BIMONTHLY SUMMARY

July - August 2005

The Florida Fire as seen from the FLWO Basecamp at 2:06 p.m. on Monday July 11, 2005. Photo courtesy of Stephen Criswell (FLWO).

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Personnel

As representatives from the Mt. Hopkins observatories, Grant Williams, Dan Brocious (FLWO), and Emilio Falco (FLWO) attended a public hearing on the Cochise County Outdoor Lighting Code on August 4. The same group met with Mary Dahl, the Director of the Santa Cruz Department of Community Development, on August 8 to continue work on the new Santa Cruz County Outdoor Lighting Code.

Primary Mirror Systems

Primary Mirror Support

In August the actuator calibration stand was re-leveled and verified; calibration and maintenance of the primary mirror support actuators began. The zero and span settings of the transducers were readjusted to 3 psi and 105 psi, respectively. All hardware and electrical connectors were checked and secured. Spares are being rebuilt to operational condition as well.

Code was added to the actuator teststand VxWorks software to include step, ramp, and sine wave transitions between force levels as part of the standard actuator calibration sequence. After testing, it was found that the values being sampled by the teststand VME crate are highly filtered. Modification of the teststand to remove the filter board allowed comparisons of the unfiltered and filtered load cell data. It was decided that the filtered data were so heavily modified by the filtering process that these new transition tests were not representative of the unfiltered data. The new tests were not included as part of the calibration sequence.

Linear regressions were done of archival and current actuator teststand data. These regressions determine the relationship of volts to pounds for the actuator load cells. The results of the linear regressions will be used to update coefficients in the cell crate code. Both the slopes and y-intercepts from the new regressions will be used in the crate code. Previously, only the slope values had been used. Teststand data from all 104 actuators (plus spares) of the primary cell were logged, analyzed, and merged into Excel spreadsheets. Plots were made of each actuator's commanded and actual positions versus time.

For some time, we have experienced "panics" from the cell crate software while slewing the telescope in elevation near full speed. The problem looked very much like a lack of response from the actuator servos, resulting in a large following error. In fact, this was not the problem at all; the problem was that the cell crate was not sampling the actuator force monitors as rapidly as it should have been, and was using stale force monitor data for safety checks. This cell crate code has been corrected, and we should now be able to operate the telescope at full slew speeds without causing panic set-down of the primary mirror.

A digital flow meter for the primary support system was installed to monitor changes in gross air demand by the cell. Duane Gibson, with assistance from the electronics team, has set up a system to log the data.

Aluminizing

The assembly of all the hardware for the welder supply for aluminization was completed. New printed-circuit boards were built for each welder's load voltage feedback and control, a new rack with power supplies and interface electronics was assembled, and all necessary cables were either built or purchased. The rack also includes a PC running a Softwire data acquisition GUI for gathering welder system data during the coating. We expect to wire the welders to a recently-purchased power panel for distribution of the 480VAC three-phase supply, and test them all on our dummy resistors for a full-load test prior to the coating. When aluminization is completed, we will have a complete set of weatherproof cases for storage of all the hardware and spares, ready for the next adventure in aluminizing. Kudos to Brian Comisso and Cory Knop for their excellent construction work on this project.

The aluminization control rack modifications continued with the discovery that the LED display modules did not have the same full scale readings. A buffer board was designed and fabricated to match the signals to the displays. The fan and some of the external cabling was installed on the rear panel. Labels were made and installed and cables were identified. The data acquisition unit (DAU) signals were sorted out and software was implemented to capture the raw data from the rate monitoring crystals and the pressure sensors.

During the Florida fire in July, we tested the #1 cryopump at the FLWO basecamp in preparation for summer shutdown activities. (In May the pump had been sent to Austin Scientific for repairs.)

Miscellaneous

Work continued on fabricating a new fabric panel for the mirror cover.

Optics Support Structure (OSS)

Secondary Hub

The fixed secondary hub was removed from the telescope for modifications on July 28. Some of the issues addressed include enlarging the keyhole for laser optics access, machining the inner diameter of the aft stiffening ring, verifying bolt patterns, and repainting all surfaces. To ensure that it will be reinstalled at the same location, its position was measured on July 22 using the K&E alignment telescope mounted on the rotator alignment tool (RAT). Crosshairs were installed on the front and rear of the secondary hub using piano wire strung between bolts on mounting flanges. A target with a 1 mm grid pattern was placed behind the rear crosshairs. The positions of three sets of crosshairs were measured: the internal K&E crosshairs (inside the telescope), the front hub crosshairs, and the rear hub crosshairs.

Telescope Tracking and Pointing

Encoders

Work continued during the reporting period on development of new absolute encoder electronics. A new angle-to-digital board was designed and committed to printed circuit. Making heavy use of surface-mount devices, this board will replace the current separate preamplifier and angle-to-digital board and associated crosstalk-prone cabling; the new board contains all the preamplifier and conversion circuitry and will install directly inside the encoder. A microprocessor will process the digital angle data for transmission over a fast serial link to a first-in first-out (FIFO) readout by the mount computer, and make the raw data available on a webpage for troubleshooting purposes. We await the completion of the project in the fall.

Seeing

Mt. Hopkins Seeing Conditions

The summer shutdown provided a good opportunity to look over the 2+ years of seeing data that have been collected with our Shack-Hartmann wavefront sensors (WFS). Every image taken with those instruments provides a seeing data point by measuring the average spot width and deriving the seeing from that using a standard atmospheric turbulence model. Thus far we have just shy of 20,000 such data points. Figure 1 shows total and cumulative histograms of this data. The distribution is similar to what was observed with the old MMT with a peak near 0.7" and a long tail. The seeing was better than 1.0" nearly 3/4 of the time and better than 0.5" about 1/6 of the time. This confirms Mt. Hopkins's status as a site with good to excellent seeing.

A breakdown of the data allows us to look for possible trends. Figure 2 shows the results of splitting the data into UT quadrants. The bin for the last quarter of the night (3 AM onward) has a significantly narrower peak and lower median seeing than the other quadrants. This is consistent with the conventional wisdom that seeing often settles down overnight and is best at the end of the night. It's possible this is due in part to selection effects since good nights may be more likely to have WFS data taken at the end of the night to take the most advantage of conditions. On the other hand, the results from the end of the night are the most consistent with those reported in MMTO Conversion Tech Memo #96-4 from the old MMT where the data were also taken at the end of the night, but in an unbiased fashion (i.e., whenever it was clear).

A month by month breakdown of the data is shown in Figure 3. Conclusions are more difficult to draw here since the smaller number of points per bin allows good or bad nights with lots of data to skew the results significantly. Figure 4 shows the seeing data plotted versus the time of year it was taken. There are still significant observational gaps in some of the months (February and September, in particular) and lots of scatter in the seeing year-round. In fact, there is frequently a lot of scatter even in a given night. This has been seen qualitatively by the AO group during *f*/15 runs, and Figures 5 and 6 show results from nights where tempfoc data were obtained. These are perhaps a bit unrepresentative since tempfoc data are taken pointing due north at an elevation of about 30 degrees, which brings ground layer seeing effects into much greater play. Still, it is not uncommon to see the seeing jump from 0.5" to 1.0" on short timescales even at zenith.

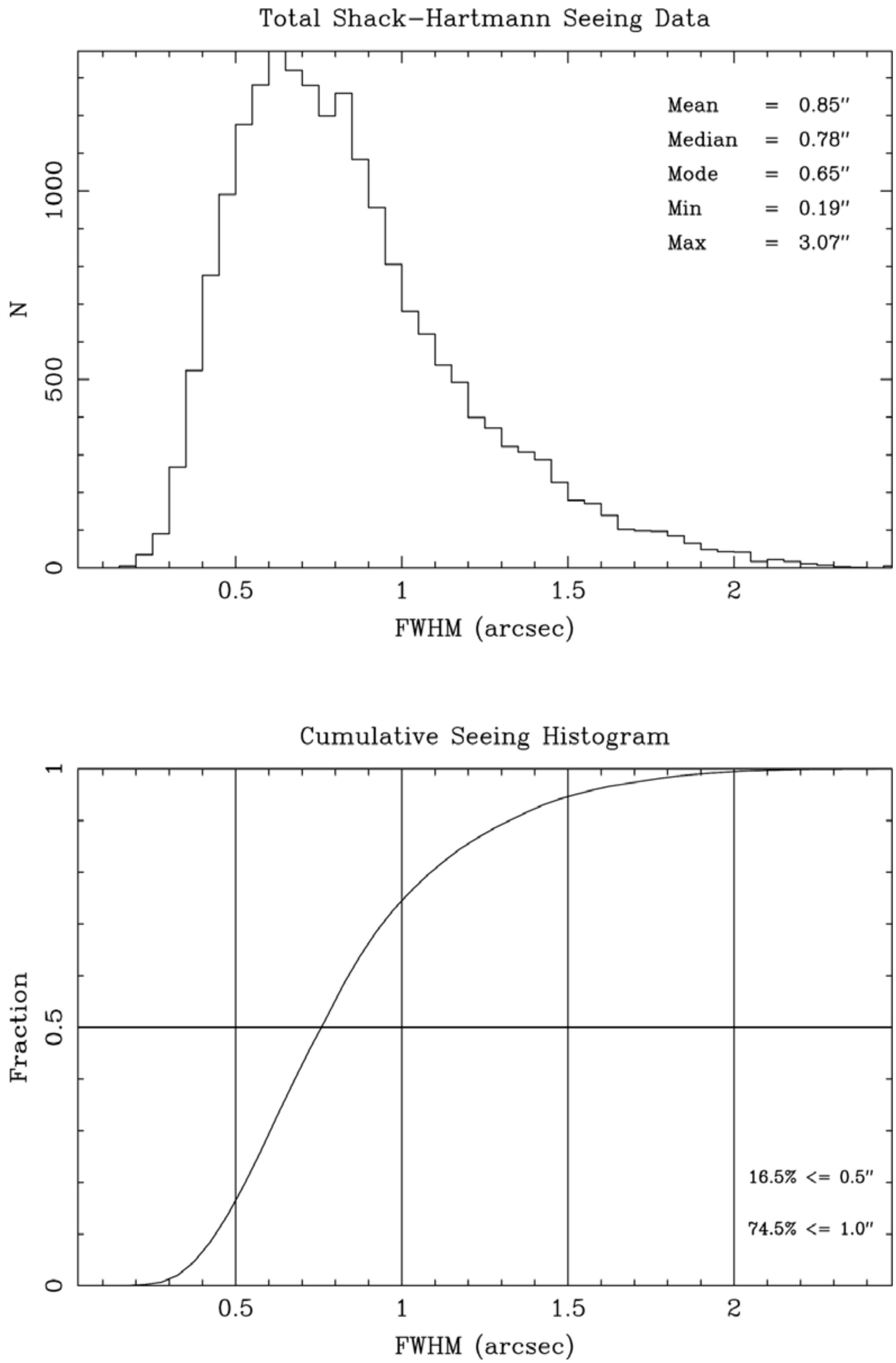

Figure 1: Total and cumulative histograms of the Shack-Hartmann seeing data.

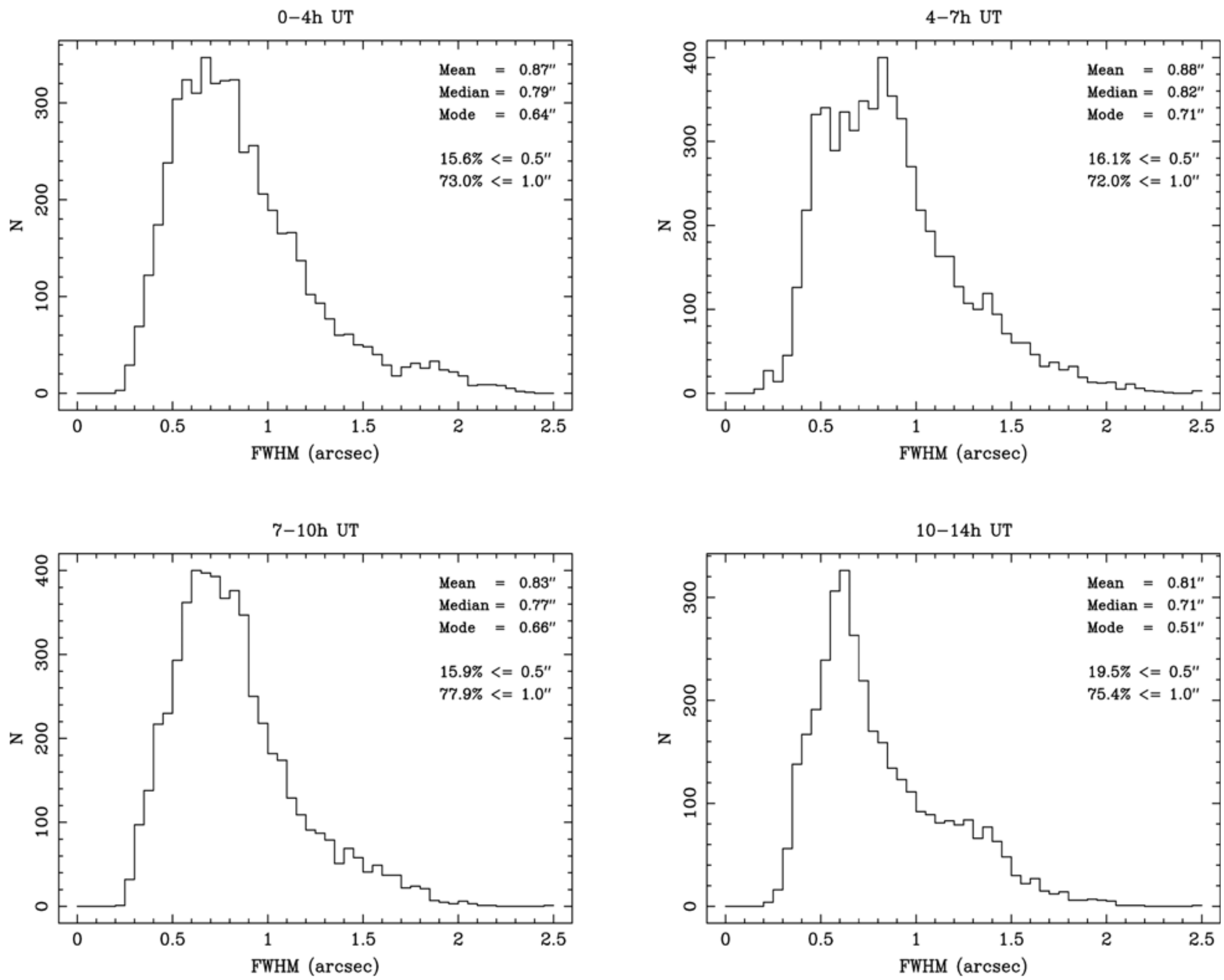

Figure 2: Histograms of seeing data divided into quadrants of the night.

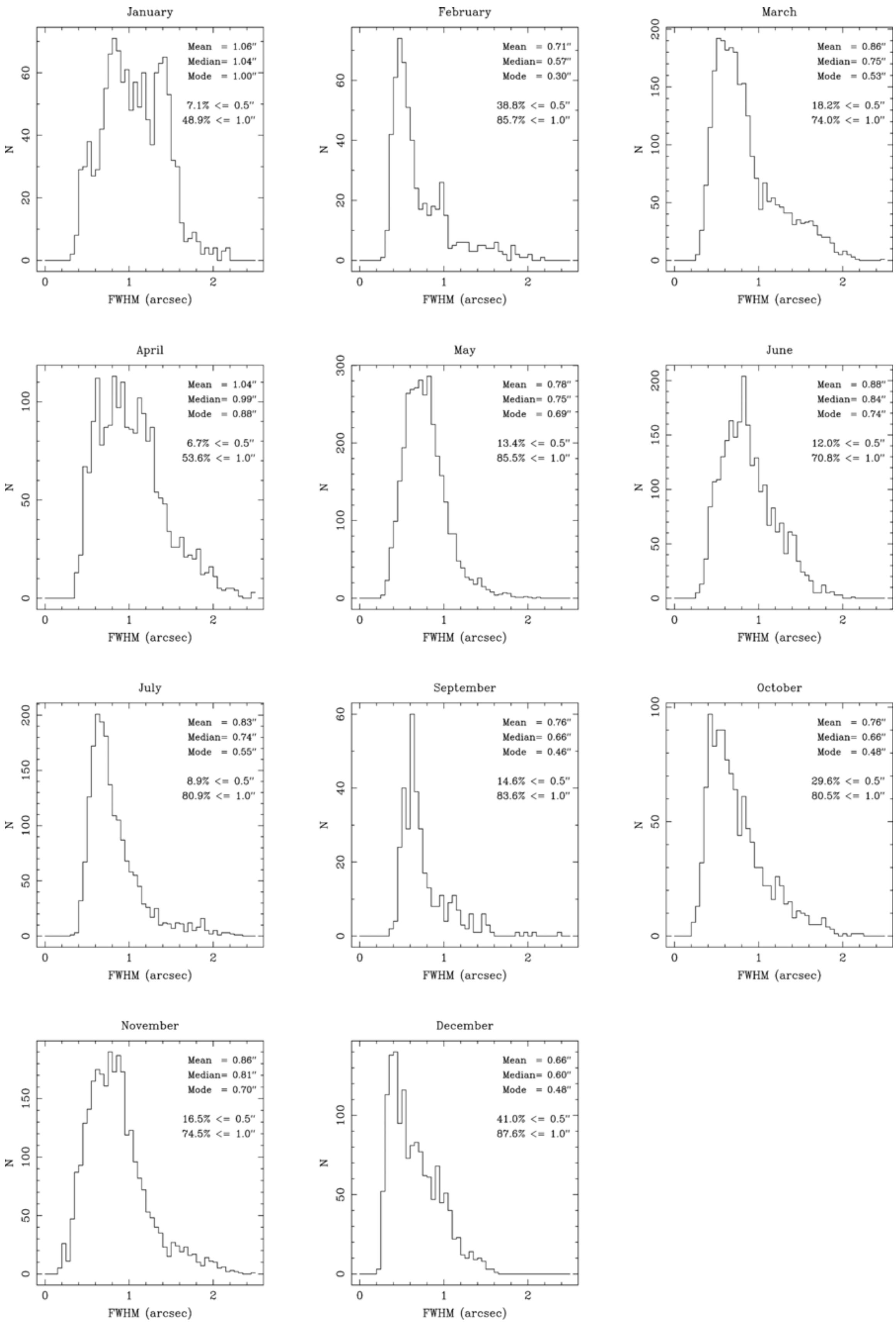

Figure 3: Histograms of seeing data divided into months of the year.

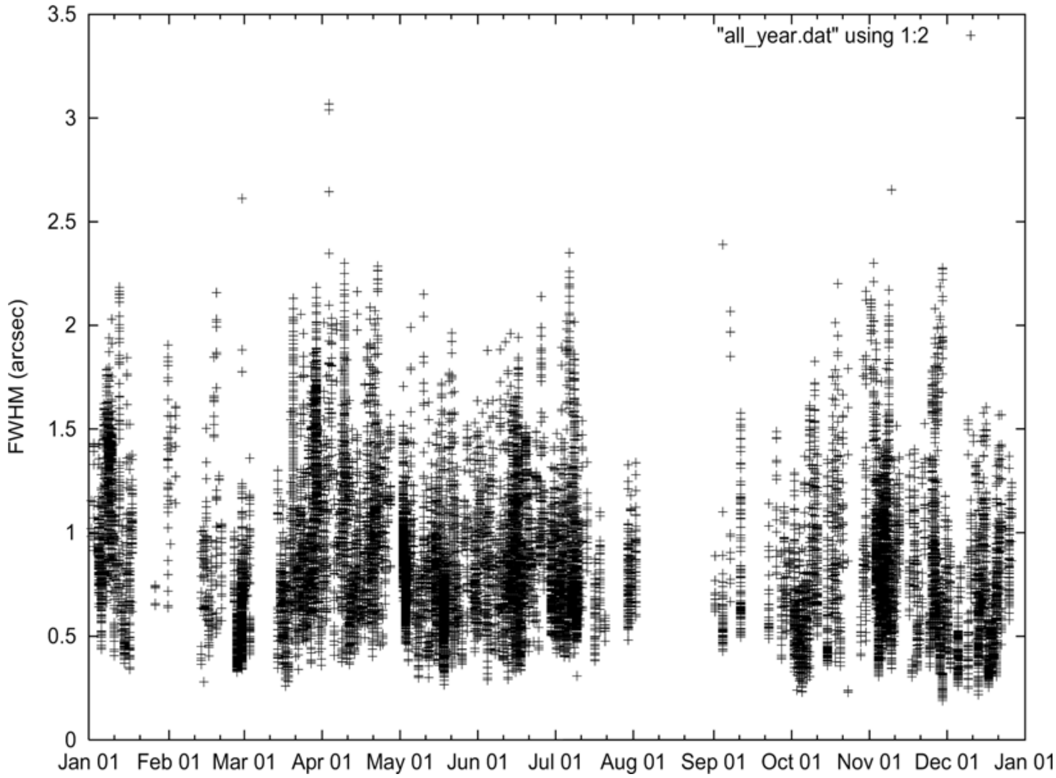

Figure 4: Plot of seeing versus time of year.

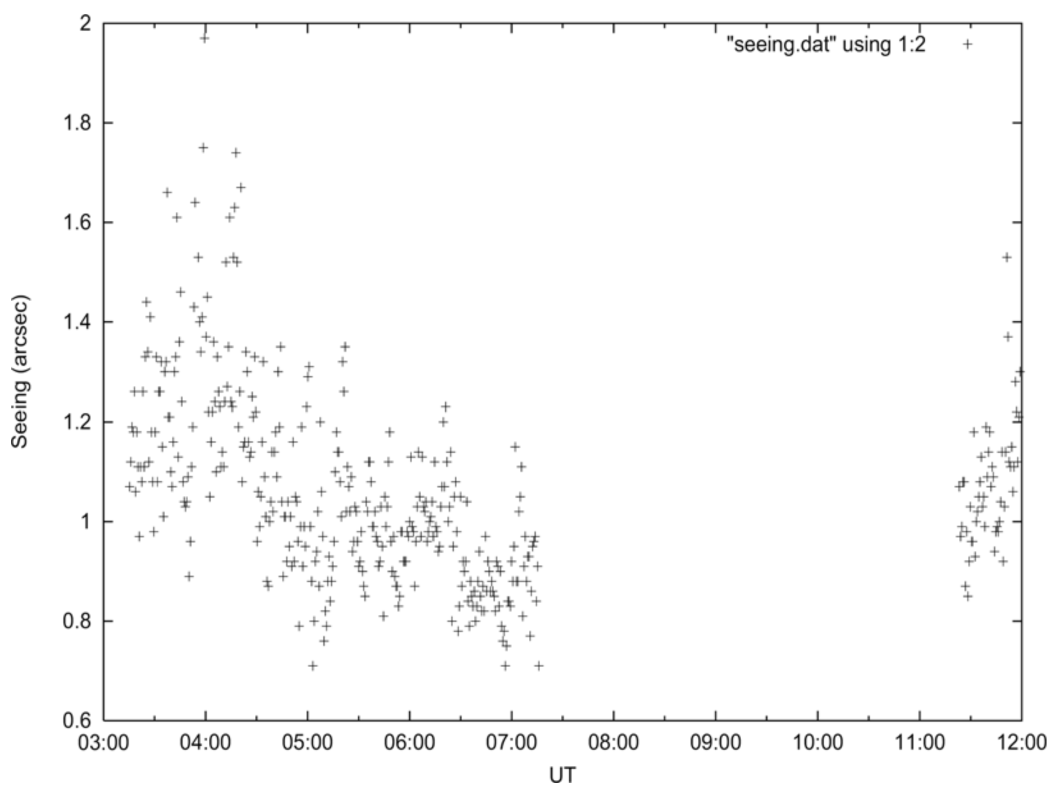

Figure 5: Seeing versus time for the night of May 2, 2005.

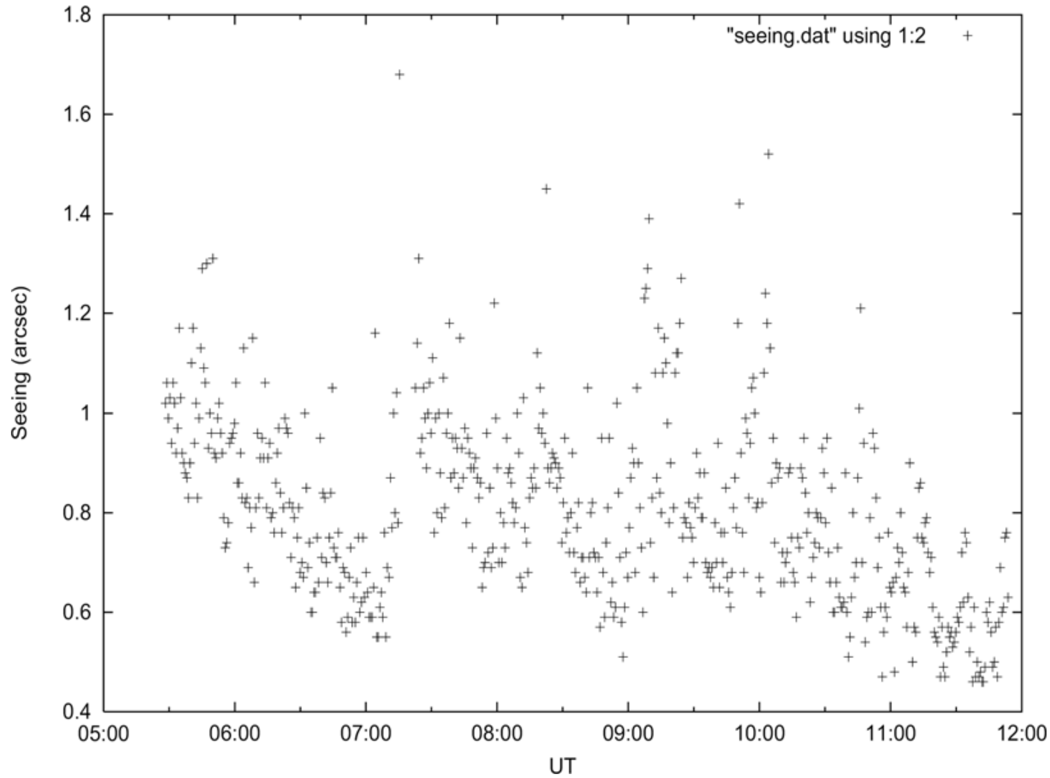

Figure 6: Seeing versus time for the night of May 3, 2005.

Computers and Software

Non-Sidereal Code Development

A major addition was made to the mount crate code that will allow high performance tracking of a wide variety of non-sidereal objects. The "libastro" library from XEphem (version 3.7) has been incorporated into the mount crate code. This library performs position calculations for earth-orbiting satellites, planets, comets, asteroids, moons of various planets, as well as sidereal objects. Coordinates for these objects are now updated at 100 Hz, (the same rate that we have been using for sidereal objects for some time). We have augmented our catalog format and "remote" communication protocol to allow catalogs of non-sidereal objects to be accepted in XEphem's "EDB" format, as well as catalogs of earth orbiting satellites in the traditional and widely used NORAD two-line element (TLE) format.

A graphic user interface (GUI) entitled "edb_gui" was created for use by MMT operators to select objects from XEphem EDB or TLE catalogs. Coordinates of objects can be sent to the mount crate. The GUI displays the current position of the mount as well as the target position calculated from the libastro library.

The mmt_xephem software was used for MMT involvement in the [1]Deep Impact NASA project where an impactor collided with the Tempel 1 comet on July 3, 2005.

New Mount Control Computer

We are now ready to replace the mount crate VME computer with a rack mount PC running VxWorks. A crucial milestone was the ability to use Matlab/Simulink/Real-Time Workshop to generate a new generation of servo software that will run on this architecture. We are now using Linux hosted Real-Time Workshop to generate C code that is then compiled by our gnu cross compiler targeting VxWorks, and loaded and run on our new mount crate. We will still retain the old mount VME computer to handle some housekeeping tasks, at least for the time-being. We have a VME bus analog input board, as well as the hardware for our interlock system, that we would like to leave on the VME bus. We will make the existence of two computers transparent and relay commands and information as necessary. The new computer will handle all of the astronomical and servo calculations.

Miscellaneous Software

Work is ongoing with SAO on a new implementation of telserver. The telserver code acts as a translator between the “msg” protocol commonly used by SAO and the “remote” protocol used by MMTO. These commands include those sent to the mount and hexapod crates for telescope control. The new version of telserver is strictly a protocol translator, and various calculations that were previously done by telserver are now handled by the crates themselves, resulting in a more concise and maintainable piece of code. The new telserver is also much more frugal in the way it uses the network to communicate with the mount and hexapod crates.

Instruments

f/9 Topbox

The *f*/9 topbox was opened to perform an inspection and cleaning of the optics, internal electronics, and cabling. Some unused cabling was removed and the inside of the topbox was wiped down to remove dust.

MMT Advanced Echelle Spectrograph (MAESTRO)

The MAESTRO team (Russ Warner, David Dean, Michelle Reed, and Jill Bechtold) brought MAESTRO’s steel frame and cart to the MMT on July 26, 2005. Dummy weights were mounted to simulate the center of gravity of the spectrograph. MMTO and FLWO personnel brought MAESTRO to the summit from the basecamp on a flat-bed truck, and used a forklift to unload it onto the loading dock of the MMT. The spectrograph was then tilted 90 degrees, and pulled up with the crane through the hatch to the building telescope floor. It was then mounted on the rotator ring. Ultimately MAESTRO will be stored in the basement, and will be raised and lowered through the hatch routinely. All procedures went smoothly, and handling of the spectrograph on the telescope

[1] Visible links: http://deepimpact.jpl.nasa.gov/home/index.html

level was easier than anticipated. Minor modifications to the steel frame were subsequently made to facilitate mounting. Many thanks to J.T. Williams and the MMTO staff for their invaluable help.

General Facility

Florida Fire

On July 7 a lightning bolt ignited a dead tree on Florida Peak in the Santa Rita mountain range. Rugged terrain and an ample fuel load hampered initial fire fighting efforts and motivated the establishment of a rather large containment boundary, which included the summit of Mt. Wrightson. After several days an unfortunate wind shift caused the fire to jump containment lines on Mt. Wrightson and enter Josephine Saddle, the steep valley immediately to the northeast of Mt. Hopkins. This event prompted the evacuation of Mt. Hopkins and Madera Canyon on July 13.

On July 14 Dennis Smith and Ricardo Ortiz, donned in fire protection suits, were allowed to visit the site to complete the sealing of fresh air louvers to the telescope building. They also moved expensive equipment away from the outside walls and windows, and filled the moat (rotating building–foundation air seal) in the pit with water. Emilio Falco was also allowed access in order to secure the Ridge facilities. As long as the fire was held at bay, a minimal team was allowed up for a few hours each day.

Fire suppression efforts included lighting backfires, slurry bombing a large area around the observatory, and cutting trees and clearing brush to create buffers around the observatory facilities, especially at the Ridge. In a review of the sites by forest fire experts two years ago, the Ridge was judged to be especially vulnerable. The MMT was expected to be able to weather a fire; the Common Building and Bowl Dorm were less certain.

Fire crews were prepared to abandon the summit if the fire reached the base of Josephine Saddle. If the winds had picked up, it would have been a very brief run upslope from there to the observatories, with no quick escape route. The fire advanced to within 1 mile of the observatory. Firefighters were able to hold the fire there until the much anticipated onset of the summer rains helped slow and extinguish the blaze. Observatory staff was allowed back on the mountain in force on July 20. Several small fires in inaccessible areas still smoldered but were no longer a threat.

Approximately 23,000 acres burned, and the fire suppression effort cost $8.1M and involved hundreds of firefighting personnel. We are very grateful to the US Forest Service and the fire fighting teams for their efforts throughout the fire.

All-Sky Camera

The storm that rolled over Mt. Hopkins on July 16 that helped extinguish the forest fire also produced lightning that struck the sky camera. Near the end of the daytime movie on that date is a bright flash at 18:31 MST followed by garbled video. At the same time, the system logs on the computer running the sky camera reported a spurious interrupt and over-voltage on the serial port connected to the camera. Subsequent forensic testing confirmed that the serial port on the computer was fried, as well as the StellaCam's power supply and RS232 communications box. The rest of the computer, including the framegrabber card, was fine. It turned out that the StellaCam itself is also fine except for its gamma adjustment and automatic iris controls. The gamma adjustment is not useful, but the iris control is essential for daytime outdoor use so a replacement camera was ordered and installed. The old camera is still useful for nighttime purposes, though, and could be used as a more sensitive RATcam or chamber surveillance camera.

July-August Shutdown

This reporting period included an extended summer shutdown period that followed a one-week forest fire evacuation of the observatory in mid July. Major tasks scheduled included realuminizing the 6.5-m primary mirror, and major upgrades to the secondary mirror hub and its spider supports. A myriad of other tasks are associated with servicing and recalibrating the mirror support actuators, maintenance of the primary mirror ventilation system seals, and replacement of the primary mirror.

Shutdown activities:

- Cleaned the 7-m belljar, removed old filaments, and installed 200 new lighter weight filaments.
- Ray Perry and Ken Daugherty of SOML removed most of the primary mirror cell actuators and ventilation ducting.
- Installed vacuum sensors and electronic equipment in and around the belljar and mirror cell: vacuum gauges, controls, data collectors, turbo pump, cryo pumps, and helium compressors, etc.
- Phil Ritz fabricated a steel handling structure for standing the belljar on edge. Designed by J.T. Williams, the structure shifts the pivot point as the belljar is raised (and lowered) to maintain the center of gravity safely below the critical tilt angle.
- Rodger Harris (FLWO) transported several semi-truck loads of mechanical vacuum pumps, assorted vacuum pipes and valves, assorted hoisting beams, and tons of mirror cell vacuum cover plates to the summit in preparation for the coating operation.

Other Facility Improvements and Repairs

The MMTO lightning shutdown procedure was streamlined in June and July, and the most recent version was adopted by MMTO Engineering in July. The previous procedure was too complex and time-consuming. It is the policy of the MMTO that system uptime should be maximized whenever possible. We aim to find a prudent mix of powering off and leaving systems running that minimizes the impact on observers and staff while protecting vital equipment from damage.

Knife switches have been specified, procured, and installed to help with lightning protection of the equipment on the third floor. This will negate the need to separate and reconnect as many as seven Hubble connectors inside the third-floor racks. The internal wiring of these racks has been re-dressed and cleaned up.

At the request of SAO, the AC power has been modified in the yoke room to provide a 30 A circuit for their new UPS. This required pulling new wires into the conduit from the breaker panel and procuring and installing several new connectors. Assistance also was provided to install wiring for the oxygen sensor on the third floor.

Other tasks completed during the reporting period are listed below:

- A replacement TempTrax probe has been installed on the roof.
- Fibers have been installed from Skycam to its computer interface.
- Power connections have been made in the pit for the heat extraction blower.
- A larger network switch has replaced the unit on the east drive arc. Major improvements were made in the drive room rack organization, and in repairing and terminating connectors and thermocouples in the primary mirror cell.
- New cables have been installed between the wavefront sensor and its computer on the east drive arc.
- The mountain staff was instructed and tested by UA Risk Management in the proper use of respirators for mirror stripping and cleaning.
- The secondary hydraset (10,000 lbs) was sent to Del Mar Avionics in Irvine, California, for rebuild and calibration.
- The MMTO area of the upper warehouse at the FLWO basecamp was organized and cleared of most surplus equipment.

Visitors

No activity to report.

Publications

MMTO Internal Technical Memoranda

05-3 Primary Mirror Actuators Test Report
D. Clark

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

05-21 First Tests of Wavefront Sensing with a Constellation of Laser Guide Beacons
Lloyd-Hart, M., Baranec, C., Milton, N. M., Stalcup, T., Snyder, M., Putnam, N., Angel, J. R. P.
Accepted to *ApJ*

05-22 On the Rotation Period of (90377) Sedna
Gaudi, B. S., Stanek, K. Z., Hartman, J. D., Holman, M. J., McLeod, B. A.
ApJ Letters, **629**, L49

05-23 *Hubble Space Telescope* STIS Observations of the Accreting White Dwarfs in BW Sculptoris, BC Ursae Majoris, and SW Ursae Majoris
Gänsicke, B. T., Szkody, P., Howell, S. B., Sion, E. M.
ApJ, **629**, 451

05-24 Hα-Derived Star Formation Rates for Three $z \sim 0.75$ EDisCS Galaxy Clusters
Finn, R. A., Zaritsky, D., McCarthy, Jr., D. W., Poggianti, B., Rudnick, G., Halliday, C., Milvang-Jensen, B., Pelló, R., Simard, L.
ApJ, **630**, 206

05-25 Outflows in Infrared-Luminous Starbursts at $z < 0.5$. I. Sample, Na I D Spectra, and Profile Fitting
Rupke, D. S., Veilleux, S., Sanders, D. B.
ApJ Supp, **160**, 87

05-26 Outflows in Infrared-Luminous Starbursts at $z < 0.5$. II. Analysis and Discussion
Rupke, D. S., Veilleux, S., Sanders, D. B.
ApJ Supp, **160**, 115

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

The Florida Fire received much coverage on local TV newscasts and numerous articles appeared in local newspapers. Listed below are various URLs featuring articles and photos.

Arizona Daily Star: http://www.azstarnet.com/sn/wildfire/
Tucson Citizen: http://www.tucsoncitizen.com/slideshow/popup.php?directory=071205fire&currentPic=0
US Forest Service: http://www.fs.fed.us/r3/coronado/florida/

CfA: http://cfa-www.harvard.edu/cfa/oir/FLWO/FloridaFire/
MMT: http://www.mmto.org/whatsnew/fire_pics.html

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:

1. General information about the MMT and Mt. Hopkins.

2. Telescope schedule.

3. User documentation, including instrument manuals, detector specifications, and observer's almanac.

4. A photo gallery of the Conversion Project as well as specifications related to the Conversion.

5. Information for visiting astronomers, including maps to the site.

6. 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

July 1 - 20, 2005

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	10.00	79.30	0.00	0.00	0.00	0.00	47.80	47.80
PI Instr	8.00	62.60	1.00	0.50	2.00	0.00	8.10	11.60
Engr	1.50	11.90	0.50	0.00	0.00	0.00	8.00	8.50
Sec Change	0.50	3.90	2.50	0.00	0.00	0.00	0.00	2.50
Total	**20.00**	**157.70**	**4.00**	**0.50**	**2.00**	**0.00**	**63.90**	**70.40**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	90.0
Percentage of time scheduled for engineering	7.5
Percentage of time scheduled for secondary change	2.5
Percentage of time lost to weather	2.5
Percentage of time lost to instrument	0.3
Percentage of time lost to telescope	1.3
Percentage of time lost to general facility	0.0
Percentage of time lost to environment	40.5
Percentage of time lost	44.6

* Breakdown of hours lost to telescope
  az drives 2

** Breakdown of hours lost to environment
  Florida fire 63.9

Year to Date August 2005

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	33.50	333.70	186.70	0.00	4.75	2.50	47.80	241.75
PI Instr	149.25	1406.20	483.20	93.35	22.90	0.00	9.60	609.05
Engr	6.75	60.15	3.00	0.00	0.00	0.00	8.00	11.00
Sec Change	5.50	53.35	11.50	6.00	0.00	0.00	0.00	17.50
Total	**195.00**	**1853.40**	**684.40**	**99.35**	**27.65**	**2.50**	**65.40**	**879.30**

Time Summary Exclusive of Shutdown

Percentage of time scheduled for observing	93.9
Percentage of time scheduled for engineering	3.2
Percentage of time scheduled for secondary change	2.9
Percentage of time lost to weather	36.9
Percentage of time lost to instrument	5.4
Percentage of time lost to telescope	1.5
Percentage of time lost to general facility	0.1
Percentage of time lost to environment	3.5
Percentage of time lost	47.4