DEIMOS
SSC Presentation: January 25, 2001
Twenty-Seventh Quarter

Camera/optics:
- See Optical Testing.

Detector/mosaic:
- For blue mosaic, see Dewar/LN2 system.
- We had a second distribution of Lot 14 high-ρ devices, from which we received 4 excellent, one good, and one fair device. However, an otherwise excellent high-ρ device in the blue mosaic proved to have a "wingy" PSF and was relegated to spare status, bringing our total inventory for the red science mosaic to 6 science-grade devices, plus two spares.
- There are six more Lot 14 devices that are still to be packaged at MIT/LL, from which we could get 1-2 more science-grade devices. Luppino may also be able to trade us 1-2 science-grade devices from his stock, but this will not be clear until Mar. 1. We are also investigating trades with ESO.
- The four extra Leach II video boards required for 16-amp readout arrived.
- CARA has now accepted our proposal to assemble the red science mosaic after the Pre-Ship Review, pending review and approval of our proposed lab-testing procedures.

Dewar/LN2 system:
- The dewar and blue mosaic were installed in DEIMOS on Oct. 16, 2000, and continued to work well until their removal on Jan. 12, 2001. The ion-pump current fell throughout, and long darks were adequately dark. The contamination problem appears solved for now but will doubtless reappear each time we open the dewar in future. However, the hope is that continued pumping will continue to solve the problem.
- A 10/1 reduction was introduced into the dewar focus gear train to overcome stiction. Travel time is still acceptably short.
- The LN_2 can hold time is 20 hours. We plan to build a new can with improved radiation shield and cold finger to try to improve this.
- Six px of flexure were seen pk-pk in the detector mounting train, an increase over the 1-px value measured when the train was first assembled. The dewar X-stage also had only about half of its design travel. The dewar was removed on Jan. 12 to fix these two items, and we will also take the opportunity to convert to 16-amp operation. The dewar is scheduled to be reinstalled on Mar. 1.

Structure/system installations:
- No work on basic structure.

Slitmask system:
- Flexure of the slitmask cassette holder was tested and is now acceptably low after the rework to the scissors mechanism last spring. A 10/1 gear reduction was installed on the scissors drive to eliminate jitter, but travel time is still adequately short.
- The final slitmask form was permanently installed on a sturdier mount.
- The slitmask insertion/retraction mechanism was tested in all PAs. Masks seat well in the curved slitmask form (see Optical Testing). However, problems remain in some PAs with the spring-plunger mechanism that kicks in at the end of the retraction stroke to free the "hotdog" pusher from the mask. This must occur before the next mask can be selected. Minor-to-moderate rework may be required on this aspect of the retraction mechanism.

Grating system:

- All parts of the original design have been fabricated.
- Slider 2 (with the imaging mirror) can now be installed on the grating box in any position angle. Flexure of the slider on the box and flexure internal to the slider itself both appear to be small. The original slider "handoff" mechanism that locates the slider on the box was too floppy and needed extensive redesign. The new handoff mechanism seems to work well.
- The success of slider 2 clears the way to implementing the same handoff mechanism for sliders 3 and 4. Drawings are being prepared.
- We are contemplating deleting slider 1 and replacing it with a copy of sliders 3/4. Slider 1 was designed to accommodate oversize 8×12-in gratings, but they are no longer considered to be necessary.
- No work was done on the problematic grating box this quarter. Flexure in this box is likely to be the major source of the 40 px of flexure seen in DEIMOS under rotation. The box is due to be removed and strengthened in February and will be back on DEIMOS for new flexure tests in early March. See further remarks under Optical Testing.

Electronics:

- The Linux PC that controls the rotation drive was received. It was configured, and new electronics that will replace the previous Galil motor controller were fabricated. The system was bench-tested with a mockup of the rotating stage. The PA drive motor is due to be reinstalled and the system handed off to Software next week.
- Fiducials and limit switches were installed and basic stage calibration was carried out on the filter wheel and grating tilt systems prior to handing off to Software.
- Most of the 27 HP temperature sensors were installed.
- The general spectrograph wiring was largely completed.

Flexure compensation system:

- The flexure calibration fibers and light source were installed and placed under software control. FC images were taken with the FC CCDs. For further results see Optical testing.
- Frame transfer mode has been deleted from the FC plan, as shutterless mode will be adequate. This saves two man-weeks from the software schedule.

Calibration system:

- The wavelength calibration and quartz lamps were installed and operated under software control. For further results see Optical Testing.

TV guider:

- No progress during this period.

Integration/alignment/optical testing:

- Image quality was tested using direct images and spectra through a pinhole/slitlet mask. The hole diameter = slitlet width = 0.5 arcsec = 4 pixels. All images show radial coma with maximum length approximately 20 pixels at the detector edge. A smaller amount of constant coma in the Y (spectral) direction also seems to be present. Where coma is low, the FWHM of the images is about 4 px as expected.
- Radial coma may come from improper spacing between Multiplet 4 and Element 9 (field flattener). Constant coma could come from a variety of tilts or displacement in the camera, any of which could be counteracted by laterally adjusting the coma modulator in Multiplet 4. Attention will be given to both adjustments when the gratings and grating box are reinstalled in early March.
- Fringing is only about 4% peak-to-peak; we had been planning on 20%. Flatfielding errors due to fringing variations should be commensurately better.

- CCDs 1 and 4 are engineering devices from Lot 14 (thick high-ρ CCDs). Their PSFs look narrow, indicating that the PSFs of the red Lot 14 mosaic should be acceptably sharp.
- The wavelength calibration system contains Hg, Ne, Ar, Xe, Kr, Cd, and Zn lamps. Many dim but usable lines are visible in the blue below 5500 A.
- The internal quartz flat-field lamp is rather dim in both the far blue and far red and also contains mysterious broad spectral features that appear to be imposed by the optic fiber transfer bundle. However, it is usable as is and will be improved only as time permits.
- The flexure compensation spectra land on the FC CCDs, and the CuAr lamps produce spots of good brightness at all grating tilts and dispersions.
- Summary of flexure progress since last report:
  ◦ To review, peak-to-peak image motion of 40 px was observed. The capture range of the FC system is only 20 px.
  ◦An in-house review on Oct. 26 suggested that we should remove, strengthen, and weld the grating box. This is being done (see Grating System).
  ◦ We are also researching a tripod support system that we will implement if the grating box cannot be made to work.
  ◦ Six px of flexure peak-to-peak was discovered in direct images looking into the dewar (see Dewar). We will attempt to fix this when the dewar is being reworked in February.
  ◦ Image rotation is $\leq$2 px peak-to-peak at the detector edge. The error budget calls for $\leq$1 px. We are hoping rotation will be reduced when the grating box flexure is improved.
- The first and second images taken upon moving to a new PA are typically displaced from one another by $\leq$0.5 px; subsequent images do not move. The slight displacement between the first pair is thought to be due to small vibrations caused by the shutter mechanism. Overall, this is a small effect and is tolerable.
- Initial tests suggest that inserted slit masks reseat to better than 1 px at a given position angle. This is an error of $\leq$0.12 arcsec.

Software/testing:
- Dewar focus, dewar X stage, science filter wheel, calibration lamps, and shutter were all operated under keyword control and tested using automated scripts.
- An engineering GUI was created and is in use.
- A power PC board replaced the previous Force 5 board in the CCD VME crate, increasing the video transfer rate over the optical fiber link from 10 to 100 Mb per second. The connection is being tested.
- Further progress was made on the Lickserve2 program to read out the mosaic array.
- Keywords for the PA rotation stage were completed.
- Software was started for optical flexure analysis. The goal is to use ghost images reflected off the grating, plus high-order distortion terms to disentangle flexures from the collimator, tent mirror, grating, and detector.
- The mask fabrication procedure and associated software were postponed until roughly one year after DEIMOS delivery. This was mutually agreed to by both the CARA and DEIMOS teams to ease the intense workload of instrument delivery. Masks will be fabricated for DEIMOS observers during that time using the identical mill in the Lick shops. Postponing the mask fabrication software shortens the Pre-ship software schedule by about three man-weeks.

Website/documentation:
- Work to clean up and improve the DEIMOS website continues. Test results are being posted there. We have also posted all the previous SSC and quarterly reports and developed a way to post Postscript files. A plan to post Autocad drawings is underway.

Shipping/commissioning:

- Discussions continued with Matson for shipping, and with the UCSC campus agent for insurance.
- Major items on the current CARA preparations list include:
  - Extend the Nasmyth platform.
  - Measure the deflection of the Nasmyth platform under DEIMOS load.
  - Design, fabricate, and install the cable boom.
  - Install and extend tracks on the instrument deck.
  - Increase clearance at the elevation axis cable wrap.
  - Produce a drawing for the DEIMOS lift into the dome.
  - Run air, glycol, co-ax, and power lines to the cable boom.
  - Mount and install DEIMOS computers and disk drives.
  - Modify the TV guider software.
  - Implement a method to archive DEIMOS data to tape.
  - Implement a method for handling DEIMOS LN_2.

Concerns:

- Failure to cure flexure in the current grating box will necessitate implementing the tripod scheme and cause an unknown but significant schedule slip.
- Significant rework is required on sliders 3 and 4 to get them to install properly.
- Two CCDs are still missing from the red science array.
- Rebuild of the CCD cables (see Oct. 16 report).
- Closed-loop FC software is needed and has not been thoroughly scoped as yet. Internal flexure in the grating sliders has also not been measured yet.
- Software has been delayed by about one month since our previous report (Oct. 16, 2000) by illness and various emergencies. Further delays may delay the Pre-ship Review.
- Switching to 16-amp operation could reveal unpleasant surprises.
- The PA rotation system remains largely unexplored as of this date.
- We are relying on the fact that we can integrate successfully the red science mosaic after the Pre-ship Review.
- Telescope baffling needs study with CARA, and a plan.

Schedule and Budget:

- Our schedule at the Oct. 16 report called for a Pre-ship Review On June 7, 2001. This has now slipped about one month to the end of June. The slip was occasioned by delays at our end and also a better fit to the CARA schedule.
- The delay adds one month's labor to the budget at high effort, or about $120,000. With this, the total cost to complete is now approximately $8,400,000. The approved budget amount is $7,298,819.