NOAO Newsletter - September 1995 - Number 43

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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

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Comments concerning this Newsletter are welcome and will be forwarded to the appropriate editors.

Getting Redshifts the Imaging Way (1Sep95)

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Getting Redshifts the Imaging Way (1Sep95)

(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 43, September 1995)

It's easy to find distant galaxies by taking deep images, but getting to know them well requires redshifts---and the daunting task of faint-object spectroscopy---if you are keen to look back to cosmologically interesting times. Andy Connolly, Robert Brunner, Alex Szalay (all at Johns Hopkins), and Matt Bershady (Penn State), however, are asking if the use of multicolor images alone to obtain "photometric redshifts" can be improved so that useful galaxy properties and distances can be measured without burning the time needed for deep spectra. To answer their question, they are using the KPNO 4-m to obtain deep multicolor CCD photometry of a sample of faint (B &lt 25) galaxies. The photometry will be reduced to obtain luminosities, spectral properties, and redshifts of galaxies within the slice of the universe probed by their survey.

[Figures not included]

Deep U (left) and I (right) survey images taken with the Prime Focus camera on the 4-m at KPNO.

The position of a galaxy within the four color space of U, B, R and I is defined by its redshift, luminosity and spectral type. A study of the colors of galaxies using the photographic data of David Koo and Richard Kron shows that the distribution of galaxy colors (in their restframe) lies on a tight locus within this four-space. Adding the luminosity of a galaxy as a further dimension stretches this line into a thin plane (see Figure 1). The principal axes of this plane are the luminosity and spectral type of a galaxy. As galaxies are redshifted, their magnitudes dim and their colors change. The "slab" in the color-space comprising the multicolor magnitudes of a complete galaxy sample at a given redshift is thus displaced from its orginal location as the redshift increases. The result is a shifted stack of slabs (each with its own constant redshift) passing through the multicolor distribution. This effect is illustrated in Figure 1 where planes of constant redshift are seen to project through the multicolor space. Because the constant-redshift slabs separate out in multicolor space, the location of a galaxy within the slab still contains sepctral information independent of redshift.

One consequence of this is that galaxies at different redshifts separate out within multicolor space. By fitting a second order relation to the data, a photometric-redshift relation can be derived. Figure 2 shows a comparison of the photometric and spectroscopic redshifts. The dispersion about this relation is delta z &lt 0.05, for galaxies out to a redshift of 0.6 (details to be published in AJ). While estimated redshifts accurate to 0.05 provide an opportunity to study the evolution of galaxies (from luminosity functions to correlation functions) the observed dispersion is already limited by uncertainties in the photographic data (simulations have shown that delta z &lt 0.03 is attainable).

To determine the intrinsic dispersion in the photometric-redshift relation and to extend the analysis to include estimates of luminosity and spectral type, Connolly, Brunner, Bershady and Szalay, in collaboration with David Koo, have undertaken a program to observe the deep redshift surveys of Koo and Kron using the 2048 x 2048 Prime Focus CCD on the KPNO 4-m in the U, B, R and I passbands. The cover figures show two CCD images taken with the TK2B CCD in the U and I passbands. Integration times of 7200s in U and 1200s in I result in a point source 5s limit of approximately 25.9 and 24.3 magnitudes respectively. All observations utilize the scan table, which substantially improves the flatness of the images and reduces small scale fringing present in the I band. These photometric data will be combined with existing redshift catalogs and follow up spectroscopic observations undertaken on the WIYN and Keck telescopes to derive a sample of galaxies with redshifts at the limit of the photometric data.

The ability to estimate the redshift, spectral type and luminosity of a galaxy from its broadband colors will allow large statistical studies of galaxy evolution tobe undertaken (i.e. where spectroscopic redshifts would require orders of magnitude more observing time). With the advent of new multicolor photometric surveys, such as the Sloan Digital Sky Survey, these techniques may open a new dimension in studies of the distribution of galaxies.

[Figures not included]

Figure 1. Galaxies occupy a small fraction of the available multicolor parameter space. This figure shows a schematic of how galaxies separate out in color space. In their restframe, galaxies lie on a plane (with principal axes of luminosity and spectral type). Redshifting the galaxies moves these planes in the flux and color directions, separating them in multicolor space. The total effect of the redshift is the vector sum of the K correction and dimming vectors.

Figure 2. A comparison of redshifts derived from broadband multicolor photometry and those observed spectroscopicly. The dispersion about the one-to-one correlation is 0.05 in redshift.

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Water on the Sun (1Sep95)

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Water on the Sun (1Sep95)
(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 43, September 1995)

The Sun may be a little on the dry side, but not so dry that we can't detect a touch of water vapor in its atmosphere. A group of solar astronomers at the National Optical Astronomy Observatories and the University of Waterloo have recorded evidence of water in dark sunspots. These new observations are of fundamental importance for understanding the atmospheres of the Sun and stars. Hot water molecules are the most important absorbers of infrared radiation in the atmospheres of cool stars such as variable red giants. Studying the physical effects of hot water in these red giant stars is central to determining the rate at which they evolve and eject material into space. Dark sunspots can be 2000^oK cooler than the surrounding bright surface of the Sun, allowing detailed studies of regions that mimic the surfaces of red giant stars. Since the temperatures of even cool stars are almost impossible to produce in the laboratory, these results are unique and show that current theory is not adequate to model these spectra.

Lloyd Wallace, William Livingston, and Ken Hinkle (NOAO) worked with collaborators in obtaining infrared spectra that reveal a large number of water absorption features originating in the solar atmosphere. The observations were obtained with the National Solar Observatory McMath-Pierce Telescope at Kitt Peak, using the Fourier transform spectrometer. Laboratory spectroscopy was carried out by P. Bernath, B. Guo, J. Busler, and K. Zhang (University of Waterloo) in support of the observations.

Livingston explained that the results of this research, which are being published in Science, will help "to emphasize that water is an important absorber in the Sun and stars that is underappreciated." He hopes this research will encourage further laboratory work for the purpose of understanding the astrophysical importance of the water spectrum in the Sun and stars. The significance of this information has been overlooked in previous studies, although water features were first identified nearly 25 years ago.

[Photo not included]

A photograph taken 26 July 1991, of the sunspot observed. The white dot represents the data collection area.

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Diffraction-limited Time Series of the Solar Atmosphere (1Sep95)

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(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 43, September 1995)

Many processes in the solar atmosphere have typical spatial scales of much less than one second of arc. If the processes are related to magnetic fields, the relevant scales are even smaller. It is therefore of great interest to reach the diffraction limit of the existing, relatively small solar telescopes. Noticeable evolution of solar features occurs on time-scales of less than a minute, if spatial resolution of better than one second of arc is reached. Speckle imaging has been used to obtain images at the diffraction limit of solar telescopes by taking about 100 frames for a single reconstruction. Time series with a temporal resolution of about 30s required very high data rates and produced an enormous amount of data. A reconstruction method that requires less data is therefore highly desirable.

Richard G. Paxman, John H. Seldin (both ERIM, Michigan), Guenther Elste (Univ. of Michigan), and Christoph U. Keller (NSO Tucson) used the new technique of phase-diverse speckle imaging to obtain diffraction-limited time series of the solar atmosphere with the 76 cm Sacramento Peak Vacuum Tower Telescope. They used three CCD cameras of the Zrich Imaging Stokes Polarimeter I in parallel at a rate of seven frames per second per camera. One camera was in focus, another one out of focus, and a third one was behind a narrow-band tunable filter. The sharpness of each acquired triplet of images was analyzed in real time, and only the three sharpest triplets out of 50 triplets were stored for later use.

[Photo not included]

Reconstructions of a plage region with time runing from left to right, top to bottom. The time between images is about 50 s. Tick marks have a 1" spacing. The data were collected under moderate seeing conditions of about 1".

Phase-diverse speckle imaging, developed by Paxman and Seldin over the last few years, was used to remove the aberrations of the atmosphere and the telescope by using the simultaneous in-focus and out-of-focus images in a 5 nm passband around 656 nm. The point-spread function determined in this relatively broad channel can then be used to restore the 0.05 nm bandpass images obtained behind the Universal Birefringent Filter. The figure shows a reconstructed time series in the 5 nm passband of a field slightly less than 4" by 4" in size. For this time sequence, a set of 300 image triplets was collected over a span of 13.5 minutes, and the phase-diverse speckle restoration algorithm was used to reconstruct a set of 30 frames from disjoint sets of 10 images spanning the collection interval. The figure shows every other reconstructed image.

The 30 object restorations were aligned and made into a movie. For ease of viewing, the movie has been Fourier-interpolated in the time dimension by a factor of 5 for a total of 150 frames. The resulting restored time series of a plage (a magnetic region without sunspots) shows the highly dynamic photosphere at scales below 0.3", close to the diffraction limit of the telescope. There is a substantial amount of evolution within less than a minute, in particular small features, probably associated with magnetic fields, evolve rapidly. An interesting example is seen in the lower left section of the field of view of the two images in the lower left part of the figure. A granule is expanding and hits an elongated, small feature, which then increases in brightness by about 30% within less than a minute. The reason for this dramatic increase of brightness will be the subject of further data analysis. The images in the narrow-band channel will help to determine the location of magnetic fields.

During the course of the observations, data sets under better seeing conditions spanned several hours. The very high spatial resolution combined with the good time resolution opens a new window to the study of the dynamics of the solar atmosphere from ground-based observatories. The movie as well as general information on phase-diverse speckle imaging has been made available on the World Wide Web at http://www.erim.org/algs/PD/pd_home.html.

Christoph Keller

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Wading Through the Magellanic Stream (1Sep95)

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Wading Through the Magellanic Stream (1Sep95)
(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 43, September 1995)

The Magellanic Stream is an enigmatic filament of neutral hydrogen, stretching over 100^o in a continuous arc behind the Magellanic Clouds, tracing their orbit around the Milky Way. Up till now, it has been detected only in 2-cm emission and in optical absorption against the background galaxy Fairall 9. No stars are known to be associated with the Stream, consequently, its distance is unknown (although one end of the Stream is connected to the SMC). The most viable theories for the origin of the Stream are tidal models, in which the Stream is torn out of the Magellanic Clouds by tidal interactions between the Clouds and the Galaxy, or ram-pressure models, in which the Stream is stripped out of the Clouds by gas postulated to exist in the Galactic halo. Clearly these scenarios are highly dependent on such unknowns as the orbit of the Magellanic Clouds and therefore the outer rotation curve of the Galaxy, as well the properties of the putative halo gas.

Ben Weiner and Ted Williams (Rutgers) observed the Stream with the Rutgers Fabry-Perot interferometer on the CTIO 1.5-meter telescope in August 1994, as part of a program to search for faint Ha emission from Galactic high-velocity clouds and the Magellanic Stream. Their goal was to set limits on the ionizing flux emergent from the Galactic disk and the extragalactic ionizing flux. The Fabry-Perot provides high sensitivity to diffuse emission lines, because it combines high spectral resolution (0.75 A) with a very large collecting area, effectively 20,000 arcsec^2.

On the second night of their observing run, the signature of an emission line appeared in their first 15 minute exposure, on the leading edge of the Magellanic Stream cloud MS IV. This leading edge is the location of a sharp density gradient in H I. The emission was unexpectedly strong--0.2 Rayleighs (1 Rayleigh = 10^6 photons cm^{-2} s^{-1}, corresponding to an emission measure (EM) of 0.5 cm^{-6} pc. This is ~10 times greater than expected from limits on the diffuse ionizing flux. Weiner and Williams undertook a short survey to constrain the origin of this Ha emission.

The results are shown in the Figure. The spectra at three positions, on the leading edges of clouds MS II, MS III, and MS IV of the Stream, show Ha emission of EM 1, 0.5, and 0.5 cm^{-6} pc. The fourth position, and three other positions (not shown), which are not on cloud leading edges, show only marginal evidence for Ha emission, of EM 0.15 cm^{-6} pc or less.

Where is the energy to power this emission coming from? The association with the cloud leading edges suggests that the Ha emission is caused by bow shocks in the Magellanic Stream as it moves through a Galactic corona of low-density gas. This is reinforced by the shape of the HI density contours on the leading edges of the LMC and the clouds of the Magellanic Stream, which resemble bow shocks. Most other sources, such as photoionization, can be ruled out. The only other source that might be able to contribute is thermal conduction from hot gas ($T \sim 10^7$K) in the Galactic halo, although this does not explain the association with leading edges.

Shocks and thermal conduction in the Magellanic Stream require the presence of an ambient medium of hot ionized gas in the Galactic halo, at a Galactic radius of r ~50 kpc, well above the Galactic plane, at b = -70 to -90, implying that baryons associated with the Galaxy extend to large radii. If, as seems likely, the emission is due to shocks, the density of the corona is on the order of $n_H \sim 10^{-4}$ cm^{-3} at r ~50 kpc. This suggests that ram pressure plays an important role in tearing the Stream out of the Magellanic Clouds. The density agrees with models in which part of the soft X-ray background comes from a hot Galactic corona. Such a large corona also accords with models of QSO absorption line systems where the absorbers are resident in extended halos around normal galaxies.

[Figure not included]

Spectra (object field minus sky field) of four positions on the Magellanic Stream, obtained with the Rutgers Fabry-Perot and CTIO 1.5-m. The solid lines are fits to the data made by LOWESS, a robust smoothing technique. The inverted triangle indicates the wavelength corresponding to the velocity of H I (heliocentric) from 21 cm measurements. The agreement confirms that the emission is H associated with the Stream. (a) MS II field, on the MS II cloud leading edge. The residuals around 6563 are due to incomplete object-sky cancellation of the geocoronal H line. (b) MS III, leading edge field. (c) MS IV, leading edge field. (d) MS II, not on a cloud leading edge.

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Doug Rabin Acting Director for the National Solar Observatory (1Sep95)

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Doug Rabin Acting Director for the National Solar Observatory (1Sep95)
(from Director's Office, NOAO Newsletter No. 43, September 1995)

Starting 1 September Doug Rabin will be Acting Director of the National Solar Observatory. This temporary appointment will give Jacques Beckers the opportunity to devote most of his time and effort to the development of a proposal for a major new national solar research facility. This facility will aim at observing both the solar disk and the solar corona at wavelengths from the visible to the far infrared. With adaptive optics it should be able to achieve high angular relolutions at those wavelengths. Jacques will return to the position of Director of NSO on 1 October 1996.

Sidney C. Wolff

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Restructuring (1Sep95)

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Restructuring (1Sep95)
(from Director's Office, NOAO Newsletter No. 43, September 1995)

Astronomers have watched with concern the reassessment currently under way in Washington of priorities for the federal budget in general, and for basic research in particular. Major changes in the level of support for space science appear inevitable, and the impacts of these changes will affect the entire field of astronomy. Support for the major recommendation of the Bahcall report seems more remote than ever. To quote from the report, "The committee's highest priority for ground-based research is to strengthen the research infrastructure at universities and at the national observatories.

- o The committee recommends that the National Science Foundation increase the operations and maintenance budgets of the national observatories to an adequate and stable fraction of their capital cost, thereby repairing the damage caused by a decade of deferred maintenance.

- o The committee recommends an increase in the individual grants program in astronomy at the NSF to permit young researchers to take advantage of the new opportunities for discovery, utilize appropriately the large amounts of new data, and to enhance support for theoretical astrophysics."

At the same time as the US appears likely to make major reductions in its support of basic astronomical research, we face growing competition from abroad. The spending outside the US for both construction and operations of ground-based astronomical facilities now substantially exceeds our own. The challenge for our community is to maintain scientific vitality while coping with declining levels of support.

The irony is that in the case of NOAO we now know how to improve scientific quality while lowering operating costs. The WIYN telescope, which has just recently begun scientific operation, has a median seeing between 0.7" and 0.8", which is significantly better than any other telescope currently operated by NOAO and clearly represents the state of the art for telescopes of this aperture. Because the WIYN was designed for easy maintenance, offers only two basic instruments (an imager and a fiber spectrograph), and has minimal instrument changes, we believe its operations costs will be about half that of the current Mayall 4-m telescope. While no equivalent demonstration project has been completed at NSO, it is certain that improved performance is possible for solar telescopes as well. We are currently exploring designs that would replace the infrared capability of the McMath-Pierce Telescope and the high resolution capability of the Vacuum Tower Telescope with a single new facility.

As business has already learned, however, restructuring in order to reduce operating costs requires an initial investment. The OIR panel, which was chaired by Dick McCray, recognized this fact in its report, which states:

"The WIYN experience has shown that Kitt Peak can deliver excellent seeing, and KPNO should strive to support programs that take advantage of this capability to provide scientific capabilities complementary to observations by Gemini North. Toward this end, it may be wise for KPNO to close its smaller telescopes, such as the 2.1-meter, the 1.3-meter, and the 0.9-meter telescopes, especially if they can be replaced by a modern 2-m class telescope. If in fact the operations costs of WIYN are as low as they have been estimated to be, it would be sensible to consider replacing the existing 4-meter telescope by a twin of WIYN."

NOAO is currently exploring restructuring options. We have defined three initiatives that are of particular interest. The first is replacing the smaller telescopes at both CTIO and KPNO with a modern 2.4-m telescope that would be used primarily for optical imaging. The second is building a new facility that would replace the telescopes now used for synoptic monitoring of the Sun with a single new telescope. This telescope would be equipped with CCDs, rather than the photographic film now in use for many synoptic observations, and the data taking and archiving would be automated. The third is a significant investment in the construction of the 4-m SOAR telescope, which would be built on Cerro Pachon in partnership with Brazil and the University of North Carolina. We are in the process of evaluating the payback period for each of the projects. Early estimates indicate that, for each 2.4-m telescope and for the synoptic solar telescope, we would recover the construction costs through lowered operating costs in only 5 to 7 years. Any business would regard this as a very good investment indeed! The McCray committee itself found even longer payback periods attractive. Their report states, "Replication of the WIYN telescope is estimated to cost approximately $12M and would pay for itself, in terms of reduced maintenance cost relative to the current 4-meter telescopes on KPNO and CTIO, in less than 20 years."

In the case of the SOAR project, NOAO's current obligation is to provide operating funds. If we were able instead to contribute to the capital cost then we could lower our long term obligations for operations.

NOAO's operating budget is going down. The question is whether we will merely close facilities or whether we will have an opportunity to replace them. The answer to this question will determine whether or not we retain the ideal of operating facilities that offer open access, based on competitive review, to the best scientific programs. Many of us are old enough to remember the alternative---a time when astronomy was the province of a privileged few---and do not believe that a reversion to that system would serve the field well.

Fortunately, the NSF itself understands the issues NOAO is facing and this year provided $2M as an initial step toward restructuring NOAO. We have used some funds to cover costs of downsizing the staff and to deploy GONG one year earlier than would otherwise have been possible, thereby lowering the total project costs. We believe that the remaining funds, coupled with a contribution from existing engineering resources, would bring us close to achieving either one 2.4-m telescope or the solar synoptic facility. We are currently preparing detailed descriptions of all three initiatives for review by our user community, AURA, and the NSF.

There appear to be several misunderstandings in the community about the $2M increment provided this year by the NSF. First, the funds are not to be used for NOAO operations---only for investment. The planning guidelines we have been given by the NSF call for essentially level dollar funding for the next five years. If we allow for likely rates of inflation in the US and Chile, this guideline corresponds to an effective reduction of 20 percent in operations, added to the 30 percent that has already occurred over the last decade. Second, it is my understanding that this $2M came from funds within the NSF (not within the astronomy division) designated for special opportunities; it is highly unlikely that the funds would have been made available to other components of the astronomy program.

I recognize that the stress in the grants program is also great. Both national centers and grants are essential components of a vital program of research in astronomy. According to statistics developed by the OIR panel, 71 percent of the NSF grant-funded projects in OIR astronomy made use of facilities at the national observatories. In fact, I view the national centers as a kind of grants program---a program that grants observing time to several hundred research projects each year. The relationship between the NSF-funded grants and the centers-supported allocations of observing time is a symbiotic one. Neither program can succeed without the other.

The McCray report made three major recommendations concerning future investments in OIR astronomy: Gemini operations should be funded through an increment to the astronomy budget; NOAO should be restructured for more cost effective operation; and instrumentation for the major new telescopes being built at the independent observatories should be funded through an increment to the astronomy budget in return for open access for the community. The first recommendation has been implemented by the NSF, and the first step toward the second has been taken. AURA and NOAO are committed to achieving the third recommendation and are doing everything we can to make the strongest possible case for this initiative at the NSF. In this very difficult funding climate, astronomers will succeed in making a compelling case for their priorities only if we work together to achieve the entire set of recommendations of the OIR panel. Divisiveness will not serve us well.

We are in the midst of an unprecedented investment in ground-based astronomy. Over the next decade the US, through federal, state, and private funding, will invest at least $400M in major new telescopes. Those telescopes will require state of the art instrumentation in order to achieve their full potential, and astronomers will require support for acquiring, analyzing, and interpreting the qualitatively new types of data that will become available. We must unite to develop the best case we possibly can for making the necessary investments.

Sidney C. Wolff

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NOAO Instrumentation News (1Sep95)

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NOAO Instrumentation News (1Sep95)
(from Director's Office, NOAO Newsletter No. 43, September 1995)

The third quarter showed steady progress on the projects in the Instrument Projects Group. Priority for allocation of resources is given to those closest to completion. We should see substantial additions to the complement of instruments available to NOAO users over the course of the next year.

The conversion of the Hydra fiber positioner and bench spectrograph for use at the WIYN telescope is in the final stages of completion. Activities in the third quarter were largely based on experience during commissioning of the instrument at the telescope. Shared risk scientific use will be starting on the timescale of publication of this Newsletter. The remaining task is commissioning of the all-transmissive camera. Efforts are underway to optimize the focus of the camera specifically for the curvature of the SITe CCD that serves as the dedicated detector. That final stage of the project is on track for completion this fall. Project Scientists, Sam Barden and Taft Armandroff, are collaborating with the CTIO staff and the Hydra engineering team to plan for an implementation of Hydra at the R-C focus of the CTIO 4-m telescope.

As discussed in the March Newsletter ("Special Opportunities for High Spatial Resolution IR Imaging Programs"), the experience of the DLIRIM experiment has now been translated into a hardware realization. The goal was rapid framing of an InSb array, using image centroid information to shift and add the accumulated frames. The DLIRIM experiment showed that a software-based version of the scheme could achieve 4mm imaging with good Strehl ratios (near diffraction-limited performance) at the Mayall 4-m telescope. The camera is the Cryogenic Optical Bench (COB), retrofitted with 1:1 optics yielding ~0.1"/pixel and a 25" field of view. Commercial Datacube hardware and software has been interfaced successfully with the Wildfire system to accomplish the shift and add accumulation on-board the controller system. An ICCD camera and dichroic beam feed provide on-axis guiding. As of this writing, the system has been successfully assembled. Project Scientists Ian Gatley and Mike Merrill are awaiting its first commissioning run once the KPNO 4-m is reassembled from shutdown.

The high-resolution infrared spectrograph, Phoenix, is the highest priority major project currently in fabrication. Phoenix will offer resolutions of 67,000-100,000 in the 1-5um range. It records a single order of a large (8 x 16 inch), coarsely ruled echelle, selected by narrow-band order sorting filters. Its use at longer wavelengths requires cooled foreoptics that provide a Lyot stop to mask the thermally emitting profile of the telescope. The instrument will be shared between CTIO and KPNO on the 4-m telescopes; it can also be accommodated on the KPNO 2.1-m. It has been requested as an NOAO-supplied instrument for the Gemini telescopes. The large dewar has been fabricated, welded and anodized; vacuum testing and minor rework will assure the integrity of the vacuum. The clean room in the IR lab is being expanded and renovated for full system integration. The project is still on track for telescope commissioning early next calendar year under the leadership of Project Scientist Ken Hinkle.

The Large CCD Mosaic Imager is in the final design and early fabrication stages. This imager will have an 8192 x 8192 pixel format, with an active area of over 12 cm on a side, and minimum gaps between the three-side buttable 2K x 4K CCDs. The dewar and filter transport mechanisms are well into the detail design phase. A major issue this past quarter has been accommodation at the Prime Foci of the 4-m telescopes. Questions requiring particular attention have been the weight moving capacity of the pedestal drives, and the hardware for installation and handling. A strong effort is underway at CTIO to produce the ARCON hardware and adapt its software for use with Mosaic. Schedule drivers for scientific use at the 4-m telescopes may turn out to be the vendor-supplied items: the lenses and prisms for the new KPNO Prime Focus Corrector (to supply adequate back focal distance), and a sufficient quantity of scientific grade thinned CCDs. Since the unit CCDs are interchangeable, the quality of the imager is likely to be steadily upgraded as better devices become available. The instrument is on track for commissioning on the KPNO 0.9-m during the summer of 1996. Project scientists are Todd Boroson and Taft Armandroff.

The last Newsletter discussed the results of the GRASP Preliminary Design Review. GRASP will be a simultaneous four-color near-IR imager and spectrograph, based on the SQIID heritage. A major recommendation of the committee was a limit on the weight and volume of the instrument. Meeting that recommendation has been the fundamental design challenge of the GRASP team in the last quarter, under the leadership of Dick Joyce. The desires for field of view and image quality provide a major challenge for optical design and create a decided tension with the need for compact packaging and maintenance accessibility. Explorations of optical redesign, scale changes, and packaging innovation are converging to a manageable solution. The Delta-PDR will be rescheduled from its original summer date as soon as an acceptable design configuration is well in hand.

There are new projects on the horizon for work in fiscal year 1996. Near the end of spring semester, COB will be decommissioned from its high resolution use on the KPNO 4-m. The detector will be upgraded to a 1024 x 1024 InSb ALADDIN array with associated controller. The instrument will then be deployed at CTIO, along with the tip-tilt f/14 secondary on the 4-m telescope, for regular use as a high-resolution imager. At the same time, it is anticipated that the ALADDIN development project will produce a number of partially functioning arrays for use at NOAO. We intend to install usable 512 square InSb arrays into SQIID over the next year, and recommission that instrument for use on the KPNO 4-m. It should serve many of the community's IR imaging needs during the interval in which GRASP is being developed and fabricated. In addition, design work will begin in earnest on the Gemini Infrared Spectrograph and its copy for CTIO and Gemini South.

As always, your input is vital to the forward look and shape of the NOAO instrumentation program. Please contact me or any of the project scientists with your suggestions.

Richard Green

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NOAO Educational Outreach (1Sep95)

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NOAO Educational Outreach (1Sep95)

(from Director's Office, NOAO Newsletter No. 43, September 1995)

IDEA Grant Status

As reported in previous Newsletters, NOAO staff members are participating in an educational outreach project partially funded by the NASA IDEA Grant "Active Learning Exercises in Planetary and Solar Astronomy for K-3 Students." Astronomers are working directly with students and teachers of the Satori School (Tucson, Arizona) over a series of 12 weeks to present basic astronomical concepts. The goals of the project are to involve scientists in classroom settings and to engage young people in the excitement and fun of scientific discovery. Four topics in planetary astronomy have been explored in the program so far:

(1) The students learned about the relative spacing and sizes of objects in our solar system as they became a "living solar system," orbiting and rotating on the school playground.

(2) This was followed by a presentation on comets, where students built their own comets from dry ice, water, dirt, and corn syrup. This popular---and messy---activity demonstrated that comets are irregularly shaped dirty snowballs that change in composition and form as they travel through the solar system.

(3) A third presentation was titled "Impacts and Hazards." In this exercise, projectiles were thrown and skipped into dishes of various materials to explore the effects of impacts on planetary surfaces. The protective benefits of an earth-like atmosphere were simulated by a thick layer of jello over the mud or flour surfaces. The possibility that a comet or asteroid impact led to the extinction of the dinosaurs added extra interest to this topic.

(4) The final presentation was titled"Space Resources," and explored what makes it possible for people to live on Earth and what would be needed to live elsewhere. The children worked in groups to define what was necessary to live in space and how those resources might be obtained.

Lesson modules developed through this pilot program are being written up now and will be disseminated in printed form and electronically through the World Wide Web of the Internet. Implementation of the IDEA Grant continues this fall with NSO astronomers presenting topics ranging from rainbows to "solar music"--helioseismology.

Web Pages On-line

The NOAO K-12 Educational Outreach Pages can now be reached through the NOAO Home Page at http://www.noao.edu. The following items are currently featured on our Educational Resources page:

An FAQ list of questions about being an astronomer. The questions are compiled from phone conversations with students who call in to NOAO for information; answers are provided by NOAO staff members.

On-line versions of the exemplary Survival Guides for Sharing Science with Children produced by the North Carolina Museum of Life and Science. Three Guides are available: one for scientists and engineers, one for teachers, and one for parents. You can browse the Guides on-line, download a PostScript version of each Guide, or send in the order form directly to the NCMLS to order multiple copies.

A recipe for "Making a Comet in the Classroom" provided by Dennis Schatz of the Pacific Science Center. We also describe our experiences using the recipe with elementary students and include a summary of comet facts by NOAO astronomer Nalin Samarasinha.

Suzanne Jacoby, Education Officer

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NOAO Preprint Series (1Sep95)

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(from Director's Office, NOAO Newsletter No. 43, September 1995)

The following preprints were submitted during the period 1 May 1995 to 30 July 1995. Please direct all requests for copies of preprints to the NOAO author marked with an asterisk.

653 *Fowler, A.M., Heynssens, J.B., Gatley, I., Vrba, F.J., Ables, H.D., Hoffman, A., Woolaway, J., "ALADDIN, the 1024 x 1024 InSb Array: Test Results"

654 *Heim, G.B., Buchholz, N.C., Fowler, A., "Controlling an ALADDIN 1K x 1K Array with WILDFIRE"

655 Roddier, N., *Blanco, D., Goble, L., Roddier, C., "The WIYN Telescope Active Optics System"

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660 *Hill, F., "Local Probes of the Solar Interior"

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*Abt, H.A., "Some Highlights of the Astrophysical Journal"

Bogart, R.S., Sa, L.A., Duvall, T.L., Haber, D.A., Toomre, J., *Hill, F., "Plane-Wave Analysis of Solar Acoustic-Gravity Waves: a (Slightly) New Approach"

Bogart, R.S., Sa, L.A., Haber, D.A., and *Hill, F., "Preliminary Results from Plane-Wave Analysis of Helioseismic Data"

Bogdan, T.J., *Braun, D.C., "Active Region Seismology"

*Braun, D.C., "Scattering of p-Modes by Sunspots. I. Observations"

Craig, N., Fruscione, A., Dupuis, J., Mathioudakis, M., Drake, J.J., Abbott, M., Christian, C., *Green R., Boroson, T., Howell, S.B., "The EUVE Optical Identification Campaign II: Late-Type and White Dwarf Stars"

Eggen, O.J. 1995, "Young Pulsating Stars in the Bhm-Vitense Decrement"

Eggen, O.J. 1995, "Distribution and Correlation of Age, Abundance and Motion of Lower Main Sequence Stars"

Eggen, O.J. 1995, "Reality Tests of Superclusters in the Young Disk Population"

Fan, Y., Braun, D.C., Chou, D.Y., "Scattering of p-Modes by Sunspots. II. Calculations of Phase Shifts from a Phenomenological Model"

Haber, D.A., Toomre, J., *Hill, F., Gough, D.O., "Local Area Analysis of High-Degree Solar Oscillations: New Ring Fitting Procedures"

*Hill, F., "Local Probes of the Solar Interior"

*Hill, F., "Resolution and Error Trade-Offs in Velocity Fields Inferred from Ring Diagrams"

Hunter, D.A., Baum, W.A., *O'Neill, E.J., Lynds, R., "The Intermediate Stellar Mass Population in NGC 604 Determined from HST Images"

Kariyappa, R., Pap, J.M., *Balasubramaniam, K.S., Kuhn, J.R., "Preliminary Results of the Analysis of Ca II K Spectroheliograms"

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*Simon, G.W., Brandt, P.N., November, L.J., Shine, R.A., Strous, L.H., "Warning: Local Correlation Tracking May Be Dangerous to Your (Scientific) Health"

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REU Opportunities at CTIO-Winter 1996 (1Sep95)

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REU Opportunities at CTIO-Winter 1996 (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

Undergraduate research programs have a long tradition at NOAO. We all know of or may even be astronomers whose careers were molded by early experience with research in the stimulating environment of KPNO or NSO. At CTIO the story is just beginning, but based on the success of our first year, we are pleased to host the undergraduate research program again in 1996. Because the CTIO program is a new feature of NOAO REU programs, we would like to provide some information on our activities, and encourage you to encourage outstanding students to apply.

The REU program at CTIO supports four undergraduate students for periods of 10 to 12 weeks, for an internship in astronomical research. Each student is paired with a staff scientist who supervises their work on a specific project (see the March 1995 NOAO Newsletter for projects from 1995).

The CTIO program includes a significant observational component; participants have ample opportunity to observe with a variety of telescopes and instrumentation, either as part of their research project, or on observing trips with staff or visiting astronomers. Last year US students helped on engineering runs with the STIS CCD and on the Curtis Schmidt, made observations in support of satellite observations at the 1-m, and provided other service observing. Trips to Tololo gave students a behind-the-scenes look at the 4-m and the operation of Argus, and allowed them to sample a seat in the prime focus cage.

Scientific and technical staff offer weekly seminars, which introduce students to basic observational techniques and current research topics. Students broaden their perspectives on astronomy and science in conversation with visitors and staff at morning coffee, in the library or computer room, or on the mountain while observing.

Working in Chile and gaining experience with the international astronomical community is an important part of the experience. Students are provided housing on the La Serena compound where they work and relax with Chilean students, and learn much more than just astronomy as members of the CTIO community.

The program operates during the Chilean summer, from January through March. We recognize that the program may not be an option for all students, but for those undergraduates who have flexible academic schedules and 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. We encourage students (and their academic advisors) to consider REU projects for independent study or directed research courses for academic credit, and are happy to work with students and faculty to ensure that course requirements are met.

Deadline for applications is 13 October 1995. Announcements and application forms are available from Revell Rayne, NOAO Human Resources Manager (rrayne@noao.edu) or Eileen Friel (efriel@noao.edu). We are looking forward to hearing from your students!

Eileen Friel (efriel@noao.edu)

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CTIO Scientific Staff Comings and Goings---and an Upcoming Job Vacancy (1Sep95)

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CTIO Scientific Staff Comings and Goings---and an ... (1Sep95)
Upcoming Job Vacancy
(from CTIO, NOAO Newsletter No. 43, September 1995)

Several changes are taking place in the scientific staff at CTIO. Much of what follows concentrates on their professional activities. Space constraints limit what could also be said about the more human side of their many contributions to life at the observatory and in the local and international community.

Following the departure of Chris Smith (now at the University of Michigan) in February, John Filhaber joined us on 1 March from Columbia University, where he worked in their program of satellite-based UV instrumentation. He worked both for CARSO and as the Canadian observer on Las Campanas. He is already heavily involved in work on upgrading the image quality of the 4-m telescope, and will provide some much-needed continuity to this effort during Jack Baldwin's 12-month sabbatical leave in 1996. He is also the engineer responsible for most of the support and upgrade activity on the smaller telescopes, as well as covering a wide variety of optical design activities.

In mid-July we held a farewell party for Jay Elias, Mario Hamuy and Andy Layden. Jay Elias will be taking sabbatical leave at NASA Ames until the end of the year and will then transfer to Tucson as project scientist for the Gemini Infrared Spectrometer. He has made major contributions in the study of young stars in the Taurus and Ophiuchus dark clouds, in spectroscopy of nova and supernovae, and in standardization of near-IR photometry. He has been the leader of the IR instrumentation program at CTIO for many years. His current area of research includes studies of AGB stars in the LMC and SMC.

Mario Hamuy has been awarded one of the new Gemini Fellowships. He has elected to use it to support studies for a PhD at the Steward Observatory. He did his MS in the University of Chile's Department of Astronomy on UBVRI integrated photometry of globular Clusters. Since 1987, he has worked with many of the CTIO staff astronomers on photometric and spectroscopic studies of SN1987A and other supernovae. He has recently published an important study of the Hubble diagram for distant Type Ia supernovae. He has also played a major role in recent efforts to control light pollution in the Cerro Tololo and Cerro Pachon area.

Andy Layden is moving to Canada to work with Bill Harris' globular cluster group at McMaster University in Hamilton. He joined CTIO in November 1992, immediately after completing his PhD thesis at Yale (with Bob Zinn) on the metallicities and kinematics of nearby RR Lyrae stars. At CTIO he has been working on four projects involving the study of RR Lyrae stars in different regions of the galaxy. He has also worked on the photometric properties of the newly-discovered Sagittarius dwarf galaxy and its globular clusters. His work looking after the CTIO photometers will be taken over by a combination of Olin Eggen and Oscar Saa.

Ron Probst has arrived at CTIO from Tucson to take up a quasi-sabbatical year---just in time to help cover some of the gap left by Jay's departure. He will spend about three quarters of his time on research, including studies with a wide-field infrared camera.

We are expecting to hire a scientist to join the CTIO infrared group at or shortly after the time Ron leaves Chile. Advertisements are likely to be issued in October, with a selection made in February and a starting date around August or September 1996.

Nick Suntzeff and Tom Ingerson return from sabbaticals at the Dominion Astrophysical Observatory in Canada towards the end of this year and by June 1996 respectively.

Michael Keane, from the University of California, Santa Cruz, will be joining us mid-August. His PhD work included considerable involvement in the very successful HIRES echelle spectrometer for the Keck Observatory. He will be spending about half time on his own research projects into the properties of quasars, active galaxies and the intergalactic medium.

Alejandro Clocchiatti (currently a student at Texas) has been granted a Gemini Fellowship to join us at CTIO in mid-September. It is a one-year fellowship which is renewable for a second year. Alejandro, who is from Argentina, has been carrying out an observational thesis on Type Ib/Ic supernovae under Craig Wheeler.

Malcolm G. Smith

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CTIO Instrumentation News (1Sep95)

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CTIO Instrumentation News (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

4-m Imaging

More effort on improving the imaging on the 4-m telescope was spent during the past quarter: the Shack-Hartmann image analyzer was completed, improvements have been made to the primary mirror cooling control, and the PFADC was collimated with respect to the primary. A companion article presents more details and some evidence that the cumulative effect of this program has been to improve the image quality significantly. The next step will be to carpet the observing floor around the telescope. This will permit the floor surface to track the temperature of the ambient air more rapidly and thus suppress seeing degradation caused by cold cells of air swept up off the floor by air entering through the ventilation doors.

Small Telescopes

Tight budgets have made it difficult to be able to work on problems plaguing our older, small telescopes. The MACHO program to search for Compact Halo Objects, which makes use of these telescopes, is providing some funds for such work. This program helped to provide resources for the construction of a new system of radial supports for the 0.9-m telescope which has just been installed (see accompanying article). Another project to improve the smaller telescopes is the installation of ventilating louvers in the dome of the 1.5-m. A mechanical engineer has been working on the design of the system. Fabrication is about to begin.

Arcon

The development and deployment of the Arcon Array Controllers continues to be a major activity. The Arcon system has for some time been in use in Tucson as well as at CTIO, and its use beyond CTIO will continue to grow to include Gemini. To help absorb the impact of these larger demands we are fortunate to have help from the Tucson instrumentation program: Neil Gaughan visited to help plan the effort to build the 16-channel version of Arcon that will run the detectors in the NOAO Mosaic Imager. Andy Rudeen of the Tucson Instrumentation Group visited La Serena for a couple of months during which time he collaborated in the design, with Roger Smith, of a major upgrade to the Video card. He will also be handling PCB procurement for the Arcon project in Tucson. We have also been able to count on the assistance of Dee Stover of Tucson in the area of PCB layout. Finally, to aid in the production of Arcons, we have contracted a young Chilean engineer, Gustavo Rahmer. Meanwhile, new printed circuit versions of the VTT (Voltage, Temperature and Telemetry) board and ADC cards, designed by Eduardo Mondaca and Rolando Rogers respectively, are advancing rapidly: Eduardo is testing the completed VTT and Dee Stover is doing the artwork for the ADC.

Work also continues on the implementation of CCDs. Indeed, the completion of the transistion from the elderly VEBs to Arcons is nearly complete. Roger Smith has nearly completed the commissioning of the Loral 1K chip for spectroscopy on the 1.5-m (see companion article). Ricardo Schmidt has completed implementation of quad readout on the STIS 2K chip for the Schmidt telescope.

New f/14 Secondary for 4-m Telescope

For some time, work has been going ahead on the design and fabrication of a new secondary for the 4-m telescope which will enable us to use f/15 instruments from the Tucson Instrumentation program (Phoenix, COB, the Second Generation IRS, etc.) as well as our HgCdTe Imager CIRIM and (modified) our present IR Spectrometer. The installation is similar to that on the KPNO 4-m and uses the modified coude-feed flip mechanism. The novel feature is that the mount will incorporate piezoelectric actuators to define the tilt of the mirror. These will enable the mirror to be tip-tilted to remove wavefront tilt, arising from the atmosphere, wind-shake or high frequency tracking errors. The mechanical fabrication of the mount has been our principal activity in the shop this quarter and it is nearly complete. Optical fabrication of the secondary itself has been going on in the KPNO Optical Shop. Tests on a dummy mirror to test the tip-tilt concept mechanically will begin shortly.

Brooke Gregory, Jack Baldwin

Workshop Announcement (1Sep95)

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Workshop Announcement (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

The fourth ESO-CTIO workshop will be held 10-15 March 1996 in La Serena, Chile. The topic will be The Galactic Center. The areas that will be discussed will include infrared imaging and spectroscopy, millimeter and radio studies, velocity and kinematics of the central cluster, Sgr A, and the central parsec.

Prospective participants or interested parties are encouraged to contact members of the local organizing committee: Roland Gredel, Jorge Melnick (rgredel@eso.org, jmelnick@eso.org), and Robert Schommer (rschommer@noao.edu). We promise a stimulating meeting in a pleasant late summertime environment.

Robert Schommer

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CCD News (1Sep95)

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CCD News (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

In NOAO Newsletter No. 42 (p. 29, 31, 33) three new CCDs entering use at CTIO were described. The implementation of these CCDs marks the end of a decade of use of the "VEB" CCD controllers, designed by Bruce Atwood. All Tololo CCDs now being scheduled are operated by Arcon controllers. A brief update follows.

Loral 3K CCD

The Loral 3K CCD will have seen 80 nights of use on the 4-m telescope by 31 July, with the R-C and ARGUS spectrographs, plus an engineering night on the Echelle spectrograph (see other articles in this Newsletter). Recent lab work has focused on attempts to reduce the read time without compromising the read noise. Since this CCD has two operative amplifiers that cannot be read out simultaneously, the strategy chosen was to leave the lower-right (LR) amplifier alone, as a point of reference, while making changes to the lower-left (LL) ARCON video chain. This work has been successful, as illustrated in the table below. The second and third columns illustrate that the video gain of LL is almost double that for LR, yet for a given e-/ADU the readout noise is the same.

Prior to this work, observers generally chose to use gain index = 4, LR amplifier, which at 2.03 e-/ADU sampled the dynamic range (7.7 e- RON, 80000 e- full well) satisfactorily, with read time a slow three minutes. Now it is possible to instead use gain index = 2, LL amplifier, which gives the same gain and read noise, but with read time of two minutes.

GAIN Index	1/G [e-/ADU] LL	1/G [e-/ADU] LR	RON [e-] LL	RON [e-] LR	Time [s]
1	4.33	8.21	11.0	12.6	88.2

2	1.99	4.17	7.7	9.3	20.5
3	1.39	2.74	7.9	8.6	52.4
4	1.03	2.03	7.3	7.7	184.4

STIS 2048 CCD

This CCD will have seen 96 nights of use on the Schmidt, from March 1 until July 31. Quad-readout has now been implemented, which makes a great improvement to observer efficiency at this telescope, since for most projects exposure times average only a few minutes. The linearity of this CCD rolls-off above 90000 e-, so use of gain index = 2 or 3 is normal. See the table that follows.

	1/G [e-/ADU]				RON [e-]				Read Time
Gain index	LL	LR	UL	UR	LL	LR	UL	UR	[s]
1	2.9	2.9	2.7	3.1	4.2	4.2	4.2	4.2	32
2	2.1	2.1	1.9	2.3	3.8	3.8	3.8	3.8	38
3	1.6	1.6	1.5	1.7	3.8	3.5	3.7	3.7	47
4	1.1	1.1	1.0	1.2	3.7	3.3	3.4	3.5	69

Loral 1K CCD

This CCD is dedicated for use with the 1.5-m spectrograph and was tested at the telescope on 17 May (see report elsewhere). Due to the block scheduling of instruments at the 1.5-m, the next use of the spectrograph is not until November, for a one month period. Prior to this time, some lab work will be scheduled to optimize the gain/read time for this CCD, in much the same way as detailed above for the Loral 3K.

Field De-Flatteners

As reported elsewhere in this issue, image quality at the 4-m prime focus has been improved by careful attention to the alignment of the primary mirror and the PF corrector. The well-known curvature of the large Tektronix CCDs we use for imaging at this focus produces defocus across the field, and observers normally compromise by focussing on stars part way between center and corner of the CCD. This de-focus is exacerbated with the sub-arcsecond images now possible at PF, so we have ordered simple fused silica lenses that will, to first order, compensate for the CCD curvature. These lenses will replace the dewar windows for our two Tek 2048 CCDs, and should arrive in 2-3 months time.

Alistair Walker

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4-m Image Quality Results (1Sep95)

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4-m Image Quality Results (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

The image quality at the 4-m f/8 focus continues to be subarcsecond on many nights. This is shown in the accompanying figure, which presents all data taken with the f/8 side-port seeing camera between 1 January and 15 May of this year. It can be seen that there was a slow decline in the median image quality between January and March, and then a sudden improvement again in April. It may or may not be coincidental that we recollimated the secondary mirror in April. The median value for all five months combined is 1.0", while it is 0.9" for April and May taken together.

F/8 Direct Imaging

The figure shows that there are many nights of 0.7"-0.8" imaging to be had at the f/8 focus. We want to call readers' attention to the existence of the f/8 direct imaging system. It is used with our best Tek2048, giving a scale of 0.16"/pixel and a field 322" on a side. The usual CTIO filter selection is available (3 x 3 inch or larger). The Shectman autoguider performs very well at this focus (we have taken 30 minute guided exposures with it which produced 0.7" FWHM images), and starting in August we hope (at long last) to offer a working image analyzer system that the night assistant can use to tweak up the active optics on a bright star near fields of special interest (but at the cost of 10-15 minutes observing time).

The potential drawback is that we don't have much experience using this system. In the past there have been obvious problems with light baffling, which produced rather awful background patterns when the moon was up. We recently covered up some embarrassingly huge holes in the main stovepipe baffle, and the background light problems are obviously greatly improved, but we got weathered out on the recent engineering run when we wanted to carefully check the present performance of the system. The other caveat is that we have never carefully checked the image quality outside the central 1024 x 1024 pixels of the CCD.

In spite of these disclaimers, persons interested in getting the best resolution that we can offer over a small field should consider applying for time at the f/8 focus. You should consider 2 x 2 binning on the CCD, which would give 1/3" pixels.

Prime Focus

We have recently spent a large amount of time getting the new prime focus corrector properly aligned with the rest of the telescope--- except that it is really the other way around. Due to a particularly perverse design, we actually have to tilt the 4-m primary mirror to do the alignment, and then spend another two (clear) nights recollimating the f/8 and f/30 secondaries to make up for it. But we have managed to get the best images with the PFCCD/ADC down to 0.8", a significant improvement over the previous 1.0" floor. Note that at 0.8" FWHM the images are very marginally sampled (0.43"/pixel with the Tek2048).

[Figure not included]

Jack Baldwin, Brooke Gregory, Gabriel Perez, John Filhaber

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Air Schmidt Plus Loral 3K on the 4-m Echelle (1Sep95)

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Air Schmidt Plus Loral 3K on the 4-m Echelle (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

The Blue Air Schmidt plus Loral 3K CCD was tested, in combination with the 4-m Echelle spectrograph, during an engineering run in May. From experience with the Reticon CCD, we anticipated that variations in image quality would limit the usable field to only a small portion of the detector. We were, therefore, delighted to find that acceptable images were obtained over most of the CCD. Indeed the image quality was very similar to that obtained when the same camera detector combination is used on the R-C spectrograph. With a very narrow slit, the measured FWHM of comparison lines was ~2.6 pixels at best focus for a wavelength of 3700A, while for a slit width of 1.3" (200 um) it was 3.0 pixels. This corresponds to R~17,400 when using either the 31.6 l/mm or 79 l/mm echelle gratings. With a 1.3" slit, the resolution was 3.5 pixels FWHM or better corresponding to R &gt 15,000 over two-thirds of the area of the CCD, and was better than 4.0 pixels even in the corners of the detector. Charge smearing in the Loral 3K CCD causes blurring of the images that is more severe at shorter wavelengths (see NOAO Newsletter No. 42 p.29). Thus slightly higher resolution will be achieved when working in the red, and slightly poorer resolution at extreme UV wavelengths.

As used on the Echelle, the long axis of the Loral CCD runs along the echelle dispersion direction. The entire free spectral range of the 79 l/mm echelle fits on the CCD out to beyond 1 mm (the FSR fills 80% of the CCD's size at this wavelength). The FSR of the 31.6 l/mm echelle occupies less than one third of the detector at 1 mm. The table below shows the approximate coverage obtained in the cross dispersion direction for some commonly used cross-dispersion gratings.

Grating	l/mm	Order	Blaze (A)	Coverage(A)
G250	158	1	4000	4210
G400	158	1	8000	4210
G226-2	226	1	8000	2940
G226-3	226	1	6300	2940
G510	300	1	10000	2217
KPGL2	316	1	4400	2105
G181	316	1	7500	2105
KPGL3	527	1	5500	1260
G510	300	2	5000	1108
G181	316	2	3750	1052
KPGL1	632	1	4200	1052

Note that the need to select appropriate order sorting filters may limit the usable cross dispersion coverage in some cases. In particular, note that when using a cross disperser in second order, it may be necessary to guard against contamination from both first and third orders. For further information users are referred to the CTIO World Wide Web page (http://ctio.noao.edu). This features an interactive tool to help determine the layout of the echelle spectrum on the CCD. Figure 1 shows sample output from this program for two cases: (1) a blue setup using cross disperser KPGL2; and (2) a red setup using cross disperser G400. The World Wide Web manual also contains a copy of the Observer Support Questionnaire for the echelle, and (hopefully, by the time this Newsletter comes out) an exposure time calculator to help you plan your observations.

Figure 2 shows the overall system efficiency (the fraction of photons striking the primary mirror, that are detected by the CCD) derived from measurements of standard stars. The plotted quantity is the OSE at the peak of the echelle blaze in each order. Note that the measurements were made with a wide (10") spectrograph slit. Curves are shown for two cross dispersers, G400 and KPGL2, used together with the 79 l/mm echelle and various order sorting filters. Two points of reference may be of use to those preparing TAC proposals. Firstly, these numbers for the throughput of the Echelle plus Air Schmidt plus Loral 3K CCD are roughly 3-3.5 times lower than the throughput of the 4-m R-C spectrograph used with the same detector, camera and grating. Resolving powers up to R~6000 can be obtained with the R-C spectrograph. Secondly, these numbers are 1.5-2.0 times higher than equivalent numbers for the Echelle when used with the Long Camera and Tek2048 CCD. This latter setup delivers R ~30,000.

[Figures not included]

Figure 1. Output from the echelle simulator tool "ECHMAP": (top) blue setup using cross disperser KPGL2 (wavelength range 3150-5175A); and (bottom) red setup using cross disperser G400 (wavelength range 5700-9800A). The heavy rectangle marks the outline of the CCD, while the roughly-vertical converging lines mark the edges of the free spectral range. The roughly-horizontal slanting lines are individual orders, and "Min. Order Separation" is the separation in arcsec of the most closely spaced orders (i.e. the usable slit length).

Figure 2. Overall system efficiency for the 4-m Echelle spectrograph with the Blue Air Schmidt and Loral 3K CCD. Curves are shown for two cross dispersers, G400 158 l/mm blazed at 8000A and KPGL2 316 l/mm blazed at 4400A, used together with the 79 l/mm echelle.

Steve Heathcote, Jack Baldwin

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Loral 1200 x 800 CCD for Spectroscopy at 1.5-m (1Sep95)

Loral 1200 x 800 CCD for Spectroscopy at 1.5-m (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

Initial tests of the Loral 1200 x 800 CCD (hereafter Loral 1K CCD) plus 1.5-m spectrograph combination were made during an engineering night in May. The science grade chip had only been installed a few days before this engineering run, so characterization of its properties was far from complete. However, the CCD was judged to be working well enough to allow initial evaluation of its performance at the telescope. The engineering run was highly successful and, as reported below, the results are encouraging. Unfortunately, following the engineering run, the CCD had to be returned to the US to have a broken bond wire repaired. This operation has now been performed successfully and work on the laboratory characterization of the detector will soon be under way again. Provided there are no unforeseen problems, we expect that the Loral 1K CCD will be made available for visitor use following a second engineering run in November. Thereafter it will be the only CCD offered with the 1.5-m spectrograph.

The Loral 1K CCD is a thinned front side illuminated CCD with a single layer AR coating. The table below compares the QE of this CCD to that of the current GEC CCD.

	QE(%)	
Wavelength(A)	GEC	Loral 1K
3000	20	25
3500	19	48
4000	17	65
5000	22	83
6000	35	93
7000	45	91
8000	30	83
9000	14	59
10000	3	10

Unfortunately, on the engineering night the skies where heavily overcast so that it was not possible to obtain measurements of the absolute sensitivity. However, observations of standard stars confirmed that the sensitivity peaks at approximately 6000A, where the QE curve peaks, and that there is significant sensitivity down to the atmospheric cutoff at 3000A. Scaling previous measurements of the system efficiency with the GEC CCD by the above QE numbers, suggests that the peak throughput of the telescope plus spectrograph plus detector combination should approach 18% at 6000A.

Because of the broken bond wire only one of the two on chip amplifiers was operational at the time of the engineering run. Operating this amplifier at a gain of 2e-/ADU the readout noise was ~7.2 e- , similar to that obtained with CTIO's Loral 3K. The readout time was 35 seconds.

An important goal of the engineering run was to measure image quality. The Loral CCD is 1.4 times longer than the GEC device currently in use and has smaller pixels (15 um compared to 22 um). It was thus anticipated that the camera optics might limit the resolution somewhat, especially at the extreme edges of the field. In addition diffusion of photoelectrons within the CCD may blur the images further, a phenomenon seen in other Loral devices. This latter effect is greatest at blue wavelengths since higher energy photons are absorbed closer to the surface of the CCD. While it was found that the camera and/or detector do degrade the images somewhat, the resolution obtained with the Loral, nonetheless, exceeds or is comparable to that obtained with the GEC CCD using a given grating. With a two arcsecond slit (110 um, which projects to 1.5 pixels on the detector) comparison lines near the center of the CCD have ~2.5 pixel FWHM for a wavelength of 4000A and about 2.0 pixels FWHM for a wavelength of 9000A . The images are somewhat poorer in the corners of the detector, but, with this slit width, are everywhere narrower than 3.0 pixels FWHM.

Grating	l/mm	blaze^1 (A)	Dispersion (A)	Coverage (A)
13	150	5000	5.73	6820
11^2	158	8000	5.45	530
09	300	4000	2.87	3410
32	300	6750	2.87	3410
22^2	300	10000	2.87	3410
58	400	8000	2.10	2560
16	527	5500	1.61	1920
26	600	4000	1.44	1705
35	600	6750	1.44	1705

56	600	11000	1.44	1705
47	831	8000	1.02	1220
36^3	1200	7500	0.72	850

(1) Littrow Value: for the actual 1.5-m spectrograph configuration the effective blaze wavelength is 0.89 of the Littrow value.

(2) This grating is silver coated and does not reflect light below ~4000A.

(3) This grating cannot be tilted far enough to be used in second order.

The table above gives the wavelength coverage and dispersion (A/pix) obtained with the various gratings.

One drawback of the Loral CCDs is that they suffer from substantial fringing at red wavelengths. For this device the peak-to-peak fringe amplitude is ~2.5% at 7500A, rising to 10% at 8400A and reaching a peak of 20.6% at 9300A. It subsequently falls, reaching 10% again at 10,200A. We do not yet know how well this fringing is corrected by flat fielding techniques. However, it seems likely that at wavelengths shortward of about 8000A, where the amplitude is below 5%, fringing will be unimportant or easily correctable. Redward of this it will likely be necessary to obtain quartz flats for each object and take great care in flatfielding the data. Even then, observations requiring high S/N at wavelengths near 9300A may not be possible with this CCD.

Updated information on this system will be posted on the CTIO mosaic page, http://ctio.noao.edu, as it becomes available.

Steve Heathcote, Mark Phillips

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0.9-m Mirror Support Improvements (1Sep95)

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0.9-m Mirror Support Improvements (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

The radial support system on the 0.9-m primary mirror has been a source of problems for some time. This hydraulic system required continual maintenance due to leaks and pressure changes (some undoubtedly due to temperature changes). It is likely that this system was responsible for much of the astigmatism seen in this telescope, and possibly some of the focus and pointing problems over the sky.

Gabriel Prez designed a new mechanical system, similar that in use on the 1-m telescope here. It was fabricated by our MACHO-funded machinist, installed in mid-June by J. Briones, Oscar Saa, and G. Perez, and the optical alignment checked by R. Gonzlez and J. Filhaber. Initial results seem encouraging. Alistair Walker reports that three nights in June consistently yielded images better than 1.2" over the sky.

Bob Schommer

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The Photomultiplier Zoo: Single-Channel Photometry at CTIO (1Sep95)

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The Photomultiplier Zoo: Single-Channel Photometry at CTIO (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

Single channel photometry continues to be popular on the small telescopes at CTIO, both for all-sky photometry and for high-speed monitoring of variable stars. There were also runs scheduled on the 1.5-m and 4-m telescopes this semester. However, many of the photomultiplier tubes are aging, and it has been some time since their performances were measured. We therefore arranged to test our best tubes (as selected from a lab testing of all our tubes by Ricardo Gonzalez a year ago) on the telescope, under real observing conditions. These data will not only allow observers to decide which tube is best for their project, it will also give them a useful means of estimating integration times when preparing proposals.

The following relative count rates were measured during two photometric nights in May 1995 on the Lowell 0.6-m telescope. The Landolt #3 UBVRI filter set was used for all tubes. 4-5 Graham E-region standards were measured using each tube. The observed counts were corrected to an airmass of 1.0 using the standard CTIO extinction coefficients and were normalized to a standard magnitude of U=B=V=R=I=10.0 mag. Count rates can be scaled to the 1-m, 1.5-m, and 4-m telescopes by scaling by the ratio of the telescopes' effective mirror areas (2.34, 5.83, and 40.8, respectively). The count rates are expressed in kilocounts per second. The response functions for the most efficient tubes are shown in the accompanying figure.

[Figure not included]

Count Rates at the Lowell 0.6-m for Stars of U=B=V=R=I=10.0 mag

		kcounts/sec					ct/sec	
Coldbox	Tube	U	B	V	R	I	Dark	Comment
48	Varian cell	5.52	5.90	9.84	13.90	14.79	6.2	best throughput
50	Hamamatsu	4.69	6.38	7.52	12.42	6.28	2.5	UBVRI
53K	RCA 31034(KPNO)	4.41	4.36	7.31	10.33	4.34	0.8	UBVRI
58	RCA 31034	3.07	3.16	5.74	8.63	3.86	9.4	UBVRI
63	S-5 EMI 9781A	10.96	11.07	7.98	-	-	1.7	UBV
61	S-5 EMI 9781A	7.18	6.37	3.18	0.28	0.00	1.1	UBV
55	S-20	4.52	4.94	5.41	4.30	0.34	4.1	UBVR
57	S-20	3.12	3.68	3.82	2.75	0.00	1.2	UBV
64	S-4	2.99	2.44	1.67	0.40	0.00	1.2	UBV
69	S-11	1.74	2.84	3.13	0.88	0.00	3.3	UBV

Notes

(1) The Varian cell traditionally has been used only in the red, since it is relatively fragile. Use of this tube at bluer wavelengths is subject to staff approval. Transformations to the standard UBV system have not been tested.

(2) In NOAO Newsletter No.34, page 10, the Hamamatsu tube in coldbox 50 was reported to show hysteresis effects at count rates above 60 kc/s. In May 1995, this tube was retested as follows. Low airmass stars were observed continuously for periods of 10 minutes at the count rates of 59, 66, 75, 110, 160, and 197 kc/s (the maximum count rate is 200 kc/s). At the highest count rates, a slight count rate increase of 0.4% was detected marginally over 10 minutes. Thus, the tube appears to be sufficiently stable for accurate photometry, even at high count rates, at least under the conditions of the present test. Observers are encouraged to perform their own count rate tests to assure themselves on this point.

(3) A new RCA tube was donated graciously from Kitt Peak, after the Mark III photometer was decommissioned (many thanks to Caty Pilachowski, Jim DeVeny, Bill Binkert, and Clark Enterline for their help in transferring this tube to CTIO, where it will remain on long term loan). We designate this tube's coldbox as 53K (note that CTIO already has a coldbox 53). Our tests show that this tube is intermediate in sensitivity between our Hamamatsu (coldbox 50) and our existing RCA (coldbox 58); it thus represents an important addition to our stable of photomultiplier tubes. An abbreviated hysteresis test suggests a decline in count rates by about 0.4% over 10 minutes of continuous observing at count rates of 76 and 189 kc/s. Further tests are planned.

(4) Coldbox 63 (S-5 type) was not tested in this run. Instead, count rates from a science run at the 1-m were scaled to the 0.6-m using the effective area ratios mentioned above. R and I count rates were not measured, but are expected to be low, like those of the S-5 tube in coldbox 61.

Andy Layden, Oscar Saa, Edgardo Cosgrove

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CTIO Computer System News (1Sep95)

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CTIO Computer System News (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

There have been a number of changes related to the CTIO computer system, mostly departures and disappearances, which may affect our users. Firstly, Mario Hamuy, who has been our resident data reduction assistant, IRAF guru, manual writer, and unjammer of stuck tape drives for over eight years, is leaving us at the end of July. Mario's enthusiasm, dedication and friendliness will be familiar to anyone who has used CTIO's computers over this period. There is no doubt that he will be very much missed by all. Mario is going on to study for his PhD in Astronomy at the University of Arizona. We wish him all the best and hope to see him back at CTIO soon---this time as a visiting observer.

Tight budgets, and a shift in the pattern of usage for our computers, means that we will not be replacing Mario. This will affect visitors in a number of ways:

- Visitor account assignments will now be made by Nelson Saavedra and Mauricio Navarrete. The letters informing you of the account assigned and password will continue to be available in reception in La Serena and at the Telops office on Tololo. Those needing advanced notification of their account assignment should send e-mail to irafhelp@ctio.noao.edu. The current account assignments are also posted on the CTIO WWW page.

- Mauricio and Nelson will continue to help visitors on Tololo with general data reduction and computer systems issues.

- During normal office hours, visitors in La Serena can obtain help with computer systems or hardware problems from the La Serena based computer staff. On weekends and during the evenings, more limited help can be obtained via e-mail or telephone from Nelson and Mauricio. In general all requests for help should be sent to the irafhelp e-mail alias. The person most appropriate to deal with your problem will then get in touch with you.

- Visitors are still welcome to use CTIO's computers both in La Serena and on Tololo to reduce their data. However, those who do so must be familiar with IRAF and know how to use the tools it provides to reduce their data. Reduced staffing levels mean that we cannot teach beginners how to use IRAF nor hand-hold them through the data reduction process. Questions about the technicalities and peculiarities of data from CTIO instruments should be addressed, in the first instance, to your staff contact, or the appropriate instrument scientist. You should also contact these people immediately if you think there may be something amiss with your data.

A departure that most users will not even notice is that of our two venerable Vax 11/750's. These machines have been obsolete and virtually unused for years, but were kept running in order to provide a limited level of VMS support. They have, however, become increasingly cantankerous and consume, by modern standards, a prodigious amount of electricity. Their decommissioning leaves us with a much more energy conscious and spacious computer room.

Another victim of streamlining is Sunview, which will disappear from

CTIO's computers over the next few months. In general the tools, such as XGterm and XImtool, available under OpenWindows are as good or better than those for Sunview, and OpenWindows adds new facilities such as Mosaic. In addition the burden of supporting software for multiple windowing systems was an unnecessary extra task for our already overloading computer support group.

As detailed in NOAO Newsletter No. 42, we try to have both DAT and Exabyte tape transports available at each telescope and in La Serena. However, it should be kept in mind that the high failure rate of Exabyte drives means that we cannot guarantee that both drives will be working at any given time. Thus you may have to share drives with users at another telescope. In our experience the DAT drives are much the more reliable of the two. Finally, note that the price CTIO charges for (data quality) Exabyte and DAT tapes has decreased to $17 each. Visitors are welcome to bring their own tapes; however, we urge you to use only data quality tapes.

Steve Heathcote

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Block Scheduling of 1.5-m Telescope (1Sep95)

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Block Scheduling of 1.5-m Telescope (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

In scheduling next semester, we have resumed enforcing a policy that has been "on the books" for over a decade, namely limiting the number of instrument changes on the 1.5-m telescope. Instrument changes represent one of the primary burdens on the mountain staff and can also take significant amounts of scientific staff time. Furthermore, statistics show that the percentage of down time on the first night of an instrument run is higher than on subsequent nights. Since we stopped enforcing the policy, the number of instrument changes on the 1.5-m telescope grew to be equal to the number of changes on the 4-m telescope, and in some semesters even exceeded the number of 4-m changes.

Implementation

What we have done is limit the total number of changes on the 1.5-m telescope during the semester to 15. This corresponds to one change at each quarter moon, plus a couple more for flexibility. When the actual schedule is made up, proposals are scheduled by moving down the Time Allocation Committee's ranking until the 15 changes are used up, at which point only proposals that require no further instrument changes are scheduled. This is done while trying to block-schedule the use of any given instrument.

The main effect of the rules is that little-used instruments tend not to be scheduled, since one needs one better-than-average proposal to create a block of time with a given instrument. On the 1.5-m, these instruments turned out to be ASCAP (single channel photometer), the Bench-Mounted Echelle, and the IR Spectrometer.

Visitor instruments are counted as an instrument change as well, on the same basis as facility instruments. That is, they are neither discriminated against nor given preference.

Implications

If you are applying for time on the 1.5-m, with any instrument, make sure you provide as wide a range of acceptable dates as possible. Also, in the case of conferences, teaching, and social engagements, you should distinguish between dates you cannot observe and dates you prefer not to observe. In the absence of the distinction, the scheduler has to assume that all such dates are unusable, even if this means that you will not get telescope time. If you are requesting time with a less-used instrument, the best strategy is to write a really good proposal. In order to be assured of getting time, you need to be in the top third of the proposals.

Jay Elias, Malcolm Smith

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No Service Observing on the 0.9-m Telescope (1Sep95)

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No Service Observing on the 0.9-m Telescope (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

In the June issue of the NOAO Newsletter, we requested feedback to a proposal to operate the CTIO 0.9-m telescope in a 100% service observing mode. The idea was that blocks of time would continue (as at present) to be assigned to observers in advance. However, instead of the astronomer coming to Tololo to observe in person, the observations would be carried out by a trained observer on the CTIO staff.

Unfortunately, only ten responses to this request were received from the user community. Three of these enthusiastically approved of the proposal, while one was totally against it. The remaining six users felt that limited service observing was a good concept, but that the telescope should not be converted 100% of the time to this mode. The main objections raised had to do with (1) the importance of the 0.9-m telescope in training graduate students to observe, and (2) concern over the quality of the data and science that would result.

In the meantime, pressure on the CTIO budget has continued to mount. Due to a hiring freeze currently in effect, it will not be possible to replace Mario Hamuy, who left CTIO at the end of July. Many of Mario's present duties will have to be transferred to the Observer Support staff, making it more difficult to find the resources to support the proposed service observing. In addition, the CTIO scientific staff have become stretched to the point that, upon closer examination of the work and responsibility implied by full-time service observing, enthusiasm for pursuing such an experiment is low.

These two factors---the apparent lack of interest on the part of users, and the increasing workload that CTIO staff must handle---suggests to us that converting the 0.9-m telescope to 100% service observing would only be justified if the scientific gains are large. While it is the case that service observing would make small allocations of telescope time and certain kinds of synoptic programs feasible, these are relatively modest advantages. Projects such as Gemini have decided to dedicate a significant fraction of telescope time to full-blown queue observing since this would appear to offer considerably greater scientific gains. However, queue observing on the 0.9-m would require significantly more scientific oversight than the proposed service observing, and hence could only be handled by the CTIO scientific staff at the expense of support of the 4-m and 1.5-m telescopes and instrumentation.

Under these circumstances, we have decided not to support either service or queue observing on the 0.9-m telescope for the foreseeable future. However, we would remind users that, for several years now, CTIO has regularly reserved a limited number of nights (up to 5 per semester) for service observing with the 4-m telescope Prime Focus CCD camera. These nights are intended to handle requests for one night or less. If you wish to apply for such time, the procedure is exactly the same as for normal observing time, with the exception that you should clearly specify on the observing form that the request is for service observing with the 4-m PFCCD camera.

Mark Phillips

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CTIO Telescope/Instrument Combinations (1Sep95)

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CTIO Telescope/Instrument Combinations (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)

4-m Telescope:

  ARGUS Fiber-Fed Spectrograph + Blue Air Schmidt Camera + Loral 3K/Reticon CCD
                                                          [40,41,42]
  ARGUS Echelle FF. Spect.     + Blue Air Schmidt Camera + Loral 3K/Reticon CCD
                                                          [40,41,42]
  R-C Spectrograph             + Blue Air Schmidt Camera + Loral 3K/Reticon CCD
                                                          [40,41,42]
        "                      + Folded Schmidt Camera   + Tek 1K CCD [25,26 ]
  Echelle Spectrograph         + Blue Air Schmidt Camera + Loral 3K/Reticon CCD
                                                          [40,41,42]
        "                      + Folded Schmidt          + Tek 1K CCD
                                                          [22,23,25,26 ]
        "                      + Long Cameras            + Tek 2K CCD
                                                          [23,25,26,39 ]
  Prime Focus Camera           + Tek^a CCD [36,39 ]
        "                      + Photographic Plates [23,38,41 ]
                                 (User must supply plates)
  Cass Direct                  + Tek^a CCD [39]
  Rutgers Imaging Fabry-Perot  + Tek^a CCD [25,26,42 ]
  CTIO IR Imager               + 256^2 HgCdTe [40,41]
  CTIO IR Spectrometer         + 256^2 InSb [37,39,41 ]

1.5-m Telescope:

  Cass Spectrograph            + Loral 1200x800 CCD/GEC^a
  Bench-Mounted Echelle Spectrograph   + BME Camera + Tek 2K CCD [22,23,39,42 ]
  Cass Direct                          + Tek^a CCD [39]
  Rutgers Imaging Fabry-Perot          + Tek^a CCD [25,26,42 ]
  ASCAP Photometer [24,25,28,43 ]
  CTIO IR Imager                       + 256^2 HgCdTe [40,41]
  CTIO IR Spectrometer                 + 2562 InSb [37,39,41]

1-m Telescope: ASCAP Photometer [24,25,28,43]

0.9-m Telescope: Cass Direct + Tek 2K CCD [39]

0.6-m Telescope: ASCAP Photometer [24,25,28,43]

Curtis Schmidt: STIS 2K CCD (Direct or Prism)[42]

* Numbers in boldface following an instrument indicate the most recent
Newsletters containing relevant articles. If there is no number, the
1990 edition of the Facilities Manual is fully up to date.  The most
recent general summary of CCD characteristics is in 33; see also 26
and 28.  Information on telescope control guiders is in 21, 22, 24,
32.

^a Tek CCDs available on 4-m and 1.5-m: Arcon-run only: Tek 1K#2, 24 um
pixels, Tek 2K#4, 24 um pixels. [33,34,39].
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Requests for CTIO Telescope Time August 1995 - January 1996 (1Sep95)

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Requests for CTIO Telescope Time August 1995 - January 1996 (1Sep95)
(from CTIO, NOAO Newsletter No. 43, September 1995)
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Telescope	Nights Req.	Nights Sched.	Reqd./ Sched.	#Vistr. Nights	%Vistr. Nights	#Staff Nights	%Staff Nights	#Eng. & Maint.
4-m Dark	234	98	2.3	81	82	17	17	5
Bright	181	62	2.9	51	82	11	11	16
1.5-m Dark	153	101	1.5	95	94	6	5	3
Bright	215	66	3.2	62	93	4	6	9
1-m Dark	24	83	0.2	74	89	9	10	-
Bright	91	24	3.7	12	50	12	50	2
0.9-m Dark	138	98	1.4	98	100	-	-	1
Bright	77	59	1.3	59	100	-	-	6
Schmidt	155	128	1.2	120	93	8	6	4

Note: Some bright time proposals on 1.5-m and 1-m were scheduled as dark time; combined requests/scheduled ratios are 2.2 and 0.9 respectively.

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KPNO Operations (1Sep95)

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KPNO Operations (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

KPNO, like all of the sites of NOAO, is being forced to change the way in which it operates in order to reduce costs. Some proposed changes have been described in earlier Newsletters. I would like to update you on how we plan to implement these changes. To the extent possible we have tried to minimize the impact on observers, and I would appreciate your input on these changes as well as suggestions for how to achieve additional cost savings. The following guidelines will apply to both the current fall semester and to the spring semester for which applications are due by 2 October.

The most important addition to the suite of KPNO telescopes in 20 years is now on line. The WIYN continues to deliver superb images. The imager was the first instrument to be used for science, and Hydra should be up and running by September. The NOAO share of the time will be scheduled in queue mode. This will be a learning experience for us and for the community. Dave Silva and his team will work closely with scheduled observers to evaluate the quality of data obtained in this new observing mode, and it is likely that many of the procedures adopted initially will be modified as the semester progresses.

During the upcoming semester, we will implement some software changes and install a new guider at the 2.1-m telescope. The goal of these modifications is to make it possible for the astronomer to operate the telescope, including slewing it to new positions. When these changes are made, the positions of 2.1-m operator and roving observing technician (OT) for the small telescopes will be combined. The person on duty will be stationed at the 2.1-m and will assist the observer there except when there are callouts at the smaller telescopes. The operator will then go to assist other observers, leaving the astronomer at the 2.1-m to operate the telescope. Since astronomers will be expected to be able to handle the entire operation of the telescope, it is advisable to bring two observers for each run. If that is not possible, we will permit a single observer, but efficiency is likely to be reduced. In cases where problems occur simultaneously at more than one telescope, we will use an aperture priority system to determine who gets assistance first, with the 2.1-m having priority. KPNO staff will be available to open and close the 2.1-m.

The 2.1-m will have priority when the operator/OT is required to open and close the 2.1-m facility; to rotate GoldCam or other instruments; and to perform any necessary operations that visiting astronomers are not permitted to carry out. Training in how to slew the 2.1-m and acquire guide stars will be provided to visiting astronomers.

The OT stationed at the 2.1-m will have prime responsibility for the safe operation of the main part of the mountain (e.g., opening/closing in response to changing weather conditions). Should there be any circumstances when this person is scheduled to assist at the other telescopes (e.g., for service observing), the WIYN Operator will take on this responsibility.

Users of the small telescopes are not required to be experienced observers. That is, there are no "authorized" observers for the small telescopes. Rather we will implement a program of "appropriate" starts by matching the level of start-up support to the experience of the observer and the complexity of the proposed observations. If the observer is experienced with a particular instrument and observing program, we will only check out the instrument and telescope configuration in the afternoon. If the observer is new to Kitt Peak or to a telescope/instrument combination, we will provide a full start-up, which includes detailed instruction on the use of the instrument and assistance with observations during the early part of the first night. Between these two extremes, we will work with the astronomer to provide the degree of start-up assistance that will enable him or her to observe effectively. The staff contact will discuss the appropriate level of start-up support with the astronomer before he or she comes to the mountain. We will expect all visitors to be thoroughly familiar with the manuals, and first time users are encouraged to come a day early to watch the previous observer, provided the same instrumentation is on the telescope. We will not, however, expect visiting astronomers to train observers. If you wish to come a day early, let us know and we will make arrangements.

Recently we have not had a (TA) on duty until 10:00 AM. In the future, the daytime TA will start work at 8:00 AM in order to improve coordination of response to telescope and instrument problems and failures from the night before; to make morning rounds of the domes (e.g., to fill the dewars); to provide general instrument support; and to assist with instrument changes. A TA will not normally be on duty Monday-Thursday from 4:00 PM to sunset; response to telescope problems during this time will be provided by Mountain Electronics (they are only a telephone call away). Technical assistance from the TAs will be available Fridays from 8:00 AM to 10:30 PM and on the weekend from 9:30 AM to 10:30 PM.

We have decided not to implement the policy of asking visiting astronomers to carry out service observations. The only exceptions will be targets of opportunity, such as a supernova explosion or a gamma ray burst, where astronomers have been traditionally very willing to help out. Consistent with this policy, we have not extended the minimum run lengths on any of the telescopes.

The 1.3-m telescope remains out of service. We are currently exploring the feasibility of using the mount as a telescope simulator. All major instrumentation that is built by NOAO for CTIO and Gemini must be fully commissioned before it is sent overseas. We wish to minimize the amount of telescope time that is devoted to commissioning in order to continue to provide as much community access as possible. These requirements can be met by constructing a simulator that will allow us to test instruments in a variety of orientations and under realistic operational conditions. The 1.3-m mount appears to offer a good solution.

As we begin to commission instruments on KPNO prior to shipment, we will work out new methods of scheduling and obtaining data so that the community can make effective use of capabilities that will be available for only relatively short periods of time. I can understand astronomers' reluctance to learn how to use an instrument that will be moving to another observatory and conceivably another hemisphere after 6 months or less at KPNO, and yet you can help us with the evaluation of scientific performance. More use of service observing by the staff and shared risk observing may be the answer. The DLIRIM experiment will be a valuable test of this approach.

I am well aware that the highest priority for the KPNO user community is access to telescopes. I wish I could promise you that all existing telescopes and instruments would remain in service as long as there is demand for them. However, given the uncertainty of the funding situation in Washington, no one would believe me even if I did promise that. What I can promise is that we are committed to maintaining access to facilities on KPNO, to sustaining scientific throughput as measured by the number of completed programs and published papers, and to completing ongoing programs before any facilities or instruments are retired. Any proposed restructuring or changes in operating procedures will be evaluated according to these guidelines, and users will be given a chance to provide input.

Sidney C. Wolff

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WIYN Progress Continues (1Sep95)

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WIYN Progress Continues (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

The WIYN Project achieved a major milestone on 15 July with the commencement of official science operations. The first three night block was devoted to the NOAO WIYN queue observing program, with Di Harmer as the WIYN Queue Observer. This was immediately followed by the first University block, a five night run for Bob Zinn and Sidney Barnes (Yale University). Although these runs were hampered by monsoon conditions typical of mid-summer in Tucson, all involved were very happy to finally make this transition. Early observers have been constrained to using the Imager, but as discussed below, MOS/Hydra is expected to be released for shared risk observations in mid-August.

The telescope continues to deliver excellent images with the median Delivered Image Quality since June 1994 being 0.9" FWHM for the standard, benchmark 10-15 s R-band exposures. We have confirmed that under median seeing conditions, closed-loop guiding does not degrade the benchmark DIQ, and we achieve 0.7"-0.8" FWHM for long (15-20 min) exposures routinely. The biggest component of DIQ degradation remains rapid thermal contraction of the telescope, but by early September a closed-loop system for measuring telescope temperature and adjusting the telescope focus should be in place.

We did experience a period of exceptional seeing in June. For five nights, the DIQ was 0.5"-0.6" FWHM with periods of 0.4" FWHM seeing. Purely by coincidence, a CCD with 15mm (0.15") pixels was being checked out at WIYN during this period, so we were still able to sample the PSF under these conditions. As noted in previous reports, the WIYN DIQ is mostly tracking atmospheric seeing when the active optics systems are working nominally. Thus, this period in June was a time of very stable atmospheric conditions.

We continue gradually to improve telescope pointing. After improving the mechanical mounting of our azimuth encoders and fine-tuning our pointing model, the current "raw" all-sky telescope pointing accuracy is roughly 10" RMS. This is comparable to the current Mayall 4-m performance but much larger than the original goal of 2" RMS all-sky, as well as being larger than that of other modern telescopes (e.g., ARC which reports 2"-3" RMS all-sky pointing accuracy). Modeling of recent pointing data suggests that pointing accuracy of 6"-8" RMS all-sky may be achievable by further fine-tuning of the pointing model. Pushing below that range seems unlikely with the current friction encoders, which appear to drift mechanically with time. Possible replacement encoder systems are currently being investigated.

We are also making progress in reducing telescope windshake. Test analog circuitry, which implements velocity and acceleration feedback into the elevation axis servo control system, has been installed and tuned. Comparison between encoder feedback errors and image motion errors shows that under windy conditions these errors are now following each other much more closely than in the past; i.e., motions in the image plane correspond in time and direction to position errors detected by the encoders. Image plane errors are still larger in magnitude than encoder errors but nonetheless smaller than they were under the baseline servo system. These results are encouraging, but more development and testing are required. This effort will be pursued during regularly scheduled T&E blocks this fall.

We have deferred further investigation of the telescope "breakaway" problem at wind gusts above 20 m/s until later this year. In practice, this problem does not significantly affect observing efficiency since even on windy nights, normal operations are possible by closing the dome vents and pointing more than 30o out of the wind. In contrast, the installation of the closed-loop telescope temperature/focus correction system has higher priority, since that currently affects every observation every night.

The Imager continues to perform well. Our Ha filters are scheduled for delivery in mid-August. Software for automating focus sequences should be installed by mid-September. An Arcon-IRAF User's Guide will be available as a Web page soon (see the WIYN Observatory link on the NOAO homepage at http://www.noao.edu).

MOS/Hydra is scheduled to be released for shared risk operations on 18 August. For the release to happen on schedule, the Hydra commissioning team must accomplish three major tasks: achieve the specified fiber positioning accuracy of 0.2" RMS, release revised user documentation, and verify that the final version of the released software is robust and debugged. To facilitate the completion of these tasks, NOAO is allocating some of its July and August observing time to MOS/Hydra commissioning. Hydra commissioning will also be top priority during the normal WIYN T&E block in early August.

The Instrument Adaptor Subsystem (IAS) achieved two major milestones since the last report: internal wiring was completed and the low-level control system code was implemented successfully in the lab. The IAS is scheduled to be shipped to WIYN in early August. Specifications for the mid-level and high-level control system interfaces have been completed and approved. Implementation of these interfaces should begin in late August. We hope to start night-time IAS commissioning in early October.

Current control system activity is focused on cleaning up the various control system software interfaces and procedural documentation. This has delayed the implementation of the IAS interfaces and the closed-loop telescope temperature/focus compensation but will result in more efficient and robust telescope operations as well as easier maintenance. As part of this effort, we are verifying that the entire software system can be easily compiled and that it is all under version control.

Although Science Operations have officially begun, further telescope and instrument performance tuning is still desirable and will likely continue for at least a year. To facilitate these activities, during the first year of Operations, the WIYN Project will be taking seven nights each month centered on full moon for "testing and engineering" (T&E). Activities during the first few T&E runs will include further pointing and servo performance testing, Hydra commissioning, control system upgrades and maintenance, and IAS commissioning. The next Project report should highlight early IAS commissioning progress as well as the first three months of science operations.

Dave Silva

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Summer Shutdown Activities on Kitt Peak (1Sep95)

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Summer Shutdown Activities on Kitt Peak (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

As the monsoon flow from the south (traditionally between the Fourth of July and Labor Day) closes the domes on Kitt Peak, we are hard at work on many large-scale engineering and maintenance projects that cannot be done while we are in regular operation. Here are the major improvement projects and some of the maintenance work that you should look for when you next come to observe at KPNO:

Mayall 4-m: The big news on the mountain is the installation of the mirror cooling system. We will have the mechanical components in place, characterized and under manual operation by the end of shutdown; a semi- automatic control system will come later. The declination brake and the hour angle dampening springs---both of which have been causing numerous drive trips---will be repaired. New software and diagnostics will be added to the R-C Spectrograph control. Annual maintenance and necessary repairs will be carried out on the Cassegrain guider, the Prime Focus guider, rotator, scan table and filter wheel, and the Echelle and RC Spectrographs. A new UPS will replace a decade-old RUPS, which could not be economically refurbished; the new UPS will allow substantial energy savings.

2.1-m: The Telescope Control System is being re-engineered to permit operation by the astronomer. Beyond significant changes to the Graphical User Interface (and some work on the underlying TCS software), the most evident improvement will be to replace the IDT with an ILS guide camera to ease the acquisition of guide stars, a system which has been proved simple and effective for astronomers at the 0.9-m. The primary mirror will be aluminized. The bellows in the primary support system will be serviced and replaced as necessary. The Cassegrain guider will be cleaned, lubricated and adjusted. Optical surfaces in GoldCam will be recoated.

0.9-m: The ancient LSI 11/44 for the FORTH TCP will be replaced with an (equally venerable) 11/73 for better system reliability and sparing. The Cassegrain guider and filter wheel will be cleaned, lubricated and adjusted.

Coude Feed: Work is proceeding to understand why the telescope does not point well in the eastern half of the sky. We now find that the overall pointing is not what it once was; the underlying symptom has the appearance of backlash.

Burrell Schmidt: A new lead screw in the CCD focus mechanism will be installed to improve focusing.

CCD Dewars: All of the dewars will be sent to town to be cleaned and evacuated. The CCDs will be flooded to improve ultraviolet sensitivity and the overall quantuum efficiency will be evaluated. Default detector gains will be set to optimize performance over a range of astronomical requirements.

Night-time Dorm 1: Carpets will be installed in all of the rooms. The smoke alarms will be replaced with heat detectors so that an alarm does not go off when one is taking a shower. Electric heaters will be cleaned, lubricated and the grill work fastened down to minimize vibration. Noisy fans in the bathrooms will be replaced.

Bruce Bohannan (for a cast of many)

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Electronic Proposal Submission - The Latest Scoop (1Sep95)

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Electronic Proposal Submission - The Latest Scoop (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

As usual, we are encouraging all proposals for the upcoming semester to be submitted electronically, although (unlike HST) we are not actually requiring this. Last semester 77% of the proposals we received were sent via e-mail, and most users seemed to find this fun and convenient. On this end, we've encountered few problems, with the largest time waster being fixing the handful of proposals which were apparently never run through LaTeX and printed at the user's end. (We do not guarantee to do this in the future, so make sure the proposal looks the way you want the TAC to see it before submitting it!)

Note: For the next time only, the deadline for all electronic or paper proposal submissions is 5:00 pm MST, Monday, 2 October 1995 (since 30 September falls on a Saturday).

To submit an observing proposal here's all you have to do:

(1) Obtain the observing proposal package by e-mailing kpnoprop-request@noao.edu. You will have to fill out the LaTeX observing proposal template. Alternatively, these forms are available via anonymous ftp to ftp.noao.edu in the subdirectory kpno/kpnoforms/. You can similarly obtain the files via the World Wide Web. (The NOAO home page is http://www.noao.edu).

(2) Fill out the LaTeX observing proposal template with a scientifically exciting, well-reasoned, and clear program. Include whatever figures are needed to make your case in the form of Encapsulated PostScript files. (See the example provided as part of the package.)

(3) If you are applying for WIYN time you will also need to fill out the queue-observing form which specifies all the parameters necessary to carry out the observations (analogous to HST's Phase II proposal). Refer to the accompanying Newsletter article on this subject.

(4) Submit the observing form to kpnoprop-submit@noao.edu. You should immediately receive an acknowledgement message telling you what your proposal ID is. (If you don't, send e-mail to kpnoprop-help@noao.edu or give Judy Prosser a call at (520) 318-8279.) Included will be instructions for submitting the figures and/or queue observing form.

(5) Submit the figures and/or WIYN queue form following the instructions received in the acknowledgement. You should also receive acknowledgements for each of these.

(6) In the case of thesis students, the advisor should send the "thesis letter" via e-mail (also to kpnoprop-submit@noao.edu) explaining how the present proposal fits into the overall scheme of the thesis, what other observing time might be required, and so on. It would help if the proposal number given in the acknowledgement message above were mentioned.

Electronic submission of observing proposals has made our lives easier as well as making it easier for observers to submit their requests, and we encourage everyone to submit their proposals in this way. Questions or suggestions for improving the process can be directed to kpnoprop-help@noao.edu, or to the undersigned (pmassey@noao.edu).

Phil Massey, Jeannette Barnes,
David Bell, Pat Patterson, Judy Prosser

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WIYN Queue Program: Spring 1995 Outcome (1Sep95)

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WIYN Queue Program: Spring 1995 Outcome (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

Our thanks to all Kitt Peak proposers who were awarded "shared risk" WIYN queue observing time for the spring 1995 observing semester. Alas, the commencement of WIYN science operations, and especially MOS/Hydra operations, slipped to a much later date than we had anticipated in July 1994 when we decided to solicit WIYN proposals for the first time. By the time WIYN observing did start, the monsoons essentially wiped out the rest of the "spring" semester.

We recognize that many of you put a significant amount of time and energy into your proposals and we truly regret that we were unable to initiate, let alone complete, any of your programs. We appreciate your patience and all the useful input we have received from you over the last year. We look forward to working with all of you in the future, especially proposers who were allocated time in the fall 1995 WIYN queue.

Dave Silva

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WIYN Queue Program: Fall 1995 Progress Report (1Sep95)

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WIYN Queue Program: Fall 1995 Progress Report (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

By now, any proposer who was granted time in the WIYN queue program for the fall 1995 semester should have received information about the status of their program as well as miscellaneous updated information about the WIYN queue program via e-mail. If you have not received such e-mail, please contact us as soon as possible at wiynq@noao.edu.

Please note that wiynq-info@noao.edu can be used to request information about the WIYN queue program, including how to apply for time. If you have further questions, please direct them to wiynq@noao.edu. This e-mail account is monitored by Dave Silva and Di Harmer, the current WIYN Queue Scientist and Queue Observer, respectively.

The fall 1995 queue was initiated in mid-August after the deadline for this Newsletter. A real queue progress report will be published in the December 1995 NOAO Newsletter. We hope to make information about fall 1995 WIYN queue progress available on the Web as the semester progresses. Please start at the NOAO Web homepage (http://www.noao.edu) and follow the link there to the WIYN Observatory homepage for WIYN Queue Program information.

Dave Silva

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WIYN Queue Program: Proposing for Spring 1996 (1Sep95)

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WIYN Queue Program: Proposing for Spring 1996 (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

Please note that there is a revised WIYN queue observing program form for spring 1996 proposals. All proposals for the spring 1996 WIYN queue must use this revised form. The revised form is distributed as part of the normal KPNO proposal form distribution and can be retrieved automatically by sending e-mail to kpnoprop-info@noao.edu.

We will contine to offer the Short Program ("2-hr") queue program during the spring 1996 semester. The goal of a typical Short Program might be to obtain a small dataset to complete a larger project, or to assess the feasibility of a particular type of observation before the submission of a full-blown observing proposal.

A maximum of two hours of WIYN time can be requested per proposal. If your program is simple, we will absorb the standard observing overhead (e.g., CCD read-down times, target acquisition times, etc.) However, if your program is more complicated, the following new rules apply:

(1)   If you are requesting more than three (3) program exposures, you must subtract two (2) minutes for every requested exposure when trying to fit your program within the two hour limit. This overhead charge

compensates for the CCD read-down time. For example, if you are requesting six program exposures, your allowed total on-target exposure time is reduced by 12 minutes.

(2) If you are requesting more than two (2) different targets, you must subtract five (5) minutes for every requested target. This overhead charge compensates for the target acquisition time. For example, if you request four target fields, your allowed total on-target exposure time is reduced by 20 minutes.

(3) If you are requesting more than one (1) Hydra fiber configuration, you must subtract 30 minutes for each additional configuration. For example, if you request two configurations, your allowed total on-target exposure time is reduced by 30 minutes.

(4) We will continue to absorb the calibration and focussing overhead for now.

These revised rules apply per proposal. Investigators are still allowed to submit up to three (3) 2-hr queue proposals. Further information about the WIYN Queue Program as well as proposal forms can be requested by sending e-mail to kpnoprop-request@noao.edu.

Dave Silva

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KPNO Alternate Observing Modes Update (1Sep95)

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KPNO Alternate Observing Modes Update (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

In the June 1995 NOAO Newsletter we announced two new alternate observing modes that would be offered to Kitt Peak observers at the 4-m, 2.1-m, and 0.9-m telescopes beginning with the fall 1995 semester. These two modes are an automatic ftp queue for those observing programs that require quick transport of data back to the home institution, and a remote observing station that seeks to duplicate the KPNO observing environment as far as possible on a computer at your institution.

We invite and encourage the community to participate in this experiment. While bandwidth is always a constraint on the Internet, you may find it to be less of a constraint in practice than one might think. Note, in addition, that the remote observing station is available as an option not just for your research colleagues, but for your students as well.

Since the deadline for the previous article, we have performed additional extensive software tests, and our plans have evolved for offering digital audio and video through the Internet for the remote observing station. Audio and video connections will be provided through the Internet MBONE clients "nv" and "vat" in point-to-point mode. Other clients have been tested, and we judge these two to be the most robust and fully featured of those available. A minimal remote setup will include an audio connection via a microphone, the built-in speaker in your workstation, and the nv and vat software. An Internet connection is required. NOAO will provide a tar file containing the files needed to configure your observing account, but we cannot guarantee support for all computer platforms.

If your observing proposal has been scheduled for the fall semester, you will have received the yellow Alternate Observing Mode form, which must be filled out in advance of your run. Please contact Rob Seaman at (520) 318-8248 or seaman@noao.edu with any questions or with suggestions for other new observing services.

Rob Seaman, Bruce Bohannan

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Observing Run Preparation Form - A Reminder (1Sep95)

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Observing Run Preparation Form - A Reminder (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

With the new fall observing semester starting up, the Kitt Peak Support Office would like to remind observers to send in their KPNO Observing Run Preparation form (the pink sheet) at least six weeks before the start of each observing run. Be sure to include the Alternate Observing Mode form (the yellow sheet) also, if applicable. Both forms can be faxed to Judy Prosser at (520) 318-8360.

The ORP form continues to be an important communication tool for your observing run. The ORP contains most of the vital information needed to prepare for your observing run to ensure the success of your observing. As soon as this form is received, it is distributed to the support staff involved with your run, and reservations for mountain accommodations are made for observers listed on the form. Shuttle and hotel reservations can be requested on this form. An e-mail from KPS will be sent to you confirming hotel reservations.

And be sure to stop in the Kitt Peak Support Office when you arrive in Tucson. As the coordinating office for your observing run, we may be holding mail or messages for you.

Any questions? For answers, send e-mail to: kpno@noao.edu.

Pat Patterson

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Current TAC Membership (1Sep95)

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Current TAC Membership (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

The membership of the KPNO telescope Time Allocation Committees for the spring 1996 semester is given below.

Bright TAC

Dave De Young (Chair, non-voting)
Chris Impey (Arizona)
Scott Kenyon (CfA)
Pat McCarthy (OCIW)
Ian Gatley (KPNO)
Caty Garmany (JILA)
Michael Bolte (Lick /UCO)

Dark TAC

Dave De Young (Chair, non-voting)
Tim Heckman (JHU)
Tod Lauer (KPNO)
Heather Morrison (CWRU)

Mario Mateo (Michigan)
Craig Sarazin (Virginia)
John Stocke (Colorado)

David De Young

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CCDPhot - The KPNO CCD Photometer (1Sep95)

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CCDPhot - The KPNO CCD Photometer (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

The KPNO 0.9-m telescope is used most often for wide-field imaging (23' field of view) with T2KA, a Tektronix 2048 x 2048 thinned CCD. The optional 2 element corrector provides an extremely uniform point-spread function across this field, so this telescope has applications for crowded field photometry (e.g., in globular clusters) as well as for studies of large, low surface brightness objects (e.g., galaxy halos, galaxy clusters).

The telescope has one alternative instrument capability---CCDPhot. The CCDPhot system is a CCD-based photometer intended to replace the Mark III photoelectric photometer that has, until recently, been available on the 1.3-m telescope. CCDPhot consists of a thinned back-side-illuminated Tektronix CCD (designated T5HA) with 512 x 512 27um pixels producing an image scale of 0.77"/pixel and a field of view of 6.6' x 6.6' at the f/7.5 focus of the 0.9-m. The CCDPhot software is an IRAF program designed to do multi-aperture, multi-filter stellar photometry in real time. It performs all of the functions of a conventional photoelectric photometer, using a CCD in place of the photomultiplier, and software apertures in place of the aperture wheel.

The CCD is read with a fast microcode, which when combined with a user defined subregion (say, 128 x 128 pixels) where the program stars are measured, results in a readout time of only a few seconds. CCDPhot then subtracts the DC offset using the overscan region, subtracts a user-derived bias frame, and divides the resultant image by a user-derived flatfield exposure for the appropriate filter. CCDPhot then reports an instrumental magnitude in each user-defined aperture, subtracts the sky contribution, and writes the result into a text file. In addition, CCDPhot has an option to save the CCD images to disk for further analysis. The entire process, including the CCD readout, image processing, and photometric measurement, requires approximately 10 seconds to complete. The observer takes home only the text file containing all of the relevant information needed to convert the instrumental magnitudes to standard ones.

In the case of BVRI photometry, we achieve photometric precision of 1% or better using simple linear color transformation terms for stars over a B-V color range of 2 magnitudes. In the U band, however, a linear color term yields a precision of only about 4% over a U-B color range of 3 magnitudes. Some observers report obtaining much better precision by restricting observations to a narrow color range, or by using higher order color terms and more standards.

If you are primarily interested in high precision photometry of individual stars, CCDPhot has a number of advantages over direct imaging on the 0.9-m telescope. First, the full-well capacity of the T5HA CCD is approximately 2.5 times greater than that of T2KA, allowing the CCDPhot system to measure brighter stars than possible with direct imaging. Secondly, the smaller CCD used with CCDPhot and the smaller shutter mean that no shutter timing correction is needed for exposure times as small as one second. Lastly and most importantly, in the case of single star photometry, CCDPhot combines short readout times with near real-time image processing and photometric measurement to significantly enhance observing efficiency.

Those interested in reading about results obtained with CCDPhot should refer to the paper by Sarajedini and Milone (1995, AJ, 109, 269). Any questions about the CCDPhot system should be directed to Ata Sarajedini (ata@noao.edu).

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

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NICMASS at the Feed - Update (1Sep95)

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NICMASS at the Feed - Update (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

The NICMASS HgCdTe system, described in the NOAO Newsletter No. 41 (March 1995), has been used successfully for a number of observing runs at the Coude Feed Spectrograph during the last semester. As we reported in the article, the performance of the system is limited largely by photon noise from infrared background within (and outside of) the bandpass of the blocking filters. We determined empirically since then that significant background was due to scattered light completely bypassing the blocking filter.

This last source of background has been virtually eliminated by mechanical baffling and modifications to the filter mounting fixture. In addition, we installed a well-blocked filter at 1.624um, particularly for use with the echelle grating, where a narrow blocking filter is required for order separation. This resulted in a substantial reduction in background, from 180 to 20 e-/s, the latter value being close to that expected from the ambient thermal background through the filter. Integration times up to 6000 s are now possible. The figure illustrates the spectrum of the late-type star AS 289 (H = 5.5) after 1 hour of integration; the estimated S/N~ 100 represents an improvement of a factor of 5 over the performance reported in the previous Newsletter article.

The CO lines in this bandpass are a useful grid for radial velocity measurements of late-type stars with this instrument configuration. A preliminary analysis by Frank Fekel (Tenn. State) of a number of such stars indicates night-to-night scatter in determined radial velocities to be less than 0.3 km/s.

[Figure not included]

Spectrum of the late-type star AS 289 (H = 5.5) using the echelle grating at a resolving power of 43000. This is the average of two 1800 sec integrations. The spectrum of the bright radial velocity standard HR 6056 is plotted at the same scale to illustrate the high S/N of the spectra.

We are in the process of purchasing a well-blocked filter at 1.0830um to replace the present filter, which appears to suffer significant extraband leakage. This should improve the performance of the system at that wavelength region with both the echelle and grating B, since the ambient thermal background should be negligible. We expect to evaluate this filter during the next scheduled observing in October and will report the results in the next Newsletter.

We will continue to offer this system for shared-risk observing at the Coude Feed Spectrograph during the spring 1996 semester. Prospective observers should familiarize themselves with the system and its operation by reference to the description on the World Wide Web at http://scruffy.phast.umass.edu/Irlab/NICMASS/nicuser.html, or by contacting the undersigned (rjoyce@noao.edu; khinkle@noao.edu) for information regarding a specific application.

Dick Joyce, Ken Hinkle

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Throughput Exposure Guide to the R-C Spectrograph (1Sep95)

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Throughput Exposure Guide to the R-C Spectrograph (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

The R-C spectrograph has been the workhorse for the Mayall 4-m telescope for 20 years. The spectrograph currently has two observing modes: the UV-fast camera using the T2KB CCD and the Cryogenic Camera with its Loral CCD. Using the first mode any of 12 gratings can be used, providing spectral resolutions from 300-9000. Complete details can be found in the R-C spectrograph manual, available via anonymous ftp in the kpno/manuals subdirectory as "rcspx.ps." Available apertures include long slits or multi-slit masks that allow the spectra of approximately a dozen objects (within a 5' field) to be observed at the same time. The Cryogenic camera mode offers higher throughput, but lower resolution (150-600). Again, either a long slit or multi-slit mask may be used.

[Figure not included]

We are in the process of combining our spectroscopic manuals for the R-C spectrograph and the GoldCam spectrograph at the 2.1-m. As part of that process, we have begun updating our measurements of the throughput of these instruments, measured under real observing conditions. We have been utilizing the beginning of "check-out" and "T&E" nights for this purpose, and although we are still obtaining data for all of the setups of the R-C, we thought it might be helpful to prospective observers to see at least some of the data prior to our final report.We present in the accompanying figure the data for two of the setups of the R-C.

Our observing procedure has been to observe a spectrophotometric standard both with a typical (2") observing slit and with a 6" slit. The latter allows us to determine the overall efficiency of the system under the limit of "perfect seeing"; the former gives us a measure of what is likely to be achieved during typical observations. We show the data for two of the gratings in the accompanying figure. We have normalized the counts to that of a m_v = 10 mag star observed at an airmass of 1.0. Using grating 181 in first order (with a GG455 blocking filter) we obtain a peak of 800 e-/s A at 10th mag; scaling to other magnitudes is straightforward. (At 18th mag we would expect about 0.5 e-/s A.) The actual spectral resolution of this grating is 7.2A (2.8A/pixel), so for an 18th mag object and an hour-long exposure we would expect to achieve 1800 e-//A 5000 e-/pixel, or 13500 e- per spectral resolution element. If sky-noise and read-noise were inconsequential (as they would be in this example), this would correspond to signal-to-noise ratios of 40 per A, 70 per pixel, or 115 per spectral resolution element. (We acknowledge Craig Foltz's MMT spectrograph manual, which gave us the idea for presenting the count rates in astronomer-friendly units!)

While the primary of the Mayall telescope is always called "4-m," like all large telescopes the actual collecting area is somewhat smaller due to several factors: the outer edge of the primary is masked, and there is a large central obscuration due to the prime focus cage/secondary mirror supports. As a result the 4-m has an effective collecting area of an unobstructed 3.42-m telescope. Using the UV Camera, we are detecting 8-9% of the photons incident on the telescope's primary with a 2" slit, and 11-16% with a wide-open slit. Using the Cryogenic camera, grism #770, and a wide-open slit, approximately 20% of the incident photons are detected. When the primary mirror cooling system comes on-line this semester, we expect the improved image quality to increase the total throughput when using typical observing slits. For the latest available information on any of our low-to-moderate resolution spectrographs feel free to contact any of the undersigned.

Daryl Willmarth, Jim De Veny,
Buell Jannuzi, Phil Massey

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What Time is it on the Mountain? (1Sep95)

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What Time is it on the Mountain? (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

Every FITS header produced at KPNO has lines like the following:

```
DATE-OBS = '26/06/95 ' / UT date (dd/mm/yy) of observation
UT = '10:57:13.00' / universal time (start of exposure)
```

How are these values generated and how accurate are they?

The main timebase for the mountain is a WWV receiver that sends coded information on coax cables strung to each dome. These coax cables drive the familiar red digital displays in each dome and also drive a CAMAC or VME module, which is connected to the telescope control computer and electronics. Thus, from the point of view of the data taking systems running on the Sun computers, the telescope control computers can be asked for the UT time just as they can be asked for the telescope position. The precision of the UT values reported by the telescope computers is 1 second, although the accuracy of these values should be substantially better than that. However, the communication between the data-taking Suns and the telescope computers takes place over a serial connection that adds significant latency.

The Sun data acquisition computers also have clocks. Currently, these clocks are synchronized once a day to a standard Sun but otherwise run free. The magnitude of these daily corrections has been measured to be less than 5 seconds. Since, under most circumstances, the duration of the CCD exposures taken with ICE depends on the accuracy of the Sun clock, we make sure that these clock "updates" take place during the daylight hours!

When a CCD exposure is started with ICE, a great deal of activity takes place including---in order---preparing the FITS headers (including telescope position), preallocation of a disk file to store the image, asking the telescope control computer for the UT, "preparing" the CCD and, finally, opening the shutter. Thus the UT recorded in the FITS header represents the time that CCD target preparation begins, which is several seconds prior to the time the shutter opens (the preparation time differs for each chip configuration---including gain and formatting). Until March 1995, the UT recorded by ICE represented the time prior to preallocating the disk file; this could, under extreme circumstances, precede the time the shutter opened by as much as 30 seconds (although 5-10 seconds was more typical).

IR array exposures taken with WILDFIRE follow a similar sequence of events. In this case, the last thing done before beginning a series of exposures is to ask the Sun for the UT. However, due to the distributed nature of the WILDFIRE controller, data taking does not commence until 1-2 seconds after the sequence of exposures is initiated.

In summary, the UT time as reported in the FITS headers of KPNO CCD and IR array images precedes the initiation of data taking by "several" seconds. Fortunately, this time difference should be repeatable to about 1 second.

We are changing things, however, with a goal of providing in the FITS header an accurate value for the UT that is as close as technically possible to the beginning of data acquisition. I speculate that for CCD images taken with ICE, we can reduce the difference between the real UT of the beginning of data acquisition and the time listed in the FITS header to be less than 0.1 second.

During the summer shutdown, all the Suns on the mountain have been changed to use a clock synchronization system called NTP (Network Time Protocol). NTP, the brainchild of David Mills of the University of

Delaware, enables the clocks on a Sun to be synchronized to UT with an accuracy of better than 0.1 second through comparisons with accurate clocks accessed over the Internet. A first order correction for clock drift is calculated for each Sun's clock so even if the mountain link to the Internet should go down for a while, the Suns should still be able to keep acceptably good time. Monotonically increasing time is also guaranteed. Thus the Suns' clocks should be an adequate timebase.

Changes to ICE are also contemplated to grab the UT value from the Sun as opposed to the telescope computer (to bypass the latency of the serial connection and to take advantage of a higher precision clock), and to move the step of grabbing the UT value from before to after the CCD preparation step.

Steve Grandi

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All You Need to Know About Kitt Peak (1Sep95)

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All You Need to Know About Kitt Peak (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

The KPNO staff have prepared a brochure describing the scientific capabilities and instrumentation available on Kitt Peak, the process for obtaining telescope time, special programs, and how to obtain further information about our facilities and programs over the World Wide Web. The brochure was distributed at the AAS meeting in Pittsburgh and is also available by sending e-mail to kpno@noao.edu to request a copy. We plan to have the brochure itself available soon via the World Wide Web.

Caty Pilachowski

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KPNO Summer Students 1995 (1Sep95)

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KPNO Summer Students 1995 (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

KPNO is pleased again to host our five Summer Students, funded through the National Science Foundation's Research Experience for Undergraduates Program. The students are working with staff members on individual research projects as well as participating in a student observing program organized by Nigel Sharp at the Burrell Schmidt telescope.

Seth Green, a Senior at Hiram College, is working with Nalin Samarasinha and Beatrice Muller studying possible rotation rates of comet P/Halley by comparison of computed images of the comet's CN jets with those observed during the 1986 Giotto encounter.

Remy Indebetouw, a Senior at McGill University, is working with Dave DeYoung on hydrodynamical simulations of young stellar jets, based in part on maps of electron density and excitation obtained from narrowband CCD images.

Regina Jorgenson, a Sophomore at the University of Puget Sound, is working with Nigel Sharp on studying emission structures in M81 and M82 from narrowband wide-field images obtained on the Burrell Schmidt telescope.

Jonathan David Kemp, a Senior at Columbia University, is working with Edward Ajhar on photometry of Magellanic Cloud globular clusters.

Angelle Tanner, a Senior at the University of Arizona, is working with Buell Jannuzi on wide-field imaging of quasar fields.

Steve Hopkins, Dick Joyce

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Phoenix Progress (1Sep95)

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Phoenix Progress (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

[Photo not included]

Outer dewar shell for Phoenix, recently received from CRE located in the city of Phoenix. The scale of this instrument is indicated by the Phoenix project mechanical designer Randy Cuberly (left) and project engineer Tim Ellis (right). Phoenix, a high-resolution infrared spectrograph, continues to progress rapidly toward first light next winter.

Ken Hinkle

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High Resolution Spectral Atlas of Arcturus, 0.9-5.3 microns (1Sep95)

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High Resolution Spectral Atlas of Arcturus, 0.9-5.3 microns (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

An atlas of the infrared spectrum of the bright K2 giant Arcturus has been completed using the FTS at the 4-m Mayall telescope. The 0.9-5.3u m spectrum of Arcturus was observed at high signal-to-noise with a resolution of 100,000. Telluric lines were removed by using telluric transmission spectra generated from McMath-Pierce solar spectra or 4-m lunar spectra. Arcturus was observed on two different dates selected to give large opposite heliocentric shifts. These spectra were independently corrected for telluric absorption to effectively remove the telluric spectrum from all but the most obscured wavelengths of the Arcturus spectrum. We have identified most lines with central depths stronger than a few percent. This atlas is intended to serve as a guide for future high resolution infrared observations taken at NOAO with the new Phoenix spectrograph or with similar instrumentation at other observatories. While the new generation of infrared spectrographs is much more sensitive than the FTS, the spectral coverage of a single observation is much less. The atlas will be available in the next few months as both a AAS CD-ROM (PASP in press) and an ASP monograph (in press). Until the CD-ROM is released the atlas will be available as an electronic preprint on the anonymous ftp area of the NOAO computer gemini (IP 140.252.1.11) in the subdirectory /pub/arcturus.

[Figure not included]

One page of more than 300 of the Atlas. The bottom panel shows the observed Arcturus spectrum on one date with the derived atmospheric transmission spectrum for this spectrum above it. The upper panel shows the ratio of the Arcturus spectrum to the transmission spectrum. In the upper panel the observations from two dates at different heliocentric shifts are overplotted with the Arcturus features shifted to laboratory rest frequencies. Note the many very weak features that repeat in both observations.

Kenneth Hinkle, Lloyd Wallace, William Livingston

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Instrument Manuals Available on HTML (1Sep95)

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Instrument Manuals Available on HTML (1Sep95)
(from KPNO, NOAO Newsletter No. 43, September 1995)

As browsers of the KPNO Home Page http://www.noao.edu/kpno/kpno.html will note, more instrument manuals are becoming available in the HTML format. Most of these manuals have been simply converted from the PostScript version already available in the ftp archive to HTML. While we realize that many observers will continue to want the PostScript versions available to them for printing, the HTML version will offer quick look capability that will be especially valuable at the telescope or at proposal writing time. We plan to offer both formats whenever possible. The manuals currently available in HTML are:

Direct Imaging Manual for Kitt Peak
0.9-m Telescope User's Manual
Operations Manual for the Burrell Schmidt Telescope
CCDPHOT User's Manual
Echelle Spectrograph Instrumentation Operation Manual
Coude Feed Help Pages
Multi-Slits at Kitt Peak
The Revised Gold Camera User's Manual
4-m R-C Spectrograph Instrument Reference Manual

Jim DeVeny, Jim Kessel, Jeannette Barnes

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Instruments Available on Kitt Peak Telescopes: Spring 1996 (1Sep95)

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Instruments Available on Kitt Peak Telescopes: Spring 1996 (1Sep95)

(from KPNO, NOAO Newsletter No. 43, September 1995)

The instruments listed below will be available for visitor use on KPNO telescopes during the February - July 1996 observing semester. Proposals for this period are due 2 October 1995. Visitor instrumentation is welcome at KPNO and can be scheduled if the instrument: a) is unique; b) is required for a project of very high scientific merit; c) conforms to block scheduling; and d) has small impact on KPNO operational and engineering resources.

4-m Telescope:
- R-C Spectrograph + CCD (T2KB)
- Echelle + UVFast, Red Long, or Blue Long Camera + CCD (T2KB)
- PF Camera + direct CCD (T2KB)
- IR Cryogenic Spectrometer (CRSP)
- Cryogenic Optical Bench (COB/DLIRIM)
- IR Imager (IRIM)
- CryoCam (with 800 x 1200 Loral chip)

WIYN Telescope:
- Hydra + Bench Spectrograph (T2KC)
- CCD Imager (S2KB)

2.1-m Telescope:
- GoldCam CCD Spectrometer (F3KA)
- Cryogenic Optical Bench (COB)
- IR Cryogenic Spectrometer (CRSP)
- IR Imager (IRIM)

Coude Feed:
- Coude Spectrograph + Camera (5 or 6) + CCD (F3KB)
- NICMASS HgCdTe Array + Camera 5 (Shared Risk)

0.9-m Telescope:
- CCD Direct Camera + CCD (T2KA)
- CCD Photometer (CCDPHOT) (T5HA)

Burrell Schmidt:
- Direct or Objective Prism + CCD (S2KA)

Sidney Wolff

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From the NSO Director's Office (1Sep95)

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From the NSO Director's Office (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

This quarter continues to show great activity at NSO. Personnel changes, GONG deployment, telescope/instrument improvements, and the by-now-usual budget reduction exercises take a prominent place. This quarter included the annual presentations of plans and progress at NSF, presentations at the AURA Board meetings, at the Solar Physics Division meeting, and at the AURA Observatory Council meeting. The AURA Observatory Council and the AURA Executive Committee met at Sac Peak.

GONG Deployment Continues

The Tenerife, Learmonth, Mauna Loa and Tucson GONG stations are now operating successfully as an extended "GONG mini-network." The CTIO, Big Bear and Udaipur sites are being prepared; the instruments are being shipped to, or have already arrived on, these sites for an anticipated full deployment of all GONG stations by the end of September. Relatively minor "teething" problems have been overcome, and quality data are being received at the Tucson data processing facility for analysis and distribution to the GONG users.

Keller Joins NSO Staff

I am most pleased to announce that on July 1 Christoph Keller joined the NSO staff. Christoph had already been with us for 18 months as a postdoc funded by the Swiss National Science Foundation. His research centers around the physics of the smallest observable structures in the solar atmosphere and on precise differential solar photometric techniques. His earlier high angular resolution observations using differential speckle interferometry are well known. Recently Christoph, often in collaboration with others, has obtained outstanding observations of solar surface structures using phase diversity techniques, line polarization at visible and infrared wavelengths, and the green- and red-line corona. Christoph will be living in Tucson. His service functions will center around NSO/KP, but he expects to carry on his research at both NSO/KP and NSO/SP.

VTT Images Continue to Improve

Continuing improvements of the thermal control of the VTT window have started paying off in improved images. At his latest observing run, Thomas Rimmele broke the 0.2" resolution barrier with images showing structures of 0.15" in size near sunspots at 470 nm. Using image selection techniques, high quality images can be obtained at many times during the day. Keller, in collaboration with Seldin and Paxman, using phase diversity image reconstruction techniques, obtained outstanding time sequences of the solar surface structure in and near the Ha and the Mg b-lines. Radick and Rimmele obtained year-end funding from the USAF Phillips lab to purchase a deformable mirror. Together with his development of a relatively slow Hartmann-Shack wave-front sensor, Rimmele plans to implement an active optics system at the VTT to remove the residual optical aberrations in the telescope. It is rapidly becoming clear that diffraction from the 76 cm VTT aperture is becoming the limiting factor in doing solar research at Sac Peak. Even in the best images, many structures remain unresolved.

FY 1996 Budget Issues

The internal NOAO budget planning for FY 1996 is starting unusually early this year. The outlook is for another 5 to 6% budget reduction (including inflation) for NSO in this next fiscal year. This follows the two 5% cuts that NSO had to absorb already since I took up my position less than two years ago, and precedes additional, similar annual cuts for a number of years to follow. Although not as drastic as the budget reductions NASA funded institutes are facing, these cuts present a major challenge to the NSO program. "Doing more with less" is a good slogan, but it requires magic to make it happen. In this ever decreasing budget environment, it is essential to have a clear image of where we want to be heading, so that a targeted restructuring of the program is possible. In the meantime, efforts in attracting separate resources to support important activities at NSO, which are less central to NSO's future goals, have been successful at least as far as the support of the laboratory astrophysics/chemistry program for the McMath-Pierce FTS goes. A substantial grant from the NSF Chemistry Division will guarantee the health of that program for at least three years to come. The continued funding for the Solar-Stellar program at the McMath-Pierce in FY 1996 is still uncertain. It was removed from the NSO budget in FY 1995 in response to the previous budget cut, and is supported presently with separate funds from the NOAO Director's office. The additional 5 to 6% budget cut for FY 1996 mentioned above will not allow reinstatement of that program; in fact, it will result in an additional restructuring of NSO so that it can best fulfill its mission even at a lower support level.

The Restructuring of NSO

As already mentioned in the last Newsletter, AURA is asking NSF to commission a high-level study of the future plans for ground-based solar astronomy, probably by the National Academy of Sciences/National Research Council. NSF has responded favorably to that request, and such a study will probably be started in the near future. To prepare for that, the AURA Observatory Council (previously named the Observatory Advisory Committee) has formed a Solar Subcommittee, which includes as non-NSO scientists Art Walker (chair), Bob Rosner, Alan Title, Juri Toomre and O. Richard White. It is expected that this committee will meet soon together with NSO/NOAO staff (J. Beckers, J. Kuhn, D. Rabin, and S. Wolff) and M. Knoelker (HAO Director).

In the meantime, a number of activities are being pursued within NSO that will probably be components of any restructuring of the observatory. As described in my report at the recent Solar Physics Division meeting in Memphis, our current planning is based on three legs. The first leg focuses on making our existing facilities work as well as possible (better imaging, better detectors, best GONG commissioning and operation, implementation of RISE/PSPT). The second leg focuses on making a major breakthrough in the next decade and a half in our understanding of the solar activity cycle and its effects on earth using GONG, RISE/PSPT and our existing synoptic facilities. The third leg aims at the creation of a major new solar research facility for individual research projects. Restructuring within NSO aims at making our facilities both more economical to operate and more capable. Jack Harvey and Larry November are presently taking the lead in defining a better, more economical solar synoptic facility to be part of the second leg. As part of the third leg, Jeff Kuhn, Don Neidig, Doug Rabin, Thomas Rimmele, Ray Smartt and myself are pursuing the study of the CLEAR telescope concept, a 4-meter-class aperture telescope capable of high angular resolution studies of both the solar disk and the solar corona at wavelengths ranging from the visible to the far infrared.

Jacques Beckers

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1995 Summer Student Program (1Sep95)

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1995 Summer Student Program (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

Robert Cameron (University of Sydney) is working with Ray Smartt on two solar topics. The first is the morphology of coronal loop interactions, especially in Ha, using high-resolution coronagraph images from the Evans Facility. The second topic involves analyzing Fabry-Perot observations that were obtained at the November 1994 eclipse in Chile by Jim Mason. The locations of the circular interference fringes superimposed on the coronal field are used to deduce velocities in the corona.

Enrique Chavez (University of Arizona) is working with Mark Giampapa and Dave Jaksha on a project to evaluate the performance of the McMath-Pierce stellar spectrograph with different transfer optics and gratings. The measurements are made using three lines (393.3, 589.5 and 656.3 nm) from a thorium-argon lamp. The line profiles can be used for comparison and calibration of stellar spectra.

Dali Georgobiani (Abastumani Astrophysical Obs.) is working with Jeff Kuhn on two problems. Her first task is to devise an algorithm in spatial frequency space which speeds up the computational speed of the Kuhn et al. algorithm used for precise flat-fielding of image array data; this is needed for the RISE/PSPT program. Georgobiani has also begun a calculation to understand how a non-spherical solar interior temperature distribution could affect the neutrino flux as measured by the Homestake, gallium, and Kamiokande detectors.

Mark Haun (Walla Walla College) is working with Bill Livingston on the evaluation of telescope seeing at the McMath-Pierce. He has constructed and tested a stellar-image motion analyzer. He is also looking into an active optics system for the 2-meter heliostat.

Kelsey Johnson (Carleton College) is working with Harrison Jones on the analysis of solar magnetogram sequences. Using a dynamical technique called multiscale regularization, she obtains flow maps for consecutive magnetograms spaced closely in time. These flow maps are examined for correlations with specific solar events.

Sean Matt (University of Arizona) is working with Donald Neidig on the analysis of coronal sky background images to determine the power spectrum and origin of background noise. He is also studying flare Moreton waves in an effort to better understand the link between flares and coronal mass ejections. Additional objectives of the latter project include studies of post-flare loops and the search for recent examples of the flare nimbus phenomenon.

Nadege Meunier (University of Paris) is working with Stuart Jefferies, developing a two-dimensional fitting algorithm designed to characterize the solar l-n spectra of solar oscillations. Model parameters determined by 2-D fitting are expected to have much improved error estimates over those from 1-D fitting. In addition, the fits can be accomplished with many fewer parameters, which should lead to more robust modeling at high temporal and spatial frequencies.

Elena Neagu (Western Ontario University) is working with Frank Hill on a project to determine how mode leakage caused by observational constraints affects the analysis of GONG data. The most important observational constraints are GONG's inability to see the entire solar surface and the limitations of discrete sampling using rectangular pixels.

Stefan Ploner (ETH Zurich) is working with Steve Keil and K.S. Balasubramaniam on modeling Stokes spectral line profile asymmetries in the presence of velocity and velocity gradients. Earlier work by Balasubramaniam, Keil and Steve Tomczyk (HAO), using Stokes profiles observed with the HAO/NSO Advanced Stokes Polarimeter (ASP), showed that both velocities and velocity gradients are clearly related to the Stokes profile amplitude asymmetries in active regions. Ploner will synthesize spectral line profiles from polarized radiative transfer calculations, using the observational vector magnetic field and velocity data from the ASP, and compare them with the observed spectral line profiles. This will help in a better understanding of the Stokes spectral line asymmetries as a diagnostic tool.

Robert Quinn (University of Arkansas, Fayetteville) is working with Jack Zirker analyzing a time series of Calcium K-line images obtained at the South Pole in 1994/95 with the High-l helioseismometer. The data span 16 days continuously at a cadence of 42 seconds. The goal of the investigation is a search for large-scale persistent flows with a scale of about one arcminute. Quinn was new to IDL at the beginning of the summer but is an expert now! Preliminary results on solar flows are expected before the end of the summer.

Seth Redfield (Tufts University) is working with Charles Lindsey, Doug Braun, Stuart Jefferies and Yeming Gu with the NSO-NASA-Bartol South Pole observations of 1987/88/90 on a project in local helioseismology. Seth has written and tested software that is being used to look for antipodal color images: acoustic deficits expected at the antipodes of far-side sunspots due to waves absorbed by the sunspots. He is also working on techniques for correcting solar images for flat-field errors using solar rotation.

Reed Riddle (Georgia State University) is working with Stuart Jefferies, modeling the individual m-n spectra for the NSO-NASA-Bartol South Pole data sets. He is updating NSO's decade-old maximum-likelihood algorithm to include the many advances in modeling that have been made since the code was written. Riddle will invert the results to obtain rotational profiles of the solar interior for each of the data sets.

Jeffrey Selden (New Mexico State University) is working with Haosheng Lin and the RISE team on the digitization and calibration of Ca K spectroheliograms collected daily for more than thirty years at the NSO/SP Evans Facility. The Ca K SHG archive is of special interest to researchers interested in the solar irradiance variations. By decomposing the Ca K SHG into different components (plages, networks, quiet sun, etc.), we hope to better understand the underlying physical processes that are responsible for the observed cyclic total solar irradiance variations. Selden has been working on a self-consistent method for calibrating photographic SHGs that have a poor or missing calibration at the time of observations.

Michael Sigwarth (Kiepenheuer-Institut fr Sonnenphysik) is working with K.S. Balasubramaniam and Steve Keil on the problem of finding vector magnetic field signatures of foot-points in solar prominences. It is unclear how these giant arches of gas are tethered to the photosphere. Sigwarth will work on data from the HAO/NSO Advanced Stokes Polarimeter (ASP) in an effort to identify the vector magnetic signature of the prominence foot-points. Solar prominences often detach, resulting in mass ejections that have consequences on near-Earth space and the terrestrial environment. This work will help identify the physical mechanisms that are involved in the stability of prominences.

Amy Winebarger (King College) is working with Stuart Jefferies modeling the solar l-v power spectra of solar oscillations observed from the NSO-NASA-Bartol South Pole observations. She is looking for variations of the model parameters over the solar cycle. Winebarger will compare the frequency differences with the measurements made by the Big Bear group and will also determine whether the mode line widths are changing with solar cycle.

K.S. Balasubramaniam, Mark Giampapa,
Stuart Jefferies,Harry Jones, Steve Keil, Jeff Kuhn,
Haosheng Lin, Charles Lindsey, Bill Livingston,
Don Neidig, Ray Smartt, Jack Zirker

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Improving the Image Quality at the VTT/SP (1Sep95)

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Improving the Image Quality at the VTT/SP (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

At the NSO/SP there is an ongoing effort to improve the optical performance of the Vacuum Tower Telescope. During several observing runs, an attempt was made to measure the optical aberrations present at the VTT, their variation in time, and their source. The tools used to measure the optical performance of the VTT are: (1) Laser interferograms of the entrance window measure the aberrations introduced by the entrance window. (2) A Dyson interferometer in conjunction with a reference flat mounted in front of the entrance window was used to determine the aberrations of the entire optical system. (3) A Hartmann-Shack wavefront sensor was used to measure the aberrations as a function of the telescope pointing.

Although the data reduction is still in progress it has been determined that the optical aberrations are mainly introduced by the VTT's entrance window. The window is 40mm thick, and is made of fused silica. Aberrations are caused by stress due to atmospheric pressure and by temperature variations across the window, which in turn cause variations of refractive index and therefore aberrations in the wavefront. It was determined that after pointing the telescope at the Sun for about 20 minutes, the measured wavefront shows a "turned-up" edge---in some cases by several waves, i.e., the entrance window introduces spherical aberration. A change in focus is also observed. In addition, we find a substantial amount of astigmatism, coma, and some higher order Zernike terms. A new, more powerful window cooling was installed in May 1995, which prevents the "turned-up" edge in the wavefront to a large extent. However, the residual aberrations are substantial. Therefore, it is planned to develop and install an active optics system at the VTT, which will correct slowly varying, low-order aberrations.

First experiments with a Hartmann-Shack wavefront sensor working on granulation have been performed. The pupil of the VTT was sampled with 6, 8, and 12 subapertures across the diameter (76 cm). First results are very promising. Even the images of granulation formed by the subapertures of 6.3 cm diameter (12 subapertures) show sufficient structure and the computed cross correlations show well-defined correlation peaks. The time average of the computed wavefronts clearly shows the telescope aberrations. These aberrations will be corrected using a rubber mirror that presently is being purchased from the XINETICS company. The mirror purchase is jointly funded by the Air Force Phillips Lab and the NSO.

Thomas Rimmele, Richard Radick, Dick Dunn

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High-Speed Camera System Update (1Sep95)

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High-Speed Camera System Update (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

The high-speed camera system uses off-the-shelf parts, a SPARC 20, and a Thomson 1K x 1K camera. The system is ready for local use to finish testing the system. The system is currently used at the Vacuum Tower Telescope, but it can easily be moved to the Evans Solar Facility.

The camera base frame rate is 5 frames per second. The software windows and bins the image, chooses the best image from a number of images at 5 frames per second, averages images at 4 frames per second, writes 2 frames per second to disk, and writes 1 frame in 4 seconds to tape. The camera S/N is 500:1, and the A-D converter is 10 bits. The exposure time can be set as short as 6 milliseconds, and incremented in milliseconds.

The user interfaces are shell script programs, graphical user interface, IDL, and remote control by a network interface. The software is modular and allows for additional software modules for instrument control. This is useful for a stand-alone instrument and data acquisition configuration, such as taking a packaged instrument to another site or an eclipse. An external trigger allows the system to be synched to other experiments as well. External trigger mode allows the camera system to be synched to Universal Time. At Sac Peak, this is within a few milliseconds.

The peripherals are a disk drive, 8.3 gigabytes formatted, and an exabyte tape drive. We expect to acquire another exabyte drive for continuous recording, and newer drives with greater capacity and speed are being considered. New CPUs have been ordered to allow for more processing on line, such as dark correction and flat fielding. Full frame rate averages are expected.

The camera system has been used for several engineering runs, in May and July 1995, and has overwhelmed the data reduction and storage. The frame selection mode during the latest engineering run produced several time sequences of granulation and sunspot images with ultra-high resolution. The software is currently being refined, and it is anticipated that the system will be available to the users starting with the October-to-December quarter.

Fritz Stauffer, Thomas Rimmele

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Workshop on Mirror Substrate Alternatives (1Sep95)

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Workshop on Mirror Substrate Alternatives (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

An international meeting to discuss progress on mirror materials other than glass and ceramics will be held in Grasse, France, 9 to 11 October 1995. It is mainly sponsored by Aerospatiale. Emphasis is on Aluminum and Silicon-carbide technologies for ground based and space telescopes. Also featured is experience in the performance of existing mirrors of this nature, including the control of mirror seeing and figure adjustment by active heating or cooling. Further information is available from:
    Jean-Pierre Rozelot (rozelot@ocar01.obs-azur.fr)
    or Bill Livingston (wcl@orion.tuc.noao.edu).

Bill Livingston

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NSF Chemistry Proposal (1Sep95)

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NSF Chemistry Proposal (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

Given the reductions experienced during the last fiscal year, and the dismal outlook for future funding, it became clear that NSO could no longer support the Fourier transform spectrometer (FTS) laboratory spectroscopy program. The laboratory user community was informed in the spring of 1994 that the program would be closed at the end of fiscal year 1995 if other support was not found. The community rallied around the program and a proposal was prepared and submitted to NSF Chemistry in the fall 1994. I'm happy to report that I have received notification that the proposal has been recommended for funding.

This proposal requested funding for a three year period to assure that the FTS on Kitt Peak can remain available for laboratory spectroscopy. The requested funds will fully support one position to operate and maintain the spectrometer. The funds will also be used to buy equipment and supplies that support the laboratory observations and enhance the use of the spectrometer for laboratory studies.

Although the FTS was designed for research in solar physics, from 1978 to the present, substantial allotments of time were made available to laboratory spectroscopists at almost no cost to them. This was possible because the instrument is a facility open to the scientific community. However, reductions of NSF/AST funding jeopardized the continued operation of this instrument for laboratory purposes; an institution devoted to astronomy must give priority to its main objectives. The funding requested will ensure continued access to the instrument for laboratory projects.

The instrument has capabilities for laboratory spectroscopy not available anywhere else in the world. Its total spectral coverage is 550-45,000 cm^-1. It simultaneously achieves high resolution (0.0025 cm^-1 at 1000 cm^-1 and 0.01 cm^-1 at 3000 cm^-1), excellent signal-to-noise ratio (500:1 for 1-hour integration) and wide bandpass (1000 cm^-1 to 3000 cm^-1 for a single spectrum). This means that high quality measurements of line positions, strengths and widths can be obtained readily. Through a decade of use as a laboratory system, necessary support equipment (absorption cells, vacuum systems, optics, detectors, etc.) has been brought together to provide a well-equipped facility for visiting investigators.

Many thanks to our laboratory users for coming to the aid of the program and special thanks to Peter Bernath (University of Waterloo) for helping to lead the effort.

Jacques Beckers, Jeremy Wagner

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SOLVE Workshop (1Sep95)

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SOLVE Workshop (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

NSO has proposed an 11-year, community-wide study of solar variability. The study, named the Solar Variability Enterprise (SOLVE), has four goals: to understand the physical cause of the solar cycle, to understand the coupling of the convection zone to the surface, to understand the coupling of the surface to the solar envelope, and to explore the unknown aspects of variability. The ultimate, overarching goal is to learn enough about the Sun to gain some predictive capability of its variability.

To initiate the study, NSO has joined with the University of Sonora to sponsor a two-part meeting on "The Solar Cycle: Recent Progress and Future Research." The first part will be held as a workshop, 28-30 March 1996, and the second part, a general meeting, in Hermosillo, Mexico, on 1-4 April. The workshop is intended to bring together specialists who will address a small number of key problems relating to the origin of the cycle in the convection zone. The general meeting opens the discussion to the full range of solar variability. If you are interested in attending or seek more information, please contact jzirker@noao.edu or tsm96@fisica.uson.mx.

Jack Zirker

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NSO/SP 95 Workshop Update (1Sep95)

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NSO/SP 95 Workshop Update (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

The 16th NSO/Sacramento Peak International Workshop, "Solar Drivers of Interplanetary and Terrestrial Disturbances" will be held at Sunspot, 16-20 October 1995. This Workshop will cover various forms of solar activity, their interplanetary manifestations and terrestrial consequences. Responses to our earlier announcements have been overwhelming. We expect to have at least seventy-five participants, representing eleven countries. Approximately eighty-five papers, both oral and posters, will be presented. Each of the workshop sessions will have a keynote speaker, counter-point speaker and moderator, with emphasis on open discussion. Most of the papers will be in poster format. The proceedings will be published by the Astronomical Society of the Pacific.

Sponsors of this workshop include the National Science Foundation, the National Aeronautics and Space Administration, the Air Force Office of Scientific Research, the National Optical Astronomy Observatories and the National Solar Observatory. Should you have questions about the Workshop, please contact Ray N. Smartt, Steve L. Keil or K.S. Balasubramaniam (ws95@sunspot.noao.edu)

K.S. Balasubramaniam

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Sunspot Education Center (1Sep95)

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Sunspot Education Center (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

Progress continues on the design and development of the $2 million Sunspot Education Center at the National Solar Observatory. Final design for the building provides for space divided in thirds with museum, auditorium and visitor conveniences totaling 7,000 square feet. The building design is about 90% complete and the construction bid documents are in final preparation. The request for bid should be issued by 1 August with award around the middle of September. If all goes well, construction could begin 1 October. In addition, the design of the exhibits and displays for the museum portion of the Education Center has begun. These exhibits will emphasize the unique instrumentation and science being undertaken at the National Solar Observatory and Apache Point Observatory (ARC), as well as the cultural and natural history of the area.

Another major activity in progress is the completion of the National Environment Protection Act (NEPA) process. All the biological and cultural resource evaluations have been completed and the environmental assessment has been issued by the US Forest Service. After the expiration of the 30 day comment period (20 July), the final decision will be rendered by the District Forest Ranger and a 45-day appeal period will begin. If no appeals are made, construction can begin on October 1 as planned. If all goes well, the opening of the Education Center should be early in the summer 1996.

Rex Hunter

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Update on McMath-Pierce Solar-Stellar Cross-Disperser System (1Sep95)

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Update on McMath-Pierce Solar-Stellar Cross-Disperser System (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

A new field lens has been fabricated (using the existing field lens) and installed. This resolved the problem we were having with vignetting of the spectral field with our new configuration (see previous NOAO Newsletter). A mechanical problem was discovered with the new dewar mount that had prevented correct collimation of the cross-dispersed system. A new dewar mount has been fabricated, which will be installed by the time of this newsletter. In the meantime, our REU student, Enrique Chavez, has been making excellent progress in re-characterizing the new spectrograph configuration with the cross-dispersed system in place.

Among the proposals approved for the third and fourth quarters of observations are (by title and PI):

"Doppler Imaging of spotted chromospherically active stars: --K. Strassmeier (U. Vienna),

"He I 587.6 nm spectra of F and G dwarfs"--V. Andretta (Armagh Obsv. and NASA/GSFC),

"Chromospheric and coronal processes in F and G-type dwarfs"--J. Valenti (JILA),

"Spectroscopic study of cool stars serendipitously discovered in EUV surveys"--G. Tagliaferri (Brera Observatory, Italy),

"Systematics of the Ca II K chromospheric emission line among red giants"--G. Smith (Lick Observatory),

"Time-resolved Doppler imaging of EI Eridani"--A. Washuettl (U. Vienna), "A search for new proto-planetary system candidates"--K.-P. Cheng (Cal State - Fullerton),

and six other programs of high resolution, synoptic spectroscopic investigations.

Mark Giampapa, Dave Jaksha

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NSO Telescope/Instrument Combinations (1Sep95)

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NSO Telescope/Instrument Combinations (1Sep95)
(from NSO, NOAO Newsletter No. 43, September 1995)

Vacuum Tower Telescope (SP):
- Echelle Spectrograph
- Universal Spectrograph
- Horizontal Spectrograph
- Universal Birefringent Filter
- Fabry-Perot Interferometer 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):
- Ha 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
- 1-m Fourier Transform Spectrometer
- Stellar Spectrograph System
- 3 Semi-Permanent Observing Stations for visitor equipment

Vacuum Telescope (KP):
- Spectromagnetograph
- High-l Helioseismograph

Razdow (KP):
- Ha patrol instrument

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Global Oscillation Network Group (1Sep95)

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Global Oscillation Network Group (1Sep95)
(from GONG, NOAO Newsletter No. 43, September 1995)

The Global Oscillation Network Group (GONG) Project is a community-based activity to develop and operate a six-site helioseismic observing network for at least three years, to do the basic data reduction, provide the data and software tools to the community, and to coordinate analysis of the rich data set that is resulting. The Project is nearing completion of the deployment of its stations, and we anticipate a fully operational network by the beginning of October. Data from the first sites is being processed and distributed to the scientific community. GONG data will be available to any qualified investigator whose proposal has been accepted; however active membership in a GONG Scientific Team will allow early access to the data and the collaborative scientific analysis that the Teams have already initiated. The GONG Newsletter provides status reports on all aspects of the Project and related helioseismic science.

[Photos not included]

The Mauna Loa Station, with the instruments of NOAA's Climate Monitoring and Diagnostic Laboratory in the background. The GONG station is being operated in collaboration with NCAR's High Altitude Observatory site.

The CTIO Station 'dwarfing' the nighttime telescopes in the background.

The Scientific Teams are starting to accelerate their activities in anticipation of data from the full network, with all of the teams on track for a collaborative analysis of the first data. The Inversions Team met in Boulder during July and August, and the others will be following suit shortly. We anticipate that summaries of the project status and the teams' activities will be presented at the AAS Meeting in January 1996, in San Antonio. The first results will be announced in a special issue of Science Magazine next May. We plan to have a series of summaries of the Scientific Teams' activities presented at the AAS and Solar Physics Division Meeting in June 1996, in Madison in conjunction with the Annual GONG Meeting.

Instrumentation

A key technical hurdle has recently been overcome. The instrument team developed, and began using, a procedure that precisely determines the orientation of the cameras in the observing stations. This information was integrated into the data reduction software that registers the velocity images into heliographic coordinates. This correction allows the registration to be accurate to a tenth of a degree of rotation about the line of sight and avoided the use of statistical approaches for determining camera orientation.

With the deployment approaching completion, we are looking forward to going back to a number of important components that we were forced to forgo initially ('minor' things like a turret cover!), as well as tackling the problems that operational experience will uncover. Ron Kroll has joined the Instrument Team and will be engaged in chasing down these instrumental "features" as we start getting network data.

Looking toward the future, a very promising 1024 x 1024 square pixel camera has been found, which may provide the upgrade path for the baseline 256 x 256 camera that we have been seeking for several years.

[Figure not included]

The velocity of a single mode of oscillation [l = 100, m = 90] for the first 36-day "month" of three-site observations.

Deployment

The last NOAO Newsletter reported the commissioning of the first station at the El Teide Observatory of the Instituto de Astrofisica des Canarias on Tenerife in mid-January of this year. Since that time, four more stations have been deployed and commissioned, and the sixth and final deployment is expected to commence in September. This should be the last time that we have this "deployment" section in the Newsletter!

The second instrument "out of the box" was the Learmonth, Western Australia station. That deployment was accomplished during April, allowing the three site "mini network" (El Teide, Big Bear operating in Tucson, and Learmonth) to begin acquiring its first 36-day sample (a "GONG month") on 7 May. The basic ("are we guiding?") duty cycle during that period was a surprisingly high 83%. Our preliminary analysis of the usable images gives a more reasonable 74% as seen in the accompanying figure.

The deployment of the next three stations also proceeded smoothly. Between May and August, instruments were brought up on Mauna Loa, Cerro Tololo, and at Big Bear, California. The two teams participating in the deployments now have the activity down to about a four-week process from the time the shelter and crates arrive on site until the last team member boards a plane to return home. This is better than we had hoped for.

The deployment of the CTIO instrument was extremely smooth. Only a few minor problems were encountered, all of which were quickly solved. The team arrived on 25 June, went to work on 26 June, achieved "first light" on 5 July, and acquired the first acoustic spectrum on 15 July. A spell of cloudy weather (it was winter) slowed the final testing down, but even so the entire team departed for Tucson on 22 July, a full week ahead of schedule. The CTIO staff, led by Oscar Saa, were extremely helpful and responsive. This was a marvelous opportunity for two divisions of NOAO to work together effectively.

The final deployment will soon be underway in Udaipur, India. That station arrived in Indian in mid-July, with setup scheduled to begin at the new Udaipur Solar Observatory campus beginning in early September.

The integration site in Tucson, once the home of all six field stations, now has only one lone instrument operating. The original prototype instrument has been relocated to that site from its old home at the University of Arizona's track-and-field facility. That station has now been upgraded to "production standard", and was put into service as part of the network on 7 July when the Big Bear instrument was taken off-line in preparation for its shipment to California. Tucson station will continue to serve as a development and "ground simulator" instrument for the duration of network operations, as well as providing additional coverage.

Data Analysis

The Data Management and Analysis Center (DMAC) has begun to reduce network data acquired by four deployed network instruments, in addition to testing data acquired to verify the successful installation of three instruments. Reductions are also being done on test data acquired when construction of the observing instruments was completed at the University of Arizona farm site and before the units were disassembled for shipment.

A high priority objective for the DMAC has been the production of data products from the first GONG "month" using raw data acquired by the three-site mini- network beginning on 7 May. The products include the 36-day mode-coefficient time series and mode frequency information from the time series. These were distributed to the scientific community for evaluation as soon as they became available (early in August).

The project received the report from the committee that reviewed the readiness of the DMAC for network operations (the review was held on 16 March). The committee's observations and recommendations have been reviewed and the project has issued a response. (Both are available on GONG's WWW server.) In summary, the committee was pleased with the status of the development of the DMAC and offered several useful suggestions. The highest priority recommendation was that the DMAC deliver to the community the data products from a GONG "month" from the mini-network as soon as possible.

The Data Storage and Distribution System (DSDS) began moving the user interface for the catalog query and data product request functions from CURSES to the WWW. This development will be presented to the DMAC Users' Committee at their August meeting in Boulder, Colorado. The DSDS also recently conducted a survey of its users regarding various technical aspects of using the project's facility for accessing data products. The DSDS received 25 responses from the 64 GONG members to whom the survey was e-mailed. With the ramp-up of network operations, the frequency of data requests has also begun to increase.

Marguerite Rodriguez, who had been working as a DSDS operator, moved to Silver City and has left the project. The project was fortunate to be able to quickly fill the vacancy. Robert ("Rob") Perry will be operating the DSDS, performing various system administrative tasks, and developing and supporting database applications.

[Figure not included]

The spatial-temporal power spectrum [l-n diagram] for a "typical" day for three-station observations.

John Leibacher and the GONG Project Team

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Gemini Mid-Infrared Imager Procurement (1Sep95)

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Gemini Mid-Infrared Imager Procurement (1Sep95)
(from USGP, NOAO Newsletter No. 43, September 1995)

Work is in progress to prepare for the procurement of the Gemini Mid-IR Imager. The US Gemini Program will conduct an open competition within the United States to select one or more contractors to perform a conceptual design study . It is anticipated that a second open competition will follow the conceptual design study to select a single contractor to finalize the design as well as to fabricate and commission the instrument.

The Mid-IR Imager has been specified by the international Gemini Science Committee as follows:

Wavelength Range:	5-25um
Array:	~256 x 256 Si:As IBC
High Throughput Scale:	~0.13"/pixel
Instrument Background:	&lt 1% effective emissivity
Filter Requirements:	20-30 cold filters
Desirable Options:	Dichroic feed to InSb array for NIR guiding/simultaneous imaging. Optical design consistent with 2x upgrade in array size

Expect the Announcement of Opportunity to be released in September/October of this year, followed by the Request for Proposals in November/December. Please contact the US Gemini Program at NOAO (usgp.noao.edu or (520) 318-8175) if you are possibly interested in bidding for this contract.

Kathy Wood

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Lucky Luke Ships to France in November (1Sep95)

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Lucky Luke Ships to France in November (1Sep95)

(from USGP, NOAO Newsletter No. 43, September 1995)

It will be a spectacle to behold when the eight meter mirror blank, Lucky Luke, leaves the Corning facility in Canton, New York headed for polishing at REOSC Optique in France. REOSC has a tradition of naming mirrors after French cartoon characters. The Gemini mirrors are named Lucky Luke and Jolly Jumper, a fast-shooting cowboy and his trusty mount. The exact date of shipment has not been set, but watch for news in November. Many New Yorkers will undoubtedly line the road to watch the parade as they did when the Subaru mirror blank left Corning for the Contraves plant in Pittsburgh. I myself prefer to join the parade route when the mirror blank barges past Notre Dame cathedral after arriving in France!

[Photo not included]

Kathy Wood

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New Observing Modes for the Next Century (1Sep95)

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New Observing Modes for the Next Century (1Sep95)
(from USGP, NOAO Newsletter No. 43, September 1995)

In early July, the USGP, along with the Gemini Project, the Joint Astronomy Centre, ESO, and the University of Hawaii at Hilo, sponsored a workshop on alternative modes of observing. About 85 participants, from a total of nine countries, attended the workshop, which was held at the University of Hawaii at Hilo. The motivation for the workshop was to compare progress and future plans among the many observatories that are trying to improve the quantity and quality of their scientific output by innovative operational approaches.

The worskshop comprised six sessions: Key issues; Needs and desires of future large telescopes; Scheduling strategies; Remote/service/queue: experience; Tools for planning, scheduling, and observing; and Data reduction and archiving. Each session included an open discussion on the issues raised during the invited and contributed talks. A number of posters were on display throughout the meeting. The proceedings will be issued as a volume in the conference series of the Astronomical Society of the Pacific.

Although almost all of the next generation of telescopes will require some kind of flexible scheduling in order to make most effective use of the varying atmospheric conditions, the presentations indicated that there is a substantial gap between what has been done and what is planned. Software systems such as Spike for HST and ATIS or APA for photometric monitoring telescopes have demonstrated the capability to address certain sorts of scheduling and planning problems. Whether they can be adapted/expanded for the somewhat different constraints of large ground-based telescopes is not yet clear. Associated with the difficulty of responding to the conditions is the difficulty of measuring (and hopefully, predicting) them. In addition to the general problem of implementing a scheduling strategy, substantial parts of the discussion centered on factors affecting the reliability of service observing and how one confidently identifies potentially successful proposals.

Todd Boroson

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1995 Software Conference Update (1Sep95)

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1995 Software Conference Update (1Sep95)
(from CCS, NOAO Newsletter No. 43, September 1995)

The Fifth Annual Conference on Astronomical Data Analysis Software and Systems (ADASS), hosted by the National Optical Astronomy Observatories, will be held in Tucson on 23-25 October 1995. Additional sponsors for the Conference include the Infrared Processing and Analysis Center, the International Gemini 8-Meter Telescopes Project, the National Aeronautics and Space Administration, the National Radio Astronomy Observatory, the National Research Council of Canada, the National Science Foundation (tentative), the Smithsonian Astrophysical Observatory, the Space Telescope Science Institute, the University of Arizona Steward Observatory, and the Vatican Observatory. Our corporate sponsors include Sun Microsystems, Inc., Co Comp, Inc., Network Computing Devices, Inc., and Research Systems, Inc. The ADASS Conference provides a forum for scientists and programmers concerned with algorithms, software, and software systems employed in the reduction and analysis of astronomical data.

The Program Organizing Committee for ADASS V 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 (CfA) Dick Shaw (STScI), Karen Strom (U. Mass.), and Doug Tody (NOAO). The Local Organizing Committee is chaired by Jeannette Barnes (softconf@noao.edu).

The Conference program will include a series of invited talks on special topics, contributed talks, poster papers, and software demonstrations. Several birds-of-a-feather (BOF) sessions are also planned. BOFs generally run 1 1/2-2 hours, often concurrently with other BOFs, and can be any format defined by the organizer. Two tag-along workshops (before and after the Conference) are scheduled: an Object Oriented Software Workshop is planned for Sunday, 22 October, and an IRAF Developer's Workshop is planned for Thursday, 26 October.

Abstracts for the meeting were due on 15 August; this was also the deadline for early registration. Registrations are continuing to be accepted until 12 October but at a higher registration fee. On-site registrations will be accepted on a space available basis. The deadline for making hotel reservations at the Conference rate is 21 September.

The Conference program, as it develops, is available over the Web at http://iraf.noao.edu/ADASS/adass.html. Registration materials and other information are also available by anonymous FTP to iraf.noao.edu in the directory iraf/conf/adass-95. Further information about ADASS '95 is available by sending e-mail to: softconf@noao.edu.

Jeannette Barnes, George Jacoby, Doug Tody

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IRAF Update (1Sep95)

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IRAF Update (1Sep95)
(from CCS, NOAO Newsletter No. 43, September 1995)

A new IRAF version, V2.10.4, was released in May for SunOS, Sun

Solaris, the DEC Alpha running OSF/1. This was mainly a bug and fix and platform support release. The DEC Alpha release was a new port. The Solaris upgrade added support for Solaris 2.4 and the Sunsoft version 3.0 compilers (Solaris 2.3 is still supported as well). Updated versions of xgterm and ximtool are available for these and other platforms in the pub/v2103-beta directory in the IRAF network archive (iraf.noao.edu). Major revisions to the applications software are being withheld for the V2.11 release, although most new applications packages are available now as layered packages. We invite people to try out this new software and give us feedback.

Now that IRAF V2.10.4 is out, work has resumed on the PC-IRAF project. IRAF V2.10.4 will be available for PCs running Linux by the time this Newsletter is distributed, or shortly thereafter. Ports for Solaris x86 and BSD will follow. Testing for the PC ports is being performed on two separate platforms, a high end Pentium 90 system (PCI/SCSI bus, 32 Mb), and a more modest 486DX2 66 MHz system (IDE/SCSI 16 Mb). The IRAF V2.10.4 port to Linux is being done using the Slackware 2.3 Linux distribution and the version 1.2.11 Linux kernel, using a beta-test driver for the Adaptec 2940 PCI-based SCSI adaptor, which does not yet have builtin support in the Linux kernel (a not uncommon situation with PC UNIX systems).

The IRAF development system is now running the development version of IRAF V2.11. However it will be some months yet before it is ready for release. We will continue to release V2.10.4 on the PC-IRAF platforms while V2.11 is under development in Tucson and the IRAF TWG sites.

A new version of the FITS image kernel is being developed for IRAF V2.11 in a collaboration between the STSDAS group at STScI and the core IRAF group at NOAO. The IRAF FITS kernel will support the FITS "image" extension and multiextension files. The IRAF kernel will allow IRAF tasks to read and write images stored in multiextension FITS files. The FITS tasks in the IRAF DATAIO package have also been modified to support multiextension FITS files containing images stored in image extensions.

Frank Valdes has been enhancing the fiber spectral reduction tasks in preparation for commissioning Hydra on WIYN. The enhancements are to align the sky lines for better sky subtraction and to use fiber identification information recorded in the header by the new WIYN/Hydra software and updates for CTIO/Argus. Lindsey Davis has completed a new task for WCS-driven image registration. This task takes a set of images, each with its own world coordinate system, and registers them to a reference image (a common problem when analyzing multi-wavelength data). This task is contained in a new layered package IMMATCH (now available for user testing). This package contains tasks for matching various characteristics of images, including spatial registration, PSF matching, and intensity matching. Interested users can obtain the package from iraf.noao.edu in the iraf/extern directory--see the immatch.readme file. Lindsey also added two new ring median filtering tasks to the IMAGES package.

Mike Fitzpatrick continues to enhance the IRAF Web pages--if you have not looked at IRAF on the Web lately, you should check it out.Our URL is http://iraf.noao.edu/. Mike has added capabilities for automatically searching the archives for such things as finding files in the FTP archive or searching the help pages, buglog, FAQ, and ADASS newsgroups, by topic.

IRAF documentation and distributions are now available on CDROM for those sites wishing to acquire IRAF on this medium. These initial CDROM distributions are simply mirror images of portions of the IRAF archives on iraf.noao.edu. IRAF distributions on CDROMs are similar to tape distributions except that the CDROM is randomly accessible. The documentation CDROM includes what is currently in the iraf/docs directory but the files are uncompressed so they can be directly read by a PostScript viewer on any host system. We plan to produce more fully featured CDROMs in the future and will be experimenting with capabilities such as browsable, searchable documentation and IRAF distributions that can be run directly from the CDROM, e.g., for the PC-IRAF distributions. These initial CDROMs are intended mainly as an alternative to tape or network distributions.

Along with other NOAO staff members from CTIO and KPNO, Doug Tody and Rob Seaman attended the "New Observing Modes of the Next Century" conference in Hilo, Hawaii. This conference provided an opportunity for observatory staff members who are responsible for the new generation of large optical telescopes to discuss the unique requirements for using these new facilities efficiently with their community of observers. Various queue and remote observing strategies were the main topics of discussion. Rob presented a poster paper with Bruce Bohannan outlining the remote telescope console and automatic

FTP options that have been offered to Kitt Peak observers for the fall 1995 semester. Rob also presented a poster outlining the features of the NOAO "Save the Bits" archive, including a site management guide that is available for other observatories that may be considering options for archiving initiatives.

Preceding the New Observing Modes conference, Doug and Rob participated in a workshop on archiving of ground based data chaired by Dennis Crabtree of the Canadian Astronomy Data Centre. Other working group attendees included representatives from the Gemini project, ESO, CFHT, Keck, and NED (IPAC). We gave a status report on our "Save The Bits" project and discussed the work NOAO is doing to develop a low cost data archiving facility. The Keck presentation included mention of their use of the Save the Bits software. Currently NOAO is investigating several alternative free or inexpensive relational databases to serve as the database server portion of a client-server based catalog query/access facility. The databases which have been looked at thus far include /rdb, mSQL, and Postgres95. User interfaces initially planned include a Web interface and a custom GUI based on the IRAF Widget Server. The client-server architecture will allow new or alternative user interfaces to be easily added in the future as new technologies emerge. A related effort is underway to define more carefully the keywords used for data taking and data reduction at the telescopes; this will eventually affect much of the IRAF data reduction software. This work is being coordinated with Gemini and the CADC. We are collaborating with the ESO/VLT project as well.

For further information about the IRAF project browse the 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

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NOAO FTP Archives (1Sep95)

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NOAO FTP Archives (1Sep95)
(from CCS, NOAO Newsletter No. 43, September 1995)

The various FTP archives for the NOAO can be found in the following FTP directories. Please log in as anonymous and use your e-mail address as the password. Alternate addresses 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 some astronomical catalogues: Jacoby et al. catalog, "A Library of Stellar Spectra," the "Catalogue of Principal Galaxies," the "Hipparcos Input Catalogue" and the Northern Proper Motion catalog.

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

gemini (gemini.tuc.noao.edu)--Information from the International Gemini 8-Meter 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 ftp 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, Hydra information, new LaTeX observing form templates, instrument manuals, KPNO observing and monthly support schedules, platelogs for 4-m PF, user questionnaire, reference documents (wavelength atlases), SQIID scripts for data reduction.

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

noao (gemini.tuc.noao.edu)--Miscellaneous databases, report from Gemini WG on the high resolution optical spectrograph.

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

preprints--NOAO preprints that are available electronically.

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

starform--project (mira.tuc.noao.edu, cd pub/sfproject)--Directory containing progress reports and information on when/where to obtain SQIID star formation project data.

tex--LaTeX utilities for the AAS/ASP.

utils--Various utilities: currently only some PostScript tools.

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 are the numerical IP addresses for the machines mentioned above:

```
argo.tuc.noao.edu    =   140.252.1.21
ctios1.ctio.noao.edu =   139.229.2.1
ftp.noao.edu         =   140.252.1.24
gemini.tuc.noao.edu  =   140.252.1.11
helios.tuc.noao.edu  =   140.252.8.105
iraf.noao.edu        =   140.252.1.1
mira.tuc.noao.edu    =   140.252.3.85
orion.tuc.noao.edu   =   140.252.1.22
ftp.sunspot.noao.edu =   146.5.2.1
```

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, and Steve Grandi (grandi@noao.edu) or Jeannette Barnes jbarnes@noao.edu) for all others (and they will direct your questions as needed).

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

Jeannette Barnes
