Smithsonian Astrophysical Observatory & Steward Observatory, The University of Arizona

MMT Observatory

Smithsonian Institution &
The University of Arizona®

End-of-Quarter Summary

October - December 2016

A new method of washing the primary mirror was used and proved to be very successful!

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

Program Management

The annual staff meeting and photo took place at the summit on November 15. Lunch was provided, followed by the "State of the MMTO" address by Director G. Williams, and the staff photo.

The following meetings were held during this reporting period: two engineering and one telescope/queue operators.

Reports and Publications

There were 40 peer-reviewed publications during this reporting period. See the listing of publications in Appendix I, p. 16.

Safety

J. Di Miceli and B. Comisso attended the National Safety Congress Expo meeting in Anaheim, CA on October 16-20. They attended seminars on various safety topics, and also saw a demonstration on safety railings and tie-ins. They met with various vendors regarding new safety products, and brought back samples for staff to try that included gloves, safety goggles, and slip-ons for shoes for walking on ice during winter at the telescope.

Training

In cooperation with the Steward Observatory Mirror Lab, several new safety videos have been added to the Steward Observatory Safety Training site that is managed by the MMTO.

A greater emphasis has been put on the documentation of safety training. Training records have been updated to include all training that MMTO personnel have received from Smithsonian personnel at the F. L. Whipple Observatory (FLWO) base camp. A new agreement has been established between Smithsonian and MMTO safety personnel that informs MMTO safety officers when MMTO staff have completed FLWO training so that staff records can be updated.

Procedures and Protocols

A new Safety Data Sheet (SDS) binder has been implemented replacing the old Material Safety Data Sheet binder. Old chemicals in the campus electronic shop have been purged. New SDSs have been printed and logged for existing chemicals, bringing the campus shop SDS program up to date.

Primary Mirror

Coating & Aluminization

After the telescope was returned to normal science operations on September 27, the aluminization project shifted focus to preparing the coating equipment for long-term storage at the base camp. On October 6, the 12" valve used on the bell jar at the summit was installed on the rear bell, and connected into the PVC roughing line. Marco Crane lifted the bell jar from the trailer to the bell jar cart on October 12. At this time, the bell jar lifting beam, the wire ropes, and corresponding shackles were removed from the bell jar and stored inside the MMTO warehouse. The pumping trailer was connected to the bell jar assembly, and on October 13 an attempt was made to pump down the bell jar. With the roots blower running, the bell jar pressure did reach the high milliTorr range, but once the pumps were shut off, the pressure quickly rose to about 2.5 Torr. The next morning the pressure was 60 Torr. An investigation revealed the turbo pump cover and the west cryopump cover were leaking due to a rushed installation on the summit. These covers were reinstalled, and the bell jar will be pumped on again in January. Until this time, the opening between the bell jar and the bell jar extension has been covered with a tarp.

Over the summer shutdown period, various items from MMTO coating equipment at the Sunnyside testing facility had migrated to base camp and to the summit in support of the activities there. A few days were spent returning the small Sunnyside coating chamber to a workable system. This work included installing welder 12 for a filament power supply and reinstalling a vacuum isolation valve on the scroll pump. After the system was returned to working order, R. Ortiz and W. Goble worked with B. DeGroff and F. Cornelius from the Discovery Channel Telescope (DCT, Flagstaff, AZ) to test a potential replacement filament for the DCT coating system. The tested DCT filament is an integrally wound tungsten and aluminum filament with a geometry very similar to those used in the MMTO bell jar. This testing was very exploratory, but did add additional coating knowledge.

On December 7, the telescope was prepared for a primary mirror wash, and the mirror was washed on December 8 (Figure 1). B. DeGroff and F. Cornelius also participated with the wash. Although the primary mirror coating was only a few months old, early December is often the last time the weather is warm enough to permit a soap and water mirror wash until later in the spring. The Minolta spectrophotometer readings (Figures 2 and 3) illustrate the improvement in reflectivity and scatter realized from the wash. Unfortunately, the fresh coating measurement is from an edge witness slide, and the wash measurements were taken near the Cassegrain opening, so while the after-coating data should be representative, caution should be used when making direct comparisons to the wash data.

Figure 1. Primary mirror wash on December 8.

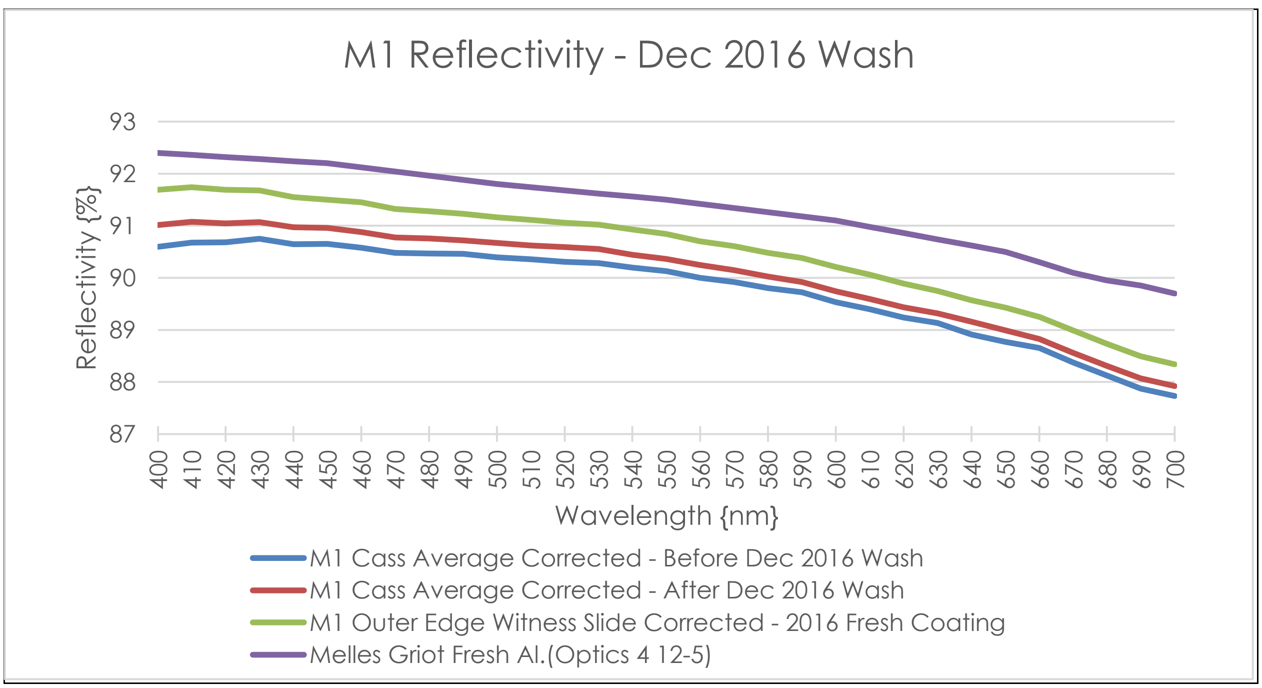

Figure 2. Graph depicting primary mirror reflectivity before and after the December wash.

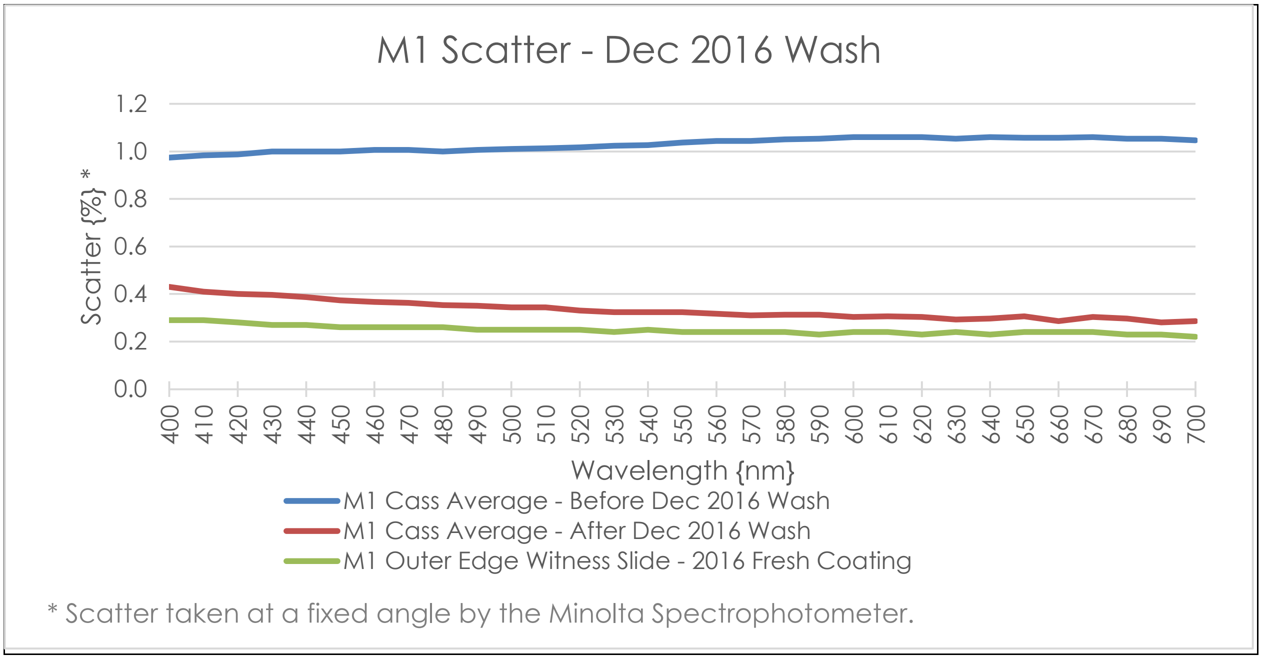

Figure 3. Graph depicting primary mirror scattering before and after the December wash.

Mirror Support System

In early November, a spare cell crate power supply was installed into the rack, replacing the original equipment manufacturer supply, to determine that the spare power supply was functional and usable. After getting some run time on the new supply, the cell crate began experiencing voltage monitor (Vmon) errors. It was determined that the +15 V supply was drifting by approximately 0.7 volt. With mirror safety the priority, a plan was developed to lower the voltage threshold to prevent future Vmon errors. This change allows the electronics group time to develop a solution for the voltage drift with no time lost on the telescope. Work will continue in January to resolve the issue.

Secondary Mirrors

f/15

There were concerns about the continuity of the f/15 cable assembly that mounts to the f/15 secondary. The cable's solder joints were inspected, and the cable assembly was ohm'ed out using the milliohm meter. No serious defects were noted.

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 the MMT for 31.9% of the available nights from October 1 – December 31. Approximately 79% of those nights were scheduled with the Blue Channel Spectrograph, 4% with Red Channel, and 17% with SPOL. 339.3 hours were allocated for f/9 observations. 49.7% of these hours were lost due to weather. Instrument, facility and telescope problems accounted for less than 2% of lost time, most of which was due to an issue with the spectrograph shutter. Blue lost 53.5% of its time to bad weather, with Red Channel losing all, and SPOL losing 21.1%.

f/5 Instrumentation

There were 61 nights scheduled for f/5 observing during this reporting period. The weather was a little worse than average, resulting in 37% of this time lost. Of that lost time, there were 11 nights when no data were taken on scientific targets. Hectospec data were taken on 21 nights, and Hectochelle data were taken on 11 nights. MMTCam observations were interspersed with the Hecto observations. Science data were taken on 5 nights, and its calibrations were taken on an additional 6 nights. MMIRS was mounted for 18 nights with observations taken on 15 of those nights.

Following is a general summary of issues experienced during this quarter. As stated in the previous quarterly report, the WFS system was not operational at the start of this quarter due to a computer issue. We returned to techniques of centering, collimating, and focusing on stars using the robot and guide probe cameras used in the past. The techniques are a little less efficient, but allow us to continue to operate. An issue also developed during the October run that caused the c*lark* computer to react slowly and to hang for some processes. That was corrected with a reboot of the system. The ION pumps on the Hecto dewars gave us some trouble this quarter. Some may have been due to human error after a lightning shutdown, but other times the cause was uncertain. If the ION pump is not working effectively, it will cause some warming of the dewar/detector. The LN2 hold time will also be diminished. All these issues were responsible for about 3.5 hours of lost Hecto time. Most of a night in the MMIRS December run was lost to another failure of the building drive. Day staff was able to get the amplifier operational by the start of the next night. A couple of hours were lost to trouble with the telescope that included oscillations, cell crate problems, and issues with limits.

The WFS computer was opened up in mid-October after the first run of the quarter so that M. Lacasse and D. Porter could troubleshoot it. The power supply was checked. The IDE board was removed to test a possible replacement motherboard. When it was reinstalled, a loose wire was noted, and we repaired a broken solder joint probably caused by the board's removal. Two spare power supplies were tested. One spare did not work and has since been fixed. A replacement motherboard with a new disk drive was checked. The older operating system would not boot due to a compatibility issue with the size of the drive or the configuration of the new motherboard. The BIOS battery was replaced in the original motherboard. After all the testing, unseating, and reseating boards and connectors, the original board and power supply worked again. There have been no further problems.

New MMTO queue observers, C. Ly and S. Kattner, began their training with veteran Hecto/MMTCam/MMIRS operators, P. Berlind and M. Calkins. There is much information to impart, and the process will continue.

Planning continues for the arrival of the Binospec instrument and the associated laser cutter. W. Goble and R. Ortiz have been the primary points of contact for the clean room and telescope simulator within it, to be installed in the Instrument Repair Facility (IRF) for assembly and maintenance work on Binospec. A new port for cables and hoses will be needed in the cell cone. M. Lacasse met with M. Tartaro, P. Brennan, and others to discuss the optimum location for the laser cutter. The room will need to be clean and environmentally controlled, both for temperature and for humidity. Location options discussed included the IRF, the MMT shop, the old Gamma Ray building, IOTA, and the Common Building basement. Currently, the final plan for the laser cutter is to renovate the east side of the Common Building basement in order to add insulation, air conditioning, fume exhaust components and access restrictions. Plans are that both Binospec and the laser cutter will arrive on Mt. Hopkins in the second quarter of 2017.

Hecto was on for a total of 35 nights. We gathered 390 exposures on 121 science fields. Another 1757 calibration exposures were taken consisting of bias, flat, comparison, dark, and sky exposures. Calibration data was taken on 5 nights that proved unsuitable for opening the front shutters. The weather was sufficiently hopeless on 3 additional nights such that we did not even home the robots. The T1 oscillation problem remains and occurs one or two times each night on average. Correcting the issue takes very little time. MMTCam obtained 105 images of 8 science targets along with 229 calibration exposures consisting of bias frames, sky flats, and dark exposures. MMTCam was inoperative during the first run due to the issues with the wavefront sensor computer.

The Hecto system has been operating on a virtualized *clark* machine for some time. This machine's display is viewed through VNC windows on the *meerkat* computer station with two monitors at the east end of the control room. Previously, the *clark* and *lewis* computer displays were direct connections of the monitors through long video cables. This quarter, the operators noticed some anomalies in the display of the guide cameras. They described it as "freckles," though they were light colored pixels in a field with "white" stars. Daytime analysis of the displays by M. Lacasse revealed that the bright pixels were changing at the monitor video display rate and not the slower camera frame rate. The "freckles" were judged to be artifacts of the VNC process, probably due to slight differences in the *meerkat* monitor display frequency, the VNC display frequency, the virtual computer video rate, and the guide camera refresh rate. In other words, they are not a problem with the guide cameras. A mounting foot of the 600 line grating for HectoSpec was "tweaked" in November when a motion command was issued while the grating was being installed. The locations of the fiber traces were noticeably different, and the data pipeline would have difficulty dealing with the change. The 600 line grating was not used for the last few days of the run. The mounting foot has since been adjusted, and spectra now seem normal.

The MMIRS instrument was on the telescope for 18 days over two runs this quarter, November 8-13 and December 9-20. Three of the nights were totally lost to weather, and another half night lost to the building drive issue. 1203 image files and 836 spectral files were obtained on 111 science fields. Over 2700 calibration/setup files consisting of dark exposures, alignment images, telluric spectra, comparison spectra, and flat fields, were also obtained. The alignment files are shorter exposures used to verify that the target objects are properly centered on the many slits of the mask. The telluric files are spectra of a nearby A star taken through several slits of the mask and are used to establish current local atmospheric transparency.

Since returning to the MMTO in June 2015, MMIRS operation has now become more routine. Staff is more comfortable with mounting the instrument. The queue observers (M. Calkins, P. Berlind, S. Kattner, and C. Ly) and telescope operators can now comfortably handle most of the normal operations of the instrument. The camera section of the instrument was kept cold for approximately 3 weeks between the November run and the December run. The camera section was also kept cold after the December run in anticipation of a mid-January run. Keeping the instrument cold required 15 minutes per day from the mountain staff or the telescope operator, plus the supply of liquid nitrogen. Warming and cooling the instrument requires 3 and 4 days of stable power and relatively close supervision by an instrument specialist. The cool-down process requires a couple of full LN2 dewars. Keeping MMIRS cold also provides a little more flexibility if the director wishes to have it mounted on shorter notice due to problems with other instruments. The surface heater system on MMIRS has been operating reliably. It is successfully keeping the exterior of the instrument near the ambient temperature and above the dew point.

MMIRS had a motor failure at the start of the November run. This was caused by the software not seeing a change in the state of the Grism wheel location indicator switches during homing tests. The instrument was also rather quiet; motion of the Grism wheel is usually audible. M. Lacasse called B. McLeod for added guidance. The fault was traced to a poorly strain-relieved cable buried in the electronics rack. A splint was made to keep the cable in a fixed (good) state and there have been no further issues with the motor. A request for some replacement, as well as spare, cables has been made with the SAO electronics staff in Cambridge, MA.

Another issue noted with MMIRS was light contamination in the Star-Tracker and Wavefront cameras. Given that there are windows on either side of the instrument for the (warm) WFS/G cameras to look at the (cold) pickoff mirrors, the contamination was not totally surprising. Some black baffle material that had been prepared during the commissioning run was recovered and adjusted to accommodate recent modifications for the electric LN2 fill valve components. The baffles were mounted on the instrument for the December run and there were fewer operator mentions of guider issues caused by light contamination.

While the new MMIRS queue software by D. Gibson was ready for testing with the November run, it was not an ideal test bed. One night was reserved for engineering (though, in practice, engineering tasks were sprinkled throughout the run). Two of the CfA observers combined their programs and requested classical observing for two nights of exploratory science. This left only one program in the queue. Of the three nights reserved for this program, 5.5 hours were lost due to poor weather, and seeing was poor throughout due to high winds.

The MMIRS December run was the first one that truly used and thoroughly tested the new queue software written by D. Gibson. Of the 144 hours allocated, 33% were lost to weather (47 hours) and 7.6% (8 hours) were lost to a building drive failure on December 12. The twelve-night run consisted of 6 programs, 18 individual slit masks, and 149 submitted targets. A mask change was done on December 15 in order to accommodate all of the requested masks. Over 110 objects were observed in the queue. The tremendous amount of bookkeeping required and the need to maintain contact between PIs, scientific staff, software staff, queue observers, and telescope operators necessitated an almost daily meetup to discuss the progress of the queue and to address any potential problems.

One problem addressed in the middle of the run involved an incorrect choice of frame of reference, which resulted in false values for moon separation in degrees. This was resolved for the rest of the run. Because all of the PIs ranked the objects within their programs in different ways, it was agreed to temporarily suspend PI priority ranking in the software. However, these preferences were available to the queue observers for guidance. A centralized system of webpages was used to post comments and notes from PIs, as well as a list of all objects completed, sorted by date or PI, and a listing of time lost per night.

J. Hinz drafted and finalized a document for PIs to address frequently asked questions about the MMIRS queue, which was sent to astronomers with programs in December and for those coming up in January.

Due to the fact that the next MMIRS run is in mid-January, eight new masks had to be ordered for that run by mid-December to ensure on-time delivery. PIs submitted field files by December 30.

f/15 Instrumentation

An NGS adaptive optics (AO) run was conducted from October 10-20. The observing run consisted of one maintenance and engineering (M&E) night and ten science nights. The run was extremely productive. Good weather enabled data to be collected continuously throughout the run, and the AO system ran without issue until the final night. On the final night, an issue with intermittent power to the adaptive secondary forced the last part of the night to be cancelled. The intermittent power issue did not seem to be a problem with the DM336 power supply itself, but possibly an issue with a cable or loose connector. After being removed from the telescope, significant testing of the deformable mirror (DM) and power supply did not reveal any problems.

Initial design and development work has begun on the adaptive secondary portion of the "MMT Adaptive optics exoPlanet characterization System" (MAPS) program that received funding from the National Science Foundation. The current work includes design of the DM electronics, PCR reconstructor, user software interface, ARIES instrument upgrades, and refurbishment of the optical test bench for DM calibration. Design and development work will continue into spring 2017 before the adaptive secondary is taken offline in March 2017.

Topboxes and Wavefront Sensors (WFS)

Nothing to report.

Facilities

Main Enclosure

A building drive problem occurred in early December. The electronics group was unable to reproduce the exact failure that the telescope operator had experienced, but was able to confirm twice that a telescope/building collision was randomly occurring. They confirmed that the building drive amps were functioning properly and that the building LVDT had no faults. A failure point could not be located. A plan was developed and hardware was procured to trap status bits to aid in identifying four possible failure modes. The data acquisition system will be installed in early January.

While troubleshooting the building drive problem, a cable for the front shutter was found to have a cracked outer jacket exposing the wires inside. A discussion identified that the cable was not designed to be flexed the way it is in the front shutter energy chain. A new cable, a Lutze Superflex Plus 113411, was ordered that is designed to be flexed on a recurring basis. It is super flexible and designed to flex at temperatures down to -25C. A couple of engineering nights is anticipated to accomplish its installation.

Instrument Repair Facility (IRF)

The removal of a section of the IRF floor for the telescope simulator foundation was started in early November. The floor required reinforcement to provide sufficient strength to hold the simulator. Unfortunately, the pipe carrying water from the "Aspen" tanks to the summit tank was damaged in the process. The contractor developed a fix, but the fix will not be implemented until January 2017. FLWO will be trucking water to the summit tank until the pipe is fixed.

After discussions between SAO, SI Facilities, and MMTO, a consensus was reached to install a concrete path between the new outside equipment lift and the IRF. The 12-foot wide path will allow instrumentation and equipment to be rolled between the telescope main building and the IRF. Since there is a 3.5% grade between the IRF and main building, a powered tug or other device will be required for safe and controlled moving.

Computers and Information Technology

Hardware/Software Interfaces

MMIRS queue scheduling was done during two separate runs during this reporting period: November 8-13 and December 9-20. The November run was a combination of classical and queue scheduling and required only limited use of the new queue scheduling software. The December run was much more extensive, involving six different observing programs from both SAO and UAO. A total of approximately 120 observing blocks were scheduled during the 12-day run. An updated queue schedule was created each morning, based upon the observations completed during the previous night.

Development continues on both the backend and frontend of the queue scheduling software. The new frontend replaces the current MMOST web interface used by astronomers to submit details of planned MMIRS observations. The new software provides revised web interfaces for both astronomers and MMTO staff. These new web interfaces are part of a larger "Observatory Manager" being developed by D. Porter.

The new backend supplements the astropy/astroplan library with several MMT-specific constraints. Targets or observing blocks are scheduled in a sequential approach. Various constraints are used to obtain an overall score for each observing block at a specific time as scheduling proceeds. The observing block with the highest overall score is scheduled in the first available timeslot, then scheduling resumes with the highest-scoring remaining observing block being scheduled in the next available timeslot. A time gap is inserted into the schedule if no observing blocks can be scheduled. Scheduling continues until either all targets are scheduled or the end of the observing run is reached.

Many lessons were learned during the two runs. One difficulty during the runs was a lack of consistency in how targets were prioritized by the principal investigators of the programs. This required the queue observer to combine the tentative queue schedule with observational notes to determine the order in which targets should be observed. This and other issues will be addressed in future queue scheduling runs.

Weather and Environmental Monitoring

Weather Stations

A new dual port Lantronix unit was installed in place of the single port Lantronix. Since the unit was suspected of being struck by lightning, RS-485 suppression units were installed on both ports. The system is operational, but still displays erroneous wind speed and directional information. Time is being scheduled to troubleshoot and repair the unit while a boom truck is available at the summit.

All Sky Camera and Web Cameras

A new enclosure for the roof webcam was received. A larger enclosure was needed to accommodate the addition of a BAS 20 controller to monitor roof temperature probes. Another DC power supply and a 4-port network switch were added as well. The enclosure will be mounted in the same location as the previous enclosure. Completion of the installation is expected to be in early February.

Seeing

As discussed in previous quarterly reports, the MMT and Magellan Infrared Spectrograph (MMIRS), a wide-field near-IR imager and multi-object spectrograph, generates WFS-related seeing values much more quickly than other f/5 or f/9 instruments. This instrument was on the telescope during both November and December. Of the 7438 total WFS data samples for the period of October 1, 2016 to January 1, 2017, 6192 are from MMIRS. There are 576 f/5 seeing values that are not from MMIRS (*e.g.,* Hecto) and 670 seeing measurements from f/9 instruments.

Figures 4 and 5 present apparent seeing values, corrected to zenith, at the MMTO during this reporting period. These values are derived from measurements made by the f/5 (MMIRS and non-MMIRS) and f/9 WFSs. Figure 4 presents the seeing values as a histogram with 0.1 arcsec bins, while Figure 5 presents the same data as a time-series chart. f/5 WFS values are divided into MMIRS and non-MMIRS categories. In Figure 4, f/5 (MMIRS) seeing data are shown in blue, f/5 (non-MMIRS) data are in green, f/9 data are in red, and the combination of all three WFS values is in cyan. In Figure 5, seeing measurements for the f/5 are similarly shown as blue (MMIRS) and green (non-MMIRS) diamonds while f/9 WFS seeing measurements are represented by red squares.

The median f/5 seeing value for MMIRS data is 1.05 arcsec. This is similar to the 1.07 arcsec value in the October-December 2015 quarter. The median non-MMIRS f/5 seeing is 0.79 arcsec while the median f/9 seeing value is 0.78 arcsec. This latter seeing quality is very similar to the 0.76 arcsec value of the October-December 2015 quarter. The combined median seeing for all data WFS systems is 1.01 arcsec. As previously stated, the combined data set is biased towards nights of MMIRS observing.

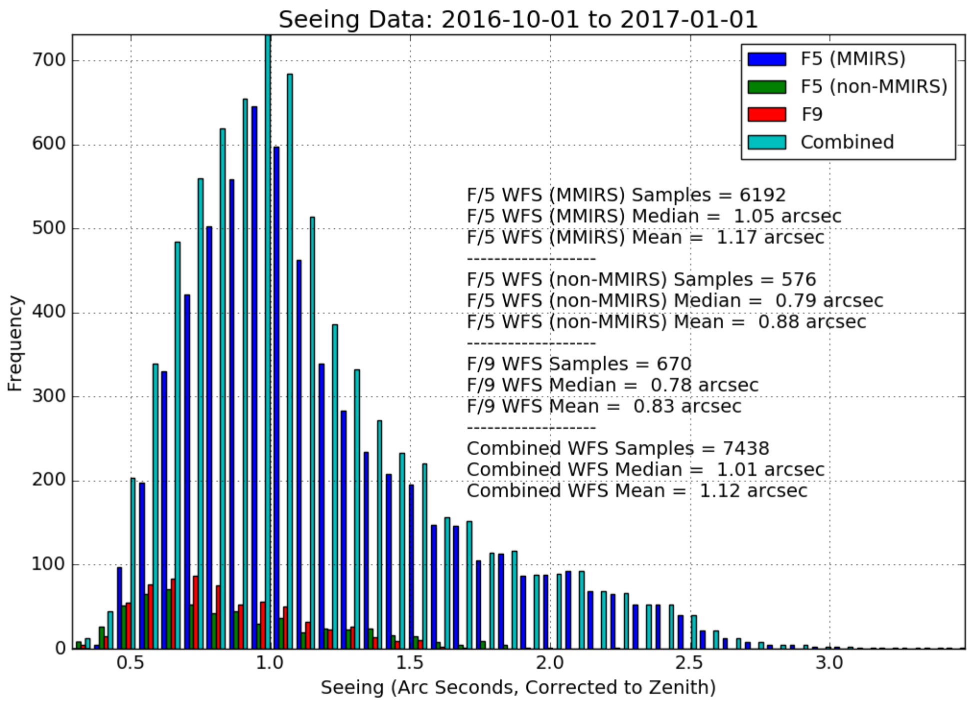

Figure 4. Histogram (with 0.1 arcsec bins) of derived seeing values for the f/5 (MMIRS and non-MMIRS) and f/9 WFSs from October through December 2016. Seeing values are corrected to zenith. The median f/5 MMIRS seeing is 1.05 arcsec and f/5 non-MMIRS seeing is 0.79 arcsec while the median f/9 seeing is 0.78 arcsec. A combined median seeing value of 1.01 arcsec is found for the total 7438 WFS measurements made during this period.

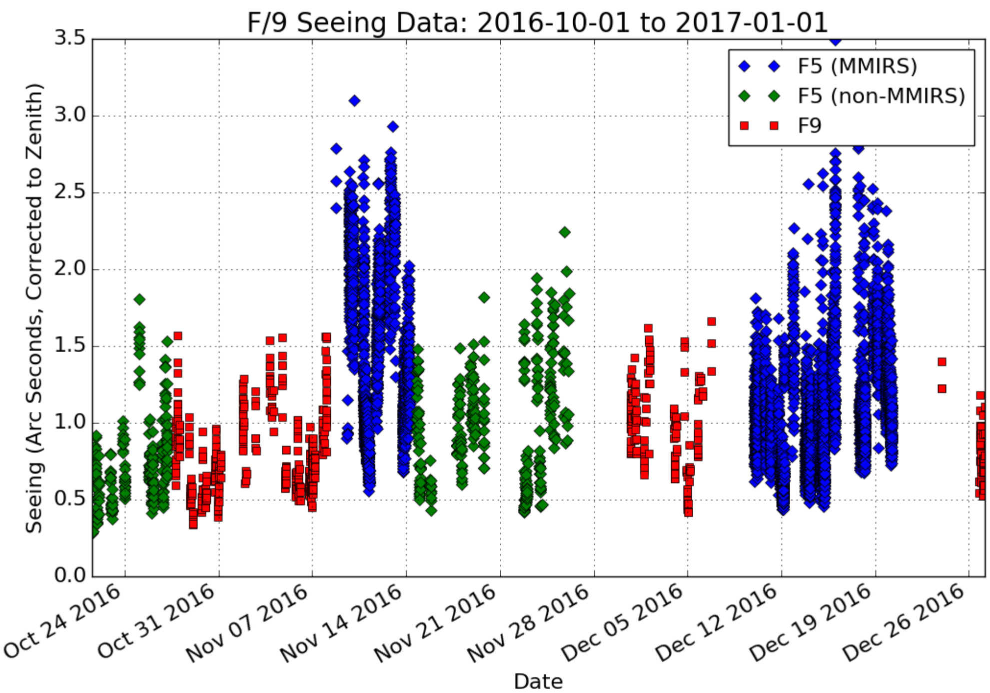

Figure 5. Derived seeing for the f/5 (MMIRS and non-MMIRS) and f/9 WFSs from October through December 2016. Seeing values are corrected to zenith. f/5 seeing values are shown in blue (MMIRS) and green (non-MMIRS) while f/9 values are in red. Data from MMIRS are typically sampled more frequently than for other instruments.

User Support

Remote Observing

The MMTO supported 14 nights of remote observing this quarter. Four nights were for UA observers, with 10 nights for CfA observers.

Documentation

Nothing to report.

Public Relations and Outreach

Visitors and Tours

10/1-2/16 – A Boy Scout troop from Scottsdale, AZ toured the MMTO and other Mt. Hopkins facilities on Saturday, camping out at the Bowl area that night, and departing on Sunday.

10/11/16 – A group of Univ. of Arizona Optical Science graduate students visited the MMTO during an adaptive optics run to see it in operation. The class was led by Dr. M. Hart.

10/12/16 – G. Williams, P. Fortin, and E. Falco gave a tour to four Santa Cruz county officials who are involved with city lighting codes/issues in the county. The MMTO and Mt. Hopkins are located within Santa Cruz county.

11/1/16 – A group of 30 visitors with a Smithsonian Journeys tour group visited the MMTO and the other facilities on Mt. Hopkins.

11/8/16 – Four visitors from GEOST, Inc., a Tucson company specializing in electro-optics and sensors, visited the MMTO. The group was led by their staff scientist, D. Kiminki, a former Steward Obs. astronomer who worked on the MAESTRO instrument used on the MMT. The tour provided the GEOST staff an opportunity to see actual operations of an optical astronomical observatory.

Public Presentations

J. Hinz organized the 47th annual Smithsonian Lecture Series on Astronomy held in Green Valley, Arizona. Lectures begin in January 2017.

MMTO in the Media

The MMTO now has over 400 followers on Twitter and over 1800 on Facebook.

Site Protection

J. Hinz served on the new City of Benson Outdoor Lighting Code Committee, which met October 20, November 6, and December 8. Significant progress has been made on revising the current outdoor lighting code.

J. Hinz continues to attend monthly meetings of the Astronomy, Planetary, and Space Sciences group, a consortium of Arizona observatories working to protect dark skies.

J. Hinz served on the committee to hire a Public Affairs Specialist for F.L. Whipple Observatory. A short list of candidates has been made, and site visits begin in January.

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)

16-44 Leveraging 3D-HST Grism Redshifts to Quantify Photometric Redshift Performance
R. Bezanson, D.A. Wake, G.B. Brammer, et al.
ApJ, **822**, 30

16-45 Direct Determination of Oxygen Abundances in Line-emitting Star-forming Galaxies at Intermediate Redshift
J.M. Pérez, C. Hoyos, A.I. Diaz, et al.
MNRAS, **455**, 3359

16-46 The Hot Gas Content of Fossil Galaxy Clusters
G.W. Pratt, E. Pointecouteau, M. Arnaud, et al.
A&A, **590**, 1

16-47 Cosmic Shear Results from the Deep Lens Survey. II. Full Cosmological Parameter Constraints from Tomography
M.J. Jee, J.A. Tyson, S. Hilbert, et al.
ApJ, **824**, 77

16-48 Luminous and Variable Stars in M31 and M33. III. The Yellow and Red Supergiants and Post-red Supergiant Evolution
M.S. Gordon, R.M. Humphreys, and T.J. Jones
ApJ, **825**, 50

16-49 WISE x SuperCOSMOS Photometric Redshift Catalog: 20 Million Galaxies over 3/pi Steradians
M. Bilicki, J.A. Peacock, T.H. Jarrett, et al.
ApJS, **225**, 5

16-50 The Metal Abundances Across Cosmic Time (MACT) Survey. I. Optical spectroscopy in the Subaru Deep Field
C. Ly, S. Malhotra, M.A. Malkan, et al.
ApJS, **226**, 5

16-51 The Spitzer Infrared Spectrograph Survey of Protoplanetary Disks in Orion A. I. Disk Properties
K.H. Kim, D.M. Watson, P. Manoj, et al.
ApJS, **226**, 8

16-52 The Metal Abundances Across Cosmic Time (MACT) Survey. II. Evolution of the Mass-metallicity Relation over 8 Billion Years, Using [OIII]4363AA-based Metallicities
C. Ly, M.A. Malkan, J.R. Rigby, et al.
ApJ, **828**, 67

16-53 SPOTS: The Search for Planets Orbiting Two Stars. II. First Constraints on the Frequency of Sub-stellar Companions on Wide Circumbinary Orbits
M. Bonavita, S. Desidera, C. Thalmann, et al.
A&A, **593**, 38

16-54 Imaging Extrasolar Giant Planets
B.P. Bowler
PASP, **128**, 2001

16-55 The LAMOST Spectroscopic Survey of Star Clusters in M31. II. Metallicities, Ages, and Masses
B. Chen, X. Liu, M. Xiang, et al.
AJ, **152**, 45

16-56 The Redshifted Hydrogen Balmer and Metastable He 1 Absorption Line System in Mini-FeLoBAL Quasar SDSS J112526.12+002901.3: A Parsec-scale Accretion Inflow?
X.-H. Shi, P. Jiang, H.-Y. Wang, et al.
ApJ, **829**, 96

16-57 Comparison of Diversity of Type IIb Supernovae with Asymmetry in Cassiopeia A Using Light Echoes
K. Finn, F.B. Bianco, M. Modjaz, et al.
ApJ, **830**, 73

16-58 The MeSsI (Merging Systems Identification) Algorithm and Catalogue
M. de Los Rios, R. Dominguez, J. Mariano, et al.
MNRAS, **458**, 226

16-59 Hydrostatic and Caustic Mass Profiles of Galaxy Clusters
B.J. Maughan, P.A. Giles, K.J. Rines, et al.
MNRAS, **461**, 4182

16-60 Progressive Redshifts in the Late-time Spectra of Type Ia Supernovae
C.S. Black, R.A. Fesen, and J.T. Parrent
MNRAS, **462**, 649

16-61 The Age and Distance of the Kepler Open Cluster NGC 6811 from an Eclipsing Binary, Turnoff Star Pulsation, and Giant Asteroseismology
E.L. Sandquist, J. Jessen-Hansen, M.D. Shetrone, et al.
ApJ, **831**, 11

16-62 A Constraint on the Formation Timescale of the Young Open Cluster NGC 2264: Lithium Abundance of Pre-main Sequence Stars
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MMT Technical Memoranda / Reports

None

Non-MMT Related Staff Publications

None

Appendix II - Service Request (SR) and Response Summary: October - December, 2016

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 6 presents the distribution of SR responses by priority during the period of October through December 2016. As seen in the figure, the highest percentage (54%) of responses have "Important" priority, followed by 19% as "Near-Critical" priority. There were 11% for both the "Critical" and "Low" SR priority levels and 6% for the "Information Only" priority.

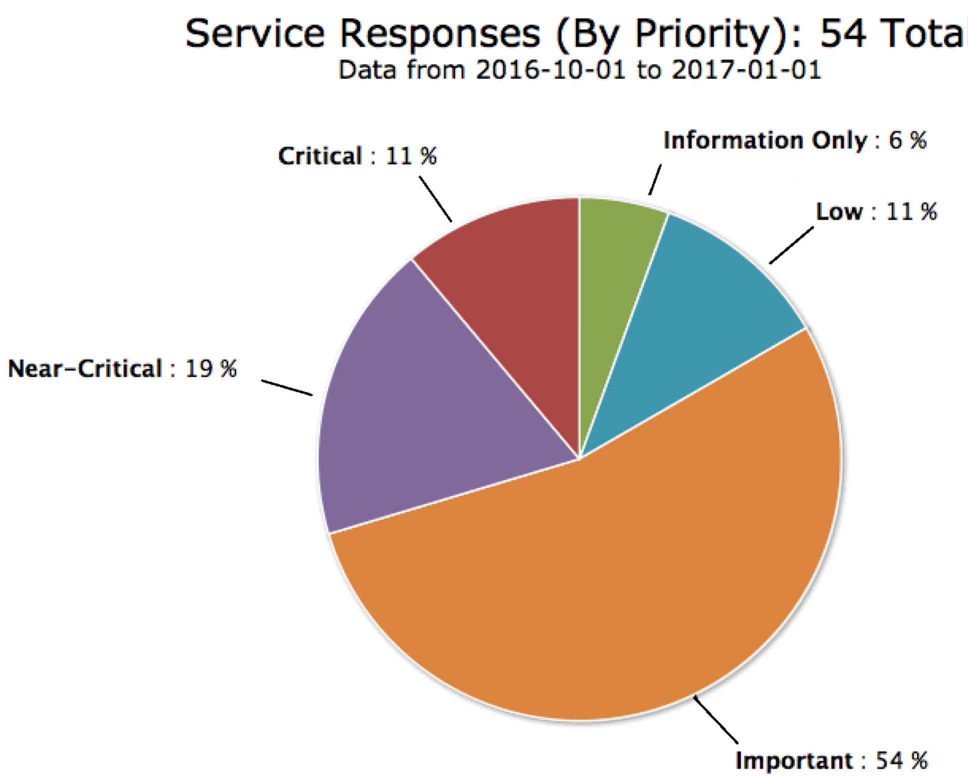

Figure 6. Service Request (SR) responses by priority during October through December 2016. 54% of the SRs were "Important" while 19% were "Near-Critical" priority. 11% of the SRs were either "Critical" and "Low" priority, while 6% were "Information Only" priority.

"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 54 SRs during this three-month period, up from 29 SRs during the previous three-month reporting period.

Figure 7 presents the same 54 SR responses grouped by category. These categories are further divided into subcategories for more detailed tracking of issues. The majority of the responses from October through December are related to the "Telescope" category with 14 responses. Eleven responses were made under the "Cell" category while 10 responses were within the "Support Building" category. Responses also occurred in the "Building," "Chamber," "Computers/Network," "Control Room," "F9 Topbox," "Instruments," "Pit," "Thermal Systems," and "Weather Systems" categories.

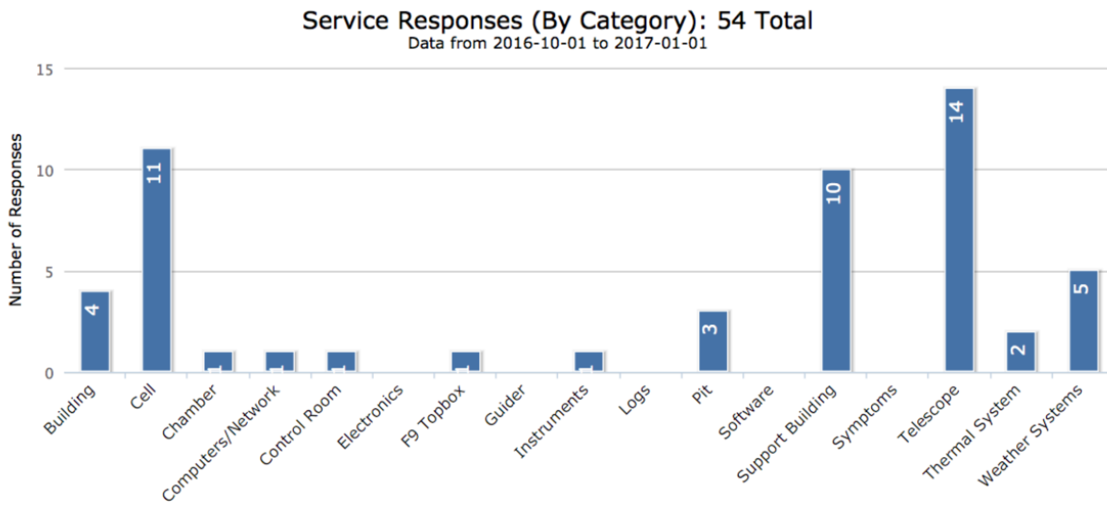

Figure 7. Service Request responses by category during October through December 2016. The majority of responses were within the "Telescope," "Cell," and "Support Building" categories.

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

October 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	4.00	44.90	7.20	0.00	0.00	0.00	0.00	7.20
PI Instr	26.00	280.80	51.75	1.50	12.75	0.00	0.00	66.00
Engr	1.00	10.70	0.00	0.00	0.00	0.00	0.00	0.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**31.00**	**336.40**	**58.95**	**1.50**	**12.75**	**0.00**	**0.00**	**73.20**

Time Summary

Percentage of time scheduled for observing	96.8
Percentage of time scheduled for engineering	3.2
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	17.5
Percentage of time lost to instrument	0.4
Percentage of time lost to telescope	3.8
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	21.8

* Breakdown of hours lost to instrument

1.00 Hecto computer "clark" problems
0.50 Issues with Aries detector

** Breakdown of hours lost to telescope

1.00 Hexapod problems
0.25 Hexapod freezes
0.25 Oscillation
1.00 Alignment and pointing issues
0.50 PCR/AO GUI unresponsive
0.75 AO cyclades communication problems
1.00 AO loop breaks
8.00 AO power loss

November 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	3.00	34.10	14.05	0.00	0.00	0.00	0.00	14.05
PI Instr	26.00	303.00	117.30	1.67	0.66	0.00	0.00	119.63
Engr	1.00	11.50	11.25	0.00	0.00	0.00	0.00	11.25
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**348.60**	**142.60**	**1.67**	**0.66**	**0.00**	**0.00**	**144.93**

Time Summary

Percentage of time scheduled for observing	96.7
Percentage of time scheduled for engineering	3.3
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	40.9
Percentage of time lost to instrument	0.5
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	41.6

* Breakdown of hours lost to instrument

0.67 Warm chelle camera
1.00 Chelle camera readout problems

** Breakdown of hours lost to telescope

0.50 M1 panic
0.16 Rotator hard limit

Year to Date November 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	61.00	615.50	249.03	0.75	1.91	5.00	0.00	256.69
PI Instr	188.00	1875.10	516.29	9.55	28.43	1.16	0.00	555.43
Engr	9.00	90.80	26.55	0.00	0.00	0.00	0.00	26.55
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**258.00**	**2581.40**	**791.87**	**10.30**	**30.34**	**6.16**	**0.00**	**838.67**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	96.5
Percentage of time scheduled for engineering	3.5
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	30.7
Percentage of time lost to instrument	0.4
Percentage of time lost to telescope	1.2
Percentage of time lost to general facility	0.2
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	32.5

December 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	16.00	191.30	123.30	4.30	0.90	0.00	0.00	128.50
PI Instr	12.00	144.00	47.30	0.00	1.75	8.00	0.00	57.05
Engr	2.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**359.30**	**170.60**	**4.30**	**2.65**	**8.00**	**0.00**	**185.55**

Time Summary

Percentage of time scheduled for observing	93.3
Percentage of time scheduled for engineering	6.7
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	47.5
Percentage of time lost to instrument	1.2
Percentage of time lost to telescope	0.7
Percentage of time lost to general facility	2.2
Percentage of time lost to environment	0.0
Percentage of time lost	51.6

* Breakdown of hours lost to instrument

4.30 Spectrograph shutter problems

** Breakdown of hours lost to telescope

0.50 Guider making poor corrections
0.25 M1 panic
0.50 M1 panic due to voltage monitor failure
1.00 Voltage monitor panics
0.40 M1 panic

*** Breakdown of hours lost to facility

8.00 Building drive failure

Year to Date December 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	77.00	806.80	372.33	5.05	2.81	5.00	0.00	385.19
PI Instr	200.00	2019.10	563.59	9.55	30.18	9.16	0.00	612.48
Engr	11.00	114.80	26.55	0.00	0.00	0.00	0.00	26.55
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**288.00**	**2940.70**	**962.47**	**14.60**	**32.99**	**14.16**	**0.00**	**1024.22**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	96.1
Percentage of time scheduled for engineering	3.9
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	32.7
Percentage of time lost to instrument	0.5
Percentage of time lost to telescope	1.1
Percentage of time lost to general facility	0.5
Percentage of time lost to environment	0.0
Percentage of time lost	34.8