

**Charter for the Science and Technology Definition Team (STDT) for
Definition of a Probe-Class X-ray Astrophysics Mission**

July 30, 2013

Purpose

The Astrophysics Division, through its Physics of the Cosmos (PCOS) Program Office, is initiating a definition study of a probe-class mission that addresses the X-ray science goals and program prioritizations of the Decadal Survey¹ *New World New Horizons* (NWNH). The X-ray Probe Science and Technology Definition Team (STDT) will optimize the scientific and technical options for a probe-class mission to meet the X-ray science goals and program prioritizations of the Decadal Survey, following the spectroscopy studies of the X-ray Concept Study Team in 2012. Specifically, the X-ray Astrophysics Probe (XAP) STDT will build on the notional probe-size mission concept developed by the X-ray Concept Study Team in 2012 (NCAL), focused on high-resolution X-ray spectroscopy of astrophysical sources with a microcalorimeter.

The Decadal Survey endorsed the scientific objectives of the International X-ray Observatory (IXO) and made recommendations regarding the capabilities of the next large X-ray observatory derived from those of IXO. Specifically, the key instrumental capability would be an X-ray microcalorimeter spectrometer at the focus of a large mirror with angular resolution of 10 arc seconds or better. The 2012 X-ray Mission Concepts Study² concluded that a probe-class mission could achieve a substantial fraction of the IXO science objectives at a significantly lower cost. This study also concluded that the key focal plane instrument for a probe-class observatory is a microcalorimeter since the main IXO science themes endorsed by the Decadal Survey centered upon high-resolution, imaging X-ray spectroscopy. The notional mission NCAL in the X-ray Study included a microcalorimeter and would serve as potential starting points for more thorough definition of an X-ray astrophysics probe.

A Science and Technology Definition Team (STDT) for an X-ray Astrophysics Probe (XAP) is chartered to define a reference mission concept of high scientific, technical, and programmatic merit that would both advance the science goals and programs articulated for X-ray astronomy in the Decadal Survey and be executable within the Astrophysics Division's current notional budget profile. As described in the *NASA Astrophysics Strategic Implementation Plan*³, if a large mission like WFIRST cannot be started this decade, then an X-ray Astrophysics Probe would be

¹ *New Worlds, New Horizons in Astronomy and Astrophysics* (NRC, 2010); http://www.nap.edu/catalog.php?record_id=12951.

² *NASA X-ray Mission Concepts Study Project Report* (August 2012); <http://pcos.gsfc.nasa.gov/x-ray-mission.php>

³ *NASA Astrophysics Strategic Implementation Plan* (December 20, 2012); <http://science.nasa.gov/astrophysics/documents/>

a candidate to start this decade as early as FY2017. A FY 2017 new start, followed by efficient development of the selected mission, requires mature technology(ies) by the end of this decade. To be ready for a FY 2017 new start, the key technology(ies) need to be at TRL 5. The mission definition study will identify technology requirements and design factors that will enable a probe-class mission maximizing NWNH science goals and programs, and these will be used to guide technology investments during the remainder of this decade.

The results of the XP STDT study will be considered by the NASA Astrophysics Division and jointly considered by the NRC Committee on Astronomy and Astrophysics along with studies from other STDTs.

STDT Scope

The PCOS Program Office will work with the STDT to define an X-ray observatory that achieves a high fraction of the NWNH endorsed X-ray science objectives within the cost constraints of a probe-class mission. A probe-class mission is to cost no more than \$1billion in FY 2014 constant year dollars. The costs include Phases A through F (formulation through final close out of the baseline mission) and the launch vehicle. It does not include costs for an extended mission. The STDT will develop further the notional mission NCAL previously defined by the 2012 X-ray Concept Study Team.

The science goal of the STDT will be to establish science requirements, investigation approaches, key mission parameters, and other scientific studies needed to support the definition of an implementable space mission for high-resolution X-ray spectroscopy of astrophysical sources. The technical goals will be to establish the programmatic, technical, risk, and implementation approach in the current environment where significant attention is paid to cost performance for NASA projects.

Among the products to be delivered by the STDT, working with the PCOS Program Office, will be a Mission Definition Study Report that includes:

1. Science yield (baseline and minimum requirements) from a cost-capped, probe-scale mission that is traceable to the recommendations of the Astronomy and Astrophysics Decadal Survey.
2. Observatory performance requirements that enable the science requirements.
3. An interim Architecture Trade Study to select from various options an architecture and instrument(s) to develop in greater detail for the DRM and for documentation in a detailed Mission Definition Report.
4. A Design Reference Mission (DRM) that describes quantifiable science objectives, the measurements required to meet those objectives, the fundamental instrument and mission requirements that allow those measurements to be executed, and an observing timeline that quantifies the science yield during the mission lifetime.
5. Sufficient detail and fidelity to allow the design to be evaluated through an independent Cost Appraisal and Technical Evaluation (CATE).
6. A top-level schedule for formulation, implementation, and operations and will also include an assessment of top technical risks to achieving the baseline science requirements.

7. Current state of technology needs for the selected architecture, and identify needed technologies to be developed through approximately 2019. Any required technologies must be brought to TRL 5 by the forecasted start of Phase A (FY 2017) and to TRL 6 by the forecasted year of a PDR (FY 2019) within the anticipated budget profile of the NASA Astrophysics Division.

To make the STDT consistent with the Astrophysics Strategic Implementation plan, the STDT will plan for its concept to be technically viable for a future flight mission new start in fiscal year 2017 and PDR in FY2019.

The PCOS Program Office will provide at the kickoff meeting the program guidelines for trade criteria to be used for the Architecture Trade Studies.

Organization

The STDT will work in close coordination with the Science and Engineering Study Team, provided through the PCOS Program Office located at GSFC. A Study Manager shall lead the Science and Engineering Study Team and shall be responsible for maintaining the study within the allocated cost and schedule. The STDT and the Study Team will iterate on science requirements and the mission concept that flows from these and will share results with each other in a two-way exchange. The STDT may ask the Study Team for additional data or to study particular mission concept(s), technical and/or programmatic trades, or other studies, including variations of concepts already studied or new concepts.

The STDT may seek input from scientists and technologists external to the STDT. The Study Team may ask the STDT for scientific or technical assessments, perspectives, and/or studies. Any external scientific inputs and discussions needed by the Study Team will flow through the STDT only. The Study Team may also seek internal scientific or technical perspectives from NASA scientists for help in developing mission concepts based on the findings of the STDT. The Study Team will name such scientists, and their perspectives will be shared with the STDT.

The STDT Chair(s) will act as the official point of contact between the members of that STDT and NASA representatives for any issue of programmatic, technical, or budgetary nature.

Membership

STDT members will be selected by NASA HQ from a pool including applicants that respond to the call for applications. Members will be selected for balance among expertise in relevant science areas, relevant hardware and technology, optics, and approaches to the implementation of the science goals. The NASA Astrophysics Division Director will appoint the STDT Chair(s) from the STDT membership.

The PCOS Program Scientist and PCOS Chief Scientist will be ex-officio members of the STDT.

Meetings

Meetings will be called by the STDT Chair(s), and the agendas will be set by the Chair(s) in coordination with NASA HQ and the Study Manager to ensure that planned activities are aligned with programmatic needs and expectations. Face-to-face meetings roughly every three or four

months are anticipated, in addition to regular (roughly every two weeks) telecons. Teleconferencing will always be provided as an alternative for those unable to attend in person.

Meeting locations and dates will be established with the Chair(s) to enable maximum participation by the membership, including a rotation of location, and possible appendage to relevant science conferences.

STDT activities will commence with a kickoff meeting to be held during October 2013 at the GSFC.

All STDT meetings will be open to nonmembers.

Time Commitment

Members will be expected to attend or dial into the meetings and participate in the telecons. There will be work and writing assignments for members that will take approximately an additional two days per meeting.

Reports

The XAP STDT will deliver an interim Mission Definition Report to NASA HQ in April 2014. A Preliminary Mission Definition Report will be delivered by November 2014 to the PCOS Program Office for use by the Study Team for the CATE. The Final Report will be delivered to NASA HQ by Jan 31, 2015. A CATE will be developed by an independent entity chartered by NASA HQ using the preliminary mission concept. The STDT Chair(s) will brief both the interim report and the final report to the Astrophysics Division at NASA Headquarters and to the NRC's Committee on Astronomy and Astrophysics (CAA).

Termination

The STDT will be disbanded after the delivery of the Mission Definition Report to NASA and prior to any future Announcement of Opportunity (AO) for participation in possible mission(s) related to these studies.

If the European Space Agency (ESA) L2 selection is an X-ray mission, and NASA and ESA decide to collaborate on that mission, the X-ray probe STDT will be disbanded even if this occurs before the completion of this charter.

Public Release of Information

Any public release or discussion of the STDT or Study Team status, or results of findings, studies and concepts, shall be coordinated directly with NASA HQ beforehand. Reports and other output of the STDT studies that are made publicly available will be in compliance with Federal export regulations (e.g., ITAR and EAR).

STDT Timeline

9/6/2013	Announcement of Membership
----------	----------------------------

10/1-2/2013	Kickoff Meeting (face-to-face or web connect) for STDT with PCOS Program Office and Science and Engineering Support Team. Introduction of trade criteria.
On or before 1/31/2014	Briefing of the Architecture Trade Study to PCOS Program
4/2014	Interim Mission Definition Report delivered to NASA HQ
11/2014	Preliminary report as input to CATE
No later than 1/30/2015	Final Mission Definition Report delivered to NASA HQ
2/27/2015	CATE completed and delivered to NASA HQ (date negotiated by HQ)

Logistics

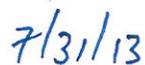
The PCOS Science and Engineering Study Team will provide logistical support for the STDT, including arranging meetings, in person and by phone, and providing online resources. Travel to the STDT meetings will be funded by the PCOS Study Team, subject to NASA policies and availability of funds from NASA. NASA will provide no support other than travel. The Study Team will provide support and direction in conjunction with NASA HQ for all ITAR sensitive activities and products.

Points of Contact

The NASA HQ point-of-contact is Dr. Rita Sambruna (Rita.M.Sambruna@nasa.gov). The PCOS Program Office point-of-contact is Dr. Ann Hornschemeier Cardiff (Ann.H.Cardiff@nasa.gov).



Dr. Paul Hertz
 Director
 Astrophysics Division
 Science Mission Directorate
 NASA Headquarters



Date