MMT Observatory
Smithsonian Institution & The University of Arizona®

End of Quarter Summary

April - June 2015

The MMIRS instrument returned to the MMTO in June. Pictured left to right are C. Chang and R. Ortiz.

MMT Observatory Activities

Our Quarterly Summary Reports are organized using the same work breakdown structure (WBS) as used in the annual Program Plan. This WBS includes a major category with several subcategories listed under it. In general, many specific activities might fall a tier or two below that. The WBS will be modified as needed in future reports.

Administrative

Staffing

T. Gerl, electrical engineer on the mountain staff and safety coordinator, accepted a position with the F.L. Whipple Observatory (FLWO). His last day with the MMTO was May 15.

Reports and Publications

There were 23 peer-reviewed publications and two non MMT-related publications during this reporting period. No technical memoranda or reports were generated. See the listing of publications in Appendix I, p. 21.

Safety

On May 5 C. Knop gave a presentation about the Steward Observatory departmental safety training database website to the Steward tri-annual Safety Committee meeting. This database, which includes the MMTO, is used to centralize and track safety training for employees. The keynote speaker for the meeting was Dr. K. Espy, UA Senior Vice-President for Research.

A second study was commissioned to design a fall safety system for the new roof at the MMT. The system will consist of tie points for life lines used when working on the roof. The second study report is now under review and comment.

On May 8 there was an imbalance runaway near-miss event. The staff acted quickly and correctly, and no damage was done to the telescope or instrument. Nevertheless, a runaway is potentially serious; when out of balance the telescope stores a great deal of potential energy, and if the telescope runs into its hard stops the consequences can be severe. A report on the incident, along with recommendations to prevent a recurrence, was prepared and distributed on May 12 by T. Gerl.

Safety Inspections

A Smithsonian Institution (SI) annual METR (Management Evaluation and Technical Review) inspection was conducted June 16-19. The inspection report will be received in the next reporting period.

Interlock System

On the nights of April 18 and 20, a fault in the interlock system caused the building drives to exhibit intermittent dropouts, bringing the building to a hard stop. After restarting the drives the fault cleared and the system recovered with minimal loss of observing time.

Primary Mirror

The primary mirror was CO_2 cleaned on April 29.

The primary mirror support system continued to exhibit intermittent problems when being raised or lowered. The logs show excessive Z-moments and occasional panics on April 22, May 7, June 17, and June 21. Each time the system recovered without any significant loss of observing time.

Inductors were added to the cell crate power supply to reduce the noise on output voltage from 200mV to 10mV.

Coating & Aluminization

On May 20 the decision was announced to postpone realuminization until summer 2016. The recommendation to do so was made by G. Williams and senior staff, with the MMTO Council supporting the recommendation. This decision was based on a full-scale aluminization test being critical to adequately test all the upgrades that have been incorporated into the realuminization process, and not having enough time to accomplish this before summer shutdown when the planned realuminization would occur. Also, the reflectivity of the primary mirror has dropped by only half (~1.5%) of the criterion usually used for recoating (3%), due to the regular mirror washes and CO_2 cleanings over the past year. Preparations and testing will continue toward the goal of fully automated realuminization next summer.

On April 16, a Grove GMK5175 all-terrain crane operated by Marco Crane and Rigging was used to lift, rotate, and place the rear bell jar, bell jar extension, and bell jar on to the tilt frame, extension cradle, and bell jar cart. The bell jar assembly components were then aligned to each other, and on May 21 all three pieces were mated together. This work was conducted at the F.L. Whipple Observatory Administrative Complex area (basecamp).

Figure 1. The rear bell jar and bell jar are shown before being placed on the tilt frame and cart.

Figure 2. The bell jar is shown being moved into position on the bell jar cart.

To connect the pumping trailer to the bell jar assembly, a 12-inch PVC roughing line and the necessary support stands were fabricated. The initial pump-down of the bell jar assembly took place on June 12 using the two Kinney KT-300 mechanical pumps and the Heraeus RO-6000 roots blower on the pumping trailer. A 20 mTorr vacuum was reached before pumping was halted due to time constraints. With a subsequent pump-down, eight mTorr has been easily reached using the pumping trailer. The bell jar assembly rate of pressure rise has been roughly 400 mTorr per day.

The design for mounting the turbo pump and foreline should be finalized in July, and foreline fabrication is expected to be completed in August. This is on track to allow a full test of the coating system that is scheduled to take place at basecamp in October.

Figure 3. The roughing line is shown connected to the rear bell jar and pumping trailer.

The new welder control box project for realuminization proceeded using the testing and designs discussed in the previous report. The welder interface control boxes were modified with new power supply and amplifier cards, and the welder interface cards were tested extensively.

Ventilation and Thermal Systems

Work continues on the heating, ventilation, and air conditioning (HVAC) system upgrade. This upgrade will also significantly impact the primary mirror ventilation system. In preparation for changes to the primary mirror ventilation system, a Contemporary Controls BAScontrol20 (a BACNET/IP compliant device) was purchased. This device can act as a remote sensor (e.g., measuring temperature and dewpoint) and a controller (e.g., activating/deactivating fan switches). This technology has many possible telemetry and control applications throughout the MMTO facility. Other devices from different vendors, such as the EasyIO controllers, can be used if the Contemporary Controls BAScontrol20 controllers are found to not meet the MMT's needs.

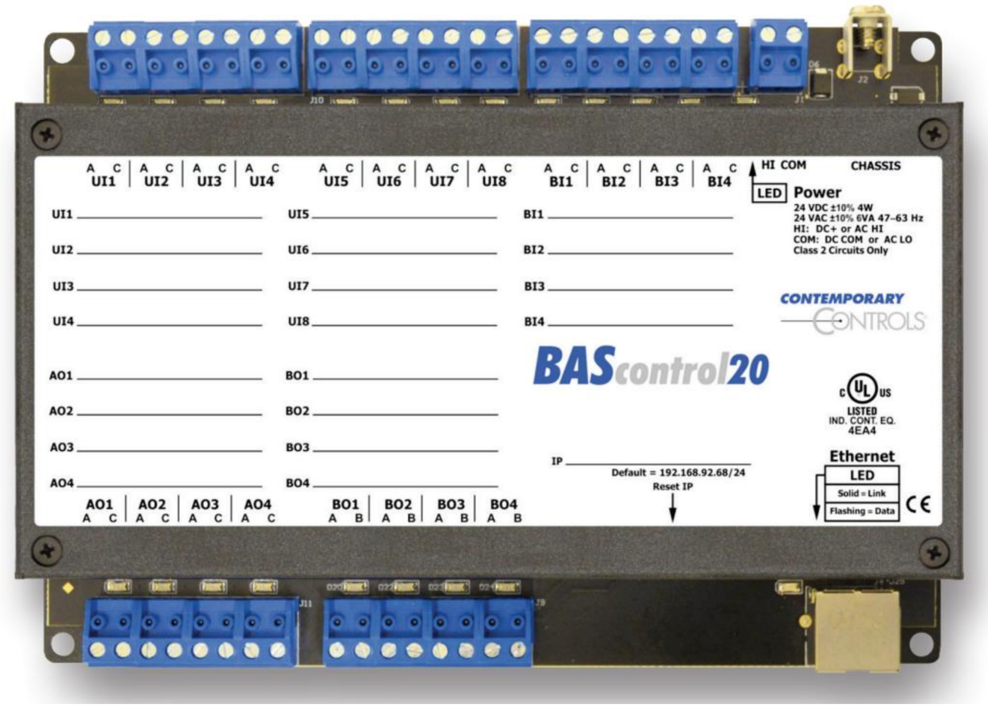

Figure 4. The Contemporary Controls BAScontrol20 controller. This is a BACnet/IP compliant device with a "BACnet Application Specific Controller" (B-ASC) device profile. It can be programmed through commercial tools such as the Niagara Workbench, or configured through a web interface.

The BAScontrol20 has a built-in web interface (Figure 5) that makes it easy to configure using a standard web browser. Network communication to and from the controller via the BACnet protocol can be made with several open-source software libraries. The two libraries that appear the most promising are the C language-based BACnet Stack "BACstack" library and the Python-based BACpypes library. Either of these libraries should provide adequate programming capabilities.

The device also uses a simple Representational State Transfer (REST) application programming interface (API) to get and set values to connected devices. We may use this REST API to control the connected BACNET devices rather than write BACnet communication servers using the Python or C libraries previously mentioned. Since the BAScontrol20 already does the translation from the XML-based REST requests to the BACNET protocol, it makes porting our existing software simpler. Work continues by Pueblo Mechanical & Controls, Inc., the HVAC contractor with the Smithsonian Institution, to have these controllers installed at each of the control points on the new ventilation system. Once they are in place we will begin porting the existing ventilation software servers to use these new devices.

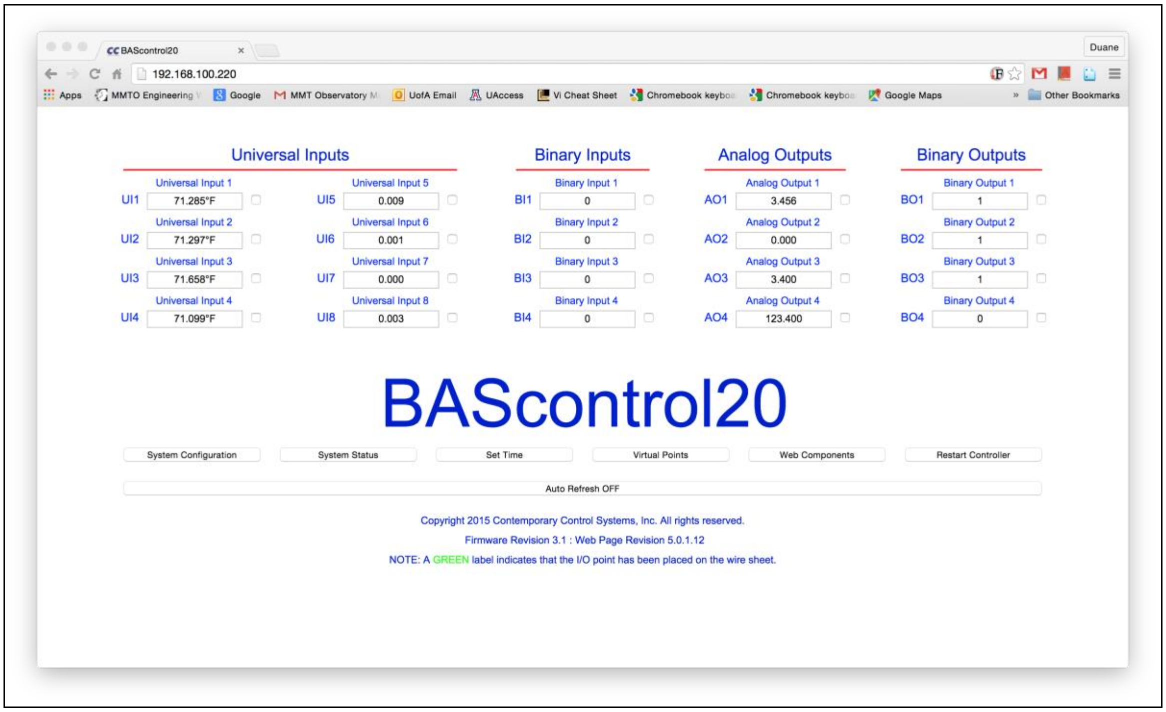

Figure 5. Web interface for configuring the Contemporary Controls BAScontrol20 controller. The 20 data channels are divided into eight universal input, four binary inputs, four analog outputs, and four binary outputs. The eight universal inputs can be configured as: 1) analog input, 2) binary input, 3) 10K type 2 thermistor, 4) 10K type 3 thermistor, 4) 20K thermistor, and 5) resistance. Analog inputs can be configured into dozens of different types of measurement units (e.g., volts, milliamperes, etc).

Secondary Mirrors

f/15

LED display cards for the adaptive optics (AO) smart card enclosure were received and populated. Testing was accomplished, with no issues. The front and back panels for the smart card enclosure were drawn and manufactured.

Arduino cards were manufactured, populated, and tested. These smart cards monitor and control voltages for the AO power supply.

The AO Thin Shell Safety (TSS) removal cable was repaired. The hub two pin connectors had visible failure of their pin locking mechanisms. The connectors were replaced and the cable was tested. The serviceable unit was returned to the summit.

Hexapods

f/9 and f/15 hexapod

New mounting plates for the f/9 hexapod signal conditioner enclosure were made. The new plates will allow removal of the enclosure without removing the circuit card inside. Additionally, a new signal conditioner card will be installed.

Noise on the f/9 hexapod was investigated and discovered to be azimuth-related, with the worst noise at 56 degrees coming from the area of the Instrument Repair Facility (IRF). At this time no adverse impact on operations has been noticed, but this issue will continue to be monitored.

Optics Support Structure

Nothing to report.

Pointing and Tracking

Nothing to report.

Science Instruments

f/9 Instrumentation

Much progress was made on the Red and Blue Channel exposure time calculator during this reporting period. The skeleton of the website that has been in development was finalized, and software hooks were written in javascript to help guide users through the inputs. The hooks were developed in a PHP interface as well as the python calculator software to allow the website to talk to the python code. Remaining steps include adding more documentation and some missing images, finalizing the output structure and supplied data products, and performing sanity checks between the calculated times and signal to noise to data in the archive.

To augment the signal to noise calculator, a number of observers have mentioned that plots of counts per pixel for a bright standard star through commonly-used gratings would be extremely helpful. A compilation of the setups and stars we have observed in the archive has been created and we are cross-correlating the nights with the operators log to exclude nights with obvious weather issues or inconsistent seeing. Once this list is ready, we will determine any missing setups that can be observed during a future Maintenance & Engineering (M&E) night. We expect both of these tools to be ready for users, at least in a beta format, before the next call for proposals.

The f/9 instruments were on the MMT for 32% of the available nights from April 1 through June 30. Approximately 69% of those nights were scheduled with the Blue Channel Spectrograph, 7% with Red Channel, and 24% with SPOL. Of the 231.6 total hours allocated for f/9 observations, 77.7 hours (34%) were lost to weather conditions. Instrument, facility, and telescope problems accounted for 14 hours of lost time. Most of this was due to a failure of the MSD box computer power supply. Blue Channel lost 34% of its time to poor weather, with SPOL losing 37%, and Red Channel losing 0%.

f/5 Instrumentation

There was much activity with f/5 instrumentation this quarter. A short re-commissioning run for MMIRS occurred at the end of June. Modifications were made to the MMTO Cisco network to establish ports on a Smithsonian Institution Virtual Local Area Network (SI-VLAN), for the MMIRS run and in anticipation of next year's arrival of BINOSPEC. Issues developed with the *clark* computer on a couple of nights as well as some power issues in April, possibly related to upgrades of the power distribution system at the summit.

The Cisco network was modified to allocate about 50 ports for use as an SAO internal net. Something similar was tried when the Cisco network was originally installed (around 3 years ago) but some equipment incompatibilities with the configurations caused the SAO group to revert to an isolated wire net for Hecto and SWIRC f/5 systems. Those issues are now better understood (the Cisco boxes were not configured to interface with old 10 M-bit hardware in the EDAS units), and we might try to migrate older f/5 equipment to the newer SI-VLAN. A few ports on the SI-VLAN were configured to work at the slower rate like the port for the MMT's mount crate system.

There were a few issues with one of the new computers disliking the local power at the MMT; running the power through a UPS did not improve the situation. The computer powered down with little warning after a few hours. We eventually found that it worked better when plugged directly to mountain clean power with the *clark* and *hudson* computers and their UPSs powered off. The power's wave form was visibly corrupted as displayed by the Fluke power meter. We will investigate switching to "C" phase power or adding filters to the power.

The *clark* computer stopped operating properly on May 22 when one of the partitions was declared write-only. After several hours of work by S. Moran, M. Conroy, M. Calkins, and M. Lacasse, the writes were redirected to a different partition as an interim solution. The home drive, which included the boot portion, was cloned onto a new disk. When the computer was booted from the new disk, everything appeared to run fine. The initial thought was that the hard drive was failing. A few weeks later the problem returned with a different partition becoming read-only, so we suspected that the problem was elsewhere in the system. Swapping disks between the *clark* box and the *lewis* box showed that the problem was not with the hard drive but with something else in the *clark* system. Swapping drive bays suggested that the issue was on the *clark* motherboard. The *clark* disk was put into the *lewis* box and the software was reconfigured to run both sets of tasks. The *lewis* GUIs (graphical user interfaces) are switched to a second desktop during operation, and the system has operated in this configuration for the past month.

In June there was a short period of oscillation noted for the telescope mount that cleared up after approximately 15 minutes.

There were 453 nighttime hours scheduled over 54 nights for observations with HectoSpec, HectoChelle, SWIRC, MMTCam, and MMIRS. About 24% of the hours were lost to weather, with approximately half of that loss occurring at the end of June.

Hecto observed 152 fields and gathered 495 science exposures over its scheduled 43 nights this quarter. To properly calibrate these exposures, an additional 1700 exposures were taken including bias, flat, comp, sky, and dark images. The annual service mission was performed June 8-16. The Gimbal axis encoder signals had drifted a bit and a few encoder counts were being lost. Some of these signals were just on the edge of the valid domain. This was discovered when the problem was eliminated while an oscilloscope measuring the signals was grounded (someone forgot to add the "cheater"). All eight of the signals were adjusted back to their nominal range and the problem has not returned. While investigating the quality of the various power supplies in the EP box, we discovered that the -15V portion of a triple power supply was not producing a clean signal. The power supply was swapped out with a spare on hand. The battery-backed memory chip in the NW calibration dome box was swapped out and the unit reconfigured.

MMTCam observations were taken on 18 nights, shared with Hecto or SWIRC. Of 47 objects, 691 object images were taken. Calibration images (753 dark, bias, and flat) were taken to assist in analysis of the object images. The "z" filter was reinstalled and the WFS system was tested to determine the source of the high near-infrared background signal. We suspected the source was the optical fiber carrying the USB signals for communication with the Apogee camera and its filter-wheel. We found that the encoders on the wavefront sensor contribute the predominant portion of the background for this filter from the WFS system. The Hecto positioner's encoder and limit LEDs contribute even more (six times more). It is therefore not reasonable to use the filter when the Hecto positioner is powered up. There was one observing run with the MMTCam paired with SWIRC, and over 100 MMTCam images were gathered.

SWIRC was installed in April and June for three observing programs. These were possibly the last runs for SWIRC as MMIRS is now available. The instrument operated over seven nights and gathered 4,425 science images of 15 objects. A similar number of dark, flat, and test images were gathered for calibration.

After traveling by air, ship, and truck, the MMIRS instrument returned to the MMTO from Chile in June. R. Ortiz had traveled to Chile on April 10-21 to help with packing the instrument for shipping. MMIRS was on the telescope for three nights at the end of this quarter (the final night was July 1, technically in the next quarter).

Thunderstorms during the MMIRS preparation and on-telescope time did not allow B. McLeod and others to perform all of the desired commissioning tasks. Connection to the MMIRS instrument from the *pixel* computer through the Fields virtual machine worked well. Many other tasks also worked fine such as cooldown and warmup. A few variables names did not quite match between the MMT TelServer and what the MMIRS software expected. We also discovered that we needed to use the target position angle (PA) rather than the measured one in some portions of the guider code because small variations in the measured PA were tagged by the MMIRS software as a failure to have tracking locked. This prevented some guide commands from executing.

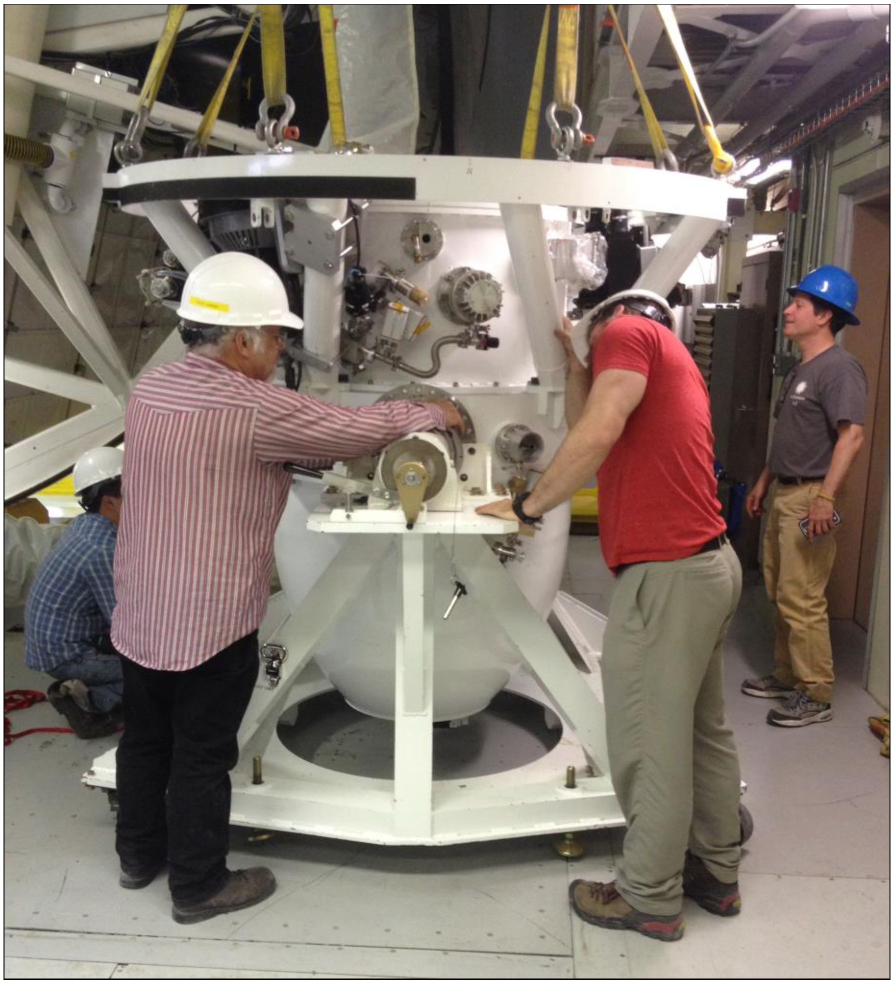

Figure 6. M. Lacasse and others readying MMIRS for mounting on the telescope.

Figure 7. The MMIRS instrument being mounted on the telescope.

f/15 Instrumentation

There was one adaptive optics (AO) run this period, May 1-7. Considerable time was lost due to poor weather. However, parts of the science nights were very productive and the AO system worked well when weather permitted. The replaced DSP board and TSS power cable repair were also verified during on-sky testing.

Testing has been proceeding with the WFS camera fiber converter card. Progress was made in getting image data from the SciMeasure camera to the EDT frame grabber card in the *ao-pcr* computer.

The PID algorithm was re-implemented in the current baseline software and was verified through on-sky testing.

Topboxes and Wavefront Sensors (WFS)

f/5 WFS

A previous fork of the WFS software was resurrected for use with MMIRS. Based on input from the MMIRS team, the software was updated to accept images from the MMIRS WFS camera. We created a "continuous" mode in the WFS software that will continuously check the MMIRS WFS camera status; if a new image has been taken, that image will be analyzed, the wavefront error calculated, and the correction supplied to the primary. In this mode the WFS can be run simultaneously with science observations, which should lead to noticeably better image quality and lower overhead compared to having to perform wavefront measurements between each observation.

The MMIRS WFS software changes were tested when MMIRS returned to the MMTO in June. While the commissioning run wasn't able to observe the sky due to monsoonal weather activity, the WFS software was able to run in an uninterrupted continuous state on the MMIRS reference LED. Archival WFS images from Magellan were also tested to ensure that realistic corrections were calculated. Finally, small tweaks were applied to the WFS spot finding algorithm for all WFS software that should make it more robust in the presence of faint spots. This is rarely an issue with standard WFS observations as very bright stars are utilized. But with continuous WFS observations the stars will be much fainter and thus a robust spot finding algorithm is needed. Further development is ongoing to improve the deblending in the spot finding algorithm to make the method more stable in marginal seeing.

Finally, work had paused on the new version of the WFS software to ensure that we had functioning software in time for the MMIRS re-commissioning. Now that this deadline has passed, work is moving forward on a full re-porting of the existing WFS software to a single language (Python).

f/9 Topbox

Issues that arose on the *f9wfs* computer were resolved after it had been powered off for many days. A recurring "prelink" problem on this computer was also addressed. "Prelinking" (also called "prebinding") is a method for speeding up a system by reducing the time a program needs to begin.

Development with something easier to support is ongoing with the SOAP communications protocol between the blue/red spectrograph server and its clients. The Ruby/SOAP server interface has been obsolete for some time.

Facilities

General Shop

Construction began on converting a toaster oven into a solder reflow oven that will help support mass production of surface-mount boards. Components can be mounted or placed directly onto the surface of printed circuit boards. A 115V power control for the oven was also completed. This oven will mostly be used for realuminization electronics, but it is considered a new shop tool that will be used to produce other boards as well.

Instrument Repair Facility (IRF)

The cable for the communications room generator back-up was rebuilt.

General Infrastructure

Progress was made on the following Smithsonian Institution (SI)-funded projects:

<u>MMT Lift</u>

This is a new project to replace the existing dock lift with a new in-ground lift capable of raising six tons to the observing chamber door. Bid documents were prepared and distributed, and a pre-bid meeting and site inspection were held. Sealed bids have been received and are being processed by SI. Documentation can be found in the MMTO Documentation Database under Administration/SI Projects/1583804 Summit Lift

<u>MMT Roof</u>

This is a project to cover the existing membrane roof with a standing seam metal roof with low-emissivity coating (Galvalume®), and fitted with an embedded heating system for melting snow. Shop drawings were prepared and reviewed, but they will need to be modified to incorporate a fall protection system, which consists of tie points for life lines when working on the roof. Concepts are being reviewed. With this delay the start of work has slipped to the fall of 2015, though completion is still expected in September-October 2015. Reports are available under Administration/SI Projects/1383801 MMT Heated Roof.

<u>HVAC Upgrades</u>

Work continued on the HVAC project, which includes a number of needed upgrades to aging HVAC equipment at the MMT. Piping and conduit runs to the new chiller have been pressure tested. New glycol pumps and an automatic makeup supply unit are in place but have yet to be plumbed in. Three new electrical panels were squeezed into position under the awning at the IRF, and conduits run and power lines were installed and tested. Three aging air handlers were removed and four new fan coil units (FCUs) have been installed. Several meetings were held between contractors and MMTO staff to work out the details of controllers for the new equipment. In the interim the FCUs are being used to cool the facility without controls – they are simply on or off. (OFEO # 1283807)

<u>Repairs to Heated Summit Road</u>

In addition to installing a new cable barrier and hand rail, bidders have been requested to provide quotes for three options. The first two are: 1) replace the existing asphalt pavement, and 2) mill off the asphalt down to the old concrete planks that underlie the rod and apply three inches of concrete to cover the old road bed. The third option is to install a test section of concrete roadway with embedded heating cable. The test section would be next to the Common Building. Bids have been received and are being processed by SI. Documents are posted at Administration/SI Projects/MMT Heated Road/Submissions. (OFEA # 0883805)

Computers and Information Technology

Computers and Storage

Pixel (the observer computer) had been reported to intermittently reboot itself every two weeks on Mondays at 2:30-2:40pm. Due to the very odd timing and rarity of the problem, it is still unclear what caused this issue. In order to isolate a possible hardware problem in the computer itself, a replacement for *pixel* was created from scratch and put in place on the mountain. The reboot problem persists (although it now occurs on Wednesdays). The power cord was replaced with a new one. If the problem persists, a different power source will be tried. The original *pixel* shows no issues in the campus offices. We will be wiping it and updating its software so that it can be used as an on-site backup should the primary observing station fail.

The Fedora Directory Server (FDS) console for our Lightweight Directory Access Protocol (LDAP) servers had not been working for some time. Its issues were researched, addressed, and it is now working.

Processes on *hacksaw* that had been consuming unexpected amounts of resources were evaluated. One miniserver was identified to be causing an excessive load on the domain name server. This issue was resolved.

Network

During this quarter the new campus VPN software, which uses two-factor authentication, was tested and it is now working satisfactorily for staff.

Hardware/Software Interfaces

The control room telescope status (telstat) displays were updated with a new component that shows a detailed icon indicating the building rotation, chamber doors open-and-close position, as well as the telescope elevation, each based on actual telescope position data. In addition, a new spiral progress bar, visualizing how the cables are winding around the "maypole," shows the current position of the telescope/building rotation. This bar will help the telescope operator and observers determine which way the telescope will slew when choosing their next targets.

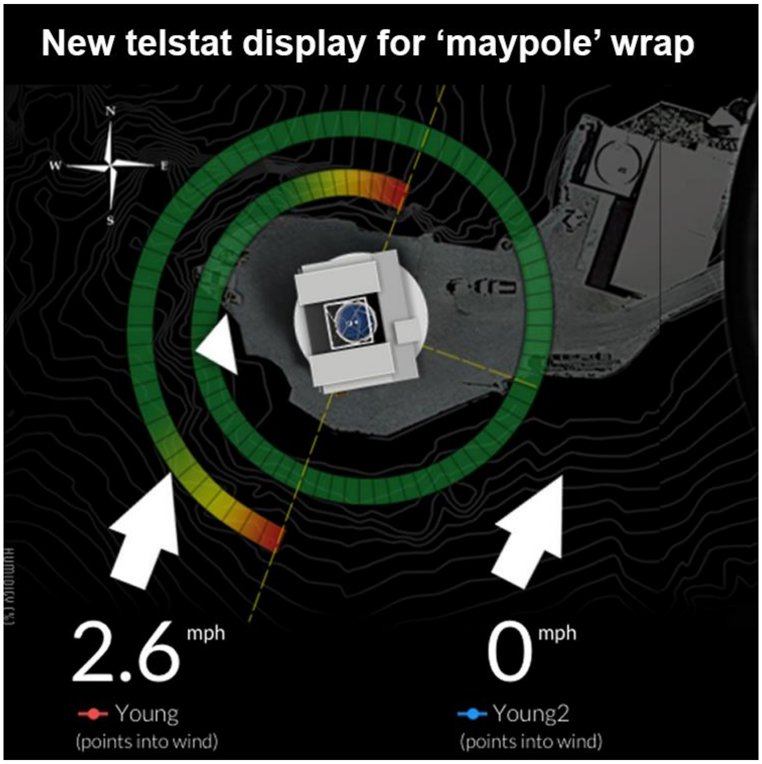

Figure 8. The detailed MMT icon showing rotation of 220 degrees, elevation of 80 degrees, and the chamber doors open. The green spiral represents the winding of the cables around the "maypole."

Figure 9. Another representation of the "maypole" is depicted above.

Work continues on a replacement for the control room CRT acquisition monitor. A prototype was created and briefly tested while f/9 was on-sky in late June. The results were very promising. The new system will display the live video on an LCD monitor rather than a CRT. The CRT had been used for many years due to its wide range of sensitivity, which is useful for viewing faint objects. Several attempts to replace the CRT with an LCD in the past have not succeeded. This time, rather than just converting the signal from analog to digital and displaying on a LCD, a series of real-time video processing tools were created to allow for a wide range of video image adjustment. The new system passes the live analog video feed into an AXIS Ethernet encoder, and then it is displayed as an MJPEG (motion JPEG) on a GUI made from HTML and JavaScript components. A scalar vector graphics (SVG) filter, which applies the image adjustments in real-time using the graphic processor, is applied to the live video object. This proves to be an extremely fast way to adjust the image with no noticeable lag or loss of image quality. A "remote control" GUI will also be provided for adjusting the display settings from a different computer. We are currently researching displays and computer hardware to run the new system.

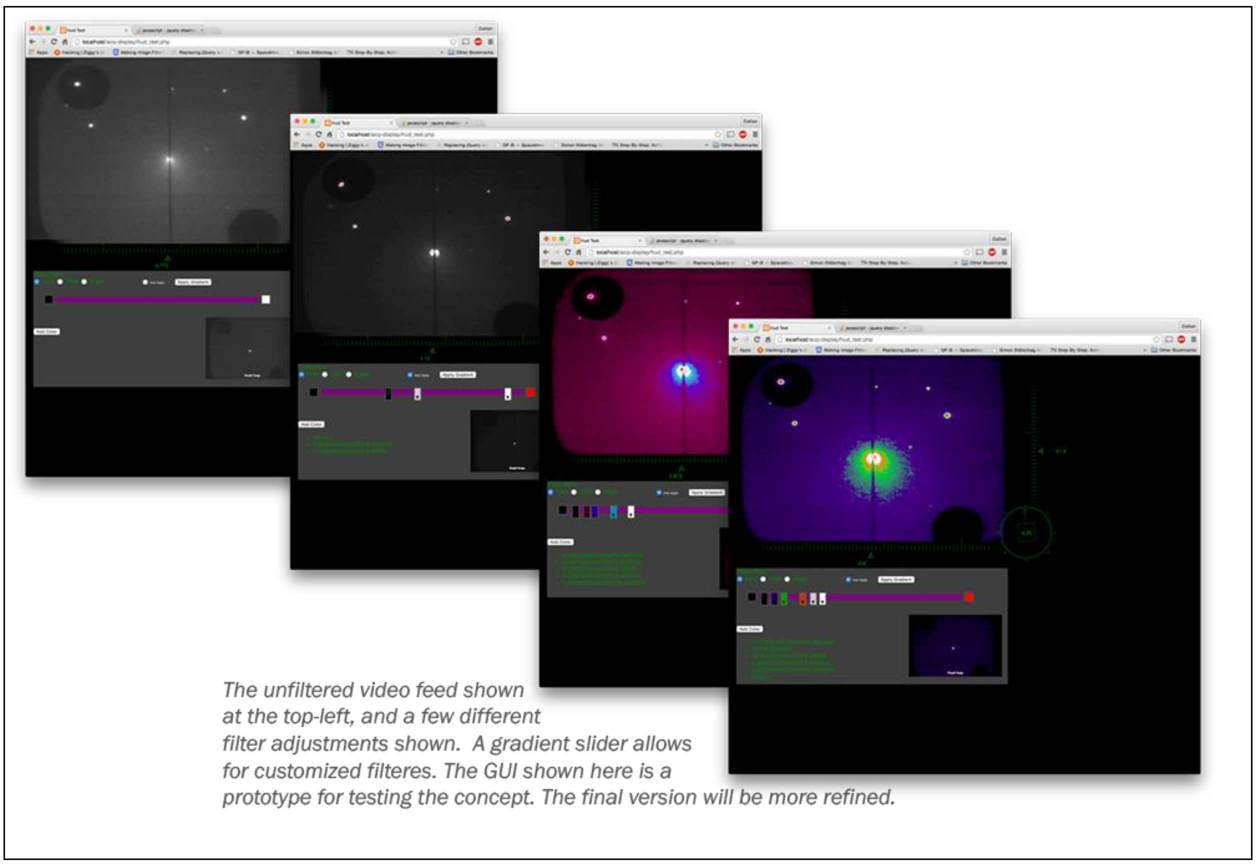

Figure 10. Prototype LCD acquisition monitor that will replace the CRT monitor previously used for many years. Real-time video processing tools were created, which allow for a wide range of image adjustments.

Weather and Environmental Monitoring

Seeing

Figures 11 and 12 present apparent seeing values, corrected to zenith, at the MMTO for the period of April 1 - July 1, 2015. These values are derived from measurements made by the f/5 and f/9 WFSs.

Figure 11 shows the time-series seeing data for April through June 2015. Seeing measurements for the f/5 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. No data were collected during f/15 configurations.

Overall seeing trends for the two WFS systems are essentially identical as seen in Figure 12. The median f/5 seeing value is 0.82 arcsec while the median f/9 seeing value is 0.83 arcsec. The combined median seeing for the two WFS systems is 0.82 arcsec. The f/5 WFS data set is larger than the f/9 WFS set (1392 points for f/5 versus 581 points for f/9), for a total of 1,973 data points.

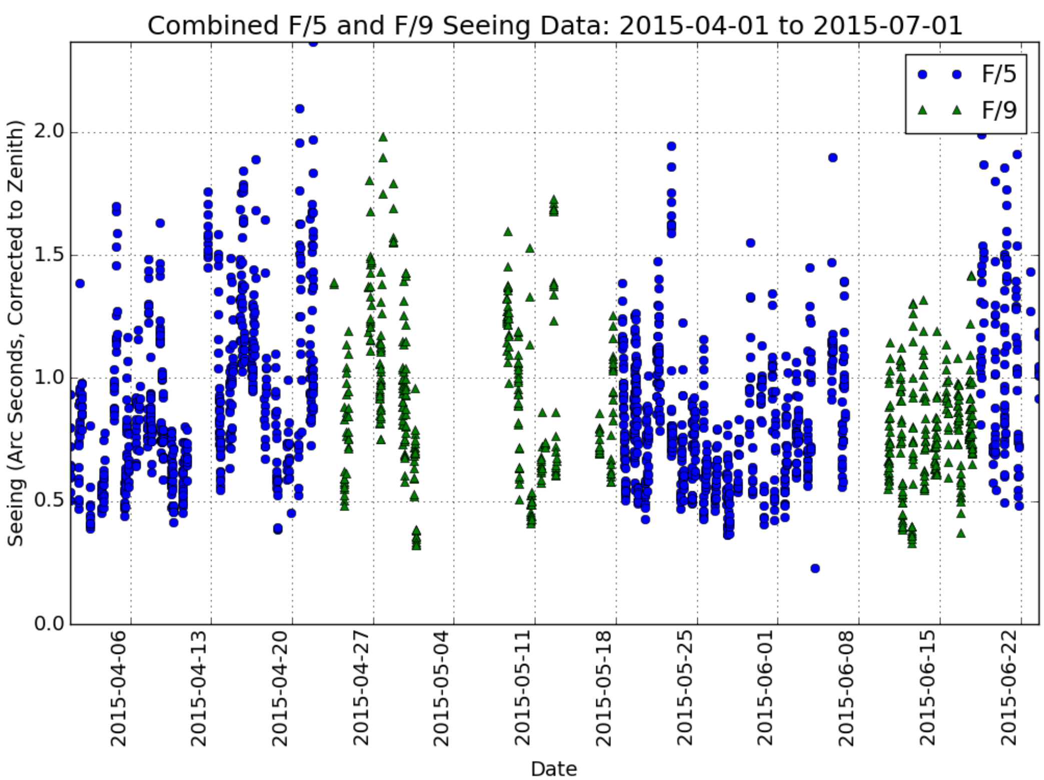

Figure 11. Derived seeing for the f/5 and f/9 WFSs from April through June 2015. Seeing values are corrected to zenith. f/5 seeing values are shown in blue while f/9 values are in green. An overall median seeing of 0.82 arcsec is found for the 1,973 combined (f/5 and f/9) WFS measurements made during this period.

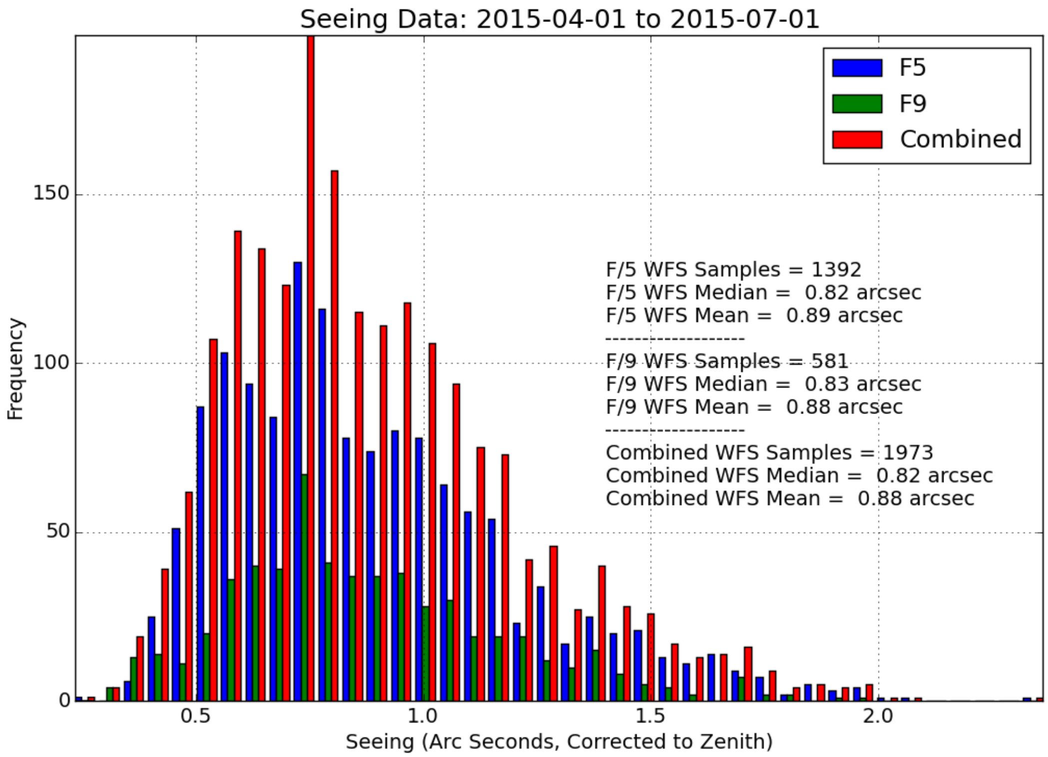

Figure 12. Histogram (with 0.1 arcsec bins) of derived seeing values for the f/5 and f/9 WFSs from April through June 2015. Seeing values are corrected to zenith. Median f/5 seeing is 0.82 arcsec while the median f/9 seeing is 0.83 arcsec. A combined (f/5+f/9) median seeing value of 0.82 arcsec is found for the 1,973 WFS measurements made during this period.

User Support

Remote Observing

A total of seven nights of remote observing were supported this quarter. Six nights were for UA observers, with one night for CfA.

Documentation

Nothing to report.

Public Relations and Outreach

Visitors and Tours

4/18/15 – G. Williams led a tour for 21 undergraduate students in E. Olszewski's Univ. of Arizona Astronomy 296 course. Dr. Olszewski is a frequent observer at the MMT.

5/18/15 – Prof. S. Oey from the Univ. of Michigan at Ann Arbor and students in her Astronomy 461 course joined the regular F.L. Whipple Obs. tour taking place that day that included the MMT.

5/21/15 – D. Franco was given a tour of the MMTO by R. Ortiz. See below for more on a follow up of her tour.

MMTO in the Media

An article entitled "Visit Observatory Atop Mount Hopkins" written by Ellen Sussman was published in the *Green Valley News* on June 17, 2015. The article advertised the FLWO public day tours.

An article entitled "World's 14th Largest Telescope Brings Visitors Closer to the Sky" written by Daniela Franco appeared on the *New York Times* Student Journalism Institute website on May 27, 2015. The article features a short interview with M. Calkins (a Hecto instrument operator) and a description of the MMT.

Research led by J. Mauerhan using MMT data appeared in the *Washington Post* and other media outlets on May 23, 2015. The articles described the unusual behavior of a star nicknamed "Nasty 1".

The MMTO's social media presence continues to grow, with over 200 followers on Twitter and over 1000 likes on Facebook.

Site Protection

The city of Benson Planning and Zoning Commission is in the process of updating their Zoning Regulations. The MMTO remains in touch with the P&Z commission and city council to await the review of the Outdoor Lighting section.

At the end of May 2015, the Sierra Vista City Council passed a limit of 100 nits as a maximum LED sign brightness at night. The MMTO worked with members of the Huachuca Astronomy Club and other groups on this issue.

Appendix I - Publications

MMT Related Scientific Publications

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

15-23 A New Luminous Blue Variable in M31
R.M. Humphreys, J.C. Martin, and M.S. Gordon
PASP, **127**, 347

15-24 Megacam: A Wide-Field CCD Imager for the MMT and Magellan
B. McLeod, J. Geary, M. Conroy, et al.
PASP, **127**, 366

15-25 Data Reduction Pipeline for the MMT and Magellan Infrared Spectrograph
I. Chilingarian, Y. Beletsky, S. Moran, et al.
PASP, **127**, 406

15-26 Selecting Superluminous Supernovae in Faint Galaxies from the First Year of the Pan-STARRS1 Medium Deep Survey
M. McCrum, S.J. Smartt, A. Rest, et al.
MNRAS, **448**, 1206

15-27 Uncovering Blue Diffuse Dwarf Galaxies
B.L. James, S. Koposov, D.P. Stark, et al.
MNRAS, **448**, 2687

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Appendix II - Service Request (SR) and Response Summary: April - June, 2015

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, staff members create responses to address and eventually close the SR. These SRs and associated responses are logged into a relational database for later reference.

Figure 13 presents the distribution of SR responses by priority during the period of April through June 2015. As seen in the figure, the highest percentage (60%) of responses was "Important" priority. "Critical" and "Near-Critical" priority responses were both 16% of the total number of SRs. "Information Only" and "Low" priority responses were 5% and 3%, respectively. "Critical" SRs address issues that are preventing telescope operation, while "Near-Critical" SRs relate to concerns that pose an imminent threat to continued telescope operation.

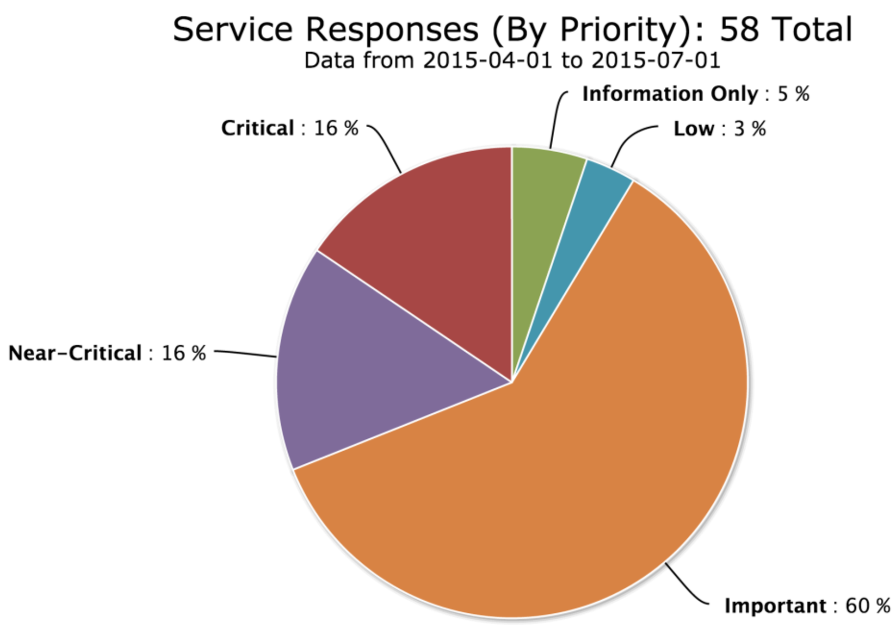

Figure 13. Service Request responses by priority during April through June 2015. The majority (60%) of the responses are related to SRs of "Important" priority, while 16% were "Critical" responses and 16% were "Near-Critical" responses. 5% of the responses were "Information Only" while 3% were "Low" priority.

There were a total of 58 SRs during this three-month period, compared to 56 SRs during the previous three-month reporting period. The percentage of Critical and Near-Critical SRs increased dramatically from the previous reporting period. Critical and Near-Critical SRs account for a combined 32% of the total SRs for this reporting period, while there were only 4% Critical SRs and no Near-Critical SRs in the previous reporting period.

Figure 14 presents the same 58 SR 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 "Building," "Telescope," "Support Building," and "Logs" categories with 15, 10, 9, and 8 responses, respectively. Responses also occurred in the "Cell," "f/9 Topbox," "Instruments," "Software," "Thermal Systems," and "Weather Systems" categories.

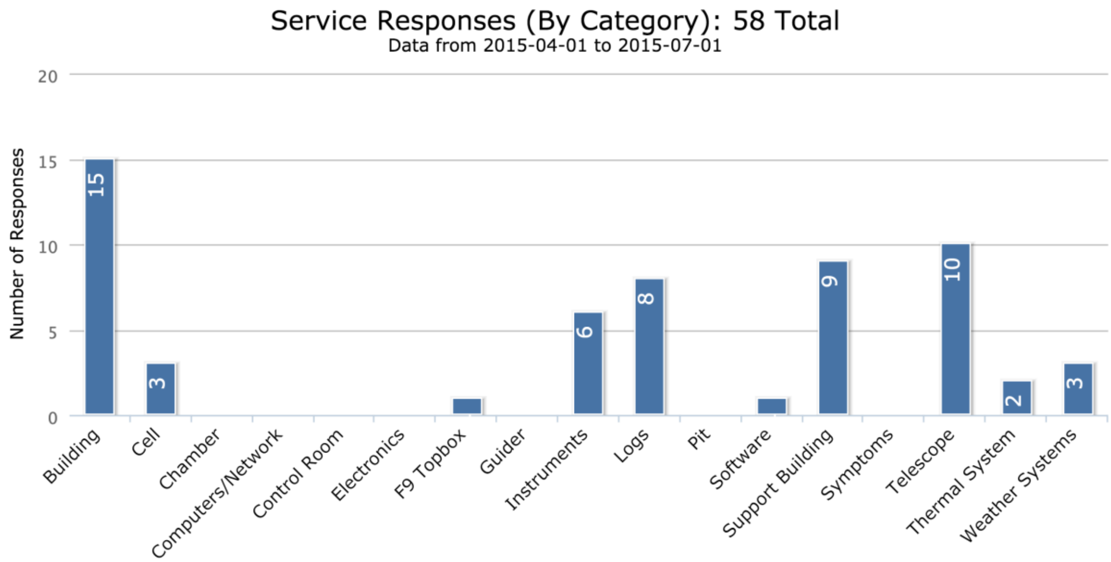

Figure 14. Service Request responses by category during April through June 2015. The majority of responses were within the "Building," "Telescope," "Support Building," and "Logs" categories.

Appendix III - Observing Statistics

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 2015

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	4.00	35.70	21.30	9.00	0.00	0.00	0.00	30.30
PI Instr	24.00	222.80	35.35	0.00	0.00	5.00	0.00	40.35
Engr	2.00	18.10	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**	**56.65**	**9.00**	**0.00**	**5.00**	**0.00**	**70.65**

Time Summary

Percentage of time scheduled for observing	93.5
Percentage of time scheduled for engineering	6.5
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	20.5
Percentage of time lost to instrument	3.3
Percentage of time lost to telescope	0.0
Percentage of time lost to general facility	1.8
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	25.5

* Breakdown of hours lost to instrument

9.00 Problem with MSD box computer power supply

*** Breakdown of hours lost to facility

3.00 Lost shop power due to work by subcontractor doing HVAC upgrade

2.00 Front shutters wouldn't open due to damaged connector in latch cable

May 2015

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	91.80	31.95	0.00	0.50	0.00	0.00	32.45
PI Instr	17.00	139.10	37.20	2.10	0.00	0.00	0.00	39.30
Engr	3.00	25.20	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**	**69.15**	**2.10**	**0.50**	**0.00**	**0.00**	**71.75**

Time Summary

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	27.0
Percentage of time lost to instrument	0.8
Percentage of time lost to telescope	0.2
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	28.0

* Breakdown of hours lost to instrument

2.10 Hecto "clark" computer problems

** Breakdown of hours lost to telescope

0.50 Hexapod issue

Year to Date May 2015

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	61.00	634.60	319.55	9.00	1.50	0.00	0.00	330.05
PI Instr	80.00	794.00	247.80	3.10	8.25	5.75	0.00	264.90
Engr	10.00	99.80	48.70	0.00	0.00	0.00	0.00	48.70
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**151.00**	**1528.40**	**616.05**	**12.10**	**9.75**	**5.75**	**0.00**	**643.65**

Time Summary

Percentage of time scheduled for observing	93.5
Percentage of time scheduled for engineering	6.5
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	40.3
Percentage of time lost to instrument	0.8
Percentage of time lost to telescope	0.6
Percentage of time lost to general facility	0.4
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	42.1

June 2015

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	6.00	46.20	3.00	0.50	0.25	0.50	0.00	4.25
PI Instr	23.00	178.50	90.10	4.00	0.25	0.25	0.00	94.60
Engr	1.00	7.80	7.80	0.00	0.00	0.00	0.00	7.80
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**232.50**	**100.90**	**4.50**	**0.50**	**0.75**	**0.00**	**106.65**

Time Summary

Percentage of time scheduled for observing	96.6
Percentage of time scheduled for engineering	3.4
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	43.4
Percentage of time lost to instrument	1.9
Percentage of time lost to telescope	0.2
Percentage of time lost to general facility	0.3
Percentage of time lost to environment	0.0
Percentage of time lost	45.9

* Breakdown of hours lost to instrument

0.25 Observer typing error changed mode parameter
0.25 Observer typo closed display window (ds9)
4.00 Hecto "clark" computer problems

** Breakdown of hours lost to telescope

0.25 Telescope vibration
0.25 Primary mirror (M1) panic

*** Breakdown of hours lost to facility

0.50 Problem w/"pixel" (observer computer) del. key
0.25 Power failure

Year to Date June 2015

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	67.00	680.80	322.55	9.50	1.75	0.50	0.00	334.30
PI Instr	103.00	972.50	337.90	7.10	8.50	6.00	0.00	359.50
Engr	11.00	107.60	56.50	0.00	0.00	0.00	0.00	56.50
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**181.00**	**1760.90**	**716.95**	**16.60**	**10.25**	**6.50**	**0.00**	**750.30**

Time Summary

Percentage of time scheduled for observing	93.9
Percentage of time scheduled for engineering	6.1
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	40.7
Percentage of time lost to instrument	0.9
Percentage of time lost to telescope	0.6
Percentage of time lost to general facility	0.4
Percentage of time lost to environment	0.0
Percentage of time lost	42.6