MMT Observatory
Smithsonian Institution &
The University of Arizona®

# BIMONTHLY SUMMARY

## March - April 2006

*Clockwise, from upper left: 1. Laser projector operating with f/15 secondary. 2. Rocket exhaust plume from Vandenberg launch spreading out on the wind at sunset. 3. Miguel Snyder and Christoph Baranec pose with the results of their hard work — the new laser guide star (LGS) topbox. 4. Miguel Snyder demonstrates the easy access feature of the new LGS topbox.*

## Personnel

Computer science undergrad Clay Barnes was hired March 10 to help maintain the MMTO web site. His main focus will be to organize and transfer existing html documentation into the docuwiki system.

Mechanical engineer Court Wainwright left the MMTO March 24 to begin a new job with Raytheon.

Electrical engineer Dondi Gerber was hired April 3.

Student mechanical engineer Ryan Odegard was accepted to MIT for graduate school. After Ryan's May graduation, he will continue work with the MMT as an Engineer, Associate through June 29.

New mechanical engineering undergrad students, Todd Jackson and Jill Cooper, have been hired and will start in May.

Thomas Stalcup, MMT adaptive optics staff scientist, successfully defended his doctoral thesis on April 25.

Grant Williams attended the "Transient Universe 2006" conference at the Kavli Institute for Theoretical Physics on the campus of UC Santa Barbara on March 13-14.

Faith Vilas attended the 37th Lunar and Planetary Conference in Houston, Texas, March 13-17, where she resented a paper entitled "Space Weathering on Asteroids: New Results from the Ultraviolet" by F. Vilas and A. R. Hendrix. She was co-author on two other presentations: "Mineralogical Composition of (25143) Itokawa 1998 SF36 from Visible and Near-Infrared Reflectance Spectroscopy: Evidence for Partial Melting" by P. A. Aell et al., and "Preliminary Results from the Hayabusa Near Infrared Spectrometer (NIRS) of Asteroid (25143) Itokawa" by M. Abe et al.

Faith Vilas gave three public talks in March. The first, entitled "The Hayabusa Mission to Near-Earth Asteroid 25143 Itokawa," was March 6 as part of the Steward Observatory Public Evening Lecture series. The second, entitled "Exploring Near-Earth Asteroid Characteristics: The Japanese Hayabusa Mission," was March 23 as part of the Steward/NOAO Joint Colloquium Series. The third, entitled "Mission to Asteroid Hayabusa," was March 29 in Green Valley as part of the Whipple Observatory New Vistas in Astronomy 2006 series.

During the week of April 3-7, Tim Pickering attended one of the short courses offered by the ZEMAX Corporation in Bellevue, WA. Subsequent use of ZEMAX modeling is reported in the Telescope Collimation and Optical Performance section.

Dusty Clark attended educational training (VxWorks) April 11-14 with Wind River in Pasadena, California.

John Glaspey was one of the judges for the annual Academic Showcase at the Ha:Sañ Preparatory & Leadership School in Tucson on April 27.

## Primary Mirror Systems

### Primary Mirror Support

Testing on the primary mirror spare hardpoint continues. Ryan designed a protective case to house the spare hardpoint for transport and maintenance.

A conceptual design for electronics to test primary mirror hardpoints was done, and most of the work to create a LabVIEW GUI to support hardpoint testing was also done. This system will use a spare Hewlett Packard data acquisition unit (DAU) with some extra I/O boards to control the hardpoint motor, measure the onboard load cell and linear variable differential transformer (LVDT), and apply different pressures to the breakaway mechanism. A separate double-acting pneumatic cylinder and load cell will allow for dynamic loading of the hardpoint. The GUI will allow data to be collected in real time for later analysis. We await the availability of the LBT hardpoint test stand. If the LBT test tool is not available, MMTO will construct a new test stand to deploy this new system to the mountain.

## Telescope Collimation and Optical Performance

### *f*/5 Open Loop Corrections

We have seen significant changes in the behavior of the *f*/5 front-end over the course of fall 2005 and through spring 2006. The most significant difference is in the Y axis. Analyzing wavefront sensor (WFS) logs over the course of the March and April *f*/5 runs finds a very large shift of 2 mm or more compared to what was observed in November 2005. There is some indication of a change in the shape of the Y-Elevation relation, but it's inconclusive due to the large scatter in the WFS data. The scatter is about twice as large as the scatter observed when doing similar analyses of WFS data from 2005.

While the Hecto fiber positioner was off-line on the night of April 25-26, we took some engineering data with the WFS to calibrate elevation-dependent effects more accurately. The data were obtained by observing stars with the WFS at a constant azimuth and over a range of elevations from 25 to 85 degrees. At each star, corrections were applied to the secondary to fix focus, coma, and pointing. Corrections were not applied to the primary mirror while the engineering data were obtained. The results are shown in Figure 1. Taking data in a consistent fashion under relatively stable conditions greatly reduces the amount of scatter in the data. Ideally, there should be no elevation dependence in X or Theta-Y since they are perpendicular to the gravity vector. However, as the telescope tips down there clearly is significant motion in one of those axes, which is then compensated for in the other axis to fix pointing and remove wavefront tilt.

The data shown in Figure 1 were taken while pointing west and keeping azimuth near constant at 270. There was a moderately strong, fairly constant 30 mph wind from the south-southwest. Swinging around and taking a set of similar data while pointing east under similar wind conditions shows some significant offsets in each of the axes. Figure 2 shows the data taken in both runs plotted together. The offsets appear to be consistent with the different wind loading on the front end. This helps explain the large scatter seen in logged WFS data.

Figure 3 shows best-fit relations between Y and elevation for the *f*/5 secondary. The different relations were determined using dedicated engineering data in November 2005 and on April 25, 2006, and using different sets of WFS data from before and after the April 2006 adaptive optics run. The most remarkable feature is the huge, almost 2.5 mm, offset between the relation from fall 2005 and the ones determined in spring of 2006. It turns out that around January 2, 2006, the SE and SW lateral hardpoints became detached from the *f*/5 secondary. As a result, the N lateral hardpoint would pull the mirror up as far as it could. This works out to be very close to the 2.5 mm Y offset we observe. The N hardpoint pulls the mirror up in Y so the hexapod compensates by moving it back down. It's also rather remarkable that the secondary has behaved as well and as consistently as it has after losing two tangent rod hardpoints. Outside of the large offset, the elevation behavior in Y is very similar between the November 2005 and April 2006 engineering data. However, the large scatter seen in the WFS data and the shifting seen during engineering on April 25-26 are probably symptomatic of the lack of positional constraint within the *f*/5 cell.

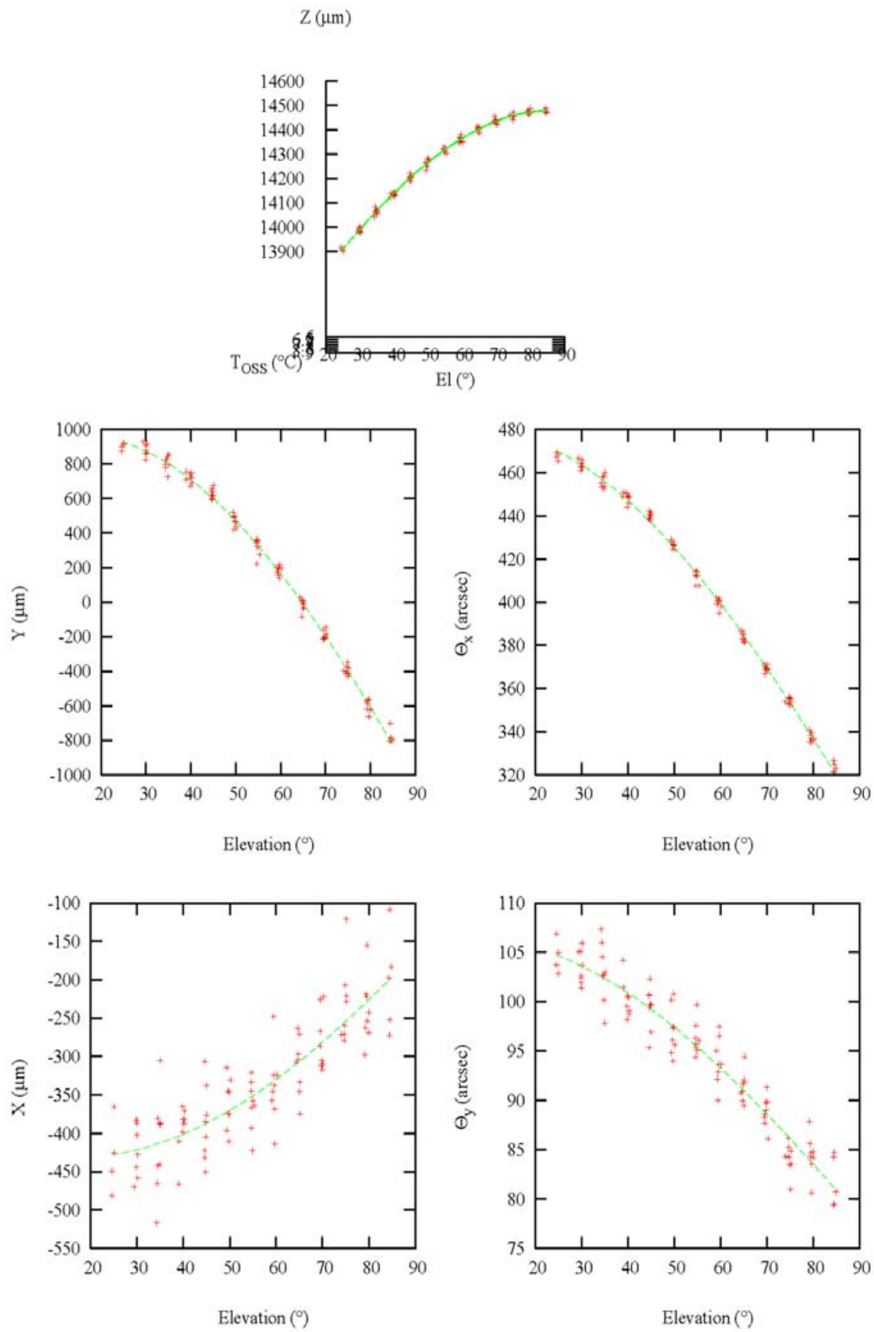


*Figure 1: Results of engineering data taken with the f/5 WFS on the night of April 25-26, 2006, showing the elevation dependence of the five axes of M2 motion. The plot of Z vs. Elevation is tilted slightly to de-project the temperature dependence.*

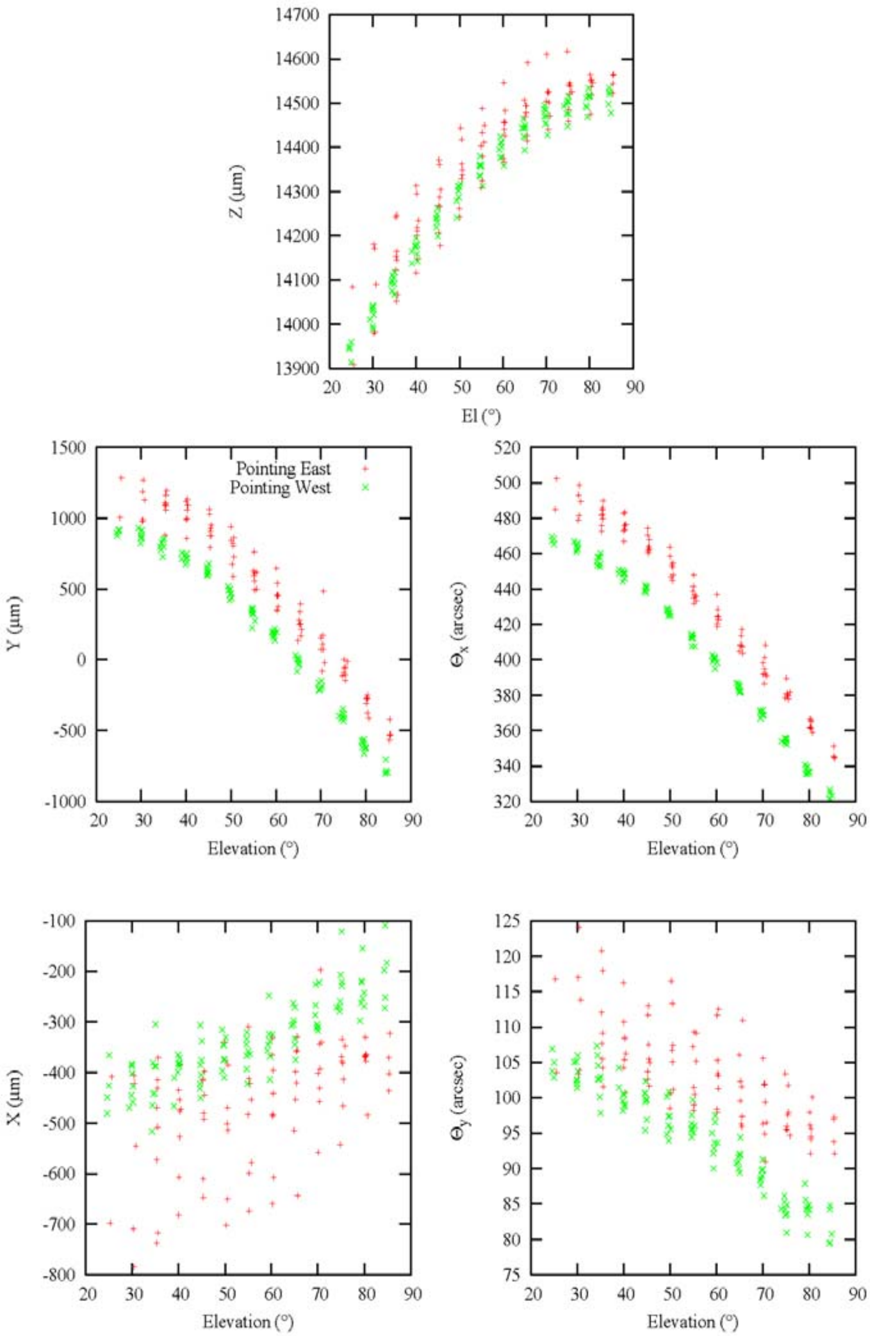


*Figure 2: Engineering data from the night of April 25-26, 2006, taken while pointing west (green points) and then pointing east (red points).*

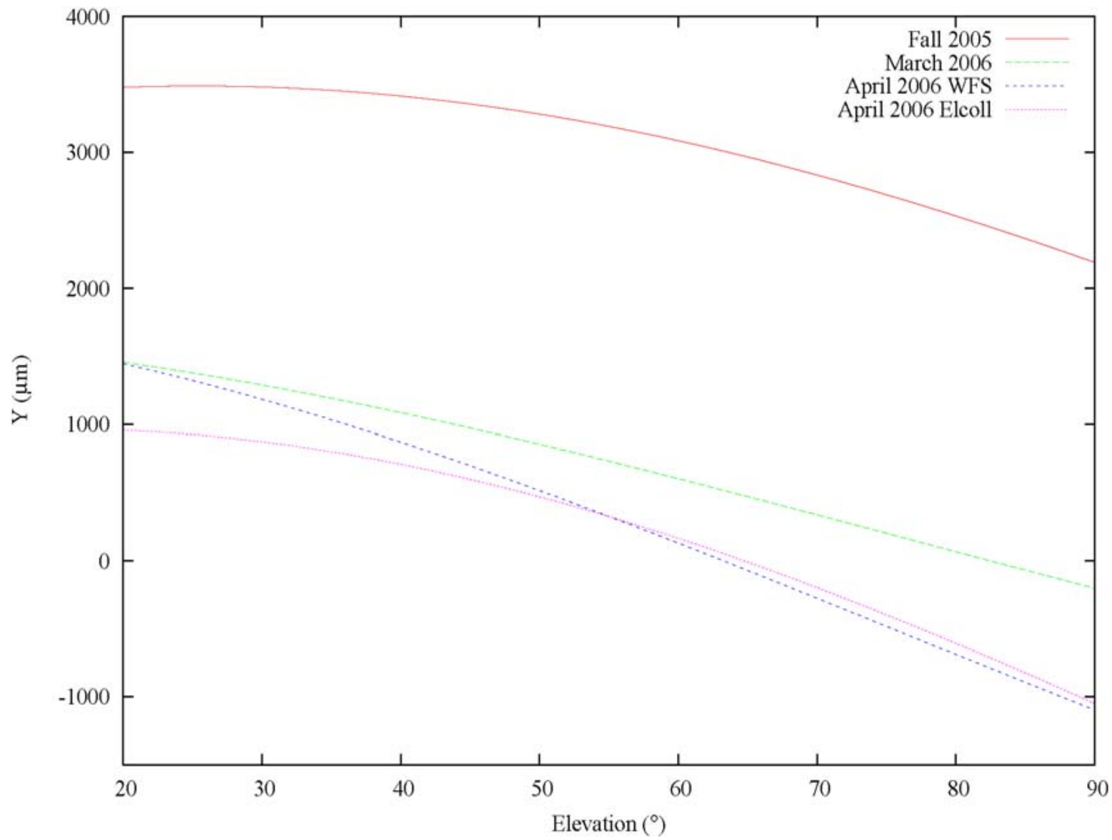


*Figure 3: Y vs. Elevation relations determined at different times between November 2005 and late April 2006. Note the very large offset of about 2.5 mm between November 2005 and all of the results from 2006.*

**Optical Modeling (ZEMAX)**

The ZEMAX introductory level short course Tim Pickering attended covered the basics of optical design and ZEMAX use. Some more advanced topics such as pupil modeling, ray aiming, and tolerancing were also covered. Since attending the class, the acquired ZEMAX proficiency has been put to use to model the surface displacements output from finite element thermal modeling and convert them to wavefront errors. Ongoing work that utilizes ZEMAX includes writing ZPL macros to generate predicted off-axis aberrations as a function of distance off-axis and rotator angle for each of our optical configurations (e.g., *f*/5 spectroscopy, *f*/5 imaging, bare *f*/9, etc.). This is a required part of supporting off-axis, continuous wavefront sensing.

## Optics Support Structure (OSS)

### Secondary Hub

Analysis and off-telescope testing of the secondary support spider arm bracing wires is almost complete. The wires will be installed on the top end of the optical support structure (OSS) in May to increase the frequency of the spiders. This may help to decouple the vibration of the *f*/15 secondary mirror from the top end of the telescope.

## Telescope Tracking and Pointing

### Servos and Encoders

Firmware development on the new encoder electronics was started during the reporting period. We discovered that we had in stock incompatible versions of the RabbitCore modules; only one of the available units will work on the RabbitCore carrier board that interfaces the core module to the encoder data output signals. We anticipate re-designing this carrier board to bring it up to the current revision level of RabbitCore modules available from the vendor. In the meantime, we have been able to power the spare absolute encoder and collect position data with the RabbitCore, serving it to a simple webpage. We have yet to connect the FIFO interface that ultimately provides the encoder data to the mount computer, but we plan to begin testing and bring the complete assembly online soon.

Testing of the secondary hub resonances using a chirp input to the elevation motors was done during the reporting period. The heretofore buggy Simulink chirp block was fixed and the new version deployed successfully. Not surprisingly, the 20Hz mode on the hub is stronger (by ~30db) than all the other modal frequencies; in addition, this strongest mode is along the optical axis (Z, or piston motion), confirming the data taken by CAAO. We await installation of the secondary vane stiffening wires for comparison to measure improvements in modal stiffness of the hub.

We attempted deployment of the auto-generated Simulink servo controller code on the new mount PC, unsuccessfully. More investigation into the behavior of the generated code inside the VxWorks infrastructure remains to be done to understand why this didn't work. While the new servo bridge interface to the mount control hardware is in working order, we had some minor cabling issues that will also need to be addressed to make it easier to switch back and forth from test mode to operational mode for further testing at the telescope.

## Computers and Software

### Logging Database

The current logging of system parameters for the MMT was reviewed in the context of using relational database software, such as MySQL, for at least a portion of this logging. Based on this review, a new MySQL database was developed on the main MMT operations computer, *hacksaw*.

A variety of tables were defined in the database. Some tables, related to the existing background logs, log all data from a particular hardware device (e.g., the mount crate) at regular intervals, depending on the nature of the data. Thermal and environmental data are currently being logged every five minutes, while more transient data, such as from the cell, hexapod, and mount crates, are being logged every five seconds. These tables fit well into a relational database framework, being indexed by a timestamp. Names of fields within the tables correspond to existing variable names used elsewhere within the MMT telemetry and logging. The data types and sizes of individual fields within the tables were optimized for efficiency. Additional secondary indices were created, where appropriate, to aid in rapid database access.

A variety of event, information, and error logs are also currently used by the MMT. Preliminary tables similar to these logs were also created in the database. Each entry in these logs is triggered by a user input, an informational message, or an error reported from the software. Additional work is required to categorize different types of events and errors and to develop table structures that are most appropriate for these types of data. Entries in these tables also need to be related to data contained in the background-log type tables.

Several new scripts have been written to input data into the database. At the present, most of the scripts are involved in periodically inserting new data into the background-log type tables. Other scripts are related to database backup and archival. In addition, several of the existing mini-servers have been modified for background data input into the database.

Preliminary web pages have also been developed to present the data in the MySQL database in tabular and graphical from. One new web page (see Figure 4) allows two variables to be plotted against each other over the same time scale. Figure 4 shows a 24-hour period sample plot of hardpoint #1 load cell data (from the primary mirror support) compared to mount altitude values. At this timescale, the large-scale fluctuations in load cell readings can be seen corresponding to large telescope slews in elevation. These and related web pages are proving valuable in understanding the inter-relation of different telescope systems. Additional work is required in data presentation, as well as in data management and archiving for the new database.

No problems have been encountered so far related to database performance and size. Decisions will need to be made in the future regarding permanent archiving of data and pruning of at least part of the data from the tables as they grow larger.

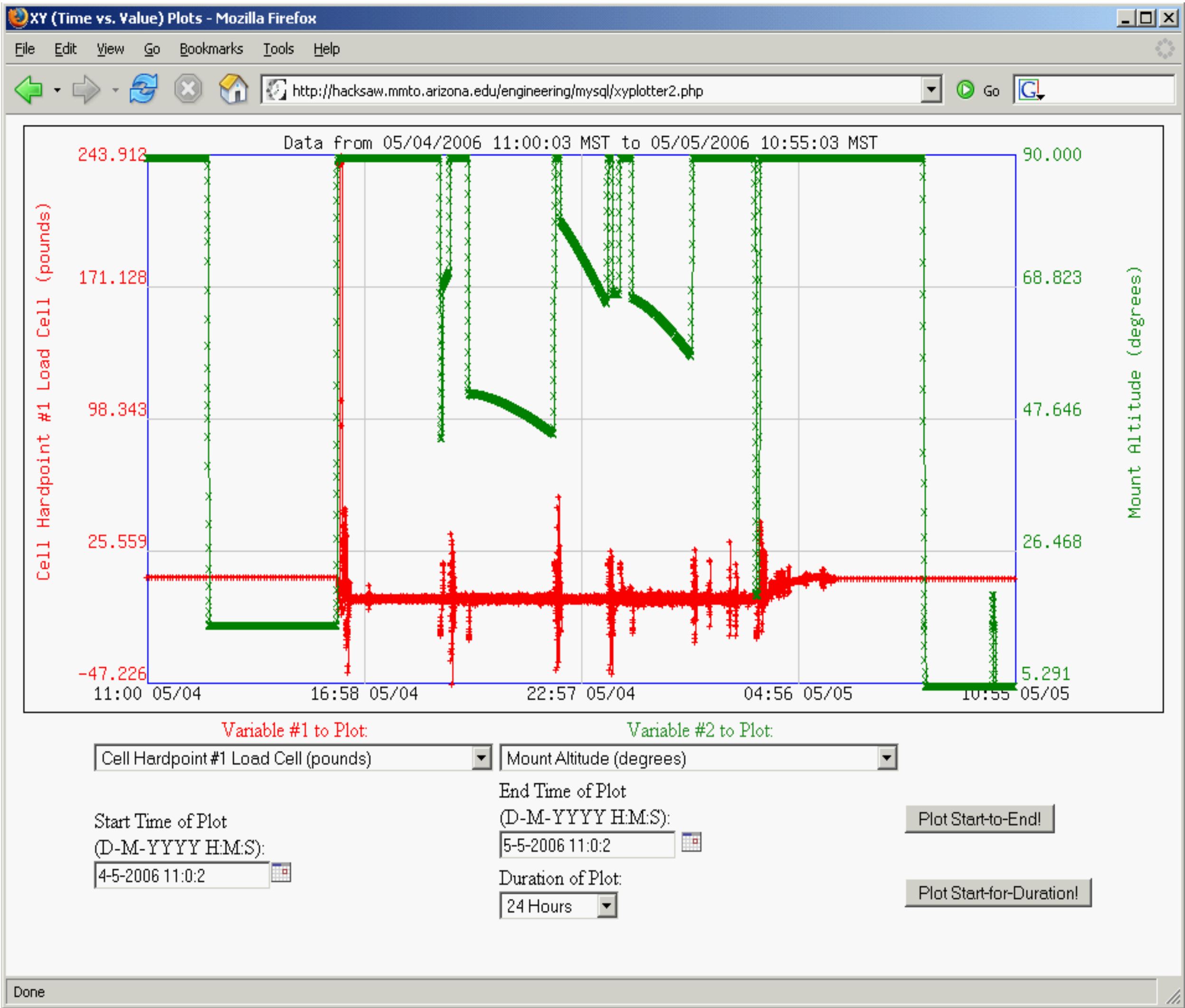


*Figure 4: A sample of data from the new MySQL database. This figure illustrates inter-relations between cell #1 hardpoint load cell and mount altitude. See text for more details.*

### Service Tracking System

The "service" tracking system, described in the previous bimonthly summary, continues to greatly facilitate identification and resolution of issues that arise during telescope operation. Definition of categories and subcategories for the MMT has stabilized during the past two months. Concise summaries of open Service Requests (SR) are now sent automatically via email to MMT staff and are available through new web pages (courtesy of John Glaspey).

### *f*/5 Secondary Control Software

Work has continued on updating the software limits for allowed moves for the *f*/5 secondary and for the user interface for all MMT secondaries and hexapods. The allowed range of motion for the *f*/5 secondary was systematically mapped in March. It was found that with large tilts, the *f*/5 secondary makes contact with its surrounding support structure at three different points. Contact was not possible with purely translational moves of the secondary. The tilts that result in contact are much larger than would be expected in normal telescope operation. Software limits have been put in place to prevent the excessive tilts for the *f*/5 secondary.

Code within *hexgui*, the main user interface for all MMT secondaries, was updated to use a more object-oriented approach to Ruby/Gtk programming. Two of the windows for *hexgui*, those related to individual pod readings and to limits, have been converted. Work continues on converting the main window to the more object-oriented approach.

**Primary Cell Support Software**

We have embarked on a new round of programming for the primary cell support computer (the "cell crate"). We have been aware for some time that this computer is pressed to its limit (it is an MVME167 VME computer with a 68040 processor). We have found that by improving the driver software for the Acromag 9330 data acquisition card, a substantial load can be removed from the main CPU, and this driver has now been developed and tested. Initial tests show that the cell crate now has over 25 percent idle time, which is very desirable headroom. We intend to exploit this by improving network protocols and developing improved logging and user interfaces for the cell.

**Environmental Systems**

As reported in the previous Bimonthly Summary, a new Yankee thermohygrometer (model MET-2010) was configured and a new mini-server was written to obtain and log data from the unit. The following figures present dewpoint temperature measurements from this and other units.

Figure 5 presents a comparison of dewpoint temperature measurements from three units for the night of March 4-5, 2006. These units include the Yankee thermohygrometer, the Vaisala HMP240, and the Vaisala WXT510. The Yankee and HMP240 units are located in the chamber, while the WXT510 unit is outside on a pole by the MMT support building. The chamber was open during the entire time period displayed in this chart: 6 p.m. to 6 a.m. The Yankee thermohygrometer directly measures the dewpoint or frostpoint temperature(s) using a chilled mirror. The unit reports these temperatures with ±0.05C accuracy down to relative humidity as low as 2%.

Figure 6 shows the corresponding relative humidity for the night of March 4-5, 2006. Note the low relative humidity through the night, especially in the morning when values were even approaching the 2% relative humidity limit of the Yankee thermohygrometer.

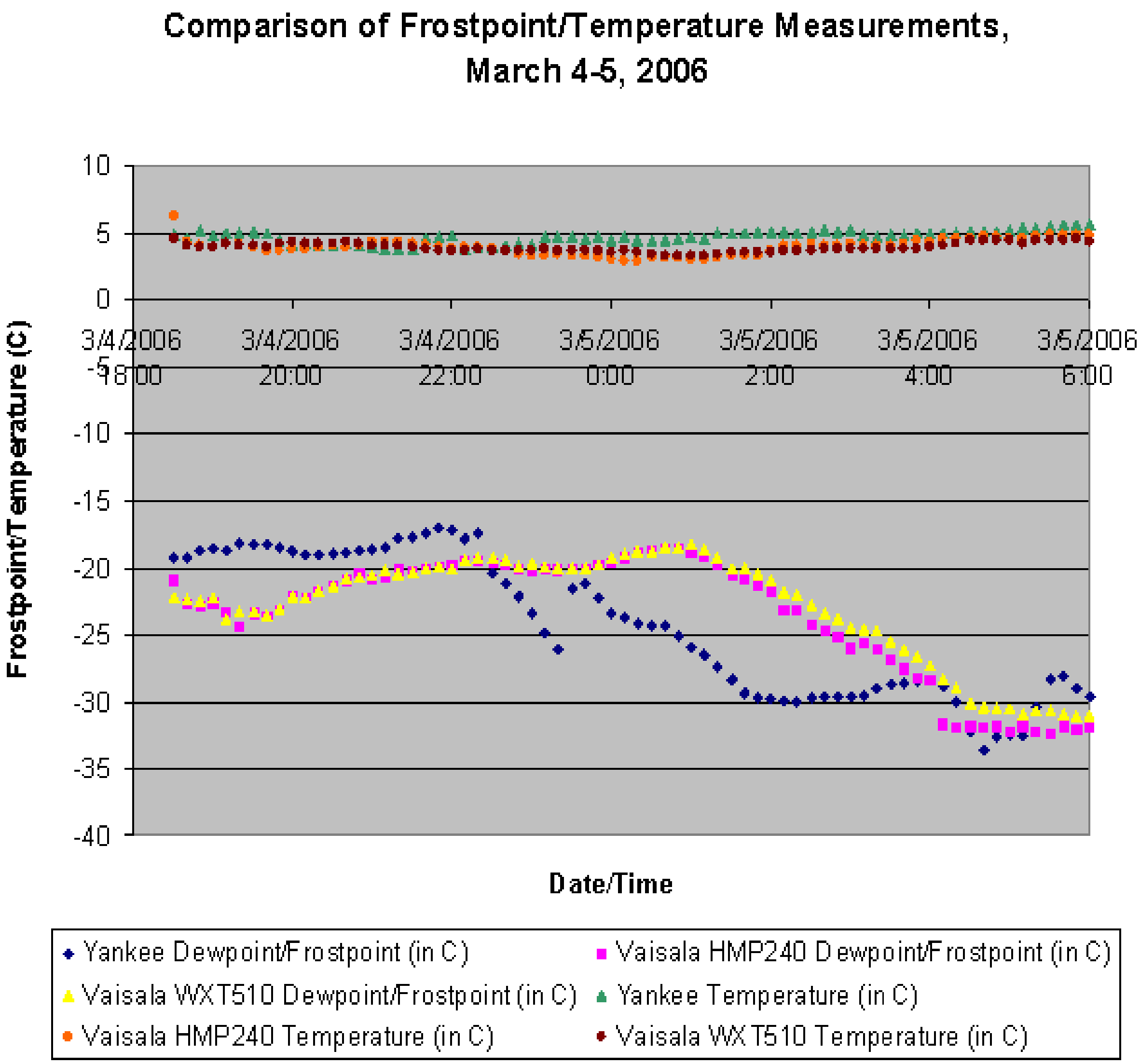


*Figure 5: Comparison of dewpoint temperature measurements from three units for the night of March 4-5, 2006.*

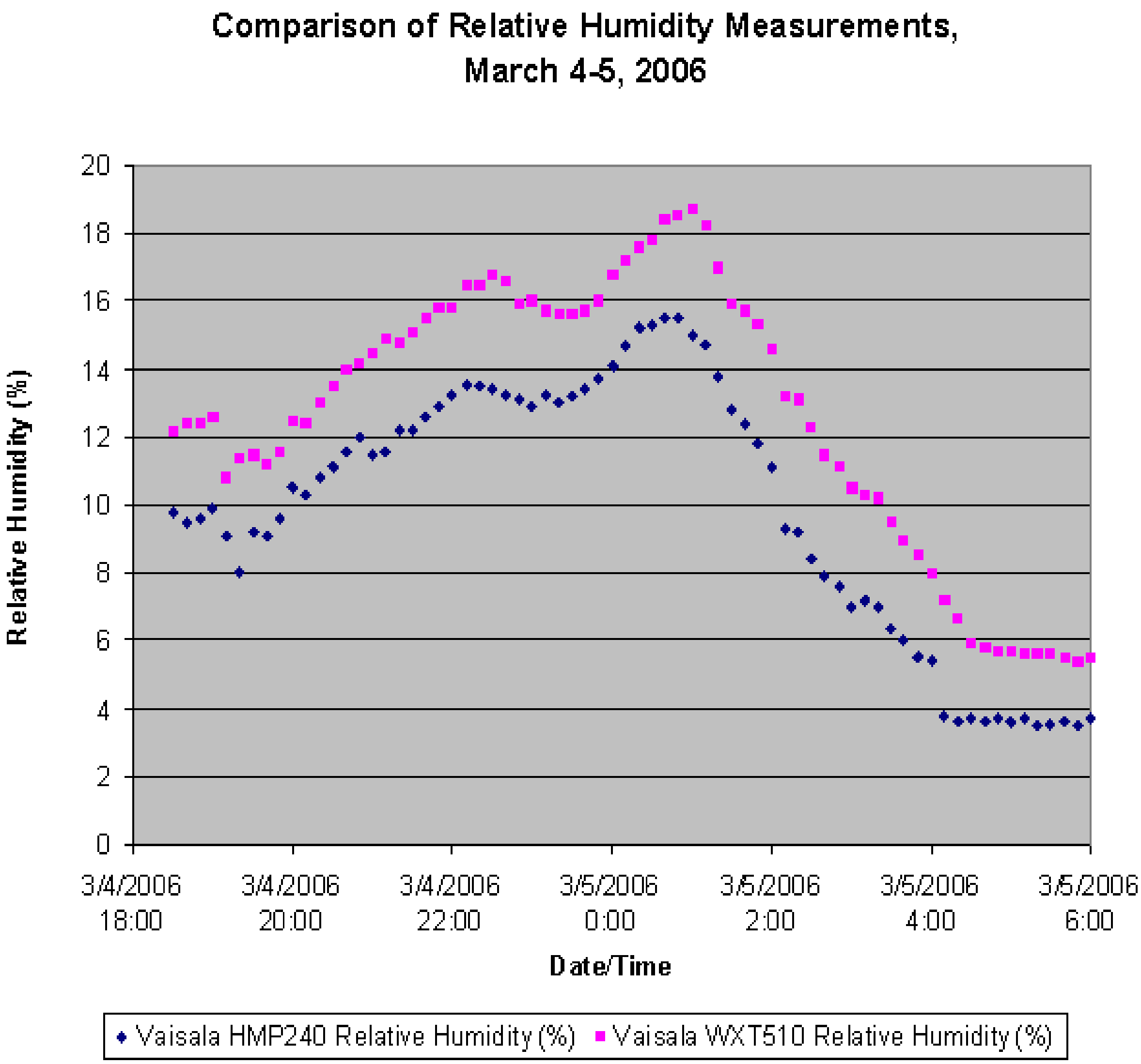


*Figure 6: Corresponding relative humidity for the night of March 4-5, 2006.*

### Miscellaneous Software

Code for a new mini-server, *hexapod_support*, was written. This mini-server can communicate with electronics that report secondary status through a Lantronix UDS-10 single-port device server. These data are currently sampled by a serial cable connected to the hexapod crate. At the moment, this mini-server is used mainly for testing of electronics.

Tim Pickering created a new MMT weather data web page (*http://www.mmto.org/weather/*) that summarizes current and past weather data.

Minutes of the engineering meetings are in the process of being added to the MMTO dokuwiki.

## Instruments

### Adaptive Optics

Overall, the *f*/15 natural guide star (NGS) observing was very smooth and uneventful. A good set of science data was collected with only minimal problems from the system. After the run, the secondary was mounted on the new handling fixture, the DM (deformable mirror) jockey. This will make handling the secondary easier and safer. It will also integrate with the new *f*/15 test stand, which will be moved from Steward to the Common Building clean room during the June run. The clean room was completed during this time period.

The laser guide star (LGS) time was also very productive. The image quality was the best seen so far, which allowed collecting 60 subaperture data at 200 Hz with a very good signal-to-noise ratio. In addition, the Microgate reconstructor was tested for the first time on-sky. During this time, data were collected that will allow the final testing of the reconstructor with the *f*/15 secondary. This will happen during summer and early fall.

### Hectospec

During the night of March 23, robot 1 inside the *f*/5 fiber positioner dropped offline with a Y-axis compare error. This was a recurrence of an error that had occurred during the previous week, and therefore was not entirely unanticipated. The problem was thought to be in the internal cabling to the linear encoders. An external cable to bypass the failed encoder was fabricated and a software modification was implemented which allowed the use of the rotary encoder.

However, on the night of Thursday April 21, robot 1 again dropped offline during a sequence with a following error on the X-axis. Remote troubleshooting by Dan Fabricant and John Roll found that a PMAC reset error was also set, indicating that both the +X and -X limit switches had been on at the same time. Together, these errors indicated that the encoder/limit power had briefly failed during the move probably due to shorting in an internal cable. This was consistent with problems in the bad Y1 encoder cable that was discovered earlier. This problem had been scheduled for repair in May.

The decision was made to disconnect the failing internal cable. Dan Fabricant, Mark Mueller, and Joe Zajac traveled to the MMT to repair the positioner. The instrument was removed from the telescope on Friday and separated on Saturday. During the separation, the procedure for separating the instrument was updated. The SAO team disconnected the suspect cable and inspected all other cabling in the energy chains inside the positioner. They found cracks in some of the other encoder cables and will therefore replace the six affected cables with ultra-high flex cable during the August shutdown.

In an unrelated incident, on the following night the pellicle beam splitter on robot 1 became separated from its mount. The instrument was again removed from the telescope and separated. The pellicle was replaced and the instrument was reassembled and remounted.

MMTO assisted with the Hecto repairs, and SAO plans to do a presentation and training session for MMTO staff on the operation and maintenance of their equipment.

The mounting procedures for the *f*/5 instruments are being added to the MMTO dokuwiki.

### Hectochelle

The Hectochelle calibration lamp assembly was completed and installed by Court Wainwright and Creighton Chute. The system is mounted on a spider structure directly in front of the *f*/5 secondary. This allows observers to obtain calibration data without changing elevation or closing the building. The lamp assembly has performed successfully during two Hectochelle runs with no problems.

## General Facility

### Road Heaters

The first time this spring that we actually needed the road heaters, they didn't work. The ensuing investigation revealed that there are two power sources: one for the 480 VAC three phase power and one for the control circuitry. The control circuit was on and indicated, via the red lights, that things were working. Apparently the three phase power had never been turned back on after aluminization. When it was turned on, most of the power came on. Three of the GFE breakers had tripped, indicating excess leakage current in those circuits. This problem has been turned over to the contractors, Sierrita Mining & Ranching (SMR) and Stark Electric, and is being handled by Steve Criswell (FLWO).

The false indication of the control circuit was rectified by adding a phase loss detector in series with the control power, so that a lost phase or total power loss of the three phase power will not allow this false indication. In order to do this, some rewiring was necessary to continue to provide proper indicators in both the old control room and the control box. This modification required elimination of the controls' second and third start buttons. The first start button now starts the first (upper) circuit and the timers for the second (middle) and third (lower) circuits. The three indicators now come on at the end of the time-out period to truly indicate that power has been applied to the circuit loads.

**Carrier Chiller**

The Carrier chiller began to exhibit an intermittent alert that one of the two compressors was shutting down because of a problem. After a number of phone calls, a Carrier technician came up and found a corroded connector on a pressure transducer on the affected compressor. This was caused by a missing gasket from the factory. A new transducer was installed but a new connector yet needs to be installed. A temporary connection was made to allow normal operation. While the technician was here he discovered a bad bearing on one of the fan motors that will need to be replaced. He also discovered that the spare parts we were about to order were incorrect. That purchase was canceled, and a new quote for the spares and upgrade to the system is underway.

**Other Facility Improvements and Repairs**

A short circuit in the 50 HP ventilation blower motor input supply, caused by vibration, was repaired by Tom Welch (FLWO). A subsequent investigation found that the protective overload heaters in the controller had operated correctly and were properly sized. Additional insulation needs to be added to the junction box on the motor.

Two of the laser warning flashers failed and were replaced. This failure was an indication of a poorly designed (and cheap) vendor part. An alternate device is being investigated.

Bruce McDuffee from Vaisala visited the mountain to see our operation and do a short presentation about their equipment.

A new transmission was installed in the mountain's International air ride truck. The old unit jumped out of first gear, not a good feature for a mountain truck.

Bill Stangret and Dennis Smith added four fluorescent light fixtures in the south end of the chamber. They will add several more when time permits. This will allow us to leave the "hot" chamber flood lights off when doing instrument or secondary changes.

Bill Stangret and Dennis Smith did preventive maintenance on the Gardner/Denver 30 HP compressor. This included changing out the drive belts.

In preparation of the upcoming LOTIS aluminization, Ricardo Ortiz and Bill Stangret built a jig to allow service of the copper lead feedthrough terminals inside the aluminizing bell jar.

A small leak in the spare line of the Neslab methanol system was discovered during the AO run. It was removed and replaced with a new section.

Bill Stangret built and installed a new protective cover guard for the Heidenhain encoder read-head at the east elevation drive arc.

Reliability issues continue with the Vaisala HMI36 unit, the "old Vaisala." Various internal readout errors have occurred over the past few weeks. Efforts are continuing to fix these errors.

The damaged RainWise remote weather station has been retired from service. It has been replaced by the Vaisala WXT510 unit, the Yankee thermohygrometer, and other weather sensing devices.

## Visitors

April 1: With the help of Ale Milone and Mike Calkins, Faith Vilas hosted 12 Embry-Riddle University space studies students and one professor for a tour of the MMT and Ridge telescopes.

April 10: Faith hosted the family of the Director of the National Endowment for Financial Education (NEFE) for a tour of the MMT.

April 18: John Glaspey hosted three KPNO mountain scientific operations staff members who observed the installation of Hectochelle and *f*/15 to *f*/5 secondary changes.

## Publications

### MMTO Internal Technical Memoranda

None

### MMTO Technical Memoranda

None

### MMTO Technical Reports

None

### Scientific Publications

06-14 First Attempt at Spectroscopic Detection of Gravity Modes in the Long-Period Pulsating Subdwarf B Star PG 1627+017
B.-Q. For, E. M. Green, D. O'Donoghue, L. L. Kiss, S. K. Randall, G. Fontaine, A. P. Jacob, S. J. O'Toole, E. A. Hyde, T. R. Bedding
*ApJ*, **624**, 1117

06-15 M33's Variable A: A Hypergiant Star More than 35 Years in Eruption
R. M. Humphreys, T. J. Jones, E. Polomski, M. Koppelman, A. Helton, K. McQuinn, R. D. Gehrz, C. E. Woodward, R. M. Wagner, K. Gordon, J. Hinz
*AJ*, **131,** 2105

06-16 Absolute Properties of the Main-Sequence Eclipsing Binary Star EY Cephei
C. H. Sandberg Lacy, G. Torres, A. Claret, J. L. Menke
*AJ*, **131,** 2664

06-17 The OGLE-II Event sc5_2859: A Classical Nova Outburst?
C. Afonso, J. F. Glicenstein, A. Gould, M. C. Smith, R. M. Wagner, J. N. Albert, J. Andersen, R. Ansari, É. Aubourg, P. Bareyre, J. P. Beaulieu, G. Blanc, X. Charlot, C. Coutures, R. Ferlet, P. Fouqué, B. Goldman, D. Graff, M. Gros, J. Haissinski, C. Hamadache, J. de Kat, L. LeGuillou, É. Lesquoy, C. Loup, C. Magneville, J. B. Marquette, É.

Maurice, A. Maury, A. Milsztajn, M. Moniez, N. Palanque-Delabrouille, O. Perdereau, L. Prévot, Y. R. Rahal, J. Rich, M. Spiro, P. Tisserand, A. Vidal-Madjar, L. Vigroux, S. Zylberajch
*A&A*, **450**, 233

06-18 Hydrogen and Helium Traces in Type lb-c Supernovae
A. Elmhamdi, I. J. Danziger, D. Branch, B. Leibundgut, E. Baron, R. P. Kirshner
*A&A*, **450**, 305

**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:

- General information about the MMT and Mt. Hopkins.
- Telescope schedule.
- User documentation, including instrument manuals, detector specifications, and observer's almanac.
- 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

## March 2006

| Instrument | Nights Scheduled | Hours Scheduled | Lost to Weather | Lost to Instrument | * Lost to Telescope | Lost to Gen'l Facility | Lost to Environment | Total Lost |
|---|---|---|---|---|---|---|---|---|
| MMT SG | 9.00 | 95.80 | 36.30 | 0.00 | 0.25 | 0.00 | 0.00 | 36.55 |
| PI Instr | 22.00 | 222.70 | 129.70 | 32.65 | 0.25 | 0.00 | 0.00 | 162.60 |
| Engr | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sec Change | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total** | **31.00** | **318.50** | **166.00** | **32.65** | **0.50** | **0.00** | **0.00** | **199.15** |

Time Summary

| | |
|---|---|
| Percentage of time scheduled for observing | 100.0 |
| Percentage of time scheduled for engineering | 0.0 |
| Percentage of time scheduled for sec/instr change | 0.0 |
| Percentage of time lost to weather | 52.1 |
| Percentage of time lost to instrument | 10.3 |
| Percentage of time lost to telescope | 0.2 |
| Percentage of time lost to general facility | 0.0 |
| Percentage of time lost to environment (non-weather) | 0.0 |
| Percentage of time lost | 62.5 |

* Breakdown of hours lost to telescope
primary panic 0.25

## April 2006

| 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 | 29.50 | 272.05 | 77.60 | 38.20 | 0.00 | 0.00 | 0.00 | 115.80 |
| Engr | 0.50 | 4.55 | 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** | **30.00** | **276.60** | **77.60** | **38.20** | **0.00** | **0.00** | **0.00** | **115.80** |

Time Summary

| | |
|---|---|
| Percentage of time scheduled for observing | 98.4 |
| Percentage of time scheduled for engineering | 1.6 |
| Percentage of time scheduled for sec/instr change | 0.0 |
| Percentage of time lost to weather | 28.1 |
| Percentage of time lost to instrument | 13.8 |
| Percentage of time lost to telescope | 0.0 |
| Percentage of time lost to general facility | 0.0 |
| Percentage of time lost to environment (non-weather) | 0.0 |
| Percentage of time lost | 41.9 |

## Year to Date April 2006

| 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 | 26.00 | 284.70 | 92.00 | 7.00 | 4.55 | 1.50 | 0.00 | 105.05 |
| PI Instr | 91.50 | 959.35 | 384.15 | 86.35 | 5.55 | 5.00 | 0.00 | 481.05 |
| Engr | 2.50 | 28.25 | 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** | **120.00** | **1272.30** | **476.15** | **93.35** | **10.10** | **6.50** | **0.00** | **586.10** |

Time Summary

| | |
|---|---|
| Percentage of time scheduled for observing | 97.8 |
| Percentage of time scheduled for engineering | 2.2 |
| Percentage of time scheduled for sec/instr change | 0.0 |
| Percentage of time lost to weather | 37.4 |
| Percentage of time lost to instrument | 7.3 |
| 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) | 0.0 |
| Percentage of time lost | 46.1 |