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**COS**  
**Monthly Status Review**  
**February 6, 2002**  
**Ball**



COS  
*Monthly Status Review*



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**Agenda**

Progress Summary Since Last Monthly	J. Andrews
Optics Development Status	J. Green
Instrument Performance Overview	J. Green
Ground Calibration Planning	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 (12/5/01)

- Received and processed final flight NUV gratings.
- Reworked FUV detector door mechanism
  - Tested successfully in vacuum
  - Vibed at Ball
  - A new anomaly observed in TV test
- Began recovery efforts to implement further door rework.



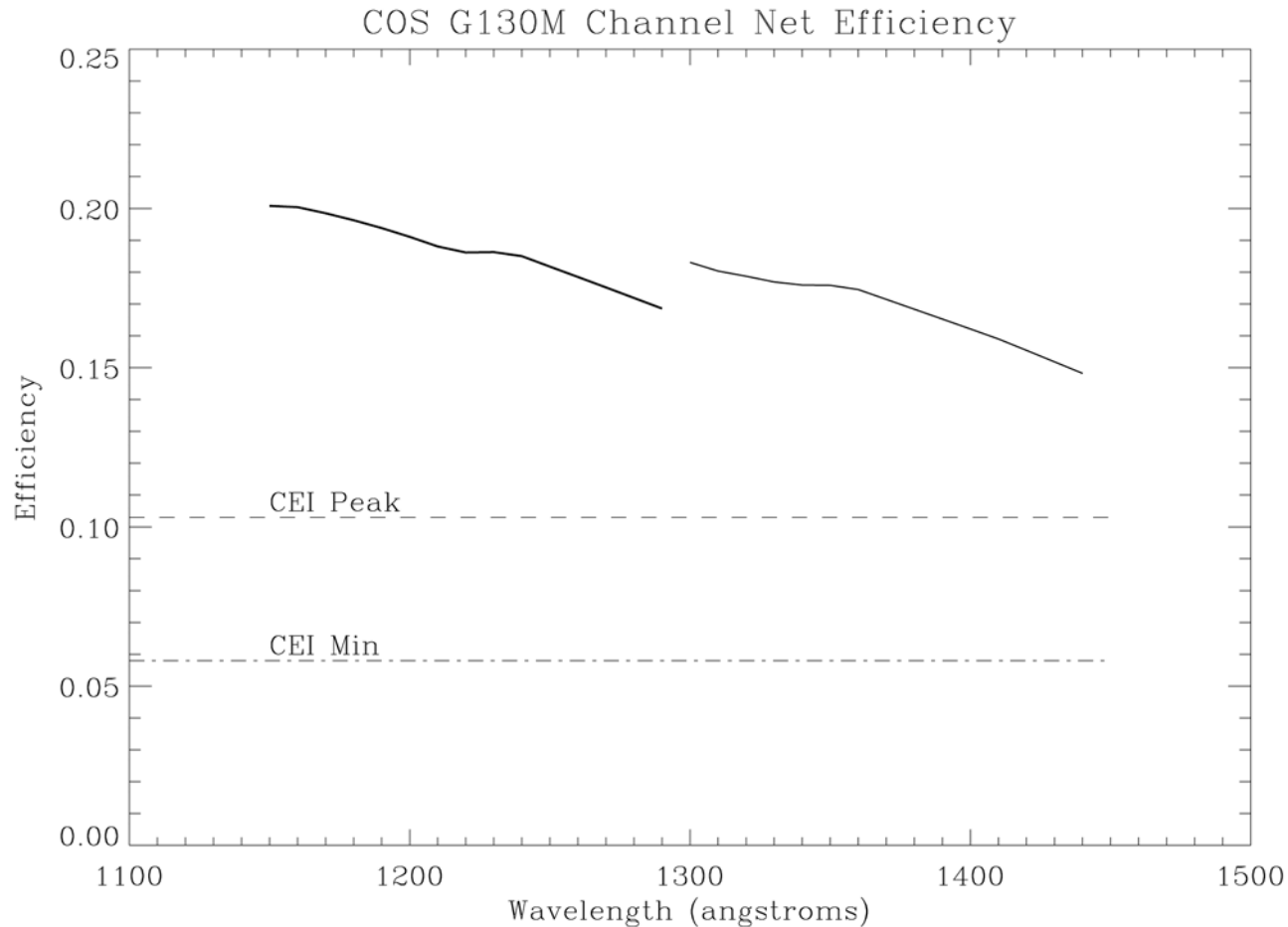
## Optics Development Status

- All FUV gratings are completed, coated, mounted, tested and meet/exceed specifications.
- All NUV flight gratings are fabricated, coated, tested and delivered to Ball. All meet/exceed CEI throughput specification.
- Two gratings utilize bare Al coatings - we have discussed this with John Mangus and Richard Harms and they agree the coatings will be fine.
- **THE NUV “PROBLEM” IS CLOSED.**



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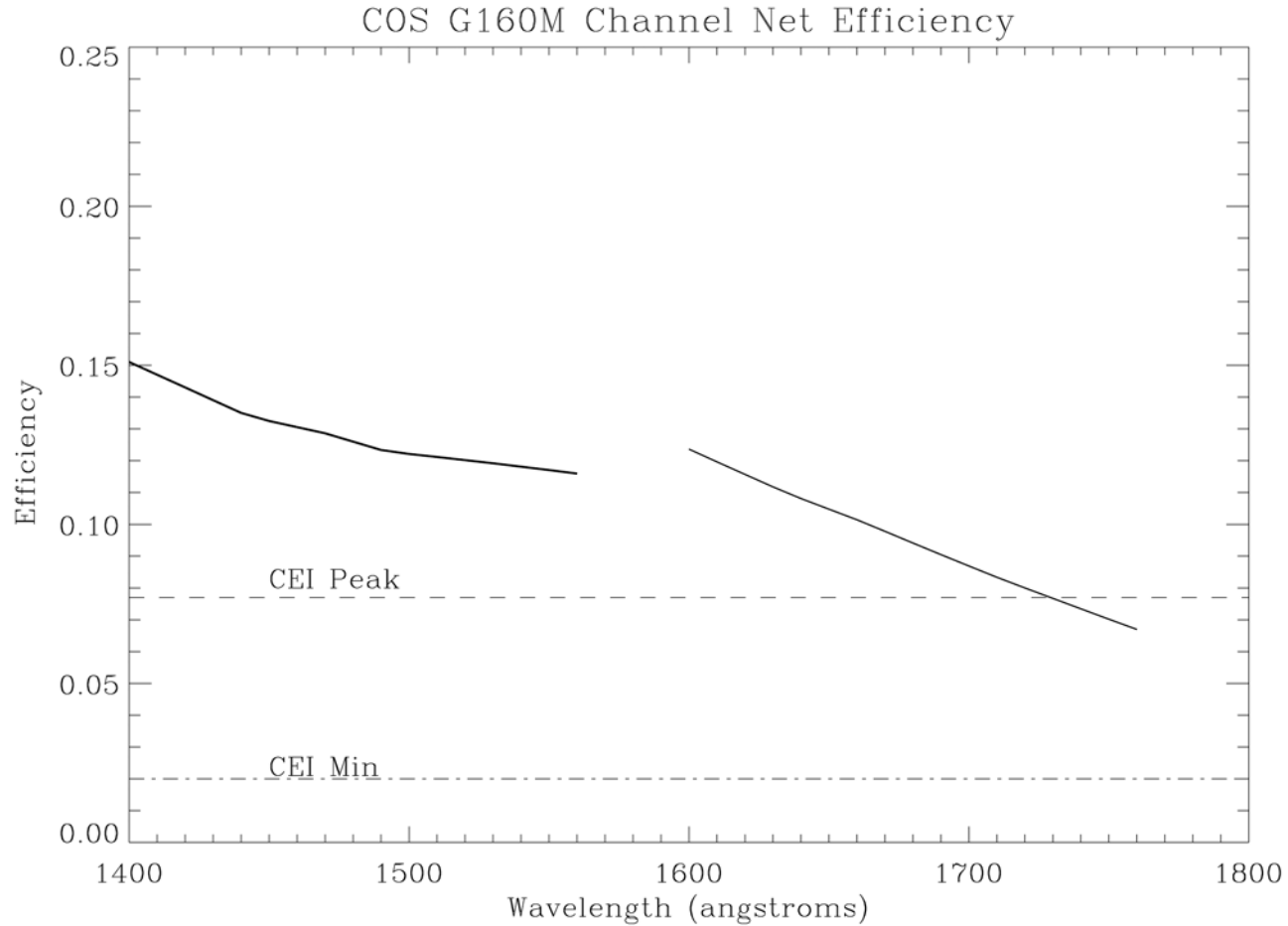
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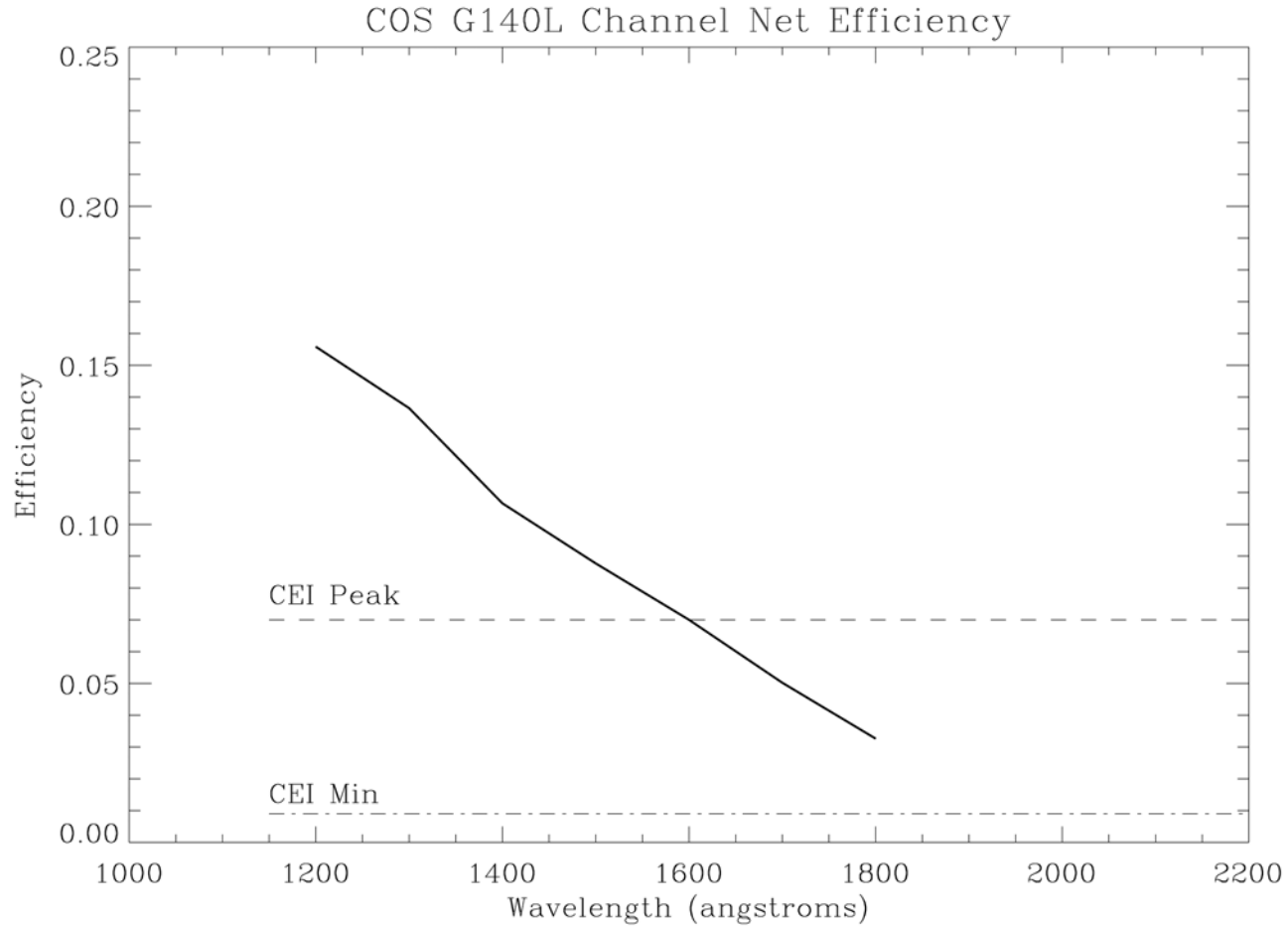
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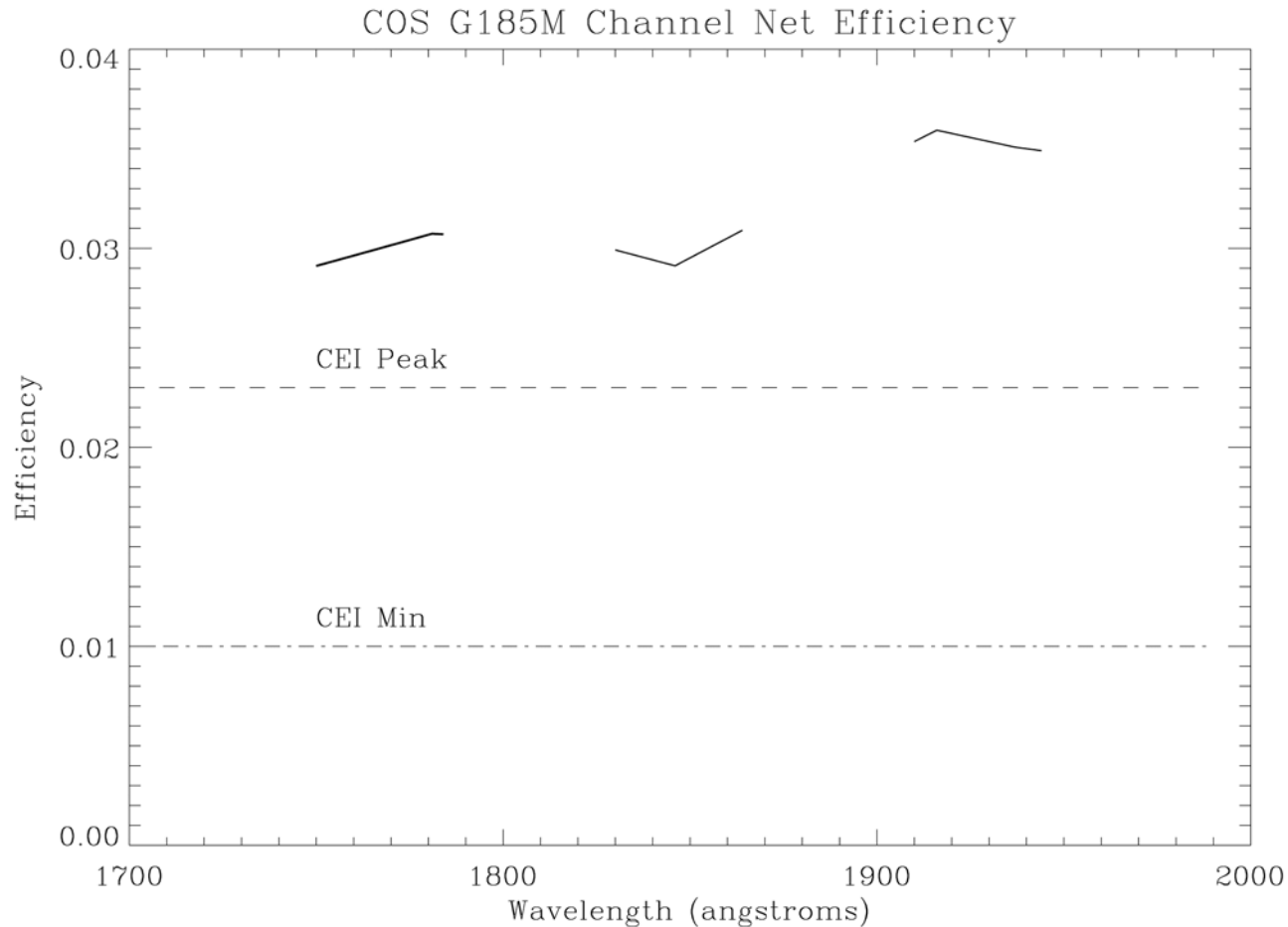
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## Monthly Status Review

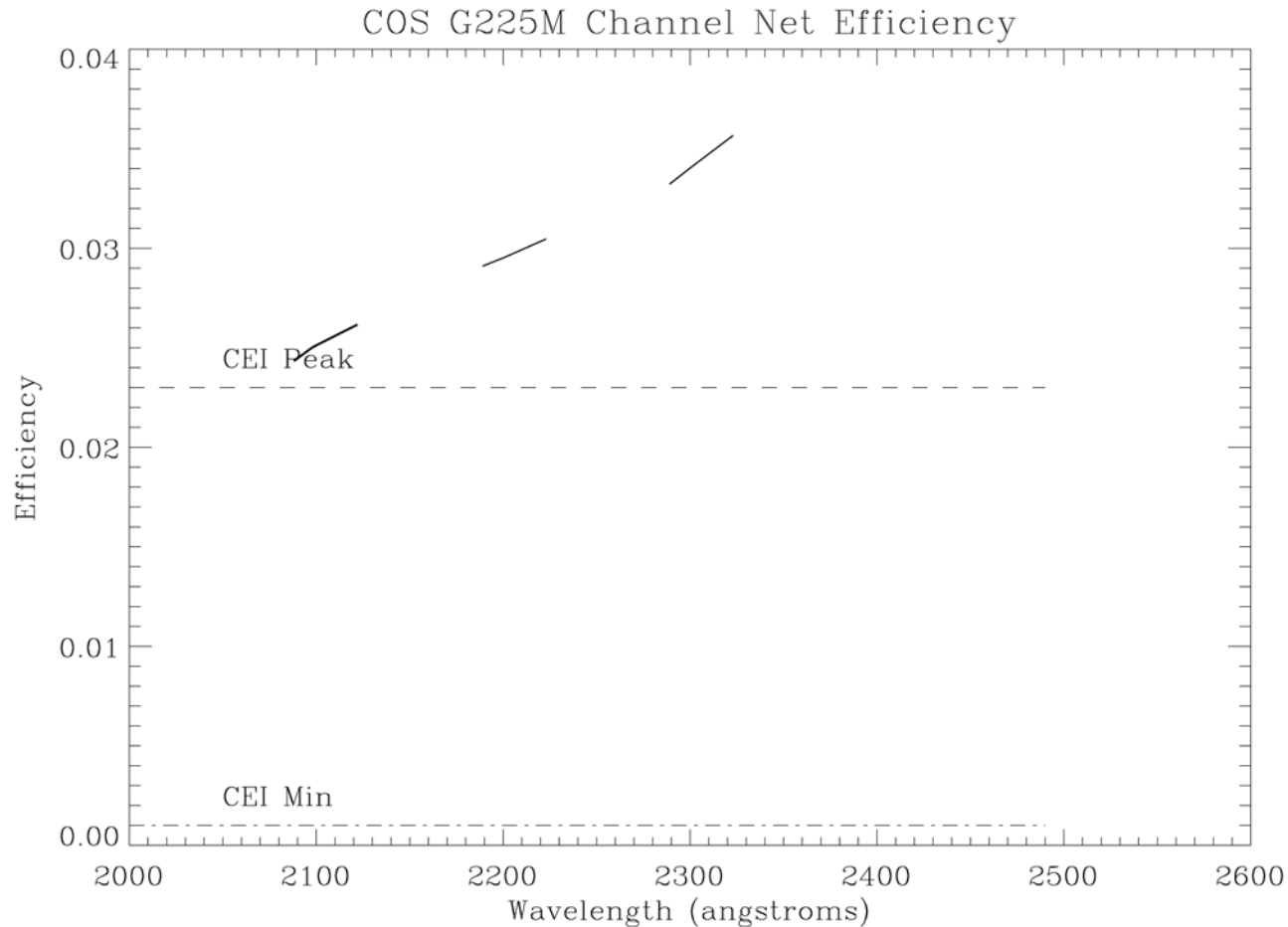






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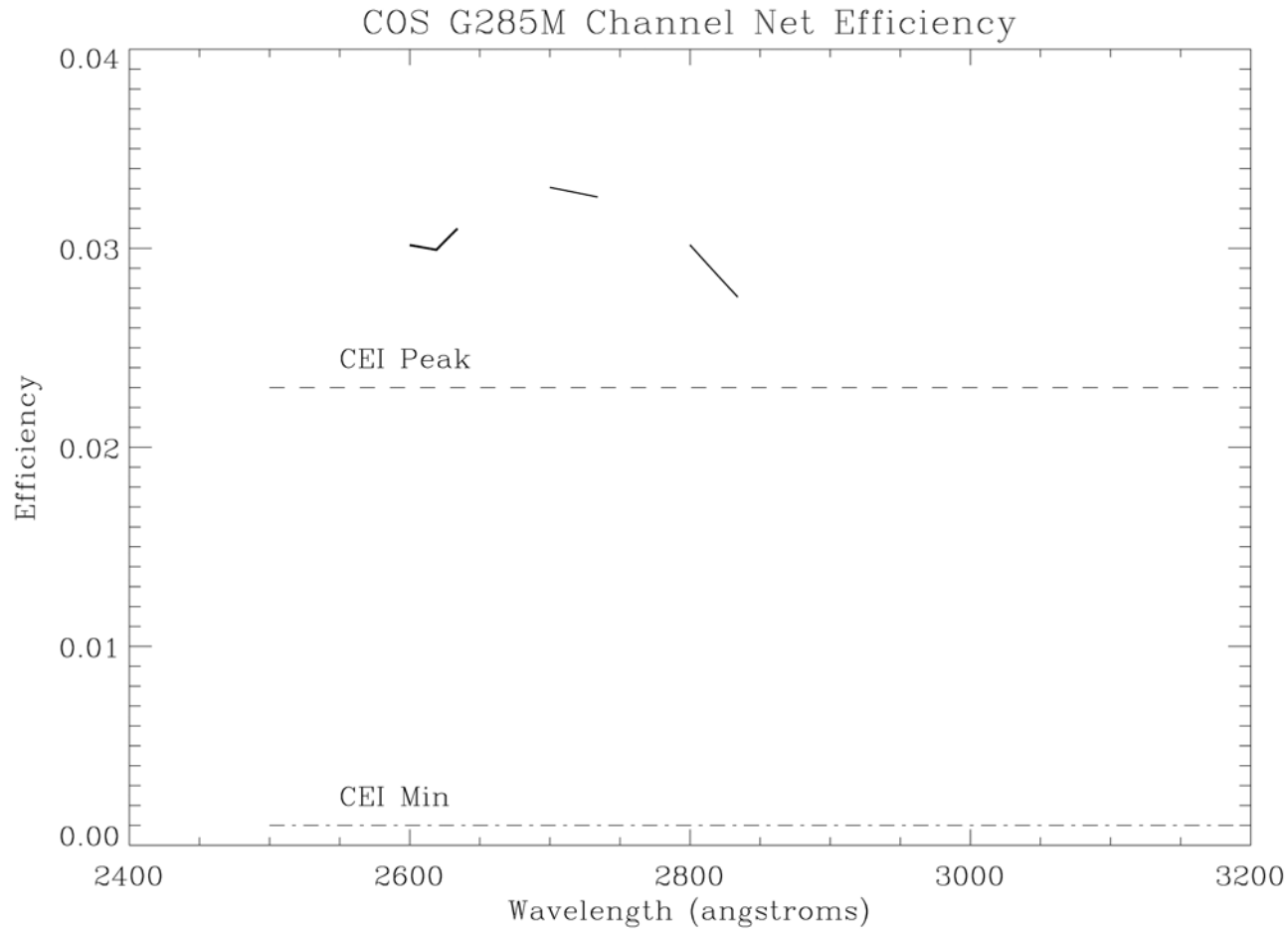
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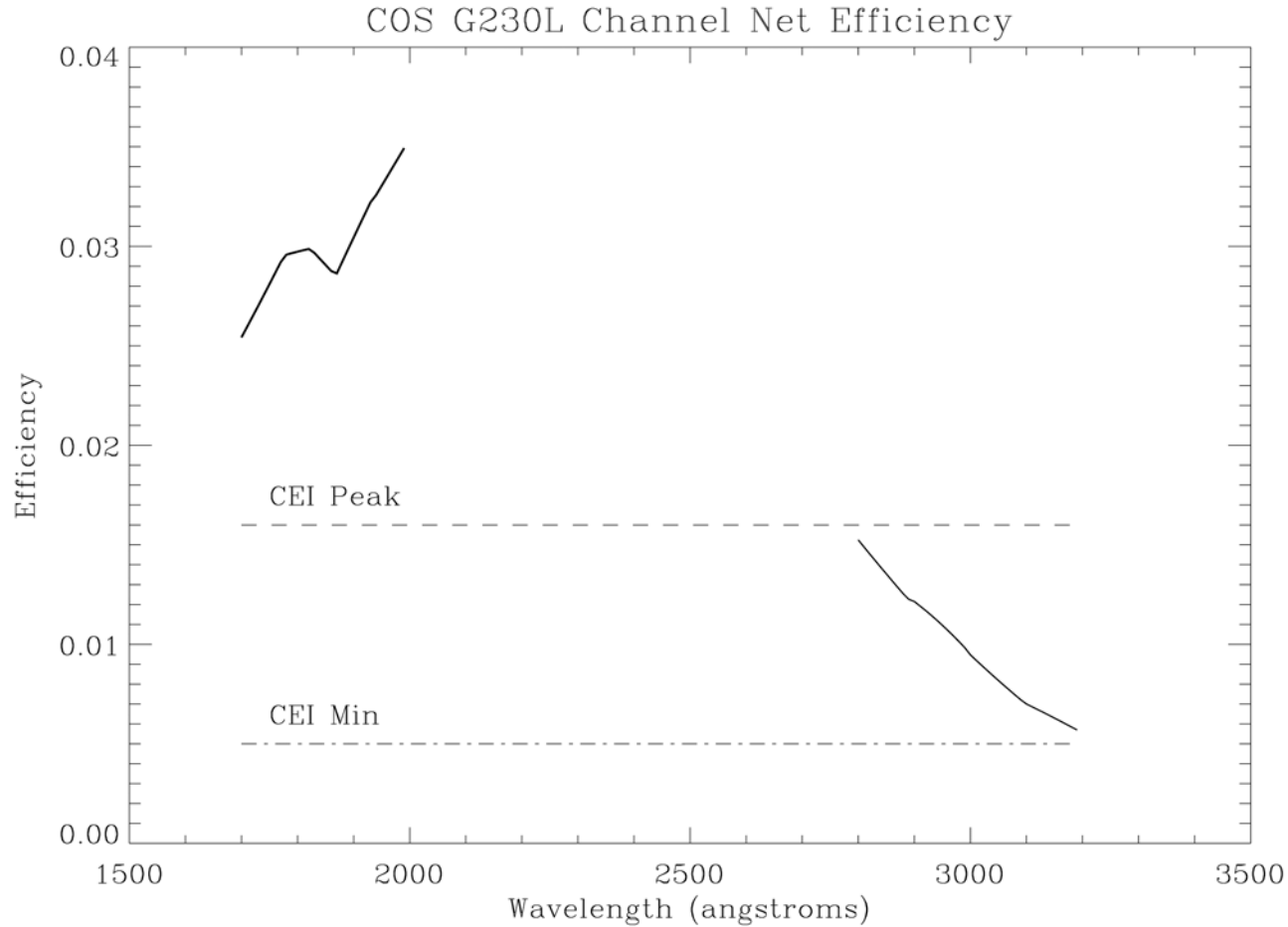
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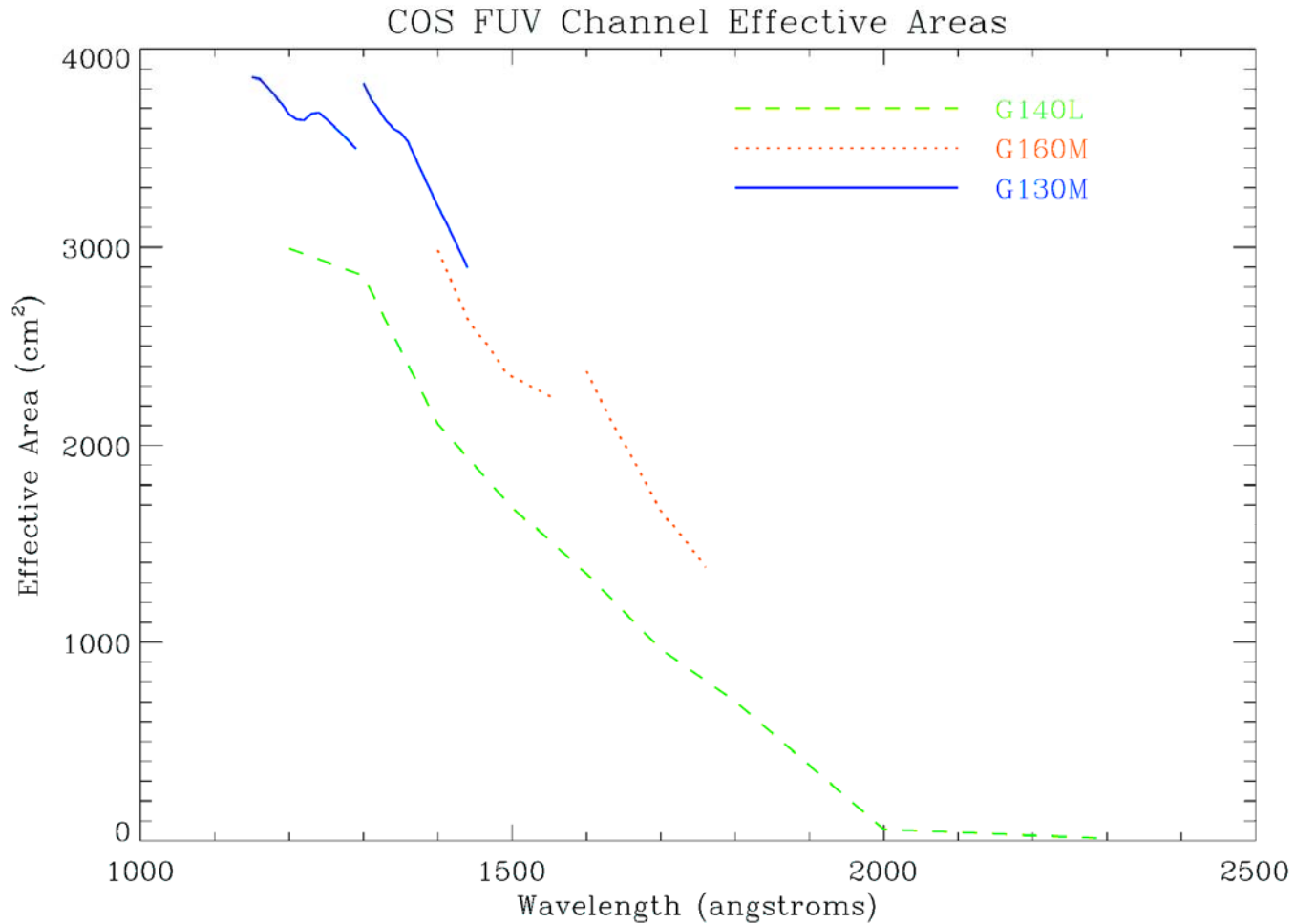
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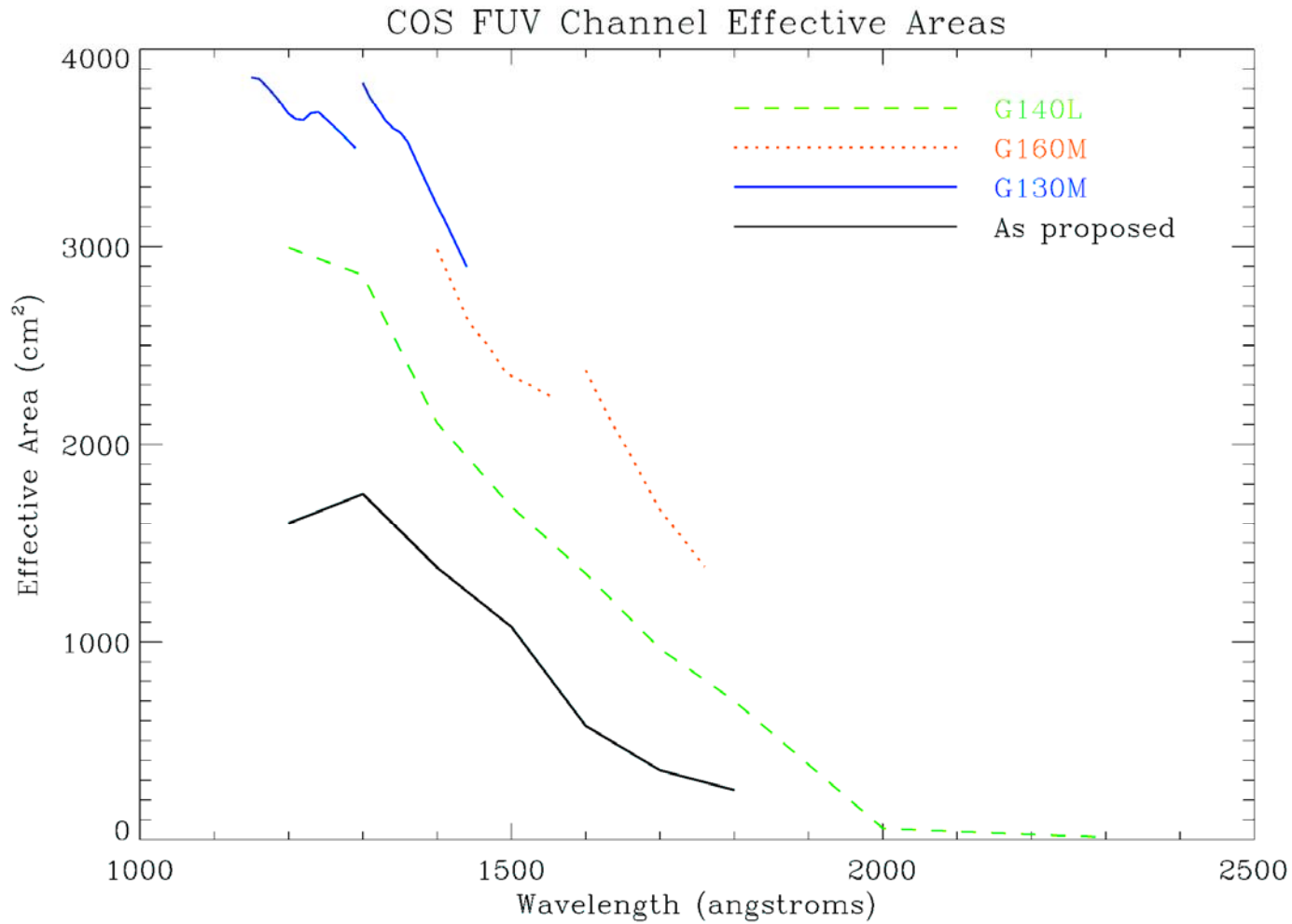
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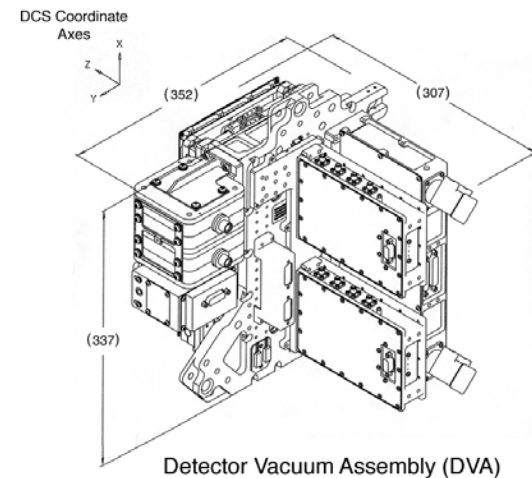
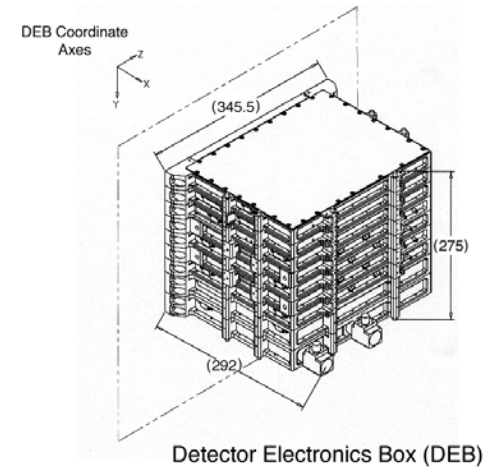


## Ground Calibration Planning

- COS ground calibration to be done at Ball in NASA-4.
- GROVER is now available for refurbishment into the COS aberrated optical simulator (CAOS).
- The COS PI is now preparing a COS Ground Calibration Plan that will be used to establish requirements on calibration procedures and test set-ups.

## Overview of FUV Detector Assemblies

- **DEB - (Detector Electronics Box)**
  - DCE (Detector Control Electronics)
  - TDCs (Time-to-Digital Converters)
  - HVPS (High Voltage Power Supply)
  - LVPC (Low Voltage Power Converter)
- **DVA - (Detector Vacuum Assembly)**
  - VHA (Vacuum Housing Assembly)
    - Detector Door Mechanism
    - Ion Pump Assembly
  - DBA (Detector Backplate Assembly)
    - Amplifiers
    - HVFM (High Voltage Filter Module)





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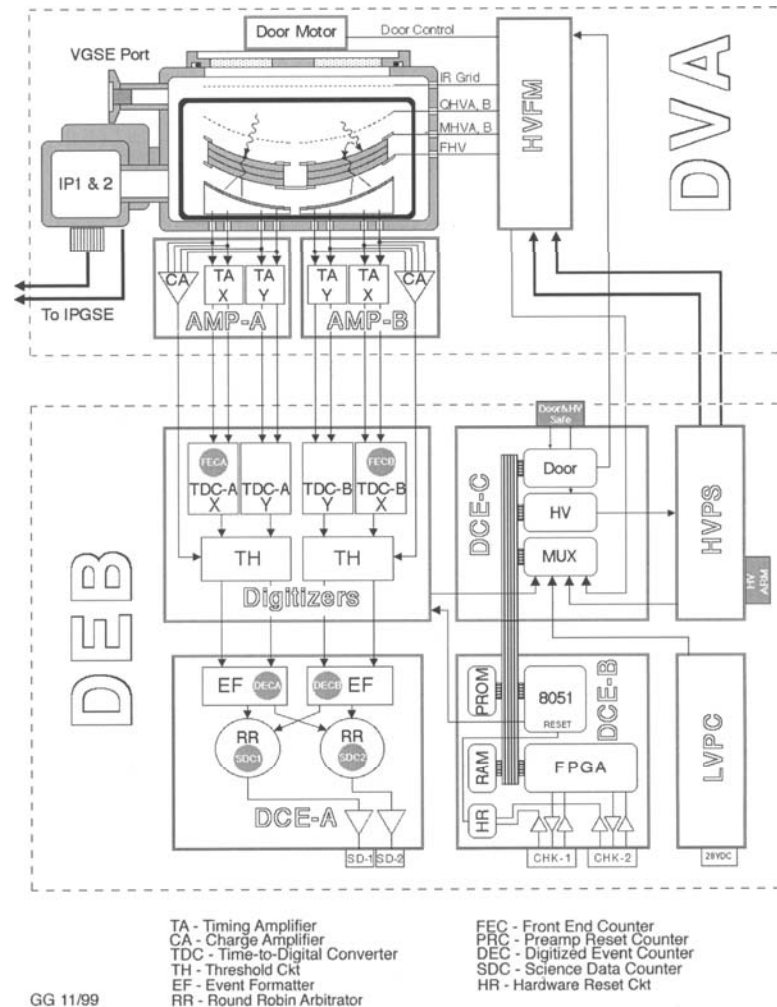
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### FUV Detector Subsystem Block Diagram

- UCB is under contract to deliver 1 flight FUV detector subsystem (FUV-01) and 1 flight-spare detector subsystem (FUV-02).







# COS

## Monthly Status Review



### 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

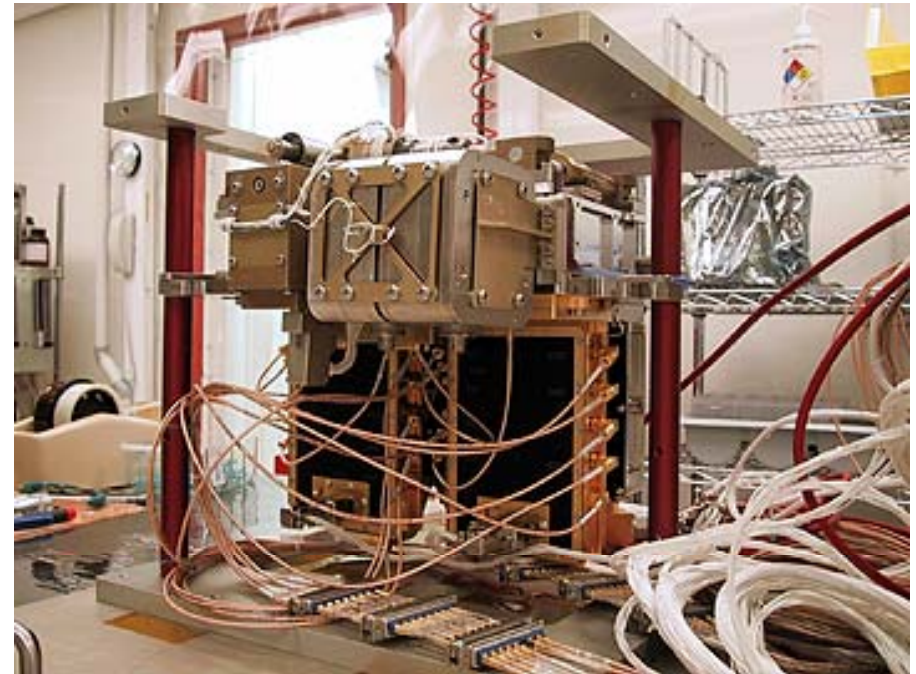
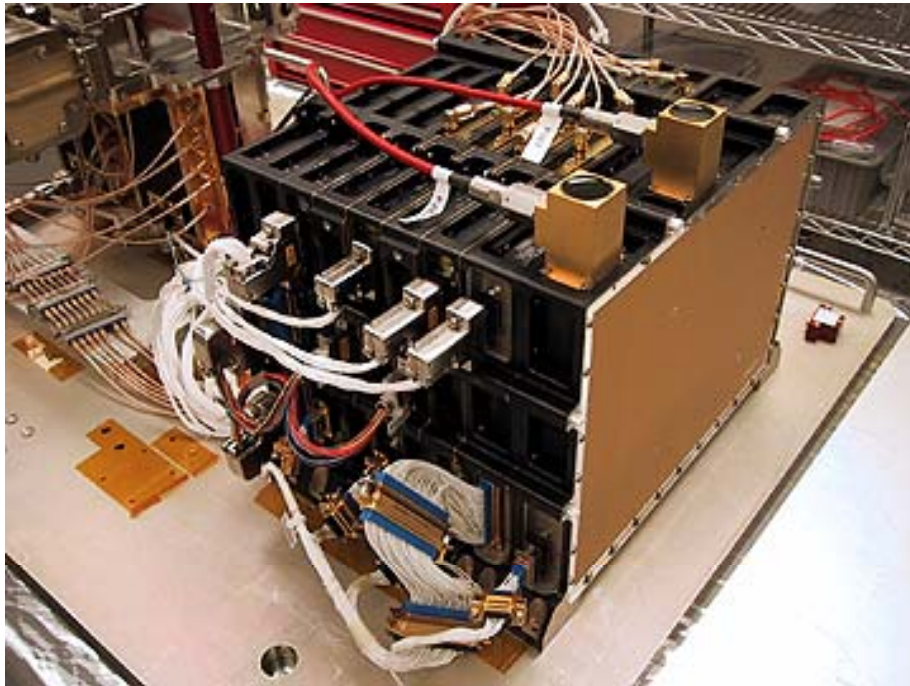
- C Complete
- @SS At Subsystem
- A Acceptance Levels
- Q Qualification Levels
- N/R Not Required
- P Planned
- (1) Old Door Mechanism
- (2) New Door Mechanism

- FUV-01 DVA has now see acceptance level vibe 2x.



## COS FUV Detector Systems

- Detector DEB
- Detector Head



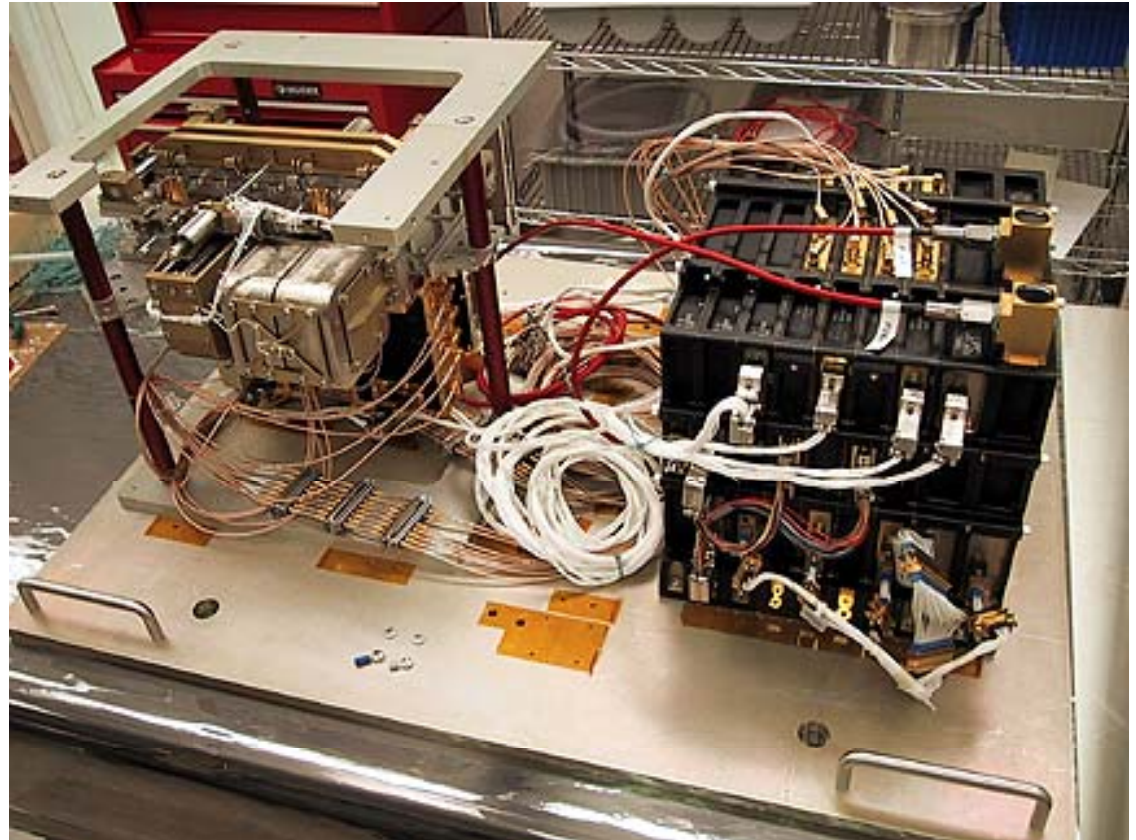
## Flight FUV01 Detector System

Detector upper door & mechanism re-worked at UCB.

Door reassembled and tested successfully at CU then vibrated at Ball.

Had door problem in CU vacuum tank post-vibration due to clamshell /shaft.

Door motor and HOP subassy at UCB being reworked in collaboration with Swales, CU & GSFC





FUV Door Redundant Mechanism Problem - 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.

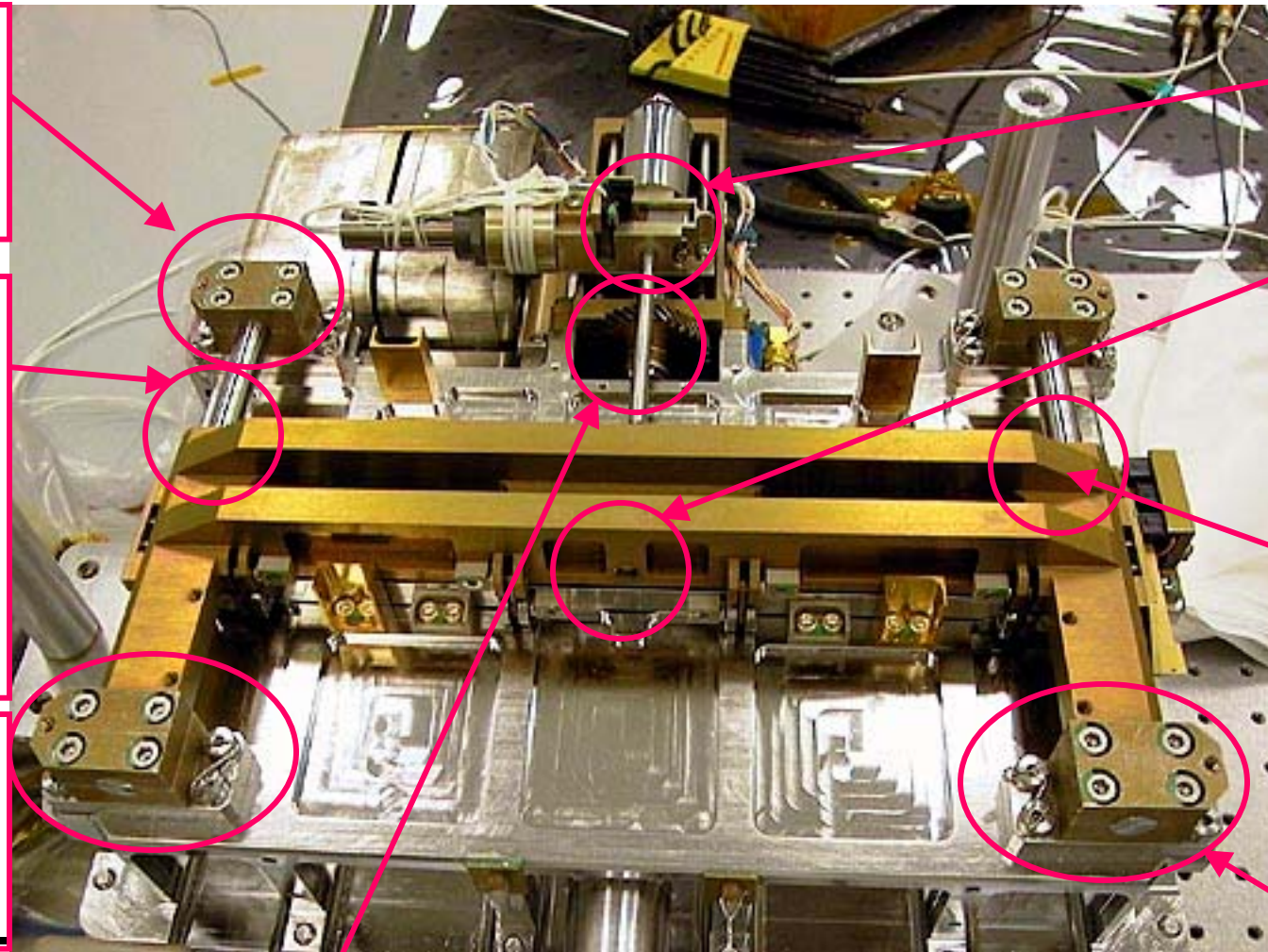
Hard mount pillar, make one piece blocks and pin rail

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

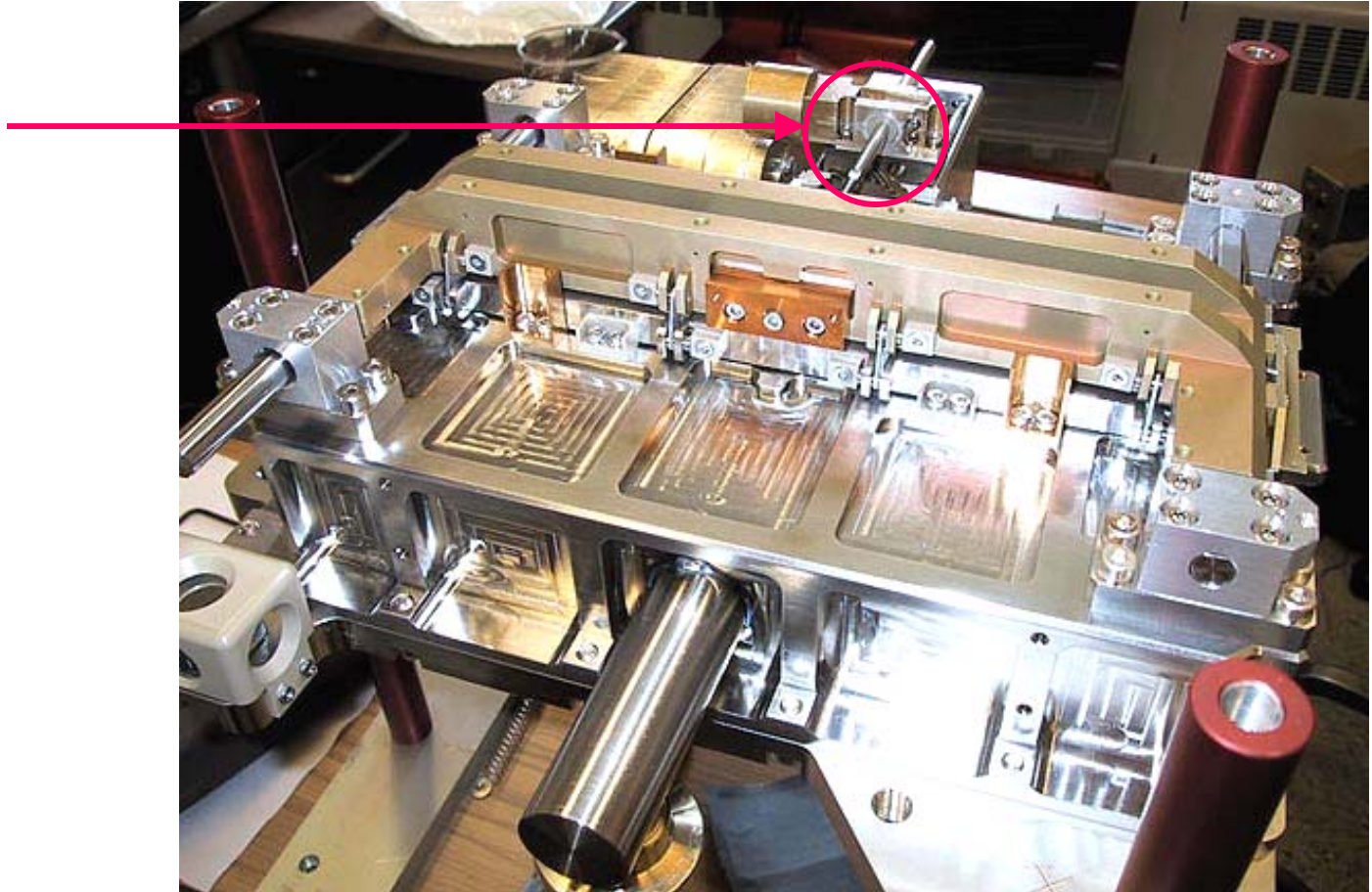


Thin shaft to allow flexure



## FUV Door - New Assembly on ETU VHA

Problem area,  
clamshells &  
shaft slots



All other  
components  
have worked  
very well



## FUV Door Problem Progress

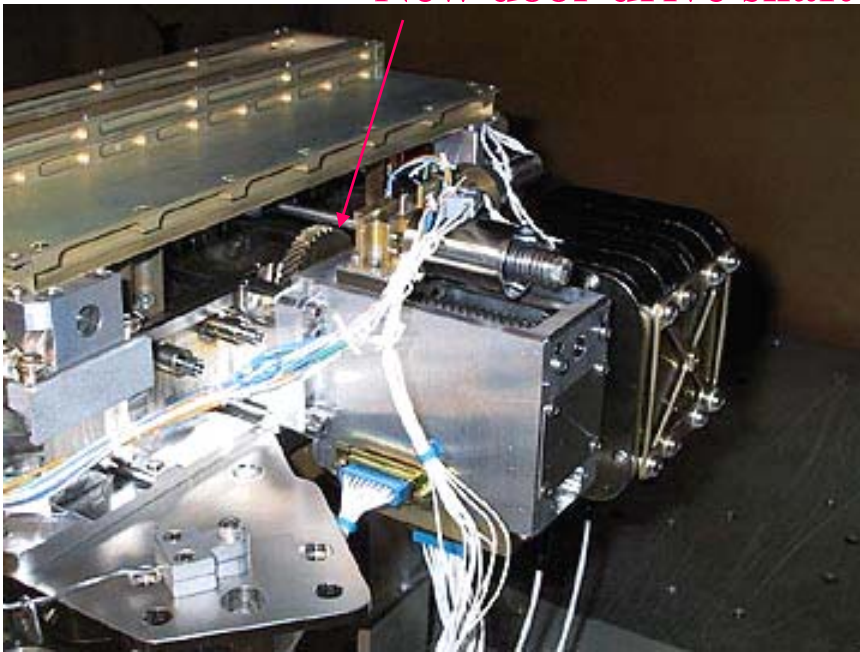
- Qualification testing of door design on ETU VHA completed successfully
  - 25 operation cycles, -done with no problems
  - vacuum test, hot (+40°C) and cold (0°C) with HOP actuation, -done OK
  - vibration at qualification levels (with notching), -completed at Lockheed
  - vacuum test, ambient, hot (+40°C) & cold (0°C) with HOP actuation -no problems
- FUV01 Door Reassembled and Tested
  - Completed FUV01 door pre-assembly preparations at UCB
  - Re-assembled FUV01 door assembly at CU, - new pushrod bent
  - Pushrod was right material (A286), but not hardened (not spec'd on dwg)
  - Made new pushrod shaft (in Boulder) with Ball material on 1 day turnaround
  - Fit checked shaft/clamshells and proceeded with assembly
  - Installed VHA & vacuum tested door motor and HOP at ambient temp - OK
  - Vibrated FUV01 door assembly & VHA to acceptance levels at Ball - OK
  - Returned FUV01 to CU tank to complete thermal vacuum testing
  - Initial HOP door open test - OK

## FUV Door Problem

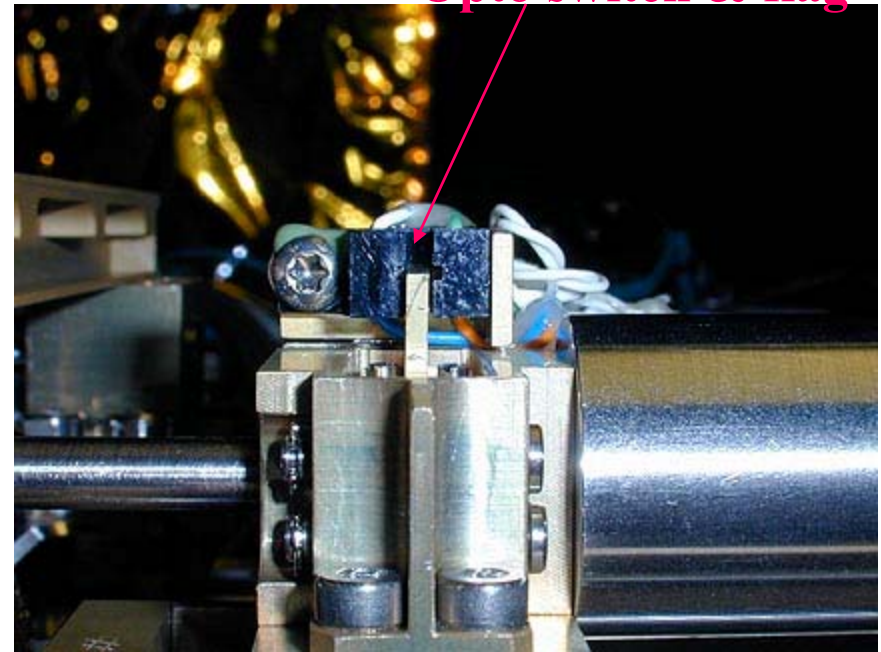
### •FUV01 Door Tests at CU Post Vibration

- Used motor to reset actuator mechanism, - **NO LATCH INDICATION**
- Motor continued to drive for 30 sec before timing out - **Opto switch problem?**
- Tried to close - open - close door with motor - **all successfully**
- Operated HOP - **successfully**

**New door drive shaft**

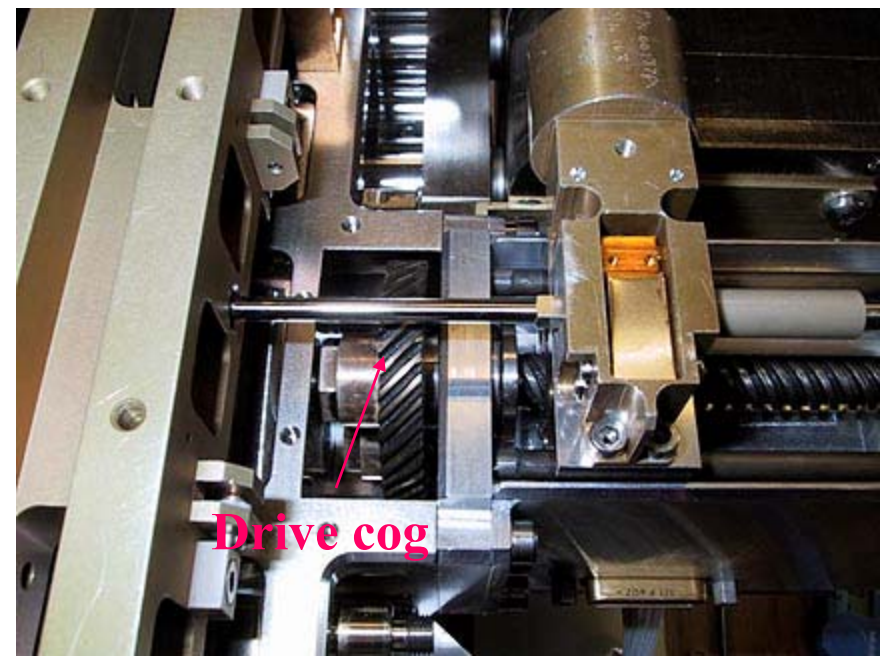
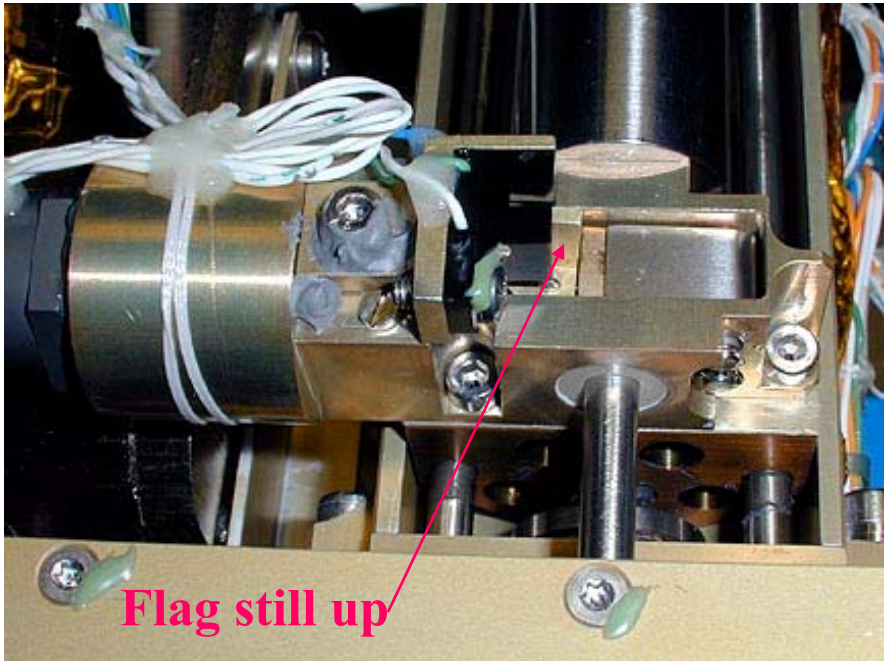


**Opto switch & flag**



## FUV Door Problem

- Tried to re-engage door with motor - **NO LATCH INDICATION**
- Could not drive door at all now**
- Used motor dither motion & temperature to finally engage lower clamshell
- Closed door, vented system and safed door with blocks
- Noticed top clamshell was not engaging the shaft & flag not depressed
- Disassembled with Casey, photographed & made measurements
- Initial assessment was clamshell/pushrod/housing tolerancing issue



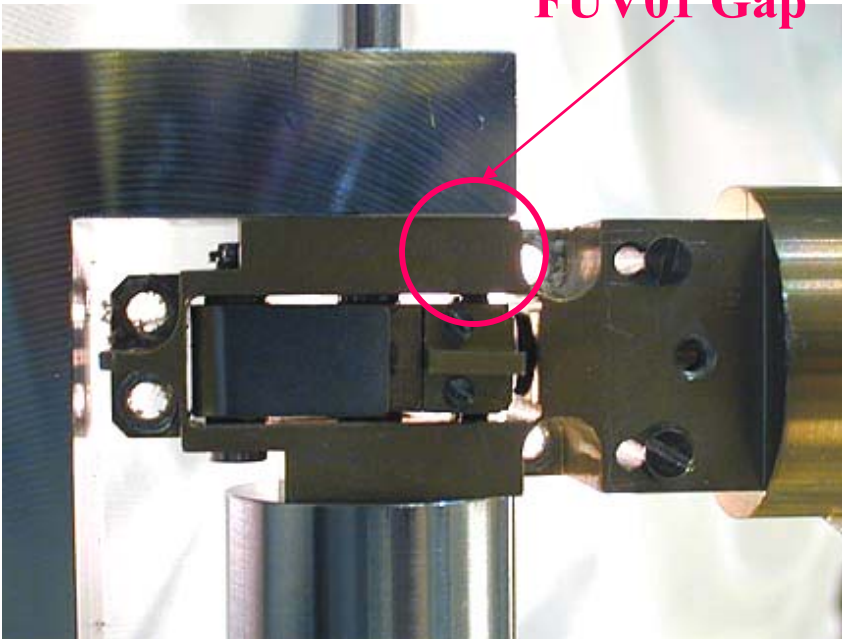


## FUV Door Problem

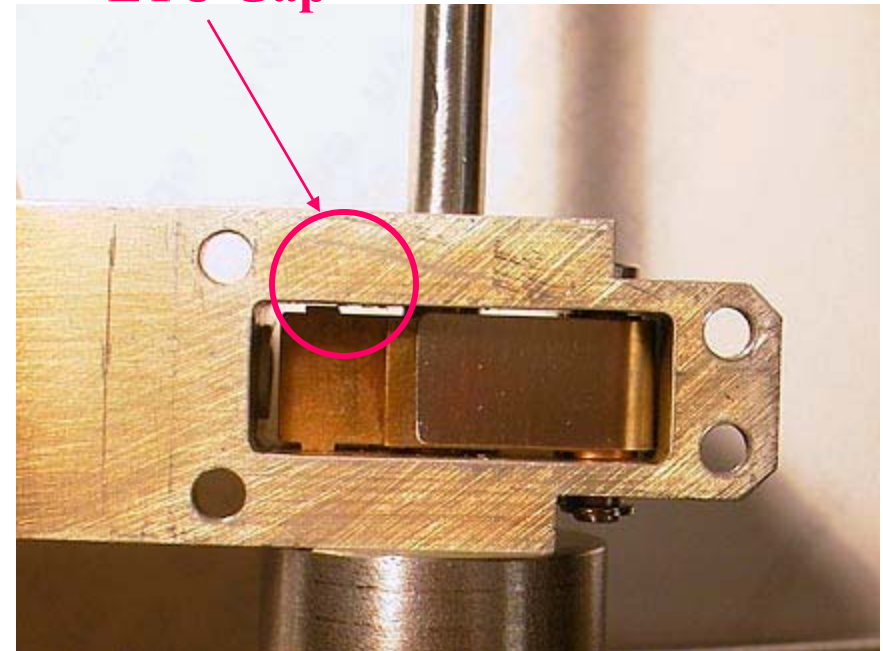
### • ETU Tests to cross check problem

- ETU door/VHA re-bench tested **-no problems**
- ETU shaft/clamshell/housing parts photo'd, and measured for tolerances
- ETU clamshells have  $\sim 0.006''$  of gapping, FUV01 have  $< 0.002''$
- This is unnecessarily tight - **narrow the clamshells by  $0.010''$ , polish housing**
- Flag is unnecessarily wide - **thin to  $0.5\text{mm}$**

**FUV01 Gap**



**ETU Gap**



## FUV Door Problem



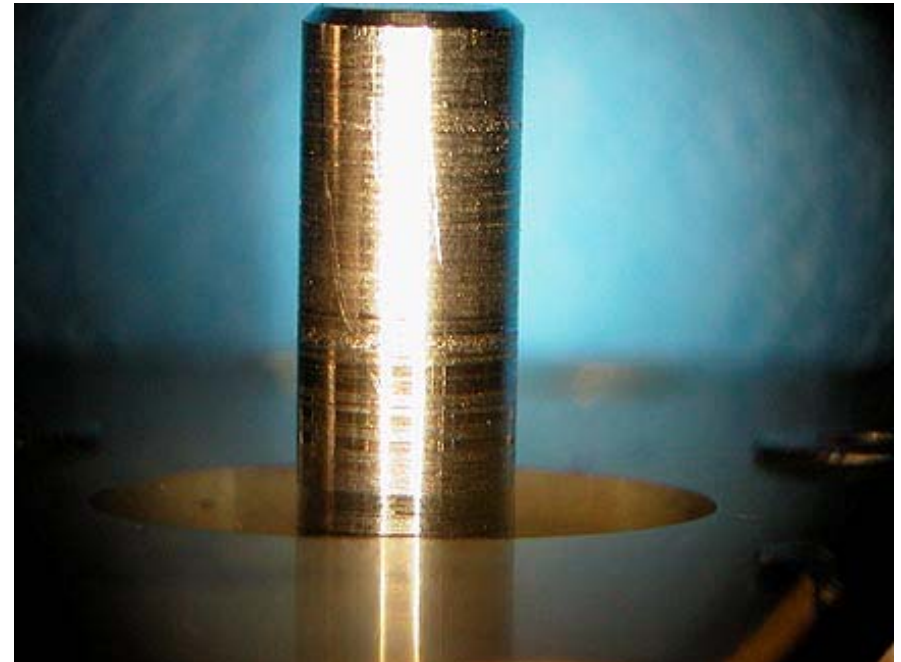
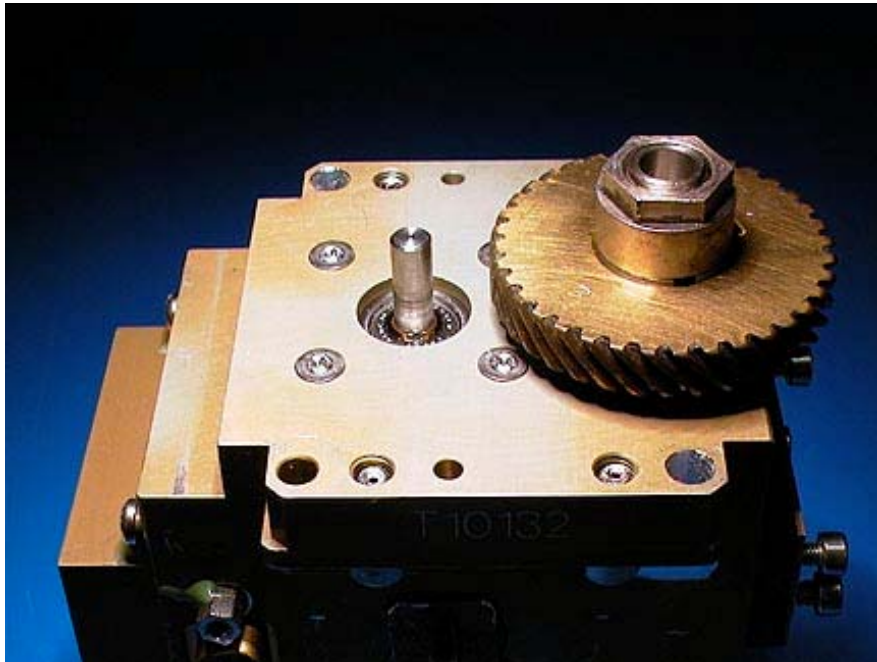
### • Clamshells and pushrod dimensions

- ETU clamshells have about 0.003" slop inside the pushrod notches
- FUV01 clamshells have about 0.001" slop inside the pushrod notches
- This is too tight - **open out notches by 0.020"**.
- Modify the clamshell teeth to ensure engagement on the large teeth surfaces.

## FUV Door Problem

### • FUV01 Door motor

- Driveshaft on motor cog showed signs of chafing/debris.
- Slipped when door was driven 30sec beyond stop
- Trantorque adaptor had low torque on FUV01 and FUV02 ~50in/lb
- **Make tool to ensure correct torque on Trantorque installation - 125in/lb**
- **Replace FUV01 motor with FUV02 motor**



## FUV Door Problem

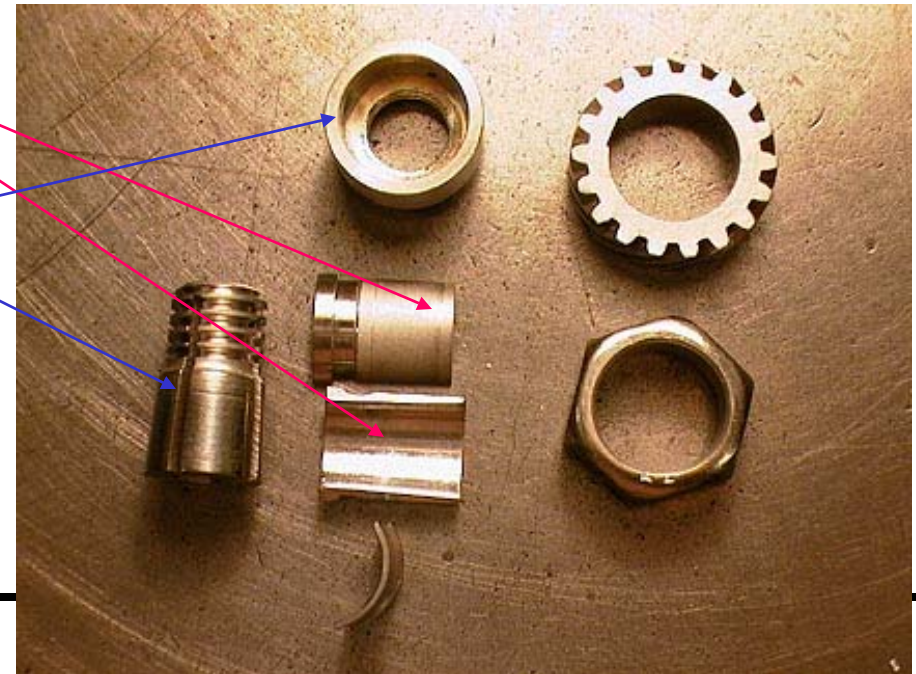
### •Trantorque adaptor

- Checked slip limit for motor cogs/shafts when installed to 125in-lbs
  - 70in-lbs/motor, 170in-lbs/driveshaft, **both sufficient per Casey's model**

•Manufacturer suggests roughing motor shaft,  
& outside of spreaders and  
polishing the inside of spreaders

•Also strap nut to inner sleeve

•Have tested modified pieces with  
similar results





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## FUV01 Immediate Actions

- **Motor Assembly Modifications**
  - Shafts, flags, & cogs are done, clamshells should be done by today
  - Rebuild FUV01 motor assy onto ETU system
  - Bench test and vacuum test
  - Vibrate to qualification levels at Lockheed
  - Retest at vacuum/thermal TBD cycles
  - Remove FUV01 motor assy and return to CU, install on FUV01
  
- **FUV01 Operations**
  - Vacuum test door operation
  - Vibrate one TBD axis to acceptance at Ball
  - Return to CU and verify door operation
  - Complete 2 cycles of thermal vac and hot/cold soak.



## 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.
  - 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.



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## FUV02 Plan

- 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

## Monthly Status Review



### FUV-01 Door Recovery Schedule

ID	Task Name	Duration	2002											
			January	February	March	April	May	June	July					
1	<b>Qualification of new FUV#1 door motor design with ETU</b>	<b>38 days</b>	[Gantt bar spanning Jan 15 to Feb 6]											
2	Design & fabricate new clam shells, push rods and trantorque adaptor	19 days	1/15	2/6										
3	Assemble & test new FUV#1 door mechanism on ETU VHA in air	3 days		2/7	2/9									
4	Vacuum test new door in T-V chamber	2 days		2/10	2/11									
5	Hot & cold thermal cycle test of door****	2 days		2/12	2/13									
6	Prepare/pack ETU VHA for vibration test at Lockheed	1 day		2/14	2/15									
7	VHA+door qualification vibration test at Lockheed	4 days		2/18	2/21									
8	Install ETU in T-V chamber at SSL	1 day		2/22	2/22									
9	Post shake tests of surrogate VHA/door at SSL****	4 days		2/23	2/26									
10	New door mechanism verified	0 days			2/26									
11	Ship FUV#1door motor assembly to CASA	1 day		2/27	2/27									
12	<b>RETRO-FIT &amp; TEST OF FUV#01 Door on Flight VHA#1</b>	<b>15 days</b>	[Gantt bar spanning Feb 27 to Mar 14]											
13	Assemble & test new FUV01 door motor ass'y on VHA at Uco	2 days		2/28	3/1									
14	Install FUV#01 in T-V chamber and initial test	1 day		3/2	3/2									
15	Vacuum test of new door motor mechanism at CASA	2 days		3/3	3/4									
16	Ship and stake for vibe test	1 day		3/5	3/5									
17	Vibration test of FUV01 DVA at BATC	2 days		3/6	3/7									
18	Post vibe test functional tests of FUV01 DVA at CU	1 day		3/8	3/8									
19	Thermal-vac cycle final tests of FUV01 *****	4 days		3/9	3/12									
20	System cleanliness cert check	1 day		3/13	3/13									
21	Remove system from chamber and pack	1 day		3/14	3/14									
22	FUV01 ready for flight integration and test at BATC	0 days			3/14									





## **COS MSR: CU Software/Operations Efforts**

- CEDAR: (Béland)
  - Added a few tools to support MEB functional tests.
  - Created an INSTALL file for easier site and user installation of whole package.
  - Resolved issue with byte-swap present in COS data files.
- CALCOS – GSE: (Béland)
  - Geometric Correction (GC):
  - INL maps for FUV01 complete.
  - Work continues on INL maps for FUV02.
  - Flat Field (FF):
  - Initial Flat Fields from Berkeley were used to estimate sensitivity variation across the detectors.



## COS MSR: CU Software/Operations Efforts

- COS Spectral Simulator: (Penton)
  - No Change - Current version is available to the science team on the COS web page.
- TAACOS: (Penton)
  - Simulations for 3 examples of ‘extended sources’ to begin March 2002. COWG currently working to define these sources.
- COS Science Preparations: (Penton)
  - Working on HST Snapshot proposal (#9506) to observe and pre-qualify up to 140 AGN, with STIS+G140L, for future GTO COS observations. Categories of observations include bright optical targets never observed in the FUV, AGN sightline-galaxy halo encounters, AGN sightline-LSB galaxy encounters, and probing the structure of the "Great Wall".



## **COS MSR: CU Software/Operations Efforts**

- DCE Flight Software: (Brownsberger)
  - No Change – DCE BOOT Code (v.1.13) stable since Jan. 2001. DCE OPERATE Code (v1.42) stable since Sept. 2001.
  - Unexplained Detector ‘Resets’ observed during FUV01 Thermal-Vac last year were isolated by UCB to be caused by insufficient grounding/shielding in GSE interface box. UCB fixed the GSE box and subsequent, week-long testing with FUV01 indicates that problem has been solved – and that existing PFR against FUV01 can be closed.
- COS FSW & Operations Support: (Brownsberger)
  - Assisting with preparations for MEB Functional Tests, and supporting the standard SW & Operations activities.
  - COS Target Acquisition component test development to begin March 2002.



**COS**  
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**COS Schedule for CU/UCB**

<b>Task</b>	<b>Status</b>
G140L – Blazed Grating Testing	Likely to be canceled
CALCOS Software Development	On-going
NUV Gratings (JY)	Complete
Cal/FF SS Optical Integration	March – May '02
FUV-01 Rework Activities	Feb. – March '02
Deliver FUV-01 to Ball	March 18 '02
Complete FUV-02	By 6/1/02



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**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 descope 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	<b>Implemented</b>	2 weeks	Knowledge of detector
Eliminate FUV Detector detailed QE tests	<b>Implemented</b>	2 weeks	Knowledge of detector
Eliminate FUV Detector deep FF tests	<b>Implemented</b>	3 weeks	Knowledge of detector
Make DCE Op Code non-uploadable	<b>Too late</b>	---	Higher risk, Ops
Early transition of FSW to Code 582	<b>Too late</b>	\$	Ops
Remove Redundant Cal/FF Elements	<b>Too late</b>	\$,t	Higher risk, Ops
Remove/reduce memory	<b>Too late</b>	---	Ops
Remove NUV gratings from OSM2	<b>Too late</b>	\$,t	Degraded science
Drop NUV channel	TBD	\$\$\$,tt	Degraded science
Remove NCM3 optics	<b>Too late</b>	\$,t	Degraded science, Ops
Eliminate Aperture Mechanism	TBD	\$,t	Ops, Obs. Efficiency, higher risk
Drop all Accum mode processing w/ Doppler	<b>Too late</b>	\$,t	Degraded science
Drop spare FUV detector	<b>Too late</b>	\$,t	Higher risk
Drop OSM1 capability (don't cover $\lambda$ gap)	<b>Too late</b>	---	Degraded science
Reduce S/N requirement to 30 (no FF lamp)	TBD	\$,t	Degraded science
Relax NUV resolution requirements below 20k	<b>Too late</b>	\$,t	Degraded science
Remove on-orbit change-out capability	<b>Too late</b>	\$,t	Higher risk
Drop dispersed light TA	<b>Too late</b>	\$,t	Ops
No Ion Gauge	TBD	\$,t	Higher risk, Ops
No external shutter	<b>Too late</b>	\$,t	Ops
Change MSRs to QSRs	TBD	\$	Save trees
Eliminate Mechanism Lifetime tests	TBD	\$\$	Higher risk
Reduce CDRLs	TBD	\$	Unknown
Drop G140L blazed effort	<b>Implemented</b>	\$,t	Missed opportunity for improved science
Reduce G160M image testing	<b>Too late</b>	\$,t	Higher risk

\*The IPT has not yet done a detailed analysis to quantify actual \$ or time to be saved.



## **Upcoming Events/Activities**

- Flight detector door rework and workmanship tests.
- Start Cal/FF subsystem I&T.
- Commence detail ground calibration planning.



## Issues

- None