Wide Field Instrument Updates

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With thanks to the many that contributed to this content!!!
WFI I&T Status

- WFI has been fully integrated at BAE Systems (formerly Ball Aerospace) and has **successfully cleared** key phases of testing
  - Thermal Vacuum Test 1 – TVAC1 (Fall 2023)
    - Test the functionality of all instrument systems
    - Establish a pre-environmental (vibe, acoustics) instrument performance baseline with a focus on optical performance
    - Performed risk reduction activities to assess and prepare for science performance tests in the second TVAC campaign in Spring 2024 (TVAC2)
  - Vibration Test (Early 2024)
  - Acoustic Test (Early 2024)
    - Vibe and Acoustics subject the instrument to a simulated launch environment
  - Thermal Vacuum Test 2 – TVAC2 (Spring 2024)
    - Post-environmental performance baseline
    - “Run for the record” for WFI requirements verification and science calibration
  - Electromagnetic Interference/Electromagnetic Compatibility (June 2024)
    - Checking that electronics/electricals do not generate unwanted noise and work together smoothly
What is in the TVAC chamber?
SORC – Telescope simulator for WFI

- Stimulus of ray cones (SORC)
- Key Capabilities
  - **Projector** to place point sources at any point on focal plane.
  - **Diffuser** to illuminate across the field.
  - **Blackbody** to block/thermally illuminate WFI.
  - **Metrology** to register SORC to WFI, WFI element wheel.

SORC has been shipped back to GSFC after successfully playing its role in the TVAC campaigns!!
Moving into the Titan chamber
Completed TVAC2 test profile

461 test scripts were executed in TVAC2, many edited/created on the fly, generating ~270 TB of data, many thanks to the teams (primarily engineers) that supported this effort!!!
WFI I&T Status – Key Changes after TVAC1

• Baffles added to filters, grism, and prism to mitigate thermal stray light paths identified in TVAC1

• Telescope simulator (SORC) has undergone several upgrades to mitigate stray light, improve mechanisms, and expand light source capabilities

• SCA operating temperature reduced to 89.5 K after correlation of TVAC1 thermal model confirmed additional margin available; requirement also being updated
PRELIMINARY Analysis Example – TVAC1 vs. TVAC2 Thermal Background

TVAC1 (no baffles) BB @ ~270 K

TVAC2 (w/ baffles) BB @ ~270 K

<table>
<thead>
<tr>
<th>EWA position</th>
<th>Blackbody @ 270K (Overtest)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOME_DARK</td>
<td>TVAC1 (median e-/pix/s)</td>
</tr>
<tr>
<td></td>
<td>TVAC2 (median e-/pix/s)</td>
</tr>
<tr>
<td>POS_10_F087</td>
<td>0.343</td>
</tr>
<tr>
<td>POS_9_W146</td>
<td>0.441</td>
</tr>
<tr>
<td>POS_8_F184</td>
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<td>POS_7_F158</td>
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<td>POS_2_F213</td>
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<tr>
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<tr>
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<tr>
<td>POS_1_GRISM</td>
<td>27.393</td>
</tr>
</tbody>
</table>

e-/pix/s
PRELIMINARY Analysis Example – FPS Dark Current, Noise

- Background was lower in TVAC2 compared to TVAC1.
- Mosaic Plate Assembly (MPA) temperature was slightly higher during TVAC2 (89.5 K) compared to TVAC1 (89.0 K)
- Dark current, total noise, and CDS noise are mostly unchanged since TVAC1, all SCAs still meet requirements.
Excellent stability of operability fraction, consistent with expectations after Roman Detector Anomaly Review Board recommendations; SCAs that start with less operability appear to change more, as expected.
PRELIMINARY Analysis Example – Filter Bandpass Edges AOI Dependence and Pupil Images

Retrieved pupil transmission at grism and prism blue edges at center field
PRELIMINARY Analysis Example – Bright Source Risk Reduction Tests

• Bright sources expected in nearly every Roman observation field
  – Designed risk reduction tests to understand what to expect from such sources in science observations
  – Investigate SCA pixel response to very deep saturation
  – Investigate persistence after very deep saturation

• Simulated sources ranging from brighter than 4th to 18th magnitude were projected through the F146 filter and Grism using the Split-IR SORC mode
  – 55 frame - ~180 sec exposures with interleaved darks
  – Grism exposures also included wavelength dependent measurements to better understand diffraction/scattering/throughput

Projected bright source on SCA 4, ~25e9 e- in core pixel

Persistence in PSF core immediately after exposure

Analysis ongoing!
Science Test Overview in TVAC2

- **Detectors** (science monitor tests, multiple times for trending)
  - Darks
  - Noise
  - Linearity

- **Filters**
  - Bandpass edges (except F213 red)
  - Edge transmission across physical extent of filter
  - Narrow band flats with 10 nm wavelength step size
  - Broad band flats

- **Spectroscopy – Grism and Prism**
  - Dispersion
  - Bandpass edges
  - (Narrow band flats provide wavelength dependent response for calibration)

- **sRCS**
  - LED performance and trending
  - Flats – Dark and Lamp-On-Lamp-Off (LOLO) – flatness, smoothness
  - Count rate dependent non-linearity (CRNL)

- **Backgrounds**
  - Thermal backgrounds and out-of-band

- **Other tests**
  - Bright point source saturation
WFI I&T Status – Summary and Outlook

- The WFI has successfully passed through all key tests!
- Near-term analysis of TVAC2 data
  - Pre-ship review (PSR; end of July)
    - Demonstrate requirements verification at WFI-level
    - Plan for longer-term characterization and calibration
- WFI ships back to GSFC (mid-Aug)
- In parallel:
  - WFI integration and testing at level of space craft and integrated payload assembly (SCIPA)
  - Long-term WFI characterization and calibration work
    - Collaborate with our SOC/SSC partners on calibration reference products and pipeline inputs
    - Collaborate with science stakeholders (you!) on calibration plans
  - Commissioning planning
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