

BIMONTHLY SUMMARY

January - February 2004



A lynx rufus, commonly know as a bobcat, curiously sauntered down Mt. Hopkins road as Shawn Callahan and Court Wainwright looked on. Photo by Court Wainwright.

Personnel

Edward Bell, formerly of NOAO, was hired as a temporary servo engineer in January. He will be helping us develop behavioral models of the MMT servo systems and looking into methods of improving the servo performance.

Primary Mirror Systems

Primary Mirror Status

There was no activity regarding the fractures around the central hole; monitoring and reporting will continue on a periodic basis.

RTV Puck Bonds

On January 13, Steward Observatory Mirror Lab (SOML) convened the first of a series of meetings to discuss a potential problem with the RTV adhesive that was used to bond the load-spreaders to the backs of all of the large borosilicate honeycomb mirrors. A test program undertaken as part of the LOTIS 6.5-m collimator project indicates that the RTV bonds creep under load up to a critical limit, where the bonds fail. The creep rate depends on a number of factors: temperature, humidity, and load history. Extrapolation of the LOTIS test results indicates that the service life of the bond may be a few to several years.

The creep rate is expected to be several microns per month, so it is observable. Since the MMT is the oldest of the SOML mirrors to use the adhesive, there is strong interest in taking measurements *in situ*, but access to the primary makes this difficult. D. Blanco has joined a working group from SOML to develop a method for *in situ* testing of the MMT RTV bonds. The implications for the MMT are serious, as it would be a major undertaking to replace the adhesive bonds.

Primary Mirror Support

On the evenings of January 1 and 18, the primary mirror support system failed to successfully carry out the “bump test,” the test done routinely on startup. On both occasions the system cleared on a crate reboot and the failure could not be reproduced the following day. On the evening of Friday, January 23, a third bump-test failure would not clear. Since fog prevented opening that night, D. Blanco, K. Van Horn, and P. Spencer responded on the 24th, focusing on the two actuators that had failed the test. Despite replacing one actuator and swapping cables with working actuators, the performance of both units was puzzling, sometimes passing and sometimes failing tests, and the problem defied solution for the next two days.

The crew was joined by D. Clark and T. Trebisky on Monday, when detailed tests of force commands indicated bit-loss in the command signal. The emphasis then shifted to the cell computer and its communication with the cell. Eventually, the problem was traced to a bent pin on the backplane of the DAC card cage. The short resulted in bit-loss; as a result the actuators received incorrect commands at certain discrete command levels. The failure of just two actuators occurred because the bump test commands only a few discrete levels, and each actuator carries its own gain

calibration. Once diagnosed, the problem was easily fixed and operations were restored just in time for the first clear weather in three days. This type of short is consistent with some of the earlier temperature-related problems that the cell actuators have exhibited this fall and winter.

On February 6 the primary support system reported low air pressure in the hardpoints. This air pressure provides the clamping force required to keep the hardpoint from breaking away, and from lowering the mirror onto its seismic restraints. Operations were not impaired, and the problem was eventually traced to a clogged pneumatic control valve, which was removed, cleaned, and replaced.

This process re-emphasized the fact that the Bellofram transducer that regulates air pressure at the hardpoint is extremely sensitive to orientation. Moreover, there continues to be discussion about the mode of operating the breakaway mechanism. At Magellan, a zener clamp and limiting resistor at the cell crate ensure that excessive pressure cannot be applied to the hardpoints, despite a shift in their orientation. LBT uses a mechanical regulator and a solenoid valve. The latter may be the better approach, but we have yet to find an appropriate regulator that is guaranteed to operate in our temperature range. Other schemes have been suggested.

During the troubleshooting of these cell actuator problems, the spare IP carrier card was installed in the cell crate rack. This card is the latest revision SBC #VIPC 616 rev C and has been functioning properly since its installation. In addition, the reworked IP translation card has been completed and is available for testing as a spare.

OSS Temperature and Focus

Several hours during the engineering nights of January 4, 8, and 9 were devoted to collecting data intended to establish an empirical relation between telescope temperature and focus. On the first night the telescope tracked a single star for ~ 3 hours until its elevation fell below 40 degrees. The telescope was then repointed to a rising target. Wavefront sensor, OSS temperature, and primary mirror temperature data were recorded in intervals of ~ 5 minutes. No corrections were made to the primary or secondary during these intervals. Early in the night we found that the focus changes tracked the temperature changes. However, later in the night, as the cooling of the OSS slowed, large deviations between temperature and focus were observed. Although the data were corrected for elevation by applying the elcoll coefficients, we could not rule out an elevation-dependent focus term. Therefore, the measurements were repeated on January 8 and 9 with the elevation constant, i.e., while pointing near the celestial pole. Again the relationship between focus and temperature was well behaved for the first few hours of the evening but deviated later in the night.

Plots illustrating the behavior are posted at <http://grb.mmt.arizona.edu/~ggwilli/mmt/tempfoc/>. The TempTrax probes were not well coupled to the OSS on December 13, so those data should be disregarded. Figure 1 below shows the data from January 8. Five quantities are shown:

1. OSS temperature. (+)
2. Mirror front-plate temperature. (x)
3. The effect of the mirror frontplate temperature in defocus units. (also as x)
4. Secondary defocus as measured by the wavefront sensor, converted from wavefront sensor units to secondary defocus and corrected for elevation using the elcoll coefficients. (Δ)
5. The addition of 1 and 3, which is the predicted defocus. (\diamond)

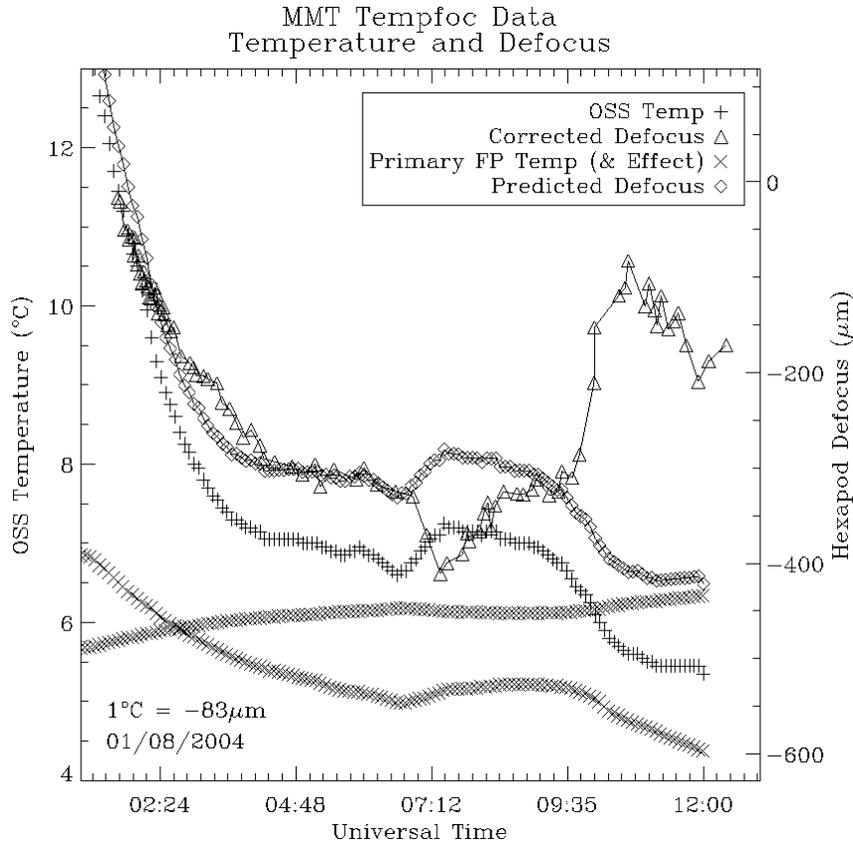


Figure 1: Temperature/Focus dependence, January 8, 2004.

The two curves that would ideally track each other are the defocus (Δ) and the predicted defocus (\diamond). Unfortunately, there appears to be an additional large component of defocus that may depend on other factors: pointing, non-structural temperature, or wind come to mind. We continue to investigate the cause of the discrepancy.

During this process, two additional TempTrax probes were mounted to the OSS, one on the secondary end of the northwest OSS tube and the other on the secondary end of the northeast OSS tube.

Thermal System

Thermal control of the primary has been hampered by several glitches in the thermal control system. The operators frequently lost control of the Carrier setpoint and had to restart the control process. Indeed, basic network communications with the Carrier chiller has been problematic. The reason(s) for these difficulties is(are) not completely understood, and a number of measures have been taken to ameliorate the problems. However, other tasks (listed below) may also have had an impact on the chiller problems.

- Critical portions of the software within the 32-port Cyclades terminal server, which connects serial ports to the network, were replaced by MMT-written software for all equipment connected to the Cyclades.
- Increased use was made of Lantronix device servers.
- Several iterations of mini-server software were tested to improve reliability of communication. For the Carrier mini-server, a new setpoint is repeatedly sent to the unit until the unit accepts the value.
- Problems were encountered in memory management for the Ruby versions of the mini-servers. Software was redesigned to reduce the number of threads required and to eliminate the use of certain subsets of the Ruby socket library. The memory management problems prompted moving the mini-servers from hacksaw to alewife so that the operators are less affected.
- A new thermal GUI was created that, among other things, automatically calculates new setpoints for the Carrier and pit Neslab chillers.
- The “old Vaisala” is now connected to the network, via a Lantronix UDS-10 device server. This Vaisala unit has provided reliable temperature and relative humidity for many years, but data from the unit had not been accessible over the network.

By the end of the reporting period, reliability of the thermal control system was improved, but not yet ideal (nor are the remaining problems fully understood).

Aluminizing

In preparation for the planned aluminization in August, C. Knop and S. King have begun the long process of gathering all the aluminization electronics components and pre-testing the power modules. Each MOSFET switching module is being disassembled, cleaned, individual components tested, and reassembled. All copper plates and heat sinks are being cleaned as well.

D. Clark and B. Kindred tested the smaller aluminum filaments at Sunnyside and found them to be satisfactory. The use of these smaller filaments will greatly reduce (by 2X) the power required for evaporation during the shot.

Optics

CO₂ cleaning of the primary mirror was done in mid-February. This cleaning was postponed until after the AO run out of concern for possible static discharge through the DM electronics.

Secondary Mirror Systems

Secondary Hub Alignment

During M&E time on January 5-6, the secondary fixed hub was aligned to the instrument rotator axis. R. Ortiz, P. Ritz, D. Smith, and D. Blanco set up a bore-sight telescope on the instrument rotator, arranged cross wires at the front and back of the hub, and adjusted the spider turnbuckles to move the hub ~3mm. The accuracy of this alignment was confirmed in late January when the AO group was able to achieve near-perfect collimation with the secondary well-centered in the hub. This provided millimeters of extra range in the hexapod for the very tight $f/15$ configuration.

During previous runs the $f/15$ secondary was oriented in a tilted, decentered condition that yielded minimum coma. The deformable secondary was used to correct the residual on-axis aberration, and the mount was offset by ~ 4 arcminutes to compensate for the pointing error. This yielded diffraction-limited performance on-axis, but compromised the diffraction-limited field of view (FOV). A ray-trace by D. Blanco, included as Figure 2, shows the effect. The horizontal bar shows the diffraction limit at 1.2 microns. For a tilted, decentered system with 4 arcminutes of pointing error, the diffraction-limited FOV after AO correction is only 7.5 arcseconds in radius.

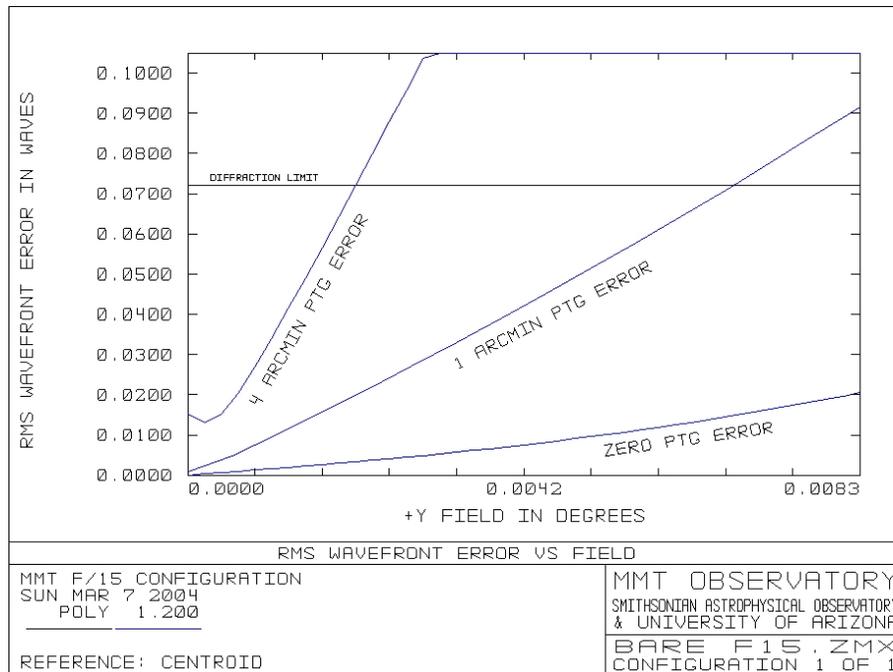


Figure 2: Ray trace showing effective field of view for various amounts of tilt and decenter.

P. Spencer worked with the AO group to install a tape switch on the inside of the hub. This was meant to sense a collision between the hub and the AO module (a problem that plagued the last run), but clearance problems prevented the installation. Much-improved hexapod software and the better centering discussed above allowed the Jan/Feb AO run to proceed without any collisions.

$f/5$ Baffles

In January C. Wainwright, S. Callahan, C. Chute, and A. Ramos began the rapid development of the mid-baffle attachment for the $f/5$ configuration. Once designed, the project underwent a design review and then fabrication drawings were detailed. Sailing hardware was hydraulically crimped onto pre-stretched support cables, and the fabrication and welding process was carried out by Arizona Research and Manufacturing during the first three weeks of February. Following a test fitting on the telescope, the baffle was returned to campus, where a team of students and engineers applied black flocking material to the critical surfaces. First light (if one can use that expression for a baffle) is scheduled for early March.

B. Kindred and J. McAfee fabricated a center baffle that was attached to the $f/5$ secondary mirror. Designed by N. Caldwell, the baffle eliminates a double-bounce stray light path.



Figure 3: The east baffle attachment.



Figure 4: The mid-baffle fully preloaded on the telescope.

Hexapod Control

During the reporting period, the PMAC/UMAC hardware was integrated and tested by S. King, and the new I/O boards for the controller were built. The spare $f/5$ hexapod strut was brought down from the mountain for use as a test article for software development. The design calls for the UMAC hardware to be installed on the top end of the telescope, and cabled to the hexapod LVDTs and encoders over the spider vanes. This allows the low-level analog signals to be captured with fair signal integrity, and the same hardware configuration will then work for all three secondary setups ($f/9$, $f/15$, $f/5$). The UMAC box is thermally insulated and equipped with a liquid/air heat exchange system to remove heat from near the optical path. Software development for the PMAC/UMAC is discussed below.

$f/9$ Hexapod

The spare $f/9$ hexapod actuator was brought to campus for testing. Our initial evaluation shows that the LVDT output on this unit was highly nonlinear, with large discontinuities in its output that led to position ambiguity. This explains the night-to-night variation in hexapod “homing” observed by the telescope operators. In the course of the investigation, it was discovered that the signal conditioning unit is operating at an excitation frequency above the rated frequency range of the LVDT core. In addition, the LVDT core rod is made of a ferrous material, in contravention of the mechanical specifications for their manufacture. We intend to install the correct rods and evaluate the LVDT signal conditioning electronics to correct these issues.

f/9 Top Box Control

For decades the comparison mirror and lamp system has been operated from a dedicated switch box. S. King is designing a replacement using a micro controller built by Rabbit Semiconductor that will allow GUI control over the self-contained Ethernet connection from a host PC. The software of the micro is battery backed-up and automatically resets via a watchdog timeout or power failure to a previously-stored state. Software control will allow integration with the spectrograph GUIs (see below) and the incorporation of lamp commands into data-taking scripts.



Figure 5: The Rabbit core module with Ethernet connection.

Telescope Tracking and Pointing

Servos

At the request of CAAO, D. Clark collected data from the mount servos to try to isolate the 20 Hz mode that plagues AO operations. It appears that, while several other dynamic frequencies are present, a 20 Hz mode is not particularly detectable with the telescope encoders; indeed, they detect only the degree of freedom about the telescope axis (i.e., theta-X in a right-handed coordinate system), while the troublesome mode is along the optical axis (i.e., Z-displacement).

Encoders

Installation of the new differential front-end circuits and associated cabling was successful on the elevation encoder. However, even with these improvements, we observe ~ 0.5 arcsecond RMS, 512 and 1024 cycle/rev cyclical errors. Adjustment of the signal envelope matching circuit in the electronics should improve the situation, but we are optimistic that the final step—the addition of a LUT correction in the mount computer software—will reduce the periodic error terms considerably. A similar upgrade of the azimuth encoders was initiated, but stymied due to the discovery of an intermittent wiring problem in the output cabling. A replacement wiring harness has been built; installation awaits access to the telescope.

Computers and Software

Hexapod Control Software

Preliminary in-lab engineering efforts to control the PMAC/UMAC uses code developed in the Ruby language using the network. We now have a simple command line script, as well as a simple GUI, that controls a single pod in a servo loop closed by the PMAC controller. Future work will be directed toward making the software more robust (with respect to failure of the fiber link), and the existing Ruby code will be replaced by C code that will run in the existing VxWorks crate. This will allow the existing operator's GUI to be used essentially unchanged with the new hardware.

Wavefront Sensor (WFS) Modifications and Elcoll

A “center image” function has been added to the WFS interface that takes the center of the spot pattern as determined by centroiding, and calculates the appropriate hexapod commands to move the spot pattern to the center of the WFS camera. This helps speed up WFS setup in normal use and improves consistency when determining elcoll coefficients. This was tested during the engineering run in early January; however, conditions were poor, so the elcoll determination was not significantly improved over what had been measured previously.

Mountain Computer Upgrades

All three of the primary Linux machines in the control room received hardware upgrades:

- alewife – motherboard, DVD burner, 1 GB RAM, 2.6 GHz CPU, and 160 GB disk
- hoseclamp – 160 GB disk
- hacksaw – 2.66 GHz CPU and 160 GB disk

In the process, they also received full operating system upgrades to Fedora Core 1. Fedora provides improved stability and performance, and a much more robust and streamlined scheme for automatic software updates via the “yum” utility. This scheme also makes it much easier to fold custom software into the automatic updates. T. Pickering has updated all of the software packages he supports (e.g., IRAF, ds9, xephem, pgplot, etc.), set up a yum-compatible web-based archive for these packages, and configured the Fedora machines he maintains to update from this archive.

Revision of mmt_xephem

“mmt_xephem” is a modification of the Xephem software, produced by Elwood Downey, that can be used at the MMT. Code in mmt_xephem was modified to be compatible with the current code in the mount crate and with the current Linux operating systems on the mountain computers. Also, the new code now includes the latest version of Xephem. The code was modified so that most of the MMT-specific code is in a separate C file, making code maintenance easier.

New Thermal GUI

Several iterations of a new thermal graphic user interface, “therm_auto,” were created using Ruby/Glade. In Figure 6 below, the image on the left shows a typical thermal signature of the

primary mirror. The user can modify the display among 8 different temperatures and 14 reference temperatures. Although absolute temperatures can be viewed in this GUI, temperature differences, such as the frontplate minus the reference temperature, are emphasized.

The default display (Figure 6, left) is the frontplate minus the reference temperature. The default reference temperature is that obtained from an E-series thermocouple located immediately in front of the primary mirror. The user can let the display adjust the color patterns automatically, based on the current temperature values, or manually set the midpoint value and range of values.

The “notebook” at the bottom of the GUI can also display a cross-sectional view through the primary mirror, as seen on top right of Figure 6. Here, the temperature differences between the frontplate (upper layer), midplate (middle), and backplate (lower) and the reference temperature are displayed. The relative air temperature in the lower plenum is also shown. Page 2 of the notebook can be used to minimize air/glass temperature contrasts both in front and behind the primary. The cross-section view can rotate by 45 degrees every 5 seconds so that the entire mirror is displayed.

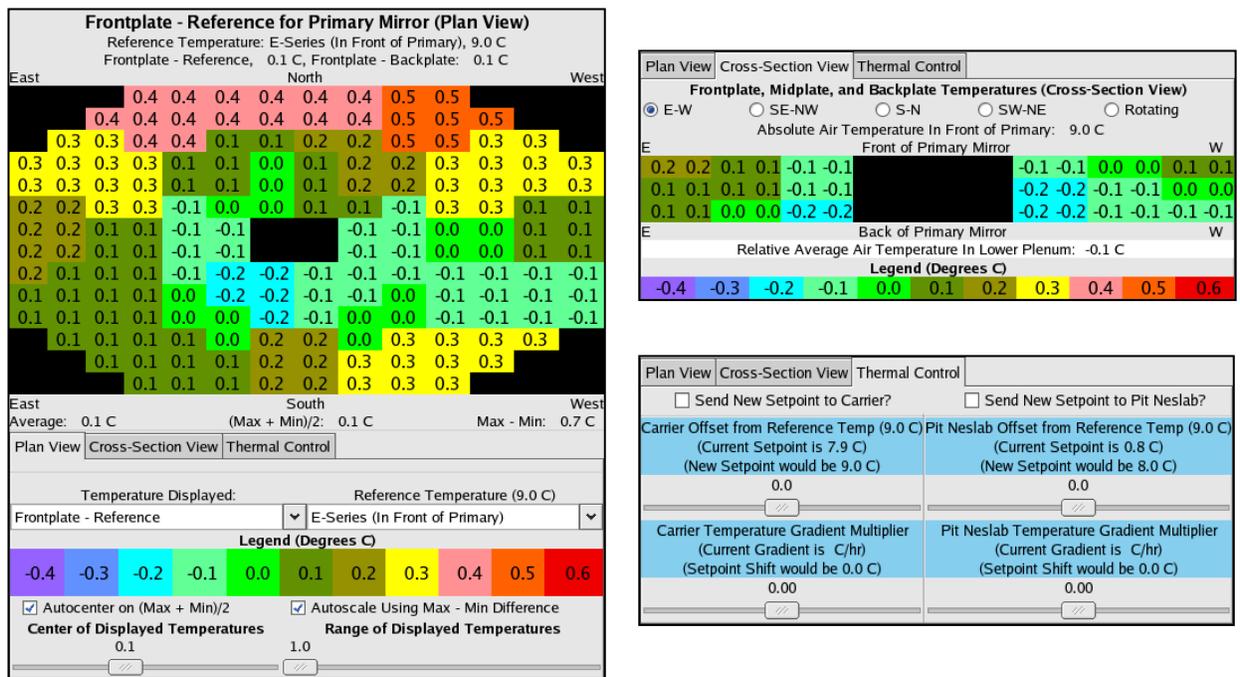


Figure 6: The therm_auto GUI with page 1 of the notebook displayed at the bottom. Pages 2 and 3 of the notebook are displayed at the right (top and bottom, respectively).

Page 3 of the GUI notebook, also shown in Figure 6, implements the thermal control. Control is available for both the Carrier and pit Neslab, together or independently. The new setpoint for the Carrier or Neslab will track a user-specified reference temperature with a specified offset. A front-to-back multiplier term, which is applied to the setpoint, can also be set by the user.

Miscellaneous

Various modifications were made to thermal- and environment-related GUIs and web pages. The web pages are being used by other organizations at Mt. Hopkins, including IOTA.

A new version of the telescope status GUI, “telstat.rb,” used primarily by observers, was generated. This version: 1) uses the mini-servers mentioned above instead of the dataserver, and 2) allows variable font size and display of selected subsets of the data within the GUI.

On January 13 the mount crate failed to boot. This was traced to a problem reminiscent of the Y2K scare; the mount computer’s clock reached the end of its ~33 year cycle and rolled over to an invalid date. T. Trebisky responded and restored operation.

Finally, background logging from the mini-servers was changed so that the background log files have a more consistent format and data content. This will make analysis of data easier for various end-users. Data on telescope elevation for 2003 were supplied to D. Blanco for analysis.

Instruments

Adaptive Optics

The January 28–February 13 AO run was very successful both in engineering and science, despite losing 6 days to poor weather. On the engineering side, G. Brusa (using software written by D. Fisher) took data that demonstrated a new method of calibrating the mirror and wavefront sensor, called “on-sky reconstructor.” This method calibrates the mirror spatial modes by injecting a modulated signal into the AO loop, and measuring the response at the wavefront sensor. In this way, the AO image quality is improved with a reconstructor measured in place, on the telescope. This is the first time in the world that this has been demonstrated on a telescope. Testing with the new reconstructor and plans for a higher order reconstructor are planned for the next AO run.

Work was also done by D. Miller, A. Breuninger, D. Curley, and C. Kulesa in testing and improving software communication between the PI instruments (BLINC/MIRAC and ARIES), the AO computers, and the MMT TCS computers. By the end of the run, dithering was almost completely automated for both instruments, and significant improvements for beam switching were made.

During the first half of the run, BLINC/MIRAC carried out observations of the asteroid Ceres (M. Sykes), nulling images of dust disks around Herbig Ae stars (W. Liu and P. Hinz), and of young star forming regions. ARIES (built by D. McCarthy) was then placed on the AO system and data were obtained with the Simultaneous Differential Imager (SDI) built by L. Close, including imaging of Titan (E. Nielsen) and looking for extrasolar planets (B. Biller). For extragalactic objects, X. Fan and D. Eisenstein took data of a $z \sim 2$ quasar in an attempt to see the host galaxy. ARIES also ran with new software written in Linux by C. Kulesa and D. Curley.

The AO team would like to thank the support staff on the mountain and the telescope operators for their enthusiastic support of the AO system.

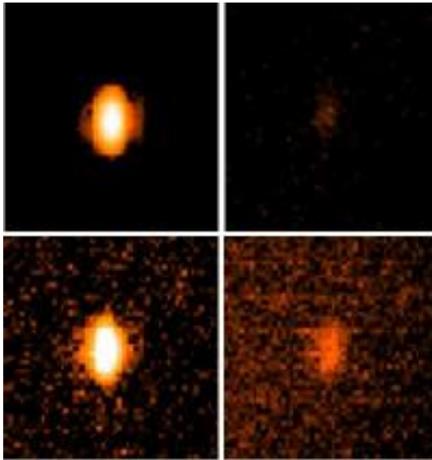
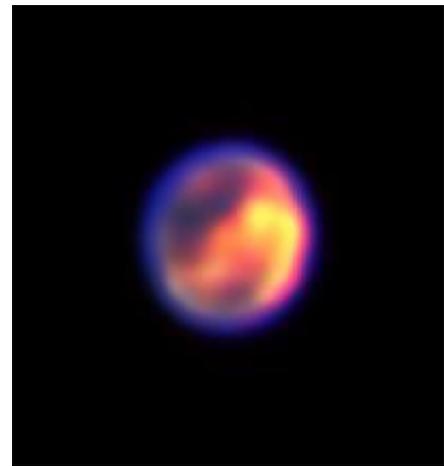


Figure 7: Nulling with BLINC/MIRAC. The top row depicts constructive and destructive interference on a point source calibrator, with the nulled image on the right showing 4.7% residual flux. The bottom row shows the constructive and destructive interference on a Herbig Ae star. The residual flux in the nulled image of 24% residual flux indicates the presence of circumstellar material around the star. All images were taken at 10.3 microns. Data from W. Liu and P. Hinz;

Figure 8: Image of Titan obtained with the MMT SDI/AO system on February 13, 2004 UT. This false color image (red=1.575 μm , green =1.600 μm , blue = 1.625 μm) shows Saturn's moon 0.8" across. The bright spot is thought to be ice-covered mountains. Dark areas may contain liquid methane or ethane. The blue haze is the dense methane rich atmosphere. These images were obtained in 1.0" seeing corrected to 0.1" and are lightly deconvolved. Data from L. Close and E. Nielsen.



Red and Blue Channel Spectrographs

Red and Blue Channel efficiency data obtained by C. Foltz, M. Wagner, and T. Pickering during several occasions in 2003 were reduced. The data consist of spectra of standard stars with a 5 arcsec slit, and include measurements using the following gratings at several tilts:

Blue Channel 300, 500, 600, 800, 832, and 1200 1/mm

Red Channel 150, 600, 1200 1/mm

M. Wagner will provide the final throughput results.

These data are also being used to establish a relationship between grating tilt angle expressed as a DVM value and the central wavelength. G. Schmidt performed fits to the entire data set for both Red and Blue Channel, and the solutions will be used in the spectrograph control GUI to calculate the DVM setting to achieve any requested central wavelength for any grating and order. This will completely do away with the need to calculate new zeropoints after changing gratings.

SCCS Modifications

With the help of D. Smith and G. Williams, the old SCCS PC was set up in the chamber to reverse-engineer the undocumented emergency-stop command to the MSD box. This is now incorporated into the new SCCS GUI. Improvements have also been made to the engineering interface of the new SCCS. The grating and filter wheel configuration has been split into two windows, and the grating configuration has been better organized.

General Facility

Building Drive

Occasional building/telescope collisions continued during the period; single events occurred on January 9 and 12 and February 15, 18, and 24. Each collision happened on start of slew and none incurred more than a few minutes' lost time. P. Spencer has installed an HP DAU data logger and is working with D. Gibson to set up a 24-hour monitor to capture telemetry from a collision event so that the cause(s) may eventually be found.

Radio Link Reconfiguration

Attempts were made to configure the Mt. Hopkins radio link to support separate broadcast domains for the MMT and SAO (ridge and IOTA, specifically) networks. Thus far, this has been unsuccessful. Part of the problem was that the downtown end had an Ethernet module that only supported 4 machines per port. It worked well enough when only one port was used, but any attempt to use more than one created problems. Replacing it with the appropriate module that supports 8192 hosts/port (like the units on the summit and ridge) solved this problem. However, there are still issues when trying to use multiple simultaneous VLANs. Resolving these issues is the subject of ongoing work.

Instrument Rotator

On the night of February 13 while tracking with the ARIES imager, the rotator lanyard pulled, killing power to the instrument rotator. Without power, the instrument rotator started to free wheel under the unbalanced load of ARIES. No damage resulted, but the incident pointed out two issues: first, the need to balance instruments about their rotation axis as specified in the Science Instrument Interface Control Document (see URL <http://www.mmt.org/MMTpapers/pdfs/itm/tm03-4.pdf>); and second, the need for a rotator brake.

PI Interface Panels

A fiber optic cable tester has been tested and purchased. The signal #2 cable to the *f*/9 topbox has been terminated into the PI panel and the power cable connector has been replaced. The ribbon cables have been used successfully as RS232 cables by at least one observer. However, a few PI interface panel lines remain to be installed.

Safety

An accident on January 22 marred MMTO's excellent safety record. While unloading a piece of steel plate at the summit shop, P. Ritz lost hold and the plate dropped on his foot, fracturing the first metatarsal. Phil spent the next three weeks hobbled in a protective boot. To reduce this danger, funds have been provided for the operations staff to buy steel-toed shoes to wear while handling heavy equipment. Phil's recovery was quick; by late February he was able to put on regular shoes and he will be able to wear a pair of the steel-toed shoes.

Miscellaneous

Storms and fog kept us closed for much of this period. The new road heaters saw considerable use, keeping the final grade free of ice and snow. Many thanks to the FLWO road crew for their continuing efforts with snowplows and sanders to keep the road passable.

On January 15 the west primary mirror air hose (a.k.a "elephant hose") blew out and was patched for the evening. D. Blanco and R. Ortiz prepared a replacement hose that was installed on the 16th.

On January 29 the UPS in the 26 V interlock rack failed, bringing operations to a brief halt. M. Alegria, working with telephone support from K. Van Horn, was able to bypass the UPS and restore operation that night.

On January 29 an insulated, powered rollup door was installed between the chamber and the west instrument lab to facilitate handling of the SAO suite of instruments. This replaces the heavy insulated panel sections that had to be manhandled aside during instrument changes. P. Ritz and R. Ortiz designed and fabricated a modular doorjamb that lets the door close after deployment of the Hecto fiber chain.

SM&R installed a gabion at the top of the road to reinforce the southwest corner of the shop foundations, but the gabion itself started to fail soon after completion. SM&R returned to inspect the problem and further work is planned in March.

A DustTrak aerosol monitor was mounted next to an access port on the south side of the primary mirror cell. D. Gibson prepared a web-accessible page that displays aerosol content over the previous 24 hours. A dust alarm and accumulation monitor is in progress. Plastic tubing will soon be routed through a port to sample the aerosol content inside the cell at the edge of the primary.

Bryan Stenman (SI fire safety officer) arrived on January 27 to inspect the new fire alarm, and the system was activated following his approval. In the first week after activation two false triggers of the system occurred. We soon expect to receive documentation for supporting the new system from Saguro Electric (TBR sub-contractor).

The Common Building basement project is near completion, awaiting final inspection and punch list. Handrails and deck coating are pending. TBR did fine work on the interior; the MMT will soon have large spaces available for storage of instruments, spares, and documentation.

The support shop's welding exhaust hood fan, which had failed the SI safety inspection, was upgraded. Both the motor and pulley were replaced, since the unit was undersized for the number of elbows in the system, and the cfm draw in the hood was doubled.

A 3000-hour preventive maintenance was performed on the Denver/Gardner air compressor. This included changing the air filter, oil separator, and oil.

An air leak in the cell air cabinet was repaired. The air line, which was routed in such a way as to put undue strain on the quick disconnect fitting, was rerouted with new fittings.

Testing was done of the loft Neslab software and hardware. This unit had not been used for several months and may be required for upcoming *f/5* secondary activity.

Heat tape was installed on the cell air drain lines, located in the pit trench and outside the RUPS room, to prevent ice forming in the lines.

K. Van Horn created a database to identify spares on hand and spares needed. This is now in an Excel spreadsheet at *mmto://mmt/electronics/In Work Projects/MMT SYSTEMS/MMT SYSTEMS DEFINITIONS*. Comments and additions to this effort are welcome. Updates to this document should be made on a separate copy, emailed to Ken. The work previously done by C. Knop has been incorporated into this document and is greatly appreciated. Ken will be asking specific people for additional information as he progresses.

A mobile DAU test unit is being assembled for data acquisition anywhere in the telescope building or chamber, using Ethernet communication. The setup consists of a Lantronix UDS 10 device server connected to the DAU via its RS232 port. Communication is achieved using the DAU window's software or by telnetting into the UDS 10 and commanding the DAU directly. Tcl and Ruby scripts for simpler remote operation are being developed.

On February 9 USFS inspector Jack Cohen and FS Fire Mgt. Officers from Tucson and Nogales met with MMTO and FLWO staff to tour the summit and ridge facilities. Jack had many excellent tips for improving fire safety. Karen Myres (FLWO facilities manager) is working with the local fire marshals to revise the FLWO fire safety procedures incorporating Jack's suggestions.

Visitors

February 28: George Coyne and Chris Corbally of the VORG accompanied a group of "Friends of the Vatican Telescope" to the site. Dan Brocius gave them an introductory talk at the basecamp. Dan Blanco gave a tour and talk at the MMT site.

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

- 04-1 The *Chandra* Multiwavelength Project: Optical Follow-Up of Serendipitous *Chandra* Sources
Green, P. J., Silverman, J. D., Cameron, R. A., Kim, D.-W., Wilkes, B. J., Barkhouse, W. A.,
LaCluyzé, A., Morris, D., Mossman, A., Ghosh, H., Grimes, J. P., Jannuzi, B. T.,
Tananbaum, H., Aldcroft, T. L., Baldwin, J. A., Chaffee, F. H., Dey, A., Dosaj, A., Evans, N.
R., Fan, X., Foltz, C., Gaetz, T., Hooper, E. J., Kashyap, V. L., Mathur, S., McGarry, M. B.,
Romero-Colmenero, E., Smith, M. G., Smith, P. S., Smith, R. C., Torres, G., Vikhlinin, A.,
Wik, D. R.
ApJ Supp, **150**, 43

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@mmt.org or to the following address:

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

MMTO in the Media

Two articles appeared on the *uanews.org* web site in January entitled "UA Astronomers Use MMT to Detect the Widest Lensed Quasar" and "Astronomers at MMTO Capture Planetary Nebula in Glowing Detail." Their respective URLs are provided below:

<http://uanews.org/cgi-bin/WebObjects/UANews.woa/wa/MainStoryDetails?ArticleID=8404>
<http://uanews.org/cgi-bin/WebObjects/UANews.woa/3/wa/SRStoryDetails?ArticleID=8434>

MMTO Home Page

The MMTO maintains a web site (<http://www.mmt.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.

Use of MMT Scientific Observing Time

January 2004

| <u>Instrument</u> | <u>Nights Scheduled</u> | <u>Hours Scheduled</u> | <u>Lost to Weather</u> | <u>Lost to Instrument</u> | <u>* Lost to Telescope</u> | <u>** Lost to Gen'l Facility</u> | <u>Total Lost</u> |
|-------------------|-------------------------|------------------------|------------------------|---------------------------|----------------------------|----------------------------------|-------------------|
| MMT SG | 21 | 247.50 | 169.80 | 3.00 | 9.00 | 2.00 | 183.80 |
| PI Instr | 3 | 34.50 | 10.50 | 0.00 | 0.00 | 0.25 | 10.75 |
| Engr | 6 | 71.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sec Change | 1 | 11.60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | 31 | 365.00 | 180.30 | 3.00 | 9.00 | 2.25 | 194.55 |

Time Summary Exclusive of Shutdown

| | |
|---|------|
| Percentage of time scheduled for observing | 77.3 |
| Percentage of time scheduled for engineering | 19.6 |
| Percentage of time scheduled for secondary change | 3.2 |
| Percentage of time lost to weather | 49.4 |
| Percentage of time not lost to weather lost to instrument | 1.6 |
| Percentage of time not lost to weather lost to telescope | 4.9 |
| Percentage of time not lost to weather lost to general facility | 1.2 |
| Percentage of time lost | 53.3 |

* Breakdown of hours lost to telescope
 mount crate 4
 primary temperature 2
 primary support 3

** Breakdown of hours lost to facility
 ventilation 2
 26v rack UPS 0.25

February 2004

| <u>Instrument</u> | <u>Nights Scheduled</u> | <u>Hours Scheduled</u> | <u>Lost to Weather</u> | <u>Lost to Instrument</u> | <u>* Lost to Telescope</u> | <u>Lost to Gen'l Facility</u> | <u>Total Lost</u> |
|-------------------|-------------------------|------------------------|------------------------|---------------------------|----------------------------|-------------------------------|-------------------|
| MMT SG | 9 | 98.80 | 65.20 | 0.00 | 0.00 | 0.00 | 65.20 |
| PI Instr | 20 | 224.10 | 99.70 | 9.00 | 1.50 | 0.00 | 110.20 |
| Engr | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sec Change | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | 29 | 322.90 | 164.90 | 9.00 | 1.50 | 0.00 | 175.40 |

Time Summary Exclusive of Shutdown

| | |
|---|-------|
| Percentage of time scheduled for observing | 100.0 |
| Percentage of time scheduled for engineering | 0.0 |
| Percentage of time scheduled for secondary change | 0.0 |
| Percentage of time lost to weather | 51.1 |
| Percentage of time not lost to weather lost to instrument | 5.7 |
| Percentage of time not lost to weather lost to telescope | 0.9 |
| Percentage of time not lost to weather lost to general facility | 0.0 |
| Percentage of time lost | 54.3 |

* Breakdown of hours lost to telescope
 telescope rebalance 1
 primary temperature 0.5

Year to Date February 2004

| <u>Instrument</u> | <u>Nights Scheduled</u> | <u>Hours Scheduled</u> | <u>Lost to Weather</u> | <u>Lost to Instrument</u> | <u>Lost to Telescope</u> | <u>Lost to Gen'l Facility</u> | <u>Total Lost</u> |
|-------------------|-------------------------|------------------------|------------------------|---------------------------|--------------------------|-------------------------------|-------------------|
| MMT SG | 30 | 346.30 | 235.00 | 3.00 | 9.00 | 2.00 | 249.00 |
| PI Instr | 23 | 258.60 | 110.20 | 9.00 | 1.50 | 0.25 | 120.95 |
| Engr | 6 | 71.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sec Change | 1 | 11.60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | 60 | 687.90 | 345.20 | 12.00 | 10.50 | 2.25 | 369.95 |

Time Summary Exclusive of Shutdown

| | |
|---|------|
| Percentage of time scheduled for observing | 87.9 |
| Percentage of time scheduled for engineering | 10.4 |
| Percentage of time scheduled for secondary change | 1.7 |
| Percentage of time lost to weather | 50.2 |
| Percentage of time not lost to weather lost to instrument | 3.5 |
| Percentage of time not lost to weather lost to telescope | 3.1 |
| Percentage of time not lost to weather lost to general facility | 0.7 |
| Percentage of time lost | 53.8 |