NOAO Newsletter - June 1996 - Number 46

-

NOAO Highlights!

Director's Office

Cerro Tololo Inter-American Observatory

Kitt Peak National Observatory

National Solar Observatory

Global Oscillation Network Group

US Gemini Program

Central Computer Services

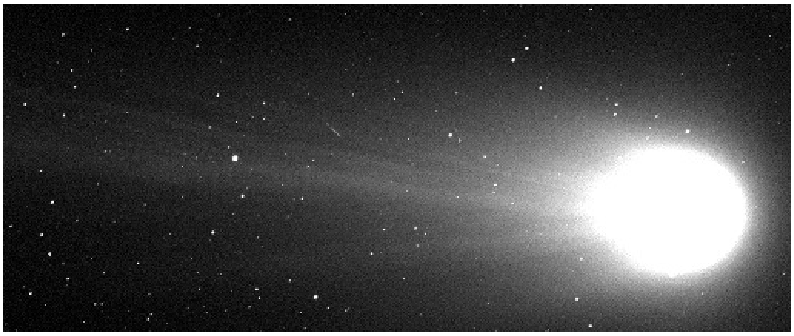
Newsletter Editorial and Production Staff

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

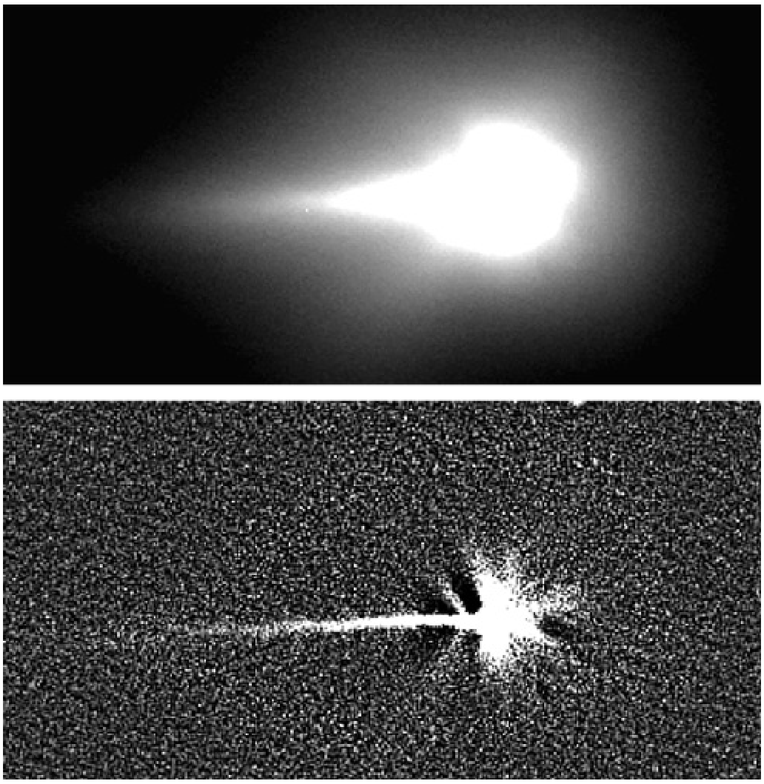
Comments concerning this Newsletter are welcome and will be forwarded to the appropriate editors.
Newsletter Posted: 25 August 1996

Hyakutake!

The extremely close approach of comet C/1996 B2 (Hyakutake) in March provided a unique opportunity to learn more about these visitors from the distant parts of the solar system. Although the comet was only discovered on 30 January by Japanese amateur astronomer Yuji Hyakutake, we were extremely lucky this time because of the great improvements in ground and orbit based instrumentation since the last close approach of a comet, IRAS-Araki-Alcock, over a decade ago. The close passage by Earth of a comet (in this case only 0.1 AU) obviously provides superior spatial resolution and higher signal-to-noise observations than would otherwise be possible. This is especially important in the study of comets, however, as some of the parent molecules of coma species in comets are extremely short lived and decay very close to the nucleus, and thus can only be observed at close range. High spatial resolution especially benefits the observation of rapid changes in the inner coma, allowing us to see what is going on much closer to the nucleus, itself. Overall, combining ovservations over a large spectral range taken with different techniques will greatly enhance our knowledge of activity mechanisms and the chemical composition of comets. The larger goal is gaining insight into the physical conditions during the formation of the early solar system. In this way, comets are visitors from the distant past of the solar system as well.



Caption: Comet Hyakutake on 2 April 1996 at the Burrell-Schmidt. This 60s B-band image shows dust and gas combined in the inner coma, but is dominated in the tail by CO^+. The FOV is 61' x 25'. (KPNO telescopes had been scheduled for the first part of 1996, by March nearly all the telescopes on Kitt Peak were observing this comet as a target of opportunity. Roland Meier (Maryland) and collaborators were using the 4-m with UV Cam to obtain high resolution spectroscopy. At the 2.1-m Wyckoff and collaborators (ASU) were using GoldCam for optical spectroscopy, the 0.9-m had Fernandez and collaborators (Maryland) taking images in broad and narrow band filters. Beatrice Mueller (KPNO) and Walt Harris (Wisconsin) used the WIYN, the 4-m, and the Burrell-Schmidt to image the comet in different filters, at different times and different spatial resolution. While at this writing, there has been little time to do detailed image processing and modeling, several exciting results are already available. Large chunks of ice or dust were observed breaking off the comet along the tail. The tail is dominated by gas rather than dust. Spatial as well as temporal evolution was seen in the inner coma and in the tail. Gas and dust (isolated with narrow band filters) show different spatial morphology in the inner coma. An anti-sunward cone-like feature, which has never been observed before in comets, can be seen in WIYN images in filters isolating neutral gas OH and C_2. As the analysis continued, see the NOAO WEB page for more information.



Caption: Narrow band (C_2) filter 4-m image of Hyakutake on 25 March 1996. FOV is 188" x 94". The lower image was median filtered with a 11 pix (5.2") kernel and subtracted from the original to enhance low surface brightness structures. (The Hubble Deep Field in the Infrared

Table of Contents - -

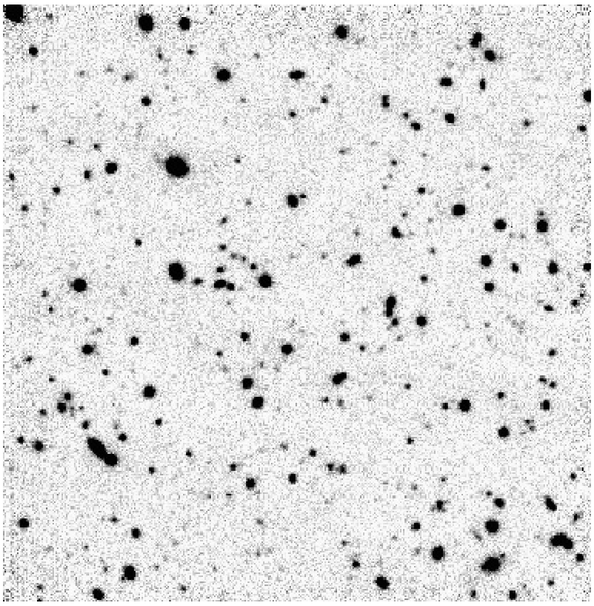
Table of Contents - -

The Hubble Deep Field in the Infrared

In December 1995, the Hubble Space Telescope was trained on a small, undistinguished patch of the sky at high galactic latitude, and was left to expose nearly continuously for ten days. The resulting data set, a remarkable image known as the Hubble Deep Field (HDF), was distributed in both raw and reduced form to the wider astronomical community on 15 January 1996 to serve as a public dataset for observational cosmology. Within a single WFPC2 field of view, 2.5' on a side, the HDF images reveal roughly 3500 faint galaxies (and a few faint stars) down to approximately V = 30--the deepest optical images of the sky ever obtained. The 0.1" resolution of HST provides kpc-scale morphological detail for objects at all redshifts, permitting the sizes and structures of the faint galaxy population to be characterized.

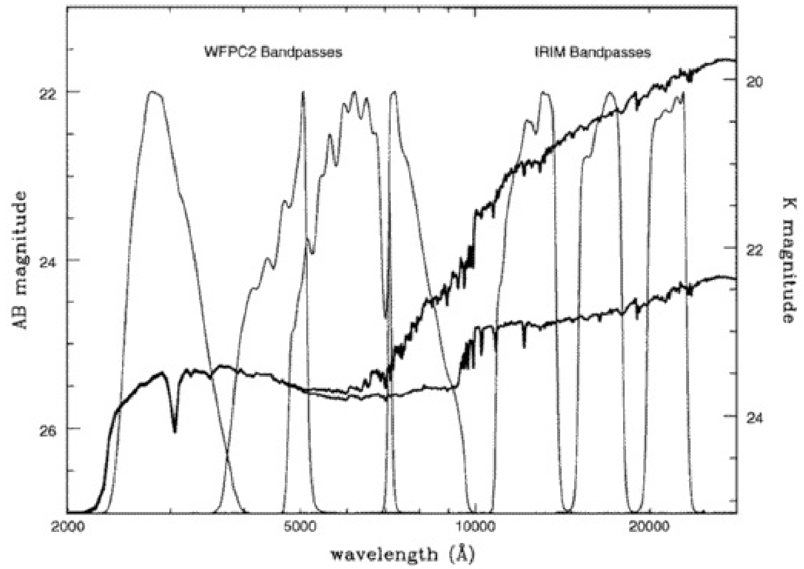
The HST images are not only deep, but are in glorious technicolor as well, having been obtained through four WFPC2 passbands spanning the wavelength range 3000-8000 Ã…. For galaxies at $z > 1$, however, which should be numerous in the HDF, the HST images probe the rest-frame ultraviolet spectral region, where light from hot young stars dominates the emission. The optical wavelengths where we are most familiar with nearby galaxies are redshifted out into the near infrared. For this reason, deep IR imaging offers a valuable complement to the optical HST data, providing photometric information necessary to measure the light from cooler, older stellar populations at high redshift (see figure on the next page).

For this reason, 10 nights with the Mayall 4-m telescope were devoted to infrared imaging of the Hubble Deep Field. Principle investigator Mark Dickinson and a rotating cast of observers (Matt Bershady, Richard Elston, Adam Stanford, and Peter Eisenhardt) took turns making coffee and dithering the IRIM camera about the HDF. Good weather (largely photometric as well) held throughout the entire run.



Caption: The composite 45-hour JHK 4-m IRIM image of the Hubble Deep Field. The area and orientation of the image is nearly identical to the HDF. North is at the top. The PC portion of the HDF corresponds to the upper-right quadrant.

IRIM on the 4-m offers an excellent match to the WFPC2 images, covering almost exactly the same field of view with its 256 x 256 NICMOS-3 array. This wide-field capability made the KPNO 4-m very well suited to the task of surveying the Deep Field. While no ground-based IR observations with present telescopes and instrumentation can go deep enough to detect all the galaxies found in the HST image, these KPNO data (probably the deepest images ever obtained with IRIM) provide valuable three band infrared photometry for hundreds of galaxies across the entire HDF.



Caption: An example application of the seven-band WFPC2+IRIM photometric system for studying distant galaxies. The filter bandpasses and two model galacy spectra at z = 1.5 are plotted. The two galaxies have similar rates of on-going star formation (as seen by their nearly identical UV spectra). The upper galaxy, however, is a mature L* spiral with modest residual star formation, while the latter is a low mass "irregular" with a young age and constant star formation. The optical colors and magnitudes observed by WFPC2 are very similar, but the near-IR reveals dramatic differences.

Altogether, 22.9 hours of exposure were obtained on the HDF in the Ks-band, along with 11.3 and 11.0 hours at H and J, respectively. These exposure times reach similar depths, in the sense that most objects are detected with comparable S/N in all three passbands. Galaxies are visible to roughly K = 23, and the seeing in the grand-sum combined images is roughly 1" FWHM.

Following the lead set by STScI with the original HDF data, the IRIM images will be made available to the wider community after they have been reduced, calibrated and cataloged. Initially, the data will be distributed via anonymous ftp from NOAO and/or STScI. Eventually, it is hoped that they will be lodged in the HST Data Archive or another permanent distribution site. For further information, please see the HDF/IRIM WWW site accessible from the STScI HDF "follow-up clearinghouse" page, at http://www.stsci.edu/ftp/observer/hdf/clearinghouse/clearinghouse.html. Further information about this data and its distribution will be reported in the next NOAO Newsletter as well.

Mark Dickinson

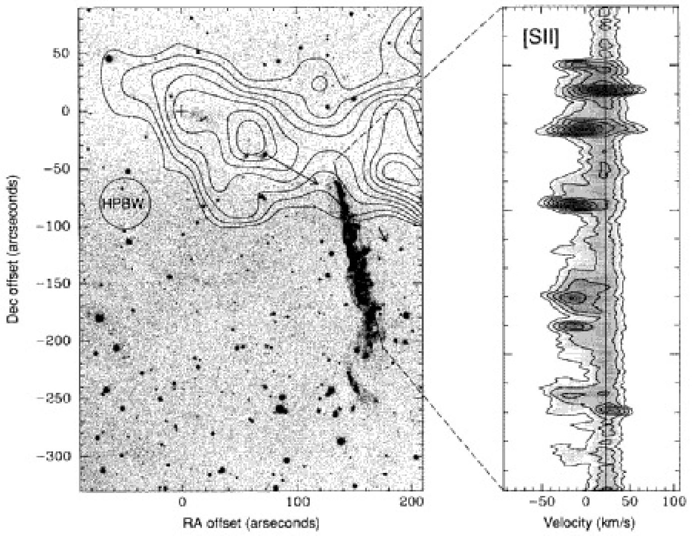
NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

Table of Contents - -

The HH 100 Jet Blaster Deflector

Herbig-Haro (HH) jets are well collimated, parsec scale, supersonic outflows from very young stars. These jets interact with the surrounding medium to produce shock fronts, entrainment of material, and knots that may be discrete structures or wave phenomena. While the precise mechanisms of jet formation are unclear, a key to locate their source. It may well be optically invisible, still buried in a natal dust cloud. The flow direction usually points to where to look at longer wavelength--almost all well collimated flows have their sources located along their axes.

A multi-wavelength, multi-observatory study of the prominent HH jet HH110 by B. Reipurth (ESO), A.C. Raga (UNAM), and S. Heathcote (CTIO) shows it to be an outstanding exception to this rule. In narrowband CCD images obtained with the 1.5-m Danish telescope on La Silla, HH110 is a spectacular, sinuous jet emanating from the dark cloud L1617. With a length of half a parsec (200") it is among the largest jets known in star forming regions. Numerous knots are visible, embedded in faint gas outlining the flow. The jet begins narrow and well collimated, strongly suggesting that the energy source is located very near its apex. However, neither an IRAS catalog search, nor a 2.2μm search with the ESO 2.2-m, nor mapping at 1300μm with the Swedish ESO Submillimeter Telescope SEST detected anything near the apex. While several other IRAS sources and a faint nebulous star were noted in the field, these were thought to be unrelated, and the driving source to be intrinsically faint or highly obscured (Reipurth and Olberg, 1991).



Caption: (Left) [SII] image of HH110 and the newly discovered HH270 flow, obtained with the ESO NNTT, overlaid by ^{13}CO intensity contours from SEST. The cross indicates the position of an IRAS catalogue source, while magnitude and direction of proper motions are shown by arrows. (Right) Position-velocity contours of [SII] emission along the HH110 flow, obtained with the CTIO 4-m. Courtesy S. Heathcote (CTIO).

Recent work has dramatically revised this understanding. New deep large-field interference filter images have been obtained with the ESO 3.5-m New Technology Telescope. An [SII] image is shown in the figure. While HH110 is by far the most prominent object in the field, the "faint nebulous star" is now identified as the westernmost knot in a new, faint HH flow that can be traced 0.2 parsecs northeast, designated HH270. A faint infrared source and an IRAS source (marked with a cross in the figure) are located near the position of flow origin suggested by the morphology. There is evidence of a deeply buried counter lobe extending to the east. The axis of this newly discovered flow points almost directly at the HH110 apex, and the "nebulous star" is a tiny bow shock facing this apex. Proper motions on a six year baseline give an average tangential velocity of about 80 km/s for HH110, but a very high speed of 300 km/s directly towards the HH110 apex for the HH270 bow shock.

Both the morphology and the proper motions strongly suggest a connection between HH110 and HH270. A long slit echelle spectrum of HH110 was obtained with a 2" slit and 2.5 hours exposure time on the CTIO 4-m. The figure includes a position-velocity contour plot of the sum of the [SII] 6717/6731 lines. The HH flow is blueshifted of order 30 km/s relative to its surroundings. This very low radial velocity indicates a space motion for the flow effectively in the plane of the sky. The apparent flow apex, at the top of the spectrum, is kinematically distinct from the other knots in being divided into a higher velocity northern part and a southern part at the cloud rest velocity. This double structure is also seen in the morphology and proper motion of this knot. While spectroscopy is not yet available for HH270, the appearance and extent of a counter lobe indicate that its motion, too, is in the plane of the sky.

Velocity integrated line ratios in [SII], [NII], and Hα were also obtained from the 4-m spectrum. These suggest a stronger shock at the HH110 apex than elsewhere along its length, and clearly indicate a gradient in electron density, decreasing along the flow axis away from the apex.

The morphology, kinematics, and physics all demonstrate that the prominent HH110 flow has its origin in the HH270 energy source, with the HH270 flow being deflected by an obstruction. The result of this collision is a strong shock at the impact point together with a change of direction. To test this idea further, SEST was used to map the molecular cloud around HH270. The resulting ^{13}CO map, which traces high density cold gas, is overlaid as contours on the [SII] image. A dense clump is seen west of the HH270-HH110 impact point, with the flow direction of HH110 tangential to its surface. This is exactly what theory predicts for such a glancing collision. The incident jet divides into a reflected tangential component (the HH110 jet) and a second shock that propagates into the clump, eventually dispersing it. Previous analytical studies provide predictions of the geometry and velocity characteristics of such collisions. The radial velocity and proper motion information permit determination of the true orientation and kinematics of the incident and reflected beams, and these are found to agree closely with the theory.

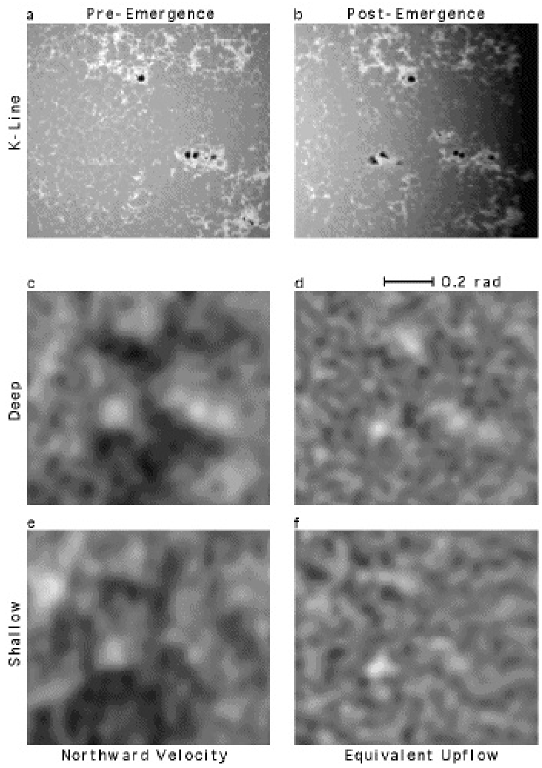
Reipurth and collaborators believe this to be the first well proven case of a grazing collision between a jet and a cloud core. Besides its intrinsic physical interest, this investigation illustrates the advantage to be had by combining unique and powerful observational facilities, in close proximity in Chile, in an international collaboration.

Table of Contents - -

Table of Contents - -

Using Sound to See Under Sunspots

Charlie Lindsey (NSO), Doug Braun (Solar Physics Research Corporation), Stuart Jefferies (NSO), Martin Woodard (Bartol Research Institute), Yuhong Fan (NSO), Yeming Gu (NSO), and Seth Redfield (Summer Research Assistant, 1995) are using soundwaves to explore the subsurface structure of solar magnetic fields. They believe that they are seeing outflow patterns below the surface of active regions. This program grew out of the discovery by Braun et al. (1988) that sunspots absorb acoustic waves. The Lindsey-Braun team subsequently developed a technique called Doppler acoustic seismology and have applied it to the Bartol-NASA-NSO South-Pole observations of 1991.



Caption: Horizontal doppler acoustic signatures of active regions visible on the Sun in the time interval 6 January 1991 (0658 UT) to 8 January (0941 UT). The top row, Frames a and b, show K-line images of the Sun just before (a) and after (b) the emergence of Active Region 6442, just below and left of frame center. Frames c-f show Doppler acoustic signatures concurrent with Frame b, the 48-hour interval just after emergence. The second row shows the Doppler acoustic signature for flow velocity in the northward direction (right, Frame c: light-positive, dark-negative, grey-zero), and the upflow velocity equivalent to the divergence of the horizontal velocity (left, Frame d), as registered by waves that penetrate deep beneath the photosphere, down to 16,000 km. The bottom row shows the same for waves that penetrate only to relatively shallow depths, roughly 8,000 km. (867 Kb image)

Soundwaves traveling under the solar surface have periods of several minutes and surface wavelengths of several thousand kilometers. Because these waves penetrate to various depths beneath the solar surface, and they are advected by flows that they pass through, their surface speeds carry useful information about subsurface velocity patterns. Helioseismic observations made continuously over a period of up to 50 hours yield images of a vector field called the horizontal Doppler acoustic signature, which is known to be sensitive to horizontal flows. The figure shows horizontal Doppler acoustic signature derived from surface waves observed over a 50-hour period on 5-6 January 1991 from the South Pole. Frames a and b show K-line images of the Sun before and during the acoustic observations respectively. The large active region (NOAA 6442) just below and left of the center of Frame b is newly emerged. Frames c and e show the Doppler acoustic signatures for northward flows for relatively long waves (c), which penetrate up to 20,000 km beneath the photosphere and for shorter waves (e), which penetrate only to about 10,000 km depths. Under this interpretation, the lighter shades indicate positive northward flows, where north is in the direction of the top of the frame. The darker shades indicate southward flow.

Frames d and e show upflow velocities estimated by taking the divergence of the horizontal Doppler signatures. These two are strongest at great depths for the two mature active regions but stronger at intermediate depths for the newly emerging one. The outflow speeds that Lindsey and Braun propose give rise to the Doppler signatures are roughly zero at the photosphere (except in narrow annuli around sunspots, called moats), and increase roughly linearly with depth to speeds of order 200 m/s at 10,000km below the photosphere. The flows appear around three major active regions that are visible at the solar surface during 1-6 January 1991, and extend several tens of thousands of kilometers laterally, into the quiet Sun. The newly emerged active region shows a considerably shallower flow than those of the mature active regions.

The Doppler acoustic signatures seen by Lindsey et al. appear to be somewhat in conflict with recent results in time-distance helioseismology, also based on the Bartol-NASA-NSO observations (Duvall et al. 1996). That work considered time-delay asymmetries that suggest rapid downflows and inflows, with speeds up to 2 km/s. This discrepancy suggests that effects besides flows may contribute both to the time-distance measurements and the Doppler acoustic signatures. The Doppler acoustic signatures measured by Lindsey et al. are calibrated by introducing artificial flows into selected regions of the South-Pole observations. This exercise assures that extended inflows of the order of 100 m/s would provide a strong Doppler acoustic signature. While this makes it difficult to interpret the time-distance measurements in terms of rapid, extended downflows, it does not necessarily assure that the much more moderate signatures that Lindsey et al. see are themselves due to flows. Lindsey, Braun, and Woodard are independently examining a range of schemes other than acoustic Doppler shifts due to submerged flows that could possible give rise to the signatures they see.

If the Doppler acoustic signatures are indeed caused by flows, or deeply submerged structure of any kind, Lindsey et al. think that it will be possible to use acoustic waves to examine solar interior magnetic structure just as our eyes use light to examine perturbations in a vacuum (or air) that scatter electromagnetic waves. This is made possible by a computational scheme ("helioseismic holography") introduced in earlier publications by Lindsey and Braun (1990) and Braun, Lindsey, Fan and Jefferies (1992). A number of modeling schemes have been tried (Kosovichev 1996) or proposed (D'Silva 1996) that do not rely on holography. Lindsey and his colleagues suspect that computational holography will be the key to diagnostics and modeling of flow structure on a small scale that lies deep under the solar photosphere.

Table of Contents - -

Table of Contents - -

Reflections

I first came to NOAO in 1984 as Director of KPNO, and I am now nearing the completion of my second term as Director of NOAO. It is therefore perhaps not inappropriate to reflect on why I came and how my aspirations for the national observatories compare with their current situation.

I came to the national observatories for several reasons. The first is that I genuinely believed-and continue to believe--in the concept of open, competitive access independent of institutional affiliation to facilities that are at the very least equal to the best available anywhere in the world. Astronomy has, through the existence of national observatories in space and on the ground--solved a problem that many fields of research have not. Excellence in astronomy is widely distributed in a diverse group of institutions, and this widely distributed excellence has surely enhanced the quality of education of both undergraduate and graduate students throughout the country.

The second reason that I came was that I had had the great good fortune to be at the University of Hawaii at the time that John Jefferies was leading the development of the astronomy program there. When I arrived in Hawaii, ground had not yet been broken for the first telescope on Mauna Kea. Participating in the development of Mauna Kea was terrifically exciting, and in 1984 I thought that only the national observatories offered the opportunity to undertake a second building program of comparable scope. And a building program was sorely needed at that time. There had been no major initiatives within the national optical astronomy observatories since the 4-m telescopes.

Over the past decade, we--and I use that term broadly to encompass the staff of NOAO and AURA and the user community--have put NOAO back on the map. The building program that we have undertaken in the past ten years has led to the Gemini telescopes project, the completion and deployment of GONG, the completion of WIYN, and delivery of a suite of instruments and detector systems that are among the best in the world.

Unfortunately, none of that success has led to improved funding for NOAO--and indeed the unprecedented rate of discovery in astronomy has, apart from the Gemini project, done nothing to improve funding for astronomy within the NSF. Since 1984, the fraction of the NSF portfolio devoted to astronomy grant funding and operation of the national centers has fallen. The chances of reversing this situation are low given the overall budget prospects for the next few years. We have posted on the Web a letter from Neal Lane holding out no hope whatsoever. In a recent interview, Hugh Van Horn was asked what he would say to users of KPNO about the prospect of closing northern hemisphere telescopes. He summarized what he said to the reporter this way:

"I said that no one wants to close productive telescopes but the budgetary conditions we now have to face will make it necessary to take some decisions we might not like. I also said that the McCray committee had thought long and hard about this, that I was going to follow their recommendations to the extent that I am able, and that I applaud NOAO's decision also to follow the McCray committee's recommendations. I stated that we have a responsibility to use the Federal investment to support US astronomy to produce the very best science, acting on the basis of the best advice we can obtain, although I recognize that there will be differences of opinion about this."

The question for all of us is how we address priorities given the circumstances we find ourselves in. I certainly did not come to NOAO with the goal of closing telescopes or reducing observing opportunities for the community. However, the failure to make choices will ultimately compromise the entire program and threaten its future viability. Given that difficult choices are required, I would like to share with you my thoughts about a variety of subjects and issues raised in the forum posted on the Web.

The Users

I am glad that so many users spoke up about their views concerning the importance of access to telescopes. It is clear that the McCray committee report did not reflect the views of those users who are vocal about NOAO priorities. It is important that the NSF and others hear from those whose science will be impacted if the recommendations of the McCray report are followed. There are limits to what NOAO and AURA can do about defending current programs since we will probably be seen to be self-serving. The community of users must assume a significant portion of the responsibility for articulating the case for continued operation of NOAO telescopes.

An assessment of the observing applications shows that the impact of the closure of small telescopes, if no corrective actions are taken, will fall most heavily on galactic astronomy. There is only a very limited amount of extragalactic astronomy currently being pursued with apertures less than 2 meters. In addition to continuing to have access to a range of apertures, the users also appear to support a balance of facilities north and south rather than the strong focus on the southern hemisphere advocated by the McCray committee.

Small Telescopes

After the TAC reviewed the proposals for the KPNO telescopes for the fall semester, 1996, NOAO staff analyzed the recommended proposals to determine what would be lost if we tried to schedule the high priority programs on fewer telescopes. We found that we could not accommodate the science by moving programs from smaller telescopes to larger ones. Most of the programs at the 0.9-m and all of the ones at the Schmidt require a wider field of view than is available with single detectors at the larger telescopes. Accordingly, we will continue to operate all of the KPNO telescopes in the fall semester. We will determine whether these telescopes are operated in the spring of 1997 after we know the budget for the coming year. At the level of the President's request, operations could continue until the mosaic CCD imager is completed so that a wide field of view is available at the 4-m prime focus. If funding for FY 1997 is significantly below the President's request, then continued operation is not possible.

Even at today's funding level we do not have the resources to maintain the level of service and support that we have in the past. Accordingly, we are stopping all upgrades and improvements to three telescopes--the Schmidt, the Coude Feed, and the 0.9-m. We will continue to provide the basic maintenance that will keep them operable for the upcoming Fall semester. We will continue to provide appropriate start up support, which means that we will expect experienced observers to require only limited assistance. Where appropriate, we will suggest that users come one day early to gain a refresher course in observing by watching the previous observer.

We are reluctant to reduce observing support below this level. When the 0.9-m was restricted for one semester to experienced observers, applications dropped by about 30 percent. Limiting support restricts access for some people, particularly students, nearly as completely as does closing telescopes.

Elsewhere in this newsletter, we announce plans for closing both the 0.6-m and 1.0-m telescopes at CTIO. Both were equipped only with photoelectric photometers, and the demand for both has declined in recent years.

Demand for Small Telescopes

NOAO has not yet closed a telescope that was significantly (more than a factor of 2) oversubscribed. Demand must be a critical factor in determining priorities in astronomy. Can NOAO justify the continued operation of telescopes that are barely oversubscribed given the pressures on the NSF astronomy budget? When we removed the 0.9-m from KPNO to make room for WIYN, the demand for observations at this aperture had dropped to the point where all of the proposals could be accommodated on the two 0.9-m telescopes; in other words, there was no over-subscription, and removing one telescope at that point had the potential of raising the over-subscription only to a factor of 2.0. In the semester that we closed the 1.3-m at KPNO, the number of applications had dropped from an average of 34 per semester in the previous five years to only 11. We provided extra observing time to ongoing programs to ensure that they could be completed prior to closure, and basically the same capabilities were available at the 2.1-m. The drop in demand for the 1.3-m was probably caused by the fact that no new instrumentation was available for this telescope, which offered only photoelectric photometry and SQIID. The latter instrument was equipped with PtSi detectors with less than 5 percent quantum efficiency.

It is also true that, compared with five years ago, a significantly larger fraction of the observing time at KPNO now goes to users rather than to staff. Because of decreases in staff size (nearly a factor of 2 since 1980 when the staff received about 40 percent of the observing time) and an increase in functional responsibilities, the number of observing proposals submitted by NOAO staff to use KPNO has dropped by 25 percent since 1990/91.

At the present time, the Coude Feed is under-subscribed, probably because the majority of the interesting problems in stellar spectroscopy require larger aperture. We received no proposals for the Fall semester for solar-stellar programs that were previously supported at the McMath-Pierce. Unfortunately, the Coude Feed is the only place at NOAO where very high dispersion spectroscopy is possible. If the field of view were not an issue, the proposals for the 2.1-m and 0.9-m telescopes could be combined onto a single telescope, and the over-subscription would be about a factor of two.

In short, the available data indicate that the discussion of priorities must focus on capability not on the number of telescopes. Unless there is some radical change in the number of proposals received, there no longer appears to be sufficient demand from the community to justify the operation of the full suite of telescopes at Kitt Peak. A similar situation prevails for some of the telescopes at CTIO. Given the current number of observing proposals, the closures of the 0.6-m and 0.9-m telescopes at CTIO will not significantly impact most users.

Privatization

What happens to telescopes that NOAO can no longer afford to run? Ideas about privatizing the 1.0-m telescope at CTIO are discussed elsewhere in this newsletter. At the upcoming meeting of the AURA Observatories' Council, we will be discussing options for privatizing other telescopes. We welcome your advice on this issue, and we will certainly share our own ideas with the users before implementing any of them.

Continuity

Closing telescopes can become a kind of self-fulfilling prophecy. Most ground-based observing programs require more than one observing run, and people are undoubtedly reluctant to develop an observing program centered around a telescope or instrument that may have a short lifetime. In developing plans for the future--and these plans include sharing instruments among KPNO, CTIO, and Gemini--we will pay attention to this issue of maintaining capability long enough to ensure that programs can be completed. This means making sure that we do not eliminate any capability if at all possible, although the telescopes on which that capability is provided may change. It also means that when we do retire or move an instrument, we will make every effort to provide the extended observing runs needed to complete ongoing programs. For this reason, it would be helpful if observing applications give some indication of the potential scope of the program.

Instrumentation

Many respondents to the Web posting have indicated that they believe that providing new instrumentation should have lower priority than continued operation of existing telescopes. If we ever reach the point where we have to choose between continued operation of 4-m telescopes and new instrumentation, I might agree. I cannot, however, give higher priority to continued operation of telescopes for which there is low demand than to providing state-of-the-art instrumentation for the 4-m class telescopes and Gemini. Observing programs at NOAO are strongly determined by the available instrumentation. Demand for 4-m Mayall time, for example, dropped by 25 percent when we removed Hydra and transferred it to WIYN. We no longer receive observing proposals to work on quasar absorption lines because we cannot compete with Keck. The community is very quick to move to fields and instruments where KPNO has a competitive advantage--and equally quick to stop using instruments that have been eclipsed by developments at other observatories.

We estimate that the lifetime over which a new instrument is competitive is 5-7 years. Elsewhere in this newsletter is an article by Dick Joyce that describes what was available at KPNO five and ten years ago. The advances are truly impressive. If our instrumentation program had been frozen in time at either of those points, NOAO would today not be a relevant contributor to ground-based astronomy.

Instrumentation from Universities

Several of the responses to the Web posting have suggested that we should place greater reliance on the universities for instruments. We agree, and our five year instrument plan assumes that at least two significant instruments will be provided by outside groups. However, these outside groups will require compensation of some kind. It makes sense for NOAO to pay cash for instruments only if the costs are lower at universities, and so far we have no evidence that this is the case. Similarly, having NSF pay for instruments built at universities through the grants program is, apart from the potential involvement of students, an effective use of astronomy resources only if costs are lower. If NOAO instead provides guaranteed observing time in return for instruments, as we will probably do, then open access for the community is reduced. Whether or not the improved instrumental capability is worth the loss of observing time depends on the details of the agreement with the outside group and on the quality of the instrument produced.

Strategy

Some respondents have noted that other national observatories have chosen to maintain services to users rather than close telescopes. This choice, however, is not without a price. In addition to staff layoffs, NRAO has announced in its latest newsletter that unless an additional source of funds can be found, there will be no budget for equipment to improve the instrumentation at the telescopes or to address the Observatory computing needs. Within NOAO, NSO has similarly given priority to keeping all of its facilities open. I believe this strategy is appropriate when the facilities themselves are unique. Capability and sometimes an entire field of science can be lost by closure of a unique facility. Furthermore, even if the instruments at unique facilities are less than state-of-the-art, there are no competitors with which those facilities can be compared. KPNO and CTIO do not have this option. If we were still operating 58 x 62 IR arrays or small format CCDs or using photographic plates, all of which represented the state-of-the-art five or ten years ago, then it would be impossible for the nighttime user community to work at the forefront of the field.

Relative Costs

As has been pointed out frequently by users and as we are aware, the operation of small telescopes, provided the instrumentation is not replaced, is relatively small. However, the costs of improving the throughput of the 4-m telescopes are comparably small. For example, we could gain about 10 percent more observing time at WIYN by making the operation of the wavefront sensor more efficient and increasing the speed with which the fibers in Hydra are positioned. The cost of each project is about equivalent to the cost of operating the 0.9-m for a single year. And the improvement in WIYN throughput requires only a one time expenditure. Which should have the higher priority--operations of a small telescope or improvements at the large ones? And how does one weigh the 20 papers that are produced annually as a result of observations with a single small telescope against a 10 percent increase in the observing time and in the number of papers (a typical 4-m class telescope produces about 75 papers per year) from a large telescope?

Reductions in Budgets for Other Activities

Recent discussion has focused on the implications for the continued operation of telescopes of further decreases in the budget. Although we believe that we have exhausted alternatives for saving money, we continue to welcome advice for how to reduce costs still further without impacting telescope operations. We have already cut scientific staff; we have already compromised facilities maintenance; we have already cut back on the instrument program and the rate of delivery of instruments; we have already stopped building new instruments for any but 4-m class telescopes and Gemini. Detailed comparisons show that our administrative costs are below those of comparable organizations and that our costs of telescope operations are well below those of national observatories in other countries and surprisingly close to those of university observatories in this country. Many people have asserted that they could run NOAO less expensively. We are ready to sit down with any group that has a demonstrated track record of running telescopes to compare our costs and ways of doing business to try to identify further cost savings. We will look at recovering the costs of supporting those portions of IRAF not required to acquire and evaluate data from NOAO telescopes, but such cost recovery simply transfers the financial burden from NOAO to the community. It remains to be seen whether this is the best overall use of astronomy funding.

The Future

These are your observatories, and we do pay attention to your input. What was posted on the Web was an attempt to outline what I believe will be the inevitable consequence of following the McCray recommendations if we receive steady-state funding at the levels specified. The budgets given for telescope operations on the Web are, in my judgment, the minimum levels required for operation over the long term. If the budget falls below those levels, then telescopes or other programs will have to be gradually phased out. No one should think, however, that NOAO staff or management believe that a national observatory of the scope described on the Web would serve the user community well.

It is important to put the current situation in a broader perspective. We have already cut operations budgets by more than 30 percent over the last decade, if allowance is made for inflation, and we have improved user services and access in the process. Ultimately, however, the cuts become so deep that the program cannot be sustained, and we have tried to identify budget levels at which this occurs. While one can argue over the detailed cost estimates--and we are prepared to have every aspect of every budget line examined in detail--ultimately the outcome is the same. If the budget decreases every year, sooner or later NOAO will cease to operate some or all of its current programs.

In the meantime, we will continue to search for ways to reduce costs, we will take scientific productivity into account as we make program changes, and we will try to minimize the impact on both individuals and areas of astronomy of those program changes. We have already discussed the option of obtaining a wide field at larger aperture telescopes by using mosaics of CCDs. We may be able to preserve the capability for high resolution spectroscopy by feeding a spectrograph with a fiber from the focal plane of a large telescope rather than with the Coude Feed. We retired the FTS but will soon offer a high resolution IR spectrometer instead that will go several magnitudes fainter. The use of small telescopes is now nearly entirely for galactic astronomy; the current division of the KPNO TAC into galactic and extragalactic rather than bright and dark subcommittees should help to ensure that galactic astronomy proposals continue to receive support.

As a result of your earlier comments on the importance of wide field IR imaging, we have modified our ideas about the mix of telescopes and capabilities that we need to offer at both KPNO and CTIO. In response to your input and reservations about queue observing, we have modified the procedures at WIYN, including scheduling some runs in the conventional way with the observer present. NOAO staff and users must continue to talk--and listen--to each other as we work our way through the very difficult years that confront us.

Sidney C. Wolff

[Table of Contents](#) - -

Table of Contents - -

Stellar Oscillations Network Group from the Sun to the Stars

The detection and study of oscillations in solar-type stars is a natural extension of the scientific goals of helioseismology. In view of the recent encouraging developments in asteroseismology and the announcement of the first results from the initial operation of the full GONG network at the Madison AAS meeting, it is time to develop a coordinated, community wide effort to achieve the potential that asteroseismology offers for progress in stellar physics, stellar structure, and stellar evolution. An effort of this magnitude can only succeed if it is truly community based.

As a first step, we are organizing a special session at the Madison meeting of the AAS to invite community participation in a new project, the Stellar Oscillations Network Group (SONG), to detect and study oscillations in solar-type stars. A Steering Committee, whose members are John Bahcall, Sam Barden, Tim Bedding, Tim Brown, Pierre Demarque, Mark Giampapa, Ron Gilliland, Jack Harvey, Frank Hill, Steve Kawaler, Christoph Keller, Hans Kjeldsen, Bob Noyes, and Caty Pilachowski, has put together the following program for the session.

We hope all who are interested in learning about or participating in the SONG project will join us for this Special Session. If you are unable to attend, or would like further information, please contact C. Pilachowski at catyp@noao.edu, or visit our Web site via http://www.noao.edu (click on "S.O.N.G.").

```
         Program for the SONG Special Session at the Madison
            Meeting of the American Astronomical Society

                        2:00 - 3:30 PM
                         10 June 1996

2:00-2:20  Pierre Demarque
           "What can we learn from asteroseismology of solar
           type stars"?

2:20-2:40  Tim Brown
           "Where do we stand?"

2:40-3:00  Sam Barden
           "Instrumentation, protocols, and networks"

3:00-3:30  Panel Discussion
           "How do we make it happen?"
```

Caty Pilachowski (on behalf of the Stellar Oscillations Network Group)

Table of Contents - -

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

---

Table of Contents - -

NOAO Newsletter - Director's Office - June 1996 - Number 46

NOAO Educational Outreach

Two NASA IDEA Grants Awarded

NOAO staff members were recently awarded two NASA IDEA Grants, one for a multi-cultural program involving teachers at a Tohono O'odham school and the other for development of classroom materials suitable for secondary science classes. Michael Belton's NOAO-based Galileo Imaging Team received funding for "Integrating Space Exploration with Interdisciplinary Curricula at a Tohono O'odham Middle School." Coordinated by Elizabeth Alvarez del Castillo, math, science, and communications teachers at the school are already working with the scientists to integrate planetary and space science topics into the lesson plans for the next academic year. The second grant brings together a professional science writer, a science educator, and scientists for "Bringing Hot Topics in Astronomy into the Classroom" through the development of instructional materials with popular appeal. The initial effort, coordinated by Suzanne Jacoby of the NOAO Educational Outreach Office, will capitalize on the current and anticipated high level of public interest in comets. Lesson modules will be based on an original article suitable for the popular press, packaged with accurate background information and lession plans and activities to facilitate the learning.

Pieces of Knowledge

Our current involvement with students and teachers at the Miles Exploratory Learning Center, a K-8 school in the Tucson Unified School District, is winding down as the academic year comes to an end. Middle school students from Miles worked with Tucson artist Linda Haworth and NOAO astronomers over an eight week period in the spring 1996. An important goal of this outreach project was to engage students in the process of science and convey the notion that science is a gradual and sometimes disjointed accumulation of knowledge. One product of this classroom work, a set of tile mosaics with astronomical themes, is currently on display in the KPNO 4-m Visitor Gallery. In astronomy, the growth of knowledge rarely comes as a sudden burst of illumination. Rather it can be likened to the assembly of a giant puzzle, pieced together like tiles in the student created mosaics.

Eight astronomers visited the three middle school classrooms at Miles and presented topics which included "The Composition and Ages of Stars," "Build Your Own Comet," "A Map of the Milky Way," and "The Size and Age of the Universe." Linda Haworth worked with students in the classroom on "Conceptualizing an Abstract Idea" and "The Design and Construction of a Tile Mosaic." Comet Hyakutake made its spectacular appearance during this time as well, adding an exciting element of scientific discovery to this shared learning experience.

Suzanne H. Jacoby, NOAO Education Officer

Table of Contents - -

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

---

Table of Contents - -

News from AURA: Coordination Among Optical-Infrared Observatories in the US

Optical-Infrared (OIR) astronomy enjoys a diversity of institutions and funding sources but also of institutional interests and priorities. Support for astronomy grants and facility operations by the National Science Foundation has stagnated even as the agency's budget doubled in recent years. This trend, and the many opportunities for advancing OIR astronomy, suggest that a unified community could be more effective.

Following a joint recommendation by Directors of observatories that operate or are building large optical and IR telescopes in the US, including the Directors of "independent" observatories, NOAO, Gemini, and the Board of Directors agreed to establish a special "coordinating" council to coordinate and advocate their shared interests.

One function of the new council will be to advise the Board on overall opportunities in OIR astronomy: to enable it and the independent institutions to provide consensus recommendations to funding agencies. Other functions will be to study opportunities for cooperation such as exchange of telescope time and/or instrumentation for community access, or technical developments of benefit to the OIR community as a whole.

Looking to the future, the new council could foster ideas or plans for major projects, especially those that are unlikely to be accomplished by a single existing organization. Through such efforts, the council can help foster communication and cooperation among the ground based OIR observatories and facilitate the overall US OIR astronomy program.

The membership of the new council includes the Directors, or their designees, of the Astrophysical Research Consortium, the Observatories of the Carnegie Institution of Washington, the Harvard/Smithsonian Center for Astrophysics, Lick Observatory, McDonald Observatory, Steward Observatory, Palomar Observatory, University of Hawaii, Gemini Project, NOAO, and the AURA President, ex officio. The council will elect its chair from among the members. Reports or recommendations of the council will be public if unanimously agreed by the council members.

I believe that the new council represents an alliance that can be highly effective, perhaps crucial, as the Federal science budget continues to decline. It can help unify some of the more diverse parts of our community and rally them to advocate more support for astronomy. It can also help make more effective use of the support that is attainable.

Goetz Oertel

Table of Contents - -

NOAO Newsletter - Director's Office - June 1996 - Number 46

News from AURA: A New AURA Board

At its recent annual meeting, the Board of Directors voted to amend and restate the By-laws. This was the most important change since the consortium was chartered in 1957. The Board also adopted a transition plan that puts the new structure in place on 1 July 1996, on an interim basis. Finally, it created an "interim" Board and empowered it to oversee the transition and to conduct the affairs of the corporation for one year until a new Board, elected at the next annual meeting, takes over on 1 July 1997.

The new Board will have thirteen Directors, a number that will not change if additional member institutions join. Twelve will be elected by the "member representatives" and will serve staggered three year terms. The other will be the President, ex officio.

The member representatives who are appointed to AURA by the member institutions will be "stake-holders" in the consortium. Member representatives will meet annually, will hold the Board accountable, and will elect the new Board. Representatives from international affiliates will have an equal voice on all matters.

From 1 July 1996, until 30 June 1997, the Executive Committee as elected or designated in April 1996 will serve as the Interim Board. The old Board will become the "Member Representatives," which include the present Directors-at-Large until their terms expire during the next three years. Councils will continue to provide oversight and advocacy for the Centers: the Observatories Council for NOAO and the Space Telescope Institute Council for STScI. Their functions remain the same. Councilors will be elected by the new Board and will come from among the member representatives and from the broader astronomy community.

The restructuring has several effects: the new Board will be smaller and can, as a whole, act more decisively because it will number thirteen instead of the former forty-one (twelve Directors-at-Large, one Director from each of twenty-eight member institutions, and the President ex officio). In the new Board, all Directors except for the President will be elected. By contrast, only twelve "Directors-at-Large" in the old Board were elected, the remaining twenty-eight were appointed, one by each member institution. When the member representatives elect the new Board, they will have greater flexibility: only four of the twelve new Directors must be from among the member representatives, and only four must be from outside that group. By comparison, the old Board includes only twelve elected "Directors-at-Large" while twenty-eight were appointed.

The Board strengthened the roles of international affiliate members and their representatives by giving them voting rights. It was its intent to give international Directors and Councilors the same roles as their US colleagues. This intent could not yet be fully implemented so as to avoid jeopardy to the consortium's tax exempt status and to its obligation as contractor with the US Government to ensure that it cannot come under "foreign control." However, the Board will shortly consider appropriate steps to accommodate its intent.

As a consequence of the restructuring, perceptions of conflicts of interest should be less likely to arise. First, appointment to AURA by a member institution no longer automatically places the appointee on its Board of Directors; it makes her or him a member representative with a voice and a vote in electing the Board. Further, because each new Director will be intimately involved in the affairs of the consortium, she or he will be more aware of situations in which perceptions of conflict of interest could arise.

The Board's action was preceded by in-depth analysis and recommendations by a special committee that was chaired by former Director and Vice Chair Dick Rossi and included Vice Chair Dick Zdanis, former Chair Bob MacQueen, former Director Bob Kraft, current Director Art Walker, and Morton Roberts.

The Board and several of its committees reviewed the advice during the past year and adopted a comprehensive restructuring proposal at its special meeting in January 1996. Extensive revisions of the By-laws, and a transition plan, were developed this spring. The Board acted at its regular annual meeting on 23 April 1996, on the eve of the sixth anniversary of the launch of the Hubble Space Telescope.

Goetz Oertel

News from AURA: New Members Elected to Board and Observatories Council

As a result of its annual elections on 24 April, members of the new Interim Board of Directors and the Observatories Council (OC) are listed below. Each body becomes effective on 1 July 1996.

Interim Board of Directors

```
*Bruce Margon, Chair        - University of Washington
*Richard Zdanis, Vice Chair - Case Western Reserve University
Cleon Arrington             - Georgia State University
John Huchra                 - Harvard/Smithsonian Center for Astrophysics
Leonard Kuhi                - University of Minnesota
Morton Lowengrub            - Indiana University
*Goetz Oertel               - AURA
Robert Rosner               - University of Chicago
*Chair, or Vice Chair, AURA Oversight Committee for Gemini AOC-G)
        - to be determined at next committee meeting
*Chair, or Vice Chair, Observatories Council (OC)
        - to be determined at next committee meeting
*Chair or Vice Chair, Space Telescope Institute Council (STIC)
        - to be determined at next committee meeting
```

Observatories Council

```
Michael A'Hearn        University of Maryland
Claudio Anguita        Universidad de Chile
Phillip Certain        University of Wisconsin, Madison
William Hoffmann       University of Arizona
Edward Kibblewhite     University of Chicago
*Goetz Oertel          AURA
Paul Schechter         Massachusetts Institute of Tech.
Juri Toomre            University of Colorado
Arthur Walker          Stanford University
Lee Anne Willson       Iowa State University

* ex officio members
```

Lorraine Reams

News from AURA: AURA on the World Wide Web

The Corporate Office now has a site on the World Wide Web, located at http://www.aura-astronomy.org. The Web site is linked to our Centers (STScI, NOAO, and Gemini), astronomy departments of member institutions, and related sites. Information regarding the Corporate Office, current events within the organization, board and committee members, member institutions, recent reports, and more, is contained in our pages and will be updated periodically. Your comments and suggestions are welcome!

Diana Whitman (dwhitman@stsci.edu)

News from AURA: Gemini Fellows for 1996-97 Cycle Awarded

The goal of the Gemini Fellowship Program is to strengthen science and technology in South America by providing fellowships, for study and research at US institutions, to selected applicants from Argentina, Chile, and Brazil--the three Gemini partner countries. Each applicant must state how his/her research is related to the planned capabilities of the Gemini telescopes. The program is co-funded by NSF and, for Chilean awardees, by Fundacion Andes of Chile.

These individuals have accepted Gemini Fellowships for the 1996-97 academic year:

Graduate Students	Host
Mario Hamuy (Chile)	University of Arizona
Marianne Takamiya (Chile)	University of Chicago

Post-Doctoral Researcher	Host
Mercedes Gomez (Argentina)	Harvard/Smithsonian Center for Astrophys.

Selections were made following consideration by a US peer review panel convened by AURA. The panel reviewed applications submitted by the three (3) Gemini national contact offices in Argentina, Brazil, and Chile and took recommendations from those offices into account. A total of nine applications were received.

The Gemini Fellowship Review Panel was comprised of: Yoji Kondo, chair (NASA/GSFC); Jay Gallagher (Wisconsin); Edward Guinan (Villanova); Bradley Peterson (Ohio State); and Robert Williams (STScI). Please contact me for more information at e-mail address: lreams@stsci.edu.

Lorraine Reams

NOAO Newsletter - Director's Office - June 1996 - Number 46

NOAO Preprint Series

The following preprints were submitted during the period 1 February 1996 to 30 April 1996. Please direct all requests for copies of preprints to the NOAO author marked with an asterisk.

```
702     *Sarajedini, A., Layden, A. "Metallicities and Reddenings for
        Young Globular Clusters"

703     *Courteau, S. "The Bulge/Disk Connection in Late-Type Spirals"

704     Vrba, F.J., Luginbuhl, C.B., Hurley, K.C., Li, P., Kulkarni,
        S.R., van Kerkwijk, M.H., Hartmann, D.H., Campusano, L.E., Graham,
        M.J., Clowes, R.G., Kouveliotou, C., *Probst, R., Gatley, I., Merrill,
        M., Joyce, R., Mendez, R., Smith, I., Schultz, A. "The Double Infrared
        Source Toward the Soft Gamma Ray Repeater SGR 1900+14"

705     *Massey, P., Bianchi, L., Hutchings, J.B., Stecher, T.P. "The
        UV-Brightest Stars of M 33 and its Nucleus: Discovery, Photometry, and
        Optical Spectroscopy"

706     *Wallace, L., Livingston, W., Hinkle, K., Bernath, P. "Infrared
        Spectral Atlases of the Sun from NOAO"

707     *Mueller, B.E.A., Ferrin, I. "Change in the Rotational Period
        of Comet P/Tempel 2 Between the 1988 and 1994 Apparition"

708     Rice, W., *Merrill, K.M., Gatley, I., Gillett, F.C.
        "Near-Infrared Structure of the Edge-On Spiral NGC 4565"
```

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

NOAO Newsletter - Director's Office - June 1996 - Number 46

Other NOAO Papers

Preprints that were not included in the NOAO preprint series but are available from staff members are listed below. Please direct all requests for copies of these preprints to the NOAO author marked with an asterisk.

*Beck, J.G., Hathaway, D.H., and Simon, G.W. "Observing Large-Scale Solar Surface Flows with GONG: Investigation of a Key Element in Solar Activity Buildup"

Bianchi, L., Hutchings, J.B., *Massey, P. "The Winds of Hot Stars in External Galaxies. III. HST UV Spectroscopy of O and B Supergiants in M31 and M33"

Byun, Y-I., Grillmair, C.J., Faber, S.M., *Ajhar, E.A., Dressler, A., Kormendy, J., Lauer, T.R., Richstone, D., Tremaine, S. "The Centers of Early-Type Galaxies with HST II: Empirical Models and Structural Parameters"

Christensen-Dalsgaard, J., Dappen, W., Ajukov, S.V., *Anderson, E.R., Antia, H.M., Basu, S., Baturin, V.A., Berthomieu, G., Chaboyer, B., Chitre, S.M. Cox, A.N., Demarque, P., Donatowicz, J., Dziembowski, W.A., Gabriel, M., Gough, D.O., Guenther, D.B. , Guzik, J.A., Harvey, J.W., Hill, F., Houdek, G., Iglesias, C.A., Kosovichev, A.G., Leibacher, J.W., Morel, P., Proffitt, C.R., Provost, J., Reiter, J., Rhodes Jr, E.J., Rogers, F.J., Roxburgh, I.W., Thompson, M.J., and Ulrich, R.K. "The Current State of Solar Modeling"

*D'Silva, S. "Measuring Solar Subsurface Magnetic Fields Using Time-Distance Helioseismology: The Forward Approach"

*Fan, Y., and Fisher, G.H. "Radiative Heating and the Buoyant Rise of Magnetic Flux Tubes in the Solar Interior"

Gough, D., *Leibacher, J., Scherrer, P., and Toomre, J. "Perspectives in Helioseismology"

Gough, D.O., Kosovichev, A.G., Toomre, J., *Anderson, E., Antia, H.M., Basu, S., Chaboyer, B., Chitre, S.M., Christensen-Dalsgaard, J., Dziembowski, W.A., Eff-Darwich, A., Elliott, J.R. , Giles, P., Goode, P.R., Guzik, J.A., Harvey, J.W., Hill, F., Leibacher, J.W., Monteiro, M.J.P.F.G., Richard, O., Sekii, T., Shibahashi, H., Takata, M., Thompson, M.J., Vauclair, S., and Vorontsov, S.V. "The Seismic Structure of the Sun"

Grillmair, C.J., *Ajhar, E.A., Faber, S.M., Baum, W.A., Holtzman, J.A., Lauer, T.R., Lynds, C.R., O'Neil, Jr., E.J. "Hubble Space Telescope Observations of Globular Clusters in M31 II: Structural Parameters"

*Harvey, J.W., Hill, F. R., Hubbard, R., Kennedy, J.R., Leibacher, J.W., Pintar, J., Gilman, P.A., Noyes, R.W., Title, A.M., Toomre, J., Ulrich, R.K., Bhatnagar, A., Marquette, W., Kennewell, J., Patron, J., Saa, O., and Yasukawa, E. "The Global Oscillation Network Group (GONG) Project"

*Harvey, K.L., Recely, F., Hirman, J., and Cohen, N. "The Current Status of Activity in Solar Cycle 22 and the Onset of Cycle 23"

Hathaway, D., Gilman, P., *Harvey, J.W., Hill, F., Howard, R.B., Jones, H.P., Kasher, J., Leibacher, J.W., Pintar, J., and Simon, G.W. "GONG Observations of Surface Flows"

*Hill, F., Stark, P.B., Stebbins, R.T., Anderson, E.R., Antia, H.M., Brown, T.M., Duvall, Jr., T.L. , Haber, D.A., Harvey, J.W., Hathaway, D.H., Howe, R., Hubbard, R., Jones, H.P., Kennedy, J.R., Korzennik, S.G., Kosovichev, A., Leibacher, J.W., Libbrecht, K.G., Pintar, J., Rhodes, Jr., E.J., Schou, J., Thompson, M.J., Tomczyk, S., Toner, C.G., Toussaint, R., and Williams, W.E. "The Solar Acoustic Spectrum and Eigenmode Parameters"

*Howard, R.F. "Tilt-Angle Variations of Active Regions"

*Keller, C.U., Bernasconi, P.N., Egger, U., Povel, H.P., and Steiner, P. "Hidden Magnetic Fields on the Sun"

*Keller, C.U., and Smartt, R.N. "Imaging Coronal Emission Lines Under High Sky-Background Conditions"

*Livingston, W.C., and Barr, L. "McMath-Pierce Upgrade: Achieving Stealth Optics to Yield a Thermally Invisible Telescope"

*November, L.J. "Rotation and Lorentz Transformations in 2 x 2 and 4 x 4 Complex Matrices and in Polarized Light Physics"

*November, L.J. "Dark-Thread Thermodynamics and the Coronal Temperature Structure"

*Penn, M.J. and Jones, H.P. "Limb Observations of He I 1083 nm"

Thompson, M.J., Toomre, J., *Anderson, E., Antia, H.M., Berthomieu, G., Burtonclay, D., Chitre, S.M., Christensen-Dalsgaard, J., Corbard, T., DeRosa, M., Genovese, C.R., Gough, D.O., Haber, D.A., Harvey, J., Hill, F., Howe, R., Korzennik, S.G., Kosovichev, A.G. , Leibacher, J., Pijpers, F.P. , Provost, J., Rhodes, Jr., E.J., Schou, J , Sekii, T., Stark, P.B., and Wilson, P. "Differential Rotation and Dynamics of the Solar Interior"

Van de Steene, G.C., *Jacoby, G.H., Pottasch, S.R. "Optical Observations of Planetary Nebula Candidates from the Northern Hemisphere"

Ann Barringer, John Cornett, Elaine Mac-Auliffe,
Jane Marsalla, Shirley Phipps, Cathy Van Atta

Table of Contents - -

Table of Contents - -

Staff Reductions at CTIO: A Painful Necessity

As a result of the recent reductions to the NOAO budget, the increased costs in Chile associated with the strength of the peso against the dollar combined with inflation in Chile, cuts of order US$ 300K in purchasing power were made on the non-payroll side of CTIO in FY1994 and FY1995. Involuntary staff cuts were postponed in the hope of eventually receiving improved support from the NSF. That support has not materialized, so, after careful discussions within NOAO and AURA and presentations to the NSF seeking some relief, the decision was taken in March to implement a formal Reduction in Force (RIF) involving 17 employees (the loss of 16.5 Full-time Equivalent positions). With that action, CTIO completes a program of staff reductions totaling 30 FTEs, i.e. just over 20% since 1993. According to current NOAO projections, we are not expecting any further losses of staff positions at CTIO prior to the start of Gemini operations.

We will of course try to minimize, as always, the direct impact felt by our users. Most of the latest cuts fell in the areas of administration and daytime operations; the two divisions covering these areas have been merged. Please bear in mind, however, that in 1993, we had 145.5 full-time equivalent (FTE) positions at CTIO. We now have 115.5. Note that Tololo had 112 FTE in 1973, 130 in FY1974 and had not been below 133 until last month; the 4-m was commissioned in 1975. This amount of belt-tightening is unfortunately bound to affect our ability to deliver. We have already mothballed the Lowell telescope and regret that we will have to do the same to the Yale 1-m at the end of January 1997--see the separate notes in this Newsletter and the AURA statement on the Web (http://www.aura.noao.edu/aura/forum/).

These are statistics. Tololo users know the faces--the people. Some have given loyal service to the observatory for 30 years or more--essentially a lifetime. Others have to face very difficult personal circumstances. I cannot hide the fact that this has been a very painful experience for all of us at CTIO. Those who have left us know they have our heartfelt gratitude, but I want to acknowledge that gratitude publicly.

Malcolm Smith

Table of Contents - -

NOAO Newsletter - Cerro Tololo Inter-American Observatory - June 1996 - Number 46

Hydra/CTIO Project Underway

At the request of the user's committee (see the March 1994 Newsletter), NOAO is in the process of fabricating a version of the Hydra multiobject spectroscopy fiber feed for use on the Blanco 4-meter telescope. A preliminary design review was held in December 1995, in which the project was endorsed and given a green light to proceed. Motors and electronics have been ordered. We are in the process of refining resource requirements and schedules to ensure that the project moves forward as timely as possible. The goal for delivery of the instrument to CTIO is during the second semester of 1998.

The instrument itself will look very similar to Hydra at WIYN. Upgrades in the motors, controllers, and stages will be implemented and should improve the positioning speed of Hydra/CTIO by a factor of 4 over Hydra at WIYN. We also plan to rework the software to modernize and better modularize the code.

The fibers will feed a renovated ARGUS spectrograph. All 288 fiber slots on Hydra will be utilized, allocated between two science cables with 138 object positions plus six guide probes per cable. The difference in the science cables will be aperture selection. A large aperture set (2") and a small aperture set (about 1.3") will be provided. The small apertures will take advantage of the image quality expected from a new wide field corrector. This will correct about a 50' field of view and will provide atmospheric dispersion compensation over that field. The corrector design also makes the telescope telecentric, allowing the instrument to utilize a warpable focal plate as is done at WIYN.

CTIO has started the construction of a new camera for the bench spectrograph to be used with this instrument, and has acquired a Tek2k CCD for use as the detector (see articles on Argus Update and CCD News in the March 1996 Newsletter). Modifications to the existing bench spectrograph and calibration system are planned at CTIO over the coming year.

Please stay tuned to future Newsletters for progress reports as this project proceeds.

Sam Barden, Tom Ingerson,
Bob Schommer, Nick Suntzeff

Table of Contents - -

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

Table of Contents - -

NOAO Newsletter - Cerro Tololo Inter-American Observatory - June 1996 - Number 46

Winter '96 Shutdown of the 4-m Blanco Telescope

A major shutdown of the 4-m Blanco Telescope is scheduled for this (southern hemisphere) winter to carry out the first phase of a program to upgrade the telescope drives and associated systems. It is hoped that this work will result in significant improvements in the tracking and guiding accuracy of the telescope that will yield an immediate payback in terms of improved image quality. By replacing major parts of the telescope's more than 20-year-old control logic, we also expect to reap benefits in terms of improved reliability, less downtime, and reduced maintenance costs. The shutdown will occupy a total of 11 weeks from 24 June to 6 September. During this period we will do the following:

- Implement measures to improve the tracking and guiding performance of the telescope. As described elsewhere in this Newsletter, while the telescope has delivered images as good as 0.5" in short, V-band frames, longer guided exposures taken on the same night had FWHM no better than 0.7". Seeing measurements taken on a large number of nights (which include the effects of tracking and guiding) show that the best images obtained in routine operation are also around 0.7" FWHM. This and other evidence convinces us that the telescope's closed-loop tracking performance now sets the floor on the best image quality that can be obtained. Quite apart from the degradation of the current image quality, this problem, if not corrected, will also limit the usefulness of the f/14 tip-tilt system. Correction of tracking errors would consume a large fraction of that system's bandwidth, leaving little headroom for following atmospheric effects. Prior to and during the first week of the shutdown we will be gathering the information needed to understand this problem in detail and correct it. The steps to be taken include a complete revision of the hardware and software used to generate the telescope drive pulses, and a complete re-tune of the servos and guider. Our goal is to obtain the very best performance that can be achieved with the present servo hardware. Replacement of the servo system in its entirety is a longer term activity slated for a future project.

- Replace the 20 year-old relay-based "ladder logic," which provides for sequencing, enabling, interlocks, etc., for any activity performed on the telescope, with the solid state equivalent--Programmable Logic Controllers. It is primarily this activity that dictates the duration of the shutdown, since the telescope will be completely immobile while this work is carried out.
- Install new, more reliable, absolute encoders.
- Implement computer control of the instrument rotator. This will benefit spectroscopists by allowing the spectrograph slit to be set to the parallactic angle or parallel to some feature in an extended object, while the telescope is slewing to the target position. The guide probe will also be moved to the position of a pre-selected guide star at the same time. Currently these operations are performed manually reducing observing efficiency.
- Carry out "normal" maintenance activities such as realuminizing the mirrors, recollimating the optics, generating new AO look up tables and pointing maps, etc. We will also carry out preventive maintenance activities, such as inspecting the gear box for the shutter drive to forestall failures of the kind recently suffered by the Mayall Telescope.

We had planned earlier to repair the declination gearbox during this shutdown. However, the cost of this repair was found to be prohibitive, and we are now planning for a more cost-effective "software solution" to the problems caused by the damaged gears. Budget and manpower constraints have also forced us to lengthen the schedule for complete replacement of the servo system. As a result we are now looking at more modern, commercially available servo systems such as the Delta-Tau controllers proposed for the Gemini telescopes, rather than copying the upgraded KPNO servos.

Steve Heathcote

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

---

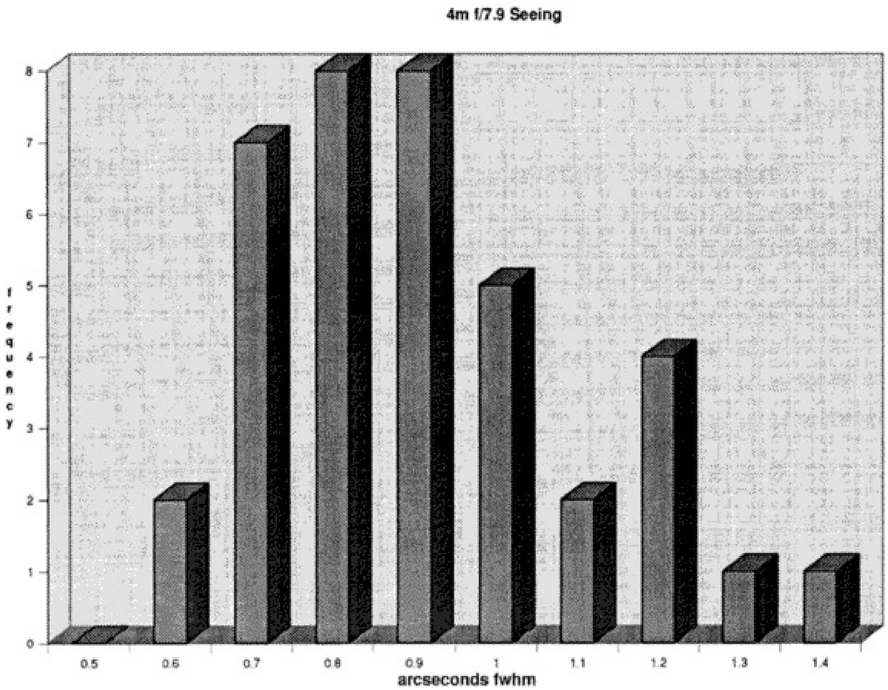
Delivered Image Quality On the Blanco 4-M: A Progress Report

The 4-m Blanco Telescope continues to deliver excellent images. Median seeing since the beginning of the year has been 0.9" FWHM as measured by the f/7.8 south port camera using George Jacoby's software. The Georgia State University speckle camera was on the telescope 4-7 March and showed 0.5" speckles. On Friday, 8 March, the optical performance and operating conditions of the of the Blanco Telescope were measured during a period of excellent seeing. The results of these tests and previous performance data show that the 4-m telescope is capable of delivering V images as good as 0.56" FWHM.

On the evening of the optical tests the environmental conditions were as follows: The primary mirror was within 0.5 degrees C cooler than the dome air. The dome air temperature was approximately equal to the outside air temperature (15 degrees C). The dome vent doors were open. The wind speed was about 5 mph from the north. The site seeing monitoring tower was reporting 0.3" seeing.

The chip used was a Tek 2048 with 0.157" pixels. Fifteen second focus frames showed images with 0.56" FWHM. Five minute guided images were 0.79" FWHM. Out of focus movies were taken with an intensified CCD guide camera at 60 frames per second. In these movies, air currents affecting the image quality can be plainly seen. The outside wind and "seeing waves" are clearly visible as well as some air currents emanating from the center of the "donut."

The new primary mirror cell air extraction system was also tested while taking data with the south port seeing camera as well as out of focus movies. The seeing camera showed no degradation in image quality; the out of focus movies showed a slight modification in the flow pattern. During these tests the south port camera was reporting 0.66" FWHM. That the air extractor did not improve the image quality is not surprising since the primary mirror temperature was already within 0.5 degrees C of the dome air temperature. The air extractor should give the best improvements when the change in outside air temperature is greater than what the primary mirror cooling system can handle. It should also help with the hot air problem in the chimney. The chimney will be modified during the July shutdown so that air may be extracted more efficiently from the chimney and focal plane area.



>

Caption: Delivered image quality at the Blanco 4-m Telescope in first quarter 1996.

The Shack-Hartman wavefront analyzer results showed 0.45" residuals in a 30s exposure. This coupled with the 15s V image at 0.56" images and the site seeing monitor data suggest that the telescope optics in their present state are contributing 0.45"-0.50" to the image quality budget. The tracking and guiding systems in the telescope are contributing an additional 0.2" increase in delivered image diameter. Identifying and reducing the tracking and guiding errors are a central goal in the upcoming July engineering shutdown.

John Filhaber

NOAO Newsletter - Cerro Tololo Inter-American Observatory - June 1996 - Number 46

Recent Instrumentation and Telescope Project Work

Over the past several months, improvements and upgrades have continued on a wide range of projects and telescopes at CTIO. As John Filhaber mentions in a separate article, the 4-m image improvement program remains at high priority, and the last several months have seen gratifyingly better image quality. The reliability of the Shack-Hartmann system has been increased, and the active primary support system is working well. Tests of the guiding and servo system have been started, and work to enhance their performance to realize fully the image quality now delivered by the telescope optics is scheduled for the engineering shutdown in July and August (see the article by Steve Heathcote). The mounting system for the f/14 secondary has been installed and tests of various components of the system have begun as part of our f/14 tip-tilt project. In particular, a high speed version of the CTIO CCDTV guide camera is being developed as the sensor. The f/14 mirror is being finished in Tucson, and is scheduled to be installed in mid-June. Tests of the tip-tilt system will begin next semester, with a goal of having a usable system by the end of the calendar year.

As was mentioned in the last Newsletter, the NOAO Cryogenic Optical Bench (COB) will be moving to CTIO in the second semester, and the CTIO IRS is being upgraded to work with the new f/14 secondary. On a longer time scale the NOAO Mosaic and the Hydra/CTIO instruments (see separate articles) are scheduled for initial deployment on the Blanco Telescope in 1998.

During March, Dave Mills from KPNO visited for three weeks and worked intensively with German Schumacher on the new 4-m GUI project. This GUI is derived from the one in use on the WIYN telescope, and from the user perspective, is similar to that at the KPNO Mayall telescope. A fully working prototype is now in nightly use on the Blanco, and offers improved guide star acquisition and more efficient telescope operation. The final version will be installed during the engineering shutdown. Documentation for users will be made available at that point.

The efforts of our Arcon development team have concentrated on preparing the controllers for the NOAO Mosaic instrument. Many of the team members will travel to Tucson during May and June to integrate the CCDs and software for the first engineering tests on the 0.9-m. During the course of this development, the performance of the base system has been enhanced to allow more rapid readout of the CCDs. Systems currently in use on Tololo have benefited from these more rapid readouts.

At the Schmidt, the long awaited NFCCD mounting box, shutter/filterbolt and smart motor controller were integrated and installed. The Schmidt now joins the 4-m in having fully automated focus from the Arcon user-interface, thus increasing observing efficiency and lessening the caloric expenditure from the rapid run up the stairs to change filters and refocus. (The dome is still not encoded, so observers do need to go upstairs to check and move it).

With considerable expert help from Rob Seaman of KPNO, the Save-the-Bits (STB) software has been installed at the 0.9-m and Schmidt telescopes. STB, a completely automatic data archiver, has been in operation at KPNO for over two years (see previous Newsletter). After each CCD readout, data is saved on exabyte tape. At the time of writing (April) the system is still being debugged, but it is expected to be fully operational soon. It will then be installed on the other telescopes, and for use with the Wildfire IR detector, during engineering runs over the coming months.

A dome ventilation system for the 1.5-m has been designed and is being fabricated in our La Serena shop. An array of 32 doors with a total area of over 500 square feet in area will be installed in the dome segments around the lower rim of the dome. We plan to begin installation of these doors next semester, which should improve the thermal environment of this dome.

Bob Schommer Chair, ACTR

Table of Contents - -

Table of Contents - -

The 1996 REU Program at CTIO

In its second year, the NSF Research Experience for Undergraduates Program at CTIO brought four adventurous US college students to La Serena to join two Chilean undergraduates in work with myself and CTIO scientific staff from mid-January through March. This year's students and their research projects were:

Alex Athey (Pomona College) - "A Search for High-Redshift QSOs" (advisor Malcolm Smith)

Roger Leiton (Universidad de La Serena) - "The Changing Sky Brightness at Cerro Tololo" (advisor Mark Phillips)

Martin Osorio (Universidad de Chile) - "The Changing Sky Brightness at Cerro Tololo" (advisor Mark Phillips)

Jodi Schneider (St. John's College) - "A Look for LMC Cluster X-ray Sources" (advisor Eileen Friel)

Alejandro Soto (Dartmouth College) - "Integrated Properties of Milky Way Open Clusters" (advisor Eileen Friel)

S. Elizabeth Turner (Georgia Institute of Technology) - "Infrared Photometry of SN 1987A" (advisor Nick Suntzeff)

Besides working on their research projects, students had ample opportunity to observe--a primary component of the CTIO REU program. In addition to observing runs related to their own science, students helped with a variety of observing programs on all the CTIO telescopes. Athey and Turner, for example, lent their expertise to finding supernovae at the 4-m, contributing to several IAU telegrams during their stay. Several students became frequent observers at the Curtis Schmidt.

Other student activities included weekly scientific seminars for the students by CTIO and Las Campanas staff, a tour of the Gemini site on Cerro Pachon, and a trip to La Silla. Students sampled the Joint CTIO/ESO Workshop on the Galactic Center, and helped out with some of the meeting logistics along the way.

Working in Chile and gaining experience with the international astronomical community is an important part of the student experience, and the inclusion of two undergraduate students from Chile was a successful new feature of the program. Although not all US students have degree programs flexible enough to accommodate an academic term REU program, for those who are interested in a special opportunity to explore research in an observational and international environment, we offer a unique REU experience. Operating the program during the Chilean summer allows us to provide a rich scientific and educational program for both Chilean and US students.

Plans are underway for next year's program--look for announcements in future Newsletters. Or contact Eileen Friel (efriel@noao.edu) for more information. We are always looking for your best students!

Eileen Friel

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

NOAO Newsletter - Cerro Tololo Inter-American Observatory - June 1996 - Number 46

Galactic Center Workshop Spawns Electronic Newsletter

The Fourth ESO/CTIO Joint Workshop was held in La Serena 10-15 March. Ninety-nine astronomers from thirteen countries participated in stimulating discussions on new data and interpretations about the Galactic Center. More than 50 talks and 35 poster papers contributed to an intense week of interaction. Some of the results were clearly earthshaking, as we all discovered Thursday morning, although the speaker barely paused while the walls shook and the building creaked under the Richter 4.7 impact.

The weather in La Serena at the end of the summer season was delightful, and scheduled tours of La Silla and Cerro Tololo were successful. Some of the participants also benefited from additional visits to parts of the USA and various South American locations that were not initially on their flight plans, when United, American, Lan Chile and Ladeco all diverted passengers or canceled flights.

I would like to thank all the participants for their interesting contributions and their cooperation during this meeting. We all should thank those involved in the complicated logistics of an international meeting, particularly Elaine MacAuliffe, David Gonzalez, Claudia Contreras, Renato Vargas and Tito Urquetta. My counterpart at ESO, Roland Gredel, was mainly responsible for organizing the scientific content of the meeting, and deserves most of the credit for the excellent selection of speakers and topics.

An ongoing result of this conference will be a new electronic newsletter under the management of Angela Cotera (IPAC) and Heino Falcke (Maryland). To promote the timely exchange of information on Galactic center research and researchers, three formats are being provided: a Web page, weekly e-mail "news flashes" (both devoted to abstracts received by the editors), and a bimonthly, formal newsletter. The latter will contain an article solicited by the editors on a topic of current interest, submitted abstracts, and announcements of interest (e.g. conference announcements or GC related job offers). Information on submission and subscription may be obtained from the WWW site, http://www.astro.umd.edu/~gcnews, or by e-mail to gcnews@astro.umd.edu. This venture will succeed to the extent it is supported by the Galactic center community, so GC researchers are strongly encouraged to get those abstract submissions rolling in.

Bob Schommer

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

NOAO Newsletter - Cerro Tololo Inter-American Observatory - June 1996 - Number 46

Supernova 1987A: "Ten Years After" Workshop Announced

On 23 February 1987, SN 1987A appeared in the Large Magellanic Cloud, sparking an intensity of observational and theoretical activity rarely before experienced in astronomy. CTIO, ESO, and (for the first time) Las Campanas Observatory will take SN 1987A as the topic for their annual workshop, to be held 22-28 February 1997 in La Serena. We will celebrate the many discoveries and advances that have come (and are still coming!) from the study of this important supernova, and consider what we have learned in general about core-collapse supernovae and explosive nucleosynthesis. Among the specific topics for the workshop are: the pre-explosion evolution of Sk 202-69 as seen in the general framework of the stellar population and chemical evolution of the LMC; early and late time observations of SN 1987A including neutrinos, gamma-rays, X-rays, UV, optical, IR, and radio; theoretical modeling of the evolution of the

SN; nucleosynthesis in SN 1987A and in other type II SNe; observations and modeling of the formation of dust in the SN debris; the circumstellar environment of Sk 202-69 and the interaction with the SN; SN 1987A in the context of observations and modeling of other type II SNe; the distance to the LMC as derived from observations of SN 1987A, and the general use of SNe II as distance indicators; and the future evolution of SN 1987A.

The Workshop will last five days. Each day will feature three invited summary talks of typically 30 to 45 minutes, with a following discussion period. There will be no parallel sessions. Contributed talks and posters are welcome, and we hope to provide an atmosphere that will encourage discussions in informal groups. It is the intention of the Organizing Committee to select the invited speakers from the astronomers who reply to the first call for participants.

Memorable excursions and social events are a significant part of the Workshop tradition. The neutrino burst, which announced the core collapse and resulting explosion of Sk 202-69, was detected at 7:35 UT on 23 February 1987. In keeping with the supernova theme, this Workshop will begin with a real bang--a "Ten Years After Party" at a local pub on the night of Saturday, 22 February! Devotees of SN 1987A will make sure that this party keeps going until 4:35 a.m. so that we can celebrate together the 10th anniversary of the neutrino burst! SN 1987A was discovered at Las Campanas Observatory independently by Ian Shelton and Oscar Duhalde around midnight (local time) on the night of 23 February 1987. In honor of this historic event, we have planned a visit to Las Campanas during the afternoon of Sunday, 23 February. Participants will see the mighty 0.25-m astrograph with which Shelton took his discovery plate and also tour the DuPont 2.5-m telescope, and the twin Magellan 6.5-m telescopes, which are currently under construction. In addition to this visit to Las Campanas, we plan excursions during the week of the conference to both La Silla and Cerro Tololo to tour the observatories.

The organizing committee expects to offer financial assistance to some participants, especially students and recent PhDs not able to obtain funds from their home institutions, to cover expenses within Chile. Funding for travel expenses to Chile is beyond our means. If you are interested in attending and/or would like to receive more information about the Workshop, please check our Web site at: http://www.ctio.noao.edu/SN1987A_conf.html or send e-mail to sn87a@ctio.noao.edu.

Mark Phillips CTIO (mphillips@noao.edu),
Nick Suntzeff CTIO (nsuntzeff@noao.edu),
Patrice Bouchet ESO (pbouchet@eso.org),
Patricia Knezek LCO (pmk@ctio.noao.edu)

Table of Contents - -

Table of Contents - -

Privatization of the Yale-Tololo 1-m Telescope

The recent series of budget cuts at NOAO have inevitably had an impact at Cerro Tololo. The NSF has indicated in a letter to AURA that the NSF embraces the priorities recommended in the McCray report and encourages us to find "other means to keep in operation those productive telescopes NSF can no longer afford to support." Partly due to the lack of money in recent years to upgrade the 1-m telescope at Tololo and to develop and implement new instrumentation for it, that telescope has (with a few individual exceptions) been less productive overall than the others on Cerro Tololo.

Consistent with the AURA statement on the World-Wide Web (http://www.aura.noao.edu/aura/forum/) it is with great regret that the 1-m Yale-Tololo telescope will be withdrawn from service at the end of the current semester (i.e. at the end of January 1997). We realize the significant negative impact this will have on the photoelectic photometry community in particular. As explained in the NOAO electronic forum, our wish is to construct a modern 2.4-m-class telescope to replace the 1-m and possibly one or two of the other small telescopes. We particularly regret this telescope closure, coming as it does before a firm commitment has been secured to fund the 2.4-m. We will continue to support ASCAP photometry on the 1.5-m telescope.

In a separate article, Charles Bailyn (Yale) outlines current plans to find funding from other sources to re-open the 1-m telescope. CTIO will do what it can to assist this privatization process. It makes no sense to close telescopes if alternative funding can be found to re-invigorate them. Those users most affected by this closure may wish to take special note of Charles' article. It is our intention that this will be the last telescope to close on Tololo for at least another three or four years.

Malcolm Smith

NOAO Newsletter - Cerro Tololo Inter-American Observatory - June 1996 - Number 46

Yale's Plans for Operation and Funding of the 1-m Telescope

The impending closure of the 1-m Yale/CTIO telescope described in the article by Malcolm Smith in this Newsletter has returned control of that telescope to Yale University. We are therefore planning to operate the telescope ourselves at its current site, but independently from NOAO. Our current intention is to equip the telescope with a CCD imager and a new telescope control system. This will enable us to carry out synoptic programs and observations of targets of opportunity which are very difficult to handle in traditional block scheduling patterns. Targets are likely to include X-ray transients, novae and supernovae, AGNs and quasars, and a variety of variable stars. Other CCD observing programs which do not require unusual scheduling will of course also be possible.

While we are cautiously optimistic about our ability to fund this venture (probably in partnership with the Portuguese astronomical community) the financial arrangements are not complete as of this writing. We may therefore still be able to accommodate additional partners. Our current estimates suggest that a 1/8 share of the telescope over a three year period will require a contribution of a total of approximately $100K over that time. Thus significant observing time may be available for a few tens of $K per year. After the first three years, costs should be reduced, since the necessary capital expenditures will have been completed. Anyone interested in participating in the project should contact Charles Bailyn (bailyn@astro.yale.edu) as soon as possible.

It is in principle possible to keep the ASCAP photometer on the telescope in addition to the new CCD detector. However such an arrangement would significantly increase operations costs. Therefore, while we would be happy to discuss supporting ASCAP with potential partners, the financial commitment is likely to be significantly greater than outlined above.

Charles Bailyn

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

Table of Contents - -

NOAO Newsletter - Cerro Tololo Inter-American Observatory - June 1996 - Number 46

Have a Crisp Twenty Dollar Bill Ready

As some of our traveling investigators have already discovered, in addition to expenses mentioned in our travel information package there may be airport taxes payable in cash on the spot that are not included in tickets issued in the US. These little surprises en route are the following:

A one time "entry fee" of US$20 charged to all US citizens entering Chile. This is imposed in reciprocity for similar fees charged Chilean citizens for entry to the US. The official in charge of receiving this fee will affix a stamp on the traveler's passport, valid until the passport expires. This fee is paid at the US port of embarkment to Chile (typically Miami). US citizens arriving from third country destinations may be charged upon arrival in Santiago. US currency only is accepted--no credit cards--so keep a twenty tucked away for this one.

Santiago airport tax, paid at the Santiago domestic terminal when taking the flight to La Serena. This is currently $Ch3100 or about $US7.50. Pesos are recommended (money exchange at competitive rates is located within the terminal complex).

La Serena airport tax, paid at the La Serena airport when taking the return flight to Santiago. This is currently $Ch2200 or about $US5.50, payable in pesos.

Departure tax upon leaving Chile, paid at the Santiago international airport. Presently this is $US18 or about $Ch7400, payable in US or Chilean currency. Be sure to set this aside with your return ticket. It's a good way to dispose of extra pesos without the hassle of currency exchange.

Because these taxes or fees are imposed by foreign entities, US airlines do not collect them in advance as part of the ticket price. Hence the necessity to have some cash ready to keep the officials smiling. Have a pleasant trip!

E. MacAuliffe, M. Phillips, M. Urquieta

Table of Contents - -

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

---

Table of Contents - -

Observing Request Statistics: August 1996-January 1997

4-m Telescope: 114 nights

Requests		Nights Requested				
Dark	Bright	Dark	Bright	Instrument	Nights	%
11	9	32	43	Argus	75	15.9
0	5	0	13	COB	13	2.8
5	2	13	3	CF/CCD	16	3.4
33	6	114	19	CS/CCD	133	28.2
1	14	4	57	Ech/CCD	61	13.0
0	7	0	22	CIRIM	22	4.7
0	11	0	38	IR/IRS	38	8.1
20	1	76	6	PF/CCD	82	17.4
1	0	6	0	PF/Plates	6	1.3
5	0	16	0	RF-P	16	3.4
2	0	9	0	Visitor	9	.9
--	--	---	---		---	-----
78	55	270	201		471	100.0

	Now	Last Semester	Semester Before Last
No. of requests	133	102	119
No. of nights requested	471	354	415
Oversubscription	4.13	2.95	2.46
Average request	3.54	3.47	3.49

1.5-m Telescope: 163 nights

Requests		Nights Requested				
Dark	Bright	Dark	Bright	Instrument	Nights	%
4	1	19	7	ASCAP	26	9.6
13	1	67	2	CF/CCD	69	25.6
6	7	37	28	CS/CCD	65	24.1
0	3	0	15	Ech/CCD	15	5.6
0	17	0	84	CIRIM	84	31.1
0	2	0	6	IR/IRS	6	2.2
--	--	---	---		---	-----
21	31	123	142		270	100.0

	Now	Last Semester	Semester Before Last
No. of requests	55	57	72
No. of nights requested	270	265	368
Oversubscription	1.66	1.65	2.18
Average request	4.91	4.65	5.11

1-m Telescope: 182 nights

Requests		Nights Requested				
Dark	Bright	Dark	Bright	Instrument	Nights	%
7	6	101	184	ASCAP	285	100.0

	Now	Last Semester	Semester Before Last

No. of requests	13	15	11
No. of nights requested	285	191	115
Oversubscription	1.57	1.06	0.68
Average request	21.92	12.73	10.45

0.9-m Telescope: 169 nights

Requests		Nights Requested				
Dark	Bright	Dark	Bright	Instrument	Nights	%
19	8	156	65	CF/CCD	221	100.0

	Now	Last Semester	Semester Before Last
No. of requests	27	26	31
No. of nights requested	221	203	215
Oversubscription	1.31	1.17	1.26
Average request	8.19	7.81	6.94

Schmidt Telescope: 140 nights NF/CCD 17 requests for 180 nights 100%

	Now	Last Semester	Semester Before Last
No. of requests	17	9	14
No. of nights requested	180	125	155
Oversubscription	1.29	1.07	0.84
Average request	10.59	13.89	11.07

ESO 3.6-m Telescope: 12 nights

ADONIS	2 requests for 4 nights	44.4
TIMMI	1 request for 3 nights	33.3
EFOSC1	1 request for 2 nights	22.2
	4 requests for 9 nights	100.0

	Now
No. of requests	4
No. of nights requested	9
Oversubscription	0.75
Average request	2.25

Table of Contents - -

Table of Contents - -

WIYN Project Report

The WIYN Project, the entity formed to construct and commission the WIYN Observatory, continues to slowly complete its formal responsibilities. Since the last Newsletter, the Project has conducted an Operations Readiness Review (ORR), has made further progress towards completing the Instrument Adaptor Subsystem (IAS), and continues to organize for a formal conclusion.

The WIYN Operations Readiness Review (ORR) was held on 1-3 February 1996. In summary, the ORR panel recommended that the Observatory be accepted as completed except for certain IAS related items, as discussed further below. The panel established a list of priorities for the operations staff to address as soon as possible. The top priorities included improving telescope hardware safety limits and interlocks in certain key areas, acquiring more spares for certain critical control system items, improving Hydra fiber position accuracy, improving computer interaction reliability, and completing the telescope temperature-focus correction feedback mechanism. Most of these items have been completed or are being actively addressed. A prioritized list of longer term improvement projects, in such areas as telescope pointing and main axis servo performance, was also generated by the panel and assigned to the operations staff. A full ORR report is available to interested readers from Dave Silva (dsilva@noao.edu).

As a result of the ORR, a expanded list of IAS completion tasks was created. These items include completion and installation of the comparison lamp assembly (since accomplished), commissioning of the wavefront sensing camera, installation and commissioning of the atmospheric dispersion corrector, implementation of a more efficient active optics update process, improvement in guide probe motion speed and reliability, and implementation of a closed-loop optically driven focus compensation process. All these tasks are either being actively worked on or scheduled. Our goal is to complete all these tasks by 1 September 1996.

Remaining Project close-out activities include organizing and storing Project documentation, writing miscellaneous final reports, and closing out the financial books. These tasks should be formally completed by mid-summer 1996, subject to the review and approval of the WIYN Scientific Advisory Committee.

Dave Silva

Table of Contents - -

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

---

Table of Contents - -

WIYN Queue Observing Experiment: Fall 1995 Summary

In the last NOAO Newsletter (No. 45), the lessons learned from the fall 1995 semester of the WIYN Queue Experiment were discussed in general terms. With the completion of fall 1995, a quantitative summary can now be presented.

On 1 February 1996, all fall 1995 WIYN queue programs were officially terminated. PIs were informed that to continue their program, to start a new program, or re-start their old program, they had to re-apply for observing time.

As discussed in NOAO Newsletter No. 45, the WIYN queue was heavily oversubscribed in fall 1995. Consider the following tables:

WIYN Fall 1995 Subscription Statistics

	Number of Proposals			Number of Nights		
	Submit	Sched	Ratio	Request	Avail	Ratio
Dark	36	26	1.4	80	34	2.4
Bright	9	6	1.5	27	16	1.7
2hrQ	20	16	1.3	5	4	1.3

WIYN Spring 1996 Subscription Statistics

	Number of Proposals			Number of Nights		
	Submit	Sched	Ratio	Request	Avail	Ratio
Dark	47	16	2.9	122	36	3.4
Bright	17	10	1.7	52	13	4.0
2hrQ	22	13	1.7	5	3	1.7

If one considers the fall 1995 "Nights Requested/Nights Available" ratios, you can see that the dark-time and bright-time over-subscription ratios were 2.4 and 1.7, respectively. However, once one factors in weather and technical problems (e.g., the 16 day secondary failure in January 1996), effective oversubscription rates became 6.0:1 and 4.2:1, respectively, by the end of the semester.

Next consider the following breakdown of how we used the hours available to the WIYN queue experiment and then read the commentary that follows:

F95 Hours Available: 554

Number of Hours Used

	Hrs	Percentage
Long Programs	222	40%
2hrQ	43	8%
Weather	171	31%
Technical Failures	92	17%
Misc Activity	26	5%

Notes: Lost 8 (6 Dark/2 Bright) nights to secondary failure

Queue Completion Statistics

	Number of Programs			
	Input	Whole	Part	None
Long Programs:				
Dark	25	4	2	19

Long Programs:				
Bright	7	0	4	3
2hrQ High Priority	7	5	1	1
2hrQ Best Effort	9	0	1	8

Notes:

(1) More dark hours than bright hours in a semester.

(2) Lost more time to weather in bright time than dark time in F95.

(3) WIYN Consortium using seven bright nights per month for T&E during F95, decreasing number of bright nights available for science operations.

(4) Programs took much longer to complete than expected, vastly exceeding allocation time. This was a combination of buggy telescope/instruments (this was the first real semester of observing) and grossly underestimated overheads during the time allocation process. Both problems have been vastly mitigated for spring 1996.

(5) Lost eight (6D/2B) nights to secondary failure

To put this in perspective, we received essentially identical numbers of 4-m and WIYN proposals, but NOAO only has 40% of the time on WIYN.

User frustration was heightened by two effects:

1. We elected to give high priority to completing programs entirely before starting new programs during fall 1995. However, since observing overheads were unknown prior to proposal submission, most programs tended to require much longer to complete than anticipated during the TAC review. So, some highly ranked programs consumed more WIYN time than anticipated at the beginning of the semester (see "Active Long Program" tables at end of this message for details). Two changes in spring 1996 should improve this situation:
    - The goal of "100% completion" has been relaxed for the spring 1996 semester. This should increase the number of programs which get some data but may reduce the number of programs which get all their requested data.
    - Programs will be held to their TAC allocated time allotments. This will increase the number of programs which get data.
2. We elected to "allocate" time to more programs than we could possibly complete to make sure we would have a good match between observing program and weather conditions at all RAs. The downside is most people expected to get some data although that was clearly impossible given the ground rules we were using. We tried to carefully match the number of nights available to the number of nights "allocated" queue time in spring 1996. While increasing the number of upfront disappointed applicants, it decreases the number of investigators who wait all semester and receive no data.

I have written about these issues in the March 1996 NOAO Newsletter (No. 45, p. 36) and I urge you to read that article. This article is also available on the Web (see the hotlink on the WIYN Observing Program Home Page (http://www.noao.edu/wiyn/obsprog/).

Users were also frustrated by lack of progress reports and clear information about how the queue was being executed. We have tried to reduce this frustration by creating the NOAO WIYN Observing Program Home Page (http://www.noao.edu/wiyn/obsprog/). This Web page contains links to application information, spring 1996 status reports (updated after every NOAO queue night), details about how the queue works, and queue experiment related NOAO Newsletter articles.

We know this experiment did not operate as smoothly or as satisfactorily as desired during fall 1995. Most of our problems were a combination of balky telescope (this was, after all, the first semester of science operations of a new, complex telescope) and inexperience on our part. We have fixed many of the telescope problems and have gained much experience. With the additional help of your feedback, we think that spring 1996 is going much better and we will continue improving things in the future. Any input you have on improving this experiment would be appreciated and considered carefully.

Nevertheless, no matter how efficient we become, it is a fact that WIYN is heavily over-subscribed right now. To get telescope time, whether through the queue experiment or as a classically scheduled observing run, you will need a strong science proposal.

Our highest goal remains to produce the best quality data possible. However, we are also committed to continuing to improve the level and quality of communication between us and you. We appreciate your concern and patience and we hope to serve you better in the future.

F95 Active Long Programs

		Hours	
ID	Allocated	Used	Status
2161	22.3	74.1	completed
2164	34.0	52.3	completed/synoptic
1929	42.5	25.3	partial

2173	17.0	19.9	partial
1999	25.5	13.7	partial
1954	4.3	13.3	completed
2006	25.5	11.9	completed/synoptic
2085	8.5	3.5	partial
2142	17.0	2.7	partial
1937	4.5	2.0	partial
Misc Cal	0.0	3.2	
Totals	201.1	221.9	

Notes: One Typical 4-m Run = 25.5 hours
Number of Equivalent 4-m Runs = 8.7

Dave Silva

Table of Contents - -

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

---

Table of Contents - -

NOAO Newsletter - Kitt Peak National Observatory - June 1996 - Number 46

Seeing: What Happens at the 4-m

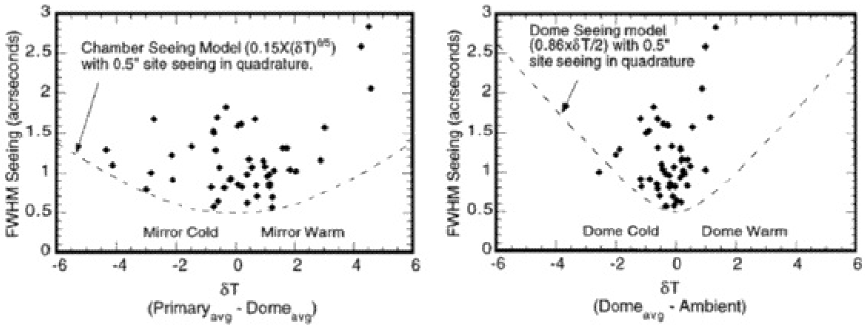
As described in earlier Newsletter articles, we are engaged in improving the image sizes delivered to observers at the 4-m. The fact that WIYN obtains images which are 0.8" in the median (with some nights images as good as 0.4" recording) tells us that Kitt Peak as a site can deliver. And, the stunning improvements that CTIO has made in the DIQ of their 4-m telescope (NOAO Newsletter No. 44) suggests that even a middle-aged telescope, in a "white elephant of a building," can be made to perform outstandingly.

So, what have we done? Our big project this year has been the implementation of cooling for the primary mirror. Anecdotal evidence combined with hard seeing measurements, and the nice empirical study at the CFHT by Racine et al. (1991 PASP 103, 1020), demonstrates that significant image degradation occurs when the primary mirror is warmer than the outside air, the effect going as $\Delta^{(6/5)}$. In practice, we find that if the primary mirror is 4C warmer than ambient dome air, the FWHM of the delivered image will go from 1.0" to 2.5"! If we can keep the primary within 1 degree of ambient, the expected degradation is of order 10%. The dome shutter problem delayed implementation of mirror cooling project, but work on the control system is now complete, and we are cooling the primary mirror from 8 AM to 3 PM each and every day that we physically can (i.e., no instrument change).

We have also been learning how to collimate the telescope more rigorously using wavefront curvature measuring as a guide. Optical analysis shows that we degrade the delivered images by 0.1" for every 0.01 degree of tilt error in the f/8 secondary. On the night of 8 April, Chuck Claver and Charles Corson used a CCD mounted directly at the f/8 focus to measure wavefronts and adjust the secondary tilt, reducing the coma terms from 0.7-0.8 waves down to a few hundredths. Subsequent seeing measurements showed substantial improvement (from 1.1 to 0.8", although of course there could have been some time dependence in this). More importantly, the visual appearance of the extrafocal images became more circular and symmetric. (Previously the telescope had been collimated by the standard "eyeball and autocollimator" method.) The procedure has now fixed the connection between amount of tilt and amount of coma so that subsequent efforts to recollimate using this method should be straightforward.

We have also returned to making nightly seeing measurements. These measurements are providing the statistical basis for identifying the major sources of image degradation and evaluating the effectiveness of changes we are currently putting into place. The seeing measurements should have minimal impact on observations (in no case more than 10 minutes during the night). At f/8 and f/15, we're using a newly installed CCD camera with good plate scale that is mounted on the south port of the rotator-guider to obtain three measurements near zenith each night: once in evening and morning twilight, and once near midnight. We have compared these seeing measurements to those obtained with a direct CCD at the Cassegrain focus to substantiate that our seeing camera is measuring something like what the astronomer would measure with a short (10s) R exposure. At prime focus, we are having the operators measure the FWHM of any focus frames obtained by the observer near zenith through "R" or a similar filter.

Among other things, we are correlating the seeing measurements with differences in temperature between the primary mirror, inside the dome and outside ambient. The accompanying figures show the type of analysis we are pursuing. For our first pass at examining the seeing data, we have divided the 4-m into three components: the primary mirror, the dome air, and the outside ambient air. In doing this we are assuming the air temperature immediately next to the primary mirror to be the same as that of the primary, and that the temperature recorded by our ambient air probe is similar to that along the line of sight. We have chosen two models (see Woolf 1979, PASP, 91, 523) to estimate the contribution of the measured temperature differences to the delivered seeing. Because the intrinsic seeing of Kitt Peak is not always 0.5", we expect to find points above the dashed lines of our chosen model. The validity of these models will be confirmed by a lower boundary forming in the data following the model shape as more data are gathered. Although the data are sparse and the models crude, the figures give us reason for some optimism that these studies will point the way to what we must do to make the 4-m a site-limited telescope much of the time.



This summer we will be installing a new corrector at prime focus in anticipation of the large Mosaic CCD camera that we expect to have available for visitor use next spring. (See article elsewhere in this Newsletter). In the meanwhile, PFCCD observers with our standard T2KB should expect better images due to the improved corrector.

Also on tap for this summer is a refurbishment and repair of the primary support system. We see evidence that the support system is not operating as it was designed, and part of this summer's shutdown activities will be to give the system a good tuning while the primary mirror is being realuminized.

Other projects on the table include the possibility of dealing with chamber seeing (either through lowering the emissivity of the telescope/dome structure or actual dome venting), completion of the total thermal control system (primary mirror temperature, oil temperature, floor temperature), and active support of the primary support system.

Phil Massey, Bruce Bohannan, Chuck Claver,
George Jacoby, Richard Wolff

Table of Contents - -

Table of Contents - -

Hydra in Routine Operation at WIYN

The multi-object spectrometer, Hydra, has undergone commissioning at WIYN over the past twelve months. In August 1995, it was made available for "shared-risk" usage while continued improvements and performance evaluation were undertaken during the monthly testing and engineering nights at WIYN.

We are pleased to announce that Hydra is now in the phase of routine operation. All components of the system have been delivered, including the all transmissive camera. A review of the instrument was also part of the overall WIYN operational readiness review conducted in February 1996. The manual and software releases are in the process of being updated to reflect the latest condition of the instrument. Access to the manual can be achieved through anonymous ftp from ftp.noao.edu and through the KPNO home page http://www.noao.edu.

400 line/mm Grating

Initially, four conventional gratings and one echelle grating were planned to be dedicated to the Bench Spectrograph at WIYN. A first-order low-dispersion blue grating was not included among these because one was not available at the time the grating complement was specified. Such a grating has become available from Milton-Roy, and we procured this 400 l/mm grating with a blaze angle of 4.2 degrees. This grating has excellent efficiency in the blue and good scattered light performance. The grating was released for shared-risk use in September and is now used quite frequently. The properties of all the Bench Spectrograph gratings are listed in the Hydra manual and are included in the exportable program which helps users design spectrograph configurations (setup.f).

Bench Spectrograph All-Transmissive Camera

Work on the all-transmissive camera for the Hydra Bench Spectrograph has been underway for some time. This camera, called the Bench Spectrograph (Red) Camera, has the advantages of no central obstruction and the utilization of high-performance broadband anti-reflection coatings. The Simmons camera, the other option, has a significant central obstruction that blocks 40% of the light in the fairly uniform beam produced by fiber scrambling. The glass and coatings of the Bench Spectrograph (Red) Camera are optimized for the wavelength interval 4500-10000 A. Our deployment of the Bench Spectrograph Camera was delayed by the fact that the WIYN CCD T2KC is warped and the Camera has a narrow depth of focus. In order to overcome this difficulty, a new final element was fabricated that optimizes the coincidence of the focal surface of the camera with the measured shape of the CCD. We can happily report that this fix has been quite successful. The images are good (2.4 pix FWHM) over 90% of the CCD. There is some degradation in the lowest and highest rows. We list below the grating configurations for which we have tested the new camera. This includes all of the on- blaxe configurations that make sense redwards of 4000 Ã…. Note that because the camera is fully refractive, the position of the best focal surface is a function of wavelength. In practice, that means that we have a tilt adjustment for the CCD dewar with respect to the final element of the camera (referred to as the dewar azimuth). As part of our testing, we determined the optimum dewar azimuth for all of the tested gratings (listed below). In practice, one sets this dewar azimuth and then performs a focus sequence in dewar-camera spacing (as usual). We have observed numerous flux standards with the new camera and various gratings. Unfortunately, these are not fully reduced. Initial indications are that the Bench Spectrograph Camera is approximately twice as efficient at 7000 A as the Simmons Camera. We plan to incorporate all our information on count rates and efficiency in the Hydra manual. Note that the wavelength coverage, resolutions, etc., with the Bench Spectrograph Camera are currently available via setup.f and Table 1 in the Hydra manual.

The Bench Spectrograph Camera is available for shared-risk use. For now, we recommend only observations that concentrate on the wavelength region 4500-10000 Ã…. We also recommend only configurations listed in the Table below. Note that the 400 l/mm (blue) grating and the Bench Spectrograph (Red) Camera do not work well in tandem and that unacceptably poor image quality results.

One note of caution regarding changing between the Simmons and Bench Spectrograph cameras. This is a time-consuming job that should not be done during the night. During the design of the camera, we did take numerous steps to enhance the speed and safety of camera changes.

Grating (lines/blaze)	Order	Angle (degrees)	Wavelength Central	Blue	Red	Dewar Azimuth (degrees)
316@7.0	1	21.953	7401	4729	10105	1.310
600@13.9	1	28.900	7735	6306	9166	0.808
860@30.9	1	38.672	9019	8026	9999	0.638
860@30.9	2	41.523	5016	4523	5500	-0.360
1200@28.7	1	43.701	7731	7029	8419	0.293
316@63.4	10	68.900	5633	5479	5768	-0.128

Note: dewar azimuth is not expected to be a function of order for the echelle due to the narrow wavelength interval covered. We have tried only 10th order so far.

Hydra Simulator Caveat

The software which runs a simulator of the Hydra instrument is valuable for inspecting and modifying one's target assignments. Unfortunately, the platform under which the software will operate is restricted to Sun computers running SunOS and OpenWindows. In some cases, the compiled version of the simulator will run on a Sun workstation running Solaris, but we have experienced cases where it does not work.

If you experience difficulty running the simulator at your home institution and your preparation is for the NOAO share of WIYN time, you may contact Jeannette Barnes (jbarnes@noao.edu) or Dave Bell (dbell@noao.edu) to set up a visitor account through which it is possible to run the simulator remotely (though not necessarily efficiently). Please refer to the Hydra manual for further information.

Hydra Positioning

One of the performance evaluations of the past year involved an analysis of Hydra's positioning accuracy, after it was discovered last fall that the fiber positioning could do with some improvement. The smaller plate scale of WIYN in comparison to that of the Mayall 4-m places tighter specifications on the physical positioning of the fibers required to land the desired target onto the fiber. We also determined the need to introduce some distortion terms to eliminate residual "plate scale" terms of the instrument stages. In addition, we found that the new fiber pivots were introducing somewhat stochastic positional errors which would cause some fibers to completely miss their targets. Simple fixtures were recently installed into the pivots to eliminate such errors. As a result of these improvements, it should now be a rare circumstance that leads a fiber to miss its target completely.

On-sky evaluation of Hydra positioning performance showed an improvement in rms positioning from > 0.5", measured last fall, to about 0.3", measured this spring.

Fun Facts

During the "shared-risk" period from August 1995 to March 1996, Hydra was operated on a total of 156 days or nights (of which about 25 were spent on testing and evaluation) and has moved 43500 fibers during that time. The reliability of the instrument is significantly better than when it was in use at the 4-m, with the failure rate of fiber motions being about 1 in 1700 moves, as compared to 1 in 200 moves at the 4-m.

Future Prospects

Attention is now focusing on fabrication of Hydra/CTIO (see related article under the CTIO section in this Newsletter). That instrument will utilize better performing motors and controllers and will involve enhancements in the controlling software. Discussions are underway with WIYN for the possibility of a retrofit project which will upgrade Hydra at

WIYN with similar new motors, controllers, and software. We hope that such an upgrade might be possible a few years from now.

Sam Barden, Taft Armandroff

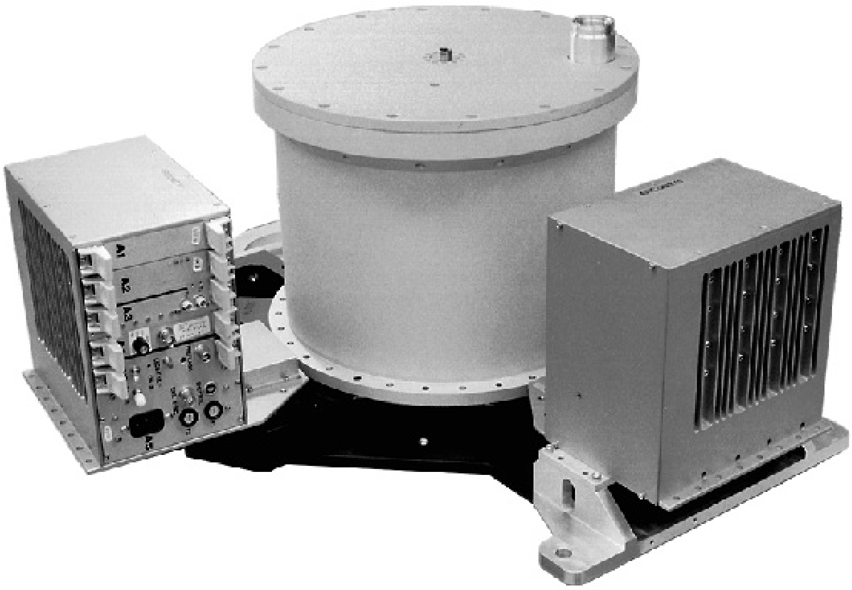
Table of Contents - -

Table of Contents - -

NOAO Newsletter - Kitt Peak National Observatory - June 1996 - Number 46

Coming Soon--The CCD Mosaic Imager

For several years now, work has proceeded at NOAO on developing a large CCD mosaic for wide-field optical imaging. Input from users' and advisory committees, comments from the community, and the interests of the NOAO scientific staff have all contributed to making this a high priority for the optical instrumentation program. The mosaic is now nearing completion. Commissioning tests are planned for this summer and fall. If all goes well, the instrument will be offered for shared-risk use in the spring 1997 semester. This article describes the instrument and gives some information on its expected performance. A detailed description of its capabilities will appear in the Newsletter before it is released for visitor use.



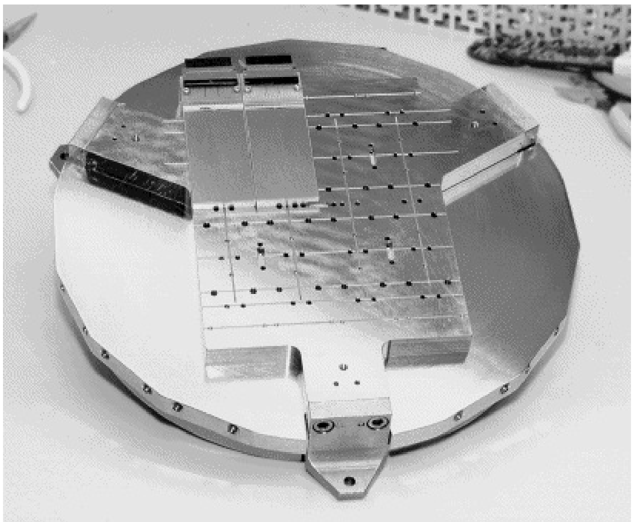
Caption: The Mosaic Dewar with two ArCon controllers attached.

The chosen format of the Mosaic Imager features eight 2048 x 4096 15 μm pixel CCDs arranged as an 8192 x 8192 pixel detector. The resulting mosaic is a square about 5 inches on an edge. The gaps between CCDs are kept to about 0.5 mm. We are commissioning the Mosaic Imager with unthinned Loral CCDs. These chips have some flaws which compromise their performance, but they will be suitable for proving the instrument and for certain types of science observations. Their principal defect is the result of a foundry processing error which requires that they be run no colder than -60 $^{\circ}$ C, resulting in a dark current of 100-200 e hr^{-1} $pixel^{-1}$. The read noise is about 10 e^{-} rms, but charge injection in three of the chips results in an effective read noise of about 30 e^{-} rms. The sensitivity of these chips will peak in the red, where they will have about 40% quantum efficiency. Their response is not UV enhanced. We are planning to replace these chips with science grade CCDs as soon as acceptable (thinned, blue sensitive, flat, and with good cosmetics) chips are available to us.

The Mosaic Imager will be available initially on both the Mayall 4-m telescope (at the prime focus) and the KPNO 0.9-m telescope. After one year of scientific operation at KPNO it will be shipped to CTIO and will be available on the Blanco 4-m telescope for one year. The field of view of the Mosaic Imager is about 38' on an edge at the 4-m telescopes and about one degree square at the f/7.5 focus of the 0.9-m telescope. See the accompanying article about the new correctors to be used with the Mosaic Imager at the KPNO telescopes.

The Dewar is a larger version of the standard KPNO universal Dewar. It holds 6.5 liters of LN2 and should have a hold time of about 30 hours. It is radiatively coupled to the chip mount in order to ensure uniform temperature over the entire array.

The filter track, running in a loop over the top of the Dewar, holds 14 filters. A pair of pneumatic cylinders positions the track to any filter in a few seconds. The filters are 5.8 inches square, and inserts will be available to accommodate smaller square and round filters with some vignetting. All filters will be parfocal. Initially, at least 5 filters, B, V, R, I, and Hα, will be provided. Additional filters will be acquired as funds permit.



Caption: The Dewar base plate with two of the eight 2K x 4K CCDs mounted.

The shutter consists of two sliding metal curtains controlled by pneumatic cylinders. Tests indicate that their motion is precise and repeatable, and exposures as short as one second should produce reproducible results.

Along two chords of the Mosaic focal plane, small prisms pick off fields for guiding. These fields, 2.5' x 4' at the 4-m PF, are optically relayed to two independent intensified CCD cameras. The camera video signals are fed to "leaky guiders". The TV fields are imaged through separate small filters in the filter track.

The eight CCDs are read out through four ArCon CCD controllers. These controllers currently run between 50 and 100 kilopixels/s per CCD, yielding an anticipated read time of approximately 83 seconds. However, a design modification is in progress which will allow them to run at twice that speed. This modification is expected to be in place by the start of shared-risk observing in the spring semester of 1997.

Each time the Mosaic Imager is read out, 128 megabytes of data are generated. It is not our intent to send visitors home with many gigabytes of unreduced data; we are putting together a data system which will run a pipeline reduction of each night's observations. This reduction will include bias and dark removal, flat fielding, geometric rectification, and combining of multiple frames. The reduced data (and raw data if desired) can then be written on Exabyte tapes for transport home.

The next few months will represent the culmination of work on the Mosaic Imager subsystems. The entire system will be integrated and tested during three engineering runs on the KPNO 0.9-m in May, June and July. Then in August and September, the first tests of the Mosaic at the KPNO 4-m with the new Corrector and atmospheric dispersion compensator will take place.

We are now entering the time frame during which it would likely be profitable for users to think about the scientific opportunities enabled by the CCD Mosaic Imager's capabilities. Watch the next Newsletter for a Mosaic update. In addition, any of the undersigned may be contacted for additional information.

We are grateful to the large number of people at NOAO who have contributed to this project over the years.

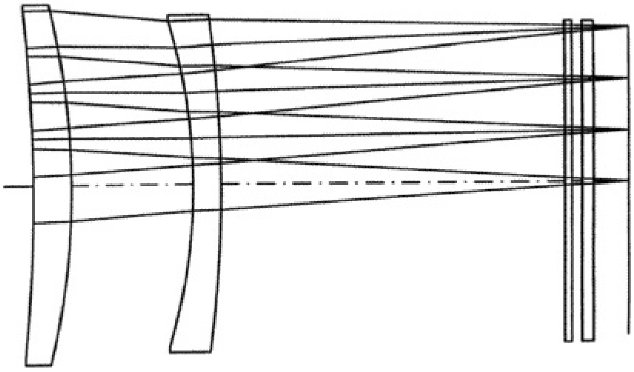
Todd Boroson, Taft Armandroff,
Alistair Walker, George Jacoby, Rich Reed

Table of Contents - -

Table of Contents - -

New Imaging Correctors For Use With the 8K x 8K CCD Mosaic

Two new correctors are needed to accommodate the wide field of the 8K x 8K CCD Mosaic (see accompanying article). The 0.9-m corrector, a relatively simple doublet of fused silica, is now complete and has been tested successfully on the telescope. The 4-m corrector is more ambitious and complex and should be nearing completion as you read this. This article provides a brief overview of the features of these optical systems, both designed by Ming Liang (NOAO).



Caption: 0.9-m Corrector

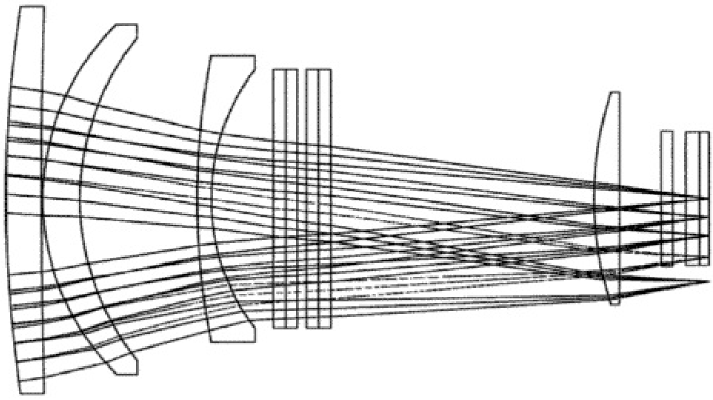
The Mosaic field of view at the 0.9-m telescope will be 59' x 59' with 0.43" pixels, compared to the existing imager having a field of view of 23' x 23' with 0.68" pixels. The corrector must accommodate the diagonal of 83'. Predicted spot sizes are much smaller than a pixel over the entire field, and actual imaging tests with a "small" CCD (the T2KA 2048 x 2048) placed off-axis confirm that there is no significant image degradation from the corrector.

Special attention was given to broad band optical coatings to ensure that the four glass-air interfaces do not adversely impact the telescope efficiency. The existing small field corrector introduces a 35% loss in the U band--we wanted to recover that deficiency with the new corrector. We contracted to Continental Optics for a coating that appears to work well; preliminary indications show the surfaces to be nearly lossless in the U and B bands.

Low surface brightness workers will enjoy the low scattering properties of the system. We saw no evidence of any scattering except close to saturated bright stars. We are working to reduce vignetting introduced by the telescope baffles, but we place the low scattered light properties at a higher priority.

The 4-m corrector layout was motivated by the atmospheric dispersion compensated (ADC) optical design by Richard Bingham (UCL) for the CTIO 4-m. Changes over the CTIO design were made to improve U-band transmission, provide a wider field, and reduce weight and cost. We expect all optical elements to be completed shortly and placed into the 4-m prime focus over the summer shutdown.

The new corrector is designed to be used with the Mosaic to provide a field of view of 36' x 36' (diagonal of 51') with 0.26" per pixel. The corrector also works with the standard T2KB imager to offer superior image quality, even over the small field of T2KB, and an ADC to enhance the image quality, especially in U and B at zenith distances greater than 45 degrees.



Caption: 4-m Corrector

Again, the new corrector design is intended to protect the U band transmission and will use a broad band coating for the fused silica elements. We are investigating options for special coatings on the UBK7 and LLF6 glasses as well. As with the 0.9-m corrector, attention is being given to minimizing scattering, and like the 0.9-m corrector, we expect the 4-m corrector to be excellent, too.

George Jacoby, Taft Armandroff,
Todd Boroson, David Vaughnn, Ming Liang

Higher Throughput for Burrell Schmidt CCD Imaging

For a number of years, the Burrell Schmidt has offered CCD imaging at the Newtonian focus and traditional photographic imaging, with the plate holder located inside the telescope tube. The high demand for CCD imaging with this telescope, coupled with the declining photographic requests, resulted in a decision to offer only the CCD as a detector, both during KPNO and CWRU time (see NOAO Newsletter No. 41).

Consequently, the opportunity arose to remove the hardware inside the tube that accepts the plate holder. It was apparent that this hardware presented significant obstruction. This obstruction undoubtedly contributed to the fact that the Schmidt's CCD count rate was below that expected based on the aperture relative to our other telescopes and the S2KA CCD's performance relative to that of our other CCDs. It also seemed likely that the extra material in and near the beam contributed scattered/stray light.

The Schmidt was shut down during the March bright run to remove the photographic plate holder and blacken exposed metal surfaces. As a secondary goal, the lead screw in the CCD focus mechanism was replaced in the hopes that this would reduce the sky-position-dependent focus variations. The mirror was also realuminized. Because the collimation has always been done using the plateholder for reference, this also provided the opportunity to use an improved laser collimation procedure, devised and carried out by Chuck Claver.

The count rates displayed below show the improvement in throughput:

$e^{-} s^{-1}$ normalized to mv = 20th mag observed at zenith

	late January	3 March	improvement
U	0.54	0.86	1.59
V	1.70	2.71	1.59

Thus, we have gained half a magnitude by removal of the plate-holder and associated hardware! It is true that in the intervening time, the primary was realuminized, and the corrector and dewar windows cleaned. However, the similarity of the gain at U and V suggest that the realuminization was a minor component. (Thanks to Nigel Sharp and Mike Corbin for obtaining the exposure of the spectrophotometric standard.)

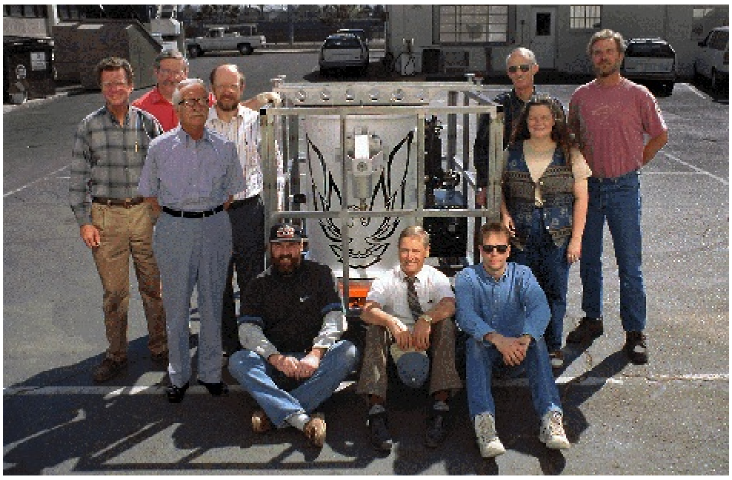
The best images obtained were considerably undersampled (1.35 pixels FWHM = 2.7"), as good as we have ever seen. This indicates that the new collimation procedure has worked well. Unfortunately, the good image quality reveals a focus gradient previously not apparent. The gradient is across a diagonal of the chip, consistent with a simple tilt. Thus we achieve 1.3 pixels in the center, but in two of the corners of the chip, the images degrade. The images are < 2.0 pixels FWHM over nearly the entire chip.

The new lead screw appears to work well, and there is no longer any change in the displayed focus values as one moves the telescope around the sky. However, there is still a noticeable shift in focus as a function of position in the sky (+250 focus units going from +70 declination [0 HA] to 0 declination [0 HA]). This indicates that some other component is likely responsible. We have documented the magnitude of the effect (and the sign!) and expect that observers can compensate for this now that the focus readout is reliable. The direct imaging manual has been updated to include all the above information. One final note: the Schmidt now has a second monitor for the data taking Sun, Loden. This enables one to easily juggle the multiple windows needed for data acquisition, display, and reduction.

Taft Armandroff, Phil Massey, Bill Schoening

NOAO Newsletter - Kitt Peak National Observatory - June 1996 - Number 46

Phoenix Progress



Caption: Phoenix with the key Phoenix personnel. Left to Right: Randy Cuberly (mechanical designer), Dick Sumner (optician), Jorge Simmons (optical designer), Ken Hinkle (project scientist), Tim Ellis (mechanical engineer), Neil Gaughan (systems engineer), Paul Schmitt (electrical and mechanical technical), Craig Danielson (mechanical technician), Julie Heynssens (electronics engineer), and Steve Rath (machinist).

Three major milestones were passed since the last Newsletter: Phoenix (without a detector) visited Kitt Peak on 1 April and was mounted on the 2.1-m telescope. Installation, including drilling a new set of bolt holes in the back of the 2.1-m telescope, went without problems. Stars were acquired on 1 April using the internal dichroic and a CCD guider. An important test was to look for any interference where the instrument could physically run into the telescope. Measurements had indicated that the yoke area could be a problem. It turns out that Phoenix clears the yoke, but there is interference at declinations greater than +75 with various attachments to the yoke. By removing a tie rod support bracket and the (currently unused) coud tube full sky access would be possible. However, given the small amount of sky north of +75, the northern declination limit will be declared to be +75 on the 2.1-m unless this limit impacts user science.

Following the trip to Kitt Peak, Phoenix was cooled down for the first time. The performance exceeded our optimistic projections. The instrument reached a stable temperature of 50 K in three days. Phoenix is cooled only by dual compressed helium refrigerators, and we had expected that cooling could take as long as five days. The temperature goal was less than 70 K, at which point the thermal radiation contribution to the dark current becomes negligible. The Phoenix mechanical designer, Randy Cuberly, and mechanical engineer, Tim Ellis, are to be commended for an exceptional job in designing the thermal insulation and radiation shielding. We are able to warm the instrument to room temperature in two days using resistive heaters. Without the use of heaters, the instrument is so well insulated that it would take weeks to warm. While the cryogenic systems all work better than planned, note that as with COB and SQIID, it will be impossible to open Phoenix without a long lead time and advanced planning.

The third milestone was the completion of electronics to run the array. The warm electronics boxes were fully checked out and a ROIC (bare read out) installed in an Aladdin array mount and operated cold in Phoenix using wildfire. The read noise of the ROIC was 37 e_- warm and 32 e_- cold. Before the ROIC can be replaced with an engineering grade Aladdin array, the detector temperature must be controlled to a few hundredths of a degree. This work is currently underway.

As announced in the previous Newsletter, a special scheduling process will occur for the fall 1996 semester Phoenix proposals. Several blocks of 2.1-m time are being set aside for Phoenix late in the 1996 schedule. The Phoenix proposal deadline for these blocks will be announced on the Web site (http://www.noao.edu/kpno/phoenix/phoenix.html). In addition, interested users should send e-mail to hinkle@noao.edu. Progress reports are being sent periodically to users who have sent email to hinkle. Unless major problems are encountered, the operating specs for Phoenix will be announced in late June. You will be notified of the proposal deadline at that time. We realize that many people have travel plans in June and July so adequate time to prepare proposals will be allowed.

Ken Hinkle

NOAO Newsletter - Kitt Peak National Observatory - June 1996 - Number 46

WIYN Queue Observing Experiment: Spring 1996

As I write this article, we are at the mid-point of the spring 1996 semester. How is the WIYN queue experiment doing? A quantitative analysis has been posted to the Web at http://www.noao.edu/wiyn/obsprog/. On those Web pages, progress reports are updated after every night allocated to the NOAO WIYN queue observing experiment. Please read those pages and send us any suggestions for improvement. We want them to be as useful as possible for you!

Qualitatively, spring 1996 is unfolding somewhat differently than fall 1995. For the most part, our feeling is that this evolution has been positive, but your comments would be welcome.

For example, during fall 1995, 70% of the usable hours (152/222) went to only three observing programs. This was driven by our goals to execute programs strictly in order of TAC grade and to complete programs at the 100% level whenever possible. This semester, we have relaxed these two rules. As a consequence, we are now servicing more programs with the goal of producing scientifically reasonable subsets of data for all "high priority" programs and as many "best effort" programs as possible. Of course, we will try to complete as many programs as possible. However, experience has shown most PIs prefer some reasonable amount of data over no data at all. We are carefully interacting with PIs to assure an accurate assessment of what constitutes a reasonable data subset when 100% completion is not feasible. This change in strategy has also eliminated the problem with programs greatly exceeding their TAC recommended time allocations.

Another positive development is the frequently updated queue activity information posted to the Web. Using this information (available at http://www.noao.edu/wiyn/obsprog/), it is now straightforward for PIs with programs in the queue to assess what is happening and when (or whether) their program is likely to be executed.

By reducing the number of programs initially entered into the queue, we have both reduced our program tracking workload and given PIs an earlier definitive answer about their program. Our goal was accept roughly an equal number of "high priority" and "best effort" hours, with the "high priority" hours being roughly 60% of the total available time. The idea was to give us a reasonable chance of servicing all "high priority" programs in the queue at the 80% or above level, and service as many "best effort" programs as possible. Unfortunately, as delineated on our Web page, we over-scheduled the spring 1996 more than we should have. In essence, this means that while most "high priority" programs will get significant datasets, many "best effort" programs will now receive no data at all. As we process proposals for fall 1996, we will keep this mistake in mind, and try to accurately schedule fall 1996 programs.

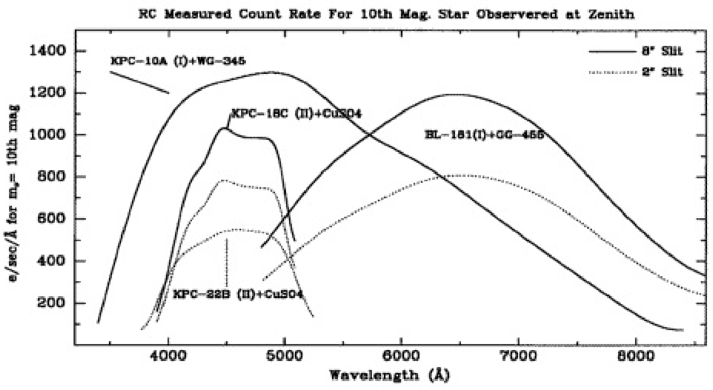
More information about the NOAO WIYN Queue Observing Experiment is available at our Web site. Please visit it and send us your suggestions for improvement.

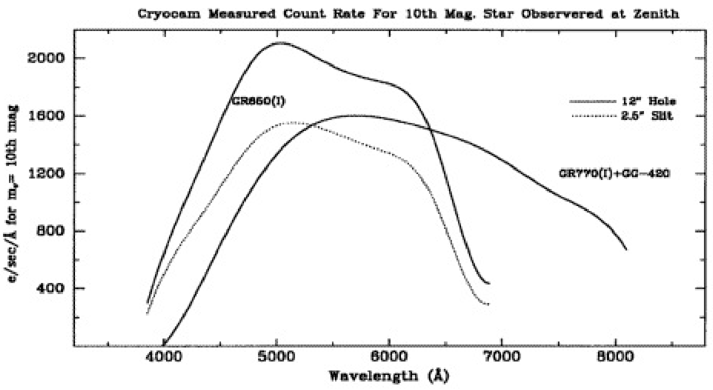
Dave Silva

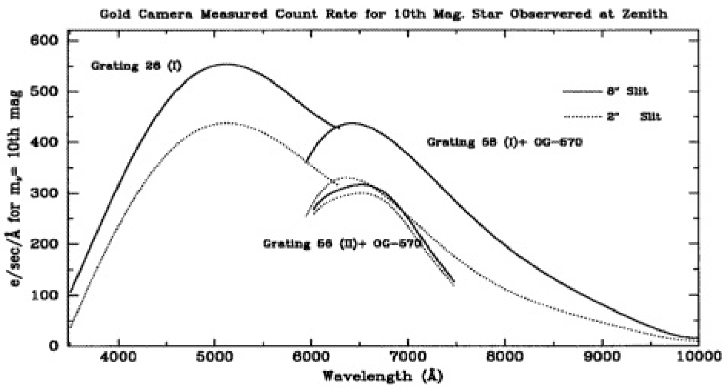
Guide for Optical Spectroscopists

As promised, we have recently completed a manual covering low-to-moderate resolution (R < 5000) optical spectroscopy at Kitt Peak. The manual covers the R-C Spectrograph and Cryogenic Camera at the 4-m telescope, and the GoldCam Spectrometer at the 2.1-m. The manual is available both by anonymous ftp (to ftp.noao.edu, cd kpno/manuals, binary, get spectroscopy.ps.Z) or via the Web under documentation on the Kitt Peak home page http://www.noao.edu.

In preparing this guide, we obtained data on spectrophotometric standard stars to serve as an exposure guide. We show in the accompanying figure the actual measured count rates (per Angstrom, not per pixel) normalized to an mv = 10.0 mag star. We show both the case where the slit is essentially wide-open (8") and when the slit has a nominal size in modest seeing conditions. Although various gratings and grisms are shown, the basis for comparing different gratings really should be the efficiency plots included in the manual. But this figure should provide a good guide as to what to expect at the telescope in terms of count rates near the grating blaze in medium and excellent seeing.







(32 Kb image)

Thus, we might expect to obtain about 800 e s^{-1} Ã…$^{-1}$ at mv = 10th mag with the 4-m R-C Spectrograph under moderate seeing conditions. If the seeing were spectacular (and we're working on that; see the article elsewhere in this Newsletter), it might be as much as 1000 or 1300. Thus at 18th magnitude we would expect to obtain 800 x $10^{(10-18/2.5)}$ = 0.5 e s^{-1} Ã…$^{-1}$. To obtain a SNR of 50 per 3 Angstroms resolution element would require 2500 e^{-} per 3 Ã…, or 830 e^{-} per Ã…, which we would achieve in 1630s at 0.5 e^{-} s^{-1} Ã…$^{-1}$. We assume in this example that photon noise from the sky is immaterial; a more complex example is given in the manual.

What does this translate to in terms of actual throughput? For the 4-m (which has a clear aperture of 3.42 m), the total system throughput (telescope + spectrograph + CCD) is 15% for the R-C Spectrograph and 21% for CryoCam under excellent seeing conditions. At the 2.1-m (which has a clear aperture of 1.94 m), the total system throughput is 19 GoldCam under excellent seeing conditions.

Phil Massey, Jim DeVeny,
Buell Jannuzi, Daryl Willmarth

Table of Contents - -

Table of Contents - -

Electronic Submission of Star Caches

For efficient observing, Kitt Peak provides caches for user coordinates at the 4-m, WIYN, 2.1-m, Coude Feed, and 0.9-m telescopes. To ensure that caches are ready for the start of a run, observers should e-mail object coordinates two weeks in advance to allow sufficient time to load and verify observer coordinate lists.

The coordinate list, which follows a simple space-delimited format, is e-mailed to coords@noao.edu. When the list has been received, a reply will verify receipt and a second e-mail will confirm that the object list has been processed and is ready for the observer's run. At the end of the run, user coordinate caches are archived and can be reinstalled in the telescope computer for later runs.

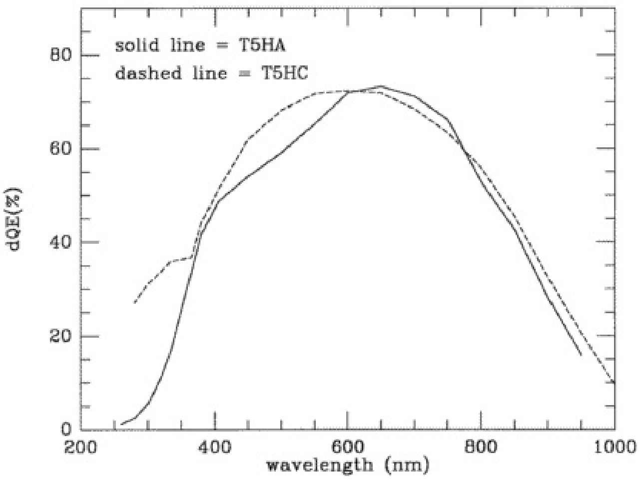
Format and instructions for e-mail coordinate submission can be found by either following the links from the NOAO home page or by pointing your web browser to http://claret.kpno.noao.edu/coords.html, which is off the "KPNO Observing Information" Web page.

Craig Mackey, Bruce Bohannan

Table of Contents - -

CCDPhot (The KPNO CCD Photometer) Gets A New Detector

Several months ago, the CCDPhot detector, designated T5HA, suddenly and inexplicably became inoperable. In deciding what to replace it with, we considered several factors. First, we felt it was important not to use a CCD larger than 512 x 512 pixels in order to maintain the ease-of-setup and ease-of-use aspects of CCDPhot. Second, the new CCD must have similar noise characteristics and dynamic range as compared with T5HA. Finally, we wanted to address the concerns of users who have requested better dQE in the U band. With these points in mind, we have selected a SITe 512 x 512 pixel back-side illuminated CCD designated T5HC. This detector has the same pixel size and approximately the same read-out noise and full-well capacity as T5HA but significantly flatter response in the U band. This is illustrated in Figure 1, which shows the dQE curve for T5HC (dashed line) as compared with that of T5HA (solid line). This improved U band response over T5HA comes at a price; the cosmetic quality of T5HC is somewhat worse. It has one hot column at (386) and a series of cold columns in the range 488 < x < 502. In addition, the first 30 rows of the CCD are affected by an abnormally high dark current and should thus be avoided. However, we feel that these imperfections will not affect the normal use of CCDPhot by observers. Furthermore, it is hoped that the flatter dQE in the U band will improve the transformability of U-B (see details in the September 1995 NOAO Newsletter).



Ata Sarajedini, Ed Carder, Lindsey Davis,
Tom Kinman, George Jacoby, Tom Wolfe

Table of Contents - -

NOAO Newsletter - Kitt Peak National Observatory - June 1996 - Number 46

The Future of High Resolution Spectroscopy at KPNO

Many astronomical studies benefit from observations of celestial objects at high spectral resolving power. Some of the facilities and instrumentation for high dispersion spectroscopy, however, are coming under the threat of closure or are reaching their limit of usefulness due to the small aperture of the telescopes that feed them. Many of the new facilities either don't have sufficient spectral resolution or are located at observatories with restricted access or scheduling.

KPNO has convened a committee, comprised of both NOAO staff and community members, to 1) examine the scientific needs of high resolution spectroscopy, 2) evaluate the facilities which are available to the general astronomical community, and 3) develop and prioritize instrumentation goals for future KPNO facilities. The committee will also consider policies for scheduling KPNO telescopes to maximize scientific return from high resolution spectrographs, including possible changes to the TAC process and visitor and queue observing modes.

We will keep you informed about the progress of the committee and hope to report on its recommendations early in 1997.

Sam Barden, Caty Pilachowski, Mark Giampapa

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

NOAO Newsletter - Kitt Peak National Observatory - June 1996 - Number 46

A Quick Look Back

A commonly used word in describing the Kitt Peak facilities has been scientific capability, a term which may be thought of as a convolution of the telescope itself, the instrumentation, image quality, and efficiency of operation. Every issue of the Newsletter has several articles describing the efforts in optimizing these various aspects of our facilities.

The quality of the instrumentation is a significant factor in keeping all of our telescopes scientifically competitive. A glance through the presently available instruments (NOAO Newsletter No. 45) will demonstrate the availability of large-format detectors (2048 x 2048 and 3K x 1K CCDs and 256 x 256 IR arrays) on large and small aperture telescopes.

Like biological evolution, the evolution of these capabilities is a quasi-continuous process, although sufficiently gradual that one is not always aware of the scope of the changes. Such changes can be better defined by discrete sampling, so we present listings of the available KPNO instrumentation five and ten years ago as a basis for comparison.

1996 KPNO Instrumentation

```
4-m     R-C Spectrograph + T2KB (2048 x 2048)
        Echelle Spectrograph + T2KB
        Prime Focus Camera + T2KB
        CryoCam + Loral (800 x 1200)
        Cryogenic Spectrograph CRSP (256 x 256 InSb)
        Infrared Imager IRIM (256 x 256 NICMOS3)

WIYN    Hydra + Bench Spectrograph + T2KC (2048 x 2048)
        CCD Imager + S2KB (2048 x 2048)

2.1-m   Direct Camera + T1KA (1024 x 1024)
        GoldCam Spectrograph + F3KA (3072 x 1024)
        CRSP
        IRIM

Coude Feed
        Camera 5 or 6 + F3KB (3072 x 1024)
        Camera 5 + NICMOS3 (256 x 256)

0.9-m   Direct Camera + T2KA (2048 x 2048)
        CCD Photometer + T5HC (512 x 512)

Burrell Schmidt
        Direct or Objective Prism + S2KA (2048 x 2048)
```

1991 KPNO Instrumentation

```
4-m     R-C Spectrograph + TI2 (800 x 800)
        Echelle Spectrograph + TI2
        CryoCam + TI1 (800 x 800)
        Fourier Transform Spectrometer (Single InSb)
        Prime Focus Camera + 2048 x 2048 CCD
        NESSIE Fibers + Plugboard (with R-C or Echelle)
        Cryogenic Spectrograph CRSP (58 x 62 InSb)
        Infrared Imager IRIM (58 x 62 InSb)

2.1-m   GoldCam Spectrograph
        Fiber Optic Echelle
        White Spectrograph (Plates)
        Direct Camera + TI6 (800 x 800); TEK2 (512 x 512)
        CRSP
        IRIM

Coude Feed
        Camera 5 or 6 + TI3 (800 x 800)

1.3-m   IRIM
        CRSP
        OTTO (Single Channel InSb Photometer)
        MkIII (Optical Photomultiplier Photometer)
        SQIID (Four Channel IR Imager; 256 x 256 PtSi)

0.9-m   Direct Imaging: TI6; TEK1 or TEK2 (512 x 512); 2048 x 2048 CCD
        Intensified Reticon Scanner (IRS)
        Automatic Filter Photometer (at #2 0.9-m)

Burrell Schmidt
        Direct or Objective Prism + TI2 or TI6 (800 x 800)
        Photographic Plates
```

Five years ago, the larger format chips which are in universal use today (2048 x 2048 CCDs; 256 x 256 IR arrays) were just starting to find use for wide-field imaging. The initial 2048 x 2048 CCDs were thick devices coated with Metachrome 2 for blue sensitivity enhancement, rather than the thinned devices used presently. After only four years, the low quantum efficiency of the large (in 1991) IR arrays in SQIID made that instrument noncompetitive and the requests for its use decreased significantly. Most of the arrays in use were 512 x 512 TEK chips, 800 x 800 TI chips, and 58 x 62 InSb arrays. Multi-object spectroscopy was possible with NESSIE and fiber plugboards. No ICE, no WILDFIRE.

```
                1986 KPNO Instrumentation

4-m     R-C Spectrograph + TI3 (800 x 800)
        Echelle Spectrograph + TI2 (800 x 800) or RCA2 (320 x 512)
        CryoCam + TI1 (800 x 800)
        Fourier Transform Spectrometer
        Intensified CCD Camera
        Prime Focus Imaging + TI2 or Photographic Plates
        Intensified Image Dissector Scanner (IIDS)
        BT Single-channel InSb Photometer

2.1-m   IIDS
        White Spectrograph + Photographic Plates
        Direct Camera + TI2 or RCA1 (320 x 512)
        BT

Coude Feed
        Camera 5 or 6 + TI2 or TI3 (800 x 800)
        Photographic Plates

1.3-m   OTTO, HERM Single-channel InSb Photometer
        AUDR Scanning InSb Spectrophotometer
        BOLO Single-channel Ge Bolometer Photometer
        CCCP Single-channel Si:As Photometer
        Mk2 Single-channel Photomultiplier Photometer

0.9-m (#1 and #2)
        Direct Camera + TI2, TI3 (800 x 800); RCA1 (320 x 512)
        Intensified Reticon Scanner (IRS)
        White Spectrograph + Photographic Plates

0.4-m   f/13 Photomultipler Photometer

Burrell Schmidt
        Direct or Objective Prism + Photographic Plates
```

Ten years ago, all scheduled IR astronomy utilized single-channel instruments; engineering tests of the first 58 x 62 arrays was just getting going. Optical CCDs were the 800 x 800 TI chips and the 320 x 512 RCAs. The Kitt Peak Photon Counting Array (KPCA) was undergoing engineering tests. Remember the IIDS and IRS? Most of the Varian 620s had been replaced by state-of-the-art PDP machines, but it was still VT100s, FORTH, and nine-track tapes.

Dick Joyce

Table of Contents - -

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

---

Table of Contents - -

NOAO Newsletter - National Solar Observatory - June 1996 - Number 46

From the NSO Director's Office

Honors to Jack Harvey and George Simon

John W. Harvey was presented with the 1995 AURA Science Award by Goetz Oertel in a ceremony at NOAO Headquarters last November. In addition to his worldwide reputation as an innovative instrumentalist, Jack remains fully engaged in the science that these instruments produce--witness his recent lead article on helioseismology in Physics Today, as well as a steady stream of research publications.

In February, George W. Simon was named a Fellow of the US Air Force Phillips Laboratory--the Laboratory's highest award for scientific and engineering achievements. As the Fellows program is new this year, George is among the inaugural group of recipients. He is widely recognized for his work on solar magnetoconvection. In addition to the gold medal and plaque he received at the Fellows awards banquet, George will receive a specialized grant to pursue research beneficial to the Air Force. You can see a nice picture of George and his fellow Fellows on the web at http://www.plk.af.mil/PLhome/PA/RELEASES/96-12.html. Congratulations to both Jack and George (and apologies to Jack for inadvertently omitting his award from the last Newsletter)!

The Sunspot Education and Visitor Center

As you'll read below, a seven-year campaign to bring an education and visitor center to Sunspot has been crowned with success and will be under construction by the time this Newsletter appears. Many people contributed to this multi-agency effort, so I must apologize in advance if I omit someone.

Rex Hunter spearheaded the campaign and will shepherd it through completion. Other NSO/SP contributors, past and present, include Ramona Elrod, Guy Gallaway, Lou Gilliam, Craig Gullixson, Frank Hegwer, Julie Hull, Don Neidig, Robert Rentschler, and Ray Smartt. Don Versluis and Andy Commissaris handled contractual issues for NOAO; Jeff Barr also consulted on the design of the center. Max Goodwin represented the Forest Service, along with Peg Crim, Jose Martinez, Lee Poague, Geri Rivers, and Johnny Wilson. Kurt Anderson represented the NMSU Apache Point Observatory. The International Space Hall of Fame was represented by Don Starkey, Ken Hitchcock and Edson Way; the State of New Mexico Tourism Department by Joseph Gutierrez and Javier Gonzalez; and the Federal Highway Administration by Joseph Edwards. The New Mexico state and federal congressional delegations provided invaluable support; the Honorable Dave Townsend sponsored the original state legislation that got the ball rolling. Congratulations and thanks to everyone who made this possible.

GONG on the Cover of Science!

Don't miss the special issue of Science to appear 31 May 1996: "First Results from GONG," with seven articles in addition to the colorful cover. GONG will also make a splash at the Madison AAS/SPD meeting (9-13 June) with an invited talk by Juri Toomre, a topical session, and the annual GONG meeting following the AAS meeting.

See you in Madison

In addition to the GONG presentations and meeting just mentioned, NSO will contribute to the SPD topical session on "New Solar Instrumentation" organized by Jeff Kuhn, including presentations on SOLIS, CLEAR, and infrared instrumentation, and to the special session on the Stellar Oscillations Network Group (SONG). We'll be contributing to other sessions as well, and looking forward to learning about your latest work.

Update your Bookmarks--New URL for the NSO Web Site

We are gradually trying to improve the utility and user-friendliness of our web site, which is now at http://www.nso.noao.edu. From there you can link to pages for NSO/Kitt Peak, NSO/Sac Peak, NSO/GONG, and NOAO; you can fill out or download an observing time request form; and you can find out more about NSO-wide efforts such as SOLIS (Synoptic Optical Long-term Investigations of the Sun). We hope in the future to start an on-line discussion similar to the AURA electronic forum (at http://www.noao.edu/aura/forum) and to provide easy entry to the nascent NSO digital library (see related item below).

The Summer Students are Rolling In

NSO's summer students this year (and their advisors in parentheses) include: Christopher Allen (Matt Penn), Eric Bell (Frank Hill), David Berger (Larry November and John Varsik), Mark Fagan (Charlie Lindsey) Kathleen Ford (Steve Keil and K. S. Balasubramaniam), Karen Griffith (Christoph Keller), Inese Ivans (Jeff Kuhn), Hina Khan (Thomas Rimmele), Sean Matt (George Simon), Abigail Paske (Bill Livingston), Ann Schiff (Haosheng Lin). Jeremy Tinker (Thomas Rimmele and Louis Strous), and Wayne Winters (Harry Jones). We'll fill you in on their activities in the next Newsletter.

Doug Rabin

Table of Contents - -

Table of Contents - -

Construction Begins on Sunspot Education and Visitor Center

The National Solar Observatory is pleased to announce that construction is scheduled to begin by the end of April on the new education and visitor center on the grounds of NSO/SP. Completion is scheduled for December 1996 with an official opening tentatively scheduled for the spring of 1997. Final plans are for a 5,000 sq.ft. building with a $1.17M construction budget. The total project budget, including initial displays, is $1.5M.

The goal of the project is to provide education and improved visitor conveniences to the 35,000+ annual visitors to NSO/SP. This education/visitor center will offer a range of activities and services including displays, restrooms, vending machines, a gift/souvenir shop, and RV/bus parking. The museum will include exhibits on solar physics, stellar astronomy, solar-terrestrial effects (global change), the ecosystem, and cultural and natural history. A trailhead will connect to the National Forest trail system, and will include interpretation of the biological and cultural resources.

A large measure of the success of this project can be attributed to the strong multi-agency partnerships behind it. The partners include both federal and state agencies: National Solar Observatory, State of New Mexico Tourism and Highway Departments, Federal Department of Transportation, New Mexico State University, Apache Point Observatory, USDA Forest Service, and International Space Hall of Fame.

Funding for the project is derived from State of New Mexico severance tax bonds under the authority of the Department of Tourism and US Department of Transportation Intermodal Surface Transportation Enhancement Act (ISTEA) Scenic Byway funds. State money was used to provide matching funds for qualification under the federal program for the development of scenic highway systems.

Rex Hunter

Table of Contents - -

Table of Contents - -

A Two-part Colloquium on the Solar Cycle

NSO and the University of Sonora at Hermosillo, Mexico sponsored a two-part meeting on the status and prospects of research on the solar cycle. The first sessions were held in Tucson 28-30 March, the second sessions in Hermosillo 1-4 April. About 30 researchers attended each meeting, including visitors from Mexico, France, Spain, Holland, Germany, Austria and Russia.

The Tucson meeting was the first of several intended to engage the community in NSO's long-range study of the solar cycle, the Solar Variability Enterprise (SOLVE). A small number of invited talks followed by extended discussions and impromptu short contributions made for a lively and productive meeting. Exchanges between theorists and observers were especially revealing to both sides.

An important theme to emerge from the Tucson meeting was that numerical modelling of the internal circulation of the convection zone and solar dynamo continues to lag far behind the observations. The alpha mechanism for amplification of poloidal magnetic fields has been shown to be inadequate, and as yet no plausible mechanism has been proposed to replace it. Two approaches seem to be favored: numerical modelling with steadily improving treatment of the huge range of relevant scales, or parametrized solutions embodying the best intuition on the relevant physics. A physical model for internal rotation, compatible with observations, is perhaps the highest priority.

Helioseismology is producing exciting results, as expected. Early data from GONG provide new estimates of the magnitude of meridional flows, torsional oscillations, and, possibly, giant cells. Local helioseismology techniques are revealing the depth variation of horizontal flows in the convection zone, down to a few tens of megameters.

The reversal of polar magnetic fields, successfully modelled as an axisymmetric phenomenon in Cycle 22, appears to be far more complicated in Cycle 23. Polar coronal holes "migrated" in latitude as if guided by a gap in the polar crown of filaments--a further challenge to the theorists!

The Hermosillo meeting surveyed the rich variety of observations that bear on the solar cycle and that remain to be incorporated in an overall empirical model. We heard contributions on the cyclic variation of coronal holes, proxies for ultraviolet variability, the magnitude of polar magnetic fields, the tilt of bipolar active regions, and large-scale magnetic patterns, among others. Proceedings will be published on a short timescale.

We were impressed with the quality of research by our Mexican colleagues and grateful for the opportunity to visit with them; their standards of hospitality were exemplary. We look forward to future international cooperative meetings of this kind.

Jack Zirker

Table of Contents - -

Table of Contents - -

NOAO Newsletter - National Solar Observatory - June 1996 - Number 46

17th NSO/SP Summer Workshop

The 17th National Solar Observatory/Sacramento Peak International Summer Workshop will be held in Sunspot during 17-21 June 1996. NSO has a long tradition of organizing annual meetings at Sacramento Peak that bring the international community together to review and discuss the most recent results in solar and solar-terrestrial physics. This year, recognizing the importance of external forces, including solar variability, on the Earth's atmosphere and climate, NSO will host the Solar Electromagnetic Radiation Study for Solar Cycle 22 (SOLERS22) 1996 Workshop.

The goals of SOLERS22 are to answer the following questions: (1) What are the daily flux values of the solar spectral irradiance in the X-ray, EUV, UV, visible and infrared wavelength ranges and the total solar irradiance for solar cycle 22 for use in research of the terrestrial effects of solar activity? (2) What evolving solar spatial structures cause the temporal variations of these solar fluxes? (3) What are the underlying physical processes?

This summer's workshop will review recent results obtained from observations, theoretical interpretation, empirical and physical models of the variations in solar and stellar irradiances. The Working Groups of SOLERS22 will hold individual and joint meetings to discuss their research progress. Leaders of each group will present progress reports on the group's activities. There will also be special sessions that highlight the research interest of each working group. Because irradiance monitoring experiments in space observe the Sun as a star, solar images must be analyzed to identify the causes of the changes observed in solar irradiance. Therefore, a considerable amount of time will be devoted to discussions of the spatially resolved data available from the ground and also recently from space (from the Yohkoh and SOHO missions). The possible causes of irradiance changes will also be discussed, as will recent results on the effect of solar variability on the terrestrial atmospheric and climate system.

The following will be covered during the Workshop:

1. Solar Irradiance Monitoring Programs: a Summary
2. Physical Interpretation of Solar Irradiance Changes
3. Stellar Analogues of Solar Variability
4. Irradiance Surrogates: Spatially Resolved Data
   - Summary and discussion of ground-based observations
   - Summary and discussion of space observations

5. Physical Causes of Irradiance Changes
    - Spectral distribution of irradiance changes
    - Relationship between luminosity and radius changes
    - Solar oscillations and irradiance changes

6. Terrestrial Effects of Solar Variability
    - Climate models including solar forcing
    - Long-term climate changes based on paleoclimatic data
    - Effects of solar variability on the stratosphere and mesosphere

The deadline for registration and receipt of abstracts was 30 April 1996. Judit Pap chairs the Scientific Organizing Committee (jpap@jplsp2.jpl.nasa.gov, telephone 818-354-2662).

Dick Altrock, for the Local Organizing Committee

Table of Contents - -

The NSO Digital Library: FTS Data Archive Now (Mostly) On-Line

The NSO Digital Library took a step forward recently with the installation of a 300-disk CD-ROM jukebox system on argo, NSO/KP's data server. While still very much in development, this system already contains 33 disks (about 23 GB) of Fourier Transform Spectrometer (FTS) spectra obtained from 1976 through the beginning of 1994. Users can now access the system via anonymous FTP. The server address is argo.tuc.noao.edu, and the directory is ftsarc. You will see a further set of directories with names of FTSXX where XX is a two-digit number, each directory corresponds to a single CD. There is a rudimentary README file that currently only contains the first and last scan number of each directory. Don't forget to set FTP to binary mode when retrieving the data files, which are in FITS format! Also please note that FTS16 is currently removed.

Current plans for this server include (roughly in order of implementation):

1. Continued archiving of FTS spectra through the latest data.

2. The gradual addition of the NSO/Kitt Peak magnetogram and Helium 1083 nm data.

3. Addition of the raw FTS interferograms.

4. Construction of a web-based search engine to allow users to search for and retrieve data without knowing the file names.

Continued development of the digital library will eventually provide quick and easy access to the major NSO data sets without the need for a user to contact a staff member.

For further information on the argo data server, contact Frank Hill (fhill@noao.edu), Jan Schwitters (jschwitters@noao.edu), or Detrick Branston (dbranston@noao.edu).

Frank Hill

Table of Contents - -

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

---

Table of Contents - -

NOAO Newsletter - National Solar Observatory - June 1996 - Number 46

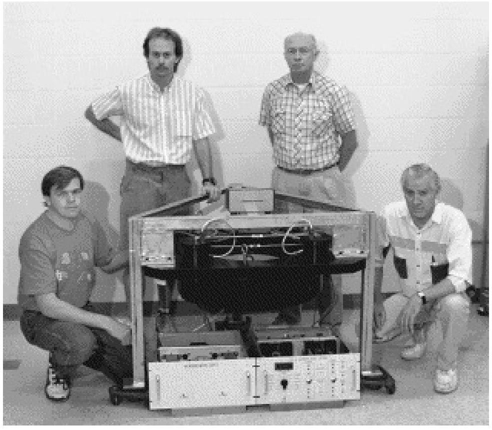
A New Guider and Control System for the Kitt Peak Vacuum Telescope

As part of an NSO-wide program to improve image quality, the replacement of the 22-year-old control and guiding system of the NSO/KP Vacuum Telescope is underway. The maintenance of the current system has become difficult, and the guider no longer functions properly in some operational modes or in light clouds. Recent magnetograph comparisons indicate that spurious image motion is a serious problem for overall magnetic calibration, and they highlight the importance of accurate polarimetry. The new system will include a fast guider mirror to remove image jitter from wind and mechanical sources. New software, data-control computer, and ancillary electronic systems will completely replace the ancient PDP 11 system.

The conceptual design calls for replacing the existing limb guider/translation stage system with a modern system coupled to a fast guider mirror. Image motion compensation will be done by remounting the #4 mirror so that it can be tilted rapidly. The error signal to control this will be derived from motion of the guider image; the servo loop will be closed by means of an existing laser system that locks the main and guider beams together. The motion compensation phase of the KPVT upgrade is partially supported by NASA.

Engineering tests to confirm the feasibility of the jitter compensation design were completed in early FY '95. The first construction phase of the project was to upgrade the mechanical drive assemblies at the #2 mirror and was completed in November 1995.

Fabrication of the mechanical components of the fast #4-mirror mount was completed in February 1996. Integration and testing of the control electronics and #4-mirror mount is now underway in Tucson. Installation at the telescope of the new mount and control electronics is planned for spring 1996. Procurement of the telescope control computer and limb-guider control hardware is underway. Installation of the new limb guider system is planned for late 1996.



Caption: Russ Cole (Instrument Maker), Tom Roussey (Sr. Electronic Technician), Ed Bell (Sr. Engineer), and John Hoey (Sr. Mechanical Designer) with the KPVT fast-guider assembly and control electronics.

Jeremy Wagner, Harry Jones, Jack Harvey

Design Study for an Automated Solar Observing System

The USAF Phillips Lab group at NSO/SP has received funding for a design study for a replacement to the Solar Optical Observing Network (SOON). The existing SOON, which was designed and built at NSO/SP under the direction of R.B. Dunn, has been the mainstay of the USAF solar optical monitoring program for two decades, and has provided the solar community with patrol images and archival data in Ha and white light. The new system will emphasize automated, "observerless" operation based on a tunable filter and CCD detectors. Happily for solar physics, the AF and NOAA/SEC requirements for solar monitoring strongly overlap those outlined for a new-generation full-disk imager described in NSO's proposal to the NSF for Synoptic Optical Long-term Investigations of the Sun (SOLIS).

Don Neidig

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

Gold versus Gold at the Kitt Peak Vacuum Telescope

A well-known problem for space researchers is polymerization of volatile hydrocarbons onto optical surfaces. Strong ultraviolet radiation from the Sun causes the formation of films that are remarkably opaque to short-wavelength radiation. These films have a brownish golden color in transmission. For spaceborne solar instrumentation it is necessary to take heroic measures to avoid forming these films. The same problem also affects the vacuum optics of the KPVT.

For the first several years of operation of the KPVT, there was no film problem. Then an experiment was run that involved filling the vacuum tank with helium. Evidently this helium was contaminated with hydrocarbons because, shortly after the experiment, nasty films formed on the optics. It also did not help that the vacuum pump system malfunctioned, resulting in vacuum pump oil being sucked into the tank. Since these events, it has been necessary to open the tank and clean the optics rather frequently. Attempts to clean the walls of the tank have not helped the problem.

In an effort to reduce these labor-intensive cleanings, we plan to fight the problem by reducing the amount of ultraviolet light that enters the vacuum tank. Currently, two aluminized coelostat mirrors feed sunlight through a fused silica vacuum window. The unfettered flow of ultraviolet light could be reduced at any of these elements. The simplest solution seems to be to coat the second mirror with gold. This will reduce the ultraviolet light by two-thirds and should extend the life of the vacuum optics accordingly. We did not want to remove ultraviolet light completely because an instrument is operated from the light feed that uses the Calcium K-line at 393 nm. A bonus will be more light at 868 and 1083 nm where nearly all of the KPVT observations are made. The gold coating may also prove to be more durable than aluminum, and may also produce less mirror heating.

Jack Harvey, Jeremy Wagner

Large-format CCD for the McMath-Pierce

An ultra-thinned 1K x 3K CCD for potential use at the McMath-Pierce Telescope has become available to NSO. Mike Lesser at Steward Observatory will coat and test the chip. As readers may recall, previous chips were afflicted with a resolution degradation problem. It is hoped that the additional thinning of the chip will alleviate this defect. We have requested that the chip receive a single-layer "500" coating. This coating seems to offer the best compromise between blue and red response. It has excellent QE near the K-line, while still retaining very good QE in the red, ranging from about 90 about 65 the "600" coating, which is more optimized for the red but drops off a bit more in the blue. With a single-layer coating there will be the prospect of adding another, second layer in the future that will improve QE even more while not having the same maintenance issues that the current double-layer coated chips are confronting.

Mark Giampapa, Dave Jaksha, Jeremy Wagner

NSO Observing Proposals

The current deadline for submitting observing proposals to the National Solar Observatory is 15 July 1996 for the fourth quarter of 1996. Forms, information and a Users' Manual are available from the NSO Telescope Allocation Committee at P.O. Box 62, Sunspot, New Mexico 88349 for Sacramento Peak facilities (sp@sunspot.noao.edu) or P.O. Box 26732, Tucson, Arizona 85726 for Kitt Peak facilities (nso@noao.edu). A TeX 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 submitted from the NSO web site at http://www.nso.noao.edu.

Dick Altrock

Table of Contents - -

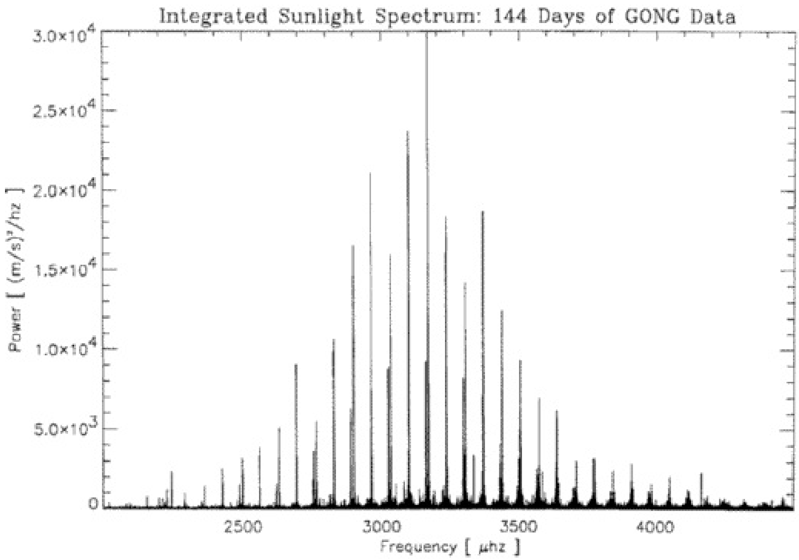
NSO Telescope/Instrument Combinations

```
Vacuum Tower 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):
        H(alpha) 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
        High-l Helioseismograph
        1083-nm Video Filtergraph

Razdow (KP):
        H(alpha) patrol instrument
```

NOAO Newsletter - GONG Oscillation Network Group - June 1996 - Number 46

Global Oscillation Network Group

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 is available to any qualified investigator whose proposal has been accepted, however active membership in a GONG Scientific Team encourages early access to the data and the collaborative scientific analysis that the Teams have initiated. The GONG Newsletter provides status reports on all aspects of the Project and related helioseismic science. Information on the status of the Project, the scientific investigations, as well as access to the data is available on our WWW server whose URL is www.gong.noao.edu.



Overview

All six of the field stations have been operational since early October, and we have spectra and eigenmode frequencies for five continuous months available for analysis. With the advent of this high spectral resolution data we are learning more and more things that need to be taken into account in the processing, but the basic data look terrific! In particular, the low-l performance is surprisingly good.

The Sun is shining on GONG 95 continue to be remarkably trouble free. We are just completing the first round of routine preventative maintenance, and settling in for the long haul. On the data side of the house, we are keeping up with the data flood, and we're distributing five gigabytes of data to the scientific community a day, and the average delivery time is a day and a half. While good duty cycle and low noise have been the goals of the instrument team, the objectives of processing the data at cadence and rapid distribution to the community to enable rapid analysis and trouble shooting have been a considerable challenge, which appears to have been met.

Science is coming out the end of the pipeline! Seven articles have been submitted to Science for a special issue scheduled to appear on 31 May with the "first results." There will be an invited presentation summarizing all of this on the first day of the Madison AAS, and the Scientific Teams will present overviews of their work at a special session of the AAS/SPD. The Annual GONG Meeting will take place in Madison, immediately following the AAS/SPD meeting.

Finally, tests of the performance of the instrument performance at higher spatial resolution--to overcome spatial aliasing in the current detector system, pursue "classical helioseismology" to small spatial scales, and to enable "local helioseismology"--have been very encouraging. We are studying the retrofitting of a 1024 x 1024 pixel format camera, as part of a proposal to continue the observing run for a full 11-year solar cycle.

Network Operations

The six-site GONG network has now been operating for more than half a year, and we've gathered enough statistics on instrument performance to begin to draw some conclusions about what works, what doesn't, and where the problems are. The good news to date (knock on wood) is that the problems are relatively few. Excellent data is being collected with a loss of only about 0.4 sites due to instrumental down time. Of an estimated 660,000 images network wide that could have been obtained in a perfect world, we only let about 2700 slip away because the instrument could not obtain data when the skies were probably clear. Many of these 2700 lost opportunities were likely covered by some other site in the network which was observing the Sun at the same time. We also find that at least one of our six guiders was locked on the Sun about 95 time. Although this number is not the final word on network performance (the actual percentage may go up or down when we find which images were actually used in the merge), it is still a rough indicator of the weather in GONG's distributed corner of the world.

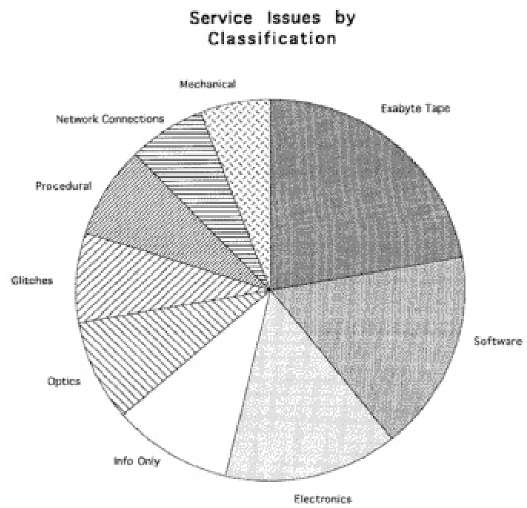
The primary source of information about what goes on in the Network, in the operational sense, is the service log. Each issue that comes to the attention of the operations group is given a title and a serial number under which all related correspondence is filed. Most of the information comes to us via the Internet, but we also log information coming to us by phone, fax or credible hallway rumor. Although the majority of this traffic is not reporting an instrument failure, it is still worth analyzing this log just to see what causes GONG people to put pen to paper in a manner of speaking. There were 214 service log entries between 1 October and 18 April. Of these, only 140 represented legitimate correspondence with or pertaining to the six field sites. The balance of the issues relate primarily to the use, and abuse, of the Tucson prototype instrument that we use for development and testing purposes.

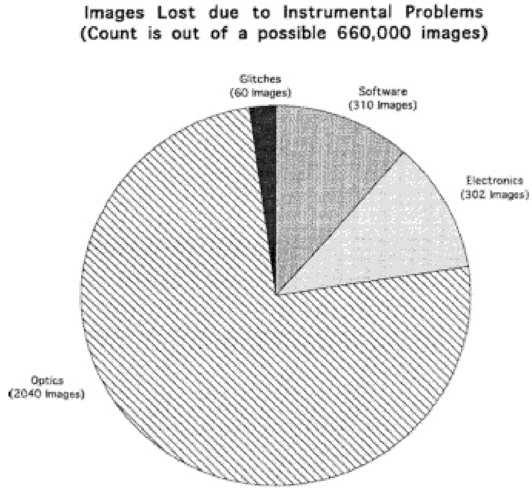
Of the 140 network related service log issues, half were initiated by our hosts in the field, and half by people in Tucson. The operations group (who systematically log into each site once a day) were the first to comment on a new issue about 36 of the entries were raised by the data reduction group. This latter group might be cause for concern because it is based on information lagging many weeks behind real time. However we find that most of these items relate to magnetic tapes or floppy disks that were slow to arrive from the field or difficult to read upon arrival, and as such can probably not be easily addressed in any other way.

Another interesting statistic is the distribution of service issues when sorted by the type. The first chart on the next page shows a breakdown of the 140 entries into nine classes. Although the classes are arbitrary, they are at least an interesting basis for discussion.

The class called "Exabyte Tape" contains all issues relating to the writing of data to tape. Most of the 31 entries relate to the failure of one of the drives in the primary tape bank, causing the system to abandon automatically their use in favor of the secondary pair. This has occurred at least twice at each GONG site, and several sites have had many more. We have attempted to address this with OEM firmware updates, bank swaps, and in extreme cases with drive replacements. As the chart shows, this is our single largest source of mail, but by some miracle it would appear that it has yet to cost us any data during daylight hours. It's only a matter of time... The split between "Software" and "Electronics" is pretty well balanced, but there is plenty of crosstalk between these two. There are still a few poorly understood items in both that may have been misfiled. Items tend to drift back and forth across this boundary, depending on who is pointing the finger.

The "Info-Only" category contains items about the weather, supply shortages, and other items that do not directly relate to the current state of the instrument. The vast majority of these items flow from the sites to Tucson. They are logged just to become part of the permanent record. Optics issues include items like blotches on displayed images (usually caused by dirt on the entrance window), long-term intensity decreases due to drifting of the interference filter, or suspected alignment problems. The category has also been expanded to include frost or dew on optical elements, and startup delays relating to Lyot oven temperature after a shutdown for heavy weather. These two items actually account for most of the lost images charged to "instrumental down time" (see below).





The "Glitch" category probably requires some explanation. These are non-recurring, unexplained phenomena that are cured by rebooting a computer, restarting a program, or cycling the power on some component. Many items start life as glitches, but grow up to be classifiable problems. The maturation process begins when the event occurs a second time; until then, it's a glitch. "Procedural" issues are a special kind of information that is a little closer to the immediate operation of the instrument. It includes items relating to the clarification or modification of the written or informal procedures. Many of our documents are continuing to evolve as we gain more experience running the instrument.

"Network Connection" issues are primarily warnings about prolonged or impending disruption of Internet service, but also includes modem problems when this is our only means of reaching the site. "Mechanical" items include the breakdown of metal things, spanning the range from Diesel generators to lens slides. There's been very little of this. It is important to note that of the 140 network-related service items in our log, only 16 caused us to lose data during clear, daylight hours. Some of this is truly exceptional luck. We have had one occurrence of a double tape bank failure, but it took place late at night on the other side of the world, and it was noted and fixed during a routine site check from Tucson. The indisposition lasted about six hours, and could have happened at any time. We are working hard to improve the procedures and reliability so this does not happen again under less fortuitous circumstances.

The second chart on the previous page shows the breakdown of these lost images, again by the categories described above. It is clear that optics dominate this pie, although real opticians would take exception to having these breakdowns laid at their feet when there is a demonstrable lack of shattered glass on the floor. The overall loss leader was a chronic late start at one site, incurred because the conventional interference filter installed at the site had allowed the signal level to drop below the prescribed guider threshold during the first hours of the morning over a period of weeks. All three of the sites that received the conventional interference filters have suffered from slow drift of the passband. Two have already received the improved ion-assisted filters during maintenance visits, and the third has been boosted back on band by increasing the oven temperature, and will receive its new filter in May. The three sites that came on line first (making up GONG's short lived "mini-net") were shipped from Tucson with the only three ion-assisted filters we had in hand at the time.

The second biggest loss event was a delay of several hours waiting for the Lyot filter oven to come up to temperature after the instrument had been shut down for an extended stormy period. The Sun was shining, the birds were singing, and we were all waiting for the servo to get the oven back under control! A liberal mind might be willing to blame this sort of delay on the weather, but we prefer to charge it against the optical folks to keep them humble. We have since changed the shutdown procedure to allow the oven alone to run on battery power whenever possible and as long as possible to avoid these delays in the future.

The final (also debatable) optical item is dew or frost on the turret mirrors caused by inadequate drying of the purge air during the (fortunately few) wet, cold spells at our sites. Fairness might dictate that this loss be charged against the mechanical people, but we note that the air pump and filter unit had no frost on them, while the turret mirrors clearly did.

Data Reduction Issues

With the advent of the network, the composition of the flow of data through the reduction pipeline has changed from artificial and prototype data into the honest-to-goodness bona fide science data. This has naturally provided us with substantial opportunities to understand the data, and has led us to a number of algorithm development paths. Here, we discuss some of the issues: peak finding, the relative angular orientation of the images at the different sites, the relative Earth-Sun velocity, differences in instrumental velocity scale factors, camera non-linearities, gap filling, remapping issues, and a full three-component spherical harmonic transform. All of these issues are under active investigation.

Peak Finding

Our first exposure to peak finding an actual 36-day spectrum from the network quickly revealed several problems. In particular, our original table of first guesses of the mode parameters was too sparsely populated, and the subsequent interpolation into the table produced large variations in the initial guesses that then resulted in a large number of unacceptable fits. Other issues were a systematic jump in the frequencies as a function of m/l at l = 150, and the lack of a method to indicate suspicious results. Ed Anderson, with the extremely capable help of H. Antia who was visiting us from the Tata Institute of Fundamental Research in Bombay, completely populated the first guess table and developed a set of criteria to select bad fits. In addition, Antia was responsible for both increasing the speed of the fitting process by a factor of 5, and developing a method to quickly and explicitly deconvolve the temporal window function from the spectrum. These improvements have greatly increased the quality of the estimated mofe parameters, and the speed increase has allowed us to perform additional tests and to fit some new data products. These include a spectrum for l <= 30 created from a long-term concatenation of the merged time series, and an incoherent average of all of the monthly spectra. In both cases, the data start with month 4. Future directions for peak finding development include:

1. the exploration of new methods to handle the spectrum above l = 150 where the spatial sidelobes begin to blend into the central peak and where the global modal structure of discrete peaks starts to fade into a composite ridge structure.
2. a detailed calculation of the spatial leakage matrix.
3. an investigation of methods to fit the spectrum as a whole rather than in many small independent segments that do not exploit information from other segments.

Angular Orientation

There are residual variations between sites of a few tenths of a degree in the orientation of the solar rotation axis on the CCD. Simulations by Jim Kennedy and Winifred Williams have shown that an error of 0.1 degrees will shift 50 We thus need to determine the actual orientation on the CCD to at least 0.1 degrees. Drift scans were performed at each site during deployment, and are also obtained at every preventative maintenance visit, and these data provide a single measurement of the desired position angle and its behaviour over the course of a day. However, the position angle depends on the declination of the Sun, and thus significant changes on the time scale of a few days. Cliff Toner has developed a self-consistent method that cross-correlates the images collected around the network. He then performs a least-squares fit to the residual differences thereby obtaining a consistent set of the relative angular offsets between the sites. With a recent drift scan somewhere in the network, the absolute offset can be obtained and the entire solution determined. Brian Pohl has installed the procedure in the DMAC pipeline, and his tests indicate that application of the method to every fifth image, combined with a five-day running mean of the results, is sufficient to provide the angles. Thhis processing stage will be routinely implemented in the near future.

Relative Earth-Sun Velocity

The low-l portion (l < 5) of the new 180-day concatenated spectrum is of surprisingly high quality. In particular, the l = 0 spectrum shown on the first page of this section is comparable to those obtained by the ground-based integrated-light networks. We still have a residual 1 m/s per minute gradient in the relative Earth-Sun velocity that remains after our two-point difference filter is applied. Thanks to Cliff Toner and Brian Pohl, we now have the ability to explicitly remove the spatially constant portion of this effect. The effect is by far the largest for l = 0.

Instrumental Velocity Scale Factors

Examination of both the low-pass filtered images, and of the temporal variation of the merged p-mode time series amplitude at transitions between sites indicates a variation as high as 10 scale factor at different sites. For the p modes, this puts steps into the amplitude of the time series. Jean Goodrich is developing a technique to remove these steps by computing the rms of the time series over 36 days at one site, and then adjusting the rms of the time series of each individual site-day to a constant. In the current development package this is done independently for each m and l, but this results in a set of steps in the l-n spectrum. The next iteration will smooth the rms over all modes.

Camera Nonlinearity

The disk-integrated total intensity, velocity, and modulation plotted as a function of time for one site day are observed to contain low temporal frequency trends that suggest the presence of cross-talk among the three quantities. One source of the contamination could be a nonlinear response of the CCD cameras to the intensity of the light falling on the pixels. Measurements at the sites indicate deviations from linearity of a few parts in 10^4. Roberta Toussaint and Jim Pintar have been working to remove this effect from the data. Their results show that the inclusion of a nonlinear gain in the calibration procedure does reduce the amplitude of the low frequency trends in some, but not all, of the test site days. The results are similar for a different choice of the functional form of the nonlinearity: it works sometimes but not always. Our current hypothesis is that other factors, such as terrestrial atmospheric effects and additional calibration uncertainties, must also contribute to the trends.

Gap Filling

The merged and gap-filled time series contain distinct signatures of the gaps, that result from the very simple autoregressive filter that we are using to fill the remaining gaps of up to 15 minutes in length. This filter obviously could stand some improvements, and we are pursuing more physically based algorithms.

Remapping

The m-n spectra display a strong amplitude dependence on m/l. Modes with m/l near 0 have substantially smaller amplitudes than those with m/l 1. This behavior is a consequence of our current choice of remapping area, which is bounded at constant latitude and longitude. Since most of the amplitude of the nearly zonal modes extend to high latitudes, and the nearly sectoral modes are concentrated more at lower latitudes, we are thereby attenuating the nearly zonal modes far more than the nearly sectoral modes. In addition, the sharp latitude cutoff creates a sharp jump in amplitude at a value of m/l that depends on the latitude cutoff value. Cliff Toner has developed a different shape of remap area whose boundary is defined by a "constant aliasing" criterion. In practice, its shape is an ellipse on the solar image in sky coordinates, and there are no sharp cutoffs in either latitude or longitude. The resulting m-n spectra have a smaller amplitude dependence on m/l, and the sharp jump is removed. This will pave the way for the inclusion of an m-dependence in our MTF correction, and should also improve our estimates of the mode amplitudes.

Three-Component Spherical Harmonic Transform

It was observed by H. Antia and Rachel Howe that, at low n and high l, the amplitude of the target mode is frequently lower than the amplitude of the spatial leak from the next higher l. Antia suggested that this might be due to the assumption that the velocity field of the p modes was purely radial when, in fact, it has a horizontal component whose amplitude relative to the vertical component increases with decreasing n and increasing l. This motivated us to begin implementation of a spherical harmonic transform that explicitly computes all three components of the velocity field: vertical, latitudinal, and longitudinal. Winifred Williams is developing the transform, has completed the vertical and longitudinal parts (the easy bits), and is finishing up the latitudinal component (the hard part). When done, we will actually be able to estimate the relative amplitudes from the data, and compare the results to theory. In addition, we will be able to improve the calculation of the spatial leakage matrix.

Data Management and Analysis Center Activities

GONG has now successfully completed two quarters of full network and data reduction operations.

During the past quarter, month-long (36-day) time series and power spectra were produced for GONG months 5, 6, and 7 (ending 960113) with fill factors of 0.87, 0.89, and 0.87. For month 6, the process delay between data acquisition and completion of the month-long power spectra was about 13 weeks. The time series and power spectra for GONG months 1 and 4 had been produced last fall. Three month (months 4, 5 and 6) and four month (months 4, 5, 6 and 7) time series and power spectra for l's less than or equal to 30 have been produced. By May, the project will have produced the month 8 (ending 960218) time series and power spectra and the five month, low-l time series and power spectra.

Mode frequency tables were produced for GONG months 1, 4, 5, 6 and 7; from the four month-long power spectra (the concatenation of the time series from months 4, 5, 6 and 7); from the month-long average power spectra constructed by averaging the power spectra from months 4, 5 and 6; and from the month-long average power spectra constructed by averaging the power spectra from months 4, 5, 6 and 7. In addition to the product containing fits to individual mode coefficient power spectra, DMAC has added three new mode frequency products, produced by fitting m-averaged versions of the mode coefficient power spectra.

The Field Tape Reader (FTR) (the subsystem that receives the raw data cartridges from the observing sites) processed 105 cartridges containing 600 site-days from the seven instruments. 475 site-days were processed through the site-dependent data reduction stages. The difference of 125 site-days is attributed to bad weather at the network sites and data from the engineering test unit in Tucson. The later is reduced only when requested by the instrument team.

The project has begun producing additional magnetogram products. Magnetograms (recorded hourly) from the fourth, fifth, and sixth GONG months were edited and registered in camera coordinates to a common shape, size, orientation, and polarity and registered in heliographic coordinates. A sample synoptic map was generated for a recent Carrington rotation cycle. Despite the low-sensitivity and high noise of individual GONG magnetograms, the large volume of data available for averaging produced a map with surprisingly high quality. The project will probably add the synoptic maps to the menu of standard magnetogram data products in the future.

With the start-up of full network operations behind us, the DMAC has become to experience incremental improvements in operating efficiency. It appears that the peak demand for labor to operate the baseline data reduction pipeline probably occurred early in the calendar year; when the first months of the six-site network data were processed. Since then the project has been able to devote small but increasing amounts of labor to analyzing various aspects of the data reduction and testing improvements in the reduction algorithms.

During the past quarter, the DSDS serviced 90 data distribution requests for 368,276 files totaling 87.5 Gigabytes of data. The average delay between receipt of a request and shipping the media containing the data products was about 1.5 days. The DSDS performed 2713 data cartridge transactions (library check-ins and check-outs) in response to requests from the data reduction pipeline and other internal operations.

During the last week of March and the first week of April, the DSDS distributed about 48 Gigabytes of data; i.e. about 5 Gigabytes per working data. With additional disk space the maximum peak distribution capacity will be increased to about 10 Gigabytes per working day.

All cartridges in the DSDS library that have not been read or written for over one year are routinely tested to be readable. In addition, the DSDS has begun a similar cartridge testing program to test the cartridges stored at the off-site storage facility.

Now that the project has been operating for several months, we are gaining a clearer picture of the type of data products and the volume of data being requested. The leading product for both the number of files requested and the number of data requests has been the calibrated velocity images with refined image geometry (the "vzi" product) followed by other image products. The data volume leader is the month time series (the "vmt" product), followed by the month power spectra (the "vmp" product) at a distant second.

Management

The GONG project has nearly completed a smooth transition from production and deployment to the operations phase. Our travels to this place have been both challenging and rewarding, and we are pleased with the place where we find ourselves at trail's end.

We have had to say farewell to many of our colleagues who were involved with design and production of the GONG instrument, but a remarkable number are not so far away. We are pleased to report that Lonnie Cole, our project engineer, has transferred from NSO/GONG to NSO/Kitt Peak, where he maintains an active interest in GONG while continuing to design and build solar instrumentation for our community. Ed Stover, a senior electronics technician, has also made that same transition to the McMath-Pierce program without even having to move his bench. Bret Goodrich, formerly our lead real-time programmer, moved "upstairs" to the Gemini program, but was still able to drop by the Mauna Loa shelter to make a power supply adjustment while on the Big Island on 8-meter business. Arden Petri, our mechanical designer, is also continuing work at the same drawing board for other projects, though he is contemplating retirement within the next few months. Neill Mills, our last remaining instrument maker, found his way to other work in the instrument shop and NOAO, and was able to participate in a preventive maintenance trip to CTIO even after transferring to his new job. Don Farris, our lead electronics technician and one of the people most responsible for the reliability of our instrumentation, is now back with Kitt Peak's Engineering and Technical Services group, and continued to follow Internet traffic from the GONG sites.

In addition to operation of the network and reduction of the data, we are continuing to push forward on a possible extension of the baseline three-year run in conjunction with a camera retrofit. We are finding ways to allow our engineering team to proceed with a Phase A study of an improved, large format CCD (perhaps 1024 x 1024), allowing investigation of the rich scientific ground at higher spatial frequencies. Pending the study outcome we plan to propose the upgrade and extension during the first quarter of 1997.

John Leibacher and the GONG Project Team

Table of Contents - -

Table of Contents - -

NOAO Newsletter - US Gemini Program - June 1996 - Number 46

US Gemini Instrumentation

The US Gemini Program has agreed to manage the procurement of the initial Gemini IR instruments as a package for the International Gemini Project. Thus, we are not only monitoring progress on each subsystem, but we are also ensuring that interfaces are identified and defined so that integration will go smoothly. Here is a brief description of the status of each US allocated instrument.

Near-IR Imager

The 1-5 μm imager will be used to commission the first Gemini telescope, on Mauna Kea. It is being built by the Institute of Astronomy at the University of Hawaii in Manoa. Klaus Hodapp is the scientific and technical leader of this effort. The imager has an approved conceptual design. Work is proceeding toward a preliminary design review in late June. Look for a technical description of this instrument in the next Newsletter.

Near-IR Spectrograph

The 1-5 μm spectrograph is being built by the Instrument Projects Group at NOAO in Tucson. Dan Vukobratavich is the project engineer and Jay Elias (CTIO) is having an extended stay in Tucson as instrument project scientist. The spectrograph successfully passed its conceptual design review in late March. (See the following article by Jay Elias for a technical description of the instrument.) Design work is proceeding toward the next major milestone, a preliminary design review near the end of the year.

Near-IR Arrays and Controllers

To assure commonality among the near-IR instruments, the detectors and controllers have been separated from the instrument efforts. The arrays will be the next generation of ALADDIN arrays, being developed at SBRC in a collaborative program involving NOAO and the US Naval Observatory. The USGP is working with NOAO to define a foundry program at SBRC aimed at delivering engineering and science-grade arrays for the Near-IR Imager and Spectrograph. Because the arrays are still under development, the International Gemini Project and the USGP have agreed that using NOAO array controllers represent the only viable approach with acceptably low technical and schedule risk. The instrument builders have concurred with this view. The USGP's intent is to deliver a stand-alone controller-array system to the Near-IR Imager team.

Mid-IR Imager

After many announcements of upcoming activity, this procurement is finally under way. The process will be divided into two parts, a Phase A program aimed at producing one or more conceptual designs and an independent Phase B program to finalize the design and fabricate the instrument. At the time of writing, the RFP for the Phase A studies is in the approval cycle and should be released to the community within two weeks. NOAO will not bid for this instrument.

The RFP for the Phase A study will be publicly available following the receipt of proposals on 5 June. The RFP contains technical information which should be of interest to those persons who are considering proposing for the Phase B contract. Please submit your request for a copy of the Phase A RFP to Kathy Wood, internet wood@noao.edu or phone (520) 318-8175.

CCDs and Controllers

The USGP has formed an international consortium to assist with the evaluation of options for the CCD detectors for Gemini. US members of this consortium include Gerry Luppino (Hawaii), Chris Stubbs (Washington), Mike Lesser (Arizona), John Geary (Smithsonian Astrophysical Obs.), and Todd Boroson (USGP). Over the next six months this group will review progress on the development of thinned 2048 x 4096 CCDs, which is ongoing at a number of potential vendors. The CCD controllers have been a Chilean workpackage, but the IGP is interested in investigating the possibility of bundling them with the CCD detectors as a US workpackage, and has asked the USGP to develop a procurement plan.

The International Gemini Observatory will have an ongoing instrument development fund in the operations phase. A Phase 2 instrumentation program will be developed by combining national and international definition processes. In the US, this will likely take the form of a call for a discussion of the interests and priorities of the US community on the , which would be followed by a meeting of scientists representing the breadth of scientific interests of the US community. We are in the process of working out a detailed plan. Watch the USGP Web site for further information.

Todd Boroson

Table of Contents - -

Table of Contents - -

NOAO Newsletter - US Gemini Program - June 1996 - Number 46

Gemini Near-Infrared Spectrometer Update

The Gemini Near-Infrared Spectrometer (GNIRS) is one of the Gemini instruments assigned to the US. The instrument is being constructed by NOAO, and passed its first major milestone in the form of Conceptual Design Review, held on 22 March 1996. The next major review, Preliminary Design Review, will take place this year in October. Delivery of the GNIRS to Gemini North on Mauna Kea is currently scheduled for late 1999. The purpose of this article is to give a brief description of the instrument design, as it now stands. There may well be some changes as design work proceeds, but the basic concept should remain the same.

Science Drivers

The main design specifications for the instrument are intended to produce an instrument that will take full advantage of the unique characteristics of the Gemini telescopes: superb image quality, low emissivity, large collecting area, and the ability to carry out flexible observing.

The "baseline requirements" set by Gemini are the highest priority requirements. NOAO is obligated to meet them. These are:

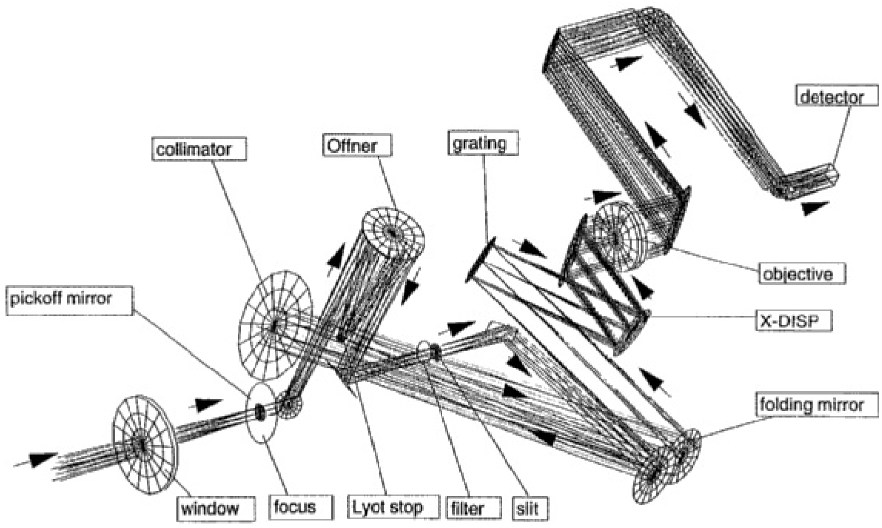
- Wavelength coverage from 0.9-5.5 μm
- Array format up to 1024 sup 2 with 27 μm pixels
- Maximize throughput and minimize internal background
- 2 dispersions: one to cover a full atmospheric "window" (R 2000) and a second that enables useful observations between atmospheric airglow lines (R 8000)
- Pixel scale of 0.05", allowing use of 0.1-0.2" slits
- Slit length >= 50"
- Polarizing prism analyzer

There are additional high-priority science "wants," of which several are included in the current design:

- Acquisition mode (slit viewing)
- Additional pixel scale of 0.15"
- 1-2.4 μm cross-dispersion
- Higher spectral resolution

- Path to integral field upgrade

Although it was not explicitly included as a requirement, a further consideration is to keep the time overheads for actual observations as low as possible. "Overhead" comprises time spent in moving mechanisms (including those external to the instrument, as well as the telescope itself), acquisition of objects, and real-time calibrations. A six-minute increase in overhead for an hour of integration is equivalent to a 10% degradation in system throughput.



Caption: Optical layout of the GNIRS with one of the long-focus cameras in use. The light path of the science beam is shown, and ket optical elements are identified.

Instrument Description

The capabilities of the instrument as currently designed are listed below:

```
Image Scales:   0.05"/pixel (long cameras)
                0.15"/pixel (short cameras)

Slit Length:    50" (long cameras)
                100" minimum (short cameras)

Wavelength Range:  0.9-5.5 um. Separate cameras for "blue" (0.9-2.5 um)
                   and "red" (2.8-5.5 um): total of 4

Resolutions:    2000, 6000, 18,000 (long cameras)
                667, 2000, 6000 (short cameras)

Other:          Cross-dispersion (0.9-2.4 um)
                Wollaston prism analyzer
                Rear-slit-viewing configuration
                On-instrument wavefront sensor
                Integral field upgrade path

Detector:       1024 x 1024 ALADDIN detector
```

An optical layout is shown in Figure 1, for one of the long-focus cameras. Light enters through the dewar window and passes through a hole in a pick-off mirror to the spectrometer fore-optics. This pick-off mirror directs light from outside the general vicinity of the slit to the on-instrument wavefront sensor, which is mounted inside the GNIRS dewar for maximum stability. The hole in the mirror is sized to allow use of a slit up to 100" in length, as well as acquisition over a field tentatively set at 30" diameter.

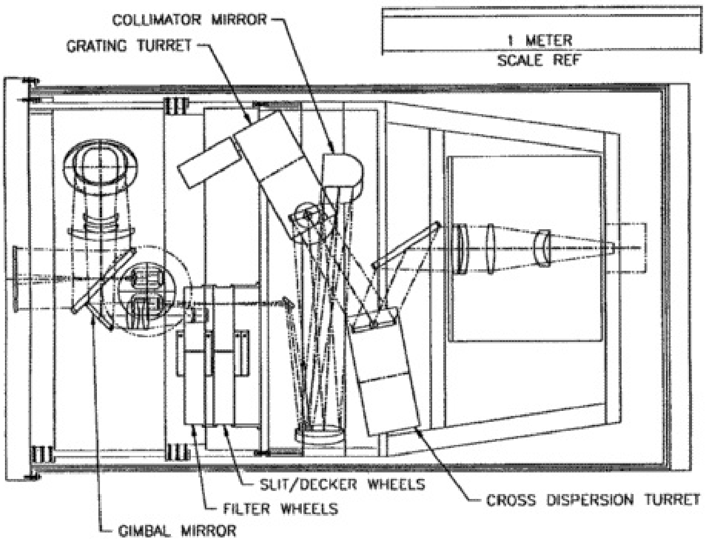
The spectrometer fore-optics are a simple Offner system, which forms an image of the telescope secondary at its own secondary, where the Lyot stop is placed. The dewar window is in fact a weak lens, for better control of the pupil. The telescope focal plane is re-imaged by the fore-optics onto the spectrometer slit.

After the fore-optics, the light passes through the filter, slit, and then off a folding mirror onto the collimator, which is an off-axis paraboloid. The collimated light then reflects again off the fold mirror to the grating and then to the cross-disperser position. For long wavelength or long-slit work, the "cross-disperser" will be a mirror, while for cross-dispersed spectra, it will be a prism with its back side gold coated. (Note that in the final design the positions of the prism and grating may be switched; this is still under evaluation.)

The dispersed light is then reflected off another fold mirror to the camera turret, and passes through one of four cameras. The long-focus cameras are simple doublets, and have been folded to make them parfocal with the short-focus cameras, which have one-third the focal length, and contain four elements. The use of separate "red" and "blue" cameras allows designs with very few elements that are still sufficiently achromatic. An additional benefit is that anti-reflection coatings for the smaller wavelength ranges are more efficient that those for the full 1-5 μm region. One of the main considerations in the camera design is minimizing scattered light and ghosting, to take full advantage of the very low natural backgrounds expected between atmospheric airglow lines below about 2.3 μm. This precludes use of field flattening elements close to the detector.

Acquisition of objects takes place with a mirror in place of the grating (and cross-disperser); a wide slit can be used for initial acquisition.

Packaging of the instrument is still preliminary; a general view of the design is shown in Figure 2, where the main elements shown in Figure 1 are also labeled. The dewar is approximately 1.2-m diameter, and 2-m in length, not including cryocooler heads and electronics enclosures.



Caption: Mechanical layout of the GNIRS, shown as a side view. The Gemini mounting surface would be on the lefthand side. Major mechanical assemblies are identified. The OIWFS, which was omitted from Figure 1, is located after the pick-off mirror near the front (left) of the instrument.

Total weight of the instrument, including electronics, is roughly 1600 kg. Much of this weight is due to the extremely rigid internal structure needed to meet the Gemini requirements that flexure in one hour of observation be no more than 0.1 pixel.

Upgrade Paths

As design work continues, at least two future upgrade paths will be evaluated. One is the practicality of upgrading to a larger array, which might be in the form of two 1K arrays edge-butted to form a 1K x 2K "mosaic." It is clear that the current design does not permit use of longer slits, but it appears likely that an array that is larger in the dispersion direction will work, and that greater separation of cross-dispersed orders would also be feasible.

The second upgrade is addition of an integral field capability. This is still under study, in part because the design parameters are not well specified. The basic idea behind integral field is quite simple--that instead of dispersing light from a one-dimensional slit across an array, one should instead rearrange and disperse light from a two-dimensional region, thus providing simultaneous data in a "data-cube." This approach allows efficient spectral mapping, while avoiding problems such as those due to variable seeing, variable atmospheric transmission, and differential refraction. It also has the potential of giving better spatial sampling than would be achieved just by stepping a slit across a region of sky.

The difficulty arises when one is compelled to specify the different dimensions of the data cube, subject to the constraint that all the data still need to fit onto a 1K x 1K array and then be extracted and reduced. The issue of the integral field specifications has been considered by the Gemini IR Instrument Science Working Group, but as yet no consensus has been reached. In any case, the generic approach to integral field in GNIRS does not depend much on the particular implementation. The science beam would be diverted near the slit, "processed" in some way (for example, by means of an image slicer, binary optics, or an enlarger/microlens array combination) and would then be sent back into the collimator to a point that does not require refocus of the instrument.

Jay Elias

Table of Contents - -

Thanks to the IRAF Users' Committee

This year's IRAF User Committee report is included below. I wish to thank the committee members for their time and energy in preparing the report. Several of the recommendations presented already have been implemented (hiring a replacement IRAF programmer, access to an SGI platform). Some of the concerns, though, are very hard to rectify, as their resolution places serious demands on the IRAF resources (new graphical user interface applications, general platform support, Open IRAF). Should you wish to express your opinions about the IRAF Project, feel free to contact me or one of the committee members.

I am pleased to announce that Jeff Pier has agreed to serve another year as the Users' Committee chair, for a total of four years on the committee. Similarly, Peter Eisenhardt has generously agreed to serve an additional year to help with planning for infrared software applications.

George Jacoby (gjacoby@noao.edu)
IRAF Project Scientist

Report of the IRAF Users' Committee - March 1996

The IRAF Users' Committee (IUC) met at NOAO on 6 February. We would like to thank the IRAF staff for their informative presentations. We realize that preparations for the meeting and attending the meeting are both time-consuming and we appreciate their efforts. Current members of the IUC (all of whom were present at the meeting) are:

```
Jeff Pier (Chair)  1993-95  (USNO)      jrp@nofs.navy.mil
Peter Eisenhardt   1993-95  (JPL)       prme@kromos.jpl.nasa.gov
Andrea Prestwich   1995-97  (CfA)       prestwich@cfa.harvard.edu
Bill Romanishin    1994-96  (Oklahoma)  romanishin@phyast.nhn.uoknor.edu
Bill Sparks        1994-96  (STScI)     sparks@stsci.edu
Steve Walton       1994-96  (Cal State Northridge)  swalton@csun.edu
```

Want To Get Involved?

Peter Eisenhardt and Jeff Pier are due to rotate off the committee this year. If you are an IRAF user and are interested in serving on the committee, or if you know of someone else who you think would be a good representative of the user community, please contact Jeff Pier or George Jacoby.

A Plea

The IUC is charged with representing the IRAF user community interests in future IRAF developments and in advising the IRAF project on priorities and schedules of releases. In order to be truly representative, we are seeking input from the IRAF user community. PLEASE feel free to contact any committee member and let the member know your concerns about IRAF, your hopes, your frustrations, what you like about it, what you don't like, what you'd like to see it do that it can't, etc.

The whole idea of this process is to make sure that IRAF is responsive to the needs of the community. Your input does make a difference!

Staffing: Kudos and Concerns

The overriding impression of the committee is that the IRAF project is seriously under-staffed. We believe that the problem is becoming critical. 1995 saw a loss of 1 FTEs from the IRAF staff. Only five years ago there were 9 FTEs. There are now only five full-time IRAF staff members who are supplemented by fractional time from another three NOAO staff members (whose contributions total less than one additional FTE). Meanwhile, the requirements placed upon the staff, as determined by any of a number of metrics (e.g., number of users, number of sites supported, number of packages/tasks, lines of code, complexity of code, number of architectures supported) continue to grow apace. We see no let up.

Upcoming software development demands to support Gemini and the Infrared detectors will have a significant impact upon IRAF staff requirements, and the IUC wants to stress that these projects must provide the IRAF project with additional staffing.

The committee can't help but be disappointed in the release schedule realized for IRAF upgrades and in non-delivery of such enhancements as the X11 Graphical User Interface for science applications. The root cause of this is insufficient staffing, combined with unrealistic expectations of what this staff can reasonably accomplish. The committee is very impressed with the caliber and talent on the staff. They are all extremely hard-working, dedicated, and conscientious.

They are performing Herculean tasks and have made significant strides this year (see below). But the committee is concerned that the effort they have already invested in some areas (e.g., on the GUIs) may be wasted, because this work had to be set aside before release to address various urgent demands, and such demands seem to be on the increase. Either additional staff must be added, or promises of what the IRAF group will deliver must be scaled back.

The good news is that this small core of dedicated programmers continues to have a positive outlook. They gave the committee the impression that they love their jobs and eagerly look forward to continuing to provide the astronomical community with quality software to meet ever increasing challenges.

Recommendation: IRAF staffing needs to be maintained at least at the level of eight FTEs. We STRONGLY recommend that two additional software positions be filled immediately: one a specialist in systems software, the other in science applications software.

General Comments

IRAF continues to be the most heavily used resource provided and maintained by NOAO, and it is certainly the most cost effective in terms of the service it provides to the astronomical community per dollar expended. Although exact counts are elusive, best estimates are that IRAF is installed at approximately 1500 different sites around the word and that roughly 5000 users see a "cl>" prompt on their computer monitor on a regular basis.

Although IRAF is now well over a decade old, it continues to keep abreast of advancing computer hardware and new astronomical detectors and techniques. IRAF remains at the forefront of software/algorithmic development for astronomical data analysis and reduction.

It is worth noting that a sizeable fraction of the IRAF team's effort is directed not just towards "Reduction and Analysis" of astronomical data, but also towards providing valuable support for instrumentation and for the acquisition and archiving of data. Some examples:

- The IRAF Control Environment (ICE) is used at KPNO and at a dozen or so other observatories for instrument control and data acquisition.
- The CCDPHOT package for CCD numerical aperture photometry.
- CCDTEST program for debugging CCD controllers.
- Save The Bits (STB) archiving of CCD data has been underway since August 1993. The Terabyte limit was passed in December 1995.
- Software to help astronomers prepare for observing runs (FINDER and much of the new astrometry package software).
- Maintaining a weather archive; developing software for the KPNO transparency monitor.
- A major effort will be getting underway in 1996 to specify and develop software to support the new generation CCD detector: the 8K square CCD array/Mosaic.

Highlights of 1995

Despite staffing limitations, a rather large number of significant accomplishments were realized in 1995. A few of the highlights:

- Release of IRAF Version 2.10.4 for Sun (SunOS and Solaris), DEC Alpha (Digital UNIX) and PC (Linux).
- The Port of IRAF to PC/Linux has proven to be hugely successful and popular. The port was released in late 1995, and in the first three months of availability almost 250 ftp downloads were recorded. This exceeds the number of downloads for all other platforms (except Sun) for the entire year of 1995! Installation on a PC running Linux is very straightforward and takes only a few minutes.
- Very substantial additions have been made to IRAF's World Wide Web home page (http://iraf.noao.edu) including searching capability, links to IRAF Help, task parameter changes, FAQs (Frequently Asked Questions), etc. The IRAF WWW home page is now a very popular site, and its existence undoubtedly relieves the staff of a substantial fraction of user support queries.
- The distribution of IRAF software and documentation via CDROM, introduced late in 1995, had shipped to over 50 customers by February 1996.
- Significant progress has been made on the IRAF Astrometry package, including the collaborative efforts with the UK to incorporate some of the Starlink software tasks (especially SLALIB) into IRAF. The new release of the IMMATCH package is a very nice application of SLALIB (as well as much new IRAF) software and which looks like it will be very useful and popular.

IUC Priorities for 1996

1. **Release V2.11**

   The first priority, from the committee's perspective, is to get the new version of IRAF (V2.11) out to the community in the first half of 1996. This release is long overdue! The community has been hearing for some time about some of the nice new features that will be available "in the next release" and we fear that their patience is being tried rather severely. This release will include the FITS image kernel, WCS function drivers, and the SLALIB library.

The committee is very concerned that if V2.11 is not released before summer, demands upon the IRAF staff to provide support for specifying and developing software for the new CCD Mosaic detector (due for on-telescope engineering tests this summer) will push the V2.11 release efforts to the back burner (again!).

2. **Platform Support**

   The committee notes that a number of previously "supported" platforms seem to be have been orphaned in recent years. Specifically, AIX, HP-UX, DEC Ultrix, and SGI IRIX have received scant attention from IRAF. Releases of patches and X11IRAF have been made available largely only for the most heavily used IRAF platforms (Suns running both SunOS and Solaris) and newer platforms (DEC Alpha OSF/Digital Unix and PC Linux).

   Meanwhile, a substantial fraction of the user community is still running IRAF essentially as it existed in 1993 or 1994, still dealing with xterm and its hang-up bug while running plot tasks, etc. Furthermore, the plans for release of V2.11 are to port first to Suns, DEC Alphas and PCs, those very platforms which are already most up-to-date in terms of IRAF support. Ports to the other platforms would follow "in a few months time"--placing this community of users even further behind the times. Of course, we see the logic in providing new releases first to the most heavily used platforms but we hope that the minority of orphaned users will not have to wait much longer.

   We feel that IRAF should make a sincere effort to support platforms that it has led the community to believe it will support. If they are unable to do so, they should announce that support for such-and-such a platform will be dropped--allowing ample time for users to plan their future computer hardware/software needs well in advance. It is simply not fair to neglect users who bought their present computers at least partly because of IRAF platform support. Perhaps even worse is the perceived uncertainty about continuing support for some platforms for those who are contemplating their next computer upgrade.

   - V2.11 should be released for ALL supported platforms.
   - X11IRAF should be released for ALL supported platforms.

3. **Open IRAF**

   The IRAF team has long recognized that it cannot be insular. The software framework developed and maintained by IRAF provides a wonderful vehicle for other software developers to take advantage of and to build upon. The amount of software running within the IRAF environment, but developed outside of the IRAF group (though with their help and cooperation) is now nearly as substantial (in terms of lines of code) as IRAF itself.

   The ability to customize/enhance the IRAF environment will become much easier with the advent of "Open IRAF." This initiative will make it easier for a user to (1) invoke individual tasks from a shell, (2) combine IRAF with non-IRAF software, and (3) more easily develop software (in other languages such as Fortran, C or C++) and incorporate it into the local IRAF environment.

   The committee strongly supports the Open IRAF Initiative, and believes that it must proceed rapidly to ensure IRAF's viability in today's rapidly changing computing environment.

4. **Graphical User Interface (GUI)**

   Considerable headway has been made towards making IRAF accessible through GUIs in addition to the traditional command line interface. X11IRAF has been released for some platforms, and provides a very nice image display (XImtool), a significantly enhanced xterm/graphics window (XGterm), a tape monitoring window (XTapemon), and a library/toolkit and "widget server" for developing GUIs.

   A lot of effort has also gone into the development of prototype GUI interfaces to some of the IRAF packages: SPECTOOL, XAPPHOT, XHELP and XRV. Unfortunately, this development effort has had to be put on the back burner because of staffing shortages and higher priority demands. It is a shame that the user community is denied the use of these user friendly interfaces, especially after so much effort went into their development. We urge the staff to complete their initial efforts here and make these nifty interfaces available to the user community.

5. **Management Plan**

   The committee is very favorably impressed with the IRAF management and we feel that significant improvement has been attained in the past couple of years in the area of project management. Nonetheless, the IUC has been pressing for some time to see a realistic, comprehensive management plan. As we pointed out last year, it is very difficult for the committee to assign realistic priorities unless we have some estimates of level-of-effort required for each project. We once again request the IRAF management to present a management plan at next year's meeting.

6. **Science Applications**

   In previous years, reports of this committee have assigned priorities to science application software needed/desired by the community. This year, due to the rather overwhelming constraints of staffing, many of these priorities have received less attention (both by the IRAF staff and by the IUC) than they deserve. We hope that additional staffing will remedy this situation so that higher priorities may once again be assigned to science application software.

Table of Contents - -

Table of Contents - -

Open IRAF Position Filled

We are pleased to announce that Nelson Zarate will be joining the IRAF group in June, to work as a member of the IRAF systems group. Nelson comes to us from STScI where he has worked as a scientific programmer with the STSDAS group for the past ten years; prior to his employment at STScI, Nelson worked as a programmer at CTIO and the University of Texas. Nelson received his Masters of Engineering degree in Computer Science from Loyola College. Nelson brings with him a strong background in IRAF system development with a wide breadth of experience in a variety of operating systems. Nelson's recent list of accomplishments with the STSDAS group includes the initial ports to the DEC Alpha under OSF/1 and OpenVMS, as well as FITS image kernel development for IRAF.

Doug Tody

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

Table of Contents - -

NOAO Newsletter - Central Computer Services - June 1996 - Number 46

ADASS '96 Update

The Sixth Annual Conference on Astronomical Data Analysis Software and Systems (ADASS) will be held 22-25 September in Charlottesville, Virginia, at the Omni Charlottesville Hotel. The conference is hosted this year by the National Radio Astronomy Observatory. Additional sponsors include the Associated Universities, Inc., the Infrared Processing and Analysis Center, the European Southern Observatory (tentative), NASA (tentative), the National Center for Supercomputing Applications, NOAO, the National Research Council of Canada, NSF, the Smithsonian Astrophysical Observatory, STScI, and the University of Virginia. ADASS is an international conference which provides a forum for scientists and programmers concerned with algorithms, software, and software systems employed in the reduction and analysis of astronomical data. The five previous ADASS meetings (1991--Tucson; 1992--Boston; 1993--Victoria, B.C.; 1994--Baltimore; and 1995--Tucson) have established ADASS as the leading world forum for scientists and software developers to discuss issues regarding algorithms and software systems for the acquisition, reduction, analysis, archiving, and retrieval of astronomical data.

The Program Organizing Committee for ADASS '96 has the following members: Rudi Albrecht (ST-ECF/ESO), Roger Brissenden (SAO), Tim Cornwell (NRAO), Dennis Crabtree (DAO/CADC), Bob Hanisch - Chair (STScI), Gareth Hunt (NRAO), George Jacoby (NOAO), Barry Madore (IPAC), Jonathan McDowell (SAO), Jan Noordam (NFRA), Dick Shaw (STScI), Karen Strom (Massachusetts), and Doug Tody (NOAO). The Local Organizing Committee is chaired by Richard Simon (NRAO), and has participants from NRAO, the University of Virginia Department of Astronomy, and the University of Virginia Computer Science Department.

The invited speakers for ADASS '96 currently include:

```
Tim Cornwell (NRAO), "Design and Implementation of Radio-Astronomical
        Calibration and Imaging in AIPS++"

Gary Ferland (Kentucky), "Cloudy: Modeling the Emission From
        Astrophysical Nebulae"

Keith Horne (St. Andrews), "Astrotomography"

Harvey Liszt (NRAO), "A Home-Grown but Widely Distributed Data Analysis
        System"

Michael Rosa (ST-ECF), "Physical Modeling of Scientific Instruments"

Martin Shepherd (Caltech), "DIFMAP: An Interactive Program for
        Synthesis Imaging"
```

```
Martin Weinberg (Massachusetts), "Modeling Galaxies" (tentative)
```

Several other speakers are still being contacted.

The key topics for ADASS '96 are:

- Simulation and Numerical Modeling
- Algorithms and Applications
- Software Costs, Management, and Planning

The Program Organizing Committee invites ADASS participants to submit papers (either oral or poster) in any area related to astronomical software, but papers that fall within the key topics will be given primary consideration for inclusion in the oral program. Because of time limitations we encourage the submission of poster papers, and may need to schedule papers submitted as oral presentations as posters instead. Authors will be informed if their papers need to be switched from oral to poster format. Participants will also have the opportunity to set up live demonstrations of software, using workstations which will be available at the conference.

We expect to schedule a number of Birds-of-a-Feather (BoF) special interest sessions. BoFs are organized by ADASS participants and are usually 1 hours in length. Please contact the Program Organizing Committee (poc@stsci.edu) if you are interested in organizing a BoF. For us to schedule the overall program, ideas for BoF sessions must be submitted to the POC no later than 9 August 1996. Please include a brief abstract describing the BoF and some estimate of the number of people you might expect to attend.

A few special events have been scheduled for ADASS this year. On the Sunday before the conference begins, attendees may choose to take a tour of NRAO's Green Bank Observatory (and view the partially completed 100-m Green Bank Telescope as well as other facilities) or attend a half-day tutorial "Introduction to JAVA Programming" presented by Steve Fritzinger of Sun Microsystems, Inc. (JAVA is the programming language for network-based applications that has become so popular on the World Wide Web). There will be a nominal charge for either of these events. There will also be an IRAF Developer's Workshop following the Conference, again with a nominal charge.

The preliminary program for the Conference is scheduled to be mailed to the Conference mailing list in mid-May, as well as on-line from the Conference home page (http://www.cv.nrao.edu/adass/). The Program includes specifics about hotel reservations, registration, abstract submissions, demo requests, and travel assistance. Important dates include:

```
17 June 1996:      Deadline for travel assistance requests
15 July 1996:      Deadline for early registration
                   Deadline for abstract submissions
9 August 1996:     Deadline for BoF session proposals
                   Deadline for demo requests
21 August 1996:    Deadline for hotel reservations
12 Sept. 1996:     Deadline for late registration
22-25 Sept. 1996:  ADASS '96, Charlottesville, Virginia
```

For further information and to be placed on the mailing list for the conference, please send a request to either:

```
adass96@nrao.edu or to:

ADASS '96
C. White
National Radio Astronomy Observatory
520 Edgemont Rd.
Charlottesville, VA 22903 USA
```

Mark your calendar now to attend ADASS '96!

Richard Simon, LOC Chair, NRAO

IRAF Update

The second patch to IRAF V2.10.4 is now in testing at several sites, and should be in distribution by the time this Newsletter goes out. As discussed in the previous issue of this Newsletter the new patch is required to support Solaris 2.5 and the SunSoft version 4 compilers, which were released around December 1995 (but not received by NOAO until

February!). Miscellaneous bug fixes have been included in the patch, as well as minor system enhancements to support external software (e.g., AXAF). Work continues on IRAF Version 2.11 which will be released later this year. IRAF V2.11 will be available for all supported platforms. We currently plan to release the V2.10.4 patch for SunOS, Solaris, Dec Alpha OSF/1, Linux, and SGI IRIX. The latter is being fast-tracked to update our SGI support now that we have access to a recent model SGI capable of running current versions of IRIX (see below).

The PC-IRAF project has been very successful, with 400 or so Linux/IRAF distributions having been downloaded from our servers since the release last fall. A patch to Linux/IRAF adding partial support for recent ELF-based Linux versions was released in January (future versions of Linux/IRAF will be fully ELF compatible). We plan to resume work on the Solaris x86 and BSD versions of PC-IRAF following necessary upgrades to our PC development systems.

In recent issues of this Newsletter we have mentioned plans to mirror the IRAF network archive and Web pages at the Rutherford Appleton Labs in the UK, as part of a collaborative effort with the Starlink group at RAL. We are pleased to announce that this mirror site is now operational. The FTP archive is available via anonymous FTP to starlink-ftp.rl.ac.uk, directory pub/mirrors/iraf. The URL for access to the IRAF Web pages is http://star-www.rl.ac.uk/iraf. The mirror is updated nightly from the Tucson archives. We expect this site will be popular with UK IRAF users who have found the network connections to the US to be very slow. We are still learning how to operate a mirror efficiently; once things are running routinely we hope to set up additional mirrors at other locations, especially overseas. If you are interested in operating an IRAF mirror at your location please contact Doug Tody (tody@noao.edu) for further information about the necessary requirements to handle this large (2 GB) archive.

The IRAF Users' Committee, which met in Tucson in February (see below), made a strong plea that we upgrade our support for those platforms neglected by recent IRAF software introductions and patches. In particular we plan to make the X11IRAF utilities (xgterm and ximtool), which have been in use for one to two years now, available on all supported platforms. A new release of X11IRAF is due out soon and this version will be made available for all IRAF platforms. We have begun negotiations with the vendors to update our platforms in preparation for the V2.11 release. This includes updating hardware where necessary and obtaining and installing the current versions of AIX, HPUX, IRIX, Digital UNIX, and OpenVMS (and a few others). This process is already underway. Support for some older platforms will be dropped as well. We haven't decided for certain which ones yet, but support for Apple A/UX has already been dropped, as our A/UX Macintosh has died. Sun 386i support was dropped sometime back. Unless we hear pleas from users we will probably drop support for the VAXstation running Ultrix (not to be confused with DECstation Ultrix, which is still supported, although it is slated for eventual retirement as well).

In other port-related news, we are pleased to announce that Wisconsin has generously agreed to let us use their new SGI, installed in the WIYN Observatory on Kitt Peak late last year, for IRAF support. Our existing in-house SGI loaner is an old system and unable to support the newer releases of IRIX, so support for IRIX/IRAF has been problematic for the past year or so. The WIYN SGI is currently running IRIX 5.3. We plan to port IRAF V2.10.4 to this system as soon as possible, for distribution late this spring along with the X11IRAF support package. Support for IRIX 6.2 will follow when IRAF V2.11 is released.

A major development project for IRAF throughout this coming year will be software support for the NOAO mosaic. Preliminary efforts have concentrated on a revised, comprehensive keyword scheme and data dictionary for future NOAO (and probably eventually Gemini) data, and definition of an archival FITS data format for Mosaic data. In coming months work will concentrate on Mosaic data reductions and the Mosaic data handling system, including data capture, data archiving, a real time display for Mosaic and other data, and the general problem of interactive Mosaic data display. Displaying or otherwise processing this data is challenging as Mosaic data consists of multiple subimages, and the overall Mosaic image is very large, about 128 megabytes in the case of the NOAO Mosaic. A powerful Ultrasparc-2 system with half a gigabyte of main memory and multiple display screens will be used to host the data handling system for the Mosaic. Although our priority for this project will be to support the NOAO mosaic, the software will be generally useful and this project will result in major enhancements to the main IRAF distribution and to X11IRAF.

Since we are currently short-staffed Mike Fitzpatrick has had to spend most of his time recently with IRAF technical support, although he has made major contributions to systems projects including Ximtool development, IRAF Web page enhancements, and helping set up the UK IRAF mirror.

Frank Valdes has completed tools for automatic arc line identifications and dispersion function solutions in one dimensional spectra. He is currently extending the algorithms to multi-order echelle spectra. Other recently completed projects include improvements to the astronomical image header editor and a new astronomical calculator tool. The calculator tool may be used for many purposes, one of which is a new task that identifies, from a large set of images, a subset of images within a specified distance of a point in the sky. Frank has enhanced the IMEXAMINE and PSFMEASURE tasks for fitting stellar profiles to include Moffat profiles. Since many ground-based stellar profiles are a better match to a Moffat profile than a Gaussian profile the new fitting model gives better full-width at half-maximum values. Frank released an external package version of SPLOT with line profile fitting of Gaussian, Lorentzian, and Voigt profiles. All the above software will be included in the upcoming IRAF V2.11 release. In the interim all this software, except the automatic line identifications for exhelle data, is included in the NMISC external package available from the IRAF archives (iraf.noao.edu or any mirror). Note that some of the tasks are only available for the latest export version of IRAF, V2.10.4.

Lindsey Davis has continued work on the new image matching package, a first version of which was released last fall. A new task IMCTRAN has been added to the package. IMCTRAN enables users to transform image celestial coordinate systems from one system to another, e.g., from equatorial FK4 B1950 to equatorial FK5 J2000 or from equatorial FK5 J2000 to galactic. Five new fitting geometries including shift (fit x and y shifts), xyscale (fit x and y shifts and x and y scale factors), rotate (fit x and y shifts and a rotation angle), rscale (fit x and y shifts, a scale factor that is the same in x and y and a rotation angle), and rxyscale (fit x and y shifts, x and y scale factors, and a rotation angle) have been added to the GEOMAP, WCSMAP, and SKYMAP tasks. The new and modified tasks are currently available in the IMMATCH layered package from the IRAF network archives (iraf.noao.edu or any mirror). Lindsey is currently developing a task for computing a WCS and storing it in an image header given an image and a list of x and y's and RAs and DECs. Lindsey has also begun work on defining the requirements for the new IRAF Astrometry package, which will be a collaborative effort of Lindsey and others in the IRAF group, working with astronomers and astrometric catalog providers from the general community. Anyone who is interested in contributing to this effort is encouraged to contact us.

Rob Seaman has been busy this quarter with the planned expansion of the NOAO "Save the Bits" archive to include a dedicated CD-ROM based archive and data distribution system for the WIYN telescope. We are also in the process of installing Save the Bits at CTIO, working with the CTIO staff. CTIO data will be saved to dual Exabytes as is currently done at KPNO. Updates to the ICE CCDACQ CCD data acquisition package, and to the prototype FINDER package for generating plate solutions from the image display using the HST Guide Star Catalog are in various stages of completion.

The IRAF User's Committee met in Tucson on 6 February to review the status of the IRAF project and to advise NOAO in setting priorities for the IRAF project during the coming year. This year's report of the IUC to the NOAO Director can be found in this section of the Newsletter, or by browsing the IRAF Web pages. We wish to thank the IUC for their support and for their guidance in helping identify priorities for IRAF development.

Lastly, we are pleased to announce that we have filled the open IRAF position. Please see the accompanying article for details.

For further information about the IRAF project please see the IRAF Web pages at http://iraf.noao.edu/ or send e-mail to iraf@noao.edu. The adass.iraf newsgroups on USENET provide timely information on IRAF developments and are available for the discussion of IRAF related issues.

Doug Tody, Jeannette Barnes

Table of Contents - -

Table of Contents - -

NOAO FTP Archives

The various FTP archives for the National Optical Astronomy Observatories can be found in the following FTP directories. Please log in as "anonymous" and use your e-mail address as the password. Alternate addresses for the following archives are given in parentheses.

ftp ctios1.ctio.noao.edu (139.229.2.1), cd ctio CTIO archives - Argus and 1.5-m BME information, 4-m PF plate catalog, TEX template for e-mail proposals, filter library, instrument manuals, standard star fluxes.

ftp ftp.sunspot.noao.edu (146.5.2.1), cd pub Directory containing SP software and data products - coronal maps, active region lists, sunspot numbers, SP Workshop paper templates, information on international meetings, SP observing schedules, NSO observing proposal templates, Radiative Inputs of the Sun to the Earth (RISE) Newsletters and SP newsletters (The Sunspotter).

ftp ftp.noao.edu (140.252.1.24), cd to one of the following directories:

```
aladdin (gemini.tuc.noao.edu) - Information on the Aladdin
program which is a collaboration between NOAO and the US Naval
Observatory to develop a 1024 x 1024 InSb infrared focal plane
at the Santa Barbara Research Center.

catalogs - Directory of astronomical catalogues: the Jacoby
et al.  catalog, "A Library of Stellar Spectr"; the "Catalogue
of Principal Galaxies"; the "Hipparcos Input Catalogue"; and
the "Lick Northern Proper Motion Program: NPM1."

fts (argo.tuc.noao.edu, cd pub/atlas) - Directory containing
solar FTS high-resolution spectral atlases.

gemini (ftp.gemini.edu, cd pub) - The FTP archives for the
Gemini 8-m Telescopes Project.

gong (helios.tuc.noao.edu, cd pub/gong) - Directory containing
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. It is best to login to iraf.noao.edu directly to
```

```
download large amounts of data, such as an IRAF distribution.

kpno (orion.tuc.noao.edu) - KPNO directory containing filter
lists and data, detector (ccd and ir) characteristics, hydra
information, new LaTeX observing form templates, instrument
manuals, KPNO observing and monthly support schedules, 4-m PF
platelogs, user questionnaire, reference documents (wavelength
idents.), and sqiid scripts for data reduction.

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

noao (gemini.tuc.noao.edu) - NOAO e-mail and phone lists, Royal
Greenwich Observatory electronic mail address databases, list
of area codes and zip codes for the US, various LaTeX tidbits,
report from Gemini WG on the high resolution optical
spectrograph, etc.

nso (orion.tuc.noao.edu) - Directory containing NSO observing
forms.

sn1987a - An Optical Spectrophotometric Atlas of Supernova
1987A in the LMC.

tex - LaTeX utilities for the AAS/ASP.

utils - Various utilities but only contains some PostScript
tools at this time.

weather (gemini.tuc.noao.edu) - weather satellite pictures.

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.
```

The following numbers are available for the machines mentioned above:

```
argo.tuc.noao.edu        = 140.252.1.21
ctios1.ctio.noao.edu     = 139.229.2.1
ftp.gemini.edu           = 140.252.15.71
ftp.noao.edu             = 140.252.1.24
ftp.sunspot.noao.edu     = 146.5.2.1
gemini.tuc.noao.edu      = 140.252.1.11
helios.tuc.noao.edu      = 140.252.8.105
iraf.noao.edu            = 140.252.1.1
orion.tuc.noao.edu       = 140.252.1.22
```

Questions or problems may be directed to the following: Steve Heathcote (sheathcote@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 (and they will direct your questions as needed).

For further information about the NOAO observatories and projects see the World Wide Web URL: http://www.noao.edu/.

Jeannette Barnes

Table of Contents - -

NOAO is operated by the (AURA), Inc. under cooperative agreement with the National Science Foundation

NOAO Newsletter Staff

Tod Lauer, Editor-in Chief

Division Editors

Jeannette Barnes, CCS
Todd Boroson, USGP
Ron Probst, CTIO
Yvette Estok, NOAO
Carol Gregory, ETS
Robert Howard, NSO
Richard Joyce, KPNO
John Leibacher, GONG
Elaine Mac-Auliffe, CTIO
Lorraine Reams, AURA

Production Staff

Joyce Duhamel
Jane Marsalla
Mary Jeanne Otten
Shirley Phipps
James Rees
La Rae Rothe

The NOAO Newsletter is published quarterly by the National Optical Astronomy Observatories, P. O. Box 26732, Tucson, AZ 85726-6732