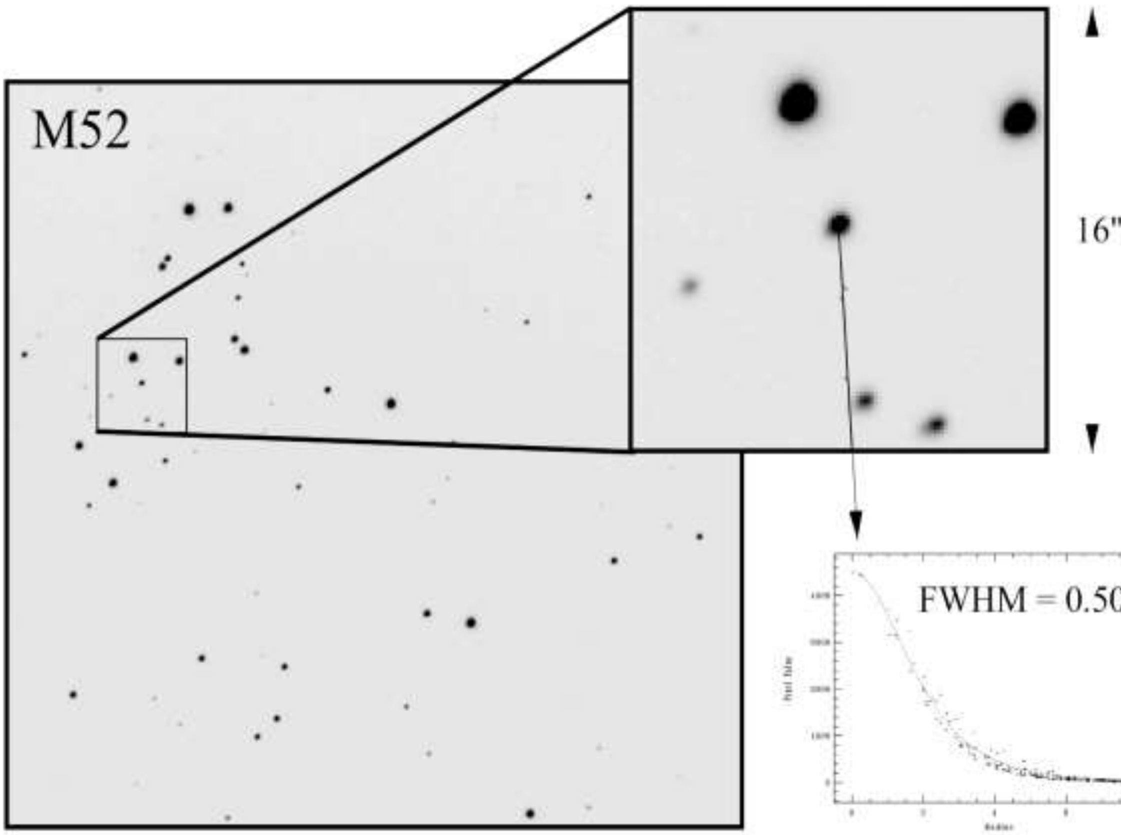
BIMONTHLY SUMMARY

May - June 2003



MMT f/5 WFS science camera commissioning image of the open cluster M52, obtained in June. These 0.50 arcsec FWHM images were obtained at the edge of the 1 degree diameter field of view! (Image by D. Fabricant and G. Williams.)

Personnel

Mechanical engineering students Court Wainwright and Steve Bauman graduated in May. Court was hired by the MMT and Steve was hired by the LOTIS project at Steward. Both started their new jobs in mid-June.

Reid Young (Purdue University) joined our crew as a summer-student hire. Reid is helping to clean, paint, and prepare the facility for the coming monsoon rains. In addition, he is exercising his computer graphics skills designing a new MMT web page.

Primary Mirror Systems

Analysis of the Primary Mirror Thermal State

A study has been undertaken to understand how the thermal conditions of the primary affect the optical wavefront and therefore the image quality. Most of these effects can be removed through wavefront sensing and subsequent corrections; however, there are some instruments that do not use wavefront sensing. In addition, preliminary results suggest that certain thermal states can degrade the figure of the primary beyond the correction capabilities of the actuators.

Operator inputs and set-points are also monitored in the analysis to correlate changes in the thermal system with conditions of the primary. These analyses will be used to produce a guide on how to drive the thermal system to best avoid image degradation. If necessary, future work may include modifications to the thermal system. As a first step in this direction, the 8-inch ducting for the ventilation system was insulated in an effort to decrease thermal gradients across the mirror.

Movies of the thermal state of the primary over the course of a night are being compiled as an analysis tool. A web page with additional information, examples of the movies, and a link to a list of daily movies is posted at *http://grb.mmto.arizona.edu/~ggwilli/mmt/logs/primarytherm.shtml*.

A single frame from one of the movies is shown in Figure 1. The large circle at the top center is a contour plot of the primary mirror front-plate temperatures as evaluated using data from 24 E-series thermocouples. The positions of the thermocouples are shown on the figure as small squares. Circles in the lower left and lower right depict the mid-plate and back-plate temperatures, respectively. The 0.5°C color contours in each plot illustrate the absolute temperature gradients; violet being the coldest (-20°C) and red being the hottest (+20°C) expected during the year.

The line plot at the bottom center shows the evolution of several system temperatures. The legend for this is shown in the upper right of the figure. The temperatures that are currently plotted are the front-plate average temperature, the chamber temperature (from an E-series thermocouple), the OSS temperature (E-series TC), the outside ambient temperature (E-Series TC), and the Vaisala outside ambient temperature. Additional system temperatures will be added in the future.

A script is being developed that will automatically produce a movie every day. These movies will be posted to the website given above. Keep an eye on the site for changes in layout and content of the plots and movies. Future investigations will include early evening trends and effects of front-to-backplate temperature gradients.

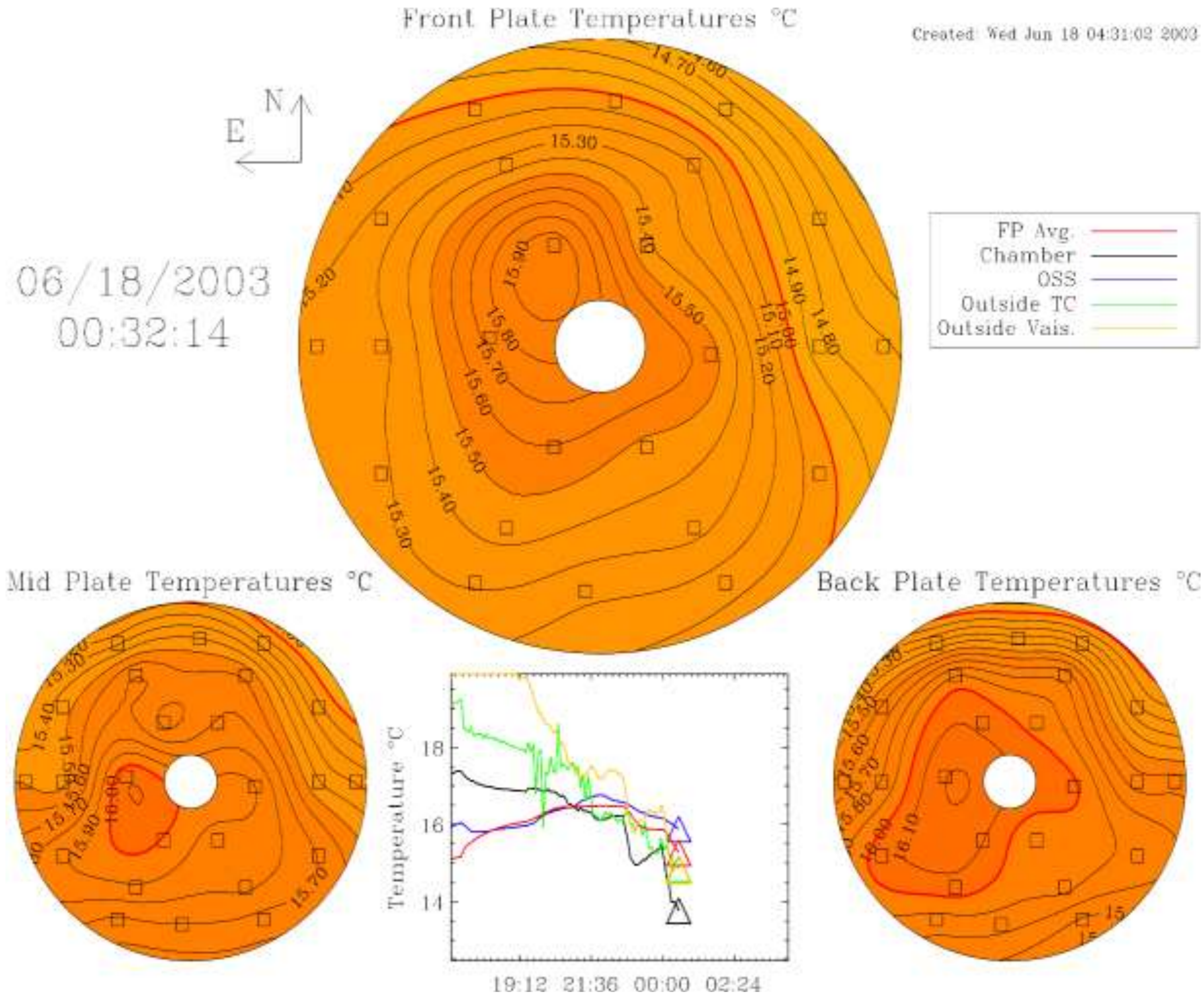


Figure 1: Contour plots of primary mirror temperatures and evolution of system temperatures.

Primary Mirror Support

On 16 May the primary mirror panicked in the afternoon and failed to respond to subsequent attempts to raise it, resulting in the loss of one full night. D. Clark worked through the night tracing what appeared to be multiple failures in the cell crate boards. The following day, D. Clark, P. Spencer, C. Knop, and B. Comisso worked through the day to develop a fix that involved bypassing a watchdog timer circuit. This watchdog also monitors the cell 5V power supply, and was being triggered by undervoltage conditions. In the course of this work, a problem was identified with the internal power wiring of the cell crate that contributes to low voltage conditions. This problem will be addressed during summer shutdown by rewiring of bus power to the crate.

Optics

Two unfortunate incidents resulted in wetting of the primary mirror. Early on the evening of 7 June, a fast moving cloud bank released a short, light shower that wet the mirror before the enclosure could be closed. The next evening a coolant leak developed at the SW corner of the secondary head frame, depositing several drops of methanol-water mix on the primary. The mirror washing scheduled for the August shutdown should remove the water marks; however, the incidents have triggered reviews of operational and engineering policies aimed at preventing recurrences.

CO_2 cleaning continues on a regular monthly basis. The mirror was cleaned on 9 May and 10 June.

Aluminization

We now have in hand a rental welding inverter from Lincoln Electric and we await the construction of a 20-filament fixture for testing at Sunnyside. After measuring the time/power characteristics of a complete MMT aluminizing circuit using the inverter and existing AC system, we will move forward on the replacement of the battery-based aluminizing power system.

Secondary Mirror Systems

f/5 Commissioning

May 16 - 22 Run

The *f*/5 wavefront sensor optics were reconfigured with a 0.6 mm pitch lenslet array, replacing the 0.3 mm pitch array supplied with the Puntino camera. The coarser array provides 14x14 spots across the MMT's pupil, sufficient to correct the primary mirror's support forces. The new configuration is much more tolerant of poor collimation at startup and/or mediocre seeing. Further details are provided in *Computers and Software* below.

B. McLeod developed a primary mirror force file for correcting "cone-mode" distortion, a combination of spherical aberration and focus. The cone-mode is a good approximation to a low order bending mode of the primary mirror. By applying cone-mode corrections to the primary and refocusing the secondary, significant amounts of spherical aberration can be removed. This aberration is difficult to remove in the primary itself because the mirror is relatively stiff in a pure spherical aberration bending mode. Moreover, spherical aberration changes significantly throughout the night as the radial temperature gradient in the primary changes.

Excellent images were obtained in the spectroscopic mode of the *f*/5 corrector during this run; the imaging mode can only be tested with Megacam since the dewar window is an integral part of the optical system. The best images recorded were 0.38" FWHM in the R band for short (few second exposures) on-axis and 0.55" FWHM at the edge of the field. Atmospheric dispersion compensation (ADC) prisms were also tested for the specified correction. It was found that the power of the ADC prism actuation motors at large zenith angle is marginal, and during August we plan to add small in-line gearboxes to provide 4.5x more torque.

June 10 - 18 Run

The shape of the curved spectroscopic focal surface was measured at various rotator angles and determined that, at the nominal back focal position, the curvature is correct. This measurement, coupled with the excellent image quality that we observe, means that the *f*/5 optics have the advertised figure, and that the corrector and focal surface are in the correct positions.

T. Pickering worked with J. Roll to improve the automation of the wavefront sensor deployment. Pickering also made significant strides in the automation of the wavefront analysis as well as collimation and primary support corrections.

A search was made for field-dependent astigmatism in the off-axis images near the zenith and at 40° elevation to check wide field collimation procedures. B. McLeod's analysis indicated that residual field-dependent astigmatism is quite low, validating the collimation procedures. Images of 0.4" FWHM on-axis were recorded for short exposures, and 0.52" FWHM at the edge of the spectroscopic field of view.

Following the *f*/5 optics commissioning runs, the major action item is an upgrade to the *f*/5 hexapod control electronics. This upgrade is necessary to achieve continuous, smooth corrections to the secondary collimation required for good image quality during long exposures. D. Clark and the SAO instrument team are working together on this issue, and we hope to install a new system by the October *f*/5 commissioning run for Hectospec and Megacam.

The SAO instrument team has asked that we communicate their thanks "to the superb MMT staff for their excellent support of the *f*/5 optics commissioning." We now move to the instrument commissioning phase.

f/5 Instrumentation

R. Eng and G. Williams worked on the Hectochelle order separating filter assembly June 24-26. The location of the filter bank was chosen and the assembly was clamped to the Hectochelle bench. The filter bank was positioned to align the filter pusher with each filter holder. Eleven filters were installed and tests of the alignment and operation were performed.

Assembly of the light- and dust-tight tent for Hectochelle and Hectospec was completed. Light-leak tests using Andycam were performed by N. Caldwell and D. Freedman. Nearly all stray light sources were identified and removed. There appears to be one final light source within the dewar, which is currently being investigated.

f/5 Baffles

A design review of the *f*/5 baffles was carried out, resulting in a decision to pursue the 3-part concept. A component of this is a modification to the secondary neutral members that will permit more efficient interchange of *f*/9 and *f*/5 secondaries without rotation of the members or regular installation of shims. Quick-disconnect fasteners are being incorporated into the design.

f/5 Ventilation System

The *f*/5 ventilation system was tested for several days. A leak of the cooling lines near the southwest corner of the OSS needs repair before further use of the cooling system with the AO secondary in October. In addition, code was added to the unified hexapod crate software (see *Computers and Software* below) to allow for direct communication with and control of the loft Neslab. Changes were made to the *f*/5 mode of the unified hexapod GUI for complete control of the *f*/5 thermal system.

Adaptive Optics

The *f*/15 deformable secondary mirror was installed and operated on the MMT May 2-14, with time devoted to both development of the system and preliminary science observations with the mid-IR imager and nulling interferometer, MIRAC-BLINC.

The system had been used in closed loop mode in November 2002 and January 2003. Operating at 550 Hz, Strehl ratios of 15-40% were achieved in H band observations, depending on guide star magnitude and conditions, and >96% Strehl in N band, demonstrating that the mirror can be used over a broad range of wavelengths. Performance and accomplishments thus far will appear in Wildi et al. (2003) and Brusa et al. (2003)

Progress during the May 2003 run included:

- Demonstrating closed-loop operation on a V=13 star.
- Demonstrating image stability to <0.5" over the airmass range 1-2.
- Demonstrating secondary shape stability in open-loop operation.
- Automating the wavefront sensor optics alignment.
- Guiding on an off-axis star while derotating up to 0.5 deg/s.

A key result of the May 2003 run was the demonstration of "routine" operation of the AO system. After setup at the beginning of the night, movement from one object to the next typically required no more than 5 minutes to move the telescope, acquire the object on the wavefront sensor, and close the loop on the new object. D. Miller and G. Brusa provided the expertise to allow this. Much of the ongoing effort involves automating this procedure to allow operation by one person.

Currently, the primary limitation in the system is a vibration causing ~20 mas jitter in closed-loop images at a frequency of ~20 Hz. During the May run accelerometers were placed on the mount, spider arms, and secondary hub to analyze the vibration. The AO group is currently analyzing the data to better understand the vibration and how best to deal with it.

The AO system was used for nulling interferometry with BLINC to look for zodiacal dust around Vega, the prototype of IRAS-excess stars. These stars are known to have a far-infrared excess thought to correspond to our own Kuiper belt. Whether they have a dust disk at mid-IR wavelengths is currently unknown due to the much brighter emission from the star. The AO system achieved a null level of 3% with a stability of 0.5-1%, limited by the vibrations mentioned above. We failed to detect any dust around Vega. However, the measurements place a constraint approximately 4x more stringent than previous observations on the amount of warm, zodiacal dust around Vega. The results are now being prepared for publication (Liu et al. 2003). We hope to improve this performance as the interferometer is refined and the vibration issue is addressed.

High-resolution (FWHM=0.3"), very high Strehl (~0.98) images with unprecedented PSF stability were also produced for the AGB stars AC Her and RV Boo and the symbiotic variable CH Cyg. No significant difference was found between AC Her's morphology and the PSF calibration stars (μ UMa and α Her) at 9.8, 11.7, and 18 μm (Close et al. 2003). This is surprising since previous (seeing-limited) 11.7 and 18 μm Keck images suggested the presence of a resolved ~0.6" edge-on circumbinary disk for AC Her. Our observations do not confirm any extended structure >0.2" around AC Her. The observation is a nice example of the advantage of a stable PSF for mid-IR observations. In the case of RV Boo we were able to detect a ~0.15" FWHM dust disk at PA=120° (Biller et al. 2003). The disk has a radius of ~40 AU and is aligned with the previously known CO disk. Taken together these observations strongly suggest RV Boo is the best example yet of a dusty disk around an AGB star.

Based on engineering progress made and the initial scientific observations, the MMT AO group has solicited proposals for observations with MIRAC-BLINC during the fall semester, and plans on working with D. McCarthy to carry out engineering and test observations with ARIES.

f/9 Hexapod

Data were collected on the *f*/9 hexapod LVDT vs. encoder positions. Analysis suggests that some non-linearity exists in the LVDTs, the encoders, or both. The hexapod will be examined in more detail when it is off the telescope during summer shutdown. New relationships between LVDT voltage and length will be determined, as needed.

P. Spencer, with the assistance of R. Young and D. Gibson, built and tested a set of *f*/9 hexapod test cables. The cables run from the eastside 3rd floor Nasmyth platform to the old control room. This arrangement will be useful for testing the *f*/9 hexapod when it is off the telescope.

Telescope Tracking and Pointing

Encoders

The MMT absolute encoders exhibit a 1024-cycles/revolution spatial error term that remains to be resolved. To this end, B. Comisso and C. Knop have built several test tools for measuring the encoder output independent of the existing readout electronics. One tool is for sorting and testing Inductosyn preamplifier cards, which require an output gain match of ≤0.1%. In addition, they have built an oscillator and readout board enclosure (with power supplies) for completely re-creating the MMT electronics on the spare encoder unit at the campus lab.

In order to obtain an adequate number of signal samples per encoder cycle (about 1800 μm of displacement), it was necessary to build a mechanism to perform small shaft motions. A cam driven through a 300:1 gear reducer by a stepper motor provides a resolution of 2 μm. Using the previously-built Inductosyn readout board, we were able to accurately measure the gain mismatch in the spare encoder and found it to be 2-3x greater than the initial gain mismatch measured by the preamplifier sorting tool.

The existing electronics readout board incorporates a final gain-matching network; however, this does not have enough span to compensate for the measured gain mismatch. We have ordered the necessary high-precision resistors to increase the adjustment span. Once these are in hand, the circuit will be re-measured and trimmed for proper amplitude matching. Assuming this is proven to be the fix, it will then be implemented on the MMT units.

Computers and Software

Wavefront Sensor Analysis Software

Over the course of the *f*/5 engineering runs in May and June, the WFS analysis software was engineered to the point where it works at least as well for the *f*/5 WFS as it does for the *f*/9 system. Figure 2 shows the image quality it is possible to achieve in as few as two iterations with the *f*/5 system under good conditions.

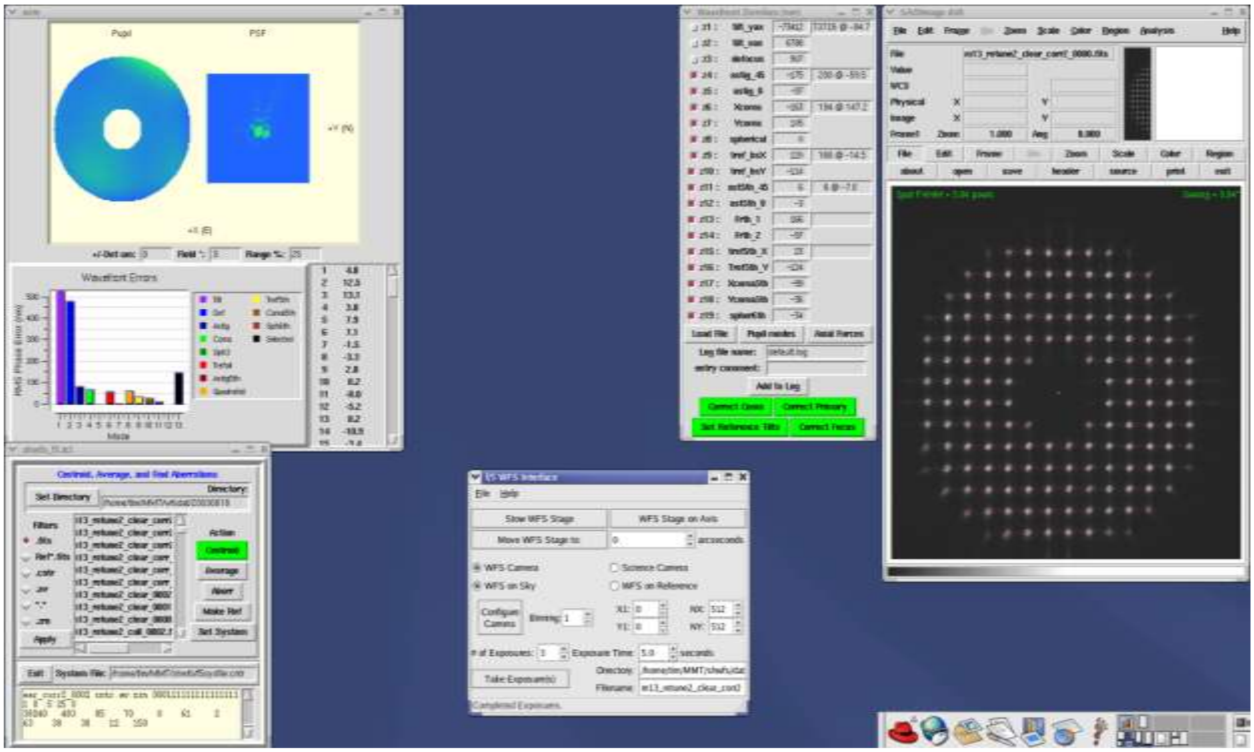


Figure 2: A screenshot of the full f/5 WFS desktop showing the results after two corrective iterations under good seeing conditions.

Specific modifications, additions, and improvements to the software include:

Interactive Aperture Overlay – S. West's original interactive overlay (Figure 3) was resurrected and upgraded to help deal with the closely spaced spots of the original lenslet array. The technique provides a useful fallback mode when conditions are poor and the default centroiding parameters do not work well. Both the *f*/5 and *f*/9 systems bring up the interactive overlay if the criteria for initial spot association are not met.

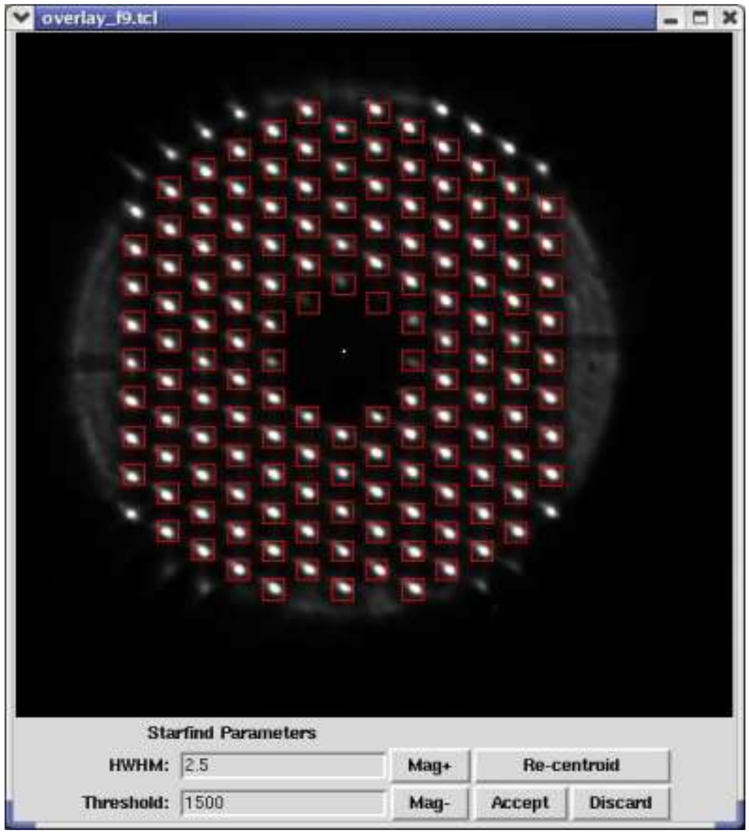


Figure 3: Screenshot of a fallback window that provides interactive alignment between the reference spot positions (red boxes) and the measured spots in the image. Clicking and dragging anywhere in the image moves the entire reference pattern around at once. The "Mag+" and "Mag-" buttons scale the reference pattern to account for any focus offsets. The centroiding parameters HWHM and Threshold can be changed and then applied to the image by clicking "Re-centroid."

Inserting Telescope and Other Data in WFS Image Headers – This was first attempted for the *f*/9 WFS, but required some non-trivial modifications of some core code in the Mill's Apogee software. This has been replaced by a much more general perl script that takes a FITS file as input, queries the mount, hexapod, and thermal systems, and places the collected information into the FITS header. Having as much information as possible in the image headers will greatly ease mining of WFS data to profile telescope performance.

Handling of Arbitrary Rotator Position – S. West installed hooks in the analysis code to handle non-zero rotator angles, but these were unused and not fully tested. It is now fully implemented via parsing rotator angles out of the image headers and has been tested by inserting known amounts of aberrations at various angles. Thus the WFS can be used successfully at any rotator angle and will even work with the rotator on, though that is not recommended.

WFS Interface GUI for *f*/5 – Starting from a script provided by J. Roll, a GUI was built to remotely control the *f*/5 WFS stage and acquire images. A screenshot of this is shown in Figure 4a. The relatively simple interface provides the ability to move the WFS stage in and out of the field, select and configure which camera to use, and configure and acquire images from the selected camera.

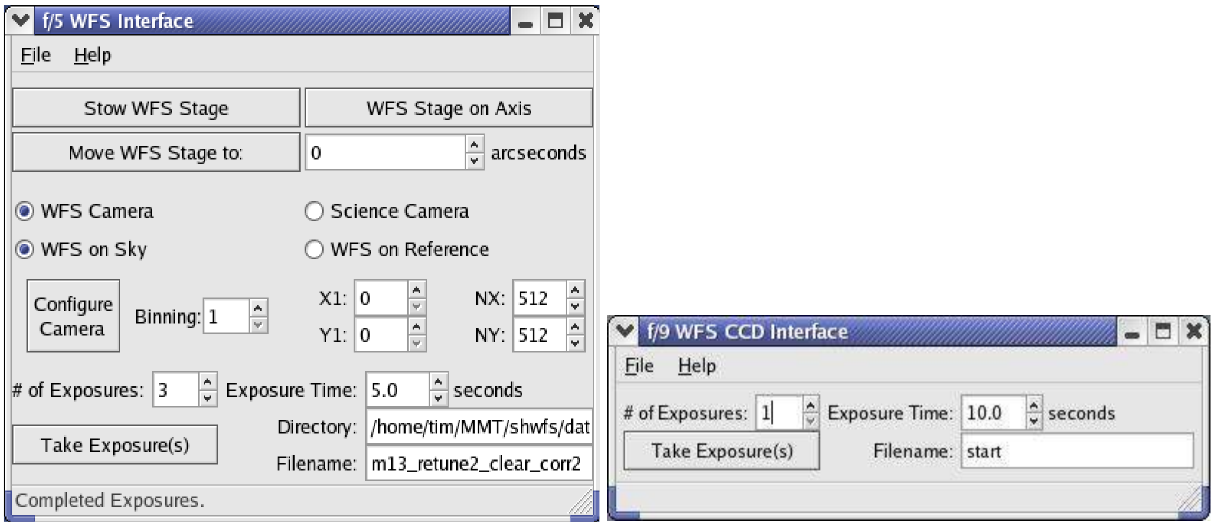


Figure 4a (left): A simple graphical interface for controlling the f/5 WFS stage and acquiring images from the CCD cameras contained within the stage. Figure 4b (right): A simple graphical interface for remotely acquiring images from the Apogee CCD hooked up to the f/9 wavefront computer.

New Interface for the *f*/9 WFS CCD - To facilitate running the *f*/9 WFS in a fully remote fashion, the original tcl/tk-based Apogee CCD interface has been replaced with a GUI based on the one used to remotely control the *f*/5 WFS. A screenshot is shown in Figure 4b. It remotely executes a script on the wavefront computer to acquire an image and reads it out over the network via NFS.

Simplified WFS Startup and Automated Data Archiving - Both the *f*/9 and *f*/5 systems can now be fully brought up via desktop menu entries on *hacksaw* and *hoseclamp*. The data generated from WFS sessions on either computer are collected every morning and archived in /mmt/wfsdat.

Unified Hexapod Software

Work continued on unifying the *f*/5 and *f*/9-*f*/15 VxWorks hexapod crate code, a project being carried out in tandem with the creation of a unified hexapod GUI. A major advance to the crate code involved combining the current operating versions of *f*/5 and *f*/9-*f*/15 code sets into one package. This package is being maintained under joint CVS control. The package can currently be compiled to run in either *f*/5 or *f*/9-*f*/15 mode on a VME crate, and further hexapod crate code development will be done on this combined code package.

VxWorks Crate Communication Protocol

Additional work has been done on network protocol support from the real time code that we run in the VxWorks computers. Ultimately all three of our VxWorks supported systems (mount, cell, and hexapod) will benefit. Our mmt native protocol (which we call the "remote" protocol), has been generalized and now supports a multithreaded server. Additionally, a new infrastructure supports access to a collection of exported parameters in a general way. This has made it possible, with only modest effort, to write a server that is compatible with the SAO "msg" protocol. We intend to allow this native VxWorks server to replace the "telserver" protocol relay in order to gain increased reliability. Additionally, we will soon support a third protocol (the Steward Observatory "tcs" protocol as currently used at the 90 inch telescope), which will allow software and instruments currently in use at the 90 inch telescope to be used at the MMT.

Primary Mirror Support Software

A number of changes and improvements have been made to the primary mirror support software to accept mirror support force adjustments. The principal source of these force adjustments is the wavefront sensor. The primary mirror now correctly handles off-zenith force adjustments by modifying the axial correction force matrix (prior to this change, correction forces "faded out" as the mirror was tipped toward the horizon). Additionally, the checking of proposed force adjustments has been made more rigorous to avoid the situation where a set of forces are accepted that would then soon trigger a mirror panic. Some first steps have been taken to improve diagnostics and logging triggered by overly energetic attempts at mirror figure correction.

Instruments

Blue Channel Spectrograph

During the week of 23 June, a crew from SAO rearranged the electronics bays in the west wing instrument lab, installing new control electronics for Hectospec and the *f*/5 wavefront sensor. In the course of that work, the Blue Channel CCD crate was inadvertently shut down without proper power sequencing. That evening we were unable to bring the CCD on-line. Due to unfortunate timing the only spares were in town being tested, and the usual support personnel were unreachable. Thus, despite valiant attempts we were unable to bring up the CCD and lost the entire night. The next day the spare controller and a VME test crate were brought to the site, and the CCD was returned to service. The root problem has since been traced to a faulty VME-CCD interface card in the MMT crate.

MAESTRO

On 20 June, S. Matthews, D. Dean, M. Reed, and J. Bechtold of Steward brought a PVC mockup of MAESTRO (MMT Advanced Echelle Spectrograph) to the MMT. The mockup was maneuvered into the chamber to check handling clearance and procedures.

General Facility

Telescope Thermal State

An 8-port, ethernet-based, digital thermometer (TempTrax) was purchased with 4 heavy-duty, stainless-steel and 4 epoxy-coated probes. The probes have absolute accuracies of <0.5°F and 75-foot leads so they can be placed virtually anywhere on the telescope. The TempTrax base unit was mounted on the east side of the telescope and all 8 probes installed on a temporary basis. The stainless-steel probes have been attached directly to the NE and SE support tubes of the OSS, and will be used to refine the temperature/focus relationship. The epoxy probes are currently monitoring chamber and outside ambient air temperatures. Data for the probes can be viewed at *http://128.196.100.243*. Additional programming is needed to integrate these probes into the thermal system.

Building Drive

No major failures of the facility were reported during this period. Only one anomalous building-telescope collision occurred (on 1 May). The cause of the collision, which did not involve any loss of observing time, has not been determined.

Instrument Rotator

A new rotator limit switch has been installed to limit the travel of the rotator to ±190°. This commercial cam switch also has three other cams that will sense direction and allow software prelimits. The stops for the switch are fully adjustable.

Miscellaneous

The high-pressure valves in the telescope air cabinet were replaced to alleviate leaking around the valve stems caused by the higher pressures provided by the Gardner/Denver compressor. In addition, P. Ritz and D. Smith performed preventive maintenance on both the Gardner/Denver and Mattei compressors. The Mattei was only providing 80 psi. P. Ritz rebuilt the off-load valve, which fixed problem.

S. I. safety inspectors from Washington D. C. conducted their annual inspection in May. They found several small items but thought the MMTO was much cleaner and more organized than in previous years. They recommended fall protection training for the staff, which D. Smith is scheduling. They also would like our chemical inventory updated annually instead of every 3 years.

Design of the panels for the PI instrument interface has been completed under the direction of K. Van Horn. Both main boxes have been fabricated and subpanels are being cut. This will be followed by anodizing and etching. The boxes should be installed and populated with cables in July.

B. Kindred visited Keck Observatory in June and observed a mirror segment change. Twice monthly, three hexagonal mirror segments are removed and replaced with freshly aluminized segments. There are thirty-six segments on each 10m telescope so this cycles every mirror once per year. Keck has no mirror covers.

The quotation for a new UPS (to replace RUPS) has been submitted to Smithsonian and includes a quote for a new phone system.

The Rainwise weather station was removed and sent back to the factory for servicing.

Visitors

May 22: Matt Johns and Charlie Hull (Las Campanas Observatory Magellan Telescope) paid an overnight visit to compare notes on operations.

June 5: *Popular Science Magazine* staff photographer John Carnett did a photo shoot of Dr. Xiaohui Fan (Steward), who was observing at the MMT.

June 12: P.-K. Chen, a freelance photographer with *Sky & Telescope* magazine, accompanied by FLWO docent Tom Saville.

Publications

MMTO Internal Technical Memoranda

03-4 Science Instrument Interface Control Document for the MMT
D. Blanco and G. Schmidt

MMTO Technical Memoranda

03-8 In Situ Aluminization of the MMT 6.5m Primary Mirror
W. Kindred, J. T. Williams, D. Clark

MMTO Technical Reports

None

Scientific Publications

03-7 New Low-Mass Members of the Taurus Star-Forming Region
Luhman, K. L., Briceño, C. Stauffer, J. R., Hartmann, L., Barrado y Navascués, D., Caldwell, N.
ApJ, **590**, 348

Observing Reports

While observing at the MMT June 4-6, X. Fan (Steward) discovered a $z = 6.2$ QSO using the Red Channel spectrograph. This is the 3rd-highest redshift quasar known. The object was selected using SDSS data and IR photometry from the Steward 90 inch telescope and 256x256 NICMOS imager.

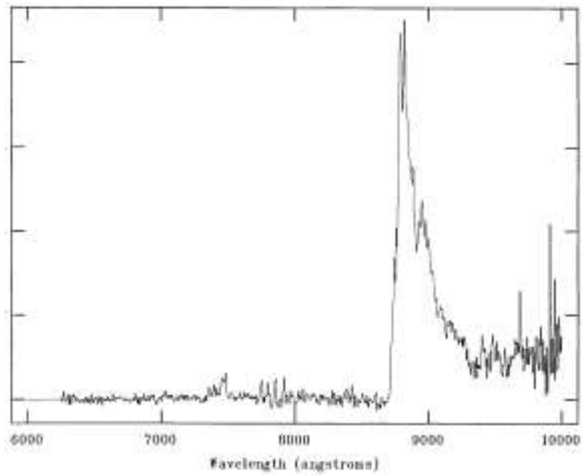


Figure 5: Red Channel spectrum of a $z = 6.2$ *SDSS QSO (X. Fan, Steward).*

Copies of these publications are available from the MMTO office. We remind MMT observers to submit observers' reports, as well as preprints of publications based on MMT research, to the MMTO office. Such publications should have the standard MMTO credit line: "Observations reported here were obtained at the MMT Observatory, a facility operated jointly by the Smithsonian Institution and the University of Arizona."

Submit publication preprints to *bruss@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 World Wide Web site (the MMT Home Page) which 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 and mechanical drawings related to the Conversion.

5. Information for visiting astronomers, including maps to the site and observing time request forms.

6. The MMTO staff directory.

The page can be accessed via URL *http://www.mmto.org*.

Observing Database

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

Use of MMT Scientific Observing Time

May 2003

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	Lost to Telescope	Lost to Gen. Facility	Total Lost
MMT SG	1	7.9	1.5	0.0	0.0	0.0	1.5
PI Instr	27	223.2	10.1	15.3	5.8	1.5	32.6
Engr	3	25.0	0.0	0.0	0.0	0.0	0.0
Total	31	256.1	11.6	15.3	5.8	1.5	34.1

Time Summary

Percentage of time scheduled for observing:	90.2
Percentage of time scheduled for engineering:	9.8
Percentage of time lost to weather:	4.5
Percentage of time not lost to weather lost to instrument:	6.3
Percentage of time not lost to weather lost to telescope:	2.4
Percentage of time not lost to weather lost to general facility:	0.6
Percentage of time lost:	13.3

June 2003

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	Lost to Telescope	Lost to Gen. Facility	Total Lost
MMT SG	20	155.3	21.2	11.2	1.5	0.0	33.9
PI Instr	9	69.5	5.0	0.0	1.0	0.0	6.0
Engr	1	7.7	6.0	0.0	0.0	0.0	6.0
Total	30	232.5	32.2	11.2	2.5	0.0	45.9

Time Summary

Percentage of time scheduled for observing:	96.7
Percentage of time scheduled for engineering:	3.3
Percentage of time lost to weather:	13.9
Percentage of time not lost to weather lost to instrument:	5.6
Percentage of time not lost to weather lost to telescope:	1.2
Percentage of time not lost to weather lost to general facility:	0.0
Percentage of time lost:	19.7

March - June 2003

Instrument	Nights Scheduled	Hours Scheduled	Lost to Weather	Lost to Instrument	Lost to Telescope	Lost to Gen. Facility	Total Lost
MMT SG	52	468.4	71.7	12.3	1.4	23.4	108.8
PI Instr	56	483.8	81.7	20.9	10.8	4.5	117.9
Engr	14	131.5	57.6	0.0	0.0	0.0	57.6
Total	122	1083.7	211.0	33.2	12.2	27.9	284.3

Time Summary

Percentage of time scheduled for observing:	87.9
Percentage of time scheduled for engineering:	12.1
Percentage of time lost to weather:	19.5
Percentage of time not lost to weather lost to instrument:	3.8
Percentage of time not lost to weather lost to telescope:	1.4
Percentage of time not lost to weather lost to general facility:	3.2
Percentage of time lost:	26.2