STARSHADE TECHNOLOGY AND SCIENCE WORKING GROUP (TSWG): REPORT

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(On behalf of TSWG)

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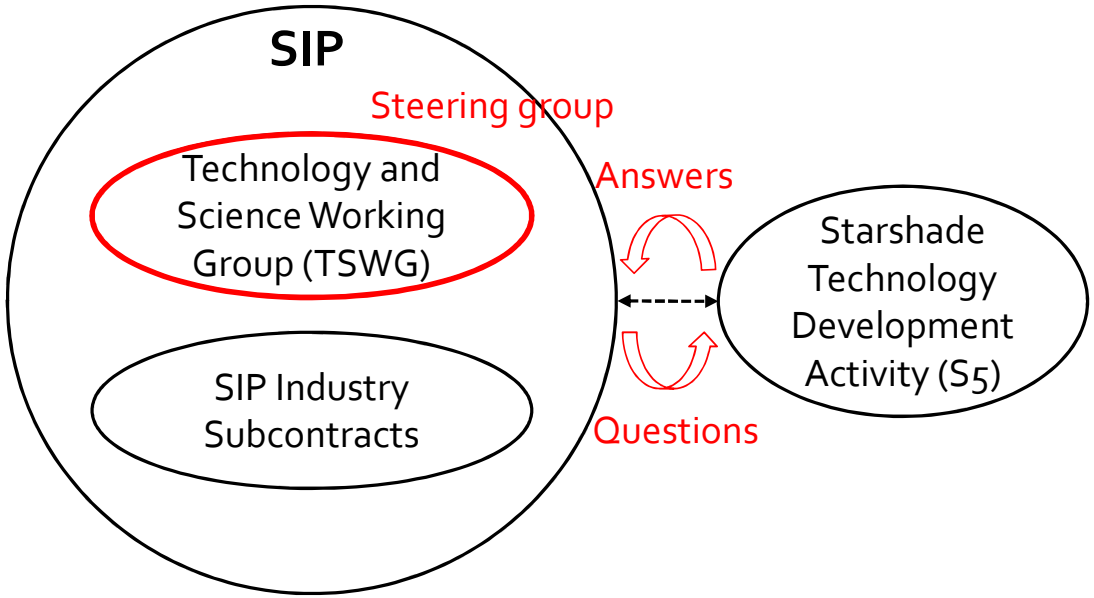

Goal of TSWG

Help SIP maximize TRL of starshades to enable future exoplanet science missions





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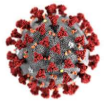
Timeline (Major Milestones)

- June 2019 – Announcement of membership
- July 2019 – Kick-off
- September 2019 – First SIP forum (Pasadena, CA)
- February 2020 – Second SIP forum (Boulder, CO)
-  
- August 2020 to May 2021 – Monthly SIP telecons

Goal: Help SIP maximize TRL of starshades to enable future exoplanet science missions


GROUP 1 – Sharpening Aim

- Identify solutions to challenges faced by the S5 development activity
- Propose new approaches, techniques, and research beyond planned S5 activities that can maximize starshade technology readiness


GROUP 2 – Selecting our Targets

- Document new mission concept drivers for starshade technology performance requirements
- Maintain alignment between S5 technology development activities and future mission needs

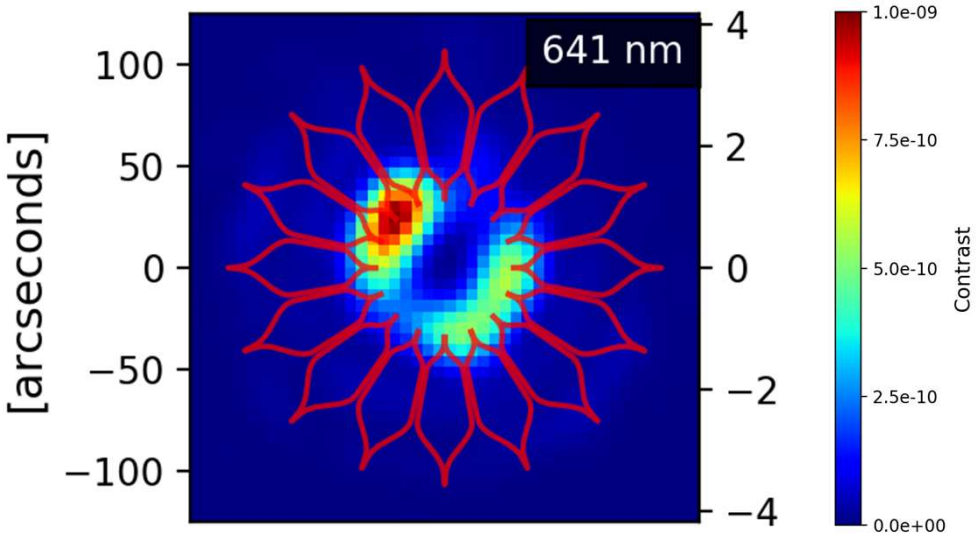

GROUP 3 – Inclusion and Participation

- Facilitate groups of investigators to communicate research, new technology, and new mission concepts across disciplinary, organizational, and geographic boundaries
- Enable continued participation of the community in NASA's starshade technology development activities

GROUP 1 – Sharpening Aim

- Identify solutions to challenges faced by the S5 development activity
- Propose new approaches, techniques, and research beyond planned S5 activities that can maximize starshade technology readiness

- Provide rationale and technical basis for the error budget in a self-contained document
- Design and support community data challenges to increase fidelity of KPPs' traceability to scientific objectives.
- Perform additional investigation into scaling of vector diffraction
- Determine if new testbed is needed for TRL 6 and identify top level requirements on that testbed
- Audit, document, and update SISTER to include relevant phenomena and interference effects

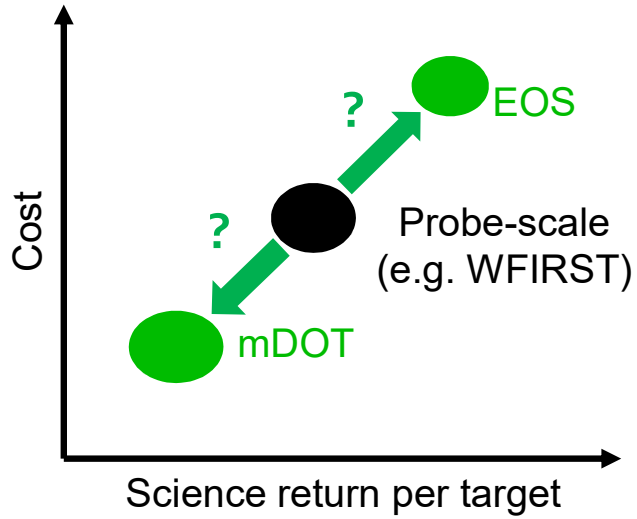


Anthony Harness (Princeton)

GROUP 2 – Selecting our Targets

- Document new mission concept drivers for starshade technology performance requirements
- Maintain alignment between S5 technology development activities and future mission needs

- Given the current landscape of starshade concepts, survey and assess TRL of required and enabling technologies
- Based on the previous action, support the further development of identified technologies which have broad applicability to starshades
- Conduct or support orbit GNC, sensing and propulsion trades for starshades at different orbits
- Establish a plan to re-direct recommendations of TSWG which fall outside the S5 scope
- Assess benefits from a flight demonstration on mDOT or other tech demo missions

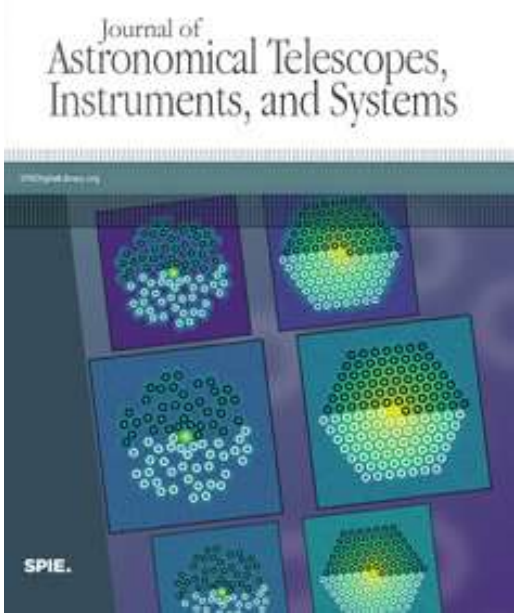


mDOT: Bruce Macintosh, Simone D'Amico (Stanford)
EOS: John Mather (GSFC)

GROUP 3 – Inclusion and Participation

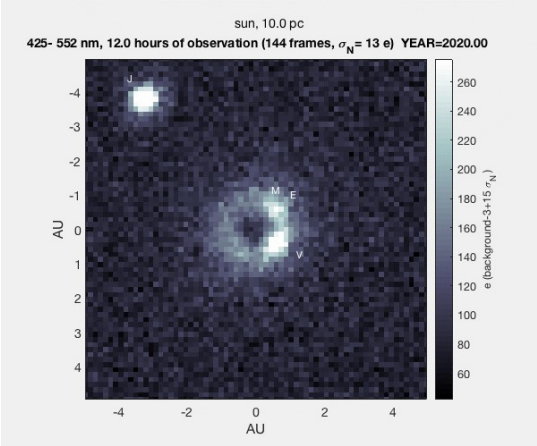
- Facilitate groups of investigators to communicate research, new technology, and new mission concepts across disciplinary, organizational, and geographic boundaries
- Enable continued participation of the community in NASA's starshade technology development activities

- Involve and engage students and the broader community with SIP through several initiatives
  - Students and PostDocs' presentations
  - Starshade data challenge
  - Special issue of JATIS on starshades



JATIS Website

Major Outcomes (In Progress)

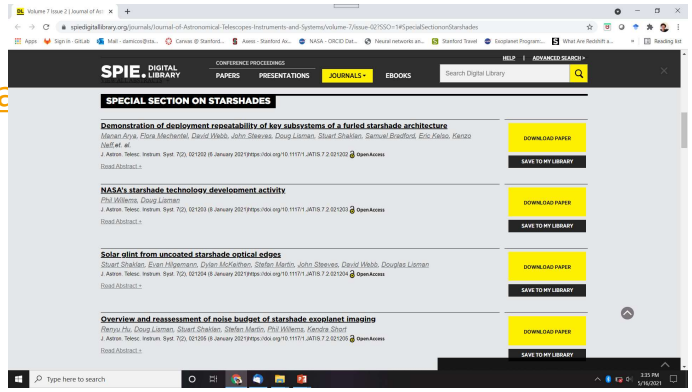


✓ **Starshade Data Challenge**

- First data challenge focused on starshade image processing
- 1440 images by S5, 2 awarded teams, open to community
- https://exoplanets.nasa.gov/exep/technology/starshade-data-challenge/

✓ **Special Issue of JATIS on Starshades**

- First consolidated dissemination of peer-reviewed research
- 18 submissions, 27 institutions, 36 reviewers
- https://www.spiedigitallibrary.org/journals/Journal-of-Astronomica Systems/volume-7/issue-02?SSO=1#SpecialSectiononStarshades



✓ **TRL progress and new trades**

- Stray light and vector diffractions analyses
- Effects of binary companions and astrophysical background
- SISTER updates for broadband imaging simulations
- Trade on possible technology demonstration missions (JPL internal)

Way Forward/Discussion

- Have TSWG's recommendations been addressed? How well?
- Is a review milestone similar to the second SIP forum needed so that TSWG and the community can provide feedback?
- TSWG might be well positioned to provide inputs to the Astrophysics Division (APD) on the most important areas for starshade technology development needed to support the priorities of Astro2020
- Are we doing enough to engage the broader community?


The New York Times

STEM WRITING CONTEST WINNER

Origami in Space Engineering: Rediscovering the Meaning of Discovery

We are honoring each of the top 11 winners of our Student STEM Writing Contest by publishing their essays. This one is by Hoonsun Lee.

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