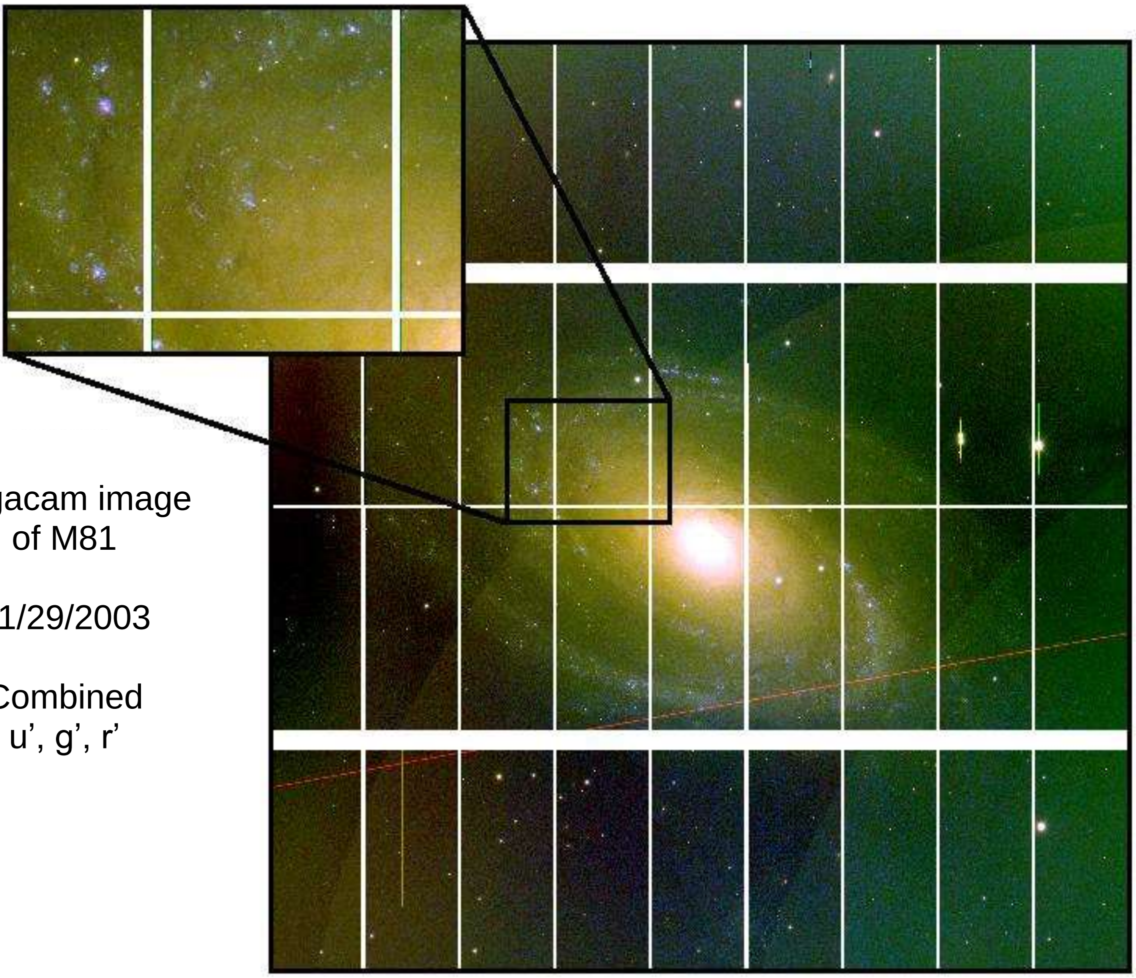
Smithsonian Astrophysical Observatory & Steward Observatory, The University of Arizona

MMT Observatory
Smithsonian Institution &
The University of Arizona®

BIMONTHLY SUMMARY

November – December 2003



Megacam image of M81

11/29/2003

Combined u', g', r'

The MMT's new f/5 wide-field imager, Megacam, obtained first light during a November commissioning run. The instrument uses a mosaic of 36 CCDs, each with 2048 x 4608 pixels, to provide a field-of-view of 24' x 24' at a pixel resolution of 0.08"/pixel. Image of M81 provided by B. McLeod.

The State of the Observatory

In any journey, it is useful to occasionally step off the path and review the obstacles that have been overcome as well as survey the road that lies ahead. With 2004 marking the 25th anniversary of the dedication of the original MMT, it seems like an appropriate occasion to evaluate our progress in bringing the telescope to the level of performance and reliability that we seek.

By any index, 2003 was an eventful year. Foremost for MMTO staff, it heralded the commissioning of the *f*/5 secondary—the integration and installation of which is a point of pride for everyone who participated. In addition, the three new large instruments, corrector, and wavefront sensor for the *f*/5 focus represent tremendous successes for the SAO developers, our support staff, and for the many astronomers who will utilize them. The most dramatic evidence of these achievements is undoubtedly the breathtaking first light Megacam image of M81—a highly shrunk version of which decorates this edition's front page—displaying 0.5 arcsec FWHM images over the entire 24 arcmin diameter field. We look forward with anticipation to many future scientific discoveries from these powerful new capabilities.

The Steward adaptive optics group made considerable progress in improving the setup and operation of the natural guide star system that first saw closed-loop operation with the unique adaptive secondary in November 2002. By May, outside science proposals were being entertained, and publications from those observing runs are now appearing in astronomical journals. Even the stately *f*/9 focus received a face-lift during the year with the installation of state-of-the-art CCDs from Steward's ITL group for both Blue and Red channels of the MMT Spectrograph. Front-page scientific discoveries followed soon thereafter, including spectroscopic proof of the link between gamma-ray bursts and supernovae in March (Stanek et al.), and the identification of the 3rd-highest redshift QSO ($z = 6.2$) in June (Fan et al.).

Perhaps less visible, but critical for realizing the capabilities of the new instrumentation, were many improvements to the telescope itself. These include better collimation, wavefront sensing at all three foci, improvements in cable routing for both the wide-field and PI instruments, numerous software developments in many of the subsystems, and progress toward developing a system of working spares for the many electronic and power components. Facility improvements included restoring the road heaters to operation (with only hours to spare before the season's first heavy frost!), and considerable work on the building drive system, among many others. We have been successful in obtaining a modest augmentation of the budget and thus in the overall staff. The success of these efforts can be measured in many ways, but one useful index is a significant reduction in the amount of time set aside for maintenance and engineering.

We have accomplished much! At the same time, we are all aware of areas that require continued attention. A smooth night dictates that a large number of complex systems must operate in unison, and we continue to lose an unacceptably large fraction of observing time to breakdowns in one or more of these components. The cold snap during the Christmas holiday was especially instructive in demonstrating that pieces of hardware operate with only a thin margin for error. We are just now beginning to develop a hands-on understanding of the thermal characteristics of the primary mirror and its ventilation system. We will require a large amount of data on the behavior of various components before we can be confident of their behavior under a wide range of ambient conditions. We are close to incorporating an improved set of electronics to read the absolute position of the telescope on the sky, but the performance of the tracking servos is far from ideal and image quality is compromised even under quiet observing conditions. Focus and collimation adjustments can now be applied to correct for known flexure and temperature variations, but the corrections are crude and the hexapods are not sufficiently smooth in operation to apply them during scientific exposures. A number of improvements must be made to the overall facility to improve safety, efficiency of operation, and integrity against the weather. And finally, we must plan for realuminizing the primary in August!

A "To Do list" as long as ours can be daunting. Faced with such an agenda, it is tempting to rush head-long from one task to another, applying only the band-aids that are necessary to stop any one wheel from squeaking before rushing on to the next. This is particularly true when staffing is short. While a certain amount of fire-fighting is unavoidable, it is far more satisfying and profitable in the long run to carefully plan each project, and then efficiently carry it out to completion. Good craftsmanship, discipline, and attention to detail offer the best insurance against any particular fire having to be fought again at some date in the future, possibly only after losing valuable observing time. Those same traits are key ingredients in maintaining a safe working environment—for personnel as well as for our irreplaceable equipment. Of course, this approach means we will not be able to accomplish every goal for every user. But the goals we do reach will be lasting, real achievements upon which we can rely.

Our overall objective is ambitious: to operate what may be the most versatile large telescope in the world, on a comparatively spartan budget, yet with as high a degree of performance and reliability as exists anywhere. This will not be accomplished overnight, nor within a single year. In fact, like scientific research itself, there will be no occasion where we can simply dust off our coveralls and announce the project as "complete." The satisfaction comes in our dedication to make steady progress, and to take pride in our labors through the astronomical discoveries made along the way.

Primary Mirror Systems

Primary Mirror Support

This reporting period saw the return of an intermittent mirror cell support electronic failure, which showed up during a bump test: the inability of all the northwest quadrant actuators (actuators 129 through 152) to apply forces to the mirror. Earlier failures were repaired by reseating the cell crate translation card and electronic IP modules on the cell crate IP carrier card. This failure mode has been attributed to rapid cooling, causing electronic components to become poorly contacted to their connectors and sockets.

On December 27, a cold snap sent temperatures plummeting to well below freezing. That evening the primary mirror lost adequate pressure and could not be raised. J.T. Williams responded the next day and located one fault: a water-ice plug had formed in the lines between the compressors in the support building and the MMT enclosure. Electric heaters placed at judicious locations melted the plug and restored air pressure. In addition, the cell VME crate was chilled below its operational range. Heat was applied to the crate and cleared this problem as well. By the next day the facility was again operational.

Primary Mirror Status

No further work was done on the primary mirror fractures; one live fracture that requires stop-drilling is still pending. Water, used as a coolant in the drilling operation, inevitably wicks into any crevices in the glass. Because of the current threat of freezing conditions, it was decided to postpone this work until warmer weather.

Primary Mirror Ventilation System

The first several hours of the engineering night of December 13 were devoted to collecting data that will be used to establish an empirical relation between telescope temperature and focus. The telescope was pointed to a bright star near zenith and collimated and focused using the video camera and then the wavefront sensor. Wavefront sensor data were then periodically recorded in intervals of approximately every five minutes while tracking the star. During these measurements no corrections were made to the primary or the secondary. The OSS temperature was measured with two TempTrax probes taped to the structure. E-series thermocouples were used to measure the temperature of the primary mirror. The measured Zernike defocus indicated that there was a delay of more than 30 minutes between a measured temperature change and the corresponding defocus. This delay indicated that the TempTrax probes were not well enough insulated from the ambient air. The measurements will be redone during the January engineering run and the results will be presented in the next bimonthly summary.

In order to measure additional temperatures on the OSS, inside the cell, and in and around the chamber, an additional Model E8 TempTrax module and 8 heavy-duty probes with 75-ft leads were purchased. The probes were remounted using thermal grease, insulating foam, and reflective aluminum tape to better connect them to the support structure. The TempTrax1 base station was moved from the east Nasmyth platform to the back of the east drive arc. TempTrax2 was mounted to the back of the west drive arc. Two TempTrax2 probes were attached to the southwest OSS truss, one at the mirror cell end and the other near the secondary end. Two additional probes from each base unit will be added to the cell end of the north and south truss and to the secondary end of the northeast and northwest truss. Work continues toward better calibrating the E-series thermocouples for the primary onto an absolute temperature scale.

The operation and performance of the ventilation system was the topic of the two operator's meetings held on November 25 and December 16. Thermal data that have been recorded over the past few months were presented, and the algorithm for controlling the temperature of the primary mirror was discussed. Suggestions were made for improving the thermal performance of the system based on the data and the current control algorithm. The operators also requested modifications to the GUI and the information presented therein.

Secondary Mirror Systems

f/9–*f*/15 Hexapod

The *f*/9 hexapod exhibited 20-50 micron positioning errors on actuator #3 during November. The problem was of sufficient enough concern to replace the actuator with the spare, an operation that was completed concurrently with the hexapod mechanical modification for the AO *f*/15 secondary. This spurred a thorough mechanical, electrical, and software inspection and recalibration of the assembly that identified and fixed several modest problems. The result was a marked performance improvement when *f*/9 was reinstalled on December 5. Construction of an electronic/computer interface box for testing both *f*/9 and *f*/5 hexapod struts on the bench is underway, and we await completion of this hardware to run a series of tests on *f*/9 actuator #3 to determine the cause of its problems.

f/5 Baffles

The 2-meter diameter *f*/5 upper baffle, including the mounting linkage, was fabricated and installed in time for the *f*/5 run at the end of November. The *f*/5 mid-baffle conceptual design was completed by the end of December, with detailed design and construction scheduled to commence in January. An *f*/5 temporary lower baffle was designed and fabricated together with a mounting shroud for the central Cassegrain hole. Unfortunately, an unsuccessful test fit of this assembly indicated that existing drawings of the mirror/cell/corrector are incorrect, and modifications are required to the lower baffle and shroud prior to any use.

Finding storage space for these large structures is quite a challenge; they rival the size of the largest facility instruments. A suitable storage solution for the upper baffle was found on the chamber wall just above the west Nasmyth platform, where it now hangs.

Miscellaneous

The new PMAC controller for the hexapod system(s) arrived during the reporting period, and S. King began the process of configuring and testing the hardware. The spare *f*/5 hexapod strut was used as a test article; we expect to be heavily into hardware construction and software development early in 2004, with the goal of deployment for the *f*/5 run in March.

The design for a neutral member storage mechanism during *f*/15 operation was completed.

Master assembly drawings that describe the telescope configurations for each of the secondary mirrors were created.

Telescope Tracking and Pointing

Encoders

The new differential front-end receiver cards for the encoder conversion electronics were completed during the reporting period. We intend to install and test their performance on the telescope during the M&E run in early January.

Computers and Software

New Spectrograph Control System

A new GUI-based spectrograph control system that runs under Linux has been deployed on the mountain for Blue and Red Channel. It replaces the DOS PC that had been used for spectrograph control, and PASCAL-based software that had been in use for well over a decade. The new system communicates over the network to a Lantronix DC-10 ethernet-to-RS232 converter attached to the computer that runs the motors within the spectrographs (the MSD box). The new software is installed under /mmt/sccs on hacksaw, hoseclamp, and alewife, and can be run from any of those machines, though the Lantronix only allows a single network connection at a time. The GUIs can be invoked by running '/mmt/sccs/bccs' for Blue Channel and '/mmt/sccs/rccs' for Red Channel. Desktop menu entries have also been added so that the new GUIs show up under Extras–>Other along with other MMT software.

Figure 1 shows screenshots of the main Blue and Red Channel GUIs. Since the spectrographs are slow to respond, configuration changes (with the exception of opening/closing the Blue Channel shutter) are queued within the GUI until the Configure Spectrograph button is clicked. The icons to the right of each setting provide feedback on that setting's status. The File pull-down menu contains entries for saving and loading spectrograph configurations. This makes it much simpler to swap between different observing modes and reduces the risk of forgetting to set something important. A link to the on-line user manual (*http://www.mmto.org/SCCS/*) is also provided via the Help pull-down menu.

For users within the mmtop group, an entry to bring up the Engineering Interface is also provided from the File pull-down. This brings up two more windows that are shown in Figure 2. The Configure Motors window provides the capability of querying and setting the index positions for each of the indexed motors (e.g. grating and filter wheels) and to command each indexed motor to a specific position. Direct access to grating and TIRP angle positions plus some MSD box commands are also provided. The Set Gratings and Filters window is used to configure what is installed in each filter and grating wheel position and on the magnetic plate. The filter and magnetic plate configuration only entails typing in a label that will be displayed in the main user GUI. Configuring the gratings is somewhat more complicated. Buttons are provided to configure the spectrographs in the way required for grating or cover changes. For each grating position, there is a menu containing all available gratings and controls for configuring the zero-point of the selected grating. The Save Configuration button will save all of the settings to disk on hacksaw, hoseclamp, and alewife, and update the main GUI accordingly.

Is CLOSED
Focus : 2.85
Aperture : 1.0" x 180"
Upper Filter Wheel : Clear
Lower Filter Wheel : Clear
Grating : 500 GPM
Wavelength : 3643 / 5211 / 6778 Å
Grating Angle : 1.319
Grating Order : 1
Spectrograph Link Status :

Focus : 3.08
Aperture : 1.0" x 180"
Upper Filter Wheel : Clear
Lower Filter Wheel : Clear
Grating : 150 GPM
Wavelength : 7981 / 11755 / 15529 Å
Grating Angle : 2.422
Grating Order : 1
Spectrograph Link Status :

Figure 1: Screenshots of the Blue Channel (left) and Red Channel (right) control system GUIs.

Current Index Values

0	1	2	3	4	5	6	7
1.852	3.106	4.357	0.000	0.000	0.000	0.000	0.000

New Index Values

0	1	2	3	4	5	6	7
1.852	3.106	4.357	0.000	0.000	0.000	0.000	0.000

Blue Channel Grating Wheel

Send Motor to DVM Position: 3.104
Set Blue Grating Angle: 1.766
Set Red Grating Angle: 2.516
Set TIRP Angle: 4.309

	Blue Channel Gratings	Central Wavelength	Current Zeropoint	Red Channel Gratings	Central Wavelength	Current Zeropoint
I	300 GPM	5015	0.000	150 GPM	7504	0.000
II	300 GPM	5015	0.000	150 GPM	7504	0.000
III	300 GPM	5015	0.000	150 GPM	7504	0.000

Turret I ✓

Stow Red Channel Grating Slide ✓

Figure 2: Screenshots of the Configure Motors window (left) and Set Gratings and Filters window (right).

Improved Wavefront Sensor (WFS) Centroiding

In an effort to improve the automation of the WFS as well as its ability to measure seeing, the relatively rudimentary centroiding routines based on IRAF's starfind were replaced with a more robust and adaptive scheme from DAOphot. The big advantage of DAOphot is that it will compute an analytical point-spread function (PSF) for each image rather than assuming a single, simple profile like a Gaussian. It can also compute the PSF as a function of location in each image. When the seeing is good (<0.8") the WFS spots are well-approximated by a Gaussian, and simple schemes like starfind or daofind (the first pass of a DAOphot analysis) perform very well. Once the seeing reaches ~1" to 1.3", however, the spot profiles begin to deviate significantly from a Gaussian and frequently vary considerably across the image (e.g. due to dome seeing or other effects).

The daofind routine has been found to be much more robust in finding the appropriate spots and far less sensitive to seeing and image brightness. A single set of parameters works quite well over a large range of seeing (<0.5" to about 2", though recently more tweaking was required to handle >3" seeing) and brightness, which obviates the need for the operators to frequently fiddle with starfind's centroiding parameters. The output from daofind is input into the rest of DAOphot where a best-fit position-dependent PSF is calculated and then the spots recentroided using that model. The PSF model is also averaged across the image to calculate a measure of the seeing. The seeing measures from DAOphot are MUCH more accurate than those from starfind, and correlate quite well with direct measures of seeing from various instruments (e.g. PISCES, Flamingos, Megacam).

One downside of DAOphot is that it is considerably slower than our old method. Tests are ongoing to help optimize and streamline the process.

Mini-Servers for Thermal and Related Systems

The existing dataserver software, which is an integral part of the thermal system, is being replaced by several mini-servers, each accessible over a separate network port on hacksaw. The motivation for this conversion is to improve thermal system reliability and robustness. Separate mini-servers are currently being used for the following hardware: Carrier, pit Neslab, loft Neslab, cell E-Series thermocouples, the four Hewlett-Packard data acquisition units (HP DAU) for the T-series thermocouples, shop HP DAU, pit HP DAU, RainWise, two TempTrax units, and Vaisala.

These new mini-servers are being written in the Ruby programming language. All of the mini-servers share a common multi-threaded TCP socket server, written by T. Trebisky and based on the Ruby Application Archive program GServer.rb. A major advance in these mini-servers is better mutual exclusion during access of shared data by separate threads, and cleaner termination of failed communication with hardware devices.

Additional mini-servers are involved in logging. A background logging service, bg_logger, is being used to replace the background logging previously performed by dataserver.

Existing thermal GUIs were modified to use the mini-servers in place of dataserver. The existing dataserver port on hacksaw will be used as a relay from the mini-server.

At the same time, new software (written by Tom Trebisky) was installed in the 32-port Cyclades terminal server to improve the reliability of information still distributed through that unit. Testing has shown this software to be more robust than that provided by the manufacturer.

New Thermal System GUI

A new thermal system GUI was created using Ruby/Gtk2. This new GUI emphasizes the difference between glass temperatures for the primary and air temperatures in front of and behind the primary. The GUI replaces several older GUIs that were written in Tcl/Tk. The GUI user can choose from a variety of reference temperatures, including chamber and outside ambient temperatures that average temperatures from several devices. The user can view primary glass temperatures as relative temperatures with respect to a user-specified reference temperature or as absolute temperatures. Cross-sectional views are also presented in the GUI that show differences in frontplate, midplate, and backplate temperatures. Finally, control of setpoints for the Carrier and pit Neslab is included in the GUI. The default mode for this control is automatic tracking of a reference temperature with the inclusion of a user-defined offset from the reference temperature. Direct control of setpoints for the Carrier and pit Neslab is also possible. Future work will include adding automatic setpoint adjustment based upon the rate at which the reference temperature is rising or falling.

Miscellaneous

Work was completed on utility programs that automatically convert XML format log files into spreadsheets. These new utility programs now generate spreadsheets with data consistently in the same columns of the spreadsheets.

Instruments

Megacam and Hectochelle Commissioning Runs

This run was a doubleheader for the MMT and the SAO instrument development teams; it saw the commissioning of both Megacam and Hectochelle. Megacam, the new mosaic 320 megapixel imager, covers a square field of view ½ degree on edge. The weather and seeing cooperated to yield some spectacular first light images that can be seen at *http://cfa-www.harvard.edu/~bmcleod/megapics/*. The raw images highlighted the need for the mid and lower baffles, the two elements needed to complete the wide-field baffling. Megacam imaging was followed by first light with the Hectochelle bench spectrograph. Much valuable engineering was accomplished and first light was achieved before weather terminated the run.

The goals met during these runs include items listed below:

- The installation procedures for the corrector and wavefront sensor were further modified during their mounting. Megacam was mounted using the Minicam mounting procedure, which was then modified to include Megacam-specific steps.

- During initial tests of Megacam, the encoders for the shutter misbehaved and occasionally provided unexpected values. The instrument GUI also indicated that the shutter was not opening and closing properly, particularly for short exposures. Upon further inspection the problem was tracked to a broken connector shell on the instrument, which resulted in a bad connection. The shell was secured with tie wraps for the remainder of the run and will be repaired prior to the next Megacam run.

- The shutter timing was tested by taking a set of images with decreasing exposure times of 10.0, 1.0, 0.5, 0.1 seconds. A linear fit of flux vs. time was calculated and the flux intercept was found to be near zero.

- Fixed pointing offsets were tested but initially were not working properly. The software was modified and retesting confirmed that it was working as expected. The guider software was also tested and found to have transformation errors. The guider orientation was then measured and the appropriate changes were made to the software.

- The center of rotation was measured by obtaining images at a rotator angle of +45 degrees and -45 degrees. The center of rotation was determined to be very close to the center of the mosaic. The offset between the science camera focus and the wavefront sensor focus was also measured.

- The Sloan filters (u', g', r', i', and z') were mounted into their filter holders and loaded into the instrument. The two guide CCDs use clear or blue filters of different thicknesses, which offset their respective focus positions to either side of the science instrument focus position. This provides a measure of defocus for the science instrument. The software routine for measuring the best focus position was tested and modified to reduce the binning, which provides a more accurate measure of the FWHM. The guider was also used to measure the oscillations in the telescope azimuth drive.

- The "gobs" software, which reads a table of targets and performs telescope pointing and observations, was tested. After several modifications it was nearly in proper working order. It still misbehaves for short exposures.

- Targets that were imaged during this run for both characterization purposes and science included M1 (the Crab Nebula), M33, M67, M81, Landolt Standard Fields, and Sloan Fields. Calibration frames included twilight flats, bias frames, and fringe frames for the i' and z' frames. Extra-focal images were also taken to measure the field dependent aberrations.

- Following initial alignment problems with Hectochelle, the instrument recorded first light and appears to be working well.

- SAO engineers removed the Hectospec collimator and camera mirrors, which were then sent out for recoating.

Blue and Red Channel Spectrographs

D. Smith and C. Knop identified and replaced a bad chip on a controller card in the MSD box when the Blue Channel shutter and Red Channel grating drive motor began having problems.

A memory battery was replaced in the MSD box, an item that has been on our list for several years. Many thanks go to C. Knop, assisted by D. Smith, for taking on this task. D. Clark assisted with reprogramming the MSD.

General Facility

Building Drive

On November 7 K. Van Horn, P. Spencer, and D. Smith reinstalled the building drive amp (which had failed in October, been repaired, damaged during shipping, and repaired again), restoring the building to full power and full slew speed. While there have not been any further dramatic failures, there were a number of telescope-building collisions (on November 15, twice on November 18–19, and on December 5, 8 (twice), 14, and 20). All of these collisions occurred on slews and resulted in negligible time lost. In each case, inspection of the building and drives has shown no mechanical problem, and the cause of the collisions has not yet been determined. During the next two-month period we expect to set up a data logger to monitor the building servos.

One of the building wheels developed a persistent squeak on November 7. This prompted the removal of the wheel's bearing covers for a closer inspection, but all was in good condition. The squeak was traced to an electrical brush contact on the wheel that provides grounding for lightning. This was replaced.

PI Interface Panels

A problem has been identified with the AC power outlets on the PI panel on the east drive arc. These outlets are powered from the UPS's on the third floor but are switched with solid-state relays powered from the 26-volt rack. Since this rack is routinely powered down during the day, instrument power can disappear during the day. To eliminate this problem the spare 26-volt power supply has been installed in the 26-volt rack and is on constantly. Currently these relays are the only things powered from this secondary source. A nuisance problem exists because the solid-state relays have a maximum leakage current of 8 mA, which is enough to light neon lamps that are used to monitor the status of the relays. Load resistors have been fashioned to dissipate this current and will be installed in January.

The investigation of the problem above revealed that, during a transfer of quiet power from RUPS to the quiet power transformer (and vice-versa), there will be a momentary dropout of quiet power sourcing the 26-volt rack. A UPS will be added to the AC input of the 26-volt rack to prevent this dropout.

RUPS

Significant effort has been put into documenting and repairing RUPS "one more time." Two sources of the most recent RUPS failure were identified. The first was a Variac that burned up; it was replaced. This failure was most likely due to age and vibration. The second was a current sensing relay that had vibrated out of calibration. While troubleshooting this problem, K. Van Horn started raiding the used RUPS that has resided out in the weather at the basecamp for several years. Many very nearly identical parts were identified and brought to the mountain. A few more electrical parts should be moved to prevent further weather damage.

The poor quality (and lack) of documentation from the RUPS manufacturer has contributed to much longer troubleshooting times and great frustration. K. Van Horn has now generated schematic diagrams that are almost adequate for most troubleshooting and repair. There are still discrepancies that cannot be resolved until power is totally off so that wiring can be safely traced. This is not to say that we should give up the effort to replace the beast, as there are still parts that are failure-prone that could shut it down for good.

Top Box

Over the holiday a failure occurred in the *f*/9 topbox that loaded down the GAITS power supply and manifested itself as a failure in the calibration lamp power source. The failure was in CMOS logic on board the two filter wheel driver cards. Since these wheels are no longer being used, and apparently will not be used in the future, the cards were removed. They have been, at least, partially repaired but not fully retested. We do have other spares for these cards.

The topbox ICCD camera, having shifted possibly due to temperature changes, was realigned by D. Smith.

Miscellaneous

On the morning of December 8, Stark Electric completed electrical connection of the road heaters just in time for the first heavy frost of the year. Conditions reached 20 F and 100% RH that evening. The ground was covered with frost, but the road was warm and dry—for the most part. Stark engineers have advised us that the existing electrical service is insufficient for the full complement of heaters by today's standards. After lengthy negotiations they agreed to connect 76 of the 96 road heating mats. The result was a series of frosty patches in the road, but much better than a fully iced road. A service upgrade is anticipated next year.

Fire alarm installation was completed during December but the system is not fully operational. Work proceeded on the Common Building basement. Both interior and exterior walls were raised and a new concrete deck was poured. The rooms are starting to take shape with the installation of drywall.

A DustTrak model 8520 aerosol monitor was purchased and tested on site. The monitor was able to detect airborne dust generated from several sources: a Kimwipe being crushed, and walking over a carpet while scuffing one's shoes. The monitor was sent to the town engineering group where it is being mated to a Lantronics communications port. Once this is completed the monitor will be installed close to the primary mirror cell where it will serve two functions: 1) provide an alarm when aerosols exceed a chosen threshold, and 2) provide a measure of dust accumulation as a guide to the schedule for periodic cleaning of the mirror.

A UPS has been procured and placed at the PI station in the control room.

Visitors

November 13: A group of FLWO volunteers was hosted for Volunteer Appreciation Day. This group helps keep FLWO and MMTO running by reading meters, checking safety equipment, providing clerical help, tour guides, and assisting in many other ways.

November 20: Steve West escorted a group of engineers from Lockheed and Kaman Aerospace. This group is working on the Lotis project, a 6.5m collimator with a primary mirror identical to the MMT's.

November 24: Charles Lee, a program manager for the Air Force Office of Scientific Research, accompanied by Buddy Martin (SOML).

December 16: Eric and Jason Simison of Seawest Incorporated visited the site. Seawest is under contract to JPL to evaluate alternate sites for deployment of an interferometric array of four 1.8m telescopes.

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

03–22 Mid-Infrared Imaging of the Post-Asymptotic Giant Branch Star AC Herculis with the MMT Adaptive Optics System
Close, L. M., Biller, B., Hoffmann, W. F., Hinz, P. M., Bieging, J. H., Wildi, F., Lloyd-Hart, M., Brusa, G., Fisher, D., Miller, D., Angel, R.
ApJ, **598**, L35

03–23 Occurrence and Global Properties of Narrow C IV λ1549 Å Absorption Lines in Moderate-Redshift Quasars
Vestergaard, M.
ApJ, **599**, 116

03–24 Photometry and Spectroscopy of GRB 030329 and its Associated Supernova 2003dh: The First Two Months
Matheson, T., Garnavich, P. M., Stanek, K. Z., Bersier, D., Holland, S. T., Krisciunas, K., Caldwell, N., Berlind, P., Bloom, J. S., Bolte, M., Bonanos, A. Z., Brown, M. J. I., Brown, W. R., Calkins, M. L., Challis, P., Chornock, R., Echevarria, L., Eisenstein, D. J., Everett, M. E., Filippenko, A. V., Flint, K., Foley, R. J., Freedman, D. L., Hamuy, M., Harding, P., Hathi, N. P., Hicken M., Hoopes, C., Impey, C., Januzzi, B. T., Jansen, R. A., Jha, S., Kaluzny, J., Kannappan, S., Kirshner, R. P., Latham, D. W., Lee, J. C., Leonard, D. C., Li, W., Luhman, K. L., Martini, P., Mathis, H., Maza, J., Megeath, S. T., Miller, L. R., Minniti, D., Olszewski, E. W., Papenkova, M., Phillips, M.M., Pindor, B., Sasselov, D. D., Schild, R., Schweiker, H., Spahr, T., Thomas-Osip, J., Thompson, I., Weisz, D., Windhorst, R., Zaritsky, D.
ApJ, **599**, 394

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 University of Arizona and the Smithsonian Institution."

Submit publication preprints to *bruss@mmto.org* or to the following address:

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Tucson, AZ 85721-0065

MMTO in the Media

In December IEEE Spectrum Online featured Michael Lloyd-Hart's article on adaptive optics (*http://www.spectrum.ieee.org/WEBONLY/publicfeature/dec03/1203star.html*).

MMTO Home Page

The MMTO maintains a web site (*http://www.mmto.org.*) that 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.
6. The MMTO staff directory.

Observing Database

The MMTO maintains a database containing relevant information pertaining to the operation of the telescope, 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.

Note that a new category has been added to account for time devoted to secondary changes.

Use of MMT Scientific Observing Time

November 2003

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	* Lost to Telescope	Lost to Gen'l Facility	Total Lost
MMT SG	8	93.80	18.00	0.00	0.25	0.00	18.25
PI Instr	21	243.00	97.90	2.25	0.00	0.00	100.15
Engr	0	0.00	0.00	0.00	0.00	0.00	0.00
Sec Change	1	11.80	0.00	0.00	0.00	0.00	0.00
Total	**30**	**348.60**	**115.90**	**2.25**	**0.25**	**0.00**	**118.40**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	96.6
Percentage of time scheduled for engineering	0.0
Percentage of time scheduled for secondary change	3.4
Percentage of time lost to weather	33.2
Percentage of time not lost to weather lost to instrument	1.0
Percentage of time not lost to weather lost to telescope	0.1
Percentage of time not lost to weather lost to general facility	0.0
Percentage of time lost	34.0

* Breakdown of hours lost to telescope

hexapod GUI 0.25

December 2003

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	* Lost to Telescope	Lost to Gen'l Facility	Total Lost
MMT SG	13	156.00	42.25	0.50	6.25	0.00	49.00
PI Instr	15	179.40	48.00	26.90	19.00	0.00	93.90
Engr	1	12.00	0.00	0.00	0.00	0.00	0.00
Sec Change	1	11.90	0.00	0.00	0.00	0.00	0.00
Total	**30**	**359.30**	**90.25**	**27.40**	**25.25**	**0.00**	**142.90**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	93.3
Percentage of time scheduled for engineering	3.3
Percentage of time scheduled for secondary change	3.3
Percentage of time lost to weather	25.1
Percentage of time not lost to weather lost to instrument	10.2
Percentage of time not lost to weather lost to telescope	9.4
Percentage of time not lost to weather lost to general facility	0.0
Percentage of time lost	39.8

* Breakdown of hours lost to telescope

primary temperature 6
topbox 3
primary support 10
cell crate 2
alewife 0.25
videoscope 4

Year to date March - December 2003

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	Lost to Telescope	Lost to Gen'l Facility	Total Lost
MMT SG	108	1033.60	268.60	12.80	8.20	23.35	312.95
PI Instr	137	1362.60	323.05	81.35	60.10	4.50	469.00
Engr	26	243.30	65.50	0.00	6.50	6.00	78.00
Sec Change	2	23.70	0.00	0.00	0.00	0.00	0.00
Total	**273**	**2663.20**	**657.15**	**94.15**	**74.80**	**33.85**	**859.95**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	90.0
Percentage of time scheduled for engineering	9.1
Percentage of time scheduled for secondary change	0.9
Percentage of time lost to weather	24.7
Percentage of time not lost to weather lost to instrument	4.7
Percentage of time not lost to weather lost to telescope	3.7
Percentage of time not lost to weather lost to general facility	1.7
Percentage of time lost	32.3