**Observing Report**

UAO-E29: MAESTRO Engineering

Nov. 14-15, 2011

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for Dan Kiminki, Grant Williams, Dallen Porter, and Mike Lesser.

**Summary**:

(1) The input optics to the spectrograph were realigned, using a newly designed and machined part for the turn mirror. Comparison lamp exposures through the 0.3” hole show that the optical image quality of the spectra is probably as good as it was before this modification. However, we did not observe a narrow lined star to verify the optical performance.

(2) The AZCAM server for both the science CCD and guider CCD were updated so that they are the same as the analogous software for MMT Blue and Red and other ITL-supported CCD systems. Although the server for the science CCD was successfully run in the lab at ITL, it failed on the mountain. Work-arounds were

found by Mike Lesser during tests in the Common building, but the guider CCD server also was unstable and hung every 10 minutes or so.

(3) The read noise on the CCD was found to be larger than it has been during

previous runs, and contained fixed pattern (Figure 1). The mean bias level is inexplicably about a factor of 2 higher than previously measured. We performed a number of tests on the telescope to isolate the cause of these changes, and eliminated several obvious possibilities. However, to fix the read noise, we are bringing the dewar and electronics back to ITL for further tests.

(4) Acquisition of objects remains the single most important problem to solve. The guide camera and slit plates were designed incorrectly, and we have made 4 or 5 modifications to try to make them work, with no success. I think the next step is to redesign the slit viewer camera mount and perhaps also fabricate new slit plates. We were unable to acquire stars that we could see last year, because of these

optical issues and perhaps also because of compromised performance of the guide camera itself (item #2).

(5) The first night was foggy and we opened only briefly with 1.8-2” seeing in the WFS. The second night was clear with excellent seeing (0.4-0.6” in the WFS). Unfortunately we were not able to acquire a standard star (see item #4) and were unable to judge whether or not the throughput problems have been solved by item #1.

**Prior to the run**.

1. **Turn mirror modifications and optical issues**. Light from the telescope enters a system of lenses to speed up the f/5 beam (“injection optics”), passes through the slit and shutter, and then is “turned” 90 degrees by a flat mirror to enter the spectrograph. The position of the injection optics, turn mirror, slit and slit viewer camera have all undergone major modifications since first light. A mirror on a movable stage also enters the beam to shine light from the comparison lamp box on the slit, and was completely rebuilt after first light. The original mechanical shutter has been replaced by an electronic one. Space is tight, and correct alignment crucial.

After the throughput of the spectrograph was measured to be low during the last engineering run, the optics were re-examined, end-to-end. It appeared that the turn mirror was 0.2” inches too far towards the grating, and as a result the input beam from the injection optics was being vignetted. The 0.2” allowed for a mechanism to adjust the tilt of the turn mirror.

The last major adjustment to the Maestro optics was carried out with Michelle Reed, where we moved the CCD about 0.2 inches closer to the grating, bumping up

on the shutter/injection mirror mechanism. This significantly reduced the astigmatism in the spectrograph, and was definitely an improvement.

A new mirror holder was designed, fabricated by the Steward machine shop, and anodized. It fit, and was installed before the run. The tilt of the turn mirror was adjusted using a laser, attached to an x-y stage above the spectrograph in the Common Building.

2. **Move to the Common Building, and Storage issues.**

We evacuated the lab on the 5th floor of Steward, and permanently moved the spectrograph, all spare parts, and a tool set to the Common Building on the mountain. Originally, we intended to occupy the “Aires” room in the north side of the building, which has the advantage that its doors may be closed, thus protecting the spectrograph from foot traffic and the large garage door of the loading dock. However, the outside wall of the “Aires” room developed a leak, the dry wall had to be removed, and several attempts over the course of the last 6-8 months were made to stop the leak through the outer layer of cement brick. It rained heavily during our run, and it appears that the leak is finally fixed, but the dry wall has not been replaced.

We instead set up in the central room of the Common Building lab, with extensive help from the MMTO staff. We cleared an area, set up the steel frame from which the spectrograph can be hung off the cart, and moved spare hardware and tools from the Steward lab to the mountain. The linux box we use for lab testing over the MMTO network was moved to the Common Building. We share this space with the f/5 instrument team, AO hardware, primary mirror actuator testing hardware, and mirror aluminizing equipment. However, the other users have been generous and helpful in letting us set up a large lab area for MAESTRO.

This lab space works well. The inconvenience of having to travel to the mountain for minor repairs was outweighed by the convenience of not having to pack up

the spectrograph to ship from campus to the summit, and by having extra pairs of hands to move heavy items readily available when needed. Dennis Smith, Ricardo Ortiz, Tom Oldham, and the other MMTO staff were extremely helpful in helping us set up the steel frame, and provided a dewar of liquid nitrogen to keep the dewar cold plus two canisters of dry nitrogen to keep the CCD window from frosting over.

Hardwire ethernet connections were installed in the lab area on Nov. 9, which greatly helped with the test set up which requires 3 hardwire Ethernet connections.

The one bad thing about the Common building is the inevitable mouse infestation.

Dan donned serious protective gear (Fig 3) and cleaned the mouse droppings, wiping everything down with bleach. He installed ultrasonic electronic mouse

repellers, but we need to protect our computer and electronics from the mice, and

have asked Russ Warner to find another cabinet or two to place the boxes in when not in use.

3. **Recabling the CCD electronics box, moving the guide camera cooler out of the box and adding wheels.**

Originally the CCD electronics box was designed to hang on the spectrograph and remain cabled when the spectrograph was off the telescope, on the cart. In order to fit through the door to the Aires room, it is necessary to uncable this box and remove it from the frame of the spectrograph. Some of the connections involved reaching inside the box and attaching cables blindly to the back of component boxes.

Dave Baxter re-cabled all the connections, so that cables are now attached and detached on the outside of the box. He also fixed the box cover so it is now easy to remove and replace. He also placed a USB connector on the outside of the box to which a monitor and keyboard can be attached to access the on-board computer, maestroccd. Wheels were attached to the bottom of the box so that it is now easy to move when off the spectrograph.

In addition, the liquid cooler for the slit viewing guider camera was in the box, and posed a danger to the electronics should a leak develop. This was removed from the box. We had a steel bracket for the PZT electronics which we are not using, and Dan Kiminki and Tom Oldham modified it to hold the cooler on the side of the telescope.

4. **Repair of the spectrograph control electronics box.**

In handling the external power switch was broken. A new one was installed.

5. **Quartz Lamps and Comparison Box modifications.**

During the last run, both quartz lamps failed to shine, and it turns out that both bulbs had burned out. Since it is not possible to change bulbs when the spectrograph is on the telescope, we will always install new bulbs before a run. The cover of the comparison box was modified to make this process easier. It’s not clear why the bulbs burn out so quickly. The backup during a run is to use the f/5 lamps in the secondary hub.

6. **User interface to Spectrograph control.**

A ruby gui is used to control the motion of the motorized stages in the spectrograph, and to turn on and off the quartz lamps. Previously we used an “engineering” gui which was OK for observers to use, but not optimal. Dan designed and tested an observer gui, which includes some software safeguards, and is easier to use (Figure 4.)

7. **Exposure Time Calculator.**

8. **Updates to AZCAM software**.

Mike Lesser updated the AZCAM server on maestroccd, which runs the science CCD and also the server which runs the guide camera. Similar updates had been made to 90prime and the MMT Spectrographs. Mike and Skip Schaller tested the science CCD and IRAF/ICE interface downtown.

We ran into a number of problems when we tried to use the science CCD on the mountain. Some of the problems caused by a poor Ethernet connection to the maestroccd computer; these were solved when a new Ethernet cable was installed. Another set of problems occurred when changing the on-chip binning. After much trouble shooting, Mike got the software to allow changes of binning, provided that the first image you take after rebooting the AZCAM server is full format, and binned 1x1.