MMT Observatory

Smithsonian Institution & The University of Arizona®

End of Trimester Summary

January - April 2010

Construction of the new MMT Instrument Repair Facility

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Personnel

An Applied Optics Scientist/Engineer position for the MMT was advertised in March. K. Powell was offered the position and accepted, with a start date of late May.

Talks and Conferences

F. Vilas, G. Williams, and M. Hastie attended the AAS meeting in Washington, DC held January 3-7. M. Hastie was first author of and presented a poster entitled "Observations of the LCROSS Impact from the MMT Observatory". Co-authors included V. Bailey[2], P. Hinz[2], S. Callahan[1], V. Vaitheeswaran[2], D. Gibson[1], D. Porter[1], and F. Vilas[1] ([1]MMT Obs., [2]Steward Obs.).

G. Williams gave a public lecture on February 18 entitled "The Upgraded MMT: A Decade of Operation and Discovery" as part of the F.L. Whipple Observatory *2010 New Vistas in Astronomy Lecture Series* held in Green Valley, Arizona.

An internal MMT discussion about the Heidenhain absolute encoder was held on February 26 among members of the staff and the parent institutions.

F. Vilas attended the Lunar & Planetary Science Conference (LPSC) in Houston held March 1-5 and presented the poster entitled "LCROSS Impact Observations from the MMT Observatory". She was also co-author on four other abstracts presented at the LPSC, one of which incorporated data acquired using the MMT:

Searching for Satellites of Vesta
    E.A. Jensen, F. Vilas, M.V. Sykes

Ultraviolet Spectroscopy of the Moon: Clues about Composition and Weathering
    A.R. Hendrix, et al.

Search for 0.7-μm Absorption Feature in Galileo Lunmos 9 Images: Implications for Lunar Surface Composition
    F. Vilas, et al.

The Atsa Suborbital Observatory: Using Crewed Suborbital Spacecraft for a Low-Cost Space-Borne Telescope
    L.S. Sollitt, F. Vilas

F. Vilas presented an invited review at the *Next Generation Suborbital Researcher's Conference* in Boulder, CO held February 18-20 and was co-author of a contributed talk presented at the conference:

Solar System Astronomy with Suborbital Crewed Spacecraft: Advantages and Challenges
    F.Vilas, L.S. Sollitt

The Atsa Suborbital Observatory: Using Crewed Suborbital Spacecraft for a Low-Cost Space-Borne Telescope
    L.S. Sollitt, F. Vilas

The following safety trainings were attended by MMT staff:

March 19 & April 19 – Manager & Supervisor Safety Training presented by OSHA
March 29 – Ladder Safety
April 15 – Laser Training
April 21 – Compressed Gas Training

External Presentations

F. Vilas gave an invited talk on March 24 at The Citadel in South Carolina.

F. Vilas gave an invited public lecture on April 21 at the Lunar & Planetary Lab., Univ. of Arizona, as part of their 50^{th} anniversary celebration.

Primary Mirror Systems

Primary Mirror Support

Design and construction of new electronics for the upgrade to the primary mirror support actuator test stand began this trimester. Beckhoff Automation EtherCAT modules were ordered and shipment is expected soon. The modules will be used to build the I/O system for control and readout of the system. D. Clark acquired a surplus Shuttle PC, rebuilding it with Fedora and EtherCAT master software from the etherlab.org website; S. Schaller will continue with its development when all parts have been received.

Thermal System

A battery-powered floating precision 1mV voltage source was built and used to test the T-series absolute and thermopile boards, one each of which was built without the thermocouple connectors and epoxy thermal bond block. Each channel on the two boards was measured with the inputs shorted, and each polarity from the 1mV source. Analysis of the measured data show that the resulting offset and gain for the 24-bit self-calibrating analog-to-digital converter data outputs are below values that correspond to less than 0.1°C error, as required. Study of the earlier calibration data can be conducted with the knowledge that the basic analog/digital conversion works correctly.

In March, a new 60 hp blower motor was installed to replace a failed blower motor.

Aluminizing

Supplies were ordered for washing and recoating the primary mirror which will be done during summer shutdown.

The PC used for data collection of the aluminization system was upgraded and its nearly-full disk was replaced.

Optics Support Structure (OSS)

The arc arms and encoder tape were cleaned and inspected.

Secondary Mirror Systems

f/5 Secondary Support

The operator noticed oscillation in the acquisition images and speculated that it might be a result of the f/5 mirror support system. Plots of the logged data confirmed that the mirror support system was oscillating based on both the logged force and LVDT position data.

A decision was made to rework the support system completely during the three weeks that the f/5 would be off the telescope. The support system was repaired during April 19 – 29, 2010. Initial maintenance included disconnection and cleaning of the tangent rods. The southeast and southwest tangent rods were serviced with minor defects noted. The north tangent rod was found to be extremely gummed up with an unknown lubricant. It was thoroughly cleaned and reinstalled. All tangent rods were re-aligned.

Off telescope testing showed excessive noise on all load cell and LVDT signals. A shielded cable was tested with very positive results. A new cable harness was manufactured and installed. Significant improvement was seen on all signals on the mirror support assembly (MSA) card. The southeast hardpoint signal was found to have a high frequency sinusoid on the load cell force signal. Lab testing of the MSA card determined that the signal was not detrimental to the operation of the system but was of concern. More testing of the MSA card found that it was causing the high frequency noise. Modifications will be made to the card to reduce the erroneous signal.

The f/5 mirror support system was tested by attaching sling cables to the f/5 secondary assembly from the overhead crane and OSS. Testing indicated the southeast hardpoint transducer had failed. It was replaced and testing continued. We concluded that the LVDTs needed to be adjusted to mid travel to further reduce noise levels on their outputs. The three axial LVDTs were adjusted to approximately mid travel. Noise levels were reduced from 10 microns to less than 3 microns. We were unable to adjust the tangent rod LVDTs because of time constraints.

The f/5 was reinstalled and exhibited no occurrences of oscillations, so the repair was successful. Further work on the f/5 should include redesign of the tangent rods as well as the mirror support card to complete repairs.

Work was done on the f/5 mid baffle. The air lines were found to be damaged and were replaced. Four air actuators were checked and adjusted. Investigation revealed that an air valve was leaking air and therefore, it was replaced with a new main air valve to fix the mid baffle extending/retracting problems.

Telescope Tracking and Pointing

Servos

Considerable effort during the trimester was expended to find and fix a long-standing tracking jitter issue on the elevation axis, known to some as "the 2Hz problem". This problem was particularly troubling for Adaptive Optics (AO) operations since the time-varying tracking error uses large amounts of the available stroke of the Deformable Mirror (DM) actuators trying to correct the associated tip tilt errors.

Command-signal jitter was thought to be the cause of this problem and was exhaustively studied. A report on the results is available at http://tinyurl.com/32qe47c. Briefly, while other issues were discovered in the course of this study, command-signal jitter was rejected as a source of the servo tracking error. However, this work was very useful, as it helped illuminate an important aspect of the "2Hz problem": the tracking jitter frequency was linearly related to the tracking velocity.

Linear relationships between servo errors and velocities point to mechanical sources of the error. This is indeed the case for the elevation axis, as is shown in Figs. 1 and 2:

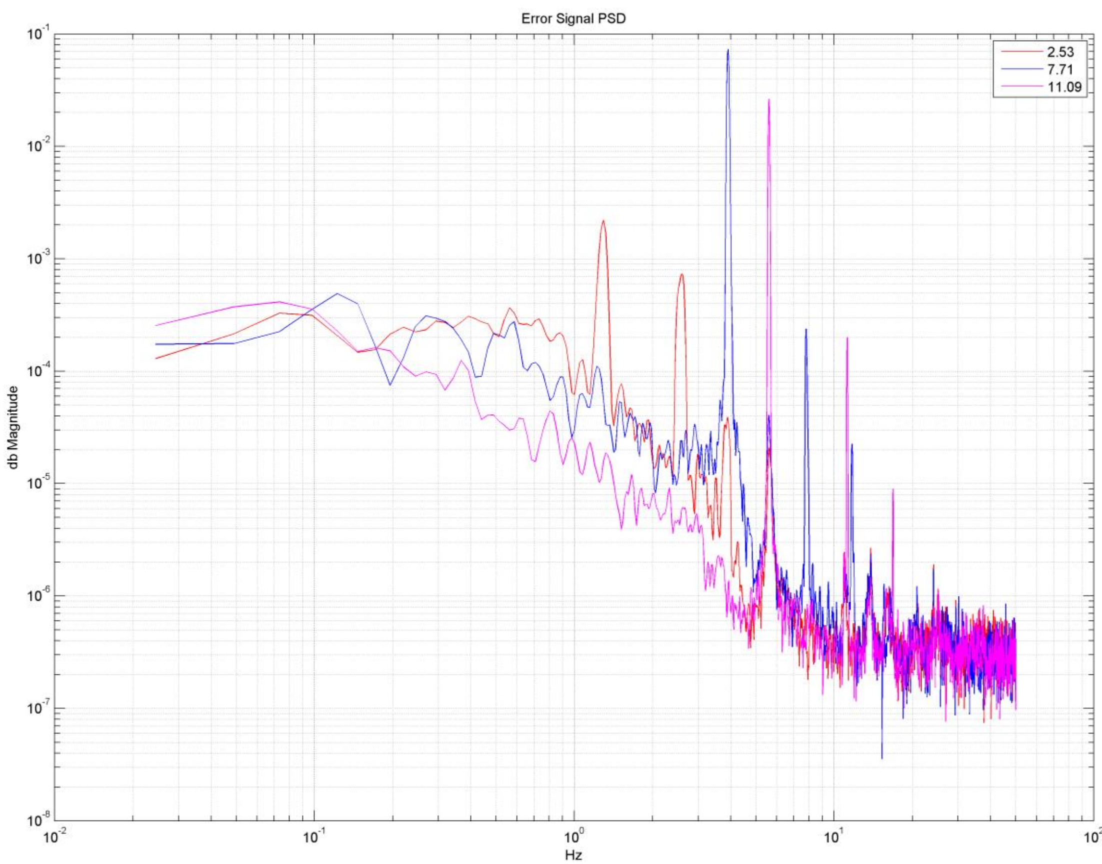

Fig. 1

Fig. 1 is the power spectral density (PSD) plot of the elevation servo position error at 3 different velocities. The tracking velocities in arcsec/sec are provided in the legend at the top right. While it clearly shows a tracking jitter frequency peak (a fundamental and 2 integer multiples), it's difficult to see how they are related. If the tracking error terms are recast from frequency (cycles/second) to spatial (cycles/revolution) representation, they have a much clearer interpretation, as shown next in Fig 2.

Fig. 2

As shown in Fig. 2, the three different velocities have a constant spatial term. The only mechanical part of the elevation servo system with a high spatial frequency as seen here are the tape encoders, which are used for position and velocity feedback in the control loop. The relationship between the spatial error frequency and the fundamental tape encoder mark spacing agree to within a couple of percent.

Cyclical error from the tape encoder outputs is evident in the SIN/COS encoder signals from the tape heads, as measured with either an oscilloscope or MMTO's Heidenhain PWT alignment tool.

Examination of the tape head SIN/COS signal output led to the discovery that both the east and west tape encoder surfaces have been damaged by an unknown source. The damage has the appearance of rub marks and scratches that, in places, have completely removed the gold overlay from the tape surface. In those areas, the tape encoder signal outputs drop well below the minimum required for good counting-mark recovery by the Heidenhain interpolation electronics. Cleaning the tapes removed even more of the flaking-off coating. This resulted in the tape encoder feedback failing at low elevations for the west tape (e.g. around 22°) which in turn led to the servo loop becoming unstable. Switching to the east encoder tape likewise failed due to damage on it near 85°.

The tape damage is documented in a report available at http://tinyurl.com/2g5afh3 that includes recommendations for mitigation and repair of the tape encoder feedback.

In light of this discovery, the elevation servo controller's feedback loop was modified by D. Clark, T. Trebisky, and D. Porter to use the on-axis Inductosyn encoder for both position and velocity information to recover proper telescope operation. The elevation disturbance-decoupling loop, however, is still fed by the tape encoder outputs, which is not completely useless between the mentioned positions of 22° and 85° and beyond the damaged areas.

The modification of the elevation servo loop was successful for approximately a week. Then, a serious failure occurred in the elevation absolute encoder. The on-axis absolute encoder has two internal encoders to form a complete 25-bit absolute position value – a coarse position from a resolver geared 1:1 with the encoder shaft, and a fine position from the 512-pole rotary Inductosyn. The encoder output failed in a strange fashion: intermittent loss of the coarse position which in turn made the encoder output jump instantaneously to large false values which the mount safety checks would interpret as large instantaneous velocities, shutting down the elevation drives.

Troubleshooting revealed that the resolver was faulty. It was replaced with a complete spare encoder kept at the campus office. The faulty resolver was sent for evaluation and repair to Servo Tech, Inc. Disassembly at their facility revealed that the fine shaft slip ring connections had become fatigued and the rotor winding was intermittently open, consistent with the failure mode seen at the MMT. Their technician re-bent the spring clips and re-assembled the unit, which passed testing on their equipment. We will carefully watch the azimuth encoder since it has seen essentially the same service life; this same failure could be experienced in that axis as well. The repaired resolver will be put in the spare encoder and its working order ensured.

Given the precarious nature of the encoder failures, a proposal for replacement of both absolute encoders with modern 29-bit equivalents available from Heidenhain has been circulated internally within MMTO and shared with the MMT Council. In the meantime, a collection of presentations, reports, and other documents relating to this proposal are available at http://tinyurl.com/344sbsm.

The azimuth axis servo received some attention during the reporting period in response to the MMT Director's requirement to produce a preliminary design, and a document for a formal Preliminary Design Review (PDR) by outside experts assembled for the purpose by the Director. A copy of D. Clark's notes, Powerpoint slides, and other relevant information can be found at http://www.mmto.org/~dclark/.

Adaptive Optics Hardware Systems

In support of acquisition of the accelerometer data from the f/15 deformable mirror (DM), a PCIe RS422 board was acquired for V. Vaitheeswaran (Center for Astronomical Adaptive Optics) to enable development of data acquisition code. As an independent means of data collection, and to mitigate the dropped-bits issue previously identified, MMT staff built two RS422/485 to USB adaptors and fiber interface boards. One of the USB interfaces is a two-channel unit with one RS232 and one RS422/485 interface; the other is a single-channel RS422 interface. These, and the fiber to RS422 adapters, are available for other projects beside the AO data acquisition as well.

Computers and Software

The annunciator (telescope operator alert system) was released to the operators and day crew for testing and has been quite successful to date. Other work on the annunciator included:

1. adding of checks on the thin shell safety (TSS), roof heater, hecto temperature, wind gust, primary frontplate temperature, primary front to back temperature difference, mount zenith, and compressor 1,
2. changing the telescope shutters status logic,
3. incorporation of the telstat server, and
4. improved documentation.

The mmtservice, loft_neslab_auto, along with its annunciator checks and web page, was implemented to automatically control the setpoint of the loft neslab.

Enhancements were made to the wavefront sensor graphical user interface (GUI) to allow for selection of off axis wavefront sensor stars.

Problems were corrected concerning weather information in the tracking plots. The wind speed and direction data were showing values for "Wind2" only. We should have had two of the three wind readings (Vaisala3 was offline, but Vaisala4 and Young were working). Also, the Temp values were all reading 0 C. This code had never been completed and some mistakes existed in what had been done. S. Schaller completed the implementation of the code and fixed the mistakes.

A problem with M1's thermal plots not updating on telstat was fixed. The problem was inadvertently introduced by someone working on these pages. Minor corrections including correcting a permissions error fixed the problem.

Adaptive Optics (AO) Software

S. Schaller and V. Vaitheeswaran replaced the computer called ao-pcr. S. Schaller also enhanced the AO GUI to support:
- loading different reconstructors on the fly,
- loading static files,
- loading new dynamic offsets,
- slope modulations, and
- a space-time two tap non-markovian reconstructor

A log for the AO operators, similar to the telescope operator's log, was implemented.

Linux/Mac/Windows system administration tasks

1) A local RPM repository of a number of tools vital to the MMT on linux hosts (including things such as IRAF) is maintained by the MMT software group. This repository is updated with each new Fedora release.

2) A system (archive.mmto.arizona.edu) has been set up for the purpose of reading some old MMT archive tapes, including 8mm Exabyte format backup tapes.

3) D. Porter upgraded mountain and town Windows XP machines to Windows 7 and implemented a new version of Autodesk Inventor, as well as other Windows and Mac administration tasks. Four new iMac's were acquired including two dedicated to mechanical design, one at the downtown office and one at the summit.

4) The two downtown MMT servers, "mmt", the main MMT network gateway server, and "vault", the MMT Windows Active Directory server, were relocated into the Steward Observatory server room on the third floor. Additional cabling from the 4th to 3rd floors was added as part of this move. This is a much better location for these machines, reducing noise within the MMT office area and providing a climate-controlled environment for the servers.

5) A new MMT SSL certificate was purchased from GoDaddy and was installed to replace the expired version. Password synchronization among the linux machines and the windows active directory were re-verified.

6) A problem with Domain Name Server (DNS) was debugged. DNS inquiries to mmto that needed to be handed off to another server started being rejected with a dnssec trust violation. T. Trebisky commented out the 3 lines in /etc/name.conf that set up dnssec, which helped but a problem persisted. S. Schaller set dnssec-enable to no, rndc validation disable, dnssec-validation no, and deleted 192.245.12.56 (ns-remote.arizona.edu) from the forwarders list which completed the debug.

7) The linux machines (homer, alewife, hoseclamp, yggdrasil, f/9 wfs) were upgraded to fedora 12.

8) Approximately 2TB of old skycam images were copied to offline storage, freeing much-needed disk space on hacksaw.

9) ICE was modified to beep at the end of an observing exposure using the external speaker instead of the internal speaker which is no longer working on alewife.

Azimuth Axis Upgrade

Extensive preparations were made during the trimester for an azimuth axis upgrade for the MMT telescope. These preparations included writing a draft planning document for a preliminary design review (PDR), scheduled for May 6. This PDR document includes proposed performance objectives, a review of the existing system, a proposed design plan, a proposed development and implementation plan, and a master schedule.

The overall objective of this proposed upgrade is to improve the performance of the MMT azimuth drive axis by modeling a new azimuth axis controller after the elevation axis controller that was implemented in 2008. Although this new proposed controller is implemented entirely in software, additional hardware improvements for the azimuth axis are also included in this proposal. The proposed work for the azimuth axis is driven by the need for improved on-sky observing performance, including recommendations from the MMT Council, dated August 18, 2008, and follows from the recent improvements of performance for the elevation axis. No further work on the elevation servo itself, such as tuning servo parameters, is anticipated as part of this proposed work. A significant part of this document describes the existing controller and the new proposed controller so that efforts between different groups within the MMT staff can be effectively coordinated as the work proceeds.

Included in the proposed azimuth axis upgrade are: 1) acquisition of a new absolute encoder, potentially with 29-bit or higher resolution, 2) implementation of a new servo controller in software, 3) an upgrade of the mount computer, including expanded PCI slots, 4) acquisition of new PCI FPGA interface boards for development of new velocity estimation and parallel I/O functions, and 5) replacement of the existing mount encoder readout electronics.

Symposium Software Preparations

Preparations were made during this trimester for the 2nd MMT Science Symposium, to be held May 19-20. The symposium celebrates the 10th anniversary of the conversion of the MMT from six identical 1.8 meter mirrors on a common mount (with a combined light- collecting power of a 4.5-meter mirror) to a single 6.5-m honeycomb borosilicate mirror.

Software preparations included: 1) development of online registration and abstract/presentation submission facilities, 2) extensive coordination between CfA and MMT staff for live teleconferencing between the Cambridge, MA, and Tucson, AZ sites, 3) network coordination with other Steward Observatory staff, 4) development of custom web-streaming and recording technologies, and 5) creation of several movies that document aspects of the past ten years at the MMT.

MMTO Service Request System (SR System) Trimester Statistics

During January through April, a total of 79 new SR requests (see Fig. 3) were created and 9 were re-opened. 79 SRs were closed during the same period.

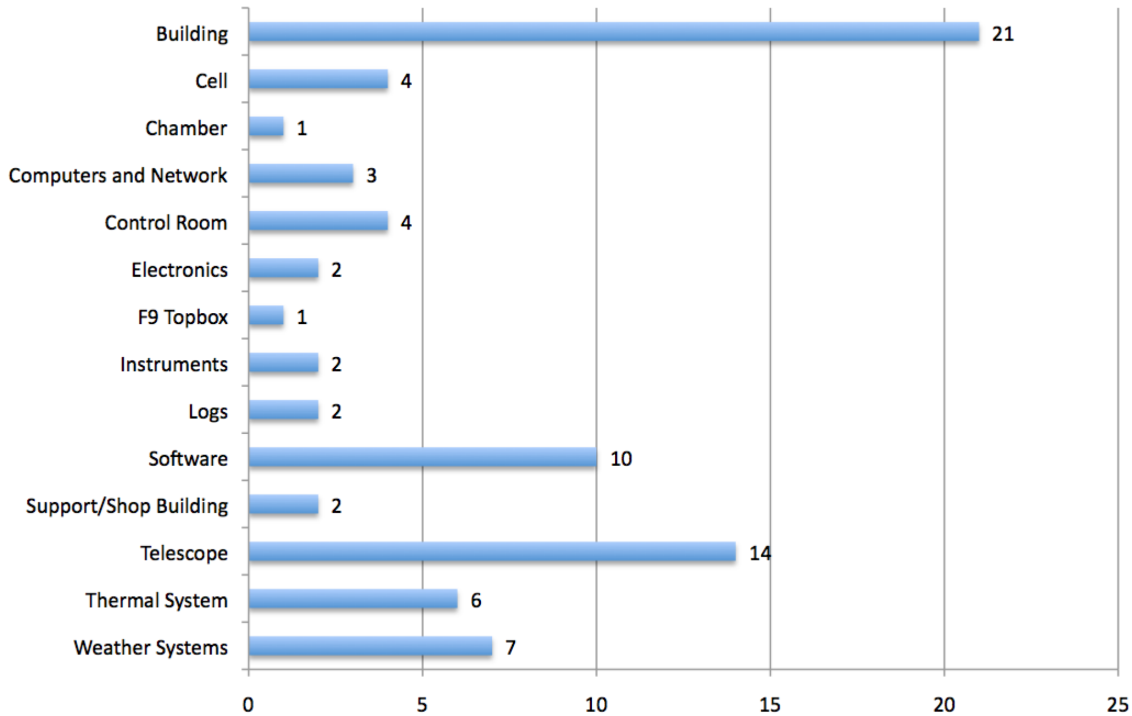

Fig. 3. New or re-opened SRs by major category that were created during January through April, 2010.

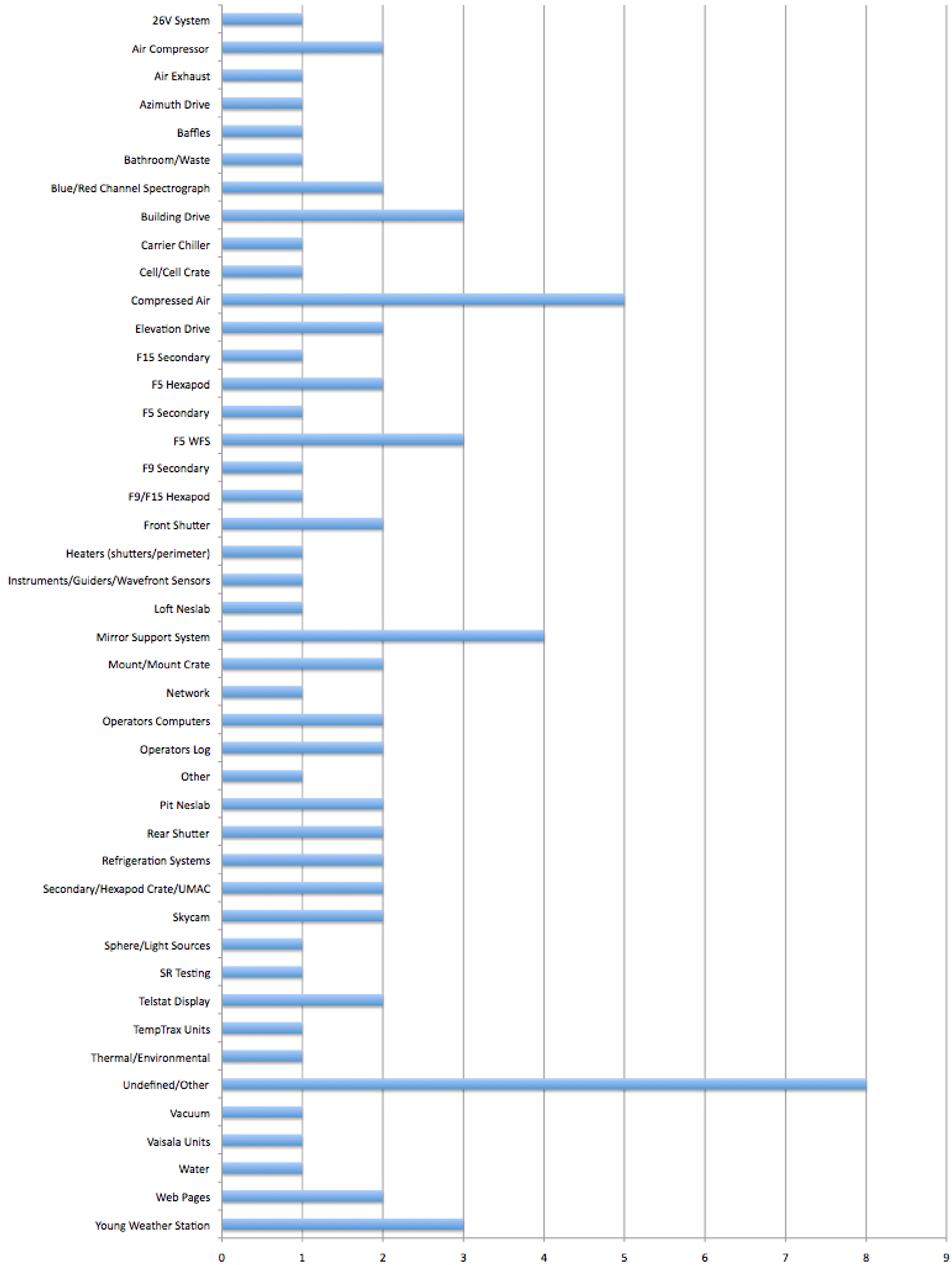

Fig. 4. New SRs by subject area that were created from January through April, 2010.

A total of 357 new responses to SRs were made during the trimester. Fig. 5 illustrates the distribution of these 357 SR responses within the various categories used by the SR system.

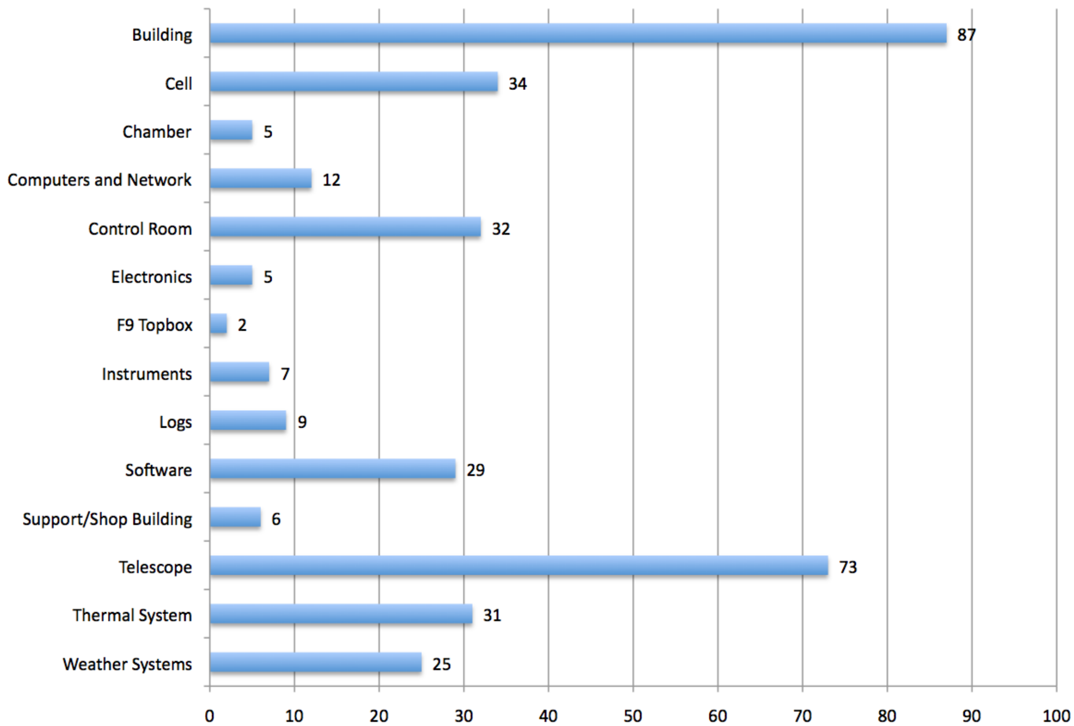

Fig. 5. The number of SR responses within different categories from January through April, 2010.

Finally, Fig. 6 presents the percentages of the 357 SR responses within the five priority categories: "information only", "low", "important", "near-critical", and "critical".

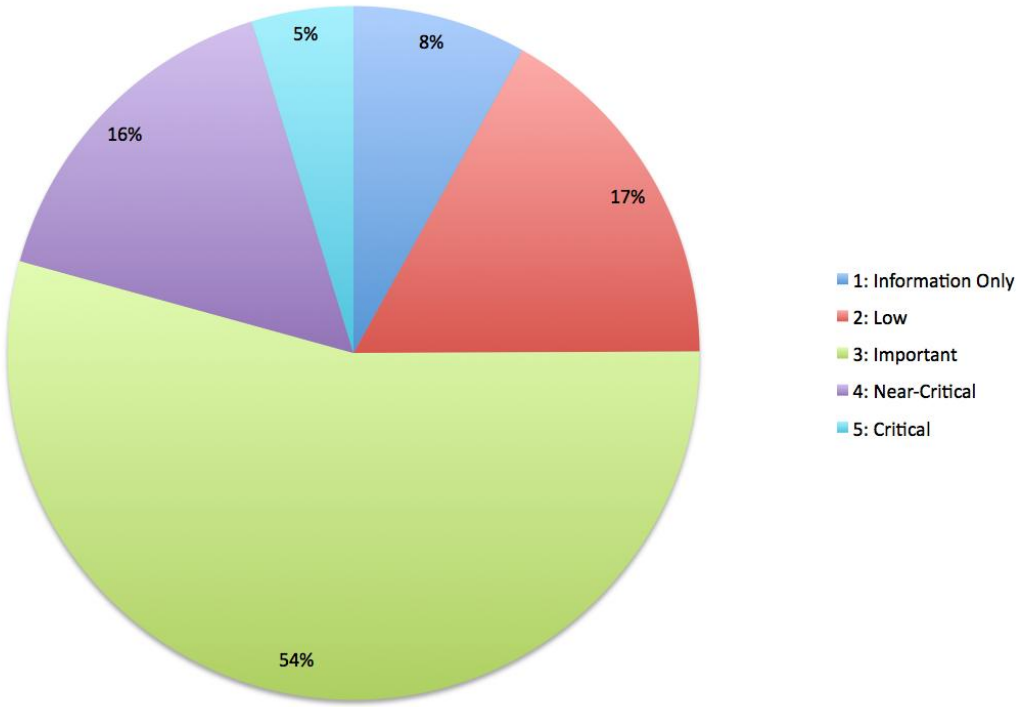

Fig. 6. Percentages of the SR responses in the five different priority categories for the reporting period of January through April, 2010.

Instruments

f/9 Topbox

In February an observer reported that the flux of the emission lines from the HeAr comparison lamp was only 65% of the level that had been measured in November 2008 using the same Blue Channel spectrograph setup. The observer provided data to the MMT staff and the report was confirmed to the extent that it could be. The HeAr lamp resides inside the f/9 topbox and a lens is used to focus an image of the bulb onto an aperture in the integrating sphere. There is a CuSO4 filter over the aperture to reduce the flux of the very bright red argon lines. The HeAr lamp was replaced with one of the spares in early April but the measured flux (actually measured equivalent width) didn't change significantly.

Next the alignment between the integrating sphere aperture and the image of the bulb was scrutinized and a very slight misalignment was discovered. An attempt was made to improve the alignment but again no significant increase in flux was measured.

We are currently considering other measures of improving the flux of the HeAr lamp to help reduce the required overhead for observers. The initial idea was simply to replace the lamps with more modern alternatives. However, we quickly discovered that this is easier said than done. The current HeAr lamps are General Electric HA-3 bulbs which were produced and marketed as night lights circa 1970. As such, they use a standard 115 V light bulb socket and produce very little heat. Web based light bulb forums discuss the difficulty in acquiring any of these collectors items and therefore our current stock of three is essentially irreplaceable. This dwindling irreplaceable supply is another motivator for replacing them.

We are seeking a relatively low cost replacement that does not produce a lot of heat since the lamp is located inside the topbox. A fiber feed is available that would allow the placement of a lamp in an external NEMA box located in the second floor west. However, there is a concern about losses in the blue for fiber fed light. Consultation with J. Sajac (SAO), G. Schmidt (NSF), and D. Ouellette (ITL) revealed a unanimous verdict; there could be no commercially available, inexpensive, cool replacements. J. Sajac has been working with a vendor to produce a custom lamp and we await his findings.

We are also now investigating other solutions to this problem including resurrecting the etalon unit, but those studies are only in the preliminary stage.

Blue Channel

Following up on earlier reports that the image of the Blue Channel slit had moved "up" on the detector, on March 15th the Blue Channel dewar was removed to inspect the field flattener lens to make sure that it was not damaged or tilted. The lens was not misaligned or damaged.

f/5 Instrumentation

Over the trimester, f/5 instruments observed 313 of 571 scheduled hours. Most of the lost time was weather related due to a lot of snow on Mt. Hopkins this winter. Most of the lost time was Hecto Spec/Chelle with a couple of nights of SWIRC. One very cold night was below the minimum temperature for the positioner robots. (See "Weather…" section on p. 17.) The elevation axis encoder failure occurred during a hecto run but was operable within a couple of days. A total of 601 science exposures were taken on 185 science fields.

A failed battery on the memory board of the computer crate called "hardware" was replaced.

A filter was added to the helium spectrum analysis lamp so that the intensity better matched that of the other comparison lamps. We explored the use of a similar argon lamp but the distribution of lines was not as good as the current hollow cathode lamps. An indicator LED was also mounted in the control room to communicate the state of the lamp to people in the control room.

Laser Guide Star (LGS)

A new cart for the LGS topbox was designed and fabricated by MMT staff. The new taller cart provides room to mount ARIES under the topbox when it is not on the telescope. A preliminary six strut design to allow ARIES to be precisely aligned under the LGS topbox was approved by the ARIES and LGS design teams.

Fig 7. Fabrication of cart for LGS topbox.

General Facility

The Whipple Observatory scissor lift truck safety rails were completed. The truck is now ready to deliver large loads to the MMT's second floor loading dock.

Building Drive

The building track was cleaned and lubricated with dry lube.

Weather and Environmental Monitoring

The RM Young weather station was replaced after it was damaged in high winds. This also eliminated the ground in the lightning suppression area of the unit. This seemed to fix the initial communication problems with the Vaisala, which shared a ground with the RM Young via the new lightning suppression box. As we looked at more data from the Vaisala, we found that data were still being dropped, with or without the new lightning suppression boxes. The new lightning suppression box is currently installed on the bottom of the West weather station and we are continuing to investigate the "unknown cmd error" on the Vaisala.

On February 5th, MMT Director Faith Vilas approved the following new weather opening policy. This policy replaces all previous policies and all future revisions will require approval by the director of the MMT.

The enclosure shall be open and remain open unless:

A) Lightning: there is imminent threat of lightning.

B) Precipitation: there is an imminent threat of liquid precipitation or melting snow from the roof striking the optics. Conditions shall be assessed from the chamber by opening the chamber approximately 2m with the mirror cover closed.

C) Wind: for f/5 and f/9: the sustained winds exceed 40 mph or gusts exceed 50 mph;
for f/15: the sustained wind is 35 mph and gusts exceed 40 mph.

D) Debris: wind-blown dust, ash, or smoke can damage the optics.

E) Condensation on optics: the average front plate temperature of the primary is less than 0.5 C above the chamber dew point temperature. Relative humidity alone shall no longer be used for closure criteria.

F) Other weather conditions: The operator shall note in the operator log any other specific weather related conditions to warrant closure.

G) To appeal any aspect of this policy, feel free to contact the MMT director.

<u>Additional instrument restrictions</u>
Hecto: Whenever the Hecto fiber positioner is mounted on the telescope, the ambient air temperature must be above 6.7 C (20°F) to operate instrument robots or change the telescope elevation.

Other Facility Improvements and Repairs

The 2010 chemical inventory was completed prior to the annual Smithsonian Institution Safety Inspection, scheduled this year for May 10-12. The MSDS file was updated.

The roof heaters were inspected by the electrical contractors that installed them last year. All wiring and circuitry was checked and inspected. They recommend adding additional snow sensors and increasing the feed line conductor sizes to reduce vibration of the wires during high startup in-rush current.

During periodic maintenance of the Carrier glycol refrigeration system, several issues were identified requiring substantial repairs. Repairs are scheduled for the next trimester.

Construction of the new instrument repair facility on the summit began in January by TBR Construction and Engineering. SM&R was subcontracted to prepare the grounds for the foundation.

Fig. 8. Foundation preparations for instrument repair facility.

Field conditions required significant modification of the footers.

Fig. 9. Wet concrete.

By April the weather cooperated to allow the foundation to be poured.

Fig. 10. New steel for the instrument repair facility.

Steel erection began at the end of April.

Visitors

2/27/10 – Sr. George Coyne, former Director of the Vatican Observatory, along with a group of 22 guests visited the MMT. They also enjoyed a lunch at the Common Building.

3/30/10 – A special tour of the MMT was conducted for Mr. Tom Hoffman, Project Engineer for the original MMT, and a group of his guests.

MMTO in the Media

1/26/10 – F. Vilas briefed NASA Headquarters personnel and Science/Technology/Space congressional aides via telecon regarding tracking near-Earth objects. Dr. Vilas served on the National Research Council's panel "Defending Planet Earth: Near-Earth Objects

Surveys and Hazard Mitigation Strategies" as Vice Chair, Report Committee and Chair, Survey and Detection Panel.

1/29/10 – F. Vilas was interviewed on National Public Radio's "Science Friday" show regarding the National Research Council report on near-Earth objects. http://www.sciencefriday.com/program/archives/201001294

3/15/10 – F. Vilas was interviewed by Smithsonian Magazine for an article regarding asteroid detection.

4/24/10 – M. Alegria, MMT Telescope Operator, was interviewed by National Public Radio for an "All Things Considered" segment on "unusual jobs". The interview will air in May.

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

10-1 Calibration and Correction of Amplifier Induced Artifacts in an Interleaved InSb Infrared Array
M.A. Kenworthy and P.M. Hinz

MMTO Technical Reports

None

Scientific Publications

10-01 Velocity Dispersion Profile of the Milky Way Halo
W.R. Brown, M.J. Geller, S.J. Kenyon, and A. Diaferio
AJ, **139**, 59

10-02 A Star in the M31 Giant Stream: the Highest Negative Stellar Velocity Known
N. Caldwell, et al.
AJ, **139**, 372

10-03 Theoretical Modeling of Star-Forming Galaxies. I. Emission-Line Diagnostic Grids for Local and Low-Metallicity Galaxies
E.M. Levesque, L.J. Kewley, and K.L. Larson
AJ, **139**, 712

10-04 Discovery of a Faint Companion to Alcor using MMT/AO 5 μm Imaging
E.E. Mamajek, M.A. Kenworthy, P.M. Hinz, and M.R. Meyer
AJ, **139**, 919

10-05 Star Cluster Candidates in M81
J.B. Nantais, et al.
AJ, **139**, 1413

10-06 A *SPITZER* Search for Substellar Companions to Low-Mass White Dwarfs
M. Kilic, W.R. Brown, and B. McLeod
ApJ, **708**, 411

10-07 Evolution of the Hα Luminosity Function
E. Westra, et al.
ApJ, **708**, 534

10-08 Detection of a Superstrong 2175 Å Absorption Galaxy AT $z = 0.8839$ toward the Quasar SDSS J100713.68+285348.4
H. Zhou, et al.
ApJ, **708**, 742

10-09 Low-Resolution Spectral Templates for Active Galactic Nuclei and Galaxies from 0.03 to 30 μm
R.J. Assef, et al.
ApJ, **713**, 970

10-10 The Stellar Population of h and χ Persei: Cluster Properties, Membership, and the Intrinsic Colors and Temperatures of Stars
T. Currie, et al.
ApJ Supp, **186**, 191

10-11 The *CHANDRA* ACIS Survey of M33: X-ray, Optical, and Radio Properties of the Supernova Remnants
K.S. Long, et al.
ApJ Supp, **187**, 495

10-12 The Evolution of the Hard X-ray Luminosity Function of AGN
J. Aird, et al.
MNRAS, **401**, 2531

10-13 The Central Energy Source of 70 μm-Selected Galaxies: Starburst or AGN?
M. Symeonidis, et al.
MNRAS, **403**, 1474

10-14 The X-ray to Optical-UV Luminosity Ratio of X-ray Selected Type 1 AGN in XMM-COSMOS
E. Lusso, et al.
A&A, **512**, A34

10-15 Metal Production in M33: Space and Time Variations
L. Magrini, et al.
A&A, **512**, A63

Non-MMT Scientific Publications by MMT Staff

Evidence for Extended Acceleration of solar Flare Ions from 1-8 MeV Solar Neutrons Detected with the MESSENGER Neutron Spectrometer,
W.C. Feldman et al., (incl. F. Vilas)
J. Geophys. Res., **115**, A01102

Observing Reports

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

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

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

MMTO Home Page

The MMTO maintains a web site (*http://www.mmto.org*) that includes a diverse set of information about the MMT and its use. Documents that are linked to include:

- What's New at MMTO.
- General information about the MMT and Mt. Hopkins.
- Telescope schedule.
- User documentation, including instrument manuals, detector specifications, and observer's almanac.
- Scientific and technical publications
- A photo gallery of the Conversion Project as well as specifications related to the Conversion.
- Information for visiting astronomers, including maps to the site.
- The MMTO staff directory.

Observing Database

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

Use of MMT Scientific Observing Time

January 2010

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	12.00	141.70	60.15	0.00	0.00	0.00	0.00	60.15
PI Instr	16.00	188.10	66.95	0.00	30.55	0.00	0.00	97.50
Engr	3.00	35.20	11.70	0.00	0.00	0.00	0.00	11.70
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**31.00**	**365.00**	**138.80**	**0.00**	**30.55**	**0.00**	**0.00**	**169.35**

Time Summary

Percentage of time scheduled for observing	90.4
Percentage of time scheduled for engineering	9.6
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	38.0
Percentage of time lost to instrument	0.0
Percentage of time lost to telescope	8.4
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	46.4

* Breakdown of hours lost to telescope

6.00 AO hardware & software
4.25 AO hardware failure
7.90 AO loop wouldn't stay closed; DM wouldn't stay flat
12.40 f/15

February 2010

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	28.00	312.20	153.55	2.50	24.50	0.00	0.00	180.55
Engr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**28.00**	**312.20**	**153.55**	**2.50**	**24.50**	**0.00**	**0.00**	**180.55**

Time Summary

Percentage of time scheduled for observing	100.0
Percentage of time scheduled for engineering	0.0
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	49.2
Percentage of time lost to instrument	0.8
Percentage of time lost to telescope	7.8
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	57.8

* Breakdown of hours lost to telescope

11.2 Elevation axis failed
7.3 f/5 oscillation
4.0 Failed elevation encoder
1.0 Telescope wouldn't slew
1.0 Crates overheated & shut off

Year to Date February 2010

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	12.00	141.70	60.15	0.00	0.00	0.00	0.00	60.15
PI Instr	44.00	500.30	220.50	2.50	55.05	0.00	0.00	278.05
Engr	3.00	35.20	11.70	0.00	0.00	0.00	0.00	11.70
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**59.00**	**677.20**	**292.35**	**2.50**	**55.05**	**0.00**	**0.00**	**349.90**

Time Summary

Percentage of time scheduled for observing	94.8
Percentage of time scheduled for engineering	5.2
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	43.2
Percentage of time lost to instrument	0.4
Percentage of time lost to telescope	8.1
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	51.7

Use of MMT Scientific Observing Time

March 2010

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	*Lost to Telescope	Lost to Gen'l Facility	Lost to Environment	Total Lost
MMT SG	14.00	143.00	46.40	0.00	0.00	0.00	0.00	46.40
PI Instr	15.00	155.00	61.10	7.00	0.25	0.00	0.00	68.35
Engr	2.00	20.50	10.70	0.00	0.00	0.00	0.00	10.70
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**31.00**	**318.50**	**118.20**	**7.00**	**0.25**	**0.00**	**0.00**	**125.45**

Time Summary

Percentage of time scheduled for observing	93.6
Percentage of time scheduled for engineering	6.4
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	37.1
Percentage of time lost to instrument	2.2
Percentage of time lost to telescope	0.1
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	39.4

* Breakdown of hours lost to telescope

0.25 Image oscillations

April 2010

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	10.00	91.50	22.00	0.60	0.25	0.00	0.00	22.85
PI Instr	19.00	176.10	58.30	2.50	0.50	0.00	0.00	61.30
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	**30.00**	**276.60**	**89.30**	**3.10**	**0.75**	**0.00**	**0.00**	**93.15**

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	32.3
Percentage of time lost to instrument	1.1
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	33.7

* Breakdown of hours lost to telescope

0.25 Server trouble for guider
0.50 f/15 failed

Year to Date April 2010

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	36.00	376.20	128.55	0.60	0.25	0.00	0.00	129.40
PI Instr	79.00	841.20	339.90	12.00	55.80	0.00	0.00	407.70
Engr	4.00	44.20	20.70	0.00	55.05	0.00	0.00	75.75
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**119.00**	**1261.60**	**489.15**	**12.60**	**111.10**	**0.00**	**0.00**	**612.85**

Time Summary

Percentage of time scheduled for observing	73.9
Percentage of time scheduled for engineering	5.1
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	39.3
Percentage of time lost to instrument	1.0
Percentage of time lost to telescope	4.4
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	44.7