

ISSUES for ExoPAG vis a viz Astro 2010

Dressler's perspective is from Electromagnetic Observations from Space Subcommittee
Astro2010 generally follows EOS recommendations, but emphasis does vary a bit.

EOS prioritized program from the perspective of exoplanet research:

1. WFIRST – a MPF-like microlensing survey
- 2) Exoplanet technology development – astrometry, direct imaging, UV-optical hybrid
- 3) Exoplanet mission: astrometric earth-finder (SIM-Lite?), Jovian Planet finder (zodi), earth-transit (ASTRO, TESS)

Note: EOS was not, by normal Decadal Survey rules, allowed to specify or prioritize missions costing under \$1B -- Explorer or Probe (if such exists)

Constraints from NASA:

- Likely total expenditure on new initiatives \$1B - \$3B
- No significant funding available until JWST launch, around 2015 (?)

Led to some self-imposed guidelines by EOS

1. Only one major mission could be started and (hopefully) completed -- no later than 2022
2. This major mission needed to be broad in the sense of advancing many areas of astrophysics and -- if possible -- supporting a large user group.
3. Regard 2011-2020 as a lean decade and take the positive approach that 2021-2030 and beyond will be better funded – make technology investments!
4. Do not obligate 2020 Decadal Survey with a large mission that can only be built after 2021.

Implications of these constraints and guidelines:

Negative: Big TPF missions like ATLAST, THEIA could not be supported – budget and (4)

Negative: SIM-Lite, though affordable and `ready to go' was problematical – timing, (1), (2).

Positive: EOS found a single, modest mission that has broad capabilities and exoplanet component.

Positive: Emphasize and increase support for technology development, including R&A and Suborbital program, increase cadence of Explorers and -- if the budget allows -- add an Exoplanet probe

Implications of Astro 2010 decisions for exoplanet research

The future of WFIRST and its role as an exoplanet mission

The need for technology development for a possible TPF technology development.

If there is any possibility to build a TPF in 2021-2030 decade, Astro2010 experience suggests it will need to be a broad mission. Only the UV-optical TPF seems to fill the bill, but is UV-opt compatible with planet finding & characterization?

Need investments in UV coatings, starlight suppression techniques (coronagraphy techniques and starshades), large mirror technologies, and UV detectors.

** If UV-opt/TPF is a forced marriage, UV-opt telescope is likely to be built anyway (seen from perspective of 2010), raising the possibility of greater interest in TPF-Interferometer – however, TPF-I faces the problem of the broad astrophysics program.

IS A TARGET LIST OF PROBABLE EARTHS A REQUIREMENT BEFORE TPF? (SIM-Lite)

If so, either space-based or (perhaps) ground-based program needs to do this first. If an astrometry mission as ambitious as SIM is required, then no suitable list could have been compiled until the late 2020's under Astro2010 constraints, so a TPF could not be built until the 2030's at the earliest.

If TPF is out of reach, need a vigorous program of smaller missions, Explorer Class to find and study earths around M-stars (TESS, ASTRO...), JPF, Zodi-finder, ground –based RV, etc

The issue of the astrophysical diversity of potential mission – why this is a much higher hurdle than just coming up with a set of general astrophysics applications

| Science Frontier Panel Question/Discovery Area | WFIRST | IXO | EXO-PLANET | BLISS SPICA | UV-opt Telescope |
|---|--------|-----|------------|-------------|------------------|
| PSF-1 What determines star formation rates and stellar masses? | | | | | |
| PSF-2 How do circumstellar disks evolve to form planetary systems? | | | | | |
| PSF-3 How diverse are planetary systems? | | | | | |
| PSF-4 Do habitable worlds exist around other Sun-like stars? Can we detect biosignatures? | | | | | |
| PSF-D Can we identify and characterize a nearby Earth? | | | | | |
| SSE-1 How do rotation and magnetic fields affect stars? | | | | | |
| SSE-2 What are type Ia supernovae? | | | | | |
| SSE-3 How do massive stars end their lives? | | | | | |
| SSE-4 What controls the masses, spins, and radii of compact stellar remnants? | | | | | |
| SSE-D Large time domain surveys | | | | | |
| GAN-1 What are the flows of matter and energy in the circumgalactic region? | | | | | |
| GAN-2 What controls the mass-energy-chemical cycles within galaxies? | | | | | |
| GAN-3 What is the fossil record of galaxy assembly and evolution from the first stars to the present? | | | | | |
| GAN-4 What are the connections between dark and luminous matter? | | | | | |
| GAN-D1 Time-domain Astronomy | | | | | |
| GAN-D2 Astrometry | | | | | |
| GCT-1 How do cosmic structures form and evolve? | | | | | |
| GCT-2 How do baryons cycle in and out of galaxies and what happens while they are there? | | | | | |
| GCT-3 How do black holes work and influence their surroundings? | | | | | |
| GCT-4 What were the first objects to light up the universe and when did they do it? | | | | | |
| GCT-D Exploring the epoch of reionization | | | | | |
| CFP-1 How did the universe begin? | | | | | |
| CFP-2 Why is the universe accelerating? | | | | | |
| CFP-3 What is dark matter? | | | | | |
| CFP-4 What are the properties of the neutrino? | | | | | |

Astro 2010 could only move on a small part of this program:

Chose the only exoplanet mission -- microlensing (MPF) -- that could be done in combination with other programs, dark energy, IR surveys, etc.

Strongly supported re-growth of Explorer program, believing that mid-EX sized missions could accomplish a lot

Proposed a substantial technology development program for NASA leading to possible UV-optical TPF.

Gave strong endorsement (but no specific facility) for ground-based RV

Final comments:

SIM, starshades, the unique challenge of Astro2010, and the role of AeroSpace Corp.

