



# 4m Alternative Architectures and the 6.5m Architecture Options

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# Sections 7, 8 and 9

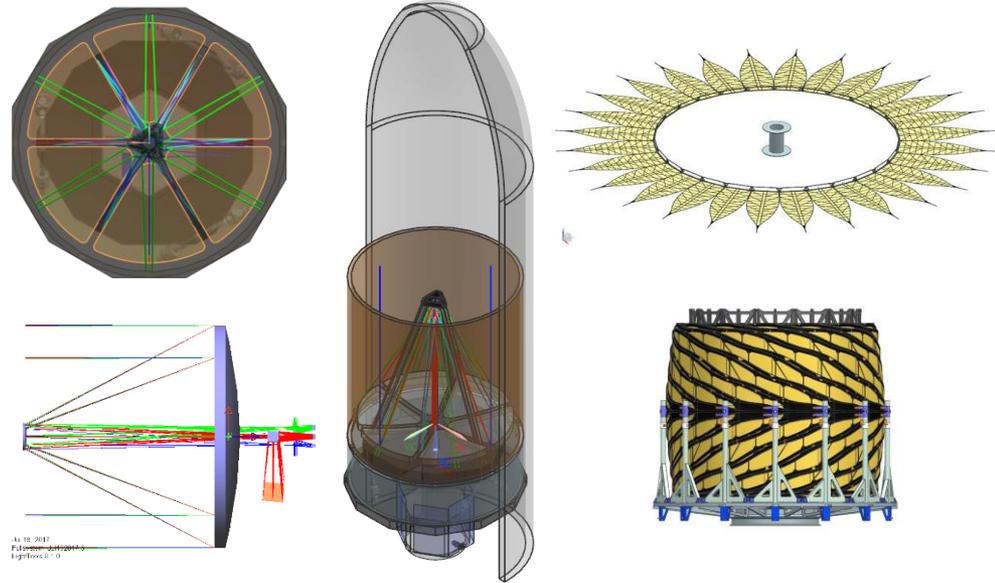


- Architecture Trade
  - KT Methodology
  - Architecture Option descriptions
  - Decision Criteria
  - Decision outcome
- Baseline Option
- **Alternative Options**
  - **Starshade Only**
    - Differences from Baseline
    - Cost and Required Technologies
  - **Coronagraph Only**
    - Differences from Baseline
    - Cost and Required Technologies
  - **Two Starshades**
    - Differences from Baseline
    - Cost and Required Technologies
- The 6.5m Architecture Trade
  - Option Descriptions
  - Decision Criteria
  - Planned work ahead

# Starshade Only Option – Differences from Baseline



		Starshade Only
HZ Completeness		65
Characterizations		33
Orbit Determinations		16
New Technologies	TRL 3	2
	TRL 4	4
Risks		WFIRST starshade captures significant fraction of exoplanet science
Opportunities		Precursor / contemporaneous observations with astrometry or radial velocity that is sensitive to potential habitable planet
Launch Vehicle(s)		Falcon H (2)

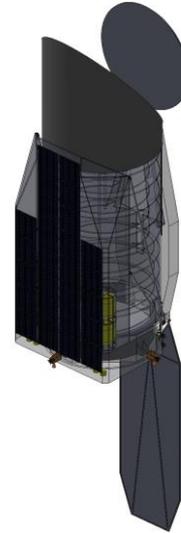


- Reduced science yield
  - Cannot observe binaries
- On-axis telescope based on the JPL NSPO design
  - All instruments mounted behind the primary mirror (no coronagraph)
  - Utilizes laser metrology for segment wavefront control
  - Does not need tight thermal control system, micro-thrusters or active isolation
- Coronagraphy related technologies are not needed so less technical risk than baseline
- Total option mass is at least 10mT lighter than the baseline
  - Able to launch on two Falcon Hs
- Funds needed may fit into available wedge AND can accommodate 2 probe missions per decade

# Coronagraph Only – Differences from Baseline



		Coronagraph Only
HZ Completeness		66 to 88
Characterizations		25
Orbit Determinations		58
New Technologies	TRL 3	0
	TRL 4	4
Risks		WFIRST starshade captures significant fraction of exoplanet science
Opportunities		
Launch Vehicle(s)		SLS

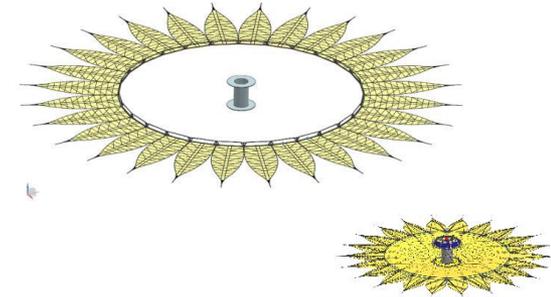
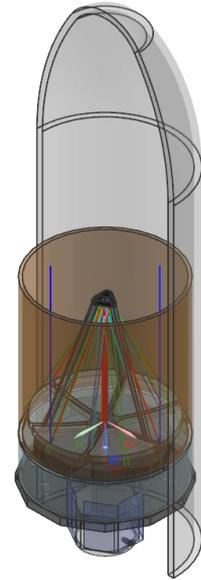


- Less science than the baseline
- The mission architecture is the same as the baseline option but without the starshade and starshade camera
- Still must launch on SLS due to both the mass (> 15mT) and fairing volume needed for a slow unobscured telescope
- Funds needed may fit into available wedge AND can accommodate 2 new probe class missions per decade

# Two Starshade Option – Differences from Baseline



		Two Starshades
HZ Completeness		73
Characterizations		~30
Orbit Determinations		32
New Technologies	TRL 3	2
	TRL 4	4
Risks		
Opportunities		Precursor / contemporaneous observations with astrometry or radial velocity that is sensitive to potential habitable planet
Launch Vehicle(s)		Falcon H (2)



- Same as starshade only option but with an added 32m starshade
- Telescope would launch in a Falcon H
- Two starshades may fit in a shared Falcon H launch
  - Mass is very close to capacity
  - 72m mass would increase slightly to carry the second starshade during launch.
    - The increased structure mass would drive up propellant
  - Could launch the 72m on a Falcon H and the 32m on a Falcon 9 - a three-launch mission
- Less science than baseline...propellant limited
  - but still can support binary observations

# Baseline with a Delayed Starshade Launch



- Starshade would launch 5 years after the Telescope launch
- Pro
  - Funds needed may fit into available wedge AND can accommodate 2 new probe class missions per decade
    - Affordable and protects non-HabEx astrophysics science...balanced science
  - No HabEx science is dropped to make mission affordable at current APD funding level
  - The lowest TRL technologies have 5 more years to mature
  - Allows coronagraph time to detect planets and establish orbits for more efficient starshade usage
- Con
  - Costs more – need a Falcon H and more operations
  - The mission would take longer to complete the baseline science
  - Starshade Camera would be 5 years old before being used for starshade science
    - Or the starshade camera must be added to the telescope during a servicing mission
  - Starshade could be descoped for programmatic reasons
- 2011 Planetary Decadal Survey prioritized a Mars sample caching rover (Mars 2020 will address) as a step toward potential Mars sample return
  - Proposing a science objective in two stages is not without precedent and success

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- **The 6.5m Architecture Trade**
  - **Option Descriptions**
  - **Decision Criteria (same as the 4m?)**
  - **Planned work ahead**

# 6.5m Option Descriptions



- The off-axis segmented design
  - Designed for coronagraphy but also includes a starshade
  - Should we also look at coronagraph-only?
- The on-axis JWST-based segmented 6.5m design
  - Starshade only architecture (should this be a two starshade architecture?)
- The on-axis NSPO segmented 6.0m design
  - Starshade only architecture (should this be a two starshade architecture?)
- Other options?
  - What if the masses are too heavy for the Falcon H? Go to SLS or reduce aperture?
    - If we go to SLS we would look at non-deployed designs
      - Allows us to use a light barrel on the telescope which works better with the starshade
    - If we go to SLS do we also want to look at monoliths?