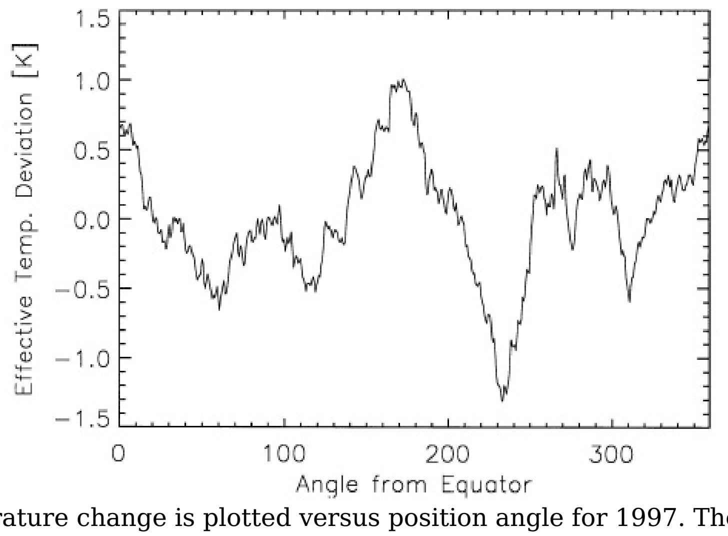
NOAO Newsletter - December 1997 - Number 52

Table of Contents - -

NOAO Newsletter - NOAO Highlights! - December 1997 - Number 52

The Sun is Oblate

Measurements of the shape of the Sun, and in particular the solar oblateness, have been published and debated for nearly a century. An unexpected capability of the Michelson Doppler Imager aboard the Solar and Heliospheric Observatory (SoHO) has been the ability to precisely determine the solar limb shape and brightness. The stable thermal environment of the SoHO experiment at the L1 Earth-Sun Lagrange point has allowed NSO scientists, in collaboration with Stanford and Lockheed experiment PIs, to obtain the most accurate measurement of the solar oblateness and hexadecapole shape terms. From an experiment performed last March where the SoHO spacecraft was rotated in fixed angular increments around the telescope axis, the difference between solar equatorial and polar radii associated with the static oblateness was derived to be 8.07 0.58 milliarcsec. For the first time a significant hexadecapole (l = 4) solar shape distortion of 1.4 0.54 milliarcsec was also determined. The measured oblateness tends to rule out the possibility of a rapidly rotating solar core although it is not yet clear if the derived hexadecapole shape is consistent with "standard solar models." An extra bonus from the solar limb astrometry experiment has been a precise determination of solar latitudinal color temperature variations. The March experiment also confirmed earlier ground-based experiments that indicated that the solar photosphere is about 1 degree hotter near the poles and equator than it is near mid latitudes.



Caption: Effective limb temperature change is plotted versus position angle for 1997. The maximum limb brightness occurs near the equator and poles, with a temperature minimum occurring near 50 - 60 degrees north and south latitude (i.e. position angles 55, 125, 235, and 305). The form of this latitudinal variation is nearly the same in both hemispheres, although its amplitude is larger in the southern hemisphere (about 2.2K versus 1.4K in the north). A pronounced 0.5K brightness dip within a few degrees of the south pole is also apparent. The south pole was inclined by approximately 6 degrees toward the earth during these observations. The west, north, east, and south limbs correspond to limb angles 0, 90, 180, and 270 degrees.

In a related analysis, the time variable limb shape (on timescales from minutes to hours) appears to be dominated only by statistical noise sources down to limb shape change amplitudes of a few microarcseconds. Analysis of an early one-month sample of SoHO/MDI data rules out the possibility of solar g-modes with corresponding surface velocity amplitudes larger than a few mm/s.

Jeff Kuhn

Table of Contents - -

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

Table of Contents - -

Comings and Goings

We are delighted to welcome Abhijit Saha as the newest member of the Kitt Peak scientific staff. Abi comes to us most recently from Space Telescope Science Institute, where he was formerly chief of the User Support Branch. Abi received his PhD from Caltech for his work with J.B. Oke on RR Lyrae stars in the Galactic Halo, then spent two years as a Kitt Peak postdoc. He is known for his research on the distances to nearby galaxies determined through Cepheid calibrators. Abi is already ramping up on a substantial set of observatory responsibilities, including those of WIYN Telescope Scientist, the WIYN Queue, the WIYN Imager, and the 2.1-meter Direct CCD imager.

We are also extremely pleased to welcome Jeff Valenti as a new Kitt Peak postdoctoral fellow. Jeff comes to us from the University of Colorado, where he worked with Jeff Linsky as a STIS postdoc. He received his PhD from UC Berkeley, working with Gibor Basri on Photospheric Signatures of Stellar Activity. Jeff is studying the magnetic properties of main sequence stars, and their relationship to both dynamo parameters and chromospheric and coronal heating. He is actively involved with the Phoenix high-resolution spectrograph as an observer, instrument support team member, and documenter.

We are happy to be the host institution for Shoko Sakai as the recipient of a NASA Long-Term Space Astrophysics grant. She is studying the properties of the red giant branch tip as a potential distance indicator for galaxies.

We regret that we must say farewell to Arjun Dey. Arjun is changing from a Kitt Peak postdoc to a Hubble Fellowship, which he will take at Johns Hopkins. Arjun has played a key role as co-PI with Buell Jannuzi on the NOAO Deep-Wide Survey to map the evolution of galaxies and large-scale structure. We wish Arjun great success in the next phases of his career, and look forward to continuing productive collaboration as the survey progresses.

Richard Green

Table of Contents - -

Table of Contents - -

AURA Celebrates 40 Years!

On 28 October, the Association of Universities for Research in Astronomy celebrated its 40th anniversary. A consortium of educational and other non-profit institutions, AURA was incorporated in 1957 in the state of Arizona to develop and operate national and international centers that enable merit-based research by members of the astronomical community.

This milestone event was marked by an "All-Hands" meeting in the University of Arizona's Gallagher Theater, where AURA President Goetz K. Oertel addressed the Tucson-based NOAO and Gemini staff.

"My vision is that the national observatories will remain at the forefront. They will be second to none in science and in service. They will also be the most cost effective. And, we will see continual renewal in them," Oertel said. A reception in the NOAO courtyard followed.

Similar events were held at the National Solar Observatory at Sacramento Peak (in conjunction with NSO/SP's 50-year anniversary) in September and in November in both Washington, DC, and at the Space Telescope Science Institute in Baltimore (in conjunction with meetings of the AURA Board). Observances are also planned at the Cerro Tololo Inter-American Observatory in Chile and the Gemini facilities in Hilo, Hawaii.

Lorraine Reams

NOAO Newsletter - Director's Office - December 1997 - Number 52

New AURA Board of Directors and Observatories Council (OC)

The Board

Effective 1 July 1997, the members of the AURA Board of Directors are:

Bruce Margon (Chair)	*University of Washington*
Richard Zdanis (Vice Chair)	*Case Western Reserve University*
James Hesser	*Dominion Astrophysical Observatory*
John Huchra	*Harvard-Smithsonian Center for Astrophysics*
Gloria Koenigsberger	*Universidad Nacional Autonoma de Mexico*
Leonard Kuhi	*University of Minnesota*
Morton Lowengrub	*Indiana University*
Jeremy Mould	*Mt. Stromlo and Siding Spring Observatory*
Dennis O'Connor	*Smithsonian Institution*
Goetz Oertel, *ex officio*	*AURA*
Robert Rosner	*University of Chicago*
Paul Schechter	*Massachusetts Institute of Technology*
Lee Anne Willson	*Iowa State University*

The Board is composed of thirteen members. Twelve are elected by the Member Representatives* and serve for staggered three-year terms. The President of AURA is a member *ex officio*. The Member Representatives annually elect the Chair of the Board from among the members of the Board. The Board elects its Vice Chair.

The by-laws prescribe that at least four of the twelve Directors shall be Member Representatives, at least four shall **not** be Member Representatives, and at least two Directors shall come from non-US institutions. Further, no more than four Directors may be non-US citizens.

The Board establishes the policies of AURA, approves its budget, elects members of the Management Councils, and appoints the AURA President and Center Directors. At their annual meetings, the Member Representatives hold the Board accountable for the effective management of AURA and the achievement of its purposes.

Observatories Council (OC)

Effective 1 July 1997, members of the OC include:

Bruce Carney (Chair)	*University of North Carolina,Chapel Hill*
Michael A'Hearn (Vice Chair)	*University of Maryland*
Susan Kleinmann	*University of Massachusetts*
Richard Larson	*Yale University*
Richard Margison	*University of Illinois*
Goetz Oertel, *ex officio*	*AURA*
Maria Teresa Ruiz	*Universidad de Chile*
David Schramm	*University of Chicago*
Juri Toomre	*University of Colorado*
Arthur Walker	*Stanford University*

The OC is a Management Council of the Board. Its members are trustees and advocates for the mission of NOAO. The OC provides stewardship and oversight, and gives support and advice to the NOAO Director on important policy and management matters.

The OC consists of nine core members and the AURA President, *ex officio*. Core members are elected by the AURA Board. Council members serve staggered three-year terms. At least four of the members are derived from the Board of Directors or the Member Representatives, or in combination therefrom, and at least four come from outside the Board and Member Representatives. Management Councils elect their own officers. The OC may elect up to three "non-core" members to add expertise not already within its core membership.

Lorraine Reams

**The president of each AURA member institution appoints one person to serve as its representative. Member Representatives typically are either astronomers or high-level administrators.*

Dick Dunn Receives the George Ellery Hale Prize

We are proud to announce that Richard B. Dunn is the recipient of the 1997 George Ellery Hale Prize, an award which recognizes his "outstanding contributions to the field of solar astronomy over an extended period of time."

Dick has been on the scientific staff of what is now the National Solar Observatory/Sac Peak site almost from its beginning 50 years ago. His talents, ingenuity and drive in developing new instrumental capabilities and telescopes have been by far the major factors in the development of that observatory into one of the leading solar observatories in the world. From the beginning his work has been directed towards the improvement of the angular resolution of solar observations, starting with the construction of forefront chromospheric and coronagraphic telescopes and reaching its high point with the successful implementation of the Vacuum Tower Telescope (VTT) at Sac Peak. Dick's images of the solar chromosphere and prominences taken many years ago are still the best available, exceeding in quality even the best images obtained with more modern ground- and space-based telescopes. Much of our scientific knowledge of these layers of the Sun derives from these observations, obtained by not only an outstanding instrumentalist but also a veritable artist who gets the best out of the facilities he has built. His Vacuum Telescope was such a success that an entire generation of solar telescopes in Germany, Sweden, France, Japan and elsewhere has followed the vacuum concept to improve solar image quality. And yet, among these the Sac Peak VTT is still giving the best solar images to date. Dick's research using the VTT includes the study of the chromospheric spicular structure and, together with Jack Zirker, the identification of the so-called solar filigree structure of the solar photosphere. The latter is now under intense study at many solar observatories as it is recognized as the site of the very small but strong solar magnetic field bundles which dominate the energy and mass transfer in the outer solar layers, probably including the heating of the solar corona.

Dick Dunn continues to contribute in many ways to the improvement of the National Solar Observatory, giving his instrumental talents selflessly to the implementation of such NSO facilities as the GONG and ISOON facilities and to the development of active and adaptive optics for solar astronomy.

Dick will give his Hale Lecture at the upcoming meeting of the American Astronomical Society in Washington, DC on the morning of 10 January. We encourage readers to attend!

Sidney Wolff, Jacques Beckers

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

Table of Contents - -

NOAO Newsletter - Director's Office - December 1997 - Number 52

NOAO Educational Outreach

The activity level remains high in Educational Outreach with our two major projects, Project ASTRO-Tucson and The Use of Astronomy in Research Based Science Education (RBSE), both having recent workshops. We expect the new position of Outreach Astronomer to be filled by December/January and are preparing for a strong showing at the January AAS meeting in Washington, DC. Recent office shuffling resulted in much of the Outreach staff being moved to Room 3, just south of the main NOAO lobby. Applications for the second year of the RBSE Teacher Enhancement program are available on paper and on-line and must be returned by 27 February 1998.

The second annual Project ASTRO training workshop was held in Tucson in late October, welcoming an additional fifty participants to the project and bringing the total number of trained ASTRO partners in the Tucson area to over one hundred. Astronomers and teachers attend the workshops together and learn hands-on activities and techniques for teaching astronomy in the classroom. Larry and Nancy Lebofsky, Don McCarthy, and representatives from the Tucson Unified School District were among the presenters; Shannon Lalor and Nicole Taddune from the ASP and representatives from the New Mexico Project ASTRO coalition were among the honored attendees. Ginny Beal (gbeal@noao.edu) coordinates Project ASTRO in Tucson.

Ten teachers from Tucson who participated in this summer's Pilot Program of the RBSE Teacher Enhancement program met again at NOAO in October to update the group on efforts to bring a research component to their classrooms and to continue refining methods for analyzing astronomical datasets with the NIH Image software.

The Year-Two RBSE Workshop will take place in July and August of 1998 with 25 middle and high school teachers from around the country coming to Tucson to spend time on Kitt Peak and at the NOAO headquarters. Additional information about the RBSE program has appeared in previous Newsletter articles and can be found off the .

Teachers are required to apply as a team of three and must be matched with a local mentor prior to acceptance into the program. Research astronomers who use the NOAO facilities on Kitt Peak should consider becoming mentors. Our understanding of the role of the mentor is evolving as this Pilot Year unfolds, but mentors are not asked to step far from their role as research astronomers in this capacity. As a mentor, you would be on-call to a RBSE teacher, answering questions about the retrieval and content of datasets as well as suggesting research questions that could be addressed with the data provided. You would receive training on implementing classroom research projects and on the overall goals of the RBSE program. Mentors, as well as teachers, receive support from the NOAO Educational Outreach office. Please speak with me at the AAS meeting or contact me at NOAO (sjacoby@noao.edu) to learn more about this opportunity.

Suzanne Jacoby

Table of Contents - -

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

---

Table of Contents - -

NOAO Preprint Series

The following preprints were submitted during the period 1 August to 31 October 1997. Please direct all requests for copies of preprints to the NOAO author marked with an asterisk.

756 *Suntzeff, N.B. "The Ten-Year Photometric Evolution of SN 1987A"

757 *Mighell, K.J. "WFPC2 Observations of the Carina Dwarf Spheroidal Galaxy"

758 *Massey, P., Hunter, D.A. "Star Formation in R136: A Cluster of O3 Stars Revealed by Hubble Space Telescope Spectroscopy"

759 *Wallace, L., Livingston, W., Hall, D.N.B. "A Twenty-five Year Record of Stratospheric Hydrogen Chloride"

760 *Lauer, T.R., Tonry, J.L., Postman, M., Ajhar, E.A., Holtzman, J.A. "The Far Field Hubble Constant"

761 *Jacoby, G.H., Morse, J.A., Fullton, L.K., Kwitter, K.B., Henry, R.B.C. "Planetary Nebulae in the Globular Clusters"

762 *Massey, P. "The Initial Mass Function of Massive Stars in the Local Group"

763 *De Young, D.S. "Jet Interaction and the Evolution of Compact Symmetric Radio Sources"

764 *Corbin, M.R., Charlot, S., De Young, D.S., Own, F., Dunlop, J.S. "The Blue Companion of 3C 65: A Star-Forming Galaxy with a Probable Redshift of 2.8"

765 Lira, P., *Suntzeff, N.B., Phillips, M.M., Hamuy, M., Maza, J., Schommer, R.A., Smith, R.C., Wells, L.A., Avils, R., Baldwin, J.A., Elias, J.H., Gonzles, L., Layden, A., Navarrete, M., Ugarte, P., Walker, A.R., Williger, G.M., Baganoff, F.K., Crotts, A.P.S., Rich, R.M., Tyson, N.D., Dey, A., Guhathakurta, P., Hibbard, J., Kim, Y.-C., Rehner, D.M., Siciliano, E.,

Roth, J., Seitzer, P., Williams, T.B. "Optical Light Curves of the Type Ia Supernova 1990N and 1991T"

Table of Contents - -

Table of Contents - -

Other NOAO Papers

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

Caldwell, N., *Armandroff, T.E., Da Costa, G.S., Seitzer, P. "Dwarf Elliptical Galaxies in the M81 Group: The Structure and Stellar Populations of BK5N and F8D1"

*Hinkle, K.H., Lebzelter, T., Scharlach, W.W.G. "Infrared Velocities of Long Period Variables: CO D v = 3 in Four Miras and Five SR Variables"

*Mndez, R.A., van Altena, W.F. "A New Optical Reddening Model for the Solar Neighborhood: Galactic Structure Through Low-Latitude Starcounts from the Guide Star Catalogue"

*Mndez, R.A, Guzman, R. "Starcounts in the Flanking Fields of the Hubble Deep Field: The Faint End of the Disc Stellar Luminosity Function and its Scale-Height"

John Cornett, Suzan Ecker,
Elaine Mac-Auliffe, Jane Marsalla,
Shirley Phipps, Cathy Van Atta

Table of Contents - -

A Workshop on Supporting Capabilities for Large Telescopes

A community workshop was held in Tucson on 26-28 September 1997 to identify and quantify required supporting capabilities for 6.5-10 meter telescopes. The motivation for this workshop was the realization that the new generation of very large telescopes would have 1) the ability to study in detail objects fainter than the limiting magnitudes of most existing wide-area surveys and 2) the requirement for accurate astrometry and photometry for both unknowns and reference stars before large telescope observations can be made. The goal of the workshop was to formulate and develop science-based arguments that would identify capabilities that are not currently available and suggest priorities or possible approaches to acquiring these capabilities.

A total of 46 astronomers representing 26 different institutions took part in the workshop. The attendees were split into eight discipline-based panels (Solar System Studies, Extrasolar planets/Low Luminosity Stars, High Resolution Studies of Stars, Star Formation/ISM, Activity in Nearby Galaxies, Stellar Populations, Galaxy Formation and Evolution, and Large Scale Structure). The entire group heard presentations on the capabilities and observing constraints of large telescopes (Keck, Hobby-Eberley Telescope, MMT, Magellan, LBT, and Gemini). The panels were charged to:

1) Develop one or more large, representative observational programs for 6.5-10 meter telescopes.

2) Analyze the support requirements for these programs including telescopes, instruments, surveys, software, and operations modes needed for sample selection, calibration, complementary or preparatory observations.

The panel chairs and the workshop organizers met during the final day to merge the panel results, attempt to quantify the common needs, and identify capabilities to which general access does not exist.

All of the panels identified large-scale surveys as essential to undertake the observing programs on very large telescopes. These surveys, different in detail but similar in overall requirements, are needed for sample selection or refinement, identification of reference stars in certain fields, and offloading the observations of the brighter objects onto smaller telescopes. Both imaging and multi-object spectroscopy were called for over survey fields of view that range up to several tens of square degrees in both the optical and IR. While a recalculation of the required nights based on a uniform set of assumptions is necessary, the preliminary numbers that came out of the workshop total to more than 2000 nights on 4-m telescopes to perform all the imaging surveys. It is important to note, however, that a substantial fraction of the surveys require only a few tens of nights.

What facilities and infrastructure are needed to carry out these surveys?

Detectors

Optical arrays are just approaching sizes to make optimal use of existing telescope focal planes. Obviously, development of IR arrays leading to larger formats and buttable physical packages would increase efficiency for survey use.

Software/Protocols/Pipelines

Standardized, well-tested software will allow rapid and consistent reduction of data obtained for surveys. Construction of catalogs with accurate measurement of fluxes and positions will make the use of these data more efficient. Also, uniform procedures for ingesting data into (and delivering data out of) archives will permit the entire community to make better use of this information.

Community Sociology

The workshop participants recognized that conflicting pressures exist in trying to enable a survey. Community support requires substantial community input and ready access to the output. However, there must be a scientific return for an individual or team to put in the very large effort that is required to carry the survey out. Any plan to carry out one of these surveys must find an acceptable balance to these two forces. Various telescope resources were discussed as potential tools to carry out these surveys.

Other Desired Capabilities

While these were prioritized behind the survey requirements, several additional capabilities were identified as desirable. These included limited interest in image quality improvement via tip-tilt correction or low-order adaptive optics. The emphasis was clearly on correction over a substantial field of view and so might be considered as correction for wind-shake, tracking errors and dome and mirror seeing. Also, non-traditional operations modes were noted as important, particularly those that would support target-of-opportunity observations.

Arguments for specific supporting capabilities have always been anecdotal. We know that the Palomar Schmidt sky survey undertaken in the 1950s provided an extremely important database for the next 30 years of observations on 4-5 meter telescopes. By analogy we expect that similar but deeper surveys (such as SDSS) will be necessary to effectively use 6.5-10 meter telescopes. Now, for the first time, we have made that argument in a scientific context. However, we must acknowledge the limitations of the process of the workshop. Many disciplines, wavelength ranges, and types of observation were not well represented. The workshop did identify some specific areas that will require development and significant effort for the effective community use of very large telescopes. It is necessary to begin immediately the job of planning and carrying out these surveys. Over the long term the results of this workshop and of future workshops should provide input for national public and private policy and funding decisions. Over the short term the community must be engaged in starting to assemble the tools and the infrastructure to carry these surveys out.

Todd Boroson

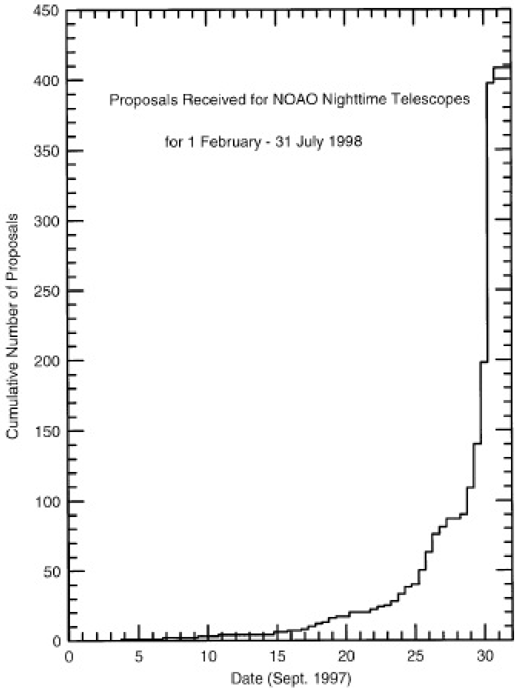
Table of Contents - -

Table of Contents - -

---

402 NOAO Observing Proposals Received

We were very pleased at how smoothly the proposal submission process went for the February-July 1998 observing proposal period. We received a total of 402 proposals, 230 for Kitt Peak and 172 for CTIO. All proposals, except four CTIO proposals, were submitted electronically. 62% of all proposals included figures (we received 431 figures!) and 24% of proposals made use of the new target table feature. 16% of proposals were requests for thesis observations. Only 2% of investigators, or eight proposals, were unable to obtain the new LaTeX form and submitted an earlier version of the template. The accompanying figure shows the cumulative number of proposals received as a function of time through September.



Caption: The cumulative number of proposals received for telescope time on NOAO's nighttime telescopes, as a function of time through September. Most investigators prefer to submit their proposals on the last day, but the SCOPE staff send special thanks to those whose proposals arrived early, allowing the workload to be spread out more!

The transition to the centralized email addresses, to the new LaTeX form, and to the Web-based form went very smoothly for NOAO and apparently for our users.

About 20% of the investigators used the new Web-based proposal form with sixty-six proposals being submitted via the Web. Others used the Web form to generate their proposals and then submitted the proposal by email, for one reason or another. Most of the investigators who used the Web form were pleased with it and plan to use it again for the next proposal period. We will try to add a few enhancements to the Web form to entice additional users for the next round. The one thing that we can not do anything about is the slow network---in some cases this made the form impossible to use, but we had investigators from South America and from Europe use the form successfully and apparently without much delay. We can only hope that the network gets better before it gets worse.

We had the usual small percentages of problems with proposals but nothing stood out in particular, and we want to thank all investigators who took the time to respond to our questionnaire distributed in October. At this time we do not see any major changes in the procedures or in the LaTeX form for the next observing proposal period. We will summarize any changes in the next Newsletter.

Caty Pilachowski for the NOAO Proposal Team

Table of Contents - -

Table of Contents - -

1998A CTIO Observing Request Statistics

February 1998 - July 1998

Summary

Telescope:	**4-m**	**1.5-m**	**0.9-m**	**Schmidt**
No. of requests:	115	47	33	4
No. of Nights Requested:	372	226	266	77
No. of Nights Available*:	150	166	173	133
Oversubscription:	2.48	1.36	1.54	0.58
Average request:	3.23	4.81	8.06	19.25

4-m Telescope	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**

ARGUS	3	0	9	0	9	2.4%
COB	2	9	4	27	30	8.3%
CFIM	4	0	9	0	9	2.4%
RCSP	18	7	60	21	81	21.8%
ECH	4	16	13	56	69	18.5%
CIRIM	0	3	0	9	9	2.4%
IRS	3	8	11	27	38	10.2%
PFIM	4	1	12	0	12	3.2%
BTC	20	0	76	0	76	20.4%
RFP	3	0	11	0	11	3.0%
OSCIR	2	8	8	19	27	7.3%
Total	63	52	213	159	372	100.0%

1.5-m Telescope	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**
ASCAP	2	3	8	33	41	18.1%
CFIM	8	3	33	11	44	19.5%
CSPEC	3	5	11	21	32	14.2%
BME	1	5	5	26	31	13.7%
CIRIM	0	12	0	54	54	23.9%
RFP	1	2	4	10	14	6.2%
VIS	1	1	7	3	10	4.4%
Total	16	31	68	158	226	100.0%

0.9-m Telescope	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**
CFIM	21	12	146	120	266	100.0%

Curtis Schmidt	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**
NFCCD	4		77		77	100.0%

Table of Contents - -

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

---

Table of Contents - -

NOAO Newsletter - SCOPE - December 1997 - Number 52

1998A KPNO Observing Request Statistics

February 1998 - July 1998

Summary

Telescope:	**4-m**	**WIYN**	**W2HR**	**2.1-m**	**0.9-m**	**C.F.**
No. of requests:	104	45	11	52	37	15
No. of Nights Requested:	346	127	2.75	215	201	91
No. of Nights Available*:	143	55	2	164	148	150
Oversubscription:	2.42	2.30	1.37	1.31	1.36	0.61
Average request:	3.32	2.82	0.25	4.13	5.43	6.07

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

Requests By Telescope:

4-m Telescope	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**
CRSP	1	4	3.00	7.00	10.00	2.9%
CRYO	11	0	36.00	0.00	36.00	10.4%
ECH	3	8	6.00	25.00	31.00	9.0%
IRIM	1	4	2.00	15.00	17.00	4.9%
ONIS	1	3	4.00	11.00	15.00	4.3%
PFIM	29	2	100.60	6.00	106.60	30.9%
PHX	1	13	2.00	47.00	49.00	14.2%
RCSP	19	3	66.00	12.00	78.00	22.6%
VIS	0	1	0.00	3.00	3.00	0.9%

Total	66	38	219.60	126.00	345.65	100.0%

WIYN Telescope	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**
DSPK	0	0	0.00	0.00	0.00	0.0%
HYDR	17	10	49.60	24.10	73.70	57.8%
NFIM	14	4	42.25	11.50	53.75	42.2%
	--	--	-----	-----	------	------
Total	31	14	91.85	35.60	127.45	100.0%

WIYN 2-HR Q	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**
DSPK	0	0	0.00	0.00	0.00	0.0%
HYDR	1	2	0.25	0.50	0.75	27.3%
NFIM	7	1	1.75	0.25	2.00	72.7%
	-	-	----	----	----	------
Total	8	3	2.00	0.75	2.75	100.0%

2.1-m Telescope	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**
CFIM	7	0	33.00	0.00	33.00	15.3%
CRSP	0	3	0.00	7.00	7.00	3.3%
GCAM	18	2	77.00	8.00	85.00	39.5%
IRIM	1	4	2.00	23.00	25.00	11.6%
ONIS	0	3	0.00	20.00	20.00	9.3%
PHX	2	10	8.00	28.00	36.00	16.7%
VIS	1	1	7.00	2.00	9.00	4.2%
	--	--	-----	-----	------	------
Total	29	23	127.0	88.00	215.00	100.0%

0.9-m Telescope	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**
CCDP	0	2	0.00	8.00	8.00	4.0%
CFIM	30	5	155.2	38.00	193.25	96.0%
	--	-	-----	-----	------	------
Total	30	7	155.2	46.00	201.25	100.0%

CF Telescope	**Requests**		**Nights Requested**		**Total Nights**	
Instrument	**Dark**	**Bright**	**Dark**	**Bright**	**Requested**	**Percentage**
CAM5	2	10	4.00	65.00	69.00	75.8%
CAM6	0	3	0.00	22.00	22.00	24.2%
	-	--	----	-----	-----	------
Total	2	13	4.00	87.00	91.00	100.0%

Table of Contents - -

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

---

Table of Contents - -

Earthquake Shakes IVth Region; Minor Damage to Observatory

Tuesday evening, 14 October, at 10:03 p.m. Chile time, a large earthquake struck the Fourth Region, giving a severe jolt both to our mountain facilities and the La Serena compound. The epicenter was located 110 km south of La Serena, near the city of Ovalle. Depth was estimated at 30 km, and the magnitude as 6.8 on the Richter scale. The duration was over two minutes in La Serena. Strong surface waves caused Recinto residences to shake and twist, but there were no injuries and only minor damage---books falling off shelves and the like. Immediately after the shaking stopped, the "neighbor network" went into action, as residents checked on each other by telephone and door to door.

All local TV stations were put out of action, and outside telephone communications lost for several hours. Recinto electrical power was out for only twenty minutes or so, and we were able to communicate with the summit by radio and be assured that there were no significant personal injuries there. Frightened children and pets (and more than a few adults) slowly calmed down as small aftershocks rumbled by under foot.

The Tololo facilities were hit harder. Gas and water lines were ruptured in some locations, and all gas and electricity were promptly turned off until a thorough review could be conducted the next morning. The most significant potential scientific impact was the rupture of an oil pad bellows on the North bearing of the 4-m, which put the telescope out of action. Two of the three water storage tanks were damaged, severely limiting fresh water supplies. Daylight showed some damage to the 4-m prime focus access platform, to one of the dome doors, and to some of the dome-shutter bearings; otherwise the telescope buildings suffered no significant harm. The mountain road had been damaged anew by another rainstorm earlier in the week, and no travel was permitted until earthquake damage could be assessed. Fortunately there was none; meanwhile, radio communications had relieved the fears of mountain personnel regarding their families in La Serena and elsewhere. Although each item of damage on Tololo was generally not a significant impediment to operations (apart from the 4-m bellows), the overall extent of damage was worse than has been seen for at least two decades.

The oil pad bellows fittings permit the pads to accommodate themselves to slight deviations from circularity of the large RA bearings and are essential to operation. In principle they are changed by raising the entire telescope and mounting on hydraulic jacks incorporated into the structure. In practice this exercise was plagued by difficulties, beginning with jacks which did not function after twenty years sitting idle! Jorge Briones and his team (Eduardo Aguirre and Luis Pasten) merit special recognition for their extraordinary effort and ingenious improvisations, which put the telescope back in service within 48 hours of the earthquake without a minute's loss of science time---by chance, this period had been scheduled for engineering work on the drive servos. An instrument change Friday proceeded as planned, and the staff astronomers on the telescope that night noticed nothing more than the need to determine the zero point for telescope pointing. While Jorge and crew restored the 4-m to service, the rest of the mountain staff put in long hours determining the functionality of other telescopes, instruments, and systems.

Damage on Pachn was minimal; a power line break, quickly restored, and a five ton rock, which tumbled onto the road and had to be drilled, blown up, and cleared. Meanwhile, Gemini construction is moving forward rapidly. One measure of the level of activity is that lunchtime meal service for the work crews, provided in a small dormitory on Pachn, now involves three shifts for seating. Back on Tololo, the damaged water tanks are being repaired, with the water shortage remaining the most visible after-effect. However, the earthquake damage comes on the heels of major damage to the road in two particularly severe storms---one of which coincided with the need to transport over 90 truckloads of Gemini dome steel to the summit from a freighter in Coquimbo harbor. As a result, the resources of the Observatory Support Service units have been stretched to the limit for several months now.

While we suffered, fortunately, no more than inconveniences, Nature's toll on the IVth Region was much worse. Initial reports in the first few days after the earthquake failed to convey the extent of damage to small communities inland from the coast and remote from communications. Nine people were killed and more than 300 injured, mostly from collapsing adobe and stone structures. Continuing aftershocks---10 above Richter 4.5 in the following week---kept people out of surviving buildings for fear of further collapse.

Over 40,000 people, about 8% of the total population, suffered serious property damage. Over 4000 homes were destroyed by the quake, and another 6000 so severely damaged as to require demolition; 10,000 more are in need of significant repair. In many smaller communities most or all of the structures were damaged or destroyed. As I write this, in late October, travel to these communities is still difficult, heavy machinery for demolition and clearing is unavailable, stocks of emergency housing are minimal and mostly located outside of the region, and the country's capacity for building more is estimated at only 200 units a day. Some people will be without housing for many weeks. To make matters worse, a severe windstorm the day preceding the quake destroyed a large portion of the spring fruit crop in the Elqui Valley, a major income source for rural communities. Many of the hardest hit areas also expect flooding as the heavy winter snowpack in the high Andes begins to melt. This puts our loss of at most a few photons in sad perspective.

Malcolm Smith (msmith@noao.edu)

Table of Contents - -

Table of Contents - -

SOAR 4-m Telescope Project Moves Into Design Phase

A new 4-m telescope, SOAR is being built in Chile. It is being funded by a consortium consisting of CNPq (Brazil, 33%), Michigan State University (MSU, 17%), NOAO (33%), and the University of North Carolina (UNC, 17%). It will be located on Cerro Pachn at a site that we expect to provide oustanding seeing, about 400m from Gemini South, and will be operated by CTIO.

After a year-long study of alternative concepts, we now are moving ahead with the design and construction of a 4-m Alt-Az telescope optimized for the highest-possible core image quality. The design goal is 0.18" FWHM image degradation from the telescope and dome (but not counting the free atmosphere) at a wavelength of 1 mm; this will rival Gemini in FWHM performance. The target date for first light on SOAR is 2002, one year after Gemini South.

The initial instrument complement is not yet decided, but it is clear that SOAR will open major new scientific opportunities to NOAO users over the optical and near-infrared wavelength bands. The major instruments will be at a pair of Nasmyth ports, with the design goals including further positions for smaller instruments. Science discussions to date have emphasized the importance of queue scheduling and of being able to rapidly switch between instruments.

The SOAR consortium members will be able to trade time on SOAR for time on the Blanco telescope, so that SOAR's instrument set can be made complementary to the wider-field (40'), lower angular resolution (0.9" median FWHM) capabilities of the Blanco. Thus the two 4-m telescopes will be operated as a complementary pair, and both in turn will complement the capabilities of Gemini South.

An important milestone was the hiring of Thomas Sebring as Project Manager. Tom was previously the manager of the Hobby-Eberly Telescope project, noted for its innovative and cost-effective design. We feel fortunate to have someone of Tom's caliber leading the SOAR effort. Also important to the project's success is the appointment of Gerald Cecil as Project Scientist. Gerald was seconded to the project by UNC and has moved to Tucson, where the project headquarters are located. Other personnel currently on the SOAR payroll are Dan Blanco (Project Engineer, drawn from the successful WIYN design team), Gilberto Moretto (Optical Scientist), and Kitty Wawzinski (Administrative Coordinator).

The project is overseen by an interim board of directors made up of Sidney Wolff (NOAO, Chair), Joao Steiner (Brazil), Paul Hunt (MSU) and Bruce Carney (UNC). Cecil chairs a Scientific Advisory Committee consisting of Jack Baldwin (NOAO), Richard Elston (Florida), Marcos Diaz (LNA, Brazil), Horacio Dottori (UFRGS, Brazil), Robert McMahon (UNC), and Sue Simkin (MSU).

The Scientific Advisory Committee is presently finalizing a set of top-level scientific requirements for the telescope, while the project team moves into a preliminary design period that will establish how to meet those requirements.

Jack Baldwin (jbaldwin@noao.edu)
SOAR SAC Member for CTIO

Table of Contents - -

Table of Contents - -

MACHO Program to Continue on 0.9-m

We are pleased to announce that the MACHO project will continue through calendar year 1998 on the 0.9m telescope. This team searches fields in the Galactic Center and the Magellanic Clouds, using a dedicated telescope in Australia (the Great Melbourne Reflector at MSSSO). The CTIO 0.9m is used 13% of the time by this project to provide accurate photometric measures for ongoing microlensing events.

The primary aim of the project is to test the hypothesis that a significant fraction of the dark matter in the halo of the Milky Way is made of objects like brown dwarfs or planets: these objects have come to be known as MACHOs, for Massive Compact Halo Objects. The signature of these objects is the occasional amplification of the light from extragalactic stars by the gravitational lens effect. The amplification can be large, but events are extremely rare. It is necessary to monitor photometrically several million stars for a period of years to obtain a useful detection rate. See the MACHO project home page at http://wwwmacho.mcmaster.ca for details, and Alcock et al ApJ, 479, 119, 1997 for some results. These surveys also provide extensive photometric catalogues for sources in the Magellanic Clouds and the Galaxy, particularly RR Lyrae and Cepheid variables. For example, see Alcock et al ApJ, 482, 89, 1997.

The observations are done by a dedicated observer each night, using a separate computer and their own calibrations. The Galactic Bulge is followed from March-October (approximately) and the Magellanic Clouds during the southern summer months. Observers granted 0.9-m time for their own programs can discuss the coordinating details with the mountain support personnel when they arrive on Tololo, or e-mail me (rschommer@noao.edu) in advance of their run. The MACHO project team members have been very cooperative and congenial colleagues. The resources they have provided have supported their special service observing requirements and also allowed some much needed upgrades to our small telescopes at CTIO.

Bob Schommer (rschommer@noao.edu)

Table of Contents - -

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

---

NOAO Newsletter - Cerro Tololo Inter-American Observatory - December 1997 - Number 52

The Yale-CTIO Collaboration: Past and Future

As we prepare to resume operation of the Yale 1-m telescope at CTIO in a new observing mode, it is appropriate to look back at the history of the Yale-CTIO collaboration, and forward to the future. The 1-m was constructed by Boller & Chivens and installed at Bethany, Connecticut in 1965. In 1973, the telescope was shipped to CTIO, and the arrangement under which it operated until this year began. Under this arrangement, CTIO was responsible for instrumenting and maintaining the telescope, and Yale was assigned up to 1/3 of the nights. When instrumentation began to diverge between the 1-m and the 0.9-m, Yale was allowed to take up to half of its nights on the 0.9-m. Recently, Yale has used most of its time on the 0.9-m, but virtually none of the time in principle available on the 1-m.

While Yale faculty and research staff have carried out a variety of projects on the 1-m and 0.9-m during the past quarter century, the majority of the science carried out during Yale's time has been the work of graduate students. Since the late 1970s, Ph.D. theses which have relied heavily on data from the small CTIO telescopes have been produced at Yale at the rate of about one per year. Recently the trend has accelerated: six such theses have been produced since 1995. Many of these projects combine extensive data from the small CTIO telescopes with data from space-based observatories and other wavelength regimes, which suggests that the new observational facilities are creating more interesting projects for small ground-based optical telescopes, rather than rendering them obsolete. The continuing importance of small telescopes as scientific and educational tools can be seen from the scope of these PhD theses, which are listed below.

Starting in April of 1998, the telescope will be operated by a new consortium, consisting of Yale, Ohio State University, the University of Lisbon (Portugal), and CTIO. 10% of the observing time will go to the University of Chile, under the agreement by which AURA operates in Chile. Of the remainder, 30% will be allocated to each university, with 10% reserved for the CTIO users community. The telescope will be equipped with a new instrument comprising both an optical CCD imager and an IR imaging array, which is currently under construction at OSU. The telescope will be operated in queue observing mode, optimized for monitoring projects and targets of opportunity. The observing will be done largely by Chilean service observers, but researchers from the three universities (especially graduate students) will frequently fill in when the CTIO staff members are on vacation, or otherwise unavailable. Information on how the community can apply for time on this telescope will be published in a subsequent newsletter.

At Yale, we are looking forward to working with our new partners. We expect that the combination of new instrumentation and novel observing modes will allow our telescope to continue to make important scientific contributions over the next quarter century, as it has done in the previous one.

Yale PH.D. Theses Employing Significant Amounts of Time on Small CTIO Telescopes

Jim Rose, 1977 "*A Dynamical Study of Compact Groups of Galaxies*"

Horace Smith, 1980 "*An Investigation of Abundance Gradients Within Galactic Globular Clusters*"

Bruce Twarog, 1980 "*An Observational Study of the Chemical Evolution of the Solar Neighborhood*"

Barbara Anthony-Twarog, 1981 "*A Photometric Search for White Dwarfs in Intermediate Age Open Clusters*"

Bob Boyle, 1981 "*Intermediate Band Surface Photometry of Intermediate Galaxies*"

John Laird, 1983 "*Carbon and Nitrogen Abundances in Field Dwarf Stars*"

Nelson Caldwell, 1983 "*Star Formation in Early Type Galaxies*"

Jim Schombert, 1985 "*The Structure of the Brightest Cluster Galaxies*"

Taft Armandroff, 1988 "*An Observational Study of Disk-Population Globular Clusters*"

Bob Light, 1988 "*Photometric Analyses of Abundances in Dwarf Spheroidal Galaxies and Globular Clusters*"

Jo Ann Eder, 1990 "*SO Galaxies: Their Gas Content, Structure and Environment*"

Ata Sarajedini, 1992 "*Globular Cluster Photometry Near the Turnoff: Blue Stragglers, Relative Ages, and the Horizontal Branch*"

Andy Layden, 1993 "*The Metallicities and Kinematics of Local RR Lyrae Variables*"

Esther Zirbel, 1993 "*The Environment of Radio Galaxies*"

Ren Mndez, 1995 "*A Semi-Empirical Model for the Distribution of Starcounts Color, and Kinematical Properties of Stars in the Milky Way*"

Xinjian Guo, 1995 "*Galactic Structure, Kinematics, and Chemical Abundances from UBV Photometry and Absolute*

Proper Motions to B 22.5 Towards the South Galactic Pole"

Jerry Orosz, 1996 "*Optical Observations of Black Hole X-ray Novae*"

Eric Rubenstein, 1997 "*The Search for Main Sequence Binary Stars in Galactic Globular Clusters*"

Becky Koopmann, 1997 "*Environmental Effects on Morphology and Massive Star Formation in 93 Bright Virgo Cluster and Isolated Spiral Galaxies*"

Sydney Barnes, 1997 "*The Rotational Evolution of Young, Solar-Type Stars*"

My apologies to anyone who was inadvertently omitted from this list.

Charles Bailyn, Yale University
bailyn@astro.yale.edu

Table of Contents - -

Table of Contents - -

CCD News: Still Pretty Mixed

On the positive side our new Tek 2048 CCD (SITe 2048 #6) continues to live up to its early promise as a really excellent device. It will primarily be used for Direct imaging and Echelle spectroscopy at the 4-m and 1.5-m telescopes. Although during its initial use at the telescope the full well capacity was rather low for one of the four amplifiers, this has been rectified by further adjustment in the laboratory. Full well is now greater than 256K e- on the two upper amplifiers and greater than 180K e- on the lower pair, very similar to the performance of our other two SITe CCDs. The only remaining fly in the ointment is that although, after prolonged periods in the dark the dark current of this detector is a very low 0.7e-/hour, even quite short periods of exposure to room lights results in a catastrophic level of dark current (8e-/hour after a 1 minute exposure and 65e-/hour after only 10 minutes). This excess dark takes many days to decay away. This is of particular concern for Echelle users especially as it is very difficult to install the CCD on the spectrograph without exposing the detector to some light. Nonetheless, experience during a recent echelle run shows that with careful handling during the installation the excess dark current can be kept to a level where it does not appreciably contribute to the noise budget, even in long exposures. When we have encountered this phenomenon in the past it has been due to fluorescence of the dewar window; however, in this case the dewar window is known not to suffer from this problem.

On the bad side the freshly deposited lumogen coating on the spare STIS 2048 CCD obtained from KPNO (see NOAO Newsletter No. 51 p. 27) fractured due to thermal stress and began to de-laminate after only a few carefully controlled thermal cycles during laboratory characterization. This CCD also proved not to be very good after more extensive laboratory testing. Inspection of our original STIS CCD re-coated at the same time revealed that its coating was also fractured after only a single cooling cycle. Consequently we still have no CCD that can be dedicated to use on the Schmidt. Hope is in sight in that KPNO has agreed to loan us the STIS CCD previously used on the Burrell Schmidt, although this device was used with only a single amplifier so the properties of the others are not yet known. In the meantime we have been able to dedicate SITe 2048 #5 to the Schmidt for the remainder of the second semester 1997 and hope to be able to do so during first semester 1998. The higher QE of this thinned CCD is an advantage for many programs, but its larger pixels (2.3"/pixel compared to 2.0 for the STIS) is a problem for others. This situation does leave us dangerously short of any backup in the event of the failure of another of our CCDs and makes it very difficult to schedule time for preventive maintenance or other laboratory work on our CCD systems.

As someone commented recently, "It's like a bad off-Broadway play. There seems to be a different cast every night." Here is the cast at the time of writing: SITe 2048 #6 for 4-m and 1.5-m direct imaging and echelle spectroscopy; Tek 2048 #3 for 0.9-m direct imaging SITe; 2048 #5 for Schmidt direct imaging; Loral 3K for 4m spectroscopy (R-C, Argus, Echelle) Loral 1K for 1.5-m spectroscopy (Cass. Spec) Tek 1024 #2 for Fabry Perot, some direct imaging. See the CTIO WWW pages for more information on the characteristics of each CCD.

Note that the BTC mosaic imager is also available for use at the 4-m prime focus and is to be preferred for all programs except those for which the large area covered is not important, or which require filters not available in 6 x 6 inch size.

Speaking of the BTC, users of this instrument in particular will be pleased to know that a Sun Ultra 2-200 workstation with 54Gb of disk space has now been installed as the data reduction computer at the 4-m telescope. With both the BTC and Arcon we expect that the resulting data will be written directly to disk on this machine, although the acquisition system will run on a different machine. The BTC has also been hooked up to Save the Bits, so data from all instruments in use at CTIO are now being backed up for an archive.

Steve Heathcote, Roger Smith
sheathcote@noao.edu, rsmith@noao.edu

Table of Contents - -

Table of Contents - -

NOAO Newsletter - Kitt Peak National Observatory - December 1997 - Number 52

4-m Dome Vents Open!

As the accompanying picture shows, the 4-m has just become a well-ventilated telescope! The 4-m dome vent project was initiated to improve the delivered image quality (DIQ). Seeing measurements, combined with temperature readings at various points around the dome, have established that the local thermal environment is the largest culprit currently degrading the 4-m DIQ. Over the past two years we have attempted to tackle the thermal problems by (a) implementing a mirror cooling system, (b) installing a dome-air mixing fan, and now (c) installing dome vents. We expect that the dome vents will provide the largest improvement in the DIQ. The 22 panels provide 1600 ftÂ² of opening; the dome slit provides an additional 2300 ftÂ². Depending upon the wind direction, we expect that a 10 mph wind will provide 100-325 flushes of the dome per hour. This is about one-third the area-to-volume ratio that is provided by dome ventilation at the WIYN and 0.9m telescopes, and is essentially identical to that installed some years ago at the CTIO 4-m telescope.

Caption: The 4-m dome with its vents open

Caption: Closeup of the ventilated 4-m dome

The engineering and design of this project were carried out by Tony Abraham and Khairy Abdel-Gawad, with Bruce Bohannan providing project management. John Hoey and Ron Harris provided mechanical support, and Scott Bulau, David Stultz, and Guillermo Montijo provided electronic support. The mechanical installation was carried out by Central Facilities under the supervision of John Dunlop, with John Scott managing the mountain crews and contracted people.

Now that the dome vents are in use, our next significant effort will be to replace the primary mirror supports with an active system. Wavefront measurements suggest that astigmatism and coma add about 0.10-0.15" to the DIQ, depending upon location in the sky. We expect to be able to remove most of this by controlling the pressure in individual air bags, in much the same way that CTIO has improved the image quality at the 4-m Blanco telescope. We are planning to install the hardware for this project next summer when the primary is removed for aluminization. Further tests are underway to understand if we need to provide active support of the secondaries.

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

---

Table of Contents - -

Table of Contents - -

WIYN Queue Program Update

The WIYN Queue observing experiment is in the midst of its fifth semester of operation. The NOAO share of science programs on the WIYN telescope has been scheduled almost exclusively within the queue program since the 2nd semester of 1996. Since the expansion of the queue program to encompass nearly the entire NOAO time allocation, 164 nights have been given to queue observing. During the past two completed semesters (102 nights), 35 of 42 "long" observing programs (programs requiring more than 2 hours to complete) were serviced and 16 of these were completed. For the same period, 21 of 24 2hr queue programs were activated, with 13 being completed. After gaining this amount of experience in managing an observing queue for an oversubscribed facility, it is time for a careful review of the current queue process and development of a strategy for the future progress of this experiment.

The NOAO Director's Office has electronically sent a questionnaire to the NOAO WIYN telescope user community to gather data from the investigators' perspective on the scientific effectiveness and efficiency of the queue program. Roughly 370 astronomers who had applied for WIYN telescope time since the start of science operations at the facility have been sent questionnaires: the mailing includes both PIs and Co-Is. If you have not received a questionnaire and you applied for WIYN telescope time in the past, please send your email address to Paul Smith (psmith@noao.edu) if you would like to receive one. Responses were due on 1 November; however, the Queue Team would be interested in your suggestions and opinions, even if your responses are returned too late to be used in the formal survey. Results from this survey will be a major factor in determining the future development of the WIYN queue observing program.

The WIYN Queue Team welcomes the arrival of Abhijit Saha to NOAO. The NOAO WIYN queue program is among the many activities in which Saha will be involved. He brings considerable experience in observational astronomy (particularly direct imaging techniques), telescope scheduling, and an impressive research background to the WIYN queue program. Saha will be an important and welcome contributor to the complex and labor-intensive WIYN queue experiment.

Progress of the WIYN queue program for the current observing semester can be found on the World Wide Web at http://www.noao.edu/wiyn/obsprog. If you have any questions, suggestions, or comments about the queue process, please send them to wiynq@noao.edu. As always, we encourage investigators to send us reprints and preprints of any work that includes data taken by the WIYN queue observing program. Please send relevant publications to:

WIYN Queue Experiment
c/o Paul Smith
National Optical Astronomy Observatories
P.O. Box 26732
Tucson, AZ 85726-6732

Paul Smith for the WIYN Queue Team,
(Di Harmer, Abhijit Saha, Daryl Willmarth)

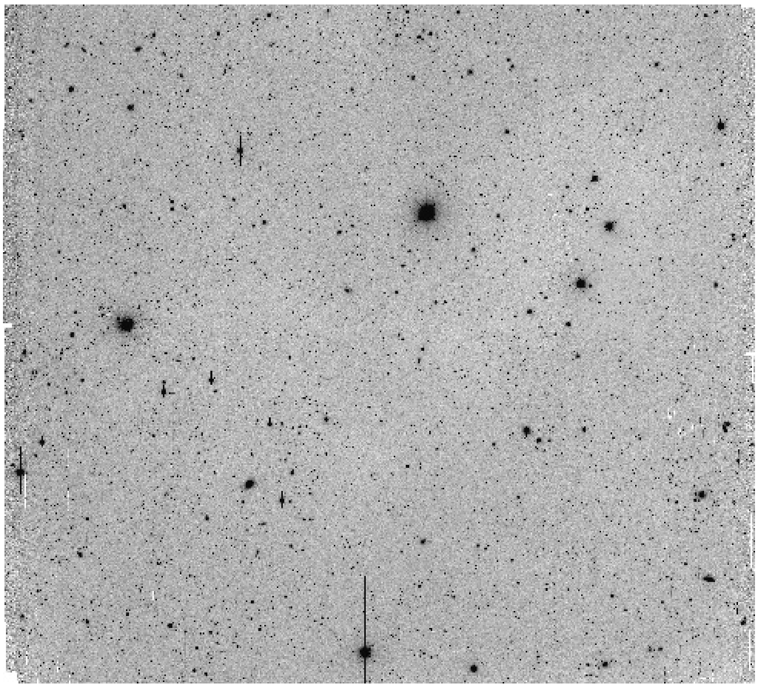
Table of Contents - -

Table of Contents - -

CCD Mosaic Imager Status

The CCD Mosaic Imager continues to evolve toward a mainline facility instrument. Fourteen nights of science observing are scheduled with the Mosaic at the 4-m this semester, and 27 nights at the 0.9-m. We had two engineering/checkout nights before the 4-m runs in September, and two more of these nights in October. For the 1998A Semester (February-July 1998), we received 18 Mosaic 4-m proposals for 66 nights, plus nine Mosaic 0.9-m proposals requesting 61 nights. Some specific areas of progress are:

- The IRAF Data Capture Agent, which automatically transfers images from the data acquisition computer to the data reduction computer, is in routine use. In addition, postprocessing capability was added for the October block. This postprocessing is controlled via the new Data Capture Agent GUI. For now, the primary functionality is the automatic display of the image upon readout. Via the GUI, the observer can turn this option on or off, resize the image display to optimize it for speed or resolution, and view the status of the readout. The next major steps to be included with postprocessing are automatic log sheet generation and data taping.
- We received and tested four new Mosaic filters: three Ha redshifted (6611/81, 6652/81, 6691/83), and [OIII] (5021/56). The [SII] filter (6730/81) did not meet specifications (primarily due to a crack), nor does the [OIII] off-band (5315/290). We are retaining the originals while the vendor fabricates suitable replacements. In addition, we are in the process of procuring the following filters: Johnson U, [OIII] redshifted, and Sloan g', r', i', and z'.
- We have upgraded the two Exabyte drives on the data reduction computer, Driftwood, for increased speed. The new drives are Exabyte Eliant 820s. They can write a Mosaic image using the IRAF task `mscwfits' in just under 3 minutes, about twice as fast as the former Exabyte drives. Tapes written with the Eliant 820s are readable by Exabyte 8505s. We continue to offer the faster DLT-7000 tape drive (1.25 minutes per Mosaic image), and we are gaining experience in writing and reading DLTs.
- As discussed in previous Newsletter articles, we plan to replace the current engineering-grade CCDs with thinned science-grade CCDs from SITe. Two of these science-grade CCDs have now been received. Initial testing shows excellent cosmetics, charge-transfer efficiency, readout noise, surface flatness, and quantum efficiency. We expect the other six needed CCDs over the next several months. As of this writing (late October), we expect that the upgrade to science-grade CCDs will be completed during June or July 1998. We will keep users and proposers informed of progress through the Newsletter and the Mosaic Web page (http://www.noao.edu/kpno/mosaic/mosaic.html) .
- Excellent image quality was seen on several occasions during our September 4-m run. The tightest images had FWHM of 0.65" in the R band across the entire 36' x 36' field, demonstrating the image quality improvement offered by the new corrector.
- The IRAF data reduction tools have been enhanced and improved (see following article). A sample fully reduced Mosaic image is shown in the Figure.



Caption: This deep R-band image, taken by B. Jannuzi as part of the NOAO Deep-Wide Survey, is a stack of five dithered images, each having an exposure of 600 seconds. The gaps and bad columns in the raw images from the eight engineering-grade CCDs are completely removed in the reductions.

Taft Armandroff, George Jacoby, Todd Boroson
(for the Mosaic Team)

Table of Contents - -

NOAO Newsletter - Kitt Peak National Observatory - December 1997 - Number 52

The Reduction of Mosaic Images

The reduction of Mosaic camera images at first glance is just like that of any other CCD camera, ignoring the immense amount of data contained in a single Mosaic image. As is standard, reduction requires overscan correction, followed by zero, dark, and flat field corrections. In detail, however, full reduction of Mosaic data requires a number of steps not normally encountered in the routine reduction of other CCD camera images. The driving factor in Mosaic reduction is the expectation that the observer will not simply obtain a single Mosaic exposure of an astronomical field, but will most likely want to construct a deep integration from several Mosaic images spatially offset or "dithered" from each other to cover both the gaps between the individual CCDs and their extensive regions of defects. Stacking dithered Mosaic images places high demands on the uniformity of the initial data reduction as well as requiring several additional steps once the basic reduction of the individual exposures is complete. Further, the large portion of defective areas in the present "engineering grade" CCDs complicates many of these steps. The Mosaic camera also has a spatially variable pixel scale that has important implications for ensuring a uniform photometric zeropoint in the reduced images. This article touches on the basic aspects of Mosaic image reduction that we explored while reducing data from the NOAO Deep-Wide Imaging Survey, which was largely done using an earlier version of the IRAF MSCRED package. At this writing we are still refining the reduction software and learning about the camera. We share what we found here with the caveat that this is still a work in progress.

At the Telescope

Good data reduction begins with obtaining good calibration data at the telescope. The Mosaic CCDs operate at warmer temperatures than usual, so good dark frames are required, in addition to the usual zero frames. Further, we recommend that you obtain darks with exposures similar to your science images. While many of the dark features will scale with time, there are regions of charge overflow that may be not completely linear. Dome flats provide a fair basic flattening of the frames to 2% or so, but night sky flats or illumination corrections will be required to produce images that can be stacked without introducing obvious artifacts. In the course of the NOAO Deep-Wide Survey, which works on regions of "blank" sky, we naturally obtained the images we needed to generate sky flats, and were able to flatten the images to 0.1%; at this time we have not attempted to use twilight flats and cannot comment on them.

The default Mosaic dither pattern is a sequence of five exposures designed to insure at least 80% coverage for all portions of an astronomical field, given the gaps between the CCDs and many of the large defects, which in a number of cases are even wider than the gaps. Other things to be aware of include the small wells and nonlinear response of CCD4. This chip saturates at only 4×10^4 e-, and becomes nonlinear by more than 1% above 1.5×10^4 e-. At this time we are investigating the nonlinearity, which is unexpected, but the full well still sets a hard limit to the exposure level. In contrast, the other seven CCDs appear to be highly linear up to this exposure level, and have much larger wells. Lastly, good astrometry is required to register and stack the Mosaic images. We have excellent solutions for the R and V band filters, but the scale varies slightly with color, so you may want to image an astrometric field if you are using filters not bracketed by these colors. The Mosaic support team will eventually supply solutions for most of the filters.

Basic Image Reduction

Almost all of the basic image reduction is done under the IRAF MSCRED package. Before you get started, you should be aware that the Mosaic multi-extension FITS data format means that you will have to be careful to stick to the routines in MSCRED that can handle this format. In many cases, useful routines from CCDRED have been rewritten with the same name to be available in the MSCRED package. IRAF routines in other packages can be used on one CCD at a time either in scripts or the command line, but will not work directly on an entire mosaic image at once. At present we are still working on this issue, but there is an MSCCMD routine that acts as an interpreter, allowing you to use traditional IRAF routines on the Mosaic files.

One of the first things that you're likely to do is to stack sequences of zero, dark, and flat exposures to produce "superimages" to feed into CCDPROC. On the assumption that the darks and zeros are all the same, using ZEROCOMBINE and DARKCOMBINE presents no complications. On the other hand, you are likely to want to scale the flats by their modes, and this at present can be tricky. Because of the importance of image defects, modes and other statistics can be biased by bad values. To estimate modes in our reductions to date, for example, we wrote a script that estimated the mode in two passes. The first pass restricted the range of allowable pixel intensities to "plausible" values to exclude "wild" numbers; the second pass used the mode from the first pass to limit the range of allowable values to between zero and twice the initial mode. With the first version of the software, we had to write a stand-alone FORTRAN program that averaged the modes from the eight CCDs with sigma rejection (and that ignored CCD4, as well) and then feed the scale factors to the combining task. These improved algorithms for mode estimations and combining to a single scaling value for each exposure will be part of the standard MSCRED version by the time you read this article.

With good zero, dark, and flat field images in hand, the basic image reduction is done with the MSCRED version of CCDPROC. If your data consists of a dither-sequence that you intend to stack later, we recommend that you do not interpolate over bad pixels; this is more logically done downstream, as we discuss later. One of the last basic steps that you may attempt is to build a sky flat or illumination correction from a portion of your reduced data. You could try going directly to a sky flat without any prior reduction with a dome flat (or any other serviceable flat), but working with roughly-flattened data first allows for more accurate estimation of the mode in the presence of faint astronomical sources, and further allows for better detection and rejection of biased regions of the images. At the same time, flat field reductions will produce wild values in the defect regions, so extra care is required when estimating modes or other statistics from flattened data.

In passing, we mention that we hope to establish a basic database of calibration images that can help you get started in your own reductions. For example, we have already found that a flat field from an earlier month provides an excellent initial reduction of new data. We also have an excellent ad hoc bad pixel mask that we will continue to refine. At the same time, the dark current appears to vary from run to run, so you will want to obtain your own dark frames.

The Variable Pixel Scale and Zeropoint Uniformity

A key assumption in traditional reduction of CCD images is that the pixel scale is uniform and that a properly reduced blank sky image will have a uniform and flat appearance. Unfortunately, this is not correct when the pixel scale varies over the field. In the case of Mosaic, the pixel scale decreases approximately quadratically from the field center, with the pixels in the field corners being 6% smaller in the radial direction, and 8% smaller in area, given the complete astrometric description of the field. Pixels in field corners thus would properly detect only 92% of the sky level seen in the field center, even with uniform sensitivity. At the same time the same number of *total* photons would be detected from a star regardless of how many pixels the PSF would be distributed over. Forcing the sky to be uniform over the image would have the deleterious effect of causing the photometric zeropoint to vary from center to field corners by 8%. Note that this effect is different from vignetting, where the flux actually delivered to the image margins is less than that at the center, an effect that is corrected by the flat field.

In practice, the photometric effect of the variable pixel scale can be ignored *provided that the reduced images will be part of a dither-sequence to be stacked later on*. As discussed below, prior to stacking the images, they first must be regridded to a tangent-plane projection, which has pixels of essentially constant angular scale. This is done with the MSCIMAGE task, which regrids the pixels and has a "flux conservation" option that can scale the pixels photometrically by the associated area change. If this function is disabled, then "improperly" flattened images will have a uniform zeropoint restored with this option *turned off*. In short, the flat field is already adjusted (if inappropriately) for the different pixel sizes, so MSCIMAGE would then do no further adjustment. Stars would be too bright in the corners of the flattened images, but after regridding, their total fluxes would be seen to be scaled down to the appropriate values.

If the Mosaic images are to be analyzed individually, however, as might be done for standard star fields, then after the flat field reductions are complete, the differential scale effects must be restored. At present we are in the process of developing a routine in the MSCRED package to do this, without actually regridding the image with MSCIMAGE (which can also be done with images not part of a dither-set). The correction process is simple; the scale at any point in the Mosaic field is already known from the astrometry, so one could just calculate and multiply by a correction surface. The final image would appear to have a variable sky level, but would be photometrically uniform. We are contemplating allowing an option to subtract a sky level prior to the correction and perhaps adding it back afterwards. In the latter case, the sky would be cosmetically but not photometrically uniform, and could cause confusion if the frame is ultimately regridded to a constant scale. We also note that performing surface photometry on Mosaic images with their native sampling can cause biased results unless care is taken to track the changes in the pixel scale.

Stacking Mosaic Images

In many ways the real work of reducing Mosaic data comes when preparing to stack the images to make a final deep image free from gaps and artifacts. Not only is there a premium on having well-flattened data to begin with, but one must also understand the relative photometric and sky level variations among the images in a dither-set. At any point in the final stacked image, different frames will be making differing contributions. Any differences in scaling will produce noticeable artifacts in the final sky background or zeropoint. In practice we have found that the stacking works beautifully with data obtained under clear conditions and with no bright stars near the fields; on the other hand we have found that simple reduction strategies produce very poorly stacked images if the shape of the sky over the field or scattered light contributions varied over the course of a dither-sequence (or over the course of the night used to define the sky flat).

The first step in stacking the reduced Mosaic images is to register them to a common coordinate system. This is done with the MSCZERO and MSCREGISTER programs. The MSCZERO routine can be used to set the coordinate system origin for any given image, given a known position or even *ad hoc* position for any star. There are three important uses of MSCZERO. The first is to set the coordinate zero point fairly accurately and then read back coordinates. With a reference star one can obtain useful "real-time" coordinates at the telescope. We did this to check asteroid detections against known asteroid positions. The second use of MSCZERO is to identify a list of stars in one "fiducial" image that will be located in the other images in the dither-set. A third use is to reset the origins of the other images in the dither-set to match the fiducial image in the event that the coordinate origin is lost or corrupted (as happened a few times in our reductions). The MSCZERO routine uses the known astrometric description of the Mosaic field so that the location of any star identified can be used to set a global origin. In passing, we note that the quality of the astrometric solution is excellent; stars can be located to a fraction of a pixel (0.26" at the 4-m) in all portions of the field.

Registering the images in a dither-set to the fiducial image can in principle be done entirely with a single star using MSCZERO, but MSCREGISTER offers more options and has the ability to use a number of stars to find the best registration. At this time we are still experimenting with MSCREGISTER, but have had the best luck with identifying about 10 stars or so in the fiducial image and asking MSCREGISTER to locate them in the other dither-set images.

MSCREGISTER uses the astrometric solution and recorded relative telescope offsets to locate the registration stars in a given image (it can also be assisted by running the images through MSCZERO if this assumption fails for some reason). Once a given star is located, it is cross-correlated with the same star in the fiducial image to calculate a positional offset. You have the option to review the quality of the match to decide if it is acceptable. The final offset is the average of the individual offsets, with a check for outliers. At this time, we think this interactive approach gives the best confidence that the correct offsets are being used. In the future, we hope to automate rejection of poor cross-correlation matches. MSCREGISTER presently has the option to find an offset by cross-correlating random regions of the images, but at present this often leads to computing offsets from regions with no bright objects or containing large defects.

The penultimate step in stacking Mosaic images is to regrid them into *common* tangent-plane projections using MSCIMAGE. The use of a common projection aligned to the centers of the pixels is done so that the shift and stack step does not require any further resampling. Up to this point the individual CCD images are each stored in their own partition in the multi-extensions FITS files. MSCIMAGE "pastes" the individual CCDs into a large single FITS image, accounting for their accurate relative positions and rotations, given the astrometric description of the field. MSCIMAGE further regrids the pixels into a tangent-plane projection, which yields pixels of essentially constant angular size over the extent of the Mosaic field. This is also the best point to fold in knowledge of the bad pixel map. The bad pixel map itself can be regridded by MSCIMAGE, giving the final routine, MSCSTACK, complete knowledge of where the bad pixels are. If the bad pixels had been replaced prior to this point, and had not been flagged in the Mosaic images themselves, their locations would have been unavailable in the final stacking.

Regridding the Mosaic images of necessity requires a method to calculate new pixels interpolated from the original ones. One can select from any number of the standard IRAF interpolation routines; however, given the immense quantity of the data involved, we have always selected bilinear interpolation for speed considerations. Unfortunately, bilinear interpolation smooths the noise slightly, and as the new pixel grid beats against the original grid, the noise in the tangent-plane image shows bands of coherent noise structure. This will be reduced somewhat in the final stacked image, given the spatial decoherence of the images in the dither-set. At this time we are experimenting with improving the speed-performance of higher-order interpolation methods to avoid smoothing of the data. Lastly, as noted above, MSCIMAGE has the option to correct the flux in the regridded pixels for the variable pixel scale. Use of this option should only be invoked when this information is preserved in the flattened images to begin with.

The final step is to combine the reprojected dither-set images using MSCSTACK. This is the stage where careful attention must be paid to variations in zeropoint and sky level among the images. Even on photometric nights, the sky level is likely to change over the course of the dither-sequence. We have used the image modes to track the sky level, but again, one must be careful that the mode is not biased by the abundant bad pixels and defects. In detail for our reductions to date, we calculated the average sky level for a dither-sequence and then gave MSCSTACK a file specifying additive offsets for each image about this average. At this stage you should also account for any photometric variations among the images. MSCSTACK can also accept a file of multiplicative offsets. These might be based on an atmospheric extinction curve on photometric nights, or determined by comparing stars among the dither-set; we are exploring the use of MSCREGISTER to measure photometric as well as spatial offsets among stars. At this writing, we are also upgrading MSCSTACK to include options for calculating both forms of scaling, so specifying the scale factors in an external file may be no longer required.

The final stacking of the image by MSCSTACK can be done with any of the standard combining algorithms within the IRAF combine tasks. We have preferred to use an average value with sigma rejection; we also make complete use of the bad pixel map at this stage to eliminate known defects. One might be tempted to use a simple median, but in the limiting case of a large number of images this will still only yield ~ 80% of the signal-to-noise available from an average. On the presumption that most vectors of pixels to be stacked will be "OK," an average (with occasional rejection) will give the best answer.

Going all the way through to this stage has produced final stacked images of variable quality, depending on the conditions of the observation. In non-photometric conditions the sky may not be flat; further, scattered light from nearby objects may affect the sky over large areas---unfortunately, the pattern of scattered light varies as the telescope is dithered. A further complication is that computation of an average mode for an image may be affected by scattered light that affects only a small portion of the Mosaic field. At this time we are still working on a solution for stacking images of this type; the solution is likely to require fitting and subtracting a sky surface to the individual Mosaic images prior to feeding them to MSCSTACK. When conditions are favorable, however, we have produced beautifully flat stacked images free from defect, showing the full scientific potential of Mosaic camera, and providing a suitable reward for our hard work.

Tod Lauer, Frank Valdes

Table of Contents - -

Table of Contents - -

Flat-fielding with the 4-m PFCCD

Two recent visitor runs with the 4-m Prime Focus CCD Camera have impressed us with the need to carefully exorcise ghosts prior to flat-fielding in some PFCCD imaging applications. As described in the June 1997 issue of the NOAO Newsletter, the new prime focus corrector produces a faint ghost image of the telescope pupil. Since that time, the "Sol-Gel" antireflection coating has deteriorated; tests conducted by George Jacoby indicate that the ghost amplitude is about a factor of 2 worse than when the corrector coating was fresh last spring. The amplitude of the ghost is currently 1% or less at B, V, R, and under 2% at broad-band U, and 4% or less at I. The amplitude is larger for narrow-band interference filters (14% at 5007), and one can expect it to be even worse at the red or UV.

What to do about the ghost? Team Mosaic is investigating means of recoating the offending corrector element with a longer-lasting coating; we are also considering offsetting the PFCCD camera to remove the ghost from the FOV, or possibly reinstalling the old corrector for use between Mosaic runs. (Mosaic requires the larger corrector.) We do emphasize that one can adequately remove the ghost from the data by care in processing. In the direct imaging manual we rather cavalierly suggest that this ghost flat-fields out, but as both Howard Bond and Bill Harris recently pointed out to us, ghost reflections are additive rather than multiplicative, and really should be subtracted first from the dome flats, and secondly from the program frame. A prescription for removing the ghosts was suggested by Bill Harris and Doug Geisler: (a) using a narrow-band interference filter, obtain a high-contrast image of the telescope pupil ghost. Measure the background in four corners, subtract a mean background value, and thus produce a zero-background version of just the ghost. (b) on your flat-field images scale the ghost until you find an empirical match to the intensity above local background, and subtract, producing a ghost-less version of the flat-field. (c) use this image to flat-field your program field. (d) if necessary, scale the ghost to the residual in your program field, and subtract. This step should only be necessarily in cases where you are not measuring local sky.

We have conducted some on-the-sky tests which users of the PFCCD may find comforting. Using broad-band U, we did photometry of multiple exposures of a star both on and off the ghost image. We processed the frames in the normal way; i.e., without any effort to remove this ghost in either the flat-field or the program data, and compared the result to what we got by removing the ghost in the flat-field image. (After all, this is the real question: how well can you do photometry?) The six measurements showed an rms of 0.007 mag when reduced in the standard way (no ghost subtraction). Removing the ghost in the flat field alone reduced this scatter to 0.004 mag. The maximum difference we measured from "on ghost" to "off ghost" was 0.015 mag for the standard reductions; for the corrected image it was 0.008 mag. We thus believe that many people interested in photometry at U, B, V, and R can simply ignore these ghosts, although we encourage everyone to carefully examine their data.

Users of Mosaic should consult the Mosaic manual and/or the local gurus (tarmandroff@noao.edu; gjacoby@noao.edu) for recommendations concerning Mosaic. We do not know at present what solution we will be offering to PFCCD users in the spring, but observers should be prepared to perform exorcism as needed.

Phil Massey

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

---

Astronomy Gastronomy

Anybody who has been around an observatory for any length of time knows that morale has at least as much to do with the quality of the food served as with the weather. The dining facility on KPNO has been in operation for over 35 years, and it has developed a reputation (both good and bad depending on the year!) among both visiting astronomers and KP staff. Recently, however, the kitchen staff have earned a number of awards. Supervisor Barry Infuso has just received the honor of being named 1997-98 "Chef of the Year" by the Southern Arizona Chef's Association. In addition to his work at Kitt Peak, Barry is very active in the local community where he volunteers as a culinary consultant to the American Heart Association and University Heart Center.

As an executive chef certified by the American Culinary Federation and the World Society of Cooks, Barry takes great pride in his profession and in his Kitt Peak staff---Walter Vermilye, David Murray, Ruth Ramon, and John Gonzales. The kitchen operates seven days per week and serves an average of 2,600 meals per month. The cooks all enjoy the constant challenge of creating and preparing food for a variety of tastes and dietary needs. Through their dedicated efforts and high standards for food preparation and sanitation, the KP kitchen has received the coveted "A" award from the Pima County Health Department for the past four years. The last two surprise visits resulted in perfect 100 scores. Just how significant and unusual this sustained performance is can be demonstrated by reading the local paper, which regularly lists outstanding restaurants in Tucson that fall short of this standard.

Please join us in congratulating the staff for a job well done---let them know how much we appreciate it!

Sidney C. Wolff, John Dunlop

Table of Contents - -

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

Table of Contents - -

From the NSO Director's Office

The annual NSO summer workshop on Synoptic Solar Physics was held this year from 9-12 September in the new Sacramento Peak conferencing facility, which is part of the just-completed Visitor Center. The new conference location allowed a wider participation in this workshop than has been possible in the past. Thanks to the scientifically stimulating presentations and interactions of the participants and the efforts of the scientific and local organizing committees, including Sac Peak administrative and technical staff, this inaugural meeting was a great success, with the added benefit of demonstrating the quality of the new facility as a superb conference venue.

Immediately following the summer workshop, the Sacramento Peak staff celebrated two major occasions: the 50th anniversary of the establishment of the observatory and the 40th anniversary of AURA. AURA President Goetz Oertel visited Sac Peak for the occasion, and as part of that visit, he presented a safety award to the staff for outstanding safety performance at the site in 1996, a year in which not a single work hour was lost due to accidents.

The SOLIS proposal has passed the scrutiny of the NSF Director's Review Board and is now in the hands of the NSF Mathematical and Physical Sciences Directorate. Although there are a few remaining issues, we are hopeful that we will indeed see a new start early in 1998.

The NSF and the US Air Force are in the final stages of renewing the Memorandum of Understanding which provides for the fund transfer from the USAF to NSF for support of the Air Force program at Sacramento Peak. This program itself has seen a change in its operational structure. Effective 31 October, its affiliation has changed from the Phillips Laboratory to the Air Force Research Laboratory and is now referred to as the Solar Effects and Mitigation Branch.

Jacques Beckers

Table of Contents - -

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

Table of Contents - -

New Synoptic Solar Maps from NSO

Just as global maps of weather on the Earth allow forecasters and researchers to understand and predict terrestrial weather, similar synoptic maps of solar activity have been constructed and used since 1915. In recent years, digital maps of the whole-Sun distribution of magnetic flux have been used as boundary conditions for numerical models of space weather. Such maps have been constructed from observations made with the Vacuum Telescope on Kitt Peak since 1975 and have been a popular data product used in many investigations.

The old maps suffer from several minor problems. In a project partly funded by the Office of Naval Research, the software used to make the maps is being rewritten to correct these problems and to add some new products. The first results are superior to those from the old processing, and the new products show several intriguing new aspects of solar activity.

As part of this project, a new web page is now on-line and presents the most current synoptic maps in three projections (latitude, sine latitude, and polar), and at several levels of reduction. The web page also allows access to an archive of past maps in the various formats and reduction levels. Perhaps the most concentrated map is one which shows the location of active regions, large-scale areas of magnetic flux polarity, and an estimate of coronal hole boundaries. The web page is accessible from the NSO/KP home page via the most recent solar images link.

As time permits, the archive of maps made will be replaced using the old processing with newly processed versions of the old data. A near-term goal is to produce maps of solar magnetic flux that account for differential rotation and evolution of solar activity on a near real-time basis for use in numerical modeling of transient solar activity such as coronal mass ejections. This involves gaining a better understanding of how magnetic flux evolves on the solar surface---a daunting research task.

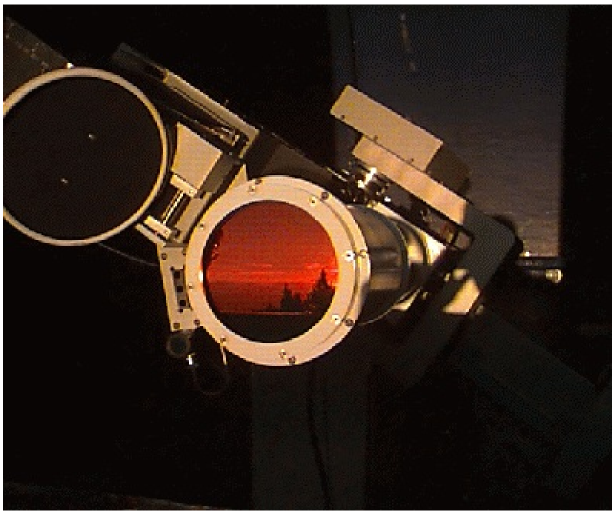
Jack Harvey, John Worden

Table of Contents - -

- -

Precision Solar Photometric Telescope on Its Way to Mauna Loa

A semi-automated solar telescope designed for precise surface photometry measurements is headed for installation at Mauna Loa. This instrument will be operated in collaboration with the High Altitude Observatory. It will work in concert with identical telescopes at the Osservatorio Astronomico di Roma and the NSO Sacramento Peak Observatory to obtain measurements which will help us understand the origins of the eleven-year solar luminosity cycle. The accompanying photo shows a view of the Organ mountains and the White Sands Basin reflected against the 15 cm telescope objective, from the site at NSO/Sacramento Peak Observatory, where the telescope was developed, assembled, and tested.



The PSPT telescopes use a new 2K x 2K pixel CCD (Thomson) camera that was developed for this experiment. The camera allows very high photometric dynamic range measurements with rapid (8 million pixels/s) readout, low readout noise, and large well capacity pixels. An active tip/tilt mirror stabilizes the full-disk image, while continuous scintillation measurements provide a mechanism for frame-selecting data to provide the highest possible spatial resolution allowed by the observing site. Photometric measurements in three 0.25 to 0.5 nm bandwidth filters at CaII K, a blue and a red continuum wavelength are obtained with photometric accuracy of about 0.1%. In combination with satellite measurements of the total integrated sunlight, the PSPT photometric network will allow us to understand the physical mechanisms that cause magnetic fields at the solar photosphere to affect the solar irradiance and luminosity.

The Precision Solar Photometric Telescope (PSPT) Project is funded jointly by the NSF/ATM and AST divisions. The instruments are collaboratively operated by the PSPT partners (HAO and OAR). The instrument was developed by Roy Coulter (Instrument Specialist), Haosheng Lin (Instrument Scientist) and Jeff Kuhn (Project Scientist).

Jeff Kuhn

- -

- -

Fundamentals of Filaments

For the past three years an international group of solar astronomers has been collaborating in a broad study of the structure and formation of solar filaments and prominences. The group calls itself the "Prom" for obvious reasons, and is led by Sara Martin (Helio Research Inc.) formerly of Big Bear Observatory. The group includes Martin, Oddbjorn Engvold (Oslo), Eric Priest (Saint Andrews),Vic Gaizauskas (Ottawa), Terry Forbes (New Hampshire), Aad Van Ballegooijen (Harvard), Karen Harvey (Solar Research Corp.) and Jack Zirker (NSO). The mixture of observers and theorists has turned out to be effective in pursuing a program of focussed research, as its lengthy list of publications testifies.

A subset of the group held its eighth meeting at Sunspot over the weekend of 1-3 November. Vic Gaizauskas presented a review on the formation of filament channels, and Aad Van Ballegooijen gave an update on global modelling of the hemispheric regularities of filaments and short reports on recent collaborative ground-based and space-based observing programs. Yuri Letvinenko, a colleague of Forbes, reported on his work on magnetic reconnection, an essential process in the formation of filament channels.

The group plans another meeting at Sunspot next March.

Jack Zirker

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

Table of Contents - -

NOAO Newsletter - National Solar Observatory - December 1997 - Number 52

Large-Format IR Array Camera: Progress on the Controller

The McMath-Pierce facility offers capabilities that are unique in the world for infrared solar observations: an unobstructed, all-reflecting light path (giving full access to wavelengths that the atmosphere transmits) and large aperture (for angular resolution and photon flux). These capabilities cannot be fully exploited without a state-of-the-art infrared array detector at the focal plane.

The present detector is a commercial 256 x 256 InSb array from Amber Engineering, re-housed in a dewar from Infrared Laboratories. This system was chosen for low initial cost and 1-5 m wavelength coverage. It has served well---for example, observing for the first time the spatial structure of the Sun's cool carbon monoxide "COmosphere" but the camera is becoming obsolete.

NSO plans to replace the Amber array with a state-of-the-art 1-5 m camera by taking advantage of NOAO's investment in the Aladdin array development project. The performance of an Aladdin-based system will surpass the current system in every important respect (dark current, readout noise, quantum efficiency, and immunity from electronic interference); its 15-20 Hz frame rate is well matched to the requirements of the infrared magnetographs (NIM and NIM-2).

NSO carried over FY 1996 funds into FY 1997 for an Aladdin controller to be constructed by the NOAO Instrument Projects Group. With the timely support of NOAO/IPG, funding was committed at the end of FY 1997 to purchase the hardware associated with the controller, including CPUs and A-to-Ds, I/O modules, power supplies, chassis, and enclosure. NSO expects to be ready by the end of FY 1998 to utilize a science-grade Aladdin array.

We thank Larry Daggert, Neil Gaughan and Richard Lund for their help in getting the requisitions out the door.

Lonnie Cole, Doug Rabin

Table of Contents - -

NOAO Newsletter - National Solar Observatory - December 1997 - Number 52

Computer Control of the Main Vertical Spectrograph at the McMath-Pierce Telescope

The main vertical spectrograph at the McMath-Pierce solar telescope has been operated manually since its construction, making it necessary to look up the wavelength and order that the user wished to observe in tables, to find the corresponding value in encoder units. The grating turret could be moved by means of a DC slue motor to the general region of interest. For final positioning, it was necessary to move the grating by hand, with a crank, to position the spectral feature accurately. With a resolution of up to 500K, this could be a time-consuming task.

As a final phase of the spectrograph upgrade, the movement of the grating has now been placed under control of a DC slue motor for large movements, and a stepper for fine control. Both motors are controlled by a VME-based computer running VXworks. In addition, a new type of hand paddle has been developed that will eventually replace all of the old "dumb" hand paddles currently used at the McMath-Pierce complex. This new hand paddle features a backlit ASCII display for informational feedback to the user. Also, each button on the hand paddle employs a backlit 36 x 24 pixel display. The button display can be dynamically changed as its function changes. The backlit color can also be changed from continuous or flashed red, yellow, and green.

The hand paddle allows both manual and automatic movement of the grating. In manual mode, the user can select either slue or stepper motor control, as well as three pre-defined speeds. As the grating is moved, the ASCII display indicates the current grating angle. The wavelength at the exit port is also displayed, based on the grating order entered into the hand paddle, the angle, and the grating (visible or IR) in use. In the automatic mode, the user enters the desired wavelength, order, or grating angle, and presses "go." The software will then position the grating using the appropriate combination of slue and stepper motor motions. The spectral line will appear at the photoelectric port. For quick optical setups, there is also a zero order function. In both the auto and manual mode, the user may also enter an offset angle to shift the desired spectral feature to the photographic exit port.

The first phase of the spectrograph upgrade is primarily designed to allow the user to control the grating position from the hand paddle. The second phase will allow users alternate methods of control. A standard command language will allow users to control the grating over a RS232 serial port, an ethernet port, or remotely via a web GUI interface. The serial/ethernet access was implemented to allow users who bring their own computers and instrumentation to control the spectrograph directly. The GUI will allow users in the main observation room to run the grating without the hand paddle, as well as providing support personnel with a means to remotely troubleshoot the spectrograph operation. Phase 2 should be completed by the end of the calendar year.

Lonnie Cole, Dave Jaksha, Carole Leiker,
Jan Schwitters, Ed Stover

NOAO Newsletter - National Solar Observatory - December 1997 - Number 52

Summer 1997 Shutdown of the McMath-Pierce Telescope

Due to scheduling constraints, the McMath-Pierce telescope shutdown in Summer 1997 was one of the shortest on record. Larry Reddell and Teresa Bippert-Plymate measured all of the telescope mirrors with the new Minolta reflectance meter and found that most of the mirror surfaces were in excellent condition after a full year in service. When cleaned, the mirror surfaces showed a degradation over the course of a year of less than 2%! Because of these findings, the decision was made to re-aluminize only the main heliostat, the west auxiliary #2 mirror (due to bat droppings), the east auxiliary #4, and the integrated-light mirror.

The shutdown work was progressing smoothly when the large Stokes vacuum pump for the solar aluminizing chamber failed. Unfortunately, the required parts could not be procured in time for this year's work, and therefore, the mirrors were loaded onto trucks and taken to the 4-m telescope chamber and aluminized. Aluminizing the west auxiliary #2 mirror has been postponed because of access problems. The parts for the chamber have arrived and await installation, and there are plans to revamp the pumps before next summer.

We are grateful to Khairy Abdel-Gawad, Larry Reddell, and the Kitt Peak crew for their efforts in getting the McMath-Pierce back on line in the scheduled time, in spite of the vacuum chamber problems.

Teresa Bippert-Plymate

NSO Observing Proposals

The current deadline for submitting observing proposals to the National Solar Observatory is 15 January 1998 for the second quarter of 1998. Forms, information and a Users' Manual are available from the NSO Telescope Allocation Committee at P.O. Box 62, Sunspot, NM 88349 for Sacramento Peak facilities (sp@sunspot.noao.edu) or P.O. Box 26732, Tucson, AZ 85726 for Kitt Peak facilities (nso@noao.edu). A TeX template and instruction sheet can be emailed at your request; obtained by anonymous ftp from ftp.sunspot.noao.edu (cd pub/observing_templates) or ftp.noao.edu (cd nso/nsoforms); or downloaded from WWW at http://www.nso.noao.edu/.

Dick Altrock

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

---

Table of Contents - -

Global Oscillation Network Group

The Global Oscillation Network Group (*GONG*) Project is a community-based activity to operate a six-site helioseismic observing network, to do the basic data reduction and provide the data and software tools to the community, and to coordinate analysis of the rich data set that is resulting. *GONG* data are available to any qualified investigator whose proposal has been accepted; however, active membership in a *GONG* Scientific Team encourages early access to the data and the collaborative scientific analysis that the Teams are undertaking. Information on the status of the Project, the scientific investigations, and access to the data are available on our *WWW* server whose *URL* is www.gong.noao.edu.

Operations

We are happy to report that the GONG network has provided excellent coverage of the Sun during the third quarter of 1997. The GONG instrument continues to operate at a high rate of reliability at all six sites. As reported for prior observing periods, much of the down-time occurred either at night or during periods of poor weather. Lost images due to instrumental problems remain at a minimum, with many of the image gaps filled by the simultaneously observed data from adjacent sites.

Down-time was associated with unusually severe winter weather at the Cerro Tololo site in Chile. Although no damage was incurred by the GONG instrument during the recent earthquake (with the exception of a blown fuse), communications to the site were lost for several days. The GONG instrument remained down for over 90 hours, but the event was overshadowed by the severity of damage sustained by the observatory and its infrastructure. Generous thanks to the staff at CTIO. In the midst of the extraordinary number of other problems facing them at the time, they were able to help track down the problem and bring the GONG instrument back on line.

Other weather-related down-time occurred at the Hawaii site when the Mauna Loa instrument suffered damage during a lightning storm. Communications were lost, other instruments around the observatory were affected, and some damage was incurred by the GONG electronics. The instrument was down nearly six days before the problems were isolated and damaged parts replaced. Another incident at Mauna Loa, causing a little more than 24 hours of lost data, was due to the suspension of a program that handles communications throughout the system. The cause is still unknown, but because other instruments at the observatory were disrupted simultaneously, the problem does not appear to be GONG specific. Sincere thanks to the on-site crew who contributed time to the GONG effort while tending to problems of their own.

The network instruments located at Learmonth and Mauna Loa suffered a combined down-time of about 47 hours due to a known intermittent problem. The data interrupt, which appears to be caused by a malfunctioning signal-generator card, is easily remedied by a reboot of the data acquisition system. Although the problem rarely occurs and is usually promptly corrected, a software patch may be implemented. The Exabyte tape drives continue to contribute their share to the number of lost images. About 14.5 hours of lost data accumulated at several sites due to the failure and replacement of problematic Exabyte drives.

The El Teide instrument was down for about a week during a scheduled preventative maintenance trip. This visit included all the routine maintenance tasks, as well as the replacement of several items that were compromising the backup capabilities of the instrument.

Data Management and Analysis

During the past quarter, month-long (36-day) velocity time series and power spectra were produced for GONG months 20 and 21 (ending 970625) with fill factors of 0.79 each. The fill factors for these two months were lower than those of the previous two months (0.92 and 0.89) but higher than the low of 0.73, which occurred during GONG month 13 (960712 through 960816).

The p-mode reprocessing campaign added GONG month 14 and the six month long (GONG months 14 through 19) time series, and power spectra were assembled.

During the current quarter, the project expects to reprocess months 12 and 13, to perform the original processing on months 22 and 23, and to produce a continuous ten-month long (one GONG year) time series and power spectra.

The project also began producing time series and power spectra from the intensity images. These products, generated from GONG intensity month 16, were produced using the new p-mode pipeline and archive. This was preceded by a test reduction of both the intensity and modulation images from month 16.

The Field Tape Reader (FTR) (the subsystem that receives the raw data cartridges from the observing sites) processed 94 cartridges (90 during the previous quarter) containing 554 (563) site-days from the seven instruments. 391 (378) site-days were calibrated.

During the past quarter, the DSDS serviced 14 (11 during the previous quarter) data distribution requests for 10,225 (3,286) files totaling 2.1 (0.9) Gigabytes of data. Each of these data requests was filled during the day on which the request was received. The DSDS performed 2,023 (1,532) data cartridge transactions (library check-ins and check-outs) in response to requests from the data reduction pipeline and other internal operations.

Data Algorithm Developments

Substantial progress has been made in the testing and implementation of advanced spectral analysis methods for helioseismic data. Rudi Komm has been working with both multi-taper and wavelet denoising methods and has found that applying both techniques in tandem to the GONG data substantially improves the quality of the estimated oscillation parameters. Specifically, the number of good converged fits increases by 50%, and the estimated variances decrease by a factor of 10. There is also no evidence that any systematic bias is introduced into the results by these methods. This is all good news, and a full fit of GONG month 16 is now underway with the new processing.

Comings and Goings

I am delighted to welcome Pat Eliason, who took on the mantle of authority as GONG Project Manager on 1 September. She has worked in planetary and earth sciences in the past, as well as bossing a construction crew or two, so ought to be able to handle our rowdy bunch!

Ron Kroll, who has served as acting operations manager since mid-June, officially donned the manager's cap and has taken over network control.

Roy Tucker has also just joined GONG to push forward the proof of concept 1024Â^2 camera system. "Should be a piece of cake" is the sort of approach we are all pleased to have on board.

Winifred Williams left the project on 31 October. Winifred has made substantial contributions in the areas of the spherical harmonic transform and the merging algorithm. We wish her well.

We are also happy to announce the arrival of Rachel Howe, who joined the project on 1 November.

Guillermo Montijo, GONG's lead electronics technician throughout the deployment and initial operations phase, has moved over to work with the "dark side" here in NOAO. We are glad he will be close at hand and his ever cheery smile will still be part of the organization.

John Leibacher

Table of Contents - -

Table of Contents - -

US Gemini Program

USGP Instrument Program

The US Gemini instrument program has been expanding, to include the Gemini Mid-Infrared Imager (MIRI). Requests for Proposals for the 8-26Â Âµm single plate scale imager were distributed 26 June, with a proposal due date of 8 August. The proposals were reviewed in August by an external committee, and continue to be evaluated. The MIRI is scheduled to be delivered to the Gemini South site on Cerro Pachon in the summer of 2000.

The Gemini Near Infrared Imager (NIRI), being built by the Institute for Astronomy of the University of Hawaii, held interim reviews in August and September. Fabrication has begun on the 1-5**Â** Âµm imager in the IfA machine shop, which is working on the dewar shell and major assemblies. Some of the prototype mechanisms worked so well in test that they could become deliverable hardware. The NIRI has three plate scales (0.02", 0.05", and 0.12" per pixel) and will be the commissioning instrument for the Gemini North telescope on Mauna Kea. PI Klaus Hodapp expects to deliver the instrument on schedule.

The Gemini Near Infrared Spectrograph (GNIRS) team at NOAO is holding its Critical Design Review 17-18 November. Most of the fabrication drawings are ready to send to the shop, and fabrication of parts is expected to begin in late November. Long-lead optical parts will be ordered at the same time. PI Jay Elias will deliver the instrument in early 2000.

NOAO completed the prototype InSb science detector array controller and began hardware integration of the controller for NIRI. The NIRI controller is scheduled for delivery in January, while the controller for the GNIRS will be delivered a year later.

Hughes Santa Barbara Research Center continued its foundry run of 1024 x 1024 InSb arrays for Gemini's near infrared instruments. NOAO is overseeing this contract, which has a goal of obtaining a science grade array for each of the two near IR Gemini instruments, plus a spare.

Work has begun on procuring science CCDs and controllers for the GMOS multi-object imaging spectrographs. A contract was placed with EEV for the 2K x 4K CCDs, and the first controller was delivered by the UCSD CCD lab. NOAO will integrate the work of the various suppliers and national observatories working on this project.

Mark Trueblood

Table of Contents - -

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

Table of Contents - -

IRAF Update

A public beta-test version of IRAF V2.11 was released at the end of June, followed by the fully tested EXPORT release in late August. A coordinated release of STSDAS, including data reduction support for the new STIS and NICMOS instruments on HST, was made available by STScI in September (this requires IRAF V2.11). Detailed notes for this release are available on the Web at http://iraf.noao.edu/v211revs.html. A summary of the major features of the release was also given in the last issue of this *Newsletter*. Highlights of the IRAF V2.11 release include many enhancements to online image data structures including a new FITS image kernel and a new machine independent ".imh" image format, major enhancements to the IMAGES package, incorporation of the latest versions of all the science packages, larger system buffer sizes throughout the system including support for longer file names and file pathnames, and updates for all supported IRAF platforms.

A new IRAF Newsletter, with detailed articles on the features of IRAF V2.11, exists in draft form and should be available soon (we would have had it out shortly after the V2.11 release but the ADASS conference interrupted things).

The initial August release of IRAF V2.11 supported only SunOS and Solaris platforms (a single release now supports both). Versions for all the remaining IRAF platforms are being prepared and should be available this fall. Those being worked on first are the DEC Alpha running Digital Unix, HP/UX, SGI, AIX, and all PC-IRAF platforms (Slackware and RedHat Linux, FreeBSD, Solaris x86, and a new port to the Macintosh running MkLinux). Updates for other IRAF platforms such as OpenVMS, DEC Ultrix, etc., will follow. As updates for these platforms become available they will be announced on the IRAF mail exploder (newsgroup/list adass.iraf.announce) and on the IRAF web pages. Please contact the IRAF group if you are uncertain about the availability of IRAF V2.11 for a particular platform.

The first patch for V2.11 is planned for release probably before this Newsletter goes to press. This patch will fix all bugs found since the EXPORT release in August (there haven't been very many). More importantly for users of the Sun platform, the Sun version of the patch will add support for Solaris 2.6. As we release V2.11 for new platforms these will automatically include any patches released up until the time of the platform release.

A new release, Version 1.1, of the X11IRAF package (Xgterm, Ximtool, etc.) was made available in early September and can be found in the /iraf/x11iraf directory in the IRAF network archives on iraf.noao.edu. This is mostly a bug-fix release to patch any problems found since the X11IRAF V1.0 release last spring. The new version of Ximtool also includes support for the new V2.11 image formats, and some optional experimental GUIs for Ximtool providing early versions of new capabilities such as a magnifier marker. In addition a new version V1.7.1 of SAOtng (an alternative image viewer for IRAF from SAO) was released in early September. See the URL http://hea-www.harvard.edu/RD/ for further information on SAOtng and related software.

The data handling system for the NOAO CCD Mosaic continues to be a major focus of development for the IRAF group at NOAO. An early but completely working version of the Mosaic DHS exists now; it and the Mosaic instrument have been in heavy use at the Kitt Peak 4-meter and 0.9-meter telescopes since mid-September. Major components of the Mosaic DHS include a data feed client for the Arcon controller used by the Mosaic, a Data Capture Agent (DCA) used to capture data to disk as multi-extension FITS files, a new GUI for the DCA, a message bus prototype used to tie all the DHS software together, and the MSCRED Mosaic data reductions package for IRAF. Within MSCRED, much work has been done on image combining and on calibrating the astrometric characteristics of the Mosaic. MSCRED is in heavy use this fall to reduce actual science data. An initial release of the DHS software for other observatories is planned for late this year; CFHT, Keck, and other observatories are collaborating on the development in the meantime. Development will continue in 1998, focusing on things such as the message bus framework (this is more a part of the NASA ADP-sponsored Open IRAF effort than of the Mosaic), real time image display, and addition of pixel mask support to MSCRED.

Members of the IRAF group attended the Astronomical Data Analysis Software and Systems (ADASS) conference in September. Papers on current IRAF developments were given by:

Lindsey Davis, "Astrometry with the NOAO Mosaic;"

Mike Fitzpatrick, "The IRAF Client Display Library (CDL);"

Doug Tody, "IRAF Message Bus and Distributed Object Technology;"

Doug Tody, Frank Valdes, "The Mosaic Data Capture Agent;"

Frank Valdes, "The IRAF Mosaic Data Reduction Package;" and

Nelson Zarate, "IRAF Multiple Extension FITS File Interface (MEF)."

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

Doug Tody, Jeannette Barnes

Table of Contents - -

NOAO FTP Archives

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

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

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

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

   catalogs---Jacoby et al. catalog, "A Library of Stellar Spectra"; "Catalogue
   of Principal Galaxies"; "Hipparcos Input Catalogue"; "Lick Northern Proper
   Motion Program: NPM1"; "Coud\'e Feed Spectral Library"; "General Catalog of
   Variable Stars, Volumes I-V 4th ed." and "Name-Lists of Variable Stars Nos.
   67-76."

   ctio (ctios1.ctio.noao.edu)---CTIO archives--- Argus and 1.5m BME
   information, 4-m PF plate catalog, filter library, instrument manuals,
   standard star fluxes.  (This archive is a nightly mirror of those files
   on ctios1.)

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

   gemini_NOAO (orion.tuc.noao.edu, cd pub)---Documents from the US Gemini
   Project Office.

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

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

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

   kpvt (argo.tuc.noao.edu)---KP VTT solar data productsmagnetic field,
   He I 1083 nm equivalent width, Ca II Kline intensity.

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

   noaoprop---NOAO nighttime observing proposal LaTeX forms.

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

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

   tex---LaTeX utilities for the AAS and ASP.

   utils---PostScript tools.

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

The following additional IP numbers are available for the machines mentioned above:

```
argo.tuc.noao.edu    = 140.252.1.21
ctios1.ctio.noao.edu = 139.229.2.1
gemini.tuc.noao.edu  = 140.252.1.11
helios.tuc.noao.edu  = 140.252.26.105
iraf.noao.edu        = 140.252.1.1
orion.tuc.noao.edu   = 140.252.1.22
```

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

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

Jeannette Barnes

Table of Contents - -

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

NOAO Newsletter Staff

Tod Lauer, Editor-in Chief

Division Editors

Jeannette Barnes, CCS
Todd Boroson, USGP
Robert Howard, NSO
Richard Joyce, KPNO
Tod Lauer, SCOPE
John Leibacher, GONG
Elaine Mac-Auliffe, CTIO
Priscilla Piano, NSO
Ron Probst, CTIO
Lorraine Reams, AURA

Production Staff

Joyce Duhamel
Mark Hanna
Shirley Phipps
James Rees
La Rae Rothe

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