

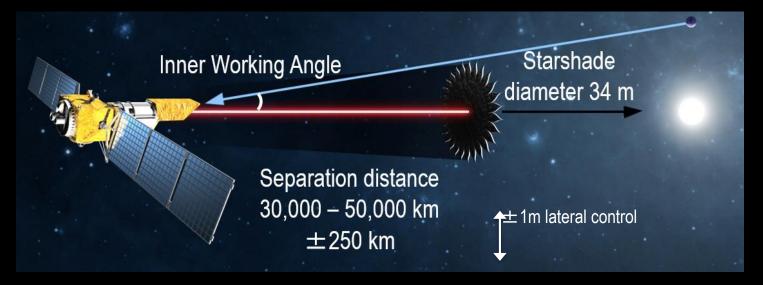
Jet Propulsion Laboratory California Institute of Technology

### **Exoplanet Exploration Program Overview**

Dr. Gary Blackwood Program Manager NASA Exoplanet Exploration Program Jet Propulsion Laboratory, California Institute of Technology

Starshade Technology Workshop December 1, 2016 Pasadena CA

## Why is NASA interested in Starshades?



- One of two technologies for high-contrast imaging of earth-sized planets in habitable zones of sun-like stars
- Provides small inner working angle, high throughput
- Different technology challenges to coronagraph
- Complementary to coronagraph
- Provides access to Earth-sized planets in habitable zones of sun-like stars for small apertures

## **Astrophysics Division: Driving Documents**



Results of NWNH:

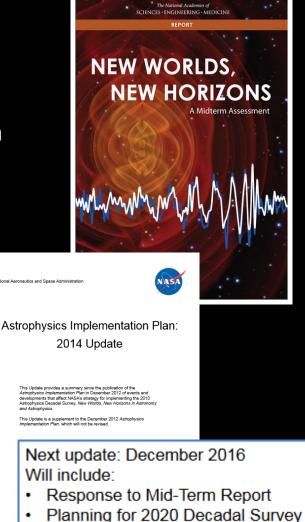
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- WFIRST is top large-scale recommended activity
- NWNH technology program is top medium-scale recommended activity



#### http://science.nasa.gov/astrophysics/documents

#### WFIRST Dark Energy, Alien Worlds

- WFIRST in Formulation Phase: NASA Key Decision Point (KDP)-B Sept 2017
- Coronagraph Instrument baselined exoplanet direct imaging
- Formulation Science Working Group and Science Investigation Teams underway (two for coronagraph: Macintosh, Turnbull)
- Project received APD direction (June 2016) to incorporate starshade <u>compatibility</u> into Phase A DRM – for SMD decision following SRR/MDR

## Why is Starshade Technology Urgent Now?

- 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 ready and inform the 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

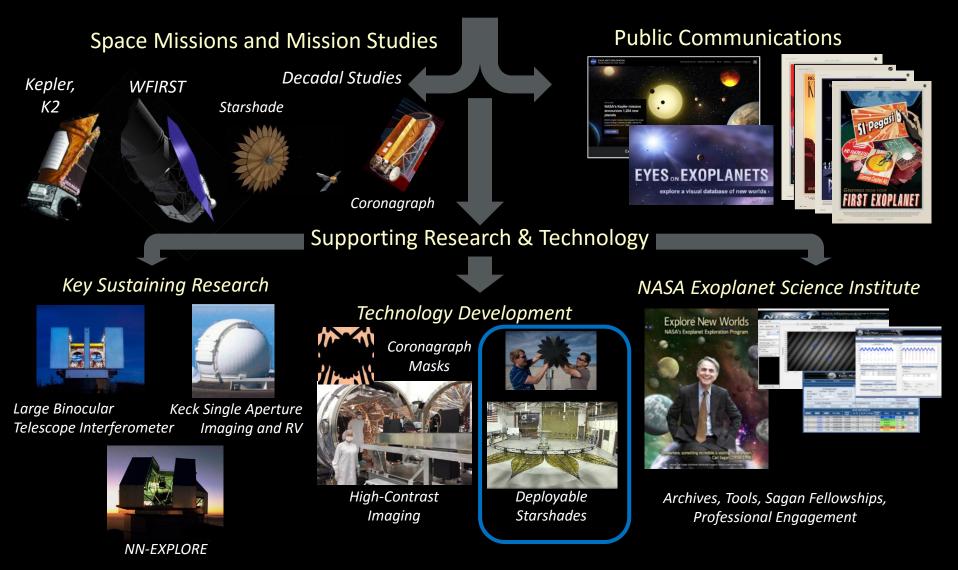
- 1. Discover planets around other stars
- 2. Characterize their properties
- 3. Identify candidates that could harbor life

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**



https://exoplanets.nasa.gov

## **The NASA Astrophysics Division**

JPL manages the Exoplanet Exploration Program for the Division

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#### **Exoplanet Exploration**

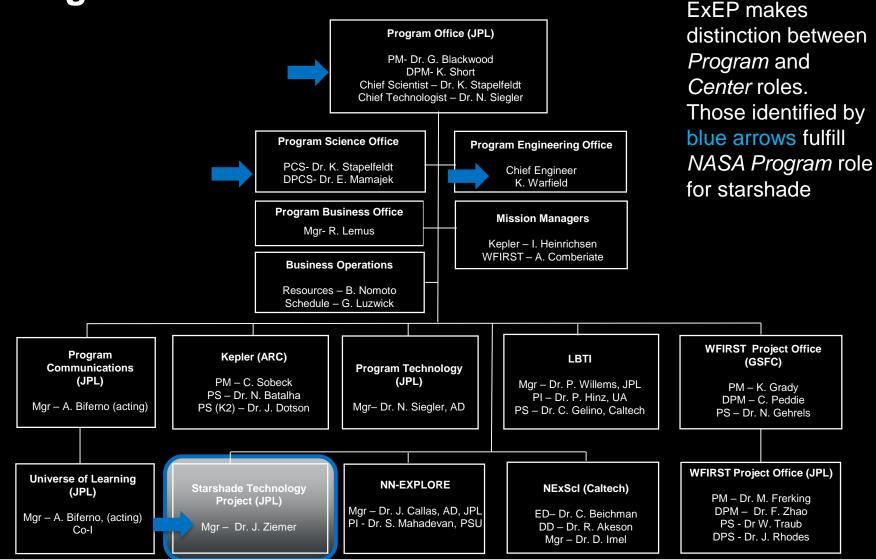
#### **Cosmic Origins**

#### Physics of the Cosmos

#### Astrophysics Explorers

#### Astrophysics Research

# Starshades in the Exoplanet Exploration Program



#### **Current Starshade Context: Developments since 2015**



**ExoPlanet Exploration Program** 

- 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, Execute during FY18-20 (conditional upon APD Director's authorization to proceed)
- What level of funding are we talking about?
- 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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