COS
Monthly Status Review
December 5, 2001
GSFC

Agenda

Progress Summary Since Last Monthly	J. Green
Optics Development Status	J. Green
Instrument Performance Overview	J. Green
UCB FUV Detector Programmatic Status	J. Green
UCB FUV Detector Technical Status	O. Siegmund
CU Software Activities Status	J. Green
Schedules	J. Green
Descope Report	J. Green
Upcoming Events/Activities	J. Green
CU Issues & Resolution Plan	J. Green
STScI Presentation	Keyes/Sembach
BATC Presentation	R. Higgins
Financial Splinter	GSFC/Ball/CU

Progress Summary Since Last Monthly (11/07/01)

- Vibe tested surrogate DVA with new door mechanism.
- Prepared for FUV-01 DVA workmanship tests.
- Final NUV grating recovery plan being implemented.

Optics Development Status

- All FUV gratings are completed, coated, mounted, tested and meet/exceed specifications.
- G230L is coated, tested, accepted and delivered to BATC.
- NUV G285M sample from JY has been received and is awaiting coating.
- Coastal has delivered new NUV substrates.
- Contract with Hitachi will be terminated.
- NUV substrates delivered to J-Y to complete NUV grating replications.

NUV Grating Issues

- We have a plan, using existing gratings, to restore almost complete capability.
- There will be continued study in the background.
- If further improvements become possible, a cost/benefit analysis will be presented at that time.

COS NUV Grating **PROBLEM**

Bright Green = Specification met & verified by measurement
Red = Specification not met, % of spec achieved listed
Grey = Channel used to access that wavelength region

	Channel G185M (using Al/MgF2 coated 6000l/mm grating S/N 185MA)	**Channel G225M** (using Al/MGF2 coated 4800 l/mm grating S/N G225MA	**Channel 285M** (Using Al/MgF2 coated 3600 l/mm grating SN 285MA	Throughput Specification Met?
1700	34.7			**96 %**
1750				
1800	33.3			**93%**
1850				
1900	22.4			**62%**
1950				
2000	17.7			**49%**
2050		37.2		√
2100				
2150				
2200				
2250		15.9		44%
2300				
2350				
2400		15.9		44%
2450				
2500				
2550				
2600				
2650		**25.1**	26.0	70%
2700				
2750				
2800			20.9	58%
2850			22.3	62%
2900			20.5	57%
2950				
3000			21.7	60%
3050				
3100				
3150				
3200				

Notes: Because of slightly higher than specified reflectivity on the NCM1, NCM2 and NCM3 optics, any measurement exceeding 95% of specification is considered to meet spec.

Proposed COS NUV Grating **Solution**

Bright Green	=	Specification met & verified by measurement
Dark Green	=	Specification met & verified by extrapolation/analysis
Yellow	=	Further tests needed to determine if specification will be met
Red	=	Specification not met, % of spec achieved listed
Grey	=	Channel used to access that wavelength region
Blue	=	Best channel still TBD

	Channel G185M (using Al/MgF2 coated 4800 l/mm grating S/N 225MA)	**Channel G225M** (using Al coated 4800 l/mm grating S/N TBD (test pieces only at this time)	**Channel 285M** (Using Al/MgF2 coated 4800 l/mm grating SN 225MB	Throughput Specification Met?
1700	37.2			√
1750				√
1800	35.6			99%
1850				√
1900	44.9			√
1950				√
2000				√
2050	39.9	18.6		√
2100	**?**	23.5		65% / ?
2150	**?**			
2200	**?**	25.0		69%
2250	15.9			
2300		34.5		96%
2350		38.1		√
2400	15.9	48.5		√
2450				√
2500		50.6		√
2550				√
2600		51.1		√
2650	25.1	**?**	26.0	72% / ?
2700		**?**		?
2750		**?**	**?**	?
2800			44.2	√
2850			40.8	√
2900			36.6	√
2950				√
3000			43.5	√
3050				?
3100				?
3150				?
3200				?

NUV Gratings

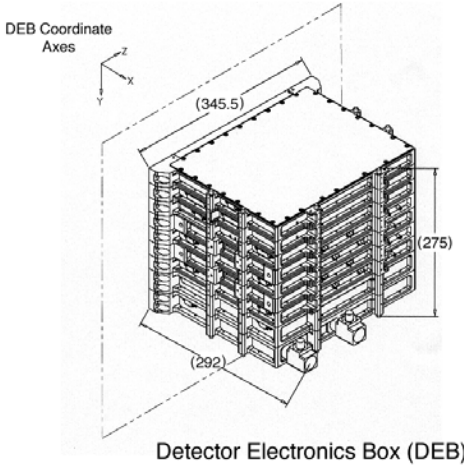
- Actions taken
  - Ordered 3 additional G225M flight quality replicas from J-Y (coat 1 with Al/MgF2 to act as spare to channel G185M and channel G285M).
  - Order 3 additional G285M flight quality replicas from J-Y (to be coated with bare Al [after successful coating/test of test piece] and act as 1 flight, 1 spare grating, and 1 test piece).

NUV Gratings

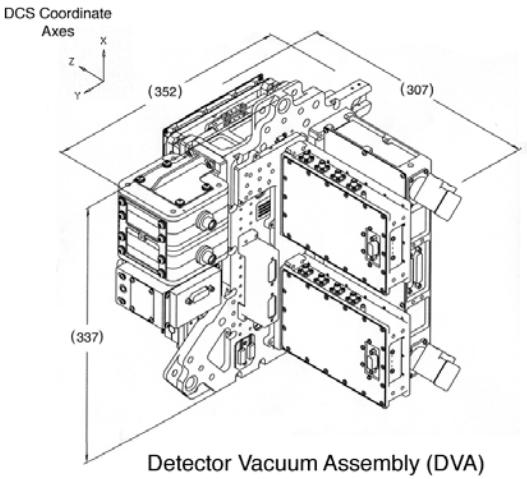
- Install and align gratings as per plan.
- Terminate J-Y G140L triangular blaze effort unless delivery can be accomplished before end of January.
  - Currently planning to receive G140L by February.

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)



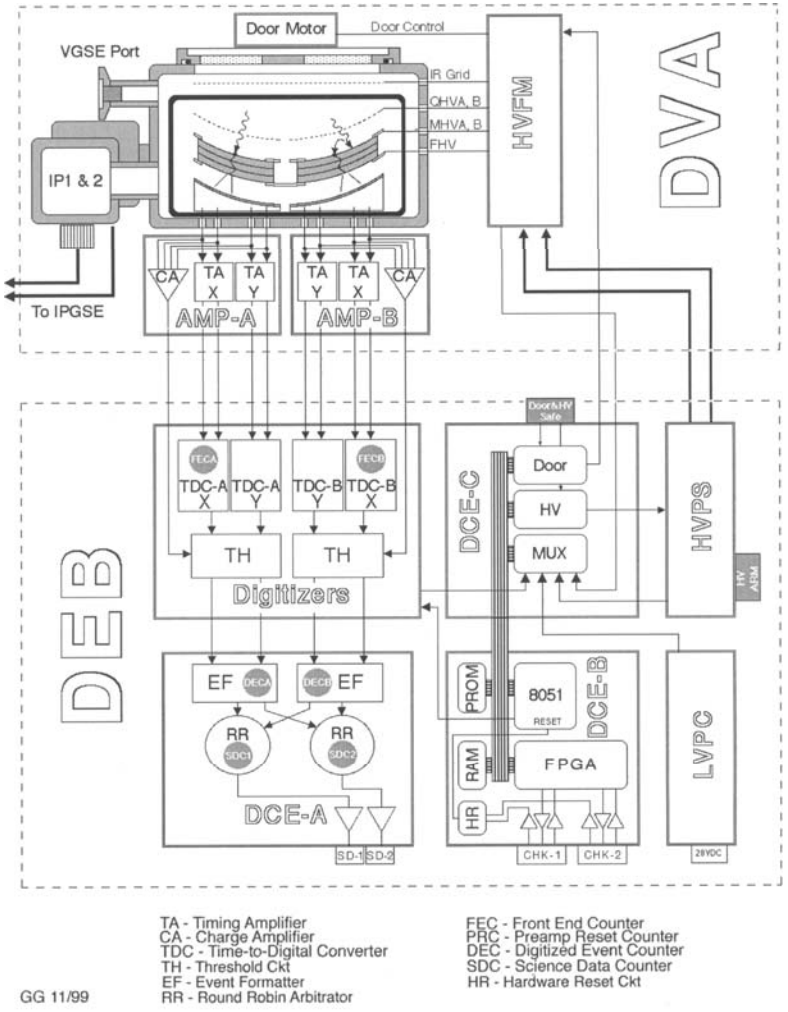
Detector Electronics Box (DEB)



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).



FUV Detector Verification Testing Summary

Unit	Functional Testing	Performance Testing	EMI/EMC	Sine Burst	Random Vibe	Thermal-Vac	Contamination Certification
FUV-01 DVA	C	C	@SS	A - C	A - C	@SS	@SS
FUV-01 DEB	C	C	@SS	Q - C	Q - C	@SS	@SS
FUV-01 SS	C	C	C	@Comp	@Comp	6-cycles	C
FUV-02 DVA	C	C	N/R	Q - P	Q - P	@SS	@SS
FUV-02 DEB	C	C	N/R	Q - P	Q - P	@SS	@SS
FUV-02 SS	P	P	N/R	@Comp	@Comp	8-cycles	P
DVA Surrogate (1)	C	N/R	N/R	C	C	N/R	N/R
DVA Surrogate (2)	P	N/R	N/R	P	P	P	N/R

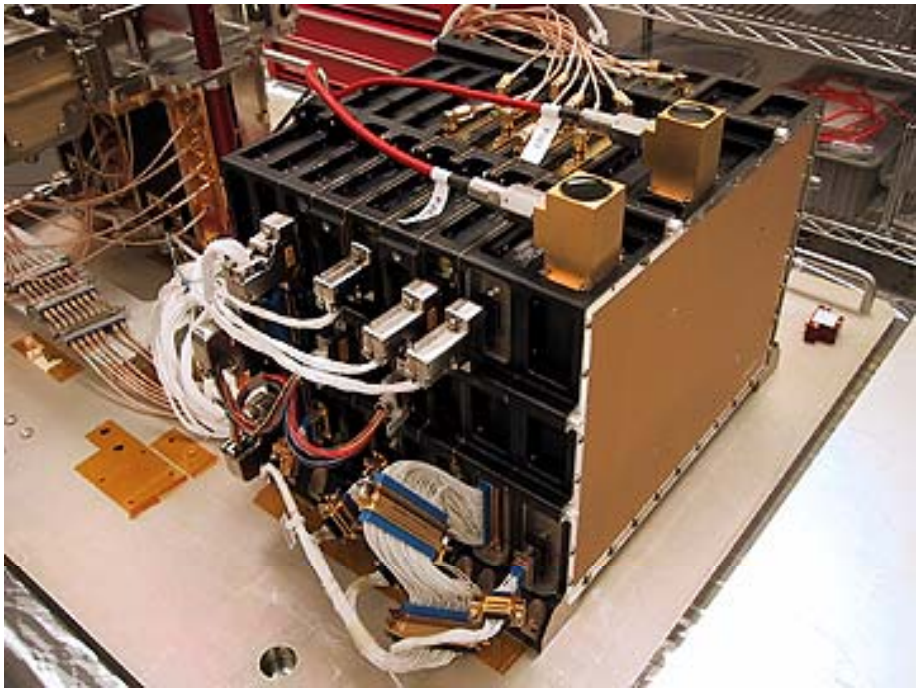
C Complete
@SS At Subsystem
A Acceptance Levels
Q Qualification Levels
N/R Not Required
P Planned
(1) Old Door Mechanism
(2) New Door Mechanism

FUV-01 DVA Re-Test Plan

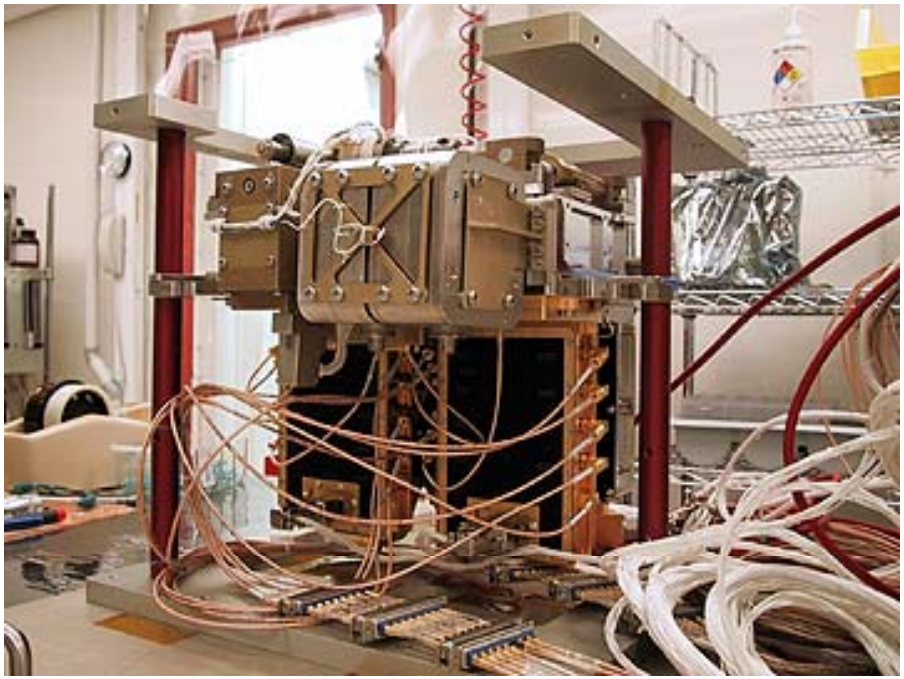
- Install reworked door mechanism at CU/CASA (week of 12/10).
- Test DVA door mechanism in vacuum at CU/CASA (week of 12/14 - 12/17).
- Workmanship vibe at Ball (week of 12/18 - 12/21).
- Workmanship TV at CU/CASA (1/4 - 1/18).
- Deliver FUV-01 detector to Ball (week of 1/21).

COS FUV Detector Systems

- Detector DEB



- Detector Head



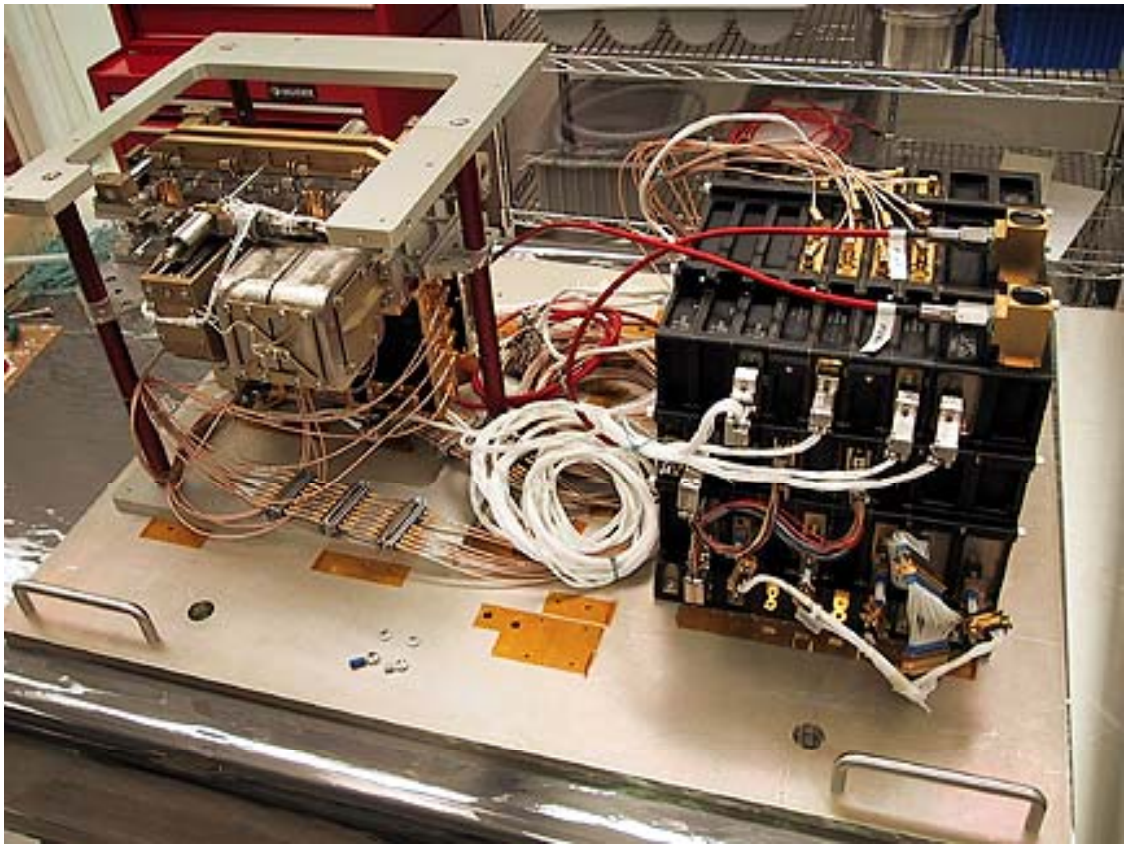
Flight FUV01 Detector System

FUV01 Flight Unit
Detector system delivered to Ball in early in September for alignment tests. Now Back at CU

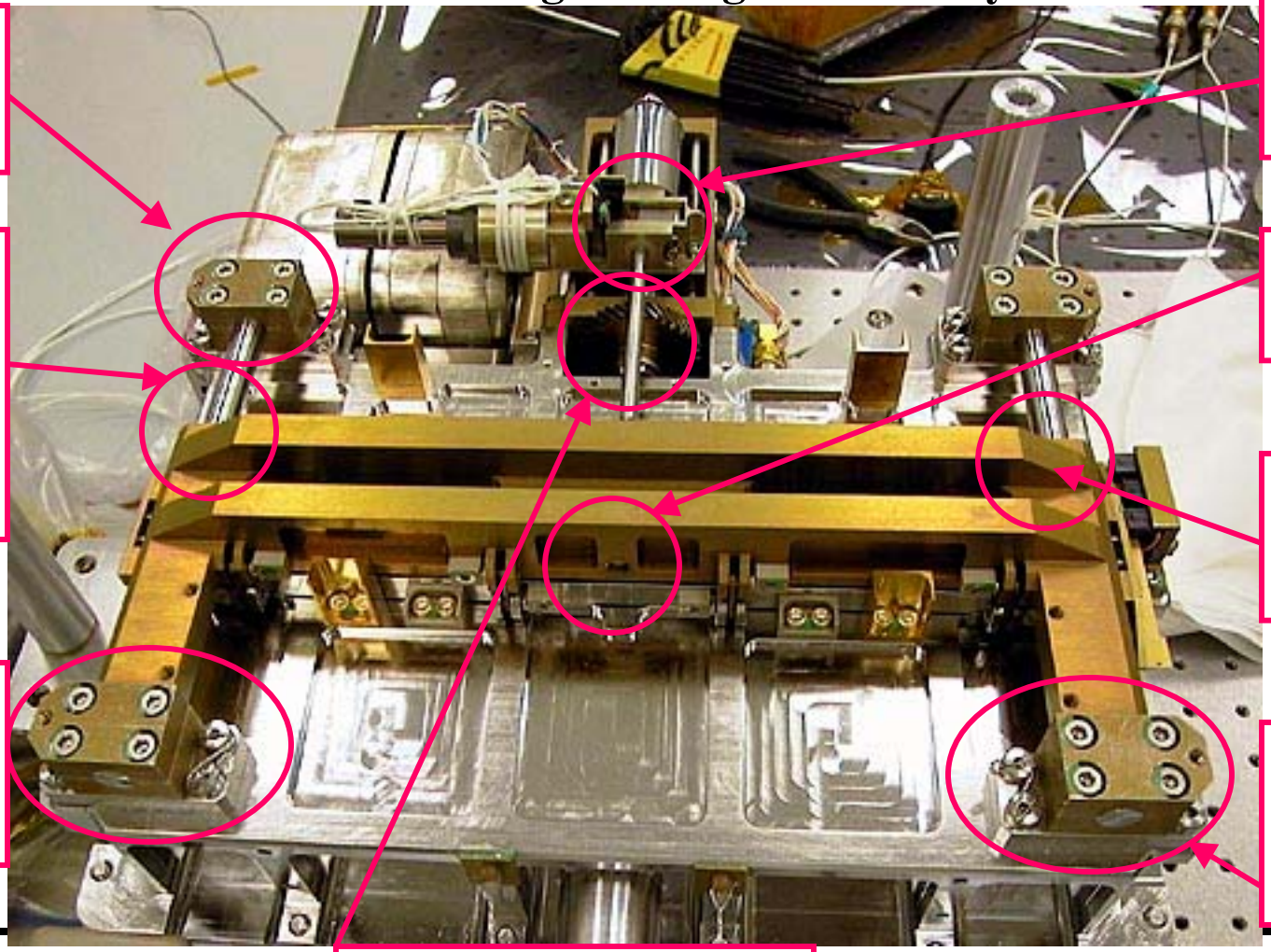
DEB in thermal vacuum chamber.

VHA has upper door & mechanism removed

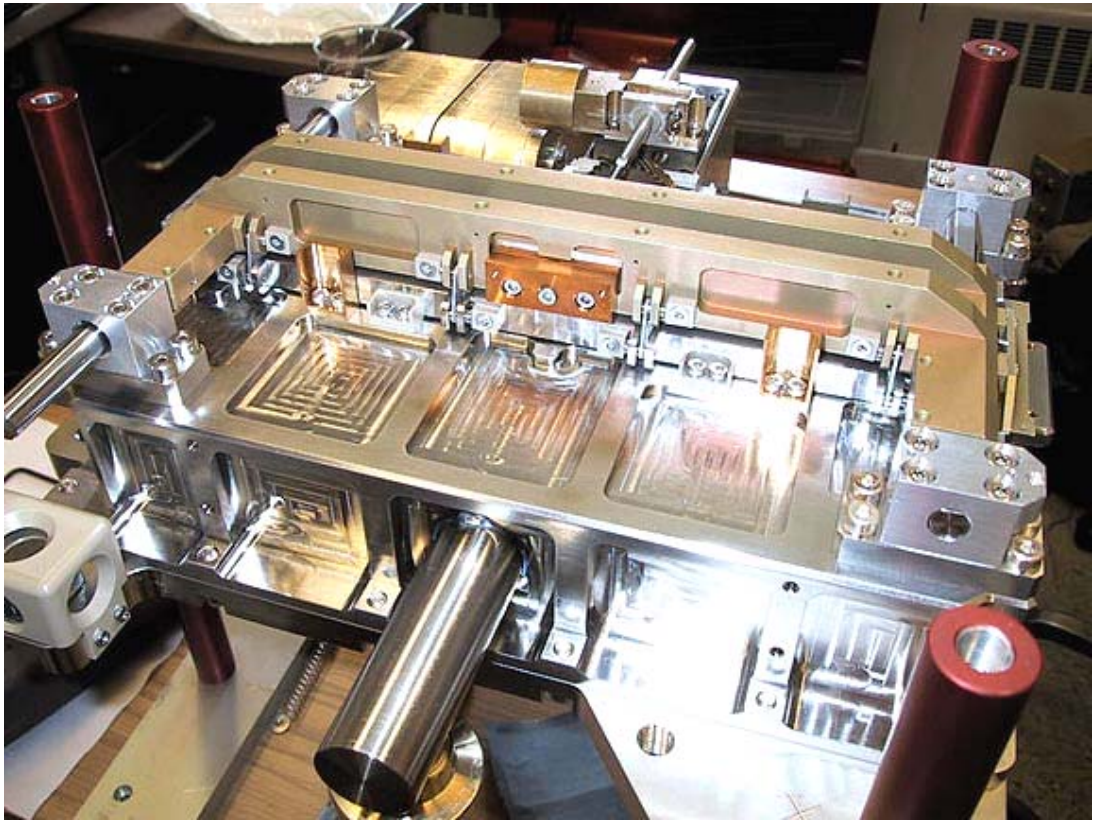
Detector upper door & mechanism at UCB completing re-work. Cables at UCB have finishing braid dressing.



FUV Door Design Changes Summary

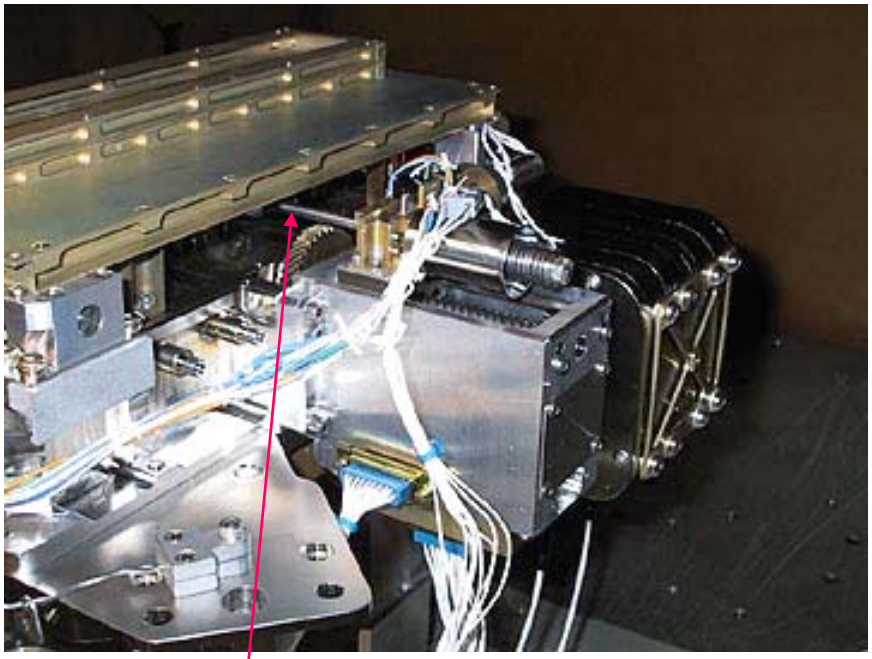


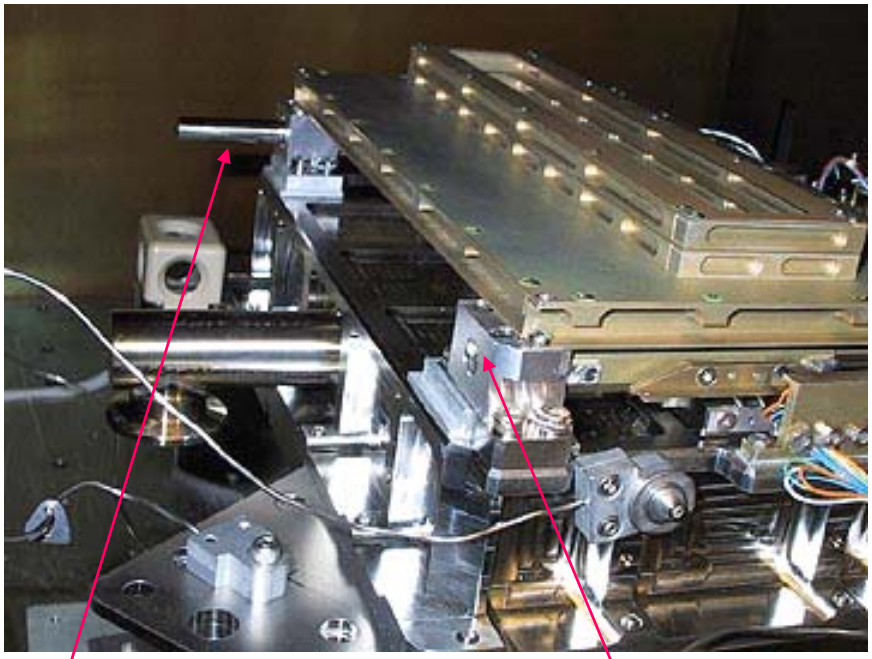
FUV Door - New Assembly on ETU VHA



FUV Door Problem Resolution (cont)

New Door on VHA "simulator" with baffle





New door drive shaft **Moving rail fixed to door** **Fixed rail**

FUV Door Problem Resolution (cont)

- Replaced one rail with longer rail, pinned rail to door carriage which allows rail to slide through the pillar blocks. Modified fixed rail to have flats.
- Built new door carriage/modified old to pin one rail
- Changed bearings for new door carriage for flat rail, and bearings in blocks.
- Hard mounted all rail pillars and used bored rail holes instead of half clamps.
- Changed link for actuator drive shaft to monoball joint on farside of door carriage, and pinned with dowels.
- Reduced actuator drive shaft diameter to allow flexing.
- Replaced actuator PEEK bushings with PEEK/PTFE (friction 0.15) & counterbored to reduce constraining length.
- Applied lower door motor current limit to ensure no stall condition occurs, in addition to existing sensor limit switches.

FUV Door Problem Resolution (cont)

- Assemble and test door design on ETU VHA.
- Have made the parts, completed the assembly and preliminary bench tests.
- The door system is very forgiving and can easily be assembled
- The only significant change was shortened bearings to resolve tolerancing.
- Door operation is much better, application of torques on blocks and shaft do not seize door and the running force is low (<<1 lb).
- Qualification testing of ETU VHA is being completed
  - 20 operation cycles, done with no problems
  - vacuum test, hot (+40°C) and cold (0°C) with HOP actuation, done OK
  - vibration at qualification levels, completed at Lockheed
  - vacuum test, ambient, hot (+40°C) & cold (0°C) with HOP actuation
- Two anomalies
  - Vacuum ion pump flange sprung a leak at vibration
    - did not change test / mass model only / was a reject ion pump to begin with
  - HOP actuated during flexure epoxy cure process
    - Cure cycle of 80°C was set too high for HOP spec (70°C), cure longer at lower temp

FUV Door Problem Resolution (cont)

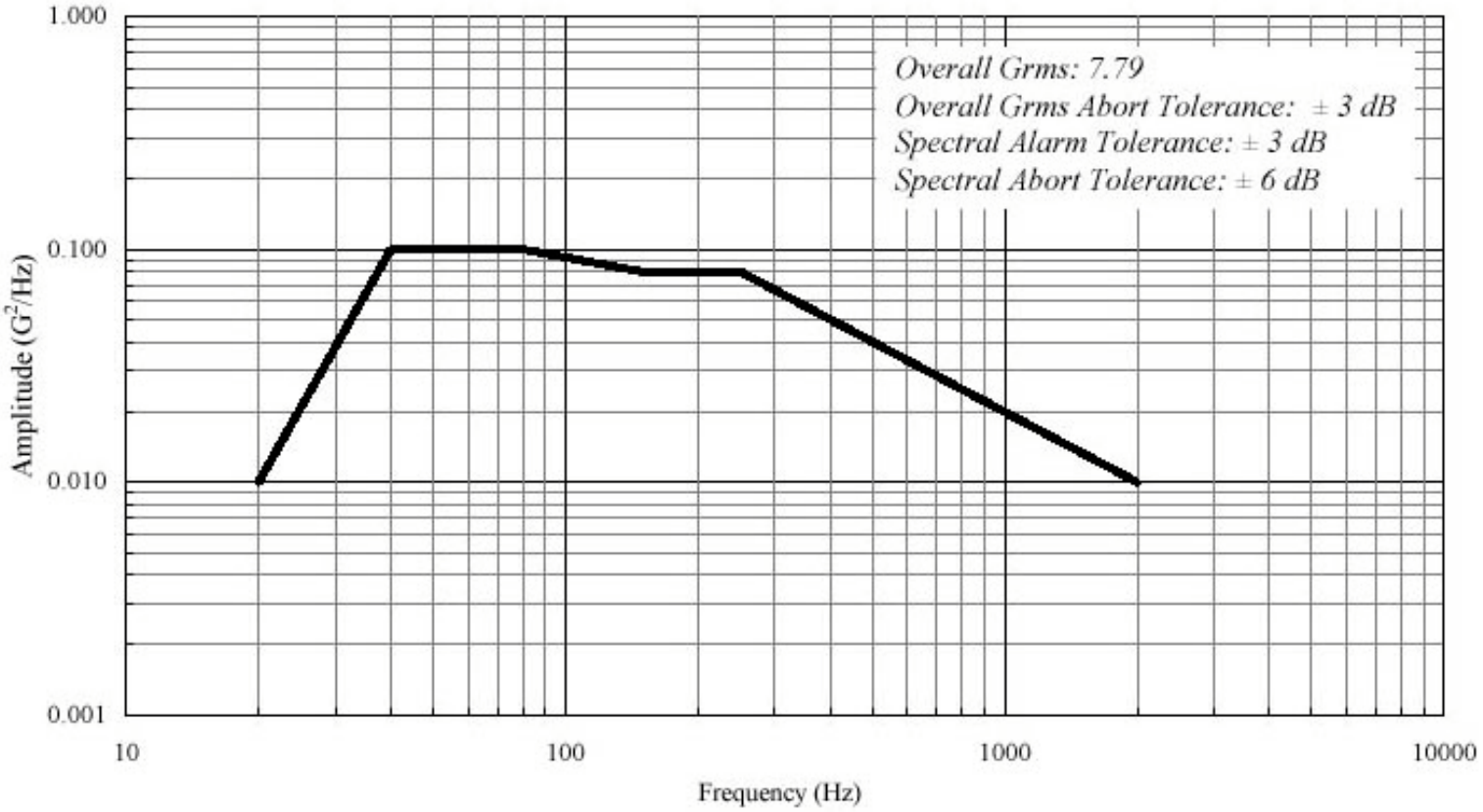
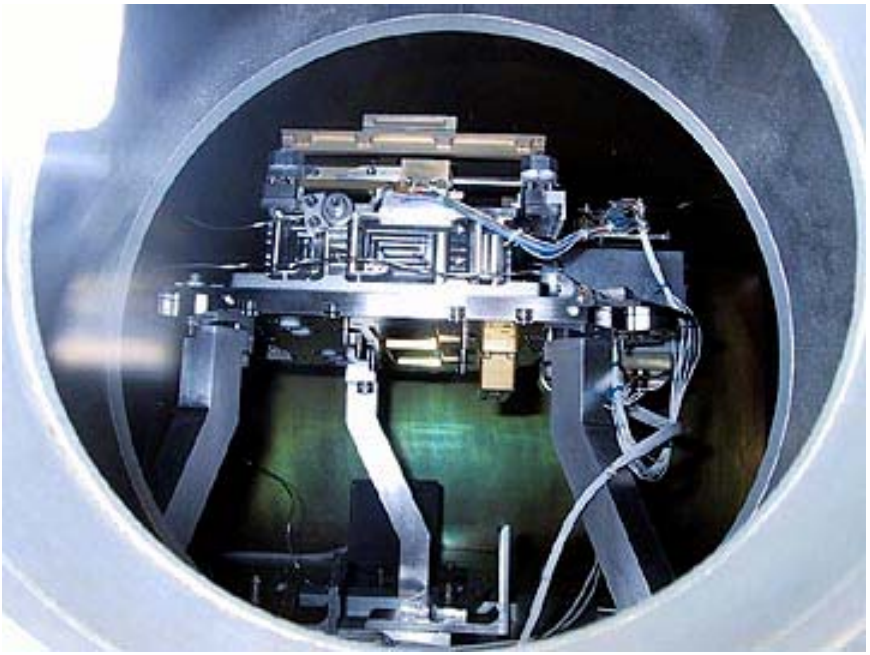


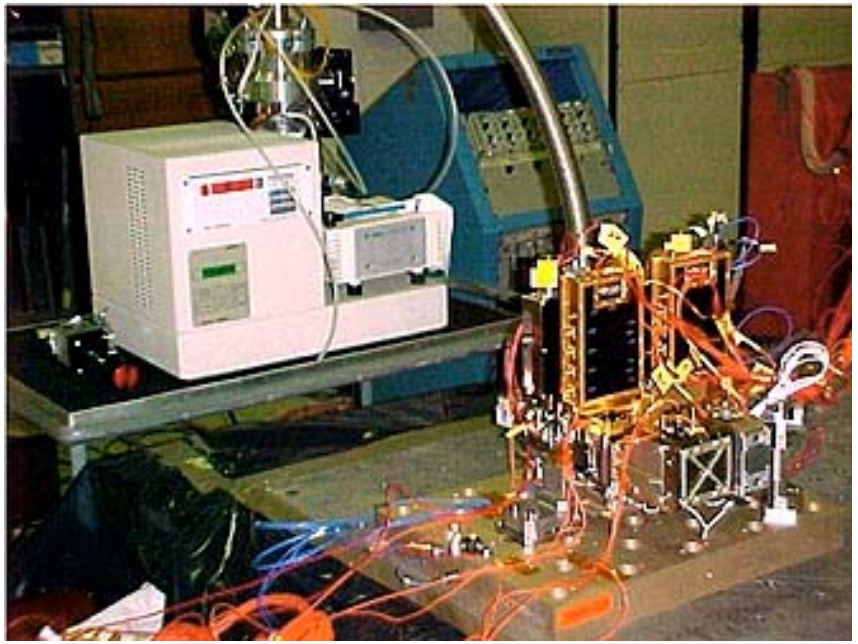
Figure 1. COS FUV DVA Qualification Random Vibration Spectrum.

FUV Door Problem Resolution (cont)

- Provided our post vibration tests confirm the door operation/integrity we will proceed to refurbish the FUV01 door.



VHA "simulator" in thermal vacuum tests



VHA "simulator" in qualification vibration tests

FUV Door Problem Resolution (cont)

- Complete FUV01 door pre-assembly preparations at UCB
- Re-assemble FUV01 door assembly at CU
- Install VHA & vacuum test door motor and HOP at ambient temperature
- Vibrate FUV01 door assembly & VHA to acceptance levels at Ball
- Return FUV01 VHA to CU to complete thermal vacuum testing
  - At least two cycles, with door motor and HOP actuation tests

- **Complete FUV02 assembly and test sequence**
- Complete FUV02 door pre-assembly preparations at UCB
- Re-assemble FUV02 door assembly at UCB and test
- Proceed with final FUV02 buildup, test, & scrub.
- FUV02 environmental testing (vibration and thermal vacuum).

UCB FUV02, Flight Backup Detector, Status

- **DEB Electronics Boards**
  - All boards have been cleaned, coated, staked, and vacuum baked.
- **Harnesses**
  - Cleaned and vacuum baked/certified.
- **Detector Backplate Assembly**
  - Built up and integrated with VHA, at UCB.
- **Vacuum Housing Assembly**
  - Successfully completed alignment tests at Ball. Back at UCB now.
  - Door assembly at UCB awaiting re-assembly with modified parts
- **Brazed Body Assembly**
  - Photocathodes deposited successfully and detector QDEs measured.
  - BBA currently in safe vacuum storage awaiting final FUV02 buildup.
- **ETU DEB**
  - ETU DEB delivered to Ball mid August.

Near Term Plan of Action

ETU Door & DVA

- Perform post-vibration vacuum/temp testing of new door at UCB

FUV01

- Re-assemble door after design verification
- Vacuum test FUV01 door
- Vibrate FUV01 door on VHA
- Finish the FUV01 thermal vacuum test

FUV02

- Assemble and test FUV02 DVA with new door and test it
- Proceed with final FUV02 buildup, test, scrub and environmentals

COS Schedule for CU/UCB

Task	Status
G140L – Blazed Grating Testing	G140L-pending JY's successful delivery. No sooner than February.
CALCOS Software Development	On-going
JY Deliveries	G230L – Delivered. NUV grating delivery still ongoing.
Cal/FF SS Optical Integration	Fall/winter '01
FUV-01 Available for Workmanship Tests	11/01 – 1/02
Deliver FUV-01 to Ball	January '02
Complete FUV-02	By 4/1/02

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

- Flight detector door qualification tests.
- Final measuring of NUV test pieces (G285M).

Issues

- None