MMT Observatory

Smithsonian Institution & The University of Arizona®

BIMONTHLY SUMMARY

November – December 2007

Soapsuds-dabbing (no-scratch) mirror wash technique is demonstrated by J. T. Williams on the 6.5-m (256 inch) diameter primary mirror.

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

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Personnel

On November 9, Faith Vilas was interviewed by Lori Stiles as part of a report on the economic impact of astronomy and planetary and space sciences research in Arizona. Webcast clips related to the subject of the report were posted, along with the news release on UANews.org.

Conferences

Grant Williams attended the Gamma Ray Bursts 2007 conference held in Santa Fe, New Mexico, November 5-9, where he presented a poster entitled "The Robotic Super-LOTIS Telescope: Results and Future Plans."

Grant Williams also attended the IAU Symposium 250: Massive Stars as Cosmic Engines conference in Kauai, Hawaii, December 10-14. He presented a poster entitled "The Progenitors of Gamma-Ray Bursts; A New Spectropolarimetric Survey of Galactic Wolf-Rayet Stars."

Faith Vilas was co-author on a poster, entitled "Search for Solar Neutrons Using the MESSENGER Neutron Spectrometer Between 0.7 and 0.32 AU" by W. C. Feldman et al., at the December 2007 AGU meeting.

Primary Mirror Systems

Thermal System

Brian Comisso and Cory Knop executed several iterations of the printed-circuit layouts for the T-series cards to ensure that no defects were present before release for fabrication. Further electronic simulations by Dusty Clark of the switching regulator circuit that powers the motherboard showed an initial design error that would have resulted in unwanted oscillations if the board had been constructed as in the initial design. These and other (minor) layout errors were corrected, and the board designs were sent off for manufacturing by Imagineering, a company used with some success by Steward ETS in the past. We await the arrival of the boards in early 2008 to begin the final system firmware integration, checkout, and construction.

Final approval was given to manufacture the thermal motherboard, thermopile, and absolute cards. All three designs were sent to PCBpro for manufacturing. The cards were ordered with two-ounce copper.

Primary Mirror Support

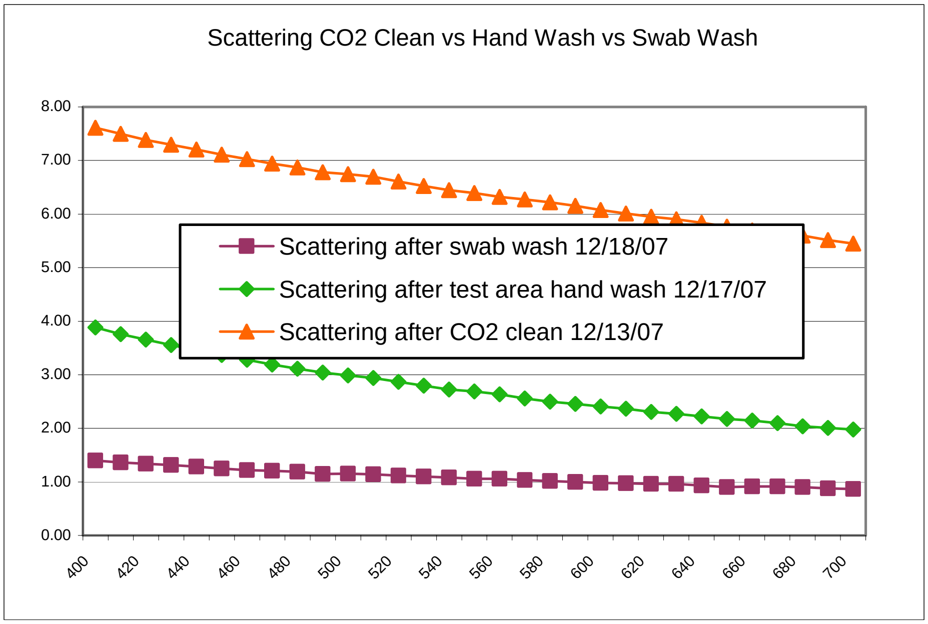
In December, Dondi Gerber began puck bond delamination testing, as long planned, by the proposed method of using accelerometer measurements of the bond response to force steps. Since the experimental setup and initial measurements were very time-consuming, the UA holiday break interrupted this activity. We expect to have some reportable results for the next reporting period.

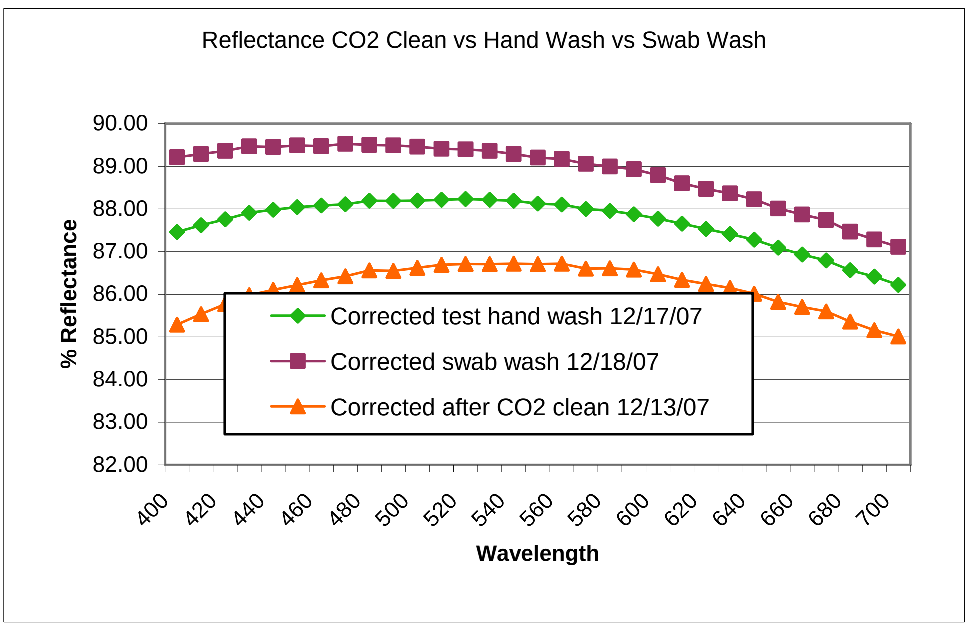
Optics

The 6.5-m primary mirror, laden with well-adhered dust (not removed by CO_2 snow) and grime from more than two years (27 months) of observing exposure, was washed December 18. The rare wet-wash tested a newly devised technique of dabbing the aluminum surface with large (~12-inch diameter) cotton swabs. With no lateral scrubbing motion allowed, the very wet, suds-filled pure cotton swabs were dabbed onto the surface manually, resulting in minimum friction drag and no scrubbing action to scratch the aluminum oxide film. Some 1600 pats with pole-handled swab heads (like mops) were carefully administered by Brian Comisso, John Di Miceli, and J. T. Williams. Dennis Smith, Dondi Gerber, and Ken Van Horn supported the six-hour operation with assorted logistics, processed water, clean air, waste water disposal, lots of towels, encouragement, and plenty of humor.

The mirror was oriented zenith pointing throughout, kept wet with high purity de-ionized water, and rinsed thoroughly. The clean surface was dried in segments using an air-knife discharging some 20 cubic feet per minute of filtered dry air to transport and evaporate water beads off the mirror.

The results were terrific, with a factor of six reduction in measured (visual light) scattering (~7.5% initial scattering to ~1.2%), and a ~3% increase in reflectance at 500 nm (~86.5% reflectance to 89.5%). There is a dramatic improvement in the mirror's visual appearance, and accompanying gains are expected in telescope performance.





Figures 1 and 2: Optical scattering and reflectance results of final wet soap dabbing, washing, and drying are compared with hand cotton pads and routine CO_2 snow techniques. Measurements were made using a Minolta CM-2002 spectrophotometer.

Figure 3: Brian Comisso and John Di Miceli join J. T. Williams in the first course dabbing and soaking of the 27-month old aluminum coating.

Figure 4: Brian Comisso and John Di Miceli complete wash of the mirror east side while the west (now clean) is being rinsed.

Secondary Mirror Systems

f/5 Secondary Support

Over the past few years we have had several failures of the pucks bonding the tangent rods to the f/5 secondary mirror. Shawn Callahan and Creighton Chute started development of a new pneumatic tangent rod to remove stress on the pucks' glue joints.

Telescope Tracking and Pointing

Servos

Additional testing on the sky of the new elevation servo revealed that in order to raise the disturbance rejection high enough for deployment, it was necessary to add observer-based disturbance decoupling to the servo loop. This was accomplished by inserting a Luenberger observer in parallel with the elevation plant, and using the plant-estimation error (scaled appropriately) as an estimate of the wind disturbance. Application of the inverse of the estimated disturbance signal to the controller's DAC (digital-to-analog) output results in cancellation of the wind position disturbance, up to certain limits imposed by closed-loop stability concerns, estimation error, and lag in forming the estimation signal.

Given the performance improvements made possible by this change, the new elevation controller was deployed during December. While not yet ideal, the closed-loop behavior of the controller is much improved with regard to control of modal frequencies in the elevation axis. As implemented, the closed-loop response of the controller exhibits gain peaking at 2.25 Hz, and an as-yet poorly understood rapid change in the phase slope at that same frequency. Both are uncaptured by the current version of the telescope open-loop model. Work is ongoing to improve the model to drive further enhancements in the controller's gain parameters and closed-loop overall performance.

Mount Alignment Telescope

During the engineering night of November 20, we attempted to align the mount alignment telescope (MAT) with the MMT pointing. The MMT was commanded to point to and track the moon. The pointing was then rastered through Alt/Az offsets until the moon was visible in the MAT. The offsets were recorded and will be used to adjust the MAT at a later time. In addition, a pointing adjustment look-up table was implemented and tested. The table corrects for differences between the absolute encoders and the tape encoders, which are used for the old and new elevation servos, respectively. Problems were encountered at low elevations (< 2.0 degrees), which are only used for secondary changes and servicing the front end. A temporary work-around has been implemented.

Computers and Software

New and Revised Web Pages and GUIs

A Flash9 version of the thermal transect was created for improved web page performance:

http://hacksaw.mmto.arizona.edu/engineering/thermal_transect/flex2/thermal_transect/bin/thermal_transect.html

Throughout this web page, links are incorporated to more detailed information on current data and graphs. The user is also allowed to choose which temperatures are included in the thermal transect display. This web page is also available from the MMT Engineering web page.

Various web pages were created and updated to accompany the new thermal transect, including http://hacksaw.mmto.arizona.edu/engineering/rrd/rrd_viewer.php. This web page now has more complete access the RRDTool databases.

Bugs were fixed in the edb_gui, which allows Xephem and two-line element (TLE) format catalogs to be used at the MMT. In addition, a CGI version of this code was written to allow calculation of sidereal and non-sidereal objects from web pages. A new web page that uses this CGI script for solar system objects is at:

http://hacksaw.mmto.arizona.edu/engineering/edb_cgi/solar.html

New web pages were created for the mount axial and transverse counterweights, the building error and mount drive currents, and the rotator motor drive currents. Links to these pages are available at the MMT Engineering web page.

Although these web pages use Flash9, techniques were developed for having similar dynamic gauges using only Javascript. These Javascript-based gauges can run on both 32-bit and 64-bit browsers, while the Flash9 versions require a 32-bit browser because of the Flash plugin. Future versions of similar web pages may use the Javascript approach to gauges.

A new weather web page was created that combines wind rose diagrams and other plots from the east and west Vaisala WXT510 units:

http://hacksaw.mmto.arizona.edu/weather/wind_details.html.

More research was done on optimizing web pages, specifically in the use of Document Object Model (DOM) textnodes for displaying data in web pages. Modifications were made to the MMTDiv Javascript class to use textnodes for optimal web page performance. Use of textnodes is perhaps the most significant way in which web pages can be optimized by minimizing DOM manipulations.

Work was started on a status server that uses the mini.pm Perl module. This server would maintain status information for the cell, hexapod, mount, thermal system, and network. A draft web page, modeled after the interlock GUI, is at:

http://hacksaw.mmto.arizona.edu/engineering/sysstat/sysstat.html

This would replace http://hacksaw.mmto.arizona.edu/engineering/sysstat/sysstat.php.

Finally, further consolidation of Apache web server configurations that are specific to the MMT have been collected into an mmt.conf file for both *hacksaw* and *mmto*.

Network Authentication

In continued efforts to integrate and secure our network authentication, various options were investigated for enabling the MMTO's Google calendar to use our LDAP scheme. Although there are some possible approaches for using LDAP, the current approach of using a common "mmtstaff" Google account seems to be the most attractive. The main reason for LDAP authentication is internal security within MMT's network. The Google calendar is outside of this security requirement.

Likewise, enabling LDAP authentication for SiteScape would be problematic. It would require significant support from Steward ETS, and would incur extra expense for MMT to enable accounts for everyone. Maintaining a single sign-on for all MMT staff does not put our network at risk, but does involve some risk to the data we wish to store within SiteScape. This should be kept in mind if we wish to store sensitive data within that system.

Autoguider Software

The SAOguider software relies on a DT3155 framegrabber to digitize video signals into images that can be analyzed. It is used primarily for Blue and Red Channel with the videoscope ICCD, but it also is used with the f/15 NGS topbox with their StellaCam. Modifications were made to the Linux driver for the DT3155 card so that it no longer limits the amount of useful ram that a machine can have. Another limitation of the DT3155 card is that it seems to require using the "noapic" kernel switch in order to operate successfully. It may be a hardware problem in that everything works properly when in APIC mode, but no interrupts are being detected. The "noapic" switch has little performance impact for a single-processor machine, so this is not a big problem at the moment.

We are investigating rationalizing the SAOguider and SOguider interfaces. The idea is to use the same user interface with all of our different cameras. Skip Schaller developed an interface between the current SAOguider program and the AzCam camera used by SOguider. However, this is based on the older version of SAOguider that we use and does not appear to be an optimal way to run the camera. The versions of SAOguider used by Megacam and Hecto are significantly updated, and they support the features we wish to use with AzCam. For example, we want the client and image server to run on separate machines, whereas our version only passes images via shared memory. We may also want to implement the automatic guide star selection and guide box configuration that has been implemented for Megacam.

OS Upgrades

Fedora Core 8 was released in late October while Fedora Core 6 was demoted to legacy status in early December. Machines that were still running FC6 were updated to FC8 over the course of late November through December. The ability to perform OS upgrades on-the-fly using the yum command has improved considerably. In each case the upgrade went very smoothly with very little extra tweaking required to make it work. The two main server computers, *mmto.org* and *hacksaw*, are still running FC6 and will be updated by the end of January.

A new version of IRAF also was released in December and was included as part of the FC8 upgrade. A few more astronomy-related tools that Tim Pickering had previously been packaging himself have now become included in Fedora, most notably DS9.

Photometrically Calibrating the MMT All-Sky Camera

Betty Stobie has been analyzing archived all-sky camera data to try to determine how photometrically accurate and stable the system is. Each image is analyzed using SExtractor to find sources and determine their fluxes. The sources are then identified and matched against the Yale Bright Star Catalog, which provides accurate V magnitudes and B-V colors. We are interested in night-to-night stability for individual stars as a way to measure relative extinction and quantify cloudiness. Figures 5 and 6 show some examples of bright stars followed over the course of five clear nights in March 2007. There is about 0.1-0.2 mag of scatter in each case, but a portion of it is repeatable from night to night. The detector in the StellaCam camera that we use has significant gate structure between pixels, so this is not surprising given how severely undersampled stars are. These results are encouraging, however, and show that it should be possible to monitor a set of standard stars to create extinction/cloud maps.

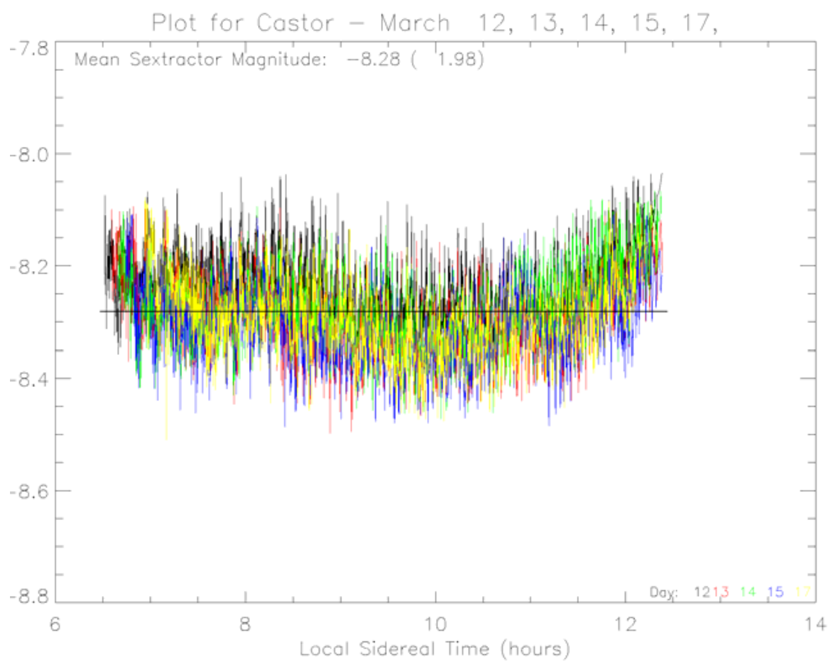


Figure 5: Plot of instrumental magnitudes as measured with SExtractor for the star Castor versus LST for the nights of March 12, 13, 14, 15, and 17, 2007.

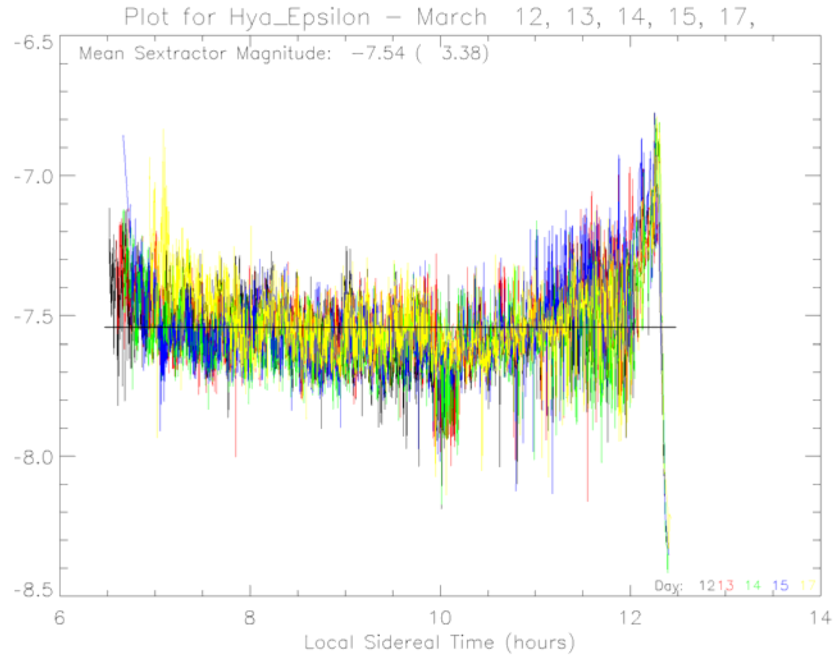


Figure 6: Plot of instrumental magnitudes as measured with SExtractor for the star Epsilon Hydrae versus LST for the nights of March 12, 13, 14, 15, and 17, 2007.

We are also interested in determining a global calibration to convert instrumental magnitudes to a standard Johnson V magnitude. This would be useful for measuring the brightness of new or transient objects such as comets or meteors and comparing them with measurements taken elsewhere. The first cut at attempting this is shown in Figure 7. The points are averages for individual stars over the course of a clear night. The red points are only corrected using a zero-point magnitude. The white points include a color term of 0.14*(B-V) mag to take into account the difference in response between our unfiltered system and Johnson V. This correction helps reduce the scatter somewhat. What is clear is that saturation becomes important for stars brighter than first magnitude. Fainter than first magnitude, the scatter is 0.2 magnitude or less, which is better than expected. Work is ongoing to use this calibration to build a light curve for Comet Holmes.

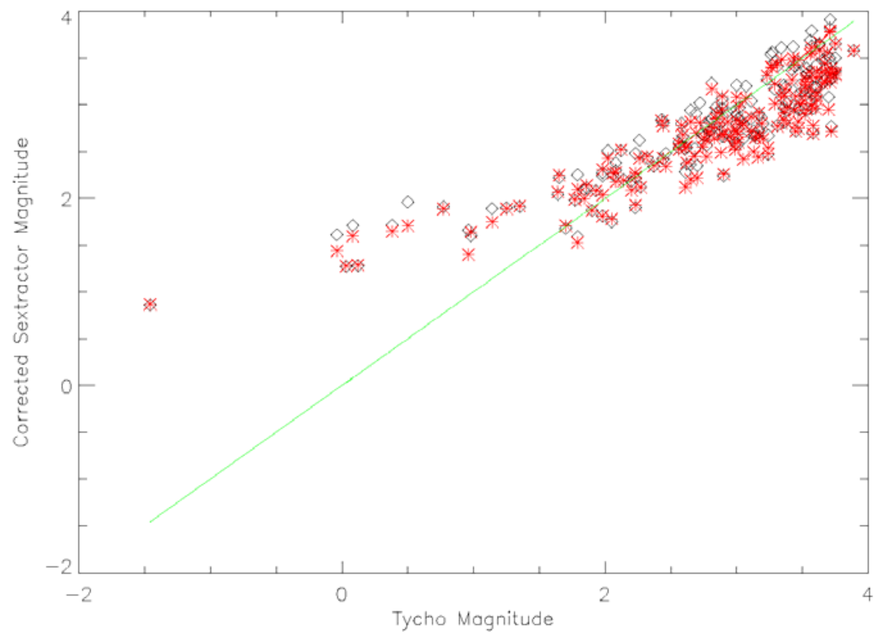


Figure 7: Plot of average measured versus catalog magnitudes for a set of stars from the Yale Bright Star Catalog observed over the course of a clear night with the all-sky camera. The red points are corrected for a zero-point offset only, while the white points also include a correction for a color term. The green lines show a 1:1 correspondence. The effects of saturation become significant for stars brighter than first magnitude.

Seeing

The end of 2007 marked the end of five years of routine operation for the Shack-Hartmann wavefront sensors. Over that time we have been making seeing estimates based on modeling the full-widths at half-maxima of the Shack-Hartmann spots. The estimates generally agree with direct measurements using imaging devices such as Megacam. Tim Pickering reanalyzed all of the archived Shack-Hartmann frames with the current version of the WFS analysis software to create a consistent database of seeing measurements. Culling out some obviously bad data leaves 48,085 WFS frames to analyze.

Figure 8 shows the raw histogram of the measured seeing values with no corrections made for airmass. The mean seeing is 1.03" and the median is 0.94". Since WFS observations are generally taken in the vicinity of science targets, these numbers are a useful metric of what the seeing quality has been during science observations. Site seeing measurements are generally extrapolated to a seeing value at zenith. The standard model of atmospheric turbulence gives the relation:

seeing(z=0) = seeing(z)/sec(z)**0.6

where z is the zenith angle of the observation. Figure 9 shows the results of applying this correction to the WFS seeing measurements. The mean seeing adjusts down to 0.9" and the median to 0.82".

Further analysis is ongoing to look for trends in seeing as a function of azimuth, time of year, time of night, wind speed, etc. The effects of tracking errors and engineering nights with lots of WFS data taken also need to be accounted for.

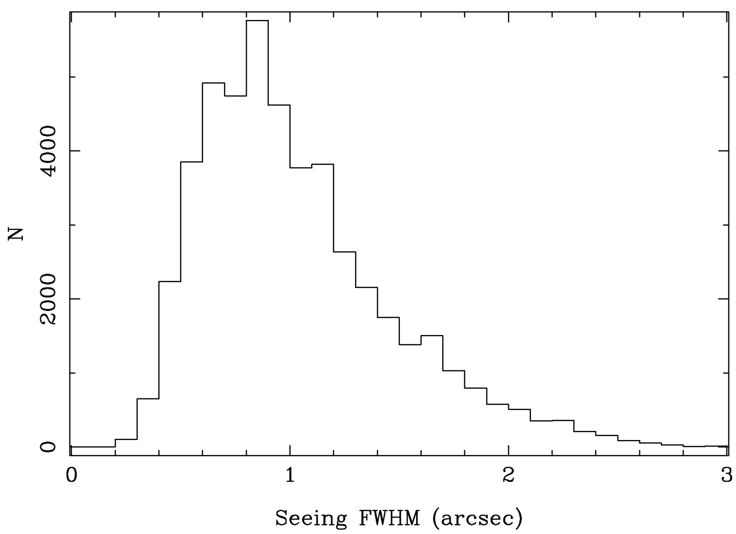


Figure 8: Histogram of 48,085 seeing measurements made by the f/9 and f/5 Shack-Hartmann wavefront sensors since March 2003.

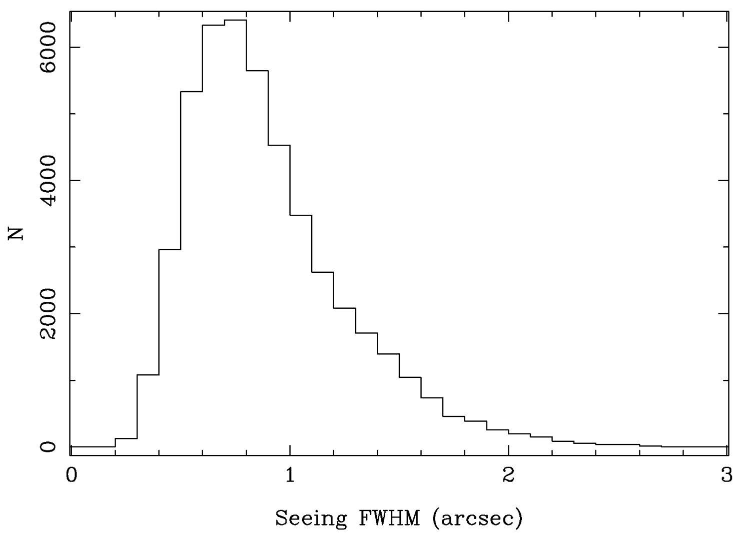


Figure 9: Histogram of the data shown in Figure 1 corrected for the airmasses of the observations to show expected seeing values at zenith.

Instruments

f/15 Instrumentation

Natural Guide Star (NGS)

The DSP board that failed during the September run was replaced in early December. The new board appears to be working well, and the actuator calibrations did not need to be changed.

During the December run, there was a major change in the GUI layout. Previously, closing the loop required actions on three different GUIs and nine mouse clicks on two different desktops. In the new GUI layout there are only two GUIs, which fit on a single desktop, and closing the loop only requires three mouse clicks. Other interface improvements include starting most of the software with a single command and more integrated control of focus adjustments. All of this combines to make the AO operator's job easier and faster, resulting in more closed loop time for the observer.

Analysis of combined accelerometer and wavefront sensor data taken in September proves that the accelerometers mounted inside the f/15 mirror assembly are accurately measuring mirror vibrations, and shows a very good correlation with the image motion. The next task is to turn those data into a working control system. Most of the hardware and software required for this is complete and will be tested during planned M&E time on January 18.

Investigation into the source of the excess read noise in the wavefront sensor camera continued. With the help of Cory Knop, Thomas Stalcup investigated several possibilities and improved the system read noise to eight electrons rms, which is the best performance yet seen with the SciMeasure controller. Previously, the lowest read noise was 13 electrons rms. While performing this work, the camera head was put on the vacuum pump for the first time in several years, and it was found to have a very soft vacuum. This could have contributed to poor cooling and increased dark current at slower frame rates, which would have further reduced the system performance on dim targets.

Laser Guide Star (LGS)

There was no scheduled telescope time for the LGS system during this period, but preparations for the next run have been underway. Improvements for the next run include a laser pupil imaging mode, and lasers in removable mounts on the secondary to help with pupil alignment.

An interconnect panel for the LGS topbox electrical connections was fabricated. It awaits anodizing and engraving.

LAIRS

On November 29, a group of MMT staff met with Suresh Sivanandam, a UA graduate student and member of the Lockheed Martin and University of Arizona Infrared Spectrograph (LAIRS) team, to discuss the logistics of the first LAIRS commissioning run December 19-20.

MIRAC

We ran plumbing for the new MIRAC helium chiller in the pit. This is an improvement over its previous location on the north skirt outside the building, which required the cooler hoses to be fed through the 12-inch vacuum port in back of the chamber.

f/9 Instrumentation

No unusual activity to report.

f/5 Instrumentation

Hectospec and Hectochelle

The long Hecto run in November was completed without any major instrument problems. Servo tests were run to verify parameters for the fiber positioning robots on November 8. Some problems with a temperature sensor were traced to earlier work on dewar electronics, which had caused a loose connection, and the problem was corrected. A light leak that was suspected to be from WFS was traced to some Hecto positioner fiducial fibers that were accidentally turned on (electrical noise, random mouse click?).

The ion pump controller for Hectospec failed, and the Hectochelle controller was swapped in until a refurbished unit was received. The failed controller was sent back to Varian. We now have two working units installed, and a new additional unit to serve as a spare.

After the Hecto run, the electronics exhaust fans in the LN_2 fill room were mounted to a bracket to get them off the floor and remove them as a trip hazard.

The design process is underway for the Hecto fiber chain transition box mounting. The current process to mount the box is cumbersome, and wastes valuable time during installation and removal of the fiber positioner. We hope to improve this portion of the procedure in terms of both safety and time.

On Thursday November 15, Andy Szentgyorgyi and a crew of SAO physicists spent time at the MMT to determine how to deploy a comb laser at the MMT. The laser will be used as a precision wavelength calibrator for the Hectochelle (and perhaps MAESTRO) instrument.

Megacam

The Megacam run in early November went well until the last night. On November 6, while setting up for Megacam sky flats, the auto sky flats routine commanded the rotator to a position that resulted in it reaching a negative limit. The operator attempted to manually back out of the limit but inadvertently rotated in the wrong direction. This resulted in damage to the f/5 wavefront sensor energy chain, which was repaired the following day. In an attempt to avoid such confusion in the future, large bright markings were added to the rotator, and a policy of manually moving only small amounts to back out of a limit was enacted. Observations continued that night, but with short exposures and no rotator correction.

MAESTRO

The MAESTRO spectrograph completed its second engineering/commissioning run at the MMT November 26-29, 2007. The SO Guider was configured to work with MAESTRO during this run. During the first night, a set of data was collected with the f/5 WFS to measure the vignetting and off-axis aberrations. The vignetting data will be used to determine the area that is available for off-axis wavefront sensing with MAESTRO. The measured aberrations will be compared with ZEMAX predictions and with results from commissioning of the f/5 corrector.

Although hampered by weather, the team succeeded in demonstrating improvements made to the instrument after the July 2007 run, and targeted future development.

The following list provides a summary:

- The MAESTRO instrument cart was modified, including the addition of wheels, which greatly assisted moving the instrument from the loading dock to the chamber floor when tipped 90 degrees in order to fit through the chamber floor hatch.
- The MAESTRO counterweights were also modified to make them more compact and easier to handle.
- The transfer of the instrument from the Steward lab to the chamber and the installation of the instrument on the telescope went smoothly and efficiently due to the improvements made.

- The guide camera that was misaligned during the July run was repositioned in the lab to be centered on the slits. However, it was discovered that the current scale on the guide camera display makes it difficult to see the smallest slits for target acquisition. Plate scale issues will be addressed, and the slit plates will be tipped slightly to improve focus and guiding performances for the next run.
- To address issues with installation, the grating platform was heavily modified, and an additional tip/tilt stage was added to provide the flexibility needed for accurate positioning of the grating. Closed-dome time was utilized to take further flexure data. The results indicate the need for flexure control with fine movements of the grating using three PZT stages. This will be implemented before the April 2008 run.
- The shutter assembly was replaced with an electrical shutter, which worked well.
- Lightweight, light-tight covers were created for the spectrograph, and external baffles were installed near the rotator bearing. Both of these additions greatly reduced scattered light, and will be further improved for the next run.
- The slit insertion assembly was modified to include a tray along which the slits are guided into the slit plane. Not only does this make the insertion of the slits easier, it provides additional protection of the injection optics directly above the slit plane.
- The instrument was returned to the Steward lab after the run. The storage tent in the pit, which will become MAESTRO's home after the April run, needs to be built by MMT staff before April 8.

BINOSPEC

The final design review for BINOSPEC (a dual channel optical imaging spectrograph) took place at SAO on December 11, 2007. Tim Pickering and Morag Hastie attended the meeting. The review went very well; the committee returned positive comments, with only minor suggested changes to the design. The project will proceed with the procurement of major components in 2008.

MMIRS

MMIRS (the MMT and Magellan Infrared Spectrograph) is a wide-field, near-IR imager and multi-object spectrograph with Brian McLeod (SAO) as instrument PI. The current plan targets a September 2008 delivery for commissioning at the MMT. Though MMIRS is a facility class instrument, it will be shared with the Magellan telescope for a period of time each year during normal operations. During December 2007, Morag Hastie visited with the MMIRS team in Cambridge, Massachusetts to review progress and start planning the delivery and commissioning periods. The instrument is currently undergoing integration and initial testing at SAO. All the major mechanical and optical components have been procured, and the optics are currently being aligned.

Meetings between the MMT and the MMIRS team will take place in the next couple of months to address issues specific to installation/commissioning and maintenance.

LOTIS Aluminizing Project

Test coatings of glass samples, including radial deposition uniformity measurements, were successfully completed in November. In early December, all outside mechanical vacuum pumps and ducting were moved to temporary storage, clearing space to load and transport the LOTIS collimator system to its home at Lockheed Martin's Sunnyvale, California, facility.

With the collimator (telescope) structure removed from the SOML integration lab, steel floor tracks were installed inside to receive the complete 7-m coating chamber system. In late December, both belljars, camber extension, handling cart, and tilt frames were set and aligned inside the facility adjacent to the LOTIS 6.5-m primary mirror and support cell. Inside, chamber vessels were cleaned and prepared for lower pressure (cryo-pump assisted) operation during the final coating of the primary mirror.

Radial aluminum film thickness profile measurements taken in the second LOTIS test shot have been analyzed, and compare favorably with MMTO model predictions (MMTO Internal Tech Memo #04-4). Further, the glass step-slides, spaced radially at 20 cm intervals, were measured with the University of Arizona Optical Sciences Center's (OSC) Wyco NT9800 optical profiling system. Actual measured radial thickness variations were 2.5 times less than predicted by the SO/MMTO model. These empirical data will now be used to calibrate our model.

General Facility

Instrument Repair Facility

In preparation for the release of the 35% review documents, meetings were held to discuss several design issues including the following: foundation types, insulation, fire suppression requirements (none required at this time), crane selection, lighting, heating, and instrument requirements. The report was initially due on December 15 but has been delayed until mid January.

Chamber Floor Replacement

The floor installation was completed by TBR in early November. This included modifying the hatch to improve clearances, and finishing the last trim panels.

Roof Repairs

TBR has been awarded the contract to add a thermoplastic roof to the telescope enclosure and replace all "P-seals" on the shutters. With help from MMTO engineering, the P-seals material has been changed to neoprene to increase longevity on the mountain.

Enclosure Pit Covers

The north and south pit apron covers are now leaking. MMTO engineering is looking into sealing the covers with a thermoplastic seal identical to that of the roof.

Enclosure Painting

The SI project office and MMTO engineering submitted review comments on the 75% design report. M3 Engineering is now incorporating these comments into the final report to be used by the painting contractors for quotation.

Summit Road Heaters

Many sections of the road heaters failed during our first winter storm. Currently, five of the 12 GFI circuits are shorted. FLWO is getting an estimate from Stark Electric to remove the failed heaters from the circuits and to restore as many circuits as possible.

Guardrails

All existing damaged guard rails have been repaired, and all cables have been re-tensioned. A new section of guard rails will be installed above kilometer 4. A representative from Brifen met with FLWO, MMTO, and Sierrita Mining & Ranching (SMR) staff to determine the best location. Site preparation for this new guard rail system is scheduled to begin in January.

Instrument Rotator

The rotator manual control system is being modified to prevent motion beyond the rotator hard limits, but to allow manual control from the drive arc to move away from the limit. Cable modifications were completed, and control card modification should be completed soon. Minor software changes may be required to complete this task.

Weather and Environmental Monitoring

After the lightning incident in the previous reporting period, a new air terminal (i.e., lightning rod), was installed on the west weather pole. The connection to the terminal was moved outside the pole to allow visual inspection of the grounding connection. A WXT-510 (Vaisala4) was installed and operationally tested. In the subsequent weeks, the system performed nominally. During a winter storm, the heater system on the unit failed. The WXT-510 was swapped with the unit (Vaisala3) from behind the shop. The current setup allows the operator to get accurate wind readings from the west side of the summit. After the AO run in January, the defective WXT-510 will be sent in for repairs.

The R. M. Young wind instrument is being rebuilt after being damaged by lightning this summer. A TempTrax unit was installed at the west weather pole. The Lantronix unit for the Yankee dewpoint sensor was moved to a warmer environment; it was exhibiting problems with low temperatures in the chamber.

Other Facility Improvements and Repairs

In an attempt to provide better lighting in the pit, we are replacing incandescent lamps with compact fluorescent bulbs. This requires the glass housing to be removed, but the bulb is still protected by the metal cage. The initial changeover of ten bulbs went well, and the rest are being ordered.

During a cold spell in December, we found that the duct heaters above the first floor were programmed to operate only during the day. They were temporarily reset to operate both night and day until warmer weather returns.

The pit pier fan, which runs full time during nighttime operations, needed a total rebuild (new motor, block bearings, and belts).

We have started using the new Gardner Denver air compressor; however, we plan to relocate it to the UPS room in the future.

The UPS battery was replaced on *alewife* and is back on-line.

Visitors

November 16: Staff from Korea Astronomy and Space Science Institute (KASI) visited the MMT, accompanied by Xiaohui Fan of Steward: Kwang-Dong Kim (head of instrument support team), Jeong-Gyun Jang (mechanical engineer), Bi-Ho Jang (electrical engineer), Young-Soo Kim (head of Large Telescope Project Group), and Jeong-Yeol Han (optical designer).

November 29: Emilio Falco (FLWO) hosted approximately 25 members of the Green Valley Hiking Club, who hiked to the MMT from the gate.

Publications

MMTO Internal Technical Memoranda

None

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

07-29 *Chandra* X-Ray Sources in the LALA Cetus Field
J. X. Wang, Z. Y. Zheng, S. Malhotra, S. L. Finkelstein, J. E. Rhoads, C. A. Norman, T. M. Heckman
ApJ, **669**, 765

07-30 Discovery of Gas Accretion onto Stars in 13 Myr Old h and χ Persei
T. Currie, S. J. Kenyon, Z. Balog, A. Bragg, S. Tokarz
ApJ Letters, **669**, L33

07-31 The Black Hole Mass of NGC 4151: Comparison of Reverberation Mapping and Stellar Dynamical Measurements
C. A. Onken et al.
ApJ, **670**, 105

07-32 An Imaging Survey for Extrasolar Planets around 45 Close, Young Stars with the Simultaneous Differential Imager at the Very Large Telescope and MMT
B. A. Biller et al.
ApJ Supp, **173**, 143

07-33 Dynamical Masses for Pre-Main-Sequence Stars: A Preliminary Physical Orbit for V773 Tau A
A. F. Boden et al.
ApJ, **670**, 1214

07-34 Broad-Line Emission in Low-Metallicity Blue Compact Dwarf Galaxies: Evidence for Stellar Wind, Supernova, and Possible AGN Activity
Y. I. Izotov, T. X. Thuan, N. G. Guseva
ApJ, **671**, 1297

07-35 A Large Population of Mid-Infrared-Selected, Obscured Active Galaxies in the Boötes Field
R. C. Hickox et al.
ApJ, **671**, 1365

07-36 Hypervelocity Stars. III. The Space Density and Ejection History of Main-Sequence Stars from the Galactic Center
W. R. Brown, M. J. Geller, S. J. Kenyon, M. J. Kurtz
ApJ, **671**, 1708

07-37 Absorption Spectrum of the Quasar HS1603+3820
A. Dobrzycki, M. Nikolajuk, J. Bechtold, H. Ebeling, B. Czerny, A. Różańska
A&A, **476**, 1205

07-38 Observations and Asteroseismic Analysis of the Rapidly Pulsating Hot B Subdwarf PG 0911+456
S. K. Randall et al.
A&A, **476**, 1317

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 University of Arizona and the Smithsonian Institution."

Submit publication preprints to *bruss@mmto.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.mmto.org*) that includes a diverse set of information about the MMT and its use. Documents that are linked to include:

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

Observing Database

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

November 2007

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	* Lost to Telescope	Lost to Gen'l Facility	Lost to Environment	Total Lost
MMT SG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PI Instr	28.50	331.00	94.60	2.00	11.65	0.00	0.00	108.25
Engr	1.50	17.60	0.20	0.00	0.00	0.00	0.00	0.20
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**30.00**	**348.60**	**94.80**	**2.00**	**11.65**	**0.00**	**0.00**	**108.45**

Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	95.0
Percentage of time scheduled for engineering	5.0
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	27.2
Percentage of time lost to instrument	0.6
Percentage of time lost to telescope	3.3
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	31.1

* Breakdown of hours lost to telescope
azimuth/building drives 0.25
rotator 11.4

December 2007

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	* Lost to Telescope	Lost to Gen'l Facility	Lost to Environment	Total Lost
MMT SG	14.00	167.60	121.80	0.00	0.25	0.00	0.00	122.05
PI Instr	15.00	167.70	81.40	4.25	0.75	0.00	0.00	86.40
Engr	2.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**31.00**	**359.30**	**203.20**	**4.25**	**1.00**	**0.00**	**0.00**	**208.45**

Time Summary Exclusive of Summer Shutdown

Percentage of time scheduled for observing	93.3
Percentage of time scheduled for engineering	6.7
Percentage of time scheduled for sec/instr change	0.0
Percentage of time lost to weather	56.6
Percentage of time lost to instrument	1.2
Percentage of time lost to telescope	0.3
Percentage of time lost to general facility	0.0
Percentage of time lost to environment (non-weather)	0.0
Percentage of time lost	58.0

* Breakdown of hours lost to telescope
az drives 0.75
M1 panic 0.25

Year to Date December 2007

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	71.00	714.60	340.60	0.00	5.10	0.00	2.50	348.20
PI Instr	238.00	2384.35	820.45	40.50	22.70	16.25	2.00	901.90
Engr	19.00	195.15	76.85	0.00	0.00	0.00	0.00	76.85
Sec Change	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**328.00**	**3294.10**	**1237.90**	**40.50**	**27.80**	**16.25**	**4.50**	**1326.95**

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	37.6
Percentage of time lost to instrument	1.2
Percentage of time lost to telescope	0.8
Percentage of time lost to general facility	0.5
Percentage of time lost to environment (non-weather)	0.1
Percentage of time lost	40.3