Smithsonian Astrophysical Observatory & Steward Observatory, The University of Arizona

MMT Observatory
Smithsonian Institution &
The University of Arizona®

BIMONTHLY SUMMARY

July - August 2004

The 2004 MMT staff photo. From left to right: Grant Williams, Dusty Clark, Phil Ritz, Barbara Russ, John McAfee, Ale Milone, Duane Gibson, Ken Van Horn, JT Williams, Court Wainwright, Tom Trebisky, Creighton Chute, Tim Pickering, Johnathan Labbe, Howard Lester, Brian Love, Cory Knop, Bill Kindred, Brian Comisso, Dennis Smith, Dan Blanco. Missing are Mike Alegria and Pete Spencer. Photo courtesy of Karen Myres.

Personnel

In mid August Creighton Chute began work at the MMT as a mechanical engineer. He worked as a student engineer at MMTO for two years, assisting in the design and fabrication of the *f*/5 baffles, rotator limit switch, and modification of the neutral members.

In late August Brian Love was hired as a mechanical engineer to work on the mountain. He comes to us from Infrared Lab after 17 years' distinguished work on a variety of instruments, vessels, and dewars.

In early August Deva Coopamah and Nima Forghani were hired as student mechanical engineers. Deva left the MMTO after 1.5 weeks.

At the July 12 Steward Observers' Lunch, Brian McLeod (CfA) reported on the new *f*/5 SAO Widefield InfraRed Camera, SWIRC. At the July 19 lunch, Michael Lloyd-Hart reported on the Laser Guide Star AO run at the MMT June 2-7, and Keith Powell reported on the MMT servo system.

Primary Mirror Systems

Aluminization

To date, John Hill's SCOPES package for IRAF has been used to model the deposition of aluminum within the MMT's aluminizing chamber. However, this software is very limited in how it models the aluminum sources and how they are baffled. It assumes that each filament has its own individual baffle whereas the MMT's chamber has baffles around each ring of filaments. Intuitively, one could imagine how this could make a significant difference in how the deposited aluminum is distributed over the mirror surface. To check this qualitatively, the algorithms from the SCOPES package were ported from IRAF to C and then extended to treat the baffles physically via ray tracing. Figures 1-3 show results predicted using the geometry of the MMT primary and the current filament positions within the aluminizing chamber. Figure 1 shows what the original SCOPES package predicts given a baffle angle of 30 degrees. The RMS here is 2.7% and the maximum peak-to-valley variation is 13 nm for a mean thickness of 95 nm. Figure 2 shows the predictions of the new ray tracing model using the as-designed geometry of the current filament and baffle system. The RMS is 15.7% and the maximum peak-to-valley is 35.7 nm for a mean of 95 nm. This is clearly much worse than we expected and suggests that our current coating may not be as uniform as we'd like. Fortunately, it appears that the results can be significantly improved by simply moving the filament rings up or down. Figure 3 shows the results of moving the inner ring down 200 mm, the middle ring up 100 mm, and the outer ring up 200 mm. This brings the RMS down to 3.9% and the peak-to-valley down to 15.2 nm. Once we determine how much range of adjustment we have for each filament ring, we will run a grid of models to find the optimum geometry.

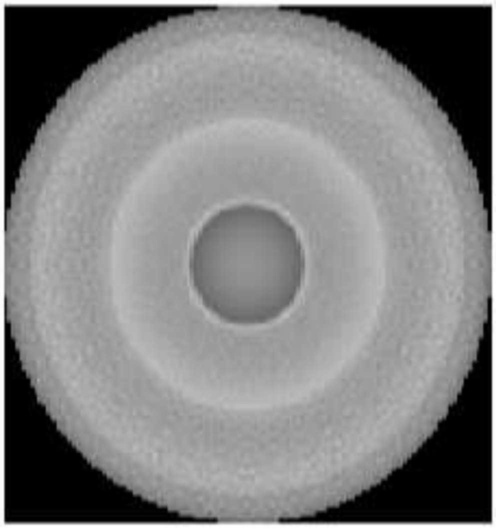


Figure 1: Results from the original aluminizing model assuming individual baffles around each filament with a baffle angle (measured down from horizontal) of 30 degrees.

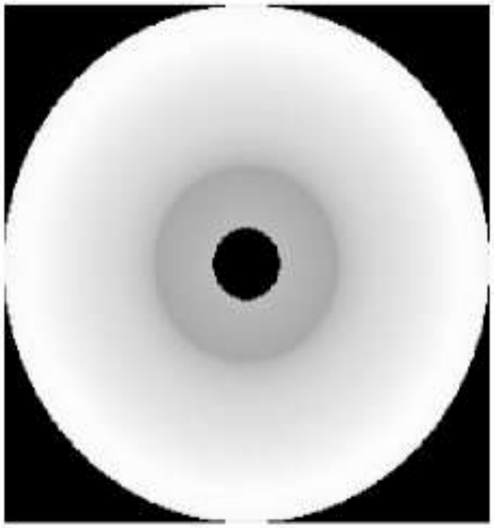


Figure 2: Results for the current system using the as-designed geometry of filament and baffle positions.

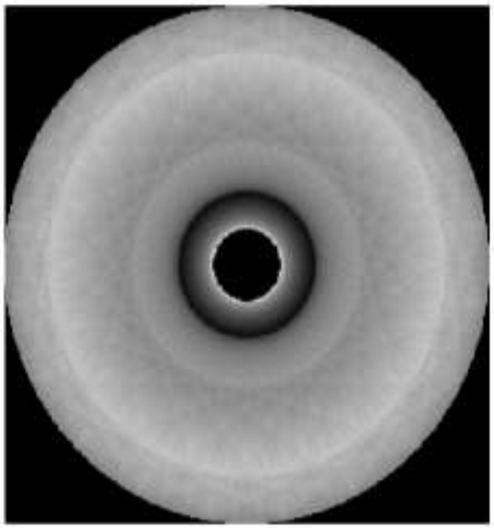


Figure 3: Results obtained by moving the inner filament ring down 200 mm, the middle ring up 100 mm, and the outer ring up 200 mm.

Interest continues in developing an alternative to the fragile, irreplaceable MOSFET switching modules used for aluminization. D. Clark has identified a vendor based in England, Dynex Semiconductor, that designs and builds switching units to spec. He has been working with J.T. Williams in pursuing more information and test units from a welder manufacturer, Miller Welding.

Thermal System

P. Spencer, with assistance from J. Labbe and D. Gibson, completed the T-series thermocouple (copper-constantan) temperature readout system. The T-series thermocouples were installed in the mirror hex cores before the mirror was delivered to the mountain, but they have not yet been used to monitor the thermal state of the primary mirror. To date, the temperature of the primary has been monitored with only the E-series thermocouples.

The current incarnation of the T-series system is modified from the original configuration, which required four HP data acquisition units (DAU). The current configuration uses only two Agilent 34970a DAUs, one for the west side of the mirror cell and one for the east side. Each DAU contains two #34901a 20 channel multiplexer cards, one for each quadrant of the mirror. Each card is wired/programmed for a minimum of 10 channels of differential voltage measurements and one channel of direct temperature measurement. The cell T-series thermocouples are wired to a gray NEMA enclosure mounted on the viewports at the northeast, southeast, northwest, and southwest quadrants of the mirror cell. The NEMA enclosure contains terminal block connections for each of the T-series thermocouples and is used to hardwire the thermocouple difference configurations to be monitored by the DAUs. Because the reconfiguration eliminated two DAUs, the northwest and southeast quadrants each required an extra 20 feet of interface cable. These cables consist of twisted shield pairs to help prevent any added noise that might be generated by the extra cable length. Future effort will include investigating and eliminating any noise problems.

The T-series mini-servers for the four mirror quadrants were modified to reflect the hardware changes. Data from the T-series thermocouples are currently being logged and are available in tabular and graphical form on the engineering web pages. After evaluation of the data, these thermocouples may be used by the operators for monitoring the thermal conditions of the primary mirror.

While working on the T-series thermocouple readout system, the cell lower plenum E thermocouples' location and condition was inspected. The thermocouple locations have been documented and will be used to improve the accuracy of the present temperature monitoring systems.

Secondary Mirror Systems

Hexapod Control

In August, a major milestone in the effort to improve our control of the *f*/5 hexapod was achieved. The UMAC hardware was moved to the mountain and used to control all six axes of hexapod motion. Contrary to popular opinion, this project does not involve any PMAC hardware. We have a UMAC turbo unit that sends commands to the motors and handles limits, and this unit is mounted in a rack on the third floor. We also have a UMAC macro unit that reads lvdt position sensors, and also receives quadrature signals from the encoders. The two units communicate by a dedicated fiber link and the servo loop is closed using encoder data transmitted over the fiber link. During summer shutdown, over a week was spent testing the unit and fixing problems that, until all the pieces were assembled and expected to work together, we were unaware of.

In the lab, we were able to achieve pod positioning to a typical accuracy of 0.2 microns using a single pod with no load. On the mountain, with all six pods in motion and handling the weight of the *f*/5 secondary, we see typical position accuracy of better than a micron and an occasional worst case position error of 2 microns. This is approximately an order of magnitude better than we were able to achieve using the PIC controller servos, which had typical 8-12 micron positioning accuracies. We are not yet exploiting the full capabilities of the UMAC controller to generate controlled trajectory multi-axis coordinated motion; this work is still in progress.

Telescope Tracking and Pointing

MMT Servos

Many open-loop measurements of the elevation axis have been taken, and in turn used as design inputs for K. Powell's and E. Bell's work on creating a new closed-loop controller for the MMT. K. Powell reduced the field data, and followed by using an automated iteration routine to fit a transfer function model to the data that agrees well with the actual plant. He will be designing the controller using his own methods with this model. E. Bell, on the other hand, has been developing a physical-insight plant model based on the measured data and the early FEA analysis carried out during the telescope's structural design. Comparing and synthesizing the two approaches will allow for the best cross-checking of the results. D. Clark will be implementing a test controller with the same PC and xPC Target kernel used for collection of the open-loop data once the controllers have been sufficiently refined.

Due to the time-consuming nature of switching the elevation servo amplifiers over from the voltage-source mode that we normally use to current-source mode for servo testing and design, C. Knop and B. Comisso have built another spare azimuth type amplifier (az has always been current-source). With the new unit and the spare from the azimuth stack, plus a couple of adapter cables, changing the servo over from operational mode to test mode now takes but a few minutes and can be done routinely. Thanks guys, for saving D. Clark lots of time!

Spare Heidenhain interpolation units for the MMT tape and rotary encoders have been ordered. These units will be 50X interpolation, instead of our current 25X. Heidenhain stopped manufacturing the EXE702 25X units, and we do not expect them to be supported in a few years. While not direct spares, due to the requirement of retuning the servos, these are the latest version, with support for the foreseeable future.

Encoders

C. Chute and C. Wainwright are currently looking into improving the alignment of the Heidenhain elevation encoders.

Computers and Software

Hartmann-DIMM Seeing Monitor

With the help of D. McCarthy—who loaned us a 10" Meade telescope (formerly owned by S. Callahan)—and M. Kenworthy (CAAO), we performed some initial feasibility tests of a simple Hartmann-DIMM (Differential Image Motion Monitor) design for a seeing monitor. The classical approach to making a DIMM for measuring the seeing is to use a 8-12" amateur-class telescope, like a Meade or Celestron Schmidt-Cassegrain, and mask the entrance aperture down to two 50-60 mm apertures. A wedge prism is placed over one of the apertures so that two separate images of a star are formed in the image plane, and the differential motion of these images is used to determine the seeing. A Hartmann-DIMM is similar, but separates the images from each aperture by changing the telescope's focus in lieu of using wedge prisms. This design has the advantage of making it very easy to implement multiple apertures, which can provide more information than just a single baseline. The trade-off is that the images formed by each aperture will be out of focus. Fortunately, the depth of focus provided by the relatively long focal length of the *f*/10 10" Meade allows us to defocus enough to separate the individual aperture images without significantly degrading those images.

For the initial tests, we constructed a Hartmann mask with four 2" apertures arranged in a cross pattern, which gives us six unique baselines to monitor. We set the telescope up in front of T. Pickering's house and used a Supercircuits PC164 video camera plus a framegrabber card as the imaging system. Figure 4 shows an example image taken of a 6th mag star. We were initially concerned that the small apertures and short exposure times (1/60th of a second) would greatly limit how faint a star we could use, but this 6th mag star provided plenty of signal. With better seeing, even a 7th mag star would probably be usable. We grabbed two sets of 500 images each and used IRAF's starfind task to find and centroid the stellar images. Averaging the results of all baselines nets a seeing of 4.22" for the first set of images and 4.15" for the second set. In both sets the two upper left to lower right baselines give significantly larger measures of the seeing than the lower left to upper right baselines. The average for the former for the two sets is 4.76" and for the latter is 3.82". This shows that the wind direction is closely aligned with the upper left-lower right image diagonal. More sophisticated temporal analysis of the image motion would allow us to determine the wind speed and actual direction.

The next step is to do similar tests with a system mounted on the MMT. This would allow direct comparison with seeing measurements from direct images as well as our Shack-Hartmann wavefront sensors. Ultimately we intend to mount the seeing monitor in such a way that it can independently offset to a bright enough star, allowing seeing measurements to be taken during science observations.

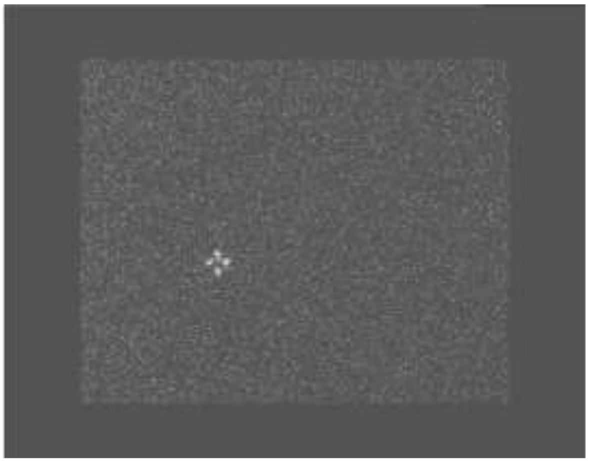


Figure 4: Example image of a 6th mag star taken with our Hartmann-DIMM prototype.

Software Documentation

Work continued on a set of "cheat sheets" for use by operators, engineers, and others at the MMT. Many newly written cheat sheets can be found online at *http://hacksaw.mmto.arizona.edu/cheatsheets/* or at *http://www.mmto.org/cheatsheets/*. These cheat sheets are intended to be short summaries for the use of the more common software programs at the MMT. Ideally, each cheat sheet would be roughly one page in length and would consist of a numbered list of steps to use a specific piece of software. More detailed information on the use of programs is found in user manuals and troubleshooting guides, which also have links from the cheat sheets web page.

One new area of documentation for the cheat sheets web pages is software code listings. Listings of the majority of software currently used at the MMT are now available over the web. These software pages are all under password protection. One objective of this effort was to create a comprehensive inventory of the programs and scripts used at the MMT by all users: operators, observers, engineers, and programmers. Additional software comments have been added to many of the programs and scripts as further software documentation. The software web pages are created dynamically (i.e., on-the-fly) with the currently used code being read from disk and filtered through a syntax-coloring program for web page generation. A compiled C program, "webcpp" (*http://webcpp.sourceforge.net/*), which handles all of the languages currently used at the MMT, is used on *hacksaw* for syntax coloring and HTML document generation. A Perl script, "code2html" (*https://sourceforge.net/projects/code2html/*), is used on *mmto* for syntax coloring and HTML generation since current versions of webcpp required a version of the C compiler newer than is available on *mmto*. Webcpp will be used on *mmto* when the Linux kernel and C compiler is updated on that computer.

In addition, much documentation in the form of HTML and PDF files was also added to the cheat sheet and engineering pages. These files include electronic schematics, manufacturer's manuals, user's manuals, and similar reference materials. As with the software documentation, many of these files are under password protection.

These web pages will continue to evolve through use and with the addition of more material. Additional software, such as the PHP scripts used for the operators' log and the C source code for the *f*/5 firmware, still needs to be incorporated. Additional existing documentation remains to be added to the web pages. Further documentation also needs to be written and incorporated into these web pages.

Software Modifications

The balancer GUI was updated to account for changes made to the telescope during summer shutdown. Additional entry fields were added for greater flexibility in accounting for new equipment in the balance calculations. New web pages that plot east and west mount drive current versus telescope elevation as X-Y scatter plots were created. These data are also presented in tabular form on a separate web page. The web pages are used to analyze current telescope balance. Data are currently being sampled at a 2-second interval and stored for a 20-minute duration in the mount mini-server. The web page user can also interactively clear data in the mount mini-server so that, after a change has been made in telescope balance, new charts and tables can be created.

Over half of the GUIs used for thermal control of the MMT were replaced during summer shutdown. The new GUIs include a set of four X-Y scatter plots where two temperatures, such as Carrier setpoint and primary mirror frontplate temperature, are plotted against each other. The scatter plots are designed so that both the X and Y axes have the same units and scales. A green line in the X-Y plot indicates ideal operating conditions. Data points on the scatter plots are color coded so that new data can be distinguished from older data. These same X-Y scatter plots are available in Ruby-Gtk2 GUIs used by the operators and on separate engineering web pages. Other new thermal GUIs reflect changes and additions in thermal monitoring equipment, such as the TempTrax units. Older Tk/Tcl GUIs are no longer automatically started when the operator starts the thermal system, but are still available to the operator if needed.

An additional change to the operator interfaces is the enhancement of the cell error logger program. Along with now performing a daily rollover of the logs themselves, we have begun an effort to make these messages more user friendly (in the past it has been almost necessary to call the software engineer to request an "interpretation" of many of the messages).

Miscellaneous

A new mini-server was created for the MGE uninterrupted power supply (UPS) that is located in the shop. This UPS supplies power to the observatory when mountain main power (commercial or generator) is lost. The MGE UPS has its own web page at: *http://128.196.100.244/*. The "tools" GUI was revised to show status of the MGE UPS rather than the retired RUPS.

Instruments

Blue Channel Spectrograph

During the past year some observers have reported that the collimator position that gives the best focus in the dispersion axis was different than the position that gives the best focus in the spatial axis. This indicated that there was astigmatism in the spectrograph, which was most evident when a high dispersion grating was used. The astigmatism may have been introduced when the new Blue Channel CCD (ccd35) was installed in February 2003. The new chip could have been mounted at a height slightly different (absolute z-position) than the old chip. To compensate for the height difference, the collimator position may have been moved from its nominal position, thereby introducing astigmatism.

The proper fix for an incorrect chip height is to shim the chip and move the collimator until the astigmatism is eliminated. However, shimming the chip is a difficult process and it cannot be done while measurements are being made. A much easier solution is to shim the entire dewar (including the corrector), which, for small shims, does not significantly degrade the image quality. With the previous CCD (ccd22), the nominal shim thickness between the dewar and the instrument was 0.030".

D. Smith, G. Williams, and J.D. Gibson performed Blue Channel engineering on July 15-16. The plan was to shim the dewar and adjust the collimator position until the astigmatism was eliminated. Measurements were made using the 1200 l/mm grating with a single 1.4 arcsec pinhole aperture and the HeNeAr calibration lamps. The FWHM of the spectral lines was measured in both the spatial and dispersion axes at several collimator positions (measured in volts). The results prior to modifying the shim thickness (i.e., with only the nominal 0.030" shim installed) are shown in Figure 5. The dispersion axis had a best focus at a collimator position of approximately 2.3 V while the spatial axis had a best focus at a collimator position of 2.9 V.

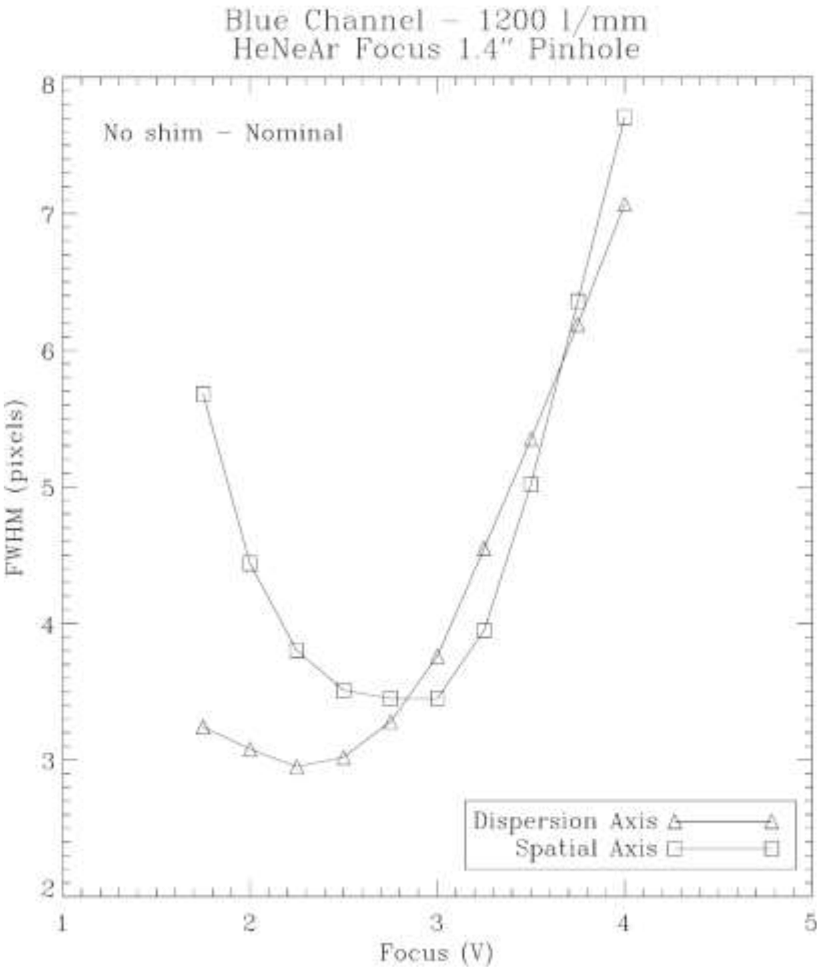


Figure 5: Results prior to modifying shim thickness (i.e., with only the nominal 0.030" shim installed).

A 0.010" shim was added to the nominal 0.030" shim. The focus measurements indicated no improvement. The shim thickness was then reduced by 0.005" from nominal (or to a total 0.025" shim). Figure 6 shows that the best focus in both axes was beyond the range of the fine focus adjustment of the collimator. Adjustment of the collimator coarse focus was needed to move the best focus into the range of the fine focus.

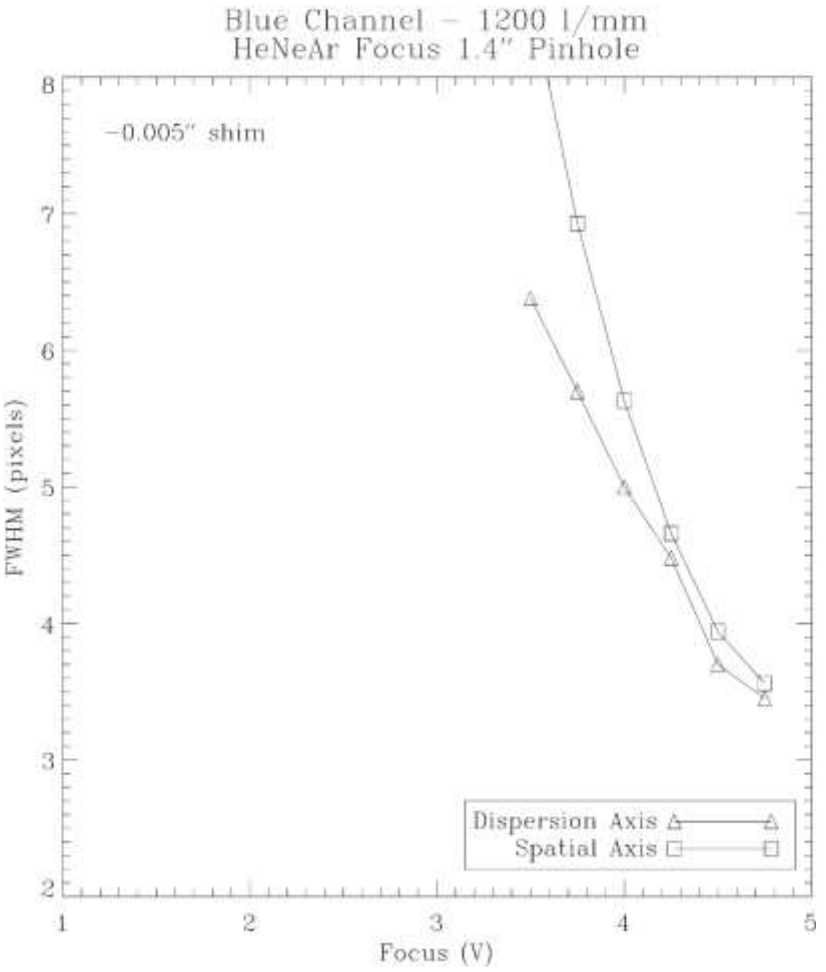
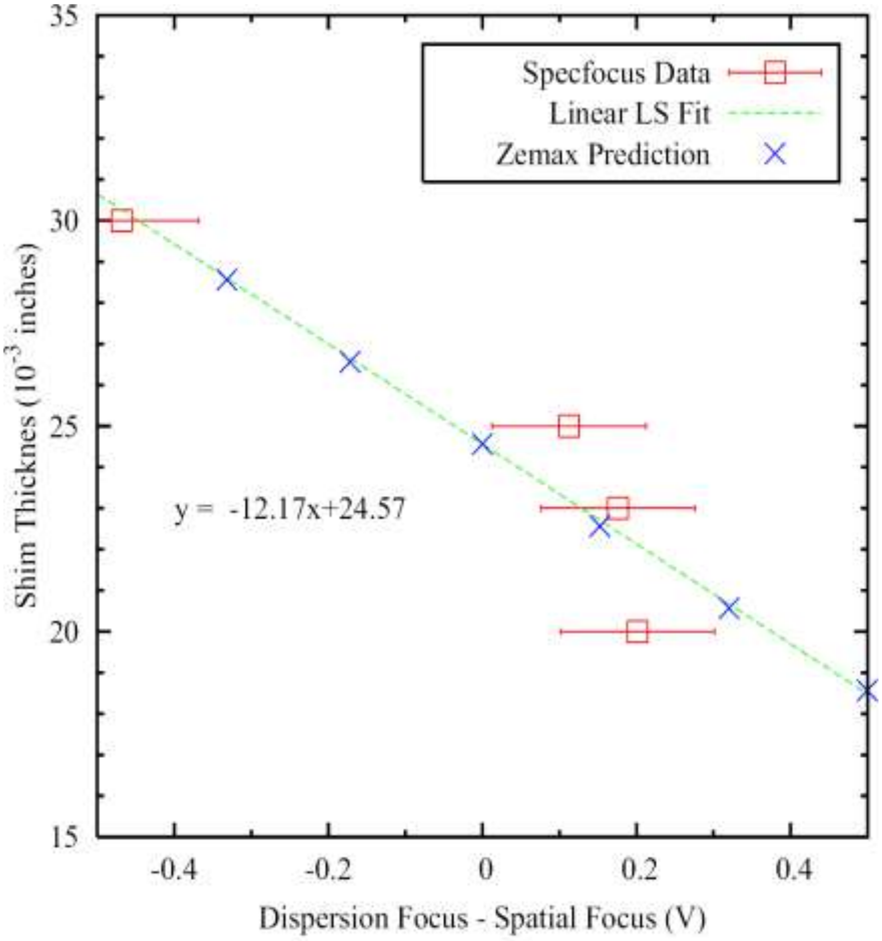


Figure 6: The best focus in both axes was beyond the range of the fine focus adjustment of the collimator.

D. Ouellette pointed out that the dial indicator measuring the coarse focus of the collimator was displaying 0.858" rather than the nominal position, which was 1.100". This provided additional evidence that the collimator had been moved to compensate for a difference in chip height. Movement of the collimator from its nominal position introduced the astigmatism.

The engineering work continued on July 26. The 1200 l/mm grating with dual 1.0 arcsec pinholes and the HeNeAr calibration lamps were used in the measurements. The coarse focus of the collimator was returned to its nominal position of 1.100". The shim thickness was then modified and the fine focus adjusted until the astigmatism was removed from the system.

Figure 7 summarizes the results. The shim thickness is plotted versus the voltage difference between the dispersion and spatial foci. The red squares indicate the measurements. The error bars were estimated from differences between IRAF's specfocus routine and manual profile fitting. There may also be some error in the shim thickness since small shims, which are more compressible than the large gasket type-shims, were used. The dashed line is the best unweighted linear least squares fit to the data. The y-intercept is 24.6 and therefore the required shim thickness is 0.025". Although the data appear slightly non-linear, a Zemax model confirms that the relationship should be linear. The Zemax predictions are shown as crosses, which have been scaled to the same zero-point as the fit.



Fri, 06 Aug 2004 10:38:32 -0700

Figure 7: Summary of results.

Figure 8 shows the measurements with the temporary 0.025" shim installed. The nominal 0.030" shim has now been replaced with a permanent 0.025" shim. Data with the permanent shim as well as Red Channel data will be presented in the September-October Bimonthly Summary.

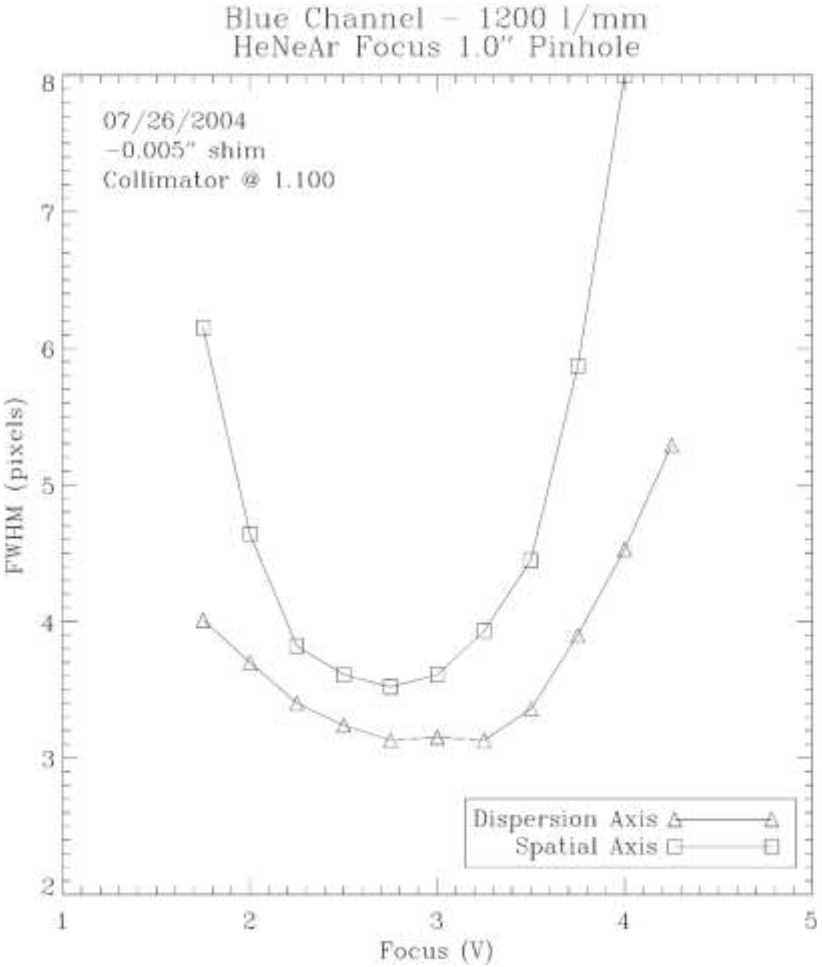


Figure 8: Measurements with the temporary 0.025" shim installed.

General Facility

The first half of July saw a very successful SWIRC commissioning run followed by Megacam. Unfortunately the monsoons set in, and most of the latter half of July was lost to rain, clouds, and high humidity. Aside from the weather, MMT operations were smooth for the month with only minor problems to report.

July Operations

The early start of the summer storms brought the usual dropouts in power to the mountain. Our new UPS bridged these glitches with no problems. On July 8 the elevation servo started oscillating, and on the 9th D. Clark traced the problem to a blown IC in the elevation encoder, probably due to a lightning strike. As a result, we are now disconnecting both az and el encoder cables as part of the normal lightning protection procedure. The night of the 8th was clouded out, so the problem did not result in any lost observing time.

On July 9 the blower for primary ventilation would not turn off from the GUI. Through the rest of the month the blower behaved erratically, sometimes turning on spontaneously. This was eventually traced to a broken fiber in the drive room that was creating a display error on the GUI for the blower control. This fiber was re-terminated.

On July 28 a high-pitched (~200 Hz) vibration was reported in the east stairwell, just above the SE building drive motor. This was traced to a loose coupling between the 50 hp motor and its tachometer, which acted to amplify an inherent ~200 Hz resonant frequency. D. Smith realigned and tightened the coupling, eliminating the hum.

August Shutdown

The decision last May not to aluminize the primary mirror this summer gave us time to get a potpourri of minor and major tasks done during the August shutdown. A few of the highlights include:

- A readout for the primary mirror thermocouple system was implemented.
- Most of the OSS was covered with aluminum foil tape to help thermal stability.
- A team from SAO spent a week repairing one of Hectospec's grippers, replacing a broken fiber, and realigning the fiber shoe.
- The primary mirror support electronics crate (cell crate) was overhauled.
- The primary mirror air supply cabinet was reworked to eliminate leaks.
- Key selectable rotator limit switches were installed, allowing the selection of either ± 105 degrees or ± 175 degrees of rotation.
- A rotator brake was test-fitted, but not completely installed.
- The safety interlock system (26 V rack) was updated to accommodate the rotator changes.
- The east elevation brake was overhauled and re-installed.
- The primary ventilation system was refurbished, including replacing some of the joints that were prone to leaks.
- The chamber to stairwell doors were dismounted and exchanged so that they swing out, rather than into the chamber. This fixes an access problem at horizon pointing.
- A spare building drive motor has been spec'd and an order is being placed.
- The compliance of both elevation drive motors was measured, revealing that the west drive was nearly four times as compliant as the east. Some pins that had been omitted from the west drive assembly were installed, decreasing its compliance.
- The building LAN was cleaned up—this seems to slowly develop odd, unplanned branches.
- A network interface connection was installed on the MGE UPS system and it now has its own web page.
- The Blue Channel Spectrograph was disassembled and a sticky TIRP drive mechanism was repaired, reinstalled, and tested.
- Cables were rerouted and cleaned out.
- Racks for holding lead ballast weights were fabricated and installed on the drive arcs.
- The staff gathered at the summit for our annual state of the observatory address and staff photo.

Some of these tasks are described in more detail in other sections.

26 V Rack Modifications

The main portion of the modification to the 26 V rack was completed, and the GUI software updated to incorporate the changes made to the rotator and elevation systems. The rotator system now has key switch selectable limits. The keys are in the east drive arc J-box and allow independent selection of the CW and CCW limits. Each can be selected as Full Limit (175 degrees) or Sub-Limit 1 (105 degrees). The system design was done such that a future Sub-Limit 2 (X degrees) may be added. Each of these limits will be calibrated, and can be changed as needed with an accompanying change in the GUI software to display the actual limits. The rotator brake assembly has been installed and connected electrically. The encoder power supplies no longer need to be on to operate the rotator in manual mode. The elevation system now reports the status of the secondary hoist independent of the overhead crane.

The documentation for the 26 V rack has been completely redone and is available in the PDF subdirectory on our server. While it is not yet quite in "H" file format, it is very close to what will become the "H-File."

Instrument Rotator

In the beginning of August, fabrication drawings for the rotator brake structure were submitted to the University Research Instrumentation Center. On August 20, C. Chute and C. Wainwright fitted the Nexen brake assembly on the telescope. The brake proved to fit and was brought back to town to be powder coated. When the assembly was to be pinned in place and deemed operational on August 24, we noticed that the gear was wobbling due to a taper on the end of the shaft. This obstacle was quickly fixed, but was followed by a failure of the solenoid valve. A new valve and spare have been ordered.

Cell Crate

The cell crate was removed from its rack and modified to remotely sense the 5 VDC power supply, which will improve the condition of the power supply rails within the chassis. The newly assembled spare power supply was fully checked out and installed back into the rack with the crate. The old power supply will now be brought to the same configuration as the new unit to provide a complete spare. Additional cleanup was done to the wiring in the cell rack.

Building LAN

All RS232 connections have been removed from the drive room Cyclades. They have been replaced by Lantronix devices, which provide direct network access for all the devices that formerly were on the Cyclades. The pit Neslab and HP DAU are included in this list. Two more Lantronix devices have been installed on the cell for the expanded thermal monitoring.

Preparations for Aluminizing

At the request of Emilio Falco, B. Kindred assisted in the recoating of the SAO 48" primary. Emilio and Gary Rosenbaum (SO) have observed that the surface is deteriorating, and it was not very good to begin with. This was an early Steward Observatory Mirror Lab casting that tested a special lot of Corning glass that exhibited some very unusual properties. After annealing, swirls of tiny bubbles, striae, and dark contaminants were visible throughout the bulk of the casting. The optician who figured the mirror reported that he could not use a magic marker on the surface … it would soak into the glass!

When we received the mirror from the optical shop about 12 years ago, bulk defects notwithstanding, the surface seemed to be reasonably smooth although imperfections were detectable. The first coat of aluminum looked very good over 98% of the surface.

Today the surface is a horrible sight: 100% of the surface has very obvious orange peel, the bulk striae seem to have "risen" to the surface over most of the mirror, and some small areas look as though they have been etched with hydrofluoric acid. We surmise that impurities in the bulk rendered some areas more susceptible to chemical attack, and repeated stripping cycles have etched away material in these areas. As one would expect, measurements revealed a surface with average scatter several times that of a "normal" polished surface.

Our interest in this, of course, is whether or not the SAO 48" is our canary in the mine shaft! We've solicited opinions from several glass experts who agree this is not the case. No such behavior has been observed in any of the Ohara E6 castings, of which our 6.5 m is one, nor has it been seen in any of the existing borosilicate astronomical mirrors (Hale 5 m, e.g.) that have been in service for many decades.

This exercise did provide a good opportunity for some destructive testing with the new pressure washer purchased for cleaning the 6.5 m mirror. This unit moves water at 1.8 gpm and 1500 psi. Before stripping the 48", B. Kindred tested the pressure washer, trying to remove some Al with no success. This reinforces his earlier conclusion that pressure washing a properly deposited, well-adhering Al film introduces little or no risk of damage.

Miscellaneous

Three commercial precipitation detectors have been purchased. At least two of them will be installed on the telescope structure at first opportunity. The third will likely serve as a testbed and development guide for an in-house design that eventually will be implemented. The latter will present a sensor of much greater area providing us with more timely alerts. With an effective precipitation detection capability, we can continue to operate in conditions that now require us to close.

A new turbomolecular pumping station has been purchased to serve the sole function of evacuating instrument dewars. The existing station will be kept for utility purposes such as cryopump startup.

The absolute encoder power supply, which had been replaced with its spare, was repaired and reinstalled. The repair consisted of reseating a connector pin and replacing the front panel switch assembly.

Two drain points and bypass valves for the secondary ethanol system have been designed. The fittings will be installed on the southeast and southwest corners of the OSS in early September.

In mid August new CAD software was purchased. The old Autodesk product, Mechanical Desktop 6, will now be replaced with Inventor 8.

Visitors

August 13: BBC producer Patrick Titley and Julie Green, astronomer/host, visited the MMT to film a segment for a BBC TV series on astronomy entitled *Stardate*, due to be released next year. The segment will feature the MMT and an interview with Thomas Stalcup (CAAO).

Publications

MMTO Internal Technical Memoranda

04-3 Control System Prototyping — A Case Study
D. Clark

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

04-29 Resolving Subdwarf B Stars in Binaries by HST Imaging
Heber, U. Moehler, S., Napiwotzki, R., Thejll, P., Green, E. M.
A&A, **383**, 938

04-30 Position-Velocity Diagrams of Ionized Gas in the Inner Regions of Disk Galaxies
Funes, J. G., Corsini, E. M., Cappellari, M., Pizzella, A., Vega Beltrán, J. C., Scarlata, C., Bertola, F.
A&A, **388**, 50

04-31 Time-Resolved, Multi-Color Photometry and Spectroscopy of Virgo 4 (OU Vir): A High Orbital Inclination, Short Orbital Period Dwarf Nova
Mason, E., Howell, S. B., Szkody, P., Harrison, T. E., Holtzman, J. A., Hoard, D. W.
A&A, **396**, 633

04-32 Optical Spectroscopy of Microquasar Candidates at Low Galactic Latitudes
Martí, J., Paredes, J. M., Bloom, J. S., Casares, J., Ribó, M., Falco, E. E.
A&A, **413**, 309

04-33 Minor-Axis Velocity Gradients in Disk Galaxies
Coccato, L., Corsini, E. M., Pizzella, A., Morelli, L., Funes, J. G., Bertola, F.
A&A, **416**, 507

04-34 *XMM-Newton* Observations of the BL Lac MS 0205.7+3509: A Dense, Low-Metallicity Absorber
Watson, D., McBreen, B., Hanlon, L., Reeves, J. N., Smith, N., Perlman, E., Stocke, J., Rector, T. A.
A&A, **418**, 459

04-35 HS 0837+4717 – A Metal-Deficient Blue Compact Galaxy with Large Nitrogen Excess
Pustilnik, S., Kniazev, A., Pramskij, A., Izotov, Y., Foltz, C., Brosch, N., Martin, J.-M., Ugryumov, A.
A&A, **419**, 469

04-36 Pox 186: An Ultracompact Galaxy with Dominant Ionized Gas Emission
Guseva, N. G., Papaderos, P., Izotov, Y. I., Noeske, K. G., Fricke, K. J.
A&A, **421**, 519

04-37 Discovery of a Huge Young Stellar Object Interaction Region in Camelopardalis
McCall, M. L., Buta, R. J., Foster, T. J., Huchtmeier, W., Huchra, J.
AJ, **128**, 375

04-38 Spectroscopy of Candidate Members of the η Chamaeleontis and MBM 12 Young Associations
Luhman, K. L., Steeghs, D.
ApJ, **609**, 917

04-39 Adaptive Optics Nulling Interferometric Constraints on the Mid-Infrared Exozodiacal Dust Emission around Vega
Liu, W. M., Hinz, P. M., Hoffmann, W. F., Brusa, G., Wildi, F., Miller, D., Lloyd-Hart, M., Kenworthy, M. A., McGuire, P. C., Angel, J. R. P.
ApJ, **610**, L125

04-40 A Survey of $z > 5.7$ Quasars in the Sloan Digital Sky Survey. III. Discovery of Five Additional Quasars
Fan, X., Hennawi, J. F., Richards, G. T., Strauss, M. A., Schneider, D. P., Donley, J. L., Young, J. E., Annis, J., Lin, H., Lampeitl, H., Lupton, R. H., Gunn, J. E., Knapp, G. R., Brandt, W. N., Anderson, S., Bahcall, N. A., Brinkmann, J., Brunner, R. J., Fukugita, M., Szalay, A. S., Szokoly, G. P., York, D. G.
AJ, **128**, 515

04-41 Quasars as Absorption Probes of the J0053+1234 Region
McIntosh, D. H., Impey, C. D., Petry, C. E.
AJ, **128**, 544

04-42 The NGC 7129 Young Stellar Clusters: A Combined *Spitzer*, MMT, and Two Micron All Sky Survey Census of Disks, Protostars, and Outflows
Gutermuth, R. A., Megeath, S. T., Muzerolle, J., Allen, L. E., Pipher, J. L., Myers, P. C., Fazio, G. G.
ApJ Supp, **154**, 374

04-43 New Debris-Disk Candidates: 24 Micron Stellar Excesses at 100 Million Years
Gorlova, N., Padgett, D. L., Rieke, G. H., Muzerolle, J., Morrison, J. E., Gordon, K. D., Engelbracht, C. W., Hines, D. C., Hinz, J. C., Noriega-Crespo, A., Rebull, L., Stansberry, J. A., Stapelfeldt, K. R., Su, K. Y. L., Young, E. T.
ApJ Supp, **154**, 448

04-44 Manufacture and Use of a Shack-Hartmann Sensor with a Multifaceted Prism for Simultaneous Sensing of Multiple Wavefronts
Putnam, N., Snyder, M., Stalcup, T., Angel, R.
SPIE, **5490**

04-45 Progress Towards Tomographic Wavefront Reconstruction Using Dynamically Refocused Rayleigh Laser Beacons
Baranec, C. J., Lloyd-Hart, M., Milton, N. M., Stalcup, T., Georges III, J. A., Snyder, M., Putnam, N., Angel, R.
SPIE, **5490**

04-46 Scientific Results from the MMT Natural Guide Star Adaptive Optics System
Kenworthy, M. A., Miller, D. L, Brusa, G., Hinz, P. M., Fisher, D. L., Lloyd-Hart, M., Wildi, F. P., McCarthy, Jr., D. W., Curley, D. L., Kulesa, C., Young, P. A., Oppenheimer, B. D., Liu, W., Meyer, M. R., Greissl, J.
SPIE, **5490**

04-47 MMT-AO: Two Years of Operation with the First Adaptive Secondary
Brusa, G., Douglas L. Miller, D. L., Kenworthy, M., Fisher, D., Riccardi, A.
SPIE, **5490**

04-48 Suppressing Speckle Noise for Simultaneous Differential Extrasolar Planet Imaging (SDI) at the VLT and MMT
Biller, B. A., Close, L., Lenzen, R., Brandner, W., McCarthy, D., Nielsen, E., Hartung, M.
SPIE, **5490**

04-49 Mounting Large Lenses for the MMT's *f*/5 Wide-Field Corrector: Lessons Learned
Fata, R. G., Kradinov, V., Fabricant, D.
SPIE, **5492**, 553

04-50 The 6.5-meter MMT's *f*/5 Wide-Field Optics and Instruments
Fabricant, D., Fata, R. G., McLeod, B. A., Szentgyorgyi, A. H., Barberis, H., Bergner, Jr., H. W., Brown, W. R., Caldwell, N., Conroy, M. A., Eng, R., Epps, H., Furesz, G., Gauron, T. M., Geary, J., Goddard, R. E., Hartmann, L., Hertz, E. N., Honsa, M., Mueller, M., Norton, T. J., Ordway, M. P., Roll, Jr., J. B., Williams, G. G., Freeman-Woods, D. L.
SPIE, **5492**, 767

04-51 MMT and Magellan Infrared Spectrograph
McLeod, B. A., Fabricant, D., Geary, J., Martini, P., Nystrom, G., Elston, R., Eikenberry, S. S., Epps, H.
SPIE, **5492**, 1306

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:

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 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 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

July 1 - August 1, 2004

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	* Lost to Telescope	** Lost to Gen'l Facility	Total Lost
MMT SG	11	89.20	76.60	0.00	0.00	0.00	76.60
PI Instr	19	151.50	59.15	6.50	0.75	0.00	66.40
Engr	1	7.80	0.00	0.00	0.00	0.00	0.00
Sec Change	1	8.00	8.00	0.00	0.00	0.00	8.00
Total	**32**	**256.50**	**143.75**	**6.50**	**0.75**	**0.00**	**151.00**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	93.8
Percentage of time scheduled for engineering	3.0
Percentage of time scheduled for secondary change	3.1
Percentage of time lost to weather	56.0
Percentage of time not lost to weather lost to instrument	5.8
Percentage of time not lost to weather lost to telescope	0.7
Percentage of time not lost to weather lost to general facility	0.0
Percentage of time lost	58.9

* Breakdown of hours lost to telescope

hexapod 0.75

Year to Date August 2004

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	Lost to Telescope	Lost to Gen'l Facility	Total Lost
MMT SG	58	574.50	345.40	4.13	9.13	3.50	362.15
PI Instr	137	1265.50	414.00	51.95	47.55	1.75	515.25
Engr	13	130.50	19.10	0.00	0.00	0.00	19.10
Sec Change	6	57.60	11.00	0.00	0.00	0.00	11.00
Total	**214**	**2028.10**	**789.50**	**56.08**	**56.68**	**5.25**	**907.50**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	90.7
Percentage of time scheduled for engineering	6.4
Percentage of time scheduled for secondary change	2.8
Percentage of time lost to weather	38.9
Percentage of time not lost to weather lost to instrument	4.5
Percentage of time not lost to weather lost to telescope	4.6
Percentage of time not lost to weather lost to general facility	0.4
Percentage of time lost	44.7