



COS
Monthly Status Review



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Monthly Status Review
July 27, 2000
NASA/GSFC

Cosmic Origins Spectrograph
Hubble Space Telescope

James Green
July 27, 2000



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Monthly Status Review



Agenda

| | |
|-------------------------------------|--------------|
| Progress Summary Since Last Monthly | J. Green |
| Optics Development Status | J. Green |
| Optics Test Status | J. Green |
| UCB FUV Detector Status | J. Green |
| UCB FUV Detector Performance Status | J. Green |
| CU Software Activities Status | J. Green |
| Schedules | J. Green |
| Upcoming Events/Activities | J. Green |
| CU Issues & Resolution Plan | J. Green |
| STScI Presentation | M. McGrath |
| BATC Presentation | D. Hood |
| Financial Splinter | GSFC/Ball/CU |



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Progress Summary Since Last Monthly

- Took delivery of flight G140L gratings from JY.
- Began incorporating NUV channel and FF/Wave Cal SS into TAACOS.
- Continued G140L test preparations.
- Worked issues surrounding CM release of OP-01.
- Completed launch delay proposal.
- UCB made final selections on flight anodes.
- UCB completed BBA #1/MCP optimization.
- TDC-X & TDC-Y board stuffing began at J&T.



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Optics Development Status - NUV Mirrors

- Tinsley:
 - Current delivery Plan for flight optics (recent changes in bold):

| Item | Previous Due Date | New Date | Slip | New Date for Spares |
|-----------|-------------------|---------------|----------------|---------------------|
| NCM1 | 7/21/00 | 8/7/00 | 2 weeks | 8/30/00 |
| NCM2 | 7/14/00 | 8/7/00 | 3 weeks | 8/30/00 |
| NCM3a,b,c | 7/24-31/00 | 8/7/00 | 2 weeks | 9/10/00 |

- We speak with Tinsley weekly to monitor their progress.
 - Recent delays due to technical challenge in meeting figure requirements across full clear aperture.
- TA-1 mirrors have been coated at GSFC and are ready for delivery to Ball.



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Optics Development Status - Gratings

- JY has restored their efficiency test system and can now test in-house.
- G140L gratings (qty=2) picked-up by CU on Friday, June 30.
- Present grating delivery plan (no change since last month):

| Item | Delivery Date | Coating Dates at GSFC | Test Dates | Planned Test Location |
|--------------|---------------|--------------------------|------------|--------------------------|
| G140L | Done | In process | 8/00-10/00 | CU |
| G160M | 11/00 | 11/00 | 12/00-3/01 | CU |
| G140L-Blazed | 11/00 | 11/00 | 1/01 | CU |
| G185M | 8/00 | 8/00 | 9/00 | GSFC (?) |
| G225M | 11/00 | 11/00 | 12/00 | GSFC (?) |
| G285M | 12/00 | 12/00 | 1/01 | GSFC (?) |
| G230L | 1/01 | 1/01 | 2/01 | GSFC (?) |



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Optics Development Status - NUV Testing at GSFC

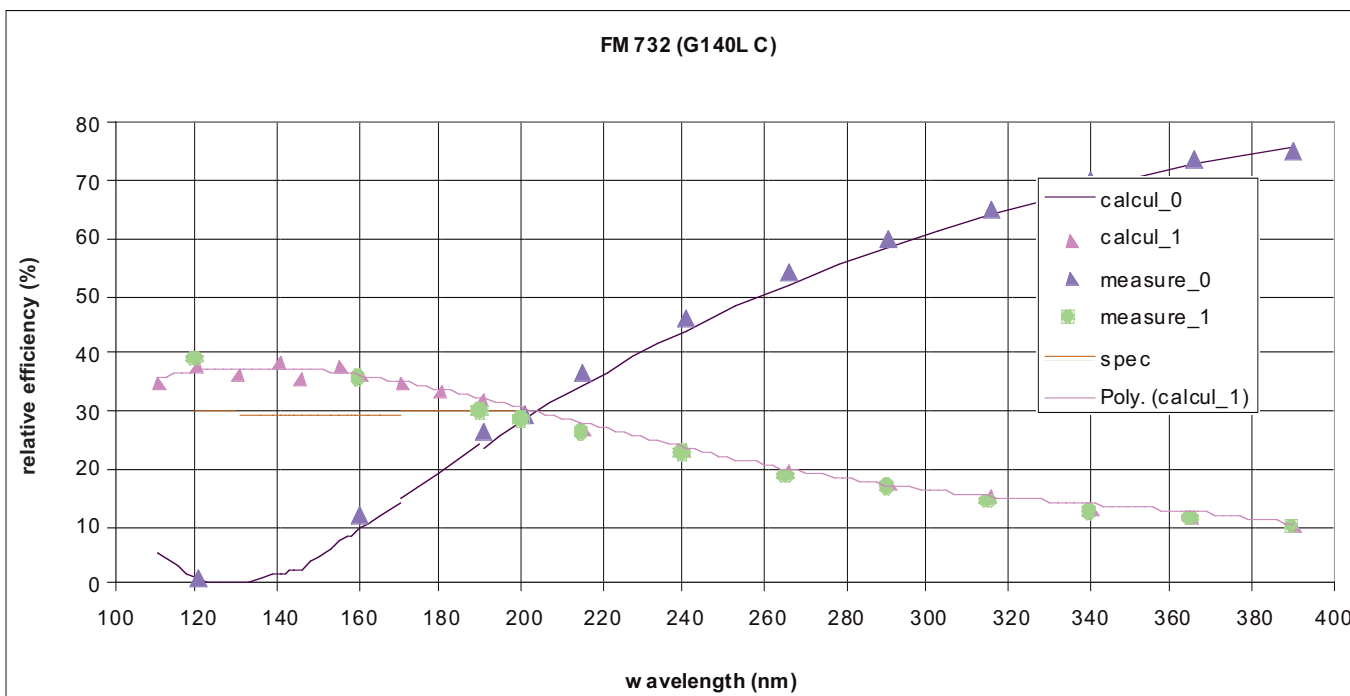
- Over the past several months, we thought we had worked out an agreement to have GSFC perform optical test of the NUV gratings.
- The GSFC optics group has recently informed the HST project that they lack the human resources to do the work.
- CU, the HST project, and the GSFC optics group are meeting today to discuss and work the problem.



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Optics Development Status - G140L Efficiency



- As measured by JY-



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COS FUV Grating Test Status 7/27/2000

- G130M Gratings
 - Testing and data analysis has been completed for both gratings.
 - Both gratings are satisfactory in all respects.
 - G130M-C calibration report is finished, G130M-B calibration report will be finished by end of month.
 - G130M-B appears to have slightly better performance.
- G140L Gratings
 - G140L-ETU testing indicated small blaze error - this was corrected prior to etching the flight gratings.
 - Flight G140L laminar optics have been delivered to GSFC for coating.
 - First G140L grating has been coated and will be picked up today.
 - Test facility will be ready for the optics when bonding of first optic is completed.



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G130M Test Results

| Wavelength (Å) (Source) | G130M-B Grating Efficiency | G130M-C Grating Efficiency | Required Efficiency |
|----------------------------|-------------------------------|-------------------------------|------------------------|
| 1164 (Kr-I) | 38.6±1.8 | 37.1±1.3 | ? 0.27 |
| 1236 (Kr-I) | 44.8±2.2 | 42.0±1.4 | ? 0.37 |
| 1304 (O-I) | 45.4±1.5 | 43.3±1.6 | ? 0.36 |
| 1356 (O-I) | 50.1±2.9 | 46.5±2.4 | ? 0.36 |
| 1411 (O-I) | 50.6±1.7 | 47.8±1.7 | ? 0.36 |
| 1470 (Xe-I) | 50.2±2.1 | 46.5±2.0 | ? 0.36 |

Grating Efficiency

| Wavelength | G130M-B FWHM (mÅ) | G130M-B Resolution $\lambda/\Delta\lambda$ | G130M-C FWHM (mÅ) | G130M-C Resolution $\lambda/\Delta\lambda$ | Required Resolution |
|------------|-------------------------|--|-------------------------|--|------------------------|
| 1219.49Å | 51.9mÅ | 23500 | 52.9mÅ | 23000 | ? 20000 |
| 1283.70Å | 56.9mÅ | 22600 | 59.2mÅ | 21700 | ? 20000 |
| 1382.05Å | 53.8mÅ | 25700 | 62.3mÅ | 22200 | ? 20000 |

Grating Resolution

| Grating ID | Source Wavelength (Å) | Scatter/Å (Upper Estimate) | Maximum Allowable Scatter/Å |
|---------------|-----------------------------|----------------------------------|-----------------------------------|
| G130M-B | 1199-1219 | 1.8×10^{-5} | 2.0×10^{-5} |
| G130M-C | 1199-1219 | 1.6×10^{-5} | 2.0×10^{-5} |

Grating Scatter

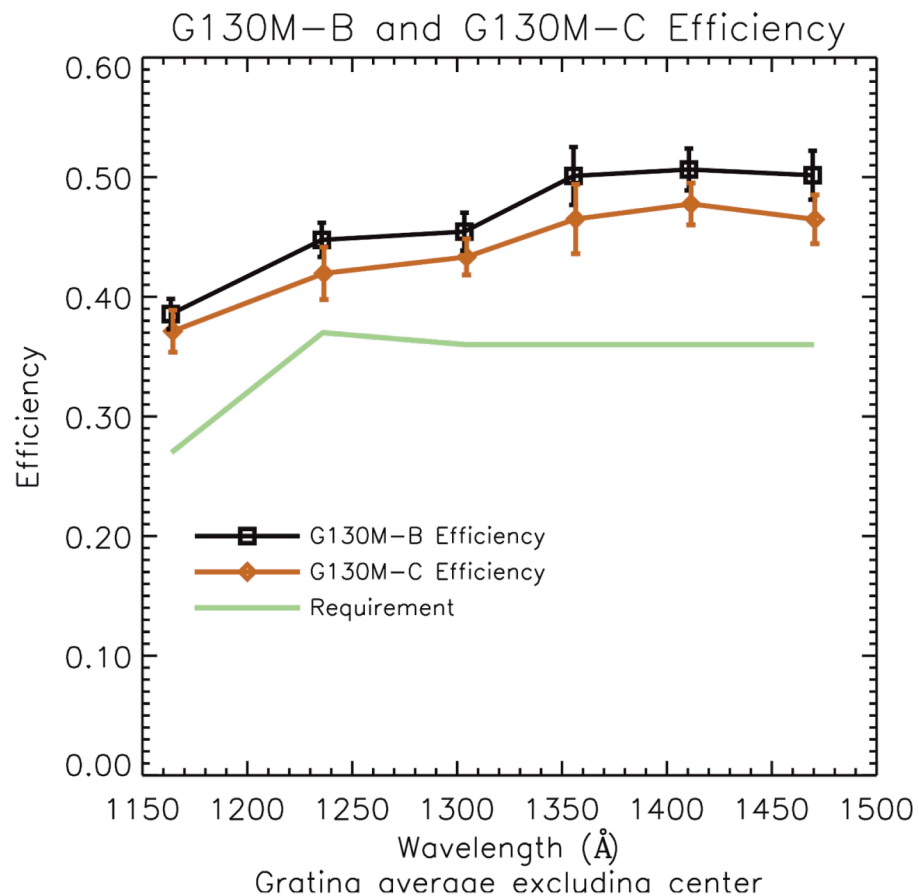


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G130M Grating Efficiency vs. Wavelength



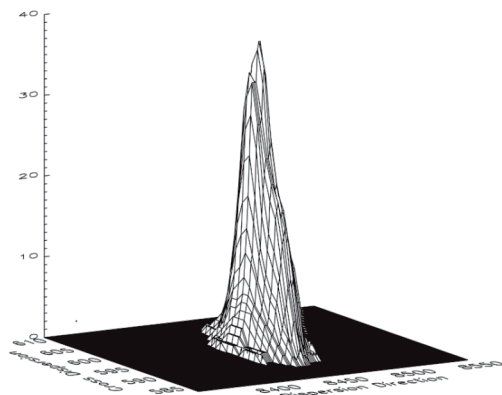
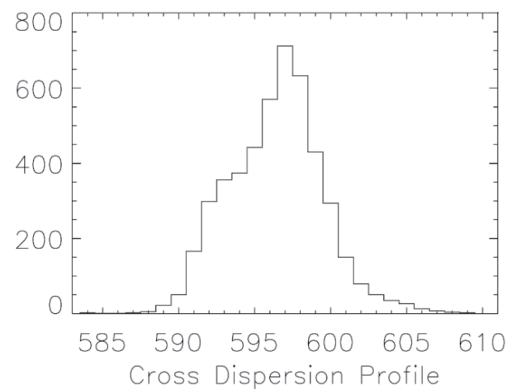
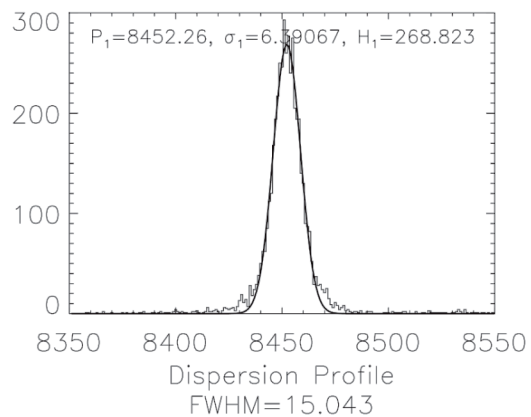


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G130M-B Resolution Test Image - 1283.7Å



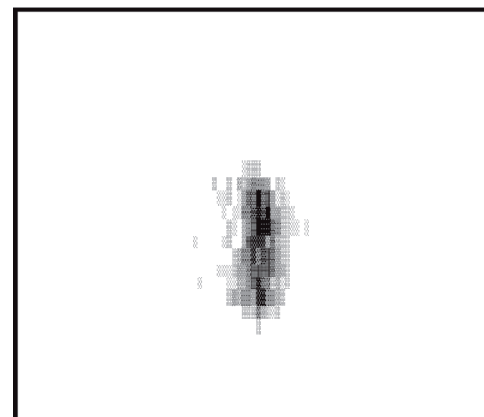
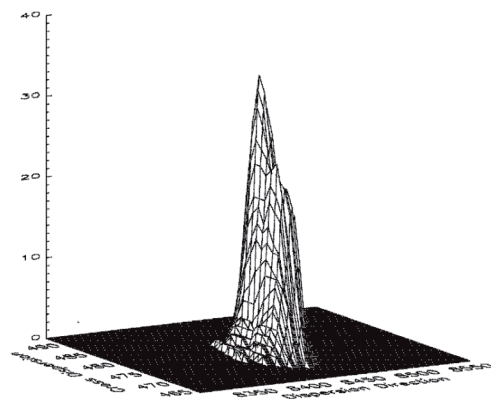
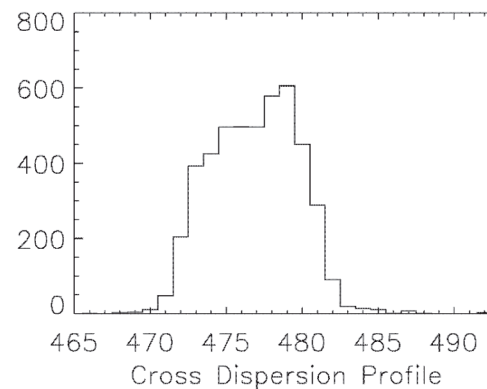
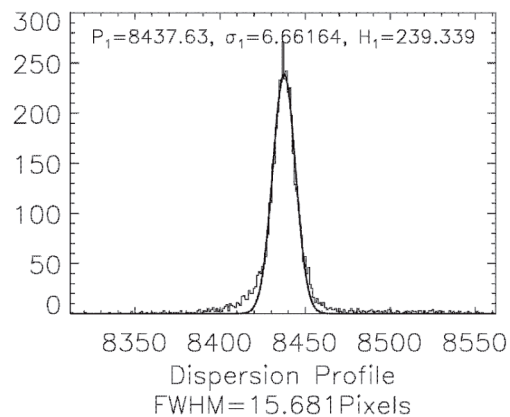


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G130M-C Resolution Test Image - 1283.7Å



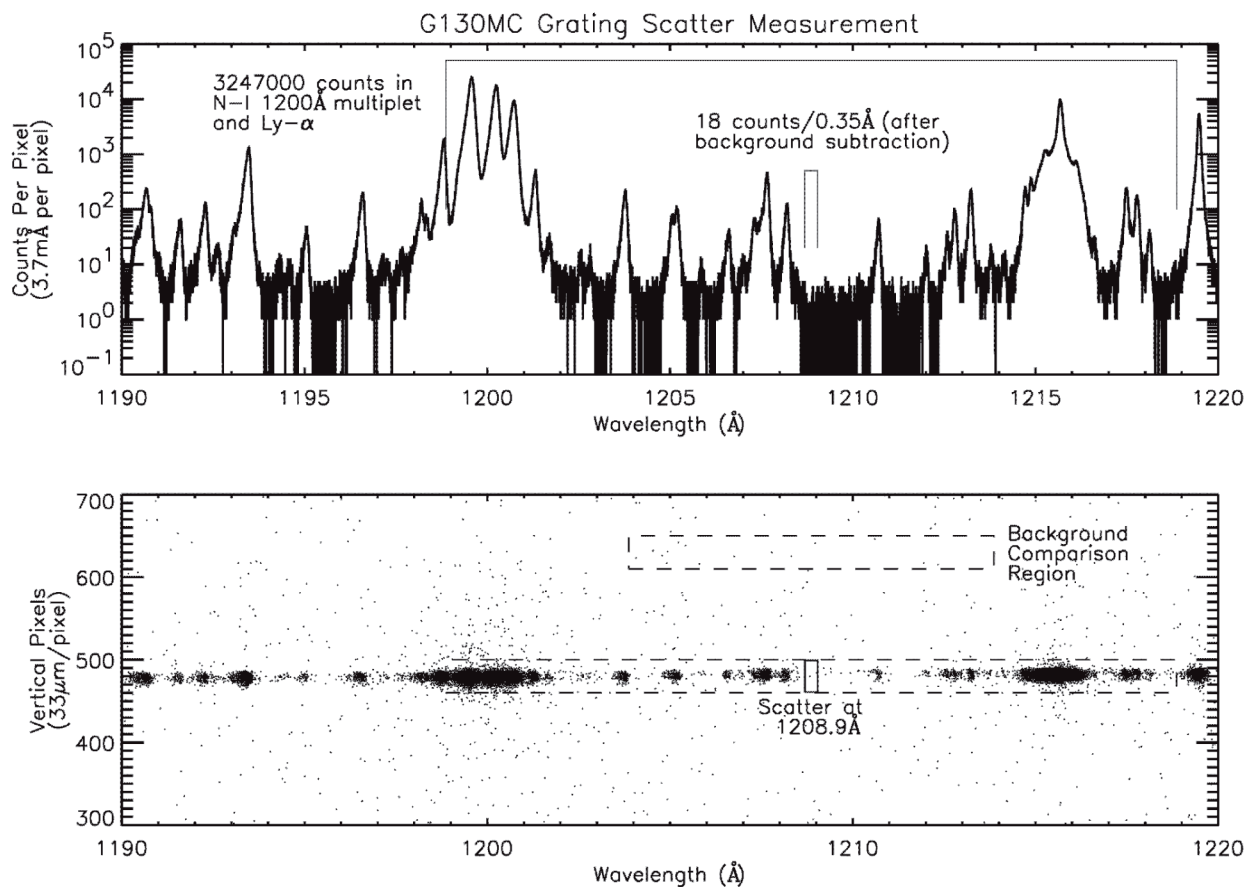


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Sample Grating Scatter at 1200Å for G130M-C



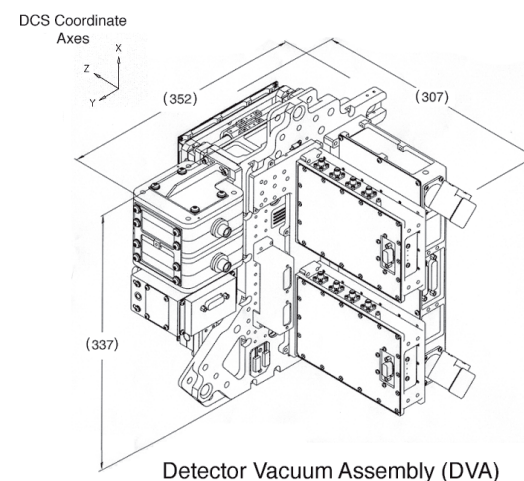
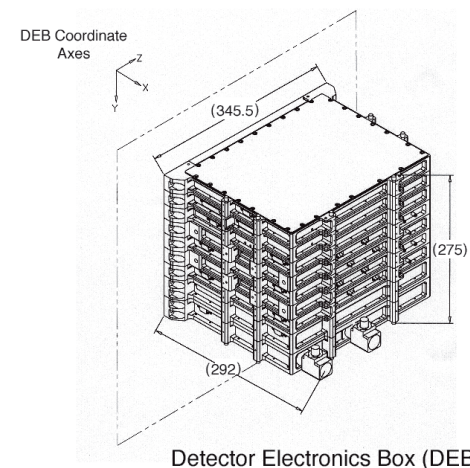


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Overview of FUV Detector Assemblies

- **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)





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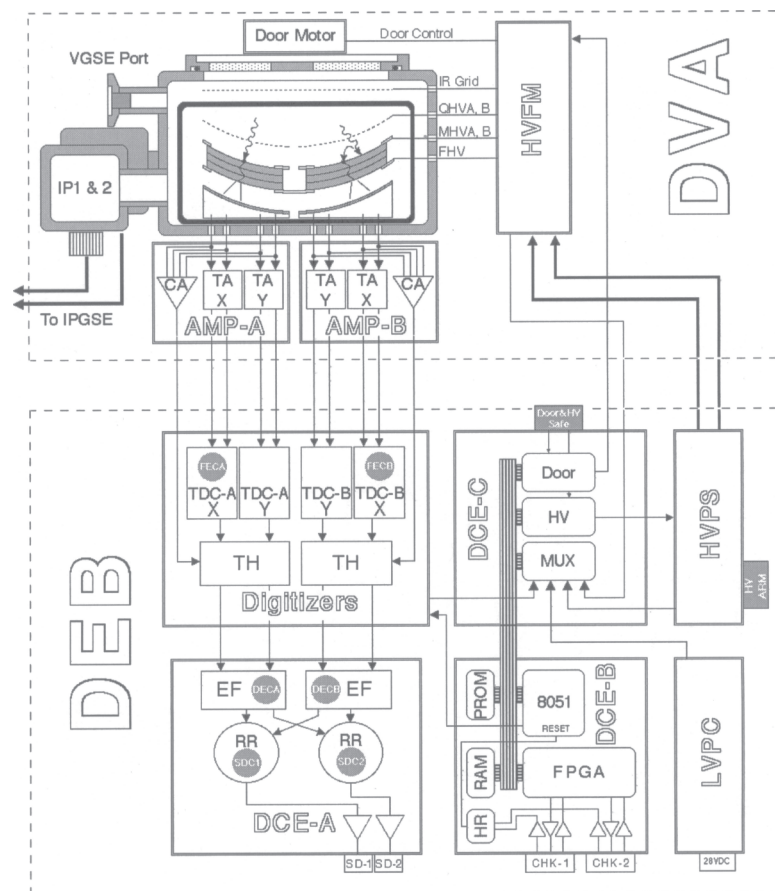
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FUV Detector Subsystem Block Diagram

- 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

- Raffanti still supporting UCB ~ 1 day/week plus consulting via daily phone conversations.
- Baja Technologies is still supporting electrical systems test and integration preparations.
- MAG Systems has temporarily completed COS activities and will pick-up spare detector assembly and test in August.
- A new Post-Doc, Adrian Martin, has joined UCB and is supporting COS DVA development.



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UCB FUV Detector Status - Facilities

- Old building renovations are well under way.
- All COS personnel have moved to office and lab space in the new building.
- New cleanroom has been assembled and is in “commissioning phase.”
- We expect to start detector work in this facility ~7/31.
- Detector electronics test lab fully operational in new building.





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UCB FUV Detector Status - Detector Vacuum Assembly

- DVA door assembly build-up has started.
- Flight door motor/gear-box assembly was TQCM contamination certified at CU.
- Vacuum Box, door assemblies, etc. are being assembled, leak checked, and operationally tested now at UCB.



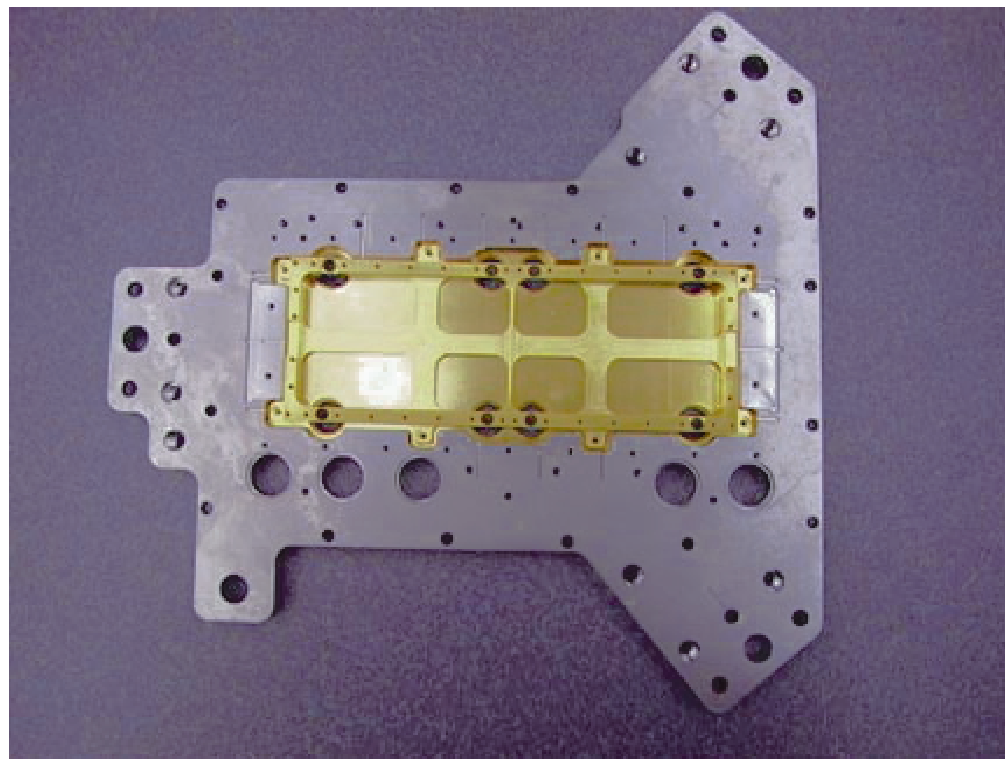
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UCB FUV Detector Status - DVA Continued

- Backplate No. 1 has been through metrology at GSFC and returned to UCB.
- Backplates No's. 2 & 3 in final processing now at UCB and scheduled for metrology at GSFC in early August.





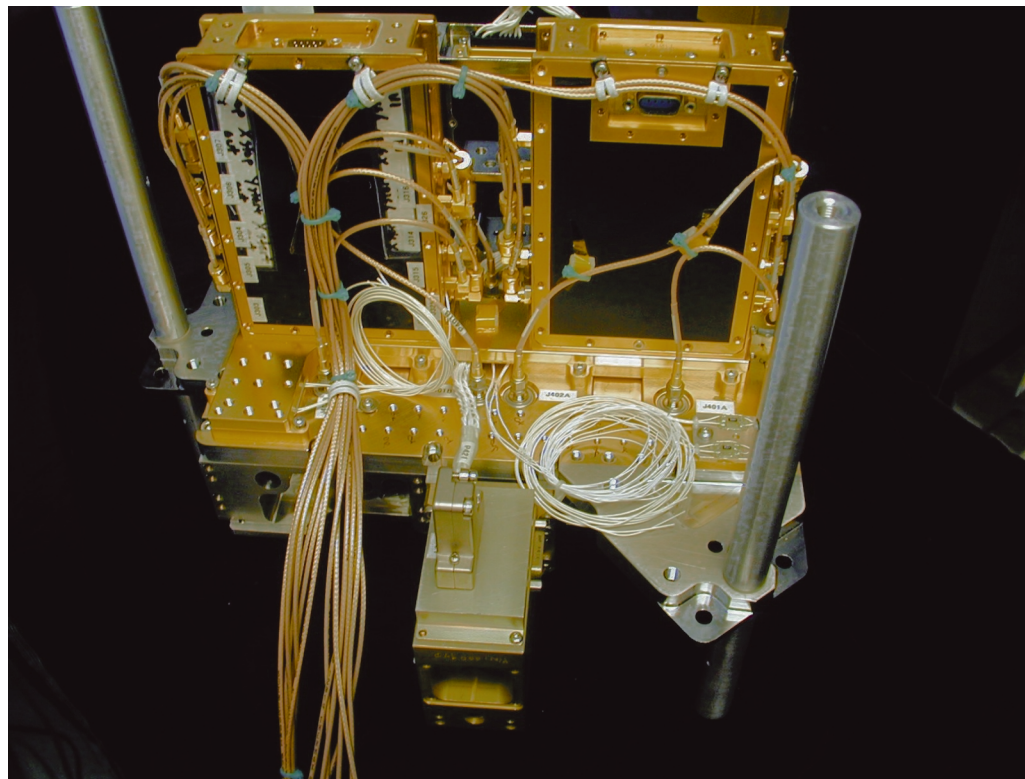
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UCB FUV Detector Status - Electronics

- Power Systems (HVPS, LVPC, HVFM):
 - All are in-house awaiting next level of integration.
- AMPS:
 - In-house undergoing adjustments to address non-linearity.
- DCE - A, B, C Boards:
 - In-house awaiting flight Actels before start of temperature cycle testing.
- Flight Harness:
 - Nearing completion.





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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 | NS | NA | NA | NA | NA | C | C | C | C |
| Worst Case Analysis | NA | NA | NA | NS | NA | C | C | C | C |
| Board Thermal Analysis | C | NS | NS | NS | C | C | C | NS | NS |
| 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 | S | S |
| Board Coupon Testing | C | C | C | C | C | C | C | C | C |
| Stuff Boards | C | C | C | C | C | C | C | S | S |
| Board Workmanship Acceptance | C | C | C | C | C | C | C | NS | NS |
| Board Engineering Acceptance | C | C | C | C | C | C | C | NS | NS |
| Engineering Test & Acceptance | C | C | C | C | C | C | C | NS | NS |
| Temperature Cycle Test | S | C | C | C | NS | NS | NS | NS | NS |
| Voltage Margin Test | S | NA | NA | NA | NS | NS | NS | NS | NS |
| Final Acceptance Test | S | C | C | C | NS | NS | NS | NS | NS |
| Legend | C = Complete | | NA = Not Applicable | | S = Started | | NS= not started | | |

Changes since last MSR in Bold

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UCB FUV Detector Status - Actels

| ACTIVITY | ACTEL FPGA's | | | | | | | | |
|---------------------------------|--------------|------|---------------------|------|-------------|-------|-----------------|-------|-------|
| | Amps | HVFM | HVPS | LVPC | DCE-A | DCE-B | DCE-C | TDC-X | TDC-Y |
| Initial ACTEL Design | NA | NA | NA | NA | C | C | NA | C | C |
| ACTEL Peer Review | NA | NA | NA | NA | C | C | NA | C | C |
| End-to-end System Simulation | NA | NA | NA | NA | S | S | NA | NS | NS |
| FPGA tests with ETU electronics | NA | NA | NA | NA | C | C | NA | S | S |
| Release ACTEL schematic/burn | NA | NA | NA | NA | NS | NS | NA | NS | NS |
| Legend | C = Complete | | NA = Not Applicable | | S = Started | | NS= not started | | |

Changes since last MSR in bold

- First UCB Actel review package was shipped 7/21/00.



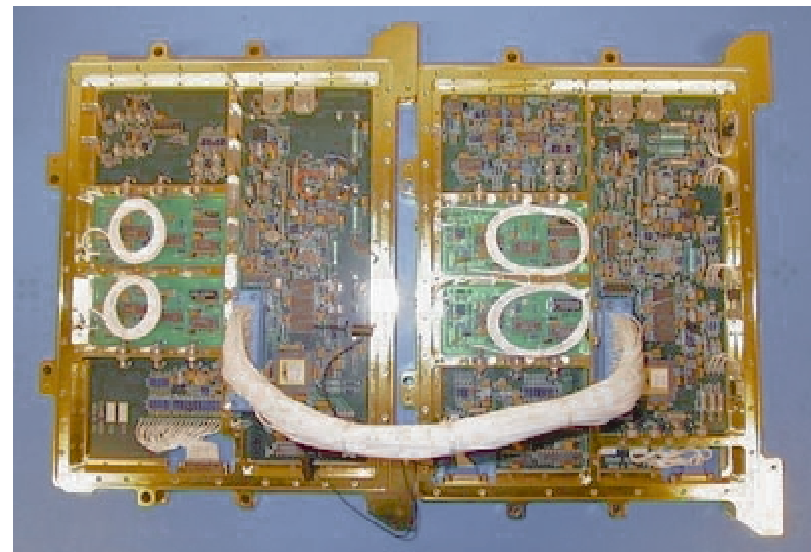
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UCB FUV Detector Status TDC

- 4 TDC-X boards are partially stuffed at J&T now.
 - Final parts issues are being addressed.
 - UCB will likely install some parts after delivery from J&T.
- TDC-Y board stuffing began last week.
- 1st X, Y pair expected at UCB ~ 8/4.
- Remaining 6 boards should be delivered to UCB ~ 8/20.





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UCB FUV Detector Status - Systems

- Documentation Update:
 - ICD Revision A - released 6/24/00.
 - Environmental Verification Plan - released 6/20/00.
 - ECO for Revision A QA Plan - in process.
- Mass and Power Updates (no change since last month):

| | Mass (Kg) | | | Power (W) | | |
|--------------|------------------|--------------------|--------------|------------------|--------------------|-------------|
| | Current Estimate | SoR Allocation (1) | Margin | Current Estimate | SoR Allocation (1) | Margin |
| DVA | 19.43 | 21.5 | 9.6% | 5.68 | - | - |
| DEB | 13.46 | 15.3 | 12% | 46.46 | - | - |
| Harness | 2.7 | 3.4 | 20.5% | - | - | - |
| Total | 35.59 | 40.2 | 11.5% | 52.14 | 53.0 | 1.6% |

Notes: (1) SoR Revision B allocations



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UCB FUV Detector Status - Schedule Overview

| Activity/Task | Last Month's Plan | This Month's Plan | Current Status or Comments |
|---------------------------------|---|-----------------------------|--|
| Complete VHA | 7/11/00 – 8/3/00 | No change | On schedule for 8/3 completion |
| TDC Fab | 7/5/00 – 8/7/00 | Completion extended to 8/20 | 1 pair expected ~8/4, others delayed until 8/22 due to parts problems |
| DCE Thermal Tests | 7/11/00 – 8/2/00 | 8/1/00 – 8/14/00 | Activity delayed pending Actel review. First DCE Actel package was shipped 7/21. |
| DBA No. 1 Ready for Integration | 8/1/00 | 8/17/00 | Optimization of flight MCPs in BBA #1 overran by 2 weeks. |
| Start System Integration | 9/6/00 | 9/22/00 | 2 week slip forecast due to TDC, DCE, and DBA slips. |
| Deliver Flight No. 1 to Ball | 2/7/00 (w/descopes) 3/28/00 (w/o descopes) | 2/23/00 | Descoped delivery date has slipped 2 weeks. |



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UCB FUV Detector Status - Descopes Plan for Schedule Recovery

- Last month UCB showed a schedule with an unacceptable delivery of 3/28/00. As a result, we implemented descopes 1 through 3 below. After these 3 descopes, the delivery moved back to 2/7/00.
- Further schedule erosion at UCB now has moved delivery to 2/23.
- New descope candidates are provided below.

| | Descoped Activity | Time Saved | Risk Incurred | Status |
|---|---|-------------------|--|------------------|
| 1 | UV QE detailed calibration | 3 weeks | Lack of detailed QE knowledge prior to detector delivery | Adopted 6/00 |
| 2 | Flat field detailed calibration | 1 week | Lack of detailed flat-field knowledge & performance prior to detector delivery | Adopted 6/00 |
| 3 | Resolution detailed scan check | 3 weeks | Lack of detailed resolution knowledge & performance prior to detector delivery | Adopted 6/00 |
| 4 | Reduce number of T-V cycles from 6 to 4 | ~ 1 week | Reduced testing of flight article | Proposed 7/00 |



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FUV Detector Status Summary

- Two flight MCP sets chosen (4 req'd, 2 flight, 2 spare)
- Four flight anodes chosen (4 req'd, 2 flight, 2 spare)
- Eng. test unit TDC rate and resolution issues resolved
- QE grid design finished and accepted by P.I.
- Move to new SSL Addition almost complete



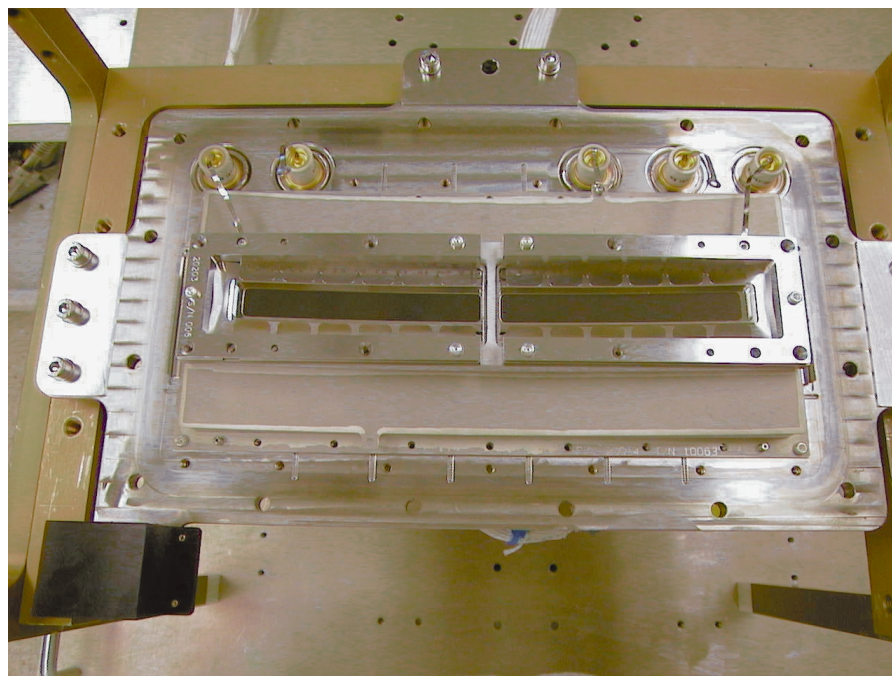
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Detector Performance - Flight MCP status

- Four flight sets required (2 flight and 2 spare).
- Two flight sets chosen for BBA #1 and stacks for BBA #2 undergoing stacking optimization.





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Detector Performance - Flight MCP Stacking Optimization

- Minimize gaps between plates that can adversely affect resolution
- Minimize dynamic range input to amplifiers
- We have one full BBA (2 sides) that is acceptable
- We have developed a method for working the bumps out of gain maps

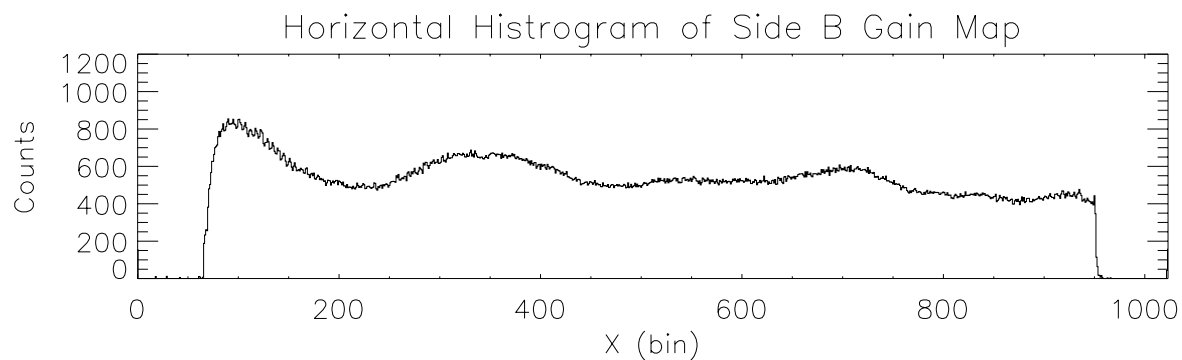
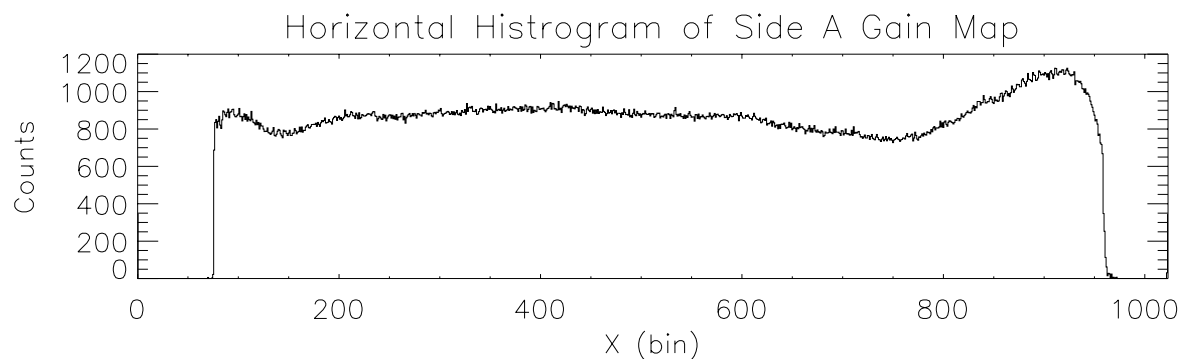


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Detector Performance - Flight MCP Stack Optimization



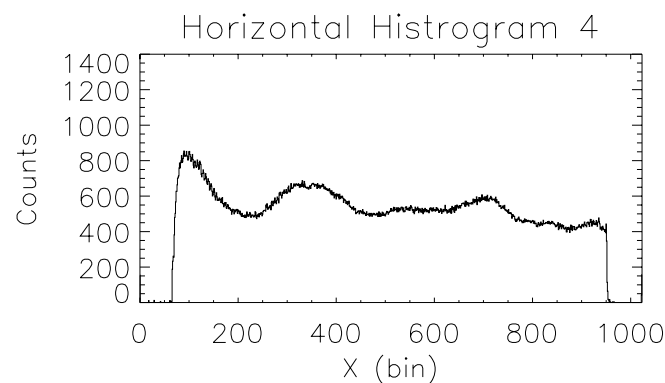
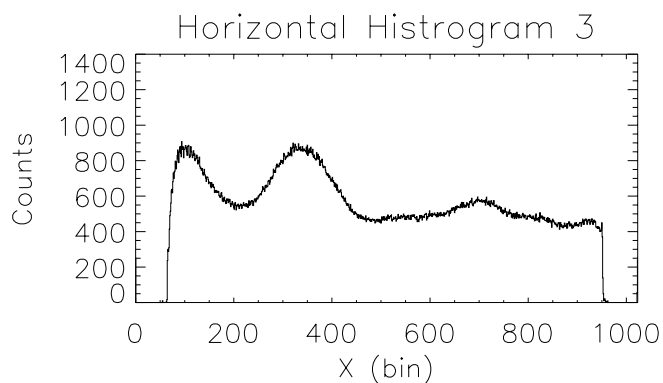
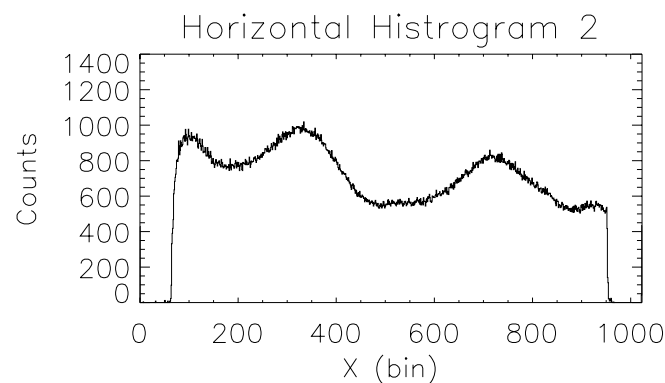
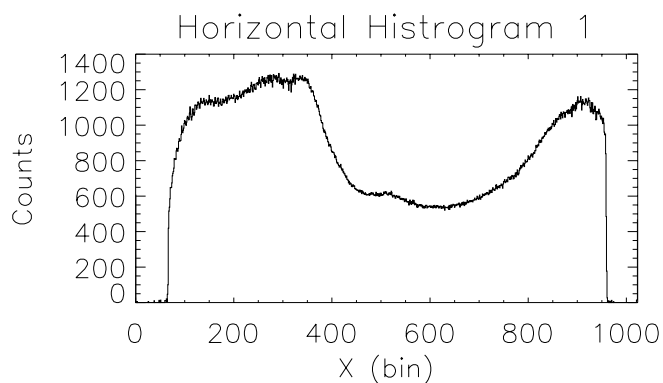


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Detector Performance - Flight MCP Stack Optimization



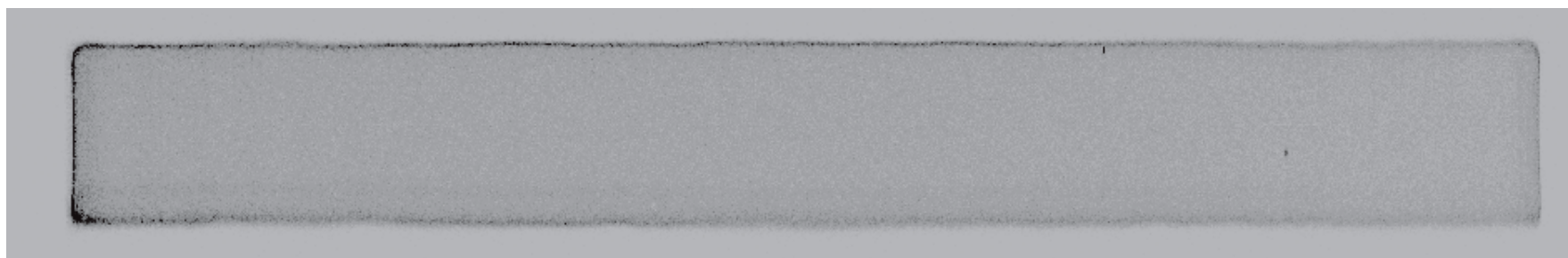


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Detector Performance - Flight MCP Stack Flat Field

- UV flat field



- Gain map:





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Detector Performance - Flight Anode Selection

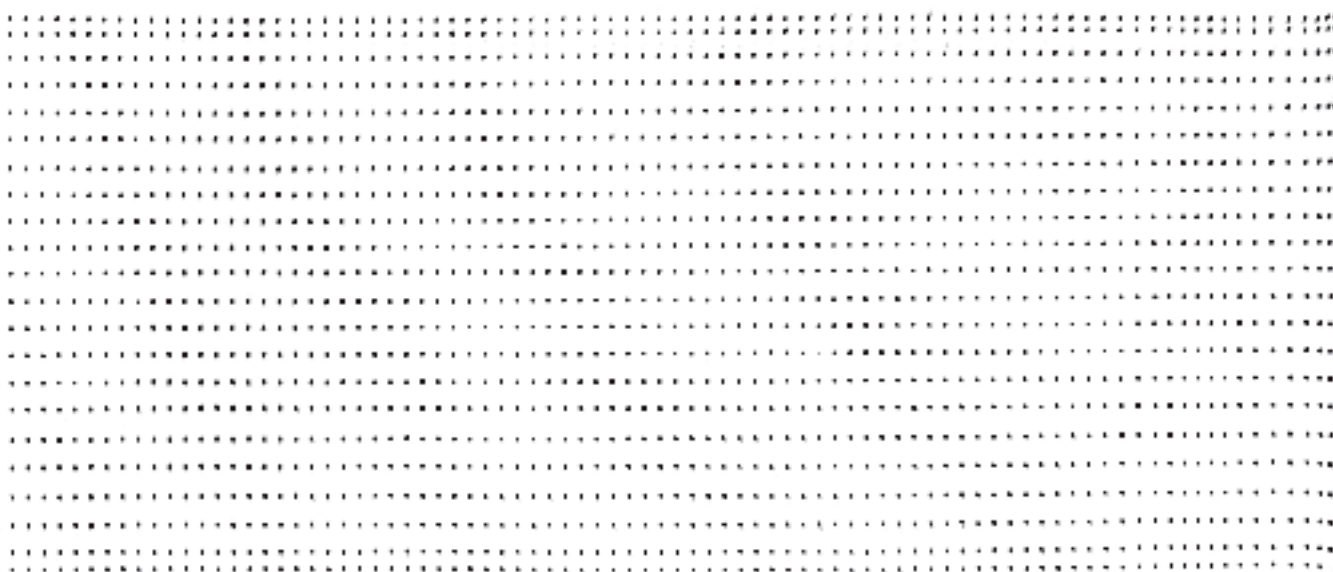
- Four Anodes required (2 Flight, 2 Spare)
- All 10 flight anode candidates tested
 - Visual inspection and bench pulse tests
 - Imaging tests with Anode test detector and pinhole mask
 - Results compared to S/N 137 which has been characterized in detail
- Five anodes pass test
 - Four are final flight version
 - One is previous version (narrow Y fingers)
- Remainder suffer from imaging non-linearities



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Pinhole Mask Image - Flight Anode SN097
(1/2 Field of View, 500 μ m centers)

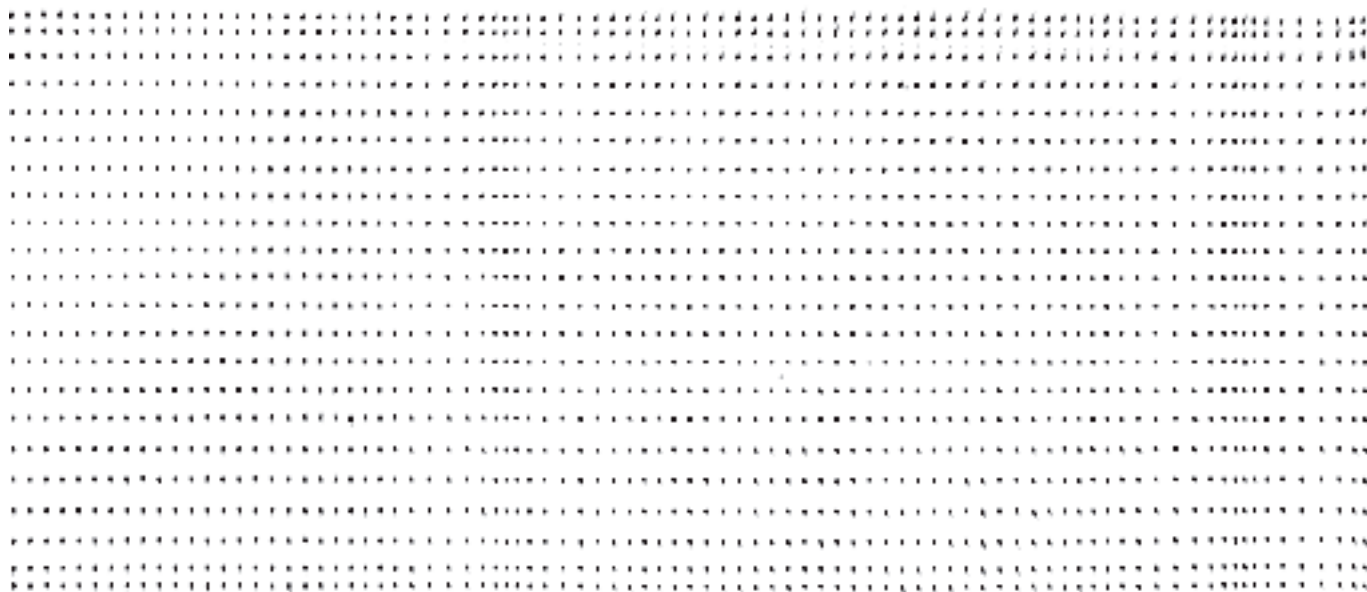




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Pinhole Mask Image - Flight Anode SN105
(1/2 Field of View, 500 μ m centers)





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Detector Performance - Flight Anode Selection

| SN | Make | X resolution(μm) | | Y resolution (μm) | | Distortions? ✓=Yes | |
|-----|-----------|-------------------------------|-------|--------------------------------|---|--------------------|---|
| | | 4800V | 4800V | X | Y | X | Y |
| 073 | Triangle | 36.7 | 28.4 | ✓ | | | |
| 096 | Tyco | 26.6 | 22.9 | ✓ | | | |
| 097 | Tyco | 25.6 | 25.9 | | | | |
| 102 | Triangle* | 30.2 | 30.9 | | | | |
| 104 | Triangle | - | - | ✓ | | | ✓ |
| 105 | Triangle | 27.7 | 23.3 | ✓ | | | |
| 106 | Triangle | 26.0 | 24.9 | ✓ | | | |
| 107 | Triangle | 32.3 | 28.1 | | | | |
| 137 | Tyco | 28.0 | 22.9 | | | | |
| 138 | Tyco | 26.6 | 29.6 | | | | |



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Flight Electronics Optimization

- TDC Eng. Test Unit (ETU) modifications completed
- Tested with
 - MCP detector
 - Flight Anode
 - Flight design amplifiers
- Close to achieving resolution specification
 - TDC not the limiting factor
- Deadtime better than specification
- Resolution loss as a function of rate appears acceptable

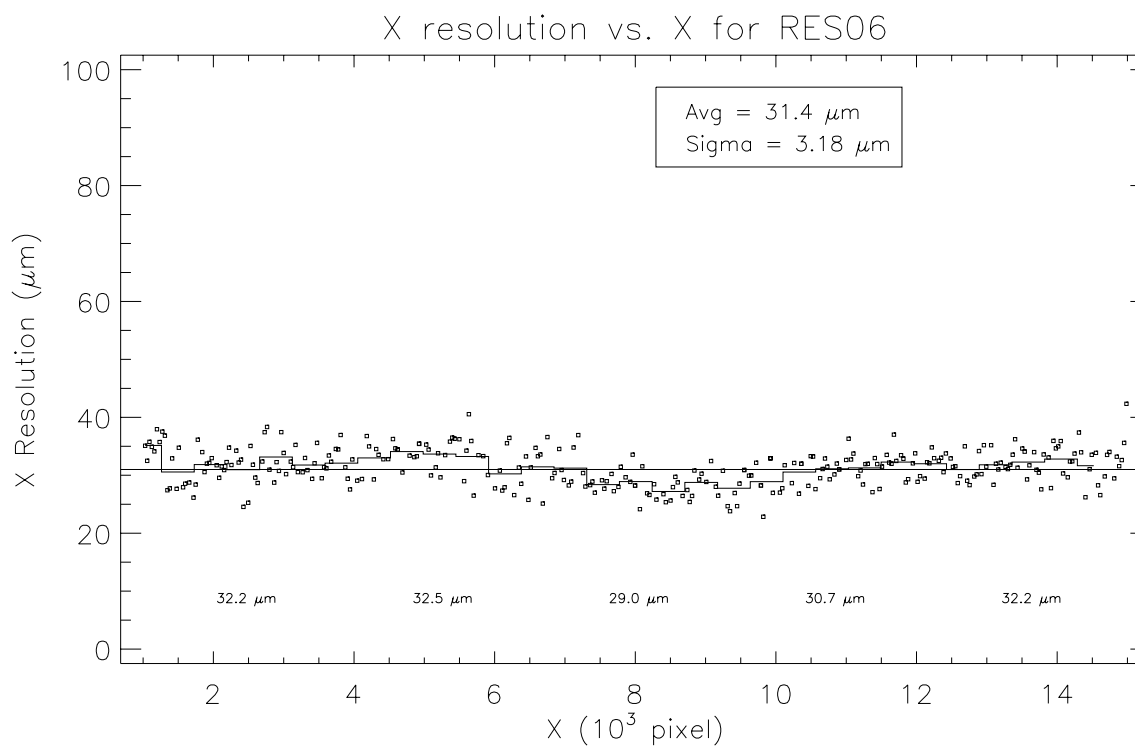


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Flight Electronics Optimization



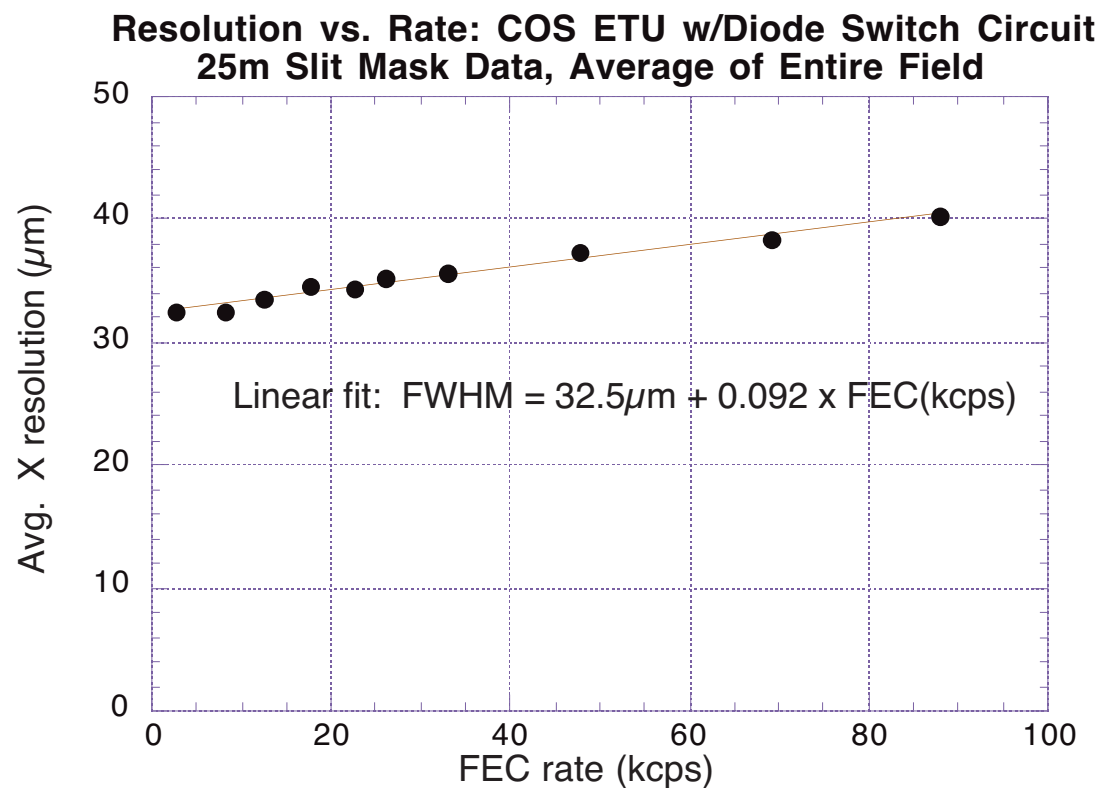


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Flight Electronics Optimization





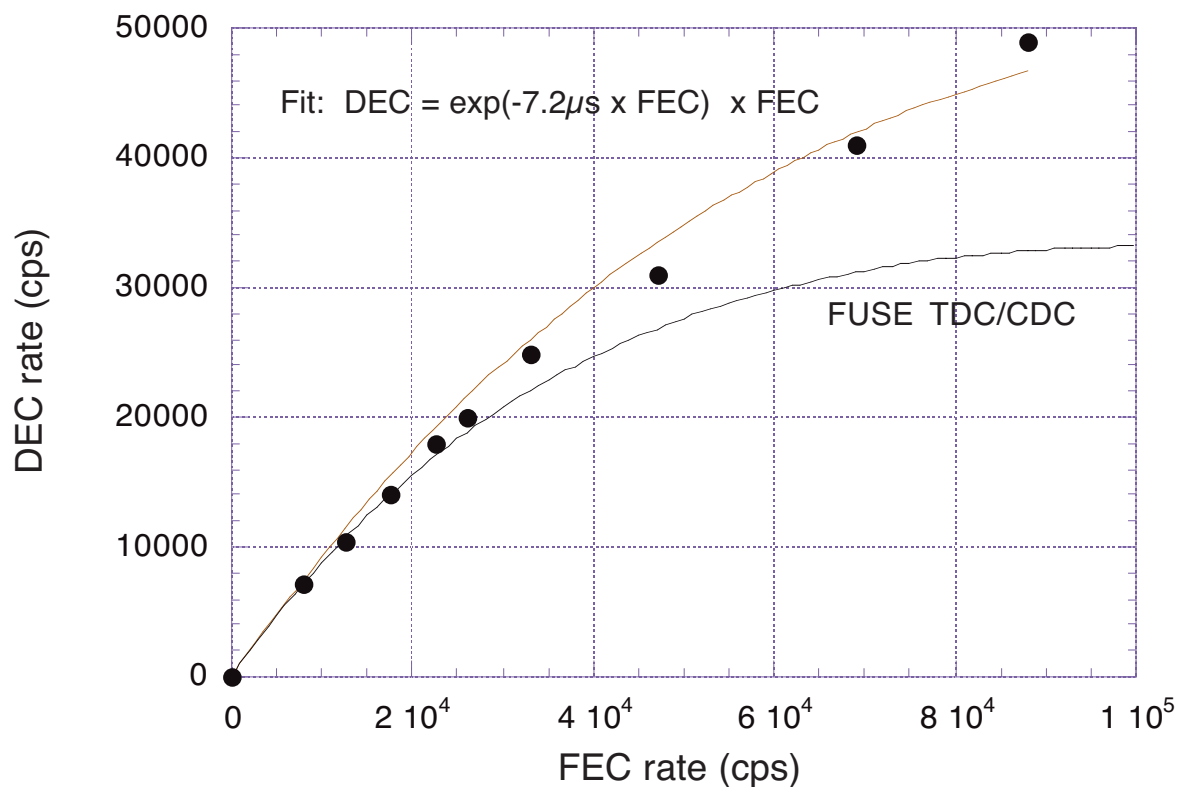
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Flight Electronics Optimization

Livetime test, TDC ETU w/ photons





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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/>
 - Build II training held at BATC on July 13, 2000.
 - Build II completed and released on July 19, 2000.
 - Build II installed at BATC on July 20, 2000.
 - Build III development currently on hold until specific TLM, Science Data Header and Science Data Format details - which are captured in DM-06 and DM-02 - are mature enough to allow further code development.
 - Build III completion will take approx. 1 month from the time these details become available.
 - In the meantime, CEDAR lead developer, Stéphane Béland, will be working full-time at BATC to assist with COS FSW Testing.



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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/>
 - Report on TA FSW "Thresholding" issues released on July 26, 2000.
 - Revised Report on Recommended TA FSW and Operations Changes to be released on August 7, 2000.
 - Phase I Software for NUV channel in development and slated for completion in late August, 2000.
 - Phase I TAACOS Report for NUV Channel to be completed in early September, 2000.
 - It is expected that Phase I TAACOS will be adequate to answer questions about COS TA FSW Requirements. Therefore, Phase II TAACOS software development will likely be put off for at least 6-12 months, so lead developer, Dr. Steven Penton, can move onto other COS SW Tasks (i.e., I&T Calibration Software).



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/>
 - DCE Software Development is well underway, with current code supporting all areas of FUV Detector HW development and test.
 - DCE FSW Code Walk-Thru (Part 2 of 3) being held at BATC on July 27 & 28. Of the 54 Action Items taken during the first Code Walk-Thru (held on June 5 & 6, 2000), 35 are closed and 19 remain open, but are being addressed.
 - DCE FSW "functionality" is approx. 90% complete. The next phase of DCE FSW development involves primarily debugging and requirements & design verification.
 - DCE Software Test Procedures are in development, and all unit and component test procedures are expected to be complete by late August, 2000.



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 | G160M/G140L-Blazed tests completion will slip out 2 months due to delays in grating delivery |
| CEDAR Software Development | Ahead of schedule |
| TAACOS Software Development | On schedule |
| G140L Gratings & Testing | Grating picked up 6/30/00. CU will be ready to start testing in 8/00. |
| JY Deliveries | Presented earlier |
| Tinsley | Presented earlier |



COS

Monthly Status Review



Upcoming Events/Activities

- Take delivery of NUV flight optics from Tinsley.
- Start G140L optical testing at CU.
- Pick-up G185M grating from JY.
- Put OP-01 under “quasi” CM.
- Receive TDC assy’s from J&T.
- Complete BBA #2/MCP optimization.
- Complete DBA #1 processing.
- Burn flight Actels and complete DCE testing.



COS
Monthly Status Review



Questions, Issues & Resolution Plan

- None