



COS
Monthly Status Review



COS
Monthly Status Review
October 25, 2000
Ball

Cosmic Origins Spectrograph
Hubble Space Telescope

James Green
October 25, 2000



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Agenda

Progress Summary Since Last Monthly	J. Green
Optics Development Status	J. Green
Optics Test Status	S. Osterman
UCB FUV Detector Programmatic Status	J. Green
UCB FUV Detector Technical Status	O. Siegmund
CU Software Activities Status	K. Brownsberger
COS Descope Candidates	J. Green
Schedules	J. Green
Upcoming Events/Activities	J. Green
CU Issues & Resolution Plan	J. Green
STScI Presentation	E. Wilkinson
BATC Presentation	D. Hood
Financial Splinter	GSFC/Ball/CU



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Progress Summary Since Last Monthly

- Completed G140L No. 1 testing, started G140L No. 2 testing
- Completed internal review of AV-03, distributed to Science Team for comments.
- Commenced CALCOS development.
- Delivered G185M gratings to GSFC for coating and testing
- Completed DCE qualification
- Started FUV detector sub-system No. 1 characterization.
- Began FUV detector PER preparations.



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Optics Development Status - NUV Mirrors

- Tinsley:
 - **All flight NUV optics delivered, coated, and now at Ball.**
 - Current delivery Plan for spare optics:

Item	Previous Due Date	New Date	Slip
NCM1 (spare)	-	11/7/00	-
NCM2 (spare)	-	11/7/00	-
NCM3a,b,c (spare)	-	11/7/00	-



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Optics Development Status - Gratings

- Present grating delivery plan (changes since last month in red/bold):

Item	Delivery Date	Coating Dates at GSFC	Test Dates	Planned Test Location
G140L	Done	Done	8/00-10/00	CU
G160M	12/11/00	12/00	12/00-3/01	CU
G140L-Blazed	12/11/00	12/00	12/00	CU
G185M	Done	In process	10/00	GSFC
G225M	11/00	11/00	12/00	GSFC
G285M	12/11/00	12/00	1/01	GSFC
G230L	2/01	2/01	2/01	GSFC

- GSFC is working on G185M coating optimization now.
- CU is awaiting GSFC's G185M test procedure for review and approval.



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COS FUV Grating Test Status

- G130M Gratings
 - Testing and data analysis has been completed for both gratings. Calibration reports have been released for both gratings.
 - Both gratings are satisfactory in all respects.
 - G130M-B appears to have slightly better performance.
- G140L Gratings
 - Flight G140L laminar optics have been coated at GSFC and bonded at Ball Aerospace to the flight bezels.
 - G140L-B testing is complete, and the grating is satisfactory in all respects.
 - G140L-C testing is in progress, and initial results indicate satisfactory efficiency and resolution.



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G140L-B Test Results (1/2)

Grating Efficiency

Wavelength (Å, Source)	First Order Grating Efficiency (Grating Average)	Measurement Uncertainty
1164 (Kr)	0.269	0.0043
1236 (Kr)	0.327	0.0046
1304 (O)	0.339	0.0047
1470 (Xe)	0.327	0.0044
1565 (CO)	0.309	0.0049
1734 (CO)	0.286	0.0051
1935 (CO)	0.255	0.0042

Spectroscopic Order	Observed Efficiency at 1470Å
1	0.334
-1	0.306
0	0.033
-3	0.031
2	0.003
-2	0.003



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G140L-B Test Results (2/2)

Grating Resolution

Wavelength	FWHM (mÅ)	Resolution $\lambda/\Delta\lambda$	Requirement
1219.49Å	0.461Å	2640	2000
1378.96Å	0.459Å	3010	2000
1509.29Å	0.515Å	2930	2000

Grating Scatter

Source Wavelength (Å)	Source Counts (background corrected)	Scatter Wavelength (Å)	Scatter Counts (background corrected)	Scatter/Å
1135.9-1189.9	42621	1135.9-1143.9	3.0/8.0Å	8.8×10^{-6}

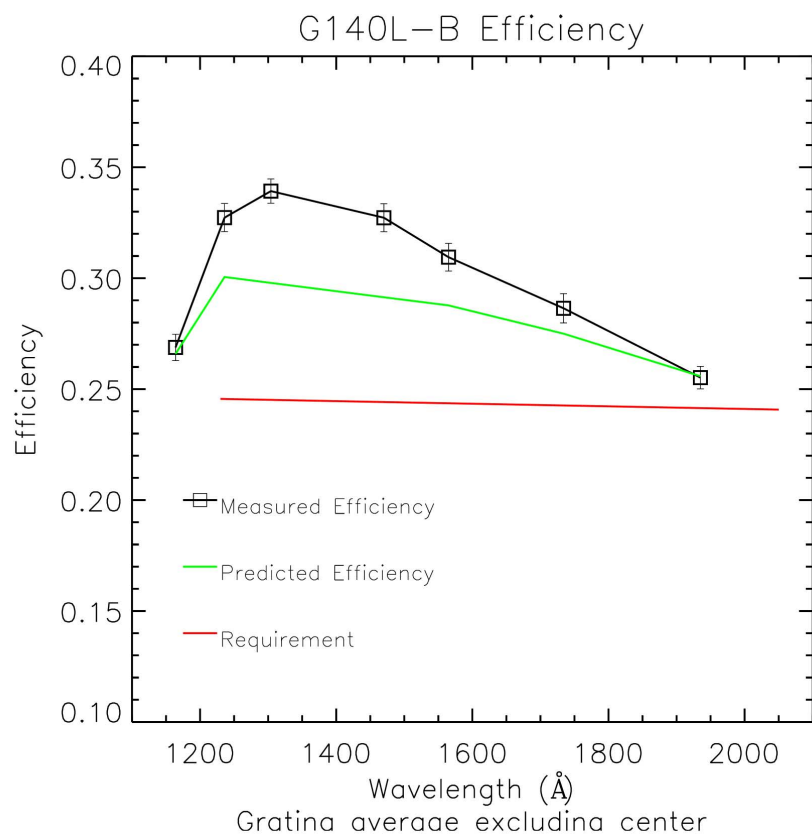


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G140L-B Grating Efficiency vs. Wavelength



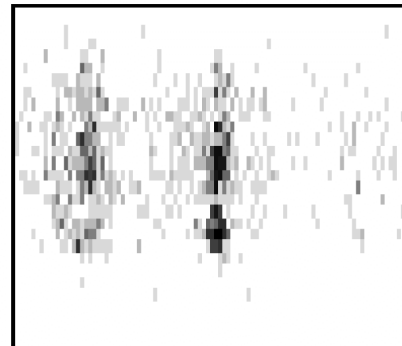
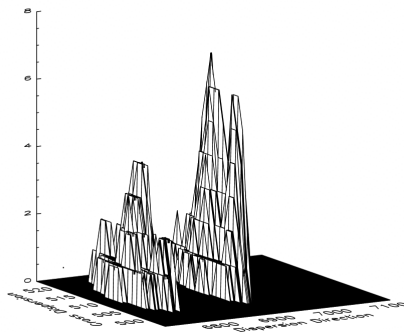
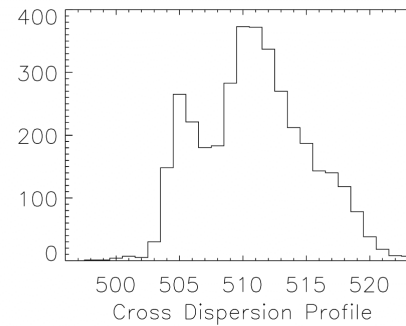
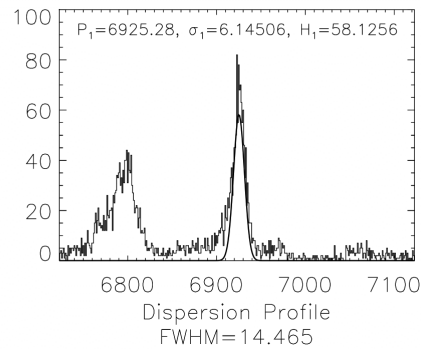


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G140L-B Resolution Test Image - 1219.5Å



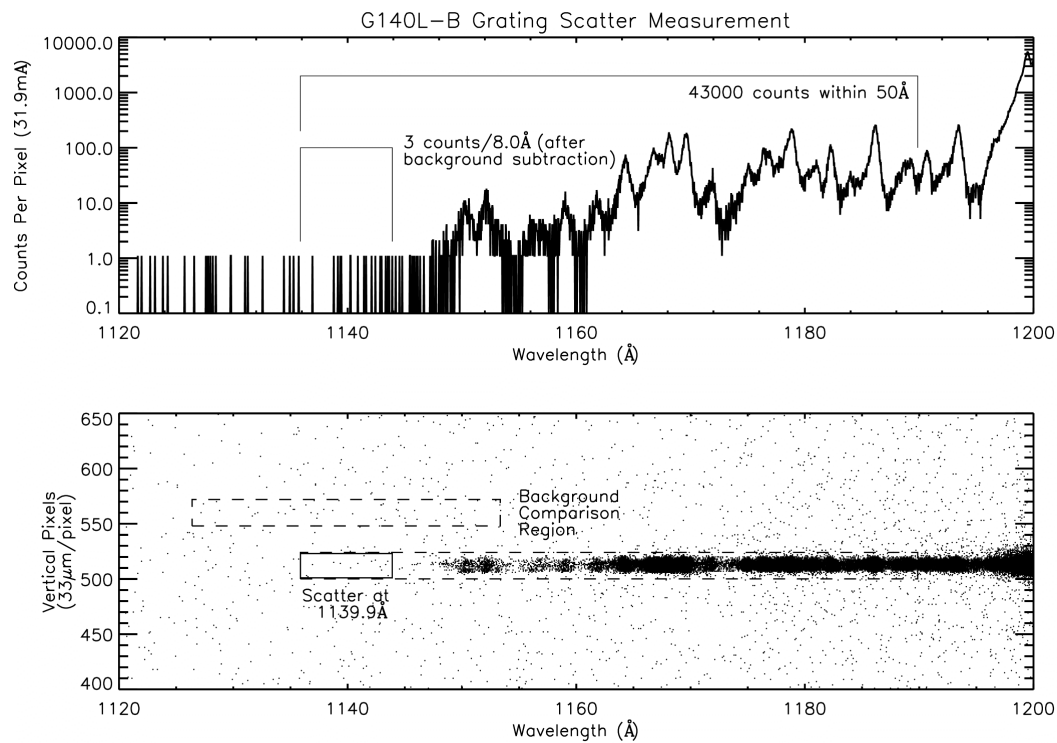


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Grating Scatter at 1140Å for G140L-B



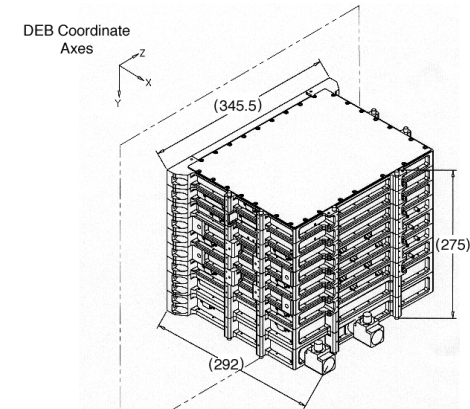


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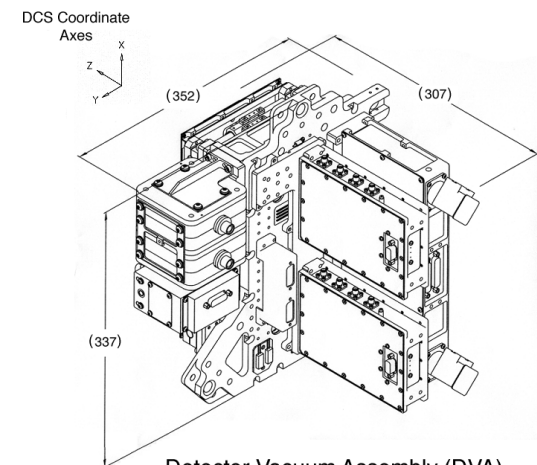


Overview of FUV Detector Assemblies

- **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)



Detector Electronics Box (DEB)



Detector Vacuum Assembly (DVA)



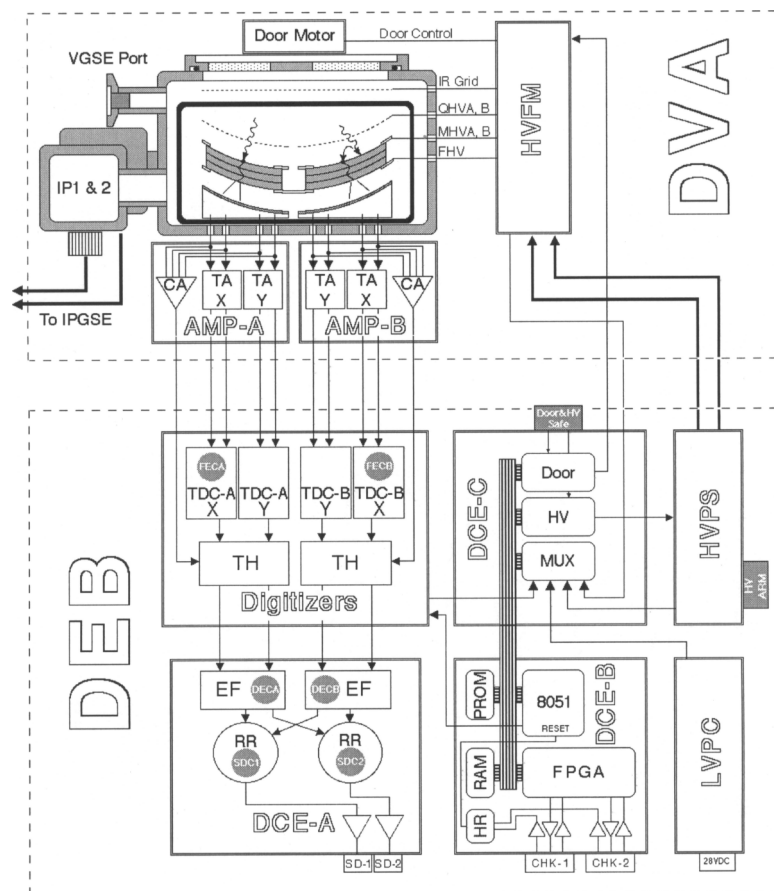
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FUV Detector Subsystem Block Diagram

- UCB is under contract to deliver 1 flight FUV detector subsystem and 1 flight-spare detector subsystem.



TA - Timing Amplifier
CA - Charge Amplifier
TDC - Time-to-Digital Converter
TH - Threshold Ckt
EF - Event Formatter
RR - Round Robin Arbitrator

FEC - Front End Counter
PRC - Preamp Reset Counter
DEC - Digitized Event Counter
SDC - Science Data Counter
HR - Hardware Reset Ckt

GG 11/99



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UCB FUV Detector Status - Personnel Issues

- No changes in personnel at UCB since last month.
 - Raffanti continues his TDC support ~ 2 days/week.
 - Baja's contract extended through December.
 - MAG Systems supporting PER preparations and spare development.
 - UCB running ~ 2 FTEs over their plan due to added technicians working on TDC/DCE boards.
 - W. Clement on-board and making excellent progress on BOOT FSW and Operate FSW.



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UCB FUV Detector Status - Electronics Summary

ACTIVITY	Electronic Board								
	Amps	HVFM	HVPS	LVPC	DCE-A	DCE-B	DCE-C	TDC-X	TDC-Y
Parts List	C	C	C	C	C	C	C	C	C
Schematic	C	C	C	C	C	C	C	C	C
Parts Stress Analysis	C	NA	NA	NA	NA	C	C	C	C
Worst Case Analysis	NA	NA	NA	C	NA	C	C	C	C
Board Thermal Analysis	C	NS	NS	NS	C	C	C	C	C
Release Layout	C	C	C	C	C	C	C	C	C
Board Fabrication	C	C	C	C	C	C	C	C	C
Kit Parts	C	C	C	C	C	C	C	C	C
Board Coupon Testing	C	C	C	C	C	C	C	C	C
Stuff Boards	C	C	C	C	C	C	C	C	C
Board Workmanship Acceptance	C	C	C	C	C	C	C	S	S
Board Engineering Acceptance	C	C	C	C	C	C	C	C	C
Engineering Test & Acceptance	C	C	C	C	C	C	C	S	S
Temperature Cycle Test	C	C	C	C	C	C	C	NS	NS
Voltage Margin Test	C	NA	NA	NA	C	C	C	NS	NS
Final Acceptance Test	C	C	C	C	NS	NS	NS	NS	NS
Staked/Conformal Coated	C	C	NS	NS	NS	NS	NS	NS	NS
<i>Legend</i>	<i>C = Complete</i>		<i>NA = Not Applicable</i>		<i>S = Started</i>		<i>NS= not started</i>		

Changes since last MSR in red/bold



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UCB FUV Detector Status - Actels

ACTIVITY	DCE A		DCE-B	TDC-X	TDC-Y
	Counter	Round Robin	CPU	X	Y
Initial ACTEL Design	C	C	C	C	C
ACTEL Peer Review	C	C	C	C	C
End-to-end System Simulation	C	C	C	S	S
GSFC Review	C	C	C	S	S
FPGA tests with ETU electronics	C	C	C	C	C
Release ACTEL schematic/burn	C	C	C	NS	NS
<i>Legend</i>	<i>C = Complete</i>	<i>NA = Not Applicable</i>	<i>S = Started</i>	<i>NS = Not Started</i>	

- There seems to have been some miscommunications between M. Voyton (GSFC) and UCB regarding the TDC Actels. Voyton has had the package for several weeks but apparently did not know it. Voyton is now leaving GSFC and the status of the Actel review is uncertain.
- Meanwhile, UCB is planning on proceeding with the Actel burn-in to stay on schedule.



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UCB FUV Detector Status - Systems

- Documentation Update:
 - No changes to report this month
- Mass and Power Updates (changes in red/bold):

	Mass (Kg)			Power (W)		
	Current Estimate	SoR Allocation (1)	Margin	Current Estimate	SoR Allocation (1)	Margin
DVA	19.43	21.5	9.6%	4.59	-	-
DEB	13.46	15.3	12%	50.94	-	-
Harness	2.7	3.4	20.5%	-	-	-
Total	35.59	40.2	11.5%	55.53	53.0	-4.77%

Notes: (1) SoR Revision B allocations

- Latest UCB power numbers are actuals measured on flight PWAs. The numbers come from Revision B of the UCB Power Budget Report (UCB-COS-RPT-1015).



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UCB FUV Detector Status - Schedule Overview

September Tracking Milestones	Status
Complete DVA No. 2 assembly	Completed on schedule
Complete DCE qualification	Complete
Complete TDC No. 1 qualification	Starting this week
Complete BBA No. 2 to DBA No. 2 conversion	Completed on schedule
Commence DBA No. 1/electronics testing	Started

October Tracking Milestones	Status
DEB No. 1 operation verified	Completed on schedule
DBA/DEB system characterization started	Started

November Tracking Milestones
Complete Flight Detector Photocathode deposition & QE test
Complete DBA/DEB system characterization started
Complete staking and conformal coating of all DEB No. 1 PWAS

Forecast flight system delivery to Ball:

This month = 3/1/01

Last month = 3/7/01

Spare detector completion:

This month = 8/10/01

Surrogate detector delivery to Ball:

This month = 2/2/01

Last month = 1/29/01

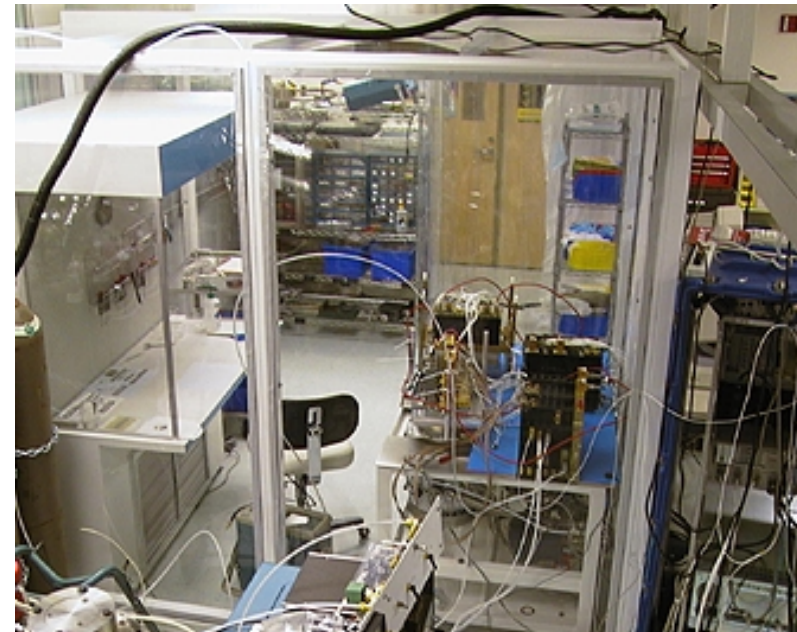
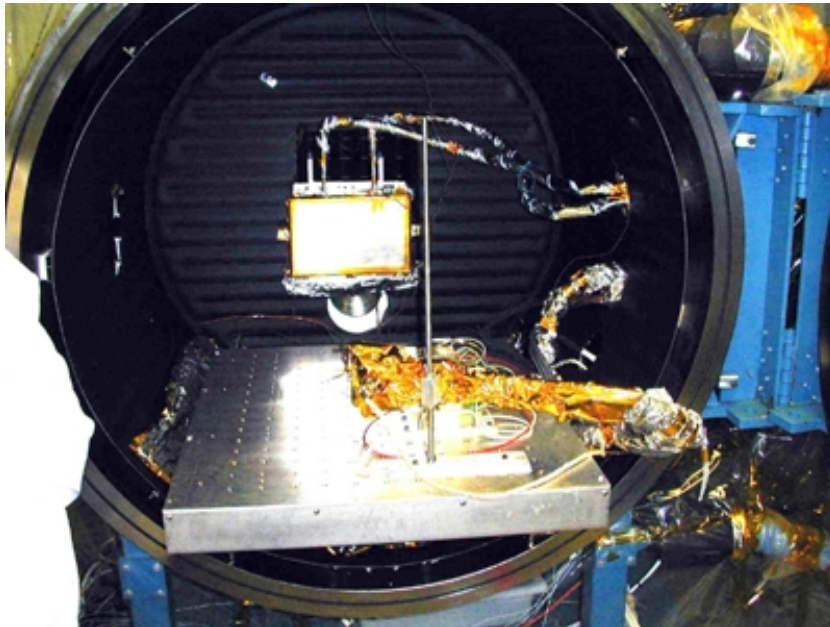


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UCB FUV Detector Status - Facilities

- Due to concerns about commissioning of Thermal Vac tank in old SSL building we are transferring system TV to Colorado tank. Have started preparations for TV hardware.



- Detector system test cleanroom
- Detector test tank facility in clean tent accommodates two full COS detector systems, currently BBA#2 in flight detector and BBA#1 tests

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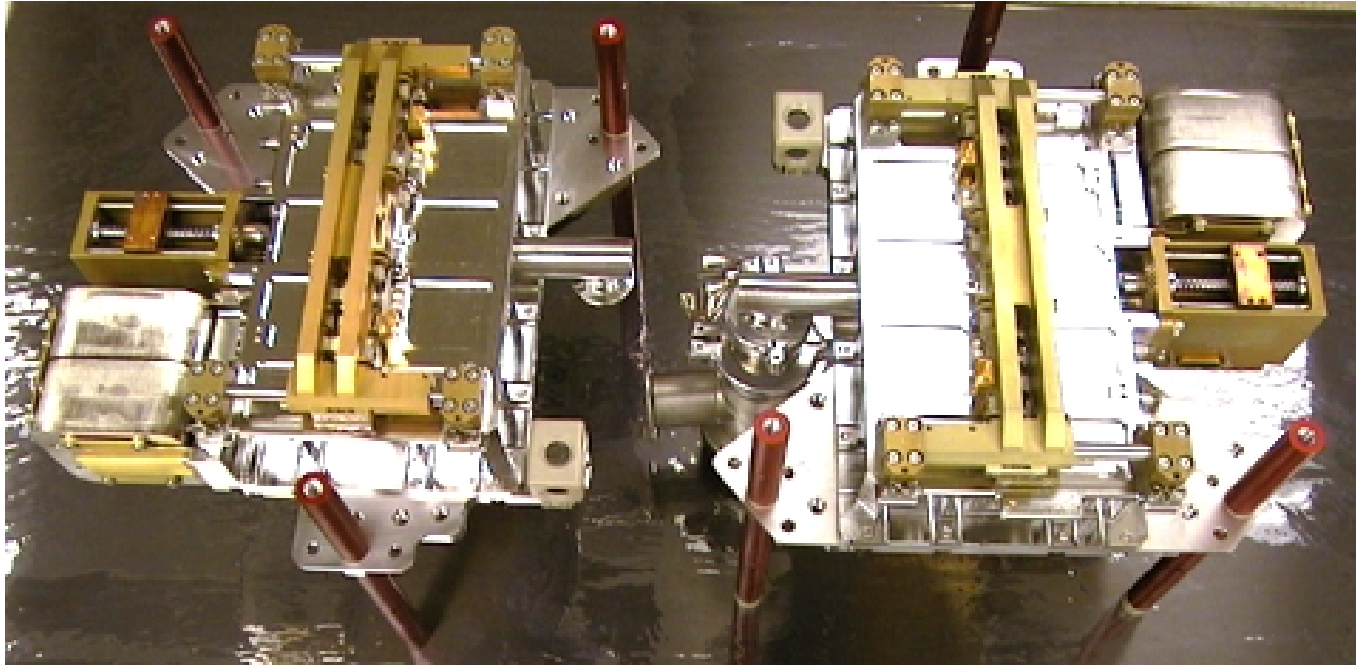
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UCB FUV Detector Status - Detector Vacuum Assembly



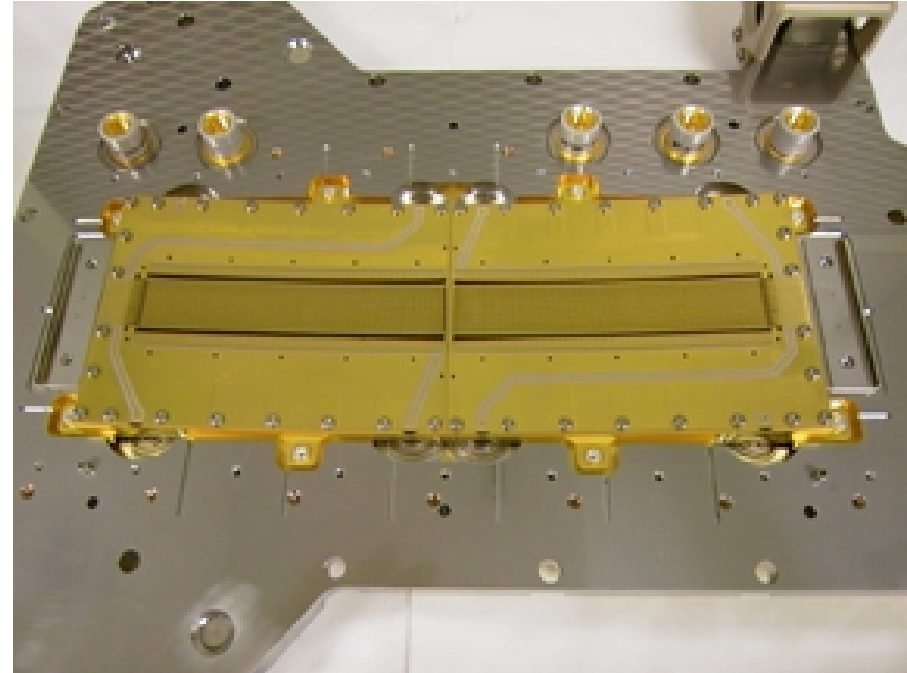
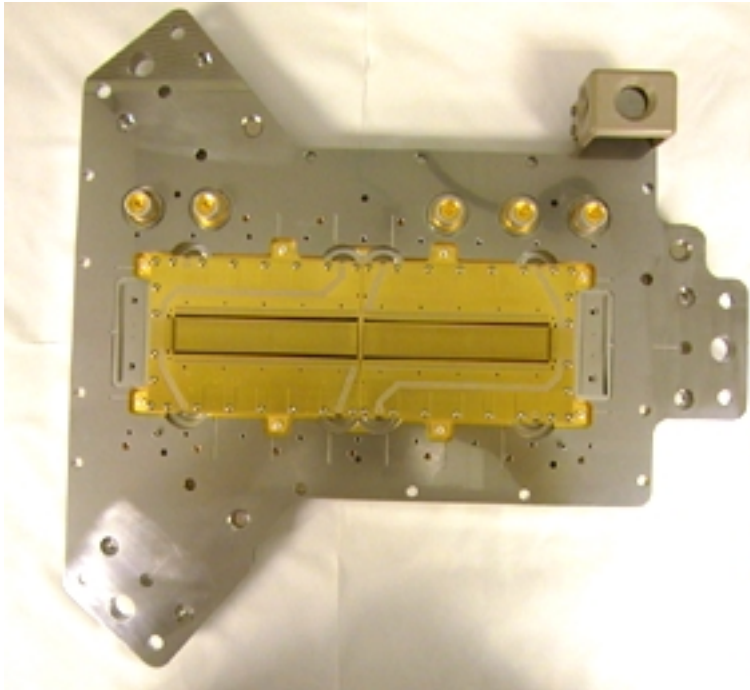
- Two VHA units assembled and attached to DBA's
- VHA #1 and #2 vacuum verified and operated with ion pumps
- VHA #1 and #2 door operation verified
- VHA's ready for detector integration



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UCB FUV Detector Status - Detector Vacuum Assembly cont.



- DBA #1 integrated with 2 flight anodes and BBA#2 in flight detector
- DBA #2 ready to be integrated with 2 flight anodes, cradle & BBA#1
- DBA #3 in test on VHA

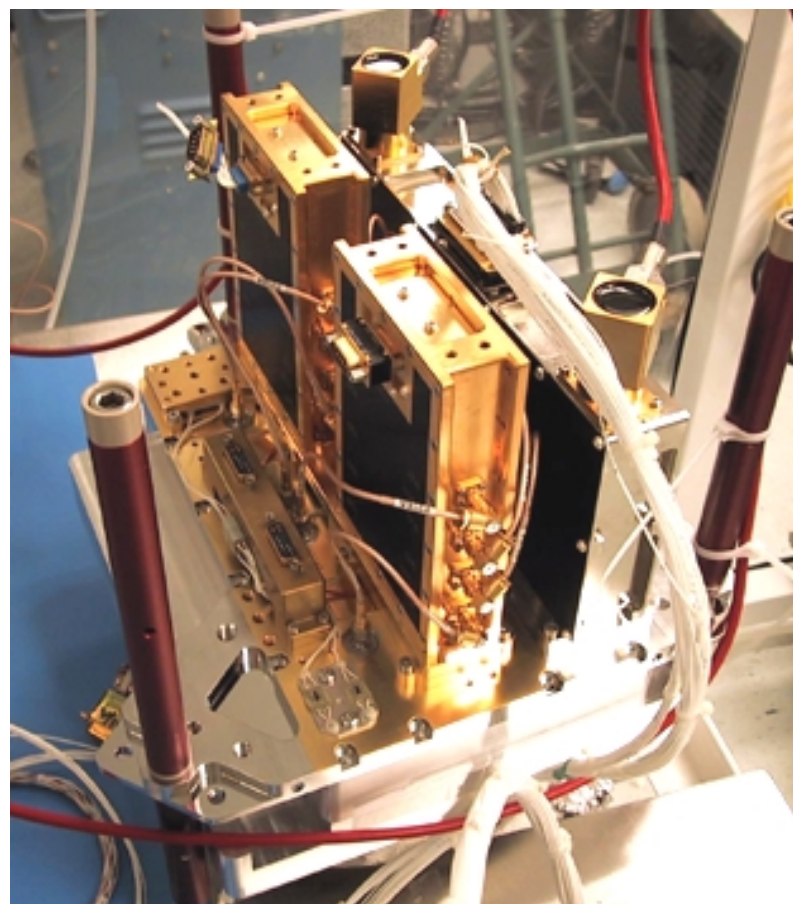
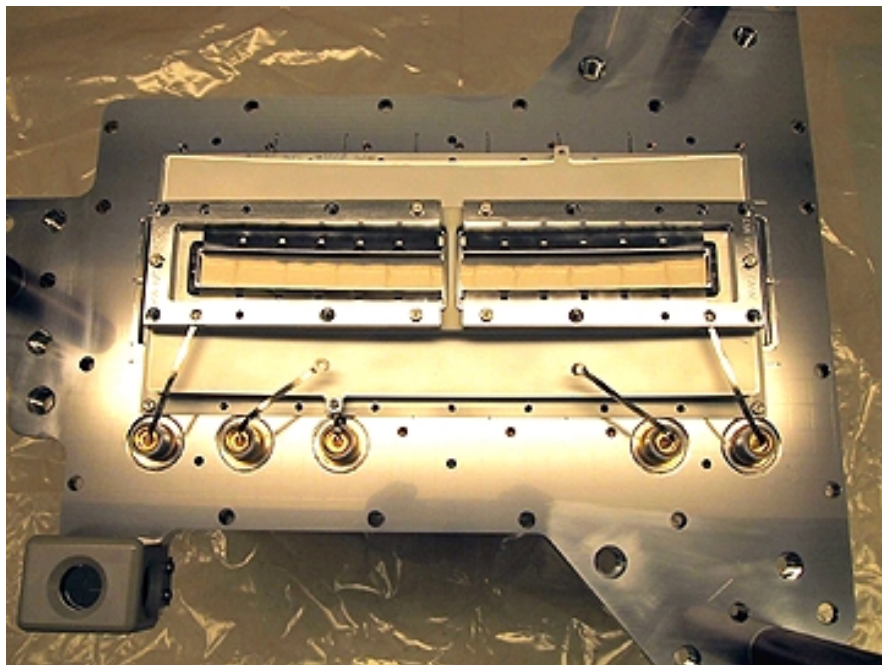


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UCB FUV Detector Status - Flight Detector

Flight detector (BBA#2) initial system test functional done.
Resolution & flat field with flight TDC in system gives good results



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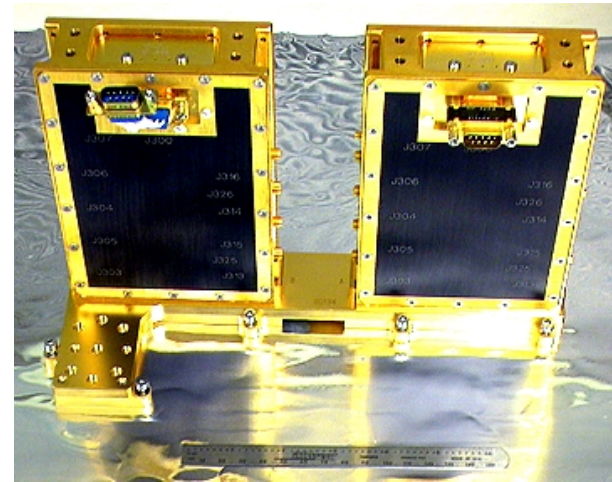


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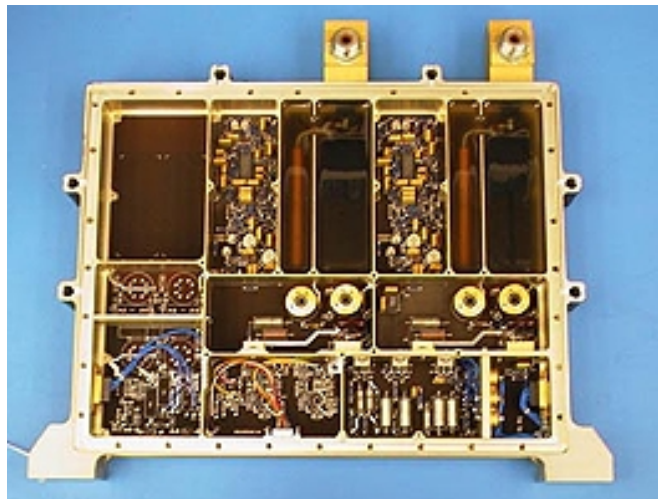


UCB FUV Detector Status - Electronics

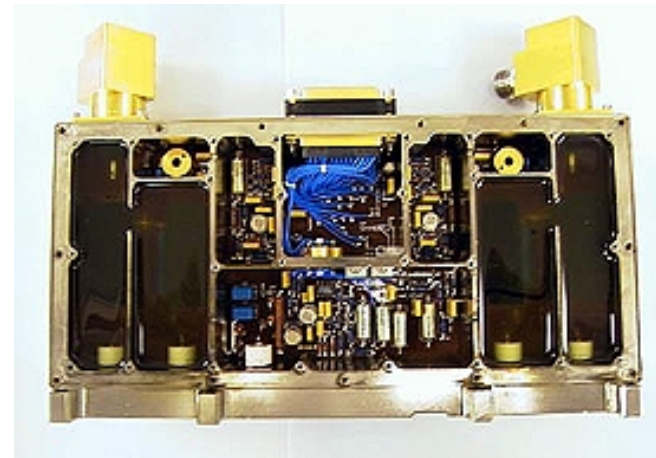
- Power systems (HVPS, LVPC, HVFM)
 - All tested, 1 HVFM coated & staked.
- Amplifiers
 - All amps tested, 2 amps coated & staked.
- Flight Harnesses
 - 2 sets complete



Amplifiers



HVPS



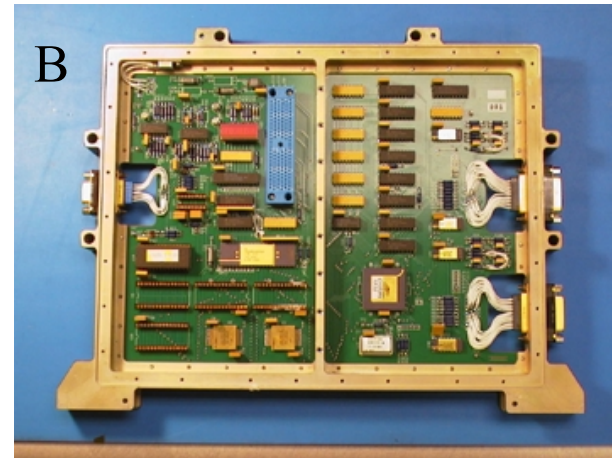
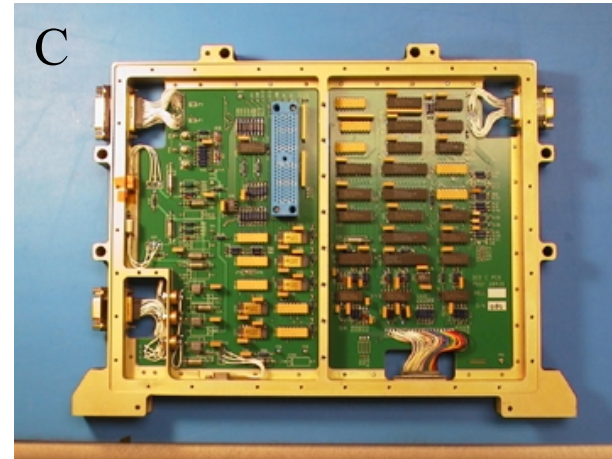
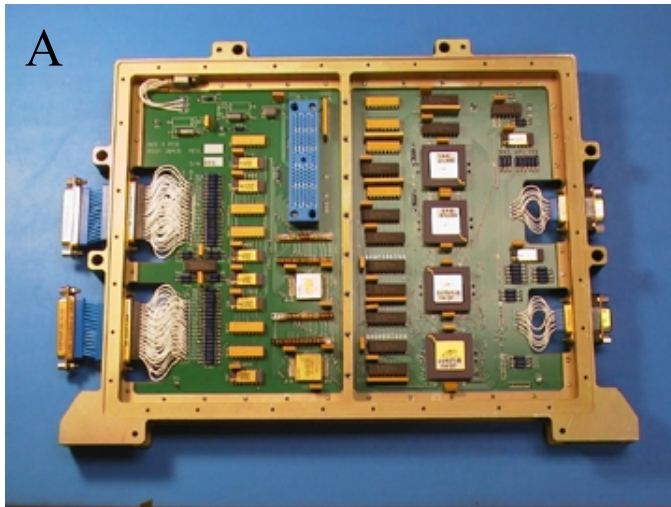
HVFM



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UCB FUV Detector Status - Electronics cont.

- DCE - A,B,C, 2 sets, in house
 - Both DCE sets functionally verified, voltage & frequency margins done, thermal soak & thermal cycle tested
 - #1 DCE has 700+Hrs burn-in and #2 DCE has 200+ hours
 - #1 DCE in flight detector test stack



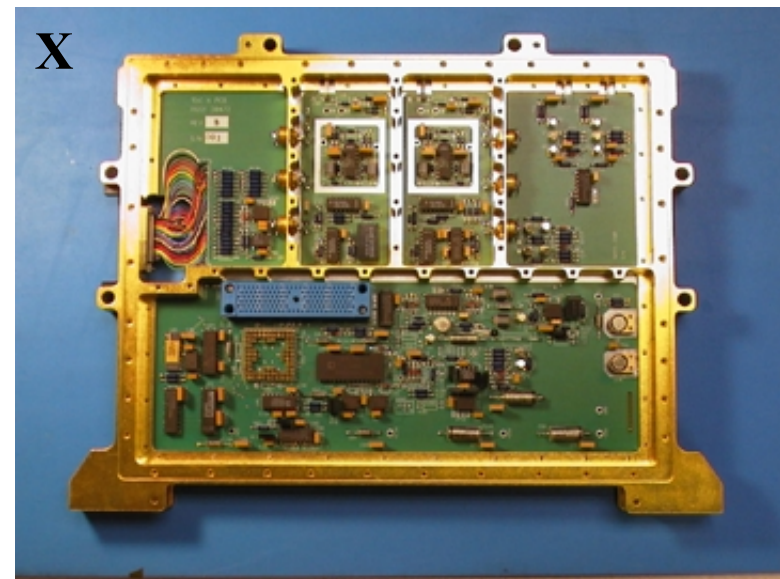
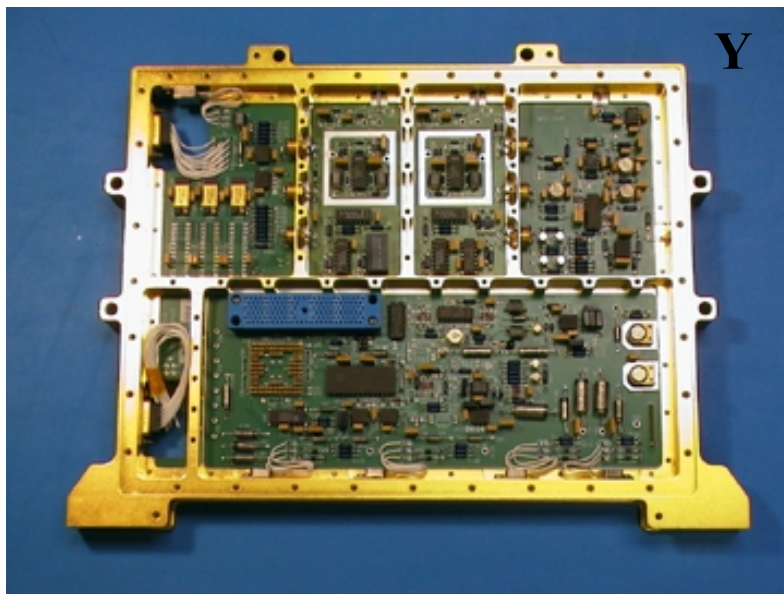


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UCB FUV Detector Status - Electronics cont.

- 2 ETU (flight board) TDC's have excellent performance, in use for BBA tests
- 4 X and 4 Y flight TDC's fully modified
 - 3 X and 3 Y in bench test
 - 1 X and 1 Y in verification test
- Flight TDC's give performance similar to ETU (flight board) TDC's



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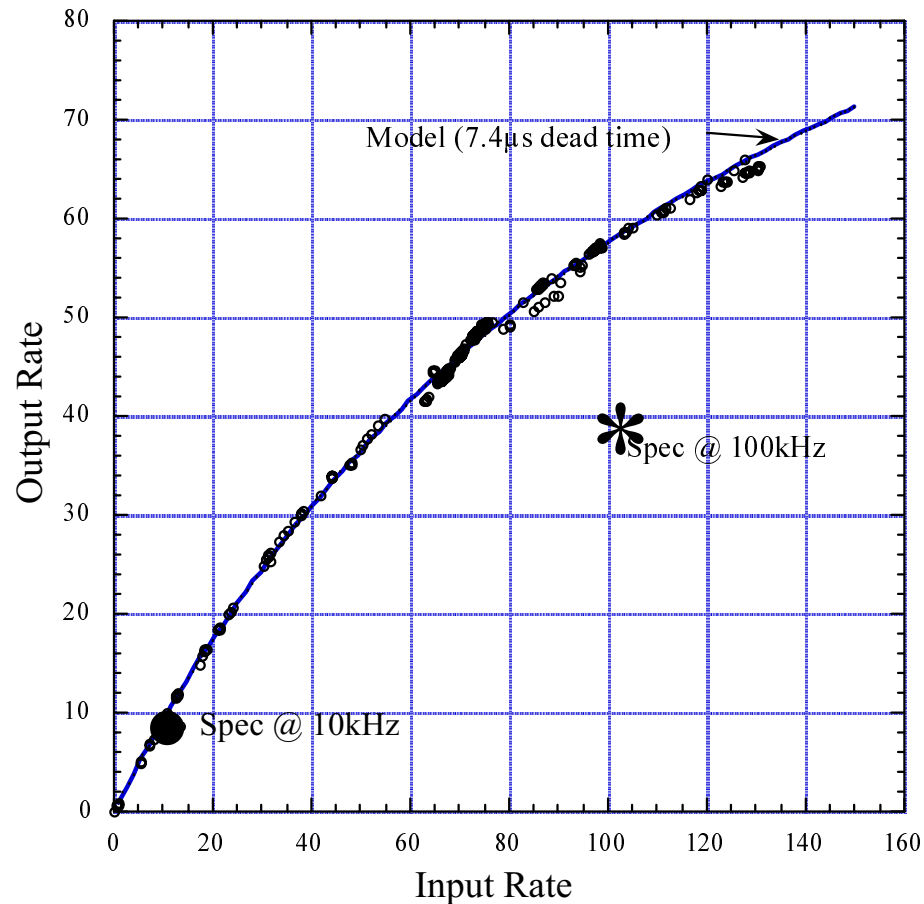
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UCB FUV Detector Status - Electronics cont.



- Throughput test on 1st flight pair of TDC's shows performance that is better than specification at the highest rates.
- Stability of TDC's is better than 2 pixel drift total up to 80 kHz input rate.

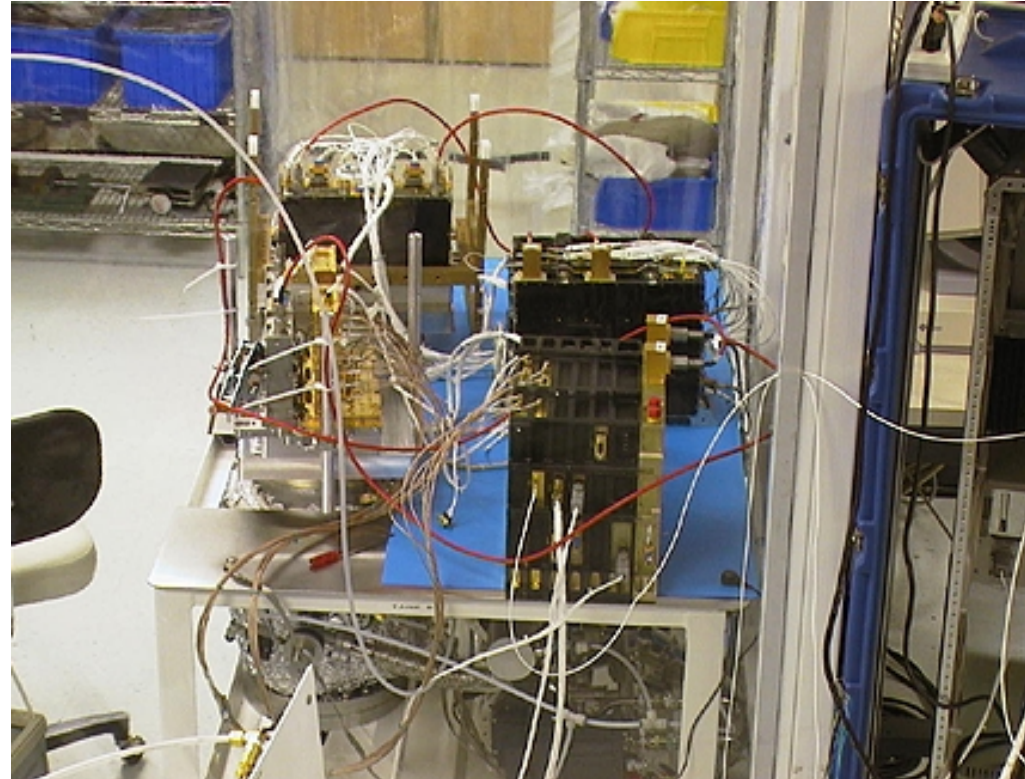


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UCB FUV Detector Test Status

- 2 systems in use
- Pair of flight board ETU TDC's in use to test BBA#1 & BBA#3 rebuild resolution, etc
- FUSE full system in use for scrub test and gain map shimming
- BBA#2 + **Flight** TDC's & flight anodes exceed specification for COS resolution performance.



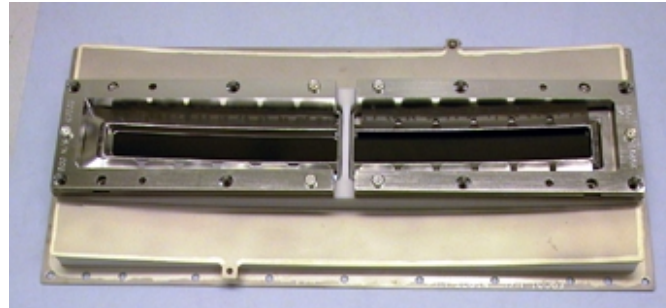


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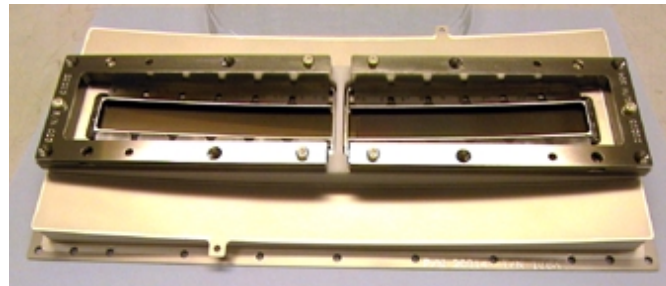


UCB FUV Detector Status - Flight BBA's

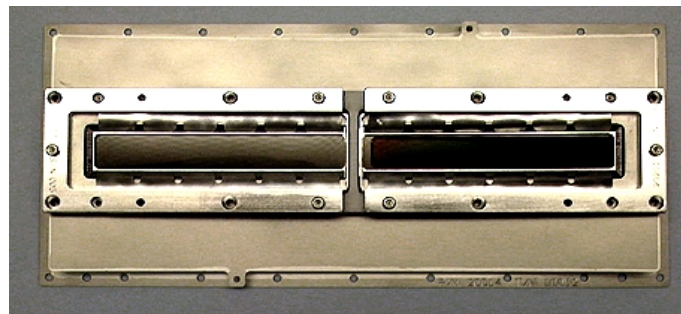
- BBA #1 rebuilt with new MCP's, resolution, & functional tests done - looks good.
- BBA #2 Integrated onto flight detector DBA. Resolution and flat field verified with flight TDC.
- BBA #3 rebuilt with new MCP's, resolution tests, gain matching in progress.



- BBA1



- BBA2



- BBA3



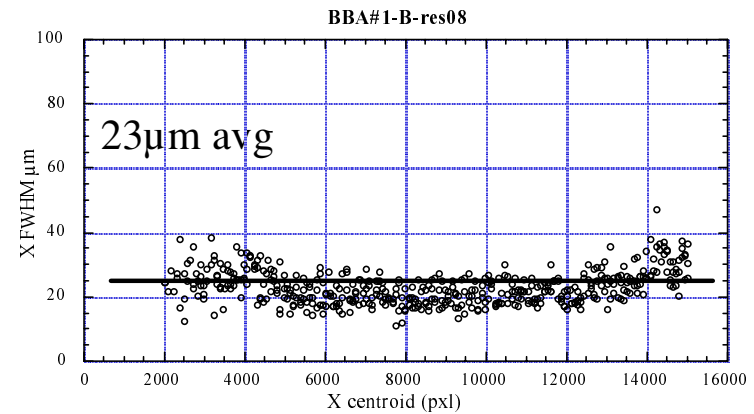
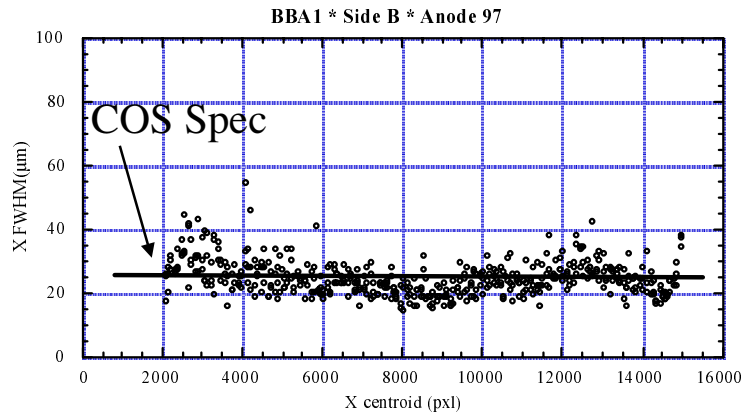
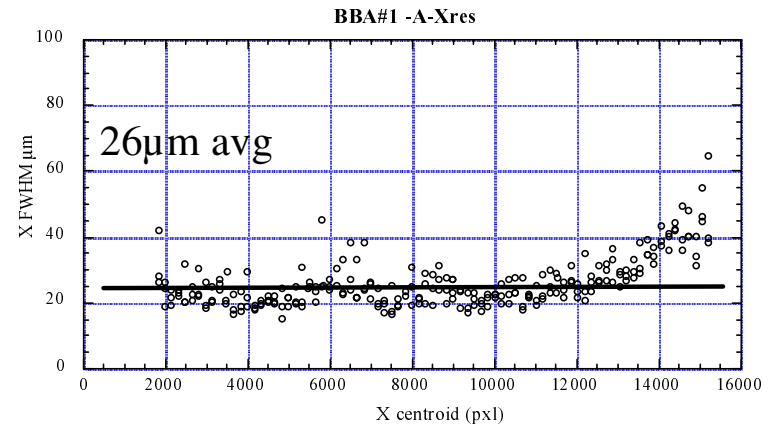
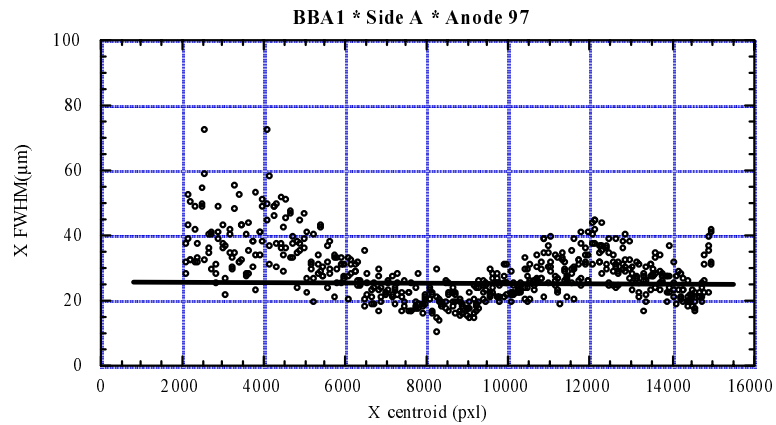
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BBA#1, X resolution measurements

old MCP's

new MCP's



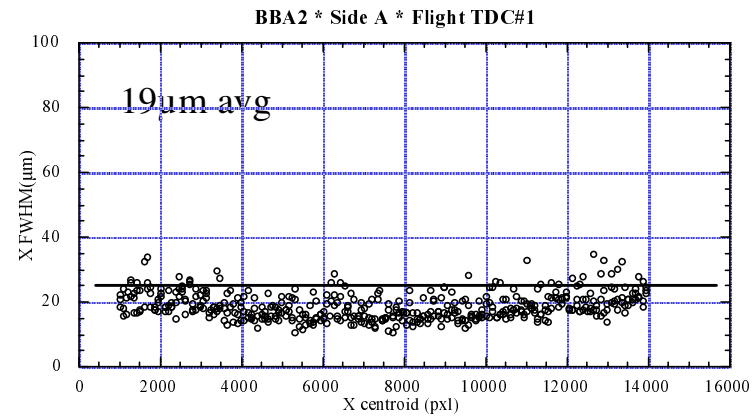
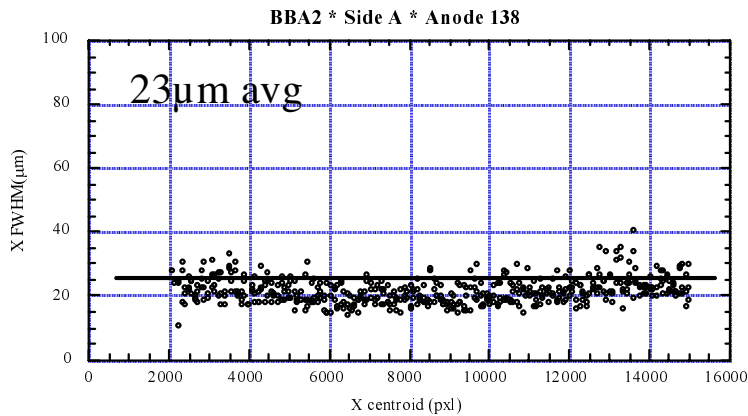
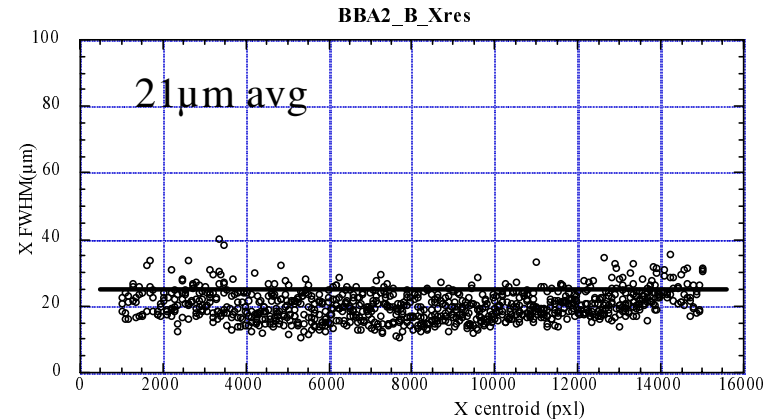
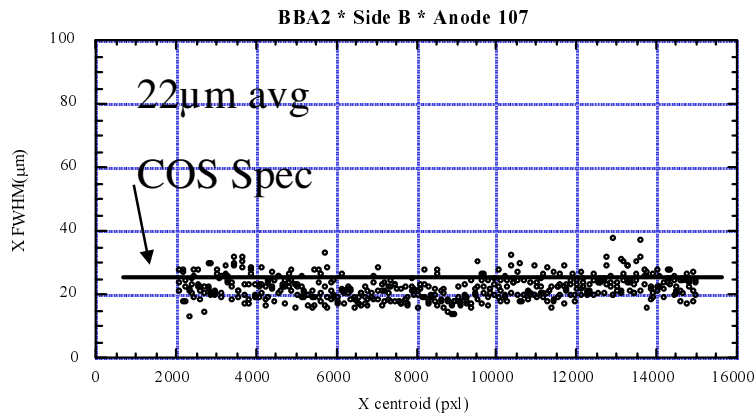


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BBA#2 X resolution data with Flight TDC's ETU (flight board) TDC

Flight TDC's





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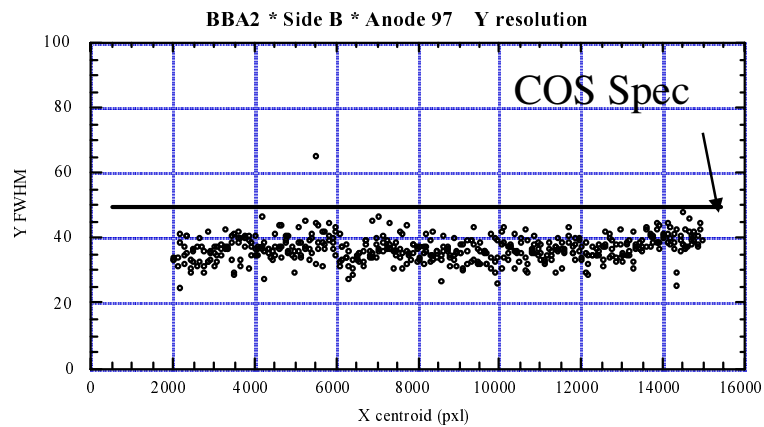
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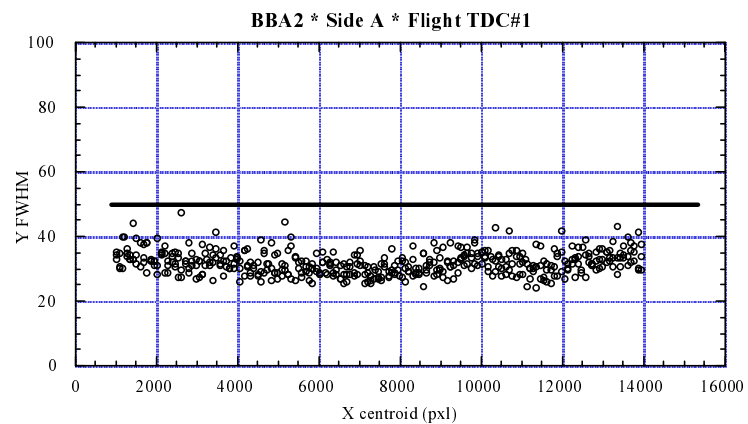
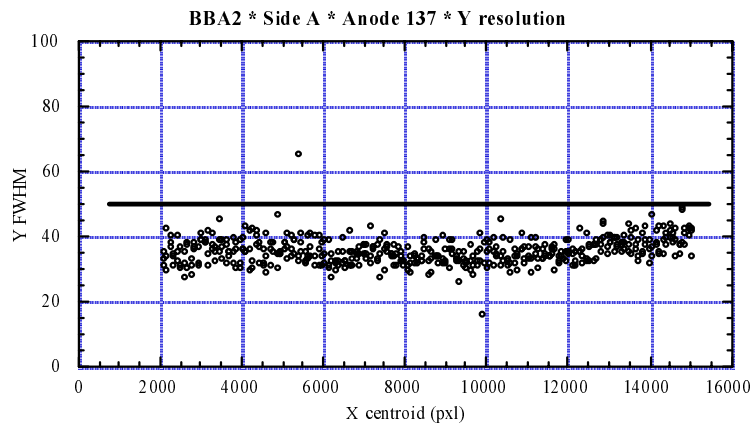
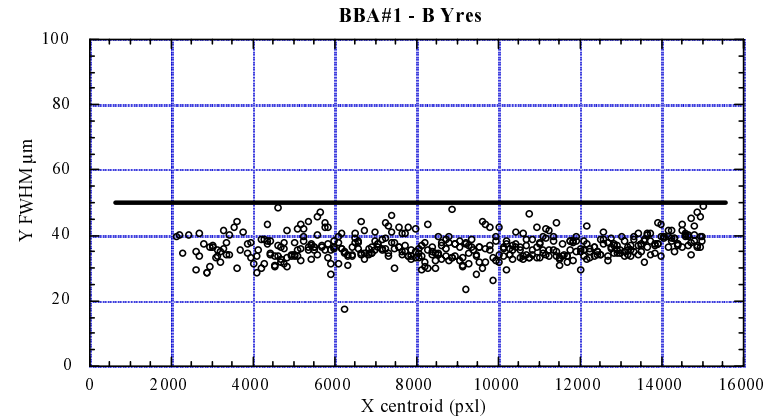
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BBA#2 Y Resolution

ETU (flight board) TDC



Flight TDC's



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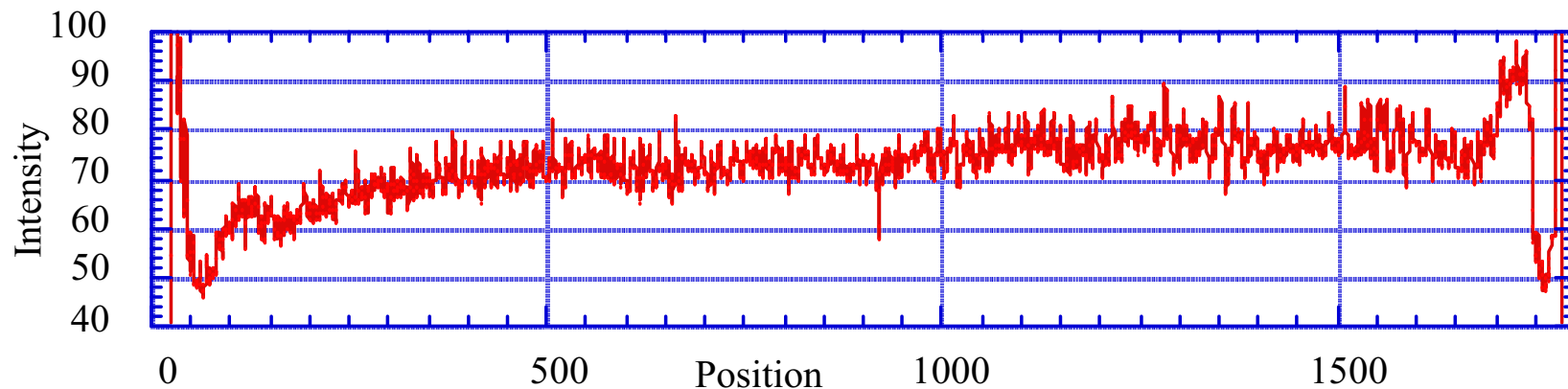
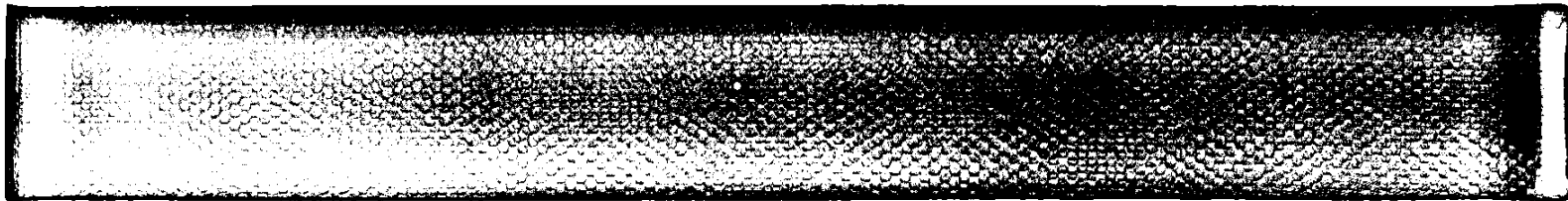


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BBA#2 MCP Stack Flat Field with Flight TDC

- COS BBA#2-B UV full field illumination



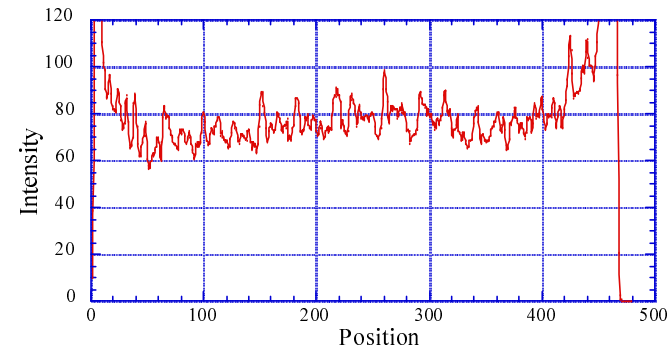
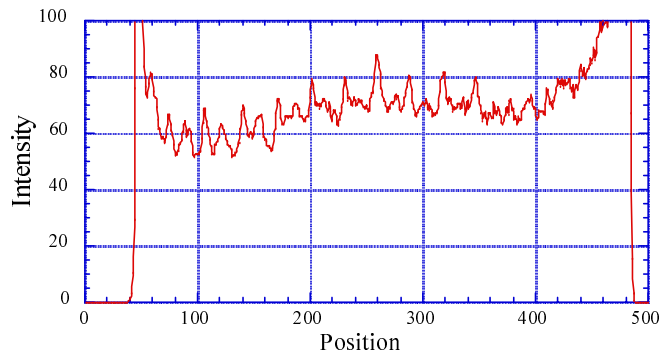
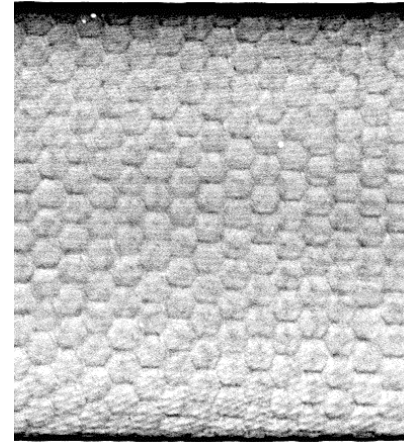
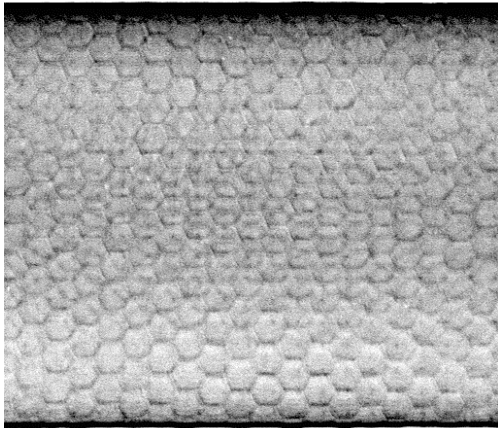
- Moire tests on BBA#2 with **flight** TDC shows small Moire at edges, multifiber MCP patterns are the major fixed pattern effect.



COS Monthly Status Review



Flight BBA#2-B MCP Stack Fixed Pattern Noise



- Multifiber modulation dominates,

small Moire at some edges



COS *Monthly Status Review*



COS BBA Test Summary

- BBA #1 rebuilt with new MCP's.
 - Old MCP's did not meet resolution/flat field spec
 - New MCP's installed and gain maps adjusted
 - Resolution is now acceptable on both sides
 - Flat field being tested
- BBA #2 resolution flat field & functional tests.
 - Resolution and flat fields look very good with flight TDC's
 - BBA#2 integrated onto flight DBA and for system verification tests
- BBA #3 re-assembled with two different MCP sets
 - Resolution with ETU TDC about to begin tests
 - Gain optimization process & flat field performance next



COS
Monthly Status Review



UCB FUV Detector Status -Risk Mitigation Planning

- BBA#2 & BBA#1 have good performance with minimal optimization due to MCP selection process & TDC stability
- Have replaced ETU TDC's with 1st flight TDC set and verified flight system performance results
- Now qualifying TDC's (thermal, frequency, margin tests)
- Replaced MCP's in BBA#1, optimized gain map & resolution
- Replaced MCP's in BBA#3, now doing gain maps & resolution
- Have started preparations for Thermal Vacuum at CU to avoid problems with UCB tank recommissioning
- Nov 00 fit check with flight design detector head & cables
- Deliver flight spare system to Ball in Jan 01 for tests with MEB simulator and UV focus/alignment test



COS
Monthly Status Review



UCB FUV Detector Status -Milestones for next Month

- Detector #1 photocathode deposition & QE test done
- DBA#2 testing with system system electronics completed
- All flight #1 PC boards coated and staked



COS

Monthly Status Review



CU Software/Operations Efforts

- GSE Software Development at CASA-ARL
 - COS Science Data Index and Analysis Software - a.k.a. "CEDAR"
 - Website gives full details for CEDAR: <http://cos-arl.colorado.edu/CEDAR/>
 - CEDAR Build III development is on hold until specific TLM, Science Data Header and Science Data Format information are mature enough to allow further CEDAR development. It is expected that this information will reach the necessary level of maturity during the month of November. The CEDAR lead developer, Stéphane Béland, is currently working on the CALCOS-GSE software effort.
 - Build III completion will take approx. 1 month from the time this information is available.



COS

Monthly Status Review



CU Software/Operations Efforts

- COS Target Acquisition Simulation Software - a.k.a. "TAACOS"
- Website gives full details for TAACOS: <http://cos-arl.colorado.edu/TAACOS/>
 - TAACOS Phase I Report for the NUV Channel released for signatures on Oct. 20th.
 - Draft of document outlining “Recommended TA FSW and Operations Changes” – and the resulting FSW Requirements Change Requests (RCR’s) - discussed during two COWG telecons on Oct. 12th and Oct. 17th.
 - Recommend FSW Changes endorsed by the COWG – with minor modifications. Implementation of RCR’s pending approval by Project CCB.
 - Final version of “Recommended TA FSW and Operations Changes” document to be released for signatures the week of Oct. 23rd.
 - Further TAACOS simulations, modifications and/or enhancements are on indefinite hold. The TAACOS lead developer, Dr. Steven Penton, will now transition over to begin work on the CALCOS-GSE software.



COS

Monthly Status Review



CU Software/Operations Efforts

- COS Science Data “Ground Support” Calibration Software - a.k.a. "CALCOS-GSE”
- Website (to be developed) will give full details of CALCOS-GSE efforts: <http://cos-arl.colorado.edu/CALCOS/>
 - Splinter-Meeting with CASA & STScI held during the last COS MSR at UCB/SSL. Memorandum of Understanding (MOU) regarding STScI COS “pipeline” software to be available at COS Thermal-Vac- updated to reflect modifications to the COS I&T schedule and the resulting software ‘need dates’ – which have changed since the MOU was originally drafted.
 - Splinter-Meeting also discussed CALCOS-GSE development, and how the development of software needed by the IDT for I&T can be done in a way that allows for an easier and more efficient transition to the “real” CALCOS pipeline software to be developed at STScI. Initial agreement for the IDT to develop algorithms and first versions of GSE software in IDL – and then transition to Python, which is the “language of choice” for calibration software at STScI.
 - Current Draft of AV-03 being used as a SW development guide for CALCOS-GSE development.
 - Formal CALCOS-GSE Development Plan currently being prepared by Béland and Penton.



COS

Monthly Status Review



Assistance with FSW Development Efforts at UCB

- DCE FSW Documentation Efforts
 - Website gives full details of DCE Documentation efforts:
<http://cos-arl.colorado.edu/DCE/>
 - Given the overwhelming success of the recent DCE BOOT Code development effort by Will Clement – and because of strong encouragement by FSW Team members at GSFC and Ball – a decision was made to drop the DCE FSW development effort at UCB/SSL, and have Will Clement develop both the DCE BOOT and OPERATE Code. This decision was given full approval by Hsiao Smith. It is understood by all parties that this “late change” to the DCE FSW development effort could have short-term impacts to the FUV Detector delivery schedule – but that the payoff would be that this approach would help mitigate long-term risk involving the DCE FSW. To date, the decision to go with Will Clement for DCE FSW Code development has not resulted in any significant schedule impact to the FUV Detector program.



COS

Monthly Status Review



Assistance with FSW Development Efforts at UCB (cont.)

- In order to maintain the FUV Detector Hardware Development schedule – the existing DCE FSW developed by UCB/SSL has been deemed “GSE-OPERATE” code, and this code is being used for hardware development and test. The exact date when the newly developed “FLIGHT-OPERATE” code will be introduced into the FUV Detector Development schedule, and replace the “GSE-OPERATE” code, is currently under negotiation.
- Formal DCE BOOT Code Reviews were held in late September and early October. The final DCE BOOT Code Walk-Thru was held on Oct. 18th. As of Oct. 20th, there are currently 7 OPEN Action Items relating to the DCE BOOT Code – and of these 7, only 2 directly related to the CODE. (The other 5 involve Documentation, Operations and/or CS FSW issues.)
- Two weeks of formal DCE BOOT Code testing will take place at UCB from Oct. 23rd – Nov. 3rd. In addition, an informal MEB-DCE Interface Test will be held at Ball from Nov. 8th – 10th.
- The first version of the DCE “FLIGHT-OPERATE” Code is expected in the second week of November. DCE OPERATE Code reviews and OPERATE Code testing will be scheduled ASAP following the initial release.



COS

Monthly Status Review



COS Descope Issues

- The COS IDT has been asked to develop a descope plan which, if implemented, can be used to control future cost-growth and/or schedule difficulties.
- A candidate list of descopes was presented at the last MSR. We are in the process of writing a descope TER, which will be routed for comments in November.
- A descope splinter meeting (requested last month by Dr. Leckrone) will be coordinated around the next MSR.



COS

Monthly Status Review



Science Activities in Conjunction with STScI

- Thermal Vac Data-Processing MOU reviewed
 - Updated draft in circulation.
- COS Operations Working Group (COWG)
 - Target Acquisition changes (per IDT TAACOS study) reviewed and approved.
- AV-03 (calibration requirements document)
 - STScI contributed to comprehensive draft review.
- “Back-end” systems (Pipeline) PDR
 - OPUS, Hubble Data Archive, calibration (calcos)
 - Scheduled for 7 December 200 at STScI.
 - IDT will participate.
 - Data formats, data volumes, processing requirements currently being evaluated.



COS

Monthly Status Review



COS Schedule for CU

- The detailed CU schedule is available as a separate hand-out.

Task	Status
G160M/G140L – Blazed Grating Testing	Awaiting JY deliveries
CEDAR Software Development	Ahead of schedule, awaiting external inputs
TAACOS Software Development	Complete
G140L Gratings & Testing	Ahead of schedule
JY Deliveries	Presented earlier
Tinsley	Presented earlier



COS

Monthly Status Review



Upcoming Events/Activities

- Complete G140L No. 2 grating tests.
- Take delivery of G225M gratings.
- FUV detector PER on 11/8/00 at UCB.
- Complete TDC qualification testing.
- Photocathode deposition and QE test flight detector.
- Stake and conformal coat DCE No. 1 PWAs.
- Continue detector T-V test preparation.



COS
Monthly Status Review



Questions, Issues & Resolution Plan

- None