COS
Monthly Status Review
August 1, 2002
Ball

Agenda

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

Progress Summary Since Last Monthly

- Received FUV-01 detector from UCB.
- Completed FUV-01 detector short T-V at CU.
- Delivered FUV-01 detector to Ball.
- Completed and delivered Cal/FF Subsystem to Ball.
- Continued COS ground calibration planning.

COS Calibration System Integration Status

- Vacuum alignment and initial calibration completed:
  - Separation between lamp images meets specifications
  - Photometric calibration data provided for all lamps at all current settings, including 9 point cruciform maps at 145nm, central brightness at 3 wavelengths, and restricted F/# measurement of the Spectral Calibration channel.
- Lamps and beam splitters have been potted in place.
- Secondary flat field lamp replaced with alignment diode laser after mount repeatability confirmed.
- Calibration platform delivered to Ball on 11 July, 2002.
- CASA is ready to proceed with post-environmental testing of the calibration platform.

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 met in Boulder on July 8th and discussed verification efforts and activities.

Software/Ops Update

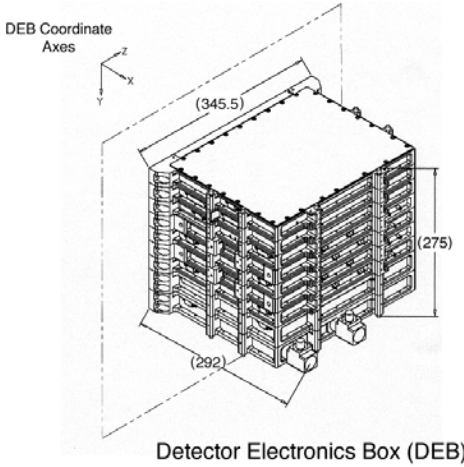
- FUV detector table-top electrical integration is starting today!
- Dr. Brownsberger is leading today's I&T activities and has no substantive news to report.
- CEDAR has been stable for some months and is ready to support upcoming GN2 alignments at Ball.

FUV Detector Overview

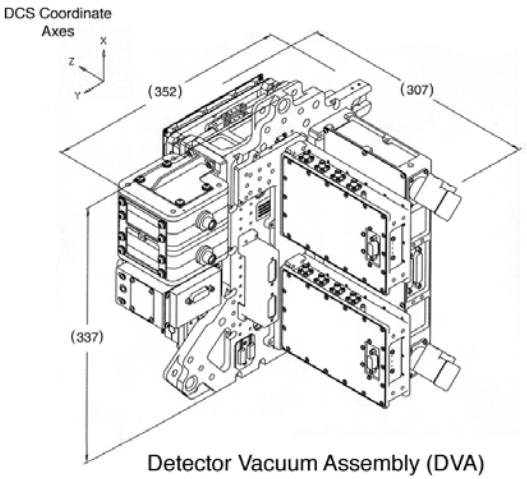
- FUV-01 was delivered to Ball on Wednesday, July 31st!
- FUV-01 has successfully completed all functional, environmental, and performance tests
  - Door rework fully completed and tested
  - QE grid rework fully completed and tested
- Jason McPhate, Adrian Martin, Chris Scholz, and others at UCB are to be commended for their hard work in completing FUV-01.

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)



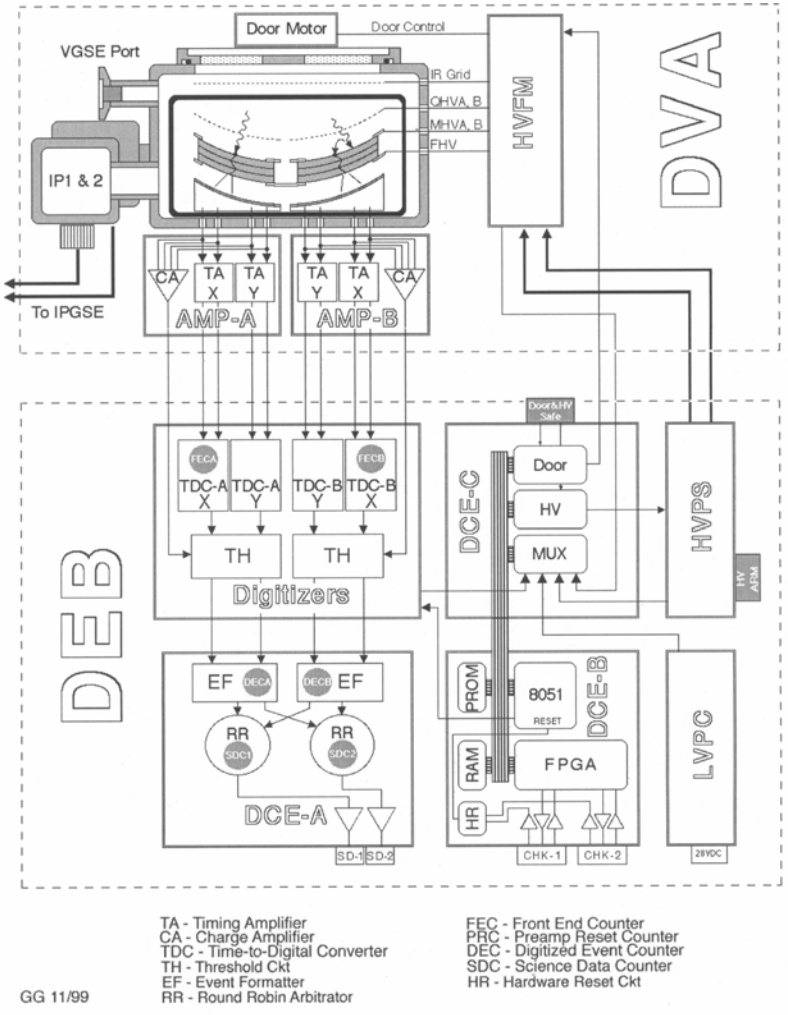
Detector Electronics Box (DEB)



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

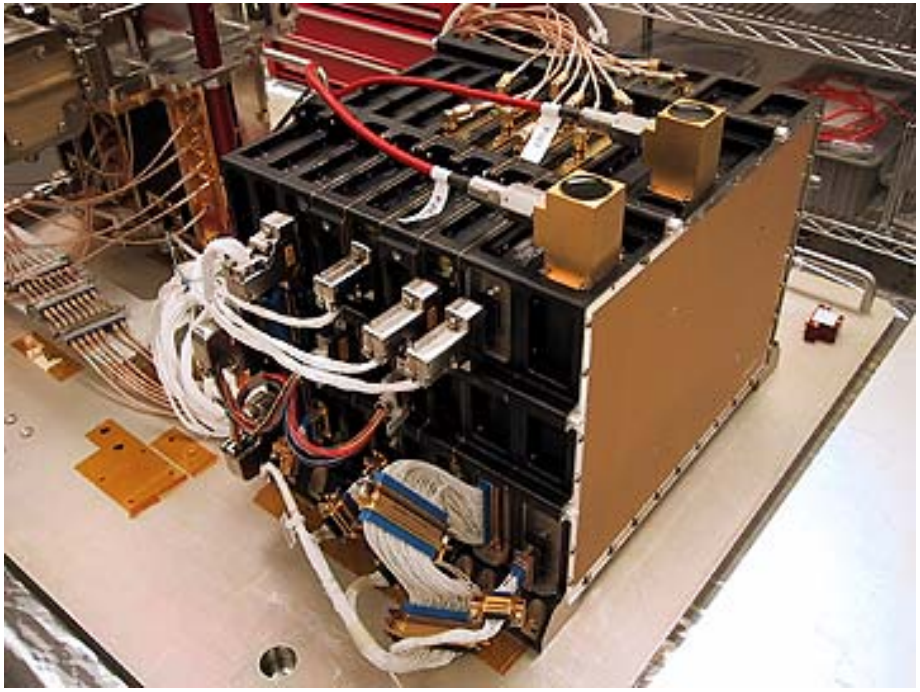
Unit	Functional Testing	Performance Testing	EMI/EMC	Sine Burst	Random Vibe	Thermal-Vac	Contamination Certification
FUV-01 DVA	C	C	@SS	A - C	A - C	@SS	@SS
FUV-01 DEB	C	C	@SS	Q - C	Q - C	@SS	@SS
FUV-01 SS	C	C	C	@Comp	@Comp	8-cycles	C
FUV-02 DVA	C	C	N/R	Q - P	Q - P	@SS	@SS
FUV-02 DEB	C	C	N/R	Q - P	Q - P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

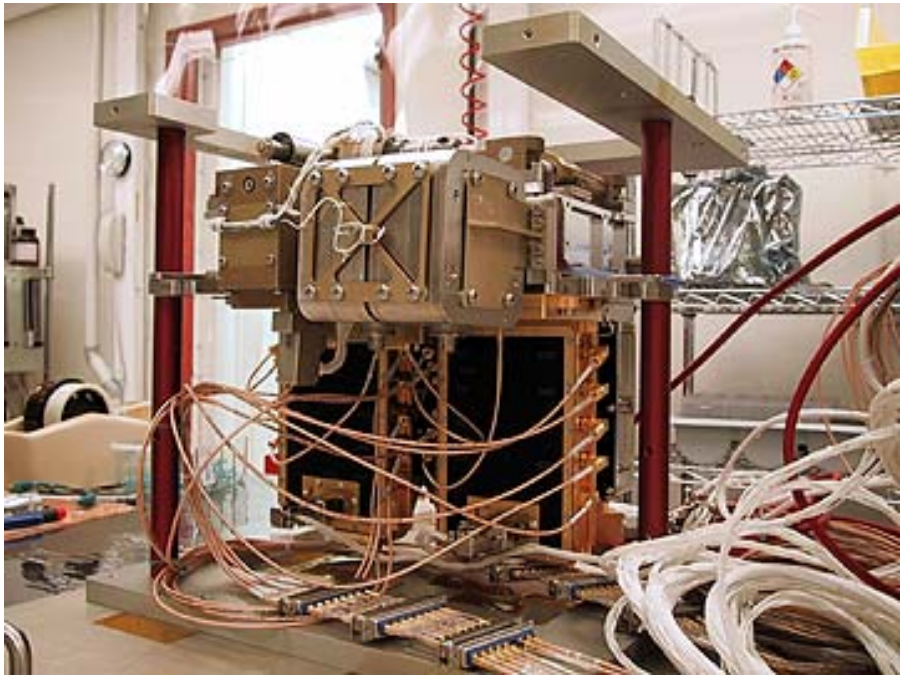
- FUV-01 DVA has now seen acceptance level vibe 2x.
- A single-axis workmanship vibe on FUV-01 DVA was completed after the door mechanism was repaired in early March.
- A single, z-axis acceptance level vibe on FUV-01 DVA was completed after installation of new grids.

COS FUV Detector Systems

- Detector DEB



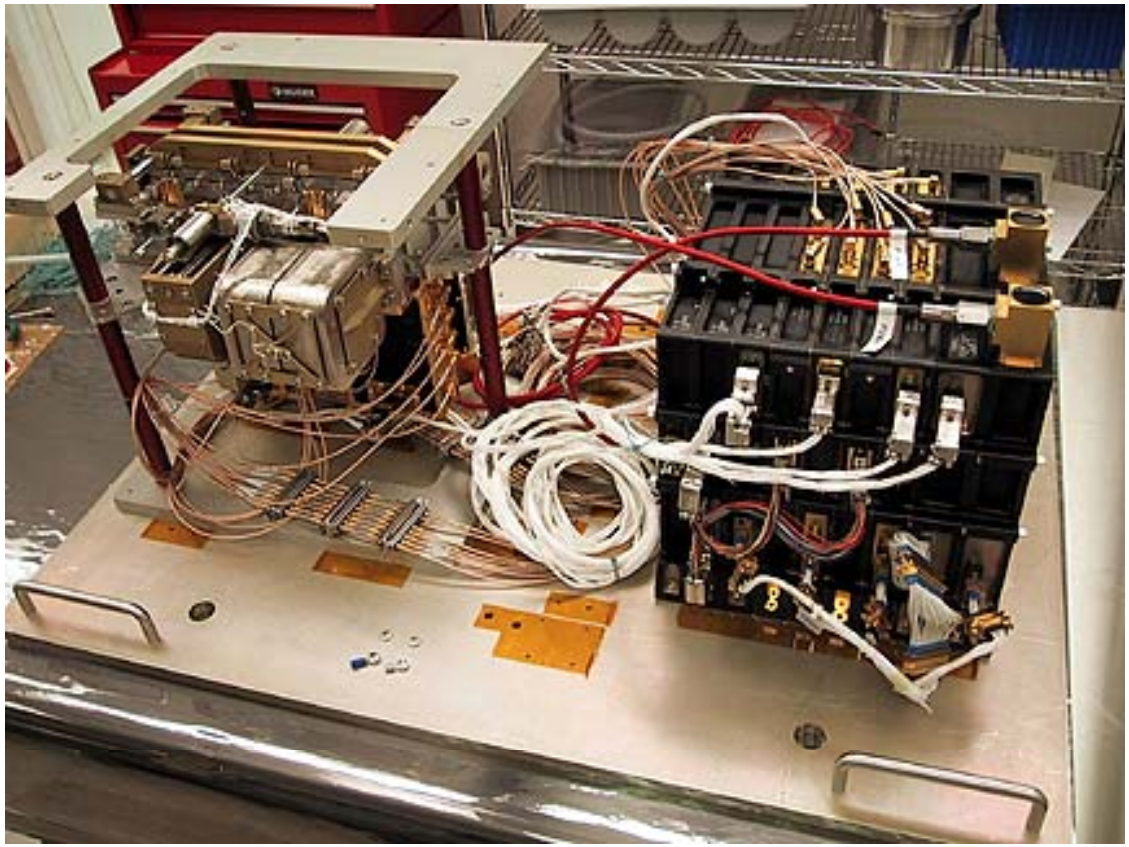
- Detector Head



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 have completed thermal vacuum, delivery to Ball imminent.

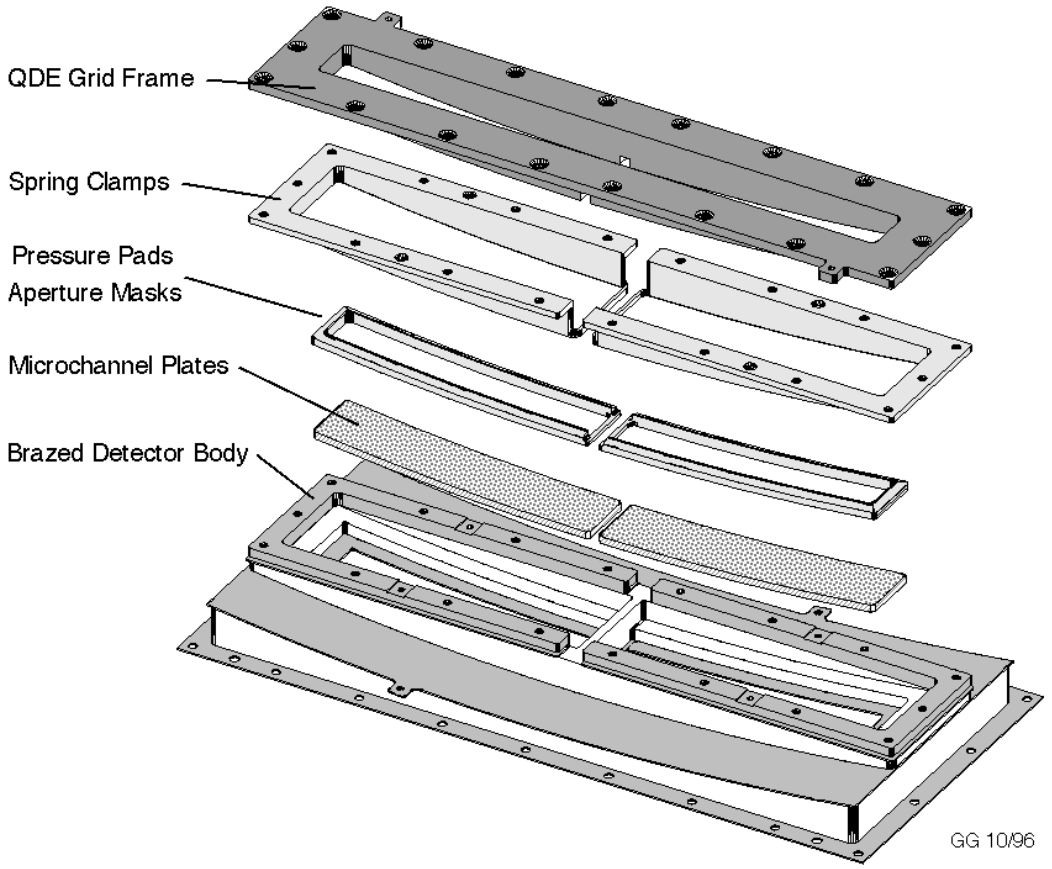


FUV01 Grid Design

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

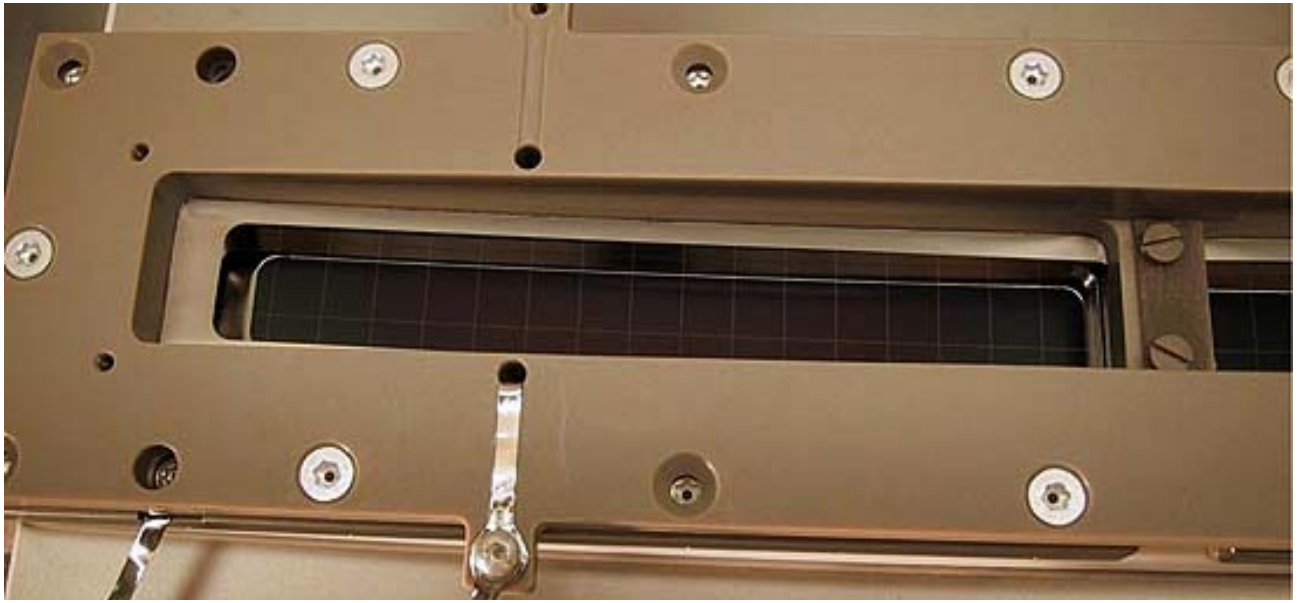
Original Buckbee-Mears mesh, several wires broke in final test.
Can be removed or installed without disturbing MCP's
Access by removing DBA & magnetic shield from VHA



FUV01 Grid Design

FUV01

Original Mesh made by Buckbee-Mears. Grids selected by optical inspection. Nodules & wire breaks rejected. Glued to frame with silver epoxy. Cured at elevated temperature (60°C)



Tests and Models of Grid Wire Problem - materials tests

Original Buckbee-Mears meshes were too fragile & thermal expansion differentials with PEEK frame caused a problem. Changed to more robust Stork-Veco mesh with room temp epoxy cure and glass filled PEEK frame.

Epoxy Tests

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

Original Buckbee Mears Grid Tests.

15µm wide, 8µm thick, Yield strength ~74 ksi with 3% elongation

New Buckbee Mears Grid Tests.

15µm wide, 8µm thick, Yield strength ~50 ksi with 3% elongation

New Buckbee-Mears meshes are weaker than originals

New Stork-Veco Grid Tests.

35µm wide, 12µm thick, Yield strength ~165ksi with 5% elongation

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

Stork-Veco Grid Assembly Verification/Lifetest Sequence

Field emission tested on a detector successfully
Completed thermal cycles, -25°C to +50°C, - OK
Inspection and field emission test - OK (with 2 broken wires, handling)
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

This month:-
2 minute Qualification Vibration - OK
Inspection and field emission test - OK
3 thermal cycles, -25°C to +50°C - OK
Inspection and field emission test - OK
4 minute acceptance vibration - OK
Inspection and field emission test - OK

Grid Lifetest Successful!

Flight and Flight Backup Grid Installation

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

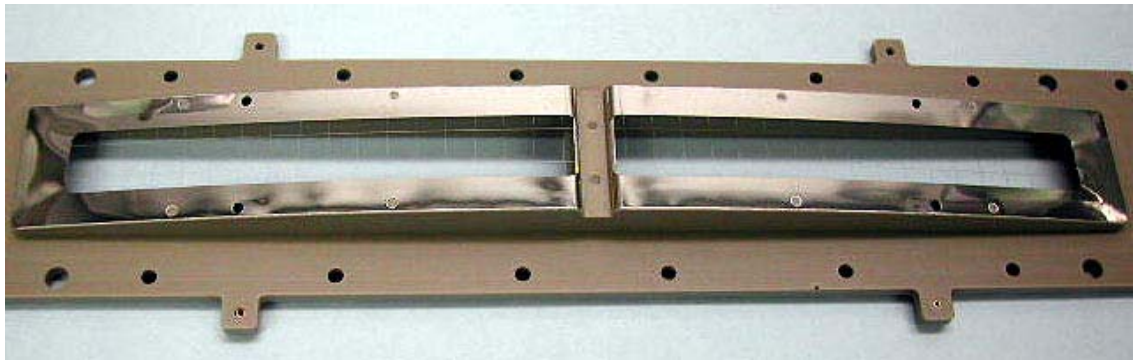
Vibration test

Inspection and field emission test

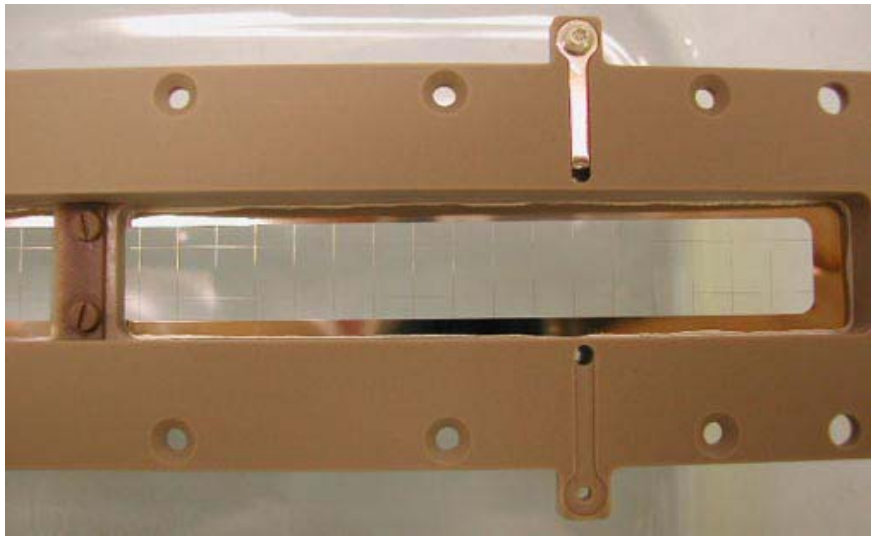
First has been installed on FUV01 and second will be used for FUV02

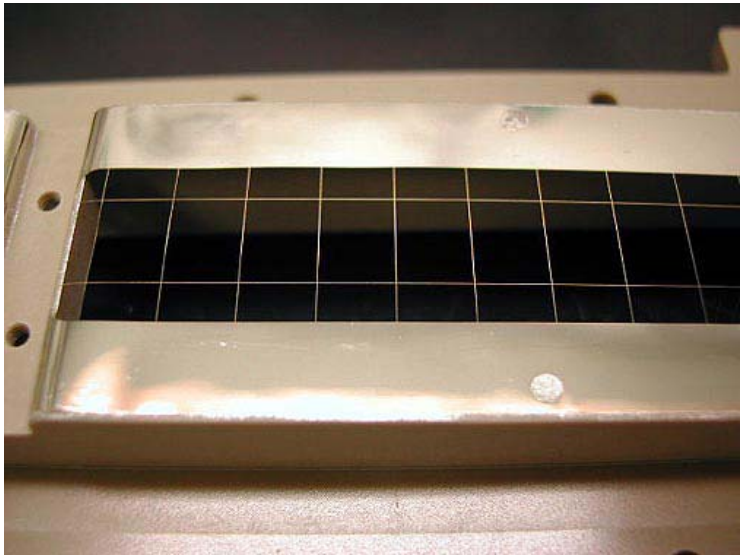
Biggest issues have been the considerable extra handling of the new grid assemblies

Flight Grid Solution



Stork-Veco mesh on 30% glass filled PEEK frame





Retrofit and Commissioning steps for FUV01

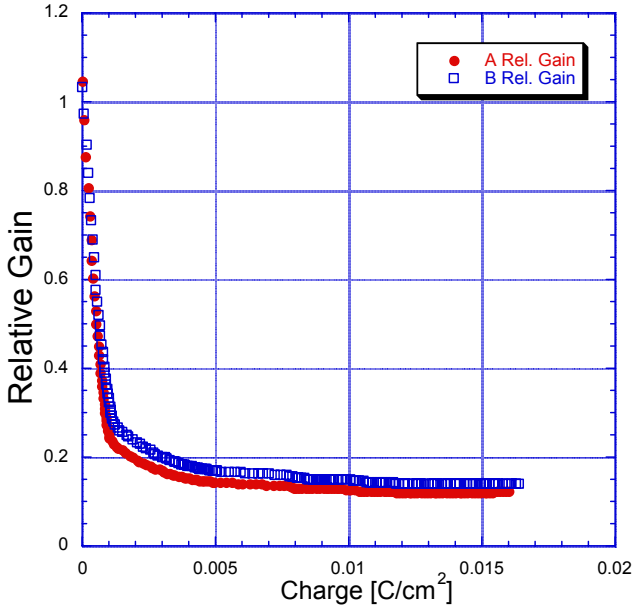
- Check of detector QE performance - DONE
- Replace broken FUV01 grid frame - DONE
- Full set of detector functional tests - DONE
- Acceptance vibration test (Z - axis) - DONE
- Full set of detector functional tests - DONE
- Check of detector QE performance - DONE
- Re-scrub detector and functional test - DONE
- Check of detector QE performance - DONE
- Ship to CU --- Thermal vacuum test - DONE
- Thermal vacuum finished successfully 7/29, including:
    - Door ops with 4 HOP firings, hot & cold soaks, plus 2 temp cycles
- Cleanliness certification looks good, but may perform repeat at Ball
- Deliver to Ball - DONE

FUV01 Post Grid Change Tests

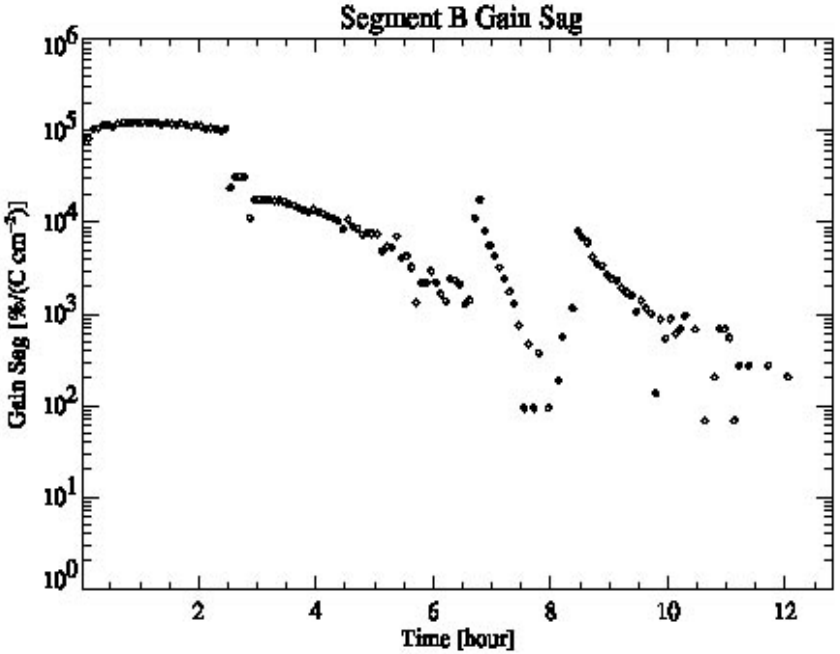
FUV01 detector background is low, gain & pulse height good

Needed short scrub to stabilize gain, initial outgas seen, then quickly stabilizing

Stabilization at <0.015 C/cm^{-2}, < 10% of original scrub



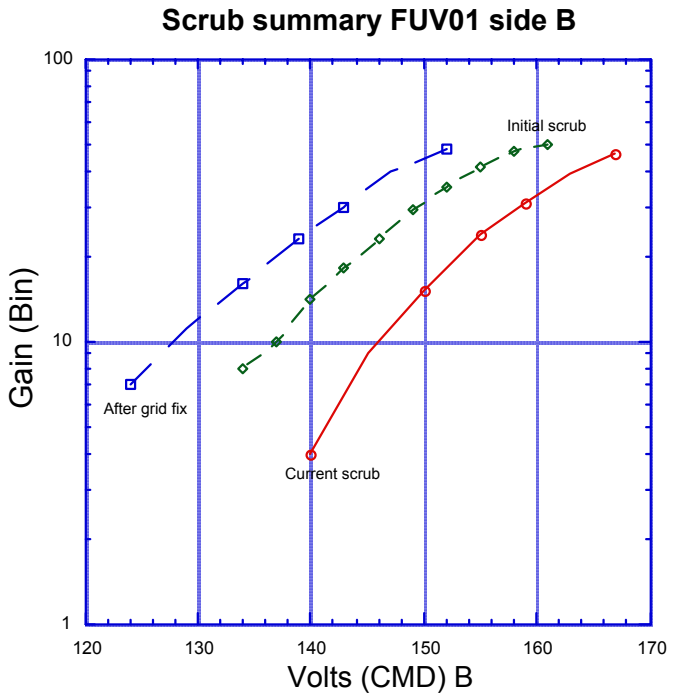
Gain drop shows initial outgas and stabilization

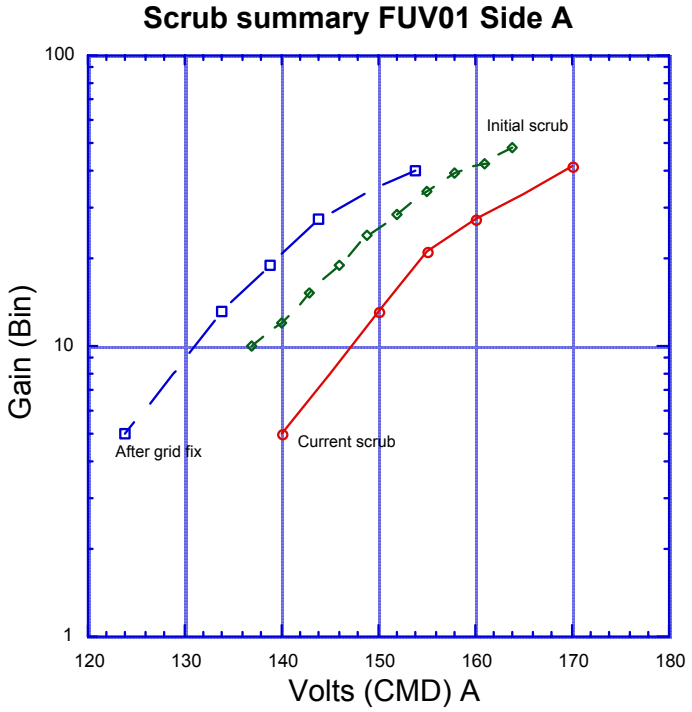


Gain sag rate, goal <100%/Coulomb/cm^{-2}

FL01 Detector Scrub Summary

FUV01 gain was higher after exposure to replace QE grid (gas adsorption)
After short scrub gain curve was lower than for previous scrub
Gain and pulse heights still good, no effect on detector performance





Flight Detector QE Checks

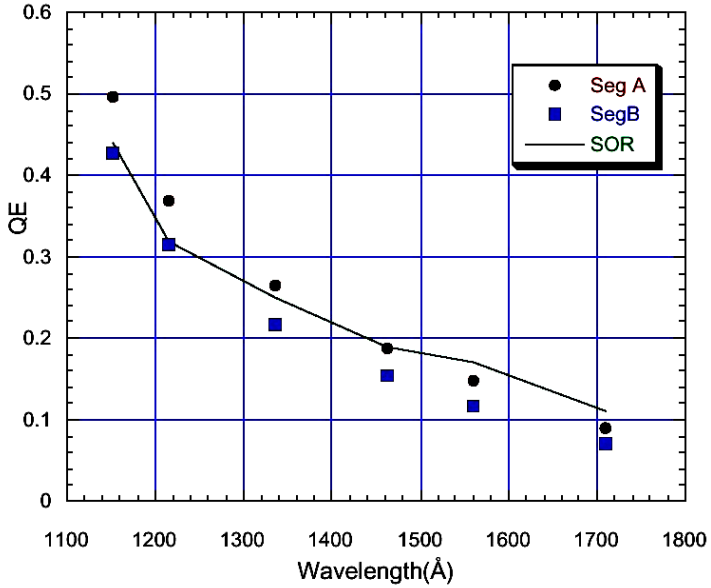
Measured QE values show drop in QE since initial cathode fabrication.

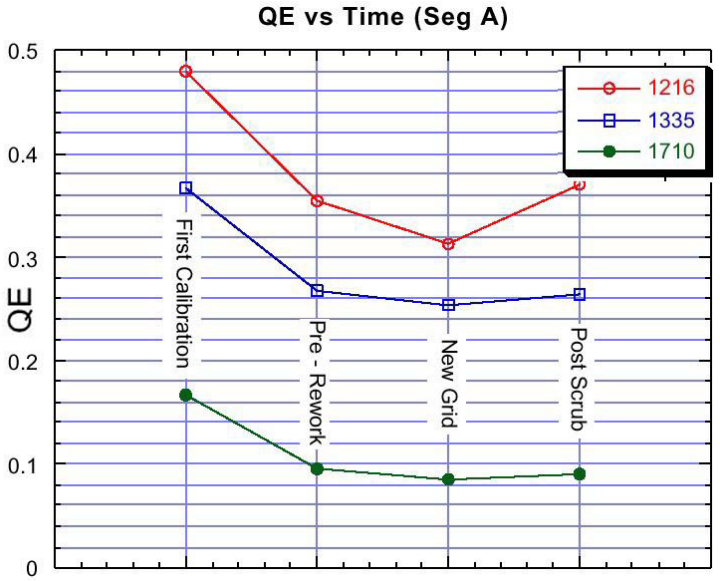
Values are still at or above SOR at short wavelengths, slightly below SOR at long wavelengths. However, system level requirements still above SOR/CEI.

QE drop in grid changeout was minimal, regained some QE in modified scrub.

QE drop is mostly due to initial scrub, as shown by recent research, and GALEX – the magnitude of this effect and its dependence on scrub parameters was not fully understood at the time of initial COS scrub.

Current measured QE values for FUV01





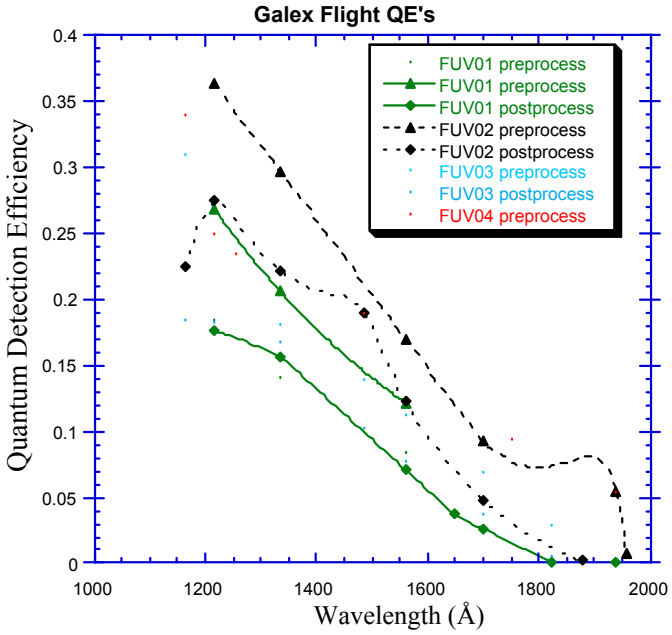
Flight Detector QE Checks

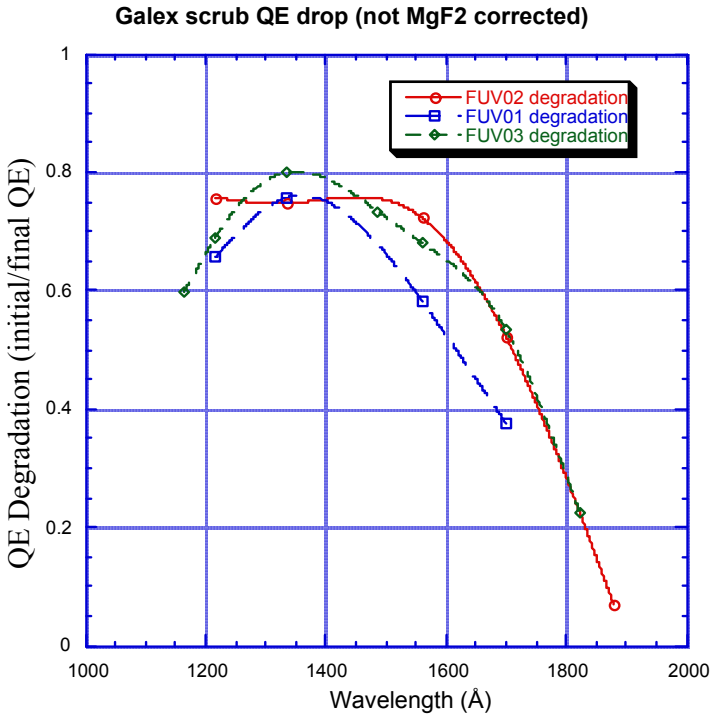
Recent data from GALEX and NASA R&D indicate scrub induces a QE degradation.

Our data shows QE loss can be minimized by scrub with longer λ scrub at higher flux for less time.

Pre-scrub before cathode deposition **is effective,** and minimizes scrub with cathode.

Propose hard scrub on FUV02 pre-cathode deposit, and short post cathode scrub – this will hopefully produce a FUV 02 detector with higher QE than the current FUV 01.





UCB FUV02, Flight Backup Detector, Status

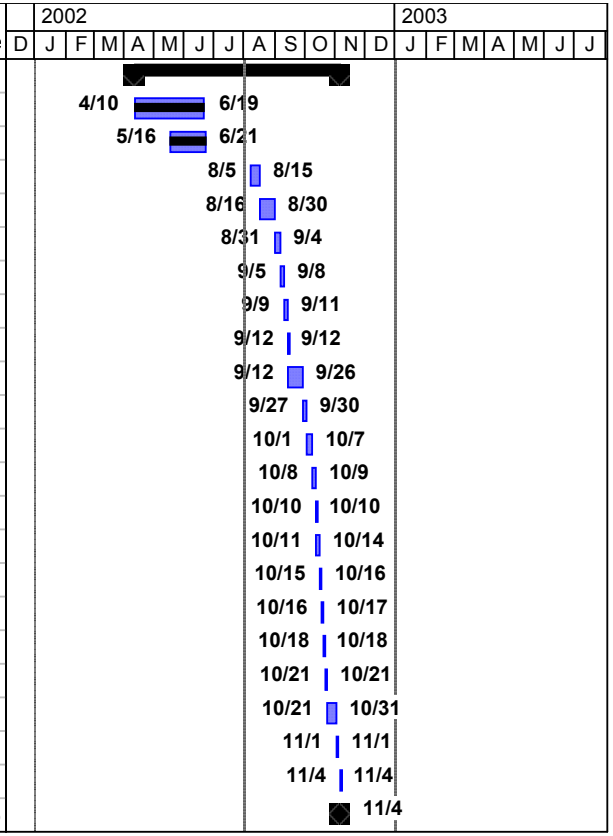
- **DEB -** All boards have been cleaned, coated, staked, and vacuum baked.
- **Harnesses -** Cleaned and vacuum baked/certified.
- **DBA -** Built up and integrated with VHA, at UCB.
- **Vacuum Housing Assembly**
  - Successfully completed alignment tests at Ball.
  - Door assembly at UCB awaiting re-assembly 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 door pre-assembly preparations at UCB - proceeding
•Maintain test vacuum tank, add better cooling - in process
•Re-assemble FUV02 door assembly at UCB and test - this month
•Proceed with final FUV02 buildup, test, & scrub, cathode dep.
•FUV02 environmental testing (vibration and thermal vacuum).

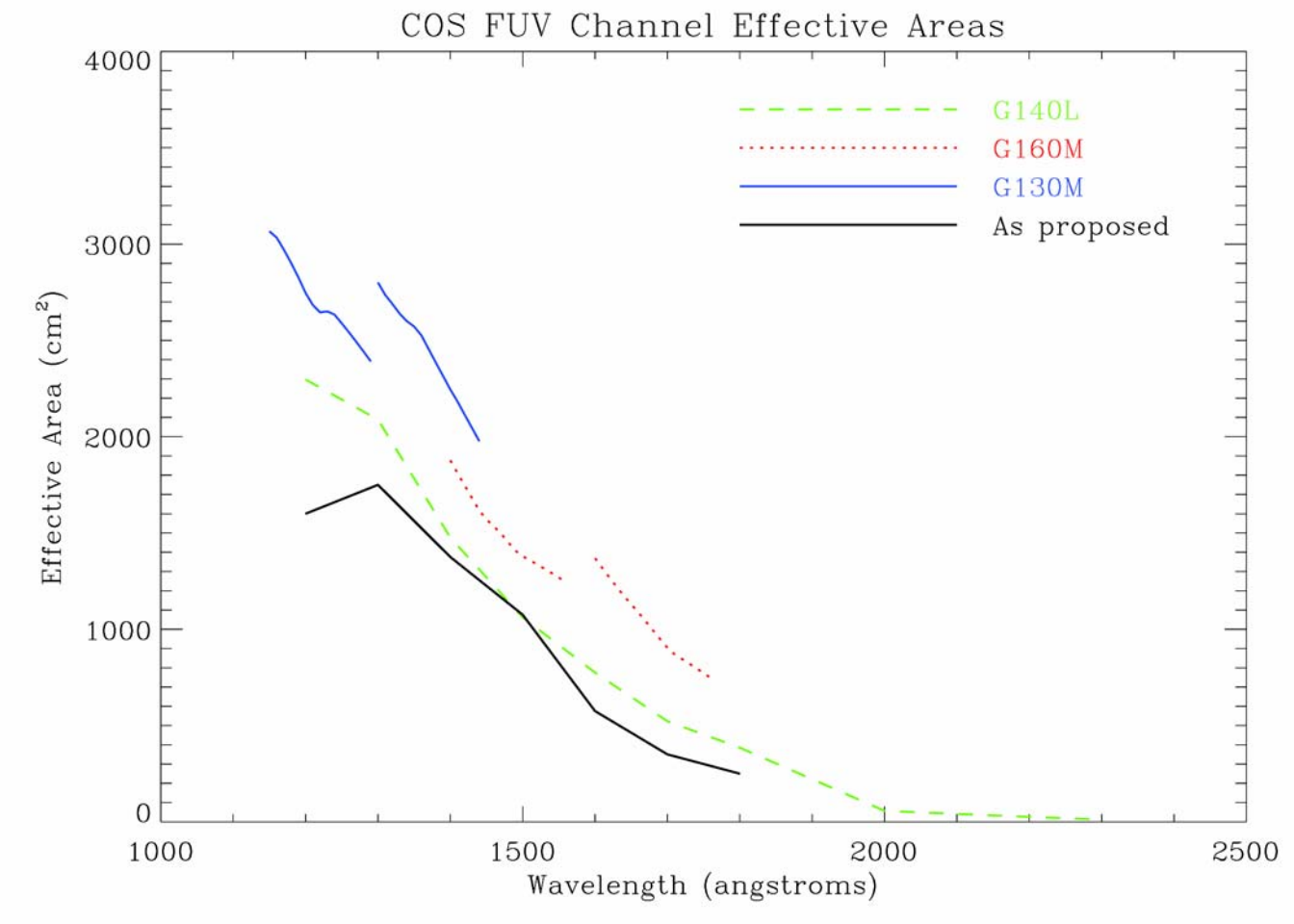
FUV-02 Detector Schedule

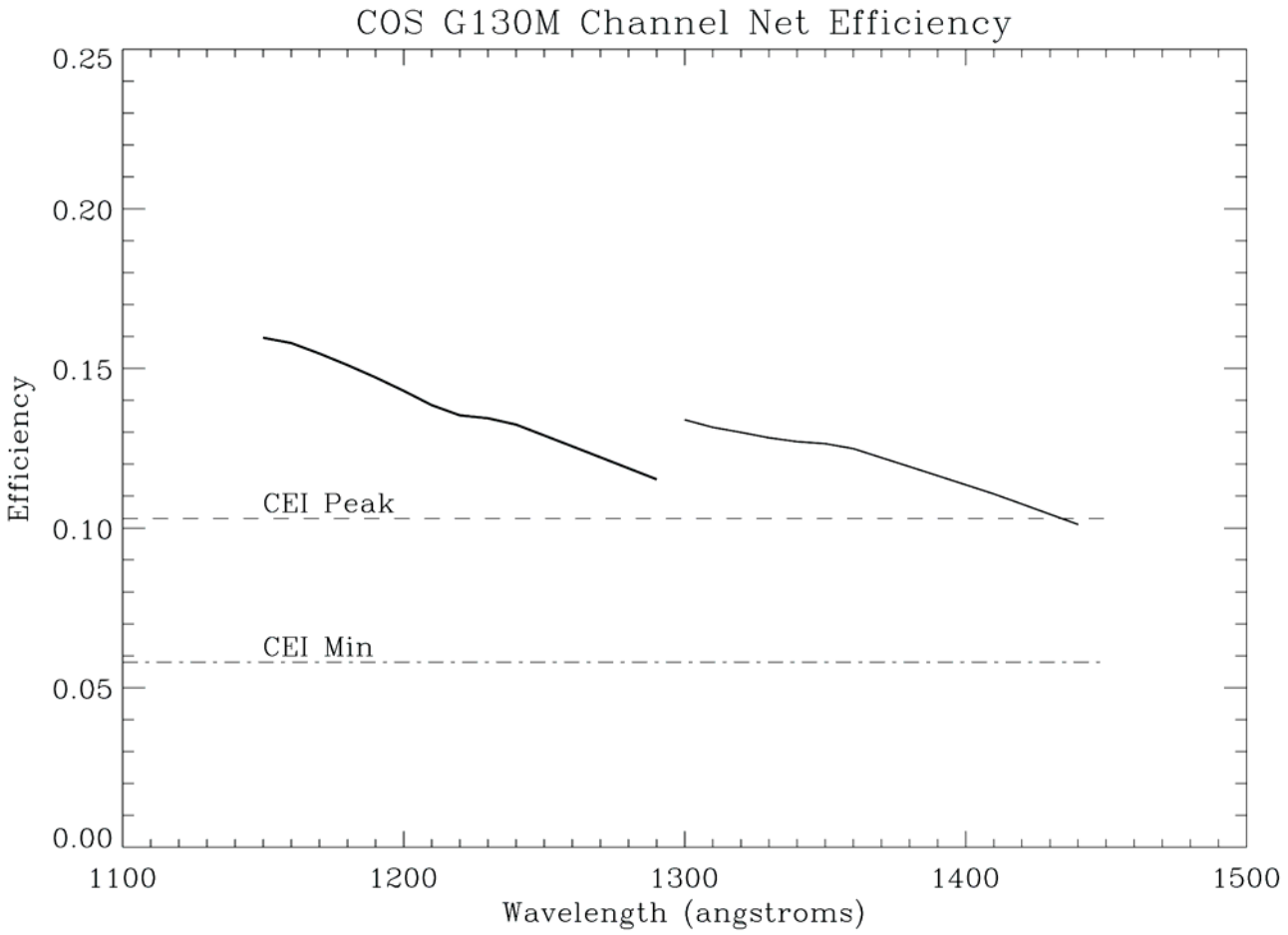
ID	Task Name	Duration	% Complete
1	**FUV-02 Completion Schedule**	**173 days**	**41%**
2	Prep FUV#2 door motor	12 wks	100%
3	Qualify FUV#2 grid (parallel task)	6 wks	100%
4	Build up and test of #2 flight door mechanism	10 days	0%
5	Reprocess BBA and Recal System	12 days	0%
6	Convert BBA#2 to DVA#2 (need ion repeller grid + door mechanism)	5 days	0%
7	Qualification vibration testing of DVA#2 at LMMS	3 days	0%
8	Install and align FUV#2 into QE chamber for scrub	3 days	0%
9	Pre-pump down FUV#2 functional test with flight DEB in air	1 day	0%
10	Scrub of FUV#2 plates in Calib chamber	14 edays	0%
11	Remove FUV#2 and deposit photocathode on MCPs	2 days	0%
12	Re-assemble DVA#2, re-install in vac chamber and calibrate quantum efficiency	5 days	0%
13	Vibration testing of DEB#2 and DVA#2 at Lockheed	2 days	0%
14	Post-vibration functional check	1 day	0%
15	Final System Functional testing	2 days	0%
16	Pack detector for shipment	2 days	0%
17	**Ship FUV02 detector system to Uco**	1 eday	0%
18	Install detector system into UCo T-V chamber	1 day	0%
19	Pre-pump down functional testing	1 day	0%
20	System T-V tests	10 edays	0%
21	System cleanliness certification	1 day	0%
22	Remove flight system and pack	1 day	0%
23	**Flight FUV#2 system ready for BATC**	**0 days**	**0%**

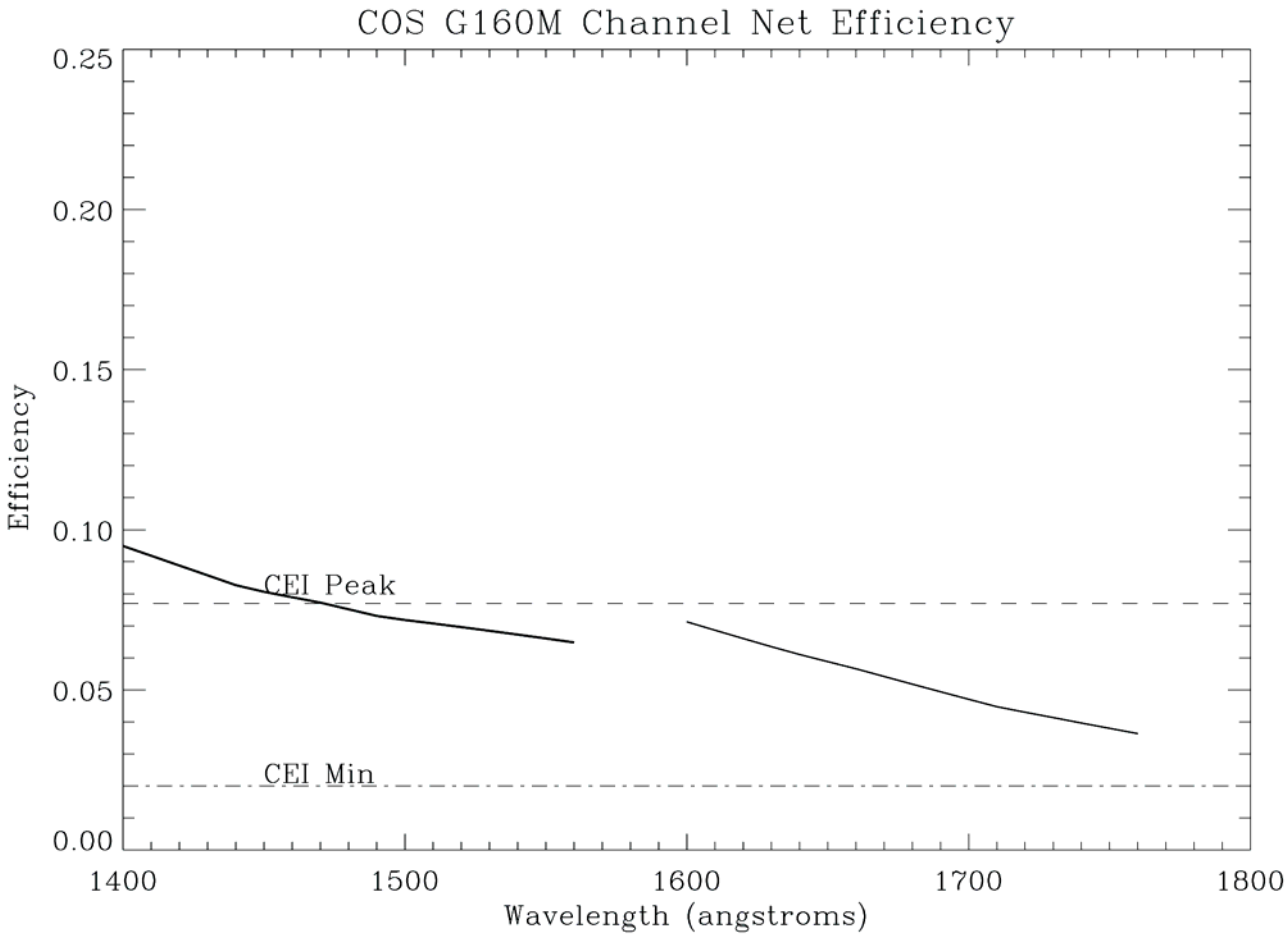


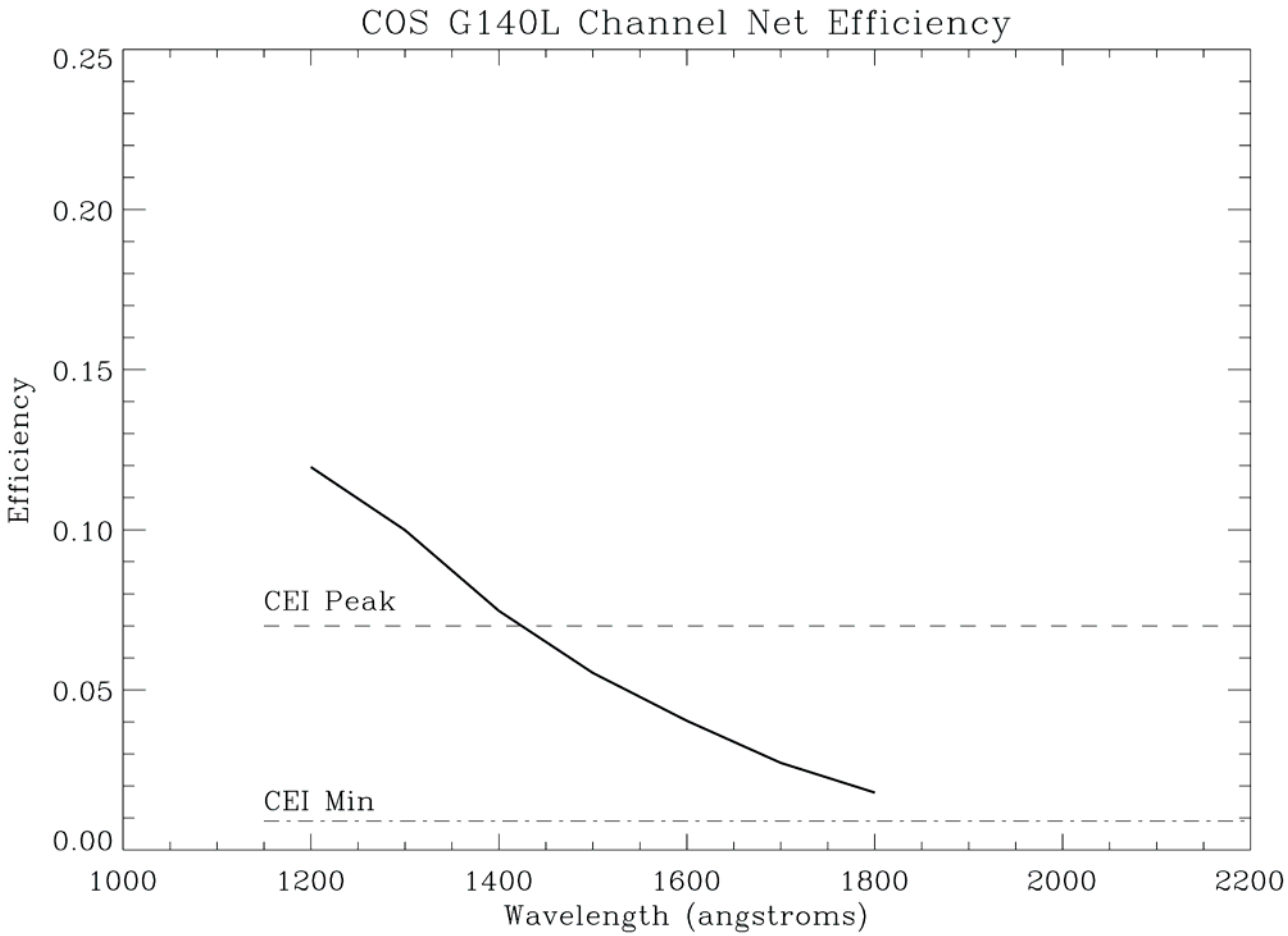
New Instrument Performance Calculator

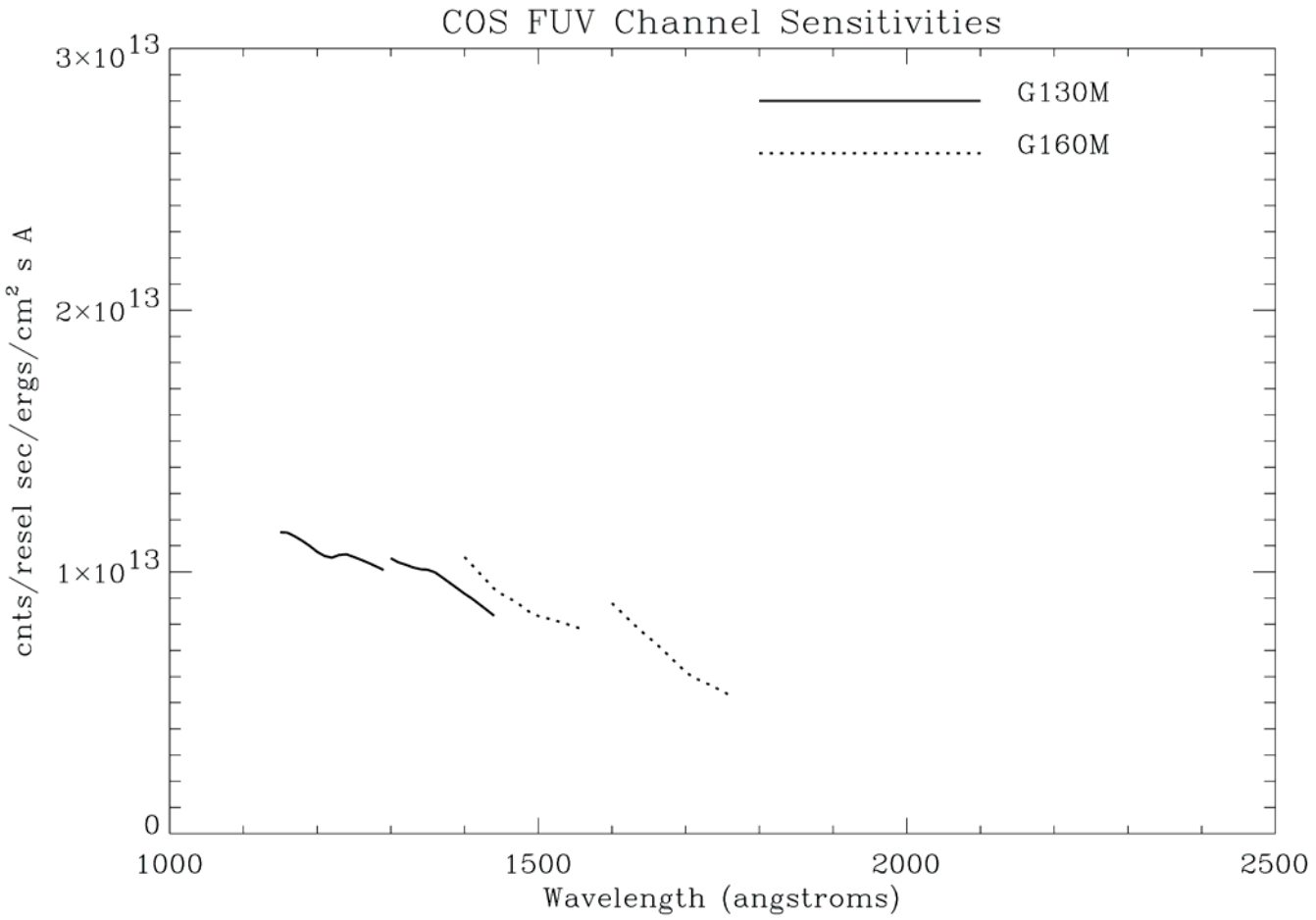
- Previously presented performance estimates used FUV 01 QE data that was measured pre-scrub. It was assumed that the post-scrub will reduce the QE, and has done so for FUV 01.
- New estimates utilize post-scrub QE measurements.
- It is hoped that by altering the scrub/photocathode deposition process, higher QEs will be achieved on FUV 02.
- If FUV 02 has significant performance improvement over FUV 01, we may propose a swap. Exact impact on schedule heavily dependent on time of swap: later in flow = more expensive.
- Current system still meets CEI and exceeds proposed performance. Our science program can still be achieved as proposed.

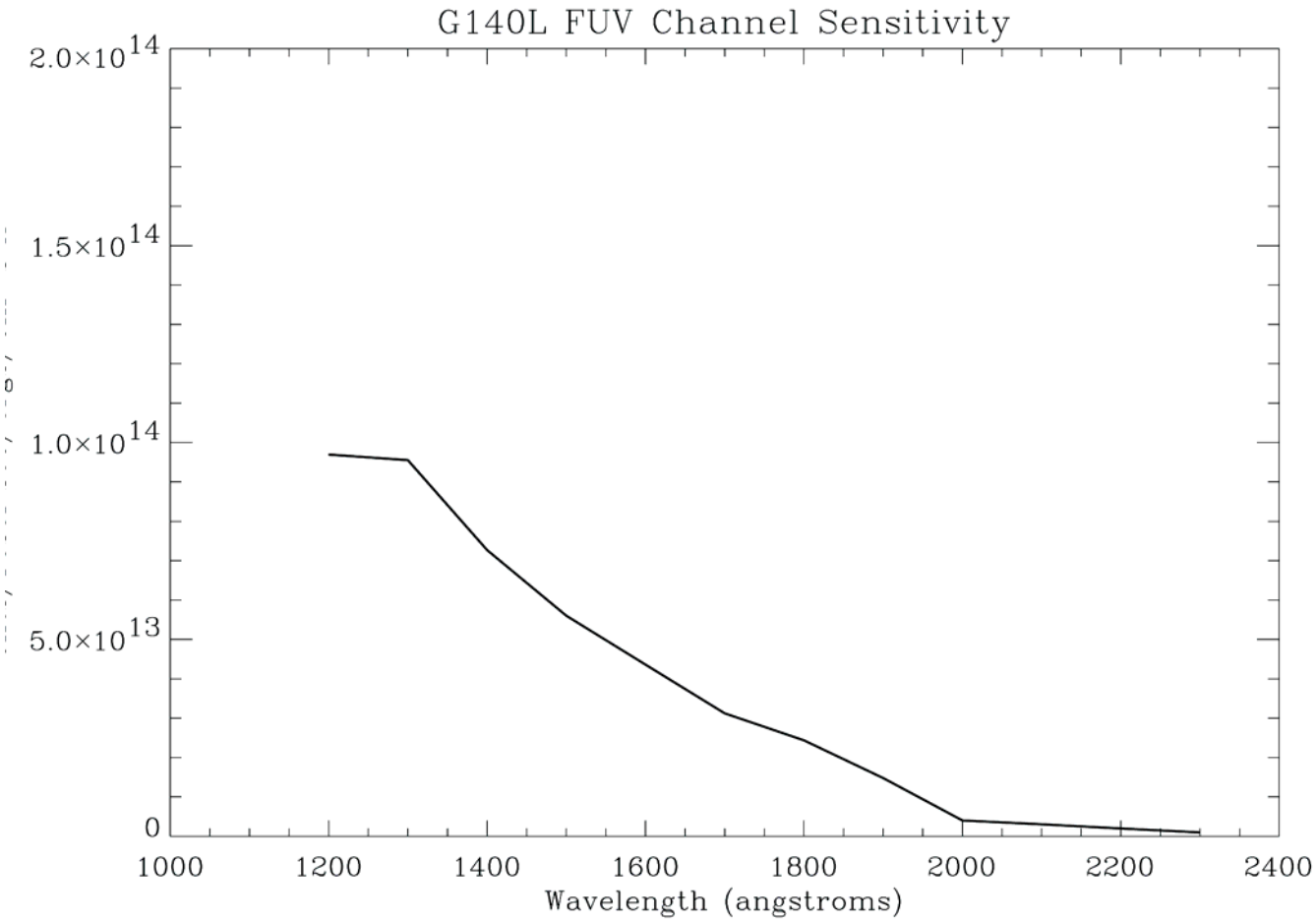

COS FUV Channel Effective Areas
G140L
G160M
G130M
As proposed
Effective Area (cm²)
4000
3000
2000
1000
0
1000
1500
2000
2500
Wavelength (angstroms)


COS G130M Channel Net Efficiency
Efficiency
0.25
0.20
0.15
0.10
0.05
0.00
CEI Peak
CEI Min
1100
1200
1300
1400
1500
Wavelength (angstroms)


COS G160M Channel Net Efficiency
Efficiency
0.25
0.20
0.15
0.10
0.05
0.00
CEI Peak
CEI Min
1400
1500
1600
1700
1800
Wavelength (angstroms)


COS G140L Channel Net Efficiency
Efficiency
0.25
0.20
0.15
0.10
0.05
0.00
CEI Peak
CEI Min
1000
1200
1400
1600
1800
2000
2200
Wavelength (angstroms)


COS FUV Channel Sensitivities
G130M
G160M
cnts/resel sec/ergs/cm^2 s A
3×10^{13}
2×10^{13}
1×10^{13}
0
1000
1500
2000
2500
Wavelength (angstroms)


G140L FUV Channel Sensitivity
2.0×10^14
1.5×10^14
1.0×10^14
5.0×10^13
0
1000
1200
1400
1600
1800
2000
2200
2400
Wavelength (angstroms)

COS Schedule for CU/UCB

Task	Status
CALCOS Software Development	On-going. Completion by ~ TV-2 mos
Cal/FF SS Optical Integration	Complete
FUV-01 Grid Rework Activities	Complete
FUV-01 Delivery	Complete
Complete FUV-02	Deliver 11/02.

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

- Support FUV-01 integration at Ball.
- Complete FUV-01 verification matrix and assemble/submit verification package.
- Post-environmental testing of Cal/FF subsystem.
- Continue ground calibration planning.
- Commence FUV-02 final assy. and start environmental testing.

Issues

- None