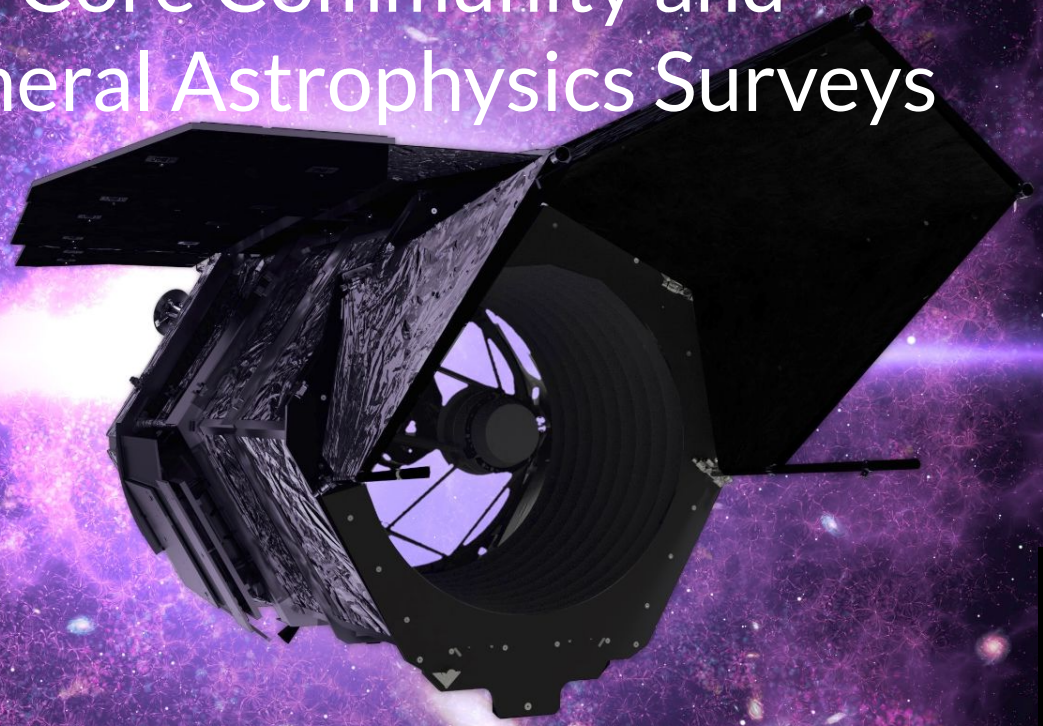
Nancy Grace Roman Space Telescope: Core Community and General Astrophysics Surveys



Saurabh W. Jha (Rutgers University) & Gail Zasowski (University of Utah)
ROTAC Co-Chairs

NAS CAA, 6 Oct 2025

NANCY GRACE ROMAN SPACE TELESCOPE

Roman WFI Observations: A Community Driven Process

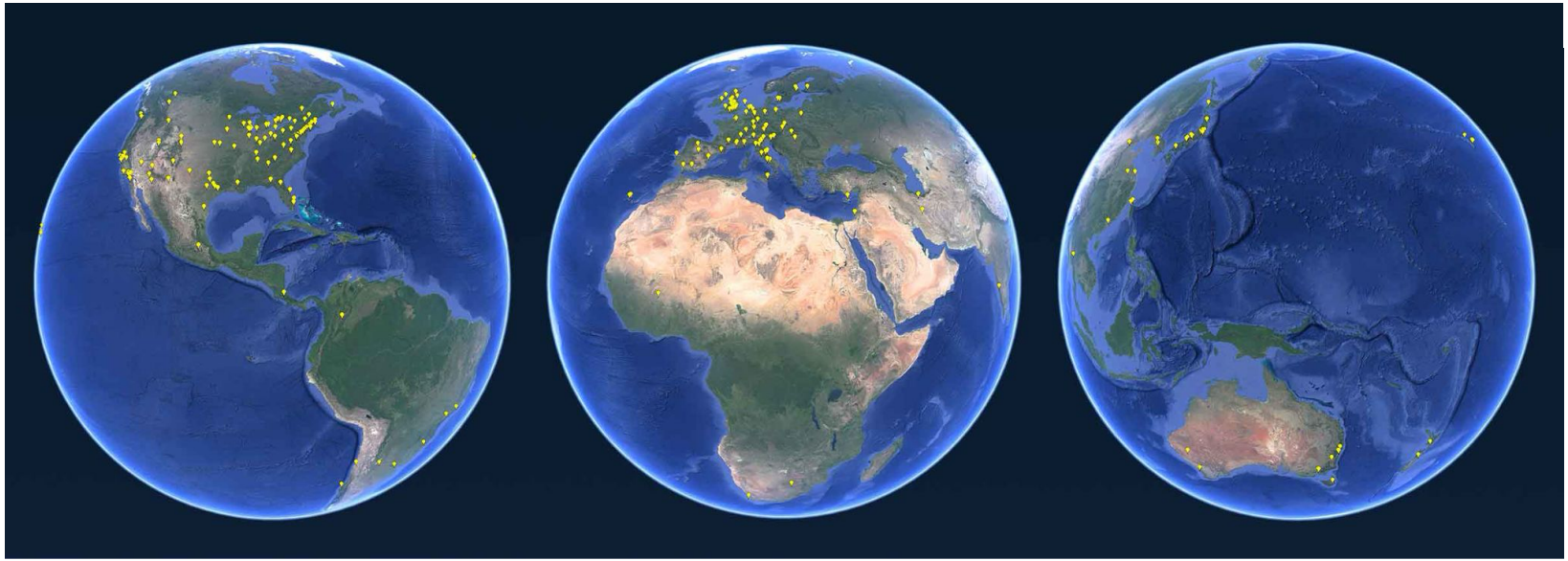
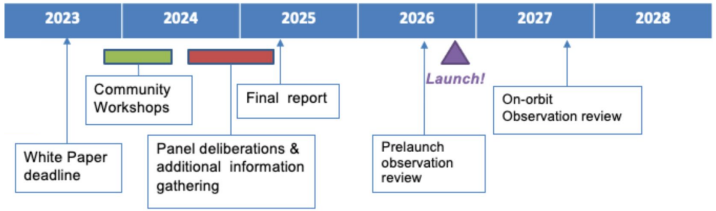


Figure credit: Margaret Carruthers, Landsat/Copernicus, IBCAO, USGS, SIO, NOAA, U.S. Navy, NGA, GEBCO, Google

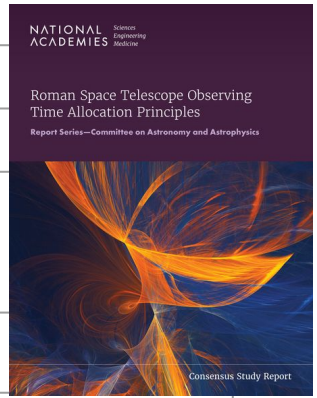
STScI Newsletter Volume 42:

More than 1,000 scientists from over 350 institutions contributed to this community process. Nearly 200 science pitches and white papers were submitted, describing science investigations that could be enabled with one or more of the surveys using Roman's imaging and slitless spectroscopy capabilities from 0.5 to 2.3 microns.

Roman Mission & Observing Strategy Timeline



2022	NAS CAA Report on Roman Observing Time Allocation Principles released
2023	White papers solicited from the community
2023–2024	Core Community Survey (CCS) Definition Committees (DCs) design survey options - Galactic Bulge Time Domain Survey (GBTDS) - High Latitude Time Domain Survey (HLTDS) - High Latitude Wide Area Survey (HLWAS)
2024 November	ROTAC convened to evaluate CCS survey options
2025 January	CCS DC reports & presentations released: GBTDS HLTDS HLWAS
2025 April	ROTAC report and presentation
2025 September	Early-Definition Galactic Plane Survey (GPS) report released
2025 November (planned)	Cycle 1 General Investigator (GI) Call for Proposals, due March 2026
2026 June–August	First GI programs and General Astrophysics Surveys (GAS) selected



Roman WFI Observations: A Community Driven Process

NANCY GRACE ROMAN SPACE TELESCOPE

Members of the Roman Observations Time Allocation Committee

Co-Chairs: Gail Zasowski (University of Utah), Saurabh W. Jha (Rutgers University)

Members: Laura Chomiuk (Michigan State University), Xiaohui Fan (University of Arizona), Ryan Hickox (Dartmouth College), Dan Huber (University of Hawaii, Manoa), Eamonn Kerins (University of Manchester), Chip Kobulnicky (University of Wyoming), Tod Lauer (NOIRLab), Masao Sako (University of Pennsylvania), Alice Shapley (University of California, Los Angeles), Denise Stephens (Brigham Young University), David Weinberg (Ohio State University), Ben Williams (University of Washington)

Galactic Bulge Time Domain Survey

Chairs: Jessie Christiansen (NExScI/Caltech), Daniel Huber (UH/USyd)

Members: Annalisa Calamida (STScI), Jessica Lu (UC Berkeley), Eduardo Martin (IAC), Benjamin Montet (UNSW), Kris Pardo (USC), Matthew Penny (LSU), Hans Walter Rix (MPIA), Jennifer Sobeck (IPAC)

High Latitude Wide Area Survey

Chairs: Ryan Hickox (Dartmouth), Risa Wechsler (Stanford/KIPAC)

Members: Micaela Bagley (UT Austin), Keith Bechtol (UWisc), Michael Blanton (NYU), Chris Hirata (OSU), Elisabeth Krause (U of Arizona), Nikhil Padmanabhan (Yale), Ismael Tereno (IA), Anja von der Linden (Stony Brook), David Weinberg (OSU), L. Y. Aaron Yung (STScI)

High Latitude Time Domain Survey

Chairs: Brad Cenko (NASA/GSFC), Masao Sako (UPenn)

Members: Alessandra Corsi (Texas Tech), Michael Fasnaugh (Texas Tech), Sebastian Gomez (STScI), Rebekah Hounsell (UMBC/GSFC), Takashi Moriya (NAOJ), Gordon Richards (Drexel), Russell Ryan (STScI), Schuyler Van Dyk (IPAC/Caltech), Ashley Villar (CfA/Harvard)

Solar System Liaisons

Susan Benecchi (Planetary Science Institute), Rosemary Pike (CFA)

Ex officio: Lee Armus, Thomas Barclay, Ori Fox, Karoline Gilbert, Jeff Kruk, Patrick Lowrance, Julie McEnery, and Kristen McQuinn

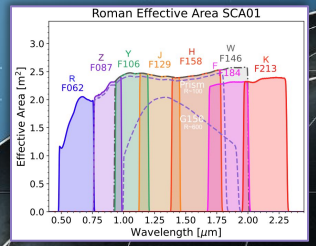
Roman Space Telescope WFI's Prime Mission

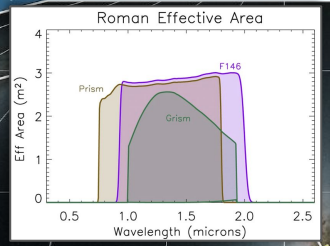
- High Latitude Wide Area Survey (520 days)
- High Latitude Time Domain Survey (180 days)
- Galactic Bulge Time Domain Survey (438 days)
- General Astrophysics Surveys (389 days)
    - 25.5% of prime mission science operations time, including the early-definition Galactic Plane Survey + any remaining margin (e.g., unused calibration time)

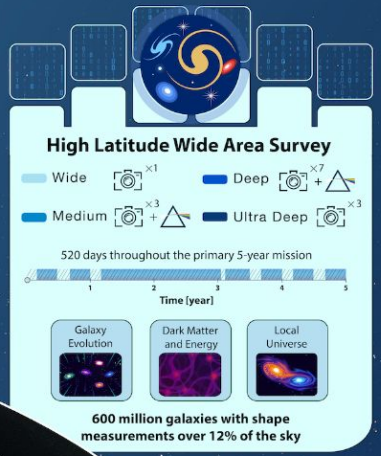
Science for All

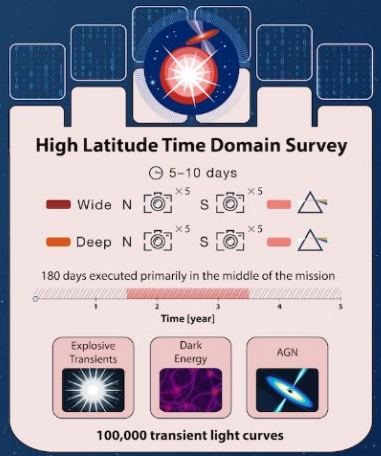
ROMAN'S EXTENSIVE SURVEYS

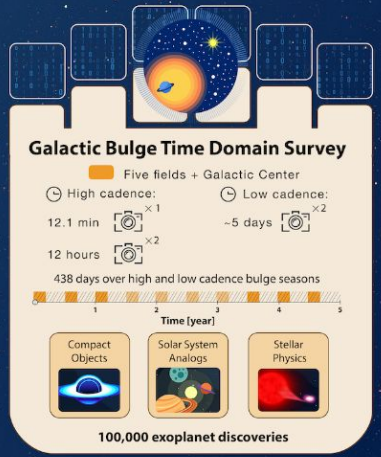
Mapping the universe in high resolution









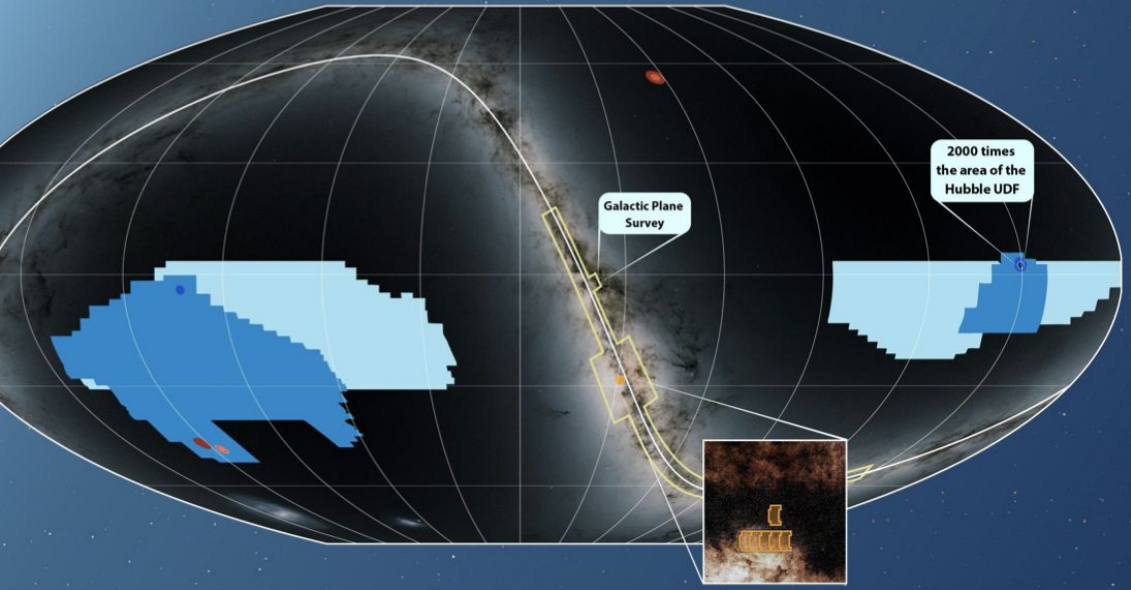


ROMAN
SPACE TELESCOPE

Science for All

ROMAN'S EXTENSIVE SURVEYS

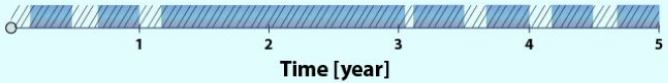
Precise measurements of cosmic expansion
and the growth of cosmic structure

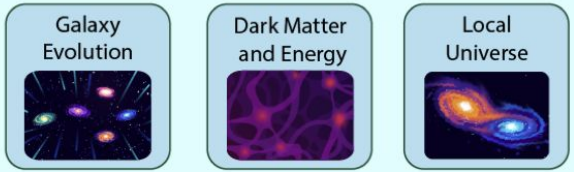


High Latitude Wide Area Survey

Wide ×1 | Deep ×7 + | Medium ×3 + | Ultra Deep ×3

520 days throughout the primary 5-year mission





600 million galaxies with shape measurements over 12% of the sky

Via weak gravitational lensing, galaxy clustering, baryon acoustic oscillations, and redshift-space distortions

Multi-band imaging and spectroscopy enabling studies from solar system objects to galaxy and quasar evolution out to the epoch of reionization

ROMAN SPACE TELESCOPE

High Latitude Wide Area Survey (HLWAS)

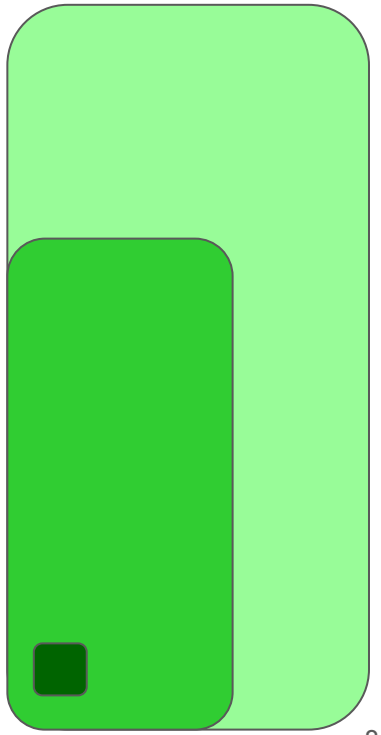
NANCY GRACE ROMAN SPACE TELESCOPE

Three tiers: **Medium**, **Wide**, and **Deep**

Medium (2400 deg^2) tier includes three bands of imaging (YJH) and grism spectroscopy. This allows detailed calibration of weak lensing measurements and a wide-area redshift survey, plus many astrophysical applications.

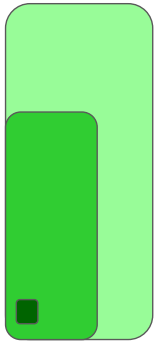
Wide (2700 deg^2) tier provides additional imaging area in a single band (H) for both cosmology and general astrophysics. Numerous community inputs advocated for a very wide-field survey.

Deep (20 deg^2) tier provides essential calibration of the **Medium** and **Wide** tiers. Includes multiple bands (WZYJHFK) and grism spectra, plus a **5 deg^2** region with **ultra-deep** YJH imaging.



W, Z, Y, J, H, F, K filters refer to Roman F146, F087, F106, F129, F158, F184, F213 filters, respectively.

High Latitude Wide Area Survey (HLWAS)



NANCY GRACE ROMAN SPACE TELESCOPE

In-Guide Survey Breakdown				
Name	Area & Filters	Exposure times	Depth	Survey yields
Wide	2702 deg^2 H	2x3x107 s (H)	26.2 (H)	n_{eff} = 26.7 arcmin^{-2} N_{shape} = 260M
Medium	2415 deg^2 YJH + Grism	2x3x107 s (YJH) 4x2x190 s (Grism)	26.5 (Y) / 26.4 (JH) 1.5x10^{-16} (Grism)	n_{eff} = 41.3 arcmin^{-2} N_{shape} = 360M N_{spec} = 19.1M (total) 9.3M (z=1-2) 1.7M (z=2-3) n_{spec}=9.8x10$^{-4}h^3$Mpc^{-3}
Deep	19.2 deg^2 WZYJHFK + Grism	+5x3x295 s (WZYJHFK) +36x2x190 s (Grism)	27.7 (ZY) / 27.6 (J) / 27.5 (H) / 27.0 (F) / 25.9 (K) / 28.3 (W) 5.8x10^{-17} (Grism)	(for calibration)
Ultra Deep	5 deg^2 YJH	+10x3x295 s (YJH)	28.2 (YJ) / 28.1 (H)	(for calibration)

Survey yields:

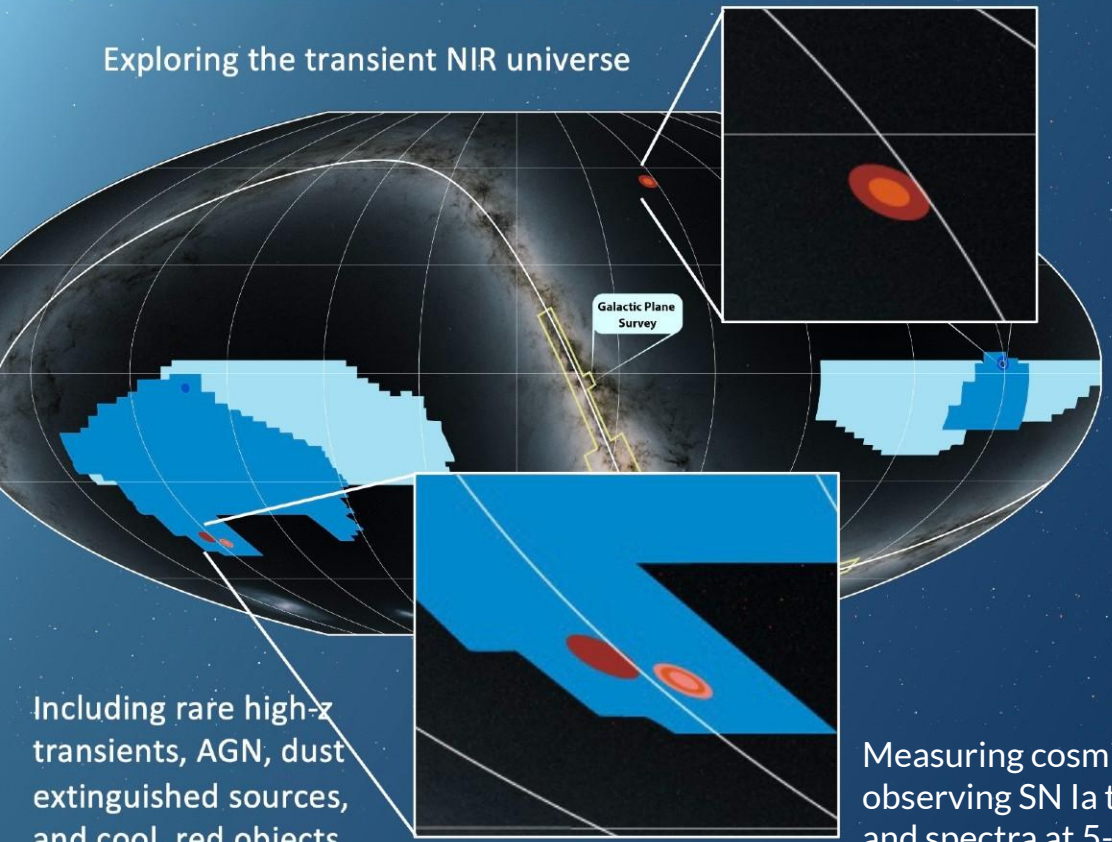
> 600M galaxies with shape measurements

> 19M galaxies with spectroscopic redshifts

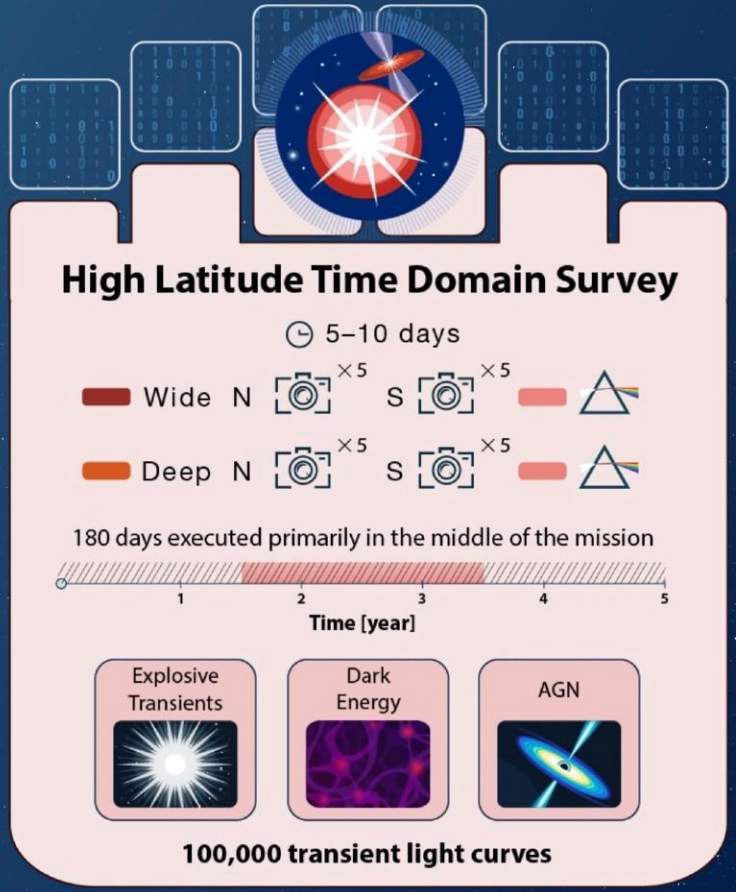
Science for All

ROMAN'S EXTENSIVE SURVEYS

Exploring the transient NIR universe



Including rare high-z transients, AGN, dust extinguished sources, and cool, red objects

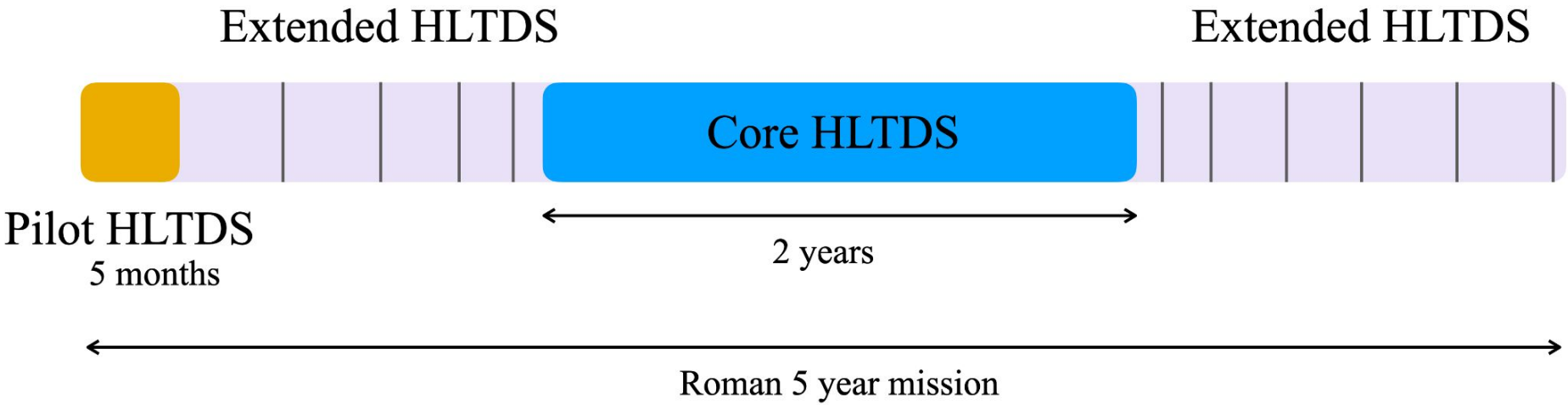


Measuring cosmic expansion and dark energy by observing SN Ia to z > 2.5, with color information and spectra at 5-day cadence over two years

ROMAN SPACE TELESCOPE

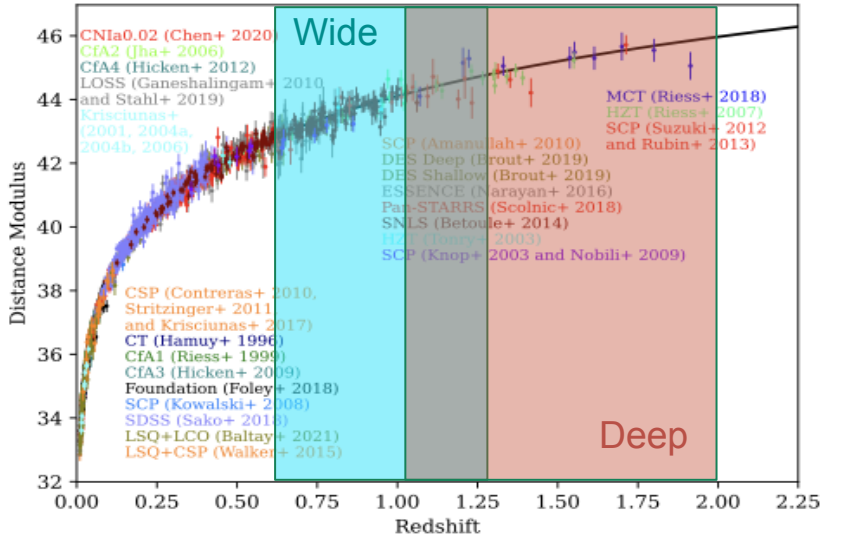
High Latitude Time Domain Survey (HLTDS)

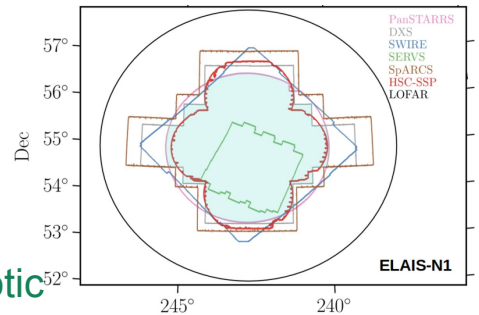
3 Components:



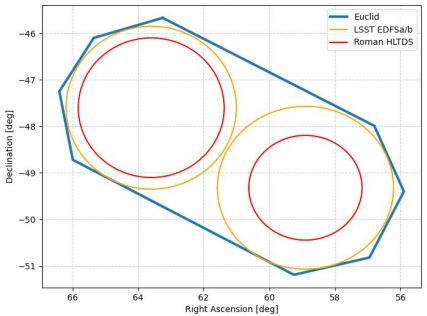
High Latitude Time Domain Survey (HLTDS)

- **Core Component** (158 days)
  - Imaging (78%)
    - SN Ia: z ~ 0.9 (Wide), z ~ 1.7 (Deep)
    - 10-day interlaced cadence
      - RZJ / RYH Wide
      - ZYH / ZJF Deep
  - Prism spectroscopy (22%)
    - 5-day cadence in Deep Imaging
    - 900 sec, 3600 sec exposures
- **Pilot Component** (15 days)
  - 8 visits to all imaging and prism fields in first ~5 months of Roman.
  - Templates & other Core Component preparation, and early science.
- **Extended Component** (7 days)
  - 8 visits to Deep Imaging fields before and after Core Component.
  - Long-term monitoring of high-redshift, exotic transients.





ELAIS-N1

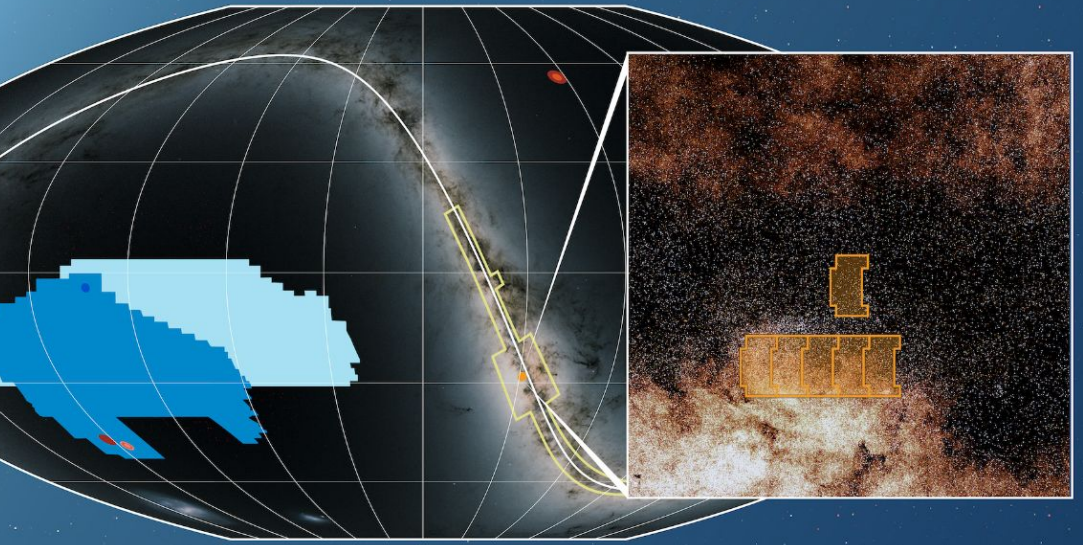


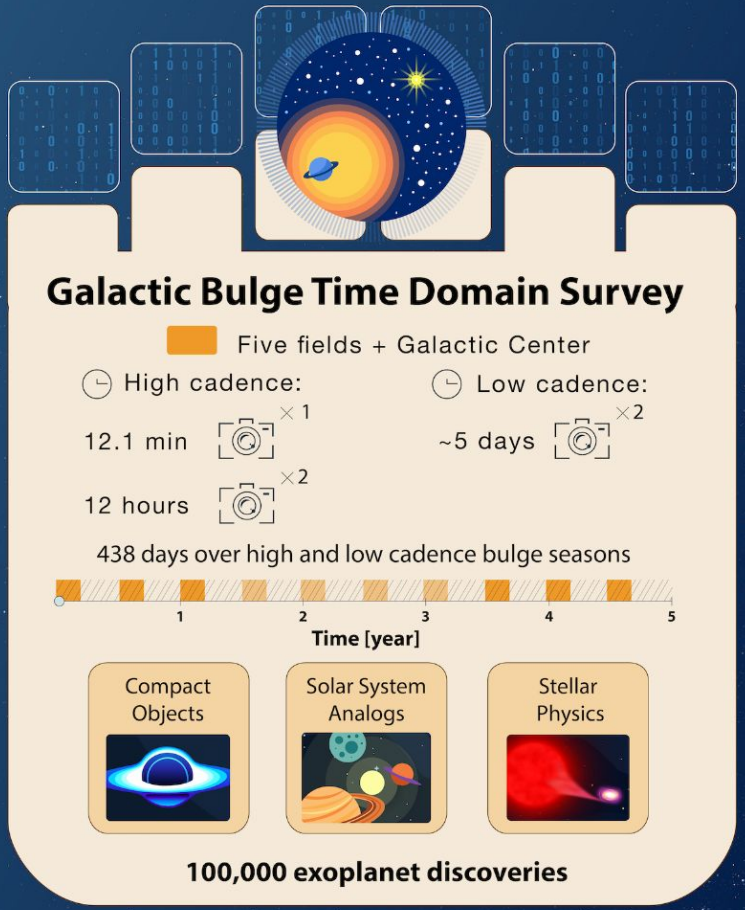
EDFS

Science for All

ROMAN'S EXTENSIVE SURVEYS

High plus low cadence seasons maximize scientific yield





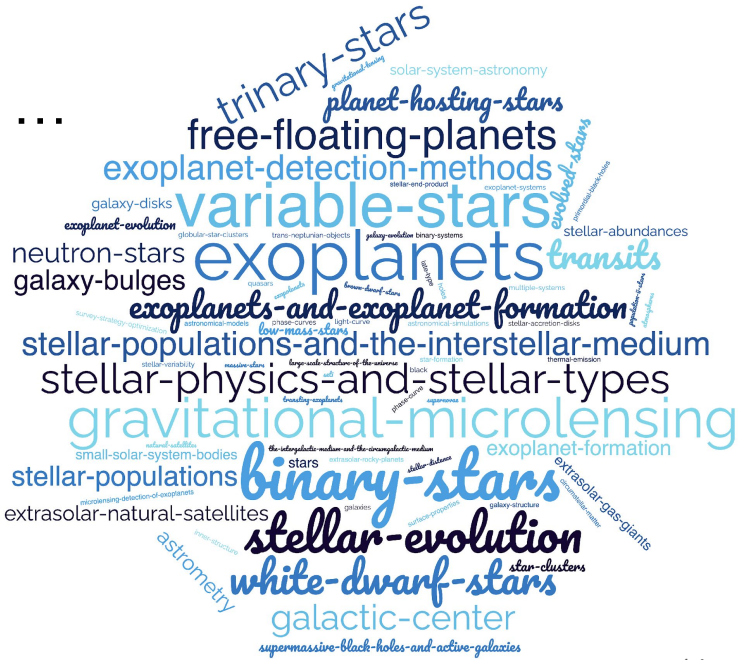
Enabling microlensing detections from scales of solar system analogues to stellar mass black holes, and detection > 100,000 transiting exoplanets

Advancing stellar and Galactic astrophysics via red giant asteroseismology, monitoring Sgr A*, and studies of compact objects

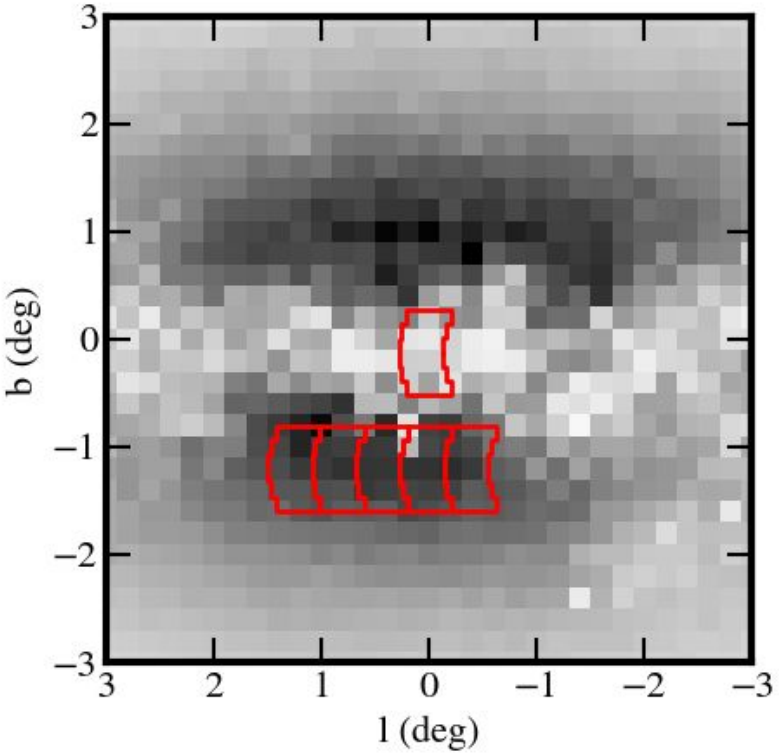
ROMAN SPACE TELESCOPE

Galactic Bulge Time Domain Survey (GBTDS)

- **High-cadence seasons:** exoplanet microlensing (Level 1 requirement), transiting exoplanets, asteroseismology, Galactic Center populations, stellar flares, …
- **Low-cadence seasons:** black hole microlensing, long-period variables
- **Photometric snapshots:** stellar colors, extinction
- **Grism snapshots:** stellar properties, kinematics, binary stars



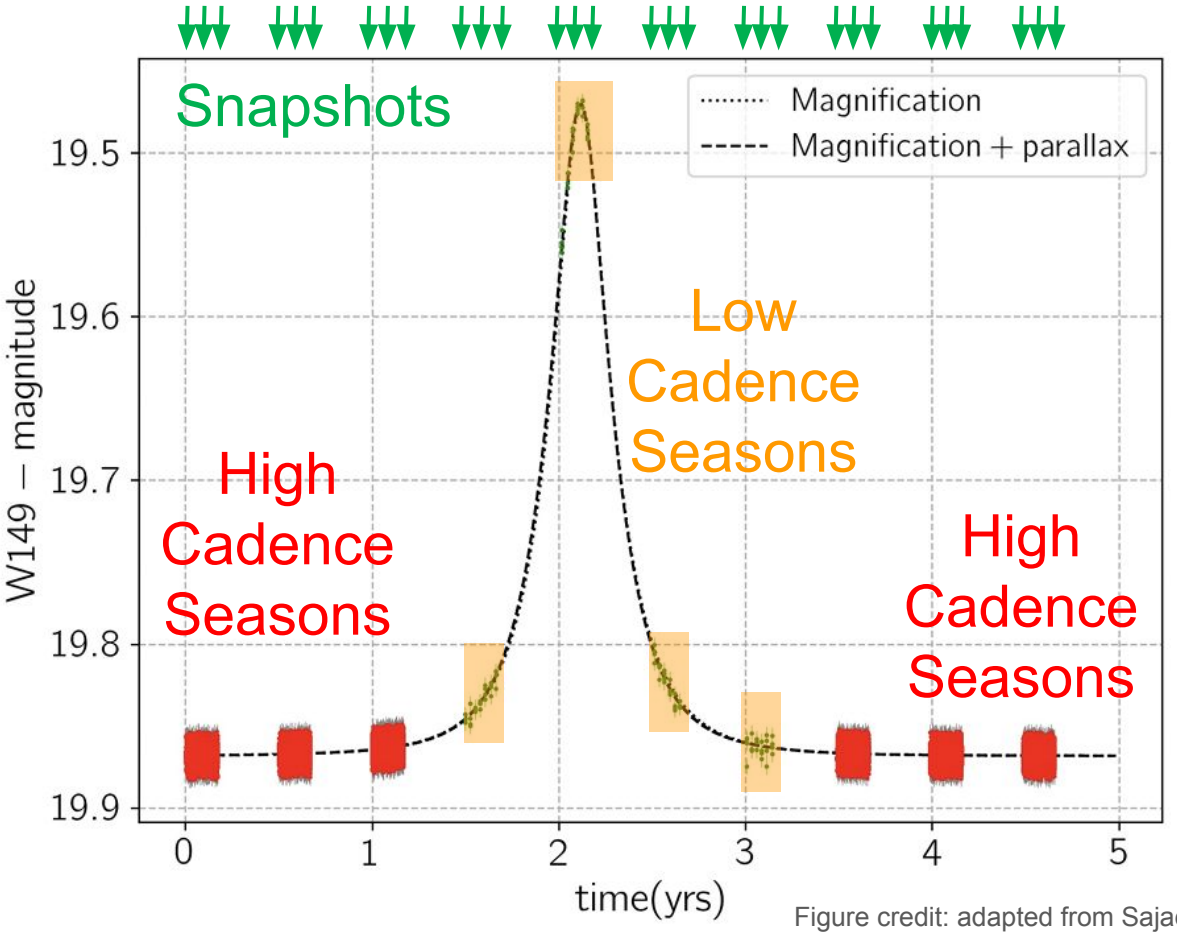
Galactic Bulge Time Domain Survey (GBTDS)



4 Components

- 6 × 70.5 day **high-cadence seasons**
  - first & last 3 bulge seasons
  - 5 fields + Galactic Center
  - 12.1 min cadence
  - wide F146 filter, 67 sec exptime
  - F087 and F213 at 12 hr cadence
- 4 **low-cadence seasons**
  - 5 day cadence (to accommodate HLTDS scheduling constraints)
- 30 **photometric snapshots** (5 filters)
- 30 **grism snapshots**

Galactic Bulge Time Domain Survey (GBTDS)



Total Survey Duration: 438 days

~423 days

~6 days

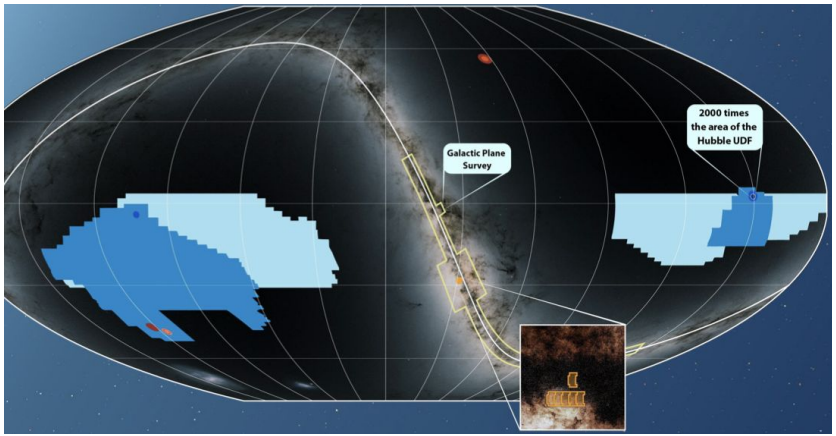
~9 days

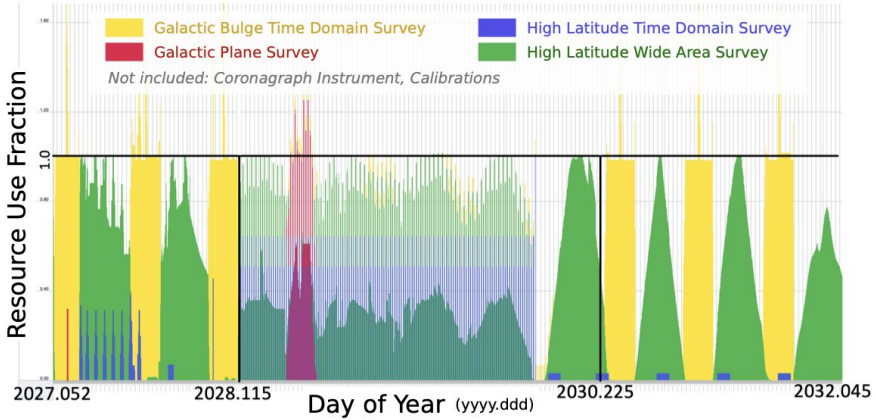
2 days during first season reserved for GPS

Figure credit: adapted from Sajadian & Sahu (2023) + CCS White Paper

General Astrophysics Surveys

- ROTAC saw its role as stewards of the highly-valued GAS time (in accord with CAA report)
- 389 days available for General Astrophysics Surveys (25.5% of prime mission science time)
  - Including the ~30 day early-definition **Galactic Plane Survey**





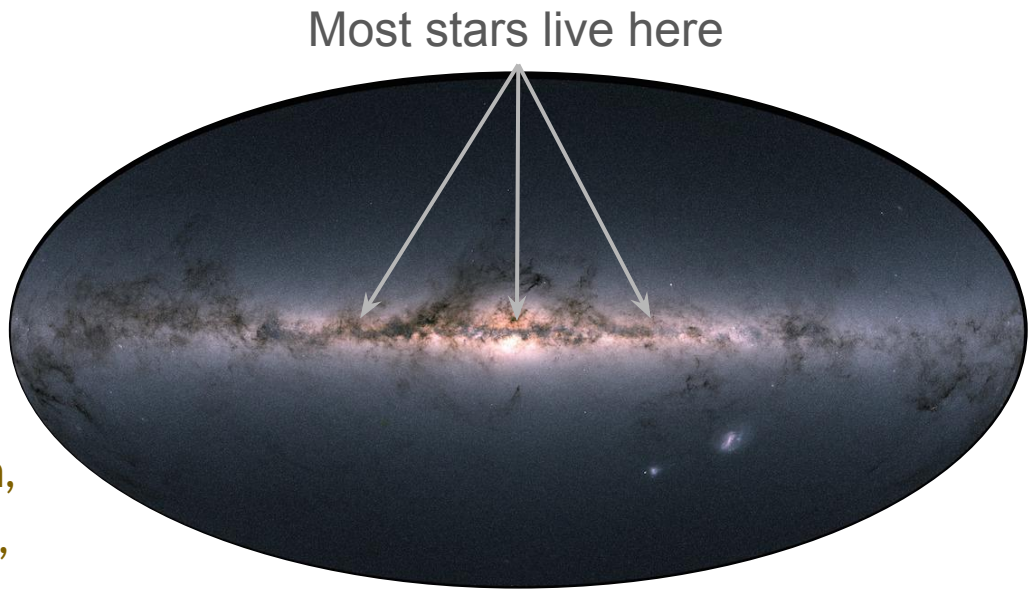
GAS #1: Galactic Plane Survey

Galaxy studies: Milky Way structure, Galactic dynamics, far side of the Galaxy

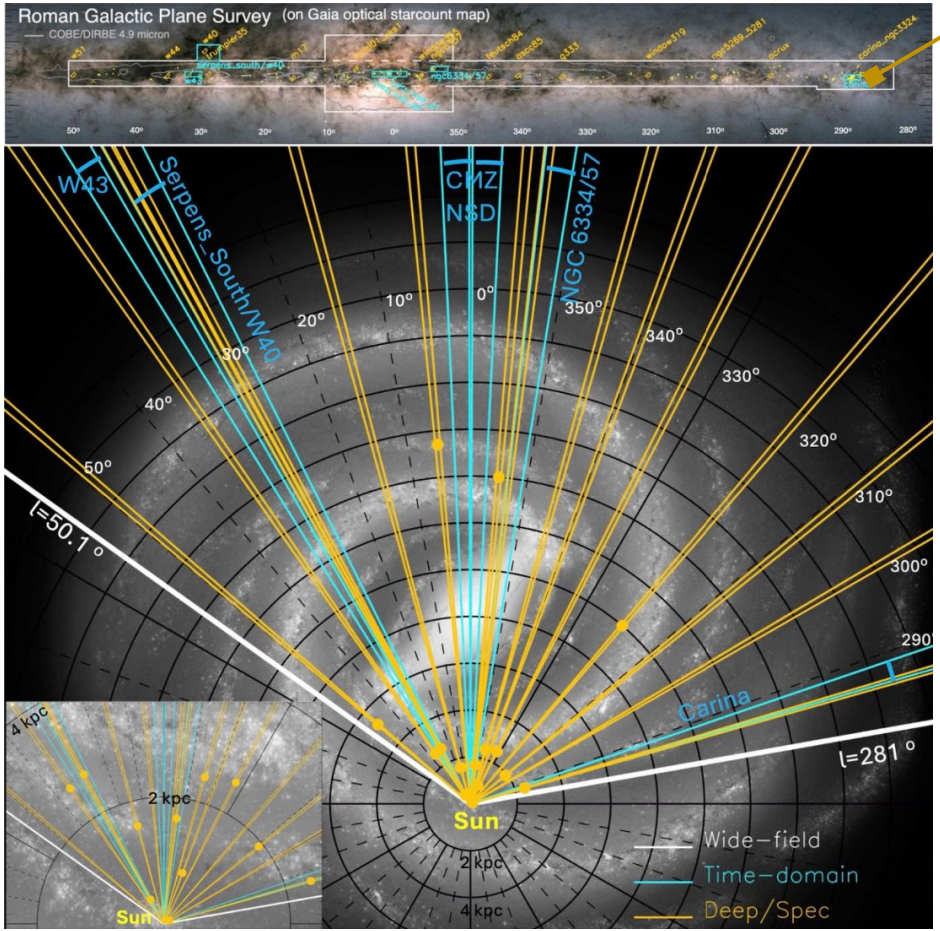
Stars & stellar physics: Low-mass stars, star clusters, brown dwarfs, eruptive stars, variable stars of all ages, compact objects

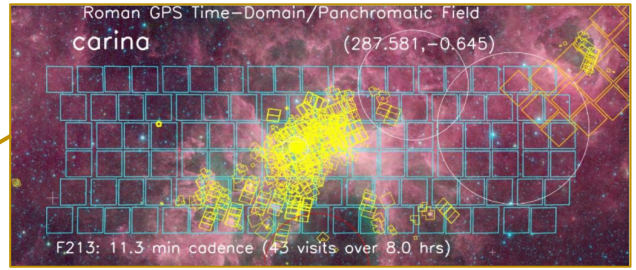
Stellar/planetary systems: Star formation, microlensing, solar system demographics, free-floating planets

Interstellar medium: dust, extinction curves, stellar nurseries



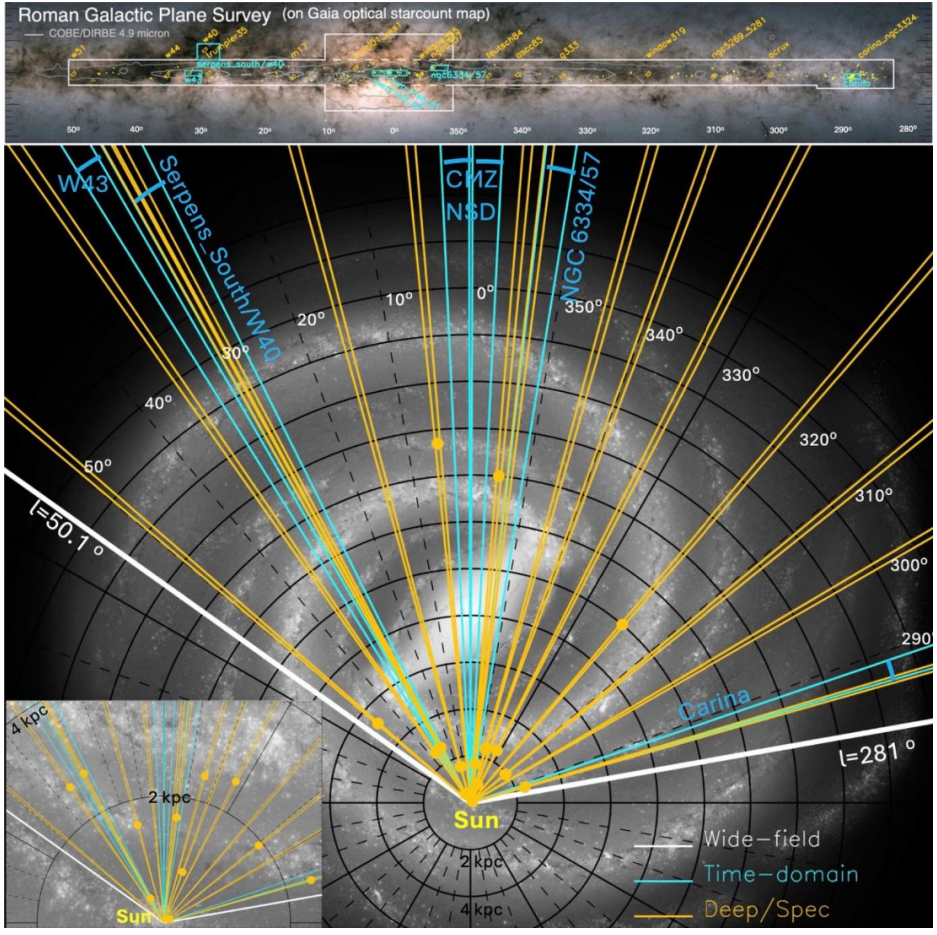
GAS #1: Galactic Plane Survey





- **Wide-field**: 3-4 filter imaging of a contiguous 691 deg^2 of the disk and bar/bulge
- **Time-domain:** Repeat observations in 1+ filters with cadences from 11 min to several weeks, in 19 deg^2 of carefully selected fields
- **Deep-field/spectra:** Deep, 7-filter imaging and grism+prism spectra in 4 deg^2

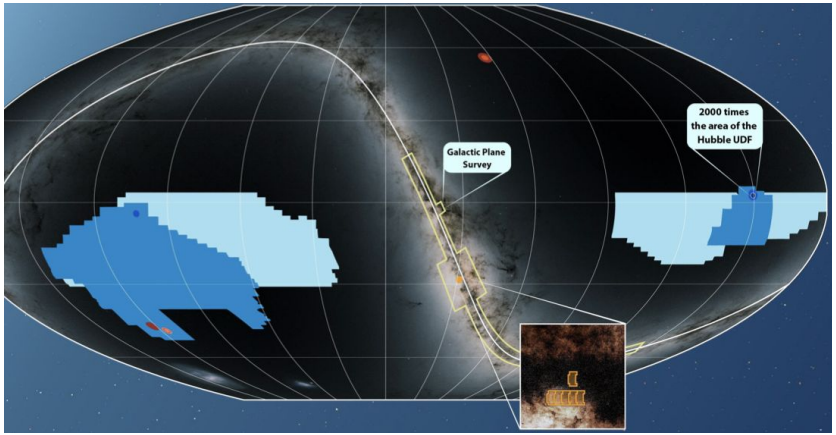
GAS #1: Galactic Plane Survey

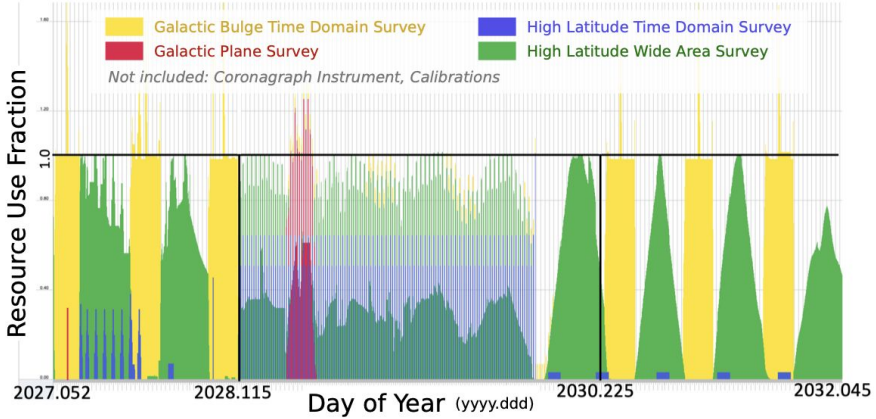


	Hours	Percent	Filters/Cadence*
Wide-Field Science	**540.65**	**77.2%**	
Disk	382.18	54.6%	**F129**,F158,F184,**F213**
Disk_Carina	44.43	6.3%	**F129**,F158,F184,**F213**
Bulge_Bpos	52.27	7.5%	**F129**,F158,**F213**
Bulge_Bneg	51.94	7.4%	**F129**,F158,**F213**
Serpens_South	9.83	1.4%	F106,**F129**,F158,F184,**F213**
Time-Domain Science	**129.52**	**18.5%**	
TDS_Carina	11.89	1.7%	F213 (min)+F062.F087,F106,F129
TDS_NGC6334_6357	11.89	1.7%	F213 (min)+F062,F087,F106,F129
TDS_Galactic_Center_Q4	39.04	5.6%	F213 (min/hrs/wks)+F129 (wks) + F062,F087,F106,F129
TDS_Galactic_Center_Q1	39.04	5.6%	F213 (min/hrs/wks)+F129 (wks) + F062,F087,F106,F129
TDS_Serpens_South_W40	14.86	2.1%	F213 (hrs) (+F106,F129,F158,F184,F213 from Wide Field Science)
TDS_W43	12.80	1.8%	F184 (min)+ F062,F087,F106,F129,F213
Deep/Spectroscopic Science¶	**30.80**	**4.4%**	
Deep_NGC_3324_Carina	1.79	0.3%	All filters deep, grism,prism
Deep_Acrux	1.79	0.3%	All filters deep, grism,prism
Deep_NGC_5269_5281	1.79	0.3%	All filters deep, grism,prism
Deep_Window_319.5-0.2	1.79	0.3%	All filters deep, grism,prism
Deep_G333	1.79	0.3%	All filters deep, grism,prism
Deep_ASCC_85	1.79	0.3%	All filters deep, grism,prism
Deep_Teutsch_84	1.79	0.3%	All filters deep, grism,prism
Deep_NGC_6357_Lobster	1.79	0.3%	All filters deep, grism,prism
Deep_Window_355.0-0.3	1.79	0.3%	All filters deep, grism,prism
Deep_VVV-CL001_UKS_1	1.79	0.3%	All filters deep, grism,prism
Deep_M17_Omega	1.79	0.3%	All filters deep, grism,prism
Deep_Trumpler_35	1.79	0.3%	All filters deep, grism,prism
Deep_W40	5.74	0.8%	Very Deep F129,F158,F213, prism
Deep_W44	1.79	0.3%	All filters deep, grism,prism
Deep_W51	1.79	0.3%	All filters deep, grism,prism
TOTAL	**700.97**	**100.1%**	

General Astrophysics Surveys

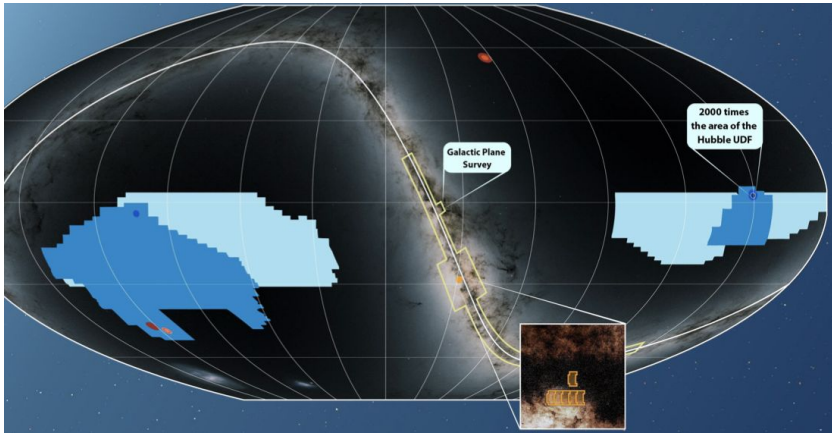
- ROTAC saw its role as stewards of the highly-valued GAS time (in accord with CAA report)
- 389 days available for General Astrophysics Surveys (25.5% of prime mission science time)
  - Including the ~30 day early-definition Galactic Plane Survey
- Up to 30 GAS selected over several proposal calls (first proposals anticipated due March 2026)
  - GAS proposals likely in Cycles 1, 3, and 4; selection will be weighted towards later calls, due to high demand for early-mission time, as well as learning from observatory performance and data
- The community is encouraged to organize and design large GAS proposals with broad science goals, including those complementary to or building on the CCS
- We anticipate GAS to comprise a larger fraction of the schedule in an extended mission, but the community should evaluate this as the science returns from early observations become known





General Astrophysics Surveys

- ROTAC saw its role as stewards of the highly-valued GAS time (in accord with CAA report)
- 389 days available for General Astrophysics Surveys (25.5% of prime mission science time)
  - Including the ~30 day early-definition Galactic Plane Survey
- Up to 30 GAS selected over several proposal calls (first proposals anticipated due March 2026)
  - GAS proposals likely in Cycles 1, 3, and 4; selection will be weighted towards later calls, due to high demand for early-mission time, as well as learning from observatory performance and data
- The community is encouraged to organize and design large GAS proposals with broad science goals, including those complementary to or building on the CCS
- We anticipate GAS to comprise a larger fraction of the schedule in an extended mission, but the community should evaluate this as the science returns from early observations become known



Roman Cycle 1:

- Funding for
  - Analysis of Roman data
  - Analysis of relevant ground-based data
  - Theory studies
- Limited number of new GAS

Roman Prime Mission: Summary

The community-driven CCS+GAS design allows Roman to address the most compelling questions in exoplanet demographics & cosmology while enabling a broad range of general astrophysics investigations, featuring fully public data. The science portfolio of NASA's next flagship observatory will be altogether transformative.