved survey or long-term programs using Mosaic on the 0.9-m will be allocated 4-meter Mosaic time on a pro-rated basis starting in Semester 2001A.

Operations of the 0.9-meter and Coudé Feed Telescopes:

Request for Proposals

Richard Green

The NOAO, on behalf of the National Science Foundation, is soliciting applications for the continued operation of the 0.9-meter and Coudé Feed telescopes located on Kitt Peak. Because of its changing mission of increasing support of US users of the Gemini telescopes and of new community-based development projects, NOAO will discontinue operation of the two telescopes by the end of its Semester 2000B. We now solicit applications by institutions or consortia that are prepared to assume the full responsibility—technical, scientific, and financial—for operations of either or both of the telescopes. Applications will be reviewed by an independent panel of astronomers.

Factors to be considered in the evaluation include: 1) quality and significance of the proposed scientific programs; 2) educational impact of the proposed use; 3) plans for instrumenting the telescope; 4) plans for public outreach; 5) technical and financial resources available to ensure that the proposed program will be implemented successfully; and 6) benefit to the collective operations and scientific impact of Kitt Peak.

Proposals will be for continued operation of the telescope facilities on Kitt Peak. In the case of the Coudé Feed, the new operators will need to provide only a detector, data system, and guide camera, although additional dispersers may be desired after examination of the complement being offered. The 0.9-meter will require a scientific instrument and guide camera; proposers are urged to plan for upgrading the telescope control system within a year of the transfer of operations authority.

Letters of intent to submit a proposal should be sent to Richard Green and are due by 31 May 2000. Specifications for the telescope and estimated costs of operation will be available through the NOAO web page. Requests for additional information about the telescope and its performance should be directed to Richard Green.

The proposals themselves are due July 15.

Synoptic, Target-of-Opportunity, and Exploratory Observations at the WIYN Telescope

Abhijit Saha and Richard Green

The queue observing experiment on the WIYN telescope has been very successful. We have been able to explore techniques of ground-based queue observing well in advance of the advent of Gemini. We have learned important lessons about the impact of tuning the "rules" of executing the queue and the relation of expectations to user satisfaction. We have quantitative information to assess the success rate of executing programs that depend on special conditions. We have the growing body of literature to explore the relative rates of publication for queue vs. classical observing. The success of this experiment was made possible by the extraordinary expertise and care of the queue observers.

NOAO is now preparing to take on support for observations with the Gemini telescopes, including enhancement of its queue observing program. Consequently, a shift in observing support resources has been required. We must therefore conclude queue observing on the WIYN telescope in the manner that has become familiar to users at the end of the current semester (2000A). Most WIYN proposals for upcoming semesters must be submitted for classically scheduled programs. We hope that for most this decision creates only a minor increase in inefficiency and/or inconvenience, with the science goals still obtainable in the "classical" way.

However, there are some types of programs that are uniquely suited to service/queue observing. They include trying out ideas to obtain proof of concept or acquisition of optical ground-based data to support multi-wavelength observations through the "2-hour queue". Also valued are synoptic monitoring (a small fraction of a night, every so often) and target of opportunity (ToO) programs. In order to retain some of these unique science-enabling modes, we will continue with a modified "2-hour queue" and explicit support for synoptic observations.

A few nights will be reserved, mainly for "2-hour" queue programs. On other nights, which are allocated to observers in classical mode, some fraction of the night may be reserved for synoptic and ToO observations. These programs will be scheduled in advance, including the *specific* part of the night that will be used by an NOAO queue-observer. The total amount of time that is allocated in these ways will depend on both the number of proposals highly ranked and the observing resources available. As a very rough guide, we expect to be able to support 3 or 4 full nights for the "2-hour queue" mode, and some 10 additional quarter nights for synoptic monitoring and ToO programs.

With the current instrument complement and the limited number of queue observing hours, there

continued

will be restrictions on available modes. Synoptic programs will be confined to imaging only. Spectroscopic monitoring programs cannot be done on nights shared with the queue, since the regularly scheduled observer's setup will presumably be different from that of the monitoring program. For 2-hour queue programs, the highest ranked proposal will determine the configuration of Hydra or Densepak and the bench spectrograph on any given night. Thus, a maximum of three or four configurations will be used in a semester, based on TAC ranking.

Within this framework, the queue observers will do their best to match the best observing conditions to programs that require it. However, with a much reduced pool of observing time, there will be fewer instances of the "best conditions." In addition, exploitation of optimal conditions is no longer a primary objective of WIYN queue observing. We urge queue proposers to be mindful of this. We also urge users to obtain photometric zero-point calibrations independently of the "mini-queue," since these are an inefficient use of a now very small pool of time. With the limited resources, our eye will be towards enabling programs with high TAC grades that CANNOT be done in other ways.

Significant Improvement in 4-m DIQ

Phil Massey, Tony Abraham, Bruce Bohannan, Chuck Claver, Richard Green, George Jacoby, and Richard Wolff

Over the past few years we have been working hard to improve the delivered image quality (DIQ) at the 4-m, the "seeing" the astronomer measures. Starting in early 1996, we began nightly seeing measurements using a dedicated CCD camera and PC-based software, implemented by G. Jacoby. We have used these data, along with the recorded temperatures, to determine how to best spend our resources in trying to improve the situation. We were encouraged by the eventual success of similar efforts at the CTIO Blanco 4-m, although conversations with the staff confirmed our own impression—one has to do everything before there's any noticeable improvement.

We appear to have finally made it past that hurdle. The median seeing has dipped below the psychological 1.0″ barrier, and we see corresponding gains in both the 25th and 75th percentiles—in other words, the best seeing, the worst seeing, and the average seeing have *all* gotten better. The significance of this is striking when we compare the data semester by semester.

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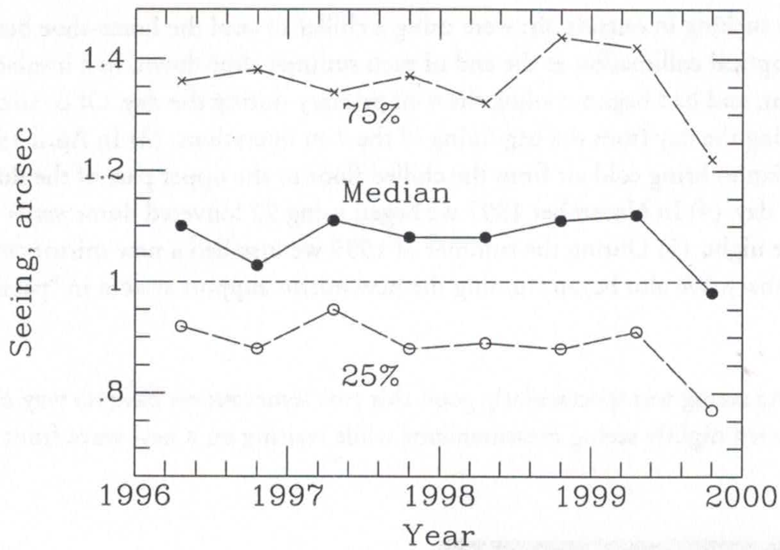


The median seeing at the Mayall 4-meter dropped below one arcsecond in semester 1999B, the best seeing has gotten better, and the worst seeing has too.

Below is a table:

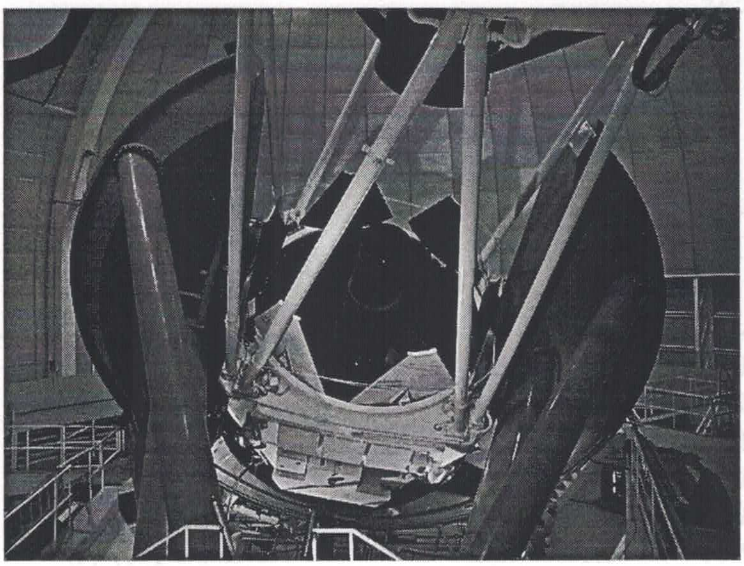
Semester (1)	Number of Points	Delivered Image Quality (arcseconds)			Improvements Implemented
		Median	25%	75%	Prior to 1996A (2)
1996A	116	1.10	0.92	1.36	
1996B	142	1.03	0.88	1.38	
1997A	120	1.11	0.95	1.34	
1997B	185	1.08	0.88	1.37	April 1997 (3)
1998A	211	1.08	0.89	1.32	November 1997 (4)
1998B	169	1.11	0.88	1.44	
1999A	202	1.12	0.91	1.42	
1999B	123	0.98	0.77	1.22	Summer of 1999 (5)

Notes: (1) Semesters "A" include the period 1 Feb through 1 Jul, while semesters "B" include the time period from 1 Sept through 31 Jan of the following year. The values correspond to a 10-second exposure through an "R" filter. We aim to obtain three measurements at night when the telescope is at f/8 and f/15; in practice we average about two. (2) Prior to the 1996A semester when we began regular DIQ measurements, we had

continued

begun using two large dome fans for sucking in outside air; were using a chiller to cool the horse-shoe bearing oil, had begun performing rigorous optical collimation at the end of each summer shut-down, had insulated the windows of the 4-m control room, and had begun cooling the 4-m primary during the day. Of course, the observing floor had been chilled during the day from the beginning of the 4-m operations. (3) In April 1997 we implemented a dome air mixing fan to bring cold air from the chilled floor to the upper part of the dome and prevent stratification during the day. (4) In November 1997 we began using 22 louvered dome vents to provide passive air mixing during the night. (5) During the summer of 1999 we installed a new mirror cover, and began extracting air over the primary. We also began running the new mirror support system in "passive emulation mode."

Of course, it could just be that the site seeing was spectacularly good this past semester; we have no way of knowing this as WIYN has discontinued nightly seeing measurements while waiting on a new wave front camera to be installed.



What made the difference in the delivered image quality at the Mayall? Was it the new mirror covers that allowed air to flush over the primary? Was it the dome vents that blew fresh air into the dome that could flush over the primary? Was it the air extraction system that exhausted air from over the primary, breaking up any residual thermals? Or was it a combination of everything we have done? Shall we experiment?

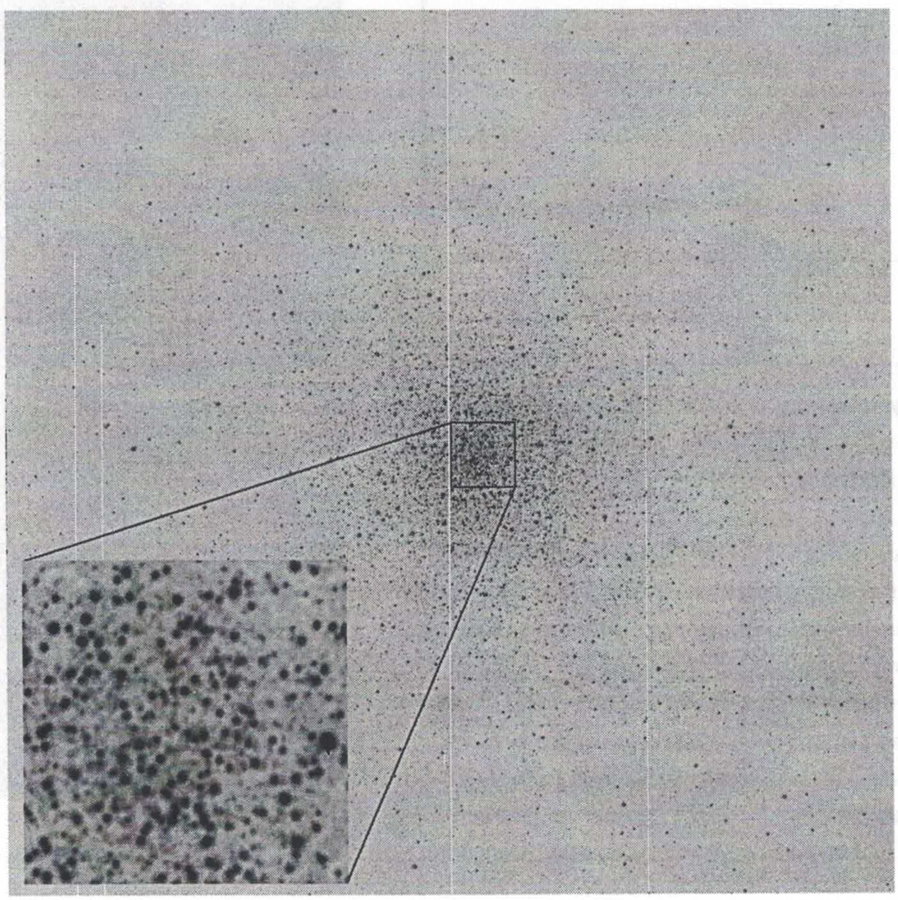
We are pressing ahead with additional improvements—a better primary mirror cooling system is being installed in late January, and this summer we will implement slow control of the tilt of the f/8 secondary to correct for systematic decollimation around the sky. Plus, our new 4-m active primary support system "4mAPS" is now fully operational, and we have begun running using look-up tables at all three foci in order to remove low-order aberrations.

The MiniMosaic Imager is On-Line at WIYN

Abhijit Saha

The WIYN telescope has a new imager, the MiniMosaic with two SITE 2K × 4K CCDs arranged side by side to provide a 4K × 4K viewing area. At the Nasmyth f/6.3 focus of WIYN, this imager covers an area that is 9.6′ on the side, with pixels that project to 0.14″ on the sky, thus providing good spatial sampling in even the 0.4″ seeing conditions that are increasingly common at the WIYN telescope. The combination of a relatively large field of view with the excellent images across the entire field produced by this camera (less than 10% change in point-spread function even in 0.4″ seeing) in excellent, naturally delivered seeing make the images suitable for stellar photometry in large, faint, crowded fields, which is a targetted goal for the WIYN.

Commissioning activities for the MiniMosaic have been completed, and the instrument has become the default imaging instrument at WIYN. The User's Manual for MiniMosaic is available at *http://www.noao.edu/kpno/docs.html* .

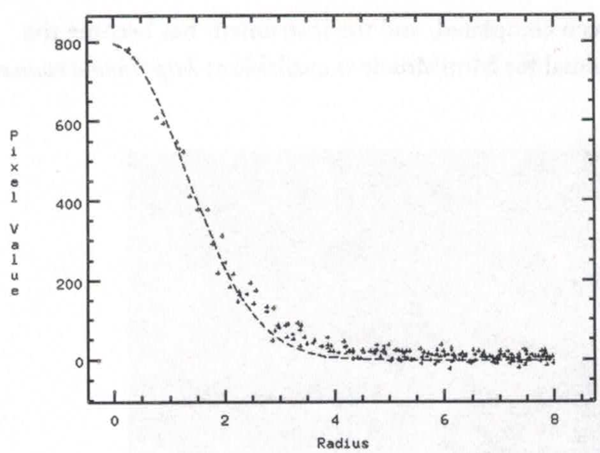


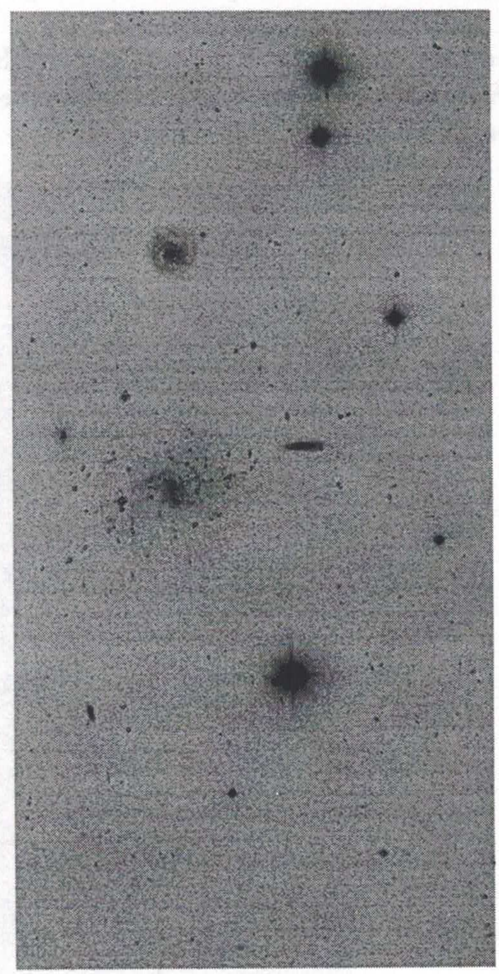
An image of the globular cluster M3 (NGC 5272) obtained with the MiniMosaic at WIYN. This 120- second exposure in the 'B' passband has stellar images with FWHM of better than 0.5″ that are uniform all the way to the corners of the 9.6′ on-a-side image. The insert shows how well the relatively small pixels in MiniMosaic sample the superb image quality obtained at WIYN.

Improving Imaging Performance at WIYN

D. Sawyer, C. Corson, A. Saha

A combination of recent improvement projects and focused maintenance have more than quadrupled the likelihood of obtaining 0.6″ or better images at the WIYN telescope. And the potential exists for yet further improvement. These efforts, coupled with the implementation of the MiniMosaic imager, which offers improved image sampling (0.14″/pixel), are allowing observers to routinely obtain images with what was once remarkable resolution.

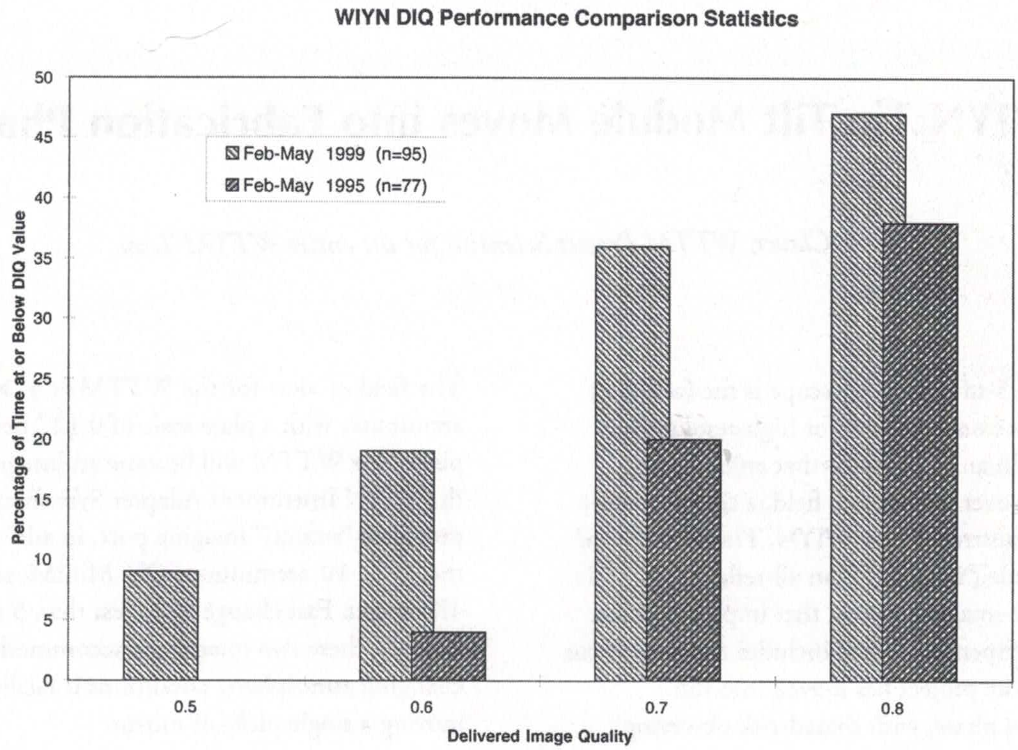




A section from a recent 20 minute MiniMosaic exposure by D.J. Pisano and E. Wilcots (Wisconsin) with 0.4″ stellar images shows the improved imaging performance at WIYN.

The improvement in delivered image quality (DIQ), as demonstrated in statistics based on 10-sec R-band exposures at the beginning of each night, are largely due to efforts that included balancing the primary mirror thermal control, refining the wavefront analysis routines and methods of tuning, improving the secondary mirror active control, and improved pointing and tracking (NOAO *Newsletter*, January 1999).

continued



Delivered image quality in February-May 1999 at WIYN included a number of nights when 0.4″ images were obtained, imaging performance not seen in the 1995 time period.

Since May 1999, the DIQ performance has further improved due to two major improvement projects. A 24-Hz resonance in the top end of the telescope, which was degrading DIQ by as much as 0.15″ in certain conditions, was successfully eliminated. In addition, a mechanical problem with one of the primary mirror lateral supports, which was contributing to unstable performance of the active support system, was discovered and corrected.

Our current imaging performance is the best it has ever been, with 0.5″ or better images obtained on 9% of the nights and 0.4″ seen on 2% of nights during the February-May 1999 interval. Wavefront aberrations are more stable night to night, with errors amounting to less than 200 nm RMS open-loop. Quantitative comparison of the current DIQ will be available when the wavefront camera is back on-line after upgrades that will allow the telescope operators to tune the optics on short enough timescales that wavefront measurements, and perhaps corrections, may be accomplished several times during the night without impacting observing efficiency.

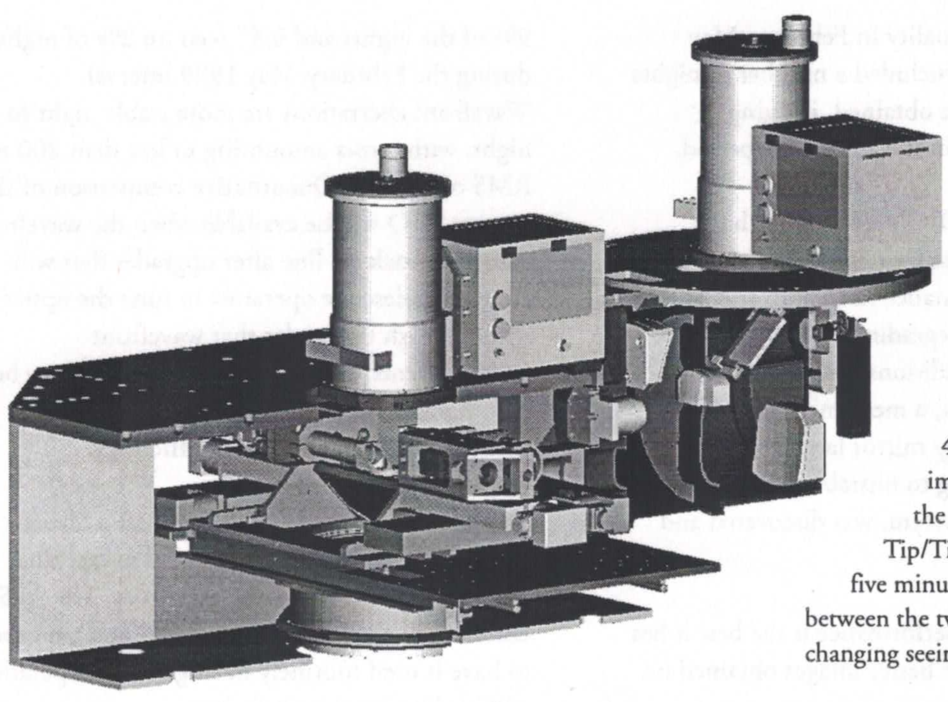
An auto-focus sensor (AFS) that uses a Shack-Hartmann test has been successful in tracking focus changes, even during exposures. The AFS is currently in the final tuning stages, and we expect to have it used routinely during science operations within the next month or two.

WIYN Tip/Tilt Module Moves into Fabrication Phase

C. F. Claver, WTTM Project Scientist, for the entire WTTM Team

The 3.5-m WIYN telescope is the facility of choice on Kitt Peak for high-resolution imaging. In an effort to further enhance this capability over a moderate field, a tip/tilt imager is being constructed for WIYN. The WIYN Tip/Tilt Module (WTTM) is an all-reflecting, visible near-IR re-imaging system that implements fast tip/tilt compensation and includes real-time focus sensing. The project has moved into the fabrication phase, with shared-risk observing projected for 2001B.

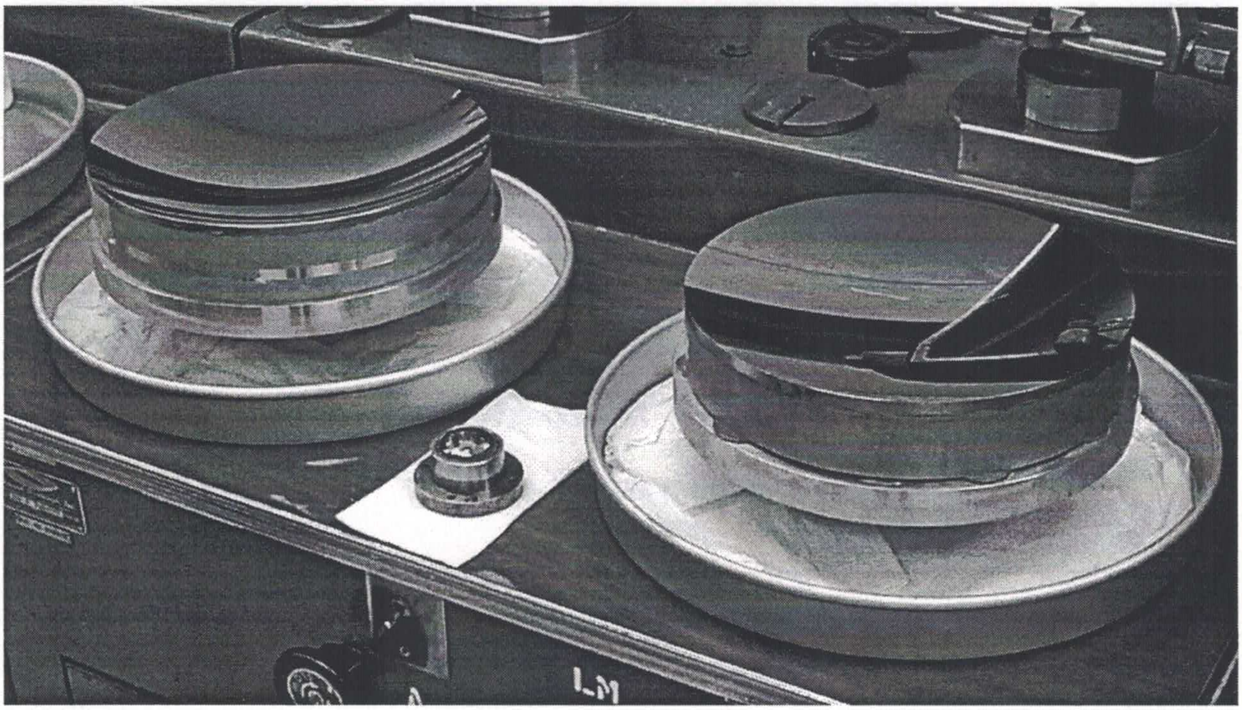
The field of view for the WTTM is 4′ × 4′ arcminutes with a plate scale of 0.12″ per 15 μm pixel. The WTTM will become an integral part of the WIYN Instrument Adapter System and provide a "second" imaging port, in addition to the 10 × 10 arcminute FOV MiniMosaic 4K × 4K imager. Fast change (e.g., less than 5 minutes) between these two imagers to accommodate changing atmospheric conditions is facilitated by moving a single pick-off mirror.



The imaging port at WIYN will accommodate both the 4K × 4K MiniMosaic imager (the left dewar in the image) and the WIYN Tip/Tilt Module, with less than five minutes required to switch between the two to respond to changing seeing conditions.

continued

To date, the bulk of the fabrication progress has been made in the WTTM's optics. In early July 1999 the WTTM project let a contract with Contour Metrological Manufacturing (CMM) of Troy, MI, for the diamond- turned off-axis mirrors. The WTTM project worked with CMM to refine the fabrication process of these optics. In the end, each mirror was made in axially symmetric pairs with a "dummy" surface of the on-axis parent surrounding them. This allows these optics to be treated as normal on-axis while being post-polished and tested. During January 2000, D. Vaughnn (WTTM Project Engineer) visited CMM for two days and conducted final acceptance testing of the three mirrors. All three diamond-turned assemblies have been delivered to NOAO. The off-axis spheres, the pupil re-imaging mirror, and the second camera mirror are ready for post-polishing in the NOAO optics shop. The first mirror in the camera, an off-axis asphere, was post-polished by CMM and awaits final inspection and testing at NOAO. The NOAO optics shop has been busy fabricating some of the optics for the WTTM error sensor.



The pupil re-imaging mirror and the second optic in the camera of the WIYN Tip/Tilt Module are ready for post-polishing in the NOAO optics shop after being diamond-turned by Contour Metrological Manufacturing.

At the heart of the WTTM is a fast tip/tilt stage manufactured by Physik Instrumente. This stage, its interface, and servo amplifiers were delivered to the project in mid-January. Initial testing is underway in the NOAO Electronics Lab.

The WTTM CCD imager uses the central 2K × 2K portion of a SITe 2K × 4K CCD. This device was originally designated engineering grade. It does have a cosmetically very good central region. Initial lab tests of this CCD have been completed successfully in the NOAO Detector Lab. Further tests await integration with the WTTM module later this year.

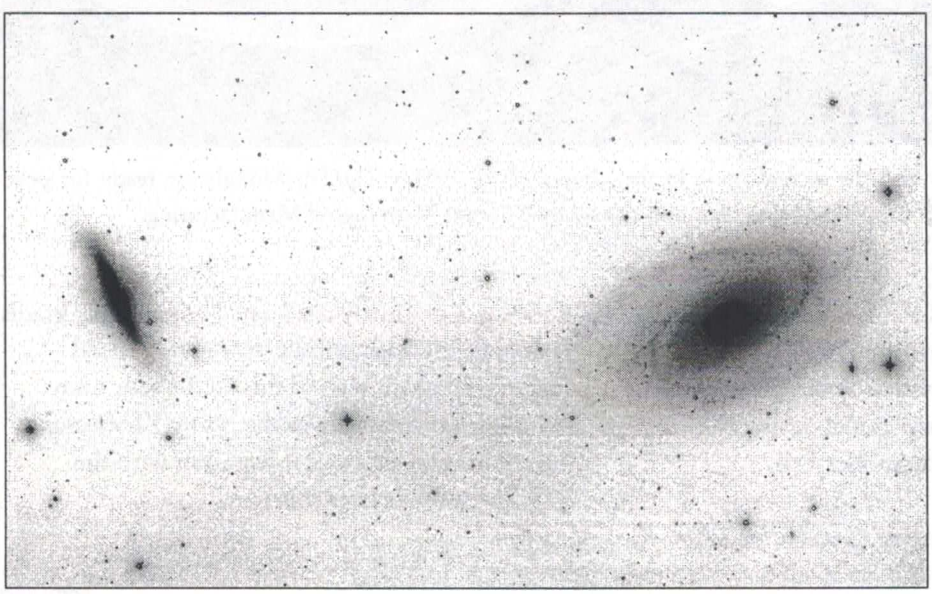
continued

After careful evaluation, the WTTM software system is being implemented under real-time LINUX with LabVIEW acting as a supervisory GUI and post-detection analysis suite. So that neither side is affected adversely by the other, a dual Pentium architecture is being deployed. The purchase of a 2 × 500MHz Pentium III machine with 256 Mb RAM to provide a large, shared-memory buffer was made in November 1999; and the system has been delivered, installed, and used in active development of the software simulation system. The detection of counts from the avalanche-photodiodes is being handled by two DUAL16CT counter/timer cards (two channels per card), and the transmission of values and receipt of status signals from the mirror electronics is carried out by a DIO316I digital i/o card. All three cards are actually 'Industry Pack' modules that attach to a single PCI-slot motherboard. The drivers for the PCI devices will likely be written in-house, and the high-level library software delivered with the modules has already been ported to LINUX.

With this activity, the WTTM is presently on schedule to begin commissioning during second quarter 2001 and is expected to have shared-risk observing in 2000B. To meet this schedule we will have the WIYN IAS in the Tucson Instrument Shop beginning 8 January 2001. During the eight weeks the IAS is "downtown," the WTTM project will make the necessary modifications and upgrades to the IAS for integration with the WTTM. During this time, the WIYN facility will be without wide-field imaging from the MiniMosaic. The January date is being driven by the Project's goal of not impacting prime North Galactic Pole time beginning with March dark-time through May, yet getting the WTTM on the telescope as soon as possible. The IAS will return to WIYN during March bright-time and undergo a brief recommissioning to ready it for the beginning of dark-time in March 2001.

CCD Mosaic Imager Status Report

George Jacoby and Taft Armandroff



The NOAO Mosaic CCD imager covers the sky on a scale previously possible only with photographic plates. This 60′×40′ section of the full 1°×1° field-of-view covers M81 and M82. This R-band image was taken at the KPNO 0.9-m by G. Jacoby and P. Massey.

continued

The NOAO CCD Mosaic Imager at KPNO has been operating smoothly with its SITe thinned CCDs since July 1998. No dramatic changes have been made to the system. Several recent upgrades are noteworthy for prospective users.

New Filters: Vendors have been experiencing difficulty in making filters in the 6-inch size needed by Mosaic. Nevertheless, since our last *Newsletter* article (September 1999), we have received the additions listed below. Detailed transmission curves are available at the Mosaic web page (***http://www.noao.edu/kpno/mosaic***).

Name	Central Wavelength	Bandpass
SDSS g′	4813	1537
SDSS r′	6287	1468
SDSS i′	7732	1548
Washington C	3860	1034
Helium II	4690	51
Carbon III	4653	52
Continuum 475	4750	51

Reduced Noise: Minor hardware and software changes were made during January 2000 to reduce the pattern noise on the Mosaic CCDs. While the noise was only reduced by about one electron, it is much more random now; the low-level moiré is gone.

New DAT Tape Drive: We have added a new DDS-4 DAT tape drive at the 4-m installation on the computer Pecan. These tapes can hold up to 20 Gbytes (uncompressed), and compression can be used to increase the capacity by ~50%. This drive also can write DDS-3 format tapes (12 Gbyte capacity uncompressed), which makes a convenient "1 tape per night" format, at a cost of roughly $20 per tape. KPNO will sell DDS-3 tapes on the mountain, but at a higher price to recover overhead costs—please bring your own.

New Display Software: The Mosaic display process (MSCDISPLAY) had been interpolating the 8K×8K pixels to fit into a screen of about 1K×1K. In doing so, some aliasing artifacts appeared, sometimes causing confusion to observers who could not be sure if they were seeing genuine noise patterns in the data. Frank Valdes has revised the display scheme so that no interpolation occurs; instead, the images are block averaged to fit into the available screen size. The only negative side effect of this change is that the displayed image may be slightly smaller than if interpolation were used.

continued

Optical Quality at the 0.9-m: Chuck Claver has recently aligned the telescope optics especially for Mosaic. Previously, alignment had been done for the popular T2KA CCD with its smaller field corrector, and the images in one corner of the Mosaic array (in CCD #1) were always sub-par. Today, the images are much improved with far better uniformity across the entire field. Reports of sub-arcsec images over the entire 1° field are not uncommon, and reports of 0.7–0.8" are no longer rare.

Scattered Light: There have been a few reports of very low-level scattered light from bright stars just outside the Mosaic field. We have been systematically testing at the telescope to track down potential sources of the scattering and have begun a ray-trace study to diagnose the problems further.

New MSCRED Available: Frank Valdes has been evolving the CCD Mosaic reduction package, MSCRED, to a mature state. The latest version is available at *ftp://iraf.noao.edu/iraf/extern/*.

Astrometry Error: Regrettably, an error in the astrometric solutions got propagated into the Mosaic headers for data taken between October 1998 and August 1999 under certain circumstances. At the KPNO 4-m, those circumstances are:

Filter	CCDs Affected
U	6
B	1, 5
V	8
R	1
"UB"	5, 8

At the KPNO 0.9-m, CCDs #1 and #5 are affected for I-band data. Note that images taken with any filter besides those listed above will use the V-band solution, so CCD #8 at the 4-m would be affected.

The magnitude of the error is small (a few pixels) in the affected CCD. Coordinates in those areas of the field will be slightly incorrect, and misalignment of dithered images may occur. The headers can be repaired using the task MSCSETWCS, using astrometric database files found in *mscdb* (*ftp://iraf.noao.edu/iraf/extern/mscdb.tar.Z*) in the directories *mscdb noao/kpno/4meter/wcs* and *mscdb noao/kpno/36inch/wcs*. Further details can be found on the Mosaic web page at ***http://www.noao.edu/kpno/mosaic/manual/recent.html***.

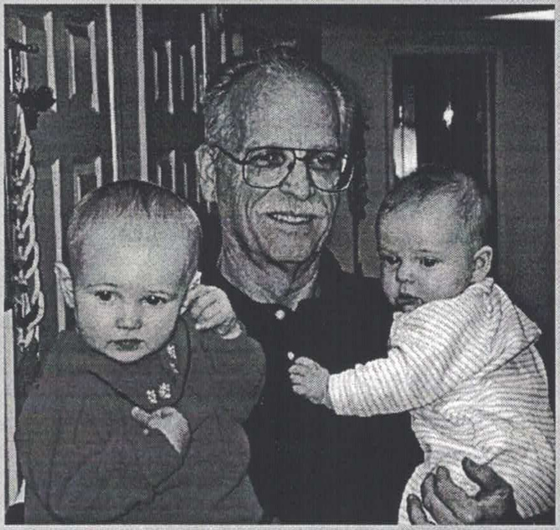
WIYN Board Commends Glen Blevins, Welcomes Pat Phelan

Richard Green

At its meeting last fall in Bloomington, Indiana, the WIYN Board recognized another major transition in NOAO personnel supporting the consortium. Glen Blevins had announced that, as part of his phasing down of professional activities at NOAO, he would be relinquishing his responsibility as Financial Officer of the WIYN corporation. Pat Phelan, NOAO's Business Manager, will be taking over that position and was warmly welcomed by the Board members.

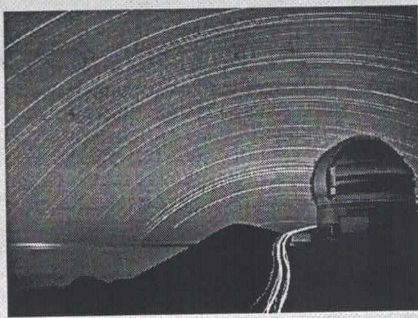
The Board expressed its appreciation for Glen's skill and dedication with the following resolution:

The WIYN Board of Directors, on behalf of the entire Consortium, expresses its gratitude and appreciation for the service contributions of Mr. Glen Blevins. As Financial Officer of WIYN from 1989 to 1999, Glen provided meticulous oversight of WIYN's financial records. His calm acuity was an important stabilizing influence through WIYN's many financial storms. His dedication and his advocacy of WIYN's interests went well beyond the requirements of his title. Without him, the complex trade-offs in the original WIYN Agreement would not have been formulated; and, without his persistent efforts, they may not have worked so well. Glen was one of the rocks upon which the WIYN organization has rested. The gentle assurance of his presence at WIYN Board meetings will be missed, but the high standards of professionalism and competence he set for all members of the WIYN organization will be remembered for years to come.



Seen here with his grandchildren, Glen Blevins, who for years served as the NOAO Manager of Central Administrative Services, is ramping down his professional activities at NOAO. The WIYN Board commended him for his responsibility as Financial Officer of the WIYN Consortium.

Here is another example of the broad range of expertise and skill required to create a dynamic observatory. As astronomers who benefit from WIYN, we all share the Board's gratitude to Glen for the creation of a successful and solvent consortium.



USGP

U.S. GEMINI PROGRAM

Evolution in the US Gemini Project Office

Bob Schommer, Caty Pilachowski, and Todd Boroson

As the Gemini Observatory evolves from a construction project into a working observatory and part of the suite of US facilities, the USGP will be evolving in both structure and personnel. Bob Schommer (based in Chile at CTIO) has become US Gemini Project scientist, as of 1 February, taking on the role that Todd Boroson has fulfilled for the past six years. Caty Pilachowski has become Deputy Project Scientist, coordinating aspects of the US project office in Tucson. Instrument support scientists drawn from both NOAO sites will be supporting US users of the Gemini telescopes, and for this year the principal players include Mike Merrill (for NIRI, the U. Hawaii IR imager and spectrograph), Tod Lauer (for Hokupa'a, the UH AO + IR imager, a "visitor instrument"), and Patrice Bouchet (for OSCIR, the Florida mid-IR imager and spectrograph, also a "visitor instrument").

Additional instrument scientists at both sites include Steve Ridgway, Nick Suntzeff, Bob Blum, Chris Smith, Ken Hinkle, and Jay Elias. All of these support scientists will be receiving e-mails for their specific instrument assignments via requests that users submit to the Helpdesk (see accompanying *Newsletter* article); their job is to help US astronomers understand the proposal process, prepare proposals, and reduce Gemini observations. They will interact closely with the International Gemini Observatory scientific staff and provide the needed additional resources to allow these telescopes to attain full scientific productivity as soon as possible. They and others at NOAO have had analogous roles as instrument or telescope scientists for KPNO or CTIO over the years, and the Gemini tasks are part of NOAO's role of supporting the US ground-based astronomy effort.

In addition, Taft Armandroff has been appointed US Gemini Project Manager, in charge of US instrumentation efforts for the Gemini Observatory. He will help define the US instrument packages and work actively with groups in the US community that have the interest and capability to build instruments for 8-m telescopes. Mark Trueblood, the USGP workscope manager, will work with Taft and help manage the on-going US instrumentation efforts. The USG Project Manager and Project Scientist will work together closely to coordinate US efforts and inputs to the Gemini Observatory to help achieve the scientific and technical goals that will advance the overall US astronomy effort.

In addition, Jeanette Barnes and members of the IRAF software group will provide support for data reduction for these new instruments and capabilities.

Gemini Help Just a Mouse-Click Away!

Caty Pilachowski

Have a Gemini question, but are not sure whom to ask? Help is just a mouse-click away:

- Send e-mail to *usgemini@noao.edu*, and we will direct your question to the NOAO staff member most capable of answering it.

- NOAO staff assigned to support users are listed on NOAO's web site at *www.noao.edu/usgp/noaosupport.html.* Just click on the person assigned in the area of your question to send your query directly by e-mail.

- Check out the Gemini Observatory's new HelpDesk at *helpdesk.gemini.edu*. Queries will be automatically directed to the appropriate person at NOAO (or in the National Project Office of your country of origin, for our readers in Gemini Partner countries), and you will receive notification by e-mail when your query has been answered. If NOAO staff are unable to answer your question, they will forward it to higher level experts—in some cases to those in other Partner countries or on to staff at the Gemini Observatory itself.

Gemini Mirror Scientists

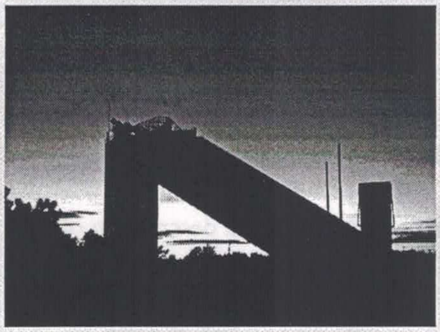
Caty Pilachowski

As the first Gemini Observatory nears completion and approaches science operations, NOAO is ramping up activity within the US Gemini Program to prepare to support US investigators awarded time on the new 8-m telescope. NOAO astronomers in both Tucson and La Serena have been assigned as Gemini instrument "Mirror Scientists," with the responsibility to assist investigators proposing for and receiving time on Gemini. The Mirror Scientists will serve the Gemini community just as NOAO's Instrument Scientists assisted our KPNO and CTIO users for many years; Gemini users can expect a similar, high quality of service. The Mirror Scientists have, collectively, decades of experience with comparable (in some cases, the same) instruments and can offer expert assistance.

If you have questions about Gemini instruments or about how to use those instruments, please contact NOAO's Gemini Mirror Scientists for help. You may also direct queries through the new Gemini HelpDesk (see accompanying article).

The NOAO scientists assigned to Gemini instruments are listed below:

NIRI	Near Infrared Imager	Mike Merrill, Bob Blum
QUIRC/Hokupa'a	UH AO Camera	Tod Lauer
OSCIR	Mid-IR Imager/Spectrometer	Patrice Bouchet
CIRPASS	Near-IR IFU Spectrograph	Jay Elias
GMOS	Optical Multi-Object Spectrograph and Imager	Chris Smith
Michelle	Mid-IR Imager/Spectrometer	Ken Hinkle
Phoenix	High Resolution near-IR Spectrometer	Ken Hinkle
T-ReCS	Mid-IR Imager and Spectrometer	Patrice Bouchet
Altair	Facility AO System	Tod Lauer
HROS	High-Resolution Optical Spectrograph	Nick Suntzeff
GNIRS	Near-IR Spectrograph	Jay Elias
NIRSPEC	Keck Near-IR Spectrometer	Ken Hinkle



NSO
National Solar Observatory

From the NSO Director's Office

Steve Keil

NSO has entered the dawn of the new Millennium by establishing its existence as an independent national center. As noted in the last Newsletter, NSO will continue its close ties with NOAO to support our operations in Tucson and on Kitt Peak, including the sharing of technical support for project development. NSO is in the process of developing its Long Range Plan and, as always, your input is encouraged. The NSO Users' committee met in November and their report appears in this Newsletter. *The report includes their reaction to parts of the Long Range Plan and their concerns about establishing an independent budget for NSO.*

The focus of the Long Range Plan will be completion and operation of SOLIS; development of high-order solar adaptive optics in collaboration with the New Jersey Institute of Technology (NJIT) and the Kiepenheuer-Institut für Sonnenphysik (KIS); completion of the GONG camera upgrades (from 256 × 256 to 1024 × 1024) to achieve local helioseismology; implementation of a new, large-format IR array detector system; and development of partnerships and a proposal to build a 4-m Advanced Solar Telescope (AST). (The first announcement about a one-day AST Workshop at the AAS/SPD in Lake Tahoe has been posted in *Solar News* and also appears in this *Newsletter*.) We plan to operate the existing low-order AO system (24 degrees of freedom) on several telescopes, including the Dunn Solar Telescope at Sac Peak, the McMath-Pierce on Kitt Peak, the KIS telescope on Tenerife, and the 64-cm at the Big Bear Solar Observatory. The low-order system continues to achieve spectacular science results, some of which can be viewed at ***http://www.sunspot.noao.edu/AOWEB***.

The AURA Observatories Visiting Committee (OVC) reviewed NSO's programs in October; the previous OVC review of NSO was in December, 1996. We appreciate the time the committee spent at both sites and their efforts to provide an assessment of the quality and plans of NSO. The committee report, as well as NSO's response to the report, have been accepted by AURA and submitted to the NSF. In general, the OVC found that NSO's program is well focused on new instrumentation and that it is producing outstanding scientific results. They were particularly complimentary of the management of the SOLIS project and of the results from the adaptive optics program. They were also very impressed with results emerging from IR measurements of chromospheric properties and coronal magnetic fields.

SOLIS remains on schedule for first light in 2001. We're planning for a period of overlapping operations with the existing patrol instruments so the synoptic data sets can be cross-calibrated before switching operations to SOLIS and

continued

shutting down the old telescopes. The length of this period depends on available resources (and pressures), but at a minimum will be one month, although we'll shoot for a longer period. A further update on SOLIS follows in this *Newsletter*.

Encouragement for those of you who have been hearing about "the next" 1-5 μm camera at the McMath-Pierce—a Request for Proposal was released in February. The camera will be based on a 1024 × 1024 Aladdin III array that has been allocated to NSO from what is now a respectable yield from the joint USNO/NOAO array development program. The camera will operate at a sustainable rate of >10 frames/sec and will have a choice of two internal (cold) demagnification factors to match the image scales of either the Main or E/W Auxiliary McMath-Pierce Telescope, as well as the DST. We will know more after proposals have been received and evaluated (by early May, we hope).

Routine operation of the RISE/PSPT (Precision Solar Photometric Telescope) instrument on Sacramento Peak began last month. There are plans to make the PSPT images available (with only crude calibration) "live" (near real time) on our WWW site. See *Newsletter No. 52* for a description of the RISE/PSPT project.

NSO looks forward to the arrival of two new scientific staff this year—Dr. Alexei Pevtsov and Dr. Han Uitenbroek. Alex, currently at Montana State University, brings to NSO extensive experience in observational astronomy in general, and with solar telescopes and vector magnetographs in particular. He's a leading expert in the measurement and modeling of magnetic helicity in the solar atmosphere. Han comes to us from the Harvard-Smithsonian Center for Astrophysics. He's a leader in the modeling of the solar atmosphere in two and three dimensions. His recent forefront scientific work has involved observations of the dynamical nature of the solar chromosphere, i.e., the COmosphere, based on high resolution CO imaging spectroscopy obtained at the McMath-Pierce telescope. Both Alex and Han will be on board by this summer.

20th NSO/Sac Peak Summer Workshop

Advanced Solar Polarimetry - Theory, Observation, and Instrumentation

11 – 15 September 2000
Sunspot, New Mexico

Registration and Abstract Deadline: ***30 June 2000***
Lodging Reservation Deadline: ***01 August 2000***
Local Transportation Request Form Deadline: ***21 August 2000***

For Complete Details:
http://www.sunspot.noao.edu/INFO/MISC/WORKSHOPS/2000/ws2k.html

Report of the NSO Users' Committee

Tom Ayres, Chair

The NSO Users' Committee met in Tucson on 16 November 1999. Present were committee members T. Ayres (Chair, Colorado), T. Duvall (NASA/GSFC, stationed at Stanford), P. Goode (NJIT), D. Jennings (NASA/GSFC), K.D. Leka (Colorado Research Associates), and R. Shine (Lockheed-Martin). T. Brown (HAO) and E. Hildner (NOAA/SEC) were not able to attend. This was the first full UC meeting with new Director Steve Keil, following an informal gathering at the Chicago AAS in June, 1999.

The Observatory has been making dramatic progress on a number of fronts, but faces significant challenges in the near future.

The Committee applauded the strong scientific staff of NSO, who, despite increasing erosion of their research time by service projects, have won the past two Hale Prizes (Dunn, Harvey), and have been Co-I's on recently-selected proposals to build Solar-B instruments and to participate in a Center for Adaptive Optics, among other successes. At the same time, staff turnover has been high, particularly among the junior researchers at the Sacramento Peak site.

The Observatory's major initiative, Synoptic Optical Long-Term Investigations of the Sun (SOLIS), has completed design and management reviews and is currently in the construction phase, proceeding to deployment in the 2001 time frame. NSO's previous large project, Global Oscillation Network Group (GONG), continues to acquire a long-term helioseismology record, now during the rise to the maximum of the present sunspot cycle. A plan to upgrade the original GONG cameras to high-performance 1K×1K CCDs has been implemented, and the system is expected to be operational in 2000.

At Sac Peak, a 20-actuator Adaptive Optics (AO) compensator has been demonstrated. The AO group is in the process of making it "user friendly" and is moving toward development of an 80-element system that would fully correct images from the 76-cm Dunn Solar Telescope—a vital step to the even more complex compensators required by large-aperture solar telescopes of the future. The 3-station RISE/PSPT network is complete, and Sac Peak's engineering role in the upgrade of the Air Force ISOON solar monitoring network continues. The infrared program at Kitt Peak has secured an astronomical quality ALADDIN InSb chip, as part of a long-term effort to upgrade the IR instrumentation on the McMath-Pierce telescope. The Advanced Solar Telescope (AST) effort is rapidly evolving from the discussion stage to concrete plans to pave the way for a proposal to develop enabling technologies, test potential sites, and eventually build the new facility. In addition, the popular Digital Archive is expanding its holdings and improving its search engine and user interface. McMath-Pierce nighttime observations continue under a self-funding plan.

The Committee was impressed with the steady progress made by NSO in all of the areas mentioned above, in spite of its eroding budget.

continued

The Observatory has been able to fund certain of these efforts from its base—the AO program, for example. However, these projects also compete for resources with other internal programs and under-funded external efforts (in particular RISE/PSPT for which construction money was provided, but support for operations was not). Some of these projects cannot continue without significant external funding. For example, full utilization of the new GONG cameras will require a major $1M upgrade of the data processing and analysis computers in Tucson. The AO program must have substantial funding to proceed to the 80-element compensator, with its more complex and demanding hardware requirements. The IR program needs a sophisticated dewar to house the ALADDIN array and an expensive controller to run it. The list goes on.

It is clear to the Committee that the present funding situation for NSO is not conducive to a healthy research organization. One must be able to support a mix of high-priority projects within the organization, not simply pick a top choice because that is all that a dwindling base budget will permit. The ultimate sufferers will be the users, who our committee represents, because NSO will not be able to push solar observing technology across a broad front of scientific disciplines. This would be a disaster for US solar physics, because unlike nighttime astronomy, the flagship ground-based observing facilities are at NSO sites. Thus, technological advances very much depend not only on NSO's willingness to develop them, but also its fiscal ability to do so.

It was against this backdrop that the Committee discussed the implications of a plan promoted by NSF and AURA to separate NSO from its parent organization, NOAO. There are several good reasons for an independent NSO, and many view it as essential if NSO is to obtain the credibility necessary to carry out a successful AST program. Such a separation carries potential dangers, however, to the extent that division of existing assets is not done fairly or if the administrative cost (ultimately borne by NSF) of running two independent organizations for daytime and nighttime astronomy exceeds that of the combined entity. The committee was unanimous in its concern over this issue and urges NSO to proceed cautiously in exploring it, and particularly to obtain a full accounting of the associated costs.

The committee discussed a number of other issues that might affect users. One was the degree of continuity in the changeover between SOLIS and KPVT synoptic data products. There clearly is a need for a substantial period of overlap between KVPT magnetograms and filtergrams and those provided by the SOLIS VSM and FDP instruments—at least a month—for cross-calibration purposes. This is somewhat of a tricky issue because the SOLIS site literally will be on top of—and completely blocking—the current KPVT. Thus, the "cross-calibration" cannot be carried out with SOLIS in its final observing location. Another issue involved the archiving of the huge flood of data that will be spewing out of SOLIS during its routine operations. Initially, the plan is to provide and archive a relatively limited set of observations, compatible with the synoptic material currently provided by NSO, but eventually to work toward retaining as much of the intermediate data products as future digital storage technology permits. Finally, the issue of the future of ground-based solar coronal physics was raised. Since the all-reflecting coronal imager was descoped from the original SOLIS plan to accommodate a funding shortfall, the future of ground-based coronal studies looks bleak; only the aging Evans facility will be available for such purposes, at a time when interest in exploiting newly discovered coronal diagnostics (such as

continued

magnetically sensitive Fe XIII λ 10747 in the near-IR) is on the rise. The perceived decline of ground-based coronal physics cannot be countered without substantial outside funding to develop a new facility; however, the incorporation of a coronagraphic capability in the AST might be a long-term solution.

In summary, the committee strongly endorses NSO's current plan to support its several projects that are critical to the user community and to develop—to the extent feasible from its base budget—the enabling technologies for a next-generation solar telescope, particularly high-order adaptive optics, site characterization systems (such as scintillometers), and infrared imaging and magnetography. The committee remains deeply concerned, nevertheless, over the recent attrition of the staff, the continuing depletion of staff research time, and the erosion of the base budget. Together, these factors restrain NSO from pressing forward key solar observing technologies—and solar research—across a broad front of disciplines. In the near future, a concerted effort will have to be made to convince the US solar physics community, the national funding agencies, and potential international partners to make a strong commitment, financial and otherwise, to support the aspirations of NSO to carry ground-based solar physics to the next level—a state-of-the-art, large-aperture daytime facility.

Advanced Solar Telescope (AST) Workshop

Steve Keil

We invite your participation in a one-day workshop to discuss ideas and formulate plans for a large-aperture (4-m) Advanced Solar Telescope (AST). The meeting will be from 9:00 am to 5:00 pm on Sunday, 18 June at Caesar's Tahoe, preceding the SPD meeting and following the SHINE meeting. The goal is to discuss science drivers and design concepts for the AST and to form working groups for issues such as site testing, telescope technologies (e.g., adaptive optics, thermal, scattered light), and advocacy. The meeting will consist of a few short introductory talks outlining some of the drivers for an AST, followed by focused discussion of science drivers, siting and site tests, telescope design, community involvement, strategies, and international participation. There will be time for short contributed presentations followed by moderated discussion. The preliminary agenda is as follows:

- Introduction to the AST
- AST Science Drivers
- Developing AST Technologies
  - *–Adaptive Optics*
  - *–IR*
  - *–Mirror Technologies*
  - *–Scattered Light Issues, Coronagraphy*
- Telescope Concepts & Design Issues
- Site Testing
- Strategies
  - *–Community Involvement*
  - *–Formation of Working Groups - Instrument Packages*
  - *–Partnerships (National and International)*
- Summary
  - *–Design Drivers*
  - *–Critical Telescope Capabilities*

continued

If you're interested in participating, please send an e-mail to *nso@noao.edu* and additional information will be provided. Our second announcement will have a full agenda and details on the workshop logistics.

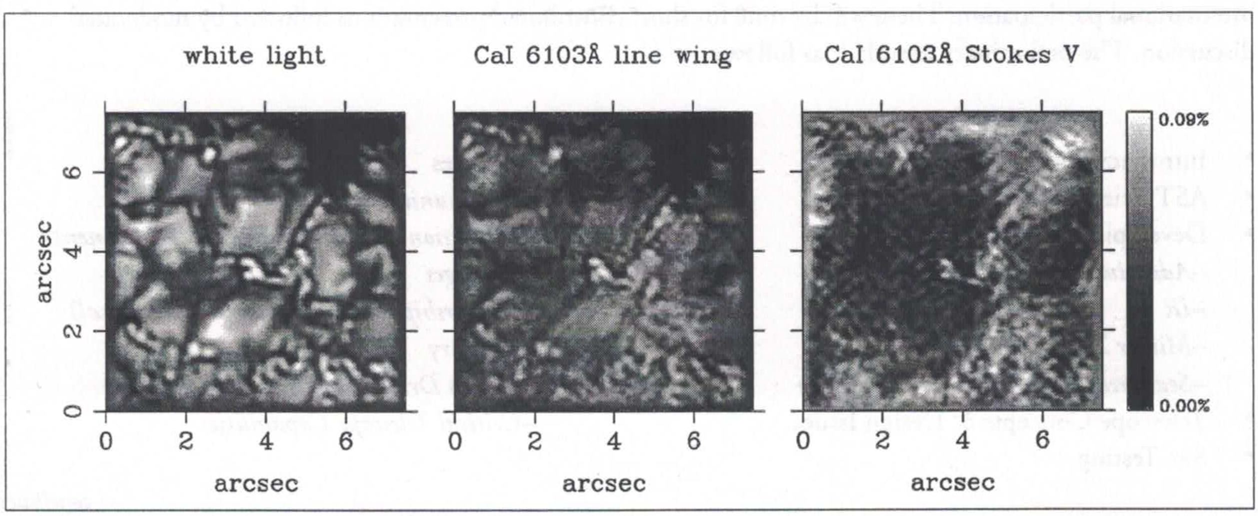
The organizing committee includes Tom Ayres (CASA), Phil Goode (NJIT), Christoph Keller, Michael Knoelker (HAO), Jeff Kuhn (Hawaii), Thomas Rimmele, Bob Rosner (Chicago), Jack Thomas (Rochester), and Alan Title (Lockheed).

Diffraction-Limited Magnetogram Movies

Christoph Keller, Thomas Rimmele, and Rick Paxman

Rick Paxman, John Seldin, Dave Carrara, and Kurt Gleichman of ERIM International in Ann Arbor, Michigan, and Thomas Rimmele and Christoph Keller of NSO recently joined forces to obtain the highest resolution magnetogram movies ever obtained. The ERIM team was responsible for restoring the images with phase-diverse speckle imaging; Rimmele operated the adaptive optics system at the Dunn Solar Telescope to provide the best possible image quality, and Keller ran the Zurich Imaging Polarimeter I (ZIMPOL) and performed the speckle deconvolution of the narrow-band images and magnetograms. The adaptive optics corrected the low-order aberrations with an update rate of about 1.5 kHz and fed a narrow-band channel with the Universal Birefringent Filter in the wing of the Ca I 610.3 nm line and two white-light channels that were used to obtain an in-focus and an out-of-focus image for the phase-diversity processing, which removes the remaining aberrations. All three channels were equipped with a ZIMPOL I camera running simultaneously at 5 frames/s. The one-hour duration was limited by the available hard-disk space.

This combined attack for obtaining the best magnetogram movies of the solar surface was very successful and led to spectacular time sequences with a consistent spatial resolution of better than 0.2″. While the team is still optimizing their data reduction process, they have made some movies available via the web at ***http://www.noao.edu/noao/staff/keller/aopds***. An example of a single frame from one of the movies is shown below.



SOLIS

Jack Harvey

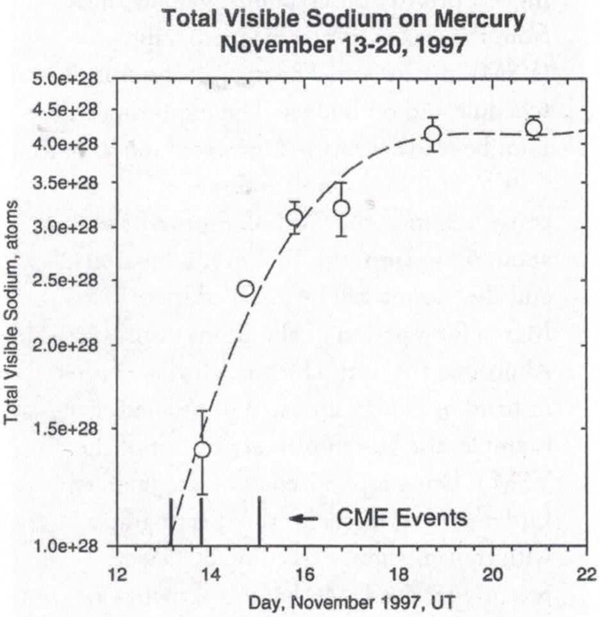
The SOLIS project is now about one year away from first light. Emphasis is on the highest priority observations, namely those from the vector spectromagnetograph (VSM) instrument. The manufacturer is on schedule and on budget. The mounting will soon be ready for its first powered movement tests. A SOLIS test area is under construction at the GONG prototype site about 5 km from the Tucson headquarters, and the mount will be installed there in March for a period of about one year. Almost all the optics for the VSM are either in hand or being fabricated or ordered. For example, the 50-cm primary mirror of the VSM is being aspherized as of late January. Order-sorting filters for the spectrograph with transmissions exceeding 80% were recently received. Mechanical activities are on schedule. Electronics activities were set back by the departure of a senior electronics engineer, which will cause a delay in the data acquisition system fabrication; however, the position has been filled. A focal plane guider system operating in a feedback loop with the agile secondary mirror significantly beats the required 40 Hz bandwidth. Software activities are progressing well with the development of engineering GUIs, and GUI-to-instrument-and-back testing is in progress. The software group has obtained first data from the integrated sunlight spectrometer CCD camera.

Rapid Changes in Mercury's Sodium Exosphere

Drew Potter (NASA/JSC)

Sodium in the atmosphere of Mercury can be detected by sunlight scattered in the D_1 and D_2 resonance lines. Images of the sodium emission show that the sodium density changes from day to day and is often concentrated in regions at high or mid latitudes. Drew Potter (NASA/JSC) and Tom Morgan (SWRI) suggested that sputtering by magnetospheric particles was the origin of the sodium. A problem with this is that the magnetic field of Mercury is strong enough that it is believed to shield the surface from solar particles much of the time, although particle precipitation at the magnetospheric cusps could deposit particles to the surface at high latitudes. Ann Sprague (UA/LPL) noted that the "spots" of sodium emission tended to coincide with major geologic features, such as the Caloris Basin. She proposed that the sodium is released from sodium-rich surface rocks that are associated with these features; however, some spots have appeared where there are no obvious geologic features.

Some of the difficulty in ascribing a source for the sodium arises from the effect of terrestrial atmospheric blurring of the image. It is hard to tell exactly where the sodium emission originates after the atmosphere has blurred the image. Potter, Killen (SWRI), and Morgan recently developed a technique for correcting sodium images for atmospheric blurring, using images made with a large-area image slicer. They applied this technique to a series of Mercury sodium observations made in November, 1997 at the McMath-Pierce Solar Telescope (*Planet. and Space Sci.* 47, 1441, 1999). Their technique for producing images from the spectroscopic data provides images of both the sodium emission and of the sunlight reflected from the surface. These images are exactly simultaneous with one another, so that the atmospheric blurring is exactly the same for each. They computed a good guess for the actual seeing function by comparing the observed surface reflection image with a theoretical model of the surface reflection image. They then used this function to correct the sodium images for atmospheric blurring. The corrected images show large daily changes in the distribution of sodium over the planet. The sodium emission was brightest at longitudes near the sub-solar longitude in the range 130° - 150°, with excess sodium at northern latitudes on some days, and excess sodium at southern latitudes on other days. There are no obviously outstanding geologic features in this range of longitudes. The rapid changes observed during this period suggest a connection with solar activity, since the planet itself is apparently geologically inactive. The total planetary sodium increased by a whopping factor of about 3 during these few days, while the F10.7-cm solar flux during this period varied only slightly, with an increase of about 15%, which is probably insufficient to account for the observed changes. However, there were a number of coronal mass ejection (CME) events, some of which were directed towards the general area of Mercury. The figure below shows the total sodium plotted as a function of time, with the three major CMEs. It is suggested that the changes in the visible neutral sodium atmosphere might be a direct result of solar weather, in particular, the effects of CMEs on Mercury.



Total visible sodium on Mercury, November 13-20, 1997

Coronal Holes Coming to You

Harry Jones

Harry Jones and NSO summer REU student Chad Bender (Illinois/Urbana-Champaign) analyzed imaging spectroscopy in the He I 1083 nm line of a solar coronal hole observed near disk center, and reported first results at the Atlanta AAS meeting in January. Observations were made on 12 January and 26 February 1999 with the NASA/NSO Spectromagnetograph at the NSO/Kitt Peak Vacuum Telescope. Jones and Bender computed images of the equivalent width of the He I absorption feature, along with its wing asymmetry as determined by the difference in wavelength positions between the line bisector at 30% of central line depth and line center. Dupree, Penn, and Jones (*ApJ* 467, L121, 1996) previously used a similar

continued

measure to show that excess blue absorption, indicative of line-of-sight motion towards the observer, is found preferentially in some polar coronal holes where the line is weakest. They suggested, on the basis of the variation of this asymmetry with heliocentric angle over the limited span of their observations, that these motions are vertical and are candidates for source regions of high-speed solar wind. Jones and Bender confirmed that this phenomenon can be observed in coronal holes at disk center with a magnitude (7-9 km/s) and center-to-limb behavior consistent with the results of Dupree et al. Motions parallel to the solar surface cannot explain the observations so that the areas of large blue asymmetry point to solar outflows low in the transition region. Whether these flows continue higher in the atmosphere can, in principal, be clarified by spacecraft EUV spectroscopy, although results to date do not present a clear picture. Preliminary analysis of observations obtained in November, 1999 show similar outflows and were obtained in collaboration with the SUMER EUV spectrometer on the SOHO spacecraft. Detailed comparison with the spacecraft data by Jones and Don Hassler, of the Southwest Research Institute in Boulder, will begin shortly.

Sunspot Spectroscopy

Peter Bernath (University of Waterloo)

The McMath-Pierce Fourier transform spectrometer (FTS) offers strong laboratory astrophysics support for solar physics and for the study of cool astronomical sources. The infrared and visible spectra of cool objects are dominated by the spectra of molecules such as TiO, SiO, H_2O and HF. All of these molecules have been detected in sunspots using high-resolution spectra recorded with the McMath-Pierce FTS. L. Wallace (KPNO) has reduced the solar and sunspot spectra into a series of spectral atlases (Wallace et al., *ApJ* **106**, S165, 1996), that are available electronically through the NSO WWW site. P. Bernath (Waterloo) and R. Ram (Arizona) have been assisting with the molecular line identifications by the joint analysis of laboratory and astronomical spectra recorded mainly with the McMath-Pierce FTS.

Solar and sunspot spectra provide a convenient source of very hot molecules (3000-6000 K). Laboratory spectra are generally cooler, but are of higher quality because of the narrower line widths. The two types of data are very complementary and have been combined to improve the spectroscopic constants and the line lists. For example, we have combined sunspot data for the *d* (Ram et al., *ApJ* **107**, S443, 1996) and *g* (Ram et al., *ApJ* **122**, S331, 1999) systems of TiO with laboratory measurements recorded with a hollow cathode lamp. These analyses are currently the best available for the near-infrared TiO bands that dominate the spectra of M-type stars and sunspots. Similar joint analyses are continuing for hot water in the infrared, a.k.a."Water on the Sun," (Polyansky et al., *Science* 277, 346, 1997; *ApJ* **489**, L205, 1997), and have been completed for SiO (Campbell et al., *ApJ* **101**, S237, 1995).

NSO Observing Proposals

Dick Altrock

The current deadline for submitting observing proposals to the National Solar Observatory is 15 April 2000 for the third quarter of 2000. Forms, information, and a User's Manual are available from the NSO Telescope Allocation Committee at P.O. Box 62, Sunspot, NM 88349 for Sacramento Peak facilities (*sp@sunspot.noao.edu*) or P.O. Box 26732, Tucson, AZ 85726 for Kitt Peak facilities (*nso@noao.edu*). A TeX or PostScript template and instruction sheet can be e-mailed at your request, obtained by anonymous *ftp* from *ftp.sunspot.noao.edu* (cd *pub/observing_templates*) or *ftp.noao.edu* (cd *nso/nsoforms*), or downloaded from *www.nso.noao.edu*. A Windows-based observing-request form is also available at the WWW site.

NSO Telescope/Instrument Combinations

Dunn Solar Telescope (SP):

Echelle Spectrograph
Universal Spectrograph
Horizontal Spectrograph
Universal Birefringent Filter
Fabry-Perot Filter System
Advanced Stokes Polarimeter
Slit-Jaw Camera System
Correlation Tracker
Branch Feed Camera System
Horizontal and Vertical Optical Benches for visitor equipment
Optical Test Room

Evans Solar Facility (SP):

40-cm Coronagraphs (2)
30-cm Coelostat
40-cm Telescope
Littrow Spectrograph
Universal Spectrograph
Spectroheliograph
Coronal Photometer
Dual Camera System

Hilltop Dome Facility (SP):

Hα Flare Monitor
White-Light Telescope
20-cm Full-Limb Coronagraph
White-Light Flare-Patrol Telescope (Mk II)
Sunspot Telescope
Fabry-Perot Etalon Vector Magnetograph
Mirror-Objective Coronagraph (5 cm)
Mirror-Objective Coronagraph (15 cm)

McMath-Pierce Solar Telescope Facility (KP):

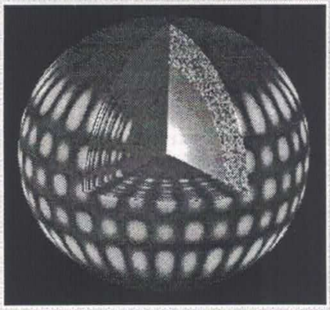
160-cm Main Unobstructed Telescope
76-cm East Auxiliary Telescope
76-cm West Auxiliary Telescope
Vertical Spectrograph: IR and visible gratings
Infrared Imager
Near Infrared Magnetograph
CCD cameras
1-m Fourier Transform Spectrometer
3 semi-permanent observing stations for visitor equipment

Vacuum Telescope (KP):

Spectromagnetograph
1083-nm Video Filtergraph

Razdow (KP):

Hα patrol instrument



GONG

Global Oscillation Network Group

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 rich data set that is resulting. GONG data are available to any qualified investigator whose proposal has been accepted. Information on the status of the project, the scientific investigations, as well as access to the data, is available on our WWW server at ***www.gong.noao.edu.***

Although the network hiccuped briefly through the passage into the new millennium, the Project embraces Y2K as we near the transition to the high-resolution GONG+ network. Components and subsystems of the 1024^2 camera systems are arriving daily, and the production and integration of the GONG+ systems is in full swing. The DMAC is gearing up as well, and is looking to the review of the GONG+ processing changes by the DMAC Users' Committee. Deployment teams are being identified and procedures readied. The first team should hit the road for California shortly.

Operations

The GONG telescope network performed well through the last quarter of 1999, despite several periods of downtime. Udaipur and El Teide suffered weather related shutdowns from the monsoon in India and the onset of winter storms in Tenerife, respectively. In addition, some scheduled downtime was incurred when preventive maintenance trips were made to Mauna Loa in October and Udaipur in December. Downtime due to hardware can be traced to tape-drive failures (somewhat routine) and an unreliable GPS receiver at Learmonth. The GPS problem required reprogramming several times before a spare receiver arrived on site.

A day of data was sacrificed at Udaipur and Mauna Loa when tests were run to improve the determination of the orientation of the camera rotator. The measurements were performed at the two sites, nearly simultaneously, to determine the consistency of the alignment method around the network in conjunction with the Mercury transit, 15 November 1999, which allowed us to independently verify the technique (see Data Algorithm Development). The GONG+ prototype instrument in Tucson also observed the event.

After a preventive maintenance visit to CTIO last Spring, an unusual variation appeared in the velocity data. A new power supply, which had been installed for the temperature-stabilized oven, was identified as the culprit and the old method of delivering power to the oven was rapidly restored. The power supply was not able to keep the Michelson interferometer sufficiently stable, thus producing the anomalous signal. However, the periodic variations in the data are of such low frequency that the effects on the p-mode results should be negligible.

continued

Data Management and Analysis

During the past quarter, the DMAC produced month-long (36-day) velocity, time series, and power spectra for GONG months 40, 41, 42, and 43 (ending 990801), with respective fill factors of 0.83, 0.87, 0.89, and 0.83, and tables of mode frequencies, which were computed from the power spectra using the three-month-long time series centered at GONG months 36, 37, 38, 39, 40, and 41. The main development activity currently underway in the DMAC is related to the development and testing of the GONG+ camera and data system upgrade.

Data Algorithm Developments

(and Some Science)

As mentioned in the previous *Newsletter*, we have compared the results of peakfitting a 108-day time series containing two different versions of Month 36 (with and without the rectangular pixel correction). Fortunately, a comparison of the inversions showed no significant differences, in contrast to the test performed with a 36-day time series. We conclude that the processing change has had no significant systematic effect on the fitted frequencies; therefore, we will not reprocess the first 35 months to include this change. Meanwhile, we now have a history of the solar cycle variations up through GM 42.

Inversions of the even-splitting coefficients are continuing. As reported in the last *Newsletter*, the images of the temporal variations in the solar structure are similar to those of the flows—bands of enhanced sound speed are seen to migrate from high latitudes at solar minimum to lower latitudes as activity increases. However, it currently appears that the bands of increased sound speed are confined to shallow depths very close to the surface, in contrast to the torisonal oscillation pattern which extends down at least 60,000 km. There are also indications that the rotation rate at the bottom of the convection zone is periodically changing. With the large number of new results, a small informal workshop on the recent helioseismic observations of the solar cycle and their theoretical implications was held January 6-12 in Boulder.

In anticipation of the deployment of the GONG+ system, work continues to improve the angular registration between simultaneous images at different sites. Tests with artificial data indicate that we will be able to achieve a precision of better than 0.01° (0.7 pixel at the limb) in relative angular offset between simultaneous measurements. The verification of this measurement with actual multi-site data will be a very high priority during the deployment of GONG+. On the other hand, the accuracy of the absolute value of P (the position angle of the solar rotation axis) is also vital. For local helioseismology analyses such as ring diagrams, a 0.01° error in the P angle results in a maximum 2 m/s velocity error near the limb. While we are continuing to improve the analysis of the drift scans, which provide the zero point for P, the transit of Mercury, which occurred in November, provided a rare opportunity for an independent determination. Analysis of the data is still underway.

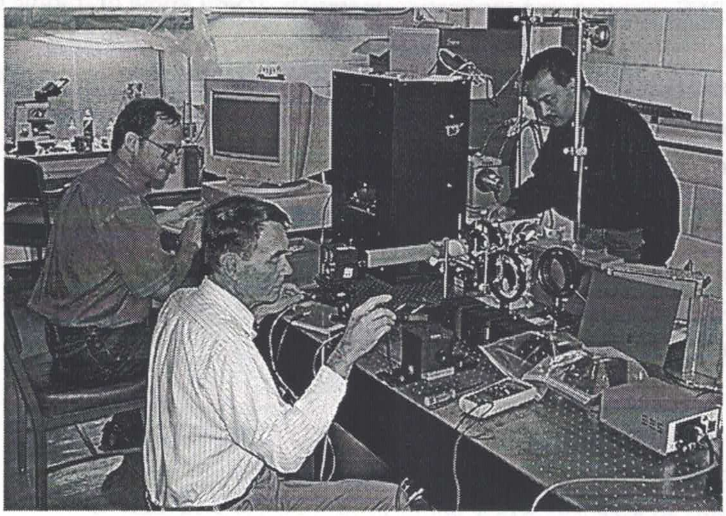
GONG+ Camera Development

Minor mechanical modification to the cameras and final characterization of the data continues. The GONG+ cameras are being equipped with mechanical mounts that permit adjustment of tip and tilt, such that the CCD imaging device

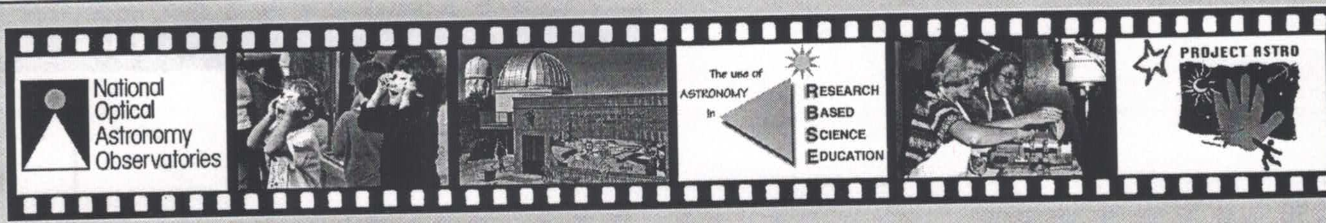
continued

will be positioned perpendicular to the optical axis of the instrument, helping to minimize geometric distortion across the image plane. Masks have been attached to the imaging devices to facilitate image correction as well. Extensive illumination testing is in progress, the results of which will provide gain adjustments that will optimally match camera response with the light level at each site.

After completion of the Data Acquisition System acceptance tests and the camera acceptance tests, which are now in the last stages, imaging system components will be integrated into complete deployment systems for the final stages of characterization, testing, and burn-in. Despite continued camera/DAS related electronics problems, we still hope to deploy the first GONG+ system to Big Bear real soon.



The GONG+ cameras enjoy a last get-together with some friends, before heading off to their new homes around the world.



NOAO Educational Outreach

Suzanne Jacoby, for NOAO Educational Outreach

The use of ASTRONOMY in RESEARCH BASED SCIENCE EDUCATION

The NSF-Funded RBSE Teacher Enhancement program is recruiting for the fourth annual workshop, to be held at NOAO/ Tucson and on Kitt Peak during the summer of 2000. Our updated web pages at ***http://www.noao.edu/outreach/rbse/*** contain information about the RBSE program and application materials. If you know of middle or high school science teachers who are interested in bringing authentic astronomical research into their classrooms, please tell them about this program. Astronomers are needed to mentor local teachers who have gone through the RBSE program. Contact Suzanne Jacoby (***sjacoby@noao.edu***) or Travis Rector (***trector@noao.edu***) for more information. The application deadline for teachers is March 5th.

RBSE students and teachers already involved in the program attended the Atlanta AAS Meeting and presented a poster paper on the discovery of 73 novae in Andromeda. Coordinates for the novae are now available on-line, as are images, text from the poster paper, and a press release about the work. See ***http://www.noao.edu/outreach/rbse/nova.html.***

The January/February issue of *Mercury Magazine* contains an excellent article about Project ASTRO in Tucson that was written by Ginny Beal, Program Coordinator for NOAO Educational Outreach. One of Ginny's goals was to involve more astronomers in their local Project ASTRO. This article includes several inspiring anecdotes from participating astronomers.

PROJECT ASTRO Tucson

NOAO/Tucson has been selected as the first chair of the National Project ASTRO Network. In this role, we will work closely with the existing sites and the National Project ASTRO office to continue the cohesiveness of the project as it matures around the country. Tucson will host the next annual Site Leaders' Meeting in April of 2000, with representatives from all eleven expansion sites in attendance.

We have just received word that our proposal to the NASA/STScI IDEAS program, "Did You See the Moon Last Night?—Scientific Inquiry through Writing, Art, and Observation," was successful! This will allow us to develop a teacher workshop that integrates Project ASTRO hands-on activities and scientific inquiry through an observational study of lunar phases.

research experiences for undergraduates

Research Experiences for Undergraduates and Teachers

Applications for the Summer 2000 KPNO REU program are currently being reviewed. KPNO will be able to select six to eight students from the 125 applicants. Supplemental funding is anticipated that would allow three teachers to participate in the REU program this summer as well.

Images

Two posters, the Rosette Nebula and Superbubbles, were produced for giveaway at the January AAS Meeting and resale at the Kitt Peak Visitor Center. The posters were well received and may be the first in a series of posters that highlight the science capabilities of NOAO. If you have an image that might be suitable for a future poster, please contact the EO group at:

outreach@noao.edu.

Eighteen new images were added to the on-line NOAO Image Gallery, bringing the total number to 570. Images are available at a variety of resolutions for downloading at:

http://www.noao.edu/image_gallery/.

NOAO Educational Outreach

CCS CENTRAL COMPUTER SERVICES

IRAF Update

Doug Tody and Jeannette Barnes

A new IRAF patch release, V2.11.3, was released in December for all supported IRAF platforms. This completes the cycle of V2.11 upgrades begun in the fall of 1999, providing the equivalent up-to-date version of IRAF, including Y2K support, for all supported platforms.

IRAF V2.11.3 includes support for all Sun Sparc systems (SunOS, and Solaris 2.5.1, 2.6, 2.7, Solaris 7), Digital Unix 4.0 (now Compaq Tru64), OpenVMS running on the Alpha chip, PC-IRAF (for FreeBSD 3.3, RedHat Linux 6.1, Slackware Linux 4.0, Solaris 7 for Intel, and SUSE Linux 6.2), HP-UX B.10.20, IRIX 6.5, AIX 4.1, and VAX/VMS. As a reminder, an IRAF V2.11 patch (version V2.11.2 or greater) is required for anyone running IRAF to make IRAF Y2K (Year 2000) compliant. Further information on the Y2K compliance of IRAF is available on our Web page at ***http://iraf.noao.edu/projects/y2k***. We are currently planning to drop support for IBM AIX and VAX/VMS after the V2.11 release. A new port to Macintosh Linux is planned for the near future, now that the V2.11 upgrades are completed.

A new release of X11IRAF (including *xgterm* and *imtool*) is in preparation and should be released sometime in February 2000. This will update X11IRAF for all supported platforms as we did for the general IRAF release with V2.11.3.

Australia became our fourth IRAF mirror site in early November. The IRAF FTP and Web sites, containing the recent IRAF distributions among other IRAF information, are now mirrored in Japan, the United Kingdom, Australia, and Europe at the ESO ST/ECF. The mirrors are updated nightly. Check our Web site at ***http://iraf.noao.edu/iraf-mirrors.html*** for a list of the mirror addresses. We appreciate the hosts of these mirror sites for making IRAF more readily available to our worldwide community.

Our major development projects going into 2000 are the Mosaic pipeline and data reduction support for Gemini. Work on both of these projects is still underway. The Mosaic pipeline includes both general enhancements to the Mosaic data reduction software and a general- purpose pipeline facility. The Gemini work will include new reduction support for IR instruments and multiobject spectrographs, support for adaptive optics (AO) data, and enhancements to the IRAF image structures to store pixel masks and variance information. Early work currently in progress includes support for describing and propagating aperture information for multiobject spectrographs, support for storing pixel masks and variance planes in images, designing a new spectral data format, and an effort to characterize AO data and evaluate the software work required to support AO observations.

continued

A new virtual memory caching package called VMcache has been developed and is now undergoing testing in the Mosaic DHS. VMcache allows images to be cached in memory and efficiently accessed by multiple processes. Use of VMcache on a system that is doing heavy image i/o can reduce paging and significantly improve system performance. Although VMcache is only available now as part of the Mosaic DHS (in the Data Capture Agent), it is a general image caching facility and should be integrated later into the Mosaic pipeline and eventually into IRAF itself.

Frank Valdes, in collaboration with Heath Jones of ESO, has prepared an IRAF package, ESOWFI, based on MSCRED to customize reductions for the ESO Wide-Field Imager. The ESO WFI is a mosaic similar to the NOAO Mosaic Imager. The package is available from the IRAF external package archive. A user's guide is under development.

This quarter Lindsey Davis continued working on the new IRAF astrometry package. The catalog access applications programming interface mentioned in the previous *Newsletter* has been used to develop a general-purpose astrometric catalog extraction and filtering task. This task can extract lists of astrometric standards for multiple fields from a single catalog or for the same field in multiple catalogs and optionally filter the results, e.g., sort and select any magnitude or a user expression, transform the coordinates from one coordinate system to another, etc. A related task for extracting astrometric fields from standard surveys such as the DSS is nearing completion.

Lindsey used the catalog access applications interface mentioned above to develop a task to search the USNO-2 catalog for guide stars. This task will be interfaced to the NOAO proposal Web form to provide investigators with an automatic guide star finding program since targets and guide stars are required with all Gemini proposals.

For further information about the IRAF project, please see the IRAF Web pages at ***http://iraf.noao.edu/*** or send email to ***iraf@noao.edu.*** The *adass.iraf* newsgroups (available on USENET or via a moderated mailing list which you can subscribe to by filling out a form on the IRAF Web page) provide timely information on IRAF developments and are available for the discussion of IRAF related issues.

NOAO FTP Archives

Jeannette Barnes

The NOAO FTP archives are found at the following FTP addresses. Please log in as "anonymous" and use your e-mail address as the password. Alternate addresses are given in parentheses.

ftp *ftp.sunspot.noao.edu* (146.5.2.181), cd pub
SP software and data products—coronal maps, active region lists, sunspot numbers, SP Workshop paper templates, meeting information, SP observing schedules, NSO observing proposal templates, *RISE Newsletters* and SP newsletters (*The Sunspotter*). The NSO/SP archive can also be reached at *http://www.sunspot.noao.edu/ftp/*.

ftp *ftp.gemini.edu* (140.252.15.71), cd pub
Archives for the Gemini 8-m Telescopes Project.

ftp *ftp.noao.edu* (140.252.1.54), cd to:
catalogs—Jacoby et al. catalog; *"A Library of Stellar Spectra"*; update to Helen Sawyer Hogg's *"Third Catalogue of Variable Stars in Globular Clusters"*; *"Hipparcos Input Catalogue"*; *"Lick Northern Proper Motion Program: NPM1"*; *"Coudé Feed Spectral Library"*; *"General Catalog of Variable Stars, Volumes I-V 4th ed."*; *"Name-Lists of Variable Stars Nos. 67-72"*; and *"A Library of Medium Resolution Infrared Stellar Spectra."*

ctio (*ftp.ctio.noao.edu*, cd ctio)—CTIO archives—Instrument manuals, 4-m PF plate catalog, filter library, standard star fluxes. (Nightly mirror of CTIO FTP site.)

fts (*argo.tuc.noao.edu*, cd pub/atlas)—Solar FTS high-resolution spectral atlases.

gong (*argo.tuc.noao.edu*, cd pub/gong)—GONG helioseismology software and data products—velocity, modulation and intensity maps, power spectra.

iraf (*iraf.noao.edu*)—IRAF network archive containing the IRAF distributions, documentation, layered software, and other IRAF related files. Login to *iraf.noao.edu* directly to download large amounts of data, such as an IRAF distribution.

kpno (*orion.tuc.noao.edu*)—KPNO archive of filter lists and transmission data, CCD and IR detector characteristics, hydra (WIYN) information, instrument manuals, 4-m PF platelogs, reference documents, and sqiid data reduction scripts.

kpvt (*argo.tuc.noao.edu*)—KP VTT solar data products—magnetic field, He I 1083 nm equivalent width, Ca II K-line intensity.

noao (*gemini.tuc.noao.edu*)—US areacodes and zipcodes, various LaTeX tidbits, reports from Gemini WG on the high resolution optical spectrograph, etc.

nso (*orion.tuc.noao.edu*)—NSO observing forms.

sn1987a—An Optical Spectrophotometric Atlas of SN 1987A in the LMC.

tex—LaTeX utilities for the AAS and ASP.

utils—PostScript tools.

wiyn (*orion.tuc.noao.edu*)—WIYN directory tree containing information relating to the WIYN Telescope including information relating to the NOAO science operations on WIYN.

IP numbers for machines mentioned above:

argo.tuc.noao.edu	=	140.252.1.21
ftp.ctio.noao.edu	=	139.229.2.67
gemini.tuc.noao.edu	=	140.252.1.11
iraf.noao.edu	=	140.252.1.1
orion.tuc.noao.edu	=	140.252.1.22

Questions may be directed to: Tom Ingerson (*tingerson@noao.edu*) for the CTIO archives, Frank Hill (*fhill@noao.edu*) for all solar archives, Steve Grandi or Jeannette Barnes (*grandi@noao.edu* or *jbarnes@noao.edu*) for all others.

For further information about NOAO, visit the Web at: ***http://www.noao.edu/***.

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