End of Trimester Summary

May – August 2010

During summer shutdown: preparing to cover the MMT 6.5-m mirror with the vacuum bell jar prior to re-aluminizing the mirror.

Personnel

Keith Powell joined the MMTO on May 30 as an Adaptive Optics Scientist. He is employed half-time while he is completing his PhD in Optical Sciences.

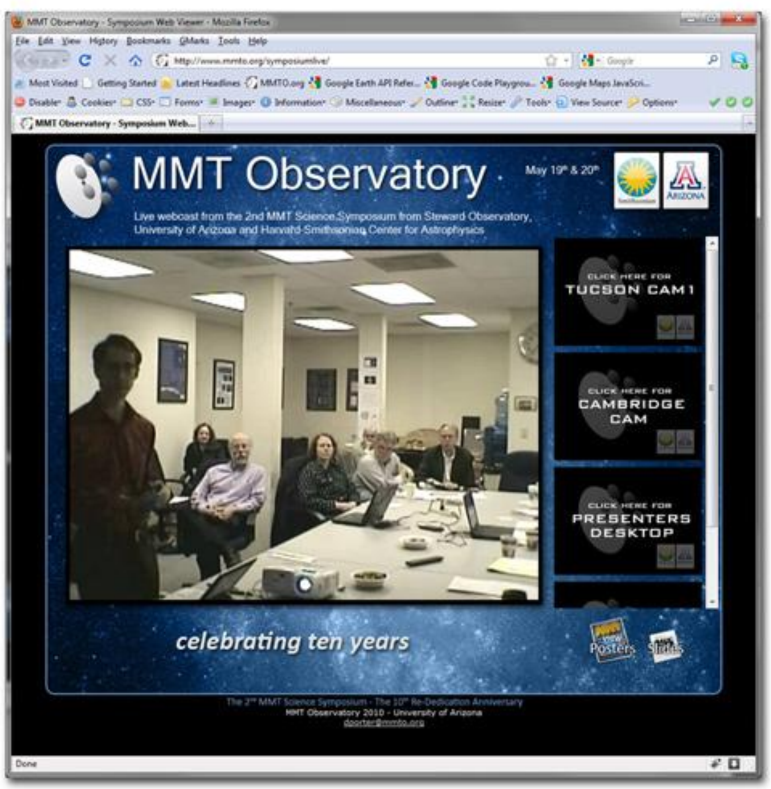
Undergraduate Eduardo Mitre was hired temporarily to assist with actuator calibrations during summer shutdown.

In July, MMT Director Faith Vilas announced her retirement. She will step down as Director of the MMTO on December 31, 2010.

Talks and Conferences

The Second MMT Science Symposium was held May 19. This symposium celebrated the 10th anniversary of the conversion of the MMT from six identical 1.8-meter mirrors on a common mount (with a combined light-collecting power of a 4.5-meter mirror) to a single 6.5-meter honeycomb borosilicate mirror.

The Symposium was held simultaneously at two sites: the Smithsonian Center for Astrophysics (CfA) in Cambridge, MA, and Steward Observatory in Tucson, AZ, with live teleconferencing and web-streaming from both sites. Below is a screen capture showing CfA attendees.



Fifty people attended the Symposium. Seventeen talks were given by scientists from both sites, covering a range of astronomy topics showcasing the diversity of science accomplished at the MMT during the decade following its conversion. There were also ten poster presentations. Following the symposium, a dinner was held in both the Tucson and Cambridge locations. Details on the software used to videoconference and webcast the Symposium can be found in the Software section, p. 8.

Following the Symposium, MMT Strategic Planning and Council Meetings were held May 20 and 21, respectively.

Seven MMTO staff members (S. Callahan, J. Di Miceli, D. Gibson, M. Hastie, R. Ortiz, F. Vilas, G. Williams) attended the SPIE Astronomical Telescopes and Instrumentation 2010 conference held June 27 - July 2 in San Diego, CA, resulting in the following publications:

Advances in Thermal Control and Performance of the MMT M1 Mirror (Poster)
    J.D. Gibson, et al.
    Proc. SPIE, **7733**, 77333Y

Implementation and On-Sky Results of an Optimal Wavefront Controller for the MMT NGS Adaptive Optics System (Poster)
    K.B. Powell and V. Vaitheeswaran
    Proc. SPIE, **7736**, 773636

Status of the 6.5m MMT Telescope Laser Adaptive Optics System (Proceedings Paper)
    E.A. Bendek, et al. (including K. Powell and S. Callahan)
    Proc. SPIE, **7736**, 77360O

Computational Fluid Dynamic Modeling of the Summit of Mt. Hopkins for the MMT Observatory (Poster)
    S. Callahan
    Proc. SPIE, **7738**, 77381M

Instrumentation Suite at the MMT Observatory (Proceedings Paper)
    M. Hastie and G.G. Williams
    Proc. SPIE, **7735**, 773507

In addition, the following presentations were given (italics denote presenters):

Washing Very Large Mirrors, In-Situ: Extending the Life of Astronomical Coatings
    Joseph T. Williams, *Ricardo Ortiz*, **7737-89**

The MMT Observatory: Operations 10 Years After Conversion
    F. Vilas, G.G. Williams, J.T. Williams, S. Callahan, and M. Hastie, **7737-02**

M. Hastie attended the International Astronomical Union (IAU) Conference held August 23 - 27 in Ventura, CA. She presented a poster entitled "A Novel Approach to Quantifying Chromospheric Activity in T Tauri Stars".

M. Hastie attended the 16th Cambridge Workshop on "Cool Stars, Stellar Systems, and the Sun" held August 30 – September 3 in Seattle, WA.

Primary Mirror Systems

Primary mirror support

Work began on an upgrade of the primary mirror actuator test stand. This work included design and construction of new electronics for data acquisition, development of new data telemetry and control system using EtherCAT, and related software for telemetry, logging, and graphical user interfaces.

Because of the close hardware/software integration that is required for this project, a software operations document was written for the new test stand hardware. This test stand is being used as a prototype for possible use of EtherCAT (http://www.ethercat.org/) data telemetry for other applications at the MMT. EtherCAT is an open, real-time Ethernet network originally developed by Beckhoff Automation, based in Verl, Germany. EtherCAT attempts to combine real-time telemetry performance and topology flexibility.

A new hardware chassis was constructed to house the power supplies for the actuator electronics, data acquisition hardware, and test stand electronics. Final design and construction of a second chassis containing the EtherCAT hardware and associated electronics will be completed after summer shutdown. All of the hardware for EtherCAT data telemetry and hardware control was acquired.

For details on the software interface, see the Computers and Software section, p. 8.

Actuators

The actuator test stand was moved to the Common Building for the duration of summer shutdown. All 104 actuators, single and double, were removed and transported there for calibration. Each one was individually cleaned, inspected, tested, and calibrated. Also, any needed repairs such as fixing loose wires or electronics cards were made at that time.

Aluminizing

In preparation for the re-aluminization of the primary mirror, equipment (welders, a computer controller, cabling, etc.) was prepared and moved to the MMT from their locations at the basecamp or the University of Arizona campus labs.

Two hundred tungsten filaments were used in the re-aluminization process. Four hundred filaments were prepared to ensure there was an adequate backup supply if needed. Each filament was wrapped with aluminum, four times around each loop, until an approximate 10-inch piece of aluminum covered each loop. The filaments were then cleaned with an aluminum etching solution in an ultrasonic cleaner. They were then loaded into the bell jar in preparation for aluminization.

The MMT primary mirror is aluminized *in situ*. This requires the removal of any hardware that cannot withstand a vacuum or that might outgas or produce contaminants under a vacuum. The aluminization event is preceded by weeks of removing hardware from the primary mirror cell and optics support structure (OSS). In addition, a portion of the OSS must be removed so that the 22-foot diameter vacuum bell jar can be lowered into place over the horizon pointing primary mirror cell. The existing aluminum coating on the mirror must be stripped using HCl and Cu_2SO_4, and all surfaces thoroughly cleaned prior to moving the bell jar into place. A movie of the mirror stripping process can be seen at: http://mmto.wordpress.com/2010/08/11/mmt-primary-mirror-coating-removed-for-re-aluminization/

The "shoot" for this year's aluminization occurred on September 1, 2010 and as such the results should technically be included in the next (2010C) trimonthly summary. However, in order to keep the user community informed, we provide a brief overview of the results here and point interested readers to the 2010C trimonthly summary and to a forthcoming more detailed aluminization report/tech memo that is currently being drafted.

Although the aluminization process appeared to have gone very smoothly, a visual inspection of the coating following the removal of the bell jar revealed areas of the surface that were "discolored". We are still investigating the cause of the blemishes and plan to conduct a thorough and complete study. The physical evidence includes several square inches of burns in the aluminized mylar vacuum membrane caused by dripping molten aluminum. This likely resulted in outgassing that contaminated the coating during deposition.

Regarding the blemishes, there is one large area (at the four-o'clock position), which we estimate impacts approximately 15% of the mirror surface and two much smaller patches separate from the larger area that are essentially devoid of aluminum. The combined effect of these blemishes is to give a wavelength dependent reduced throughput (or effective collecting area). The measured reflectivity is lower in the blue than in the red. In the location that appears most impacted, at 400nm the reflectivity is ~18% and at 700nm is ~50% (for reference a good aluminum coating has a reflectivity of ~91%). Moving away from the most impacted position the reflectivity increases at least linearly. We will provide a position dependent reflectivity map in the upcoming report. We estimate that the imperfection of the coating delivers an equivalent collecting area of a telescope approximately 6.2-m in diameter.

For numerous reasons including budget and staffing restrictions, we made a decision to postpone any re-aluminization until summer 2011. This will give us time to investigate what caused the imperfect coating and correct it.

For more information and images, please see Grant Williams' presentation from the Univ. of Arizona Steward Observatory *Observer's Lunch* presented on 10/5/10. If you have any further questions or comments, please direct them to Morag Hastie (mhastie@mmto.org).

Secondary Mirror Systems

f/5 Secondary Support

More work was done to increase the reliability of the mid-baffle extension/retraction system. All of the air actuators were inspected and aligned. The hardware for each was then torqued and safety wired.

Telescope Tracking and Pointing

Servos

A preliminary design review (PDR) for a proposed upgrade to the MMT azimuth drive and servo control was requested by the MMT Director. The review was held in Tucson on May 6. SAO members joined in via videoconference. In preparation for this review, the MMT staff prepared an extensive PDR document that included: 1) project performance goals, 2) an existing systems overview, 3) a proposed design plan, and 4) a proposed development and implementation plan. An overall schedule with milestones for the upgrade was also presented. MMT staff members presented the major aspects of this document to an independent, five-member review team led by S. H. Bailey of Steward Observatory.

The Azimuth Axis Upgrade PDR review panel sent their findings and recommendations for the proposed work to F. Vilas, MMT Director, on May 13. The panel was in agreement with most of the proposed work. However, they found that the proposed PDR was incomplete in selected areas, including: 1) performance requirements, 2) operational requirements, 3) the azimuth tracking error budget, 4) a test and verification plan, and 5) use of software unit tests. They were concerned about the current single-point failure for the azimuth tape encoder. Recommendations by the review panel included: 1) evaluate the proposed change in motor gear ratios to avoid destabilizing the control loop, 2) hand-write the control-loop code in the C programming language to be incorporated into VxWorks code rather than hand-adjusting Simulink-generated code, 3) evaluate by analysis and simulation whether the data from the azimuth motor encoder should be incorporated into the azimuth control loop, 4) incorporate a real-time clock, and 5) incorporate 1/T counting.

Initial work on gathering and analyzing open-loop azimuth servo data began in July, immediately prior to summer shutdown. These data were found to have unwanted scaling and collection method artifacts. Additional data collection is planned to address these data deficiencies. Work also began on hand-coding in C the servo control loop and filters that will be used in Simulink modeling of the azimuth axis. The best approaches to integrating this C code into the existing VxWorks mount code were also considered by MMT staff. In addition, the hand-writing of C servo control code was also evaluated for the existing elevation axis control servo. This possible re-implementation of the elevation servo in hand-written C does not change the nature or behavior of the existing elevation servo, but does improve code maintainability and can be used as a prototype to upgrade the azimuth axis servo controller.

Adaptive Optics (AO) Hardware Systems

Problems were found with the PCIe RS422 board acquired for V. Vaitheeswaran of the Center for Astronomical Adaptive Optics (CAAO) to enable development of data acquisition code on the PC Reconstructor (PCR) for gathering accelerometer data. It did not operate at the baud rates used by the deformable mirror (DM) DSP hardware. Use of a second Windows computer was also unsuccessful in getting it to work.

As backup, MMT staff had built two RS422/485-to-USB adaptors and fiber interface boards. One of the USB interfaces is a two-channel unit with one RS232 and one RS422/485 interface; the other is a single-channel RS422 interface. These enumerate over the USB bus on the PC as standard *tty* ports in Linux, and can be configured with standard syscalls. Using a PyQt graphic user interface (GUI) supplied by D. Clark, we were able to collect some accelerometer data from the DM with a laptop separate from the PCR. To get these data time-synced with the PCR frame data, an attempt was made to get the same hardware to work on the PCR system. However, this was unsuccessful due to issues connecting the data sources together within the PCR software framework. Work is continuing on this issue.

D. Clark built an emulator, for use by V. Vaitheeswaran, that supplies a data stream via a fiber link to a USB-to-serial interface like that sent from the DM. This will enable software development to be done on campus rather than at the summit where time pressures are often involved. We hope to use this in gathering data on the DM system in the future.

Computers and Software

In support of the upgrade of the primary mirror actuator test stand, S. Schaller wrote a low-level software interface for the EtherCAT hardware. Development of this interface was followed by coding of a high-level graphical user interface (GUI) for the new test stand. User interfaces to the existing actuator test stand are all command-line based. The new GUI performs various tests on the test stand itself and on any actuator that needs to be calibrated or tested or both. Results are displayed in graphical form on the GUI and are logged to a MySQL database on "hacksaw", the main server at the telescope. A software simulator was also written for the hardware that has not yet been built.

S. Schaller completed Fedora 13 system upgrades on MMT Linux machines mmto, hacksaw, yggdrasil, hoseclamp, alewife, homer, and f9wfs. Keeping the security patches up to date on these machines minimizes the chances of security breaches, and possible loss of observing time due to breaches.

Changes were made to the annunciator (the telescope operator alert system) to split up the Thin Shell Safety (TSS) checks and also to install new f/5 secondary mirror support values.

Changes were made to the AO GUI software to support easy switching of PCR hosts, and to compensate for the misalignment of the tip/tilt axes.

Science Symposium Software

The Second MMT Science Symposium was held on May 19 simultaneously at two sites: the Smithsonian Center for Astrophysics (CfA) in Cambridge, MA, and Steward Observatory in Tucson, AZ, with live teleconferencing and web-streaming from both sites.

The two conference rooms were connected with the traditional Polycom videoconference equipment. D. Porter used a computer to splice into both CfA and Tucson video feeds in order to encode the video streams. These streams were then published to a Red5 Media Server running on the MMT's Vault server in Tucson. A webpage was then created and made available to the public, which provided a simple web-interface for online viewers to watch the Symposium live inside of a Flash-enabled web browser. Besides the two main video feeds (the CfA Polycom video and Tucson Polycom video), a live video stream of the presenter's desktop was also published, allowing web-viewers to see the PowerPoint presentations along with the live audio feed. For viewers who might have missed the event live, each of the video streams was recorded and is available for playback on the Symposium webpage. There were also separate webpages that provided links to the Symposium posters and each speaker's PowerPoint files in PDF format. An application called 'YuuGuu' was used on both presentation laptops (at CfA and Tucson) to enable screen-sharing, which allowed for seamless transitions between PowerPoint presentations as speakers' locations alternated between Tucson and CfA.

MMTO Service Request (SR) System Trimester Statistics

Figure 1 shows the distribution, based upon category, of the 213 service requests (SRs) submitted to the online MMT Service Request system by MMT staff from May through mid-July, 2010, when summer shutdown began. The SR system was not used during the summer shutdown period from mid-July through August.

The majority of the SRs for this period are under the categories "Telescope" and "Building", followed by "Software", "Weather Systems", "Computer and Network", and "Thermal System". Of these 213 SRs, 50 were new or re-opened (see Figure 2). Figure 3 shows the priority of the new SRs. Note that none of the new SRs are of a "critical" priority, which is the highest priority. Only 8% of these new SRs are "near-critical" priority. The majority (62%) is of "important" priority, while the remainder is of "low" or "information only" priority.

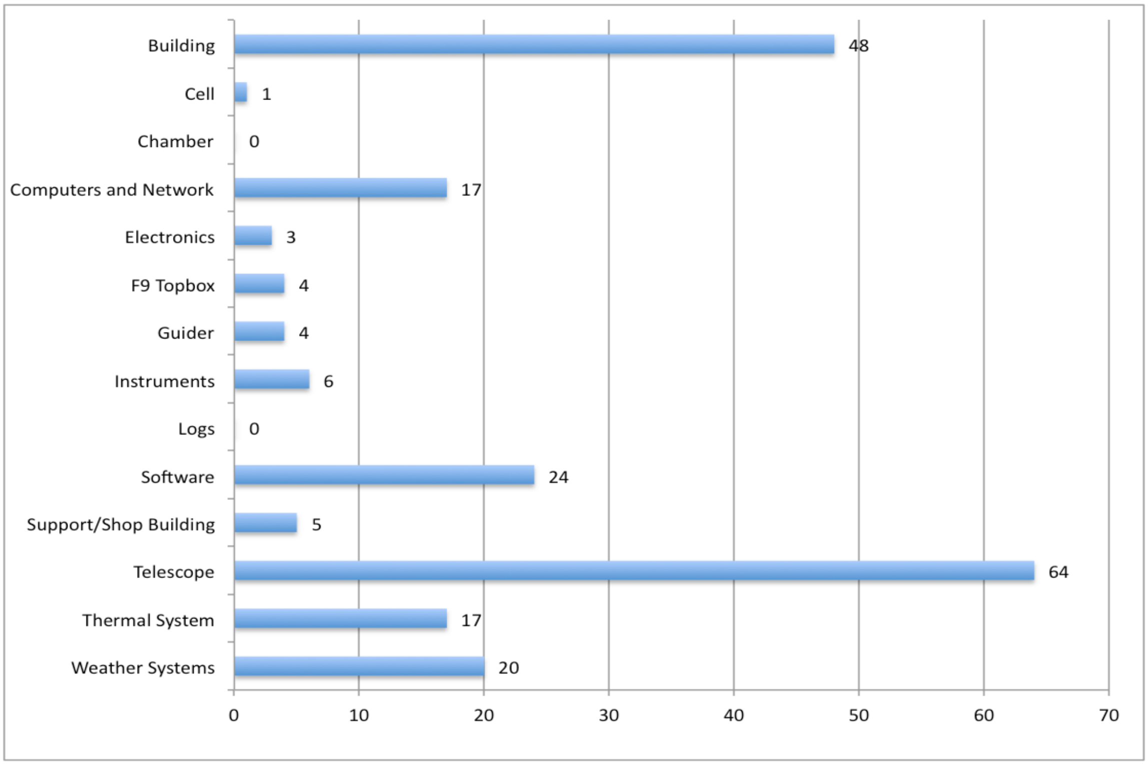


Figure 1. Distribution of the 213 Service Requests (SRs) by category from May through mid-July, 2010.

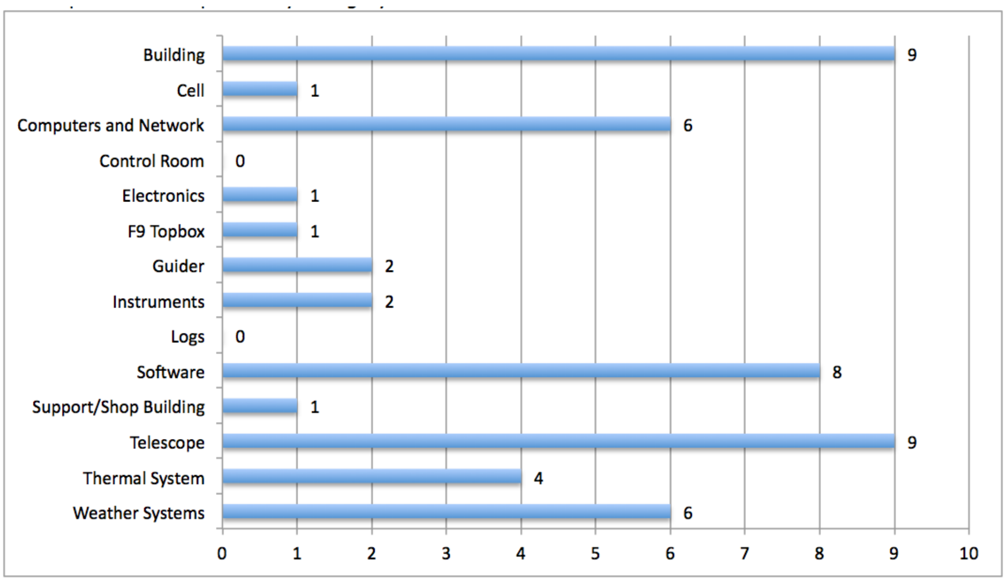


Figure 2. Categories of the 50 new or re-opened SRs from May through mid-July, 2010.

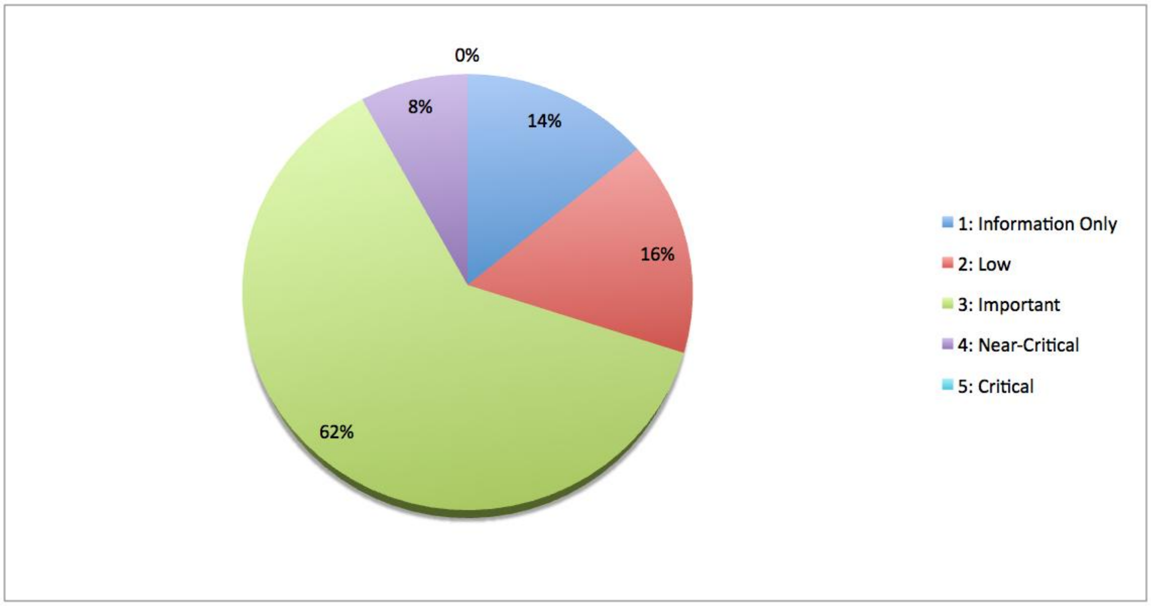


Figure 3. Priorities of the 50 new or re-opened SRs from May through mid-July, 2010.

Instruments

MMT personnel supported the development of proposals submitted to the Telescope Systems Improvement Program (TSIP) that grants funds for instrument improvements in exchange for community access time.

f/15 Instrumentation

Natural Guide Star (NGS)

Work is progressing on software improvements that will allow the NGS-AO system to operate more efficiently. V. Vaitheeswaran has developed software and modified GUIs to allow for a one-click 'close the loop' process. The modifications will need some on-sky maintenance and engineering time for check-out and commissioning. Plans are also underway to automate pupil alignment after slewing, along with other software upgrades intended to make the system simpler to operate.

Work continues on integrating accelerometer data into the PC reconstructor (PCR). The accelerometer's signals will be useful for removing vibrational tip/tilt from the science camera images. This will be especially useful for instruments like ARIES, which operate at shorter wavelengths and could result in significant increases in Strehl and image resolution in J, H, and K-bands.

Laser Guide Star (LGS)

The LGS laser racks were relocated from the yoke room to second floor west. Significant work in documenting and re-cabling the system was completed by C. Knop, D. Clark, and E. Bendek

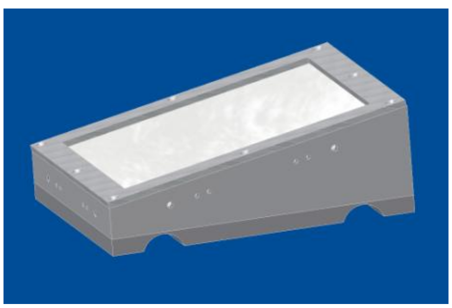
(CAAO). Some components, including the interlock and cooling systems, are still being rebuilt. Checkout and testing will be required prior to the next LGS run. Much of the testing can be done with the chamber closed, but some maintenance and engineering time will be required for those tasks that require on-sky time.

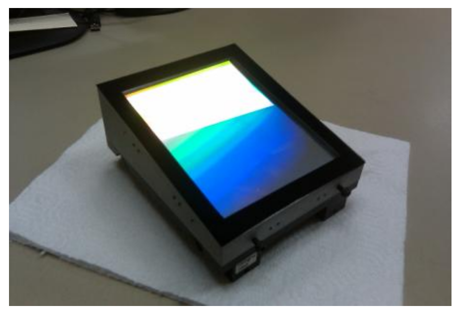
A SCSI-to-fiber demonstration kit was acquired to convert the camera signals to fiber to accommodate future storage and testing in the Instrument Repair Facility (IRF). The fiber converter kit will be tested and evaluated before a decision is made whether to purchase it.

f/9 Instrumentation

Blue Channel and Red Channel Spectrographs

The cell for the red channel 1200 lpm grating was redesigned to tilt the grating further, allowing for a redder central wavelength, which has been in demand since the detector was upgraded to a fully depleted red sensitive device. The new cell was designed using 3D CAD modeling, and was fabricated using a rapid prototyping technique called selective laser sintering. This allowed the complex parts to be produced out of aluminized nylon with a turnaround time of less than 24 hours.





f/5 Instrumentation

During the trimester, SAO f/5 instruments observed 213 of 234 scheduled hours with 18 hours lost to weather, three to the instrument, and one half hour lost to telescope problems. The hecto instruments gathered 462 science exposures on 118 fields over 26 nights. One of the SWIRC programs took almost seven thousand short exposures searching for a planetary eclipse. This required an exposure counter reset in the software. The other SWIRC program this trimester acquired about 1500 exposures of several WISE fields.

A problem that manifested as additional audible noise was investigated in the southeast wall-mounted calibration lamp box. The problem was a jammed fan motor. A replacement from the MMT stocks was installed, and two more fans were later purchased. Many moths and a lot of dust were removed from the box during the repair process.

In late June/early July, the yoke room racks became very warm, which led to some unexpected restarts of the server "clark", one of which occurred during a fiber configuration sequence. Air circulation was increased to the computers to bring the temperature down, and "clark" eventually recovered. The configuration completed normally, though the progress displays paused while "clark" was offline. The hot operating environment may have contributed to the degradation of some computer components. SAO purchased a TempTrax unit, which is now monitoring the temperature of the computers and other SAO racks, with D. Gibson's assistance. Computers were moved to third floor east of the MMT building at the end of the trimester.

In the middle of lightning season, the voltage regulator on one of the SWIRC A/D boards failed at about the same time as one of "clark's" apparent overheating sessions. The boards, along with other electronics, were sent to J. Geary and S. Amato in Cambridge for repair and upgrades. The blown regulator meant that one quadrant was missing half of its data. The observer was able to get data using the other three-fourths of the focal plane, which was unaffected.

Hecto

A problem with one of the tilt actuators on Robot 2 developed on May 20, the last night of the hecto run. In one region of the focal plane, the actuator suffered following errors. The motor amplifier was swapped out, since that had fixed an earlier similar problem with an actuator on Robot 1. That seemed to fix the problem, and we observed most of the night before the problem returned and prevented us from parking the fibers before the instrument was removed from the telescope. Later testing with the positioner in the lab suggested that the problem might be with the wiring or the actuator. During a service mission in June, it was determined that the actuator itself was the problem. Manually turning the motor shaft revealed that there were sections of the drive screw that were sticky or irregular. If the actuator was stopped in one of these areas, the static friction was sometimes sufficient to temporarily prevent rotation of the motor shaft. One other actuator showed similar symptoms. All four actuators were replaced and the old units were sent out for refurbishment. The normal summer shutdown service items of cleaning, inspecting, and lubricating were completed at this time. The positioner has worked well since.

General Facility

Smithsonian Institution safety inspectors performed their annual site inspection in May.

Summer shutdown began on July 20 and extended through August. Along with the preparation for and re-aluminization of the primary mirror, many other activities were also completed.

The electronics group participated in numerous summer shutdown tasks as well as completed several projects that improved power quality, organization, and functionality in the MMT building. These activities are provided below.

The LGS and SAO computers were moved from the yoke room to remove the thermal load directly under the telescope. The SAO computers were moved to the third floor east and the LGS computers were moved to the second floor west. New racks were ordered and installed to house the LGS and SAO computers. The new racks allowed for a new layout of each rack to facilitate better airflow and easier access to work on individual components in the rack. The new racks also have glycol cooling units installed. During the move, all cables were combed out, repaired if necessary, removed if unneeded, and routed properly.

Major renovation took place on third floor east of the MMT building. This involved removing the drop ceiling, installing a new dimmable rope light, rerouting power to all knife switches, and correcting ground and neutral violations in the quiet power for each rack. The existing lights were grounded properly. The gigabit switch was mounted to the wall, and new CAT6 cables were run to components, replacing the existing CAT5 cable. The knife switch on the Nasmyth platform was reconnected to QT1. The excess ventilation ducting was removed, and registers were installed.

Significant work was also done in the second floor west. New cable trays were installed, a dimmable rope light was installed, excess ventilation ducting was removed, a new gigabit network switch was installed, CAT5 cable was replaced with CAT6 cable, a new hole was drilled in the wall for the LGS cables, and the cables in the ceiling were cleaned up and routed properly. The fluorescent lights now can be turned on/off from the north side of the room.

To aid with lightning shutdown, two new knife switches were installed in third floor east. The original knife switches were relocated so that each knife switch corresponds to only one rack, and each rack has a specific function. During the move of the LGS rack, its corresponding knife switch was also moved to the second floor west.

In preparation for re-aluminization, all cables were removed from the east and west drive arc. All cables were tested, and all fibers were cleaned and tested when reinstalled. The west cable drape was combed out and restructured to prevent building coupling and cable damage. The east cable drape was combed out. All electronics in the cell were removed and subsequently reinstalled, all primary ventilation tubing was installed, all cell actuators were removed and reinstalled, and the chamber lift was removed and reinstalled. The welders and glow discharge box were connected and extensively tested. The hardpoint limit switch cable was replaced with more reliable connectors, the rotator brake was removed and reinstalled, covers were installed, and elephant hoses were installed. The electronics group also added new video and USB cables for the f/5 wavefront sensor to the Cassegrain cone, ran new quiet power and noisy power to the drive arc, repaired a connector on the laser box, and repaired damaged wiring on three hardpoints. All wall penetrations to the chamber, as well as the feed-throughs between second floor east and third floor east, were properly filled with fire blocker bags.

Other completed tasks include:

-Several obsolete cables in the control room were removed.
-The vacuum pumps on the trailer were rewired.
-All actuators were tested and, if necessary, repaired.
-The building swing arms, motor couplings, side rail bearing, and the OSS pintle bearing were inspected and greased.
-The building drive Grizzly gear boxes were inspected and the oil changed.
-The building drive motor brushes were inspected and filters changed.
-The pit sump pump was replaced and the trench cleaned.
-Troubleshooting and repairs were performed on the pit HP DAU, Vaisala 4, dock lift, building rotation bell, and various phones.
-The RM Young's wind direction was aligned to astronomical north.
-The MGE overtemp fault was corrected.
-The videoscope shutter was inspected and cleaned.
-The mouse was replaced on "hoseclamp".

-UPS batteries were replaced.
-Replaced the RCU-4 unit for roof heaters.
-A noise issue with f/5 wavefront sensor stellacam was resolved.
-Blower contacts were resurfaced.

Other Facility Improvements and Repairs

The Common Building scissor lift was repaired. A hydraulic hose had become pinched and was leaking. New hoses were installed and tested.

The new Instrument Repair Facility (IRF), funded by the Smithsonian Project Office, was completed in July at the summit. This added approximately 1,050 additional sq. ft. to the existing summit support building.

CAT6 cabling was installed in the new IRF by MMTO personnel. A 2-ton hoist was also connected and tested.

Final painting and door work on the Instrument Repair Facility.

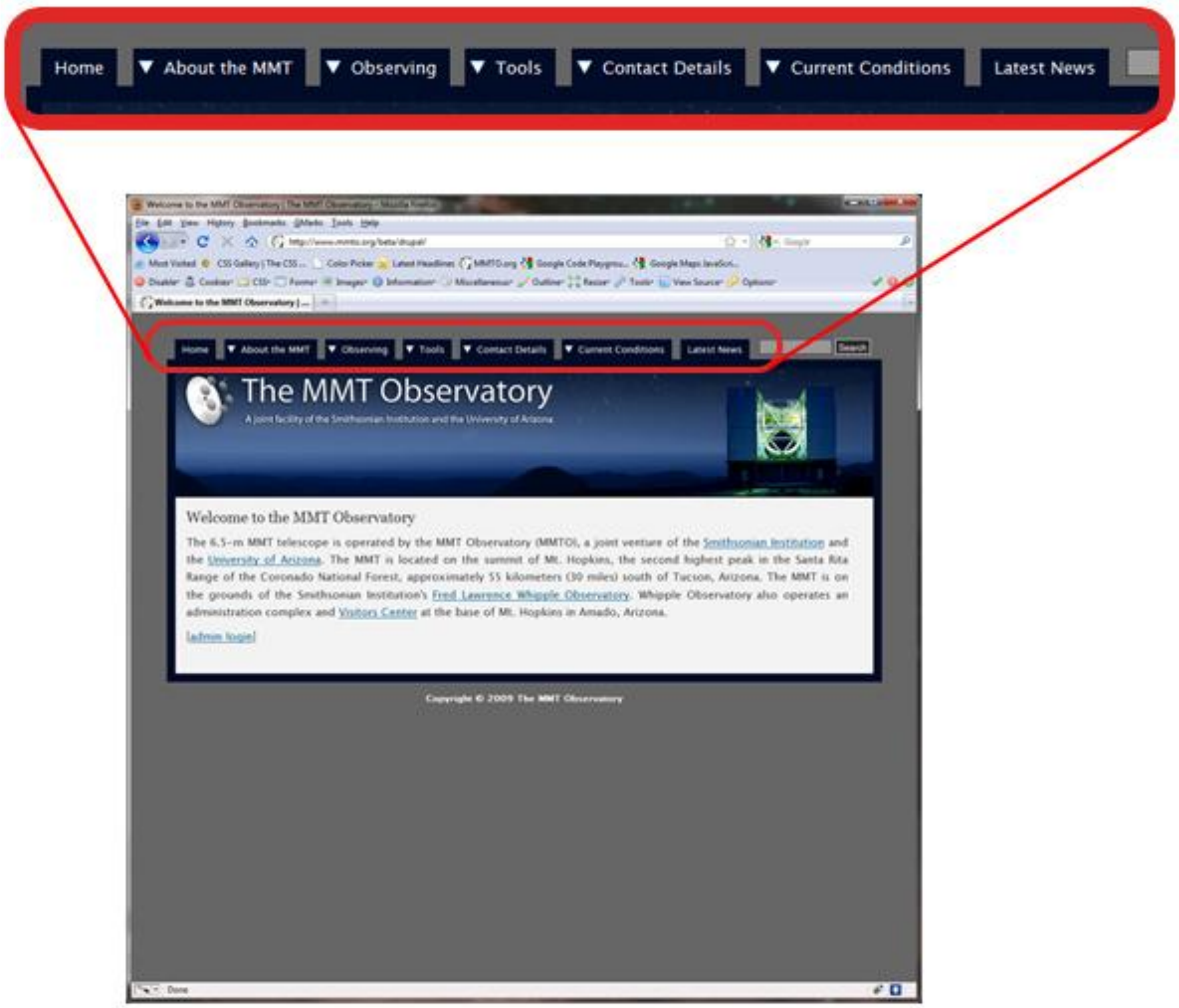
New MMT Website Status

Much progress was made on the new MMT website over the past few months. During this period, many meetings took place with the website team (D. Gibson, D. Porter, M. Hastie, G. Williams, and M. Guengerich) and most of the final details were implemented. The team decided to use an open source CMS (content management system) called Drupal, and a database called MySQL.

New MMT website powered by: Drupal MySQL

The visual design and layout of the new site were completed, and we are in the final stages of filling in the contents of each page. We are taking most of the content from the existing website and adding it to the new site, as well as adding new content and updating out-of-date content.

The main menu layout of the new site has been finalized, and we hope it will provide visitors with an easy and intuitive way to navigate the entire website. Dropdown menus are being used to allow easy access to the most important pages, without having to navigate through multiple pages to find the desired page.



The Drupal CMS allows for content pages to be created and modified directly inside of the website, using any standard web browser. This feature eliminates the need to modify html files directly. A WYSIWYG (What You See Is What You Get) editor is embedded into the web interface, which allows for visually customizing the content to get a consistent look-and-feel.

The Drupal 'Revision' module is used to keep track of changes made by all users. This allows us to 'go back' to any previous version of each page if needed. This is a very useful feature for a website that has multiple users modifying content and has been used several times.

Visitors

7/16/10 – S. Callahan gave a tour of the MMT to approximately one dozen engineers from various facilities including the Large Synoptic Survey Telescope (LSST), the Advanced Technology Solar Telescope (ATST), and the National Optical Astronomy Observatory (NOAO). It was an in-depth tour of the facility, including the utilities, mirror cell, and both the f/9 and f/5 secondary mirrors. The tour was well-received and it was agreed that as soon as their telescopes were built, they would reciprocate with a tour of their new facilities. The purpose was to promote correspondence between institutions.

MMTO in the Media

6/4/10 – National Public Radio's *"All Things Considered"* - MMT Telescope Operator Mike Alegria was featured in an "unusual job" segment.
http://www.npr.org/templates/story/story.php?storyId=127477503

8/4/10 – The University of Arizona "*UA News*" website – An interview of UA astronomer Michael Hart and his laser work done at the MMT was featured. http://uanews.org/node/33078

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

10-16 SHELS: Testing weak-Lensing Maps with Redshift Surveys
M.J. Geller, et al.
ApJ, **709**, 832
http://iopscience.iop.org/0004-637X/709/2/832/pdf/0004-637X_709_2_832.pdf

10-17 Doublets and Double Peaks: Late-Time [OI] λλ6300, 6364 Line Profiles of Stripped-Envelope, Core-Collapse Supernovae
D. Milisavljevic, et al.
ApJ, **709**, 1343
http://iopscience.iop.org/0004-637X/709/2/1343/pdf/0004-637X_709_2_1343.pdf

10-18 The Environmental Dependence of the Evolving S0 Fraction
D.W. Just, et al.
ApJ, **711**, 192
http://iopscience.iop.org/0004-637X/711/1/192/pdf/0004-637X_711_1_192.pdf

10-19 ISM Dust Grains and *N*-Band Spectral Variability in the Spatially Resolved Subarcsecond Binary UY Aur
A.J. Skemer, et al.
ApJ, **711**, 1280
http://iopscience.iop.org/0004-637X/711/2/1280/pdf/0004-637X_711_2_1280.pdf

10-20 Non-Maxwellian Hα Profiles in Tycho's Supernova Remnant
J.C. Raymond, et al.
ApJ, **712**, 901
http://iopscience.iop.org/0004-637X/712/2/901/pdf/0004-637X_712_2_901.pdf

10-21 The NGC 404 Nucleus: Star Cluster and Possible Intermediate-Mass Black Hole
A.C. Seth, et al.
ApJ, **714**, 713
http://iopscience.iop.org/0004-637X/714/1/713/pdf/0004-637X_714_1_713.pdf

10-22 Constraints on Long-Period Planets from an L'-and M-Band Survey of Nearby Sun-like Stars: Modeling Results
A.N. Heinze, et al.
ApJ, **714**, 1570
http://iopscience.iop.org/0004-637X/714/2/1570/pdf/0004-637X_714_2_1570.pdf

10-23 Visitors from the Halo: 11 Gyr Old White Dwarfs in the Solar Neighborhood
M. Kilic, et al.
ApJ Lett, **715**, L21
http://iopscience.iop.org/2041-8205/715/1/L21/pdf/2041-8205_715_1_L21.pdf

10-24 Triggered Star Formation in Galaxy Pairs at z = 0.08-0.38
D.F. Woods, et al.
AJ, **139**, 1857
http://iopscience.iop.org/1538-3881/139/5/1857/pdf/1538-3881_139_5_1857.pdf

10-25 Low-Amplitude Variables: Distinguishing RR Lyrae Stars from Eclipsing Binaries
T.D. Kinman and W.R. Brown
AJ, **139**, 2014
http://iopscience.iop.org/1538-3881/139/5/2014/pdf/1538-3881_139_5_2014.pdf

10-26 Discovery of a Nova-like Cataclysmic Variable in the *Kepler Mission* Field
K.A. Williams, et al.
AJ, **139**, 2587
http://iopscience.iop.org/1538-3881/139/6/2587/pdf/1538-3881_139_6_2587.pdf

10-27 LoCuSS: A *Herschel* View of Obscured Star Formation in Abell 1835
M.J. Pereira, et al.
A&A, **518**, L40
http://dx.doi.org/10.1051/0004-6361/201014695

10-28 Comparison of Hectospec Virial Masses with Sunyaev-Zel' Dovich Effect Measurements
K. Rines, M.J. Geller, and A. Diaferio
ApJ Lett, **715**, L180
http://iopscience.iop.org/2041-8205/715/2/L180/pdf/2041-8205_715_2_L180.pdf

10-29 The Discovery of Binary White Dwarfs that will Merge Within 500 Myr
M. Kilic, et al.
ApJ, **716**, 122
http://iopscience.iop.org/0004-637X/716/1/122/pdf/0004-637X_716_1_122.pdf

10-30 Thermal Infrared MMTAO Observations of the HR 8799 Planetary System
P.M. Hinz, et al.
ApJ, **716**, 417
http://iopscience.iop.org/0004-637X/716/1/417/pdf/0004-637X_716_1_417.pdf

10-31 Spectroscopy of M81 Globular Clusters
J.B. Nantais and J.P. Huchra
ApJ, **139**, 2620
http://iopscience.iop.org/1538-3881/139/6/2620/pdf/1538-3881_139_6_2620.pdf

10-32 Recent Advances in Astronomical Adaptive Optics
M. Hart
Applied Optics, 49, No. 16, D17
http://www.opticsinfobase.org/ao/abstract.cfm?uri=ao-49-16-D17

10-33 H I Column Densities, Metallicities, and Dust Extinction of Metal-Strong Damped Lyα Systems
K.F. Kaplan, et al.
PASP, **122**, 619
http://www.journals.uchicago.edu/doi/full/10.1086/653500

10-34 A Uniform Analysis of 118 Stars with High-Contrast Imaging: Long-Period Extrasolar Giant Planets are Rare Around Sun-like Stars
E.L. Nielsen and L.M. Close
ApJ, **717**, 878
http://iopscience.iop.org/0004-637X/717/2/878/pdf/0004-637X_717_2_878.pdf

10-35 A Deeper Look at Leo IV: Star Formation History and Extended Structure
D.J. Sand, et al.
ApJ, **718**, 530
http://iopscience.iop.org/0004-637X/718/1/530/pdf/0004-637X_718_1_530.pdf

10-36 The Discovery of the Most Metal-Rich White Dwarf: Composition of a Tidally Disrupted Extrasolar Dwarf Planet
P. Dufour, et al.
ApJ, **719**, 803
http://iopscience.iop.org/0004-637X/719/1/803/pdf/0004-637X_719_1_803.pdf

10-37 Binary Quasars at High Redshift. I. 24 New Quasar Pairs at $z \sim 3$-4
J.F. Hennawi, et al.
ApJ, 719, 1672
http://iopscience.iop.org/0004-637X/719/2/1672/pdf/0004-637X_719_2_1672.pdf

10-38 A *Spitzer* View of Star Formation in the Cygnus X North Complex
I.M. Beerer, et al.
ApJ, **720**, 679
http://iopscience.iop.org/0004-637X/720/1/679/pdf/0004-637X_720_1_679.pdf

10-39 The Properties of X-Ray Luminous Young Stellar Objects in the NGC 1333 and Serpens Embedded Clusters
E. Winston, et al.
AJ, **140**, 266
http://iopscience.iop.org/1538-3881/140/1/266/pdf/1538-3881_140_1_266.pdf

10-40 A Ground-Layer Adaptive Optics System with Multiple Laser Guide Stars
M. Hart, et al.
Nature Lett, **466**, 727
http://www.nature.com/nature/journal/v466/n7307/pdf/nature09311.pdf

10-41 Advances in Thermal Control and Performance of the MMT M1 Mirror
J.D. Gibson, et al.
Proc. SPIE, **7733**, 77333Y
http://dx.doi.org/10.1117/12.856335

10-42 Implementation and On-Sky Results of an Optimal Wavefront Controller for the MMT NGS Adaptive Optics System (Poster)
K.B. Powell and V. Vaitheeswaran
Proc. SPIE, **7736**, 773636
http://dx.doi.org/10.1117/12.856590

10-43 Status of the 6.5m MMT Telescope Laser Adaptive Optics System
E.A. Bendek, et al.
Proc. SPIE, **7736**, 77360O
http://dx.doi.org/10.1117/12.857663

10-44 Computational Fluid Dynamic Modeling of the Summit of Mt. Hopkins for the MMT Observatory
S. Callahan
Proc. SPIE, **7738**, 77381M
http://dx.doi.org/10.1117/12.857275

10-45 Instrumentation Suite at the MMT Observatory
M. Hastie and G.G. Williams
Proc. SPIE, **7735**, 773507
http://dx.doi.org/10.1117/12.857331

Non-MMT Scientific Publications by MMT Staff

None

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 *mguengerich@mmto.org* or to the following address:

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

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

May 2010

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	31.00	256.10	13.50	3.50	5.85	0.00	0.00	22.85
Engr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**31.00**	**256.10**	**13.50**	**3.50**	**5.85**	**0.00**	**0.00**	**22.85**

Time Summary

Percentage of time scheduled for observing	100.0
Percentage of time scheduled for engineering	0.0
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	5.3
Percentage of time lost to instrument	1.4
Percentage of time lost to telescope	2.3
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	8.9

* Breakdown of hours lost to telescope

3.75 AO M2
1.50 DM actuators and software
0.50 DM actuator
0.10 WFS

June 2010

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	15.00	116.40	19.30	0.00	1.00	0.00	0.00	20.30
PI Instr	13.00	100.70	5.00	0.25	0.25	0.00	0.00	5.50
Engr	2.00	15.40	0.00	0.00	0.00	0.00	0.00	0.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**232.50**	**24.30**	**0.25**	**1.25**	**0.00**	**0.00**	**25.80**

Time Summary

Percentage of time scheduled for observing	93.4
Percentage of time scheduled for engineering	6.6
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	10.5
Percentage of time lost to instrument	0.1
Percentage of time lost to telescope	0.5
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	11.1

* Breakdown of hours lost to telescope

0.75 Videoscope
0.50 Primary panic

Year to Date June 2010

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	51.00	492.60	147.85	0.60	1.25	0.00	0.00	149.70
PI Instr	123.00	1198.00	358.40	15.75	61.90	0.00	0.00	436.05
Engr	6.00	59.60	20.70	0.00	55.05	0.00	0.00	75.75
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**180.00**	**1750.20**	**526.95**	**16.35**	**118.20**	**0.00**	**0.00**	**661.50**

Time Summary

Percentage of time scheduled for observing	80.3
Percentage of time scheduled for engineering	4.5
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	30.5
Percentage of time lost to instrument	0.9
Percentage of time lost to telescope	3.6
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	35.0

Use of MMT Scientific Observing Time

July 1 - 20, 2010

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	14.00	111.00	71.05	0.00	0.00	0.00	0.00	71.05
PI Instr	4.00	31.20	7.60	0.50	0.00	0.00	0.00	8.10
Engr	2.00	15.50	2.00	0.00	0.00	0.00	0.00	2.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**20.00**	**157.70**	**80.65**	**0.50**	**0.00**	**0.00**	**0.00**	**81.15**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	90.2
Percentage of time scheduled for engineering	9.8
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	51.1
Percentage of time lost to instrument	0.3
Percentage of time lost to telescope	0.0
Percentage of time lost to general facility	0.0
Percentage of time lost to environment	0.0
Percentage of time lost	51.5

Year to Date August 2010

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	65.00	603.60	218.90	0.60	1.25	0.00	0.00	220.75
PI Instr	127.00	1229.20	366.00	16.25	61.90	0.00	0.00	444.15
Engr	8.00	75.10	22.70	0.00	55.05	0.00	0.00	77.75
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**200.00**	**1907.90**	**607.60**	**16.85**	**118.20**	**0.00**	**0.00**	**742.65**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	81.1
Percentage of time scheduled for engineering	5.0
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	32.2
Percentage of time lost to instrument	0.9
Percentage of time lost to telescope	3.3
Percentage of time lost to general facility	0.0
Percentage of time lost to environment	0.0
Percentage of time lost	36.4