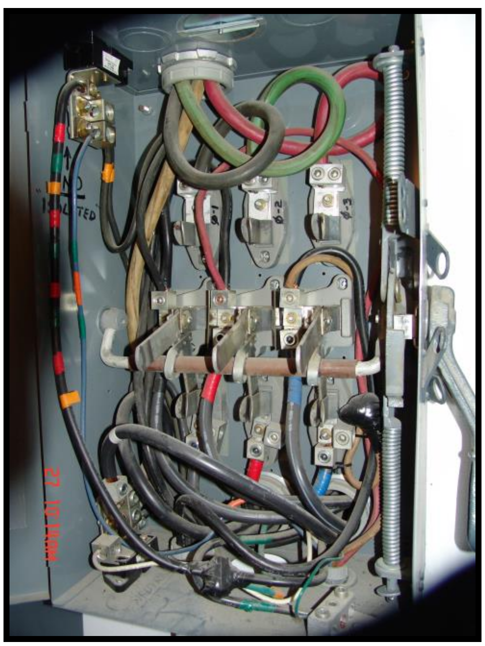
Smithsonian Astrophysical Observatory & Steward Observatory, The University of Arizona

MMT Observatory
Smithsonian Institution & The University of Arizona®

End of Trimester Summary

May - August 2012



BEFORE

AFTER

A significant project addressing the quiet power in the main MMTO enclosure was completed during shutdown. The electronics staff re-engineered and upgraded the main transfer switch as shown above and described on p. 31.

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Personnel

Dennis Smith retired on July 19 after 25 years with the MMTO, five of those years as Mountain Operations Manager. He will continue part-time as a technical consultant.

Joannah Hinz was hired as an Assistant Staff Scientist and started on July 23.

Erin Martin was hired as a Telescope Operator, Sr. and started on August 6.

Interviews were conducted for a Mechanical Engineer position during this trimester.

Eduardo Mitre was employed with mountain operations as a student worker during the summer.

Grant West, Univ. of Arizona undergraduate and Steward Observatory student worker, worked with MMTO mountain operations during summer shutdown in July and August. Grant is the son of former MMTO employee, Steve West.

Talks and Conferences

Grant Williams gave a talk entitled "The Science and Technology of the 6.5-m MMT Telescope" on May 11 to a "Smithsonian Journeys" group at the Arizona Inn in Tucson. The group then traveled to Mt. Hopkins where he gave them a tour of the MMT Observatory.

Grant Williams attended the American Astronomical Society (AAS) meeting held June 10-15 in Anchorage, Alaska. He presented a poster entitled "The Supernova Spectropolarimetry Project: A Study of the Evolution of Aspherical Stellar Explosions."

Four MMTO staff members (D. Clark, D. Gibson, D. Porter, and R. Ortiz) attended the *SPIE* Astronomical Telescopes and Instrumentation 2012 Conference held July 1 - 6 in Amsterdam, Netherlands. The following five posters/papers were presented:

> Seeing Trends from Deployable Shack-Hartmann Wavefront Sensors, MMT Observatory, Arizona, USA (Proceedings Paper)
> J.D. Gibson, G.G. Williams, T. Trebisky
> *Proc. SPIE*, **8444**, 844432

This paper and the related poster synthesized the more than 75,000 wavefront sensor (WFS) measurements and associated seeing values obtained for the f/5 and f/9 WFS systems from 2003 to March, 2012. It summarizes the numerous relationships of seeing with thermal, environmental, and other operational conditions, and presents guidelines for optimizing local seeing.

> An Integrated Scheduling and Program Management System (Proceedings Paper)
> D. Porter, J.D. Gibson, G.G. Williams
> *Proc. SPIE*, **8448**, 844824

This paper and the related poster presents a systems-engineering approach to combining existing and new relational databases, spreadsheets, and file storage systems for scheduling and program management at the MMTO. The goals of this approach are to streamline observatory and science operations and related data management, and to optimize the user experience. This work will continue into future reporting periods.

An Updated T-series Thermocouple Measurement System for High-Accuracy Temperature Measurements of the MMT Primary Mirror (Proceedings Paper)
D. Clark and J.D. Gibson
Proc. SPIE, **8444**, 844433

Upgrading the MMT Primary Mirror Actuator Test Stand: A Unique Vehicle for Evaluating EtherCAT as a Future I/O Standard for Systems (Proceedings Paper)
D. Clark and S. Schaller
Proc. SPIE, **8444**, 84445P

MMT Nightly Tracking Logs: A Web-Based Database for Continuous Evaluation of Tracking Performance (Proceedings Paper)
D. Clark, J.D. Gibson, D. Porter, T. Trebisky
Proc. SPIE, **8444**, 84445Q

Primary Mirror Systems

Primary Mirror Support

There is still an unidentified stray force issue with the primary mirror support actuator test stand. Work is being done on it as mechanical support allows.

Skip Schaller made the following enhancements to the primary mirror actuator test stand graphical user interface: loadcell readouts were added to the direct force tab, and a toggle was added to enable continuous monitoring of the loadcells.

Optics

A very successful wash of the primary mirror took place on May 2-3. The plots below show the reflectance and scattering measurements before and after the wash. For comparison, results from the 2010 coating are also shown.

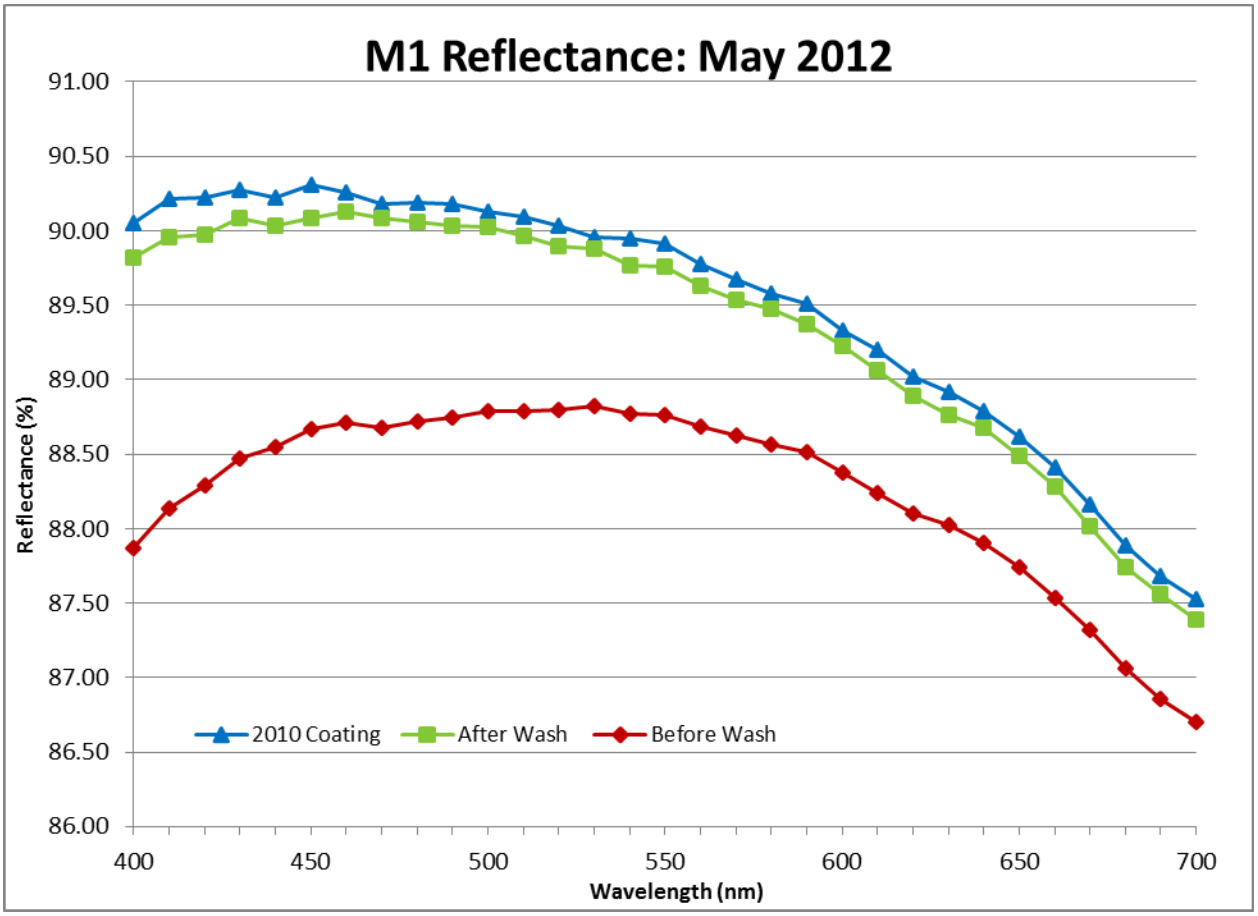

Figure 1. M1 Reflectance: May 2012, before and after wash, compared with 2010 coating.

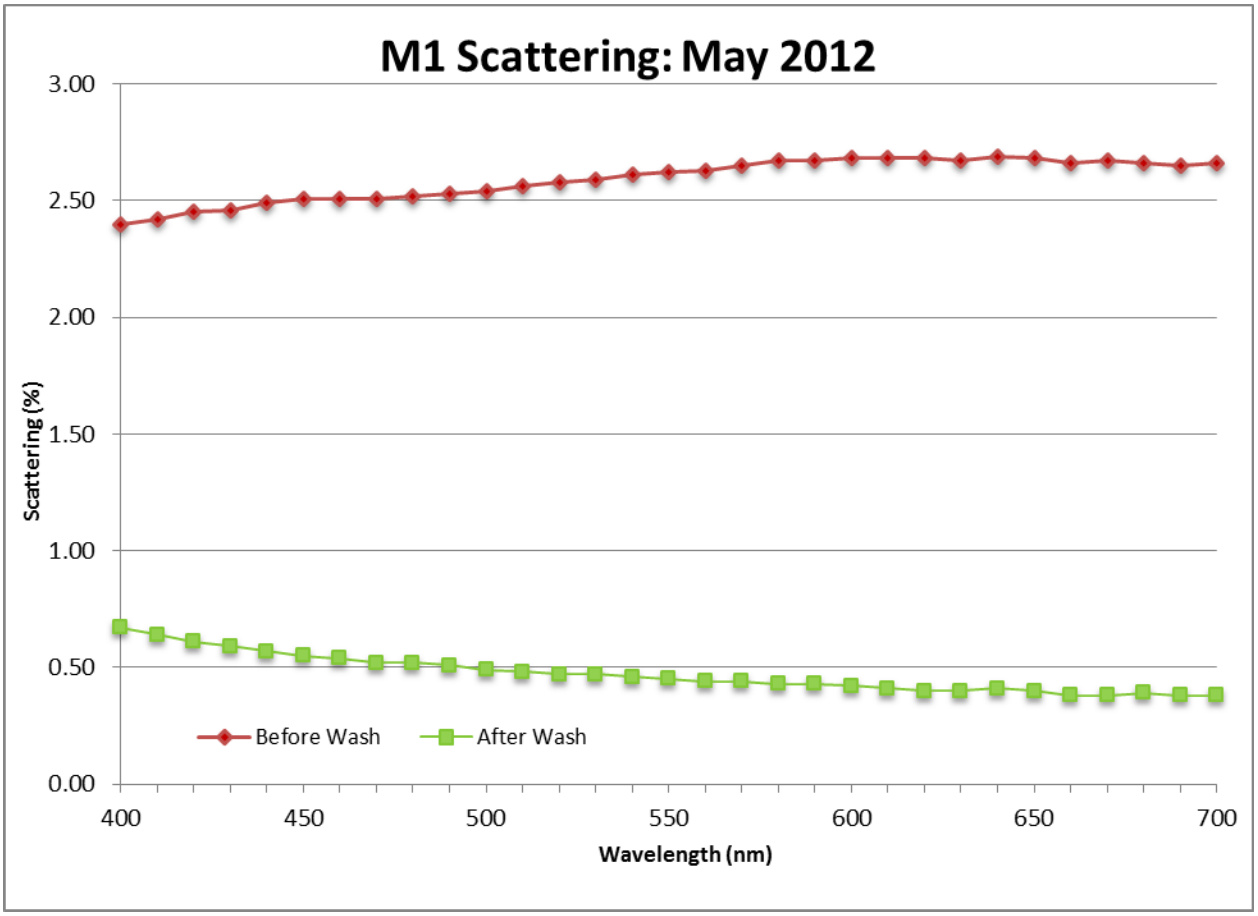

Figure 2. M1 Scattering: May 2012, before and after wash.

Thermal System

Another Type T thermocouple electronics enclosure was mounted to the northeast quadrant of the mirror cell. Two absolute and two differential cards were installed. However, there is a problem with communication to the RabbitCore controller module. Even after reprogramming the unit, no network communication was possible. Faulty network connections are suspected. We expect to fix this issue before the next reporting period.

Aluminizing

A new isolation front-end card was designed to replace the data acquisition unit (DAU) used to sample the coating equipment data (pressure sensors, deposition monitors, etc.) and to connect the signals to the new aluminization PC data acquisition PCI board. This new board will provide galvanic isolation to maintain good signal integrity and avoid any ground loops or other problems with the many signal sources in the aluminization equipment. With all the aluminization data sources connected to the PCI acquisition boards, we can greatly increase the sample rate of the data and correlate all the different sources in time, which will help with system automation and post-coating analysis.

An HP DAU and an old welder interface, constructed for the original Miller welder tests at the Sunnyside vacuum facility, were wired to make it possible to collect correlated data with the welder voltage and current, along with the operator setpoint. The DAU also has a multifunction card installed to enable the welder and a DAC output to automate the 0-10V setpoint signal source when we are ready to test filaments under software control. Dallan Porter is writing the acquisition interface software to bring all the data collected in the small chamber at Sunnyside into a MySQL database for analysis.

Secondary Mirror Systems

f/5 Secondary Support

During summer shutdown, work was done on the intermittent support oscillation issue in the f/5 mirror support using the newly improved secondary test stand. A broken wire was found in the southwest tangent rod load cell connector, which we believe caused the oscillation issue. Work was also done on the axial support height, since several axial support actuators were nearly bottomed with the mirror support running. All the axial hardpoints were disassembled and the Steward Observatory machine shop chamfered and polished them, as had been done on the lateral tangent rods. They were found to have been slightly gummed up, along with scratches inside where they had been hanging up. A few small air leaks were corrected in the actuator tubing as well. The mirror axial height was reset to keep all the axial actuators inside their operating range. The top of the mirror was tipped out about 0.004" to ensure the axial support servo in the upper sector keeps working at horizon pointing in the pull direction, since no axial actuator can push.

After these fixes, no mirror support oscillations were reported during the f/5 run in late August after re-opening from summer shutdown. A complete report on the f/5 work was produced by Dusty Clark and is available upon request.

f/5 Secondary Test Stand

During the f/5 secondary maintenance detailed above, improvements made to the secondary test stand fixture (reported in the previous reporting period) were analyzed. Procedures for installing and removing the f/5 secondary from the test stand in the front of the chamber were tested and finalized. The calculated balance point with the f/5 secondary mounted was within 5% of the empirical value. This position was marked on the balancing structure. The leveling feet were able to get the cell reference plate set to gravity (set perpendicular to the gravity vector) within .0015 inches over 12 inches. The integrated braking system and stow pin were used and kept the stand set at precise angles, safe from unwanted movement during f/5 metrology.

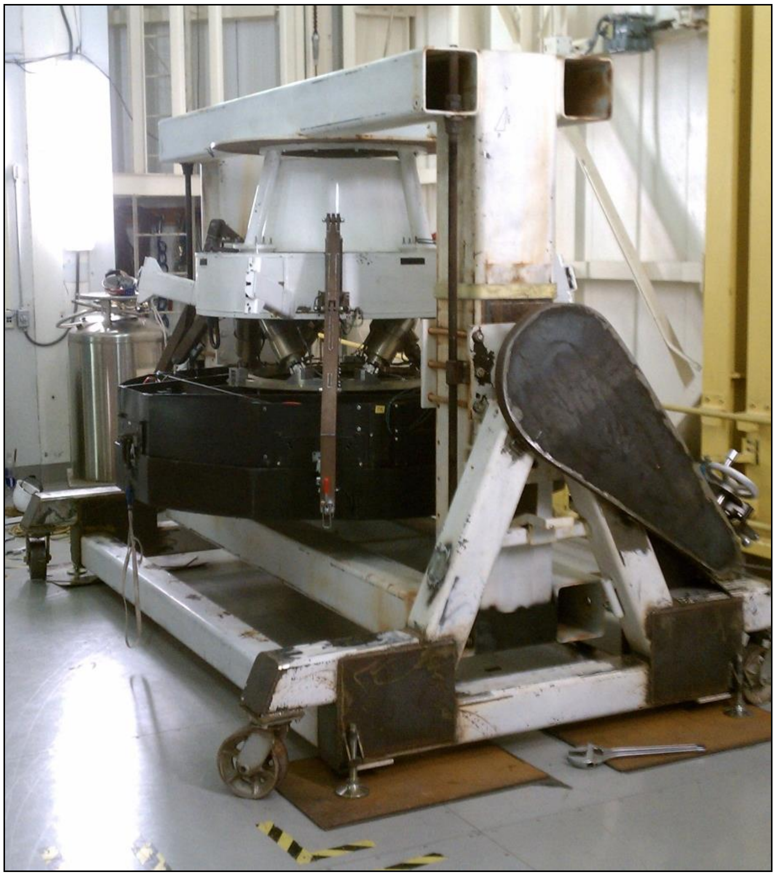

Figure 3. f/5 secondary on test stand at nadir pointing.

Figure 4. f/5 secondary on test stand at 45 degrees.

f/5 Secondary Baffles

A mid-baffle mechanical synchronization system was installed so that the air actuators defining the position of the lowest leaf of the baffle extend and retract at the same rate regardless of environmental differences. This system is comprised of several pulleys, in-house machined brackets, and a continuous loop of wire rope that connects each of the four air actuators. When one actuator moves, the other three actuators are "forced" to move the same distance and at the same speed with a maximum difference of +/- 0.2 inches due to cable stretch. This system was tested on August 27 during an f/5 run, and was successful in maintaining lower leaf proper motion.

Figure 5. Machined pulley brackets for mid-baffle synchronization system.

f/5 Baffle Calibration Sources

The f/5 baffle calibration lamp system was re-cabled during summer shutdown. The old SHV cabling was removed and replaced with color-coded wiring that matched the connectors. All cables that had previously interfered with the handling of the f/5 baffle were also removed.

f/5 Secondary Cart

A conceptual design was started for the f/5 secondary cart. This design incorporates triangulated towers for improved rigidity and strength as well as a shock absorption system to protect the f/5 secondary mirror during transportation, all while maintaining a suitable size to fit within the original cart's footprint. Once approved, the design will undergo further analysis to ensure it meets the safety and performance requirements of the f/5 secondary mirror.

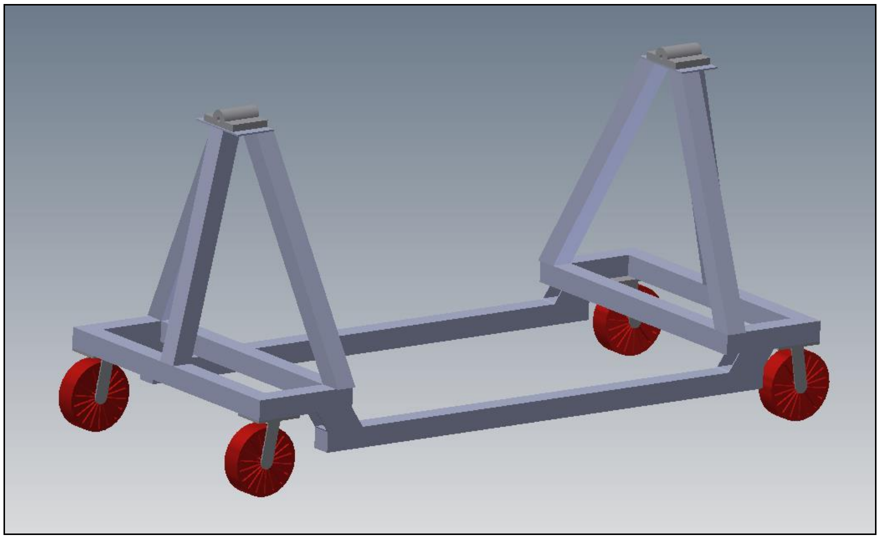

Figure 6. CAD concept for the f/5 secondary cart.

f/15 Secondary

The electronics group assisted Keith Powell in re-assembling the old adaptive optics (AO) computer and test equipment for checking out the deformable mirror (DM) digital signal processor (DSP) boards. The DSP crate motherboard was repackaged into a new enclosure with good mechanical support underneath to resist flexing when boards are inserted and extracted, along with solid card guides so that installed boards are well-supported mechanically. A power supply chassis with a unitized cable was also made to connect to the test box, eliminating the banana jacks that had been used previously. The test box for cards was modified to include cooling fans for each card after its use showed that heat buildup was causing loss of communication to the cards. The new box, along with some minor jumper connections, can now be used to test communications with DSPs, the program memory on the boards, and the capacitive gap-measurement circuitry.

Keith Powell and Ricardo Ortiz disassembled the DM DSP crates and brought all the DSP boards to the campus electronics shop for testing and evaluation in the new box. All were inspected and several cold solder joints were found. These solder joints were re-flowed, and the cards put back into service.

The electronics group also completed the construction of the new DM actuator test box, which integrates testing the actuator coil magnetics and gap-sensor circuit into a single unit for stand-alone testing of the actuators from the system.

Other AO activities during summer shutdown

Significant work was performed on the adaptive secondary mirror (ASM) and electronics to improve the system reliability and performance. The major tasks are listed below. Testing of the deformable mirror (DM) was performed after the work was completed to ensure the system was operating normally.

- Five DSP boards and one thin shell safety (TSS) card were replaced in the ASM. This restored the ASM to proper working condition.
- The deformable mirror (DM) shell was removed for cleaning and inspection. A large chip of either metal or glass was found and removed from the gap. A number of other places on the shell surface were cleaned with distilled water to remove contaminants.
- A software constant was modified to allow the DM to flatten properly.
- A method was developed for identifying bad or drifting actuators using telemetry data and the Visualization toolset.
- A leak was found in one of the cooling line connectors to the DM. That line will be replaced.
- Work was done on the DM power supply to make the VCCA voltage adjustments faster and easier to perform.
- A new short power cable was made that has greatly improved solder joints, to connect the power supply to the hub. This should help the issues with the VCCA voltage by lowering the voltage drop from the power supply rack to the telescope hub.

Telescope Tracking and Pointing

Elevation Axis

A Mercurial repository was created, as stated in the previous reporting period, for version control of the elevation controller Simulink files. It remains in use and contains several updates at this writing. Tom Trebisky created a similar repository using Git for important mount computer source files.

Rotator Axis

During summer shutdown, work was done on the rotator tape encoders. The southwest unit had been unable to reliably detect the semi-absolute index marks on the tape, and previous attempts to improve the head alignment using improved head bracket mounts had failed. During this work, it was found that of the three spare tape heads in hand, two had signal-detection issues that could not be resolved with careful alignment to the tape, or with adjustment of the internal pots inside the units. However, we were able to successfully align one tape head, but with a very small (0.020") clearance over the top of the bull gear face. Improved drawings are needed to understand why the head must be mounted so low. In the meantime, the other two heads will be shipped back to the vendor, Heidenhain, for evaluation and repair.

Other Mount Control

With the eventual replacement of the telescope operators' desktop PCs, "hoseclamp" (and later on, "yggdrasil"), we will lose the parallel port hardware long used for the operators' mount paddle. Preliminary design and development of a replacement paddle was started by Dallan Porter and Dondi Gerber. Their design uses an Arduino microcontroller and power over Ethernet (PoE) shield with a small hand-held 4-way rubber membrane button. This hardware will use a standard network connection and will communicate directly with a small paddle server running on the "hacksaw" server to pass paddle commands to the mount, and should be a robust long-term solution. The new paddle will be completed and deployed in the next trimester.

Computers and Software

OS System Updates

The software group upgraded ten Linux computers from Fedora 16 to 17 during the 2012 summer shutdown. Some remaining Linux computers cannot be upgraded to Fedora 17 at this time because of hardware and software compatibility issues. In addition, routine Macintosh and Windows updates were applied, as necessary, during this reporting period.

The software group is preparing for future operating system upgrades. These upgrades include: 1) Fedora 17 to Fedora 18 (to be released in December, 2012), 2) Mac OS X Lion to Mountain Lion, 3) Windows 7 to Windows 8, and 4) Windows Server 2003 to Windows Server 2012. The local, MMT-managed Fedora repository that maintains several MMT-specific RPMs was also updated to be compatible with Fedora 17.

Primary Mirror Thermal Software

Work continued on the software for the northwest quadrant T-series thermocouples. A new miniserver and associated logging infrastructure was created, similar to the existing miniserver and logging for the northeast quadrant T-series thermocouples. Other priorities have prevented further work until a later date on data acquisition from the northwest quadrant T-series thermocouples.

Work was also started on new web-based graphical interfaces for thermal information from the northwest quadrant T-series thermocouples, and for combining the E-series and T-series thermocouple thermal information into a unified interface.

The T-series thermocouples in the southeast and southwest quadrants are currently not being read or logged. Systems similar to the northeast and northwest quadrants are planned for these last two quadrants of T-series thermocouples.

"Hacksaw" Server Recovery Plan

Work on the "hacksaw" recovery plan was essentially completed by the end of August 2012. This work has been ongoing for the past two years, culminating in the virtualization of the main mountain server, "hacksaw," during the 2012 summer shutdown.

The "hacksaw" recovery plan addresses the main server, "hacksaw," at the MMT as a potential single point for failure. Failure of this server would make operating the telescope impossible. The cost of this RAID-based computer (~$8000) is too high to purchase a comparable second computer as a backup server.

The two main MMT servers, "hacksaw" at the telescope and "mmto" at the campus offices, were migrated to virtual machines (VMs) running on <$2000 commodity computers. In addition, file storage has been delegated to specialized network-attached storage (NAS) file servers, also costing <$2000 each. Benefits of NAS devices include faster data access, easier administration, and simple configuration.

Figure 7 gives an overview of the new server/file storage infrastructure for the MMTO. The infrastructure includes: 1) host machines (*e.g.*, "vmhost1"), 2) NAS devices (*e.g.*, "nas1"), and 3) VMs (*e.g.*, "hacksaw"). Figures 8 and 9 show the installed hardware at the MMT on Mt. Hopkins (Figure 8) and at Steward Observatory on the University of Arizona campus (Figure 9).

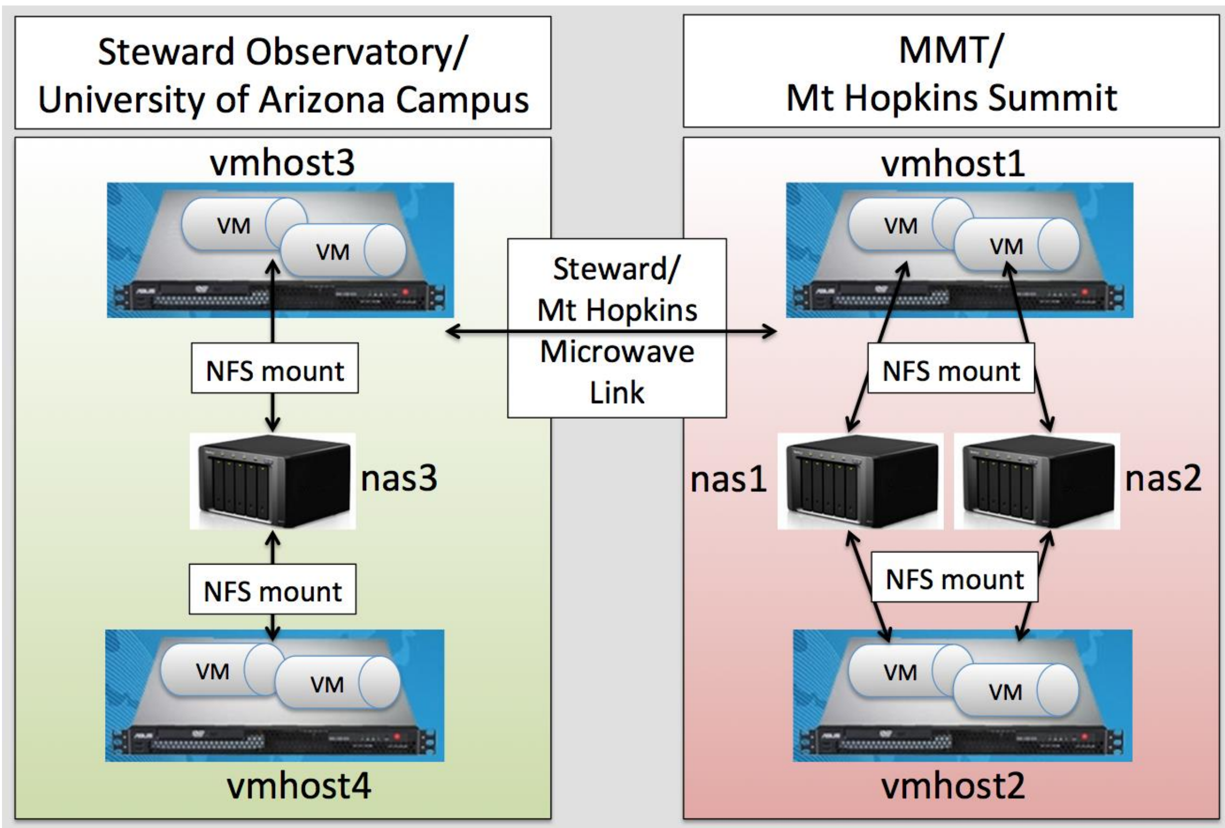

Figure 7. Host computers, virtual machines (VMs), and network-attached storage (NAS) devices now in use at the MMT Observatory on Mt Hopkins and at the MMT offices at Steward Observatory on the University of Arizona campus.

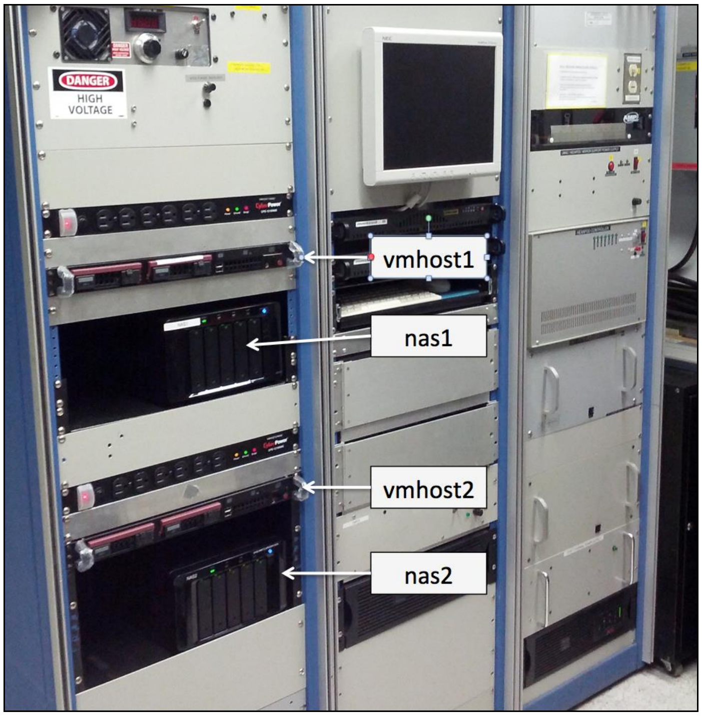

Figure 8. VM host computers and NAS devices in the "Server Room" (Room 3E) at the MMTO. The new hardware related to the "hacksaw" virtualization is labeled. Virtual host #1 ("vmhost1") and its associated network-attached storage device #1 ("nas1") are located above the similar vmhost2 and nas2. Power to vmhost1/nas1 is isolated from power to vmhost2/nas2 for additional safety and reliability. See text for more details.

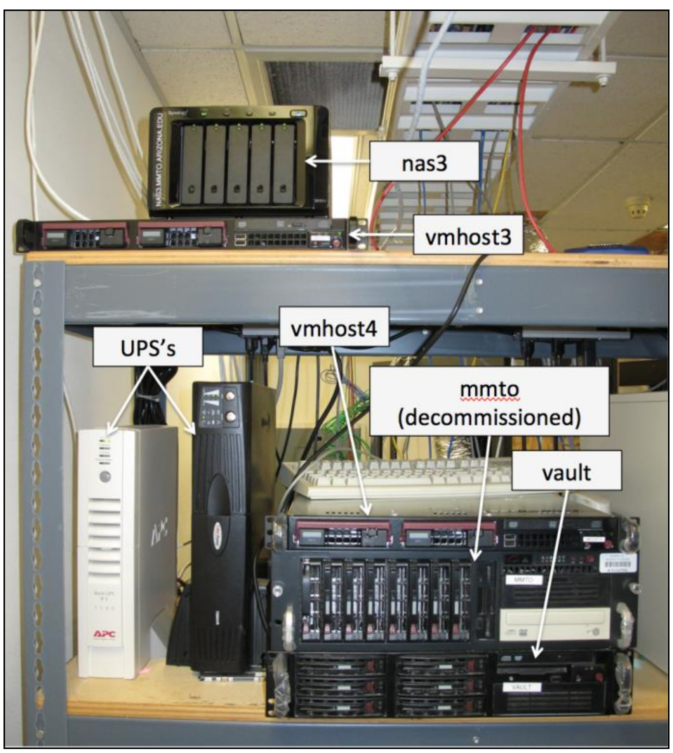

Figure 9. VM host computers, NAS boxes, and uninterrupted power supplies (UPS's) on the 3rd floor of Steward Observatory, on the campus of the University of Arizona. See text for additional details.

The “hacksaw” and “mmto” VMs each run as a separate process on the host computer. There are four similarly configured host computers now in use at the MMTO: “vmhost1” and “vmhost2” are located in the server room (3E) at the MMT Observatory on Mt. Hopkins (see Figure 8), while “vmhost3” and “vmhost4” are located in the server room on the third floor of Steward Observatory on the University of Arizona campus (see Figure 9). All four of these host computers are running Linux (Fedora). Each of the host machines has 24 GB (gigabytes) of RAM (random access memory) and is capable of running several VMs (typically with 4 to 8 GB of RAM each) at a time, if necessary. The VMs can be configured with up to 8 CPUs, and are currently running with 4 CPUs.

The VMs are running using the open-source VirtualBox (https://www.virtualbox.org) virtualization software, currently being developed by Oracle Corporation. Each VM is a single virtual disk image (VDI) file that is executed as a process on the host machine. This VDI file can be copied between machines and run on Linux, Mac or Windows platforms. We are running Linux VMs on Linux host computers for the “mmto” and “hacksaw” servers.

The majority of file and data storage for the MMTO has been moved to NAS boxes, which are also RAID-based specialized Linux machines. All that remains on the virtualized servers is the Linux operating system, which is used for critical network functions, *e.g.,* DNS (Domain Name Server) hostname resolution and LDAP (Lightweight Directory Access Protocol) authentication. Restricting the size of each VDI file to a minimal operating system makes backing up of the disk image much faster and manageable. Files on the NAS boxes are network file system (NFS) mounted to the VMs as shown in Figure 7. Data are routinely backed up and archived as described below.

The former “hacksaw” computer was decommissioned during the 2012 summer shutdown. Its RAID array was cloned into a single file that was used to create a VM through a multi-step process. Several days were required to complete the conversion. Prior to cloning the RAID array, extensive cleanup of user accounts and other files was completed to reduce the amount of used disk space. The RAID array was cloned by booting “hacksaw” from a rescue CD. The cloned disk image was copied onto vmhost1. The image was then reduced in size by removing disk space that was not being used to hold data, using “zerofree.” This optimized disk image was then used to create a new VM via VirtualBox. The new VM was then started on the host machine through the VirtualBox interface.

Relatively few changes were required for successful booting of the new “hacksaw” VM. For example, the MAC (Media Access Control) address for the IDL (Interactive Data Language) license server had to be changed to the MAC address of the new “hacksaw” VM. The disk image for a VM is exactly the same regardless of the host machine on which the VM is running. So, details such as the MAC address for the VM are the same regardless of the host machine. Similarly, only one instance of the VM can be running at any one time. Otherwise, multiple machines (*i.e.,* VMs) with the same internet protocol (IP) address and hostname would be on the same network, which would cause hostname collisions.

The MMT software group is using a rotation schedule to backup the VDI files and to run the VMs on alternate host computers. The current VDI files for both “mmto” and “hacksaw” are copied on a weekly basis from the vmhost that is currently running the VM to the alternative vmhost for that VM. The VM is halted during this copying. The vmhost2 acts as an alternative for vmhost1; vmhost4 acts as an alternative for vmhost3.

On a monthly basis, the host machines for "mmto" and "hacksaw" VMs are switched. On odd number months (where January equals "1"), the VMs are run on the odd number vmhosts, *i.e.,* vmhost1 and vmhost3. On even months, the VMs are run on vmhost2 and vmhost4. This ensures that we are able to start up the VM server on an alternate host machine quickly (within a few minutes, at most). VMs can be started manually, but are also started automatically when the host computers are rebooted. An off-site backup of the VDI files for "mmto" and "hacksaw" is also made on a monthly basis. This is not done more often because the file must be copied over the relatively slow microwave link. This overall VDI file management strategy ensures that a backup server VM is never more than a week old. In the case of multiple computer failures at the MMT (*e.g.,* from an incident on floor 3E at the MMT that destroys both vmhost1 and vmhost2), an off-site server VM is never more than a month old.

The VDI files for the VMs are dynamically sized, growing as storage requirements increase. These VDI files do not dynamically shrink as files are deleted. As the VDI files grow in size, copying the VDI takes additional time. Because of this, files are regularly removed from the VM, and the size of the VDI file is shrunk through a series of commands to remove the extra free space from the VDI file.

The main directory of MMT software on "hacksaw" is contained in the /mmt directory. This directory is a network file system (NFS) mounted by "hacksaw," as well as the control-room Linux computers directly to either nas1 or nas2. At the moment, the NFS mounts are made to nas1. The /mmt directory is copied weekly from nas1 to nas2 on Sundays. The /mmt directory is copied from nas2 to nas3 on Saturdays for an off-site backup. This strategy allows for an extra six days to recover from files accidentally deleted or corrupted. The file directories "/fedora/mmt" (which contains selected MMTO-related files on the campus server) and "/www" (the mmto.org home web site) are copied from the campus NAS device, nas3, to nas1 at the summit daily.

Finally, log files, images, and similar files that are more than two years old are moved from the /mmt directory to external USB drives. We currently have two ~2TB external USB drives to hold this archival data. These USB drives are stored at the campus MMTO offices at Steward Observatory.

Power for the vmhost1/nas1 and vmhost2/nas2 has been isolated from each other through separate circuit breakers. This provides additional reliability to these critical computers in case of a power surge or power failure.

Procurement of two uninterruptible power supplies (UPSs), one for vmhost1/nas1 and the other for vmhost2/nas2, is planned. The existing UPS for the former "hacksaw" computer in the mount room may be moved to the 3rd floor server room as one of these UPSs. This procurement may include smart UPSs that can notify computers that they should perform a clean shutdown. A smart UPS is designed to safely and automatically shut down any connected computers before the batteries are depleted. This commanded shutdown would need to be sent to the host computers (vmhost1 and vmhost2), the NAS boxes (nas1 and nas2), and the VM (hacksaw). Details of cleanly shutting down the VM from a smart UPS are currently being worked on.

Future work includes converting the Windows Server 2003 Active Directory servers, "vault" and "integral", to VMs, with "integral" running at the MMT/Mt. Hopkins and "vault" running at the MMT/Steward Observatory locations. The new Windows Server VMs would be running Windows

Server 2012, the current Windows Server operating system. A similar approach of separating the data from the operating system will be used for these Windows Server VMs. The MMTO Windows-based data, which includes many of the engineering drawings and photos for the MMT, will be migrated to one or more NAS boxes. Some of these drawings and photos may be moved to the new Documentation Database (see p. 17). The VM itself would only contain the Windows Server operating system. The Windows Server VM would run on a Linux host.

MMT Control Room Computer Replacements

A new Dell XPS One 27" all-in-one has been purchased and configured to replace the existing "hoseclamp" computer. This computer, temporarily named "hoseclamp-aio," is being evaluated by the telescope operators. A few minor software issues remain before replacing the existing "hoseclamp" with the new computer.

One of the main issues for replacing the current "hoseclamp" was the requirement for a parallel port for the telescope mount paddle. Preliminary design of a replacement of the existing paddle with a new network-based paddle was started during this reporting period.

The remaining graphical user interfaces (GUIs) that are not working on the new "hoseclamp" all-in-one computer have been identified. Work proceeds on resolving these GUI issues.

The six small telescope status ("telstat") displays in the MMT control room that were connected to the computer "brak" have been replaced by a Mac mini and two 40-inch high-definition (HD), wide-screen TV monitors. Much work is underway by the software group in updating content for these telstat displays, using current web technologies (*e.g.,* HTML5, CSS3, web sockets, etc). Improved readability and consistency in style will be emphasized for the new telstat content. Plans are to have different content on the two new monitors: one monitor will be designed for the telescope observer while the content for the other will be designed for the telescope operator. The content for each monitor may be configured by the user(s) and may change based upon telescope configuration, weather conditions, or other operating factors.

A 27" iMac has been configured to replace the current Linux-based observer computer "alewife." An initial list of the software requirements has been made for this computer. One major issue in converting the observer's computer from Linux to Mac OS is the requirement for a 64-bit version of the IRAF/CCDACQ software. Work continues on upgrading this software for use on the new "alewife" iMac.

MMT Documentation Database

The new MMT documentation system was officially launched in July 2012. This documentation system uses a shared Google Docs collection entitled "Documentation Database" within the MMTO Google Educational domain. The philosophy behind the new documentation system is to use Google's powerful search capabilities to locate documentation, rather than to "file" documents within a nested folder hierarchy. Documents, including photos, can be found by searching for keywords, such as "f/5" and/or "electronics." In the case of photos, figure captions are added to the photos to aid in searching. Documents, including PDF files, are indexed by the Google search engine.

This new documentation system is primarily for internal MMTO use. Users need to have an active MMTO Google domain account to access the system. The MMTO Google domain authentication system is separate from the LDAP or Active Directory authentication systems used on MMTO computers.

Users can access the Documentation Database through a variety of portals, including: 1) any web browser, 2) a Google Drive client, and 3) various mobile applications ("apps"), including:

- QuickOffice Pro HD
- ScannerPro
- PhotoSync
- GoodReader
- GoogleDrive

The mobile apps listed here have been installed on a new MMT-owned iPad, dedicated to documentation.

Figure 10 shows a typical web browser session for accessing existing documents or creating new documents. Use of this web interface should be familiar to any Google user.

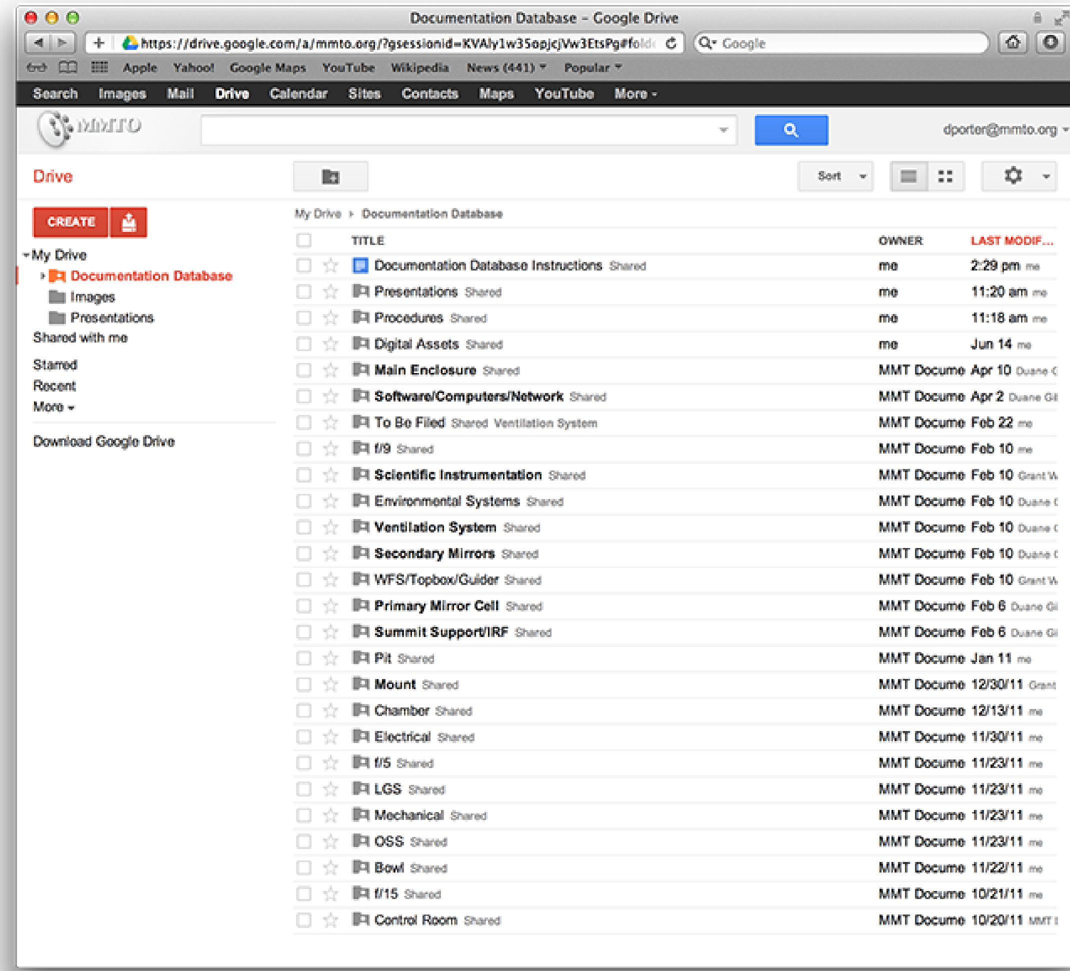

Figure 10. Web interface to the MMTO "Documentation Database" Google Docs collection. New and existing documents can be accessed from this interface. The current collections within the database are shown at the right in the figure.

An initial set of "collections" or "tags" has been created within the Documentation Database including:

- Administrative
- Bowl
- Chamber
- Control Room
- Digital Assets
- Electrical
- Environmental Systems
- f/9
- f/5
- f/15
- To Be Filed
- LGS

- Main Enclosure
- Mechanical
- Mount
- OSS
- Pit
- Presentations
- Primary Mirror Cell
- Procedures
- Scientific Instrumentation
- Secondary Mirrors
- Software/Computers/Network
- Summit Support/IRF
- Ventilation System
- WFS/Topbox/Guider

This set of collections is meant to remain relatively short and straightforward to use when submitting new documents. Documents can be in one or more collections as users feel is appropriate. Documents will typically be found through a search rather than by file name or assigned collection(s).

Work continues on migrating new and existing documentation into the new MMT Documentation Database system.

Aluminization Data Acquisition and Logging Software

A new data acquisition computer has been configured to record data from aluminization tests. The new computer is a reclaimed Shuttle PC with Fedora 17 Linux operating system. New software has been developed to gather data from an HP DAU unit through a Lantronix via Ethernet. A custom Python script is used to initiate the data acquisition scan and record the data points into a MySQL database. A new web-based GUI has been created to provide an interface to start and stop the scan. A live data stream is also displayed in charts in the web browser. A separate tab on the web page allows for selecting previous data sessions and viewing the archived data in a line chart. The software also records webcam images and links the images to the data points. The archive viewer allows for the user to select points in the line chart, and the appropriate webcam image is displayed to the right (see Figure 11).

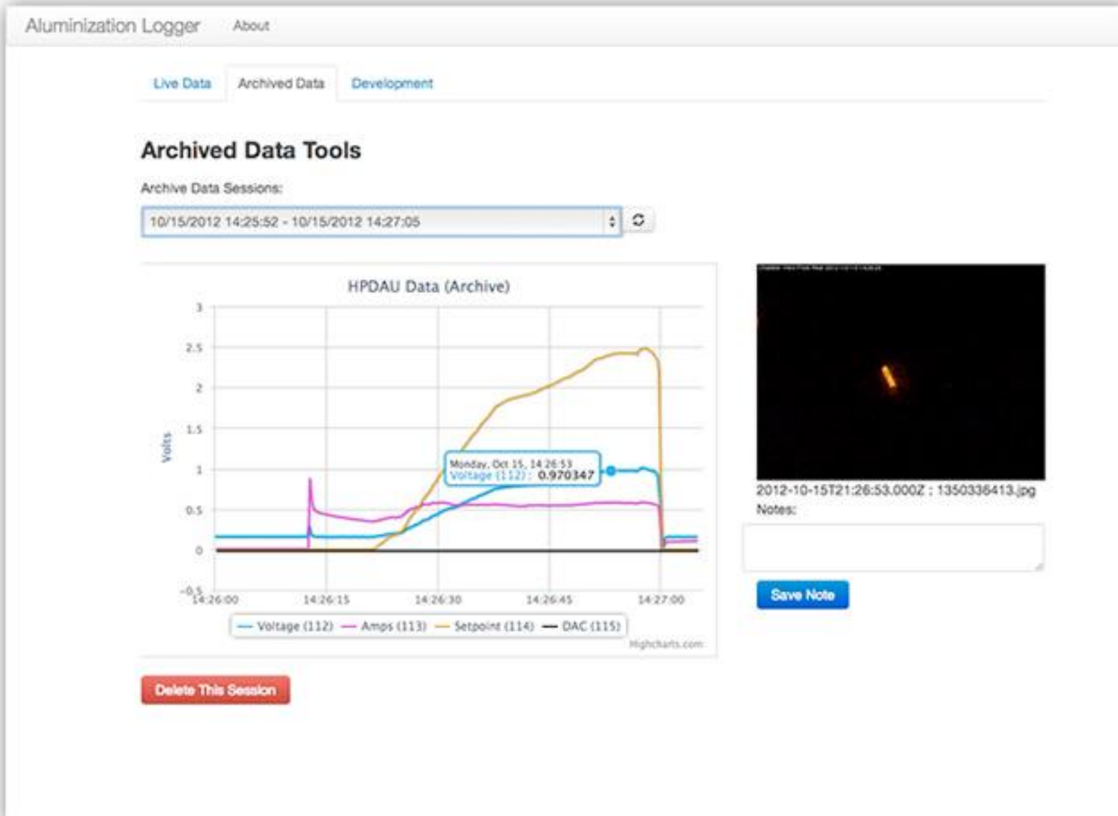

Figure 11. Screenshot of the archive viewer for data recorded from aluminization tests.

The new web interface software has been created with some of the latest web technologies. The web server is using Node.js, and the HTML pages are served using the Express.js web server module. The HTML page is generated using the Jade template engine, making it extremely easy to modify. The data from the python acquisition script is simultaneously pushed to both a MySQL database and a Redis memory store. As the data is pushed to Redis, it is immediately pushed out to all open web GUIs using the Node.js Socket.io module and is displayed in line plots nearly real-time. Multiple copies of the webpage GUI can be open on different computers or devices and they are all kept in sync on the server-side.

Summary of Service Request (SR) Activity

The Service Request (SR) system is a web- and email-based informational system of operational issues that are segregated within a MySQL database by priority, subject, and category. The SR system is used by the staff and affiliated organizations for immediate communication and long-term documentation as operational issues are addressed and resolved.

Figure 12 shows the distribution of the 72 newly created or re-opened SRs during this reporting period. The four largest categories for newly created or re-opened SRs are: 1) Telescope, 2) Building, 3) Computer and Network, and 4) Software.

Figure 13 summarizes the priority levels of the newly created or re-opened SRs, with "Important" being the most common priority.

Figure 14 illustrates the distribution of the 235 SR responses within different categories on which work was performed during the same reporting period. The dominant categories are similar to those found in Figure 12 for new or re-opened SRs.

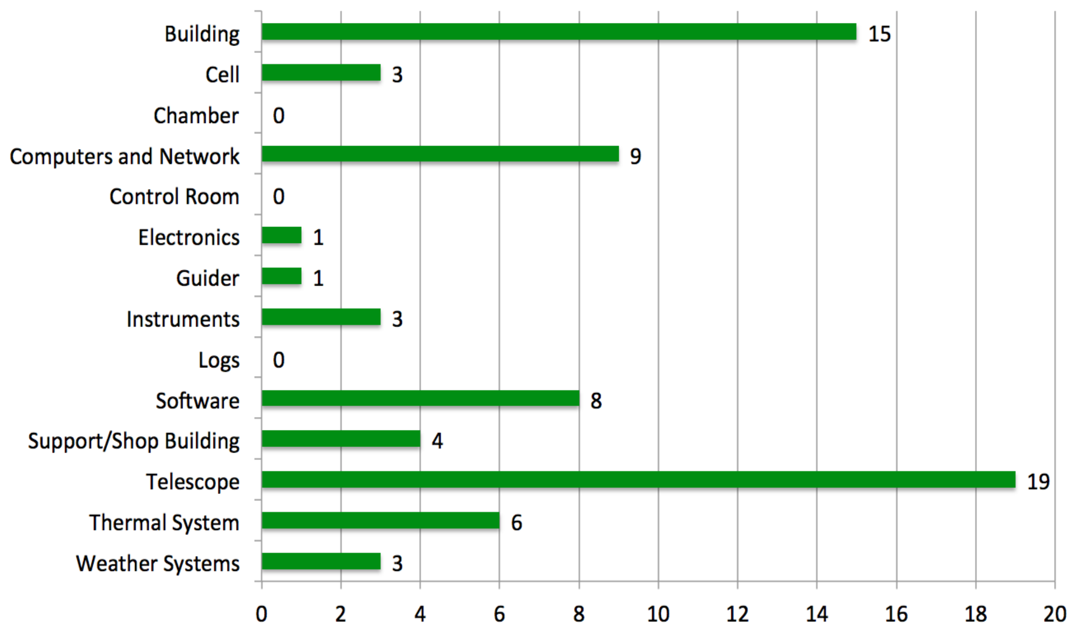

Figure 12. Categories of 72 new or re-opened SRs from May through August 2012.

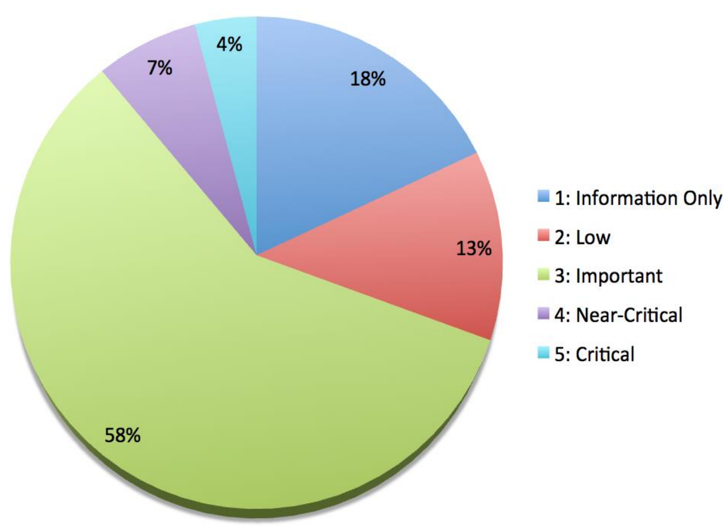

Figure 13. Distribution of open SRs into the five priority categories from May through August 2012.

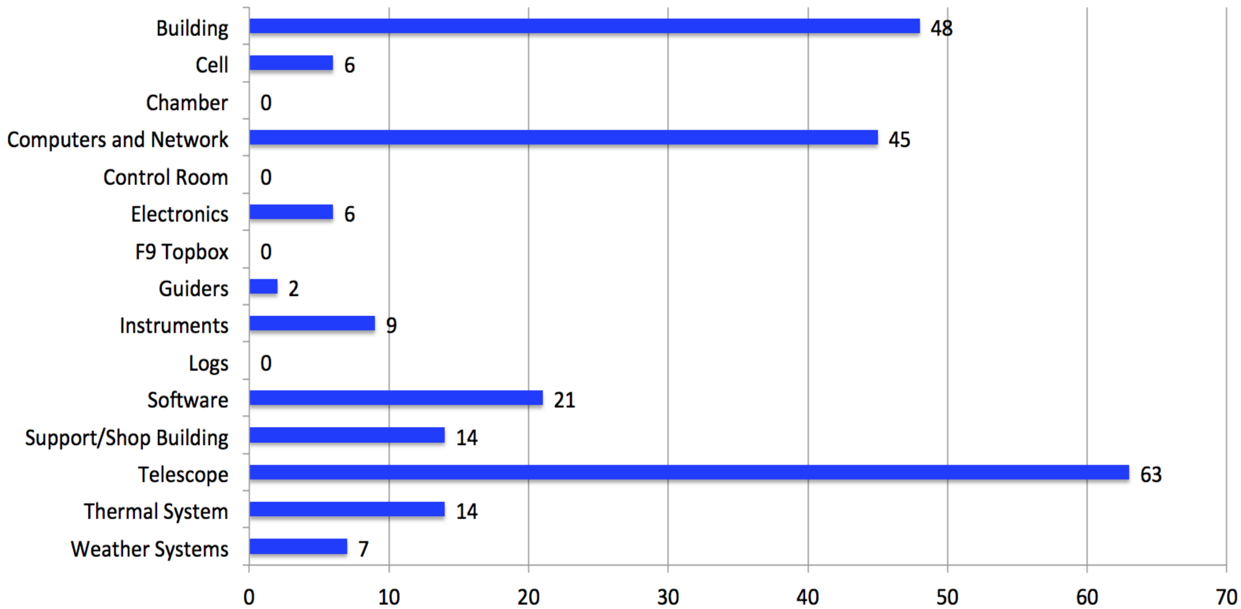

Figure 14. There were a total of 235 SR responses within different categories from May through August 2012. These responses are related to work on subsystems throughout the MMTO.

Instruments

f/9 Instrumentation

Blue Channel and Red Channel Spectrographs

During summer shutdown almost all the hardware for Blue and Red Channel was sent to ITL for yearly maintenance and upgrade. The old "mmtccd" 2U rack server was replaced with two 1U rack servers which now spare each other. Both new machines are called "mmtccd" and are not intended to be turned on at the same time or there will be a network conflict. The idea is that if one goes bad it can be turned off and all the cables can be moved to the other and it can be used with no changes. The old 2U "mmtccd" server has been returned unchanged except for removal of the PCI fiber controller interface card that was installed into one of the new machines. The old computer is no longer used for the CCD systems. ITL loaned MMTO one additional PCI fiber controller interface card so both servers have the same fiber optic interface board. The new servers are labeled "mmtccd A" and "mmtccd B". There is no difference in the machines or software and both machines run Windows 7.

All the AzCam software was updated to AzCam 5.0. The ControllerServer software has been updated to 20.04. The guider.tcl program has been updated to 5.24. It is also now possible in an emergency to guide from the "mmtccd" computer. Software is installed for this option but not yet configured. A screen icon and script have been added to easily change the IP address of the machines from DHCP, as used at ITL, to the mountain values. A text file needs to be edited if the IP addresses change in order to use this script.

ITL identified and fixed an issue with the spare Blue Channel controller having a different noise and bias levels than the normal controller. The video processes had a different gain. The spare controller was modified so that it performs the same way as the original. The two controllers are now called "BlueChan A" and "BlueChan B". Because of this change, the "spare" controller will now no longer spare Red Channel. Therefore, a second spare system was modified and loaned to the MMTO for used as the Red Channel spare. The two controllers are now called "RedChan A" and "RedChan B". All three controller power supplies may be used with either RedChan or BlueChan.

The hard disk in the "mmtag" computer that controls the Steward Observatory guide camera was replaced and OS was updated to Windows 7. The mmt2guider camera was baked and tested and the mmtguider camera, which did not require baking, was tested.

During shutdown, preventative maintenance was performed on the blue channel spectrograph by Dennis Smith and Mike Alegria. It was vacuumed, dusted, the aperture wheel lubed, and the filter wheels cleaned. The f/9 top box was also vacuumed and wiped clean of dust and bugs.

f/5 Instrumentation

The SAO service mission during the first week of August was very productive. The linear encoder was replaced with a spare unit, the wires soldered in, and the cable carefully routed to a safe path. Some cables and software were modified to re-enable operation controlled by the linear encoder. The electronics of the gimbal axes were checked and tweaked a little. The positioner was carefully cleaned before the upper and lower units were reassembled, and the offsets of robot 1 were trimmed to match the coordinate system of robot 2. The housing of the Wide Field Corrector was then cleaned of accumulated moth parts before washing the top surface.

Hectospec

This was a relatively good trimester. Of the 375 nighttime hours assigned to SAO f/5 instruments, the telescope was open to the sky 88% of the time. Only slightly more than one hour of time was lost due to telescope oscillations, a mount computer crash, network issues, and a mirror panic. All were quickly resolved by the MMT staff. Storms came a little early this year, but we were able to operate many partial nights.

Eighty-nine percent of the f/5 time was for hecto observations, which produced 575 science exposures on 173 fields. Observers using SWIRC obtained over 4200 science exposures over their five nights of operation.

A few issues arose with the dome calibration system this trimester. Communication problems with some of the dome calibration boxes were eventually traced to a single bad port on a network switch. The server software did not reliably initialize subsequent boxes when the communication failure occurred, so it was a bit more difficult to identify the problem. The configuration was changed to increase the available number of network ports by returning to the use of a network switch in the dome calibration rack. On the next observing run, one of the three series of lamps in the Chelle calibration can was found to be drawing less than the expected 15 milliamps of current. Tom Gerl and Marc Lacasse quickly removed the can from the secondary so that lamps in the series could be individually tested and the problem lamp replaced.

Near the end of the trimester, the server control computer "clark" failed to boot. After some investigation, the problem appeared to be due to an issue with a disk controller board or SATA cables. The computer chassis was swapped out with the spare unit. The disks, RAID controller card, memory and video card were also moved from the old computer to the spare computer. The computer then booted and operated properly. Repair of the problem chassis will be done in the next trimester.

A few days after we resumed hecto operation in late August, the home report showed that the encoder had lost some pulses. This was following the night that the telescope had a bout of significant oscillation. We reversed the modifications performed earlier in the month and will evaluate the issue further.

Wavefront Sensor

A new Apogee camera was purchased by Warren Brown (SAO) and installed in the wavefront sensor to allow for rapid imaging of targets of opportunity such as GRBs and supernovae. Two new computers were also purchased to be the servers for operation of the camera (one active, one for testing/spare). A new fiber pair was installed from the Cassegrain cone in the cell to the SAO computer rack on 3East, and new cabling was installed in the WFS for power and communication with the camera and its filter-wheel. Test fitting was done during the start of the service mission, and only minor adjustments were needed. To accommodate the additional communication cable, a new adapter plate was fabricated for the installation cone for the WFS. It includes all the WFS connectors and eliminates any sharp bends on the cables. The old plate was removed and installed a few times to get accurate measurements. On one of the reinstalls, the plate was mounted a bit low and it collided with the WFS energy chain anchor point. The damaged anchor point was quickly replaced with a spare and no observing time was lost.

The new computer in the SAO computer rack is a Windows machine named "long," which will be controlled through a KVM switch at the robot operator's station.

Binospec

The housing for the Binospec calibration unit was shipped to the mountain for a test fit. Everything fit as expected, and plans were made to include fine guides and guide rods to facilitate the mounting procedure when the unit is completed.

Seeing

Figures 15 through 20 present measured seeing values at the MMT Observatory for the period of May through August. These values are derived from measurements made by the f/5 and f/9 wavefront sensors (WFSs). (For additional information, see "Seeing Trends from Deployable

Shack-Hartmann Wavefront Sensors", *Proc. SPIE*, **8444**, 844432.) No WFS data were collected from late July through late August because of summer shutdown. Additional data gaps occur during inclement weather.

Figure 15 shows the time-series seeing data for May through August 2012. The f/5 seeing measurements are shown in blue circles; f/9 WFS seeing measurements are represented by green triangles. Data points alternate through time between these two WFS systems as the telescope configuration and observing programs change. As seen in the figure, overall seeing values for the two WFS systems are similar. As will be shown in subsequent figures, seeing values are influenced by many factors that include thermal and environmental conditions.

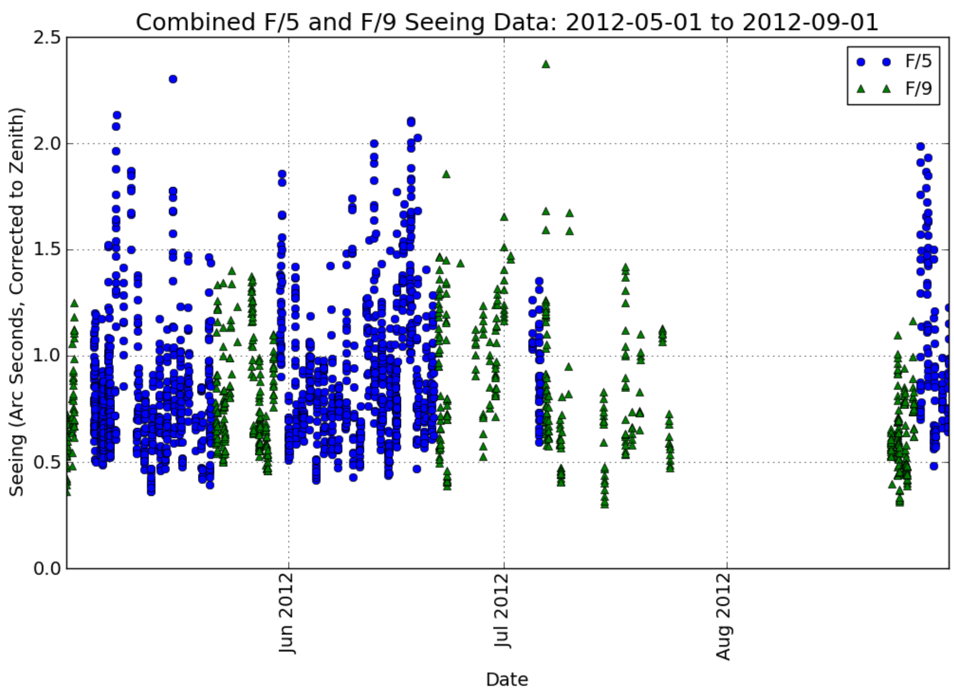

Figure 15. Derived seeing for the f/5 and f/9 WFSs from May through August 2012. Seeing values are corrected to zenith. The f/5 seeing values are shown in blue while f/9 values are in green. A median seeing of 0.78 arcsec is found for the 2,182 WFS measurements made during this period.

Figure 16 shows the distribution of f/5, f/9, and combined f/5+f/9 seeing values for the May through August 2012 reporting period. Median f/9 seeing is 0.1 arcsec better than median f/5 seeing (0.70 arcsec for f/9 versus 0.81 arcsec for f/5). The overall combined median seeing for the two WFS systems is 0.78 arcsec. Twice as many f/5 WFS seeing measurements were made within the period compared to f/9 WFS measurements.

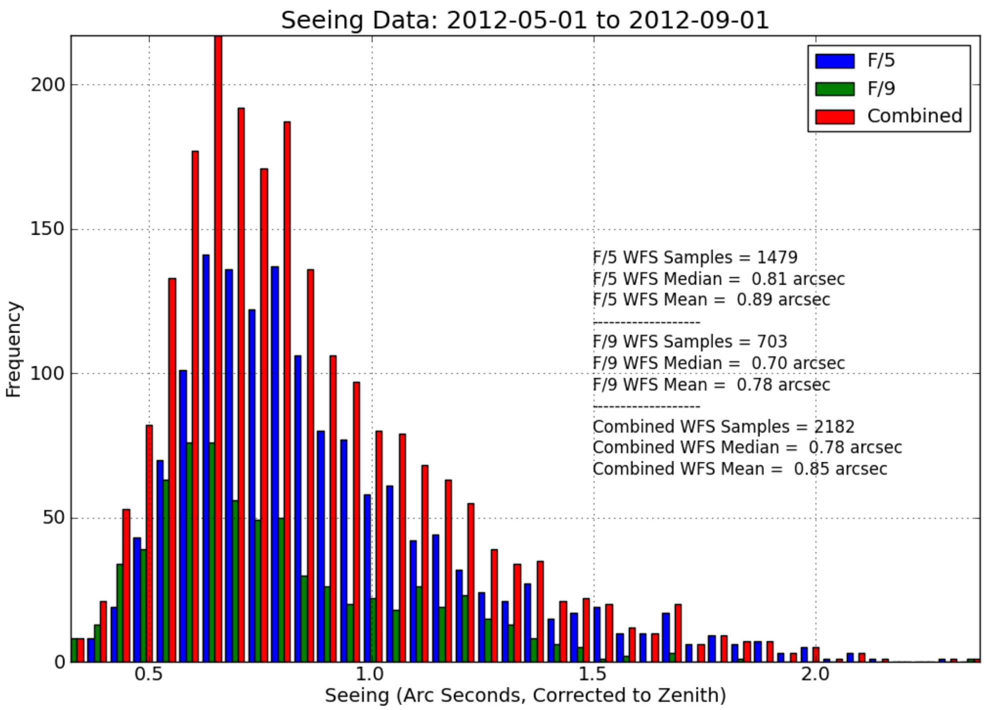

Figure 16. Histogram (with 0.1 arcsec bins) of derived seeing values for the f/5 and f/9 WFSs from May through August 2012. Seeing values are corrected to zenith. Median f/5 seeing is 0.81 arcsec while the median f/9 seeing is 0.70 arcsec. A combined (f/5+f/9) median seeing value of 0.78 arcsec is found for the 2,182 WFS measurements made during this period.

Figure 17 shows the distribution of combined f/5+f/9 WFS seeing values under different primary mirror (M1) glass/air thermal conditions. Both glass and air temperatures are obtained from the M1 cell E-series thermocouples. The "chamber temperature" E-series thermocouple is used to measure the air temperature adjacent to the M1 glass.

The data plotted in blue in Figure 17 represent seeing values when the mirror is colder than the adjacent chamber air temperature. The data in red were obtained when the mirror glass was warmer than the adjacent air temperature. The latter case is unfavorable since local mirror seeing is introduced at the glass-air interface under these conditions. The data show that the majority of WFS measurements were made under these unfavorable conditions. However, the median and mean seeing values are only slightly degraded because of these M1 glass-air thermal conditions. WFS measurements are commonly taken during the early portion of the night. This may explain, in part, why the majority of WFS measurements are under the unfavorable glass-air thermal conditions. Efforts are needed to increase the proportion of time that the M1 glass temperature is colder than the adjacent air.

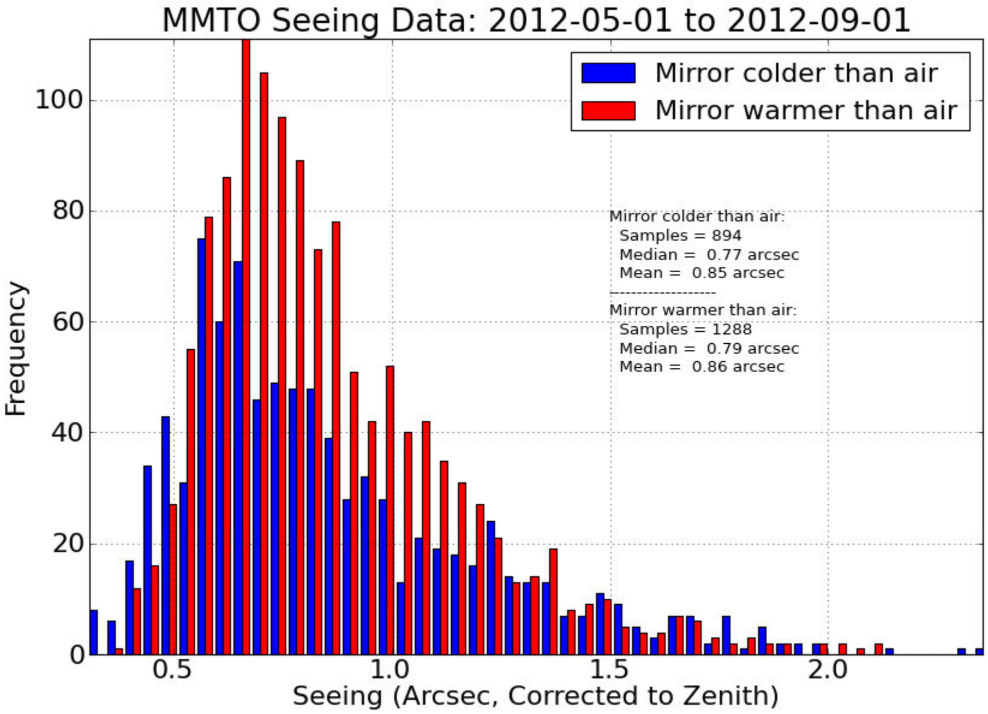

Figure 17. Seeing values under different M1 glass-air temperature conditions. The data plotted in blue represent seeing values when the mirror is colder than the adjacent chamber air temperature. The data in red were obtained when the mirror glass was warmer than the adjacent air temperature. The latter case is unfavorable since local mirror seeing is introduced at the glass-air interface under these conditions.

Figures 18 and 19 investigate the influence of wind direction and speed on seeing during the May through August 2012 reporting period. Figure 18 shows the variation of median seeing with wind direction. As has been seen in previously published results, wind from the east/northeast typically results in degraded seeing. These conditions are much less common as reflected by the lack of data at 75° east of north. Conversely, seeing is typically much better when the wind is dominantly from the prevailing direction of south to west. Figure 18 shows that seeing is typically 0.6 to 0.8 arcsec under these conditions.

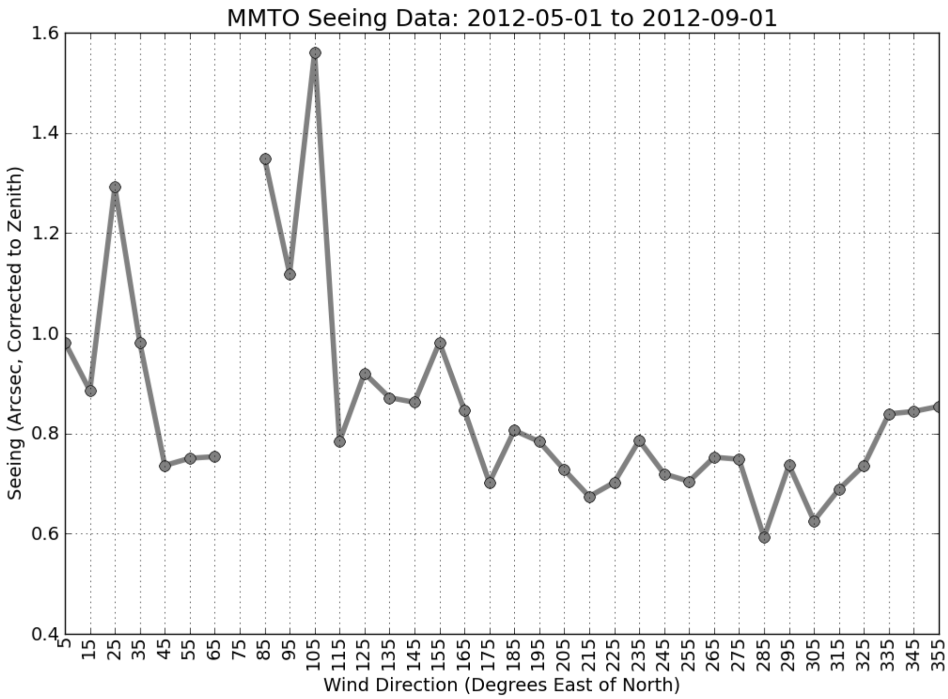

Figure 18. Median seeing variation with respect to wind direction for May through August 2012. No seeing measurements were made at a wind direction of 75° east of north during this period. In general, seeing is degraded when the wind is from the east and improved when the wind is from the south to west.

Figure 19 presents median seeing values versus average wind speed for May through August. The figure shows the relatively constant seeing up to 10 meters/second (m/s). Median seeing is typically approximately 0.75 arcsec up to 10 m/s, represented by the "low" and "medium" wind speeds in Figure 19. Seeing degrades to around 0.9 arcsec when the wind speed is over 10 m/s as seen in Figure 19.

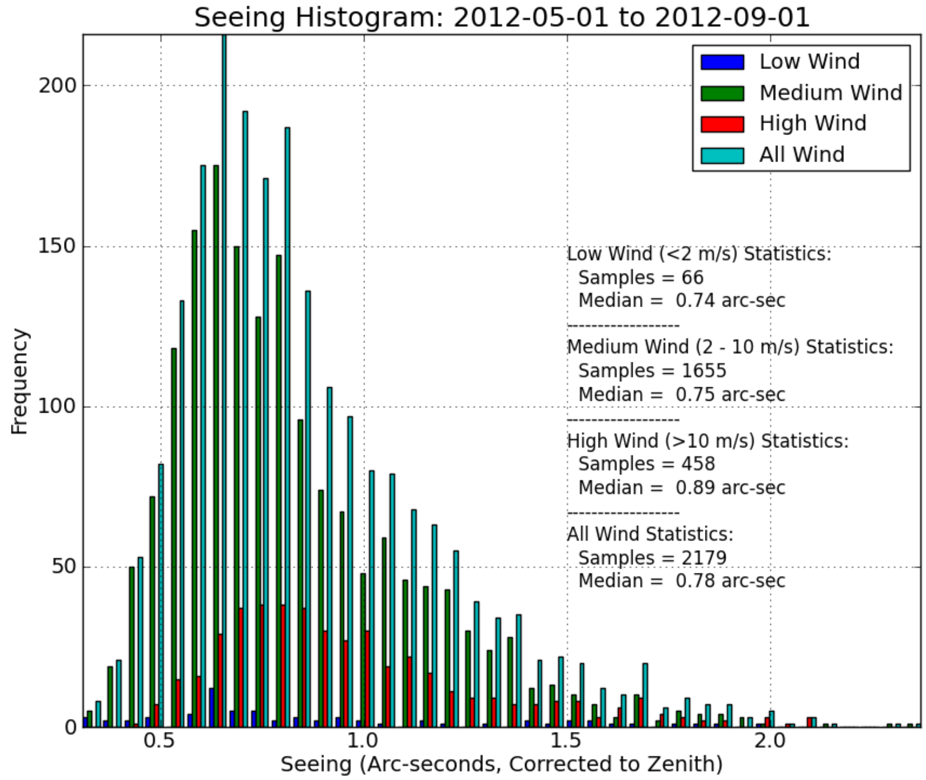

Figure 19. Histograms (with 0.1 arcsec bins) of seeing within different wind speed ranges for May through August 2012. For "low" and "medium" wind speeds, defined as <2 m/s and 2-10 m/s, respectively, the median seeing is approximately 0.75 arcsec. For high wind speeds (above 10 m/s), seeing is substantially worse with a median value of 0.89 arc-sec.

Safety

A new employee orientation safety document was created for both mountain and campus facilities. It provides a comprehensive overview of safety equipment, safety procedures, and location of first aid kits. Staff safety representatives will provide the document and a walk-through of facilities when a new staff member is hired.

Three new videos were added to the Safety Training web page:

- Eye Protection
- Lockout/Tagout
- Ladder Safety

Four MMTO staff members attended a CPR and First Aid Class on July 24 conducted by Lori Chavez of Desert Fire, Inc. Currently, 70% of the staff is certified in CPR and First Aid procedures.

General Facility

Summer shutdown was July 24 through August 20. The annual general clean-up day of the observatory by the staff was held the last day before re-opening on August 21. Following are other general facility projects completed during shutdown.

Network

The backup virtual machine (VM) host computer arrived, along with a second NAS box for the mountain (see Software section, p. 12). Both VMhost1 and VMhost2 are installed in the 3rd floor rack with the two sets of NAS boxes, and all have surge suppressors and receptacles fed directly from Q3. These new receptacles are not attached to the lightning disconnects on the wall and will remain powered up when lightning disconnection protocol is followed. MMTO software and electronics groups are in discussions on how best to determine when and how these units should be powered down in case of emergency (i.e., loss of power for longer than the MGE battery time or extreme weather) to avoid possible bad consequences from an ungraceful shutdown. As noted in the Software section of this report, smart UPS's designed to safely and automatically shut down are being considered, and shutdown details are being discussed.

Additional work on the network completed during summer shutdown included:

- Finalized documentation of the new MMT network
- Replaced cables from patch panel to switch in 3E
- New color code for patch cables was initiated to aid in identification:
    - Blue – general network
    - Red- SAO network
    - Purple – Microgate network (f/15)
    - Yellow – Trunk ports (fax server, wireless repeaters, fire alarm)
    - Black – PoE devices (phones and videoservers)

Wireless Access

A new fiber cable was run from the IOTA facility to the summit "Bowl" dorm to enable the installation of a wireless hub in the dorm's 2nd floor storage room. The fiber link will provide a more reliable and faster connection to the internet for dorm residents than the previous microwave connection, which is now old and unreliable. The new wireless access point (AP) in the storage room is temporary and only provides coverage for most of the dorm. The existing wireless link ("aerosummit") from the summit to the dorm is still in use and provides limited wireless network access to rooms at the far end of the dorm. Plans are for the Smithsonian Institution (SI) to install a new wireless AP at the center of the dorm to replace this temporary AP, as well as install more APs throughout the MMT and other summit buildings by the end of 2012.

Inventories

Mike Alegria, Xioayin Zhu, and Dennis Smith cleaned and organized the west loft Blue/Red Channel spares locker. They also began organizing and cleaning the top box cabinet and other west loft instrument spares storage lockers and shelves. Photos were taken of the optical and mechanical parts for cataloging purposes and will be added to the Documentation Database. Old items no longer used were removed and will be officially surplussed once it has been determined they are no longer needed.

Skycam

The videoserver was damaged by a lightning strike during shutdown and was replaced. The skycam interface box was modified to cycle all the power from a single front-panel switch. A broken power LED holder was replaced.

Chamber Bridge Crane

A new disconnect was installed on the 4th floor mezzanine for the new bridge crane that was installed in the chamber in April. A separate disconnect was installed for the Neslab chiller located near the unit by pulling a new wire to the west loft. Previously, the chiller and old bridge crane had shared a single disconnect located on the 2nd floor.

During shutdown, the bridge crane's upper limit was also adjusted, and a stop on the west side was installed.

Chamber Instrument Lift

A wireless remote control was installed in the instrument lift. This will enable instrument changes to be done much more easily. The old control unit's cable at times interfered with moving parts and other equipment needed during instrument changes.

Telescope Quiet Power

The installation of the new quiet power transfer switch in the first floor hallway was completed in August during shutdown. The new transfer switch has 4 poles to switch the 3 power phases and the neutral, avoiding the ground-loop issue encountered with the old transfer switch when connected to the pad-mount transformer source. The old wiring was relocated to a junction box in the wall on the drive-room side, and all the connections were neatly tied using junction blocks and flexible cable. A safety ground was installed, and a redundant circuit breaker was eliminated on the MGE source in the hallway. The transfer switch enclosure was placarded as suggested by T. Welsh (SI) to inform workers that it is fed from two sources for safety.

Air Conditioning

The air conditioners on the 1st, 2nd, and 3rd floors of the MMT building were worked on during shutdown by Cory Knop and Tom Gerl. A flow switch was added on the glycol line to prevent operation without coolant flow, and a front panel indicator was added to each unit to show status and fault conditions. Documentation was generated to show the old configuration and the new modifications.

Roof Camera

The roof camera circuit was completed. Power is supplied from 4th floor noisy power. This arrangement doesn't endanger quiet power or shutter power in the loft. A lightning rod was installed with the camera in its 45 degree cone of protection.

Building Drive

During shutdown, the building drive motors and drive electronics rack were cleaned and inspected. The motor ventilation filters were replaced.

Weather and Environmental Monitoring

A new R. M. Young Alpine wind sensor was added to the east pole, and lightning suppression boxes were also installed. It is now possible to compare wind readings on similar systems on opposite sides of the building. Unfortunately, the new sensor displayed erroneous data. Troubleshooting isolated the problem to the RS232 card. It was removed and returned to the vendor for repairs.

The Vaisala WXT-520 (aka Vaisala3) failed to display wind data. The unit has been removed again and sent to the vendor for evaluation. The Vaisala WXT-520s have had a record of frequent failures of the wind sensor. Other sources of wind data, such as R. M. Young monitors, are under evaluation as replacements for the WXT-520s.

Miscellaneous Work

During shutdown, the following additional work was completed:

- The blower power contacts were replaced.
- The MGE UPS air filters were changed.
- The conduit fittings, electrical receptacles and plugs were organized in the pit.
- A new organizer was designed for wire stored in the electronics shop loft.
- The electronics shop hardware cabinets were re-organized, and the entire shop was given a general cleanup.
- Yellow safety paint around the MMT building was touched up.
- Damaged and missing ceiling tiles were replaced, as well as burnt-out light bulbs, throughout the MMT building.

Visitors

5/2/12 – Tony Davis, Arizona Daily Star science reporter, was escorted by Dan Brocious and Emilio Falco of the F.L. Whipple Observatory to the summit of Mt. Hopkins to view the impacts of light pollution for a newspaper article.

5/11/12 – "Smithsonian Journeys", a group of 20 visitors, toured the MMTO led by G. Williams.

6/13/12 – R. Ortiz gave a tour of the MMTO to a group from Kitt Peak National Observatory.

MMTO in the Media

7/3/12 – G. Williams was interviewed by reporter Mark Duggan of *Arizona Public Media* regarding the documentary, ***City Dark***, which chronicles the loss of night sky to encroaching city lights around the world. The interview can be found at https://www.azpm.org/s/9503-dark-skies-waning.

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

(An online publication list can be found in the MMTO ADS library at http://www.mmto.org/node/244)

12-33 An Ultraviolet-Optical Flare from the Tidal Disruption of a Helium-rich Stellar Core
S. Gezari, et al.
Nature, **485**, 217

12-34 The Spectroscopic Diversity of Type Ia Supernovae
S. Blondin, et al.
AJ, **143**, 126

12-35 Identifying Star Streams in the Milky Way Halo
C. King, III, et al.
ApJ, **750**, 81

12-36 The Yellow and Red Supergiants of M33
M.R. Drout, P. Massey, and G. Meynet
ApJ, **750**, 97

12-37 Testing Weak-lensing Maps with Redshift Surveys: A Subaru Field
M.J. Kurtz, et al.
ApJ, **750**, 168

12-38 SDSS J184037.78+642312.3: The First Pulsating Extremely Low Mass White Dwarf
J.J. Hermes, et al.
ApJ, **750**, 28

12-39 Late-time Optical Emission from Core-collapse Supernovae
D. Milisavljevic, et al.
ApJ, **751**, 25

12-40 MMT Hypervelocity Star Survey. II. Five New Unbound Stars
W.R. Brown, M.J. Geller, S.J. Kenyon
ApJ, **751**, 55

12-41 Ice Mineralogy Across and Into the Surfaces of Pluto, Triton, and Eris
S.C. Tegler, et al.
ApJ, **751**, 76

12-42 AGES: The AGN and Galaxy Evolution Survey
C.S. Kochanek, et al.
ApJ Supp, **200**, 8

12-43 An Oxygen Abundance Gradient Into the Outer Disc of M81
M.T. Patterson, et al.
MNRAS, **422**, 401

12-44 The First High-redshift Quasar from Pan-STARRS
E. Morganson, et al.
AJ, **143**, 142

12-45 The ELM Survey. IV. 24 White Dwarf Merger Systems
M. Kilic, et al.
ApJ, **751**, 141

12-46 The Low-mass Stellar Population in L1641: Evidence for Environmental Dependence of the Stellar Initial Mass Function
W-H Hsu, et al.
ApJ, **752**, 59

12-47 The Chandra Multi-Wavelength Project: Optical Spectroscopy and the Broadband Spectral Energy Distributions of X-Ray-selected AGNs
M. Trichas, et al.
ApJ Supp, **200**, 17

12-48 First Light LBT AO Images of HR 8799 bcde at 1.6 and 3.3 μm: New Discrepancies between Young Planets and Old Brown Dwarfs
A.J. Skemer, et al.
ApJ, **753**, 14

12-49 A Population of Dust-rich Quasars at z ~ 1.5
Y. Sophia Dai, et al.
ApJ, **753**, 33

12-50 Kiloparsec-scale Spatial Offsets in Double-peaked Narrow-line Active Galactic Nuclei. I. Markers for Selection of Compelling Dual Active Galactic Nucleus Candidates
J.M. Comerford, et al.
ApJ, **753**, 42

12-51 The Type II Supernova Rate in z ~ 0.1 Galaxy Clusters from the Multi-Epoch Nearby Cluster Survey
M.L. Graham, et al.
ApJ, **753**, 68

12-52 The Metallicity of the Monoceros Stream
A.M. Meisner, et al.
ApJ, **753**, 116

12-53 A Resonant Feature Near the Perseus Arm Revealed by Red Clump Stars
C. Liu, et al.
ApJ Lett, **753**, 24

12-54 Evidence for Inhomogeneous Reionization in the Local Universe from Metal-poor Globular Cluster Systems
L.R. Spitler, et al.
MNRAS, **423**, 2177

12-55 Adaptive Optics Images of Kepler Objects of Interest
E.R. Adams, et al.
AJ, **144**, 42

12-56 Dynamical Measurements of the Young Upper Scorpius Triple NTTS 155808-2219
G.N. Mace et al.
AJ, 144, 55

12-57 LoCuSS: A Dynamical Analysis of X-Ray Active Galactic Nuclei in Local Clusters
C.P. Haines, et al.
ApJ, **754**, 97

12-58 Direct Oxygen Abundances for Low-luminosity LVL Galaxies
D.A. Berg, et al.
ApJ, **754**, 98

12-59 Masses, Radii, and Cloud Properties of the HR 8799 Planets
M.S. Marley, et al.
ApJ, **754**, 135

12-60 Measuring Microlensing Using Spectra of Multiply Lensed Quasars
V. Motta, et al.
ApJ, **755**, 82

12-61 A Uniformly Selected Sample of Low-mass Black Holes in Seyfert 1 Galaxies
X.-B. Dong, et al.
ApJ, **755**, 167

12-62 High-velocity Outflows without AGN Feedback: Eddington-limited Star Formation in Compact Massive Galaxies
A.M. Diamond-Stanic, et al.
ApJ Lett, **755**, 26

12-63 Ultraluminous Supernovae as a New Probe of the Interstellar Medium in Distant Galaxies
E. Berger, et al.
ApJ Lett, **755**, 29

12-64 The Chandra COSMOS Survey. III. Optical and Infrared Identification of X-ray Point Sources
F. Civano, et al.
ApJ Supp, **201**, 30

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 at the end of this report are taken from that database.

Use of MMT Scientific Observing Time

May 2012

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	11.00	89.40	19.75	1.00	0.75	0.00	0.00	21.50
PI Instr	18.00	149.50	8.60	0.00	0.83	0.33	0.00	9.76
Engr	2.00	17.20	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**	**28.35**	**1.00**	**1.58**	**0.33**	**0.00**	**31.26**

Time Summary	
Percentage of time scheduled for observing	93.3
Percentage of time scheduled for engineering	6.7
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	11.1
Percentage of time lost to instrument	0.4
Percentage of time lost to telescope	0.6
Percentage of time lost to general facility	0.1
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	12.2

* Breakdown of hours lost to instrument
1.00 Grating cover did not close (red)

** Breakdown of hours lost to telescope
0.75 M1 panic, troubleshooting hexapod limits
0.83 Mount oscillation, M1 panic

*** Breakdown of hours lost to facility
0.33 Network glitch, lost "heartbeat"

June 2012

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	9.00	69.30	40.80	0.00	0.00	0.00	0.00	40.80
PI Instr	21.00	163.20	5.50	0.00	0.00	0.25	3.00	8.75
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	**30.00**	**232.50**	**46.30**	**0.00**	**0.00**	**0.25**	**3.00**	**49.55**

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	19.9
Percentage of time lost to instrument	0.0
Percentage of time lost to telescope	0.0
Percentage of time lost to general facility	0.1
Percentage of time lost to environment (non-weather)	1.3
Percentage of time lost	21.3

*** Breakdown of hours lost to facility
0.25 Network connectivity failure with "mount" computer

**** Breakdown of hours lost to environment
3.0 Smoke & haze from N. Mexico fire

Year to Date June 2012

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	72.00	698.90	142.75	4.75	0.75	0.00	0.00	148.25
PI Instr	100.00	970.80	209.50	32.30	36.48	3.68	3.00	284.96
Engr	10.00	101.90	3.00	0.00	0.00	0.00	0.00	3.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**182.00**	**1771.60**	**355.25**	**37.05**	**37.23**	**3.68**	**3.00**	**436.21**

Time Summary	
Percentage of time scheduled for observing	94.2
Percentage of time scheduled for engineering	5.8
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	20.1
Percentage of time lost to instrument	2.1
Percentage of time lost to telescope	2.1
Percentage of time lost to general facility	0.2
Percentage of time lost to environment (non-weather)	0.2
Percentage of time lost	24.6

July 2012

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	16.00	127.30	82.90	0.00	0.00	0.00	0.00	82.90
PI Instr	6.00	47.10	38.80	0.00	0.00	0.00	0.00	38.80
Engr	2.00	15.80	11.10	0.00	0.00	0.00	0.00	11.10
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**24.00**	**190.20**	**132.80**	**0.00**	**0.00**	**0.00**	**0.00**	**132.80**

Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	91.7
Percentage of time scheduled for engineering	8.3
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	69.8
Percentage of time lost to instrument	0.0
Percentage of time lost to telescope	0.0
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	69.8

August 2012

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	5.00	45.50	21.10	0.00	0.00	0.00	0.00	21.10
PI Instr	4.00	37.20	11.25	0.00	0.25	0.00	0.00	11.50
Engr	1.00	9.00	9.00	0.00	0.00	0.00	0.00	9.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**10.00**	**91.70**	**41.35**	**0.00**	**0.25**	**0.00**	**0.00**	**41.60**

Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	90.2
Percentage of time scheduled for engineering	9.8
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	45.1
Percentage of time lost to instrument	0.0
Percentage of time lost to telescope	0.3
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	45.4

** Breakdown of hours lost to telescope
0.25 Oscillations

Year to Date August 2012

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	93.00	871.70	246.75	4.75	0.75	0.00	0.00	252.25
PI Instr	110.00	1055.10	259.55	32.30	36.73	3.68	3.00	335.26
Engr	13.00	126.70	23.10	0.00	0.00	0.00	0.00	23.10
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**216.00**	**2053.50**	**529.40**	**37.05**	**37.48**	**3.68**	**3.00**	**610.61**

Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	93.8
Percentage of time scheduled for engineering	6.2
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	25.8
Percentage of time lost to instrument	1.8
Percentage of time lost to telescope	1.8
Percentage of time lost to general facility	0.2
Percentage of time lost to environment (non-weather)	0.1
Percentage of time lost	29.7