

**Terms of Reference
Probe Concepts Assessment Team (PCAT)**

Introduction

NASA is sponsoring 10 medium-size mission concept studies for missions in the cost range \$400M - \$1B (“Probes”) as part of its preparations for the 2020 Astrophysics Decadal Survey. The 10 Probe concepts were selected competitively in February 2017. The proposing Probe Teams were each awarded a grant (~\$300K) to develop their concepts through an 18 months long study and prepare a written report that NASA will review and then submit to the Decadal Survey Committee. Only 9 Probe Studies were awarded NASA support to conduct one-time design lab runs. The 9 Probes concept studies of interest for this Terms of Reference are:

Probe Concept Mission	Principal Investigator	Assigned to/Design Lab
Transient Astrophysics Probe (TAP)	J. Camp, GSFC	GSFC/IDC
Cosmic Evolution through UV Spectroscopy (CETUS)	W. Danchi, GSFC	GSFC/IDC
A High Spatial Resolution X-ray Probe Satellite (AXIS)	R. Mushotzky, UMD	GSFC/IDC
Probe of Extreme Multi-Messenger Astrophysics (POEMMA)	A. Olinto, Univ. of Chicago	GSFC/IDC
X-ray Timing and Spectroscopy on Dynamical Timescale from Microseconds to Years (STROBE-X)	P. Ray, NRL	GSFC/IDC
Cosmic Dawn Intensity Mapper (CDIM)	A. Cooray, Univ. of Irvine	JPL/Team-X
Galaxy Evolution Probe (GEP)	J. Glenn, Univ. of Colorado	JPL/Team-X
Inflation Probe Mission Concept Study (PICO)	S. Hanany, Univ. of Minnesota	JPL/Team-X
Starshade Rendezvous Missions	S. Seager, MIT	JPL/Team-X

Five Probes (TAP, CETUS, AXIS, POEMMA, and STROBE-X) were assigned to the PCOS/COR Program Office at GSFC for oversight, while four (CDIM, PICO, GEP, and Starshade Rendezvous) were assigned to the Exoplanet Program Office at JPL. One Probe (EarthFinder) was accepted as proof of concept only, overseen at JPL; this study will not be considered here.

NASA provided resources to 9 Principal Investigators to utilize NASA’s concurrent engineering design labs, (the Integrated Design Center (IDC) at the Goddard Space Flight Center and Team-X at the Jet Propulsion Laboratory, hereafter referred to as “the design labs”), to conduct mission

level design studies and cost assessments. The above Table delineates which studies were assigned to which design lab. The two design labs generated high-level mission design products for each Probe concept that serve as the basis for the Engineering Design Packages subsequently finalized by the Probe Teams, to be attached to the Teams' Final Reports at delivery to the Decadal Survey. The mission level design studies provided by the design labs comprise cost assessments for each Probe Concept. Beside those cost estimates, the Probe Teams were free to generate additional cost estimates through various other means, and also to update or modify the design lab provided cost estimates as their concepts evolved after their design lab runs.

NASA has requested GSFC's and JPL's in-house costing offices, the Resource Analysis Office (RAO) and the Cost Estimation and Pricing Section (CEPS), respectively (hereafter referred to as the "costing offices") to perform independent cost assessments of the Probe Concepts using the resources of their respective Centers.

In order to provide an independent non-advocate assessment and validation of the costing offices' results, NASA is assembling an independent Probe Concepts Assessment Team (PCAT). The PCAT is composed of subject matter experts who will work with the costing offices and the Probe Teams.

Charge and Review Criteria

The PCAT will conduct a "cost and technical validation" of the Probe mission concepts. A cost and technical validation is not an Independent Cost Estimate (ICE) and it is not a Cost and Technical Estimate (CATE); rather it is a validation that the mission design, as proposed by each Probe mission concept team, is consistent with the cost estimate developed by the costing offices and is feasible for under \$1 billion.

The purpose of conducting a cost and technical validation of the Probe mission concept studies is to provide NASA Headquarters confidence in the science, technical, cost, and risk conclusions of the Probe Mission Concept Reports that will be presented to the Decadal Survey.

Specifically, the PCAT will:

- Provide a high-level assessment of whether the proposed Probe can achieve the stated science goals and objectives with the proposed architecture
- Comment on the technology maturity of any enabling technologies
- Develop a process for cost validation of the costing offices assessments. This will be a qualitative estimate of the likelihood that the Probe concept is feasible within \$1 billion based on the Probe Final Reports and Engineering Data Packages.

PCAT Deliverables to HQ

The PCAT's primary final deliverable to NASA HQ will be a written report covering:

- Overall Summary
- Brief description of PCAT Methodology and Process

- High-level assessment of whether the proposed mission addresses the science goals and objectives
- Strengths and Weaknesses in the context of costing models.
- Qualitative assessment of the confidence that the Probe Mission Cost is under the \$1B maximum cost target (Likely, Possible, Unlikely)
- Comments to NASA

The PCAT final written report will be in the form of a short narrative summary and a set of PowerPoint slides with explanatory notes. Additionally, the PCAT's Chair and Chair's delegates will debrief HQ orally on the written report.

After the delivery of the written report and outbrief, NASA will disband the PCAT.

Probe Team deliverables to HQ

Each Probe Team will provide the PCAT with the needed documents for their assessment, including:

- The Final Report. This is to be structured as per the guidelines in the Probe Studies' Management Plan
- The [Engineering Concept Definition Package](#) originally generated by the IDL and Team-X studies, and subsequently evolved by the Probe Teams, also structured as per the guidelines in the Probe Studies' Management Plan

Costing Offices' Deliverables to HQ

- The output of the cost assessments by RAO and CEPS.

The Probe Studies' Executive Secretary at HQ, Rita Sambruna, will be the point of contact for the Probe Teams, PCAT, and Costing Offices' deliverables, and will be the interface for all communication between the Probe Teams and the PCAT.

PCAT Schedule

The PCAT will operate based on the following proposed schedule:

Milestones	Due Date (as of February 2019)
Select Chair and populate the PCAT	November 2018
Kickoff Telecon of the PCAT	December 2018
JPL costing office brief to the PCAT	February 12, 2019
GSFC costing office brief to the PCAT	February 14, 2019
Probe Final Reports to HQ	NLT March 4, 2019
Briefing of the Probe Teams to PCAT	April 4-5, 2019
Costing Offices deliver their ICA to HQ and debrief the PCAT in person	RAO: by May 24, 2019 JPL: by April 30, 2019

PCAT review	June-August 2019
PCAT debriefs to each Probe team	August 2019 (as early as practical)
PCAT report to HQ	August 2019
HQ review and submit to Decadal Survey	September 2019

NASA HQ POCs

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PCAT Membership

The PCAT will consist of a core membership with experience in overall mission design, development, and implementation. The PCAT will supplement its core membership as required with SMEs with in depth expertise in particular technical areas and disciplines.



Paul Hertz, Astrophysics Director

3/1/19

Date