COS
Monthly Status Review
June 26, 2002
Ball
## Agenda

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<th>Item</th>
<th>Presenter</th>
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<tr>
<td>Progress Summary Since Last Monthly</td>
<td>E. Wilkinson</td>
</tr>
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<td>E. Wilkinson</td>
</tr>
<tr>
<td>COS I&amp;T Preparation &amp; Support</td>
<td>E. Wilkinson</td>
</tr>
<tr>
<td>Software/Ops</td>
<td>K. Brownsberger</td>
</tr>
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<td>UCB FUV Detector Programmatic Status</td>
<td>E. Wilkinson</td>
</tr>
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<td>UCB FUV Detector Technical Status</td>
<td>O. Siegmund</td>
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<td>Schedules</td>
<td>E. Wilkinson</td>
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<td>Descope Report</td>
<td>E. Wilkinson</td>
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<td>Upcoming Events/Activities</td>
<td>E. Wilkinson</td>
</tr>
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<td>CU Issues &amp; Resolution Plan</td>
<td>E. Wilkinson</td>
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<td>STScI Presentation</td>
<td>K. Sembach</td>
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<td>BATC Presentation</td>
<td>R. Higgins</td>
</tr>
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<td>Financial Splinter</td>
<td>GSFC/Ball/CU</td>
</tr>
</tbody>
</table>
Progress Summary Since Last Monthly (5/22/02)

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

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

Calibration platform in CU vacuum calibration chamber. All optical components mounted in final locations except for lamps, which are being adjusted in translation. nominal positions.
COS I&T Preparation and Support

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

- **CEDAR**
  - Updated Diagnostic Tool capability to assist with COS Diagnostic FSW component testing at Ball.
  - Ongoing updates to support files coincident with updates to COS database release(s).

- **CALCOS-GSE**
  - Lifetime correction
    - Design completed, code to be completed by July 1
  - T.E.R., COS-11-0039 (COS FUV Detector Geometric Distortion Maps), to be released for signature by July 1.
  - Work on combined, ground flats for FUV and NUV channels is nearing completion. T.E.R. on COS Ground Flats is in progress.
Software Operations Status

• COS Spectral Simulator
  – Capability for simulating a limited type of diffuse point sources is in production.

• TAACOS
  – T.E.R’s released:
    • COS-11-0017 (Initial Release), TAACOS: Detector Summary Images
    • COS-11-0014 (RevB), Recommended TA FSW and Operations Changes, based upon the TAACOS Phase I Reports for the FUV and NUV Channels.
  – Simulations for Target Acquisition of extended sources are in progress.

• DCE Flight Software
  – DCE FSW OPERATE v1043 successfully completed component testing and SCR closed. This version is now the default for both flight and test-bench environments.
Software Operations Status

• Personnel
  – Beland and Brownsberger completed BATC ESD and cleanroom training in support of COS I&T activities. Brownsberger continues to support SW/OPS activities at Ball 4-5 days a week. Beland is ramping up support at BATC and will support at 4-5 days a week by the time COS system functional testing begins.

• Report from meeting with Brian Rehm
  – Myself and others recently met with Brian to discuss overall COS SW/OPS status. IMHO, COS is in excellent shape in the SW/OPS areas. The bulk of the FSW is completed and tested and has been run successfully against flight hardware.
Software Operations Status

- Largest remaining FSW activities:
  - OSM Rotary Motor FSW changes
  - CS-DCE CommTask FSW changes
  - Target Acquisition FSW Testing
  - Formal qualification Testing

- Risks
  - The recent SW/OPS personnel cutbacks which were necessary to keep within budget constraints have been difficult. We now have a small, but still excellent SW/OPS team which is fully capable of completing the job.

- Risk Mitigation
  - Recent allocation of Donna Wilson from the HST payload FSW team to cover work on CS-DCE SCR(s) has been wonderful. If the HST project wishes to further mitigate risk in the COS SW/OPS areas they could provide additional, technical “core-team” resources of the caliber of Donna Wilson.
Overview of FUV Detector Assemblies

- **DEB** - (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)
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

<table>
<thead>
<tr>
<th>Unit</th>
<th>Functional Testing</th>
<th>Performance Testing</th>
<th>EMI/EMC</th>
<th>Sine Burst</th>
<th>Random Vibe</th>
<th>Thermal-Vac</th>
<th>Contamination Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUV-01 DVA</td>
<td>C</td>
<td>C</td>
<td>@SS</td>
<td>A - C</td>
<td>A - C</td>
<td>@SS</td>
<td>@SS</td>
</tr>
<tr>
<td>FUV-01 DEB</td>
<td>C</td>
<td>C</td>
<td>@SS</td>
<td>Q - C</td>
<td>Q - C</td>
<td>@SS</td>
<td>@SS</td>
</tr>
<tr>
<td>FUV-01 SS</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>@Comp</td>
<td>@Comp</td>
<td>6-cycles</td>
<td>C</td>
</tr>
<tr>
<td>FUV-02 DVA</td>
<td>C</td>
<td>C</td>
<td>N/R</td>
<td>Q - P</td>
<td>Q - P</td>
<td>@SS</td>
<td>@SS</td>
</tr>
<tr>
<td>FUV-02 DEB</td>
<td>C</td>
<td>C</td>
<td>N/R</td>
<td>Q - P</td>
<td>Q - P</td>
<td>@SS</td>
<td>@SS</td>
</tr>
<tr>
<td>FUV-02 SS</td>
<td>P</td>
<td>P</td>
<td>N/R</td>
<td>@Comp</td>
<td>@Comp</td>
<td>8-cycles</td>
<td>P</td>
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<tr>
<td>DVA Surrogate (1)</td>
<td>C</td>
<td>N/R</td>
<td>N/R</td>
<td>C</td>
<td>C</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td>DVA Surrogate (2)</td>
<td>P</td>
<td>N/R</td>
<td>N/R</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>N/R</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>% Complete</th>
<th>Duration</th>
<th>2002</th>
<th>2003</th>
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<tbody>
<tr>
<td>2</td>
<td>Initial Problem Diagnosis</td>
<td>100%</td>
<td>15.5 days</td>
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<tr>
<td>16</td>
<td>Test &amp; Qualify New Grids</td>
<td>100%</td>
<td>32 days</td>
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<tr>
<td>28</td>
<td>Life Test of Qual Grid Assembly (Pending Hardware Availability)</td>
<td>69%</td>
<td>18 days</td>
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<tr>
<td>41</td>
<td>Assembly &amp; Test of Flight Grid Assembly</td>
<td>20%</td>
<td>10 days</td>
<td></td>
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<tr>
<td>48</td>
<td>Reassembly &amp; Test of Flight FUV-01 Detector</td>
<td>29%</td>
<td>51 days?</td>
<td></td>
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<tr>
<td>49</td>
<td>Complete FUV-01 QE Tests</td>
<td>100%</td>
<td>12 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Open FUV#1 and Install qualified QE grid</td>
<td>100%</td>
<td>1 day</td>
<td></td>
<td></td>
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<tr>
<td>51</td>
<td>Install FUV#1 in QE test chamber</td>
<td>100%</td>
<td>2 days</td>
<td></td>
<td></td>
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<tr>
<td>52</td>
<td>Detector #1 functional test with flight DEB</td>
<td>100%</td>
<td>1 day</td>
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<tr>
<td>53</td>
<td>Open FUV #1 and Check Grids for FE Problem</td>
<td>100%</td>
<td>1 day?</td>
<td></td>
<td></td>
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<tr>
<td>54</td>
<td>QE check of FUV#1 detector</td>
<td>100%</td>
<td>2 days</td>
<td></td>
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<tr>
<td>55</td>
<td>Pre-vibration functional testing</td>
<td>100%</td>
<td>1 day</td>
<td></td>
<td></td>
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<tr>
<td>56</td>
<td>FUV#1 vibration test at Lockheed</td>
<td>100%</td>
<td>1 day</td>
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<tr>
<td>57</td>
<td>Post vibration function tests in QE chamber</td>
<td>0%</td>
<td>2 days</td>
<td></td>
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<tr>
<td>58</td>
<td>Install FUV#1 system in cal chamber + set-up scrub</td>
<td>0%</td>
<td>2 days</td>
<td></td>
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<tr>
<td>59</td>
<td>Mini-Scrub of FUV#1 plates in Calib chamber</td>
<td>0%</td>
<td>6 edays</td>
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<tr>
<td>60</td>
<td>Final QE calibration of FUV#1</td>
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<td>4 days</td>
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<td>61</td>
<td>Final System Functional testing</td>
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<td>62</td>
<td>Pack detector for shipment</td>
<td>0%</td>
<td>1 day</td>
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<tr>
<td>63</td>
<td>Ship FUV01 detector system to UCo</td>
<td>0%</td>
<td>1 eday</td>
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<td></td>
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<tr>
<td>64</td>
<td>Install detector system into UCo T-V chamber</td>
<td>0%</td>
<td>1 day</td>
<td></td>
<td></td>
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<tr>
<td>65</td>
<td>Pre-pump down functional testing</td>
<td>0%</td>
<td>1 eday</td>
<td></td>
<td></td>
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<tr>
<td>66</td>
<td>Completion of FUV#1 System T-V tests</td>
<td>0%</td>
<td>4 edays</td>
<td></td>
<td></td>
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<tr>
<td>67</td>
<td>FUV#1 System cleanliness certification</td>
<td>0%</td>
<td>1 day</td>
<td></td>
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<tr>
<td>68</td>
<td>Remove flight system and pack</td>
<td>0%</td>
<td>1 day</td>
<td></td>
<td></td>
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<tr>
<td>69</td>
<td>FUV#1 system ready for BATC</td>
<td>0%</td>
<td>0 days</td>
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</tbody>
</table>

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Cosmic Origins Spectrograph
Hubble Space Telescope

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June 26, 2002
COS FUV Detector Systems

- Detector DEB
- Detector Head
Flight FUV01 Detector System

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

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

Mounts to top of detector  
Frame is PEEK insulator  
Grids are electroformed Ni  
One grid on each segment  
Used to enhance QE by 30%  
-1500v bias to MCP  
Bias can be turned off  
Ramps with MCP HV  

Can be removed or installed without disturbing MCP’s  
Access by removing DBA & magnetic shield from VHA
FUV01 Grid Wire Problem

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

Grid wire through window  Grid wire from side angle  Grid wire attachment point
FUV01 Grid Frame Assembly

FUV01 Grid is held on detector with 10 screws
FUV01 Grid Wire Design

**FUV01**

Original Mesh made by Buckbee-Mears.

Grids selected by optical inspection. Nodules & wire breaks rejected.

Thickness 8 ±2µm.

Wires 15µm wide.

Wires on 5mm pitch.

Glued to frame with silver epoxy.

Cured at elevated temperature (60°C)
Grid Status

FUV01 original grids have undergone two full acceptance vibrations and one Z axis acceptance vibration, plus thermal vac soaks (+50, -20°C) and four cycles (0 - 40°C).

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

Further Analysis and Tests.

Pull tests on original and new batch grid material done at GSFC (Ben Reed).
Epoxy mix cure tests and glass transition tests done at GSFC (Ben Reed)
GSFC grid simulation (Bart Drake) indicates thermal grid to frame CTE mismatch problem.
Shock tested COS ETU DVA with HOP at AMES, shows large margin - not a problem
Electric field strength model shows only 1G force with QE grid field on - not a problem
Basic vibration model indications OK, provided grids have not yielded, or excessive slack.
Tests and Models of Grid Wire Problem - materials tests

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

**Original Buckbee Mears Grid Tests.**
Yield strength ~74 ksi with 3% elongation

**New Buckbee Mears Grid Tests.**
Yield strength ~50 ksi with 3% elongation

**New Stork-Veco Grid Tests.**
Yield strength ~165 ksi with 5% elongation

**New Buckbee-Mears meshes are weaker than originals**

**Stork-Veco are twice the strength and elongation of original Buckbee-Mears mesh**
Tests and Models of Grid Wire Problem - Grid model

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

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

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

- new Stork-Veco meshes are an even better

<table>
<thead>
<tr>
<th>PEEK</th>
<th>Grid Part</th>
<th>Stress (psi)</th>
<th>M.S. Yield (%)</th>
<th>M.S. Ultimate (%)</th>
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<tbody>
<tr>
<td>Unfilled</td>
<td>Wire</td>
<td>125382</td>
<td>-52.69</td>
<td>-33.87</td>
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<tr>
<td>Unfilled</td>
<td>Annulus</td>
<td>48604</td>
<td>22.05</td>
<td>70.60</td>
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<tr>
<td>30% Filled</td>
<td>Wire</td>
<td>48986</td>
<td>21.10</td>
<td>69.27</td>
</tr>
<tr>
<td>30% Filled</td>
<td>Annulus</td>
<td>17769</td>
<td>233.84</td>
<td>366.66</td>
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</table>
Plan for Grid Solution and Verification/Lifetest

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

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

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

**Flight Grids on 30% Glass Filled PEEK Frames**

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

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

Both have undergone :-

- Field emission tested on a detector successfully
- Completed thermal cycles, -25°C to +50°C,
- Inspection and field emission test
- Vibration test
- Inspection and field emission test

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

Biggest issues have been the considerable extra handling of the new grid assemblies
Each test step requires an install/removal from a detector!
Flight Grid Solution

Stork-Veco mesh on 30% glass filled PEEK frame
FUV01 Grid Changeout

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

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

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

**Side A, ion pumps on ~3000 cps**

**Side B, ion pumps on ~3000 cps**
Retrofit and Commissioning steps for FUV01

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

Six broken wires
2 on “B” side, 4 on “A” side
None where model predicts!
Only 1 field emits - bent
Puckering indicates hot cure
Slight slackness in meshes
FUV01 Detector Status

Have configured our QE tank and installed entire FUV01 detector successfully
Have done functional tests and a QE check (grid voltage off) successfully
Grid Backup Solution - Metal Grid Carriers

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

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

Original frame design solid PEEK

Brazed body assembly
UCB FUV02, Flight Backup Detector, Status

- **DEB** - All boards have been cleaned, coated, staked, and vacuum baked.
- **Harnesses** - Cleaned and vacuum baked/certified.
- **DBA** - Built up and integrated with VHA, at UCB.
- **Vacuum Housing Assembly**
  - Successfully completed alignment tests at Ball.
  - Door assembly at UCB awaiting re-assembly with modified parts
- **Brazed Body Assembly**
  - BBA currently in safe vacuum storage awaiting final FUV02 buildup.
- **ETU DEB** - ETU DEB delivered to Ball mid August.

UCB FUV02, Flight Backup Detector, Next Actions

- Complete FUV02 assembly and test sequence
- Complete FUV02 door pre-assembly preparations at UCB - in progress
- Re-assemble FUV02 door assembly at UCB and test
- Proceed with final FUV02 buildup, test, & scrub.
- FUV02 environmental testing (vibration and thermal vacuum).
### COS Schedule for CU/UCB

<table>
<thead>
<tr>
<th>Task</th>
<th>Status</th>
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<tbody>
<tr>
<td>CALCOS Software Development</td>
<td>On-going.</td>
</tr>
<tr>
<td>Cal/FF SS Optical Integration</td>
<td>On-going: deliver to Ball in early July.</td>
</tr>
<tr>
<td>Complete FUV-02</td>
<td>Deliver ~9/18/02.</td>
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</table>
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
  – Baseline environmentals at GSFC
**COS Descope Tracking List**

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

*The IPT has not yet done a detailed analysis to quantify actual $ or time to be saved.
Upcoming Events/Activities

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

• None