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

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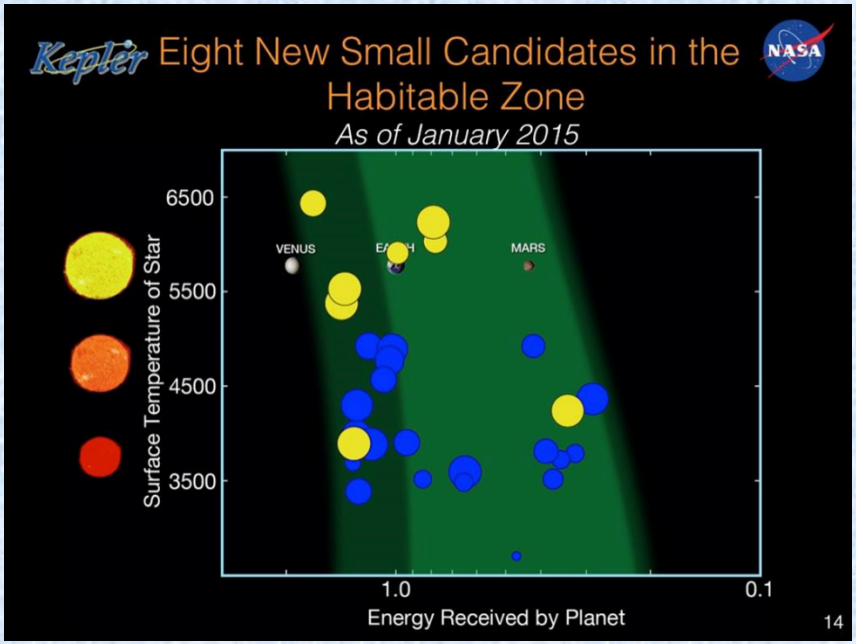
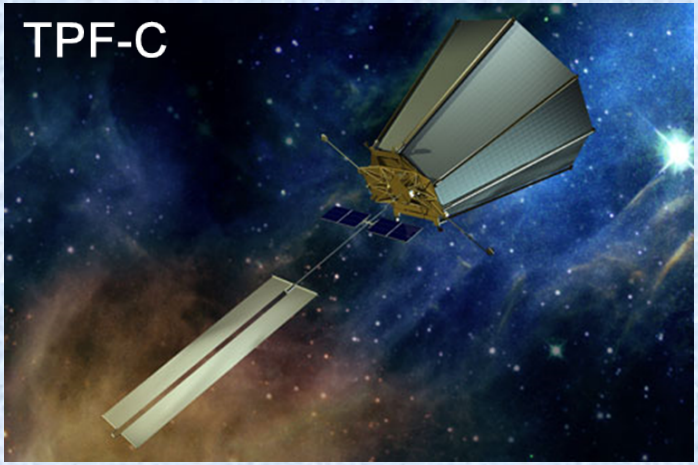
Results from Kepler

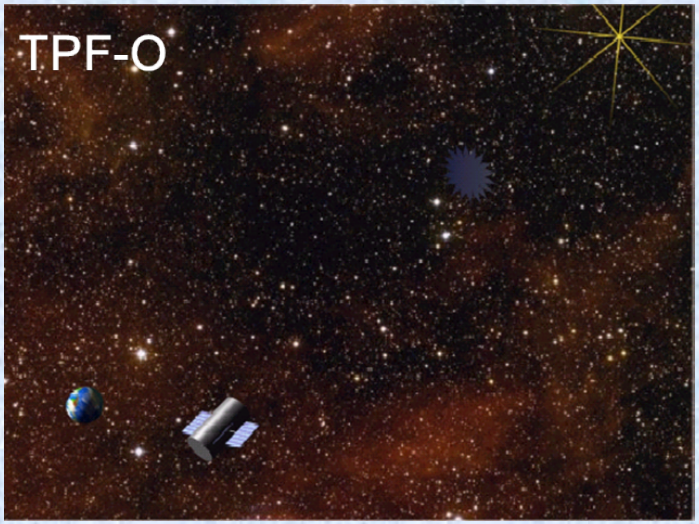
- Kepler has demonstrated that η_{Earth}, the frequency of rocky planets in the habitable zones of various stars, is in the range of 0.1-0.5
- In order to learn more about whether such planets might be habitable, or inhabited, we need to do direct imaging from space
  - JWST *might* be able to characterize 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

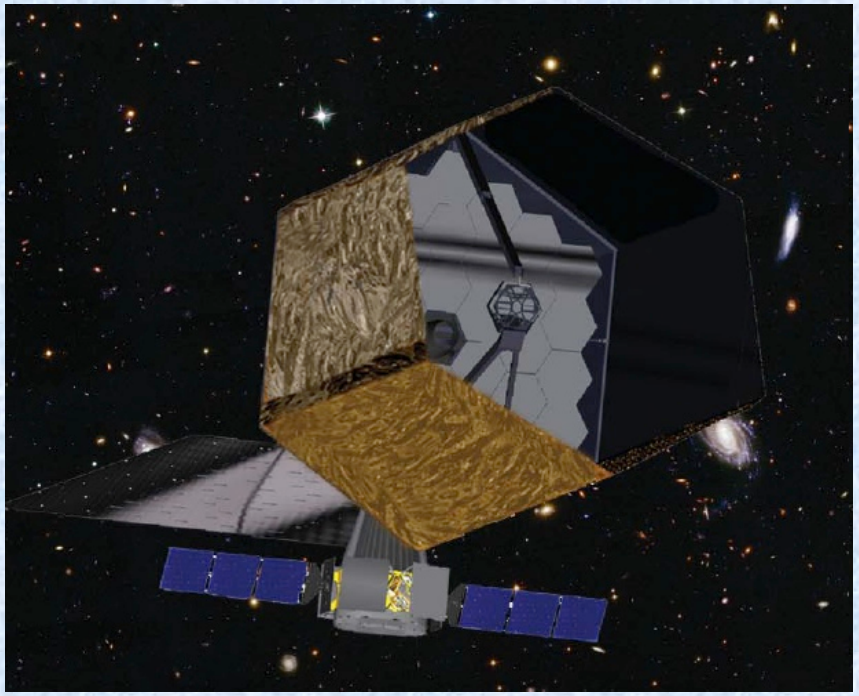
- A mission like the old TPF-C but with an improved coronagraph might be able to do the job
- Alternatively, a starshade mission like TPF-O/NWO might be preferred
  - The ongoing Exo-S and Exo-C studies may shed new light on the advantages and disadvantages of each concept
- Both missions would probably 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

FEASIBILITY OF USING HUMAN SPACEFLIGHT OR ROBOTIC MISSIONS FOR SERVICING EXISTING AND FUTURE SPACECRAFT
RFI # NNG10FC43-RFI

January, 2010

Authors:
M. Postman[1], M. Stiavelli[1], L. L. Whitcomb[2], J. Tumlinson[1], H. Ferguson[1], D. C. Redding[3], J. Green[3], M. Mountain[1], G. Hager[2], A. Okamura[2], P. Kazanzides[2], N. Cowan[2], R. Kumar[2], I. Iordachita[2], R. Taylor[2], G. Chirikjian[2], J. Grunsfeld[1], R. Brown[1]

- 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