COS
Monthly Status Review
April 25, 2001
GSFC

Agenda

Progress Summary Since Last Monthly	J. Andrews
Optics Development Status	J. Andrews
Optics Test Status & NUV Issues	J. Green
UCB FUV Detector Programmatic Status	J. Andrews
UCB FUV Detector Technical Status	J. Andrews
CU Software Activities Status	J. Andrews
Cal/FF Subsystem Activities at CU	J. Andrews
Schedules	J. Andrews
Descope Report	J. Andrews
Upcoming Events/Activities	J. Andrews
CU Issues & Resolution Plan	J. Andrews
STScI Presentation	T. Keyes
BATC Presentation	R. Higgins
Financial Splinter	GSFC/Ball/CU

Progress Summary Since Last Monthly (2/28/01)

- Continued troubleshooting TV tank contamination issue.
- Received flight FUV detector at CU.
- Continued assessment of NUV grating problem.
- Continued G160M grating tests.
- Continued processing spare FUV detector at UCB.

Optics Development Status - NUV Mirror Coatings

- All NUV optics have been or are about to be coated
  - Coating complete:
    - NCM1-A, B
    - G185M-1, 2
    - NCM2-1, 2
    - NCM3a, b, c-1, 2
    - G225M-1, 2
  - Awaiting coating:
    - G285M-1, 2 (pending resolution of NUV grating issue)
    - G230L-1, 2 (still at JY)
    - G140L Blazed (if we get it)

Optics Development Status - Gratings

- Present grating delivery plan (changes since last month in red/bold):

Item	Delivery Date	Coating Dates at GSFC	Test Dates	Planned Test Location
G140L	Done	Done	Done	CU
G160M	Done	Done	3/01-5/01	CU
G140L-Blazed	TBD	TBD	TBD	CU
G185M	Done	Done	**Done***	GSFC/CU
G225M	Done	Done	**Done***	GSFC
G285M	Done	On hold	**TBD**	GSFC
G230L	6/01	6/01	7/01	GSFC

*G185M & 225M testing has been completed and identified the substandard efficiency performance. Retesting and/or the correction of the problem is under evaluation.

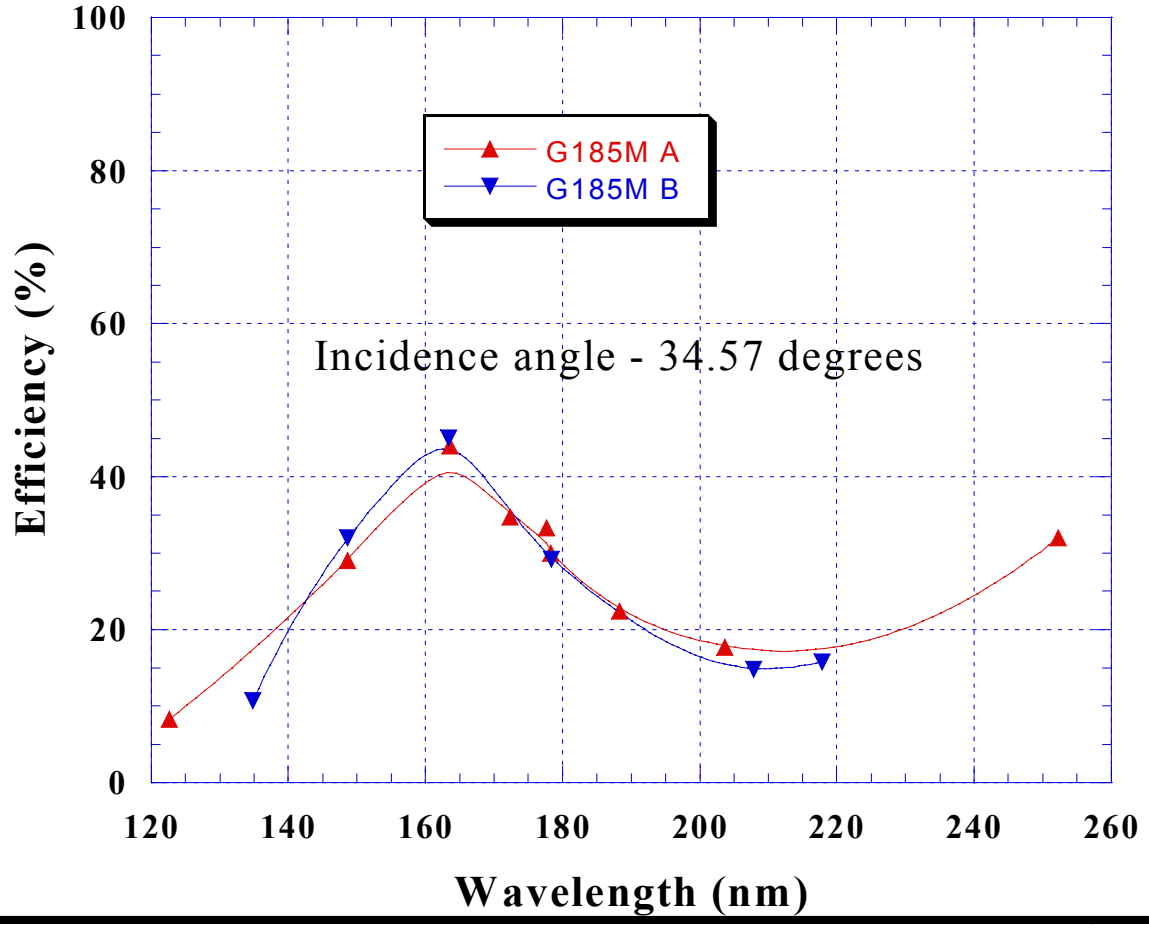
COS FUV Grating Test Status

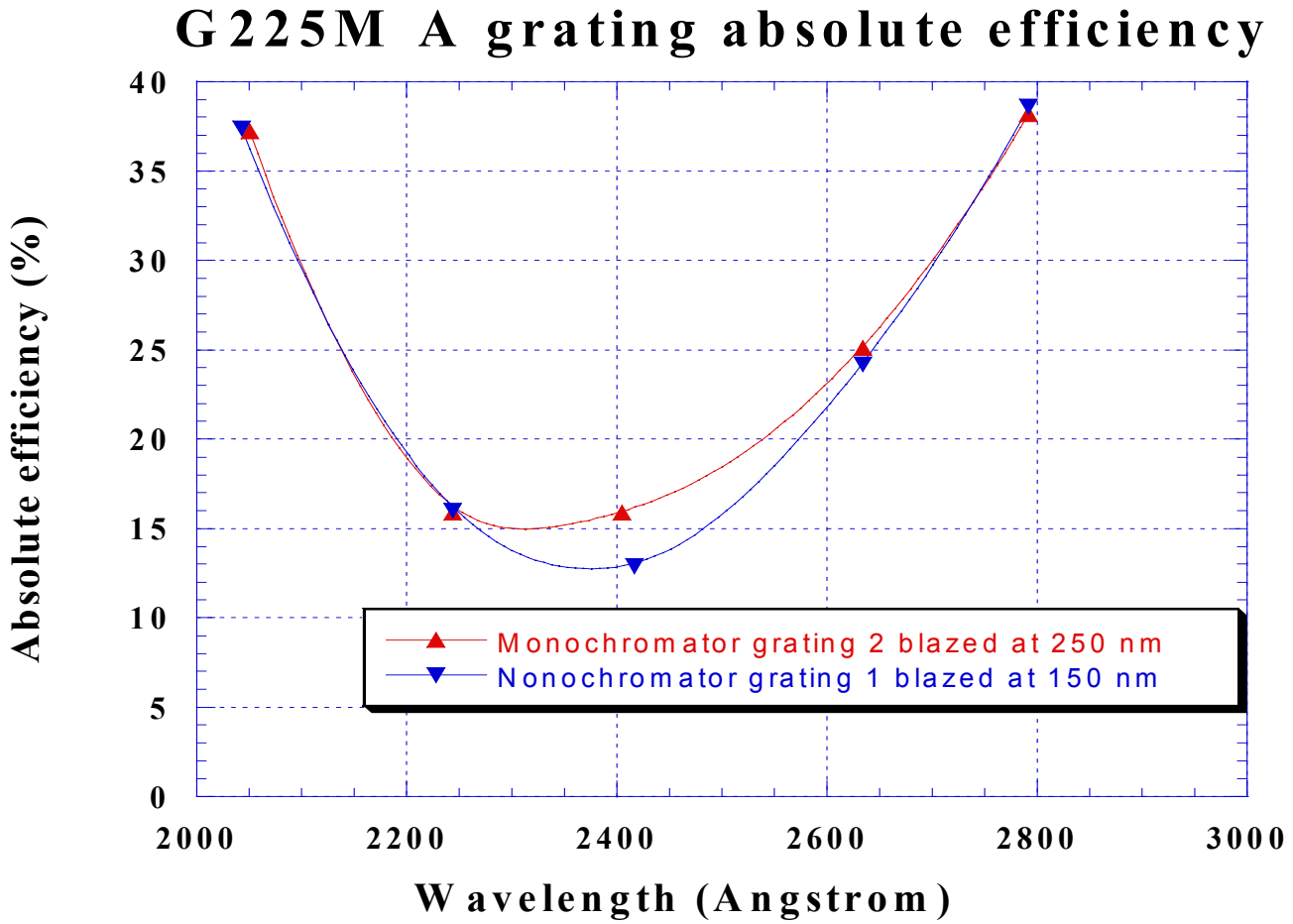
- G130M Gratings
  - Testing and data analysis have been completed for both gratings. Calibration reports have been released for both gratings.
  - Both gratings are satisfactory in all respects.
  - G130M-B appears to have slightly better performance.
- G140L Gratings
  - Testing and data analysis have been completed for both gratings.
  - G140L-B is satisfactory in all respects. G140L-C has slightly lower efficiency, but is otherwise acceptable.
- G160M Gratings
  - Tests have started and are proceeding slowly due to resources diverted to TV tank support.

Review of G185M Grating Issues

- Uncoated G185M was tested at J-Y and met specifications. It was accepted on the basis of the J-Y test results.
- Flight & spare (G185Ma & G185Mb) were coated with Cr/Al/MgF_2 at GSFC.
- Post coating tests at GSFC indicate that the efficiency of the gratings is substantially below specification.
- CU and GSFC test results are now consistent. Additional measurements of a coated G185M at J-Y also consistent with GSFC and CU results.

G185M A&B absolute efficiency data




G225M A grating absolute efficiency
Absolute efficiency (%)
40
35
30
25
20
15
10
5
0
2000
2200
2400
2600
2800
3000
Wavelength (Angstrom)
Monochromator grating 2 blazed at 250 nm
Nonochromator grating 1 blazed at 150 nm

G185M Efficiency

- Testing of G185M and G225M have been performed at CU and GSFC. G225M has similar problem.
- GSFC results have been confirmed by independent test, test in multiple GSFC set-ups, and confirmed by full E-M simulations of coated gratings.

G185M Grating Issues

- Source of Problem:
  - Full E-M effect of coatings not appreciated in groove depth optimization - gratings were fabricated as designed and originally tested without a coating.
  - It appears the groove depth is too shallow for maximizing efficiency at correct wavelengths.
  - Simulations indicate that a thicker MgF_2 may substantially improve performance. G185M-c has been coated with 650Å of MgF_2 (instead of standard 400Å) to test this hypothesis. If this solution works, recoating of new replicas should solve problem. Test results may be available by time of presentation.
  - Replication of the masters with standard techniques result in a groove depth ~50Å shallower on replica compared to master. This effect was known and included in the original master fabrication to produce replica of the desired (erroneously) depth. An alternate replication technique may result in deeper grooves on the replica. This replication effort is in process. Latest updates may be available at the time of presentation.

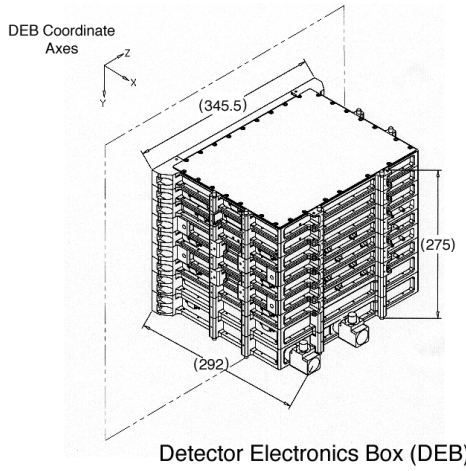
Solutions (Assuming Groove Depth Hypothesis Correct)

A) Refabricate G185M, G225M, and G285M at J-Y. Install current grating for alignment purposes and swap gratings later.

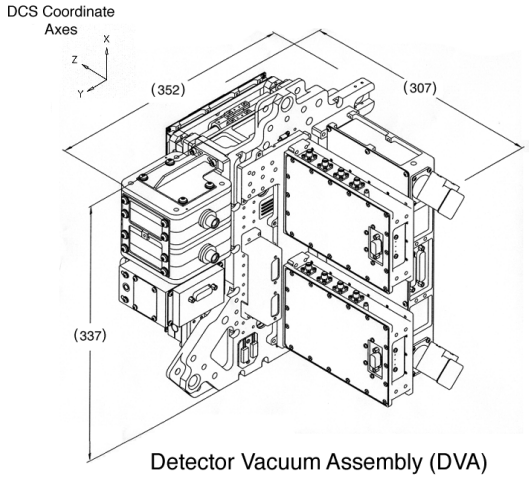
B) Procure grating from alternate vendor (Hitachi) and swap later. Hitachi is currently preparing a bid for us. Bid not available on 4/20/01.

Overview of FUV Detector Assemblies

- **DEB** - (**D**etector **E**lectronics **B**ox)
  - **DCE** (**D**etector **C**ontrol **E**lectronics))
  - **TDCs** (**T**ime-**to**-**D**igital **C**onverters)
  - **HVPS** (**H**igh **V**oltage **P**ower **S**upply)
  - **LVPC**(**L**ow **V**oltage **P**ower **C**onverter)
- **DVA** - (**D**etector **V**acuum **A**ssembly)
  - **VHA** (**V**acuum **H**ousing **A**ssembly)
    - Detector Door Mechanism
    - Ion Pump Assembly
  - **DBA** (**D**etector **B**ackplate **A**ssembly)
    - **Amplifiers**
    - **HVFM (H**igh **V**oltage **F**ilter **M**odule)



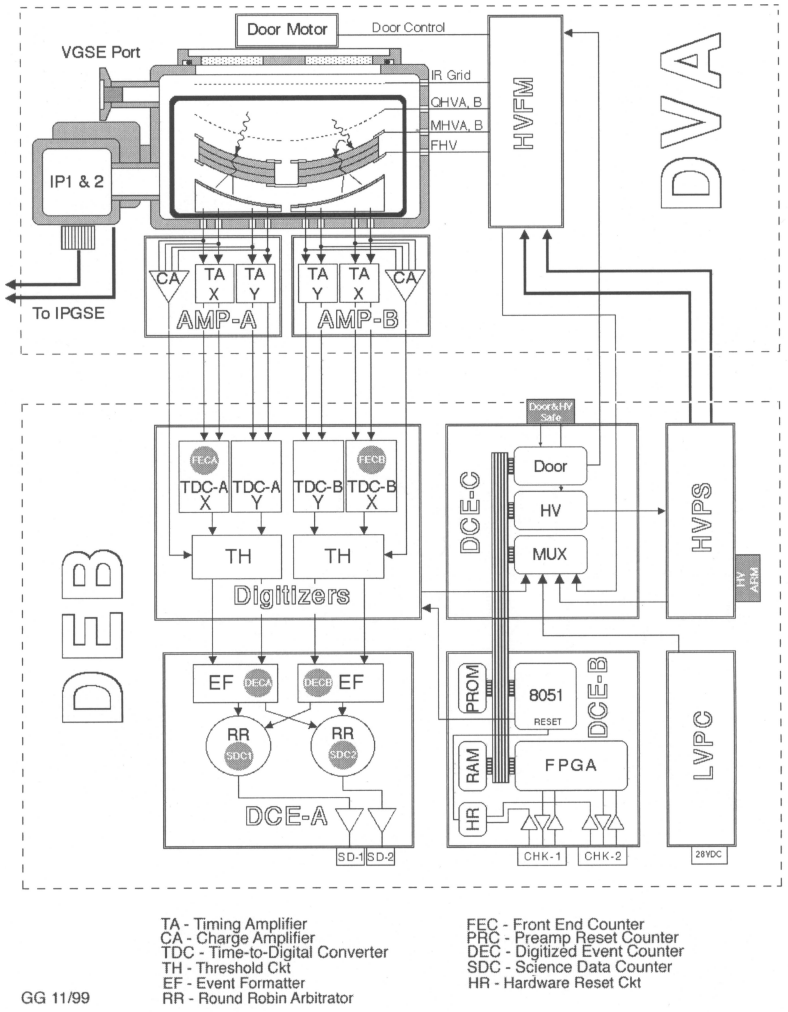
Detector Electronics Box (DEB)



Detector Vacuum Assembly (DVA)

FUV Detector Subsystem Block Diagram

- UCB is under contract to deliver 1 flight FUV detector subsystem and 1 flight-spare detector subsystem.



UCB FUV Detector Status - Spare Electronics Summary

ACTIVITY	Electronic Board								
	Amps	HVFM	HVPS	LVPC	DCE-A	DCE-B	DCE-C	TDC-X	TDC-Y
Parts List	C	C	C	C	C	C	C	C	C
Schematic	C	C	C	C	C	C	C	C	C
Parts Stress Analysis	C	NA	NA	NA	NA	C	C	C	C
Worst Case Analysis	NA	NA	NA	C	NA	C	C	C	C
Board Thermal Analysis	C	NA	NA	NA	C	C	C	C	C
Release Layout	C	C	C	C	C	C	C	C	C
Board Fabrication	C	C	C	C	C	C	C	C	C
Kit Parts	C	C	C	C	C	C	C	C	C
Board Coupon Testing	C	C	C	C	C	C	C	C	C
Stuff Boards	C	C	C	C	C	C	C	C	C
Board Workmanship Acceptance	C	C	C	C	C	C	C	C	C
Board Engineering Acceptance	C	C	C	C	C	C	C	C	C
Engineering Test & Acceptance	C	C	C	C	C	C	C	C	C
Temperature Cycle Test	C	C	C	C	C	C	C	C	C
Voltage Margin Test	C	NA	NA	NA	C	C	C	C	C
Final Acceptance Test	C	C	C	C	C	C	C	C	C
Staked/Conformal Coated	C	C	C	C	NS	NS	NS	NS	NS
Legend	*C = Complete*		*NA = Not Applicable*		*S = Started*		*NS= not started*		

Changes since last MSR in red/bold

UCB FUV Detector Status - Systems

- Documentation Update:
  - No changes to report this month
- Mass and Power Updates (changes in red/bold):

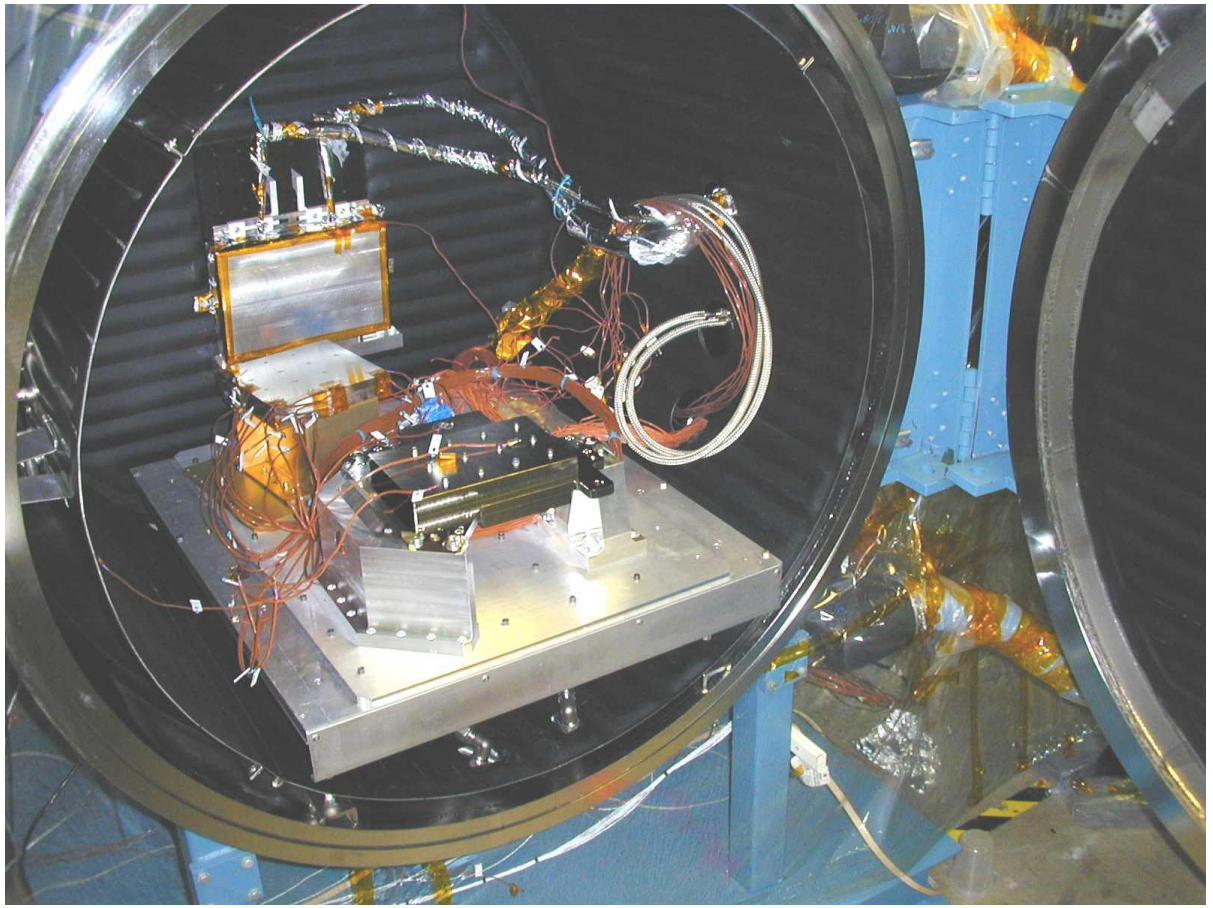
	Mass (Kg)			Power (W)		
	Actuals	SoR Allocation (1)	Margin	Actuals	SoR Allocation (1)	Margin
DVA	20.43	21.5	5%	4.59	-	-
DEB	14.44	15.3	5.6%	47.42	-	-
Harness (est.)	2.7	3.4	20.5%	-	-	-
Total	37.57	40.2	6.5%	52.01	53.0	1.73%

Notes: (1) SoR Revision B allocations

- Latest UCB masss & power numbers are actuals measured on the flight system. The numbers come from Revision D of the UCB Mass & Power Budget Report (UCB-COS-RPT-1015, UCB-COS-RPT-1004).

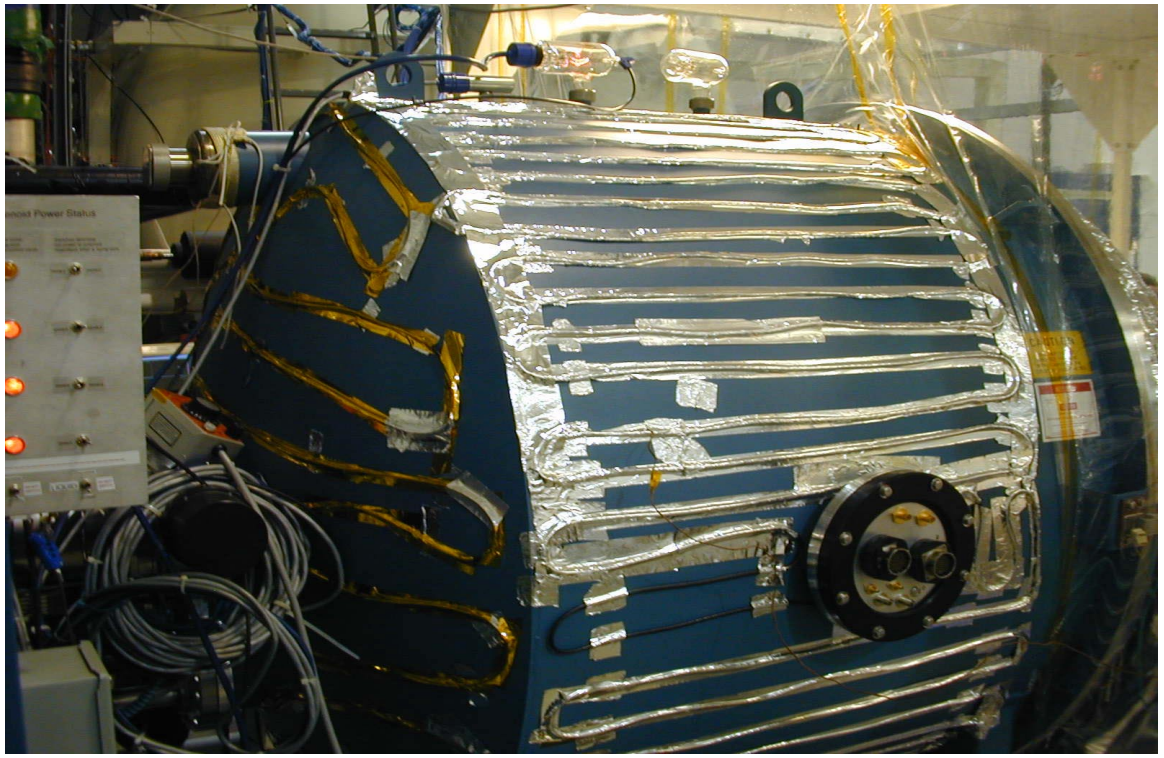
UCB FUV Detector Status - Thermal-Vac Test Preparation

- Detector arrived CU 4/3/01.
- Test procedure now in signature cycle.
- We are ready to start test as soon as contamination certifications are complete.

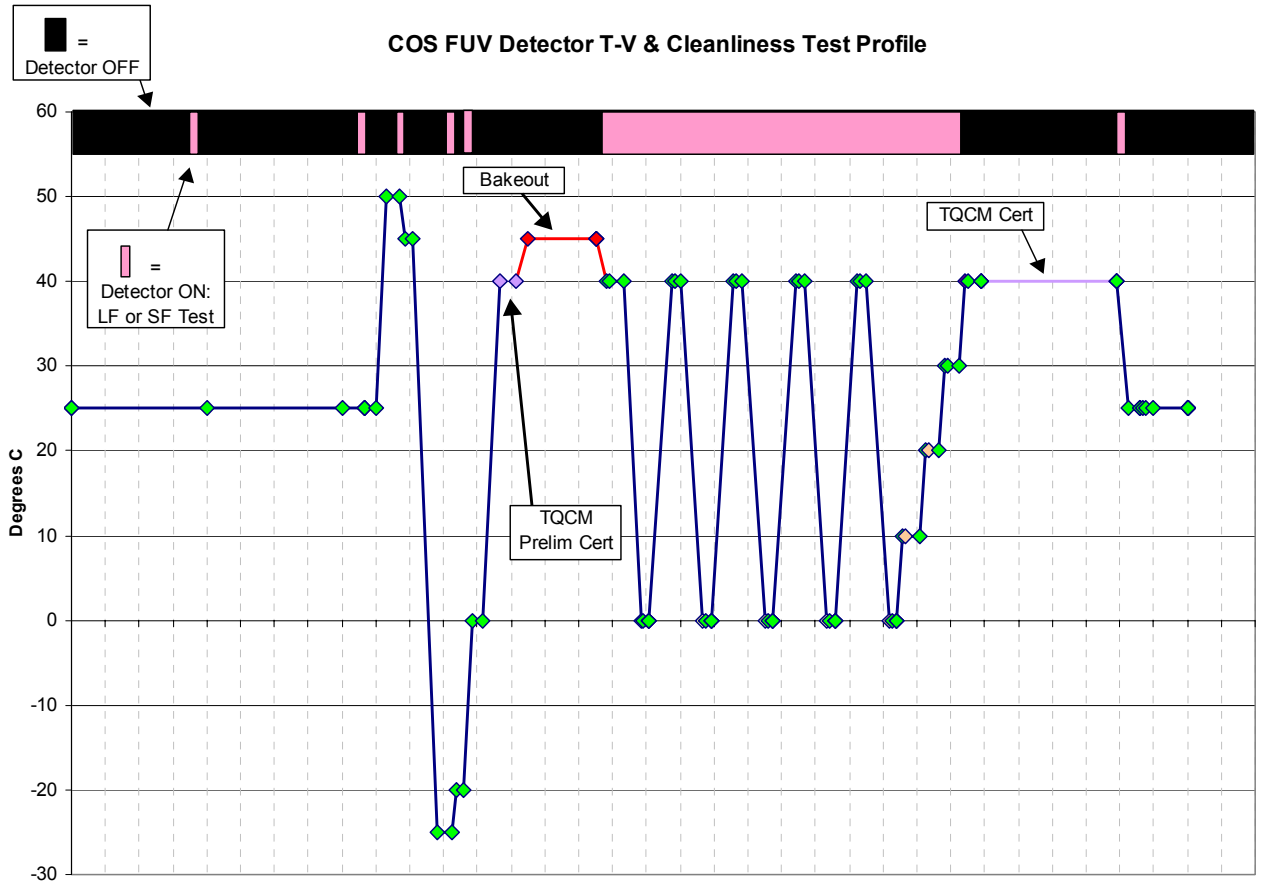


UCB FUV Detector Status - Leaking Shroud Recovery Status

- Shroud repair completed and tested by early April.
- Chamber has had difficulty in cleaning up since repairs were done.
  - At 40°C TQCM rates have been between 200 Hz/hr to 1200 Hz/hr.
  - Background rates should be ~10 Hz/hr.
- Ball (J. Heuser) & GSFC (D. Hughes) have been providing support.
- A long, >100 °C bake of the chamber and a recertification of the GSE has just been completed.



COS FUV Detector T-V & Cleanliness Test Profile



UCB FUV Detector Status - Schedule Overview

March Tracking Milestones	**Status**
Ship flight detector to CU	Arrived 4/3/01
Start TV test on flight unit	Slip to this week
Deposit photocathode on spare MCPs	4/23/01

April Tracking Milestones	**Status**
Deliver flight unit to Ball	Expected 5/15/01
Start spare DEB/DVA characterization	Complete

May Tracking Milestones	**Status**
Assemble spare system in preparation for environmentals	By 6/1/01

Forecast flight system delivery to Ball:

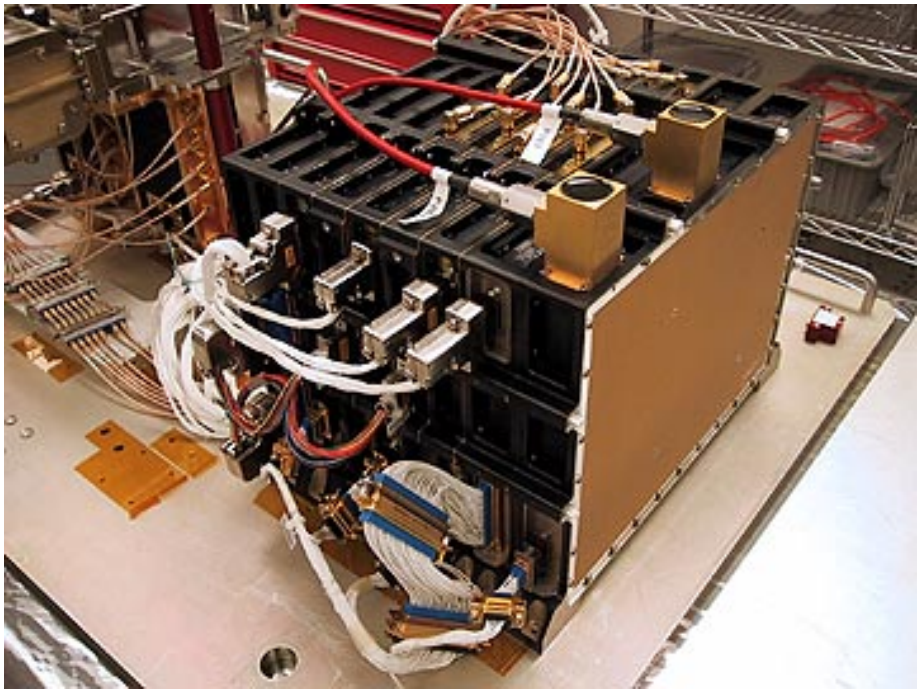
This month = 1/15/01

Last month = 5/7/01

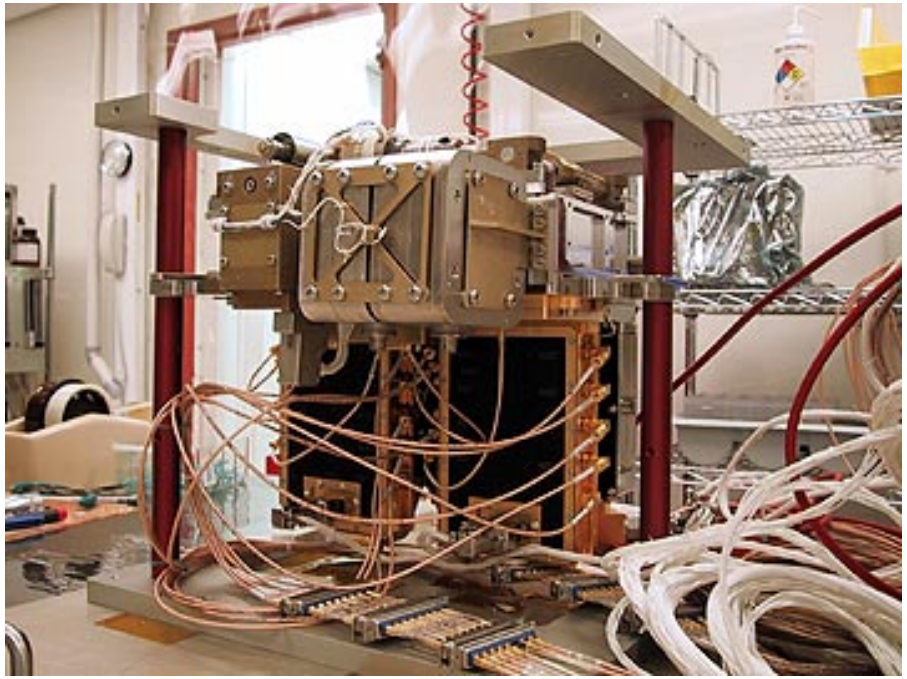
Ball's need date is driven by Ras/Cal's availability. The FUV detector can be removed from TV to support alignment testing and then returned to TV.

COS FUV Detector Systems

- Detector DEB



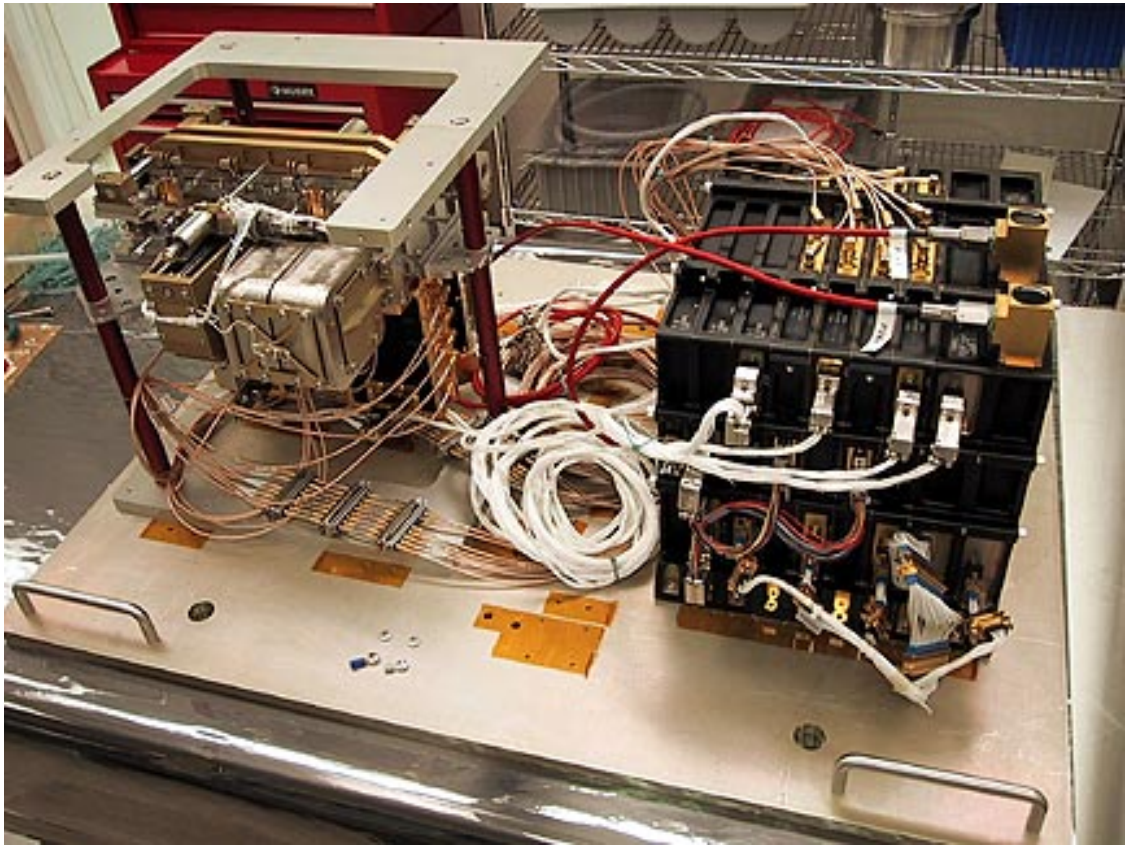
- Detector Head



Flight FUV01 Detector System

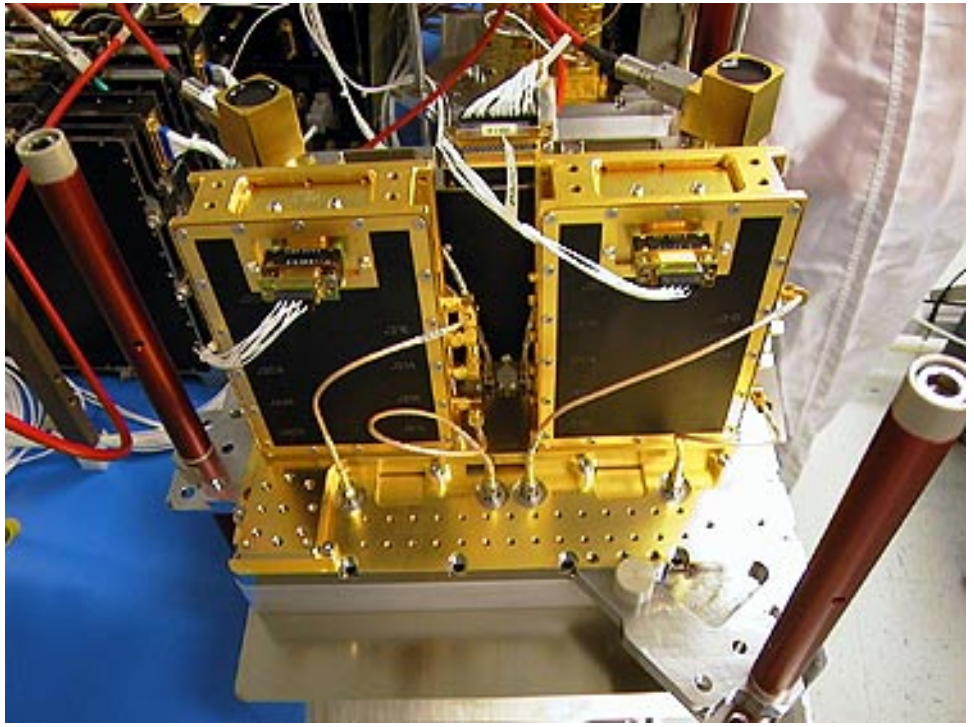
FUV01 Flight Unit

Detector & flight DEB were shipped on 4/2/01. Have performed the post ship functional successfully. Detector system is "safed" with the pumping system on (+ UPS backup) ready for TV tank installation.



UCB FUV02 Detector Test Status

- **FUV02 Flight spare**
  We received the approval from CU to do the cathode coating (4/13/01). Side B looks good, Side A has some residual Moire fixed pattern in places. We will coat one side 4/24 and the other on 4/26. Then the QDE's will be measured.
- (Scheduled water shutdown last week made coating impractical)



FUV02

UCB FUV Flight Backup Detector Electronics

- **TDC high rate duplicate event issue - decided to put fixed ACTELS into FUV02 at last monthly**.
  - We have tested code and have burned the Round Robin ACTEL's (2) with the correct code for the FUV02 detector
    - We still need a firmware review of the corrected Round Robin code (need GSFC participants)
- **Perturbation of Housekeeping analogs at high FEC rates**
  - Decided to leave resistors unchanged at last monthly and implement S/W fix.
- **Noticed excessive image drift in FUV02 side B in Y**
  - The Y axis on side B was tested and the thermal drift is 2x worse than the other Y axis TDC's. We have suspected the lumped delay line but this tested to spec on one sample. The drift level is still able to be accommodated by our offset command range of the Y ADC. However, we want to find the source before committing to coat and stake of the board. Rick Raffanti will be probing the board with us this week and then we will recommend any actions.

UCB FUV Detector Other Status Issues

- Updated version of ICD (rev B) issued
- Updated Thermal Vac procedure issued for approval
- Settings for spike inhibition under review. Thermal Vac data will also be useful for this.
- Proceeding with closeouts on a number of resolved PFR's
  - 1 through 17 closed out, 18 through 22 in process
- Final vibration report has been issued

GSE Software Development

CEDAR, TAACOS, CALCOS-GSE, Keywords & SDF

http://cos-arl.colorado.edu/CEDAR/
http://cos-arl.colorado.edu/TAACOS/
http://cos-arl.colorado.edu/CALCOS/

Highlights:

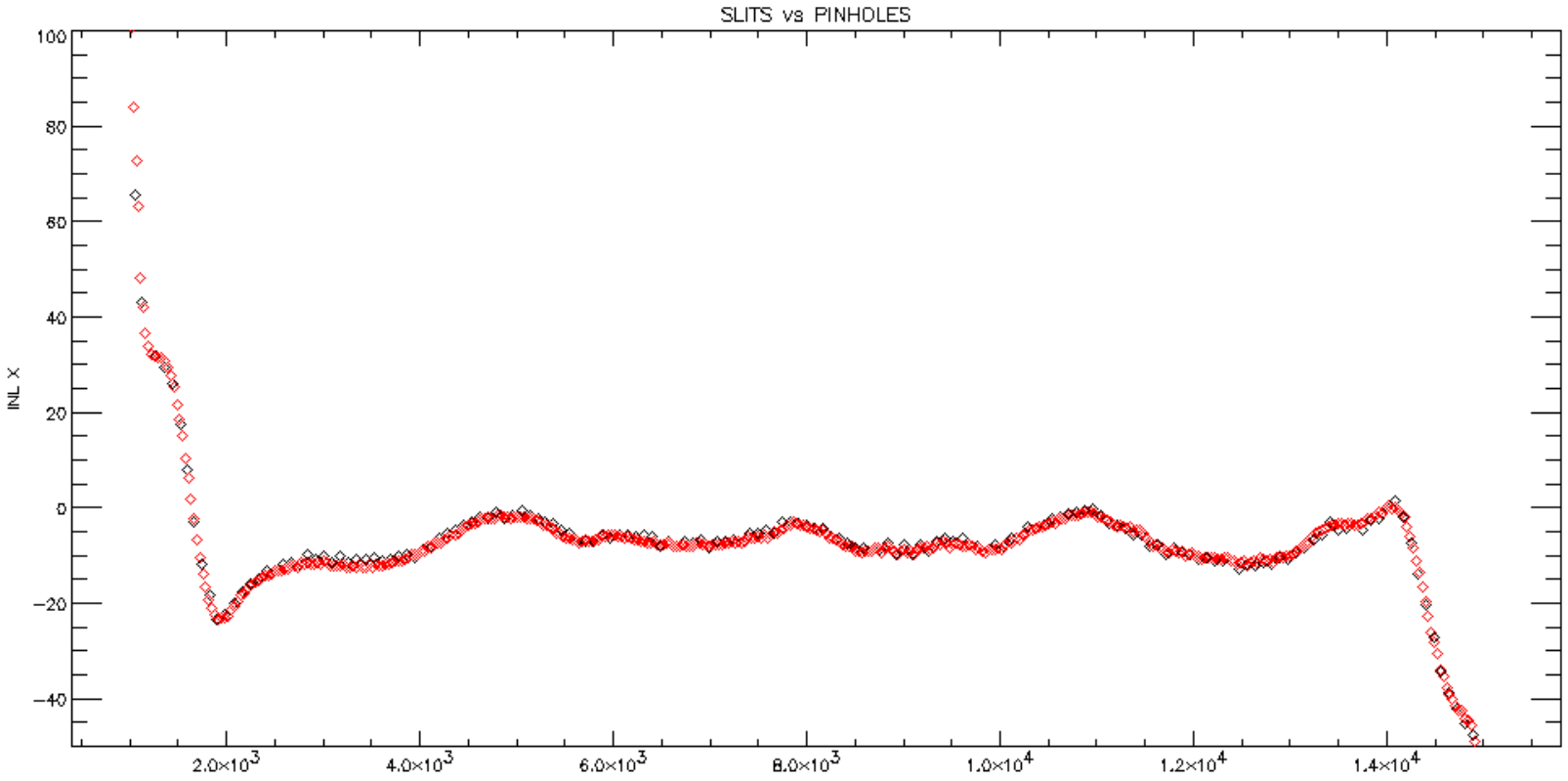
- CEDAR: Latest version of CEDAR installed at BATC. Includes minor updates to HEXVIEW portion of CEDAR.
- TAACOS: No change. All TAACOS Reports released. No new TAACOS studies are currently planned.
- SPECTRAL SIMULATOR: Initial version of COS Spectral Simulator currently on-line. Includes all gratings, 2 different sample targets (many more in progress), wavecal exposures, and flat fields. User inputs exposure time and initial flux estimate – and simulator returns sample spectra (in counts) and average S/N estimate. Available on the main COS webpage: http://cos.colorado.edu/

CALCOS-GSE Progress Report

- Work continues in implementing and verifying the procedures described in AV-03
- Geometric Correction (GC) Algorithm (cont.):
  - Used Pinhole and Slit data to determine Integral Non-Linearity (INL) map along dispersion and cross-dispersion direction.
  - Apply INL map to event location to remove variations in the plate scale of the detector that occur on scales > 1mm. ($1\sigma = 0.6$ pixel)
  - Different algorithms have been used to verify the concepts and the best implementation is being investigated (lookup table vs interpolation)
- Flat Field Data (cont.):
  - The post-scrub deep-flat-field data will be used (after TC and GC) to generate the Data Quality Lookup Table

COS
Monthly Status Review

Center for Astrophysics and Space Astronomy



Cosmic Origins Spectrograph
Hubble Space Telescope

April 25, 2001

FUV Detector FSW Development

DCE Flight Software Development and Test

http://cos-arl.colorado.edu/DCE/

Highlights:

- No changes to DCE FSW since last month.
- DCE "OPERATE" Component Testing has taken longer than expected. New completion date for all DCE FSW Component Testing: 4/27/2001.

Calibration/Flat-Field Subsystem Activities at CU

- CU and Ball have worked out a plan where CU will assemble, align, and optically test the COS calibration/flat-field subsystem.
- This effort will be lead by Dr. Steve Osterman.
- The effort will take place in CASA's cleanroom where the FUV grating tests were done.
- The activities will start this summer/fall (after completion of G160M grating test) with a Cal/FF platform delivery to Ball in TBD (schedule uncertainties due to impacts of bench rework).

COS Schedule for CU

- The detailed CU schedule is available as a separate hand-out.

Task	Status
G160M/G140L – Blazed Grating Testing	G160M testing started and will run into June. G140L-Blazed efforts TBD
CALCOS software development	On-going
JY Deliveries	G230L – slipped to 6/01
Cal/FF SS Optical Integration	Starting summer '01

COS Descope Issues

- The COS IDT has been asked to develop and track a descope plan which, if implemented, can be used to control future cost growth and/or schedule difficulties.
- At the beginning of the COS development effort, late CY97 and early CY98, we prepared and presented several descope options. At that time we descoped the following:
  - Reduced the MEB SRAM buffer memory
  - Fewer NUV/FVU optics/grating spares
  - No parallel technology path for NUV gratings
  - Reduced I&T/calibration effort
  - Baselined environmentals at GSFC

COS Descope Tracking List

Candidate De-Scope	Trigger Date	Resource Saved*	Impacts
Eliminate FUV Detector detailed resolution tests	**Implemented**	2 weeks	Knowledge of detector
Eliminate FUV Detector detailed QE tests	**Implemented**	2 weeks	Knowledge of detector
Eliminate FUV Detector deep FF tests	**Implemented**	3 weeks	Knowledge of detector
Make DCE Op Code non-uploadable	**Too late**	---	Higher risk, Ops
Early transition of FSW to Code 582	TBD	$	Ops
Remove Redundant Cal/FF Elements	TBD	$,t	Higher risk, Ops
Remove/reduce memory	**Too late**	---	Ops
Remove NUV gratings from OSM2	TBD	$,t	Degraded science
Drop NUV channel	TBD	$$$,tt	Degraded science
Remove NCM3 optics	TBD	$,t	Degraded science, Ops
Eliminate Aperture Mechanism	TBD	$,t	Ops, Obs. Efficiency, higher risk
Drop all Accum mode processing w/ Doppler	**Too late**	$,t	Degraded science
Drop spare FUV detector	**Too late**	$,t	Higher risk
Drop OSM1 capability (don't cover λ gap)	**Too late**	---	Degraded science
Reduce S/N requirement to 30 (no FF lamp)	TBD	$,t	Degraded science
Relax NUV resolution requirements below 20k	TBD	$,t	Degraded science
Remove on-orbit change-out capability	TBD	$,t	Higher risk
Drop dispersed light TA	**Too late**	$,t	Ops
No Ion Gauge	TBD	$,t	Higher risk, Ops
No external shutter	**Too late**	$,t	Ops
Change MSRs to QSRs	TBD	$	Save trees
Eliminate Mechanism Lifetime tests	TBD	$$	Higher risk
Reduce CDRLs	TBD	$	Unknown
Drop G140L blazed effort	TBD	$,t	Missed opportunity for improved science
Reduce G160M image testing	**Too late**	$,t	Higher risk

*The IPT has not yet done a detailed analysis to quantify actual $ or time saved.

Upcoming Events/Activities

- Start FUV detector TV test at CU.
- Deliver FUV detector to Ball for alignment activities.
- Complete testing of 1st G160M grating.
- Continue NUV grating anomaly resolution.
- Coat spare MCPs with photocathode.
- Reassemble spare FUV detector subsystem and begin characterization test.

Questions, Issues & Resolution Plan

- None