EXOPLANET SCIENCE WITH A FLAGSHIP MISSION

The Case for:
1) an Aperture of ≥ 8 meters
2) a Unified SDT

Avi Mandell

NASA Goddard

Guiding Principles for Flagships

The Science Must Be Revolutionary

- A flagship must achieve science that is unachievable by other facilities and moves the ball forward dramatically
- The science must be compelling to non-scientists, able to generate excitement for all the "stake-holders"

The Science Must Be Broad and Diverse

- To top of the Decadal Survey and survive years of budgetary and technological hurdles, a flagship-class mission must have support across the Astronomy Community, and even the wider Science Community

"Bigger and Better" Makes a Difference

- The excitement from NASA HQ, Congress, and even the general public will be significantly more muted for a mission that does not fit traditional ideas of technological advancement

What This Means For Exoplanets

- **The Science Must Be Revolutionary**

  "More planets" is NOT ENOUGH – we must make the jump to a robust and credible search for life

- **The Science Must Be Broad and Diverse**

  We MUST collaborate with the broader astronomical community to design a mission that is compelling beyond exoplanet science

- **"Bigger and Better" Makes a Difference**

  We must make sure our mission does not appear incremental or even a step back from previous flagships

The Case for A Large (8+ m) Aperture

- ## Revolutionary Exo-Science: The Search For Life
  - Stark et al.: A 95% chance of searching for water on 3+ habitable planets requires an aperture ≥ 5 meters, and an aperture of ≥ 10 meters yields 30+ planets and credible constraints on the frequency of life in the universe

- ## Revolutionary Science Across Astronomy
  - The AURA Beyond JWST Committee, the NASA HQ Vision Committee, and others have identified 8 - 10 meters as the minimum aperture for game-changing non-exoplanet science

- ## "Bigger and Better": The Post-JWST Era
  - We are about to launch a 6.5-meter telescope, and we are planning 30 - 40 meter telescopes on the ground. How do we plan a mission that meets the public's expectations?

Some Questions on Feasibility

- Do we have a launch vehicle? YES
  - Designs exist for > 9-meter apertures that fit inside an existing Delta IV rocket (Feinberg et al. 2014), and launch vehicles in the 2020s and 2030s could be larger
- Do we have a starlight suppression system? WORK IN PROGRESS
  - There are at least five candidate systems for obscured apertures (VNC, PIAA-CMC, APLC, ACAD, and starshade), and more may surface with proper incentives
- Can we overcome cost and technology hurdles? HISTORY SHOWS WE CAN
  - A mission with revolutionary science will be able to maintain support to push past issues (e.g. HST and JWST)

The Case for A Unified SDT

- Habitable Planet Imager? LUVOIR? Same Thing.
  - Paul Hertz's seed ideas for flagships (HPI and LUVOIR) are not mutually exclusive
  - We must avoid the idea that the Exo-PAG doesn't need the rest of astronomy, and push for a telescope that has broad appeal
  - We absolutely MUST avoid fragmenting our own community
- A Single Science Definition Team, with separate Engineering Architecture teams
  - The previous Exo-PAG meeting demonstrated a unified picture of the science we want, but there are different potential architectures (starlight suppression, aperture) to achieve it
  - A single SDT that examines the science achievable with different architectures will avoid fragmentation within the community
  - It will provide a true "apples to apples" consideration of the cost and technological issues for different architectures, and a consensus on the science achievable with each one

BACKUP SLIDES

9.2m and 11.2m Telescope Architectures

Feinberg et al. 2014, SPIE

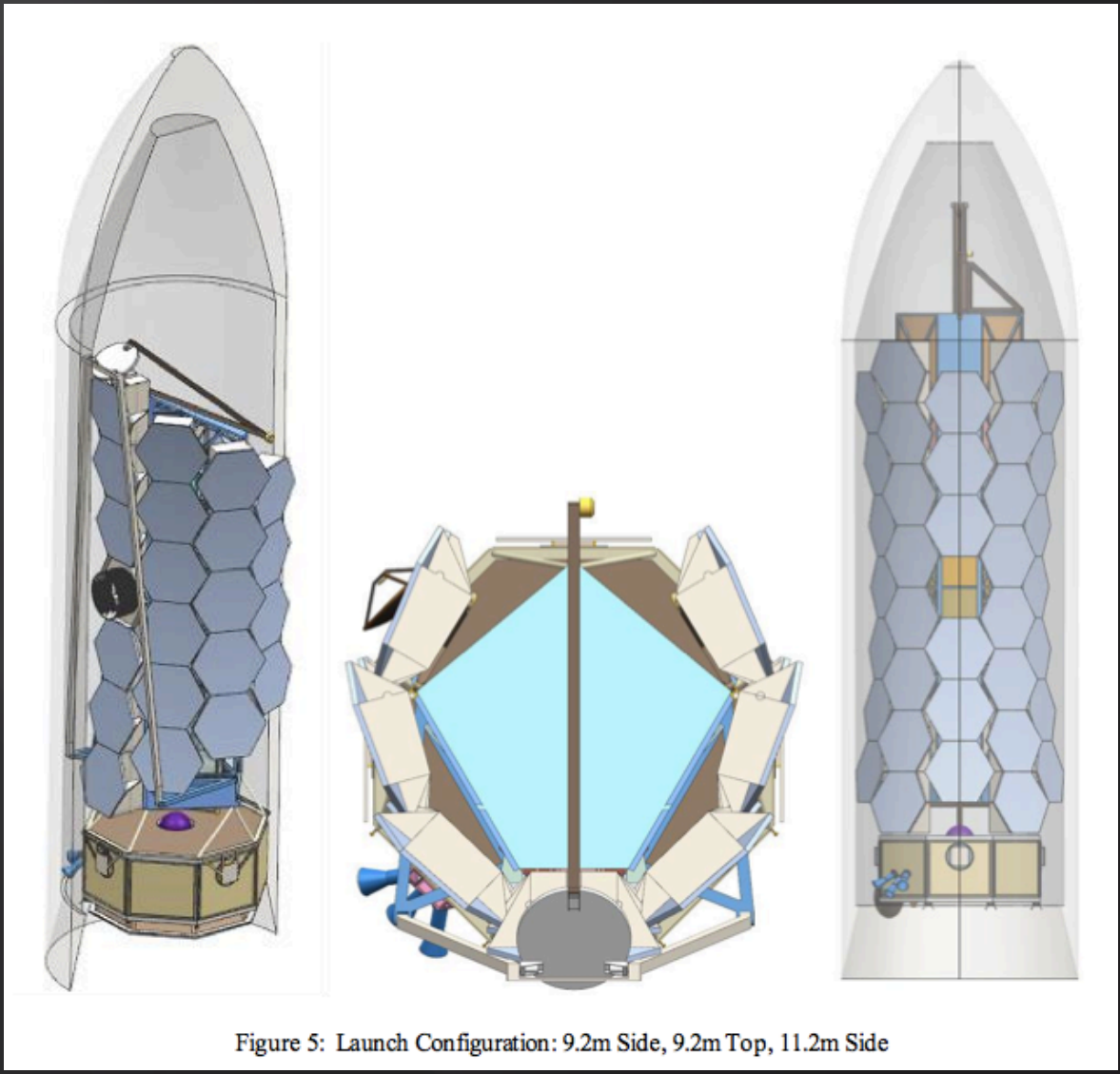

Figure 5: Launch Configuration: 9.2m Side, 9.2m Top, 11.2m Side