End of Trimester Summary

September – December 2009

September at the MMT

December at the MMT

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Personnel

Bryan Cardwell was hired as an Electrical Engineer in September. Bryan's previous position was Engineer, Temporary.

Tim Pickering left the MMTO in October for a position at the South African Astronomical Observatory. Tim had been with the MMTO for 8 years, and with Steward Observatory for 9 years prior to working at the MMTO. Duane Gibson assumed the duties of IT Coordinator.

Tom Trebisky retired in December after 12 years with the MMTO. Prior to working with the MMTO, Tom had worked a total of 19 years combined at Steward Observatory and the Lunar & Planetary Lab. Tom continues to work with the IT group on a part-time basis.

Talks and Conferences

An all-hands MMTO meeting was held on September 15 at the summit for the annual staff status update and photo. A safety seminar and walk-through was also conducted, led by C. Knop.

An MMT Council meeting was held on September 22.

An MMTO Planning Strategy meeting was held on October 7 with SO, SAO, and ASU to discuss future plans for the MMTO.

External Presentations

G. Williams gave a presentation on October 21 at the noon Journal Club at Steward Observatory.

Primary Mirror Systems

Primary Mirror Support

During the December MMTO engineering meeting, a design study/proposal regarding upgrades to the primary actuator test stand was requested. This proposal is available at **http://preview.tinyurl.com/ybqrevj** as a PDF. We await final pricing quotations from Beckhoff Automation for several parts.

Optics

A mirror wash scheduled for December was cancelled due to storms and below–freezing temperatures. It was rescheduled for April 2010.

Thermal System

The laboratory calibration of the first few T-series thermocouple boards was a difficult and error-prone process that revealed some potential problems with the 24-bit digital-to-analog converters.

Unfortunately, we were unable to separate purely electronic problems from thermocouples and their connectors.

To decouple the measurement data, a thermopile board and an absolute board were constructed without thermocouple connectors for purely electronic testing. To provide a low-level signal for measurement of the A/D conversion electronics, a precision 1mV battery-powered reference box was constructed. The 1mV corresponds to an absolute temperature of about 25° C, and can be used in either polarity when connected to the thermocouple measurement boards so that checking the output linearity is possible.

Using these precision measurements, we can then more carefully characterize the performance and calibration of the T-series. This should help to make possible the final calibration of boards to be used on the telescope to ensure absolutely reliable measurements are being reported by the system.

The first T-series box installed on the telescope continues to work and provide data without significant interruption, so we are confident in the basic system reliability.

Secondary Mirror Systems

f/15 Secondary

We continued to encounter drifting values for approximately 50 of the 336 capacitive position sensors for the Deformable Mirror (DM). In an attempt to eliminate the problem, several shell cleanings were performed without success. During the September NGS/CLIO run, we noticed that many sensors drifted in the same direction. To determine if the drifting was correlated with humidity, the chamber humidity was adjusted by opening and closing the rear shutters. An approximate range of 71 - 76% relative humidity was probed, but there was no correlation with actuator drift. We next attempted to correlate the drift with Neslab setpoint. Ambient conditions were 13° C. At 25° C, we found that many of the unstable actuators were drifting in the positive direction. We adjusted the setpoint to 15° C and found that, approximately 40 minutes later, many of the actuators were drifting in the negative direction. We returned the setpoint to 25° C and saw the trend again reverse, with the bad actuators trending positive. It appears as if the temperature was affecting this subset of actuators. These tests demonstrated that we need to keep the mirror close to ambient temperature until we determine the underlying source of the drift.

V. Vaitheeswaran modified the software so that we are able to add or remove actuators from the xadsec gui. Previously, we were forced to close the gui to make these changes.

Telescope Tracking and Pointing

Servos

The azimuth servo project began with the preliminary work listed in the azimuth system test plan distributed by D. Clark. With significant help from the mountain staff, many of the mechanical inspections and maintenance items were performed, as well as some other measurements relevant to the azimuth drive train. This work is documented as a PDF at **http://tinyurl.com/yf8smym** for the interested reader.

Additional work on the intermittent 0.1 arcsec tracking jitter on the elevation axis was done during the reporting period. The Center for Astronomical Adaptive Optics (CAAO) group has been particularly sensitive to any tracking jitter in the elevation axis due to excitation of unwanted structural vibrations and low-frequency movements that take excessive amounts from the DM actuator stroke range. One possibility that was explored in detail was excessive command-signal variation going into the elevation controller was creating this jitter through amplification in the control-loop forward path. A detailed report investigating this possibility is available as a PDF at **http://tinyurl.com/yddyuof.**

The frequency of the elevation command jitter has been confirmed to be linearly related to tracking velocity and as the command-jitter report makes clear, is coming from a source outside the control loop. Finding the source of the jitter is a high priority.

Adaptive Optics Systems

In support of Optical Sciences graduate student K. Powell's work on acquisition of the DM reference body accelerometer data, MMTO constructed a USB to RS422 converter to trigger and collect the DM accelerometer data from the existing fiber-optic interface box. D. Clark wrote a PyQt GUI to handle the data acquisition and some preliminary data were taken. In the course of this work, problems were encountered with integrity of the data connection to the DSPs on the DM and occasional dropped bits in the serial dataflow. Testing showed the Moxa fiber converter box in the interface chassis was occasionally dropping the data connection. Plans are to construct a replacement for this unit and retest the data acquisition.

Once the data-acquisition hardware is working reliably, we should be able to assist in implementation of the planned accelerometer feed-forward into the Adaptive Optics (AO) PC Reconstructor (PCR). This should significantly improve the DM response bandwidth and image quality.

Computers and Software

Annunciator

Much progress was made during the reporting period on the annunciator, our new telescope operator (TO) alert system. The annunciator is a new mmtservice that runs continuously on "tcs-server" and periodically performs a large number of checks on various telescope subsystems. These checks are grouped into six subsystems:
1) mount ("mnt")
2) primary mirror ("pri")
3) secondary mirror ("sec")
4) environment ("env")
5) utilities ("utl")
6) miscellaneous ("msc")

An overall status is published by the annunciator for each of these subsystems with three possible status values:
1) "good", indicated by green
2) "warning", indicated by yellow
3) "error", indicated by red

The annunciator also includes an audible alarm to notify the TO of a changing status.

The TO's graphical user interface (GUI) for the annunciator is shown in Fig. 1. This GUI was purposely designed to be simple and compact and to stay on top of other GUIs in the active user desktop. At the left of this figure is an acknowledge (ACK) button. When a subsystem status changes to warning or error, an audible alarm sounds. The TO acknowledges the warning or error by clicking on the ACK button, which terminates the audible alarm. The user making the acknowledgment is logged.

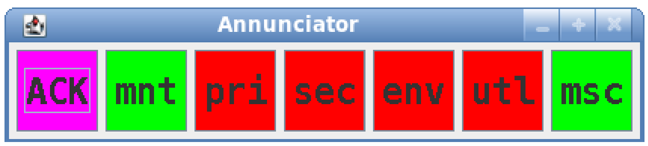

Fig. 1. The graphical user interface (GUI) for the annunciator. The acknowledge (ACK) button is shown at the left and the status indicators of the six subsystems, mnt, pri, sec, env, utl, and msc, are shown to the right. See text for additional details.

Detailed listings of the current reasons for each subsystem status are available. The TO can use the mouse to click on any of the six status boxes in Fig. 1 to launch a separate window with details for a particular subsystem. Fig. 2 shows the current reasons for the primary mirror ("pri") subsystem status. During the day, several subsystems commonly have a warning or error status since hardware is turned off or otherwise off-line. This is the case in Figures 1 and 2. During normal nighttime operations, all subsystems should have a green indicator and no reasons listed.

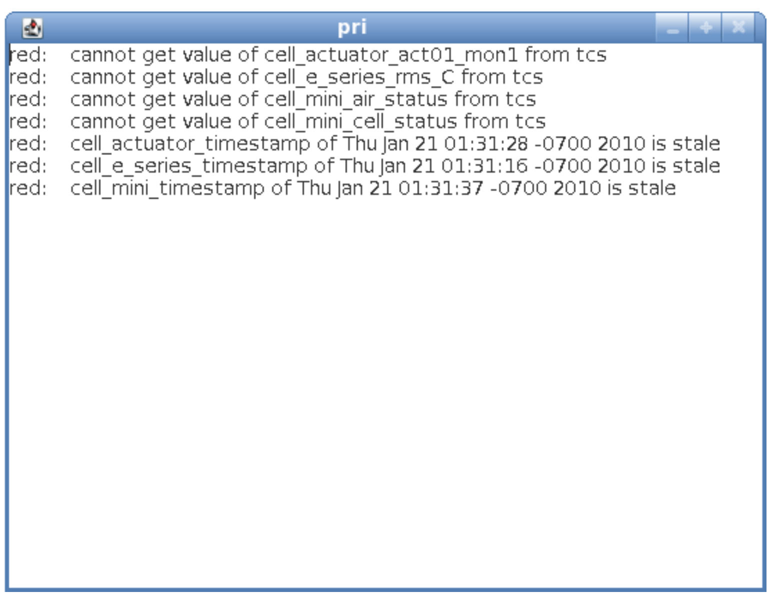

Fig 2. Details reasons for the current primary mirror status seen in Fig. 1.

At the present time, approximately 80 different checks are performed by the annunciator. Individual checks occur from every few seconds up to roughly once a minute, depending on how quickly data associated with the check changes. New checks can easily be added. In addition, individual checks can be enabled or disabled, and the specific values used for warnings and errors can be readily modified through an annunciator parameters editor, shown in Fig. 3.

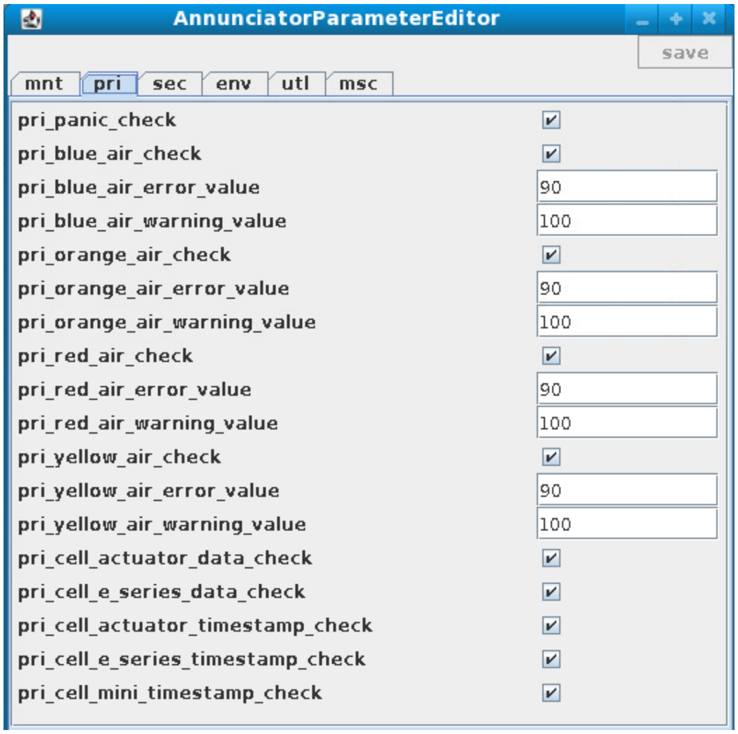

Fig. 3. The annunciator parameter editor, showing details for the primary mirror parameters.

Failure of a check is logged by the annunciator as an event into the same MySQL database as used for events from the mount, cell, hexapod, and interlock. A web interface to this event log (http://hacksaw.mmto.arizona.edu/eventlog/) allows details of annunciator status to be viewed and to be correlated with other events in this database.

Finally, a web interface (Fig. 4) is also available for daytime and remote use of the annunciator: http://tcs-server.mmto.arizona.edu/annunciator/. This web interface does not include the acknowledgement button of the TO's version of the annunciator GUI. This web interface includes three checkboxes that can be used to show: 1) the current reasons, 2) the parameters associated with the reasons, and 3) annunciator entries from the event log for the current day. This web interface also can be used on mobile devices, either by the day crew at the telescope or remotely by other users. The format of the web page changes when used on a mobile device for better formatting.

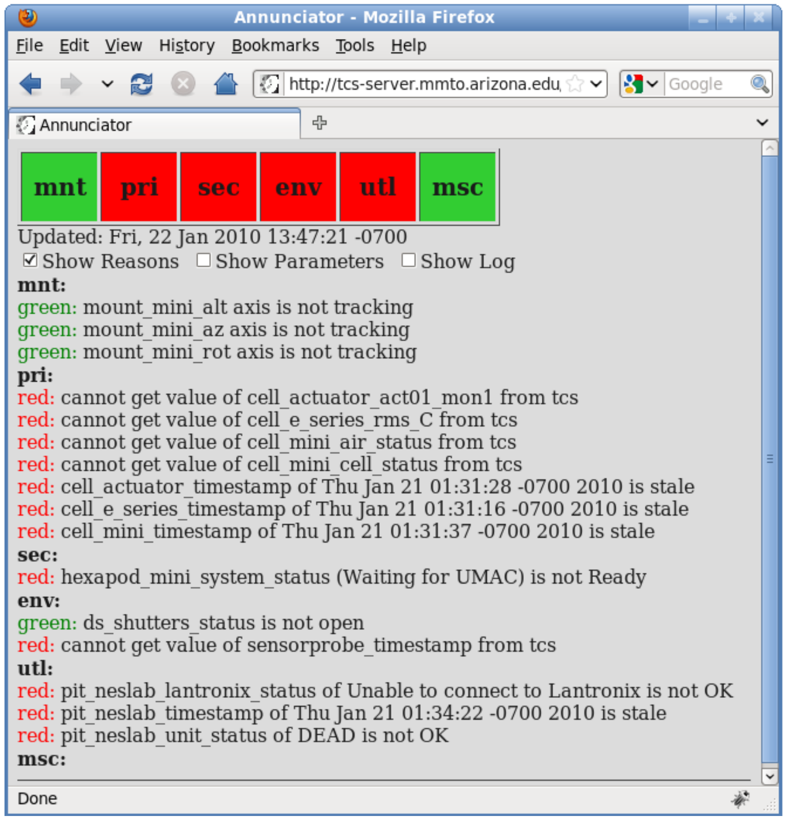

Fig. 4. Web interface to the annunciator for daytime and remote use.

Engineering Web Pages

The MMT Engineering web page, http://hacksaw.mmto.arizona.edu/engineering/, has been reorganized and reformatted for easier use.

An "accordion" menu style has been used to group web links for several hundred web pages under seventeen different categories (see Fig 5). Each category is represented by a horizontal menu bar. Each web page is assigned an incrementing number for easy reference, e.g., "Mount (215 to 225)". The numbers for web pages under each menu bar are listed in the label on the menu bar. Each menu header or menu "bar" can be clicked to expand for links under that menu header.

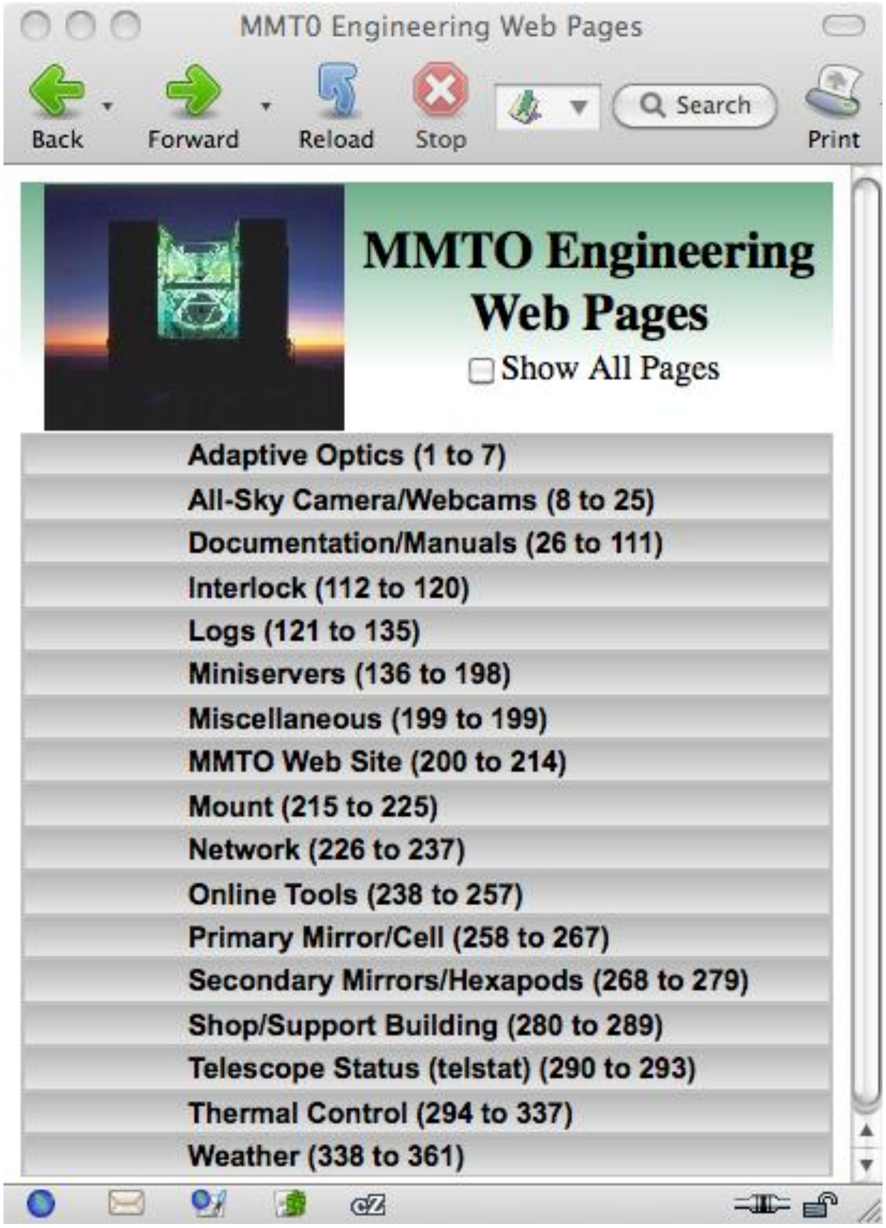

Fig 5. The revised MMT Engineering Web Pages home page, using an accordion menu style.

Clicking the "Show All Pages" check-box near the top of the GUI expands all of the menu headings for a complete listing of web pages. This can be used to search for a specific key word on the home page through the web browser.

The new Engineering home page uses different cascading style sheets (CSS) formats, depending on the device being used to view the page. For a normal desktop web browser, the default CSS styles are used. When a mobile device is being used, the column width is reduced and the letter size is increased for ease of reading on the smaller mobile screen.

Adaptive Optics Software

A software timing problem was fixed in the Adaptive Optics (AO) servers. Some of the server startup messages were not being displayed in the log viewing windows. Several changes were made to the AO GUI, including: 1) added mode 55 to the alignment page (allows loading of a reconstructor with 55 modes), 2) zeroed servo proportional-integrative-derivative (PID) gains when open loop button is clicked, 3) added PID on/off buttons, and 4) allowed PID gain direct entry.

During the reporting period, the AO Thin Shell Safety (TSS) miniserver underwent troubleshooting and modifications. This miniserver was migrated from "ao-server" computer to "hacksaw", where the majority of the MMT miniservers run. Among other advantages, this move allows logging into MySQL dataservers that reside on "hacksaw". The network protocol between the TSS itself and the TSS miniserver differs from that of other miniservers. For this and other reasons, the tss_server may not fit into the generic miniserver framework and may be kept as an independent code set.

Linux Administration

Linux administration tasks continued during the reporting period. These included upgrading mmto.org from Fedora 11 to Fedora 12. Various custom xsession issues were addressed that required Fedora 12. Additional issues with the Nvidia driver were also taken care of for Fedora 12. The MMT Fedora mirror was updated to Fedora 12.

An upgrade of the telstat computer was attempted. Serious issues with the multiple video card setup on this computer prevented the upgrade at this time.

Seeing Server

A new seeing server was written to publish and log guider seeing and wavefront sensor seeing values. This miniserver differs from most other miniservers in that its data are obtained from several sources, not a single source. The miniserver records separate acquisition timestamps for each of these different seeing values. Future work includes modifying MMT AO software to push AO seeing values to this seeing server.

Operator Paddle

The telescope operator's paddle, used for manual guiding and refinement of telescope pointing, is back in service. This paddle had been connected to a parallel port, which was found to be defective, on the telstat computer. The paddle has been moved to "hoseclamp", which has a working parallel port. Since parallel ports are generally being phased out on motherboards for new computers, efforts are underway to use a USB interface for the paddle.

Dataserver2 and related software

Work during this reporting period on the annunciator, described elsewhere, required changes in other MMT software. The high reliability of data communication and status information demanded by the annunciator resulted in the original dataserver being completely rewritten. The "as-needed" or non-caching data approach of the original dataserver generated too many false negatives and false positives for use by the annunciator. The revised dataserver, referred to as "dataserver2", uses a different approach to interacting with the numerous MMT miniservers, and caches data pushed from all of the miniservers. Modifications were made to all of the miniservers so that they now push new data as it becomes available to dataserver2.

Both the older and new versions of the dataservers publish parameters relayed from the miniservers as well as derived parameters. An example of a derived temperature is "outside_temp", i.e., outside temperature, where the best data source (e.g., vaisala3, vaisala4, or temptrax1) is selected for the current value of this parameter. A derived parameter could also be the average of several parameters, a calculated value, or the original parameter converted to different units, such as converting from degrees C to degrees F. Each derived parameter is associated with a function so that essentially any numerical calculation can be made to obtain a new derived parameter. Cached values are used for the derived parameters and relayed miniserver parameters published by dataserver2.

Dataserver2 interacts with a large configuration database to evaluate the staleness of parameters and to compare current values with acceptable maximum and minimum values on a parameter-by-parameter basis. If a data value is stale or outside allowed ranges, dataserver2 publishes "NA" ("Not Available"). A large effort was made by the software group to improve consistency of parameter names published by dataserver2. The configuration database maps existing miniserver names to the consistently-named dataserver2 parameters. All parameters relayed by dataserver2 from the various miniservers now have the name of the miniserver as a prefix to the variable name, e.g., "mount_mini_alt" instead of "alt". Previously, several miniservers used prefixes in this manner while others did not. The dataserver2 and related annunciator also required that various status parameters within the miniservers, such as "server_status" and "unit_status", also be re-examined to improve reliability. The result of these varied software changes is that the annunciator, dataserver2, and all of the miniservers are more reliable, robust, and consistent in use of parameter names.

A variety of clients were converted during the reporting period so that they are now using dataserver2 as their data source. In general, these clients require one or more of the derived parameters, such as outside temperature, mentioned above. These clients include the telstat displays, located in the control room, and vent_auto, used to control the primary mirror thermal system. Use of dataserver2 provides consistency in parameter values displayed in graphical user interfaces (GUIs). For example, a consistent outside temperature is displayed in all weather-related GUIs and used within software for temperature-related calculations, such as vent_auto. Future work includes conversion of more clients to using dataserver2.

MMTO Service Request System (SR System) Trimester Statistics

Various other software and computer-related issues were addressed. These issues are included below as part of the Service Request System (SR System) statistics.

Newly Opened Service Requests for Trimester

There were 65 new SR's opened. Figure 6 shows the breakdown of these new SRs in terms of categories. Figure 7 shows the breakdown in terms of sub-categories (subject). Figure 8 shows the breakdown in terms of priority.

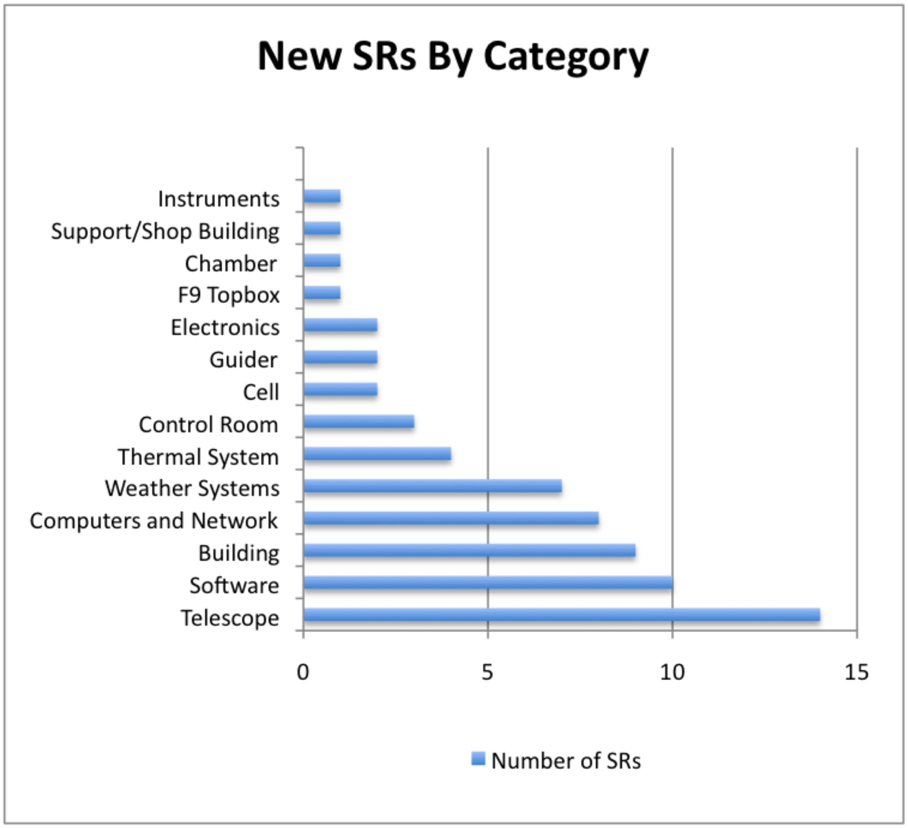

Fig. 6. New SRs created in this trimester by category.

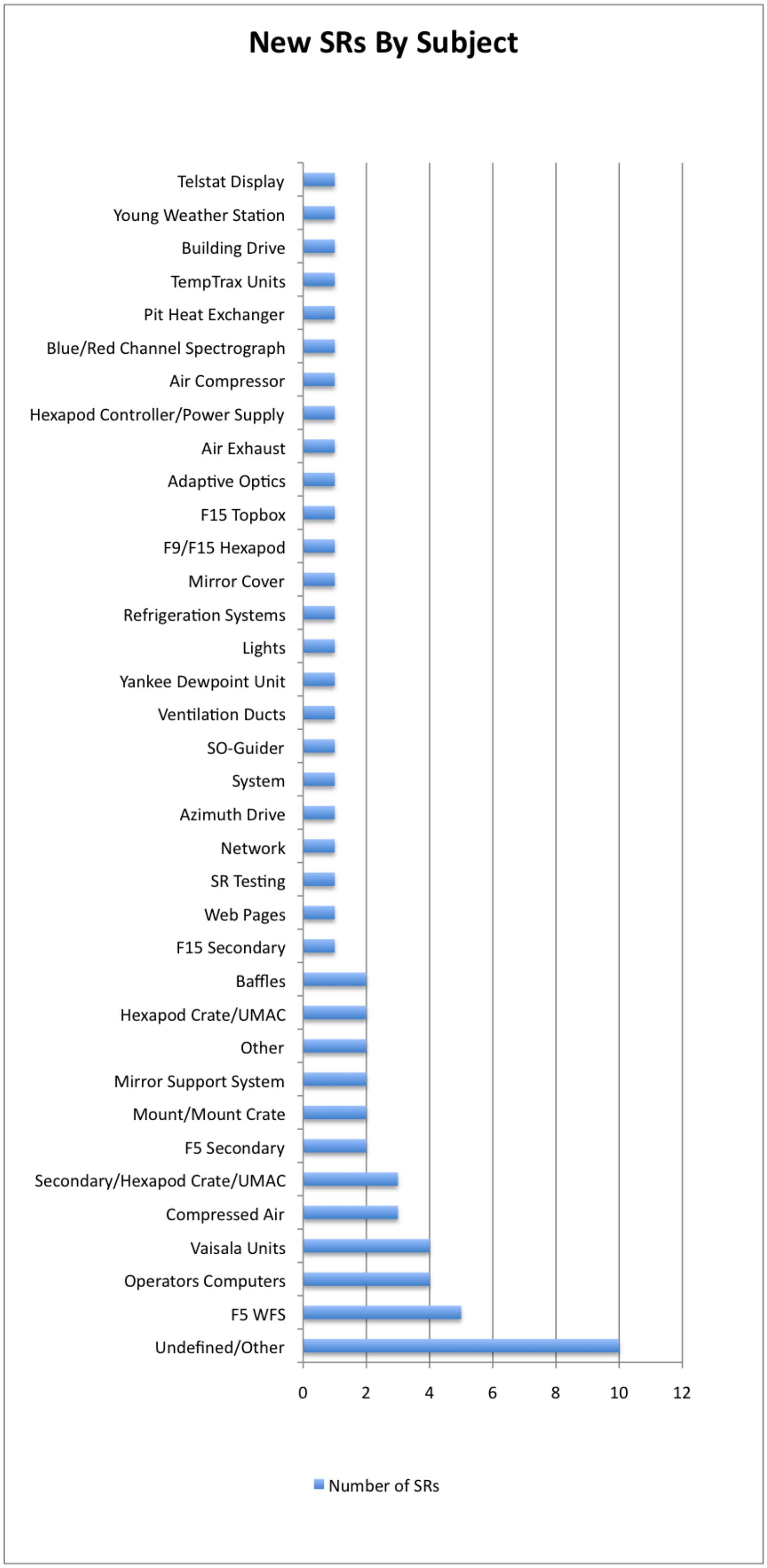

Fig. 7. New SRs created in this trimester by subject.

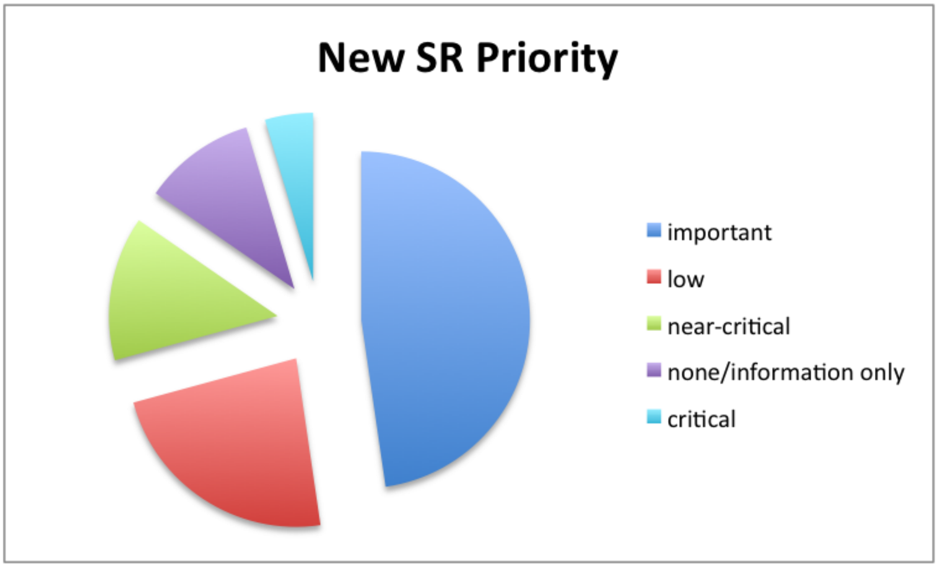

Fig. 8. New SRs created in this trimester by priority.

Service Request Responses for Trimester

During the trimester, 233 responses were submitted addressing both new and existing service requests. Fig. 9 shows the breakdown of these responses by category.

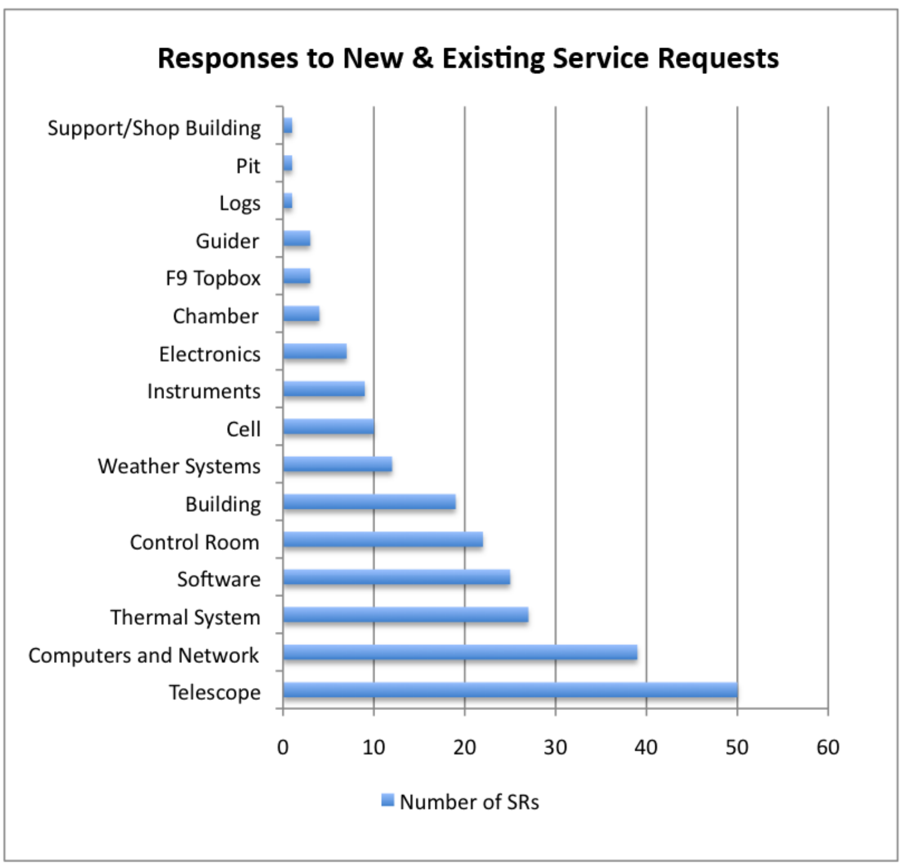

Fig. 9. Responses by category.

A breakdown of all new responses by subject can be seen in Fig. 10.

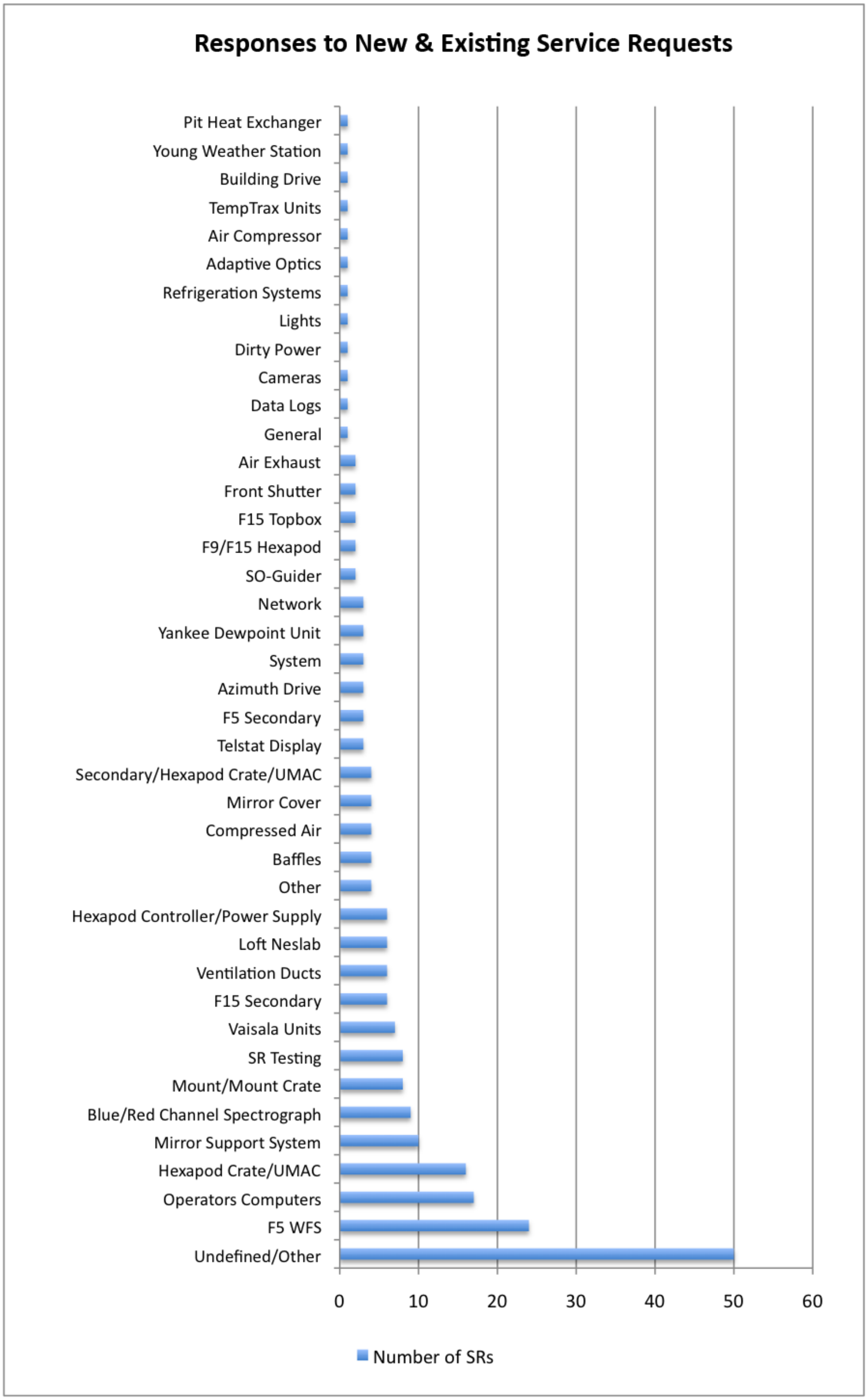

Fig. 10. Responses by subject.

Instruments

Blue Channel and Red Channel Spectrographs

Installation and testing of a new detector for Red Channel was completed by the UA Imaging Technology Laboratory (ITL). A new fully depleted detector for the Red Channel Spectrograph was commissioned in November 2009. The new device has 15-micron pixels and a format of 520 x 1032 pixels (spatial x dispersion). The read noise of the detector is 3.5 electrons. ITL's web page (http://uao.itl.arizona.edu) and (www.mmto.org/instruments/rc_upgrade2.shtml) provide additional details and information.

f/5 Instrumentation

The rewiring work completed during summer shutdown provided an opportunity to learn more details about the power to the SAO racks.
The cables near the west elevation bearing are being monitored after some chaffing damage was discovered during the summer. Protective material consisting of 20 mil thick polyethylene was added to sharp edges and no further damage has been seen.

MMIRS

MMIRS had a short run, with poor weather, before being packed up for shipment to Magellan. The instrument is still relatively new and a lot of software, mechanical and electronic development was done before it was mounted, while it was on the telescope, and in the week between dismounting and packing up. We discovered a slight quality control issue with the MOS masks that were produced; an apparent mix-up in the warm and cold dimensions resulted in a couple of masks that did not fit properly in the holder.

Hectospec

A new fiber transition box support for the Hecto fiber chain was designed, built, and implemented by MMT staff in October. The new method makes the changeover from cart-mounted to floor-mounted support more efficient and has been working well.

A new fiber transition mount will minimize risk to the fibers and improve safety and operations for the Hectospec and Hectochelle instruments.

There were a few residual software issues between MMIRS and Hecto operation to deal with during the October instrument change. The SAO programmers took care of things within a couple of hours. Over the trimester the Hecto instruments took almost 700 science exposures on more than 200 fields over 38 nights. A little over a third of the time allocated to Hectospec and Hectochelle was lost to weather and other problems. A problem with one of the disk drive bays on "lewis" was fixed in mid-November.

Temperatures dropped suddenly and drastically in October and there were discussions about safety of the fiber positioner hardware in cold temperatures. There are multiple bundles of cables that are flexed hundreds of time during a typical five minute configuration. The required few micron tolerances in positioning accuracy and the added stiffness of the wires were of concern. The operating limit was set to 20°F.

A new calibration lamp was added to the four-box constellation for Hectospec. It is a helium spectrum analysis tube with its power supply on a shelf near the NW box. The three external spectrometer calibration boxes that were on the 4th floor landing have had their fiber link to the spectrograph room removed, and the boxes are currently at the Common Building. In late November, the calibration lamps for Hectochelle had a failure that was traced to some of the connectors at the hub. It was fixed by replacing a couple of high voltage connectors.

On the morning of October 17, Guide Probe 1 on the positioner began to stop intermittently in the wrong location. After a few tests, it was decided that the brake was dragging and not releasing properly, preventing the probe from reaching the desired position. On November 2, M. Mueller arrived with replacement parts. A new solenoid was installed with slightly weaker springs so that it would release more reliably.

SWIRC

A two day run with SWIRC occurred in early November. A problem reading the dither catalogs emerged once we got on the sky. The issue was the product of a software upgrade for other f/5 instrumentation and was quickly corrected for SWIRC. There were also some weather delays but the observers were able to gather several hundred images (IR requires short exposures). Observers reported odd images after the run. The instrument was powered up a week after the run to verify that the filter wheel was moving smoothly. The odd images were actually typical for J band images.

Wavefront Sensor

The following work was completed on the wavefront sensor (WFS):

1) Continuous on-axis and off-axis guiding was implemented for f/5 WFS stellacam.
a) The file "/mmt/shwfs/cont_wfscat.rb" was modified to accommodate the Maestro instrument.
b) A new MMT desktop item was created under "Autoguiders for "F5 WFS Stellacam" that executes file "/data/mmti.new/src/guide/f5wfs_stella.csh"

2) A new version of F5 WFS was implemented using the stellacam camera.
a) The directory "/data/mmti/src/oldiccd200sm/" on "hacksaw" was copied to a new directory, "/data/mmti/src/f5wfs_stella/".
b) The configuration file, guideserv.unique.rc, was updated with: 1) the CCD pixel array geometry (768 x 494), 2) pixel size (in arc-sec) , and 3) instrument rotation (38 degrees) for stellacam camera.
c) A new MMT desktop item was created under "WFS GUIs" for "F/5 Wavefront Sensor for Maestro" (filename: "/mmt/shwfs/shwfs_unified.tcl F5 Maestro")

3) waveserv.tcl modifications on the wavefront PC.
a) The rotator was rotated to 38 degrees (the instrument rotator offset for the WFS) so that measurements at different WFS field angles would be performed in elevation only. ("elcoll" corrections were being applied through this testing.)
b) The stellacam image was then optimized with the WFS for a zero-degree WFS field angle.
c) WFS mirror tilt and focus corrections were then visually optimized at 0.05 WFS field angle increments for a range of 0.0 to 0.5 degrees field angle.
d) A third-order polynomial fit was made of WFS mirror tilt versus WFS field angle. These coefficients were then put into /home/wave/src/waveserv/waveserv.tcl on the wavefront Windows PC to obtain new values for the "mdeg" Tcl variable in the Tcl "tposi" procedure. (The previous version of waveserv.tcl was copied to waveserv.11Dec2009.tcl.)

e) A second-order polynomial fit was made of WFS focus correction versus WFS field angle. This second-order fit was used to calculate new "f_mm" values in the tposi Tcl procedure in waveserv.tcl.

f) The existing code to calculate "t_mm", WFS stage translation, was unchanged in waveserv.tcl.

g) For reference, the previous calculations for mdeg and f_mm were made based upon equations in the WFS manual: http://www.cfa.harvard.edu/mmti/wfs/wfs_manual.pdf

General Facility

Facility Improvements and Repairs

Over the past three decades, the staff of the MMT Observatory used a variety of techniques to predict the summit wind characteristics, including wind tunnel modeling and the release of smoke bombs. With the planned addition of a new instrument repair facility to be constructed on the summit of Mt. Hopkins, new computational fluid dynamic (CFD) models were made to determine the building's influence on the thermal environment around the telescope. The models compared the wind profiles and density contours above the telescope enclosure with and without the new building. The results show the steeply-sided Mt. Hopkins dominates the summit wind profiles, and confirmed the telescope continues to lie above the ground layer. In typical winds, the facility has been located far enough from the telescope to prevent any heat from the new building from mixing with the air above the telescope. This ensures the new building has minimal effect on the seeing. The results also confirmed the observatory's waste heat exhaust duct location needs to be relocated to prevent heat from being trapped in the wind shadow of the new building and lofting above the telescope. The results of this analysis were presented to the MMT Council and will be presented at the 2010 summer SPIE conference.

After the final approval by the Forest Service, the instrument repair facility was funded by the Smithsonian Project Office. The contract for fabrication was awarded to TBR Construction.

The new loading dock and scissor lift truck were put to use for the first time to assist with mounting MAESTRO onto the telescope. This installation was the first one using these new MMT additions and the installation went smoothly.

The rotating duct in the pit that supplies ventilation air to the primary mirror cell was insulated to reduce heat loss and to improve the thermal time response of the system.

In early September, the summit parking lot was re-contoured to improve access to the second floor loading dock and to improve drainage.

A cooling fan was installed on the 3-ton Yale chamber overhead hoist/crane to help cooling when operating at slow speed. We also had a crane service person pinpoint a problem with speed control. Parts will be installed 1/26/2010 and the unit will be inspected.

The azimuth bearing in the yoke room was inspected, the oil changed, and gear teeth lubed. Azimuth gearboxes were also inspected, the oil changed, zerks greased, and gear teeth lubed.

Visitors

9/24/09 – Lucian Abernathy, guest of the Smithsonian Institution, was given a tour of the MMT by G. Williams, Associate Director, who was observing that night. Mr. Abernathy also observed with him for a portion of the night.

10/20/09 – FLWO Volunteer Night: volunteers toured the MMT, along with other telescopes on Mt. Hopkins.

MMTO in the Media

12/9/09 – Science Daily, "First Known Binary Star is Discovered to be a Triplet, Quadruplet, Quintuplet, Sextuplet System" (E. Mamajek (PI), Univ. of Rochester).
http://www.sciencedaily.com/releases/2009/12/091210092005.htm

Following is a listing of articles regarding the MMTO participation in the lunar impact mission in October 2009:

Note: The MMTO observed the Cabeus crater during the impact of the Lunar Crater Observation and Sensing Satellite (LCROSS) mission. The LCROSS successfully impacted the Moon at 4:31 AM (MST). Data were collected by the MMT using the f/15 coupled with CLIO and a VNIR CCD camera before, during, and following the impact. Four different cameras were used to monitor different aspects of the MMT observing. Live video of these cameras plus one trained on the MMT control room was also streamed to UA, SAO, The Citadel, and a YouTube site available to 2500 viewers. At the time of impact, the live stream was completely subscribed. We confirmed observers ranging from New Zealand to Ireland. The streaming capabilities developed for the LCROSS transmission are now available to the MMTO to use in future efforts.

10/3/09 - *Arizona Daily Star* newspaper, article entitled "Early birds may catch NASA's moon crash". This article can be found at: http://nl.newsbank.com/nl-search/we/Archives?p_action=doc&p_docid=12B3D0C4D4797098&p_docnum=1&p_theme=gannett&s_site=azstarnet&p_product=ADSB

10/8/09 – *Arizona Daily Star* newspaper, "Best view of moon crash will be on TV or online". This article can be found at: http://nl.newsbank.com/nl-search/we/Archives?p_action=doc&p_docid=12B3D0C64FF46190&p_docnum=1&p_theme=gannett&s_site=azstarnet&p_product=ADSB

10/9/09 – multiple articles including:
- *Arizona Daily Star* newspaper, "Shot at the moon: No dust cloud, but lots of data". This article can be found at http://azstarnet.mobi/site/more/1006547/9

- *Computerworld*, "Scientists refute online rumors on moon bombing". This article found at http://www.computerworld.com/s/article/9139198/Scientists_refute_online_rumors_on_moon_bombing

- *CIO*, "NASA: Moon Bombing Provides 'the Data We Need'". This article can be found at http://www.cio.com/article/504629/NASA_Moon_Bombing_Provides_the_Data_We_Need_

11/14/09 – *Arizona Daily Star* newspaper, Associated Press article entitled "Moon crash kicked up lots of water". "Local angle" paragraph added regarding the observations made with the MMT.

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9/19/09 – *Nature News,* article entitled "Water on the Moon?". This article can be found at: http://www.nature.com/news/2009/090918/full/news.2009.931.html

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

09-52 Buoyancy Waves in Pluto's High Atmosphere: Implications for Stellar Occultations
W.B. Hubbard, et al.
Icarus, **204**, 284

09-53 The Distance to NGC 2264
E.J. Baxter, et al.
AJ, **138**, 963

09-54 Kinematics and Metallicities in the Boötes III Stellar Overdensity: A Disrupted Dwarf Galaxy?
J.L. Carlin, et al.
ApJ, **702**, L9

09-55 The Discovery of a Large Lyα +He II Nebula at $z \approx 1.67$: A Candidate Low Metallicity Region?
M.K.M. Prescott, A. Dey, and B. Jannuzi
ApJ, **702**, 554

09-56 Follow-Up Studies of the Pulsating Magnetic White Dwarf SDSS J142625.71+575218.3
E.M. Green, et al.
ApJ, **702**, 1593

09-57 Red Supergiants in the Andromeda Galaxy (M31)
P. Massey, et al.
ApJ, **703**, 420

09-58 Yellow Supergiants in the Andromeda Galaxy (M31)
M.R. Drout, et al.
ApJ, **703**, 441

09-59 A Plethora of Active Galactic Nuclei Among Lyα Galaxies at Low Redshift
S.L. Finkelstein, et al.
ApJ, **703**, L162

09-60 A Universal Mass Profile for Dwarf Spheroidal Galaxies?
M.G. Walker, et al.
ApJ, **704**, 1274

09-61 The Deep Optical Imaging of the Extended Groth Strip
Y.-H Zhao, et al.
Res. in Astron. and Astrophys., **9**, 1061

09-62 The Infrared Array Camera Dark Field: Far-Infrared to X-Ray Data
J.E. Krick, et al.
ApJ Supp, **185**, 85

09-63 A Progress Report on the Carbon Dominated Atmosphere White Dwarfs
P. Dufour, et al.
J. Physics, *Conf. Series*, **172**, 012012

09-64 Pulsations in Carbon-Atmosphere White Dwarfs: A New Chapter in White Dwarf Asteroseismology
G. Fontaine, et al.
J. Physics, Conf. Series, **172**, 012066

09-65 REM Near-IR and Optical Photometric Monitoring of Pre-Main Sequence Stars in Orion
A. Frasca, et al.
A&A, **508**, 1313

09-66 A Spectroscopic Survey of Dwarf Galaxies in the Coma Cluster: Stellar Populations, Environment and Downsizing
R.J. Smith, et al.
MNRAS, **392**, 1265

09-67 The Planetary Nebula Spectrograph Elliptical Galaxy Survey: The Dark Matter in NGC 4494
N.R. Napolitano, et al.
MNRAS, **393**, 329

09-68 The Discovery of Segue 2: A Prototype of the Population of Satellites of Satellites
V. Belokurov, et al.
MNRAS, **397**, 1748

09-69 The HST/ACS Coma Cluster Survey – V. Compact Stellar Systems in the Coma Cluster
J. Price, et al.
MNRAS, **397**, 1816

Non-MMT Scientific Publications by MMT Staff

None

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.

Work is continuing on a new MMT website. The site will be powered by Drupal (an open source content management system).

Documents that are linked include:

- MMTO Latest News and Blog.
- 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 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 University of Arizona and the Smithsonian Institution."

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

September 2009

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	11.00	110.70	8.00	0.00	0.00	0.00	0.00	8.00
PI Instr	19.00	185.80	69.85	0.25	10.85	0.00	0.00	80.95
Engr	1.00	9.70	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	**31.00**	**306.20**	**80.85**	**0.25**	**10.85**	**0.00**	**0.00**	**91.95**

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	26.3
Percentage of time lost to instrument	0.1
Percentage of time lost to telescope	3.7
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	30.0

* Breakdown of hours lost to telescope

5.05	f/15 issues
1.5	Computer and focus issues
2.0	WFS issues
2.3	SO guider camera

October 2009

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	31.00	336.40	126.00	24.40	8.65	0.00	0.00	159.05
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	**31.00**	**336.40**	**126.00**	**24.40**	**8.65**	**0.00**	**0.00**	**159.05**

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	37.5
Percentage of time lost to instrument	7.3
Percentage of time lost to telescope	2.6
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	47.3

* Breakdown of hours lost to telescope

2.25	WFS
3.9	f/15 issues
1.5	Replaced elephant hose
1.0	Hexapod issues

Use of MMT Scientific Observing Time

November 2009

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	163.50	29.70	0.00	8.50	0.00	0.00	38.20
PI Instr	14.00	162.20	47.20	1.30	1.30	0.00	0.00	49.80
Engr	2.00	22.90	1.00	0.00	0.00	0.00	0.00	1.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**348.60**	**77.90**	**1.30**	**9.80**	**0.00**	**0.00**	**89.00**

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	22.3
Percentage of time lost to instrument	0.4
Percentage of time lost to telescope	2.8
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	25.5

* Breakdown of hours lost to telescope
- 1.0 WFS connection
- 7.0 Hexapod
- 1.0 Guider issues
- 0.3 f/15
- 0.5 M1 panic

December 2009

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	335.30	123.65	9.50	25.55	0.25	0.00	158.95
Engr	2.00	24.00	12.00	0.00	0.00	0.00	0.00	12.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**359.30**	**135.65**	**9.50**	**25.55**	**0.25**	**0.00**	**170.95**

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	37.8
Percentage of time lost to instrument	2.6
Percentage of time lost to telescope	7.1
Percentage of time lost to general facility	0.1
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	47.6

* Breakdown of hours lost to telescope
- 10.25 Hexapod failure
- 6.3 AO-M2 problems (f/15)
- 7.0 AO software
- 1.0 M2 (f/15) loop
- 0.5 Gap contamination
- 0.5 Thin Shell Safety

** Breakdown of hours lost to facility
- 0.25 Building drive

Year to Date December 2009

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	753.50	216.90	0.00	19.20	0.00	0.00	236.10
PI Instr	241.00	2451.20	839.70	46.05	97.00	0.75	0.00	983.50
Engr	18.00	183.50	59.90	0.00	0.00	0.00	0.00	59.90
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**336.00**	**3388.20**	**1116.50**	**46.05**	**116.20**	**0.75**	**0.00**	**1279.50**

Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	94.5
Percentage of time scheduled for engineering	5.5
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	33.2
Percentage of time lost to instrument	1.4
Percentage of time lost to telescope	3.5
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	38.0