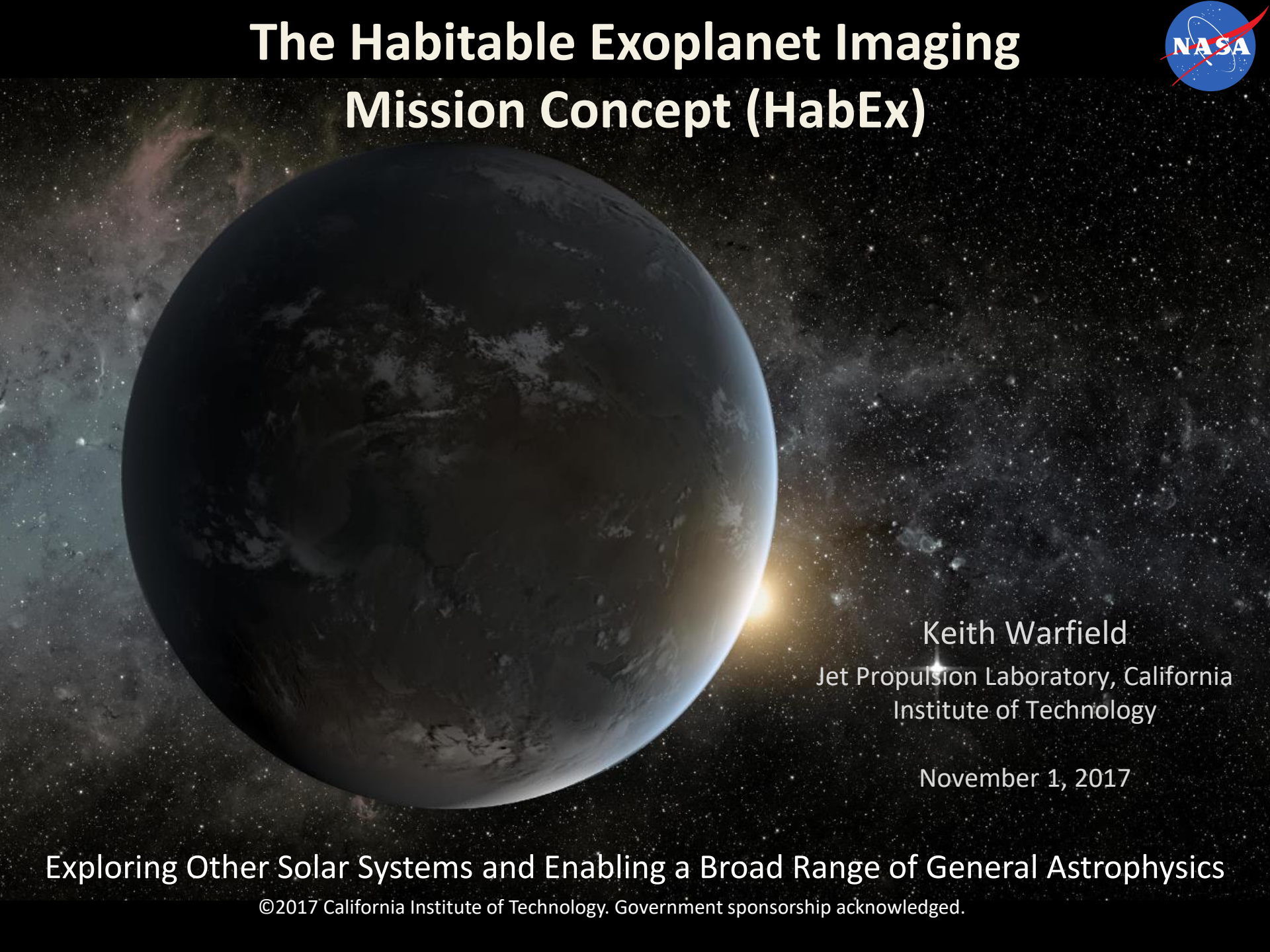
The Habitable Exoplanet Imaging Mission Concept (HabEx)



Keith Warfield

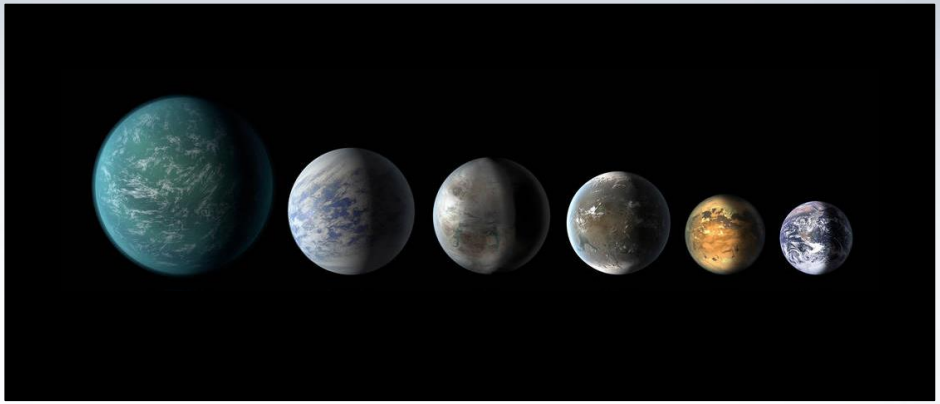
Jet Propulsion Laboratory, California Institute of Technology

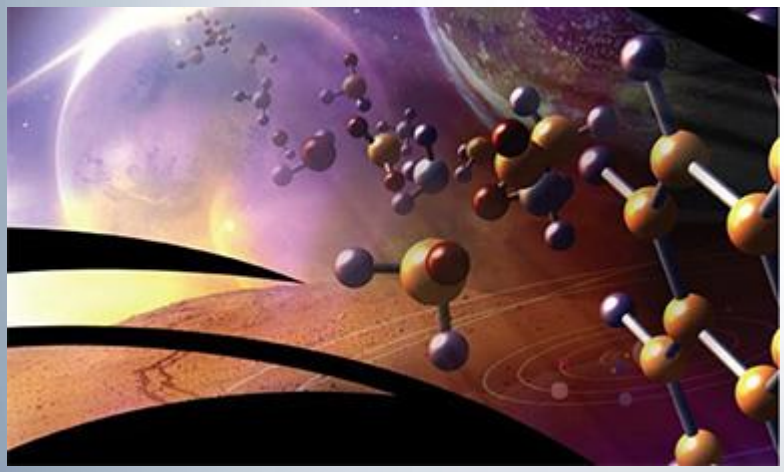
November 1, 2017

Exploring Other Solar Systems and Enabling a Broad Range of General Astrophysics

HabEx Science

The primary goal of HabEx is to directly image and spectrally characterize terrestrial exoplanets. However, it would also study the full range of exoplanets within the systems.





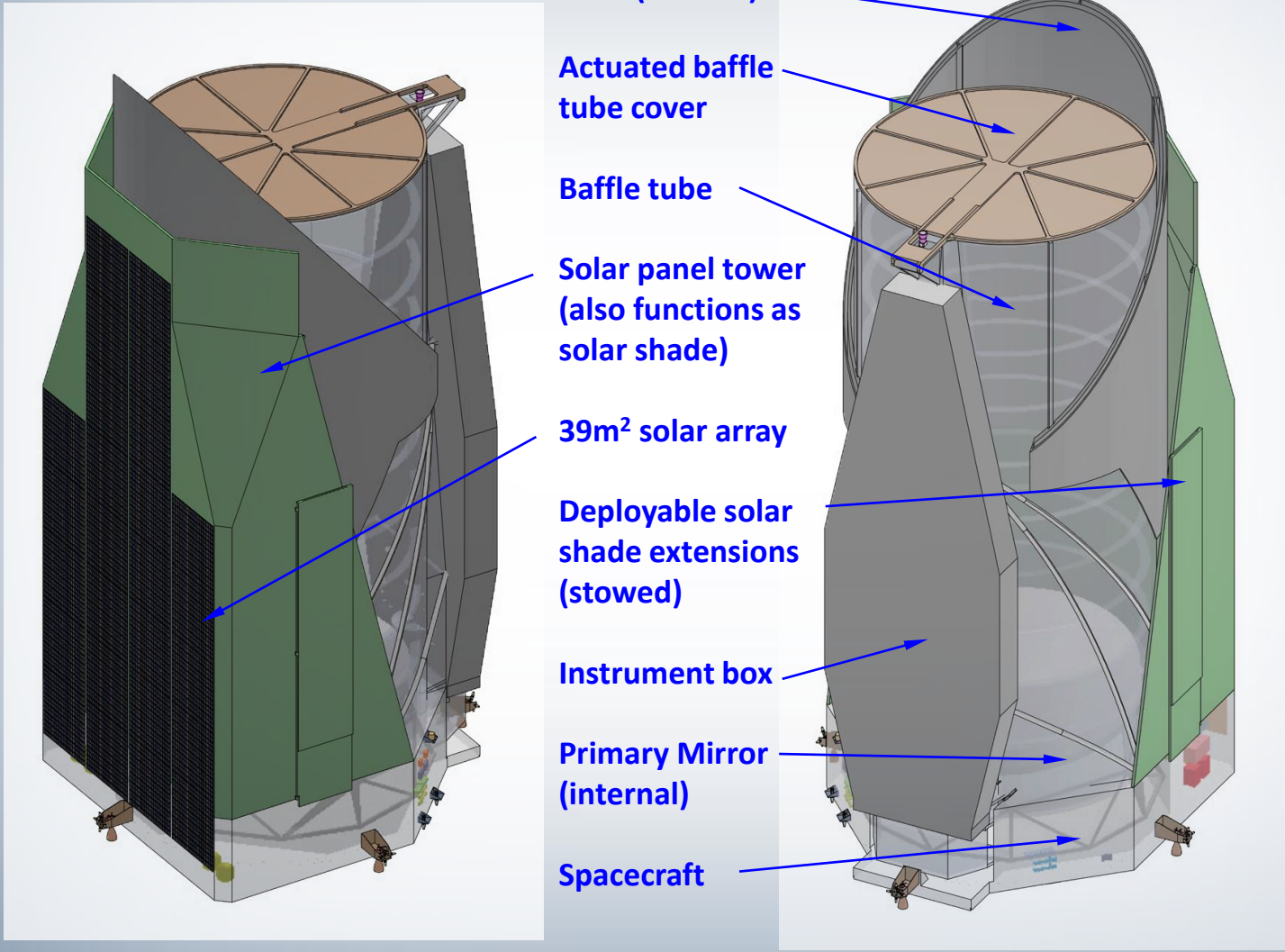
HabEx would search for potential signs of habitability in the atmospheres of exoplanets by seeking spectral features of water and other biosignature gases, including oxygen and ozone.

With a large ultrastable optical space-based telescope, it would be possible for HabEx to study a broad range of Solar system, Galactic and extragalactic astrophysics.

HabEx Mission Concept Architecture

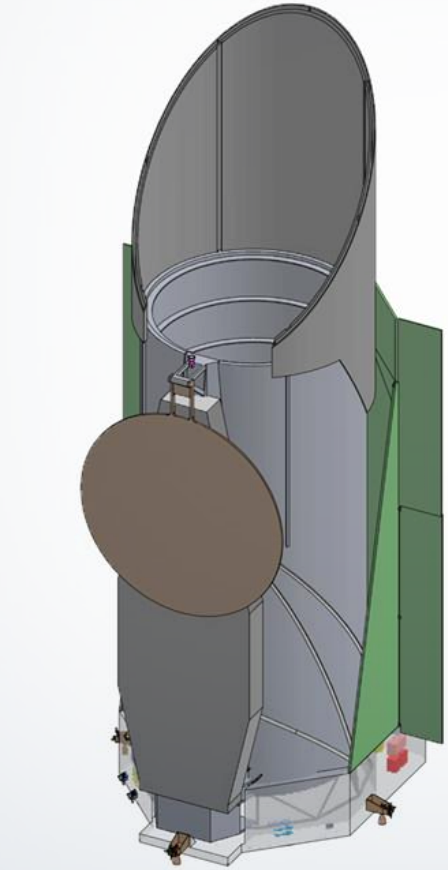
- HabEx is investigating two different telescope mirror sizes and design options: a 4m monolithic and 6.5m segmented design. The 4m architecture includes a companion starshade; the 6.5m will likely have one as well.
- The 4m telescope is an unobscured #F2.5 design to maximize coronagraph throughput and minimize polarization effects that can reduce coronagraph performance.
- The HabEx 4m design uses micro-thrusters instead of reaction wheels to minimize telescope pointing jitter.
- There are two instruments dedicated to General Astrophysics: a UV Spectrograph and the “HabEx Workhorse Camera” used for imaging and spectroscopy from the near UV to the near IR. Both have 3x3 arcmin FOV
- HabEx would observe in the UV, Optical, and Near Infrared wavelengths (120nm – 1,800nm).
- The starshade is 72m in diameter and would fly ~124,000 km from the telescope.
- The HabEx 6.5m architecture trade investigation will take place over the coming year.

HabEx 4m Telescope Concept Stowed

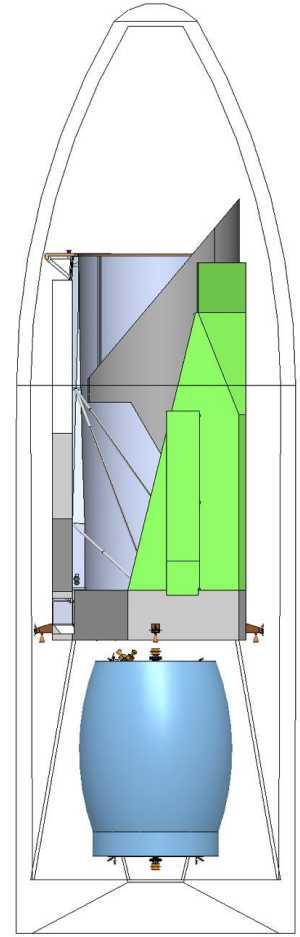


HabEx 4m Telescope Concept

Deployed

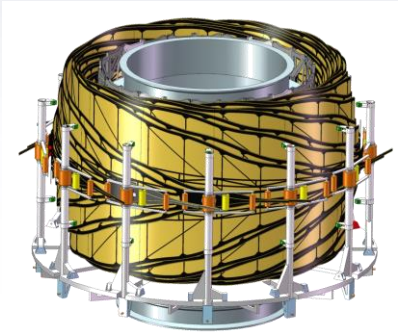


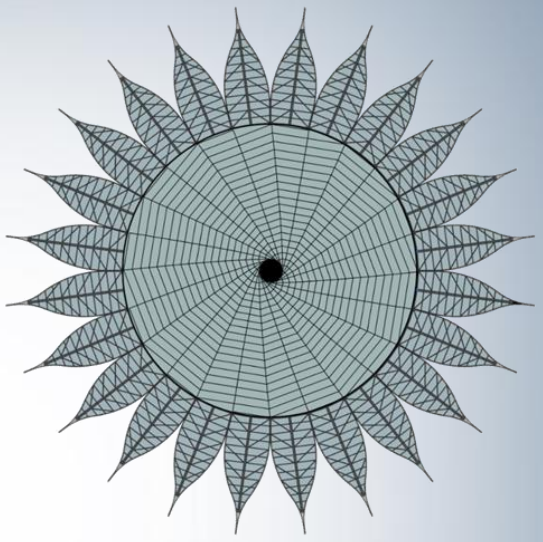
Shared Launch Configuration



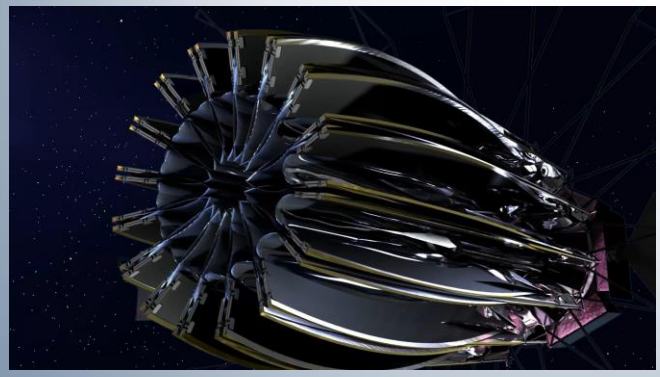
HabEx Starshade Options

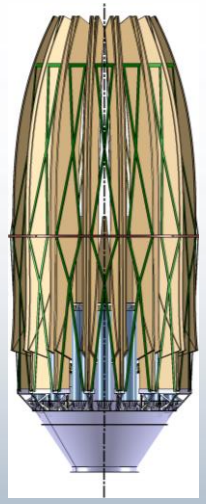
JPL Starshade Design

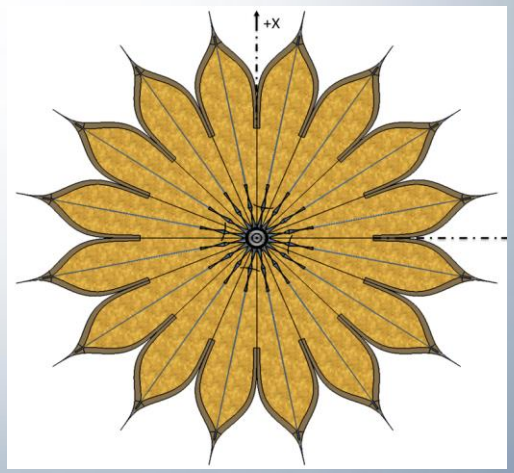




NGAS Starshade Design







Current Servicing Plans for HabEx

- Current HabEx servicing planning assumes a dedicated, robotic servicing mission
- Current notional Telescope Servicing Plan is based on WFIRST
  - Flight system is refuelable
  - Bus avionics are on removable panels on the outside of the bus
  - Instruments are removable
  - Microthrusters and thrusters will be replaceable
  - Solar array is not removable but a new, light-weight array could be installed over the original array
  - Telescope primary, secondary and tertiary mirrors are not replaceable
- Starshade is also serviceable
  - Bus avionics will be removable
  - Starshade can be refueled
  - Thrusters can be replaced
  - The starshade itself is not replaceable or repairable

Servicing HabEx Assuming Cis-Lunar Gateway

- Assuming a robotic and astronaut servicing capability exists at a cis-lunar "Gateway" at the time of the HabEx mission, how would the HabEx mission concept change?
- The Gateway could be able to support all the currently planned servicing activities plus:
  - Telescope secondary and tertiary mirror replacement.
    - Mirrors could be recoated in space to avoid ground-based degradation threats.
  - Mirror decontamination
  - Starshade deployment
    - Starshade deployment checkout and position adjustment
    - Starshade edge launch protector removal
  - Starshade repair
    - Starshade micrometeoroid damage identification and repair
    - Starshade solar array replacement
- Capabilities that could be useful to a HabEx mission
  - Robotic spacecraft handling and subsystem replacement capabilities
  - Precision mechanical measuring systems (e.g., photogrammetry system)
  - Optical decontamination support equipment (e.g., cold traps to collect contaminants)
  - Mirror recoating capability