Smithsonian Astrophysical Observatory & Steward Observatory, The University of Arizona

MMT Observatory

Smithsonian Institution &
The University of Arizona®

BIMONTHLY SUMMARY

November – December 2006

The 2006 MMT staff photo. From left to right: Dennis Smith, John Glaspey, Ricardo Ortiz, Dallan Porter, Barbara Russ, Grant Williams, J.T. Williams, Shawn Callahan, Betty Stobie, Howard Lester, Skip Schaller, Dondi Gerber, Dusty Clark, Jill Cooper, Tom Trebisky, Creighton Chute, Tom Gerl, Faith Vilas, Thomas Stalcup, Tim Pickering, Brian Comisso, Duane Gibson, Cory Knop, Ken Van Horn, Ian Shelton, and Marc Lacasse. Missing are Mike Alegria, John McAfee, Ale Milone, and Bill Stangret. Photo courtesy of Dan Brocious and Howard Lester.

Personnel

On November 6, Ian Shelton joined our mountain staff as an Astronomical Observing Support Engineer (backup telescope operator and instrument specialist). He is an astronomer who brings an extensive observing background to our ranks.

Faith Vilas attended the Belton Symposium: Journey Through the Solar System, November 10-11, and gave a talk entitled "MMT Spectra of Irregular Outer Jovian Satellites and Asteroids: Addressing Compositional Similarity."

In mid December, J. T. Williams spent nine days in China at the invitation of the Nanjing Institute of Astronomical Optics & Technology (NIAOT) and the Chinese National Astronomical Observatories at Beijing, where he gave presentations on in-situ aluminizing of large mirrors. He conducted workshops at major observatories on coating preservation, mirror cleaning, and measurement techniques. He received detailed design briefings and technical interactions on the optics fabrication, support, and coating of mirrors for the LAMOS telescope at the Nanjing prototype facility and the 4-m LAMOS telescope and 2-dome facility at the Xinglong Observing Station. Observing Geminid meteors from high atop the Great Wall was an extra treat!

Betty Stobie volunteered to participate as a member of the IAU FITS Working Group Technical Panel to draft updates and clarifications to the wording of the FITS Standard document, last updated in 1999. She has been reviewing the document in question: The Definition of the Flexible Image Transport System (FITS) Document.

Primary Mirror Systems

Primary Mirror Support

Hardpoint test stand work continues. Effort to verify the accuracy of the test stand by use of calibrated aluminum, steel, and brass rods was abandoned. To achieve realistic results would have required extensive effort. The LabVIEW software that controls the hardpoint tests was modified so that the testing parameters are input and the test is then fully automatic. This has increased the number and resolution of the tests and the consistency of the data. A limited set of tests on hardpoint 6 indicates better repeatability. New hardware including breakaway locknuts, spring keepers, and springs are in place on the spare hardpoint.

We acquired the hardware to attach a load cell to an RTV-bonded base plate interface in our actuator pull-test fixture. This will allow us to mount an accelerometer on the load-cell side to measure the time/frequency characteristics of the RTV glue joint. We plan to design a short series of experiments to see if a weak or failing glue joint can be detected by changes in its force-acceleration response to an input force step, similar to what is already routinely done in the MMT primary mirror support (i.e., the "bump" test). If successful, this would point the way towards a fairly simple, nondestructive method of early detection of RTV bonds becoming delaminated, a source of much anxiety in the borosilicate honeycomb mirror world.

Optics

We continue the planned monthly CO_2 cleaning of the primary mirror, and are getting good results.

Thermal System

We acquired the balance of the parts required to construct the first units of the new Type T thermocouple electronics. Dondi Gerber received some training in Orcad schematic and layout to transition the design from the drawing-only stage to printed-circuit layouts. In November, the "absolute" thermocouple printed circuit board layout was complete, but due to various errors much rework was necessary. By the end of December the board layout was 90% complete. Before board production begins, extensive verification and testing must be completed; this started at the end of December and is still in progress. Two separate boards will be implemented in the new thermocouple design (absolute and thermopile references). We await the final design of the microprocessor-interface board for reading out the digital conversion results for network consumption. Layout of the thermopile referenced section will begin shortly.

Secondary Mirror Systems

f/5 Support

During an inspection of the f/5 mirror cell on November 3, we discovered that the southeast axial hardpoint flexure was bent and was touching the side of the removable hub in which it is mounted. We suspect that this may be the cause of image shifts and wavefront sensor (WFS) problems reported in previous runs. On December 11, Shawn Callahan, Ricardo Ortiz, Cory Knop, and Brian Comisso removed the hardpoint and realigned the flexure. The unit was then reassembled and tested, and no problems were experienced. Additionally, the radial bumpers were readjusted because two of them were found to be in contact with the glass when in the operating position. Once adjusted, there was no glass contact. It is possible that the bumpers also contributed to the image shifts and WFS problems.

f/9 Hexapod

The elusive hexapod tape limit problem was finally resolved by installing filter capacitors on the hexapod controller digital card. We believe that the noise of the system caused the system logic to latch in the fault status. No problems have been reported since the installation of the capacitors.

Telescope Tracking and Pointing

Encoders and Servos

The new absolute encoder electronics work moved ahead somewhat during the reporting period: this phase focused on completing the software middleman for implementation of the hardware I/O functions and the network-interface software. It now has the ability to respond to a limited set of commands via a telnet session, and can be made to turn a webpage on and off for viewing the encoder data in real time. The telnet command set also allows for downloading the past several thousand encoder values for more detailed examination. We have yet to test the FIFO interface, however, as the test computer designated for this work has been required on the summit for ongoing servo tasks.

Some additional work to support test and evaluation of encoder to digital conversion ICs (we use Analog Devices AD2S80 units in the MMT encoders) was done during the reporting period. We constructed and checked out part of a new test tool for inserting a questionable AD2S80 unit and testing its digital angle outputs. This will allow us to detect and replace failed units without the headache of inserting/testing units in the actual encoder system, which has a (potentially unknown) encoder angle that is difficult to relate to the actual physical encoder angle. With the test tool, known electrical angles can be input, and the digital angle compared to the expected output to determine the units' pass/fail status.

The problematic open-loop data collected on the elevation axis during October received some follow-up attention in December. Another open-loop test series shows that the open-loop response had once again returned to that measured during the initial servo design phase in 2005. Resurrecting old data from that period and comparing it to the October 2006 data shows a strong resemblance to data collected with one elevation motor unpowered. We may choose to explain the anomalous October results as having been due to some problem with the motor drives (i.e., grease contamination, incorrect test cabling setup) that as yet cannot be reproduced. Careful examination of the motor mounts, flexure assemblies, and preload revealed no obvious problems with either motor. We will continue to monitor this situation as it has much bearing on the success/failure of implementation of the new controller system for elevation. The interested reader is directed to *http://www.mmto.org/~dclark/Reports/* for a series of PDF reports on the progress of the new controller implementation.

We are also continuing to develop and test the implementation of the new controller within the VxWorks mount control PC; a successful test run in December gives hope that we will be able to complete a full suite of commissioning tests to fully verify the new controller's operation in early January.

In December, Faith Vilas formed a review committee to review main axis servo control. Members include Grant Williams, Tom Trebisky, Dusty Clark, J. T. Williams, Tim Pickering, and Shawn Callahan. This committee meets weekly to review and coordinate activities. Dusty Clark and Tom Trebisky are jointly writing weekly progress reports.

Azimuth amplifier #3 exhibited some strange oscillations related to the bias selection circuit. The amp was removed, opened, and inspected with no problem observed. It has worked fine since reinstallation.

Computers and Software

Primary Mirror Cell Software

Skip Schaller has developed web-browser-based replacements for the old WindX-based primary cell GUIs. The old GUIs actually ran on the cell crate and were displayed remotely. This required fairly significant resources on the crate side and special configuration on the client side to allow the cell crate access to the local X windows environment. Such configuration is somewhat of a security risk.

The first iteration of a new GUI used a PHP back-end with an "AJAX" javascript+html interface. This version ran into performance problems with certain browsers due to the large number of widgets updating once per second. The second iteration implemented the GUIs using Java. This version can be viewed either in a browser using a Java plugin or run as standalone GUIs, though the browser method is more straightforward. It has been well-tested and used routinely for a while.

Hexapod Software

Skip Schaller added high resolution UMAC data gathering to the hexapod and developed associated visualization tools. This allows us to observe the motion of the pods closely during commanded moves. Data taken with f/9 demonstrate that tuning the servos could yield improvement in the following error. Data have yet to be taken with f/5, though we expect its servos are in even greater need of tuning. We expect to do testing with f/5 in mid-January.

Skip Schaller and Tom Trebisky modified the hexapod code so that it can be compiled and built under both Linux and VxWorks. The VxWorks build of this code appears to work the same as before, as it should, and is now being used in the hexapod crate. Testing of the Linux build is still pending. Once the Linux build is working and tested, we will deploy it as a server running on *hacksaw* and retire the VME crate we currently use.

Engineering and Operator Interfaces

Duane Gibson made numerous changes to the MMTO Engineering web pages (*http://hacksaw.mmto.arizona.edu/engineering*), other GUIs, and related MySQL and RRDtool databases. These changes include:

- Increased use of Ajax updating of web-page content. A custom, minimalistic Ajax-style library was developed for updating web pages for the MMT. This approach uses a JavaScript XMLHttpRequest object to get data from the web server without reloading the web page. JavaScript Object Notation (JSON) replies from the web server are used to update the web page. The technique can easily be applied to standard Ajax libraries, such as "prototype.js," *http://prototype.conio.net/*, and the "YAHOO User Interface library/YUI-Ext," *http://www.jackslocum.com/blog/index.php*. The widespread use of these libraries makes their use attractive.

- Refinement of an MMT-specific, "MMTDiv" JavaScript class that optimizes JavaScript interaction with the web-page Document Object Model (DOM) and encapsulates MMT GUI styles and behavior.

- Addition of new data and logging variables to MySQL databases and tables. Data were migrated from older ASCII background logs into the MySQL database. This increases MySQL database coverage to the past three years. New variables were added to the MySQL database, including RMS azimuth, elevation, and rotator servo errors for the new mount software.

- A new web-based GUI, "hexpositioner," was created to allow telescope operators to move the hexapod to an absolute target position by adjusting hexapod operator offsets. The web page automatically calculates the required operator offsets for the desired move, based on all other current hexapod offsets. Hexapod moves made through this GUI are compatible with other software that use hexapod offsets.

- A web-based version of the "interlock" GUI was created and included in the telstat displays above the operator station.

- Minor changes were made to existing GUIs:
  - The Ruby/Gtk "interlock" GUI was modified to include telserver status
  - The "altaz" GUI was modified to include the 15-degree elevation limit bypass status.

- Web pages and MySQL database tables related to the TempTrax digital thermometers were modified to reflect the upgrade of the TempTrax1 unit from an 8-probe to a 16-probe unit and the relocation of selected probes.

- Modifications were made to web pages related to the secondary mirror support system in anticipation of removal of the hexapod crate. New web pages were developed that present secondary mirror support data versus telescope altitude.

- Modification was made to thermal web pages to allow zooming of the images.

- New web pages were created for real-time monitoring of RMS servo errors in the mount crate and building errors.

- Numerous web pages were modified so that they increasingly use MySQL and RRDtool databases for data presentation in tabular and graphical form.

Software Knowledge Sharing With the LBTO

The MMTO and LBTO software groups gathered for a series of knowledge sharing meetings. The first meeting was largely a high level discussion of LBTO's telescope control system (TCS) architecture and some of their software development methodologies. At the second meeting, Alex Lovell-Troy and Chinmaya Tumkur gave us a presentation on their web application and authentication frameworks. They use the open-source and freely available Fedora Directory Server to store all of their user information and use it to integrate web, Windows, and Linux authentication. They have developed frameworks to allow web applications to access and manage directory information. This makes it possible for users to access secured web pages using the same password that they use to login to Windows or Linux machines. Such an integrated authentication system would be very desirable, so we will be in further contact with Alex and Chinmaya about setting up something similar for our network. At the third meeting, Duane Gibson presented a tutorial about our use of RRDtool (*http://oss.oetiker.ch/rrdtool/*) for logging and visualization of meteorological and thermal system data. We will continue to have semi-regular meetings between our groups as schedules permit.

Primary Thermal Structure Modeling Tools

The IDL routines draw_temp and batch_temp were further refined by Betty Stobie. The main modification was to add support for loading lists of data files into draw_temp. When a list is loaded, it can be navigated via a scrollable list widget, which makes it much easier to interactively select data to analyze and view. Tim Pickering has been using these tools to analyze logged WFS and thermal system data to verify and calibrate the focus corrections we calculate from the models. The predicted corrections match very well under some circumstances, but not well at all at other times. Occasionally the predictions do worse than our current scheme of only following the temperature of the optics support structure (OSS). We need to understand better why this happens and under what circumstances before using these predictions to make open loop focus corrections.

Mining Sky Camera Data for Transient Events

Betty Stobie continues to work on automating the processing of all-sky camera data to identify transient events. Images are processed using the Hough Transform and the SExtractor program with three tables of resultant detections (Hough only, SExtractor only, and dual) written. Input is currently limited to data taken when the Sun is below -12.0 degrees. So far, the results of the dual detections have been very robust. Work is ongoing to try to determine how many real events are still being missed and how we might integrate this analysis into a real-time pipeline.

This work is being done, partially, as a backup for the Laser Guide Star group's airplane detection system, but mostly for possible meteor science. Once LBTO and KPNO deploy sky cameras of their own, we will be able to triangulate meteor paths to measure heights and trajectories.

MMT Service Request System Upgrades

Dallan Porter is working on the upgrade and redesign of the MMT Service Request System. The new version will eliminate the use of PEAR template modules, allowing for easier feature additions. New PHP classes will help make the database easier to work with and allow for non-SR applications to interact with the database.

A few of the new features include:

- Redesigned layout
- Ability to quickly sort requests
- Enhanced searching capabilities
- Customizable settings on a per-user basis including optional pager/SMS phone messages on critical events
- Previewing requests/responses before submitting
- Upload image feature
- Enhanced email option for users with HTML capable email clients
- Reports and logging

The beta version is located at *http://hacksaw.mmto.arizona.edu/service_no_PEAR/*

Calibrating Hexapod Open Loop Corrections

We had two opportunities in early November to collect dedicated engineering data to measure how the f/5 front-end behaves as a function of elevation. The first set of data was collected during the engineering night of November 7/8. An instrument failure allowed us to get more data on the night of November 9/10. While the data were being collected, it was clear that the previously determined coefficients were doing a pretty good job. They kept stars well-centered within the field of the WFS over the entire range of elevation. Figures 1, 2, and 3 show the results from the November observations as well as the results from October 3 when f/5 was previously mounted. The focus offset in Figure 1 is due to differences in the amount of spherical aberration that has been corrected. The offset in Figure 2 is likely due to f/5 being remounted slightly differently. Results from these and other similar engineering data can be found at *http://mmto.org/~tim/hexapod_open_loop/*

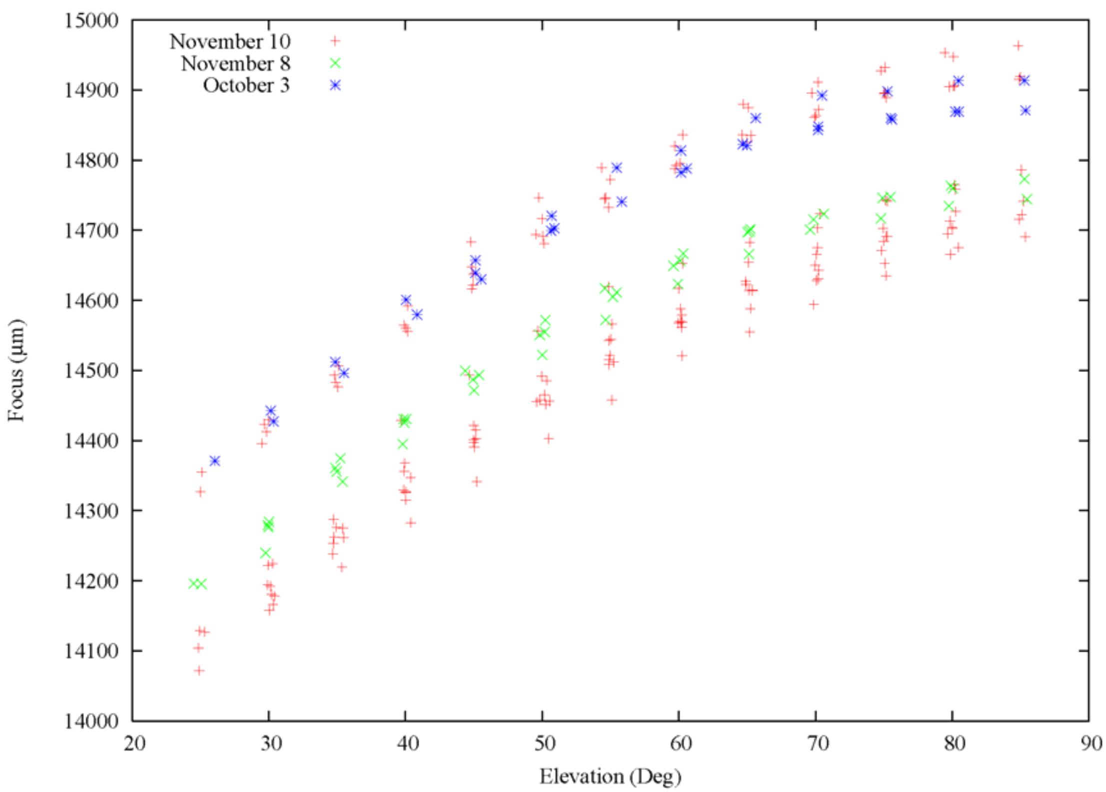

Figure 1: Focus vs. elevation from engineering data taken in October and November 2006

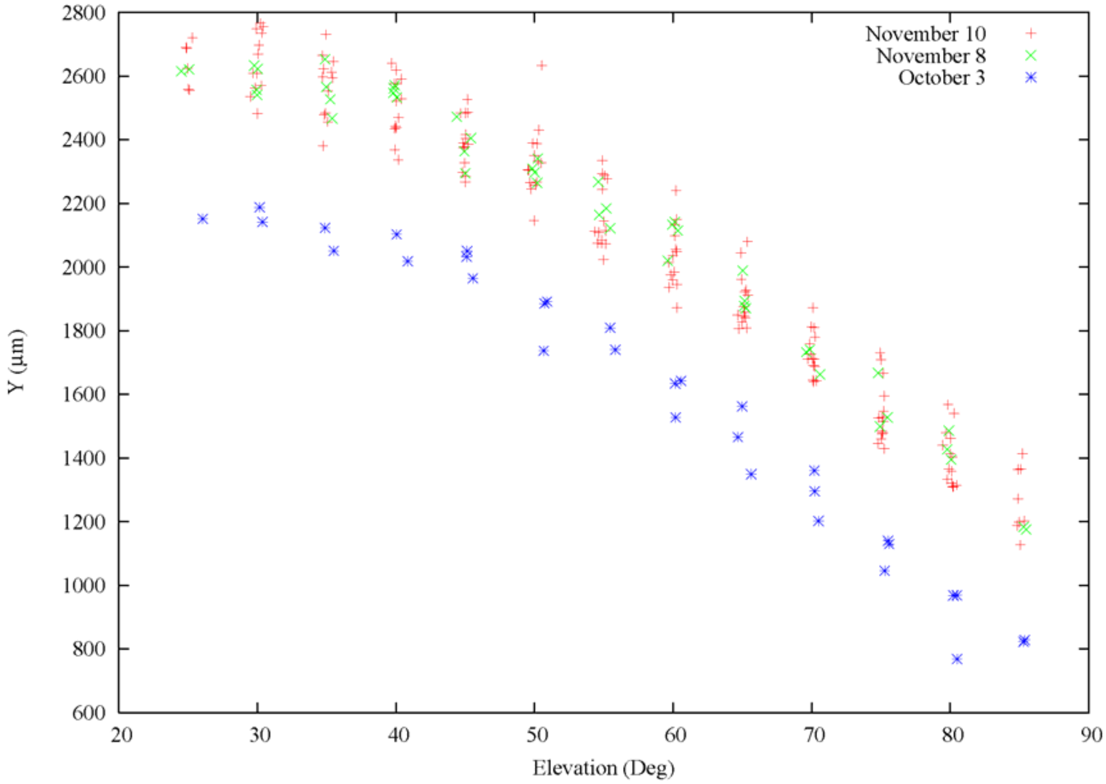

Figure 2: Y-translation vs. elevation from engineering data taken in October and November 2006

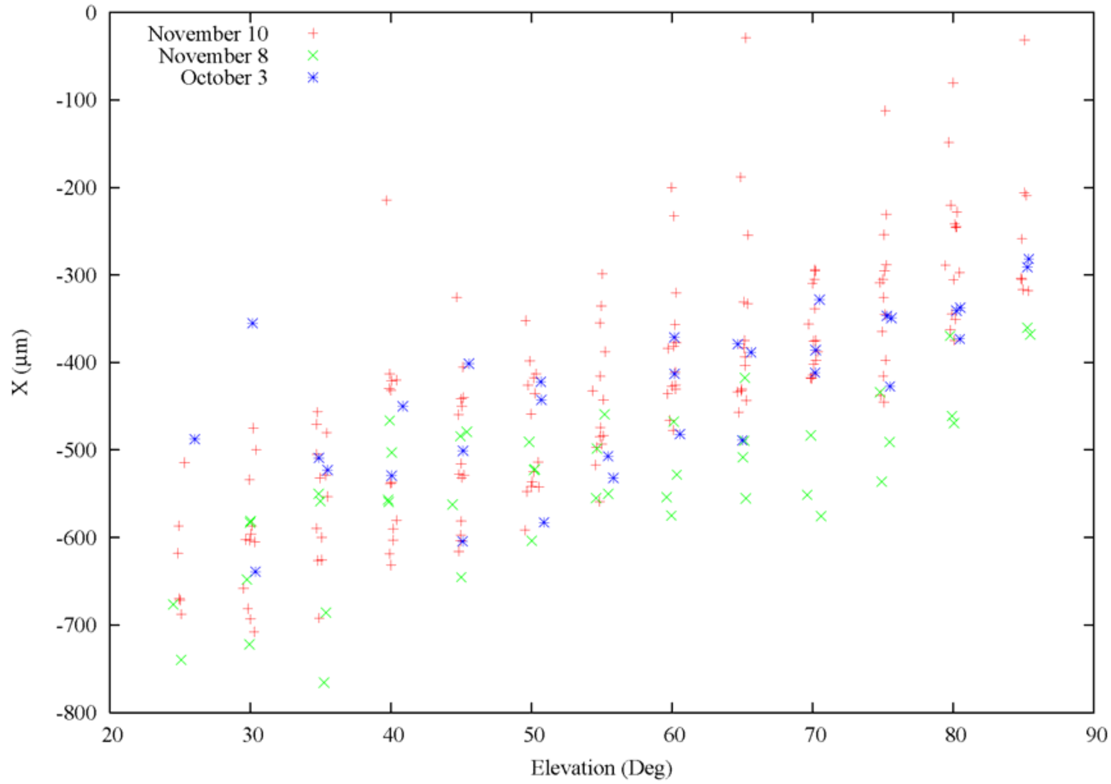

Figure 3: X-translation vs. elevation from engineering data taken in October and November 2006

MMT Documentation

The MMT has joined forces with Steward Observatory to implement an all-inclusive documentation system called SiteScape. Cory Knop is in the process of designing and implementing this system for the MMT. SiteScape will be our centralized repository for all documentation. This will provide the staff a faster and easier way to track valuable documents.

SiteScape will also store historical data so trend analysis can be performed on systems with intermittent problems. SiteScape will also provide a way to track Preventive Maintenance Inspections (PMI). It will be programmed to notify the staff of required PMIs at the beginning of each month.

Miscellaneous Software

Dusty Clark acquired a copy of Lattice Semiconductor's ispLever FPGA and CPLD/PLD design software. Coupled with our new Xeltek Superpro 280U device programmer, we once again have the ability to design, program, and install programmable logic devices and memory ICs. This replaces functionality we had ~10 years ago with the then-current AMD PALASM software and a JR Devices IC programmer. ispLever can handle design entry in VHDL, Verilog, and ABEL. And for the truly motivated, we also have JTAG programming cables for uploading firmware to in-circuit programmable devices.

Instruments

Adaptive Optics

Natural Guide Star

The f/15 transfer from CAAO to the MMTO is proceeding. We have received a draft of the terms, which are currently under review. The actual transfer will not happen before the PC-based Reconstructor (PCR) is operational. The PCR will greatly simplify operations and make the system much faster and more stable. The current plan is to use the PCR during the January/February 2007 adaptive optics (AO) time as the main WFS. If this is successful, it will be a major step forward for the AO system.

A gap contamination scare during the run at the end of December served to underline the need to have a deformable mirror (DM) cleaning crew on call at all times when the f/15 mirror is mounted. It was not needed this time, however, as a procedure that consisted of gently manipulating the mirror manually managed to work out the problem. This was successful because the problem was likely not contamination, but interference between clips that hold the actuators in the reference body as well as the magnets glued to the back of the mirror.

Thomas Stalcup raised the question of the quality of the fibers going from the third floor east to the hub. These fibers were inspected, during full transitions of the elevation axis, and appeared to be fine.

Laser Guide Star

At the end of December, the first attempt to close the loop with the lasers was made. Unfortunately, Mt. Hopkins received about 10 inches of snow during the first two days of the run. When the weather finally permitted opening of the chamber, the first part of the night was spent aligning and calibrating the various cameras in the topbox. Attempts were made to close the loop using only the tilt information from a natural star, and this worked for short periods before some sort of data corruption was seen in the mirror data. Shortly thereafter, the gap contamination was found, which prevented additional work for the remainder of the night.

The mirror was operational early in the second night but more problems with data corruption were found, which resulted in unreliable data being sent to the mirror. This was a potentially unsafe condition, so work switched to open-loop investigations to try to track down the source of the problem. About halfway through the night, the wind shifted to the east with the attendant bad seeing. The spots in the laser pattern were completely washed out, indicating seeing of at least 3-5 arcseconds.

The AO test stand in the common building basement is being evaluated as a way to test the mirror in closed loop before the next laser run. It is not yet clear if this is possible, but it is a strong possibility.

Hecto

On the night of Wednesday, November 8, a following error on the T1 axis (robot 1 tilt) caused the robots inside the Hectospec fiber position to halt during a configuration. Remote debugging by Dan Fabricant and John Roll (SAO) revealed that the problem was most likely an electrical failure inside the positioner. The positioner was removed from the telescope on November 9, and the upper unit was separated from the lower unit on November 10. Dan Fabricant traveled to the MMT on November 10 to continue debugging the problem. The large connectors for the fiber positioner, which are located on the telescope drive arc, and the 25-ft. cables that connect the instrument to the electronics racks were ohmed out and found to be good.

The voltage swing on the T1 actuator was measured, and it was determined that both the sine and cosine phases had drifted from the August 2006 measurements. In an attempt to repeat the problem, the sine phase was adjusted to swing as low as -0.10 volt, but that did not cause a failure. During inspection of the hardware, a slight pressure was applied to a connector and the actuator suddenly accelerated and ran into the limit. This behavior indicated a loss of encoder signal. The voltages were again measured, and when pressure was applied to the connector only negative sine and cosine phases were present. The connector was removed, and a defective pin was identified on the line for the negative encoder reference voltage. The pin was replaced, and the T1 axis was tested and operated properly. The sine/cos encoder levels were then adjusted to proper values by Marc Lacasse (FLWO).

SCCS/ICE Modifications and Updates

To support the new Red Channel camera that arrived in December, some modifications were made to the AZCAM server, ICE (IRAF Control Environment) client software, and mmtobs observer account. The changes were mostly minor and we were able to successfully acquire images without issue during the commissioning night of December 8. A new ccdacq task called "compflats" was added for taking flat-field exposures with continuum lamps. It works the same as the "comps" task, but sets the image type to "flat" instead of "comp."

One wrinkle with the new SCCS/AZCAM/ICE system is that pausing and resuming exposures with Blue Channel is not nearly as reliable as before. After much testing by Skip Schaller, Red Channel appears to be fairly reliable at doing this, but Blue Channel fails a significant fraction of the time. It fails both with the AzCamTool provided by Mike Lesser (ITL) and with our ICE interface, though more frequently with the ICE interface. We suspect the problem is due to bugs in the Gen1 controller's DSP code. Blue Channel still uses its original Gen1 controller while Red Channel has a new Gen2 controller. We will confer with Mike Lesser about what can be done to help fix this.

Red Channel Spectrograph

The engineering night of December 8 was used to test the new deep depletion detector in the Red Channel spectrograph. Despite not being able to open because of poor weather, the night was deemed a success. Skip Schaller's new SCCS/AZCAM/ICE interface worked flawlessly; several bias, continuum, comparison, and dark frames were obtained.

The biggest issue was that we were unable to focus the spectrograph because the new detector was mounted slightly too far back in the dewar. The different housing for this device made it difficult for the Imaging Technology Lab (ITL) to position it exactly where the old device was.

Figure 4 below shows the FWHM of comparison lamp lines as a function of collimator position (in volts) for four different configurations: LP495 filter, LP495 and UV36 filters, no filter, and LP495 with a 0.010" shim between the dewar and the instrument. Focus was not achieved for any of the configurations and, as expected, it was found that a filter helped get closer to focus whereas a shim did not.

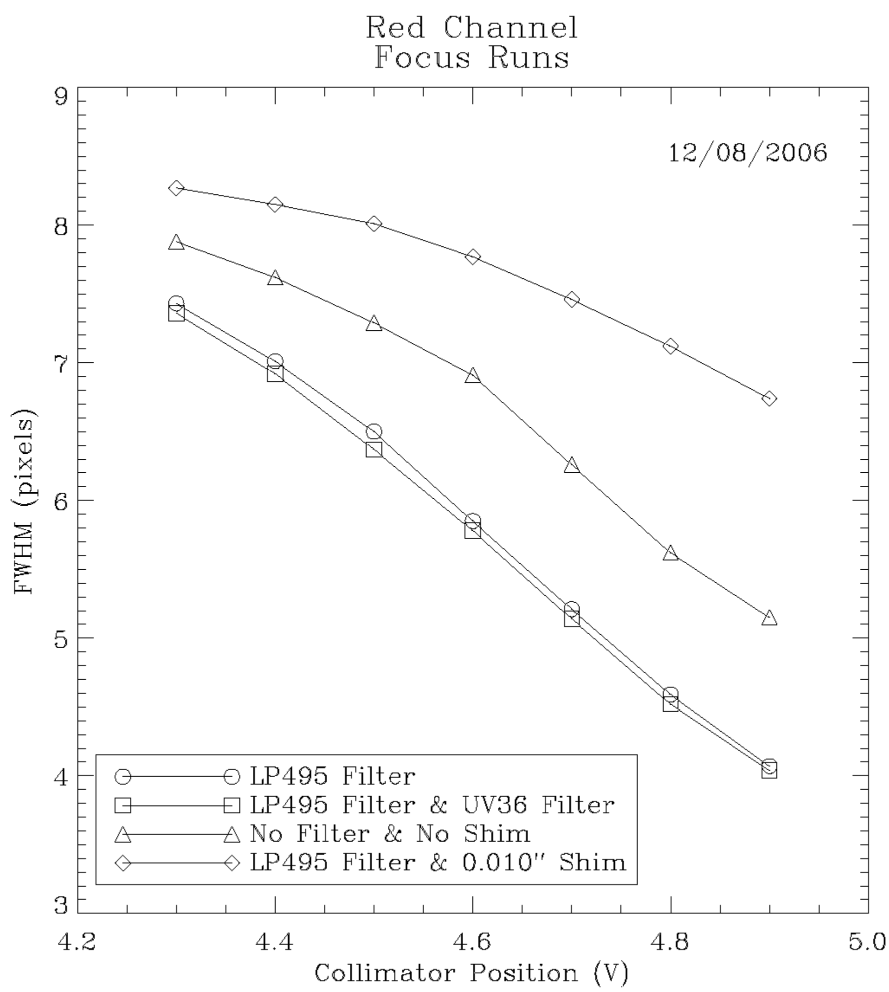

Figure 4: FWHM of comparison lamp lines

Using the FWHM values from focus measurements made with the old detector, we estimated the best focus value for the new device, taking into account its larger pixels (18 microns vs. 15 microns) and its wider point spread function. In order to achieve best focus at the center of travel of the collimator (2.5 volts), the device would need to be moved approximately 0.050" toward the dewar window. However, the zero astigmatism position of the collimator with the old device was near 4.0 volts rather than 2.5 volts. We chose to request moving the device by 0.050", if possible, so that we could shim to the zero astigmatism position.

We also found that the chip was clocked 90 degrees, i.e., the dispersion was along columns. This is to be avoided so that bright saturated lines will not bleed along the dispersion direction.

The dewar was returned to ITL to have the chip rotated and moved closer to the dewar window. The spacing inside the dewar only allowed the device to be moved by approximately 0.015" before introducing a thermal short. The new position will be tested on the engineering nights of January 9-10.

The Red Channel echellette mode was also tested using a ~7 arcsec long slit (a 20 arcsec slit masked down to 7 arcsec). There was no order overlap in this configuration. Both continuum and comparison frames were obtained in echellette mode. Additional testing of the echellette mode will occur in January following the repositioning of the detector.

Spectrograph Echellette

Shawn Callahan, Grant Williams, and John Di Miceli are designing a new set of aperture slit plates to be used in the cross dispersed echellette mode for both Blue and Red Channel. Cross dispersed modes require short slits so that there is no order overlap of the red orders. The shortest slits that are currently available are 20 arcsecs long, too long for this mode. In the past, observers have used a single 1.0 arcsec wide slit that has been masked off with tape to approximately 7 arcsecs long. Several ~7 arcsec long slits with varying widths will be designed and manufactured.

Science Camera

Jill Cooper and Shawn Callahan are preparing the requirements document for a fast science camera for "targets-of-opportunity." Dondi Gerber will assist Jill as needed. At this early stage of development we are looking for possible locations for a camera for all telescope foci.

Pluto Occultation

Shawn Callahan has been investigating a means of mounting a fast camera into the f/9 top box for use as a simultaneous optical imager when PISCES observes the March 18 Pluto occultation. A preliminary design is exploring temporarily mounting an iXon camera in place of the Steward Observatory guide camera. Shawn will be working with Don McCarthy (SO) and Grant Williams to ensure correct installation of the camera before Don's March 16 observing run.

General Facility

Instrument Storage

In early November, the MMT staff began to review plans from M3 Engineering to provide additional instrument storage space.

M3 provided six options that ranged from expanding the existing facility, expanding the existing summit support building, moving the storage to the common building, and various combinations of expanding the MMT facility and expanding the summit support building.

Faith Vilas formed a building committee with Ricardo Ortiz, Shawn Callahan, Grant Williams, John Glaspey, J. T. Williams, and herself to oversee MMT's design input. The MMT staff was invited to review all the options and to provide their input. The building committee compiled and reviewed all input and then chose the option to expand the existing summit support building and to add a second floor loading dock to the MMT enclosure.

In mid December, the building committee met with M3 Engineering architect Ruben Sibayan to discuss our input. Ricardo Ortiz, Shawn Callahan, and Steve Criswell (FLWO) then had a phone conference with Ruben and several engineers from the Smithsonian project office to review additional input.

M3 Engineering is now preparing plans for their 65% design review.

Other Facility Improvements and Repairs

Tom Gerl completed the installation of the four goose-necked dimmable incandescent lamp assemblies in the instrument garage above the SAO racks.

The switch was replaced in the marine toilet in the MMT bathroom to help prevent the flooding issues we have had. A new poster has been installed to instruct people on how to use the toilet properly.

The building drive system sensed AC line "brown-out" had occurred, which prevented the building drive from working one night. This is the proper behavior of the electronics under such conditions, but troubleshooting revealed that the detection device had been modified and was no longer adjustable. This device has been replaced with one that is adjustable.

The roof heaters were reconnected and the control circuit was modified to provide a time limit for the high power condition, which can become too hot. Once the high power mode is turned on it will revert to low power in 15 minutes. The indicators in the old control room will indicate the true power status. If additional time at high power is needed, turning high power off and back on will restart the timer.

The glycol pump switches have been relubricated with dry graphite. They should not be lubricated with anything else (i.e., WD40).

The ventilation system Carrier failed due to an imbedded fuse in a transformer. After performing surgery to replace this fuse, we observed that the load on this transformer was not being shared equally with another transformer. The circuit was modified to more equally share the load. Additional modifications should be implemented to eliminate the imbedded fuses.

We have made a concerted effort to mask or eliminate as many extraneous light sources in the chamber as possible. Unfortunately, some of these devices have LEDs that are sometimes needed during operation and must remain uncovered. We must all make a diligent effort to recover them when no longer needed. One of the Ethernet switches on the drive arc was modified to provide a momentary switch to enable the LEDs. The switch on the other drive arc also needs this modification.

As part of the effort to remove light and heat sources from the chamber, Tom Gerl and Brian Comisso relocated the TempTrax1 unit from the east drive arc to the 2nd floor east room. At the same time, the unit was upgraded from an 8 port unit to a 16 port unit. TempTrax4 probes were then relocated to the new 16 port TempTrax1 unit. This move eliminates the need for two TempTrax units, and freed up a spare TempTrax. TempTrax1 probe 7 was thermally epoxied — with Wakefield Deltabond 155 thermal epoxy — to the roof in order to obtain the true building skin temperature. It is located at the top of the elevator shaft just outside the roof access door.

In early December, the HMI-36, affectionately known as the "Old Vaisala," was removed from service. We thought that this unit was non functional, even though it had been recalibrated by Vaisala the previous year. It was returned to Vaisala for recalibration under warranty. The unit was reinstalled on December 14 and is being monitored for serviceability. Additionally, it was moved to a new IP address. If it proves to be functional, it will be reinserted on the telstat display. If not, it will be retired permanently. Vaisala has stated that it has limited repair capability on this system and that there is no form fit replacement from them.

At the AO group's request, a switch was added to their short rack on the third floor to remove the load from their battery back-up supply when the unit is not in use. We also modified a cable per their request.

Dennis Smith installed a pressure building regulator to the 230 liter liquid nitrogen dewar. This feature will help in transferring liquid and retaining the needed 20 psi in the dewar without having to add UHP N2.

Shawn Callahan, John Glaspey, Dennis Smith, and Ricardo Ortiz investigated a report from the operators that loud noises were emanating from the pit. They determined that one of the sheet metal snow guards was dragging against the building track. Dennis persuaded the metal to move back into place.

John Di Miceli is working with Shawn Callahan, Grant Williams, and Tim Pickering to prepare the design requirements for a mount alignment telescope.

Preparation for the upcoming LOTIS test coating continues. In January, the MMT belljar will be moved from the FLWO basecamp to the parking lot at the Steward Mirror Lab (SOML). Later in 2007, it will be moved inside the Mirror Lab.

Visitors

No activity to report.

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

06-53 Quasars Probing Quasars I. Optically Thick Absorbers Near Luminous Quasars
J. F. Hennawi, J. X. Prochaska, S. Burles, M. A. Strauss, G. T. Richards, D. J. Schlegel, X. Fan, D. P. Schneider, N. L. Zakamska, M. Oguri, J. E. Gunn, R. H. Lupton, J. Brinkmann
ApJ, **651**, 61

06-54 Photometric Redshifts in the IRAC Shallow Survey
M. Brodwin, M. J. I. Brown, M. L. N. Ashby, C. Bian, K. Brand, A. Dey, P. R. Eisenhardt, D. J. Eisenstein, A. H. Gonzalez, J.-S. Huang, B. T. Jannuzi, C. S. Kochanek, E. McKenzie, S. S. Murray, M. A. Pahre, H. A. Smith, B. T. Soifer, S. A. Stanford, D. Stern, R. J. Elston
ApJ, **651**, 791

06-55 Thermal Infrared Constraint to a Planetary Companion of Vega with the MMT Adaptive Optics System
P. M. Hinz, A. N. Heinze, S. Sivanandam, D. L. Miller, M. A. Kenworthy, G. Brusa, M. Freed, J. R. P. Angel
ApJ, **653**, 1486

06-56 Probing the Evolution of Infrared Properties of $z \sim 6$ Quasars: *SPITZER* Observations
L. Jiang, X. Fan, D. C. Hines, Y. Shi, M. Vestergaard, F. Bertoldi, W. N. Brandt, C. L. Carilli, P. Cox, E. Le Floc'h, L. Pentericci, G. T. Richards, G. H. Rieke, D. P. Schneider, M. A. Strauss, F. Walter, J. Brinkmann
AJ, **132**, 2127

06-57 High-Resolution Spectroscopy in TR 37: Gas Accretion Evolution in Evolved Dusty Disks
A. Sicilia-Aguilar, L. W. Hartmann, G. Fürész, T. Henning, C. Dullemond, W. Brandner
AJ, **132**, 2135

06-58 Halo Stars Near the Hydrogen-Burning Limit: The M/L Subdwarf Transition
J. E. Gizis, J. Harvin
AJ, **132**, 2372

06-59 Characterizing Three Candidate Magnetic Cataclysmic Variables from SDSS: X*MM-NEWTON* and Optical Follow-up Observations
L. Homer, P. Szkody, A. Henden, B. Chen, G. D. Schmidt, O. J. Fraser, A. A. West
AJ, **132**, 2743

06-60 Constant-Velocity Stars at the North Galactic Pole Suitable for Use as Secondary Velocity Standards
R. P. Stefanik, D. W. Latham, R. J. Davis
PASP, **118**, 1656

Non MMT Scientific Publications by MMT Staff

Early Time Chromatic Variations in the Wind-Swept Medium of GRB 021211 and the Faintness of its Afterglow
M. C. Nysewander, D. E. Reichart, H.-S. Park, G. G. Williams, K. Kinugasa, D. Q. Lamb, A. A. Henden, S. Klose, T. Kato, A. Harper, H. Yamaoka, C. Laws, K. Torii, D. G. York, J. C. Barentine, J. Dembicky, R. J. McMillan, J. A. Moran, D. H. Hartmann, B. Ketzeback, M. B. Bayliss, J. W. Bartelme, J. A. Crain, A. C. Foster, M. Schwartz, P. Holvorcem, P. A. Price, R. Canterna, G. B. Crew, G. R. Ricker, S. D. Barthelmy
ApJ, **651**, 994

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:

- General information about the MMT and Mt. Hopkins.
- Telescope schedule.
- User documentation, including instrument manuals, detector specifications, and observer's almanac.
- Scientific and technical publications
- A photo gallery of the Conversion Project as well as specifications related to the Conversion.
- Information for visiting astronomers, including maps to the site.
- 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: Beginning January 2005, the formula for accounting lost time on the telescope has been changed. Previously, time lost to weather was deducted from the total observing time before calculating time lost to instrument, telescope, and facility from the remaining balance. From now on, the time lost to each source is computed as a fraction of the total scheduled time.

And beginning June 2005, a new category, environment, was added to account for time lost to natural, uncontrollable, non-weather events such as flying insects melting in laser beams and forest fires.

Use of MMT Scientific Observing Time

November 2006

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	* Lost to Telescope	Lost to Gen'l Facility	Lost to Environment	Total Lost
MMT SG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PI Instr	27.00	314.00	45.95	52.75	1.50	0.00	0.00	100.20
Engr	3.00	34.60	11.80	0.00	0.00	0.00	0.00	11.80
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**348.60**	**57.75**	**52.75**	**1.50**	**0.00**	**0.00**	**112.00**

Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	90.1
Percentage of time scheduled for engineering	9.9
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	16.6
Percentage of time lost to instrument	15.1
Percentage of time lost to telescope	0.4
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	32.1

* Breakdown of hours lost to telescope
wavefront sensor 0.25
az oscillation 0.75
hexapod 0.5

December 2006

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	* Lost to Telescope	** Lost to Gen'l Facility	Lost to Environment	Total Lost
MMT SG	17.00	204.00	67.00	0.00	2.00	0.00	0.00	69.00
PI Instr	12.00	143.30	61.75	12.25	1.50	1.00	0.00	76.50
Engr	1.00	12.00	6.00	0.00	0.00	0.00	0.00	6.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**359.30**	**134.75**	**12.25**	**3.50**	**1.00**	**0.00**	**151.50**

Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	96.7
Percentage of time scheduled for engineering	3.3
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	37.5
Percentage of time lost to instrument	3.4
Percentage of time lost to telescope	1.0
Percentage of time lost to general facility	0.3
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	42.2

* Breakdown of hours lost to telescope
az and el drives 1.5
wavefront sensor/hexapod/elcoll system 2

** Breakdown of hours lost to facility
Carrier 1

Year to Date December 2006

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	Lost to Telescope	Lost to Gen'l Facility	Lost to Environment	Total Lost
MMT SG	87.00	872.55	310.25	7.50	6.55	12.70	0.00	337.00
PI Instr	228.50	2295.50	804.80	185.90	46.80	11.55	0.00	1049.05
Engr	14.00	141.50	46.15	0.00	0.00	0.00	0.00	46.15
Sec Change	0.50	3.85	3.85	0.00	0.00	0.00	0.00	3.85
Total	**330.00**	**3313.40**	**1165.05**	**193.40**	**53.35**	**24.25**	**0.00**	**1436.05**

Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	95.6
Percentage of time scheduled for engineering	4.3
Percentage of time scheduled for sec/instr change	0.1
Percentage of time lost to weather	35.2
Percentage of time lost to instrument	5.8
Percentage of time lost to telescope	1.6
Percentage of time lost to general facility	0.7
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	43.3