Jet Propulsion Laboratory
California Institute of Technology

Exoplanet Exploration Program Overview

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Starshade Technology Workshop
December 1, 2016
Pasadena CA

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Why is Starshade Technology Readiness Urgent?

- Decadal Large Mission Studies (HabEx, LUVOIR) are considering starshades and the science they enable
- Possibility for “Rendezvous at L2” of Starshade with WFIRST
  - Would require new probe-scale mission start early in 2020’s, and Decadal Survey endorsement of directed or competed probe budget line
- In all cases: Be persuasive at 2020 Astrophysics Decadal Survey with mature technology (at TRL5 or close to it)

NASA Exoplanet Exploration Program

Astrophysics Division, NASA Science Mission Directorate

Purpose described in 2014 NASA Science Plan

1. Discover planets around other stars
2. Characterize their properties
3. Identify candidates that could harbor life

ExEP serves the science community and NASA by implementing NASA's space science vision for exoplanets

Exploring a galaxy of worlds while inspiring our own

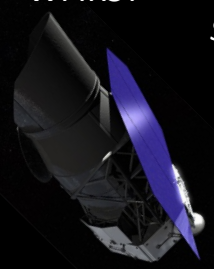
http://exoplanets.jpl.nasa.gov

NASA Exoplanet Exploration Program

Space Missions and Mission Studies

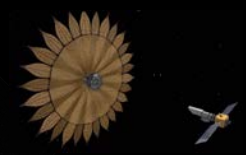
Kepler, K2

WFIRST



Decadal Studies

Starshade



Coronagraph

Public Communications

Supporting Research & Technology

Key Sustaining Research

Large Binocular Telescope Interferometer

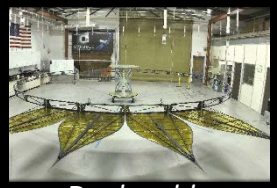
Keck Single Aperture Imaging and RV

NN-EXPLORE

Technology Development

Coronagraph Masks

High-Contrast Imaging



Deployable Starshades

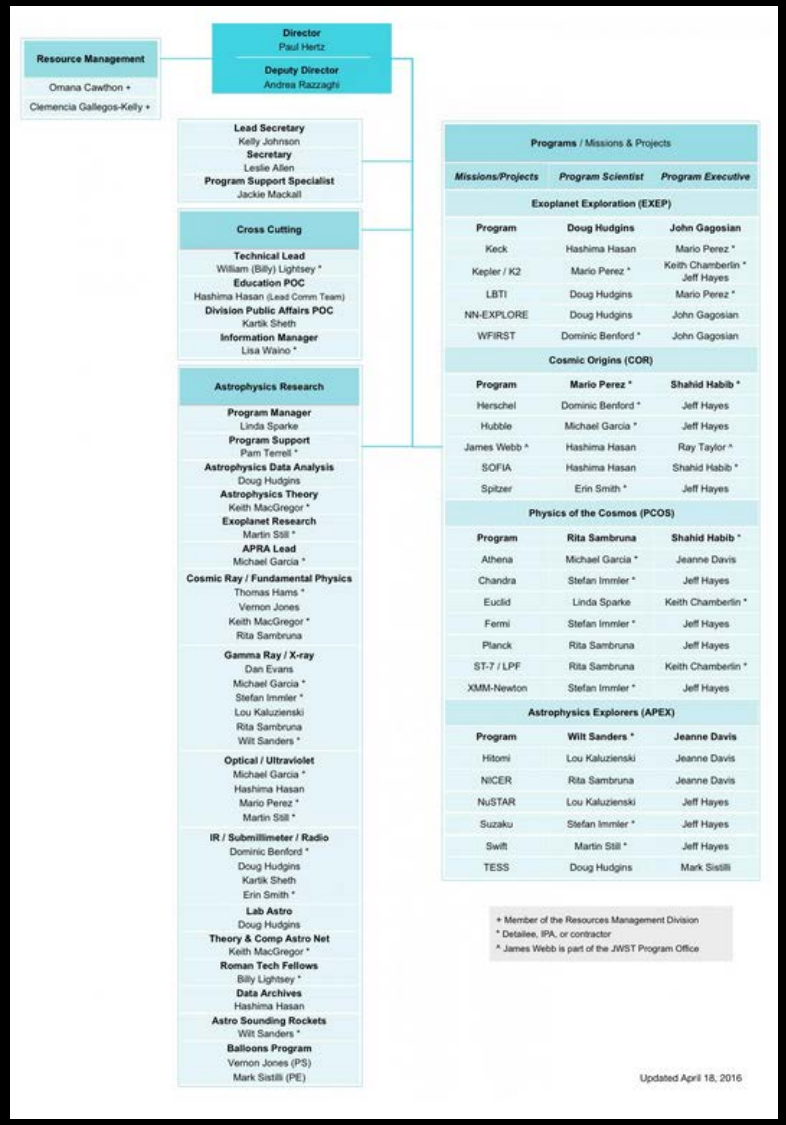
NASA Exoplanet Science Institute

Archives, Tools, Sagan Fellowships, Professional Engagement

https://exoplanets.nasa.gov

The NASA Astrophysics Division

JPL manages the Exoplanet Exploration Program for the Division



Exoplanet Exploration

Cosmic Origins

Physics of the Cosmos

Astrophysics Explorers

Astrophysics Research

NASA Exoplanet Exploration Program

Astrophysics Division, Science Mission Directorate

Program Office (JPL)
PM- Dr. G. Blackwood
DPM- K. Short
Chief Scientist – Dr. K. Stapelfeldt
Chief Technologist – Dr. N. Siegler

Program Science Office
PCS- Dr. K. Stapelfeldt
DPCS- Dr. E. Mamajek

Program Engineering Office
Chief Engineer
K. Warfield

Program Business Office
Mgr- R. Lemus

Mission Managers
Kepler – I. Heinrichsen
WFIRST – A. Comberiate

Business Operations
Resources – B. Nomoto
Schedule – G. Luzwick

Program Communications (JPL)
Mgr – A. Biferno (acting)

Kepler (ARC)
PM – C. Sobeck
PS – Dr. N. Batalha
PS (K2) – Dr. J. Dotson

Program Technology (JPL)
Mgr– Dr. N. Siegler, AD

LBTI
Mgr – Dr. P. Willems, JPL
PI – Dr. P. Hinz, UA
PS – Dr. C. Gelino, Caltech

WFIRST Project Office (GSFC)
PM – K. Grady
DPM – C. Peddie
PS – Dr. N. Gehrels

Universe of Learning (JPL)
Mgr – A. Biferno, (acting)
Co-I

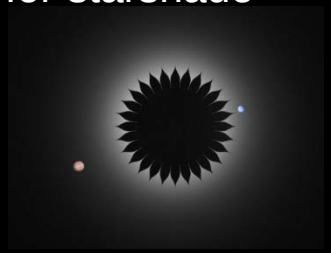
Starshade Technology Project (JPL)
Mgr – Dr. J. Ziemer

NN-EXPLORE
Mgr – Dr. J. Callas, AD, JPL
PI - Dr. S. Mahadevan, PSU

NExScI (Caltech)
ED– Dr. C. Beichman
DD – Dr. R. Akeson
Mgr – Dr. D. Imel

WFIRST Project Office (JPL)
PM – Dr. M. Frerking
DPM – Dr. F. Zhao
PS - Dr W. Traub
DPS - Dr. J. Rhodes

ExEP makes distinction between *Program* and *Center* roles. Those identified by blue arrows fulfill *NASA Program* role for starshade



Current Starshade Context: Developments since 2015

- **3/2015:** Final report from Exo-S Probe-Scale Study. Developed concept for (34m) starshade standalone mission and introduced concept for WFIRST Starshade Rendezvous (34m)
- **1/2016:** Signed charter of the Starshade Readiness Working Group (SSWG)
- **2/2016:** Final Report of the Exo-S Extended Study. Explored Rendezvous variants: larger (40m) and smaller (26m) starshade sizes
- **3/2016:** Starshade Technology Development Activity created to achieve TRL5.
- **4/2016:** Decadal large studies chartered, both HabEx and LUVOIR considering starshades for exoplanet direct imaging
- **6/2016:** APD directs WFIRST to be designed to accommodate a starshade, under study by project, ExEP and SITs.
- **11/2016:** SSWG final briefing to APD Director. Concludes that WFIRST Rendezvous starshade mission does not require a prior tech demo.
- **12/2016:** Starshade Technology Workshop (12/1)
- **12/2016:** WFIRST Starshade Accommodation - Interim assessment to APD Director (12/13), final decision prior to KDP-B

Starshade Technology – Plan Forward

- Plan in FY17, Implement FY18-20 (conditional upon APD Director's authorization to proceed)
- What level of funding are we talking about?
- Specific FY17 funding and planning guidance
- Next steps:
  - Informed by this workshop, recommend FY17 investments to APD Director
  - APD Director makes the decision
  - Present FY18-20 plan to APD Director by end of 2017

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