MMT Observatory

Smithsonian Institution & The University of Arizona®

BIMONTHLY SUMMARY

September – October 2003

The fiber positioner mounted on the nearly horizon-pointing telescope during the October Hectospec commissioning run. The fiber bundle, containing 300 fibers, runs inside the black S-shaped energy chain. (Image by D. Fabricant.)

MMT Observatory • The University of Arizona • Tucson, Arizona 85721 • PHONE: 520. 621. 1558 • FAX: 520. 670. 5740

Personnel

Steve King was hired in mid-October as an Engineer, Senior to augment the campus electronic staff. Steve comes to us from Kaman Aerospace, where he was recently involved in the LOTIS project. Welcome Steve!

Dan Blanco and Bill Kindred traveled to Ensenada, Mexico, October 20-22 to attend the 8th biannual Cleaning and Coatings Conference and Site Manager's Meeting. The meeting was attended by representatives from several major observatories around the world. Bill presented a paper on coating the MMT primary that was well received. Dan gave a brief presentation of the MMT conversion. Thanks to Bob Thixten (Palomar) and Mark Klaene (APO) for organizing this informative conference.

UA undergrad Zachary Graham was hired as a student electronic technician aide in late October.

At the September 15 Steward Observer's Lunch, Gary Schmidt reported on MMT summer shut-down and Doug Miller (CAAO) described the state of the MMT AO system.

Primary Mirror Systems

Primary Mirror Support

On two occasions the northwest quadrant actuators (actuators 129 through 152) failed the primary mirror bump test through an inability to apply a negative force (−50 lbs) to the mirror. The report indicates that either the command is not being seen by the actuator or the force monitor is not seeing the response. The behavior was attributed to possible intermittent or failed address byte/s in the cell crate translation card. In the first instance the translation card was reseated and the cell worked properly for about one week. During the second event an I/P digital I/O module was replaced, and it was observed that another I/P digital I/O module was walking out of its connector socket. Locking hardware was then installed for the I/P modules and the problem has not recurred.

Another actuator failure (#129) was the result of a blown 48 volt fuse in sector distribution panel #8. The actuator was inspected and found to have a bad DC-DC converter module. The actuator electronic card and fuse were replaced and this failure has not recurred. During this process several actuator cards were repaired and tested, and an effort to improve mirror cell documentation has been initiated.

Optics

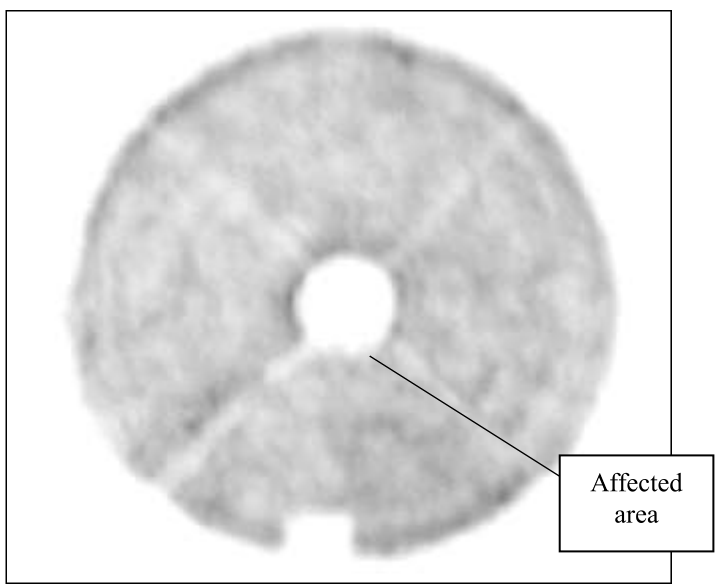
The primary mirror was CO_2-snow cleaned on September 29 and again on October 30. Identical equipment was used on both occasions. The flow had been tested for contaminants as usual, but during the October cleaning an incident occurred. The equipment clogged and started to release an unknown contaminant onto the glass. P. Ritz quickly stopped the process, but a small streak was left on the mirror surface. After replacing the tank and rechecking all equipment, the cleaning was completed without further incident. B. Kindred inspected the contamination and concluded it was minor; it should have negligible effect on reflectivity.

Primary Mirror Status

The primary mirror fractures reported in the July-August report were re-inspected when the Cassegrain area was vacated during the instrument change on September 1. During the drilling of the initial 8 stop holes on August 12, water used as a coolant soaked into the fractures and precluded a proper examination. By September the water had dried out and Blain Olbert (SOML) was able to map the fracture pattern. The inspection showed that some of the fractures had potential to propagate and additional stop holes were needed. On September 10 Randy Lutz (SOML) drilled 5 more stop holes, bringing the total to 11.

Analysis of wavefront data taken in September has not shown any evidence of degraded figure; however, the affected area is in the shadow of the secondary and/or baffle for all but the *f*/15 configuration. Moreover, the wavefront analysis, normally limited to 20 Zernike terms, does not have sufficient spatial resolution to "see" the effects in the small area.

On October 15 an image of the primary surface around the Cassegrain hole was obtained with a video camera located at prime focus. The image below is a 6-sec integration approximately 1.5 mm outside of focus. The notch at the bottom of the frame was a flag held in front of the south side of the primary to establish orientation. A few of the circular zones, artifacts of the polishing, are discernable.



During the October 16 instrument change the mirror fractures were again inspected. While there was no evidence of growth of previously-known cracks, a small (~1/2 inch) live fracture was discovered. This may be new, or it may have been overlooked in previous inspections since it can only be seen by looking into the glass through the polished lip of the Cassegrain hole. SOML has been notified and appropriate measures will be taken in November.

Secondary Mirror Systems

f/5 Baffles

N. Caldwell and S. Callahan completed the final design of the *f*/5 upper baffle. The fabrication drawings were detailed by C. Wainwright and S. Callahan. The picture below shows C. Wainwright during final inspection at the fabricator, Arizona Research and Manufacturing.

The linkages that attach this baffle to the removable hub were designed by S. Callahan and C. Wainwright, and detailed for fabrication by the mechanical team, including C. Chute and A. Ramos. Fabrication was awarded to University Research Instrumentation Center.

A temporary lower baffle for the initial tests of Megacam was designed by B. McLeod and S. Callahan. This baffle attaches to the lower baffle shroud inside the primary Cassegrain hole. The shroud was developed by S. Callahan and C. Wainwright to protect the inside diameter of the primary during corrector installation. Doors have been included to allow visual inspection of the cracks in the mirror. The shroud proved especially challenging, as it must allow full movement of the primary yet clear the installation guides of the corrector. The goal is to have this shroud completed and installed before the next installation of the corrector.

New spacers were designed and fabricated to allow attachment of the *f*/9 primary baffle without removal of the lower baffle shroud.

f/9 Hexapod

The October 1-15 AO run was plagued with hexapod problems, resulting in part from residual bugs in the unified hexapod software that is described in a following section. One event resulted in the binding of an AO electronics module against the inner edge of the secondary fixed hub. D. Blanco,

S. Callahan, R. Ortiz, and P. Spencer responded on the night of October 2 and worked with the AO team to retract the hexapod. The overhead crane was rigged to support the module and the hexapod brakes were released. The module was then moved about 3 mm out of its bound condition. The module was carefully removed and the hexapod was restored to a normal state and then exercised to confirm its operation. Finally, the AO module was re-installed. This was the most severe, but not the only, problem encountered during the run.

The less than ideal performance of the *f*/9 - *f*/15 hexapod has been present in one form or another since the start of operations of the new MMT. The tight fit between the AO module and fixed hub exacerbates this condition and draws our attention to the problem. We expect to review the run with the AO group and implement appropriate measures to correct the problems encountered. The control upgrades discussed below should also improve hexapod performance.

Hexapod Control Upgrades

Using the draft specification from SAO and the Delta Tau documentation, two new I/O interface cards have been built to handle the interfacing between the new Delta Tau controller and the existing hexapod electronics. The backpanel to backplane design and the cabling design for the MACRO interface unit at the telescope top end remain to be finalized. We now plan to install the top end unit at the top beam of the telescope, near the existing cable junction box. This makes the unit accessible and useable for *f*/5 as well as *f*/9 - *f*/15 configurations. We await the arrival of the hardware to complete the configuration of the cards and finalize the packaging design of the controller.

f/5 and *f*/15 Temperature Control

During a visit to the mountain, a consultant from Granberry Hose recommended replacement of the PVC telescope cooling lines with heavy-duty braided stainless steel. The lines were replaced by C. Wainwright and S. Callahan and insulated by C. Chute and A. Ramos. Interconnections were reduced to the minimum number to improve reliability.

Neutral Members

During the October 1-15 AO run the neutral beams that support the *f*/9 and *f*/5 secondaries were removed and reworked, and on October 16 S. Callahan and C. Wainwright re-installed the beams. The new design fixed a problem that required removal of two of the beams, rotating them 180°, and re-installing them each and every secondary change. The rework also eliminated a potentially dangerous procedure that required tightening bolts a few mm from the face of the *f*/9 secondary. The new beams therefore improve the connection rigidity, reduce installation time, and reduce the risk of handling near the optics.

Telescope Tracking and Pointing

Absolute Encoders

We continue to investigate the cyclical error problem with the MMT absolute encoder electronics. Careful gain-matching of the Inductosyn preamplifiers and adjustment of all the electronics on the elevation unit resulted in no improvement. However, careful measurement of the sine/cosine output signals of the Inductosyn shows that they have much more crosstalk than the original design target. This crosstalk term will definitely cause a 512 cycles/telescope rev error. Why this appears as more of a 1024 cycle/rev error appears to be explained by the discovery that the resolver excitation, which is at the same frequency, in quadrature phase with the Inductosyn signals, also appears in the sine/cosine signals. The complex mixing of ±90° phase and ±180° phase signal terms results in higher-frequency cyclical error terms.

The spare encoder unit at the campus lab was again set up as a test article for implementing a fix to the crosstalk issue. It appears that significant effort will be required to bring the crosstalk down to a manageable level. We have so far made some minor rearranging of the wiring in the encoder housing, added a differential receiver circuit to the conversion board, decreased the resolver excitation level, and added a return-current circuit to provide magnetic-field cancellation to all the output signals. With these fixes in place, the crosstalk level on the spare unit dropped from −25db to −75db. We also put together a Perl script for gathering signal-level data from the encoder once all the electronics are in place to verify the signal level matching and output linearity.

We expect all the new cables and small front-end cards to be ready in early November, with final assembly and testing at the telescope in December.

To improve access to electrical connectors, new covers for the Inductosyn encoders were designed by D. Clark, C. Knop, and B. Comisso and detailed for fabrication by C. Chute and S. Callahan.

Computers and Software

AO Optical CCD Camera

In collaboration with Matthew Kenworthy (CAAO), an attempt was made to interface the Axiom AX-6 CCD camera in the AO topbox to the MMTO's Apogee interface card located in the wavefront computer. The AX-6 is a rebranded version of the Apogee AP-6, and uses what appears to be an ISA interface card very similar to those we've been using at the MMT for various Apogee cameras. Interfacing that camera to our own interface would greatly simplify their setup, and would allow it to use the same image acquisition routines we've developed for the *f*/9 WFS system. Unfortunately, the interface of that camera with our PCI card was not successful. The shutter and cooler control worked fine, but the firmware in the camera is sufficiently different than an AP-6, or any other Apogee camera, that nothing we tried yielded useful data. It may be possible with more time to hack the Apogee driver to support the AX-6, but it was decided that a better long-term solution would be to replace the camera with something newer and more modern.

f/5 WFS GUI

During the October *f*/5 run, more work was done to flesh out the operator's GUI interface to the *f*/5 wavefront sensor. Three new windows were added to the interface and can be brought up via the menu bar on the main window:

- Interface to the PixelLink camera
- Interface to set the positions for the various stages within the WFS assembly

- Interface to monitor and toggle power to the WFS systems

The PixelLink interface is especially handy for setting stars onto the center of rotation. When an image is taken with the PixelLink, a marker is placed on the DS9 display window to denote the position of the center of rotation. For the next run we will try to incorporate more automated schemes for selecting a star on the PixelLink and moving it to the center of rotation. The stage position interface is mostly a convenient sanity check since the default positions have been determined and should remain fairly constant. The power interface will greatly simplify the WFS startup and shutdown processes at the beginning and end of the night. Once procedures are finalized, they will be automated as much as possible to further simplify operation.

Hexapod Control Software

A major focus of our efforts over the past months has been the development of a unified hexapod control system. The new system has now been used with all of the telescope configurations. Significant new functionality was added to support the *f*/15 secondary, which has extremely rigorous limits on hexapod motion as the AO package occupies almost all available space within the secondary hub. We are now well-positioned to utilize new motion control hardware, as we anticipate doing as soon as the *f*/5 servo hardware is upgraded.

Associated with this effort was the development of two GUIs in Ruby/Gtk2 for use with the three secondaries. The first of these is directed toward engineering use where details of servo loops and individual actuators must be known. The GUI has a variety of features, including a history window and a listing of previous positions used for different instruments. The second GUI was based on a preliminary design by D. Blanco. It presents a simple display in which the telescope operator can make moves relative to the current secondary position by pressing a single button. Like the engineering GUI, this includes a history window and a listing of previously used positions. Included in this development was refinement of the Gtk2 widgets used in Ruby. In particular, the Gtk2 Label and Eventbox classes were augmented with new methods that greatly improve GUI performance. A preliminary user guide/tutorial was written for both new GUIs.

Engineering Web Pages

Approximately 45 MMT engineering web pages have been written in PHP. These pages report current data on the thermal (including weather), secondary, mount, and a portion of the cell telescope subsystems. They can be accessed at URL *http://www.mmto.org/~jdgibson/engineering.html*. The web pages only show current status of the various subsystems, and cannot be used to control the telescope in any way. The pages automatically gather new data from the telescope subsystems at either a 20-second or a 5-second interval, and the user can command a refresh at any time by pressing the web browser Reload or Refresh button. A main advantage of these pages is that they allow monitoring of telescope data at remote sites and on any computer that has a standard web browser.

One of the engineering web pages allows interactive determination of telescope balance: *http://www.mmto.org/~jdgibson/balancer.php*. A variety of different instruments, baffles, counterweights and other attachments can be specified by the user. Graphics are modified on the page as the user adds or removes attachments from the telescope. The approximate counterweight setting is calculated when sufficient information has been supplied by the user.

Cyclades Terminal Server

We have begun replacing our multiport Cyclades terminal server with single port Lantronix UDS-10 units. We have long recognized that the Cyclades is a significant vulnerability as a single point of failure. Rather than obtain an identical unit as a spare, we can replace it with distributed single port units for approximately half the cost. These are essentially serial port-to-ethernet media converters. Using them capitalizes on the network infrastructure we already have throughout the building, obviating the need to run long, dedicated serial cables. Additionally, at the current price of $126 per unit, it is reasonable to keep several on the shelf as spares. The first of these units was installed for the Vaisala weather station, was simple to set up, and has proven to be robust.

Miscellaneous

A variety of tasks were performed on *hacksaw* and other MMT computers to keep up with changing software versions. Ruby version 1.8 was installed on the mountain machines along with associated modules. In addition, a new version of the GServer class, a Ruby socket server class, was also incorporated in the dataserver and other MMTO socketserver scripts.

New elevation collimation "ElColl" coefficients were derived for the *f*/5 secondary by G. Williams, and were incorporated in the hexapod crate code and into auxiliary Ruby scripts that can dynamically modify constants in the hexapod crate.

Instruments

Adaptive Optics

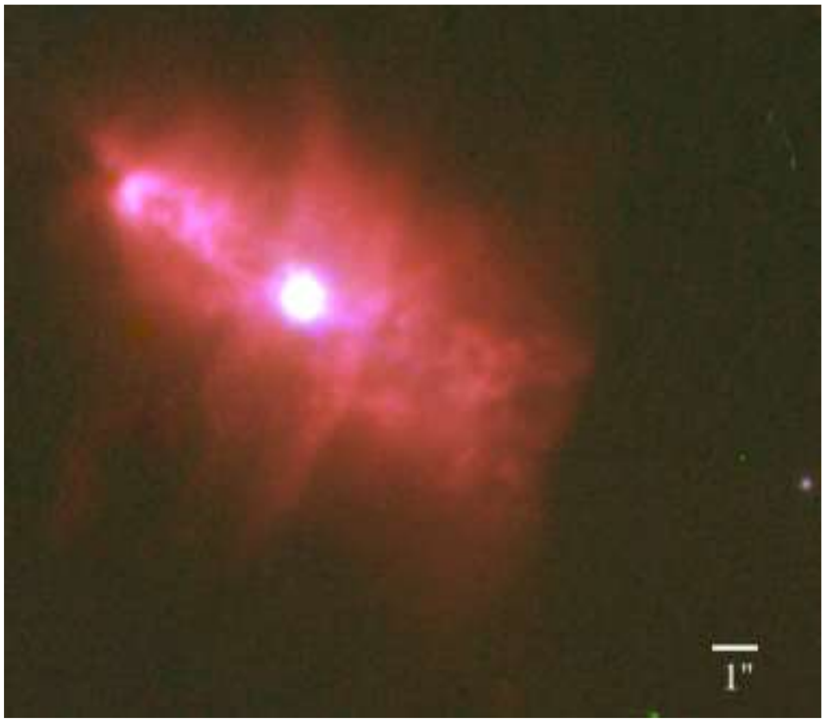
The MMT AO system went on the telescope for the fourth time at the beginning of October. Despite the remnants of a hurricane clouding out a week of nights and teething problems with the secondary, the imaging mode of ARIES was successfully commissioned with science grade data being taken three nights in a row.

The AO loop was locked on stars fainter than 13th magnitude and at elevations as low as thirty degrees from the horizon. Near-diffraction limited images of a planetary nebula, star forming regions in a nearby galaxy, and polarimetry of extragalactic cores were obtained and are in the process of being reduced by astronomers. The AO group is looking forward to the next run sometime early next year, with a wide range of scientific targets from multiple brown dwarf systems to quasar hosts taking advantage of the high spatial resolution in the infrared afforded by the AO system's atmospheric correction.

ARIES

The Arizona Infrared Imager and Echelle Spectrometer (ARIES) obtained first-light images during the October adaptive optics run. Point-spread functions show diffraction-limited cores with a FWHM of 2.5-3.5 pixels (0.035 arcsec/pixel) in the H and K bands. Images were obtained for several scientific and engineering projects relating to the polarization of the double nucleus in M31, the nucleus of NGC 1068, methane-band detection of brown dwarfs, the planetary nebula IC 2149, extragalactic objects such as NGC 7252 and Arp 279, and star clusters for isoplanicity measurements. Continued development is planned to install a cold pupil stop, anti-reflection coated optics, and a much improved software interface with the MMT TCS computer and the adaptive optics control system.

This coming spring, the longer wavelength half of ARIES will begin extensive lab testing in preparation for commissioning on the MMT next fall. This side of ARIES will provide 1-5 μm imaging as well as both long-slit and echelle spectroscopy.



The planetary nebula IC 2149 with Adaptive Optics on the MMT. Image credits: Patrick A. Young, Donald W. McCarthy, Craig Kulesa, Karen A. Knierman, Jacqueline Monkiewicz (Steward Observatory), Guido Brusa, Douglas Miller, Matthew Kenworthy (Center for Astronomical Adaptive Optics). (Image posted at http://kalhjasse.as.arizona.edu/~payoung/IC2149.html)

The image of IC 2149 above is a false-color composite of three narrow-band filters at 2.088, 2.118, and 2.17 μm, (blue, green, and red, respectively). The central star has been allowed to saturate in order to bring out details in the surrounding nebula, which is several thousand times fainter. The 2.17 μm filter includes the Brackett-gamma transition of atomic hydrogen, and the 2.118 μm filter falls on an important emission line of molecular hydrogen. The 2.088 μm filter provides a baseline against which to estimate the strength of the emission lines. The gas of the nebula is glowing brightly in the light of ionized hydrogen, reflected by the predominantly red color of the image. There is no excess emission at 2.118 μm, indicating that all the molecular hydrogen has been destroyed by the light of the central star. There is substantial continuum emission at all wavelengths. This may be light from the central star being scattered by dust or thermal emission from the dust itself. It is likely that IC 2149 is a relatively old planetary nebula. The image has a spatial resolution of ~0.1". This is comparable to the resolution of the WFPC2 instrument on HST at optical wavelengths, and two and a half times better than that of NICMOS on HST at 2 μm.

Hectospec Commissioning Run

Another milestone in the commissioning of the *f*/5 instruments occurred during October with the successful calibration and first-light with the bench-mounted spectrographs. The run began with mounting of the *f*/5 secondary, wide field corrector, wavefront sensor, and fiber positioner on October 17. The procedure for mounting each component of the instrument was reviewed, tested, and modified. Photos of the installation process were obtained and will be included in future revisions of the installation procedure.

The telescope was collimated and focused using the *f*/5 wavefront sensor. An elcoll (elevation dependent collimation) calibration run was performed and the new coefficients were added to the operations software. The new coefficients were tested and the results were verified using wavefront sensor data.

The position of the center of the focal surface was measured relative to the rotator center, and one of the robots was positioned at the center. A target star was placed on axis and its location in the upward looking robot camera was measured while rotating from −90° to +90°. The center of the focal surface is aligned very well with the rotator axis, well within the required tolerance.

Several measurements were made to determine the precise angular orientation of the instrument (the robot's Cartesian coordinate system) and the guide probes with respect to the rotator angle. The guider software was modified to include these positions and angles. The guider software was then tested and used for the remainder of the run to guide both the telescope and the rotator. The brakes on one of the guide probes malfunctioned occasionally; therefore that probe was not used. The brakes will be repaired before the next run. The software, which provides a list of potential guide stars given the astrometry of a particular field, was also tested and used for the remainder of the run.

The ADC prisms were tested and used for the second half of the run. A measurement of the focal surface scale was made by stepping a star across the focal surface in small arcminute steps from center to the edge. The position of the star was measured using the upward looking cameras on the positioner robots. This measurement will also be used to identify differential distortion.

The "set-down" error of the fiber buttons was calibrated. Each button was moved to a specified position in the field and placed on the focal surface. The back-lit fiber was viewed with the downward looking robot camera and its measured position was compared with the requested position.

The best focus of all the instrument components was measured and intercompared. The best focus of the wavefront sensor is very close to that of both the guide probes and the robot cameras. The best focus of the fibers relative to the focus of the upward looking robot cameras was measured. A bright star was positioned to the center of the field and a fiber was placed on it. The "flux" of the trace was measured at different hexapod focus positions. We found that the best focus of the robot camera is also the best focus in the fibers.

Calibration images including sky flats, dome flats, and calibration lamps were obtained. All the fibers were positioned just inside their parked position to obtain the first spectra through the entire system: morning sky solar spectra. First light through a single fiber resulted in a spectrum of QSO 0739+0137. First astronomical light with the full Hectospec instrument was achieved when 252 fibers were placed on targets in the field of Abell 399. By the end of the run thousands of spectra were recorded during observations of many clusters. The SAO Telescope Data Center is reducing the data and testing the reduction pipeline.

SPOL

The late October observing run with G. Schmidt's spectropolarimeter (SPOL) initiated use of the PI patch panel (described below) for general-purpose cabling of instruments and the *f*/9 Top Box. The few minor problems that were encountered were readily remedied, and the patch panel will be greatly appreciated by scientists who have heretofore had to string cables from the chamber to the control room for each and every observing run.

General Facility

SAO Instrument Lab

The SAO instrument lab racks experienced intermittent power failures with one phase of their 230 volt AC. The failure was attributed to a reusable-type fuse in the AC switch distribution panel. The fuse uses a hollow brass tube with a replaceable internal link that is secured with screw-on end caps. It was found that the internal fuse link connection was making insufficient contact because the end caps were only loosely installed. This exercise involved T. Gauron (SAO), T. Welch (FLWO), J.T. Williams, P. Spencer, and D. Smith.

Common Building and MMT Facility

Work started on the Common Building with a September 4 kick-off meeting with Tucson Building & Remodeling (TBR). This project will enclose the space under the Common Building to make a basement area with rooms suitable for long-term instrument storage, a documentation library/ office, and general equipment storage. The contract also includes replacing the deteriorating deck on the south side of the building. Through the two-month period there was steady progress as the space was excavated, new utility lines installed, a concrete floor cast, exterior brick walls erected, and interior framing raised.

Contractors worked on the MMT facility during this period re-tiling the floors in the elevator, bathroom, and site manager's office. Electrical contractors began the extensive task of replacing the building fire alarm per the recommendations of the SI safety committee; this work is expected to be completed in November.

Building Hatches

M3 Engineering completed a partial submission of a contracted design study for two building hatches: one on the third floor through the chamber wall to allow removal of the Hectochelle collimator, and the other in the first floor directly below the main chamber hatch to enlarge the existing pit hatch. The new, larger pit hatch would provide access to the ring pit for storage of large instruments, with ready access to the observing chamber using the overhead crane. The ring pit has sufficient room for storage of several instruments and should provide sufficient space for instrument handling for the next decade or more of operations.

To make way for a sufficiently large hatch, two major diagonal braces would have to be removed and replaced with steel decking. Based on finite element analyses of the building before and after the proposed perforation, M3 concluded that the impact on the building stiffness would be negligible and the hatch is feasible.

Instrument Rotator

A remote-control paddle for the rotator has been installed in the east drive arc J-box. This requires only that the 26 volt rack be powered and the circuit breaker on the drive servo power supply be turned on. The computers and GUIs are not needed but show a red flag if the remote control is left on. These modifications also provided bias currents to two of the four motors in order to remove the backlash in the gear drives.

Building Drive

On the evening of October 16 one of the Copley building drive amplifiers failed. K. Van Horn responded, removed the failed amplifier, and reconfigured the building drives to run on one motor. We were not able to determine the cause; failure occurred during normal tracking without any pre-indication of a problem. Subsequent inspection of the building wheels, tracks, and drives showed nothing amiss. We do not currently possess a spare amplifier and the particular model is no longer available. The drive amp was sent to Copley for repair together with a request for quotation on a custom amplifier suitable as a spare. The building operated on one drive for the remainder of the month, running at reduced slew speed and noticeably rough building tracking, but otherwise unimpaired operations.

RUPS

RUPS continues to exhibit occasional hiccups; during the reporting period it went into a strange mode of producing an output-side frequency of 120Hz (not 60Hz!). Much troubleshooting and tweaking later, we found that the power-factor control module on the motor side had gone out of adjustment. These and other problems with the unit illustrate the importance of regular testing and adjustment of the unit, as well as for continued efforts to acquire a replacement.

D. Smith replaced the flex element coupling, and he and P. Spencer replaced two batteries.

PI Interface Panels

The PI instrument interface panels have been put into service. Some additional cable termination is needed and will be accomplished in early November. The fabrication of adapter cables will be an ongoing effort, with those for the old Top Box being at the top of the list. The AC power interface is installed and operating without the remote control feature. No actual need has been identified but it can be implemented with a software change to add the feature to the GUI, and a short cable run to connect to the 26 volt rack.

Miscellaneous

P. Ritz started work on re-attaching the fabric skirt between the telescope yoke and building. This was detached during the conversion; when complete we intend to re-install the yoke room downdraft fan also dismantled during the conversion. The downdraft system proved to be successful in improving the seeing of the old MMT.

The 9-pin I-CCD connector inside the Top Box was reseated. This failure showed up as not being able to adjust the gain on the I-CCD camera.

MMTO staff worked on handling equipment for the Hectospec fiber positioner, and on organizing tool and equipment storage in the observing chamber.

The Rainwise weather monitor was reinstalled.

Visitors

As part of the MMTO Council meeting, the Council toured the telescope facility on October 2. The tour was followed by a closed session with reports from D. Blanco on the facility status and from P. Hinz on the status of AO.

October 8: Dr. Keith Hege and his wife Elizabeth accompanied Professor Naoshi Baba, Hokkaido University, Sapporo, Japan, and his wife Tatkuso to the MMT. Professor Baba is in Faculty of Engineering, Division of Applied Physics, and was in Tucson for the Optical Society of America (OSA) meeting. He and Dr. Hege share research interests in interferometric imaging techniques and image processing algorithms. He has also been active in optical testing of the 8 m Subaru Telescope, and is now (paper presented at OSA) investigating nulling interferometry. He had previously visited the MMT in its preconversion state during the 1980's.

October 14: Tucson photographer Edward McCain and two assistants visited Mt. Hopkins to photograph the MMT 6.5-m telescope for use as a cover image for the December or January issue of the IEEE magazine, *Spectrum*. The cover art relates to a story on the AO secondary and associated detectors.

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

03-12 QSO Polarization in the Era of Deep Surveys and Large Telescopes
Schmidt, G. D.
To appear in *AGN Physics with the Sloan Digital Sky Survey*, ASP Conference Series, 2004, eds. G.T. Richards and P. B. Hall

03-13 Magnetic White Dwarfs from the Sloan Digital Sky Survey: The First Data Release
Schmidt, G. D., Harris, H. C., Liebert, J., Eisenstein, D. J., Anderson, S. F., Brinkmann, J., Hall, P. B., Harvanek, M., Hawley, S., Kleinman, S. J., Knapp, G. R., Krzesinski, J., Lamb, D. Q., Long, D., Munn, J. A., Neilsen, E. H., Newman, P. R., Nitta, A., Schlegel, D. J., Schneider, D. P., Silvestri, N. M., Smith, J. A., Snedden, S. A., Szkody, P., Venden Berk, D.
ApJ, **595**, 1101

03-14 Towards First Light of the 6.5m MMT Adaptive Optics System with Deformable Secondary Mirror
Wildi, F. P., Brusa, G., Riccardi, A., Lloyd-Hart, M., Martin, H. M., Close, L. M.
SPIE, **4839**, 155

03-15 Calibrating the Wavefront Sensor for the 6.5-m MMT with a Phase-Shifting Interferometer
Johnson, R. L., Martin, H. M., Allen, R. G.
SPIE, **4839**, 206

03-16 Design and Expected Performance of the 6.5-m MMT MCAO System
Lloyd-Hart, M., Milton, N. M.
SPIE, **4839**, 578

03-17 MMT Adaptive Secondary: Performance Evaluation and Field Testing
Brusa, G., Riccardi, A., Salinari, P., Wildi, F. P., Lloyd-Hart, M., Martin, H. M., Allen, R., Fisher, D., Miller, D. L., Biasi, R., Gallieni, D., Zocchi, F.
SPIE, **4839**, 691

03-18 AAS Annual Report
Schmidt, G. D.
BAAS, **36**

03-19 A Detailed Thermal Analysis of the Binospec Spectrograph
Brown, W. R., Fabricant, D. G., Boyd, D. A.
PASP, **114**, 1389

03-20 Development of Binospec and its Optics
Fabricant, D. G., Epps, H. W., Brown, W. L., Fata, R. G., Mueller, M.
SPIE, **4841**, 1134

03-21 Thermal Considerations in Modern Spectrograph Design: The Binospec Spectrograph
Brown, W. L., Fabricant, D. G., Boyd, D. A.
SPIE, **4841**, 1265

Observing Reports

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@mmto.org* or to the following address:

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

MMTO in the Media

No activity to report.

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 to 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 via URL *http://www.mmto.org*.

Observing Database

The MMTO maintains a database containing relevant information pertaining to the operation of the telescope and facility instruments, and the weather. Details are given in the June 1985 monthly summary. The data attached to the back of this report are taken from that database.

Use of MMT Scientific Observing Time

September 2003

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	* Lost to Telescope	** Lost to Gen'l Facility	Total Lost
MMT SG	18	178.50	71.50	0.00	0.25	0.00	71.75
PI Instr	7	70.20	16.10	0.50	3.00	0.00	19.60
Engr	4	38.40	0.00	0.00	6.50	3.00	9.50
Total	**29**	**287.10**	**87.60**	**0.50**	**9.75**	**3.00**	**100.85**

Time Summary Exclusive of Shutdown	
Percentage of time scheduled for observing	86.6
Percentage of time scheduled for engineering	13.4
Percentage of time lost to weather	30.5
Percentage of time not lost to weather lost to instrument	0.3
Percentage of time not lost to weather lost to telescope	4.9
Percentage of time not lost to weather lost to general facility	1.5
Percentage of time lost	35.1

* Breakdown of hours lost to telescope
alewife 0.25
rotator 1.5
hoseclamp/guider 1.5
az servo 6.5

** Breakdown of hours lost to facility
blower & building drives 3.0

October 2003

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	* Lost to Telescope	** Lost to Gen'l Facility	Total Lost
MMT SG	1	10.40	0.00	0.00	0.00	0.00	0.00
PI Instr	28	303.90	79.30	30.80	27.35	0.00	137.45
Engr	2	22.10	0.00	0.00	0.00	3.00	3.00
Total	**31**	**336.40**	**79.30**	**30.80**	**27.35**	**3.00**	**140.45**

Time Summary Exclusive of Shutdown	
Percentage of time scheduled for observing	93.4
Percentage of time scheduled for engineering	6.6
Percentage of time lost to weather	23.6
Percentage of time not lost to weather lost to instrument	12.0
Percentage of time not lost to weather lost to telescope	10.6
Percentage of time not lost to weather lost to general facility	1.2
Percentage of time lost	41.8

* Breakdown of hours lost to telescope
hexapod 5.25, 5.25, 10.6, 4.5
elcoll 0.25
cell crate 1.5

** Breakdown of hours lost to facility
drive amps 3.0

March - October 2003

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	Lost to Telescope	Lost to Gen'l Facility	Total Lost
MMT SG	87	783.80	208.35	12.30	1.70	23.35	245.70
PI Instr	101	940.20	177.15	52.20	41.10	4.50	274.95
Engr	25	231.30	65.50	0.00	6.50	6.00	78.00
Total	**213**	**1955.30**	**451.00**	**64.50**	**49.30**	**33.85**	**598.65**

Time Summary Exclusive of Shutdown	
Percentage of time scheduled for observing	88.2
Percentage of time scheduled for engineering	11.8
Percentage of time lost to weather	23.1
Percentage of time not lost to weather lost to instrument	4.3
Percentage of time not lost to weather lost to telescope	3.3
Percentage of time not lost to weather lost to general facility	2.3
Percentage of time lost	30.6