

## **Charter for the Science and Technology Definition Teams (STDTs) for Probe-Class Exoplanet Direct Imaging Mission Concepts**

### **Purpose**

The Astrophysics Division, through its Exoplanet Exploration (ExEP) Program Office, is initiating mission concept studies of probe-class missions to advance the science of an exoplanet characterization and imaging mission as prioritized in the Astronomy and Astrophysics 2010 Decadal Survey<sup>1</sup>. In this context, the designation as “probe-class” is taken to mean missions with a total life cycle cost (LCC) not to exceed \$1B. The highest priority Decadal Survey medium scale recommendation is a New Worlds Technology Development Program in preparation for an exoplanet imaging mission beyond 2020, including precursor science activities. The Decadal Survey’s proposed program is designed to allow a habitable Exoplanet imaging mission to be well formulated in time for consideration by the 2020 Decadal Survey.

Two Science and Technology Definition Teams (STDTs) for probe-class exoplanet direct imaging mission concepts are chartered to define reference mission concepts of high scientific, technical, and programmatic merit that would both advance the compelling scientific priorities articulated in the Decadal Survey and which could be started within the current decade and within the Astrophysics Division’s current budget profile. As described in the NASA Astrophysics Strategic Implementation Plan<sup>2</sup>, if a large mission like WFIRST cannot be started this decade, then an Exoplanet probe which is technologically ready would be a candidate for a probe to start this decade as early as FY2017. An FY 2017 new start, followed by efficient development for the selected mission, requires mature technology by the end of this decade. The mission concept studies will identify technology requirements, and these will be used to guide technology investments during this decade.

Leading toward the NRC Mid-Decade Review, the results of the concept studies will be considered by the NASA Astrophysics Division and jointly evaluated along with studies from other Astrophysics programs. The probe-scale mission concepts developed by the STDTs are intended to be representative of concepts that are fully responsive to the constraints described above. They are not intended to be the only possible probe-scale exoplanet mission concepts for consideration by the Astrophysics Division in its strategic planning.

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<sup>1</sup> *New Worlds, New Horizons in Astronomy and Astrophysics* (NRC, 2010); [http://www.nap.edu/catalog.php?record\\_id=12951](http://www.nap.edu/catalog.php?record_id=12951).

<sup>2</sup> *NASA Astrophysics Strategic Implementation Plan* (December 20, 2012); <http://science.nasa.gov/astrophysics/documents/>

## STDT Scope

The Exoplanet Exploration Program Office will work with the science community to develop new probe-scale mission concepts capable of direct imaging of exoplanets. Two Exoplanet Direct-imaging STDTs (Exo-C and Exo-S) will be established:

- Exo-C will explore potential probe-class implementations involving the use of an internal coronagraph.
- Exo-S will explore potential probe-class implementations involving the use of an external occulter (starshade).

The science goal of the Exo-C and Exo-S teams 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 concept. The technical goals of each STDT 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 STDTs, working with the Exoplanet Exploration Program Office, will be a Mission Concept Report from each team that includes:

1. Science return (baseline and minimum requirements) from a cost-driven, probe-scale mission that is traceable to the recommendations of the Astronomy and Astrophysics Decadal Survey.
2. Observatory performance requirements that meet the science requirements.
3. An interim Architecture Trade Study within each STDT 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 Concept 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. The Report will include 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. The Report will assess the 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 maturity by the forecasted year of a PDR within the anticipated budget profile of the NASA Astrophysics Division. Each STDT will recommend a PDR readiness date based on its technology assessment.

To make the STDTs consistent with one another and with the Astrophysics Strategic Implementation plan, the STDTs will plan for their concepts to be technically viable for a future flight mission new start in fiscal year 2017 and PDR in FY2019.

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

## **Organization**

The STDTS will be assisted by the ExEP Study Office located at JPL. Each STDTS is independent of the Study Office yet is expected to work in close coordination. Each STDTS and the Study Office will iterate on science requirements and the mission concepts that flow from these and will share results with each other in a two-way exchange. The STDTS may ask the Study Office 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 STDTS may seek input from scientists and technologists external to the STDTS. The Study Office may ask the STDTS for scientific or technical assessments, perspectives, and/or studies. Any external scientific inputs and discussions needed by the Study Office will flow through the STDTS only. The Study Office may also seek internal scientific or technical perspectives from NASA scientists for help in developing mission concepts based on the findings of the STDTS. Such scientists will be named by the Study Office, and their perspectives will be shared with the STDTS.

For efficiency ExEP will staff one Study Office to support both STDTS and will bring in specialists as needed to support the two concepts. No firewall will be required between the Study Office and each STDTS since the purpose in convening these STDTS is to make each concept as strong as possible for consideration by the Astrophysics Division.

Each STDTS Chair will act as the official point of contact between the members of that STDTS and NASA representatives for any issue of programmatic, technical, or budgetary nature. The STDTS Chair may delegate the role of POC for specific tasks to other members of the STDTS as appropriate.

The Program Office will actively coordinate with the STDTS Chairs to implement efficient and effective technical exchange between the two STDTS as appropriate.

## **Membership**

STDTS members will be selected by NASA HQ from the pool of 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 both ground and space-based approaches to the implementation of the science priorities. To comply with Federal export regulations, only US citizens or US permanent residents (green card holders) are allowed to be members of the STDTS. The STDTS Chairs will be appointed from the STDTS membership by the NASA Astrophysics Division Director.

## **Meetings**

Meetings will be called by the STDTS Chairs, and the agendas will be set by the Chairs in coordination with NASA HQ and the Study Office to ensure that planned activities are aligned with programmatic needs and expectations. Face-to-face meetings (roughly every 3 or 4 months) are anticipated, in addition to regular (roughly biweekly) telecons. Teleconferencing will always be provided as an alternative for those unable to attend in person. Meeting dates will be carefully coordinated by the STDTS Chairs, working with the Program Office, to avoid conflicts between the two STDTS and to maximize time efficiency and convenience for STDTS Members.

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

STDT activities will commence with a joint meeting of both STDTs, to be held during July 2013 at the GSFC.

All meetings of the STDTs will be open to nonmembers who are US citizens or permanent residents.

### **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 2 days per meeting.

### **Reports**

Each STDT will deliver an interim Mission Concept Report to NASA HQ in March 2014. Preliminary Mission Concept Reports will be delivered by November 2014 to ExEP for use by the Study Office for the CATE. Final Reports will be delivered to NASA HQ by Jan 31, 2015. A CATE will be developed using the preliminary Mission Concept Reports, with delivery of the completed CATE to NASA HQ no later than Feb 27, 2015 (see Timeline below). The STDT Chairs will brief both the interim reports and the the final reports from the STDTs to the Astrophysics Division at NASA Headquarters and to the National Academies' Committee on Astronomy and Astrophysics (CAA).

### **Termination**

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

### **Public Release of Information**

Any public release or discussion of the STDT or Study Office 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

5/2/2013	Announcement of Membership
7/1-2/2013	Joint Kickoff Meeting (face-to-face or web connect) for both STDTs with Exoplanet Exploration Program Office and Study Office. Introduction of trade criteria. Will include both parallel and combined sessions.
On or before 1/31/2014	Briefing of the Architecture Trade Study to Exoplanet Exploration Program
3/2014	Interim Mission Concept Report delivered to NASA HQ; interim report briefing by STDT Chairs to NASA HQ and CAA.
11/2014	Preliminary report as input to CATE
No later than 1/31/2015	Final Mission Concept Report delivered to NASA HQ; final report briefing by STDT Chairs to NASA HQ and CAA
2/15/2015	STDT Chairs present Final Reports to the NASA HQ
2/27/2015	CATE completed and delivered to NASA HQ

## Logistics

The ExEP Study Office 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 Exoplanet Exploration Program Study Office, subject to NASA policies and availability of funds from NASA. No support other than travel will be provided by NASA to the STDT members. The Study Office 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. Douglas Hudgins ([Douglas.M.Hudgins@nasa.gov](mailto:Douglas.M.Hudgins@nasa.gov)). The Exoplanet Exploration Program point-of-contact is Dr. Stephen Unwin ([Stephen.C.Unwin@jpl.nasa.gov](mailto:Stephen.C.Unwin@jpl.nasa.gov)).



Paul Hertz  
Director  
Astrophysics Division  
Science Mission Directorate  
NASA Headquarters