



PCOS Program Office Update

ANN HORNSCHEMEIER

Chief Scientist, Physics of the Cosmos Program

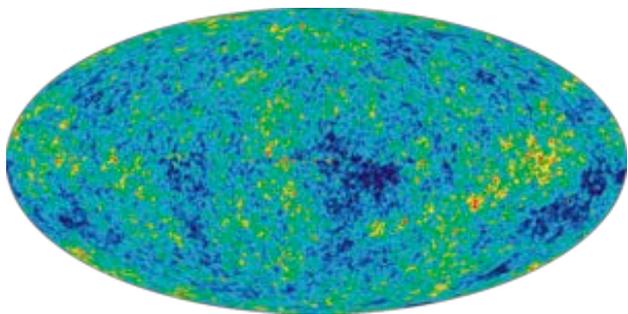
<http://pcos.gsfc.nasa.gov>

Deputy Chief Scientist: Alan Smale

HQ Program Executive: Lia LaPiana

HQ Program Scientist: Richard Griffiths

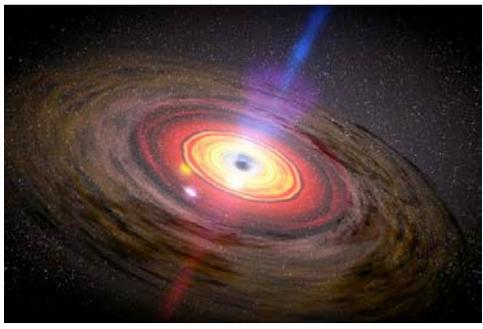
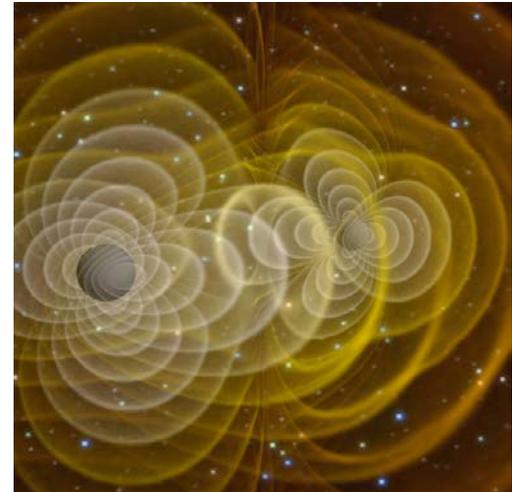
HQ Deputy Program Scientist: Wilt Sanders



Physics of the Cosmos Science Objectives



- Expand our knowledge of dark energy
- Precisely measure the cosmological parameters governing the evolution of the universe and test the inflation hypothesis of the Big Bang
- Test the validity of Einstein's General Theory of Relativity and investigate the nature of spacetime
- Understand the formation and growth of massive black holes and their role in the evolution of galaxies



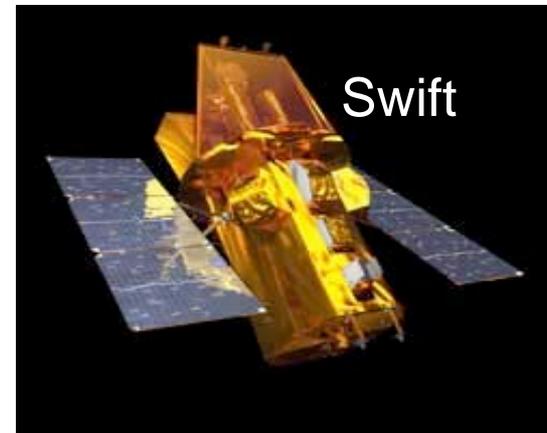
- Explore the behavior of matter and energy in its most extreme environments
- *(Note that the language of these science objectives is currently being reviewed by NASA HQ)*

PCOS Operating Missions

OPERATING



RELATED



MOONI PCOS Program Office Leadership

- ** Program Manager: Mansoor Ahmed a.k.a. Mooni)
- ** Deputy PM: Tom Griffin
- ** Deputy PM: Mark Brumfield
- Chief Scientist: Ann Hornschemeier
- Deputy Chief Scientist: Alan Smale
- ** Chief Technologist: Mark Clampin
- ** ACTO Chief Technologist: Thai Pham

**** = Shared with COR, Cosmic Origins**



TOM



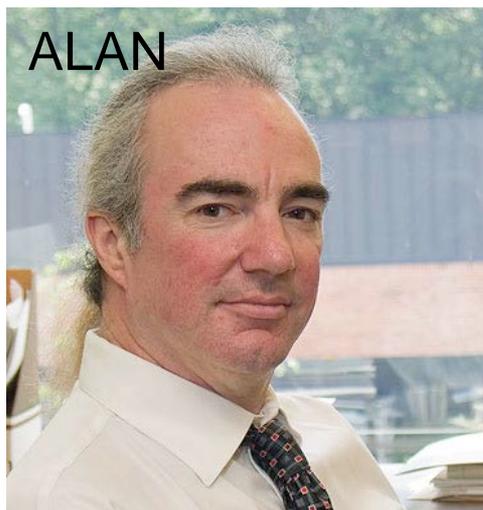
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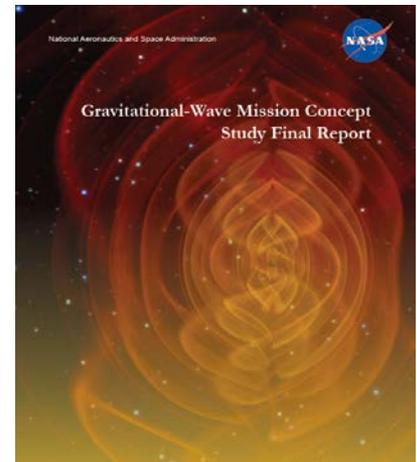


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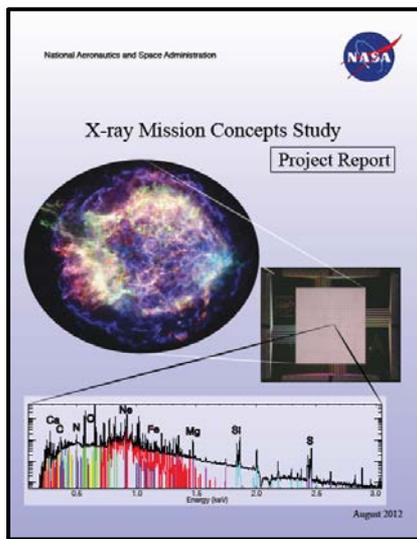
Current Gravitational-Wave Activities

NB: Gravitational waves likely will be detected by LIGO before JWST launches

- **Preparing Technology Development Plans for two tracks**
 1. ESA-led partnership on L2 (TRL5 by 2018)
 - Lasers
 - Telescope
 - Phase Measurement System
 - Micronewton thrusters
 2. NASA-led partnership after Astro2020 (TRL 5 by 2020)
 - Optical bench
 - Gravitational Reference Sensor
- **Participating in the eLISA Consortium in support of L2/L3**
 - Meetings in October, January and March, preparing a white paper for May 2013 deadline
 - L2/L3 call allows international participation up to 20% of the European contribution
- **Concept refinement for future NASA-led partnership**
 - Preferred concept is the Space-based Gravitational-wave Observatory Mid (SGO Mid) from the 2012 study.
 - Scaled-down LISA, retaining 3 arms
 - Delivers most of the Astro2010 endorsed science
 - Exploring trade studies for risk and cost reduction



Current X-ray Study Activities



X-ray observatories in the \$1B class that address all or most of the IXO science objectives are feasible for start within this decade, but only if technical risk is controlled through advance development of key technology to TRL-6

● X-ray Technology Development Plan (TDP)

- Focusing on technology for near term opportunity (probe class mission)
 - 5-10 arcsec mirrors, calorimeters, gratings
- Cost and schedule to advance these technologies to TRL 6

● Preparations for FY2014 Probe-class mission study

- Revisit science case (via X-ray SAG subcommittee)
- Determine key technical and mission trades using notional mission concepts as starting point

● Discussions with European counterparts about participation in L2/L3 X-ray mission

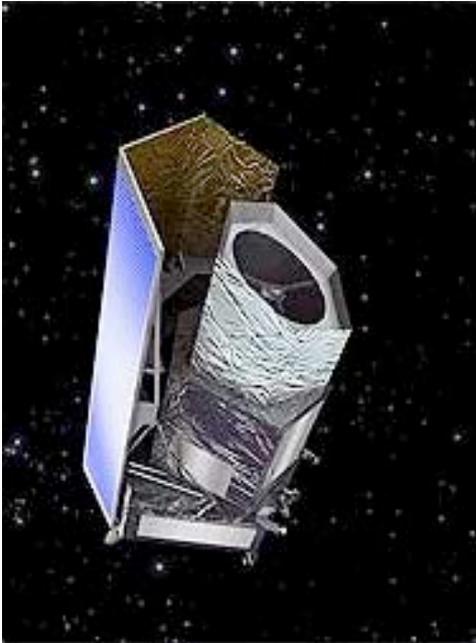
- L2 science white papers due in May: European X-ray community is preparing Athena science white paper
- Potential NASA participation at ~15-20 percent level

Euclid – NASA Contribution

HQ Program Executive: Lia LaPiana

HQ Program Scientist: Richard Griffiths

- NASA's contribution to ESA's Euclid mission:
 - Near Infrared Spectrograph and Photometer (NISP) flight subassemblies (detector + ASIC + cryo-cable = 'triplet') that meet ESA's requirements for testing & characterization.
 - Currently in Phase B.
- Euclid Project assigned to JPL under NASA's PCOS Program:
 - JPL Euclid Project Manager – Ulf Israelsson
 - JPL Euclid Project Scientist – Michael Seiffert
- **NASA now has a seat on the Euclid Consortium Board, the Consortium's governing body, and on the ESA Euclid Science Team:**
 - 40 U.S. scientists selected to participate in Euclid Science Team with P.I.s Jason Rhodes (JPL), Sasha Kashlinsky (GSFC) and Ranga-Ram Chary (Caltech)
- PCOS Program Office: provides programmatic insight and oversight; worked with NASA HQ on tailoring NPR 7120.5 for Euclid; appointed the Independent Review Team; and provides the Euclid Mission Manager (Tom Griffin).
- Euclid Science Data Center study underway (IPAC)

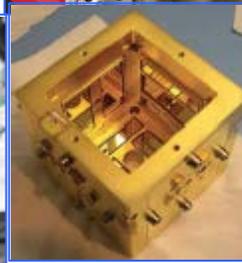
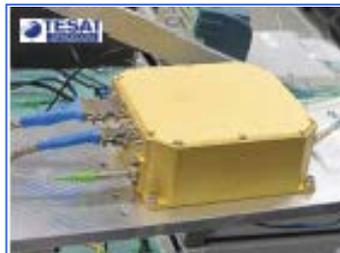
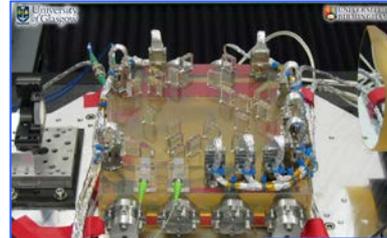
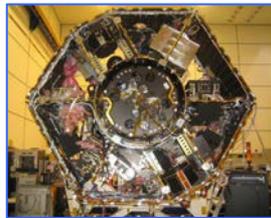
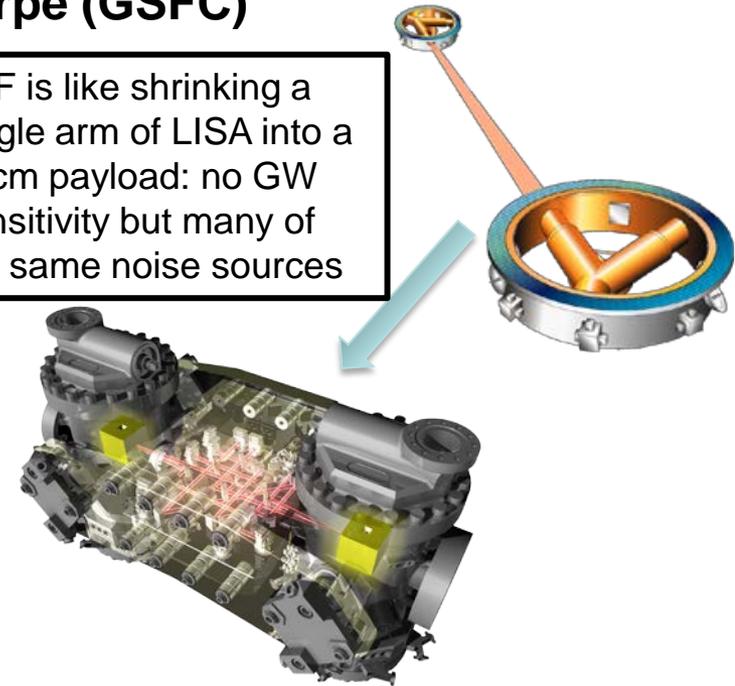


LISA Pathfinder

U.S. study scientist: Ira Thorpe (GSFC)

Purpose	Demonstrate essential technology for future space-based GW missions
Scientific Payloads	LISA Test Package (LTP) - Europe ST7 - NASA
Measurement Goal	Drag-free flight of test masses with atto-g residual accelerations
Status	LTP – finalizing construction ST7 – delivered & integrated Spacecraft – undergoing I&T
Anticipated Launch	2015

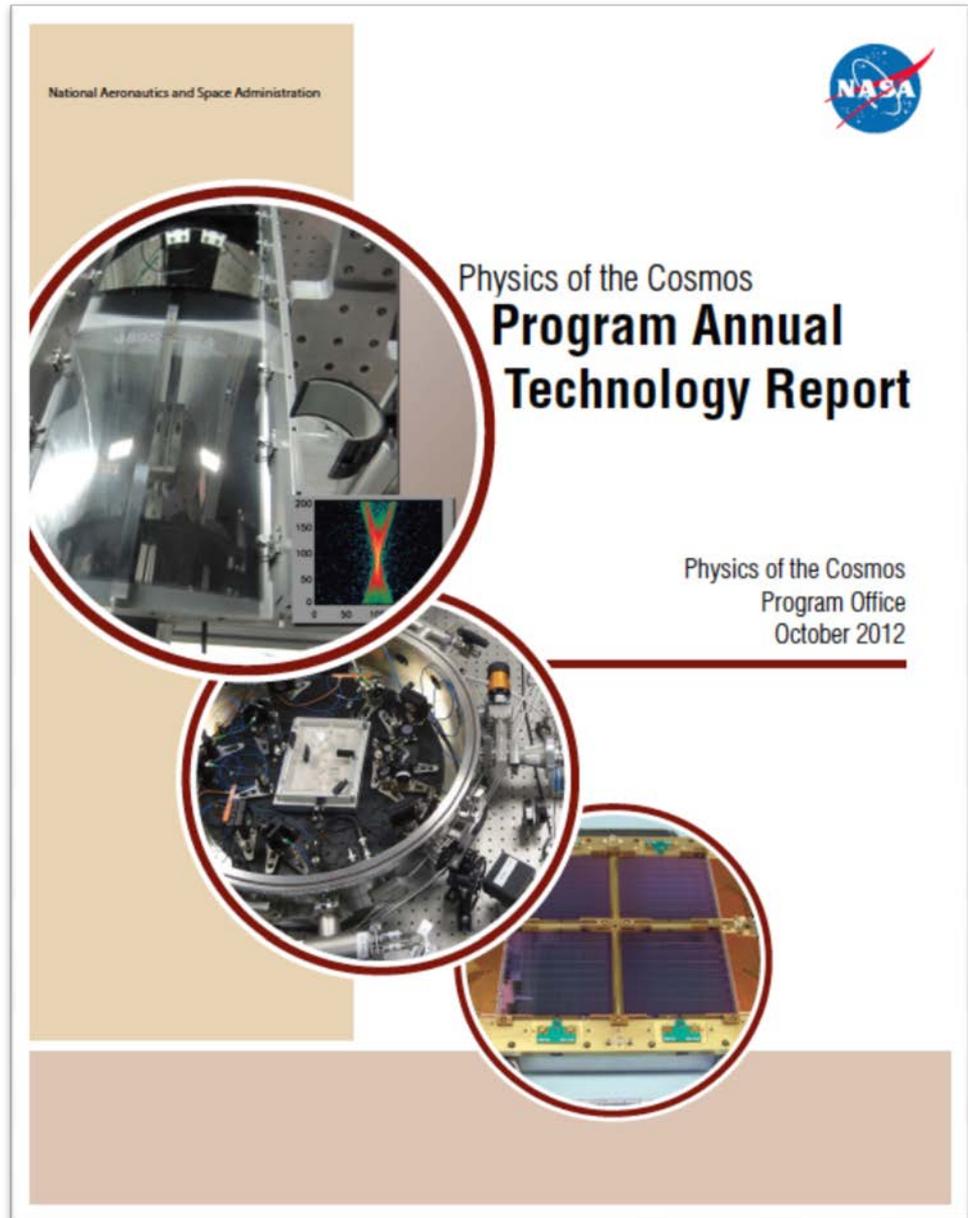
LPF is like shrinking a single arm of LISA into a 30cm payload: no GW sensitivity but many of the same noise sources



LPF hardware is nearly complete and has been subjected to an extensive ground test campaign. Clockwise from top left: LPF spacecraft, LTP optical bench, LTP laser, LTP electrode housing, ST7 thruster unit.

Technology Prioritization

- The PCOS Program Annual Technology Report (PATR) describes the Program's technology management activities
- **The PATR summarizes progress on all currently-funded SAT programs.**
- **The PATR defines priorities for technology investments for the upcoming year.** The technology needs are prioritized using a set of criteria (described in the report).
- The PCOS Program Analysis Group (PhysPAG) is the main conduit for collecting technology needs identified by the community.



Upcoming PCOS Community Interaction Opportunities

- **Here at the HEAD Meeting**
 - PhysPAG/PCOS Town Hall
 - X-ray SAG Meeting - Friday
- **April 2013, APS (DAP) meeting in Denver**
 - PhysPAG/PCOS Town Hall, April 16th, 12:30pm
- **Future opportunities TBD**
- **MORE INFO: pcos.gsfc.nasa.gov/physpag**

BACK-UP SLIDES

PCOS SAT Technologies Selected for Development Starting in FY12 for 2 Years

Title	PI	Institution	Area
Development of Fabrication Process for Critical-Angle X-ray Transmission Gratings	M. Schattenburg	MIT	X-ray
Antenna-Coupled Superconducting Detectors for Cosmic Microwave Background Polarimetry	J. Bock	JPL/Caltech	Inflation
Directly-Deposited Blocking Filters for Imaging X-ray Detectors	M. Bautz	MIT	X-ray
Off-plane Grating Arrays for Future Missions	R. McEntaffer	University of Iowa	X-ray
Development of Moderate Angular Resolution Full Shell Electroplated Metal Grazing Incidence X-ray Optics	P. Reid	SAO	X-ray

PCOS SAT Technologies Selected for Development Starting in FY13 for 2 Years

Title	PI	Inst.	Area
Next generation X-ray Optics: High Resolution, Light Weight, and Low Cost (W. Zhang	GSFC	X-ray
Demonstrating Enabling Technologies for the High-Resolution Imaging Spectrometer of the Next NASA X-ray Astronomy Mission	C. Kilbourne	GSFC	X-ray
Colloid Microthruster Propellant Feed System for Gravity Wave Astrophysics Missions	J. Ziemer	JPL	GW
Telescope for a Space-based Gravitational Wave Mission	J. Livas	GSFC	GW
Advanced Laser Frequency Stabilization Using Molecular Gasses (co-funded with OCT GCTP)	J. Lipa	Stanford	GW

PCOS/COR Education and Public Outreach

Award-winning Team

- Team members have won numerous awards, including NASA Exceptional Public Service Medal (2011), NASA Honor Awards (2009, 2011), Goddard Team Award for Outreach (2008), Goddard Honor Award for Outreach (2011) and ASD Peer Awards (2011, 2012)

Substantial Achievements

- AfterSchool Universe Program: 12-session astronomy program for middle-schoolers, has reached >12,000 children in 3 yrs; 900+ facilitators in 44 states + DC and Puerto Rico; 58 certified trainers
- Big Explosions & Strong Gravity: day-long Girl Scouts event has reached thousands of girls; now being broadened to other young audiences
- Blueshift Podcast/Blog: behind the scenes look at PCOS/COR science, missions, news, has 22,000+ Twitter followers; ~8,500 Facebook fans

Strong Future

- Continuing involvement/expansion of the above, plus:
- Space Forensics: presents astronomical mysteries in the style of crime scene investigations
 - Cornerstone of PCOS/COR EPO effort - piloted in 2007 – four cases currently under development – standards-based classroom packages developed 2013-2014 - interactive website, traveling museum kiosk planned for future years
- Multiwavelength Universe Tour: video clips + online interactive photo studio to provide the public with a multiwavelength view of astronomical objects



PCOS Technology Needs Prioritization

From 2012 PATR (top 2 of 4 priorities)

Priority	PCOS Technology Needs	Science
1	Large format Mercury Cadmium Telluride CMOS IR detectors, 4K x 4K pixels	Dark Energy
	High-resolution X-ray microcalorimeter: central array ($\sim 1,000$ pixels): 2.5 eV FWHM at 6 keV; extended array: 10 eV FWHM at 6 keV.	X-ray
	Dimensionally stable optical telescope: stringent length (μm) and alignment (nrad) stability with low straylight	Gravitational Wave
	Metrology laser: 10 yr life, frequency-stabilized, 2W, low noise, fast frequency and power actuators	Gravitational Wave
	Lightweight, replicatable x-ray optics	X-ray
	High resolution X-ray gratings (transmission or reflection)	X-ray
	Large format (1,000-10,000 pixels) arrays of CMB polarimeters with noise below the CMB photon noise and excellent control of systematics	Inflation
	Micronewton thrusters: 10 yr. life, low contamination, low thrust noise	Gravitational Wave
	Lightweight precision mirror mounting structure	X-ray
2	High throughput anti-reflection coatings with controlled polarization properties	Inflation
	Stable and continuous sub-Kelvin coolers for detectors	Inflation
	High-throughput, light, low-cost, cold, mm-wave telescope operating at low backgrounds	Inflation
	Polarization modulating optical elements	Inflation