Physics of the Cosmos Program Analysis Group:

Status

John Nousek (Penn State University)

NASA APS meeting – NASA HQ – 16-17 Apr 2013

Charter (Terms of Reference)

- PhysPAG is responsible for soliciting and coordinating community input in the development and execution of NASA's Physics of the Cosmos (PCOS) Program
- PhysPAG serves as a community-based forum for analysis in support of PCOS objectives, architecture planning, and activity prioritization.
- PhysPAG formally presents findings of its analyses to NASA SMD through the NASA Advisory Council (NAC).

- The Chair of the PhysPAG is drawn from the membership of the NAC Astrophysics Subcommittee
- The PhysPAG Chair is assisted by an Executive Committee that supports planning and activities of the group

- Executive Committee:
- Jason Rhodes, JPL
- Shaul Hanany, Univ. of Minnesota
- Jay Bookbinder, Harvard-Smithsonian
- Liz Hays, GSFC
- Guido Mueller, Univ. of Florida
- Angela Olinto, Univ. of Chicago

Agenda – Monterey HEAD – 9 Apr

- 12:30PM – Introduction, John Nousek
- 12:35PM - PCOS in the Astrophysics Implementation Plan,
  Richard Griffiths, NASA HQ, PCOS Executive Secretary
- 12:45PM - FY13 Activities in the PCOS Program Office and the PhysPAG,
  Ann Hornschemeier, GSFC, PCOS Project Office
- 12:55 PM – WFIRST in the light of Euclid, Daniel Stern
- 1:05 PM – LISA in the light of eLISA, Guido Mueller
- 1:15 PM – IXO in the light of ATHENA, Jay Bookbinder

Agenda – Denver APS – 16 Apr

- 12:30PM – PCOS/PhysPAG, Ann Hornschemeier, GSFC, PCOS Project Office
- 12:45PM – Inflation Probe in the light of Planck/Suborbital programs,
  Shaul Hanany
- 12:55 PM – LISA in the light of eLISA, Neil Cornish
- 1:05 PM – Gamma-Ray SAG – the Next Steps, Liz Hays
- 1:15 PM – Cosmic Ray SAG – the Next Steps, Angela Olinto

Topic for Townhalls at HEAD/APS

- The NASA Astrophysics Division has released an Astrophysics Implementation Plan which attempts to implement the Decadal Survey.

- The NAS/NRC Decadal Survey (New Worlds, New Horizons) was based on a situation which has been deeply affected by Federal budget changes and steps taken by other space agencies.

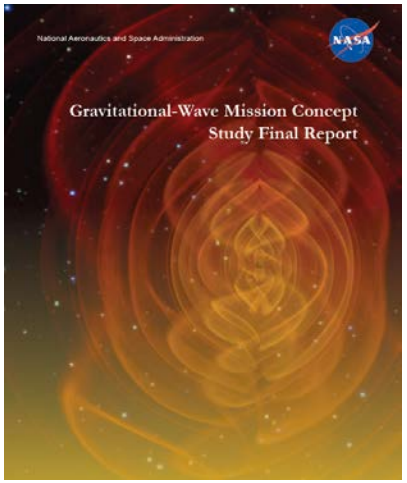
- Paul Hertz (Astrophysics Div. Director) has stated an intention to request the CAA to do a mid-decadal assessment of NASA's current implementation.

- We will hear a description of the NASA Implementation Plan, and have talks on the status of the Study Analysis Groups, both here and at the Denver APS.

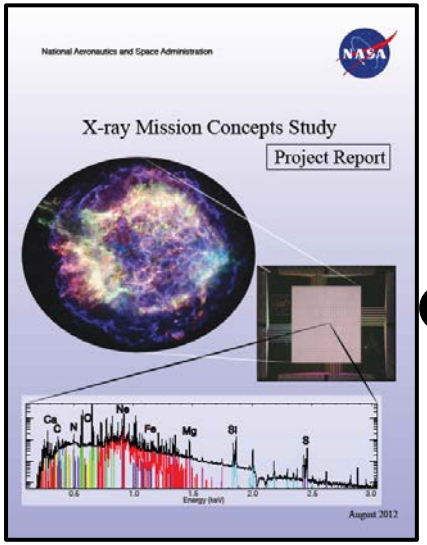
Current Gravitational-Wave Activities

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

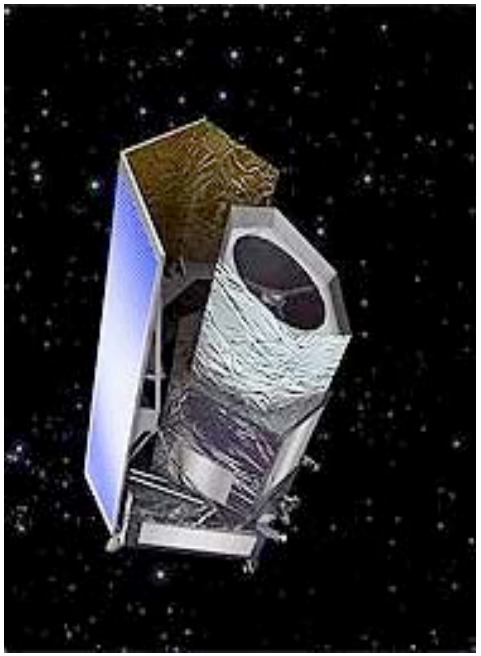


X-ray observatories in the $1B class that address all or most of the IXO science objectives are feasible for start within this decade, but only if technical risk is controlled through advance development of key technology to TRL-6

- 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



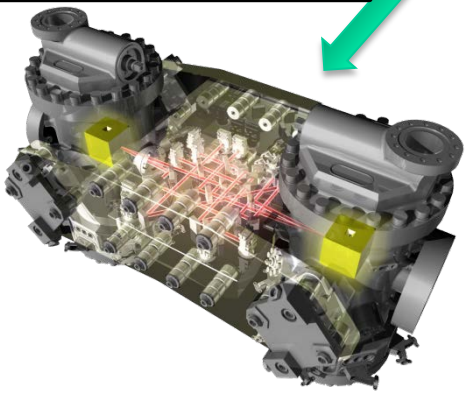
- NASA's contribution to ESA's Euclid mission:
  - Near Infrared Spectrograph and Photometer (NISP) flight subassemblies (detector + ASIC + cryo-cable = 'triplet') that meet ESA's requirements for testing & characterization.
  - Currently in Phase B.
- Euclid Project assigned to JPL under NASA's PCOS 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)

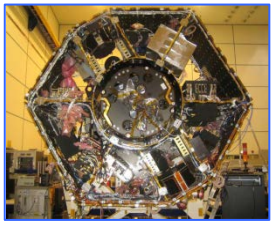
LISA Pathfinder

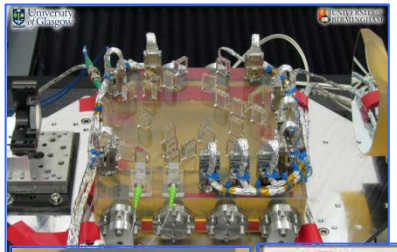
U.S. study scientist: Ira Thorpe (GSFC)

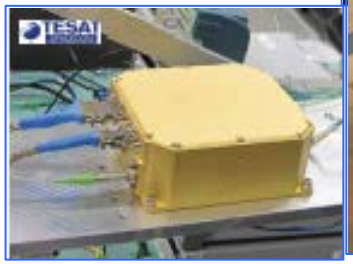
Purpose	Demonstrate essential technology for future space-based GW missions
Scientific Payloads	LISA Test Package (LTP) - Europe
	ST7 - NASA
Measurement Goal	Drag-free flight of test masses with atto-g residual accelerations
Status	LTP – finalizing construction
	ST7 – delivered & integrated
	Spacecraft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





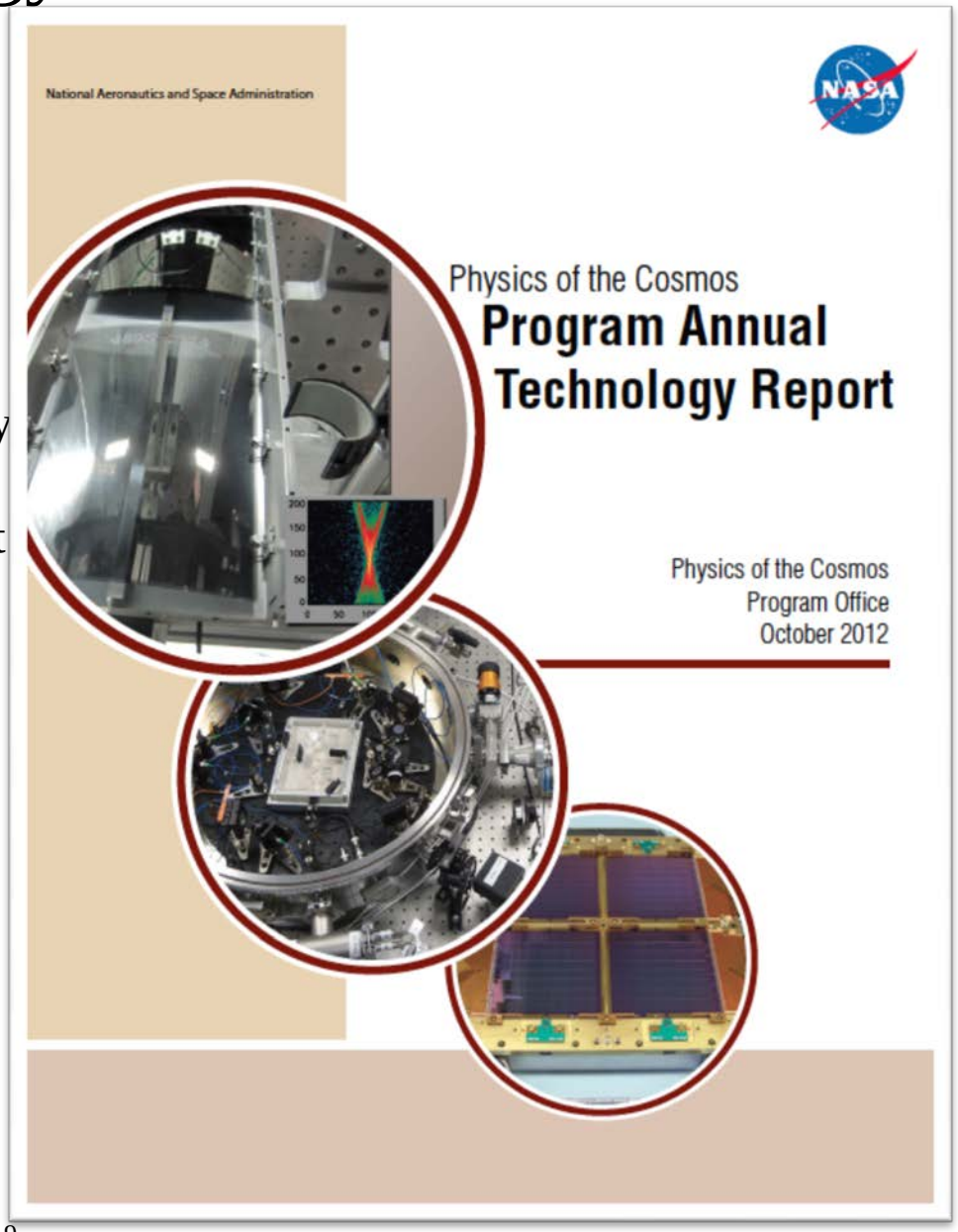




LPF hardware is nearly complete and has been subjected to an extensive ground test campaign. Clockwise from top left: LPF spacecraft, LTP optical bench, LTP laser, LTP electrode housing, ST7 thruster unit.

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.



PhysPAG

John Nousek, PhysPAG chair

PhysPAG Executive Secretary

Richard Griffiths, NASA HQ

PCOS Program Office

Ann Hornschmeier

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

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 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 (~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 (pm) 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