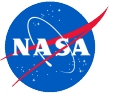




Physics of the Cosmos: The view from Headquarters

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The Program



PCOS Science Themes

The Physics of the Cosmos (PCOS) program incorporates **cosmology, high-energy astrophysics, and fundamental physics** projects aimed at addressing directly central questions about the nature of complex astrophysical phenomena such as black holes, neutron stars, dark energy, and gravitational waves. Ultimate quest is to understand ***How the Universe works, from the very small to the very large scales.***

Specific science questions:

- *What are the origin, evolution, and fate of the Universe?*
- *What are the conditions of space, matter, and time in extreme gravitational fields?*
- *Why is the Universe accelerating, and how does this acceleration depend on cosmic time?*
- *What makes “dark matter” and why is it dark?*
- *Can we validate General Relativity by testing its predictions?*



PCOS Missions

Mission	Project Center	Partners	Launch Date	Mission Phase	Comments
Planck	JPL	ESA	05/09	Operations	IPAC provides data reduction and analysis support to U.S. based scientists
Fermi	GSFC	DOE, Int'l Team	06/08	Operations	
XMM-Newton	GSFC	ESA	12/99	Operations	XMM-Newton GOF at GSFC provides support to U.S. based scientists
Chandra	MSFC	SRON	07/99	Operations	
ST-7	JPL	ESA		Development	US hardware delivered and integrated with spacecraft; waiting for system testing
IXO	GSFC	ESA, JAXA	TBD	Pre-formulation	Under review
LISA	GSFC	ESA	TBD	Pre-formulation	Under review
Missions performing PCOS-related science in Explorers Program					
Suzaku	GSFC	JAXA	07/2005	Operations	NASA GOF support to be terminated by end of FY11
Swift	GSFC	UK, ASI	11/2004	Operations	
RXTE	GSFC		12/1995	Operations	To be terminated by end of 2011
NuSTAR	JPL	ASI		Development	LRD Feb 2012
Astro-H	GSFC	JAXA		Development	LRD Feb 2014 CBE
GEMS	GSFC			Development	LRD July 2014 (TBR)
Other related science					
WFIRST				Under study	Dark Energy



The Einstein Fellowship

PCOS supports research investigations, both theoretical and observational, in science areas closely related to the main topics of the program, through award of Fellowships to early-career scientists ~ 3 years or less after PhD.

Scientists apply from Institutions worldwide to work in US-based Institutions. About 10 Fellows are selected each year. This year the subscription rate was ~20:1.

Average award: ~ \$100K

Total funds in program: ~\$4M

Program “success”: 85% (Chandra) Fellows in permanent jobs

95% still in the field

Next Einstein Science Symposium: Washington, DC, Fall 2011



APD Supporting Programs

- PCOS science and technology is supported by various R&A programs:
 - **Astrophysics Data Analysis Program (ADAP)**
broad range of data analysis efforts for past or current NASA missions
 - **Astrophysics Theory Program (ATP)**
theoretical investigations/modeling of phenomena targeted by past, present, or future NASA space missions
 - **Astrophysics Research and Enabling Technology (APRET)**
suborbital flights, detector development, laboratory astrophysics, and more
 - **Strategic Astrophysics Technology (SAT)**
development efforts for key technologies mature enough (TRL4-6) to feed into major missions
TPCOS
TCOR
TDEM



Keeping ties with the community

The PCOS Program Analysis Group (PAG):

- Provide community input to NASA via the NAC Astrophysics subcommittee (APS) and other appropriate channels
- Identify most important technology investments related to PCOS science for near- and long-term in light of the Decadal Survey strategic recommendations
- Provide input through the advisory structure to the Program Office's mission concept study process

PhysPAG has 3 working Groups (SAG):

- ***NRC Technology Study “NASA Technology Roadmap”*** inputs (Chair – Roger Brissenden; NASA POC – Jaya Bajpayee)
- ***Inflation Probe*** (Chair – Hanany; NASA POC – Bill Danchi)
- ***Community Interactions/Interfaces/communication*** (Chairs Steve Ritz/Jason Rhodes; NASA POC – Rita Sambruna)

Education and Public Outreach program:

The PCOS program engages students, teachers, and the general public in PCOS-related science through a range of activities and media.



Programmatic Update



LISA and IXO (1/2)

- 3 candidate concepts were competing for ESA's L1 2020 opportunity: LISA, IXO and EJSM/Laplace, each with a significant NASA partnership
- None of these were recommended as top priority by the US decadal surveys
- The decadal rankings combined with the constrained projected out-year resources in the FY12 President's Budget Request led ESA to conclude that a 2020 schedule is not feasible for any of the 3 candidates
- An exploratory ESA activity has started to see if any and which of the science goals of the three L missions could be implemented as an Europe-led mission targeting an early 2020's launch date
 - European "Science Teams" are being formed with rapid mission definition effort
 - A "NASA HQ-empowered scientist" will participate on each of the three Science Teams
 - L1 plan to be discussed at June ESA SPC meeting; tentative plan for downselect foreseen at Feb 2012 SPC meeting



LISA and IXO (2/2)

- Consideration of the LISA and IXO concepts with the scale and partnerships as proposed to the NWNH decadal survey is ended
- NASA-APD plans to continue the base funding for the LISA and IXO teams through FY11
- NASA-APD will consult with the community about strategic investments in gravity wave and X-ray astrophysics in future years in the context of the NWNH recommendations and projected resource availability.

APD will engage community through discussions and possible solicitations for new concept studies, in parallel with on-going interactions with ESA re-scoped L1 mission candidates

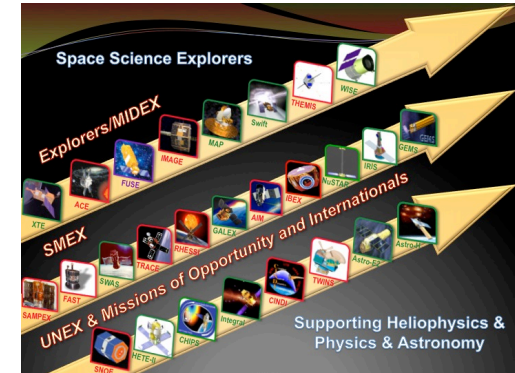


Explorers

The schedule for the current round of NASA Explorer proposals is:

- Step 1 Selections announced (target)Sept 2011
- Phase A Concept Study Reports due (target)August 2012
- Down-selection for flight (target)February 2013

- There are:
 - 15 Astrophysics EX mission proposals - \$200M plus launch costs
 - 11 Astrophysics SALMON/Missions of Opportunity proposals - \$55M includes both Partner MOs and Small Complete Missions



APD expects to release the next SALMON/MoO AO late-2011

As recommended by NWNH, a Future Astrophysics Explorer missions budget was created to increase the flight rate to achieve the recommended four missions and four missions of opportunity selected by the end of the decade. Notional Mission Selection Dates:

- 2013 EX 1 (current AO)
- 2014 SMEX 1
- 2016 EX 2
- 2018 SMEX 2



Conclusions

- PCOS includes a wide variety of science topics from astrophysics to fundamental physics
- Currently operating missions are fueling a vibrant science program both for observational and theoretical investigations. Upcoming launch of 3 Explorers with PCOS-related science (GEMS, NuSTAR, Astro-H)!
- Funding opportunities are planned by APD to support new missions and PCOS-related science and technology
- The IXO, LISA science was highly rated by the Decadal and still a priority for NASA. Programmatic realities require possibly redefining these efforts. NASA will consult the community for strategic advice.
- The PCOS community is strongly encouraged to continue thinking of ways to implement the Decadal science priorities within the current environment

PCOS technology roadmap and investments remain vital to future program success