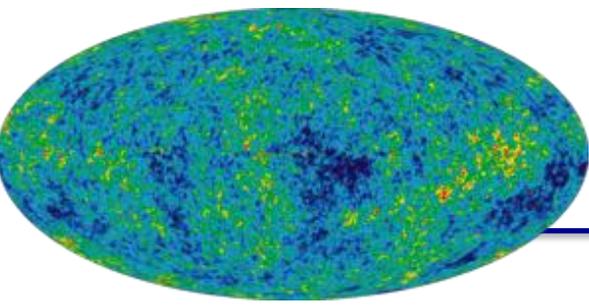


FY14 Activities, NASA's Physics of the Cosmos Program

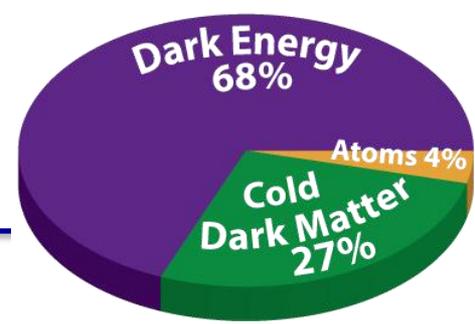
**Ann Hornschemeier
PCOS Chief Scientist**

pcos.gsfc.nasa.gov

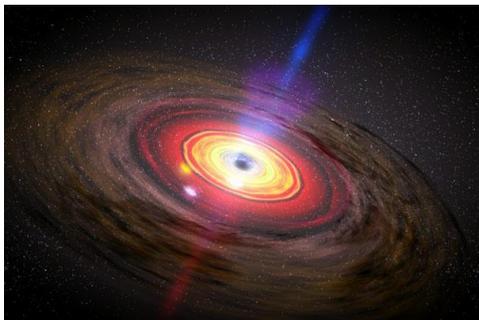
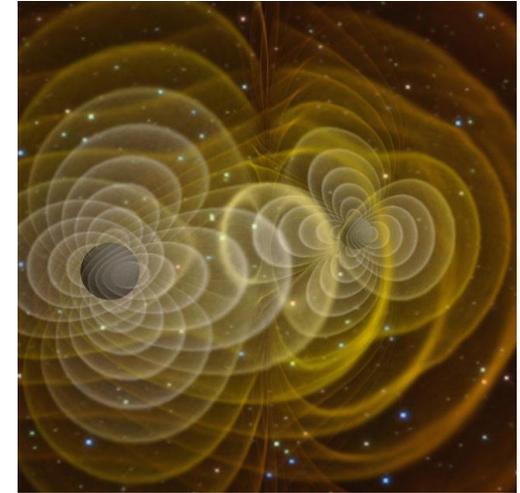


Physics of the Cosmos

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

PCOS MISSIONS

OPERATING

RELATED

Chandra



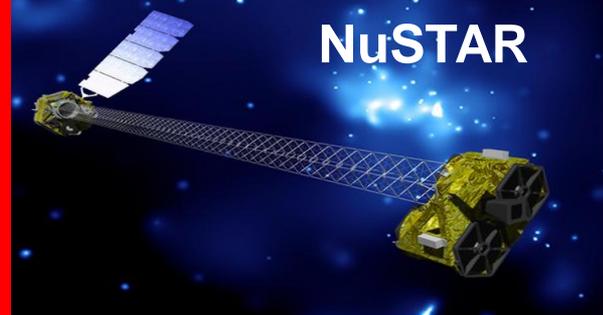
Fermi



XMM



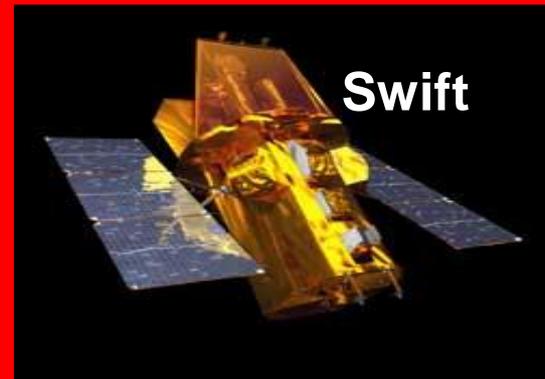
NuSTAR



Suzaku

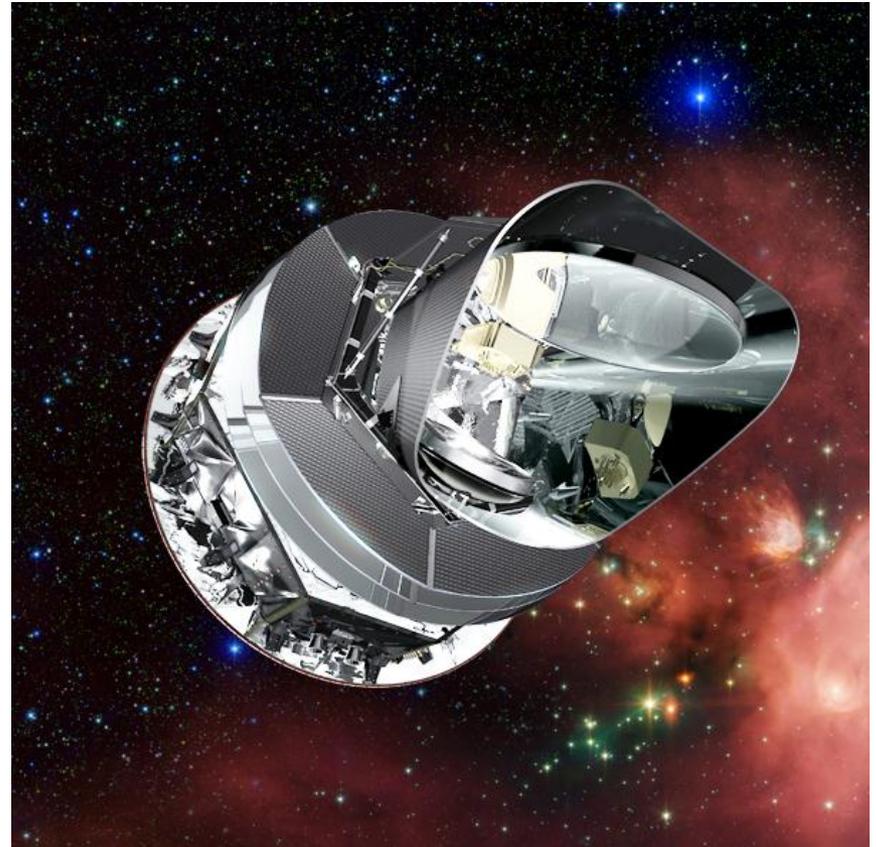


Swift



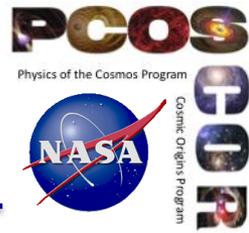
CMB Polarization from space: Planck

- Planck will release full mission data in 9 spectral bands, and first release of polarization data in fall 2014.
- CMB polarization results expected to be sensitive enough to test BICEP2 results.
- The Inflation Probe Science Interest Group (IPSIG) has released a white paper entitled “**CMB Polarization Measurements: 2015 and Onward**”, which is posted on the NASA PCOS website in reaction to the BICEP2 result



Euclid

A visible and near-infrared telescope to explore cosmic evolution



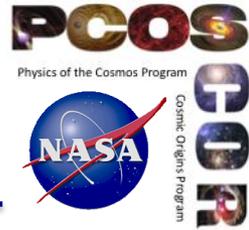
euclid

- **ESA Cosmic Vision 2015-2025 Mission, M-Class with NASA participation.**
- 1.2-m mirror, visible & near-IR images, spectra
- 6 year mission surveying 15,000 sq. deg.
- **Launch Date:** Mar 2020

CURRENT STATUS:

- ~50 U.S. scientists are members of the Euclid Consortium that will analyze the data
- First experimental manufacturing run for the Euclid near-infrared detectors to in process (ESA). NASA is testing detectors from the ESA NRE phase.
- NASA will buy, test and characterize the flight infrared detectors starting in ~ 2015, depending on the NRE-phase experimental manufacturing run.
- NASA developing ground system node and U.S. science center (ENSCI: Euclid NASA Science Center at IPAC).

Physics of the Cosmos (PCOS): Scientific and Technical Stewardship for future missions

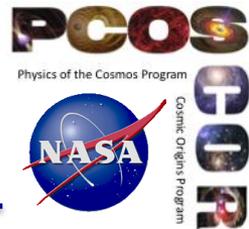


- **Provide scientific and technical stewardship for decadal-survey recommended missions:**
 - Of the six highly-ranked medium and large-scale space-based priorities in NWNH, three fall within the PCOS science program:
 - LISA (Gravitational Waves)
 - IXO (X-ray)
 - Inflation Probe (medium-scale)
 - NOTE: Although dark energy SCIENCE is within PCOS program, WFIRST is located within the Exoplanet Program

Note:
**Astrophysics Implementation Plan
update in process**

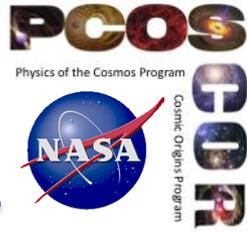


ESA's L2 Advanced X-ray Observatory: Athena



- **The Advanced Telescope for High Energy Astrophysics (Athena) has been selected for the ESA L2 slot. Launch date ~2028.**
- **NASA and ESA are discussing a potential NASA contribution.**
 - The Decadal Survey recommended an international partnership for an advanced X-ray observatory.
 - NASA solicited applications for a U.S. representative on the ESA Athena Science Study Team. Randall Smith (CfA) is U.S. member. Robert Petre (GSFC) and Michael Garcia (HQ) are ex officio. First meeting July 2014.
 - An ESA instrument AO will be released in early 2015.
- **NASA's FY15 budget request supports a potential Athena partnership.**
 - NASA will continue investing in technologies likely to be appropriate for an Athena contribution; investments include both directed and competed SAT investigations.
 - NASA is budgeting for development of contributed flight hardware, U.S. participation in the Athena science team, and a U.S. data center and GO program.
- **NASA has suggested the following types of contributions, limited to \$100-150M for contributed flight hardware.**
 - Portions of the calorimeter instrument
 - Inner mirror shells
 - Portions of the wide field imager
 - Contribution to science data center (U.S. node)

Future Gravitational Wave Observatory (Launch 2030's)



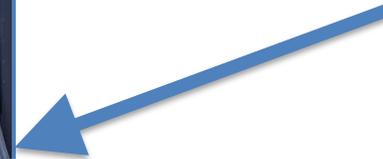
- **NASA and ESA are discussing a potential NASA contribution to ESA L3 which has the theme “The Gravitational Universe”**
 - ESA L3 planned for 2034 launch
 - NASA is interested in contributing to this mission because it is responsive to the U.S. Decadal Survey. The U.S. Decadal Survey recommended an international partnership for a gravitational wave observatory.
- **NASA is participating in ESA’s planned assessments for its L3 gravitational wave observatory.**
- **The partnership likely will be subject to Astro2020 decadal approval**
- **NASA (PCOS) looks forward to community input via the GWSIG and PhysPAG regarding the future**

Please attend Thursday
Morning 10:30AM session
“The Gravitational Universe”
Organized by Guido Mueller

LISA Pathfinder Status (including JPL project ST7)

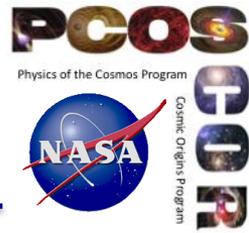
- **LPF Current Status: Late stages of integration with *launch expected in July 31, 2015.***
 - Preparations for mission and science operations underway with numerous exercises/test campaigns planned for the coming year

ESA
Transfer Orbit
Thermal Test



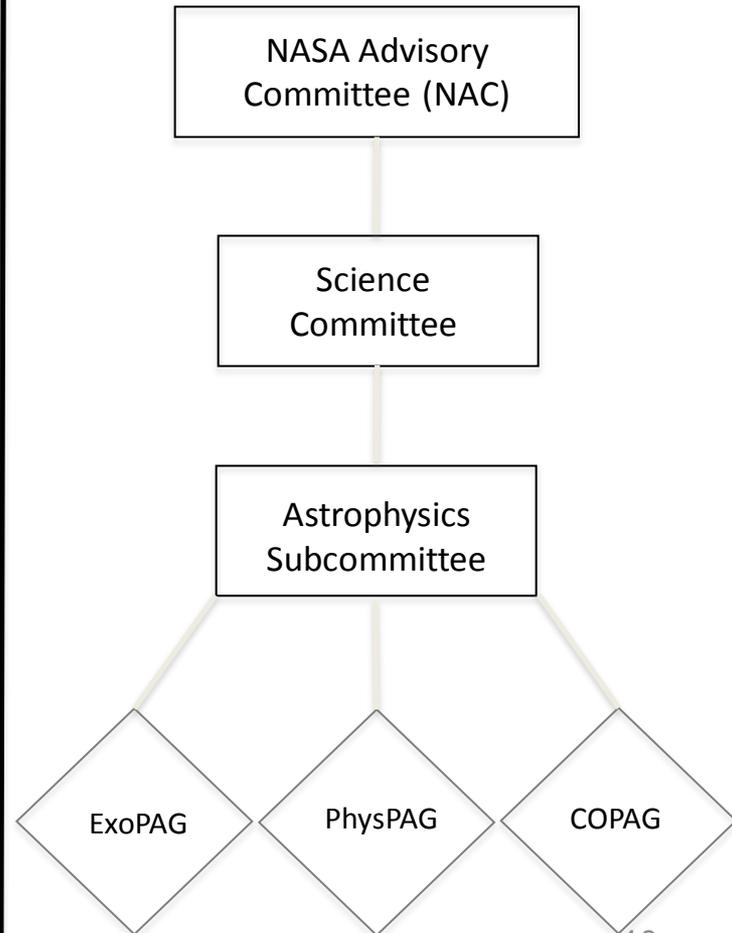
How can you interact with NASA's Physics of the Cosmos program?

Communicating with NASA Astrophysics via the Program Analysis Groups (PAGs)



- The Physics of the Cosmos Program Analysis Group (PhysPAG) serves as a forum for soliciting and coordinating input and analysis from the scientific community in support of the PCOS program objectives.
- The Program Analysis Groups (PAGs) include all members of the community interested in providing input to NASA on issues of strategic importance via analysis studies
- PAGs hold regular public meetings.
- PAGs identify specific, well-defined topics for further detailed studies assigned to Study Analysis Groups (SAGs) as well as longer-standing, discipline-centered analysis groups – Science Interest Groups (SIGs). All are task forces of volunteers.

Advisory Committees



PhysPAG and SIGs

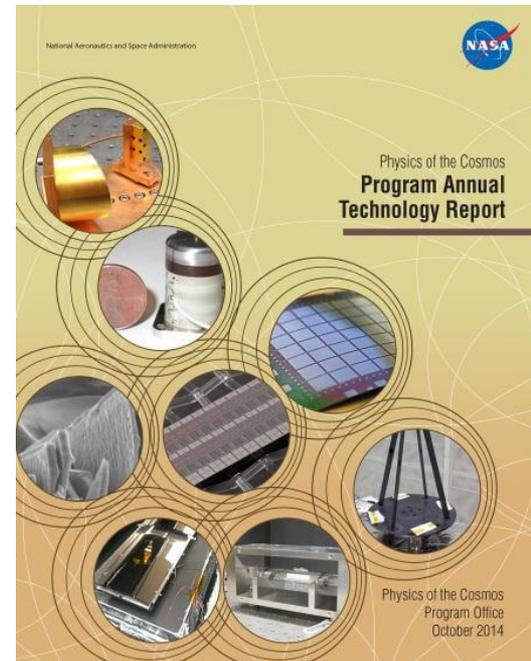
- **PhysPAG has five SIGs in operation for the Inflation Probe, Gamma Rays, Cosmic Rays, Gravitational Waves and X-rays.**
- **PhysPAG EC membership:**
 - J. Nousek, Chair, Penn State Univ., X-rays
 - J. Bookbinder, XRSIG chair, SAO, X-rays
 - M. Bautz, MIT, X-rays
 - **S. Hanany, IPSIG chair, Univ. of Minnesota, CMB**
 - J. Bock, Vice-chair, Caltech/JPL, CMB
 - **G. Mueller, GWSIG chair, Univ. of Florida, Gravitational Waves**
 - N. Cornish, Montana State Univ, Gravitational Waves
 - **J. Rhodes, JPL, Dark Energy**
 - R. Bean, Cornell, Dark Energy
 - A. Olinto, Univ. of Chicago, Astroparticles
 - Eun-Suk Seo, Univ. of Maryland, Astroparticles
 - **L. Hays, GSFC, GWSIG chair, Gamma rays**
 - M. McConnell, Univ. of New Hampshire, Gamma rays
- **Rotating off in Dec 2014, Call for applications in Fall 2014**

PCOS community activities

- Encourage your finishing students and early-career postdocs to apply for the Einstein fellows' program
 - Einstein Fellows hold their appointments at a Host Institution in the U.S. for research that is broadly related to the science goals of the NASA Physics of the Cosmos program.
- The PhysPAG provides input on technology needs to the PCOS program office that are fed into the PCOS Annual Technology Report (PATR) each year. (Thanks for sending in 21 technology gaps during summer 2014!)



Laura Blecha, 2012 Fellow



Keeping up with PCOS

- Sign up for email announcements, or for a Science Interest Group
- pcos.gsfc.nasa.gov

Physics of the Cosmos Newsletter

August 2014

Vol. 4 No. 2

Summer 2014 PCOS Update

Mansoor Ahmed, *PCOS Program Manager*Ann Hornschemeier, *PCOS Program Chief Scientist*

Since February 2014, progress has continued on a number of fronts in the PCOS portfolio. Chief among these are the next steps in defining a U.S. role in the European Space Agency (ESA) L2 and L3 opportunities. Following the June 2014 announcement by ESA of the selection of the L2 mission Athena we are now referring to this mission by name and are pleased to have selected, via an open community call in early July 2014, a U.S. representative to the Athena Science Study Team (SST).

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Please read Robert Petre's article on Athena which includes the full list of members of the ESA-selected SST. Conversations with ESA concerning L3 are at a much earlier stage and we ex-
(continued on page 2)

NASA's Fermi Finds A "Transformer" Pulsar

In late June 2013, an exceptional binary containing a rapidly spinning neutron star underwent a dramatic change in behavior never before observed. The pulsar's radio beacon vanished, while at the same time the system brightened fivefold in gamma rays, the most powerful form of light, according to measurements by NASA's Fermi Gamma-ray Space Telescope.

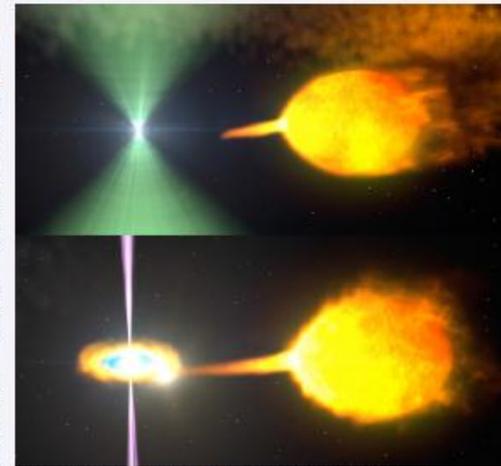
The binary pairs a 1.7-millisecond pulsar named PSR J1023+0038—J1023 for short—with a star containing about one-fifth the mass of the sun. The stars complete an orbit in only 4.8 hours, which places them so close together that the pulsar will gradually evaporate its companion.

For J1023, the dramatic changes seem to reflect an erratic interaction with its companion star, according to a recent study by an international team led by Ben Stappers at the University of Manchester in England.

The stars are close enough that a stream of gas flows from the sun-like star toward the pulsar. The pulsar's rapid rotation and intense magnetic field are responsible for both the radio beam and a powerful outflow of high-energy particles. When the radio beam is detectable, the pulsar wind blows back the companion's gas stream, preventing it from approaching too closely. But when the flow from the companion surges, the gas is able to reach toward the pulsar and establish an accretion disk.

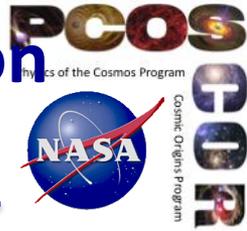
Gas in the disk becomes compressed and heated, reaching temperatures hot enough to emit X-rays. Next, material along the inner edge of the disk quickly loses orbital energy and descends toward the pulsar. When it falls to an altitude of about 50 miles (80 km), processes involved in creating the radio beam are either shut down or, more likely, obscured.

Read the full article at <http://www.nasa.gov/content/goddard/nasas-fermi-finds-a-transformer-pulsar/> and published paper Stappers et al. *ApJ*, Vol. 790, p. 39 at <http://adsabs.harvard.edu/abs/2014ApJ...790...39S>



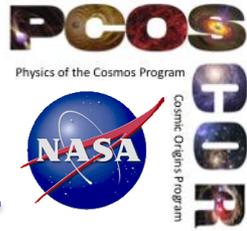
These artist's renderings show one model of pulsar J1023 before (top) and after (bottom) its radio beacon (green) vanished. Normally, the pulsar's wind staves off the companion's gas stream. When the stream surges, an accretion disk forms and gamma-ray particle jets (magenta) obscure the radio beam. Image Credit: NASA's Goddard Space Flight Center

Upcoming PCOS/PhysPAG Community Interaction Opportunities



- **Full list of upcoming SIG meetings on website.**
- **January 2015 Seattle AAS**
 - Half-day PhysPAG meeting Sunday January 4.
 - XRSIG, CosmicSIG, GammaSIG meetings
 - PCOS/HEAD “Centennial of General Relativity” sessions on Monday January 5 (10AM and 2PM)
 - Reports from NASA’s Program Analysis Groups (scheduled Wednesday morning, January 7)
 - PCOS Table in NASA HQ SMD area
- **April 2015, APS (DAP) meeting in Baltimore, MD**
 - CosmicSIG meeting
 - Centennial of GR activities, TBD
- **MORE INFO: pcos.gsfc.nasa.gov/physpag**

THANK YOU



Ann.Hornschemeier@nasa.gov

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

(Sign up for email list at “PCOS News and Announcements tab)