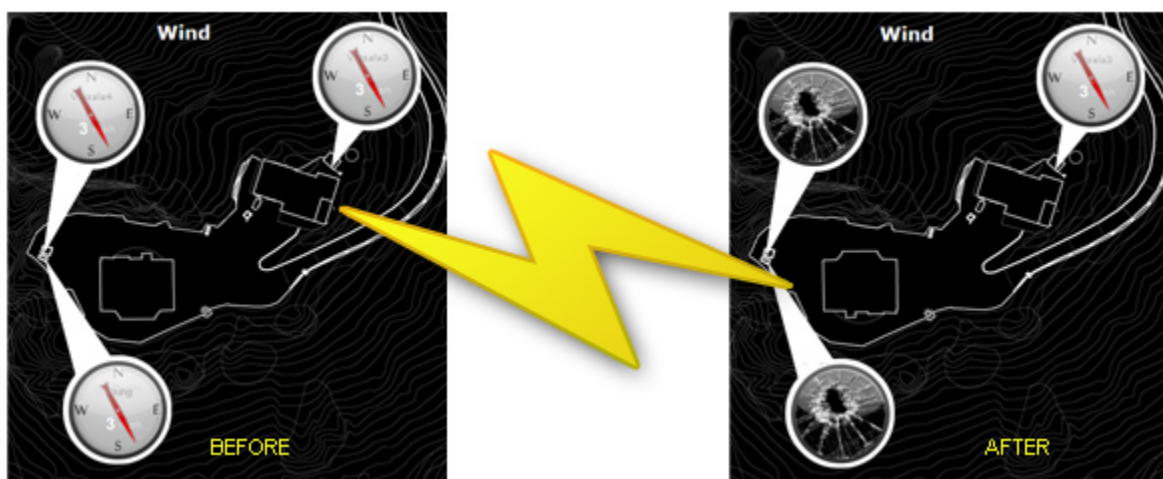


## BIMONTHLY SUMMARY

September – October 2007



A screenshot, taken from a webpage created by Dallan Porter to help visualize data from three summit wind sensors, depicting before and after shots of the R. M. Young and Vaisala4 weather stations, which took a direct lightning hit on September 17, 2007.

**Starting in calendar year 2008, this report will be issued on an end-of-trimester basis.**

## **Personnel**

John Di Miceli, former student mechanical engineer, was hired as a half-time Engineer, Associate.

Tom Gerl and Cory Knop attended the Tucson Safety Expo on October 9-10. A great deal of information was gathered and is in the process of being implemented at the MMTO.

Creighton Chute, Dondi Gerber, Tom Gerl, and Ken Van Horn attended fork lift training and certification at the FLWO basecamp on October 16. Training was provided by Dan West of FLWO.

## **Conferences**

The 17th annual Astronomical Data Analysis Software and Systems (ADASS) Conference was held September 23-26 at the Kensington Town Hall in London, U.K. There were 315 attendees with 246 presentations including orals, posters, demonstrations, birds-of-a-feather sessions, and tutorials. Tim Pickering and Betty Stobie attended the conference, presenting posters on “Web-based Interfaces to Telescope Control Systems at the MMT” and “Data Mining the MMT All-Sky Camera,” respectively. Betty also co-authored a poster on “Proposed Changes to the FITS Standard” with the rest of the IAU FITS Working Group Technical Panel. As a member of the Conference Program Organizing Committee, Betty chaired the 7th Oral Session: Algorithms and Image Processing II, and attended the annual POC business meeting.

Betty serves on the IAU FITS Working Group and is a member of five-person Technical Panel to update the FITS Standard. The Panel’s recommended revised Standard was made public in early September. Betty has reviewed the public comments for possible modifications to the document. She also attended the FITS Birds of a Feather Session at ADASS, where the proposed changes were discussed.

Morag Hastie attended the Astrophysics in the Next decade: JWST and Concurrent Facilities conference in Tucson, Arizona, September 24-27, and the Astronomy with Laser Guide Star Adaptive Optics conference at Ringberg Castle, Tegernsee, Germany, October 29 - November 2.

Faith Vilas attended the 39<sup>th</sup> meeting of the Division for Planetary Sciences, American Astronomical Society, where she presented a paper entitled “MMT Reflectance Spectra Of NEA 1999 JU3: In-situ Study Of An Aqueously-altered Asteroid In JAXA’S Future?” by F. Vilas, and co-authored a paper entitled “Optical Spectroscopy of the Icy Dwarf Planet 136472 (2005 FY9)” by S. C. Tegler, W. M. Grundy, F. Vilas, W. Romanishin, D. Cornelison, G. Consolmagno. Both papers were based on MMT observations. She also chaired the “Asteroids: Spectra, metals, and minerals” session.

## **Primary Mirror Systems**

### **Thermal System**

Some minor design changes were made to the T-series board electronics to accommodate some envisioned needs in the acquisition-board data addressing. Analysis of the data collected, using the Peltier cooler evaluation fixture, showed that a more advanced fit of the thermocouple output to the

ITS-90 data table was required. This was accomplished using a cubic fit to the ITS-90 data over a wider range of temperatures, and a slope-correction equation to bring the data into better agreement with the Platinum reference resistance temperature detector (RTD). We now get agreement between the thermocouple and the Platinum RTD to better than 0.15C rms over the entire operating range (-20C to 40C) that we envision for this system. The firmware will be completed when actual boards are manufactured, and we have test articles to base generation of the multiple-board addressing code required to support the many boards and channels the system will ultimately be populated with.

## **Optics**

A 4" witness mirror was installed on the southeast corner of the mirror cell under the mirror cover to mimic the primary mirror's exposure to the elements. This mirror will be routinely measured and CO<sub>2</sub> cleaned with the primary mirror.

## **Secondary Mirror Systems**

### **f/5 Secondary Support**

Brian Comisso continues to monitor the f/5 mirror support system, which underwent extensive troubleshooting during the reporting period. On October 12, the telescope was slewed 15 to 85 degrees several times to gather data. A thorough inspection revealed that the lateral hardpoint pucks show some movement. They will require careful inspection and possibly re-bonding at the next f/5 observing break.

The spare card was swapped in to determine the cause of the support electronics oscillations. Unfortunately, the performance was worse with the spare card. The original was reinstalled and the system retested. Testing of the spare card in the lab revealed that the negative regulator had a saw-tooth voltage output. While the design was good, the capacitor installed did not have a low equivalent series resistance value. A tantalum capacitor was installed, and elimination of the saw-tooth voltage was verified. The mountain crew also verified that the installed card had the same problem. A new capacitor was installed on that card as well. Again, the saw-tooth voltage was eliminated. A tantalum capacitor was also installed in the positive regulator circuit. Following this installation, noise levels on the mirror support system were reduced. The LVDT GUI reflects a noise reduction from 20 microns to 3 microns. Also, the load cells are displaying values of less than 1 newton of change. This directly impacts the performance of the mirror support servo. The southeast tangent rod LVDT is displaying more noise than the other LVDTs. We suspect that the noise is due to the length of the LVDT; the farther it is extended, the more AC noise there is. The other LVDTs are all near their midrange of travel. The southeast LVDT will be adjusted during the next reporting period.

The spare card that was reported as noisy has been tested in town and found to be operational. It has new capacitors installed and the offsets have been adjusted to match the installed card.

The f/5 tangent rod puck bonds need to be evaluated. We suspect they are being damaged by the load put on them during the storage of the f/5 cell. Until a determination is made, we will store the f/5 with air and power applied to the support system. While this will require continuous air and power, it will reduce the stress on the lateral hardpoint pucks.

Dusty Clark completed preliminary analysis of a possible re-design of the mirror support electronics. Early results suggest significant power savings by using switching regulators on the board. In addition, integrating internal signal multiplexer analog-to-digital converters should give good results while saving significant board real estate. An evaluation board arrived during the reporting period for this purpose, and we expect to have more in-depth results once it has been run through its paces. Another improvement of note is the elimination of all potentiometers from the board in favor of digital-to-analog converters, which will facilitate adjustment of the mirror servo forces at any angle, rather than requiring it be done either at service or off the telescope with the problematic mirror cart.

## Telescope Tracking and Pointing

### Servos

Some on-sky testing with the new servo controller for the elevation axis was performed on the night of September 19. A pdf report of the results is available at <http://mmt.org/~dclark/Reports/Results%20of%20Wind%20LM%20and%20RTW.pdf>. The bottom line is that the disturbance rejection of the new controller is not yet high enough to deploy it for normal operations. Some work on improving the disturbance rejection has already been done, and we await an opportunity to test this improved controller during the day. A pdf document summarizing this work is available at <http://mmt.org/~dclark/Reports/Improving%20Elevation%20Axis%20Disturbance%20Rejection.pdf>

We now have a stable framework to support the execution of Matlab/Simulink generated models. We can run both single-rate and multi-rate models on our x86 VxWorks system, using our GCC cross compiler to handle the generated code, as we do for VxWorks. The model of interest is presently the elevation servo controller. In the future, the model will include Simulink generated controllers for other axes as well. We have developed a number of telemetry facilities especially for the elevation controller. These automatically capture data used to characterize (and analyze) the servos whenever we start a model, start the drive, and slew to an object. Captures can also be triggered by manual commands.

## Computers and Software

### Transverse Counterweights

We have now implemented and tested computer control of the transverse counterweights. For a long time these were run simply by connecting a power supply to the motors and using a switch to move them one way or the other. The next generation controller, which was commanded by a hand paddle (which may still be used when desired), used Copley servo amplifiers. We are now able to command motion from the mount computer via the interlock subsystem (a.k.a the “26 volt rack”). The current GUI allows the operator to move them in either direction, and then stop them when the encoded position is achieved. A simple control algorithm (too simple to call a servo) has been able to achieve positions better than 0.10 unit on the arbitrary 0-100 position scale that we use, which is certainly better than can be achieved by hand. This type of control can easily be extended (and will be) to position the axial counterweights as well. Once this is done, it would be possible to use our present balancer GUI to manipulate the counterweights.

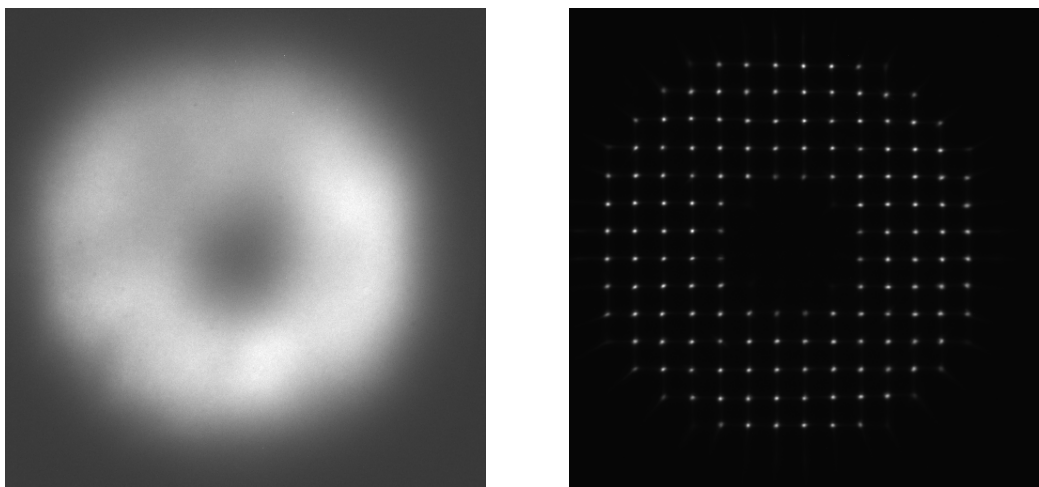
## **f/5 Wavefront Sensor**

When the f/5 wavefront sensor (WFS) was installed on October 5, we discovered that it could no longer boot from the network boot image that had worked previous to summer shutdown. In fact, none of the boot images that were known to work previously worked at all. They would either hang indefinitely or continuously reboot.

Thinking at this point that it was a hardware failure, we proceeded to replace the on-board computer's motherboard. We had intended to do this over summer shutdown, but decided to postpone it until the chamber floor installation was finished in order to prevent contamination from dust generated by the construction process. Upon installing the spare motherboard, we discovered that it didn't work at all with the on-board power supply. Testing the spare motherboard with the spare power supply revealed that it worked, but still ran into the same boot problems. At this point, we decided to install the spare power supply as well. This required some modifications to the power supply's wiring, which Ken Van Horn carried out with some assistance from Tom Gauron (SAO). In the meantime, Tim Pickering used the original motherboard as a test-bed to figure out how to get the system running again. Eventually, the system was brought back up by configuring it to boot from the hard drive again. This required significant Windows XP manipulation to remove the network boot tentacles, but the system is now working well.

After the resurrected wavefront sensor was reinstalled for the hecto run, it performed normally for the first couple of nights. However, the image acquisition began to fail intermittently. After extensive testing, it was found that the data transfer was hanging up, but we still don't understand why. Similar problems are observed when transferring files via SMB or ftp. However, ssh and scp work fine for even very large transfers. As a workaround, we configured an ssh tunnel between the wavefront computer and the computer running the WFS interface. This only required a change to one line of the interface code and has worked well, though it requires the tunnel to be reconfigured whenever the wavefront computer is restarted. Once the WFS is off the telescope, we will investigate the root of this problem further, and try to fix it.

Once everything was working, we were beset with several nights of extremely poor seeing. The telescope operator described the resulting WFS images as "frosted doughnuts." The image on the left in Figure 1 below shows an example of how bad it was.



**Figure 1: The exposure time of the image on the left was only 1 second, which further shows how turbulent it was. For reference, the image on the right (5 second exposure) shows what a WFS image looks like under 0.45 arcsec conditions. To completely smear out the WFS spots like that requires seeing of 10 arcsec or worse.**

## Unified Network Authentication

The LDAP-based network authentication system that was deployed over shutdown has continued to work well serving our Linux workstations. MMT Windows user accounts on the Active Directory (AD) server (VAULT) are now synchronizing with the Linux user accounts using LDAP. This means that if a user changes their password on a Windows machine, the password will be automatically changed on the Linux machines for that same user account. There are still a couple of Windows users on campus that need to be migrated over to the Active Directory, along with most of the mountain staff's Windows desktops. Dallan Porter will migrate these Windows users onto the AD in the next couple of weeks. The samba configurations on the Linux machines have been updated to authenticate via LDAP (specifically, via AD) to help simplify file sharing between Windows, Mac OS X, and Linux. Samba previously required its own password database, which was painful to reliably keep in sync with normal Unix and Windows passwords.

We have also begun to migrate our web page authentication to use the LDAP server via SSL. Dokuwiki was the first service to migrate to the new scheme. Its installation was transferred from [mmt.org](http://mmt.org) to [hacksaw.mmt.arizona.edu](http://hacksaw.mmt.arizona.edu), and its code base was updated to the current version, 2007-06-26b.

LDAP authentication and the requirement for secure web connections (SSL/HTTPS) were set up for the <http://hacksaw.mmt.arizona.edu/ssl/> web directory. The new dokuwiki installation has been placed under this directory. Efforts will continue to move the current <http://tcs.mmt.arizona.edu/> site into this more open, yet secure, LDAP/SSL directory.

A self-signed certification was created for use with OpenSSL on *backsaw*. This certification is valid for one year.

The new dokuwiki installation was configured so that only one LDAP authentication is required for user login. A second login using dokuwiki authentication was eliminated.

### **Wind Sensor Displays and Miniservers**

The R. M. Young wind sensor, which was previously connected to a console in the control room, was recently converted to connect to the network using a Lantronix RS232-to-ethernet converter. To make use of the newly available data, Dallon Porter created a new “young1” miniserver and logging framework to make this data available online. A new webpage was created to help visualize the wind direction, speed, and sensor location for this wind sensor as well as the other two existing wind sensors (Viasala3 and 4). A miniserver was also created to record the “vaisala4” Model WXT510 weather station’s data. Unfortunately, shortly after the page went online, lightning struck both the R. M. Young and the Viasala4, taking them offline.

### **DT3155 Linux Driver**

Skip Schaller is looking into modifications to the Linux driver for the DT3155 framegrabber card. Modifications are needed to the interrupt handling and memory management so that this driver can be used efficiently on more modern machines with multiple CPUs and more than 896 MB of RAM.

### **Linux Desktop Menu Items**

Work continued on adding items to the “MMT” desktop menu on the mountain Linux machines. These desktop items will give the telescope operators and daytime engineering staff easier access to the various programs required for operating the telescope and support systems.

Submenus under the “MMT” pull-down menu include:

- Autoguiders
- Cell GUIs
- Hexapod and M2 GUIs
- Instrument GUIs
- MMTAO GUIs
- Mount GUIs
- Thermal System GUIs
- WFS GUI

Each of these submenus contains several menu items that launch the related software.

Separate menu items are also available for a 32-bit version of the Firefox web browser for the operator’s use, the WIS (a.k.a. the “Operator’s Log”), and a WIS screen capture tool. The 32-bit version web browser is required to display web pages that include Flash and/or Java plug-ins.

Individual Firefox profiles were set up for each web page that is included as a menu item. This approach allows each of these critical web pages to be run as a separate process, reducing the inter-dependency between web pages. The profiles also “remember” user preferences, such as size of the web browser window when the web page is more recently displayed. These profiles are shared between users within the “mmtop” user group and between the mountain Linux machines.

A new WIS screen capture tool has also been implemented and is incorporated into the desktop menu items.

Finally, additional menu items were created to launch a suite of GUIs with one mouse click. This includes the “vmount all” command line command for mount GUIs and a new script for all the thermal GUIs.

## **Web Application Benchmarking**

A comparison of different programming approaches to routine Ajax/HTML update operations was made on different web browsers for Linux, Mac, and Windows machines. This comparison aims to improve the often excessive CPU usage for web pages that contain highly dynamic data, i.e., data that are changing at 1 Hz or faster. An MMT programming goal is to have these web pages update at 1 Hz.

Different Ajax/HTML approaches were also compared to Flex2/Flash9 implementations of the same web pages.

Preliminary results of this comparison were presented by Tim Pickering at the ADASS conference in London in September. More detailed results may be presented at the SPIE conference on Astronomical Telescopes and Instrumentation in Marseilles, France, next summer.

## **Other Software Updates**

MySQL logging was consolidated into one Perl script, `/mmt/dataserver/mysql_updater`, which is called from a cron job on *backsaw*. Further work was also done on accessing data from the `/tcs` shared memory on *backsaw*. A PHP-based, “comet” back-end script, `comet_backend.php`, was written that delivers new data from the `/tcs` shared memory to web pages or other clients in XML, JSON, CGI, or the MMT “all” format. Server-push is used to send new data to the client as soon as they become available. The thermal transect is being updated to use this back-end and to use Flex2 to improve its CPU efficiency.

## **Instruments**

### **f/15 Instrumentation**

#### ***Natural Guide Star (NGS)***

Vidhya Vaitheeswaran (CAAO) found and fixed a bug in the PC-based Reconstructor code that was causing problems with the loop timing. As a result, we obtained 0.1 arcsecond images in H-band during an ARIES engineering night when the native V-band seeing was about 0.7 arcseconds. Don



McCarthy (SO) was very pleased, and said that the last time he saw images that were this well corrected was a few years ago with the old VME system. That time, however, was during exceptional seeing.

During the laser guide star (LGS) time later in the run, there was a problem with one of the digital signal processor (DSP) boards mounted on the secondary. A software workaround was developed, which avoided the need to remove the mirror to replace the card. This was all done during bad weather, so no time was lost. Prior to the next run, a replacement DSP card will be installed.

A heat exchanger/fan assembly was added to cool the CCD power supply and controller for the NGS topbox.

### ***Laser Guide Star (LGS)***

In early September, more testing was done with the mirror on the test stand. Previously it was discovered that the actuator calibrations were not being used for the laser reconstructor. This resulted in high currents on the mirror that would then break the loop. The desired command was derived directly from the wavefront error sensed by the LGS wavefront sensor and then applied to the mirror. Differences in the calibration of individual actuators, however, resulted in a high spatial frequency error appearing on the mirror, and also caused high currents. A correction factor was derived by applying a shape to the mirror and measuring the resultant current pattern. Any actuator that was miscalibrated would show a high current and so was adjusted. After a few iterations the high currents were eliminated. This is just an interim solution, however, since it does not ensure that the target wavefront is reached, only that the currents are minimized. Full calibrations are planned that will also take into account the resultant wavefront produced by the mirror.

Later on the telescope, the loop was once again not closed using the lasers. Out of four nights, we were able to open only about five hours during just one night, which was spread out over three different times. In addition, the displacement sensor target that is epoxied to the resonator came off, so the resonator was unusable.

A protective cover, to be in place while the secondary is on the test stand, was designed and fabricated. Previously the secondary optics and test stand optics were susceptible to falling objects, such as wrenches or screws, while on the test stand.

### **f/9 Instrumentation**

No unusual activity to report.

### **f/5 Instrumentation**

The connectivity of the SAO computer cluster — *lewis*, *clark*, and *hudson* along with the instrument systems hardware topper, Megacam, Chelle and Spec — was improved in September by John Roll, Tom Gerl, Cory Knop and Marc Lacasse. Ethernet switches and fiber optic switch boxes were relocated to the yoke room. Fibers were run from the yoke cluster to the loading dock to enable testing of Megacam and SWIRC at that location. The SAO and crate rack was also relocated to the chamber for flooring work, and all of the connections for Hecto and Megacam needed to be unplugged and then plugged back together after the floor under the rack was completed. Thanks to

careful work by many, everything worked. The lithium battery failed on a memory card in the “hardware” computer in the west lab racks, which is used to control the fiber positioner, and a replacement was installed by Tom Gerl.

Coincidentally, after the above reconfiguring, a network problem surfaced in which multiple computers responded to the same IP addresses. With a great deal of effort it was determined that the problem originated on a Ridge ES3810 switch associated with the Fairborn Observatory. The problem has been resolved.

The Megacam run in early October operated at diminished capacity because of the failure of the WFS unit. The six-day run was further hindered by an unplanned nighttime power outage one day before a planned morning power outage.

Things settled down after this, and the Hectochelle, Hectospec, and SWIRC runs went well. New fiber optic interface cards had been added to the Hecto cameras and they operated well once the connections were sorted out. The fiber positioner robots had a number of minor follower issues that were temporarily dealt with by relaxing tolerances in software.

Bill Stangret finished the MAESTRO’s counterweight cart, “Denny.” He removed the extra steel, with the assistance of J. T. Williams, and then repainted it. It is now ready for next month’s run.

## **Safety and Documentation**

The Safety Computer Based Training program is progressing steadily. Steward Observatory purchased a new server, and Dallon Porter and Paul Hart (Steward) are now configuring the operating system, finishing the compression of the videos, and developing tracking software. This system should be ready for implementation by the new year.

Cory Knop developed a safety process plan for MMTO. This documentation, which is currently under consideration by the MMT Director, encompasses the following:

- How to provide safety training
- Disciplinary procedures for people who violate safety requirements
- Safety rules
- Safety values
- Safety responsibilities for managers, supervisors, and all associated employees
- Identification of plan administrators
- Management policy statement
- Emergency action plan

Cory established individual training records (“MMT Health and Safety Record”) to track one-time and recurring safety training requirements (e.g., one-time training: orientation training, computer based training; and recurring training: fork lift, lockout/tagout). This awaits implementation.

Due to budget constraints, SiteScape licensed seats have been cut back to two: mmtstaff and Cory Knop. This does not, however, cut down on the emphasis that we place on SiteScape

documentation. We still post all documentation there; this system provides us with a central repository for all information associated with the telescope. The only change is that the user must log-in with the mmtstaff login and password. Changes made to documentation should include the date of the change and the name of the person who made the change in the remarks section.

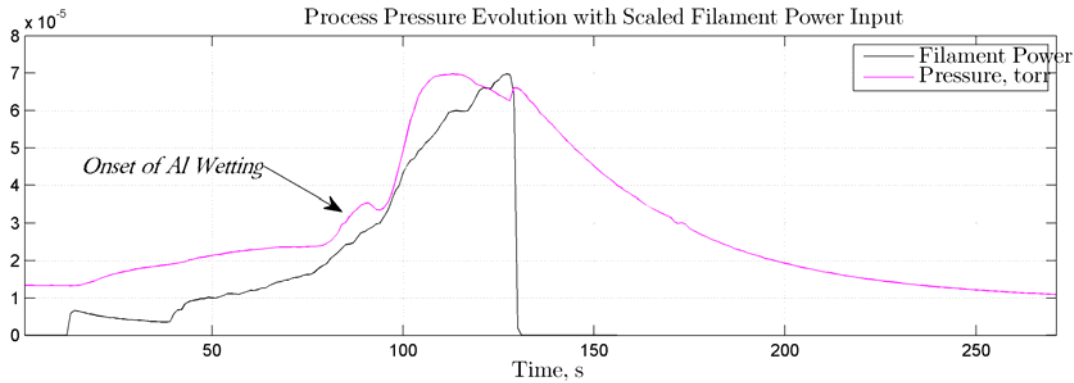
We received the digital copies of all the drawings that were sent to the Smithsonian Institution for digital photocopy. Creighton Chang is in the process of putting these 175 drawings in SiteScape under the proper headings. All the old paper copies of the documentation are being stored by Smithsonian, and are available upon request.

## **LOTIS Aluminizing Project**

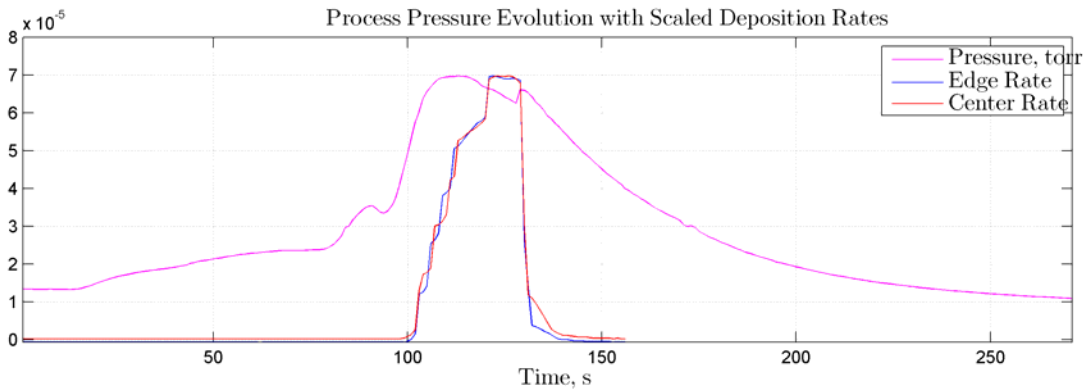
We coated a second set of LOTIS test slides during the reporting period, with excellent results. We had corrected the shorted filament bus discovered during the last coating, and were able to run all 10 welder circuits during the coating. Dondi Gerber assisted in the preparation of the filaments for this coating as well.

Thin-film thickness monitors (STM-100/MF from Sycon) were used in two locations. One in the center of the mock 6.5-m mirror recorded a total aluminum deposition of 1.009 kAngstrom; the other at mirror edge recorded a total of 0.972 kAngstrom. LOTIS and OSC measured the film thickness of adjacent slides using OSC's Wyco NT9800 Optical Profiling System (center 1.100KA and edge 1.050KA), confirming a calibration factor of 8% for our sensors.

For the first time, we ran a fully integrated data-acquisition and display GUI developed by Duane Gibson. The GUI displays real-time aluminization data as well as the webcam video feed from the rear of the coating chamber. This allows the coating operator to, at a glance, take in all the relevant information about the coating operation (i.e., pressures, deposition rates, the filament color temperature, etc.). National Instruments LabVIEW software was used to interface with an Agilent 34970A Data Acquisition Unit (DAU) and a Measurement Computing PCI-DAS 6023 analog and digital I/O board. The Agilent DAU samples belljar pressure and aluminum deposition rates. The PCI-DAS board measures outputs from the ten welders used to supply high current for the aluminization process. These time synchronized data captured (for our first time) the aluminum loads "wetting" the hot tungsten filaments, the timing of a familiar hydrogen surge, and the combined effects of real-time aluminum "gettering."



**Figure 2: Vacuum chamber hydrogen surge vs. time, as approximately 70 kilowatts of power is applied to 200 source filaments.**



**Figure 3: Bell jar pressure vs. time, with aluminum deposition rates up to 70 Angstroms/second.**

Logging of all aluminization data was implemented. The aluminization system data are concurrently logged and archived into the MMT0 MySQL database for easy analysis and historical base-lining over the network. A web page interface to the MySQL database was created. The web page updates at 1 Hz, and displays the most recent data appended to the MySQL database. Images from the video feed are also logged at a 1-second interval.

MMT0's residual gas analyzer (RGA) was operated throughout the coating process; video data are available at [http://www.mmt0.org/engineering/aluminization\\_images/videos/alum.html](http://www.mmt0.org/engineering/aluminization_images/videos/alum.html). Using the MMT network camera and adding time delays in the still images from the RGA, we can understand, in much more detail, the chemical reactions happening during aluminum deposition. Notice the breakup of residual water into hydrogen, leaving oxygen to react with aluminum, forming sapphire ( $\text{Al}_2\text{O}_3$ ). This confirms the importance of the cryo pumping to remove water vapor from the chamber before aluminum deposition; creating sapphire reduces the total amount of aluminum available to coat the mirror (the 48-inch cryo pumps were not used for this test coating).

As part of the preparations for the LOTIS 6.5-m mirror aluminizing, the two 48-inch cryo pumps were tested at the FLWO basecamp. Each pump's charcoal panels were regenerated using ultra dry nitrogen, and cryo tested to liquid helium temperature. For the first time, we performed these tests while the pumps were mounted on the 60-inch diameter vacuum gate valves. The test was successful for both pumps.

## **General Facility**

### **Chamber Floor Replacement**

The new chamber floor is nearing completion. One pallet of cut steel arrived the week of October 22, and at the end of October all but seven panels were in place. Bill Stangret operated the fork lift for the floor installation contractors as needed. Warning signs were posted noting the slippery floors.

### **Roof Repairs**

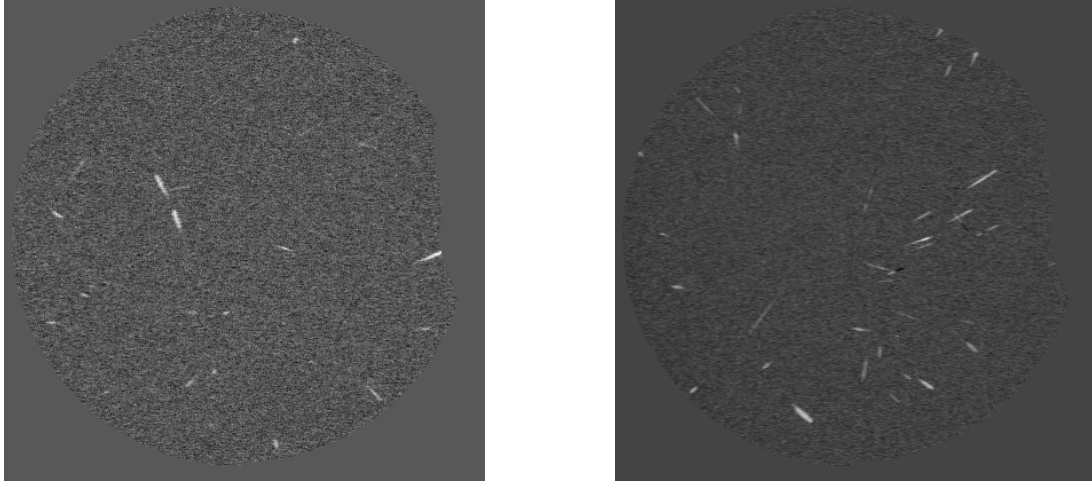
The new elastomeric roof contract has been awarded to TBR Construction and Engineering. On October 15, TBR and subcontractor Rain-Tite met on the summit with MMT and Whipple staff to discuss a myriad of topics including preparation work, safety requirements, new heat tape requirements, seals specifications, submittals, and schedule. TBR submitted the specifications on the seals and heat tapes toward the end of October.

### **Instrument Repair Facility**

In mid October, the soil conditions of the new repair facility site were tested by Terracon Consulting Engineers. The results from this study will be used by M3 Engineering to complete the 35% design of the building. The 35% study will include a detailed conceptual design of the building and the required modifications to the MMT enclosure. The enclosure will allow access for the new large instruments. This study is due November 30.

### **Transient Search with the All-Sky Camera**

From October 20 through October 24, 2007, we experienced a spectacular Orionid meteor shower. For the nights of October 20-21, the moon set early and there were few clouds, making perfect conditions for detecting meteors in the All-Sky Camera data with the transient search program. On October 20 from 00:12:04 until 05:14:38 MST, 51 meteors were detected; on October 21 from 01:21:50 to 05:26:33 MST, 85 meteors were detected (see Figure 4 below.)



**Figure 4: Both images are composites of masked difference images. The image on the left (October 20) contains the 29 brightest meteors. The image on the right (October 21) contains the 38 brightest meteors and two aircraft.**

### **Weather and Environmental Monitoring**

The R. M. Young anemometer and the WXT-510 weather station (vaisala4) were installed on the west weather pole at the summit. Both units, mounted side by side, displayed similar indications of wind speed and direction. Within a week they both took a direct lightning strike; we found some of the pieces. Damaged components in the power module at the base of the pole were replaced, and lightning protection devices were added. The WXT-510 was removed and sent back to Vaisala for repair. It was found to be defective and was repaired under warranty. It has since been returned and awaits installation. A lightning air terminal will be installed above the weather stations. Once the rod is replaced, the rest of the equipment will be reinstalled.

The Yankee MET-2010 thermohygrometer had been reinstalled outside the elevator shack. After the aforementioned lightning strike, that location was deemed high risk; it was removed within one day and was subsequently installed inside the chamber on the west wall above the primary mirror. Web pages were updated to reflect this new location. Once roof repairs are done and air terminals installed, this system may be reinstalled outside. Until then, it will remain in its current location.

The “roof” TempTrax digital thermometer probe, which records metal temperatures on the roof and is also used to compute a relative humidity, has been removed to allow the installation of the new roof membrane.

### **Other Facility Improvements and Repairs**

The Smithsonian Office of Facilities Engineering and Operations (OFEO) and MMTO staff reviewed the 75% design study for painting the outside of the enclosure.

Sierrita Mining & Ranching (SMR) began guard rail repairs along the Mt. Hopkins road.

Bill Stangret and Creighton Chute changed out the hardware on the beam on which the M2 hoist trolley is mounted. When the beam was installed several years ago, there were concerns about the strength of the hardware used. Using a rented articulating boom lift, they swapped out the hardware, bolts, washers, and nuts with hardened hardware. This change-out alleviates safety concerns about the hardware breaking.

The secondary hoist hook-up switch is now installed and interlocked with the elevation safety chain.

Bill Stangret and Dennis Smith serviced the front shutter doors and greased all the zerks. They used the articulated boom lift, which is the only way to safely reach the top zerks. One wheel follower on the lower section may need to be swapped out once it has been decided how best to reach it.

The lanyard that supports the cables on the east front shutter failed when one of the heavy springs at the top broke. Tom Gerl, J. T. Williams, and Ken Van Horn worked to get it repaired with a spare spring, which was in stock within less than two hours. J. T. has a concept for a new system that will use a counterweight instead of springs.

The newly wire-wrapped AD2S80 test tool card was finished in early October, but had some errors. (The purpose of the test tool is for function verification of the AD2S80 converter when and/or if a lightning storm should hit the MMT.) With much assistance from Brian Comisso, the card was inspected and mistakes were repaired. Troubleshooting continued, and the card is now finally complete.

On October 22, J. T. Williams and Ricardo Ortiz inspected the glycol system after discovering the flow to the pit box heat exchanger was only 8 GPM. They noticed the Freon refrigeration units for the control room were bypassing a significant amount of glycol. Adjusting the valves doubled the flow. This should return the primary mirror thermal control system back to normal efficiency.

Tom Gerl continued AC power repairs as needed, including repairing loose connections, replacing light bulbs, and reprogramming phones.

There was another troubling incident with the elevation stow pin. The cause is currently unknown.

One of the building drive motor fan assemblies was not working. It turned out that the screen between the fan and the motor was plugged with dirt. Cleaning out the dirt restored normal operation.

One of the fan motors on the Carrier chiller was making noise as though it had bad bearings. Carrier was called and they replaced the motor. It took five hours to get the fan off the motor shaft. The next time this happens we should also purchase a new fan.

Pressure sensing switches have been installed at each of the elevation brake units. These are not interlocked in hardware to the elevation system, but they are readable through software.

The hardware of the transverse counterweight system is fully installed and awaits troubleshooting of the east motor.

At least five of the smaller UPS's required either replacement or new battery installation.

To help utilize the small area in the RUPS room, Bill Stangret and John Di Miceli are building a stand on which to stack Gardner-Denver compressors.

John Di Miceli and Bill Stangret removed and shortened snow plows on the shutter doors for the new roof.

Bill Stangret fabricated two wall hangers to support handrails for the loading dock, and coated the wood floor of the van/truck with linseed oil to seal the floor.

## **Visitors**

October 22: Elizabeth Alvarez (SO), Grant Williams, and Dan Brocious (FLWO) escorted Frank Woelfle and Mike Knowles of the U. S. Customs and Border Protection on a tour of Mt. Hopkins and the MMT. The agents were visiting from the Washington D. C. area to inspect SBInet (Secure Border Initiative) installations in Southern Arizona. The group discussed potential impact of SBI on FLWO and other Southern Arizona Observatories.

October 25: To recognize their contributions to the MMT and Whipple observatories, FLWO volunteers were given a tour of the Mt. Hopkins facilities, accompanied by Dan Brocious and several guides. A catered dinner was then provided at the Ridge, where they were joined by Karen Myres and Dan West of FLWO.

## **Publications**

### **MMTO Internal Technical Memoranda**

None

### **MMTO Technical Memoranda**

None

### **MMTO Technical Reports**

None

### **Scientific Publications**

07-21 A Survey of Local Group Galaxies Currently Forming Stars. III. A Search for Luminous Blue Variables and Other H-alpha Emission-Lined Stars  
P. Massey, R. T. McNeill, K. A. G. Olsen, P. W. Hodge, C. Blaha, G. H. Jacoby, R. C. Smith, S. B. Strong  
*AJ*, in press



- 07-22 Hypervelocity Stars. II. The Bound Population  
W. R. Brown, M. J. Geller, S. J. Kenyon, M. J. Kurtz  
*ApJ*, **660**, 311
- 07-23 First On-Sky High-Contrast Imaging with an Apodizing Phase Plate  
M. A. Kenworthy, J. L. Codona, P. M. Hinz, J. R. P. Angel, A. Heinze, S. Sivanandam  
*ApJ*, **660**, 762
- 07-24 The Essence Supernova Survey: Survey Optimization, Observations, and Supernova  
Photometry  
G. Miknaitis et al.  
*ApJ*, **666**, 674
- 07-25 Observational Constraints on the Nature of Dark Energy: First Cosmological Results from  
the Essence Supernova Survey  
W. M. Wood-Vasey et al.  
*ApJ*, **666**, 694
- 07-26 Multiple Scattered Sight Lines to the Red QSO 2MASX J10494334+5837501  
G. D. Schmidt, P. S. Smith, D. C. Hines, C. A. Tremonti, F. J. Low  
*ApJ*, **666**, 784
- 07-27 Velocity Dispersion Profiles of Seven Dwarf Spheroidal Galaxies  
M. G. Walker, M. Mateo, E. W. Olszewski, O. Y. Gnedin, X. Wang, B. Sen, M. Woodroffe  
*ApJ Letters*, **667**, L53
- 07-28 Detectability of Occultations of Stars by Objects in the Kuiper Belt and Oort Cloud  
T. C. Nihei, M. J. Lehner, F. B. Bianco, S.-K. King, J. M. Giammarco, C. Alcock  
*AJ*, **134**, 1596

### 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 [bruss@mmt.org](mailto:bruss@mmt.org) or to the following address:

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

## **MMTO in the Media**

No activity to report.

## **MMTO Home Page**

The MMTO maintains a web site (<http://www.mmtto.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 to the back of this report are taken from that database.

NOTE: Beginning January 2005, the formula for accounting lost time on the telescope has been changed. Previously, time lost to weather was deducted from the total observing time before calculating time lost to instrument, telescope, and facility from the remaining balance. From now on, the time lost to each source is computed as a fraction of the total scheduled time.

And beginning June 2005, a new category, environment, was added to account for time lost to natural, uncontrollable, non-weather events such as flying insects melting in laser beams and forest fires.

## Use of MMT Scientific Observing Time

### September 2007

<u>Instrument</u>	<u>Nights Scheduled</u>	<u>Hours Scheduled</u>	<u>Lost to Weather</u>	<u>Lost to Instrument</u>	<u>* Lost to Telescope</u>	<u>Lost to Gen'l Facility</u>	<u>Lost to Environment</u>	<u>Total Lost</u>
MMT SG	12.00	117.40	55.90	0.00	0.50	0.00	0.00	56.40
PI Instr	8.50	87.00	55.00	4.00	0.00	0.00	0.00	59.00
Engr	4.50	44.80	34.80	0.00	0.00	0.00	0.00	34.80
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total</b>	<b>25.00</b>	<b>249.20</b>	<b>145.70</b>	<b>4.00</b>	<b>0.50</b>	<b>0.00</b>	<b>0.00</b>	<b>150.20</b>

#### Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	82.0
Percentage of time scheduled for engineering	18.0
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	58.5
Percentage of time lost to instrument	1.6
Percentage of time lost to telescope	0.2
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	60.3

#### \* Breakdown of hours lost to telescope guider 0.5

### October 2007

<u>Instrument</u>	<u>Nights Scheduled</u>	<u>Hours Scheduled</u>	<u>Lost to Weather</u>	<u>Lost to Instrument</u>	<u>* Lost to Telescope</u>	<u>** Lost to Gen'l Facility</u>	<u>Lost to Environment</u>	<u>Total Lost</u>
MMT SG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PI Instr	31.00	336.40	89.65	7.35	2.25	14.25	0.00	113.50
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
<b>Total</b>	<b>31.00</b>	<b>336.40</b>	<b>89.65</b>	<b>7.35</b>	<b>2.25</b>	<b>14.25</b>	<b>0.00</b>	<b>113.50</b>

#### Time Summary Exclusive of Summer Shutdown

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	26.6
Percentage of time lost to instrument	2.2
Percentage of time lost to telescope	0.7
Percentage of time lost to general facility	4.2
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	33.7

#### \* Breakdown of hours lost to telescope az drives 0.5 wfs 1.75

#### \*\* Breakdown of hours lost to facility

mountain blackout 7  
network outage 3  
network, power failure 2.25  
shutters 2

### Year to Date October 2007

<u>Instrument</u>	<u>Nights Scheduled</u>	<u>Hours Scheduled</u>	<u>Lost to Weather</u>	<u>Lost to Instrument</u>	<u>Lost to Telescope</u>	<u>Lost to Gen'l Facility</u>	<u>Lost to Environment</u>	<u>Total Lost</u>
MMT SG	57.00	547.00	218.80	0.00	4.85	0.00	2.50	226.15
PI Instr	194.50	1885.65	644.45	34.25	10.30	16.25	2.00	707.25
Engr	15.50	153.55	76.65	0.00	0.00	0.00	0.00	76.65
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total</b>	<b>267.00</b>	<b>2586.20</b>	<b>939.90</b>	<b>34.25</b>	<b>15.15</b>	<b>16.25</b>	<b>4.50</b>	<b>1010.05</b>

#### Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	94.1
Percentage of time scheduled for engineering	5.9
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	36.3
Percentage of time lost to instrument	1.3
Percentage of time lost to telescope	0.6
Percentage of time lost to general facility	0.6
Percentage of time lost to environment (non-weather)	0.2
Percentage of time lost	39.1