

Probe-Scale Mission with Starshade



The Team:

Jenn Carter
Benjamin Charnay
Statia Cook
Antoney Harness
Conor Francois
Jake
Catarina Ubach



Starshade CatalOgue ProbE for Exoplanets

Science Goals:

- Primary: maximize the detection of Jupiter analogs.
- Secondary: estimate the yield of other types of planets
- Tertiary: estimate how the yield is impacted by astrophysical uncertainties.



Define the telescope and instrument

- a. Size: 1.5 m
- b. Starshade: 30 m
- c. Contrast: $1\text{E-}10$
- d. Inner Working Angle: 151 mas
- e. Mission Lifetime: 5 years
- f. Any other modifications to default parameters:
exoplanet science fraction = 1



Total mission cost estimates

	System	Parameter	Option A
Inputs 1	Telescope	Diameter (m)	1.5 m
	<u>Starshade</u>	Diameter (m)	30 m
	Mission Duration	Lifetime (years)	5 yrs
	Orbit	L2 (2) or Trailing Orbit (3)	3
Inputs 2	Spacecraft	Telescope Spacecraft Selection	Spacecraft D
		<u>Starshade</u> Spacecraft Selection	Spacecraft Z
	Launch Vehicle	Launch Vehicle Selection	L/V E
Auto Outputs	<u>Starshade & Telescope</u>	Payload Driven Spacecraft Pointing Requirement	0.30 asec
		Payload Power Requirement	185 W
		Payload Mass	1235 kg
		<u>Starshade</u> Mass	635 kg
		Telescope Mass	600 kg
	Overall Mass and Cost	Launch Capability	9225 kg
		Launch Mass	8717 kg
		Launch Margin	508 kg
		Cost (FY14)	\$1428 M

Potential yield for each type of exoplanet

- a. Jupiters: 0.86 (Nstars = 99)
- b. Earths: 1.04 (Nstars = 35) $\rightarrow$ 2.94
- c. Neptunes: 0.38 (Nstars = 19) $\rightarrow$ 1.98
- d. warm mini-Neptunes: 1.0 (Nstars = 47) $\rightarrow$ 2.11

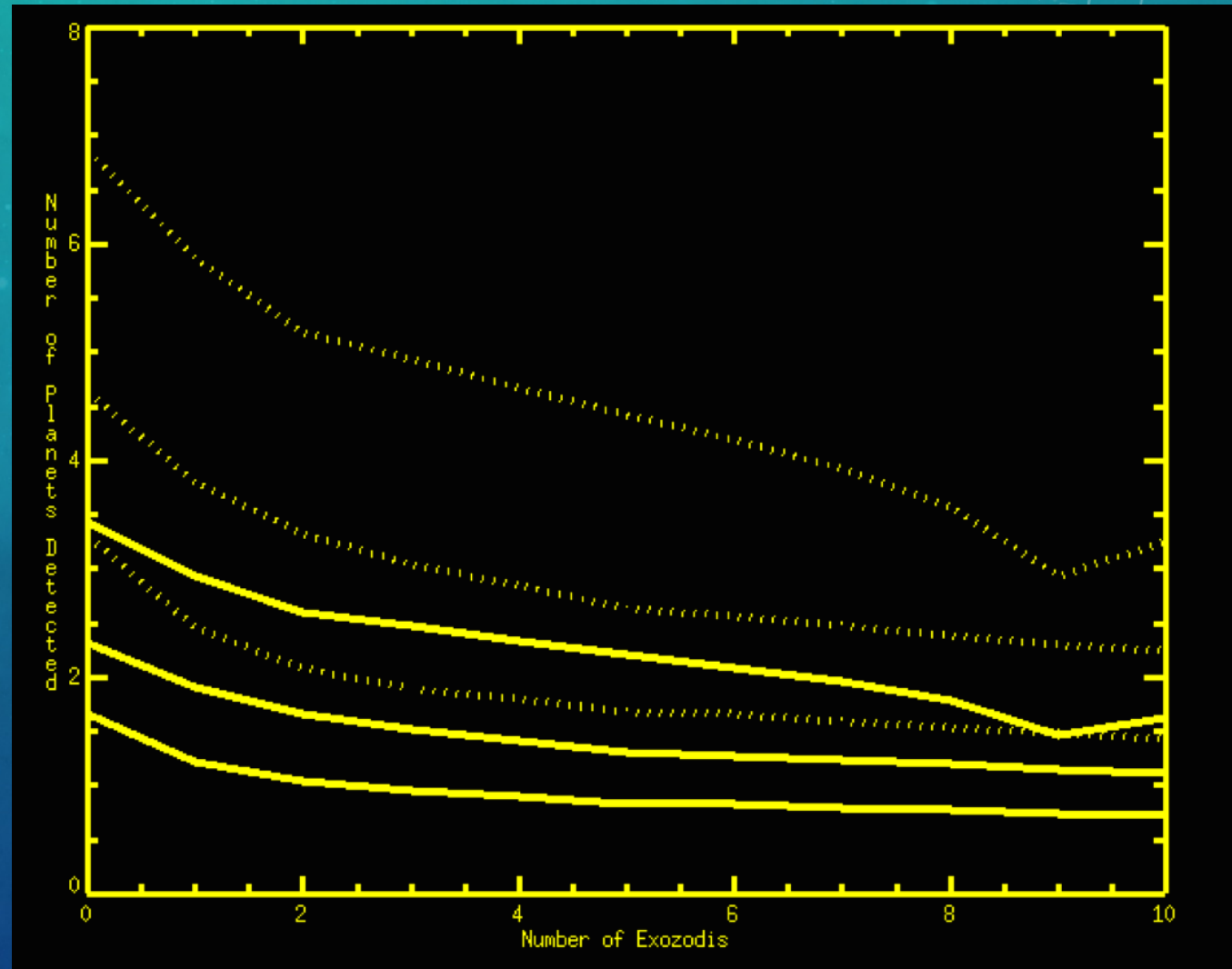
Total : 3.28 $\rightarrow$ 7.89





Earth yield as a function of astrophysical uncertainty

Plot of number of Earth-like planets vs. exozodis. Dashed lines correspond to $\eta_{\text{Earth}} = 0.2$ and solid lines to $\eta_{\text{Earth}} = 0.2$. Each set runs top to bottom with telescope diameter = 2.4, 1.5, and 1.0 m.





What we learned

1. Starshade is not a survey instrument.
2. The Starshades are optimized to detect Earth's.
3. It can be added to an existing telescope.
4. We can maximize observing time by minimizing slew time.