# End of Trimester Summary

## January - April 2012

Moving the old 1978 bridge crane out of the chamber and the new 3-ton bridge crane into the chamber. For details, see page 18.

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

## Personnel

Interviews were conducted for the Assistant Staff Scientist positions and the Telescope Operator position.

## Talks and Conferences

G. Williams gave a talk to the Sonoran Astronomical Society on January 10 in Green Valley, Arizona.

G. Williams gave a public lecture on February 28 entitled "Aspherical Supernovae Explosions." This lecture series is sponsored by the F.L. Whipple Observatory and is held in Green Valley, Arizona.

## Primary Mirror Systems

### Primary Mirror Support

Integration and testing of the new primary mirror support actuator test stand electronics continued during the trimester. During testing, we discovered that the input signal was loading on the EtherCAT analog inputs. To fix this, the auto-calibration board was modified with chopper-stabilized low-offset opamps to buffer the input signals. It was also found that the work plate interface used to connect the actuator to the test stand was the wrong height and subtly tilted. The height issue meant that the actuator was very near the full stroke when mounted on the test stand and was almost bottomed out when pushing on the work plate. The tilt is between the work plate and actuator mounting surface, which led to problems when the actuator was connected to the work plate.

To minimize the stray force and moment when the actuator is connected to the work plate, a new "sandwich" interface plate was made that has a rubber interface between the work plate and actuator attachment. The stray force on the load cell, when attached, was improved. However, there is a large (about 22 lbf) Y-axis moment when using the test stand. We are working to determine why there is an apparent tilt on the actuator causing force tests to fail when moments are out of specification.

The actuator test stand load cell boxes were modified to eliminate the Molex connectors. DB connectors were installed, the wiring was modified, and the boxes were remounted. All documentation was updated to reflect the changes, and a binder now contains all of the documentation.

A cell crate power supply unit was designed and manufactured. It will buffer the initial load placed upon the cell crate at start-up. A solid state relay was placed in-line to absorb the initial current draw.

### Aluminizing

The aluminization PC was upgraded with a new power supply, new hard disk, and a modern multicore AMD CPU motherboard with increased memory and three PCI expansion slots. Two of those were needed to collect welder data during coating; we added a third PCI data acquisition board to add 16 more channels of data input. The additional input channels will be used to replace the HP DAU that is presently used to collect data from the pressure sensors and deposition monitors in the coating display cabinet.

With all the data acquisition done on the PC, we can greatly increase the sample rates and get correlated samples of all the coating data. We will construct an isolation board to place in-line with the former DAU signals to maintain electrical isolation among all the various sensors and welder signals. This will avoid ground loops and ensure signal integrity and safety.

## Secondary Mirror Systems

### f/5 Secondary Support

A test was initiated for the f/5 lateral support system, using the f/9 mirror support actuator card rather than the f/5 mirror support actuator card. The f/9 card was wired into the main power connector and its inputs connected to the tangent rod load cell outputs. The output of the f/9 card was connected to the lateral transducer. The initial test showed an intermittent connection on the southeast load cell. The only way to repair this is to remove the tangent rod and realign the mirror. This repair will be accomplished during f/5 down time. The southeast tangent rod was disconnected, and its input was reduced to zero with a shorting plug. Data show positive results, with hunting reduced from 40 microns to less than 10 microns. More tests need to be conducted on the system, as well as an evaluation of the differences between the f/9 and f/5 servo systems. Overall, the reduced hunting is a positive sign in the pursuit of improved image quality under certain conditions.

A new power switch was added to the hexapod/mirror support power supply. The new switch separates the 115V UMAC power and the 115V mirror support power. The system can now be run with mirror support turned on while the UMAC/hexapod system is powered off. This allows the secondary mirror support to be operated and tested independent of the UMAC.

### Baffles

The f/5 secondary mid-baffle was serviced to address problems with actuation of the lowest leaf. The four pneumatic pistons that are responsible for extending and retracting the lower leaf were lubricated and realigned. All of the baffle air lines were replaced with a larger diameter hose, and adjustable regulators were added to the extension and retraction air lines of each piston. Impedance was also minimized by increasing the diameter and shortening the length of the main air supply line. The actuation valve for the baffle was relocated to the Nasmyth platform to enable extension and retraction of the lower leaf while the telescope is zenith pointing.

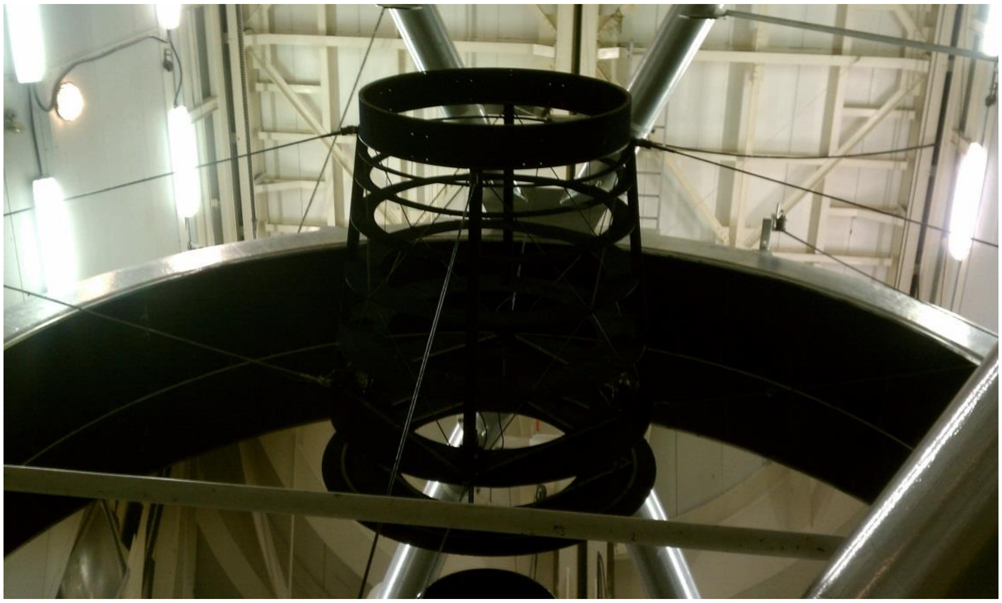

Figure 1. Mid-baffle extended at zenith.

**Secondary Test Stand**

After some discussion, it has been determined that the "Iron Maiden" test stand fixture is a necessity in troubleshooting ongoing issues with the f/5 secondary mirror support. Safety and performance requirements were determined, and the test platform was redesigned to meet those needs. The structure was brought to the basecamp area where it was modified over a four-week span. The modifications included shortening the overall height of the test stand, redesigning the drive train system, adding a leveling system, and incorporating mechanisms to keep staff and instrumentation safe. Several tests were performed after the modifications to ensure the test stand met or exceeded the predetermined requirements. There will be a trial run with the f/5 before declaring the project complete. The structure will be powder coated before the start of this year's summer shutdown.

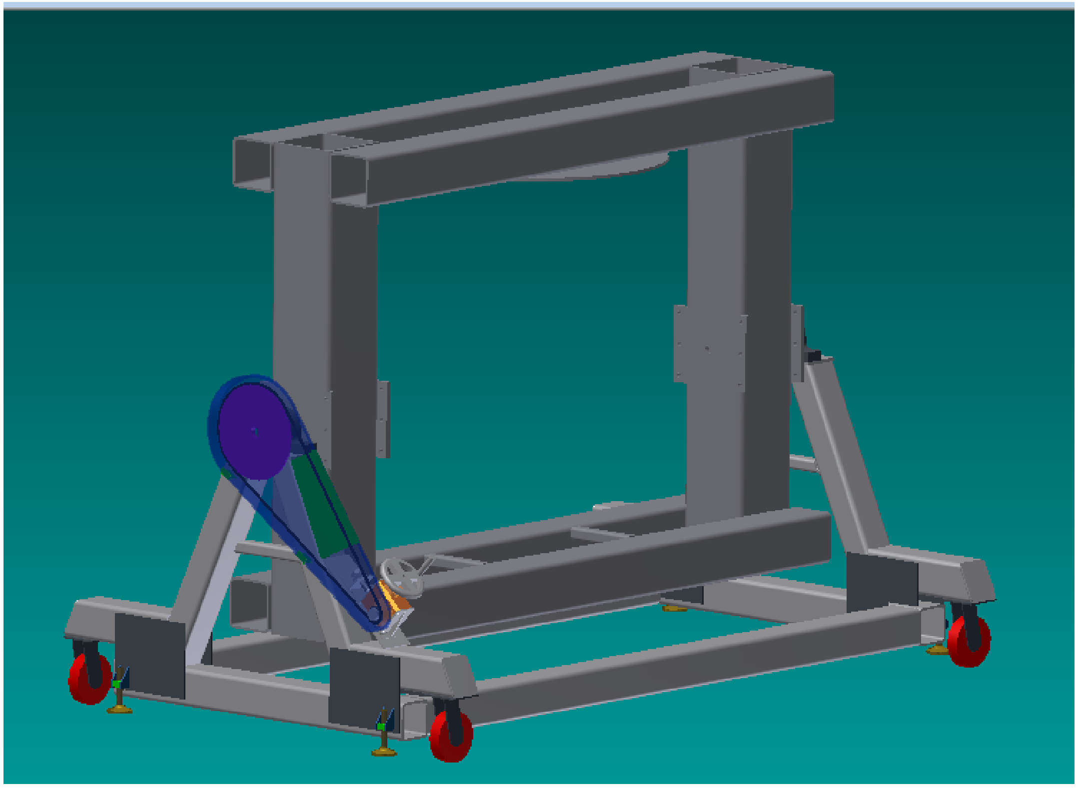

Figure 2. CAD Model of Secondary Test Stand Final Design

**f/15 Secondary**

An event during the April Laser Guide Star (LGS) Adaptive Optics (AO) observing run resulted in the failure of multiple digital signal processor (DSP) boards. At least four DSP boards were affected. The DSP board failures appear to be due to failed coil driver circuits that supply power to their associated voice coil actuators. The failures prevented the mirror from being either flattened or operated in closed loop. The cause of the coil driver circuit failures is currently unknown. Problems also existed with the thin shell safety (TSS) boards. The problematic TSS boards were sent to Microgate in Italy for repair.

Test fixtures are being built to test the DSP board communications as well as the actuator coil driver circuits and capacitive sensors measurements. These fixtures will be used to assess which DSP and coil driver circuits are functioning properly. The fixtures may also be useful in diagnosing the failure mechanism(s). Depending on the type of failure, the non-functioning boards may need to be sent to Microgate for repair.

Progress in understanding the failure mechanisms and repairing the f/15 has been slowed primarily due to a lack of resources, both in terms of available spare DSP boards as well as personnel familiar with the electronics and system design of the adaptive secondary mirror. The availability of both hardware and personnel is critical, not only in returning the f/15 to operation status, but in maintaining a robust and reliable MMT AO system in the future.

## Telescope Tracking and Pointing

### Servos

A new open-loop elevation axis model has been created from the high-resolution measurements performed early in the trimester. Using this, the controller has been updated with new notch filters and the proportional-integral-derivative (PID) loop gains to bring the operation of the controller into proper operation with the absolute encoder position-loop feedback. The controller updates included:

- The flexible-mode filters were re-adjusted so as to better notch out all problematic modal frequencies in the telescope's open-loop response.
- The velocity and position-loop PID control gains were adjusted.
- The Luenberger Observer model was changed to one that contains only rigid-body dynamics.
- The disturbance-decoupling loop PID gains were adjusted.
- The Simulink diagram was simplified and cleaned up wherever necessary to provide the simplest controller implementation.

Reconstruction of the Simulink Real-Time Workshop tools needs to be done to support code generation for testing and validation of the new elevation controller. In parallel with this, initial validation will be performed using xPC Target as was done in the past. In order to make the transition between operating systems and development paradigms simpler, a Mercurial repository was created to hold all necessary files for servo design and development. (See *Computers and Software* section, *New Version Control*, p. 7.) Going forward, this will eliminate the possibility of losing track of the files and parameters needed to produce a working controller.

## Computers and Software

Progress continued on the plan to implement a method for quick recovery in case of a failure of "hacksaw," our central server on the mountain. We continued the campus test of the plan by setting up the backup host for "mmto.org." Regular backups of mmto.org are being done and have verified that it functions correctly on both hosts. With the campus test completed, we started the first steps of the plan for the mountain. The directory, /mmt, was moved from hacksaw to the first network-attached storage device, and the first host was prepared to receive the virtualized hacksaw. Disk space usage on hacksaw is being reduced in preparation for virtualization, which is scheduled to occur during summer shutdown.

All thirteen Linux machines were upgraded to Fedora 16.

Our saoguider code was reworked with the following goals: remove unused components, reorganize cameras and guiders to make selecting them clearer, fix bugs, improve efficiency, produce a 64bit version, and commit to SVN. It has passed daytime testing, and is ready for testing at night.

The following modifications to ao_gui were implemented: setting "Display Spots Realtime" checked on by default in the main window, removal of "Camera Source" from the "Camera Settings" tab, and removal of "Load Background From File" from the "Camera Background" tab.

**New Version Control**

For some time, the software group has used version control software for all projects of any magnitude. The group used SVN for most projects, although some had not yet been converted from CVS. The main benefit we derive from version control at this time is as a backup facility, guarding mainly against accidental file deletions and user error. We have become aware that newer version control tools such as Git and Mercurial are now available, and we decided to evaluate these.

We have found fairly straightforward methods to convert from both SVN and CVS to either Git or Mercurial while preserving project history. These newer tools offer a number of advantages. Both support branching well enough to encourage regular use of branching. Both Git and Mercurial are distributed version control systems that support multiple repositories, with or without a master repository. An advantage of this is that we can work within a local repository during test and development, and only push to the master repository when changes are entirely stable. This also has advantages when working remotely.

We have not yet selected and standardized one version control tool as the best. We want to get some experience with both before standardizing on any one, if we do so at all. We are abandoning our old approach of having a single repository for all projects. We feel that this "all eggs in one basket" approach gives up the ability to make per-project decisions about who has access to a repository. We have chosen a central location on one of our network-attached storage devices to host all repositories, yet keeping them as independent repositories. Conversion to the newer tools will be done on a per-project basis.

**Summary of Service Request (SR) Activity**

The Service Request (SR) system is a web- and email-based informational system of operational issues that are segregated within a MySQL database by priority, subject, and category. The SR system is used by the staff and affiliated organizations for immediate communication and long-term documentation as operational issues are addressed and resolved.

Figure 3 shows the distribution of the 64 newly created or re-opened SRs during this reporting period. The three largest categories for newly created or re-opened SRs are: 1) Building, 2) Computer and Network, and 3) Telescope.

Figure 4 summarizes the priority levels of the newly created or re-opened SRs, with "Important" being the most common priority.

Figure 5 illustrates the distribution of the 230 SR responses within different categories on which work was performed during the same reporting period. The categories for the majority of the SRs on which work was performed include: 1) Network, 2) Heaters (shutters/perimeters), and 3) Undefined/Other.

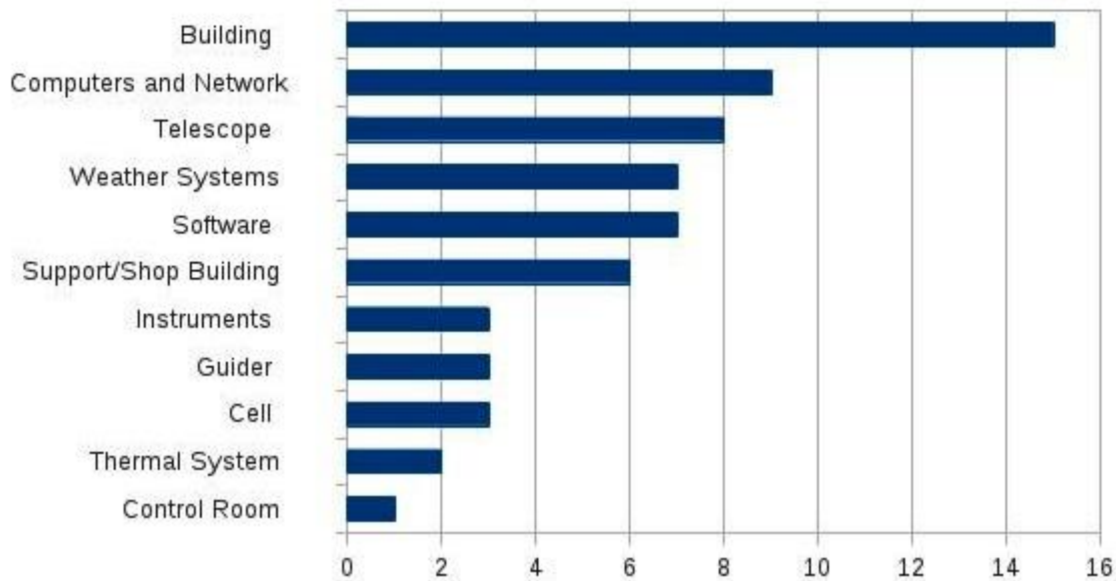


Figure 3. Categories of 64 new or re-opened SRs from January through April 2012.

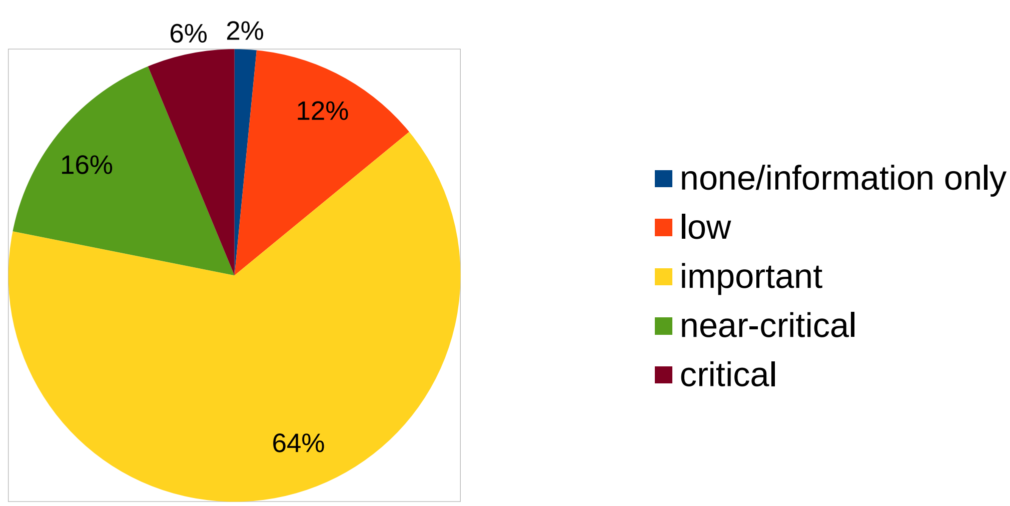


Figure 4. Distribution of open SRs into the five priority categories from January through April 2012. The majority of open SRs are in the "important" priority.

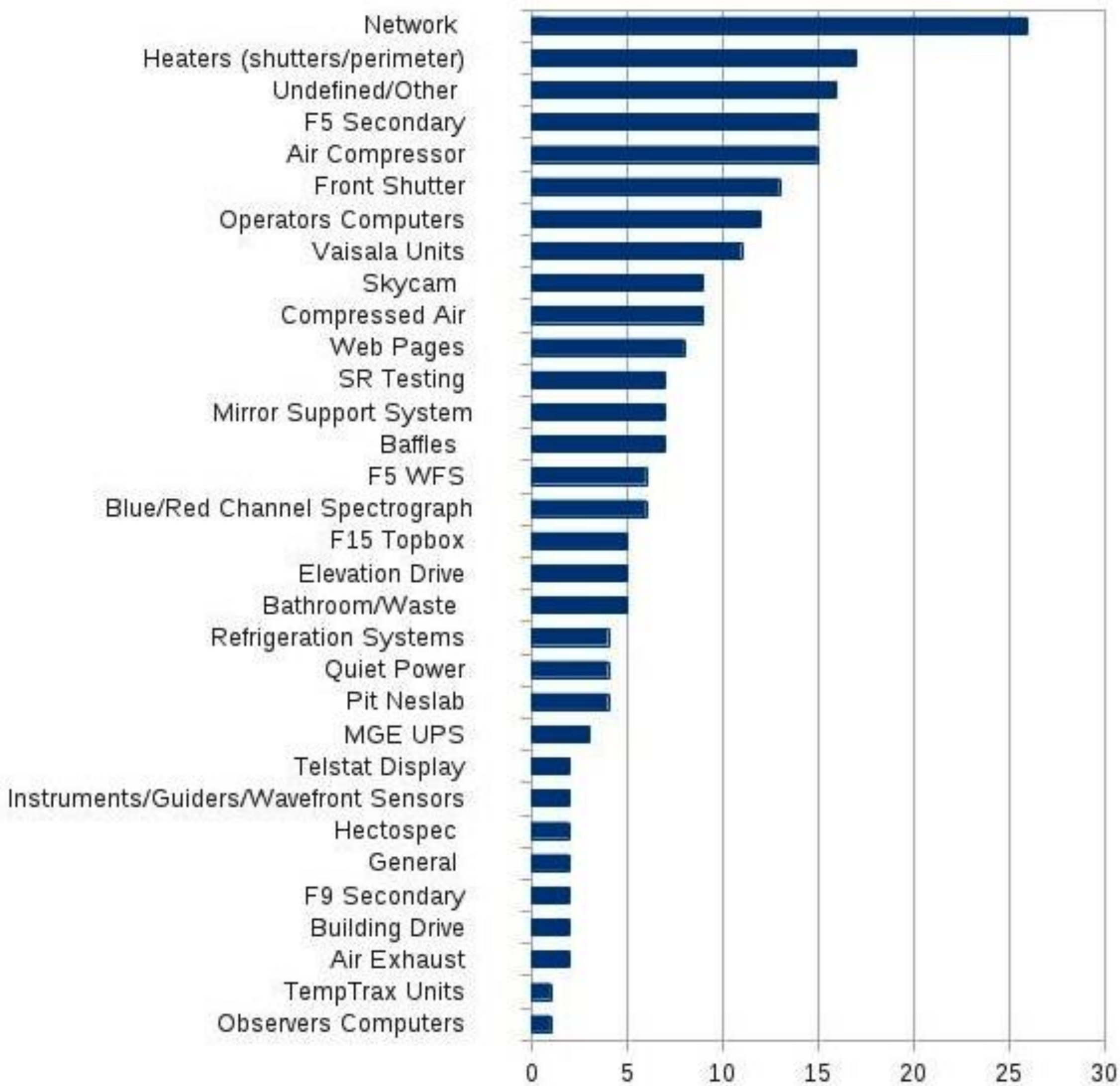


Figure 5. There were 230 SR responses within different categories from January through April 2012. Many of the network-related SRs are related to the network upgrade that includes new Cisco switches, new Cat-6 cabling throughout the MMTO, new subnets, and new microwave links from the MMTO to the UA campus.

# Instruments

## f/9 Instrumentation

### *Blue Channel and Red Channel Spectrographs*

The Red Channel grating tilt mechanism failed during the trimester. The failure was due to the binding of the gearbox between the stepper motor and the output sprocket. Disassembly of the gearbox revealed several bad shaft-support bearings and an over-constrained input worm gear. The bearings were replaced, and B. Love of the Steward Observatory machine shop relocated one of the shaft hub spacers so the spur gears wouldn't rub on the gearbox housing. The position pot was also found to have a bad shaft bearing, and it was replaced. With both spur gear shafts in place, the worm gear was still over-constrained, so one was removed. The gearbox then spun freely, but had more output backlash; this was judged satisfactory, given the short time available before the instrument was needed, and we found that we were in fact able to run the grating tilt mechanism satisfactorily.

## f/5 Instrumentation

### *Hectospec*

Approximately 573 hours were allocated for SAO f/5 instruments during this trimester. Weather closed the observatory for slightly more than a quarter of those. There was one night during which the temperature was too cold for the positioner to operate safely, and another stormy night during which the positioner was in need of repair. Nearly two nights were lost to issues with the telescope: rotator, exceeding of elevation axis limit, and power supply failure. A couple of hours were also lost to issues with the use of the new network switches with the old SAO equipment. There were a few instances of image oscillation seen when the SWIRC instrument was mounted.

With the 37 nights that the f/5 spectrographs were on the sky, we were able to obtain 547 science exposures on 149 fields. On its 8 nights of observations, SWIRC obtained 8940 frames. This includes focus, sky, and dark frames, as well as science exposures.

During installation of the positioner on January 20, a handful of pins in the positioner cables were found to have been severely bent. T. Gerl performed preliminary repairs by bending them back into position. On the morning of January 23, the hecto positioner had a significant failure. There was a limit error in the gimbal axes. We were able to recover from the error and obtained a couple more fields that night. Investigation the following day revealed that the limit problem was due to lost encoder pulses. The reported values of the gimbal coordinates were not accurate. This problem was serious enough that a service mission was set up to investigate the cause and address the issue. The positioner was removed from the telescope two days early, and the time re-allocated to Blue Channel.

During the service mission, it was discovered that the electronics used with the gimbal axis encoders had drifted out of the proper operating range. Unfortunately, adjusting these electronics required that the two halves of the positioner be separated. The electronic components inside the P1 actuator were also suspect in the signal drift, so that actuator was replaced with a new unit. The electronics for all gimbal axes were adjusted to be able to accommodate a little more drift, and will be re-examined during the next service mission. F. Collette accompanied the hecto service team and replaced the damaged pins. During checkout of the instrument after service, the X1 axis was not moving smoothly. The motor servo amplifier was replaced with a new unit. A week later the X1 axis reported "fault," so M. Lacasse installed another new servo amplifier. The system has been working since the second amplifier replacement, with the robots coming on-line reliably on the initial command.

Early this year, some of the network-based equipment used by the SAO instruments did not function properly with the new network. The EDAS boxes (ethernet to serial converters) required almost daily power cycling to get them to operate with the new network. The SAO internal network connections were migrated back from the new network to older switches, and they have functioned better since.

There were two issues with the SWIRC instrument. Some software hangs occasionally occurred around readout time, with one necessitating a reboot of the "hudson" computer. Another issue was a filter wheel jam. W. Brown and M. Lacasse opened up the dewar in April and adjusted the coupling mechanism slightly, which took care of the problem.

### ***MAESTRO***

The MAESTRO instrument was scheduled for the last five days in January. However, it was determined that it would be best to postpone the run. It was brought to campus on March 7 for additional work.

## Seeing

Figure 6 presents the overall calculated seeing trends for the f/5, f/9 and combined (f/5 and f/9) configurations, as determined from wavefront sensor (WFS) data. (A discussion of the algorithm for determining seeing from the WFSers is provided in the January-April 2008 trimester summary, p. 6, at this link: [http://www.mmto.org/node/345](http://www.mmto.org/node/345).)

During this reporting period, the median seeing for the f/9 configuration was 0.83 arc seconds, while that for the f/5 configuration was 0.99 arc seconds. Historically, seeing values from the two secondary configurations have been closer to each other. Additional data are presented here that may help explain the higher seeing values for the f/5 configuration.

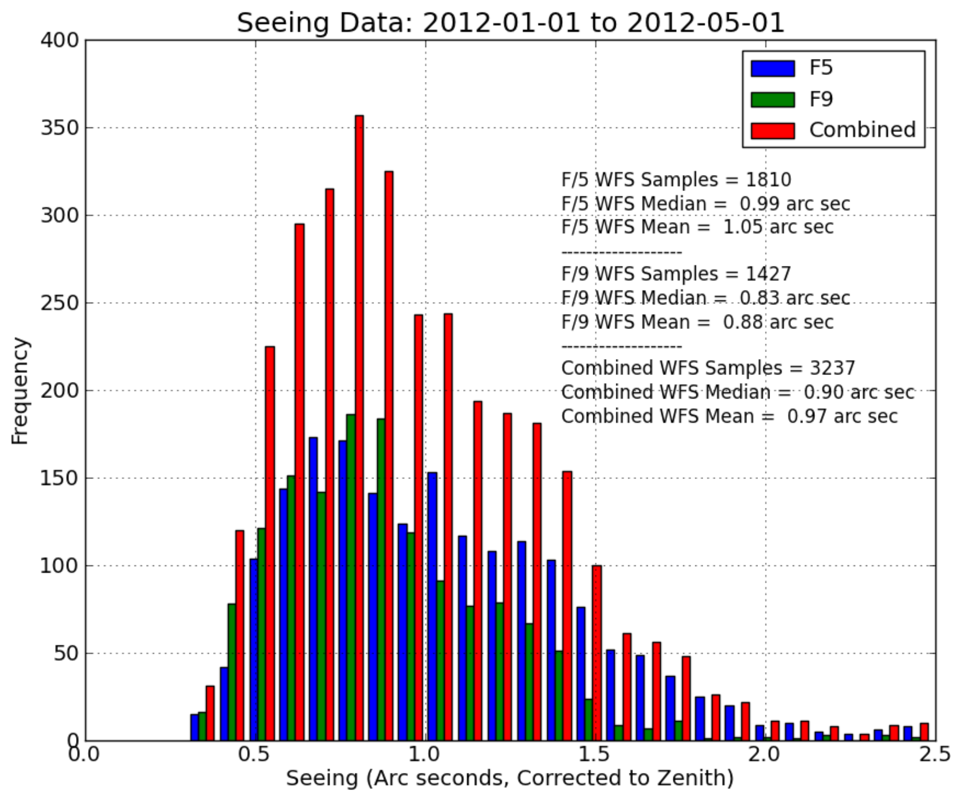


Figure 6. Histograms of f/5, f/9 and combined f/5 and f/9 WFS-derived calculated seeing values for January through April 2012. The median f/5 seeing is 0.99 arc seconds while the f/9 median seeing is 0.83 arc seconds. Data are grouped into 0.10 arc-second bins.

Other factors affecting astronomical seeing are the overall wind speed and direction. Figures 7 and 8 show average wind speed versus calculated seeing for the f/9 and f/5 WFS systems, respectively. The f/9 seeing data in Figure 7 shows a tight clustering of wind speed versus seeing. This shows that there isn't much data for higher wind speeds. In contrast, a strong correlation between increased wind speed and seeing is seen in Figure 8 for the f/5 data. The f/5 secondary was used under wind conditions somewhat higher than those with the f/9 secondary during these four months. The median wind speed for f/5 WFS measurements is around 1.1 meter/second (m/s) (2.4 miles per hour) higher than for f/9 WFS measurements (6.9 m/s for the f/9 versus 8.0 m/s for the f/5). These higher wind speeds may help explain the higher seeing values found for the f/5 configuration. However, this trend for the f/5 configuration has not been as apparent in previous data, as reported in the previous trimester summary.

We present only the ensemble of the data here. We have not yet investigated individual data sets to understand the trends seen.

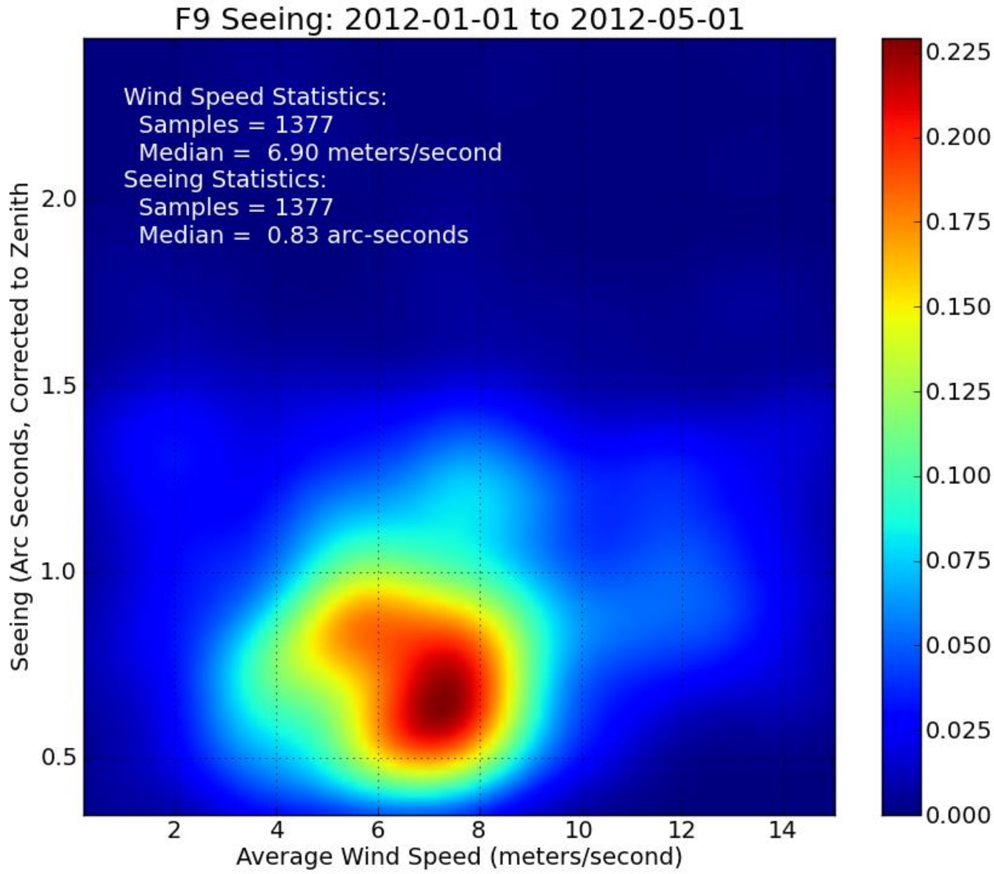


Figure 7. Gaussian kernel density estimation (KDE) diagram of average wind speed (X axis) versus calculated seeing (Y axis) for the f/9 WFS system from January through April 2012. The colorbar represents the data density.

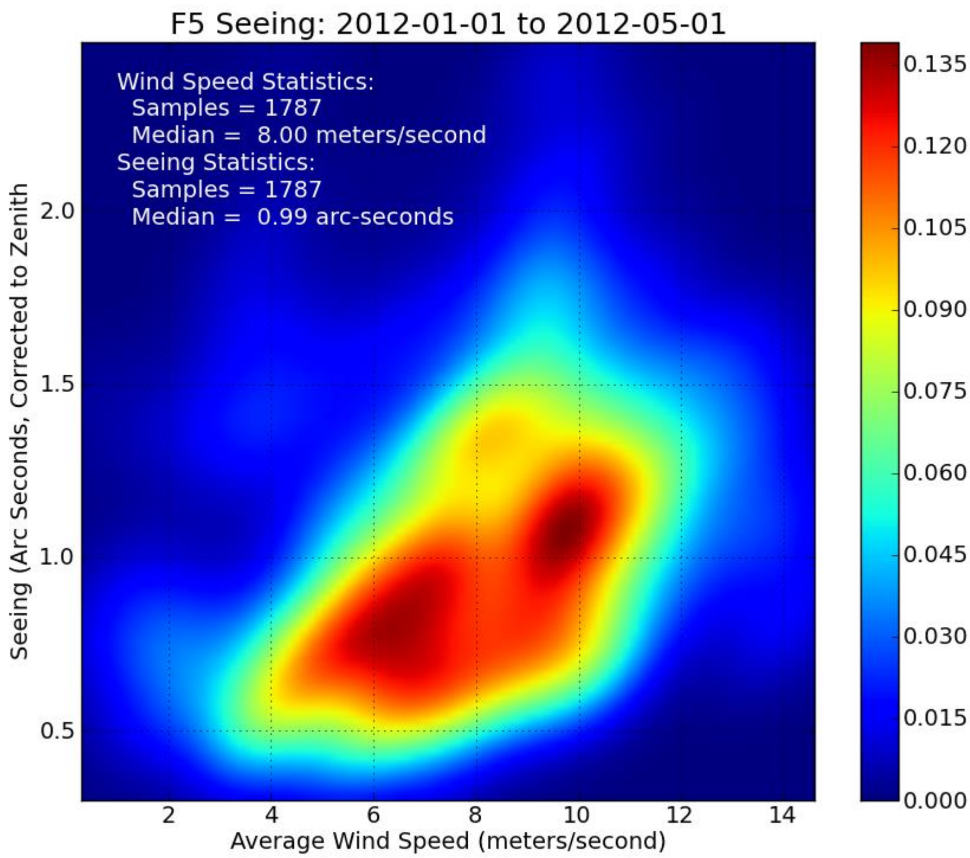


Figure 8. Gaussian KDE diagram of average wind speed (X axis) versus calculated seeing (Y axis) for the f/5 WFS system from January through April 2012.

Wind direction can also be a contributing factor in astronomical seeing. Figures 9 and 10 show the relationship of wind direction versus calculated seeing from the f/9 and f/5 WFS systems, respectively. Both of these figures show a similar relationship between wind direction and seeing. In both cases, the majority of WFS images were taken with the wind from the south to west, the prevailing wind direction.

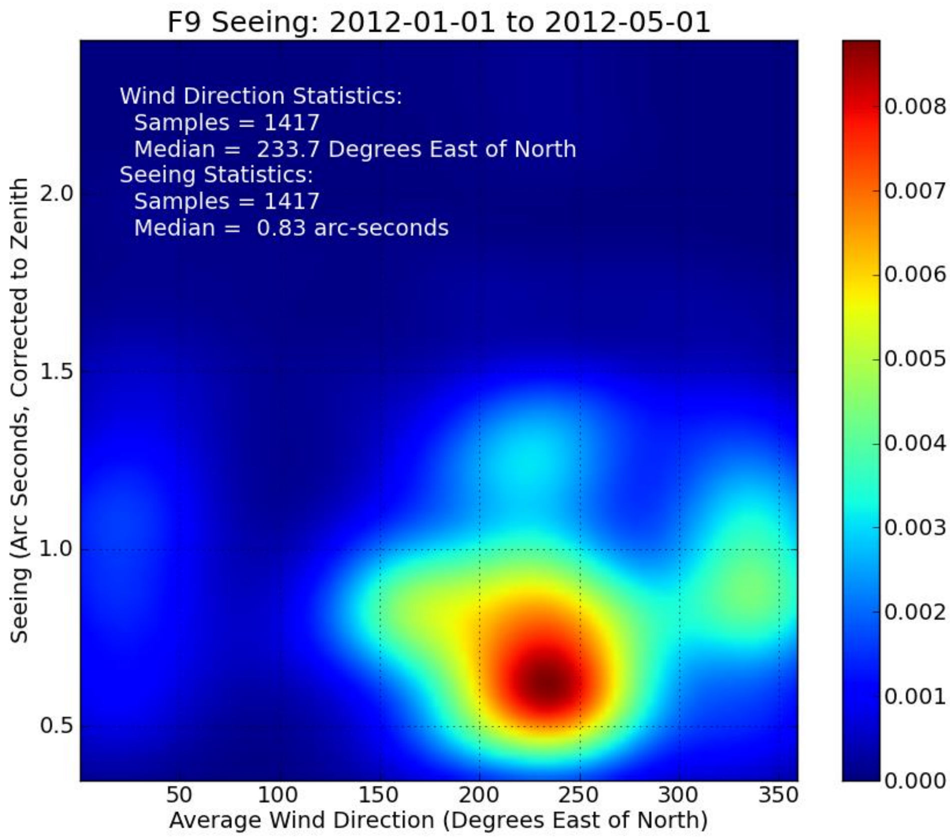


Figure 9. Gaussian KDE diagram of average wind direction (X axis) versus calculated seeing (Y axis) for the f/9 WFS system from January through April 2012.

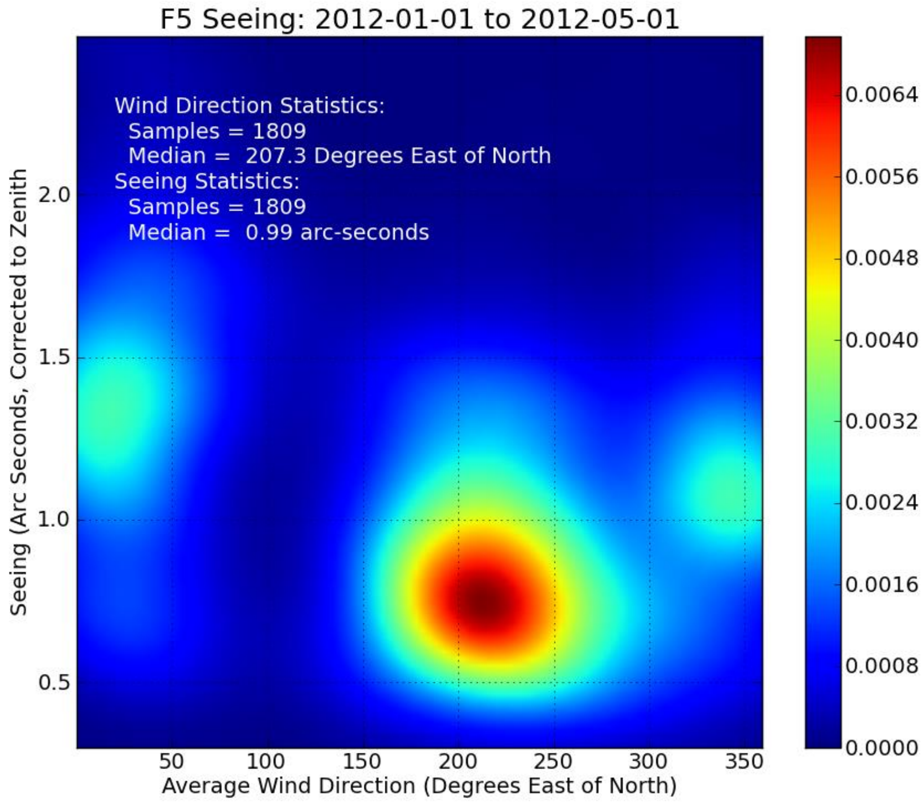


Figure 10. Gaussian KDE diagram of average wind direction (X axis) versus calculated seeing (Y axis) for the f/5 WFS system from January through April 2012.

## Safety

The MMTO staff participated in the following safety training classes during this trimester:

- Mountain staff attended Fall Arrest Training (Phase 1) on March 1 provided by Smithsonian personnel at the F.L. Whipple Observatory.

- The majority of the staff participated in a hands-on Fire Extinguisher Training on March 14 provided by the University of Arizona Fire Department / Risk Management.

- Seven staff members attended a rigging class on March 27 provided by BC Wire Rope & Rigging and the Crosby Group.

## General Facility

Preventative maintenance was performed on the pit Neslab on March 8 to recharge and test the correct proportion of methanol for normal operating conditions.

In late February, several problems developed with the operation of the front shutters. Repairs included removing the upper horizontal locking actuator and greasing its worm gear. The pivot plate was also cleaned and lubed and a damaged pivot bolt was replaced. The festoon cable was replaced. Finally, the spacers on the west shutter were enclosed in a "cage" to prevent them from slipping out of position.

Temptrax 4 failed after almost a month on the new network. The suspected cause of failure was power-over-ethernet (POE) being enabled over the new network. The unit was returned to the campus electronics shop, and several days of troubleshooting ensued. The system functioned intermittently, and a bad Rabbit core was suspected. However, it was discovered that a wall wart power supply was failing. A new power supply was located and the unit was reinstalled.

Facility network upgrades continued this trimester. Fiber cable was run between the lower green conex (across from the common building) and the IOTA site. A 6-pair fiber cable was run and terminated. The IOTA network is fully operational and connected to the MMTO network

Two additional runs of 6-pair fiber were required to meet the topology specifications for the new MMTO network. Two runs were added between the drive room and 2West, and between the drive room and 3East. All fibers were terminated and tested. Bad fiber strands were found in both the 2West run and the 3East run, reducing the operational pairs to five. This reduction was acceptable, as the five usable pairs exceed network requirements.

Several major projects were completed at the summit by Sierrita Mining & Ranching (SMR) during the first half of March. Following is a description of the work.

1. In the southeast corner area, a reinforced concrete drainage barrier was installed, and the existing steel landing mat was removed. The site drainage in this area was restored using crowning to prevent water pooling and flooding down the 26% grade access road. The graded area was contoured with compacted ABC material, and finished with a two-inch deep layer of screened one-inch crushed light color rock.

2. The low white pole fence was replaced with fencing similar to the chainlink fence that exists around the summit. The main area for this repair was also in the southeast corner.

3. Excess loose rock was removed from the summit shop and Instrument Repair Facility (IRF) drainage area, and a water diversion was constructed outside the existing gabion structures. This should help stop water erosion. Also, an existing unsupported gabion section was removed, and a 3 to 4 foot extension was constructed to extend to the original rock bank.

4. A gabion retainer wall was installed along the base of the steep bare-earth bank located under the IRF access walkway. The steep slope grade was then mechanically reduced, and the loose earthen bank was stabilized. The area of exposed soil was covered with course landscape fabric and course rock to prevent wind-driven dust.

Dearborn Cranes manufactured a new 3-ton bridge crane with wireless controls for the MMTO and installed it in the telescope chamber between April 2 and April 4. The previous bridge crane, also 3-tons, had been at the MMTO since 1978. Installation of the new crane was a tedious process, requiring the entire bridge to be taken out with the old crane attached, swapping out the old and new cranes in the parking lot, and then re-installing the whole new bridge crane unit. The bridge crane is used for mid-baffle installation and removal, as well as lowering instruments and equipment into the lower-level loading dock area or down into the lower basement area.

Five new hydraulic cylinders were ordered for the instrument lift. The old ones that came with the lift were poorly constructed and often leaked. Howard's Hydraulic will custom build the new cylinders. We plan to install four, and have the fifth one as a "hot" spare. The cylinders control the lift platform using hydraulic oil and pressure to raise and lower the instrument lift.

In order to better assess the condition of the roof following inclement weather, an Axis 207W webcam in a heated/cooled enclosure was installed on the northeast corner of the roof shutters. Initial results show that while the camera works, the heater section did not adequately keep the front window of the enclosure defrosted during a recent snowstorm. The roof cam is fiber isolated from the network via standard fiber converters.

The roof heater controls were reinstalled after being repaired, and they are now fully functional. The roof snow sensor was tested using water and freeze spray. The sensor uses a combination of temperature and moisture to determine whether there is rain or snow. If both conditions are met, the roof heaters come on. Tests showed the sensor was operational.

**Weather and Environmental Monitoring**

Following reports that the Vaisala 3 and Vaisala 4 (WXT-520) units were not returning wind data, attempts were made to repair them. We determined that the wind section in both units had failed. Vaisala 3 was removed and sent to Vaisala for repair. During its re-installation, the main cable in the east weather pole was found to be bad. The cable was replaced with a spare, and the system was returned to operational status. Vaisala 4 wind data are still unavailable. After discussions, an R.M. Young Alpine wind sensor was ordered and will be added to the east weather pole. The unit is very reliable and parts are easily replaceable. The Alpine version is currently used on the west pole.

## Visitors

1/9/12 – A group of engineers from Lockheed visited the MMTO, led by J. Kingsley, Associate Director of Steward Observatory. They have an interest in building a 6.5m telescope.

1/15/12 – The new SAO Advisory Board visited the MMTO and other FLWO facilities on Mt. Hopkins.

2/29/12 – Fifteen prospective astronomy graduate students toured the MMTO along with two UA astronomy department faculty members.

3/22/12 – A Canadian film company, Inigo Athenaeum Enterprise Inc., did follow-up filming of Dr. Neville Woolf at the MMTO for a documentary they are making entitled "Following Four Wise Men." Dr. Woolf was the acting director during the completion of the original MMTO in the late 1970s. Previous filming for this documentary took place in March 2011 at the MMTO.

### MMTO in the Media

None

## Publications

### MMTO Internal Technical Memoranda

None

### MMTO Technical Memoranda

12-01 MMT AO Performance
K. Powell, April 2012
http://www.mmto.org/node/245

### MMTO Technical Reports

None

### Scientific Publications

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

12-01 M94 as a Unique Testbed for Black Hole Mass Estimates and AGN Activity at Low Luminosities
A. Constantin and A.C. Seth
*Ad. Ast.*, **2012E**, 13C

12-02 Star Clusters in M31. IV. A Comparative Analysis of Absorption Line Indices in Old M31 and Milky Way Clusters
R.P. Schiavon, et al.
*AJ*, **143**, 14

12-03 Systematic Blueshift of Line Profiles in the Type IIn Supernova 2010jl: Evidence for Post-shock Dust Formation?
N. Smith, et al.
*AJ*, **143**, 17

12-04 Kinematics and Chemistry of Stars Along the Sagittarius Trailing Tidal Tail and Constraints on the Milky Way Mass Distribution
J.L. Carlin, et al.
*ApJ*, **744**, 25

12-05 Very Early Ultraviolet and Optical Observations of the Type Ia Supernova 2009ig
R.J. Foley, et al.
*ApJ*, **744**, 38

12-06 Four Decades of IRC + 10216: Evolution of a Carbon-rich Dust Shell Resolved at 10 μm with MMT Adaptive Optics and MIRAC4
J.R. Males, et al.
*ApJ*, **744**, 133

12-07 The ELM Survey. III. A Successful Targeted Survey for Extremely Low Mass White Dwarfs
W.R. Brown, et al.
*ApJ*, **744**, 142

12-08 First Results from Pan-STARRS1: Faint, High Proper Motion White Dwarfs in the Medium-Deep Fields
J.L. Tonry, et al.
*ApJ*, **745**, 42

12-09 The GALEX Arecibo SDSS Survey. V. The Relation Between the H I Content of Galaxies and Metal Enrichment at Their Outskirts
S.M. Moran, et al.
*ApJ*, **745**, 66

12-10 Chandra X-Ray Observations of the Redshift 1.53 Radio-loud Quasar 3C 270.1.
B.J. Wilkes, et al.
*ApJ*, **745**, 84

12-11 Near-perfect Collimation of Wide-Field Cassegrain Telescopes
D.R. Blanco
*PASP*, **124**, 36

12-12 Old Massive Globular Clusters and the Stellar Halo of the Dwarf Starburst Galaxy NGC 4449
J. Strader, A.C. Seth, and N. Caldwell
*AJ*, **143**, 52

12-13 Deep Ultraviolet Luminosity Functions at the Infall Region of the Coma Cluster
D.M. Hammer, et al.
*ApJ*, **745**, 177

12-14 AKARI Observation of the North Ecliptic Pole (NEP) Supercluster at z=0.087: Mid-infrared View of Transition Galaxies
J. Ko, et al.
*ApJ*, **745**, 181

12-15 Kepler-21b: A 1.6 $R_{\text{Earth}}$ Planet Transiting the Bright Oscillating F Subgiant Star HD 179070
S.B. Howell, et al.
*ApJ*, **746**, 123

12-16 The Multi-Epoch Nearby Cluster Survey: Type Ia Supernova Rate Measurement in z~0.1 Clusters and the Late-time Delay Time Distribution
D.J. Sand, et al.
*ApJ*, **746**, 163

12-17 The Evolution of the Star Formation Activity per Halo Mass up to Redshift ~1.6 as Seen by *Herschel*
P. Popesso, et al.
*A&A*, **537**, 58

12-18 Environmental Quenching and Hierarchical Cluster Assembly: Evidence from Spectroscopic Ages of Red-sequence Galaxies in Coma
R.J. Smith, et al.
*MNRAS*, **419**, 3167

12-19 SN 2010jp (PTF10aaxi): A Jet in a Type II Supernova
N. Smith, et al.
*MNRAS*, **420**, 1135

12-20 Dust Attenuation and Hα Star Formation Rates of z~0.5 Galaxies
C. Ly, et al.
*ApJ*, **747**, 16

12-21 Counting Low-mass Stars in Integrated Light
C. Conroy and P. van Dokkum
*ApJ*, **747**, 69

12-22 The Galaxy Optical Luminosity Function from the AGN and Galaxy Evolution Survey
R.J. Cool, et al.
*ApJ*, **748**, 10

12-23 The Ongoing Assembly of a Central Cluster Galaxy: Phase-space Substructures in the Halo of M87
A.J. Romanowsky, et al.
*ApJ*, **748**, 29

12-24 Infrared Variability of Evolved Protoplanetary Disks: Evidence for Scale Height Variations in the Inner Disk
K.M. Flaherty, et al.
*ApJ*, **748**, 71

12-25 The SDSS-III Baryon Oscillation Spectroscopic Survey: Quasar Target Selection for Data Release Nine
N.P. Ross, et al.
*ApJ Supp.*, **199**, 3

12-26 The Faint End of the Luminosity Function and Low Surface Brightness Galaxies
M.J. Geller, et al.
*AJ*, **143**, 102

12-27 A Successful Broadband Survey for Giant Lyα Nebulae. I. Survey Design and Candidate Selection
M.K.M. Prescott, A. Dey, and B.T. Jannuzi
*ApJ*, **748**, 125

12-28 Identifying Luminous Active Galactic Nuclei in Deep Surveys: Revised IRAC Selection Criteria
J.L. Donley, et al.
*ApJ*, **748**, 142

12-29 Detailed Compositional Analysis of the Heavily Polluted DBZ White Dwarf SDSS J073842.56+183509.06: A Window on Planet Formation?
P. Dufour, et al.
*ApJ*, **749**, 6

12-30 High-resolution Images of Orbital Motion in the Orion Trapezium Cluster with the LBT AO System
L.M. Close, et al.
*ApJ*, **749**, 180

12-31 A Deep, Wide-field Hα Survey of Nearby Clusters of Galaxies: Data
S. Sakai, R.C. Kennicutt, Jr., and C. Moss
*ApJ Supp.*, **199**, 36

12-32 What Drives the Ultraviolet Colours of Passive Galaxies?
R.J. Russell, J.R. Lucey, and D. Carter
*MNRAS*, **421**, 2982

**Non-MMT Scientific Publications by MMT Staff**

None

**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

**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 to the back of this report are taken from that database.

# Use of MMT Scientific Observing Time

## January 2012

| 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 | 15.00 | 175.90 | 48.00 | 0.00 | 0.00 | 0.00 | 0.00 | 48.00 |
| PI Instr | 13.00 | 153.40 | 21.90 | 27.80 | 11.25 | 3.10 | 0.00 | 64.05 |
| Engr | 3.00 | 35.70 | 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** | **365.00** | **69.90** | **27.80** | **11.25** | **3.10** | **0.00** | **112.05** |

Time Summary

| | |
|---|---|
| Percentage of time scheduled for observing | 90.2 |
| Percentage of time scheduled for engineering | 9.8 |
| Percentage of time scheduled for sec/instr change | 0.0 |
| Percentage of time lost to weather | 19.2 |
| Percentage of time lost to instrument | 7.6 |
| Percentage of time lost to telescope | 3.1 |
| Percentage of time lost to general facility | 0.8 |
| Percentage of time lost to environment (non-weather) | 0.0 |
| Percentage of time lost | 30.7 |

* Breakdown of hours lost to instrument
- 0.50 Reading out error of SWIRC exposure
- 3.10 Bent pins in hectospec connectors
- 1.00 Hecto robot problems
- 23.20 Encoder issues w/z-axiz on a hecto robot

** Breakdown of hours lost to telescope
- 0.25 image oscillation due to power supply problems
- 7.00 Actuator power supply key switch
- 4.00 f/15 issues (AO guis & software; unable to flatten)

*** Breakdown of hours lost to facility
- 3.10 Ethernet problems

## February 2012

| 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 | 9.00 | 99.50 | 11.80 | 0.75 | 0.00 | 0.00 | 0.00 | 12.55 |
| PI Instr | 19.00 | 212.70 | 90.80 | 3.00 | 7.00 | 0.00 | 0.00 | 100.80 |
| 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** | **29.00** | **322.90** | **102.60** | **3.75** | **7.00** | **0.00** | **0.00** | **113.35** |

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 | 31.8 |
| Percentage of time lost to instrument | 1.2 |
| Percentage of time lost to telescope | 2.2 |
| Percentage of time lost to general facility | 0.0 |
| Percentage of time lost to environment (non-weather) | 0.0 |
| Percentage of time lost | 35.1 |

* Breakdown of hours lost to instrument
- 0.50 MMT SG-RC grating tilt motor slipping/stalling
- 0.25 MMT SG-RC grating stuck in position
- 3.00 Testing after hecto robot failure (1/25/12)

** Breakdown of hours lost to telescope
- 7.0 Rotator calibration and elevation above limit

## Year to Date February 2012

| 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 | 24.00 | 275.40 | 59.80 | 0.75 | 0.00 | 0.00 | 0.00 | 60.55 |
| PI Instr | 32.00 | 366.10 | 112.70 | 30.80 | 18.25 | 3.10 | 0.00 | 164.85 |
| Engr | 4.00 | 46.40 | 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** | **60.00** | **687.90** | **172.50** | **31.55** | **18.25** | **3.10** | **0.00** | **225.40** |

Time Summary

| | |
|---|---|
| Percentage of time scheduled for observing | 93.3 |
| Percentage of time scheduled for engineering | 6.7 |
| Percentage of time scheduled for sec/instr change | 0.0 |
| Percentage of time lost to weather | 25.1 |
| Percentage of time lost to instrument | 4.6 |
| Percentage of time lost to telescope | 2.7 |
| Percentage of time lost to general facility | 0.5 |
| Percentage of time lost to environment (non-weather) | 0.0 |
| Percentage of time lost | 32.8 |

**March 2012**

| 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 | 120.90 | 6.50 | 3.00 | 0.00 | 0.00 | 0.00 | 9.50 |
| PI Instr | 18.00 | 187.80 | 64.70 | 1.50 | 1.00 | 0.00 | 0.00 | 67.20 |
| Engr | 1.00 | 9.80 | 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** | **318.50** | **71.20** | **4.50** | **1.00** | **0.00** | **0.00** | **76.70** |

Time Summary

| | |
|---|---|
| Percentage of time scheduled for observing | 96.9 |
| Percentage of time scheduled for engineering | 3.1 |
| Percentage of time scheduled for sec/instr change | 0.0 |
| Percentage of time lost to weather | 22.4 |
| Percentage of time lost to instrument | 1.4 |
| 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 | 24.1 |

* Breakdown of hours lost to instrument
1.50 Filter wheel & hudson computer
3.00 Hysteresis; unable to change central wavelength

** Breakdown of hours lost to telescope
1.00 f/5 oscillation

**April 2012**

| 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 | 143.90 | 15.90 | 0.00 | 0.00 | 0.00 | 0.00 | 15.90 |
| PI Instr | 11.00 | 104.20 | 18.00 | 0.00 | 16.40 | 0.00 | 0.00 | 34.40 |
| Engr | 3.00 | 28.50 | 3.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 |
| Sec Change | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total** | **30.00** | **276.60** | **36.90** | **0.00** | **16.40** | **0.00** | **0.00** | **53.30** |

Time Summary

| | |
|---|---|
| Percentage of time scheduled for observing | 89.7 |
| Percentage of time scheduled for engineering | 10.3 |
| Percentage of time scheduled for sec/instr change | 0.0 |
| Percentage of time lost to weather | 13.3 |
| Percentage of time lost to instrument | 0.0 |
| Percentage of time lost to telescope | 5.9 |
| Percentage of time lost to general facility | 0.0 |
| Percentage of time lost to environment (non-weather) | 0.0 |
| Percentage of time lost | 19.3 |

** Breakdown of hours lost to telescope
16.40 AO M2 (f/15)

**Year to Date April 2012**

| 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 | 52.00 | 540.20 | 82.20 | 3.75 | 0.00 | 0.00 | 0.00 | 85.95 |
| PI Instr | 61.00 | 658.10 | 195.40 | 32.30 | 35.65 | 3.10 | 0.00 | 266.45 |
| Engr | 8.00 | 84.70 | 3.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 |
| Sec Change | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total** | **121.00** | **1283.00** | **280.60** | **36.05** | **35.65** | **3.10** | **0.00** | **355.40** |

Time Summary

| | |
|---|---|
| Percentage of time scheduled for observing | 93.4 |
| Percentage of time scheduled for engineering | 6.6 |
| Percentage of time scheduled for sec/instr change | 0.0 |
| Percentage of time lost to weather | 21.9 |
| Percentage of time lost to instrument | 2.8 |
| Percentage of time lost to telescope | 2.8 |
| Percentage of time lost to general facility | 0.2 |
| Percentage of time lost to environment (non-weather) | 0.0 |
| Percentage of time lost | 27.7 |