

# The Roman Space Telescope Science Operations Center: Overview of Software and Data Simulation Tools

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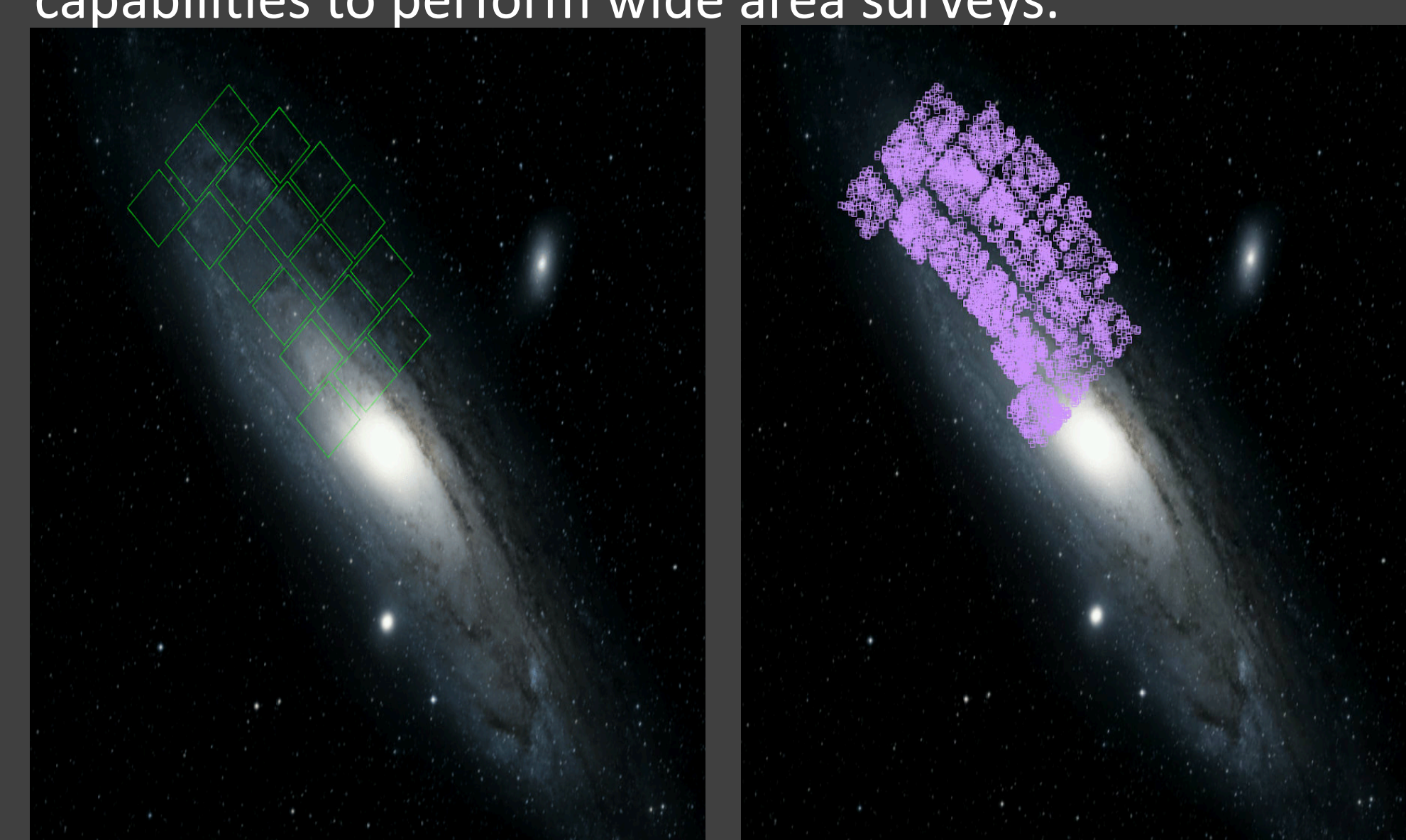


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## FOV Overlay Tool

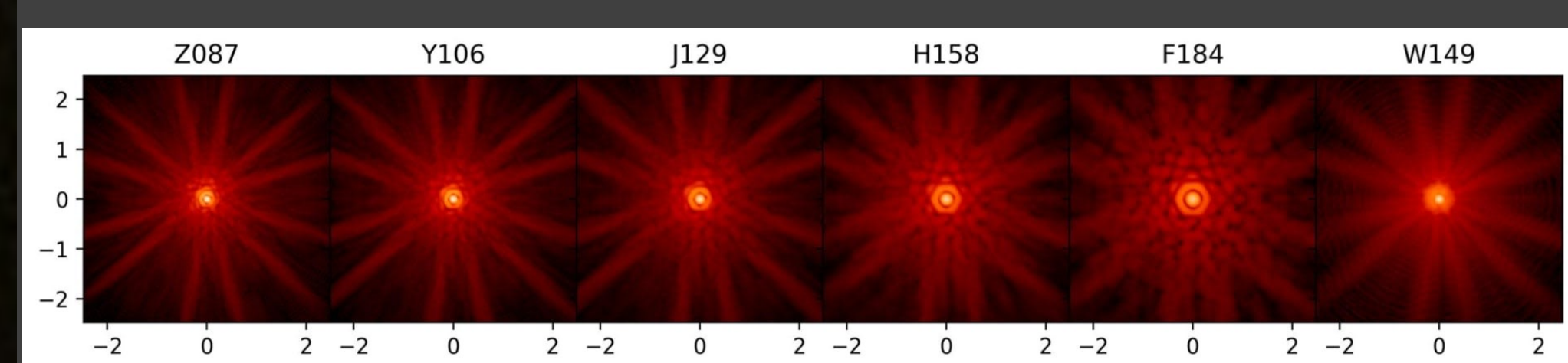
The [MAST FOV Overlay Tool](#) is a web-service in the Barbara A. Mikulski Archive for Space Telescopes (MAST) that allows the display of the Roman focal plane footprint on sky images from the DSS, SDSS, or GALEX. The tool also allows retrieval of catalog objects (e.g., GSC2, 2MASS, WISE) within specified detectors.

The Overlay tool supports observation planning, and it allows users to become familiar with the Roman capabilities to perform wide area surveys.



Left panel: WFI footprint on DSS image of M31  
Right Panel: 2MASS catalog sources within the WFI footprint

## PSF Simulations Tool



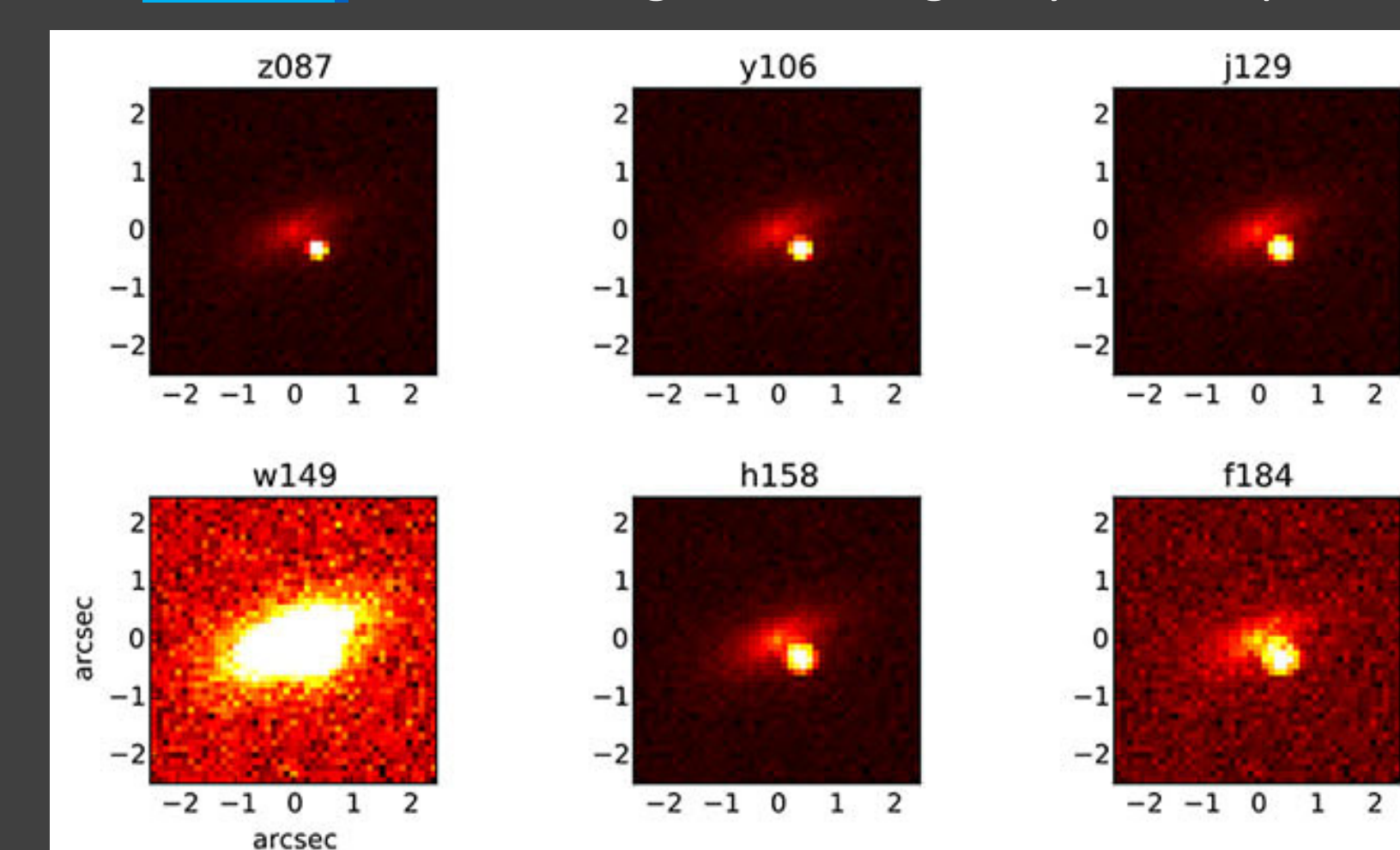
Above: Simulated point-spread functions of a GOV star observed in six filters with the Roman WFI. Intensity is shown in log scale and axes are in arcseconds.

The [WebbPSF-Roman](#) software calculates high-fidelity point-spread function (PSF) models. It was originally developed for JWST, and has been extended to include Roman functionality. It provides a customizable multi-mission interface to produce PSFs for use in other tools and for precursor science planning. Simulated PSFs are critical to predict the performance of the observatory and to simulate scenes. WebbPSF accounts for pupil shapes, source spectral energy distributions, filter bandpasses, and field-dependent aberrations within flexible Python tools.

Version 1.0.0 of WebbPSF was released on December 20, 2021

## Exposure Time Calculator

Below: [Pandeia](#) simulated high-redshift galaxy with superimposed

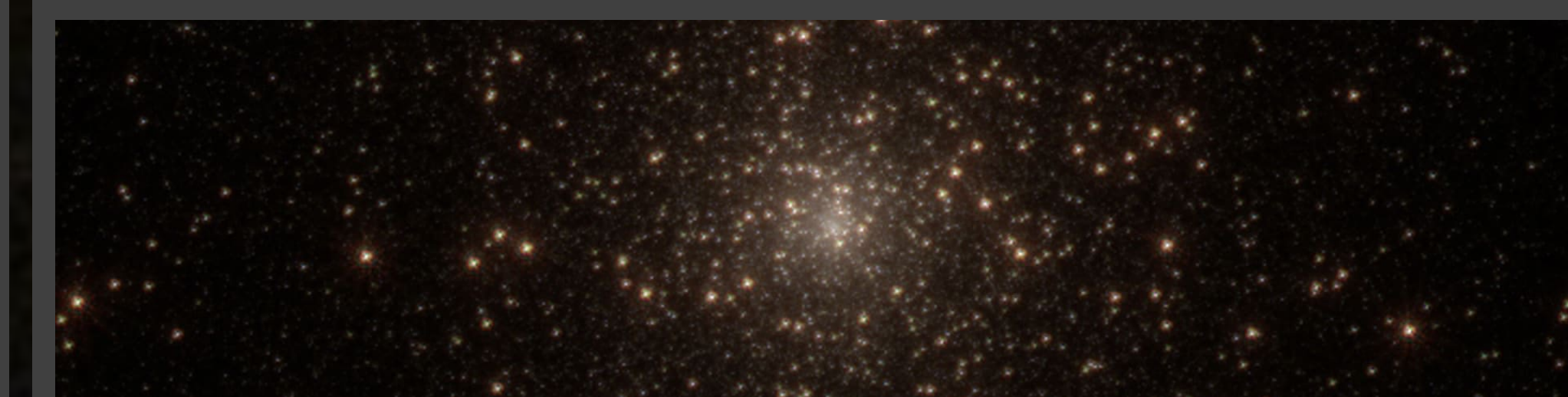


[Pandeia](#) is a multi-mission source simulator and Exposure Time Calculator that computes three-dimensional (x, y, lambda) data cubes for astronomical sources with various spatial and spectral properties. Developed for JWST, it has been extended to include Roman functionality. Data cubes are processed through instrument models to generate simulated data, enabling for accurate signal-to-noise ratio calculations. It accounts for the effects of wavelength-dependent PSFs and pixel-to-pixel correlations inherent to IR detectors. It is a self-contained Python package designed for scripting calculations.

## Scene Simulation Tool

The [STIPS](#) software (Space Telescope Image Product Simulator) allows calculation of simulated data for complex astronomical scenes, using instrument models and library catalogs for a range of stellar and/or galactic populations. It was developed for JWST, and has been extended to include Roman functionality. STIPS can be used for creation of complex star fields with specified clustering, age, metallicity, IMF, and other user specified inputs and properties.

STIPS includes the most current information about the telescope sensitivity, spectral elements, and detector properties. It uses the PSF model generated by WebbPSF, and it calls the appropriate Pandeia modules to compute instrumental throughput and count rates.



Above: Pseudocolor image of the central region of a globular cluster viewed in the F087, F129, and F184 filters of the Roman WFI, as simulated using [STIPS](#).

## Big Surveys, Big Data

Roman is a NASA flagship mission planned for launch in late 2026. It will perform breakthrough science in dark energy cosmology, exoplanet microlensing, and near-infrared sky surveys with its Wide Field Instrument (WFI).

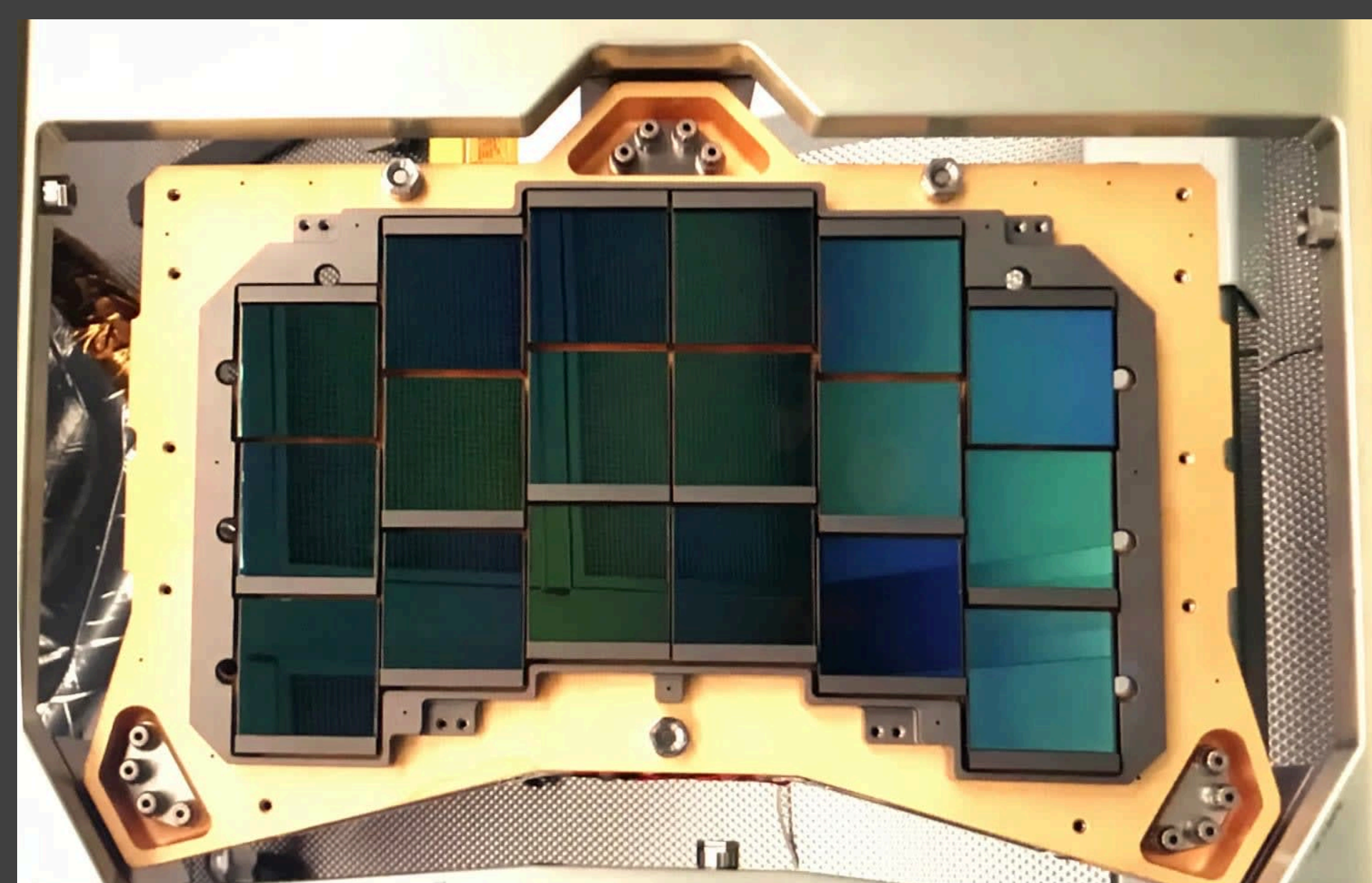
Roman is expected to produce ~4 Petabytes per year. All data will be non-proprietary and will be hosted at the Mikulski Archive for Space Telescopes (MAST) at STScI.

Core Community Surveys (~75% mission) to be defined through an open community-driven process:

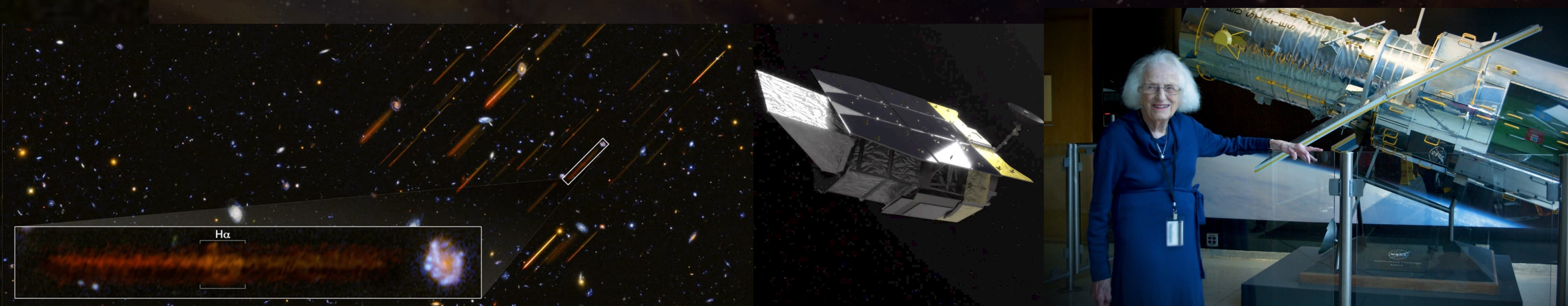
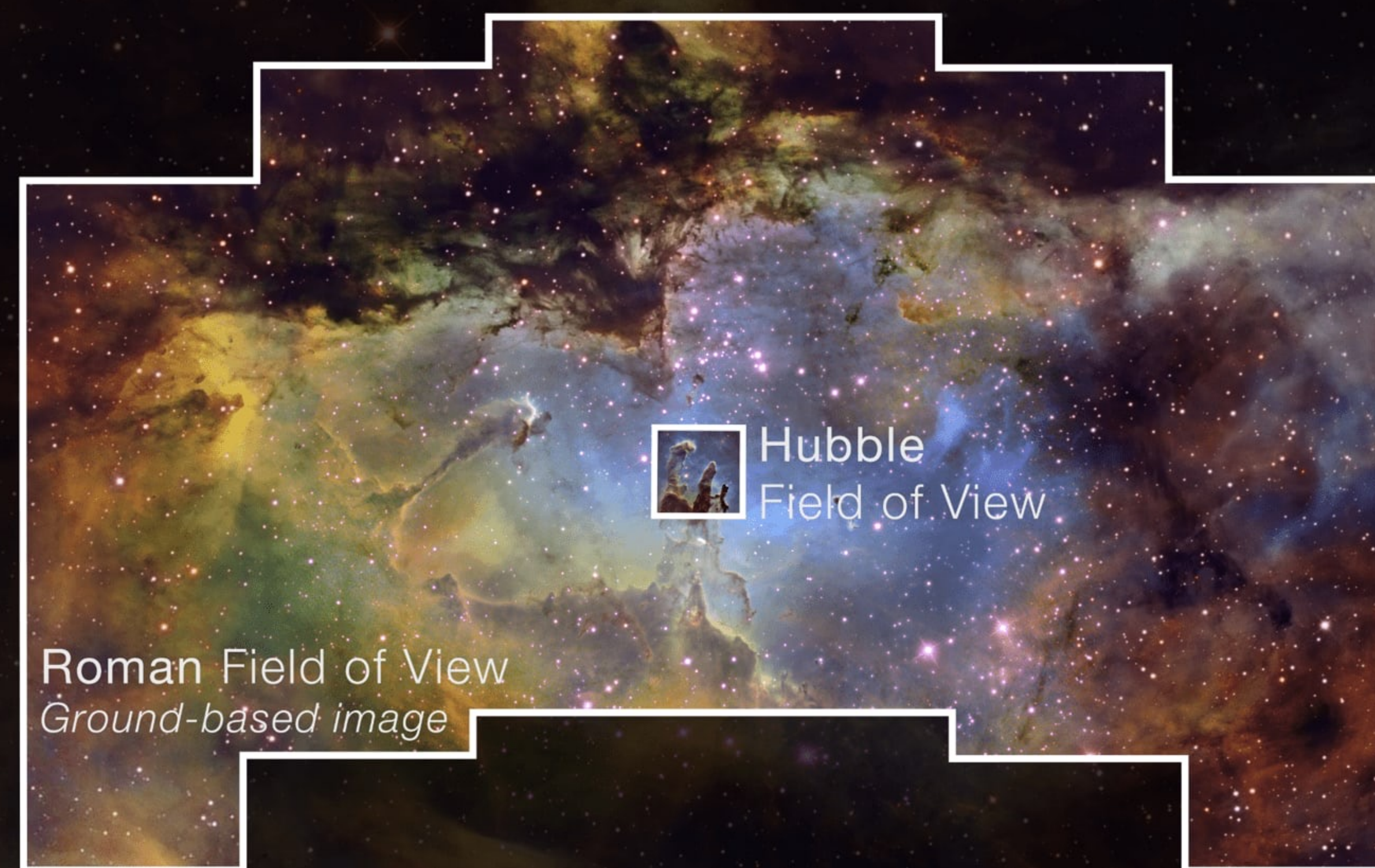
- High Latitude Time Domain Survey
- High Latitude Wide Area Survey
- Galactic Bulge Time Domain Survey
- General Astrophysics Surveys (~25% mission) to be selected via peer review.

### Wide Field Instrument (WFI)

- Eighteen 4k x 4k near-IR detectors
- Imaging and spectroscopy covering 0.48 to 2.3 microns
- FOV is 0.28 square degrees (200x bigger than Hubble's WFC3 / IR channel) at ~0.1" resolution



Above: WFI Engineering Test Unit



## Abstract

The 2.4m Nancy Grace Roman Space Telescope will be NASA's next flagship astrophysics mission after JWST, with launch planned for October 2026, and no later than July 2027, with an operational baseline of five years. Roman is a survey mission by-design. The Wide Field Instrument (WFI) is the central observational engine for these surveys, with comparable sensitivity and resolution to Hubble, but with a field of view 200 times larger.

The Space Telescope Science Institute (STScI) is the Science Operations Center (SOC) for Roman, with leadership over the mission's scheduling, archive, and most WFI-imaging related systems (including data processing, calibration, user support). In this presentation, we highlight the resources available from the Roman SOC which can be used to enable preparatory Roman science and explore the capabilities of the WFI. This includes a point-spread function (PSF) simulator, an exposure time calculator, and an image simulator.

## More About The Roman Survey

Roman will also feature a [Coronagraph Instrument](#) (CGI), a technology demonstration that will directly image and take spectra of exoplanetary systems using several novel technologies together for the first time in space

### Mission partners

The Nancy Grace Roman Space Telescope is managed at NASA's [Goddard Space Flight Center](#), with participation by NASA's Jet Propulsion Laboratory and Caltech/IPAC, and the Space Telescope Science Institute (STScI). STScI is the Science Operations Center (SOC), and IPAC is the Science Support Center (SSC) for Roman. The primary industrial partners are Ball Aerospace and Technologies Corporation, L3Harris Technologies, and Teledyne Scientific & Imaging.

### Science Operation Center

The SOC is responsible for the mission's observation planning and scheduling system, the WFI data processing system, with different levels of processing varying depending on the mode, archive for all mission observations (WFI and Coronagraph), community interface for WFI imaging (excluding spectroscopy and microlensing), including user support, documentation, community engagement and public outreach.

### Help Desk

The Roman Help Desk is operated jointly by the the SOC and SSC. Contact the SOC helpdesk ([help@stsci.edu](mailto:help@stsci.edu)) for questions about SOC tools, WFI imaging, data calibration and archiving, proposal planning and scheduling. Contact the SSC helpdesk ([roman-help@ipac.caltech.edu](mailto:roman-help@ipac.caltech.edu)) for questions about WFI spectroscopy, microlensing data processing, the proposal submission and review process, and the coronagraph.