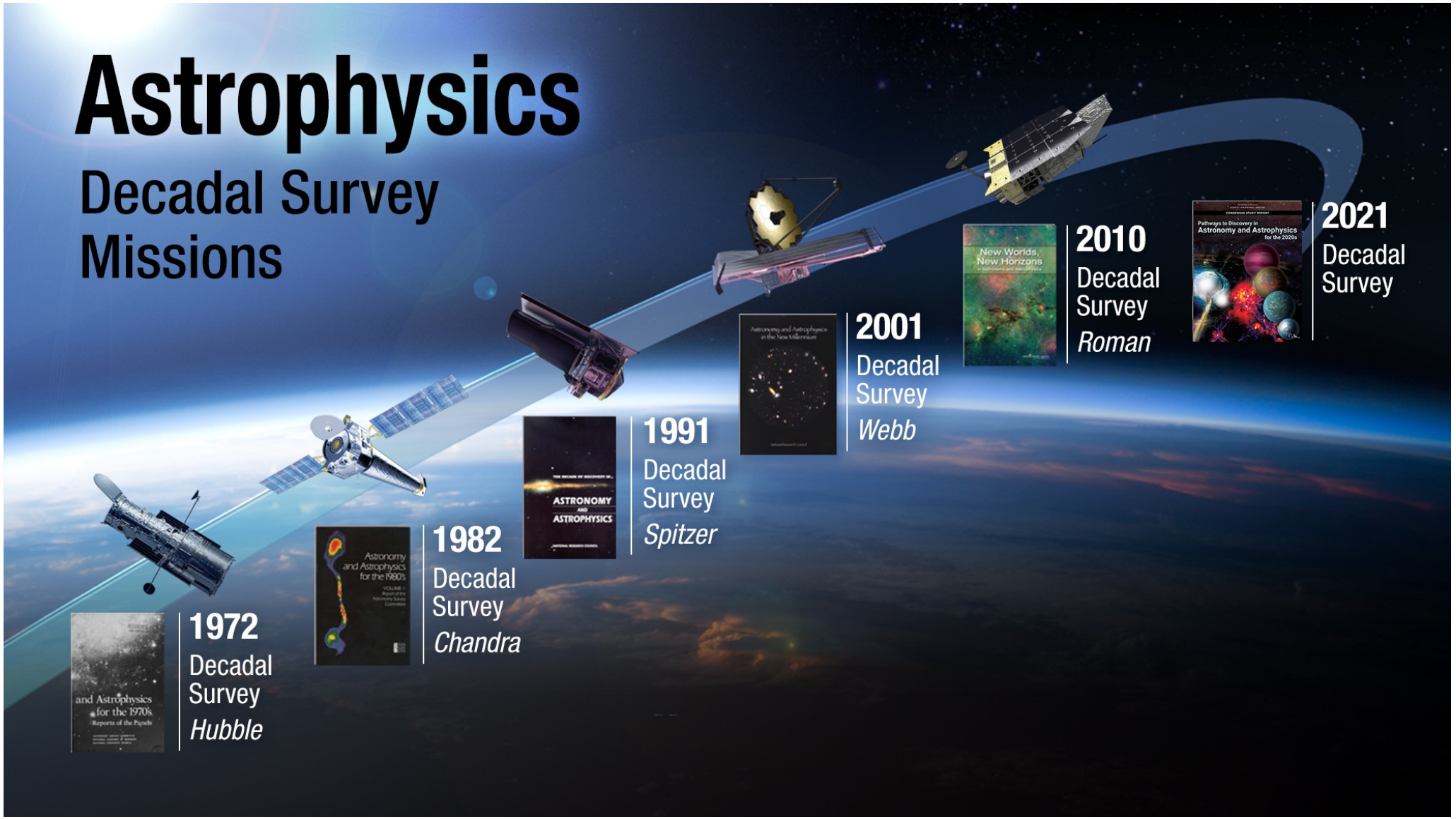
Astrophysics

Decadal Survey Missions



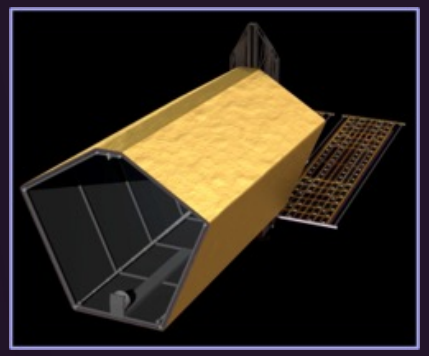
Pathways to Habitable Worlds

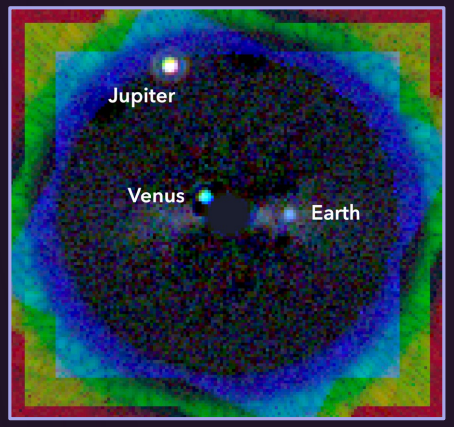
- Decadal Survey (ASTRO2020) priority science area
  - Are there habitable planets harboring life elsewhere in the universe?
  - Survey sun-like, nearby stars for habitable planets anmd search for evidence of life

- Primary recommendation:
  - Space telescope similar in wavelength coverage to Hubble, with an aperture of ≥6 meter and coronagraphic imaging capability
  - Observe ~100 nearby stars, and successfully detect potentially habitable planets around at least a quarter of the systems.

- Primary Technical requirements
  - 6 meter Segmented mirror telescope with active control of optics to achieve ultrastability
  - Coronagraph achieving contrast levels of 10^{-10}

- **Habitable Worlds Observatory**





A Better Path to Habitable Worlds

A NEW APPROACH TO DEVELOP FLAGSHIPS

NASA Astrophysics Great Observatory Maturation Program (GOMAP)
Program Executive: Julie Crooke (julie.a.crooke@nasa.gov)
Program Scientist: Shawn Domagal-Goldman(shawn.goldman@nasa.gov)
May 5, 2023

National Academies Astro2020 Decadal Survey

Astro 2020: “Great Observatories Mission and Technology Maturation Program would provide significant early investments in the co-maturation of mission concepts and technologies.”

Astro 2020: First [GOMAP] entrant: Infrared / Optical / UV observatory

National Academies Astro2020 Decadal Survey

Astro 2020: “Great Observatories Mission and Technology Maturation Program would provide significant early investments in the co-maturation of mission concepts and technologies.”

NASA: Great Observatory Maturation Program (GOMAP)

Astro 2020: First [GOMAP] entrant: Infrared / Optical / UV observatory

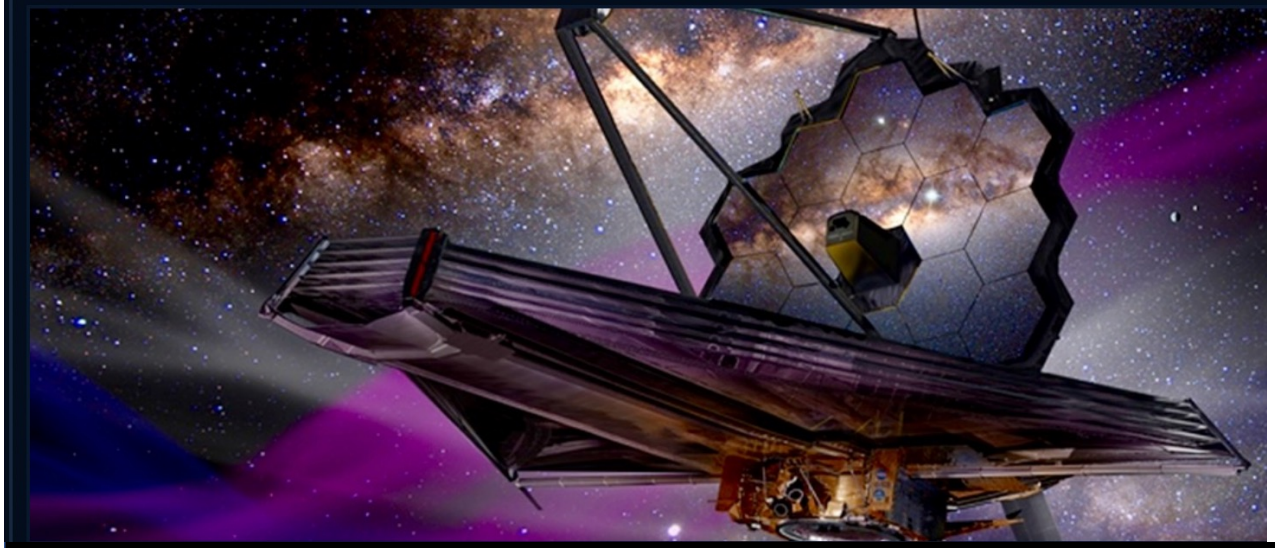
NASA: Habitable Worlds Observatory (HWO)

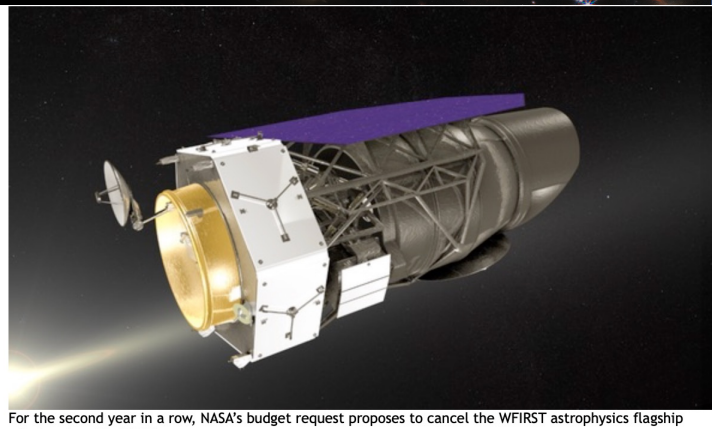
Why GOMAP?

JWST EXCEEDS COST CAP, LAUNCH DELAYED TO 2021

JUNE 28TH, 2018

1 Shares





For the second year in a row, NASA's budget request proposes to cancel the WFIRST astrophysics flagship mission. (credit: NASA)

Cost challenges continue for NASA science missions

by Jeff Foust
Monday, March 25, 2019

Why GOMAP?

Silver Line's second phase was to be different. It fell into the same trap.

During eight years of construction, the new $3 billion stretch of rail recorded multiple problems, cost overruns and four years of delays.

By Lori Aratani and Michael Laris
November 12, 2022 at 6:00 a.m. EST

MOST READ TI

1 Federal r… major rai… decades

2 D.C. has the… 'intensity' o… any U.S. city

3 Discovery o…

COST OVERRUN AT BALTIMORE STADIUMS MAY EXCEED 50 PERCENT

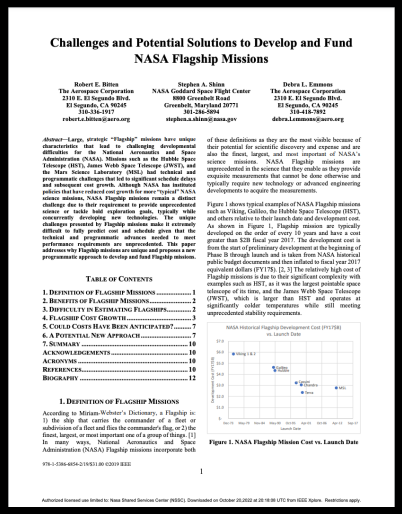
By Robert Barnes
August 31, 1988

ANNAPOLIS, AUG. 30 -- The cost of building a new sports stadium complex in downtown Baltimore may exceed original estimates by as much as $110 million, an increase of more than 50 percent, Maryland legislative leaders were told today.

Megaprojects (projects with costs > $1bn) almost always come in over-budget, over-schedule, and/or do not meet originally promised goals. This is true across fields and national boundaries. -Flyvbjerg, 2021

Why GOMAP? Decades of research-based consensus on megaprojects

Independent Research Papers



Challenges and Potential Solutions to Develop and Fund NASA Flagship Missions

Robert E. Bitten
The Aerospace Corporation
2310 E. El Segundo Blvd.
El Segundo, CA 90245
310-336-1917
robert.e.bitten@aero.org

Stephen A. Shinn
NASA Goddard Space Flight Center
8800 Greenbelt Road
Greenbelt, Maryland 20771
301-286-5894
stephen.a.shinn@nasa.gov

Debra L. Emmons
The Aerospace Corporation
2310 E. El Segundo Blvd.
El Segundo, CA 90245
310-416-7892
debra.Lemmons@aero.org

Abstract—Large, strategic "Flagship" missions have unique characteristics that lead to challenging developmental difficulties for the National Aeronautics and Space Administration (NASA). Missions such as the Hubble Space Telescope (HST), James Webb Space Telescope (JWST), and the Mars Science Laboratory (MSL) had technical and programmatic challenges that led to significant schedule delay and subsequent cost growth. Although NASA has instituted policies that have reduced cost growth for more "typical" NASA science missions, NASA Flagship missions remain a distinct challenge due to their requirement to provide unprecedented science or tackle bold exploration goals, typically while concurrently developing new technologies. The unique challenges presented by Flagship missions make it extremely difficult to fully predict cost and schedule given that the technical and programmatic advances needed to meet performance requirements are unprecedented. This paper addresses why Flagship missions are unique and proposes a new programmatic approach to develop and fund Flagship missions.

TABLE OF CONTENTS

1. DEFINITION OF FLAGSHIP MISSIONS

According to Miriam-Webster's Dictionary, a Flagship is: 1) the ship that carries the commander of a fleet or subdivision of a fleet and flies the commander's flag, or 2) the finest, largest, or most important one of a group of things [1] In many ways, National Aeronautics and Space Administration (NASA) Flagship missions incorporate both of these definitions as they are the most visible because of their potential for scientific discovery and expense and are also the finest, largest, and most important of NASA's science missions. NASA Flagship missions are unprecedented in the science that they enable as they provide exquisite measurements that cannot be done otherwise and typically require new technology or advanced engineering developments to acquire the measurements.

Figure 1 shows typical examples of NASA Flagship missions such as Viking, Galileo, the Hubble Space Telescope (HST), and others relative to their launch date and development cost. As shown in Figure 1, Flagship mission are typically developed on the order of every 10 years and have a cost greater than $2B fiscal year 2017. The development cost is from the start of preliminary development at the beginning of Phase B through launch and is taken from NASA historical public budget documents and then inflated to fiscal year 2017 equivalent dollars (FY17$). [2, 3] The relatively high cost of Flagship missions is due to their significant complexity with examples such as HST, as it was the largest pointable space telescope of its time, and the James Webb Space Telescope (JWST), which is larger than HST and operates at significantly colder temperatures while still meeting unprecedented stability requirements.

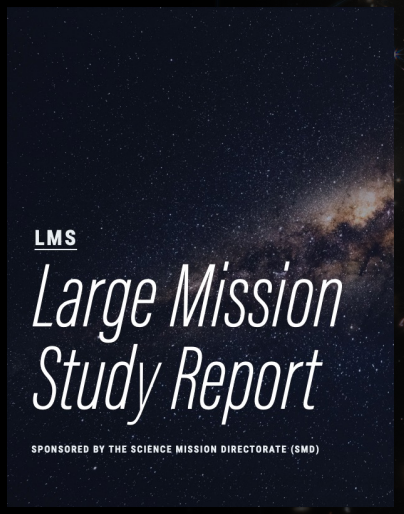
Figure 1. NASA Flagship Mission Cost vs. Launch Date

978-1-5386-6854-2/19/$31.00 ©2019 IEEE

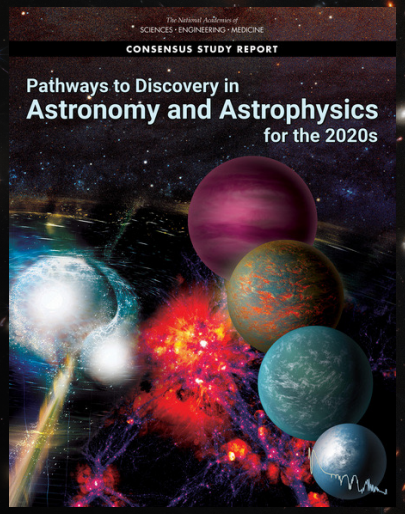
Mission Concept Reports

GAO Report on Major Projects

SMD Internal Study on Flagship Projects



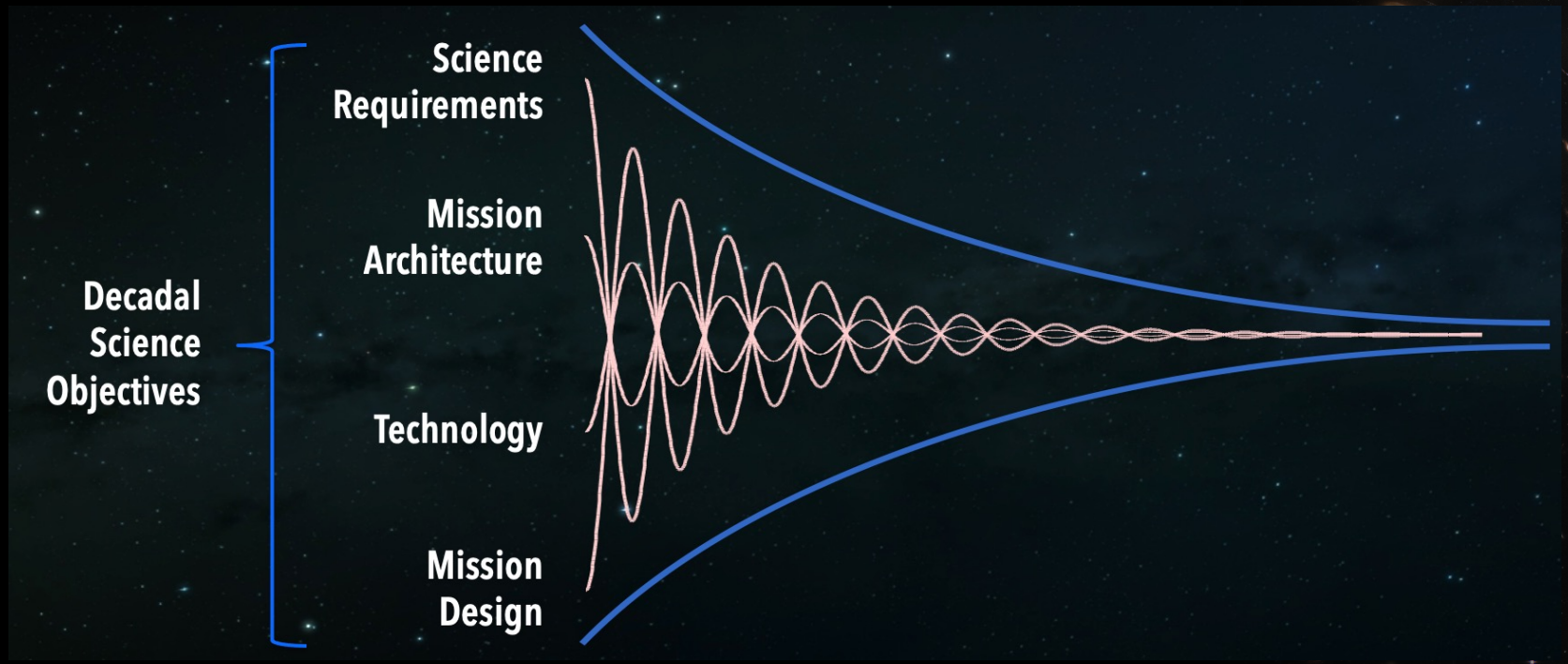
National Academy Recommendations



A variety of documents from internal, external, and oversight groups all point to a consistent set of problems & solutions for large/flagship projects, across sectors

How Do Complex Things Get Done On Time?

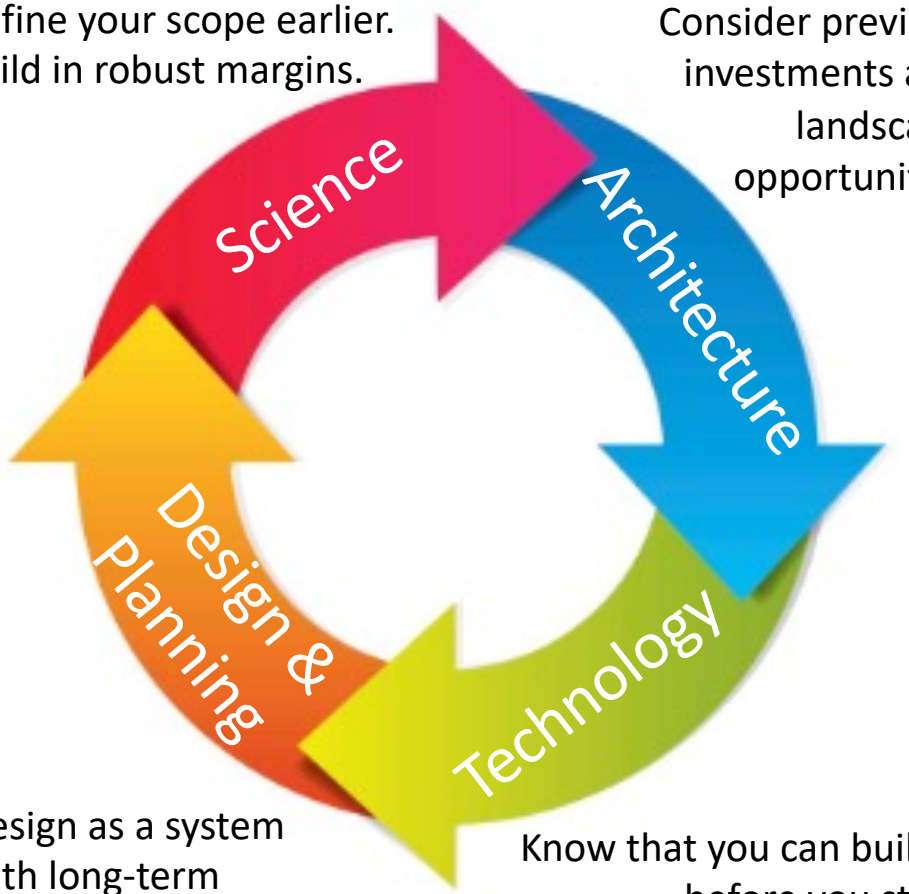
A successful flagship starts long-term work before staffing ramps up, and details get refined as the trade space continually gets more focused.



How Do Complex Things Get Done On Time?

Define your scope earlier.
Build in robust margins.

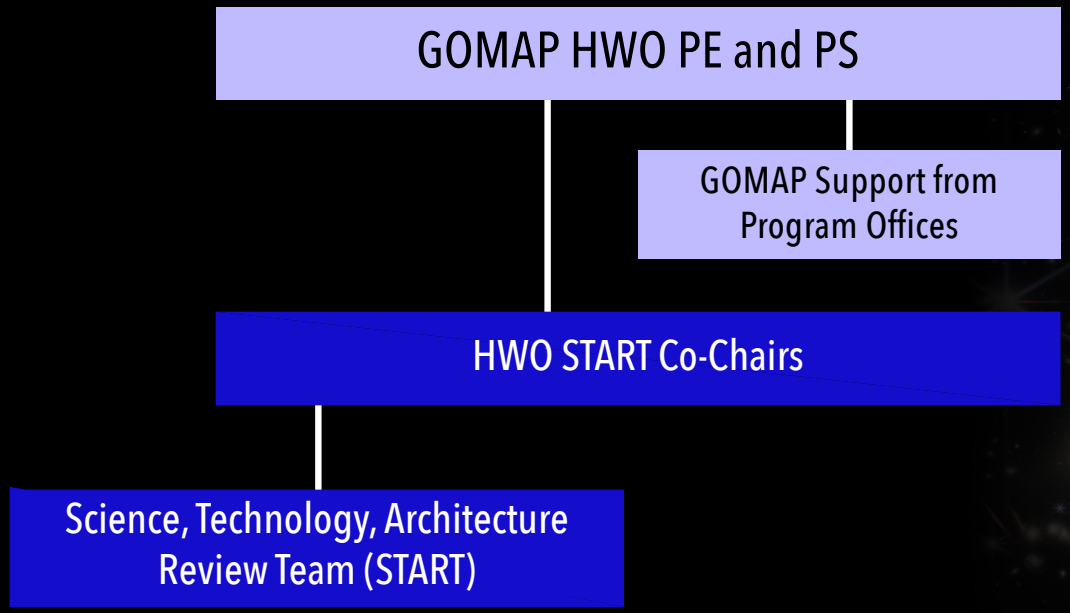
Consider previous investments and landscape opportunities



Design as a system with long-term needs in mind

Know that you can build it before you start.

HWO Technology Development and Concept Maturation Phase

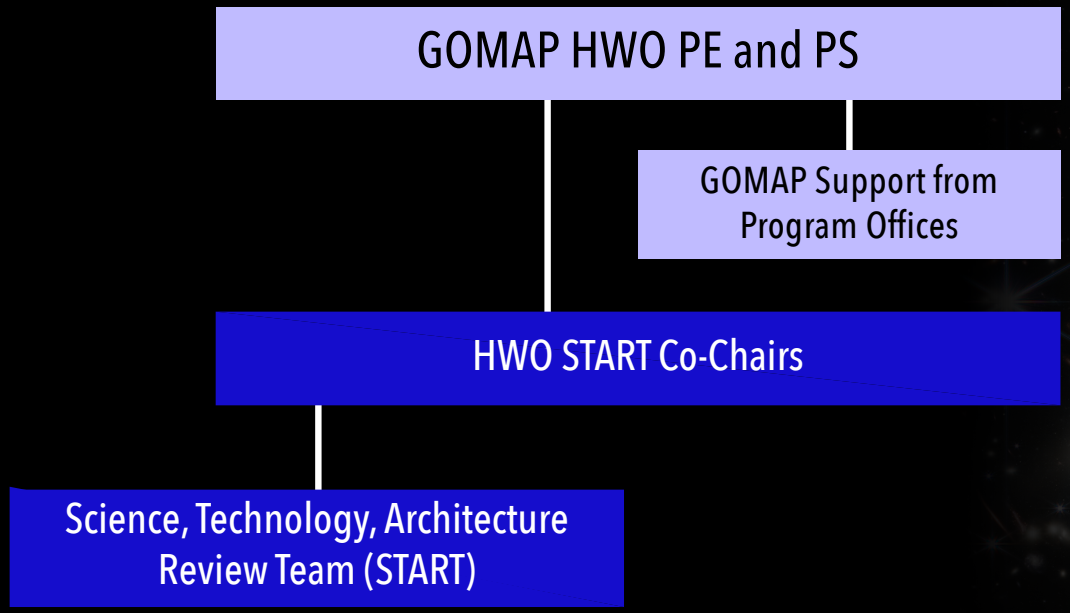


Color Key

HQ / PO only

NASA formed review groups
Industry, Academia, NASA, Science Centers

HWO Technology Development and Concept Maturation Phase



Color Key

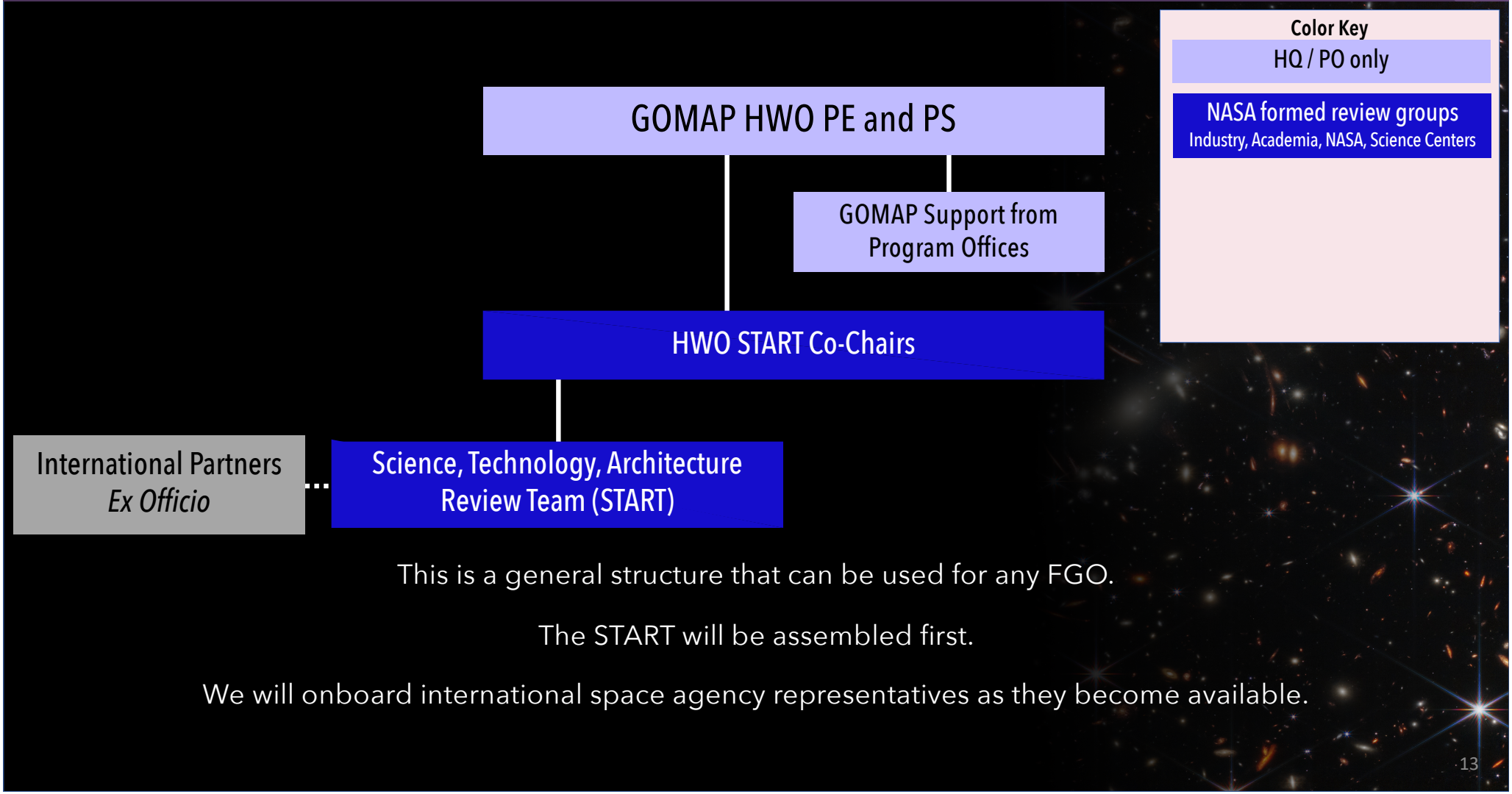
HQ / PO only

NASA formed review groups
Industry, Academia, NASA, Science Centers

This is a general structure that can be used for any FGO.

The START will be assembled first.

HWO Technology Development and Concept Maturation Phase

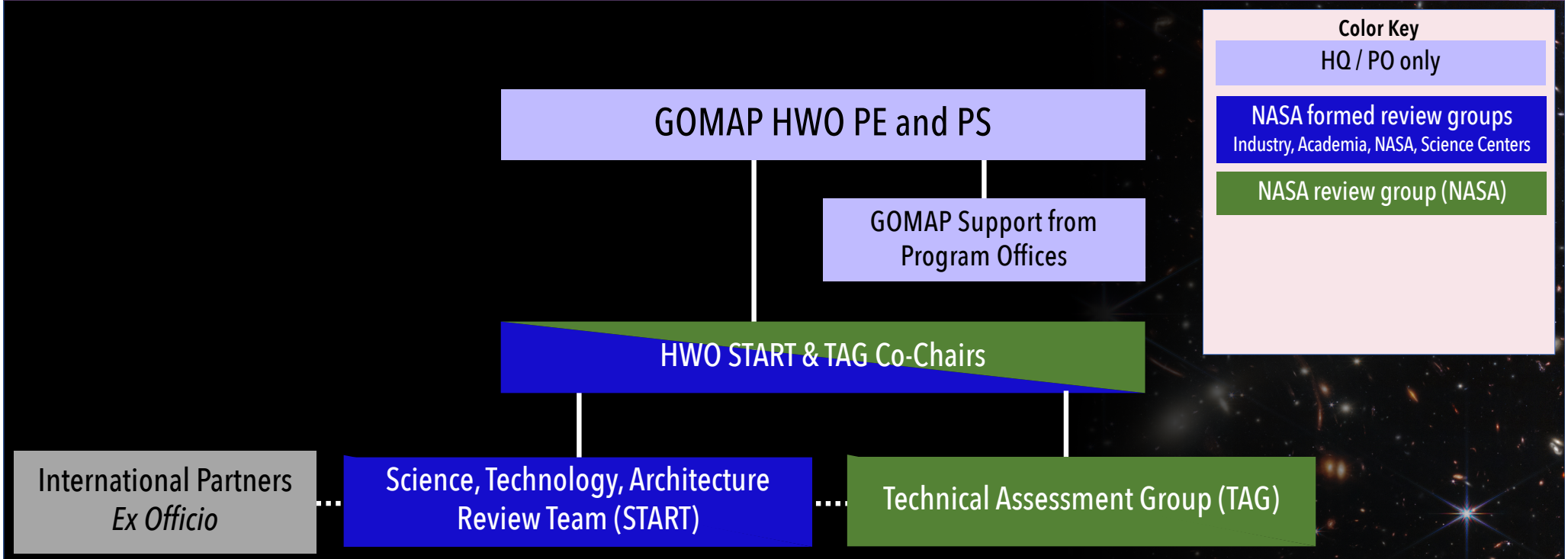


This is a general structure that can be used for any FGO.

The START will be assembled first.

We will onboard international space agency representatives as they become available.

HWO Technology Development and Concept Maturation Phase



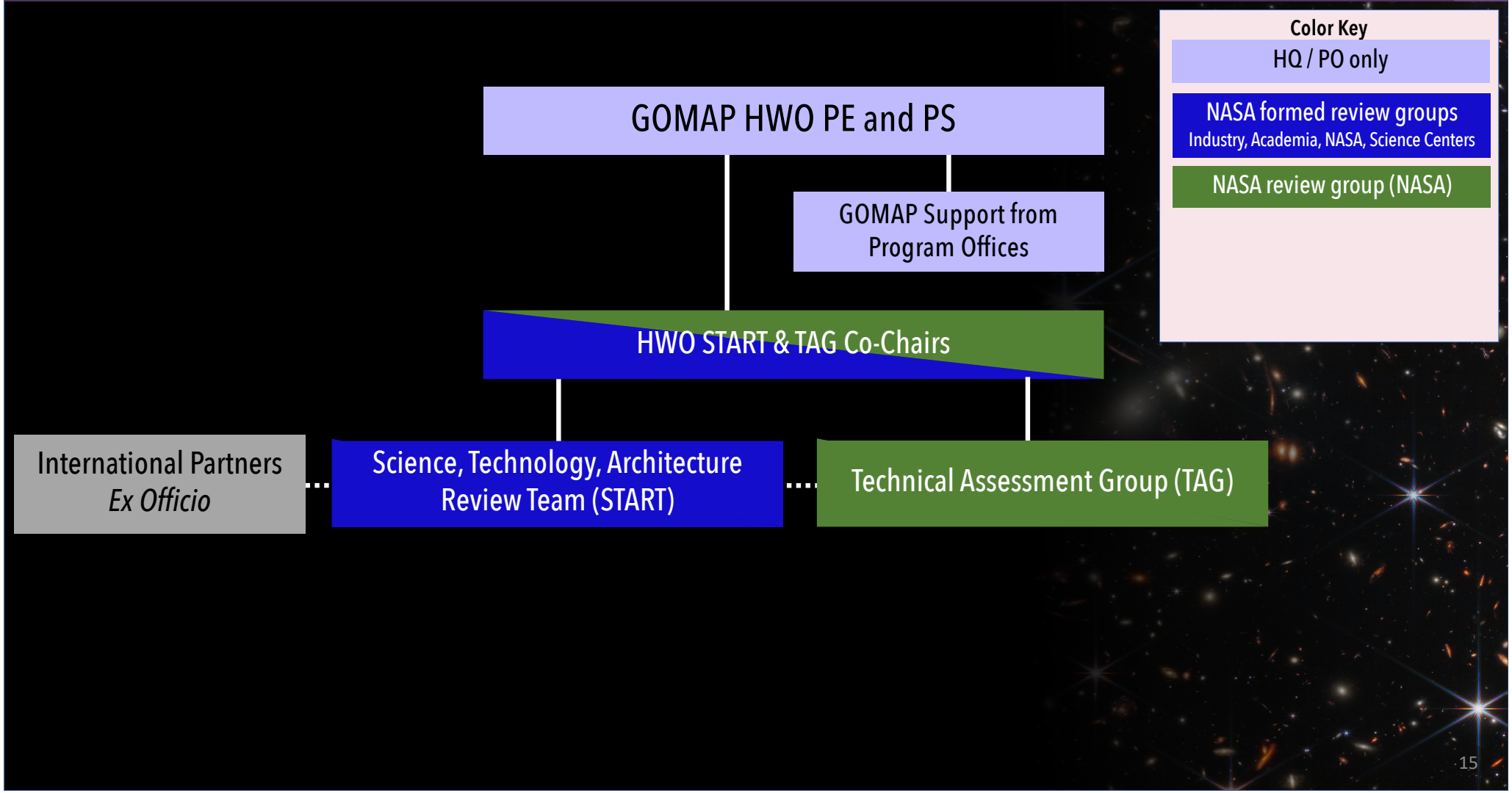
This is a general structure that can be used for any FGO.

The START will be assembled first.

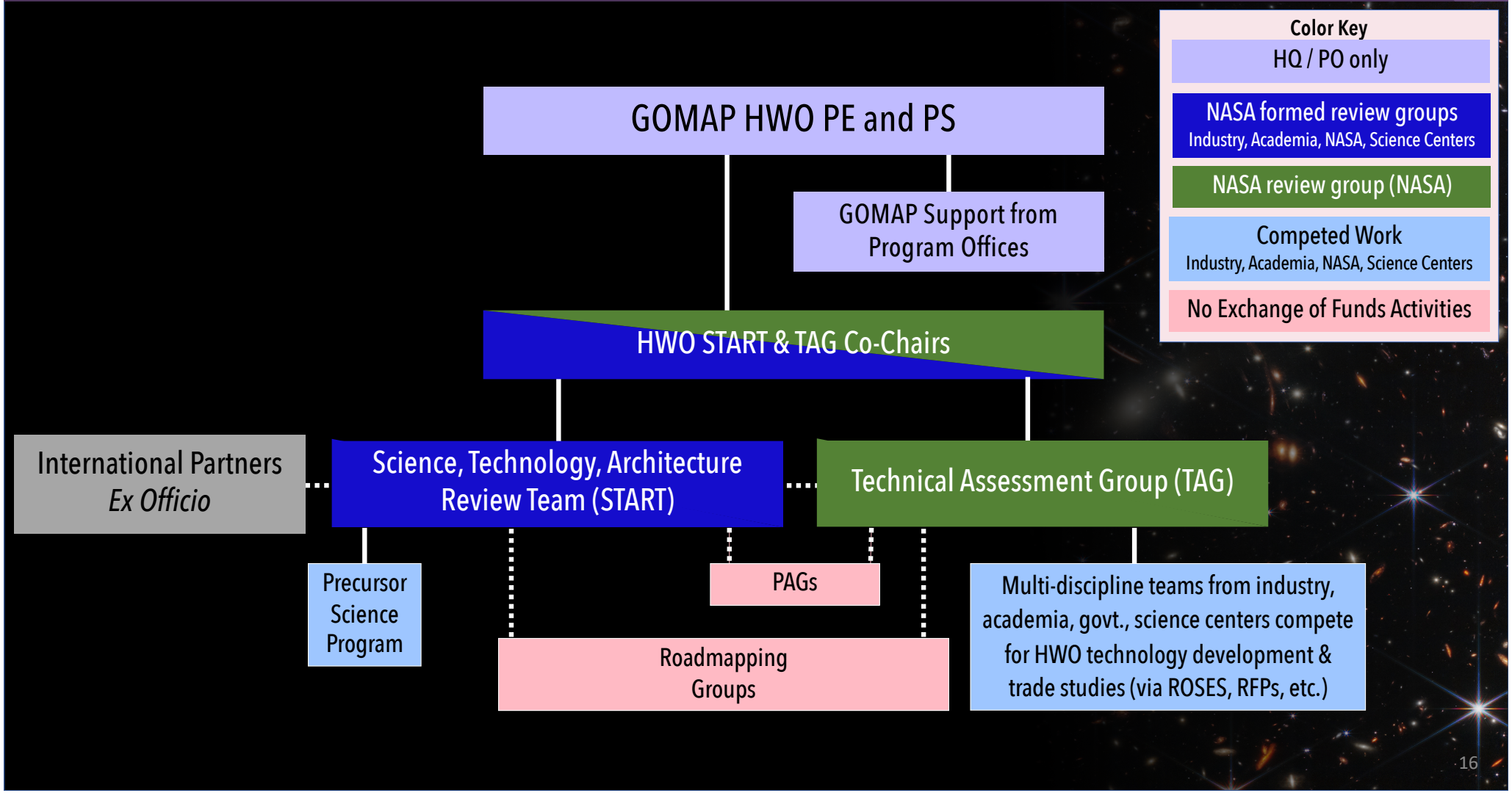
We will onboard international space agency representatives as they become available.

Soon after the START is assembled, we will onboard the Technical Assessment Group.

HWO Technology Development and Concept Maturation Phase



HWO Technology Development and Concept Maturation Phase

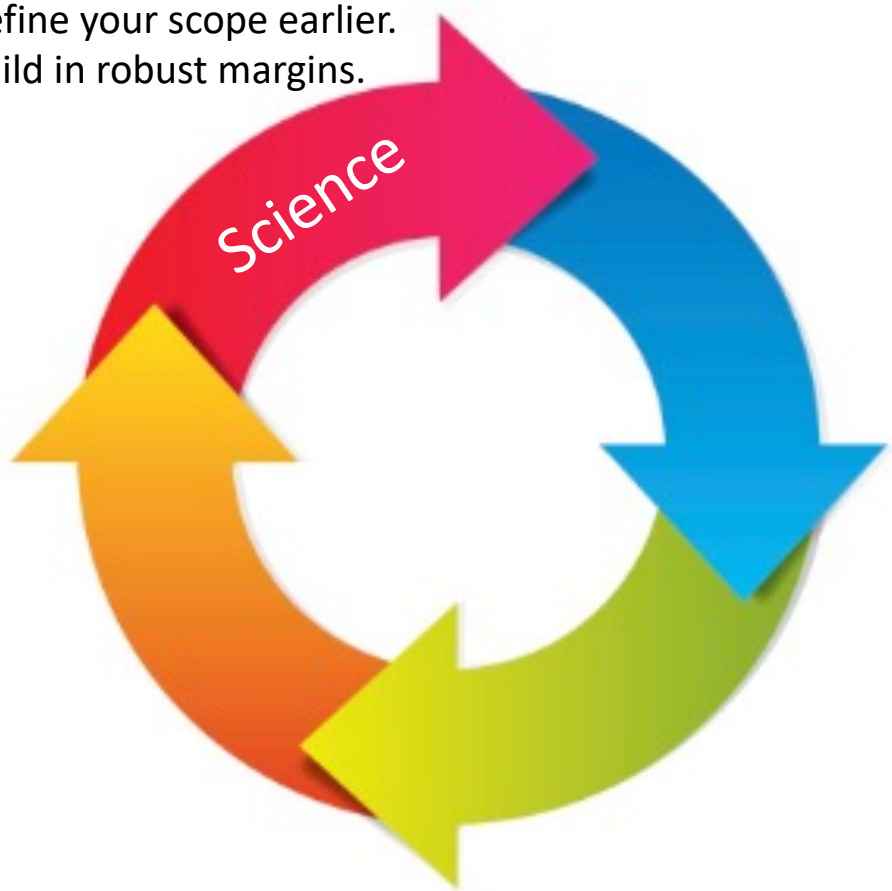


How Do Complex Things Get Done On Time?

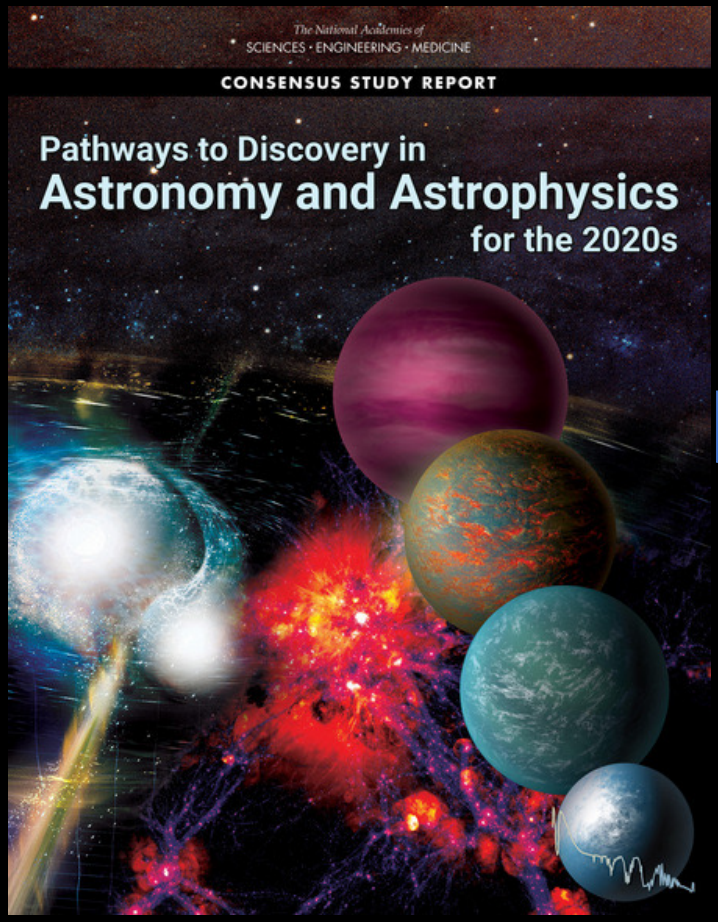
Science, Technology, Architecture Review Team (START)

- Start with Decadal science
- Quantify all science objectives including their break points & slope of performance degradation
- Identify observatory/instrument capability needs

Define your scope earlier.
Build in robust margins.



Science, Technology, Architecture Review Team (START)



Which decadal science questions can HWO help address?

What observations do we need to answer those questions?

What capabilities will deliver those observations?

What performance can we expect?

Where do performance breakpoints exist?

What models do we need to predict performance?

Science, Technology, Architecture Review Team (START)

Who is eligible?

- US-persons at US-based institutions with terminal degrees, including postdocs
- Scientists, engineers, and technologists

What about non-US persons or US-persons outside the US?

- Stay tuned – we are exploring future opportunities for these people
- Also see other community groups, including Science Analysis Groups (SAGs)

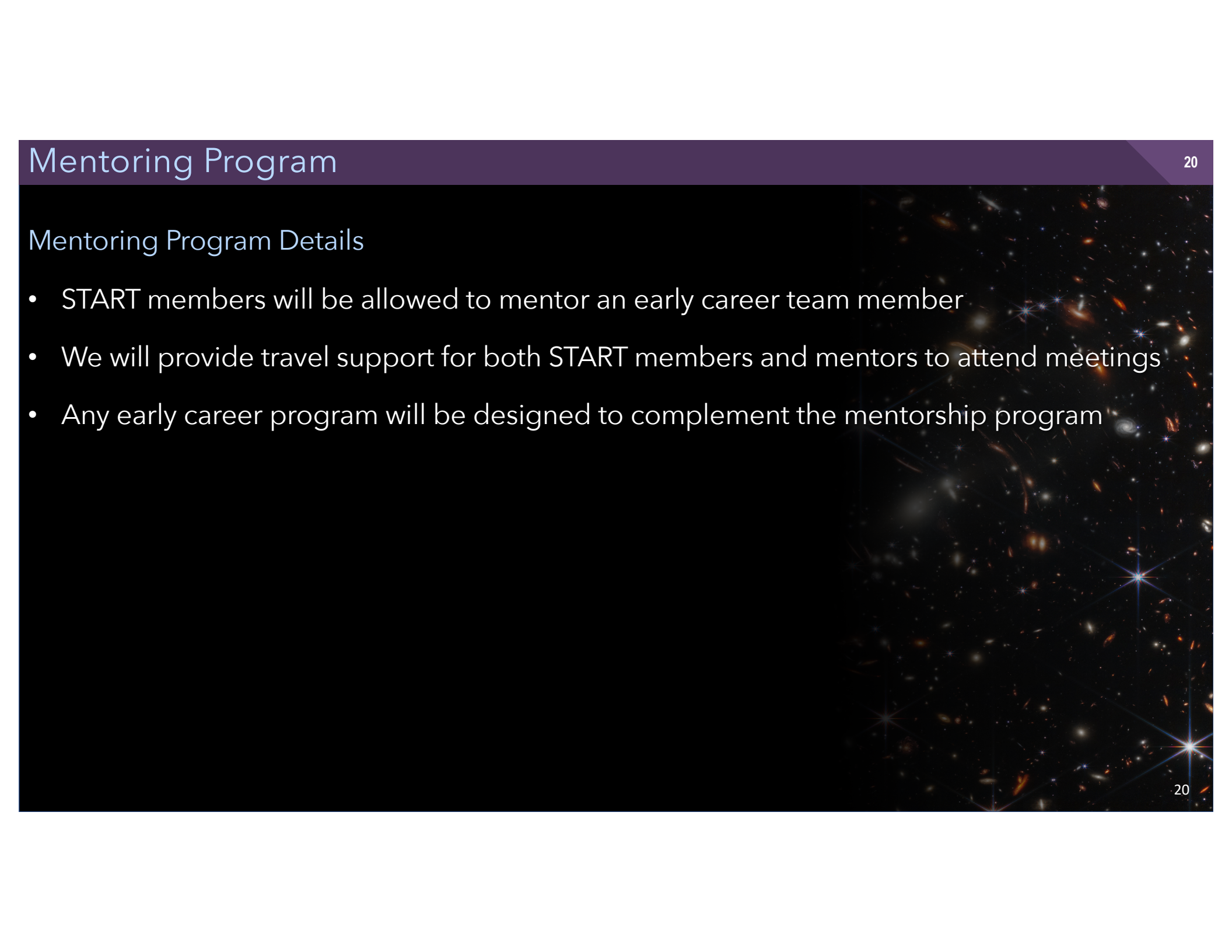
What about students and postbac scholars?

- Stay tuned – we will explore a separate opportunity for early career people including students, postbacs, and postdocs (possible postdocs may be eligible for both groups)
- We want the START to help determine this

Mentoring Program

Mentoring Program Details

- START members will be allowed to mentor an early career team member
- We will provide travel support for both START members and mentors to attend meetings
- Any early career program will be designed to complement the mentorship program



START self-nomination process

- 1. Interest in being a member or co-chair (if applicable)
- 2. Expertise, capabilities, and experience that the submitter would bring to the START
- 3. Intended contributions and available level of effort to START activities (Quarterly hybrid meetings, more frequent remote meetings on a TBD cadence, and contribute to the final report. Additionally, START analyses and assessments may be performed by START members and/or their immediate colleagues/team members.
- 4. Commitment to incorporating NASA's core values of IDEA as a member or co-Chair
- 5. Commitment to act in a manner consistent with the NASA Astrophysics Division's Statement of Principles.
- 6. Interest, ability, availability, and experience to mentor an early career individual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#UnfoldTheUniverse
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The START is only the beginning…

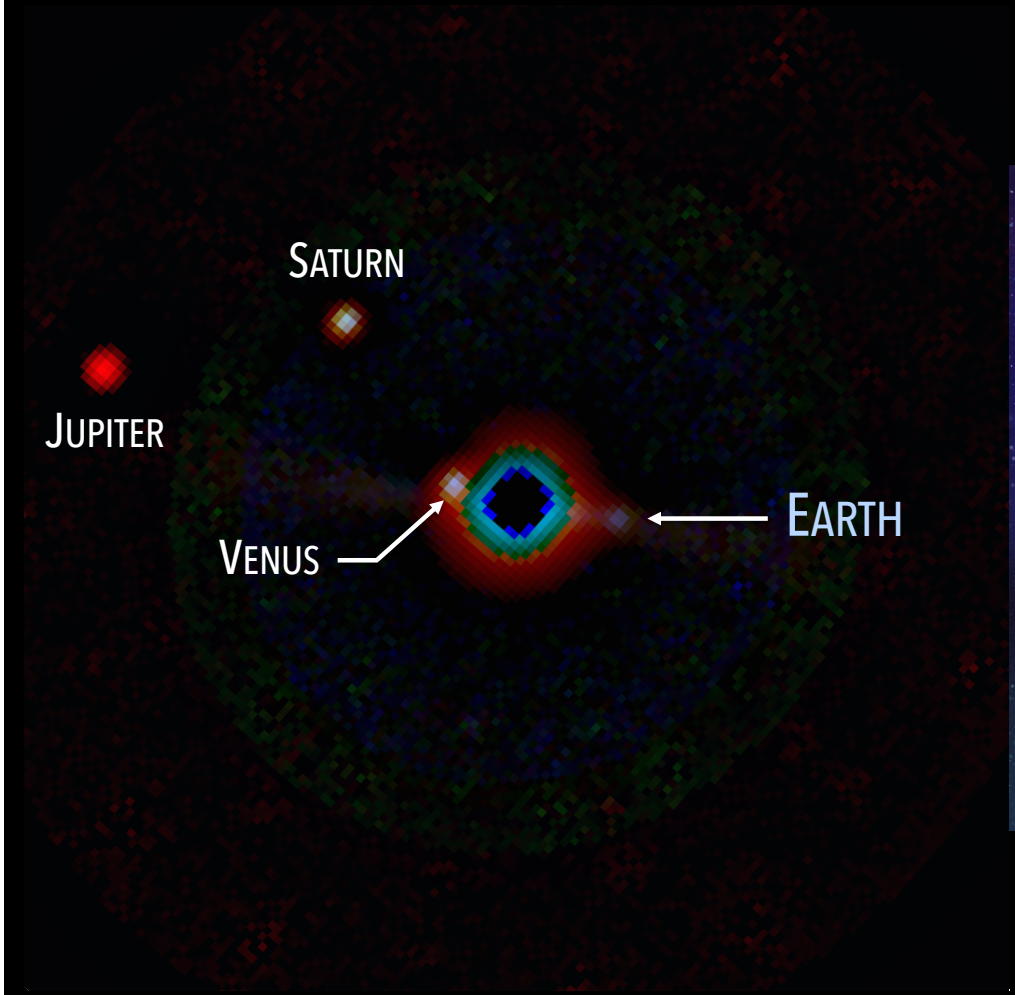


Figure courtesy Roser Juanola and Jens Kammerer

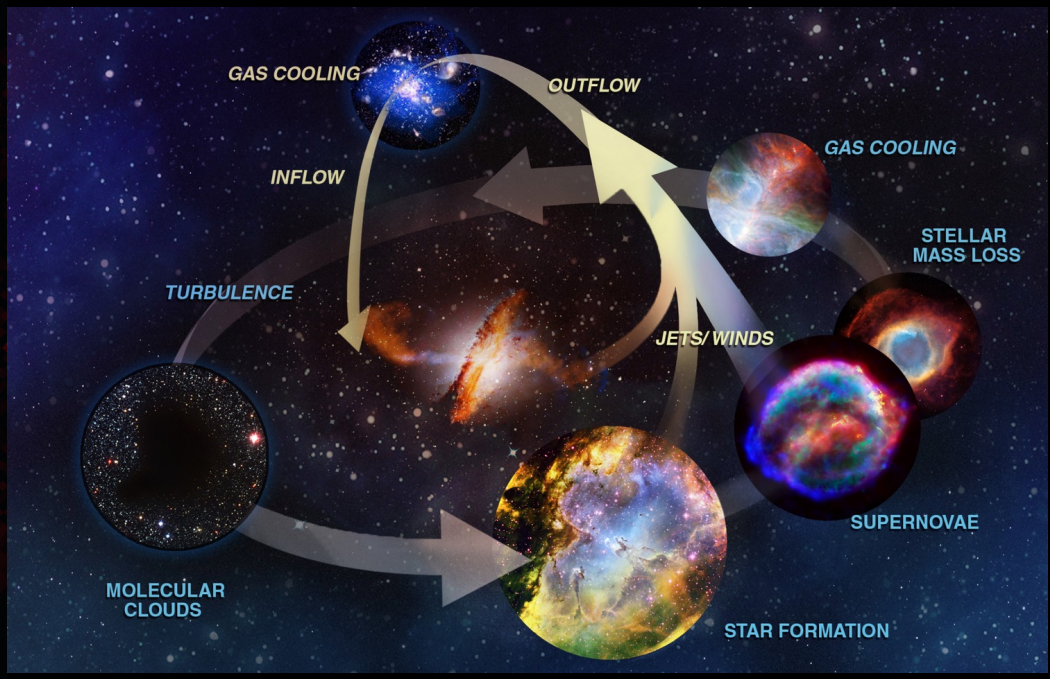


Figure from HabEx Final Report

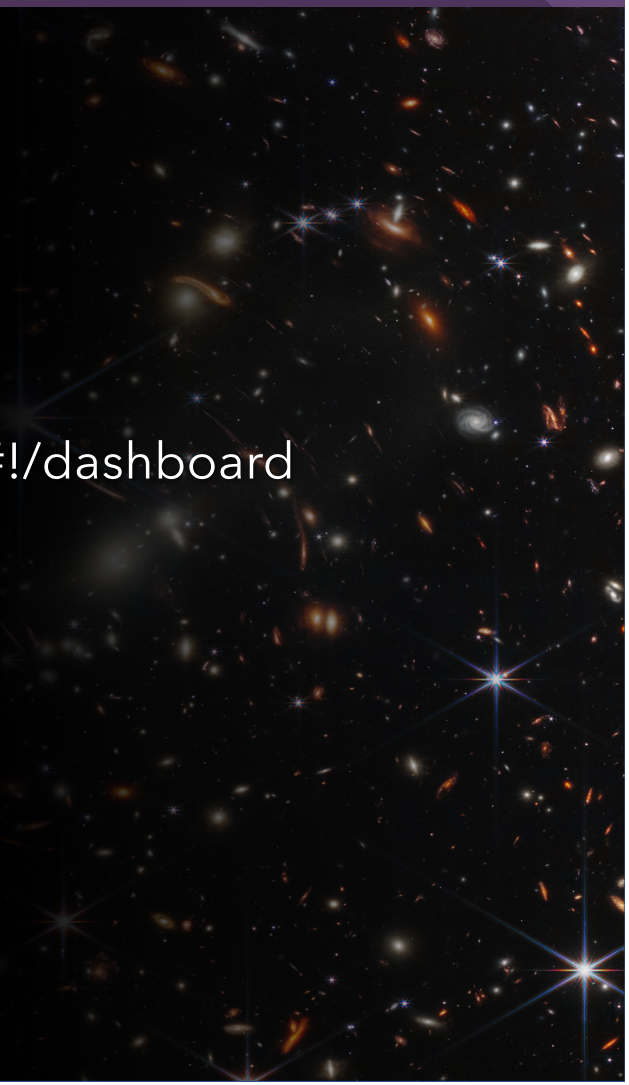
Questions and more information

ASD Statement of Principles:
go.nasa.gov/3Kwn07s

Town Hall Q&A:
https://nasa.cnf.io/sessions/rra9/#!/dashboard

NASA GOMAP website:
go.nasa.gov/4107ZzC

julie.a.crooke@nasa.gov
shawn.goldman@nasa.gov



Backup