Smithsonian Astrophysical Observatory & Steward Observatory, The University of Arizona

MMT Observatory
Smithsonian Institution & The University of Arizona®

Quarterly Summary

July - September 2017

Photo credit: D. Porter

August 27: G. Williams (Dir, MMTO), K. Espy (Sr VP for Research, UA), R. Robbins (Pres, UA), and B. Jannuzi (Dir, Steward Obs.)

MMT Observatory • The University of Arizona • Tucson, Arizona 85721 • PHONE: 520. 621. 1558 • FAX: 520. 621.4144

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

Bianca Lara started on August 21. She is a UA student and will work with the software group.

Scheduling

Summer shutdown began on July 25 and ended on August 21. The observatory reopened on August 22. The all-hands cleaning day took place on the following day, August 23.

Reports and Publications

There were 14 peer-reviewed publications during this reporting period. See the listing of publications in Appendix I, p. 24.

Safety

C. Knop and J. Di Miceli attended the National Safety Council Safety Expo held September 25-27 in Indianapolis, IN.

Training

C. Chang attended a WFR (Wilderness First Responder) course at Flagstaff Field Institute held August 11-19 in Flagstaff, Arizona. The course taught prevention, assessment, and treatment of injury and illness in remote, austere settings. Training consisted of the following:

- Performing a patient assessment and preparing SOAP (subjective, objective, assessment, plan) notes
- Understanding principles for prevention of wilderness medicine problems
- Identifying and assessing potential hazards in the wilderness
- Treating injuries, illness, and environmental problems
- Performing medical and rescue skills

- Decision-making about the need for urgency of evacuation while balancing risk towards patient care
- Leadership roles and communication

C. Chang earned the following three certifications, each good for two years:
- Wilderness First Responder
- Adult/Child CPR, AED & Airway Management
- Epinephrine Auto-injector

Primary Mirror

Ventilation and Thermal Systems

Replacement of the old filters in the blower house during shutdown was postponed due to the incorrect size being ordered. The correct filters (16"x20"x4" with 62R media) arrived just after shutdown ended. The new filters are on the summit and the replacement will take place as soon as the telescope schedule permits.

In the process of starting the blower house filter replacement, the two filters were removed and the blower house plenum was inspected. Overall, the sealant and paint were in good shape, so no additional work was necessary. A wiper for delicate tasks was used to wipe a few areas of the plenum. No evidence of dust was observed on the wiper.

Hardpoints

One of the hardpoint (hp3) motors was removed to inspect the grease and the coupling. Both looked fine, and the motor was reinstalled. Due to the effort required to remove the hardpoint motors, the inspection of this hardpoint is considered a representative sample. While this inspection was being performed, the lack of a mechanical travel stop on the MMT hardpoints was noted; subsequent Steward mirror cells have mechanical travel stops on the hardpoints. Retrofitting the MMT hardpoints with a mechanical stop has been identified as a future improvement project.

The discrepancy between the reported and actual hardpoint air pressure values was resolved during shutdown. The cell graphical user interface (GUI) was reporting hardpoint air pressure values about 20% below the pressure measured at the cell with an analog test pressure gauge. This was noticed during the checkout of the new pressure sensors installed in the air loops. The scaling factor in the cell code was updated to reflect the actual pressure at the cell. With the GUI reporting a lower value than the actual pressure, the 44 psi reported at the GUI (and in the background logs) was actually about 50 psi at the hard points. This hard point air pressure is much higher than the 34 psi at which the cell was originally intended to operate. While the MMTO hard point pressure had been increased shortly after commissioning of the 6.5m telescope to deal with hardpoint breakaway during slews, the 50 psi pressure could potentially induce a higher than desired force on the primary mirror in a breakaway event. The commanded hardpoint air pressure when the mirror is in the magic position was changed to 44 psi; this pressure was verified with the analog pressure gauge. Due to the non-linear adjustment of the hardpoint air pressure transducer, adjustment of scaling factors has changed the hardpoint air pressure during a mirror raise to 38 psi. Previously, the hardpoint air pressure during a mirror raise was reported to be 29.4 psi. However, the actual pressure on the hardpoints was probably 35 psi. A new hardpoint pressure transducer designed for the operational pressure range of the hardpoints has been ordered and will be installed when resources allow.

Actuators

Five mirror actuators (L109, L102, L132, L33, and L120) were removed from the cell and tested on the actuator test stand. These actuators were selected due to these units having intermittent operational issues over the past year. Some of the actuators had issues that were repaired, such as debris in the orifice of one of the transducers. Other actuators did not exhibit any issues when operated on the test stand. The actuator from location 132 (actuator 041) exhibited strange behavior on the test stand, so actuator 014 was installed in location 132. The issues with actuator 041 will be investigated at a later time. The pressure transducers on all of the removed actuators had the zero and span values adjusted to three psi and 110 psi, respectively, before calibration on the test stand. The checking and adjustment, if necessary, of the zero and span values for each of the transducers is a new step added to the actuator test/calibration procedure.

The actuator test stand was displaying calibration errors. This may have been caused by the precision reference voltage being out of specification. The voltage was adjusted to a value that matched the software code when the system is operating. Additional testing will be done.
In order to standardize all of the actuator loop air pressure sensors, the four loop air pressure sensors were replaced with new sensors. All were tested and the cell crate code updated to reflect the new electronic values. Spare sensors are on hand as well. This upgrade eliminated the issue of one loop pressure always reading low and simplified the crate code conversion.

Secondary Mirrors

Nothing to report.

Hexapods

f/5 hexapod

On September 3, the f/5 hexapod malfunctioned. Encoder values were not updating when the pods were moving. The system was rebooted and it became operational. After an hour, the system failed again. The system was shut down and the next day a team began troubleshooting. The system was losing communication between the UMAC and TURBO UMAC. A fault indication of “B” was noted on the UMAC Macro CPU module. The power supply on the UMAC was replaced, and the hexapod began working nominally. The Service Request (SR) was closed.

On September 11, the hexapod had several pods run into their limits. It was possible to back all pods except pod B out of the limit. After extensive troubleshooting, it was determined that the pod B cherry switch was bent. The lever arm was repaired and the pod was backed out of its limit. The hexapod was tested for two hours with no faults.

The following night, pod F ran into its limit. The pod was successfully retracted from its limit, but the cause for it going into a limit was unclear. With the help of the operator during the daytime, it was determined that a fiber was failing during elevation movements. The fiber was replaced and the system was operated for six hours with no failures. The SR was closed. Three Delta Tau modules (fiber module, macro CPU, and power supply) were sent to the manufacturer for evaluation and repair.

f/9 and f/15 hexapod

A new radio repeater system was installed during the previous quarter. With the f/9 secondary mounted, the telescope was pointed to various azimuths at and around 56 degrees as well as 270 and 180 degrees. Data gathered and reviewed showed minimal interference when the land mobile radios (LMR) were keyed and the repeater was active. It was noticed that if a LMR was keyed within a meter of the hexapod, interference was significant. The SR was closed.

Optics Support Structure

Nothing to report.

Pointing and Tracking

Rotator

The rotator read heads were addressed during summer shutdown. The northeast read head has failed to calibrate for more than a year. This failure did not cause any down time because the southwest read head would always calibrate. The electronics group acquired a PMT meter used for analyzing read head signal quality and signal strength. It was determined from the meter readout that the northeast head was not seeing the absolute reference track of the tape encoder.

From visual inspection, it appeared the read head was not seeing the reference track due to a possible ride height issue. Using the encoder data sheet, measurements were taken to determine head to tape alignment. It was noted that the northeast head was indeed riding about .010” above the reference track on the tape. The read head was then lowered, and PMT data taken showed significant improvement on signal quality and strength.

However, as testing progressed, the northeast read head was found to calibrate over a range of approximately 300 degrees. This meant that we would not get a calibrated head at the rotator stow position +/-30 degrees. Upon closer inspection, it was determined that the reference track of the tape encoder was scratched. This was not a serious problem since the southwest head was located 180 degrees from the damaged area and would always calibrate at the rotator stow position.

After a lengthy discussion, the decision was made to continue rotator calibrations at stow position. If the telescope operator wants both read heads calibrated, they were advised to position the rotator at +60 degrees, and then perform another calibration. Since this revised procedure, the rotator has not failed to calibrate.

Mount Alignment Telescope

Final tweaks were made to the mount alignment telescope (MAT) during summer shutdown, and a new web interface was created for it (Figure 1). The interface is built around the JS9 (https://js9.si.edu/) widget that allows you to display, analyze, and manipulate FITS images directly within a web browser. The rest of the interface interacts with a backend server that controls the camera and exposes the camera's capabilities to the user (e.g. cooling, set-point temperature, filter, etc.). As images are acquired, the JS9 widget is updated to display them. The display can be manipulated in a way very similar to the DS9 viewer that has been in use at the MMTO for many years.

Figure 1 also shows that the MAT is well-aligned with the main telescope. The star in the image was placed at the center-of-rotation in the VideoScope display and is within a few arcsec of the center of the MATcam image. More on-sky engineering is required to fully verify/quantify the quality of the MAT's alignment.

The JS9/backend server model used here can easily be applied to building new web-based interfaces for other MMTO imaging systems. The software is available at:
https://github.com/MMTObservatory/camsrv.

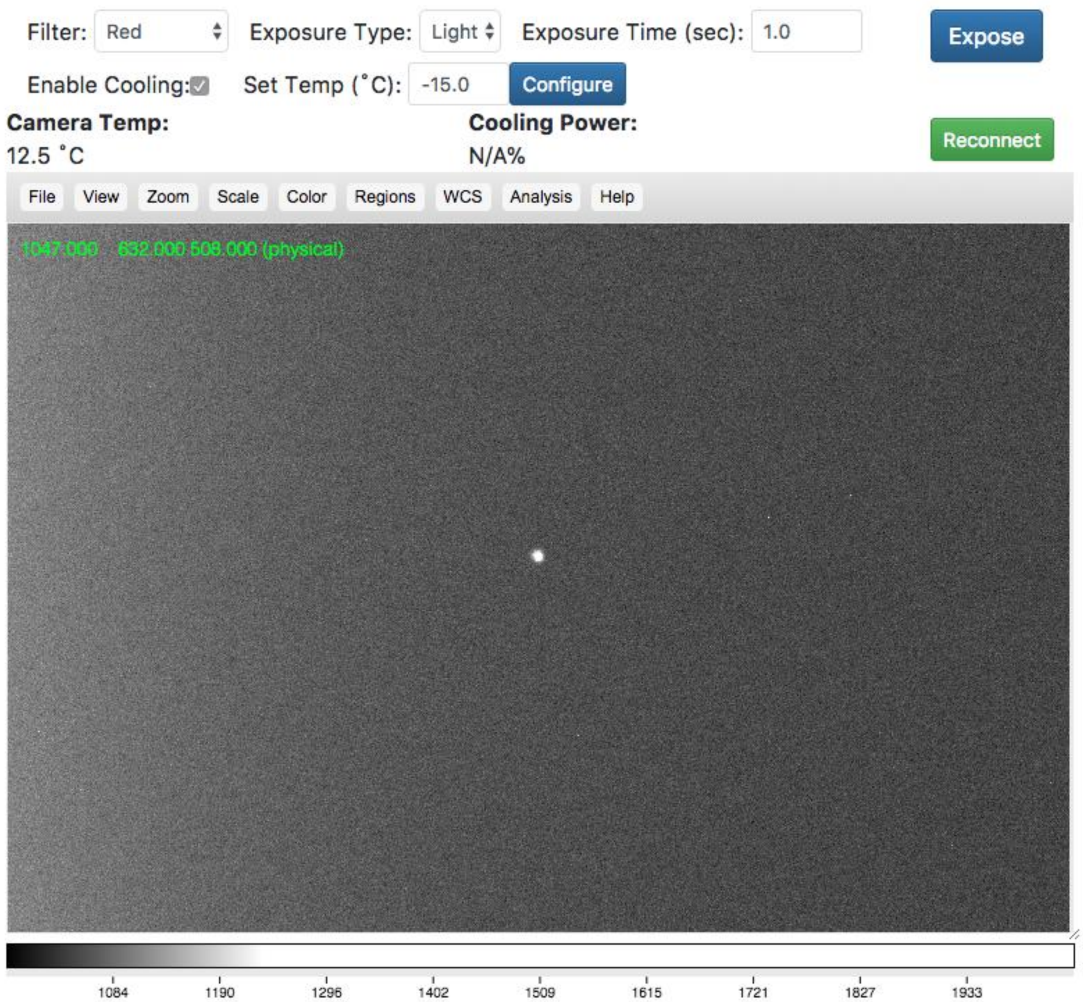

Figure 1. Web interface to the mount alignment telescope (MAT).

This interface provides a means of controlling and acquiring data from the SBIG ST-402 that is attached to the Mount Alignment Telescope (MAT). Its use should be fairly straightforward and the 'Help' button provides details on the capabilities of the JS9 image analysis widget used here.

Some tips/caveats:

- It is recommended to enable cooling when taking images and then turn it off when not in use. The cooler maxes out at about 30 degrees Celsius below ambient, but every bit helps in reducing dark current and hot pixels.
- Reconnecting the camera from this interface is still not fully reliable. If there are issues or if the MAT has been powered off, it is best to login to an operator's machine, run mmtserv matcam restart, and then reload this page.
- A circular region is added by default which can be used to measure image or object properties using tasks in the 'Analysis' menu. In particular, when focusing the MAT the 'Radial Proj' task can be used to create a radial profile of a star located in the selected region. The 'sigma' parameter is a measure of the width of the profile.

Figure 2. Three-color composite image of the Ring Nebula (M57) taken with the MAT at the end of summer shutdown. Note the effects of field rotation at the edges of the field of view.

Science Instruments

f/9 Instrumentation

The f/9 instruments were on the telescope for only 19% of the available nights from July 1 – September 30. Approximately 88% of those nights were scheduled with the Blue Channel Spectrograph, 0% with Red Channel, and 12% with SPOL. A total of 139.5 hours were allocated for f/9 observations. 62% of these hours were lost due to monsoon weather. No time was lost due to instrument, facility, or telescope problems. Blue Channel lost 71% of its time to bad weather, with SPOL losing 0%.

f/5 Instrumentation

MMIRS was on the telescope from June 30–July 18 and August 31–September 8, with observations run exclusively in queue mode.

The July run consisted of nine programs, including one Target of Opportunity program, using 15 custom slit masks and 133 submitted targets. No mask changes were conducted mid-run due to the monsoon weather in the first half of the run. There were seven new masks cut at SAO with the Binospec laser-cutting machine, and two new masks cut at Photomachining, Inc. Of the 141.7 hours allocated, 118.3 hours were lost to weather, and 1.66 hours were lost due to an issue aligning one of the slit masks. Approximately 16 of the submitted fields were observed.

The September run consisted of six programs, using two old and nine new custom slit masks, with 27 submitted targets. A mask change was conducted on September 6 to accommodate all of the requested slit masks. Of the 76.1 hours allocated, 36.25 were lost to weather, and 2.25 due to an issue with an actuator. Approximately 21 of the submitted fields were observed.

Mask designs for the upcoming October and November MMIRS runs were due on September 25. Four new masks were cut at SAO with the Binospec laser-cutting machine.

The Binospec power cable was installed in the mirror cell and connected into the e-chain mount in the cone. Unfortunately, SAO needed the e-chain mount returned, so the cable remains in the cell, and the cover for the hole in the cone was reinstalled.

The f/5 corrector was shipped to SAO in mid-June so that it could be serviced and cleaned. The optics were cleaned, the bearing were lubed, and the mesh on the ADC motors was readjusted. The RTV mounting pads for lens one were also replaced. The corrector arrived back at the MMT on August 30.

Figure 3. W. Goble with the repaired f/5 corrector after its return.

f/15 Instrumentation

The main focus of MAPS activities throughout July and August continued to be on development of the actuator hardware and electronics, specifically in regard to the coil and capacitive sensor. Significant development work is also being done on the four and 19 actuator prototype deformable mirror test stands that will be used for electro-mechanical and optical testing, respectively. In addition, the legacy MMT ASM is being integrated into the optical test stand for future optical testing and calibration of the mirror flat.

Development of the MAPS simulation continues, as well as development of physical models for the full scale deformable mirror. The simulation hardware models will be updated from the legacy system to the current designs as the hardware becomes more mature, and test data becomes available. This will allow the simulation to be used for rapid control system prototyping, and for performance analysis of both the 19 actuator and full scale deformable mirrors.

Instrument Handling

The MMT-Pol instrument was picked up on September 6 by the T. Jones (PI) group, and returned to Minnesota for upgrades while the f/15 secondary is undergoing upgrades.

Topboxes and Wavefront Sensors (WFS)

Laser Guide Star (LGS) Topbox

Excess cables associated with the decommissioned LGS system were removed from the west drive arc and room 2 west. They will be stored at base camp.

Wavefront Sensor Software

Work has continued on the refactored wavefront sensor software. Some specific accomplishments include:

- Improvement in the reliability of the initial association between reference aperture and spot positions. The scale of grid of aperture positions is set by the reference focus of a WFS configuration, and a best-fit center position is found by maximizing the number of associated apertures and minimizing the distances between the reference and measured positions. The fitting scheme that was developed can also allow the scale (i.e. focus) and X/Y coma to vary. However, that proved to be unreliable when too many spots were missing or parts of the pupil were obscured (common with MMIRS). Only allowing the center to vary may in principle reduce the ability to handle very large amounts of focus or coma, but in practice the current scheme can easily handle +/- 200 um of focus and +/- 3 um of X/Y coma. This is more than sufficient the vast majority of the time.
- Minor improvements were made to the WFS web interface. Most notable of them was an “Analyze Latest” button that automatically picks the most recent image and analyzes it. Initial

support for continuous operation was added as well. Of most significance, the web interface and backend server code were moved to their own repository, https://github.com/MMTObservatory/WFSsrv.

- Initial support for the Binospec WFS was added using the MMIRS mode as a template. The configuration parameters are based on the published specifications and some reference images that were taken in the lab. Final configuration of the Binospec mode will require on-sky testing during commissioning.

Facilities

To improve the safety of hauling the liquid nitrogen trailer up and down the mountain, F.L. Whipple Observatory (FLWO) motor pool converted the trailer brake system from one that was hydraulically activated to one that is now electrically activated. The hydraulic system was problematic when in use on Mount Hopkins Road, and the new system will only apply the trailer brakes when the brakes are applied in the tow vehicle. Additionally, FLWO improved the overall roadworthiness of the trailer by replacing the tires and the damaged marker lights.

To diversify the MMTO's liquid nitrogen supply, the dewar trailer was hauled to the University of Arizona's Cryogenics and Gas Facility for inspection. Since the dewar and trailer were deemed safe for shipment, the dewar was filled and delivered to base camp by the Cryogenics and Gas Facility.

Main Enclosure

In late 2016, the front shutter cable was found to have a jacket that exposed the individual conductors inside. During this summer shutdown, a wiring list was generated to allow this rather large cable assembly to be completely replaced with a low temperature Superflex cable. The assembly contained all shutter functions from open/close status, upper/lower locks control, as well as status and limit power. After completion, a complete function test was successfully performed.

The building drive position sensor Linear Variable Differential Transducer (LVDT) was modified with a quick disconnect connector to allow easy removal and replacement, eliminating the original terminal block connections for a more robust connection point. A mounting plate was installed to mount the new bulkhead connector. In addition, the wiring between the LVDT and yoke room junction box was replaced with a single shielded cable instead of two individual cables.

The east and west drive arc cable drapes and cable management systems were cleaned up, including removing network drops from the drive arc and adding the drop to the breakout panel, cutting back excess cable lengths, and re-terminating the cable at the patch panel.

Instrument Repair Facility (IRF)

KappCon load tested the new 2-ton crane in the IRF using the MMTO 5200-pound lead block. The crane handled the load (130% of capacity) fine, but shortly after the test, the crane became inoperable. This issue may be the result of the internal load cell being inadvertently misconfigured when the crane controller was placed back into its operational normal mode. KappCon is working with Dearborn crane to remedy the issue.

General Infrastructure

Removal of the oil cooler (Gardner Denver 202EBE201) from the bottom air compressor (compressor 2) revealed that the air path across the oil cooler was almost completely blocked due to bent fins and debris. The damaged oil cooler was repaired by a local radiator repair shop, and reinstalled into compressor 2. In addition, the radiator repair shop also fixed a spare oil cooler that had a small leak.

The top air compressor was thoroughly cleaned with degreaser, low pressure water, scrub brushes, and absorbent rags. The bottom compressor will be cleaned after shutdown.

The new compressed air receiver tank was moved into the MGE room, but due to resource limitations, the tank was not yet plumbed into the system.

After a failure with one of the ports on the dual port Lantronix unit used for logging the air compressor data, the Lantronix was replaced with a new unit. The Lantronix failed in a manner that caused the compressor front panel to be completely unresponsive. Both compressors are now operating normally.

To provide a smoother path when moving instruments on air casters, two thirds of the floor joints in 2East were sealed with epoxy.

The front steps, loading dock, and the west stairwell were painted during shutdown.

Computers and Information Technology

B. Lara worked with D. Porter, D. Gibson, and W. Goble to develop a read-only version of the heating, ventilation, and air conditioning (HVAC) graphical user interface (GUI). This version of the GUI is hosted on a public web server, and can be used by the MMT staff to monitor conditions within the HVAC system. Active control of the HVAC system can be done only on the internal MMTO subnet at the summit. She is also beginning work on various data analysis projects, including performance evaluation of the M1 support system.
C. Oswald continued work, along with MMTO staff, on updating the MMTO website. The current website uses an outdated version of Drupal, making modification of content very difficult. He initially worked on transferring the content of the present website into Wordpress. He then began the process of giving the site a more modern look-and-feel through the use of a commercially-available Wordpress template. He will be on a study-abroad program this fall semester and plans to return spring semester and continue work on the website.

Network and Computer Administration

The two computers used for telescope status ("telstat") in the control room were updated from Mac minis to Intel NUCs. The Mac minis have had issues with overheating because of the extensive graphics rendering in the telstat web pages. The computers are reaching end-of-life, and they do not support the current version of the Mac operating system (OS). The new NUCs have 7th generation Intel Core i7 processors and Intel Iris Plus Graphics 650 cards. This increased graphics power allows additional features, such as wind simulation, to be displayed on the telstat monitors. A new small Windows application service was written for the telstat computers. The service is launched automatically when the systems boot up and open the desktop. This new service connects to the Windows subsystem and can detect when a monitor is turned off or on, or even completely unplugged, and can reconfigure automatically. Traditionally, we have had problems getting the telstat GUIs to startup in full-screen mode consistently, due mostly to the never-ending powering on-and-off of the TV screens. So far it's been working very well, easily reducing Dallan's evening telephone support calls by over 80%!

During this quarter, the usual monthly backups of *mmto* and *hacksaw* servers were performed, and reboots were made to pick up new kernels and VirtualBox drivers. Most Linux machines were upgraded to Fedora 26. Only hacksaw is left to upgrade next quarter. Pending updates were also installed on *nas1*, *nas2*, and *nas3*.

Minor cleanup of the LDAP and DHCP servers on *mmto* and *hacksaw* was done. Shared memory segments were investigated that were sometimes being flagged by rkhunter. Skip and Tim addressed an LDAP problem on the observer's computer, *pixel*.

A few more improvements were made to the annunciator alert messages. Work also continued on making modifications to the hexapod_linux code, further improving the code with respect to timeouts so that the code doesn't hang upon encountering new failure modes of the umac.

A review was made of the observer's computer *pixel*, which is getting rather old. Due to the large amount of remote observing and the increased use of queue observers, we are considering migrating the observing-related applications on *pixel* to a Linux-based virtual machine (VM). This VM may run on the new "*vsphere1*" server. A new, less powerful iMac may be purchased to replace the current *pixel* computer for routine astronomical work by observers at the summit.

Network performance issues developed on all summit subnets during the middle of September, both for MMTO and Whipple Observatory. Numerous email exchanges occurred during debugging of the issues between UA UITS, Whipple, Smithsonian/Washington, and MMTO staff. One of the interfaces (i.e., "Gi1/0/3") on the 3750X Cisco switch located on the 5th floor in Steward Observatory was failing intermittently. All network traffic to and from the summit passes through this network switch. Jun Wu (Smithsonian/Washington) disabled this faulty network interface, which resolved the issues.

Hardware/Software Interfaces

<u>MMIRS, Binospec, and Observatory Manager Scheduling Software</u>

After a handful of successful MMIRS queue runs using the new Observatory Manager scheduling software, the code was branched off and modified substantially to provide queue scheduling for both MMIRS and Binospec. The current "live" version of the Observatory Manager remains unchanged running on the *Ops* server as before, and is still being used for current and upcoming MMIRS runs. The new development branch is running our new shared MMTO/SAO server named "*dbshare*." One of the major goals of Binospec integration is to combine both SAO's observing and mask design with the MMTO Observatory Manager. This is achieved by sharing the same physical server and connecting the two databases into a single shared database (hence the name "*dbshare*").

The original Observatory Manager with integrated MMIRS queue scheduling was created using MySQL as the database engine. SAO uses PostgreSQL for their database for Binospec Masks and GUIs. Both database engines are very good, and since there was no MySQL-specific functionality required, the decision was made to migrate the Observatory Manager to a PostgreSQL database to make it possible to merge them together. The MySQL-to-PostgreSQL turned out to be time-consuming, but the migration is complete, and both MMTO and SAO software are now interacting directly with each other within the Observatory Manager framework.

Some enhancements were added to the catalog submission pages to accommodate both MMIRS and Binospec observing modes and different formats of slit masks. Based on earlier feedback from the MMIRS queue runs, a new "wizard" style catalog target submission form has been created to make it more user-friendly. S. Moran's (SAO) BinoMask web-based software has been integrated directly into the Observatory Manager catalog submission process. Ongoing tasks include finishing the catalog submission process for all observing types of Binospec, verifying that new and modified pieces still work with MMIRS catalog targets, and final integration with SAO's Binospec software GUIs. Eventually, the MMIRS information will be exported from the *Ops* version of Observatory Manager onto the *dbshare* version, and the *Ops* version will be decommissioned.

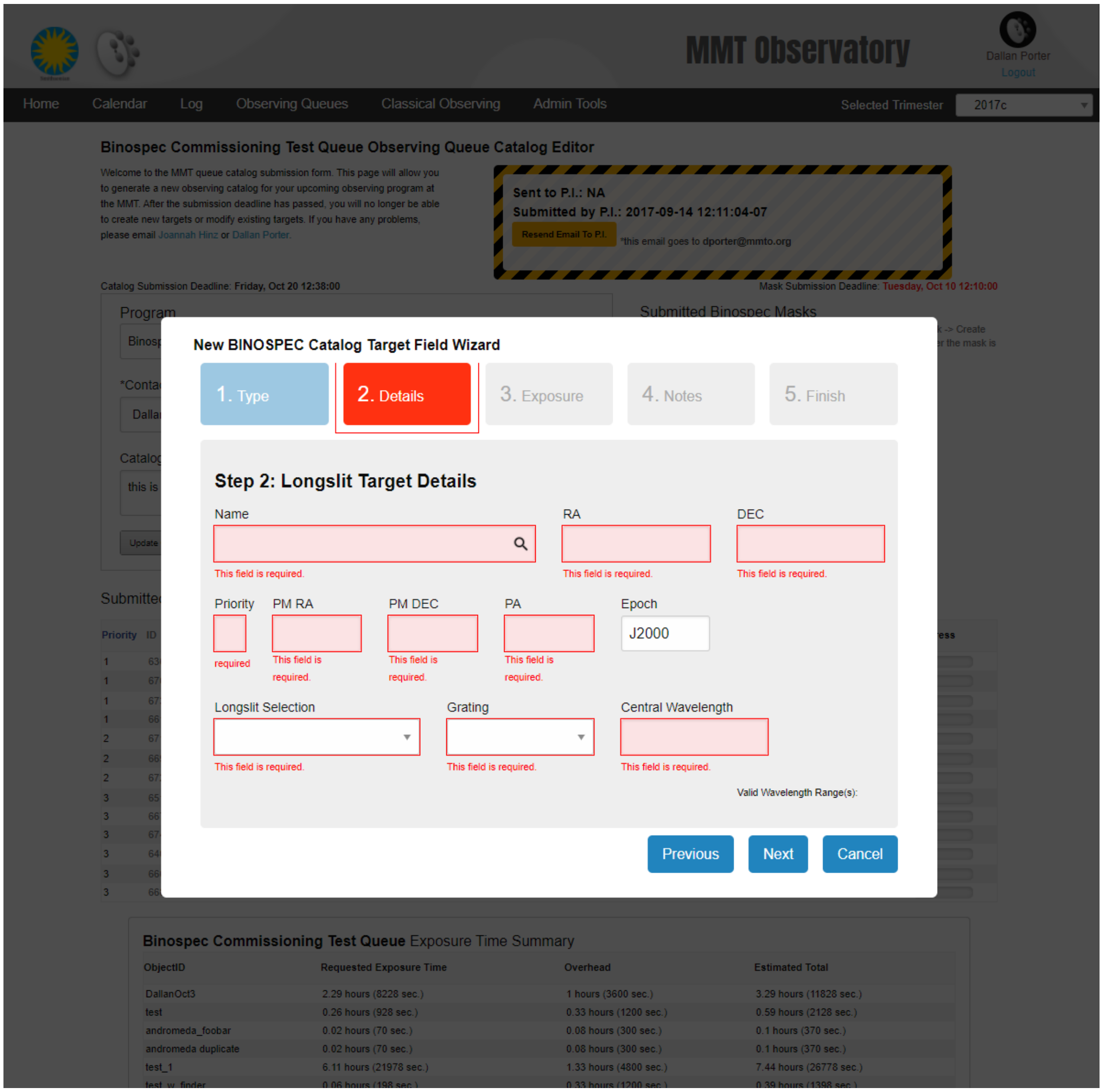

Figure 4. Screen shot of the new Binospec catalog target submission form.

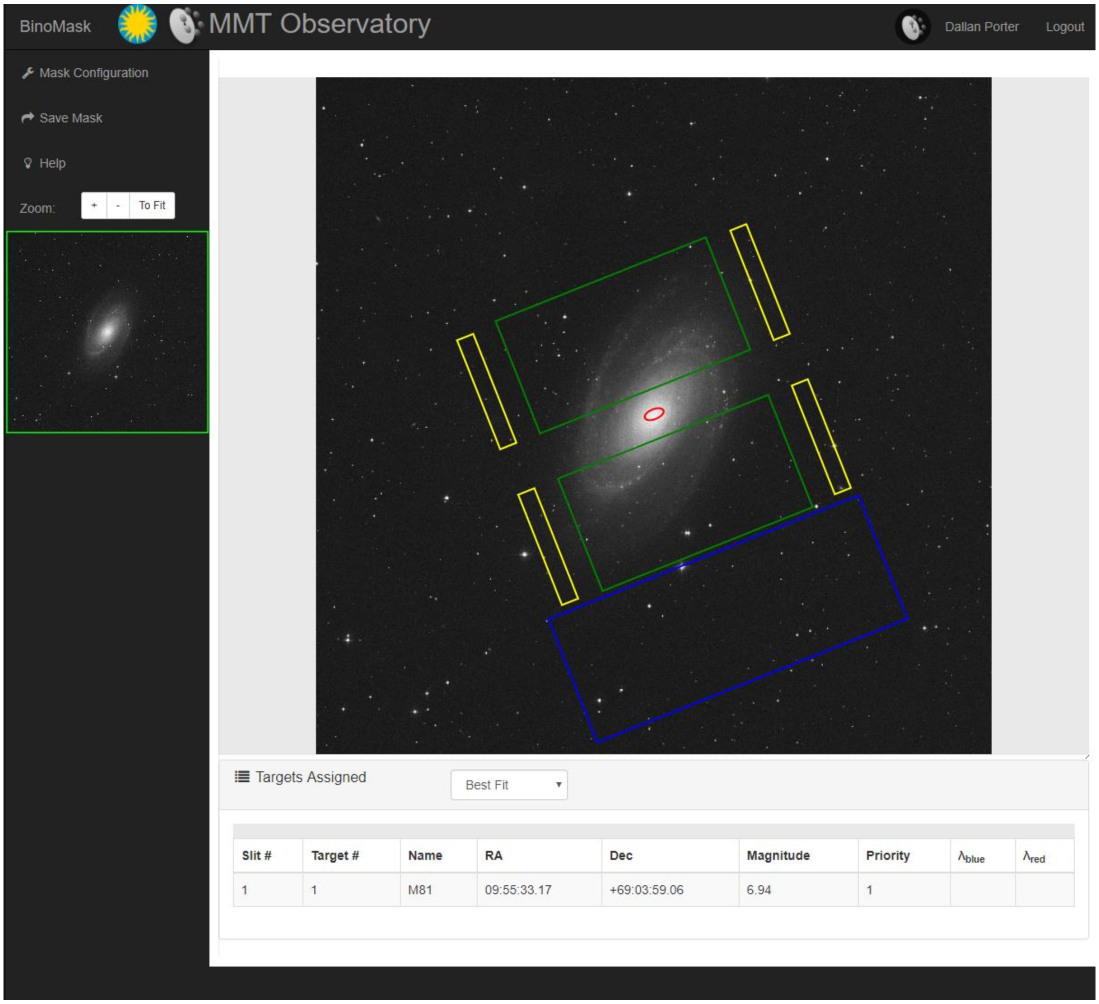

Figure 5. Screen shot of the BinoMask design software integrated into the catalog submission process.

B. Weiner has been testing the Binospec slit-mask design software web interface, written by S. Moran, and its interaction with the queue management system written by D. Porter.

Outreach

D. Porter was invited to demonstrate his virtual reality (VR) tour of the MMTO at the University of Arizona VR Summit. The summit was held on August 4 and 7 at the Science and Engineering Library. This VR demo was a combined version of previous VR demos created by Dallan and used at the annual Tucson Festival of Books. It included the in-chamber experience of the telescope tipping down, and the chamber doors opening to a sunset view, plus a new interactive ride around the MMTO in a 100-foot high Genie-Lift. This ride shows the work involved in the aluminum re-coating of the primary mirror (subtitled "Take a drive around the summit on a fully-extended Genie Lift with soft suspension"). The turnout was good on both days, and the MMT tour was a big hit!

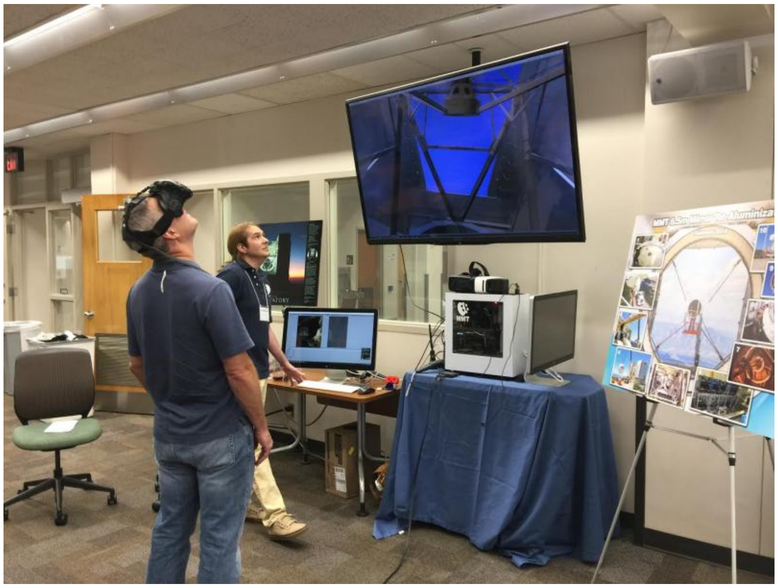

Figure 6. G. Williams visited the demo by D. Porter at the VR Summit held in August.

Weather and Environmental Monitoring

A small lightning-caused fire on the side of Mt. Wrightson that faces the MMT started in the afternoon of July 2. The Forest Service conducted three water drops by helicopter on July 3. It was ruled officially out on July 4 at 11:00pm.

Weather Stations

The west flagpole weather instruments have been returning inaccurate data. The plan is to rewire the entire west side. An articulating lift rental is scheduled for early October. The east weather station blew its input power fuses during a thunderstorm. They were replaced and more fuses were ordered.

Seeing

Thanks to a healthy monsoon season and summer shutdown, there is wavefront sensor data available for only 5 nights in July and 6 nights in August. Figure 7 shows a histogram of all of the seeing data that was collected along with a best-fit log-normal probability density function. The median seeing calculated directly from the data agrees almost exactly with the best-fit median, 0.81". The most probable seeing, the "mode," is 0.74". These numbers are consistent with historic averages.
Figure 8 shows the histograms for each individual month. We were open for only a few nights in July. MMIRS was the instrument that was used, so a lot of wavefront sensor data was taken (777 usable images). The seeing for those nights was excellent at times with extended periods < 0.5". Relatively little data was acquired in August because f/9 was mounted for those nights. September had a more representative mix with data acquired on 27 of the 30 nights. Figure 9 shows the median, minimum,

and maximum seeing for each night. It shows that the very best seeing specifically happened during the first two nights of July. The night-to-night and intra-night variability of the seeing is also consistent with what we normally see. Figure 10 shows the seeing data split into first half (before midnight) and second half of the night. The median seeing follows the trend we've been finding in historical data: Seeing is systematically better in the second half of the night. However, the best seeing of the quarter occurred during the first half, so there are obvious exceptions to that trend.

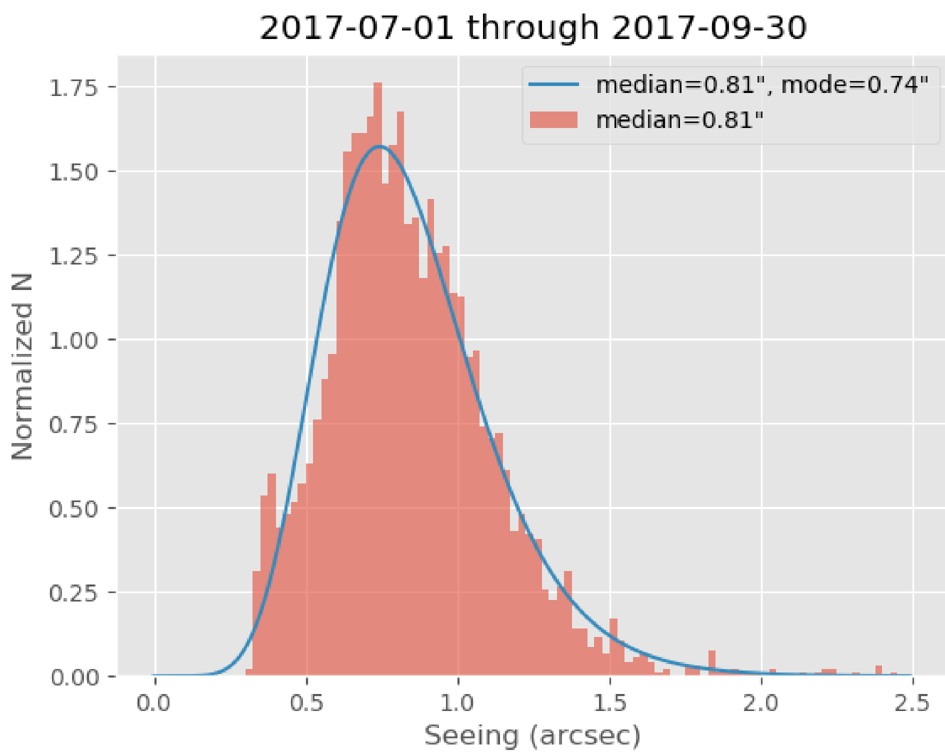

Figure 7. Histogram of all seeing data collected between July 1 and September 30, 2017. The blue line is the best-fit log-normal probability density function.

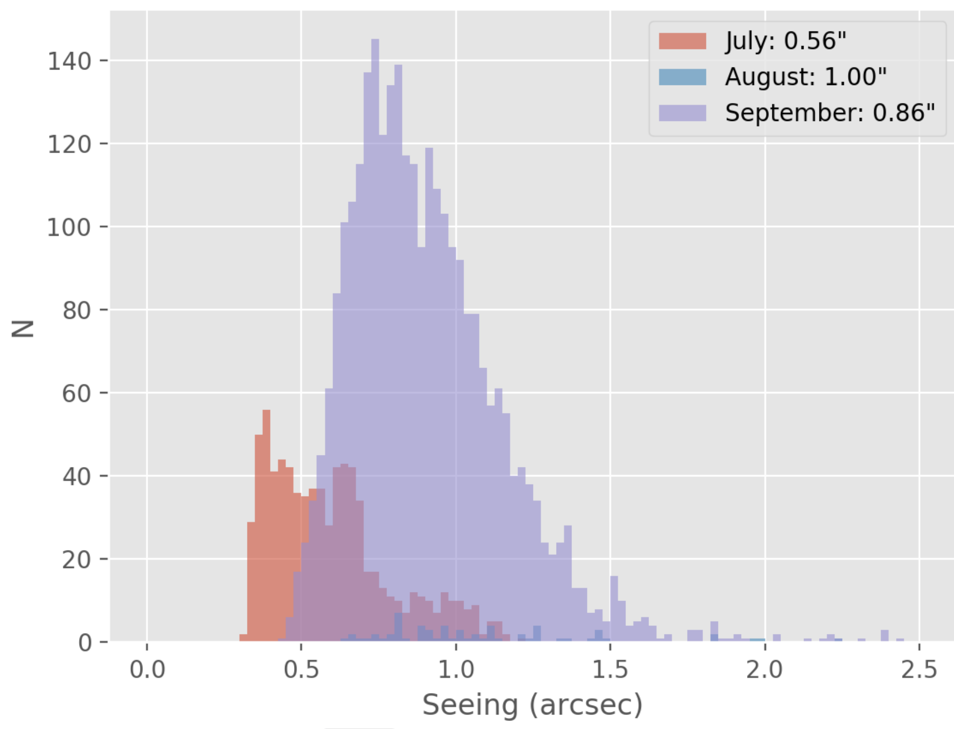

Figure 8. Seeing histograms for each month.

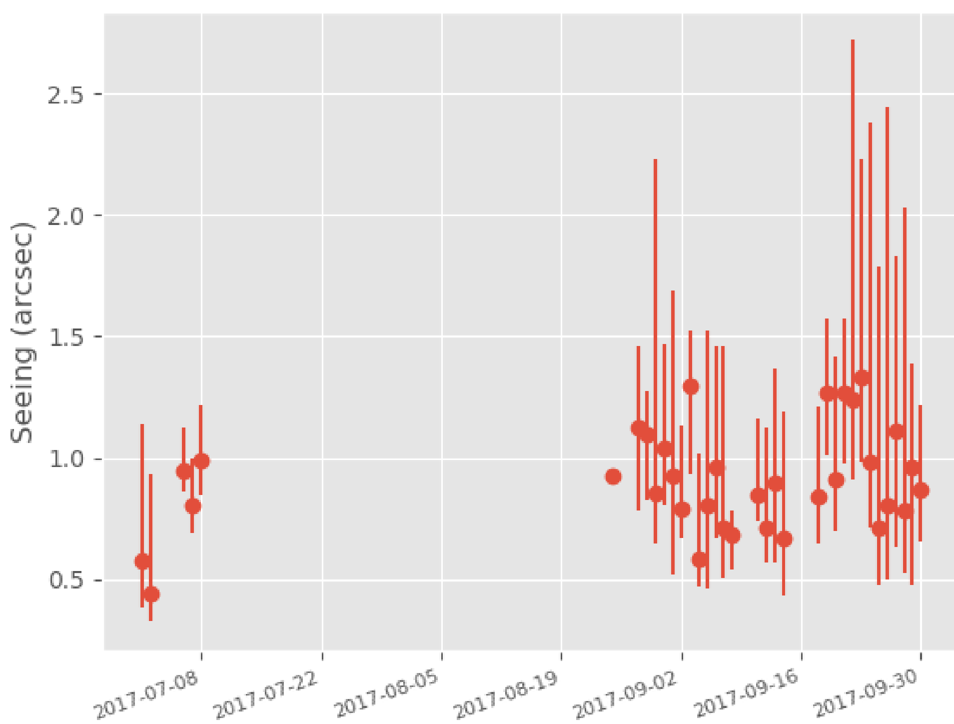

Figure 9. Median seeing for each night of the quarter with error bars indicating the min and max recorded seeing values.

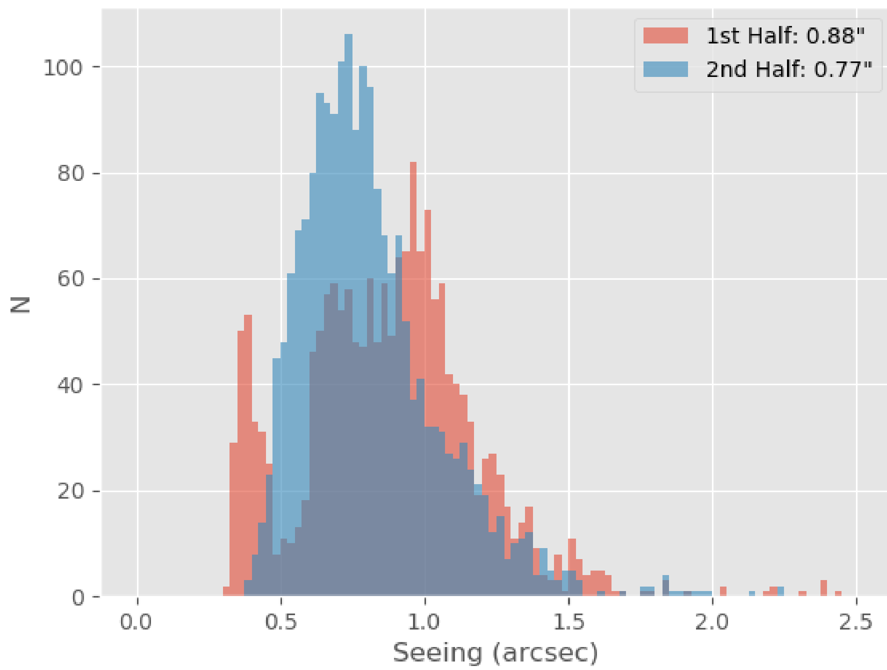

Figure 10. Seeing histograms split between the first and second halves of the night.

User Support

Web Pages

B. Weiner hosted and is updating a web page with preliminary information for Binospec observers in anticipation of 2018A shared-risk Binospec proposals. This will be updated during commissioning, and eventually migrated to the MMTO website.

Remote Observing

The MMTO supported 11 nights of remote observing this quarter. Nine nights were for CfA observers, with two nights for UA observers.

Reduction Procedures

B. Weiner is continuing to debug a Hectospec pipeline problem that causes reduction failures for a small number of users/configurations. These data appear to reduce correctly with the older HSRED v1.1, so he can provide reduced data to observers. This is, however, a stopgap solution.

Documentation

Document Database

A. Williams began work on a photo archive project to digitize historical MMTO images that were in various formats. He began by sorting them into two groups: the original MMT (six 1.8-m mirrors) and the current MMT (6.5-m mirror). He then sent out over 1,100 photographs, more than 1,220 negatives, nearly 1,000 slides, and 18 movies in several different formats to be digitized. Upon their return, he created appropriate categories and folders within the photo archive folder in the documentation database, and uploaded them. Plans are to continue organizing them using the WBS structure that this quarterly summary follows. Captions for the images will continue to be added.

Public Relations and Outreach

Visitors and Tours

On July 1, K. Van Horn conducted a tour of the MMTO for four students of Ian Scott-Fleming, a former computer specialist of the MMTO, who currently teaches at the Univ. of Texas at Lubbock. K. Van Horn is also a former engineer with the MMTO who currently volunteers as a tour guide with the F.L. Whipple Observatory.

On August 27, G. Williams, along with B. Jannuzi, provided a tour of the MMTO to the new UA President Robert C. Robbins and to the UA Senior VP for Research, Kimberly Espy (see cover photo).

Public Presentations

J. Hinz gave a presentation on the Whipple and MMT Observatories to the California Retired Public Employees Association (CRPEA) on July 19.

D. Porter participated in the UA Virtual Reality Summit held at the Science-Engineering Library on campus on August 4 and 7 (http://new.library.arizona.edu/events/virtual-reality-summit) See more details on p. 17.

Figure 11. A visitor viewing the VR demonstration by D. Porter at the VR Summit.

J. Hinz gave a presentation on the MMTO to colleagues at the ASU School of Earth and Space Exploration in Tempe on September 8.

MMTO in the Media

D. Porter took his DJI Mavic drone for a flight around the MMTO, and included a flyby of the ridge helicopter landing pad. A video of the flight can be seen on YouTube:
https://www.youtube.com/watch?v=ecH_QeZd3CM

Site Protection

The International Dark-Sky Association announced on August 31 that Kartchner Caverns State Park is now a designated International Dark Sky Park. The application was supported by a letter from the F.L. Whipple and MMT Observatories.

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)

17-42 Probing the Broad-Line Region and the Accretion Disk in the Lensed Quasars HE 0435-1223, WFI 2033-4723, and HE 2149-2745 Using Gravitational Microlensing
V. Motta, E. Mediavilla, K. Rojas, et al.
ApJ, **835**, 132

17-43 A Candidate for an Intrinsic Dusty Absorber with a Metal-rich Damped Lyα Absorption Line System in the Quasar J170542.91+354340.2
X. Pan, H. Zhou, J. Ge, et al.
ApJ, **835**, 218

17-44 Characterizing 51 Eri b from 1 to 5 μm: A Partly Cloudy Exoplanet
A. Rajan, J. Rameau, R.J. De Rosa, et al.
AJ, **154**, 10

17-45 Measuring the Properties of Dark Energy with Photometrically Classified Pan-STARRS Supernovae. I. Systematic Uncertainty from Core-collapse Supernova Contamination
D.O. Jones, D.M. Scolnic, A.G. Riess, et al.
ApJ, **843**, 6

17-46 Star Formation at z = 2.481 in the Lensed Galaxy SDSS J1110 = 6459. I. Lens Modeling and Source Reconstruction
T.L. Johnson, K. Sharon, M.D. Gladders, et al.
ApJ, **843**, 78

17-47 PS16dtm: A Tidal Disruption Event in a Narrow-line Seyfert 1 Galaxy
P.K. Blanchard, M. Nicholl, E. Berger, et al.
ApJ, **843**, 106

17-48 Joint Strong and Weak Lensing Analysis of the Massive Cluster Field J0850+3604
K.C. Wong, C. Raney, C.R. Keeton, et al.
ApJ, **844**, 127

17-49 The TWA 3 Young Triple System: Orbits, Disks, Evolution
K. Kellogg, L. Prato, G. Torres, et al.
ApJ, **844**, 168

17-50 The Velocity Dispersion Function for Quiescent Galaxies in the Local Universe
J. Sohn, H.J. Zahid, and M.J. Geller
ApJ, **845**, 73

17-51 The Superluminous Supernova SN 2017egm in the Nearby Galaxy NGC 3191: A Metal-rich Environment Can Support a Typical SLSN Evolution
M. Nicholl, E. Berger, R. Margutti, et al.
ApJ Lett, **845**, 8

17-52 iPTF15eqv: Multiwavelength Exposé of a Peculiar Calcium-rich Transient
D. Milisavljevic, D.J. Patnaude, J.C. Raymond, et al.
ApJ, **846**, 50

17-53 The SAGA Survey. I. Satellite Galaxy Populations around Eight Milky Way Analogs
M. Geha, R.H. Wechsler, Y.-Y. Mao, et al. (B. Weiner)
ApJ, **847**, 4

17-54 Discovery of a Detached, Eclipsing 40 Minute Period Double White Dwarf Binary and a Friend: Implications for He+CO White Dwarf Mergers
W.R. Brown, M. Kilic, A. Kosakowski, et al.
ApJ, **847**, 10

17-55 Blueberry Galaxies: The Lowest Mass Young Starbursts
H. Yang, S. Malhotra, J.E. Rhoads, et al.
ApJ, **847**, 38

MMT Technical Memoranda / Reports

Non-MMT Related Staff Publications

Appendix II - Service Request (SR) and Response Summary: July - September, 2017

The 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 12 presents the distribution of SR responses by priority during the period of July through September 2017. This distribution is different from those of previous reporting periods. Typically, more than half of the SRs are of "Important" priority. For this reporting period, however, 39% are "Critical" and 39% "Near-Critical" priority with only 22% as "Important". There were no "Low" and "Information Only" priority SRs. This latter result indicates that users did not use the SR system for routine documentation of low-priority issues.

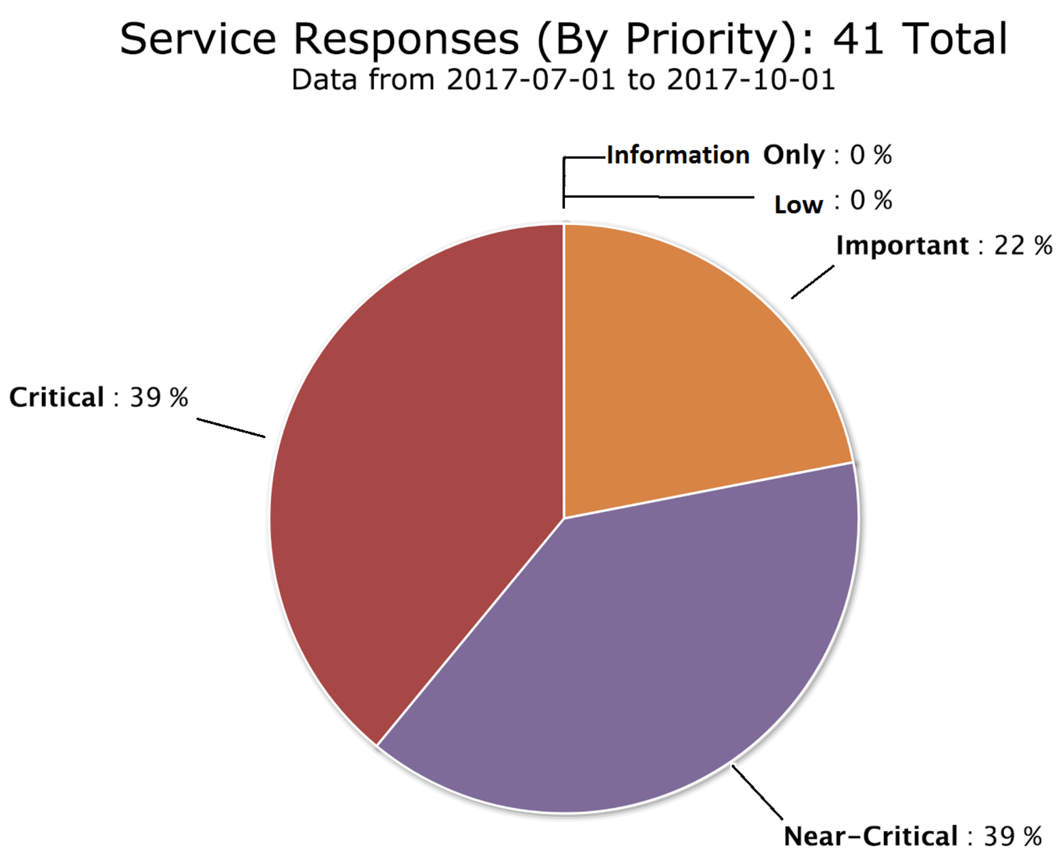

Figure 12. Service Request (SR) responses by priority during July through September 2017. 39% of the SRs were "Critical" and "Near-Critical" while 22% were "Important" priority. There were no "Low" or "Information Only" priority SRs.

"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. There was a total of 41

SRs during this three-month period, compared with 48 for the two previous reporting periods. Summer shutdown would contribute to the lower number of SRs during this reporting period.

Figure 13 presents the same 41 SR responses grouped by category. These categories are further divided into subcategories for more detailed tracking of issues. Fifteen responses from July through September are related to the "Telescope" category. These telescope-related responses included many of the "Critical" and "Near-Critical" SRs. Six responses were made under the "Building" and "Thermal System" categories while five responses each were within the "Electronics" and "Support Building" categories. Responses also occurred in the "Instruments" and "Weather Systems" categories.

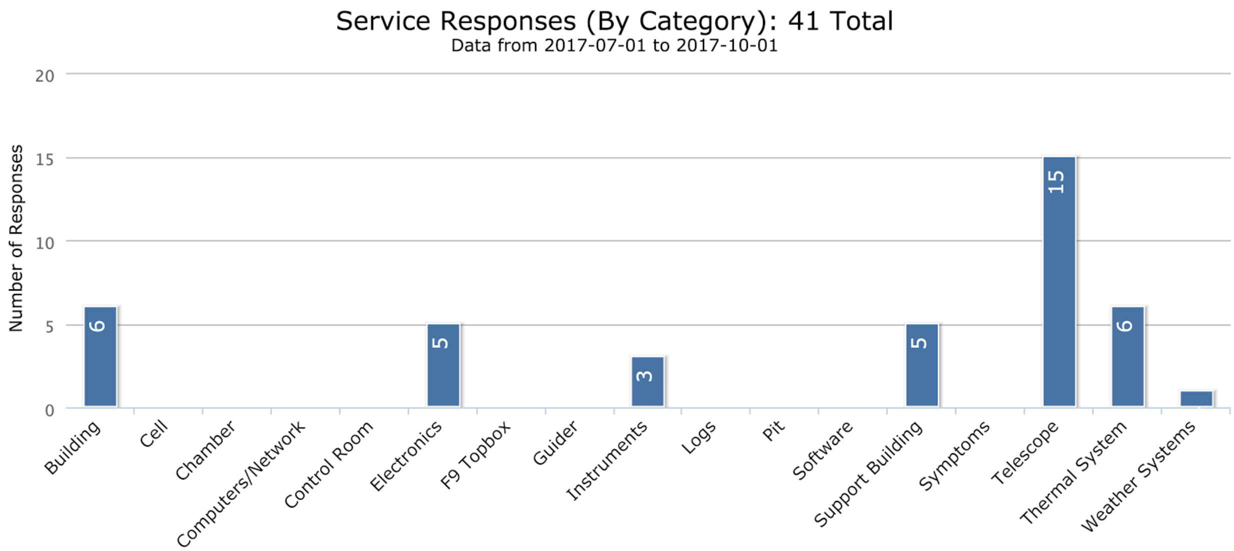

Figure 13. Service Request responses by category during July through September 2017. The majority of responses were within the "Telescope", "Building", "Thermal System", "Electronics", and "Support Building" categories. The number of responses for each are listed with the category.

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

July 2017

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	7.00	56.80	56.80	0.00	0.00	0.00	0.00	56.80
PI Instr	18.00	141.60	119.80	1.66	0.50	0.00	0.00	121.96
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	**25.00**	**198.40**	**176.60**	**1.66**	**0.50**	**0.00**	**0.00**	**178.76**

Time Summary Exclusive of Shutdown

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	89.0
Percentage of time lost to instrument	0.8
Percentage of time lost to telescope	0.3
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	90.1

* Breakdown of hours lost to instrument
1.66 Possible MMIRS alignment issues

** Breakdown of hours lost to telescope
0.50 Rotator problems

August 2017

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	55.00	20.30	0.00	0.00	0.00	0.00	20.30
PI Instr	2.00	18.70	0.00	0.00	0.00	0.00	0.00	0.00
Engr	1.00	9.00	9.00	0.00	0.00	0.00	0.00	9.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**9.00**	**82.70**	**29.30**	**0.00**	**0.00**	**0.00**	**0.00**	**29.30**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	89.1
Percentage of time scheduled for engineering	10.9
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	35.4
Percentage of time lost to instrument	0.0
Percentage of time lost to telescope	0.0
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	35.4

Year to Date August 2017

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	64.00	623.60	265.19	5.42	0.25	1.25	0.00	272.11
PI Instr	139.00	1299.60	517.82	13.07	11.75	14.58	0.00	557.22
Engr	12.00	118.80	17.50	0.00	0.00	0.00	0.00	17.50
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**215.00**	**2042.00**	**800.51**	**18.49**	**12.00**	**15.83**	**0.00**	**846.83**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	94.2
Percentage of time scheduled for engineering	5.8
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	39.2
Percentage of time lost to instrument	0.9
Percentage of time lost to telescope	0.6
Percentage of time lost to general facility	0.8
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	41.5

September 2017

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	*Lost to Instrument	**Lost to Telescope	***Lost to Gen'l Facility	****Lost to Environment	Total Lost
MMT SG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PI Instr	29.00	286.80	107.65	6.85	11.95	0.50	0.00	126.95
Engr	1.00	9.70	2.75	6.95	0.00	0.00	0.00	9.70
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**296.50**	**110.40**	**13.80**	**11.95**	**0.50**	**0.00**	**136.65**

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	37.2
Percentage of time lost to instrument	4.7
Percentage of time lost to telescope	4.0
Percentage of time lost to general facility	0.2
Percentage of time lost to environment	0.0
Percentage of time lost	46.1

* Breakdown of hours lost to instrument

1.50 MMIRS mask alignment issues
6.95 WFS and hecto camera problems
5.35 Hecto guide-probe camera issues

** Breakdown of hours lost to telescope

0.75 Actuator 143 issues
9.70 Hexapod limit problems
0.25 Hexapod runaway
1.00 WFS problems
0.25 WFS computer needed reset

*** Breakdown of hours lost to facility

0.50 Pit Neslab, compressor 2

Year to Date September 2017

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	64.00	623.60	265.19	5.42	0.25	1.25	0.00	272.11
PI Instr	168.00	1586.40	625.47	19.92	23.70	15.08	0.00	684.17
Engr	13.00	128.50	20.25	6.95	0.00	0.00	0.00	27.20
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**245.00**	**2338.50**	**910.91**	**32.29**	**23.95**	**16.33**	**0.00**	**983.48**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	94.5
Percentage of time scheduled for engineering	5.5
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	39.0
Percentage of time lost to instrument	1.4
Percentage of time lost to telescope	1.0
Percentage of time lost to general facility	0.7
Percentage of time lost to environment	0.0
Percentage of time lost	42.1