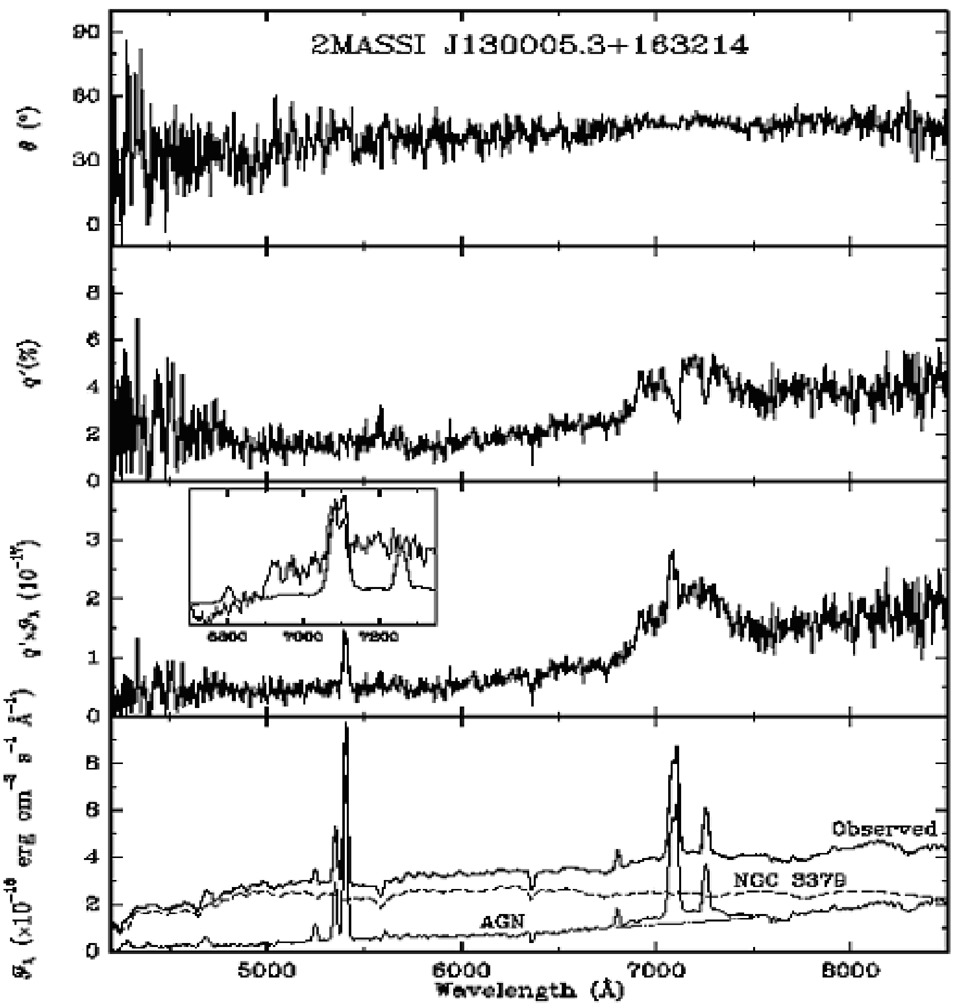
BIMONTHLY SUMMARY

July - August 2002



Spectropolarimetry of the AGN 2MASS J130005.3+163214 obtained by G. Schmidt, P. Smith, C. Foltz and D. Hines using SPOL on the 6.5-m telescope. From bottom to top, the panels show total flux, polarized flux, percent linear polarization and polarization angle. This is an extreme example of a hidden Seyfert 1 galaxy whose broad lines are only seen in polarized flux. Note the extreme width of the H-alpha emission line (30,000 km/sec) seen in the second panel from the bottom. (Figure courtesy of G. Schmidt.)

Personnel

Clede O'Neal was hired as a Mechanical Engineer in late July.

Student engineer David Jones left the MMTO in late July.

Five Mexican observatory engineers from UNAM toured the MMT and FLWO facilities accompanied by E. Falco and C. Foltz.

C. Foltz participated in a multi-media web-based exhibit on light pollution at the Kock Science Center and Planetarium of the Evansville Museum in Evansville, IN.

Summer Shutdown Report

Most of the activities during this reporting period were spent in preparation for and during the MMTO's annual summer shutdown. The telescope was taken out of service on the morning of July 18 and returned to operation on September 3.

Development

Mount

Both elevation tape encoders and encoder read heads were mounted. The gap between the tape and read heads was shimmed to insure proper spacing from zenith to horizon. The alignment of the read heads was adjusted to optimize signal strength over the entire range of motion.

The elevation servo has an inner and outer loop. The inner loop is closed by the LM628 motion controller chip, and establishes velocity control. The outer loop is closed in software and establishes positional tracking. Up until this summer, the inner loop obtained encoder feedback from incremental encoders mounted on the motor shafts. The friction motors drive the elevation arcs with significant compliance. Now we are closing the inner loop on encoder feedback obtained from encoder tapes mounted on the drive arcs themselves. The tapes also afford the opportunity to obtain absolute positional information, but we are not using that feature at this time. We still close the outer loop around the Inductosyn absolute encoder as we have done in the past. Results thus far indicate that tracking with the loops closed around the tapes is much superior to tracking that was obtained with the previous motor encoder arrangement.

Removable fiberglass covers were fabricated and installed to protect the elevation tape encoder attachments at the end of the drive arcs.

The west elevation motor linkage to the telescope was stiffened. Since we saw no change in the elevation servo performance we were able to show that the motor linkage was not limiting the performance of the elevation servo.

Both elevation motors have now been modified to allow servicing the brush holders without removing the motors from the telescope.

The elevation motor seals were replaced and new grease was added. This should prevent leakage of grease onto the drive arc.

The elevation brake housing was modified to allow servicing the brake without motor removal.

The Inductosyn absolute encoders present 32 bits of parallel digital data to the mount computer for each axis. For some time now we have been noticing almost random spikes in this encoder data. This was found to be due to timing issues as the bit values change from one state to another. It is much as though when counting from 099 to 100, the 0 digit quickly changes to a 1 but the 9 digits more slowly change to zeroes, so we briefly read an erroneous value of 199. We are now using a software digital filter, and the problem is now significantly reduced, if not entirely eliminated.

Encoder dropouts are easily seen during telescope slews because the encoder discontinuity vibrates the structure, which in turn vibrates the primary mirror and shows up as force impulses on the hardpoint platform. After the digital filtering of the encoder electronics described above, it was found that virtually all of the encoder discontinuities were eliminated, and those rare events that remained were substantially reduced in magnitude. The few remaining events may be reduced with more sophisticated digital filtering schemes, but do not seem to present any significant problems for tracking or slewing the telescope at this time.

The SAO guider was modified so that the log files it outputs are integrated into the main MMT logging hierarchy, are rotated on a daily basis, and contain guide correction timestamps with better than 0.1 arcsec precision. This will facilitate monitoring and profiling of the telescope's tracking performance whenever the guider is run, i.e. on a nightly basis. B. Wyatt (CfA) did some initial analysis on existing logs and posted the results at: *http://cfa-www.harvard.edu/oir/MMT/guider/guide.report.html*. The 120 second oscillation he observes confirms what had been seen subjectively in the past, namely that there can be significant long-term tracking errors. If the guider is running, however, the tracking rms is usually better than 0.1 arcsec and frequently much better, depending somewhat on seeing and the brightness of the guide stars used.

A software bug that prevented calibration of the instrument rotator at certain angles far from zero has been found and eliminated.

Cable trays were added to the cell from the drive arcs to the rotator cable drape. New cable has been purchased for replacement of both sets of cabling. The new location of cable routing is over the main elevation bearing where it is well protected and sees much less abuse. The west elephant trunk will be incorporated into the energy chain to be installed by SAO. A new bulkhead interface panel is to be designed for the existing drive arc junction boxes so the PI and MMT instrument cables will have a termination point on the drive arcs.

A spare Azimuth amplifier was built and tested.

Thermal

The Neslab cooler had been non-functional following a lightning strike. The differential pressure switch failure of the Neslab was traced to the manufacturer's continually sending incorrect versions of the controller chip (to replace the chip that burned out from the lightning strike many months ago). Once the correct chip revision was installed, the differential pressure fault was eliminated. Neslab tech support sent us more recent controller chip revisions so we could take advantage of upgraded firmware; however, they were unaware that new revisions also corresponded to hardware modifications in the newer machines.

We obtained a new flow transducer for the Neslab (apparently also damaged in the lightning strike). The part appears to be incompatible with the wiring in our machine. For the interim, the flow fault interlock has been turned off since the pump itself appears to be functioning properly. This allows the machine to continue running by ignoring the flow transducer feedback.

Following the repair of the Neslab, it was hoisted into the pit and plumbed into the glycol system and the new heat exchanger cabinet. By teeing inside the pier a 1.5" line, we deliver glycol into two 1" lines. The first one serves as facility coolant for the Neslab; the other line is delivered to the bottom two heat exchangers in the new thermal cabinet (see below). Both 120V and 480V power connections required by the Neslab were made by T. Walsh (FLWO).

After the Neslab was moved to the pit, new communication lines were routed from it to the Cyclades serial communications board. The connections and network communications with the Cyclades were fully debugged. The Cyclades is a multiport terminal server that allows many serial cables to be accessed via the network. Previously, serial cables had been connected to random control room PCs. Now the cable connections have been centralized, and the thermal software modified to access these devices through the terminal server.

During the winter months it was shown that we were unable to use the full capacity of the Carrier refrigeration unit to adequately cool the mirror. Carrier modified the unit for low temperature operation down to -13 C. The flexible hose carrying glycol from the Carrier to the outside heat exchangers was replaced with rigid PVC pipes. The final mounting of the glycol booster pumps and glycol reservoir will be completed after shutdown.

A new bank of heat exchangers was designed, built, and installed in the pit. These new heat exchangers allow us to use more of the cooling capacity of the Carrier refrigeration system. Modifications were made to the underfloor duct to provide air to the bottom of this cabinet. Four heat exchangers are mounted in the cabinet – two are fed by the Carrier; the other two by the Neslab. A thermocouple system for measuring the air and fluid temperatures for all of the heat exchangers in the new box was designed, planned, and installed. The signals are handled with an HP data acquisition unit (DAU) and passed to the mount computer via the Cyclades terminal server. Electrically-controlled valves were installed for each of the four new heat exchangers in the new box. The control signals are handled by the HP DAU and Cyclades box.

A new engineering GUI was created to monitor the thermocouples in the new pit heat exchanger box and to control the flow valve for each heat exchanger. This GUI also logs data on a one-minute period or when the user changes a valve setting. These thermal data are currently being evaluated in conjunction with data from other portions of the thermal system. This GUI has been used to detect problems within thermocouples and in coolant flow within the pit heat exchanger.

A new HP DAU was ordered to replace the one currently in use in the pit. The new unit will become part of the aluminizing system.

Telescope Control System

The operator's thermal system GUI is being rewritten using SpecTcl. The current thermal GUI code is over 10,000 lines in length. The majority of this code is embedded in SpecTcl in the new interface, substantially reducing the number of lines of code. The new version of the thermal GUI will communicate directly with the data server.

A bug in the mount software was forcing an unnecessary azimuth slew of 360 degrees when one attempted to acquire objects towards north with the telescope positioned to the northwest. This was a frustrating waste of several minutes of observing time, and this bug has now been fixed.

Spares

We identified all on-hand spares and fully stocked a spares locker. Those spares that remain to be made or procured were identified.

Cell

New limit switches that will detect a hyper-extended hardpoint and cut system power were designed, fabricated, installed, and tested on all of the primary hardpoints. Fault-recovery procedures were developed and tested. Low-torque stepper motors were installed on five of the six hardpoints.

All the nozzles around the perimeter of the primary were installed from above. Approximately 25% were installed with the telescope at the service position; the remainder were done zenith-pointing.

F/9 Topbox

Optics and mounts for a new laser alignment fixture for the f/9 topbox have been acquired. Design/fabrication of ancillary fixturing will occur next time the topbox is off the telescope for an extended period.

The connector for the Videoscope intensified camera was repaired. This connector had several intermittent connections that caused the unit to fail.

Longer cables are now in place for the I-CCD, I-VID, and MSD. These were required by the routing scheme for cables to the Cassegrain focus.

F/9 Topbox Wavefront Sensor

The topbox wavefront sensor uses an Apogee CCD camera as its detector. Since the old Apogee software we had been using under Linux only supports older Linux kernels, the search began for a new version. Discovered during the process was the completely free and open source Apogee drivers and control/analysis software written by David Mills at *http://www.randomfactory.com*. This new software was tested with a borrowed Apogee controller card and camera and a spare computer. Under RedHat 7.3 the new software worked more-or-less right out of the box and fixed some of the minor quirks found in images taken with the older software. Some extra, but minor, fiddling of the driver source files was required to get the kernel modules to build and install under RedHat 8.0. Other fiddling was required to create the device files that are not created by the main install script and also to deal with the fact that the versions of ds9 and xpaset that the Mills package includes are different (2.0) than those installed on the system (2.1). The big advantage of the new Mills software is that it allows direct camera control from TCL programs. In contrast, the old software requires the use of a completely separate control GUI for image acquisition. Using the Mills software, it should be possible to automate wavefront sensor image acquisition and analysis to a high degree.

Much work has been put into simplifying the data analysis from the wavefront sensor, largely by removing the many interactive steps of the original program (these allowed detailed debugging during the early testing phases). A simple selection of the FITS images containing the desired spot patterns is passed to the data reduction routine. It now automatically: determines the spot centroids (using IRAF STARFIND), determines the registration of the entire pattern relative to another (global wavefront tilt removal), averages the spot pattern centroids, calculates the aberrations after removing the system spot pattern obtained with the diode laser, graphs the pupil aberrations, graphs the image psf, and calculates rms phase errors of the various modes. Additionally, the correction forces, collimation, and focus corrections are passed to the telescope automatically (or by having the operator manually push a button). Substantial data logging was added.

The software interface between the primary mirror forces and wavefront sensor optimization was enhanced to allow direct transmission of force corrections and to obtain specific error information rather than a global indication of failure.

The topbox wavefront sensor contains two optical benches. One contains the Shack-Hartmann optics and the other a simple re-imager for acquisition. Control electronics provide the ability to select either channel. The electronics and motor control are finished except for the micro-adjustment of the opto sensors needed to align each channel precisely to the telescope optic axis. Because the telescope now points so well, stars can be blind pointed into the wavefront sensor without the aid of the imager. So currently, this means that we have a spare optical bench in the f/9 topbox that can be used for any purpose.

Because the cables to the topbox have been re-routed, the Apogee control cable is now 20 feet too short. Until a booster box and extension cables are purchased, the control computer is temporarily located at the top of the east yoke arm in the chamber.

F/5 Hexapod and Cell

The f/5 linear amplifier card that will drive the hexapod struts was prototyped and tested. A design for the final printed-circuit version was completed. In addition to the strut length, they will control the brakes, temperature sensors, computer interface, etc. on the f/5 hexapod.

F/9 Hexapod

When the AO secondary is attached, the hexapod is rotated 180 degrees. Actuator 5 is force neutral in the f/9 orientation, but takes substantial force when rotated for AO. During the July AO run, problems were reported with this actuator. It was thoroughly tested when the f/9 secondary system was re-assembled, but has not failed in this configuration. Further diagnosis of this potential problem awaits the next AO run in November.

Semi-annual hexapod maintenance requires a full platform positioning checkout. This is accomplished by moving the mobile plate in a series of systematic motions. The response of each strut to these motions (inverse kinematics) is compared to the theoretical matrix transformations of the hexapod. The test showed that the hexapod is functioning within its positioning specifications to the accuracy that the LVDT electronics currently allow.

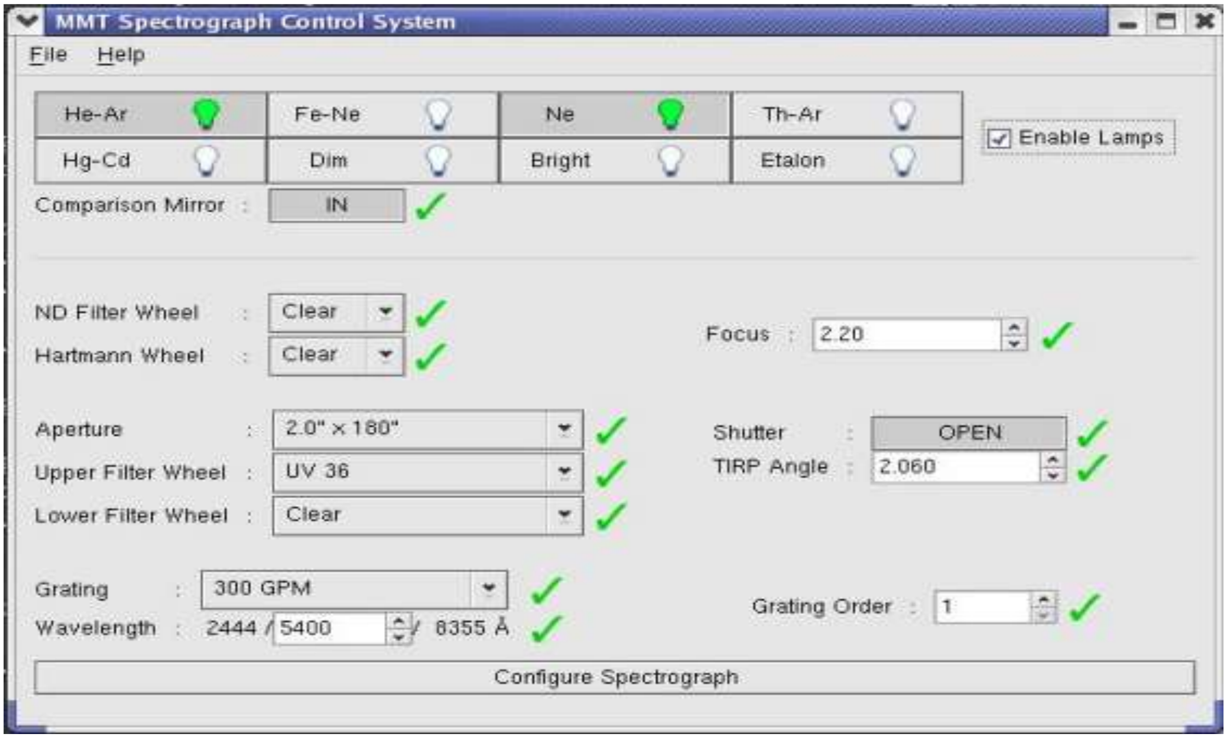
Spectrograph

The new I-CCD intermittent problems were eliminated by swapping the CCD controller with the spare Red Channel controller. The problem controller was sent to the CCD lab for repairs.

A spare spectrograph PC was located and tested with the SCCS program. The PC is now located in the spectrograph cabinet. Spare cards, cabling, switches, power supplies, and software disks were located and stored in the spectrograph cabinet. We have a battery in hand for the MSD solid state disk, and are checking the safest way to install it. Preliminary study indicates utility software exists from Octogon to save files to a floppy before attempting to replace batteries. We will probably swap batteries when the Blue Channel comes off in mid November.

Yearly Blue Channel preventive maintenance was carried out. It included light oiling of the 6" brass worm gear, cleaning of the instrument, and inspection for wear.

Gspec, the GTK-based replacement for the old DOS-based spectrograph control system, is nearly complete. The new interface is shown in the figure below and was designed to be somewhat similar to the screen format of the old system. The serial communications between Linux and the spectrograph have been tested and a few baudrate-related issues sorted out. Gspec was then able to talk to the spectrograph successfully via T. Trebisky's network-to-serial relay script. Ultimately, the Cyclades will be used to relay between the network and RS232. Unfortunately, the topbox controls for the comparison lamps are not currently RS232, and even the old SCCS control of the topbox no longer seems to work. Some alternatives are being explored, but topbox support in Gspec may need to be postponed or scrapped. This is probably fine since most observers seem to prefer to use the topbox console for controlling lamps anyway.



Gspec interface

Computers and Software

All summit Linux machines were brought up to Red Hat 7.3 with all appropriate patches applied. The main machine, hacksaw, was upgraded to a 1.6 GHz Pentium 4 CPU due to some weird hardware conflict between the previous Athlon motherboard and the framegrabber card. The bug would manifest itself most noticeably when trying to run a framegrabbing utility over the network using VNC or something similar and would lock the machine hard within 10-15 minutes or so. Machines with Pentium 3 and 4 motherboards have not shown the same problem and have been able to run a framegrabber application over VNC for literally weeks on end. Subsequently, hoseclamp, the main guider computer, was also upgraded to a 2.4 GHz Pentium 4 and both it and hacksaw have been framegrabbing reliably since their upgrades.

Optics

Primary mirror reflectance was measured extensively before and after CO_2 cleaning. We refer the reader to Internal Tech Memo 02-1 by W. Kindred.

General Facility

The existing crane mounted to the inside of the building shutters and used for secondary mirror installation did not have the capacity to lift the entire f/5 secondary package as one piece. A new crane rail was fabricated and a new hoist installed. The crane limit switch assembly was fabricated and installed. This switch needs to be relocated and its position set for proper operation, and the new pendent cable needs to be connected to complete this task. The secondary crane system was re-cabled to allow the shutters to open without needing to unplug the connector. The crane stow position limit switch has been adjusted to insure proper storage of the crane before the telescope can be moved.

A new insulated rolling door was installed on the east side of the chamber to allow storage of the large new secondary mirrors into the east instrument storage room. The curb around the telescope was also modified to increase access through this door.

Cables were inventoried and obsolete cabling was removed. All cables were organized and clearly labeled for ease of connectivity and troubleshooting.

Obsolete test and computer equipment was surplused. The electronic shop and loft were organized by function (i.e., all aluminization equipment together, all test equipment together, etc.).

Maintenance and Repair

The motor on the air compressor after-cooler was replaced, and all eight filters were replaced. Yearly preventive maintenance was performed on the compressor (oil change, check belts, etc.).

RUPS maintenance included inspecting the flex coupling alignment, greasing the motors, and load testing the batteries.

The oil was changed and repaired leaks were checked in the building drive gearboxes. The building side rail bearings and pivots points were greased. The magnetic drain plugs in the gearboxes were cleaned.

The building drive motors' brushes were inspected, couplings greased, and filters cleaned.

The oil was changed in four Azimuth gearboxes and bearings, and all were inspected for leaks. The magnetic drain plugs were cleaned.

Yearly preventive maintenance for the Mattei 15 and 20 hp compressors was carried out, including oil change, filters, etc.

The motor and belt in the yard trench fan were replaced. The pillow blocks were inspected for wear and greased.

Visitors

Five UNAM engineers visited the MMT in late July. C. Foltz and E. Falco were hosts.

Publications

MMTO Internal Technical Memoranda

02-1 Effects of CO_2 Cleaning and Detergent Washing on Specular and Diffuse Reflectance of the MMT 6.5m Primary Mirror
W. Kindred

MMTO Technical Memoranda

None

MMTO Technical Reports

None

Scientific Publications

02-10 Discovery of a Group of Star-Forming Dwarf Galaxies in Abell 1367
Sakai, S., Kennicutt, Jr., R. C., van der Hulst, J. M., Moss., C.
To appear in *ApJ*

Observing Reports

Copies of these publications are available from the MMTO office. We remind MMT observers to submit observing 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 observing reports and 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 in two ways. First, it can be loaded via URL *http://www.mmto.org*. Second, it can be accessed via a link from the OIR's MMT page at URL *http://cfa-www/cfa/oir/MMT/mmt/foltz/ mmt.html*. The former should be used by interested parties west of the Continental Divide; the latter is a copy, which is locally mirrored at SAO and is much faster for East Coast access.