

Astrophysics

Planning for the 2020 Decadal Survey



Committee on Astronomy and Astrophysics

Space Science Week

National Academy of Science Building

March 30, 2016

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Progress Toward Decadal Survey Priorities



The NASA FY16 Appropriation, the President's FY17 Budget Request, and its notional out year budget planning guidance support:

Complete JWST	JWST remains within budget guidelines and on track for an October 2018 launch.
Large-scale 1. WFIRST	2 years of preformulation and focused technology development for WFIRST (a 2.4m version of WFIRST with a coronagraph) are complete. Formulation (new start) commenced in February 2016.
Large-scale 2. Augmentation to Explorer Program	Astrophysics Explorers planned budget increased to support cadence of four AOs per decade including a SMEX AO in Fall 2014 and a MIDEX AO in Fall 2016.
Large-scale 3. LISA	Planning partnership on ESA's L3 gravitational wave observatory and participating in ESA-led assessments in 2014-2015. Strategic astrophysics technology investments plus support of LISA Pathfinder. Established L3 Study Team.
Large-scale 4. IXO	Planning a partnership on ESA's L2 Athena X-ray observatory; the Athena study phase, with U.S. participation, is underway. Strategic astrophysics technology investments.
Medium-scale 1. New Worlds Technology Development Program	Focused technology development for coronagraph on WFIRST, strategic astrophysics technology investments, exoplanet probe mission concept studies. Partnership with NSF to develop precision Doppler spectrometer as facility instrument. Exozodi survey using LBTI.

Progress Toward Decadal Survey Priorities



The NASA FY16 Appropriation, the President's FY17 Budget Request, and its notional out year budget planning guidance support:

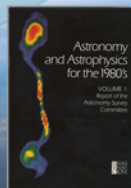
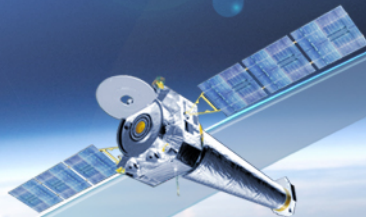
Medium-scale 2. Inflation Probe Technology Development	Balloon-borne investigations plus strategic astrophysics technology investments. Studying partnership on JAXA's LiteBIRD.
Small-scale. Research Program Augmentations	Increased annual R&A budget by 10% from FY10 to FY12 and another 10% from FY14 to FY16. Within R&A: established Theoretical and Computational Astrophysics Networks program with NSF; funding available for astrophysics theory; funding available for lab astrophysics; funding available for suborbital payloads.
Small-scale. Intermediate Technology development Augmentation	Established competed Strategic Astrophysics Technology program element; directed technology funding for WFIRST and other large-scale decadal priorities (e.g., WFIRST coronagraph, Athena detectors).
Small-scale. Future Ultraviolet-Visible Space Capability	Strategic Astrophysics Technology and Astrophysics R&A investments; mission concept studies.
Small-scale. SPICA (U.S. contribution to JAXA-led)	Not supported as a strategic contribution; candidate for Explorer Mission of Opportunity.
Future: Planning for 2020 Decadal Survey	Initiated four large mission concept studies. Discussing medium mission concept studies.

ASTROPHYSICS

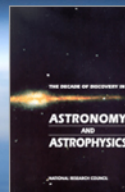
Decadal Survey Missions



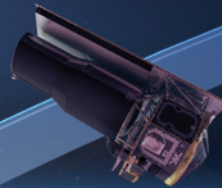
1972
Decadal Survey
Hubble



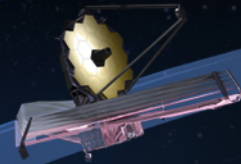
1982
Decadal Survey
Chandra



1991
Decadal Survey
Spitzer, SOFIA



2001
Decadal Survey
JWST



2010
Decadal Survey
WFIRST



Preparing for the 2020 Decadal Survey Large Mission Concepts



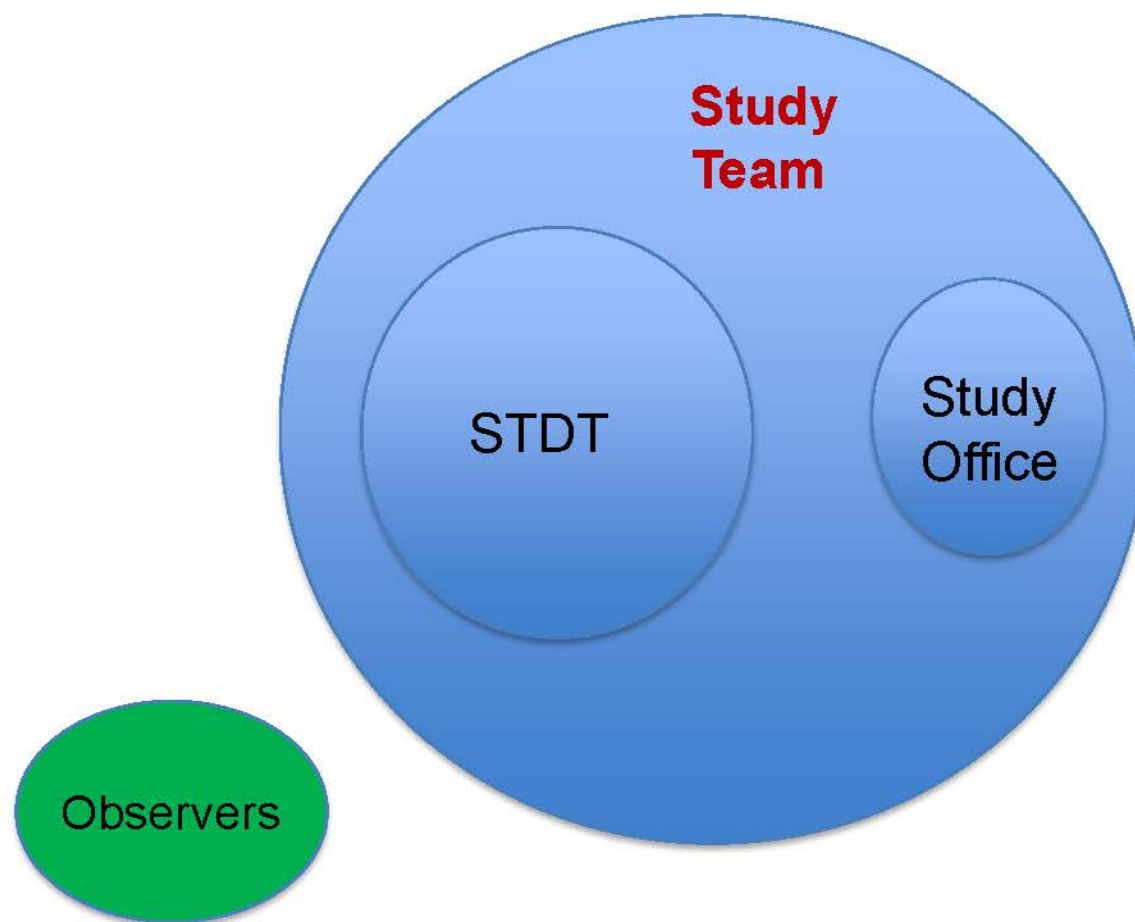
NASA has begun to study large mission concepts as input to the 2020 Decadal Survey

- Science and Technology Definition Teams (STDTs) have a significant role and responsibility
 - Develop science case
 - Flow science case into mission parameters
 - Vet technology gap list
 - Direct trades of science vs cost/capability
- STDT members appointed by NASA HQ
- STDTs chartered by HQ and administered through the Program Offices
 - Charter and management plan available at:
<http://science.nasa.gov/astrophysics/2020-decadal-survey-planning/>



Definition of term: “Study Team”

ExoPlanet Exploration Program



Study Team

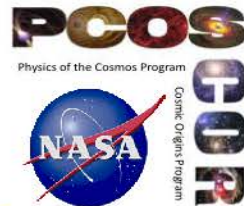
- Union of STDT and Study Office
- STDT and Study Office work together as one team for success of Study
- Each has distinct and complementary roles within the Study Team

Observers

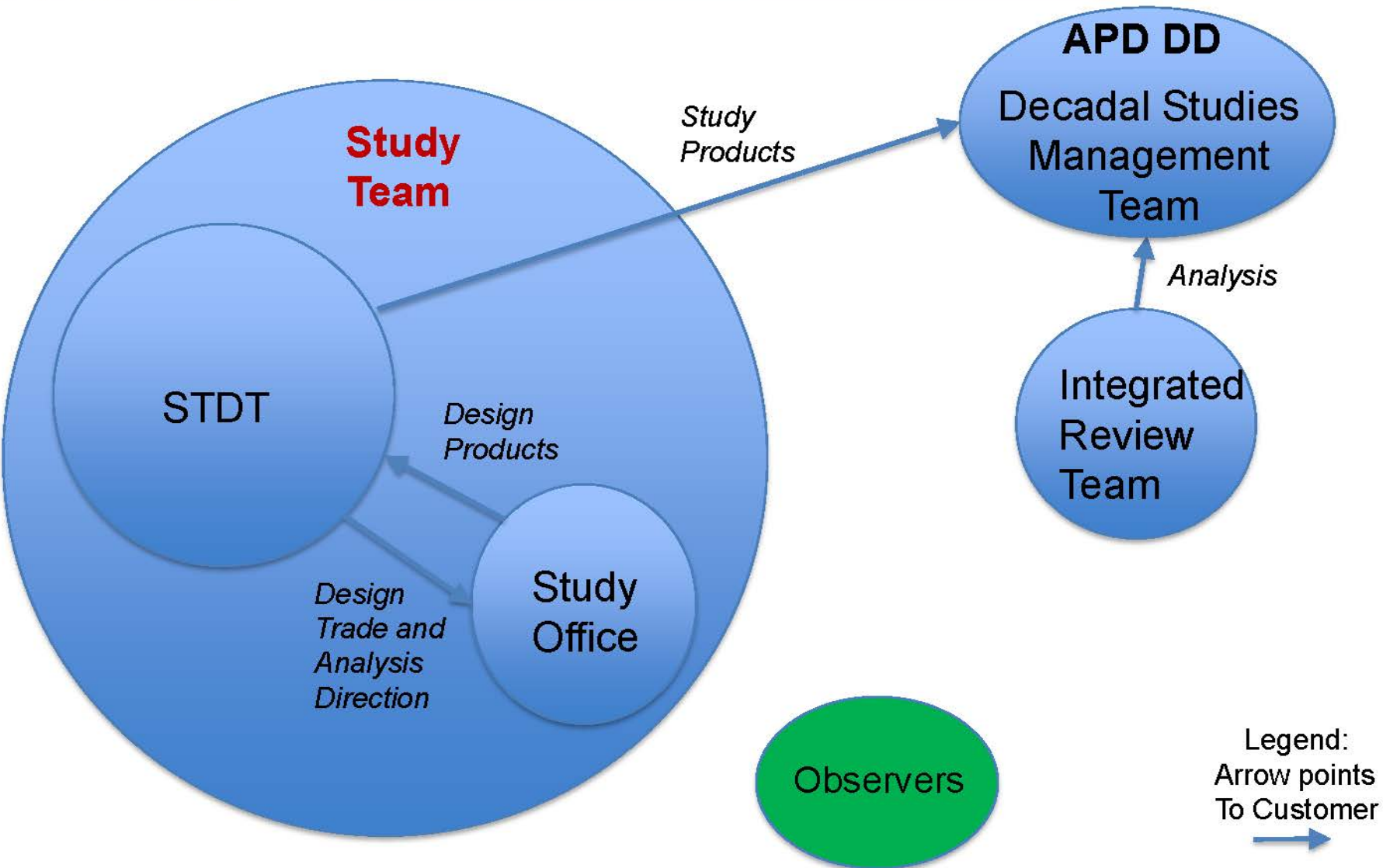
- Welcome and not part of Study Team per se
- Attendance is optional or on-call



Roles and Responsibilities: A Team and Customer View



ExoPlanet Exploration Program





Study Team: Detail

Members

- Appointed from community by APD DD
- Appointed from Centers and PO by APD DD

Examples

- Members of community and NASA Centers
- Center Study Scientists

Ex-Officio Non-voting Members

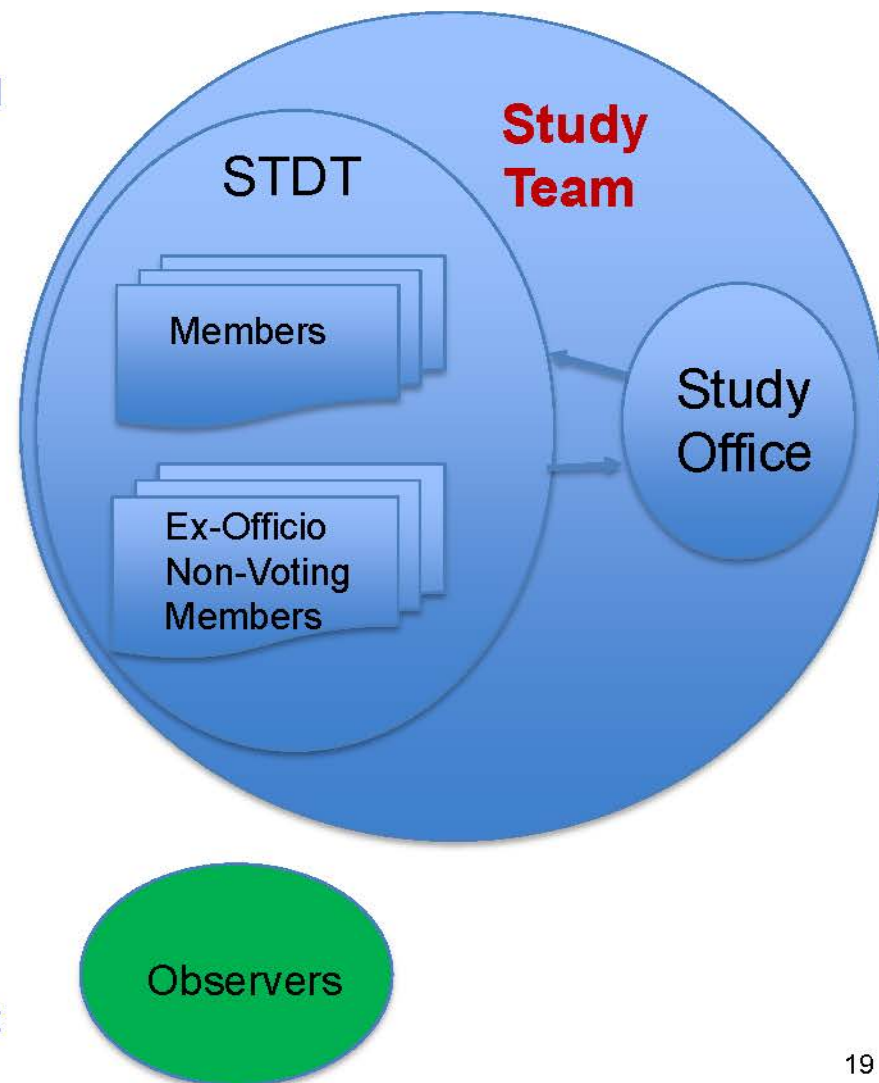
- Appointed by APD DD virtue of office
- Not participate in deliberations

- APD Study Scientists
- Program Chief Scientists
- Representatives of International Partners

Observers

- Welcome and not part of Study Team per se

- Mission Concept Coordinator (APD)
- Program Executive (APD)
- Program Manager (PO)
- Program Chief Technologist
- Program Chief Engineer



Decadal Survey Concept Study Deliverables



All products delivered to APD Deputy Division Director

M1	Comments on Study Requirements and Deliverables – Accept the study requirements/deliverables and submit plan--- or – Provide rationale for modifying requirements/deliverables	April 29 2016 ¹
O1	Optional: Initial Technology Gap Assessment – To impact PCOS/COR/ExEP 2016 technology cycle	June 30 2016
M2	Detailed Study Plan – Document starting point CML – Deliver detailed study plan for achieving Decadal CML – Deliver resource required to meet the deliverables for the study duration – Deliver schedule to deliver milestones	August 26 2016
M3	Complete Concept Maturity Level 2 Audit – Identify, quantify and prioritize technology gaps for 2017 technology cycle	February 2017 ²
O2	Optional: Update Technology Gap Assessments	June 2017
M4	Interim Report – Substantiate achieving Concept Maturity Level 3 – Deliver initial technology roadmaps; estimate technology development cost/schedule	Early Dec 2017 ²
M5	Update Technology Gap Assessments – In support of 2018 technology cycle	June 2018
M6	Complete Decadal Concept Maturity Level 4 Audit and Freeze Point Design – Support independent cost estimation/validation process	August 2018
M7	Final Report – Finalize technology roadmaps, tech plan and cost estimates for technology maturity	January 2019
M8	Submit to Decadal	March 2019

¹ APD will provide final study requirements by May 2016

² Timed to influence following NASA budget cycle

Preparing for the 2020 Decadal Survey

Large Mission Concepts



NASA is initiating community-led studies of the following four large mission concepts.

	Community STDT Chairs	Center Study Scientist	Study Lead Center	HQ Program Scientist
Far IR Surveyor	Asantha Cooray Margaret Meixner	David Leisawitz	GSFC	Kartik Sheth
Habitable Exoplanet Imaging Mission	Scott Gaudi Sara Seager	Bertrand Mennesson	JPL	Martin Still
Large UV/Optical/IR Surveyor	Debra Fischer Bradley Peterson	Aki Roberge	GSFC	Mario Perez
X-ray Surveyor	Feryal Ozel Alexey Vikhlinin	Jessica Gaskin	MSFC	Dan Evans

Following charts from APS Updates by
D. Leisawitz (GSFC), B. Mennesson (JPL), A. Roberge (GSFC), J. Gaskin (MSFC)

Preparing for the 2020 Decadal Survey Large Mission Concepts



<http://cor.gsfc.nasa.gov/studies/far-ir/>

<http://cor.gsfc.nasa.gov/studies/luvoir>

(none yet for HabEx)

<http://pcos.gsfc.nasa.gov/studies/xray-surveyor/>

First membership lists:

http://science.nasa.gov/media/medialibrary/2016/03/17/Decadal_Survey_Mission_Concept_Studies_Team_Members_List_3_16_2016.pdf



- ◆ Great turnout! Received 90 applications and a good deal of international interest (Canada, Chile, France, Germany, Greece, The Netherlands, UK)
- ◆ Community Chairs:
 - Dr. Asantha Cooray, University of California, Irvine
 - Dr. Margaret Meixner, Space Telescope Science Institute
- ◆ NASA Center Study Scientist
 - Dr. David Leisawitz, NASA GSFC



◆ Members of the STDT

- Dr. Lee Armus, NASA Infrared Processing and Analysis Center
- Dr. Cara Battersby, Harvard-Smithsonian Center for Astrophysics
- Dr. Edwin Bergin, University of Michigan
- Dr. Matthew Bradford, NASA Jet Propulsion Laboratory
- Dr. Kim Ennico-Smith, NASA Ames Research Center
- Dr. Gary Melnick, Harvard-Smithsonian Center for Astrophysics
- Dr. Stefanie Milam, NASA Goddard Space Flight Center
- Dr. Desika Narayanan, Haverford College
- Dr. Klaus Pontopiddan, Space Telescope Science Institute
- Dr. Alexandra Pope, University of Massachusetts
- Dr. Thomas Roellig, NASA Ames Research Center
- Dr. Karin Sandstrom, University of California, San Diego
- Dr. Kate Y. L. Su, University of Arizona
- Dr. Joaquin Vieira, University of Illinois, Urbana Champaign
- Dr. Edward Wright, University of California, Los Angeles
- Dr. Jonas Zmuidzinas, California Institute of Technology

Study team (continued)



◆ Ex officio non-voting members of the STDT

- Dr. Dominic Benford, NASA Headquarters, Far-IR Surveyor Deputy Program Scientist
- Dr. Sean Carey, NASA Infrared Processing and Analysis Center liaison
- Dr. Maryvonne Gerin, Ecole Normale Supérieure, CNES liaison
- Dr. Frank Helmich, SRON liaison
- Dr. Karl Menten, Max Planck Institut fuer Radioastronomie, DLR liaison
- Dr. Susan Neff, NASA GSFC, Cosmic Origins Program Chief Scientist
- Dr. Deborah Padgett, NASA GSFC, Cosmic Origins Program Deputy Chief Scientist
- Dr. Douglas Scott, University of British Columbia, CAS liaison
- Dr. Kartik Sheth, NASA Headquarters, Far-IR Surveyor Program Scientist



Current State of STDT Selections



- “An embarrassment of riches”: 88 very high profile scientists and technologists applied to the HabEx STDT
- Very competitive selection process led by HQ, in consultation with ExEP, JPL study team and study chairs
- Ensure a community led study by maximizing community membership
- Ensure some continuity with exo-C/ exo-S studies
- Ensure a good balance in terms of expertise between:
 - The various fields of (exo)-planets + disks science and technology
 - General astrophysics themes enabled by the largest diffraction limited optical telescope in space



STDT Selections



Community Chair	Cahoy, Kerri (MIT)	Space Systems technology and Xpl spectra
	Domegal-Goldman, Shawn (GSFC)	Bio-signatures and Xpl spectra
	Feinberg, Lee (NASA GSFC)	Picometer wavefront control
	Gaudi, Scott (Ohio State) [Co-Chair]	Xpl Demographics / WFIRST
	Guyon, Olivier (Arizona)	Coronagraph design / Wavefront control
Center Study Scientist	Kasdin, Jeremy (Princeton)	Starshade and Coronagraph designs
	Mawet, Dimitri (Caltech)	Coronagraph design / Disks/ Post processing
	Mennesson, Bertrand (JPL)	Debris disks / High Contrast Imaging
	Robinson, Tyler (UC Santa Cruz)	Atmospheric spectral retrieval
	Rogers, Leslie (Chicago)	Low mass Xpl Interior structure & evolution
Community Chair	Scowen, Paul (Arizona State)	General astro/ UV/ ISM COPAG Chair
	Seager, Sara (MIT) [Co-Chair]	Starshade / Bio-signatures
	Somerville, Rachel (Rutgers)	Star and galaxy formation / theory vs observations
	Stapelfeldt, Karl (NASA JPL)	Disks/ ExEP CS
	Stern, Daniel (JPL)	General astrophysics/ AGNs/ NIR
	Turnbull, Margaret (SETI)	mission design / target selection

CNES Observer: Mouillet, David (IPAG) – CSA Observer: Marois, Christian (NRC Canada)
DLR Observer: Quirrenbach, Andreas (Heidelberg)

THANKS TO ALL APPLICANTS! WARM CONGRATS TO THE 16^(*) HABEX STDT MEMBERS: WELCOME ABOARD !!!
KICK-OFF MEETING IN SPRING 2016

STDT members

136 STDT nominations, 24 voting members selected

Debra Fischer (Chair)	Yale	Bradley Peterson (Chair)	Ohio State
Jacob Bean	Chicago	Leonidas Moustakas	JPL
Daniela Calzetti	U Mass	John O'Meara	St. Michael's
Rebekah Dawson	Penn State	Victoria Meadows	Washington
Courtney Dressing	Caltech	Ilaria Pascucci	Arizona (LPL)
Lee Feinberg	NASA GSFC	Marc Postman	STScI
Kevin France	Colorado	Laurent Pueyo	STScI
Jay Gallagher	Wisconsin	David Redding	JPL
Olivier Guyon	Arizona	Jane Rigby	NASA GSFC
Walter Harris	Arizona (LPL)	Aki Roberge	NASA GSFC
David Schiminovich	Columbia	Britney Schmidt	Georgia Tech
Mark Marley	NASA Ames	Karl Stapelfeldt	JPL

Additional study team members

Aki Roberge	NASA GSFC	Study scientist; also on STDT
Shawn Domagal-Goldman	NASA GSFC	Deputy study scientist
Julie Crooke	NASA GSFC	Study manager
Mario Perez	NASA HQ	Program scientist
Erin Smith	NASA HQ	Program scientist
Susan Neff	NASA GSFC	COR program chief scientist
Deborah Padgett	NASA GSFC	COR program chief scientist
Nicholas Cowan	McGill	CSA observer
Marc Ferrari	LAM	CNES observer
Thomas Henning	Max Planck	DLR observer

STDT Members



Steve Allen, Stanford



Megan Donahue, MSU



Laura Lopez, Ohio State



Alexey Vikhlinin, SAO (Chair)



Feryal Özel, Arizona (Chair)



Mark Bautz, MIT



Ryan Hickox, Dartmouth



Piero Madau, UCSC



Mike Pivovarov, LLNL



Eliot Quataert, Berkeley



Niel Brandt, Penn State



Tesla Jeltema, UCSC



Rachel Osten, STScI



Dave Pooley, Trinity



Chris Reynolds, UMD



Joel Bregman, Michigan



Juna Kollmeier, OCIW



Frits Paerels, Columbia



Andy Ptak, GSFC



Daniel Stern, JPL

Ex-Officio Non-Voting Members Of The STDT



**Daniel Evans, NASA HQ
(Program Scientist)**



**Ann Hornschemeier,
PCOS Program
Office Chief Scientist**



**Jessica Gaskin, MSFC
(Study Scientist, voting
member of STDT)**



**Rob Petre,
GSFC X-ray Lab
Branch Chief**



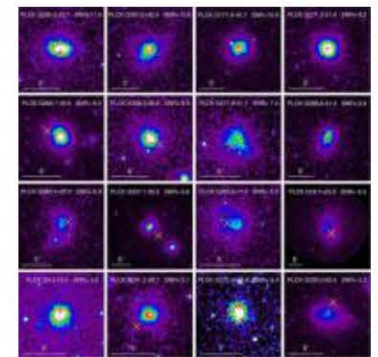
**Randall Smith,
Athena liaison**



**Paul Nandra
DLR-Appointed
Observer**



**Brian McNamara
CSA-Appointed
Observer**



**Gabriel Pratt
CNES-Appointed
Observer**



- Formulation
- Implementation
- Primary Ops
- Extended Ops

Spitzer
8/25/2003

Kepler
3/7/2009

WFIRST
Mid 2020s

LISA Pathfinder (ESA)
12/3/2015

JWST
2018

Euclid (ESA)
2020

Chandra
7/23/1999

XMM-Newton (ESA)
12/10/1999

TESS
2017

NuSTAR
6/13/2012

Swift
11/20/2004

Hitomi (JAXA)
2/17/2016

Hubble
4/24/1990

Fermi
6/11/2008

CREAM (on ISS)
2017

NICER (on ISS)
2017

SOFIA
Full Ops 5/2014