HabEx Design Status

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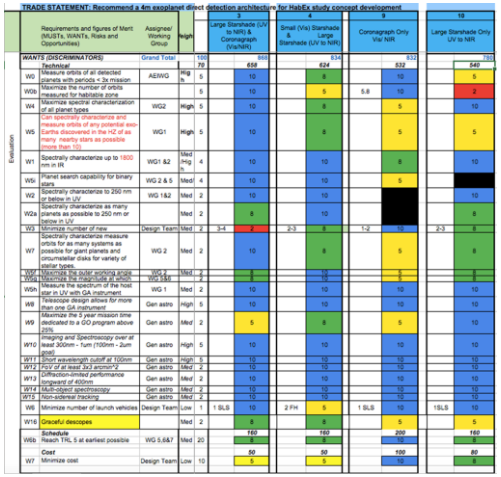
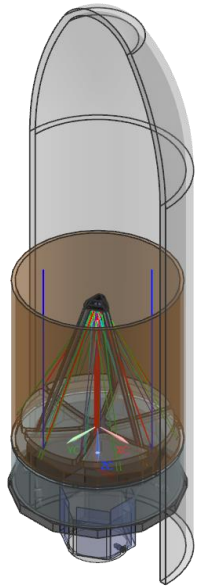
CL#

HabEx Status

- Completed several design trades before the 4m architecture trade
  - Polarization driven contrast vs. telescope F#
  - Coronagraph sensitivity to telescope induced wave front error
  - Starshade sizing vs bandwidth and inner working angle
  - Instrument sizing, cost and technical risk studies were conducted
  - Technologies were assessed to allow the STDT to evaluate technical risk within different architectures
- 4m Architecture trade is settled
  - Evaluated 4 architectures: starshade only, coronagraph only, starshade and coronagraph and two starshades
  - Baseline design is an unobscured telescope with a coronagraph and starshade
  - Primary general astrophysics instrument is a UV spectrograph with a wide field “workhorse” camera as a possible second contributed instrument
  - Received input from JPL’s National Security Program Office on a 4m segmented telescope design for starshade use only. We will use it as the notional on-axis design in our alternative starshade-only architectures.

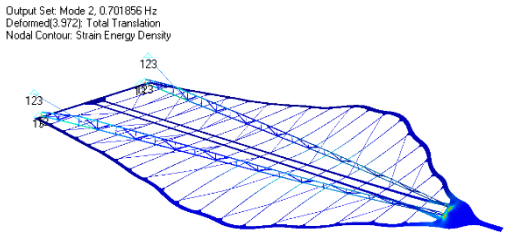

TRADE STATEMENT: Recommend a 4m exoplanet direct detection architecture for HabEx study concept development

		Requirements and figures of Merit (MUSTs, WANTs, Risks and Opportunities)	Assignee/ Working Group	High		3 Large Starshade (UV to NIR) & Coronagraph (Vis/NIR)	4 Small (Vis) Starshade & Large Starshade (UV to NIR)	9 Coronagraph Only Vis/ NIR	10 Large Starshade Only UV to NIR
		WANTS (DISCRIMINATORS)	Grand Total		100	650	624	532	540
		Technical			70				
Evaluation	W6	Measure orbits of all detected planets with periods < 3x mission	AEWG	Hig h	5	10	8	10	5
	W6b	Maximize the number of orbits measured for habitable zone			5	10	5	10	2
	W4	Maximize spectral characterization of all planet types	WG2	High	5	10	8	5	10
	W5	Can spectrally characterize and measure orbits of any potential exo-Earths discovered in the HZ of as many nearby stars as possible (more than 10)	WG1	High	5	10	8	5	5
	W1	Spectrally characterize up to 1800 nm in IR	WG1 &2	Med /Hig h	4	10	10	8	10
	W5c	Planet search capability for binary stars	WG 2 & 5	Med	4	10	10	5	
	W2	Spectrally characterize to 250 nm or below in UV	WG 1&2	Med	2	10	10		10
	W2a	Spectrally characterize as many planets as possible to 250 nm or below in UV		Med	2	8	10		8
	W3	Minimize number of new	Design Team	Med	2	3-4 2	2-3 8	1-2 10	2-3 8
	W7	Spectrally characterize measure orbits for as many systems as possible for giant planets and circumstellar disks for variety of stellar types	WG 2	Med	2	10	8	5	8
	W2f	Maximize the outer working angle	WG 4	Med	2	8	10	5	8
	W5a	Maximize the magnitude at which	WG 1&4		2	10	10	10	10
	W5h	Measure the spectrum of the host star in UV with GA instrument	WG 1	Med	2	10	10	10	10
	W8	Telescope design allows for more than one GA instrument	Gen astro	High	5	10	10	10	10
	W9	Maximize the 5 year mission time dedicated to a GO program above 25%	Gen astro	Med	2	5	8	5	10
	W10	Imaging and Spectroscopy over at least 300nm - 1um (100nm - 2um goal)	Gen astro	High	5	10	10	10	10
	W11	Short wavelength cutoff at 100nm	Gen astro	High	5	10	10	10	10
	W12	FoV of at least 3x3 arcmin^2	Gen astro	Med	2	10	10	10	10
	W13	Diffraction-limited performance longward of 400nm	Gen astro	Med	2	10	10	10	10
	W14	Multi-object spectroscopy	Gen astro	Med	2	10	10	10	10
	W15	Non-sidereal tracking	Gen astro	Med	2	10	10	10	10
	W6	Minimize number of launch vehicles	Design Team	Low	1	1 SLS 10	2 FH 5	1 SLS 10	1SLS 10
	W16	Gracefu l descopes		Med	2	8	8	5	5
		Schedule				160	160	200	160
	W6b	Reach TRL 5 at earliest possible	WG 5,6&7	Med	20	8	8	10	8
		Cost				50	50	100	80
	W7	Minimize cost	Design Team	Low	10	5	5	10	8



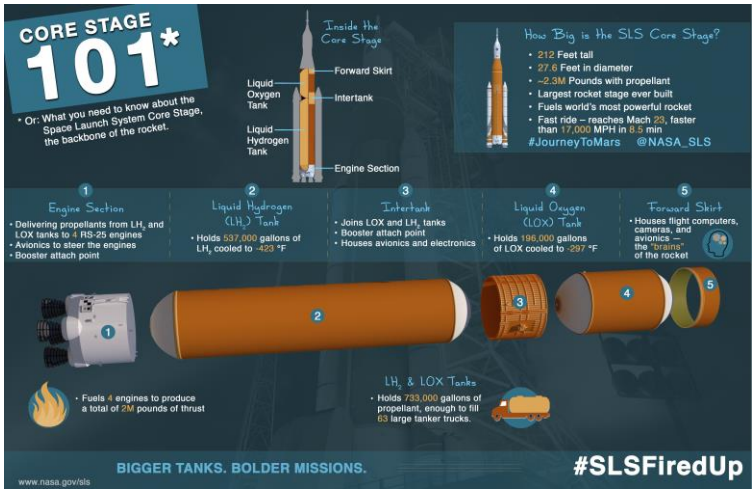
HabEx Status

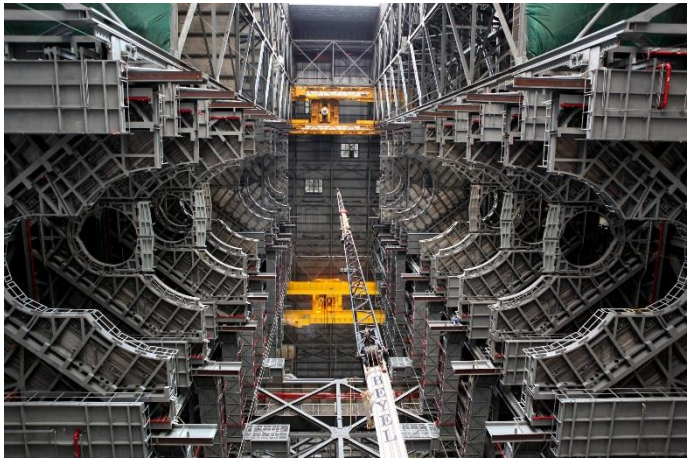
- JPL and NGAS Starshade designs have been completed
- The telescope and instrument optical layouts have been completed
- Telescope and starshade designs have been completed
- Team X designs of the starshade and telescope buses are complete
- Currently pursuing a telescope bus design without reaction wheels
  - Micro-thruster technology is flight proven
  - Simplifies the design and reduces risk
- Submitted HabEx technology gap list to O2 delivery
- RFI responses are in. We will be contacting UTAS and two micro-thruster developers for added expertise to the study.
- Ongoing work to complete UVS Team X design, micro-thruster/telescope stability modeling, and starshade thermal performance simulations



SLS

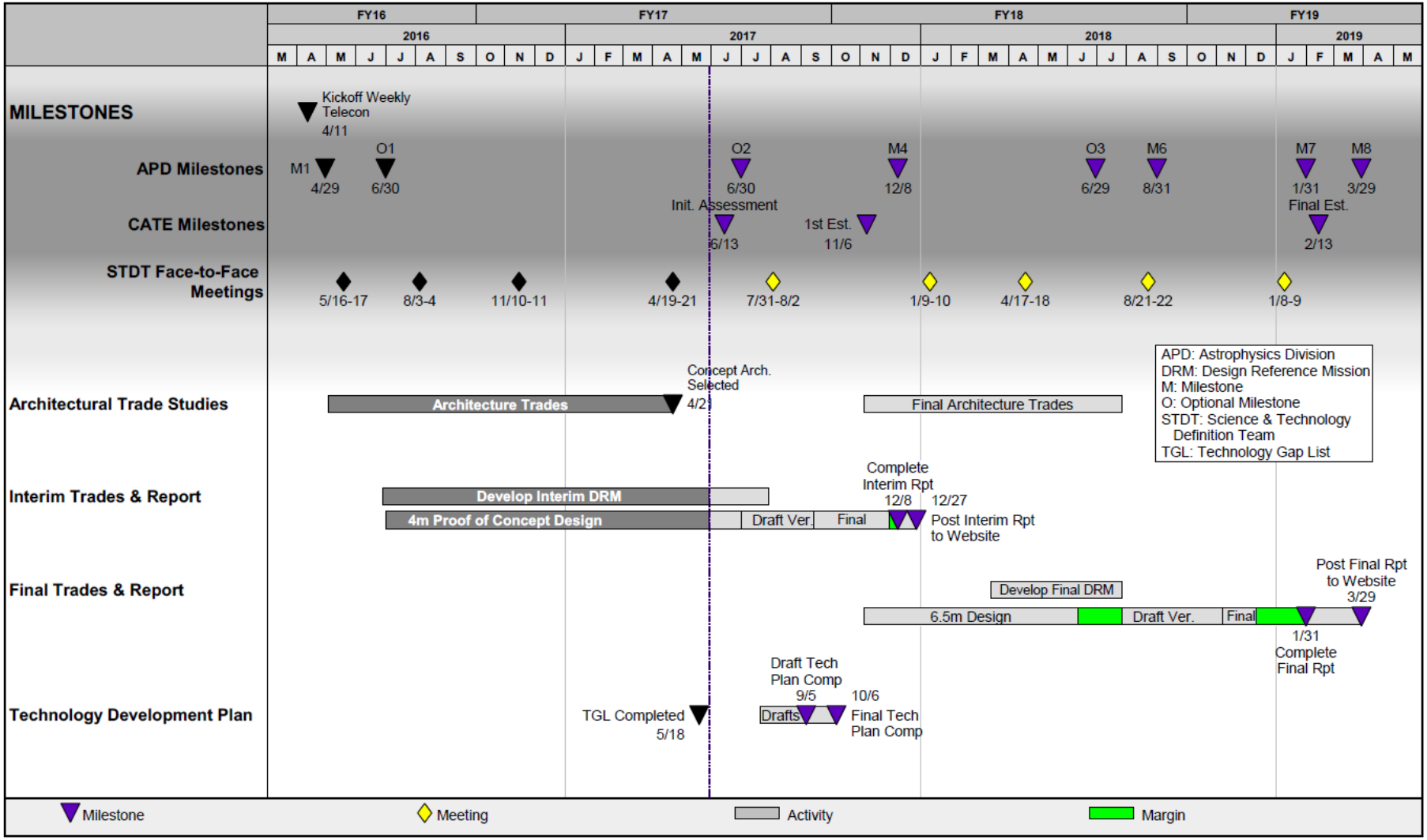
- SLS is baselined in the HabEx 4m design
  - Co-launching starshade and telescope
- SLS is moving forward in development
  - No reduction in funding for core rocket
  - Launch site in development
- 12 planned missions from 2019-2033
- First launch was scheduled for FY18 but delayed until FY19
  - Lightfoot to make an announcement on specifics about the delay this month





HabEx: Habitable Exoplanet Imaging Mission Study

5/28/17



HabEx Work Ahead

- FY17
  - CATE critique of the 4m architecture
  - Get telescope and micro-thruster industrial participants on the Design Team
- FY18
  - Deliver Interim Report
  - Discuss Interim Design at AAS
  - Deliver Interim CATE inputs
  - Settle the 6.5m architecture and design
    - Option identification and cost, risk and performance assessments will begin in FY18 with selection around January. Design work will run to July
    - MSFC will oversee the telescope design. Will likely get help from GSFC and JPL NSPO .
    - Starshade may not require much more design work but we may choose a different design
  - Team X study on the 6.5m bus design
    - Another Team X study will be run to design a bus for the 6.5m telescope
  - O3 delivery on the 6.5m option and any update on the 4m option
- FY19
  - Deliver the final report
  - Deliver the final CATE inputs