The Argument for a Large, Serviceable, Direct Imaging Space Telescope

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Results from Kepler

- Kepler has demonstrated that $\eta_{Earth}$, the frequency of rocky planets in the habitable zones of various stars, is in the range of 0.1-0.5
- In order to learn more about whether such planets might be habitable, or inhabited, we need to do direct imaging from space
  - JWST might be able to characterize an Earth-like planet around a nearby M star, but this is not likely to be enough to satisfy our curiosity
Two flavors of UVOIR direct imaging missions

- A mission like the old TPF-C but with an improved coronagraph might be able to do the job
- Alternatively, a starshade mission like TPF-O/NWO might be preferred
  - The ongoing Exo-S and Exo-C studies may shed new light on the advantages and disadvantages of each concept
- Both missions would probably need to fly at L2, either for thermal stability (TPF-C) or for orbital stability (TPF-O)
Why we need a large mirror

- One ambitious concept that might work with either mission architecture is the ATLAST telescope
  - A significant segment of the astronomical community (as represented by COPAG) sees 8 m as the minimum telescope size required to do revolutionary science
  - The UV community would probably be content with a 4-m, UV-capable, telescope
  - We might be able to get by with a 4-m telescope, as well, but then we might lose support from part of the COPAG community

http://www.stsci.edu/institute/atlast/images/ATLAST16m.jpg

Proposed aperture sizes for ATLAST range from 8 to 16 m
Partnering with the manned space program

• Putting big space telescopes up at L2 is expensive and risky
  – JWST had better work!

• HST, arguably NASA’s most successful scientific mission ever, was serviced 5 times and has lasted for almost 25 years

• We should once again have an active manned space program by the time this flagship mission flies (circa 2034)
  – Servicing could be done at Earth-Moon L1 (idea from Chuck Lilly)
  – Servicing is particularly critical if a starshade is employed because this technology has never been tested and because slewing the starshade from target to target is slow
Others besides me have explored the feasibility of servicing a large space telescope.

This white paper offers details on how an 8-m ATLAST space telescope might be designed for manned or robotic servicing.
Conclusions

• We should start planning for a flagship direct imaging mission to find and characterize other Earths
  – NASA Astrophysics Director Paul Hertz announced in January that this planning will begin again shortly

• The telescope should be big (8 m or more in aperture) to attract support from a broad segment of the astronomical community

• The telescope should also be serviceable to lower its risk and to prolong its useful lifetime