BIMONTHLY SUMMARY

January - February 2001

The adaptive secondary hangs on its test fixture in the Steward Mirror Lab.
(Image by S. West)

Personnel

Duane Gibson was hired in late January as a Computer Specialist, Sr., and began employment in early February.

Temporary drafter Ricardo Ortíz was hired in mid-February as a full time Associate Engineer.

Graduate Research Assistant Prem Kandalu and temp worker Tony Nichols left the MMTO in early January.

Development

Instrument Commissioning

F-Spec

New cabling for the use of the Fairchild I-CCD off the topbox was constructed and tested prior to F-Spec installation at the end of February. We had been attempting to use what was thought to be the old cabling, but either it is not the old cabling or it has been modified by persons and for reasons unknown. Also, complaints have been received regarding video levels in the Fairchild. We are investigating, although performance appears to be normal. We are currently trying to identify a replacement intensified camera so that the venerable Fairchild can be retired.

Flamingos

M. Alegria and D. Smith hauled Flamingos to the MMT to install it on the telescope for its commissioning run.

Aluminizing

B. Kindred visited Austin Scientific January 15-16 to discuss specifics of the new cryopump. After considering several proposed changes we decided to make an exact clone of the existing pump. It should be ready for testing in early March.

Aluminum bar stock was ordered mid-January for the deposition electrical bus and support structure. T.A. Caid bid approximately $2.2K to roll the bars. We are looking into the possibility of rolling it ourselves.

Design of the new deposition system is nearing completion. Detailing should be completed and construction well underway by mid-April. There is much work to do before we aluminize again; we estimate one man-year.

Mirror Support

January began with an extensive effort by a large portion of the available mountain staff to repair and maintain the pneumatic cylinders used in the primary mirror support. As the temperatures dropped through the winter months, the primary support air consumption began to dramatically increase. It was discovered that the neoprene diaphragms in the cylinders had relaxed under compression and over time. By disassembling the cylinders, a method was devised using Teflon tape to repair them to the point where air consumption could be easily provided by either of the two air compressors.

The actuator seals were modified during this effort. This required the repair of the actuator test stand. P. Spencer and K. Harrar, with telephone support from D. Clark and K. Duffek, diagnosed and repaired the problems. The test stand required the replacement of a 5V surface mount supply fuse for the ADC, and the replacement of a 68230 programmable interface timer integrated circuit in the Greensprings IP Digital 48 module contained in the VME control rack. A common problem with IP Digital 48 is individual channel malfunction from voltage transients. The module can be configured by software for up to 48 digital I/O channels. An acceptable fix would be to reconfigure the entire I/O channels for integrator lockout use. Presently the teststand only uses one channel to control the integrator lockout function of the actuator. Should the present I/O channel quit, repair would only require rewiring to another digital I/O channel.

Another interesting incident occurred during actuator installation. When a single actuator is replaced in the mirror cell, it must be properly adjusted. That is, when the unit is installed, the shaft position must be within spec for best operation. When the shaft is incorrectly positioned by a large amount, the actuator could "machine gun." This symptom was evident in two improperly installed units.

The task of rewiring the cell computer backplane continues at an extreme background level. The mechanical assembly of the backplane is complete and one of the eight cables has one end terminated.

Primary Mirror Hardpoints

As reported in the July-August 2000 Bimonthly Summary, one of the primary mirror hardpoints breaks away and then re-engages for large slews in elevation. Relatively large forces can build up on the hardpoints (of order +/- 150N) because the outer loop of the mirror support system has insufficient bandwidth to correct the unwanted moments induced by large elevation motions at full slew rates. The hardpoints were designed to maintain stiffness for forces up to +/- 300N. Clearly, one hardpoint breakaway mechanism has become soft. Preliminary tests suggested that the failure is internal to the hardpoint and not due to a problem with the breakaway air pressure. It was decided to replace the hardpoint with the spare unit. The following figures show the hardpoint lengths vs. elevation for a large elevation motion before (top) and after the replacement.

As seen in the top figure, the soft force breakaway of the hardpoint caused its length to shorten by ~400 microns during the slew. After replacement (bottom figure), the length changed by less than 20 microns during the slew. In the future, we will have to address the remaining elevation-dependent hardpoint lengths (which are not dependent on slew rate), and the mirror support outer loop will have to be re-tuned to minimize the spurious forces put on the hardpoints during slewing.

Thermal System

During the month of February R. James, S. Callahan, M. Orr (SO), R. Murray (SO), and the mountain support crew installed the primary ventilation system in the cell. The attachment of the ducting from the rotating duct in the pit to the telescope was also completed by the end of February.

A Microchip Semiconductor PIC16C773-based test board was built and tested to develop the software needed to report force monitors and thermopile temperatures on the f/5 secondary mirror. The board contains the microprocessor, mux, 12/16-bit ADC, and signal conditioning circuitry for the thermopile inputs, with all the analog measurements output over an RS-232 link. On successive samples with a 12-bit ADC, the final result of the delta-temp data collection was a standard deviation of 0.006 degrees C with a peak-to-peak variation of 0.034 degrees C. The input scale factor was 0.5V/deg C with a +/-5V full-scale input at the ADC. The total noise referred to the thermocouple input was 1.8 microvolts. It is clear from the results that averaging the data over 1 minute periods will give more than adequate results. Total power consumption for the test board was 0.9 W. We expect that the version of the board to be used on the primary mirror will use about 1.5 W or less.

Work on the thermal system included configuring and testing a second thermopile radius to implement the measuring of the full diameter of the mirror. Each radii will be configured with an added thermocouple to the mirror cell isothermal junction block for a common thermal reference and for thermal coupling with the type E thermal system. Furthermore, each radii will be attached to its own HP DAU. Each DAU can be operated through a single computer with two RS232 ports. To this end, the "camera" computer in D. Smith's lab was connected to the two radii via two RS-232 cables and then loaded with a Tcl/Tk script installed and developed by S. West. The Tcl/Tk software improves interfacing with the HP DAU with a useful GUI that runs on both NT and UNIX operating systems.

A test setup was made of one complete diameter of the new type-T differential temperature measurement system for the primary mirror. For each mirror radius, five hex cells were connected in series with overlapping pairs of thermocouples. A checksum pair was connected to the two end cells. All thermocouples were connected to an HP 34970A data unit. The HP DAU was programmed over a serial link with a Tcl/Tk script run from a linux box. It was found that the checksum measurement agreed with the five separate differential temperatures added in series to an accuracy of several microvolts (40 microvolts/C), giving the system an accuracy of about 0.04 C ptp. Additional accuracy was gained by averaging more samples and/or integrating over more power line cycles. The system will meet our specifications, so the final wiring scheme is being planned.

Servos and Controls

The new mount interface chassis was completed during the reporting period and we expect to put it into service some time in March. It has been decided that more tools for servo characterization are needed in order to measure things like incremental encoder feedback, total torque, and telescope velocity/position. All this information will need to be digitized and logged into a PC. A board to handle this task is being designed and is expected to be ready in late April.

The assembly of the mount interface chassis has been completed, wrung out, and installed in the rack in the drive room. D. Clark and K. Van Horn have checked it out and it is operational. More work is necessary to clean up its interface to the mount computer. An additional IP carrier card and its associated modules need to be installed in the mount computer, and the additional ribbon cables connected to the mount interface chassis. Some additional cable modifications are necessary in order to complete this task.

f/9 Hexapod

An inspection of the hexapod showed that it is in generally good working order. However, the corners of the box that houses the single board computer are making occasional contact with several actuator lvdt rods. This will be addressed during summer shutdown.

f/5 Hexapod

ADS Italia continues performance testing of the individual struts.

Shack Hartmann for the f/9 Top Box

Lenslet geometry modeling continued for the low resolution Shack Hartmann wavefront sensor. Due to other commitments (and classes for Heidi), there was little activity.

High Resolution Interferometric Hartmann

This instrument was not used during this reporting period.

Miscellaneous

N. Caldwell and S. Callahan designed the f/9 primary and secondary baffles. They were fabricated at the University instrument shop. Steve Pompea (Pompea & Associates) was hired as a consultant to determine the best surface treatment to reduce scattering off the shiny aluminum surfaces of each baffle. After obtaining several samples of black flocking, it was decided to use a roll of adhesive backed material from Boston Felt. This will be installed during the next removal of the baffles from the telescope.

Computers and Software

The new mountain network came on line with new radios and much new bandwidth (which as yet has not been realized). In preparation to connect the radios at the downtown end, we ran cables in the Steward Building and began to arrange for a dedicated connection to CCIT.

The downtown backup computer was placed back into service with upgraded software so it will no longer be subject to security vulnerabilities and spam abuse. An Exabyte tapedrive was removed and returned for warranty repair.

New programming was focused on enhancing network performance within the mount software. As more and more applications begin to access the mount control computer, shortcuts taken in network programming are becoming significant bottlenecks. The first of several measures to deal with this problem was taken.

The data acquisition Sun computer named ringo, an old Sparc 5, was replaced with a Sparc Ultra 170E.

Optics

No activity to report.

General Facility

The new Harris 7 GHz microwave link was put into service. It currently handles the data and telephone links with the same bandwidth as the old 2 GHz link, so additional work is necessary to upgrade the data service to the mountain. SI will be handling this requirement soon.

Maintenance and Repair

The telephone contractor (Lenny) removed the key system from the pit and disconnected much of the unnecessary wiring from the system. While reliability has improved, it is still not great. K. Van Horn replaced all the batteries with some of higher quality, which has helped. The phones' going into a constant beep mode is indicative of bad batteries. We will watch for this to determine the normal replacement interval.

The paging system to the common building quit working. Someone had turned off the amplifier in the equipment rack. It had been off for many weeks, apparently.

The installation of the primary mirror ventilation system necessitated the modification of the cable trays in the yoke room, creating some very tight fits. Cables have been moved and seem to be functional. But, in the process of moving cables, a number were found that had been installed by various people (often visiting astronomers) without thought of proper installation or consideration of others who must deal with the cables in the future. We need observers to coordinate their cable needs more carefully with MMTO staff in order to know which cables need to be permanently installed. We also request that temporary cables be removed by whomever installs them. Duct-taped cables on the floor are unsightly and dangerous, and leave a residue on the floor.

Visitors

February 16: SI Emeritus Under Secretary for Science David Challinor and guest, Scott Benjamin, accompanied by C. Foltz.

February 24: George Coyne and Guy Consolmagno of the Vatican Observatory accompanied a Vatican Observatory Board to the telescope. J.T. Williams hosted the tour.

Miscellaneous

Steve West has assembled a fascinating web site that presents digital images of various atmospheric effects that he has seen from the summit of Mt. Hopkins. The site includes excellent images of glories, parahelia, coronae, etc.

The site's URL is: http://nemo.as.arizona.edu/~swest/atmo/atmo.html

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

MMT Conversion Internal Technical Memoranda

None

MMT Conversion Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

01-1 The Halo Black-Hole X-Ray Transient XTE J1118+480
Wagner, R. M., Foltz, C. B., Shahbaz, T., Casares, J., Charles, P. A., Starrfield, S. G., Hewett, P.
Submitted to *AJ*

01-2 H_2, C I, Metallicity, and Dust Depletion in the $z = 2.34$ Damped Lyα Absorption System Toward QSO 1232+0815
Ge, J., Bechtold, J., Kulkarni, V. P.
ApJ Letters, **547**, L1

01-3 Multifrequency Analysis of the New Wide-Separation Gravitational Lens Candidate RX J0921+4529
Muñoz, J. A., Falco, E. E., Kochanek, C. S., Lehár, J., McLeod, B. A., McNamara, B. R., Vikhlinin, A. A., Impey, C. D., Rix, H.-W., Keeton, C. R., Peng, C. Y., Mullis, C. R.
ApJ, **546**, 769

01-4 The Large Bright Quasar Survey. VII. The LBQS and First Surveys
Hewett, P. C., Foltz, C. B., Chaffee, F. H.
Submitted to *AJ*

Observing Reports

B. McLeod: January 29-31, Flamingos

Copies of these publications are available from the MMTO office. We remind MMT observers to submit observers' reports, as well as preprints of publications based on MMT research, to the MMTO office. Such publications should have the standard MMTO credit line: "Observations reported here were obtained at the MMT Observatory, a facility operated jointly by the Smithsonian Institution and the University of Arizona."

Submit publication preprints to *bruss@as.arizona.edu* or to the following address:

MMT Observatory
P.O. Box 210065
University of Arizona
Tucson, AZ 85721-0065

MMTO in the Media

Both the *New York Times* (February 20, 2001) and the *Arizona Daily Star* (February 22, 2001) ran articles about research being conducted at the MMT 6.5-m telescope. Working independently, teams from both the UA and Harvard (led by Mark Wagner and Jeffrey McClintock, respectively), obtained data on a stellar black hole. Its ideal location above the gas and dust of the Milky Way's galactic plane provides a fairly unobscured view. Their findings will appear in *The Astrophysical Journal*.

MMTO Home Page

The MMTO maintains a World Wide Web site (the MMT Home Page) which includes a diverse set of information about the MMT and its use. Documents that are linked include:

1. General information about the MMT and Mt. Hopkins.

2. Telescope schedule.

3. User documentation, including instrument manuals, detector specifications, and observer's almanac.

4. A photo gallery of the Conversion Project as well as specifications and mechanical drawings related to the Conversion.

5. Information for visiting astronomers, including maps to the site and observing time request forms.

6. The MMTO staff directory.

The page can be accessed in two ways. First, it can be loaded via URL *http://sculptor.as.arizona.edu*. Second, it can be accessed via a link from the OIR's MMT page at URL *http://cfa-www/cfa/oir/MMT/mmt/foltz/mmt.html*. The former should be used by interested parties west of the Continental Divide; the latter is a copy, which is locally mirrored at SAO and is much faster for East Coast access.