



Starshade Exoplanet Data Challenge

Telecon #1

NASA Exoplanet Exploration Program

Gary Blackwood, Renyu Hu

January 27, 2020

Telecon Agenda

- Welcome – **Gary Blackwood**
- S5 Overview – **Phil Willems**
- Starshade Image Simulations – **Sergi Hildebrandt**
- Timeline and Logistics – **Renyu Hu**
- Open Floor for Discussion

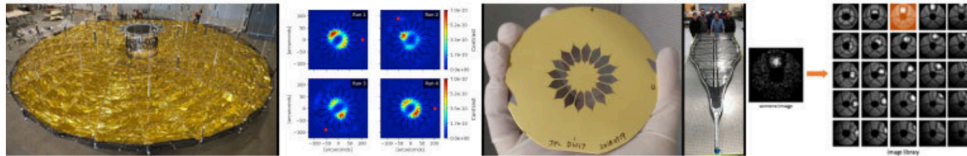
Starshade Science and Industry Partnership

The purpose of the Starshade SIP is to maximize the technology readiness level of starshades to enable potential future exoplanet science missions.

- Starshades (or External Occulters) are **one of the starlight suppression technologies** for high contrast imaging of exoplanets and are baselined for large- and probe-class mission concept studies funded by the NASA Astrophysics Division for submission to the Astro2020 Decadal Survey.
- The Astrophysics Division authorized the Exoplanet Exploration Program (ExEP) to **execute a directed technology development activity** to advance starshades to Technology Readiness Level (TRL) 5.
- The Starshade **Technology Development Activity to TRL5, or S5**, follows an approved **Technology Development Plan** with technology milestones that respond to documented mission performance requirements.
- The ExEP recognizes that robust and impactful technology maturation requires **ongoing consideration** of new technology approaches and new mission concept drivers.



Starshade Technology Development



The Exoplanet Exploration Program Charter identifies one of the Program’s critical functions to be to “...manage exoplanet-related technology initiatives, including the management of specifically directed technology activities, facilitation of a coordinated NASA Astrophysics technology identification/prioritization process, oversight of competitively-selected technology activities, and certification of technology milestones and or Technology Readiness Levels (TRLs).”¹

A key method in the pursuit of these goals and objectives is the direct imaging of planets around other stars. Directly sampling the light from an exoplanet separately from that of its host star facilitates measurement of its size, orbit, albedo, and ground and atmospheric spectra, which provide clues to its habitability, and potentially could provide signatures of the presence of life itself. However, direct observation of small, rocky planets like Earth close enough to their host stars to harbor liquid water is very difficult due to the extreme faintness of the exoplanet relative to the very nearby star. The starlight must be suppressed, either interferometrically or by an occulter, to allow exoplanet detection. Occulters that are internal to the telescope are referred to as coronagraphs. Occulters that are external to the telescope are referred to as starshades.

Starshade Technology Development Activity (S5) Documents

- [Starshade Technology Development Plan](#)
- [Level 1 Technology Milestones – Summary Table](#)

Milestone #1

- [1A Report - Narrowband Optical Contrast Performance](#)
- [1B Report - Broadband Optical Contrast Performance](#)
- [ExoTAC Review of #1A, #1B](#)

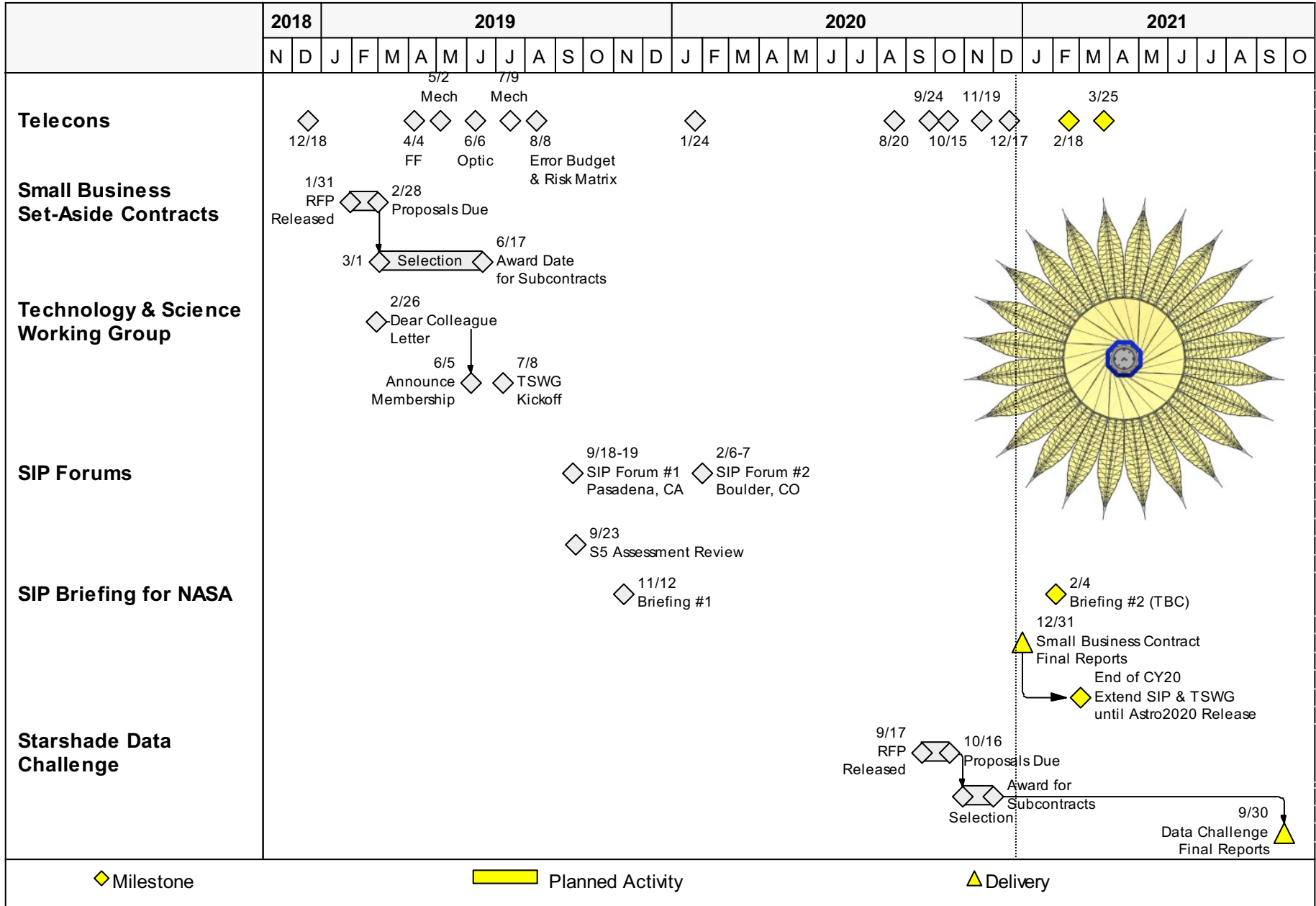
Milestone #3

- [Report- Demonstration of Solar Glint Lobe Scatter Performance](#) ***NEW**

Starshade Science and Industry Partnership (SIP)

Tier 2 Schedule

12/25/2020



Starshade Exoplanet Data Challenge

- Recommended by the Technology and Science Working Group
 - “Document a flow down of requirements from science to key performance parameters based on synthetic images”
 - “Produce a plan for the starshade data challenge”
- Objectives
 - Validate requirements from science to key performance parameters
 - Quantify the accuracy of calibration of solar glint and exozodiacal light
 - Prepare science community for analyzing starshade exoplanet observations
- Two teams have been selected from submitted responses to a JPL Request for Proposals
 - **Mississippi State University**, Mississippi State, MS. The Principal Investigator is Dr. Angelle Tanner
 - **Quartus Engineering Incorporated**, El Segundo, CA. The Principal Investigator is Brian Dunne
- The data challenge is open to the the general astronomy and exoplanet community

Telecon Agenda

- Welcome – **Gary Blackwood**
- • S5 Overview – **Phil Willems**
- Starshade Image Simulations – **Sergi Hildebrandt**
- Timeline and Logistics – **Renyu Hu**
- Open Floor for Discussion

Telecon Agenda

- Welcome – **Gary Blackwood**
- S5 Overview – **Phil Willems**
- • Starshade Image Simulations – **Sergi Hildebrandt**
- Timeline and Logistics – **Renyu Hu**
- Open Floor for Discussion

Telecon Agenda

- Welcome – **Gary Blackwood**
- S5 Overview – **Phil Willems**
- Starshade Image Simulations – **Sergi Hildebrandt**
- • Timeline and Logistics – **Renyu Hu**
- Open Floor for Discussion

Telecon Agenda

- Welcome – **Gary Blackwood**
- S5 Overview – **Phil Willems**
- Starshade Image Simulations – **Sergi Hildebrandt**
- • Timeline and Logistics – **Renyu Hu**
- Open Floor for Discussion

Open Discussion

- Q: Could you provide a table or spreadsheet of parameters (including units) to be estimated by the image-processing algorithms?
- A: Yes. We will provide a spreadsheet.
- Q: What are the motivations for the broader community to participate in the data challenge?
- A: The community is encouraged to look at the synthetic images and perform analyses. Participants are free to publish results on the analyses. We will invite participants to showcase their results in the final presentation meeting.
- Q: Is SISTER open-source software?
- A: Yes.
- Q: Do the locations of the planets between the two epochs follow Keplerian motions?
- A: The orbit elements would not be sufficiently constrained from two visits and should be assumed unknown when analyzing images.



Jet Propulsion Laboratory
California Institute of Technology

Acknowledgements

This work was carried out at the Jet Propulsion Laboratory, California Institute of Technology under contract with the National Aeronautics and Space Administration. © 2020 All rights reserved.

Disclaimer

The cost information contained in this document is of a budgetary and planning nature and is intended for informational purposes only. It does not constitute a commitment on the part of JPL and/or Caltech.

Contact Information

Starshade Science and Industry Partnership

- **Gary Blackwood**, NASA ExEP Manager, Starshade SIP Chair
 - Gary.blackwood@jpl.nasa.gov
 - W: 818 354 6263
 - M: 818 458 0507
- **Renyu Hu**, ExEP Starshade Scientist
 - Renyu.Hu@jpl.nasa.gov
 - W: 818 354 6090
 - M: 818 281-9459

Program Office – Key Participants

NASA Exoplanet Exploration Program (ExEP)

Science and Industry Partnership

- **Gary Blackwood**, NASA ExEP Manager, Starshade SIP Chair
- **Renyu Hu**, ExEP Scientist for Starshade Technology

Starshade Technology Development Activity (S5)

- **Phil Willems**, Manager of S5, LBTI Project Manager

NASA Headquarters Leadership

Astrophysics Division

- **Shahid Habib**, Program Executive for ExEP
- **Douglas Hudgins**, Program Scientist for ExEP
- **Mario Perez**, Division Technology Lead
- **Jeff Volosin**, Deputy Division Director
- **Paul Hertz**, Division Director