

# Update from the Committee on Astronomy and Astrophysics

*Thomas Greene, CAA Co-Chair*

*Christopher McKee, CAA Co-Chair*

*Disclaimer: These slides represent a personal assessment of the issues discussed by the CAA. This document should not be cited or quoted because the views expressed do not necessarily reflect those of CAA, SSB, BPA, or the NRC.*

# Roles and Responsibilities

- CAA reports to the National Academies Board on Physics and Astronomy (BPA) and the Space Studies Board
- CAA is not the Decadal Survey committee, and it does not set policy for the Survey
- CAA focused on implementation of Astro2020
  - <https://nap.nationalacademies.org/catalog/26141/pathways-to-discovery-in-astronomy-and-astrophysics-for-the-2020s>
- CAA also writes short reports as needed or charged
  - Roman Space Telescope (reported here)
- Most recent meetings (virtual) were March 21-24, 2022 during Space Science Week plus agency feedback meetings. Next meeting (virtual) Dec 1-2, 2022
- Nomination package for new members under construction; delay due to staff turnover

<https://www.nationalacademies.org/our-work/committee-on-astronomy-and-astrophysics>

# Membership

- Thomas Greene, Co-Chair, NASA Ames Research Center
- Christopher McKee, NAS\*, Co-Chair, University of California, Berkeley
- William Nielsen Brandt, Pennsylvania State University
- Daniela Calzetti\*\*, NAS, University of Massachusetts
- Ian Dell'Antonio\*\*, Brown University
- Peter Garnavich\*\*, University of Notre Dame
- Anthony Gonzalez\*\*, University of Florida
- Gabriela Gonzalez, NAS, Louisiana State University
- Alyssa A. Goodman, Harvard University
- Shaul Hanany, University of Minnesota
- Elizabeth Hays, NASA Goddard Space Flight Center
- Garth Illingworth\*\*, University of California, Santa Cruz
- Mustapha Ishak-Boushaki\*\*, University Texas at Dallas
- Eamonn Kerins\*\*, University of Manchester
- Christopher S. Kochanek, The Ohio State University
- Quinn M. Konopacky\*\*, University of California, San Diego
- Jeff R. Kuhn, University of Hawaii
- Scott Ransom, National Radio Astronomy Observatory
- Kate Scholberg, NAS, Duke University
- Joseph Silk, Institut d'Astrophysique, NAS
- Alycia J. Weinberger, Carnegie Institution of Washington
- \* Member, National Academy of Sciences
- \*\*Temporary members (9/30/2022) to prepare short report for NASA on the Roman Space Telescope

# Report of the Roman Space Telescope Operations Working Group [\(https://nap.nationalacademies.org/read/26740/\)](https://nap.nationalacademies.org/read/26740/)

- Shaul Hanany, Chair
- Presented 9/28/2022

# The Roman Space Telescope

- 2.4 m primary mirror, same as Hubble, with 100 times the field of view
- The Wide Field Instrument will observe a billion galaxies
- It will perform a microlensing survey of the Galactic Bulge to find ~ 2600 exoplanets and an unknown number of isolated stellar-mass black holes
- The Coronagraph Instrument (CGI) will perform high contrast imaging and spectroscopy of individual nearby exoplanets
- Primary mission lifetime of 5 yr with potential of 5 yr extension

# Background

- NASA requests CAA response to Astro2020 recommendation: “Advice on how to optimize the science return includes: holding a non-advocate review of Roman Space Telescope’s science program to set the appropriate mix of survey time to guest investigator-led observing programs” in view of scientific advances since 2010
- ROWG first meeting on 2/24/2022, with initial expected delivery within ~6 months
- 22 weekly meetings, 22 individuals presented
- Roman project team members (incl. Senior Project Scientist)
- Roman science support centers (incl. IPAC and STScI Directors)
- Roman Formulation Science Working Group members representing
  - surveys for weak lensing, baryon acoustic oscillations, supernovae, and exoplanets
  - general astrophysics, including Milky Way, galaxy formation and evolution, circumgalactic medium, and stellar populations
- Community (Roman Science Interest Group)
- Reports + slide stacks provided by the project; answers to written questions

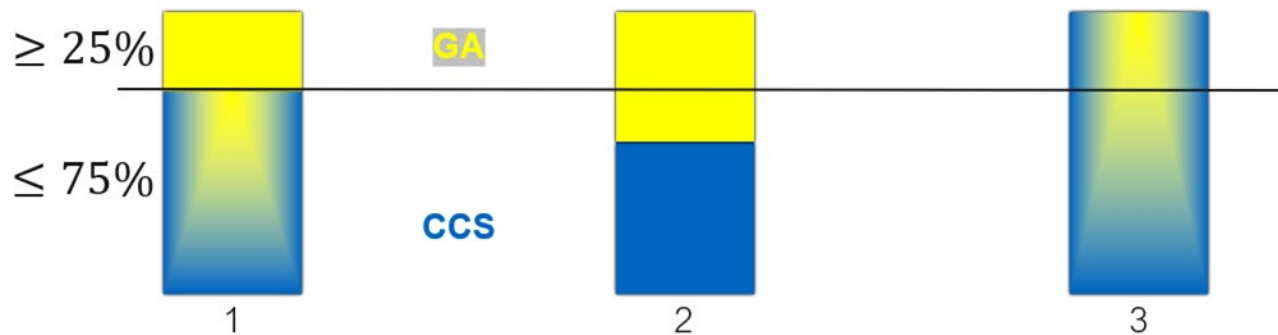
# The Charge

- NASA's community process:

Background. Roman's current observing plan constraint is that the three Core Community Surveys + 3 months of CGI tech demo observations take up no more than 75% of the available observing time. The remaining  $\geq 25\%$  is for General Astrophysics Surveys as proposed by the community. The baseline plan is to conduct an open community process in the 2022-2023 timeframe to maximize the overall scientific return from the Core Community Surveys, while also providing the observations needed to meet the cosmology and exoplanet demographics science requirements derived from Astro2010 and reiterated by Astro2020.

# The Charge

“Question 1: Should this community process (1) continue as is and maximize the utility of the Core Community Surveys (CCS) for general astrophysics science while strictly maintain the constraint of  $\geq 25$  percent of available observing time for General Astrophysics Surveys (GA Surveys); (2) focus the CCS solely on cosmology and exoplanet requirements, and optimize for shortest possible surveys, thereby maximizing the time available for GA Surveys; or (3) relax the  $\geq 25$  percent constraint to enable greater optimizations of the CCS for general astrophysics science?”



# The Charge

“Question 2: How should the Roman project set the balance between the fractions of time allocated to large/medium/small General Astrophysics Surveys (i.e., allocate more time to large coherent observations, or allocate more time to a multitude of smaller independent ones)? How should the Roman project set the overall number of GA Surveys (note that increasing the number of GA Surveys, even holding total time constant, will come at increased cost to the mission)?”



# Findings and Conclusions

- Significant work has gone into translating the Astro2010 guidelines into the ground-breaking mission that Roman will be
- Design Reference Mission Reference Surveys demonstrate that Roman can achieve its dark energy and microlensing science goals
- The DRM gives 72%/28% of astrophysics observing time for CCS/GA
- Reference Surveys  $\neq$  Flight Surveys
- Flight Surveys  $\Rightarrow$  Community Process which has yet to occur

# Findings and Conclusions

- As was appropriate at the time —
- Finding: “The current DRM reference surveys were developed without competition against each other or against other GA surveys”
- And: Identical or similar CCS science objectives may be achieved with less observing time
- Examples: number of filters used for the high latitude imaging survey (two, three, or four); number of low redshift supernovae available for the high latitude time domain survey (2000 vs 8000); optimization of cadence vs area in the microlensing survey.
- Quantitative trade-offs between competing science goals is not currently available, but it will be after observing proposals are submitted
- No quantitative information is available about the impact of including GA science objectives into the CCS or in addition to the CCS

**Paradigm: CAA provides a set of principles and a suggested structure that NASA can follow to maximize overall science return instead of a direct response to questions**

# Principles

P1: “Roman’s overall science output could be increased by having the design of the CCS be informed by GA science objectives.”

P2: “Roman’s overall science output could be increased by establishing a combined evaluation of all observing time requirements, including CCS, their GA extensions, and GA-only surveys.”

P3: “The process of selecting Roman’s observing plan would benefit from including both community collaboration and competition.”

P4: “Roman’s science output would benefit from an observing plan selected by an independent Super-Time Allocation Committee (STAC).”

P5: “To make optimal use of Roman observing time, proposing teams would provide the STAC with quantitative sensitivity analyses relating observing time options with science deliverables. Smaller exploratory projects might be exempt.”

# Principles

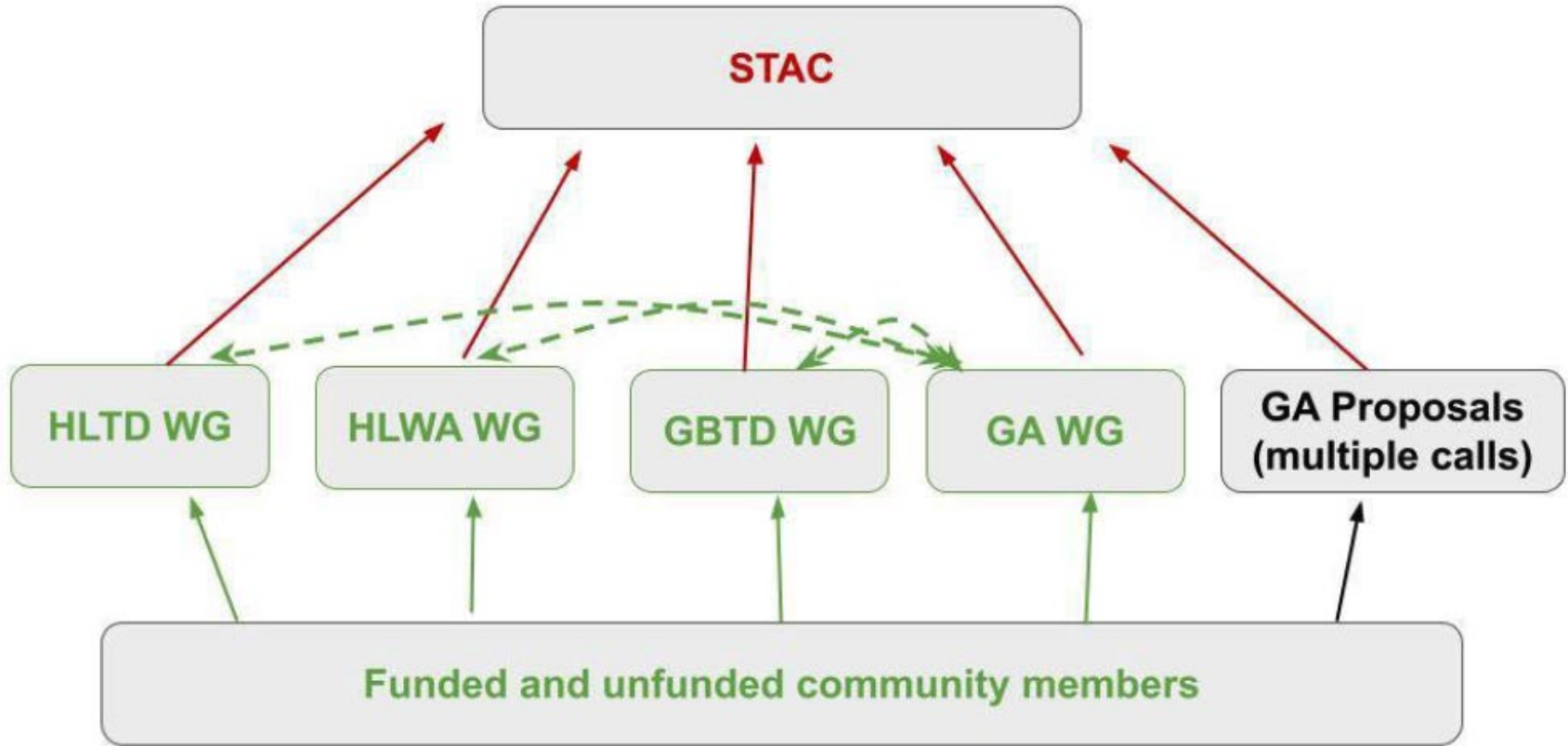
P6: “Among the options each CCS proposes, it will be beneficial to include one with the minimum time required for achieving the science objectives laid out by Astro2010.”

P7: “An independent STAC would optimize Roman’s scientific return without constraints of pre-set observing time allocations.”

P8: “For a survey instrument, it is beneficial to establish a process of consolidating observational programs. However, it is conceivable that some programs cannot be consolidated, and the CAA encourages a selection process that allows a broad range of program sizes.”

P9: “Roman’s science output may benefit from increasing the number of GA competed programs above 30. The final number of programs may be best determined by the STAC, or subsequent regular TAC reviews, so as to maximize the scientific return consistent with programmatic constraints at the time of the review.”

P10: “It would be beneficial to plan for post-launch flexibility should updates to the observing plan be warranted.”



HL = High Latitude; TD = Time Domain; WA = Wide Area; GB = Galactic Bulge; WG = Working Group

# Summary — Response to Charge

- The CAA's report:
- Finds that Roman's science objectives for dark energy, microlensing and general astrophysics are still compelling
- outlines a set of principles: collaboration + competition; collaborative planning of GA + CCS; combined review; sensitivity analysis
- gives an example process to implement the principles
- encourages proposals spanning large and small observing time, and suggests that the STAC will choose among them
- advocates that no limit be set now on the number of accepted proposals and that NASA will decide on the number in real time

Thank You!



# Findings and Conclusions

- Science presentations + review of Astro2010/Astro2020 =>

F: “The scientific objectives to be achieved by Roman’s Core Community Surveys remain scientifically valid and will have a significant impact on the fields of cosmology and exoplanets.”

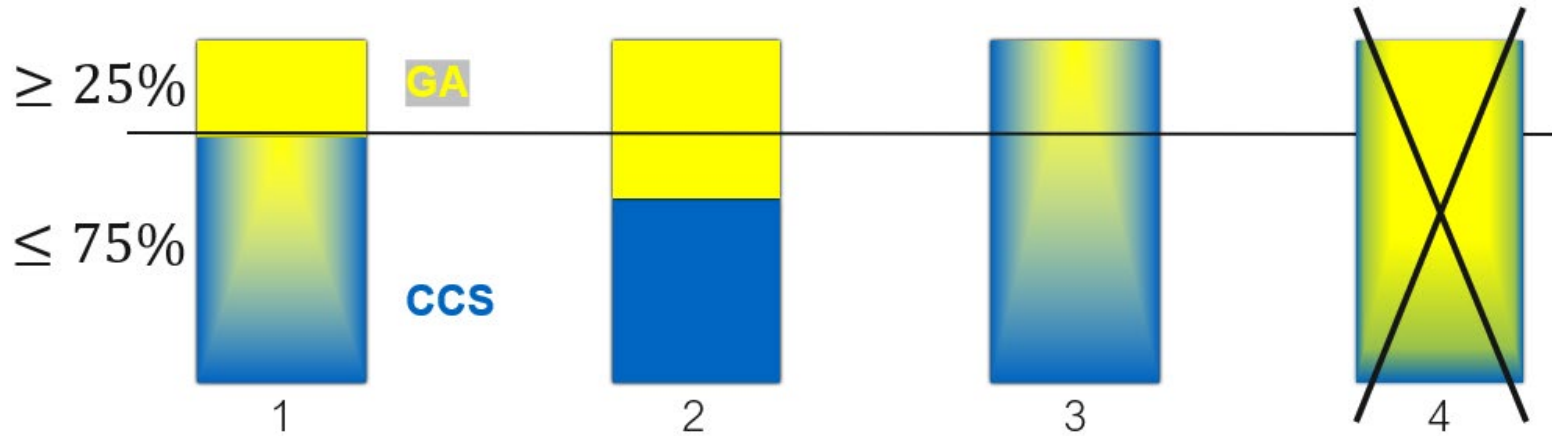
F: “The General Astrophysics science return of Roman is compelling and may lead to unexpected discoveries.”

C: *“Maximizing the General Astrophysics science return of Roman, while still achieving the science objectives envisioned by Astro2010 and endorsed by Astro2020, would enhance the scientific reach of the mission.”*

# Maximizing Flexibility

- If anomalies identified => establish a committee to assess readjustment of science deliverables
  - For example, avoid insisting on the dark energy science if Roman is no longer competitive with Euclid.
- Prepare contingency plans ahead of time
- Consider leaving budget margins for possible costly re-scheduling of observing plan
- Maintain periodic reviews throughout the mission to assess progress and to adapt to the evolving science landscape

# Report Boundary Condition



**CAA set to optimize Roman's science return within the goals set by Astro2010/Astro2020, within our interpretation of NASA's charter, and within the time allocated for finalizing this report.**

# NSF Response to Astro2020

- Extremely large telescopes (top priority among large "frontier" projects): Cost larger than anything NSF has done before. Considering Environmental Review in partnership with Native Hawaiians. Will assess technical and site readiness of 2 proposals.
- CMB-S4, the next generation cosmic microwave background experiment, joint with DOE (tied for 2nd): In a surprise to the community, needed support at the Antarctic site is reduced or delayed.
- ngVLA (tied for 2nd): A prototype antenna is being fabricated with NSF midscale funds. Costs well understood, ready to begin.
- Cited 6 programs to support students and early career scientists (particularly under-represented minorities)
- Planning underway to implement Astro 2020, but in our view few if any of the recommendations requiring significant funding will be implemented unless the AST budget is increased and the facilities operations funding issue is addressed.

# CAA STATUS

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