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

The PhysPAG

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

- **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

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

- 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, γ-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

- 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 LUVOIR
  - 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

- **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

- **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**