SCIENTIFIC OPPORTUNITIES WITH A STARSHADE WORKING WITH A 2.4 METER TELESCOPE AT L2

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Exoplanet Probe – Starshade (EXO-S)

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- Investigating concepts for relatively low-cost missions
- Largely informational studies. No current opportunity to actually execute probe missions
Starshade strengths

- Contrast and inner working angle decoupled from telescope aperture size

\[ \theta \sim \frac{R}{z} \]

IWA \( \sim \) angle to edge of starshade

\[ \theta \sim \frac{R}{z} \]
Starshade strengths

- No outer working angle
- 360 degree suppression
- Broad bandpass, high throughput
- High quality telescope not required
  - Segments & obstructions not a problem
  - Wavefront correction unnecessary
Starshade drawbacks

- Full-scale end-to-end optical test on ground not possible
  - Sub-scale lab and field tests possible (more tomorrow)
- Long times between observations
- Limited number of starshade movements
- Can’t be in Earth orbit

T. Glassman / NGAS

\~ 1 week
\~ 40,000 km
Technical challenges

- Precise edge profile (≈ 50 µm tolerance) required over large structure
- Knife-edge to limit sunlight scattering into telescope
- On-orbit deployment of large structure
- Precise lateral alignment between starshade and telescope needed (± 1 meter)
Starshade for a 2.4 meter

Primary bandpass: 600 – 850 nm
Raw contrast: $1 \times 10^{-10}$
IWA: 100 milliarcsec

34 meter diameter

35,000 km

2.4 meter telescope

Assuming use of AFTA coronagraph (slight modification desired)
Preliminary science performance

- Current strategy (not yet optimized)
  - Target known exoplanets (from RV) at right times to measure masses. R = 70 spectroscopy.
  - Fill in w/ blind search targets, minimizing fuel use & prioritizing hab. zones. R ~ 10 spectroscopy.

- Observe 52 stars in 2 years
  - 13 known exoplanets
  - 19 HZ targets. Expect ~ 2 Earths or Super-Earths
  - Can detect sub-Neptunes to Jupiters around all HZ targets and 20 additional stars
Simulated image of Beta CVn plus solar system planets (8.44 pc, G0V)

- Earth
- Venus
- Jupiter
- Saturn
- Hypothetical dust ring at 15 AU

Background galaxy

Image credit: M. Kuchner
Questions for the community

- Would interleaving starshade observations affect WFIRST primary science goals?
  - Wide field instrument can operate while the starshade is moving and while it’s being used

- How to prioritize spectroscopy of known giant exoplanets?
  - Valuable guaranteed science, but constrain observing schedule
More info


[https://www.youtube.com/watch?feature=player_detailpage&v=h5w6z0jow1Q#t=0](https://www.youtube.com/watch?feature=player_detailpage&v=h5w6z0jow1Q#t=0)


