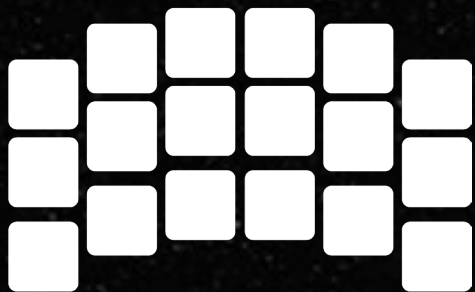
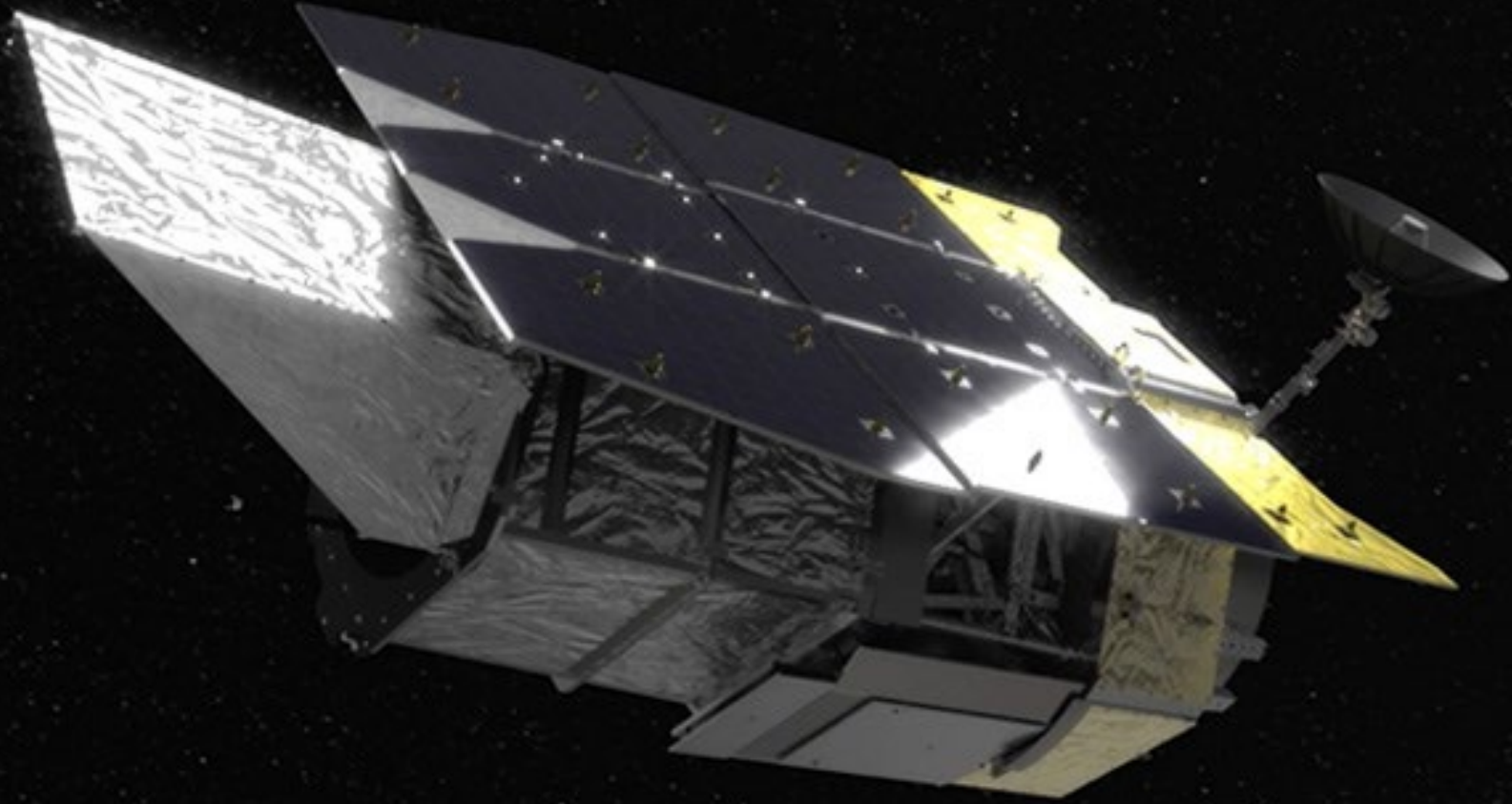




NANCY GRACE R.ÖMAN



SPACE TELESCOPE



the Nancy Grace Roman Telescope

Rachael L. Beaton
Roman Science Operations Center
Space Telescope Science Institute



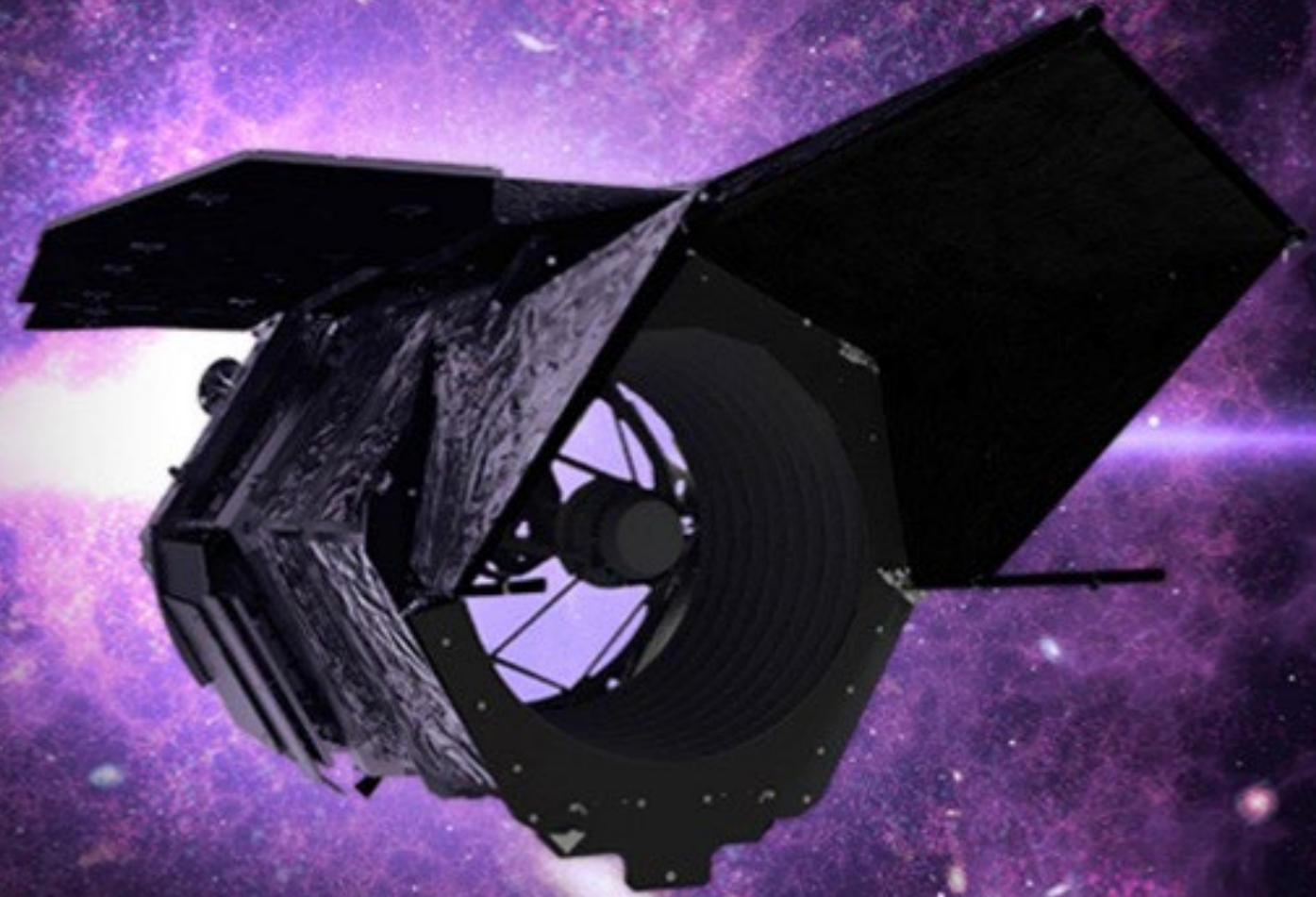
STScI | SPACE TELESCOPE
SCIENCE INSTITUTE



Plus Industry, International, and Academic Partners



Roman @ AAS245

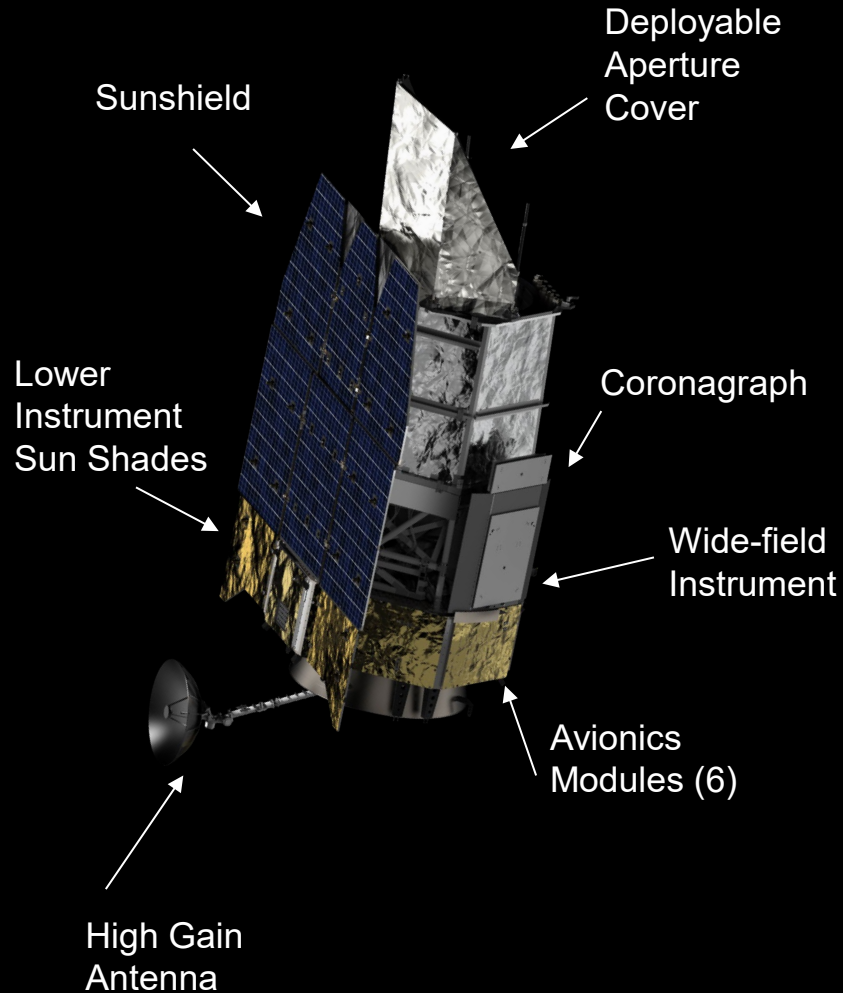


Roman is a Survey Space Telescope

Roman is also a Community Driven Mission

Roman Observatory

Telescope: 2.4 m aperture



Wide Field Imager (WFI)

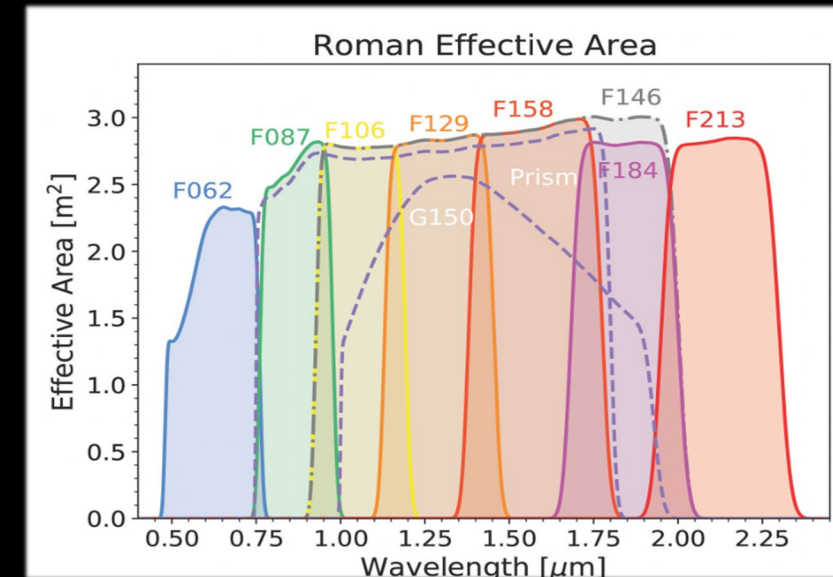
- Visible / Near IR (0.48 – 2.3 μm)
- Field of view 0.281 deg²
- 18 4K x 4K detectors
- Grim (500), Prism (100)

Coronagraph

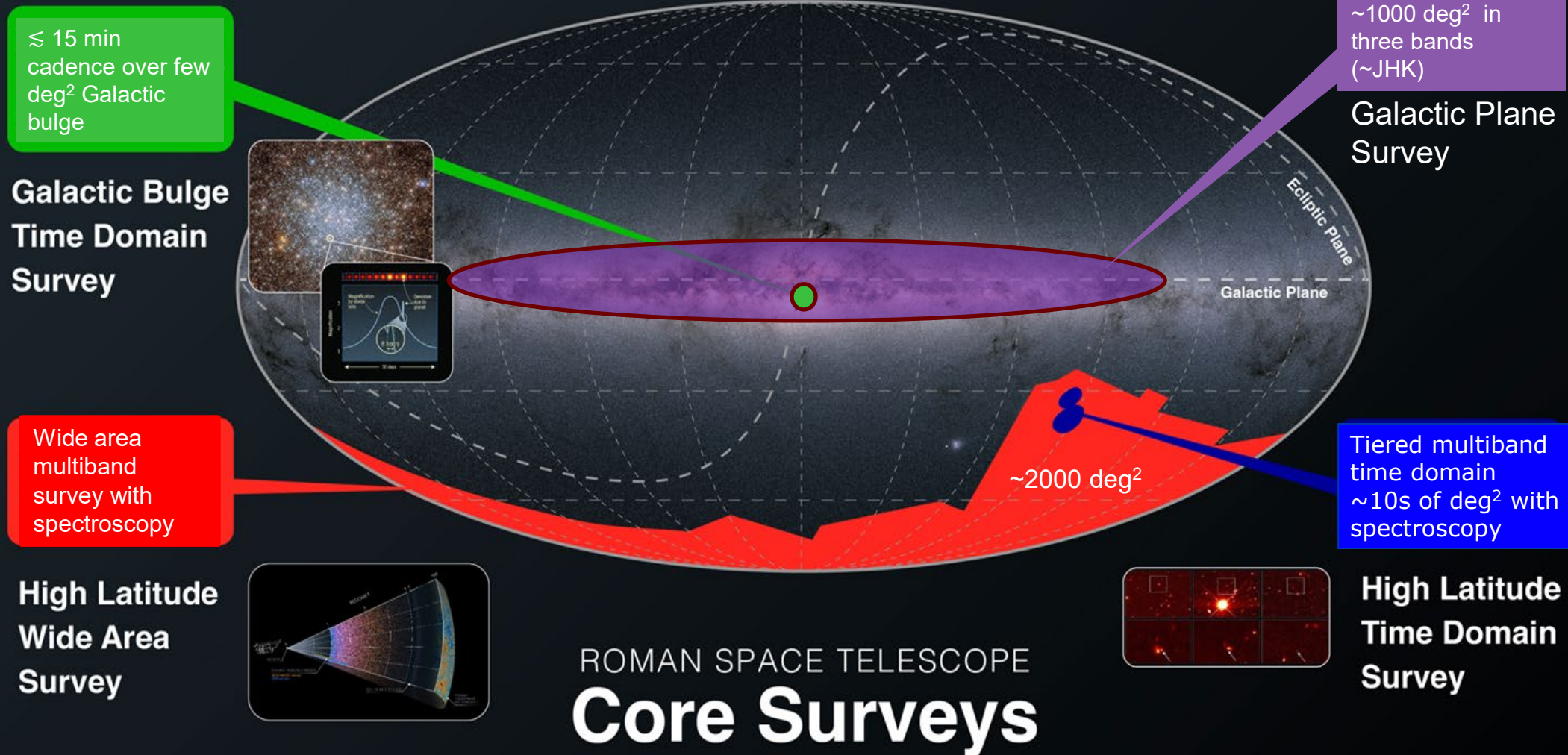
- Visible bandpass
- Contrast 10^{-8} - 10^{-10}

Data Volume: 11 Tb/day
Orbit: Sun-Earth L2

Mission Duration: 5 years, 10 years goal



Example Implementation of Roman Core Surveys



Roman Space Telescope's larger view and fast survey speeds will unveil the evolving universe in ways that have never been possible before.

Roman Observational Program

Large Core Community Surveys *majority of observing time*

Dark Energy

Exoplanets

High-latitude wide area survey

Enables Weak Lensing, Baryon Acoustic
Oscillation cosmology investigations

High-latitude time-domain survey

Enables Supernovae Ia cosmology
investigations

Galactic Bulge time-domain survey

Enables exoplanet microlensing
investigations

Astrophysics with Wide Field IR Surveys

General Astrophysics Surveys *at least 25% of observing time* – includes Galactic Plane Survey

- ❖ Include **Galactic Plane Survey** (Early Definition Community Call)
- ❖ Primarily selected via a peer-review process

Archival Investigations

- ❖ All data will be public immediately
- ❖ Anticipated to be main component of community involvement

Also
Coronagraph
Technology
Demonstration
Observations



Community definition of the Core Survey and Community Contributed Survey

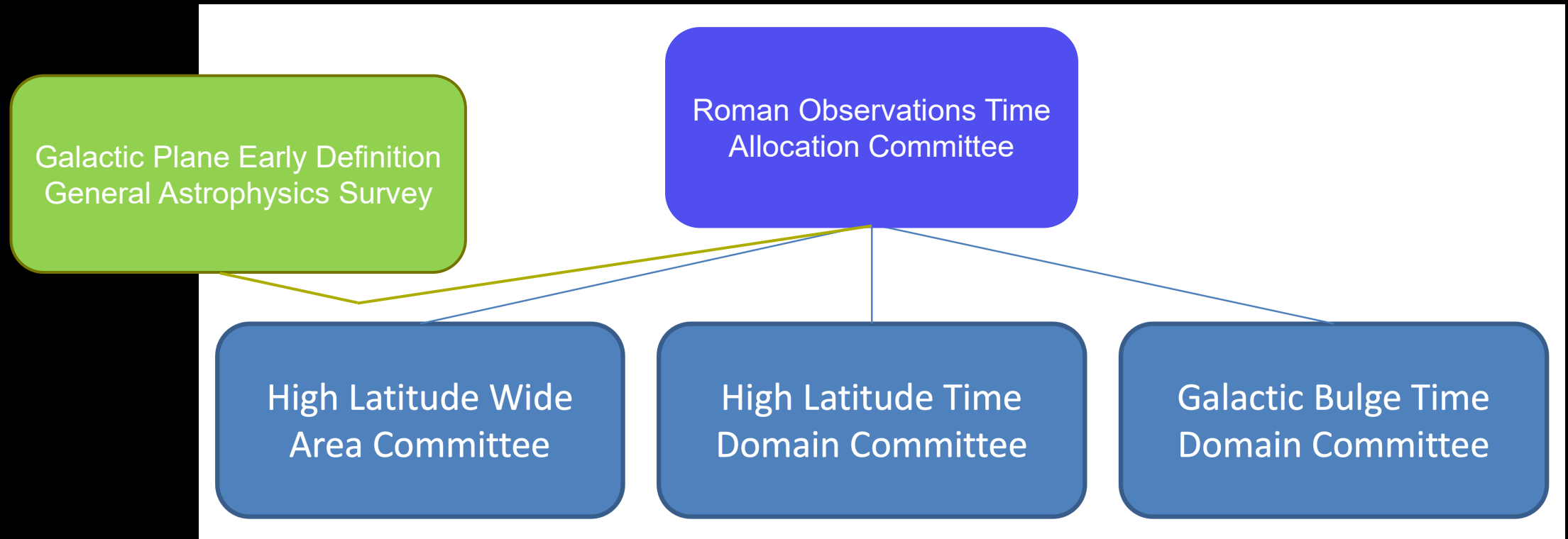
Maximize the overall science return of Roman WFI IR surveys
while meeting Mission Requirements focused on cosmology and
exoplanets

The existing survey strategies served their primary function in
showing the mission can meet its requirements.

The actual surveys to be implemented are being defined by the
science community.

*There will be no “survey teams” selected to define or
implement the surveys.*

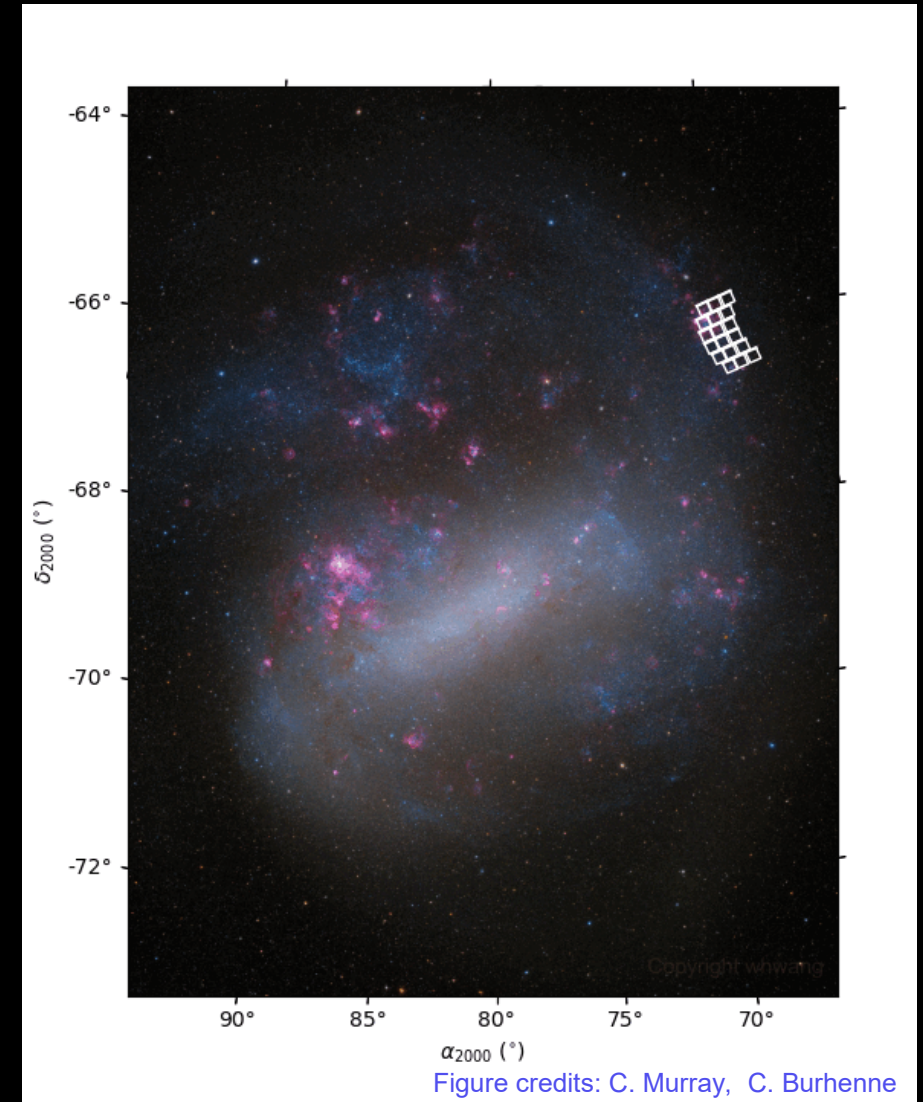
Community definition of the Core Survey and Community Contributed Survey



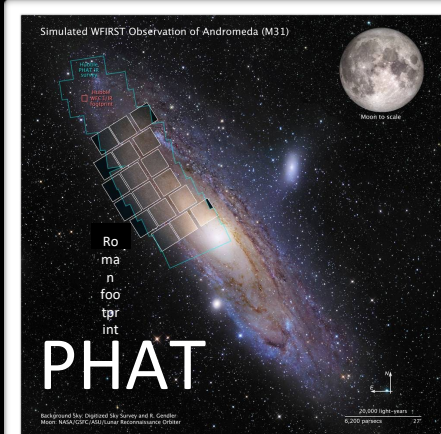
Evaluate initial community input; solicit additional, targeted community input through a variety of channels; evaluate survey options against science metrics; produce recommendations for survey implementations with options for enhancements/descopes

Survey Science Helps Your Science

- Survey Speed (1000x's faster)
- Calibration Levels
- Rapid slew & settle times
- No Earth Occultation
- No SAA



PI J. Dalcanton



Survey Nearby Galaxies ~1500 Times Faster

Survey PHAT region
in Y, J, H equivalent
Roman filters to 25.5
mag in < 30 minutes

PIs S. Faber, H. Ferguson



Image Galaxy Fields > 1000 Times Faster

PI P. van Dokkum

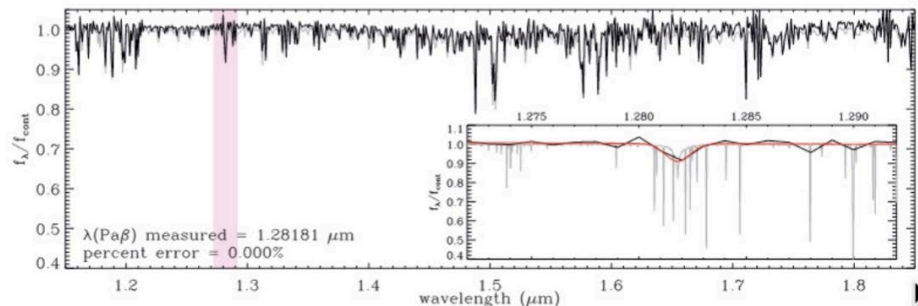


Perform Slitless Spectroscopy Galaxy Surveys > 700 Times Faster

Akeson et
al. 2019

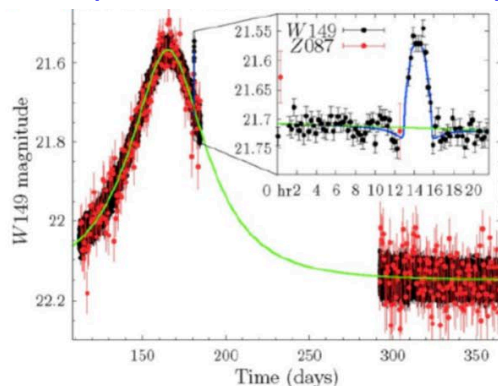
Stringent Mission Calibration Requirements

0.1% wavelength accuracy (for BAO; maps to source redshift)



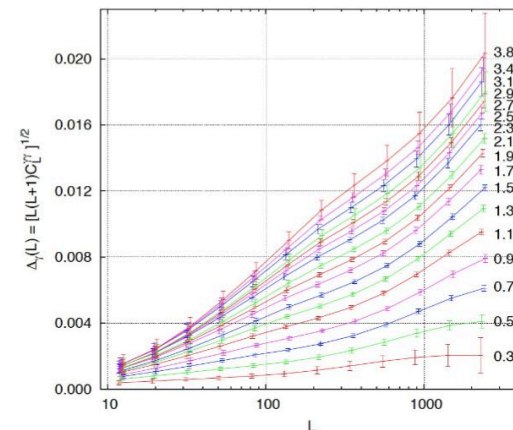
$\text{Pa}\beta$ in simulated stellar spectrum (Ryan+ 2019); 0.027% error

0.1% Photometric stability (for microlensing; maps to planet mass uncertainty)



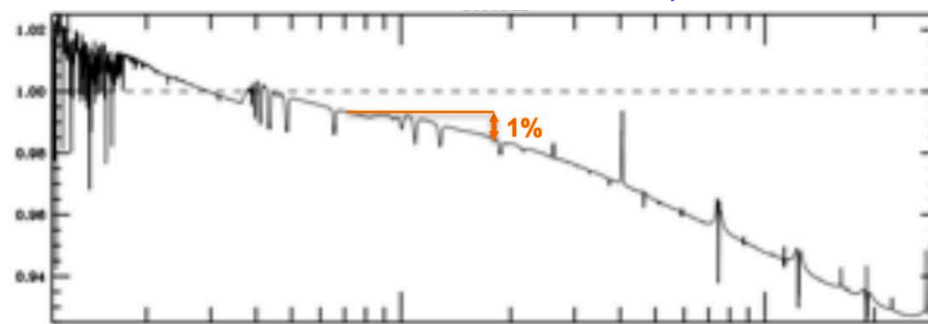
Simulated microlensing event (S. Carey)

0.05% PSF shape (cosmic shear measurements)



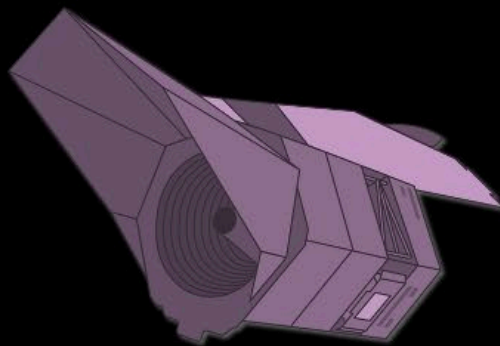
Expected shear power spectrum
(SDT report, Spergel+ 2015)

0.5% Absolute color calibration (for SNe; maps to luminosity distance vs. redshift)



Ratio between white dwarf spectral models (Bohlin+ 2014)

Requirements significantly exceed what we've achieved on Hubble and the requirements for Webb



Mission
Operation
Center



Roman Science Operations Center

1

WFI
Exposure-
Level
Processing

2

WFI
High-Level
Processing

3

Roman
Archive @
MAST

Roman
Science
Platform

4

WFI
Spectroscopic
Pipeline

Galactic Bulge
Microlensing
Science
Pipeline

Roman Science
Support Center

5

6

Science
Community

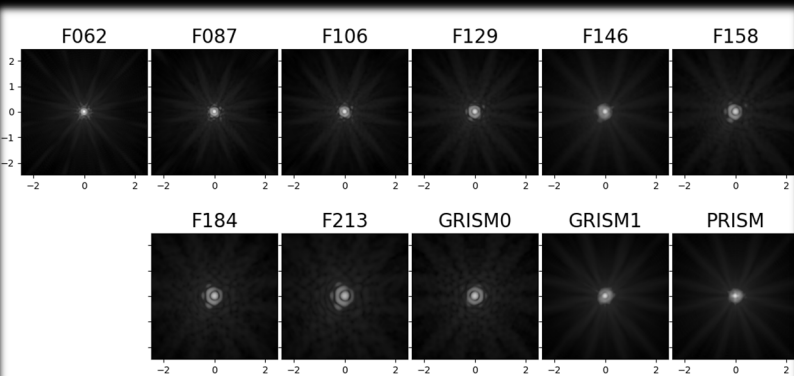
Roman Science Operations Center



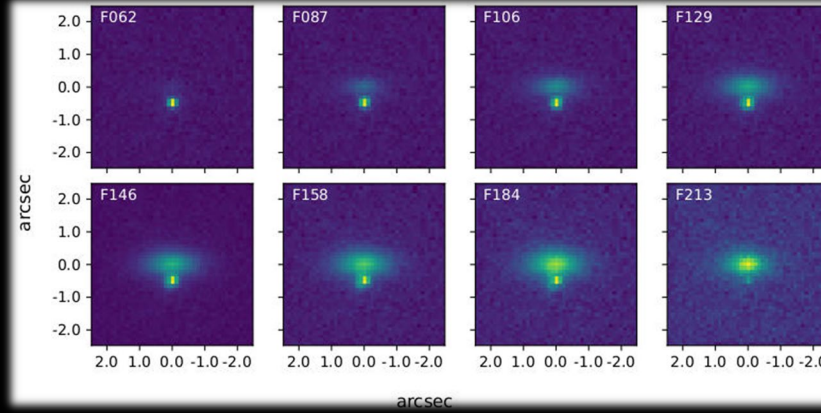
Planning &
Scheduling

Planning Observations – Simulation tools & utilities

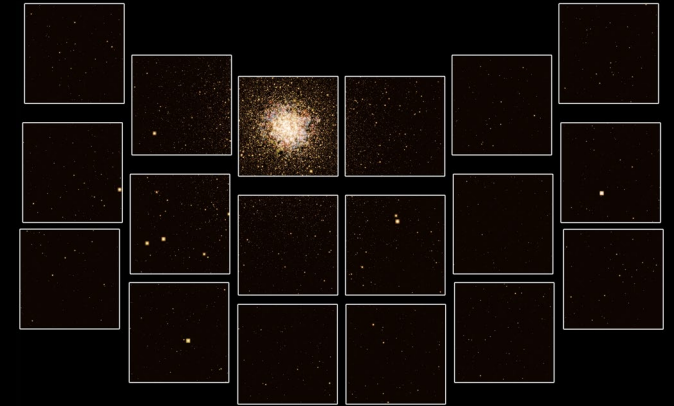
WebbPSF



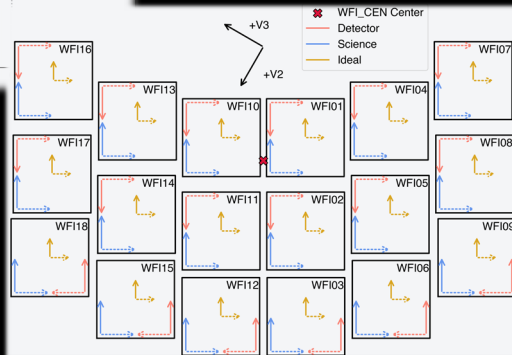
Pandeia - Exposure Time Calculator



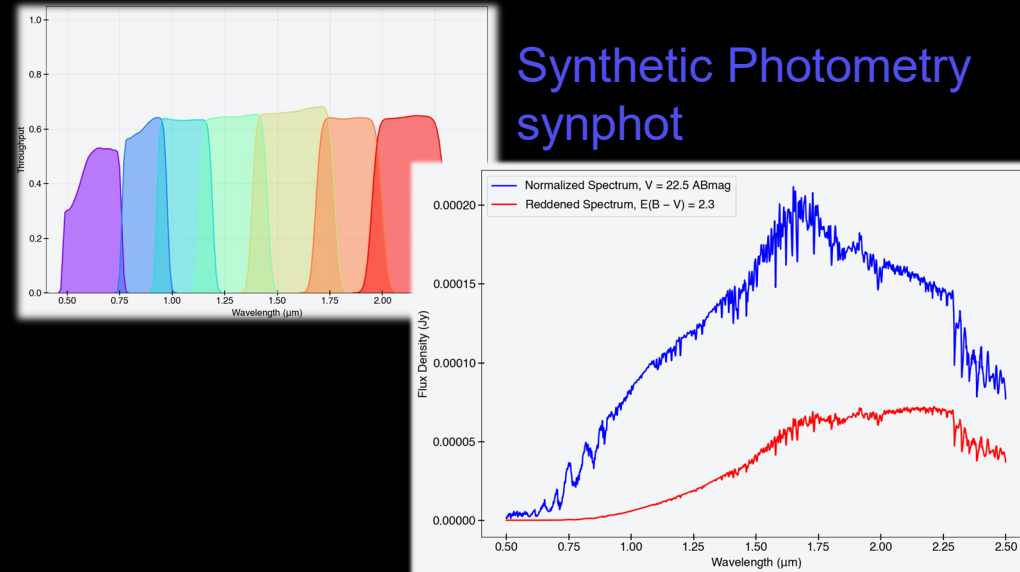
STIPS



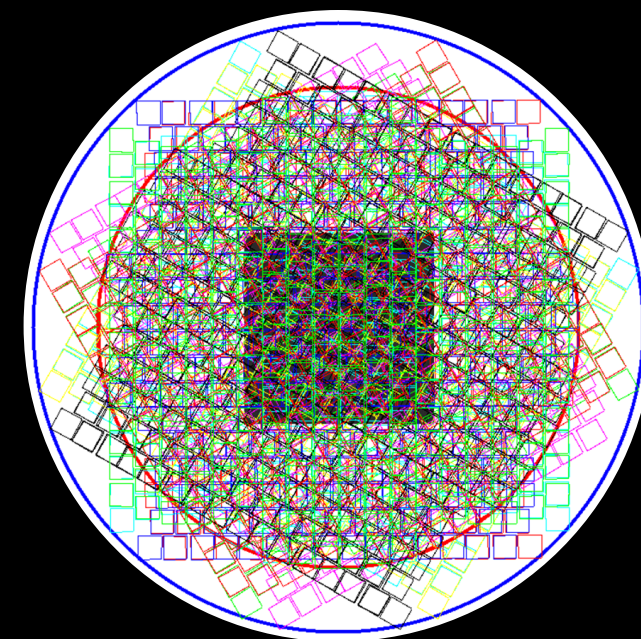
Science Aperture pySIAF



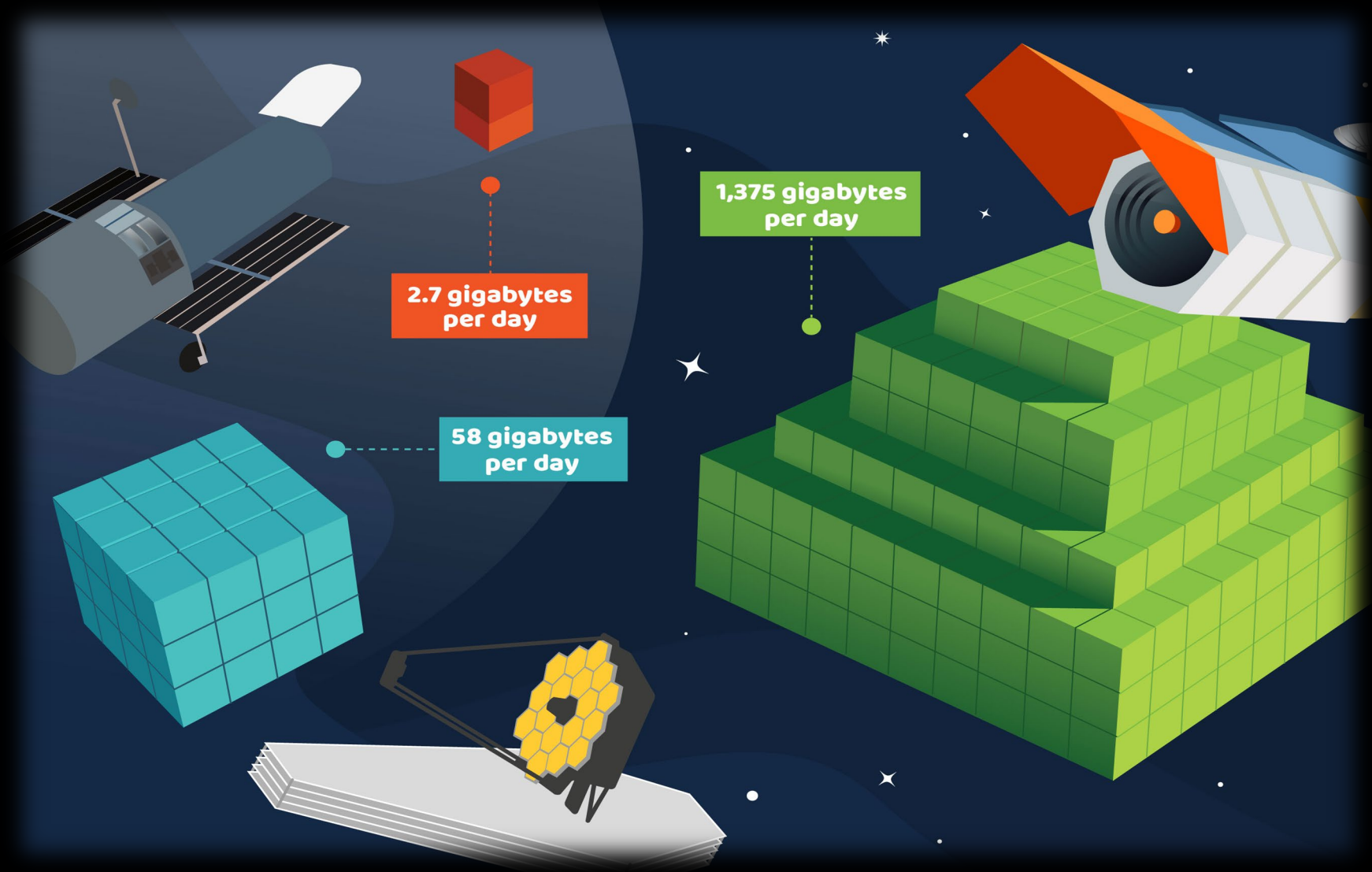
Synthetic Photometry synphot



Planning Observations – Roman APT



Big Data



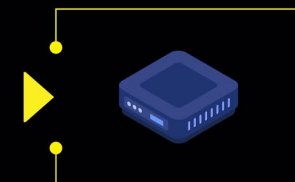
BIG DATA

172

Terabytes

Hubble's data archive

30 years (1990–2020)

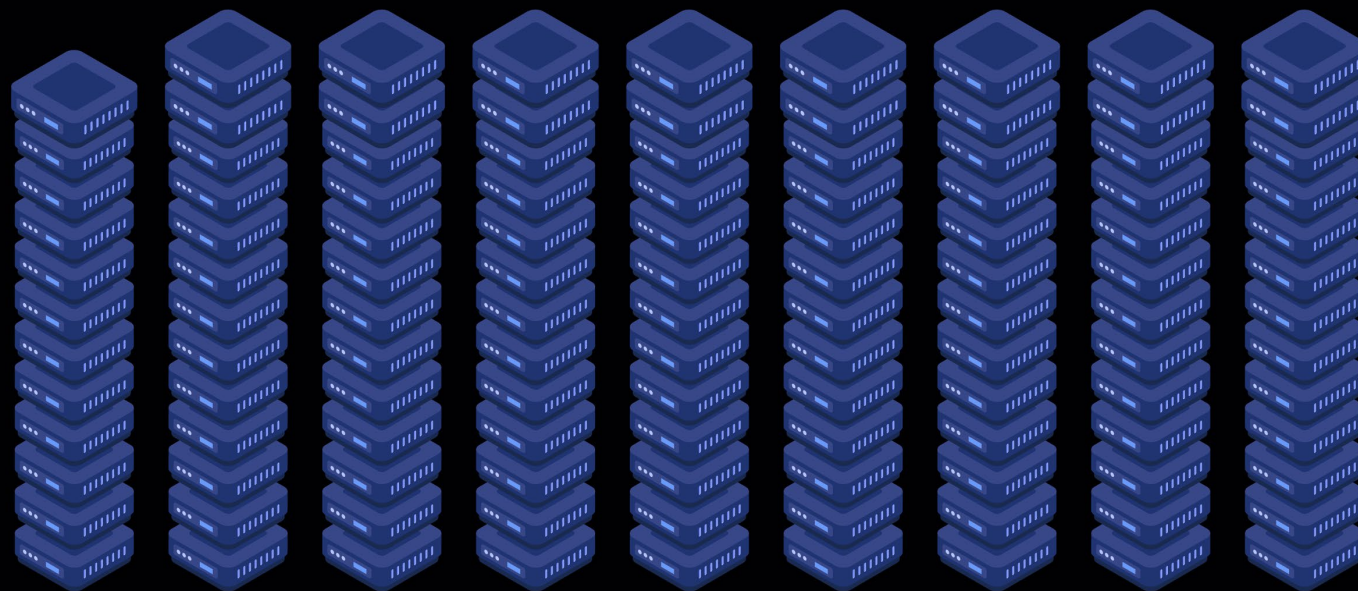


20,000

Terabytes

Roman's data archive

5 year primary mission
(projected)





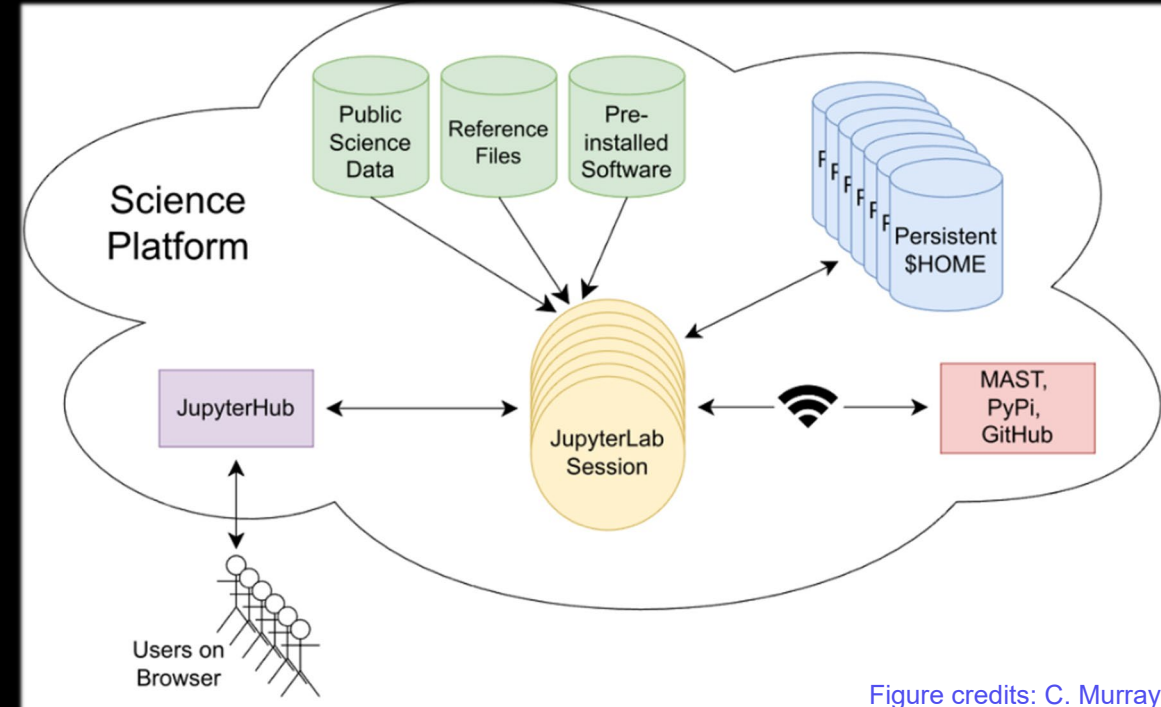
The Roman Science Platform will enable the community to perform **transformational science** on big data by providing a rich computing environment that will allow **broad, low-barrier access to data, computing, and software resources.**

- *Enable collaboration*
- *Support the community*
- *Build software and tools that bring people to the platform*

Roman Science Platform Vision

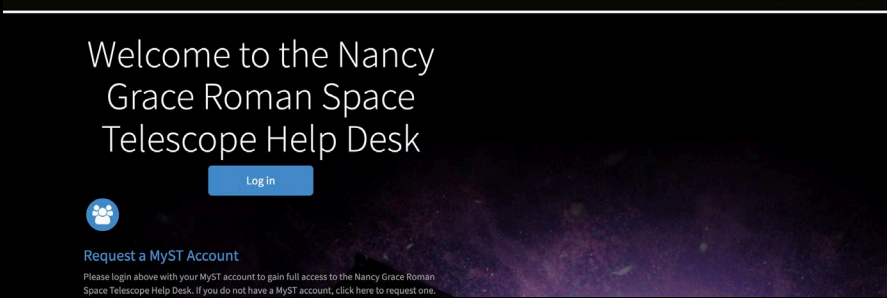


- Cloud-compute environments – Jupyterlab
- Brings users to the data – easy and efficient access, decreased need for downloads
- Cloud-based computing resource
 - Resources for exploratory work will be available with no need to write grant proposal
- Offers flexible and scalable architecture
- Includes pre-installed software and tools for calibration, analysis, visualization, and training





Roman Documentation



SOC Roman Helpdesk

Quick Start APT for Roman



Simulation Tools Handbook

Getting involved with Roman

Roman Working
Groups



Calibrations, Simulations,
Software, Survey Definition

Roman ST
Advisory Committee



Roman Science
Interest Group

Roman conference “Challenging Theory with
Roman: From Planet Formation to Cosmology”,
Caltech campus + online, July 9-12, 2024





Nancy Grace Roman

NASA's First Chief of Astronomy

1925–2018

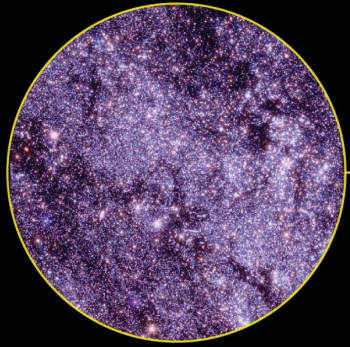
Roman's Instrument Capabilities



Roman Space Telescope Imaging Capabilities								
Telescope Aperture (2.4 meter)	Field of View (45'x23'; 0.28 sq deg)			Pixel Scale (0.11 arcsec)		Wavelength Range (0.5-2.3 μm)		
Filters	F062	F087	F106	F129	F158	F184	F213	W146
Wavelength (μm)	0.48-0.76	0.76-0.98	0.93-1.19	1.13-1.45	1.38-1.77	1.68-2.00	1.95-2.30	0.93-2.00
Sensitivity (5 σ AB mag in 1 hr)	28.5	28.2	28.1	28.0	28.0	27.5	26.2	28.3

Roman Space Telescope Spectroscopic Capabilities				
	Field of View (sq deg)	Wavelength (μm)	Resolution	Sensitivity (AB mag) (10 σ per pixel in 1hr)
Grism	0.28 sq deg	1.00-1.93	461	20.5 at 1.5 μm
Prism	0.28 sq deg	0.75-1.80	80-180	23.5 at 1.5 μm

Roman Space Telescope Coronagraphic Capabilities					
	Wavelength (μm)	Inner Working Angle (arcsec)	Outer Working Angle (arcsec)	Detection Limit*	Spectral Resolution
Imaging	0.5-0.8	0.15 (exoplanets) 0.48 (disks)	0.66 (exoplanets) 1.46 (disks)	10 ⁻⁹ contrast (after post-processing)	47-75
Spectroscopy	0.675-0.785				



NEARBY GALAXIES



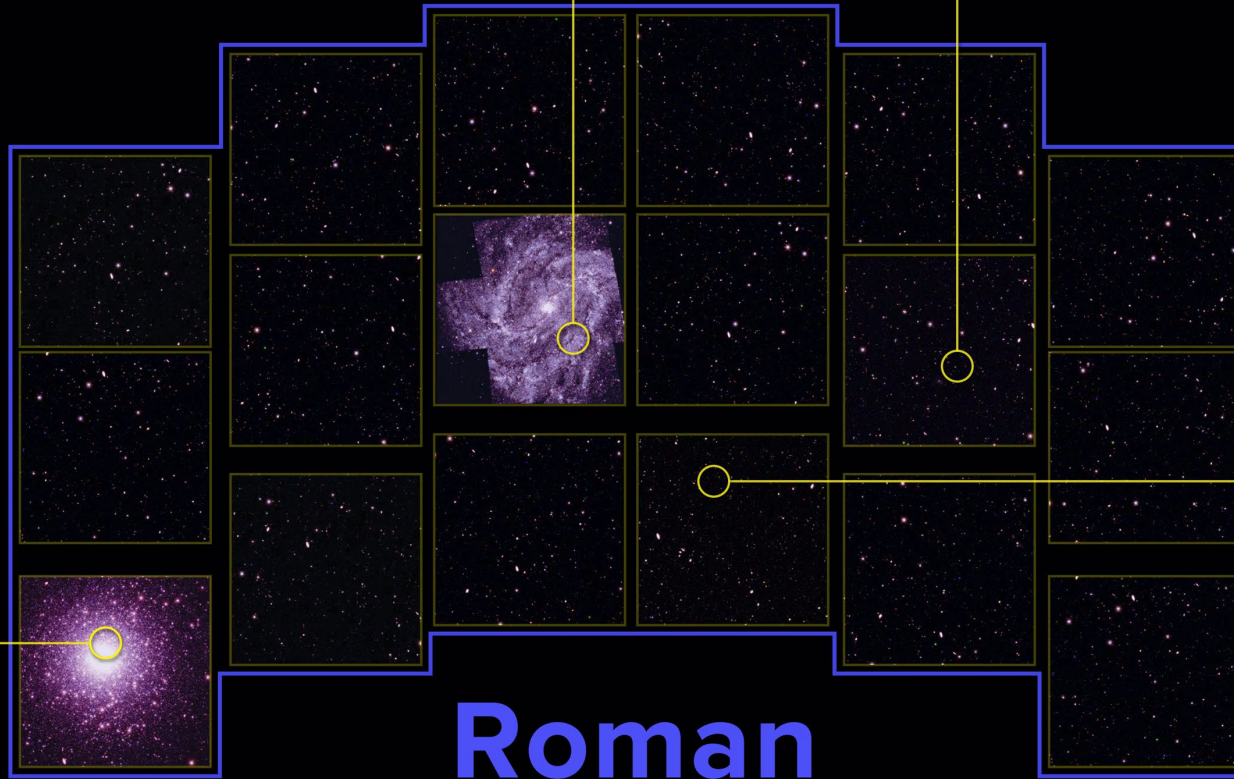
DWARF GALAXIES



STAR CLUSTERS



DISTANT GALAXIES



Roman



Hubble

Galactic Plane Survey

Roman's high angular resolution, sensitivity, NIR wavelengths, and survey speed will minimize confusion and extinction in the plane of the Galaxy, enabling surveys that can

- Resolve previously unresolved stellar populations, e.g., stellar clusters in star-forming regions, globular clusters
- Place new constraints on Galactic structure, by surveying red clump stars and YSOs over a greater volume of the disk
- Measure the stellar Initial Mass Function to lower mass limits; resolve low mass stars in extincted regions
- Observe more “background” sources for the construction of 3D dust maps
- Obtain a complete census of evolved massive stars in the disk: measure physical properties, constrain their binary fraction, and enable multi-messenger stellar astronomy

Roman will be capable of detecting a complete sample of red-clump stars

