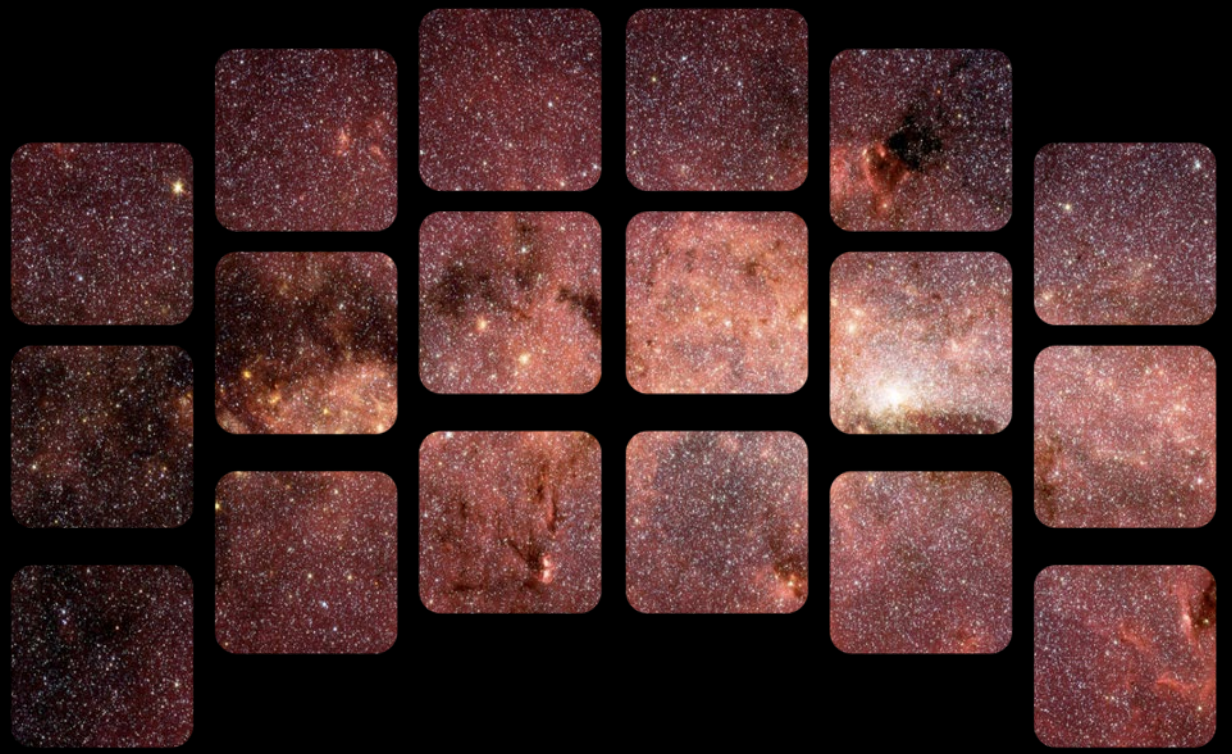
# Project Status

Julie McEnery
Roman Senior Project Scientist



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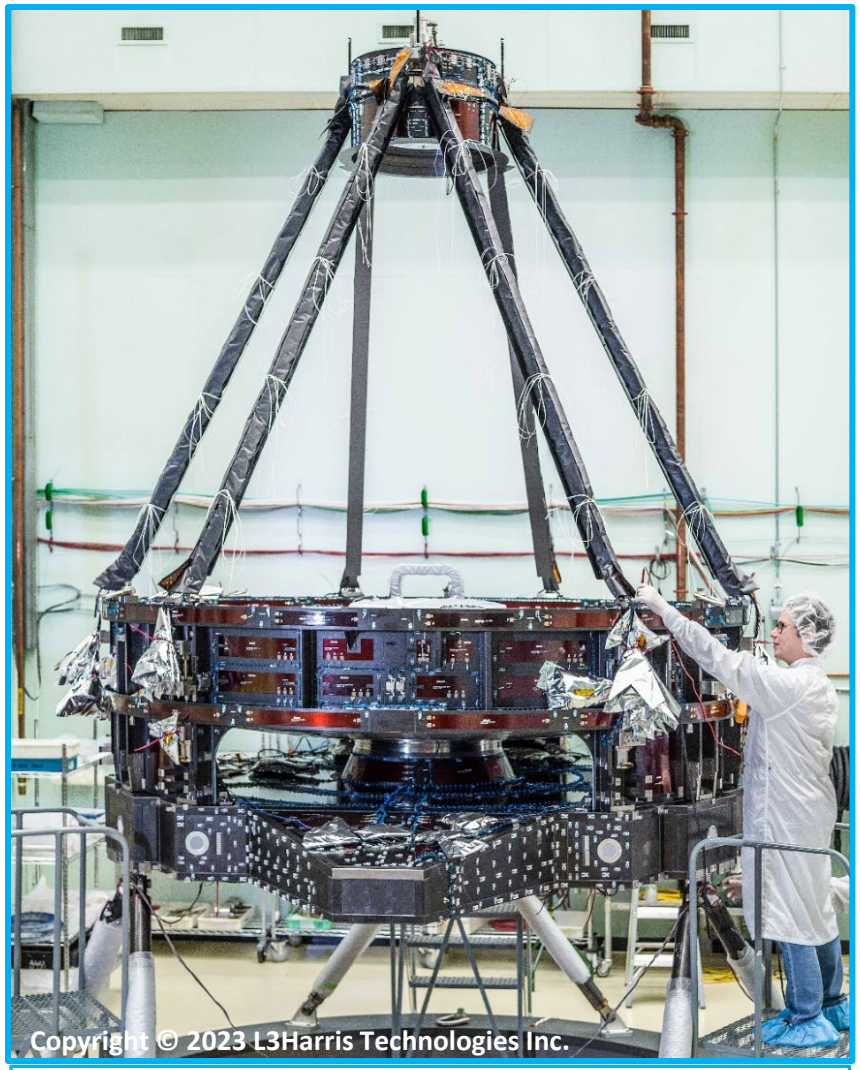
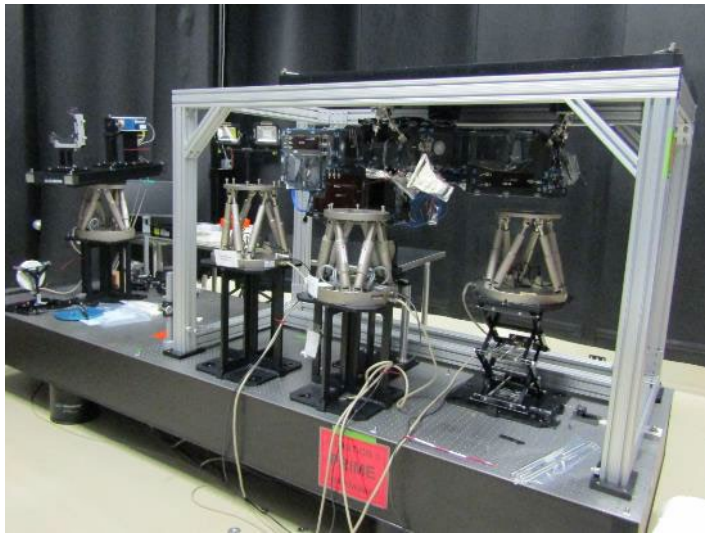
# Mission Hardware Status




Forward Structure Assembly (FSA) successfully integrated to Primary Mirror Assembly (PMA)
✯ Heritage Hardware Complete ✯



Tertiary Optical Mirror Assembly (TOMA) Mirror Integration and Alignment. Enhanced the Tip Tilt Fold Assembly (TTFA) actuator to comply with GSFC standard practice

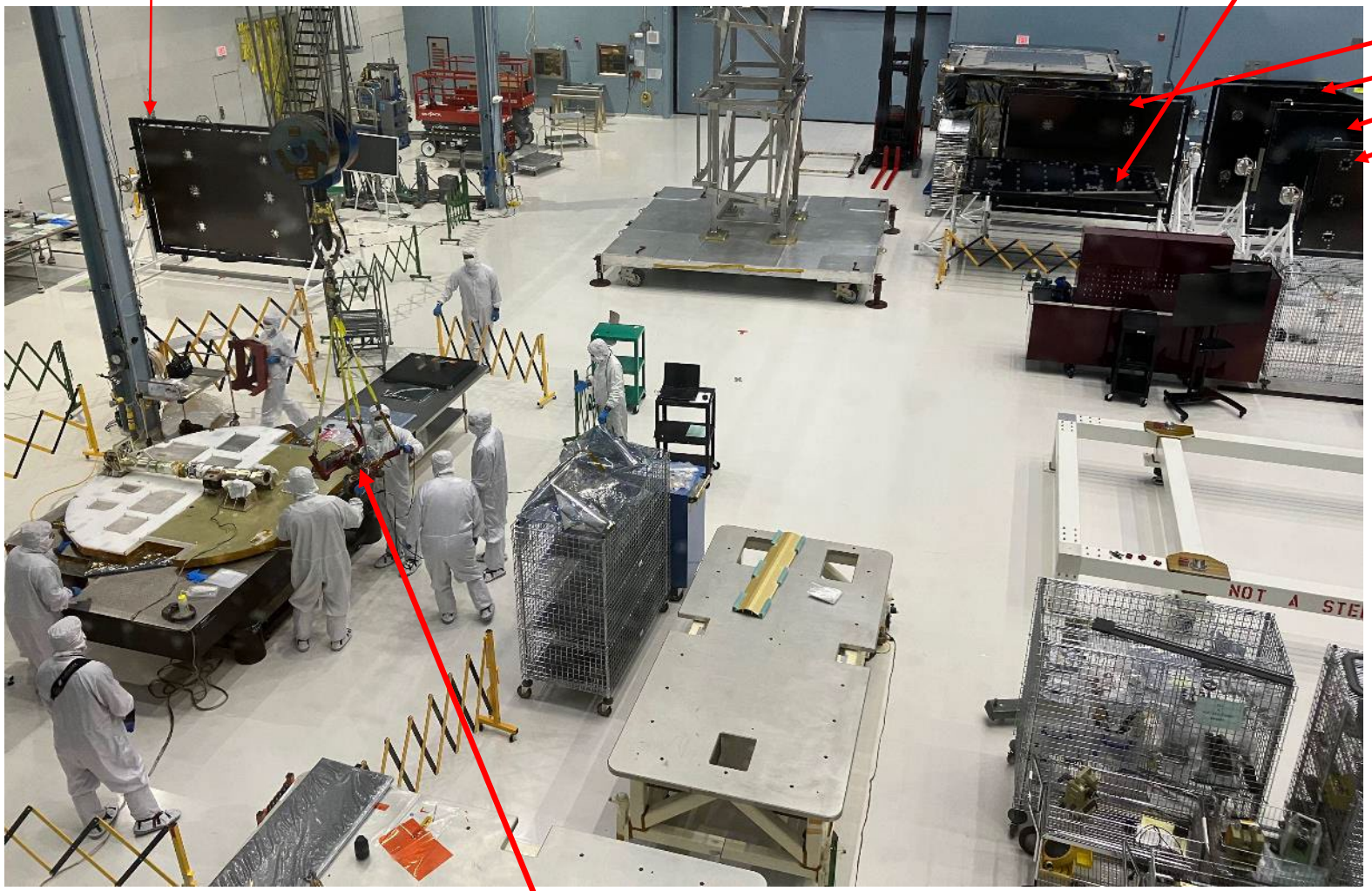

Telescope Control Electronics (TCE) Module Complete

## Optical Telescope Assembly

# Mission Hardware Status

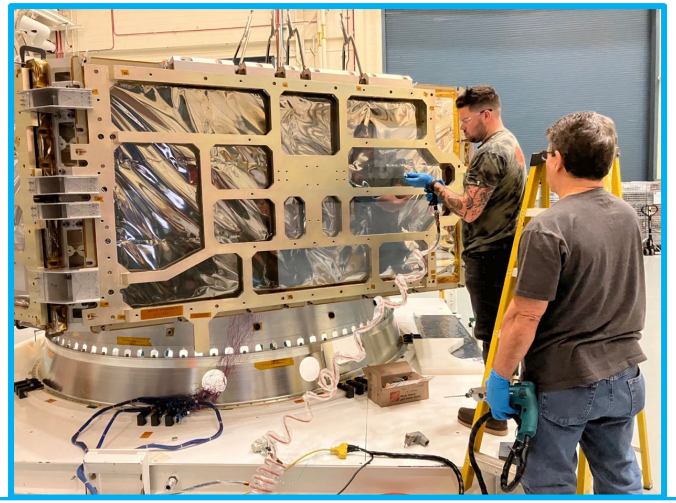
Flight SASS panel substrate (6th of 6)

Flight SASS panel substrate (5th of 6) - horizontal



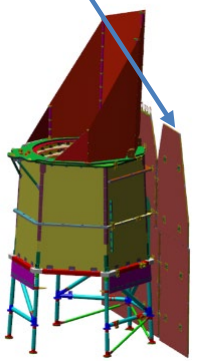
Gimbal actuator Flight assembly being lifted onto the High Gain Antenna System (HGAS) Communication Panel for a fit check prior to match drilling

Flight SASS panel substrates (4 of 6) - blanket and harness mounts nearly complete - ready for cell laydown at vendor in January 2023



Match drilling of bus to avionics panels in B.29 High Bay

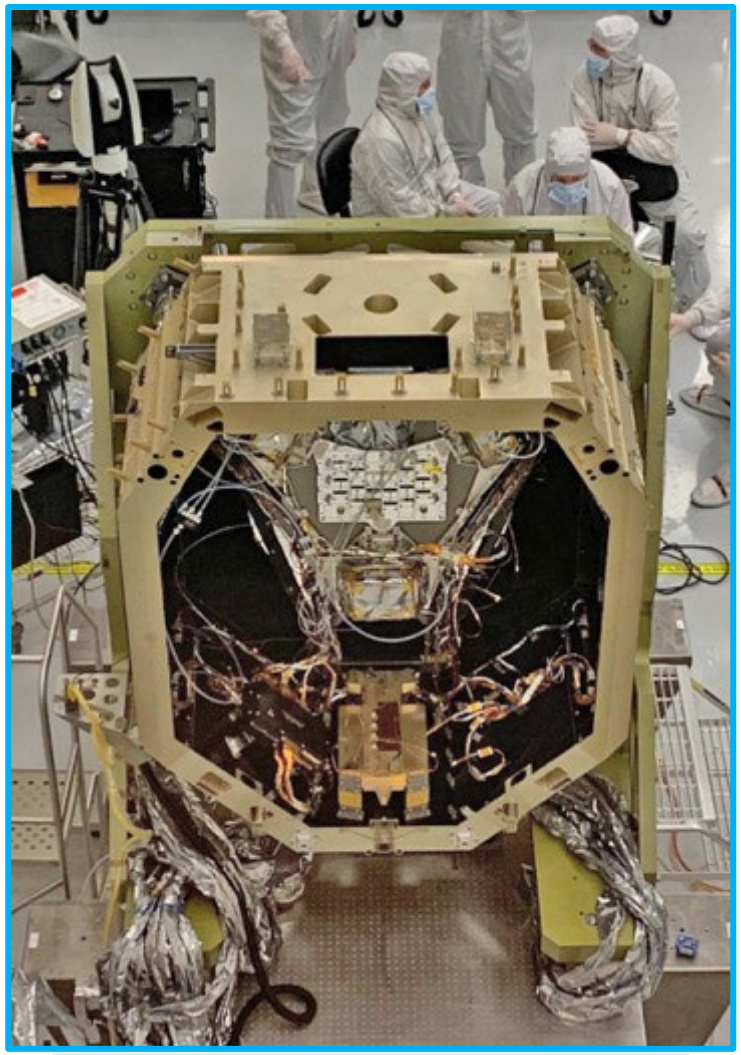
SASS



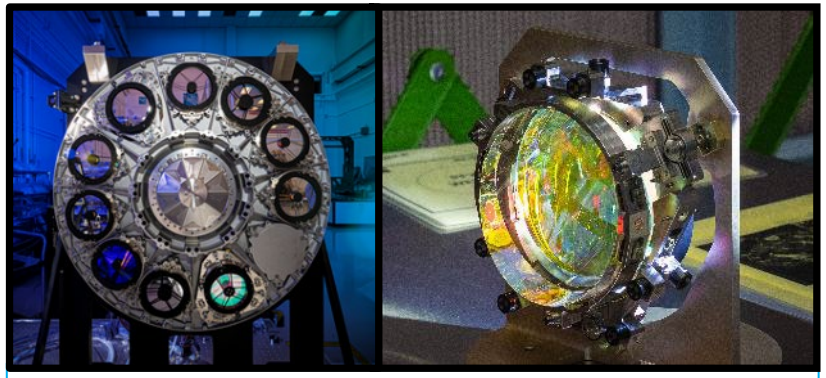
**Solar Array Sun Shield (SASS)**
Shown on Observatory – see right

## Spacecraft

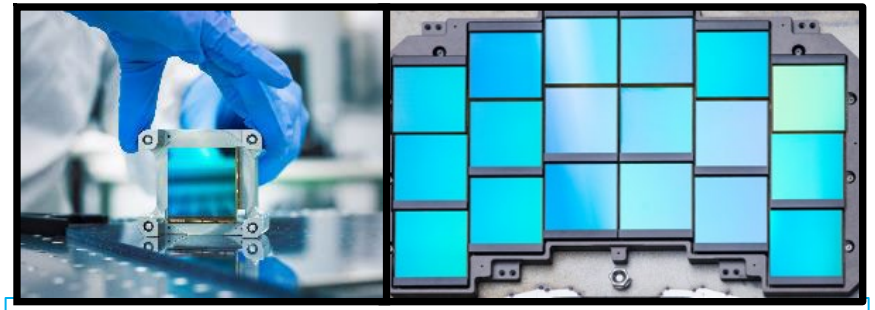
# Mission Hardware Status



WFI Cold Module integration continues with the addition of the sRCS



The Wide flight Element Wheel Assembly (EWA) is complete, installed, and aligned in the instrument at Ball

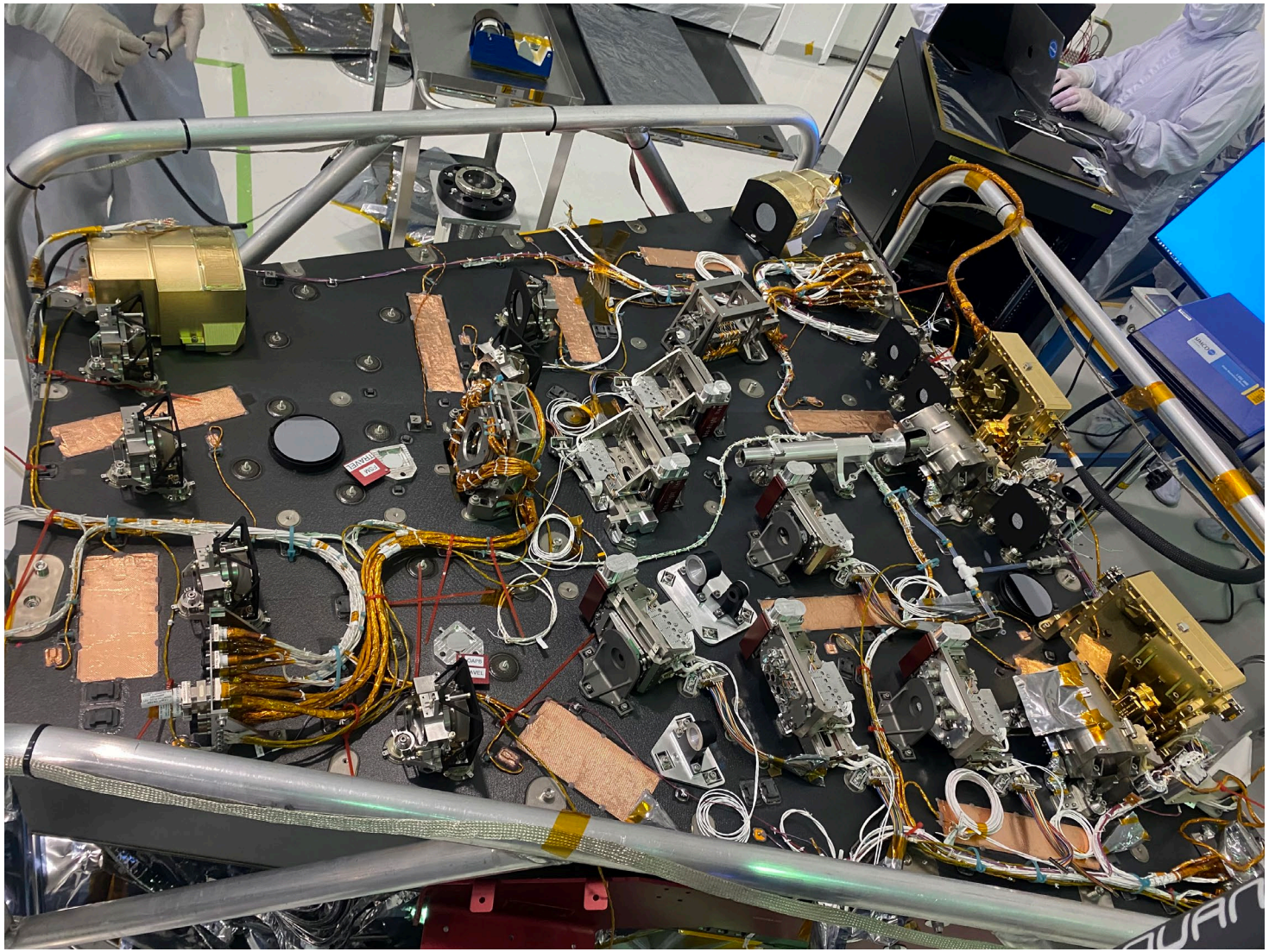


The flight Focal Plane Assembly is reassembled and aligned following replacement of 3 detectors. ARB to study root cause of performance changes in those detectors. Focal Plane Electronics ready in late March. System delivery in Spring 2023

## Wide Field Instrument

# Coronagraph Instrument Status

- < 1 year to instrument delivery
  - All flight hardware @ JPL
- Optics  bench fully populated
  - Alignment of several mirrors adjusted to substantially increase margin on deformable mirror stroke
- Predicted performance: ~80% margin on our L1 requirement
- Work underway to prepare test plans and *some* equipment for commissioning modes beyond the required one
  - higher performance imaging, spectroscopy, polarimetry



# Budget and Schedule

- **No change to launch readiness date or budget since last APAC meeting**

- **Completed replan and optimization of the integration and testing flow at higher levels of assembly across the project, to address schedule challenges through Dec 2022**
  - Resulted in healthy schedule margin to our planned launch date (Oct 2026)

# Three Paths for Community Engagement with Roman

- **Help define and shape core community surveys**
  - Submit science pitch and/or white paper for Core Community Survey definition
    - Science pitch – few paragraphs describing science case for one of the community surveys, short questionnaire on survey parameters
      - Deadline 17 Feb 2023, low bar to entry to encourage high participation
    - White papers – several page document with details on science case, sketch of survey design and methods/metrics on how to evaluate science metric against survey parameters
      - Deadline summer, detail enables more meaningful evaluation

- **Actively engage with mission partners and science community**
  - Join Roman Technical Working Groups
    - Groups pursing topics of interest across many science areas
      - Two groups currently (calibration, software) but will add more after ROSES proposal selection
    - Simple web sign up page, rolling deadline, open to all
  - Plan to form community-led science collaborations later this year

- **Obtain funding to prepare for and enhance Roman Science**
  - Submit proposal to Roman ROSES solicitation
    - Funding to work on Roman science preparation (including engagement in technical working groups and survey definition)
    - Proposal deadline March 21 2023; another opportunity in 2025

# Project Infrastructure Teams

- The APAC requests additional conversations with Roman regarding the stand-up of infrastructure teams, especially those with focus on pipeline and user-tool software architectures

- Proposal deadline was March 21, anticipate team selection by Summer
  - Since we haven't yet reviewed the proposals and selected the teams, we can't yet talk about specifics

- However, it is useful to discuss coordination of pipeline and software development

# Roman pipelines and software

- **Science centers – SOC@STScI and SSC@IPAC are responsible for production pipelines, user tools and associated architecture**

- **The SOC and SSC jointly run the Roman software and pipelines working group**
  - Open to Roman science community

# Response to CAA report on Roman Observations

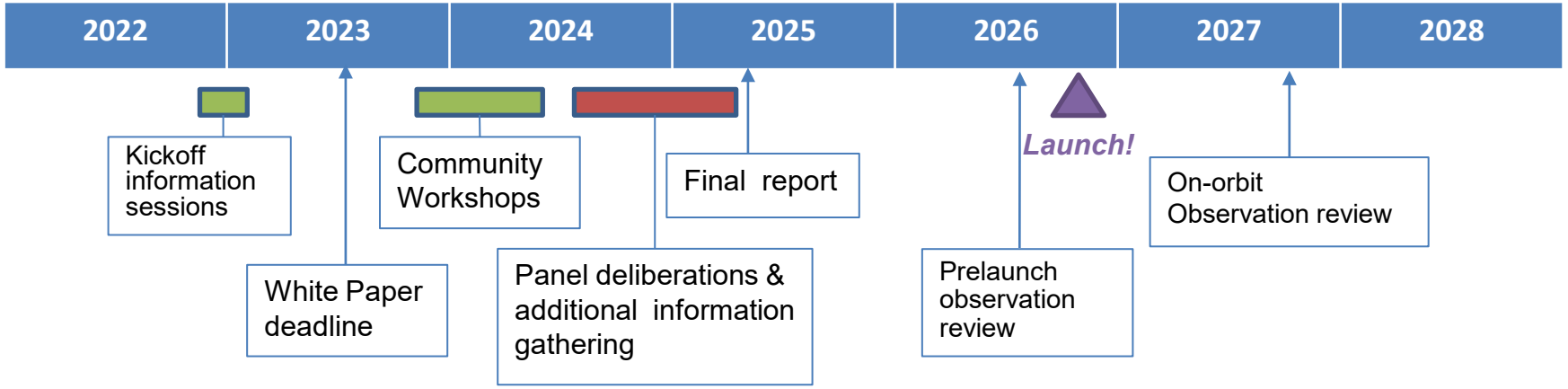
- **Committee of Astronomy and Astrophysics Report on Roman Space Telescope Observations**
  - Provided a set of 10 principles to guide NASA and Roman on the process for assigning mission observing time allocations

- **Some takeaways include**
  - Endorses community led approach to setting Roman observation program
  - Emphasizes importance of competitively balancing/awarding time between each of the three CCS and GA Surveys

- **We agree with the findings and conclusions in the CAA report**
  - The Roman mission (science centers + project) have developed and started implementing a plan to define the core community surveys that builds upon the principles laid out in the CAA report

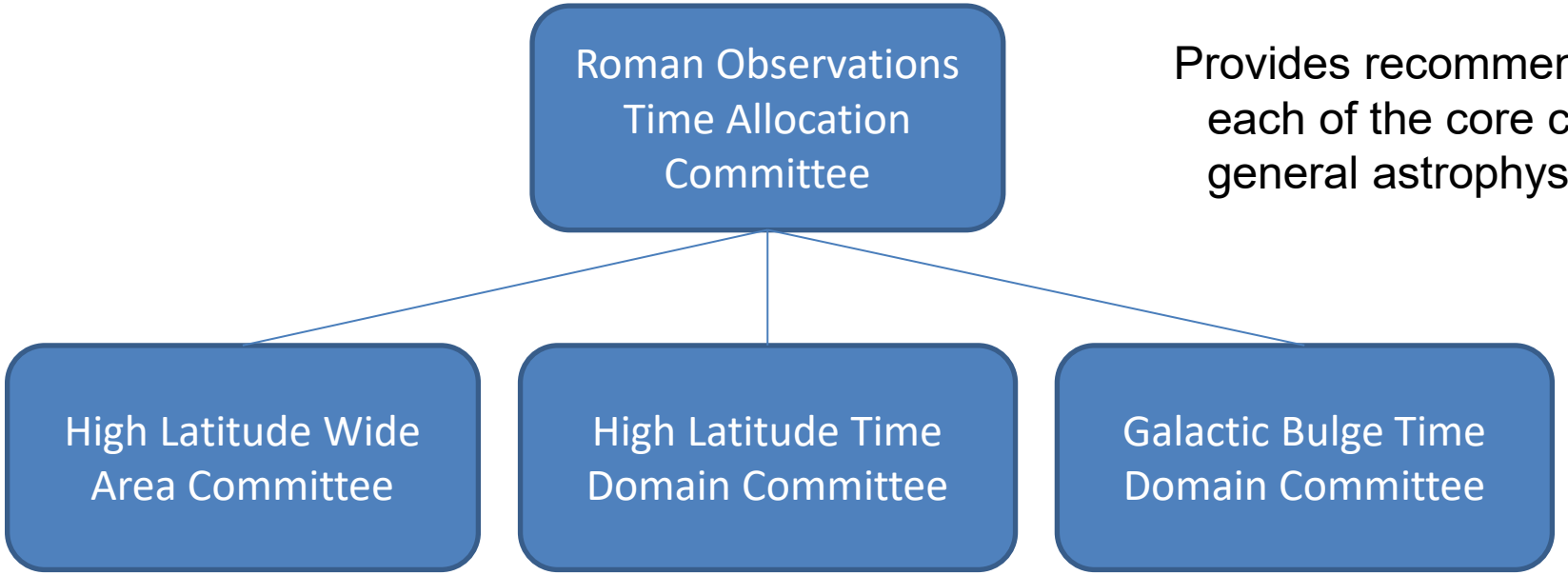
# Community Definition of Core Surveys

- **Workshops to inform community about Roman capabilities**
  - Outline available parameter space for each survey (done!)
- **Science Pitch/White paper call for papers detailing science that can be done with the survey**
  - Submit science pitch and/or white paper for Core Community Survey definition
    - Science pitch – few paragraphs describing science case for one of the community surveys, short questionnaire on survey parameters
      - Deadline 17 Feb 2023, low bar to entry to encourage high participation
    - White papers – several page document with details on science case, sketch of survey design and methods/metrics on how to evaluate science metric against survey parameters
      - Deadline summer, detail enables more meaningful evaluation
- **Additional workshops/information gathering to enable community cooperation and consensus**
  - Provides a forum for iterative development of survey concepts



# Peer process to define and review survey plans

- **Set up and charter a tiered committee structure to do the work of recommending survey definitions based on community input**
  - Committees include representatives of all science areas to be addressed by each survey (determined from white paper submissions etc)

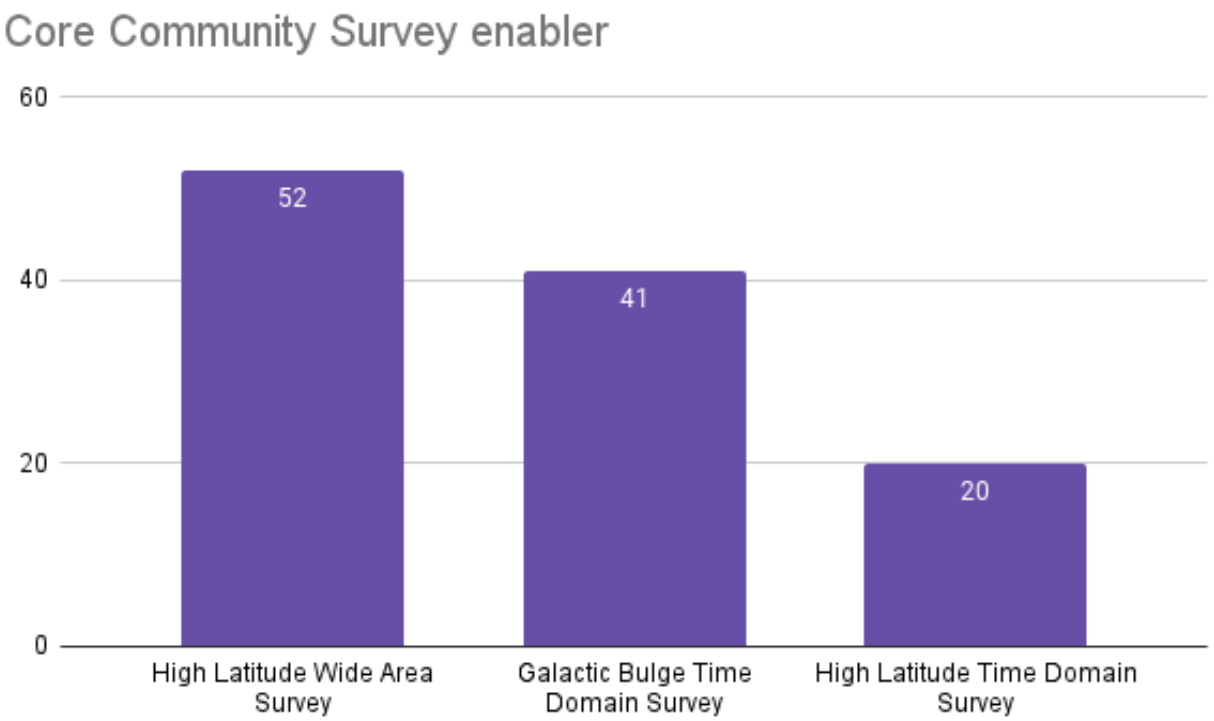



Provides recommendations on balance between each of the core community surveys, and the general astrophysics survey allocation above 25%

Evaluate white papers, solicit additional community input, evaluate survey options against science metrics, produce recommendations for survey with options for enhancements/descopes

# Science Pitches: Demographics

- **113 science pitches received from the astronomical community**
  - 96 unique submitting authors*
  - International response
    - 67 US, 18 Japan, 22 ESA and 6 other (Australia, Canada, Israel)
  - Robust response for all three core community Surveys




** Does not account for overlap (partial or full) in co-authorship*

# Science Pitches: Demographics

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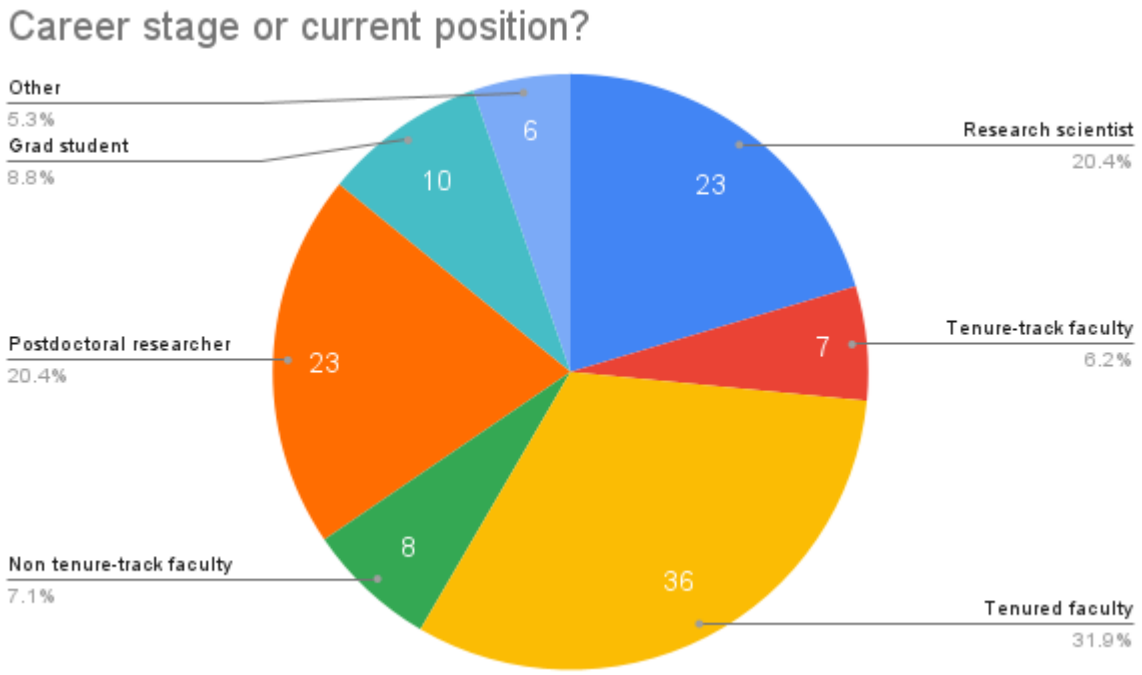
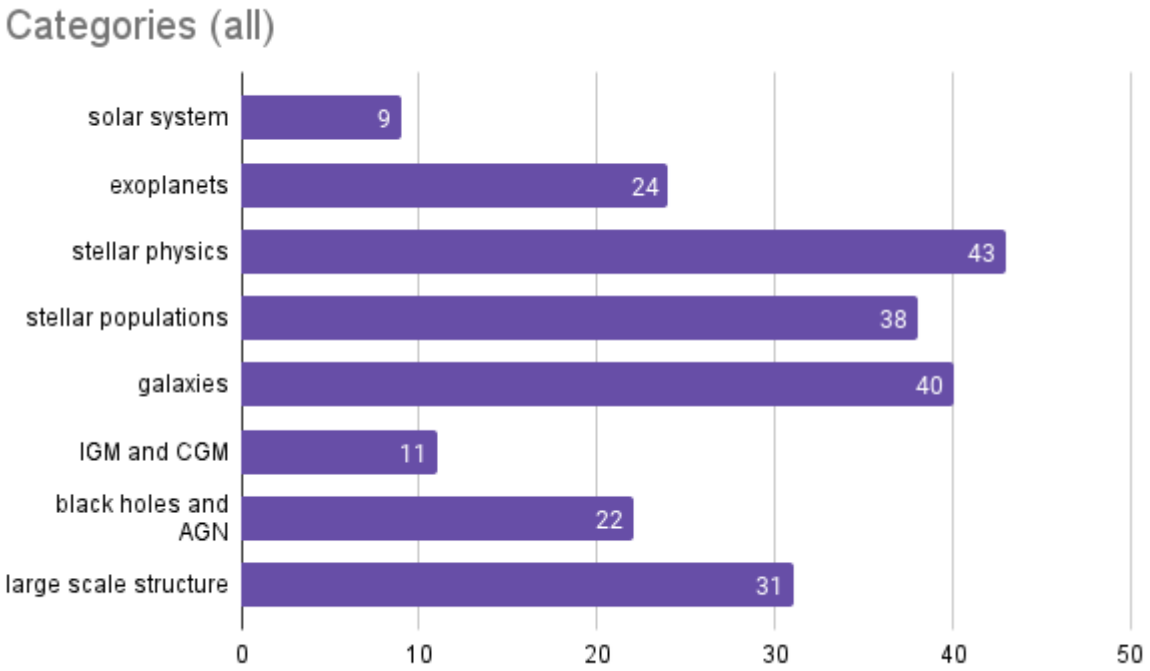
  - International response
    - 67 US, 18 Japan, 22 ESA and 6 other (Australia, Canada, Israel)
  - Robust response for all three core community Surveys
  - Successfully engaged astronomers new to Roman community
  - Successfully engaged junior astronomers
    - 35% of submitting authors graduate students, postdocs, or tenure-track faculty



# Broad Range of Science Topics

## Provided Keywords


## Selected Category



# High Latitude Wide Area Survey: Science Topics

**The HLWA Survey is a wide area (>1700 deg$^2$) multiband survey with slitless spectroscopy.**

- Cosmology and large scale structure
  - IR background
  - galaxy clusters and gravitational lensing
  - IR transients
- Milky Way
  - Galactic structure and history (tidal streams, dwarf satellites, etc.)
  - star formation and stellar evolution (stellar clusters, brown dwarfs, transients)
- Nearby and Distant Galaxies
  - galactic structure (tidal streams, groups and mergers, satellites, etc.)
  - dwarf galaxies
  - precision distance ladders
  - star formation and stellar evolution
  - active galaxies and galay evolution
  - very rare transients, transients with long time baseline variations
- Solar system science
  - minor body discovery/tracking

# Galactic Bulge Time Domain Survey: Science Topics

**The GBTD Survey is ~<15 min cadence observations over few deg$^2$ towards Galactic Bulge for six ~70 day seasons spanning the prime mission phase.**

- Stellar Variability
  - Stellar flares, eclipsing binary stars, cataclysmic variables, x-ray binaries, asteroseismology
- Exoplanets
  - Exoplanet microlensing (and extensions for additional companions, brown dwarfs), exoplanet transits (including transiting planets around white dwarfs, earth-like planets in earth transit zone), exomoons
- Multimessenger Astrophysics
  - White dwarf binaries/LISA counterpart sources
- Stellar populations
  - Astrometry, initial mass function
- Transients
  - Galactic center, XRBs etc
- Compact Object Census
  - Finding isolated black holes and neutron stars via microlensing
- Looking behind the galactic bulge
  - Quasars, supernova (exploring advantages of high cadence observations)
- Synergies with other facilities

# High Latitude Time Domain Survey: Science Topics

**The High Latitude Time Domain Survey provides tiered, multiband time domain observations on timescales of days of 10s deg$^2$ at high latitudes.**

- All types of SNe
- Rare Transients
  - Strongly lensed supernova, tidal disruption events, statistical samples of rare and exotic (Pop III star) supernovae at high *z* (including z>10), fast blue optical transients
- AGN
  - evolution with redshift of AGN dust via dust reverberation mapping, low mass AGN beyond Local Universe, massive black hole binaries
- Galaxy Evolution
  - using survey as a deep field to study cosmic dawn, investigate the bright-end of the UV luminosity function and massive galaxy formation in the early universe at z>10
- Multimessenger Astrophysics
  - kilonova detection
- Milky Way
  - solar system planetary analogs, stellar mass black holes, detecting the stellar pulsation of stars near the tip of the red giant branch to measure distance and identify the edge of the MW's stellar halo, nearby bright stars for joint radial velocity/astrometry

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# Looking Forward

**‘Lessons learned’ relevant to white paper call and targeting future engagement**

- By design (for brevity and simplicity), science pitches capture ideal requirements. White papers will need to switch gears and discuss ‘envelope’ of acceptable survey specifications. *This is not something people are generally used to doing.*

- By design, science pitches are high level. For some, it is not obvious they are feasible within reasonable bounds. White papers will need to illustrate feasibility.

- While breadth of science pitches was excellent, there were a few areas that stood out as potentially under-represented.

# Looking Forward

## A few areas where targeted future engagement may be particularly fruitful:

- Many pitches noted synergies with other facilities: maximizing synergies with existing or future facilities or surveys should be a two-way discussion
  - UV/optical/NIR
    - Subaru, LSST, Euclid, DESI, Kepler and Tess, Zwicky Transient Facility, the La Silla Schmidt Southern Survey, the WAVES spectroscopic survey (with 4MOST), the ISAS/JAXA JASMINE NIR astrometry mission
  - radio:
    - VLA Sky Survey (VLASS), MWA/ASKAP, MeerKAT, and 21-cm surveys with the SKA and the Hydrogen Epoch of Reionization Array (HERA)
  - X-ray: *eROSITA*
  - Other: LISA

*There are likely more synergies at multi-wavelengths than captured, especially radio and X-ray*

# Looking Forward: White Paper Call

**Turn majority of 'maybe' responses into white paper contributions:**

- Provide ample time for white paper creation
  - Targeting a mid-June deadline, with an announcement and updated call circulated ~ end of March
- Make expectations for, and future use of, white papers as clear as possible in call
- Hold a series of topical virtual sessions for targeted back and forth discussion
  - organized by survey and potentially broad science topic
  - advertise broadly and openly while sending targeted invites to relevant pitch authors
  - goals:
    - make connections between researchers interested in similar topics and encourage discussion
    - answer questions, clarify goals of white papers and bounds of surveys

# Roman Coronagraph Instrument

## Discussion of considerations for observations beyond first 18 months

# WFIRST, Roman and Coronagraph History

- **Some history**
  - WFIRST was recommended by Astro2010 as wide field near-IR mission with 5-year prime mission; 2010
  - Added Coronagraph instrument as technology demonstration but treated as science instrument, increased prime mission to 6 years; 2013
  - Descoped Coronagraph Instrument to technology demonstration only, decreased prime mission to 5 years; 3 months reserved for Coronagraph instrument observations within first 18 months; WIETR 2017
  - Descoped IFS from Coronagraph Instrument, replace with Prism; Sept 2019 (pre-PDR)
  - Coronagraph Instrument team directed to focus only on threshold (TTR5) requirements but retain PDR design, change to class D; Feb 2020 KDP-C
    - Following SRB and CGI tiger team recommendations

- **TTR5:** *Roman shall be able to measure brightness of an astrophysical point source w/ SNR ≥ 5 located 6 – 9 λ/D from an adjacent star with VAB ≤ 5, flux ratio ≥ 10-7; bandpass shall have a central wavelength ≤ 600 nm and a bandwidth ≥ 10%.*

# Threshold Technical Requirement 5

| Band | $\lambda_{center}$ | BW | Mode | FOV radius | FOV Coverage | Pol. | Coronagraph Mask Type | TTR5 |
|---|---|---|---|---|---|---|---|---|
| 1 | 575 nm | 10% | Narrow FOV Imaging | 0.14" – 0.45" | 360° | Y | Hybrid Lyot | Y |
| 2 | 660 nm* | 15% | Slit + R~50 Prism Spectroscopy | 0.17" – 0.51" | 2 x 65° | - | Shaped Pupil | - |
| 3 | 730 nm | 15% | Slit + R~50 Prism Spectroscopy | 0.18" – 0.55" | 2 x 65° | - | Shaped Pupil | - |
| 4 | 825 nm | 10% | "Wide" FOV Imaging | 0.45" – 1.4" | 360° | Y | Shaped Pupil | - |

- **TTR5 means that only band 1 is required for full success**
  - Robust technology demonstration
  - Science return is modest
    - 0 imaged mature exoplanets
    - Valuable to study inner region of spatially extended sources/debris disks

- **We should manage community expectations of performance above TTR5, or science with CGI above TTR5**
  - But, internally, Roman and NASA can prepare for both these things

# Phase E observations

- **The Coronagraph instrument is currently allocated 3 months of observing time within the first 18 months of the mission**
  - It is expected to take much less than 3 months observing to meet TTR5
  - Our working assumption is that the remainder of the 3 months will be used for additional technology demonstration or science observations with the Coronagraph
    - How this time gets used will depend on the as-built capabilities and the results from the TTR5 observations
    - Recommendations on how to use this time will be made by Coronagraph instrument team, and the Community Participation Program Team (including representation from SSC/IPAC)

| | First 18 months | Prime mission (5 year) | Prime mission (original 6 year) |
|---|---|---|---|
| CGI | 3 months (fixed) | 3 | 12 |
| HLWA Survey | 6.2 months | 24 | 24 |
| HLTD Survey | 1.6 months | 6 | 6 |
| GBTD Survey | 3.2 months | 12 | 12 |
| GA Surveys | 4.0 months (minimum) | 15 | 18 |

Cannot add more CGI observations in 5 year prime mission without breaking science requirements (in cosmology and exoplanet demographics) or >25% GA survey requirement. Would need to also increase planned mission lifetime.

# Considerations for observations beyond 18 months

- **Coronagraph instrument is a class D tech demo with minimal redundancy – likelihood of limited instrument lifetime**
  - Execute additional CGI observations early in the mission, or at least soon after the end of the initial 18-month period
    - Make decisions early, don't wait until the end of the 18-month period
    - Maximize efficiency
      - Currently working options to allow CGI parallel ops (e.g. for calibrations) during WFI observations
  - Consider science operations similar to a typical explorer
    - Higher fraction of resources to the community/instrument team, relatively modest level of user support

- **To stay within cost and schedule constraints, the CGI team have descoped activities not needed for TTR5**
  - Testing Shaped Pupil Coronagraph mode
    - Consider adding testing of SPC modes before launch on testbed
  - Pipeline support for Shaped Pupil Coronagraph mode

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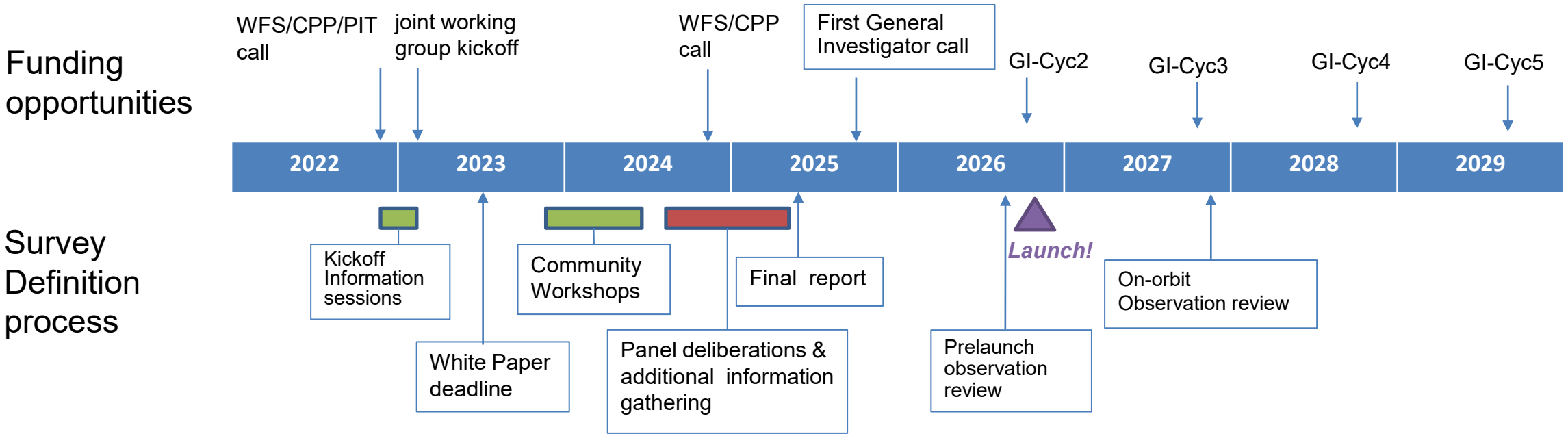
# A possible option for continued observations

- **Hold review early in mission (e.g. 6 months into science observations)**
  - Add TBD months of Coronagraph Instrument observations within first 3 years, increase prime mission duration
- **Reschedule some of the Core Community Survey observations to later years to create space for Coronagraph Instrument observations in early mission**
    - This may be complicated, as teams may have planned science investigations that depend on the CCS surveys being executed when originally planned. (can mitigate this by collecting information during GI proposal selection)
- **Continue (or recompete) Community Participation program, and plan the second set of CGI observations in a similar way as the first 3 months.**
  - This may be the most efficient way to exploit the pathfinder role for Coronagraph
  - Would need to manage the process in an open transparent way, so that the community has a voice

Note that it is premature to make firm decisions on the best path forward before the science community has had an opportunity to become involved in Coronagraph Instrument. No need to make choices today!

# The Road Ahead




- **Roman progressing; remains within cost & schedule commitments**
- **For more information**
  - https://roman.gsfc.nasa.gov/engaging_with_Roman.html