STScI | SPACE TELESCOPE SCIENCE INSTITUTE

EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

What Comes Next - HWO and the New Great Observatories

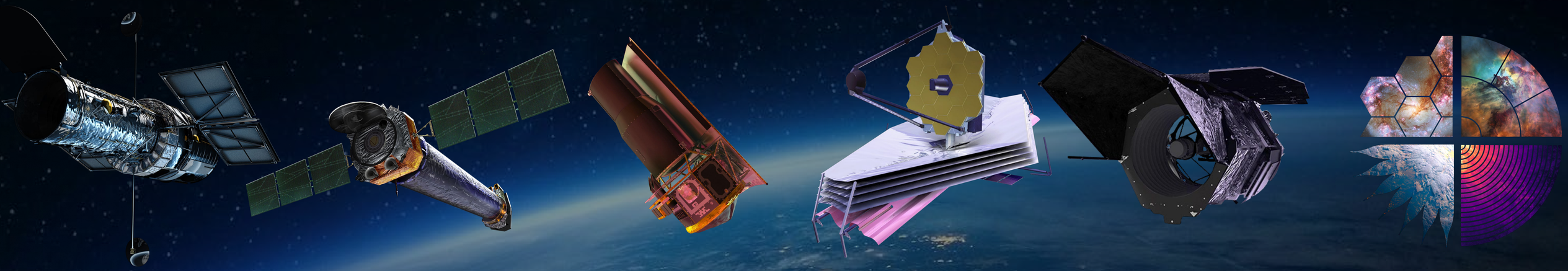
Jason Tumlinson

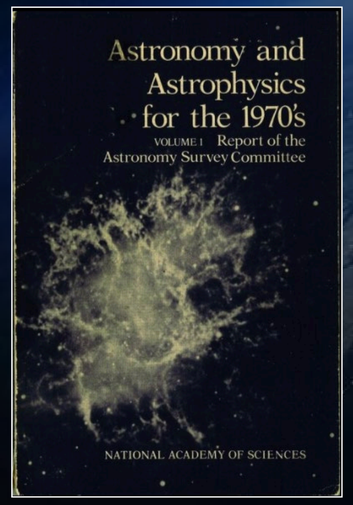
STScI Head of Community Missions

January 2023

How We Got Here - Astrophysics Decadal Surveys

HUBBLE CHANDRA SPITZER WEBB ROMAN The NGOs





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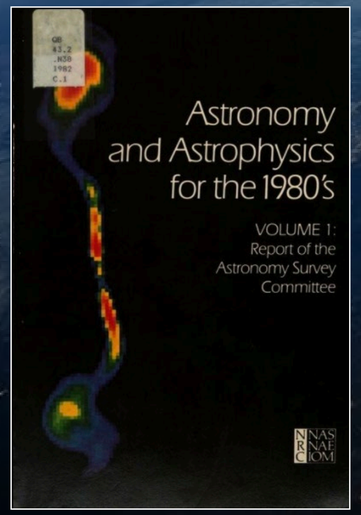

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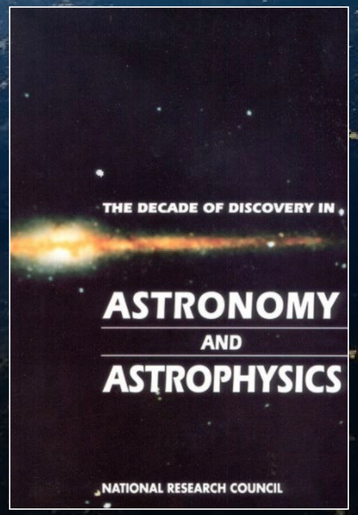

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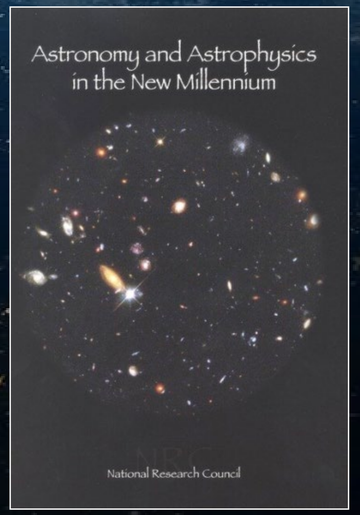

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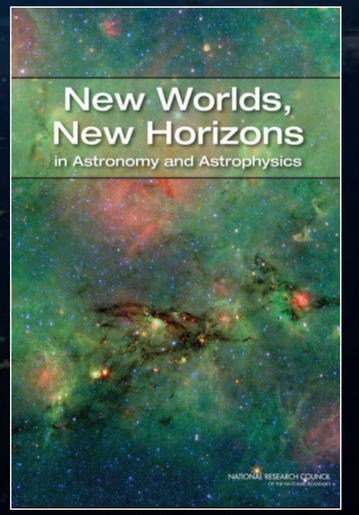
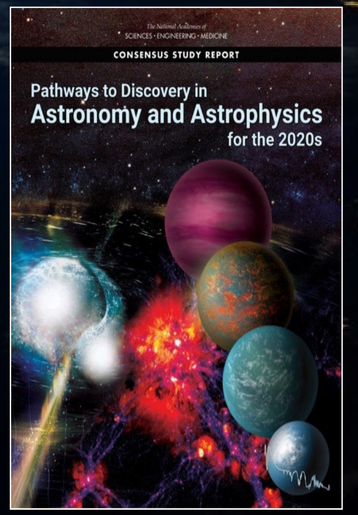


2011



2021

courtesy Grant Tremblay

THE NEW GREAT OBSERVATORIES

Transformative

for the scientific aims of the next decades and for fields and problems yet unknown.

Achievable

by maturing technologies wisely and building on the experience of past flagships

Inclusive

by pursuing open science in which the best ideas rise to the top and all are welcome

Ready

to proceed to development, supported by a strong and united community

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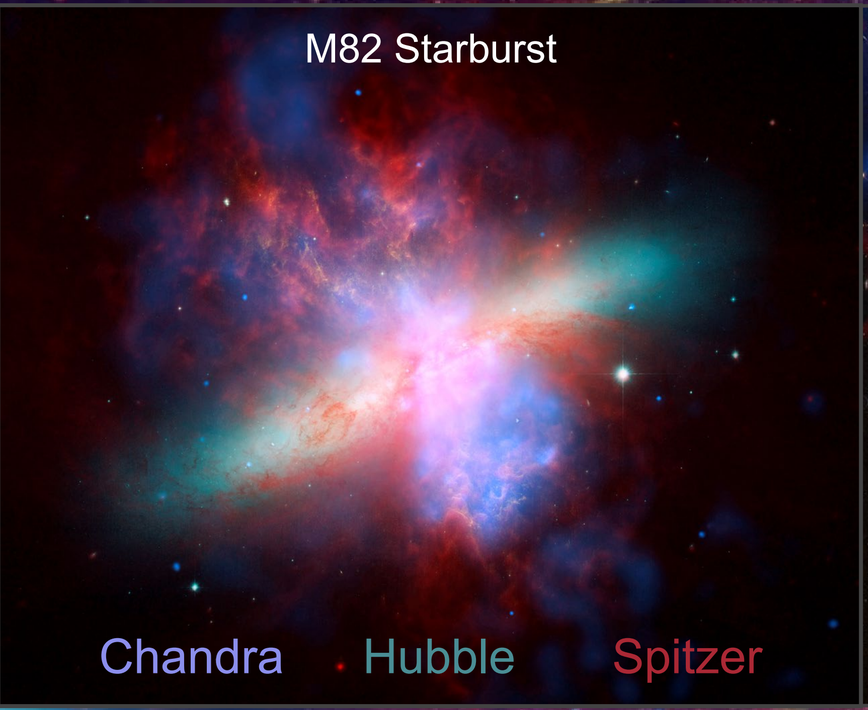
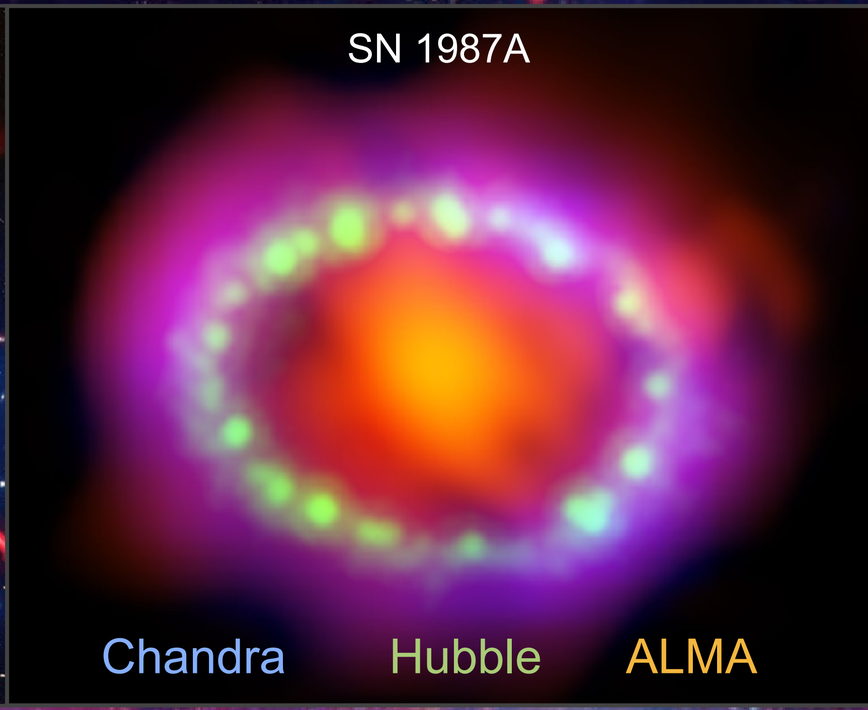
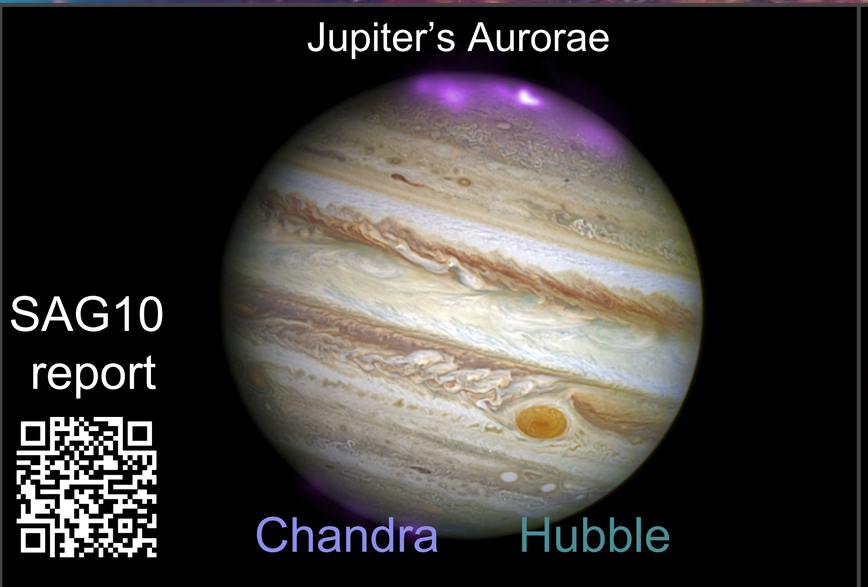
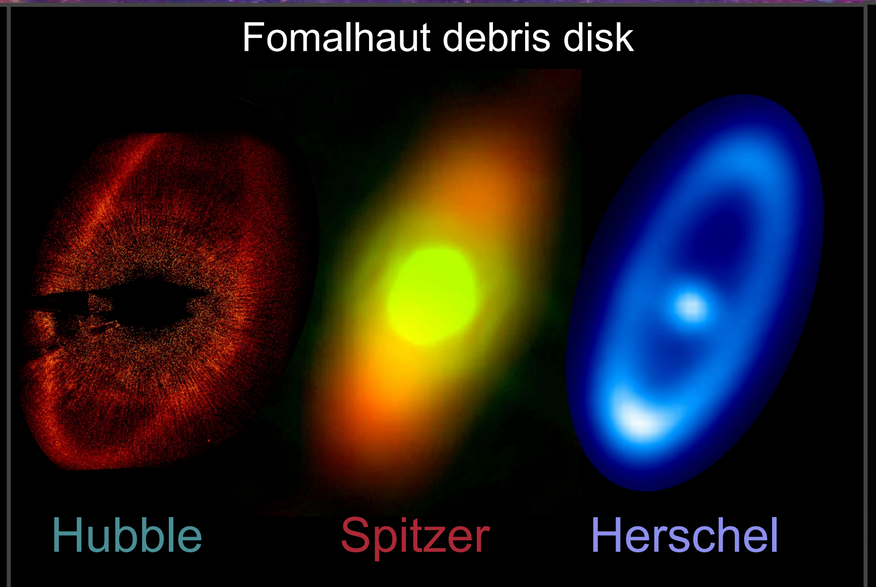
The "Old" Great Observatories — Transformative Science Together!

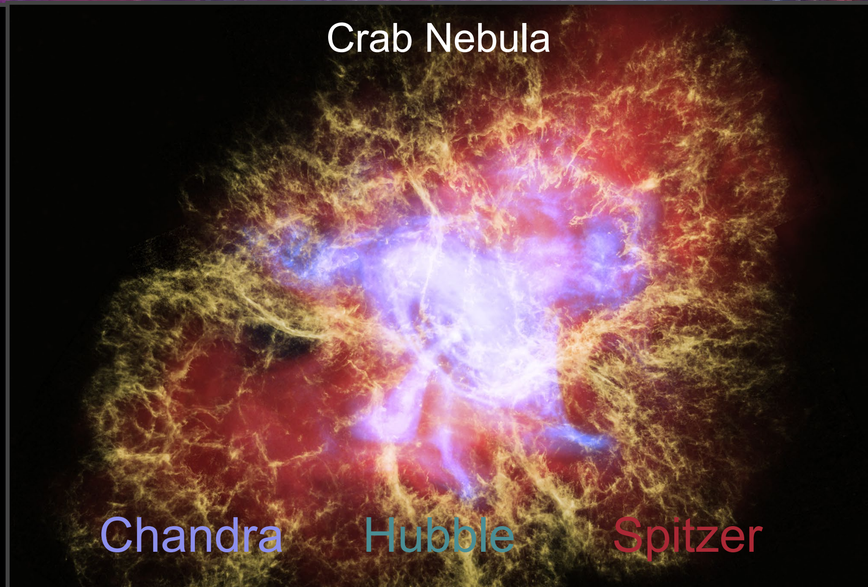




science highlight graphics available at www.newgreatobservatories.org







Science Always Leads - The Vision of Astro2020

Worlds and Suns in Context

Priority Area: Pathways to Habitable Worlds

Understanding the connections between stars and the worlds that orbit them, from nascent disks of dust and gas through formation and evolution, is an important scientific goal for the next decade. The effort to identify habitable Earth-like worlds in other planetary systems and search for the biochemical signatures of life will play a critical role in determining whether life exists elsewhere in the universe.

KEY RECOMMENDATIONS:

New Messengers and New Physics

Priority Area: New Windows on the Dynamic Universe

Over the next decade, a range of complementary observations—from radio to gamma rays, gravitational waves, neutrinos, and high-energy particles—will enable investigations into the most energetic processes in the universe and address larger questions about the nature of dark matter, dark energy, and cosmological inflation. These growing capabilities will enable closer study of neutron stars, white dwarfs, black hole collisions, stellar explosions, and the birth of our universe.

KEY RECOMMENDATIONS:

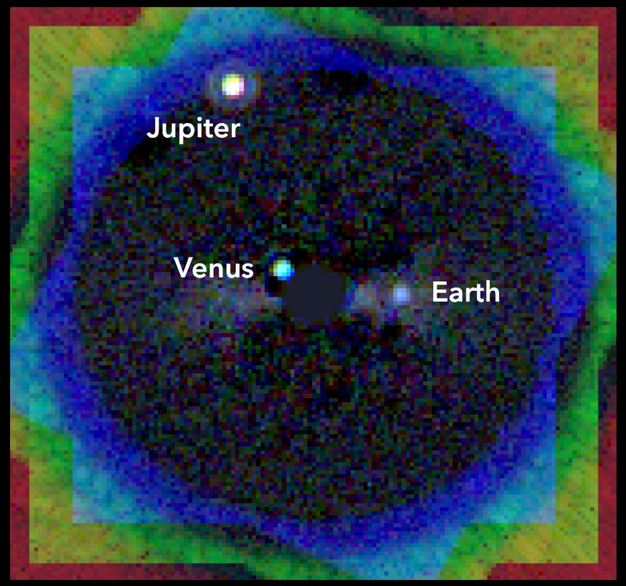
Cosmic Ecosystems

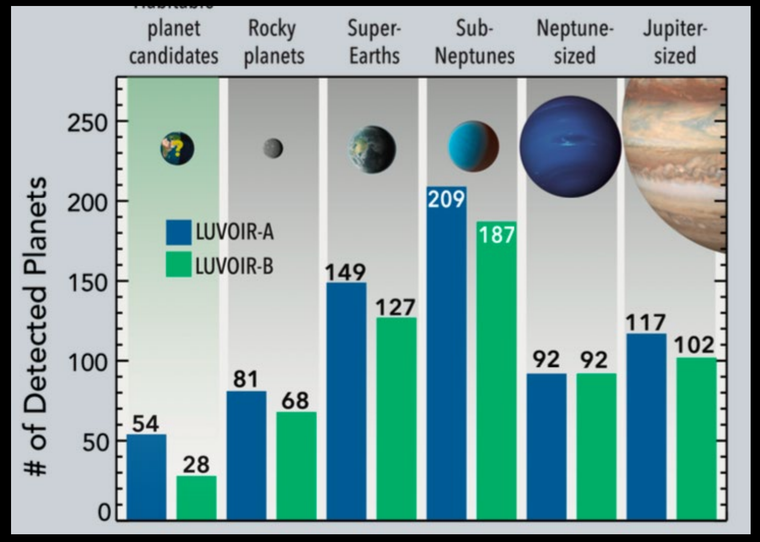
Priority Area: Unveiling the Drivers of Galaxy Growth

Research in the coming decade will revolutionize our understanding of the origins and evolution of galaxies, from the cosmic webs of gas that feed them to the formation of stars. New observational capabilities across the electromagnetic spectrum along with computation and theory will help resolve the rich workings of galaxies on all scales.

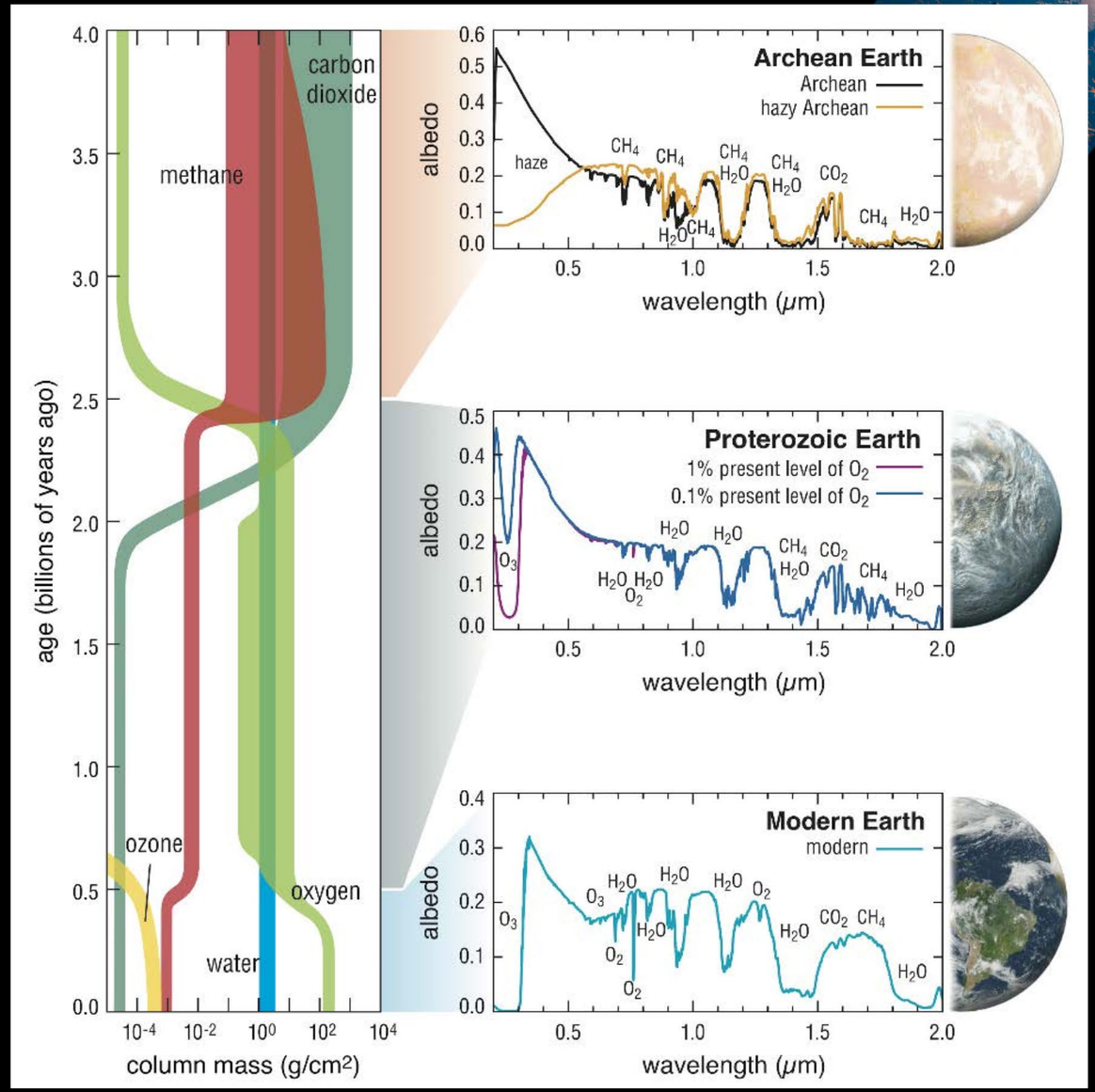
KEY RECOMMENDATIONS:

Habitable Worlds Observatory



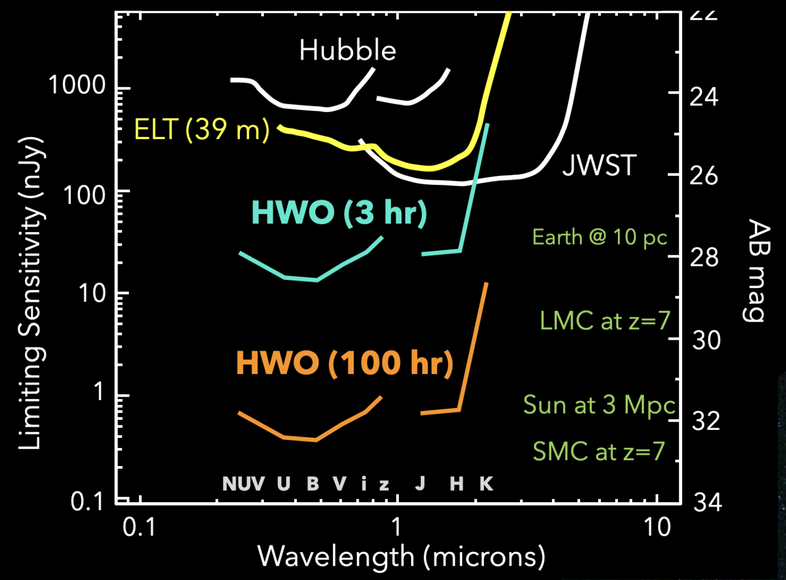


What is a scientific revolution worth?



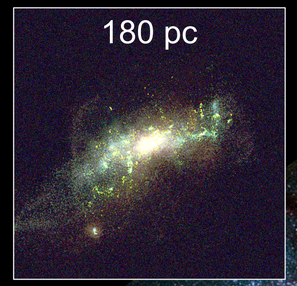
Habitable Worlds Observatory

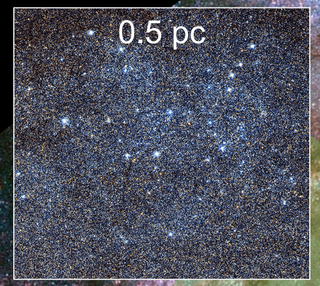
Revolutionary Depth



Spatial Resolution

at z = 2	at 5 Mpc	at 50 pc	at 3 AU
180 pc	0.5 pc	1 AU	40 km

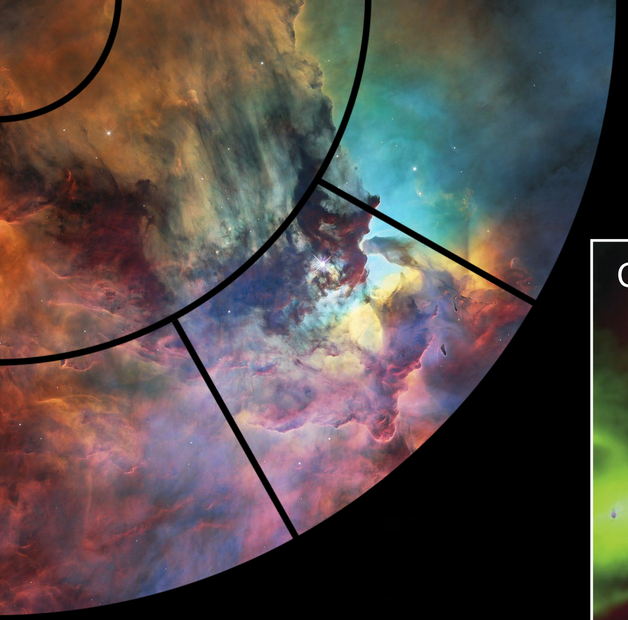


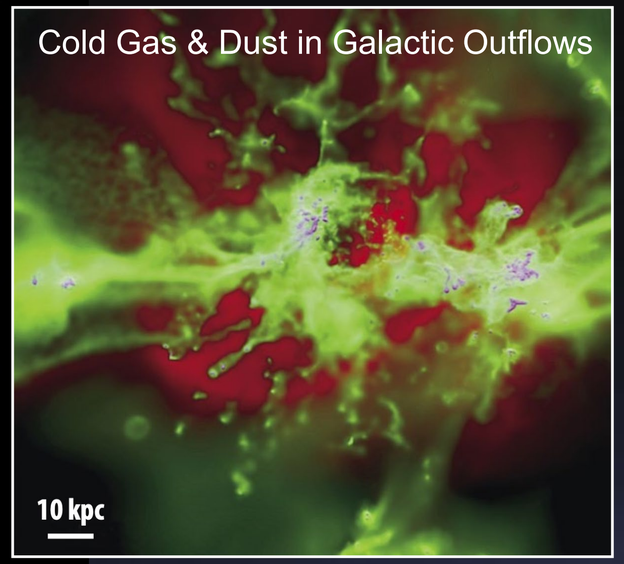


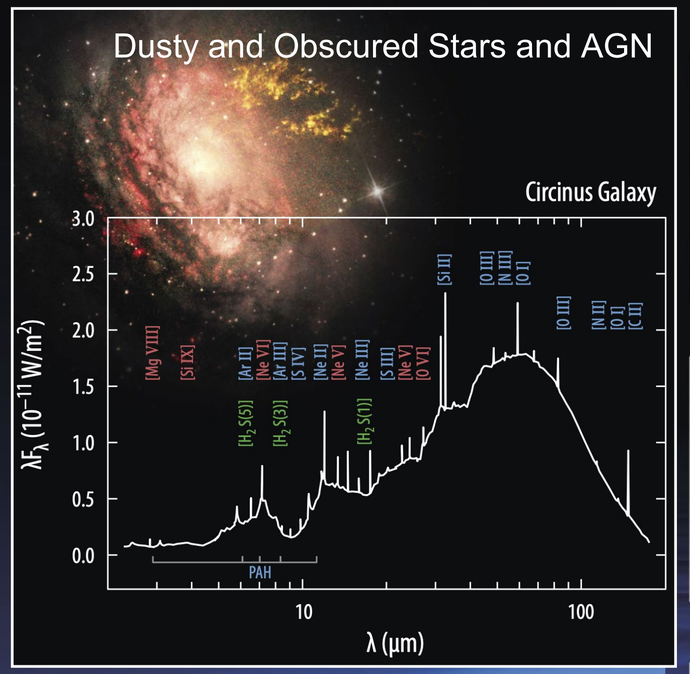
Wide-Field, High Spatial Resolution
UV Multiobject Spectroscopy

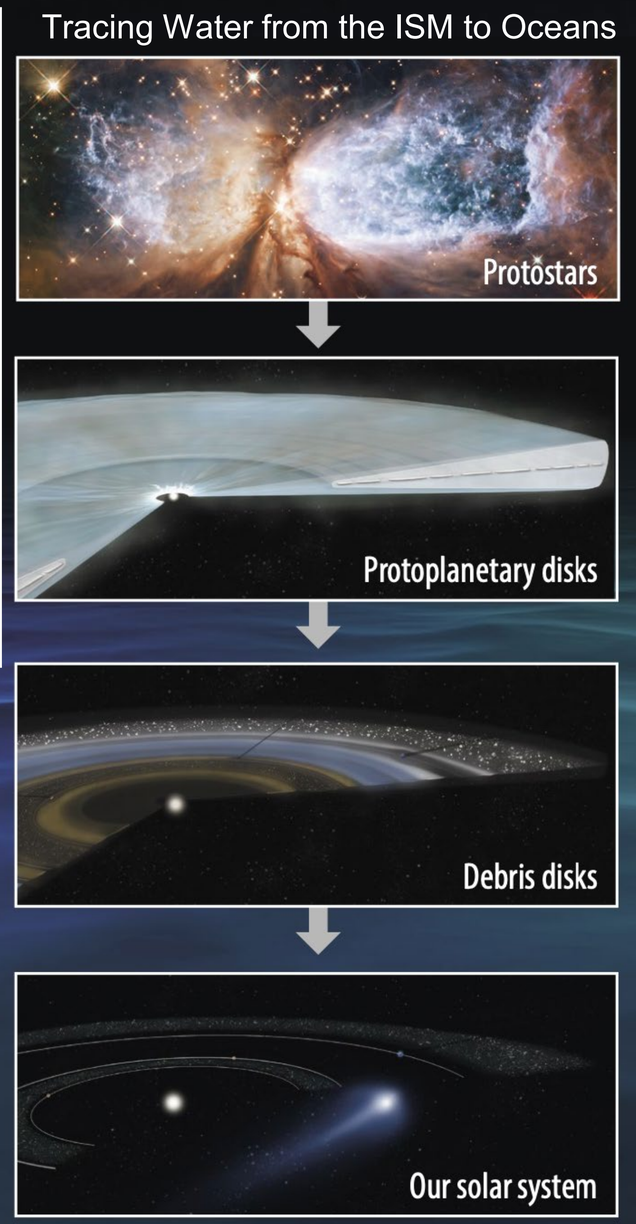
Cold — Gas Temperature Probed by Key Ultraviolet Lines — Hot

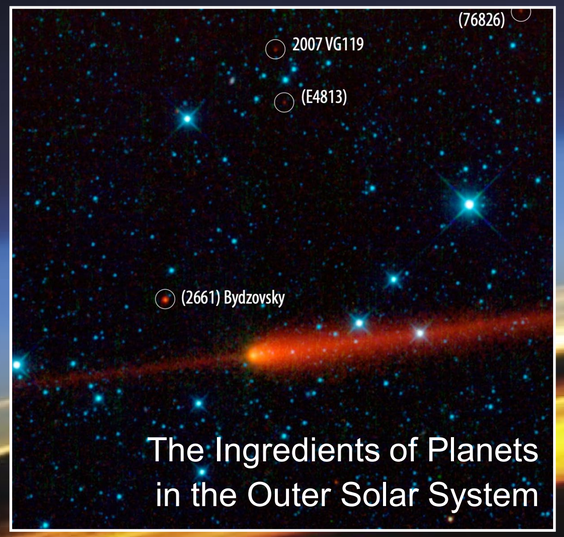
The Far-Infrared Great Observatory

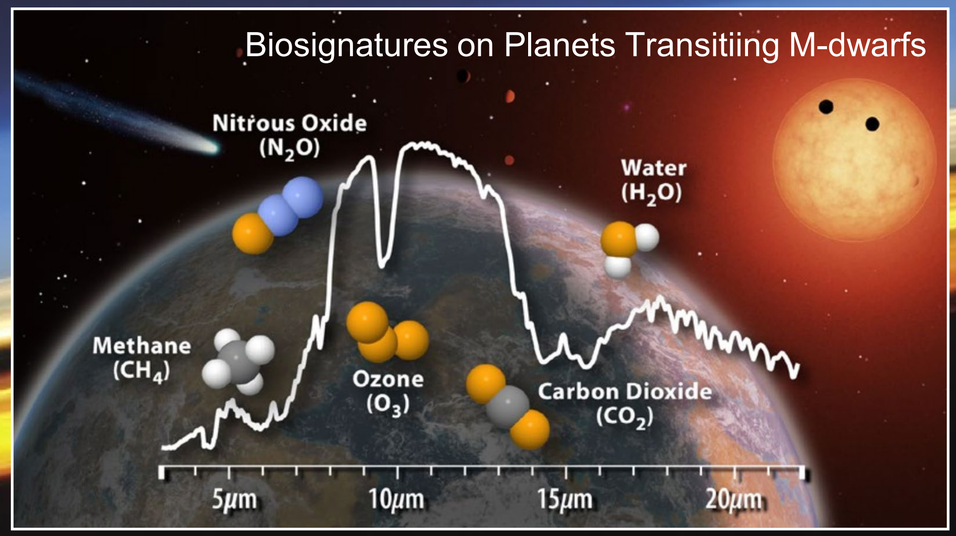




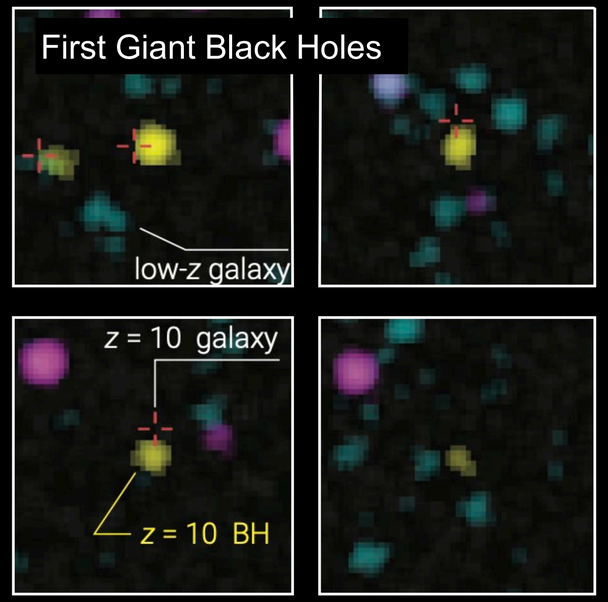




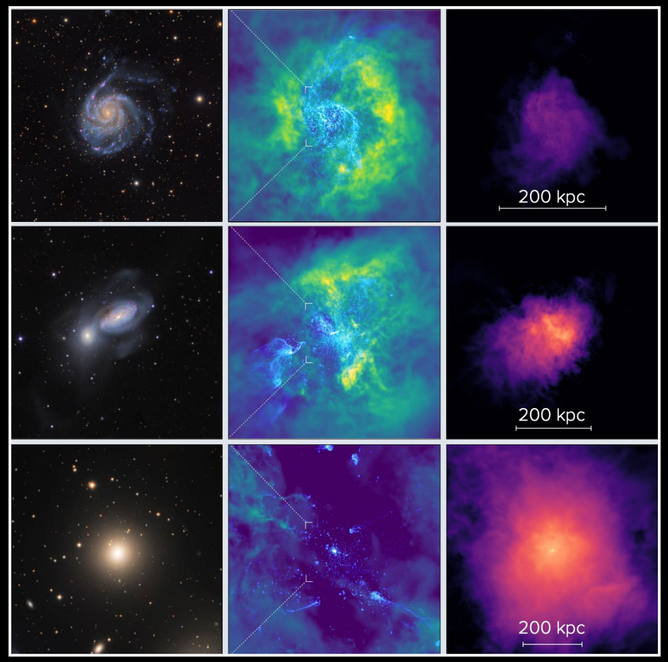


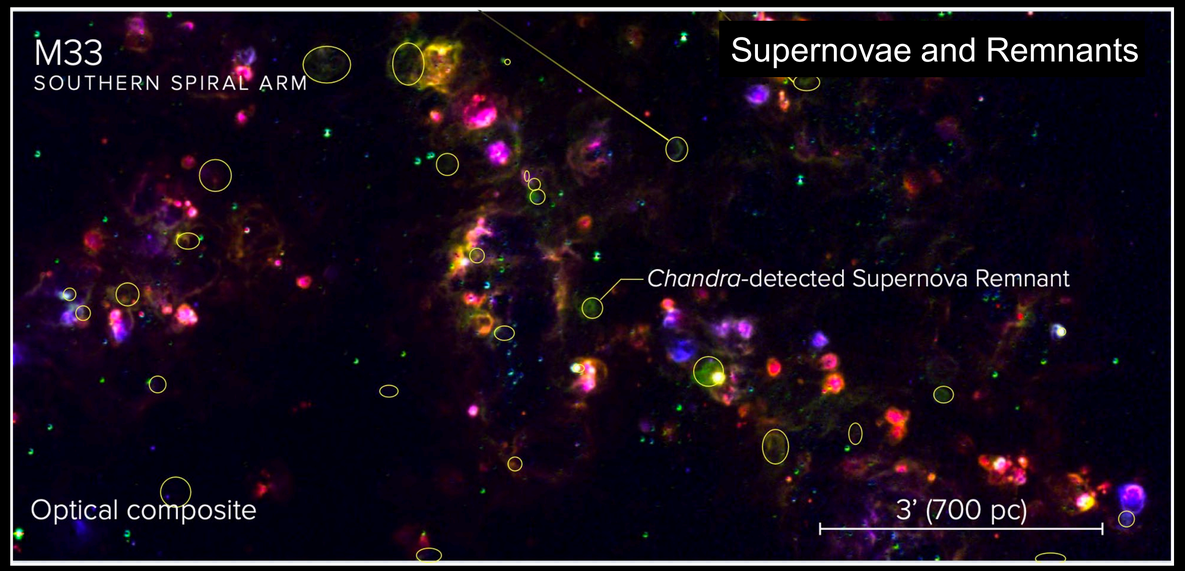


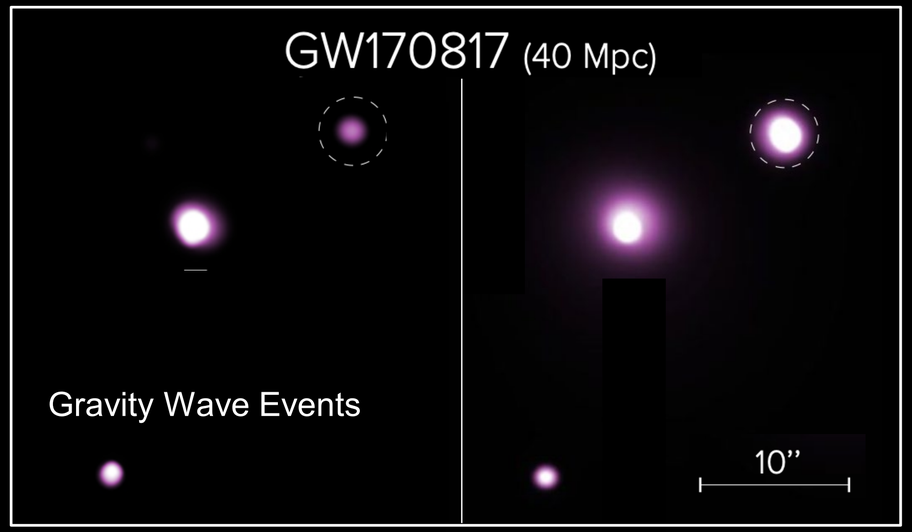
The X-ray Great Observatory



Galactic Winds and the Missing Baryons







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Achievable with lessons learned from:

JWST

It works! We can deploy complex systems and operate them at the diffraction limit, so let's evolve from this.

Make future missions "evolutions" but not "revolutions" on existing designs and engineering.

Using a big rocket provides ample mass and volume margin to reduce system complexity.

Mature architecture and technology fully before starting development phase, to better align funding.

Other missions

Costs cannot be estimated robustly, and therefore controlled, until a design is matured.

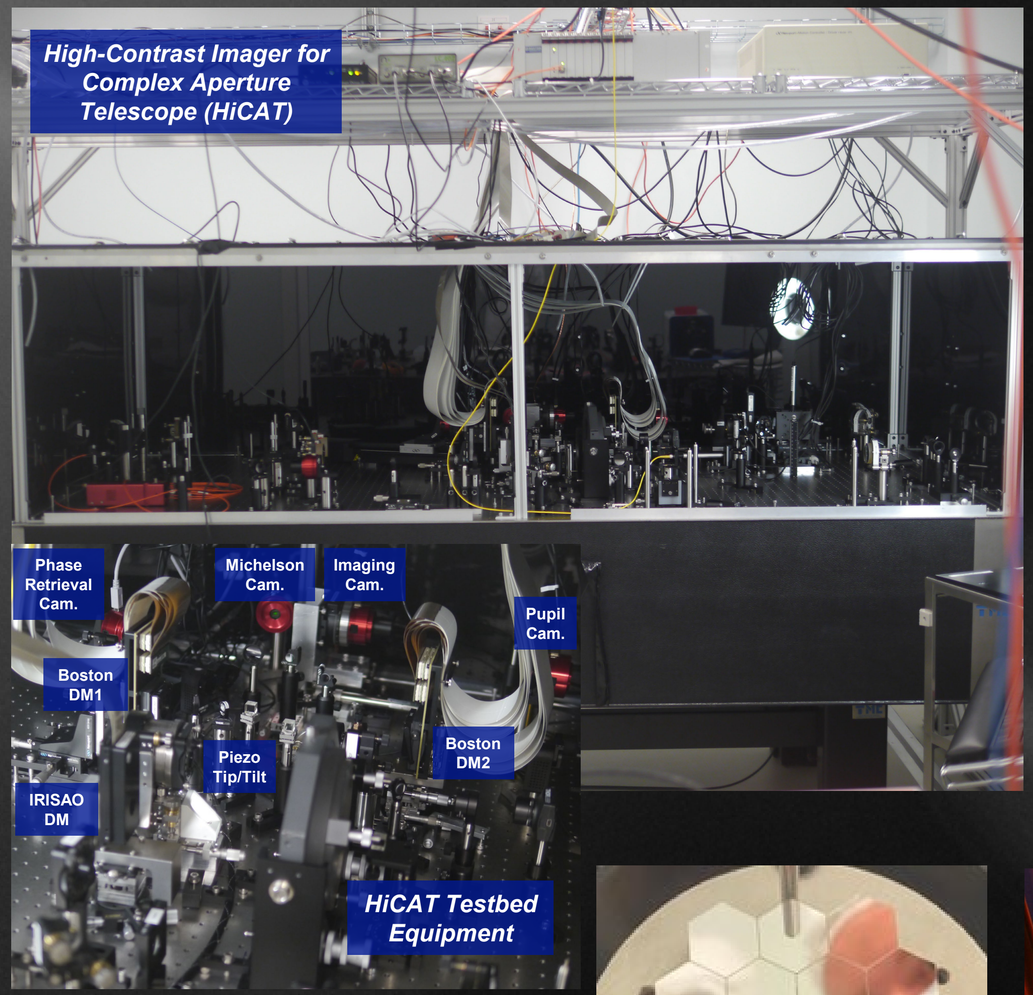
This will increase costs in the early phases but make flagships cheaper in the long run.

Plan for servicing to expand capabilities, control initial costs, and reduce risks.

Build to schedule so as to avoid an open ended development path (like planetary missions).

The Astro2020 **Great Observatories Maturation Program (GOMAP)**, now started by NASA, will incorporate these lessons into the development of the NGOs.

Achievable with wise technology development



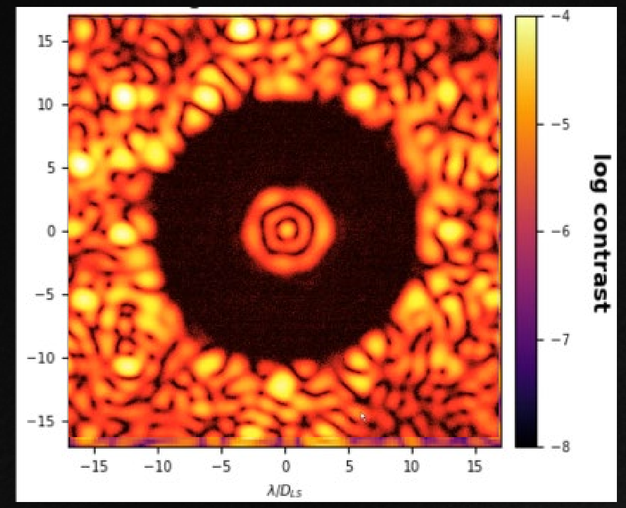
Soummer et al. 2022 SPIE paper

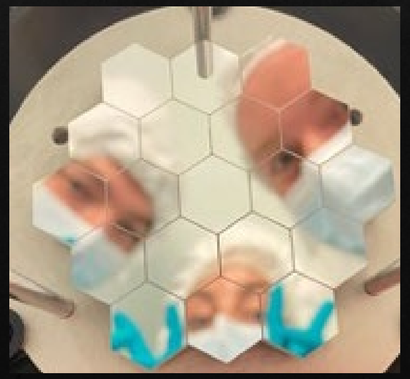
The Makidon Lab at STScI is developing high-contrast imaging technology for segmented-aperture telescopes.

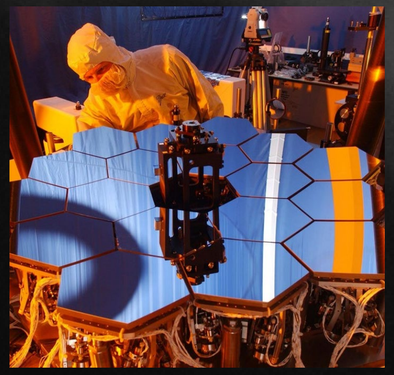
We have detected 10-8 contrast injected planets in a realistic “dark hole”.

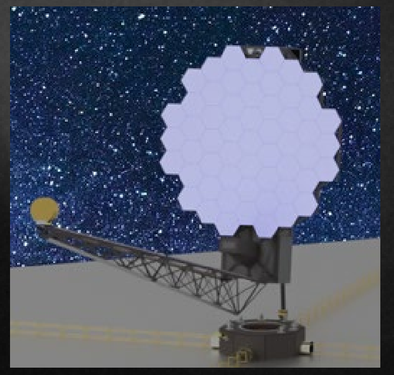
We plan for 10^{-10} in broadband light by 2027.

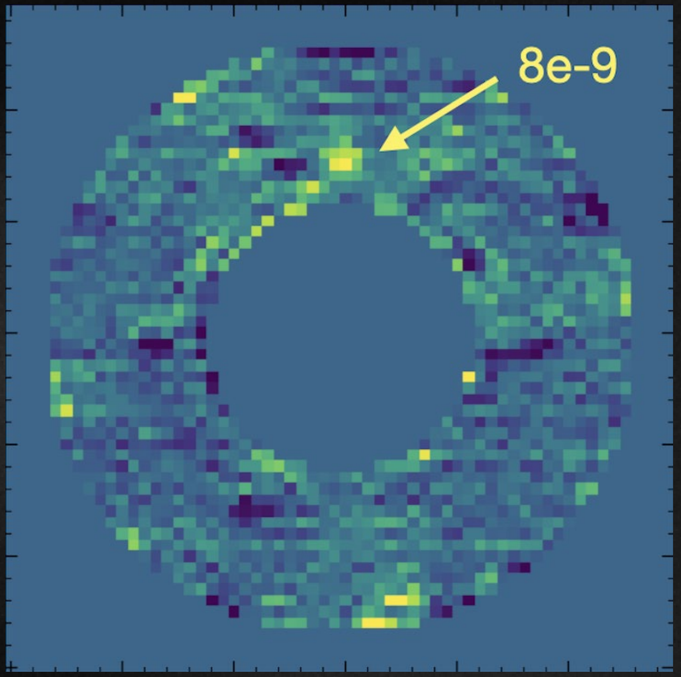
Latest “dark hole” contrast ~2e-8, IWA 4.6 λ/D











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a.k.a. Only NASA Missions Can Train People for Future NASA Missions*

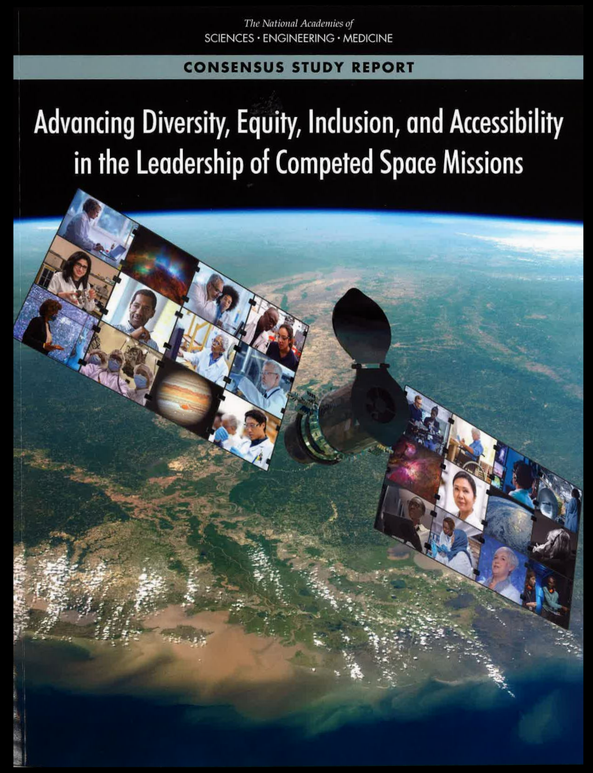
You, yes you! are qualified and welcome to contribute to the pathway of mission development for the NGOs.

There is no such thing as being too early in your career, too inexperienced, from the wrong science area / institution / background.

There are also opportunities for involvement across many levels of time commitment.

Following recommendations by the NAS report “Advancing DEIA in the Leadership of Competed Space Missions” (2022), the NGO effort seeks active involvement and mentoring well beyond the “insiders” who typically drive mission development.

For more info on how to get involved, attend Wednesday’s splinter: https://www.greatobservatories.org/aas241



**This idea and some others here are from Keivan Stassun’s talk at the AAS 240 NGO Splinter*

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TWO HUNDRED FORTY FIRST MEETING OF THE AAS SEATTLE, WASHINGTON, 8–12 JANUARY 2023

SCHEDULE of EVENTS

ALL TIMES PACIFIC

MONDAY

NASA TOWN HALL
12:45PM — 1:45PM | BALLROOM 6E

***the* GREAT OBSERVATORIES MISSION & TECHNOLOGY MATURATION PROGRAM**
2:00PM — 3:30PM | ROOM 4C–3

TUESDAY

STARLIGHT SUPPRESSION *for the* HABITABLE WORLDS OBSERVATORY (IROUV)
9:00AM — 11:00AM | ROOM 4C–3

STScI TOWN HALL
12:45PM — 1:45PM | ROOM 612

ULTRAVIOLET SCIENCE & TECHNOLOGY INTEREST GROUP SPLINTER
1:30PM — 3:30PM | ROOM 211

WEDNESDAY

***the NEW GREAT OBSERVATORIES* SCIENCE ANALYSIS GROUP**
1:00PM — 3:00PM | ROOM 303

THURSDAY

***the NEW GREAT OBSERVATORIES at the* NASA HYPERWALL**
9:20AM — 9:35AM | EXHIBIT HALL

REMAIN IN LIGHT

Ready
for your involvement!

Attend events here in Seattle!

Learn more about GOMAP!

Join our website and Slack team!

Join the New Great Observatories Science Analysis Group (Wed 1-3 PM)

www.newgreatobservatories.org

Join us!

STScI will host a special workshop this summer to support community involvement in the next stages of this grand movement.

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Thank you!

www.newgreatobservatories.org

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