The background of the slide is a dark gradient with a glowing DNA double helix structure on the left and a signal waveform on the right. The DNA is composed of small, glowing particles, and the waveform is a series of connected dots forming a wave pattern. The overall aesthetic is scientific and futuristic.

21st Century: “The Century of Biology” On Earth and Beyond

PCAST

September 19, 2014

Dr. Jill Tarter – Bernard M. Oliver Chair, SETI Institute

Life Beyond Earth

- Discover it
 - In situ biomarkers
 - Remote biosignatures
- Communicate with it
 - Technosignatures
 - Serendipitous observations
- Export it
 - Moon, Mars, Asteroids
 - 100 Year Starship Study



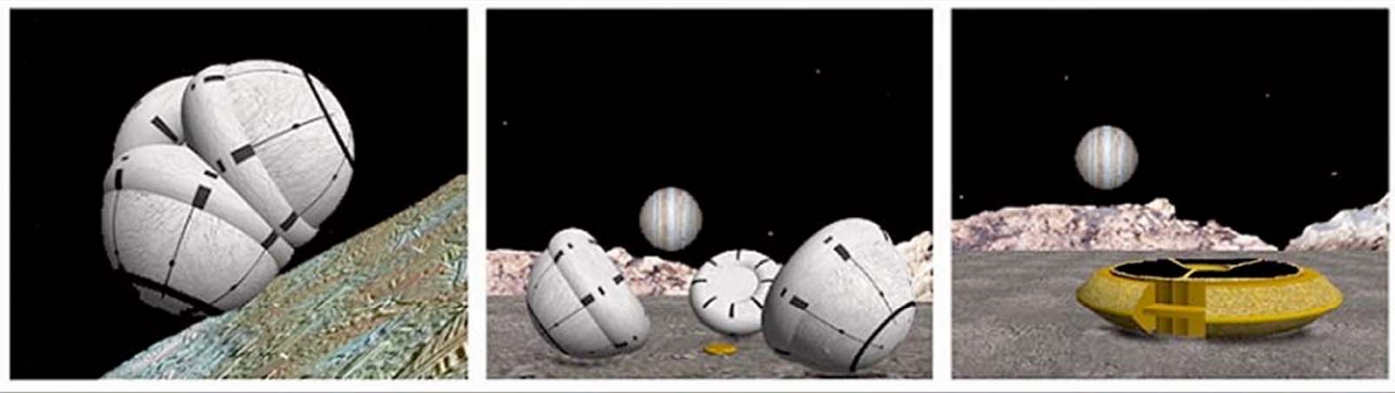


Biomarker
Detection

Sample Return

Mars is \$\$\$

Landers May Be Boats Or Rovers



Europa

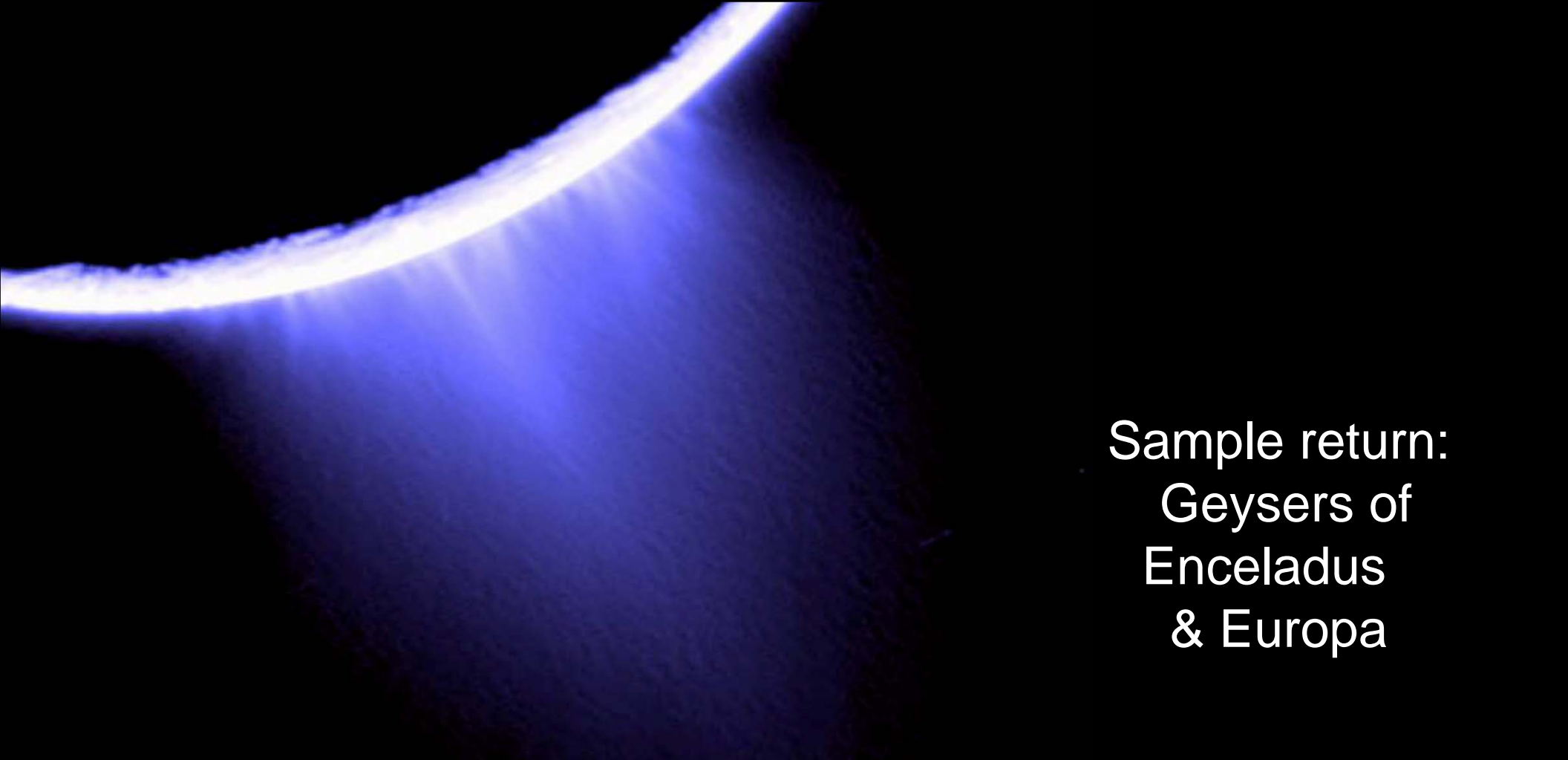
Titan

PLANETARY
LAKE LANDER

funded by NASA ASTEP



Solar System (Almost) Free Lunch

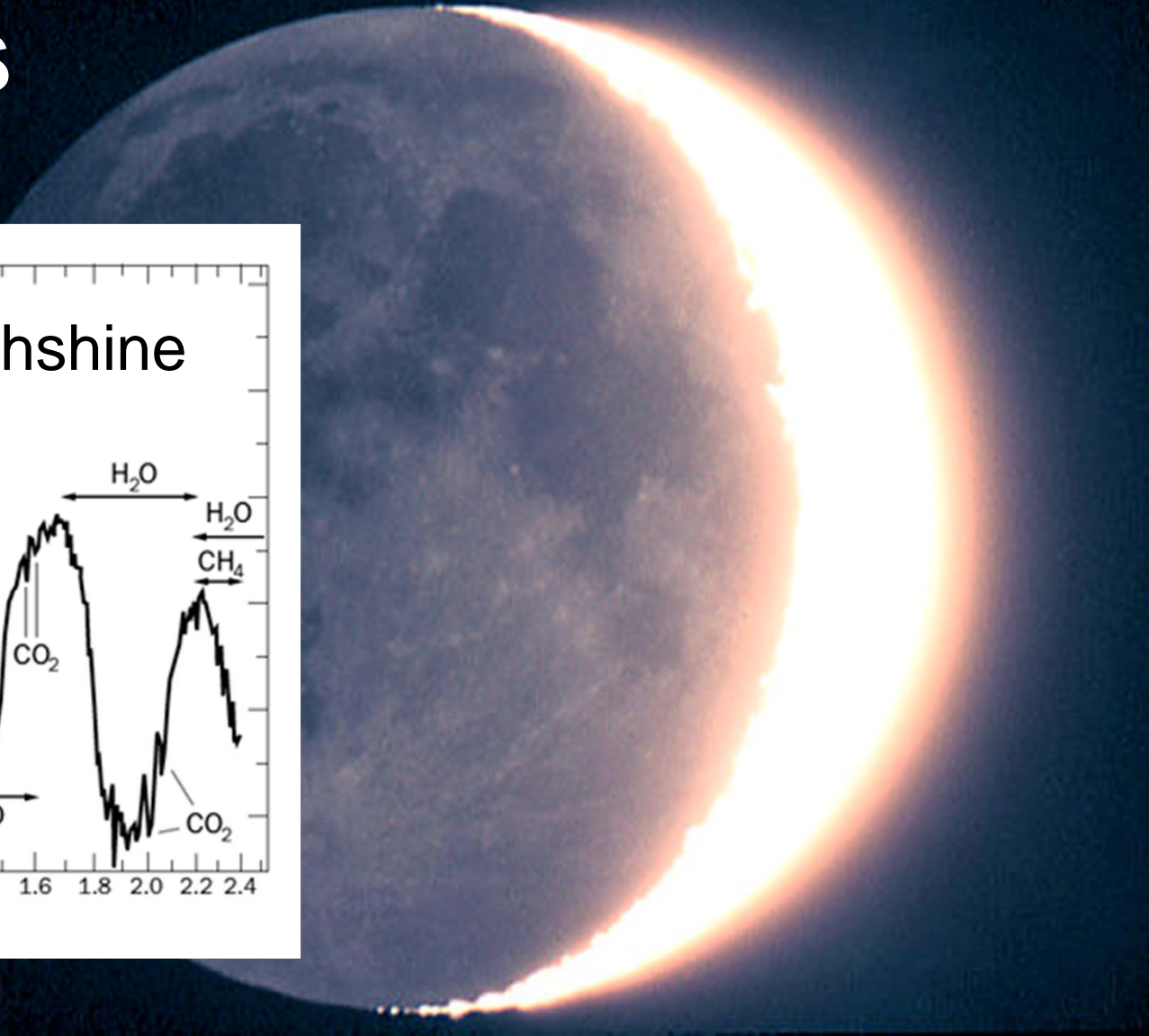
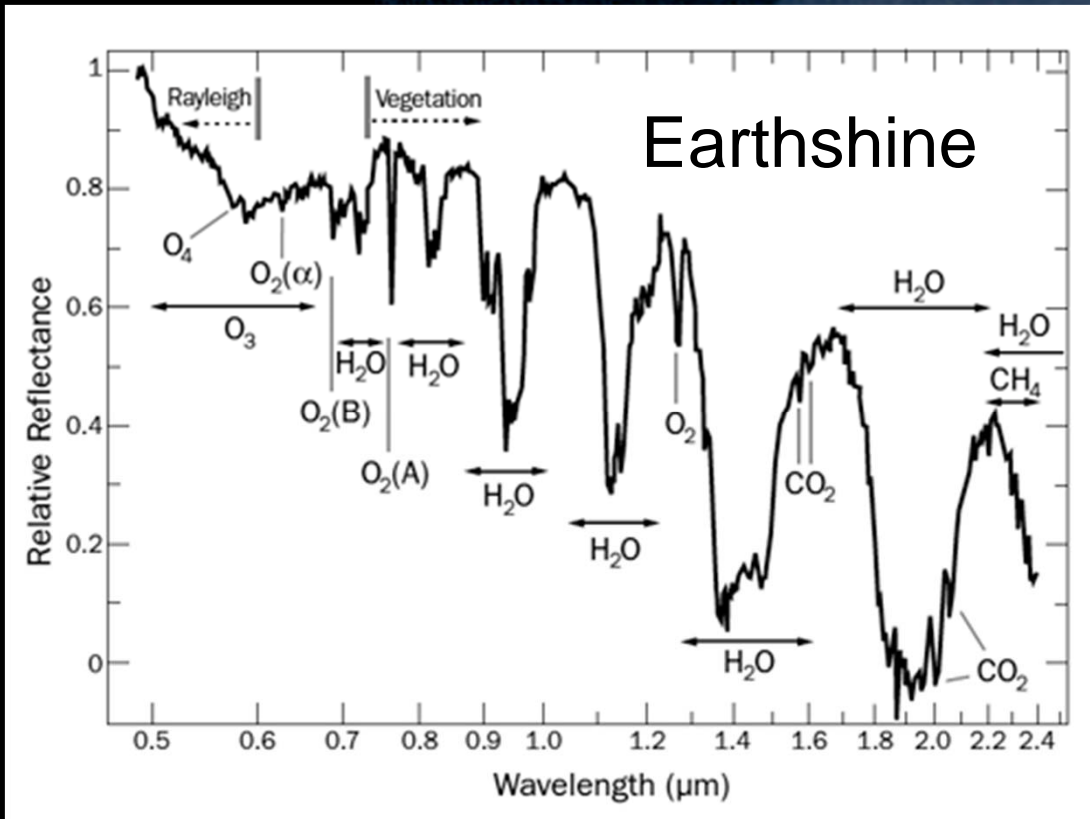


Sample return:
Geysers of
Enceladus
& Europa

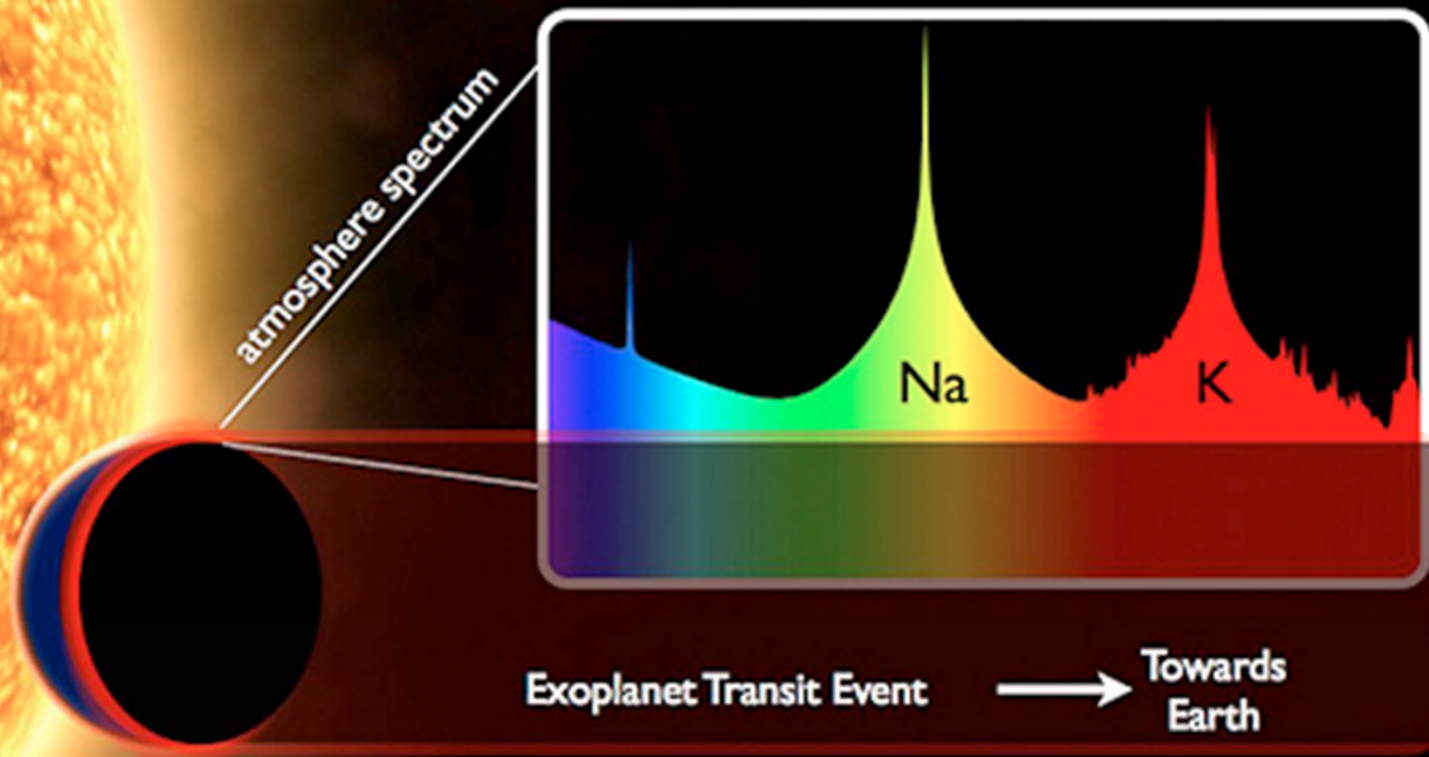
Biology As We Don't Yet Know It (a second genesis)



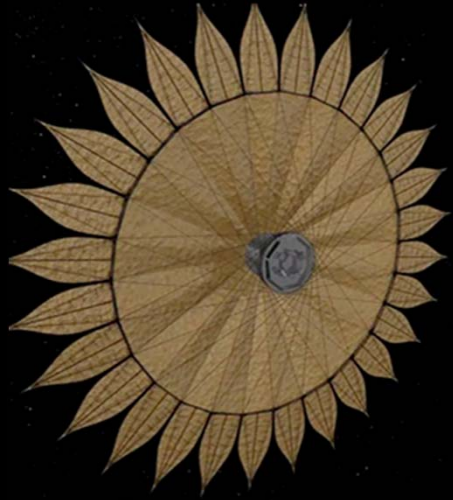
Biosignatures



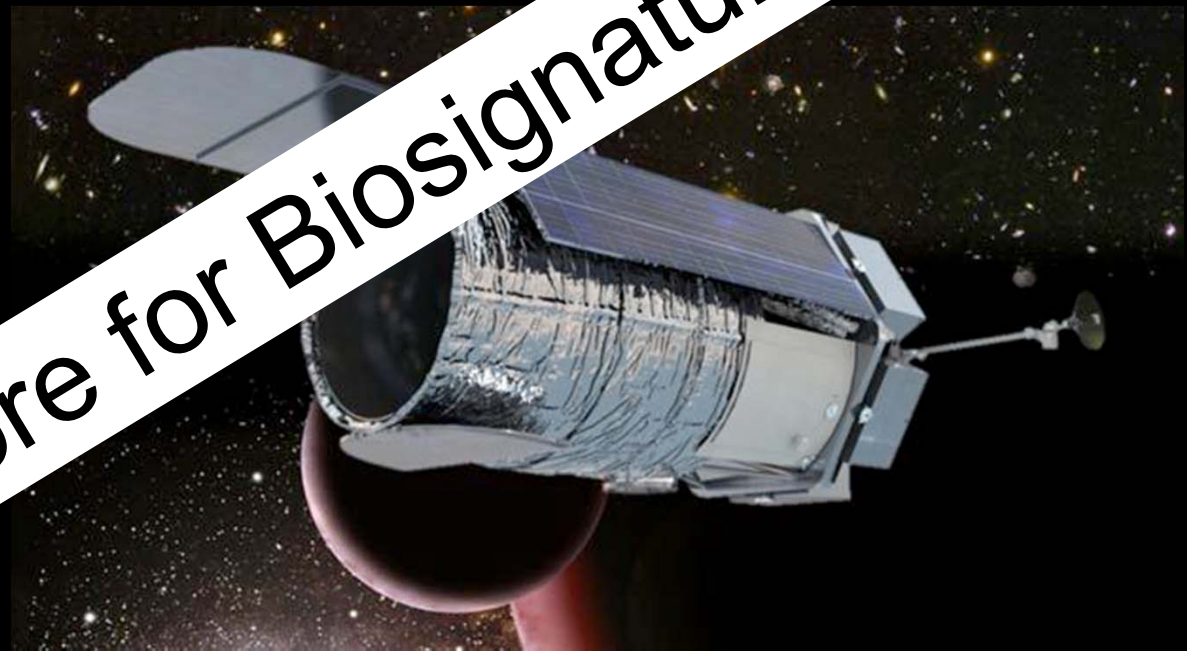
Exoplanet Atmospheres



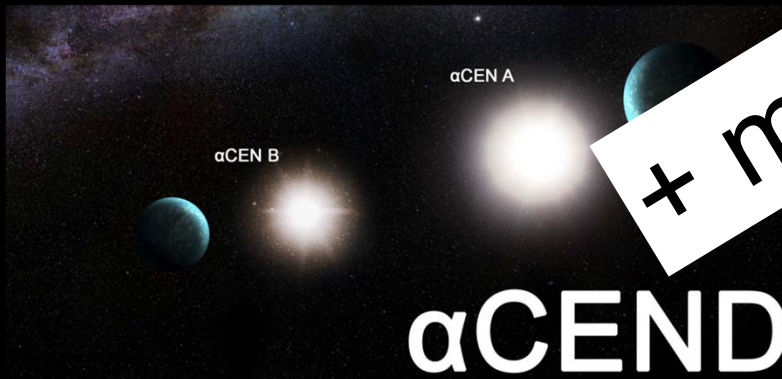
Imaging Other Planetary Worlds



New Worlds Telescope



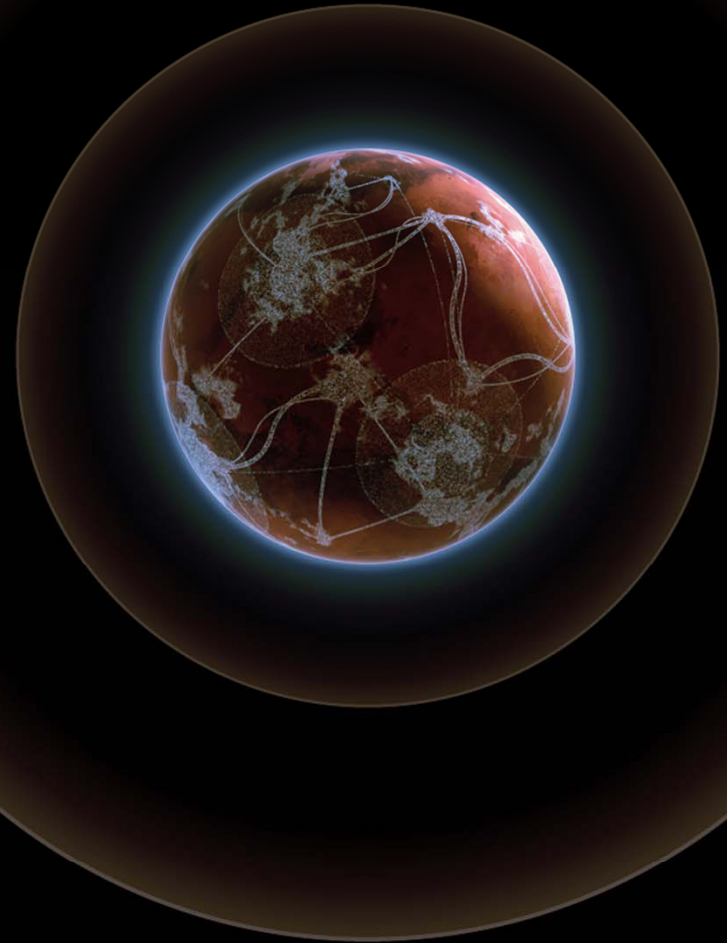
+ more for Biosignatures



α CEND

WFIRST-AFTA+Coronagraph

Technosignatures

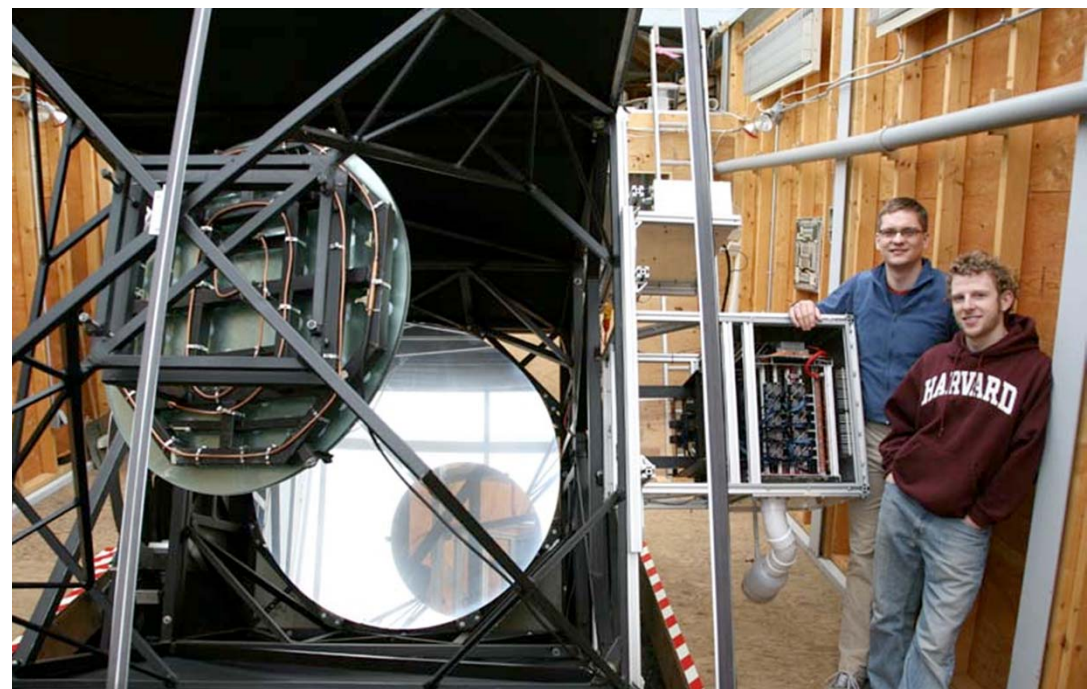


Technosignatures

RADIO

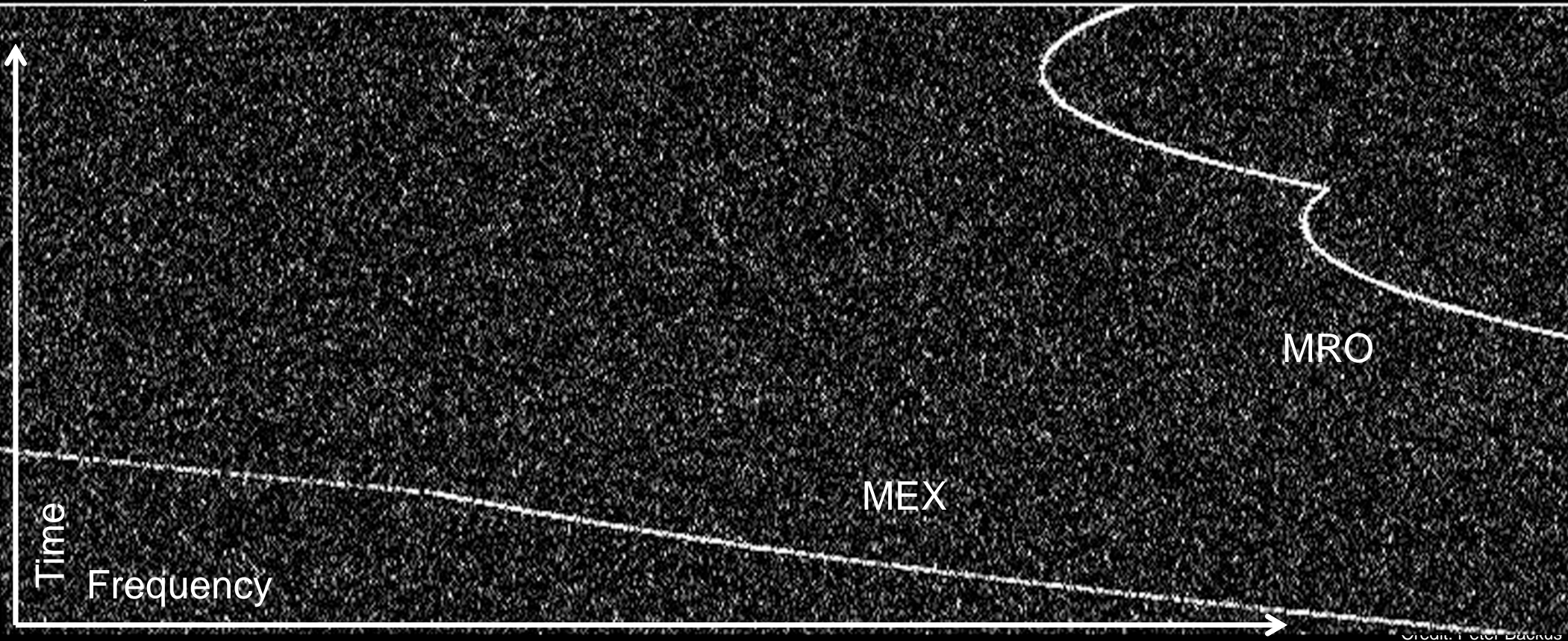


OPTICAL

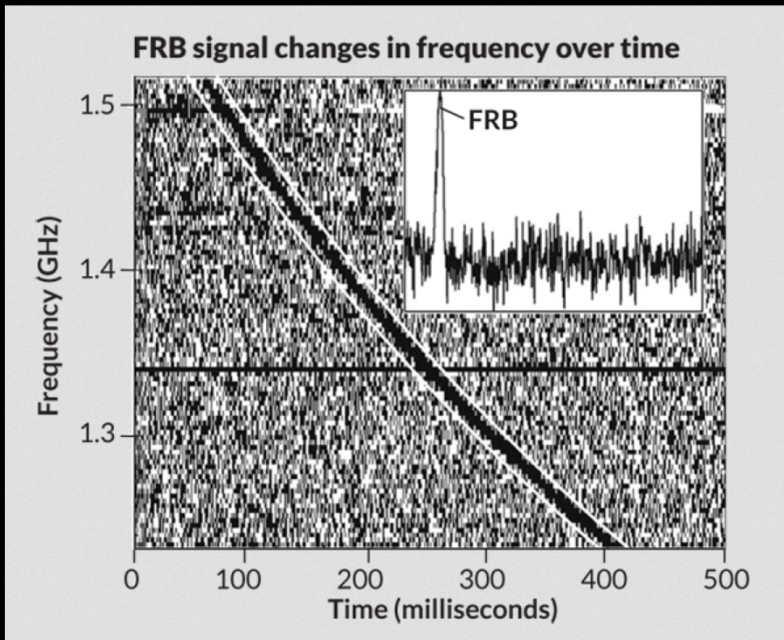


Engineered vs. Natural

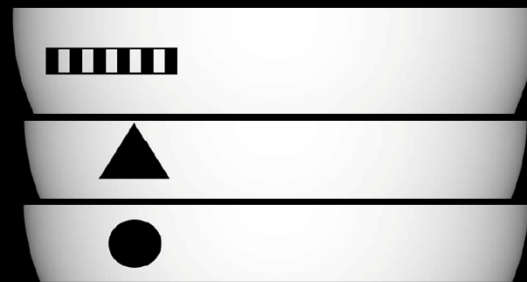
Waterfall: File: 2011-11-15_19-19-12.UTC.act3151.dx3017.id-2.R.archive-compamp
Center Freq: 8439.757867 MHz Subband: 0659 BW: 533.3 Hz #Half Frames: 0256 ActId: 3151



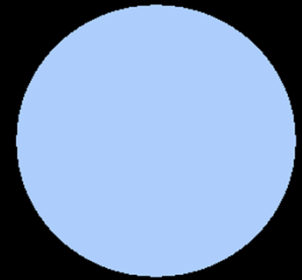
Serendipity



Fast Radio Bursts



Artificial Transits



Cepheid
Morse-code



High Energy Neutrinos

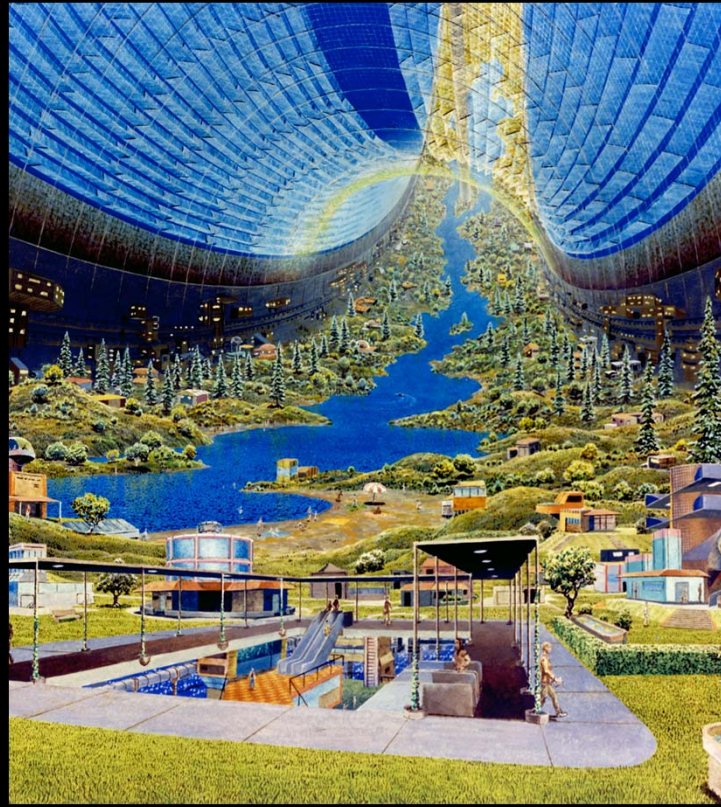
The image features a dark, star-filled space background with a faint nebula. Nine Earth-like planets are arranged in a loose, roughly circular pattern. Each planet is shown in a different state of development, from a dark, rocky sphere to a fully developed planet with green continents, blue oceans, and white clouds. The planets are illuminated from the side, creating a bright glow around their edges. The word "Longevity" is written in white, sans-serif font in the bottom-left corner.

Longevity

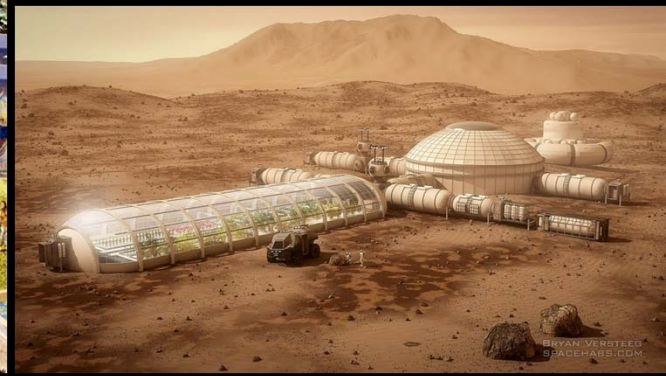
Going There



Tourism

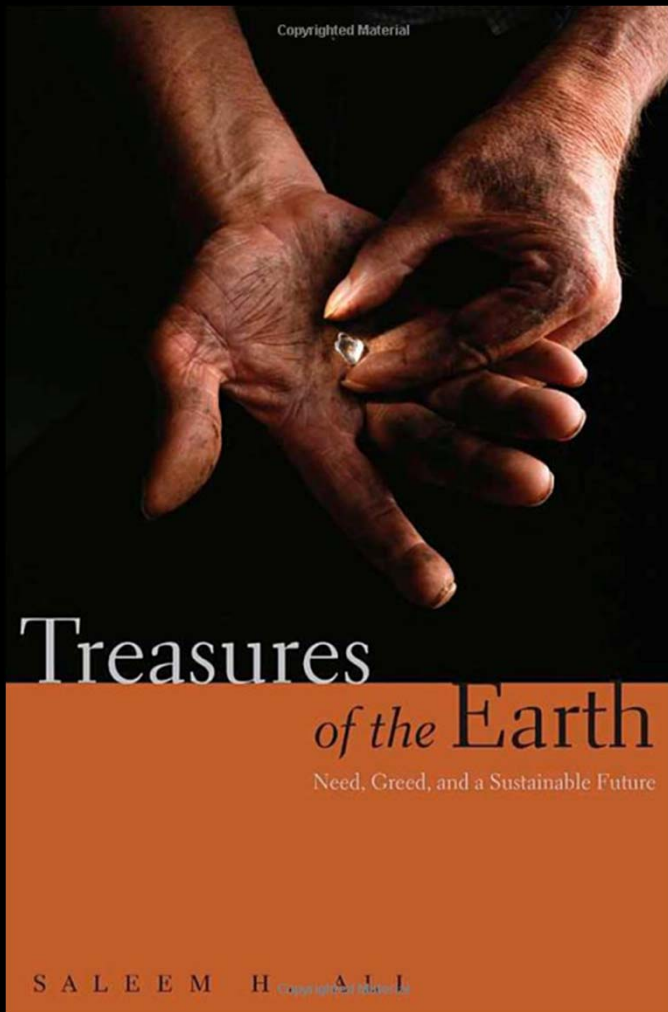


Orbital Habitats



Settlements

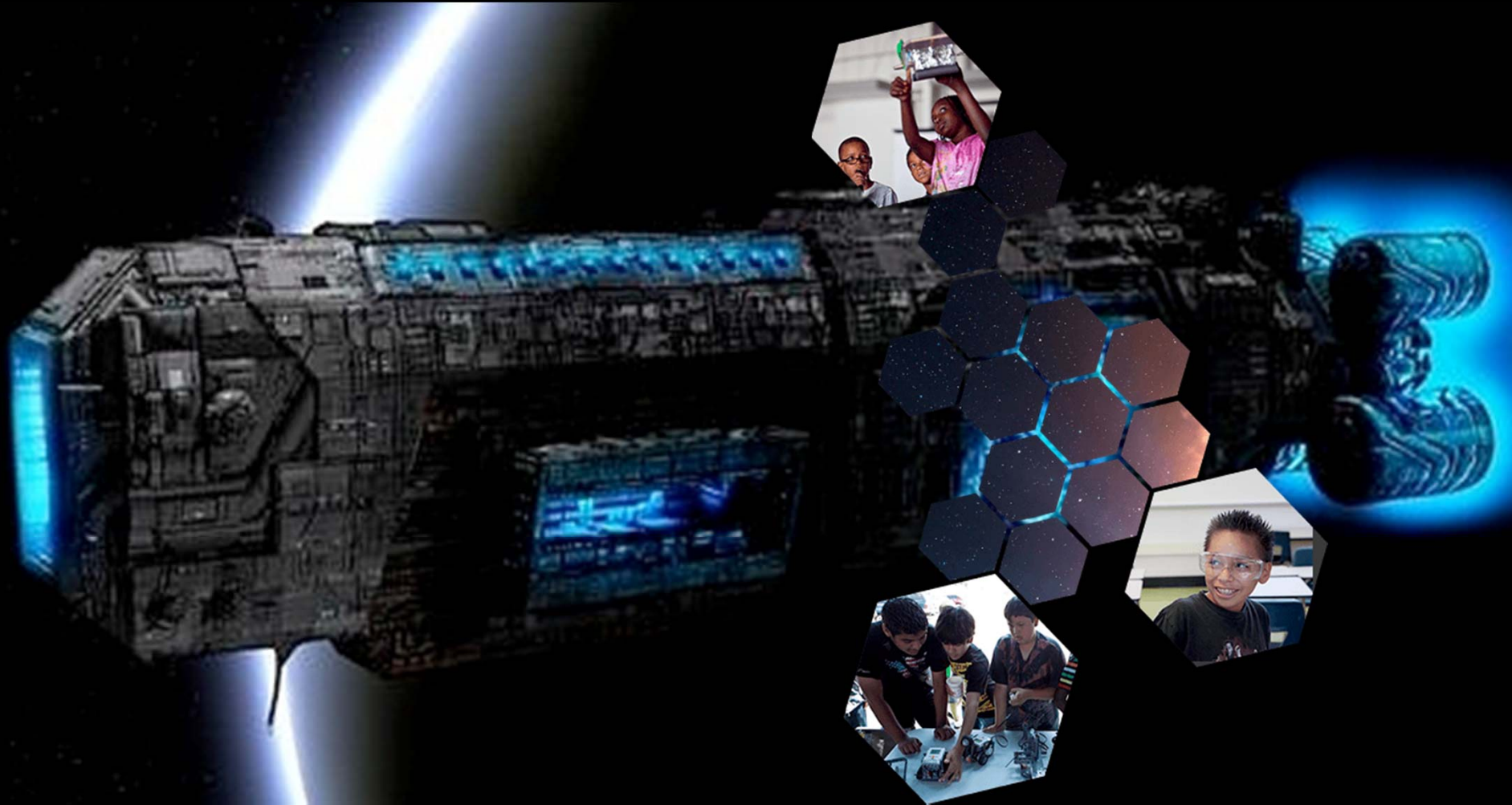
Human/Robotic Resource Extraction

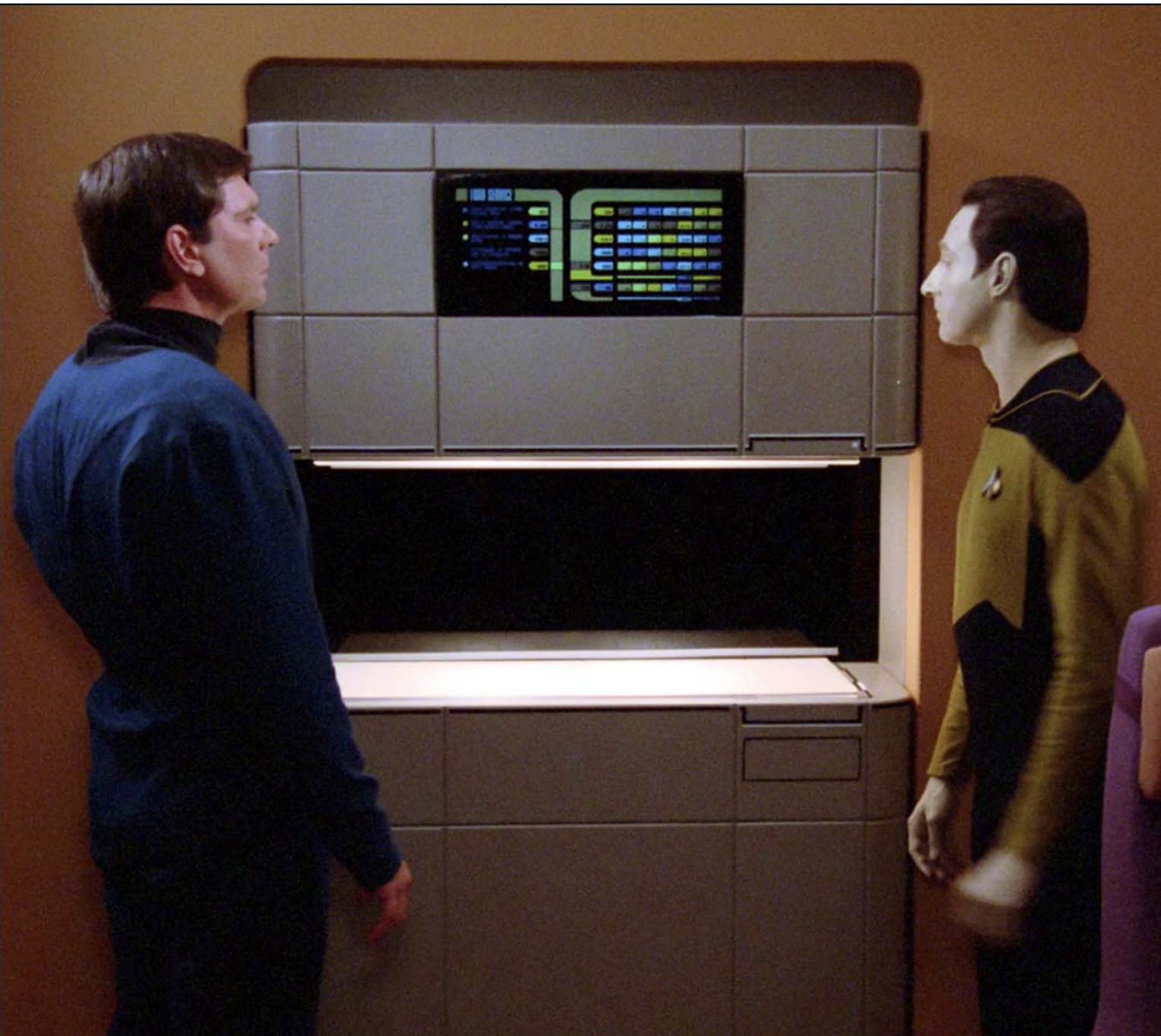


951 Gaspra



Going Farther





A Starship Has Both A Replicator and A Deconstructor

Fallacy Of The Replicator-Only

NYC



1894: Drowning in manure

(2.5 million pounds/day)



Today: Drowning in mechanical
horses and CO₂

Fallacy Of The Replicator-Only

NYC

Tomorrow: Drowning

Treat Our Megacities Like Starships

Use Biomimicry To Engineer Their Defense