COS
Monthly Status Review
March 28, 2001
Ball

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	O. Siegmund
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	M. McGrath
BATC Presentation	R. Higgins
Financial Splinter	GSFC/Ball/CU

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

- CU team members at UCB 2/26 - 3/2 completed detector operations training.
- Completed scrub of flight MCPs.
- Completed deep flat-field of flight FUV detector.
- Continued spare FUV detector processing at UCB.
- Visited JY to assess NUV grating discrepancy.
- Worked to repair CASA's thermal-vacuum chamber.

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
    - 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	In Process	GSFC/CU
G225M	Done	**Done**	**Started**	GSFC
G285M	Done	**On hold**	4/01	GSFC
G230L	**6/01**	**6/01**	**7/01**	GSFC

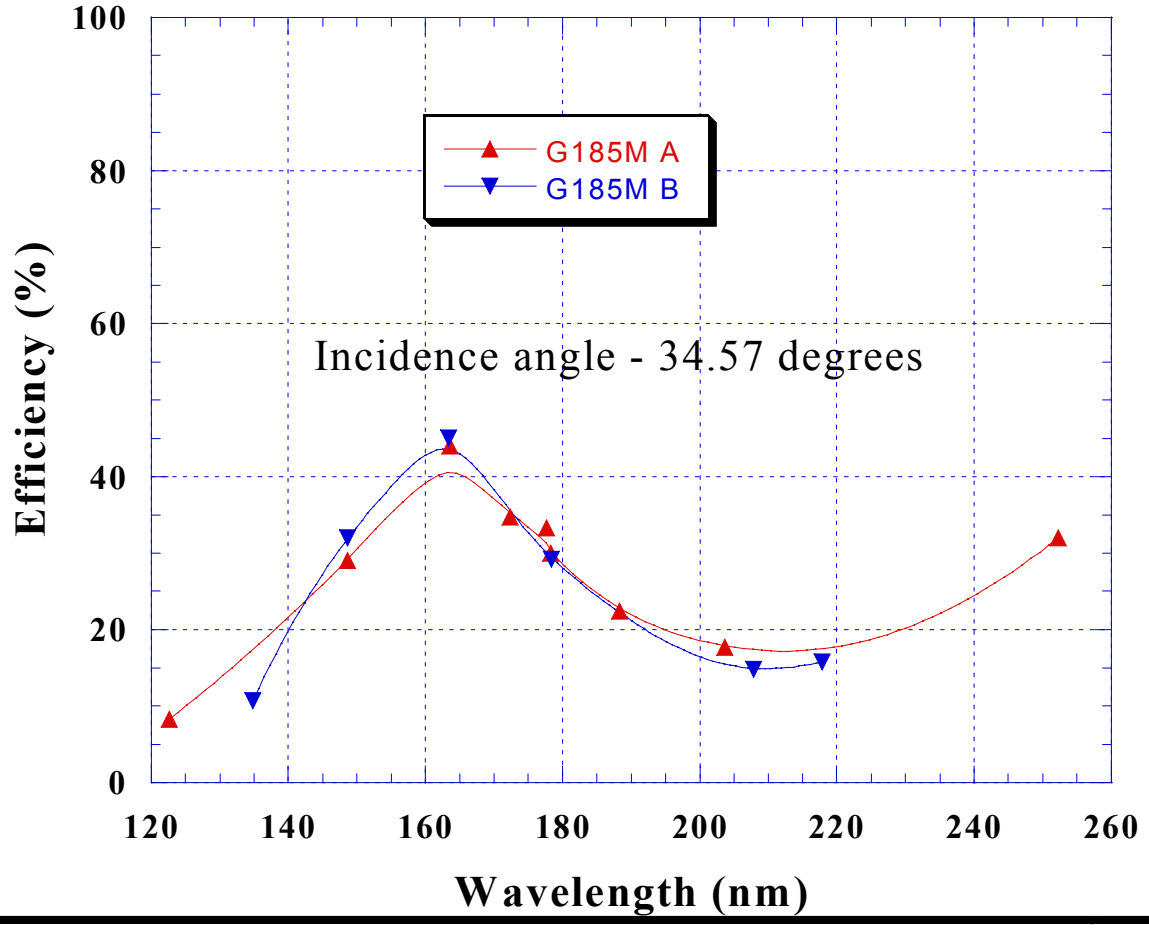
COS FUV Grating Test Status

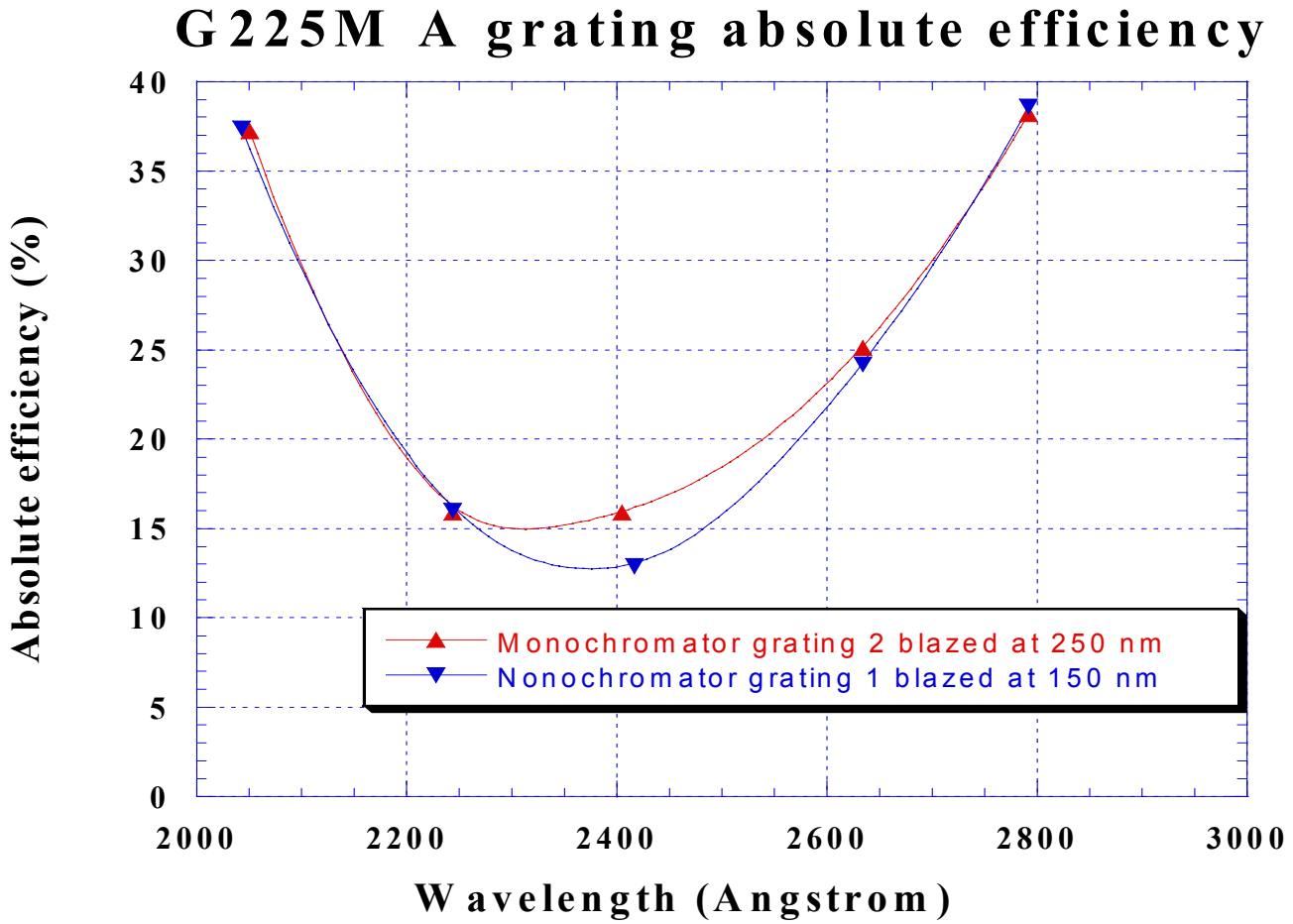
- G130M Gratings
  - Testing and data analysis have been completed for both gratings. Calibration reports have been released for both gratings.
  - Both gratings are satisfactory in all respects.
  - G130M-B appears to have slightly better performance.
- G140L Gratings
  - Testing and data analysis have been completed for both gratings.
  - G140L-B is satisfactory in all respects. G140L-C has slightly lower efficiency, but is otherwise acceptable.
- G160M Gratings
  - Start of tests deferred while CU facilities and resources are being used to evaluate G185M gratings. Grating now installed in tank and test are in progress.

G185M Grating Issues

- 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. In addition a measurable ghost image is present.
- At last monthly, it was reported that CU test results for G185 were inconsistent with GSFC results. Subsequent tests indicated that the CU test results had an error. CU and GSFC test results are now consistent.

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. The problem is real.

G185M Grating Issues

- Possible explanations:
  - Groove shape changed by coating.
  - Full E-M effect of coatings not appreciated in groove depth optimization.
  - 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 will be 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.

Solutions (Assuming Groove Depth Hypothesis Correct)

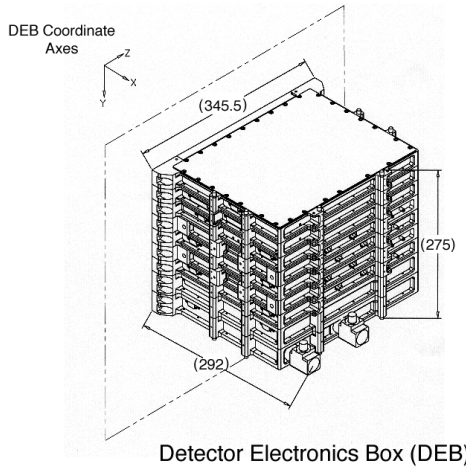
A) Refabricate G185M, G225M, and G285M at J-Y. Install current grating for alignment purposes and swap gratings later.

B) Procure grating from alternate vendor (Hitachi) and swap later. Hitachi is currently preparing a bid for us.

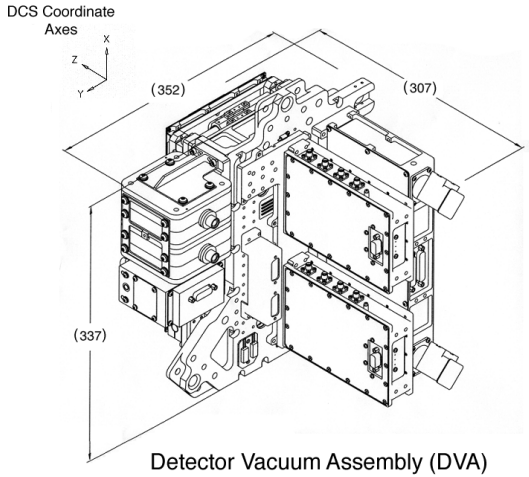
- The PI recommends the allocation of contingency funds to pursue both options. Should have cost/schedule for Hitachi in less than 2 weeks. J-Y currently developing schedule and cost (?) for new NUV masters.

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)



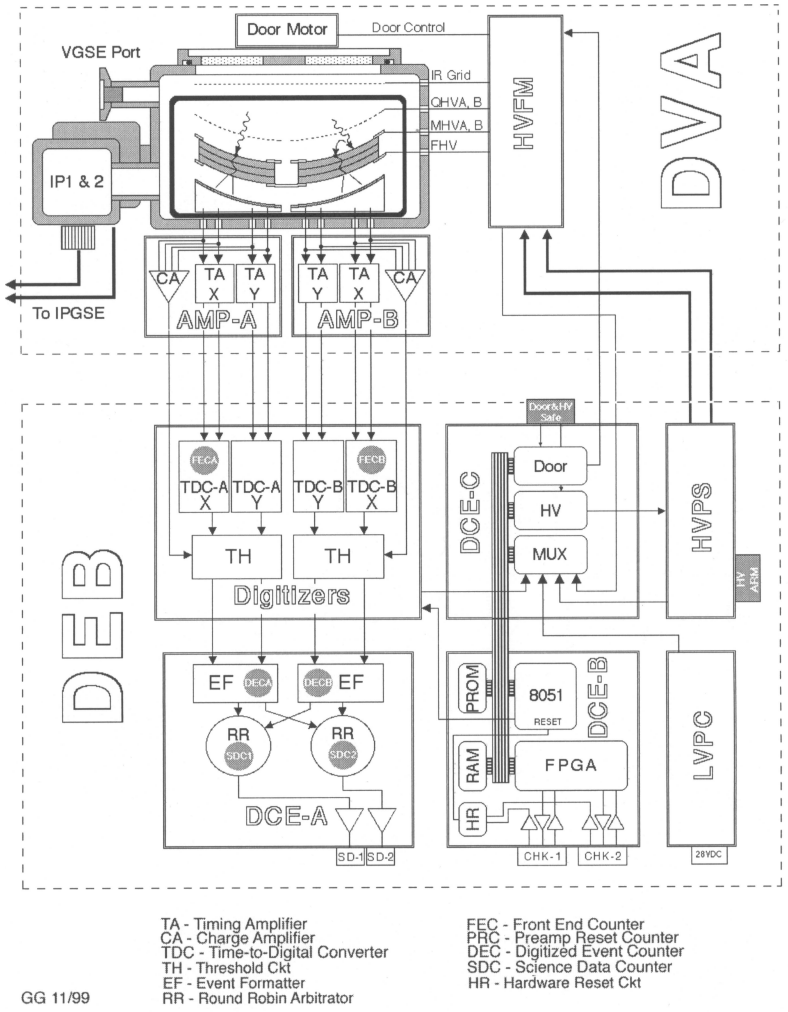
Detector Electronics Box (DEB)



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):

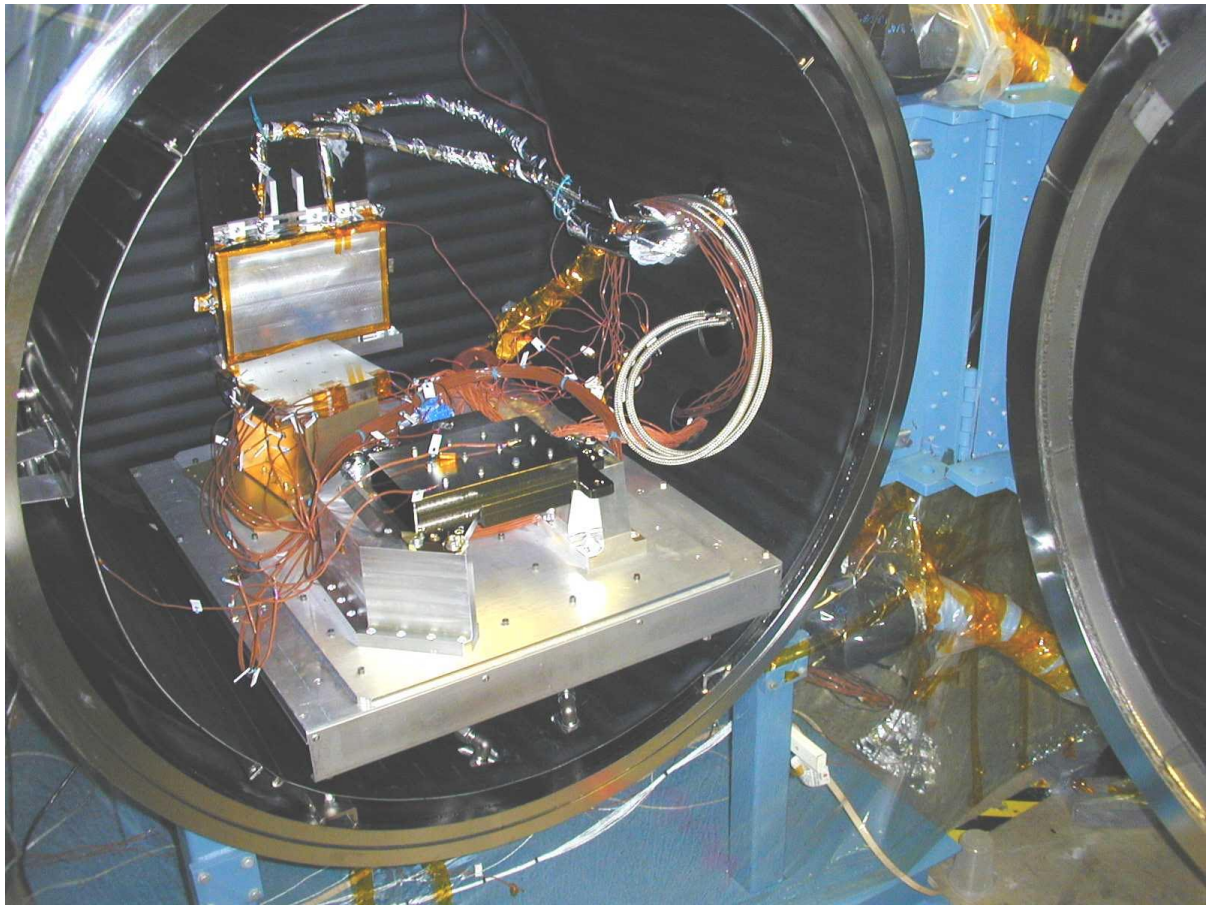
	Mass (Kg)			**Power (W)**		
	Actuals	SoR Allocation (1)	Margin	Actuals	SoR Allocation (1)	Margin
DVA	20.43	21.5	5%	4.59	-	-
DEB	14.44	15.3	5.6%	47.42	-	-
Harness (est.)	2.7	3.4	20.5%	-	-	-
Total	37.57	40.2	6.5%	52.01	53.0	1.73%

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).

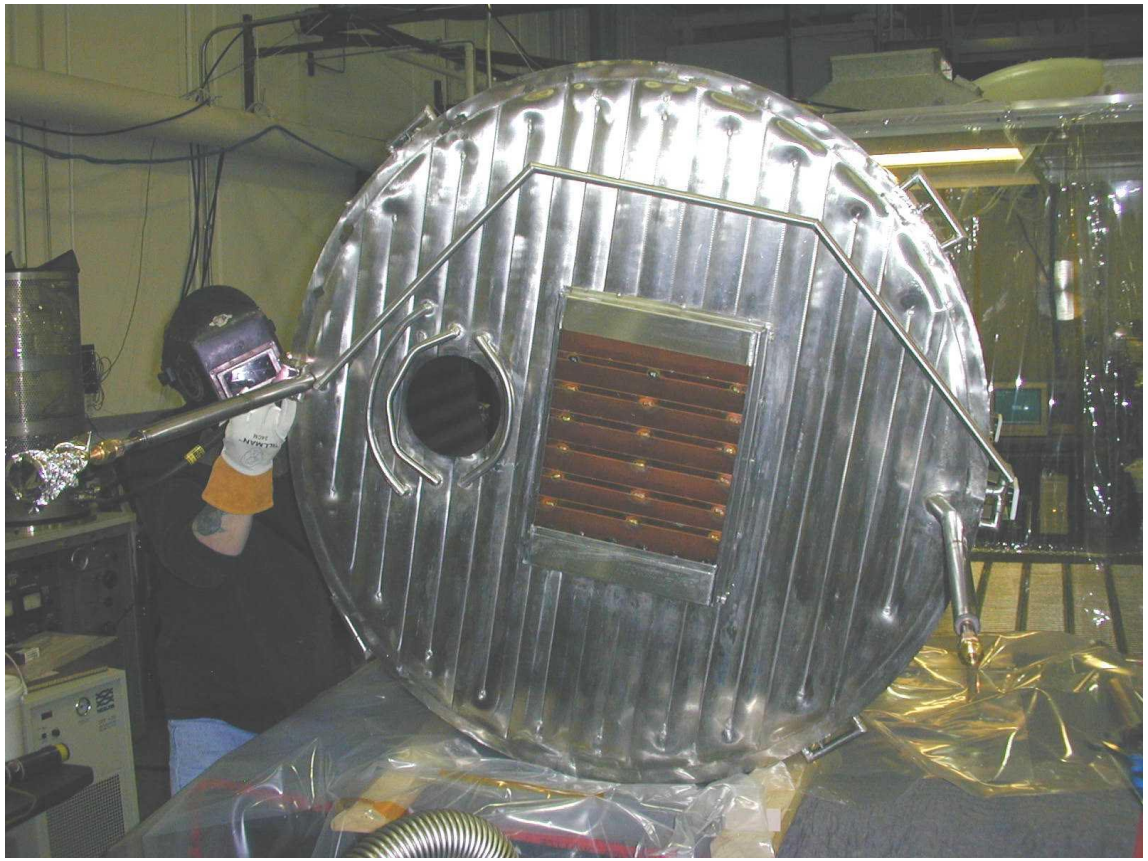
UCB FUV Detector Status - Thermal-Vac Test Preparation

- Thermal-vacuum testing of the flight FUV detector has been baselined to occur at CU.
- CU is working with UCB to define and develop test cabling and UV light source.
- Test procedure in the final stages of review. Comments have been received from GSFC, Ball, and CU.
- Expect to start TV test on 4/6/01 pending shroud repair.

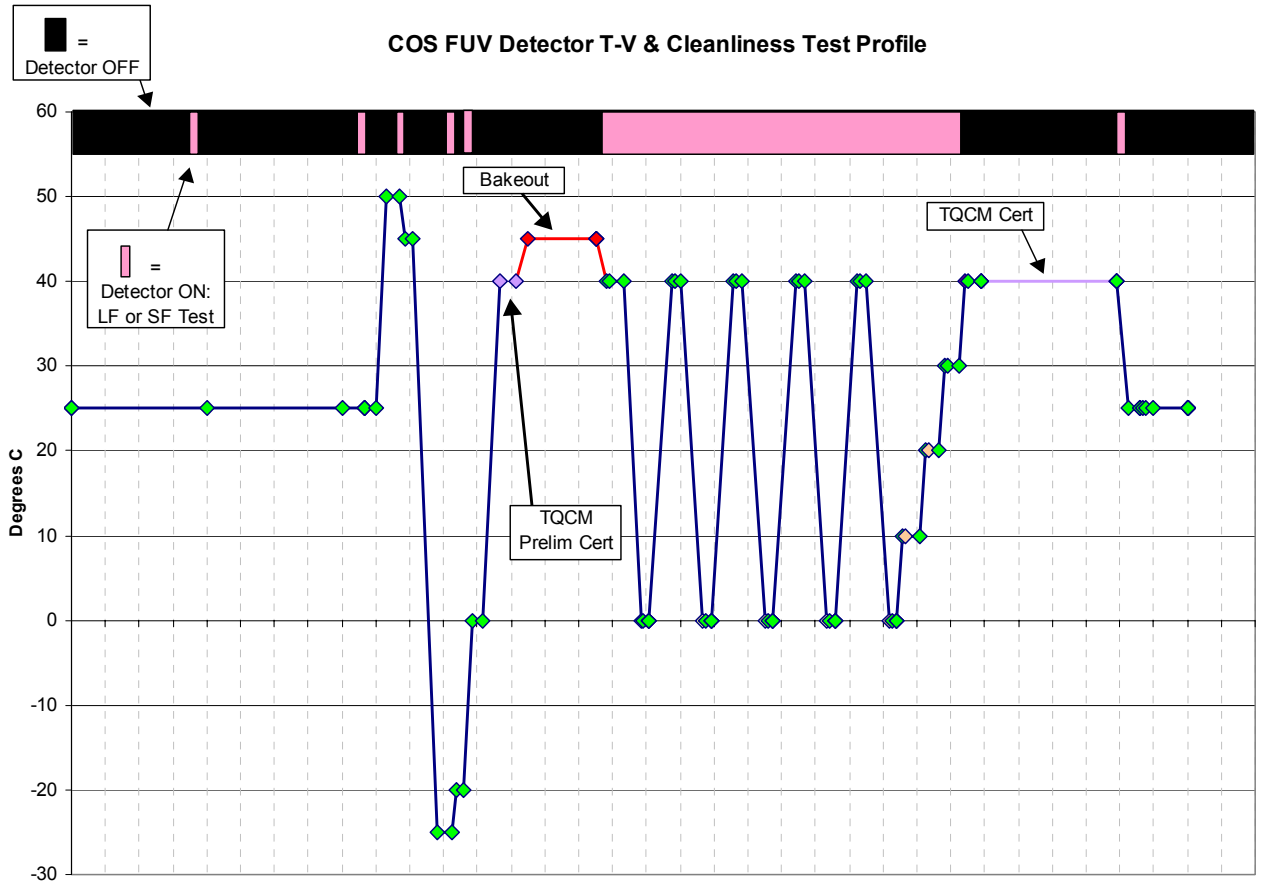


UCB FUV Detector Status - Shroud Repair Status

- Late in the TV test preparation cycle we discovered tank's shroud leaked when LN2 was pulsed through system (3/14/01). Since system was working nominally just prior to this, we've concluded leak has only recently occurred.
- Last week was spent removing shroud, finding leak, attempting repairs and restoring shroud. Efforts were unsuccessfully supported by tank vendor.
- This week GSFC personnel are here to assist in shroud repair and reinstallation into tank.



COS FUV Detector T-V & Cleanliness Test Profile



UCB FUV Detector Status - Schedule Overview

February Tracking Milestones	**Status**
MCP Scrub	Complete
Start T-V Tests at CU	Pending shroud fix

March Tracking Milestones	**Status**
Ship flight detector to CU	Slip to 4/2/01
Start TV test on flight unit	Slip to 4/6/01
Deposit photocathode on spare MCPs	Pending resolution approval

April Tracking Milestones	**Status**
Deliver flight unit to Ball	Slip to 5/7/01
Start spare DEB/DVA characterization	Complete

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

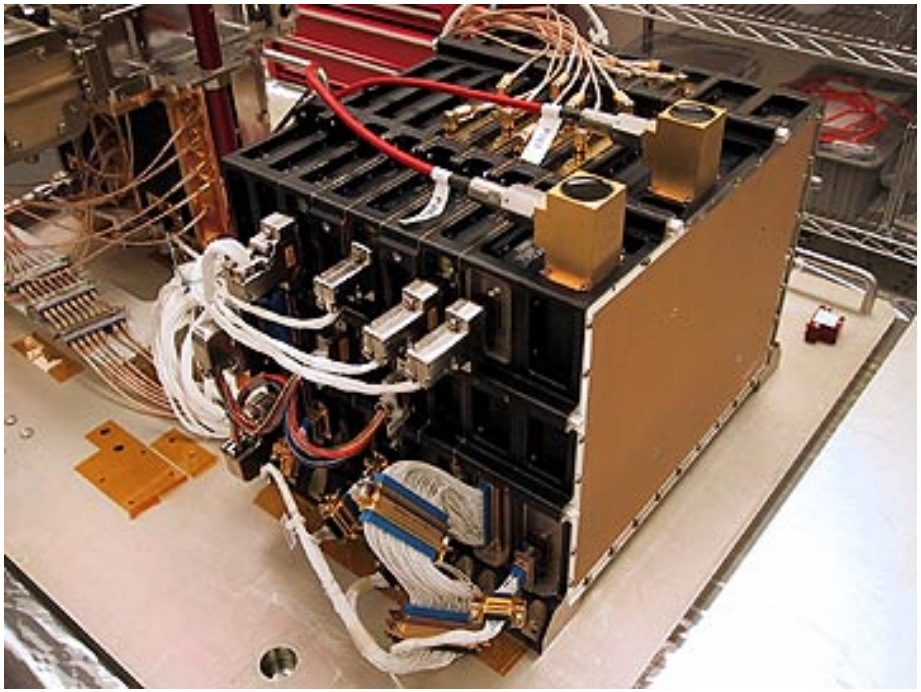
Forecast flight system delivery to Ball:

This month = 5/7/01

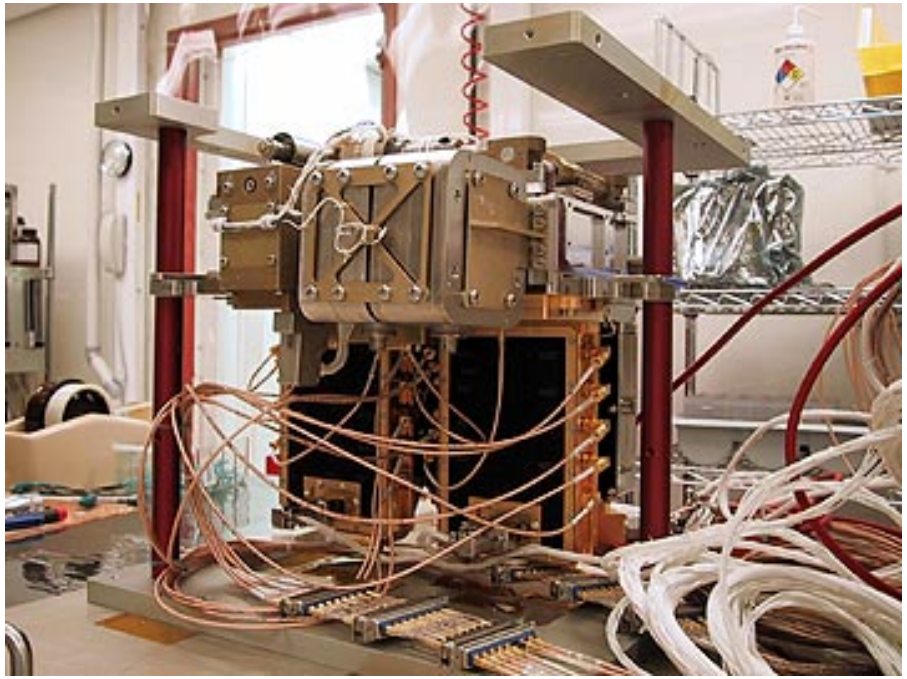
Last month = 4/9/01

COS FUV Detector Systems

- Detector DEB



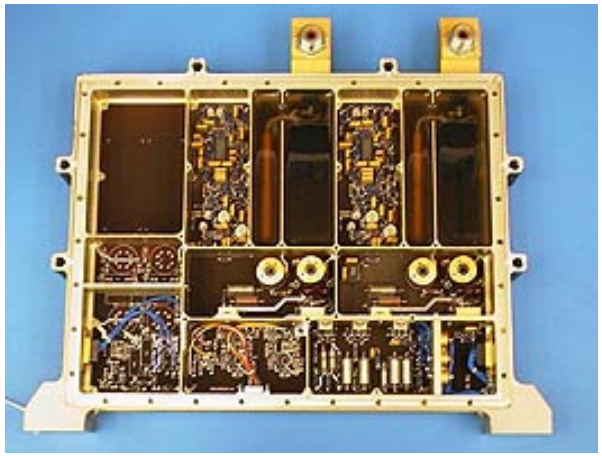
- Detector Vacuum Assy.



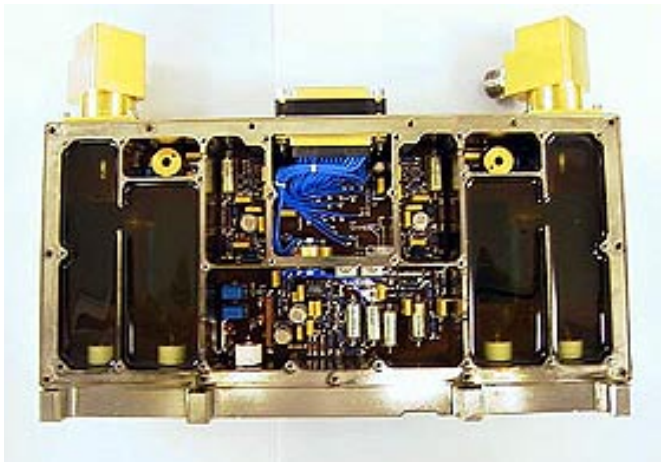
UCB FUV Detector Status - Electronics

- Power systems (HVPS, LVPC, HVFM)
  - All coated, staked, vac baked & certified.
- Amplifiers
  - All 4 amps tested, coated & staked, vac baked and certified.
- Flight Harnesses
  - 2 sets complete, vac baked & certified.
  - Wrapping complete

Amplifiers



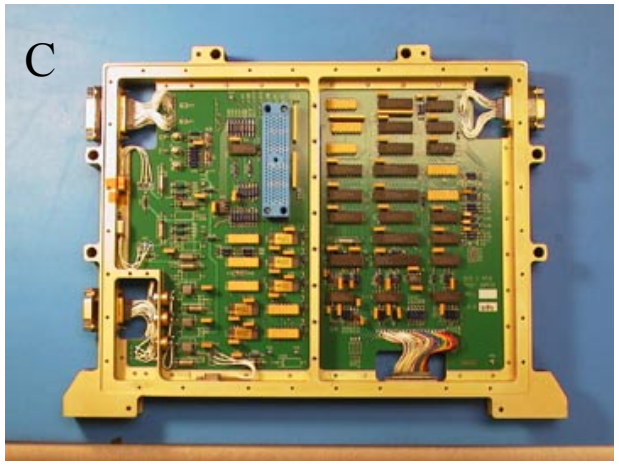
HVPS

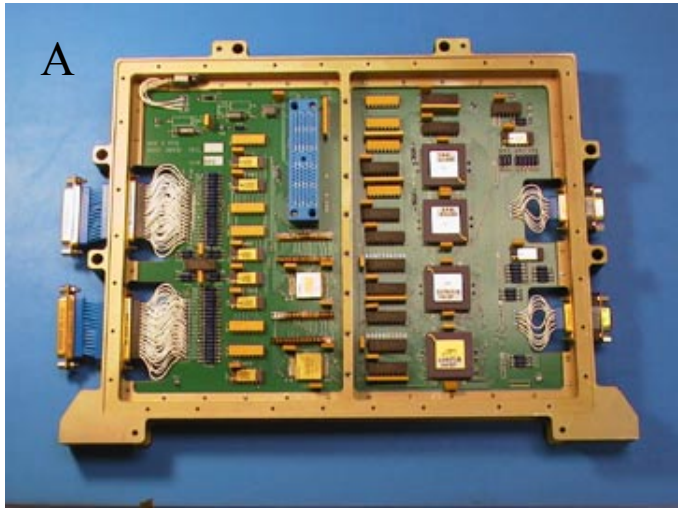


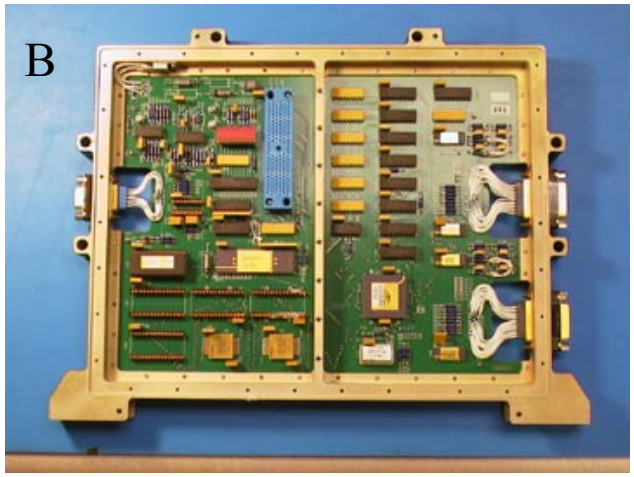
HVFM

UCB FUV Detector Status - Electronics ctd

- DCE - A,B,C, 2 sets, in house
  - Voltage & frequency margins done, thermal soak & cycle tested, POR tests done
  - Flight set , coated, staked, vac baked & certified. Backup set ready to coat & stake.
  - #1 DCE has 1200+ Hrs burn-in and #2 DCE has 900+ hours.
  - Final PROMS & new boot code installed

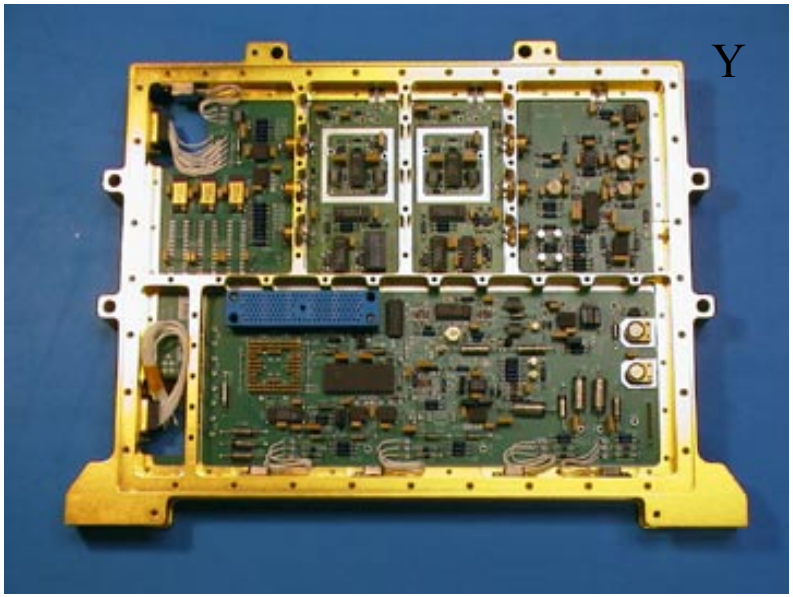


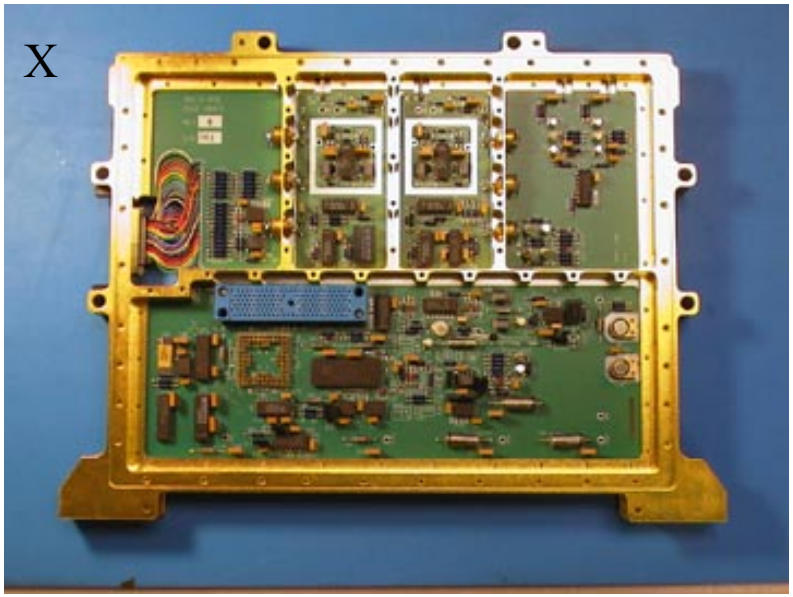




UCB FUV Detector Status - Electronics ctd

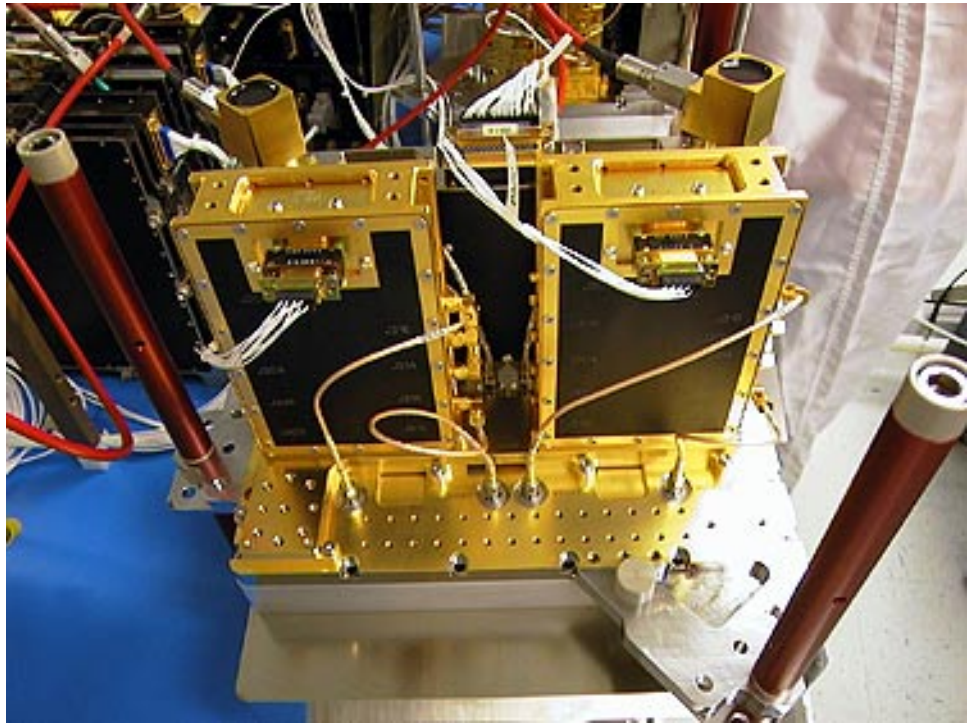
- 4 X and 4 Y flight TDC's fully functional
  - Voltage margin & frequency margin tests done
  - Thermal cycle and acceptance tests done.
  - Flight sets coated & staked, vac baked and certified, heat sinks added.
  - Spare sets ready to coat & stake





UCB FUV Detector Test Status

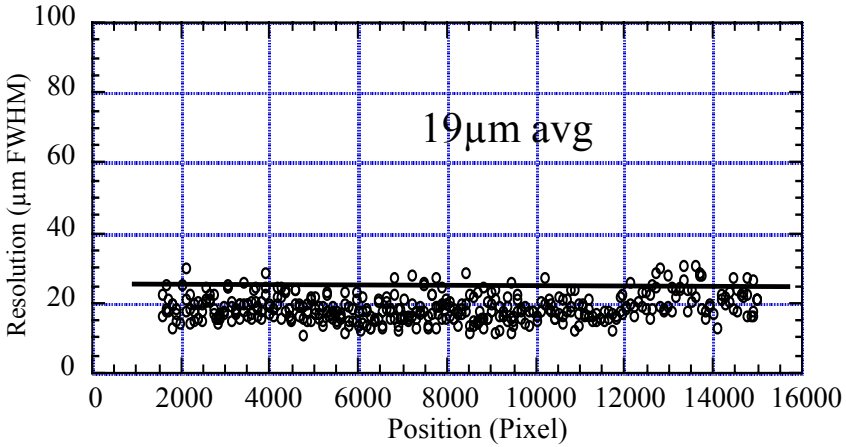
- **FUV02 Flight spare**
  In test with spare DEB. Resolution re-evaluated - looks better. Complete slit test and stability test prior to cathode coating.
- **<u>FUV01 Flight Unit</u>**
  Detector & flight DEB vibration tested, post vibration functionally tested, MCP's scrubbed, final closeouts done, functionally tested.
- Ready to ship on 4/2/01.

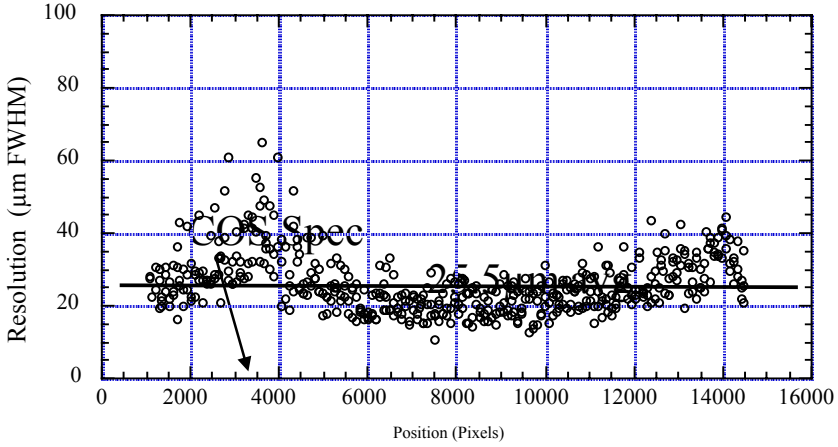


FUV02

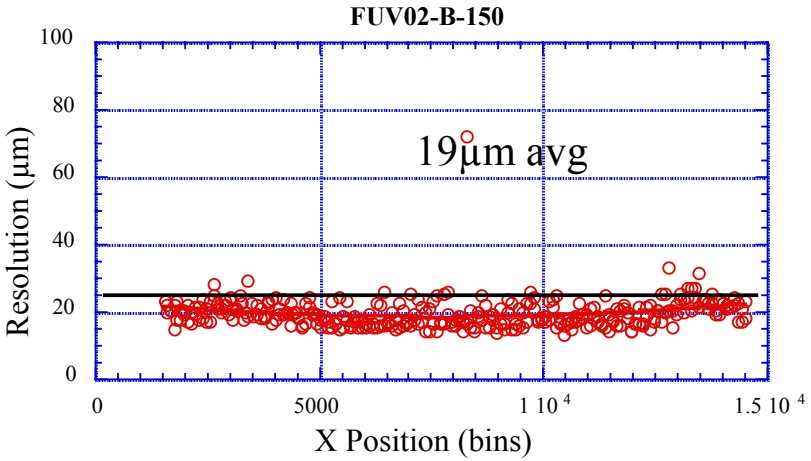
FUV02 X resolution measurements

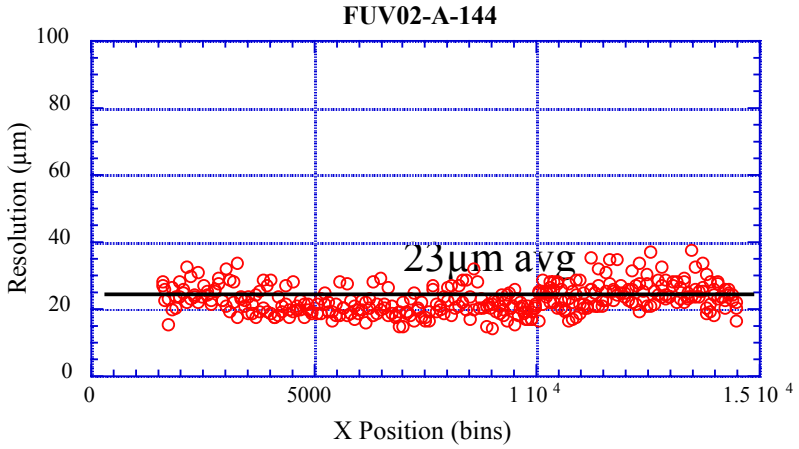
Last data - after Mini-scrub



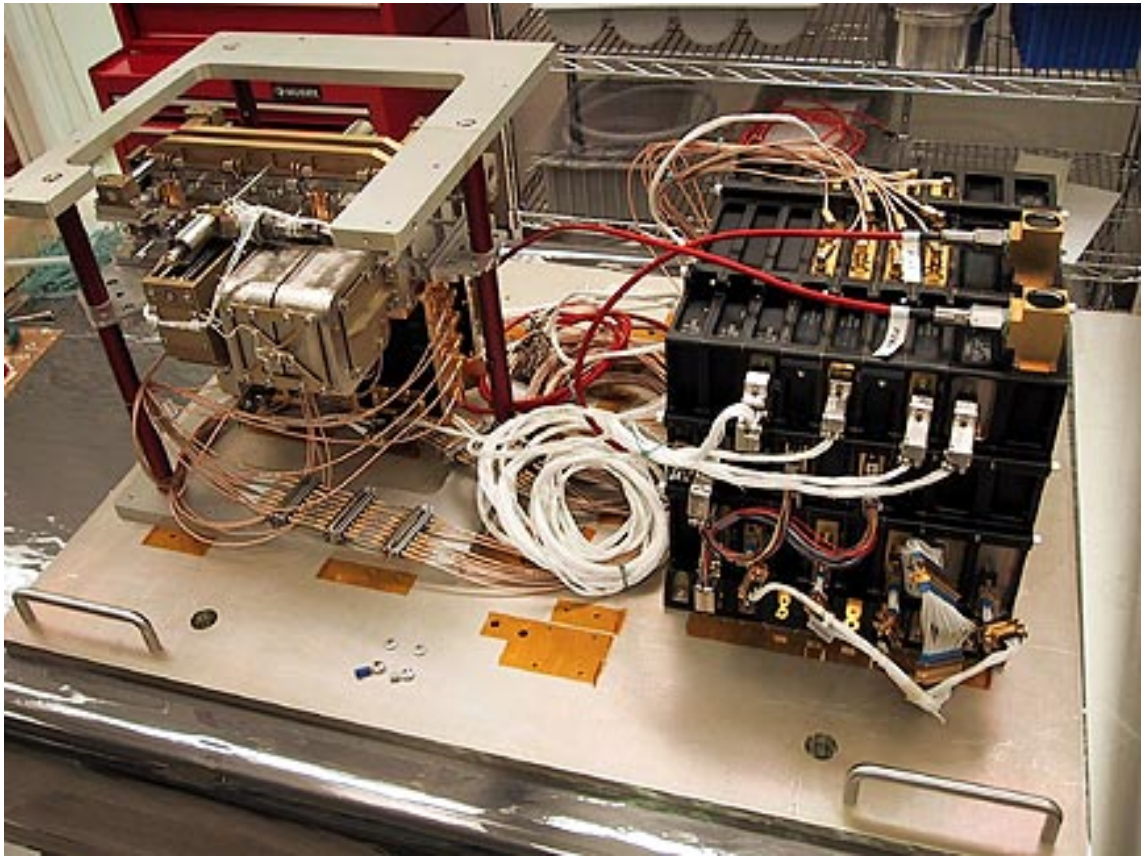


Now





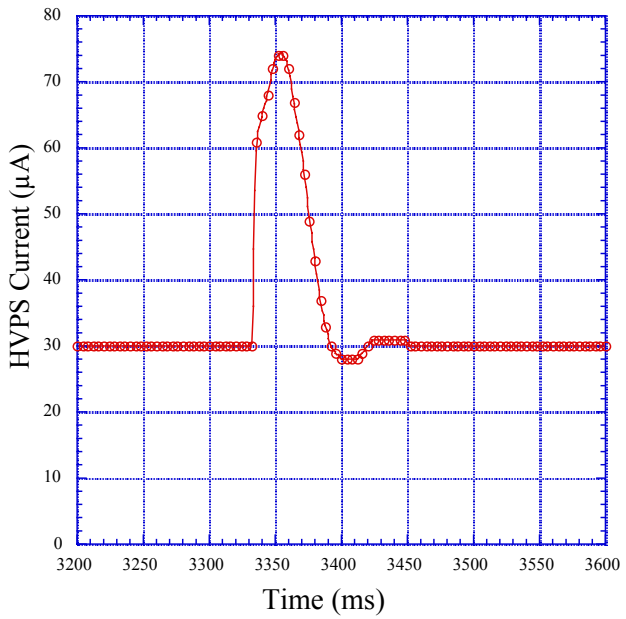
Flight FUV01 Detector System



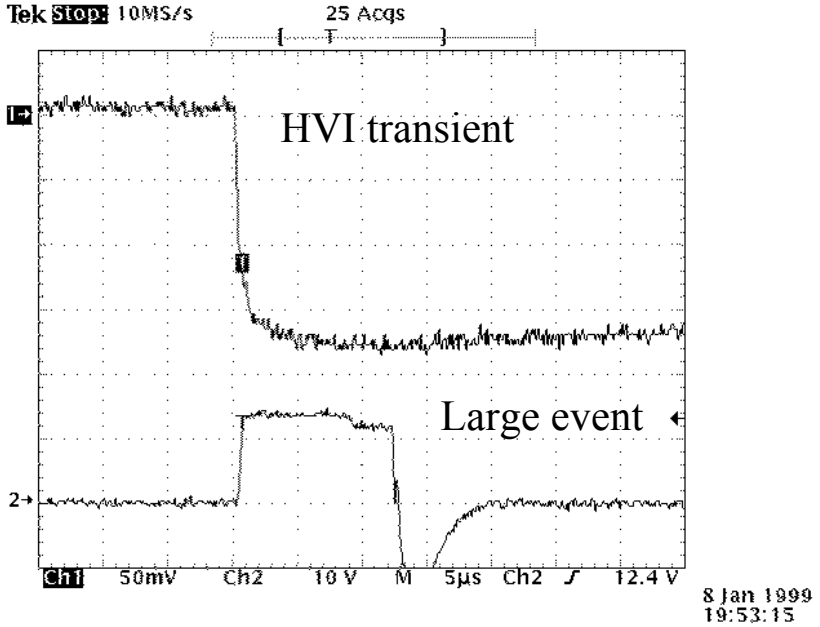
UCB FUV Flight Detector - Test Data Analysis

- It was discovered that a small fraction of all events are duplicates of the previous event, but only on Segment B. The fraction of duplicate events is a function of input event rate (0.2% at 18kHz on both A and B). Problem goes away when there are no events from side A. This has now been traced to the DCE Round Robin ACTEL due to a schematic transcription error at the output of one gate. This was confirmed and fixed on the ETU DCE. **This is currently being left as is - as a small but quantifiable error at high data rates - to avoid an ACTEL change-out.**
- After MCP scrub we had several high voltage shutdown events due to MCP current transients. These are similar to those seen on FUSE, and are detected by the HVI monitor. We realized that our trigger level for these events was set too low, so we changed to an appropriate threshold and have not had a shutdown since. These events do no harm, self quench and are usually initiated by high energy events (cosmics), and we have considerable Lab data. FUSE rate is about 1 shutdown every 2 or 3 months.

High Voltage Transient Characteristics

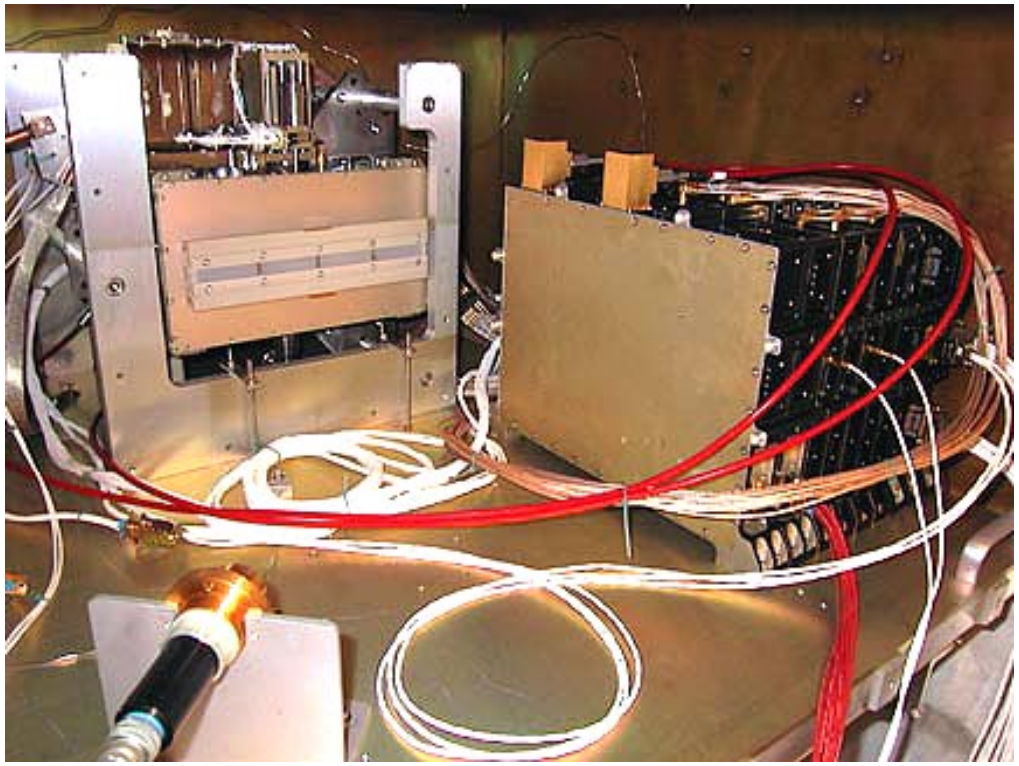


COS non-trip HVI transient (threshold = 120), event spontaneously decays away



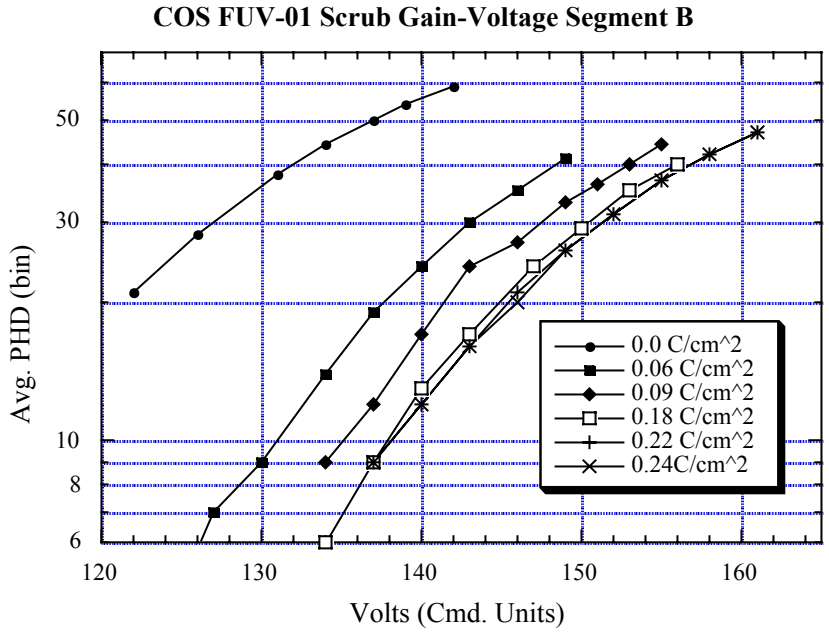
Lab study - HV transient example
Large saturated event and HVI transient

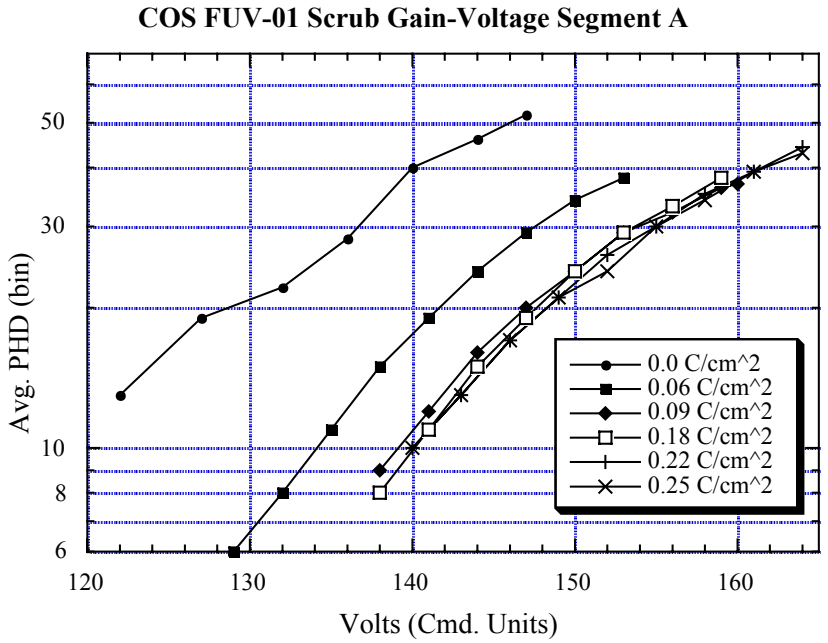
UCB FUV Flight Detector - Scrub Setup



- FUV01 detector with sapphire window diffusers, and DEB in tank with Deuterium scrub lamp external.

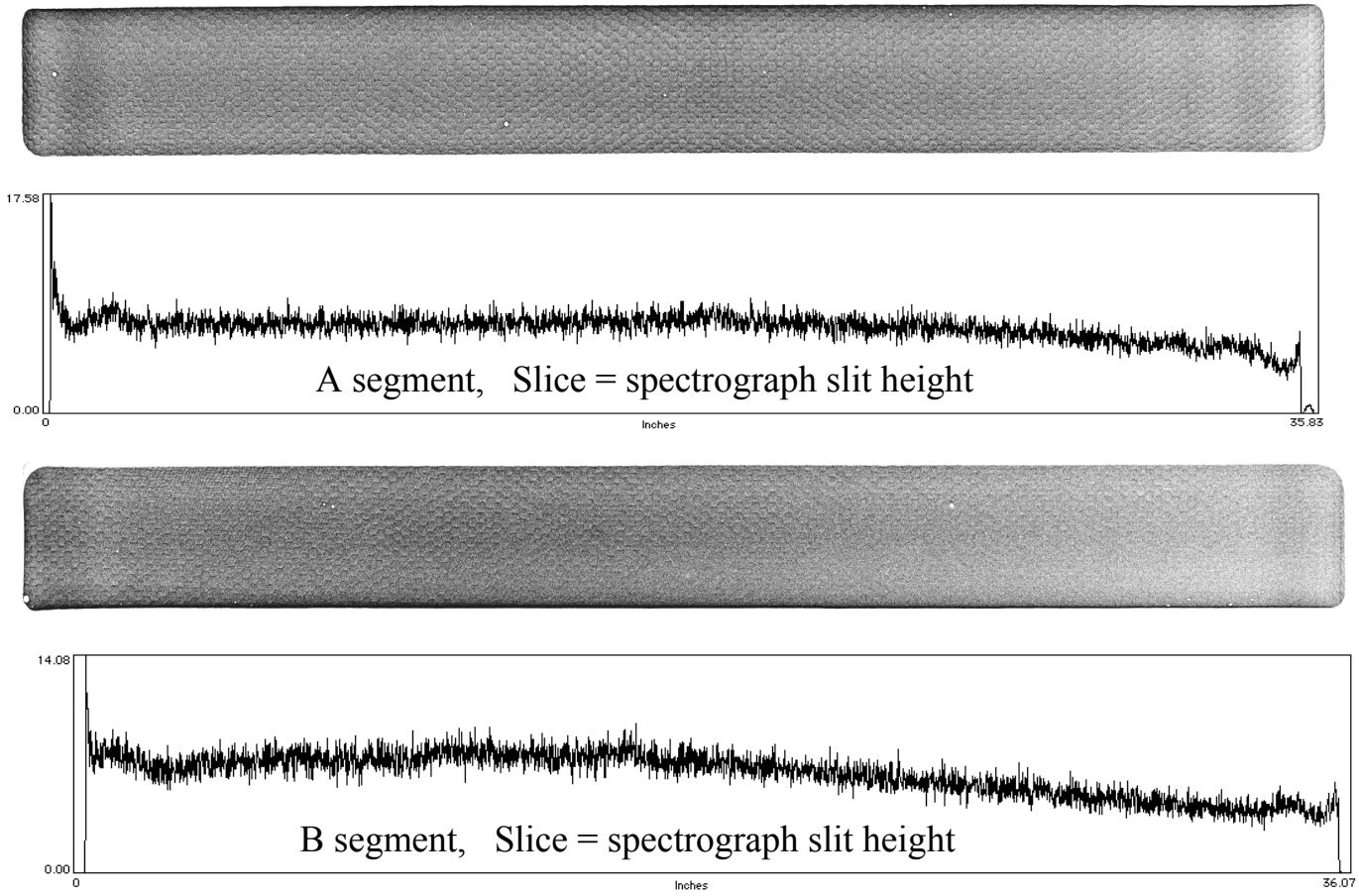
UCB FUV01 Flight Detector - Scrub



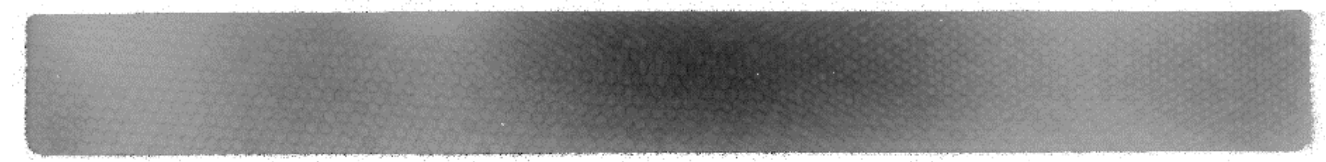


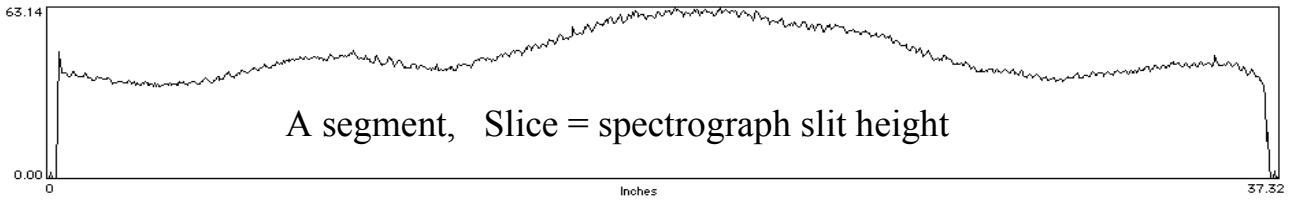
Both segments stabilized after about 0.18 C/cm^2 and required about 20 more high voltage command units to re-establish the nominal operating gain.

FUV01 Full flood Image Fixed pattern noise

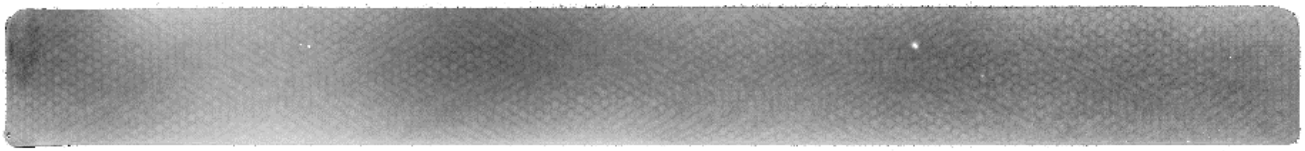


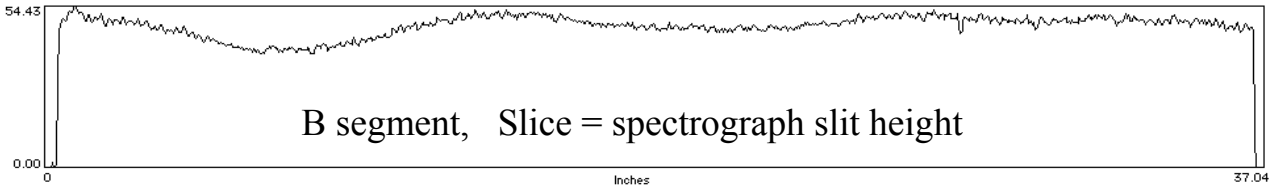
FUV01 Full flood Image - Gain Map





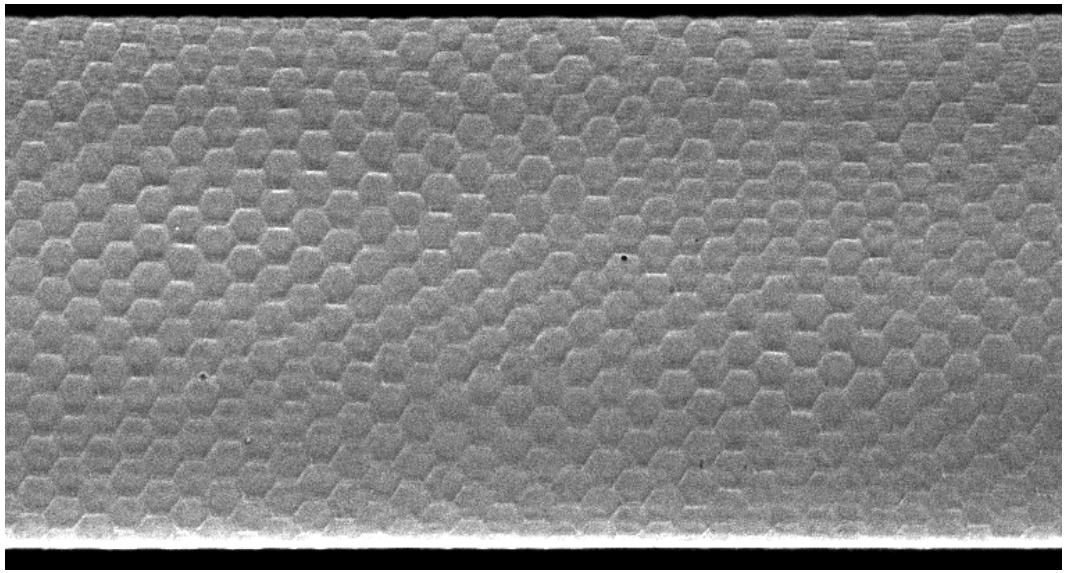
A segment, Slice = spectrograph slit height

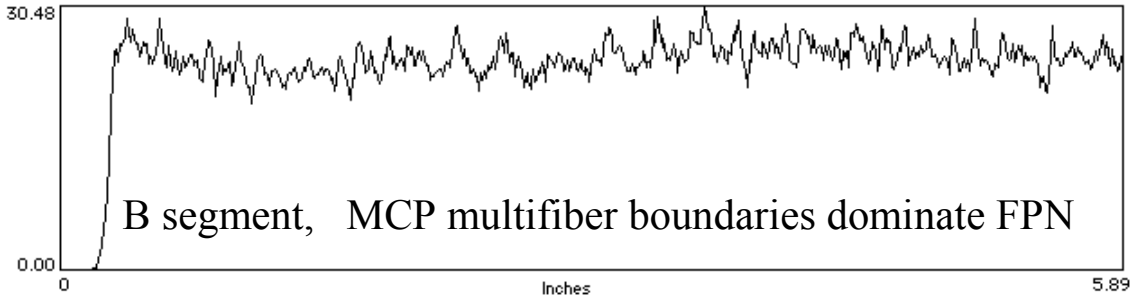




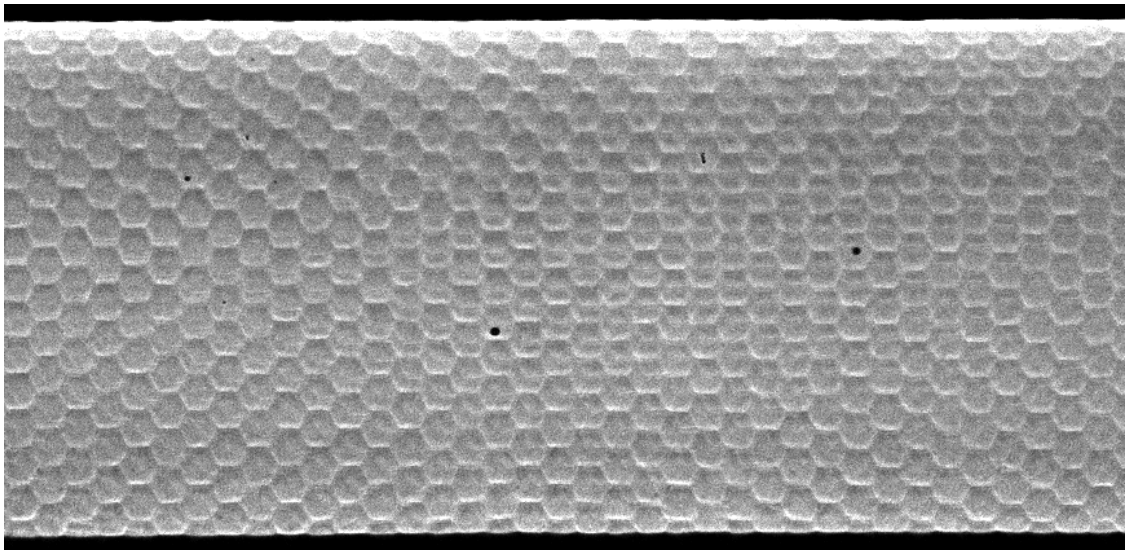
B segment, Slice = spectrograph slit height

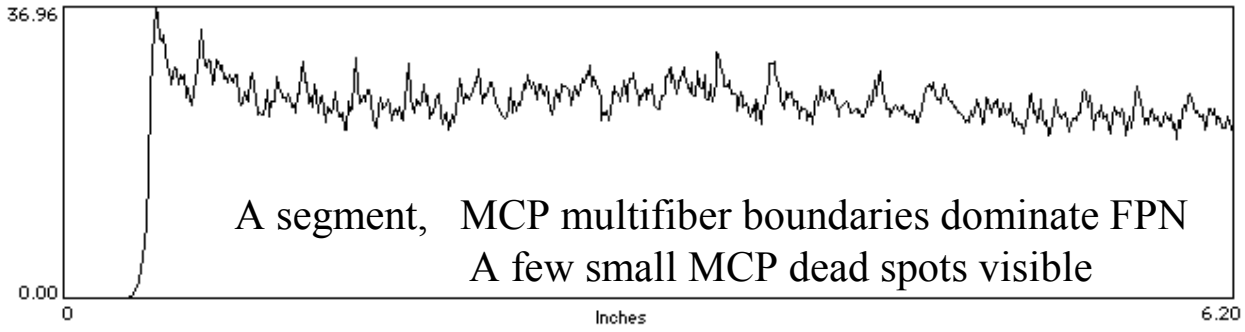
FUV01 Segment B Fixed Pattern Noise





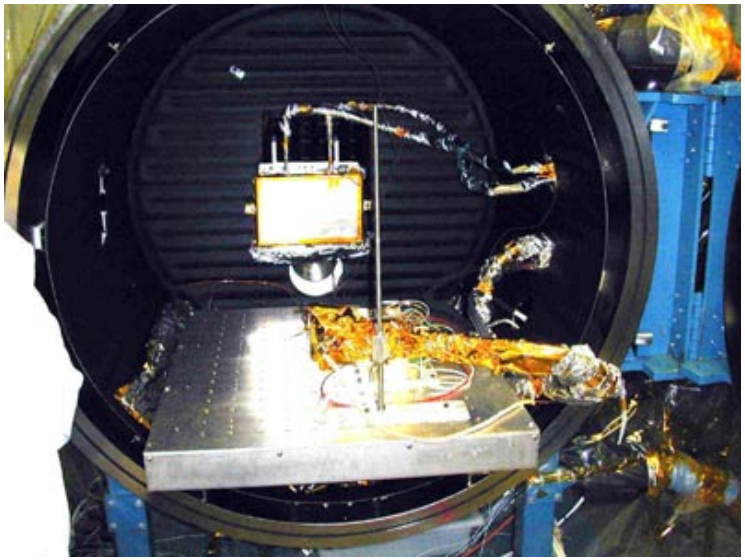
FUV01 Segment A Fixed Pattern Noise

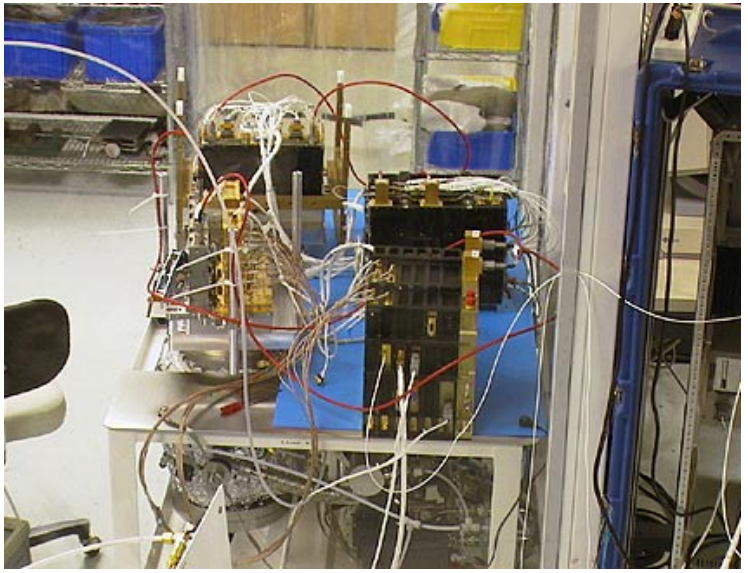




UCB FUV01 Detector Thermal Vac Test, & FUV02 checkout

- FUV01 detector system Thermal Vac test scheduled for Colorado tank.
- Will deliver FUV01 4/3/01, and do post delivery checkout





FUV02 Detector system Tests

- Full detector system with spare DEB established in UCB test tank facility in clean tent with COS GSE. Undergoing final tests before cathode deposition.

UCB FUV Detector Status -Near term tasks

- Pack FUV01 flight detector
- Ship FUV01 to Colorado April 2nd
- Install FUV01 into CU tank and perform Thermal Vac test
- Perform FUV01 cleanliness certification in CU tank
- Complete FUV02 + DEB performance tests
- CsI coat FUV02

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

Highlights:

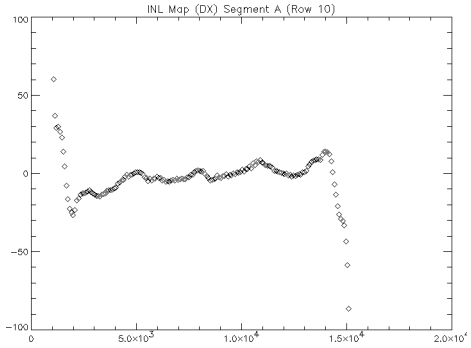
- CEDAR: Second-Round of Simulated SDF Data, produced from TAACOS output, was provided to STScI to help them maintain their "Back-End Systems" development schedule.
- TAACOS: All TAACOS Reports released or in signature cycle – except possible "LATBD" FSW Recommendations. Recall, "LATBD" is the placeholder for the TA FSW procedure that might be needed to autonomously correct for OSM1 position errors.

CALCOS-GSE Progress Report

Implementation of Algorithms described in AV-03

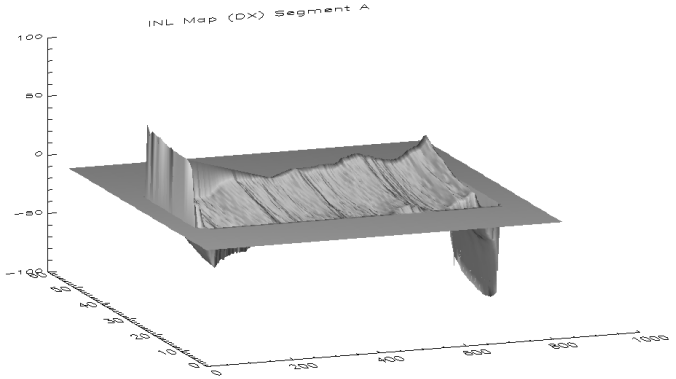
- **Thermal Correction (TC) Algorithm**:
  - Move location of events according to the location of the Stim pulses from data relative to reference frame (shift/stretch of image data).
  - Re-centering of Stim pulse is done to within ±0.2 pixels
- **Geometric Correction (GC) Algorithm**:
  - Used Pinhole 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)
  - Different algorithms have been used to verify the concepts. ($1\sigma = 0.25$ pixel)
- **Flat Field Data:**
  - The post-scrub deep-flat-field data will be used (after TC and GC) to generate the Data Quality Lookup Table

Integral Non-Linearity Data

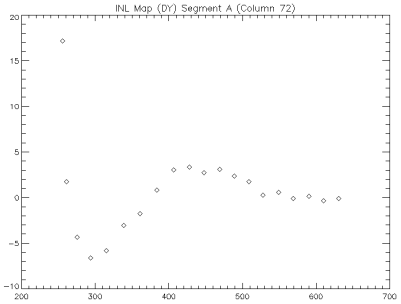


INL in X

Row 10

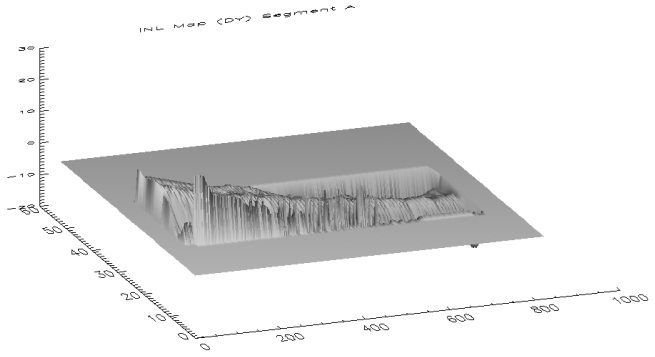


Surface Plot of INL in X



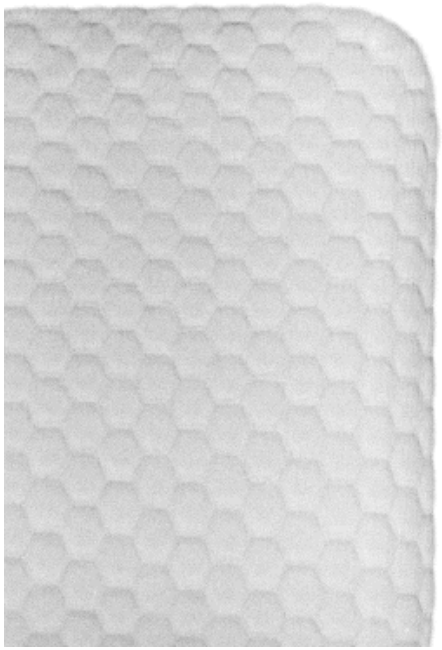
INL in Y

Column 72



Surface Plot of INL in Y

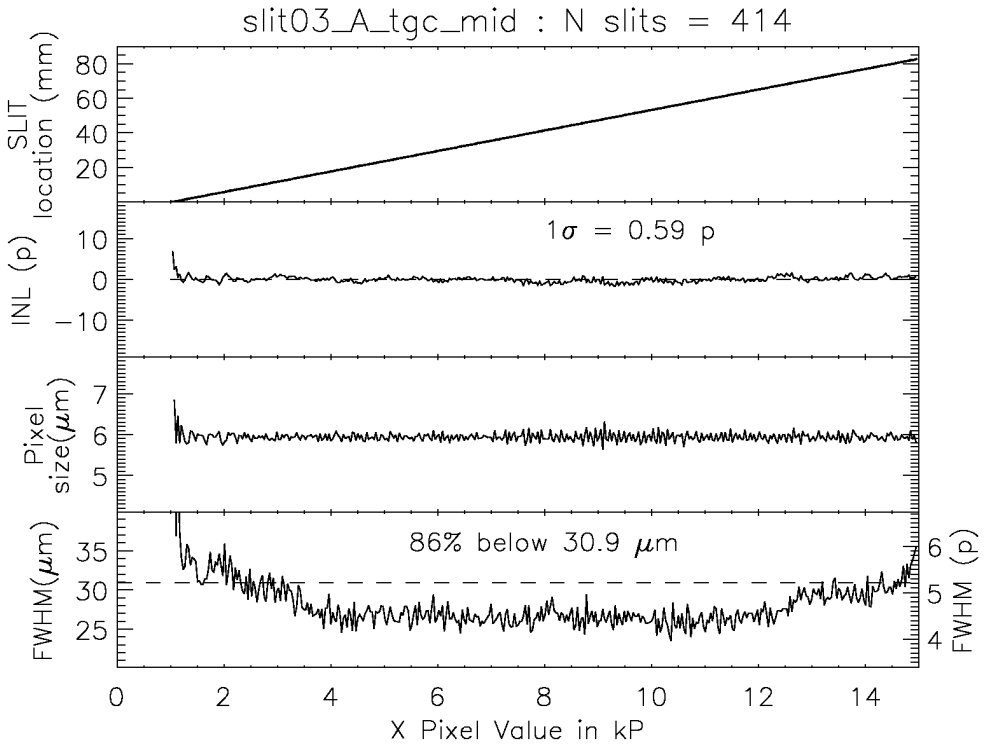
Sample Geometric Correction (Segment A)



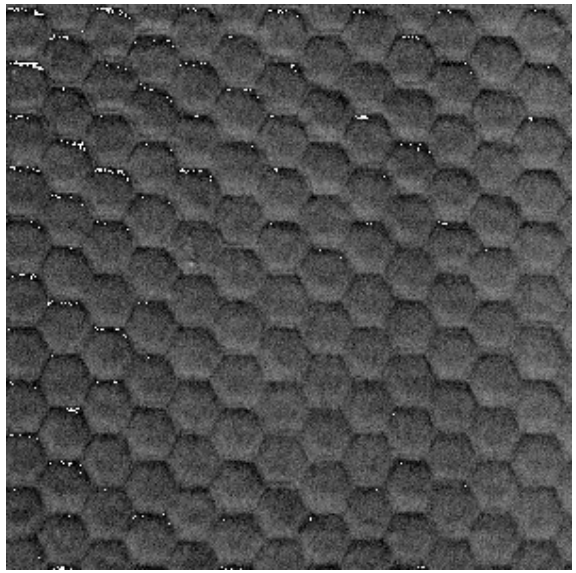
Thermally Corrected

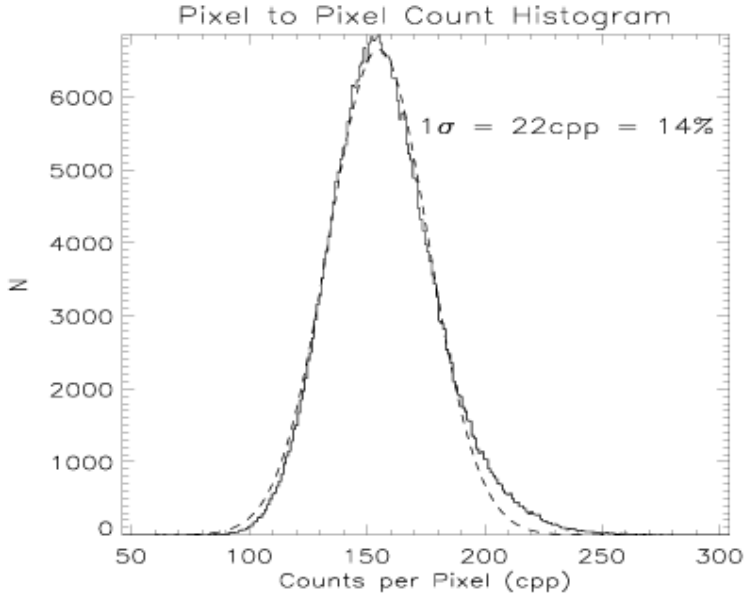
Thermally and Geometrically Corrected

Residual INL from Slit Data after correction with Pinhole INL Map



Pixel to Pixel Count Distribution in Deep Flat Field (Segment A)





FUV Detector FSW Development

DCE Flight Software Development and Test

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

Highlights:

- Minor fix to OPERATE Code – In v1040, "Stim Pulse" SW Status Bits now reported correctly after using the DCE OPERATE command LFSAFE.
- DCE "OPERATE" Component Testing to be completed by 3/30/2001. As-run Procedures to be circulated for signature in early April.

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 delayed to late March by G185M issue. G140L-Blazed efforts TBD
CEDAR Software Development	Build 3 completion in early March
TAACOS Software Development	Complete
CALCOS software development	On-going
JY Deliveries	G230L – slipped to 6/01
Calibration Planning & Implementation	AV-03 released
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	$$$,tt	Degraded science
Remove NCM3 optics	TBD	$,t	Degraded science, Ops
Eliminate Aperture Mechanism	TBD	$,t	Ops, Obs. Efficiency, higher risk
Drop all Accum mode processing w/ Doppler	**Too late**	$,t	Degraded science
Drop spare FUV detector	TBD	$,t	Higher risk
Drop OSM1 capability (don't cover λ gap)	**Too late**	---	Degraded science
Reduce S/N requirement to 30 (no FF lamp)	TBD	$,t	Degraded science
Relax NUV resolution requirements below 20k	TBD	$,t	Degraded science
Remove on-orbit change-out capability	TBD	$,t	Higher risk
Drop dispersed light TA	**Too late**	$,t	Ops
No Ion Gauge	TBD	$,t	Higher risk, Ops
No external shutter	**Too late**	$,t	Ops
Change MSRs to QSRs	TBD	$	Save trees
Eliminate Mechanism Lifetime tests	TBD	$$	Higher risk
Reduce CDRLs	TBD	$	Unknown
Drop G140L blazed effort	TBD	$,t	Missed opportunity for improved science
Reduce G160M image testing	TBD	$,t	Higher risk

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

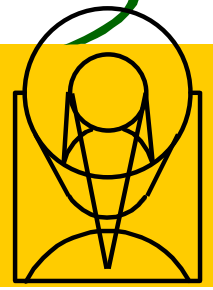
Upcoming Events/Activities

- Complete TV tank repairs.
- Ship flight FUV detector to CU.
- Finalize/implement NUV grating recovery plan.
- Complete G160M-a optics testing.
- Start and finish FUV detector TV test.
- Continue processing spare FUV detector at UCB.

Questions, Issues & Resolution Plan

- None

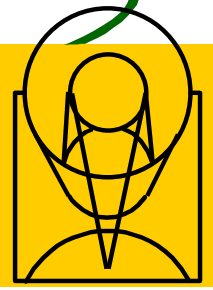
COS Status - STScI



Topics

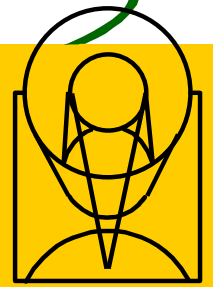
- General support
- CEDAR
- Front end development status
- Back end development status

General support



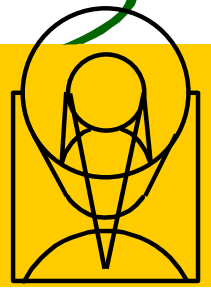
- Berkeley: 26 Febr – 2 March
  - FUV detector TV prep
- Science team meeting: 5 March
- FUV detector TV Boulder: April
  - schedule TBD

CEDAR



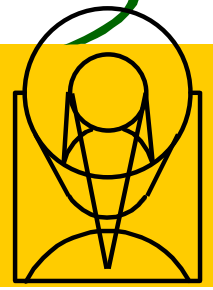
- IDT quick-look data analysis software
- Expect to use for detector TV in April
- Installed @ STScI 13 March w/ no problems
- Accessible to COS STScI team w/ partial data archive (slit masks, a few flat fields)

Front-end development



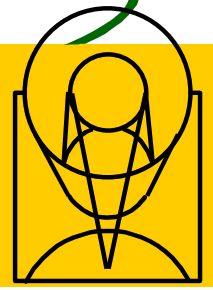
- **Phase 1 (1/1/00 – 6/30/00)**
  - α Macro Development
  - α Reconfigurations
- **Phase 2 (7/1/00 – 12/31/00)**
  - α NUV Timetag Mode + Darks
  - α FUV Timetag Mode + Darks
- **Phase 3 (1/1/01 – 6/30/01)**
  - α FUV & NUV Accumulation Science Exposures
  - FUV & NUV Target Acquisition Exposures
  - FUV & NUV Target Peakup Exposures
- **Phase 4 (7/1/01 – 12/31/01)**
  - Aperture Alignment Exposures
  - OSM1 Focus Alignment Exposures
  - OSM1 Rotation Alignment Exposures
  - OSM2 Rotation Alignment Exposures
  - FUV & NUV Flat Field Lamp Calibration Exposures

Front-end development



- STScI work & testing being completed on schedule
- Awaiting availability of FSW for testing at Ball
- Major requirements effort for target acq completed by COWG & development begun

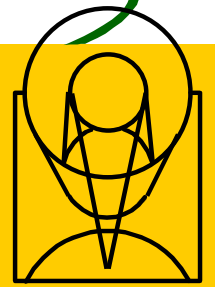
Back-end development



Thermal-Vac Data Processing Effort

- Discussion of status & dependencies in splinter mtg Tuesday 3/27
- Deliverables to STScI postponed ~3 months from MOU dates due to slips in FSW/hardware schedule
- STScI OPUS/HDA CDR delayed ~3 months

Back-end development



- Ops bench hardware-generated test data critical for beta-release of TV data processing software
  - - Beta now 1 Oct 01
  - Enables timely feedback from IDT to STScI
- Integrated SI hardware-generated test headers, images remain critical path item for final delivery of software to IDT