

# NASA's Physics of the Cosmos Program

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*Chair of the Physics of the Cosmos  
Program Analysis Group*

[pcos.gsfc.nasa.gov](http://pcos.gsfc.nasa.gov)

# The PhysPAG

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**Physics of the Cosmos Program seeks to understand the nature of the Universe.** What are its constituents? What are the laws that govern its birth and evolution?

**Dark Energy:** Probe the nature of dark energy by studying the expansion rate of the universe and the growth of structure

**Inflation:** Test the theory of inflation by measuring the polarization of the Cosmic Microwave Background.

**Black Holes & General Relativity:** Probe the properties of black holes and test General Relativity in strong gravity environments using x-ray emission and gravitational waves

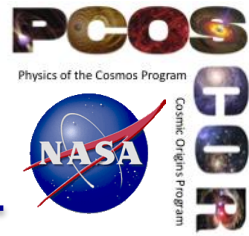
**Behavior of Matter in Extreme Environments:** Explore extreme astrophysical processes with Cosmic rays, X-rays and Gamma-rays

# PhysPAG and SIGs

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- **PhysPAG has six SIGs in operation:**
  - Inflation Probe SIG (Chair: Amber Miller and Ed Wollack)
  - Gravitational Wave SIG (Chair: Neil Cornish)
  - X-ray SIG (Chair: Jay Bookbinder and Mark Bautz)
  - Gamma ray SIG (Chair: Mark McConnell)
  - Cosmic Ray SIG (Chair: Eun-Suk Seo)
  - Cosmic Structure SIG (Chair: Olivier Doré, Rachel Bean)

# PhysPAG EC membership

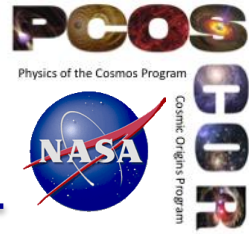


Name	Institution	Topical Area	Term end
J. Bock, Chair	Caltech/JPL	CMB	December 2016
M. Bautz, Vice Chair	MIT	X-rays	December 2016
R. Bean	Cornell Univ.	Dark Energy	December 2016
J. Bookbinder	SAO	X-rays	December 2015
J. Conklin*	Univ. of Florida	Gravitational Waves	December 2017
N. Cornish	Montana State	Gravitational Waves	December 2016
O. Doré*	JPL	Dark Energy	December 2017
H. Krawczynski*	Washington Univ. in St. Louis	Gamma-rays	December 2017
M. McConnell	U. of New Hampshire	Gamma-rays	December 2016
A. Miller*	Columbia Univ.	CMB	December 2017
J. Nousek	PSU	X-rays	December 2015
A. Olinto	Univ. of Chicago	Astroparticles	December 2015
Eun-Suk Seo	U. of Maryland	Astroparticles	December 2016
E. Wollack*	NASA/GSFC	CMB	December 2017

\*new member

# Gathering Input to Large Mission Charge

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## Community discussion and input at face-to-face meetings:

- X-ray-, Gamma- & Cosmic-SIG, PhysPAG & Joint PAG meetings at AAS, January
- IP-SIG discussions at Minneapolis CMB Pol. Workshop, January
- Gamma-SIG at 'Future Space-Based Gamma Observatories', February
- Joint PAG executives meeting, March
- Cosmic-, Gravitational-Wave- & Gamma-SIG meetings; PCOS & Gamma Mini-symposia at APS, April
- Gamma-, X-ray-SIG & various panels, HEAD meeting, June
- Presentations from large missions at PhysPAG EC telecons

# Reactions from the PhysPAG Community

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- Articulating PCOS Science Themes in Large Missions
  - Mapping large-scale structure
  - Forming supermassive black holes
  - Multi-messenger follow-up of gravitational wave events
  - And more (the “intersection of physics and astronomy”)
- Report is Predicated on Two Assumptions Relating to the PhysPAG
  - 1) The L3 Collaboration Constitutes the Gravitational-Wave Mission
    - PAGs assume US participation is going ahead
    - US role will be fully developed for presentation to the 2020 decadal review
  - 2) The Inflation Probe is a Probe-Class Mission
    - IPSIG feels the mission fits this category
    - PAGs assume the 2010 decadal recommendations will be fulfilled

*If these assumptions change, report needs to be reevaluated*
- Strong Interest in Probe Missions
  - Developing point mission concepts (particularly strong X-ray,  $\gamma$ -ray, cosmic-ray interest)
  - Developing a probe mission category ala Discovery or New Frontiers
  - PAGs willing to assist in a future process defined by NASA

# Preparing the PhysPAG Report

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- Joint Statement Being Prepared Between the Three PAGs
- Joint Table of Nominal Large Mission Parameters
- Sections of PhysPAG Report in Draft Form
  - PhysPAG science in X-Ray Surveyor
  - PhysPAG science in Far-Infrared Surveyor
  - PhysPAG science in LUVVOIR
  - PhysPAG science in HABEX
  - L3 Gravitational-Wave Mission Science and Development with ESA
  - Inflation Probe Science, Mission Parameters and Development
  - Probe Missions

# PCOS Gap Technologies

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- **Received 37 Gap Technologies from Community**
  - Includes 14 items carried over from 2014 list
  - 11 new for X-Rays
  - 7 new for general relativity and gravitational waves
  - 4 new for cosmic rays
- **List was Reviewed by the PhysPAG**
  - Many of the new items overlap with new and existing items
  - Non-uniform treatment of mission applications and need dates
  - Implemented a standard template for ‘time to anticipated need’
  - Carried out in consultation with the SIGs and topical experts
- **Revised List Sent to Thai Pham for Prioritization**
  - 2014 list was reduced from 15 to 14 due to a merger (mm-wave optics)
  - Many of the new gap items covered aspects from the original list and were merged
  - 4 new for X-Rays
  - 2 new for general relativity and gravitational waves
  - 3 new for cosmic rays



# PhysPAG Future Activities

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- **IAU in Hawaii, August 7**
  - Presentations by Paul Hertz, PhysPAG, COPAG, ExoPAG
  - Test audience on preliminary findings
  - Open discussions: L3, LUVIOR/HABEX, Q&A, etc
  - John Conklin will represent PhysPAG
- **Reports to APS, October**
- **Preparing for the Mid-Decadal Review**
- **Annual PhysPAG EC Meeting at AAS, January**