MMT Observatory
Smithsonian Institution &
The University of Arizona®

End of Quarter Summary

January – March 2013

Personnel

Interviews were held for an Electronic Technician, Sr. position.

Talks and Conferences

J. Hinz attended the American Astronomical Society (AAS) meeting held January 7-10 in Long Beach, CA and gave a talk in a Special Session entitled "MultiGALFIT: Automated Decomposition of Galaxy Images for S4G."

J. Hinz gave the presentation "A Study in Scarlet: Exploring Nearby Galaxies with the Spitzer Space Telescope" as part of the Smithsonian's New Vistas in Astronomy Lecture Series in Green Valley, AZ on January 29.

J. Hinz gave a talk on March 5 to the Whipple Observatory volunteer tour guides at the Visitors Center, updating them on operations at the MMTO. She also provided two new binders of MMT images to the tour guides for use on the public tours, which resumed on March 15.

Primary Mirror

Actuators

Following the late December water contamination of the dry air system, a sample actuator that was deemed "not properly functioning" was brought to the campus electronic shop for inspection. During careful inspection, the actuator was found to have water in both the push and pull transducers. A few more misbehaving actuators from the primary mirror cell (one single and one dual) were brought to campus from the mountain. In all cases, water was either present in the transducers, or evidence of water damage was seen inside the transducers. All of the transducers were cleaned, refurbished, and recalibrated. Many were returned to service, although some remained problematic and were not returned to service.

Extra transducers stored at the mountain facility and at the campus shop were inspected and recalibrated. Several spare transducers were put together to build swap sets of both single and dual actuators.

Two documents were produced with instructions for transducer removal/overhaul, and for transducer calibration. These documents were placed in the document database.

To make it easier to repair actuators on the mountain, the spare brackets, piping, and new hoses were used to build complete single and dual actuator transducer assemblies. When an actuator is deemed "bad," we can quickly replace the assembly, test and recalibrate it, and send it back for use on the mountain.

In January, the orange primary mirror support air loop pressure transducer failed, and the primary mirror could not be raised. A spare transducer was located, but it wasn't electrically compatible with the cell electronics. An offset and scale-adjustment box was constructed to make it work properly. We are trying to identify other transducers that can be acquired to standardize the various air pressure sensors so that only one kind needs be stocked, along with a small printed circuit board to allow them to be used in various systems. It is unknown if this failure is related to the water contamination in the cell.

Due to evidence of long-term water damage and water still being trapped in the cell hardware, we will remove and service all of the actuators during summer shutdown to ensure they are dry, working properly, and properly calibrated.

A stray force issue persisted with the primary mirror actuator test stand. To solve this problem, the mechanics of the system were checked. All hardware was torqued and visually inspected for abnormalities. The actuator mounting surface was set plumb to gravity in both the x and y axes. The test stand work plate, where the actuator shaft is attached, was identified as not parallel to the actuator mounting surface. Precision shims were used to correct this. It was also determined that the bore axis of the test stand plate was not co-aligned with the center line of the actuator. This disagreement was more than 0.125", and realignment required the removal of the original locating pins. It was then adjusted to within a profile of 0.006". This alignment yielded a tenfold improvement in stray moments.

Test stand improvements continued with a check of the ability of the test stand load cell outputs against a known force. Using a precision machined test tool and known weights, force was applied to the work plate and its resultant forces were recorded. The test stand load cells measured the known weights with an average disagreement of -1.03 +/- 0.40 lb of force. This test was improved by adding dry lubricant to contacting parts, and a controlled vibration was used to break any residual friction between parts. This improved the test stand results with an average disagreement of -0.43 +/- 0.27 lb of force. Moment tests in both Mx and My were completed using the same procedure and yielded similar results. With the new and stringent checks, the test stand can correctly identify an actuator with a bent flexure.

Several other mechanical and software changes were made to bring the test stand into an operational state with single-axis actuators. We await construction of metrology and test hardware to repeat the process with the dual-axis actuator mounting equipment.

The test stand has been relocated to the Instrument Repair Facility (IRF) at the summit. It will be used in the next few months to rebuild and recalibrate the primary mirror actuators.

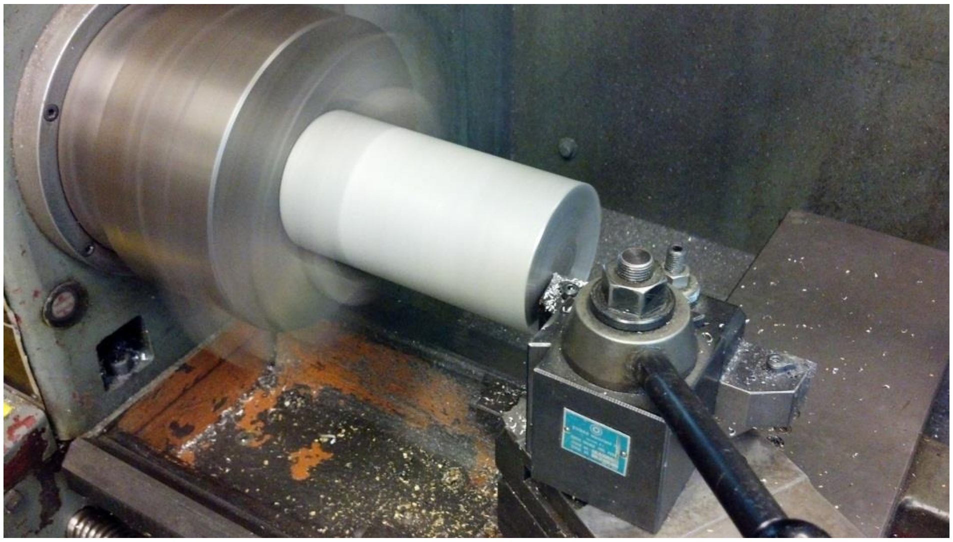

Figure 1. Rough cutting aluminum stock to be used for the test tool.

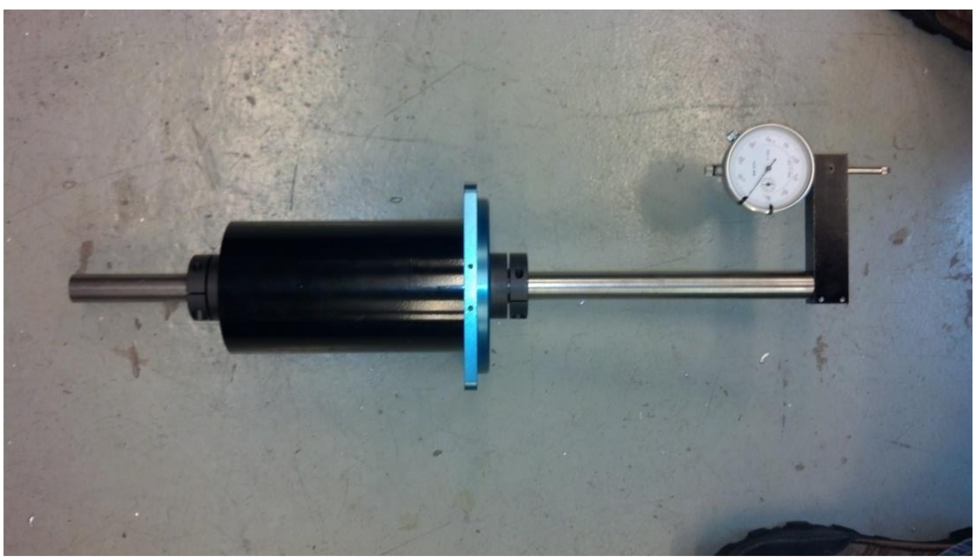

Figure 2. Completed test tool.

Figure 3. Actuator test stand setup in the Instrument Repair Facility.

Mirror Cover

The mirror cover crank was replaced with a new, safer unit. The whole system has also been stiffened to improve operation.

Figure 4. New mirror cover crank.

Aluminization

A new chassis to replace the Hewlett-Packard (HP) Data Acquisition Unit (DAU) used to collect data from the mirror coating hardware was completed, and all internal cards were tested. These data include vacuum pressures within the bell jar and aluminum deposition rates on the M1 surface. The new chassis provides 16 channels of galvanically-isolated analog inputs to the new aluminization computer, which now has a total of 3 PCI data acquisition (DAQ) cards in it. Time-correlated data of all the coating process parameters can now be sampled at rates greater than 10 Hz with a target sampling rate of 100 Hz. Additional design changes were required to the signal-isolation cards to bring them into compliance with our part-stocking and board-construction methods. The next version of boards is expected to be available in May.

To allow automated control of the coating supply (i.e., "welder") setpoint, an additional digital-to-analog (D/A) converter was prototyped to the existing PCI DAQ card digital I/O signal lines, using a 16-bit serial D/A conversion board. This setup requires only three of the eight digital lines that are available. Future plans include using a fourth line for the welder-enable signal, leaving four lines as spares for other purposes. This approach was significantly cheaper than buying yet another PCI card to sample the analog outputs.

D. Porter successfully added the software to write welder setpoints to this new output, so we anticipate adding this as a printed circuit to the aluminizing isolation chassis. With the new data acquisition hardware and the ability to control the welder system in place, it will be possible to completely automate the mirror coating process.

To gain better understanding of the deposition process physics and the welder control system, extensive modeling in Simulink was performed by D. Clark, using data collected at the Sunnyside vacuum facility, to construct a working 2-filament/single welder source model. The electrical parameters from the model were then used to design the welder control algorithm using Simulink continuous-time blocks, along with temporal and logic control using Stateflow elements within the model. The controller uses the continuously-collected welder output voltage and current to close a control loop that maintains a power setpoint (since the filament temperature is directly related to the electrical input power). The Stateflow logic transitions from a power command to a deposition rate command, by automatic selection of a control law closed on the deposition rate sensor once a given power level is reached and deposition rate is detected. The controller then maintains a given deposition rate until a target thickness has been achieved and cuts off the welder supply.

Both the electronic and software groups are working on how best to implement this new automatic deposition control algorithm. We plan to test it at the Sunnyside facility with the existing 2-filament test jig, and expand it to another welder and a full load of 20 filaments, once we are satisfied that the algorithm works.

A preliminary state diagram for a preferred heating profile has been developed. This state diagram has separate states for heating (aluminum in solid state), melting (aluminum in liquid state), and evaporation (aluminum in vapor state). D. Clark is revising the state diagram to more closely match results from testing at Sunnyside. This revised state diagram will be coded and used to control the welder setpoint for further refinement of the heating profile.

Secondary Mirror Systems

f/9 Secondary Support

Oscillations in the f/9 mirror support system were reported by the operator and submitted as a service request (SR #1006). A team determined the next morning that the mirror continued to oscillate. Knowing that a contamination of the clean air system had recently occurred, the air outputs from all four transducers were disconnected and warm air was applied with an inline purge gas heater.

Approximately a half hour later, the team noticed that the hissing sound from air escaping the air transducers seemed louder. The air inputs were reconnected after a full hour of application of warmed (but not hot) air through the system. The f/9 mirror support appeared to be operational again. Although the SE axial servo seemed to be hunting at low elevations, similar to the behavior observed in the f/5 mirror support last year, all the forces appeared comparable to those seen during normal operations. With the air lines reconnected, the purge gas heater was relocated to the yoke room at the f/9 supply regulator output to keep the supply air warm overnight for operations.

Additional testing the following day confirmed there was still a problem with the mirror support system. A crew removed the f/9 secondary mirror, and the white shroud and top hat were removed from the mirror cell. Four spare Bellofram air transducers were modified and calibrated to f/9 mirror cell requirements (10V input to 14 PSI output with 1K resistors installed on the red wires). The air transducers were replaced with the new air transducers. The system was tested with dry nitrogen at 40psi. The mirror cell graphical user interface (GUI) displayed nominal values. The mirror cell was reassembled and reinstalled on the telescope. The system was operational all night and the SR was closed. We sent the failed transducers to Bellofram for evaluation by their technicians, who determined they were internally contaminated, and therefore would not proceed with testing. The transducers were returned to MMTO for further investigation by staff.

f/9-f/15 Hexapod

The f/9 hexapod had a position transducer fail on the night of February 5 (Service Request #1011). The initial failure was identified by an annunciator warning that there was a large discrepancy between the Pod E encoder and Pod E transducer lengths. This error caused alignment difficulties throughout the night. After a good position was found, a decision was made to keep the system powered until the end of the run. This allowed the system to maintain valid encoder positions, since the length transducers are used only at startup to determine the absolute pod lengths.

The following day, troubleshooting was performed by the electronic engineering team. Since the system remained up and running, the encoders had valid positions. The transducers are also on a different connector and cable than the encoders. Troubleshooting started by inspecting the connections on the UMAC unit (a modular rack format system) mounted to the Optical Support Structure (OSS). Connections inside and on the exterior of the box were inspected. All connections looked good. A visual of the connections at the hexapod as well as pod E were good as well. All cables were wiggled with no change in the erroneous transducer data. The cable from the UMAC MACRO to the hexapod was swapped with no change. All cables and connections were returned to their normal places. A few minutes later, the UMAC rebooted by itself and reacquired a bad position from the pod E transducer. It was unclear why or how it rebooted. We swapped the inputs into the

ACC-28E A/D card in the UMAC MACRO and determined the problem was at the transducer end, not the UMAC end. We measured the actuator position and found it had not moved during the reboot. A new signal conditioner box was connected, and it displayed valid positions. The new transducer signal conditioner box was piggy-backed onto the defective one and realigned to the known encoder position. The system was recalibrated with some platform positions changed.

Changes in platform positions were:

x from 500.93 to 532.97
y from 210.54 to 298.93
z from 1136.78 to 1181.47
Theta x from 296.93 to 302.74
Theta y from 83.04 to 64.30
Theta z from -20.67 to -73.12

Operations continued the next night with only minor adjustments needed to accommodate the new signal conditioner position data. The new unit was installed, and all pods realigned when the secondary was removed. Self-adhesive measuring tapes approximately 20 mm in length were installed parallel to the transducer shaft to allow visual confirmation of the transducer length in relation to the "zero" position.

The serious issue of the UMAC restarting without command remains. The fiber connection was tested and found to have a 4 dB drop over the length of the cable. This drop is 60 percent of the signal strength and is believed to be a possible failure mode for the system. Further troubleshooting is ongoing.

With the second failure of the f/9 transducer signal conditioner, a complete redesign of the signal conditioner using a digital potentiometer was done. The initial board layout was also completed. Replacement of the existing potentiometer adjustments with their digital equivalents will eliminate the time and temperature drift experienced with the existing signal conditioning circuit. However, since this repackaging effort will require major time to accomplish, it is considered lower priority for now due to aluminization preparations.

Service Report #1004 was started to document electronic noise on the f/9 transducer signal that was causing up to 30 micron variations in transducer length values. Troubleshooting is ongoing. A test plug was manufactured for shorting transducer high and low inputs to each to determine offset values of the system. The plug was connected to the UMAC input connector as well as the connector at the hub. Electronic noise was significantly reduced when connected. The DIN rail-mounted power supply, a switcher type, was disconnected and the system powered with a linear bench power supply. No difference in noise levels was seen. The system was reconnected to the DIN rail power supply. We will continue to work to determine if UMAC noise can be reduced or eliminated.

f/15 Secondary Support

We are working on finalization of the packaging and layout of the boards, cables, and power supplies inside the next-generation deformable mirror (DM) power supply.

Two new spare digital signal processor (DSP) boards were received from Microgate. The boards were modified at Microgate to allow for TSS operation.

Software changes were made to the IDL-graphical user interface (GUI), *xadsec*, which allowed the adaptive optics (AO) operator to close the loop more quickly. The changes were tested on-sky and are now considered part of the baseline software version.

The application of static offsets to the DM through AO-GUI was tested. This could be potentially useful for calibrating the mirror on-sky and removing static errors from the point spread function (PSF). In addition, this could be useful for applying various levels of correction in AO seeing limited modes.

There was significant correlated noise in the wavefront sensor (WFS) camera while locking on to faint targets that was not present before. The noise floor varied, but was on the order of 150-300 counts. The problem was determined to be with the BNC cables running from the camera electronics to the preamplifier board. T. Gerl made a new set of BNC cables with improved insulation and routed them along a shorter run and away from motors, to the camera controller. The preamplifier was also removed and inspected. There continues to be intermittent camera crashes. It is undetermined at this time if they are related to the cabling or the preamplifier.

Two AO runs were scheduled for this reporting period. The first run consisted of one Maintenance & Engineering (M&E) night on January 1. The second run was a total of five nights including one M&E night.

The M&E night on January 1 was lost due to continuing issues with the primary mirror support system – issues that are due to the water contamination that occurred in the primary mirror cell at the end of December 2012.

An AO science run was scheduled for March 21-24. Much of the first night was lost to clouds and high winds. Toward the end of the night, the weather conditions improved enough for the telescope to open. The AO system performed without issues. Both the second and third science nights had significant problems due to the camera syncing issue seen on previous runs. Approximately two hours were lost each night. System performance otherwise was good and the DM worked well. On the final night of the run, the AO system performed quite well until approximately 1:00 a.m. when the power supply died. Several hours were spent diagnosing the problem, but we were unable to restart the unit.

The VCCL supply would turn on, and the other supplies could not be enabled. We thought the issue was possibly with thin shell safety (TSS) taking over and shutting down the system due to the voltages being out of bounds. We removed the unit from the rack and attempted to adjust the VCCA supply level. Extensive troubleshooting revealed a broken trace on a board that passed the power-good signal from the VCCL supply to the smart card. The power-good level is the first thing the smart card checks on the VCCL before enabling the other supplies. The logic interface card had a cracked trace and broken eyelet on the board that prevented the logic on it from being powered with the 5V VCC supply from the smart card. The smart card properly prevented the supplies from being enabled, as it should when the power-good condition is indicating failure. The board was subsequently replaced, and the power supply was tested to ensure the problem was fixed.

Telescope Tracking and Pointing

Telescope Drives

During operations on March 7, the telescope drives shut off due to runaway conditions. The operator called the senior electronics engineer and, after several hours of troubleshooting, it was determined that one of the elevation motors had no current. The telescope was stowed and shut down for the night.

The next day, efforts to repair the elevation drive identified a blown fuse. The fuse was replaced. When power was subsequently applied, the new fuse blew immediately and a large spark was visible from the west motor slave amplifier. It was determined that the slave amplifier was inoperative, and it was replaced with a spare. The system was tested and returned to operation.

The following day, Copley Controls was contacted to coordinate repair of the defective slave unit. To our dismay, they stated that they no longer repaired the units, having sent out an end-of-life statement several years earlier. An internet search revealed a company in Texas, Power Clinic Inc., that repairs the units, so the failed slave amplifier was sent to them for evaluation and repair.

Given that replacement amplifiers and repairs are no longer easily available for the original elevation and rotator-axis amplifiers, the electronics group is researching what equivalent replacements are available on the market. In the interim, we still have some available spares.

Safety Interlocks

The E-stop button that formerly was a "portable" mushroom switch stored on the 2East wall was relocated to the east drive arc. This adds a convenient E-stop location where people commonly work, and prevents inadvertent actuation of the mushroom switch when equipment is moved in and out of the 2East garage.

Computers and Software

Computer/Software/Network Administration

Following is a listing of individual tasks accomplished for computer and network administration:

- A new Dell all-in-one computer with 2560x1440 resolution, "chisel," was purchased to replace "yggdrasil" as the main telescope operator computer. MMT-specific software has been installed on this computer. Initial testing indicates that the computer is in final testing prior to the retiring of "yggdrasil."
- An external Dell monitor, also with 2560x1440 resolution, was purchased and attached to "chisel." "Chisel" has only one HDMI output as the only video output. This constraint required definition of a new X-display HDMI configuration option to allow the external monitor to have the high 2560x1440 display resolution.
- The current observing computer, "alewife," used for the f/9 spectrographs, MAESTRO, and ARIES, is in the process of being replaced with a new iMac computer, "pixel." This new observing machine has been configured for observer use and will be tested onsite and remotely

during M&E activities in May. This new system should allow observers to work at top efficiency while observing.

- With the growing popularity of remote observing with Red and Blue Channel, we have added an iMac, "friction," to the Steward Observatory remote observing room, Room 367A, for local remote observers. While a remote observer can connect from any location that has a stable internet connection with a computer that has access to ssh and vnc, this room provides an alternative for observers who may be uncomfortable with their home internet speed or reliability, or who wish to observe as a group without traveling to the summit. The computer is equipped with a camera, microphone, and Skype for real time video communications with the operator.
- Extensive research was done in preparation for the Fedora 17 to Fedora 18 upgrade. Several changes, particularly to the installation and upgrading procedures, have been implemented in the latest Fedora upgrade. The following Linux upgrade schedule was used for the Fedora 18 upgrade:
    - March 18-22: vmhost4, mmto, vmhost3, f9wfs, homer
    - March 25-29: alewife, hoseclamp, pipewrench, yggdrasil
- A wireless repeater, "dd-common-repeater," was installed in room 8, a centrally located room at the summit Bowl dorm. A firmware update with an open-source firmware for the Linksys wireless router was performed. The combined "dd-common" and "dd-common-repeater" access points provide good wireless coverage throughout the dorm.
- The Linux-based DiskStation Manager (DSM) operating systems on the three network-attached storage devices ("nas1," "nas2," and "nas3") were updated during February.
- New SSL certificates were installed on the "mmto" and "hacksaw" servers.
- The MMT software group coordinated with the University Information Technology Services (UITS) group for upgrades of the MMT campus, MMT-SAO mountain, and other Steward Observatory firewalls on March 8. The MMT subnets were down for a brief time during this firewall upgrade.
- The USB-to-ethernet connection for "pipewrench" was upgraded from USB-to-100Mbps to USB-to-gigabit. The "chisel" ethernet connection is USB-to-gigabit.
- During this quarter, the latest versions of IRAF and ccdacq, were installed and tested successfully on control room Linux computers. A Macintosh version of ccdacq was also developed for use on Macintosh computers that will eventually replace the observers' Linux computers in the control room.
- Four Lantronix SecureLinx SpiderDuo devices were purchased. These remote KVM-over-IP devices allow local access for remote management of PCs and servers, down to the BIOS level. The four new "spiders," spider1 through spider4, have been attached to the four headless virtual machine host servers, vmhost1 through vmhost4. A fifth Lantronix spider KVM-over-IP device is available at the summit for debugging of other PCs and network devices, as required.
- A recurring issue at the MMT has been the inability to obtain an IP address from DHCP, especially at the MMT. The same pool is used for wired and wireless DHCP connections. To improve this, the number of available DHCP leases has been increased from 20 to 30. In addition, the duration of leases has been decreased from 24 hours to 4 hours. Both of these modifications will help increase the availability of DHCP leases, both at our campus office and at the summit. Jun Wu, at SI/Washington, has indicated that he will configure and send a new Cisco router to handle the increased wireless traffic at the MMT. He will visit the MMT in the near future and reconfigure our existing "summit-data" wireless access point (AP) to use a vlan. This will reduce the demand for DHCP leases on "hacksaw."

- To improve the wireless reliability in the Common building, a new Apple Airport Extreme wireless base station was installed in the main room of the Common building. This base station has the same "MMT Wireless" SSID as the Airport Extreme-based non-Cisco wireless system at the summit. Both "MMT Wireless" wireless networks are available to staff and visiting observers.
- The MMT is considering acquiring a new Skycam camera as part of making this popular system more robust. Various possible models for cameras are being considered, including gigabit network based cameras. Included in the consideration is noise level for a gigabit camera and the cost. We are trying to avoid the RS232 interfaces for the all-sky camera. This interface requires a separate serial-to-network device, although it offers low noise and low cost.

Applications/Systems Programming Tasks

The following programming tasks were accomplished by the software group during the reporting period:

- Most of the extensive modifications made to the primary mirror actuator test stand software were implemented during this quarter. These modifications had been requested by the hardware engineers.
- The software group worked on software memory leaks in the video (e.g., Skycam) and SVG charts (i.e., Highcharts) widgets. These memory leaks are believed to be resolved.
- Issues were found for the f/5 WFS GUI software. The issues were related in part to changes in the Ruby/Gtk GUI system. The Glade template system has been replaced with the Builder template system. The specific drop-down menu that was generating errors is no longer used with the current WFS hardware. The code has been left unchanged for now.
- Work was done by the software group on the status of the Atheros ethernet driver used in the new Dell all-in-one, "pipewrench." This driver is available for the Linux 2.0 kernel, but not yet for the Linux 3.0 kernel. A USB-to-100mbps ethernet was installed on "pipewrench" (and later upgraded to USB-to-gigabit). USB-to-gigabit adaptors, which are compatible with the Dell all-in-one computers, are available from various manufacturers.
- Modifications were made to the hexapod_linux code and to the hexapod GUI code to allow injecting encoder positions. When the hexapod hardware is turned on, the six transducer positions for each pod are transferred to the encoders. After that first initialization, all hexapod movement is based upon encoder position. There have been several cases where we have known the hexapod position, but have had a failure of one or more transducers. The ability to inject a known value into the encoders, overwriting any values that might have been obtained from faulty transducers, would let the telescope operate for the night. The modifications to the hexapod's GUI include six "Manual Calibrate" buttons that transfer the user-supplied values (in microns) from the GUI's text fields to the encoders. The values are copied into both the encoder positions and to the "commanded" positions within the hexapod_linux code so that the hexapod's position has been fully recalibrated based on user input.
- New web pages were created for monitoring statistics and status of Service Requests (SRs). These web pages present a summary of SRs in both graphical and text form over a period of time, as specified by the user. Examples of these plots are shown in this report on p. 22.
- We are continuing to convert the Matlab Simulink elevation servo model to hand-coded C. Additional blocks have been identified that correspond to the current Simulink servo model. Future work includes converting these blocks to hand-coded C.

- We are currently constructing a setup for testing the hand-coded C blocks on the VxWorks system itself. The setup consists of both a server, which runs on the VxWorks system that selects any block for test and injects data into that block, and a client, which passes data to the selected block and receives data, comparing the results with the expected results from a Simulink model/block.
- Development of a new azimuth servo model is ongoing.

Documentation Tasks

The following tasks were completed related to MMTO documentation:

- Documentation of the new telstat displays was prepared for users. This documentation can be found in the Documentation database. Various telstat profiles have been created for the telescope operators and observers. Additional profiles have been made for use under adverse weather conditions, such as high wind or high dewpoint/relative humidity.
- With the transition from other documentation databases to the centralized Google Documents (Cloud), a complete backup of Content Central was put onto a USB hard drive for future installation in the Google Documentation database. (Content Central is a database previously used by MMTO as well as by Steward Observatory.)
- A new "tag" has been created for the Documentation database for "Cheat Sheets." These cheat sheets will be short documents of informal procedures. The folder can be used by both day and night staff.
- G. Williams and R. Ortiz have been working on a database cheat sheet and associated GUI to create a web-based checklist of various procedures, including instrument mounting procedures.

Realuminization Data Acquisition Software Development

Figure 5 presents the current proposed information technology (IT) framework for the re-aluminization effort of the MMTO primary mirror. This figure includes: 1) software processes running on the aluminization computer, included within the block entitled "Aluminization PC," 2) various hardware components shown in the block entitled "Hardware," 3) an additional computer for handling the video streams and logging, entitled "Video PC" in the figure, and 4) the various client graphical user interfaces (GUIs) that can run on any computer, entitled "Client PC GUIs."

The block entitled "Aluminization PC" outlines the aluminization software that runs on an upgraded Intel-based computer that is dedicated to aluminization activities. This software consists of several independent software components, communicating with each other via a Redis data structure server. In the final version of this software, the components are expected to include: 1) a control process written in C for acquiring the data from the PCI boards at 100 Hz and commanding the welder output DAC, 2) a Node.js/Express application server for serving browser-based GUIs and real-time plots to clients using websockets, 3) a Perl logger script for issuing the SQL commands to the MySQL databases, and 4) a Simulink model for computation of the welder power output commands, based upon feedback from the welder supplies and thickness deposition monitors. Several months of testing has occurred at the Sunnyside test facility, using prototypes of these components, and has been very successful. Work is underway to convert the prototypes into a production version.

As illustrated in the figure by the "OR" statements, several options are available within the IT framework for differing data acquisition, welder's setpoint control, and hardware configurations. These various options interact with a central Redis key-value store server, running on the aluminization PC. This Redis server allows data and welder control setpoints to be provided by different clients, depending on the approach to be taken during the realuminization effort.

In previous realuminization efforts, data were gathered by an HP DAU device. Although data can be logged internally much faster by this device, it can only provide data real-time to an external client at approximately 1Hz. These data are necessary in order for external control of the welder setpoint, either by a human operator or for automated control by a computer. The HP DAU for the aluminization setup is being replaced by PCI boards within the aluminization computer and custom-built data acquisition boards. Prototypes of the custom-built boards have been used to collect data and to set new welder setpoints. Work continues on the final version of these boards. Two options for hardware input (*i.e.*, PCI boards and HP DAUs) to the Redis server are included in the "Data Acquisition" box within Figure 5.

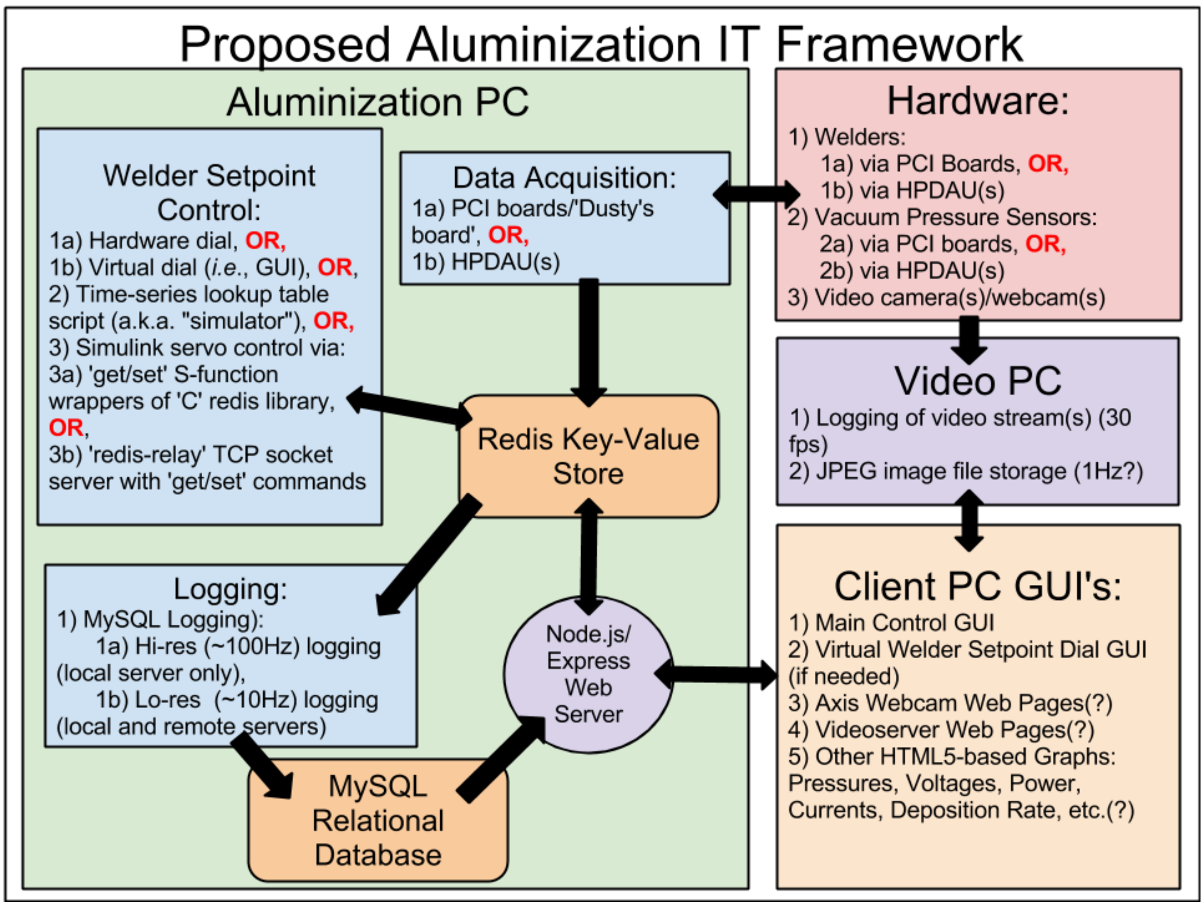

Figure 5. Proposed information technology (IT) framework for the MMTO primary mirror (M1) re-aluminization effort.

The aluminization process is controlled by varying the welder setpoint for the bank of ten commercial welders (see "Welder Setpoint Control" box in Figure 5). In past aluminization efforts, the welder setpoint has been controlled manually with a rotating dial. Visual input from various data sources and user experience has been used to control the welder setpoint during the aluminization process. Although this approach has been successful on several occasions, it requires a high degree of user experience with the system to determine the appropriate welder setpoint control. Decisions must be made quickly since the entire aluminization "shot" takes 1-2 minutes. Besides the hardware dial, a virtual dial or GUI input is also provided for manually controlling the welder setpoint.

A second approach to controlling the welder setpoint is to use a time-series lookup table for welder setpoints, based upon previous aluminization efforts. The approach has been used to simulate past aluminization efforts when developing the software. Advantages of this approach is that it uses real data logged from previously successful aluminizations to drive the welder setpoint values and removes the active human decision-making elements during the aluminization process. Disadvantages include the inability of the system to adjust for changing or unforeseen conditions and for the effects of modifications to the aluminization setup, such as changes in aluminum filament design.

The third approach to welder setpoint control is to use a Simulink-designed servo model that actively uses feedback from the aluminization process for control of the system. The welder setpoint could be set within the Redis key-value store by either "get/set" S-functions within the Simulink code or by a "redis-relay" process that acts as an intermediary between the Simulink model and the Redis key-value store. This "redis-relay" may be required because of the limited network communication and string handling capabilities of Simulink. Further work on these various control approaches is needed with accompanying testing at the Sunnyside test facility and with the MMT aluminization bell jar.

Logging of all data during the aluminization will be to a MySQL relational database, similar to previous realuminizations. Because of the faster data acquisition rates planned for this realuminization, real-time logging to MySQL databases are planned at both "high-resolution" (nominally, 100 Hz) and "low-resolution" (nominally, 10 Hz) rates. The "hi-res" data will only be stored on the local aluminization computer while the "low-res" data will be stored both locally and on a remote server. Using a remote MySQL server provides additional redundancy in case of hardware failure of the aluminization control computer.

New HTML5 and web server technologies have been introduced in the upcoming realuminization effort. A Node.js/Express web server, combined with the Redis key-value store, allows real-time pushing of data to clients as opposed to usually polling for data by clients. This is particularly useful because of the rapid data acquisition rates (e.g, 100 Hz). These new technologies will allow web-based applications to provide real-time information to users. New web applications, including several new HTML5-based charts, have been developed. These charts will display the various pressures, voltages, currents, and deposition rates that are being measured throughout the system.

GUI Details

The “Live Data” OLD Tab

This tab shows live data coming from the HP-DAU unit showing raw sensor values updated at 1Hz. The main plot shows a 10-minute timespan and averages the datapoints for each second. A smaller chart (on the right of the main plot) shows full 10Hz data for the past minute and also updates at 1Hz. A series of voltage meters, shown at the bottom, didn’t prove to be very useful.

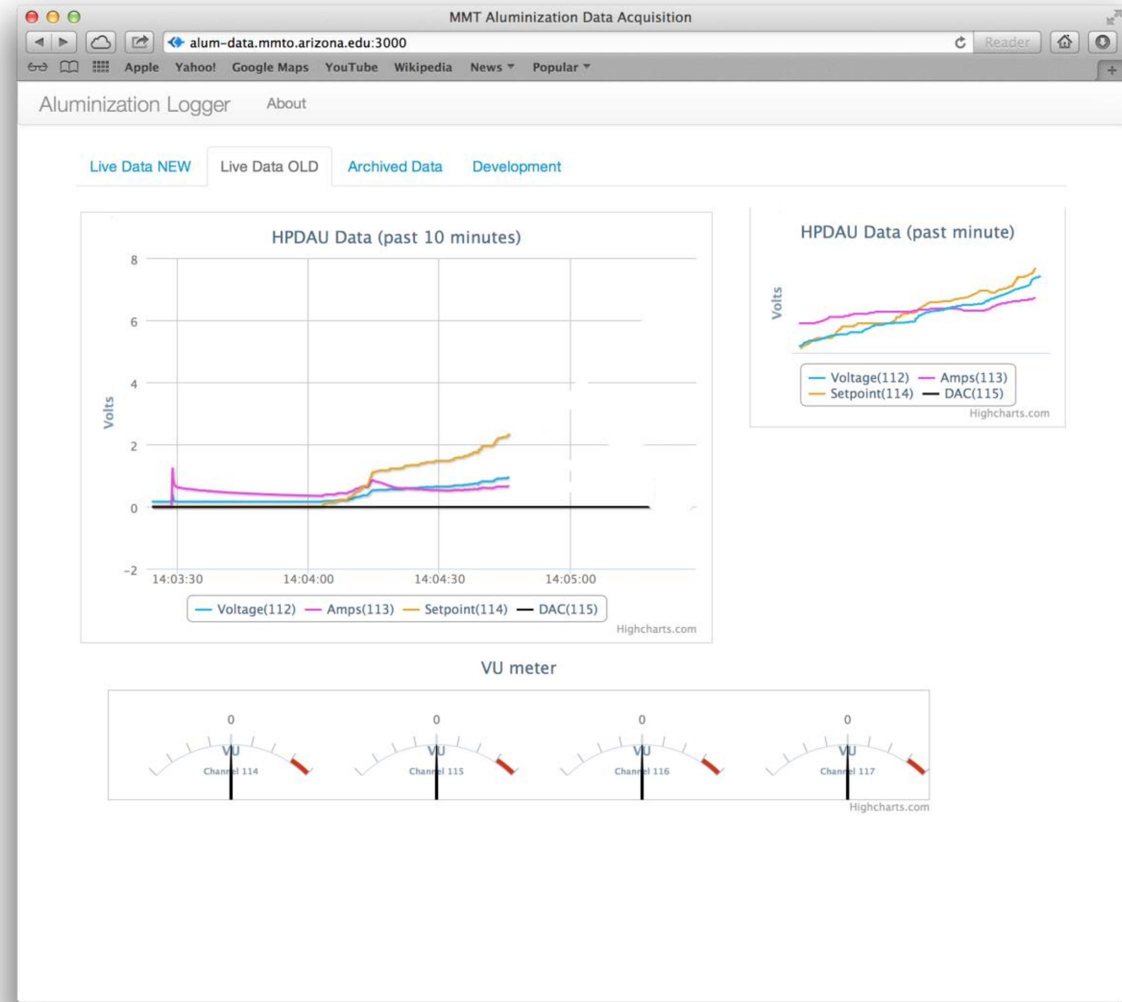

Figure 6. “Live Data” OLD tab

The "Live Data" NEW Tab

A newer "Live Data" tab was implemented to allow for faster updating of the chart and to convert the data from raw values into the correct units. After a few months of using the old live data tab, we learned that our framework was capable of handling more data points at faster update rates without any performance problems. Temperature and Power are also calculated real-time and shown in the plot. The chart updates at 10Hz to give the operator a more responsive view of data. A duration counter was also added to show the amount of time passed from the start of the logger session. Webcam images are also shown under the plot and updated at 1Hz.

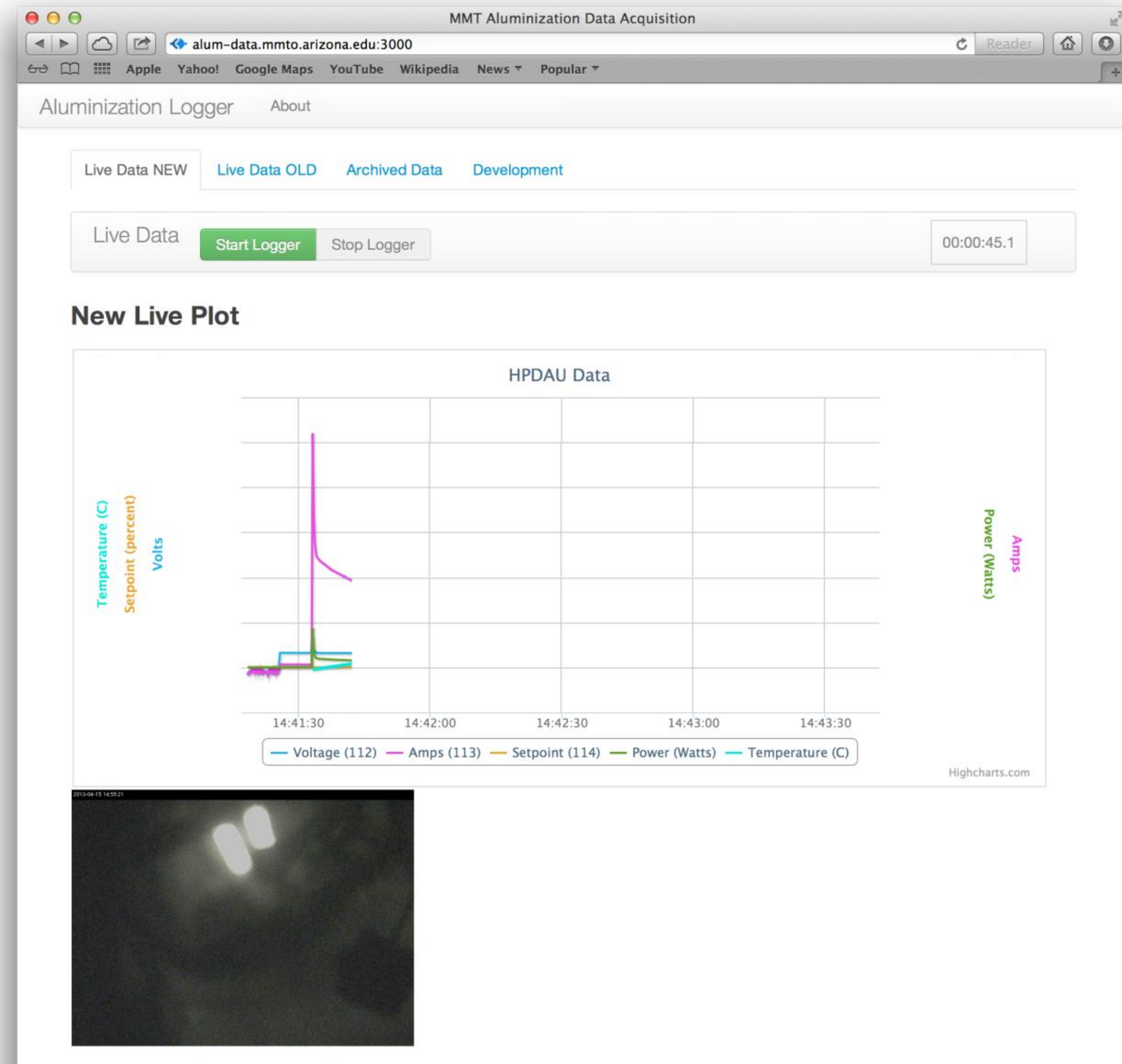

Figure 7. "Live Data" NEW tab

The “Archived Data” Tab

This tab provides a drop-down input for selecting past logging sessions. After a value is selected, it will automatically populate the chart below the drop-down selector. Hovering over the chart will automatically show the corresponding webcam image for that timestamp.

The Archived Data plot shows only the raw data values. This tab also allows for text input for “notes.” This is useful for keeping track of which filaments were used and other useful information.

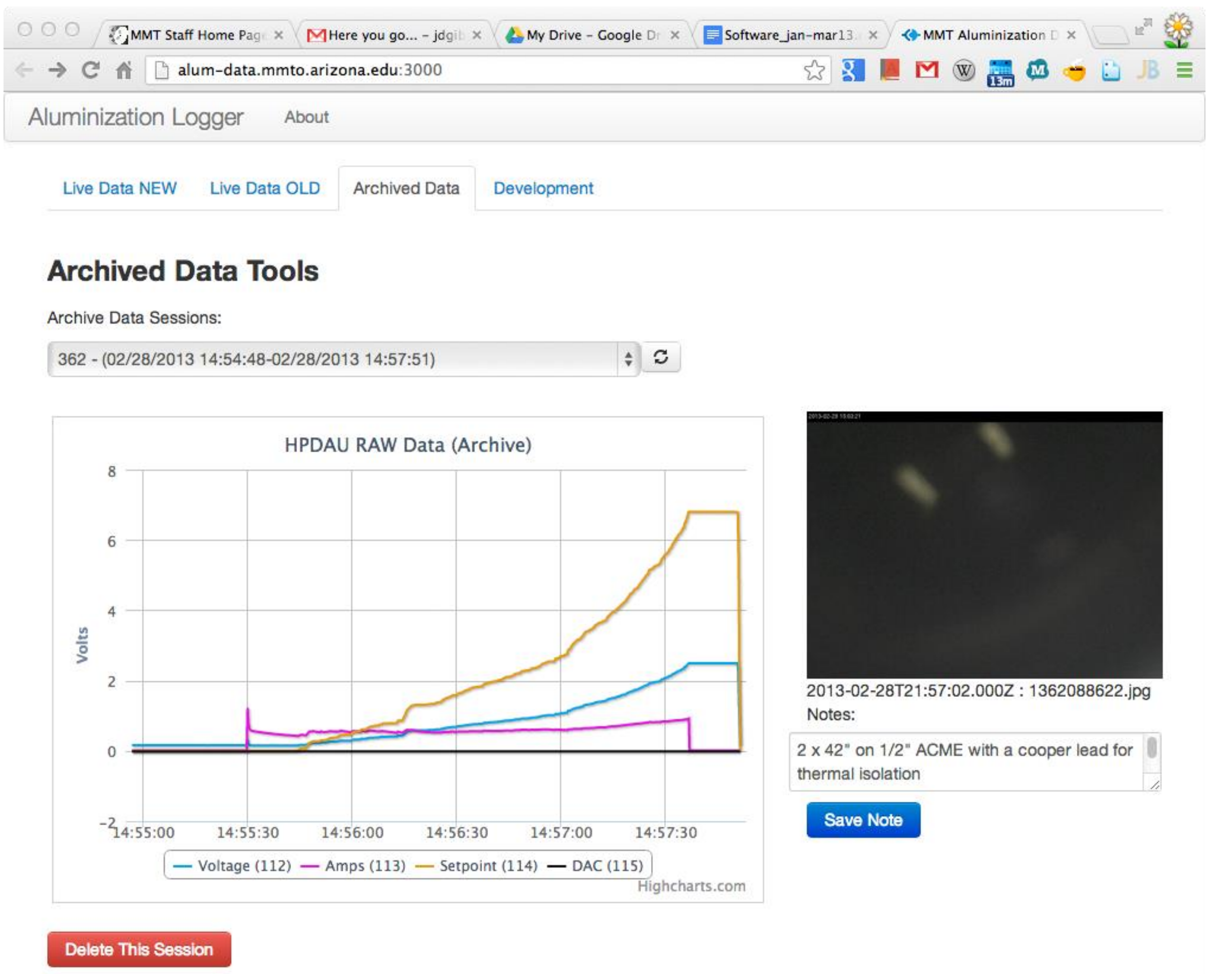

Figure 8. The “Archived Data” tab showing recorded session and notes entered in the “Notes” input field.

The "Development" Tab

This tab was added to show similar output as the Archived Data tab; however, the raw data are converted into the correct units, and the calculated power and temperature are shown. Hovering over the chart will show the corresponding webcam image similar to the Archived Data tab, and also shows the data series value for that timestamp. This tab also shows any notes that were previously added to the session record from the Archived Data tab, and provides a way to selectively enable/disable specific data series.

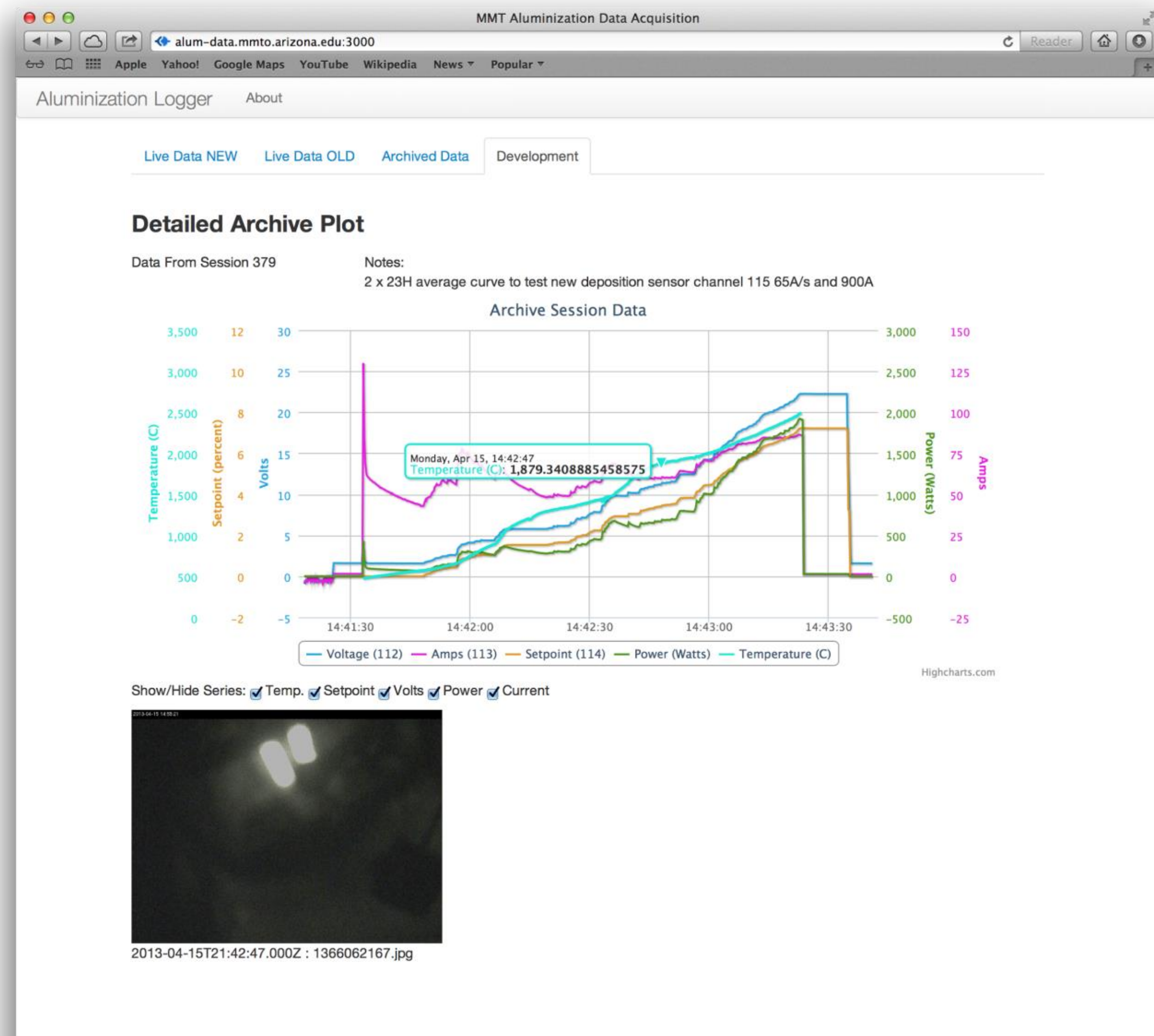

Figure 9. Screen capture of the "Development" tab. The corresponding image from within the vacuum chamber is shown.

Finally, as in previous aluminizations, video capture of the aluminization process has been invaluable for understanding the changing dynamics within the vacuum bell jar. Use of multiple cameras/webcams is planned for the upcoming realuminization with logging of both video streams and of discrete images, nominally at 1Hz. A separate computer will be used for this logging because of the high resource requirements for video streaming, encoding, and logging.

Summary of Service Request (SR) Activity

The MMT Service Request (SR) system is an online tool to track ongoing issues that arise primarily during telescope operations, although the system can be used throughout the day and night by the entire staff. Once a SR has been created, one or more responses are created by staff members to address and, eventually, to close the SR. These SRs and associated responses are logged into a relational database for later reference.

Figure 10 presents the distribution of responses by priority during the period of January through March, 2013. As seen in the figure, the highest percentage (40%) of responses are in the "Important" priority. Eighteen percent have "Low" priority, while 12% have a "Critical" priority. The remaining responses are "Information Only" (14%) and "Near-Critical" (16%). "Critical" SRs address issues that are preventing telescope operation while "Near-Critical" SRs relate to concerns that pose an imminent threat to continued telescope operation. There were a total of 113 responses during this three-month period.

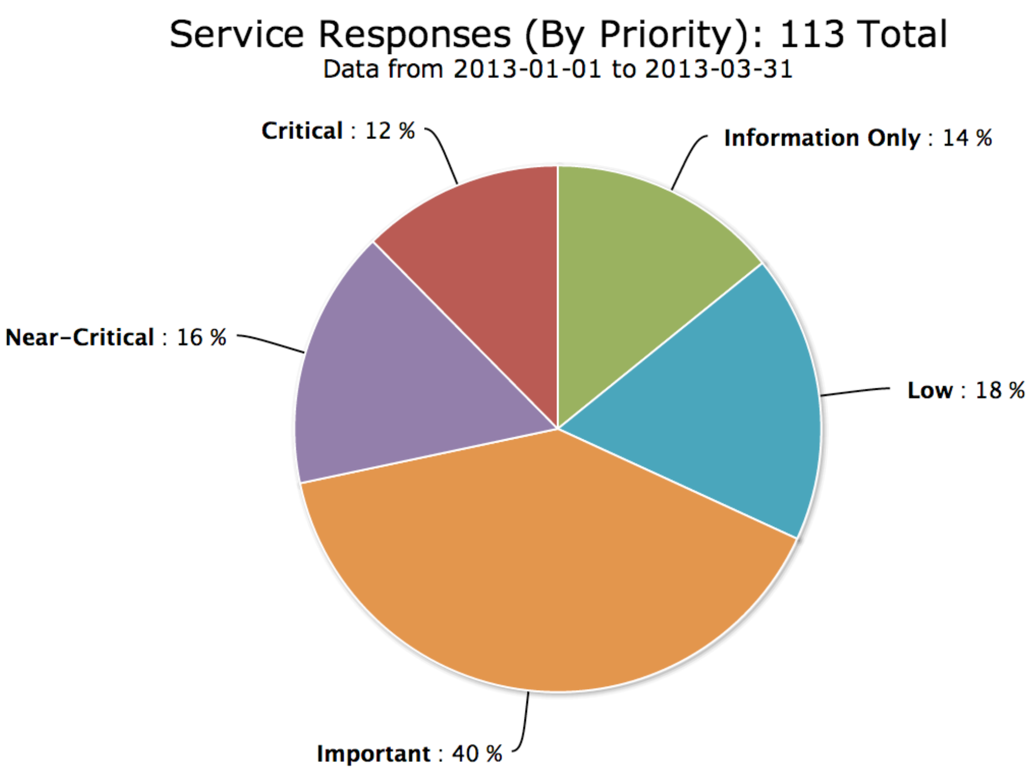

Figure 10. Service Request responses by Priority, January through March, 2013. The majority (40%) of the responses are related to SRs of the "Important" priority, while "Critical" and "Near-Critical" priority responses are 12% and 16% respectively, of all responses.

Figure 11 presents the same 113 SR responses grouped by category. These categories are further divided into subcategories for more detailed tracking of issues. The majority of the responses from January through March, 2013, were related to "Telescope" category.

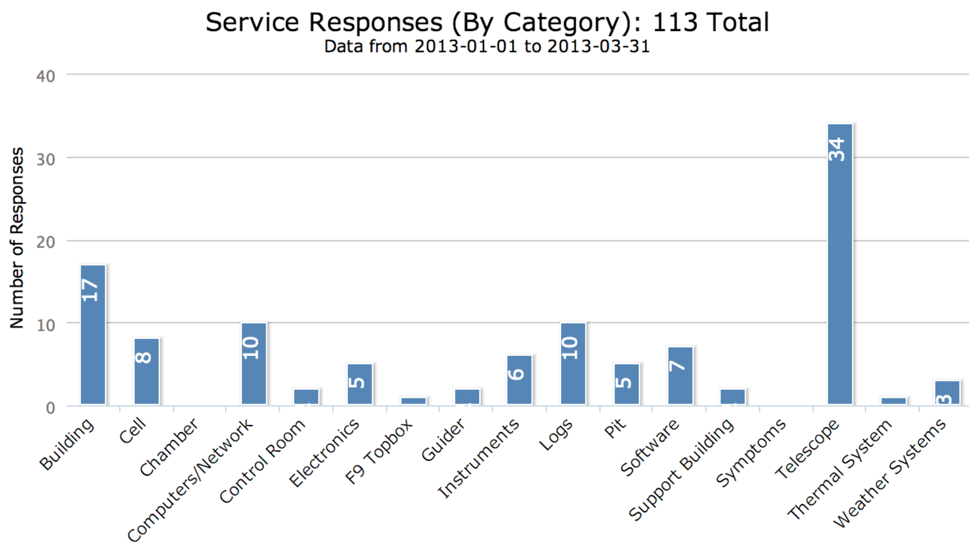

Figure 11. Service Request responses by category, January through March, 2013. The majority of responses were within the "Telescope" category.

Instruments

f/15 Instrumentation

Natural Guide Star (NGS)

ARIES science observations were scheduled for March 21-24, with all nights split between two observers. ARIES performed well on this run. No time was lost to instrument problems, and the throughput, characterization, and stability of the instrument continue to improve. The installation and testing of the 1 - 5 um detector was postponed until April 2013, so ARIES was equipped with the same detector as in previous AO runs. The ARIES wiki continues to be updated with information for observers. Progress has been made in writing an IRAF script for improved efficiency in focusing the instrument at the beginning of the night.

f/9 Instrumentation

Blue Channel and Red Channel Spectrographs

The f/9 instruments were on the MMT for 43% of the available nights from January 1 – March 31. Approximately 69% of the f/9 nights were scheduled with the Blue Channel Spectrograph, 23%

with Red Channel, and 8% with SPOL. Of the total 446.7 hours allocated for f/9 observations, 128.5 hours (28%) were lost to bad weather. Instrument (1.41 hours), facility (13 hours), and telescope (2.75 hours) problems accounted for an additional 17.16 hours (4%) lost, with the main portion of these losses due to primary mirror and hexapod issues. Blue Channel lost 34% of its time to bad weather, with Red Channel losing 17%, and 14% for SPOL.

Exposure Time Calculator

Considerable progress was made on an exposure time calculator for the Blue and Red channel spectrographs. One key component in creating a functioning and accurate exposure time calculator (ETC) for Blue and Red Channel is well-understood measurements of the spectrograph performance. As much of the documented sensitivity information on the MMT website was taken pre-conversion, considerable effort was put into creating more up-to-date response functions for the f/9 spectrograph systems. Using the large amount of data in the backup images kept after each observing run, we constructed estimates of the total system efficiency and count rates. We supplemented these archival data with new throughput measurements through a very wide slit when M&E activities permitted. These updated throughput measurements will be published on the MMTO webpage for the community as soon as they have been vetted to ensure they are accurate.

Based on our new measurements of the instrument and telescope efficiency, we have created a prototype exposure time calculator for the MMT spectrographs. This is an on-going project, but we expect a fully deployed version to be available to the observing community in the next several months.

Observing logs

We have completed a prototype automated logger for Red and Blue Channel. This program will monitor a user-supplied directory for new images, allows the observer to edit comments on the fly, and generates a PDF observing log. We are in the process of adding some features to make the final logs as useful as possible to observers. The coding for the system is modular as well. This means only a short wrapper will be needed to allow it to work successfully on other instrumentation. As soon as possible, we plan to extend the logger to all MMT instruments that do not currently provide their own integrated logger. Final testing of the logger is currently being completed, and we expect to deploy it on the mountain shortly after summer shutdown.

Remote observing

The MMTO supported a total of 5.5 nights of remote observing with the Blue Channel Spectrograph. These included one CfA observer and three University of Arizona (UA) observers. One night of engineering for the f/5 secondary was also run remotely. Online instructions for remote observing continued to be refined and updated.

An iMac computer to be used for remote observing was set up in Room 367A at Steward Observatory with an accompanying binder of instructions and other information. More on this can be found on p. 11.

f/5 Instrumentation

Hecto

Work on the Hecto guide camera system continued from late 2012. A power supply and an integrated circuit on the controller board in the electronics parts box were replaced. The intensified camera was returned to the manufacturer for correction to a failure in its high voltage power supply. The pellicle for the robot 2 camera was replaced. This work involved three service missions by the Cambridge crew to access components within the positioner.

The memory card for the positioner failed when it was removed to replace a weak battery. J. Roll was able to reconfigure some software so that operations could continue. The software is now recording to disk the change of location of each of the fibers so that it is possible to recover in the event the power to the hardware VME rack is turned off when there are fibers on the focal plane.

The weather for the quarter was poor. Nearly half the 450 hours scheduled for f/5 operation was lost to weather. Additional hours were lost due to a noisy building wheel, an elevation drive failure, oscillations of hexapod, and tracking down the aforementioned broken pellicle.

Almost 400 science exposures were taken of 98 fields with the Hecto instruments over the 31 scheduled nights. The robot operators, M. Calkins and P. Berlind, were able to work around the broken pellicle by centering the target location on the shadow of the robot's gripper jaws against the night sky.

SWIRC

Because of weather, SWIRC was able to observe on only two of its scheduled eight observing nights. On those two nights the observers were able to acquire over 2,000 images of 74 fields. An additional 400 images were obtained for calibration of flats and darks. One of the temperature sensors in the dewar did not work when we prepared the dewar for the late January run. The temperature sensor began working again when the dewar temperature dropped closer to operating temperatures and again stopped working at the end of the run when the dewar had warmed up. Warren Brown did not feel the loss of the sensor was a major issue since there is another operating sensor near the one that is not operating reliably.

MMTCam

The software team at CfA has been improving the performance of the interface and pipeline for MMTCam. Problems with executing dither patterns and the irregular numbering sequence have been cleared up. M. Calkins, P. Berlind, and M. Lacasse have become more familiar with the operation of the instrument. MMTCam was scheduled for short intervals on several nights during the quarter while the Hecto positioner was on the telescope. During these observing windows we were able to collect 161 science images in addition to over 900 dark, engineering, bias and flat images. The MMTCam package (Apogee camera, filter wheel controller and USB to fiber converter) was found to generate some light at 844 nm in hectospec exposures. Examination of the interior of the wavefront sensor with night vision equipment did not reveal the source of the light contamination. Current practice will be to power down the camera except when needed. The half hour cool-down time for the Apogee can overlap the time needed to configure for the next field and to wavefront so that there is minimal impact on efficiency.

MAESTRO

MAESTRO had a successful commissioning run on February 26-28. Staff assisted with commissioning activities as well as a malfunctioning shutter (details below) on the instrument. Targets were successfully acquired on the MAESTRO acquisition camera, testing was completed, and a procedure documented to allow the telescope to guide, based on acquisition camera images. Tests were also completed using the f/5 WFS camera as an off-axis guide camera for MAESTRO. While guiding was successful, several software limitations were uncovered that made off-axis guiding impossible while observing a MAESTRO target. Changes to the software will be tested in the April and May f/5 M&E time and MAESTRO commissioning time.

A malfunction with the MAESTRO shutter nearly halted observations. However, upon inspection it was determined that one of the wires had clearly pulled away from the coil connection. The shutter was in need of replacement, but for a quick fix the wire was resoldered to the coil, and the piece returned to its position in the instrument. Replacement of the shutter assembly and documentation for the shutter and instrument wiring was recommended to MAESTRO personnel.

Seeing

Figures 12 and 13 present measured seeing values at the MMT Observatory for this report period. These values are derived from measurements made using the f/5 and f/9 wavefront sensors (WFS).

Figure 12 shows the time-series seeing data for January through March, 2013. The f/5 seeing measurements are shown in blue circles; f/9 WFS seeing measurements are represented by green triangles. Data points alternate through time between these two WFS systems as the telescope configuration and observing programs change. Overall seeing values for the two WFS systems are similar, although the median f/9 seeing value is lower than the f/5 as seen in Figure 13.

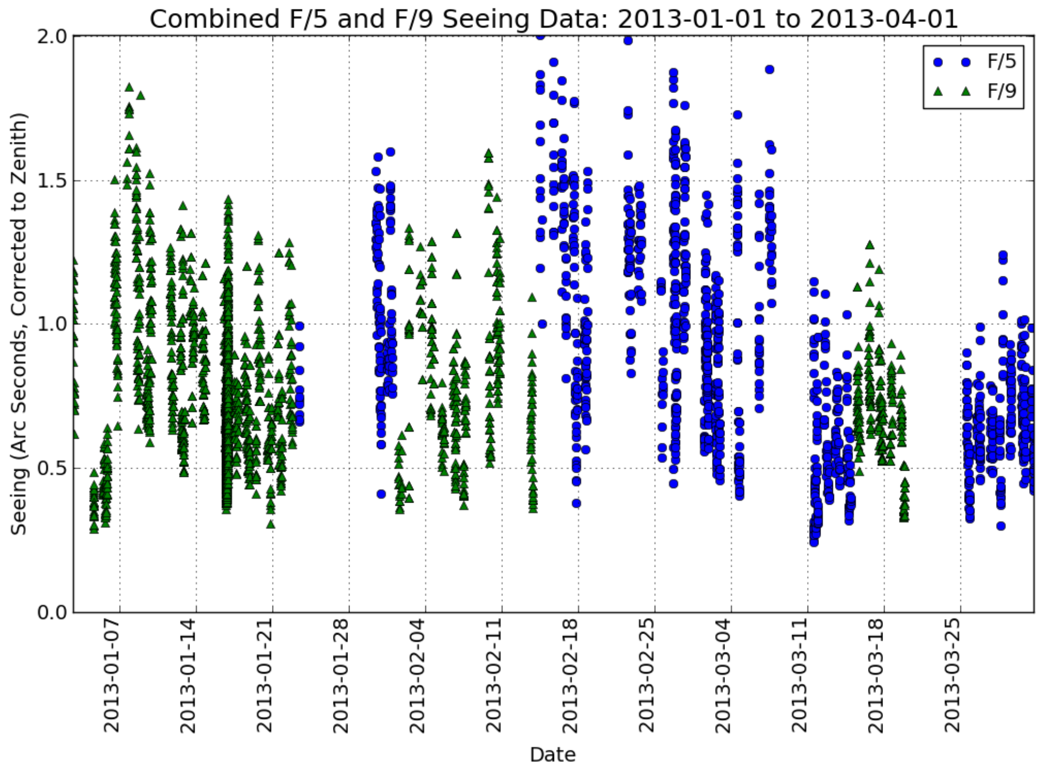

Figure 12. Derived seeing from the f/5 and f/9 WFS for January through March, 2013. Seeing values are corrected to zenith. f/5 seeing values are shown in blue while f/9 values are in green. An overall median seeing of 0.71 arc-sec is found for the 4,105 WFS measurements made during this period.

Figure 13 shows the distribution of f/5, f/9 and combined f/5+f/9 seeing values for the January through March, 2013 reporting period. Median f/9 seeing is around 0.15 arcsec better than median f/5 seeing (0.68 arcsec for f/9 versus 0.82 arcsec for f/5). The overall combined median seeing for the two WFS systems is 0.71 arcsec. Twice as many f/9 WFS seeing measurements were made within the period compared to f/5 WFS measurements due to a greater number of f/9 observations during this reporting period.

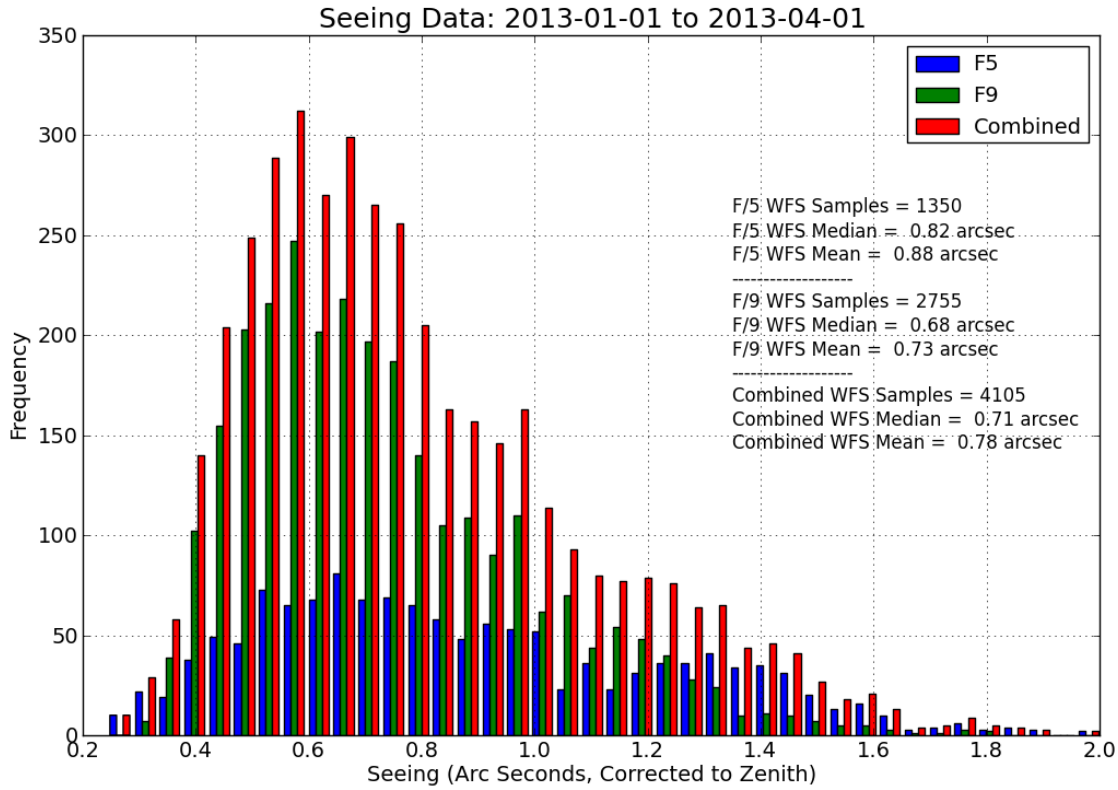

Figure 13. Histogram (with 0.1 arcsec bins) of derived seeing values from the f/5 and f/9 WFS for January through March, 2013. Seeing values are corrected to zenith. Median f/5 seeing is 0.82 arcsec while the median f/9 seeing is 0.68 arcsec. A combined (f/5+f/9) median seeing value of 0.71 arc-sec is found for the 4,105 WFS measurements made during this period.

Safety

In March, D. Porter and C. Knop gave a presentation about the MMT safety website to the Steward Observatory Safety Committee. B. Jannuzi, Steward Observatory department head and director, attended the meeting and afterwards recommended that other departments within Steward Observatory use the MMT program.

Support has been provided to other Steward departments/groups in using the MMT safety website. Two documents are being created for the safety website, one for administrators and one for department managers.

Several new Icom FRS radios were purchased from a local vendor for mountain use to replace the old and unsupportable Kenwood FRS radios. The new radios use the same frequencies as the old radios, but have improved transmission and reception capabilities. The new radios can transmit and receive signals around the summit regardless of indoor/outdoor location. Dropped communications was a problem with the Kenwood system, i.e. dropped communications inside the Instrument Repair Facility (IRF).

Staff safety video compliance for this reporting period is 71%.

General Facility

Building

The front and back shutter latch actuators and building stow pin actuators have been removed and modified to add connectors to their electrical wiring to make it easier to remove and replace them. Two remain to be modified.

The dead outlet reported in the control room was found to have been used for space heaters that exceeded the current rating of the wiring to the outlet. The circuit breaker was oversized on that circuit so the wires inside the conduit box melted their insulation and shorted, opening the breaker. The wire was replaced and the circuit repaired. To prevent this issue in the future, we are considering installation of ceiling-mounted heaters like those installed in the kitchen.

Other Facility Improvements and Repairs

Webcam 6 was installed at a window facing southward in the IRF. The view can be used to determine weather conditions south of the MMTO.

Visitors

2/17/13 – UA science journalism graduate student, Jason Davis, filmed Prof. E. Olszewski of Steward Observatory during his night of observing at the MMT. Prior to filming, he interviewed MMTO assistant staff scientists, J. Hinz and R. Cool, regarding background information on the MMTO.

2/28/13 - Approximately twelve astronomy students and their professor from Wales toured the MMTO.

3/4/13 – A small film crew for a public television show, "Fringe Benefits," toured the MMTO and did some filming. Their program highlights cities and surrounding locations of interest to travelers.

3/13/13 – Dr. Guy Perrin, President of the Scientific Council of the Observatoire de Paris, visited the MMTO and the Whipple Observatories on Mt. Hopkins. M. Lacasse conducted his tour.

MMTO in the Media

2/13/13 – Joannah Hinz, Assistant Staff Scientist, started an MMTO public Twitter page (http://twitter.com/mmtobservatory) offering daily updates on instrument changes, science results, road conditions, weather and more.

3/7/13 – An article appeared in the March 7 issue of the Green Valley News entitled "A Drive to the Top of Mt. Hopkins," by Jason Davis, UA graduate student and Wick Communications Science Intern, who interviewed staff members J. Hinz, R. Cool, A. Milone, and M. Calkins, and attended and filmed part of a Hectospec run with UA astronomy professor Ed Olszewski.

A video also resulted from his interviews and filming, and is posted on the MMTO website at http://www.mmto.org/node/493.

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

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 *)*

13-01 A Successful Broadband Survey for Giant Lyα Nebulae. II. Spectroscopic Confirmation
M.K.M. Prescott, A. Dey, B. Jannuzi
ApJ, **762**, 38

13-02 Evidence for Grain Growth in Molecular Clouds: A Bayesian Examination of the Extinction Law in Perseus
J.B. Foster, et al.
MNRAS, **428**, 1606

13-03 Asteroid Belts in Debris Disk Twins: Vega and Fomalhaut
K.Y.L. Su, et al.
ApJ, **763**, 118

13-04 Coronagraphic Observations of Fomalhaut at Solar System Scales
M.A. Kenworthy, et al.
ApJ, **764**, 7

13-05 Measuring the Mass Distribution in Galaxy Clusters
M.J. Geller, et al.
ApJ, **764**, 58

13-06 Evidence for Environmental Dependence of the Upper Stellar Initial Mass Function in Orion A
W.-H. Hsu, et al.
ApJ, **764**, 114

13-07 Rotational Spectra of (162173) 1999 JU3, the Target of the Hayabusa2 Mission
D. Lazzaro, et al.
A&A, **549**, L2

13-08 Luminosity Function from Dedicated SDSS-III and MMT Data of Quasars in $0.7 < z < 4.0$ Selected with a New Approach
N. Palanque-Delabrouille, et al.
A&A, **551**, 29

13-09 Metal Abundances of 12 Dwarf Irregulars from the ADBS Survey
N.C. Haurberg, J. Rosenberg, J.J. Salzer
ApJ, **765**, 66

13-10 Discovery of Pulsations, Including Possible Pressure Modes, in Two New Extremely Low Mass, He-core White Dwarfs
J.J. Hermes, et al.
ApJ, **765**, 102

13-11 X-Ray Groups of Galaxies in the AEGIS Deep and Wide Fields
G. Erfanianfar, et al.
ApJ, **765**, 117

13-12 SDSS 1355+0856: A Detached White Dwarf + M Star Binary in the Period Gap Discovered by the SWARMS Survey
C. Badenes, et al.
MNRAS, **429**, 3596

13-13 A Sub-Mercury-Sized Exoplanet
T. Barclay, et al.
Nature, **494**, 452

13-14 On the Source of Astrometric Anomalous Refraction
M. S. Taylor, et al.
AJ, **145**, 82

13-15 Measuring the Dark Matter Halo Mass of X-ray AGN at $z \sim 1$ Using Photometric Redshifts
G. Mountrichas, et al.
MNRAS, **430**, 661

13-16 Multi-Wavelength Study of a Complete IRAC 3.6 μm Selected Galaxy Sample: A Fair Census of Red and Blue Populations at Redshifts 0.4-1.2
J.-S. Huang, et al.
ApJ, **766**, 21

13-17 Kepler-68: Three Planets, One with a Density between that of Earth and Ice Giants
R.L. Gilliland, et al.
ApJ, **766**, 40

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 2013

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	189.20	33.90	1.16	2.75	7.00	0.00	44.81
PI Instr	10.00	116.60	74.40	0.00	6.00	0.15	0.00	80.55
Engr	5.00	59.20	20.40	0.00	0.00	0.00	0.00	20.40
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**31.00**	**365.00**	**128.70**	**1.16**	**8.75**	**7.15**	**0.00**	**145.76**

Time Summary

Percentage of time scheduled for observing	83.8
Percentage of time scheduled for engineering	16.2
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	35.3
Percentage of time lost to instrument	0.3
Percentage of time lost to telescope	2.4
Percentage of time lost to general facility	2.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	39.9

* Breakdown of hours lost to instrument
1.00 Red channel focus issue
0.16 Filling dewar

** Breakdown of hours lost to telescope
6.00 Problem with spare SO guider camera
2.00 Frozen water in f/9 secondary support system
0.50 f/9 support failure
0.25 Guider gui not working

*** Breakdown of hours lost to Facility
7.00 Risk to M1 due to thermal state
0.15 Repair of interlock alert

February 2013

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	13.00	147.20	72.45	0.00	0.25	0.00	0.00	72.70
PI Instr	14.00	153.80	51.55	1.00	0.50	4.10	0.00	57.15
Engr	1.00	11.20	5.00	0.00	0.00	0.00	0.00	5.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**28.00**	**312.20**	**129.00**	**1.00**	**0.75**	**4.10**	**0.00**	**134.85**

Time Summary

Percentage of time scheduled for observing	96.4
Percentage of time scheduled for engineering	3.6
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	41.3
Percentage of time lost to instrument	0.3
Percentage of time lost to telescope	0.2
Percentage of time lost to general facility	1.3
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	43.2

* Breakdown of hours lost to instrument
1.00 Broken pellicle

** Breakdown of hours lost to telescope
0.50 Hexapod oscillation
0.25 Issues with hexapod limits

*** Breakdown of hours lost to facility
4.10 Scraping building wheel

Year to Date February 2013

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	29.00	336.40	106.35	1.16	3.00	7.00	0.00	117.51
PI Instr	24.00	270.40	125.95	1.00	6.50	4.25	0.00	137.70
Engr	6.00	70.40	25.40	0.00	0.00	0.00	0.00	25.40
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**59.00**	**677.20**	**257.70**	**2.16**	**9.50**	**11.25**	**0.00**	**280.61**

Time Summary

Percentage of time scheduled for observing	89.6
Percentage of time scheduled for engineering	10.4
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	38.1
Percentage of time lost to instrument	0.3
Percentage of time lost to telescope	1.4
Percentage of time lost to general facility	1.7
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	41.4

March 2013

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	5.00	51.00	3.15	0.00	0.00	0.00	0.00	3.15
PI Instr	25.00	257.40	91.50	0.00	17.10	0.00	0.00	108.60
Engr	1.00	10.10	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	**31.00**	**318.50**	**95.65**	**0.00**	**17.10**	**0.00**	**0.00**	**112.75**

Time Summary

Percentage of time scheduled for observing	96.8
Percentage of time scheduled for engineering	3.2
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	30.0
Percentage of time lost to instrument	0.0
Percentage of time lost to telescope	5.4
Percentage of time lost to general facility	0.0
Percentage of time lost to environment	0.0
Percentage of time lost	35.4

** Breakdown of hours lost to telescope

5.60	Elev problem
2.00	WFS camera issues
3.50	WFS camera crash problems
5.50	AO power failure; camera frozen & stopped
0.50	Hexapod issues

Year to Date March 2013

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	34.00	387.40	109.50	1.16	3.00	7.00	0.00	120.66
PI Instr	49.00	527.80	217.45	1.00	23.60	4.25	0.00	246.30
Engr	7.00	80.50	26.40	0.00	0.00	0.00	0.00	26.40
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**90.00**	**995.70**	**353.35**	**2.16**	**26.60**	**11.25**	**0.00**	**393.36**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	91.9
Percentage of time scheduled for engineering	8.1
Percentage of time scheduled for secondary change	0.0
Percentage of time lost to weather	35.5
Percentage of time lost to instrument	0.2
Percentage of time lost to telescope	2.7
Percentage of time lost to general facility	1.1
Percentage of time lost to environment	0.0
Percentage of time lost	39.5