COS
Monthly Status Review
June 28, 2001
Ball

Agenda

Progress Summary Since Last Monthly	J. Andrews
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Optics Test Status & NUV Issues	J. Andrews
UCB FUV Detector Programmatic Status	J. Andrews
UCB FUV Detector Technical Status	J. McPhate
CU Software Activities Status	K. Brownsberger
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 (4/25/01)

- Completed 6-cycle thermal-vacuum test of FUV-01 detector.
- Worked issues associated with FUV-01 door mechanism failure.
- Completed update to and testing of FSW OPERATE v.1041.
- Completed G160M Grating testing.
- Continued working NUV grating issues.
- Completed FUV-02 photocathode deposition and initial QE check.
- Delivered FUV-01 detector to Ball for temporary I&T activities.

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	**Done****	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.

**G285M was tested uncoated and it too did not meet efficiency requirement.

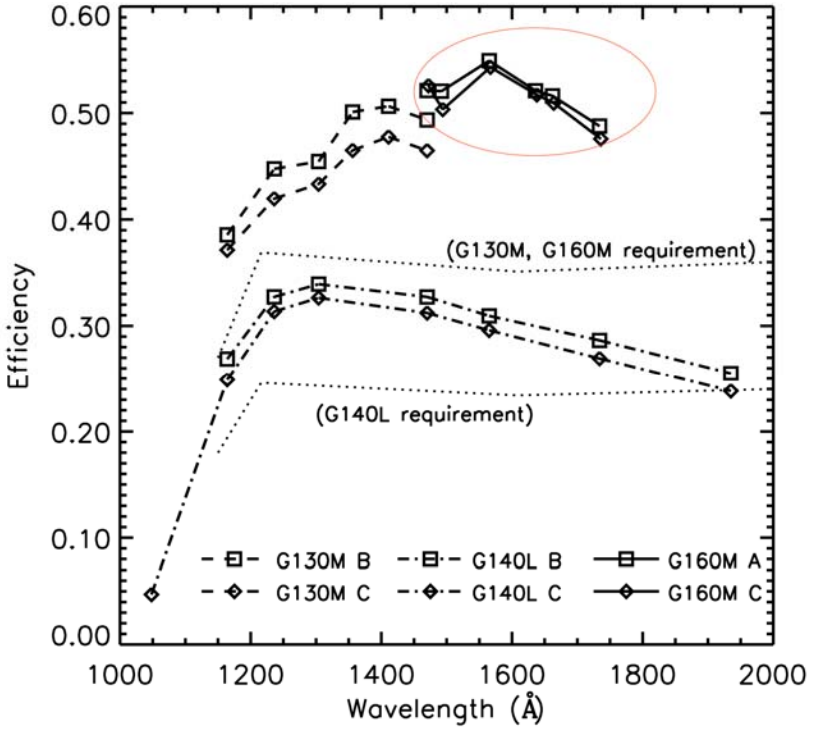
COS FUV/NUV Grating Test Status 6/28/2001

- G130M and G140L Gratings
  - Testing and data analysis has been completed and calibration reports have been released for all gratings.
  - All gratings are satisfactory in all respects.
  - G130M-B and G140L-B appear to have slightly better performance and should be considered first choice for flight optics.
- G160M Gratings
  - Efficiency testing and data analysis has been completed for both gratings. Image testing is complete for G160M-A, and will resume for G160M-C later this summer.
  - G160M-A is satisfactory in all respects and is suitable for use as the flight optic pending analysis of scatter data. It is our expectation that G160M-A will be designated the flight grating.
- G225M Grating for G185M Pass Band
  - G225M-A has been tested for use in place of the existing G185M gratings and the results are promising. Confirmation by GSFC is recommended before final selection of flight optics.

G160M Test Results (1/2)
Grating Efficiency vs. Wavelength

G160M Grating Averages
(Excluding Center)

Wavelength (Å)	G160M-A Grating Efficiency	G160M-C Grating Efficiency	Requirement
1470 (Xe)	0.527	0.528	0.36
1492 (N_2)	0.521	0.504	0.36
1565 (CO)	0.552	0.543	0.35
1636 (CO)	0.523	0.519	0.35
1662 (CO)	0.518	0.511	0.35
1734 (CO)	0.490	0.476	0.35

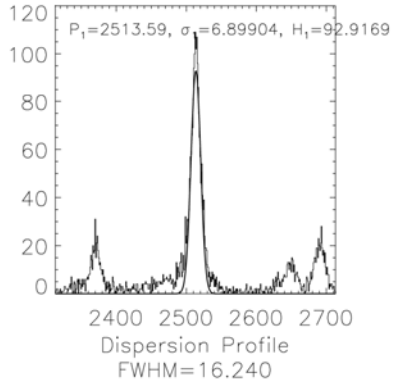


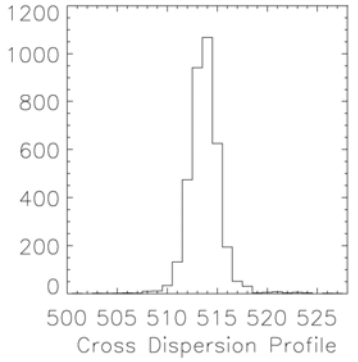
FUV Grating Averages (Excluding Center)

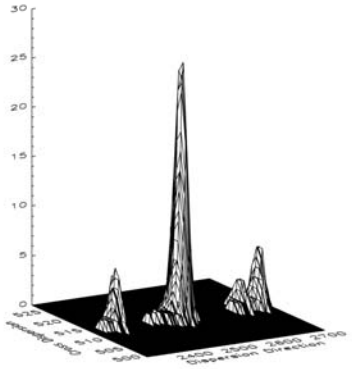
G160M Test Results (2/2)

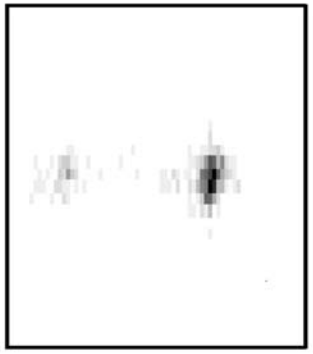
G160M A Resolution Test Results

Wavelength (Å)	Line width (FWHM, Pix.)	Line Width (FWHM, Å)	Resolution (λ/λΔ)
1574	16.37	0.0784	20077
1636	16.24	0.0784	20867









NUV Grating Problem Status

- G185M, G225M, and G285M gratings have all been tested multiple times (GSFC, CU, JY) - all tests indicate grating's performance is substantially below in-band requirement.
- Present theory for substandard performance is inadequate groove depth in replicated gratings from JY; once coated, groove depth goes to as little as 50Å.
- JY is in process of attempting new replication process in hopes of achieving deeper groove profile in replicated grating. We hope to bring such a grating back next week.

NUV Grating Problem - Candidate Solutions

- If we are correct in our groove depth theory and if JY is successful in replicating with deeper grooves we will make new replicas, coat them, then test to verify fix. Again, hope to return with such a G185M next week.
  - We have successfully incentivized JY's contract to promote rapid delivery of new gratings.
- Testing of G225M in a G185M configuration has been completed at CU and looks promising. We are awaiting tests at GSFC to confirm our results.
- Could pursue alternate grating development at Hitachi.

NUV Grating Problem - Hitachi Approach

- Hitachi USA has been contacted for pricing and schedule for producing mechanically ruled NUV gratings.
  - If we provide substrates (14 required per delivered grating) Hitachi is quoting delivery in 5 months after blanks arrive in Japan.

Prioritization	Type	14 Substrates	Substrate Lead Time	Grating $/EA	Grating Lead Time	Total $	Total t
3*	G185M	$26.2K	10 wks	$86K	5 mos	$112.2K	~7.5 mos
1	G225M	$26.2K	10 wks	$84K	5 mos	$110.2K	~7.5 mos
2	G285M	$26.2K	10 wks	$84K	5 mos	$110.2K	~7.5 mos
4**	G230L	$26.2K	10 wks	$84K	5 mos	$110.2K	~7.5 mos

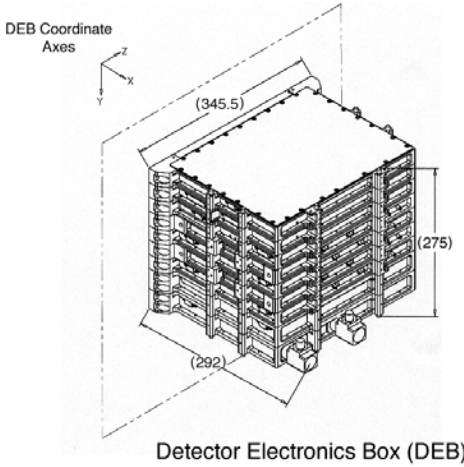
(All info is still somewhat tentative)

Problem(s)

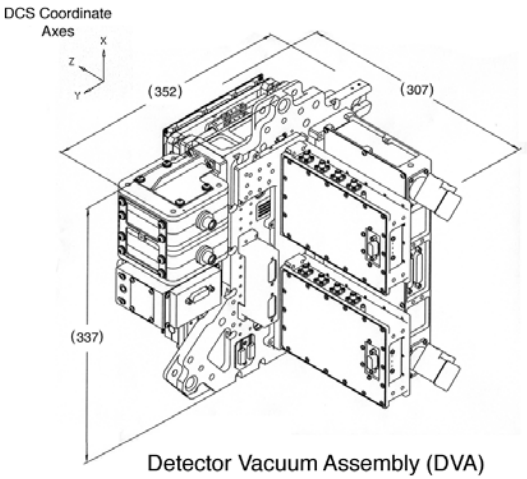
Once received gratings still require coating and testing (+2-3 months).
Ball's ability to integrate NUV gratings 12 months from now.
Cost and risk.

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)



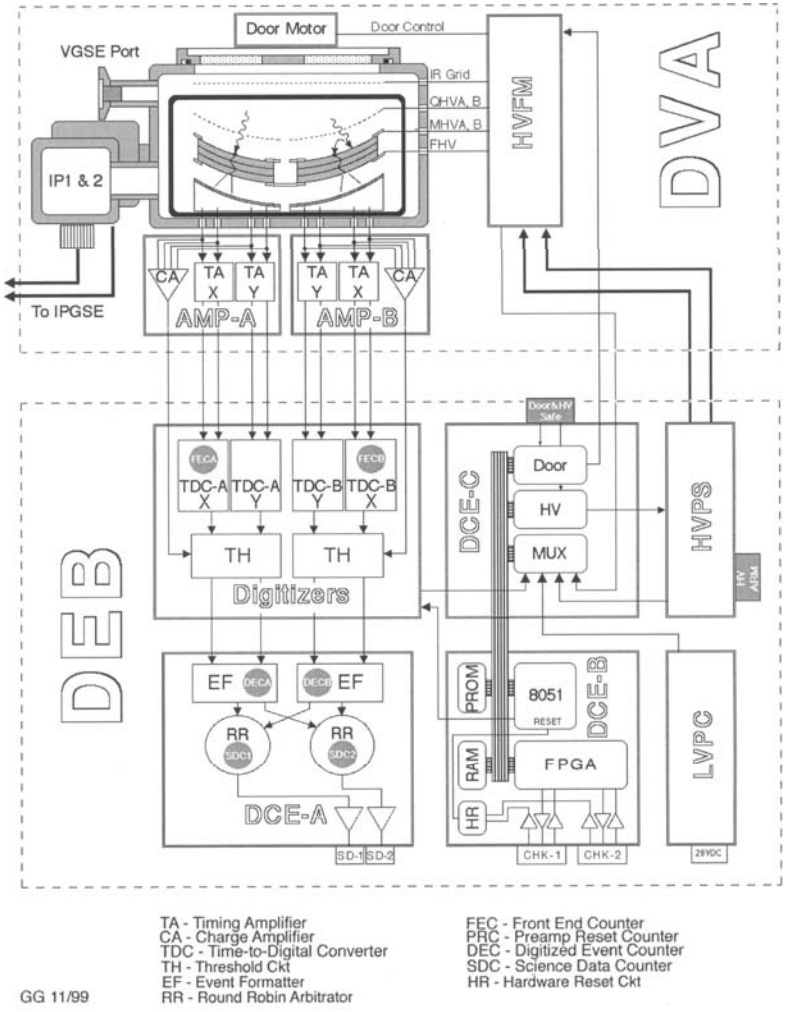
Detector Electronics Box (DEB)



Detector Vacuum Assembly (DVA)

FUV Detector Subsystem Block Diagram

- UCB is under contract to deliver 1 flight FUV detector subsystem (FUV-01) and 1 flight-spare detector subsystem (FUV-02).



UCB FUV Detector Status - FUV-02

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	**C**	**C**	**C**	**C**	**C**
Legend	*C = Complete*		*NA = Not Applicable*		*S = Started*		*NS= not started*		

Changes since last MSR in red/bold

UCB FUV Detector Status - Systems

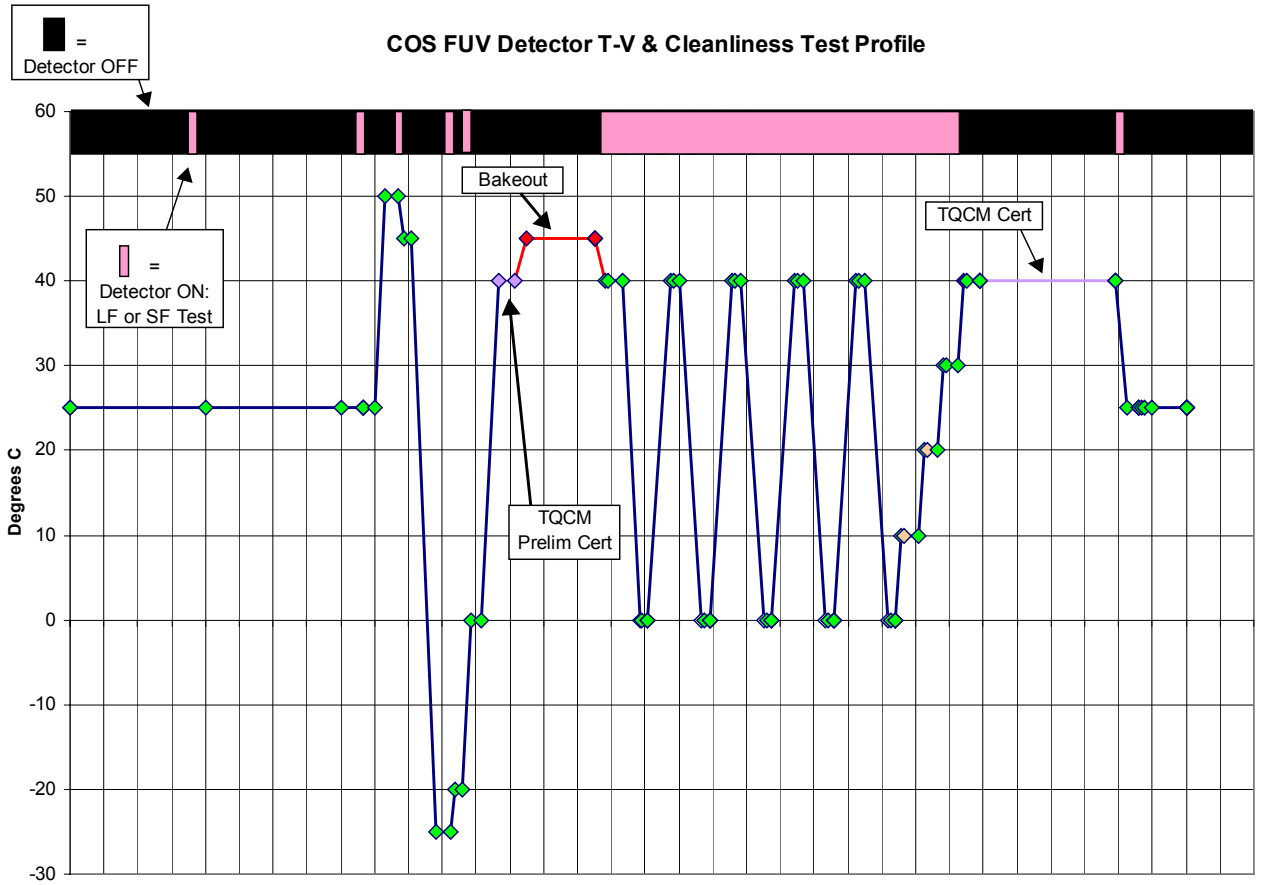
- Documentation Update:
  - ICD Rev B reviewed and released in May.
- Mass and Power Updates (changes in red/bold):

	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).

COS FUV Detector T-V & Cleanliness Test Profile - As Run

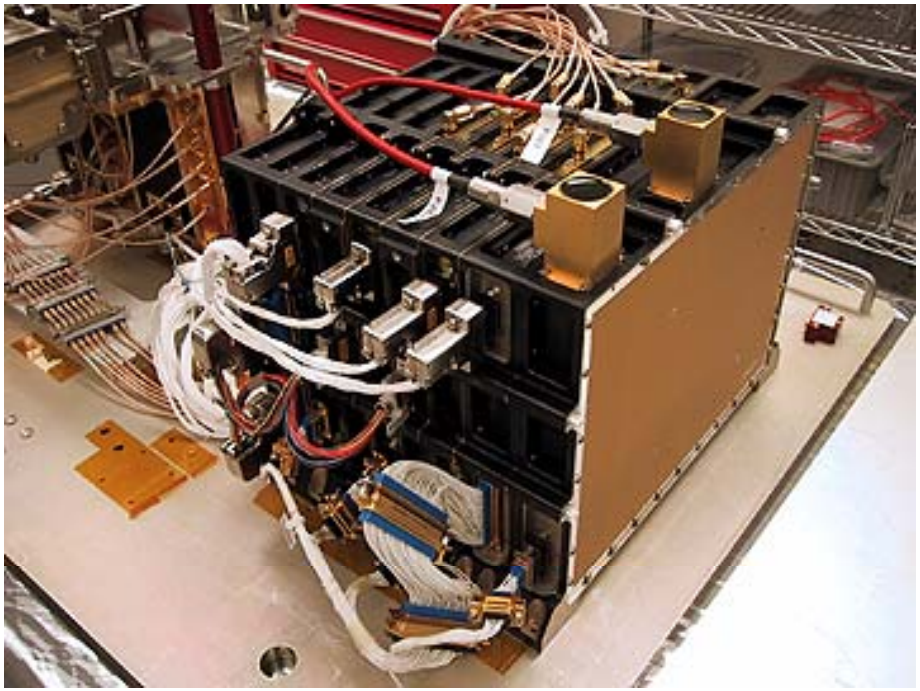


UCB FUV Detector Status - Schedule Overview

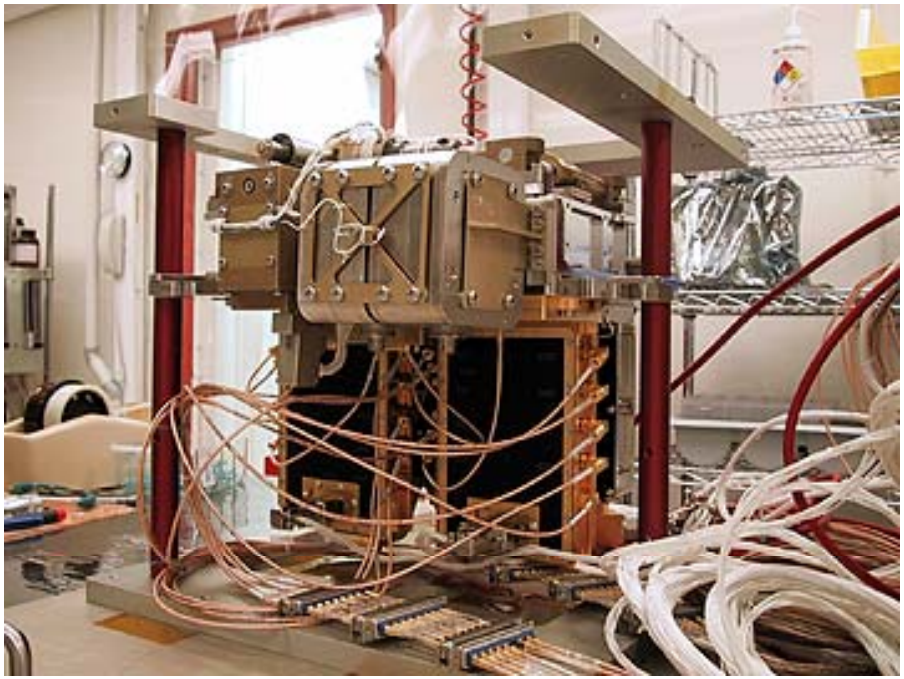
- Flight Unit - FUV-01:
  - DVA is now at Ball for temporary I&T activities.
  - DVA should be released from Ball 7/10/01 and is needed back 8/31.
  - This gives us a 7 week window to repair and retest the FUV-01 DVA.
- Spare Unit - FUV-02:
  - DVA is 10 days from qual vibe testing once door fixes are known and implemented. This vibe will be done at qual-level without MCPs.
  - After a successful qual vibe series, the door mechanism will be fully tested, MCPs installed and tested and the unit will then proceed along its normal development flow.
  - Once MCPs are installed in the FUV-02 unit it is approximately 2.5 months to final delivery.

COS FUV Detector Systems

- Detector DEB



- Detector Head



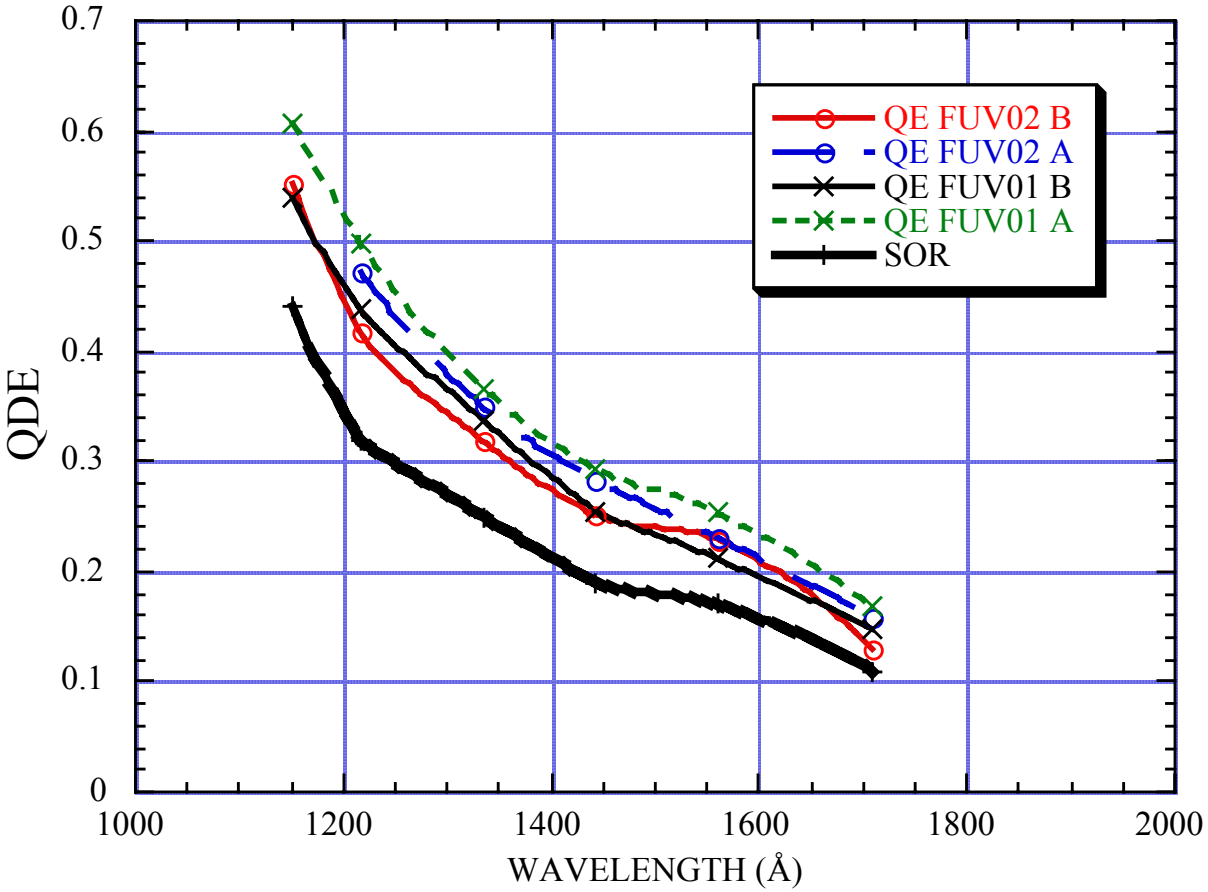
UCB FUV02, Flight Backup Detector, Status

- **Excessive image drift in Y of FUV02 side B**
  - The Y axis on side B was tested and the thermal drift (4.1 pix/°C) was 2x that of the other 3 Y axis TDCs (2.5 pix/°C) . We suspected the lumped delay line but this tested to spec on one sample. While the command range of the Y ADC offset can accommodate the drift, we wanted to find the source before committing to coat and stake of the board. Rick Raffanti debugged the board and found that the rate stabilization circuit was not thermally matched to the rest of the circuit. Change of several components reduced the drift to 3.3 pix/°C. This has been accepted by CU, along with knowledge of the cause.
- **DEB Electronics Boards**
  - All boards have been cleaned, coated, staked, and vacuum baked.

UCB FUV02 Status (cont)

- **Harnesses**
  - In final cleaning prior to wrapping and vacuum bake.
- **LVPC Efficiency Measured**
  - 73% - Measured in flight like configuration with near nominal operation power use levels (using HV load boxes instead of MCPs).
  - Data provided to Steve Battel for LVPC thermal analysis.
- **Detector Backplate Assembly**
  - Built up and awaiting integration with VHA for vibration testing.
- **Vacuum Housing Assembly**
  - Currently in use with ETU DEB, testing potential solutions to the FUV01 door mechanism problem.
- **Brazed Body Assembly**
  - Photocathodes deposited successfully and detector QDEs measured.
  - BBA currently in safe vacuum storage awaiting final FUV02 buildup.

UCB FUV01 and FUV02 Detector QDEs



Flight FUV01 Detector System

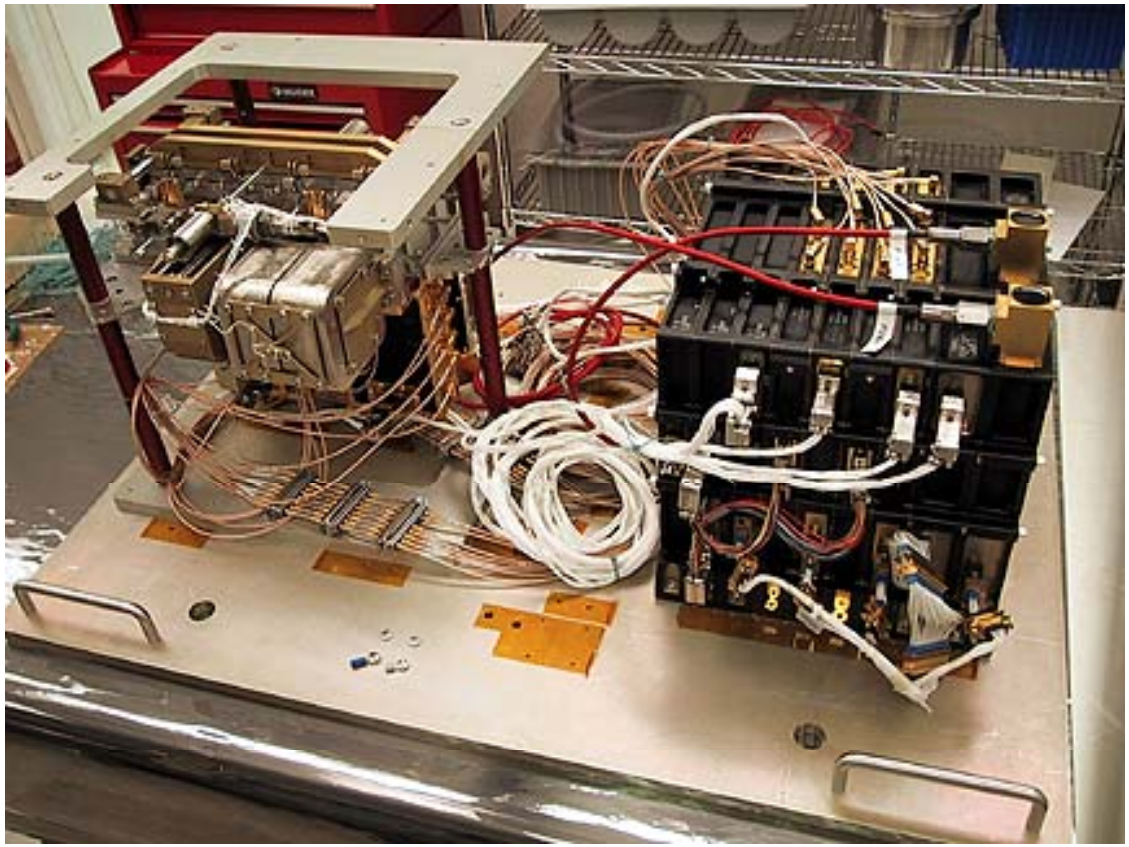
FUV01 Flight Unit

DVA now at Ball for temporary I&T.

DEB at CU/CASA pending door mechanism rework plan.

Detector system has completed 6 cycles in thermal vac to date.

Several anomalies occurred during thermal vac.



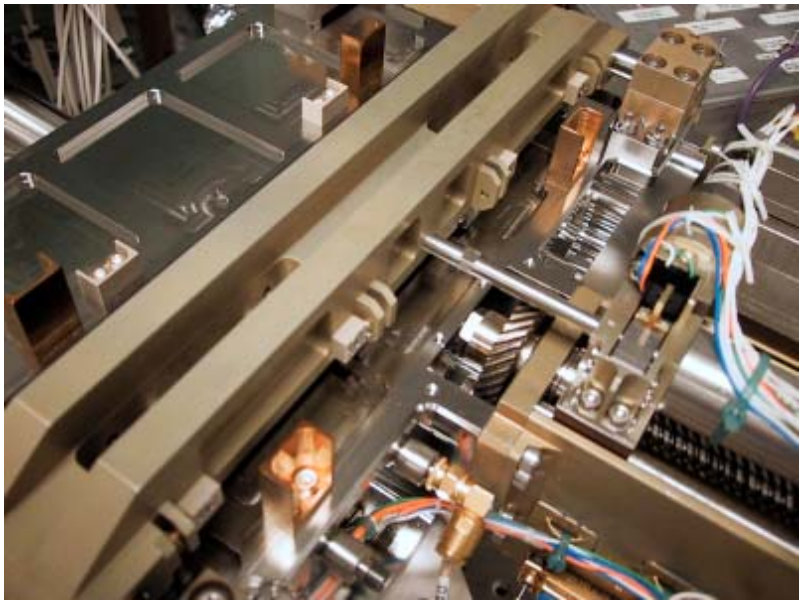
UCB FUV01 Detector Thermal Vacuum

- **One High Voltage Current Transient**
  - Newly released flight software (v. 1041) uses a 60 ms (from 20 ms) persistence for the HV current limit task. This will significantly reduce the occurrence of HVI shutdowns, as 20 ms is the characteristic width of most transients.
- **Three Count Rate Protection HV Reductions**
  - One during door closed/QE grid on operations. QE grid off during door closed HV operations prevented further occurrences.
  - Two during T/V cycles while chamber ion gauge was on. No occurrences after a policy of turning off the vacuum tank's ion gauge for HV operations was implemented.
- **Multiple EGSE – DEB Communication Hangs/Interruptions**
  - Unresolved. Suspect the Hardware Reset Circuit in EGSE Interface Box. This problem has not been seen on ETU or FUV-02 testing. Further testing will be done on FUV-01 after its return from Ball.
- **Door Redundant Actuator Mechanism**
  - Found the door redundant actuator only partially opens the door.
  - At all temperatures (+40°C, 0°C, and +20°C) the door opened to ~1/3 open when the redundant actuator (RA) mechanism was used.
  - All door motor driven operations worked correctly.

FUV01 Door Redundant Actuator Mechanism

- Testing on FUV02 door at UCB indicates several possible sources of binding.
  - Stressed baffle installation.
  - Door clearance block interference (excess staking epoxy).
  - RA carriage stiction.
  - Door rail misalignment.
- Stressed baffle installation and door clearance block interference were eliminated by further actuator operations on FUV01 with those components removed - mechanism then opened ~50%.
- On 6/13 a door mechanism anomaly review was held at UCB with Goddard and CU.

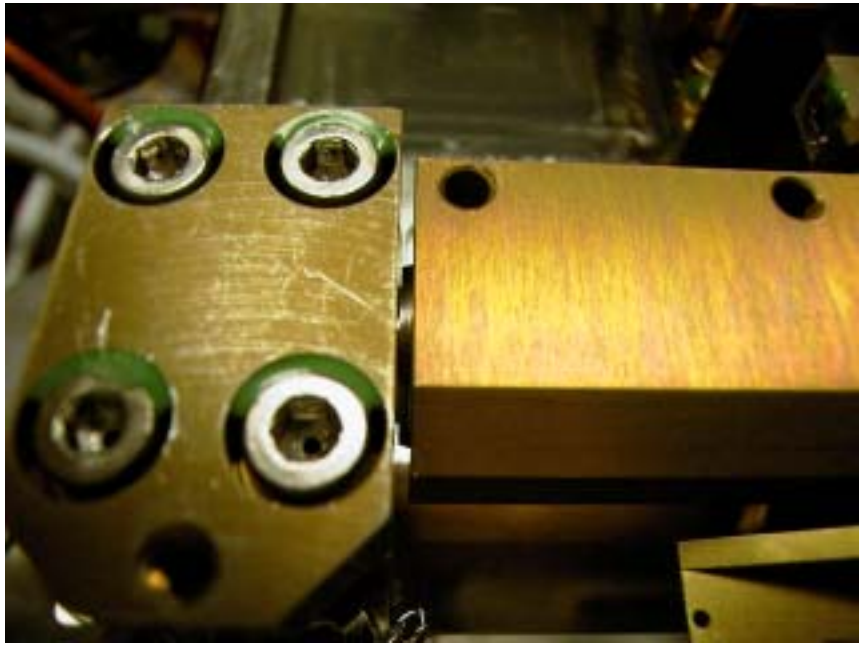
FUV02 Door Test



FUV01 Door Redundant Actuator Mechanism (cont)

- Elevated door motor current during first operation after vibration implies door rail misalignment.
- Linear bearing protruding from FUV01 door carriage is consistent with door rail misalignment.
- Testing on FUV02 indicates that door rail misalignment induced by a lateral force on the door rail mount block is not fully released upon removal of the lateral force. Resistance to door travel remains even after successive operations of the door with the motor.

FUV01 Door Carriage



FUV01 Door Problem Resolution

- **UCB Approach and Philosophy**
  - We are receptive to Goddard and CU inputs and assistance.
  - Investigate all viable options before implementation on the flight unit.
  - Test selected solution on FUV02 before implementation on FUV01.
  - Address the root cause of the problem and make sure the implemented solution prevents future occurrence of problem.
- **Concerns**
  - VHA vacuum break is likely to require some level of UV scrub of MCPs. Exposing the MCPs to dry GN_2 only will minimize scrub.
  - Investigate possibility of scrubbing at CU or Ball.
  - Current door parts are shimmed for proper alignment as are position readouts. Changing these parts out requires an exacting shimming process.
  - FUV02 is still considered a flight unit. A staid and well thought out approach will prevent damage to this hardware.

FUV01 Door Problem Resolution (cont)

- **Insitu Repair of FUV01**
  - Likely not to require breaking of VHA vacuum.
  - Minimal effect on door shimming as same parts or like parts used.
  - Results in a corrected, now untested, unit.
  - Least schedule impact.
- **Exchange FUV01 and FUV02 VHAs**
  - Requires venting VHA to GN_2. Requires some level of MCP re-scrub.
  - Could install a fully corrected and vibration qualified VHA.
  - Results in a fully corrected, fully tested unit.
- **Replace FUV01 Door Parts with New Parts**
  - Requires shimming of door parts to get proper alignment.
  - Requires venting VHA to GN_2 at least. Requires some level of re-scrub.
  - Results in a pristine, untested unit.

Proposed Plan of Action

- FUV01 DVA to BALL for optical alignment and shim modification.
- Finalize solution path for FUV01 door problem.
- Test solution scenario on FUV02 VHA.
- Perform qualification testing of corrected FUV02 VHA (vibration and mechanism tests at least) with no MCPs.
- Apply corrective action to FUV01 door assembly/VHA.
- Complete/Re-iterate FUV01 thermal vacuum testing.
- Vibrate corrected FUV01 DVA to *TBD* levels.
- FUV02 final buildup with MCPs.
- FUV02 environmental testing (qualification level vibration and thermal vacuum).

GSE Software Development

CEDAR, TAACOS, Spectral Simulator, CALCOS-GSE

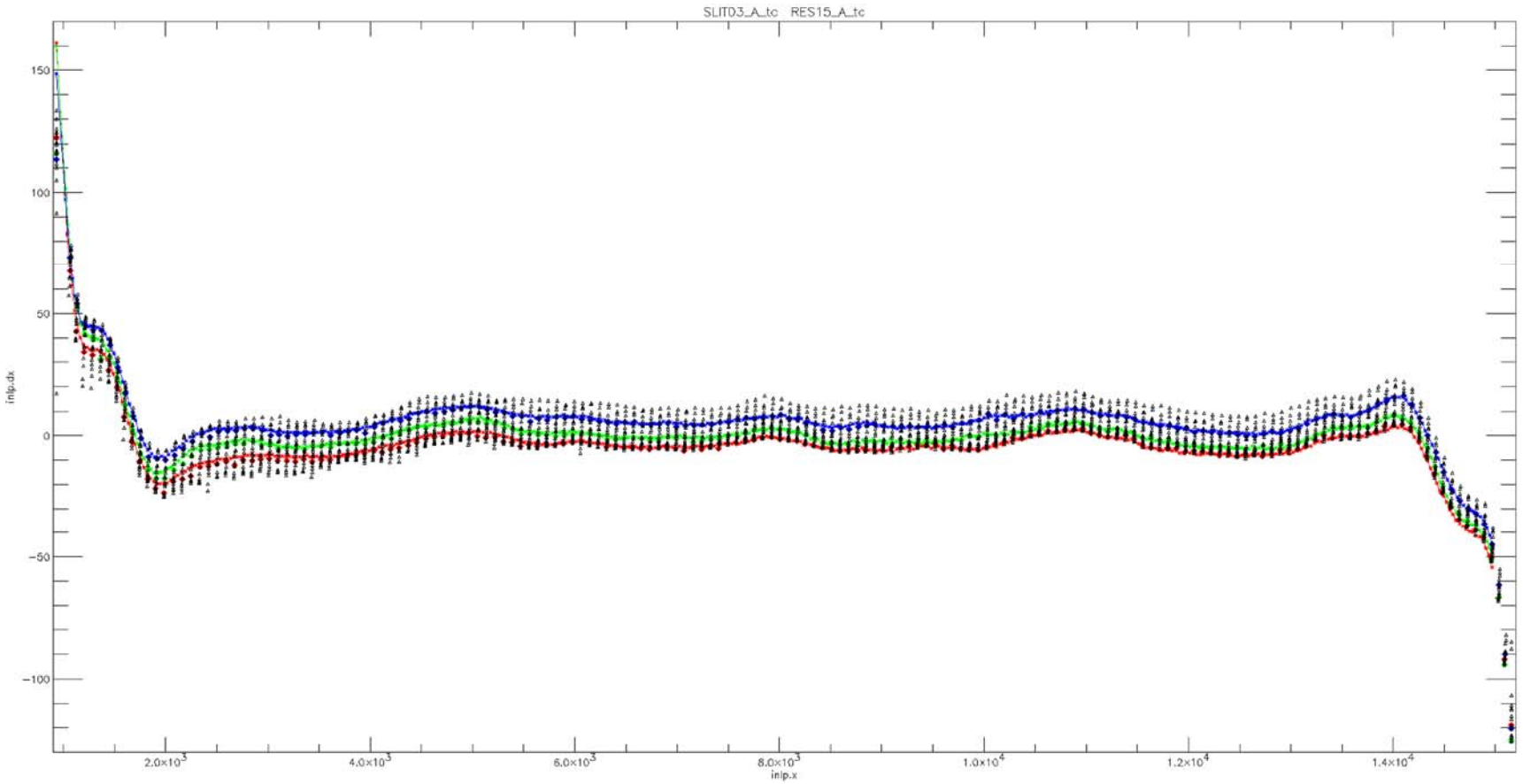
http://cos-arl.colorado.edu/CEDAR/
http://cos-arl.colorado.edu/TAACOS/
http://cos-arl.colorado.edu/CALCOS/
http://cos.colorado.edu/ (Click on Link for Spectral Simulator)

Highlights:

- CEDAR: No change. Small list of features to be added to extend capabilities – additions expected to take 2-3 weeks.
- TAACOS: No change. All TAACOS Reports released. No new TAACOS studies are currently planned.
- SPECTRAL SIMULATOR: Feedback from initial release of simulator in April resulted in several small enhancements and changes. Reminder: Based on discussions and agreements with STScI – the spectral simulator will eventually be transitioned to the Institute to become the official Exposure Time Calculator (ETC).
- CALCOS-GSE: Work continues in implementing and verifying the procedures described in AV-03

CALCOS-GSE Progress Report

- Geometric Correction (GC) Algorithm:
  - 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)
  - Estimation of the geometric correction for each photon event using either a bilinear interpolation of the position offset or a lookup table gives identical results.
  - The lookup table (as a FITS image) is a much faster computational approach but requires more memory to process: 2 images per segment over the active area requires: 23.4MB x 4 = 93.5MBytes
- Data Quality Lookup Table:
  - A Lookup Table of rectangular areas with various types of defects has been created.


SLIT03_A_tc RES15_A_tc
150
100
50
0
−50
−100
inlp.dx
2.0×10^3
4.0×10^3
6.0×10^3
8.0×10^3
1.0×10^4
1.2×10^4
1.4×10^4
inlp.x

FUV Detector FSW Development

DCE Flight Software Development and Test

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

Highlights:

- Based on results from FUV01 T-V, and component testing with OPERATE v1040, a few changes were made to the DCE OPERATE FSW - and it has been upgraded to v1041.
- Unit and Component testing of v1041 has been completed.
- OPERATE FSW v1041 changes:
  - Changed the way in which the 'DOOR_LATCH' value is read to prevent against false readings when Detector Powers up with the door in an 'unlatched' state.
  - Change Default HV Current Limit Persistence Value from 20 to 60ms, per UCB recommendation. (Note - this new persistence value now matches the value that has been recommended to the FUSE program for the past year.)
  - Added new procedure 'In_The_Weeds', so that if code ever winds up in one of the "filled areas" (i.e., memory locations where OPERATE FSW should NEVER normally be), a call will be made to routine 'In_The_Weeds' which will record the return address associated with the call then Reset and Safe the Detector. (Useful for debugging purposes.)

FUV Detector FSW Development

- Added new 1-byte counter which records number of seconds since the last stroke of the watchdog. (Useful for debugging purposes.)
- Modified the Count Rate Protection Algorithm as follows:
  1. Recall, if CRP violation occurs on either segment A or segment B - the detector system will immediately put the HV into the HVLOW state and issue an error. What's new is that no new error will be reported from the offending segment, until the segment first goes back within limits and then back out of limits. (In short, the system will no longer 'flood' the CS with repeated CRP errors - a situation which could arise in a few, specific circumstances with v1040.)
  2. Added history buffer which contains the last 256 FEC values from whichever segment caused a CRP violation. This values in this buffer remains intact until a new CRP violation occurs - and then it will overwritten with the latest 256 FEC values from the offending segment. (More data now available to help resolve events leading up to an unexpected CRP violation.)
  3. CRP Task now uses a full 256 locations in 2x circular buffers to store FEC data (one for each segment). As before, however, the CRP Task only uses the number of values from the last commanded value of 'LFPINT' to compute the average Count Rate.
  4. HST Error parameters for CRP violation changed from buffer address to '0Axx' for segment A and '0Bxx' for segment B, where 'xx' is the index into the history buffer for the specific event which caused the CRP violation.

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 test were done.
- The activities will start this winter with a Cal/FF platform delivery to Ball early in CY02.

COS Schedule for CU

Task	Status
G160M/G140L – Blazed Grating Testing	G160M complete except repeat of image testing on G160M-b
G140L – Blazed Grating Testing	G140L-Blazed efforts TBD
CALCOS software development	On-going
JY Deliveries	G230L – July/01
Cal/FF SS Optical Integration	Fall/winter ‘01

COS Descope Issues (No Changes Since Last MSR)

- 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	**Too late**	$	Ops
Remove Redundant Cal/FF Elements	**Too late**	$,t	Higher risk, Ops
Remove/reduce memory	**Too late**	---	Ops
Remove NUV gratings from OSM2	TBD	$,t	Degraded science
Drop NUV channel	TBD	$$$,tt	Degraded science
Remove NCM3 optics	**Too late**	$,t	Degraded science, Ops
Eliminate Aperture Mechanism	TBD	$,t	Ops, Obs. Efficiency, higher risk
Drop all Accum mode processing w/ Doppler	**Too late**	$,t	Degraded science
Drop spare FUV detector	**Too late**	$,t	Higher risk
Drop OSM1 capability (don't cover λ gap)	**Too late**	---	Degraded science
Reduce S/N requirement to 30 (no FF lamp)	TBD	$,t	Degraded science
Relax NUV resolution requirements below 20k	TBD	$,t	Degraded science
Remove on-orbit change-out capability	TBD	$,t	Higher risk
Drop dispersed light TA	**Too late**	$,t	Ops
No Ion Gauge	TBD	$,t	Higher risk, Ops
No external shutter	**Too late**	$,t	Ops
Change MSRs to QSRs	TBD	$	Save trees
Eliminate Mechanism Lifetime tests	TBD	$$	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

- Support temporary integration of FUV-01 at Ball.
- Meet with J-Y to discuss NUV grating recovery plan.
- Continue testing existing NUV gratings for use in alternative configurations.
- Repair FUV-01 door mechanism and commence retest.
- Continue FUV-02 final build-up and preparations for qual-level testing.
- Retest 1st G160M grating with corrected Grover to verify image test results.

Questions, Issues & Resolution Plan

Issue: One of UCB's key detector support people is a non-green card holding alien (U.K. citizen) working in the U.S. (well, Berkeley) on a J1 visa. The COS team is relying on his support to the COS I&T activities.

Problem: ITAR

Resolution: Can GSFC "pull-strings' or provide assistance/direction to allow this individual to support at Ball/GSFC/KSC?