COS
Monthly Status Review
November 7, 2001
Ball

Agenda

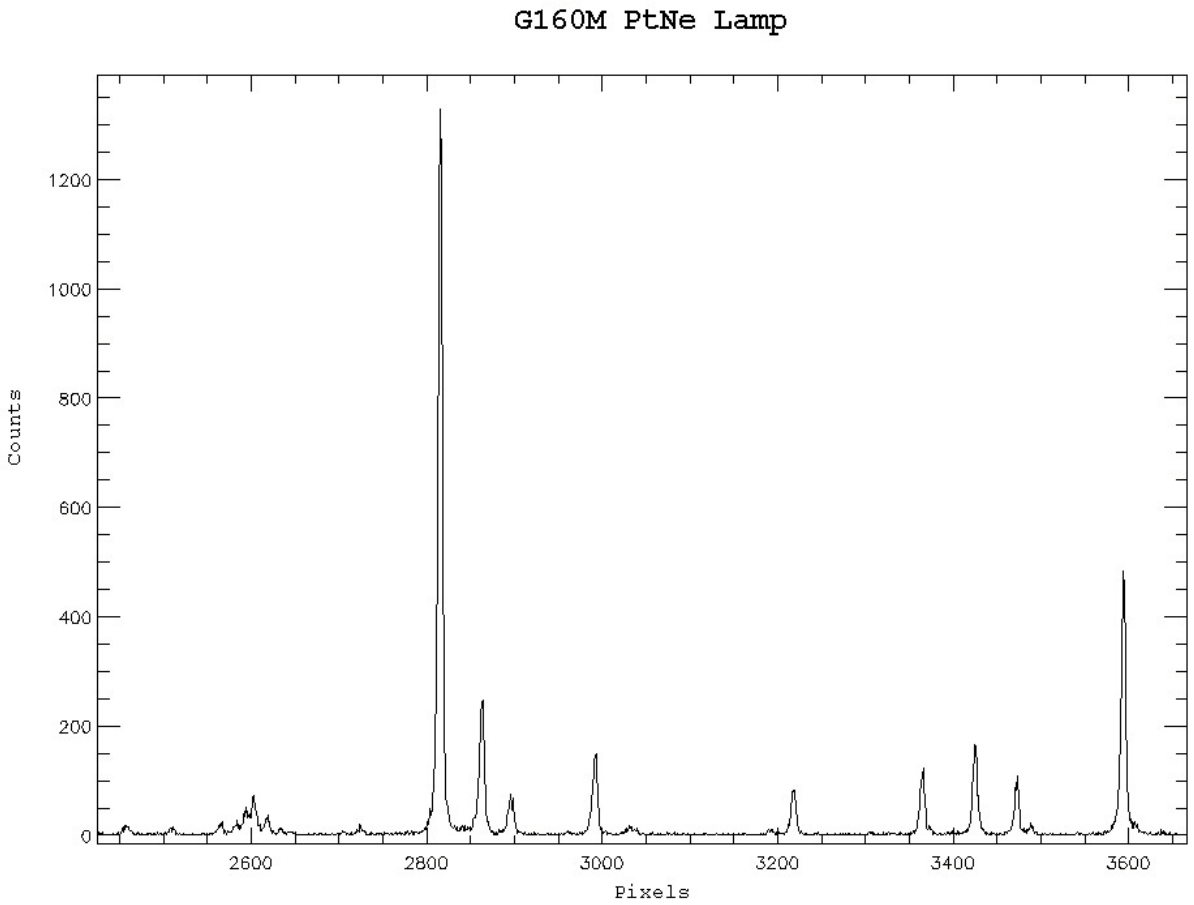
Progress Summary Since Last Monthly	J. Andrews
Optics Development Status	J. Andrews
Instrument Performance Overview	J. Green
UCB FUV Detector Programmatic Status	J. Andrews
UCB FUV Detector Technical Status	O. Siegmund
CU Software Activities Status	K. Brownsberger
Schedules	J. Andrews
Descope Report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

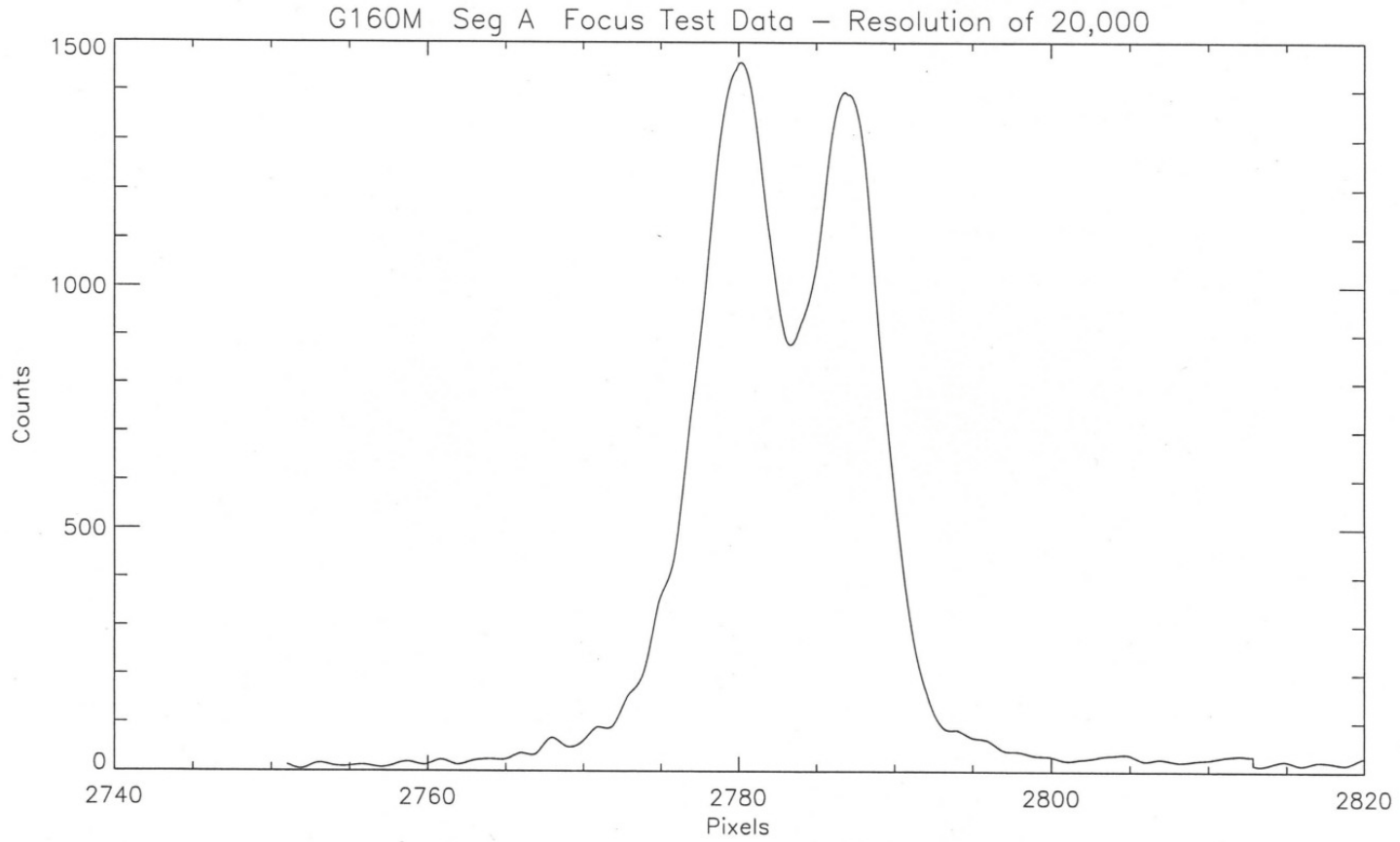
Progress Summary Since Last Monthly (9/26/01)

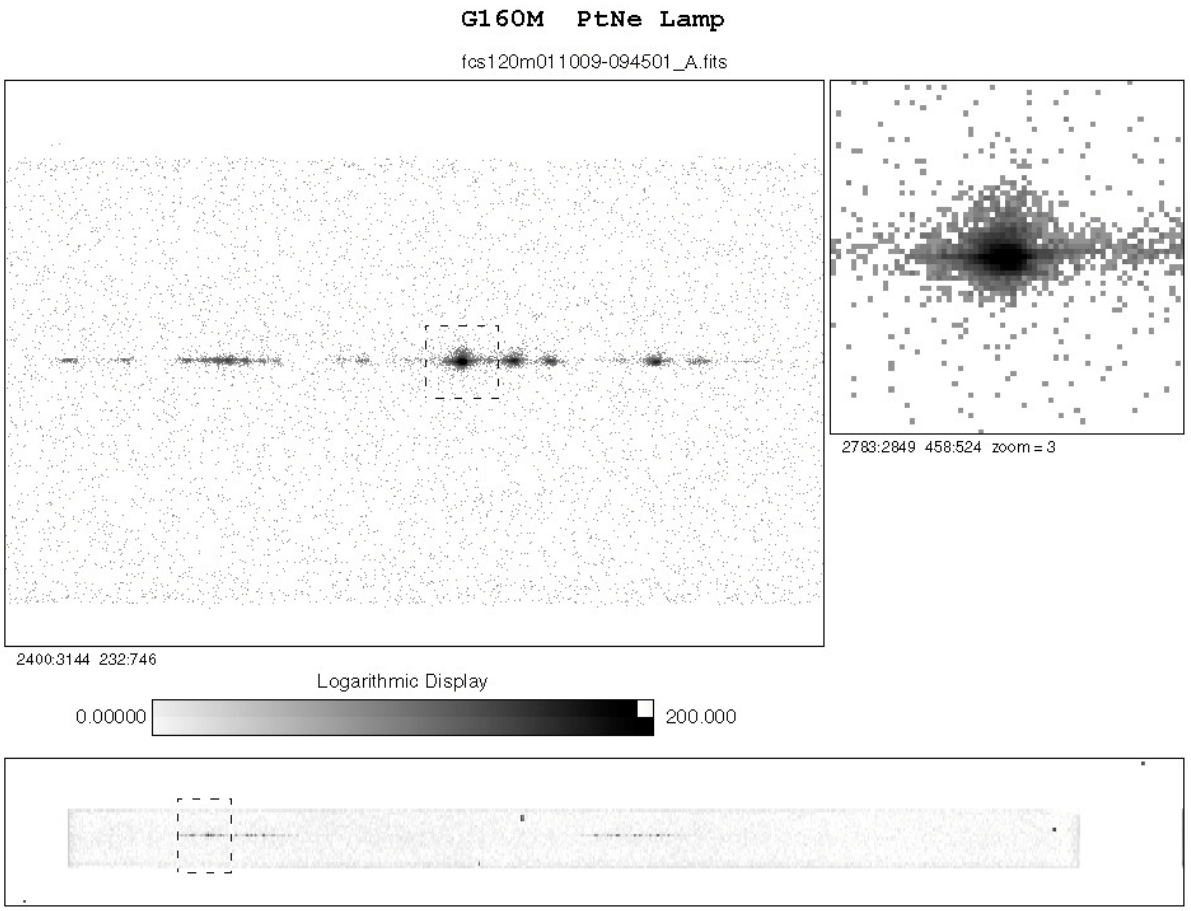
- Began assembly of modified DVA door mechanism on surrogate DVA at UCB.
- Successfully completed surrogate DVA qual-level vibe testing at GSFC.
- Successfully completed initial FUV alignment tests at Ball.
- Continued working NUV grating recovery.
- Continued support of MEB functional tests.

Optics Development Status

- All FUV gratings are completed, coated, mounted, tested and meet/exceed specifications.
- G230L is at GSFC for coating and testing.
- Al coated NUV samples from JY have been received and tested.
- Coastal should deliver new NUV substrates this week.
- Procurement with Hitachi is underway for mechanically ruled G225M. However, Hitachi has finally responded to our specification and requested numerous exceptions to our requirements. Hitachi may prove to be a non-viable option.


G160M PtNe Lamp
Counts
0
200
400
600
800
1000
1200
2600
2800
3000
3200
3400
3600
Pixels


G160M Seg A Focus Test Data – Resolution of 20,000
1500
1000
500
0
Counts
2740
2760
2780
2800
2820
Pixels


G160M PtNe Lamp
fcs120m011009-094501_A.fits
2783:2849 458:524 zoom = 3
2400:3144 232:746
Logarithmic Display
0.00000
200.000

NUV Grating Issues

- Significant progress has been made in this area.
- 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.

NUV Grating Issues

- Review:
  - Al/MgF2 coated NUV gratings had low efficiency in bandpass, but often excellent efficiency out of band pass.
  - All other aspects of NUV gratings (figure, scatter, etc.), were within specification.
  - Primary science driver for COS NUV is sensitivity.

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.

NUV GRATINGS

- Studied multiple avenues to solve problem
  - Use of gratings designed for one channel in another channel.
  - Use of different optical coating (Bare Al).
  - Pursuit of alternate manufacturing technology.
  - Alteration of grating groove depth.

NUV Gratings

- Results:
  - Increasing groove depth had no discernable improvement.
  - Alternate vendor (Hitachi) has informed us that they cannot meet figure quality specification - this is fatal!
  - Bare Al coating on G225M is promising.
  - Bare Al coating of G285M is TBD.
  - Bare Al coating of G185M does not improve performance.

NUV Gratings

- Solution -
  - Immediate goal is to have a *plan* that has little or no impact on the current I & T schedule and that comes as close to meeting spec as possible.
    - WE HAVE SUCH A PLAN!
  - Will continue with testing of a G285M bare aluminum grating, if superior to present plan, will propose, at that time, cost and schedule impacts.

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

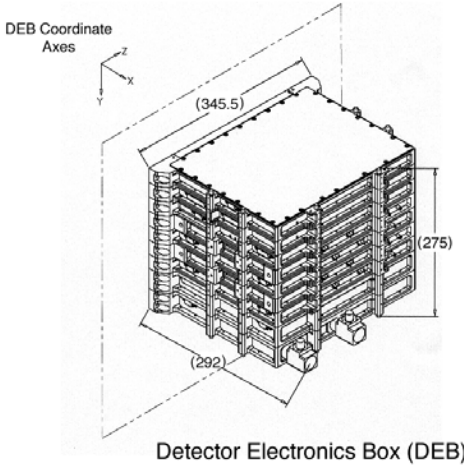
- Actions to be taken
  - Order 4 additional G225M flight quality replicas from J-Y (coat 2 with Al/MgF2 to act as spares to channel G185M and channel G285M).
  - Order 3 additional G285M flight quality replicas from J-Y (all to be coated with bare Al [after successful coating/test of one piece] and act as 1 test, 1 flight and 1 spare grating).

NUV Gratings

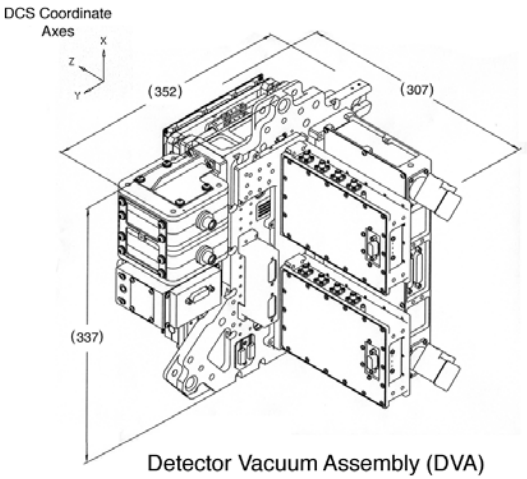
- Install and align gratings as per plan.
- Terminate J-Y G140L triangular blaze effort unless delivery can be accomplished before year end.
  - Lose ability to test imaging performance and select for flight.

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)



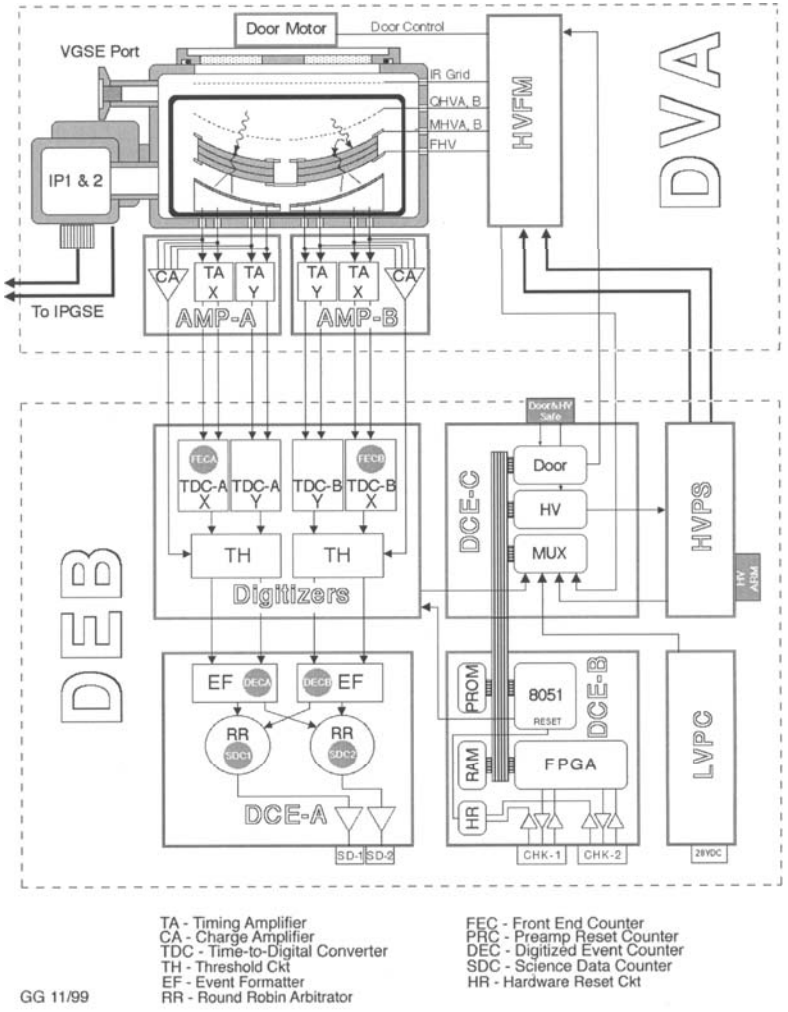
Detector Electronics Box (DEB)



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

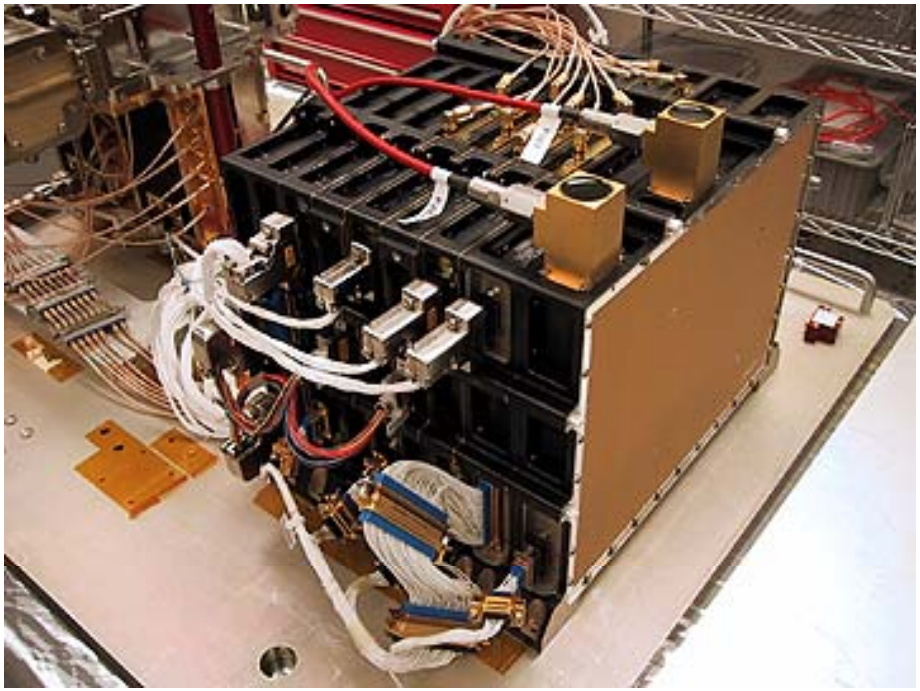
C Complete
@SS At Subsystem
A Acceptance Levels
Q Qualification Levels
N/R Not Required
P Planned
(1) Old Door Mechanism
(2) New Door Mechanism

FUV-01 DVA Re-Test Plan

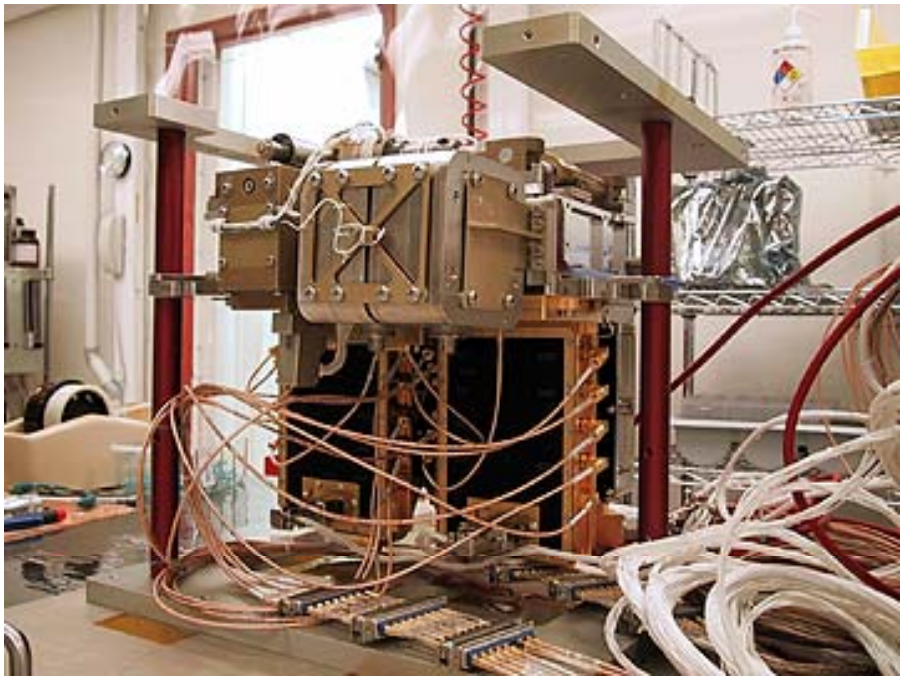
- Install reworked door mechanism at CU/CASA (week of 12/10).
- Test DVA door mechanism in vacuum at CU/CASA (week of 12/14 - 12/17).
- Workmanship vibe at Ball (week of 12/18 - 12/21).
- Workmanship TV at CU/CASA (1/4 - 1/18).
- Deliver FUV-01 detector to Ball (week of 1/21).

COS FUV Detector Systems

- Detector DEB



- Detector Head



Flight FUV01 Detector System

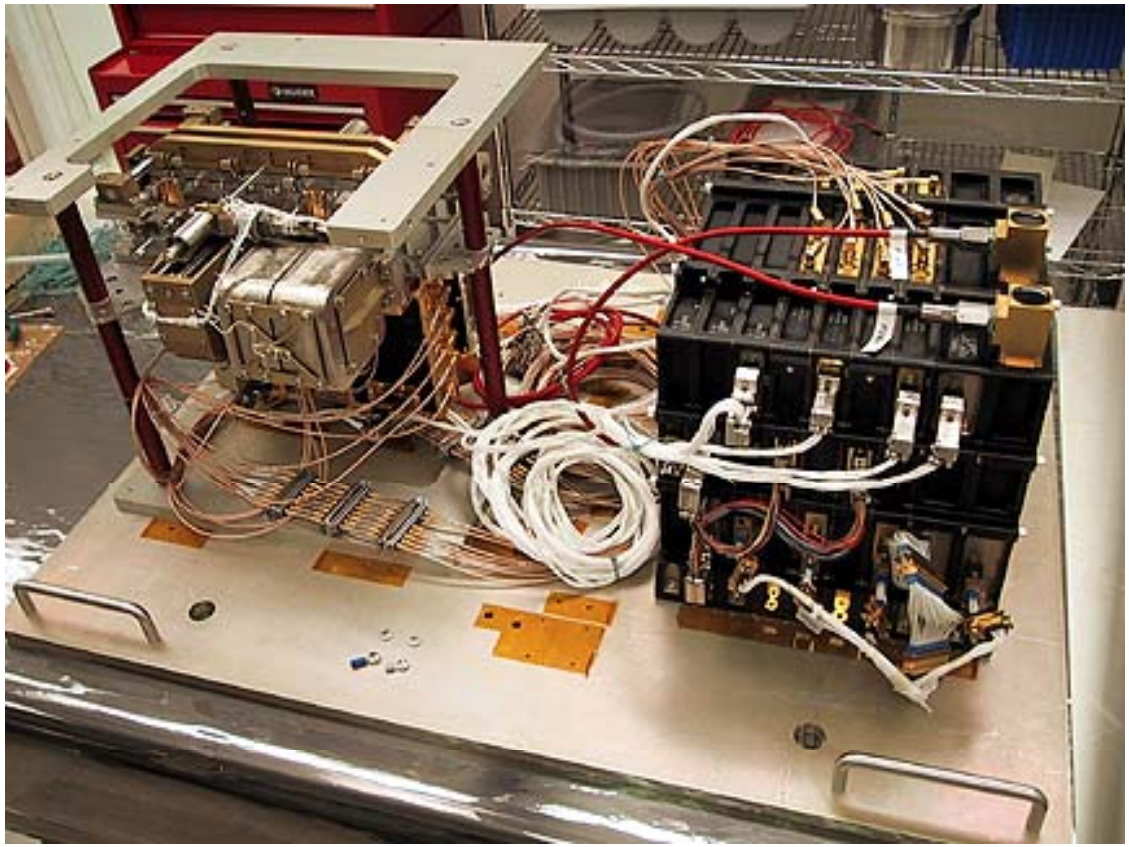
FUV01 Flight Unit

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

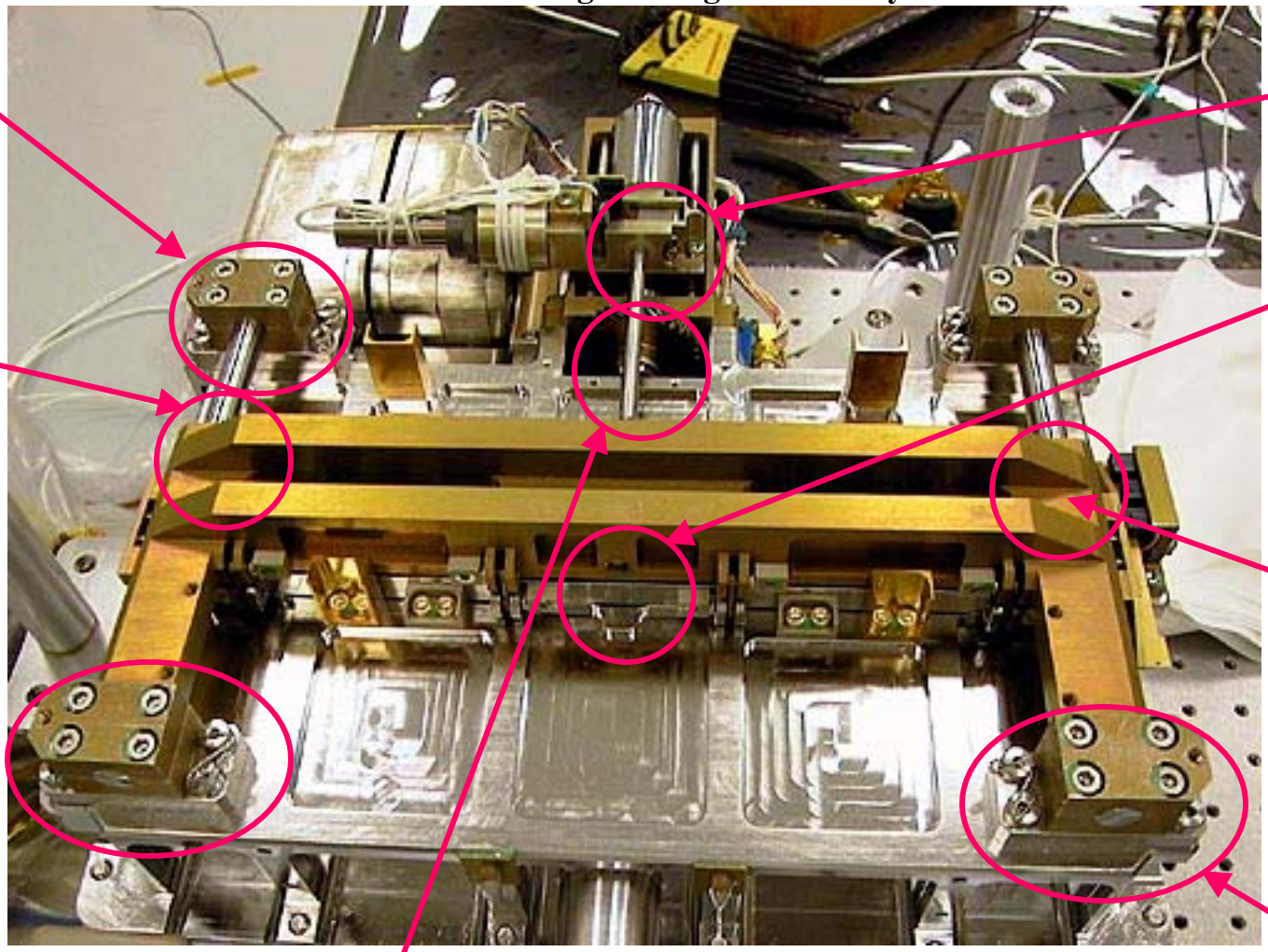
DEB in thermal vacuum chamber.

VHA has upper door & mechanism removed

Detector upper door & mechanism at UCB for rework. Cables at UCB for braid dressing.



FUV Door Design Changes Summary



Hard mount pillar, make one piece block with bearing

Put upper & lower flats on rail, change carriage bearings to allow lateral movement.

Hard mount pillar, make one piece blocks and pin rail

New PEEK/ PTFE bushings with greater tolerance

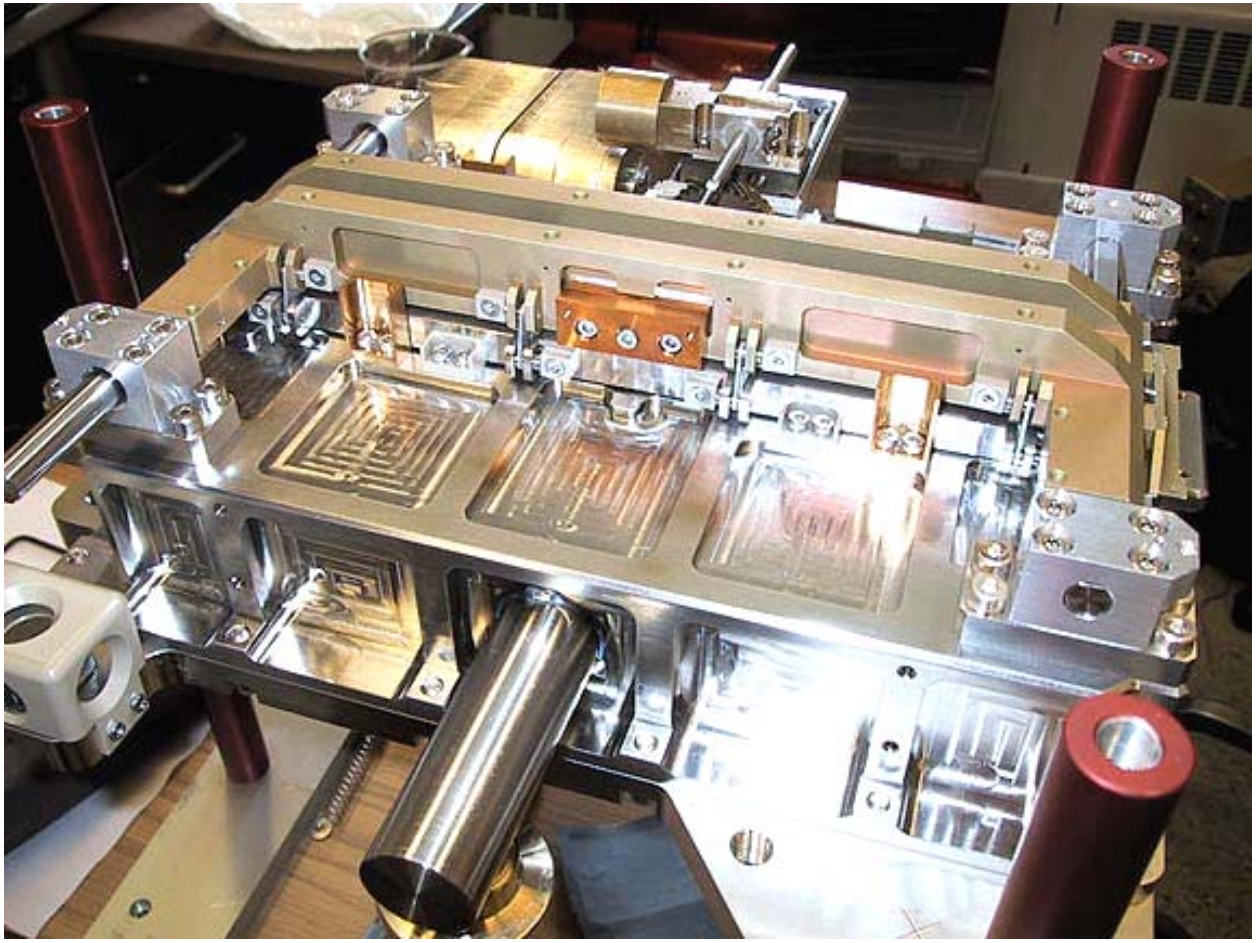
Widen bore and install uniball

Pin rail to carriage, and extend rails, grease rails

Hard mount pillars, make one piece blocks and install bearings

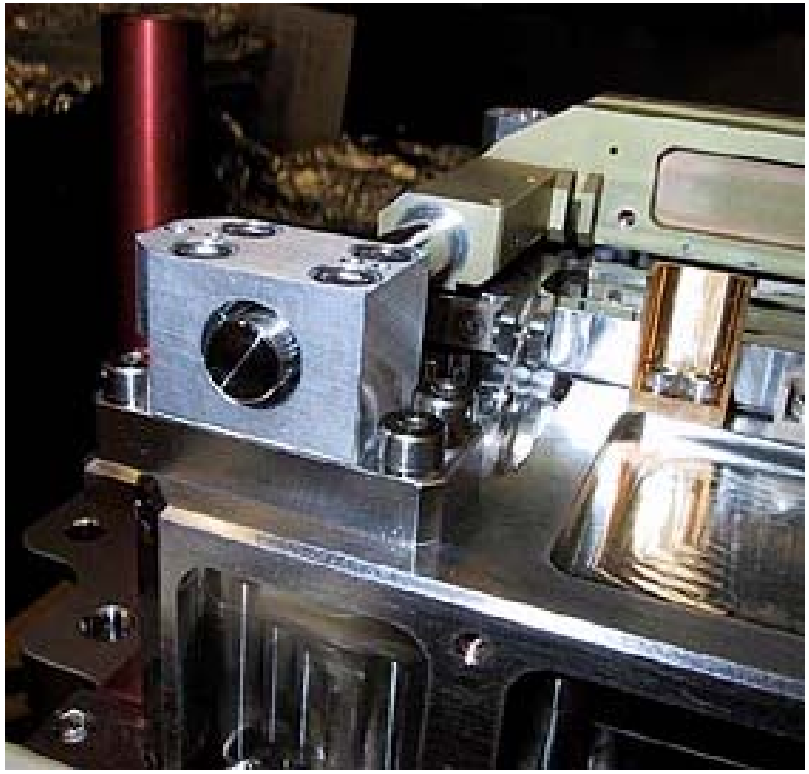
Thin shaft to allow flexture

FUV Door - New Assembly on ETU VHA

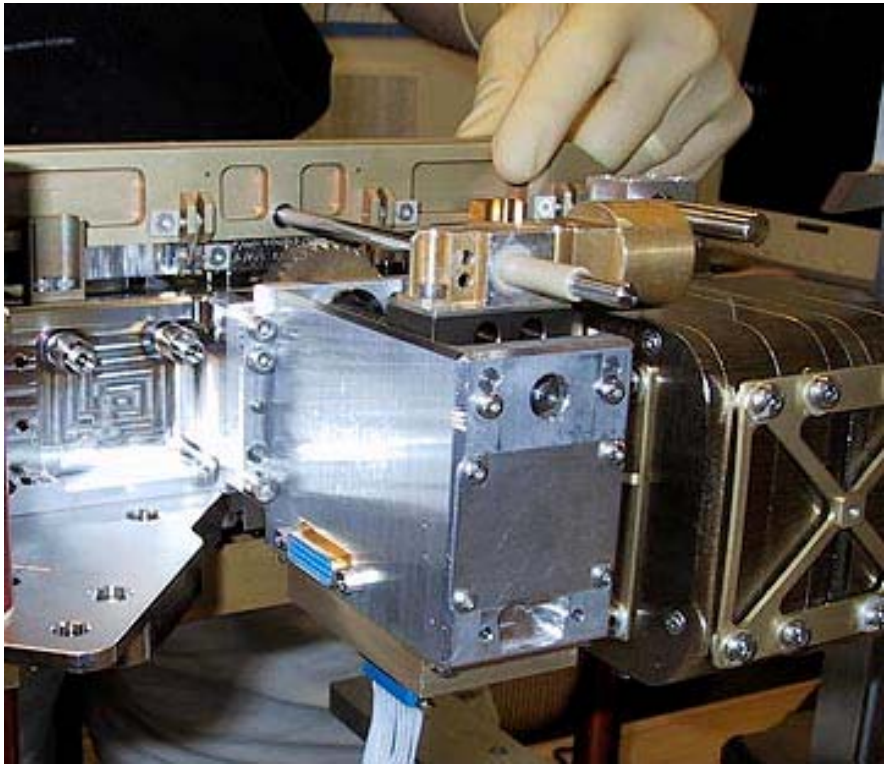


FUV Door Problem Resolution (cont)

New Door Moving Rail & fixed block



New door drive shaft & bore



FUV Door Problem Resolution (cont)

- Replace one rail with longer rail, pin rail to door carriage and allow rail to slide through the pillar blocks. Modify fixed rail to have flats.
  - Rails and dowel pins made and assembled onto ETU VHA.
- Build new door carriage/modify old to pin one rail & change bearings for flat rail.
  - Bearings made, and carriage modifications done.
- Hard mount all rail pillars and use bored rail holes instead of half clamps.
  - Rail pillars and dowel pins made.
- Change link for actuator drive shaft to monoball joint on farside of door carriage.
  - Ball and socket, and dowel pins made and installed onto ETU.
- Reduce actuator drive shaft diameter to allow flexture, and grease shaft.
  - Drive shafts made and installed onto ETU
- Replace actuator PEEK bushings with PEEK/PTFE (friction 0.15) & counterbore
  - Bushings made and counter-bored. Installed into HOP carrier and set.
- Apply lower door motor current limit to ensure no stall condition occurs, in addition to existing sensor limit switches.
  - Current limit changed to prevent stall

Plan of Action - Status and plan

- Assemble and test door design on ETU VHA.
- Have made the parts to be changed, and done trial assembly.
- Door operation is generally much better, application of torques on blocks and shaft do not seize door and running force is low.
- However, the rail alignment is very demanding and torque on the door does cause bearing binding on the travelling rail.
- We are testing shortened bearings to resolve this issue.
- Qualification testing of ETU VHA - 20 operation cycles, vacuum test, hot and cold, vibration at qual levels with notching no lower than 0.02 G^2/Hz).
- Apply corrective action to FUV01 door assembly/VHA & vacuum test.
- Vibrate FUV01 door assembly/VHA & complete thermal vacuum testing.
- Return FUV02 from Ball and proceed with final buildup, test, & scrub.
- FUV02 environmental testing (vibration and thermal vacuum).

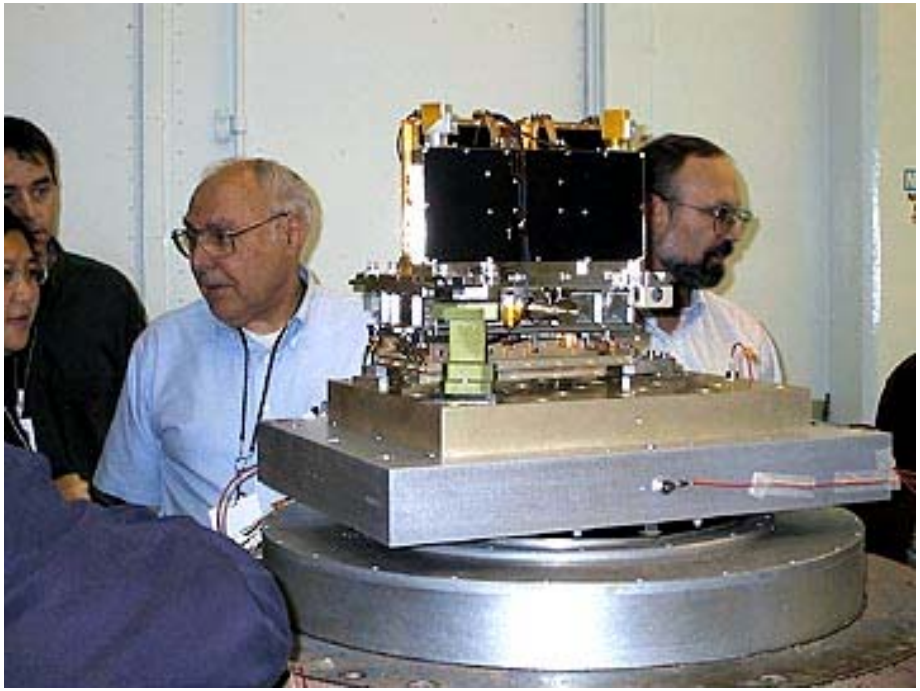
UCB FUV02, Flight Backup Detector, Status

- **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 Ball for alignment tests.
- **Vacuum Housing Assembly**
  - At Ball for alignment tests (using temporary GSE door)
  - 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.

Flexure Mount - Detector VHA Vibration

- Assembled ETU components into a detector vibration VHA "simulator" that is representative of the true mass and configuration (Old door design).
- The detector vibration "simulator" was vacuum tested and shipped to GSFC

- Used Ball prototype/spare flexures for vibration test
- Vibration test completed, UCB, GSFC, Ball & Swales at GSFC 9/24-28/01
- No vacuum problems in vibration test
- Ion pump levels were deemed acceptable with current brackets
- Don't have test results write-up yet



Near Term Plan of Action

ETU Door & DVA

- Complete bench test of new door parts
- Do temperature, vacuum and 20 cycle tests
- Perform vibration testing of ETU Door & DVA at Lockheed

FUV01

- Refit door after design verification and vacuum test
- Vibrate and then finish the Thermal Vac test

FUV02

- Complete alignment tests with VHA at Ball
- Assemble and test FUV02 DVA with new door design

COS Schedule for CU/UCB

Task	Status
G160M Repeat Image Test	Complete
G140L – Blazed Grating Testing	G140L-pending JY's successful delivery. No sooner than TBD.
CALCOS Software Development	On-going
JY Deliveries	G230L – Delivered. NUV problem still ongoing.
Cal/FF SS Optical Integration	Fall/winter '01
FUV-01 Delivery to Ball for Alignment	Complete
FUV-02 Needed at Ball	Complete
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

- Vibe test surrogate DVA with new door mechanism.
- Assemble new door mechanism on FUV-01 DVA.
- Prepare for FUV-01 DVA workmanship tests.
- Commence assy. of Cal/FF SS.
- Finalize NUV grating recovery plan.

Issues

- None