COS
Monthly Status Review
April 2, 2002
Ball

Agenda

Progress Summary Since Last Monthly	J. Andrews
Ground Calibration Planning	J. Green
COS I&T Preparation & Support	J. Andrews
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	None
BATC Presentation	R. Higgins
Financial Splinter	GSFC/Ball/CU

Progress Summary Since Last Monthly (2/6/02)

- Successfully installed reworked door assembly on FUV-01, completed workmanship vibe, operated door in vacuum with no anomalies.
  - At start of post-vibe TV test a field emission problem was detected.
  - Diagnosed broken grid wire as cause and began recovery activities.
- Released draft Ground Calibration Requirement Plan for team's internal comment.
- Supported Ball's efforts to assess OSM-1 performance data.

Ground Calibration Planning

- Prioritized list of ground cal requirements has been written and distributed for comment.
- This list needs to be merged with the existing calibration plan in AV-03 to produce a final prioritized calibration requirements plan.
- The plan then needs to be used to lay support, schedule and facilities requirements on Ball to allow for a final plan/schedule.

Example of Cal Plan Req.

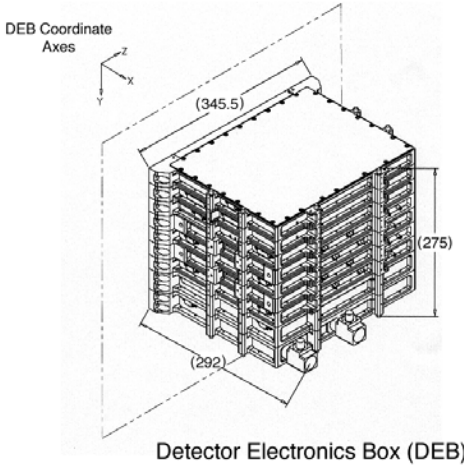
- **Point Spread Function**
  - Level I: none
  - Level II: none
  - Level III: for 3 lines in each FUV M segment, 3 lines in G140L and G230L, and 3 lines in any one wavelength setting for each NUV M grating, obtain images with at least 10,000 counts/line and model the point spread function including any non-gaussian tail. Move grating mechanism 1 step forward and repeat. Move grating mechanism 2 steps backwards and repeat.
  - Level IV: repeat Level III measurements with QE grid off; repeat measurements at different HV levels for the detector; repeat measurement at different detector

COS I&T Preparation and Support

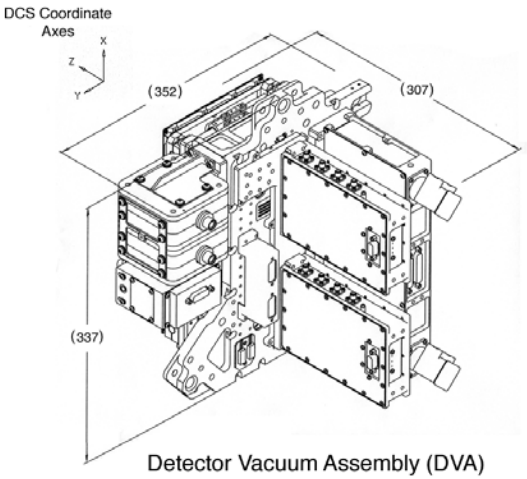
- As noted at many previous MSRs, Dr. K. Brownsberger has been at Ball for the past several months supporting FSW/OPS development and test. This CU support will increase and continue through SMOV.
- CU/Ball/UCB/GSFC met on 4/1 to discuss I&T planning and staffing for all activities at Ball and GSFC.
- CU is finished with GROVER and is returning it to GSFC for reconditioning into CAOS.

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)



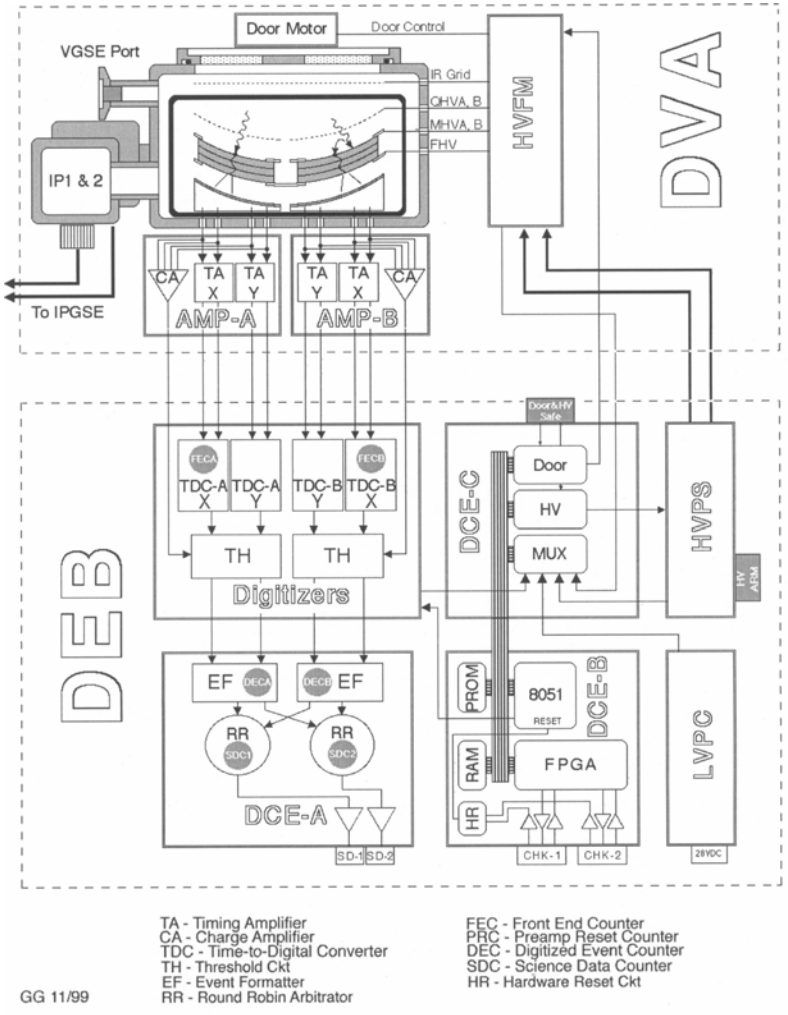
Detector Electronics Box (DEB)



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

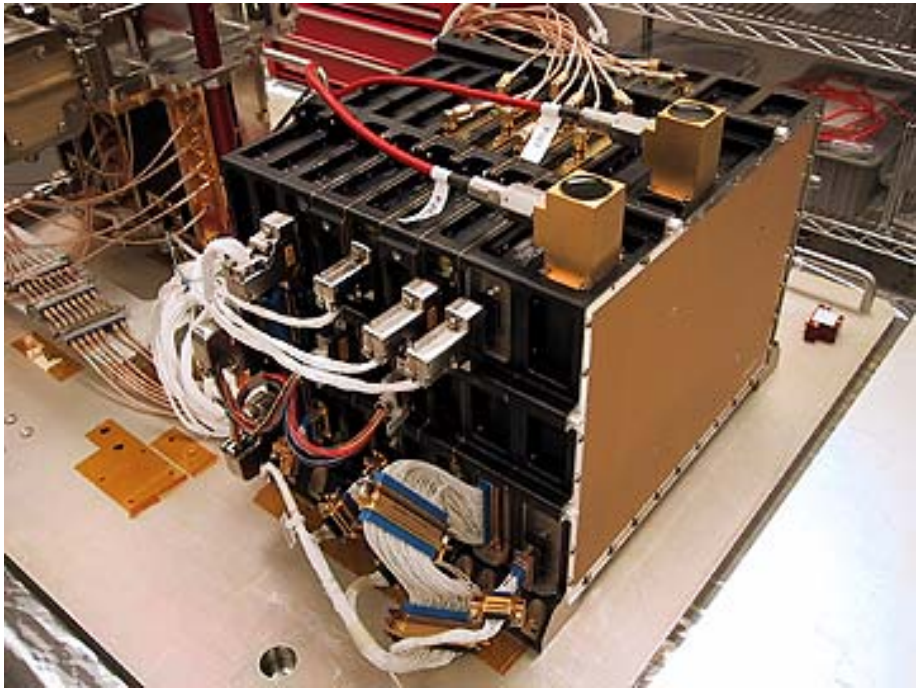
Unit	Functional Testing	Performance Testing	EMI/EMC	Sine Burst	Random Vibe	Thermal-Vac	Contamination Certification
FUV-01 DVA	C	C	@SS	A - C	A - C	@SS	@SS
FUV-01 DEB	C	C	@SS	Q - C	Q - C	@SS	@SS
FUV-01 SS	C	C	C	@Comp	@Comp	6-cycles	C
FUV-02 DVA	C	C	N/R	Q - P	Q - P	@SS	@SS
FUV-02 DEB	C	C	N/R	Q - P	Q - P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

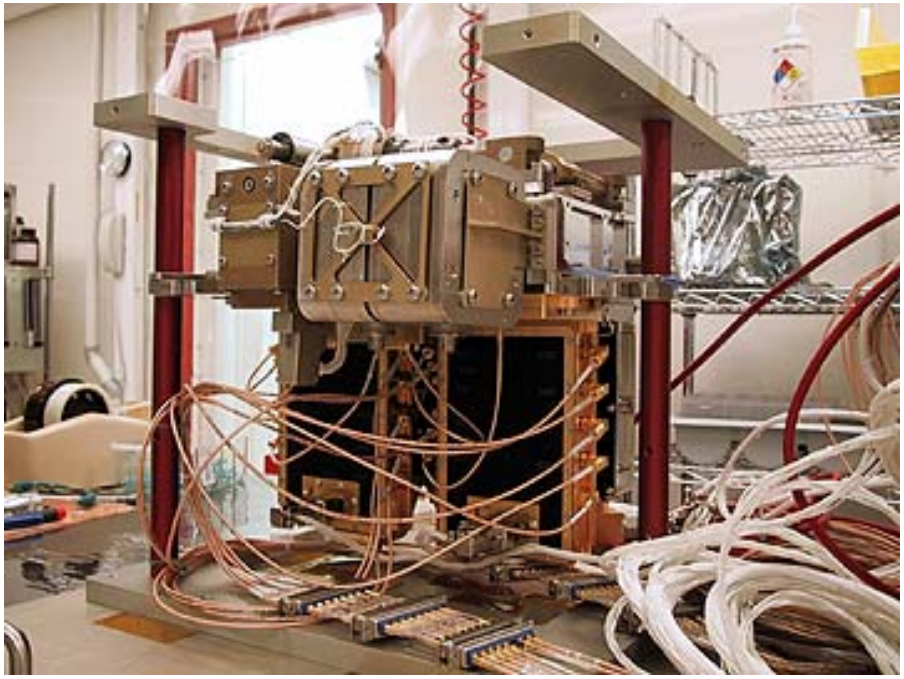
- FUV-01 DVA has now seen acceptance level vibe 2x.
- A single-axis workmanship vibe on FUV-01 DVA was completed after the door mechanism is repaired in early March.
- Future testing to be negotiated with project pending outcome of grid failure recovery.

COS FUV Detector Systems

- Detector DEB



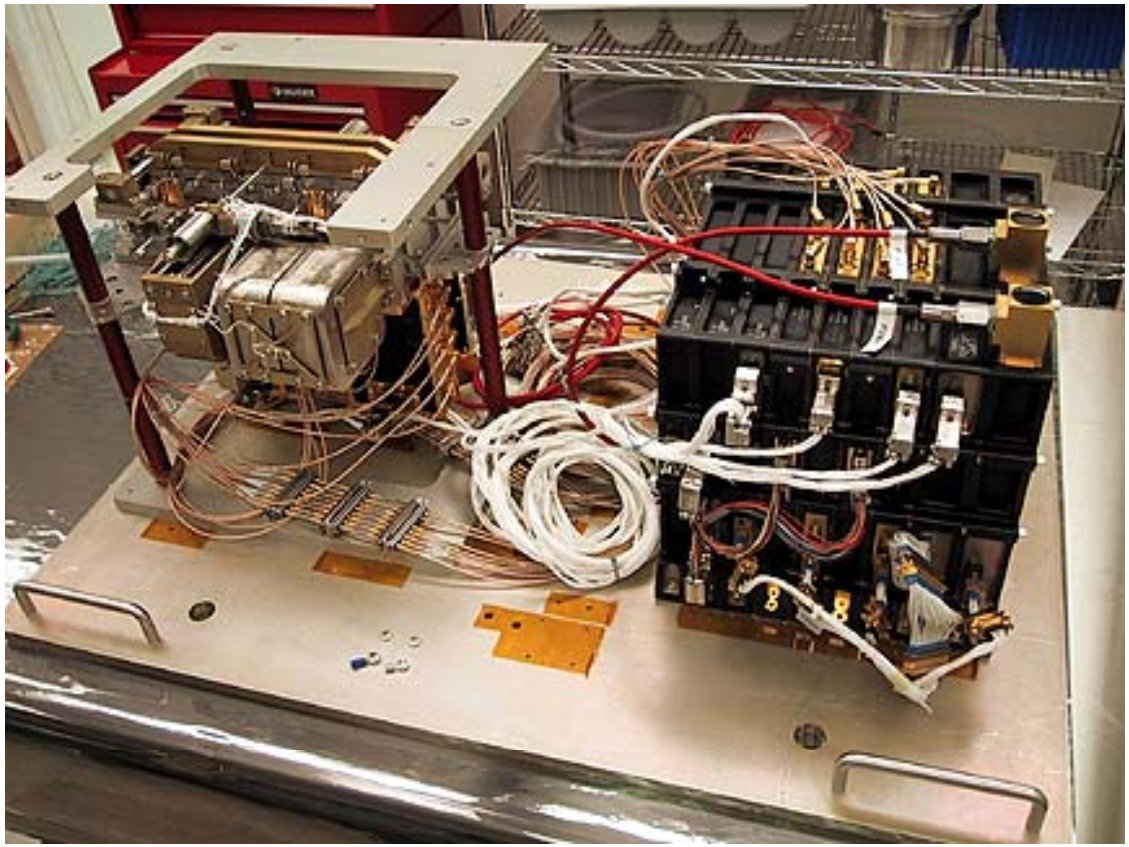
- Detector Head



Flight FUV01 Detector System

Detector upper door & mechanism re-worked at UCB in collaboration with Swales, CU & GSFC.

FUV01 door motor and HOP subassy rebuilt and tested at UCB successfully on ETU. Door reassembled and tested successfully at CU before and after vibration at Ball.

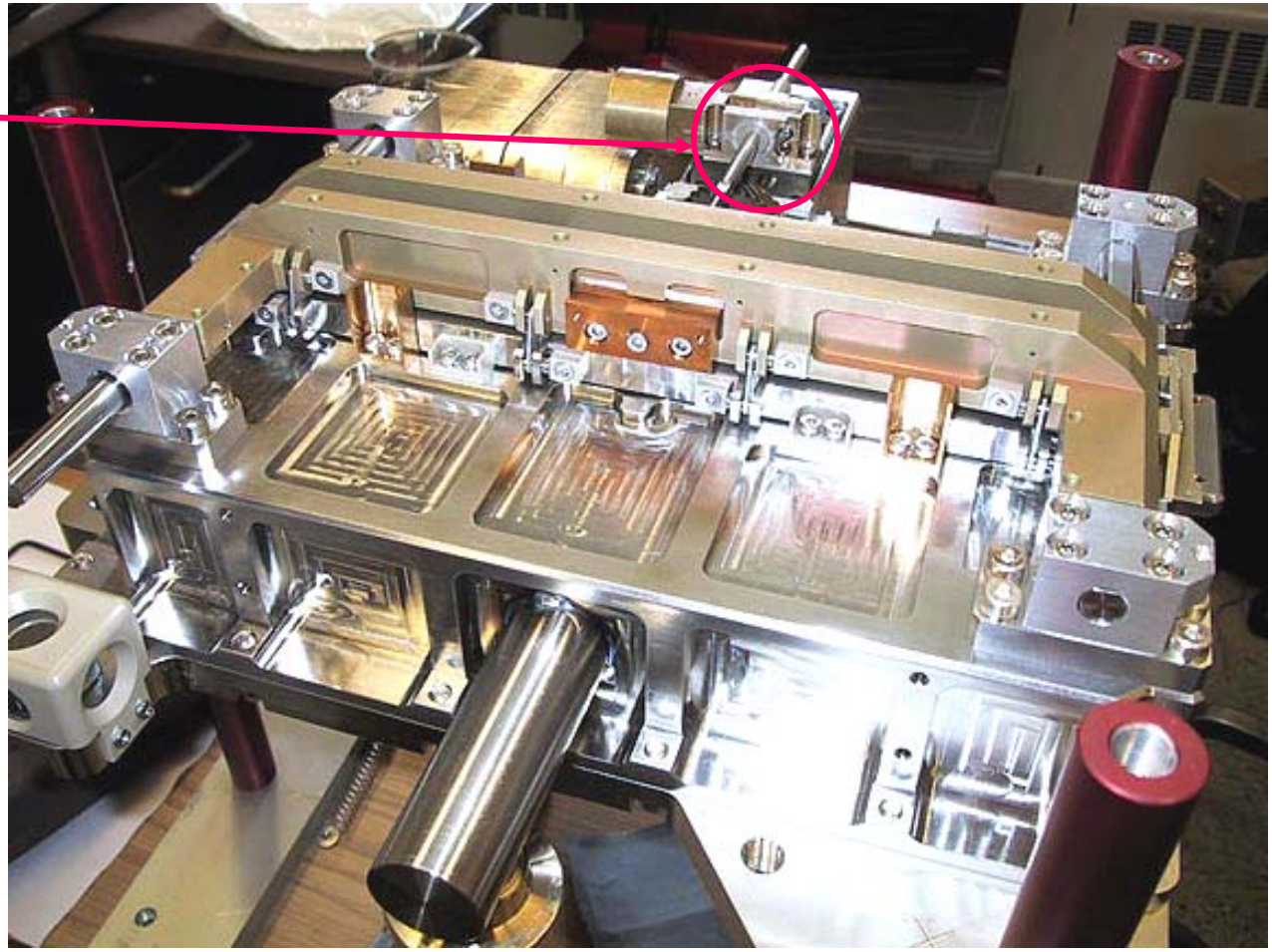


FUV Door - New Assembly on ETU VHA

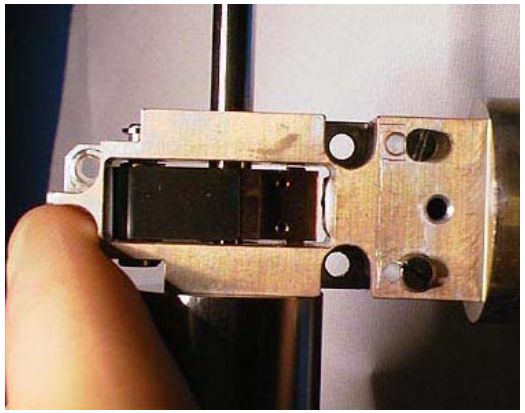
Problem area, clamshells & shaft slots.

Reworked, and now through all tests, except for final two thermal cycles.

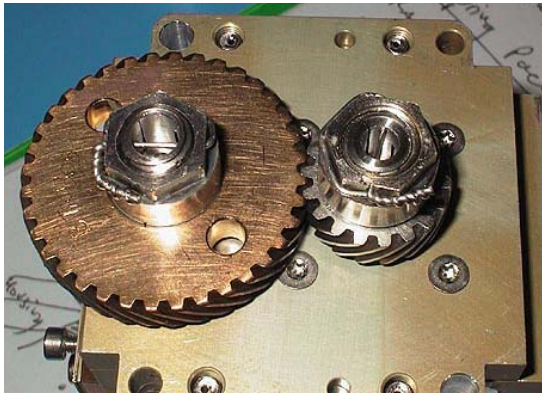
All other new door components have worked very well.



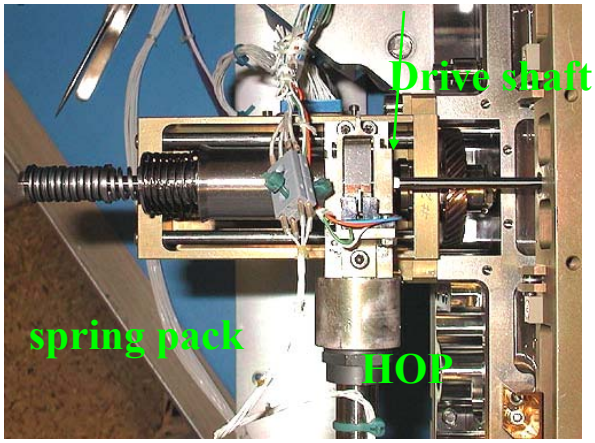
FUV Door Problem - Motor subassembly solution summary



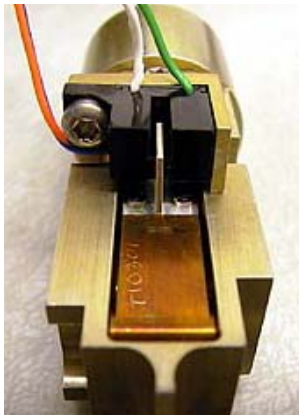
More tolerance for HOP housing



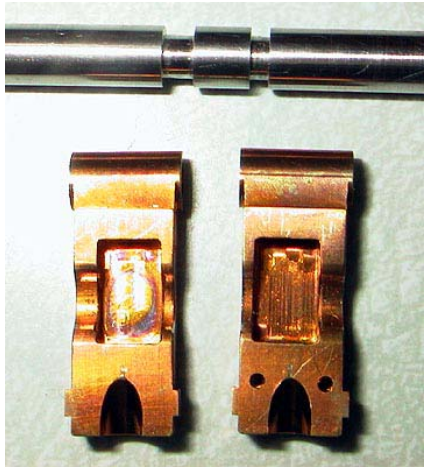
Lock and key drive cogs



HOP carrier & shaft/spring pack



Thinned Flag



Looser fit for clamshells

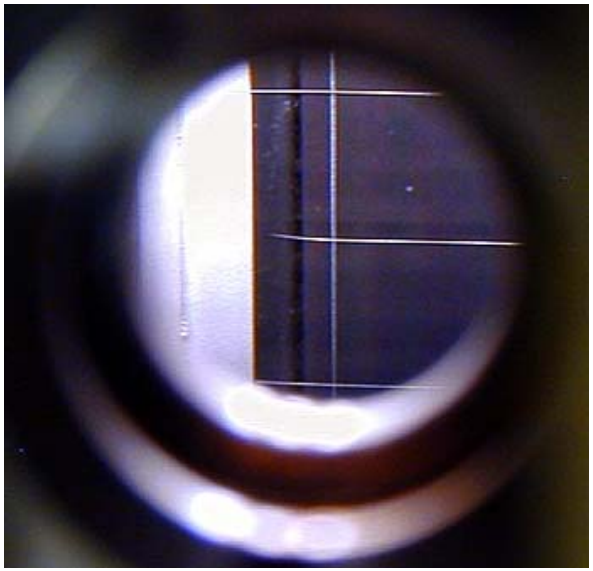
FUV Door Problem Progress

- FUV01 Door Reassembled & Tested on ETU with Motor/Clamshell Fixes
  - **FUV01 shafts, flags, cogs, clamshells, motor, modified & subassembly rebuilt**
  - **Installed FUV01 motor sub assembly onto ETU DVA**
  - **Bench tested, door open/close with motor, HOP firing, relatch, - OK**
  - **Installed in thermal vac tank and tested**
    - **door open/close with motor, HOP firing, relatch, at ambient/cold/hot -OK**
  - **Vibrated to qualification levels at Lockheed**
  - **Re-installed in thermal vac tank and tested**
    - **door open/close with motor, HOP firing, relatch, at ambient/cold/hot -OK**
- FUV01 Door Reassembled & Tested on FUV01
  - **Removed FUV01 motor assy and returned to CU, installed on FUV01**
  - **Vacuum tested door systems operation successfully at vacuum**
  - **Vibrated in Z axis to acceptance levels at Ball**
  - **Returned to CU and verified door operation successfully at vacuum**
  - **Post vibration problem discovered later on detector QE grid**

FUV01 Grid Wire Problem

- **FUV01 Grid wire broke on last acceptance vibration at Ball**
  - **Intense field emission observed on "B" side only when grid bias on**
  - **Inspection through window shows one wire has broken & bent towards MCP's**
  - **FUV01 brought back to UCB for analysis and correction**
  - **Working closely with GSFC and CU to expedite solution**

Grid wire through window



Grid wire from side angle

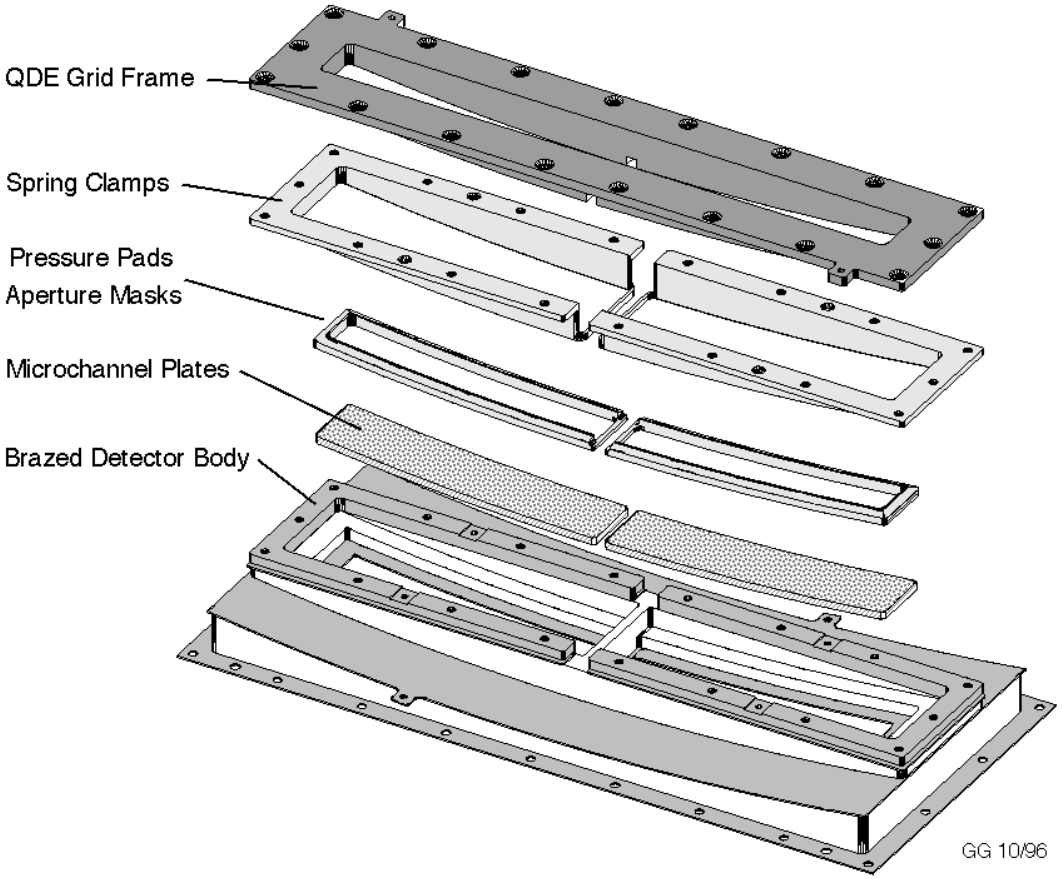
Grid wire attachment point

FUV01 Grid Design

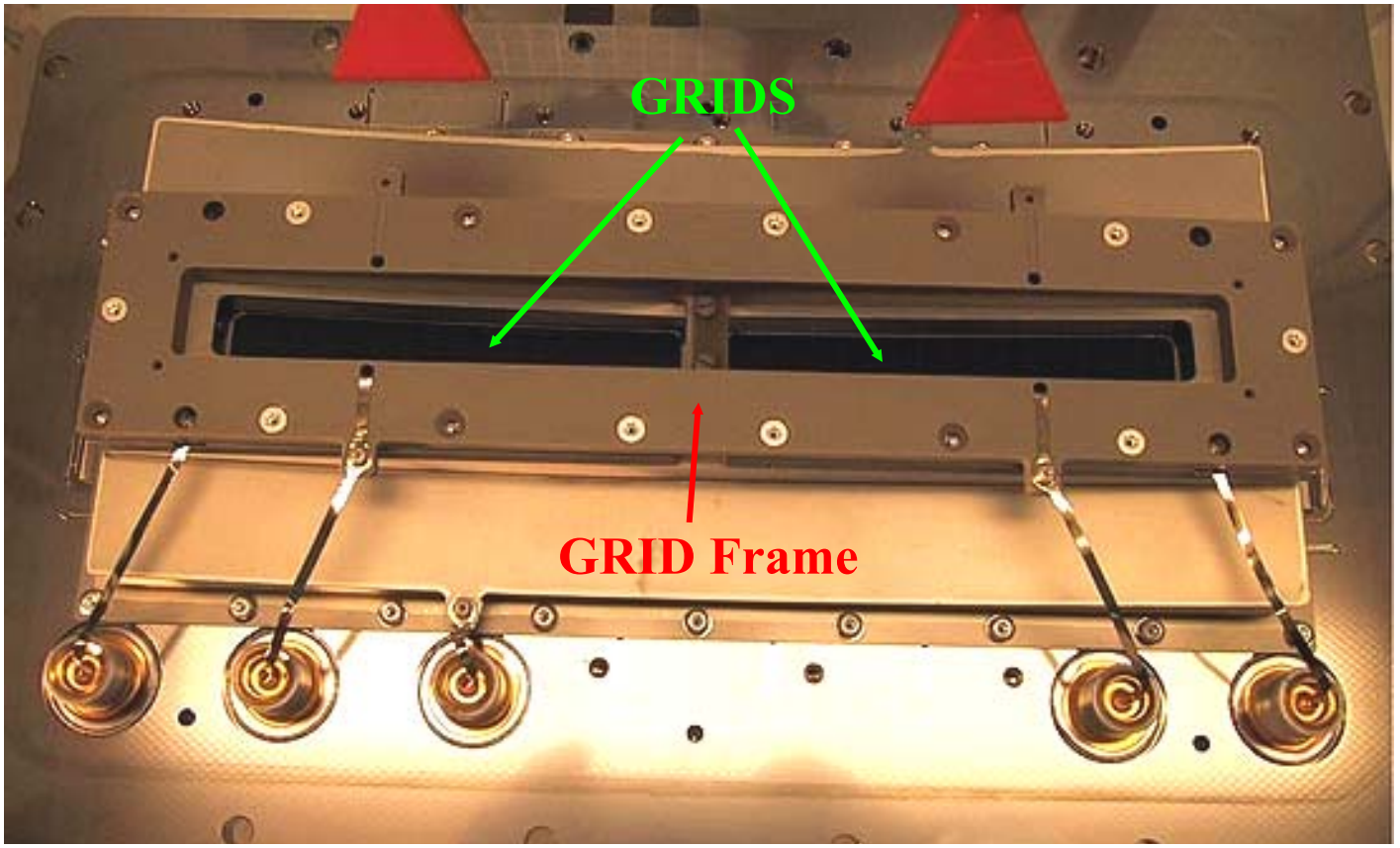
FUV01 QE Grid

Mounts to top of detector
Frame is PEEK insulator
Grids are electroformed Ni
One grid on each segment
Used to enhance QE by 30%
-1500v bias to MCP
Bias can be turned off
Ramps with MCP HV

Can be removed or installed without disturbing MCP's
Access by removing DBA & magnetic shield from VHA



FUV01 Grid Frame Assembly



FUV01 Grid is held on detector with 10 screws

FUV01 Grid Wire Design

FUV01

Mesh made by Buckbee-Mears.

Grids selected by optical inspection.

Nodules & wire breaks rejected.

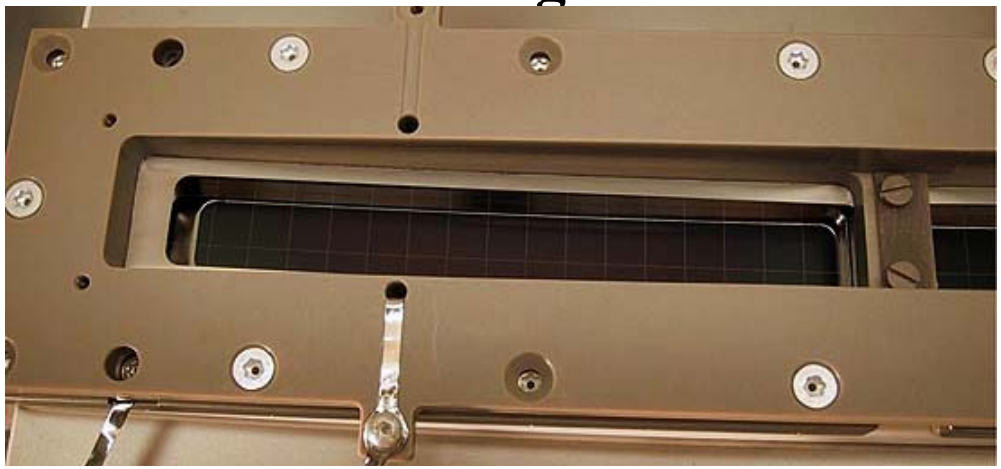
Thickness 12 ±6µm.

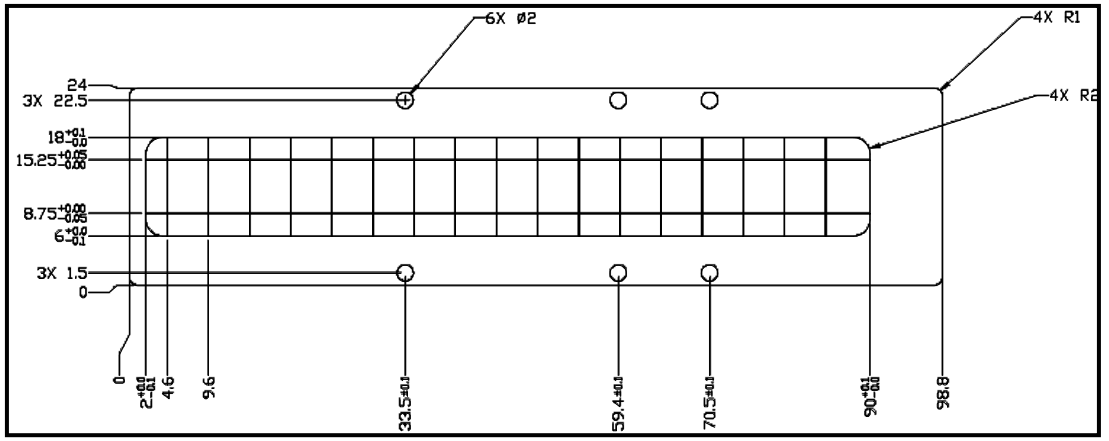
Wires 25 ±10µm.

Wires on 5mm pitch.

Glued to frame with silver epoxy.

Cured at elevated temperature (60°C)



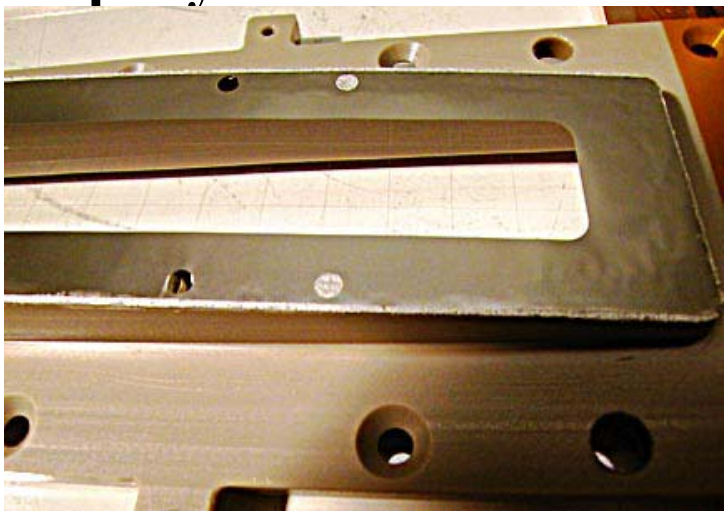


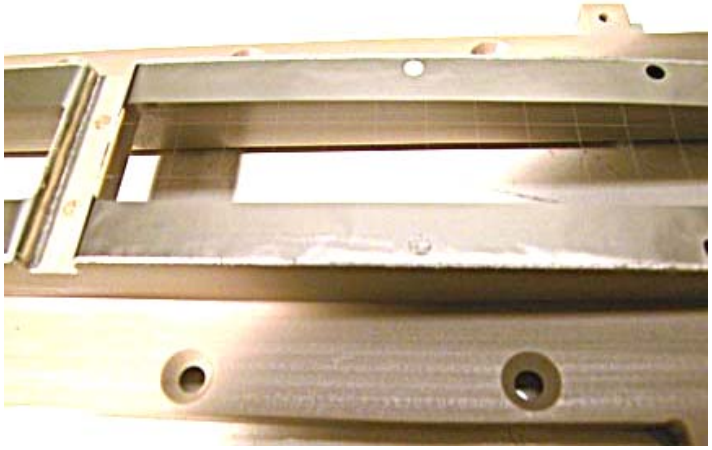
FUV01 Grid After Epoxy Cure

Grid was selected by optical inspection.
Epoxy to frame & smooth out.
Placed in oven to cure.
Re-inspected post cure.
Slightly slack at room temp.

Procedures and inspections reviewed by GSFC representative last week.

9 grids & 4 frames remained after FUV01 grid fabrication,
3 rejected, 6 OK.
Thickness 6µm to 10µm, wires ~15µm wide.



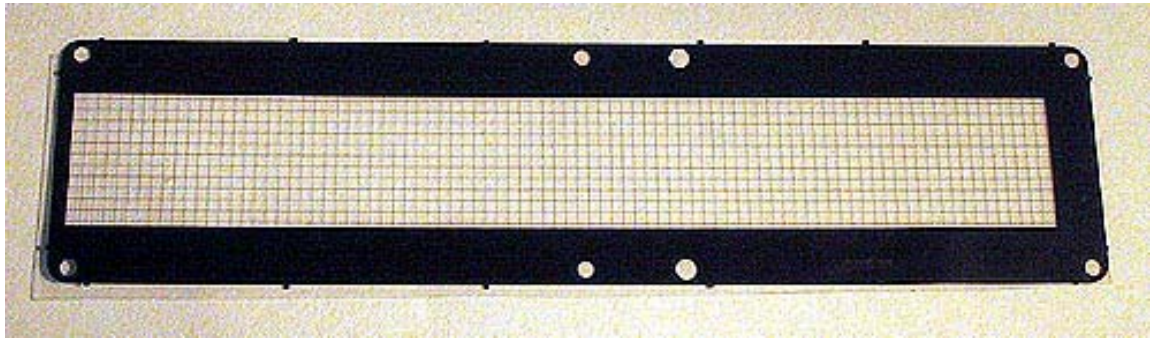


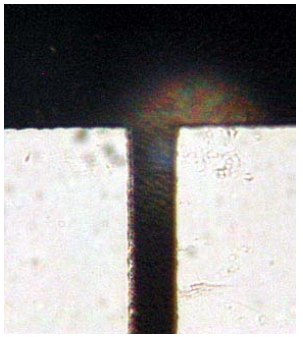
Successful Grids on Other Missions

- **EUVE - various shapes, all 70 wires/inch, sizes up to 60mm**
- **SOHO - UVCS & SUMER smaller all 70 wires/inch**
- **FUSE - similar to COS size, but finer mesh, 25 wires/inch**
- **Orfeus - similar to COS, but one segment & finer mesh**
- **ALEXIS - annular mesh, 70 wires/inch**
- **Many sounding rockets (30+ flights)**

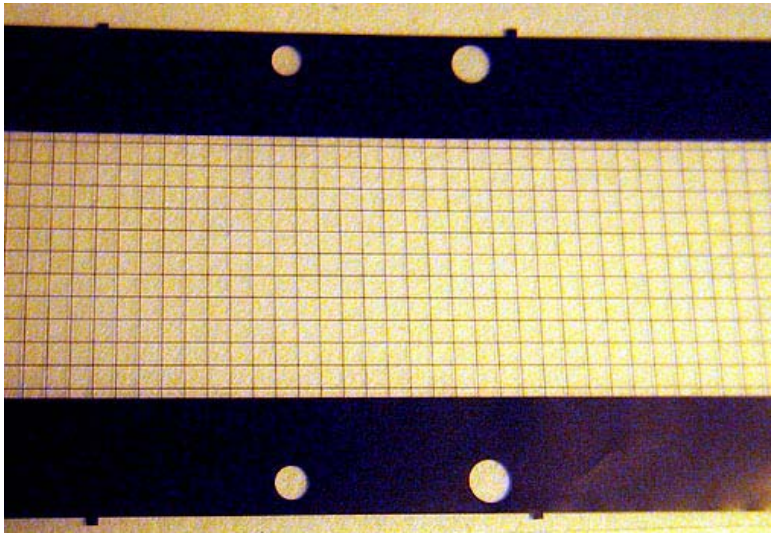
- **FUSE grid is the most similar to COS**
- **FUV01 grids have undergone two full acceptance vibrations and one Z axis acceptance vibration, plus thermal vac soaks (+50, -20°C) and four cycles (0 - 40°C).**

FUSE Grid design (4 in orbit)



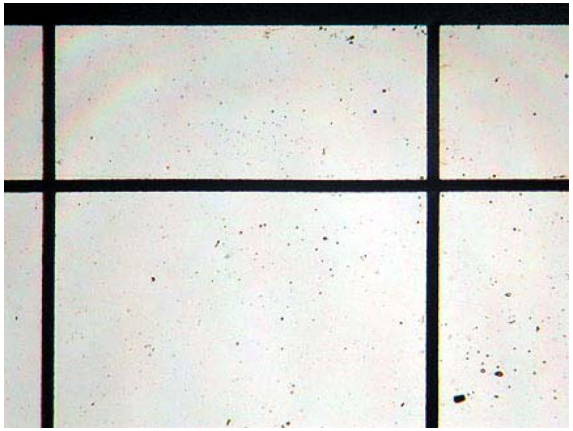


Finer pitch (1mm) than COS



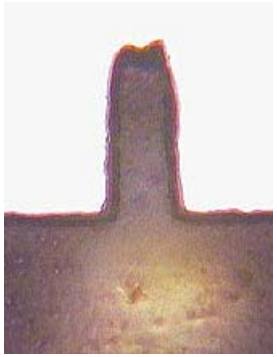
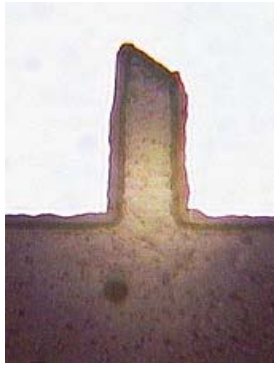
Grid thickness same (~7µm avg) as COS

Wires slightly wider (~20µm)

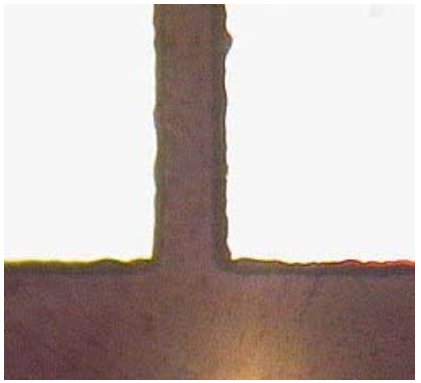


COS non-flight Test Grid Assembly - Pull Tests

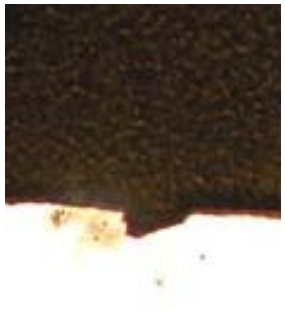
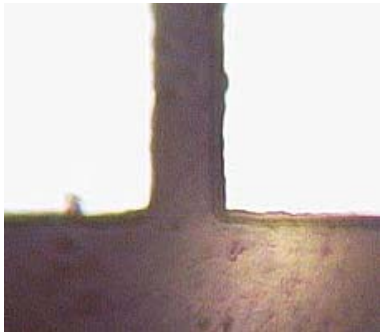
- Deliberately pulled wires to break point and recorded wire images
- Wires break close to, but not at, the frame edge
- Wire extension tests indicate >1% stretch before break

Broken wire shapes



Normal wire shape

Tests and Models of Grid Wire Problem

Had 6 grids left over from FUV01 grid frame fabrication/inspection/selection.

20 grids ordered from Buckbee-Mears to original design, due end of this week

40 new on order from Stork-Veco,with thicker/wider wires, due end of this week

Analysis and Tests.

Pull tests on original batch grid wires at UCB show >1% extension before wire break.

Simple GSFC vibration simulation indicates 1700G grid limit, better model in progress.

Shock tested COS ETU DVA with HOP at AMES, shows ~40G rms at DVA.

Electric field strength model shows only 1G force with QE grid field on.

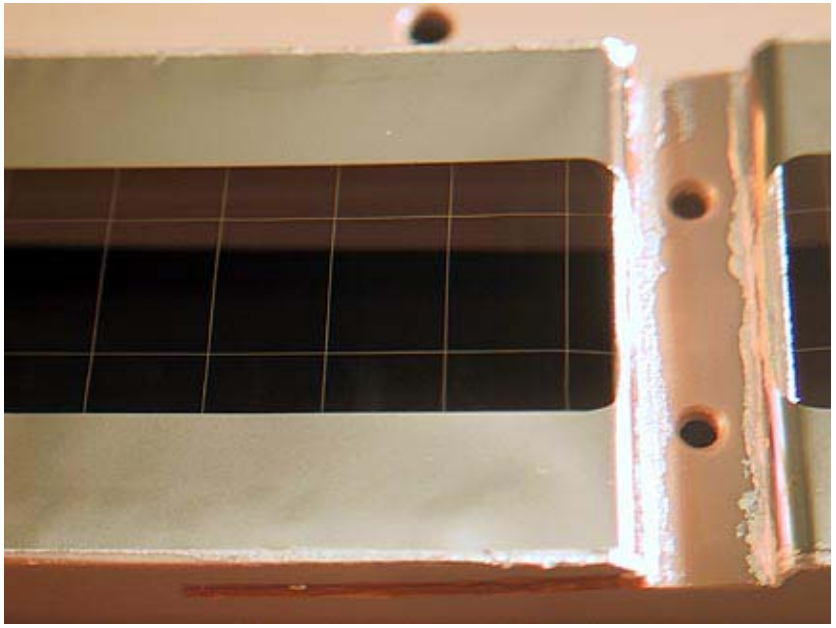
Basic thermal model indicates potential stretching for large delta temps above epoxy cure temp.

Vibration and thermal models are being worked on at GSFC

Grid Tests.

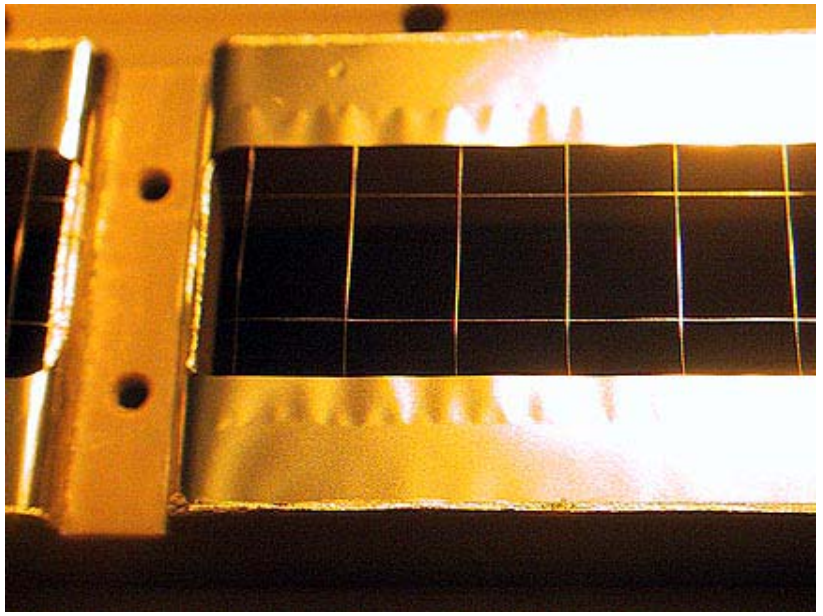
Made 3 grid assemblies, 1 with reject grids as a fabrication trial
Two with flight grids, one epoxy cured at 40°C, and one with room temp cure
Both subjected to 3 thermal cycles, -25°C to +55°C
40°C cure vibrated at qualification levels on ETU detector

Test Grid Assemblies



Grid cured at room temp is flat (but not taught)

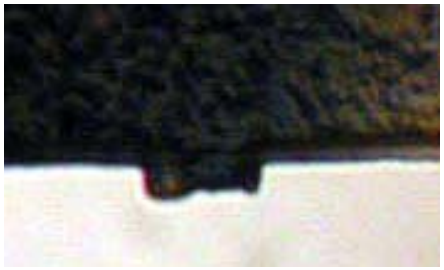
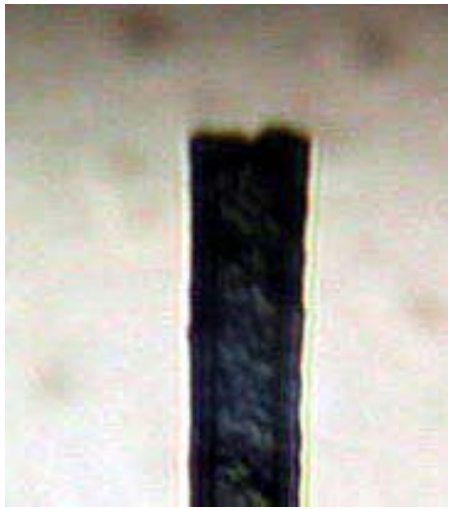
One short (Y) wire broke almost at center due to thermal cycle test



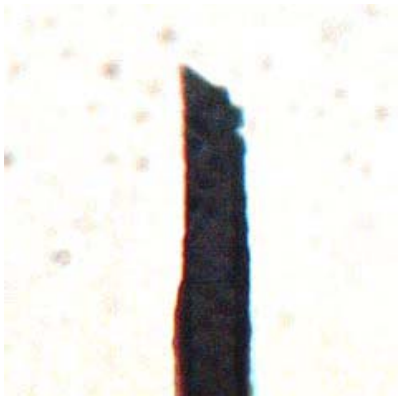
Grid cured at 40°C is slightly puckered

Ok in thermal test - but two short (Y) wires broke almost at edge in vibration test

Test Grid Assemblies


Grid cured at 40°C. Wire at breaks is close to frame edge, no sign of narrowing, more like stress fracture (due to flexing).

Grid cured at room temp. Wire at break is narrowed due to stretching before break . Others also stretched.

FUV01 Grid Wire, Possible Solutions

- **Change grid frame mesh mount protrusion to Nickel**
  - **Matches grid thermal expansion/shrinkage, will not stretch-stress mesh**
  - **Grid will not slacken and cause vibration flexing**
  - **Allows each grid to be made on a separate sub-assembly**

Grid frame is shaped for each side of detector

Replace frame protrusions with Nickel subassemblies

FUV01 Grid Wire, Possible Solutions

Review resolution options, models, test data with GSFC & CU

Design and fabricate Nickel grid subassemblies

Assemble test grids with Buckbee-Mears and Stork-Veco new grids
Subject to 3 thermal cycles, -25°C to +55°C
Vibrate at qualification levels on ETU detector
Select and functional test (ETU detector) grids for FUV01 retrofit

Retrofit and Commissioning steps for FUV01

Replace broken FUV01 grid frame
Full set of detector functional tests
Acceptance vibration test
Re-scrub detector and functional test
Check of detector QE performance
Ship to CU --- Thermal vacuum test
Deliver to Ball
Expect this will take about 6 weeks after grids are ready

UCB FUV02, Flight Backup Detector, Status

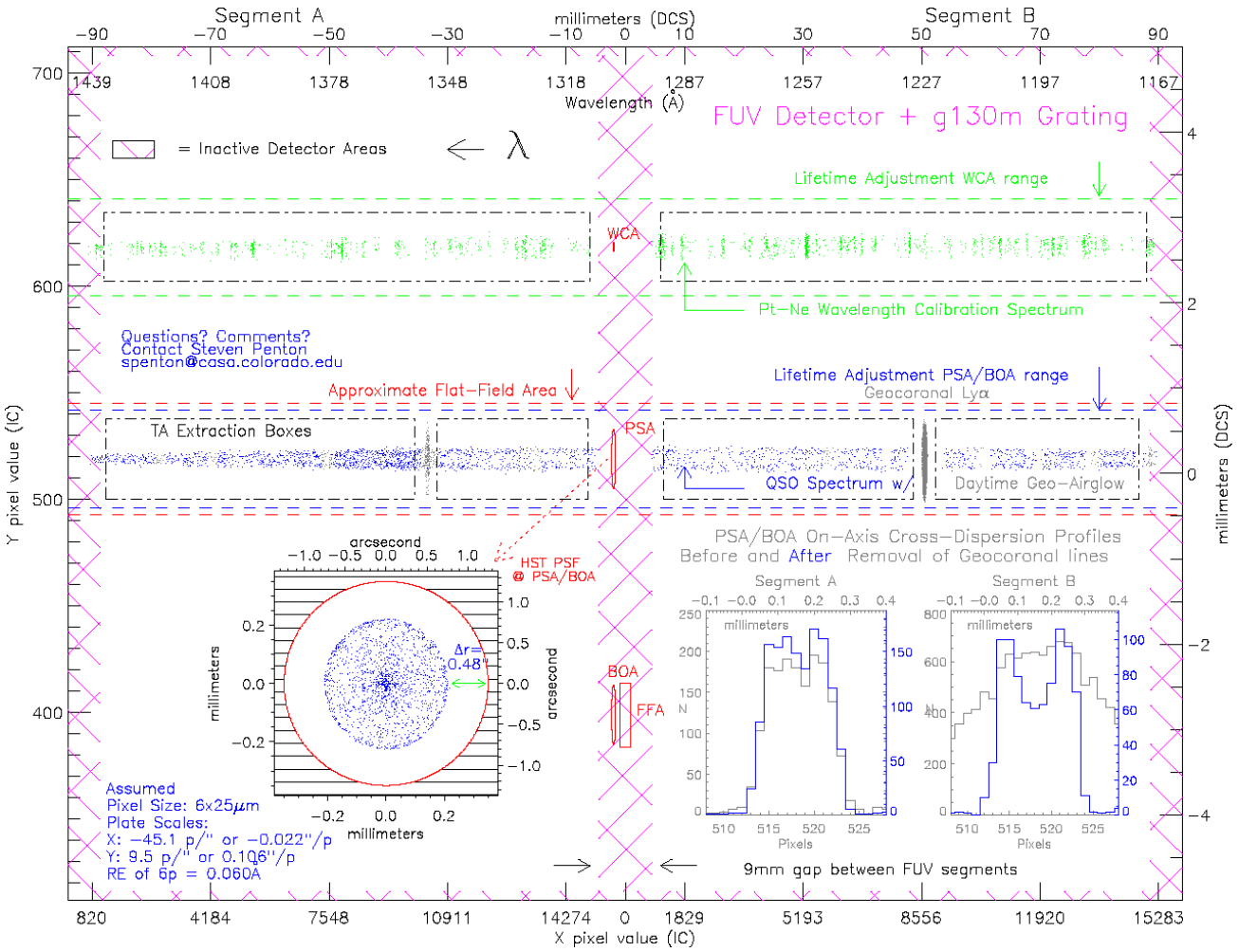
- **DEB -** All boards have been cleaned, coated, staked, and vacuum baked.
- **Harnesses -** Cleaned and vacuum baked/certified.
- **DBA -** Built up and integrated with VHA, at UCB.
- **Vacuum Housing Assembly**
  - Successfully completed alignment tests at Ball.
  - Door assembly at UCB awaiting re-assembly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

UCB FUV02, Flight Backup Detector, Next Actions

- 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).

COS MSR: CU Software/Operations Efforts

- CEDAR:
  - Updates to support files – coincident with updates to COS database release(s).
- CALCOS – GSE:
  - Issued draft of T.E.R. on Geometric Distortion Correction for FUV detectors.
  - COS Spectral Simulator:
  - Updated instrument efficiency curves.
  - New capability simulating diffuse point sources in beta testing.
- TAACOS:
  - Simulations for Target Acquisition of extended sources is in progress.
  - Issued draft of T.E.R. on Simulated Detector Images for COS.
  - Revision to T.E.R. on Recommended Values for Target Acquisition Patchable Constants is in progress.
- DCE Flight Software:
  - New version of DCE FSW OPERATE v1043 is ready to begin component-test phase. Update implements HV shutdown in the event of a Global Rate Violation. New error action implements more conservative approach – as a result of analysis of recent 'grid wire' failure. SCR filed on 3/27/02.
- COS Instrument Development Website:
  - Implementing reorganization and streamlining of CU/CASA COS website.


Segment A
millimeters (DCS)
Segment B
Wavelength (Å)
FUV Detector + g130m Grating
= Inactive Detector Areas
Lifetime Adjustment WCA range
WCA
Pt–Ne Wavelength Calibration Spectrum
Questions? Comments?
Contact Steven Penton
spenton@casa.colorado.edu
Approximate Flat-Field Area
Lifetime Adjustment PSA/BOA range
Geocoronal Lyα
TA Extraction Boxes
PSA
QSO Spectrum w/
Daytime Geo-Airglow
Y pixel value (IC)
millimeters (DCS)
HST PSF
@ PSA/BOA
arcsecond
millimeters
Δr=
0.48"
BOA
FFA
PSA/BOA On-Axis Cross-Dispersion Profiles
Before and After Removal of Geocoronal lines
Segment A
Segment B
Pixels
Assumed
Pixel Size: 6x25μm
Plate Scales:
X: −45.1 p/" or −0.022"/p
Y: 9.5 p/" or 0.106"/p
RE of 6p = 0.060A
9mm gap between FUV segments
X pixel value (IC)

COS Schedule for CU/UCB

Task	Status
G140L – Blazed Grating Testing	Canceled – substantial improvement not shown
CALCOS Software Development	On-going
NUV Gratings (JY)	Complete
Cal/FF SS Optical Integration	March – May ’02 – awaiting hardware from Ball
FUV-01 Grid Rework Activities	Ongoing. Earliest delivery by 5/23.
Complete FUV-02	Pending 01 recovery

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	**Too late**	$,t	Degraded science
Drop NUV channel	TBD	$$$,tt	Degraded science
Remove NCM3 optics	**Too late**	$,t	Degraded science, Ops
Eliminate Aperture Mechanism	TBD	$,t	Ops, Obs. Efficiency, higher risk
Drop all Accum mode processing w/ Doppler	**Too late**	$,t	Degraded science
Drop spare FUV detector	**Too late**	$,t	Higher risk
Drop OSM1 capability (don't cover λ gap)	**Too late**	---	Degraded science
Reduce S/N requirement to 30 (no FF lamp)	TBD	$,t	Degraded science
Relax NUV resolution requirements below 20k	**Too late**	$,t	Degraded science
Remove on-orbit change-out capability	**Too late**	$,t	Higher risk
Drop dispersed light TA	**Too late**	$,t	Ops
No Ion Gauge	TBD	$,t	Higher risk, Ops
No external shutter	**Too late**	$,t	Ops
Change MSRs to QSRs	TBD	$	Save trees
Eliminate Mechanism Lifetime tests	TBD	$$	Higher risk
Reduce CDRLs	TBD	$	Unknown
Drop G140L blazed effort	**Implemented**	$,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 to be saved.

Upcoming Events/Activities

- Continue FUV-01 recovery from QE grid failure.
- Start Cal/FF subsystem I&T.
- Commence detail ground calibration planning.

Issues

- None