

The Habitable Exoplanet (HabEx) Imaging Mission Study

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Credits: NASA Ames/JPL-Caltech/T. Pyle

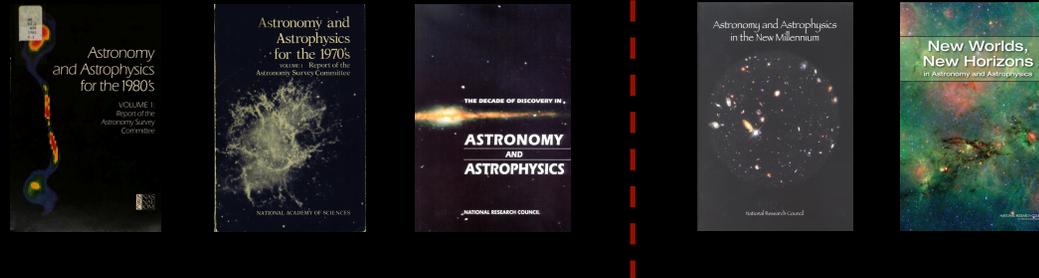
AAS Session on STDT Studies, Wed Jan 6 2016



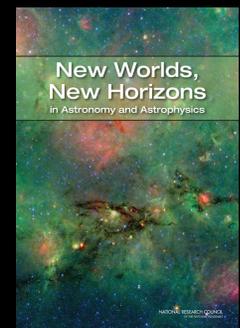
Habitability of Earth-like Exoplanets: a Long Standing Question in Astronomy ...

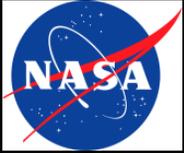


- The plurality of worlds (both like our own and different) was already postulated (and heavily debated) by the ancient Greeks
- Every Decadal Review so far has highlighted the question of Earth-like exoplanets and their habitability



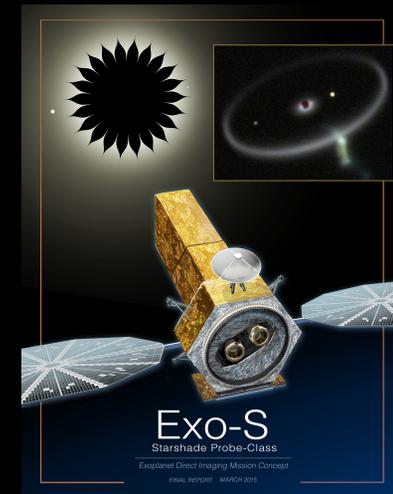
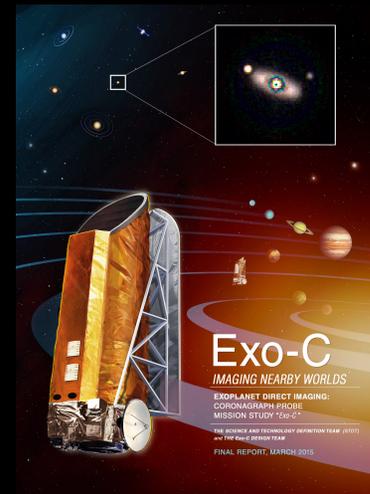
- Revolution of the exoplanets field since the mid 90s, with rapid transition from conjuncture to proven existence, basic demographics and physical characterization
- Astronomy and Astrophysics in the New Millenium (A&A SC, 2001)
“Astronomers stand poised to image Earth-like planets beyond our solar system, and to learn whether some show evidence of life.”
- 2010 Decadal Survey: New Worlds, New Horizons in Astronomy & Astrophysics
“The committee’s proposed program is designed to allow a habitable-exoplanet imaging mission to be well formulated in time for consideration by the 2020 decadal survey.[...]. The observational challenge is great, but armed with new technologies and advances in understanding of the architectures of nearby planetary systems, astronomers are poised to rise to it.”

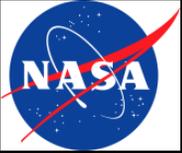




... That We Can Finally Address with HabEx

- Amazing recent results from Kepler and other projects, the coronagraph planned for the WFIRST-AFTA mission, and previous Probe-class studies (Exo-C and Exo-S) all indicate there are multiple architectures now ready to search for and characterize potentially habitable exoplanets!
- *January 2016:* HabEx is one of 4 large missions recommended by the 3 NASA Program Assessment Groups (PAGs) and endorsed by the NAC's Astrophysics Subcommittee as a mission concept that NASA should study in preparation for the 2020 Decadal Survey



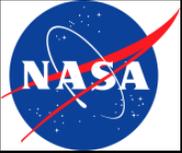


HabEx Primary Science Goals

(Notional)



- **Search for and characterize potentially habitable worlds**
 - Search for Earth-sized planets in the HZ of other stars via direct detection of reflected starlight
 - Observe a large enough sample for high probability detection of at least “x”
 - Understand the atm and surface conditions of those exoplanets
 - Specifically, search for water and biosignature gases on those exoplanets
- **Place the Solar System in the context of a diverse set of exoplanets**
 - Directly detect reflected starlight and transit spectra from a wide range of exoplanets, in order to:
 - Understand their atm structure and composition
 - Search for signs of habitability and bio activity in non-Earth-like exoplanets
 - Image faint debris disks and ExoZ light in order to constrain their structure and composition and hence planet formation processes
 - Characterize the architectures of exoplanetary systems as a function of stellar type and age (planet evolution processes)

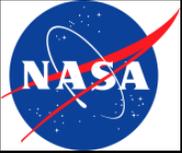


HabEx Primary Science Goals

(Notional)



- **Study and Characterize Protoplanetary Disks**
 - Image surface brightness features (gaps, vortices) in PP disks and determine whether they are due to newly-formed planets
 - Use repeat observations to detect the movements of the features
 - Search for faint scattered light in the inner optically thin region of transitional disks nearing the ends of their lives
 - Determine the locations of the outer edges of PP disks
- **Broad range of additional astrophysics enabled by large diffraction limited optical telescope in space**



HabEx Primary Requirements (Notional)



- **Mission Parameters** (taken from PAG reports and whitepapers):
 - Aperture likely $< \sim 8\text{m}$
 - Monolithic or segmented primary
 - 10^{-10} contrast in the HZ of nearby stars, with $R > 70$ spectro-imaging
 - *Optimized for exoplanet direct imaging in optical and NIR*
 - Orbit: likely L2 or Earth-trailing
 - *Secondary payload TBD*

Now is the time for the community to participate in the study
and *define* what HabEx should be!

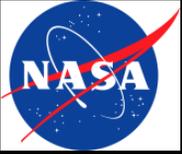


Role & Structure of Habex Science & Technology Definition Team (STDT)



Paul Hertz: “A Successful Concept Study shall develop a design reference mission that is compelling, credible, affordable, and ready for implementation if chosen by the Decadal 2020”

- STDT members will:
 - Define science requirements for both exoplanet and cosmic origins science
 - Define basic reference mission and observatory performance parameters, based on extensive trade studies (science yield vs complexity, risk and cost)
 - Assess Science Gap and prioritize precursor observations
 - Help assess Technology Gap
- HabEx STDT members shall represent:
 - All parts of exoplanet science (including planetary scientists, astro-biologists and instrument scientists)
 - The broader astrophysics community interested in a large diffraction limited optical telescope in space



Study Team = STDT + support from HabEx Study Office at JPL



- HabEx Study Team is fully committed to partnering with all interested NASA Centers, Industry and Academia
- HabEx Study Team expects to share information and some membership with the LUVOIR Study Team, exploring Scientific and Technical synergies
- Make sure your voice is heard and that we all make the most of this great opportunity:

Come aboard the HabEx STDT !

***It's a community study and the study team is led by the STDT,
which is why we want strong community participation***