NOAO Newsletter - December 1994 - Number 40

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NOAO Highlights!

Director's Office

Cerro Tololo Inter-American Observatory

Kitt Peak National Observatory

National Solar Observatory

Global Oscillation Network Group

US Gemini Program

Central Computer Services

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

WIYN Telescope Dedicated! (1Dec94)

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WIYN Telescope Dedicated! (1Dec94)
(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 40, 1 December 1994)

The new 3.5-m WIYN Telescope on Kitt Peak was dedicated on 15 October. The project was completed in a remarkably short time--only eight years since the KPNO staff first began conceptual development of a new telescope and only four years after the WIYN agreement was signed by Wisconsin, Indiana, Yale, and NOAO. Completion of the WIYN telescope on schedule and within budget is a tribute to Matt Johns, WIYN Project Manager, and to all of the many individuals who worked on the project.

The event was witnessed by nearly 400 hardy souls who braved cold, wind, and rain to participate in this historic event. Guests included representatives from all of the WIYN institutions, the contractors who assisted in the construction of the new observatory, NOAO employees, and special guests, including Congressmember Jim Kolbe from Arizona's 5th Congressional District.

[Figures not included]

[Figure not included]

Guests admire the WIYN primary mirror active supports.

[Figure not included]

Sam Barden demonstrates the Hydra Fiber Positioner on WIYN.

Months of planning for the dedication were tossed to the winds (literally) when, early in the morning of the Dedication, the tents which had been erected to house the celebration were blown down by 100 mph winds. Bruce Bohannan, Pat Patterson, and the KPNO mountain staff quickly mobilized to find alternate arrangements, and by the time the crowd began to arrive, new plans were well in hand.

Vans were provided to shuttle guests from the Visitor Center and parking lot to the WIYN Telescope. Extra tables and chairs were set up in the Dining Room and the TV room, and the caterers, who provided an excellent Mexican buffet, set up in the entry hall. Even the Mariachi Saldivar, who provided musical entertainment, found a spot in the relative warmth of the Dining Hall.

The Dedication itself was moved to the newly remodeled Kitt Peak Visitor Center. The ceremony was conducted by Blair Savage (Wisconsin), President of the WIYN Consortium. Speakers included Congressmember Kolbe, Sidney Wolff (NOAO), Gus Oemler (Yale), Kent Honeycutt (Indiana), Caty Pilachowski (KPNO), and Matt Johns. Each institution had an opportunity to cut a portion of the Dedication Ribbon. The ceremony concluded with a blessing by Tohono O'odham Medicine Man William Antone. Following the ceremony, guests had an opportunity to view the new WIYN observatory and to enjoy a delicious Mexican supper. Plans for evening observing were cancelled due to the weather.

It is not often that we have the opportunity to dedicate a major new facility like the WIYN telescope. Despite the weather, the event was thoroughly enjoyed by all and will be remembered for a long time. If you have occasion to visit Kitt Peak in the near future, please take the opportunity to visit our newest telescope!

[Figures not included]

The Dedication begins in the Visitor Center. WIYN Board President Blair Savage starts it off.

[Figures not included]

Project Manager Matt Johns cuts the ribbon. Guests tour the new WIYN Observatory.

[Figure not included]

The WIYN control room was part of the tour.

[Figure not included]

High winds forced a sudden change in plans!

Caty Pilachowski for the KPNO Staff

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Getting to Know Our New Neighbor (1Dec94)

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Getting to Know Our New Neighbor (1Dec94)
(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 40, 1 December 1994)

This year, Ibata, Gilmore, and Irwin (1994) discovered that the Milky Way has a neighbor that previously escaped our notice. Our "new" neighbor is a dwarf spheroidal galaxy in the constellation of Sagittarius, and is only 25 kiloparsecs from the Sun on the opposite side of the galactic bulge. To make up for our previous sins of omission, Ata Sarajedini (KPNO) and Andy Layden (CTIO) decided to take a good look at the stellar population of the field around and including the globular cluster M54, a system apparently in the line of sight to the Sgr dwarf. What they found was that M54 and Sgr may be different parts of a common system, an intriguing clue to the formation and evolution of both globular clusters and dwarf spheroidals.

The clumpy distribution of stars in Sgr suggests that it may be in the process of being tidally disrupted and accreted by the Milky Way galaxy. This, along with its relative proximity, make Sgr an excellent candidate for detailed studies, which can potentially reveal much about the processes whereby small galaxies are absorbed by larger ones and the role such processes play in galaxy formation and evolution. M54 is apparently close to the densest clump in Sgr, so Sarajedini and Layden decided that V and I images of M54 (obtained with the CTIO 0.9-m) would be valuable in determining its metallicity, distance, and relationship to Sgr. A first glance at the images, in fact, just shows M54, a typical bright globular cluster, with no hint whatsoever of another population belonging to a dwarf galaxy (Figure 1). However, the color data identifies a population of extremely red stars (Figure 2). In general, extremely red stars such as these are very rare in a relatively metal deficient object like M54, implying the existence of another population.

[Figure not included]

The real picture of what's going on is provided by color-magnitude diagrams (CMD) of fields on and off the M54 cluster. The upper panel in Figure 3 shows the CMD of the on-cluster frames with the red stars indicated as crosses, with the lower panel serving as interpretive guide. The CMD of the off-cluster region is shown in Figure 4, but includes the extremely red giant stars from Figure 3 as a guide because the observed off-cluster field lies in a low density portion of Sgr and therefore contains few of these stars. The nearly vertical red giant branch (RGB) and blue horizontal branch (HB) in Figure 3 appear to belong to M54 because they do not appear in Figure 4. In contrast, the metal-rich horizontal branch can be seen in both figures, as can a weakly-populated red giant branch (Metal-Rich RGB). Stars are not present at these locations in CMDs constructed by Mateo et al. (1994) at a "control" position on the opposite side of the galactic bulge and thus are likely to be stars associated with Sgr. Lastly, the vertical scattering of stars at 0.8 &lt V - I &lt 1.3 are the foreground bulge stars that have masked the Sgr galaxy for so long.

[Figures not included]

One would be inclined to attribute the Intermediate Metallicity HB to M54 because it is not apparent in Figure 4. However, the radial distribution of these HB stars is not concentrated toward the cluster center, as are the M54 RGB and Blue HB stars. Furthermore, the stars are about 0.15 mag fainter than expected from the horizontal branch fiducials of other clusters, when fit to the Blue HB and RR Lyrae stars of M54. Finally, detailed luminosity functions of the cluster frames, along with luminosity functions from the on-Sgr and control CMDs of Mateo et al. (1994), suggest that the Red HB is present in all of the on-Sgr fields, but is not in the control fields. The red HB is thus likely to belong to Sgr, not to M54. This interpretation is further supported by the "sequence" of stars between the M54 and Sgr Metal-Rich RGBs in Figure 3, which may be the red giants associated with this Red HB population. Their positions suggest a metal abundance intermediate between that of M54 and the more prominent metal-rich Sgr population.

Sarajedini and Layden argue from Figure 3, as well as a more detailed analysis, that the three horizontal branch populations (one associated with M54 and two with Sgr) all lie at the same distance of ~25 kiloparsecs, to within the accuracy of the RR Lyrae distance scale. This suggests that M54 is in fact a part of the Sgr dwarf galaxy. The cluster and galaxy also have very similar velocities (131 vs 140 km/s), and M54 lies in the highest-density region of Sgr. These further strengthen the interpretation that M54 formed in, and is a member of, the Sgr dwarf galaxy.

The association of M54 with Sgr leads to intriguing conclusions. Firstly, rescaling existing integrated luminosity estimates of M54 for its new (greater) distance indicates that it is nearly as luminous as Omega Centauri, the most luminous globular cluster in the Milky Way. M54 is then two orders of magnitude brighter than the brightest cluster in Fornax, which is the only other Galactic dwarf spheroidal satellite possessing globulars.

Secondly, the high metal abundance of the Sgr field population implies a high integrated luminosity for Sgr, assuming it follows the well-established absolute magnitude-metallicity relation for dwarf galaxies. In contrast, star counts suggest a much lower absolute magnitude. Perhaps much of this galaxy has already been "stripped off" in its interaction with the Milky Way. The foreground confusion of the galactic bulge could easily mask tidal tails extending from the main body of Sgr.

Sgr is clearly a surprising galaxy. Its anomalously luminous globular cluster and its high metallicity, along with its position as the "smoking gun" of galactic formation-by-accretion, make it an extremely attractive target for further study.

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Diffraction Limited Imaging at the KPNO 4-m (1Dec94)

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Diffraction Limited Imaging at the KPNO 4-m (1Dec94)
(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 40, 1 December 1994)

Diffraction limited imaging at infrared wavelengths is a key goal of Gemini and other large telescope projects. Ian Gatley, Ron Probst, Steve Ridgway, and Mike Merrill of the KPNO IR group, working in collaboration with Frank Low (Steward) recently got a sneak preview of this technique at the 4-m by reconfiguring the Cryogenic Optical Bench into a high resolution camera called the Diffraction Limited IR Imager, or DLIRIM (pronounced "delirium"). This was an experiment to explore the technical and scientific aspects of operating in this mode, and to define requirements for future instruments.

DLIRIM turns the necessity for taking extremely quick pictures to operate in the thermal infrared into a virtue, by sampling the speckle pattern at rapid time scales. Thermal emission of the atmosphere in the L' band (3.5-4.1 um) requires high speed operation--50 millisecond integrations--to avoid saturation, a capability provided by the KPNO Wildfire electronics. This is also fast enough to "freeze" the atmospheric seeing, which together with the long wavelength can produce excellent image quality. In speckle terms, a point source image often has a single dominant speckle. To get the highest resolution available on Kitt Peak, Gatley et al. used the 4-m telescope (3.8 meters effective aperture), known from wavefront curvature analysis to have high quality surface figure.

The DLIRIM configuration replaces COB's internal reimaging camera module with a camera providing 0.1' per pixel on a 256 X 256 InSb array, with the data system modified to store long strings of contiguous 50 msec frames. To obtain dynamic range while retaining image quality, DLIRIM uses shift-and-add frame addition with a bright point source in the field as a reference. This is a postprocessing analog to tip-tilt correction, with the distinction that by centering on a dominant speckle some high order correction is obtained as well.

DLIRIM on the 4-m clearly produced diffraction limited cores on point sources in the L' band. Segments of the Airy rings could be seen in the raw single frames on bright stars, and a uniform point source core FWHM was achieved across the full 25" field with the reference source in one corner. Limited data in the K band showed more of the core-halo image structure predicted for adaptive optics systems at shorter wavelengths. These results were obtained in very unstable atmospheric conditions with rapidly varying low cloud plus high cirrus. The 4-m optical seeing monitor, operating at 30 Hz, reported typically 1.25" FWHM seeing on bright stars near our IR targets.

[Figure not included]

Figure 1. The field of the Becklin-Neugebauer source in Orion at 3.6 um. This 2 X 2 mosaic was obtained by using BN as the reference and placing it sequentially in each corner of the array field. It represents 90% of the field of the Gemini telescopes, using a 1024 X 1024 array at 0.05" per pixel. The inset shows two point sources separated by 0.4". Dynamic range between these sources and BN itself is 7.5 magnitudes.

DLIRIM demonstrates that the KPNO site and 4-m telescope can deliver outstanding performance in the infrared. DLIRIM also gives a technical preview of what this type of imaging science entails, and the requirements it imposes on a facility instrument. While DLIRIM was an ad hoc experiment taking best advantage of existing capabilities, it gives a clear picture of things to come. Indeed, the DLIRIM camera is designed to utilize the 1024 X 1024 arrays being jointly developed by NOAO and USNO as they become available.

Ron Probst for the Infrared Group

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Lifting the Veil on Young Massive Stars (1Dec94)

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Lifting the Veil on Young Massive Stars (1Dec94)
(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 40, 1 December 1994)

Massive stars spend the beginning of their main sequence lifetimes buried behind 10 to 20 magnitudes of visible extinction in the molecular clouds from which they formed. The true nature of the stellar nurseries for massive stars has, for the most part, been obscured, as spectroscopic studies in the optical regions have been precluded. Under the normal galactic extinction law, interstellar absorption at 2 um (K-band) is 1/12th that at 4500 . If a consistent system of photospheric lines in hot stars could be identified at

2 um, they could be used to identify, classify and thereby quantify the spectra of massive stars otherwise shrouded by dust.

Margaret Hanson and Peter Conti (Colorado) set out to create a 2 um spectral classification system using nearby, unobscured normal OB stars. Using a combination of hydrogen, He I and He II lines, they found a well behaved variation of stellar features that would allow the temperature of thestar to be estimated fairly accurately (Figure 1).

[Figure not included]

Figure 1. High resolution (R ~1000) 2 um spectra showing the spectral sequence in dwarf O and early-B stars. The typical integration times were from 30 seconds (for K=4) to 5 minutes (K=7) on the 1.5-m. Signal-to-noise achieved is ~70-80.

With a classification system in hand, they set out to identify the stellar content of M17, a well known, heavily shrouded, H II region.

The stars responsible for the ionization of the M17 nebula have never been clearly identified. Radio recombination line surveys at 6 cm indicate that the production rate of Lyman continuum photons is 5 X 10^50 s^-1. That equates to 50 O7V type stars! Deep, high spatial resolution images of M17 at the near infrared bands of J (1.25 m), H (1.65 m) and K (2.2 m) obtained by Ian Gatley and Michael Merrill (NOAO) show tens of stars and strong extended nebulosity not visible in the optical. The extinction toward these stars is on the order of 15 magnitudes at V!

Hanson and Conti obtained 2 um spectra of the brightest heavily reddened stars in the cluster in June 1994, using the OSIRIS instrument on the 4-m at CTIO. Gatley and Merrill obtained follow up spectra in September 1994 using the newly upgraded IR Cryogenic Spectrometer (CRSP) on the KPNO 1.3-m telescope. The initial low resolution spectroscopic survey identifies 5 new O-type stars in the M17 region (Figure 2). The locations of the hot stars found in M17 are shown in a K-band image of the region in Figure 3.

[Figures not included]

Figure 2. 2 um spectra of the new hot stars found buried in the M17 cluster. Spectra of known O stars are also shown for direct comparison.

Figure 3. An image of the young star forming region M17, taken at 2 m. The newly found hot stars are indicated. Image provided by Ian Gatley and Michael Merrill.

Somewhat unexpectedly, Hanson and Conti found a second class of stars. A large number of the brightest 2 um stellar sources show excess 2 um emission relative to their J and H magnitudes when compared to normal reddened stellar atmospheres. Spectra taken of these stars show no photospheric absorption lines at all, unlike normal stars. Instead, these stars appear to be completely featureless (with strong upper limits on the strength of their Brackett absorption) or they show pronounced CO bandheads in emission (Figure 4).

Hanson and Conti believe that these objects are still enshrouded in a dense pre-main sequence (PMS) disk or shell, which is being picked up in the K-band as excess emission, causing the underlying star to be completely obscured. In some cases the disk or shell is warm and dense enough (~10^10 cm^-3) to excite the CO overtone bandheads into emission. Hanson and Conti plan to obtain additional spectra to better determine the spectral classes of the new found O stars and to search deeper in the cluster for an underlying B-star population that is expected to be present. A lack of normal main sequence stars could explain the large number of very luminous PMS stars found.

[Figure not included]

Figure 4. The CO overtone emission line stars found in M17 within the giant molecular cloud.

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Measurement of High-Degree Solar Oscillation Frequencies (1Dec94)

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Measurement of High-Degree Solar Oscillation Frequencies (1Dec94)
(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 40, 1 December 1994)

The chief method of testing models of solar interior structure and the physical processes occurring within the Sun involves studying the acoustic oscillations within the Sun that are observed as coherent radial displacements across the entire solar surface. Kurt Bachmann (NSO), Tom Duvall (NASA/Goddard), Jack Harvey (NSO), and Frank Hill (NSO) have made a new measurement of high-degree solar oscillation frequencies using the High-L Helioseismometer (HLH) recently installed on top of the NSO Kitt Peak Vacuum Telescope. These frequencies represent an improvement in accuracy and spatial resolution over previous measurements; they are allowing solar astronomers to discriminate among theoretical treatments of the convection zone, the outer region of the Sun that is difficult to model.

The improved frequencies reflect advances in both instrumentation and computing capabilities. The HLH detector is a 1000 X 1024 pixel CCD that uses a fast guiding system to maintain good spatial resolution during long exposures. The oscillations measured by the HLH detector are of smaller spatial extent represented by spherical harmonics of higher degree than the oscillations that will be observed by the GONG (Global Oscillation Network Group) instruments.

Bachmann, Duvall, Harvey, and Hill have made detailed comparisons of their observed frequencies with predictions from three different models, as shown in the figure. The clear disagreement of two of the models suggests that the treatments of convection, low-temperature opacities, and the equation of state in the third model are superior. The HLH research program serves as ground-based support for the Solar Oscillations Imager mission experiment on the SOHO satellite to be launched in 1995. The complete list of over 5000 observed frequencies from this study is available.

[Figure not included]

HLH frequencies (small dots) agree better with the Los Alamos model (filled squares, Guzik and Cox 1992) than with the Denmark (large dots, Christensen-Dalsgaard, Proffitt, and Thompson 1993) or Yale (plus signs, Guenther, Demarque, Kim, and Pinsonneault 1992) models.

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Gemini Primary Mirror Blank Fused (1Dec94)

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Gemini Primary Mirror Blank Fused (1Dec94)
(from NOAO HIGHLIGHTS!, NOAO Newsletter No. 40, 1 December 1994)

Fifty-five blocks of low expansion ULE=81 glass were successfully fused together at Corning's Canton, New York facility on 20 September to form the first Gemini primary mirror blank. The resulting blank is over 8.1 meters in diameter, 27 cm thick and weighs approximately 32,000 kg. Gemini Project members inspected the fused blank in mid-October and were delighted with the outcome. To their surprise, they were invited to walk on the mirror (but dancing was strictly forbidden). The mirror is surpassing performance specifications at this stage and appears outstanding.

Prior to fusing, the thermal expansion coefficient of each block, although nearly zero, was carefully measured and the position of each block within the blank was carefully optimized to result in minimum mirror surface figure deformation because of temperature changes. The component blocks were then laid on the surface of a turntable, which served as the base of a furnace, and fused together at temperatures exceeding 1700C.

Generation of the edge and plano surfaces has now begun in preparation for slumping of the blank, scheduled for March 1995, which will form the meniscus shape with the desired radius of curvature. The blank will then be diamond-generated to net shape with a final thickness of 20-cm, and transported next October to REOSC Optique in Paris, France for polishing of the optical surface. Fabrication of the second primary mirror blank slated for Gemini South is also well under way, with fusion of that blank scheduled for December 1995.

[Figure not included]

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Achievements and Prospects (1Dec94)

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Achievements and Prospects (1Dec94)
(from Director's Office, NOAO Newsletter No. 40, 1 December 1994)

A number of very significant milestones have been achieved since the last newsletter. The Gemini project officially initiated construction in October at both Mauna Kea and Cerro Pachon. Corning successfully completed the fusing of the first 8-m blank for Gemini. During the next year this blank will be slumped and generated before it is shipped to REOSC for polishing. The WIYN telescope on Kitt Peak was dedicated in October; the imaging performance achieved to date is remarkable. Site preparation has begun at the GONG sites in Learmonth, Australia, Tenerife, Spain, and Mauna Loa, Hawaii. Well-calibrated imaged data obtained simultaneously in November with the GONG equipment destined for Tenerife and Big Bear agree at a level that exceeds specifications. Ground was broken for a new visitor center at Sacramento Peak in September, and re-modeling of the visitor center at Kitt Peak was completed in November. Both of the visitor center projects were financed with non-NSF funds.

This is a remarkable set of achievements, and it is a tribute to the staff of NOAO and of the Gemini project that all of these projects are moving forward as close to schedule and budget as funding allocations have permitted. The staff have demonstrated their capability to carry out highly complex projects successfully; observing evaluation reports indicate that we have maintained a high level of service for the user community.

Nevertheless, NOAO is facing some very difficult times. The changed priorities in Washington, the emphasis within the NSF on research that directly supports these changed priorities, and the constraints on growth in the federal budget all will impact the support for astronomy research in this country and at NOAO. We do not yet know our budget for the fiscal year that began on 1 October, but it is unlikely that we will see any growth in that budget either this year or in the next several years. If there is no growth, then the addition of major new programs such as WIYN, support for US involvement with Gemini, the development of a new generation of infrared array detectors, the deployment and operation of GONG, combined with the increasing complexity of the new instruments that are being commissioned at the telescopes, will force reductions in the support of existing facilities and instruments.

NOAO is not the only organization facing hard choices. NASA, too, is re-examining the balance between new missions and operations of still productive older missions. Both of our northern hemisphere Gemini partners are reassessing their priorities in astronomy. Several independent observatories in the US will place large new telescopes into service in this decade--the twin Kecks, Magellan and its probable twin, the MMT upgrade--all of which will need both instrumentation and operating funds. The national radio observatories operated by the NSF are experiencing budgetary stress. It seems unlikely that belt-tightening alone will be sufficient over the next ten years. It certainly will not be enough for NOAO, which has already been forced to accommodate to about a 30 percent cut in inflation-corrected dollars for operations. We will instead have to look at archiving, new scheduling algorithms, and other changes in the way we obtain and distribute data in order to maintain community access at lower cost.

A relatively modest increment in the support of groundbased astronomy--about 10 percent in the astronomy budget at NSF--would be sufficient to allow us all to reap the benefits of the magnificent new facilities that will come on line over the next ten years. Qualitative changes in the types of facilities available in the community--nearly half a billion dollars has been, or will be, invested in new optical telescopes that will become accessible to US astronomers in the next ten years--would in more normal times surely have led to an increased budget. Even in these changed times, we should work as a united community to make the case for enhanced investment.

We must also, as a community, deal realistically with priorities should that enhancement not be achieved. NOAO expects to work closely with the user community as we formulate our own program. That program will have to include support for such major initiatives as Gemini and GONG, open access for a significant portion of the astronomical community, and a technical program that is capable of providing state of the art instrumentation in selected areas. The difficult issue is to achieve the optimum balance among these three types of activities. We have no desire to cut back on any of the existing programs--after all, if we and the user community judged any of what we do now to be not worth doing, we would have already canceled it. Unfortunately, decisions that neither the users nor NOAO can justify in scientific terms are likely to be forced upon us by external circumstances.

We need your advice, and we also need your support. It is as difficult and painful for NOAO staff to downsize or eliminate programs and facilities that we believe in as it is for the users to modify their research programs to accommodate to those changes. We will work closely with the user community to define the best program possible within the resources provided to us. Fortunately, whatever happens, we can all look forward to making qualitatively new types of observations with Gemini, GONG, and WIYN. Even with constrained resources, we can be justified in thinking that the pace of discovery in astronomy will be unabated during the next decade.

Sidney C. Wolff

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New Director for Gemini--Old Director for NOAO (1Dec94)

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New Director for Gemini--Old Director for NOAO (1Dec94)
(from Director's Office, NOAO Newsletter No. 40, 1 December 1994)

Effective 1 December, Matt Mountain became the Director of the Gemini telescopes project. Fred Gillett will serve as Acting Project Scientist for the Gemini project for one year, filling the position formerly held by Matt. An international search will be conducted for Gemini project scientist. I will return full time to the position of Director of NOAO. I especially want to express my thanks to Richard Green, who has performed many of the duties of NOAO Director while I was dividing my time between Gemini and NOAO. Richard will continue as Deputy Director of NOAO, with responsibility for leading the joint KPNO/CTIO nighttime instrumentation program.

Sidney C. Wolff

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Upcoming Telephone Changes (1Dec94)

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Upcoming Telephone Changes (1Dec94)
(from Director's Office, NOAO Newsletter No. 40, 1 December 1994)

The Tucson area code will be changing in mid-March of 1995 from 602 to 520. A grace period, of approximately three months, will be provided by U S West to allow for orderly transition. Shortly after, we will also make some needed changes to our direct inward dial numbers for both Tucson and Kitt Peak. The new dialing information and expected conversion date will appear in the next NOAO Newsletter.

Bob Barnes

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Engineering and Technical Services: Aladdin - 1024 x 1024 InSb FPA Project (1Dec94)

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Engineering and Technical Services:...(1Dec94)
Aladdin--1024 X 1024 InSb FPA Project
(from Director's Office, NOAO Newsletter No. 40, 1 December 1994)

We have completed the warm wafer testing on the development lot of readouts and it has been a great success. We now have yield statistics on the readout design and processing. In summary the development lot yielded 37% perfect (i.e. no bad rows or columns) quadrants (there are four quadrants per readout die) and 27% good quadrants (less than 2 bad rows/columns total). Because of grouping, due to wafer quality and processing issues, we obtained seven perfect 1024 X 1024 readout die (~8.7%), 9 good die (~11.2%), and another four which have one quadrant with 3 bad rows/columns. This gives us an overall useful yield of 25%. Several of the die were packaged for cold testing at NOAO and SBRC. We have completed our testing from LN2 down to 30K and the readout functions as designed. We have tested both the PMOS and NMOS output drivers and see very little performance difference at the bare readout level. The final decision as to which is the better choice will have to await hybrid testing. The gain uniformity is better than 1% and the noise at the readout level is comparable to the 256 InSb device. A meeting was held at SBRC in June on the Readout Development Phase of the contract and it was decided to go to the next phase, which is producing a limited number of hybrids for further evaluation. These are expected to be in test before the end of the year and at the telescope soon thereafter. Watch the ALADDIN ftp directory for the first images.

A paper, "Next Generation in InSb arrays: ALADDIN, the 1024 X 1024 InSb focal plane array readout evaluation results" was presented at the SPIE Conference in San Diego in July. The paper presents the first test data on the bare readout. A copy of the paper can be obtained by contacting Carol Gregory, cgregory@noao.edu. Work is continuing on a plan whereby the community can participate with NOAO in a production run at SBRC of Aladdin FPAs. More will be forthcoming on this effort.

Carol Gregory

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NOAO Preprint Series (1Dec94)

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The following preprints were submitted during the period 1 August 1994 to 30 October 1994. Please direct all requests for copies of preprints to the NOAO author marked with an asterisk.

608 *Ajhar, E.A., Blakeslee, J.P., Tonry, J.L., "VRI Photometry of Globular Clusters in Virgo and Leo Ellipticals"

609 Andretta, V., *Giampapa, M.S., "A Method for Estimating the Fractional Area Coverage of Active Regions on Dwarf F and G Stars"

610 *Bachmann, K.T., Duvall, T.L., Harvey, J.W., Hill, F., "Measurement of High-Degree Solar Oscillation Frequencies"

611 *Smith, R.C., Chu, Y.-H., Mac Low, M.M., Oey, M.S., Klein, U., "Two New Supernova Remnants in OB Associations in the Large Magellanic Cloud"

612 *Hinkle, K.H., Joyce, R.R., Smith, V., "Circumstellar CO in FG Sagittae"

613 *Sarajedini, A., Milone, A.A.E., "BVI CCD Photometry of NGC 5053: The Most Metal-Poor Galactic Globular Cluster"

614 *Komm, R.W., "Hurst Analysis of Mt. Wilson Rotation Measurements"

615 *Rimmele, T.R., "Sun-Center Observations of the Evershed Effect"

616 Li, X-q., Zhang, Z., *Smartt, R.N., "Magnetic Reconnection Theory for Coronal Loop Interaction"

617 *November, L.J., Wilkins, L.M., "The Liquid Crystal Polarimeter for Solid-State Imaging of Solar Vector Magnetic Fields"

618 *Bachmann, K.T., Duvall, T.L., Harvey, J.W., Hill, F., "Frequencies of High Degree Solar Oscillations"

619 *Hill, F., "Local Helioseismology Via Ring Diagrams and Trumpet Surfaces"

620 Tripathy, S.C., *Hill, F., "Detection of Chromospheric Oscillations in High-l Data"

621 Patron, J., *Hill, F., Rhodes, E.J., Korzennik, S.G., Cacciani, A., "Ring Diagram Analysis of Mt. Wilson Data: Velocity Fields Within the Solar Convection Zone"

622 Haber, D., Toomre, J., *Hill, F., Gough, D., "Solar Oscillation Ring Diagrams: Benefits of Great-Circle Remapping"

623 Beck, J.G., Ulrich, R.K., *Hill, F., "A Study of the Magnetic-Darkening Velocity Using GONG Modulation Images"

624 Elowitz, R.M., *Green, R.F., Impey, C.D., "Search for Correlations of Lyman Alpha Clouds and Metal Systems on Closely Spaced Lines of Sight"

625 *Neidig, D.F., Grosser, H., Hrovat, M., "Optical Output of the 24 April 1984 White-Light Flare"

626 *November, L.J., Koutchmy, S., "White-Light Coronal Fine Structure"

627 *D'Silva, S., "Brunt-Vaisala Growth Rate and the Radial Emergence of Equipartition Fields"

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Non-NOAO Preprints (1Dec94)

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(from Director's Office, NOAO Newsletter No. 40, 1 December 1994)

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

*Airapetian, V.S., Koutchmy, S., "Fast Coronal Transient (CME) With Twisted Legs"

*Airapetian, V.S., Smartt, R.N., "Role of Loop-Loop Encounters in Coronal Heating"

*Altrock, R.C., Hick, P., Jackson, B.V., Hoeksema, J.T., Zhao, X.P., Slater, G., Henry, T.W. "Solar Coronal Structure: a Comparison of NSO/SP Ground-Based Coronal Emission Line Intensities and Temperatures with Yohkoh SXT and WSO Magnetic Data"

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CTIO Instrumentation News (1Dec94)

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CTIO Instrumentation News (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

A major activity during the past three months was the 4-m shutdown, which took the telescope out of service for four weeks starting 8 August. During this time we installed the active primary mirror support system (see accompanying article), realuminized the primary mirror, made improvements to the ducting for the primary-mirror cooling system, installed insulating material on the interior of the telescope structure above the primary mirror, and worked on the radial support system for the primary mirror. All of this went very successfully except for the last item.

The primary mirror is supported in the radial (sideways) direction by 24 counterlevers that are attached to the side of the mirror by epoxy. We found that the epoxy joint had broken on one of these supports on the SE side of the mirror. We reglued the broken joint and put the telescope back together.

For reasons which we are still trying to understand in full, during the test period after reassembling the telescope, the reglued joint plus the epoxy joint on a different radial support detached themselves. The net result was two broken supports instead of one. This seemed unacceptable, so we removed the primary mirror from the telescope again, reglued the broken supports, and reassembled the telescope. This was a grueling five-day job for Jorge Briones and his crew of telescope mechanics, which they undertook with great cheerfulness and competence.

Then when we started testing the telescope again, the second radial support (the one that had been reglued just once) detached itself again. At that point we decided to leave the telescope in operation while we tried to figure out what was going wrong. Subsequent laboratory tests have shown that our gluing procedure sometimes produces very weak joints, and we believe that this explains why the same radial supports are failing twice in a row. It is unclear why the glue joints failed in the first place, although this has been a continuing problem throughout the life of the telescope. We plan to take the telescope down for another week in May 1995, and at minimum reglue the broken joint using improved procedures.

The 4-m shutdown was a large effort that depended on having a considerable number of people put in their maximum effort for a long period. We are especially grateful to Eduardo Aguirre, Gale Brehmer, Jorge Briones, Mario Fernandez, Eduardo Huanchicay and Oscar Saa from the Telescope Operations division on Cerro Tololo, and to Fabian Collao, Rodolfo Diaz, Eduardo Mondaca, Juan Orrego, Victor Pasten, Gabriel Perez, Fernando Saleh, German Schumacher and Pedro Vergara from the La Serena Engineering and Technical Services division.

On a different front, mechanical engineering design work has now started on the f/14 tip-tilt secondary for the 4-m. The mechanical, electronics and software parts of this project are being done at CTIO. At the same time, the optical work is now underway in Tucson, under the direction of Gary Poczulp. The mirror will be reduced in weight by boring a number of holes in its back surface, and then ground and polished. The target date for delivery of the polished mirror is the third quarter of 1995. CTIO is aiming to have a mirror cell ready to receive it at that time, with a computer-controlled collimation system suitable for active optics applications and the basic piezo-electric tip-tilt actuators installed.

The actual tip-tilt implementation will then follow during the next several months. This will require the addition of a tip-tilt detector system with software for calculating the guide star centroid and sending the appropriate commands to the piezos. The tip-tilt detector will be on a remotely controlled x-y stage mounted at the straight-through position on an instrument cube installed at the Cassegrain focus. Dichroic mirrors will permit the tip-tilt detector to view a guide star while light is sent to an instrument at one of the side ports. The initial instruments will be IR and optical imagers. Eventually we hope to also offer an IR spectrograph.

Work on the Arcon CCD controllers and characterization of CCDs during this period is described in a separate article. The Arcons have reached new low levels of readout noise and continue to be enthusiastically reviewed by our users. The major effort on the user interface part of the software is now winding down; the very considerable efforts of Pedro Gigoux and Steve Heathcote have led to a very popular user-friendly interface that continues to get even better during this mop-up phase of their work. Pedro will now gradually be switching over to work on the 1.5-m telescope control system. Dan Smith and Gary Webb are continuing to work full-time on other aspects of the Arcon Software.

In addition to the projects mentioned above, the mechanical group has been designing a new filter wheel and shutter assembly for the CCD system on the Curtis Schmidt telescope. The unit will then be fabricated by the University of Michigan, in a spirit of shared investment in improving the telescope.

J. Baldwin

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Active Optics on the CTIO 4-m (1Dec94)

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Active Optics on the CTIO 4-m (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

The new active optics system on the CTIO 4-m telescope came into routine use on 21 October. The active optics system includes both a computer-controlled collimation unit for the f/8 secondary mirror, and an active axial support system for the primary mirror. As in other active optics telescopes (cf. WIYN, NTT), coma is compensated for by moving the secondary mirror while the other low-order aberrations (spherical, astigmatism, trefoil, etc.) are removed by changing the shape of the primary mirror. The new collimation system for the f/8 secondary has been in use since January of this year, but the active primary support system is new, and appears to work quite well.

The Active Primary Mirror Support System

As has been described in previous Newsletters, the axial support system for the 4-m primary mirror lent itself very well to an upgrade to active control, because it is based on 33 force actuators which are arranged in two rings below the back of the mirror (Figure 1). The actuators are pneumatic pistons ("air bags"). They had previously been controlled by supplying all of the air bags within each ring with the same air pressure from a single controller, adjusting that air pressure to compensate for the changing axial component of gravity as the telescope pointed away from zenith.

[Figure not included]

To convert this to an "active" support system, we changed the plumbing in the mirror cell so that each air bag now has its own separate air pressure controller. These are controlled by a personal computer that calculates the force patterns (i.e. the correct air pressures for each air bag) to bend the primary mirror to compensate for astigmatism, spherical, trefoil, and quatrefoil aberrations. The desired corrections to the mirror shape can be obtained either from a lookup table (the normal operating mode) or can be explicitly entered (for instance, if new values have just been measured with an image analyzer). For each air bag, the PC adds the forces needed to correct each of the individual aberrations to the nominal force needed to support the mirror against gravity, converts the total force to a desired air pressure, and in turn converts this to a control voltage, which is sent to the air pressure controller. The PC receives commands from the telescope operator and obtains the telescope position from the Telescope Control System (TCS) computer. The active optics can be turned off, in which case the PC exactly emulates the old air-pressure control system.

The air-pressure controllers are inexpensive ($200 each) electropneumatic transducer units manufactured by Mamac Systems. With a slight modification, these work with ample precision to control the shape of our rather stiff mirror to well within the measurement limits. The PC talks to these controllers through ADCs and DACs connected to an RS-485 network. Also connected into the system are various interlocks to shut down the mirror support system in case of excessive air pressure, or if the mirror lifts off any of its three defining hard points, or if the TCS or other vital components should drop out of communication. These software safeguards are backed up by a parallel series of electromechanical safety shutoff switches, consistent with our great desire not to be the people who launch our 4-m mirror into orbit.

Our active optics system is patterned directly after the one pioneered on the ESO New Technology Telescope (NTT). Our main innovations are to apply the technique to an old-fashioned, thick-mirrored telescope, and to use the very low-cost approach based on the existing air-bag force actuators. While planning and carrying out this project, we have received tremendously valuable help from Ray Wilson and Lothar Noethe, who were principal figures in the NTT project. We are deeply grateful.

Our in-house team was led by German Schumacher (software), Gabriel Perez (mechanical hardware) and Eduardo Mondaca (electronics hardware), with Jack Baldwin and Brooke Gregory functioning as scientific rubberneckers. These people were backed up by a considerable number of other engineers, machinists and electronics technicians who put in a huge amount of work during the installation phase. We would especially like to thank Gale Brehmer, Jorge Briones and Oscar Saa in this regard. Finally, we must give full credit to Bill Weller, who became the original champion of this project after we had all visited the NTT one day.

Why We Need It

The primary mirror support system has worked reasonably well for approximately twenty years now, but as a result of an intensive series of measurements with various image analyzers over the past few years, we have come to realize that low-order optical aberrations do cause significant degradation of the image quality. This has been especially true over the past year or so, during which the telescope was plagued by serious amounts of astigmatism when it was looking to the north. Figure 2 shows a map of astigmatism over the sky, with the zenith at the center. Astigmatism is expressed as a vector, since there is both a magnitude and a direction associated with it. There are obviously large and systematic effects for northern declinations.

This problem appeared sometime during 1993. For most of the time since then we thought we had concrete evidence that it was due to a problem in the primary mirror radial support system, but our attempt to fix it during the 4-m shutdown this August did not work out (see "CTIO Instrumentation News" article in this issue). In late October (just as this article was being written) we found indications that the astigmatism might instead be due to a problem with the f/8 secondary mirror's support system, so we are re-evaluating our various measurements over the past year. In any case, the active primary mirror support is capable of compensating for this astigmatism.

Results with the Active Optics

The active primary mirror support system was installed during the month-long shutdown this August. It basically worked the first time we turned it on. After a couple of nights of testing using the old air-pressure regulators to make sure that the telescope was working at some basic level, we first tested the new system in a mode that emulated the original support system and showed that it produced results identical to the old system at telescope positions all over the sky. Then we calibrated the active modes by forcing various amounts of each aberration, using a Hartmann screen to measure the amount and direction of the resulting aberrations.

Once this calibration was in hand, we went to the area at hour angle = 0, declination = +30^o, where the astigmatism problem was at its worst. The Hartmann screen showed that with the active optics we were able to decrease the astigmatism by at least a factor of 6, which brought it down to zero to within the measurement errors.

The following night we used the telescope without the Hartmann screen. The seeing was good, with 0.7" FWHM images at zenith. We looked at a star at 0h, +20^o and measured FWHM = 1.22" without the active correction. Turning on the active correction reduced this to FWHM = 0.97". We were consistently able to obtain a 0.2"-0.3" improvement in the image FWHM at various points in the north, and focus sequences showed that the astigmatism clearly went away when the active optics corrections were turned on.

Since that time, we have had two subsequent engineering runs which concentrated on mapping the aberrations over the sky and on developing and testing the software necessary to use those maps as lookup tables for correcting the image problems. As of this writing, we have installed a system that uses a still-preliminary map, but which as far as we can tell is able to reduce the astigmatism to acceptable levels at all points in the sky. Figures 2 and 3 compare astigmatism maps with the active optics corrections turned OFF and ON, respectively. We have left the new support system running in its "active" mode while the f/8 focus is in use, as a test, because we feel that it will be of benefit to all users of the telescope.

[Figures not included]

Future Plans

Our main goal over the next 2-3 months is to continue improving the maps used to generate the lookup tables and to continue enhancing and debugging the active primary mirror support system. To do this, we have 1-2 engineering nights each month through January.

We have now gotten most of the way through a three-year plan for upgrading the optics on the 4-m telescope. We have completed the conversion of the telescope control program (TCP) to the VxWorks operating system (thus gaining comparability with KPNO), refiguring the f/8 secondary mirror (which improved our best f/8 images from 1" to 0.7" FWHM), the computer-controlled collimation system for f/8 (another important component of our active optics system), and now we are almost done with the primary mirror support system.

The above has all been done within our initial three-year schedule. The one thing that has slipped is our image analyzer project. Full use of the active-optics system requires having an image analyzer permanently mounted on the telescope in a way that it can be used with any instrument. This will permit astronomers to tune up the optics in real time for limiting observations. Our plan is to install a Shack-Hartmann image analyzer on the existing Cassegrain offset guider. This is aimed mainly for the f/8 focus, although it may be possible also to use it with the f/14 secondary, which is now being figured. All of the mechanical work and optics for this system have been finished for a year, but the CCD detector system has been delayed because of manpower shortages. We now hope to have the image analyzer in operation sometime during the first half of 1995.

Beyond these projects, the continuing image improvement program for the 4-m will consist of a lower-level effort of trying to consolidate the improvements in the optics and thermal environment to push closer to the site's seeing limit. While we find it gratifying to see 0.7" images frequently, we still need to find out why that is our best case rather than our median.

The main effort at improving the 4-m telescope (as opposed to its instrumentation) over the next few years will be directed towards a) implementation of an f/14 tip-tilt secondary system, and b) a three-year program of improvements to the telescope's control systems and drive servos.

German Schumacher, Gabriel Perez,
Eduardo Mondaca, Jack Baldwin

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New and Improving Images on the 0.9-m (1Dec94)

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New and Improving Images on the 0.9-m (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

Over the past several years we have been evaluating the performance of the 0.9-m telescope. Since this instrument is used exclusively for CCD direct imaging (and now almost totally with a Tek 2048), image quality becomes a scientific concern for many programs. As the CCD size and field have grown, the limitations of the existing system have become obvious: these include spherical aberration, coma, and astigmatism, with typical seeing of 1.5"-1.6" (V bandpass). The causes for this rather inferior performance include faulty mirror supports, inherent optical limitations, poor guiding implementation, and inadequate thermal control over the telescope, dome, and building.

We have begun a program to upgrade this and other small telescopes on CTIO. With resources made available by the MACHO agreement (see accompanying article) it appears that we will be able to find ways to implement some of the obvious improvements over the next year or two.

To talk about something which has been done, a shortened guider box was installed in July on the 0.9-m. Tests over the past 1.5 years with a Hartmann screen had indicated that significant spherical aberration existed, and that the minimum spherical focal plane was 96 mm above the nominal detector position. Although this is a slow f/13.5 telescope, this despace error contributes approximately 0.6" to the image spread. When removed (in quadrature), typical seeing therefore might approach 1.2"-1.3", and the best nights should produce subarcsecond images (if other effects do not mask this).

Jorge Briones and Oscar Saa fabricated a new guider box and TV guider mount. Tests show that the system seems rigid and reliable, so it is in routine use. Image quality at the guide TV immediately seems improved, and reports of 1.2" seeing seem more common, although the database is still quite limited. One observer has reported a guided image with FWHM = 0.95".

We are currently aluminizing the 0.9-m mirror and taking the opportunity to inspect the primary support system (which has several flaws). We also will be installing exhaust fans in the (closed) telescope tube over the next month, which should improve some local seeing and entrapped air issues (gradients of 1^oC have been measured along the tube).

This is, of course, one of the first scientific telescopes put into service on Tololo. In fact, this telescope was one of the first KPNO telescopes, and was subsequently shipped to Chile when the KPNO #1 0.9-m became a R-C telescope with a flip-top secondary. I would dearly love to improve it to the point where it routinely produces the subarcsecond images that we know the site delivers. Many of the scientific programs could derive significant benefits from such an improved performance.

Bob Schommer

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CTIO IR Imager Commissioned (1Dec94)

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CTIO IR Imager Commissioned (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

We have had commissioning runs with the new CTIO IR Imager (christened CIRIM to distinguish it from its predecessor) on the CTIO 1.5-m and 4-m telescopes, and it has been used for several science programs (scheduled programs) already. There are a few minor problems that need further work, but it is generally working quite well.

Below we describe the performance as currently measured, as an aid to people contemplating proposing to use it, and as reassurance to those who have proposed or have time with it. The instrument is based on a 256 X 256 Rockwell NICMOS III HgCdTe detector, run using the NOAO WILDFIRE electronics plus the CTIO motor controller. The optics consist of a 1.5:1 focal reducer and three cold filter wheels and a cold Lyot stop wheel. The different Lyot stops allow operation with different telescopes and secondaries; those that we offer currently are listed below:

Telescope Scales

Telescope	F/ratio	Pixel Scale	FOV
4-m	f/7.5	0.40	26"
4-m	f/30	0.10	102"
1.5-m	f/7.5	1.16	297"
1.5-m	f/13.5	0.645	166"
1.5-m	f/30	0.30	75"

We are considering offering the instrument on a smaller telescope (most likely to be the 1-m), but this has to await both engineering tests with the instrument on the 1-m and a decision on how extensive the instrument complement on the 1-m telescope should be.

It is possible to flip between f/7.5 and f/13.5 on the 1.5-m in about 20 minutes. It is possible to flip between f/7.5 and f/30 on the 4-m provided that the f/30 secondary has been installed; this must be requested (and justified) in the original proposal. Changes to and from the f/30 top end on the 1.5-m are a major operation, and can only be done if the telescope schedule was set up accordingly. This means you must request the f/30 secondary at the time you request telescope time.

Filters

CIRIM contains three stacked filter wheels which can hold up to 30 filters total. Currently, we have installed the following filters:

Broadband: I'(1.0 um), J, H, K[SUB S], K. K[SUB S] is UMass "K-short" and not UHawaii "K-prime."

Narrowband 1%: 1.083 u, 1.094 u, 1.237 u, 1.257 u, 1.281 u, 1.644, 2.122 u, 2.166 u, 2.420 u.

Narrowband other: H[SUB 2]O (1.99 u 3%), continuum (2.20 u 4%), CO (2.36 u 3%), H[SUB 2] continuum (2.38 u 2%).

There is also a dark position and a small lens for diagnostic viewing of the Lyot stop. Other filters may be present for test purposes, or may be added if we acquire other astrophysically useful filters. The detector has minimal sensitivity beyond 2.5 um, and the optics do not transmit longer wavelengths in any case, so 3 um filters are not available.

The filter wheels are located in the converging beam, behind the Lyot stop, which means that telescope focus varies from filter to filter. Since the optics also re-image the focal plane onto the detector, the different optical thicknesses of the filters have the effect of changing the effective geometry slightly, so that the plate scales also vary from filter to filter, by amounts of up to 1%. This effect will be important for programs where structure of complex objects needs to be registered (for example, color gradients in galaxies). Programs where the exact scale is important should measure the relative scales in the individual filters (for example using a globular cluster). We may make an attempt in future to provide a set of JHK or JHK[SUB S] filters that are exactly confocal.

Performance

Measured performance at the CTIO 1.5-m at f/7.5 is as follows:

	Counts, mag 15		Background		
Filter	ADU/ sec	e^-/sec	ADU/ sec/pix	e^-/sec/ pix	mag/ arcsec^2
I'	113	1020	15	135	17.6
J	135	1220	50	450	16.5
H	136	1220	300	2700	14.5
K[SUB S]	86.4	778	500	4500	13.5
K	94.2	848	1000	9000	12.8

The detector gain is about 9 e^-/ADU. Full well at nominal bias (900 mv) is over 39,000 ADU, but non-linearity is significant. We recommend keeping count levels below 15,000 ADU and correcting for the residual non-linearity (2% or less). Read noise is about 37 e^- (i.e. a bit more than 4 ADU).

The numbers above can be scaled to the 4-m or other f/ratios. These correspond to a total system efficiency, including telescope and atmosphere, of about 34% at K. In practice, in about 10 minutes you should be able to detect sources as faint as K[SUB S] = 17.5 at f/7.5; performance at f/13.5 will be a factor of two better because of the smaller pixels, and performance at f/30 may be another factor of two better still under good seeing conditions (subarcsecond).

Note that since both airglow and temperature affect background, those numbers should be considered approximate. The tabulated values were obtained at an ambient temperature of 8^oC, which is around the mid-point of typical Tololo temperatures.

Ghost images appear to be negligible. Repeatability of photometry over the chip and repeatability of flat fields both appear to be quite good (better than 2% at least), which is consistent with the observed stability of the Lyot stop (well under 1% motion over the sky).

The WILDFIRE software provides the observer with control of the motor and telescope functions from the instrument control window, and scripts can be written (in tcl) which allow sequences of commands, such as grids, beam switching or sequences of filters. Users who have written similar scripts for KPNO instruments will find these familiar.

Manual

A version of the manual (in LaTeX) will eventually be placed in the CTIO public ftp directory. In the meantime, a draft version can be obtained from one of the undersigned.

R. Elston, J. Elias, B. Gregory

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Loral 3K X 1K CCD in the Blue Air Schmidt Camera (1Dec94)

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Loral 3K X 1K CCD in the Blue Air Schmidt Camera (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

As mentioned previously (Newsletter No. 39, p.21) we are in the process of installing a Loral 3K X 1K CCD in the Blue Air Schmidt camera, with the goal of bringing it into service towards the end of the present year.

The Arcon controller that will be used with this device has been fabricated and was thoroughly tested using an engineering grade CCD. However, when the science grade detector was installed we had a most unwelcome surprise. This chip had been selected as an excellent device based on the initial evaluation carried out at NOAO Tucson. However, when operated for the first time at CTIO, the CCD exhibited some 30 hot columns, and more seriously had read-out noise of 30e^- RMS, compared to the 8-12 e^- RMS typical of similar Loral CCDs. It is speculated that the CCD may have suffered damage in transit between KPNO and CTIO. Subsequent investigation has revealed that the high RON is due to hot pixels (LEDs) in both serial registers. These inject substantial excess dark current during readout, and hence add an extra shot noise contribution to the effective RON. By reducing the serial clock voltages we have been able to eliminate the LEDs from one of the two serial registers and achieve a RON of ~9e^- RMS at the cost of substantially reduced full well capacity. The other serial register has not responded to such treatment, so this CCD will have to be used in single readout mode, doubling readout times. At the time of writing we are still determining whether there exists an operating regime in which acceptable full well capacity, linearity, serial charge transfer, and low dark current are all obtained, while still maintaining RON low enough to make this device scientifically interesting. We also need to find out if the required operating parameters remain sufficiently stable over time.

If further tests show that the present Loral CCD can be made to give scientifically useful performance, then the benefits this chip offers relative to the present Reticon CCD will likely outweigh its remaining disadvantages, and we will bring it into service as originally planned. In brief, the Loral has somewhat higher QE than the Reticon at all wavelengths from 3000-9000 --up by a factor of 1.4 or more from 4500-8000 . Its much larger format and smaller pixel size result in a factor of 1.4 more coverage and a factor 1.8 higher dispersion (fewer per pixel) when used with a given grating, as well as finer spatial sampling (0.5"/pix compared to 0.8"/pix) and a matching slit width (1"-1.5") more closely in accord with typical seeing conditions. Since the Loral CCD is flat it should be possible to achieve more uniform image quality than was allowed by the roller coaster surface of the

Reticon. Mechanical problems during our first, and so far only, engineering run meant that we had to operate the spectrograph far from auto-collimation in order to reach focus, which introduced substantial astigmatism. Despite this, we were able to achieve better than 3 pixel FWHM image quality over the entire chip and saw images of 2 pixels FWHM at best. Certainly, there was no evidence that the resolution of the CCD was a limiting factor in the image quality, a problem which has been experienced with the Loral CCDs at KPNO. One additional concern with the Loral is that it fringes at wavelengths longward of 7000 . However, the fringe amplitude was found to be only 5% (compared to 3% with the Reticon) so that conventional flat fielding techniques should reduce residual fringing to 0.5% or below.

If the Loral does not prove to be useable, then we will continue to use the Reticon CCD with the blue Air Schmidt. Unfortunately, we can only offer one or the other, since exchanging the CCD installed in the camera is not something that can be done on a routine basis. We must therefore select the one that offers the best mix of characteristics for most users, even though it may be less than optimum for some programs. In the meantime we are trying to obtain a replacement Loral CCD, although the remaining stock of potential good devices obtained during the foundry run is not very large.

A final decision on which chip to leave installed in the Blue Air Schmidt will be taken following two more engineering runs at the end of October and November. The Folded Schmidt plus Tektronix 1K CCD will in any case continue to be available. This provides useful sensitivity from 4000-10000 , low 3e^- RON, and does not fringe. The wavelength coverage and dispersion obtained with a given grating are similar to those with the Reticon while image quality is somewhat better although variable (see Newsletters No. 25 and No. 26 for full details). For programs scheduled to use the R-C Spectrograph from December onwards, we will decide which of the two supported Camera/CCD combinations to assign based on information in the proposal and inform the PIs accordingly. Users needing further information on the characteristics of the different Camera/CCD combinations should contact Steve Heathcote or Bob Schommer.

Steve Heathcote, Ricardo Schmidt,
Bob Schommer, Alistair Walker

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Large Filters for CCD Imaging (1Dec94)

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Large Filters for CCD Imaging (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

We are slowly building up our stock of 4 X 4 inch filters for imaging with large CCDs at the 4-m prime focus and, for next semester, at the Schmidt telescope. Given the expense of these filters, we have decided not to duplicate some of them in the 3 X 3 inch size required for the 0.9-m, 1.5-m and 4-m Cassegrain filter wheels. Instead, we have modified a filter wheel module such that it will accommodate the larger filters at these focal positions, if need be. In the unlikely case of a conflict of interest, the observer at the larger telescope has priority. The full list of CTIO filters can be found via anonymous ftp to ctios1.ctio.noao.edu as described in Newsletter No. 34, p.11. However, for convenience we give below a list of the 4 X 4 filters that we have now or expect to have delivered in the near future.

- Johnson Kron-Cousins UBVRI (two sets)
- Washington CMT1
- DDO 51
- Stromgren uvby
- Gunn griz
- HST F555W, F814W
- Tyson J
- [SII] 6723 / 50
- [OIII] 5008 / 50
- H 6563, 6600 /75

Alistair Walker, Bob Schommer, Steve Heathcote

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MACHO Observations: Sharing 0.9-m Telescope Time (1Dec94)

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MACHO Observations: Sharing 0.9-m Telescope Time (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

As of 1 September, the MACHO project started nightly observations on the 0.9-m telescope. MACHO stands for Massive Compact Halo Object; the MACHO team is searching for gravitational lensing events that might reveal baryonic dark matter in the galactic halo.

The MACHO agreement, between the Center for Particle Astrophysics at the University of California, Berkeley, and CTIO/NOAO, runs for two years, five months, subject to yearly renewals. They have been allocated 13% of the 0.9-m time throughout the year, with an additional week of dedicated observing per year, to result in a total of 15% of the available time.

As part of the agreement, CTIO has agreed to obtain MACHO observations every usable night on relevant target fields in the Galactic bulge and the Magellanic Clouds. The MACHO team have shipped a Sun workstation, disk, and Exabyte drive here, which have been integrated into our network. When the telescope is turned over for the MACHO time (currently about 70 minutes/night) the CCD acquisition and data storage runs from their machine. The "normal" 0.9-m observers stay logged into their own console and can continue to process and inspect data, etc. A timer is started in the MACHO Sun, which begins a countdown. Observations are being taken by CTIO Observer support personnel, and calibrations are being taken in the mornings by observer support.

In return for these services, the MACHO project is providing CTIO with some funds dedicated to improving the performance of our small telescopes. With these funds, we intend to make additional hires to assist in the data taking and to carry out a telescope improvement plan. Currently on our improvement list for the 0.9-m are installation of fans in the (closed) telescope tube, a temperature monitoring system, a corrector/field flattener, guiding and focus upgrades, and primary mirror support improvements.

The 0.9-m observers were notified of this program by a memo from J. Elias in their telescope assignment letters. They have been allocated additional nights over the TAC recommendation to compensate for the 13% loss to the MACHO observations. We have been e-mailing the observers to notify them about the actual time during each night that the MACHO observations are scheduled, approximately one week in advance of the scheduled runs.

As always, sharing nights and telescope time is a delicate business. The MACHO team are aware of these issues, and have been very reasonable and flexible. Cordial relations and considerate discussions among all involved will help make this a successful scientific program, and should benefit all the users of our telescopes, and the observatory in general.

Bob Schommer

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Internet/Remote Observing Experiment (1Dec94)

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Internet/Remote Observing Experiment (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

We conducted a successful Internet "remote observing" experiment 18/19 August. Greg Bothun (U. Oregon) logged in via the net to the 0.9-m CCD computer and snapped four pictures of two galaxies (B and I). He was running the controller, moving the filter wheels, and receiving the same detector information that our normal (in dome) observer gets. We opened a "talk" window on another computer, and Greg sent me coordinates as we had a "realtime" discussion. At his request, I slewed the telescope and acquired a guide star. He had complete control of the instrument.

The night was marginal, seeing about 2.5", scattered cirrus, and a nearly full moon. But the M83 exposure was wonderful. I could see the picture on readout, hear the shutter open and close, and see the exposure time countdowns on a status window. This was Arcon 3.3 (Tek2k) running two amplifiers. Greg "quadproced," compressed, and ftp'ed the images back to the University of Oregon. The images are archived on one of his mosaic pages at the University of Oregon: (http://zebu.uoregon.edu/messier.html).

It took a few minutes to get the images back there and redisplayed in IRAF. We considered running remote X windows, etc., and we have done that in tests, but we were nervous about the time delays and fragility of the link for these higher-tec treats. In fact, 15 minutes after the experiment ended (6 pm Oregon time) the University of Oregon, Physics Department temporarily lost T1 connectivity to the network.

The reason we attempted all this was that a public television crew was filming in Greg's computer lab at the University of Oregon. They had contacted Greg for a special 90 minute PBS special on the Internet. The program is scheduled to be aired in the US in December, and includes a variety of interviews and commentators. We gave them real scientific images taken by a remote station, in almost real time.

Because of obvious issues concerning bandwidth, guiding, telescope control and environmental monitoring, remote observing is not yet practical over our network link. Limited eavesdropping and extensive data transfers often do occur with collaborators around the world, and many of our observers are finding the link vital in making their observing runs successful. Tests like this provide us with resource evaluations and help us to understand the strengths and limitations of the evolving network capabilities.

I want to thank those who helped set this up during the week. Particularly R. Smith, N. Saavedra, D. Smith, C. Smith and G. Webb. Special thanks to the Yale observers, S. Jogee and C. Bailyn for use of a bit of their telescope time, and for their gracious cooperation.

Bob Schommer

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Network Reliability (1Dec94)

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Network Reliability (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

Our satellite link has proven very reliable over the years, but it can still go down at times for reasons ranging from Hurricane Andrew to network maintenance, either at CTIO or in the US. We are seeing that this reliability has in fact led people to sometimes rely on the link to excess; the link is something like 99.9% reliable, but not 100.0%. We encourage people to use the network link, but we urge you not to put yourselves in a position where loss of the connection for a few hours seriously compromises your work. In particular:

1) If you are coming to observe, do not come planning to ftp all your coordinate lists, critical software, or finding charts. If you need a machine-readable form, consider ftp'ing it before you arrive (contact Mario Hamuy for a visitor account or an ftp location), or bringing it on

a floppy disk or tape. You can add this precaution to the long-standing one of not putting critical papers in your suitcase and hand-carrying them instead.

2) If you are sending in a proposal by e-mail, consider sending it in several hours--maybe even a whole day!--early. Obviously we don't schedule maintenance at proposal deadlines, but we have no control over events elsewhere. It may not even be our connection that fails, but yours--see the story on remote observing.

Jay Elias (for ACTR)

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CTIO Observing Requests: February - July 1995 (1Dec94)

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CTIO Observing Requests: February - July 1995 (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

This semester represented our first use of the new LaTeX proposal form; we have been using the older TeX form for electronic submission for a few years, but the new form makes electronic submission of figures possible. We ended up with 171 proposals, somewhat lower than usual (see statistics below). Of these, 82% came in by e-mail. The proportion is even higher if one eliminates local staff proposals, since most of these were not submitted electronically. A few of the electronic submissions were using the old TeX form, but most used the new form and procedures and roughly a third of these included figures. Some of the proposals were clearly prepared with considerable care and effort and, whatever their content, look very nice. Almost exactly half of the proposals arrived on the last day (30 September), and about half of these arrived between 5 pm and midnight (about one proposal every nine minutes during the last twelve hours, corresponding to about 2% of our satellite link capacity)!

With only one exception, we were able to print out the proposals on the default printer (Sun Sparcprinter). The one recalcitrant proposal printed out on an Apple Laserwriter. A number of the proposals required tinkering to process correctly (roughly 10%). The problems mainly fell into three categories:

- Recognizing Postscript figures. The processor looks for certain keywords in the figure headers in order to identify them as such, and not all programs produce these keywords. (Lick Mongo in particular). This can be solved with better instructions and a bit more sophistication in the processor.

- Mistakes in following instructions. A few people misunderstood instructions, misread their proposal ID number, or even forgot what they had called the figure file in the LaTeX file.

- Proofreading. We got a couple of proposals where the proposer clearly made one last change and never LaTeXed it, because these proposals had extra or missing delimiters or other basic errors. Other people clearly edited the sample file, not the template, and left in some of the sample text, or had overlapping text: in all these cases they clearly did not print out and carefully read the proposal.

Lessons and Instructions for the Future

First of all, as stated previously, we will no longer accept the old TeX form, either by regular mail or by electronic mail. As a reminder, if you've lost your copy of the previous Newsletter, you can get the new forms by sending an e-mail to ctioprop-request@noao.edu, or by anonymous ftp from ctio.noao.edu. The e-mail request doesn't require any particular subject or content lines.

Second, if you do send your proposal in by mail, make sure you send a second copy to Tucson. If you send the proposal in by courier, send the Tucson copy by similar means. Also, if you send the proposal by courier do not (that's do not) send it to the post-office box address in La Serena; use our Santiago address (given in the proposal instructions) instead. This is because none of the international courier services deliver directly to La Serena, and therefore hand off your proposal to a local courier service--and these in turn cannot deliver to a post-office box, and don't always know what to do with the letter, resulting in delays.

Second, print out the final version of your proposal. That one last change you made may not have done what you thought it would.

Third, follow the instructions. We will have cleaned up the ambiguities discovered on this round, but mostly they can be resolved by reading carefully.

Jay Elias, Ximena Herreros

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Proposal Statistics (1Dec94)

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Proposal Statistics (1Dec94)
(from CTIO, NOAO Newsletter No. 40, 1 December 1994)

4-m Telescope: 153 nights available

Requests		Nights Requested				
Dark	Bright	Dark	Bright	Instrument	Nights	%
1	0	4	0	ASCAP	4	1.2
11	10	39	30	Argus	69	21.5
22	8	80	19	CS/CCD	99	30.8
0	6	0	24	Ech/CCD	24	7.5
0	2	0	6	IR/Imager	6	1.9
0	13	0	51	IR/IRS	51	15.9
14	0	42	0	PF/CCD	42	13.1
4	3	12	9	RF-P	21	6.5
1	1	1	4	OSIRIS	5	1.6
53	43	178	143		321	100%

	Now	Last Semester	Semester Before Last
No. of requests	96	114	120
No. of nights requested	321	391	404
Oversubscription	2.10	3.05	2.42
Average request	3.34	3.43	3.37

1.5-m Telescope: 168 nights available

Requests		Nights Requested				
Dark	Bright	Dark	Bright	Instrument	Nights	%
1	0	8	0	ASCAP	8	2.9
16	0	70	0	CF/CCD	70	25.7
5	5	27	25	CS/CCD	52	19.1
0	3	0	14	Ech/CCD	14	5.1
2	6	4	38	IR/Imager	42	15.4
0	7	0	28	IR/IRS	28	10.3
1	0	8	0	PF/CCD	8	2.9
2	4	6	21	RF-P	27	9.9
0	3	0	23	Visitor	23	8.5
27	28	123	149	272	100%	

	Now	Last Semester	Semester Before Last
No. of requests	55	58	67
No. of nights requested	272	267	340
Oversubscription	1.62	1.58	2.00
Average request	4.95	4.60	5.07

1-m Telescope: 168 nights available

Requests		Nights Requested				
Dark	Bright	Dark	Bright	Instrument	Nights	%
7	5	72	59	ASCAP	131	86.8
0	1	0	6	CS/2DF	6	4.0
0	1	0	14	IR/Imager	14	9.3
7	7	72	79		151	100%

	Now	Last Semester	Semester Before Last
No. of requests	14	12	19
No. of nights requested	151	103	189
Oversubscription	0.90	0.58	1.09
Average request	10.79	8.58	9.95

0.9-m Telescope: 174 nights available

Requests		Nights Requested				
Dark	Bright	Dark	Bright	Instrument	Nights	%
29	10	185	96	CF/CCD	281	100%

	Now	Last Semester	Semester Before Last
No. of requests	39	37	36
No. of nights requested	281	210	220
Oversubscription	1.61	1.24	1.31
Average request	7.21	5.68	6.11

Schmidt Telescope: 108 nights available

CF/CCD 9 requests for 86 nights 100%

	Now	Last Semester	Semester Before Last
No. of requests	9	20	16
No. of nights requested	86	122	133
Oversubscription	0.80	1.16	1.23
Average request	9.56	6.10	8.31

0.6-m Telescope: 181 nights available

ASCAP 1 request for 21 nights 100%

	Now
No. of requests	1
No. of nights requested	21
Oversubscription	0.12
Average request	21.00

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More Changes to Kitt Peak Facilities (1Dec94)

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More Changes to Kitt Peak Facilities (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

The new 3.5-m WIYN telescope will begin scientific operations in the spring semester, and we have received already exciting science proposals for observations with WIYN. The telescope promises excellent performance for both optical imaging and multi-fiber spectroscopy. KPNO is responsible for most of the operations costs for WIYN; that support effort has already begun through the training of operators and other mountain and downtown staff who will work to keep the telescope at its peak performance. At the same time, our budget in real dollars continues to decline, by some 30% in the last decade, and this trend is continuing. After many years of belt-tightening, we are unable to absorb further cuts without significant impact on our users, particularly as we take on WIYN operations.

Our guiding principle as we contemplate how to accommodate further budget cuts is the provision of those critical scientific capabilities most heavily used by our user community, across telescope aperture. These basic capabilities which must be provided at a national facility such as Kitt Peak include optical and infrared imaging, and both high and low resolution spectroscopy at both optical and infrared wavelengths. Extending those capabilities to improve performance and productivity and to assure that our users have access to competitive instrumentation is our goal.

For the spring 1995 semester we have implemented several changes to the instrumentation offered on Kitt Peak telescopes. These changes include the restriction of IR instrumentation to particular telescopes, the retirement of the FOE and the white spectrograph, the change of status of the 4-m Cryogenic Camera to "reduced availability," and the restriction of FTS operations to service observing only. Further changes to the list of available instruments for the fall, 1995 semester are also under consideration. These include the retirement of the 4-m prime focus camera and of photoelectric photometry, as described in the accompanying articles. We are making every effort to assist those astronomers impacted most heavily by these changes to complete their programs.

We are forced also to make a more serious change in the facilities available to the community--the closing of the 1.3-m telescope. The 1.3-m has been in operation for decades. It was originally built as a "remote observing" telescope, and later became heavily used for infrared observations and for IR array development. New infrared instrumentation now underway, including the Phoenix high resolution spectrometer and the GRASP multi-color grating spectrometer, will not be usable on the 1.3-m because of size and weight restrictions. While the 1.3-m telescope has been a highly productive facility for many years, the scientific capabilities it offers are now largely duplicated on the 2.1-m and 4-m telescopes.

During the spring semester, 1995, the 1.3-m telescope will be scheduled to complete two graduate theses already underway, and to complete two ongoing programs using photoelectric photometry. The telescope will also be used occasionally for testing new IR arrays as the Aladdin project gears into production. Other highly ranked proposals approved by the TAC for the 1.3-m telescope have been moved to the 2.1-m, and some 2.1-m proposals have been moved to the 4-m telescope to accommodate our users' needs. We will continue to pay close attention to approved thesis programs so that students can complete their degrees.

We at Kitt Peak want to keep our telescopes open. You, our users, have told us with no uncertainty that keeping telescopes open is your highest priority. Access to telescope time is important to you, and to us as well - much of our own research is done using the small telescopes on Kitt Peak. The 0.9-m, Coude Feed, and Burrell Schmidt telescopes offer unique and specialized scientific opportunities in wide field imaging and high resolution spectroscopy. The pattern of budget cuts and telescope closures has persisted for 15 years, and will continue to threaten our small telescopes. To keep those telescopes open, we must break the pattern.

Over the next 2-3 years we will explore new styles of operation of the small telescopes to see if we can learn to operate them with fewer resources. We may ask observers to come a night early to learn how to use a small telescope from the previous observer, and to provide the same courtesy to the next observer. We may ask users to assist us with the tasks of documentation and advocacy for individual telescopes and their instruments as telescope and instrument scientists. We may ask graduate students to serve as "resident astronomers" to assist users, in return for telescope time. Many of you may have other ideas for ways to reduce the cost of operating small telescopes, and we welcome your suggestions as we work to find ways to keep these telescopes open.

Caty Pilachowski

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IRIM to Remain in Service at Kitt Peak! (1Dec94)

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IRIM to Remain in Service at Kitt Peak! (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

Through the new NOAO Instrumentation plan we are able to continue to provide the HgCdTe infrared imager IRIM beyond the spring semester at Kitt Peak. The wide field capability it provides for infrared imaging is quite popular, especially at the 4-m telescope. We are pleased that we can continue to make it available. This continuation is due largely to the implementation of the Joint NOAO Instrumentation Program by KPNO and CTIO. This has allowed us to combine resources to provide well balanced instrument capabilities North and South while also pursuing a vigorous development program.

IRIM will remain in its present configuration with its demonstrated performance unchanged.

Ron Probst

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4-m Prime Focus Photography (1Dec94)

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4-m Prime Focus Photography (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

The prime focus photographic camera at the 4-m telescope has been restricted to ongoing programs for some time. The continuing decline of the Kitt Peak budget is forcing us to spread our resources so thinly that frequently used instruments are not receiving the attention they need. Support of the prime focus camera requires us to maintain the darkroom, plate loading room, hypersensitizing room, and chemical preparation room, as well as the instrument itself. As part of our seeing-improvement program for the 4-m, we are working to reduce the heat generated in the building, and we want to reduce the energy costs associated with operation of the 4-m (electricity to run the 4-m costs $40,000 annually!). We are also losing our expertise in scientific photography. Because of his other responsibilities, Bill Schoening cannot be as up-to-date in his knowledge of photographic technology, and it is increasingly difficult, if not impossible, to obtain suitable plates.

For all these reasons, we are planning to retire the 4-m prime focus photographic camera in the fall of 1995. In the near future we expect to install a new, wide field corrector on the 4-m for use with the 8K X 8K CCD Mosaic, which will provide a field of view only slightly smaller than the photographic camera.

To assist in the completion of ongoing photographic programs at the 4-m, we have scheduled Director's Discretionary Time in the spring and summer (and will schedule some in the fall semester) to take a few final photographic plates. We have contacted observers whom we know to be carrying out programs with the prime focus camera, to ask for observing lists. In case we have missed someone we are also announcing an opportunity to request "final plates" for ongoing programs using the prime focus camera.

Finally, we are willing to entertain proposals from the community to take over responsibility for the prime focus camera, which could then operate at the 4-m as a "visitor instrument." We welcome observing proposals for visitor instruments and schedule them if they fall within the top 1/3 of approved programs. As with other visitor instruments, we would assist with the installation on the telescope. In this mode, darkroom facilities would be provided in our downtown headquarters. If you are interested in assuming responsibility for the prime focus camera, please contact me for details.

Caty Pilachowski

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Mark III Photoelectric Photometer to Retire (1Dec94)

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Mark III Photoelectric Photometer to Retire (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

A second instrument to be retired in the fall 1995, semester is the Mark III photometer, used at the 1.3-m. This retirement is forced by the closing of the telescope, described above. The capability for all-sky and differential photometry has been shifted to the 0.9-m telescope with the new CCDPHOT photometer. CCDPHOT has proven capable of providing quantitative photometry for most scientific programs, except in the U band, where the rapid decline in sensitivity of the CCD makes the transformation difficult. We are hoping to provide a different CCD with better ultraviolet sensitivity (TI5) to overcome this problem.

As with the 4-m prime focus camera, we are willing to entertain proposals from the community for a long term loan of the Mark III photometer. Priority will be given to applications that provide community access in some form. If you are interested in proposing to obtain this equipment, please contact me for details.

Caty Pilachowski

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CoudÃ© Feed Open Time (1Dec94)

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Coude Feed Open Time (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

Some unscheduled observing time may be available during the spring semester on the Coude Feed telescope. Open blocks of time can be found by examining the Kitt Peak observing schedule available over the World Wide Web via the NOAO and KPNO home pages:

http://www.noao.edu/noao.html

Our policy on open time is that we accept requests (in the form of a letter to the KPNO Director), and assign open nights approximately 6 weeks in advance. Proposals for open time should explain why the request could not be submitted through the normal process. Programs which have been denied time by the TAC are generally not granted open time.

Caty Pilachowski

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The NOAO WIYN Observing Program (1Dec94)

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The NOAO WIYN Observing Program (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

In anticipation of the start of WIYN shared risk science operations in March 1995, KPNO solicited proposals for observations with the WIYN telescope as part of the normal KPNO observing proposal process in September. The WIYN telescope will be scheduled in a queue observing mode, unlike the other telescopes on Kitt Peak.

We believe that the efficiency of the telescopes can be improved by scheduling in this way. As part of the development of an operations strategy for the Gemini telescopes, Todd Boroson has written a program that simulates queue scheduling and compares it to classical scheduling. This model has been applied to simulate the WIYN Telescope on Kitt Peak. The simulations suggest the following:

- about 20% more exposures get taken in queue mode than in classical mode.

- 60% of the approved proposals get completed in queue mode, as opposed to about 10% in classical mode.

- 60% of the approved proposals get at least some data in queue mode, as opposed to 90% in classical mode.

- the gain in queue mode is almost entirely in the imaging queues, particularly in the "good seeing" queue (for which only 16% of the exposures are done in classical mode, while 100% are done in queue mode). This is a result of the fact that this kind of observation requires conditions that occur only occasionally.

- among the exposures that are obtained in classical mode, there is no discrimination with grade, while for queue, essentially all the of the most highly ranked proposals (to a grade of 2.25) get done, with a tail down to grade 3.

We received 26 proposals for observing programs on WIYN, as follows:

Dark time:	Imager: 8 proposals
	MOS/Hydra: 11 proposals
Bright time:	Imager: 0 proposals
	MOS/Hydra: 7 proposals

These proposals will be reviewed by the KPNO TAC in early November and ranked according to scientific merit. Technical reviews will be conducted by KPNO staff once the commissioning of the WIYN facility instruments is underway. In addition, 19 short program (2 hrs) proposals were received. These proposals will be reviewed internally.

The total number of nights requested is approximately 60 dark nights and 25 bright nights. NOAO expects to be allocated roughly 25 dark nights and 25 bright nights between 1 March and 1 September 1995.

Once these reviews are completed, a preliminary queue schedule based primarily on scientific merit of all technically feasible programs will be prepared. The principal investigators of these programs will be requested to provide additional information necessary to complete the proposed observations (e.g., Hydra configurations).

Proposers whose programs were judged to be technically infeasible will be notified individually, and their programs will not be scheduled.

More detailed information about the WIYN queue observing program will be included in the next NOAO Newsletter.

Caty Pilachowski, Dave Silva

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WIYN Project Review: October 1994 (1Dec94)

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WIYN Project Review: October 1994 (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

Commissioning of the WIYN Observatory continues to unfold smoothly, as the Project begins the transition from telescope commissioning to instrument commissioning.

The main optics systems continue to function quite well and routinely produce the best images on Kitt Peak. Whenever the telescope is operated at night, delivered image quality measurements are made at approximately 80^o elevation in the R band. For short (10 sec and less) exposures, image sizes are typically in the 0.6"-0.7" FWHM range. About 10% of the time, image sizes of 0.5" FWHM or less are measured. The image quality of longer exposures is still limited by open-loop tracking accuracy, but image sizes of 0.8" FWHM or smaller are often achieved over 60-120 s exposures. At present, the number of measurements is insufficient to assess the statistical significance of these image sizes. However, image quality measurements are being made 3-4 days per week, so a statistically meaningful determination should be available for publication in the next NOAO Newsletter.

Image quality degradation at lower elevation appears to be consistent with known atmospheric effects, such as differential atmospheric refraction, and errors in the current open loop telescope focus lookup tables. These latter errors are not unexpected, since these lookup tables do not yet reflect the nightly thermal contraction of the telescope. Very simple closed loop lookup tables that are tied to telescope temperature will be implemented shortly. A more sophisticated closed loop focus adjustment based on measuring the actual focus in real time will be implemented in the Instrument Adaptor Subsystem next spring.

As mentioned above, long exposure image quality continues to be limited by telescope tracking. Although telescope pointing has been improved to approximately 5" RMS over the whole sky, non-random errors in the current pointing model lead to position dependent open loop tracking errors which can be as high as 1"/min in some parts of the sky. However, by 15 November, an improved pointing model as well as closed loop guiding should be implemented.

The MOS Nasymth port Wide Field Corrector (WFC) lenses were finally accepted in September. The lenses slightly exceed their original polishing specification. They are currently being AR coated by Continental Optical and are due back in Tucson in late November. The lenses will then be assembled into their cell and installed at the Observatory. Once the WFC is installed, the 1^o diameter field-of-view will be characterized photographically to assess the magnitude of residual optical aberrations and field distortions. The latter measurement is crucial for achieving accurate fiber positioning by MOS/Hydra.

Unfortunately, since final MOS/Hydra installation and commissioning cannot begin until these measurements are made and WFC installation is now several months behind schedule, it now appears that MOS/Hydra will not be available for science operations until at least mid-May 1995.

The WIYN Imager is making steady progress and should be available for shared-risk science operations by mid-March 1995. Deploying the Imager requires completing and commissioning three components: the Instrument Adaptor Subsystem (IAS), the Filter/Shutter Assembly (FSA), and the CCD detector system. The permanent IAS, which encompasses all the hardware for guiding, wavefront curvature sensing, and closed loop focusing on the WIYN Imager Nasymth port, is now scheduled for telescope installation in late February 1995 and commissioning completion by mid-March 1995. In August, Indiana University delivered a substitute IAS, which consists of a duplicate of the IAS outer shell and a single axis stage. A ICCD borrowed from KPNO has been mounted on this stage. This substitute IAS will allow the Project to start
commissioning the FSA and the CCD detector system immediately. It will also be used as a closed loop guiding testbed. In September, the FSA was delivered to Indiana University. The FSA is currently being commissioned and interfaced to the Harcon CCD control software.

As discussed elsewhere in this Newsletter, the initial WIYN Imager CCD detector will not be a KPNO Mini-Mosaic with 15 um pixels as originally planned but a thinned STIS 2048 X 2048 pixel device with 21 um (0.197") pixels.

The University of Wisconsin Controls Group (UWCG) continues to work towards completing delivery of the control system and to support WIYN commissioning activities. Closed loop guiding remains the most significant undelivered capability at this writing but should be implemented by December 1994. Commissioning activities being supported include tuning main axis servo performance, diagnosing control system bugs revealed during commissioning operations, finishing documentation delivery, and transitioning the day-to-day maintenance of the control system to the KPNO based operations staff. This is expected to be completed by the end of 1994.

Work continues on the WIYN control system graphical user interfaces (GUIs). UWCG supplied several engineering GUIs which are being used routinely by the WIYN and UWCG staff to diagnose control system problems. Several of the operations GUIs being implemented by the KPNO Mountain Programming Group are now in use during normal night-time operations. This GUI effort is scheduled to be completed in early 1995.

The WIYN Observatory was officially dedicated on 15 October under memorable weather conditions. In the weeks leading up to this event, the WIYN Project staff spent many days cleaning up and organizing the Observatory, an effort which has already had great benefit for the Project beyond the Dedication event itself.

The telescope is now routinely used 3-4 nights a week and it is anticipated that this will increase to 5-6 nights per week by the end of the year. To support this increase in night-time activities, the WIYN Project has trained a second Observing Technician, Bridget Watts.

In recognition of the complex nature of this new facility, the WIYN Board approved the allocation of one week per month during the first year of science operations for engineering activities. This extended engineering time will be used for normal facility maintenance as well as to resolve problems that arise during the rest of the month. These nights will be allocated to specific consortium members and returned to the designated institution if no engineering is required or engineering tasks are completed early.

The current major project scheduling milestones are: (1) complete closed loop guiding implementation by 15 November; (2) install WFC and begin photographic assessment of the wide-field by 1 December; (3) complete Imager commissioning, including IAS, FSA, and CCD detector commissioning by 15 March; (4) begin shared risk Imager operations by 1 April; (5) finish MOS/Hydra commissioning and begin shared risk MOS/Hydra operations by 15 May.

Dave Silva

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WIYN First-Science CCD Imager (1Dec94)

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WIYN First-Science CCD Imager (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

The WIYN telescope, with its excellent image quality and thermal properties, offers distinct advantages for CCD imaging. NOAO has planned for several years to deploy a 2 X 2 array of thinned Loral 2048 X 2048 CCDs (the MiniMosaic) as the WIYN imaging detector. The limited yield of thinned CCDs for the MiniMosaic has delayed its expected deployment beyond the initial period of shared risk observing. However, we have acquired a thinned STIS 2048 X 2048 CCD with 21 um pixels for early science observations at WIYN. This CCD, christened S2KB, has a quantum efficiency curve (displayed below) that is comparable to or better than T2KB. It has a read noise of 8 e^- and good cosmetics. The imager scale at WIYN is 0.197"/pixel, allowing good sampling of the images, which often have FWHM as small as 0.6". The CCD field of view at WIYN is 6.7 X 6.7 arcmin. Initially, the WIYN imager CCD will be controlled with a HARCON controller using one CCD amplifier. Eventually, an Arcon will be deployed for the WIYN imager that will enable multiple-amplifier readout.

This STIS CCD, together with the Indiana Filter Shutter Assembly and the Instrument Adapter System (IAS), should provide excellent first-light imaging capabilities at WIYN.

NOAO and WIYN are very grateful to the STIS project (Bruce Woodgate, PI) for making this excellent detector available.

[Figure not included]

Taft Armandroff, Dave Silva,
Richard Green, Rich Reed

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CRSP Modifications--Summer 1994 (1Dec94)

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CRSP Modifications--Summer 1994 (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

During the summer, the old grating 4 (60 l/mm), which had been rendered obsolete by the installation of the 256 X 256 detector array in 1993, was replaced by a 200 l/mm grating blazed at 3 um. This new grating 4 is intended as a counterpart of grating 3 to provide intermediate spectral resolution at high efficiency over the entire range of CRSP. Grating 3 is blazed at 4 um to yield optimum performance in second order in the short end of the K band; with the 256 X 256 array, it can cover the entire J band and most of the K band at a single setting. However, the efficiency in the H band and short L band is very poor, as these regions fall between blaze orders. Grating 4 will work efficiently in the short L band (m = 1), the H band (m = 2), and the I band (m = 3). The ability to observe in the I band (0.9 um-1.2 um) in third order alleviates the order overlap encountered in fourth order with this relatively broad filter. Grating 4 will also work in the J band, at only slightly lower resolution (12.6 versus 11.3 /pixel) and efficiency than grating 3; this allows observations in both the J and H bands without the need to change gratings.

Due to machining tolerances in the original construction of CRSP, the detents for the grating positions are marginally different, leading to small differences in the grating drive encoder values corresponding to zero order. Since grating 1 is the most commonly used, the zero order position was kept at 128 ecu for that grating, and settings used in the past will still be correct.

However, the settings for gratings 2 and 3 will be roughly 45 ecu larger than previously. These changes have been incorporated into the `lambda' command.

The new recommended settings (c.f., Appendix X, p.42, CRSP Manual, April 1994) are:

Grating	Band	Setting	Wavelength	Notes	
1		Unchanged			
2	I	850	0.90 - 1.12	(1)	Wavelengths &gt 1.12 um contaminated by adjacent order.
	J	950			
	H	950			
	K	875			
	L	700			
3	I	1160	0.89 - 1.18	(2)	Grating 4 more efficient 0.9 um-1.05 um, but this does provide single-setting I band coverage.

	J	1345	1.08 - 1.36		
	K	1595	2.01 - 2.42		
	L	1195	2.79 - 3.65		
		1375	3.35 - 4.19		
4	I	1440	0.89 - 1.10		
		1580	1.00 - 1.20		
	J	1200	1.06 - 1.38	(3)	Slightly lower resolution and efficiency than with grating 3, but still reasonable.
	H	1490	1.40 - 1.71		
		1600	1.52 - 1.83		
	K	1120	1.95 - 2.59	(4)	Lower resolution than grating 3, but more efficient &gt 2.2 um.
	L	1540	2.91 - 3.53		

Spectra of the Ar and Kr lamp sources have been obtained over the 0.9 um-2.5 um range with all four gratings and fit with the IRAF `identify' task. Copies of these identified spectra will be available as an addendum to the Manual and are now in the observing rooms of the telescopes. With grating 2, many of the Ar lines in the I, J, and H bands are severely blended, and one should pick well-separated lines and use a low-order solution (the dispersion is nearly constant across the array with this grating). The HeNeAr lamps in the 2.1-m and 4-m guiders yield primarily an Ar spectrum in the infrared, with a few He and Ne lines thrown in.

These spectra were obtained with slit 5 to ensure separation of closely spaced lines and to yield a sharp line for the `identify' task. This will result in a small spectral shift with respect to observations taken through wider slits.

Dick Joyce

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Scattered Light Analysis of the Coud&eacute Echelle/Grism System (1Dec94)

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Scattered Light Analysis of the Coude Echelle/Grism System (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

Use of the 31.6 g/mm echelle and grism cross-dispersers has become quite popular, comprising roughly half the usage of the Coude Feed during the current semester. This combination allows resolutions of about 100,000 on camera 5, and about 2.5 times higher with camera 6. As with all cross-dispersed echelle setups, there is some scattered light, the characterization of which is important for proper subtraction. A recent observer, Jason Cardelli, has done an analysis of some aspects of the scattered light which forms the basis of this report.

Scattered light was found to originate primarily from two sources: echelle grating scattering along its dispersion direction, and grism scattering in the cross dispersion direction.

Echelle scattering was determined by analyzing a very high S/N Th-Ar spectrum formed from the average of 90 exposures. The line profiles could be well represented by the linear sum of a Gaussian core and power law wings:

```
I (x) = e^-(x-xo)^2/1.44 + 0.038 (x - x[SUB o])^-1.6
                    (x  x[SUB o])
```

where x[SUB o] (the line center) and x are measured in pixels. While the data used in this analysis cover a limited wavelength interval (3700-4500), in general the relative intensity of the power law wings should show a decrease with increasing wavelength.

Grism scattering probably also includes the usual Gaussian core and power law wings, but the data used for this study were obtained with a slit too long to effectively characterize this component. However, analysis of flat lamp data does reveal the main component of scattered light in this system to be "ghost" orders in the interorder space on either side of the parent order. These weak "ghosts" are probably the result of internal reflections in the grism wedge or in the 3^o fused silica wedge used for tuning the grism central wavelength. For point sources, the average per pixel intensity of this background ranges between about 3%-8% of the integrated on-order intensity for the wavelength interval studied here. The ratio of background to spectral order intensity increases towards shorter wavelengths.

Analyses of the profiles of strong interstellar Ca II K absorption lines indicate that background underneath the spectral orders appears to be generally consistent with a simple average of the interorder background from above and below the order of interest. On-order data corrected using such a simple interorder background extraction scheme result in net spectra with a conservative accuracy of about 1-2% of the average net on-order intensity.

Copies of Jason's report may be obtained from the undersigned or found at the coude spectrograph. IRAF routines for echelle data are described in "A Users' Guide to Reducing Echelle Spectra With IRAF," which includes a description of background subtraction algorithms. This document is available via anonymous ftp as described in the September 1994 NOAO Newsletter.

[Figure not included]

The observed profiles for a pair of Th-Ar lamp lines (filled and open symbols) plotted in pixel space and normalized to their peak intensity.

Daryl Willmarth

We are pleased to include contributions from KPNO users in the Newsletter and are grateful to Jason Cardelli for his careful analysis of scattered light in the coude spectrograph.

Caty Pilachowski

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Electronic Proposals: Second Round (1Dec94)

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Electronic Proposals: Second Round (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

The current proposal cycle was the second in which Kitt Peak encouraged electronic submission of observing forms. In total, we received 224 proposals, of which 172 (77%) were submitted by e-mail. This is slightly higher than the 73% we received electronically last semester. There were 108 figures submitted electronically for 66 proposals.

Proposals being submitted electronically are handled automatically by a set of scripts written by Chris Biemesderfer (who also provided the LaTeX forms and style files); these scripts return automatic acknowledgements, strip off the mail headers, and perform the simple editing required to insert the proposal number and correct figure names. Humans (in this case, Pat Patterson, Marlene Salzer, and Judy Prosser) oversee the process, print out the completed proposals, and deal with any problems that come up.

The process has worked quite smoothly both times, and it is clear that the support requirements are actually lower than in dealing with the 15 paper copies we used to require. However, a few problems did crop up:

1) Of the handful of proposals with problems, the most common problem was simple typographical errors within the proposal. Evidently, not everyone is running their proposal through LaTeX at home and ensuring

that they print out correctly! This semester we fixed these problems ourselves and sent notes to the PIs detailing the changes we had to make. One may reasonably suppose that the TAC will see the proposals in the way they print out when we receive them--so the person submitting the proposal should be happy with their look and feel. We are happy to provide help if needed.

2) The most interesting technical problem was one in which four proposals resulted in a blank acknowledgement being returned. After impressive detective work by David Bell, it was determined that these were all proposals whose titles contained the "+" character, and a fix was installed.

3) Some "encapsulated post-script" figures lacked the standard "%PS-Adobe" at the start of the file. These were invariably generated by Lick Mongo, and had to be fixed manually.

4) Due to last-minute decisions as to how to handle WIYN time, the WIYN queue form had incorrect instructions on submitting the form; these instructions contradicted those found in the observing proposal itself. We tracked down the errant queue forms and fixed the instructions.

The transition to electronic submission of proposals continues smoothly, and we are hopeful that the 77% will asymptotically approach 100% in the near future.

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

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Who's Who Among the Kitt Peak Postdocs (1Dec94)

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Who's Who Among the Kitt Peak Postdocs (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

KPNO has a lively post-doctoral research program as evidenced by the accompanying photograph of the postdoctoral fellows resident at KPNO for the 1994-1995 academic year. Each year, KPNO is typically able to offer one or two postdoctoral appointments supported directly by NOAO funds. We are also pleased to be able to host Hubble fellows as well as a number of other researchers supported by external grants.

This year we are pleased to welcome Stephane Charlot and Paola Sartoretti to the program. Charlot is an NOAO postdoc and comes to us from a postdoctoral position at the Center for Particle Astrophysics at the University of California, Berkeley. Sartoretti is supported by NASA funds, and comes to us from STScI, where she completed her thesis while officially enrolled at the University of Padua.

With the start of a new year, we thought that this would be a good time to summarize the research activities of all of our postdocs.

Edward Ajhar is supported by the HST Wide Field/Planetary Camera team through KPNO staff member Tod Lauer. Ajhar is studying the stellar populations in globular clusters in M31, as well as the cores of giant elliptical galaxies from HST WFPC images. Ajhar with other collaborators is using surface brightness fluctuation distances to early-type galaxies to determine the nearby large-scale flow, as well as developing surface brightness fluctuations as a probe of stellar populations.

Stephane Charlot is an NOAO postdoc mainly interested in the formation and evolution of galaxies. His interests include phenomenological models of galaxy formation, absorption-line systems of distant quasars, the evolution of early-type galaxies in clusters, stellar population synthesis, and diagnostics of the star formation history in galaxies.

Michael Corbin is supported by the HST Archive program, and is working with Todd Boroson on the construction and analysis of a large sample of combined ultraviolet and optical spectra of low-redshift QSOs based on HST, IUE, and ground-based data. The goal is to compare the properties of the ultraviolet and optical emission lines to develop a detailed model of the line emitting regions. Projects with other collaborators include studying the emission-line properties of the QSO population during the "QSO epoch" at z ~ 2, and studying the spectra and IR morphologies of starburst galaxies having large numbers of Wolf-Rayet stars.

Stephane Courteau is an NOAO postdoc working on various problems in cosmology and extragalactic astronomy. His main research focuses on the global distribution of matter in the universe, as well as the mapping of mass in individual galaxies, the effect of dust obscuration in disk galaxies, and tests of galaxy formation theories. Courteau and his collaborators have recently assembled the largest homogeneous catalog of galaxy peculiar velocities, which they use as input for potential (POTENT) reconstruction of local velocity and density fields, as well as for alternative velocity field analyses.

Beatrice Mueller is supported partly by the Galileo imaging team through KPNO staff member Michael Belton and partly by a grant from the Swiss National Science Foundation. She is presently working on images of the SL-9 comet impact onto Jupiter obtained both by Galileo and the 0.9-m at Kitt Peak. She is also involved in numerical studies of rotational properties of cometary nuclei.

Nalin Samarasinha is a NASA planetary science postdoc studying cometary rotational states including long-term evolution of rotational states under sublimation induced torques, as well as the inter-relationship between the rotation and the orbital dynamics. In particular, Samarasinha is working to explain the observed rotational behavior of comet Halley.

Ata Sarajedini is an NOAO postdoctoral fellow conducting research on the stellar populations of the Local Group. In particular, he is trying to understand the formation and evolution of the Local Group by studying the ages and abundances of the globular clusters in its member galaxies. Sarajedini has devised and refined a number of methods which allow more precise determinations of cluster ages, reddenings, and metallicities. In addition, he and his collaborators are investigating the nature of blue straggler stars in open and globular clusters.

Paola Sartoretti is supported by the Galileo imaging team through KPNO staff member Mike Belton. Sartoretti will be studying Jupiter's atmosphere, with particular attention to the regions that are expected to be sounded by the Galileo atmospheric probe. Sartoretti recently completed a PhD thesis on the surface and atmosphere of Io based on HST Faint Object Camera data. She is also interested in the search for extrasolar planets.

Sylvain Veilleux is a Hubble fellow studying the structure, dynamics, and origin of active galactic nuclei (AGN). Specifically, Veilleux and collaborators are exploring the effects of the AGN or central starburst on the host galaxy and the transport of material from large scales into the active region. Other work consists of testing the so-called unification theory of active galaxies by using infrared spectroscopy to look through the obscuring tori purported to exist in AGN. Veilleux and collaborators are also studying luminous infrared galaxies to determine the origin of nuclear activity in galaxies and searching for evolutionary links between active and starburst galaxies.

[Figure not included]

These are the postdoctoral fellows resident at KPNO for the 1994-1995 academic year. Moving from left to right they are: (back row) Nalin Samarasinha, Michael Corbin, Stephane Courteau, Stephane Charlot, Edward Ajhar, (front row) Ata Sarajedini, Sylvain Veilleux, Beatrice Mueller, Paola Sartoretti.

Tod R. Lauer

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High Resolution Spectroscopy Workshop in Tucson (1Dec94)

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High Resolution Spectroscopy Workshop in Tucson (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

A workshop to discuss new scientific programs to be carried out by high resolution spectrographs on the Keck, Gemini, and Hobby-Eberly telescopes was held 13-15 October 1994 at the Radisson Suite Hotel in Tucson. The workshop was sponsored jointly by The University of California Observatories/Lick Observatory, The National Optical Astronomy Observatories and the McDonald Observatory of the University of Texas. Seventy attendees from seven countries met to discuss the impact on high dispersion spectroscopy of the new very large telescopes that are becoming available. The meeting began with a review of the high resolution spectrographs for these telescopes that have either been recently built or are currently being designed. At the end of the meeting several of the instrumentalists discussed the impact of the meeting on their thinking. The majority of the meeting was taken up with a discussion of the astronomy that will be possible with the new equipment in the fields of: (a) stellar physics; (b) stellar populations and abundances; (c) the ISM and SNR, and (d) AGNs and quasars. A feature of the meeting was the presentation of new data taken with the HIRES spectrograph of the Keck telescope. Summaries of the various sections of the meeting will be published in the PASP, and will be available via the NOAO homepage on the World Wide Web.

[Figures not included]

Tom Kinman

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Leave the Driving to Us (1Dec94)

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Leave the Driving to Us (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

For visitors who find it cheaper or more convenient to fly into Phoenix Sky Harbor Airport, there is a limo service seven days a week between Sky Harbor and Tucson that is run by Arizona Shuttle Service Inc. (1-800-888-2749 for outside Tucson and 795-6771 in Tucson). The pickup points are at the various Sky Harbor Terminals in Phoenix and include 6th Street (Univ. of Arizona) and 5350 East Speedway in Tucson. The limo departs from Tucson hourly from 4:00 am to 9:00 pm and from Sky Harbor from 6:30 am to 11:30 pm. 24 hour reservations are preferred. The one-way cost is $19 for the roughly 2 hour trip.

Tom Kinman

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Nine-Track Tape Reminder! (1Dec94)

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Nine-Track Tape Reminder! (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

On 15 April 1995 the Central Computer Services department will begin to recycle all the remaining nine-track tapes stored for non-NOAO staff.

No warnings or e-mail reminders will be issued! If you have important data stored at NOAO on nine-track tapes, contact Jeannette Barnes (jbarnes@noao.edu) immediately to arrange to acquire the tapes. Unfortunately we have no resources for copying tapes.

Jeannette Barnes, Bruce Bohannan, Steve Grandi

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Data Grade Tapes Only on Kitt Peak (1Dec94)

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Data Grade Tapes Only on Kitt Peak (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

Changes in the specifications of video-grade 8-mm "Exabyte" tapes have caused significant failures in writing data on the mountain. Because these failures are a big drain on our maintenance and technical staff, effective 1 January 1995 only data-grade tapes will be used at Kitt Peak. Data-grade tapes--both for Exabytes and DATs--may be purchased in limited quantities from Reception for $10.00 per tape.

Bruce Bohannan, Caty Pilalchowski

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Key Project Workshops for Spring 1995 (1Dec94)

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Key Project Workshops for Spring 1995 (1Dec94)
(from KPNO, NOAO Newsletter No. 40, 1 December 1994)

The Kitt Peak National Observatory is continuing to offer the opportunity to small groups wishing to prepare key project observing proposals to meet together in Tucson. KPNO will fund a small number of workshops to be organized by prospective proposers of key projects. Our idea is to bring small groups together for a day or two in Tucson to explore a strategy for a key project. We will provide travel funds and pay room and board expenses. We will provide access to local expertise in the capabilities of any of the Kitt Peak telescopes and instruments. For complete details, see the June 1994, issue of the NOAO Newsletter. The outcome of such a workshop should be a proposal for telescope time at Kitt Peak.

If you wish to be considered for a key project workshop, please send a short proposal in the form of a letter to the KPNO Director's Office. The letter should indicate the nature of the problem to be addressed, the general approaches to be explored, the makeup of the proposing team (limited to six participants from outside Tucson), and the dates desired for the meeting. Letters received by 1 February 1995 will be considered for funding in February and March.

Caty Pilachowski, Dave De Young

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Infrared Tools for Solar Astrophysics: What's Next? (1Dec94)

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Infrared Tools for Solar Astrophysics: What's Next? (1Dec94)
(from NSO, NOAO Newsletter No. 40, 1 December 1994)

An extremely varied group of scientists attended the 15th Annual NSO/Sac Peak Workshop. The goal of the workshop was to investigate new ways that infrared tools can be used to study the Sun, and to see where the major future efforts should be.

Studying the solar corona at infrared wavelengths is a new application; this was discussed at length during the first two days. After solid reviews of the current state of coronal heating theories (Zirker and Cargill), exciting optical observations of interacting coronal loops (Airapetian) and coronal density variations (November) were presented. Infrared line calculations were discussed by Chang and Castner: a new prediction of a forbidden Fe XII line near 2 um (Chang), and a chromospheric O II emission at 1.1 um (Castner). Penn reviewed new efforts to measure such lines, concentrating on new observations of the Fe XIII line pair at 1.1 um and the Si X line at 1.4 um.

Several speakers discussed the IR camera systems that are in current use by commercial or astronomical users, after which several speakers showed how such detectors are being used in scientific instruments. Kuhn discussed new measurements of the coronal magnetic field. Simons reviewed an operating imaging FFT spectrometer and showed results of studies of planetary nebula. Jones discussed the new NSO/Kitt Peak He I 1083 nm narrow-band filter system, which promises exciting new views of the chromospheric magnetic field.

Several night-time astronomers were invited to summarize the infrared coronagraphic science currently being done with post-focus coronagraphs. Jewitt reviewed recent work on the well-known dust disk around Pictoris. Fort reviewed new techniques for finding dark matter concentrations by using the lensing effects such concentrations have on the distant background of blue galaxies. Finally, Morgan discussed solar system observations using true coronagraphs; he has investigated the lunar atmosphere and suggests that the Mercurian atmosphere is another good target.

Ayres discussed new observations of the CO molecule in the solar atmosphere. Schmidt presented new time-series observations of sunspot magnetic fields which show that oscillations in the magnetic field intensity, if they exist at all, must be at a very low level. Chromospheric oscillations using the He I 1083-nm absorption line were discussed by Bocchialini and Fleck. Ruedi presented new measurements of the chromospheric magnetic field and compared them with simultaneous photospheric observations to measure the vertical gradient of the field.

The last day of the workshop was devoted to a discussion of the scientific uses for a large reflecting coronagraph. Workshop participants had earlier submitted mock observing proposals for a proposed 2-4m reflecting coronagraph; these proposals served as a basis for discussion about the science that could be done with such an instrument. Significant solar science led the discussion, from multi-wavelength observations of solar flux tubes on the disk to direct and detailed measurements of the coronal magnetic field. Planetary applications for such a telescope seem to abound, from weak planetary atmospheres to asteroid and comet observations. Also, such a telescope appears to be useful for some gravitational lensing questions. The plethora of scientific applications proposed for a large reflecting coronagraph suggests that it would certainly operate 24 hours a day.

Matt Penn, Jeff Kuhn

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Near Infrared Magnetograph: The Sequel (1Dec94)

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Near Infrared Magnetograph: The Sequel (1Dec94)
(from NSO, NOAO Newsletter No. 40, 1 December 1994)

NIM-2 is a concept for a near-infrared imaging magnetograph based on a narrowband filter and an infrared array camera. It will complement rather than replace the existing spectrograph-based NIM instrument. A principal objective of NIM-2 is to study the evolution of the vector magnetic field in active regions. NIM-2 will use the 1.56 um g = 3 line of Fe I to provide true field strengths in sunspots and plages. This line is completely split in kilogauss fields, so the three polarized Stokes components are comparable in magnitude--an advantage for vector magnetometry. At the expense of somewhat lower spectral resolution, NIM-2 will have an advantage over NIM in studying spatial structure and evolution because the whole spatial field will be imaged simultaneously rather than built up by scanning.

NIM-2 will use the same infrared array camera (Amber 256 X 256) and data acquisition system as NIM. A Queensgate Fabry-Perot etalon was ordered at the end of the last quarter. The etalon will be stable to 0.02 cm^-1 and tunable over a free spectral range of 3 cm^-1 at video rates. Rapid sampling of the line profile and nearby continuum will be synchronized with polarization modulation by liquid crystal variable retarders.

Doug Rabin

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Cross-dispersion Project at the McMath-Pierce Solar-Stellar Spectrograph (1Dec94)

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Cross-dispersion Project at the...(1Dec94)
McMath-Pierce Solar-Stellar Spectrograph
(from NSO, NOAO Newsletter No. 40, 1 December 1994)

The mechanical design for this major upgrade to our nighttime facility was completed last quarter. Machining of the parts is now also complete. Interoptics and Tucson Optical Research Corporation (TORC) have completed fabrication of the optical components. Assembly of the mechanical and optical components is now underway in the Tucson optics shop.

Mark Giampapa

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Mark II Correlation Tracker (1Dec94)

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Mark II Correlation Tracker (1Dec94)
(from NSO, NOAO Newsletter No. 40, 1 December 1994)

Two years ago, the NSO copy of the correlation tracker that was developed jointly during the 1980s with the Kiepenheuer Institut fr Sonnenphysik

(KIS) in Freiburg, Germany, quit working because of a hardware failure. This correlation tracker was based on custom-built hardware components. A second copy was built for use at the German Vacuum Tower Telescope on the Canary Islands. Since KIS is currently completing a Mark II correlation tracker in conjunction with the Instituto de Astrofisica de Canarias, KIS has loaned its copy of the original tracker to NSO. This unit is frequently used at the Sac Peak VTT, effectively without spares or backup. This high-risk situation has led to efforts at NSO/SP to develop its own Mark II tracker.

A study has been performed to compare different tracking algorithms. In particular, the performance of the "absolute difference algorithm" and the "FFT cross-correlation algorithm" were compared via computer simulation using data taken at the NSO VTT under varying seeing conditions. The simulations clearly show a performance advantage for the FFT algorithm in conditions where the image contrast is low. The ability to track low-contrast images is important to a user-friendly system and to the possible use of such a tracker in a Shack-Hartmann type wavefront sensor. Based on the results of the simulation studies, it was decided to design and build a Mark II correlation tracker system that uses FFT cross-correlation. The initial design has been completed and is based purely on commercially available hardware components. The system should therefore be easy to maintain and clone for use at other NSO sites. First engineering runs are projected to occur early next year.

Thomas Rimmele, Richard Radick,
Fritz Stauffer, Phil Wiborg

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IR Activities at NSO/SP (1Dec94)

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IR Activities at NSO/SP (1Dec94)
(from NSO, NOAO Newsletter No. 40, 1 December 1994)

A small Ebert-Fastie IR spectrograph was completed. The instrument is designed for an f/6 beam and yields a dispersion of about 0.08 nm/pixel in the 1-1.6 um range using the NICMOS III camera system. The instrument is designed for the upcoming total eclipse expedition but will be useful for other coronal IR spectroscopy at low spatial resolution.

A liquid crystal-based Lyot filter has been ordered from CRI, Inc. This device will use a new type of IR polarizer that should yield a high system transmission (30%) over the 1-2.3 um range. The filter is modular, allowing a high resolution mode (3.0 nm passband) or a wide-field passband (15 nm). This is needed for IR coronal imaging and spectroscopy studies at the Evans coronagraph. In collaboration with the Air Force group, a Queensgate Fabry Perot etalon has also been ordered, to be used with the existing Fabry-Perot controller. This system will be used for IR magnetometry using the infrared iron lines. A complete Stokes IR polarization analyzer is being built from Meadowlark Optics liquid crystal retarders. The optical and electrical components for this system are currently on order. NSO/SP will soon have its own HgCdTe detector system (all previous IR detectors have been cost-shared with WIRO, MSU and Haverford). A 256 X 256 deep-well device has been ordered from Rockwell. A copy of an existing electronic controller will be used with an existing spare dewar on loan from NSO/KP.

We have begun to improve our ability to build and test vacuum equipment. A surplus mass-spec leak detector has arrived from Los Alamos, along with much-needed vacuum fittings and evaporator components.

Jeff Kuhn

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Fast Microphotometer Scanner (FMS) at NSO/SP (1Dec94)

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Fast Microphotometer Scanner (FMS) at NSO/SP (1Dec94)
(from NSO, NOAO Newsletter No. 40, 1 December 1994)

The Fast Microphotometer Scanner (FMS) is a precision microphotometer which is used to digitize rectangular photographic images. The FMS consists of a bright Gaussian-distributed laser spot that is mounted so as to scan back and forth in the Y-axis and to step the photographic image in the X- axis. The FMS compares favorably with conventional microphotometers in terms of photometric resolution (D[SUB rms] = 0.003 at all densities D), and linear accuracy (&lt 2.5 m).

Intrinsic FMS limitations include the minimum spot size (33 m) and the range of the densities that can be encoded (5 density units). Also fringes are introduced across the field. In thin film bases at low densities, fringes are introduced across the field by multiple-reflection interference of the coherent laser light within the mylar base. The fringe amplitude is &lt D &gt = 0.015 rms for densities between 0.3 and 0.9. Above D = 0.9 the fringes become undetectable at the &lt D &gt = 0.006 level. To avoid fringing, a wet gate is available to contain the film while scanning.

To make the FMS a more reliable instrument for the user community, software and hardware maintenance is being turned over to the computer and electronics group.

NSO will now allocate time on the FMS through the NSO/SP Telescope Allocation Committee (TAC). We ask all potential FMS users to submit proposals to the TAC (NSO/SP TAC, P.O. Box 62, Sunspot, NM 88349, or sp@sunspot.noao.edu). Some advance notice will allow us to do preventative maintenance on the instrument and associated software before the user's arrival.

As part of this change a new user manual will be produced and will be available on our WWW server.

Robert McGraw

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16th NSO/Sacramento Peak International Summer Workshop (1Dec94)

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16th NSO/Sacramento Peak International Summer Workshop (1Dec94)
(from NSO, NOAO Newsletter No. 40, 1 December 1994)

Solar Drivers of Interplanetary and Terrestrial Disturbances

There is a growing awareness by national and international agencies of the need to understand solar-terrestrial interactions. This view is driven by a variety of national and international, strategic and economic needs. These include: enhanced use of satellites for communications and monitoring of terrestrial resources; increased human activities outside of the Earth's protective atmosphere; concern about apparent deterioration of the earth's eco-system, leading to a need to separate impacts of human activity from solar influences on atmospheric chemistry, weather, and global change; vulnerability of man-made systems such as power grids and pipelines at high northern and southern latitudes to solar induced geomagnetic activity. This picture is reflected in the current interest to establish a National Space Weather Center. With this perspective, it seems appropriate that the next NSO/Sac Peak workshop revisit Sacramento Peak's origins--the need to understand and predict solar activity that affects the Earth's environment.

The 1995 Workshop will concentrate on solar drivers of terrestrial effects. We wish to address such issues as: What are the major solar drivers of terrestrial effects? How do solar drivers interface with and how are they propagated by the interplanetary medium? How do they finally interface with the Earth's magnetosphere and atmosphere? What are the future experimental/observational requirements that will clarify the solar and terrestrial connectivity?

The Workshop will have sessions devoted to solar drivers, the coronal-interplanetary interface, interplanetary propagation, the interplanetary-terrestrial interface and to correlating solar drivers with terrestrial effects. Each session will emphasize its connectivity to the other sessions and the adjoining links in the solar-terrestrial chain. Each session will have a keynote review talk, a few contributed talks and posters, and ample time for discussions. Less than half the available time will be devoted to scheduled talks. Emphasis will be on discussions to highlight what we currently know about solar-terrestrial connectivity and what we need to know to improve space weather prediction. How can solar inputs be used? What observations and models are needed to make solar data more useful to interplanetary and terrestrial models?

A major goal of the workshop is to produce proceedings that review the current state-of-the-art in using solar outputs in space weather global impact predictions that would outline a road map for future progress. We expect to hold the workshop in the early August 1995 to mid-October 1995 time frame.

We solicit your comments on our agenda, dates, and format before finalizing our next major announcement. Based on the number and nature of your responses, we will produce a well-focused agenda that should appeal to both theoreticians and observers. Should you be interested in participating, and/or wish to suggest names of keynote speakers and experts in any of the areas mentioned, please send an e-mail message and we will be happy to add your name to the workshop mailing list. We ask for your quick response to help us take the workshop planning beyond this initial step. Your comments on the following issues will be greatly useful:

1) I would change/expand/reduce the subjects to be covered. How? Which subjects should be added/eliminated/modified to make a better workshop?

2) I am interested/not interested in attending Workshop 16.

3) I would be particularly interested in talking/learning about the following subjects...

4) I prefer the following dates for the workshop because...

5) I believe the workshop format should emphasize invited/contributed/long/short/oral/ poster papers, working sessions, debates, discussions ...

6) Colleagues (with e-mail addresses, if available) at my/other institution/department who may be interested in this workshop are...

It is our intention to maintain a workshop environment for this meeting with participation only by active workers in the field, and by restricting attendance to 60 people.

Please send your responses by e-mail to skeil@sunspot.noao.edu or bala@sunspot.noao.edu, or by fax at (505) 434-7029, or by phone at (505) 434-7000, or by regular mail to National Solar Observatory, Sunspot, NM 88349, USA. Please share this information with interested colleagues and encourage them to send their comments too. Replies are requested by 1 February at the latest.

Jacques Beckers, Steve Keil

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NSO Telescope/Instrument Combinations (1Dec94)

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NSO Telescope/Instrument Combinations (1Dec94)
(from NSO, NOAO Newsletter No. 40, 1 December 1994)

Vacuum Tower Telescope (SP):
- Echelle Spectrograph
- Universal Spectrograph
- Horizontal Spectrograph
- Universal Birefringent Filter
- Fabry-Perot Interferometer Filter System
- Advanced Stokes Polarimeter
- Slit-Jaw Camera System
- Correlation Tracker
- Branch Feed Camera System
- Horizontal and Vertical Optical Benches for visitor equipment
- Optical Test Room

Evans Solar Facility (SP):
- 40-cm Coronagraphs (2)
- 30-cm Coelostat
- 40-cm Telescope
- Littrow Spectrograph
- Universal Spectrograph
- Spectroheliograph
- Coronal Photometer
- Dual Camera System

Hilltop Dome Facility (SP):
- H Flare Monitor
- White-Light Telescope
- 20 cm Full-Limb Coronagraph
- White-Light Flare-Patrol Telescope (Mk II)
- Sunspot Telescope
- Fabry-Perot Etalon Vector Magnetograph
- Mirror-Objective Coronagraph (5 cm)
- Mirror-Objective Coronagraph (15 cm)

McMath-Pierce Solar Telescope Facility (KP):
- 160-cm Main Unobstructed Telescope
- 76-cm East Auxiliary Telescope
- 76-cm West Auxiliary Telescope
- Vertical Spectrograph: IR and visible gratings
- Infrared Imager
- 1-m Fourier Transform Spectrometer
- Stellar Spectrograph System
- 3 Semi-Permanent Observing Stations for visitor equipment

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

Razdow (KP):
- Ha patrol instrument

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The Global Oscillation Network Group (1Dec94)

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The Global Oscillation Network Group (1Dec94)
(from GONG, NOAO Newsletter No. 40, 1 December 1994)

The Global Oscillation Network Group (GONG) Project is a community-based activity to develop and operate a six-site helioseismic observing network for at least three years, to do the basic data reduction, provide the data and software tools to the community, and to coordinate analysis of the rich data set that should result. The Project is currently looking forward to deployment of its first sites in 1994, and a fully operational network and data management and analysis center in 1995.
GONG data will be available to any qualified investigator whose proposal

has been accepted; however, active membership in a GONG Scientific Team will allow early access to the data and the collaborative scientific analysis that the Teams have already initiated. The GONG Newsletter provides status reports on all aspects of the Project and related helioseismic science.

Sites

The Learmonth pre-delivery site grading and foundation construction, begun in June, was completed in August. The remaining work must wait for the arrival of the instrument. The comparable (though less complex) work at Tenerife began in September and was completed in October. The contract for the Mauna Loa work was awarded in September and work has begun.

[Figure not included]

The GONG instruments together for the last time at the integration site. (The careful reader may note a superficial similarity to the picture in the June NOAO Newsletter. Note however the lightfeeds, cable trays, weather stations, air conditioning, etc. not to mention what is inside!)

The rather complex permitting process for the fill in the lake for the instrument pad at the Big Bear Solar Observatory has continued to receive considerable attention as the fill must be allowed to settle for several months before installation of the
instrument to insure reasonable angular stability. Initial work was completed in November. The station is slated for installation in July 1995.

Preparation of the Udaipur site is planned for February, and CTIO will follow in March. The Tenerife instrument is being packed for shipment now and the Learmonth field instrument will be shipped in December.

The GONG Project would like to congratulate Jess Patrn on his successful PhD defense at the Instituto de Astrofsica de Canarias (IAC) on 21 September. Jess performed all of his thesis research at NSO. Juan Morrison and Antonio Pimienta (IAC) visited Tucson for three weeks to gain familiarity with the operation of "their" instrument. Damien Burtonclay (Univ. of Sydney) is working with Frank Hill on rotational inversions, and Alex Liu (Learmonth) also visited in November for familiarization training on the instrument to be shipped there in December.

Instrumentation

The GONG instruments are (literally) coming together! The month of August marked the beginning of the integration of the six Doppler instruments at our Campbell Research Farm site in Tucson. To date, progress has been by leaps and bounds, meeting or exceeding schedule requirements. The emphasis so far has been on getting the instruments that will make up the initial three-site "mini-network" running first. Thus, the Tenerife Station, the Learmonth Station, and the Big Bear Station (destined to run temporarily in Tucson) are the furthest along. All three stations have their instruments installed, and optics aligned. The Tenerife, Learmonth, and Big Bear Stations are currently taking data. The other three stations, (CTIO, Mauna Loa, and Udaipur) are not very far behind. All three have light coming into the shelter from their respective light-feed turrets, with all other motors having been powered up and exercised. Once our attention shifts back to those stations, we can likely install the balance of the optics and bring them online within a week or two.
An important step toward integration was the definition of the deployment teams. The general strategy for deployment has been known for some time. There is to be an advance team (which has in fact already traveled twice and is preparing for a third outing) that is responsible for being at the host site when the concrete is poured, anchoring the instrument-table leg bases, and transferring the north-south line onto the foundation. There are two setup teams ("red" and "blue"), each of which will deploy three of the six instruments. Members of these teams will meet the station after it arrives in country, see it safely to the host site, and do all of the unpacking and setup of the instrument. Finally, there is a certification team that will confirm proper operation once setup is complete. The Project announced the makeup of the teams on 11 August:

Advance Team (will visit all sites)

Bob Hartlmeier	Instrument Maker
Arden Petri	Mechanical Designer

Red Setup Team (will install Tenerife, Udaipur, and CTIO)

Bret Goodrich	Real-time Programmer
Frank Hill	Liaison
Neil Mills	Instrument Maker
Guillermo Montijo	Electronic Technician
Sang Nguyen	Electronic Technician

Roberta Toussaint	Scientific Programmer

Blue Setup Team (will install Learmonth, Mauna Loa, and Big Bear)

Ed Anderson	Scientific Programmer
Tom Bajerski	Electronic Technician
Rob Hubbard	Liaison
Duane Miller	Instrument Maker
Ed Stover	Electronic Technician
Jeff Vernon	Real-time Programmer

Certification Team (will visit sites as needed)

Lonnie Cole	Electronic Engineer
Don Farris	Electronic Technician
Jack Harvey	Instrument Scientist
Andrew Jones	Instrument Scientist

Data

We have completed the processing for the large-scale merge test using artificial data. After swatting a bug that flipped the sign of a six-day segment of one of the data sets, a quick, preliminary comparison of the time series of spherical harmonic coefficients shows that the baseline merge algorithm continues to produce acceptable results. The merged time series is very similar to the "perfect" time series, with the largest differences appearing around changes in the number of stations observing. We are currently working on statistical comparisons of the time series, which will most likely consist of regressions, and paired student's t-tests. We will also "peak find" the spectra and compare the results of the line parameters. Of course, we will very shortly have the opportunity to finally apply the method to real data from the field instruments in the comparatively easy situation of virtually identical atmospheric conditions. Stay tuned!

Testing of other parts of the Data Management and Analysis Center (DMAC) pipeline also continues with the use of artificial data. The input spectra are being used to further test the peakfind algorithm, and a set of images containing grid marks and a spot is under construction to test the remapping algorithm. Work is also continuing on the calibration of the modulation transfer function from wavenumber to spherical harmonic degree, and a new timing test of the pipeline is about to begin.

[Figure not included]

A comparison of the velocity of a single solar mode observed by the instruments destined for Tenerife and Big Bear, while they were operating side by side at the "Farm."

During the previous quarter, the DMAC calibrated and produced site-day l-spectra and 4-minute averages for 29 prototype data days: 22-30 June; 1-5, 15, 21-22 July; 4-8, 19-22 August; 5, 9-10 September. This is all the calibratable data acquired during the quarter. The 25-day interval from 11 June through 5 July is a nearly continuous sequence of calibrated days. There are a few missing days due to clouds and some of the calibrated days have less than perfect sky conditions. However, the dataset is homogeneous in that there were no significant instrument changes during the interval.

The DSDS volume catalog now contains over six hundred cartridges and there are over two hundred thousand files in the file catalog. The cartridge count is higher (or, alternatively, the data volume per cartridge is lower) than we anticipate will be the case during the network phase of the Project, since most of the calibratable data obtained for the instrument development have been recorded during relatively short acquisition intervals (e.g. a few days). Accesses (including `ftp' logins) to the DSDS users' machine by non-project GONG members are currently about eight per day. The users' machine (helios), which was a DECstation5000, has been replaced with a SPARC20/61 with additional disk space. The node name (helios) and IP address (140.252.8.105) remain the same. However, the operating system has changed from ULTRIX 4.2 to SOLARIS 2.4. GONG now has a World-Wide-Web home page helios.tuc.noao.edu including links to general information about the Project, sample images, documentation regarding GONG membership and Members' scientific programs, and a searchable version of the GONG bibliography.

The Project has established a mechanism for documenting, and reporting to the community, problems that are identified in the data products. These are referred to as "data events" and include a list of the products that were affected by the data reduction problem and a description of the problem. The report describing the problem will be mailed automatically to any members of the community who took delivery of the products before the problem was identified, and notifies the member if the products have been superseded. During the past quarter, the Project recorded 5 data events (numbers 3-7). Event 3 pertained to reprocessing using the 2-point detrending filter. Event 4 pertained to a volume table of contents problem that was resolved without regenerating the data products and so the event was canceled. Event 5 pertained to a volume table of contents and cartridge format problem that was resolved by rewriting the cartridge. Event 6 pertained to reprocessing part of the June data run so that the 21-point detrending filter was used throughout. Event 7 pertained to regenerating calibrated images to correct calibration and FITS conversion problems. Before data event 6 was recorded, the data distribution data base was altered so that the five Data Users Committee (DUC) members appeared to be recipients of the affected products. Consequently, the report for data event 6 was sent to the DUC members as an exercise to demonstrate the data event process.

The DUC met in Boulder on 26 July and 13 October at Lake Tahoe. Topics discussed included data events, the detrending filter, spatial aliasing, identification and removal of defective images before the temporal averaged images are generated, and an external, pre-commissioning review of the data system.

In the immediate future, the DMAC will continue to focus on providing data reduction support to the instrument group and preparation of the data reduction system for network operations. The DMAC will reduce data from tests of the production units that will be conducted before they are disassembled for shipment to the operating sites. Regarding system development, work is continuing to be directed toward resolving outstanding technical issues and building data reduction capacity. The later results from automating the software, installing the workstations that will be used for the network data reduction, and hiring additional staff to handle the expanding data reduction workload. In recent weeks, the Project has hired two new employees. One will operate the data reduction stage that converts calibrated velocity images into site-day power spectra. The other will complete the staffing of the DSDS bringing the number of people involved in that aspect of the Project to three.

Management

Thanks to supplemental funding from the NSF, that brought the FY 1994 project budget to almost its requested level, rapid progress has been made on all fronts toward the operation of the first three network stations (at 120 longitude points) by the end of March 1995. The second three sites will be installed between April and July 1995.

In the last quarter, many major milestones were met. These included the late-year acquisition of custom circuit boards and other instrument components, the completion of the awards for site-preparation contracts for four of the sites (Learmonth, Tenerife, Mauna Loa, and Big Bear), and the acquisition of necessary DMAC production computing systems. Four staff positions, essential for deployment and operations, were filled.

On a much sadder note, the program lost its long-time Project Assistant, Linda Johnson, to a heart attack in late August. Linda's family has asked that we thank her many friends throughout the GONG community who sent messages of sympathy and encouragement.

John Leibacher and the GONG Team

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Gemini Breaks Ground at Both Sites (1Dec94)

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Gemini Breaks Ground at Both Sites (1Dec94)
(from USGP, NOAO Newsletter No. 40, 1 December 1994)

Official ground-breaking ceremonies were held in October at both Gemini telescope sites in Hawaii and Chile. The 7 October ceremony on Mauna Kea was well attended by international Gemini enthusiasts who were blessed with exceptionally beautiful weather. Construction activities at Mauna Kea have begun with the relocation of utilities and removal of the enclosure of the existing 24" telescope. More substantial construction will begin in the spring.

The "laying of the cornerstone" for Gemini South took place 22 October at Cerro Pachon to mark the official start of construction there. The event received notable support from representatives of the South American partner countries, Chile, Argentina and Brazil, who have all now signed the Gemini Agreement. The Cerro Pachon site is also undergoing the preliminary construction work of laying roads and providing utilities.

[Figure not included]

A photo taken by Mark Hanna and Glynn Pickens of NOAO of the recently completed Gemini model. The model, built by Bob Rice of Tucson, is 1/50th scale and is beautifully detailed. It will be on display at the upcoming AAS meeting in Tucson.

Kathy Wood

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Gemini Operations: A Queue Scheduling Simulation (1Dec94)

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Gemini Operations: A Queue Scheduling Simulation (1Dec94)
(from USGP, NOAO Newsletter No. 40, 1 December 1994)

At the recent meetings of the US Gemini Science Advisory Committee and the Gemini Science Committee, the scientific case for non-traditional observing modes was explored. As input to this discussion, a simulation program has been developed, allowing an assessment of the relative advantages of queue scheduled observing and "classical" observing. Although the simulation requires a number of assumptions and simplifications, it demonstrates some of the gains that queue scheduling produces for certain types of observations.

The Gemini model includes six instrument configurations, each with different requirements for environmental conditions (phase of moon, transparency, water vapor, and seeing). The table below lists these requirements.

Note that 10 um imaging is limited by telescope emissivity, rather than the atmosphere. The Fiber Feed programs are spectroscopy carried out by connecting a small number of fibers from the Gemini/North focal plane to the CFHT high resolution spectrograph. The MOS-high resolution category signifies high spatial resolution spectroscopy for which the best seeing is required. The MOS-low resolution observations are background limited, but are not necessarily aimed at achieving the highest spatial resolution.

Each program consists of 24 exposures requiring one hour each under median conditions. Each night is eight hours long. Each program is given a scientific grade, and the distribution of grades mimics the top 25% of a gaussian distribution between 1 and 5.

The simulation runs through a semester twice with the same programs, first by assigning a randomly chosen program three nights at the telescope and then by selecting a program each night based on the current conditions. It is assumed that the environmental conditions are constant throughout an entire night. The transparency, water vapor, and seeing are drawn from distributions measured at Mauna Kea. In order to achieve some statistical accuracy, the simulation is run for 100 semesters.

The chart below shows the average success of queue and classically scheduled observations as a function of proposal grade. Note that it is the percentage of observations completed which is shown. The average number of observations in each bin is printed above the chart.

Program	% of Time	Moon	Skies	Water vapor	Seeing
10 um Imaging	15	any	photometric	any	not sensitive
5 um Spect.	10	any	spectroscopic	low	not sensitive
2 um Imaging	25	dark or grey	spectroscopic	any	background limited

Fiber Feed	10	dark or grey	spectroscopic	any	not sensitive
MOS-high res.	20	dark	spectroscopic	any	requires 20% best
MOS-low res.	20	dark	spectroscopic	any	background limited

The results of the simulation for the total set of observations is as follows (Listed in the Classical and Queue columns are the number of observations completed/the number of possible observations and the corresponding percentage):

	Classical	Queue
Total Observations	619/1440 (43.0%)	972/1440 (67.5%)
Programs Completed	13.2/60 (22.0%)	39.5/60 (65.8%)
10 um Imaging	106/224 (47.3%)	169/224 (75.5%)
5 um Spectroscopy	68/133 (51.0%)	130/133 (97.7%)
2 um Imaging	191/354 (54.0%)	272/354 (76.8%)
Fiber Feed	76/150 (50.8%)	111/150 (73.9%)
MOS-High Resolution	29/289 (10.2%)	83/289 (28.6%)
MOS-Low Resolution	148/289 (51.2%)	207/289 (71.7%)

[Figure not included]

Todd Boroson

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US Gemini Science Advisory Committee Meeting (1Dec94)

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US Gemini Science Advisory Committee Meeting (1Dec94)
(from USGP, NOAO Newsletter No. 40, 1 December 1994)

The US Science Advisory Committee (US SAC) met in October prior to the semi-annual international Gemini Science Committee (GSC) meeting to discuss issues of scientific impact. The agenda included presentations on the overall Project status, the Project Scientists' Report on the System Review held in July, design issues regarding telescope baffling, primary mirror coatings/coating facility/cleaning and primary mirror heating, Reports from the three Instrument Science Working Groups (Infrared, Optical and Adaptive Optics/Acquisition and Guiding), and planning for future operations and observing modes. In addition, the Committee advised the USGP on strategies for US instrument procurement.

Readers interested in detailed information may request copies of the referenced Reports from the USGP.

Kathy Wood

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The Gemini Instrumentation Program in the US (1Dec94)

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The Gemini Instrumentation Program in the US (1Dec94)
(from USGP, NOAO Newsletter No. 40, 1 December 1994)

The 1-5 um Camera, previously allocated to the University of Hawaii, is just starting a conceptual design phase, with a conceptual design review expected to take place around mid-March 1995. After completion of the conceptual design phase, a development phase contract will be negotiated with UH.

A competitive procurement is under way for the 1-5 um Spectrograph. The Request for Proposals was released 4 August 1994; proposals were received October 21 with the selection of the spectrograph team expected around the end of 1994. A committee appointed by the NSF, and including Gemini Project representation, will be evaluating the proposals and recommending a winner.

The 8-30 um Camera will be the subject of a competitive procurement starting in early 1995 with completion of the procurement expected before the end of the year.

The Gemini CCD consortium has received rough order-of-magnitude quotes from a number of vendors for 2K X 4K CCDs, which will be required for the Gemini optical spectrographs. The consortium is now evaluating these responses in order to develop a plan for acquiring these detectors. The goal is to utilize a foundry run approach which will allow additional collaborators to join the effort.

Fred Gillett

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Gemini Newsletters and World Wide Web (1Dec94)

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Gemini Newsletters and World Wide Web (1Dec94)
(from USGP, NOAO Newsletter No. 40, 1 December 1994)

For those readers interested in more detailed information about the Gemini Project, a Gemini Project Newsletter is available for the asking by sending a complete mailing address to the USGP (e-mail, usgp@noao.edu). Please note that the Gemini newsletter (and other Project information/ documentation) is available on the World Wide Web through locator http://www.gemini.edu.

Kathy Wood

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1994 Software Conference Update (1Dec94)

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1994 Software Conference Update (1Dec94)
(from CCS, NOAO Newsletter No. 40, 1 December 1994)

The Fourth Annual Conference on Astronomical Data Analysis Software and Systems (ADASS) was held in Baltimore on 25-28 September 1994. The Conference was hosted by the Space Telescope Science Institute. Additional sponsors included the National Aeronautics and Space Administration, the National Optical Astronomy Observatories, the National Radio Astronomy Observatory, the National Research Council of Canada, the National Science Foundation, and the Smithsonian Astrophysical Observatory. ADASS '94 would like to acknowledge the generous support of its corporate sponsors that included Hughes STX, Sun Microsystems, Inc., Resource One, Sybase, Inc., Silicon Graphics, Inc., Open Concepts, Inc., Research Systems, Inc., and Digital Equipment Corporation. The ADASS Conference provides a forum for scientists and programmers concerned with algorithms, software, and software systems employed in the reduction and analysis of astronomical data.

There were over 300 registered participants for the Conference representing 17 countries. There were 38 oral presentations during the General Sessions including 11 invited talks. More than 90 poster papers and 15 software demos were presented as well. Five special sessions (BOFs) were also held. The Proceedings for ADASS IV, like those of the earlier conferences, will be published as part of the Astronomical Society of the Pacific Conference Series. We expect this volume to be available mid-summer 1995.

Two "tag-along" workshops were held on the Thursday following the Conference. A preprint workshop, with 75 registrants, was held to discuss electronic preprints and what was needed by the astronomical community. An IRAF developers' workshop was held at STScI, with about 35 attendees, to discuss issues related to software development in the IRAF environment.

Plans are in progress for the next ADASS Conference, which will be held in Tucson on 22-25 October 1995, hosted by NOAO. Information about ADASS '95 is available by sending e-mail to softconf@noao.edu or by connecting to the Conference homepage, http://iraf.noao.edu/ADASS/adass.html. We will keep you posted as plans develop.

Jeannette Barnes, George Jacoby, Doug Tody

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IRAF Update (1Dec94)

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IRAF Update (1Dec94)
(from CCS, NOAO Newsletter No. 40, 1 December 1994)

IRAF Version 2.10.3BETA was released in late August for both SunOS4 and Solaris 2.3. IRAF Version 2.10.3BETA is the first native IRAF release for the Sun Solaris operating system. It was decided to also release V2.10.3BETA for SunOS platforms so that sites running both SunOS and Solaris could have compatible IRAF systems. V2.10.3BETA also includes much of the new software slated for the upcoming V2.11 general release available to users now for early testing. The initial release of IRAF for Solaris 2.3 supports the V2.0.1 SunSoft Fortran and ANSI C compilers and includes IRAF shared library support.

Although few problems have been encountered with V2.10.3BETA, a bug-fix patch is planned and will probably be released in November. The exact timing may depend upon when Solaris 2.4 is publically released, as we would like to wait until Solaris 2.4 is out to release the patch so that we can support both Solaris 2.4 and the new SunSoft V3.0.1 compilers. The bug-fix patch also fixes a number of minor bugs throughout the IRAF software.

A new version of the X11 support package X11IRAF, which includes xgterm and ximtool, was made available for SunOS and Solaris in late August (this includes binaries for both platforms). Anyone running earlier versions of these programs will want to update to this latest version. Look in the pub/v2103-beta directory on iraf.noao.edu. Support for platforms other than Sun (our development system) will follow when IRAF V2.11 is released; however, anyone can get the sources now and build these on their favorite platform. This software is still under development and yet another update can be expected later this fall.

With the Solaris port out of the way, the next port scheduled is to the 64-bit DEC Alpha running OSF/1 (a preliminary port to this platform is already available from STScI). Work is also beginning on the PC-IRAF port, in the sense that we are investigating what hardware to purchase to support this platform. The initial PC-IRAF port will almost certainly be to Linux; however, we are planning to look at BSD386 and Solaris as well.

The major effort for the remainder of this year will be preparation of the Version 2.11 IRAF release. Our target date for freezing and testing the SOS4 version is the end of the year. Following the initial release V2.11 will be made available for all supported platforms as time permits throughout 1995. V2.11 will look a lot like V2.10.3BETA (hence the BETA designation) but will include some new applications and additional system enhancements and bug-fixes, including the FITS image kernel and some early graphical user interface (GUI) applications.

The March 1994 issue of the NOAO Newsletter discussed our plans for the IRAF Network Information Service, including our existing FTP archive, the IRAF e-mail support services, various WWW services, and the then-new network news hierarchy ADASS (named after the conference of the same name). We have since expanded these services to add listserver support for the ADASS newsgroups so that people can get the ADASS and IRAF news via e-mail, and a new "irafinfo" facility which allows IRAF information and files to be retrieved via e-mail.

All of the ADASS newsgroups are now available through the listserver. For example, to subscribe to the "iraf.announce" and "iraf.buglog" newsgroups:

```
% mail listproc@iraf.noao.edu
subscribe adass-iraf-announce "Joe Smith, Boston University"
subscribe adass-iraf-buglog "Joe Smith, Boston University"
```

Articles will be sent to the e-mail address of the subscriber as they are posted to one of the listed newsgroups. One can subscribe or unsubscribe at any time, as often as desired.

For a list of IRAF related files available through the irafinfo service send mail to irafinfo as follows:

```
% mail irafinfo@iraf.noao.edu index iraf
```

For more detailed information on the ADASS newsgroups and how to access them, try the following:

```
% mail irafinfo@iraf.noao.edu get iraf newsgroups
```

Information on IRAF is also available via the World Wide Web via the URL http://iraf.noao.edu. This facility is still under development and will be expanded as time allows.

The IRAF FTP archives have been reorganized. The "iraf.old" directory is now obsolete and has been replaced by the following directories:

```
/iraf/extern    IRAF external packages from NOAO
/iraf/misc      Miscellaneous software distributions
/contrib        IRAF and non-IRAF contributed software
```

The former contents of iraf.old have been frozen and moved to iraf.old/archive. Users should look in iraf/extern or iraf/misc for the latest copies of external packages or miscellaneous software. Refer to the README file in iraf.old for further information on this reorganization.

The compressed text file "ls-lR.Z" in the root directory of the FTP archive contains a detailed list of all files in the archive. Download and scan this file if you are not sure where to find a particular file in the archive.

The IRAF exercises that were discussed in a previous issue of the Newsletter (No. 37, March 1994) have been updated for IRAF Version 2.10.3BETA. The new version of the exercises assumes that the user is using the latest versions of xgterm and ximtool. The older version of the exercises is still available for V2.10.2. The exercises have been moved to the iraf/misc directory on iraf.noao.edu.

Members of the IRAF group attended the Astronomical Data Analysis Software and Systems Conference in Baltimore in late September (see the accompanying article about the ADASS Conference in this section of the Newsletter). An IRAF demo was presented to the participants of the Conference during the three-day meeting, highlighting the latest GUI applications and other new IRAF software. Several papers about some of the latest IRAF applications and systems development were presented by members of the group. An IRAF developer's workshop was held at STScI following the ADASS conference to allow IRAF developers from many projects to discuss current issues and future directions pertaining to software development in the IRAF environment.

Members of the IRAF group will be available to demo the latest IRAF software at the AAS meeting in Tucson in January. The AAS IRAF demo not only provides the IRAF user community an opportunity to see the latest IRAF software, it also provides users a chance to meet members of the

IRAF group and talk to them personally about any problems one may have experienced with IRAF, or present suggestions for improvements or new software. So if you are at the AAS please stop by and say hello.

For further information about the IRAF project, please contact Jeannette Barnes, Central Computer Services.

Doug Tody, Jeannette Barnes

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NOAO FTP Archives (1Dec94)

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NOAO FTP Archives (1Dec94)
(from CCS, NOAO Newsletter No. 40, 1 December 1994)

The various FTP archives for the NOAO can be found in the following FTP directories. All archives are provided on Sun or DECstation servers, so please log in as anonymous and use your e-mail address as the password. Alternate addresses are given in parentheses.

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

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

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

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

catalogs--Directory of astronomical catalogues. At this time only the Jacoby et al. catalog, "A Library of Stellar Spectra," and the "Catalogue of Principal Galaxies" are here.

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

gemini (gemini.tuc.noao.edu)--Information from the Gemini Project.

gong (helios.tuc.noao.edu, cd pub/gong)
Directory containing GONG helioseismology software and data products--velocity, modulation and intensity maps, power spectra.

iraf (iraf.noao.edu)--IRAF network archive containing the IRAF distributions, documentation, layered software, and other IRAF related files. It is best to login to iraf.noao.edu directly to download large amounts of data, such as an IRAF distribution.

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

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

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

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

preprints--NOAO preprints that are available electronically.

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

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

tex--LaTeX utilities for the AAS/ASP.

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

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

wiyn (orion.tuc.noao.edu)--WIYN directory tree containing information relating to the WIYN telescope, including information relating to the NOAO science operations on WIYN.

The following numbers are available for the machines mentioned above:

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

Questions or problems may be directed to the following:

Steve Heathcote (sheathcote@noao.edu) for the CTIO archives,

Frank Hill (fhill@noao.edu) for all solar archives,

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

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

Jeannette Barnes

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