COS
Monthly Status Review
June 26, 2002
Ball

Agenda

Progress Summary Since Last Monthly	E. Wilkinson
Cal/FF Subsystem Assembly	E. Wilkinson
COS I&T Preparation & Support	E. Wilkinson
Software/Ops	K. Brownsberger
UCB FUV Detector Programmatic Status	E. Wilkinson
UCB FUV Detector Technical Status	O. Siegmund
Schedules	E. Wilkinson
Descope Report	E. Wilkinson
Upcoming Events/Activities	E. Wilkinson
CU Issues & Resolution Plan	E. Wilkinson
STScI Presentation	K. Sembach
BATC Presentation	R. Higgins
Financial Splinter	GSFC/Ball/CU

Progress Summary Since Last Monthly (5/22/02)

- Commenced life-time testing of QE grid assy.
- Installed new grids in FUV-01 and started re-test.
- Continued Cal/FF S. S. assembly at CU.
- Continued I&T Support activities.
- Continued ground calibration planning.

COS Calibration System Integration Status

- Pre-vacuum alignment completed, with all components in nominal positions. Beam splitter and ellipse shims ground and installed.
- Initial active alignment using lamps and PMT complete.
- Vacuum alignment and initial photometric calibration to begin this week.
- NDF selection to be performed this week
- Detailed photometric calibration, staking of components and installation of alignment diode to be performed next week, with earliest delivery to Ball on 5 July, 2002.

Calibration platform in CU vacuum calibration chamber. All optical components mounted in final locations except for lamps, which are being adjusted in translation. nominal positions.

COS I&T Preparation and Support

- CU's support of COS I&T at Ball continues and has ramped-up further with S. Beland joining K. Brownsberger to support FSW/OPS activities.
- CU/Ball/UCB/GSFC scheduled to meet in Boulder on July 8th to discuss verification efforts and activities.

Software Operations Status

- CEDAR
  - Updated Diagnostic Tool capability to assist with COS Diagnostic FSW component testing at Ball.
  - Ongoing updates to support files coincident with updates to COS database release(s).
- CALCOS-GSE
  - Lifetime correction
    - Design completed, code to be completed by July 1
  - T.E.R., COS-11-0039 (COS FUV Detector Geometric Distortion Maps), to be released for signature by July 1.
  - Work on combined, ground flats for FUV and NUV channels is nearing completion. T.E.R. on COS Ground Flats is in progress.

Software Operations Status

- COS Spectral Simulator
  - Capability for simulating a limited type of diffuse point sources is in production.
- TAACOS
  - T.E.R's released:
    - COS-11-0017 (Initial Release), TAACOS: Detector Summary Images
    - COS-11-0014 (RevB), Recommended TA FSW and Operations Changes, based upon the TAACOS Phase I Reports for the FUV and NUV Channels.
  - Simulations for Target Acquisition of extended sources are in progress.
- DCE Flight Software
  - DCE FSW OPERATE v1043 successfully completed component testing and SCR closed. This version is now the default for both flight and test-bench environments.

Software Operations Status

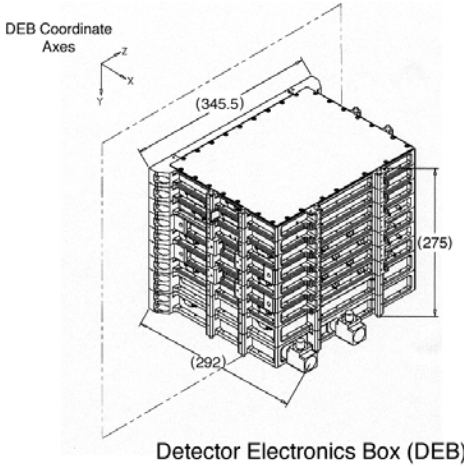
- Personnel
  - Beland and Brownsberger completed BATC ESD and cleanroom training in support of COS I&T activities. Brownsberger continues to support SW/OPS activities at Ball 4-5 days a week. Beland is ramping up support at BATC and will support at 4-5 days a week by the time COS system functional testing begins.
- Report from meeting with Brian Rehm
  - Myself and others recently met with Brian to discuss overall COS SW/OPS status. IMHO, COS is in excellent shape in the SW/OPS areas. The bulk of the FSW is completed and tested and has been run successfully against flight hardware.

Software Operations Status

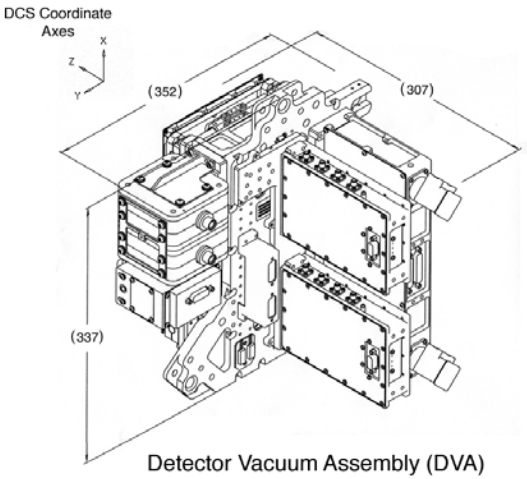
- Largest remaining FSW activities:
  - OSM Rotary Motor FSW changes
  - CS-DCE CommTask FSW changes
  - Target Acquisition FSW Testing
  - Formal qualification Testing
- Risks
  - The recent SW/OPS personnel cutbacks which were necessary to keep within budget constraints have been difficult. We now have a small, but still excellent SW/OPS team which is fully capable of completing the job.
- Risk Mitigation
  - Recent allocation of Donna Wilson from the HST payload FSW team to cover work on CS-DCE SCR(s) has been wonderful. If the HST project wishes to further mitigate risk in the COS SW/OPS areas they could provide additional, technical "core-team" resources of the caliber of Donna Wilson.

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)



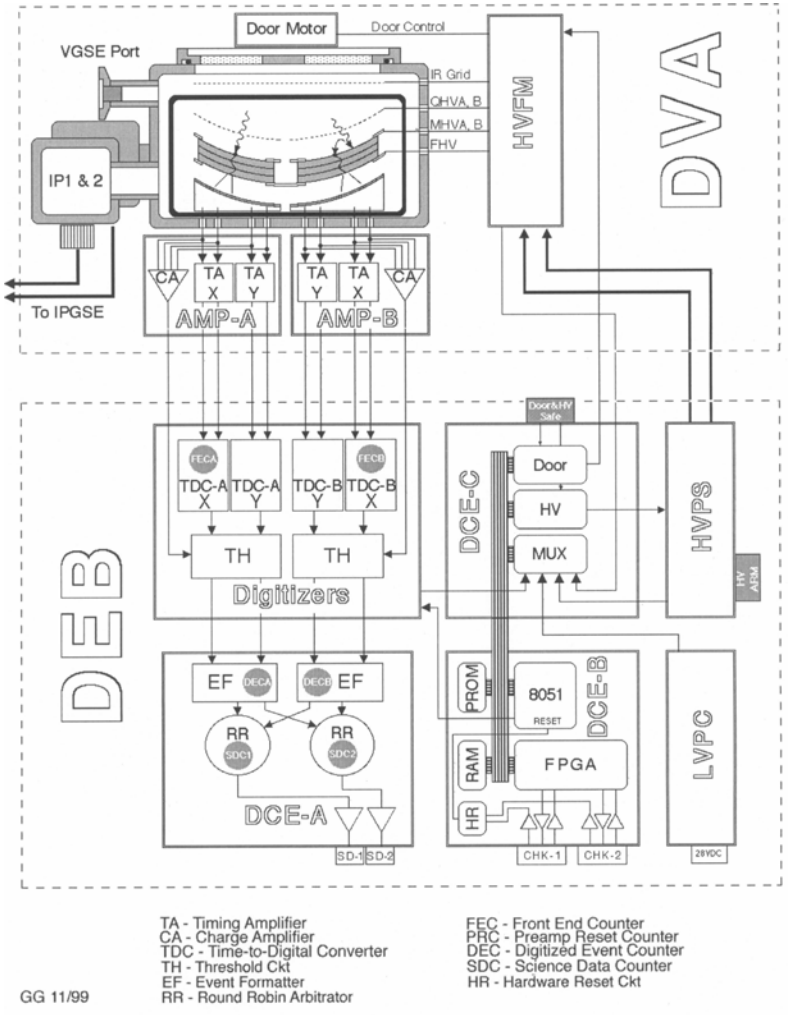
Detector Electronics Box (DEB)



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

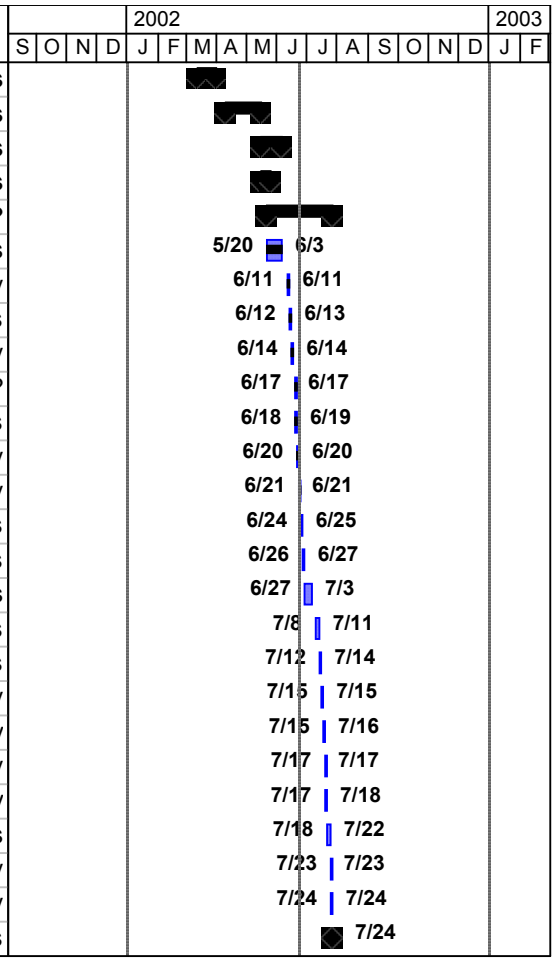
Unit	Functional Testing	Performance Testing	EMI/EMC	Sine Burst	Random Vibe	Thermal-Vac	Contamination Certification
FUV-01 DVA	C	C	@SS	A - C	A - C	@SS	@SS
FUV-01 DEB	C	C	@SS	Q - C	Q - C	@SS	@SS
FUV-01 SS	C	C	C	@Comp	@Comp	6-cycles	C
FUV-02 DVA	C	C	N/R	Q - P	Q - P	@SS	@SS
FUV-02 DEB	C	C	N/R	Q - P	Q - P	@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 was repaired in early March.
- A single, z-axis acceptance level vibe on FUV-01 DVA was completed after installation of new grids.

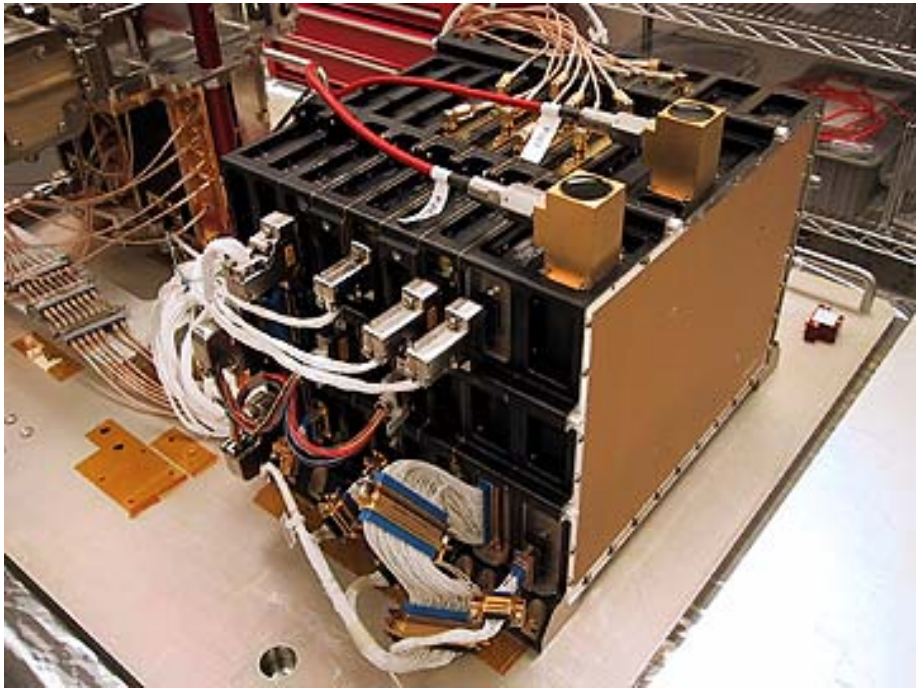
FUV-01 Detector Schedule

ID	Task Name	% Complete	Duration
2	**Initial Problem Diagnosis**	**100%**	**15.5 days**
16	**Test & Qualify New Grids**	**100%**	**32 days**
28	**Life Test of Qual Grid Assembly (Pending Hardware Availability)**	**69%**	**18 days**
41	**Assembly & Test of Flight Grid Assembly**	**20%**	**10 days**
48	**Reassembly & Test of Flight FUV-01 Detector**	**29%**	**51 days?**
49	Complete FUV-01 QE Tests	100%	12 days
50	Open FUV#1 and Install qualified QE grid	100%	1 day
51	Install FUV#1 in QE test chamber	100%	2 days
52	Detector #1 functional test with flight DEB	100%	1 day
53	Open FUV #1 and Check Grids for FE Problem	100%	1 day?
54	QE check of FUV#1 detector	100%	2 days
55	Pre-vibration functional testing	100%	1 day
56	FUV#1 vibration test at Lockheed	100%	1 day
57	Post vibration function tests in QE chamber	0%	2 days
58	Install FUV#1 system in cal chamber + set-up scrub	0%	2 days
59	Mini-Scrub of FUV#1 plates in Calib chamber	0%	6 edays
60	Final QE calibration of FUV#1	0%	4 days
61	Final System Functional testing	0%	3 days
62	Pack detector for shipment	0%	1 day
63	Ship FUV01 detector system to UCo	0%	1 eday
64	Install detector system into UCo T-V chamber	0%	1 day
65	Pre-pump down functional testing	0%	1 eday
66	Completion of FUV#1 System T-V tests	0%	4 edays
67	FUV#1 System cleanliness certification	0%	1 day
68	Remove flight system and pack	0%	1 day
69	FUV#1 system ready for BATC	0%	0 days

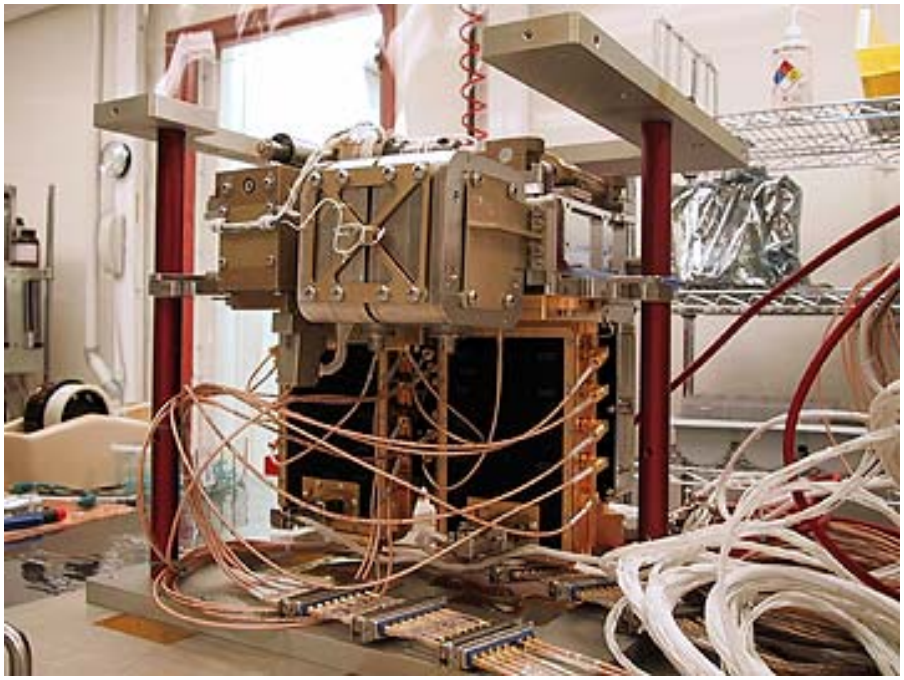


COS FUV Detector Systems

- Detector DEB



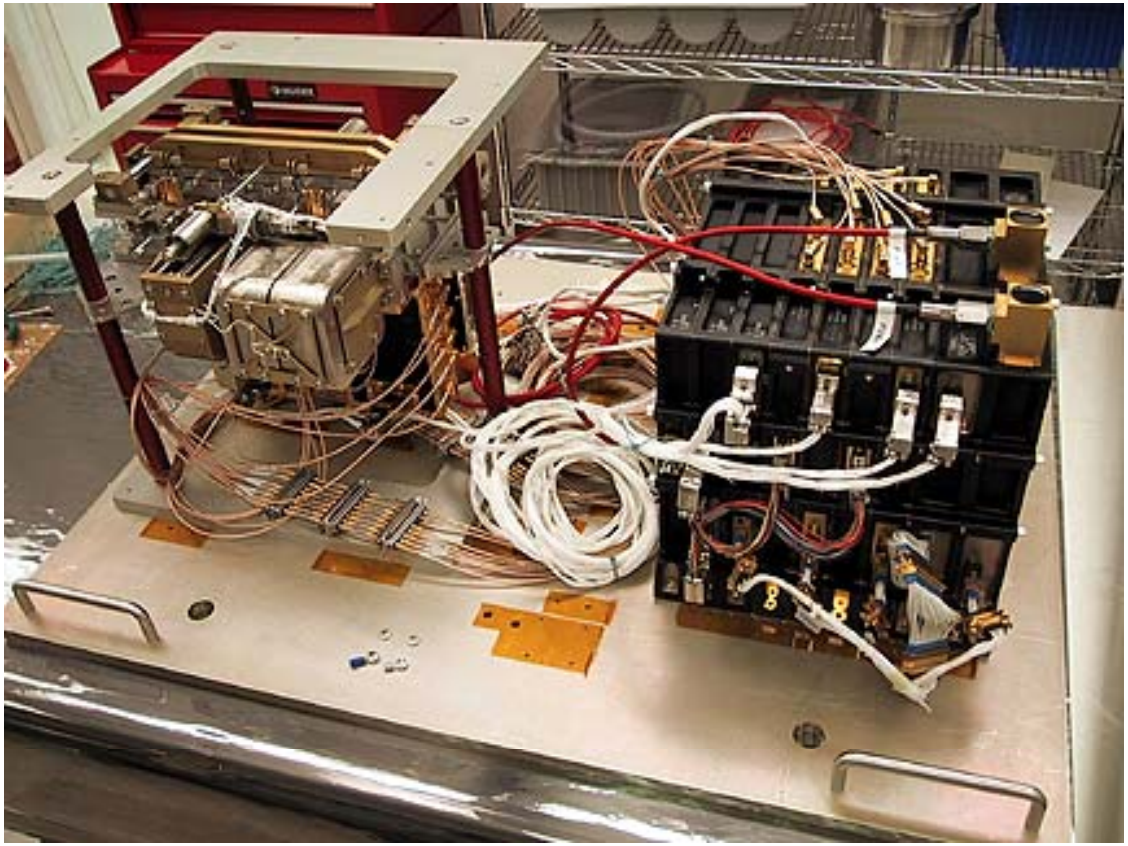
- Detector Head



Flight FUV01 Detector System

FUV01 upper door & mechanism, door motor and HOP sub-assy rebuilt and tested successfully at UCB and CU and before and after vibration at Ball.

Have made and replaced the FUV01 QE grid, and are completing the final test sequences before delivery to Ball.



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%

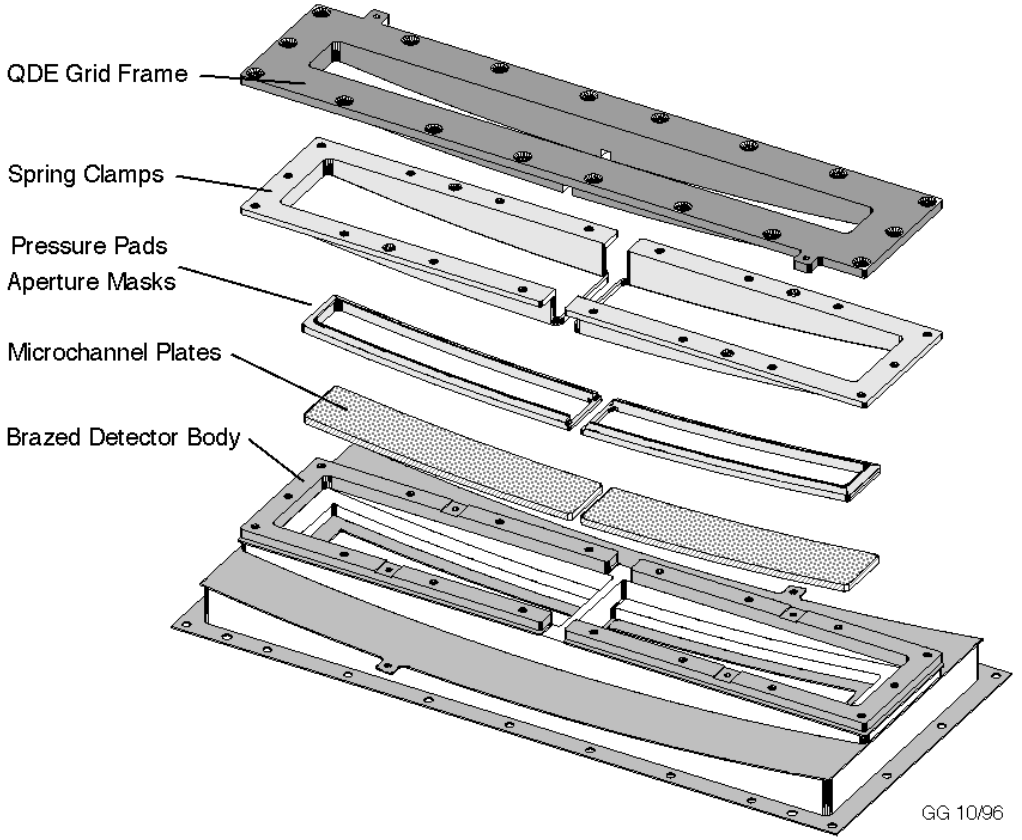
-1500v bias to MCP

Bias can be turned off

Ramps with MCP HV

Can be removed or installed without disturbing MCP's

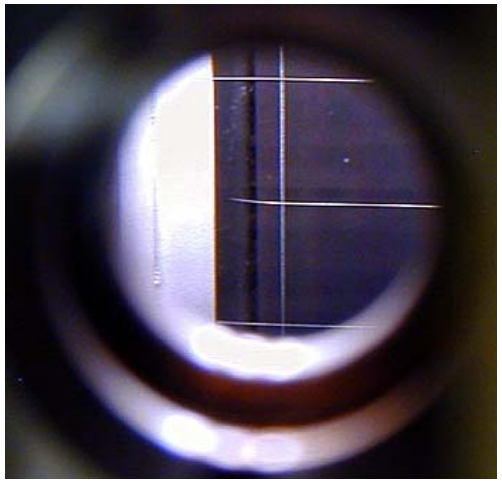
Access by removing DBA & magnetic shield from VHA



FUV01 Grid Wire Problem

- FUV01 Grid wire broke on last FUV01 acceptance vibration at Ball
  - Intense field emission observed on "B" side only when grid bias on
  - Inspection through window showed a wire had broken & bent towards MCP's
  - FUV01 brought back to UCB for analysis and correction
  - Have a new set of grids, replaced the FUV01 broken grid, testing in progress

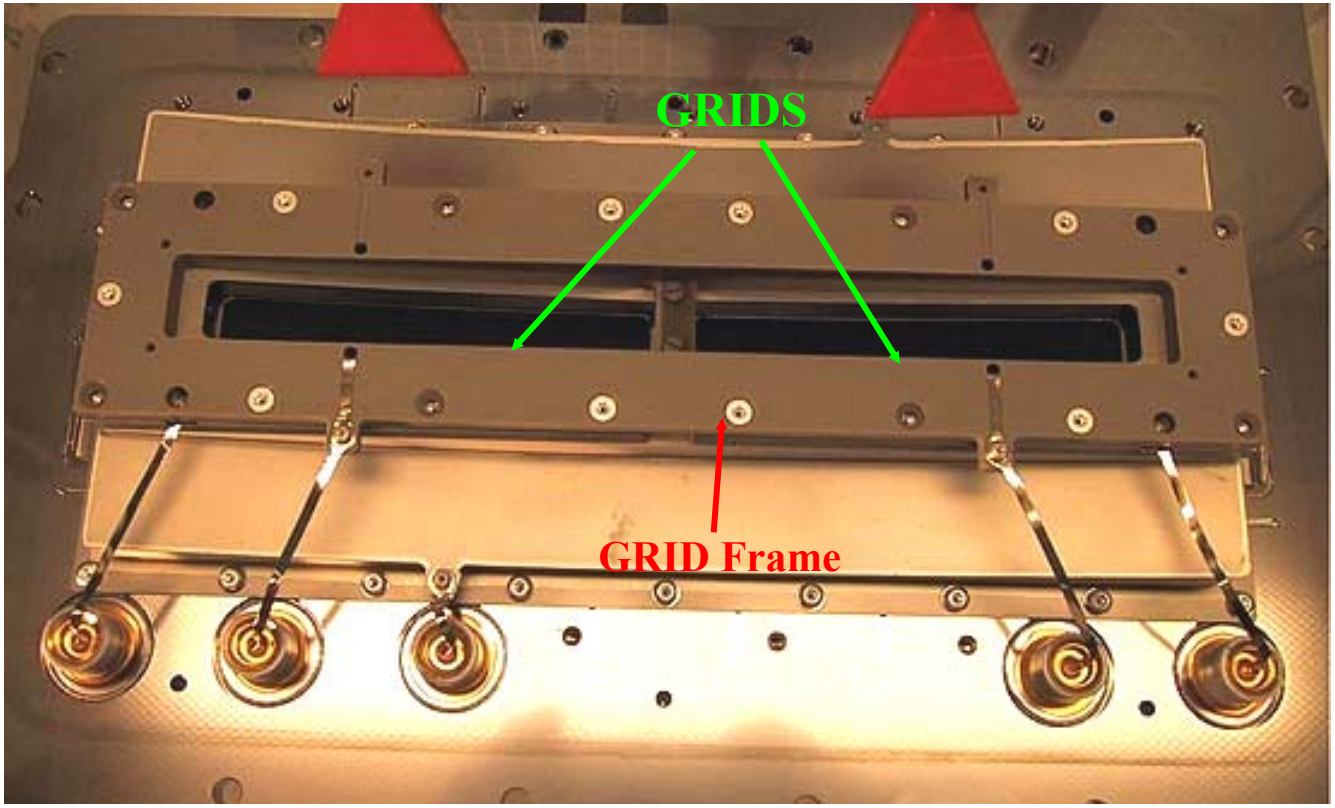
Grid wire through window



Grid wire from side angle

Grid wire attachment point

FUV01 Grid Frame Assembly



FUV01 Grid is held on detector with 10 screws

FUV01 Grid Wire Design

FUV01

Original Mesh made by Buckbee-Mears.

Grids selected by optical inspection.

Nodules & wire breaks rejected.

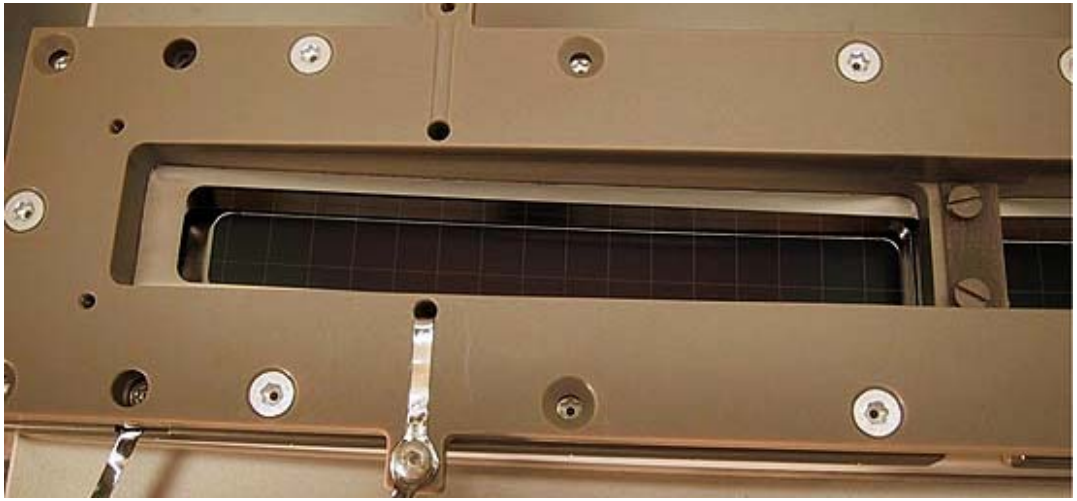
Thickness 8 ±2µm.

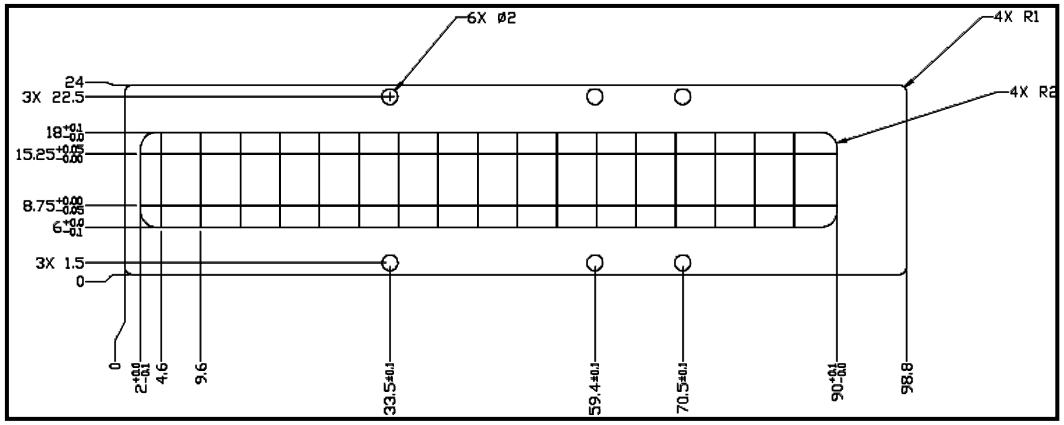
Wires 15µm wide.

Wires on 5mm pitch.

Glued to frame with silver epoxy.

Cured at elevated temperature (60°C)





Grid Status

FUV01 original 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).

Had 6 Buckbee-Mears grids (+ 3 rejects) left over from first FUV01 grid frame fabrication/inspection/selection. Used four (+ 2 rejects) for test grids.
20 new grids received from Buckbee-Mears, specification 25µm wide, 12µm thick (actually 15µm wide, 8µm thick)
40 new Stork-Veco grids received, with thicker/wider wires (35µm wide, 12µm thick)

Further Analysis and Tests.

Pull tests on original and new batch grid material done at GSFC (Ben Reed).

Epoxy mix cure tests and glass transition tests done at GSFC (Ben Reed)

GSFC grid simulation (Bart Drake) indicates thermal grid to frame CTE mismatch problem.

Shock tested COS ETU DVA with HOP at AMES, shows large margin - not a problem

Electric field strength model shows only 1G force with QE grid field on - not a problem

Basic vibration model indications OK, provided grids have not yielded, or excessive slack.

Tests and Models of Grid Wire Problem - materials tests

Epoxy Tests

Epoxy, glass transition point is >50°C for all cure temps - Acceptable

Original Buckbee Mears Grid Tests.

Yield strength ~74 ksi with 3% elongation

New Buckbee Mears Grid Tests.

Yield strength ~50 ksi with 3% elongation

New Stork-Veco Grid Tests.

Yield strength ~165ksi with 5% elongation

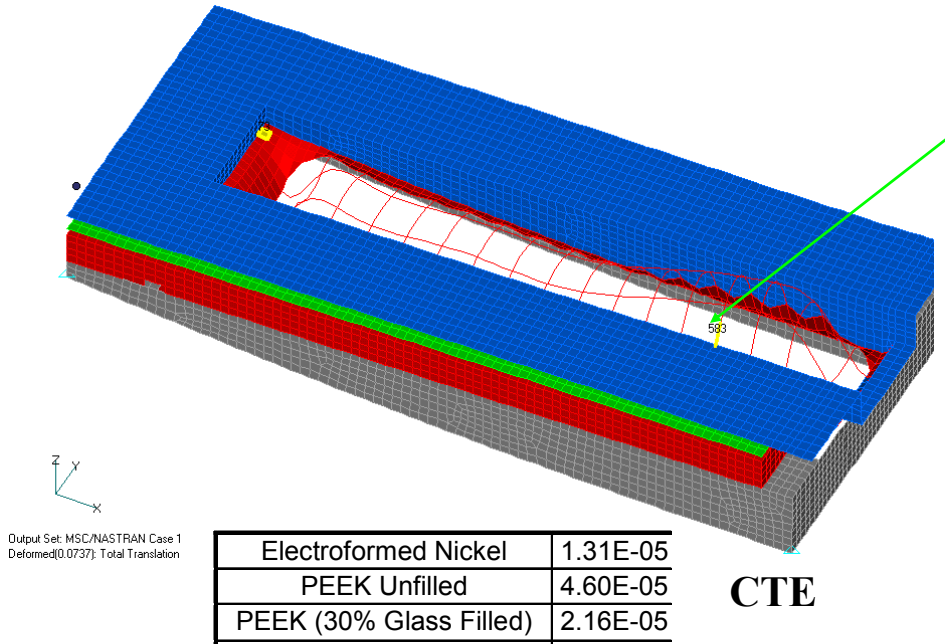
New Buckbee-Mears meshes are weaker than originals

Stork-Veco are twice the strength and elongation of original Buckbee-Mears mesh

Tests and Models of Grid Wire Problem - Grid model

PEEK	Grid Part	Stress (psi)	M.S. Yield (%)	M.S. Ultimate (%)
Unfilled	Wire	125382	-52.69	-33.87
Unfilled	Annulus	48604	22.05	70.60
30% Filled	Wire	48986	21.10	69.27
30% Filled	Annulus	17769	233.84	366.66

Using original Buckbee-Mears mesh data, assumes room temp cure, +35°C temp excursion with grid mounted to brazed body



Model of original configuration predicts wire break here, assuming there are no other issues (tension/slack etc)

Electroformed Nickel	1.31E-05
PEEK Unfilled	4.60E-05
PEEK (30% Glass Filled)	2.16E-05
304 Stainless Steel	9.60E-06

CTE

Model indicates a 30% glass filled PEEK frame with a room temp cure and original Buckbee-Mears mesh will solve problem

- new Stork-Veco meshes are an even better

Plan for Grid Solution and Verification/Lifetest

Use New Grids on 30% Glass Filled PEEK Frames, Qualification and Lifetest

Had 3 vendors fabricate 30% Glass Filled PEEK frames, received 4 from J3
Have 4 more just shipped from J3, other vendor frames were warped.
Made 2 test grid assemblies in 30% Glass Filled PEEK frames, one of each grid type
Epoxy cured at room temp to avoid wire slackness that occurs with hot cure.
Thorough grid microscopic examination, then field emission tested on a detector
Both subjected a set of thermal cycles, -25°C to +50°C, with no visual grid damage
Field emission tested both on a detector, Stork-Veco OK,
Buckbee-Mears assembly field emitted on both grids - cannot fix or use this option
Proceeded to qual vibration with Stork-Veco assembly (broke 2 wires in handling!)
However - had no field emission even with broken wires - proceeded to vibrate
No damage and no field emission after qualification level vibration
Replaced broken mesh and proceeded to do lifetesting
Stork-Veco grids have better performance and ruggedness, better flight choice!

Grid Verification/Lifetest Sequence

Stork-Veco lifetest grid assembly :-

Field emission tested on a detector successfully
Completed thermal cycles, -25°C to +50°C, - OK
Inspection and field emission test - OK (even with 2 broken wires)
Qualification vibration test - OK
Inspection and field emission test - OK
Replaced one broken grid
Inspection and field emission test - OK
Completed 6 thermal cycles, -25°C to +50°C, - OK
Inspection and field emission test - OK
Ready for 2 minute Qualification Vibration
Inspection and field emission test
3 thermal cycles, -25°C to +50°C
Inspection and field emission test
4 minute acceptance vibration
Inspection and field emission test

Plan for Flight Grid Changeout

Flight Grids on 30% Glass Filled PEEK Frames

Made **2** flight grid assemblies on 30% glass filled PEEK frames, Stork-Veco mesh

Epoxy cured at room temp, with thorough post cure grid microscopic examination

Both have undergone :-

Field emission tested on a detector successfully

Completed thermal cycles, -25°C to +50°C,

Inspection and field emission test

Vibration test

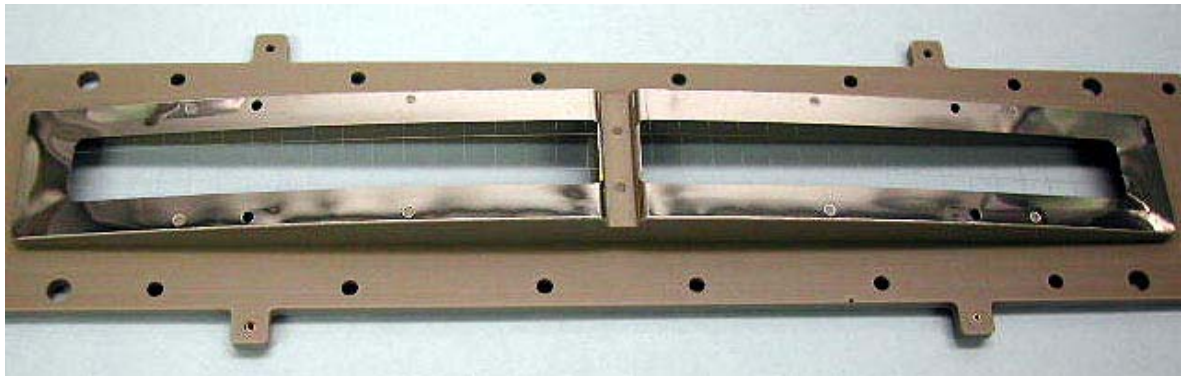
Inspection and field emission test

First has been installed on FUV01 and second will be used for FUV02

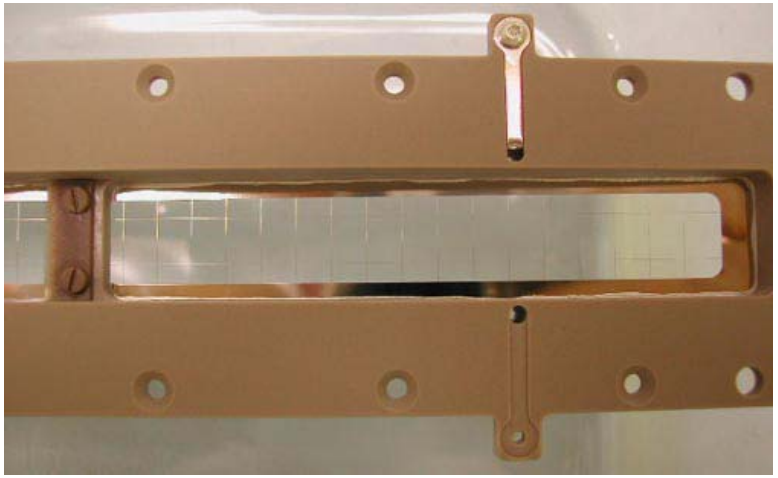
Biggest issues have been the considerable extra handling of the new grid assemblies

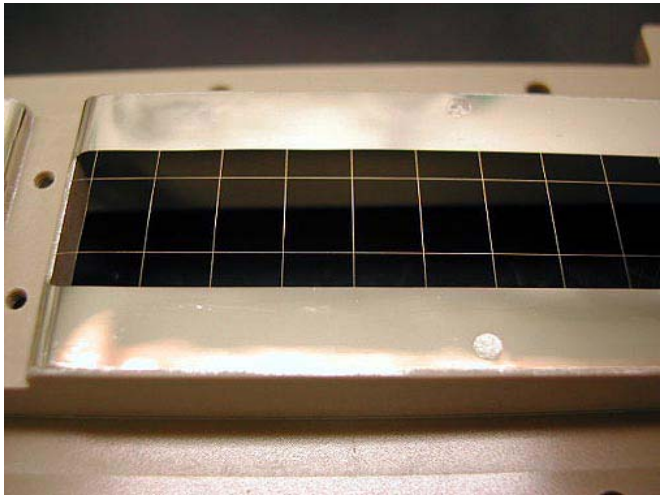
Each test step requires an install/removal from a detector!

Flight Grid Solution



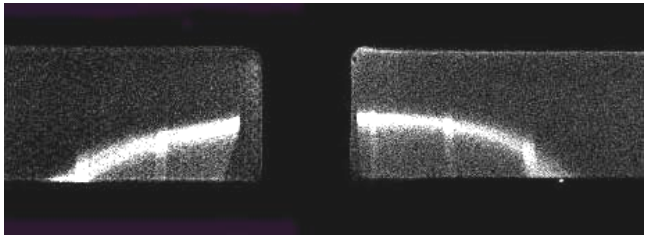
Stork-Veco mesh on 30% glass filled PEEK frame





FUV01 Grid Changeout

- New Stork-Veco mesh assy installed
- Total changeout time ~45min
- Constant nitrogen purge used
- Post changeout field emission observed!

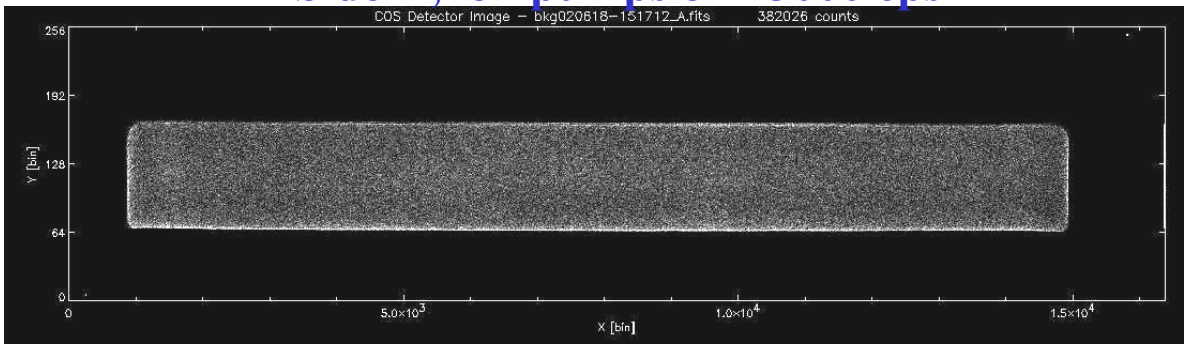


- Diagnosed as mounting hardware
- FUV01 grid mount screws changed out
- All field emission gone!
- Background 10 - 20 events/sec on each side of detector

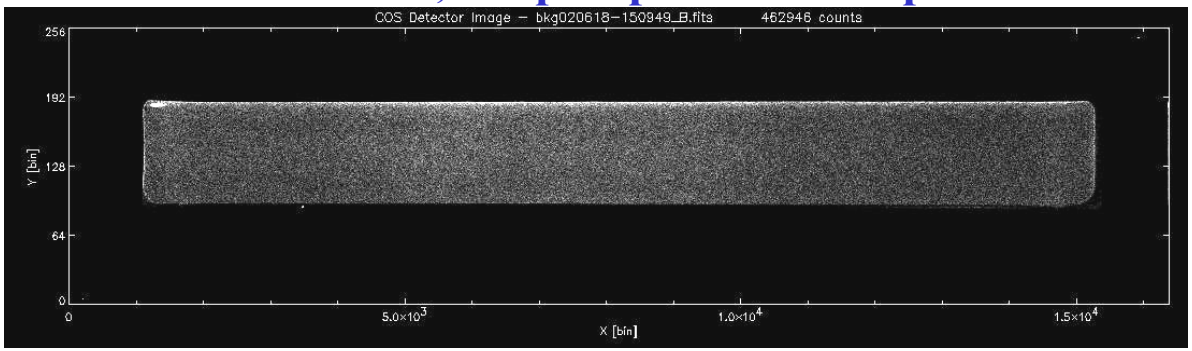
FUV01 Detector - Post Grid Changeout Tests

Field emission gone, none in any voltage configuration
Background 10 - 20 events/sec on each side of detector

Side A, ion pumps on ~3000 cps



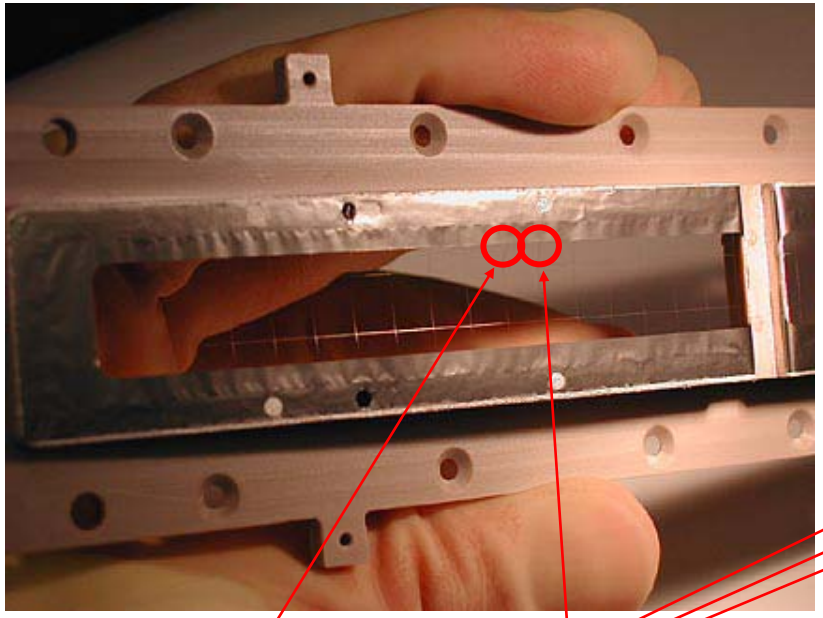
Side B, ion pumps on ~3000 cps

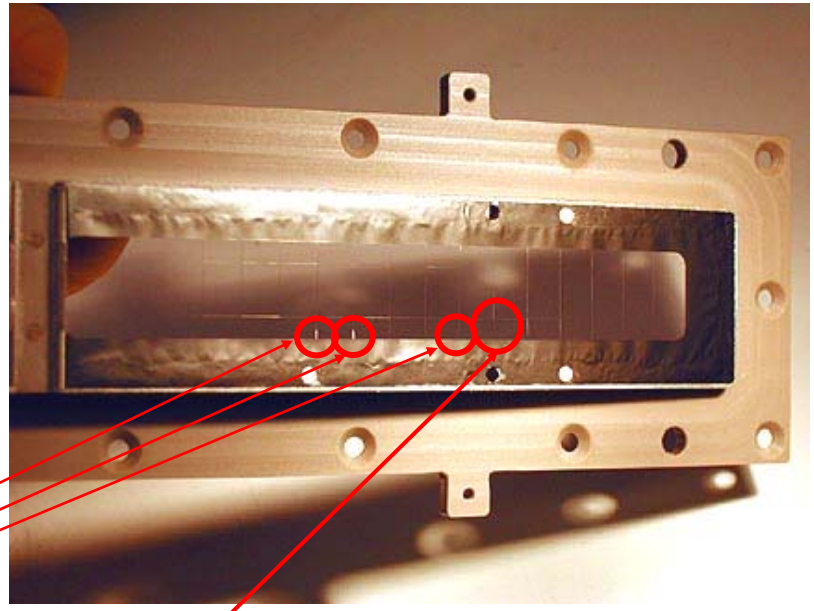


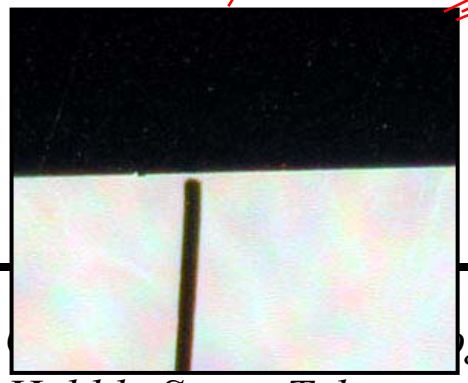
Retrofit and Commissioning steps for FUV01

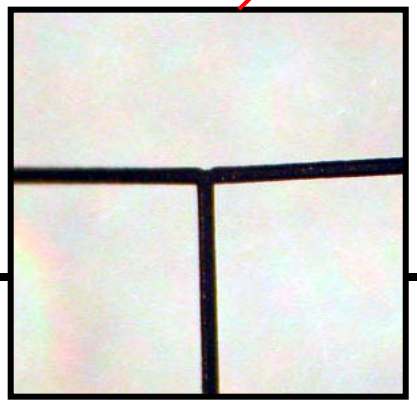
- Check of detector QE performance - DONE
- Replace broken FUV01 grid frame - DONE
- Full set of detector functional tests - DONE
- Acceptance vibration test (Z - axis) - DONE
    - 1/4 G sine sweep/ -6db of full random 30 sec/ full random 60 sec/ sine sweep
- Full set of detector functional tests - early this week
- Check of detector QE performance - this week
- Re-scrub detector and functional test - next week
- Check of detector QE performance - 2nd week July
- Ship to CU --- Thermal vacuum test - 2nd/3rd week July
- Deliver to Ball - 4th week July

Original FUV01 Grid Inspection - Post Removal







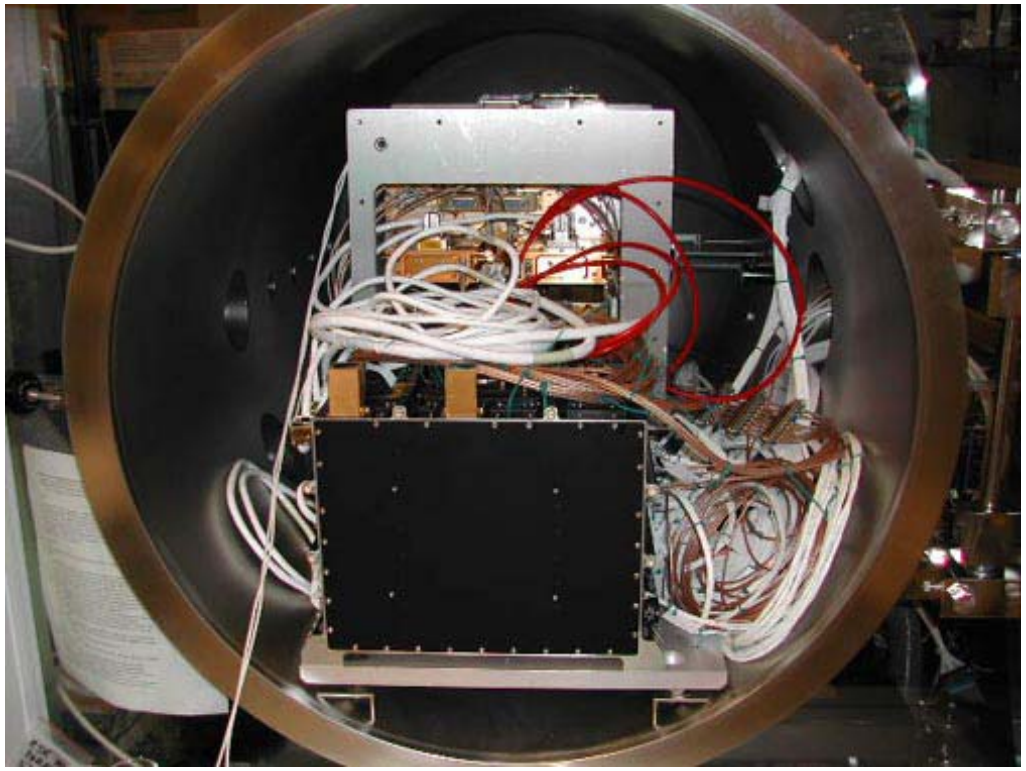


Six broken wires
2 on “B” side, 4 on “A” side
None where model predicts!
Only 1 field emits - bent
Puckering indicates hot cure
Slight slackness in meshes

FUV01 Detector Status

Have configured our QE tank and installed entire FUV01 detector successfully

Have done functional tests and a QE check (grid voltage off) successfully



FUV01 detector and electronics inside the QE tank

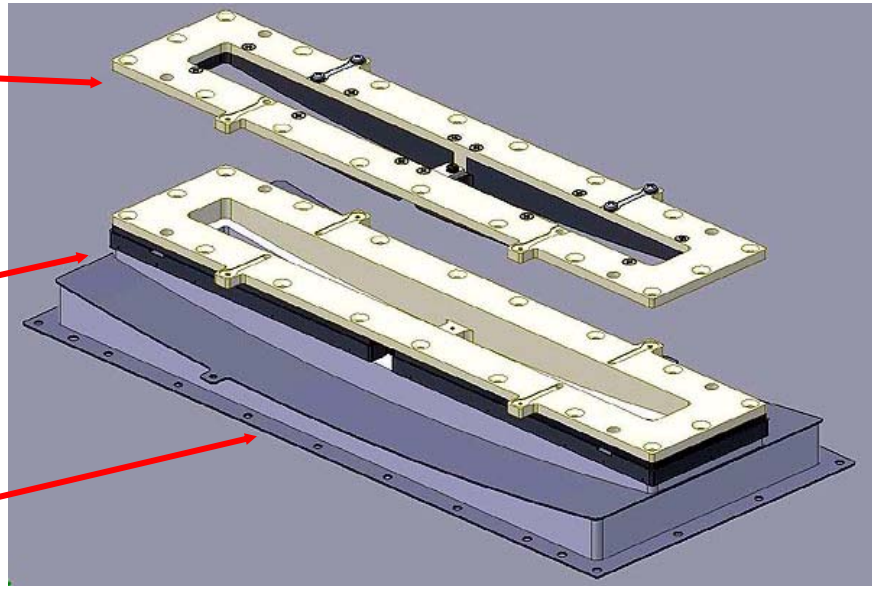
Grid Backup Solution - Metal Grid Carriers

Allows each grid to be made on a separate sub-assembly
A test frame was made and passed initial field emission testing
Awaiting 30% glass filled PEEK carriers on order from J3
Matches grid thermal expansion/shrinkage
Will do thermal cycles, and vibration when PEEK carriers arrive
Option only worked on when the prime solution allows progress.

New metal frames on 30% glass filled PEEK flat carrier design

Original frame design solid PEEK

Brazed body assembly



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 - in progress
- Re-assemble FUV02 door assembly at UCB and test
- Proceed with final FUV02 buildup, test, & scrub.
- FUV02 environmental testing (vibration and thermal vacuum).

COS Schedule for CU/UCB

Task	Status
CALCOS Software Development	On-going.
Cal/FF SS Optical Integration	On-going: deliver to Ball in early July.
FUV-01 Grid Rework Activities	Ongoing. Earliest delivery by 7/24.
Complete FUV-02	Deliver ~9/18/02.

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	**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

- Receive FUV-01 detector from UCB.
- T-V FUV-01 detector (2 cycles) at CU.
- Deliver FUV-01 detector to Ball.
- Complete and deliver Cal/FF Subsystem to Ball.
- Further ground calibration planning.

Issues

- None