MMT Observatory
Smithsonian Institution & The University of Arizona®

End of Trimester Summary

January – April 2011

J.T. Williams, MMTO Chief Engineer, talks with Smithsonian Institution Secretary Wayne Clough. Sec. Clough and other distinguished SI guests (see p. 18) visited the MMT Observatory on March 9, 2011.

In the MMTO control room, Sec. Clough, Undersecretary for Science E. Pell, Chief Counsel J. Leonard, and Dr. C. Alcock (Dir., Smithsonian Astrophysical Obs./Center for Astronomy) listen as astronomer L. Jiang (Steward Obs., Univ. of Arizona) explains the research he's conducting using the MMTO.

Personnel

G. Grant Williams assumed the Directorship of the MMTO on January 1, 2011. The previous Director, Faith Vilas, stepped down on December 31, 2010, and is now affiliated with the Planetary Science Institute.

Scott Gottilla was hired for the Telescope Operator position and started on January 10. Scott worked with the MMTO day crew for the first two weeks, becoming familiar with MMTO operations before starting the night schedule in his new position.

Mike Alegria transitioned from Telescope Operator to Instrument Specialist on the MMTO day crew in late January.

Talks and Conferences

G. Williams attended the American Astronomical Society (AAS) meeting in Seattle, WA held January 9-13.

An MMTO All-Hands meeting was held January 21. The new director informed the staff of his priorities and policies.

G. Williams gave a public lecture on January 26 entitled "Active and Adaptive Optics at the MMT". This lecture series is sponsored by F.L. Whipple Observatory and is held in Green Valley, Arizona.

The MMT Council met on February 11, marking its first meeting with the new director.

A Smithsonian Institution Safety meeting was held March 23 at basecamp. MMTO personnel attending were John Di Miceli and Tom Gerl.

G. Williams attended "A Decade of Exploration with the Magellan Telescopes" meeting held April 26-28 in San Marino, California.

External Presentations

G. Williams presented a talk entitled *"Evolution of the Asymmetric Type IIn SN 2010jl"* at the April 3 lunch seminar at NOAO.

Primary Mirror Systems

Actuators

The document *"Actuator Troubleshooting"* was completed in February. The schematics of the actuator electronics cards were completely reconstructed. The document includes explanations on how to test the actuator cards, verify they are in good working order, and what to repair or replace if cards are defective. Using the new document, all spare cards were tested and, if necessary, repaired. The cards were inventoried and sent back to the mountain, ready for use as spares.

The fabrication and operational check of the actuator test stand loopback interface circuit card assembly was completed.

Secondary Mirror Systems

f/5 Secondary Support

Extensive work was initiated to identify, isolate, and repair the intermittent f/5 image oscillation issues. A plan was developed that included the rebonding of the tangent rod pucks (it was believed that a possible cause of the oscillations were loose pucks), realignment of the mirror support system, and installation of the f/5 secondary onto the secondary test stand.

In late February, the f/5 secondary was moved into the Instrument Repair Facility (IRF) for extensive testing. It was suspended in a nadir pointing position using the hexapod and an overhead crane. Steward Observatory Mirror Lab and MMTO personnel determined a fiducial for the north side of the mirror and re-verified the proper location of the tangent rod pucks. The southeast puck still had the fishing line spacer under the puck. (To ensure proper curing of the RTV, this line should be removed after setting.) The pucks were removed and reattached using Dow Corning RTV Q3-6093 and allowed to cure for 96 hours. While the tangent rod pucks were curing, the tangent rods were disassembled, cleaned, lubricated with dry lubricant, and reassembled. The north tangent rod assembly had some evidence of contamination, but the other two were clean.

The tangent rods were reattached and aligned to optimal position. Tangent LVDTs were adjusted to near mid-stroke for reduced noise levels. The center plug and rotational plug were inserted with no problems. (The rotational plug tines had sprung due to material issues and had to be turned to the diameter of the mirror metrology hole.)

Figure 1. Tangent rod puck installation brackets

A thorough inspection of the mirror cell identified loose hardware on the stiffener rib. All screws were removed and locktite was applied to the threads prior to reinstallation. All air transducers were removed, locally calibrated, and reinstalled. The southeast transducer was found to be sensitive to angular motion and was replaced as a preventive measure. The clear air lines used throughout the cell, which appeared to be cracking and leaking, were replaced with green tubing. Several actuators required adjustment. The load placed on each axial actuator should be the same when the mirror is suspended in a nadir pointing position. Actuators G31, G28, G17, G22, G6, B11, B24, and B35 were all loose, i.e. not sharing the load. Each actuator was adjusted to show some load sharing. B22 would not adjust to show any load sharing when air was off. With the servo system on, it did carry a load. To allow easy removal of the tangent rods, a slot was milled in the side stiffener plates. The milled plates now allow removal of the tangent rod without removal of the side stiffener plate. The rubber bumpers around the mirror were inspected, and the one on the south side had a failed glue bond. It was reglued and reinstalled. All bumpers were adjusted while the f/5 was nadir pointing.

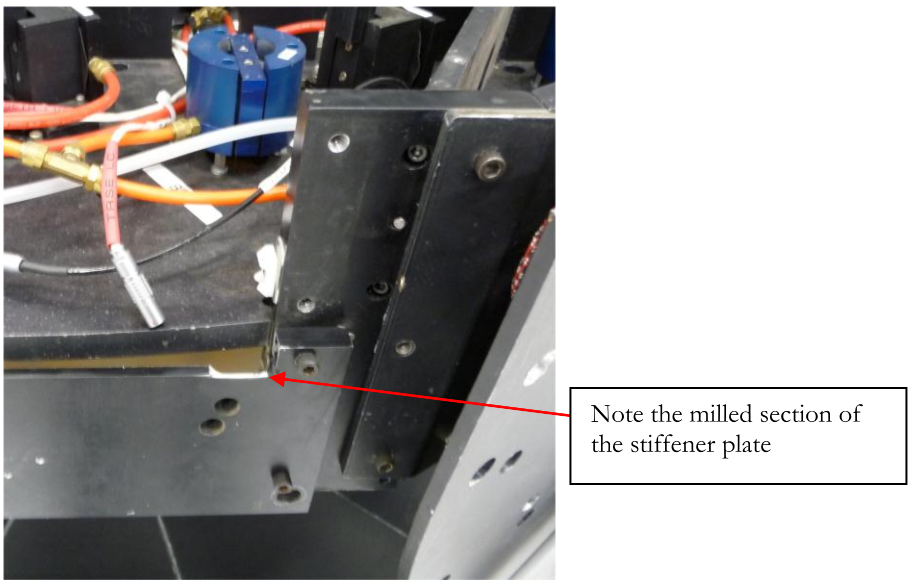

Figure 2. Stiffener plate with milled slot.

On March 10, the f/5 secondary was installed on the "iron maiden", the secondary test stand. Extensive testing was done for one week. It was determined that the mirror support system is not oscillating, but instead is hunting. While this may seem a lesson in semantics, it sends us down a different path of troubleshooting. Capacitors were added across C62, C64, C63, in the tangent rod integrator circuit. This modification was to reduce the gain at lower signal levels and it had a major effect in the hunting of the axial support system. The lateral system hunting was reduced to less than 20 microns, and only when the elevation is higher than 80 degrees. The mirror support electronics card #1 was replaced with card #2 because of an intermittent problem with the southwest hardpoint forces. The secondary will be monitored during the next run to evaluate performance. The plugs used to confirm mirror position were inserted at various elevations with no problems.

We are working on a method to run the lateral system using the f/5 mirror support card and f/9 mirror support card. The two designs are nearly identical with only minor differences. The f/9 card was connected to the f/5 lateral load cells and its output to the lateral air valve. The output of the f/9 card was also connected to the mux on the f/5 card to allow monitoring of the forces. Testing conducted at the MMT electronics shop on campus proved the system worked. Testing was then done on the f/5 at the observatory. The modified card and connectors were installed, and while the reporting side of the system worked, it did not raise the mirror. Subsequent evaluations determined that the f/9 mirror wiring inverts the load cell output prior to the support card. More testing is planned in the following months. This will help isolate issues with the in-use f/5 cards (e.g., layout or other problems).

f/9 Secondary Support

Following a service report about excessive forces (reported by the annunciator) in the f/9 secondary mirror support system, a decision was made to move the f/9 to the Instrument Repair Facility (IRF) for a thorough testing on April 5. Initial inspection showed no visible mechanical problems. Due to the mechanical design of the f/9 mirror cell, we were unable to mount it to the test stand, so all testing was done on the storage cart with an overhead crane and hydroset attached. After some testing, excessive forces were still observed on the Graphical User Interface (GUI). The lateral transducer and circuit card were then replaced but the excessive forces remained. Testing was done to ensure there were no leaks in the lateral air system. A closer look at the glass while raising and lowering it revealed that the glass was lifting and shifting to one side. The position plug for the f/9 was located and attempts to insert it into the center metrology hole failed.

After a conference of involved personnel, a decision was made to turn the glass to a nadir pointing position and loosen all three tangent rods, following a theory that the glass was being held by an improperly positioned tangent rod. This theory was reinforced by analysis of the f/9 data from the MySQL database. This analysis revealed that during the week of 11 November 2009, the lateral forces became excessive. On that same night, the hexapod ran away to its hardware limit. We believe that the cell contacted the white outer shroud and caused the tangent rod to shift from its proper location.

The mirror was repositioned to nadir pointing, the tangent rods were loosened, and the mirror swung into its natural position. The positioning plug was easily inserted and removed. Voltage readings were taken from the tangent rods in an unloaded position, and the tangent rods were then reconnected while maintaining that voltage. The mirror support system was reconnected and the system was tested. The position plug was easily inserted at various elevations. The forces on all load cells were significantly reduced. New values were entered into the annunciator GUI and will be tweaked as needed. Since the servicing, the f/9 secondary has been remounted and performed nominally during the run.

f/15 Electronics

The f/15 electronics were relocated into a new rack. This provided an opportunity to improve the f/15 system wiring and the MMT336 power supply. The following is a list of the work that was completed.

Thin Shell Safety (TSS) power supply: added a load-safety breaker; covered live terminal connections; replaced broken connectors; replaced an old battery with smaller UPS batteries; added quick disconnects to the battery for easy replacement; added an input fuse, and ensured all connections were easy to disconnect for removal of the chassis. These modifications shrank the chassis height by 25%. The TSS voltage was added to the parameters monitored by the HP DAU.

Internal connections were documented and the documentation for internal components was located. Unused components, some of which were energized, were removed.

Topbox 24-volt power supply: removed obsolete cables and connections which reduced the size of the chassis by 50%; added quick disconnects for easy component replacement; added an input fuse; replaced the indicator lights; and identified and removed a ground loop violation. Internal connections were documented and the documentation for internal components was located.

MMT336 smart power supply: the undersized RFI filter was replaced along with chafed wires; the Dsub connector was replaced with a CPC; the test cable TSS power and deformable mirror (DM) signal connection were re-pinned correctly; the entire MMT336 smart power supply was troubleshot and completely documented along with documenting the power supply card; and a test load bank for the MMT336 as well as a test jumper for the DM Signal cable was designed and fabricated. The spare card for the MMT336 was found to have been fabricated incorrectly by the vendor. Several diodes and an LED were installed backwards, preventing the card from receiving a "good" power supply signal from the power supplies. The card was repaired and tested.

The "modified" power distribution panel was replaced with an ethernet controllable distribution panel with more ports. A new test point panel was added to prevent personnel from taking ground readings by reaching in next to energized bus bars. A new communication panel was designed and fabricated to prepare for the new network install. The Hirshmann fiber converter was securely connected by adding threaded standoffs.

The HP DAU buffer overflow problem was corrected by D. Gibson and B. Comisso. The multiplexer card was modified to have relays on headers for easy replacement. All relays were replaced. The multiplex card was documented and rewired to the correct wire gauge. TSS voltage was added as a parameter on the multiplexer card. A label was added to the front of the rack, noting which supply is monitored by which channel as well as the expected voltage.

The UPS batteries and electronics rack batteries were separated to decrease weight and make transporting easier. The UPS batteries were placed on rails and spaced to allow airflow. New and larger casters were ordered to prevent wheels from getting stuck in the elevator and to make moving over gaps easier. The battery interconnection receptacle on the Tripp-lite was fixed and re-fastened.

All components were spaced and cooling fans were added to provide airflow. All chassis were placed on slides or rails. We determined that the loading of the old rack was a heavily loaded single phase power on Q3. The loads were redistributed in a logical way, and 3rd floor east was rewired to provide 3-phase power to the rack.

The layouts of the old and new racks were documented, including interconnections. Wiring was verified from 3rd floor east all the way to the hub, and the cabling was documented. A block diagram of the entire f/15 system was generated. A documentation binder containing all schematics and applicable modifications was included in the rack.

f/15 Actuator Test Tool

We began building a new deformable mirror (DM) actuator test tool. It will enable us to determine which actuators need repair and to test them following the repair.

Telescope Tracking and Pointing

Servos

During the reporting period significant progress was made on developing a complete structural model of the azimuth drivetrain. D. Clark met with J.T. Williams and Tom Hoffman (of Hoffman Design & Development) to review the original drawings of the drive gearboxes and the mechanical design; this proved to be very valuable.

Using Simulink's Simscape Toolbox, the azimuth drive system model was extended to take into account most of the torsional elements in the gearboxes. The model does not completely describe things like gear tooth deformation and friction. Also, the model has a severe limitation that requires a single mechanical reference, making it very difficult to correctly represent the flexible elements in the absolute encoder mechanics. Given this limitation, the model was bifurcated into two output channels: the motor shaft encoder output, and the absolute encoder output.

The resulting single-input, multi-output model gave good general agreement with the measured data. The model was then iterated to produce a better fit to the experimental data. The resulting full-state model, of order 45 for each output channel, was then reduced and balanced using the Matlab Control System Toolbox to eliminate redundant and weak states that contribute little to the model output, giving robust models of order 6 (motor channel) and 7 (absolute encoder channel) that are much faster in simulation. The reduced-order models were again iterated against the measured data to ensure that the models were useful for the next step: closed-loop controller design.

The reduced-order, fitted models were reported internally within MMTO, and a copy can be found at: http://www.mmto.org/~dclark/Reports/Reduced%20Order%20MMT%20Azimuth%20Models.pdf

Using the models, preliminary design of the azimuth controller was started. Some upgrading of the analog inputs on the xPC Target test machine was also performed to support the next campaign of open (and closed) loop data collection. We expect to perform this work during the next trimester.

Tracking

We have resumed the series of tracking reports, having reduced the tracking data for the final trimester of 2009 and the first trimester of 2010. The 3rd trimester of 2009 report has been produced, and is posted on the MMT website, located under the Publications tab at http://www.mmto.org/node/245

The tracking data for the first trimester of 2010 has been reduced and a report is in progress.

Computers and Software

MMT Network Upgrade: Campus

As part of the ongoing MMT network upgrade, a subnet (199.104.150/24) was transferred from the Smithsonian Institution (SI) to the MMT for campus operations. Previously, the MMT used a single subnet (128.196.100/24) that spanned both the campus and mountain operations. The 128.196.100 subnet will now be dedicated to MMT mountain operations. The new 199.104.150 subnet is active for MMT campus operations. All campus computers, printers, and other network devices have been reconfigured for the new subnet. This work involved reconfiguring servers and clients for DNS, firewalls, printing, NFS, NTP, samba, DHCP, mail and HTTP, as well as coordinating with various networking groups, both on and off campus. The final reconfiguration of the two-subnet MMT network topology by University Information Technology Services (UITS), SI, and MMT staff is expected to occur in June. Various network topology changes are also planned to increase network flexibility, reliability, and security.

MMT Network Upgrade: Mountain

The entire MMT mountain facilities, including the MMT itself, the support/IRF building, and the common building were re-cabled by Copperstate Communications for CAT6 network. New Cisco network switches for MMT operations have been purchased by SI and are currently at the F.L. Whipple Observatory basecamp, awaiting installation at the MMT. An upgrade of the microwave link from Steward Observatory on the University of Arizona campus to the Mt. Hopkins summit is underway.

Email

All of the mmto.org staff email has been migrated from the main MMT campus server, "mmt", to Google Gmail, using a Google Educational Domain for "mmto.org". The MMT has been using portions of the potential use of this domain, such as the Google calendar, for several years. Individual accounts have been set up for all MMTO staff, allowing staff access to individual Gmail, Google Docs, and other Google services. This transfer of email to Google has greatly reduced the requirements on the campus server, primarily in processing spam emails, and has simplified email administration for software staff.

Wavefront Sensor Software

Since the primary mirror re-aluminization in 2010, there have been issues with the performance of the wavefront sensor software. An initial quick look at the software caused us to suspect either the spot centroiding algorithm or the spot correlation algorithm as the source of the difficulties. The software reports a count of spots "linked," and often this number was very low compared to the spots visible to a human observer.

We found that the spot centroiding routine was doing its job perfectly. However, the algorithm that correlates the spot centroids with the centroids from the reference image was not robust enough. After aluminization, the spot pattern was asymmetric and this caused a poor first approximation for the spot correlation algorithm to be generated.

A number of improvements were made to the spot correlation algorithm, and the software is now able to deal with the post-aluminization spot patterns, and even provides usable results with data where it would have failed previously.

Resolving the recent problem was an opportunity for us to learn how the software was written and organized by previous employees, allowing for future modifications to be done more easily.

The same software is used for both the f/5 and the f/9 wavefront sensors. The systems differ in a number of aspects; most significantly, each uses a different lenslet array, camera, and computer system. The f/9 wavefront sensor is supported by a dedicated machine "f9wfs" that runs Linux and hosts a PCI bus camera controller card for the Apogee camera. Work is underway to improve the packaging of the driver software for this card, with the ultimate intent of packaging it (and all the software we use on this dedicated computer) as a set of RPM packages to simplify administration and software updates.

Computer Systems/Server Administration

Ten Linux machines (ao-server, homer, brak, blur, f9wfs, alewife, mmto, hoseclamp, yggdrasil, and hacksaw) were upgraded to Fedora 14 during the reporting period. We maintain a number of open source packages (including IRAF) in RPM format for our convenience when updating systems. We often need to rebuild these packages when either new versions of the package are published or when we upgrade to a new release of Fedora Linux. We have completed a full set of packages for Fedora 14, but will soon be tackling this again for Fedora 15, to be released on May 24.

Considerable time was spent evaluating performance on the mountain server, “hacksaw.” As a result of this evaluation, the memory on hacksaw was increased from 4GB to 8GB. The RAID controller backup battery was also replaced. The two telescope operator computers, “yggdrasil” and “hoseclamp,” were upgraded from 2GB to 4GB each. The periodic (i.e., “cron”) housekeeping tasks on “hacksaw” and “mmt” were rationalized, reducing loads on the MMT servers. Images, including those from all-sky camera, as well as adaptive optics (AO) telemetry, were transferred to external USB drives.

Applications Programming

Applications work included:

- fixing the “stop” command and the “end of exposure” beep for the blue/red spectrograph,
- adding a “return to zero focus” button to the AO-GUI,
- testing MMTpol software,
- creating a HTML5/canvas based version of the web-based background log plotting tool: https://hacksaw.mmto.arizona.edu/ssl/xy8flot/
- creating a new internal staff home page at: http://staff.mmto.org/

Miscellaneous

The Serial/Ethernet controller for the f/15 StellaCam (from the f/15 NGS topbox) was put into a small enclosure that will mount in the NGS topbox.

“Seeing” calculations from 2003 to the present were updated and entered into a MySQL database. There are currently over 70,000 “seeing” calculations in this database.

Updated versions of minimalistic web browsers were created for the "gecko" (used in the Firefox web browser) and webkit (used in the Safari web browser). These minimalistic browsers eliminate unused features of the full-feature web browsers, such as the file menu, and are used by the telescope operators for web-based applications.

A five-year schedule for replacing MMTO computers was compiled. The top priority is replacement of the servers "hacksaw" (the main mountain server), "mmt" (the main town server), and "vault" (the primary Windows Active Directory server). These servers are approximately five years old, a typical lifetime for computers. The software group is also considering different approaches to replacing these computers, such as dividing tasks currently performed on specific computers, and perhaps the use of virtual machines for one or more servers.

Administration of all network facilities in the common building was migrated from SI to MMT. This includes the wireless access point in the main room and the computer in the library. Discussions are underway to migrate management of the "aerosummit" wireless access point, which connects the MMT summit with the Bowl dorm, from SI to the MMT.

A new HP color all-in-one printer (HP 8500) was installed in the MMTO control room. This printer offers printing, scanning, and copying capabilities. It is now the default printer for the control room Linux computers.

A new AO Stellacam GUI and Arduino replacement for the "indigo" computer was implemented.

Hardware for the "homer" computer was replaced.

Summary of Service Request (SR) Activity

The MMT 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 entire staff for immediate communication and long-term documentation as operational issues are addressed and resolved.

During January through April, a total of 40 new SR requests were created. Figure 3 summarizes the priority levels of these requests. The different possible SR priority levels include: none/information only, low, important, near-critical, and critical.

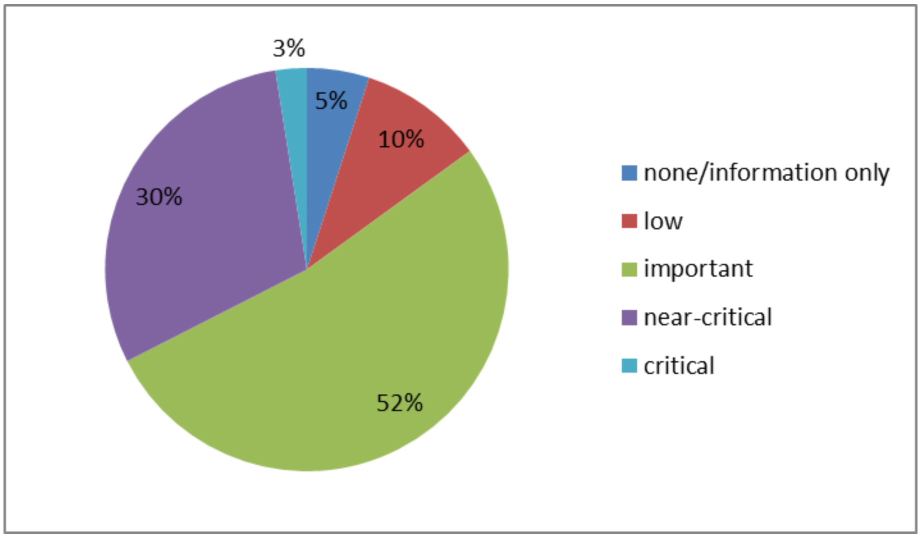

Figure 3. Percentages of the SRs in the five different priority categories for the reporting period of January through April 2011.

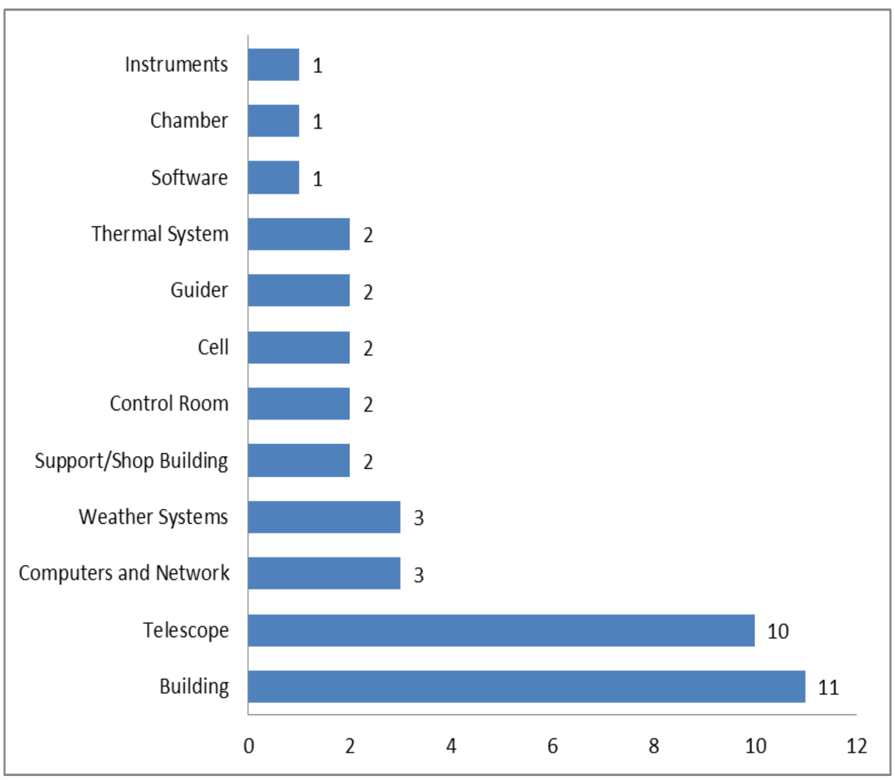

Figure 4. Categories of new SRs created January through April 2011.

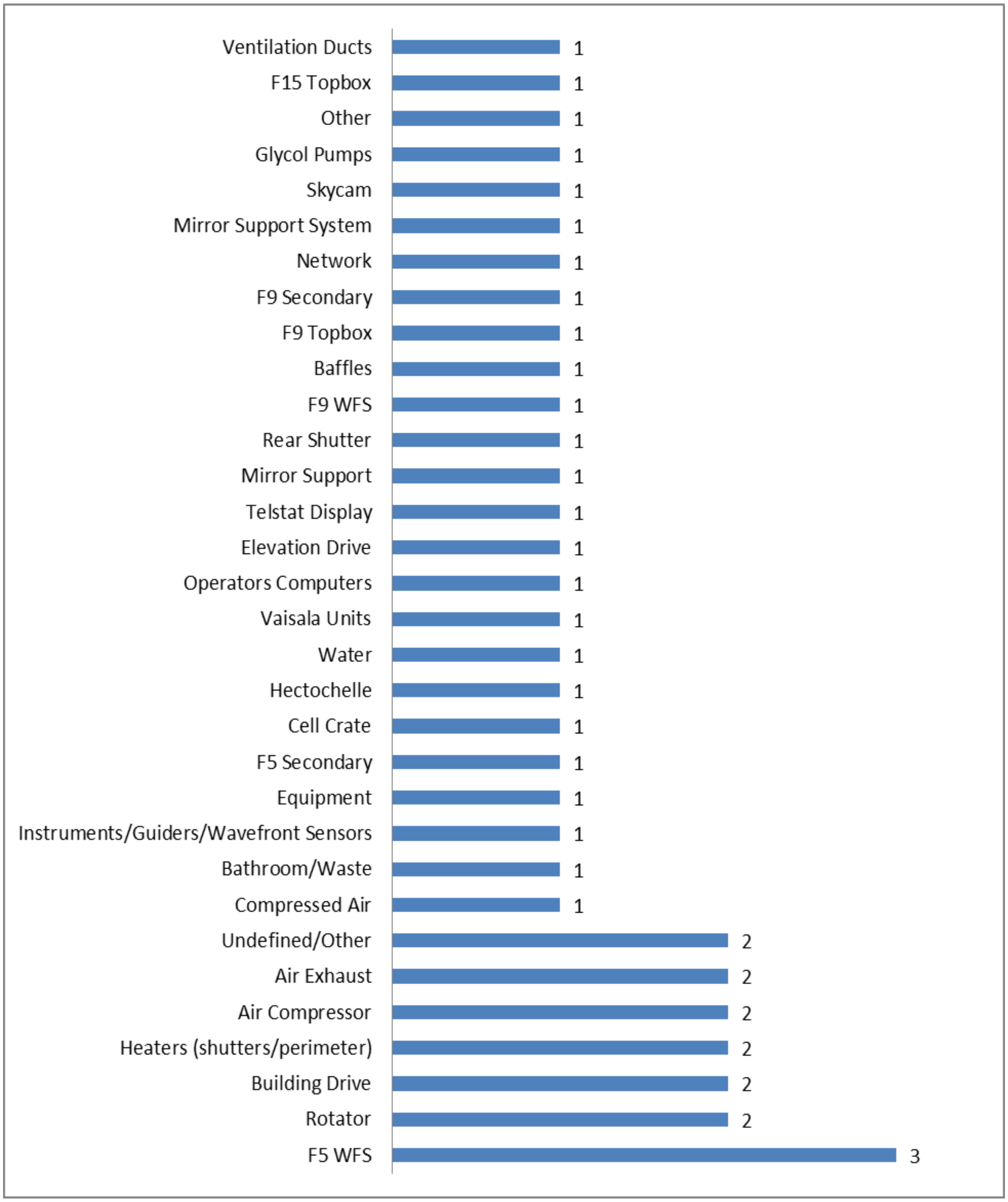

Figure 5. Subject areas of new SRs created January through April 2011.

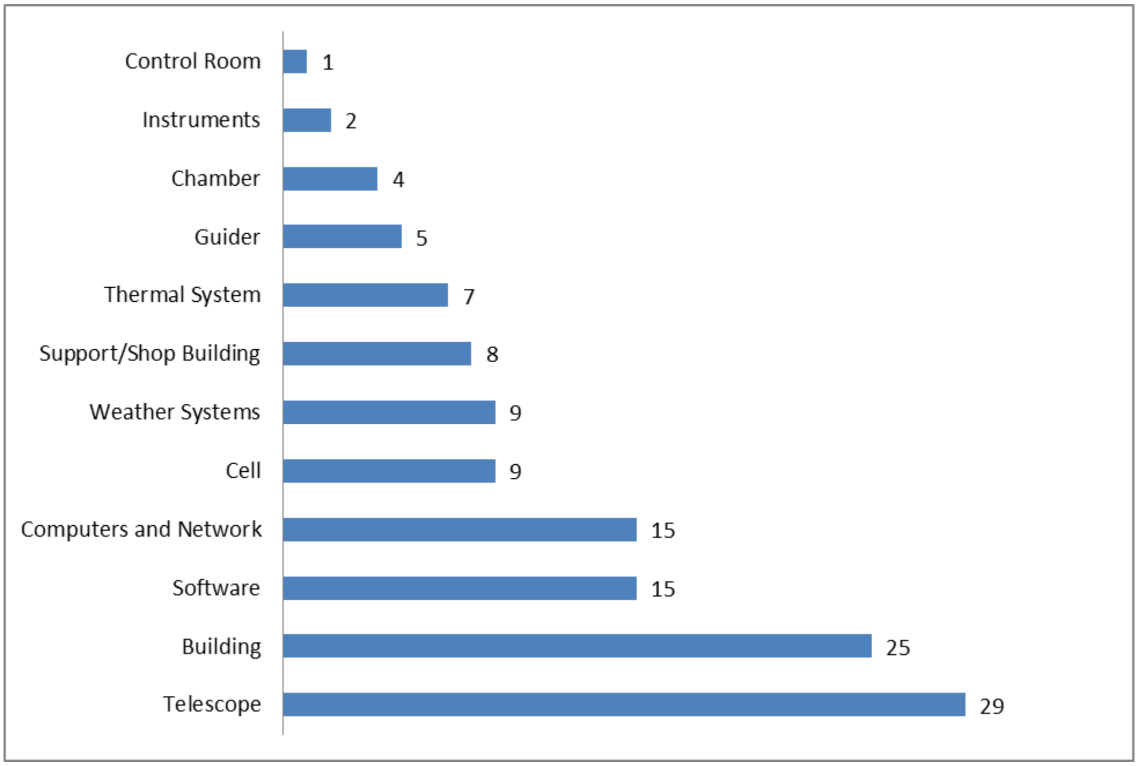

Figure 6. There were 129 SR responses within different categories from January through April 2011.

Instruments

A new instrument, an optical multi-object spectrograph called Binospec, is being developed for use on the MMT. The Principal Investigator is D. Fabricant of the Smithsonian Astrophysical Observatory (SAO). Funds for the final construction and commissioning of Binospec were awarded to SAO by the Telescope System Instrumentation Program (TSIP), which is funded by the National Science Foundation (NSF) and administered by the National Optical Astronomy Observatories (NOAO). A Memorandum of Understanding (MOU) was signed this trimester that will allow 28 nights of observing on the MMT by the public astronomical community in exchange for the TSIP funds.

A second TSIP proposal to support upgrades and maintenance of the MMT f/15 secondary mirror was also submitted but was not selected for funding. We plan to revise and resubmit the proposal later this year.

f/5 Instrumentation

The trimester had reasonably good weather and no major f/5 instrument problems. There were fifty-two nights scheduled with the f/5 secondary and instruments over two long runs. Seven hundred eighty Hecto science exposures were gathered on 218 fields. The spectrographic nights were divided into twenty-six Hectospec nights and eighteen Hectochelle nights. There were also eight SWIRC nights for infrared imaging on which over 5000 exposures were recorded. We were able to operate for more than two thirds of the scheduled hours this trimester. We lost three nights to temperatures below 20° F, which is too cold to open with the hecto instruments. A net of approximately sixteen nights were lost to wind, clouds, or precipitation.

The SAO trio of computers had trouble recovering after a lightning shutdown in early February, but were up and running properly before operations began. A new battery was purchased and installed in the SAO computer UPS. The battery was then exercised to recalibrate the system. A spare server computer was upgraded with a new motherboard, more memory, new raid card, and larger disks to run some tests of upgrade paths for the other SAO computers. Passwords were reset and ssh code was upgraded after a break-in was detected on the computers at SAO in Cambridge.

The problems we had been experiencing with the failure of some of the Hectochelle calibration lamps returned. Over a couple of nights the robot operator had to verify whether one, two, or three series of lamps lit, and adjust the exposure time appropriately. Some of the SHV connectors on the cables were replaced, and the cables were labeled. Afterward, the cables were checked and found to be working properly. The next step was to reduce the number of lamps in each series from six to five, providing higher voltage per lamp. This improved the situation, but added 20% to the required calibration time. After the Hectochelle run, all the Thorium Argon lamps were tested, and those that failed or required too high a voltage were replaced with existing spares. All eighteen lamps regularly worked properly after this. Additional spares are now enroute.

While doing calibrations, we had some minor issues with the Hectochelle filter changer, possibly affected by the extreme cold the summit experienced. We were back on line in a short time after adjustment of a guide block. The positioner home offset on one of the gimbal axes had been stable over most of the trimester, unlike the previous trimester, and the stored offset is now updated.

The drive arc panel, where the Hecto cables connect, was slightly modified so that the video cable could be removed more easily. A plate covers the enlarged hole, and some back structure was added to provide strain relief for cable.

Prior to observations after one of the SWIRC mountings, there was an intermittent problem with images and server responsiveness while the instrument was being tested. Further testing showed that the problems were due to a dirty optical fiber. Cleaning the fiber connection after the secondary installation was completed resolved the problem.

MMTO and SAO-Cambridge have been discussing the reintroduction of a science camera in the wavefront sensor. Measurements and photos were taken of the available space at different locations for the wavefront sensor stage. SAO is continuing investigations.

Seeing

Figures 7 and 8 summarize calculated seeing values at the MMT for the period January through April 2011, as determined by the wavefront sensor (WFS) software. (For more details on how these values are calculated, see the January-April 2008 trimester summary, p. 6, at this link: http://www.mmto.org/node/345.)

A total of 2414 WFS seeing values are included in the data. The seeing values are corrected to zenith, using the equation:

$$seeing(zenith) = seeing(z) * sec(z)^{0.6}$$

where "z" is the zenith distance, the angular distance from the zenith to the WFS object.

Median seeing over this time period was 0.859 arc-seconds for the combined f/5 and f/9 WFS data, 0.868 arc-seconds for the f/5 data only, and 0.839 arc-seconds for the f/9 data only.

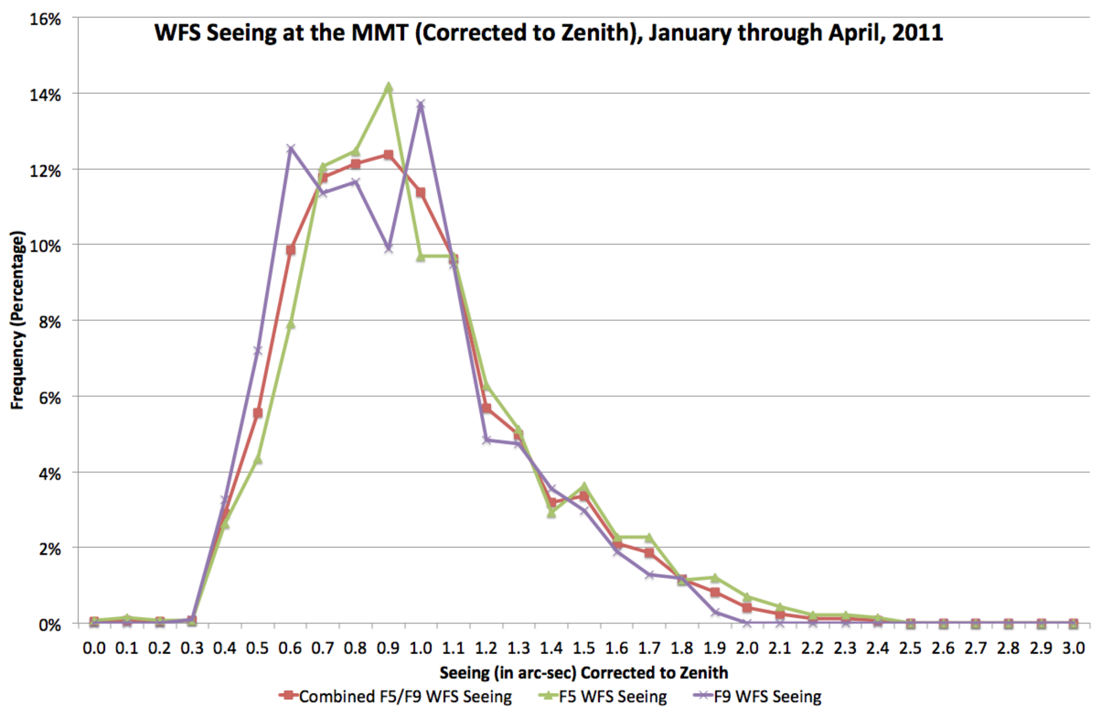

Figure 7. Distribution of f/5, f/9, and combined f/5 and f/9 seeing values (as a percentage of total occurrence), as determined from the WFS software, corrected to zenith.

	Combined F5/F9 Seeing (Corrected to Zenith)	F5 Seeing (Corrected to Zenith)	F9 Seeing (Corrected to Zenith)
Count	2414	1402	1012
Median	0.859	0.868	0.839
Average	0.910	0.938	0.872
Standard Deviation	0.347	0.363	0.320

Figure 8. Statistics on the f/5, f/9, and combined f/5 and f/9 seeing values, as determined from the WFS software, corrected to zenith.

General Facility

Roof

We've begun to study the MMT roof to better understand the reasons it so rapidly accumulates frost and snow, and the ineffectiveness of the heaters to dry it completely. Especially frustrating is the time lost when ice or snow between the roof's heat traces is not completely melted. Large amounts of power (>18kW) dissipated in the heat traces leave snow or ice between them, mainly due to the low thermal conductance of the roof membrane, which is made of thermoplastic olefin (TPO), a rubber-like plastic with very poor thermal conductivity.

One way to improve the roof heat conductivity is to apply a layer of aluminum tape atop of the TPO membrane to better carry the heat trace output across the roof. We've constructed a small-scale aging test to check the weather and sun resistance of a layer of tape attached to a sample of TPO material. Using aluminum tape may also help lower the roof's emissivity and reduce the dark-sky coupling that makes it more likely to supercool and condense water.

The aluminum overlay, provided the sample aging test succeeds, will be done on a small scale to see if the roof heat traces become more effective.

Safety

Red cargo nets were installed on the chamber hatch to prevent personnel or equipment from falling through when the hatch is open for maintenance operations.

Guard rails were designed, manufactured, and installed in both the 4th floor east and west lofts, eliminating the fall hazard.

Figure 9. New guardrails installed in a 4th floor loft area.

Guard rails were also installed around the shop heat exchanger, replacing mule tape previously used to cordon off the area.

Figure 10. Guardrails installed around the shop heat exchanger.

Safety Manual and Safety Training Videos

The staff completion rate for viewing safety videos and reviewing the Steward Observatory Safety Manual has steadily increased this trimester. (MMTO is under the umbrella of Steward Observatory safety guidelines.)

Other Facility Improvements and Repairs

The timer was replaced in the instrument air cabinet that cycles the air dryer. This unit supports f/9 instruments and f/15 ARIES with clean, dry air.

Three portable AC units (obtained from government surplus, and that had been in storage in the FLWO warehouse), were cleaned, tested, and repaired. The three units were re-located to the summit in areas where major heat loads exist: the third floor east (hexapod, guider, SAO calibration system, f/15 and NGS electronics, etc.), the second floor west (SAO f/5 electronics, cell crate, LGS electronics, etc.), and the main drive room off the loading dock area. New glycol plumbing was installed to each of these rooms to provide coolant to carry the heat away.

These new units have so far been an overwhelming success. We expect that the reduced temperatures in these rooms will improve the longevity of the electronics and reduce chamber seeing.

Inventory, clean up, and re-stocking of passive parts in the campus electronic shop was completed.

Visitors

3/9/11 – Dr. Wayne Clough, Secretary of the Smithsonian Institution (SI), visited the MMT. He was accompanied by: SI Undersecretary for Science Eva Pell, SI Chief Counsel Judith Leonard, SAO/CfA Director Charles Alcock, and SI Public Information Officer Amanda Preston. They toured the observatory and summit facilities in the afternoon and returned in the evening, following a catered dinner at the ridge dorm, to witness some observing.

3/25/11 – Dr. Neville Woolf toured the MMT with his guests, renowned astronomers Drs. R. Griffin and D. Lynden-Bell of Cambridge University, UK, and Dr. W. Sargent of the California Institute of Technology. Dr. Woolf was acting director during the completion of the original MMTO in the late 1970s.

3/31/11 – Five visitors from the Instituto Nacional de Astronomia, Optica y Electronica (INAOE) in Puebla, Mexico and the Cananea Observatory in Sonora, Mexico, were given a tour of the MMT. They included Alberto Carramiñana, Director of Cananea Observatory, and the INAOE Astrophysics Coordinator, Itziar Aretxaga. They were escorted by E. Falco and D. Brocious of the F.L. Whipple Observatory.

MMTO in the Media

1/4/11 – The University of Arizona "UA News" website – an interview with G. Williams upon his appointment as the new director of the MMTO. http://www.uanews.org/node/36473

1/11/11 – The Arizona Daily Star newspaper – an interview with G. Williams about the MMTO and becoming its director.
http://azstarnet.com/news/local/article_23b2c2fb-0cea-5a8a-b08e-5ec355e963d4.html

2/4/11 – Photo gallery of lasers used at several large observatories. The fifth image is of the MMTO. http://www.newscientist.com/gallery/laser-guide-star

Publications

MMTO Internal Technical Memoranda

11-01 Azimuth Tracking for the 3rd Trimester of 2009 (September-December 2009)
D. Clark and D. Gerber, February
http://www.mmto.org/node/245

11-02 Status of Adaptive Secondary Testing – Nov/Dec 2010
K. Powell, March
http://www.mmto.org/node/245

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications
(online publication list can be found in the MMT ADS Library at http://www.mmto.org/node/244)

11-01 The ELM Survey. II. Twelve Binary White Dwarf Merger Systems
Kilic, M., et al.
ApJ, **727**, 3

11-02 Star Clusters in M31. II. Old Cluster Metallicities and Ages from Hectospec Data
Caldwell, N., et al.
AJ, **141**, 61

11-03 AEGIS: Demographics of X-ray and Optically Selected Active Galactic Nuclei
Yan, R., et al.
ApJ, **728**, 38

11-04 The merger rate of extremely low mass white dwarf binaries: links to the formation of AM CVn stars and underluminous supernovae
W.R. Brown, et al.
MNRAS Lett., **411**, L31

11-05 A Combined Subaru/VLT/MMT 1-5 μm Study of Planets Orbiting HR 8799: Implications for Atmospheric Properties, Masses, and Formation
Currie, T., et al.
ApJ, **729**, 128

11-06 UV-to-FIR Analysis of *Spitzer*/IRAC Sources in the Extended Groth Strip. I. Multi-Wavelength Photometry and Spectral Energy Distributions
G. Barro, et al.
ApJ Supp, **193**, 13

11-07 Mapping the Asymmetric Thick Disk. III. The Kinematics and Interaction with the Galactic Bar
R.M. Humphreys, et al.
AJ, **141**, 131

11-08 UV-to-FIR Analysis of *Spitzer*/IRAC Sources in the Extended Groth Strip. II. Photometric Redshifts, Stellar Masses, and Star Formation Rates
G. Barro, et al.
ApJ Supp, **193**, 30

11-09 The Chandra ACIS Survey of M33 (ChASeM33): The Final Source Catalog
Tullmann, R., et al.
ApJ Supp, **193**, 31

Non-MMT Scientific Publications by MMT Staff

None

Observing Reports

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

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

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

Observing Database

The MMTO maintains a database containing relevant information pertaining to the operation of the telescope, facility instruments, and the weather. Details are given in the June 1985 monthly summary. The data attached to the back of this report are taken from that database.

Use of MMT Scientific Observing Time

January 2011

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	*Lost to Instrument	Lost to Telescope	**Lost to Gen'l Facility	Lost to Environment	Total Lost
MMT SG	15.00	178.60	37.80	13.30	0.00	0.00	0.00	51.10
PI Instr	14.00	162.90	18.10	0.00	0.00	0.50	0.00	18.60
Engr	2.00	23.50	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	**31.00**	**365.00**	**58.90**	**13.30**	**0.00**	**0.50**	**0.00**	**72.70**

Time Summary

Percentage of time scheduled for observing	93.6
Percentage of time scheduled for engineering	6.4
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	16.1
Percentage of time lost to instrument	3.6
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)	0.0
Percentage of time lost	19.9

* Breakdown of hours lost to instrument
1.50 Reading out Blue Channel exposures issue
11.80 Setup issues with BC Echellette

** Breakdown of hours lost to facility
0.50 Chelle Th-Ar lamps failure

February 2011

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	98.00	43.30	0.25	0.00	1.50	0.00	45.05
PI Instr	19.00	214.20	87.40	0.00	0.00	0.00	0.00	87.40
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	**28.00**	**312.20**	**130.70**	**0.25**	**0.00**	**1.50**	**0.00**	**132.45**

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	41.9
Percentage of time lost to instrument	0.1
Percentage of time lost to telescope	0.0
Percentage of time lost to general facility	0.5
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	42.4

* Breakdown of hours lost to instrument
0.25 Blue Ch. guide camera issue

** Breakdown of hours lost to facility
1.50 Hacksaw server problems

Year to Date February 2011

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	24.00	276.60	81.10	13.55	0.00	1.50	0.00	96.15
PI Instr	33.00	377.10	105.50	0.00	0.00	0.50	0.00	106.00
Engr	2.00	23.50	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	**59.00**	**677.20**	**189.60**	**13.55**	**0.00**	**2.00**	**0.00**	**205.15**

Time Summary

Percentage of time scheduled for observing	96.5
Percentage of time scheduled for engineering	3.5
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	28.0
Percentage of time lost to instrument	2.0
Percentage of time lost to telescope	0.0
Percentage of time lost to general facility	0.3
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	30.3

Use of MMT Scientific Observing Time

March 2011

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	147.90	18.35	0.00	0.50	1.00	0.00	19.85
PI Instr	14.00	139.80	31.20	0.00	0.00	1.50	0.00	32.70
Engr	3.00	30.80	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**	**318.50**	**49.55**	**0.00**	**0.50**	**2.50**	**0.00**	**52.55**

Time Summary

Percentage of time scheduled for observing	90.3
Percentage of time scheduled for engineering	9.7
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	15.6
Percentage of time lost to instrument	0.0
Percentage of time lost to telescope	0.2
Percentage of time lost to general facility	0.8
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	16.5

* Breakdown of hours lost to telescope
0.50 Rotator issues

** Breakdown of hours lost to facility
2.50 Hacksaw server problems

April 2011

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	70.80	4.00	0.00	0.25	0.75	0.00	5.00
PI Instr	20.00	187.20	46.95	4.00	1.50	0.00	0.00	52.45
Engr	2.00	18.60	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**	**50.95**	**4.00**	**1.75**	**0.75**	**0.00**	**57.45**

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	18.4
Percentage of time lost to instrument	1.4
Percentage of time lost to telescope	0.6
Percentage of time lost to general facility	0.3
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	20.8

* Breakdown of hours lost to instrument
1.00 Blinc not working
3.00 Clio computer & other issues

** Breakdown of hours lost to telescope
1.50 AO softward issues
0.25 M1 panic

*** Breakdown of hours lost to facility
0.75 Videoserver failure

Year to Date April 2011

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	46.00	495.30	103.45	13.55	0.75	3.25	0.00	121.00
PI Instr	67.00	704.10	183.65	4.00	1.50	2.00	0.00	191.15
Engr	7.00	72.90	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	**120.00**	**1272.30**	**290.10**	**17.55**	**2.25**	**5.25**	**0.00**	**315.15**

Time Summary

Percentage of time scheduled for observing	94.3
Percentage of time scheduled for engineering	5.7
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	22.8
Percentage of time lost to instrument	1.4
Percentage of time lost to telescope	0.2
Percentage of time lost to general facility	0.4
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	24.8