Today's Agenda

Please stick around for Joint PAG session immediately following this! 3:00-5:00, in this room.

Physics of the Cosmos Program Analysis Group Splinter Session

Brian Williams
NASA GSFC
Acting PCOS Chief Scientist

Summer AAS Meeting
June 2022

Universe

Learn More About This Image

Big Questions

How does the universe work?

How does the universe work? Understanding the universe's birth and its ultimate fate are essential first steps to unveil the mechanisms of how it works. This, in turn, requires knowledge of its history, which started with the Big Bang.

How did we get here?

How did we get here? In order to understand how the universe has changed from its initial simple state following the Big Bang (only cooling elementary particles like protons and electrons) into the magnificent universe we see as we look at the night sky, we must understand how stars, galaxies and planets are formed.

Are we alone?

Are we alone? For millennia, people have turned their eyes to the stars and wondered if there are others like themselves out there. Does life, be it similar to our own or not, exist elsewhere?

What We Study

- Dark Energy, Dark Matter
- Black Holes
- The Big Bang
- Galaxies
- Stars
- Exoplanets

Helpful Links

- Organization and Staff
- 2020 Decadal Planning
- 2022 Senior Review of Operating Missions
- Astrophysics Fleet Mission Chart
- Astronomy Picture of the Day

PCOS Program Office enables ground-breaking science from space by working at the interfaces between missions and studies, technology, the community, and NASA Centers and HQ.

Current PCOS Science Goals and Priorities:

- Ensure a successful **implementation of Astro2020 Decadal Survey priorities** by supporting community preparations and HQ activities, spanning the range of inputs: from science, missions, technology, and state of the profession, which impact our ability to do ground-breaking science

- Ensure more **successful missions** by
  - -supporting ongoing mission studies and pre-projects, e.g., LISA
  - -through technology efforts, e.g., SAT;
  - -by coordinating with current missions; and
  - -by preparing for studies for missions recommended by the Astro2020 Decadal

- **Engage the community through the PhysPAG** to support a successful APD portfolio.

pcos.gsfc.nasa.gov

Search NASA

Physics of the Cosmos

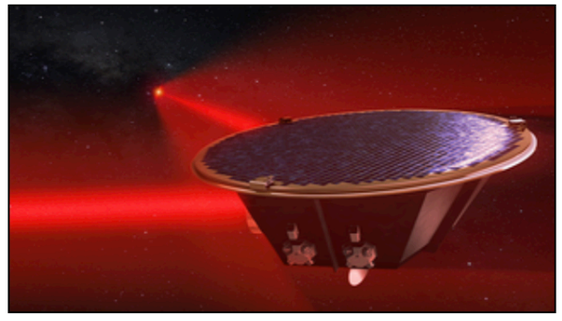
About PCOS | PhysPAG | Mission Studies | Technology | PCOS News Archive

About Physics of the Cosmos (PCOS)

The Physics of the Cosmos (PCOS) 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)**. PCOS 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 PCOS Program Office supports, tracks, and studies a suite of science missions and enabling technologies that focus on specific aspects of these topics. PCOS activities include:

- Facilitating the **PCOS Program Analysis Group (PhysPAG)**, which comprises standing Science Interest Groups (SIGs) engaged in particular branches of high-energy astrophysics, and shorter-term 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 PCOS science. This technology gap prioritization informs APD's strategic



PCOS News

See our new **Events Calendar**

Program News and Announcements

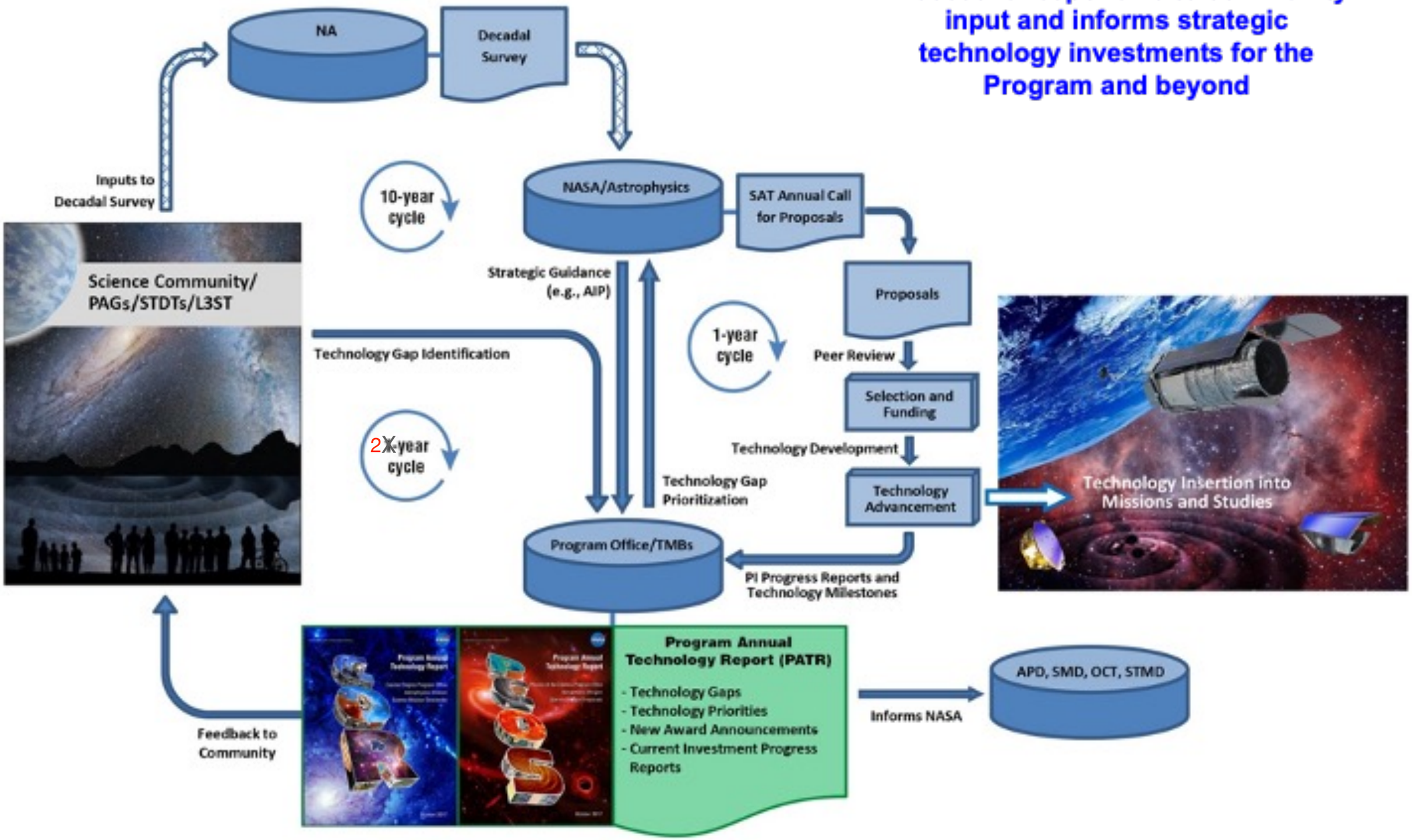
10 June 2022
Physics of the Cosmos Activities at Summer AAS » **Details**.

10 June 2022
NASA Will Hold Precursor Science Workshop August 2–4, 2022 » **Details**.

26 May 2022
Astrophysics Biennial Technology Report and Tech Gaps Announcements » **Details**.

Strategic Technology Development Process

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



Second Astrophysics Biennial Technology Report

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

ABTR: Tech Gaps

Tier 1 Technology Gaps

Advanced Cryocoolers
Coronagraph Contrast and Efficiency
Coronagraph Stability
Cryogenic Readouts for Large-Format Far-IR Detectors
Heterodyne Far-IR Detector Systems
High-Performance, Sub-Kelvin Coolers
High-Reflectivity Broadband Far-UV-to-Near-IR Mirror Coatings
High-Resolution, Large-Area, Lightweight X-ray Optics
High-Throughput Bandpass Selection for UV/VIS
High-Throughput, Large-Format Object Selection Technologies for Multi-Object and Integral Field Spectroscopy
Large Cryogenic Optics for the Mid IR to Far IR
Large-Format, High-Resolution Focal Plane Arrays
Large-Format, Low-Darkrate, High-Efficiency, Photon-Counting, Solar-blind, Far- and Near-UV Detectors
Large-Format, Low-Noise and Ultralow-Noise Far-IR Direct Detectors
Long-Wavelength-Blocking Filters for X-ray Micro-Calorimeters
Low-Stress, High-Stability, X-ray Reflective Coatings
Mirror Technologies for High Angular Resolution (UV/Vis/Near IR)
Stellar Reflex Motion Sensitivity – Astrometry
Stellar Reflex Motion Sensitivity – Extreme Precision Radial Velocity
Vis/Near-IR Detection Sensitivity

ABTR: Tech Gaps

Tier 1 Technology Gaps

- Advanced Cryocoolers
- Coronagraph Contrast and Efficiency
- Coronagraph Stability
- Large Cryogenic Optics for the Mid IR to Far IR
- Large-Format, High-Resolution Focal Plane Arrays
- Large-Format, Low-Darkrate, High-Efficiency, Photon-Counting

Tier 2 Technology Gaps

- Broadband X-ray Detectors
- Compact, Integrated Spectrometers for 100 to 1000 μm
- Far-IR Imaging Interferometer for High-Resolution Spectroscopy
- Far-IR Spatio-Spectral Interferometry
- Fast, Low-Noise, Megapixel X-ray Imaging Arrays with Moderate Spectral Resolution
- High-Efficiency X-ray Grating Arrays for High-Resolution Spectroscopy
- High-Resolution, Direct-Detection Spectrometers for Far-IR Wavelengths
- Improving the Calibration of Far-IR Heterodyne Measurements
- Large-Aperture Deployable Antennas for Far-IR/THz/sub-mm Astronomy for Frequencies over 100 GHz
- Large-Format, High-Spectral-Resolution, Small-Pixel X-ray Focal-Plane Arrays
- Polarization-Preserving Millimeter-Wave Optical Elements
- Precision Timing for Space-Based Astrophysics
- Rapid Readout Electronics for X-ray Detectors
- Starshade Deployment and Shape Stability
- Starshade Starlight Suppression and Model Validation
- UV Detection Sensitivity

ABTR: Tech Gaps

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Tier 2 Technology Gaps

Broadband X-ray Detectors
Compact, Integrated Spectrometers for 100 to 1000 μm
Far-IR Imaging Interferometer for High-Resolution Spectroscopy
Far-IR Spatio-Spectral Interferometry
Large-Format, High-Spectral-Resolution, Small-Pixel X-ray Focal-Plane Arrays
Polarization-Preserving Millimeter-Wave Optical Elements
Precision Timing for Space-Based Astrophysics

Tier 3 Technology Gaps

Advancement of X-ray Polarimeter Sensitivity
Detection Stability in Mid-IR
Far-UV Imaging Bandpass Filters
High-Efficiency Far-UV Mirror
High-Efficiency, Low-Scatter, High- and Low-Ruling-Density, High- and Low-Blazed-Angle UV Gratings
High-Quantum-Efficiency, Solar-Blind, Broadband Near-UV Detector
Photon-Counting, Large-Format UV Detectors
Short-Wave UV Coatings
Warm Readout Electronics for Large-Format Far-IR Detectors

ABTR: Tech Gaps

Tier 1 Technology Gaps

- Advanced Cryocoolers
- Coronagraph Contrast and Efficiency
- Coronagraph Stability
- Large Cryogenic Optics for the Mid IR to Far IR
- Large-Format, High-Resolution Focal Plane Arrays
- Large-Format, Low-Darkrate, High-Efficiency, Photon-Counting,

Tier 2 Technology Gaps

- Broadband X-ray Detectors
- Compact, Integrated Spectrometers for 100 to 1000 μm
- Far-IR Imaging Interferometer for High-Resolution Spectroscopy
- Far-IR Spatio-Spectral Interferometry
- Large-Format, High-Spectral-Resolution, Small-Pixel X-ray Focal-Plane Arrays
- Polarization-Preserving Millimeter-Wave Optical Elements
- Precision Timing for Space-Based Astrophysics

Tier 3 Technology Gaps

- Advancement of X-ray Polarimeter Sensitivity
- Detection Stability in Mid-IR
- Far-UV Imaging Bandpass Filters
- High-Efficiency Far-UV Mirror
- High-Quantum-Efficiency, Solar-Blind, Broadband Near-UV Detector
- Photon-Counting, Large-Format UV Detectors
- Short-Wave UV Coatings
- Warm Readout Electronics for Large-Format Far-IR Detectors

Tier 4 Technology Gaps

- Advanced Millimeter-Wave Focal-Plane Arrays for CMB Polarimetry
- Improving the Photometric and Spectro-Photometric Precision of Time-Domain and Time-Series Measurements
- UV/Opt/Near-IR Tunable Narrow-Band Imaging Capability
- Very-Wide-Field Focusing Instrument for Time-Domain X-ray Astronomy

ABTR: Tech Gaps

Tier 1 Technology Gaps

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Advancement of X-ray Polarimeter Sensitivity
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Advanced Millimeter-Wave Focal-Plane Arrays for CMB Polarimetry
Improving the Photometric and Spectro-Photometric Precision of
UV/Opt/Near-IR Tunable Narrow-Band Imaging Capability
Very-Wide-Field Focusing Instrument for Time-Domain X-ray Astronomy

Tier 5 Technology Gaps

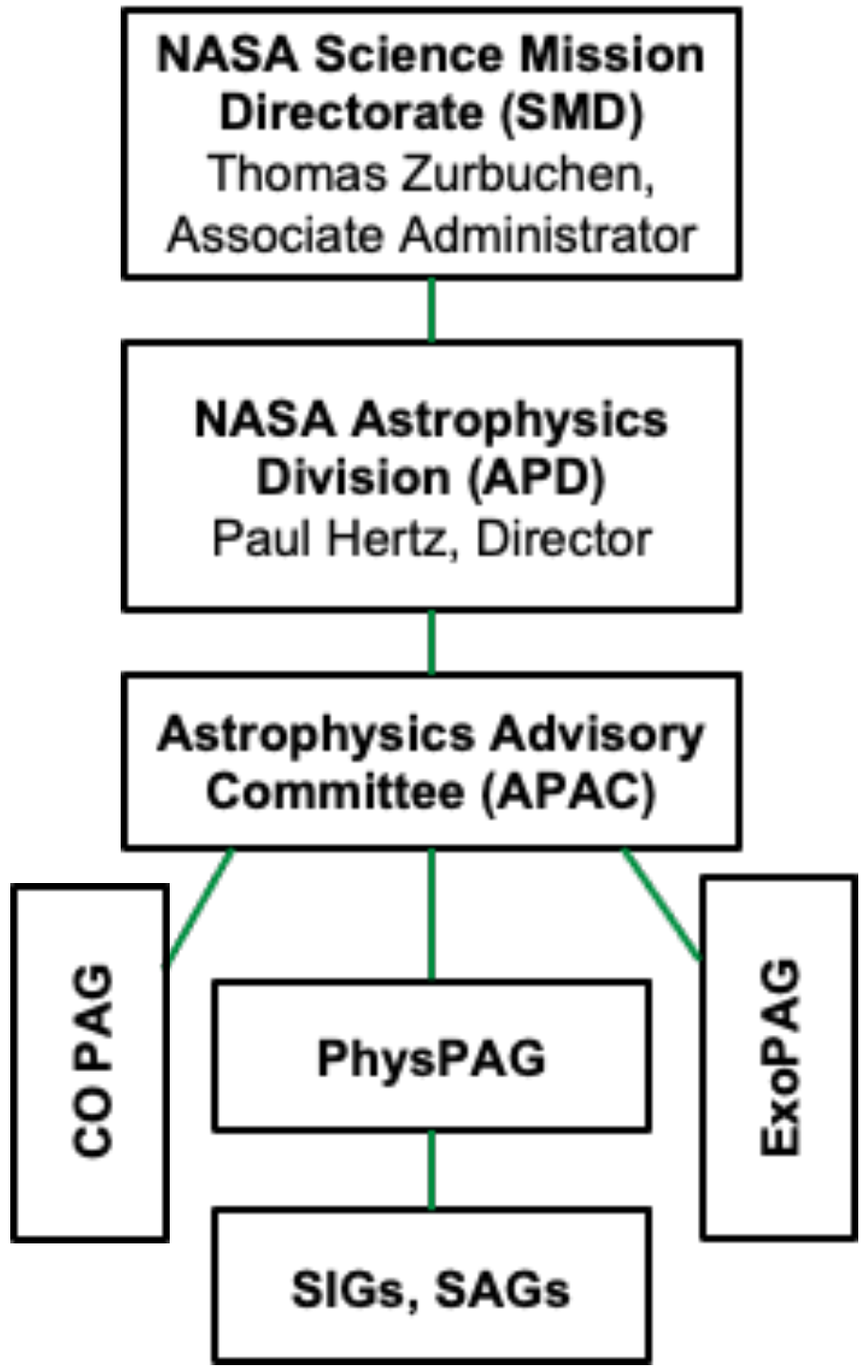
Complex Ultra-Stable Structures for Future Gravitational-Wave Missions
Disturbance Reduction for Gravitational-Wave Missions
Gravitational Reference Sensor
High-Performance Spectral Dispersion Component/Device
High-Power, High-Stability Laser for Gravitational-Wave Missions
Laser Phase Measurement Chain for a Decihertz Gravitational-Wave Mission
Micro-Newton Thrusters for Gravitational Wave-Missions
Stable Telescopes for Gravitational Wave-Missions

PhysPAG

Physics of the Cosmos Program Analysis Group

- **Purpose:**
  - provide input to NASA relevant to PCOS
  - help NASA inform interested parties about PCOS doings
- **Membership:** ***You!***

Anyone interested in providing input to NASA relevant to its Physics of the Cosmos Program



- **Executive Committee** (EC):
- Chair Emeritus: Ryan Hickox
- Chair: Grant Tremblay
- Vice Chair: Justin Finke
- 11 EC members chair 6 Science Interest Groups (**SIGs**): longer-standing discipline-specific
- support formation of Science Analysis Groups (**SAGs**): group created to analyze a specific science question
- facilitate **info flow** between NASA and community

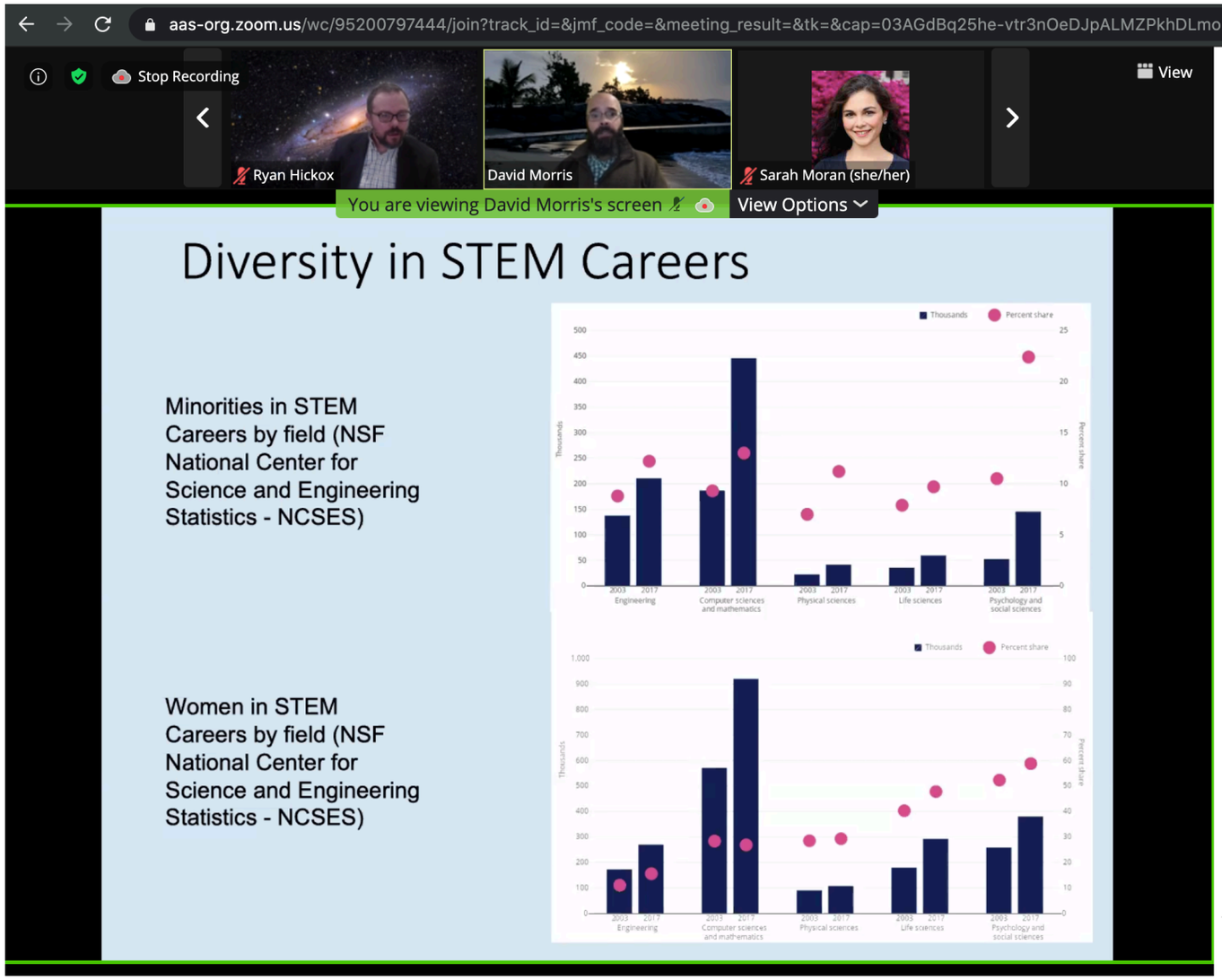
- PhysPAG Executive Committee members chair 6 Science Interest Groups
  - **X-ray SIG** (XR SIG)
  - **Gamma-ray SIG** (GR SIG)
  - **Cosmic Ray SIG** (CR SIG)
  - **Gravitational Wave SIG** (GW SIG)
  - **Cosmic Structure SIG** (CoS SIG)
  - **Inflation Probe SIG** (IP SIG)
- SIGs serve as **forums for soliciting, discussing, and coordinating community input**.

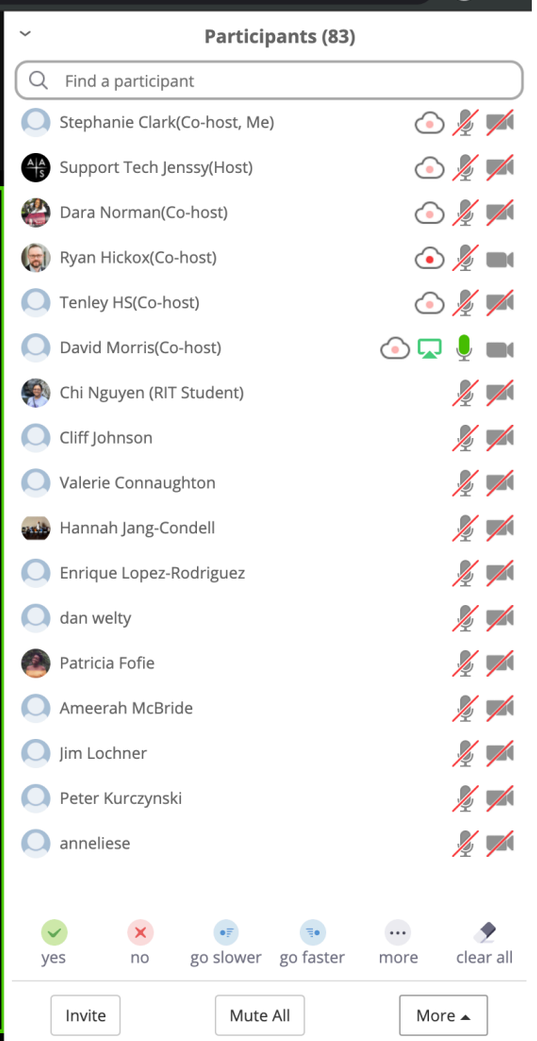
For more info: https://pcos.gsfc.nasa.gov/physpag/physpag-sigs.php

[All NASA Program Offices are committed to NASA's core principle of Inclusion]

2021 SACNAS NDISTEM DIGITAL CONFERENCE

October 25 – 29, 2021

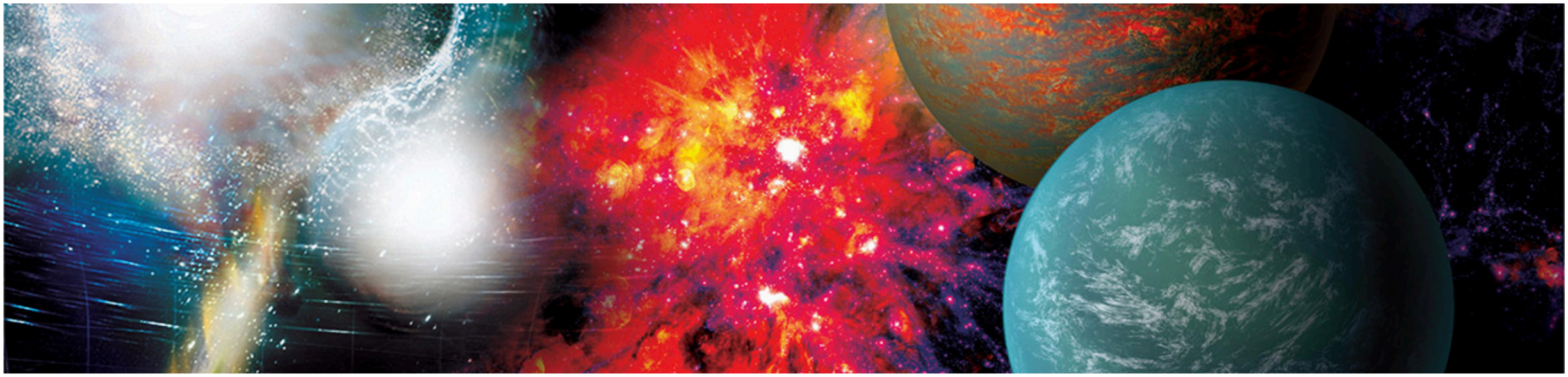




"Enhancing Participation of Minority Serving Institutions in Space Science," Jan. 2021 AAS

2021 Conference Home Page

Precursors to Pathways: Science Enabling NASA Astrophysics Future Great Observatories



Welcome

- **When:** 20-22 April 2022
- **Where:** Virtual
- **Who:** all community members interested in precursor science for NASA's future Great Observatories

Precursors to Pathways:

- **Welcome**
- Agenda

First “Precursor Science” workshop held in April; 2nd workshop happening August 2-4th, 2022. Details TBA.

Precursor science defined as science investigations that will reduce future Great Observatory mission risk and inform mission designs and trades when those activities begin. **NASA ROSES funding element to be released later in 2022**.

Best way to get updates is to sign up for PCOS-News mailing list at pcos.gsfc.nasa.gov

Time Domain and Multi-Messenger Astrophysics NASA Workshop

Physics of the Cosmos Program

TDAMM Workshop Home	Abstract Submissions	Registration

The NASA Physics of the Cosmos (PCOS) Program Office is organizing a TDAMM Initiative Workshop. The goal of the 3-day workshop, to be held August 22–24, 2022, in the Annapolis area, is to identify and prioritize the top science questions for Time Domain and Multi-Messenger Astrophysics (TDAMM) that need to be addressed to implement the recommendations of the Astro 2020 Decadal Report. NASA invites US and international members of the ground and space science community and of the astronomy and physics communities to attend the workshop and contribute to its final product, a publicly available report with findings for the NASA Headquarters Astrophysics Division.

This workshop is strictly on science only and we are steering away from proposed missions, focusing instead on current and already approved missions and facilities. NASA needs the science information before we can all start planning for missions. Contributions highlighting proposed missions are not solicited.

Registration open through June 30th!

Best way to get updates is to sign up for PCOS-News mailing list at pcos.gsfc.nasa.gov

- Please welcome Brian Humensky into the PCOS Chief Scientist Office. I am transitioning out of this position, and I thank several people who have worked with me in this office over the past 22 months: Zaven Arzoumanian, Terri Brandt, Jacob Slutsky, and Kim Weaver.

- Thai Pham has retired as Technology Development Manager for the PCOS/COR Program Offices. Rachel Rivera (NASA GSFC) has assumed this role.

- PCOS/COR/ExEP Program Offices will also have role in “GOMaP” process; see talk later in this session by Cathy Barclay

- Please stick around after this for Joint PAG session from 3:00-5:00. Talks by Paul Hertz (NASA Astrophysics Division Director), Opher Ganel (Program Technologist/Systems Engineer for PCOS/COR), and Nick Siegler (ExEP Chief Technologist)

- Questions for Paul’s talk *must* be submitted through submission portal located at https://gsfc.cnf.io/sessions/gf5r. Easiest way to find direct link to this is go to pcos.gsfc.nasa.gov, click “Meetings” under “PhysPAG” dropdown menu.