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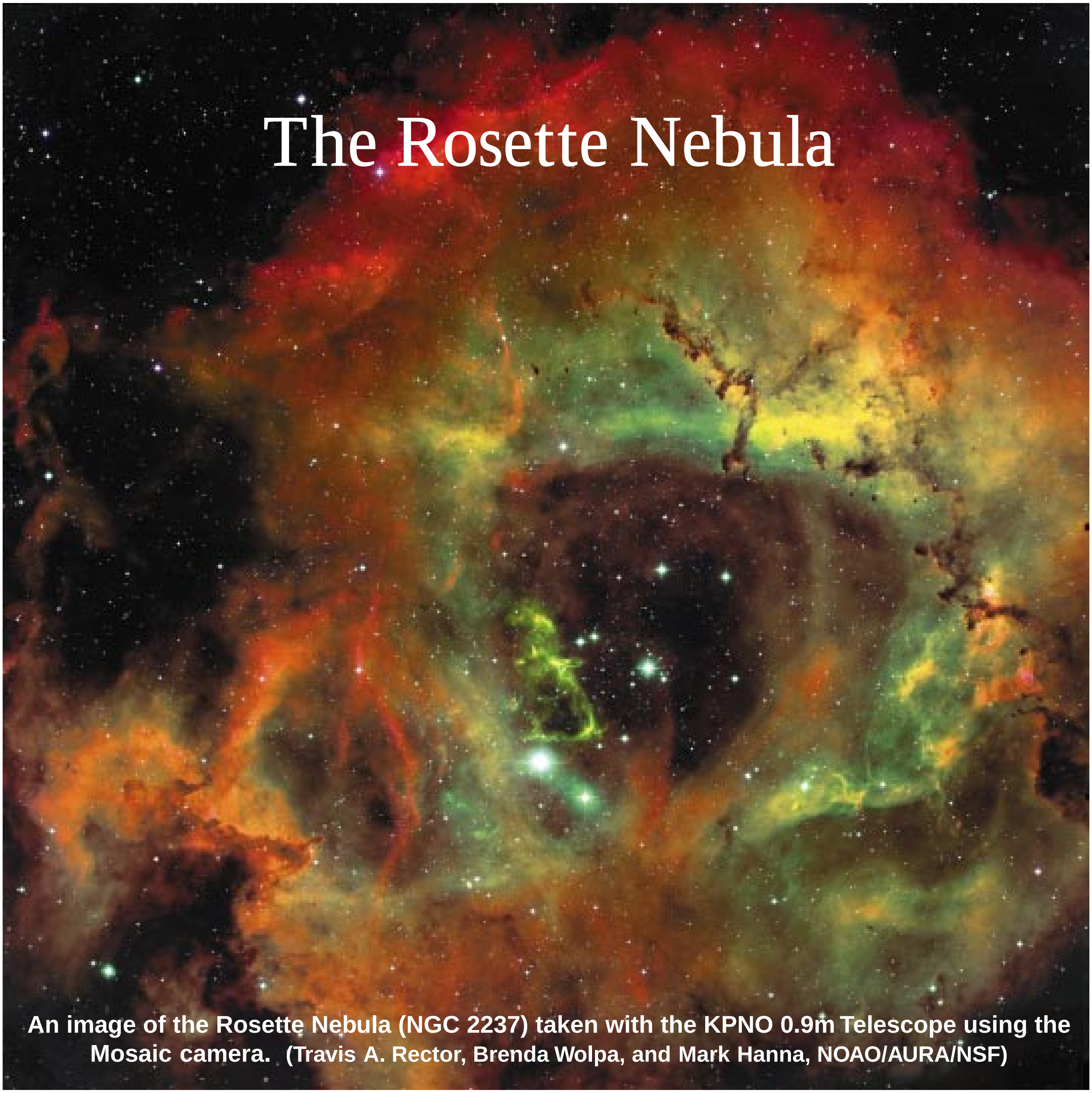
*Newsletter No. 60* — *December 1999*

# The Rosette Nebula



**An image of the Rosette Nebula (NGC 2237) taken with the KPNO 0.9m Telescope using the Mosaic camera. (Travis A. Rector, Brenda Wolpa, and Mark Hanna, NOAO/AURA/NSF)**

# Cover Image: The Rosette Nebula

NOAO's CCD Mosaic imagers provide US astronomers with the ability to survey large areas of sky with excellent spatial resolution (0.26") and sensitivity (R > 26; B > 26.5). Nearly identical 8K×8K imagers are available at the 4-m telescopes at the Kitt Peak National Observatory in the north and at the Cerro Tololo Inter-American Observatory in the south.

This image of the Rosette Nebula (NGC 2237) was taken with Mosaic at the National Science Foundation's 0.9-m telescope on Kitt Peak. Five 10-minute exposures were made with H$\alpha$, O[III], and S[II] filters and assigned to the red, green, and blue color channels, respectively, to create this false color image.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# LALA LOOKS at the EARLY UNIVERSE

*Based on a Solicited Contribution from James Rhoads*

Sangeeta Malhotra and James Rhoads (both at NOAO) have initiated a Large Area Lyman Alpha ("LALA") survey using the KPNO 4-m Mosaic CCD camera to search for Ly-α emitting objects in the early universe. Keck spectra obtained of some of their first candidate objects demonstrate that the survey is indeed detecting galaxies at high redshift.

Ly-α emission has long been sought as a signpost of galaxies in formation. The history of the field began with a theoretical prediction by Partridge & Peebles (1967) that the first burst of star formation in giant galaxies should produce bright, easily observable Ly-α line emission. This prediction prompted many emission line protogalaxy searches (see Pritchet 1994 for a review). However, no search up to 1997 detected the hoped-for field population, demonstrating that the putative emitters are either faint or rare. Subsequent studies have detected the first such objects, but the total sample remains very small.

The primary challenge in searching for Ly-α emitting objects is to achieve a suitable combination of sensitivity and survey area. The wide field of the NOAO CCD Mosaic camera allows narrowband searches to be conducted with a much higher efficiency than previous instruments (measured by the quantity AΩ, the product of telescope collecting area and detector solid angle). Malhotra & Rhoads began the LALA survey in the spring of 1998 to exploit this new capability.

To date, Malhotra & Rhoads have completed imaging observations of one Mosaic field in five overlapping H-α filters, with a total integration time of 6 hours per filter. Additional observations of other fields in a subset of the filters nearly double this data set. In all, the sampled volume is $1.3\times10^{-6}$ comoving $Mpc^{-3}$ at redshifts from 4.37 to 4.56 (assuming a cosmology with $H_0$=70, $\Omega_m$=0.2, Λ=0). The 5σ sensitivity limit in each 80Å filter is

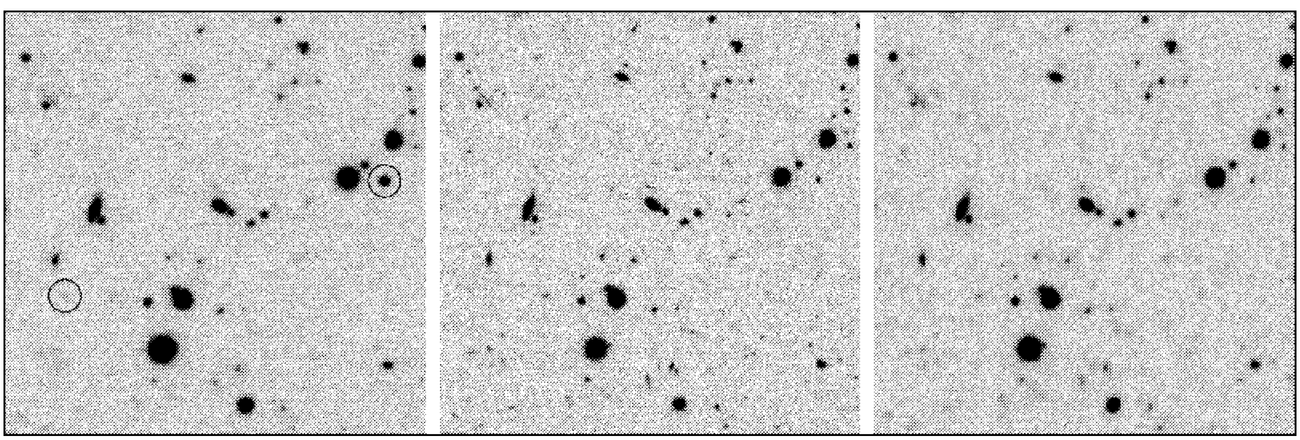

Figure 1. 0.4% of the LALA project's first field. Each image is 2.2' on a side. Left: The H-α+16 filter (λ=6721 Å, Δλ=80 Å). Two emission line sources are marked. Middle: The H-α+0 filter (λ=6561 Å, Δλ=80 Å). Right: The NOAO Deep Wide-Field Survey R band data for this field (courtesy Jannuzi, Dey, and the NDWFS Team).

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$2.6\times10^{-17}$ erg/cm$^2$/s. Because the Mosaic H-α filters overlap, fainter sources (to $1.8\times10^{-17}$ erg/cm$^2$/s) can be detected at wavelengths sampled by two filters, or over 40% of the volume in the current data set. As these limits include both line and continuum fluxes, the faintest detected emission lines can be appreciably weaker (~40 % of the line+continuum limit) for souces with equivalent widths smaller than the 80Å bandpass.

The first spectroscopic follow-up of LALA survey sources was obtained at the Keck 10-m telescope by Arjun Dey (NOAO), Daniel Stern, Hy Spinrad, and collaborators (UC Berkeley). These spectra yielded a confirmed $z$=4.5 Ly-α emitter, a comparatively weak source with a line flux of $1.7\times10^{-17}$ erg/cm$^2$/s and an 80Å equivalent width. They also elucidated the nature of the most dramatic emission line yet found in the survey (with equivalent width ~1400Å and flux $7\times10^{-16}$ erg/cm$^2$/s), which turned out to be the O[III] 5007Å line from an unusual, high-excitation galaxy at $z$=0.33. On- and off-band images of both sources are shown in Figure 1, and corresponding spectra are shown in Figure 2. By obtaining spectra of sources with a variety of fluxes, equivalent widths, and broadband colors, Malhotra & Rhoads optimized these first spectra to help refine selection criteria for later follow-up. In so doing, they demonstrated that they could achieve high reliability for sources with equivalent widths as small as 50Å in the observer frame.

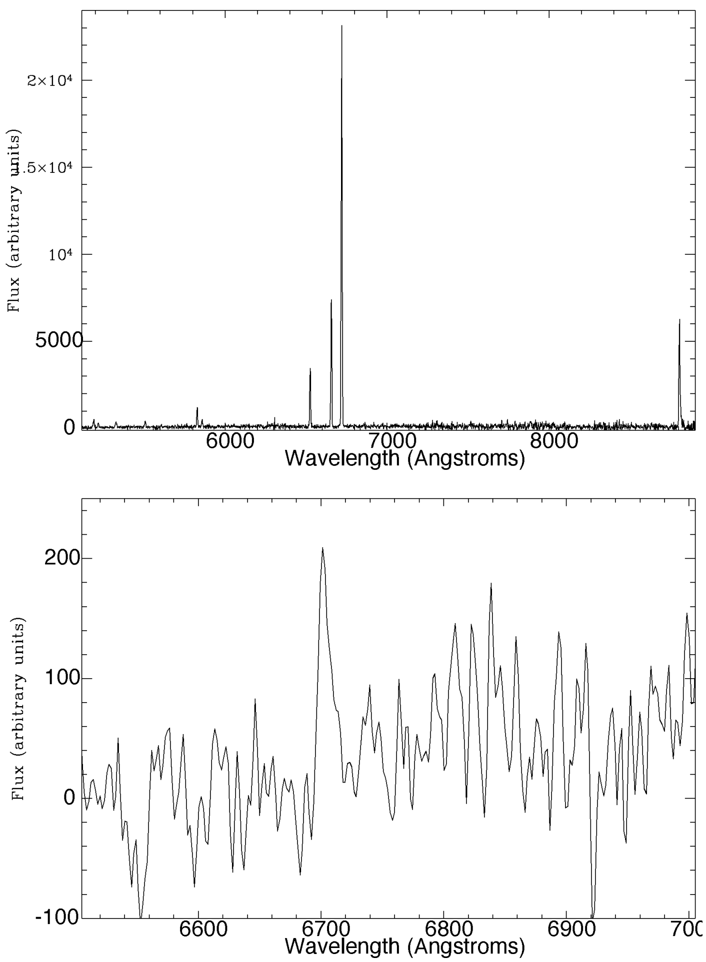


Figure 2. Spectra of the two sources marked in Figure 1, obtained at the Keck by Dey, Stern, Spinrad, and collaborators. Top: The brighter source, an extraordinary O[III] emitter at $z$=0.34. Bottom: A smoothed spectrum of the fainter source, a $z$=4.5 Ly-α emitter.

To maximize scientific return on the narrowband observations, the primary LALA survey fields are placed in fields studied by the NOAO Deep Wide-Field Survey. This allows LALA to combine narrowband emission line strength estimates with broadband colors to better discriminate among different classes of candidate emission line objects.

Typical $z$=4.5 Ly-α emitters are expected to have faint flux levels (< $5.2\times10^{-17}$ erg/cm$^2$/s) and large equivalent widths (>80 Å). The number density of such sources in the first field is about 225 per field per filter brighter than $2.6\times10^{-17}$ erg/cm$^2$/s line+continuum flux (the single filter 5σ detection threshold). This would correspond to a source density of 11000 per square degree per unit $z$ if all of these sources were bona fide Ly-α emitters. Early spectroscopic follow-up suggests that in fact some 30 to 50% of these sources are Ly-α emitters, leaving 4000 per square degree per

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unit $z$ in this narrow range of flux. Further planned spectroscopic follow-up will improve these statistics. They expect a final sample of ~$10^3$ objects.

Given this large sample, Malhotra & Rhoads expect to determine the distribution of line fluxes, equivalent widths, and colors for $z$=4.5 Ly-α emitters. By studying the spatial distribution of emitters, they will also be able to examine large-scale structure issues for this population. Ultimately, by comparing this data set with present day and intermediate redshift galaxy populations, it will be possible to study the evolution of Ly-α emitters and to understand their role in the galaxy formation process.

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# XX MARKS the SPOT

*Caty Pilachowski*

Klaus Strassmeier (Vienna) used the technique of Doppler imaging on observations obtained with the KPNO 0.9-m coudé feed telescope to discover the largest starspot ever seen. Images reconstructed from a series of spectra obtained of the K0 giant XX Triangulum (HD 12545) reveal a starspot with dimensions of 12×20 solar radii—60 times the extension of the largest sunspot group ever observed or 10,000 times its areal surface coverage. This spot is by far the largest ever observed.

To observe spots on the surfaces of other stars, astronomers need to "resolve" the stellar disk. This cannot be done directly with the largest telescopes even planned, but Doppler imaging can be used to obtain a map of inhomogeneities on a star's surface. The principle is similar to medical tomography, but instead of a scanner rotating around a fixed object, a rotating star is observed with a fixed telescope. A cool starspot rotating into view at the preceding limb of the star causes a blue-shifted asymmetry in each spectral line profile. This asymmetry moves into the line center at the time of meridian passage, and turns into a red-shifted asymmetry after meridian passage. The asymmetry fades away when the spot disappears at the receding limb. The higher the latitude of the spot, the shorter will be its visible path across the projected disk of the star, or the spot may even be circumpolar if the stellar rotation axis is inclined. All this information is hidden in the variation of the spectral line profiles and is reconstructed by mathematical inversion to create a true picture of the stellar surface. For a successful application, the telescope needs to "see" the entire stellar surface during at least one stellar rotation.

XX Triangulum is an active K0 giant binary star, approximately 10 times larger and twice as massive as the Sun. Its rotation period is 24 days, so that 24 consecutive (clear) nights of telescope time with an excellent high-resolution optical spectrograph are needed to obtain a good Doppler image. Because starspots vary on the same (short) time scales as Sunspots do (they are stable for about one stellar rotation), all the observations must be made on one rotation cycle. NSF's Kitt Peak National Observatory is one of the few facilities worldwide that offers this capability with the 0.9-m coudé feed telescope.

During the observations, XX Triangulum had its brightest magnitude since the discovery of its light variability in 1985 and showed the largest photometric amplitude so far (0.63 magnitudes in V). The large photometric amplitude was explained when the Doppler-imaging inversion algorithm also

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recovered a not-quite-as-large equatorial warm spot (350 K above the photospheric temperature) in the hemisphere opposite the dark spot. Strassmeier speculates that the warm spot harbors the same magnetic field as the cool spot but opposite polarity. Surprisingly, the fact that the star was brighter at a time of high spot activity is in agreement with the solar analogy despite the "unsolar" dimension of the gigantic spot.

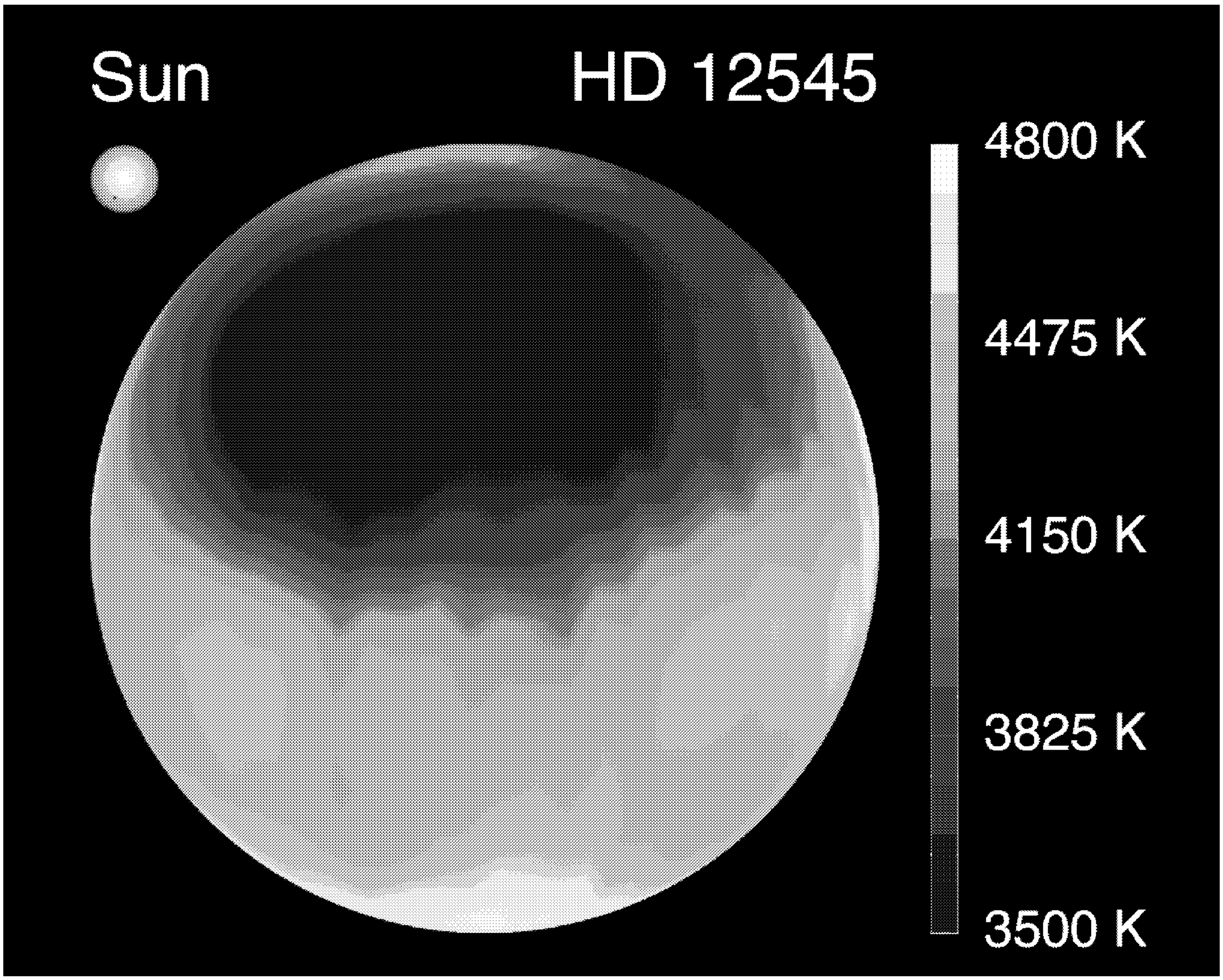


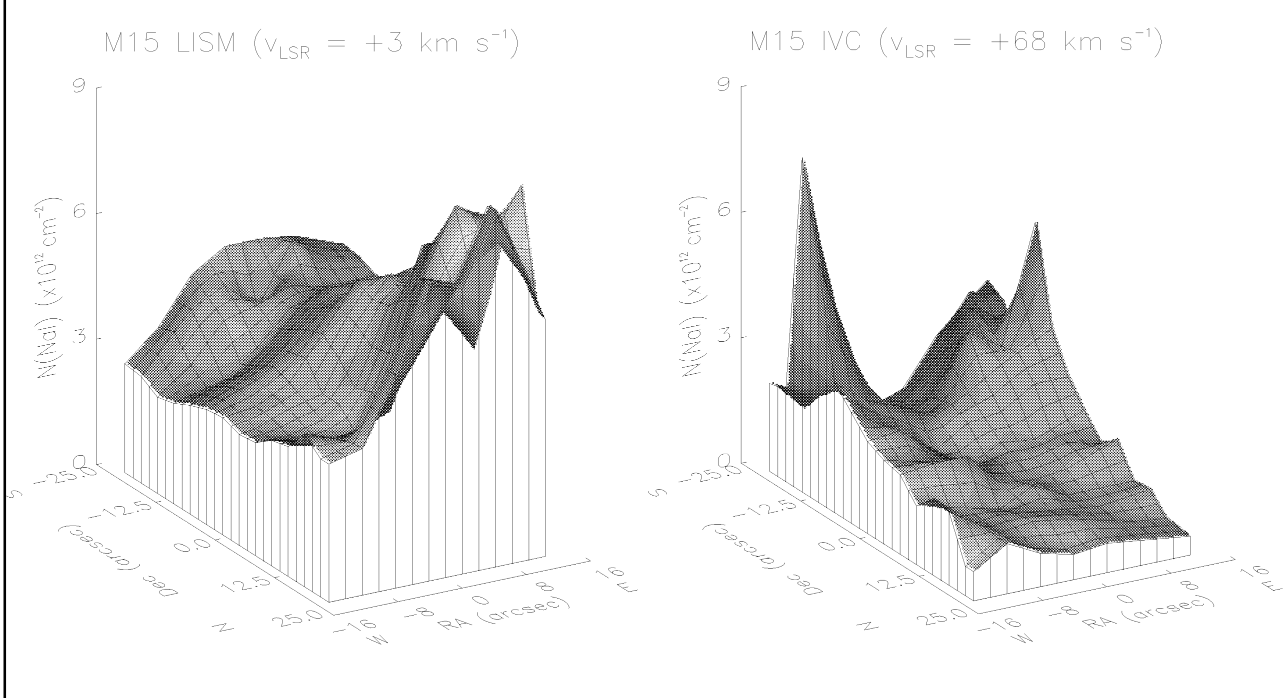

Figure 1. A Doppler image of the K0 giant star HD 12545 (= XX Triangulum) and its super starspot (the dark area in the upper hemisphere). The Doppler image in this picture is shown in a spherical projection at a particular rotational phase with the stellar rotation axis in the plane of the paper. An image of the solar disk is shown to scale as a comparison.

# Use A Cluster to See Clustering in the ISM

*Caty Pilachowski*

David Meyer and James Lauroesch (Northwestern) used the DensePak fiber optic array on the 3.5-m WIYN Telescope at Kitt Peak to study the intervening interstellar gas in the direction of the globular cluster M15. Na I absorption seen along the line-of-sight to the various stars within M15 provides a rich map of the structure within the intervening interstellar medium. Meyer and Lauroesch's results imply either that there is significantly stronger fine-scale structure in the IMS than might have been expected or that there are significant variations in the Na/H ratio from point to point.

Recent studies of HI 21-cm absorption toward high velocity pulsars and extended extragalactic radio sources, as well as optical observations of the interstellar Na I D absorption toward globular cluster stars and binary stars, have revealed subparsec-scale structure in the diffuse interstellar medium. At the spatial scales sampled (~10 to $10^2$ AU in pulsars, ~$10^2$ to $10^4$ AU in binaries, and ~$10^4$ to $10^6$ AU in globular clusters), the observations imply dense concentrations of atomic gas ($n_H \sim 10^3$ $cm^{-3}$) in otherwise diffuse sightlines. These dense concentrations are difficult to accommodate in the standard pressure equilibrium model of the interstellar medium, due to their large overpressures. Two approaches that might account for the observed column densities are a geometric model with lower density sheets or filaments aligned along the line of sight, or a turbulence-




Column density of Na I as a function of RA and DEC along the M15 line-of-sight for two velocity systems.

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driven fractal model that produces structure at even small scales. Observations with both high spatial resolution and good spatial coverage are needed to understand the origin of these diffuse structures in the interstellar medium.

Two major interstellar components are known to exist between the Sun and M15—a local, low velocity ($v_{LSR}$ = +3 km $s^{-1}$) cloud associated with the disk (LISM), and an intermediate velocity cloud (IVC) at $v_{LSR}$ = +68 km $s^{-1}$. The distances to these components are estimated to be 500 pc and 1500 pc, respectively, based on their presence or absence in the spectra of stars nearby on the sky. The DensePak fiber array consists of 91 (3” diameter) fibers bonded into a 7×13 rectangle that covers 27”×43” of sky, with a center-to-center fiber spacing of 4”. The bright, extended core of M15 provides a background source suitable for mapping the absorption-line structure of the intervening gas at high spatial resolution, in two dimensions, and with full sampling. At these distances, the 4” DensePak fiber spacing translates to spatial resolutions of 2000 and 6000 AU for the LISM and IVC, respectively.

Column densities for the two clouds range from $2.3\times10^{12} \le n(\text{Na I}) \le 8.5\times10^{12}$ $cm^{-2}$ (LISM) and from $5.0\times10^{11} \le n(\text{Na I}) \le 8.0\times10^{12}$ $cm^{-2}$ (IVC).

The column density measurements are shown in the form of maps of the two clouds in the figures. The LISM and IVC gas toward M15 exhibits significant structure in terms of its physical conditions and/or H I column density down to arc second scales. The Na I data seem to rule out both a flat distribution on the 27”×43” scale of the DensePak array and a random distribution on the 4” scale of the individual fibers. Since Na I is not a dominant ion in HI clouds, the physical interpretation of the Na I structure can be ambiguous. However, the N(HI) column density inferred from the IVC N(Na I) column density is a factor of 10 higher than from 21-cm measurements. This implies either that there is significant clumpiness within the HI radio beam or that the N(Na I)/N(H) ratio in the IVC can be significantly higher than that typically observed in the diffuse ISM. In the case of the former, this result would have important implications for determining the metallicities of such halo clouds.

# Definitive Measurement of the Coronal Magnetic Field

*Haosheng Lin*

The magnetic field in the solar corona is generally believed to be responsible for a wide range of phenomena—from being the carrier of MHD waves to heat the corona, to producing the gyro-synchrotron radiation in the radio wavelength range. Yet, there are scarcely any direct measurements of the coronal magnetic field to date. Early magnetograph observations in the “green” Fe XIIII 5303 Å coronal emission line (Harvey 1969) gave us a pretty good idea of just how difficult these measurements could be. The strongest flux he detected in the rising phase of a solar cycle (1967, 1968) was only 13 ± 20 G. More recent spectro-polarimetric measurements (Kuhn 1995) placed an upper limit of 50 G, using the near-infrared Fe XIII 10797 Å line. Linear polarization observations in the 1980’s (Querfeld and Smartt 1984, Arnaud and Newkirk 1987) were more successful in mapping the

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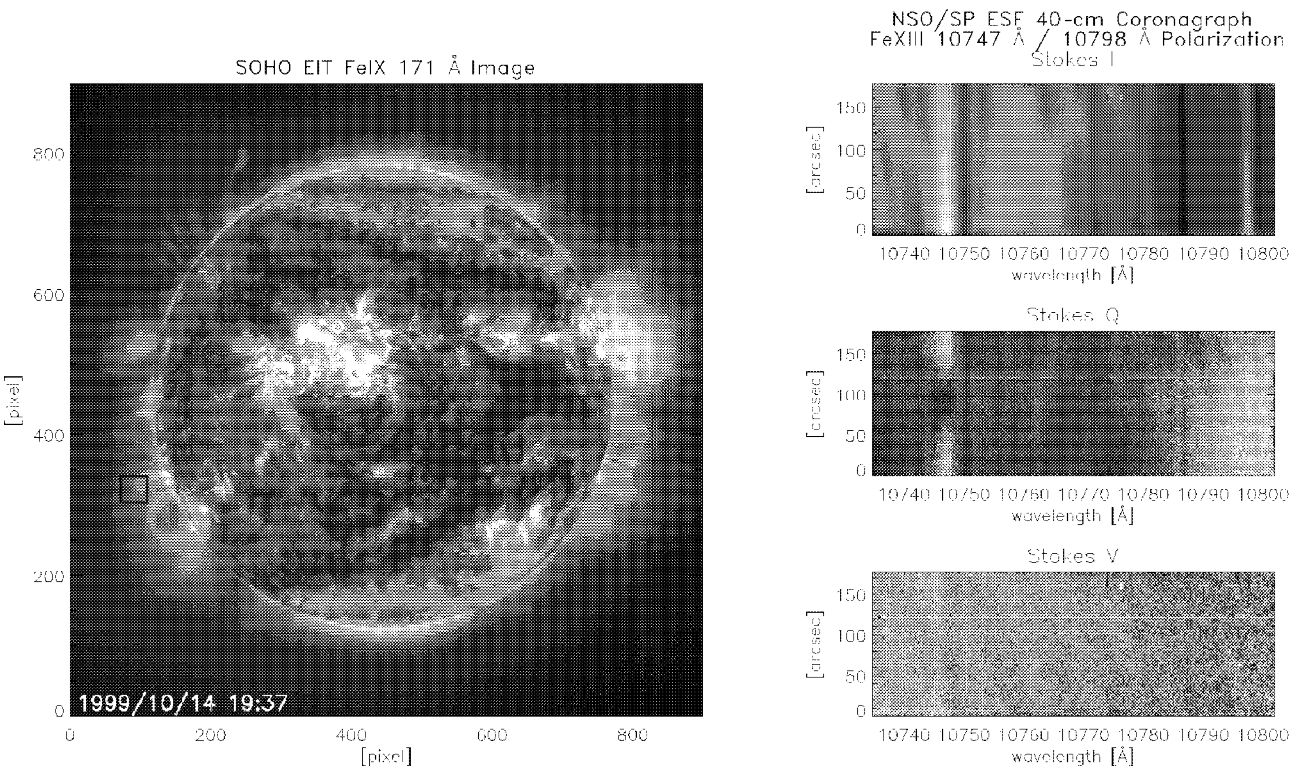


Figure 1. The SoHO EIT Fe IX 171 Å image shows the structure of the solar corona near the time of the IR observation. The region marked by the square box is the target area observed by the IR polarimeter. The Stokes *Q* spectra show variation across the field of view, indicating magnetic field variation across the FOV. The Stokes *V* spectra show a faint anti-symmetric structure across the FOV at the location of the Fe XIII 10747 Å line. The averaged Stokes *V* spectrum is shown in Figure 2. (SoHO/EIT image courtesy of SoHO/EIT consortium. SoHO is a project of international cooperation between ESA and NASA.)

*direction* of the coronal magnetic fields. However, because the linear polarization of coronal emission lines (CEL) is not sensitive to the strength of the magnetic field, no quantitative information of the magnetic flux can be derived from these linear polarization experiments. We are faced with the dilemma of believing that magnetic fields exist in the solar corona and play a crucial rule in almost all coronal activities; numerous new theoretical investigations and results from current space-borne experiments (SoHO, TRACE) only reinforce this conviction, while definitive quantitative measurement of the magnetic field is conspicuously missing. In order to further advance our knowledge of the solar corona, direct measurement of the coronal magnetic field strength and configuration is indispensable.

To first order approximation, the CEL linear polarization measurement only provides information on the orientation of the magnetic field vector. Information about the magnetic field strength (flux) is contained only in the circular polarization of the CELs (Cassini and Judge 1999, Lin and Cassini 1999). Measurement of the Stokes *V* signal due to the coronal magnetic field is one of the most difficult experiments in the field of observational solar astronomy. The magnetic field strength is expected to be very small, around 10 G; therefore,

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the degree of circular polarization is expected to be minute. The high coronal temperature broadens the spectral lines, further reducing the Stokes *V* signal. Under coronal conditions, the expected Stokes *V* amplitude is only $10^{-3} I_{line}$ or smaller. Also, the linear polarization of the CELs is typically two orders of magnitude higher than the circular polarization. Therefore, measurement of the coronal Stokes *V* signal is only feasible with a very sensitive polarimeter with extremely small instrumental (telescope and polarimeter) polarization cross talk. The low photon flux of the emission line solar corona ($\approx 10^{-5}$ disk intensity) also aggravates the situation. Nevertheless, encouraged by recent successes of high-precision spectro-polarimetric observations of weak photospheric magnetic fields, Haosheng Lin (NSO), Steve Tomczyk (HAO), and Matt Penn (Cal State, Northridge) attempted to obtain a quantitative measurement of the coronal magnetic field.

The NSO/Sac Peak Evans Solar Facility's (ESF) 40-cm coronagraph was used for the experiment. Lin and colleagues designed and built a new Echelle spectrograph optimized for the Fe XIII 10747 Å and 10798 10Å line pair. A liquid crystal variable retarder polarimeter and the Michigan State University NICMOS 3 IR camera were used to analyze and record the Stokes spectra. To eliminate telescope polarization cross talk, the polarimeter was mounted directly behind the O1 focus of the coronagraph before any of the polarization cross talk generating reflecting optics. An iterative retardation tuning algorithm was developed to minimize the linear to circular polarization cross talk within the polarimeter itself. With these special considerations in minimizing the instrumental cross talk, the linear to circular cross talk is typically at the low $10^{-3}$ level.

The first positive detection of a coronal Stokes *V* signal was achieved on 14 October 1999, observing in a region of the solar corona with strong (83 millionth of disk-center intensity) Fe XIIII 5303 Å green-line emission. Several attempts during subsequent days in weaker green-line regions yielded weak Stokes *V* signals that were barely above the noise level. Figure 1 shows the IR Fe XIII 10747 Å and 10798 Å emission line *I*, *Q*, and *V* polarization spectra of the October 14 observation, and the SoHO EIT Fe IX 171 Å image to indicate the IR target region (the square box in the EIT image). The integration times for the Stokes *Q* and *V* frames are both 20 minutes, while the total observing time was 70 minutes. A total of 2,048 exposures were taken for this observation. The Stokes *Q* spectrum image clearly shows the linear polarization of both the Fe XIII 10747 Å and 10798 Å lines. The anti-symmetric Stokes *V* signal is only barely discernible in the circular polarization spectrum image. To improve the signal-to-noise ratio of the Stokes *V* signal, we averaged over the full frame to generate an averaged Stokes *V* profile, shown with the averaged Stokes *Q* profile in Figure 2. Here, the anti-symmetric signature of the Stokes *V* profile is unmistakable. There was no evidence of Stokes *Q* to *V* cross talk in the image. A magnetic flux of 33 ± 0.7 (3σ) G was derived from this Stokes *V* spectrum using the standard magnetograph formula. The alignment effect correction to the Stokes *V* profile (Cassini and Judge 1999, Lin and Cassini 1999) was not applied since we did not measure the full Stokes vector. A second detection was obtained on 23 October 1999, when a large active region just rotated behind the west limb of the Sun, which also yielded strong (79 millionths) green line intensity. The amplitude of the Stokes *V* signal of the October 23 observation was smaller compared to the October 23 measurement in line intensity units, but due to better sky conditions (13 millionths) and longer integration time (34 minutes for each Stokes state, 150 minutes total observing time), it was possible to detect a weak Stokes *V* signal. A magnetic flux of 10 ± 0.5 (3σ) G was derived from this region.

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These preliminary results provide the first definitive quantitative measurements of the coronal magnetic field, which will be an important input to all the theoretical modeling of the solar corona. Future measurements with improved signal-to-noise ratio, spatial coverage, and temporal resolution will make major contributions to the advancement of the physics of the solar and stellar coronae.

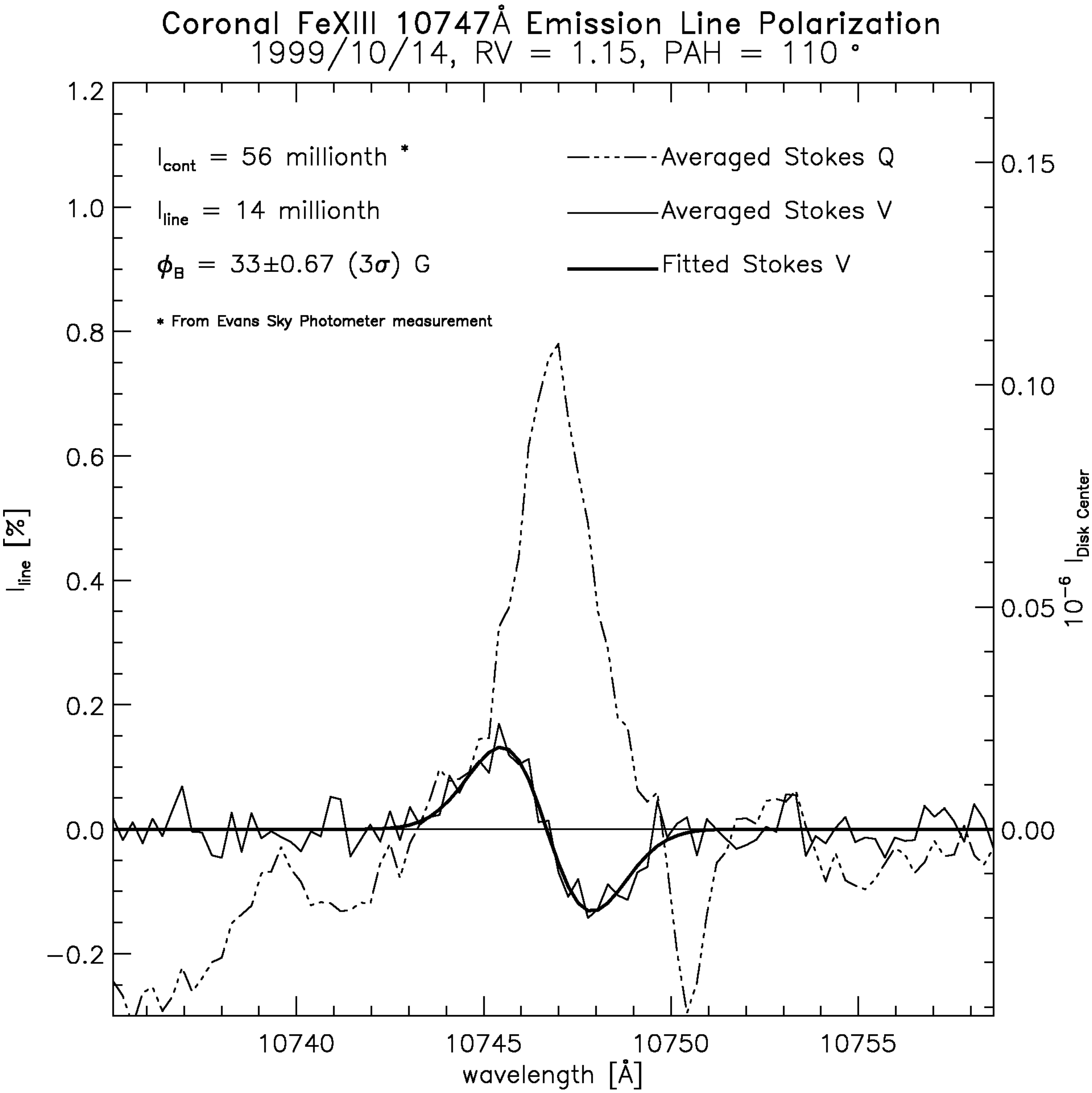


Figure 2. The Stokes *Q* and *V* profiles averaged over the entire field of view in Figure 1. The magnetic anti-symmetric profile of the Stokes *V* spectrum is clearly shown. The thin solid line is the fitted Stokes *V* profile. The observers did not have disk-center intensity calibration data for this observation, and the calibration to disk-center intensity was obtained from sky brightness measurement using the Evans' sky photometer.

# Livermore Imaging Fourier Transform Spectrograph at the McMath-Pierce Telescope

*Ron Wurtz (LLNL)*

A team from Lawrence Livermore National Laboratory (LLNL) and a collaboration investigating an imaging Fourier transform spectrograph (IFTS) for the Next Generation Space Telescope (NGST) obtained data cubes using an IFTS on the main spectrograph table at the McMath-Pierce Solar Telescope Facility. The McMath-Pierce was chosen for several reasons: long experience with Fourier transform spectroscopy, a de-rotated horizontal field, and eagerness for supporting novel user instruments.

LLNL is building a series of instruments to test and demonstrate imaging Michelson interferometry as a viable astronomical technique for multi-object spectroscopy and multi-band imaging. (BEAR at CFHT is the first facility instrument astronomical IFTS. It has been running with two InSb arrays since the mid-1990s.) The LLNL team evolved these visible-band prototype IFTS instruments from other LLNL projects. The long-range goal is to migrate to 4-meter and 10-meter class ground-based telescopes, in the mid-IR as well as the visible. At the same time, these interferometers will help to promote and design IFIRS, an IFTS for the NGST. The LLNL group is working in the IFIRS collaboration, an NGST pre-phase A study led by James Graham (Berkeley).

The advantage of an IFTS for astronomy is that it obtains an interferogram for every pixel. These interferograms can be transformed into spectra

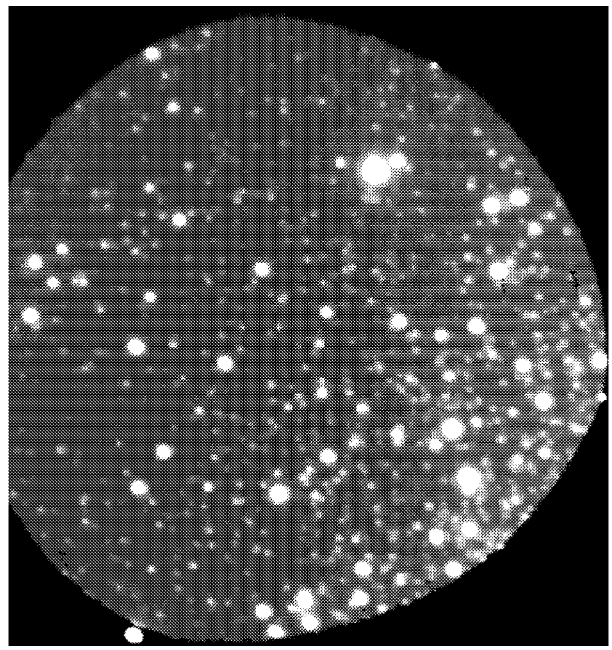

Figure 1. Panchromatic image of edge of M4, made by co-adding the cube of interferometric sample images. The field of view is four arcminutes in diameter. The interferograms of 454 stars were extracted.

resulting in a true data cube—“a spectrum for every pixel.” No field objects need to be pre-selected, no slits need to be placed, and co-adding all the frames of the interferogram yields a deep panchromatic image. When designed properly with two cameras, very few photons are lost—the instrument is simultaneously an imaging camera and a high throughput spectrograph.

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The operation of a ground-based optical IFTS leads to better understanding of the proposed NGST IR instrument. Although NGST is an IR facility, the observing environment of NGST will be quite different from IR observing on the ground. Its orbit at L2 will feature comparatively low backgrounds and long dwell-times. The relatively low background in ground-based optical observing allows mimicking of the long-dwell, step-scan operation of the proposed infrared NGST FTS.

The LLNL instrument brought to the McMath-Pierce facility is a two-input, two-output Michelson interferometer, similar to the team's current design for the NGST instrument. Because this first prototype was sensitive to a changing gravity vector, the team picked off the McMath-Pierce's horizontal focal plane projected onto a (de)rotating table. In the ideal configuration, there are science cameras on both output ports, but this one used a guide camera on the second port. Science data was collected with an off-the-shelf PixelVision CCD camera with a 1024 × 1024, thinned SITe chip thermoelectrically cooled to 235K. The final plate scale was about 0.4"/pixel with an unvignetted field of about 4'. After some modifications to the environment in the spectrograph room, the best seeing was about 1.2".

The IFTS ran for nine, mostly clear nights and obtained data cubes for well-known objects including globular clusters, open clusters, spiral galaxies, elliptical galaxies, and nebular regions. The collaboration presented results from two McMath-Pierce data cubes at the 1999 meeting of the American Astronomical Society in Chicago. The first shows the IFTS as a low resolution photometer for hundreds of stars in the globular cluster M4. The second is a medium resolution data cube of the emission line region around the trapezium in M42.

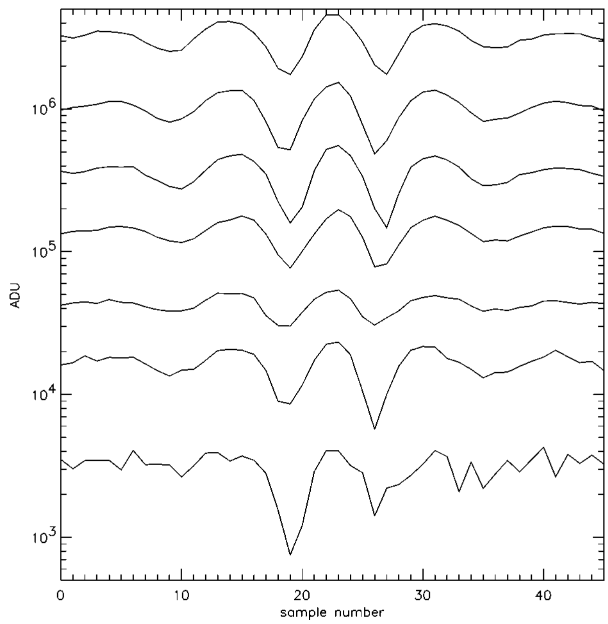


Figure 2. A set of representative interferograms for M4 stars over a range of 7.5 magnitudes. Note that the interferograms are plotted with a logarithmic y-axis.

These are the first-ever visible band astronomical data cubes presented from an IFTS. See Figures 1 and 2.

The LLNL team consists of C. L. Bennett, J. Bixler, D. Carr, K. H. Cook, E. Wishnow (also of SSL), and R. Wurtz. Members of the NGST IFIRS collaboration who made significant contributions to the run were M. C. Abrams (ITT), A. Dey (NOAO), J. R. Graham (UCB), and A. Villemaire (Bomem).

Special acknowledgment goes to the NSO/Kitt Peak staff, particularly Claude Plymate, for helping to make the run a success.

# KNOTES from the HODGEFEST

*Knut Olsen (kolsen@noao.edu)*

*(Since much of Paul Hodge's work, and that of his students and associates, has been carried out in the southern hemisphere and at CTIO, we are pleased to present this conference summary from a former Hodge student and present CTIO postdoc. The Editor.)*

On 9-11 September 1999 more than 40 astronomers converged on Friday Harbor, WA to acknowledge and celebrate the profound influence that Paul Hodge has had on their lives and astronomy. Officially dubbed the Hodgefest (but some preferring "Hodgeapalooza"), the meeting had the atmosphere of both a serious scientific conference and a family reunion. This mix was decidedly appropriate, as Paul has played a leading role in fields as diverse as meteoritics and the distance scale, while also earning the universal admiration of students and colleagues through his kindness and enthusiasm. But by no means was the meeting a send-off party; rather, it was an opportunity for Paul's friends to place a milestone along the path of his career. As Professor of Astronomy at the University of Washington, Paul continues to edit the *Astronomical Journal*, supervise many of the Department's graduate students, and conduct his own astronomical research.

A well-organized set of oral sessions and accompanying posters on subjects representing Paul's many research interests occupied the bulk of the meeting. Don Brownlee (Washington) led off the meeting with an update on Stardust, a NASA Discovery mission currently in flight that will collect cometary particles from Comet Wild 2 and interstellar dust grains, returning the samples to Earth. Don's description of the mission and his video of the launch were impressive, as was his slide of himself and Ed Olszewski as graduate students.

The focus of the meeting then drifted outwards in distance. Ivan King (Berkeley) showed impressive results of using HST to derive proper motions of globular cluster stars, establishing membership and distance through statistical parallax.

The Magellanic Clouds, the subject of Paul's thesis work, merited their own session. Paul introduced the concept of the open cluster specific frequency in considering how to quantify a galaxy's ability to produce open star clusters. The Clouds have been very successful in producing clusters, in stark contrast to galaxies such as IC1613, which have produced practically zero clusters despite their active state of star formation. The concept of separate field star and cluster modes of star formation is confirmed through analysis of the field star formation history of the LMC, discussed separately by Jason Harris (UCSC) and Knut Olsen (CTIO); field star formation appears to have been active in the LMC over a period where few, if any, clusters formed. Olsen echoed a suggestion by Sidney van den Bergh (HIA) that the LMC's Bar may aid in forming clusters.

Much attention was given to the Local Group, one of Paul's favorite astrophysical laboratories. Sidney van den Bergh and Eva Grebel (Washington) gave excellent reviews. Eva focussed on the evolutionary histories of Local Group dwarfs; she concluded that there is no evidence that dwarf irregulars and ellipticals represent exclusive sets of stellar

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populations—there is simply too much variety in their star formation histories. This idea was supported by the many population boxes (a concept introduced by Paul in 1989) of LG dwarfs shown at the meeting: LGS3 (Bryan Miller, Leiden), NGC 185, NGC 205 (Myung Gyoon Lee, Seoul), and Sextans A (Robbie Dohm-Palmer, Michigan), among others. Much of this work was based on HST data, and the color-magnitude diagrams contained spectacular detail; Eline Tolstoy (ESO) showed that the new 8-m ground-based telescopes (e.g., the VLT) will provide still more detail, and extend resolved stellar population work to galaxies outside the local Group. Eric Wilcots (Wisconsin) discussed his ongoing survey of HI gas in Local Group galaxies; while dwarf spheroidals appear to contain very little gas, confirming past searches, one dwarf may harbor distant HI—perhaps the signature of blowout of the ISM. This concept of gas blowout as a result of active star formation in dwarfs was supported by the thorough abundance analyses of Evan Skillman (Minnesota). George Wallerstein (Washington) extended the definition of what makes a Local Group galaxy by suggesting that the globular cluster ω Cen, unique among clusters in containing both an age and metallicity spread, may in fact be the nucleus of a dissolved dwarf galaxy.

Moving beyond the Local Group, Rob Kennicutt (Arizona), representing the HST $H_0$Key Project, made a good case for the Project's claim that $H_0$is now known to an accuracy of 10%. Rob acknowledged that astronomers have reason to be suspicious of such a claim, since $H_0$ has changed by a factor of 10 since Hubble's discovery of the expansion, while published error bars have remained roughly constant (10%). However, Kennicutt argued that parallel rungs of the distance ladder traditionally at odds are now converging to the same value. Much of the remaining uncertainty now hinges on the distance to the LMC. Peter Garnavich (CfA) argued for the benefits of using red clump stars as distance indicators, which produce a distance to the LMC smaller by ~10% than that adopted by the Key project.

There was also plenty of time for social activities, with Friday Harbor offering whale-watching, kayaking, bicycling, and pleasant surroundings for exploration. Despite the attractive venue and superb scientific program, however, not all of the expectant registrants attended, weakly excusing themselves because of HST proposals or other engagements. The worst excuse was judged to be that of Brooke Skelton, who claimed that she was stranded on Orcas Island after a ferry crashed into and splintered the dock—for this whopper of a tale she was offered a prize by Mario Mateo of the Scientific Organizing Committee (1). Nevertheless the conference was well attended, with astronomers arriving from such distant locations as Moscow, Seoul, and Concepción, Chile—though none, argued Mateo, had travelled as far as George Wallerstein, who "comes from another planet."

Thanks go to the SOC—Mario Mateo, Don Brownlee, Schuyler van Dyk, Eva Grebel, Rob Kennicutt, Evan Skillman, and Ed Olszewski—and, of course, Paul Hodge, for making Hodgefest '99 a brilliant success.

(1) New reports have since confirmed Brooke's story of the fiery crash.

# John W. Evans (1909–1999)

## *First Head of Solar Observatory*

*George Simon*

The people of the National Solar Observatory and the worldwide solar community have lost one of their greatest friends, supporters, colleagues, and mentors. John W. (Jack) Evans, first Director of the Sacramento Peak Observatory (Sac Peak), from 1952 to 1976, and his wife, Elizabeth (Betty), died on October 31st at their home in Santa Fe. He was 90 and she was 89. They had been married 67 years.

Jack, who received his PhD from Harvard in 1938, was the third recipient (1982) of the Hale Prize of the Solar Physics Division of the American Astronomical Society. He won the David Richardson Medal (1987) of the Optical Society of America, and was given Honorary Doctor of Science degrees by the University of New Mexico (1967) and Swarthmore College (1970). He received the Newcomb Cleveland Prize of the American Association for the Advancement of Science (1957) and was elected a Fellow of the American Academy of Arts and Sciences (1964). He also received a number of prizes and awards from the Air Force, which operated the Sacramento Peak Observatory while he was the Director, including the Rockefeller Award for Distinguished Public Service (1969), the Distinguished Civilian Service Award (1965), the Guenter Loeser Memorial Award (1967), and the Outstanding Achievement Award (1970).

Starting from a bare site in the Lincoln National Forest, Jack collected an outstanding scientific staff, and with their help, built Sac Peak into the world's premier solar observatory. During those years Sac Peak was such a magnet that over 80% of all US solar astronomers, and over 60% of solar physicists worldwide, spent time at Sac Peak. A number of these scientists later became Directors of other solar institutions. The observatory cost about $100 million to build and remains the only nationally supported solar observatory in the United States. It is now financed chiefly by the National Science Foundation

The Evans are survived by their daughter Nancy, of Santa Fe, by another daughter, Jeanne Regentin of Harbor Springs, Michigan, and by a son, Wayne, of San Carlos, Mexico.

A memorial service for Jack and Betty Evans was held at the Sunspot Astronomy and Visitor Center on November 12, 1999, with family, friends, and former colleagues in attendance.

## from the Director's Office

# Changing Directions and NOAO's Plans

*Sidney Wolff*

NOAO has traditionally had a dual mission—We operate telescopes so that the user community can take data *today*, and we also develop new facilities so that we will continue to provide competitive facilities *tomorrow*. And we must do this for both daytime and nighttime astronomy. It is fair to say that there is no community consensus on what the balance among these activities should be. The challenge in setting priorities is compounded by the fact that all of the goals are good ones. It is still the case that 50 percent of observers do not have access through their home institutions to telescopes with apertures greater than 2 meters. Every time we reduce current services, some observers are disenfranchised; not only can they not obtain ground-based data, their ability to write competitive proposals for spacecraft observations in the absence of ground-based support may also be compromised. At the same time, those who say that the national observatories should concentrate on providing capabilities that are beyond the scope of what universities can offer, are setting an appropriate standard for NOAO. The complexity of the mission and of the organization of NOAO has an additional disadvantage. It is difficult for the community to be certain that the support and advocacy of NOAO will lead to support of those components of the program that they care most about.

We have decided that the best way to address the issue of the complex mission is to simplify NOAO. We plan to reorganize in order to streamline the interfaces to the diverse communities that we serve and also to allow us to focus better on changing the directions of the programs. As many of you already know, I am quite skeptical about solving problems through reorganization. No structure is perfect, and there are only a finite number of ways to organize; so we move in a cycle, each modification correcting the excesses of the previous structure, until we complete the cycle and come back to where we started. NOAO was created 15 years ago by combining KPNO, CTIO, and NSO under common leadership; now we propose to move back to separate solar and nighttime programs, while retaining some of the advantages derived from sharing of personnel and achieving economies of scale, particularly in administrative and facilities support services.

We have, effective with the start of FY 2000, made NSO programmatically separate. Steve Keil now reports directly to AURA, has control over the NSO budget, and will prepare separate program and long range plans for NSO. His position within AURA is now exactly parallel to the position of the NOAO Director in terms of authority and responsibility. Further, the NOAO Director will no longer review any of the programmatic actions taken by the NSO Director. This autonomy for NSO means that advocacy for such initiatives as the Advanced Solar Telescope will be undertaken by the NSO Director and will not have to compete for advocacy with major nighttime initiatives.

I will propose to AURA that the nighttime program be renamed the National Optical Astronomy Observatory (note the singular). The programs of user support, instrument development, time allocation, etc. for CTIO, KPNO, and the US share of Gemini are so closely intertwined that we are already, in practice, operating a

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single observing system. Applications for observing time may request access to any subset of the components of this observing system in order to achieve the optimum strategy for carrying out a complex program.

Within the nighttime program, we must identify resources for several new tasks. The first is support of US users of the Gemini telescopes. NOAO is responsible for Gemini user support except for the time when observations are actually being taken. That means that we must have a good understanding of how to use the instruments so that we can advise users on how to prepare observing proposals and optimize their observing strategies. Planning observations with active telescopes requires more attention to such details as astrometry than is the case for conventional telescopes, and taking effective advantage of the opportunity for queue observations requires very accurate information about exposure times, S/N, etc. We have assigned two mirror scientists , who will be the primary contacts for the US community, to each instrument.

We are also obligated to provide the software for reducing data from the Gemini instruments. Several of the instruments, including the AO system and IFU spectrographs, provide capabilities for which NOAO staff have little previous experience in extracting quantitative information. Even if we rely on outside groups to develop the necessary software, we must still have a deep understanding of the procedures and their limitations in order to incorporate the necessary routines into IRAF.

Overall, we expect a quarter of the nighttime scientific staff, north and south combined, to be focusing on Gemini support. Since the staff size is not changing, this means that there will be relatively less support for users of KPNO and CTIO. This change of emphasis is consistent with recommendations of the users committee, who have stated that support of Gemini should be given high priority and that NOAO staff should focus on doing what the users cannot do for themselves. Fortunately, the instruments at KPNO and CTIO should be relatively stable for the next couple of years, and they are fairly well documented.

A management plan for Gemini support is being developed by Todd Boroson, Bob Schommer, and Caty Pilachowski. In the spring, after the management plan is complete, we plan to transfer responsibility for US Gemini activities from Todd Boroson to Bob Schommer, who will remain at CTIO and who will be assisted by Caty Pilachowski in the north.

There are a number of new directions outlined in the NOAO long range plan (see the NOAO Web site for the plan prepared a year ago; a revision is in progress and will be available in March, 2000). This plan calls for developing the scientific case, defining the science requirements, and conducting the technology studies for the Next Big Telescope (aperture > 30 m).

Several workshops have already been sponsored by AURA, Gemini, and NOAO, and further work is in progress. We have worked with the Steward and Lowell Observatories to develop the scientific case and explore the technical feasibility of constructing a telescope that would be able to conduct an all-sky survey every few days. We are beginning to explore the issues that must be addressed in order to mine the growing number of astronomical databases. We are developing agreements that will make it possible to obtain coordinated ground and space data through a single observing application for programs that will provide rich and coherent data sets for community use.

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In order to explore the opportunities and issues associated with each of these initiatives, we have established a Planning and Development Office, under the leadership of Steve Strom. This office will be responsible for working with the community to define the tasks needed to launch each initiative; identify community capabilities and interests, since we see this work being carried out in partnership with institutions and scientists outside NOAO; and develop proposals for funding. We believe that we must find the resources to prepare proposals from within NOAO; obviously, however, we cannot support major programs like the construction of the NBT from within our current resource base.

NOAO recently announced that it would provide multi-year allocations of observing time for those groups who wished to conduct large-scale surveys that would lead to databases that could address a broad range of problems and that would be made available to the community after a minimal proprietary period. This opportunity was oversubscribed by about a factor of 5/1; five survey proposals were selected. While the groups themselves will be responsible for reducing and archiving the data, it is important to make sure that optimum observing and calibration strategies are adopted from the beginning of the surveys, that the capabilities and limitations of the existing NOAO pipelines are well understood, and that the data are actually made accessible in a timely fashion. Todd Boroson will be taking responsibility for overseeing the NOAO effort to support these surveys.

So where does all this leave us? Still with a complex program, balanced between current services and future investments. We are committed to continuing to operate the Blanco, SOAR, Mayall, and WIYN telescopes for the indefinite future, and the 2.1-m on KPNO for at least the next several years, particularly for wide-field IR imaging. NSO will operate both the McMath and Sac Peak facilities until they are replaced by the Advanced Solar Telescopes. We would still like to see an imaging survey telescope for Chile, and a SOLIS network that spans the globe. We are trying to lay the groundwork for major telescope initiatives for both solar and nighttime astronomy—the Advanced Solar Telescope, a 30-m or larger telescope, and an ultra-wide-field survey telescope, along with advanced capabilities in data mining—with the relative priority and timing for these initiatives being guided by the decade survey, which is now in progress.

One of the pieces of advice I give people is that if it takes a compound sentence to sell an idea or program, then they need to try again. NOAO, unfortunately, takes multiple compound sentences, as the preceding paragraph demonstrates. Simplifying the program either would serve too narrow a range of the science or would not lead to the constant renewal of capabilities that the rapid developments in our field demand.

It is my view that the need for a national observatory will be even greater in the next decade than it was in the previous one. The kinds of questions we are beginning to ask in astronomy require both facilities and data sets that transcend what is likely to be be achievable within the capabilities of a single university or research group. They also transcend what NOAO can achieve by itself. Much larger telescopes, all-sky surveys repeated every few nights, and sustained imaging of the solar surface at a resolution of 0.1" are all within reach; and breakthroughs in our understanding of problems ranging from the changing levels of solar activity to the evolution of galaxies require new facilities. Their successful construction will depend on the talents of *all* of the community. We see the national observatories in both solar and nighttime astronomy (now that there will be one of each) working in new forms of partnership with the community to realize the ambitious goals laid out in NOAO's long range plan.

## NOAO Preprint Series

The following preprints were submitted during the period 15 August 1999 to 15 November 1999. Please direct all requests for copies of preprints to the NOAO author marked.

852 *Méndez, R.A., Paltais, I., Girard, T.M., Kozhurina-Platais, V., van Altena, W.F., "*A Large Local Rotational Speed for the Galaxy Found from Proper-Motions: Implications for the Mass of the Milky-Way*"

853 *Sakai, S., Mould, J.R., Hughes, S.M.G., Huchra, J.P., Macri, L.M., Kennicutt, R.C., HST HoKey Project, "*The Hubble Space Telescope Key Project on the Extragalactic Distance Scale XXIV: The Calibration of Tully-Fisher Relations and the Value of the Hubble Constant*"

854 *Méndez, R.A., Minniti, D., "*Faint Blue Objects on the Hubble Deep Field North & South as Possible Nearby Old Halo White Dwarfs*"

855 *Méndez, R.A., Paltais, I., Girard, T.M., Kozhurina-Platais, V., van Altena, W.F., "*Galactic Kinematics Towards the South Galactic Pole. First Results from the Yale-San Juan Southern Proper-Motion Program*"

856 Corbin, M.R., *Smith, P.S., "*Long-Term Spectroscopic Monitoring of Low-Redshift Quasars. I. Five-Year Report*"

857 *Massey, P., "*An Unprecedented Change in the Spectrum of S Doradus: As Cool As It Gets*"

858 DaCosta, G.S., *Armandroff, T.E., Caldwell, N., Seitzer, P., "*The Dwarf Spheroidal Companions to M31: WFPC2 Observations of Andromeda II*"

859 Julian, W.H., *Samarasinha, N.H., Belton, M.J.S., "*Thermal Straucture of Cometary Active Regions: Comet 1P/Halley*"

860 *Komm, R.W., Howe, R., Hill, F., "*Solar-Cycle Changes in GONG P-Mode Widths and Amplitudes 1995-98*"

## Other NOAO Papers

Preprints that were not included in the NOAO preprint series but are available from staff members are listed below.

Cole, A.A., Tolstoy, E., Gallagher, J.S., Hoessel, J.G., The WFPCZ IDT, *Saha, A., "*Stellar Popluations at the Center of IC 1613*"

Dickinson, M., Hanley, C., Elston, R., Eisenhardt, P.R., Stanford, S.A., Adelberger, K.L., Shapley, A., Steidel, C.C., Papovich, C., Szalay, A.S., Bershady, M.A., Conselice, C.J., Ferguson, H.C., Fruchter, A.S., "*The Unusual Infrared Object HDF–N J123656.3+621322*"

Matthews, L.D., Gallagher, J.S., van Driel, W., "*The Extraordinary 'Superthin' Spiral Galaxy UGC 7321. I. Disk Color Gradients and Global Properties from Multiwavelength Observations*"

Perlman, E.S., Madejski, G., Stocke, J.T., *Rector, T.A., "*X-Ray Spectral Variability of PKS 2005-489 During the Spectacular November 1998 Flare*"

Walborn, N.R., Drissen, L., Parker, J.W., *Saha, A., MacKenty, J.W., White, R.L., "*HST/FOS Spatially Resolved Spectral Classification of Compact OB Groups in the LMC*"

# Observational Programs

## Public Access Observing Time on the Hobby-Eberly Telescope

*Caty Pilachowski and Tom Barnes, University of Texas and McDonald Observatory*

Beginning in June 2000, the 9.2-meter Hobby-Eberly Telescope (HET) at McDonald Observatory will be available to the astronomical community for queue-scheduled observing. This time is made available under an agreement with the National Science Foundation administered through NOAO. The HET is a unique, queue-scheduled, segmented-primary telescope optimized for spectroscopic observations. The agreed amount of time is 101 nights of queue-scheduled observing time over six years. This community access time will be distributed over the phases of the moon and the seasons of the year in the same proportion as the scientific observations scheduled for the members of the HET consortium (The University of Texas at Austin, Pennsylvania State University, Stanford University, Ludwig-Maximilians-Universitaet Muenchen, and Georg-August-Universitaet Goettingen).

Access to HET through the Public Access Program will begin in June 2000. Researchers should be aware that a month of summer shutdown of the HET is a possibility (July or August), with a decision in Spring 2000. Proposals for the period from 1 June 2000 through 31 January 2001 will be due on 31 March 2000. Proposals should be submitted through NOAO using the standard NOAO proposal form. Proposals will be reviewed by the NOAO TAC, and those approved will be forwarded to the HET for queue-scheduling (approximately 20% more proposals will be forwarded than can be scheduled to permit a deep queue).

The unique nature of the HET makes it absolutely essential that potential users of the HET become thoroughly familiar with its capabilities and restrictions. Descriptions of the salient features of the HET may be found in eleven papers in the March 1998 SPIE conferences at Kona, Hawaii. Researchers are especially urged to read Ramsey et al. (SPIE, 3352-06, 1998), Booth et al. (SPIE, 3351-20, 1998), and Gaffney & Cornell (SPIE, 3349-17, 1998). Potential PIs are also strongly urged to become familiar with the HET scheduling tools available on the Web at ***http://www.noao.edu/gateway/het/***.

Among the most important differences between the HET and other NOAO telescopes are the following:

- HET is fully queue-scheduled using a Phase I, Phase II proposal process similar to that of the HST. Approved research programs resulting from Phase I proposals are required to complete a Phase II proposal prior to the commencement of observations. These proposals are described at ***http://www.noao.edu/gateway/het/***.

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- As a queue-scheduled telescope, there is no provision for the researcher to come to the HET. Data and calibrations acquired for a researcher are made available by *ftp* with notification to the researcher shortly after the observation is received at NOAO.

- The design of the HET permits observation only in a torus centered on the zenith. Time critical and synoptic observations must be considered very carefully with this observing constraint. The central circle of the torus is offset 35° from the zenith, permitting observations from approximately 71° to –10 ° declination (see Figure 8 of Ramsey et al. SPIE, 3352-06, 1998).

- Target tracking is accomplished with a prime focus tracker and is limited in duration to the time it takes the target to transit the torus (12°). This varies from about 0.75 hour at the southern declination limit to 2.5 hours at the northern limit.

- The HET has a roving pupil on the primary mirror. This changes the effective aperture (through a maximum of 9.2 m) over the course of an integration.

Investigators will be able to request telescope time on any or all nighttime facilities available through NOAO, including the HET, in a single proposal. Because the HET is queue-scheduled, approved community access programs will be entered into the queue rapidly upon receipt from NOAO of the completed Phase II proposal. Procedures and forms for applying for telescope time will be available on the Web at ***http://www.noao.edu/noaoprop/noaoprop.html*** after 1 February 2000. More detailed information about HET access can be found on the Web at ***http://www.noao.edu/gateway/het/***.

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# Status of the Hobby-Eberly Telescope

*Tom Barnes, University of Texas and McDonald Observatory*

The Hobby-Eberly Telescope has reached the end of its Commissioning phase and has entered 'Early Operations'. The Early Operations phase emphasizes research operation of the HET 50% of each lunation, with instrument commissioning and facility improvements occupying the remainder of the time. Observing time is approximately centered on the date of the new moon. Early Operations will continue at least until June 2000 and may continue into the period of first public access.

In October 1999 the HET is operating at or near specification in pointing, sidereal tracking, autoguiding, and all other essential electromechanical functions. The primary mirror is in operation with a full array of 91 segments (9.2-m aperture on axis). The array is aligned using the Center of Curvature Alignment System (CCAS, a shearing interferometer) in about 15 minutes to a median-delivered primary mirror quality better than 1.1“ (50% encircled energy, EE50). An intensive

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program to improve primary mirror quality to specification, EE(50) = 0.6“, is continuing.

In the presence of typical seeing and immediately after a mirror alignment, the image quality is currently about EE50 = 1.8“. During the course of typical on-object tracks, the primary mirror stack degrades as a function of the ambient thermal gradient. The typical degradation in image quality leads to a delivered image quality for 30 minute tracks between 2.0“ and 2.5“. Imaging performance is expected to improve modestly before June 2000, but major improvement is not expected until installation of the Segment Alignment and Maintenance System (SAMS) on the primary mirror array (an edge-sensor system). The SAMS will provide closed-loop control of the 91 segments and their global radius of curvature. We expect SAMS to reduce the need to align the segments using the CCAS from hourly to twice monthly. With SAMS, we expect the HET to be seeing-limited most of the time. The nominal schedule for SAMS calls for completion in January 2001 and for minimal impact upon research operation during installation.

The community will be kept informed of the status of the HET through frequent updates of the NOAO web site: ***http://www.noao.edu/gateway/het/***.

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# Hobby-Eberly Telescope Instrumentation

*Tom Barnes, University of Texas and McDonald Observatory*

The instrumentation suite of the HET will ultimately include a prime focus Low Resolution Spectrometer (LRS PI Gary Hill, CCD PI Phillip MacQueen, McDonald Observatory), a fiber-fed High Resolution Spectrometer (HRS PI Robert Tull, CCD PI Phillip MacQueen, McDonald Observatory), and a fiber-fed Medium Resolution Spectrometer (MRS PI Larry Ramsey, Pennsylvania State; CCD PI to be determined). During this first Public Access period, the LRS and HRS will be available. The MRS is expected to be commissioned after this initial Public Access period and will then be available under this program.

The LRS is described by Hill et al. (SPIE, 3355-20, 1998), Cobos D. et al. (SPIE, 3355-71, 1998) and Hill et al. (SPIE, 3355-74, 1998). It is a grism spectrometer with imaging, long-slit, and multi-object capability. (Multi-object capability will not be available in this first Public Access period.) The field of view is 4’ in diameter. Two grisms are currently available—grism 1 covers 410 to 1000 nm at R~600 and grism 2 covers 430 to 740 nm at R~1300. Resolutions are quoted for a 1.0“ wide slit. Slit widths of 1.0“, 1.5“, 2.0“, 3.0“, and 10.0“ by 4’ long are available. The CCD is a Ford Aerospace 3072×1024 device with 15 µm pixels, and the image scale is ~0.25“ per pixel. The LRS entered instrument commissioning in April 1999; it is now in research operation. Initial performance characteristics of the LRS are available at ***http://www.noao.edu/gateway/het***. These will be updated as they are refined.

The HRS is a single channel adaptation of the ESO UVES spectrometer as described by Tull (SPIE,

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3355-21, 1998). It uses an R-4 echelle mosaic with cross-dispersing gratings to separate spectral orders. An all-refracting camera images onto a mosaic of two thinned and anti-reflection coated 2K×4K CCDs with 15 µm pixels. The CCDs are abutted along their 4K side with an ~69 pixel dead space between them. This dead space is approximately parallel to the spectral orders. Resolving powers of R ~ 30,000, 60,000, and 120,000 will be available by means of three effective slit widths. Spectral coverage is 420–1100 nm. The HRS is expected to enter instrument commissioning in March 2000. Potential researchers should take note that instruments occasionally slip schedule and that there is some risk of this for HRS in the summer of 2000. Projected performance characteristics of the HRS are available at ***http://www.noao.edu/gateway/het***. These will be updated as instrument commissioning proceeds.

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# MMT Proposals Flood In

*Todd Boroson and Craig Foltz*

In the September *Newsletter*, NOAO and the MMT Observatory jointly announced a call for proposals for public access time on the new 6.5-m telescope of the MMT Observatory. Beginning in March 2000, 162 nights of observing time over 6 years are being made available to the astronomical community under an agreement with the National Science Foundation. Twenty-six proposals requesting 75 nights were received by 30 September for time during the period from March–July, 2000. Since only 11 nights are available to the community during this period, the oversubscription factor is a huge 6.8 (see Observing Request Statistics at the end of this section). The proposals are being reviewed by the NOAO TAC along with all of the CTIO and KPNO proposals also received, and investigators will be notified of the status of their proposals in early December. Successful proposals will be forwarded to the MMT for scheduling, but investigators should note that approximately 20% more proposals will be forwarded than can be scheduled to allow for block scheduling, conflicts in dates, etc. Craig Foltz, the Director of the MMT Observatory, will notify investigators of the dates of their observing runs. Runs early in the semester will be scheduled quickly, but the schedule for the second part of the semester won't be written until the spring.

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# Keck Time for the Gemini Community

*Todd Boroson*

In return for the long-term loan of one of Gemini's Aladdin InSb arrays to the Wm. S. Keck Observatory for use in the 1–5 µm infrared spectrograph, NIRSPEC, the Keck Observatory has agreed to provide 12 nights of telescope time on the Keck II telescope with NIRSPEC to the Gemini community over the next 2 years. The observations will be taken as a "service" program by Gemini staff.

The International Gemini Observatory (IGO) will call for an initial round of proposals for this time early in 2000. Watch for an announcement of an application form and information regarding instrument capabilities, contact information, application rules and deadlines, and observing dates from NOAO.

# Round 2: NOAO Survey Proposals Due March 15

*Todd Boroson*

In 1999 NOAO initiated the first round of Survey Proposals for large programs to be carried out at its CTIO and KPNO facilities. Such programs allow the identification of complete, well defined samples of objects that can yield both conclusions based on statistical analysis of the survey data itself and also provide important subsets for more detailed observations with larger telescopes. Twenty-one Survey Proposals were received, and 5 were accepted. The accepted programs are:

- *Deep Imaging Survey of Nearby Star-Forming Clouds* (PI Bally, Colorado)
- *In Search of Nearby Stars: A Parallax Program at CTIO* (PI Henry, JHU)
- *The NOAO Deep Wide-Field Survey* (PI Jannuzi and Dey, NOAO)
- *Deep Lens Survey* (PI Tyson, Lucent)
- *A Fundamental Plane Peculiar Velocity Survey of Rich Clusters within 200 $h^{-1}$ Mpc* (PI Willick, Stanford)

Proposals for the second round of the NOAO Survey Program are due 15 March 2000. Investigators interested in applying for time under the Survey Program MUST submit by 31 January 2000 a letter of intent to propose a survey program describing the broad scientific goals of the program, the membership of the survey team, the telescopes and instruments to be requested, the approximate amount of time that will be requested, and the duration of the proposed survey. Up to 20% of the telescope time at CTIO and KPNO may be awarded through the Survey Program. About half of this time was awarded in the first round of Survey proposals, and a comparable amount is available for the second round.

A more detailed description of the Survey Program requirements and guidelines is available at *http://www.noao.edu/gateway/surveys/*. Proposals must be initiated using the NOAO Web Proposal form (*http://www.noao.edu/noaoprop/noaoprop.html*), which will be available approximately 15 February 2000.

# NSF Provides Travel Support for Observing at Major Foreign Optical Telescopes

*David S. De Young*

For several years the National Science Foundation has provided funding, administered by NOAO, to support travel to large or unique foreign optical telescopes. The telescopes normally covered by this policy include:

*Anglo-Australian Telescope (Australia)*
*Canada-France-Hawaii Telescope (Hawaii)*
*European Southern Observatory (Chile)*
*Las Campanas Observatory (Chile)*
*La Palma Observatory (Spain)*
*Special Astrophysical Observatory (Russia)*
*United Kingdom Infrared Telescope (Hawaii)*

To qualify for travel support, the applicant must be the PI on the proposal for foreign telescope time, and must be based in the United States. In addition, the PI should give evidence that his/her presence is essential for the successful pursuit of the research program. Graduate students are encouraged to apply if they meet the above criteria. These funds are not available to staff employed at national observatories. Reimbursement covers round-trip intercontinental airfare only; intra-country travel, subsistence and incidental expenses are not covered. Normally, only one trip per fiscal year per investigator can be supported (our fiscal year begins 1 October).

To apply, send a letter explaining why your presence is essential at the foreign telescope, together with a copy of your proposal and the letter or observing schedule that indicates you have been granted observing time. Please mail this to me at the following address:

David S. DeYoung
NOAO
P. O. Box 26732
Tucson, AZ 85726-6732

Requests should be received at least one month before travel commences. Please note that travel must be on a US carrier if available.

# 2000A KPNO Observing Request Statistics
# February 2000 - July 2000

## Summary

| | 4m | WIYN | 2.1m | CF | 0.9m | W2HR |
|---|---|---|---|---|---|---|
| No. of requests | 112 | 44 | 68 | 21 | 28 | 7 |
| No. of nights requested | 375.60 | 103.98 | 311.20 | 166.00 | 157.50 | 1.75 |
| No. of nights available* | 140 | 62 | 120 | 143 | 156 | |
| Oversubscription | 5.62 | 1.68 | 2.59 | 1.16 | 3.10 | |
| Average request | 3.38 | 2.36 | 4.58 | 7.90 | 5.63 | 0.25 |

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

*Requests by Telescope:*

## 4m Telescope

| | Requests | | Nights Requested | | Total Nights | |
|---|---|---|---|---|---|---|
| Instrument | Dark | Bright | Dark | Bright | Requested | Percentage |
| CRSP | 0 | 1 | 0.00 | 4.00 | 4.00 | 1.1% |
| CRYOL | 1 | 1 | 3.00 | 2.00 | 5.00 | 1.3% |
| CRYOM | 3 | 0 | 13.00 | 0.00 | 13.00 | 3.4% |
| ECHLB | 0 | 1 | 0.00 | 3.00 | 3.00 | 0.8% |
| ECHLR | 0 | 6 | 0.00 | 17.00 | 17.00 | 4.5% |
| ECHUV | 0 | 1 | 0.00 | 4.00 | 4.00 | 1.1% |
| IRIM | 0 | 4 | 0.00 | 15.00 | 15.00 | 3.9% |
| MOSA | 38 | 5 | 129.00 | 17.00 | 146.00 | 39.7% |
| ONIS | 0 | 7 | 0.00 | 14.60 | 14.60 | 3.8% |
| PFIM | 5 | 3 | 20.00 | 9.00 | 29.00 | 7.6% |
| PHX | 0 | 9 | 0.00 | 29.00 | 29.00 | 7.6% |
| RCSPL | 15 | 8 | 54.00 | 26.00 | 80.00 | 21.0% |
| RCSPM | 1 | 0 | 3.00 | 0.00 | 3.00 | 0.8% |
| VIS | 1 | 1 | 4.00 | 9.00 | 13.00 | 3.4% |
| | 64 | 47 | 226.00 | 149.60 | 375.60 | 100.0% |

## WIYN Telescope

| | Requests | | Nights Requested | | Total Nights | |
|---|---|---|---|---|---|---|
| Instrument | Dark | Bright | Dark | Bright | Requested | Percentage |
| DSPKB | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| DSPKR | 0 | 3 | 0.00 | 6.00 | 6.00 | 5.8% |
| HYDRB | 3 | 5 | 10.40 | 15.00 | 25.40 | 24.4% |
| HYDRR | 6 | 7 | 13.50 | 18.50 | 32.00 | 30.8% |
| MIMO | 16 | 4 | 36.43 | 4.15 | 40.58 | 39.0% |
| | 25 | 19 | 60.33 | 43.65 | 103.98 | 100.0% |

## 2.1m Telescope

| Instrument | Requests Dark | Requests Bright | Nights Requested Dark | Nights Requested Bright | Total Nights Requested | Percentage |
|---|---|---|---|---|---|---|
| CFIM | 17 | 2 | 95.00 | 7.00 | 102.00 | 32.8% |
| CRSP | 1 | 4 | 4.00 | 7.00 | 11.00 | 3.5% |
| GCAM | 8 | 10 | 40.00 | 36.00 | 76.00 | 24.4% |
| IRIM | 1 | 2 | 2.00 | 7.00 | 9.00 | 2.9% |
| ONIS | 0 | 15 | 0.00 | 83.20 | 83.20 | 26.7% |
| PHX | 0 | 8 | 0.00 | 30.00 | 30.00 | 9.6% |
| SQIID | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| VIS | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| | 27 | 41 | 141.00 | 170.20 | 311.20 | 100.0% |

## CF Telescope

| Instrument | Requests Dark | Requests Bright | Nights Requested Dark | Nights Requested Bright | Total Nights Requested | Percentage |
|---|---|---|---|---|---|---|
| CAM5 | 2 | 12 | 28.00 | 88.00 | 116.00 | 69.9% |
| CAM6 | 0 | 7 | 0.00 | 50.00 | 50.00 | 30.1% |
| VIS | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| | 2 | 19 | 28.00 | 138.00 | 166.00 | 100.0% |

## 0.9m Telescope

| Instrument | Requests Dark | Requests Bright | Nights Requested Dark | Nights Requested Bright | Total Nights Requested | Percentage |
|---|---|---|---|---|---|---|
| MOSA | 18 | 10 | 106.50 | 51.00 | 157.50 | 100.0% |
| VIS | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| | 18 | 10 | 106.50 | 51.00 | 157.50 | 100.0% |

## W2HR Telescope

| Instrument | Requests Dark | Requests Bright | Nights Requested Dark | Nights Requested Bright | Total Nights Requested | Percentage |
|---|---|---|---|---|---|---|
| DSPKB | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| DSPKR | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| HYDRB | 2 | 1 | 0.50 | 0.25 | 0.75 | 42.9% |
| HYDRR | 3 | 0 | 0.75 | 0.00 | 0.75 | 42.9% |
| MIMO | 0 | 1 | 0.00 | 0.25 | 0.25 | 14.3% |
| | 5 | 2 | 1.25 | 0.50 | 1.75 | 100.0% |

# 2000A CTIO Observing Request Statistics
# February 2000 - July 2000

## Summary

| | 4m | 1.5m | YALO | 0.9m | 0.9mQ | SCHM |
|---|---|---|---|---|---|---|
| No. of requests | 114 | 50 | 8 | 25 | 13 | 6 |
| No. of nights requested | 363.90 | 211.50 | 37.40 | 207.00 | 118.50 | 37.00 |
| No. of nights available* | 122 | 141 | 22 | 99 | 25 | 79 |
| Oversubscription | 5.70 | 1.50 | 1.70 | 3.10 | 4.74 | 0.47 |
| Average request | 3.19 | 4.23 | 4.67 | 8.28 | 9.12 | 6.17 |

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

*Requests by Telescope:*

## 4m Telescope

| | Requests | | Nights Requested | | Total Nights | |
|---|---|---|---|---|---|---|
| Instrument | Dark | Bright | Dark | Bright | Requested | Percentage |
| CIRIM | 0 | 4 | 0.00 | 14.00 | 14.00 | 3.8% |
| ECH | 0 | 13 | 0.00 | 52.00 | 52.00 | 14.3% |
| HYDR | 5 | 7 | 15.00 | 26.00 | 41.00 | 11.3% |
| IRS | 0 | 7 | 0.00 | 19.00 | 19.00 | 5.2% |
| MOSAIC | 28 | 6 | 82.50 | 15.00 | 97.50 | 26.8% |
| OSIRIS | 0 | 18 | 0.00 | 42.10 | 47.10 | 12.9% |
| RCSP | 18 | 6 | 60.80 | 17.50 | 78.30 | 21.5% |
| VIS | 1 | 2 | 3.00 | 12.00 | 15.00 | 4.1% |
| | 52 | 63 | 161.30 | 197.60 | 363.90 | 100.0% |

## 1.5m Telescope

| | Requests | | Nights Requested | | Total Nights | |
|---|---|---|---|---|---|---|
| Instrument | Dark | Bright | Dark | Bright | Requested | Percentage |
| ASCAP | 1 | 4 | 6.00 | 22.50 | 28.50 | 13.5% |
| BME | 0 | 3 | 0.00 | 13.00 | 13.00 | 6.1% |
| CFIM14 | 5 | 6 | 15.00 | 31.00 | 46.00 | 21.7% |
| CFIM8 | 9 | 1 | 38.00 | 4.00 | 42.00 | 19.9% |
| CIRIM | 0 | 5 | 0.00 | 12.00 | 12.00 | 5.7% |
| CSPEC | 5 | 3 | 23.00 | 14.00 | 37.00 | 17.5% |
| OSIRIS | 1 | 7 | 2.00 | 31.00 | 33.00 | 15.6% |
| VIS | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| | 21 | 29 | 84.00 | 127.50 | 211.50 | 100.0% |

## YALO Telescope

| Instrument | Requests Dark | Requests Bright | Nights Requested Dark | Nights Requested Bright | Total Nights Requested | Percentage |
|---|---|---|---|---|---|---|
| ANDICAM | 1 | 7 | 4.00 | 33.40 | 37.40 | 100.0% |
| | 1 | 7 | 4.00 | 33.40 | 37.40 | 100.0% |

## 0.9m Telescope

| Instrument | Requests Dark | Requests Bright | Nights Requested Dark | Nights Requested Bright | Total Nights Requested | Percentage |
|---|---|---|---|---|---|---|
| CFIM | 3 | 22 | 28.00 | 179.00 | 207.00 | 100.0% |
| VIS | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| | 3 | 22 | 28.00 | 179.00 | 207.00 | 100.0% |

## 0.9mQ Telescope

| Instrument | Requests Dark | Requests Bright | Nights Requested Dark | Nights Requested Bright | Total Nights Requested | Percentage |
|---|---|---|---|---|---|---|
| CFIM | 2 | 11 | 5.00 | 113.50 | 118.50 | 100.0% |
| | 2 | 11 | 5.00 | 113.50 | 118.50 | 100.0% |

## SCHM Telescope

| Instrument | Requests Dark | Requests Bright | Nights Requested Dark | Nights Requested Bright | Total Nights Requested | Percentage |
|---|---|---|---|---|---|---|
| NFDIR | 4 | 2 | 22.00 | 15.00 | 37.00 | 100.0% |
| NFPRM | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.0% |
| | 4 | 2 | 22.00 | 15.00 | 37.00 | 100.0% |

# 2000A MMT Observing Request Statistics
# February 2000 - July 2000

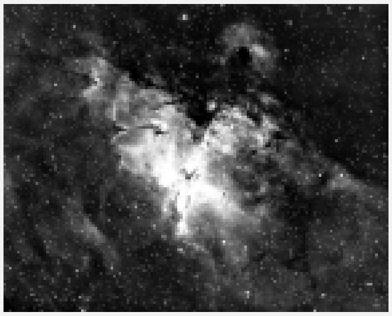
## Summary

| | MMT |
|---|---|
| No. of requests | 26 |
| No. of nights requested | 75.00 |
| No. of nights available | 11 |
| Oversubscription | 6.82 |
| Average request | 2.8 |

*Requests by Telescope:*

## MMT Telescope

| | Requests | | Nights Requested | | Total Nights | |
|---|---|---|---|---|---|---|
| Instrument | Dark | Bright | Dark | Bright | Requested | Percentage |
| BCHAN | 5 | 2 | 18.00 | 2.00 | 20.00 | 26.7% |
| FSPEC | 0 | 1 | 0.00 | 5.00 | 5.00 | 6.7% |
| MCAM | 2 | 1 | 11.00 | 4.00 | 15.00 | 20.0% |
| MIRAC3 | 0 | 4 | 0.00 | 10.00 | 10.00 | 13.3% |
| PISCES | 0 | 4 | 0.00 | 11.00 | 11.00 | 14.7% |
| RCHAN | 5 | 1 | 10.00 | 2.00 | 12.00 | 16.0% |
| SPOL | 1 | 0 | 2.00 | 0.00 | 2.00 | 2.7% |
| | 13 | 13 | 41.00 | 34.00 | 75.00 | 100.0% |



# C T I O
## O P E R A T I O N S

## MOSAIC II
### Successfully Commissioned

*Bob Schommer (bschommmer@noao.edu)*
*for the Mosaic II team*

During July and August, the Mosaic II camera was commissioned on the Blanco 4-m telescope. The first shared-risk science observing in August was successful. The long September science run also provided excellent data (guided 600 exposures with 0.6-0.7” FWHM on several occasions) despite some cloudy nights due to a late Chilean winter weather pattern. We are currently (mid-October) performing lab tests and further improving the system robustness, and will be operating in the 8-channel mode for the remainder of the semester. We have found a small mis-space in the back focal distance from the Blanco prime focus Atmospheric Dispersion Corrector. This produces elongated images at the corners of the field. Some mechanical work should eliminate this and produce a very flat focal plane for the November science run. Check our web page for the latest news and system performance (*www.ctio.noao.edu/mosaic/index.html* ).

## CTIO Hydra Update

*T. Ingerson (tingerson@noao.edu)*

The CTIO Hydra fiber positioner has proven to be robust and reliable. It positions fibers accurately and consistently. The bench spectrograph also performs as expected. Overall instrument performance has been compromised because it has been necessary to use the Loral 1K x 3K CCD with the Air Schmidt camera on Hydra. This limits users to a maximum of about 60 independent targets at only fair efficiency. This was a choice we made in order to get the Hydra functionality on the air as quickly as possible, rather than wait on the final camera.

Now that MOSAIC is operational, resources have been freed to allow work to proceed on commissioning the design detector for Hydra. This is a SiTe 2 x 4K in a 400mm f.l. bench-mounted Schmidt camera. This new camera/CCD combination is expected to allow Hydra/CTIO to use all its fibers simultaneously and with significantly higher efficiency and resolution than at present. The new camera and CCD will almost certainly become operational sometime next semester.

The large (300 µm/2”) Hydra fibers have performed well to date. Slit plates 200 µm and 100 µm wide can be placed in front of the line of fibers in the spectrograph to improve resolution, albeit with some loss of light.

The small (200 µm/1.3”) fibers have been a disappointment. They proved to be quite brittle, apparently as a result of manufacturing problems. After they had been installed in Hydra, about half were found to have low or zero throughput. This means that even with the new camera/CCD combination, only about 60 independent targets will be selectable with the small fibers. Fortunately, the small fibers do not appear to break while being positioned, so we believe the number of targets that can be observed with the them will remain constant. This will provide enough fibers to be adequate for many programs.

*continued*

The primary motivation for using the small fibers is to obtain better S/N by excluding sky. Use of 1.3” fibers is indicated only for very dim objects when seeing is better than about 0.7”, which is uncommon. We expect almost all observers will request the large fibers. Thus, scientific use of Hydra now is little compromised by the small-fiber problem. The defective fibers could be replaced, but it would be expensive and it is not an easy job. At present there are no plans to do so.

# On the Road Again

## Travelling with a Laptop Computer

*Chris Smith (csmith@noao.edu)*

More and more visiting astronomers are asking if they can bring their own computers to CTIO with them and connect them to our network. You are welcome to do so, and we are taking measures to make the experience easier and safer.

### Plugging In

We have installed spare ethernet connections at each telescope and downtown in the computer room and conference room, specifically for visitor computer use. These are 10/100 baseT connections (the ones that look like phone jacks on steroids). You should plan on bringing your own ethernet cable just in case, as our spares seem to disappear at an amazing rate and we may or may not have any available. Near each of these connections we have a label providing all of the general setup information (IP numbers, gateway/router, DNS, etc.) necessary for you to get up and running on our network. Please be familiar with how to change these settings on your computer before you come down. Given the variety of operating systems and network configurations that computers sport these days, we cannot guarantee support for setting up visitors’ computers. Finally, before plugging in please read and follow CTIO’s guidelines for visiting computers (*http://www.ctio.noao.edu/sys/usys.html*). In particular, misconfigured Linux machines can play havoc with our local network.

### Remote Connections:
#### Getting Out of and into CTIO Computers

We’ve taken a number of additional steps to improve the security of the CTIO network. Most importantly, we installed a firewall that separates the outside network (which now connects directly in La Serena) to our internal net, which includes both La Serena and Tololo. For most users, this change should be transparent, but if you’ve brought your own computer, you may find that some services, like FTP and telnet connections into your computer, are blocked from outside our network.

Whether you’re on your own portable or logged in to one of CTIO’s machines, we strongly recommend that you use the SSH (Secure SHell) software for logging into remote machines. This provides for secure remote log-ins in a way similar to *telnet*, *rlogin*, or *rsh* and for secure file transfers in a way analogous to *rcp*. This software package is available for most operating systems, and is free of charge to educational and noncommercial users, while an enhanced version is available commercially (follow the links on the CTIO security page for further information on SSH):

*http://www.ctio.noao.edu/sys/security.html*

We have installed the SSH on all our machines, and do not accept log-ins from machines outside the *ctio.noao.edu* domain except via *ssh*. This means that users who wish to log into our machines from outside must first install *ssh* on their home machines. You will still be able to log onto your home machine from CTIO without using *ssh*, using *telnet*, for

*continued*

example. However, we strongly recommend using *ssh* if you have it installed on your home machine, in this case to protect your home system.

FTP service is another security risk that we have severely limited. Regular anonymous FTP service for getting information from our systems (e.g., downloading instrument manuals, etc.) is only available through our central server, *www.ctio.noao.edu*. Depositing files into the CTIO anonymous FTP area is not allowed. If you need to transfer files down here while you're observing, you can pull them in by FTPing from our machines to your home machine. Alternatively, we encourage you to use *scp*, the secure remote copy component of *ssh*, as an alternative to FTP to bring your files over.

# CTIO Staff Garner AURA Awards

*Ron Probst (rprobst@noao.edu)*

In a ceremony held in the CTIO Library in May, AURA President Goetz Oertel distributed AURA science and service awards to several staff.

Science awards went to Nick Suntzeff, Co-Principal Investigator (with Brian Schmidt, Mt. Stromlo Observatory) on the High-Z Supernova Project, and to local project team members Bob Schommer and Chris Smith, for their efforts in using supernovae to determine the distance scale of the Universe. The startling conclusion reached by this group, and by an independent effort led by Saul Perlmutter (Berkeley), is that the expansion of the Universe appears to be accelerating. This result was named by the journal *Science* as the top scientific discovery for 1998. It has had great impact not only scientifically, but also in the popular press, contributing to the public perception of astronomy as an exciting cultural endeavor. Far from resting on these well-deserved laurels, Nick will be on sabbatical in Australia in early 1999 to continue his work in this field in association with Dr. Schmidt.

AURA presented a service award to longtime CTIO administrative staff member Elaine Mac-Auliffe "for her sustained outstanding service in pursuit of the AURA mission in Chile." Elaine's dedication to the highest possible level of service in support of our mission is well known to CTIO staff and scientific visitors. Elaine is now Administrative Assistant to the Director of the AURA Observatory in Chile, and to the NOAO Associate Director of CTIO.

# Update on 4-M TIP/TILT Activities

*Ron Probst (rprobst@noao.edu), Maxime Boccas (mboccas@noao.edu),*
*Patrice Bouchet (pbouchet@noao.edu), Eduardo Mondaca (emondaca@noao.edu),*
*Ricardo Schmidt (rschmidt@noao.edu), and Rolando Cantaruti (rcantaruti@noao.edu)*

The IR f/14 tip/tilt system has been in use for about a year and a half now. It has performed reliably and has delivered an improvement in IR image quality. We have continued to improve its performance, reliability, and ease of use, within a resource environment constrained by work on SOAR, Hydra, and MOSAIC.

We have just upgraded the optical tip/tilt sensor to one that is better suited to our small-field, high-speed application. This is an EEV CCD 39-02 with 80×80 pixel format, 4 $e^-$ read noise, and QE in excess of 0.7 from 0.4 to 0.75 μm; 0.9 in the V band. We use reducing optics to optimally match its 24 μm pixels to the reference star FWHM for use with a quadrant-sensor algorithm. With lower read noise and higher QE than its predecessor, this sensor should give better performance on stars of intermediate brightness (V ~10–15) and permit guiding on fainter stars than previously. In initial tests under full moon and a hazy sky, we were able to guide robustly on a V = 16.5 star at a correction frequency of 20 Hz, a factor of two gain in speed. Correcting faster on a brighter star (V ~11.5, 130 Hz) produced an rms error of the star centroid of 0.01”. This represents significant improvement in the minimum necessary speed, reference star faintness, and achieved correction with respect to previous performance.

Optimizing system operating parameters for best performance under different conditions requires experimentation with actual seeing-degraded images. Since the 4-m telescope is a very expensive optical bench, we have set up an atmospheric seeing simulator, or “turbulator,” for lab tests in La Serena. This is based on a simple design developed by a French group (Masciadri and Vernin, *Applied Optics* 36, 1320, 1997). It has allowed us to use our telescope engineering time to best effect as we work on improving the hardware and the algorithms.

Several background tasks to address system maintenance issues, invisible to users, have been accomplished or are ongoing. The piezo controller electronics from Physik Instrumente have been replaced and duplicated to provide a backup. Telemetry circuitry developed in-house has been added to the controller for easier setup and troubleshooting, from the control room, of piezo control behind the secondary. Printed circuit boards, which had been modified extensively by hand during system commissioning, are being replaced with final versions to avoid subtle failures later. Mountain personnel have been systematically trained in setup, operations, maintenance, and troubleshooting at the telescope, and in La Serena during lab tests. A second dedicated instrument PC was purchased to provide a backup, but unfortunately some internal components necessary for network communication on the mountain were damaged beyond repair in last April’s lightning storm. This PC is now used in La Serena with the laboratory simulator. Finally, recovery from a severe mechanical miscollimation following removal and replacement of the entire system (for work on the prime focus pedestal in support of MOSAIC II) resulted in some mechanical modifications to prevent a recurrence.

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While the job of a tip/tilt sensor is to stabilize an image centroid (and our system does this very well), the ultimate goal is to deliver a tighter image to the science sensor. Other aspects of the wavefront error that we can control relate to optical alignment and the telescope thermal environment. Optical engineer Max Boccas has taken the lead on these issues. Telescope alignment, diagnosible in real time with the IMage ANalyzer, has been improved. The mechanical modifications mentioned above also addressed a small random decenter of the f/14 secondary. Once we are satisfied that this is under control, we can institute a lookup-table active correction for the secondary similar to what is done now for the 4-m primary. We are also investigating alignment issues between the tip/tilt optics box and the IR cameras, and improving thermal control of the Cass cage environment and the primary mirror. These are now the areas where we expect improvements to impact FWHM with our stabilized images.

# Science and Support:
## Whom to Ask About What

*Alistair Walker (awalker@noao.edu) and*
*Ron Probst (rprobst@noao.edu)*

Due to sabbaticals and other comings and goings of the scientific staff, there have been some changes in staff responsibilities related to telescope, instrument, and visitor support. The reorganization of administrative responsibilities into AURA Observatory Support Services should be transparent to users, but a summary of whom to ask about what seems timely for these activities also. Everyone listed below can be contacted by email. Addresses are of the form (*first initial + last name*)*@noao.edu*, for example *msmith@noao.edu*. Where two names are listed, please copy any query to both people.

### Scientific and Technical Support

A useful summary of whom to ask about what can be found on our Web pages at *http://www.ctio.noao.edu/obsaid/staff_resp.html*. This is accessed from the CTIO home page by clicking on "Observing Resources and Forms," scrolling to the section "CTIO staff support," and clicking on "staff members to contact."

Astronomers who are awarded observing time at CTIO are assigned a staff contact scientist, named on the Proposal Report Form. This is your contact for astronomical and technical questions prior to your run. It is also wise to touch base with your contact upon arrival in La Serena. During your run, this is also the person to contact with any question that mountain Observer Support people can't answer. Your staff contact can be identified by consulting your Proposal Report Form or by following the Web links given above to the list for the current semester, e.g., *http://www.ctio.noao.edu/obsaid/contacts_1999B.html*.

Individual staff scientists have particular responsibilities for various telescopes and instruments. Your staff contact may refer a query to one of these local experts. They can also be consulted for information about our facilities before a proposal is scheduled, for example while preparing your proposal. Follow the Web links via "staff members to contact" to *.../obsaid/responsibilities.html* for the current list.

The Telescopes Operations division (TELOPS) is responsible for operating and maintaining the telescopes and instruments on Cerro Tololo. TELOPS is divided into three sections. People in Observing Support are responsible for introducing

*continued*

observers to their telescope and instrument, and for nighttime operations. This team is backed up by Telescope Mechanics and by Telescope Electronics. Specific members of the Electronics Section are knowledgeable and responsible for various instrument systems. Names and lists are Web-accessible via the "staff members to contact" page. Normally, you would not need any advance contact with these staff. The division manager is Oscar Saa. While you are on the mountain, he is the person to talk to (together with your staff contact) if some difficulty that needs real-time resolution seems to persist.

If there is an instrument or telescope problem, the night assistant will call the relevant people to assist. On the 4-m this call-out is allowed at any time of night. On the smaller telescopes, there is a midnight cutoff. Almost all problems can be fixed by the Tololo support team, at times in consultation with staff in La Serena. Some problems take longer than others; if there is a failure lasting more than one hour, the observers are strongly urged to call their contact scientist. Our electronic nightly reporting system should also be used to ensure prompt follow-on response the next morning.

## Administrative Matters

A great deal of necessary and useful information about planning your trip and professional travel within Chile can be accessed from the CTIO homepage by clicking on "Preparing for an observing run" and then "travel information." The URL is *http://www.ctio.noao.edu/misc/observer_info.html*. Web forms that must be submitted in advance, to allow us to support your travel and observing plans, are found via "Observing resources and forms" on the CTIO homepage. If you need information or assistance from a knowledgeable human, one of these people can help:

- *Travel and Lodging Arrangements:* Julia Faltin (Tucson) and Marcela Urquieta (La Serena). Julia and Marcela will arrange transport and lodging within Chile for your professional visit (AURA facilities in Santiago, La Serena, and Tololo) after receiving details of your international travel arrangements.

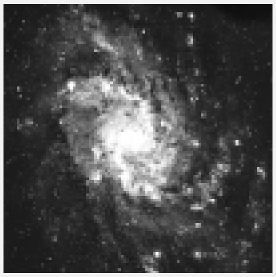
- *Graduate Student Travel Reimbursement:* Julia Faltin. Julia can provide prepaid round-trip airline tickets from US point of departure to La Serena. If you wish to make your own arrangements and then request reimbursement, please contact her first to find out about allowable costs.

- *Paying Your Bill:* Marcela Urquieta. Food and lodging costs are payable in La Serena upon departure. Observers leaving on a weekend or going directly from Tololo to the airport may pay in advance. Cash, personal checks, VISA, and Mastercard are accepted.

- *DD Time Requests:* Alistair Walker and Elaine Mac-Auliffe. Director's Discretionary ("open") time is noted on the Web telescope schedules. CTIO prefers to assign this about two months in advance. An e-mail letter stating telescope, instrument, and dates requested, with a brief outline of the science to be achieved, is required. No travel or lodging support is provided for DD time.

- *Special Requests:* Alistair Walker and Elaine Mac-Auliffe. Anything out of the ordinary, such as permission to arrive on Tololo early, change observers, bring someone not on the original proposal, request an extended stay in the La Serena motel, etc. We try to be as accommodating as possible.

- *Colloquia*: Knut Olsen. We are always happy to hear visitors talk about the exciting science they are doing with our facilities!



# KPNO OPERATIONS

## From the KPNO Director–

# WIYN Telescope Comes Closer to Full Potential

*Richard Green*

The WIYN SAC and Board assembled for their semi-annual meetings at Indiana University on October 22nd and 23rd. The theme was that the current level of base operations support of the Observatory is now at a successful equilibrium. That success is reflected in performance, reliability, and steady progress on new instrumentation. Continuing attention to the WIYN telescope system has produced a continuing improvement in delivered image quality (DIQ). While the median remains at an impressive 0.8", a DIQ of 0.6" or better is achieved 18% of the time. (For reference, the site-delivered median DIQ is ~0.66"). The 23 Hz oscillation of the secondary mirror support, that could elongate images by as much 0.2", has been completely eliminated by improvements to the damping. Another decrease to the local contribution to image distortion is attributable to improved uniformity of primary mirror temperature, by painstaking sector-by-sector recalibration, and tuning of the thermal control system. Finally, improvements to the focus algorithm and its ultimate automatic implementation will both improve the DIQ and save observational overhead.

Even more impressive is the year's average downtime statistic–only 2.5% of time that could have been used for observation was lost to failure. This represents a full factor of two reduction from the previous year's value. The main factor is improved robustness in the complex telescope control software. The typical night-to-night figures are actually better yet, since the average was increased by two significant events during the year–a primary mirror support system failure and a required rework of the cable-wrap "maypole" on the azimuth axis.

Meanwhile, progress is being made on new instruments and upgrades. The Mini-Mosaic imager was successfully used in a shared-risk trial in mid-October, and is expected to be fully commissioned and routinely available by January. This imager contains two of the same SITe 2K×4K CCDs as in the NOAO Mosaic Imagers. It will provide larger field of view and better sampling at the imaging port. The WIYN Tip/Tilt Module has made steady progress as well, with most system trades complete and designs moving into the detail stage. Because we had an unfilled Mechanical Engineer position for almost six months, there has been some delay compared to the most optimistic schedule, but we still anticipate full-time use by 2001. In addition, the University of Wisconsin is moving forward with a Cassegrain instrument adapter, which will accommodate Densepak fiber cables without requiring removal of the imager. It should be ready in time to allow imaging while the Instrument Adapter System is off the telescope to be refitted for the WTTM in early 2001.

*continued*

These improvements are the accomplishments of the many individuals invested in the success of WIYN. Charles Corson has assumed the job of Site Engineer and has been able to devote considerable time to the diagnosis and solution of issues such as the primary mirror thermal non-uniformity and focus. Although the dedicated software engineer, Jeff Lewis, left us earlier this year, Bob Marshall, Shelby Gott, and David Mills have stepped up to understand and substantially improve the control system. As always, the Consortium greatly appreciates the effective efforts of David Sawyer, the WIYN Operations Manager, backed up by Tony Abraham and the KPNO Engineering Team.

The origin of the enhanced effort is the decision by the WIYN Board to increase its annual commitment to the WIYN operations budget. That amount now includes 7.6 FTE of effort, raised from the 6.5 FTE called for in the original agreement, and an additional $100K for capital items and contract efforts. The direct translation of resources into improved performance has been gratifying to the whole Consortium.

Finally, I note a change in NOAO's representation to the WIYN Consortium. Bob Mathieu of the University of Wisconsin has stepped down as Chair of the SAC to become President of the Board. Abi Saha will replace him as SAC Chair. After more than 10 years of service, Caty Pilachowski has stepped down from her role as Board Secretary, to be replaced by Taft Armandroff. The Board noted its gratitude to Caty with the following resolution:

*The WIYN Board of Directors, on behalf of the entire Consortium, expresses its gratitude and appreciation for the service contributions of Dr. Caty Pilachowski. Caty was one of the original WIYN negotiators, back in the days when all we had to go on was a mirror blank, some travel money, and dreams of a telescope. It was clear early on that Caty brought a hard-nosed perspective to our deliberations. Her tenure as Board member and Secretary from 1989 to 1999 has been an important contribution. With her departure, WIYN truly loses a major part of its institutional memory. Like the minutes of the preceding Board meetings, one of Caty's essential roles on the Board was to remind us of things we needed to remember, whether pleasant or not. Caty was one of WIYN's indispensable people, and she has left upon WIYN the imprint of her own unique blend of quiet delight and seriousness of purpose. Hopefully, the WIYN Consortium has become mature enough now to survive without her. To quote Caty's own words, although she will no longer be present at our meetings, we should think of her "instead, happily doing science with WIYN data." She has not left WIYN, she is using it!*

# NOAO Wide-Field Infrared Imager Project

Dick Joyce

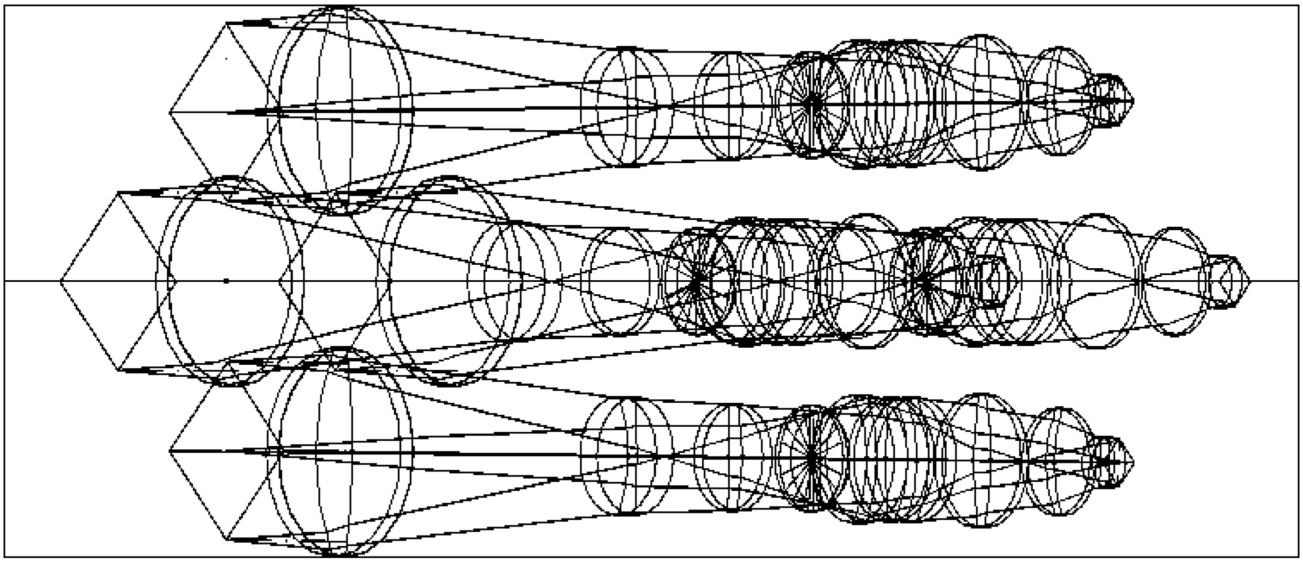


Figure 1. The current conceptual design of the NOAO Extremely Wide-Field IR Imager (NEWFIRM) consists of four identical IR imagers with 15' field of view supported on a central optical bench.

Wide-field imaging—both in the optical and infrared—is a long-term, key element in the research capability of Kitt Peak National Observatory. We have initiated a concept study of the next generation IR imager to complement that in the optical provided by 'Mosaic.' Up-to-date information on the NOAO Extremely Wide-Field IR Imager (NEWFIRM) is available on the NEWFIRM web page, which can be reached from the NOAO Home Page, *http://www.noao.edu*.

The development of wide-field imaging has been a consistent component in the KPNO long-range instrumentation plan. The need for wide-field IR imaging capability was highlighted in the USGP Workshop on Supporting Capabilities for Large Telescopes, in which it was identified as a critical element in a large number of potential scientific programs to complement observations on 8–10 meter class telescopes. This capability is also crucial for limited survey programs to a much greater depth than provided by surveys such as 2MASS and for ground-based support of space missions such as Chandra and SIRTF.

Based on the results of the Supporting Capabilities Workshop and through internal discussions, we have formulated the following baseline specifications for NEWFIRM:

- Equivalent field of view of 30' square on the KPNO 4-m.

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- Pixel scale in the range 0.3–0.5".
- Wavelength coverage 0.9–2.4 μm.
- Narrow-band (1 %) imaging capability.
- High throughput.

The first two requirements suggest a 4K×4K detector format. IR detectors in this format do not yet exist, nor are they envisioned for the near future. A monolithic all-transmissive instrument of this size would require optical elements that may be unobtainable. Our initial approach is to investigate an open mosaic of four 15' FOV imagers, which keeps the optics to potentially feasible dimensions and avoids the issue of generating a close mosaic of IR arrays.

Our goal is to complete the conceptual study of the baseline configuration during FY 2000. Additional features such as grism spectroscopy, performance at longer wavelengths, and use on the KPNO 2.1-m telescope will be evaluated as well. Such additions will be weighed against the additional cost and possible compromise of the baseline specifications outlined above. We will post status updates on the WWW as the opto-mechanical study progresses.

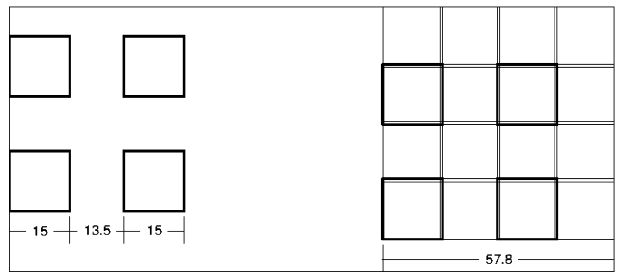


Figure 2. The "open mosaic" concept of NEWFIRM covers an area of 0.93° by taking four telescope positions of four 15' fields in one exposure. Offsetting each telescope position by 14.25' will allow sufficient overlap of the fields, which are separated by 13.5', for registration.

# Hector Rios Wins 1999 Southern Arizona Outstanding Employee Award

*Richard Green, John Scott, John Dunlop, and Sandra Abbey*

At an impressive awards luncheon at the Westward Look Resort on August 9, KPNO's Hector Rios won the Outstanding Employee Award for 1999. The award was given by the Southern Arizona Indian Workforce Development Council, and was supplemented by a scholarship from Pima Community College. *The Arizona Daily Star* subsequently ran a front-page report on Hector and his accomplishments.

The nomination that was submitted for Hector tells the story: When Hector started working for the Observatory, he had little formal training. He was initially hired in 1973 as an entry-level custodian.

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Over the next few years he worked very hard to increase his skills and knowledge, and was promoted to a lead position in 1978. Hector continued to expand his skills through his own initiative, outside training, and on-the-job training. In 1988 he joined our Mechanical Maintenance group as a Crafts Helper. Here he became involved with the maintenance and improvement projects for the various telescopes and equipment on Kitt Peak. Hector continued to increase his skills in the trades and learned mechanical maintenance, welding, pipe fitting, equipment operations, and so forth. Hector was promoted to a Craftsperson position in 1993 and is now the primary 50-ton overhead crane operator within the 4-meter telescope structure. He is a key member of the mechanical crew and his extensive knowledge of the observatory facility has enhanced the entire crew's abilities.

Hector also serves as a role model for many employees. His pleasant "can-do" attitude enables Hector and his crew to complete varied and challenging projects. He has participated in several major telescope improvement projects during his career. His crane operation skills have been critical to the removal and reinstallation of the 4-meter primary mirror for periodic maintenance.

Hector has an innate ability to get along with all people and treat everyone with respect. He is extremely intelligent, but very humble and modest about this. Hector has a wonderful sense of humor that is never deprecating and always appreciated by his co-workers and supervisors. (Example: The Director decided that the mechanical crew should wear hardhats during the entire summer shutdown. The next day, Hector appeared at work with a cowboy-hat-shaped hardhat, just to add a little style.) Additionally, Hector has been a cattle rancher on the Tohono O'odham Reservation for most of his life and is a respected member of his District.

We are grateful to Hector for his many years of dedicated service to the Observatory, and congratulate him once again for this well-deserved honor.

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# Y2K Is Not A Problem at Kitt Peak

*Bob Marshall*

If anyone should care about the century, astronomers should. Accuracy in pointing a telescope requires absolute knowledge of the year. Two digits just don't work; but shortcuts in writing telescope control software—particularly the venerable FORTH system—may have been taken over the years. Our Y2K review is complete and we are ready for the Year 2000 to begin.

Testing for the Y2K problem at Kitt Peak began in July of 1997 with the verification of the WWV-based IRIG-B time signal hardware and software.

Individual telescopes were tested this past spring. During the 1999 Summer Shutdown, a mountain-wide test looked at the telescope and instrument control, all the computers and networks, and the time signal hardware as a system.

No problems were found with the main calculation codes for the Telescope Control Systems, but some changes were needed where date input routines used two digits. We were able to track and guide with no problems with dates set into next year. Most of the instrumentation software did not have a reliance on

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dates. However, we did have to update FITS keyword routines to handle the Year 2000 changes in the FITS standard that took effect this year. See *http://www.cv.nrao.edu/fits/documents/standards/year2000.txt* for information on the FITS update. Most of the computers required operating system patches for Year 2000 problems. For the mountain networks, a new Cisco router was installed, as the previous one was not certified for Year 2000. The network router at WIYN needed a new firmware version.

The KPNO telescopes will be closed on 31 December 1999 to allow our staff to celebrate the last year of the millennium, with a T&E night scheduled for 01 January 2000 to ensure that we have correct operation and that visiting astronomers will not have to fly on the first day of the Year 2000.

# The 1999 and 2000 REU Programs at Kitt Peak National Observatory

*Buell Jannuzi*

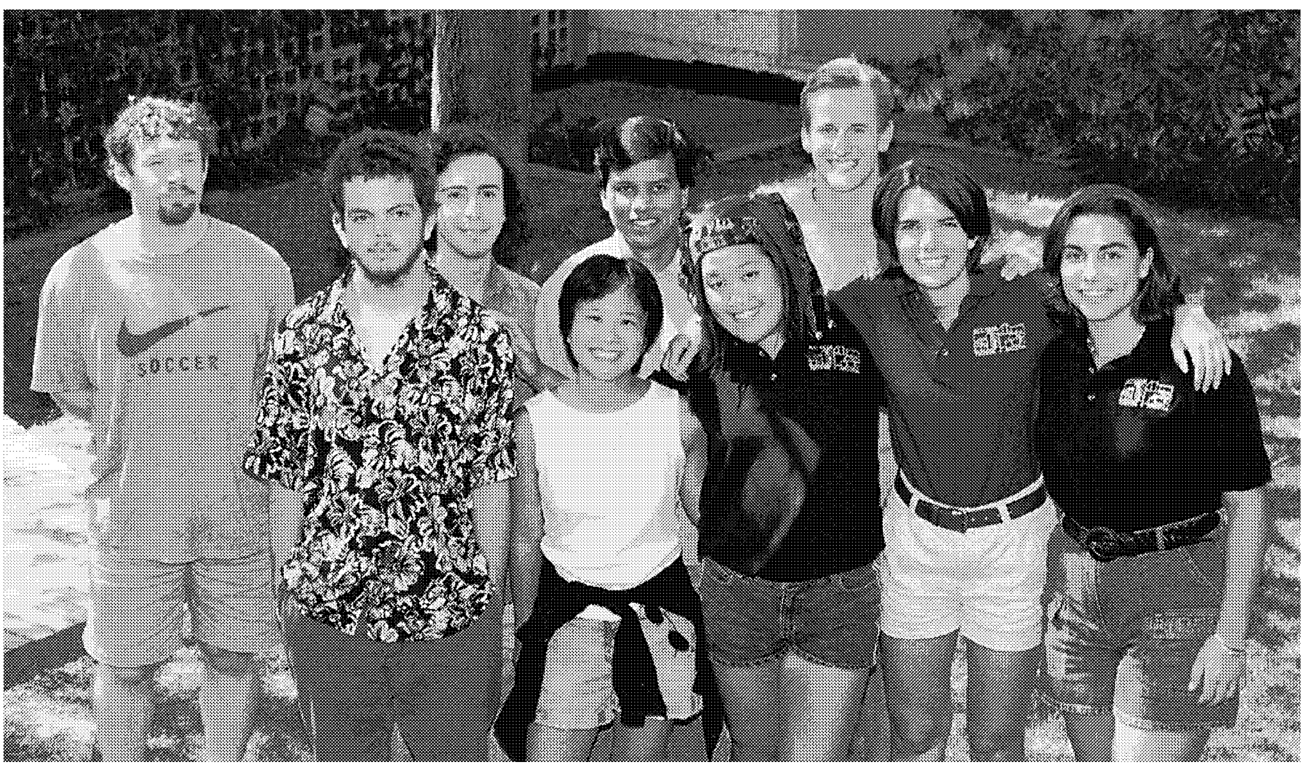


Figure 1. The summer of 1999 saw nine undergraduates come to Tucson as participants in the KPNO REU program. Shown are (left to right), Robert Comstock (Central Washington), Benjamin Jones (Utah), Aaron Einbond (Harvard), Jacqueline Chen (Yale), Proteep Mallik (Oregon), Felicia Tam (Stanford), Nick Mostek (Iowa State), Rachel Parks (North Park), and Cynthia Gomez-Martin (South Florida).

Every summer KPNO is fortunate to have a group of talented college students come to Tucson to participate in astronomical research under the sponsorship of the National Science Foundation's Research Experiences for Undergraduates Program. The program provides an exceptional opportunity for undergraduates considering a career in science to engage in substantive research activities with scientists working in the forefront of contemporary astrophysics. Each REU student is hired as a full-time research assistant to work on specific aspects of major on-going research projects at KPNO. As part of their research activities, REU students gain experience with KPNO's telescopes and develop expertise in astronomical data reduction and analysis.

During the summer of 1999, nine students participated in the KPNO REU program and worked on a wide range of topics. In addition, they participated in a weekly lecture series, several observing runs with telescopes on Kitt Peak, and a "field trip" to visit both NRAO's VLA and NSO's Sacramento Peak Observatory.

At the end of the summer, the students shared their results with the Tucson astronomical community by giving oral presentations describing their research. Most of these students will be attending the January 2000 AAS meeting in Atlanta thanks to the REU program, and we encourage you to stop by their posters and attend their talks. Their end-of-summer presentations and advisors are listed below:

Jacqueline Chen (Yale University): "*A Survey for Dwarf Galaxies in the NGC 3109/Antlia Group*," Taft Armandroff & George Jacoby

Robert Comstock (Central Washington University): "*Constraining Observational Interpretation of Cometary Rotational States Using Numerical Simulations*," Nalin Samarasinha & Beatrice Muller

Aaron Einbond (Harvard University): "*Stellar Kinematics of the Outer Spiral Arm of the Galaxy*," James Rhoads

Cynthia Gomez-Martin (University of South Florida): "*Understanding the Evolutionary History of the Draco Dwarf Spheroidal Galaxy*," Ken Mighell

Benjamin Jones (University of Utah): "*Paschen-$\beta$ and H-$\alpha$ Line Emission and Extinction Maps of Four Galaxies*," Sangeeta Malhotra

Proteep Mallik(University of Oregon): "*Reexamining Variables in M3*," Abi Saha (Mr. Mallik Participated in the REU program activities, but was funded from an alternative source of non-NSF funds.)

Nick Mostek (Iowa State University): "*New M31 Globular Clusters and IR Data Reduction*," Jay Elias

Rachel Parks (North Park University): "*Investigation of Optimal Aperture Size for the Next Generation Optical Spectrograph*," Sam Barden

Felicia Tam (Stanford University): "*Radio Sources in the NOAO Deep Wide-Field Survey*," Arjun Dey and Buell Jannuzi

We expect to be able to have six REU positions available for the summer of 2000. Participants must be citizens or permanent residents of the United States. The positions are full-time for 10 to 12 weeks between May and September, with a preferred starting data no later than early June. A salary of $345 per week and funds to cover travel to and from Tucson are provided. Completed applications including applicant information, official transcripts, and letters of recommendation are to be submitted KPNO no later than 21 January 2000. Additional information and application forms are available from http://www.noao.edu/kpno/reu.

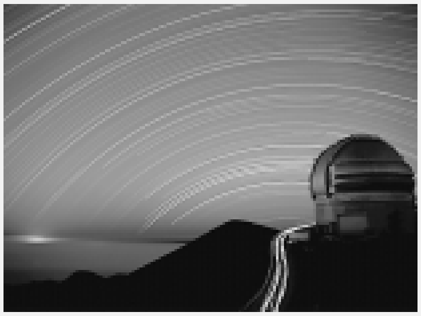
# KPNO Improvement Projects for FY2000

*Bruce Bohannan, Tony Abraham, and Richard Green*

Improvement projects for Fiscal Year 2000 mark a transition from work at the Mayall 4-m directed at improving the delivered image quality (DIQ) to starting a similar program at the 2.1-m. In looking at the less than 3.5 FTE we now have available for projects after setting aside time for basic operations, maintenance, and response to failures, it is no wonder our ambitions take several years to achieve.

For our on-going program to improve the DIQ at the Mayall 4-m, this year we expect to finish the improved 4-m primary mirror cooling system, complete commissioning of the active control system of the 4-m primary (the 4mAPS), and install a wavefront camera for the Cassegrain focus that will enable wavefronts to be taken on a nightly basis. At the 2.1-m we plan to upgrade the servo system to eliminate the oscillation in hour angle that causes elongated images. Other work on the DIQ at the 2.1-m has been proposed, but has been given a lower priority so that we might complete the most important work that will show immediate gains.

Other projects initiated this year include replacing our aging electronic guiders with those designed by CTIO, installing a seeing monitor patterned on that developed by ESO, and prototyping a data reduction computer based on PC hardware. We are also upgrading the 4-m aluminizing facility by moving the chamber into a “room” built in the main floor of the Mayall building so that we will have a cleaner environment in which to coat mirrors.



# U S G P

## U.S. GEMINI PROGRAM

# Gemini Call for Proposals Readiness Review

*Matt Mountain, Director, Gemini Observatory*

In early November the Gemini Project and Observatory held a "Call for Proposals Readiness" Review. The Review Panel, Chaired by Fred Chaffee (Director of the W.M. Keck Observatory) looked at whether the Gemini North Telescope, its first facility instrument (NIRI), the Science Operations Team and the National Gemini Offices (NGOs) would be ready for our first "call for proposals". Their conclusions were instructive.

They were "enormously impressed by the state of readiness of the telescope and of the NGOs to receive proposals, manage the TAC process and forward the proposals to Gemini in a uniform way so they can be assembled into a combined classical and queue schedule. Similarly, [they] were impressed with the results of the immense amount of work that has gone into the web-based proposal planning and submittal process, and the training program at Gemini HQ for those charged with disseminating this information to potential users in the partner countries." The Review Panel however were concerned that "Gemini is attempting to break new ground on many levels—[for example] its use of queue scheduling, its serving of a global users community, [and] its eventual operation of two telescopes with a single team of engineers. We feel strongly that such an ambitious program requires a much higher level of readiness than ever before and believe that it would be essential to have a first-class NIRI [Near Infrared Imager] to offer its users at the beginning of Gemini Science operations". The Panel is concerned that NIRI and its associated detector systems do not yet meet the "higher level of readiness" required. NIRI has completed a very successful first cool down as a fully assembled instrument; however, it will not be until the next cool down that we anticipate a demonstration of its scientific performance.

Therefore, before issuing our first call for proposals and setting a proposal deadline, Gemini will:

1. Undertake a further in-depth review of NIRI's performance as part of the planned acceptance testing of this instrument and its associated systems after its next cool down in January 2000.
2. On the same time scale, reassess the state of readiness of the telescope and associated systems.
3. Ask, in line with the recommendations of the Review Panel, that all the National Gemini Offices and University of Hawaii conduct end-to-end tests of their proposal submission and forwarding processes.

We are planning to hold a "Science Operations Readiness Review" of the Gemini North Telescope in May of 2000.

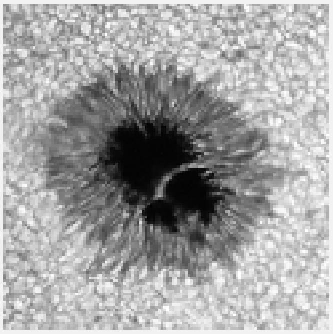
# NOAO Supports US Gemini Investigators

*Todd Boroson and Bob Schommer*

Each of the Gemini partner countries (US, UK, Canada, Australia, Chile, Argentina, and Brazil) has a national Gemini office that will provide support to its astronomers. In the US, that office is the US Gemini Program (USGP) at NOAO in Tucson and La Serena. While the Gemini Observatory will assist observers who come to use the telescope, the USGP will provide all assistance before and after the observing run. This includes the proposal and time allocation process, assistance for proposal writers and those planning their observations, support for users and prospective users to understand the instrumental capabilities and performance, as well as the provision of and support for data reduction software.

Three NOAO scientists will play a critical role in assisting US investigators planning Gemini observations. Mike Merrill will serve as NOAO Mirror Scientist for the Gemini facility instrument NIRI (the Near Infra-Red Imager). Patrice Bouchet will serve as Mirror Scientist for the OSCIR mid-infrared camera and spectrometer on loan from the University of Florida, and Tod Lauer and Steve Ridgway will serve as Mirror Scientists for the UH adaptive optics system Hokupa'a with the QUIRC infrared camera. These Mirror Scientists are already up to speed on Gemini instruments, and will be reviewing documentation, developing data reduction procedures, and responding to queries from investigators. If you have questions about the use of these instruments on Gemini, feel free to contact the US Mirror Scientists.

US investigators planning to submit proposals for time on the Gemini North telescope should also become familiar with the Gemini HelpDesk. The HelpDesk is the primary means by which individuals can make requests for information about science operations on Gemini. Investigators submit queries via the Web or by e-mail, and the query will be answered automatically by the HelpDesk software at the International Gemini Observatory. If an answer to the question is not available, the query will be routed to the national project office of the person asking the question (for US investigators, this is NOAO, where our Mirror Scientists will search out the answer and respond to the query). The answer will be saved in the HelpDesk system to be used again for similar queries. If Mike, Patrice, Tod, or Steve are unable to answer the question, they can call on Gemini experts at IGO and in other partner countries to find an answer. The Gemini HelpDesk will be available via *http://www.us-gemini.noao.edu/* at the time that the first call for proposals is issued. Investigators with questions about the proposal process itself can send e-mail to *noaoprop-help@noao.edu*, and a member of the NOAOprop Team (Jeannette Barnes, Dave Bell, Jane Kennedy, or Caty Pilachowski) will respond promptly with an answer!



# N S O
# National Solar Observatory

## From the NSO Director's Office

*Steve Keil*

Plans are being made to operate the National Solar Observatory as an independent observatory that would report directly to the NSF through AURA. NSO and NOAO will continue to share resources to support programs on Kitt Peak and in Tucson, but NSO will conduct its planning, resource allocation, and reporting functions separately from NOAO. NSO will continue operating its current facilities, in support of user and staff research, which are being enhanced with increased capabilities through completion of SOLIS, enhancement of GONG, and—in conjunction with the solar community—development of an Advanced Solar Telescope. Your comments and opinions both on the separation, and on the current and future facilities and capabilities that NSO should provide the user community, are welcome and can be sent to me at *skeil@noao.edu*.

SOLIS is well into its construction phase and beginning to take delivery on instrument and telescope components. A brief update on the project appears later in this section. NSO recently completed the third RISE/PSPT (Precision Solar Photometric Telescope) instrument and will begin operations at NSO/Sac Peak. The PSPT is designed to measure and identify the sources of solar irradiance changes and to study the solar interior. All three telescopes have been completed. The first was installed in Rome and the second in Hawaii. For an overview of the instrument and design drawings visit *www.sunspot.noao.edu/PSPT*, and for information about the sunRISE program and access to the data visit *rise.hao.ucar.edu*.

The NSO low-order adaptive optics system is now available for observations at the Dunn Solar Telescope (DST). Two NSO scientists, Thomas Rimmele and Christoph Keller, recently collaborated with John Seldin and Richard Paxman of the Environmental Research Institute of Michigan (ERIM) to obtain very high resolution movies of the vector magnetic field in active regions. The data were obtained by combining NSO's adaptive optics and ZIMPOL polarimetery systems with phase-diversity techniques developed at ERIM. The combined system permits polarimetery at the diffraction limit of the DST. To see some results from the observations, visit our WWW site at *www.noao.edu/noao/staff/keller/aopds*. A nice movie of convection motions in and around a pore is available at *www.noao.edu/noao/staff/keller/aopds/pds1802.gif*. If you download the movie, watch in particular how the bright point in the upper right is pushed around by granulation.

Eric Tatulli has joined the NSO staff to work with Thomas Rimmele for the next 15 months on the adaptive optics program. Eric comes from ONERA in France with Jean-Marc Conan.

## SOLIS

*Jack Harvey*

The SOLIS project is approximately half completed. Design activities are becoming less dominant as construction ramps up. The mounting has taken form at a local commercial shop. Optics for the vector spectromagnetograph (VSM) are arriving. The primary and secondary mirrors have been generated and are on track. The main entrance window was delivered ahead of schedule and it exceeds specifications. Mechanical parts for the VSM are being built in our shops in Tucson and Sac Peak, as well as at numerous outside vendors. Off-the-shelf optics for the full disk patrol are being ordered. The integrated sunlight spectrometer (ISS) was delivered and is nearing a first sunlight test. Software development is concentrating on use of the ISS as the first of the three major instruments of SOLIS. The code developed and proven with that instrument will transfer immediately to the others. A storage area network for capturing data from SOLIS was delivered and brought into operation.

## Kitt Peak Vacuum Telescope to the Max

*Harry Jones*

Observers at the NSO/KPVT continue to use the NSO/NASA Spectromagnetograph to support observing campaigns, spacecraft operations, and other special observing programs although they were limited by this summer's vigorous and extended monsoon season. Recent examples include H. Jones' 1083-nm line asymmetry and EUV line shifts guest investigator program with SoHO and GSFC's SERTS 99 rocket flight in June, ongoing support of various TRACE programs, a continuing study of prominences initiated by D. Rust, and several campaigns (Max-Millenium, Whole Sun Month, MEDOC, etc.). Usually such support is undertaken after the standard synoptic data have been obtained by the observer, who takes into account weather and instrument conditions as well as the various e-mail and web announcements. For special scheduling or observing requirements, contact Harry Jones (*hjones@noao.edu*) or Jack Harvey (*jharvey@noao.edu*).

## The McMath-Pierce FTS is Alive and Scanning

*Mike Dulick*

The NSO has been awarded an additional three years of funding by the NSF Division of Chemistry, as well as three years of funding from the NASA Upper Atmosphere Research Program, to continue to make the high-resolution Fourier transform spectrometer (FTS) on Kitt Peak available for laboratory spectroscopy. The NSO FTS has capabilities for laboratory spectroscopy that are not available anywhere else in the world. Its total spectral coverage is 550–45,000 $cm^{-1}$. It

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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.

Over 120 visiting scientists have used the NSO FTS in their research. A very wide range of projects has been carried out, including high-resolution spectroscopy of free radicals and molecular ions, spectroscopy of atoms, atmospheric spectroscopy, long-term monitoring of atmospheric constituents, and laboratory astrophysics. The following visiting investigators have had long-standing research projects that utilize the NSO FTS and are co-investigators on the proposals that were funded: Peter Bernath (Waterloo); Sumner Davis (Berkeley); James Lawler (Wisconsin); Leah O'Brien (Southern Illinois); Curtis Rinsland, Mary Ann Smith, and co-workers (NASA/Langley); Linda Brown, Robert Toth, and co-workers (JPL); Charles Chackerian and co-workers (NASA/Ames); D. Chris Benner and V. Malathy Devi (William and Mary); Don Jennings, Dennis Reuter, and co-workers (NASA/Goddard).

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# What's New at the Sunspot Astronomy and Visitor Center

*Ray Smartt*

The Sunspot Astronomy and Visitor Center was formally dedicated in April of last year, the culmination of several years of planning by the principal partners in this project: the National Solar Observatory, NOAO, the Apache Point Observatory, New Mexico State University, and the staff of the Lincoln National Forest. Considerable assistance in different aspects of the development of the Center has also been provided by the New Mexico State Departments of Tourism, Highway and Transportation, and Cultural Affairs, with technical assistance also from the local International Space Hall of Fame. Initial funding was obtained from the State of New Mexico, with matching funds from the Federal Highway Administration (the initiative was eligible for consideration for FWA/ISTEA construction funds since it lies at the terminus of a National Scenic Byway).

The Center has a conference room, gift shop, and exhibit area. The ongoing development of science exhibits emphasizes educational value, especially for school-age children, but also for the general public. The overall scheme reflects the different areas of scientific interest of the two observatories and of the US Forest Service, with principal emphasis on solar astronomy. Educators stress the value of interactive-type exhibits and, where feasible, exhibit designs are of this type.

Visitors first encounter a five-foot-diameter, extremely accurate sundial and a solar light-feed for a spectrograph within the building (this light feed was originally used as a solar telescope at the South Pole for solar oscillation measurements). Inside, the story line starts with things of some familiarity (the day-night cycle from the Earth's rotation, including the identification of the tropic

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latitudes; the relationship of the sizes of the Sun and the Earth; the reason for blue skies and orange sunsets; the seasons; measurement of the Sun's brightness; and the concept of the precession of the Earth's axis). The full range of the electromagnetic spectrum is also presented, which emphasizes the wide spectral coverage of modern astronomical systems, while other exhibits provide an elementary introduction to some of the tools of astronomy. Some of the properties of light as they relate to astronomical methods are also illustrated. Two panels will discuss early astronomical observations in the Americas, as well as key ideas and discoveries in the history of astronomy. The solar system is then presented with a variety of exhibits, including one or more meteorites. This leads the visitor to solar astronomy, featuring NSO and space observations. This part of the sequence of exhibits includes a virtual walking tour of Sac Peak and a spectrographic presentation of the solar spectrum with a solar disk image. This is followed by the study of the planets, stars, and galaxies as illustrated in the Apache Point Observatory exhibit, which includes a diorama of the 3.5-m telescope facility. Finally, the visitor walks through the USFS exhibit that illustrates the difference in forest plant species according to north- and south-facing slopes, other phenomena associated with the level of insolation, and the sensitivity of the immediate forest environment to climate variations and human activities. Throughout the exhibit, backlit panels and video presentations illustrate various aspects of the story line. While some of this work is being carried out through external contracts, the development of most of the exhibits continues to rely principally on the technical expertise and direct involvement of various members of the NSO/SP staff, some of whom have carried out different tasks on a purely volunteer, after-hours basis.

# 20$^{th}$ NSO/Sac Peak Summer Workshop

*Michael Sigwarth*

The 20$^{th}$ NSO/Sac Peak Summer Workshop, scheduled for the second week of September 2000, will focus on recent progress made in the investigation of solar magnetic fields and on future projects within the framework of solar polarimetry and modeling of solar magnetic fields.

The development of new polarimetric instruments in the last decade has provided a steady stream of high-quality polarimetric data, leading to new insights in solar magnetism. Spectropolarimetric measurements in the visible and IR with unprecedented precision and resolution permit the investigation of small-scale and weak magnetic fields, as well as a detailed study of active region developments. Adaptive optics systems are about to usher in a new era of ground-based, high-resolution solar observation. Measurements of scattering polarization and the Hanle effect have opened a new field of research. Space-based observations greatly enhanced the possibility of long-term studies, as well as joint observations with ground-based instruments. Direct measurements of magnetic fields in the chromosphere and the corona are challenging us to explore and understand the outer solar atmosphere. At the same time, advanced modeling and numerical simulations of active region development and the formation and behavior of small scale flux tubes have opened new perspectives. Radiative transfer calculations, based on such models, and sophisticated inversion techniques applied to observational data have become an indispensable interface between theory and observation.

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Despite this progress, further qualitative steps are necessary to address basic questions in solar polarimetry:

- A substantial increase in spatial and temporal resolution, as well as sensitivity of polarimetric measurements, is needed in order to arrive at a clear understanding of the physics of photospheric flux concentrations.
- Models, simulations, and inversion techniques have to be improved and redesigned, especially to include higher layers of the solar atmosphere.
- Precise polarimetric measurements in the chromosphere and corona are necessary for understanding coronal heating and activity.
- The interpretation of scattering polarization is still in a preliminary phase, and many of its aspects have to be clarified in order to have a good diagnostic of the weakest magnetic fields.
- Synoptic measurements of the vector magnetic field are needed to understand and predict solar activity and variability.

The solar magnetic field and polarization community are invited to Sunspot, New Mexico to review the latest achievements, to present breaking news, and to discuss the next steps in Advanced Solar Polarimetry.

The meeting will comprise invited reviews, selected oral contributions, and poster papers. During the workshop, recent progress made in theoretical modeling, observations, and instrumentation will be reviewed. There will be discussions on new approaches in theory and observations, such as upgrades of existing instrumentation that may include use of adaptive optics; new UV, IR, and 2D polarimeters (ground- and space-based); and advanced instrumentation for synoptic observations. The workshop will also provide for discussions on the polarimetric techniques being used in different instruments and the sensitivity that these techniques have provided so far. This will be important in the context of future large solar telescopes and their polarimetric capabilities in the visible and IR.

The meeting will be held in the Sunspot Astronomy and Visitor Center and the Sunspot Community Center at the National Solar Observatory at Sacramento Peak. There are plans to publish the presentations made at this meeting.

*Registration:* Please submit your abstract and registration information as soon as possible and no later than 30 June 2000. The second announcement will be issued soon and will include detailed information on lodging and transportation. The total number of participants will be limited to the capacity of the meeting facilities (approximately 80). The registration fee is $80. Partial support to help defray travel and housing costs will be available to those with demonstrated need.

The scientific organizing committee includes M. Sigwarth (Chair), S. Keil, H. Lin, D. Rabin, E. Landi (Florence), B. Lites (HAO), S. Solanki (Max-Planck-Institut fur Aeronomie), O. Steiner (Kiepenheuer), and V. Martinez Pillet (IAC, Tenerife).

Prospective participants are invited to direct suggestions concerning this workshop, within the framework outlined above, to:

*ws2k@sunspot.noao.edu* or to M. Sigwarth
National Solar Observatory, Sunspot, NM
88349-0062 USA; Ph. (505) 434-7018;
FAX (505) 434-7029;
email: *msigwarth@noao.edu.*
Additional information about the workshop is also available at: ***www.sunspot.noao.edu/INFO/MISC/WORKSHOPS/2000/ws2k.html***.

# NSO Observing Proposals

*Dick Altrock*

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

## NSO Telescope/Instrument Combinations

### Dunn Solar Telescope (SP):

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

### Evans Solar Facility (SP):

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

### Hilltop Dome Facility (SP):

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

### McMath-Pierce Solar Telescope Facility (KP):

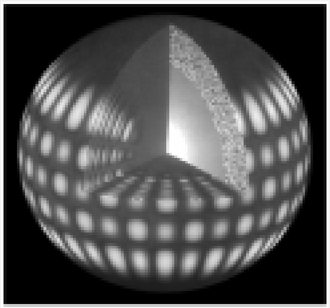
160-cm Main Unobstructed Telescope
76-cm East Auxiliary Telescope
76-cm West Auxiliary Telescope
Vertical Spectrograph: IR and visible gratings
Infrared Imager
Near Infrared Magnetograph
CCD cameras
1-m Fourier Transform Spectrometer
3 semi-permanent observing stations for visitor equipment

### Vacuum Telescope (KP):

Spectromagnetograph
1083-nm Video Filtergraph

### Razdow (KP):

Hα patrol instrument



# GONG

## Global Oscillation Network Group

*John Leibacher*

The Global Oscillation Network Group (GONG) Project is a community-based activity to operate a six-site helioseismic observing network, to perform the basic data reduction and provide the data and software tools to the community, and to coordinate analysis of the rich data set that is resulting. GONG data are available to any qualified investigator whose proposal has been accepted. Information on the status of the project, the scientific investigations, as well as access to the data, is available on the Web at *www.gong.noao.edu*.

October marked the fourth birthday of GONG's full network operations, which continue to produce excellent data as solar activity grows. We've had several months recently with over 90% duty cycle out of the full data processing pipeline; interesting—and real!—variations in flows below the surface are manifesting themselves. The GONG+ camera system development continues; in spite of the inevitable teething problems, we still hope to deploy the new system around the network in the first half of 2000.

### Operations

The arrival of the monsoon in India has again resulted in considerable downtime at the Udaipur site. The monsoon conditions increase the need for backup electrical power to the site, and although the diesel generator operated effectively, the circuitry that effects the changeover from utility to generator power proved unreliable. Consequently, the site was shut down continuously for a period in July and August, and intermittently throughout September. Since the weather was so poor during these months, the loss of data due to instrument downtime was comparable to that lost due to poor observing conditions. Thanks to the on-site Udaipur staff, the system was operational in time for the improving weather conditions.

In spite of two preventative maintenance trips—Learmonth, July 8-17 and Big Bear, July 29-August 5—a few minor instrument failures occurred around the network during the past quarter. The uninterruptable power supplies at Big Bear and Mauna Loa suffered component failures, resulting in total network downtime of about 20 hours. An additional 3.5 hours of lost images occurred at Mauna Loa due to a problem with the GPS timing and synchronization. CTIO experienced about 5 hours of down time, when the turret became coated with ice during two different storms.

The good news is that our timing, which depends on the GPS system, survived the GPS 1024-week rollover that occurred in August.

PM crews will be visiting Mauna Loa and Udaipur in October and November.

### Data Management and Analysis

With the upgrade of reduction software used for calibrating the raw images and producing global p-mode power spectra, the project resumed routine reduction of

*continued*

network data this past quarter. Month-long (36-day) velocity, time series, and power spectra were produced for GONG months 36, 37, 38, and 39 (ending 990310), with respective fill factors of 0.91, 0.94, 0.92, and 0.88.

The main development activities currently underway in the DMAC are related to the development and testing of the GONG+ camera and data acquisition prototype system.

## Data Algorithm Developments (and Some Science)

As mentioned above, determination of the frequencies beginning with GONG Month 36 (Sept–Oct 1998) is underway. A comparison of the results from peakfitting GM 36, reduced with and without the rectangular pixel correction, showed small differences in the odd-splitting coefficients. A comparison of the inversions of these splittings showed differences in the rotation rate near the poles. Since these results were obtained with a 36-day, instead of our typical 108-day, time series, we will compare the inversions obtained from 108-day series containing the two different versions of GM 36. Unfortunately, given the currently available resources, it will probably not be possible to test other combinations of processing; however, we will use the information from the available comparisons to estimate any systematics introduced by the processing change.

Inversions of the even-splitting coefficients are now becoming available. The images of the temporal variations in the solar structure are very similar to those of the flows. Bands of enhanced sound speed are seen to migrate from high latitudes at solar minimum to lower latitudes as activity increases, but with one important difference—the temperature excess bands are not exactly in the same place as the flows, but are displaced in latitude. This is exactly what is observed at the surface when the torsional oscillation velocity and the surface magnetic field distribution are compared.

In anticipation of the deployment of the GONG+ system, work is underway to improve the angular registration between simultaneous images at different sites. Comparison of GONG and SOI/MDI data have indicated an angular offset of about 0.1°; however, this was substantially reduced after a thorough revamping of the analysis of the drift scans, which set the absolute position angle of solar North as observed by the network.

Sasha Serbryanskiy from the Ulugh Beg Astronomical Institute in Tashkent, Uzbekistan, is working with the project in Tucson for three months. Sasha is merging SOI/MDI data into the GONG time series. During the GONG+ deployment, Sasha's merging results will be extremely valuable when we attempt to join the data obtained with the two different spatial sampling functions.

## GONG+ Development

As acceptance testing of the Data Acquisition System continues, the development team has moved ahead on other areas of the prototype. An internal committee reviewed the Data Caching Subsystem and accepted the GONG+ home-grown RAID1 data storage scheme. Production components (hard disk drives and DLT tape drives) needed for the field systems have been purchased. A committee also reviewed the modifications that have been made to the instrument's mechanical system. With the exception of a few minor refinements, all designs were accepted.

# Educational Outreach

*Suzanne Jacoby, for NOAO Educational Outreach*

The third annual workshop for middle and high school teachers on “The Use of Astronomy in Research Based Science Education (RBSE)” hosted 15 participants from around the country in Tucson and on Kitt Peak this past summer. A total of 41 teachers have been trained in this NSF-funded Teacher Enhancement Program to date. Recruitment is underway for our fourth summer workshop in 2000. Mentors were located for all teachers in the 1999 program; we are pleased to acknowledge these astronomers for their support:

Catherine Pilachowski (NOAO)
Shawn Cruzen (Columbus State)
William Keel (Alabama)
Jose L. Alonso (Arecibo)
Pamela Marcum (Texas Christian)
Heather Morrison (Case Western)
Mark Adams (McDonald)
Margaren Hanson (Cincinnati)
Deborah Golader (Pennsylvania)
Ted Williams (Rutgers)
Michael J. Wolff (SSI)
Daniel Boice (SRI)
Wayne Osborn (Central Michigan)
Glenn Williams (Central Michigan)
Tim Barker (Wheaton College)

A total of 22 telescope-nights were used in support of the RBSE Teacher Enhancement Program in the last quarter: eleven on the 0.9-m, four on the 4-m, and seven nights on the 2.1-m. Results of one of the three RBSE research projects, “Searching for Novae in Local Group Galaxies,” will be presented as a poster paper at the Atlanta AAS Meeting by KPNO astronomer Travis Rector and Brenda Wolpa. Brenda is a chemistry teacher at Canyon Del Oro High School in Tucson who also works part-time for NOAO Educational Outreach. Our updated web pages at *http://www.noao.edu/outreach/rbse/* contain additional information about the RBSE program.

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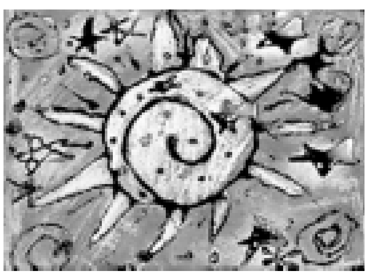
The fourth annual NOAO-hosted Project ASTRO-Tucson workshop took place in September with 39 participants, bringing the number of astronomers and teachers trained in the Tucson area to nearly 200. This was a bittersweet workshop for the Tucson project, as our three years of start-up funding for Project ASTRO-Tucson have expired and additional funds have not been secured to continue the project at its current level. As a result, Ginny Beal will reduce her hours from full-time to half-time as our Education Program Coordinator. Ginny’s dedication, enthusiasm, and personal commitment to the goals of

Project ASTRO are largely responsible for the success the project has experienced in Tucson. She will continue to support ASTRO-Tucson in her half-time position, but we are not confident of being able to run a fifth annual workshop until additional funding sources are identified.

Meanwhile, Project ASTRO is evolving in Tucson to best meet the needs of our local educational community. This includes having teachers gain more astronomy content knowledge through the program, increasing the emphasis on inquiry as a pedagogical method at the workshop, and exploring ways to have teacher partners less dependent on their astronomers. Even in astronomer-rich Tucson, we are experiencing a shortage of astronomers, compared to the number of teachers, who wish to participate in Project ASTRO.

Authors Gina Rester-Zodrow and Joni Chancer came to Tucson to participate in our September workshop and present ideas from their book "Moon Journals–Art, Writing, and Inquiry through Focused Nature Study." Our Project ASTRO coalition, particularly the Tucson Unified School District, is interested in developing interdisciplinary ways of teaching science through inquiry, and in using the student-developed journals as an assessment tool. Project ASTRO's emphasis on hands-on, inquiry-based activities provides a way to extend the concepts of Moon Journals into authentic scientific observation. We'll see over the next year where these overlapping ideas lead as our collaborations continue. More information on Project ASTRO-Tucson and our last workshop including the Moon Journals ideas can be obtained from a media advisory at *http://www.noao.edu/outreach/press/*.

## Outreach Web Pages



By splicing together two E/PO supplements with some NOAO dollars, we have been able to add a Web Designer to the NOAO EO staff. Mark Newhouse is working to bring a consistent look and feel to the Outreach web pages, and we encourage you to take a look at these newly available materials:

An on-line Virtual Tour of Kitt Peak National Observatory is now available at *http://www.noao.edu/outreach/kptour/*. The bulk of the work for the tour was done by Rick Donahue, a middle school technology teacher from Eastchester, NY and an RBSE 1998 participant, who spent a month with the Educational Outreach group over the summer of 1999 funded by a Teacher Supplement to our Research Experience for Undergraduates program.

The "Jewels of the Night," an educational module for measuring the color and brightness of stars in the Jewelbox Cluster, was added to the NOAO Educational Outreach web pages. This activity was developed by NOAO astronomer Caty Pilachowski, in collaboration with Jeff Lockwood and other Tucson teachers. The activity has been extensively tested over the past two years, in Tucson schools and at the Flagstaff AASTRA summer workshops. Teacher notes and classroom materials can be downloaded and printed from *http://www.noao.edu/education/jewels/*; a color printer is required.

"A Resource List about the Sun"–a printed brochure listing books, periodicals, and URLs about the Sun–was produced by the Educational Outreach Office as part of our effort to more efficiently handle information requests. This is the first in what will be a series of thematic resource lists. We encourage you to download and print the PDF version of the brochure for local distribution. Go to *http://www.noao.edu/outreach/resource/sun.html*.

# C C S CENTRAL COMPUTER SERVICES

# IRAF Update

*Doug Tody and Jeannette Barnes*

The IRAF V2.11.2 patch release, mentioned in the previous issue of this *Newsletter*, was released in August for selected platforms. This patch supports all Sun Sparc systems (SunOS, and Solaris 2.5.1, 2.6, 2.7, Solaris 7), Digital Unix 4.0 (now Compaq Tru64), OpenVMS running on the Alpha chip, and VAX/VMS. This odd collection of platforms is a reflection of the internal operational priorities (primarily for pipelines) of the institutions that develop IRAF. As a reminder, an IRAF V2.11 patch (version V2.11.2 or greater) is required for anyone running IRAF to make IRAF Y2K (Year 2000) compliant. Fixes are required to fix several Y2K-related bugs, as well as to implement support for the new format, Y2K-compliant FITS date format. Further information on the Y2K compliance of IRAF is available on our Web page at *http://iraf.noao.edu/projects/y2k*.

As this article is being written, an upgraded version of PC-IRAF is in testing, with a release planned for mid-November. The new version of PC-IRAF will run IRAF V2.11.3; a V2.11.3 patch will be released to upgrade the platforms for which V2.11.2 was released in August. Shortly after the PC-IRAF upgrade is out, we will upgrade the remaining IRAF platforms (e.g., HP, SGI, AIX) so that the V2.11.3 patch is available for all supported platforms. The new release of PC-IRAF will support FreeBSD 3.3, RedHat Linux 6.1, Slackware Linux 4.0, Solaris 7 for Intel, and SUSE Linux 6.2. The Solaris x86 and SUSE platforms are new ports. Linux on Macintosh (another new port) is not included in this upgrade, as it was just too much to do all at once, but we will try to get it out as soon after the upgrade as possible. Currently we are favoring LinuxPPC and Yellow Dog Linux over MkLinux, due to the limited support for the latter platform.

Our new IRAF data acquisition and quick look environment, the Mosaic Data Handling System, was extended in June to add support for the CTIO Mosaics and Mosaic II. Efforts are underway to add support for 16 amp readout to reduce the readout times for the Mosaic (the DHS already supports this, but further system tuning and testing are required).

As part of the Mosaic DHS support, we have been looking at the problem of doing heavy image *i/o* systems like Solaris, which use a virtual memory file system for all ordinary file *i/o*. Heavy image processing on such a system runs a large amount of data through the virtual memory file system, causing heavy paging in some circumstances. A caching scheme is being investigated to avoid this problem. This scheme will continue to use ordinary file *i/o* to access images, and image data will be cached in system memory in the usual way, but we will control the caching of data in system memory to minimize the paging that occurs when memory fills and the system pageout daemon is run. The caching scheme will be implemented initially for the Mosaic DHS, but may migrate to the IRAF system itself in a later release. If it proves successful, the cache control scheme could be very beneficial for any virtual memory file system computer used for heavy file *i/o*. This code is part of the distributed shared image facility being supported in part by the NASA ADP Open IRAF and AISR PIE grants.

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Work continues on the automated pipeline system that is being developed initially to pipeline process Mosaic data. We are just wrapping up work on the database system. A database has been defined that will be used to catalog all raw and processed data, as well as keep track of all data as it flows through the system. Work on the pipeline modules, which are mostly IRAF MSCRED tasks, is coming along well. This now includes facilities for automated astrometric and photometric calibration of data frames. Work on the data extraction subsystem, pipeline GUIs, and the pipeline manager is next up.

Several NOAO staff scientists and members of the IRAF group met with Gemini staff at the Gemini Observatory headquarters in Hilo in late August to begin planning jointly-developed IRAF facilities for reducing data from the Gemini instruments. This meeting was very productive and has resulted in a preliminary development plan extending through the year 2000. The new software is expected to provide not only support for the Gemini instruments, but much improved general IRAF support for multi-extension image and spectral data formats, variance arrays and variance handling, IR reductions, multispectral instruments including IFU support, and eventually, support for adaptive optics.

During this quarter, work has resumed on the IRAF astrometry package. A general catalog access applications programming interface has been developed that can be used within IRAF applications to make network connections to catalog servers, format and send catalog queries, and to decode query results. The new catalog access facilities are currently being used to build a new astrometry tool that will support multiple catalogs.

The IRAF programmers attended the 1999 ADASS Conference in Hawaii in early October. Several IRAF-related papers were presented by the programmers at the Conference, and these papers will appear in the conference proceedings to be published next year as part of the Astronomical Society of the Pacific Conference Series.

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"A Web Interface for Access to NOAO Spectral Atlases,"
Matthew Cheselka

"A New IRAF Catalog Access Tool for Astrometry,"
Lindsey Davis

"XHelp: A Help Navigator for the IRAF System,"
Mike Fitzpatrick

"Save the Bits - New Features for a New Millennium,"
Rob Seaman

"A Spectroscopy Exposure Time Calculator for IRAF,"
Frank Valdes

"What's New in Mosaic Reductions at NOAO,"
Frank Valdes

"FITS Foreign File Encapsulation",
Nelson Zarate

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

# NOAO and Y2K

*Steve Grandi*

It seems that everybody has a Y2K compliance plan—your bank, your utility companies, your PC vendor, your mechanic, and the kid down the street with a lemonade stand. NOAO is no exception: the current state of our Y2K preparations can be seen at *http://www.noao.edu/y2k/*.

Seriously, there are important Y2K issues with FITS records and with IRAF; see *http://iraf.noao.edu/iraf/web/projects/y2k* for a thorough discussion. Also, over the night of 31 December 1999–01 January 2000, the NOAO night-time observatories will be shut down (just in case!). On the next night, there will be no visiting observers and all telescope and instrument systems will be verified before science observations re-commence.

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# NOAO FTP Archives

*Jeannette Barnes*

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

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

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

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

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ftp *ftp.noao.edu* (140.252.1.54), cd to: *(continued)*

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

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

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

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

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

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

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

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

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

tex—LaTeX utilities for the AAS and ASP.

utils—PostScript tools.

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

IP numbers for machines mentioned above:

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

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

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

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