Agenda

Progress Summary Since Last Monthly 
UCB FUV Detector Programmatic Status 
UCB FUV Detector Technical Status 
Software/Ops 
Schedules 
Descope Report 
Upcoming Events/Activities 
CU Issues & Resolution Plan 
BATC Presentation 
Financial Splinter 

J. Andrews 
J. Andrews 
O. Siegmund 
J. Andrews 
J. Andrews 
J. Andrews 
J. Andrews 
J. Andrews 
R. Higgins 
GSFC/Ball/CU
Progress Summary Since Last MSR

- Implemented O-ring “fix” to FUV-02 vacuum leak.
- Restarted FUV-02 acceptance flow.
- Continued COS TV and calibration planning and preparation and baselined early instrument ship to GSFC for acoustics, EMI, etc.
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 Overview

- FUV-01 was delivered to Ball on Wednesday, July 31st.
- FUV-01 has operated flawlessly since its integration into the instrument and has accumulated > 72 hours of instrument level run-time (>50% of that time was with HV on).
- FUV-02 is in processing now at UCB:
  - Vacuum seal has been fixed with shaped o-ring.
  - Fix has been vibed with ETU assy. At qual levels, shortened duration.
  - 02 unit is back in processing at UCB now.
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>
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<tbody>
<tr>
<td>FUV-01 DVA</td>
<td>C</td>
<td>C</td>
<td>@SS</td>
<td>A - C</td>
<td>@SS</td>
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<tr>
<td>FUV-01 DEB</td>
<td>C</td>
<td>C</td>
<td>@SS</td>
<td>Q - C</td>
<td>@SS</td>
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<tr>
<td>FUV-01 SS</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>@Comp</td>
<td>@Comp</td>
<td>8-cycles</td>
<td>C</td>
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<tr>
<td>FUV-02 DVA</td>
<td>P</td>
<td>P</td>
<td>N/R</td>
<td>Q – P, C</td>
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<td>FUV-02 DEB</td>
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<td>N/R</td>
<td>A - P</td>
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<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>N/R</td>
<td>N/R</td>
<td>N/R</td>
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<tr>
<td>DVA Surrogate (2)</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>
</tr>
</tbody>
</table>

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

— ETU DVA w/shaped o-ring qual vibed at NASA Ames  
— DVA-02 to see qual-level vibe at LMMS  
— FUV-02 to see 8 cycle T/V at CU  
— DEB-01 to see 1-axis workmanship vibe at Ball
<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Start</th>
<th>Finish</th>
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<th>2003</th>
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<tr>
<td>1</td>
<td>QUALIFICATION OF FUV#2</td>
<td>Wed 4/10/02</td>
<td>Mon 2/3/03</td>
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<td>2</td>
<td>FUV-02 Final Build-up</td>
<td>Wed 4/10/02</td>
<td>Mon 12/2/02</td>
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<td>27</td>
<td>FUV 02 QE check</td>
<td>Mon 12/2/02</td>
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<td>28</td>
<td>Break vacuum and reconfigure system</td>
<td>Tue 12/3/02</td>
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<td>29</td>
<td>Mini-scrub of FUV02</td>
<td>Wed 12/4/02</td>
<td>Thu 12/5/02</td>
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<td>30</td>
<td>Break vacuum and reconfigure system</td>
<td>Fri 12/6/02</td>
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<td>31</td>
<td>Final post scrub QE calibration</td>
<td>Mon 12/9/02</td>
<td>Tue 12/10/02</td>
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<td>32</td>
<td>Break vacuum and reconfigure tank</td>
<td>Wed 12/11/02</td>
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<td>33</td>
<td>Final flat field measurement</td>
<td>Thu 12/12/02</td>
<td>Fri 12/13/02</td>
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<td>34</td>
<td>Pre-vibration functional testing</td>
<td>Mon 12/16/02</td>
<td>Mon 12/16/02</td>
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<tr>
<td>35</td>
<td>Fit check on BATC shake fixture</td>
<td>Tue 12/17/02</td>
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<td>36</td>
<td>Final staking etc Close-outs on DVA and DEB</td>
<td>Wed 12/18/02</td>
<td>Fri 12/20/02</td>
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<td>37</td>
<td>Xmas break</td>
<td>Mon 12/23/02</td>
<td>Wed 1/1/03</td>
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<td>38</td>
<td>Qual Vibration testing of DEB#2 and DVA#2 at Lockheed with BA</td>
<td>Mon 1/6/03</td>
<td>Wed 1/8/03</td>
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<td>39</td>
<td>Post-vibration functional check</td>
<td>Thu 1/9/03</td>
<td>Fri 1/10/03</td>
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<td>40</td>
<td>Final System Functional testing</td>
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<td>Pack detector for shipment</td>
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<td>42</td>
<td>Ship FUV02 detector system to UCo</td>
<td>Wed 1/15/03</td>
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<td>43</td>
<td>Install detector system into UCo T-V chamber</td>
<td>Thu 1/16/03</td>
<td>Fri 1/17/03</td>
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<td>44</td>
<td>Pre-pump down functional testing</td>
<td>Mon 1/20/03</td>
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<td>45</td>
<td>System T-V tests</td>
<td>Mon 1/20/03</td>
<td>Thu 1/30/03</td>
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<td>46</td>
<td>System cleanliness certification - Location TBD</td>
<td>Fri 1/31/03</td>
<td>Fri 1/31/03</td>
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<td>47</td>
<td>Remove flight system and pack</td>
<td>Mon 2/3/03</td>
<td>Mon 2/3/03</td>
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<td></td>
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<tr>
<td>48</td>
<td>Flight FUV#2 system ready for BATC</td>
<td>Mon 2/3/03</td>
<td>Mon 2/3/03</td>
<td></td>
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</tr>
</tbody>
</table>
COS FUV Detector Systems

- Detector DEB
- Detector Head
Flight FUV01 Detector System

Completed thermal vacuum at CU, delivered to Ball 7/31.

Post delivery functional tests nominal.

Cleanliness certification at Ball completed successfully.

Alignment tests done.
Status for FUV01

- Ship to CU -- Arrived 7/19, Thermal vacuum test -, begun 7/23
- Thermal vacuum finished successfully
- Delivered to Ball - 7/31, functional test completed - OK
- Repeated cleanliness certification at Ball - OK
- Alignment tests completed at Ball
- Two minor DEB repairs done,
  - Replaced torn HVFM connector socket rubber boot
  - Replaced rotating jack post on one “D” connector on DCE
- One axis acceptance shake of DEB done successfully at Ball
- Harnesses were routed and connected in flight configuration
UCB FUV02, Flight Backup Detector, Status

- **DEB & Harnesses**
  - Completed and tested successfully.

- **Detector integrated with Vacuum Housing Assembly**
  - Completed functional test and MCP “deep” scrub
  - New cathode deposition done, QE’s measured better than FUV01.
  - While preparing for mini-scrub noticed small VHA leak at full atmosphere

- **Vacuum Housing Assembly (VHA)**
  - Small, intermittent, leak discovered at door/VHA seal
  - Re-greased “O” ring and seal was OK
  - Initial evaluation showed known sag of VHA (0.005”) at atmosphere but also indicated a small (0.007”) bowing of the VHA seal at one specific area.
  - Proposed two main solutions, “shaped” O ring, and match machining of door.
  - EDM match machined prototypes proceeding, but slower than “O” ring effort.
  - Shaped “O” rings were received and tested successfully.
  - Shaped “O” ring has been installed in FUV02 and test sequence is proceeding
FUV02 VHA completed assembly

- Door assembly
- Motor assembly
- Ion pumps
- Pumping port
- Top of vacuum housing
Lower door detached from upper door (links disconnected)

Lower (seal) door

$\text{MgF}_2$ windows

Pumping port
Door assembly attached to VHA

Area where leak occurred

Upper door carriage

Pumping port
FUV02 VHA with ion pumps, showing metrology

- Ion grid SMA location
- ~0.0015” dip
- ~0.007” dip
- Pumping port weld area
FUV02, New “O” ring design

IER, custom, viton. 0.070” diam, with 0.077” section in one axis graded over 7”

Parker 2-050, Standard, viton

0.070” diam

Thick section
FUV02, VHA Seal Leak, Status

- We have two doors, FUV01 and FUV02 both flat to better than ~0.001”
- We suspect that the FUV02/ETU VHA distortions were incurred when the pumping ports and SMA feedthroughs were welded in.
- Door/VHA has accumulated >40 successful operations,
  - There is probably a re-distribution of grease on the “o” ring with ops
  - Leak appears only at 1 Atm differential, after many operations
- After “o”ring regrease the VHA sealed and there was no leak
  - But - requires 20 lb force to create leak after re-grease
- Blanks of door with weight relief were made and sent for EDM reshaping as part of door re-work solution, EDM blanks completed but after “O” ring solution was complete.
- Shaped “O” rings with a fat section where the leak occurs were ordered
- IER shaped “O” rings were used for test, measurement and qualification
FUV02, VHA Seal Leak, Progress

- Proceeded with “o” ring replacement
  - Metrology gives detailed measure of shape of the seal surface & gaps
  - Removed FUV02 “O” ring seal and substituted new “O” ring
  - Checked the gap measurements & tested the vacuum seal - OK
  - Ran door operation tests (40 cycles) re-verifying seal and metrology
  - Did Qual level shake test with FUV02 DVA and ETU DBA at AMES
    - Under vacuum with ion pump pressure monitored
    - Showed no anomalies compared to expected behavior
  - Checked the gap measurements & tested the vacuum seal - OK
  - Re-installed detector/DBA and continued with FUV02 completion plan
  - This minimized disassembly of VHA (none on DBA) and risk to assy
  - Door did not need reshimming, door was only removed/reinsalled
  - Achieves desired uniform seal “o”ring compression
FUV02, VHA Seal Leak, Status

- Door seal gap is set at ~0.007” during door installation
- We have four Vacuum Housings (Spec is <0.002” seal flatness)
  - FUV01 - records indicate door seal gap is ~0.007” and uniform
  - FUV02 - seal surface shows extra dip of ~0.007” at center/port side
  - ETU - seal surface shows extra dip of ~0.003” at center/port side
  - Spare - seal surface is flat to 0.001”
- FUV01, FUV02, & ETU all have SMA connectors and pump ports welded on. Spare has not been welded.
- FUV02 also shows small dip 0.0015” dip at SMA connector side
- Measurements of original FUV02 seal gap
  - At air, 0.008” at corners, 0.013” at center/port side
  - At vacuum differential, 0.007” at corners, 0.014” at center/port side
- Measurements of new “O” ring FUV02 seal gap after 40 cycles
  - At air, 0.008” at corners, 0.014” at center/port side
  - At vacuum differential, 0.006” at corners, 0.016” at center/port side
- Result - greater “o ring” compression & better seal with new “o ring”
FUV02, Flight Backup Detector Status/Actions

- Resolved VHA seal leak issue using shaped “O” ring
- Performed 40 successful door/motor open close cycles
- Vibration on DVA confirmed solution
- Installed detector into DVA
- Re-installed in test chamber, performed QDE test
- Detector Mini scrub completed
- QDE calibration and full functional test in progress
- Deep flat field test
- Vibration test and post vibration functional
- Pack and ship to CU
- Thermal vacuum test at CU
- Cleanliness certification and delivery to Ball
FUV02, Cathode

FUV02 detector with QE grid installed

New CsI cathode, A side

New cathode is in accord with the best CsI we have previously done on COS microchannel plates

New CsI cathode, B side
FUV02 New Photocathode QE measurements

QE for FUV02 is better than FUV01

QE FUV02 Seg. B - New cathode

QE for FUV01

QE FUV02 Seg. B - New cathode
FUV02 New Photocathode QE measurements

QE for FUV02 is better than FUV01

QE for FUV01

QE FUV02 Seg. A - New cathode

Cosmic Origins Spectrograph
Hubble Space Telescope
FUV02 MiniScrub2 Gain Curve History
Gain decreases due to scrub which is compensated by increasing the MCP voltage
We accomplished the deep scrub before a cathode deposition to avoid QE degradation!

Deep scrub data

Miniscrub2 data

Cosmic Origins Spectrograph
Hubble Space Telescope

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FUV02 MiniScrub2 Gain Curve History

The gain decreased then stabilized to levels required for flight
FUV02, Flight Backup Detector Next Actions

- QDE calibration and full functional test in progress
  - Post mini-scrub QE values by tomorrow
- Deep flat field test will be done by early next week
- Vibration test and post vibration functional
  - Need minor shake fixture mods to accommodate potted shims
  - Will do this mid next week
  - Cannot get Lockheed facility until Jan 6-8
- Pack and ship to CU
- Thermal vacuum test at CU
- Cleanliness certification and delivery to Ball
Software/Ops Update

- Brownsberger and Beland continue their presence at Ball supporting the SW/OPS efforts.
  - Brownsberger is working CS/DCE activities
  - Beland is working Target Acquisition component testing.
- CEDAR has been stable for some months and is supporting GN2 alignments at Ball.
### COS Schedule Milestones 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. Completion by ~ TV-2 mos</td>
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<tr>
<td>Cal/FF SS Retest</td>
<td>1/03</td>
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<tr>
<td>Deliver FUV-02</td>
<td>2/03</td>
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<tr>
<td>Complete COS TV/TB Plan</td>
<td>1/03</td>
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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 descoped the following:
  - Reduced the MEB SRAM buffer memory
  - Fewer NUV/FVU optics/grating spares
  - No parallel technology path for NUV gratings
  - Reduced I&T/calibration effort
  - Baselined environmentals at GSFC
## COS Descope Tracking List

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

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

- Vibe FUV-02 at LMMS (1/03)
- Ship FUV-02 to CU and perform T-V (1/03)
- Complete TV/TB test procedure (1/03)
- Support COS PER
- Compete Cal/FF sub-system characterization (1/30)
Issues

• None