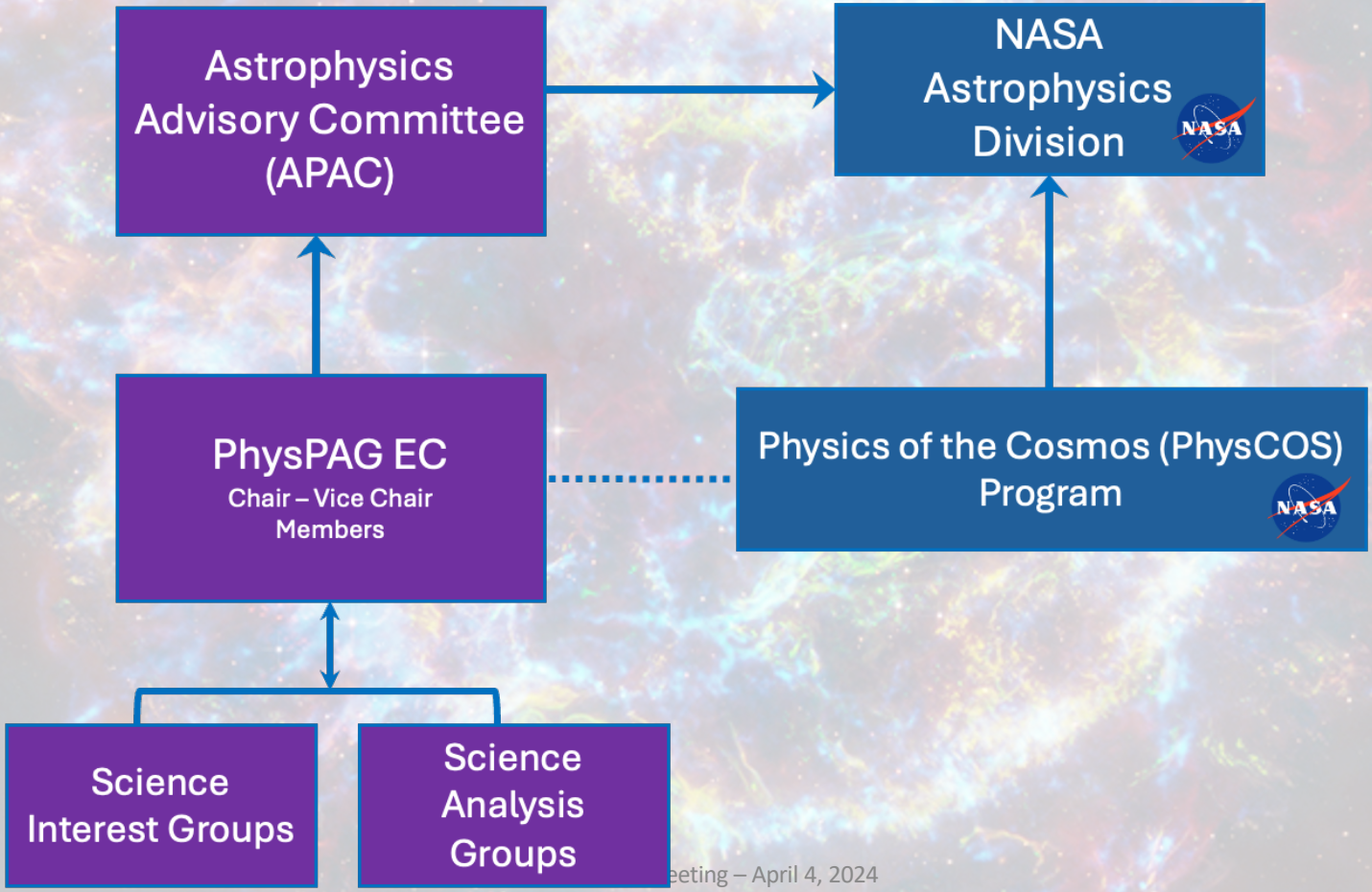
The Physics of the Cosmos Program Office and Program Analysis Group

Brian Humensky and Francesca Civano,

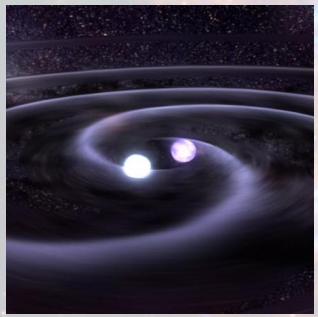
Chief Scientists, PhysCOS

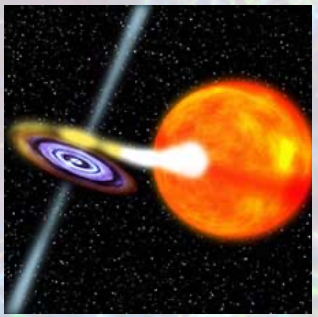
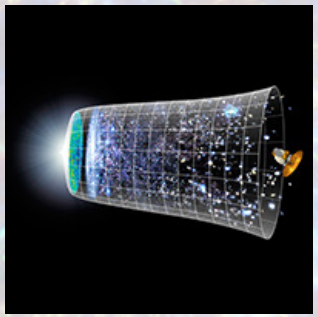
Phys… What?!?


Astrophysics Advisory Committee (APAC)
NASA Astrophysics Division
PhysPAG EC
Chair – Vice Chair
Members
Physics of the Cosmos (PhysCOS) Program
Science Interest Groups
Science Analysis Groups

The PhysCOS Program Office

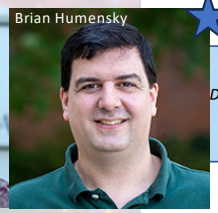
Physics of the Cosmos spans the fields of high-energy astrophysics, cosmology, and fundamental physics, to explore some of the most fundamental questions regarding the physical forces and laws of the universe:




- Manages strategic technology development
- Provides a two-way communication conduit between community & NASA
- Works with sibling program offices: **Cosmic Origins** and **Exoplanet Exploration**

NASA Physics of the Cosmos (PhysCOS) and Cosmic Origins (COR) Programs



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*
RA's: Jessie Hughes*, Ryan Bradley*

Procurement Support:
Space Science Procurement Manager: Malika Graham

Program Support
IPTL: Patricia Butler* *PSM*: Mary Dobay*

Strategic Studies & Implementation

Program Science
PhysCOS Chief Scientists: Dr. Francesca Civano, Dr. Brian Humensky
COR Chief Scientist: Dr. Peter Kurczynski
Deputy COR Scientist: Dr. Swara Ravindranath*[1]
PhysCOS/COR Science PSM: Stephanie Clark*

Program Technology & Systems Engineering
Program Systems Engineer: Dr. Mark Matsumura^
Technology Development Manager: Rachel Rivera
Chief Technologist: Jason Derleth[2]
Program Technologist: Dr. Opher Ganel*

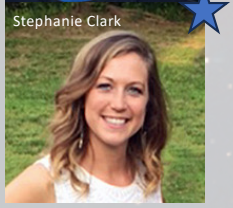
Fornax Initiative
Initiative Manager: Patrick Coronado*
Lead Scientist: Dr. Tess Jaffe
Deputy Scientist: Dr. Francesca Civano

TDAMM ACROSS Initiative
Initiative Manager: Dr. Chris Roberts
Study Scientist: Dr. Brian Humensky
Systems Engineer: Dr. Mark Matsumura

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

ATHENA Study
Study Manger: Dr. Mark Matsumura (Acting)
Study Scientist: Andy Ptak
Deputy Study Scientist: Kristin Madsen
Systems Engineer: Robert Studer*

ULTRASAT MOU Implementation
Initiative Manager: Barbara Grofic
Deputy Initiative Manager: Cathy Barclay
Initiative Scientist: Dr. James Rhoads
System Engineer: Dr. Mark Matsumura

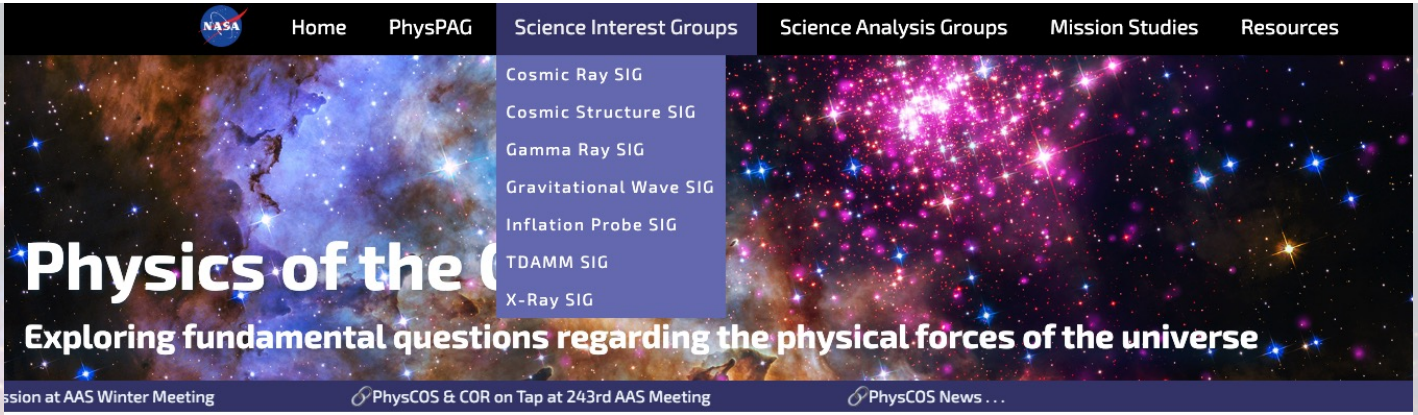


HQ Program Executive: Shahid Habib
HQ Program Scientist: Valerie Connaughton
HQ Dep. Program Scientist: Sanaz Vahadinia

*Contractor
^Independent Technical Authority
Habitable Worlds Observatory/GOMAP
[1] START Member (Ex-Officio)
[2] TAG Member (Ex-Officio)

PhysCOS Program Office Activities

- The program office supports the community by
  - Facilitating the PhysCOS Program Analysis Group (PhysPAG);
  - Supporting the activities of Science Interest and Analysis Groups (SIGs and SAGs)
  - Informing members of upcoming funding and engagement opportunities;
  - Soliciting community-identified science and technology gaps;
  - Managing funded technology projects with benefits to PhysCOS science;
  - Maintaining science cognizance to enable more successful NASA strategic planning; and
  - Community engagement: AAS, HEAD, APS, SACNAS, NSBP, …



About Physics of the Cosmos

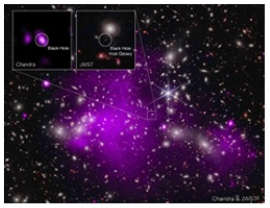
The Physics of the Cosmos (PhysCOS) Program is one of three focused programs contained within NASA's Astrophysics Division (APD), together with Cosmic Origins (COR) and the Exoplanet Exploration Program (ExEP). PhysCOS lies at the intersection of physics and astronomy. Its purpose is to explore some of the most fundamental questions regarding the physical forces and laws of the universe: the validity of Einstein's General Theory of Relativity and the nature of spacetime, the behavior of matter and energy in extreme environments, the cosmological parameters governing inflation and the evolution of the universe, and the nature of dark matter and dark energy.

Located at the Goddard Space Flight Center, the PhysCOS Program Office supports, tracks, and studies a suite of science missions and enabling technologies that focus on specific aspects of these topics. PhysCOS activities include:

https://pcos.gsfc.nasa.gov

- 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.

NASA Telescopes Discover Record-Breaking Black Hole



Astronomers have discovered the most distant black hole yet seen in X-rays, using NASA's Chandra X-ray Observatory (purple) and infrared data from NASA's James Webb Space Telescope (red, green, blue). The black hole is at an early stage of growth that had never been witnessed before, where its mass is similar to that of its host galaxy. This result may explain how some of the first supermassive black holes in the universe formed. Read more »

News

4 January 2024

Physics of the Cosmos at the January 2024 AAS Meeting!

Site QR Code:

Mailing List QR Code:

PhysCOS Program Analysis Group Executive Committee

R. O'Brient – JPL
IP SIG

M. Errando - WU SL
GR SIG

B. Grefenstette - Caltech
XR SIG

A. Corsi – TTU
GW SIG

D. Pooley – Trinity U.
XR SIG – Vice Chair

E. Burns – LSU
TDAMM SIG

C-T. Chen - USRA
XR SIG

A. Meli – NC A&T
CR SIG & Chair

V. Miranda – Stony Brook
CoS SIG

C. Mingarelli - Yale
GW SIG

R. Hounsell - UMBC
CoS SIG

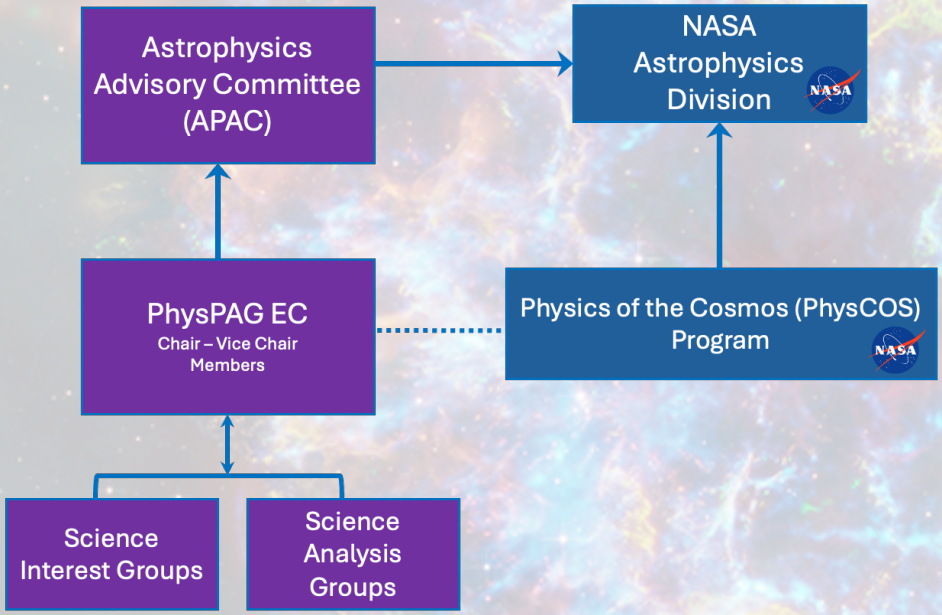
Stephanie Wissel - PSU
CR SIG

K. Madsen - GSFC
XR SIG

J. Finke - NRL
GR SIG & Chair Emeritus

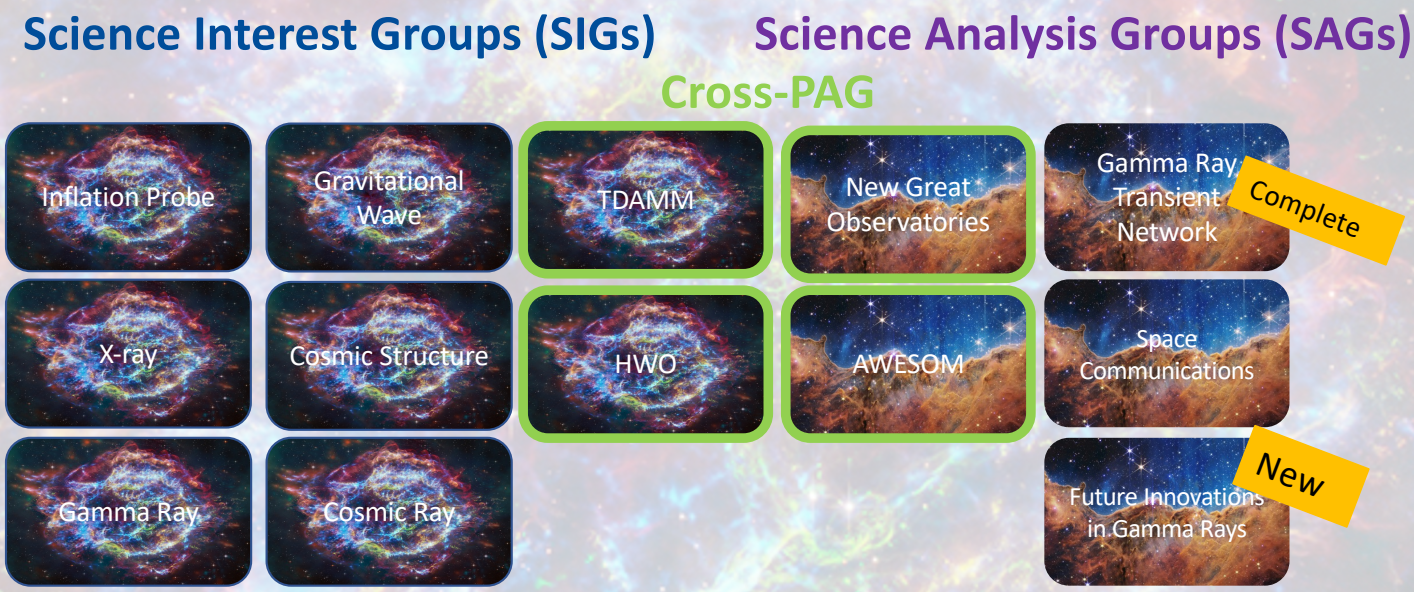
J. Perkins - GSFC
GR SIG

Science Interest Groups & Science Analysis Groups



- **Science Interest Groups** are community-led affinity groups focused on a particular area that are long-term.
  - Meet regularly to discuss science and technology developments, concerns in field
- **Science Analysis Groups** are stood up for a short term (1-2 years) to analyze a specific issue and deliver a report to APAC & Astrophysics Division.
  - Proposed by SIGs or requested by HQ
  - Membership open to any who are interested

Science Interest Groups & Science Analysis Groups



- **New Time Domain and Multi-Messenger Astrophysics SIG**
- **Science Analysis Groups**
  - Gamma-ray Transient Network SAG delivered report to HQ & APAC.
  - Space Communications SAG is drafting their report.
  - Future Innovations in Gamma Rays SAG has started – see Tiffany Lewis' talk later in this session!

This Session

Programmatic

SIG/SAG Updates

IP SIG Micro-Symposium

Time	Topic	Speaker
1:30pm – 1:48pm	Physics of the Cosmos and PhysPAG Overview	Brian Humensky
1:48pm – 2:03pm	The Gravitational Wave Science Interest Group of the NASA Physics of the Cosmos Program	Alessandra Corsi
2:03pm – 2:18pm	Community Efforts in Gamma-Gay Astrophysics: Insights from the GR SIG	Jeremy Perkins
2:18pm – 2:33pm	Future Innovations in Gamma Rays: A New Science Analysis Group	Tiffany Lewis
2:33pm – 2:48pm	The Probe of Inflation and Cosmic Origins – Capabilities of a Next Generation $1B CMB Space Mission	Elisa Russier
2:48pm – 3:03pm	Future CMB Observations from Space: CORE, PRISM, and Voyage 2050 Proposals and Science Programs	Jacques Delabrouille
3:03pm – 3:18pm	Complementing Future CMB Ground-Based Data Sets with Balloon Observations	Shamik Ghosh

Strategic Technology Development

The Program Office

- Monitors and manages PhysCOS and COR Strategic Astrophysics Technology (SAT), Internal Scientist Funding Model (ISFM), Roman Technology Fellowships (RTF) and other direct-funded technologies;
- Focuses on Astro2020-related technology development (FGOs, Probes); and
- Conducts Technological Readiness Level (TRL) assessments.

- PhysCOS/COR Technology Website https://apd440.gsfc.nasa.gov/technology.html
  - Program Overview, Tech Gaps, Technology Photo Gallery, Publications
- AstroTech Database http://www.AstroStrategicTech.us/
  - Published PI Annual Reports 2023
- Astrophysics Biennial Technology Report (ABTR) 2022 & Astrophysics Technology Update (ATU)
  - Plan to publish 2024 ATU by July and 2024 ABTR and by September

Technology Gaps Call

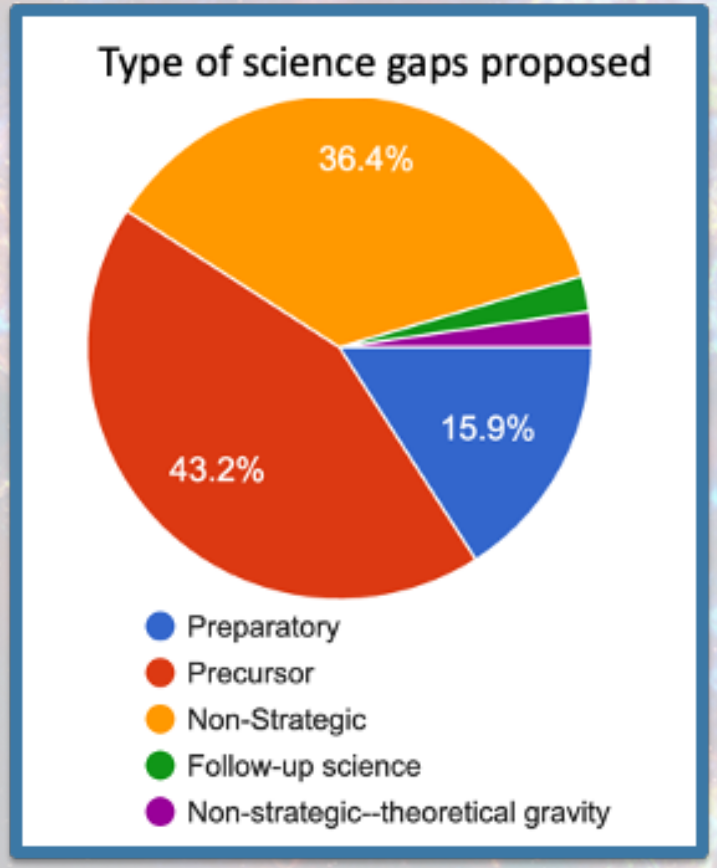
- Biennial strategic technology gap prioritization process to ensure that APD invests in the right technologies.
- Reaching out to the community to help identify gaps between today's state-of-the-art technologies and what will be needed for missions & development activities prioritized by Astro2020.
- Details at https://pcos.gsfc.nasa.gov/news/2024/6_Technology_Gaps_Submissions_Due.php
  - Public webinar planned for May 14th
- Tech gaps submissions are due by June 3rd – please submit to ensure that technologies needed for PhysCOS science are well covered
- PhysPAG EC will assist in reviewing gap submissions
  - Merging similar gap submissions, updating previous gaps, editing text
  - Then hand off to the Program Office for prioritizing into tiers

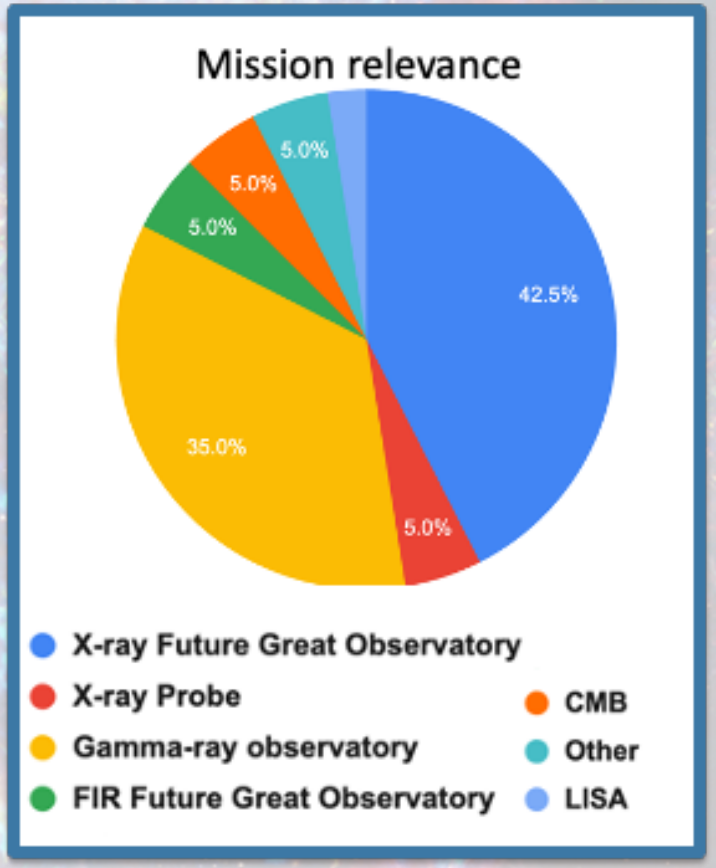
Compiling Science Gaps

GOAL: produce a list of precursor and preparatory science gaps for PhysCOS-related science as a resource for the community

- Precursor Science informs the mission architecture and trades
  - Needed soon for HWO and over coming years for X-ray/FIR future great observatories
  - Looking for natural gaps, thresholds, and gradients in the science return vs. measurement parameters
- Preparatory Science informs data / interpretation or early operations; potentially from new observations, but needed just before or soon after launch to help inform the best way to conduct investigation
- Started a process similar to the Technology Gaps process:
  - Science Gaps site with link to google form for submissions
  - Next steps: (1) review and iteration by SIGs and program office; (2) review by HQ; (3) Publish the list on PhysCOS website; (4) annually/biennially update the list

Community inputs on Science Gaps





The Habitable Worlds Observatory

- NASA's next flagship mission concept recommended by Astro2020 Decadal Survey
- First telescope designed specifically to search for signs of life on planets outside our solar system
- HWO is perceived as an exoplanet GO but it will also conduct a **transformative** general Astrophysics program
- START and TAG will guide HWO maturation

Science, Technology, Architecture Review Team (START)

- Quantify HWO's science objectives using Astro2020's guidance
- Outline the observatory and instrument capabilities needed to accomplish those goals.
- Develop the science goals and objectives portions of the Science Traceability Matrix.
- Assess the fidelity of models needed in the future to execute future trades.

Technical Assessment Group (TAG)

- Study architecture options.
- Identify and assess the mission architectures and technologies needed to enable those options.
- Evaluate the risks associated with those options.

Adapted from J. O'Meara AAS presentation

START Working Groups

- **Evolution of the Elements**
- Stars, Stellar Populations, & Their Environments
- Star Formation
- ***Transients***
- **Galaxy Growth**
- ***The Dark Sector***
- ***AGN Over Cosmic Time***
- Intergalactic & Circumgalactic Medium
- ***Ionizing Photons and Their History***
- **Living Worlds**
- Biosignature Possibilities
- Biosignature Interpretation
- Target Stars
- **Solar Systems in Context**
- Birth and Evolution of Planetary Systems
- Demographics & Architectures of Planetary Systems (includes mass & orbit determination)
- Characterizing Exoplanets
- Solar System Observations with HWO

The START WG participants will begin with a definition of the key science cases, their objectives, and their observables to define the scientific figures of merit. These will be passed to the TAG for incorporation into modeling and analysis, and the process may iterate

NASA GOMAP Website

Adapted from J. O'Meara AAS presentation

PhysPAG involvement in START WGs

What are the transformative astrophysics questions relevant to PhysCOS that HWO can address?

Uncovering the Drivers of Galaxy Growth

Study how galaxies, constituents, and their environments evolve over the history of the universe.

Sub-Groups:

- ***AGN over cosmic time***: Studying the central engines of galaxies and their impacts on galaxy evolution in imaging and spectroscopy at multiple scales.
- ***Ionizing photons and their history***: Understanding the galaxies and their stars that drove reionization by observing their analogues at lower redshift in the UVOIR.
- ***The dark sector:*** Exploring the nature of dark matter and dark energy via their impacts on galaxies and large-scale structure.

NASA GOMAP Website

Following the Evolution of the Elements Over Cosmic Time

Trace the rise of the periodic table via studies of the formation, distribution and evolution of stars.

Sub-Groups:

- **Transients**: Studies of supernovae, merger-driven stellar and stellar remnant explosions, and sources of gravitational wave events.

Adapted from J. O'Meara AAS presentation

Astrophysics Cross-Observatory Science Support (ACROSS) Pilot Project

- ACROSS was developed as a result of the 1st year of the TDAMM study, with a goal of partnering with observers and science teams to provide services and infrastructure that enable the full potential of time domain and multi-messenger (TDAMM) science
- The study continues, to understand how this coordination can extend to ground-based and international observatories
- What we're developing:
  - TDAMM Toolkit & API sharing observatory state and status information, observing plans, observability constraints, and target of opportunity (ToO) request pages.
  - Web Portal: links to tools, ToO requests, funding opportunities, conferences, and Events of Interest pages.
  - TDAMM Research Announcement: Initial call targeted for 2026, subject to funds availability.
  - Community support: help desk, documentation, tutorials, and workshops.

Core Team:
- Jamie Kennea (Penn State)
- Dan Kocevski, Michelle Hui (Marshall Space Flight Center)
- Tom Barclay, Christina Hedges, B.H., Chris Roberts, Kirill Vorobyev, Samuel Wyatt (GSFC)

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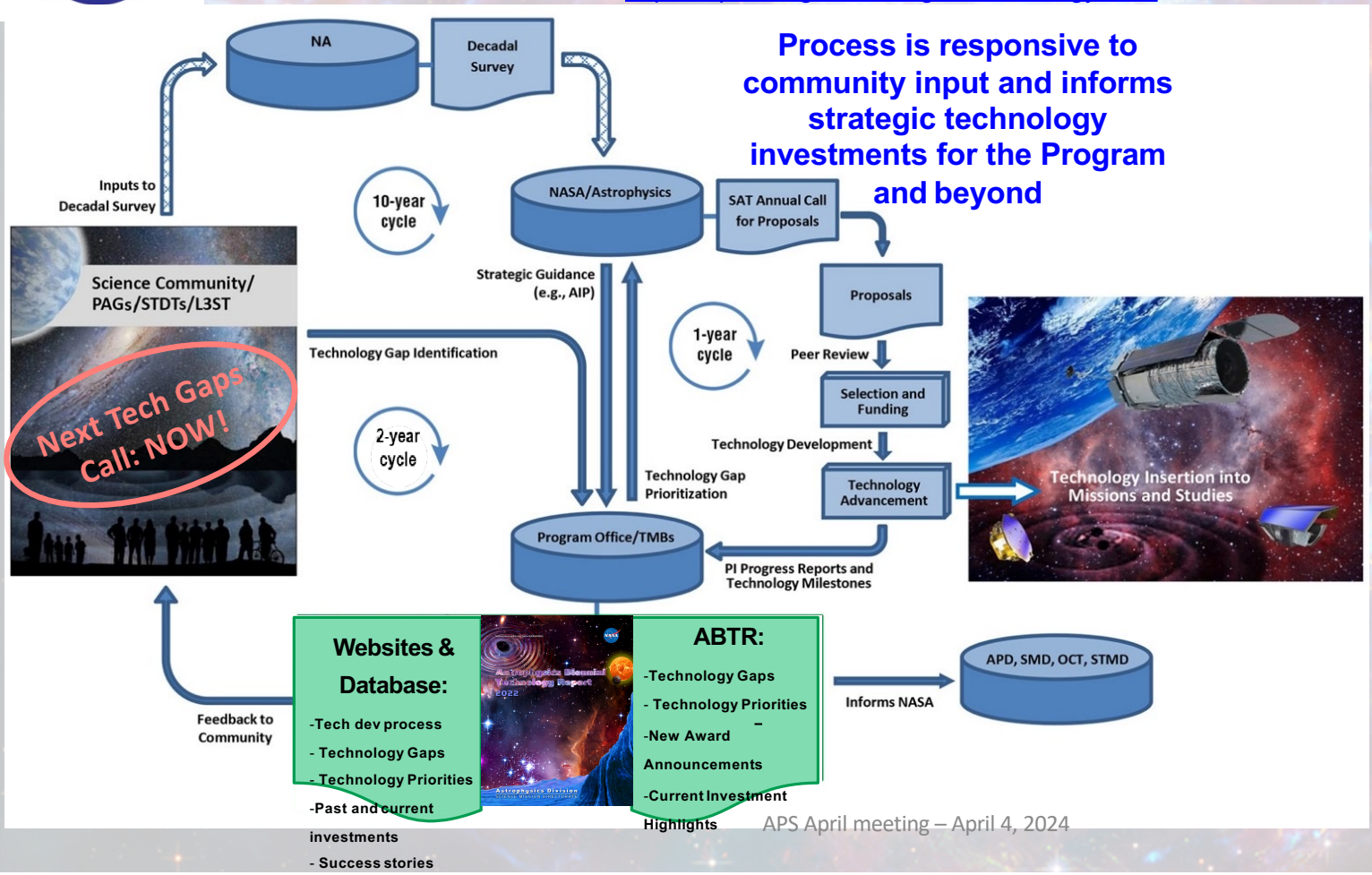
Mailing Lists QR Code:

Backup

Astrophysics Biennial Technology Report

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



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