



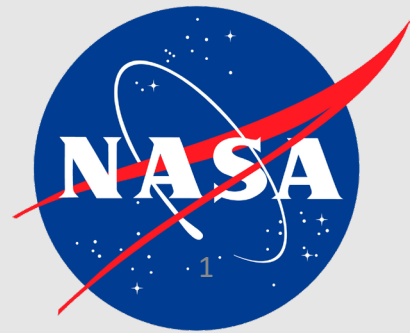
# The Physics of the Cosmos Program Office

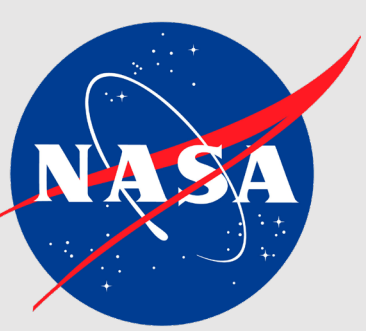
**Francesca Civano and Brian Humensky**

PhysCOS Chief Scientists

*NASA – GSFC*

APS meeting 2023

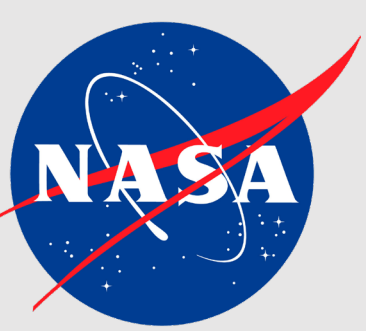




# Outline



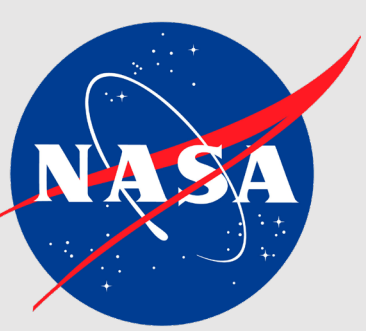
- Role of the PhysCOS Program Office
- Technology Gaps
- Science Gaps
- PhysCOS Science for the Habitable Worlds Observatory
- PhysCOS and TDAMM
- How to get involved: SIGs and SAGs, Conferences



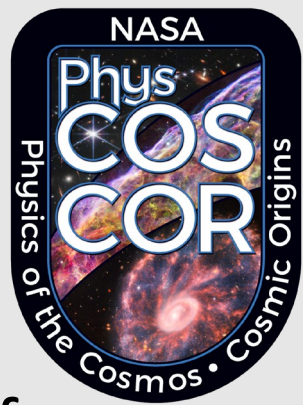
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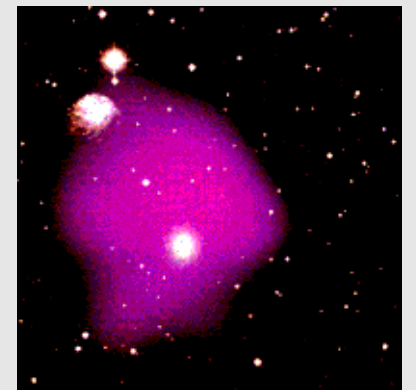
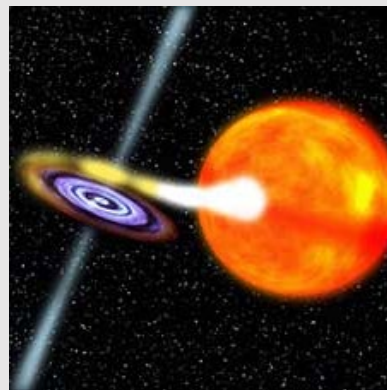
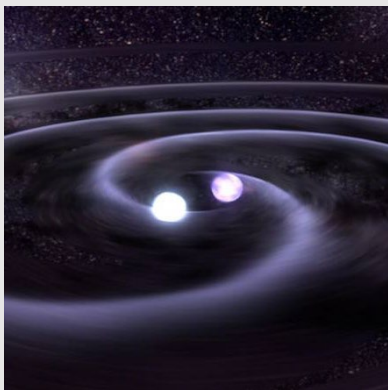
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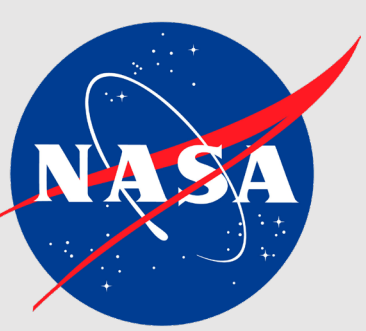


# PhysCOS Program Office Purpose



The program office supports the community working in the fields of high-energy astrophysics, cosmology, and fundamental physics, to explore some of the most fundamental questions regarding the physical forces and laws of the universe.



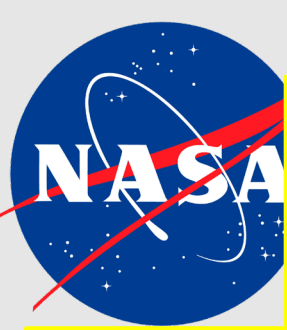


# Activities Supporting PhysCOS Goals & Priorities

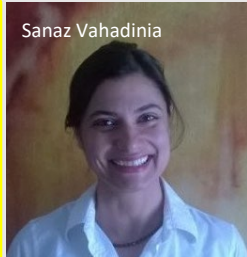


The program office **supports the community** working in these fields by

- Facilitating the PhysCOS Program Analysis Group (PhysPAG)
- Informing members of upcoming funding and engagement opportunities
- Soliciting and prioritizing community-identified technology gaps
- Managing funded technology projects with benefits to PhysCOS science
- Our activities include:
  - **Mission studies** and pre-project mission oversight, insight, and support
  - **Strategic technology** (SAT) maturation oversight, insight, and support
  - Maintaining **science cognizance** to enable more successful NASA strategic planning

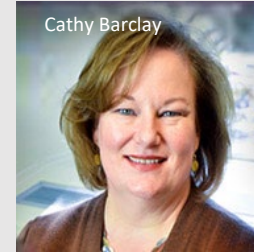
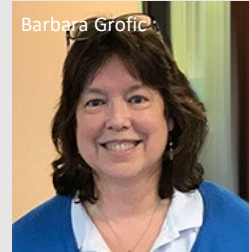


# PhysCOS: Who We Are



HQ Program Executive: Shahid Habib  
 HQ Program Scientist: Valerie Connaughton  
 HQ Dep. Program Scientist: Sanaz Vahadinia

**Program Management**  
*Program Manager:* Barbara Grofic  
*Deputy Program Manager:* Cathy Barclay  
*Program Business Manager:* Tracy Felton-Robinson  
*Administrative Assistant:* Susan Wright



**Resources Management Group**  
*Deputy Program Business Manager:* Patricia Smith  
*Programmatic Officer:* Patricia Butler\*  
*Resource Analyst:* Jessie Hughes\*  
*Resource Analyst:* Ryan Bradley\*

**Procurement Support:**  
 Dean Patterson

**Program Support**  
*IPTL:* Colleen Ponton\*  
*PSM:* Mary Morrow\*

**Program Technology & Systems Engineering**  
*Program Systems Engineer:* Dr. Mark Matsumura^  
*Technology Development Manager:* Rachel Rivera  
*Chief Technologist:* Jason Derleth (detail)  
*Program Technologist:* Dr. Opher Ganel\*

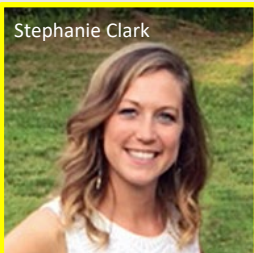
**Program Science**  
*PhysCOS Chief Scientists:* Dr. Francesca Civano, Dr. Brian Humensky  
*COR Chief Scientist:* Dr. Peter Kurczynski  
*PhysCOS/COR Sup.Scientists:* Bernard Kelly\*, Ron Gamble\*  
*PhysCOS/COR Science PSM:* Stephanie Clark\*

**Strategic Studies & Implementation**

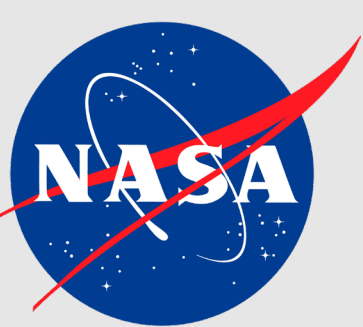
**ULTRASat Study**  
*Project Manager:* Barbara Grofic  
*Deputy Project Manager:* Cathy Barclay  
*Project Scientist:* Dr. James Rhoads  
*System Engineer:* Dr. Mark Matsumura

**LISA Study**  
*Study Manager:* Terry Doiron  
*Study Scientist:* Dr. Ira Thorpe  
*System Engineer:* Norman Rioux^

**Decadal Studies**  
**TDAMM Study**  
*Study Managers:* Dr. Chris Roberts  
*Study Scientists:* Dr. Brian Humensky  
*Study Systems Engs:* Dr. Mark Matsumura  
*Study Technologist:* Jason Derleth



^Independent Technical Authority  
 \*Contractor



https://pcos.gsfc.nasa.gov/

Search NASA



# Physics of the Cosmos



- About PhysCOS
- PhysPAG
- Mission Studies
- Technology
- Documents

## About Physics of the Cosmos

The Physics of the Cosmos is NASA's **Astrophysics Division Exploration Program (ExEP)** is to explore some of the most fundamental questions in the universe: the validity of Einstein's General Theory of Relativity, the nature of matter and energy in extreme environments, the evolution of the universe, and the nature of dark matter and dark energy.

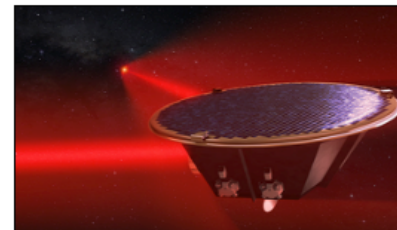
Located at the Goddard Space Flight Center, the Physics of the Cosmos Office supports, tracks, and coordinates a suite of science missions and enabling technology topics. PhysCOS activities include:

- Facilitating the **PhysCOS Program Analysis Group (PhysPAG)**, which comprises standing Science Interest Groups (SIGs) and Science Analysis Groups (SAGs) convened to address related science and technology topics.
- Keeping its members informed of upcoming developments and funding opportunities, both within NASA and at other agencies engaged in science and technology activities.
- Soliciting, and prioritizing community-identified technology gaps that must be closed to enable or enhance future strategic Astrophysics missions with benefits to PhysCOS science. This technology gap prioritization informs APD's strategic technology development solicitation, selection, and funding.
- Managing funded technology projects with benefits to PhysCOS science.

- SIGs and SAGs
- Executive Committee
- Meetings
- Events Calendar
- IP SIG
- CoS SIG
- CR SIG
- GR SIG
- GW SIG
- XR SIG
- AWESOM
- GTN SAG
- MMA SAG
- NGO SAG
- Tech SAG

focused programs contained within the **Origins (COR)** and the **Exoplanet** programs. Its purpose is to explore the physical forces and laws of the universe, the nature of spacetime, the behavior of matter and energy in extreme environments, the parameters governing inflation and the evolution of the universe, and the nature of dark matter and dark energy.

PhysCOS Office supports, tracks, and coordinates a suite of science missions and enabling technology topics. PhysCOS activities include:

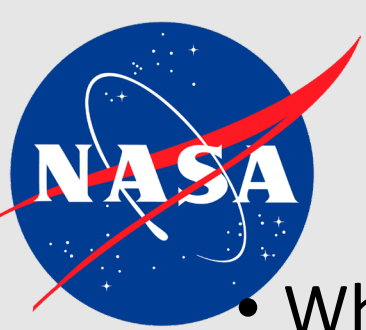


## PhysCOS News

See our new [Events Calendar](#)

Program News and Announcements

- [Sign up for PhysCOS News and Announcements](#)
- 1 March**  
PhysCOS Announces New PhysPAG Executive Committee Members » [Details](#).
- 1 March**  
PRIMA Science Community Workshop from 21–22 March 2023 » [Details](#).
- 1 March**  
The AGN Vision Series » [Details](#).
- 1 March**  
ROSES-23 Released » [Details](#).
- 7 February**



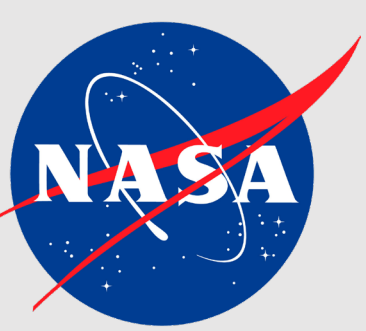
# PhysCOS & the Astro2020 Report



- What PhysCOS science should drive the design of the Future Great Observatories?
  - PhysPAG, SIGs and SAGs
  - Precursor and Preparatory science
  - Science with Habitable Worlds Observatory (HWO)
- Technology investments to enable X-ray Probes
- Time Domain and Multi-Messenger Astrophysics
  - Studying implementation options for a General Observer Facility focused on TDAMM.
  - TDAMM Science Interest Group spinning up to study infrastructure issues.
- State of the profession: AWESOM SAG.

See D. Norman talk

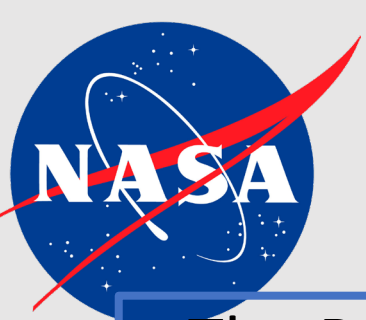




# Outline



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# Strategic Technology Development

See B. Humensky talk

- The Program Office monitors and manages the PhysCOS and COR Strategic Astrophysics Technology (SAT) and direct-funded technologies
  - Astro2020 related technology development (FGOs, Probes)
  - Conduct Technological Readiness Level (TRL) assessments
- 
- PhysCOS/COR Technology Website <https://apd440.gsfc.nasa.gov/technology.html>
    - Updated with 2022 SPIE and AAS papers
  - AstroTech Database <http://www.AstroStrategicTech.us/>
    - Published Annual Reports 2022
  - Astrophysics Biennial Technology Report (ABTR) 2022

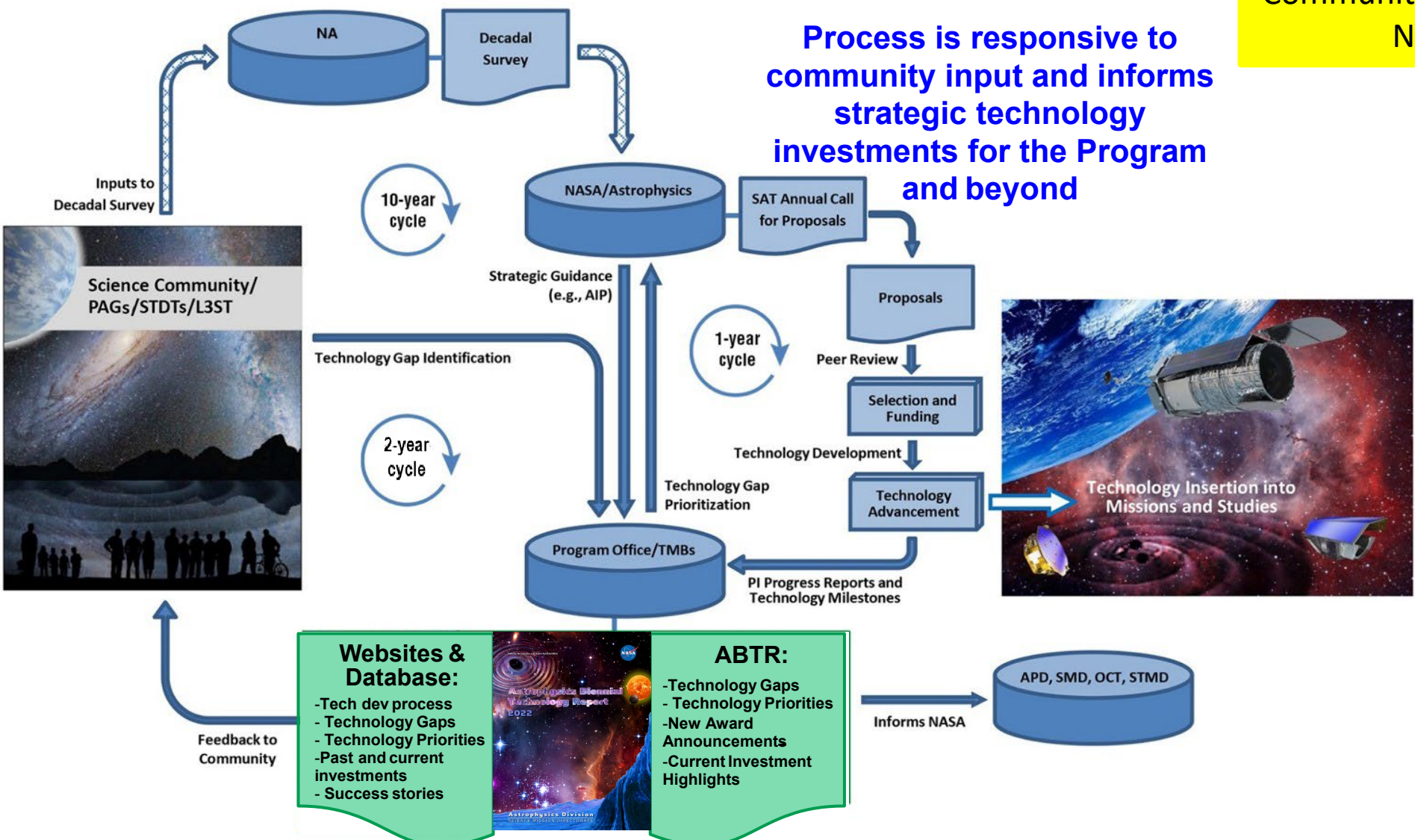


# Astrophysics Biennial Technology Report

<https://apd440.gsfc.nasa.gov/technology.html>

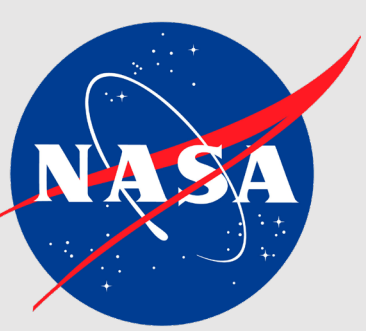
Community Inputs due on May 31<sup>st</sup>, 2024  
Next report in Fall 2024

Process is responsive to community input and informs strategic technology investments for the Program and beyond



[https://apd440.gsfc.nasa.gov/images/tech/2022\\_ABTR.pdf](https://apd440.gsfc.nasa.gov/images/tech/2022_ABTR.pdf)

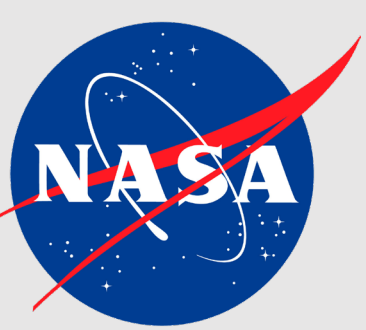




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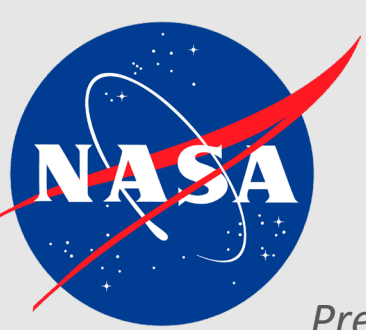
# Science Gap Typology



Definitions from 1<sup>st</sup> Precursor Science Workshop:

- Follow-up science: Enhances the science return of a *mission already flying*
- Preparatory science: Enhances the science return & helps plan operations for an *upcoming mission* that is already designed
- Precursor science: Provides information needed to quantify a *future mission's ability* to meet its science goals and to assess mission design options

<https://exoplanets.nasa.gov/exep/astro2020-precursor-sciws1/>



# FGO Precursor Science

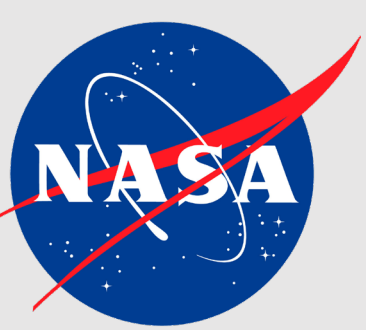
*Precursor Science: Science investigations that will inform mission architectures and trades with the goal of reducing mission design and development cost, scope, and risk where possible.*



- Two workshops during 2022 (April and October 2022)
  - Community effort to work on science gaps for the three Future Great Observatory concepts identified in the Astro2020 Decadal Survey Report.
  - Community science gap lists are available on workshop website.
  - Chief Scientists of Program Offices distilled a set of science gaps from community draft; NASA HQ revised list for ROSES Call on Precursor Science.
- Precursor Gaps dominated by Exoplanet science, only five Astro science gaps are related to the HWO and X-ray FGOs concept



**GOAL:** revise and update this list

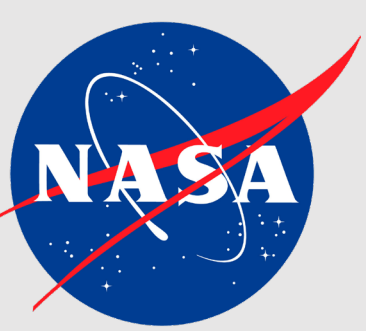


# Compiling Science Gaps



**GOAL:** produce a detailed science gap list for PhysCOS related science (not just strategic gaps)

- Physics of the Cosmos has a very broad scope!
  - > Figuring out how to include discussion of science gaps relevant to entire field: X-rays, CMB, gamma rays, cosmic rays, gravitational waves, dark matter, dark energy
- Like technology gaps, science gaps need review and update – but some still formulating for the first time
- Anticipate developing a process similar to the Technology Gaps process and following the "lessons learned" by ExEP – for example:
  - Call for “one-pager” science gap
  - Review by SIGs and by PhysPAG EC
  - Publish the list on PhysCOS website
  - Continuously update the list in the years and add new science gaps

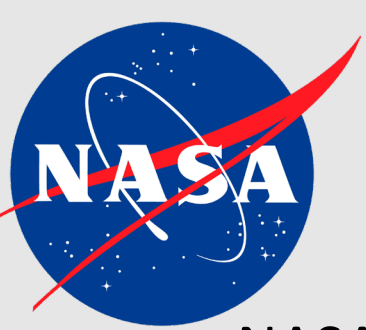


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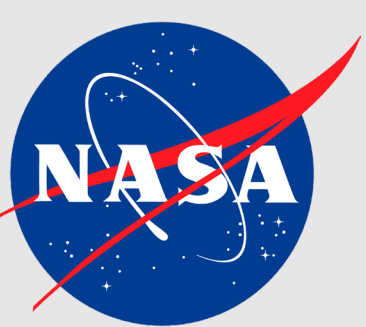


# The Habitable Worlds Observatory



- NASA's response to Astro2020 recommendation of an IR/Opt/UV observatory
- HWO will conduct a **transformative** general Astrophysics program
- From Clampin AAS presentation:

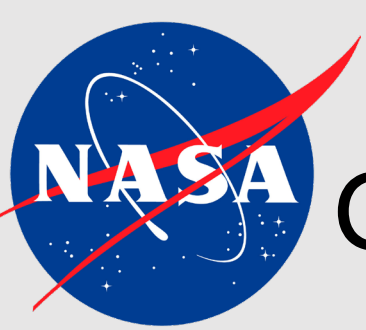
- **Build to schedule:** Mission Level 1 Requirement e.g Planetary missions
- **Evolve technology:** Build upon NASA investments i.e.
  - JWST segmented optical system, Roman coronagraph, & Sensors
- **Next Generation Rockets:** Leverage opportunities offered by large fairings to facilitate mass & volume trades
- **Planned Servicing:** Robotic servicing at L2
- **Robust Margins:** Design with large scientific and technical margins
- **Mature technologies first:** Reduce risk by fully maturing the technologies prior to development phase.



# PhysCOS and HWO



- Collect community input:
  - What are the PhysCOS science questions that HWO can address in the general Astrophysics program?
  - Compile a list of topics/abstracts that can be developed by EC, SIGs and SAGs
  - Move to mini-white papers as done early on for JWST

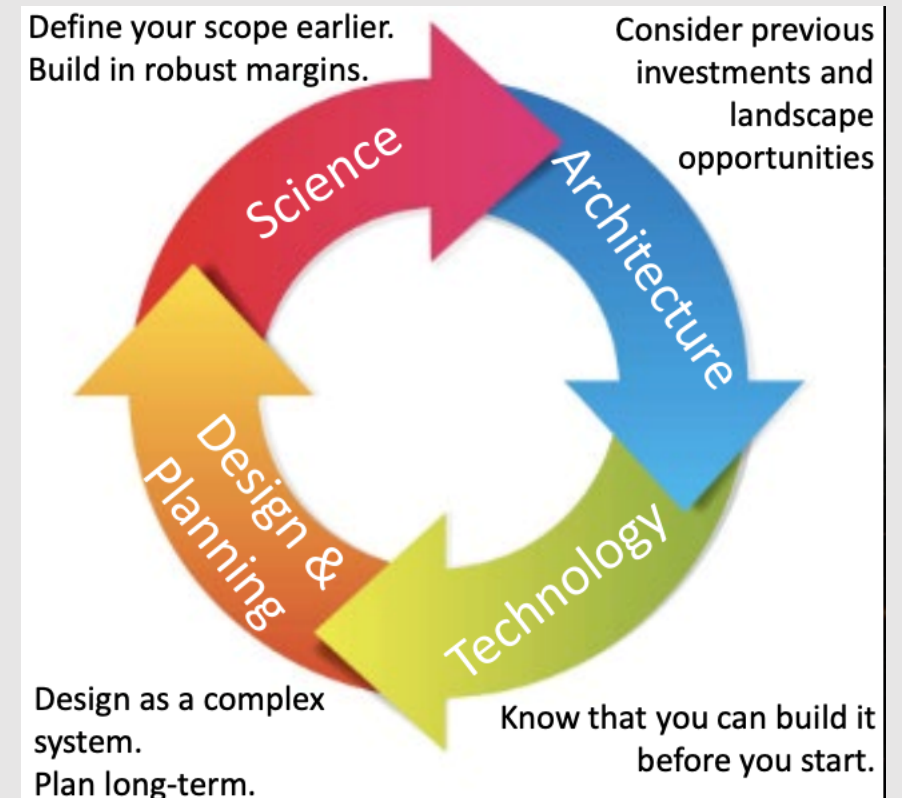


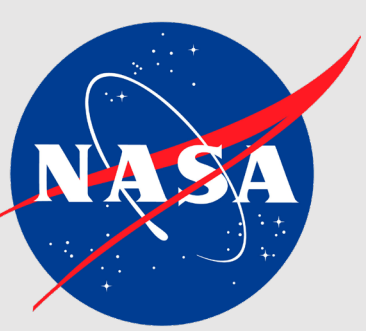
# Great Observatories Maturation Program

<https://science.nasa.gov/astrophysics/programs/gomap>



- Response to Astro 2020: “Great Observatories Mission and Technology Maturation Program would provide significant early investments in the co-maturation of mission concepts and technologies.”
- Projects: HWO first, Future Great Observatories (FGO-2 and FGO-3) when appropriate
- 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
- DCL and TOR released on April 13, 2023 → deadline to apply for START June 5, 2023

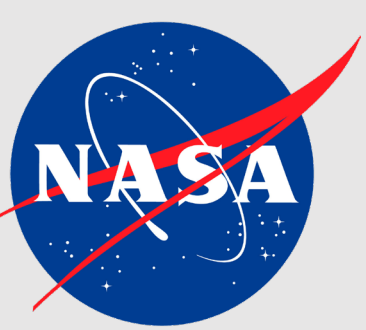




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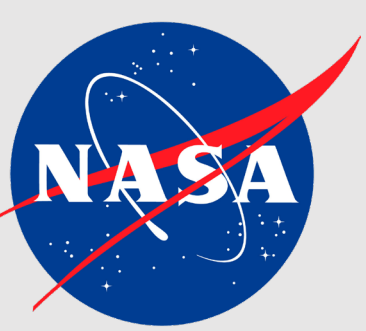


# PhysCOS and TDAMM

See E. Burns talk



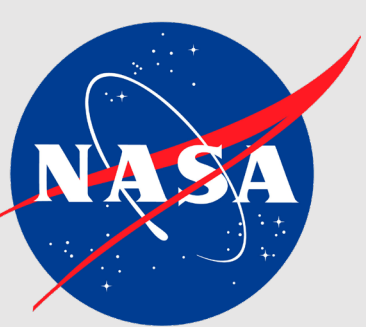
- Lead TDAMM General Observer Facility Implementation Study
  - Ongoing study of the possibility optimizing the NASA fleet for TDAMM through centralized planning, proposal submission, Target-of-opportunity initiation, and science-driven coordination of observations
  - How can we better coordinate NASA response to interesting events?
  - Is there a proposal call to implement to specifically handle TDAMM events?
- New TDAMM SIG (cross-PAG)
  - Beginning to draft ToR; splinter session at HEAD mtg
  - Separately, supporting SAGs studying futures of IPN, space communications
- TDAMM Workshop in August 2022 → White Paper (on our website)
  - Perhaps TDAMM SIG can engage with White Paper as a starting point



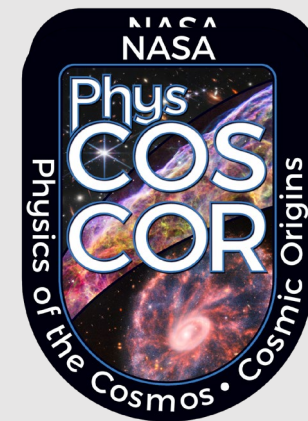
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# How YOU can get involved



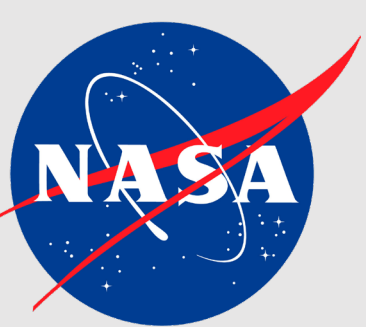
- Join our mailing list: [PCOS-News-join@lists.nasa.gov](mailto:PCOS-News-join@lists.nasa.gov) with Subject="join"
- Join the PhysPAG Executive committee: nominations in the fall
- Join the Science Groups:

## Science Interest Groups (SIGs) Science Analysis Groups (SAGs)

### Cross-PAG



See A. Corsi, J. Finke, C-T Chen and D. Norman talks

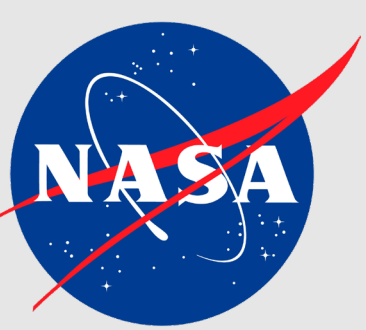


# What do SIGs DO?



- Organize meeting AAS/APS sessions
- Discussions/online seminars
- Organizing white papers in response to questions/studies – as done for Astro 2020
- Starting SAGs to address a specific question/topic and produce a report (~1 year long)
- Anything else that you think of (within reason)
  - E.g., is there a topic that needs a workshop to to address it?

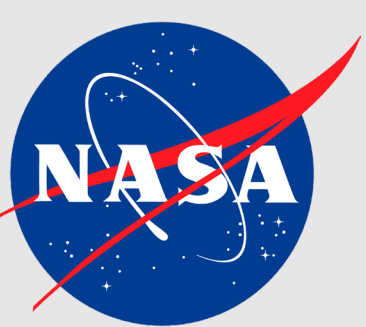




# SIG/SAG Support from Program Office

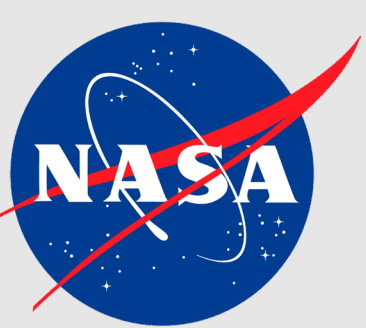


- Dedicated mailing lists for each SIG/SAG
- Webex available for virtual meetings
- Web page maintenance, including event announcements, slides, recordings, documents
- Assistance publicizing activities via PhysCOS News mailing list and at conferences
- Dedicated workshop support



# Get involved!





# PhysCOS Program Analysis Group Executive Committee

