MMT Observatory
Smithsonian Institution &
The University of Arizona®

End of Quarter Summary

April - June 2013

Personnel

Tyler Barbaree was hired as an Electronic Technician, Sr., and started on May 13.

Interviews were held for a Senior Mechanical Engineer position. An offer was made and accepted by Will Goble, who will start in November.

Telephone interviews were held in June for an Operations Manager/Chief Engineer position. Site visits will follow in the next quarter.

Kevin Comisso was hired May 28 as a temporary Office Assistant to inventory and organize all mechanical drawings for both the original and converted telescopes.

Talks and Conferences

J. Hinz gave a talk entitled "The Edges of Island Universes: Understanding the Evolutionary History of Galaxies in Our Neighborhood" to the Quail Creek Science Club in Green Valley, AZ on May 6.

J. Hinz presented "Updates and New Capabilities at the MMT" to the Steward/NOAO Galaxy Group Seminar on May 20.

R. Cool and J. Hinz visited Harvard-Smithsonian Center for Astrophysics (CfA) on June 10-12. They met with the CfA director, the telescope allocation committee chair, and many frequent users of the MMT to discuss the efficiency and productivity of the Observatory. They were given a tour of the Cambridge lab to see the progress being made on Binospec, a new instrument for the MMT. They met with D. Fabricant, N. Caldwell, B. McLeod, and the CfA software group to discuss changes and upcoming plans for the MMT's f/5 instruments, data acquisition, and data reduction packages.

Primary Mirror Systems

Actuator Test Stand

Parts were designed and fabricated to support testing dual actuators on the test stand. At this time, the test stand is ready to calibrate each of the five possible types of actuators that are present in the primary mirror cell.

Thermal System

The final two T-series thermocouple readout boxes were completed, and a full set of Rabbit Semiconductor RCM3305 units were programmed with firmware for deployment, along with a spare.

Aluminization

G. Williams, MMTO Director, announced on April 23 that realuminization of the primary mirror would be postponed until summer shutdown in 2014. Work still continued, however, on preparations for realuminization.

Work continued on optimizing the Simulink model for prediction of the welder and filament loads. Significant improvement and simplification of the system models were made. During the course of this work, we investigated the possibility of using an auto-generated control algorithm with the data acquisition unit (DAU) serial controls used at the Sunnyside vacuum facility. It was deemed impractical, however, due to the need for a serial-conversion code interface that would be too time consuming to produce. Instead, we will attempt to use the auto-generated algorithm on the actual aluminization PC along with a much simpler code interface to the proposed Redis relay data server.

The data acquisition (DAC) circuit prototyped and successfully programmed by D. Porter will be turned into a printed circuit board for integration into the aluminization PC's data acquisition chassis.

Mirror Cover

The mirror cover crank was modified to operate at double the speed to reduce the amount of time and effort needed to raise and lower the cover.

Secondary Mirror Systems

f/9-f/15 Hexapod

On April 8, we discovered a broken wire at a solder joint junction inside the transducer cable connector of the f/9 hexapod. The wire was the +15V to the transducer circuits. The wire was re-soldered which resulted in a reduced noise level. Electronic noise on the f/9 transducer signals had been an issue, and was being tracked. After many tests following this repair, it was concluded that the UMAC (a modular rack format system) noise can be reduced but not eliminated. Work on this issue will continue as an ongoing project.

f/15 Secondary

The chassis drawings for the new f/15 power supply were completed and handed over to B. Comisso for final integration into the supply units. The printed circuits needed for interconnecting the power supply modules and the necessary parts for handling the remote sense, set point adjustment, and supply output monitoring were completed and sent out for manufacturing.

Telescope Tracking and Pointing

Servos

We continue to investigate the intermittent elevation tracking oscillations. We have evidence that stick-slip on the axis results in several servo samples with zero change on the encoder feedback. The resulting feedback, when fed through the velocity loop differentiator, results in a sinusoidal velocity feedback signal. We think this may be the source of this problem. Friction-induced servo hunting and instability are well known in the literature, and we are presently evaluating a solution for this issue.

Brian Cuerden of Steward Observatory continues to assist MMTO with analysis and design support on a proposed replacement absolute encoder. We have determined that the standard Heidenhain offering has too much shaft starting torque to perform well with the existing encoder torque tube(s). In response to our concerns, Heidenhain has quoted a special-order unit with much lower starting and running torque that appears to be acceptable. A design with the additional bearing support needed to meet the stringent mounting and alignment tolerances required is currently being looked at by Cuerden.

Telescope Drives

We experienced another set of elevation drive amplifier failures: the slave unit for the west motor, which had been sent out for repair and returned to service; and the master unit for the east motor. The slave unit was returned to the original repair vendor for repair under warranty, and an alternate vendor was found that will provide a free estimate for the repair of the master. We have raised the priority of finding a viable replacement amplifier accordingly, due to the high risk of interrupting operations if another failure occurs while we have no remaining spares on hand. We are working to understand why these failures have occurred.

The azimuth drives experienced an oscillation that was traced to a gear anti-backlash bias switch. We also determined that some of the circuit breakers in use on the amplifiers were becoming unreliable. New circuit breakers were installed in all units, and we expect to rewire the bias switches during summer shutdown due to the intrusiveness of the procedure. We also have on hand a set of cables for pressing an azimuth amplifier into service as an elevation drive amplifier if the need arises. To do this, the internal circuit would need to be modified to run the amplifier in voltage-source mode. We will do this modification to the two spare amplifiers during summer shutdown as well.

Mount Alignment Telescope

The mount alignment telescope (MAT) was co-aligned to the optical axis of the telescope on May 18. This will allow the use of the MAT in the near future for detecting mount/hexapod issues. It should also improve the system to help with zeroth order pointing models of the telescope.

Computers and Software

Work was finalized on the new observer computer, "pixel," and it was deployed for general use by observers with Red Channel and Blue Channel. We also contacted the PIs for MMTPOL, ARIES, SPOL, and MAESTRO to inform them of the impending retirement of "alewife," and to plan for tests of the new machine with their instruments during future observing runs. Tests with MAESTRO and SPOL were very successful and these two instruments are now ready for permanent use with "pixel." After MMTPOL and ARIES have been tested during observing runs, we plan to retire "alewife." Red and Blue Channel observers have reported very favorable experiences with the new machine.

With the deployment of "pixel," we also implemented a more rigorous data archiving system for data taken with the instruments controlled by this machine. Previously, at the end of an observing run, the *mmtobs* account would be reset on "alewife," and a copy of all the files in the "alewife" home directory would be copied to an archive directory. However, if an image in the archive and a new image shared the same name, even if taken on different days, the new file would overwrite the older file. In addition, each observer has their own system for directory naming (or lack of directory use). As a result, this archive was particularly hard to navigate. Its original purpose was intended as a short-term backup solution for observers, not as a long-term data housing solution.

Recently, many tests of the 'wellness' of the Red and Blue Channel system have been done using the archival data on "alewife." Metrics such as the relative emission line strength of the arc lamps, counts per second of the continuum lines, and years of standard star spectroscopy have enabled us to test various aspects of the system while also minimizing the amount of new observations needed during maintenance and engineering (M&E) time. In order to continue to provide a backup in the event of catastrophic data loss and to better facilitate future monitoring, we created a system on "pixel" that ensures that each image taken is recorded in an archive directory with a time-stamped name. This ensures that files with duplicate names are not immediately deleted from the archive, and also allows us to create a directory structure that makes quick data recovery possible. Each morning the "pixel" archive is synced to two machines at the campus office as a secondary backup.

Computer/Software/Network Administration

The following is a list of individual tasks accomplished for computer and network administration:

- The upgrade from Fedora 17 to 18 was finished for the mountain Linux computers, including the main server at the summit, "hacksaw." Issues related to the local MMTO Fedora repository were addressed, and the repository was brought up-to-date.
- Custom X11-display settings were defined for mirroring on the dual monitors for "chisel," the main telescope operator computer. The high resolution of the two monitors requires these non-standard settings.
- IDL licenses for the MMTO were renewed during the reporting period. The existing single-user license was cancelled, and several node-locked licenses were purchased. The existing floating licenses on *mmto.org* were renewed. This provides reliable IDL license support for critical computers, and also makes IDL available on an as-needed basis for MMTO staff.
- Work on an upgraded layout for the new control room continued, with assistance from the software group. This work included discussion of additional telescope status (telstat)

displays, locations of these displays, modifications to the room layout, and different options for new furniture. The software group assisted in the evaluation of various video-conferencing options, including Polycom devices, for both the summit and campus MMTO facilities.

- More debugging of the wireless access point near the elevator on the 4th floor of the MMT building continued with the electronics group, along with Jun Wu of the Smithsonian Institution in Cambridge, MA. The access point is still not working.
- The University of Arizona Information Technology annual security review for the MMTO was completed and submitted by software and administrative staff.
- A new computer was purchased and configured for T. Barbaree, a new electronics staff member at the summit. This computer was added to the MMT Windows Active Directory, managed by the software group.
- A new computer was purchased and configured with Windows 7 for C. Chang, mountain staff engineer.
- Maintenance was done on the mount computer, including replacing its onboard CMOS battery.

Applications/Systems Programming Tasks

Work continued on the aluminization task as described in the previous quarterly report. More work was done on the welder setpoint "play-back" and Redis-relay scripts described in that quarterly report. Data from previous MMT and LOTIS aluminizations has been included for the welder setpoint play-back scripts.

Recently, S. Schaller worked extensively on various approaches to archiving Blue/Red spectrograph data. A main objective of this work was to systematically save data from Blue/Red Channel observations for future potential use. He found two major efforts were required for this work: 1) modifying the "post-processing command" of the CCD acquisition (ccdacq) software to both display the data via ds9 and to copy the data into a specified file location, and 2) making the archived data available to the appropriate audience, whether that is limited to researchers at the MMTO or to the public in general. Much of this latter role depends on a policy decision for MMTO data, and whether offline backups are sufficient for our needs or if on-line access is required. Modifications to the post-processing command for ccdacq were implemented by R. Cool and S. Schaller. A separate copy of the Blue/Red Channel data is now being archived as data are being acquired. S. Schaller outlined several approaches for making the archival data available, including systems currently used by the Virtual Observatory (VO) community. Of these systems, he chose Saada (http://amwdb.u-strasbg.fr/saada), an astronomical database generation tool that is being developed at the University of Strasbourg, France, as the preferred approach. Little to no programming would be involved if this system was adopted by the MMTO.

The NW and SW quadrant T-series primary mirror thermocouples were brought online. The circuits for these thermocouples were debugged by B. Comisso and others. Two new miniservers were created to read and log temperature values from these sensors.

The "Rotator Time-to-Limit" parameter was added to the telstat displays. This value is published by the mount crate and uses the same algorithms to determine the projected time to limit as is used in pointing calculations within the mount code. Other changes to the telstat displays included modification of labels for catalog right ascension, declination, and epoch values. These modifications make the meaning of the displayed parameters more obvious to users.

The touchscreen features of the new Dell all-in-one computers have been deactivated by S. Schaller upon the request of the telescope operators. These features were found to be an inconvenience and to cause accidental software commands to be issued.

Quality Control/Performance Assessment Tasks

An extensive assessment of the mount/interlock "heartbeat" issue was conducted. Briefly, the mount and interlock software communicate with each other via a small User Datagram Protocol (UDP) network packet at 10Hz. When this communication or "heartbeat" fails repeatedly, the mount shuts down for safety reasons. The heartbeat issue began with the introduction of the new Cisco network switches at the summit during the previous summer/fall. When the mount and interlock crates are communicating through ports on the new Cisco switches, the heartbeat will fail after a few hours to days. This failure is not seen when an older, non-Cisco switch is included in the network path. Much testing was done to try to determine why the UDP packets were not reliably being transmitted between the mount and interlock computers through the Cisco switches.

A simulator of the UDP heartbeat was written by T. Trebisky, using the same C libraries that are used in the interlock and mount computer code. The simulation sent the same UDP packets (that are sent between the mount and interlock crates) between two other Linux computers at 10Hz. Tests by this simulator showed consistent network communication, and did not provide significant insight into the heartbeat issue.

D. Gibson also ran TCP echo client/server tests to assess the overall reliability of the new network. These tests focused on the time required for echoing a string between two computers across our network. It was found that the limiting factor in a successful echo response was the name resolution of the echo server. This name resolution uses the UDP protocol, which is not as reliable as the widely used TCP network protocol. In a small fraction of a percent of cases, name resolution was either delayed by several seconds (typically, 5 seconds) or failed by timing out. Once a connection was made, however, the message string was consistently echoed back from the server. Other constraints have required that DHCP caching be disabled on the MMTO servers. This requires that name resolution occur on each network connection rather than to use a cached value for the name resolution.

Another quality control issue that was addressed during this reporting period was the occasional annunciator warnings of stale data from the primary mirror cell miniservers, specifically the miniservers gathering actuator and e-series data. After much investigation, it was found that data were being pushed to the annunciator late by an entire sample cycle. With small additional delays, the staleness criteria for these miniservers were being exceeded. Software in all of the miniservers was modified to push data to the annunciator as soon as it was obtained from hardware. The staleness warnings for the cell miniservers are no longer present.

Documentation Tasks

The following documentation tasks were completed during this reporting period:

- T. Gerl produced a detailed, 10-page description of the current MMTO network configuration, complete with photos of the various hardware devices. This document is on the Documentation Database Google drive.
- A "Software Checklist for Control Room Computers" document was created and placed on the Documentation Database Google drive.

Summary of Service Request (SR) Activity

The MMT Service Request (SR) system is an online tool to track ongoing issues that arise primarily during telescope operations, although the system can be used throughout the day and night by the entire staff. Once an SR has been created, one or more responses are created by staff members to address and, eventually, to close the SR. These SRs and associated responses are logged into a relational database for later reference.

Figure 1 presents the distribution of responses by priority during the period of April through June, 2013. As seen in the figure, the highest percent of responses, 60%, are the "Important" priority. Eight percent are "Low" priority, while 28% are "Critical" priority. The remaining responses are "Information Only" at 4% and "Near-Critical" at 0% this period. "Critical" SRs address issues that are preventing telescope operation while "Near-Critical" SRs relate to concerns that pose an imminent threat to continued telescope operations. There were a total of 53 responses during this three-month period.

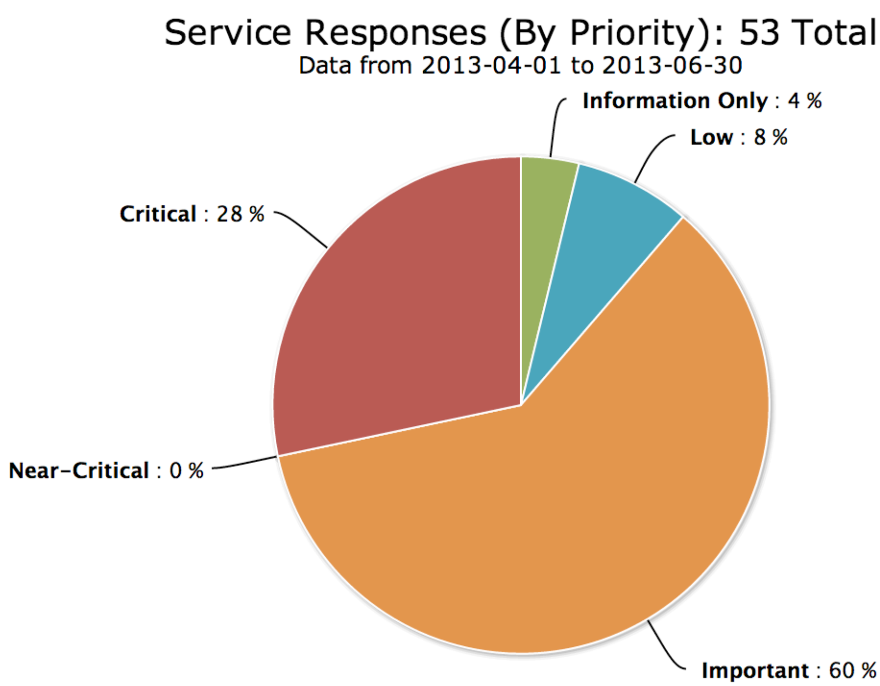

Figure 1. Service Request responses by Priority, April through June, 2013. The majority (60%) of the responses are related to SRs of the "Important" priority, while "Low" and "Critical" priority responses are 8% and 28% respectively, of all responses.

Figure 2 presents the same 53 responses grouped by category. These categories are further divided into subcategories for more detailed tracking of issues. The majority of the responses from April through June were related to the "Computers/Network" category.

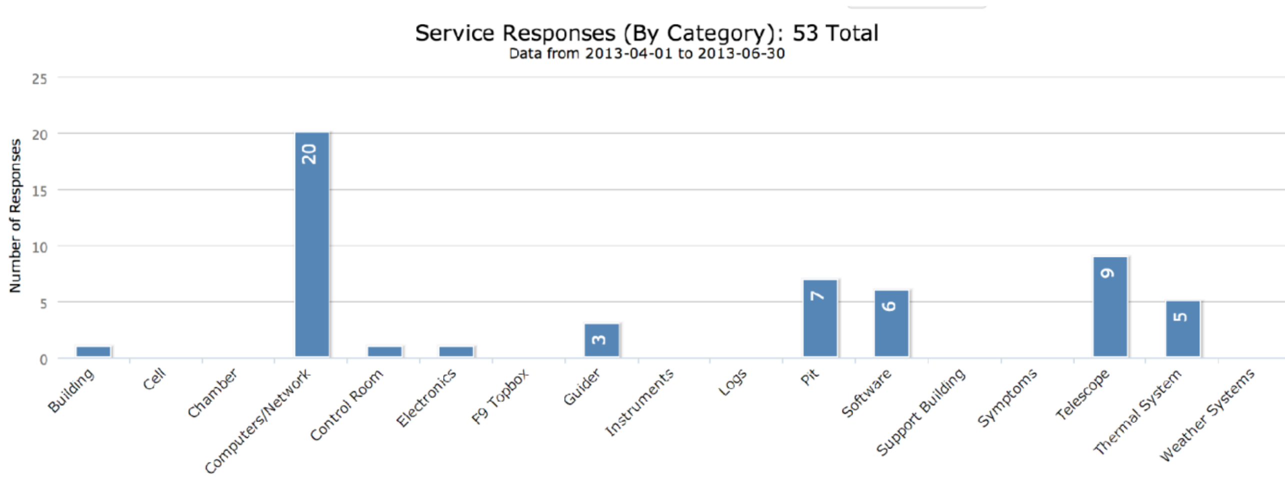

Figure 2. Service Request responses by category, April through June, 2013. The majority of responses were within the "Computers/Network" category.

Instruments

f/15 Instrumentation

Natural Guide Star (NGS)

There was one adaptive optics (AO) run during this quarter. The run was scheduled for May 20-23 and consisted of one M&E night and three science nights. Continuing issues with the power supply and WFS camera syncing resulted in lost observing time of approximately 2.5 hours during the four nights, with the majority of time lost due to the power supply. One full night was lost to failure of the Carrier air conditioning, which resulted in the inability to cool the instruments.

Just prior to the May observing run, the usual ARIES detector was removed and replaced with a 2k x 2k HAWAII detector in its Steward Observatory lab. This detector, while larger, covers the same wavelength range, 1-2.5 microns, as before. Testing of the detector proceeded well. However, there was not enough time to fully characterize the new detector before the May run, and continuity was desired for one of the observers engaged in using the echelle mode. Therefore, the usual detector was reinstalled in ARIES before the observing run.

ARIES was mounted May 20, coinciding with the first night of the f/15 engineering run. Science observations were scheduled for May 21-23, with two nights for Steward Observatory observers and one for observers from Arizona State University (ASU). Approximately half of the engineering night was lost due to high winds. Closed loop data on four objects were obtained with ARIES on increasingly faint stars for later analysis of AO performance in the second half of the night.

Several tasks were accomplished on the M&E night including general checkout of the f/15 operation on-sky, f/15 hexapod pointing, and ARIES alignment. In addition, work was done, with limited success, on the WFS camera sync issues, and data were gathered to improve the loop performance for faint targets. At the conclusion of the engineering night, increased noise was seen in the ARIES images. This was rectified by sunset of the first science night, with a rebuilt cable and spare replacement preamplifier.

On the first science night, a power outage at the ridge and summit lasted for approximately 40 minutes; however, the Carrier unit did not power up properly afterwards and was not able to be fixed. The entire first night of the science run was lost due to the failure of the building Carrier air conditioning, which prevented the secondary from being cooled. The deformable mirror (DM) electronics temperature rose to approximately 40 degrees Celsius for several hours, but no apparent damage was done. During this time, however, the observers took the opportunity to carry out long dark exposures to characterize a known dark current effect in the ARIES detector and to obtain four sets of flexure test exposures using the ARIES calibration lamps.

Six hours were lost the second night due to high winds preventing the dome from opening. Once open, the AO system performed well, and data were obtained on at least one standard star and one science object. However, issues with the WFS camera sync were still apparent, resulting in some lost time.

The third and final night of observing was the most successful, with both imaging and spectroscopic data obtained for many science targets for the group from ASU. The AO system performed well on this night with the exception of a power supply failure resulting from low VCCL voltage. Adjusting the VCCL voltage higher ultimately fixed the problem, but cost 1.5 hours of lost observing time. WFS camera sync issues were also seen but were quickly reset, and time lost was minimal (approximately 0.5 hour total). About six hours were lost due to high winds.

f/9 Instrumentation

The f/9 instruments were on the MMT for 43% of the available nights from April 1 - June 30. Approximately 64% of the nights were scheduled with the Blue Channel spectrograph, 23% with Red Channel, and 13% with SPOL. Of the total 328 hours allocated for f/9 observations, only 38.9 hours (12%) were lost due to bad weather. Instrument, facility, and telescope problems accounted for only a small fraction (2%) of lost time, with the majority of the lost time due to difficulties with the Blue Echellette mode. Blue Channel lost 17% of its time to bad weather, with Red Channel losing 2%, and SPOL losing 5%.

Blue Channel and Red Channel Spectrographs

Work continued with measuring the throughput of each grating with each of the f/9 spectrographs during M&E time. These throughput curves feed the backend of a signal-to-noise calculator, which will be in beta relatively soon.

We also obtained measurements of the brightness of blank sky patches in preparation for development of the Rosemont Copper Mine. We measured the sky spectrum at 4 azimuths with the 300 gpm grating and Blue Channel, as well as multiple elevations both in the direction and in the anti-direction of the mine's proposed location. Unfortunately, these measurements were taken on a night with a relatively large moon (although they were taken after moonset). Initial reductions suggest lunar contamination, which makes analysis difficult. We hope to obtain dark M&E time in the future to ensure that we can get a baseline measurement of sky brightness before Rosemont begins operations.

Red Channel Spectrograph

A new, rapid prototyped grating cell has been created for the 9000/1200 lpm grating. This new cell was created in a single part and was an improvement over the original two part design. It was also manufactured out of a new carbon reinforced matrix, increasing its strength by 30%. Threadserts were added into the final product to increase durability, since thread degradation was an issue with the first design.

Figure 3. New grating cell with backplate and positioning springs attached.

New grating door blocks for adjacent grating cells were designed and fabricated to eliminate contact with the angled 9000/1200 lpm and 7700/1200 lpm cells. These blocks were successfully tested and approved on June 4. Additional blocks are being fabricated and should be completed by late September.

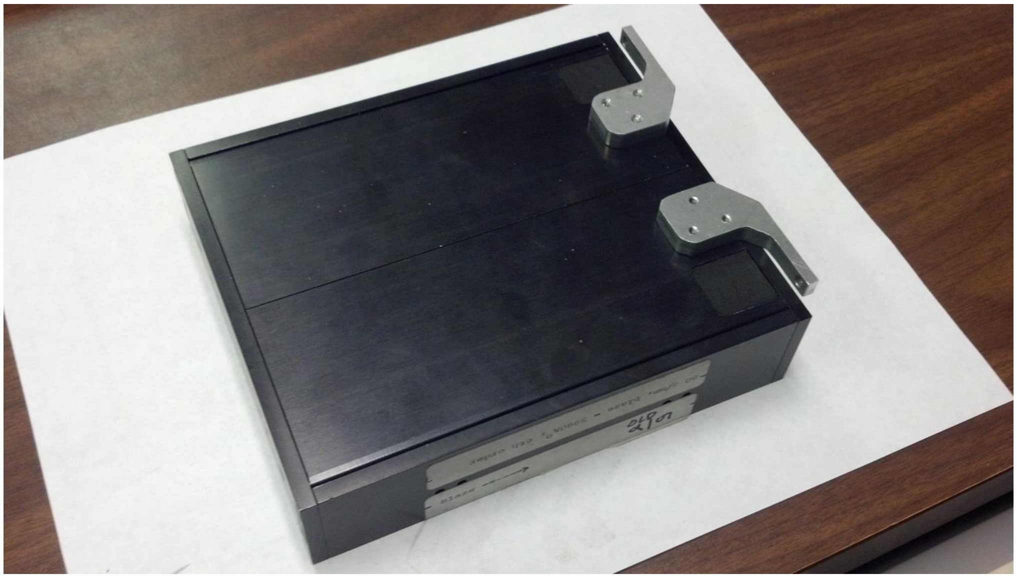

Figure 4. Old grating cell with new door blocks installed.

Remote observing

The MMTO supported a total of 6 nights of remote observing. Three nights of observing were with the Blue Channel spectrograph. One night of engineering for the f/9 secondary was run remotely. The remaining two nights were Director's time with the Blue Channel spectrograph used by R. Cool, Assistant Staff Scientist, for observing and engineering. Observers have begun to test the new observing computer, "pixel," for remote observing, with success. "Pixel" will soon replace "alewife."

f/5 Instrumentation

Hectospec

The f/5 operations for this quarter were relatively successful. Of the scheduled 44 nights, 82% were spent observing on the sky. Hectochelle and Hectospec gathered 584 exposures on 168 fields over the interval. SWIRC obtained almost 3000 science exposures along with a couple of hundred darks and flats. MMTCam took 162 science exposures along with about three times that many biases, darks, and flats plus additional engineering exposures.

In mid-April, a replacement VME memory backup card for the positioner was installed and the software was reconfigured. During much of this quarter, the P2 axis gimbal actuator in the positioner was not homing reliably. We monitored it closely and adjusted offsets as needed. One night in June, the Pulizzi power circuit controller for the f/5 bench electronics turned power off for unknown reasons. After restarting the equipment, all connections were checked and confirmed to be fine. The unit has behaved properly since that incident. The wavefront sensor had an unexpected reboot near the end of the quarter. The telescope operator attempted to do some moves, but the mechanisms did not respond to commands. M. Lacasse checked into the situation the next morning and discovered the reboot, which had disabled operations. He performed the full startup procedure, and everything worked properly afterwards. There were some instrument issues this quarter that resulted in the loss of a couple of hours of observing time.

The telescope elevation drive had issues on multiple occasions during f/5 observations this quarter. Oscillations appeared on three nights, resulting in two hours of lost time, and the elevation drive failed at the start of the quarter and again at the end of the quarter. The elevation amplifiers were quickly replaced by the MMTO staff, but approximately four hours of observing time were lost.

Wavefront Sensor

As part of the May MAESTRO commissioning run, we continued work on utilizing the f/5 wavefront sensor (WFS) as an off-axis guide camera for MAESTRO. Previously, commanding the WFS stage to move to a possible guide star worked about 50% of the time, but for the remaining 50% the star would not appear on the relatively small field of view (FoV) of the WFS camera. During M&E work in April, we discovered the cause of this issue, allowing us to find a star on the WFS field of view 100% of the time.

The next phase of the process was to implement a system that allowed us to move the WFS to a position such that the guide star would be on the FoV of the WFS while the target was centered in the MAESTRO slit. If the MAESTRO slits were on-axis, this would be an unneeded step, but the slits are far enough off-axis that simply moving the WFS in the position with the target on-axis would result in the guide star moving off the field of view of the WFS when we offset the target to the slit. If we instead first offset the target to the slit and then searched for guide stars (to remove the telescope offset from the process), the rotation needed to move the WFS to the needed position angle to reach the guide star resulted in the target leaving the slit. This required a telescope offset to correct it (which often also removed the guide star from the WFS FoV).

Ultimately, we opted to "teach" the software about the geometry of the system. Rather than calculate the position the WFS stage needs to go, assuming the coordinates are going to be observed on-axis, we calculate the corrections to this default position such that a target on-axis would be observable at the approximate location of the slit and have the WFS star be observable. A technical memo is in preparation describing the details of these transformations, as well as documenting the current values for each of the parameters involved.

Once this new system was deployed during the MAESTRO run, we had nearly 100% success in acquiring a guide star quickly when slewing to a MAESTRO target and then guiding on the WFS star.

Seeing

Figures 5 and 6 present apparent seeing values for the period of April 1 to June 30. These values are derived from measurements made by the f/5 and f/9 wavefront sensors (WFSs).

Figure 5 shows the time-series seeing data for April through June, 2013. 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. Overall seeing values for the two WFS systems are similar during this reporting period.

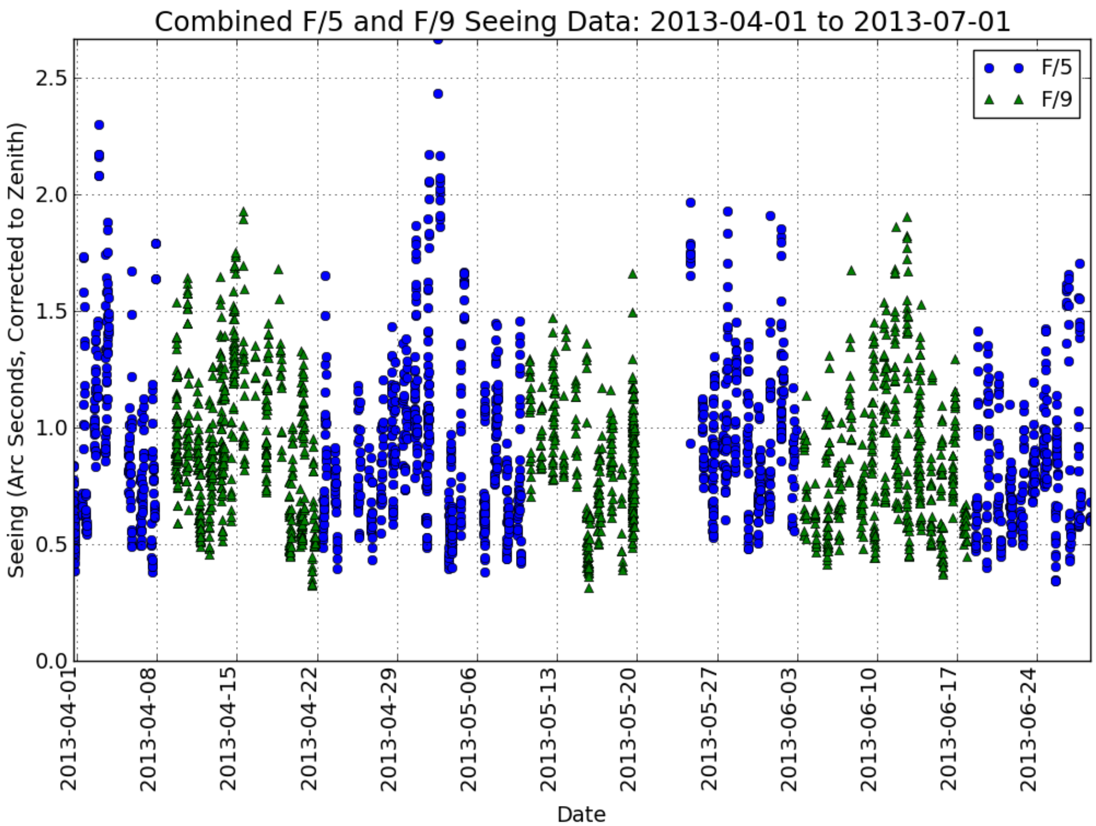

Figure 5. Derived seeing for the f/5 and f/9 WFS from April through June, 2013. Seeing values are corrected to zenith. F/5 seeing values are shown in blue, while f/9 values are shown in green. An overall median seeing of 0.85 arcsec is found for the 2,965 WFS measurements made during this period. This compares with an overall median seeing of 0.71 arcsec for the January through March, 2013 reporting period (see previous quarterly report).

Figure 6 shows the distribution of f/5, f/9, and combined f/5+f/9 seeing values for the April through June, 2013 reporting period. Median f/9 seeing was similar to median f/5 seeing (0.84 arcsec for f/9, versus 0.85 arcsec for f/5). The overall combined median seeing for the two WFS systems is 0.85 arcsec. A similar number of total seeing measurements were made for the two WFS systems during this reporting period (1,486 arcsec for f/5 versus 1,479 arcsec for f/9). Worse seeing occurred during the f/9 observations during this period compared to the previous reporting period. The median f/9 seeing for January through March, 2013, was 0.68 arcsec compared to the 0.84 arcsec found during this reporting period. The median f/5 seeing values are similar for the two reporting periods.

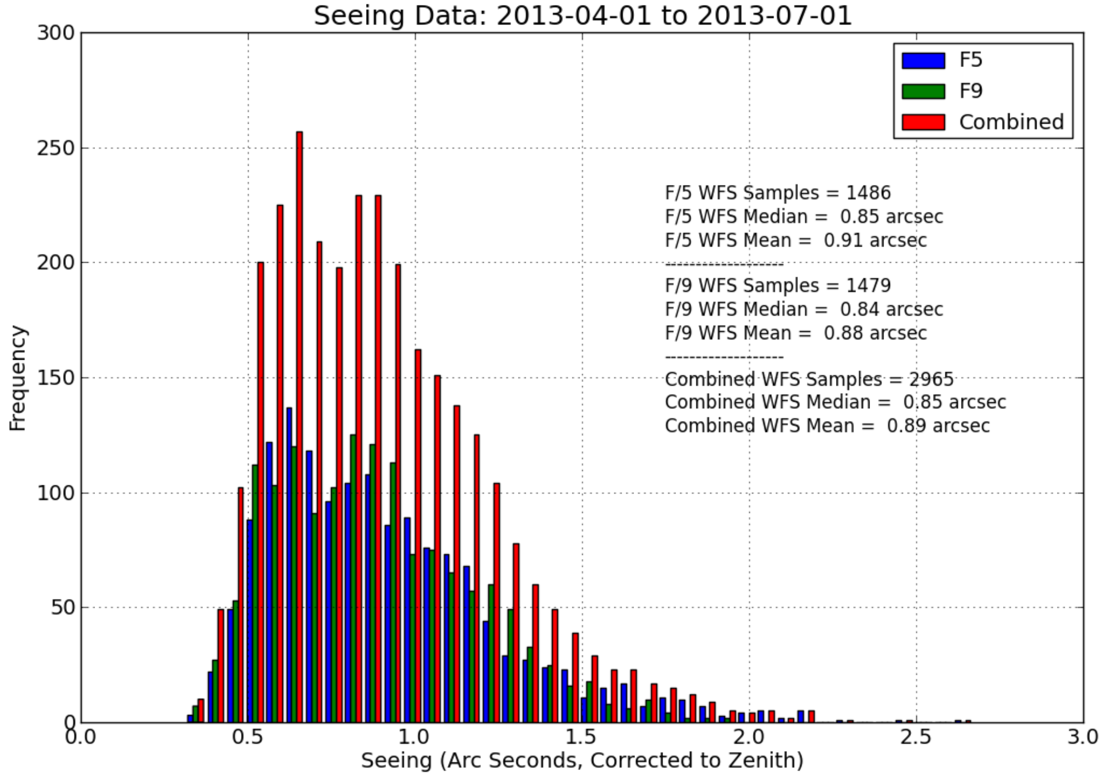

Figure 6. Histogram (with 0.1 arcsec bins) of derived seeing values for the f/5 and f/9 WFSs from April through June, 2013. Seeing values are corrected to zenith. Median f/5 seeing is 0.85 arcsec while the median f/9 seeing is 0.84 arcsec. A combined (f/5+f/9) median seeing value of 0.85 arcsec is found for the 2,965 WFS measurements made during this period.

Safety

The winch mechanism for the drawbridge in the 3rd floor west lab was replaced with a safer unit that does not allow for free movement of the cable. The new winch has an integrated brake that keeps the drawbridge in place unless the winch is used.

Visitors

4/2/13 – MMTO Director, Grant Williams, gave a tour of the Observatory to Richard and Barbara Blake and some of their family members. The Blakes have been strong supporters of the MMTO and helped raise funds for the observatory in the past. They are also the owners of property where the original "basecamp" was located.

4/29/13 – A delegation of astronomers from the Instituto de Astronomia from UNAM in Mexico were given a tour of the MMTO by Grant Williams. They were interested in seeing the observatory as building a 6.5-m telescope in Mexico is under consideration. Representatives from the Steward and Whipple Observatories also accompanied the group on the tour.

MMTO in the Media

University of Arizona science journalism graduate student and Wick Communications Science Intern, Jason Davis, released his short film about the MMTO, entitled "An Evening on Top of the World." It was featured in the online version of *Astronomy Magazine* on June 11 and in the inaugural (Spring 2013) issue of the multimedia magazine *Scientific Tucsonan.*

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*)*

13-18 Steps Toward Unveiling the True Population of Active Galactic Nuclei: Photometric Characterization of Active Galactic Nuclei in COSMOS
E.E. Schneider, C.D. Impey, J.R. Trump, and M. Salvato
ApJ, **766**, 123

13-19 Metal Abundance and Kinematical Properties of the M81 Globular Cluster System
J. Ma, et al.
RAA, **13**, 399

13-20 The Unprecedented 2012 Outburst of SN 2009ip: A Luminous Blue Variable Star Becomes a True Supernova
J.C. Mauerhan, et al.
MNRAS, **430**, 1801

13-21 Measuring the Ultimate Halo Mass of Galaxy Clusters: Redshifts and Mass Profiles from the Hectospec Cluster Survey (HeCS)
K. Rines, M.J. Geller, A. Diaferio, and M.J. Kurtz
ApJ, **767**, 15

13-22 A Thermal Infrared Imaging Study of Very Low Mass, Wide-separation Brown Dwarf Companions to Upper Scorpius Stars: Constraining Circumstellar Environments
V. Bailey, et al.
ApJ, **767**, 31

13-23 Focal Plane Wavefront Sensing Using Residual Adaptive Optics Speckles
J.L. Codona and M. Kenworthy
ApJ, **767**, 100

13-24 Ruprecht 147: The Oldest Nearby Open Cluster as a New Benchmark for Stellar Astrophysics
J.L. Curtis, et al.
AJ, **145**, 134

13-25 The Mass of KOI-94d and a Relation for Planet Radius, Mass, and Incident Flux
L.M. Weiss, et al.
ApJ, **768**, 14

13-26 Disk-related Bursts and Fades in Young Stars
K. Findeisen, et al.
ApJ, **768**, 93

13-27 The $z = 5$ Quasar Luminosity Function from SDSS Stripe 82
I.D. McGreer, et al.
ApJ, **768**, 105

13-28 Nonlinear Color-Metallicity Relations of Globular Clusters. V. Nonlinear Absorption-line Index versus Metallicity Relations and Bimodal Index Distributions of M31 Globular Clusters
Sooyoung Kim, et al.
ApJ, **768**, 138

13-29 A Survey for Planetary Nebulae in M31 Globular Clusters
G.H. Jacoby, et al.
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13-30 *Hubble Space Telescope* Imaging of the Binary Nucleus of the Planetary Nebula EGB 6
J. Liebert, et al.
ApJ, **769**, 32

13-31 PS1-12sk is a Peculiar Supernova from a He-Rich Progenitor System in a Brightest Cluster Galaxy Environment
N.E. Sanders, et al.
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13-32 The ELM Survey. V. Merging Massive White Dwarf Binaries
W.R. Brown, et al.
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13-33 Connecting Stellar Mass and Star-Formation Rate to Dark Matter Halo Mass Out to $z \sim 2$
L. Wang, et al.
MNRAS, **431**, 648

13-34 SN 2011ht: Confirming a Class of Interacting Supernovae with Plateau Light Curves (Type IIn-P)
J.C. Mauerhan, et al.
MNRAS, **431**, 2599

13-35 Spatially Resolved Star Formation Histories of Nearby Galaxies: Evidence for Episodic Star Formation in Discs
M.-L., Huang, et al.
MNRAS, **431**, 2622

13-36 Improved Photometric Redshifts via Enhanced Estimates of System Response, Galaxy Templates and Magnitude Priors
S.J. Schmidt, and P. Thorman
MNRAS, **431**, 2766

13-37 A Highly Unequal-Mass Eclipsing M-Dwarf Binary in the WFCAM Transit Survey
S.V. Nefs, et al.
MNRAS, **431**, 3240

13-38 Photometric Variability in a Warm, Strongly Magnetic DQ White Dwarf, SDSS J103655.39+652252.2
K.A. Williams, et al.
ApJ, **769**, 123

13-39 Gradients of Stellar Population Properties and Evolution Clues in a Nearby Galaxy M101
L. Lin, et al.
ApJ, **769**, 127

13-40 A Chandra X-Ray Study of the Interacting Binaries in the Old Open Cluster NGC 6791
M. van den Berg, et al.
ApJ, **770**, 98

13-41 SN 2012au: A Golden Link between Superluminous Supernovae and Their Lower-luminosity Counterparts
D. Milisavljevic, et al.
ApJ Lett., **770**, L38

Non-MMT Scientific Publications by MMT Staff

The Distance to the Massive Galactic Cluster Westerlund 2 from a Spectroscopic and *HST* Photometric Study
C.A. Vargas Alvarez, et al. (R. J. Cool)
AJ, **145**, 125

PRIMUS: Constraints on Star Formation Quenching and Galaxy Merging, and the Evolution of the Stellar Mass Function from z=0-1
J. Moustakas, et al. (R. J. Cool)
ApJ, **767**, 50

The PRIsm Multi-object Survey (PRIMUS) II: Data Reduction and Redshift Fitting
R. J. Cool, et al.
ApJ, **767**, 118

PRIMUS: Infrared and X-Ray AGN Selection Techniques at $0.2<z<1.2$
A.J. Mendez, et al. (R. J. Cool)
ApJ, **770**, 40

A Detailed Study of the Radio-FIR Correlation in NGC 6946 with Herschel-PACS/SPIRE from KINGFISH
Tabatabaei, F. S., et al. (J. Hinz)
A&A, **552**, 19

Star Formation Rates in Resolved Galaxies: Calibrations with Near- and Far-Infrared Data for NGC 5055 and NGC 6946
Li, Y., et al. (J. Hinz)
ApJ, **768**, 180

The Impact of Bars on Disk Breaks as Probed by S4G Imaging
Munoz-Mateos, J. C., et al. (J. Hinz)
ApJ, **771**, 59

Calibration of the Total Infrared Luminosity of Nearby Galaxies from *Spitzer* and *Herschel* Bands
Galametz, M., et al. (J. Hinz)
MNRAS, **431,** 1956

Observing Reports

Copies of these publications are available from the MMTO office. We remind MMT observers to submit observers' reports, as well as preprints of publications based on MMT research, to the MMTO office. Such publications should have the standard MMTO credit line: "Observations reported here were obtained at the MMT Observatory, a facility operated jointly by the Smithsonian Institution and the University of Arizona."

Submit publication preprints to *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

April 2013

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	129.00	27.55	6.00	0.25	0.00	0.00	33.80
PI Instr	16.00	147.60	18.75	0.00	1.00	0.00	0.00	19.75
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**	**276.60**	**46.30**	**6.00**	**1.25**	**0.00**	**0.00**	**53.55**

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	16.7
Percentage of time lost to instrument	2.2
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	19.4

* Breakdown of hours lost to instrument
6.00 Blue Echellette problems

** Breakdown of hours lost to telescope
1.00 Azimuth oscillation
0.25 Mirror panic

May 2013

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	8.00	66.30	9.50	0.00	0.00	0.00	0.00	9.50
PI Instr	20.00	165.40	28.55	2.65	1.50	8.10	0.00	40.80
Engr	3.00	24.40	4.00	0.00	0.00	0.00	0.00	4.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**31.00**	**256.10**	**42.05**	**2.65**	**1.50**	**8.10**	**0.00**	**54.30**

Time Summary

Percentage of time scheduled for observing	90.5
Percentage of time scheduled for engineering	9.5
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	16.4
Percentage of time lost to instrument	1.0
Percentage of time lost to telescope	0.6
Percentage of time lost to general facility	3.2
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	21.2

* Breakdown of hours lost to instrument
2.50 L1 mirror & electronic issues with MAESTRO
0.15 MAESTRO cable problems

** Breakdown of hours lost to telescope
1.50 Camera/PCR/DM power supply issues

*** Breakdown of hours lost to facility
8.10 Carrier A/C failure

Year to Date May 2013

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	56.00	582.70	146.55	7.16	3.25	7.00	0.00	163.96
PI Instr	85.00	840.80	264.75	3.65	26.10	12.35	0.00	306.85
Engr	10.00	104.90	30.40	0.00	0.00	0.00	0.00	30.40
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**151.00**	**1528.40**	**441.70**	**10.81**	**29.35**	**19.35**	**0.00**	**501.21**

Time Summary

Percentage of time scheduled for observing	93.1
Percentage of time scheduled for engineering	6.9
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	28.9
Percentage of time lost to instrument	0.7
Percentage of time lost to telescope	1.9
Percentage of time lost to general facility	1.3
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	32.8

June 2013

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	70.00	0.00	0.00	0.00	0.00	0.00	0.00
PI Instr	20.00	154.80	18.95	2.50	4.95	0.20	0.00	26.60
Engr	1.00	7.70	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**	**18.95**	**2.50**	**4.95**	**0.20**	**0.00**	**26.60**

Time Summary

Percentage of time scheduled for observing	96.7
Percentage of time scheduled for engineering	3.3
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	8.2
Percentage of time lost to instrument	1.1
Percentage of time lost to telescope	2.1
Percentage of time lost to general facility	0.1
Percentage of time lost to environment	0.0
Percentage of time lost	11.4

* Breakdown of hours lost to instrument

0.50 Hecto server hung up
1.00 MMTCam software issue
1.00 Hecto guider software issue

** Breakdown of hours lost to telescope

3.15 Elevation drives stopping; elevation oscillation
0.25 Front shutters accidentally closed due to touchscreen
0.80 Oscillations
0.75 Elevation drive stop

*** Breakdown of hours lost to facility

0.20 Elevator shaft light on

Year to Date June 2013

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	652.70	146.55	7.16	3.25	7.00	0.00	163.96
PI Instr	105.00	995.60	283.70	6.15	31.05	12.55	0.00	333.45
Engr	11.00	112.60	30.40	0.00	0.00	0.00	0.00	30.40
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**181.00**	**1760.90**	**460.65**	**13.31**	**34.30**	**19.55**	**0.00**	**527.81**

Time Summary

Percentage of time scheduled for observing	93.6
Percentage of time scheduled for engineering	6.4
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	26.2
Percentage of time lost to instrument	0.8
Percentage of time lost to telescope	1.9
Percentage of time lost to general facility	1.1
Percentage of time lost to environment	0.0
Percentage of time lost	30.0