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Comments concerning this Newsletter are welcome and will be forwarded to the appropriate editors.
Newsletter Posted: 23 Aug 1999

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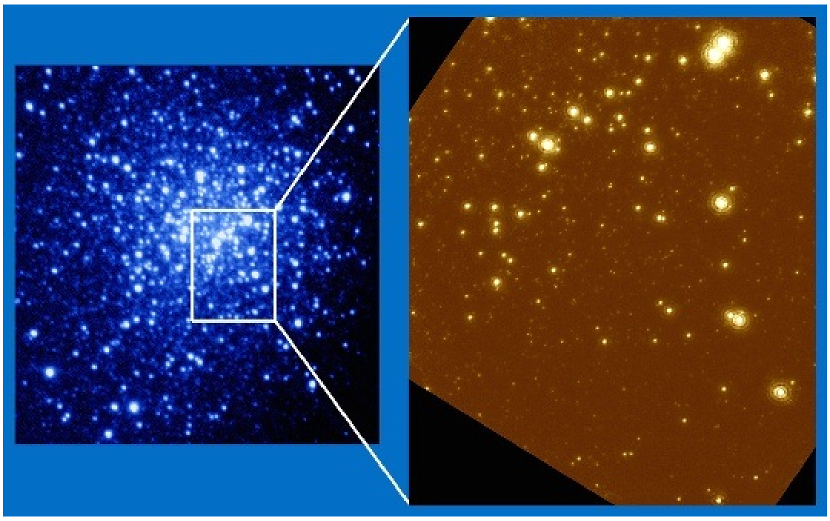
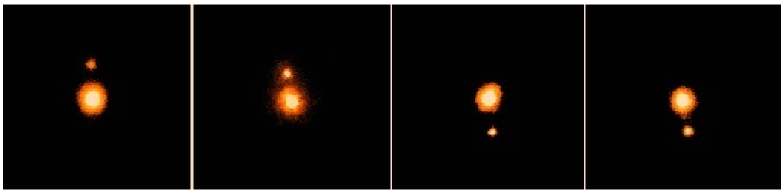
Gemini North Dedicated! Operations to Begin June 2000

The Gemini North Telescope on Mauna Kea was dedicated 24 June 1999 in a ceremony that brought together scientists and dignitaries from all seven Gemini partner countries. While this was primarily a non-scientific event, it did represent a milestone in the technical development of the Gemini telescopes; the Gemini staff worked hard to provide outstanding and dramatic images to demonstrate the capabilities of the Gemini telescopes.



Caption: *The central region of globular cluster NGC 6934. The image on the left is taken in the V-band using the Gemini North Telescope without Adaptive Optics (Resolution = 0.6" FWHM). The image on the right is taken in the K-band using the Gemini North Telescope plus adaptive optics (Resolution = 0.09" FWHM). (Gemini Observatory, US National Science Foundation and the University of Hawaii Institute for Astronomy)*

Almost from the beginning, Gemini has been advertised as an IR-optimized telescope. The truth is that nothing that was done to IR-optimize it has made it any less effective for visible-light observations -- in fact, some of the choices made will significantly enhance its visible-light performance. The two most dramatic requirements related to this optimization are: 1) 50% of the encircled energy at 2.2 Âµm inside a diameter of 0.1" and 2) telescope emissivity less than 4% (with a goal of 2% when silver coatings are in place on the optics; the initial coating on the primary is aluminum). Currently, it appears that both of these requirements will be achieved. (The Gemini North primary mirror puts over 81% of the light at 5500â‰ˆ inside of 0.1" diameter!) In addition, many steps have been taken to minimize dome- and telescope-generated atmospheric turbulence, to ensure clean optical surfaces, and to maximize throughput and versatility of operation.



Caption: *Pluto and its moon Charon are shown in this sequence of four K-band images obtained on different nights during June 1999 at Gemini North, utilizing the University of Hawaii's infrared camera QUIRC and adaptive optics (AO) system, Hokupa'a. The maximum separation between the two objects is 0.9", and the measured FWHM of unresolved images in these frames is 0.08".*

Gemini is one of a new breed of telescope; it has active optical surfaces. The 1-m secondary is controlled through a five-axis mechanism that also allows chopping. The primary figure is controlled with 180 actuators. This control is effected through a number of servo loops that are operating at a variety of timescales, incorporating lookup tables, occasional pointings at bright stars and high-bandwidth (200 Hz) sampling of stars with low-order peripheral wave-front-sensors. As one might anticipate, the initial debugging of this hardware and software was not trivial. Progress was impeded by connectors that showed intermittent failures, processors that ran too slow, and many nights of clouds and high winds. These have all been overcome.

Caption: *The Gemini North Telescope.*

The images that accompany this article show the truly dramatic potential of this telescope. Using the Hokupa'a adaptive optics system and the QUIRC 1024 â—Š 1024 IR imager, both kindly made available by the University of Hawaii's Institute for Astronomy, the Gemini team has held its own in a game in which the rules have been set by the impressive first-light and commissioning images from the VLT and Subaru telescopes.

Gemini is a partnership. It is a partnership among funding agencies, and it is a partnership among national observatories. Despite the fact that there is a separate organization that has been established to build and operate the telescopes, this organization depends on a national project office in each partner country to act as the "gateway to Gemini." In the US, that is the US Gemini Program, a division of NOAO. In the operations phase of Gemini, the USGP will focus on its role of providing and supporting access to Gemini for the US community. That includes time allocation, assistance in technical areas, and data reduction. Thus, for most interactions, astronomers in the US will contact the USGP rather than the Gemini observatory. The exception will be when you actually go to the telescope for an observing run. Gemini will handle support of its observers when they are on-site.

Although the timing of this article is due to the dedication, it is also the right time for US astronomers to begin thinking about proposals, so here is some idea of what to expect over the next nine months. The first "semester" will run from 15 June 2000 through 31 January 2001. Thereafter, semesters will coincide with the usual NOAO semesters, and proposals for Gemini will be completely integrated with those for NOAO-operated facilities. It is expected that 60-80 nights will be available to US proposers in the first semester. The US share of Gemini North is 41.6% of the available time; a substantial amount of time during this first semester will be used for engineering and instrument commissioning.

One facility instrument and three "loaned" instruments will likely be available during the first semester:

1. NIRI, now being assembled and tested by Klaus Hodapp of the Institute for Astronomy, is a versatile 1-5Âµm imager with three focal plane scales, a variety of filters, and grisms for low-dispersion spectroscopy. It uses a 1024 â—Š 1024 InSb array as detector.

2. Hokupa'a is a 36-element natural-guide-star Adaptive Optics system on loan from the AO group at the University of Hawaii. It feeds either a 12.5 Âµm imager with a 1024 â—Š 1024 HgCdTe array or another instrument called CIRPASS.

3. CIRPASS is an uncooled 1-1.5 Âµm spectrograph whose entrance aperture is an integral field unit. Its loan to Gemini by the University of Cambridge is currently being negotiated.

4. Gemini is also negotiating the loan of OSCIR, a mid-IR imager and spectrograph built by Charles Telesco (University of Florida). It provides 10 Âµm low-dispersion spectroscopy and 10 Âµm and 20 Âµm imaging through various filters.

More information on all of these instruments and their expected performance on Gemini will be available on the Gemini and USGP web sites listed at the end of this article by the middle of December. Although the Gemini telescopes carry multiple instruments that can be switched in and out rapidly, all the instruments may not be available through all of the semester.

Proposals for Gemini time in this first semester will be due by midnight PST on 31 January 2000. Proposals must be submitted using the NOAO proposal form and associated tools. Complete instructions for using this form are available on the NOAO web site at http://www.noao.edu/noaoprop/noaoprop.html.

The Gemini telescopes will be queue scheduled approximately half of the time in order to optimally match the observations to the current conditions. While this might not seem so important in the early days of the observatory, the staff is eager to develop the processes and mechanisms that will allow them to support this observational mode. Proposers will have access to predicted frequency of occurrence of different atmospheric conditions, allowing them to understand whether their requirements are better suited for queue or classical observing. Classical observing can be carried out either from the summit or from the Hilo base-level facility.

As the proposal deadline nears, the USGP will widely publicize this new opportunity for the US community. More information will be circulated through the NOAO Newsletter, email announcements, and a forum at the January 2000 AAS meeting.

You can find out more about the Gemini Project and the telescope and facility status from the Gemini web site (mirrored for the US community at http://www.us-gemini.noao.edu/) and about access for US astronomers at the USGP web site (http://www.noao.edu/usgp/).

Todd Boroson

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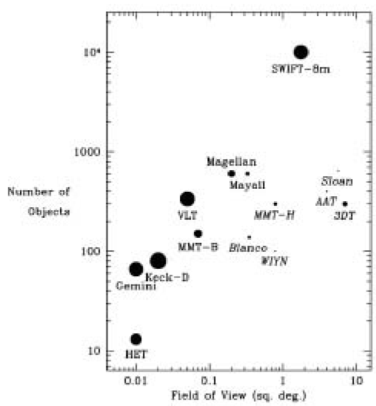
SWIFT: Spectroscopic Wide-Field Telescope

At the approach of the new millennium, we find ourselves poised to address fundamental questions about the origin and evolution of the Universe and its contents. The confluence of advances in telescope and spectrograph design, computing power, pathfinding imaging capabilities on the ground and in space, and the maturity of many astrophysical fields, have inspired us to look beyond the study of a few unique objects to the systematic study of large samples in order to characterize their properties, formation and evolutionary history, and cosmological significance. These studies *require* spectroscopic observations to probe the kinematics, chemical composition, dynamics, ages, masses, and evolutionary histories of astronomical objects.



Caption: *As a multi-object spectroscopic system, an 8-m SWIFT would deliver more than an order of magnitude performance over any existing or planned facilities. Increasing symbol size indicates the system limiting magnitude. Fiber systems are in italics. The slit density for 8-m SWIFT, Gemini+GMIS and VLT+VIRMOS are assumed to be comparable.*

To meet this challenge, scientists at NOAO have proposed a national facility optimized for efficient multi-object spectroscopy over wide fields. This facility, *Spectroscopic Wide-Field Telescope* (SWIFT), is conceived as a spectroscopic system with an integrated telescope and spectrograph design that achieves deep (> 25 mag), high throughput, highly multiplexed (2,000-10,000 objects), spectroscopy over a wide field (~1 degree) at optical and near-infrared wavelengths.

We are currently investigating the scientific case and technical feasibility of implementing the SWIFT concept at 8-m and 30-m apertures. Even with an 8-m aperture, SWIFT will provide spectroscopy that is nearly two orders of magnitude more efficient than that provided by extant or planned facilities. The multi-object spectroscopic capability of this facility will allow astronomers to contemplate and complete ground-breaking investigations of a larger scope and more comprehensive nature than have been possible to date. For example, we would be able to answer fundamental questions about the formation of structure in the Universe (e.g., the evolution of large-scale structure, galaxy evolution, and the formation and evolution of the Milky Way) within the next decade.

The wide-field science enabled by SWIFT complements the high angular resolution science targeted by existing 8-m and 10-m designs. In particular, SWIFT fills a need for wide-field multi-object spectroscopy that is driven by our ever increasing ability to carry out deep, large area imaging surveys at X-ray to millimeter wavelengths. In the next few years, facilities on the ground (e.g., NOAO, CFHT, Subaru, VST, VISTA, Magellan, MMT, DMT, ALMA) and in space (e.g., Chandra, XMM, IRIS, SIRTF, GALEX, NGSS) will survey the sky to faint flux levels and correspondingly high source densities (10^3 - 10^6 per sq. deg.). Discovering the nature of the detected sources requires the spectroscopic capabilities of SWIFT. In addition, because SWIFT will enable large-scale, comprehensive investigations, archived SWIFT data will have tremendous potential for discovery beyond the intent of the original investigations.

A whitepaper on the scientific case for and the technical feasibility of such a facility is available at http://www.noao.edu/swift. The current version of the whitepaper, which demonstrates that an 8-m SWIFT can be built today with limited technical risk, was presented to the OIR panel of the Decadal Review Panel in June 1999. This document will continue to evolve as we continue to examine the science case, telescope and spectrograph options, and software needs of SWIFT, in particular, when implemented with a 30-m aperture.

We welcome feedback from the community. Please contact any one of us with questions and comments.

Joan Najita, Arjun Dey, George Jacoby,
Sam Barden, Chuck Claver, Charles Harmer

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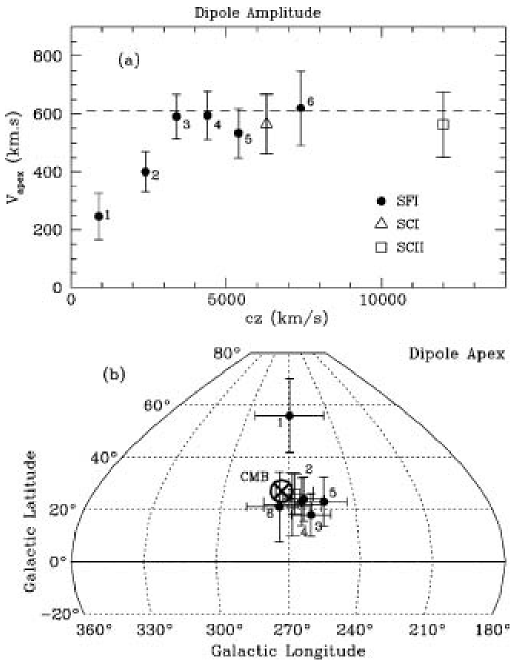
The Convergence Depth of the Local Universe

Riccardo Giovanelli, Martha Haynes, and Daniel Dale (Cornell), working with a large team of collaborators from other institutions, have used the CTIO 0.9-m, Blanco, and KPNO 0.9-m telescopes to search for the scale on which the motion of the Local Group originates. The Local group and its neighbors all appear to be moving with respect to the cosmic microwave background radiation (CMB); searching for the convergence length of this flow has been a critical problem in cosmology. Giovanelli and collaborators argue that the flow decreases steadily as larger volumes of the universe are sampled, finding that it ends or "converges" at distances corresponding to an expansion velocity of only 4000 km/s or so.

It is believed that the motion of our galaxy induces the strong CMB dipole. The implied "reflex motion" of the Local Group with respect to the CMB reference frame has amplitude 611 22 km/s, directed toward l = 273 3, b = 27 3. This motion is thought to be generated by the net gravitational influence of fluctuations in the matter density field surrounding us. As one looks out to larger and larger distances, including increasingly larger volumes of the universe, on average the fluctuations in enclosed mass should begin to average out, contributing less and less to any net pull on the Local Group. Because various theories of galaxy formation have differing spatial scales of mass distribution, measuring the reflex motion of the LG with respect to progressively more distant shells of material is a key cosmological probe. The distance by which the bulk of the CMB dipole is recovered by the reflex motion is referred to as the "convergence depth."



Caption: *Dipole amplitude (a) and direction (b) of the "reflex peculiar" motion of the Local Group, with respect to several galaxy samples. Filled symbols correspond to the reflex dipole with respect to separate shells extracted from the SFI field galaxy sample; they are labeled 1 through 6 according to increasing distance and for ease of cross-reference between panels (a) and (b); the unfilled triangle identifies the dipole derived from the SCI clusters farther than cz = 3000 km/s, while the unfilled square is the dipole with respect to the SCII cluster sample. The dashed horizontal line in panel (a) identifies the amplitude of the Local Group motion in the CMB reference frame, and the crossed circle in panel (b) the direction of that dipole motion.*

In 1994, T. Lauer and M. Postman obtained a disturbing result: using a sample of cluster galaxies of effective depth near 12,000 km/s, they concluded that the whole volume had a bulk flow of about 700 km/s with respect to the CMB reference frame. Several groups were thus strongly motivated to obtain an independent verification of the result. Bulk flows of amplitude comparable to that of Lauer and Postman have more recently been reported by Willick and the SMAC collaboration (M. Hudson, R. Smith, J. Lucey, and colleagues), although the directions of the reported motions disagree widely from the Lauer-Postman result. Large bulk flows over scales in excess of 100 h^{-1} kpc pose serious difficulties to the otherwise most favored cosmological models and thus stimulate great attention in the field.

Using the Tully-Fisher (TF) relationship between luminosity and rotational width of spiral galaxies, Giovanelli and collaborators have completed three all-sky observational programs aimed at the determination of galaxy distances. The various samples complement each other in a manner that allows useful insights in the dynamics of the local universe. All samples have relied heavily on access to NOAO facilities, namely the KPNO and CTIO 0.9-m telescopes for I-band photometry and the CTIO Blanco Telescope for high dispersion, emission line spectroscopy. The first of such samples is referred to as SCI. It includes 780 galaxies in 24 clusters within cz ~ 9000 km/s. This sample has been used primarily to provide an accurate template for the TF relation and to investigate the impact of various biases on the analysis process. The SCI collaboration included R. Giovanelli, M. Haynes, T. Herter and N. Vogt (Cornell), J. Salzer (Wesleyan), G. Wegner (Dartmouth), and L. da Costa and W. Freudling (ESO). With roughly the same depth as SCI, a field sample of approximately 2000 galaxies referred to as SFI provides dense and homogeneous sampling of the peculiar velocity field and thus reconstruction of the matter density field. This collaboration involved Giovanelli, Haynes, Salzer, Wegner, da Costa, Freudling and P. Chamaraux (Meudon). Finally, a sample approximately twice as deep as the two preceding ones, referred to as SCII, includes distances to 522 galaxies in 52 clusters to 20,000 km/s. It was observed by D. Dale, Giovanelli and Haynes , E. Hardy (NRAO), and L. Campusano (Universidad de Chile). SCII formed the core of Daniel Dale's PhD thesis.

The results of SFI, SCI and SCII, as presented in recent articles in the Astronomical Journal and the Astrophysical Journal, exhibit a relatively quiet velocity field. SCI and SCII measure significantly lower peculiar velocities for clusters than the values obtained by other groups, yielding a 1-d velocity dispersion of about 300 km/s. More graphically dramatic perhaps, the reflex motion of the LG with respect to SFI subsamples in shells of increasing radius exhibits a convergent trend towards the CMB dipole (see Figure): the motion of the LG with respect to a shell of radius greater than 5000 km/s closely matches the CMB dipole. Each shell's thickness in the Figure is 2000 km/s, each filled symbol corresponding to the average of between 275 and 689 galaxies. Consistency between the CMB dipole and that of the SCI clusters (unfilled triangle) between 3000 km/s and 9000 km/s is also seen; reassuringly, the dipole of the more distant SCII sample also matches that of the CMB. The bulk flow of all galaxies within a sphere of 6000 km/s radius, including the LG, is only 200 65 km/s, while that for a sphere of 12,000 km/s is indistinguishable from the measurement error near 200 km/s. The close match not only in amplitude, but also in direction, between the dipole of the peculiar velocity field of spiral galaxies farther than ~ 5000 km/s and that of the CMB provides a strong statement in favor of a relatively modest convergence depth for the local universe. The characteristics of the peculiar velocity field, as well as its comparison with the distribution of luminous matter as evidenced by redshift surveys, imposes important constraints on the value of cosmological parameters, favoring, for example, values of the Hubble constant near 69 km/s Mpc^{-1} and relatively low values of the density parameter.

Based on a solicited contribution from
Riccardo Giovanelli (Cornell)

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Changing Directions

Recently I was driving around Boston (actually being driven around Boston -- as a non-resident, I would not think of actually driving in Boston), and I was impressed with the number of new companies, some I had heard of and many more I had not, with their logos proudly displayed on buildings of all shapes and sizes throughout the city. We live in a time of remarkable technological change. A generation or two from now, this period of time will probably be recognized as marking the same kind of historical change as is associated with the industrial revolution.

Not only can astronomy not escape this change, we must embrace it. We must deploy all of the new tools as quickly as possible to answer the fundamental questions at the frontiers of astrophysics -- how and when the universe became structured the way we see it today. We live in a time when advances in our understanding of astronomy allow us to ask -- and answer -- questions that we could not have contemplated a decade ago. NOAO's long range plan (http://www.noao.edu/dir/lrplan/) summarizes what we see as some of the key science questions and describes the new facilities and capabilities that we believe will be required to answer these questions.

In this environment, the community rightly expects NOAO to take on a new and different role. Europe is already moving boldly to take the first steps toward building a 100-m telescope. In the US, building such a facility is beyond the capability of any single institution. For the first time in groundbased optical/infrared astronomy, our ambitions transcend the financial and intellectual resources of even the richest institutions, public or private. The challenge for the US is to take advantage of the diversity of skills throughout the astronomical community and to coalesce our efforts to achieve goals, facilities, and science of scale that are beyond the reach of any one of us.

During the coming fiscal year, NOAO will take the first steps toward the goals outlined in our long range plan. Specifically, working closely with Gemini and the independent observatories, we have created a steering committee to lead the effort to define the scientific requirements and establish the technical feasibility of building the next generation large telescopes. We are also beginning an active program to support science of scale, most notably exploratory surveys of the sky to the deep limiting magnitudes that can be reached spectroscopically with the Gemini and other 6.5-m to 10-m telescopes. We will use new methods of scheduling some of the time on NOAO telescopes and develop tools for data pipelining, archiving, and sophisticated database querying. At the same time, this is the year that observing time will become available to the community on Gemini North, the MMT, and the HET. We will also exploit the wide fields-of-view of the existing 4-m class telescopes at NOAO to complement the narrow-field, high angular resolution of the Gemini telescopes. To do so, we will require wide-field IR imagers and high throughput spectrographs that cover several tens of arcminutes.

Moving in these new directions at a time when the budget appears unlikely to grow rapidly will require a change in emphasis within the existing program. We will be redirecting the effort of many of the scientific staff toward these new initiatives, and we will need to acquire technical expertise, particularly in data management and systems engineering, that is not now represented on the staff. If we combine the necessity of undertaking these new programs with the downsizing of the staff that occurred last February, then it becomes clear that we cannot maintain the existing program in its entirety. The impact on Kitt Peak is described elsewhere in this Newsletter. As an editorial comment, I would add that I believe these are the last cuts that are feasible at Kitt Peak for the next several years. The continued operation of the 4-m class telescopes and the deep infrared imaging capability that will be available at the 2.1-m are essential to the effective planning of observing programs at Gemini North.

Any organization -- indeed every household -- must balance current consumption against future investment. The federal government itself is wrestling with this issue, not with notable success. I hope we will do better, but as always I welcome your advice. The stakes are high, and our goal must be nothing less than continued leadership for the US community in astronomy.

Sidney C. Wolff

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Deep Impact Mission Selected by NASA: NOAO Connections

Deep Impact, a space mission to study the structure of a comet's deep interior, was one of two missions selected by NASA on 7 July for its Discovery program. The other mission, called *Messenger*, is designed to do an orbital exploration of the planet Mercury. *Deep Impact*, whose name was chosen well before the motion picture of the same name was announced, will be led by PI Michael A'Hearn (Maryland). The Deputy PI will be Michael J.S. Belton (NOAO).

The spacecraft will be launched in January 2004 and follow a trajectory that will allow it to deliver a 500 kg impactor to comet P/Tempel 1 at hypersonic speed on 4 July 2005. The impact will excavate a crater in the cometary surface more than 100-m in diameter and more than 20-m deep. This is expected to punch through the first few meters of highly evolved surface materials to the more primitive material expected (on the basis of simple models) at depth. Instruments on the delivery vehicle will make time-resolved spectroscopic and imaging measurements on the progress of the formation of the crater, which will take several minutes, on the nature of the ejecta, and on the nature of the cometary materials that are exposed. Resolution of questions associated with the primitive composition and internal structure of these objects, which may have interiors essentially unchanged since the origin of the solar system, is expected.

The original concept studies performed for Deep Impact were done at NOAO in cooperation with Ball Aerospace and the Jet Propulsion Laboratory in which a "dumb" impactor was targeted to the suspected dead comet Phatheon. The current winning concept, which is now selected for flight, built on this foundation and, under the leadership of A'Hearn at the University of Maryland, now has an active periodic comet as the target and includes many novel and ingenious technical innovations. The most significant of these is a "smart" impactor.

The impact event will be visible from the Earth and a scientific program of worldwide groundbased observations will be coordinated by mission science team member Karen Meech (Hawaii).

Lucy McFadden (Maryland), the Director for Public Education and Outreach for the mission, said that because the impact will be spectacular and visible through small telescopes, the mission should be of great interest to the public and provide a tremendous opportunity for students and others to learn more about comets, the formation of the solar system, and the role of comets in the history of the Earth.

The total cost of Deep Impact to NASA is $240 million. NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California will manage the technical implementation. The project manager at JPL is James E. Graf. Ball Aerospace and Technology Corporation in Boulder, Colorado is responsible for all flight hardware.

Further information about the mission is available at: http://www.ball.com/aerospace/deepimpact.html .

Sidney C. Wolff

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NOAO Preprint Series

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

841 Sigwarth, M., *Balasubramaniam, K.S., Knolker, M., Schmidt, W., "Dynamics of Solar Magnetic Elements"

842 Gupta, S.S., Sivaraman, K.R., *Howard, R.F., "Measurement of Kodaikanal White Light Images"

843 Arns, J.A., Colburn, W.S., *Barden, S.C., "Volume Phase Gratings for Spectroscopy, Ultrafast Laser Compressors, and Wavelength Division Multiplexing"

844 *Barden, S.C., Williams, J.B., Arns, J.A., Colburn, W.S., "Tunable Gratings: Imaging the Universe in 3D with Volume-Phase Holographic Gratings"

845 Soderberg, A.M., *Pilachowski, C.A., Barden, S.C., Willmarth, D., Sneden, C., "Radial Velocities of Giant Stars in Globular Clusters"

846 *Mighell, K.J., "Algorithms for CCD Stellar Photometry"

847 *Keller, C.U., "5000 by 5000 Spatial by 1500 Spectral Resolution Elements: First Astronomical Observations with a Novel 3-D Detector"

848 *Rhoads, J.E., "The Dynamics and Light Curves of Beamed Gamma Ray Burst Afterglows and Gamma Ray Burst Beaming Constraints from Afterglow Light Curves"

849 Veilleux, S., Bland-Hawthorn, J., *Cecil, G., "A Kinematic Link Between Boxy Bulges, Stellar Bars, and Nuclear Activity in NGC 3079 & NGC 4388"

850 *Cecil, G., "Ionized Outflows in 3-D Insights from Herbig-Haro Objects & Applications to Nearby AGN"

851 *Lauer, T.R., "The Photometry of Undersampled Point Spread Functions"

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Other NOAO Papers

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

Albrow, M.D., Beaulieu, J.-P., Caldwell, J.A.R., Dominik, M., Greenhill, J., Hill, K., Kane, S., Martin, R., Menzies, J., Naber, R.M., Pel, J.-W., Pollard, K., Sackett, P.D., Sahu, K.C., Vermaak, P., Watson, R., Williams, A., *Sahu, M.S., "Limb Darkening of a K Giant in the Galactic Bulge: Planet Photometry of Macho 97-BLG-28"

Deutsch, E.W., Margon, B., Anderson, S.F., Wachter, S., Goss, W.M., "Infrared Candidates for the Intense Galactic X-Ray Source GX17+2"

Howk, J.C., Savage, B.D., "A Search for Extraplanar Dust in Nearby Edge-On Spirals"

Hunter, D.A., van Woerden, H., Gallagher, J.S., "Neutral Hydrogen and Star Formation in the Irregular Galaxy NGC 4449"

Ivans, I.I., Sneden, C., Kraft, R.P., Suntzeff, N.B., Smith, V.V., Langer, G.E., Fulbright, J.P., "StartoStar Abundance Variations among Bright Giants in the Mildly MetalPoor Globular Cluster M4"

Millard, J., Branch, D., Baron, E., Hatano, K., Fisher, A., Filippenko, A., Kirshner, R., Challis, P., Fransson, C., Panagia, N., Phillips, M., Sonneborn,G., Suntzeff, N., Wagoner, R. Wheeler, J., "Direct Analysis of Spectra of the Type Ic Supernova 1994I"

Owen, F.N., Ledlow, M.J., Keel, W.C., Morrison, G.E., "Cluster Mergers as Triggers of Star Formation and Radio Emission: A Comparative Study of the Rich Clusters A2125 and A2645"

Quillen, A.C., *Bower, G.A., "M84A Warp Caused by Jet Induced Pressure Gradients?"

Rosati, P., Stanford, S.A., Eisenhardt, P.R., Elston, R., Spinrad, H., Stern, D., *Dey, A., "An X-Ray Selected Galaxy Cluster at z = 1.26"

Schmidt, G.D., Hoard, D.W., Szkody, P., Melia, F., Honeycutt, R.K., Wagner, R.M. "Accretion in the High-Field Magnetic Cataclysmic Variable AR Ursae Majoris"

Smale, A.P., Wachter, S. "A Cessation of X-ray Dipping Activity in X1254-690"

Van der Tak, F.F.S., van Dishoeck, E.F., Evans, N.J., Bakker, E.J., Blake, G.A., "The Impact of the Massive Young Star GL 2591 on its Circumstellar Material: Temperature, Density and Velocity Structure"

Veilleux, S., Kim, D.-C., Sanders, D.B., "Optical Spectroscopy of the IRAS 1-Jy Sample of Ultraluminous Infrared Galaxies"

Vreeswijk, P.M., Galama, T.J., Owens, A., Oosterbroek, T., Geballe, T.R., van Paradijs, J. P., Groot, J., Kouveliotou, C., Koshut, T., Tanvir, N., Wijers, R.A.M.J., Pian, E., Palazzi, E., Frontera, F. Masetti, N., Robinson, C., Briggs, M., in `t Zand, J.J.M., Heise, J., Piro, L., Costa, E., Feroci, M., Antonelli, L.A., Hurley, K., Greiner, J., Smith, D.A., Levine, A.M., Lipkin, Y., Leibowitz, E., Lidman, C., Pizzella, A., Boehnhardt, H., Doublier, V., Chaty, S., Smail, I., Blain, A., Hough, J.H., Young, S., Suntzeff, N., "The Xray, Optical and Infrared Counterpart to GRB 980703"

Williams, R.M., Chu, Y.-H., Dickel, J. R., Petre, R., Smith R.C., Tavarez, M., "Supernova Remnants in the Magellanic Clouds III: An X-ray Atlas of LMC Supernova Remnants"

Sally Adams, John Cornett,
Suzan Ecker, Mary Guerrierri,
Elaine Mac-Auliffe, Phil Sharpley

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NOAO Nighttime Proposals Due for 2000A

Proposals for observing time for the 2000A observing semester (February-July 2000) at Cerro Tololo Inter-American Observatory and Kitt Peak National Observatory, and for community access time at the Multiple Mirror Telescope Observatory are due in September 1999. (See accompanying articles in this section for information about the new MMT capability.) The deadline for all proposals is Thursday evening, 30 September 1999, Midnight MST.

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

- **Web submissions**. The Web form may be used to complete and submit proposals. The information provided on the Web form is formatted and submitted as a LaTeX file, including figures that are "attached" to the Web proposal as Encapsulated PostScript files.
- **E-mail submissions**. If you prefer to prepare your proposal locally as a LaTeX file and then submit it by e-mail, that option is still available. Using the Web form investigators are requested to fill out the general information, investigator information, and run information pages -- after these pages have been completed a "customized" LaTeX file can be returned to you by e-mail or through a download for completion and submission by e-mail. Follow the instructions in the LaTeX template for submitting proposals and figures.

There are several addresses available to help with proposal preparation and submission:

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

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

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

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

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

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

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

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

The NOAO Proposal Team

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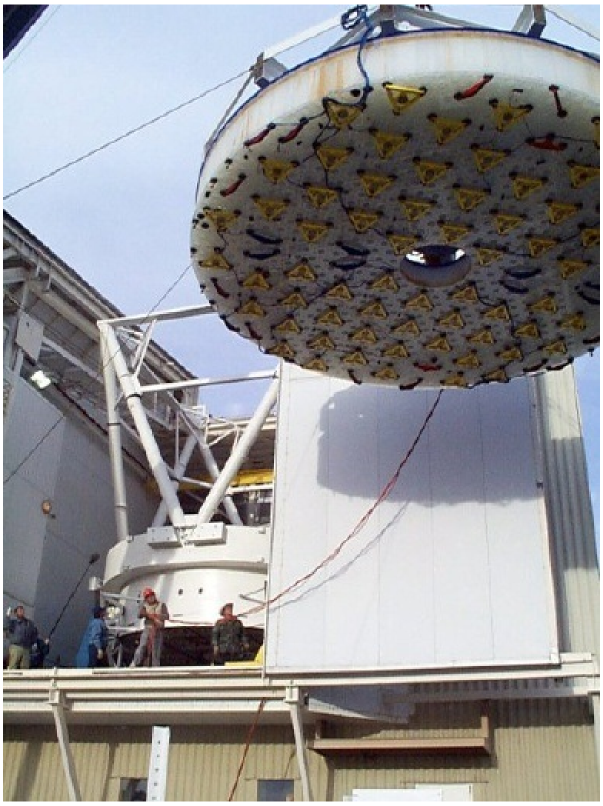
Public Access Observing Time on The MMT

Beginning in March 2000, a significant amount of observing time on the MMT Observatory 6.5-m telescope will be made available to the astronomical community through the NOAO proposal process. Under an agreement with the National Science Foundation, 162 nights of observing time will be allocated to the astronomical community over six years. This public 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 staffs of the MMT Observatory's parent institutions, the Smithsonian Astrophysical Observatory and Steward Observatory. Therefore, roughly 27 nights per year will be allocated for national access, although the actual number of nights available in a given year will vary, particularly in the first year or so after the telescope's commissioning.



Caption: *The 21,000 lb., 6.5-m primary mirror is lifted into the MMT building.*

Access to visiting observers through the Public Access Program will begin in March 2000. Proposals for the period from 1 March through 31 July 2000 will be due on 30 September 1999. Proposals should be submitted through NOAO using the standard NOAO proposal form. Proposals will be reviewed by the NOAO TAC, and those approved will be forwarded to the MMT for scheduling (approximately 20% more proposals will be forwarded than can be scheduled to allow for block scheduling, conflicts in dates, etc).

Investigators may request telescope time on any or all nighttime facilities available through NOAO, including the MMT, in a single proposal. Time on the MMT may also be requested as part of an NOAO Survey Proposal (note that NOAO Survey Proposals are only accepted during the March call for proposals). Because of the limited support provided by the MMTO, access to the telescope will be restricted to those who have:

some experience in observing with large telescopes;

general familiarity with the type of instrument they will be using; and

some expertise with IRAF.

Note that, while the NOAO TAC will meet on a semester basis, the 6.5-m telescope is scheduled trimesterly (January through April, May through August, and September through December). This means that although all proposals submitted for a given semester will be reviewed at the same time, the scheduling of those projects approved for observing time will not all happen shortly thereafter. Note also that the month of August is traditionally reserved for major telescope maintenance projects.

All observing will be carried out in classical mode. Observers will normally be expected to arrive one night early to become familiar with the MMT environment by watching the previous observer.

Procedures and forms for applying for telescope time can be obtained on the Web at http://www.noao.edu/noaoprop/noaoprop.html. More detailed information about MMT access can be found on the Web at http://www.noao.edu/scope/mmt.

Todd Boroson, Craig Foltz

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Status of The MMT Upgrade

Community access to the new 6.5-m telescope of the MMT Observatory will begin in March, 2000. Good progress is being made toward replacing the 4.5-m Multiple Mirror Telescope atop the 8500 foot summit of Mt. Hopkins, about 40 miles south of Tucson, Arizona. The new telescope uses a 6.5-m (256 in) spin-cast honeycomb mirror that was cast and polished in the Steward Observatory Mirror Lab. The conversion of the telescope is jointly funded by the University of Arizona and the Smithsonian Institution. The project is being directed by MMT Observatory in close cooperation with University of Arizona and Smithsonian scientists and engineers.

The new telescope will be a general purpose optical/IR telescope. All instruments will mount at the Cassegrain focus. The telescope will have three focal ratios: f/9 for feeding existing MMT instrumentation, f/5.4 giving a field of view of one degree for multi-fiber spectroscopy and 30' for optical imaging, and f/15 for infrared observations. The f/15 secondary will be adaptive with the goal of producing diffraction-limited images at wavelengths of one micron and longer. The staging of the implementation of these configurations is such that the f/9 secondary will be integrated in fall 1999 with the other two arriving sometime in 2000.

First light at f/9 Cass is anticipated in the fall of 1999. Instrument integration and high-risk scientific observations will begin shortly thereafter. All observations for at least the first half of 2000 will be made at the f/9 focus.

Craig Foltz

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Changes to the NOAO Proposal Form and Process

We have made some minor changes and enhancements to the NOAO proposal form and process of the 2000A proposal period. We summarize the changes here. Also see other articles in this section of the Newsletter.

- **MMT time available**. Investigators may request community access time on the MMT through the NOAO proposal form. See articles elsewhere in this section of the Newsletter for details.
- **One title, one proposal**. A single observing proposal may request up to six observing runs at any of the NOAO facilities as well as the MMT. For example, a single proposal may include requests for time on the WIYN at Kitt Peak, the 4-m at Cerro Tololo, and the MMT.
- **PDF format available**. Investigators may request to have a PDF version of their proposal returned to them through the Web form. The "View PS File" button was changed to "View/Download Files," which presents a page with various options, including downloading of the LaTeX proposal and style file, a PS version of the proposal, and a PDF version.
- **Long-term status clarified**. A new field/keyword was added for requesting long-term status on the Web form and in the LaTeX template. Look at this section carefully and only request long-term status if that truly is your intention.
- **Spectroscopic ETC**. More instruments have been added to the spectroscopic exposure time calculator this proposal period. Investigators are asked to use the spectroscopic and/or imaging exposure time calculators whenever possible for estimating exposure times for NOAO instruments. Links to both of these utilities are

available from the proposal home page.

- **Instrument lists update**. As always, investigators should check the telescope/instruments lists for any changes. Many of these will be documented in this Newsletter in this, the CTIO, or KPNO sections.

There are other minor changes to the form so please read all the documentation provided on the side-bar of the proposal form home page (http://www.noao.edu/noaoprop/noaoprop.html) before preparing your proposal for 2000A. If you have any questions about the proposal process or form please send e-mail to noaoprop-help@noao.edu.

The NOAO Proposal Team

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The NOAO Survey Program

In 1999 NOAO began a new program to support major survey programs of up to five years duration on telescopes at the Cerro Tololo Interamerican Observatory, the Kitt Peak National Observatory, and, when available, the Gemini, MMT and HET Observatories. Up to 20% of the observing time available through NOAO may be allocated to Survey Programs. Survey proposals will be solicited annually as part of the March proposal cycle.

A Survey Program is a significant observational program which:

Addresses novel, well-focused scientific goals;

Enables scientific programs requiring large, statistically complete, and homogeneous data;

Provides a basis for planning more detailed follow-up studies;

Enables extensive archival research; and

Represents a significant enhancement over existing surveys.

Survey programs must make processed data available to the community within 12 months of the first pipeline processing, and representatives from each survey team will also be expected to attend an Annual Open Meeting held in conjunction with the January AAS meeting to present science results and progress reports to the community.

As part of the March 1999 proposal round, NOAO received 21 proposals for major survey programs. These proposals were peer-reviewed by a Survey Panel chaired by S. Strom. Five programs were recommended for scheduling:

- Deep Imaging Survey of Nearby Star-Forming Clouds, PI: John Bally (Colorado)
- In Search of Nearby Stars: A Parallax Program at CTIO, PI: Todd Henry (Harvard-Smithsonian CfA)
- The NOAO Deep Wide-Field Survey, PI: Buell T. Jannuzi and Arjun Dey (NOAO)
- Deep Lens Survey, PI: J. Anthony Tyson (Bell Labs, Lucent Technologies)
- A Fundamental Plane Peculiar Velocity Survey of Rich Clusters within 200 h^{-1} Mpc, PI: Jeff Willick (Stanford)

To apply for the 2000 Survey Program, investigators must submit a Letter of Intent by e-mail to surveys@noao.edu no later than 31 January 2000. Check the NOAO Web page for Survey Proposals for detailed instructions on the required content of the letter of intent. Proposals are due 15 March 2000. Proposers may obtain detailed proposal information and forms on the web.

Todd Boroson, Steve Strom

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NOAO Assists Chilean National TAC

For the first time, proposals for telescope time at CTIO from Chilean national astronomers were reviewed by the new Chilean National TAC, chaired by Maria Teresa Ruiz. NOAO was pleased to be of assistance as this new process was set up. Chilean astronomers were able to submit their proposals through the usual NOAO channels, and the proposals were forwarded to Chile for review by the CNTAC. Chilean astronomers could take advantage of the tools and documentation available to NOAO's users, the CNTAC did not have to set up its own form or documentation, and the proposals could be entered seamlessly into the scheduling process for CTIO's telescopes.

Sixteen proposals were received by the deadline and mirrored to the University of Chile for review. Following the CNTAC meeting, the ranked proposals were forwarded to CTIO for scheduling.

Todd Boroson

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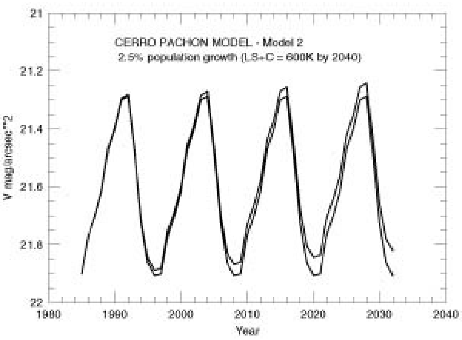
Pachon-Tololo Skies: Dark, and Keeping Them That Way

Recent measurements and computer models for Cerro Pachon indicate that it is one of the darkest sites in the world. However, the growth of the population centers in the vicinity of Cerro Pachon and Cerro Tololo (La Serena-Coquimbo, Vicuna, Andacollo, Ovalle), and the rapid growth of the coastal region as a center of tourism, has caused concern that poor lighting-control practices could threaten the dark skies in the decades to come. Even very pessimistic projections, with aggressive population growth and no lighting-control measures, indicate that Pachon will continue to be a very dark site until at least 2020. This worst-case scenario predicts an augmentation of 0.1 mag above the natural solar-minimum background of 21.9 V mag per square arcsec at the zenith in 2020. This should be compared with the 0.6 mag variation of night sky brightness induced by the solar cycle (Figure 1 and Model 3 below).



Caption: *Sky brightness model prediction for Cerro Pachon with (upper curve) and without (lower curve) light pollution from artificial sources. The dominant effect is the variation in natural sources induced by the solar cycle. This model projects rapid population growth and modest light control measures.*

Moderate controls would extend our present very dark sky even further into the future. CTIO has begun a campaign of public awareness and specific pro-active and corrective measures in the surrounding municipalities to secure this future now . This has included working closely with Vicuna in the development of attractive, low-cost, low-impact street lighting, and with large international mining operations in Andacollo for the selection and positioning of outdoor industrial safety lighting. On the national level, lighting control regulations intended to protect Chile's world class scientific resources for observational astronomy have been crafted by CONAMA (the Chilean EPA), with technical assistance from CTIO and other observatories, and are making their way into law.

Here we present some models and measurements of light contamination for Pachon and Tololo, followed by a "success story" illustrating a collective response to a recent case of poor lighting practice.

Models and Measurements for Pachon and Tololo

The natural night-sky brightness is made up of several components. From Benn and Ellison, La Palma Technical Note

115, and for the V band at zenith:

Zodiacal light (mean value):	34 nL *
Airglow (varies with solar cycle):	11-50 nL
Backround stars (V>20 + interstellar scattering):	13 nL
Galaxies:	0.1 nL
Aurorae (for b < 40):	0 nL
Total:	58-97 nL

*nano Lamberts

It is often not appreciated that the brightness of the night sky varies with the solar cycle, with a B or V-band peak-peak of over half a magnitude; this is shown for Mauna Kea by Krisciunus (PASP, 109, 1181, 1997).

The dispersed brightness from artificial sources -- light pollution -- includes contributions from direct light, aerosol scattering, and Rayleigh scattering by molecules. These vary as a function of zenith distance. The calculation of the amount of light pollution at a given site has been treated by Roy Garstang (PASP, 101, 306, 1989a) and the evolution with time discussed by Garstang (ARAA, 27,19, 1989b). Predicted man- made contributions for several observatories that have strong light pollution are shown in Figure 3 of Garstang (1989b). Note that the solar cycle modulation of 0.6 mag amplitude has been removed. The pollution growth models are based on population estimates and assume that no attempts are made to reduce the light output per person by installation of environmentally friendly light fixtures, etc.

Garstang has kindly calculated the evolution of light contamination at Cerro Pachon by his methods, using the location and elevation of Pachon and neighboring communities (La Serena-Coquimbo, Vicuna, Andacollo, Ovalle-Monte Patria); population measures or estimates for each center by decade, from 1990 to 2030; and light output per person of 150 L (1990) or 300 L (all other dates).

Note that the model does **not** include:

The effects of intervening mountains. Almost all the direct light is scattered at angles just above the horizontal, so intervening mountains remove a substantial amount of the direct light contamination. In our case, Ovalle is not directly visible, and large fractions of Vicuna and La Serena-Coquimbo are occulted.

Cloud cover. On approximately 50% of nights La Serena and Coquimbo are totally covered by low clouds, which reduce light contamination from these cities to near zero. Until 2010, La Serena-Coquimbo contribute around half of the light contamination, and more in later years.

The model calculates V magnitude light output at zenith. Since the street lights are all high pressure sodium, and there are virtually no mercury lamps, the V band is a good test case. We also have some calculations for 2010 (i.e., near next solar minimum) looking at zenith distance 45 to and away from La Serena-Coquimbo.

Garstang's calculation, which we call Model 1, assumes a moderate population growth. Andacollo is a small mining center, with little growth potential both for population and mining; Ovalle is an agricultural service center that also has little growth potential. La Serena and Coquimbo have turned into major tourist centers in the past 10 years, but there is no industry, and our model shows the population growth slowing down over that experienced in the last 15 years. Official figures show Vicuna as having near-stagnant population. We have chosen to increase it rather drastically to allow for an increase of tourism-related activity in the Elqui Valley. Here is the population model used for Model 1:

City/Year	1990	2000	2010	2020	2030	2040
LaS-Coq	220K	240K	260K	280K	300K	320K
Andacolla	12K	12K	12K	12K	12K	12K
Vicuna	20K	22K	28K	30K	32K	34K
Ovalle	105K	110K	115K	120K	125K	130K

The light output per person in a "typical uncontrolled US city" is 1000 L per person. Our estimates relevant to the cities here were based on installed street lighting figures for Vicuna and La Serena, population density compared to a US city (about a factor 5 smaller), the lack of any industry apart from tourism, the existence of only two malls for 250,000 people, and the active steps being successfully taken to install environmentally friendly fixtures. However we realize our estimates are ad-hoc, and will re-do the calculations when better estimates are available.

We have also produced a Model 2 by scaling results from Model 1. We use the same light output per person but a much more aggressively increasing population model. We do not think this is very likely, but it is the model we will use for planning purposes:

City/Year	1990	2000	2010	2020	2030	2040
LaS-Coq	220K	240K	307K	393K	503K	644K
Andacolla	12K	12K	14K	16K	18K	21K
Vicuna	20K	22K	28K	35K	40K	50K
Ovalle	105K	110K	120K	140K	165K	200K

Finally, we calculate a Model 3, with Model 2's population growth but no light control whatsoever. Additionally, the light output per person is assumed to be the "US uncontrolled city model." We consider that this model is very pessimistic and very much a worst-case scenario.

The outstanding results of this study are:

Cerro Pachon is an extremely dark site! The V-magnitude per arcsec2 above the natural background (assuming solar minimum sky) is predicted to be (in mag units):

	Model 1	Model 2	Model 3
1990	0.010	0.010	0.010
2000	0.022	0.022	0.033
2010	0.025	0.042	0.075
2020	0.027	0.062	0.130
2030	0.028	0.082	0.220

Compare these to the 0.6 mag increase in sky background from solar minimum to maximum shown in the figure! *Even the worst case model 3 shows that by 2030 the sky brightness at solar minimum is still only about half that at an unpolluted solar maximum.*

The model 1 2010 figures for 45 zenith distance towards La Serena-Coquimbo and directly away are +0.041 mag and +0.031 mag respectively (cf +0.025 mag at zenith). Note that the sky naturally brightens as zenith distance increases.

The accompanying Figure shows our planning model, Model 2, together with a natural-brightness-only model including the effects of the solar cycle. Facilities presently under construction on Cerro Pachon face a long, dark future!

Cerro Tololo is closer to La Serena-Coquimbo and Vicuna than Cerro Pachon and is roughly estimated to suffer 65% more light contamination than Cerro Pachon. But since Pachon is so dark, how much is this quantitatively for Tololo, and how has it evolved?

We have, near sunspot minimum 1987-1988, from measurements by A. Walker: U = 22.0 mag/"2, , B = 22.7, V = 21.8, R = 20.9, and I = 19.9.

Compare these to measurements by M. Phillips in 1997: B = 22.8 and V = 22.2; and at ZD = 45 in the direction of La Serena + Coquimbo: B = 22.6 and V = 21.8.

Given that the likely error on each measurement is ~+- 0.15 mag (see discussion in Krisciunas 1997) we conclude that there is **no** increase in light pollution detectable in broad-band colors at zenith distances less than 45 between these observations made at the last two sunspot minimum. We will continue to monitor the sky brightness through the present solar cycle.

For more details and graphs, see http://www.ctio.noao.edu/site/pachon_sky/.

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Working Within the Community, a Success Story

During March and April of this year, CTIO developed a collaborative effort with local public works authorities from La Serena, and representatives of a newly inaugurated shopping mall, to minimize light pollution from the mall's parking lot. This was a case in which everybody won.

During the first few weeks after the inauguration of the SeaGate Mall in northwest La Serena, it became apparent that there was a problem with the light fixtures illuminating their parking lot. Shoppers visiting the Mall could readily appreciate that there was excessive, poorly directed illumination. Drivers on the heavily traveled, high speed Pan American Highway nearby suffered impaired visibility coming into and leaving the region of glare -- an obvious safety hazard. From our offices on a hill several kilometers to the east, the effect of bad illumination practice was obvious: too much light was being directed or diffused skywards. (The International Dark Sky Association Website, http://www.darksky.org/ida/, is a good information resource for the non-astronomical problems caused by poor lighting.)

Following a long-term preventive and corrective plan, we approached the head of public works in La Serena, with whom we maintain very good relations. She immediately understood the situation, and together we met with the executives at the Mall. They were also very responsive, and investigated the cause of the problem. After consultation with their architects, it was found that the light fixtures had simply been wrongly installed. The individual housings were supposed to be pointed straight down. But due to misreading a drawing, they were inclined instead at 45! At this point, the Mall management instituted an immediate fix of the problem at their expense, bringing in a truck with a cherrypicker from 500 miles away to access the fixtures.

The photo shows a fixture group being re-oriented. The result of correcting this geometrical mistake can be seen directly. The effects were immediate: parking lot illumination was improved, the hazard to highway drivers eliminated, and light pollution dramatically reduced. Our measurements from before and after the change indicate a 200 reduction in diffuse light in the first 50 meters above the Mall. Since so much of the light formerly diffused to the sky was now being sent to the ground, the mall was able to turn off some of the lights, thus further reducing light pollution and saving money on their electricity bill. The monetary savings are not trivial; electricity is expensive in Chile, and a shortage of hydropower induced by drought has resulted in additional incentives for large users to reduce consumption.

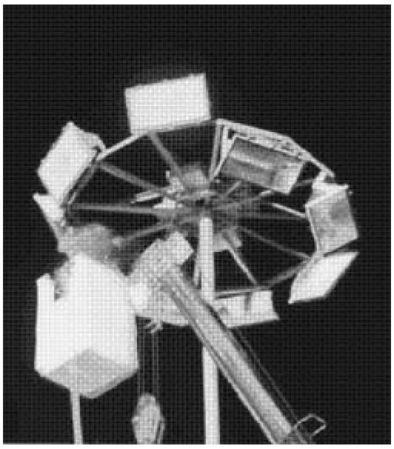

Figure 1: *Changing the installation angle of lighting fixtures at the SeaGate Mall, La Serena. The effect on illumination pattern is readily seen.*

This successful experience has shown us once again that, while there is a general lack of awareness of lighting issues, there is plenty of willingness to help prevent or correct problems when the issues are explained. The SeaGate Mall example is a success for the community, for the business involved, and for astronomy in the IV Region.

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Maxime Boccas (mboccas@noao.edu)

SOAR Telescope Project Starts Construction

During May, the SOAR 4.2-m telescope took two very important steps towards becoming a completed reality. These were the signing of contracts for the two major subsystems of the telescope: (1) the Telescope Mount System including the drives; and (2) the Active Optics System including polishing and providing the active support systems for the primary, secondary, and tertiary mirrors (M1, M2, M3). Simultaneously, the design of the enclosure and support building has moved essentially to completion, so construction on Cerro Pachon can go into high gear. The SOAR (Southern Astrophysical Research) Telescope is a joint project involving Brazil (31% of observing time), Michigan State (13%), North Carolina (16%), and NOAO (30%). Chile receives 10% of the observing time as host country. The goal is to construct and instrument a 4.2-m telescope offering the highest possible image quality over a tip-tilt corrected field of view about 7' in diameter. SOAR will be located on Cerro Pachon, 11 km from Cerro Tololo, which it will share with the Gemini South telescope. The construction cost will be $28 million. CTIO will operate SOAR for a twenty-year period as part of our contribution to the project. SOAR partners will be able to swap for time on the Blanco 4-m telescope with its wide field capabilities, so that SOAR can be specialized for programs requiring the highest image quality.

The Project Team

The project team is headed by Tom Sebring (Project Manager) and Gerald Cecil (Project Scientist). The approach is to have most of the design work done by the major contractors described below, with only a small in-house team whose main duty is to oversee the contracts. The lean, mean contract team consists of Victor Krabbendam (Project Engineer and active optics system), Dave Porter (mount and dome), Oliver Wiecha (electrical), German Schumacher (software), Gilberto Moretto (Optical Engineer), Eduardo Serrano (Chile Site Manager), Jeff Barr (Architect) and Christine Stone (Administrative Assistant). CTIO is very happy to have been able to second Schumacher to the project from our staff, since his return here for the SOAR operations phase will ensure continuity in the maintenance and continuing development of the telescope's software package.

The Mount Design

The mount contract went to RSI Universal Antennas, in Richardson, Texas. This company has a long history of constructing radio and radar antennas, but also recently provided the mount for the Hobby-Eberly Telescope.

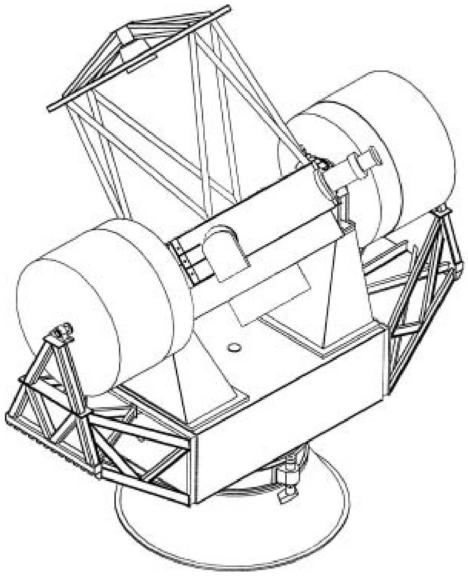

Figure 1: *Perspective view of the preliminary design for the SOAR telescope mount, with the two large Nasmyth instrument volumes shown as cylinders.*

The general layout of the mount is shown in Figures 1 and 2. The telescope will be built with two Nasmyth foci and three Bent Cassegrain foci. This will support quick interchange between a variety of instruments. The large cylinders shown on Figure 1 on either side of the primary mirror area represent the volumes allocated to the two Nasmyth instrument packages. Each Nasmyth package may be subdivided between up to three permanently mounted instruments or can carry one large instrument that might be shared with Gemini. In Figure 2, the ear-like protuberances on either side of the telescope indicate the volume allocation for a Gemini instrument.

Figure 1 also shows two Bent Cassegrain instruments sticking out of the uphill side of the primary mirror area. A third such focus is located on the opposite side of the telescope.

The basic performance specifications for the mount are:

Tracking jitter and drift <0.1" each

Pointing accuracy and repeatability < 2.0"

First eigenmode > 12 Hz

Instrument payloads: 2800 kg at Nasmyth, 300 kg at Bent Cass.

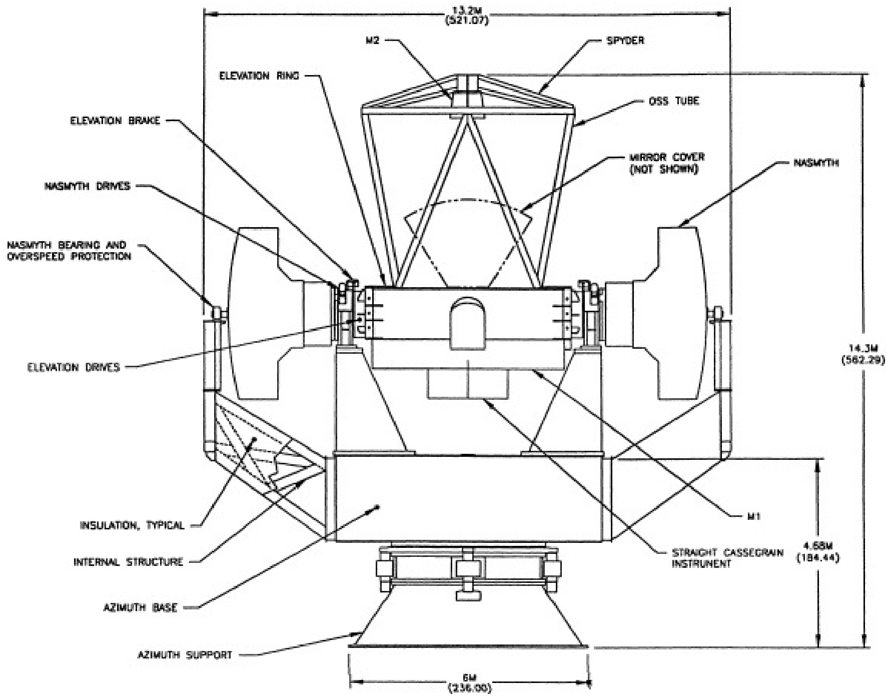

Figure 2: *Side view of the SOAR telescope mount, at the preliminary design phase.*

The mount will use roller bearings at all locations, taking advantage of RSI's great depth of experience at building large radio antennas using this sort of drive.

The Active Optics System

The primary mirror substrate will be a meniscus, 4.25-m in diameter by 104 mm thick. This is about half the thickness of the Gemini 8-m mirrors, but the SOAR mirror actually will be stiffer than the Gemini mirrors because of its smaller diameter. An important advantage from such a thin mirror is the short thermal time constant, which will simplify the control of the mirror temperature and hence of mirror seeing. The substrate currently is being manufactured by Corning, from ULE low-expansion glass. Raytheon (Danbury, Connecticut), won the contract for polishing M1, M2 and M3 and for providing their active support systems. Their design (see Figure 3) will provide axial support for the primary mirror with 120 very stiff electro-mechanical push-pull actuators, providing high correctability of the mirror figure. In contrast to most recent support systems for meniscus mirrors, there will not be a complex lateral support system to support the mirror when the telescope is pointing at the horizon.

Rather, there will be just three tangent-bar locating links. This is because even at large zenith distances the axial support system will be able to compensate for gravitational flexure of the mirror to the very high accuracy required. This is expected to provide a very simple and easily maintainable mirror support system.

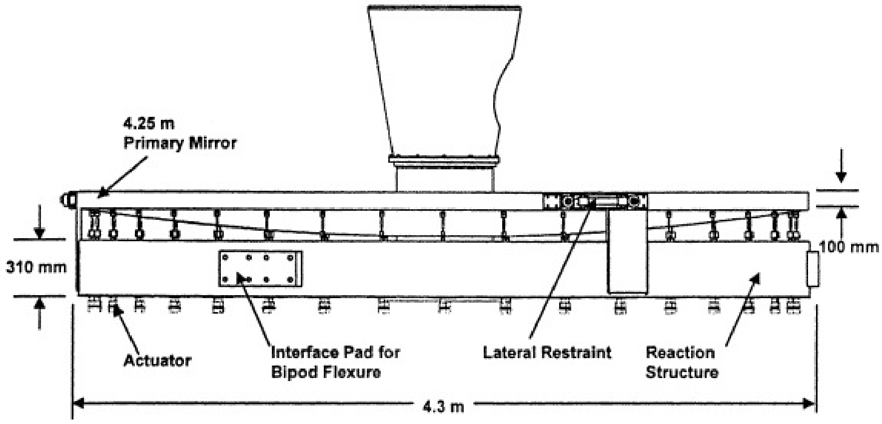

Figure 3: *Sketch of the primary mirror support system (including the central baffle which supports M3).*

The secondary mirror (M2) will be ~ 0.6-m in diameter and will be mounted on a fully-controlled hexapod with five degrees of freedom to provide the usual sort of active optics correction for coma and focus.

All of the foci currently being implemented will have tip-tilt correction, provided by tip-tilt control of the M3 flat. This flat also will rotate to select between the various Nasmyth and Bent-Cass ports. The tip-tilt loop will be closed in most cases by on-instrument wavefront sensors, although some ports will also offer facility tip-tilt sensors. The low-bandpass active optics corrections will be calibrated using a wavefront sensor permanently mounted at one of the instrument ports. At least initially these slow corrections will then be supplied from lookup tables during actual observing.

SOAR will be an f/16 telescope, to maintain compatibility with Gemini so that future instruments can be shared. Although the optical performance is specified in terms of a structure function, in general terms the image degradation by the telescope (including dome seeing and tracking errors) will be < 0.16". SOAR's instruments will be matched to expected tip-tilt-corrected best image sizes of 0.24". It is expected that the median image size will be about two times better than is achieved by the Blanco telescope. The basic goal is to obtain essentially the same image quality as Gemini, but at half the wavelength where Gemini gets its best images, and to equip the telescope with instruments optimized for that capability.

Control System

SOAR is also pioneering new territory with its software systems. It will use PC's running a distributed PCI architecture, built around the Labview/Bridgeview software languages offered by National Instruments. The underlying operating systems probably will be LINUX for the TCS, and Windows NT for the instruments.

Instrumentation

The SOAR partners are banding together to provide an ambitious suite of instruments for the initial instrument package. These are:

High-throughput UV Spectrometer.. This will be built by UNC and Brazil, under the leadership of Chris Clemens (UNC). It will employ volume-phase holographic gratings to get resolving powers R = 5-18,000. It will offer high UV throughput and also multi-slit spectroscopy over a 3'-5' FOV.

IFU-fed, Bench-mounted Optical Spectrometer. This is being built by Brazil under the leadership of Jacques Lpine. The IFU (Integral Field Unit) will use 1500 fibers behind a lenslet array to completely cover a field which can vary between 50"-250"^{2}, according to the zoom setting of the foreoptics. The bench spectrograph will have a variety of modes with resolving power up to R ~ 30,000. The instrument will be used both for two-dimensional spectroscopy of extended objects, and for point sources while maintaining full spectral resolution and throughput under all seeing conditions.

Optical CCD Imager. This instrument will use a 4K 4K mini-mosaic behind a focal reducer and atmospheric dispersion corrector producing an f/9 output beam. This will give ~ 0.08" sampling over a 5' field. The optical imager will have high UV throughput, with sol-gel coatings and UV-transmitting elements in the ADC. It is being built at CTIO under the leadership of Alistair Walker.

Infrared Imager. A $2K^2$ Near-IR Hg-Cd-Te imager is being built by Ed Loh at MSU. This instrument will be easily upgradable to a 4K 4K mosaic, which with the 0.08" pixel size again will sample essentially the full isokinetic patch at the full angular resolution of the telescope. A Lyot Tunable Filter will be available, and there probably will be additional provisions for grism spectroscopy.

IR Spectrographs. Current plans are for NOAO to provide a pair of existing IR spectrographs as interim measures until a new instrument can be built. To support low-medium resolution spectroscopy of point sources, the CTIO IRS will be upgraded with a 1K 1K HgCdTe detector. For higher resolution work, we expect to offer the R = 100,000 Phoenix spectrograph which was built in Tucson and currently is in use on Kitt Peak. It is possible that Phoenix will be shared between SOAR and Gemini-South.

The Enclosure

The enclosure design is sketched in Figure 4. In contrast to many recent new telescopes, SOAR will use a forced ventilation system to control dome seeing. Air will be sucked in through the observing slit (which will be a small aperture defined by a shutter and a semi-porous windscreen, and which follows the telescope motion), and then will be exhausted by a ring of large fans in the non-rotating part of the enclosure. The vents for two of these fans can be seen in Figure 4. Similarly, the top surface of the primary mirror will be flushed by an active system rather than by natural ventilation. The rotating dome will be built in Brazil, and will either be a geodesic design or made of free-standing interlocking panels which do not require a supporting frame.

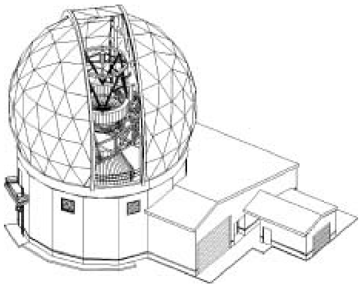

Figure 4: *Perspective view showing the SOAR building and enclosure. The building design is 95% complete, but the enclosure shown is only a nominal design.*

The construction of the fixed building will be contracted to the new AURA Observatory Support Services (formerly the CTIO Operations division), who will then subcontract out the work as needed. This approach will take maximum advantage of CTIO's long history and special knowledge of operating in Chile.

The attached support building will be kept very simple, with just a control room, one instrument workroom, a computer room, and a high-bay receiving area. Through an arrangement negotiated with Gemini, SOAR will be able to utilize space and facilities at Gemini-South telescope, 400m away. In particular, the SOAR primary mirror will be recoated in Gemini's facility.

Schedule

As was noted at the start of this article, letting the major contracts for the telescope was a very important milestone and opens the way for a rapid construction schedule. The mount system and active optics systems will be tested separately in the respective factories and then shipped to Chile in late 2001 and the first quarter of 2002. First light is scheduled for mid-2002, and operational hand over will be in early 2003.

Jack Baldwin (jbaldwin@noao.edu),
for the SOAR Consortium

Increased Access to YALO for NOAO Users -- Call for Proposals for November 1999-January 2000

At the beginning of July, a large-format IR array was installed in ANDICAM at the YALO telescope. The YALO facility now offers the unique capability of simultaneous optical and IR observations in a queue-scheduled mode for NOAO users. ANDICAM's IR array is a 1024 1024 HgCdTe device with dark current < 0.5 e-/s and read noise of about 11 e-. The field of view is about 200" 200" with a pixel scale of 0.2"/pixel. Further details about the current IR and optical performance of ANDICAM are given in the subsequent article.

In return for providing the IR array to the YALO consortium, NOAO has negotiated a larger time share for NOAO users as well as access to Galactic Bulge observing time, which was excluded in the original agreement. As a result of these negotiations, NOAO's share has increased from 15% to 27.5% during all of the "non-Bulge time." While some Bulge time remains exclusively reserved for Ohio State's microlensing follow up program, the "sliding apportionment" defined in the table below will give NOAO users access to Bulge targets. Also, note that service/synoptic/target-of-opportunity observing is now available on the 0.9-m with unrestricted access to Bulge targets for the NOAO community (see related article in this Newsletter).

OSU Bulge time allocation on YALO*

Month	**OSU time**
June	ALL
July	ALL
Aug	LST < 23 hr
Sept	LST < 23 hr
Oct	2 hr/night
Nov	1 hr/night
Dec	NONE
Jan	NONE
Feb	1/2 hr/night
Mar	1/2 hr/night
Apr 1-14	1 hr/night
Apr 15-30	2 hr/night
May 1-15	3 hr/night
May 15-31	4 hr/night

* Of the remaining time, NOAO users get 27.5% of the observing time.

This increased time-share results in fourteen equivalent nights of additional time available to NOAO users during the remainder of semester 1999B. The additional time will be allocated as Director's Discretionary (DD) time. We therefore solicit applications for DD time from November 1999-January 2000, and encourage applications via the normal proposal process for 2000A during the upcoming proposal cycle.

DD time may be requested by a letter to the CTIO Assistant Director, Alistair Walker (awalker@noao.edu) with copy to telescope scheduler Ron Probst (rprobst@noao.edu). Outline your scientific program (1-2 paragraphs) and your observing time needs. The YALO Web pages (http://www.ctio.noao.edu/yale/yale.html) can be consulted for help with observation planning. Be sure to read the guidelines for appropriate requests to this facility. DD time requests received by 30 September 1999 will be internally evaluated as a group for time assignment. Later requests will be evaluated upon receipt for any time remaining.

With the increased NOAO share and the true queue service observing in simultaneous dual optical-IR mode, the community should find YALO an even more useful and competitive facility. We are looking forward to your science proposals!

Rene Mendez (rmendez@noao.edu),
Stefanie Wachter (swachter@noao.edu)

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YALO ANDICAM Receives Its IR Channel

With the installation of an IR array provided by CTIO, both the optical and IR channels of the Ohio State University-supplied camera ANDICAM on YALO are now functioning. This enables simultaneous optical and infrared imaging, including dithering in the IR channel while the optical channel integrates. However, ANDICAM still has only half of its CCD working due to amplifier problems. As a result of providing the array, a nominal engineering-grade device obtained as part of the OSIRIS upgrade, the CTIO observing time share with YALO + ANDICAM has increased to 27.5% and some access to the Galactic Bulge is now available. See the accompanying article for details and a near-term observing opportunity.

In July, the Ohio State team installed the IR array, a 1024 1024 HgCdTe HAWAII array from Rockwell. This permitted a checkout of the IR channel end-to-end. The internal mechanisms (dither/focus mirror and filter wheel) have been thoroughly exercised and appear quite reliable. The dither/focus motion in particular functions very well; the motions are accurate and repeatable, which should allow for straightforward assembly of dithered images. The IR channel is sufficiently parfocal with the optical filters that no internal refocus amongst the possible filter combinations is required (that is, the IR and CCD channels are "locked" together in focus, so only the telescope focus should ever be adjusted).

The array has very low read noise (~ 11 e-) and is flat to ~ 20% (most of the variation is a gradient towards the right-hand-side or north edge of the array). There is a group of about 300 dead pixels and ~ 50 scattered dead/hot pixels over the array. The system throughput is about as expected, suggesting the array has reasonable quantum efficiency for devices of this type. Measurements of a grid of standards spanning all four detector quadrants and ~ 15% of the area of the array show very good reproducibility (< 1% rms in the photometry). These tests were limited by weather, and a larger grid covering more of the detector is planned.

Sensitivity of the infrared channel is as expected. A web page to assist observation planning is under construction. A rough guide is that H = 13 is easy (high S/N in a few minutes), H = 15 is possible (high S/N in 30-40 minutes or so), H = 17 is tough (poor S/N in an hour); anything fainter should be done elsewhere. Numbers at J and K are similar (a bit higher at J, a bit lower at K).

Preliminary use of the instrument over the first few nights suggests that only occasional sky measurements are required, which should improve observing efficiency. Optimal observing strategies (exposure times, co-adds, dither spacing, etc.) will be defined during July and August. All observing is done in queue-scheduled mode by a telescope operator/observer.

On the optical side, we had hoped to reactivate the "dead" half of the CCD.

Unfortunately, we were unable to configure the device for science-quality 2048 2048 operation. The full device is now reading out, but the left-hand-side (south) does not contain science-quality data. Stars can be seen on that half of the CCD, but there are several problems that prevent the data from being useful. Principally, the effective full well of that side of the detector is only about 1000 DN (roughly 15 times smaller than the "good" side); there may be other systematic problems with the data that we don't fully appreciate. Users should note that, because of the reconfigurations of the readout, the half of the detector that is "good" is now different from before (the "good" half is now the right-hand-side or north edge). Users will need to modify their data reduction routines to change the "good" part of the CCD. The good part is obvious on inspection.

There is some further good news. The new control system is working very well. Our observers have assimilated the changes and seem comfortable with taking CCD, IR, and DUAL mode images. We have a good set of web tools to help the operators with observation planning and will soon integrate the nightly operations with user supplied parameter files for the observations.

The dual-channel imaging capability is nearly magical to watch. Seeing the CCD integrating while the IR channel reads out and dithers around the sky is fascinating -- especially when the images arrive on the data reduction computer and you can look at optical and IR images of the same field taken at the same time.

Darren Depoy (Ohio State),
Bruce Atwood (Ohio State),
Jerry Mason (OSU), Rick Pogge (OSU),
Ken Sills, (OSU), Ren Mndez (CTIO)

MACHO Observations on the 0.9-m to End This Semester

As most readers know, the CTIO 0.9-m has been working in tandem with the MACHO microlensing survey telescope since 1994. The MACHO project officially terminates in January 2000, as do the microlensing follow up efforts of the Global Microlensing Alert Network (GMAN), for which the 0.9m has served as the flagship telescope. The purpose of this network has been to obtain high-accuracy photometry of microlensing-like variability without sacrificing the overall detection rate of the MACHO survey system. In this, the project has been extremely successful. All variants of exotic microlensing have been detected by the CTIO 0.9-m, and in most cases real-time recognition of these effects has been largely due to the CTIO data.

Specific examples include prediction of the behavior of event MACHO 95-BLG-30, where the lens actually transited the face of the lensed source. Our prediction was based largely on CTIO data, and allowed us to resolve subtle center-to-limb spectral changes as the lens preferentially magnified certain regions of the stellar atmosphere. The 0.9-m was also responsible for the real-time recognition of lens binarity in MACHO 98-SMC-1, the single most important lensing event seen to date. In this event, the source underwent a caustic crossing, where strong lensing features pass over the face of the source -- in fact, at its peak the source brightened by approximately 5 magnitudes. Resolution of the temporal width of this crossing by multiple telescopes allows us to say with strong confidence that this lens resides in the SMC. This has exciting implications for the nature of the lensing population, and the velocity structure of the SMC. We were also able to measure limb-darkening profiles of the lensed source, a metal-poor A star.

In all cases, the staff and visiting observers at CTIO have allowed enormous flexibility in the night-to-night scheduling of the telescope. And in many cases, this provided access to lightcurve fine structure which would otherwise pass unobserved. The MACHO Collaboration, in particular Chris Stubbs and Andy Becker, would like to thank all involved with the CTIO 0.9-m over the past five years for their contribution to dark matter science, and to the realization of gravitational microlensing as a viable tool to study Galactic and Magellanic populations, both dark and luminous.

With the end of the MACHO project, changes are in store for the CTIO 0.9-m telescope. In addition to implementing a synoptic/service/target-of-opportunity observing program (see related article in this newsletter), we are investigating options for a nightly monitoring project similar to MACHO.

Andy Becker (Macho Project, Washington),
Bob Schommer, CTIO (bschommer@noao.edu)

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CTIO to Offer Synoptic/Observing on 0.9-m Telescope

For the 2000A observing semester (proposals due 30 September), CTIO will offer a new mode of observing on the 0.9-m telescope with the introduction of the Synoptic/Service/Target-of-Opportunity (SSTO) program. We will be offering this opportunity on a trial basis for the 2000A semester, and may continue the program in subsequent semesters depending on demand. Proposers who need synoptic observations of the Galactic Bulge may be especially interested in the 0.9m SSTO program as an alternative to the YALO telescope (on which NOAO has limited access to the Galactic Bulge).

What is the SSTO Program?

Approximately 20% of NOAO time on the CTIO 0.9m will be devoted to this new SSTO program, scheduled (on average) as one full night of SSTO observing after every four nights of "classical" observing. The SSTO observations will be scheduled and performed in service mode by the SSTO scientist and/or by qualified CTIO 0.9-m telescope operators.

SSTO observations will be made using the normal CTIO 0.9-m telescope CCD camera (see CTIO web page at http://www.ctio.noao.edu for details) and only *standard BVRI filters*. Proposals should be tailored to take advantage of optical imaging in a synoptic or service mode, generally requiring only a fraction of any given night. Proposals requiring IR or IR+optical capability and/or different synoptic spacing should apply for NOAO time on the YALO telescope -- see related article in this Newsletter. Programs that can be completed in the classical observing mode should not be submitted for the SSTO program.

What If It's Cloudy During My Service Observations?

This service observing is offered on a shared-risk, "no-guarantee" basis: observations will **not** be repeated if they cannot be accomplished at the scheduled time due to weather conditions, equipment malfunctions, etc. Conditional scheduling requirements other than timing within the observing semester (e.g. seeing better than 1", photometric conditions, etc.) will generally not be accepted. However, observations of Landolt standard stars will be obtained on all service observing nights having photometric sky conditions, and limited requests for photometric calibration of fields will be considered.

Where/When/How Do I Get My Data?

Data will be made available to SSTO proposal PIs via WWW and/or FTP access, typically within 12 weeks of each night of service observing (faster access may be provided, depending on demand). Bias and dome flat-field images will be acquired by the service observer on each night of service observing. Sky flat-field and Landolt standard star images will be acquired by the service observer when sky conditions are judged to be appropriate. SSTO proposals do **not** need to include overhead time for obtaining these calibration images. All calibration images will be made publicly available via WWW and/or FTP, and all other SSTO observations will be made publicly available following a one-year proprietary period.

What About Targets-of-Opportunity?

The target-of-opportunity (TO) aspect of the SSTO program on the 0.9-m will operate in parallel to the existing CTIO-wide TO program, but will operate only during the scheduled service mode nights on the 0.9-m.

Thus, it is appropriate for targets for which a delay of 0-5 days after the triggering event occurs will not adversely affect the scientific potential of the observations. When the PI triggers an 0.9-m SSTO program by notifying the SSTO Scientist, the TO observation will be added to the schedule for the next upcoming service mode night. TO observations under the SSTO program are offered on the same shared-risk basis as the synoptic observations.

How Can I Sign Up for the SSTO Program?

Proposers will be asked to identify 0.9-m SSTO observing proposals (for both synoptic and TO programs) on the NOAO proposal form. SSTO proposers should be prepared to provide in their proposals specific information in addition to the standard proposal instructions. For synoptic programs, the proposer should provide an optimum requested observing schedule (e.g. total time per exposure in each filter, number of exposures per night in each filter, number and spacing of nights, etc.) and justification for observing in synoptic mode.

Additional information for this new observing mode at the CTIO 0.9-m telescope can be found on the CTIO SSTO web page at http://www.ctio.noao.edu/servobs. Please direct any questions regarding the SSTO program on the CTIO 0.9-m telescope to the SSTO Scientist, Donald W. Hoard (dhoard@noao.edu).

Donald W. Hoard (dhoard@noao.edu),
R. Chris Smith (csmith@noao.edu),
Stefanie Wachter (swachter@noao.edu)

OSCIR No Longer Available

The University of Florida mid-infrared camera/spectrometer OSCIR, which has been available as a facility instrument on the 4-m for several semesters, has now been withdrawn. This instrument was made available to our users by an agreement with Charles Telesco under which his team provided visitor support, and received a modest allocation of guaranteed time.

The decision not to renew this agreement was mutual and cordial. OSCIR is headed to Gemini North, and Charlie has expressed the desire to get it back into his lab for necessary modifications. At the same time, the arrival of the Mosaic Imager at 4-m prime focus makes it less operationally attractive to continue installations of the f/30 chopping secondary, which requires dismounting Mosaic.

OSCIR has been used productively by both Florida astronomers and other visitors. It has supported several theses and produced a Newsweek cover story about the discovery of the dust disk around HR4796 -- good press for astronomy. Use at Tololo in both imaging and spectroscopic modes has enabled the Florida team to establish improved protocols for the difficult tasks of mid-IR observing, and they have benefited from expert advice from other users. Since this group is now building the facility mid-IR instrument for Gemini South, CTIO has played a role as a test bed for 8-m instrumentation in addition to supporting good science.

We are sorry to see OSCIR go. It leaves a significant gap in US-accessible instrumentation in the Southern Hemisphere (and the Florida group always brought great snacks for observing!). It will continue in use on Gemini North and Keck. We wish it well.

Ron Probst (rprobst@noao.edu),
Patrice Bouchet (pbouchet@noao.edu)

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Rutgers Fabry-Perot Retired, to be Replaced

The Rutgers Fabry-Perot (RFP) imaging spectrometer is being withdrawn from service as of next semester (2000A), and no proposals for using the instrument will be accepted. The RFP has had a productive thirteen-year career at Tololo. Its first use was to measure the Ha rotation curve of NGC 7552 by R. Schommer, M. Phillips, and night assistant P. Ugarte on the 1.5-m on 23 October 1986; its final observation was of the kinematics of stars in the Milky Way center by T. Williams and night assistant P. Ugarte on the 1.5-m on 21 June 1999. In the intervening years, a wide variety of imaging spectroscopy has been carried out using the unique capabilities of the instrument.

CTIO will not be without an imaging Fabry-Perot instrument for long, however. A successor to the RFP is being constructed at Rutgers and should be in operation for semester 2001A. This new instrument, the Rutgers Advanced Spectroscopic Imager (RASI), will offer significant new capabilities. In addition to the two spectroscopic resolutions provided by the RFP (R = 8000 and 2500), a third etalon will provide lower resolution (variable from R = 400 to 1200). The linear field of view will be twice that of the RFP, making the instrument 4 times faster for extended objects. The RASI will operate at the 1.5-m f/13.5 focus and the Blanco f/14 focus, and will be suitable for use on both SOAR and Gemini in the future; the internal optics of the instrument will fully exploit the excellent imaging performance of these telescopes. A monitor channel will measure the atmospheric transparency during observations, to allow use of the RASI in non- photometric conditions with no loss of accuracy; the monitor CCD will also generate error signals for fast guiding/tip-tilt correction. A new filter suite and dual-etalon operation will allow the use of the RASI at any wavelength from 4700 to 8700 at all resolutions, with no need for additional blocking filters. Updates and status of RASI will be available on the web as the project nears completion.

Ted Williams (Rutgers University),
Bob Schommer (bschommer@noao.edu), CTIO

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Undergraduates Wanted for the 2000 CTIO REU Program!

The CTIO Research Experiences for Undergraduates (REU) program heads into the next millennium! After a great program in 1999 (with all four CTIO REU students presenting posters at the Chicago AAS meeting), we're looking forward to another outstanding program for 2000. We anticipate offering four Undergraduate Research Assistant positions for a ten-week program starting in January 2000 under the supervision of the Donald W. Hoard (CTIO REU Site Director).

The CTIO REU program offers students the unique opportunity to gain observational experience studying objects in the rich Southern Hemisphere sky (the Magellanic Clouds, the Galactic center, etc.), while also providing them a chance to work alongside Chilean astronomy and engineering students who come to CTIO to participate in the "Practica Investigacon en Astronoma" and summer engineering internship programs. CTIO hosts the only NSF REU site that is run during the northern academic year (from January through March). It provides an alternative for students who can take advantage of a quarter or semester away from their home campuses, and/or who are interested in participating in an overseas program.

The application deadline is 4 October 1999. Please check the CTIO REU web page (http://www.ctio.noao.edu/REU/reu.html) for application materials and the latest news about our 2000 program, as well as for more information about the CTIO REU program, projects, and participants from previous years. Please direct inquiries to dhoard@noao.edu.

Donald W. Hoard (dhoard@noao.edu)

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Comings and Goings (and Some Returnings) at CTIO

The CTIO "family" has gained some new members and lost -- at least temporarily -- some old ones, over the past months. Here are some new faces that our scientific visitors may see, and some old ones they may miss.

Eric Rubenstein, his wife Debbie and sons Yoni (5) and Ari (2.5) arrived in early July. They come to us from Yale. Eric has won a NSF fellowship under the "International Research Fellow Awards Program" and will be spending a year at CTIO. He is an expert in CCD photometry with HST and ground-based data. His major interests are Pop II stellar mass-luminosity relationships, globular cluster studies, and instrumentation and detectors.

Lisa Germany (a six months visitor from Australia), left in July to return to ANU and finish her thesis. Much of her time here was spent at the 0.9-m, completing photometric calibrations for a large-scale study of supernovae in Abell clusters under the direction of Brian Schmidt. Her local sponsor was Nick Suntzeff. Lisa's thesis topic is a determination of the motion of the Local Group against the background cosmic flow, testing the Lauer and Postman results with a different distance indicator. In return for perfect photometric weather, Lisa taught us the rudiments of cricket.

Joining us for two months of the Northern summer was **Timothy Bowers** (University of Arizona undergraduate). Tim was recommended to us by his UA Honors Program academic mentor, Don McCarthy, and worked with Don Hoard on observations and analysis of interacting binary stars. Tim's Flinn Foundation scholarship includes a travel budget that allowed his stay here. His long hours at the telescope and computer terminal were relieved by a trip to the south of Chile during his stay.

Gabriel Perez (Senior Mechanical Engineer) is leaving CTIO after 25 years to work for Gemini. He will spend a few months in Hawaii, then return for the startup of Gemini South. So we will soon be seeing his friendly face once more in the AURA recinto, although it will be under a different hat.

Recent Gemini "returnees" are: **Gustavo Arriagada** and **Manuel Lazo** (former CTIO Electronics Engineers). They've spent two years in Hawaii bringing Gemini North on-line, and will now do the same for Gemini South. They are easily recognized as the only people in the recinto wearing aloha shirts.

New residents in the recinto are **Mike Sheehan** (Gemini Mechanical Systems Manager), his wife Michele and daughter Monica. Son Dan will be an occasional resident, between terms at college in Oregon. They will be here for about a year during the assembly of Gemini South.

As noted in the article about the SOAR telescope, **German Schumacher** (Senior Scientific Programmer) has been seconded to the SOAR project in Tucson for two years to develop telescope control software and instrument interfaces. We anticipate long-term benefits to CTIO's operational commitment for the telescope. German leaves behind his beloved and recently upgraded off-road vehicle for the more civilized(?) streets of Tucson.

Mauricio Navarette, long familiar to our mountain scientific visitors and most recently working in mountain Software support, has resigned to take a position at Las Campanas Observatory.

Ron Probst (rprobst@noao.edu)

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AURA Observatory Support Services: What's That?

AURA in Chile, formerly identified exclusively with CTIO, is expanding to the management of Gemini South, SOAR, and perhaps other future major facilities, each of which has a distinct organizational and operational face. By pooling operating resources, AURA will lower the cost of support services to each of these individual units of AURA's observatory here. The most obvious indication of this reorganization which our scientific visitors may see is the new sign at the bottom of the AURA observatory preserve, welcoming them to "The AURA Observatory in Chile," with the logos of the various units underneath.

A need has also arisen to provide administrative and logistical services in a readily accountable way to the various telescope sites, their staffs, and visitors. To do this, people involved in these activities and formerly denoted as "CTIO" have been reorganized into a separate unit, "AURA Observatory Support Services." This includes people with whom our scientific visitors interact directly: the Guesthouse and Business Office in Santiago, the Travel Office in La Serena, and the staff on Tololo who handle transportation, room and board. Visitors to the mountain may notice a letterhead change on various forms, from "CTIO" to "AOSS," and slightly more emphasis on record keeping. Otherwise, you should see the same friendly faces, competent assistance, comfortable quarters, and great food as before.

Enrique Figueroa (efigueroa@noao.edu)

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Chronicling Astronomy in Chile

An interesting article about the state of astronomy in Chile appeared in the *Chronicle of Higher Education* for 23 July 1999, authored by Kim McDonald. It discusses the world-class facilities available now or under development, the virtues of Chile's climate for astronomy, and the challenges faced by Chilean universities in accommodating the tremendous research opportunities opened to them by this development.

McDonald accompanied Charlie Telesco and the University of Florida team on a 4-m observing run with OSCIR, and interviewed a number of Chilean and foreign astronomers connected with collaborative programs for graduate training. He was assisted in this by Ren Mndez at CTIO. The resulting article, written for the larger academic community, is well-informed and well-balanced.

Ron Probst (rprobst@noao.edu)

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Alistair Walker -- Cerro Tololo's New Assistant Director

In April, Alistair Walker was named Assistant Director for the Cerro Tololo Inter-American Observatory. This follows the departure of Mark Phillips (the previous holder of this position) and the increased responsibilities being taken on by Malcolm Smith in connection with AURA's observatory in Chile (described in March 1999 Newsletter No. 57).

Alistair is recognized at an international level not only for his scientific and technical contributions to precise photometry but particularly for his substantial contributions to problems of the distance scale -- both galactic and extragalactic. He has also made major contributions towards addressing crucial problems related to the age of stellar clusters, which provide a significant constraint on cosmological models for the age of the universe.

At Cerro Tololo, Alistair has provided over a decade of experienced, hands-on, scientific leadership that has allowed CTIO to remain at the forefront of CCD imaging and photometry.

Among a variety of new duties, Alistair has been taking particular responsibility for scientific and technical aspects of the day-to-day operation of Cerro Tololo. He continues his role as chairman of the Advisory Committee on Technical Resources, CTIO's internal development and priority-setting committee for instrumentation and other technical matters.

With this promotion, Tololo is in a stronger position to manage the many changes that are occurring as a result of the arrival of Gemini South and SOAR in Chile.

Malcolm G. Smith

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Strategic Repositioning and Further Evolution in KPNO Operations

NOAO's responsibility is to provide leadership for new directions in national optical/IR ground-based astronomy. We have a community with talent, resources, and facilities distributed over a wide range of institutions. To enhance the scientific strength in that diversity, NOAO must emphasize its changing role and broadened mission.

Two key aspects of the evolution are:

Operating existing nighttime facilities in a way that maximizes scientific output not only of NOAO, but from the perspective of the suite of telescopes nationwide.

Maintaining an adequate level of investment in new developments to provide cutting edge instrumentation for NOAO telescopes on a competitive timescale and to support new strategic initiatives such as large telescopes and nationally accessible survey databases.

The expectation of an expanded mission does not come with an enhanced budget. Much of the initial investment in new initiatives must come from the reprogramming of existing resources, in this case, away from KPNO. The internal allocation to KPNO is now $3.8 M/yr of direct costs, exclusive of scientific staff and new instrument development. This low level of support now falls within the range from which the McCray Committee Report defined the necessity and the order of closing existing facilities. We must now follow their mandate. The outcome is a short-term reduction in scientific productivity and community access. The gain is anticipated to be in the long-term development of NOAO instrumentation and national telescope and data initiatives to keep US astronomy competitive.

The transfer of scientific and technical resources from support of KPNO (in the context of a decreasing budget envelope) leads to the following operational changes:

At the budget level currently allocated to KPNO, it is impossible to maintain the full suite of capabilities currently offered. Accordingly, we plan to phase out the operation of the 0.9-m and the Coud Feed telescopes on a one-year timescale.

Semester 2000A will be the last opportunity for new proposals for the spring sky. Some weight will be given to completing projects already started. A limited amount of time will be offered in Semester 2000B for completion of projects (since users were not notified prior to 1999B).

Solicitations for operation of the two telescopes by other groups will be prepared and decided promptly enough that little gap in science operations ensues.

NOAO has always received guidance and pressure from the community at large that reflects the diversity of opinion on the priorities of our program. *Many of these pressures do not arise from consideration of the current scientific productivity of our facilities.* After debating the following arguments, the scientific staff was reluctant at best to support the closures, particularly of the 0.9-m.

External Arguments Against Running 1-m Telescopes

NOAO's highest priorities should be community leadership for new large telescope projects and support of US science from Gemini and other 6-10 meter facilities. Resources supporting access to existing facilities should be minimized to create support for new initiatives. Observations with 1-m class telescopes are not generally adequate to support limiting investigations with 8-m class telescopes.

NOAO should not allocate resources to facilities that could, in principle, be supported at the university observatory level. Implied prioritization by national committees and AURA has emphasized NOAO's support of leading edge research over educational activities. Within a year, several observatories will have CCD Mosaic imagers -- as long as the science can be done somewhere, the capability need not be available on a competitive basis to everyone.

In times of tightly constrained resources, NOAO can justify supporting only those facilities with competition factors comparable to those of the NSF research grants program, which now is able to fund only about 20% of the proposals received. A casualty of reduced budgets is the support of unique, but lower demand science, such as high dispersion stellar spectroscopy at the Coud-Feed.

The beginning of Gemini operations marks the change where NOAO's largest aperture is 8-m, and we should ratchet up the rest of the support structure by a factor of 2 in telescope size (we don't now operate 0.4-m telescopes on Kitt Peak).

The (admittedly small) amounts of money spent on operating 1-m telescopes would produce more exciting science if spent on larger apertures.

Operating 1-m telescopes is equivalent to the night lunch cook -- it makes the wrong impression, even though it is a capability offered at very low marginal cost for great return. In this case, the apperance is that NOAO still has a budget sufficient for NSF Astronomy to redirect funds to other Division priorities outside NOAO without major impact.

Arguments for Continuing Operation of the KPNO 1-m Telescopes

Given that we are operating KPNO, the 1-m telescopes are highly cost effective, producing excellent science at extremely low marginal cost.

Both 1-m telescopes provide unique capabilities.

The 0.9-m provides a vehicle for science with the CCD Mosaic imager rather than having it sit idle when the 4-m is scheduled for other instruments.

Programs carried out on the 1-m telescopes represent 30% of the total programs undertaken at KPNO. This lost science represents a substantial fraction of our user base, which would potentially make KPNO seem less essential to an increased fraction of the community.

The 0.9-m is the most effective way to support the use of Hydra on WIYN because of the uniform astrometry it produces.

The 0.9-m is a good match to supporting spectroscopy with 4-m telescopes, in general, and wide-field surveying is essential to survey for potential objects to carry out a scientific program without a known object list.

The 0.9-m can provide calibration for non-photometric data for KPNO and Gemini North.

KPNO still has an obligation to support graduate training and other educational programs, for which the 1-m telescopes play a key role as many of today's young and mid-career astronomers would attest.

Some members of the scientific staff strongly support operation of the 0.9-m as reflective of our historical mission to provide excellent capabilities on the basis of scientific merit alone.

Internal Arguments Against Running KPNO 1-m Telescopes

At the current budget level, KPNO does not have enough support personnel to operate five telescopes effectively, and we should not sacrifice the reliability and productivity of our major facilities by trying to do too much.

The demand on time at the margin impacts nearly all our main skills -- OA's, mountain programming, electronic maintenance, detector and instrument support, scientific staff. Satisfaction with a job of a manageable scale is a major component in retention of key people.

Transferring the Mosaic between the 4-m and the 0.9-m entails risk and is a significant support burden.

The telescopes would still be used productively, although differently, if they were run by a group or consortium instead of KPNO.

These arguments demonstrate convincingly that the choice for change is extraordinarily difficult. In the end, I felt compelled to call for the phased closure of the two telescopes. This action responds to political realities, reshapes the suite of capabilities to one that we can support adequately and safely, and accelerates the pace of changing our mission. The intent of the revised investment strategy is to provide excellent instruments and operations of the largest KPNO telescopes for mid-decade while supporting NOAO's strategic initiatives for national programs.

As always, I value your opinion and reaction.

Richard Green

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Revised Policy for Thesis Observing

With the imminent availability of Gemini North and the phasing out of the smaller telescopes on Kitt Peak, the scientific staff has re-examined the policy for thesis observing at KPNO. The intention is to give thesis work equal status on all KPNO telescopes, regardless of aperture. We are still addressing the issue of implied long-term commitment. Before a major change is implemented, we may adopt a unified policy for both sites, and we must assure that the proposal ingest and evaluation system has the tools in place. For the coming semester, students who seek a long-term guarantee for their thesis observing should also apply for long-term status. Given the strong oversubscription, only a very few superior proposals are likely to be granted long-term status, but continuing proposals can, as before, be submitted on a semester by semester basis. The initial proposal should request clearly the total amount of time required for successful completion of the project. The final allocation will, of course, be determined by the Director on the basis of TAC advice. Thesis students are expected to take the lead on their observing programs and to be present on the mountain for scheduled runs. The WIYN telescope will be classically scheduled for such programs.

Richard Green

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SQIID Returns in 2000

As anticipated, one of the results of the ALADDIN InSb array development program was useful devices with fewer than four working 512 512 quadrants. Simultaneous Quad Infrared Imaging Device (SQIID) was the intended home for such arrays, because SQIID's optics can illuminate the inscribed circle of one 512-quadrant in each of four wavelength bands. SQIID is currently being retrofitted with four ALADDIN arrays and the controller is being upgraded to run the four individual quadrants. SQIID is likely, but is not at all guaranteed, to be available for shared risk use on the Mayall 4-m and 2.1-m for Semester 2000A.

The increased sensitivity of SQIID with InSb arrays will be ~ 1.4 mag at J and ~ 1.8 mag at K over the successful PtSi arrays. The field-of-view will be twice that of the original configuration with 256 256 arrays (that's four times the area).

The retrofit of SQIID is now well along, with T&E time for the instrument currently scheduled for the 2.1-m just before Thanksgiving 1999. Propsosals in 2000A for IR imaging with ONIS or IRIM that could make use of the unique properties of SQIID should note this opportunity briefly in their proposal. If SQIID is your preference and is available, your successful proposal will be scheduled with it when possible.

The following are anticipated performance characteristics of the upgraded SQIID:

KPNO telescope:	2.1-m	4-m
Platescale:	0.68	0.39"/pixel
Circular FOV:	348	200"

The plate scale represents a reasoned balance between FOV and image sampling appropriate to the delivered image quality.

The estimated limiting magnitude for S/N = 3 in 60s integration time for a point-source (pt: mag) and a diffuse-source (diff: mag/square arcsec) (temperature = 50F; 3mm PWV; midrange KPNO OH background)

	2.1-m		**4-m**	
	pt	**diff**	**pt**	**diff**
J	19.43	20.38	20.60	20.94
H	18.55	19.55	19.72	20.07
K	18.00	18.96	19.17	19.52
3.28nb*	12.15	13.10	13.31	13.66

*0.074 m bandpass

Michael Merrill, Richard Green

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Wide-Field CCD Imaging at the 2.1-m Telescope

The guider at the Cassegrain focus of the 2.1-m telescope has been modified during Summer Shutdown 1999 to increase the field-of-view to permit imaging with a $2K^2$ CCD. Previously, the field-of-view was restricted to ~ 6' by the guider pick-off mirror and a detector larger than $1K^2$ would have been vignetted. Beginning in Semester 1999B T2KA will be available at the 2.1-m to allow a field ~ 10' on a side (~ 14' diagonal).

The 2K 2K Tektronix CCD T2KA, which is no longer to be used at the 0.9-m telescope, will be the imaging device in the visible at the 2.1-m, starting in Semester 2000A. With 0.3" pixels, it will cover a 10' field, which should include all of the useable area. The modifications being made to the guider/adapter are expected to make the entire field free from vignetting.

A run to test and characterize the performance of T2KA at the 2.1-m Cassegrain focus is scheduled in late August, following completion of the modifications to the guider/adapter. We shall report on image quality, PSF variation and geometrical properties of the image over the full area when the results from this test are obtained. Look for this report via the KPNO page (www.kpno.edu) in early September.

Abi Saha

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Mini-Mosaic and Densepack Available at WIYN for 2000A

Two instrument changes at WIYN will enhance its scientific capability. In Semester 2000A, the "Mini-Mosaic" will become the standard imager and DENSEPAK will be available at all lunar phases.

We are currently commissioning the "Mini-Mosaic" camera for the Imaging Nasmyth Focus at WIYN (see June issue, p 22). This camera utilizes two 2K 4K SITE chips set side by side to make a 4K 4K image. The CCDs are nominally identical to the ones used in the MOSAIC camera. The 15 m pixels project to ~ 0.14" on the sky, so that the not uncommon seeing of 0.5" at WIYN is adequately sampled. We will present performance evaluations in the next Newsletter.

Data taken thus far confirms that these chips, which are flatter than S2KB, provide excellent images across the entire field (9.6' on a side). At 0.5" seeing, changes in the point-spread-function with field position are not significant. The blue and UV throughput is also higher relative to S2KB. The commissioning efforts are now concentrating on a rigorous examination of the photometric performance of this new device. Barring any serious problems, it is expected to be used on a shared risk basis later in 1999B, and will be the standard imaging device on WIYN in Semester 2000A, replacing the S2KB entirely.

"DENSEPAK," the integral field unit (IFU) fiber feed to the WIYN bench spectrograph, has been available only in bright time. The rationale was that since it mounts on and occupies the imaging port, while its other end occupies the bench spectrograph, installing it precludes use of HYDRA as well as direct imaging. Queue observing thrives on a multiplicity of options, selecting the `best' observations to execute, based on proposal priority matched with available conditions. On the other hand, we worry that we may be shutting out pressing projects that require an IFU in dark skies. Thus, in Semester 2000A, DENSEPAK will be available for all lunar phases.

Abi Saha

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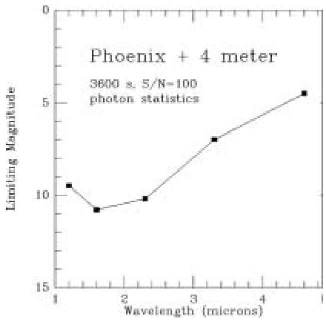
Phoenix Fully Operational for 1999B and 2000A

Phoenix has been out of service for the past six months to correct a number of problems that have been present since first light. These included astigmatism in the collimator, high slit losses, and balky, slow performance of the mechanisms. We are pleased to report that all the instrumental problems have been solved. Overall system throughput including slit losses in the H band is now 10%, a high efficiency for an echelle spectrograph and an improvement of a factor of three from the original instrument performance.



Caption: *Performance of Phoenix at the Mayall 4-m was measured with the widest slit (R = 45,000). This graph is based on measured count rates. Prospective users should note that the large number of high dark current pixels in the present InSb array can significantly degrade this performance.*

Resolution

The astigmatism in the collimator was traced to a warped collimator mirror mount. The problem was solved by installing three mounting pads made from a piece of aluminum foil! The width of the spectrum on the array is now the result of image scaling and seeing. Using the 2 pixel slit, a best FWHM resolution of 70,000 is possible. This resolution is consistent with optical models of the collimator.

Imaging and Throughput

The infrared imaging and spectroscopy modes now share a common focus. At the focus determined from infrared imaging, the spectrograph has both highest throughput and best spatial focus. Slit losses are those expected from slit geometry. In July the 4-m was producing 0.7" images in the near IR and the spectrograph throughput including slit losses at 1.6 m was 10%. We find the best throughput is possible on the 4-m using the off-axis guide probes on faint guide stars. Because of size and weight restrictions on the 2.1-m, Phoenix cannot be used there with the off-axis guider.

Mechanism Control and Times

The maximum time to convert from spectroscopy to imaging modes is now 20s. The new Ethernet controlled mechanisms allow the slit and viewer wheels to operate simultaneously and much faster than previously possible. A number of small improvements also were made to the individual mechanisms resulting in much improved reliability.

Thermal IR Performance

While a number of spectra have been taken at both 3.3 m and 4.6 m, a complete set of calibration exposures has not been possible due to bad weather during both the evaluation runs this spring. As a result the limiting magnitudes in the thermal infrared are approximate. Also in the thermal infrared it is important to remember that the limiting magnitude depends largely on background radiation and thus on weather conditions.

Array Characteristics

The detector in Phoenix is a two-quadrant section of 1024 1024 Aladdin array manufactured in the original foundry run. While the array is cosmetically nearly perfect and has an average dark current of less than 1e-/s, the array has a large number of pixels with high dark current. Perhaps 5% of the pixels have dark current significantly higher than the mean. In long exposure images, high dark current pixels in the area of the array with the signal can significantly degrade the signal-to-noise of the extracted spectrum. We find that high dark current pixels dominate the noise for all but the brightest stars and significantly degrade the resulting spectra for objects fainter than 7-8th magnitude. The figure for limiting magnitude as a function of wavelength is based on count rates ignoring these bad pixels. In principle it should be possible to remove some of the bad pixels with software mapping. However, the bad pixels may be so numerous that this will not result in spectra of the quality that should be possible from the optical performance of the spectrograph.

Availability

Detailed plans for sharing Phoenix between Gemini, CTIO, and Kitt Peak are being discussed. As announced previously in this Newletter, Phoenix is scheduled to be at Kitt Peak only through 2000A.

Ken Hinkle

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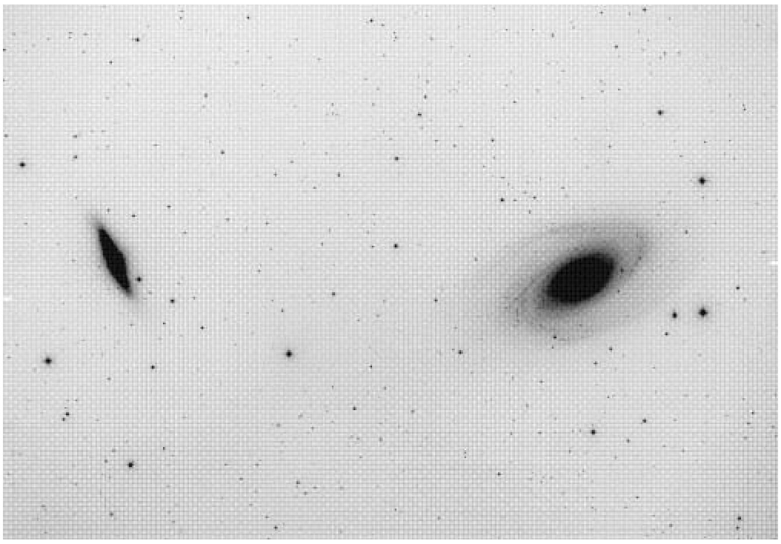
KPNO CCD Mosaic Imager Update

The CCD Mosaic Imager is being used almost every night for science; in Semester 1999A, Mosaic was used for 132 nights (48 on the Mayall 4-m telescope, 84 on the 0.9-m), with 121 nights scheduled for Semester 1999B (61 4-m nights, 60 0.9-m nights). In this article, we provide a few updates since our last Newsletter contribution (December 1998). These updates are in the areas of usage, filters, and electronic cross-talk. Please see the article in the CTIO section on the recent commissioning of Mosaic II, a twin of the KPNO Mosaic, at the Blanco 4-m Telescope. Also see the Massey and Slesnick article on photometry with Mosaic.



Caption: *This Mosaic image of the field of M81 and M82 by G. Jacoby and P. Massey illustrates the power of Mosaic to observe the sky on a scale formerly available only through large photographic plates, but with over 100 times the efficiency of photon detection and greater accuracy of measurement. This 60' 40' R-band image was taken at the KPNO 0.9-m telescope during bright time. It is a dithered sequence of five 300s exposures using Mosaic I, processed with the IRAF Mosaic package MSCCRED.*

Two new Mosaic filters have been commissioned: Washington M and DDO 51. These allow luminosity discrimination between late-type dwarf and giant stars (Geisler 1984, PASP, 96, 723). The ongoing U filter construction saga that we reported in the last Newsletter article has been completed successfully. A liquid copper sulfate U filter, with transmission properties nearly identical to our standard 4-inch U filters, has been in use since January 1999. Please see the Mosaic Web page for a complete list of supported filters (http://www.noao.edu/kpno/mosaic).

There is some low-level electronic cross-talk between pairs of CCDs in the Mosaic that are attached to the same controller. The cross-talk is not bidirectional. For example, a bright star on CCD[2] produces a "ghost" on CCD[1], but the converse does not occur. The strength of the cross-talk ghosts appears to be directly proportional to the input signal on the "contaminating" chip, with scaling coefficients of order 1/1000. The coefficients have been measured for the science-grade Mosaic I camera, and can be used to remove cross-talk ghosts within the IRAF MSCRED package, applied as the first data processing step in CCDPROC. The residuals from this correction are less than or approximately equal to 1 ADU, even for saturated objects. Within the accuracy of the measurements, the coefficients have remained stable from January through June 1999. Cross-talk correction is now included in the default Mosaic data reduction procedures of IRAF V2.11.2's *mscred.ccdproc* task.

Taft Armandroff, George Jacoby, James Rhoads

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WIYN is an Asteroid!

Frank Edmondson (Indiana) has received approval to name an asteroid for the WIYN Telescope, (4299) WIYN = 1952 QX. (4299) WIYN was discovered at Indiana University's Goethe Link Observatory in 1952. Asteroids are named by the "Small Bodies Names Committee" of the IAU, under guidance of the Minor Planet Center. By convention, the discoverer of the asteroid may suggest a name for that asteroid. We have Edmondson to thank for honoring the WIYN Observatory in this way.

(4299) WIYN has a period of 3.36 years and orbits the sun with a semi- major axis of 2.2 au. It was last at opposition on 1999/8/30 when it was 15th magnitude.

The citation in naming 1952 QX reads "Named for the WIYN telescope, located at the Kitt Peak National Observatory. This 3.5-m telescope is jointly operated by the University of Wisconsin, Indiana University, Yale University, and the National Optical Astronomy Observatories."

Caty Pilachowski

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We've Been Busy During the Monsoon

While the monsoon flows over the Sonoran Desert from the 4 July to Labor Day, and the storms cause nothing but problems of cloudy skies to observers and lightning damage to our electronics, KPNO shuts down to pursue a variety of improvement projects and maintenance work. Almost all of the large-scale improvement projects involving seeing enhancements have been undertaken during this time. This summer is no exception, although we had a shorter shutdown than usual -- the last astronomer at the Mayall finished on the morning of 20 July and the first run for 1999B will start on the night of 30 August.

At the Mayall, beyond the usual computer and mechanical maintenance, the following major projects were on the schedule: new mirror cover to allow airflow over the primary, ducting for enhanced mirror cooling, encoding of the tip/tilt of the f/8 secondary for repeatable collimation, complete refurbishment of the control room, and keepers for the primary mirror defining units. The two weeks before the first observer will see a thorough optical tune-up, continued commissioning of the active primary support system (4mAPS), and an operations verification.

At the 84-inch, the optics will be aluminized and components of the coud-train removed to enhance performance in the IR. The optics will be thoroughly collimated and operations verified here as well.

And last, and by no means least, the Mountain Programming Group has led a complete test to ensure that we will be ready for the new century. While each telescope has been tested in turn, a test was made in August of the mountain as a whole. We are ready to point to the correct positions on 1 January 2000.

As we have looked back at all of the improvements that have been completed the past decade to the telescopes on Kitt Peak, we wonder how we would have gotten them done without Summer Shutdown.

Bruce Bohannan, Tony Abraham (for the scores of individuals who worked so hard this past summer)

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NOAO Newsletter - National Solar Observatory - September 1999 - Number 59

From the NSO Director's Office

NSO continues to move forward with its long-range plan to replace, rejuvenate, and increase its observational capabilities and support of the solar community. Enhancement of our synoptic capabilities and replacement of many of our aging synoptic facilities through SOLIS is on schedule with operation of SOLIS beginning in 2001. Improvement of our high-resolution capabilities with adaptive optics is progressing rapidly. A low-order AO system that corrects telescope aberrations and atmospheric seeing under fair seeing conditions (~ 1") is now available to users of the Dunn Solar Telescope on a shared-risk basis. Collaborative efforts with NSO staff to use the system for observations are encouraged.

We continue to work with the solar community to develop plans for an Advanced Solar Telescope (AST) that will provide solar astronomers with the ability to go well beyond current ground- and space-based capabilities in the spatial, spectral, and temporal domains. During the Chicago AAS meeting in June, an interested-parties meeting for the AST was held with about 30 people in attendance. Issues concerning an AST management structure and development plan were discussed, with almost unanimous agreement that the AST should proceed as a collaboration between the university community and the national centers. NSO has prepared a draft AST science brochure for the Astronomy and Astrophysics Survey Committee, which will be available at our Web site. Your comments are welcome. NSO also continues to explore some of the technical issues involved in developing an AST. In addition to adaptive optics, we are developing near and thermal IR detectors that will be needed to fully exploit the AST. NOAO has recently committed a science-grade Aladdin array to the NSO program. In addition, we are developing methods of integrating the adaptive optics with advanced Stokes polarimetery, narrow-band imaging, and multi-lens arrays for simultaneous 2-D spatial and spectral imaging.

The NSO Users' Committee also met during the AAS meeting to discuss the role NSO should play in AST development and the balance of the NSO program as the AST is developed. It was evident at this meeting that providing synoptic observations and continuation of GONG are also viewed as high priorities along with giving access to high-resolution facilities. The AURA Observatory Council met at NSO/Sac Peak in June and discussed NSO plans for revitalizing national solar facilities in both optimistic and pessimistic funding scenarios. It's clear that meeting our current responsibilities to support the solar community and developing an AST are not feasible within our current funding levels. Incremental funding is required to support community involvement and to support efforts at the national centers if the AST is to move forward.

Jack Harvey presented the George Ellery Hale Prize lecture at the Chicago AAS meeting; it was one of the best-attended solar talks I have witnessed at an AAS meeting. Again, our congratulations to Jack on receiving the prize (see last quarter's Newsletter for a description of Jack's accomplishments). Frank Hill received the AURA service award for his outstanding and dedicated service to the solar community through his work with GONG and the NSO Digital Library. We greatly appreciate his efforts in making NSO data available and useful to a broad range of scientists. Frank's work has helped turn the data from both NSO sites and from GONG into useful research tools.

I am sad to relate that some of our long-time NSO employees have moved on recently. **Roy Coulter**, who has worked at NSO for 16 years, left for the University of Hawaii to develop the Solar-C coronagraph. Roy began his career at NSO as an observer, and more recently had been in charge of projects. He helped develop the RISE/PSPT telescopes now operating in Hawaii, Italy and at NSO/SP. Roy made substantial contributions to the SOLIS project. The progress SOLIS has made on the FDP instrument was a direct result of the work Roy did with Jack Harvey. Roy also provided critical support to the development of the VSM guider. Fortunately, NSO may be involved in the development of Solar-C, so we may still see a lot of Roy. **Robert McGraw**, NSO/Sac Peak computer system administrator for the past 13 years, left to take up a position with a company in North Carolina. Robert put together a very robust system at the Sac Peak site to support users, staff and observations. He will be missed. Finally, **K.S. Balasubramaniam** (Bala) is leaving to take a position with a financial firm in Chicago. Bala has made a tremendous contribution to solar physics through his research on solar activity and polarimetery, and through his efforts as chief editor for several workshop proceedings. His leaving represents not only a loss for NSO, but for solar physics. We wish him well in his new career.

On a happier note, we'd like to welcome **Ben Glick** and **Carl Henney** to the NSO. Ben has taken the position of mechanical designer and engineer for the Improved Solar Observing Optical Network (ISOON) project at NSO/SP. Carl comes to us from UCLA, where he recently completed his PhD in Astronomy. Carl has joined the SOLIS project in Tucson as a data scientist.

Steve Keil

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1999 Summer Student Program -- Another Successful Year

The NSO summer student program has had another successful year. Participants included three Research Experience for Undergraduates (REU) students and two graduate students, or Senior Research Assistants (SRAs), at NSO/Sac Peak and four REUs and two SRAs at NSO/Tucson. Information about the students and the work they did is presented below. In addition to work performed at the respective NSO sites, the students exchanged site visits, which included stopovers at the White Sands National Monument in New Mexico and the Very Large Array (VLA) near Socorro, New Mexico.

Chad Bender (Illinois, Urbana-Champaign) worked with Harry Jones on the observation and analysis of He I 1083 nm imaging spectroscopy. The project was designed to explore the origins of the solar wind and involved 1083 nm data obtained with the NSO/NASA spectromagnetograph at the Kitt Peak Vacuum Telescope and the Near Infrared Magnetograph at the McMath Pierce telescope in conjunction with EUV observations from the SOHO/Coronal Diagnostics Spectrometer.

Scott Catanzariti (Indiana State) analyzed full disk Ca II spectroheliograms obtained daily at the Evans Solar Coronal Facility at NSO/SP. The project had two goals. The first was to integrate the calibrated Ca II images, which were obtained in a 0.5 band centered on the K3 absorption feature, to generate a disk integrated flux. This was then compared with the emission index generated from disk integrated K-line spectral scans (see http://www.sunspot.noao.edu/AF/cak.html) that are also obtained daily. The spectroheliograms were used to identify the chromospheric changes contributing to variations in the emission index. This information was then used to refine techniques for predicting variations of the solar EUV flux which effects ionization levels in the Earth's atmosphere. The second goal was to verify the capability of the disk integrated measurements to measure differential solar rotation. The latter goal is important for verifying the ability to measure stellar differential rotation. Scott's advisors were Steve Keil and Leo Milano.

Tim Donaghy (Stanford) worked with Christoph Keller and Jack Harvey in exploring very small scale features in the solar atmosphere and solar magnetic fields. Tim's first project involved using sophisticated image restoration algorithms to reconstruct diffraction-limited images using in- and slightly out-of-focus simultaneous records obtained with the Dunn Solar Telescope. The goal was to study the time evolution of tiny magnetic structures in the solar photosphere. Tim's second project was stimulated by the forthcoming SOLIS instruments. Using data from the NSO Kitt Peak Vacuum Telescope, Tim developed techniques to compare magnetic field measurements made in the photosphere and chromosphere in order to easily show their differences. He also studied a time series of magnetic field measurements made during a good-sized solar flare.

Heather Eddy (Cornell) worked with Bill Livingston on the full-disk spectrum archives. Having collected all the CaK observations from 1974 to 1999 and following a suggestion of Caty Pilachowski, Heather searched for evidence of comet infalls to the sun. From SOHO it is now known that such events are fairly common. Lloyd Wallace wrote a program that automatically put two observations on the same wavelength scale and took their ratio or difference. The expectation, based on certain stellar analogs, was that infalling material would reveal itself as a weak, narrow Ca absorption in the wing of Ca K 3933. Several suspicious cases were found. Confirmation involved finding an identical signal in Ca H 3967. Nothing panned out. Heather then turned to an examination of Ca 8542 for solar cycle effects. Using the same program and differencing solar minimum vs maximum, it was found that the difference signal of the line cores displays an emission feature at a constant displacement to the red of about 0.1 (3.5 km/s). The next task, undertaken with help from Harry Jones, was to explain this signal in terms of what is known of the behavior of Ca 8542 on the resolved disk.

Robert Gutermuth (Alfred) concentrated on the analysis of large scale surface velocities in flaring and erupting filament regions as observed in chromospheric Ha images. The data were obtained with the Hilltop full-disk Ha patrol camera at NSO/SP at a 10s cadence. The surface velocities in active regions are determined from local correlation tracking of sub-images within the active region. Robert also used these surface velocities to calculate shear within the material at locations of concentrated magnetic field. Spikes in the shear of the surface material have been observed just prior to some solar flares, suggesting that this could be a valuable tool for forecasting flare events. Robert's advisors were Leo Milano, K. S. Balasubramaniam and Steve Keil.

James Hague (North Carolina) worked with Michael Sigwarth on high resolution Stokes spectra and imaging data to investigate the evolution and dynamic behavior of magnetic flux tubes of network and internetwork fields. The data were taken with the HAO/NSO Advanced Stokes Polarimeter at the Dunn Solar Telescope and consist mainly of a one-hour time sequence of a quiet sun region. Jimmy concentrated on analyzing the Stokes-V spectra to obtain information on the vertical motions within the magnetic field and to classify the significant amount of Stokes-V spectra with an unusual shape. In addition, he obtained flow maps for horizontal convective motions in the observed region to investigate the interaction of flux tubes with convective motions.

Matthew Povich (Harvard) worked with Mark Giampapa and Jeff Valenti (KPNO) on the analysis of high-resolution spectra of solar-type stars with reported planetary companions. The data were obtained with the McMath-Pierce solar-stellar spectrograph over the course of a year, under the auspices of a NASA grant from The Origins of Solar System Program. The photospheric line profiles were analyzed by Matt to discover the nature and amplitude of any variations in their line bisectors. Variations in line profile shapes, as reflected in line bisector variability, will have an effect on the accuracies that can be attained in radial velocity searches for extrasolar planets. In addition, bisector variability is of interest in the context of the study of active regions and large-scale convective patterns in solar-type stars.

Michael Gericke (Arkansas) concentrated on evaluating the suitability of surface velocities and vorticities as precursor indicators to flares and filament eruptions as observed in Ha images. The data were obtained at the Dunn Solar Telescope on 27 December 1998 over a region of about 635"^{2} from active region 8421. The surface velocities in active regions are determined from local correlation tracking of kernels within the active region. The results are obtained by comparing time sequences of intensities, velocity magnitudes, vorticities, and the divergence of several particularly active sub regions and determining how far their peak values precede each other. Michael also used magnetograms obtained on the same day at Kitt Peak to evaluate the correlation between the vorticities and magnetic fields in the active regions. Michael's advisors were K.S. Balasubramaniam, Leo Milano, and Steve Keil.

Oleg Ladenkov (Ulugh Bek Astronomical Institute, Tashkent, Uzbekistan) is working with Frank Hill and Doug Rabin on a study of the relationship between wave energy and cool regions in the solar chromosphere. Five data sets, from the Near-Infrared Magnetograph at the McMath-Pierce telescope, the High-Degree Helioseismometer at the Kitt Peak Vacuum telescope, and the Michelson Doppler Imager on SOHO, are being combined to study correlations between the spatial distribution of photospheric and chromospheric acoustic power, and chromospheric temperature as observed in the infrared.

K. Sankarasubramaniam (Indian Institute of Astrophysics, Bangalore) is working with Thomas Rimmele and Rich Radick (AFRL/VSBS) on spectral and imaging data taken with the NSO adaptive optics system at the Dunn Solar Telescope. Sankar is reducing time series of high resolution (0.2") spectra of the iron line FeI 5434 with the goal of detecting high-frequency wave motion at the edge of magnetic field concentrations. He has also been working on a time sequence of vector-polarimetric data of excellent quality taken with the Advanced Stokes Polarimeter and adaptive optics in order to study the fine structure and dynamics of active regions.

1999 NSO REU and SRA Advisors

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NSO Observing Proposals

The current deadline for submitting observing proposals to the National Solar Observatory is 15 October 1999 for the first 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 the WWW at http://www.nso.noao.edu/. A Windows-based observing-request form is also available at the WWW site.

Dick Altrock

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NOAO Newsletter - US Gemini Program - September 1999 - Number 59

USGP Instrument Program

NIRI

Gemini's Near Infrared Imager is nearing completion. Klaus Hodapp (PI at the University of Hawaii), is installing the final components, completing dewar wiring, and performing optical alignment in anticipation of completing the final cooldown and passing the pre-ship acceptance test early this fall.

GNIRS

The Gemini Near Infrared Spectrograph team is pushing ahead after a successful Restart Review held 20-21 July. The review committee found the redesign effort was proceeding at the proper pace for completion of the instrument in 2002. The technical problems detailed by the committee last Fall have all been addressed. Jay Elias (Instrument Scientist), Neil Gaughan (Project Manager), and their team are to be congratulated on six months of very long hours spent getting this instrument back on track. The computer-based 3-D engineering model of the instrument will be complete early in 2000, at which point fabrication of parts will begin.

T-ReCS

The Thermal Region Camera and Spectrograph, designed to operate in the 8 m to 26 m region (N and Q bands), completed its Critical Design Review (CDR) the last week in July. No major problems were uncovered, so while addressing the usual issues raised at outside reviews, the team will let contracts for optical fabrication and will begin to manufacture parts. Essentially all mechanical fabrication drawings were completed in time for the CDR, which may be a record for Gemini instruments.

The instrument concept has grown somewhat from a simple imager by the addition, at the recommendation of the Gemini Science Committee and the approval of the Gemini Board, of a spectrographic capability of R = 100 and 1000 at N, and R = 90 at Q. This was done without sacrificing the diffraction-limited imaging performance. Immediately after the CDR, most of the review committee stayed on for the Safety Review and were joined by the University of Florida's safety officer. No major safety issues were identified. Charles Telesco (PI) and Tom Kisko (Project Manager) are justly proud of the performance of their small and effective team.

NICI

The Near Infrared Coronagraph/Imager contract is now underway, with Mauna Kea Infrared leading its team in a conceptual design study. Doug Toomey (Project Engineer) is overseeing an outstanding instrument team that includes Christ Ftaclas, a noted expert in coronagraphic design and mask apodization techniques. In early 2000, this team will present its findings, leading into the fabrication phase of this NASA-funded instrument.

WIRMOS

Gemini is undertaking to produce a wide-field near infrared multi-object spectrograph for its southern telescope. Proposals were received in late July for a short design study to begin this autmumn.

Mark Trueblood

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Gemini Lessons Learned Workshop

The International Gemini Project Office and the Canadian Gemini Project Office hosted a meeting in Parksville, BC on Vancouver Island in July to review the instrument program so as to determine what can be done to make instruments less costly and to ensure that they are delivered on schedule.

The first Gemini instrument is about a year late in delivery, and others are suffering varying degrees of cost and schedule overruns. Instrument programs at Keck were reviewed, and for the most part, they are experiencing similar problems. A common theme among failed instruments or those in trouble was that they were not properly managed as large projects by someone with project management experience. There was a general consensus that all too often, either project management is ignored as a frivolous expense, or "wallpaper" management is used, in which a schedule and budget are worked out at the beginning, thumbtacked to the wall, then ignored. What is needed are careful planning at the beginning of the project, diligent oversight throughout the project to determine its status, the willingness to admit that a problem exists, and the fortitude to take needed corrective action that sometimes can be painful.

Jim Oschmann (Gemini Project Manager), gave a short tutorial on the concept of designing to cost. This technique assigns to each engineer three things: technical specifications, a budget, and a schedule. To have that part of the project considered to be successful, all three goals must be met. All too often, engineers stop investigating alternatives when one or two solutions to a technical problem are found. Frequently, the first solution takes too long to implement or drives up the cost, when a simpler approach could save money and time. Rather than blindly trying to meet a specification, which is sometimes arbitrary, engineers should be willing to admit they cannot meet the technical spec with the assigned budget, but could meet 90% of the spec within the budget and schedule. Good project management includes continuing systems engineering and instrument scientist input to determine when to relax a specification to save time and money without adversely affecting the science. This concept is new to most astronomical instrumentation teams, but is increasingly important in the era of large, expensive instruments.

The consensus was that the meeting was helpful, and that similar meetings should be held in the future not only among managers and executives, but also at the technical level to help instrument teams identify good solutions to problems already solved elsewhere.

Mark Trueblood

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IRAF Update

The IRAF V2.11 patch, mentioned in recent issues of this Newsletter, has been completed and was in beta testing at NOAO, STScI, and other sites as this article was being prepared. Versions for SunOS, Solaris, Digital Unix, and OpenVMS should be publicly released by the end of August. Versions for PC-IRAF, HP-UX, SGI IRIX, and IBM AIX will follow as soon as possible.

The IRAF V2.11 patch (version V2.11.2) is important for anyone running IRAF, since it will include the modifications necessary to make IRAF Y2K compliant (detailed information is available on our Web page at: http://iraf.noao.edu/projects/y2k). The patch includes not only bug fixes, but support for the new ISO-style FITS date format. Support has been added for Solaris 7 on Sun platforms, as well as for the new version 5 Sun compilers. Other modifications and additions were previewed in the June issue of this Newsletter. A more complete description of the patch will be available by the time it is released.

An "emergency" port of V2.11 was released for RedHat 6.0 in mid-May, since IRAF would not run on this platform at all due to a shared library dynamic linking problem. Support was also added for the new version of GLIBC and for the new EGCS compilers; these enhancements will be available for all PC-IRAF platforms in the next release.

The Mosaic DHS (Data Handling System) has been enhanced to support Mosaic II, a new version of the NOAO CCD Mosaic. This version supports 16 amp readouts, and dynamic reconfiguration of the DHS if the number of amps (subimages) changes during readout. Single CCD readout is also supported.

Work continues on the automated data reduction pipeline facility, to be used initially to reduce Mosaic data. A way was developed to store arbitrary host files as FITS extensions (foreign file extensions), and later restore them to disk. This allows non-FITS data such as PostScript or text files, observing logs, weather pictures, etc., to be archived along with FITS image or tabular data in a FITS-based archive. The Save The Bits (STB) software was revised to support this new extension type, and to automatically transmit Mosaic data to the archive pipeline machine in the Tucson offices. Work is currently underway on the database facilities for the archive, and on the pipeline modules.

The IRAF group has been meeting with representatives of the Gemini Science Operations Group to plan data reduction support for the Gemini instruments. The IRAF group, working with the Gemini staff and the Gemini instrument scientists, will be implementing reduction facilities for Gemini instruments over the next couple of years. We will keep you informed as the projects develop.

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

Doug Tody, Jeannette Barnes

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NOAO FTP Archives

The NOAO FTP archives are found at the following FTP addresses. Please log in as "anonymous" and use your email 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, Radiative Inputs of the Sun
   to the Earth (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"; "CoudÃ© Feed Spectral
   Library"; "General Catalog of Variable Stars, Volumes I-V 4th ed."
   and "Name-Lists of Variable Stars Nos.  67-76."

   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 (helios.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. It is best to login to iraf.noao.edu directly to download large
   amounts of data, such as an IRAF distribution.

   kpno (orion.tuc.noao.edu)---KPNO archive of filter lists and transmission
   data, CCD and IR detector characteristics, hydra (WIYN) information,
   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 Kline intensity.

   noao (gemini.tuc.noao.edu)---Lists of US areacodes and zipcodes, various
   LaTeX tidbits, report from Gemini WG on the high resolution optical
   spectrograph, etc.

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

   sn1987a---An Optical Spectrophotometric Atlas of Supernova 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 the 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
helios.tuc.noao.edu  = 140.252.26.105
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/.

Jeannette Barnes

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