Smithsonian Astrophysical Observatory & Steward Observatory, The University of Arizona

End of Quarter Summary

July - September 2016

Photograph of the realuminized primary mirror. Photo taken by Dallan Porter.

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

ShiAnne Kattner started as Queue Observer on August 31. Chun Ly started as Queue Observer on September 12.

Ken Duffek started as Principal Engineer, Electrical, on September 12.

Interviews for the Assistant Staff Scientist position were held with three applicants on August 17 and 19.

Scheduling

Summer shutdown began on July 12 and ended on September 26. The primary mirror was re-aluminized during shutdown (see p. 3 for details). The observatory reopened on September 27. The all-hands cleaning day took place two days later, on September 29.

Reports and Publications

There were 14 peer-reviewed publications during this reporting period. See the listing of publications in Appendix I, p. 18.

Presentations and Conferences

J. Hinz visited Harvard/CfA on July 27-29. She visited the Cambridge Discovery Park lab to see the progress on the Binospec instrument. She met with D. Fabricant, N. Caldwell, B. McLeod, W. Brown, D. Eisenstein, and the CfA software group to discuss the MMIRS upcoming observing run, the MMIRS queue software, the arrival of the queue observers, the plans for upgrades to the AO system, and plans for the future Binospec queue software.

Safety

The Steward Observatory (SO) Safety Committee held its quarterly meeting on July 27 at the Mount Lemmon Telescope Facility. C. Knop attended the meeting and represented the MMTO.

Two recent incidents that occurred locally were discussed, underscoring the importance of following safety procedures. The first incident occurred at the Mt. Lemmon telescope facilities when an outside contractor was working on one of the radio towers. The contractor failed to secure his lanyard properly and fell approximately 50 feet to his death. Three SO employees tried to revive the contractor using CPR, but were unsuccessful. They stressed the importance of knowing CPR and knowing the location of AEDs and how to use them.

The second incident occurred at Biosphere 2, a nearby facility also owned by the University of Arizona. While changing light bulbs, an employee fell from a 9-foot ladder, hitting her head and sustaining some brain trauma. She was not wearing appropriate safety equipment at the time. Two subordinate employees were present, but too intimidated to question their supervisor. Lessons learned from this incident were: do not be complacent in any job that you perform, always follow safety procedures, and there is no chain of command regarding safety issues - anyone can question anyone regarding following appropriate safety practices.

Primary Mirror

Coating & Aluminization

After the successful completion of the last full scale coating system test at the base camp, the bell jar was opened to inspect the witness slides and the Mylar® drip indicator. From visual inspection, the witness slides were consistent with the deposition monitor measurements. The sun could barely be seen through the witness slides toward the outside edge of the bell jar; this is representative of the 850 Å reported by the deposition monitor located at the outside edge of the bell jar. The slides located at roughly 2/3 radius of the mirror were completely opaque. This is also consistent with the recorded deposition monitor measurements of 1150 Å at the center, and 1040 Å at the 2/3 radius location. Unfortunately, time constraints prohibited a detailed inspection of the drip indicator, but only a very minor amount of aluminum, if any, appeared to have made contact with the indicator.

As the start of the summer shutdown approached, the aluminization equipment stored at the base camp was prepared for transport. To reduce the overall weight of the bell jar trailer, the steel trunnion mounts were removed. These mounts had been welded to the trailer to facilitate transportation of the primary mirror in its shipping container on Mt. Hopkins Road. This modification also allowed the bell jar to be positioned 42" further forward on the trailer. This helped balance the load between the axles on the trailer and the axles on the semi-tractor.

In a deviation from previous coatings, all but five of the primary mirror actuators were left in the mirror cell during the coating process. However, due to some concerns about the ability of the actuator electronics cards to survive the vacuum environment, all of the cards were removed. Five single axis actuators (L006, L106, L138, L149, and L151) were removed only because the electronics card on each of these actuators could not be separated from the actuator when mounted in the cell.

The ventilation tubing and the jet ejector cones were removed from the mirror cell to provide better access to the actuator cards. In the process of this removal, a large amount of fiberglass insulation was found throughout the ventilation system on the east side of the cell. This fiberglass was attributed to an insulated 12" supply (elephant) hose that was damaged a couple of years ago. Using a shop vacuum and pipe cleaners, the jet ejectors were cleaned in-situ. Furthermore, almost all of the ventilation tubing was replaced upon reinstallation with Flexaust MGV-R125050G-R. These actions removed a large amount of the insulation, but when the ventilation system was started after shutdown, a number of jet ejectors were completely plugged. The plugged jet ejectors were removed, cleaned, and reinstalled.

On July 26, the existing coating was stripped from the primary mirror (Figure 1). As in previous years, mops were used to strip the coating and to clean the substrate. The drying and the isopropyl alcohol wipe were accomplished by four individuals in the appropriate attire crawling on the bare glass. After the final wipe, the cleaning plastic was removed, and the vacuum barrier was installed between the edge of the glass and the pneumatic seal. A sheet of plastic was then installed in place of the mirror cover to protect the cleaned glass.

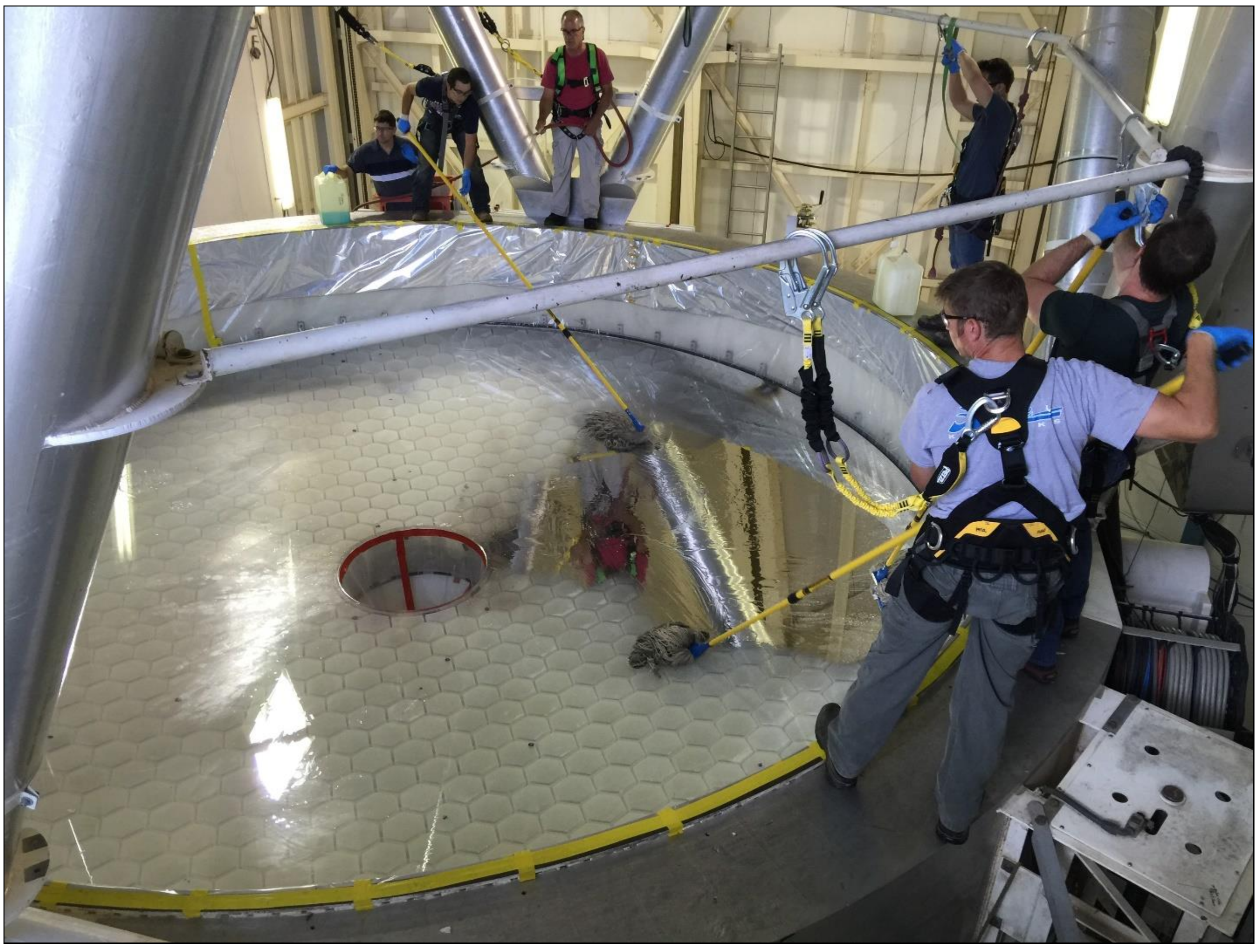

Figure 1. Stripping the 2010 coating.

While the telescope was being prepared for the installation of the vacuum equipment, new cryopump handling fixtures were fabricated at the base camp. This equipment was designed to safely lift the cryopump and gate valve assemblies and to provide the ability to rotate the valves into the required orientation for mounting the valve to the bell jar. The new lifting fixtures also made the necessary rigging for each of the cryopumps identical. Figure 2 shows the new lifting hardware being utilized to lower the west cryopump onto wooden blocks after being removed from the bell jar.

Figure 2. West cryopump being lowered onto blocks using newly fabricated handling fixtures.

All of the sections of roughing line were leak-tested at the base camp before being shipped to the summit. This testing was completed by capping and carefully pressurizing each pipe section using a low pressure blower. Soap bubbles were then applied to each solvent joint to determine the integrity of the pipe section. One section of pipe was identified to have two bad solvent welded joints. This section of pipe upon installation would be located between the Roots blower and the building. Additionally, another section of pipe used on the outside of the building was visibly damaged. To address the compromised pipe sections, the replacement of the entire section of roughing line between the pumping trailer and the building was necessary. To reduce the fabrication and installation time, one section of pipe and the stainless steel expansion joint from the base camp assembly was reused on the summit. An additional pipe stand was fabricated on the summit to support the roughing line between the building and the pumping trailer.

On August 11, the bell jar was loaded onto the trailer at the base camp. It was driven to the summit on August 15 by Sierrita Mining & Ranching (Figure 3). The 275-ton hydraulic crane from Marco Crane & Rigging was also moved to the summit on the same day. Unfortunately, the crane was overheating during the climb up the mountain and required approximately 5 ½ hours to reach the summit.

Figure 3. The bell jar being moved up the final portion of the summit road.

On August 16, the OSS V was removed, and the bell jar was placed in the chamber. The bell jar support jib was then installed, and finally both cryopumps were mounted to the bell jar. The crane demobilized and left the mountain the next day. Although a multiple day delay was introduced in the schedule, a design was developed to roll the bell jar open and closed on Hilman rollers. In the past, the bell jar was moved while in the chamber by supporting some of the bell jar weight on the support jib and then rolling the bell jar on 1-1/4" pipes. After the necessary hardware was fabricated, the bell jar was raised using jacks and jack stands and then lowered onto the Hilman rollers. With this modification completed, the bell jar can easily be opened or closed using two chain hoists. One hoist is connected between the west drive arc and the bell jar, and another hoist mounted in a similar manner on the east side of the telescope.

After replacing the filaments, a shield to protect the vacuum membrane was fabricated from high vacuum aluminum foil. The 30" wide by 20' long shield was placed over the vacuum membrane and held in place by gravity. Since the shield was installed to protect the vacuum membrane from aluminum drips, the shield was designed to only cover the lower third portion of the membrane.

The primary was snow cleaned and the bell jar was closed on August 30. After a section of roughing line running under the telescope was shortened, the vacuum system plumbing was completed. On the afternoon of August 31, shortly after starting the pumpdown, a leak was discovered at a compression fitting in the differential pressure line. This leak was repaired by tightening the fitting. Rough pumping was continued throughout the night, and both sides of the mirror were at a pressure of 6 Torr the next morning. However, a sizable leak in the liquid-nitrogen trap of the east cryopump was identified. The liquid nitrogen fill line and vent were capped using compression fittings that were readily available on site. Unfortunately, this did not appear to completely stop the leak. The east cryopump was placed out of service and isolated from the system. The roots blower was then used to pull both sides of the mirror vacuum into the milliTorr range, and the mirror side vacuum was crossed over to high vacuum using the turbo pump.

On the morning of September 2, glow discharge cleaning was performed for approximately one hour. Then the west gate valve was opened, and the bell jar pressure stabilized at $8x10^{-5}$ Torr. After performing the final check of the coating control system, the welders were enabled, and the coating process started. After reaching a coating thickness of 724 Å, signal noise caused the center2 deposition monitor to erroneously reach the thickness set point and terminate the process early. Since the vacuum was steady at $8x10^{-5}$ Torr, the coating process was restarted to bring the center coating thickness up closer to the target of 1100 Å. During the second coating attempt, the process was manually terminated after the thickness target was reached.

For the first shot, a maximum deposition rate of 41 Å/s was achieved, and for the second shot, a maximum rate of 27 Å/s was reached. Figure 4 shows the deposition rate and overall coating thickness for both of the shots.

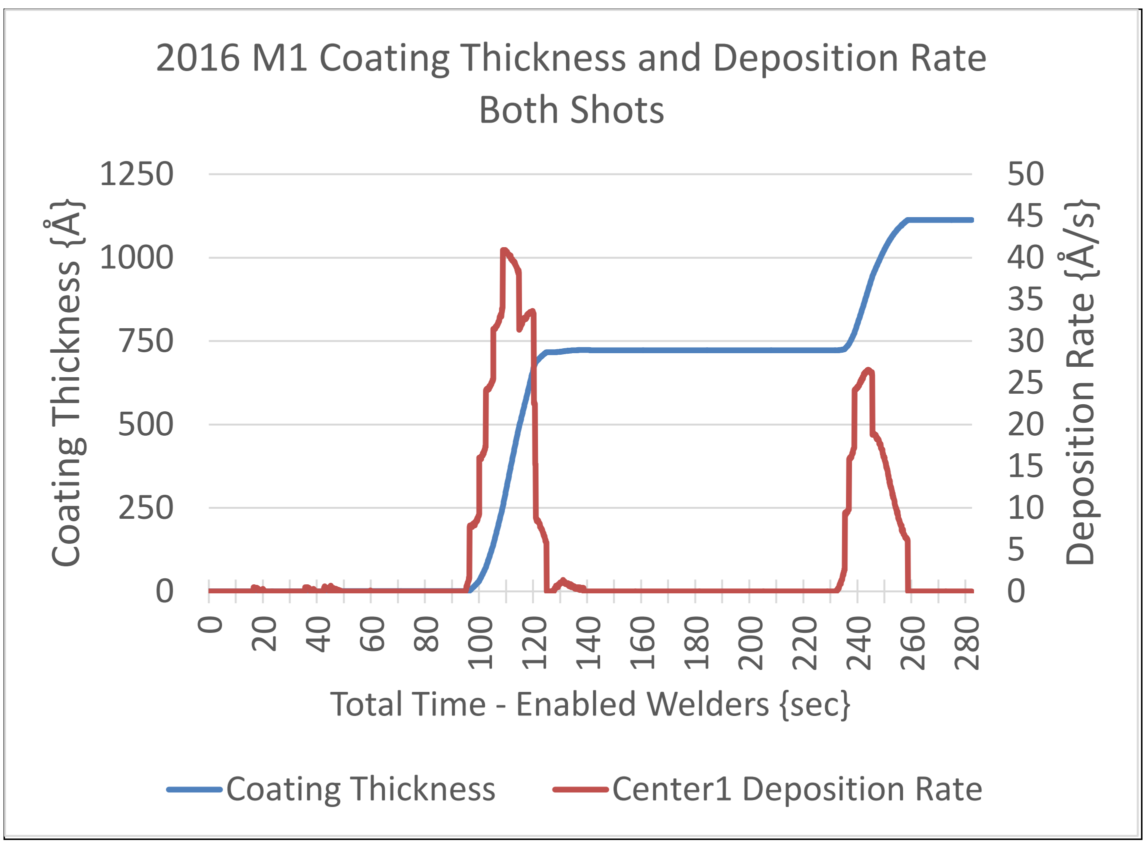

Figure 4. M1 coating deposition rate and thickness for both shots.

Since the same welder set point curve was followed for both shots, the average array power reached a maximum of 11 kW for both attempts as shown in Figures 5 and 6.

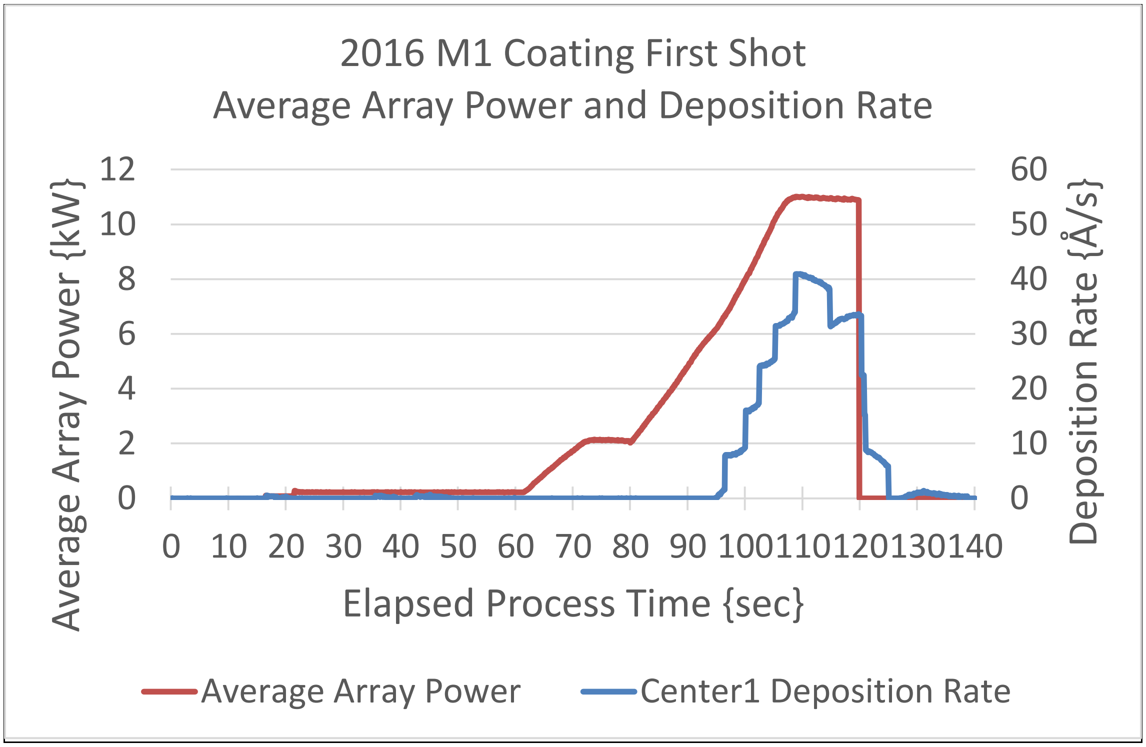

Figure 5. M1 coating, first shot deposition rate and average array power.

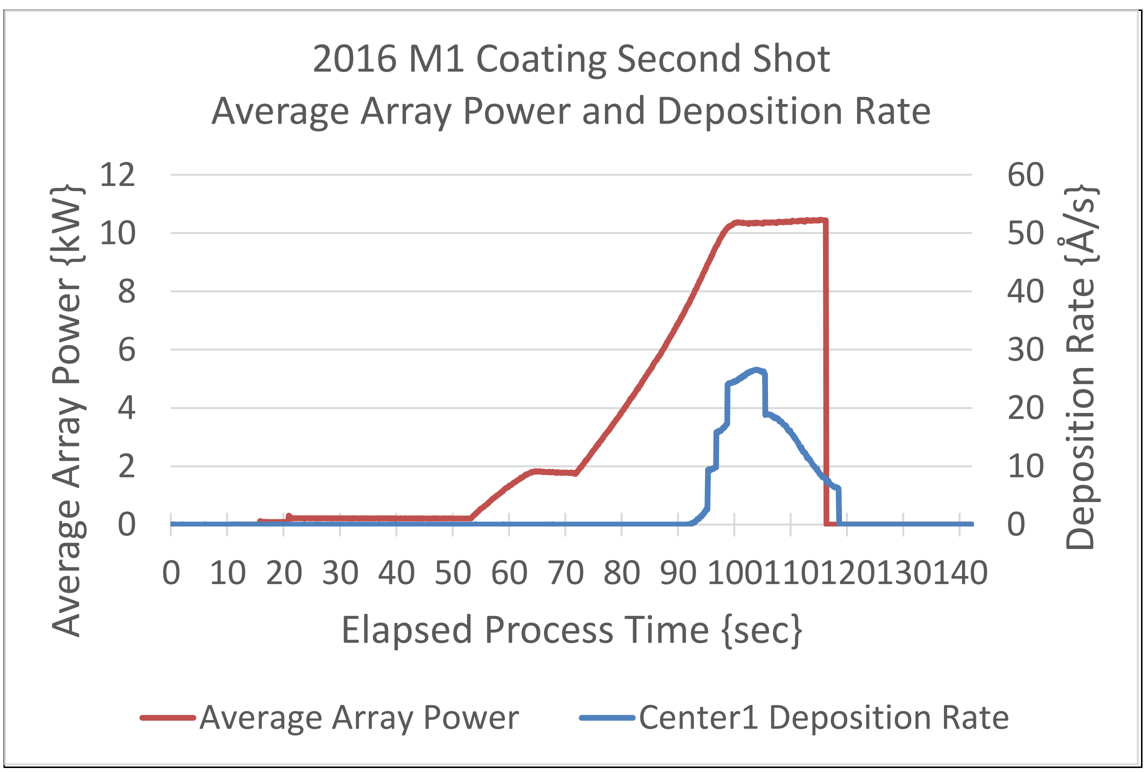

Figure 6. M1 coating, second shot deposition rate and average array power.

The bell jar was opened on September 6 to reveal a solid mirror coating, as shown in Figure 7. Similar to the coating tests at the base camp, evidence was found indicating a small number (fewer than 12) of aluminum droplets (under 1/16" in diameter) contacted the aluminum membrane shield. After the coating was accepted, the disassembly of the coating system was started, and the telescope was prepared to be returned to normal operations. The telescope was officially released for science on September 27 with the f/5 secondary and the Hectospec instrument installed.

Figure 7. Open bell jar showing fresh coating.
(Pictured front to back are: J.T. Williams, W. Goble, and G. Williams.)

Secondary Mirrors

f/15

An adaptive optics uninterrupted power supply showed a failed battery. The unit was brought to the campus electronics shop and 9 amp-hour batteries were ordered. The batteries were replaced, load testing of the unit was performed, and it maintained power for the specified amount of time. The unit will be returned to the summit.

Hexapods

Nothing to report.

Optics Support Structure

Nothing to report.

Pointing and Tracking

Nothing to report.

Science Instruments

f/9 Instrumentation

The f/9 instruments were on for 74% of the available nights from July 1 – September 30. Approximately 71% of those nights were scheduled with the Blue Channel Spectrograph, 7% with Red Channel and 21% with SPOL. Only 116.7 hours were allocated for f/9 observations due to the extended summer shutdown. Of those hours, 33% were lost due to monsoon weather. Instrument, facility, and telescope problems accounted for less than 1% of lost time. Blue Channel lost 39% of its time to bad weather, with Red Channel losing none, and SPOL losing 24%.

f/5 Instrumentation

Due to the extended shutdown period for realuminization of the primary mirror, Hectospec was the only f/5 instrument on the telescope this trimester. It was on for four nights at the end of September, with mostly cloudy weather, and no data was taken.

Work was done to facilitate the Hecto LN2 fills by moving the valve manifold to a shelf fixed to the wall. It will no longer be necessary to transfer from one LN2 tank to another every few weeks. We now simply swap the tank after valving off the tank and then connect the transfer tube to the new tank. With this setup, the fire alarm should be triggered less frequently.

The MMIRS spare HXRG computer was addressed during the summer. A new solid state disk drive was added and the Windows 10 operating system was loaded. S. Moran of CfA found appropriate drivers for most of the necessary software and we are close to being able to operate the MMIRS detector with an updated operating system.

Discussions were held on the MMIRS surface heater system. The decision was made to add more heat elements, but keep total power similar. This should spread the heat around and prevent hot spots. This work will be done after additional planning.

M. Lacasse traveled to SAO in Cambridge in early August and again in mid-September to see the progress on the Binospec instrument and to lend a hand on a few tasks. The September visit was to assist with setup and to train with the LPKF laser cutter, currently located on the ground floor in the SAO engineering department. It is an impressive instrument and requires regular, careful maintenance. Assembly and initial testing of the unit was completed by an Oregon- based LPKF technician. Sample MMIRS and Binospec masks were generated as a test of the assembled equipment. The technician trained M. Lacasse, J. Zajac, and K. Bennet on the operation of the unit. S. Moran, B. McLeod, and others were on hand to learn about data files for the unit.

Discussions were held on where an optimum location for the laser cutter would be at MMTO/FLWO. Initial plans focused on the Common Building. Thoughts then shifted to the Instrument Repair Facility (IRF) at the summit where a room within a room will be constructed to keep the laser cutter clean and the temperature stable. Smithsonian Institution (SI) facilities staff will construct the room after they are finished with other projects.

When the Hecto instrument was put on the telescope at the end of September, two issues appeared. One wall-mounted calibration box was not communicating with the computer. A battery backed memory chip, which "remembered" the IP address and the operating parameters, had failed. With the help of R. Ortiz, J. Wood, and B. Comisso, the box was lowered to the floor, opened, and cleaned. M. Lacasse changed out the problem chip with a spare, and the box was closed and remounted on the wall. He then set up the IP address with one piece of WebDaq software and uploaded the operating parameters with another piece of software using an archive of the configuration data created last year.

The second issue was that the wavefront computer stopped working after the September mounting. Upon mounting the wavefront sensor (WFS), the fiber for the MMTCam was not allowing communication. A separate fiber was used to verify that both ends of the hardware were good. The initial thought was that one component of the fiber pair had been broken during the work on aluminization. When the original fiber was put back in after the testing, the MMTCam system began communicating again, leading us to think that a dust speck must have been brushed off in the repeated connect-disconnect sequences. Three days later, after bringing the MMTCam power on and doing dark and bias exposures, the WFS computer stopped communicating. Power to the system was cycled multiple times, but we were unable to revive it.

All other circuits for the positioner and Spec detector worked fine after the long summer shutdown, although one power switch on the rack had been bumped, and it took us a few minutes to realize the cause of that issue.

We plan to start the next quarter observing without WFS and deal with its issues after the run.

f/15 Instrumentation

There were no NGS adaptive optics (AO) observing runs during this reporting period. Work was performed on the wavefront sensor camera and topbox to better integrate the EDT fiber optic framegrabber card and to attempt to reduce noise levels in the WFS camera. Testing was also performed using the adaptive secondary mirror (ASM) accelerometers to reduce effects of structural vibration on AO system performance.

Work was started for the upcoming ASM upgrade and refurbishment project. Significant progress was made in both electronics and software architecture designs. Prototypes for some new electronics components were developed and tested to ensure the new software/hardware architecture could meet the project specifications.

Funds from the National Science Foundation for the ASM refurbishment project are expected to become available in November. The ASM will be taken off line sometime in the spring of 2017 to begin the upgrades and refurbishment.

Topboxes and Wavefront Sensors (WFS)

Nothing to report.

Facilities

Main Enclosure

Due to the aluminization effort, most of the facilities work on the summit was suspended for this quarter. However, before summer shutdown started, most of the work on the outside equipment lift was completed. The lift was successfully load tested on July 12. The skid steer loader and the excavator approximated the 18,000 lb maximum capacity of the lift, as shown in Figure 8.

Figure 8. Load testing of the outside equipment lift. A safety monitor is in position to the right of the lift.

Since the safety railings for the in-ground pit had not yet been installed, a safety monitor was used to ensure that personnel did not come near the pit while the lift was up. Limit switches and the railing system around the in-ground pit are expected to be installed in the fall. After thorough review of the job hazard analysis, a limited number of MMTO staff received approval to operate the lift.

The lift was immediately used to move instrumentation out of the chamber and to move aluminization equipment into the building.

A search was initiated for a vendor to repair the Copley 264 amplifier. Initial calls to Copley Amplifier revealed that the company had been bought by Analogic Corporation. Analogic was contacted and, after discussions, it was determined they might be able to repair our model, even though it is obsolete. The unit was crated and shipped to them and, after approximately three weeks, it was returned to us. The repair facility had found a bad capacitor. It appeared the unit had also been thoroughly refurbished. The refurbished Copley 264 was reinstalled in the building drive system and the bypass jumpers were removed. The 100A fuse was reinstalled. Initial testing revealed no problems with fast or slow slews. Several nights of operational testing were successful. The service request generated on the issue was closed.

Testing was also conducted on the Copley 262 amplifier. Although not as powerful as the 264, the 262 meets the needs of the building drive. The 262 was successfully powered and tested in the electronics shop. It was determined that if the fan voltage is too low, as per instructions, the unit will not power up. Testing at the mountain on the actual system is still required. (Testing on the mountain of the 262 was conducted in previous months. We were unable to test the system since there is no equalizer connection on the 262. This connection is used to power the half of the fault card logic for the Copley. A Y-cord was made to split power from the Copley configuration plug to the fault card. Initial electronic shop test results were good.)

Bowl Dorm

SI facilities staff began work to repair or replace the gutters at the summit dorm during this reporting period.

Computers and Information Technology

Computers and Storage

Extensive computer system and software maintenance was done during the summer shutdown. This maintenance included upgrading the Fedora-based Linux servers and control room workstations to Fedora 24. Updates were also applied to the two CentOS-based Linux servers, the Mac OS X-based observer's computer, *pixel*, and the three network-attached storage (NAS) devices. Servers and databases were backed up to external storage devices. Issues with the MMT Fedora mirror were also resolved.

The hard drive began failing on the Linux-based f/9 wavefront sensor (WFS) computer. The Fedora operating system and MMT applications were installed on a new hard drive. The Windows-based f/5 WFS computer also began failing near the end (September 29) of this reporting period. Issues related to this computer will be discussed during the next reporting period.

Software staff worked with open-source developers on the "alx" ethernet driver problem on the two control room Linux computers, *chisel* and *pipewrench*. This issue is nearly resolved.

The cell computer software was modified and deployed to easily update the location and calibration data for the primary mirror cell support actuators. Previously, these calibrations were hard-coded in the control software, and one would have to edit and recompile the software. Now the calibrations are used automatically from the actuator test stand results, and the locations are updated with a simple graphical user interface (GUI).

Hardware/Software Interfaces

Work continued on developing software for queue scheduling at the MMT. The astropy-based astroplan library is being assessed for possible use. This Python library contains much of the functionality needed for any type of observatory scheduling. Custom constraints for observing at the MMT Observatory are being created, as needed. Web interfaces for observers, queue operators, and staff are also being developed. The queue software will be used next during the November and December MMIRS observing runs.

Weather and Environmental Monitoring

Weather Stations

The Lantronix unit for R. M. Young 1 / Vaisala 4 was found to be dead. A single Lantronix was installed and connected to Vaisala 4 wiring. A new dual port Lantronix was ordered.

The R. M. Young has also displayed erroneous wind directions, and a thorough inspection of the wiring is being done, as well as installation of lightning suppression for the entire system.

Seeing

Figures 9 and 10 present apparent seeing values, corrected to zenith, at the MMTO during this reporting period. These values are derived from measurements made by the f/9 WFS. The f/9 secondary was on the telescope for the first half of July and for three nights near the end of September prior to the scheduled reopening of the observatory. Relatively few WFS measurements were made. (Because of the extended summer shutdown, the f/5 secondary was on the telescope only four nights at the end of September, and no data was taken due to weather.) Figure 9 presents the seeing values as a histogram with 0.1 arcsec bins while Figure 10 presents the same data as a time-series chart. The median seeing value for the 476 f/9 WFS samples is 0.80 arcsec, similar to the April-June 2016 quarter, while the mean is slightly higher at 0.89 arcsec.

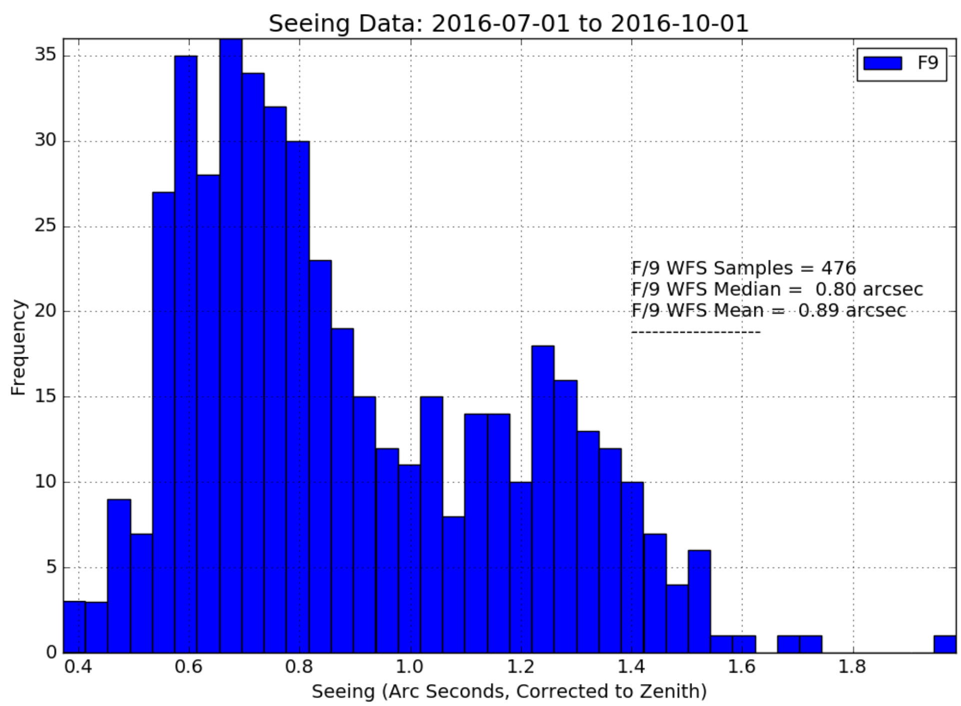

Figure 9. Histogram (with 0.1 arcsec bins) of derived seeing values for the f/9 WFS from July through September 2016. Seeing values are corrected to zenith. The median f/9 seeing is 0.80 arcsec while the mean is 0.89 arcsec.

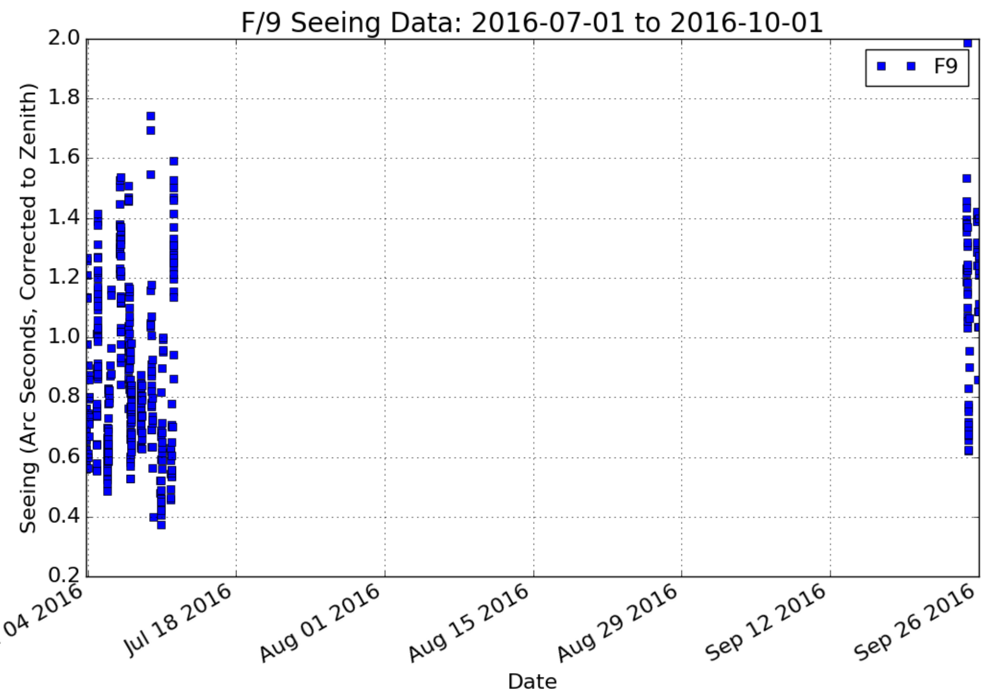

Figure 10. Derived seeing for the f/9 WFS from July through September 2016. Seeing values are corrected to zenith. Seeing data is limited to the f/9 secondary and to relatively few measurements (explanation in text).

User Support

Remote Observing

The MMTO supported 10 nights of remote observing this quarter. Three nights were for UofA observers, with 7 nights for CfA observers.

Documentation

Nothing to report.

Public Relations and Outreach

Visitors and Tours

7/25/16 – Two telescope operators from the Discovery Channel Telescope (DCT) located near Flagstaff, Arizona, visited during their summer shutdown period to see operations and aluminization activities at the MMTO, a larger facility than the DCT. G. Williams and R. Ortiz gave them a tour.

Site Protection

J. Hinz attended four public meetings of the Benson City Council (July 5, 9, 11, 18). She spoke in favor of revising the existing Outdoor Lighting Regulations code, encouraging the compliance of the proposed Villages at Vigneto development with a revised code. The MMTO and F. L. Whipple Observatory also sent the Benson Mayor and City Council members a letter in support of revising the code. On September 12, the Benson City Planning Commission agreed to select a committee to revise the Outdoor Lighting Regulations. J. Hinz will serve on the committee, which will meet for the first time on October 6.

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)

16-30 Characterization of an Integrally Wound Tungsten and Aluminum Filament for Physical Vapor Deposition
W. Goble and R. Ortiz
SPIE, **9912**, 38

16-31 Automation and Control of the MMT Thermal System
J.D. Gibson, D. Porter, and W. Goble
SPIE, **9913**, 1

16-32 The 6.5-m MMT Telescope: Status and Plans for the Future
G.G. Williams, R. Ortiz, W. Goble, and J.D. Gibson
SPIE, **9906**, 0V

16-33 Mitigation of H2RG Persistence with Image Illumination
B.A. McLeod and R. Smith
SPIE, **9915**, 0G

16-34 The Chemical Composition of Red Giant Branch Stars in the Galactic Globular Clusters NGC 6342 and NGC 6366
C.I. Johnson, N. Caldwell, R.M. Rich, et al.
AJ, **152**, 21

16-35 The UV-bright Quasar Survey (UVQS): ER1
T.R. Monroe, J.X. Prochaska, N. Tejos, et al.
AJ, **152**, 25

16-36 The Prevalence and Impact of Wolf-Rayet Stars in Emerging Massive Star Clusters
K.R. Sokal, K.E. Johnson, R. Indebetouw, et al.
ApJ, **826**, 194

16-37 The Red Supergiant Content of M31
P. Massey and K.A. Evans
ApJ, **826**, 224

16-38 Carbon and Oxygen Abundances in Low Metallicity Dwarf Galaxies
D.A. Berg, E.D. Skillman, R.B.C. Henry, et al.
ApJ, **827**, 126

16-39 Ultraviolet Fe II Emission in Fainter Quasars: Luminosity Dependences, and the Influence of Environments
R.G. Clowes, L. Habersettl, S. Raghunathan, et al.
MNRAS, **460**, 1428

16-40 A Spectroscopic Survey of Massive Stars in M31 and M33
P. Massey, K.F. Neugent, and B.M. Smart
AJ, **152**, 62

16-41 Asymmetries in SN 2014J near Maximum Light Revealed through Spectropolarimetry
A.L. Porter, M.D. Leising, G.G. Williams, et al.
ApJ, **828**, 24

16-42 A Survey of Luminous High-redshift Quasars with SDSS and WISE. II. The Bright End of the Quasar Luminosity Function at z ≈ 5
J. Yang, F. Wang, X.-B. Wu, et al.
ApJ, **829**, 33

16-43 BUDHIES – III. The Fate of H 1 and the Quenching of Galaxies in Evolving Environments
Y.L. Jaffe, M.A.W. Verheijen, C.P. Haines, et al.
MNRAS, **461**, 1202

MMT Technical Memoranda / Reports

None

Non-MMT Related Staff Publications

None

Appendix II - Service Request (SR) and Response Summary: July - September, 2016

The MMTO 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 11 presents the distribution of SR responses by priority during the period of July through September. As seen in the figure, the highest percentage (38%) of responses have either "Near-Critical" and "Important" priority, followed by 17% as "Low" priority. There were 3% for both the "Critical" and "Information Only" SR priority levels.

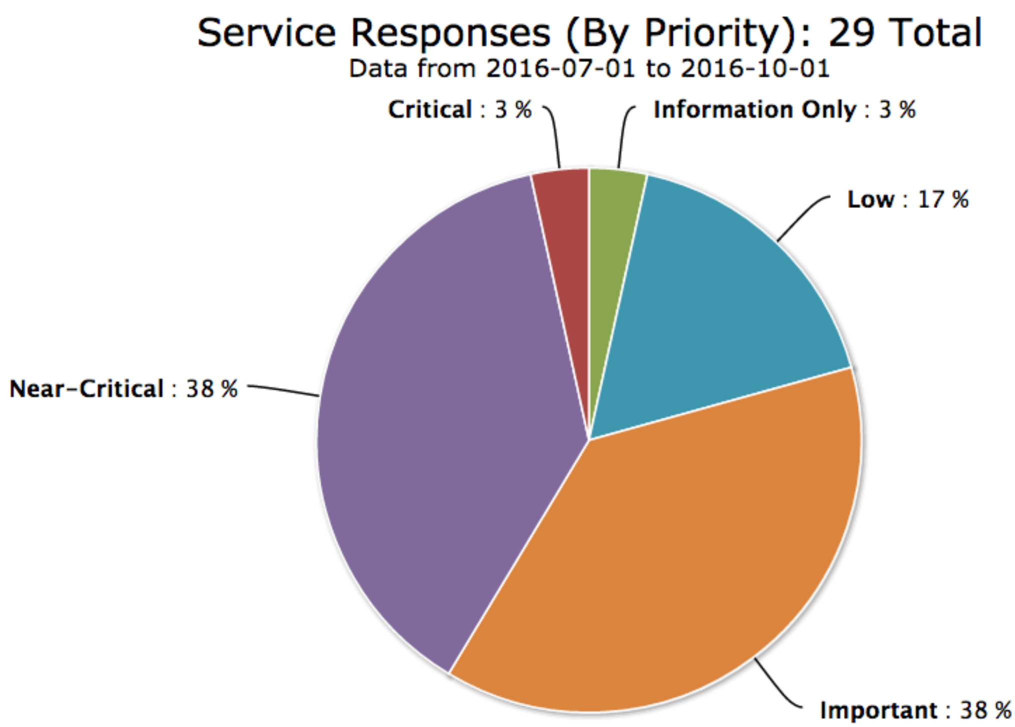

Figure 11. Service Request (SR) responses by priority during July through September 2016. 38% of the SRs have either "Critical" and "Important" priority, while 17% were "Low" priority. The observatory was closed for summer shutdown and re-aluminization during much of this time period, resulting in fewer than normal 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 were a total of 29 SRs during this three-month period, down from 42 SRs during the previous three-month reporting period.

Figure 12 presents the same 29 SR responses grouped by category. These categories are further divided into subcategories for more detailed tracking of issues. The majority of the responses from July through September are related to the "Building" and "Weather Systems" categories with 5 responses each. Responses also occurred in the "Cell," "Chamber," "Computers/Network," "Electronics," "F9 Topbox," "Software," "Telescope," and "Thermal Systems" categories.

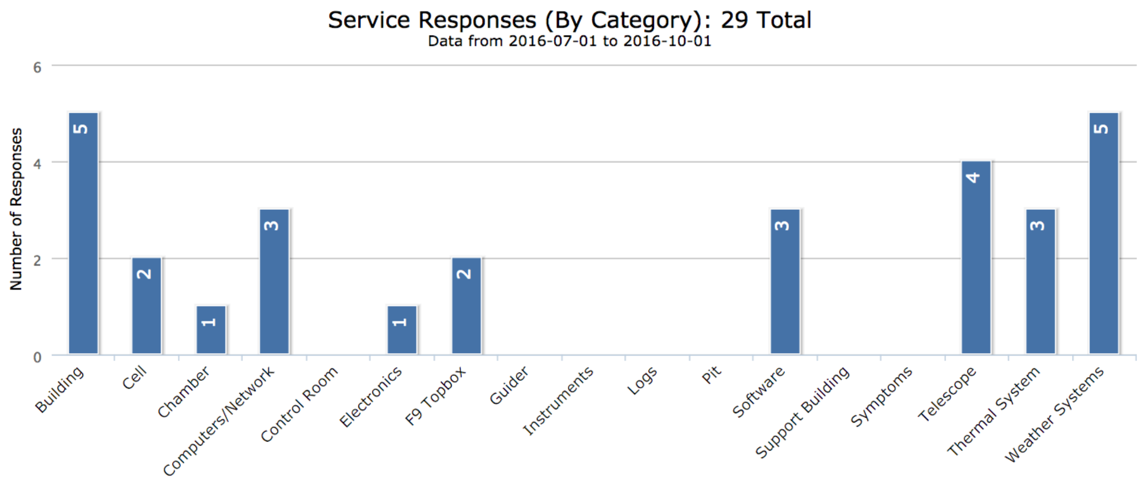

Figure 12. Service Request responses by category during July through September 2016. The majority of responses are within the "Building," "Telescope," and "Weather Systems" categories.

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

July 2016

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	62.70	18.40	0.75	0.00	0.00	0.00	19.15
PI Instr	4.00	31.10	12.93	0.00	0.00	0.00	0.00	12.93
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	**12.00**	**93.80**	**31.33**	**0.75**	**0.00**	**0.00**	**0.00**	**32.08**

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 secondary change	0.0
Percentage of time lost to weather	33.4
Percentage of time lost to instrument	0.8
Percentage of time lost to telescope	0.0
Percentage of time lost to general facility	0.0
Percentage of time lost to environment	0.0
Percentage of time lost	34.2

* Breakdown of hours lost to instrument

0.25 Blue Channel hung reading out

0.50 Power cable issue in topbox

Year to Date August 31, 2016

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	54.00	536.50	227.78	0.75	1.91	5.00	0.00	235.44
PI Instr	133.00	1260.30	316.24	6.38	15.02	1.16	0.00	338.80
Engr	7.00	68.60	15.30	0.00	0.00	0.00	0.00	15.30
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**194.00**	**1865.40**	**559.32**	**7.13**	**16.93**	**6.16**	**0.00**	**589.54**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	96.3
Percentage of time scheduled for engineering	3.7
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	30.0
Percentage of time lost to instrument	0.4
Percentage of time lost to telescope	0.9
Percentage of time lost to general facility	0.3
Percentage of time lost to environment	0.0
Percentage of time lost	31.6

September 2016

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	3.00	31.00	31.00	0.00	0.00	0.00	0.00	31.00
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	**3.00**	**31.00**	**31.00**	**0.00**	**0.00**	**0.00**	**0.00**	**31.00**

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 secondary change	0.0
Percentage of time lost to weather	100.0
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	0.0
Percentage of time lost	100.0

Year to Date September 2016

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	54.00	536.50	227.78	0.75	1.91	5.00	0.00	235.44
PI Instr	136.00	1291.30	347.24	6.38	15.02	1.16	0.00	369.80
Engr	7.00	68.60	15.30	0.00	0.00	0.00	0.00	15.30
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**197.00**	**1896.40**	**590.32**	**7.13**	**16.93**	**6.16**	**0.00**	**620.54**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	96.4
Percentage of time scheduled for engineering	3.6
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	31.1
Percentage of time lost to instrument	0.4
Percentage of time lost to telescope	0.9
Percentage of time lost to general facility	0.3
Percentage of time lost to environment	0.0
Percentage of time lost	32.7