

THE NANCY GRACE ROMAN SPACE TELESCOPE

Wide Field Instrument Updates

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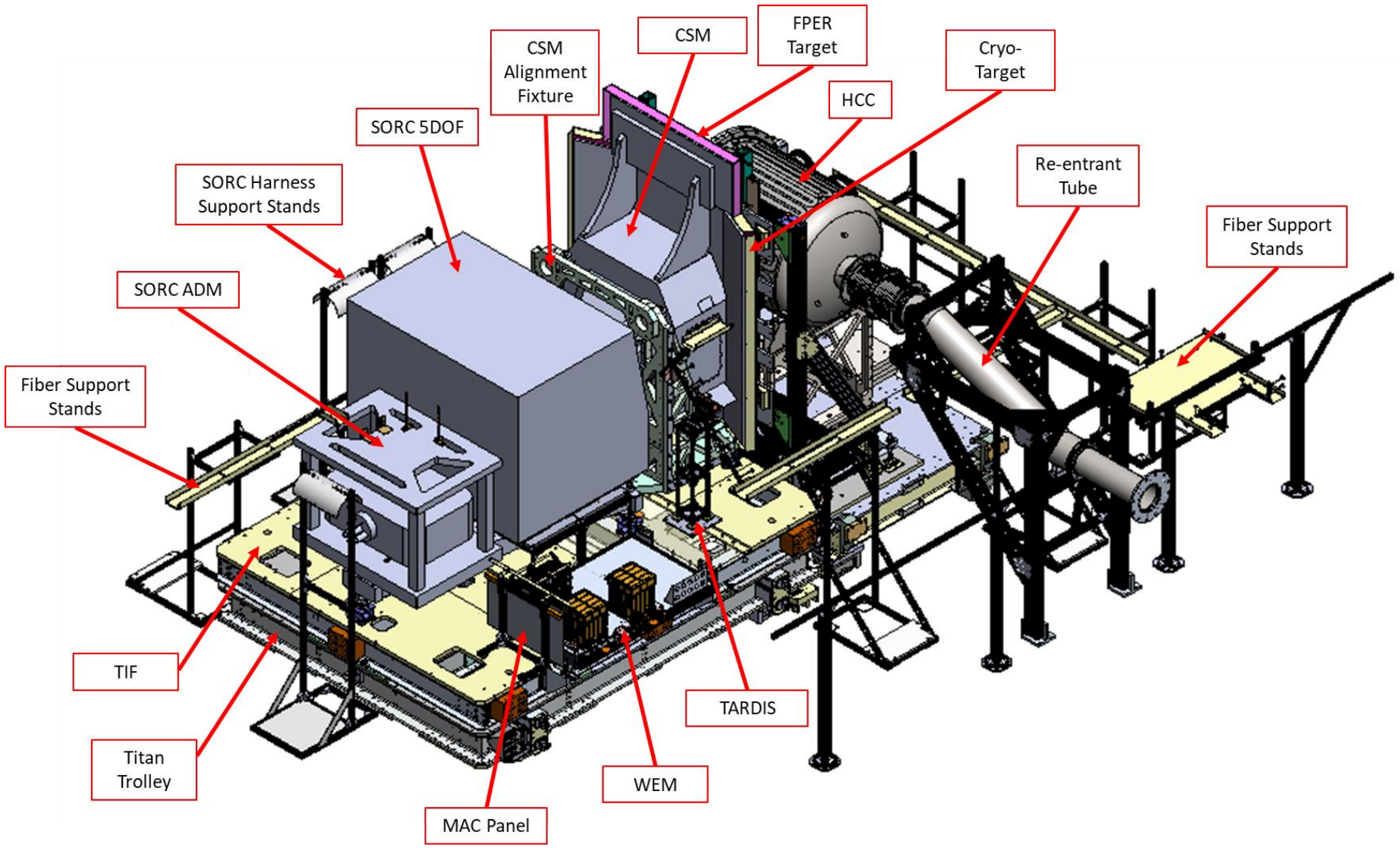
Community Forum

December 13th 2023

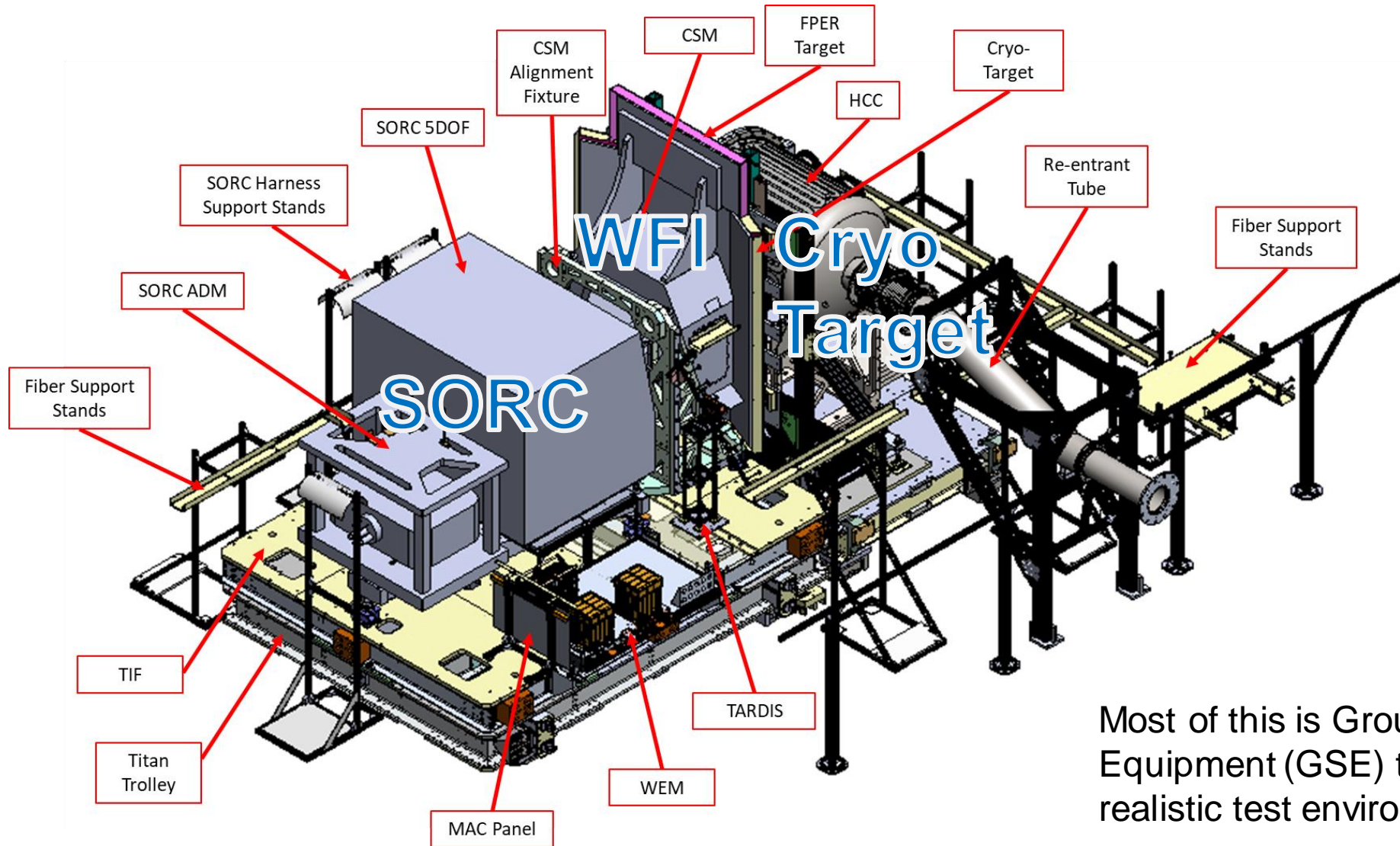
Based on contributions from many!!

- **WFI fully integrated at Ball Aerospace and completed first of two 60-day instrument thermal vacuum test campaigns (TVAC1)**
- **Goals of TVAC1:**
 - Test the functionality of all instrument systems
 - Establish a pre-environmental (vibration, acoustics) instrument performance baseline with a focus on optical performance
 - Perform risk reduction activities for further characterization and performance tests in the second TVAC campaign in Spring 2024 (TVAC2)
- **In the current schedule, WFI will undergo environmental testing over the next few months and start TVAC2 in March 2024**

What goes in the TVAC chamber?



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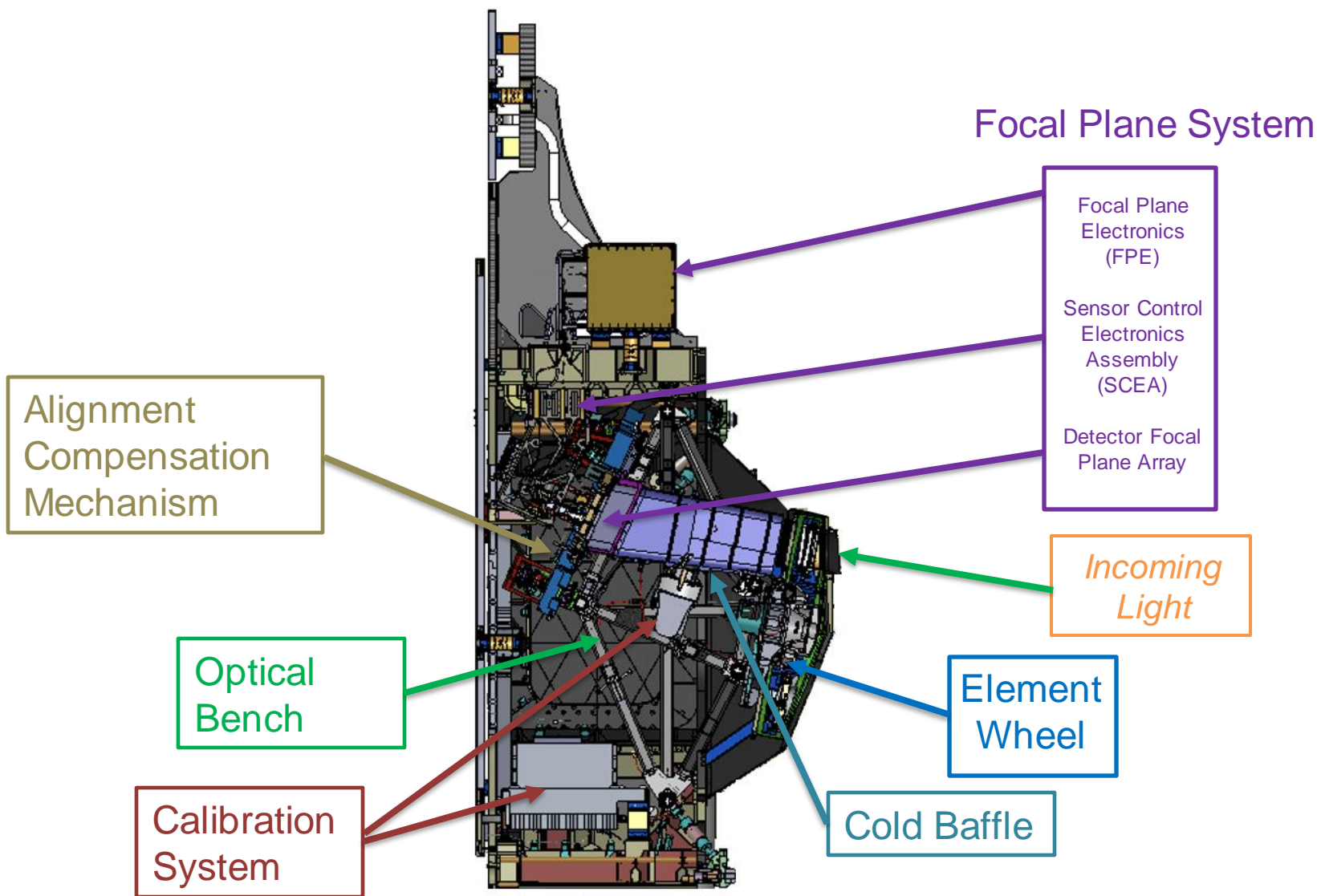
Most of this is Ground Support Equipment (GSE) to enable a realistic test environment

- **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 in the Space Environment Simulator at GSFC, 3/23

Wide Field Instrument – Key Subsystem Overview



WFI moving to SORC/fixture



WFI mated to SORC with radiator exposed



WFI+SORC moving to face cold target in Titan chamber

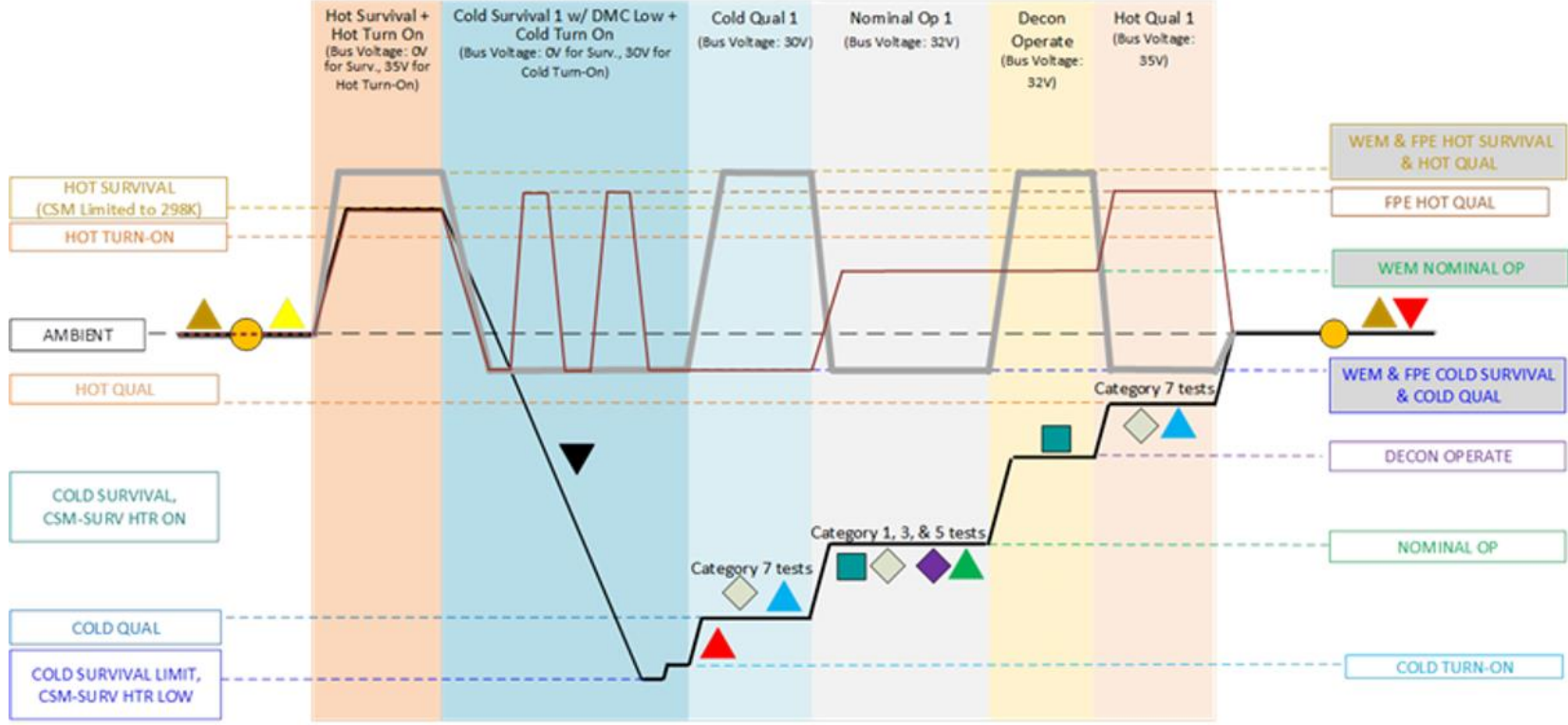


Another view of WFI+SORC moving into the Titan chamber



Completed TVAC1 test profile

WFI TVAC-1 Profile



LEGEND:

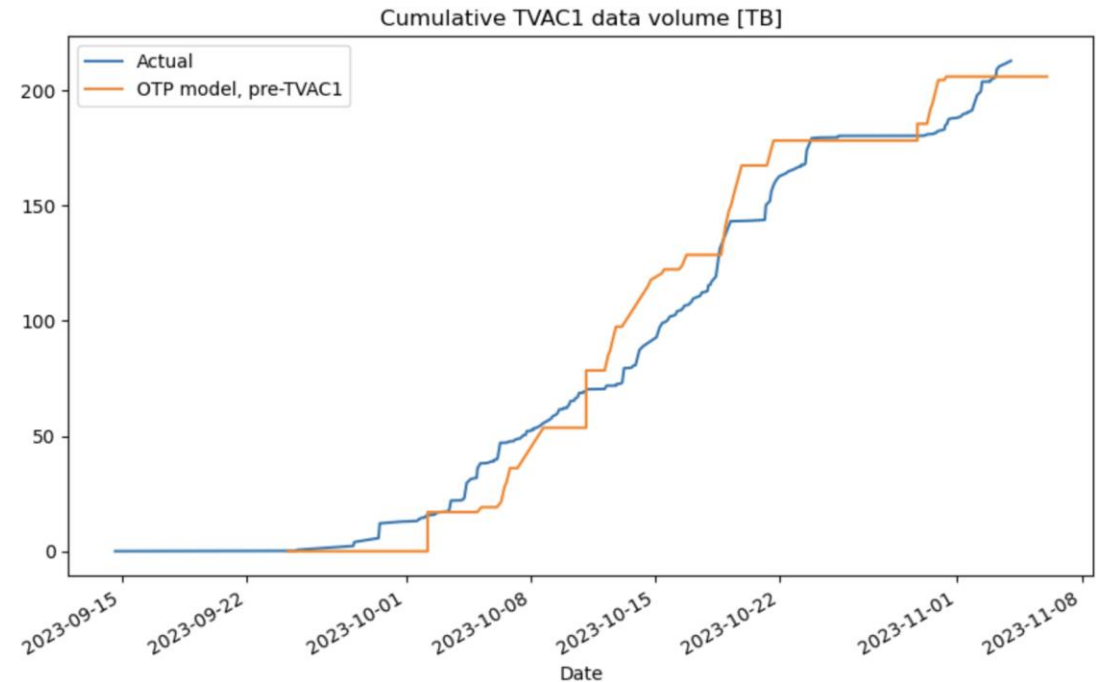
CSM Temperature Plateau	● Open/Close Chamber Door	▲ ACM Deployment
WEM Temperature Plateau	▲ Ambient Functional	▼ ACM Stow
CSM Profile	▲ Aliveness Test	◇ Optical Performance Testing
WEM Profile	▲ CPT Short Test	◆ ACM Phase Retrieval
FPE Profile	▲ CPT Full Test	■ Thermal Balance
	▲ Survival Heater Checkout	

TEST CATEGORIES:

- Category 1: Must-Occur Engineering Tests (TVAC1)
- Category 2: Must-Occur Engineering Tests (TVAC2)
- Category 3: Pre/Post Vibe Comparisons (TVAC1 and TVAC2)
- Category 4: TVAC1 / TVAC2 Agnostic
- Category 5: Risk Reduction (TVAC1)
- Category 6: Final Flight Reference Items (TVAC2)
- Category 7: Qual Plateau Tests

Slide credit: Eric Switzer

- **Goals:**
 - Verify GSE+WFI system meets requirements or is requirements capable
 - Establish instrument cryo performance baseline prior to environmental tests
 - TVAC1 performed risk reduction tests to further prepare for TVAC2
 - Key for TVAC2 tests that are used to verify science requirements and produce calibration reference files
- **Types of Science Data obtained:**
 - Focal Plane System performance
 - Optics performance – backgrounds, element blocking, and stray light characterization
 - Calibration system (sRCS) performance
 - Risk reduction tests
- **High heritage tools used for data acquisition and analysis**
 - Test Planning Tool (TPT) / Optical Test Procedure (OTP from JWST testing for test scripting
 - Quicklook and longer-term analysis tools from WFI subsystem testing (e.g. SCAs, FPS, sRCS)
- **270 data collects performed during TVAC1, longest script ran for 9 hours**



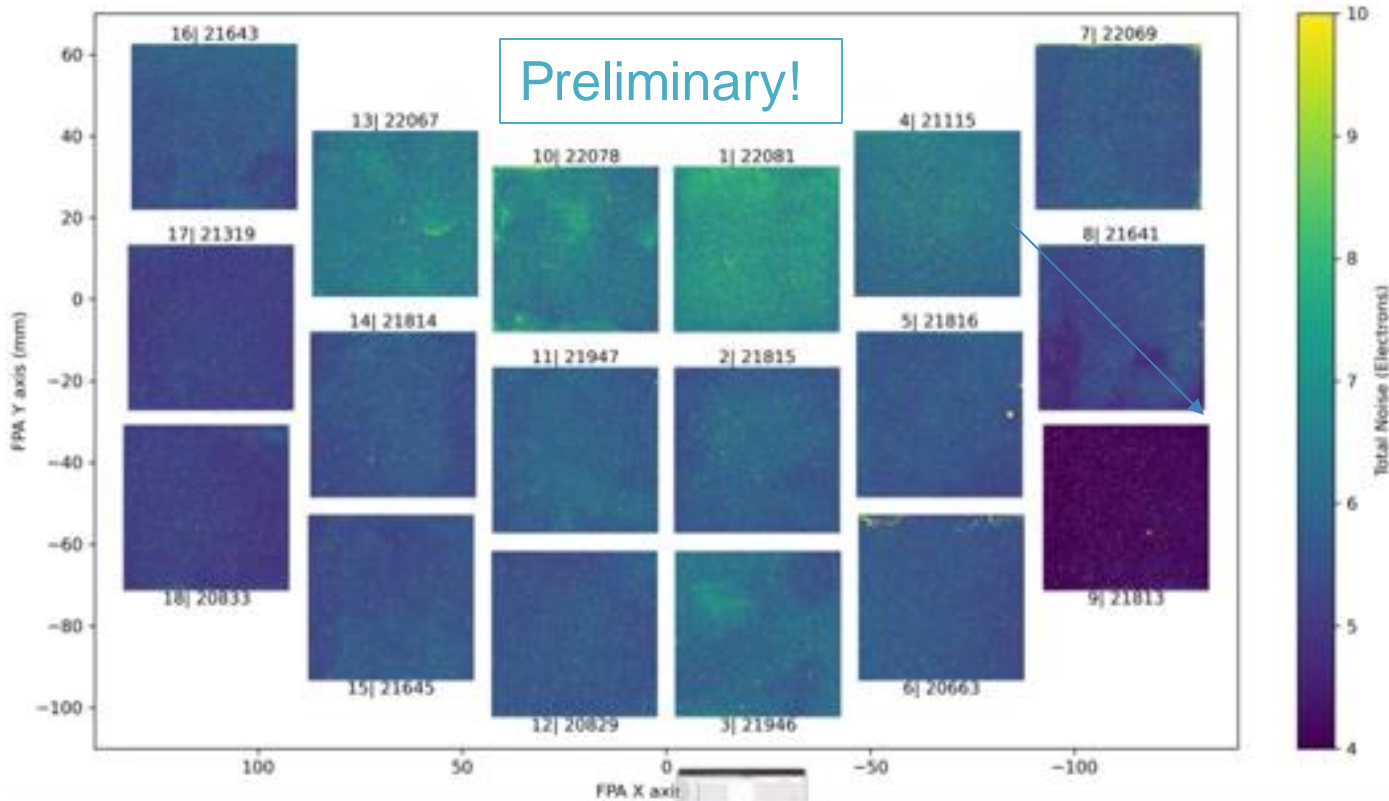
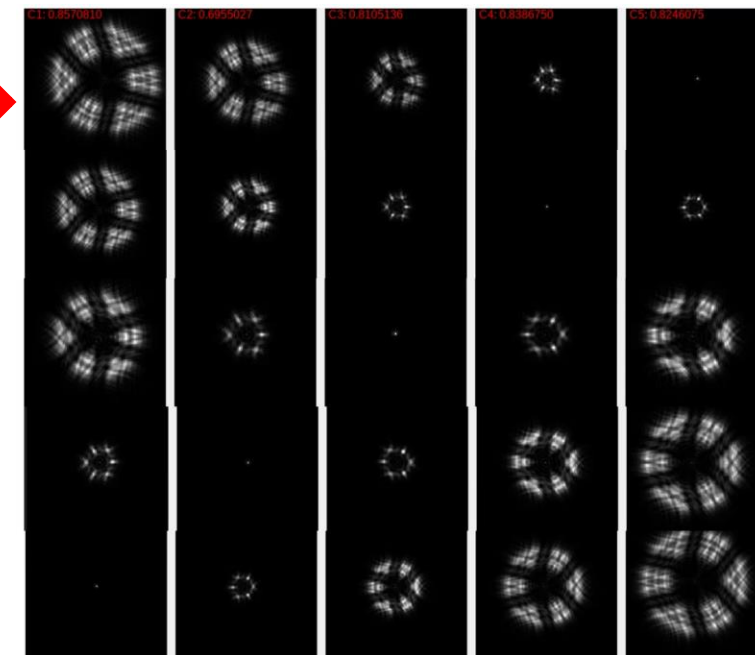
Excellent fidelity for data volume requirements and test plan

Comparison of pre-TVAC data volumes per test plan and schedule to actual accumulated test volume.

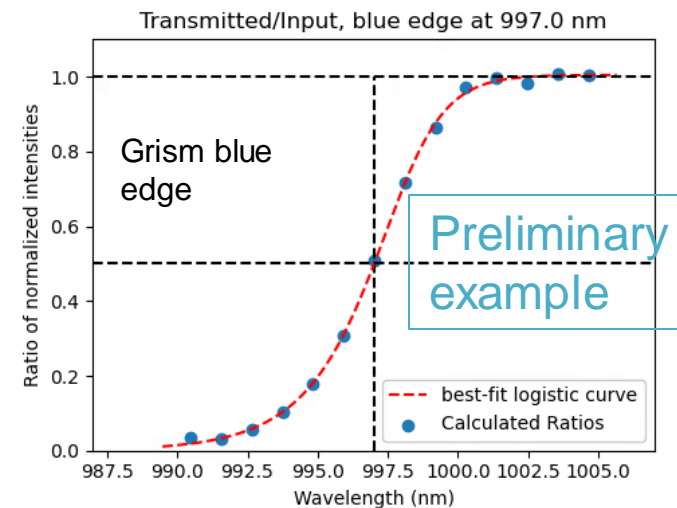
1. **FPS performance and reliability was remarkable**
 - Multiple WFI level requirements met
 - Performance baseline established
2. **In-band stray light performance is excellent**
 - Multiple WFI level requirements either met or data demonstrates that system is requirements capable
 - Some thermal leaks were identified, review board convened, and corrective action in progress
 - Performance baseline established
3. **sRCS flat field smoothness appears excellent**
 - Data demonstrates system is requirements capable
 - Performance baseline established with full characterization planned for TVAC2
4. **Confocality between elements across the field is excellent**
 - All elements focus in the same plane, except for prism which might be slightly out of tolerance (also a bit more forgiving – analysis underway)
5. **Focus-corrected wavefront error performance is excellent**
 - Sensing the instrument wavefront with SORC went well beyond expectations.
 - Overall performance is met with margin for all elements
6. **Executed a very successful campaign of risk reduction tests**
 - Data demonstrates that system is requirements capable
 - Data is immensely helpful and critical for developing final characterization plans in TVAC2

- Some examples of early TVAC1 results

Snapshots of going in and out of focus for wavefront error analysis

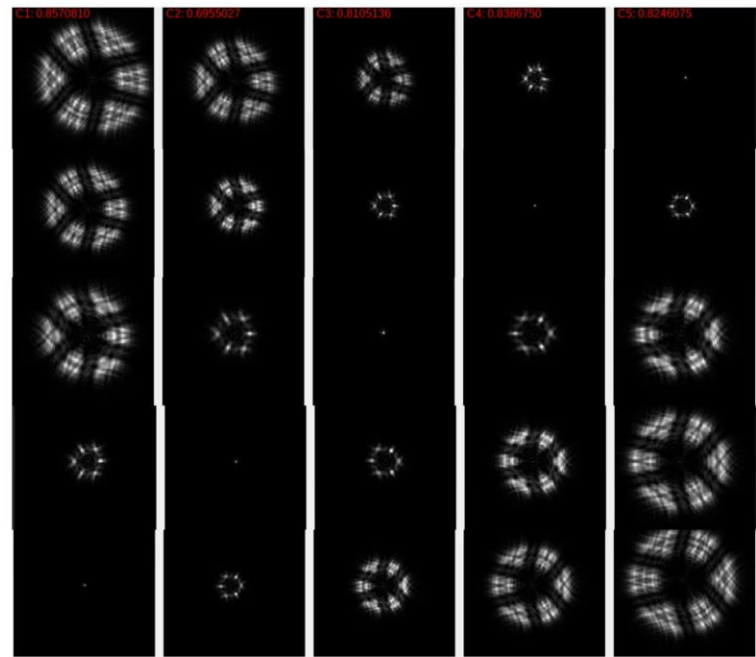


Flight FPA total noise mosaic from TVAC1



- Full analyses of TVAC1 data ongoing in parallel with preparations for environmental testing and TVAC2
- Working with the Science Operations Center (Space Telescope Science Institute) to host and archive these integration and test (I&T) data for community use, stay tuned
- TVAC1 results are precursors to full characterization from TVAC2 that are important ingredients for instrument performance reference files and calibration

Longer term:
delivery of WFI back to Goddard next year



followed by integration into the Instrument Payload Assembly!