

THE NANCY GRACE ROMAN SPACE TELESCOPE

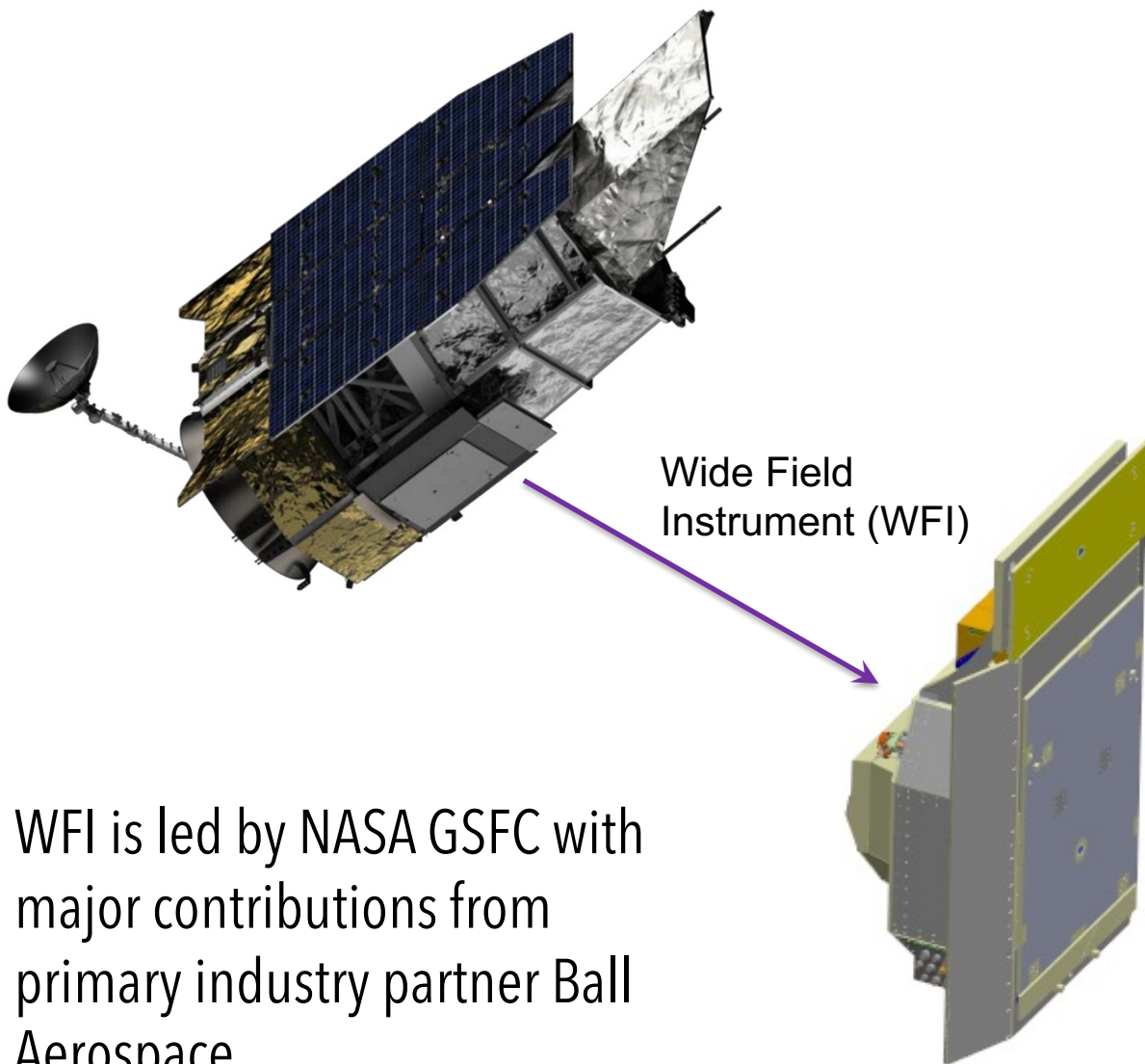
Wide Field Instrument Status

Ami Choi

Deputy WFI Scientist – NASA GSFC

Roman Community Forum

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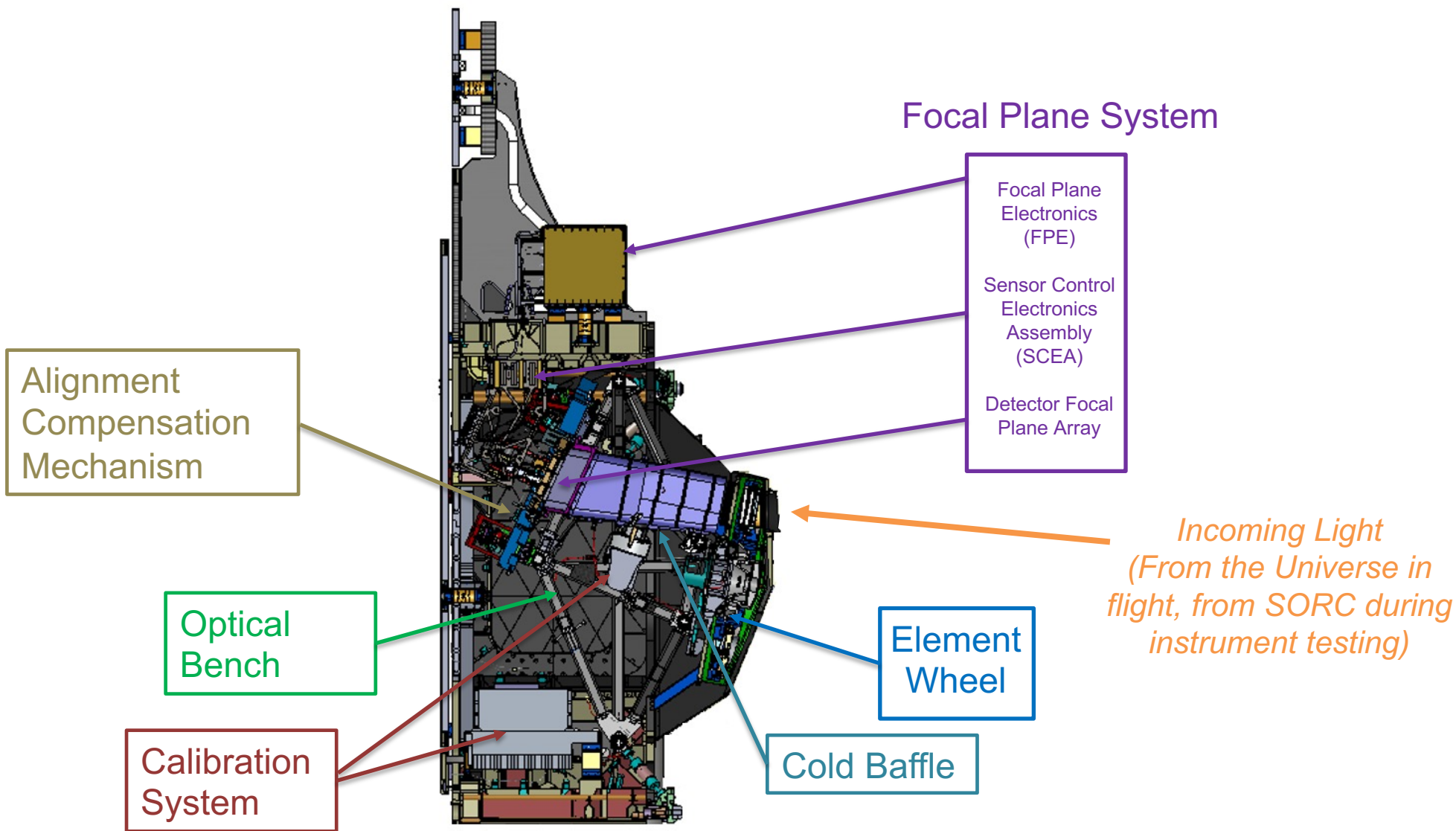
WFI is led by NASA GSFC with major contributions from primary industry partner Ball Aerospace

Instrument Overview

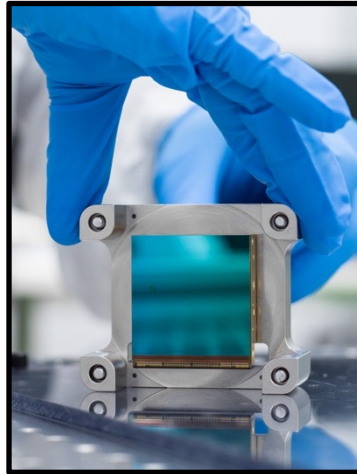
- Focal plane array of 18 Teledyne 4k × 4k detectors
 - Large field-of-view (FOV) – 0.8 x 0.4 deg (0.281 deg², excluding gaps)
 - Spatial sampling: 0.11 arcsec/pixel
 - Image stability: 1.0 nm RMS wave front error (WFE) variation in 180 sec
 - Guide star sensing interleaved with science data collection
- Element wheel enables imaging and spectroscopy spanning 0.48 to 2.3 μm
 - 8 imaging filters
 - Prism and grism for full-field, slitless spectroscopy
 - Blank position for darks, flat fields, and other calibrations
- Internal relative calibration system
- Instrument is passively cooled

https://roman.gsfc.nasa.gov/science/WFI_technical.html

Wide Field Instrument – Key Subsystems

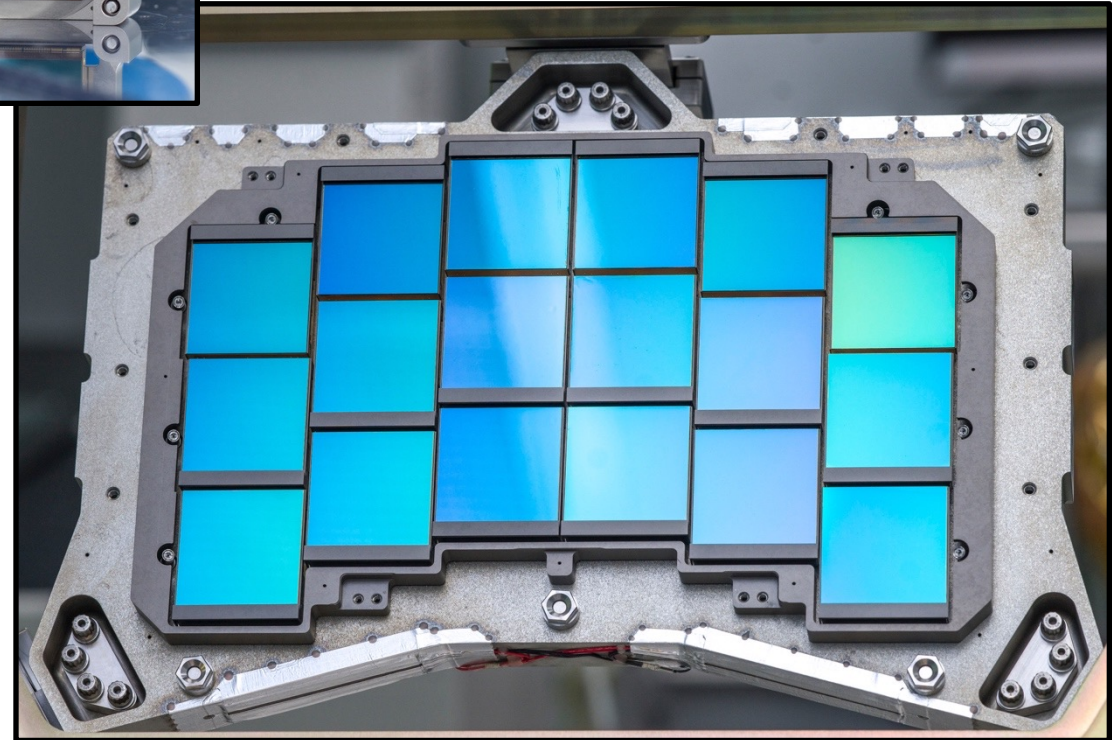


Focal Plane System (FPS)



Roman H4RG-10
detector

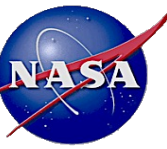
- FPS consists of:
 - Focal Plane Array - 18 detectors mounted to a mosaic plate
 - Sensor Control Electronics Assembly - 18 ACADIA application specific integrated circuits (ASICs), one for each detector
 - Focal Plane Electronics box - provides overall instrument control
 - Associated harnesses and mechanical and thermal hardware



Flight focal plane array

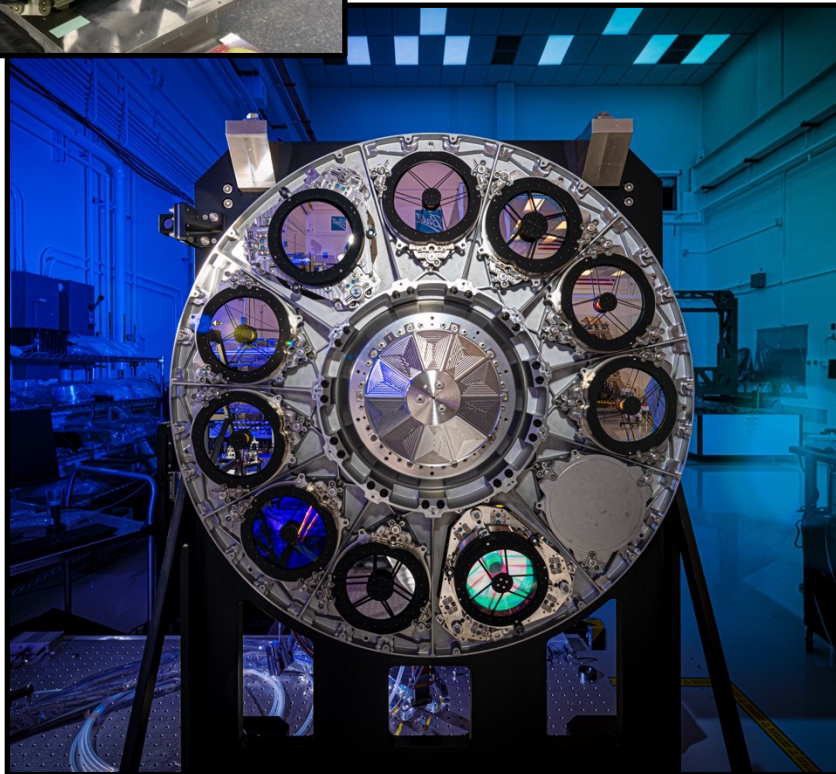
- After detector + control electronics subsystem thermal vacuum (TVAC) test in December 2022, 3 detectors were swapped out due to observed changes in performance (increased dark current).
- Project convened a team of experts to determine the root cause and likelihood of further performance changes. Investigation is ongoing in parallel.
- Complete flight detector array, control electronics, and instrument electronics box cleared individual testing and have been fully integrated into the flight FPS.
- **Full flight FPS cleared functional testing and TVAC test campaign completed! Successfully passed through full set of functional and performance tests across multiple thermal cycles**
- Flight FPS transported via temperature-controlled truck to Ball Aerospace and arrived on May 11 to begin integration into the WFI

Major WFI Subsystems at Ball Aerospace



Complete Flight
Element Wheel

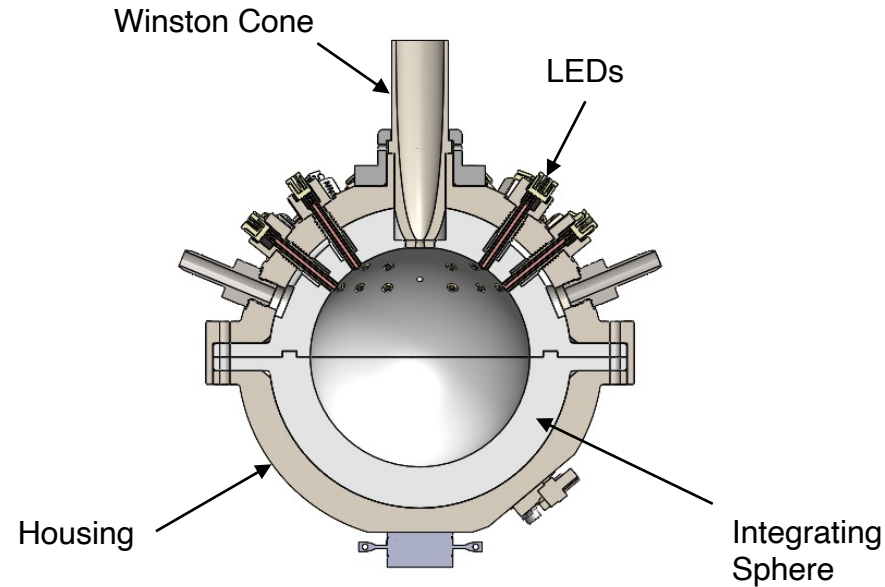
Flight Optical Bench



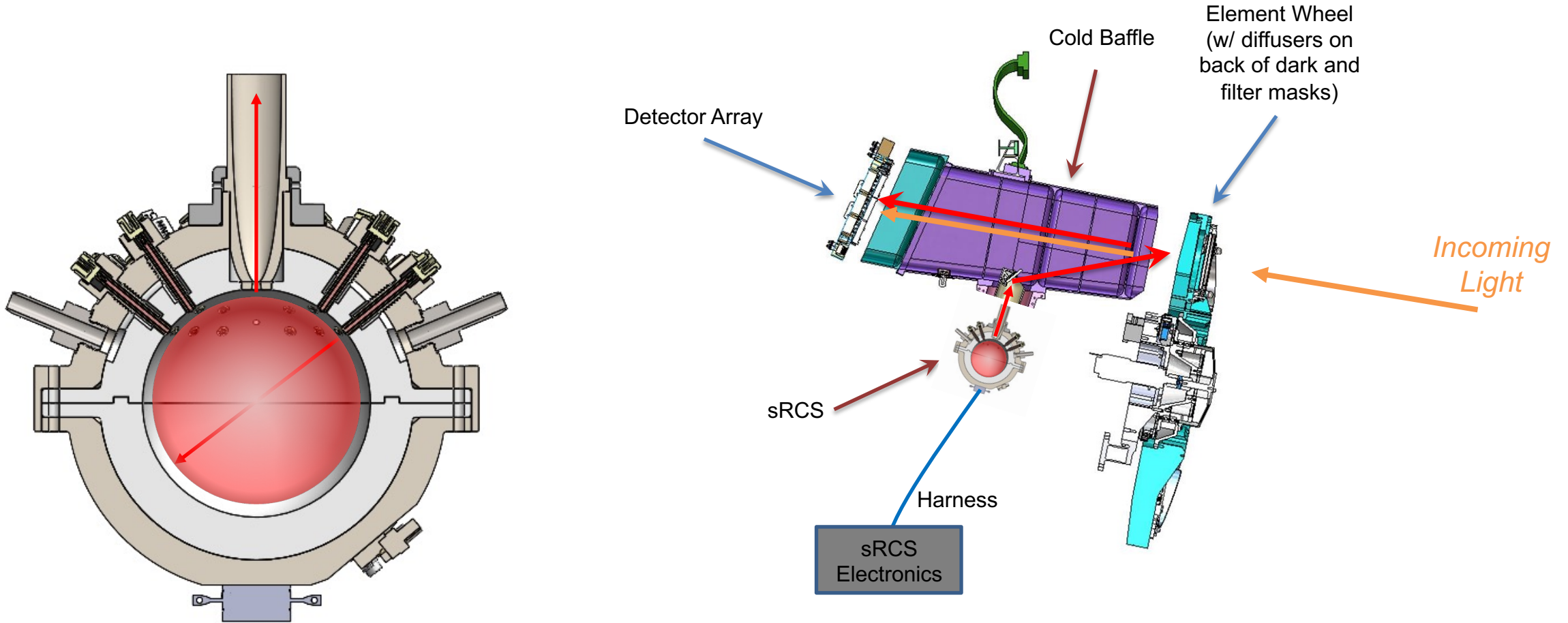
- WFI Enclosure, Optical bench, Alignment Mechanism, Baffle, and other key subsystems complete and integrated into WFI at Ball Aerospace
- Major thermal system components fabricated and undergoing test
- Flight Filters, Grism, and Prism complete and integrated and aligned into flight Element Wheel at Ball Aerospace
- Element Wheel integrated and aligned into WFI and completed performance and optical tests

- Roman science requirements lead to the necessity for highly accurate detector calibration
 - High accuracy photometry over a large flux dynamic range is required for various science cases, in particular:
 - Type Ia Supernova and Weak Lensing cosmology
 - Both require accurate calibration of detector count rate non-linearity
- To achieve this, the WFI is equipped with an on-board calibration system to enable multiple measures of count rate non-linearity
 - This is the Simplified Relative Calibration System (sRCS)
- The sRCS is an instrument inside the WFI that projects smooth flat fields onto the detector focal plane array using custom LEDs
 - Wide range of fluxes at 6 different wavelengths matched to the WFI filters
 - Two modes:
 - Lamp-On/Lamp-Off - flatfields are projected on top of an astronomical scene
 - Direct – flatfields are projected with the light path to the telescope closed
- sRCS calibration measurements are repeated throughout the mission to trend systematics as they change due to radiation effects and other factors
- The RCS is integral to the WFI, not a part of the telescope or spacecraft

sRCS Light Source Assembly (“Sphere”)



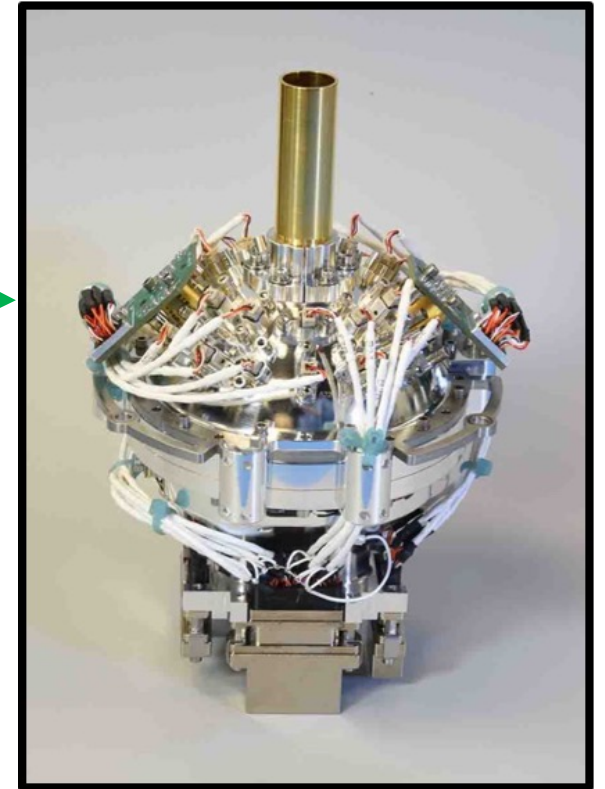
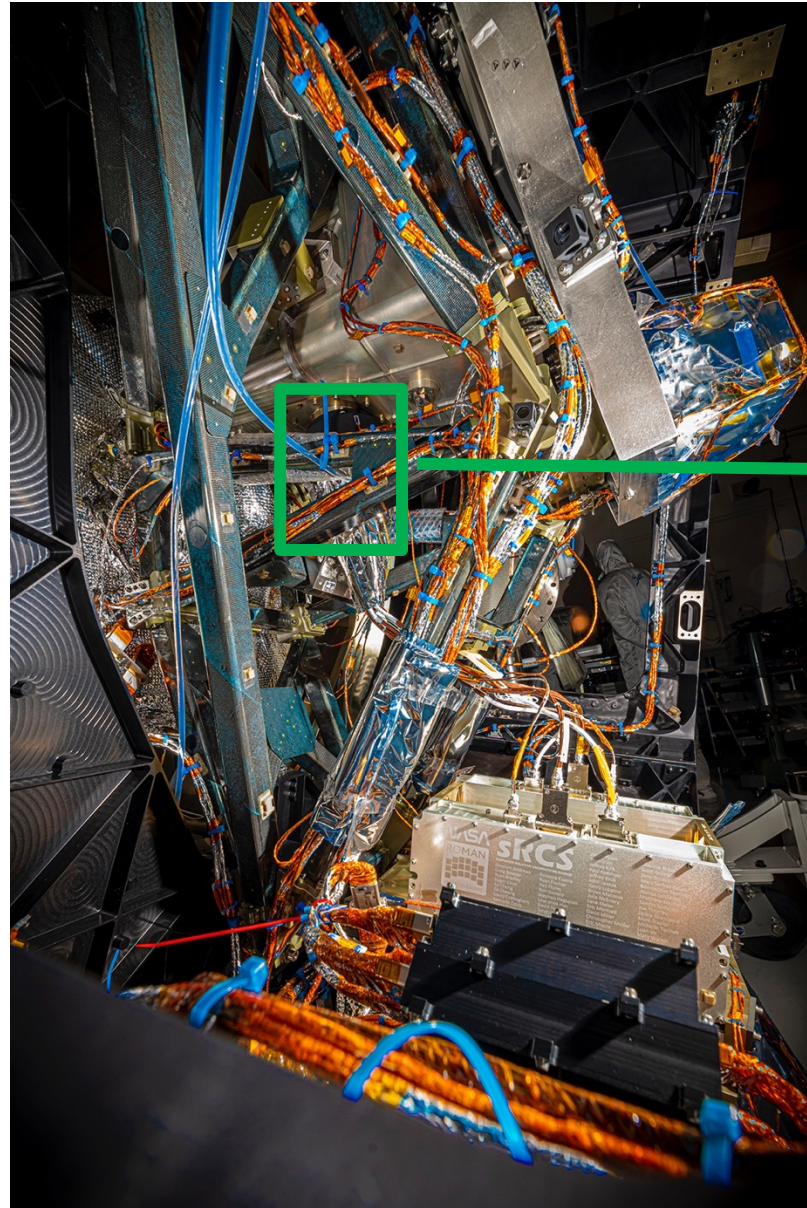
- Key components
 - LEDs, Integrating sphere, Winston cone
 - *Not shown here* - thermal control system, harness, and electronics
 - Redundant system of LEDs covering 6 wavelengths matched to WFI filters
 - Each set of LEDs contains 2 of each wavelength that can be operated individually or simultaneously over a range of flux levels
- RCS mounts to baffle in between the filter wheel and detector focal plane
- Fold mirror projects LED light to diffusers in filter wheel and onto detector array



- sRCS is operated in two complementary modes
 - *Lamp On/Lamp Off* – illuminate diffusers on backs of filter masks to provide flat field pedestal with science scene
 - *Direct Illumination* – illuminate diffuser on back of dark element to project smooth flat field onto focal plane

- **The sRCS has been built, tested, delivered, and integrated into the instrument at Ball Aerospace!**

sRCS Status at Ball Aerospace

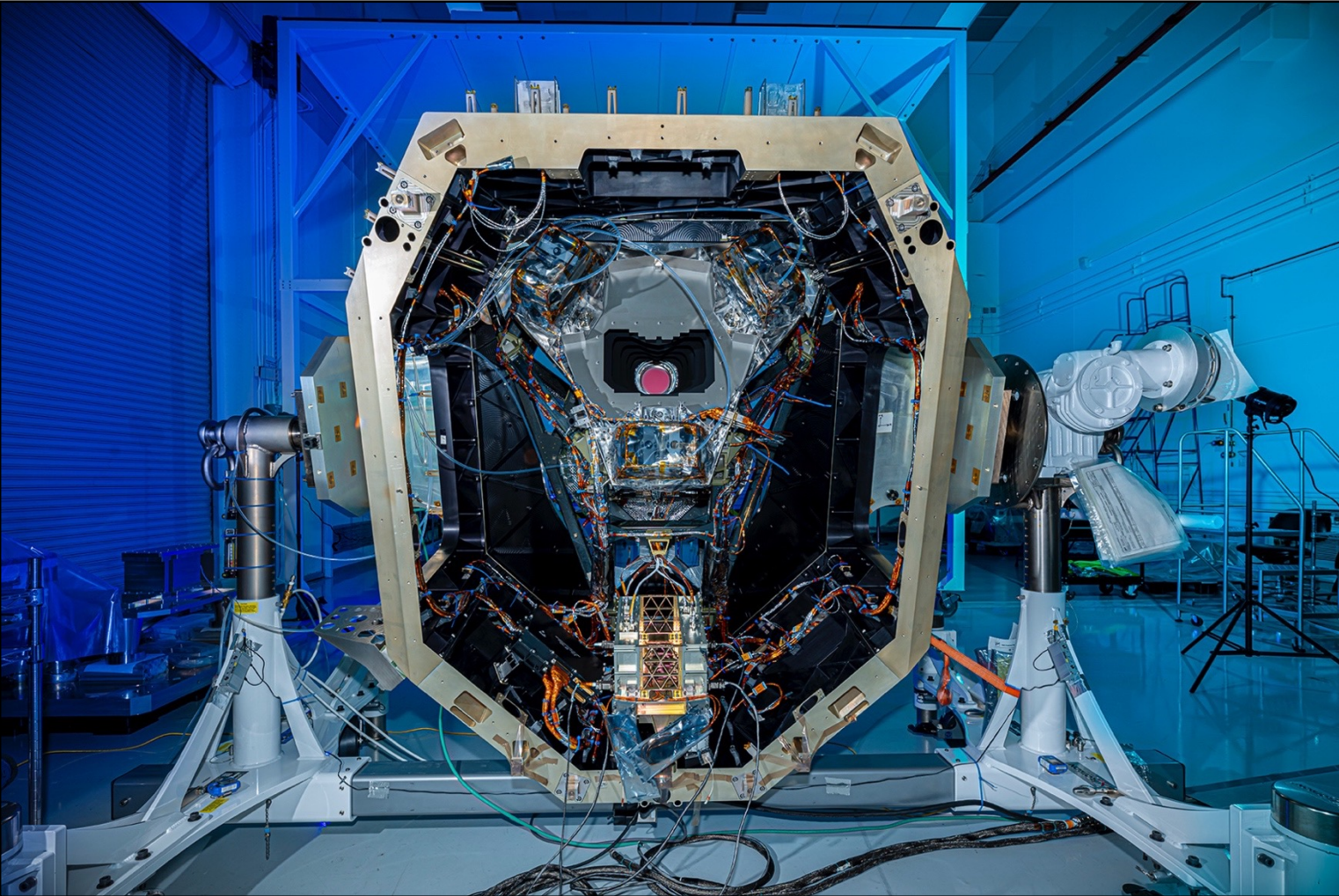


Thanks to the sRCS Team!

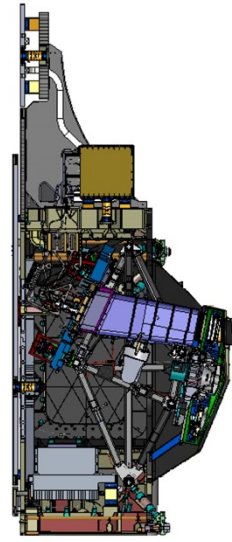


- **A full spare sRCS is being built to continue testing the system and tuning calibration approaches**
- The spare electronics box and sphere assembly have undergone individual TVAC tests and the full spare sRCS system is now being built for an extended TVAC campaign
- TVAC set-up will include flight like detector and ACADIA for CRNL calibration tests using CFA method
- The spare sRCS TVAC tests will start next week and continue into June 2023

WFI Integration – Cold Sensing Module

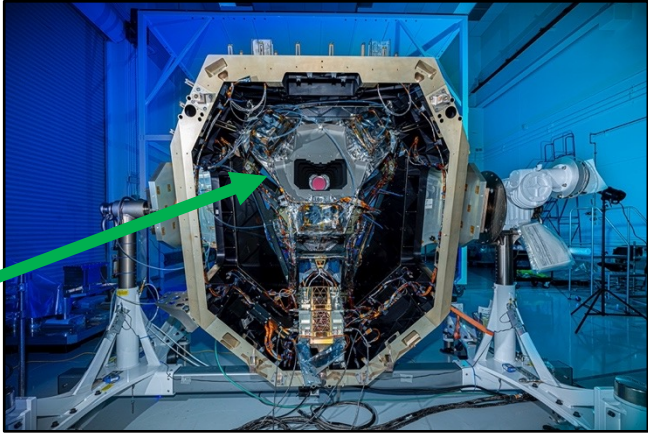


We are looking here



WFI integration at Ball Aerospace

WFI Integration – Focal Plane System



Focal plane assembly is being installed *now*

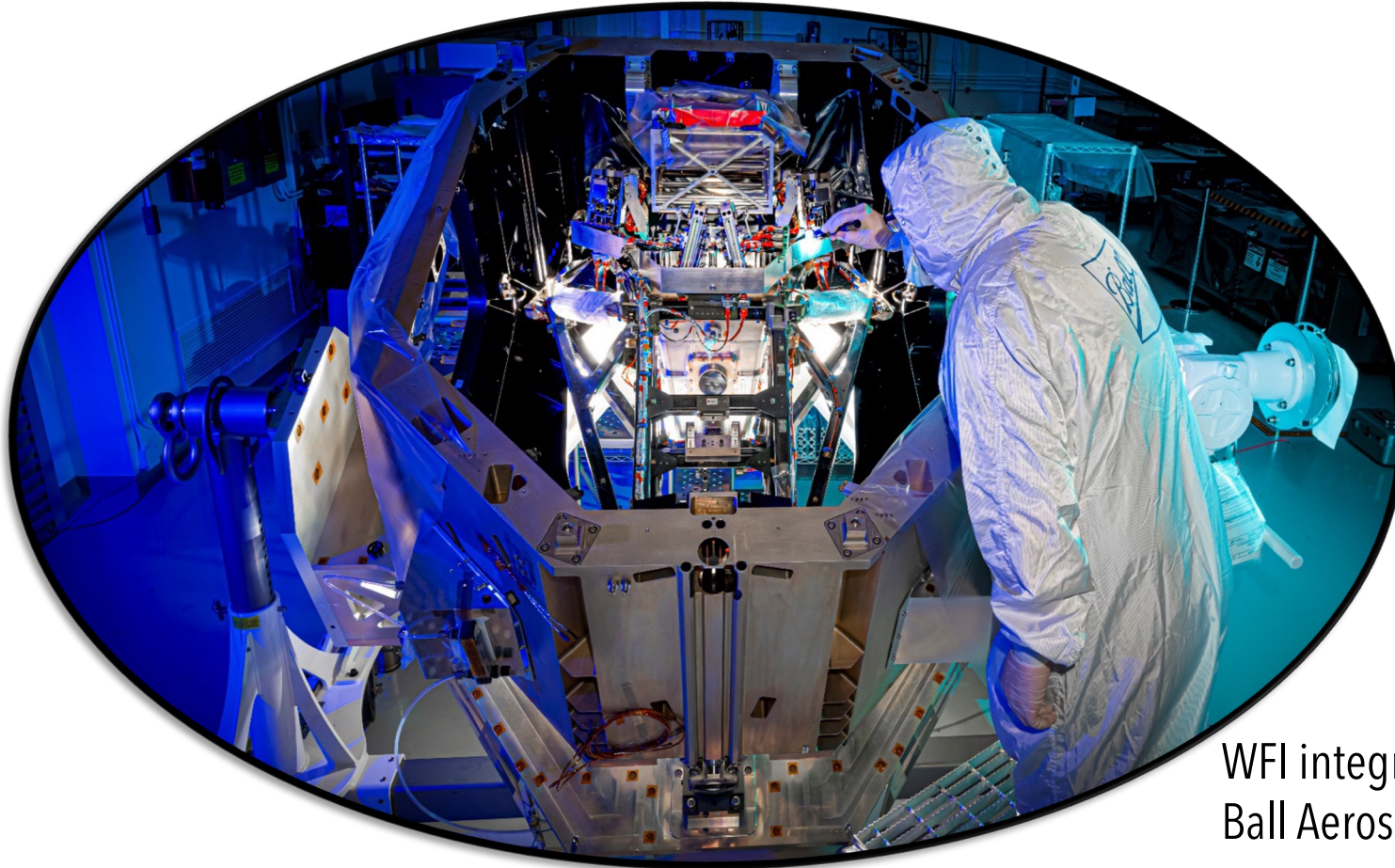
- The SORC is a critical piece of ground support equipment that acts a telescope simulator for the WFI during instrument TVAC testing
- At the heart of SORC is a projector assembly fed by a light source rack
 - The projector has 5 degrees of freedom and can place a point source anywhere in the WFI focal plane
- Also has multiwavelength flat field projection capability and a black body source
- SORC is used for WFI optical verification, characterization of the optical elements (filters, grism, prism), assessing aspects of detector performance, and other tests
- Without SORC, we can't test WFI before flight

- **Full SORC system has been built, tested at ambient temperature and pressure, and finished TVAC testing in the large SES chamber at NASA Goddard**
- SORC was delivered to Ball Aerospace in April 25!
- SORC work at Ball running in parallel with work to complete WFI so they are both ready for the instrument TVAC test campaign later this year



Roman WFI Status Summary

WFI is on track for full instrument integration and two TVAC test campaigns, with the first starting in September of this year!



WFI integration at
Ball Aerospace