COS
Monthly Status Review
February 28, 2001
Ball

Agenda

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

Progress Summary Since Last Monthly (1/31/01)

- Successfully completed flight FUV detector acceptance level vibration tests.
- Started scrub of flight MCPs.
- Released AV-03: COS Calibration Requirements & Procedures Document.
- Began effort to assess G185M performance discrepancy.

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
  - Awaiting coating:
    - G225M- 2
    - G285M-1, 2
    - G230L-1, 2
    - 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	In Process	**3/01**	GSFC
G285M	Done	In Process	**4/01**	GSFC
G230L	3/01	4/01	**5/01**	GSFC

- G140L - blazed effort at JY is still a research project.
  - Phase 1 complete with questionable results.
  - CU is awaiting Phase 1 report form JY before making final decision on Phase 2.
  - Efforts to be discussed at JY in March at G230L pick-up.

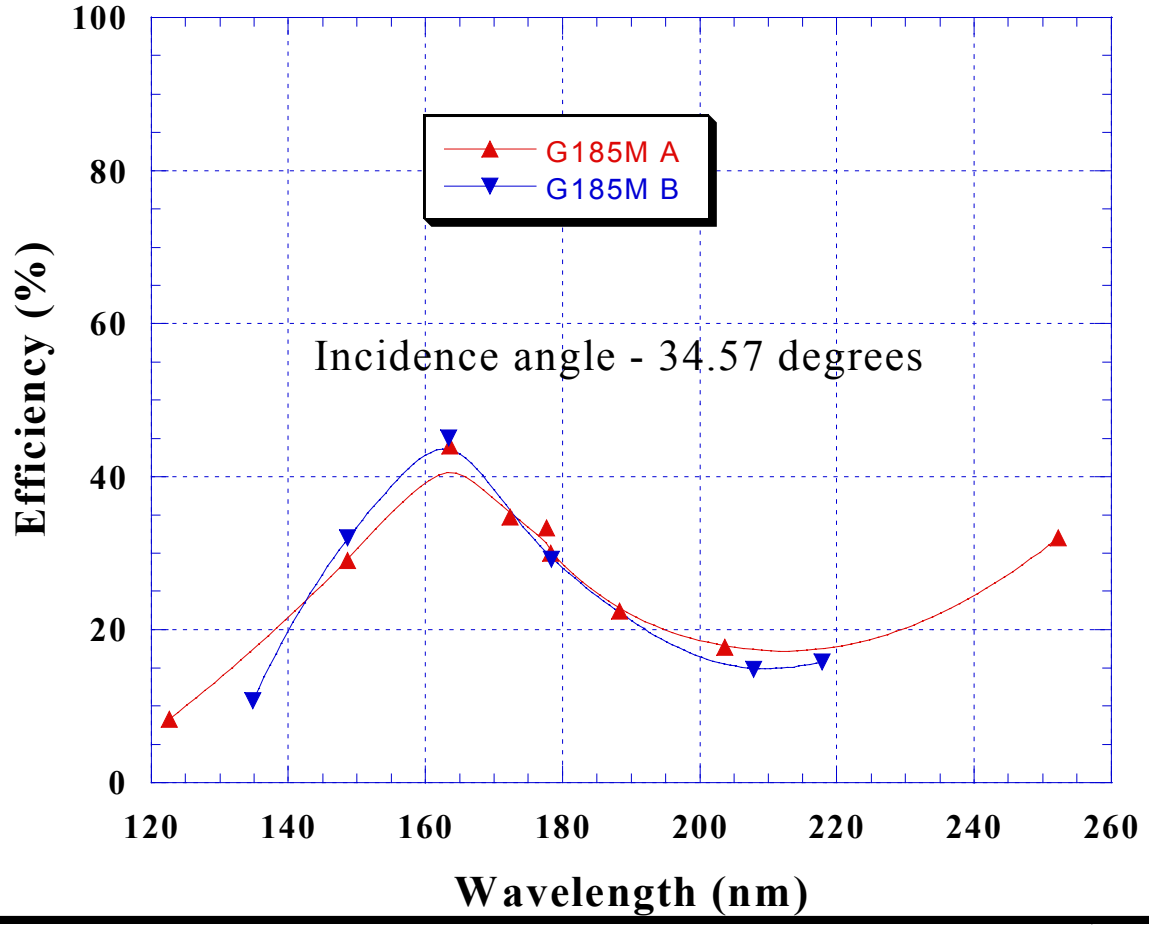
COS FUV Grating Test Status

- 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.

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.

G185M A&B absolute efficiency data



G185M Efficiency

- Possible sources of discrepancy that are unlikely
  - Contamination: performance is worst at longest wavelengths and identical on both 185Ma & 185Mb.
  - Coating problem: test flats coated had excellent reflectivity.
- Gratings are being tested at CU to try and resolve possible discrepancy.

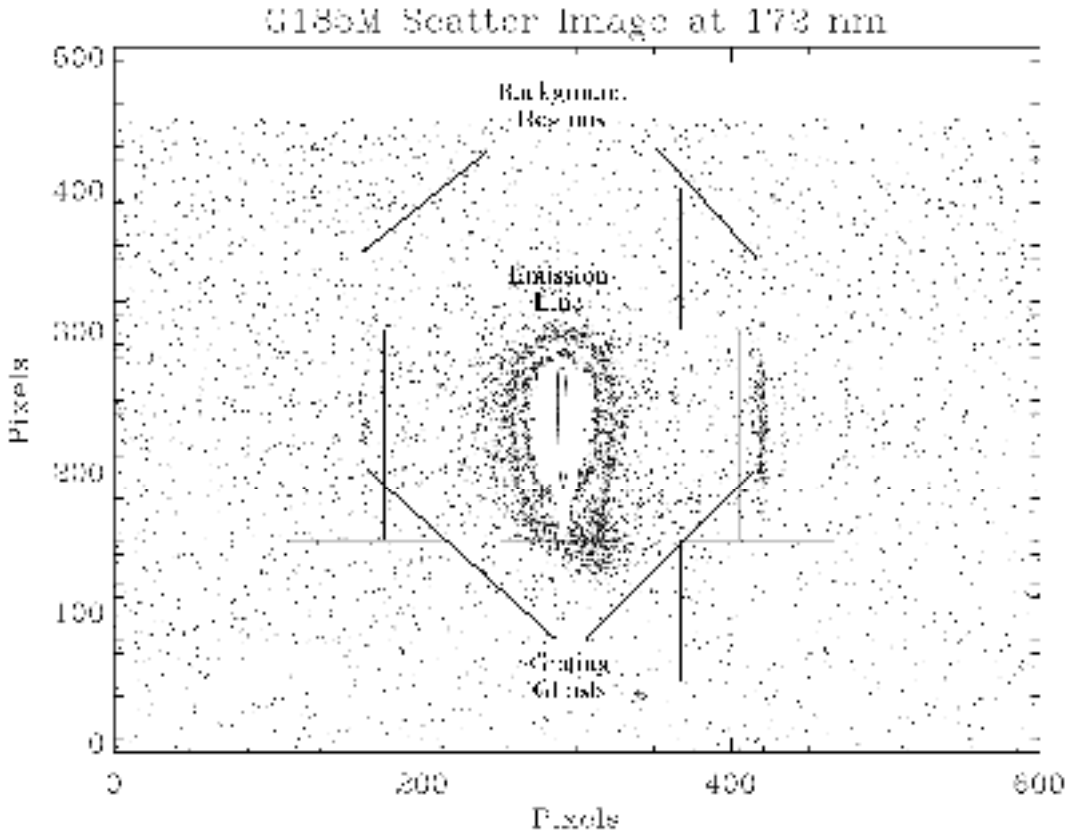
G185M Grating Issues (cont.)

- Possible explanations:
  - Groove shape changed by coating
  - Chemical interdiffusion in grating coating
  - Polarization in GSFC and/or J-Y set-up induce misleading results
  - J-Y or GSFC test results wrong
- Possible outcomes
  - If test procedure is only problem - we have no problem
  - If coating procedure is problem, we get more replicas and re-coat
  - If substrates are flawed, we need new grating from J-Y or somewhere else
  - If new gratings are needed, proceed with align/install of current grating and replace later
  - Need to test 225 & 285 ASAP to see if problem is generic

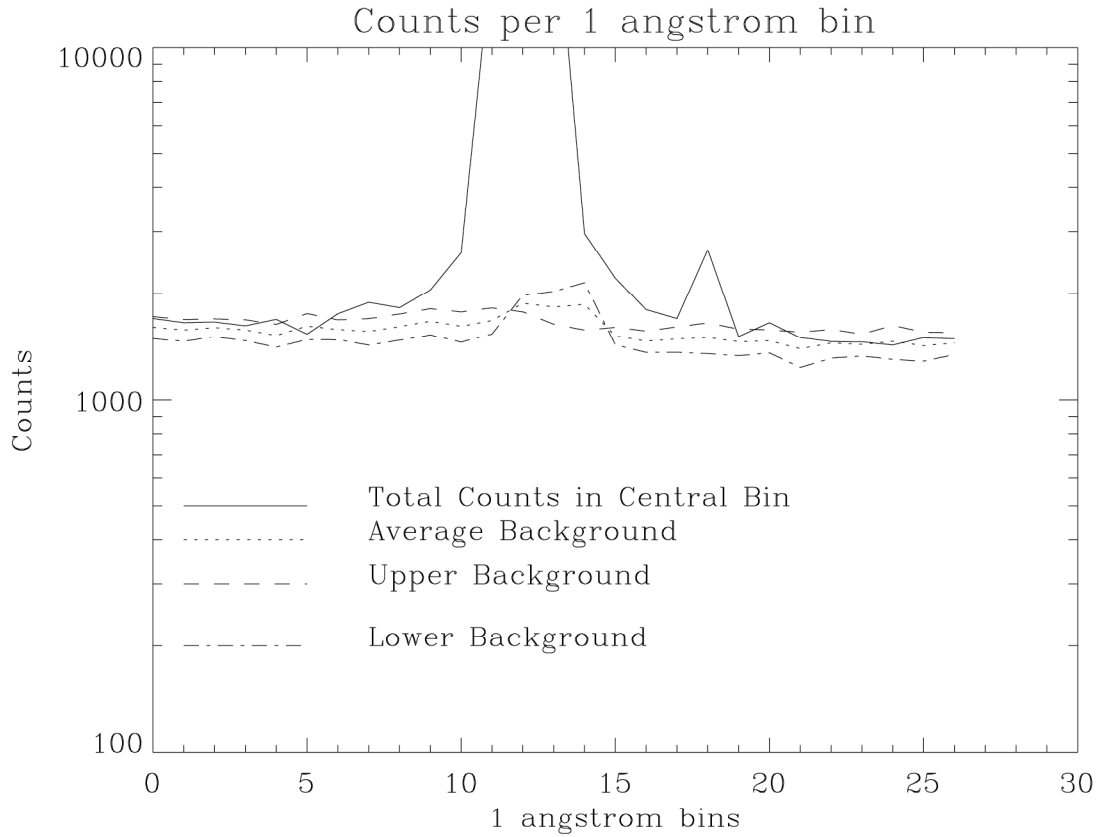
G185M Ghost

- A ghost has been detected at the $1x10^{-3}$ level (specification is $1x10^{-4}$). This will effect continuum source only if S/N of 1000/1 is achieved (unlikely). Strong emission lines will be ghosted at a precisely known location at $1/1000^{th}$ of their strength. This is easily removed in data analysis for the few science observation where it will be applicable.

Scatter Results for G185M-A (cont.)

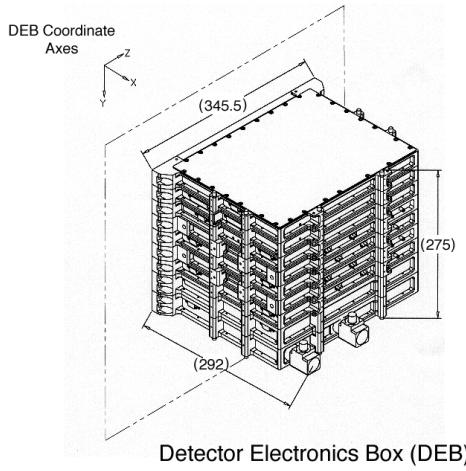


Scatter Results for G185M-A (cont.)

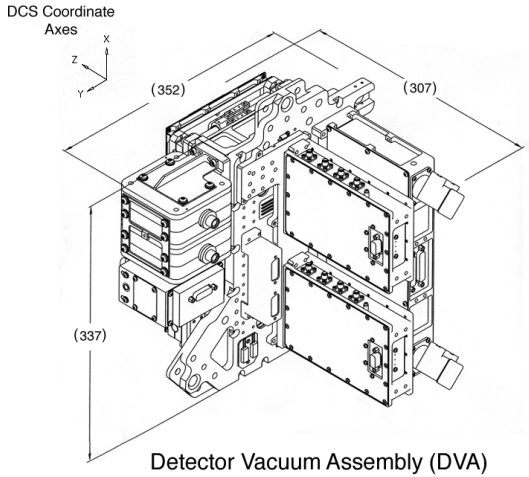


Overview of FUV Detector Assemblies

- **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)



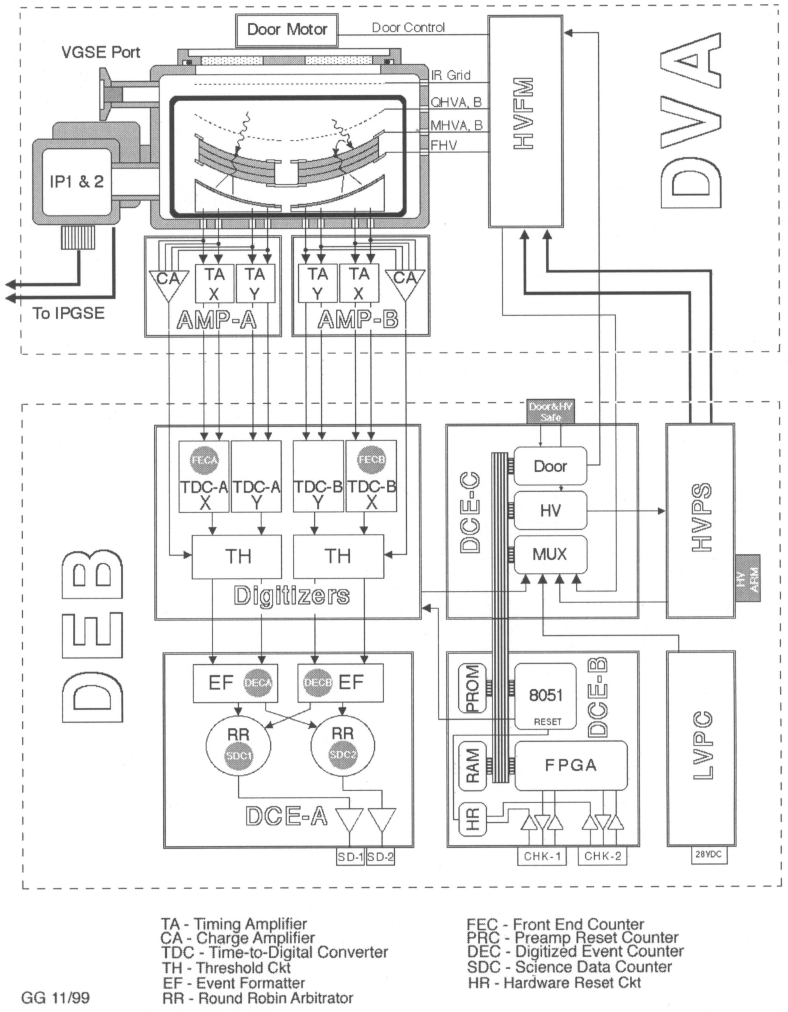
Detector Electronics Box (DEB)



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):

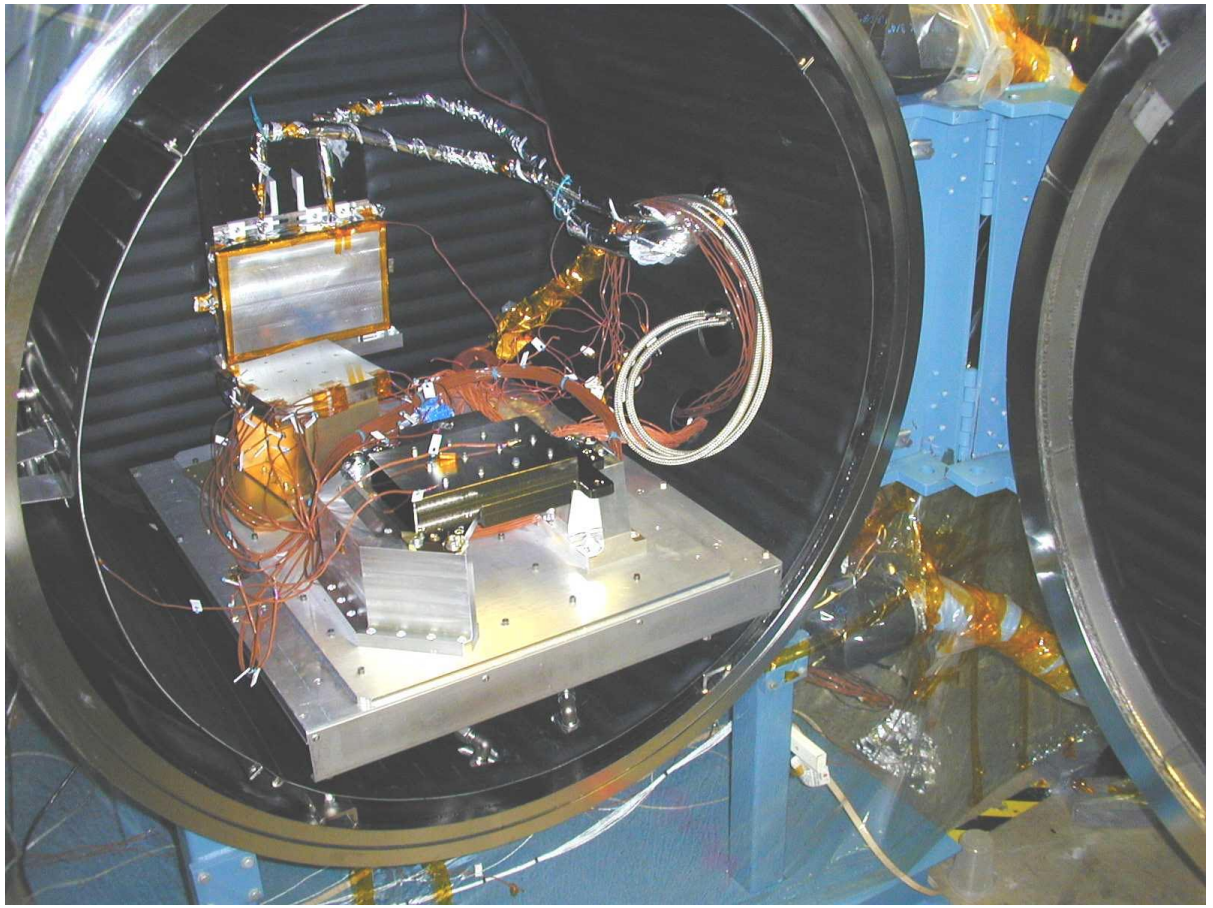
	Mass (Kg)			**Power (W)**		
	Actuals	SoR Allocation (1)	Margin	Actuals	SoR Allocation (1)	Margin
DVA	20.43	21.5	5%	4.59	-	-
DEB	14.44	15.3	5.6%	47.42	-	-
Harness (est.)	2.7	3.4	20.5%	-	-	-
Total	37.57	40.2	6.5%	52.01	53.0	1.73%

Notes: (1) SoR Revision B allocations

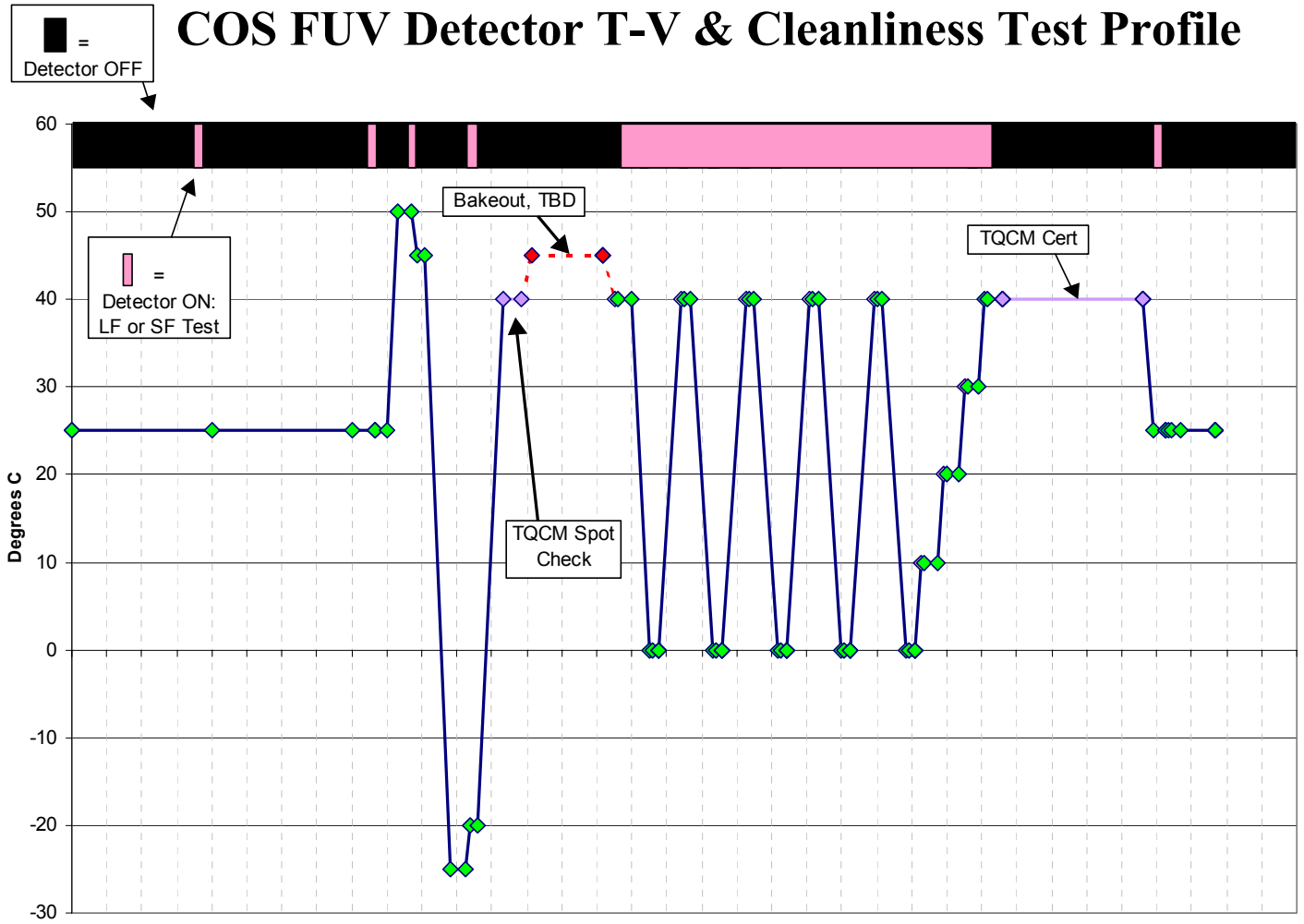
- Latest UCB masss & power numbers are actuals measured on the flight system. The numbers come from Revision D of the UCB Mass & Power Budget Report (UCB-COS-RPT-1015, UCB-COS-RPT-1004).

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 development between CU and UCB.



COS FUV Detector T-V & Cleanliness Test Profile



UCB FUV Detector Status - Schedule Overview

December/January Tracking Milestones	**Status**
FUV #1 system vibration test	Completed 2/7/91
FUV #1 EMI/EMC test	Complete

February Tracking Milestones	**Status**
MCP Scrub	Started late
Start T-V Tests at CU	Start 3/14/01

March Tracking Milestones	**Status**
Ship flight detector to CU	3/9/01
Start TV test on flight unit	3/14/01
Deposit photocathode on spare MCPs	3/20/01

April Tracking Milestones	**Status**
Deliver flight unit to Ball	4/9/01
Start spare DEB/DVA characterization	4/01

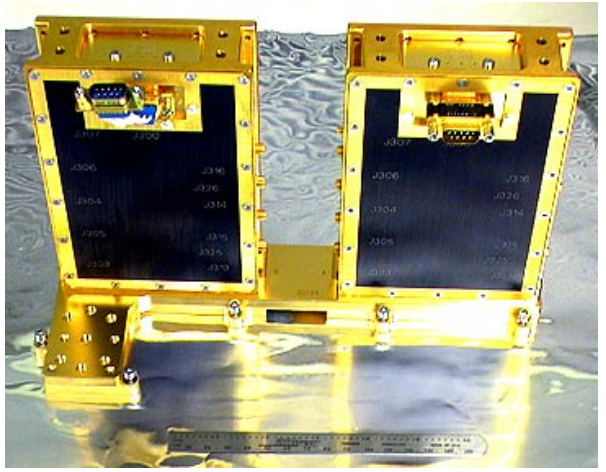
Forecast flight system delivery to Ball:
This month = 4/9/01
Last month = 3/30/01

Spare FUV Detector Status

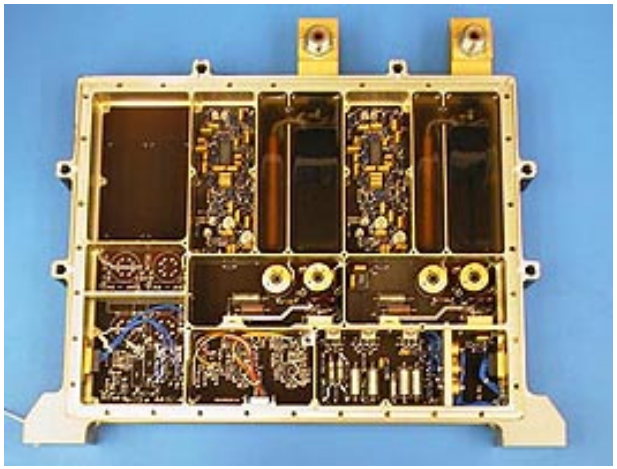
- Spare DVA is undergoing characterization tests with spare DEB. Upcoming efforts include:
  - Checking/setting rear field, trim, walk
  - Checking spatial linearity/stability
  - Checking resolution performance
- Next major milestone will be photocathode deposition and QE check.
- System will then be reassembled, tested, and readied for environmental tests, which will occur May, June.
- Spare system delivery expected in early July ‘01.

UCB FUV Detector Status - Electronics

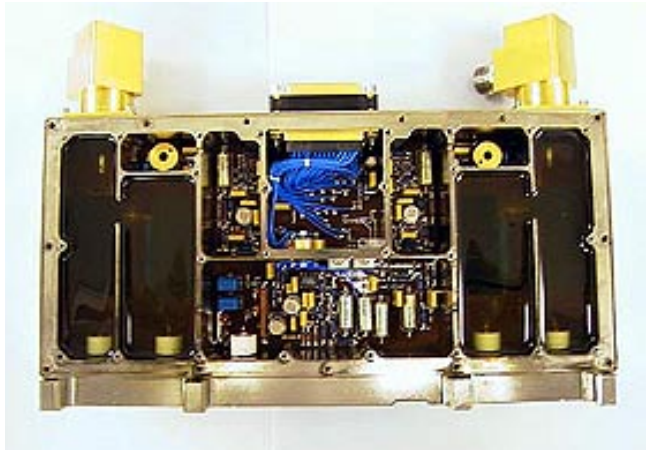
- Power systems (HVPS, LVPC, HVFM)
  - All coated, staked, vac baked & certified.
- Amplifiers
  - All 4 amps tested, coated & staked, vac baked and certified.
- Flight Harnesses
  - 2 sets complete, vac baked & certified.
  - Wrapping complete



Amplifiers



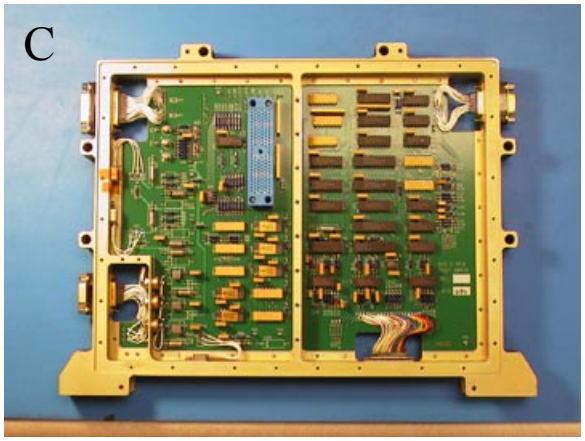
HVPS

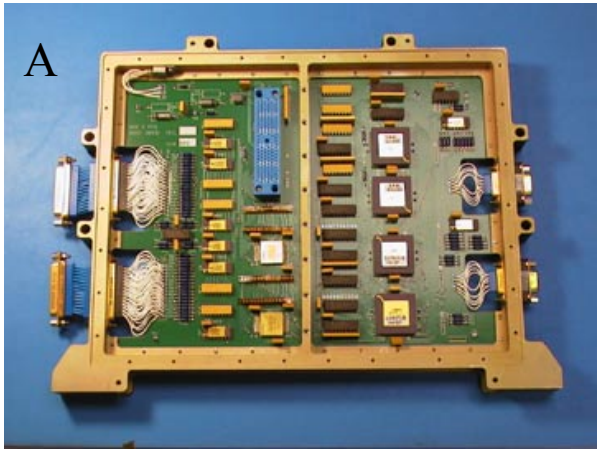


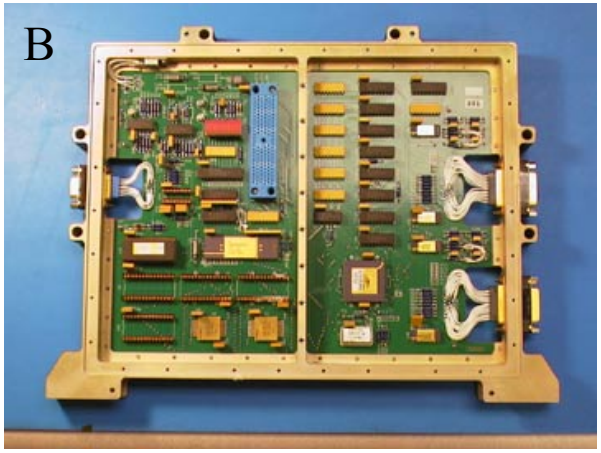
HVFM

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.
  - #1 DCE has 1025+ Hrs burn-in and #2 DCE has 850+ hours.
  - Final PROMS & new boot installed

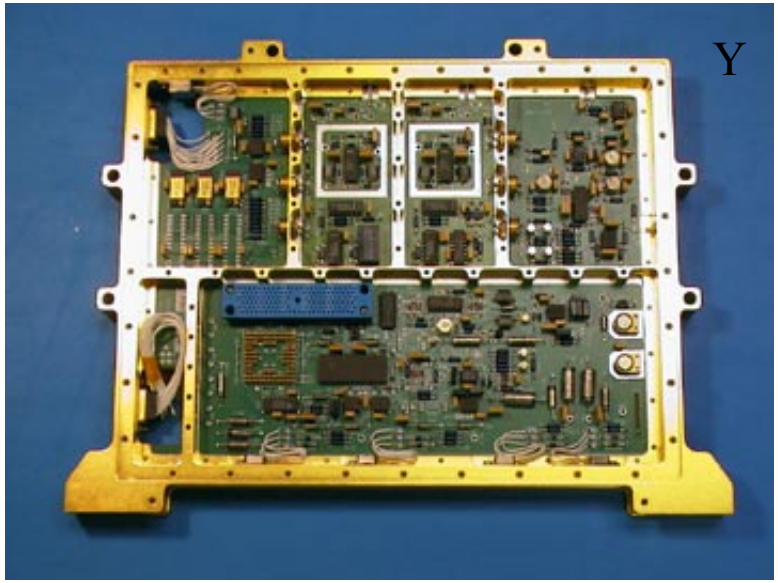


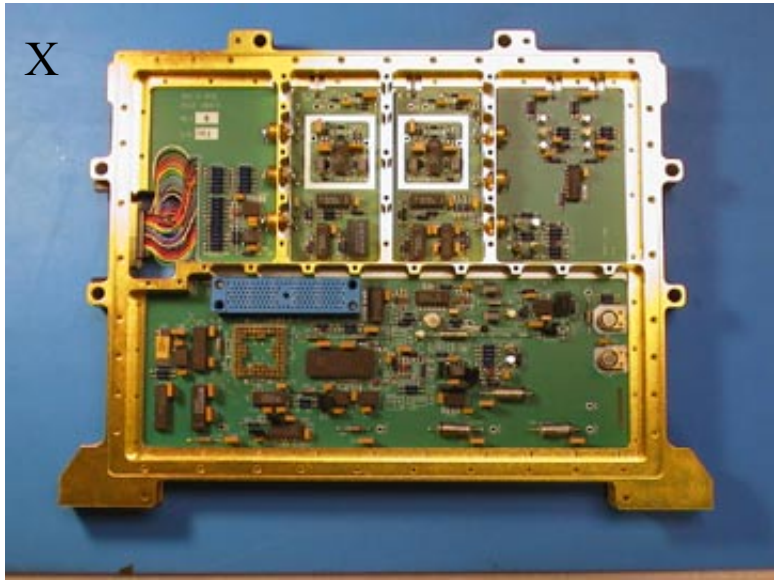




UCB FUV Detector Status - Electronics ctd

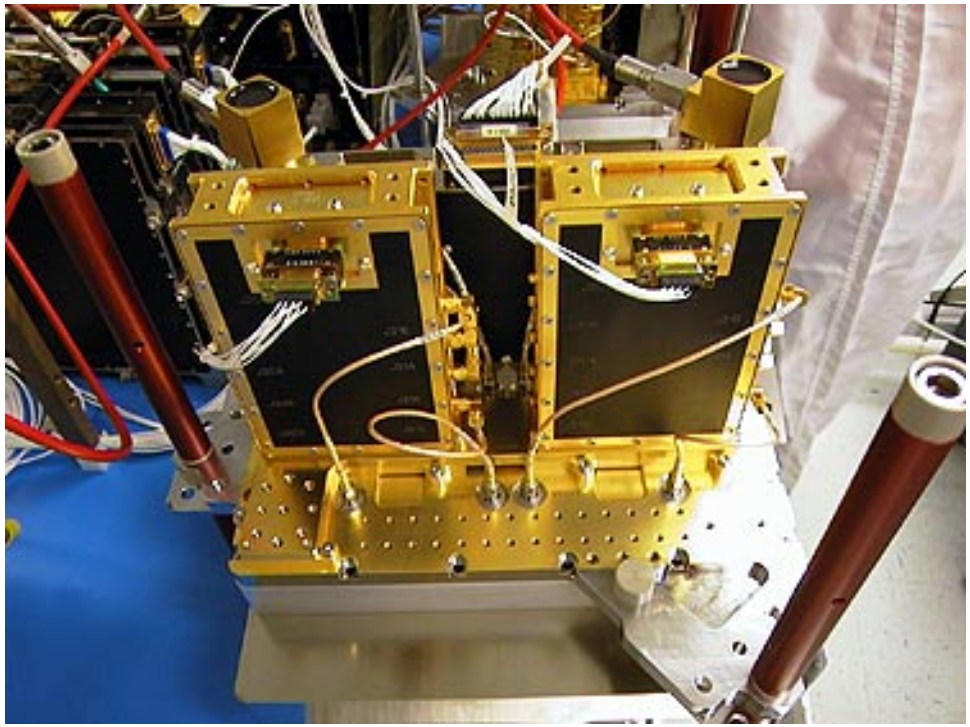
- 4 X and 4 Y flight TDC's fully functional
  - Voltage margin & frequency margin tests done
  - Thermal cycle and acceptance tests done.
  - Flight sets coated & staked, vac baked and certified, heat sinks added.





UCB FUV Detector Test Status

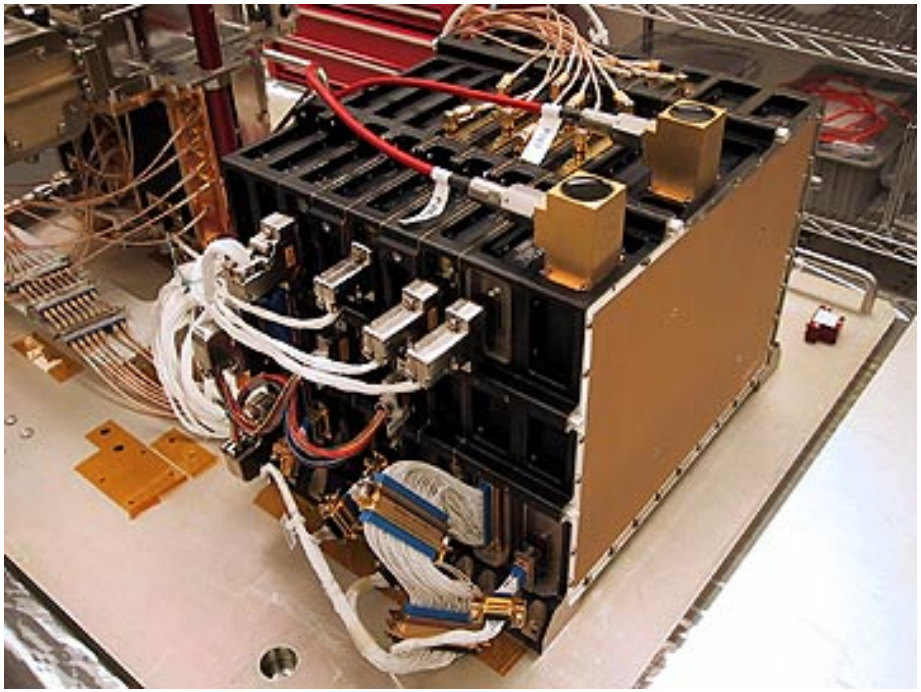
- **FUV02 Flight spare**
  In test with spare DEB for final verification tests prior to cathode coating.
- **<u>FUV01 Flight Unit</u>**
  Detector & flight DEB re-integrated, functionally tested, vibration tested, post vibration functionally tested, in MCP scrub.



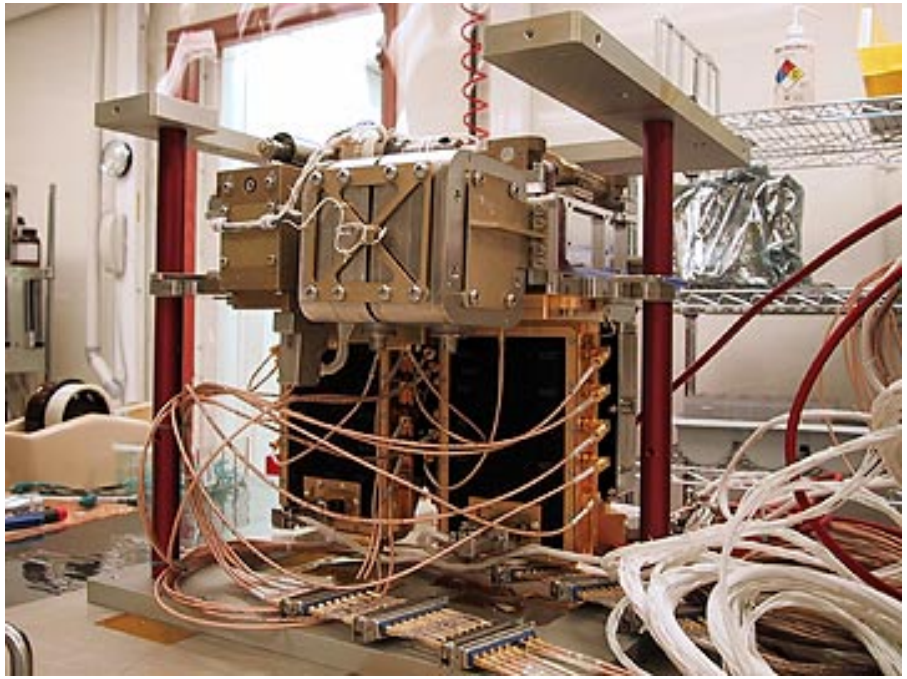
FUV02

COS FUV01 Detector System

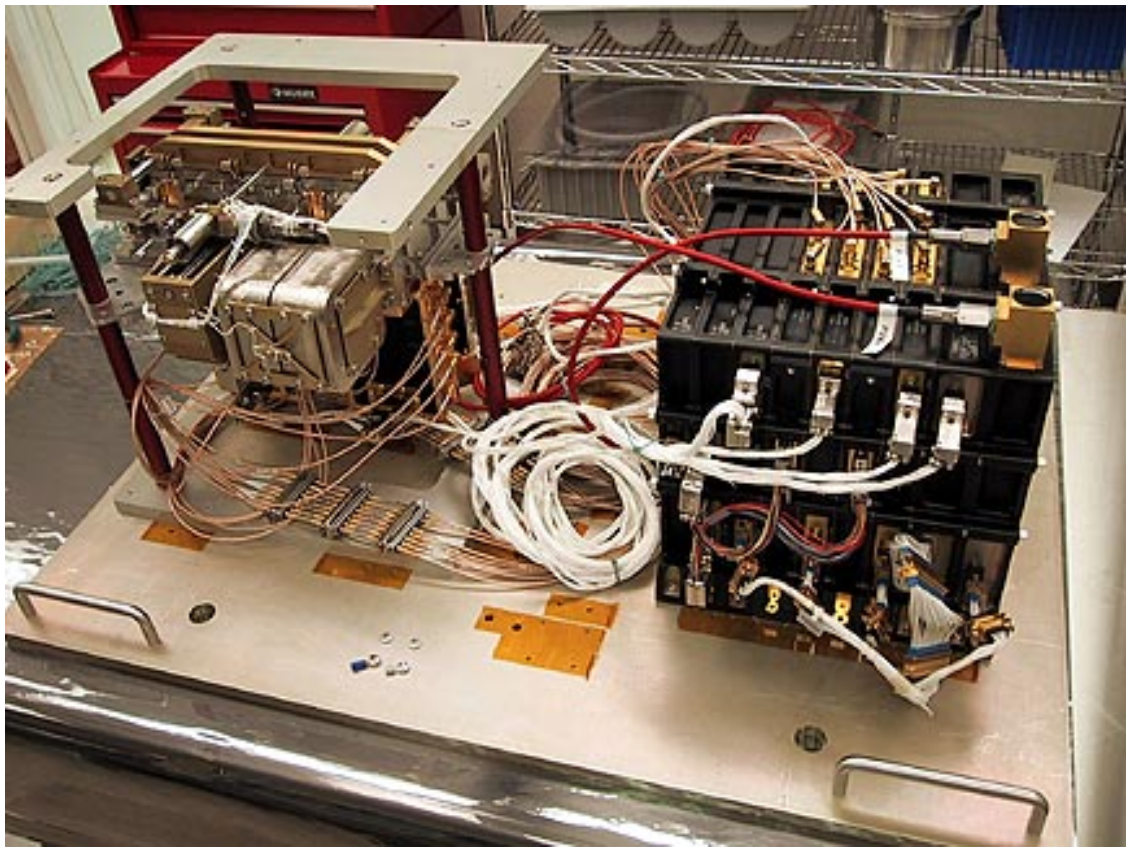
- Detector DEB



- Detector Head



Flight FUV Detector System



FUV DETECTOR P.E.R RFA STATUS

- 18 of 20 RFA's from the FUV PER completed and closed out

- Remaining RFA's are still in progress of close-out :
  - #14 (Orlowski) check on failure rate of amplifier capacitor at 15V
  - #15 (Orlowski) explain the analog waveforms obtained during DCE verification testing

FUV01 Vibration Testing

- Flight detector system (DVA + DEB) vibration tested at Lockheed Martin facility (Sunnyvale, CA) 2/1 - 2/8/01
  - Attended by 4 UCB personnel, with oversight from GSFC (Metzger, Koffey, Jenkins & Nielsen), Univ of Colorado (Andrews) & Dale Phelps (HST QA)
- Vibration system and shake procedures fully tested initially on DEB and DVA mass dummies
- Flight DEB then vibrated to Qualification levels
- Flight DVA then vibrated to Acceptance levels (Flight spare DVA will be vibrated to Qualification Levels at a later date)
- Detector system vacuum maintained throughout vibration test using powered ion pumps - no appreciable increase in pressure observed
- Full detector functional testing performed at UCB before and after shipment to Lockheed (flat fields, stim position, background etc)

FUV01 Vibration Testing

- Flight DEB vibrated to Qualification levels.
- Flight DVA vibrated to Acceptance levels (Flight spare DVA will be vibrated to Qualification Levels at a later date).
- First modes of system (Hz)

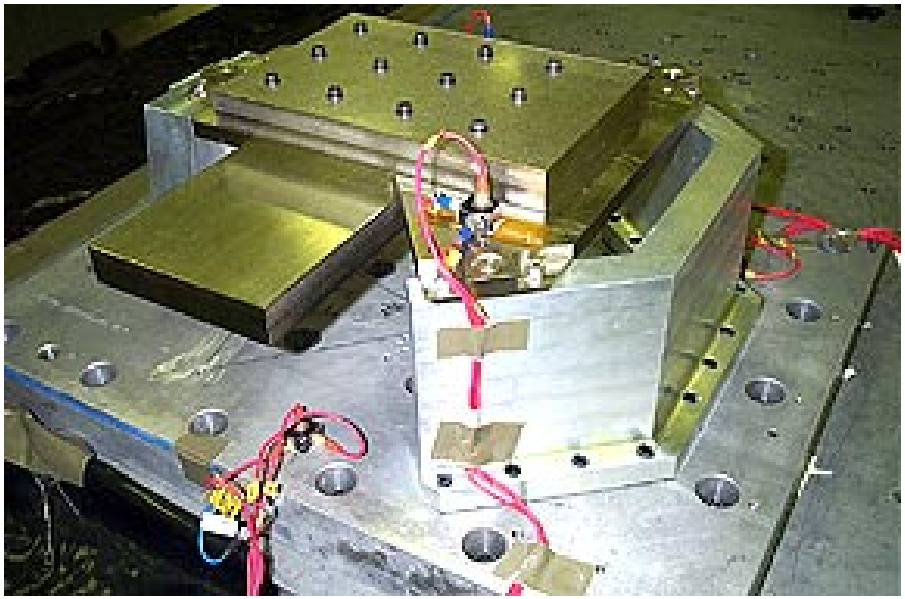
	X	Y	Z	
• DEB	1000	300	700	Requirement >75Hz
• DVA	300	300	180	Requirement >125Hz

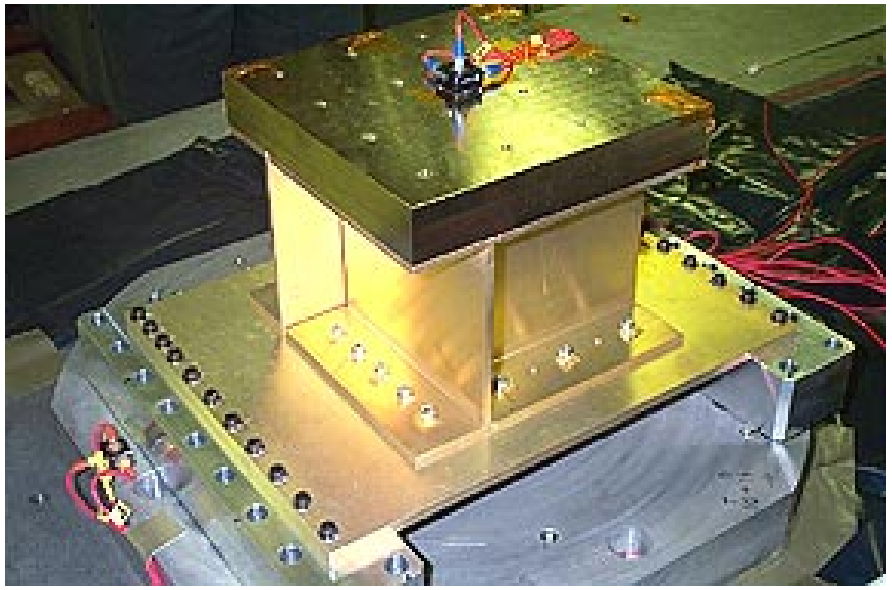
- Both DVA and DEB had full spectrum random shake at -6dB (no notching).
- Force limiting used, notched modes limited to output of $1g^2/Hz$. On one occasion this constrained input to $<0.01g^2/Hz$ within the notch. Notch bandwidths shown below:

	X	Y	Z
• DEB	none	280-300	600-800
DVA	250-550	230-600	150-250

- Vibration test results verbally OK'd by Mark Turzin (GSFC).
- Final report to be issued 3/9/01.

Mass Model Shake Tests

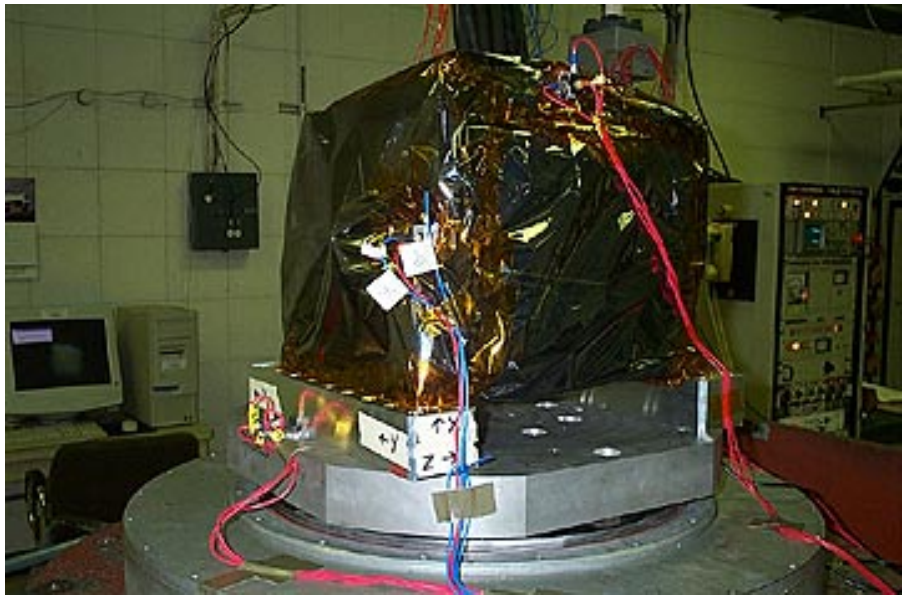


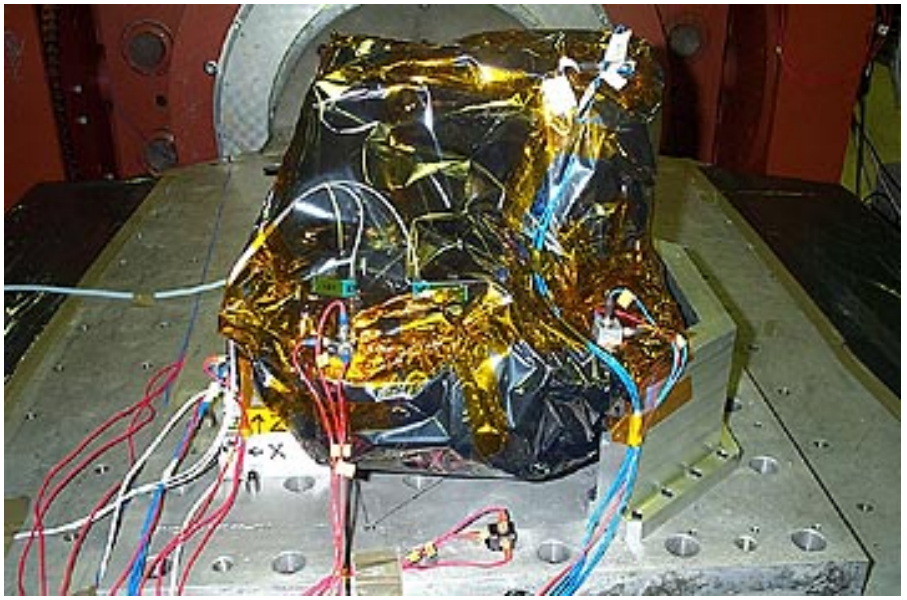


- FUV01 detector DVA mass model

FUV01 detector DEB mass Model

UCB FUV Flight Detector - Shake Test

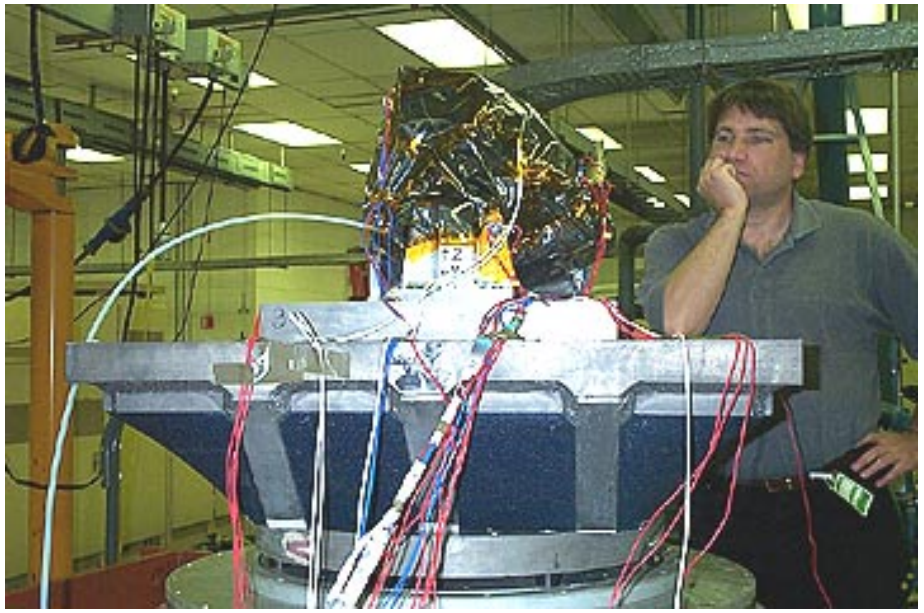




- FUV01 detector DEB shake

FUV01 detector DVA shake

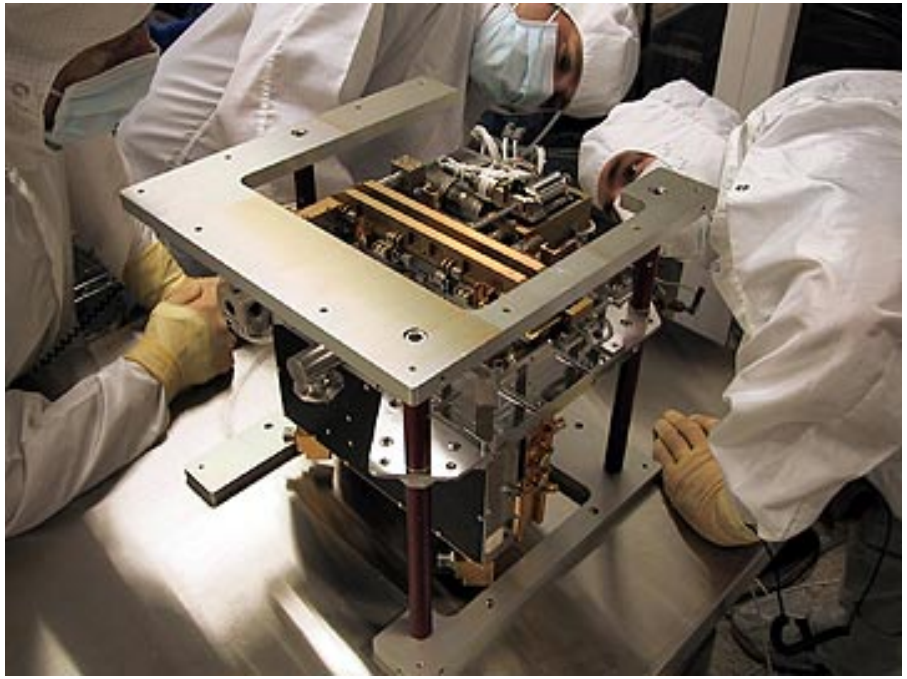
UCB FUV Flight Detector - Shake Test Support Crew



- Detector shake task support team

Real-time monitoring?

UCB FUV Flight Detector - Post Shake Inspection



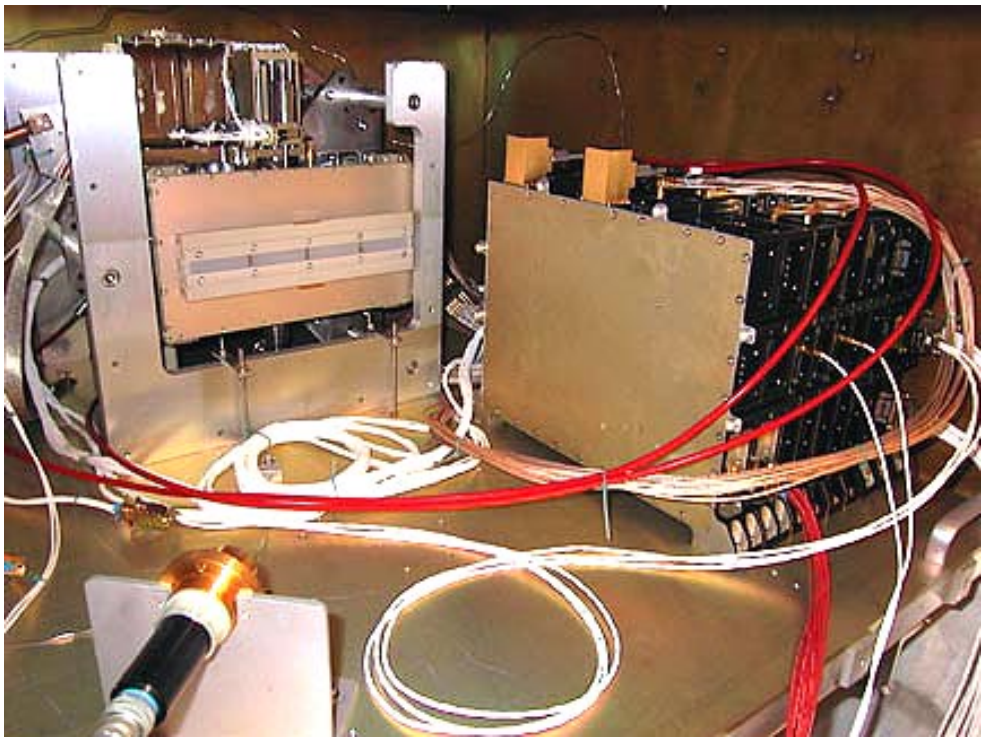
- FUV01 detector DEB

FUV01 detector DVA

UCB FUV Flight Detector - Pre &Post Shake Tests

- Pre and Post Vibration Test Functionals
  - Gain and pulse height distribution, no noticeable changes
  - Background no changes, about 30 cnt/sec on A and 10 cnt/sec on B
  - Flat fields show no changes, also shows that MCP's have not moved
  - Ion grid and QE grid check out nominal
  - Ion pump pressures stable
  - MCP current also stable

UCB FUV Flight Detector - Scrub Setup

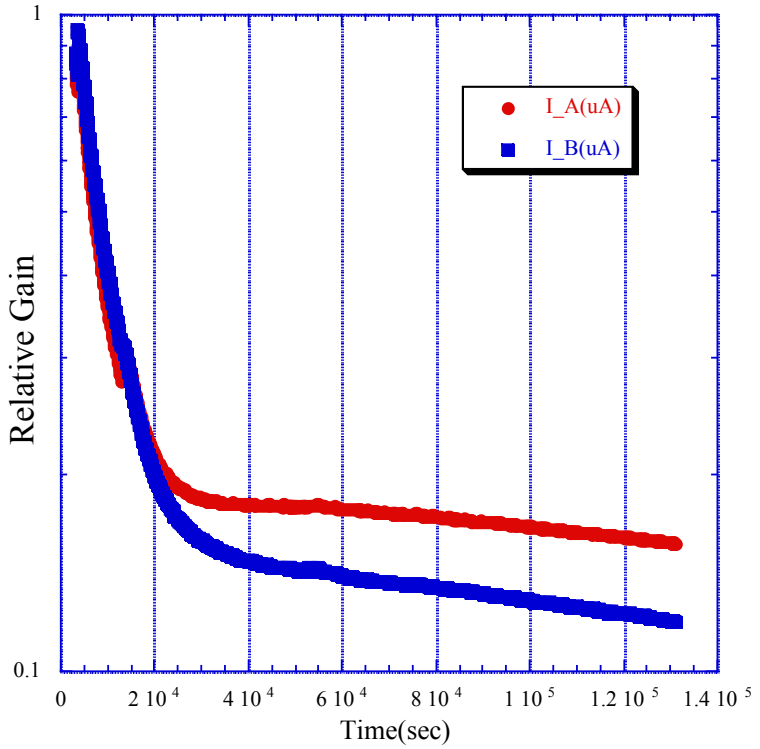


- FUV01 detector with sapphire window diffusers, and DEB in tank with Deuterium scrub lamp external.

UCB FUV Flight Detector - Scrub

- Uniform, in-band, diffuse illumination using Deuterium lamp
- Goal is to extract 0.2 coulombs cm^{-2} or 1.76 C each segment
- At 2 micro-amps, this will take ~ 10 days
- SOR specification is on *rate* of gain decrease of 100%/C cm^{-2}
- Initially, we start current at 1 µA and eventually raise to >2µa
- Initial scrub outgassing at 1 µA looks very normal

- Initial scrub down



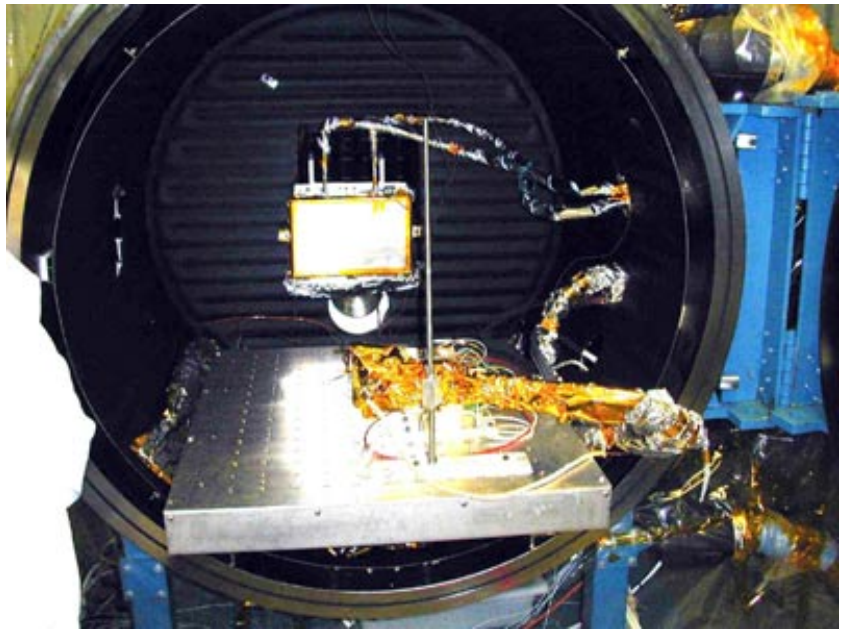
UCB FUV Flight Detector - Test Data Analysis

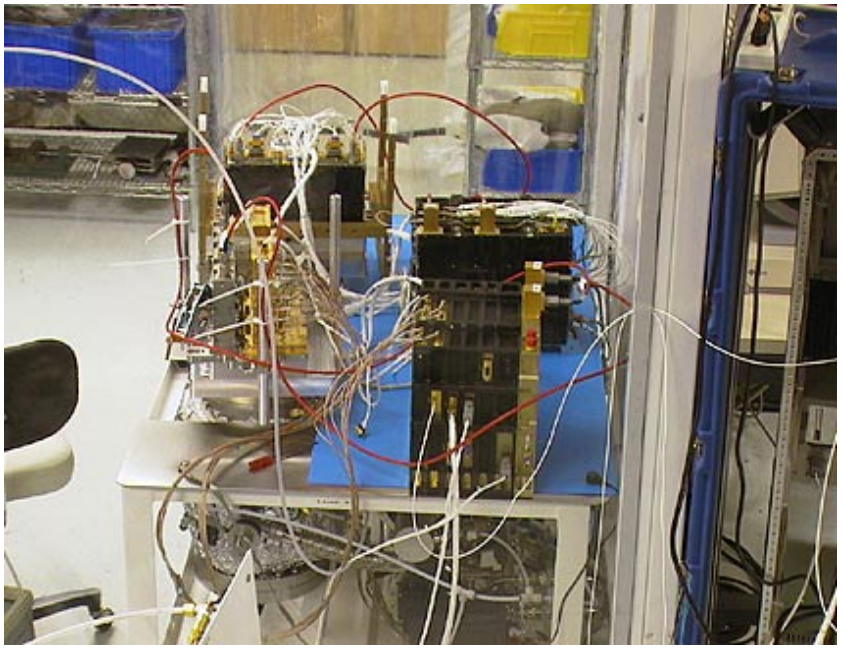
- CU noticed that stim event deadtime was higher than expected during imaging calibration tests. "Anomalous Deadtime Effect" was traced to a too small buffer size in EGSE software for the higher event rates used in this calibration - increased EGSE buffer size resolves problem.

- While investigating this effect, 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, 2.6% at 30kHz each). Problem goes away when there are no events from side A implying interdependence. The "Duplicate Event Effect" (Berkeley PFR #18) has now been traced to the DCE, most likely the Round Robin ACTEL. An asymmetry between A and B in the Round Robin code has been found on 1 gate and we are in the process of testing this theory on the ETU DCE.

UCB FUV01 Detector Thermal Vac Test

- **FUV detector system TV will be done in Colorado tank.**





Detector system TV operator training

- ***ETU detector system established in UCB test tank facility in clean tent with COS GSE specifically for CU operator training ongoing this week.***

UCB FUV Detector Status -Near term tasks

- Finish scrub of FUV01 flight detector
- Post scrub functional test and flat field verification
- Ship to Colorado and begin thermal vacuum tests
- 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/

- CEDAR Build III development nearly completed. (TBD: Finalized FITS Keywords & SDF Definitions)
- Science Data "Keyword" Discussions ongoing between CU, BATC and STScI.
- Simulated SDF Data – produced using TAACOS & CEDAR – provided to STScI to help them maintain their "Back-End Systems" development schedule.
- TAACOS Phase I completed. TAACOS Reports & Recommendations in Signature Cycle.
- AV-03 Released. (Recall, AV-03 is the Requirements Document for CALCOS.)
- CALCOS-GSE "Draft" Development Plan Released.

FUV Detector FSW Development

- ***DCE Flight Software Development and Test***
  - http://cos-arl.colorado.edu/DCE/

- DCE Test Plan and "BOOT" Code Test Report Documentation in Signature Cycle.
- Minor "Byte-Swap" issue with PHA Data fixed in v1039 of OPERATE Code.
- DCE "OPERATE" Component Testing nearing completion.

CU Software & Operations Personnel Status

- **Stéphane Béland** is currently working on CEDAR, CALCOS-GSE, and is supporting FITS Keyword discussions – and is providing simulated SDF data to STScI. Stéphane is traveling to UCB this week to participate in Detector Operations Training. Stéphane will support FUV Detector Thermal-Vac at CU/CASA during the month of March.

- **Steve Penton** is finishing up TAACOS Documentation and supporting FUV Detector Data analysis and CALCOS-GSE algorithm verification. Steve will support FUV Detector Thermal-Vac at CU/CASA during the month of March. FYI: In late Summer 2001, Steve will take a 3-month "sabatical" from daily software duties to pursue scientific investigations with members of the COS Science Team. Steve's "sabbatical" should not adversely affect the CALCOS-GSE development schedule.

- With the DCE FSW situation now stable, **Ken Brownsberger** is ramping up to support COS Operations & FSW Testing at BATC. Ken is traveling to UCB this week to participate in Detector Operations Training. Ken will support FUV Detector Thermal-Vac at CU/CASA during the month of March – and begin spending the bulk of his time at BATC starting the second week of 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 Calibration and Verification Test Planning

- AV-03, COS Calibration Requirements and Procedures Document, has been released.
- Document is available at: cos-arl.colorado.edu/AV03/

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 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 – 3/01
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	$$$,tt	Degraded science
Remove NCM3 optics	TBD	$,t	Degraded science, Ops
Eliminate Aperture Mechanism	TBD	$,t	Ops, Obs. Efficiency, higher risk
Drop all Accum mode processing w/ Doppler	TBD	$,t	Degraded science
Drop spare FUV detector	TBD	$,t	Higher risk
Drop OSM1 capability (don't cover λ gap)	**Too late**	---	Degraded science
Reduce S/N requirement to 30 (no FF lamp)	TBD	$,t	Degraded science
Relax NUV resolution requirements below 20k	TBD	$,t	Degraded science
Remove on-orbit change-out capability	TBD	$,t	Higher risk
Drop dispersed light TA	TBD	$,t	Ops
No Ion Gauge	TBD	$,t	Higher risk, Ops
No external shutter	TBD	$,t	Ops
Change MSRs to QSRs	TBD	$	Save trees
Drop G. Hartig support activities	TBD	$	Unknown
Eliminate Mechanism Lifetime tests	TBD	$$	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

- CU team members at UCB 2/26 - 3/2 for detector operations training.
- Complete deep flat-field of flight FUV detector.
- Ship FUV detector to CU for TV testing.
- Start FUV detector TV testing.
- Complete G185M testing at CU and resolve performance discrepancy.
- Start G160M grating tests.
- Continue spare FUV detector processing at UCB.

Questions, Issues & Resolution Plan

- None