

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?

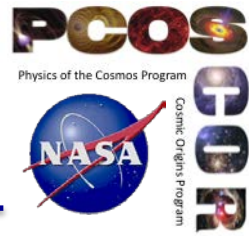
Dark Energy: Probe the nature of dark energy by studying the expansion rate of the universe and the growth of structure

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

SIG Activities



PCOS General

- PCOS general meeting, AAS Grapevine TX, 3 January 2017
- Joint PAG meeting, AAS Grapevine TX, 3 January 2017
- PCOS Mini-Symposium, APS Washington DC, 28-31 January 2017
- SIG meetings at HEAD/AAS Idaho, 20-24 August 2017

Gravitational Wave SIG

General interest:

NASA L3ST interim report released 28 July 2016

Ongoing activities:

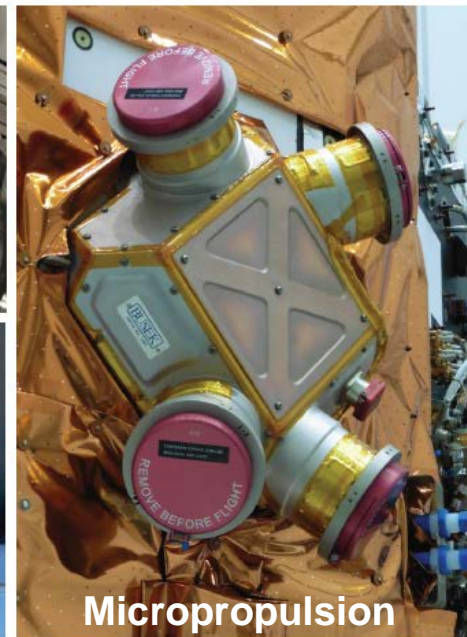
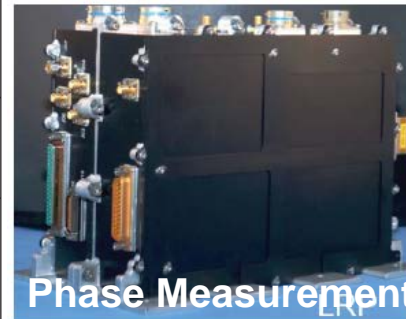
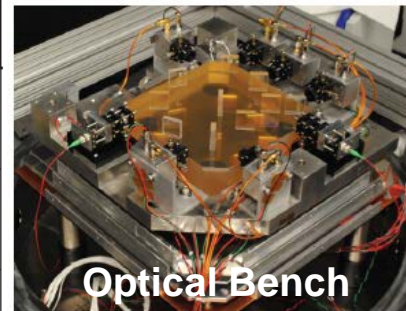
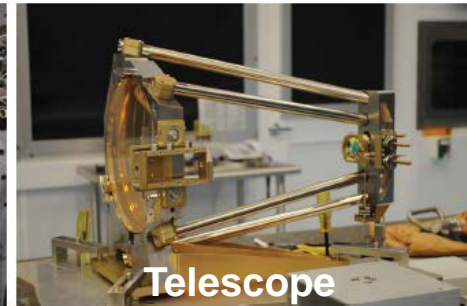
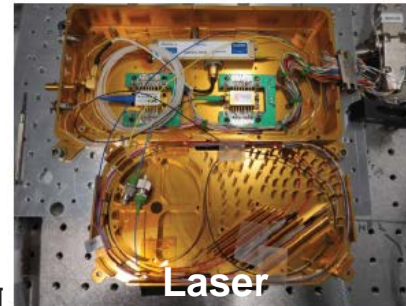
- LISA Symposium, Zurich, September 2016
- Developing L3 Gravitational Wave Technology Roadmap
- Developing science white paper for L3 Gravitational Wave Observatory
- Discussion with L3 about how US can contribute to ESA AO for mission concepts (Oct 2016)

Upcoming activities:

- GWSIG splinter meeting, APS Washington DC, 28-31 January 2017

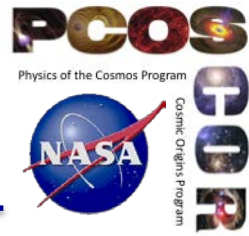
NASA L3 Study Team Interim Report

- Five options for US contribution to L3
- Evaluated cost, US capability, impact of each option
- A combination of these also viable
- Ongoing process, next step includes 2017 ESA architectural study



Major Instrument System	Impact and Insight	US Capabilities & Heritage	Implementation Simplicity	Rough Delivery Cost Estimate (FY16 M\$)
Laser	Moderate coupling to science performance	Novel seed laser; transparent design	Simple Instrument interfaces. Requirements moderately stable.	~60
Micropropulsion	Limited coupling to science performance	Flight demo on LPF No equivalent European system	Minimal interfaces with instrument. Additional interfaces with flight system	~90
Optical Bench	Core of physical measurement. Insight into other systems	Limited investment to date.	Many optical, mechanical, and thermal interfaces. Design less mature. Close coupling with telescope	~100
Phase Measurement	Core of instrument control & operation	Extensive LISA development Flight demo on GRACE-FO	Many electrical and control system interfaces	~70
Telescope	Significant impact on science performance	Moderate grant-funded development. Aligns well with core competencies	Several optical, mechanical, and thermal interfaces. Close coupling with optical bench	~90

SIG Activities



X-Ray SIG

General interest:

ESA/NASA Athena study ongoing

NICER in storage at KSC awaiting launch to the ISS

US participation in *Hitomi* recovery mission under discussion

Two X-Ray polarimetry SMEX mission concepts (IXPE and PRAXys) submitted step2 proposals

Ongoing activities:

X-Ray Surveyor face-to-face meetings 25-26 July 2016 (CfA); 15-16 Nov 2016 (Washington DC)

Upcoming activities:

XRSIG splinter meeting AAS Grapevine TX, 3 January 2017

X-Ray Surveyor splinter session, AAS Grapevine TX, 4 January 2017

Athena splinter session, AAS Grapevine TX, 5 January 2017

XRSIG splinter meeting, APS Washington DC, 28-31 January 2017

Gamma-Ray SIG

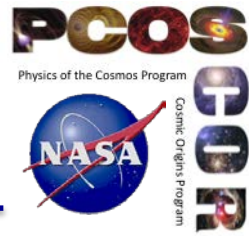
Ongoing activities:

Develop gamma-ray astronomy roadmap for input to the 2020 decadal survey focusing on probe-class and explorer-class concepts, and including sub-orbital developments

SIG meeting at AAS/HEAD, Naples, April 2016; instrument concepts

Upcoming activities:

SIG Activities



Inflation Probe SIG

General interest:

US MO participation in Japanese LITEBIRD submitted step 2 proposal

SPHEREx SMEX mission concept submitted step 2 proposal (inflation & large-scale structure)

Ongoing activities:

CMB S4 workshop, Chicago IL, September 2016

Upcoming activities:

Upcoming CORE++ proposal for ESA M5 proposal opportunity

Cosmic-Ray SIG

General interest:

ISS-CREAM in storage at KSC awaiting launch to the ISS

Upcoming activities:

CRSIG splinter meeting APS Washington DC, 28-31 January

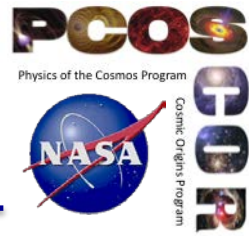
Cosmic Structure SIG

General interest:

Supporting large-structure science in flagship studies

SPHEREx SMEX mission concept submitted step 2 proposal (inflation & large-scale structure)

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
R. Kraft	SAO	X-rays	December 2018
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
I. Moskalenko	Stanford	Astroparticles	December 2018
Eun-Suk Seo	U. of Maryland	Astroparticles	December 2016
E. Wollack	NASA/GSFC	CMB	December 2017

New members added in 2016

Call for new members released August 2016