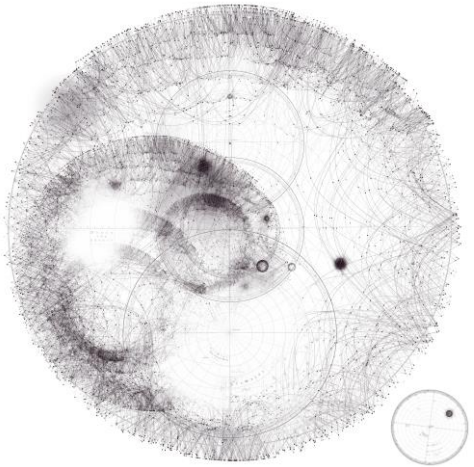


LIFE IN THE UNIVERSE

BREAKTHROUGH INITIATIVES

Dr. S. PETE WORDEN - CHAIRMAN, BREAKTHROUGH PRIZE FOUNDATION - PETE@BREAKTHROUGHPRIZE.ORG


BREAKTHROUGH
INITIATIVES
BREAKTHROUGH
INITIATIVES
BREAKTHROUGH
INITIATIVES
BREAKTHROUGH
INITIATIVES

Fundamental Questions

Is there other life in the universe?

Is there intelligent life elsewhere?

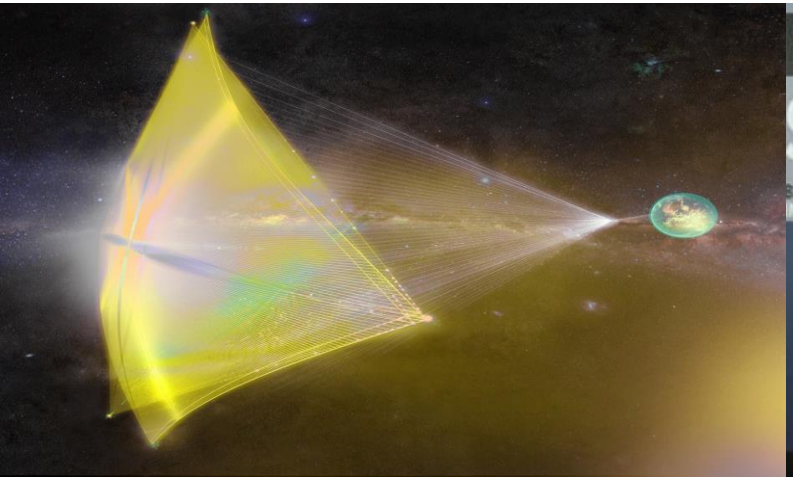
Can we travel between the stars?

Breakthrough Prize

WORLDS LARGEST PRIZES IN SCIENCE


BREAKTHROUGH
STARSHOT

BREAKTHROUGH
STARSHOT



Starshot Objectives

1. Determine if there are potentially life-bearing planets in the Alpha Centauri system

2. Take science data of star system focused on planets and beam data back to Earth

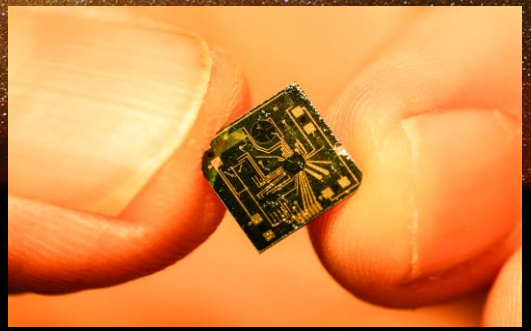
3. Launch within 30 years, at an affordable cost

4. Go FAST – 20% the speed of light

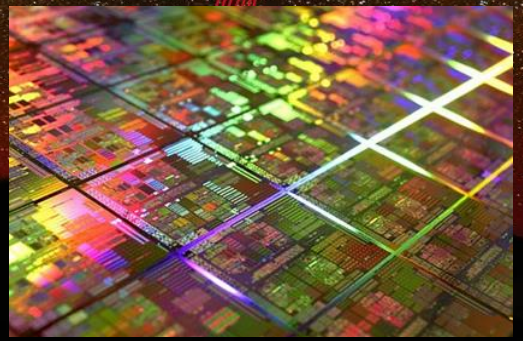
Solution to go fast

1. Lowest possible mass
2. Leave engine/fuel on Earth
3. Attach a chip to a sail
4. Laser beam is the wind

Photonics

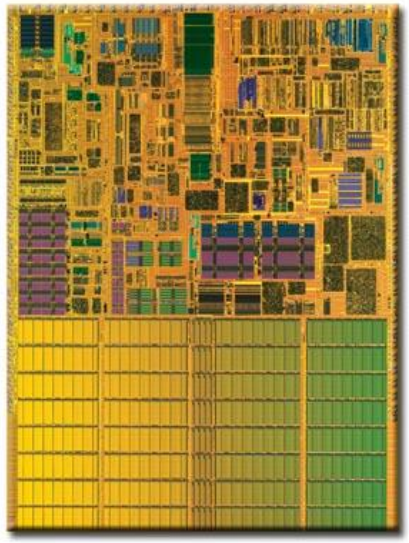


StarChip - 0.22 gram



Microelectronics

StarChip Size



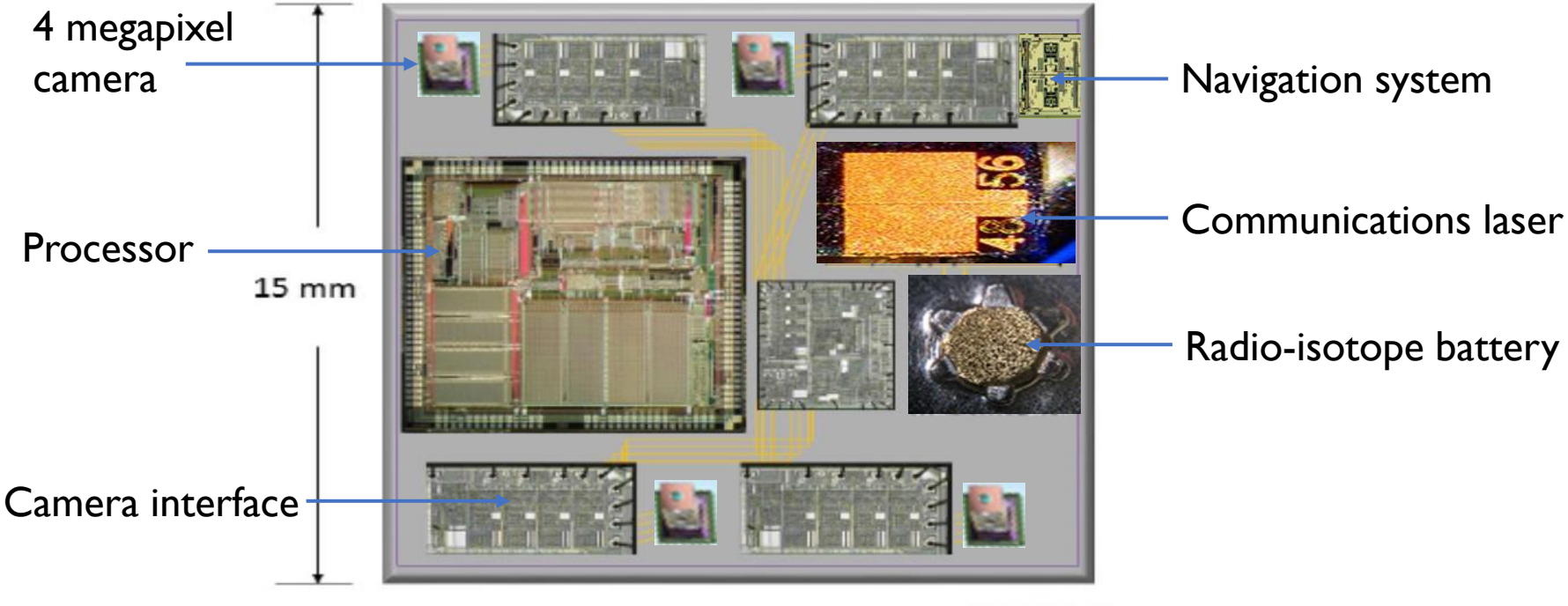
15mm

StarChip

25mm

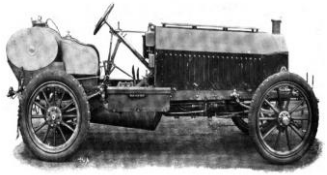
Apple Watch chip

StarChip Componets

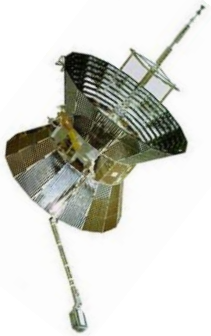


Is there a Moore's law for speed?

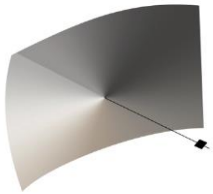
Helios 2
1976



Helios 2
1976



?

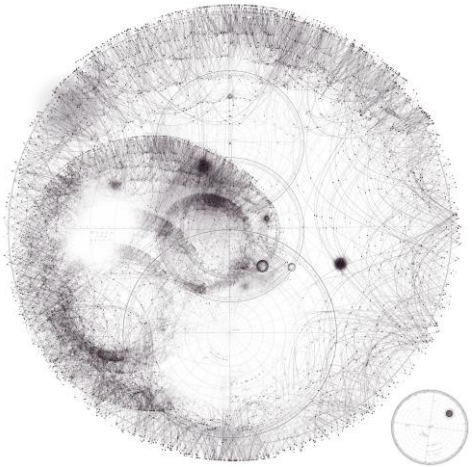


1000 times faster within 100 years

1000 times faster within ? years

THE SEARCH FOR LIFE IN THE UNIVERSE:

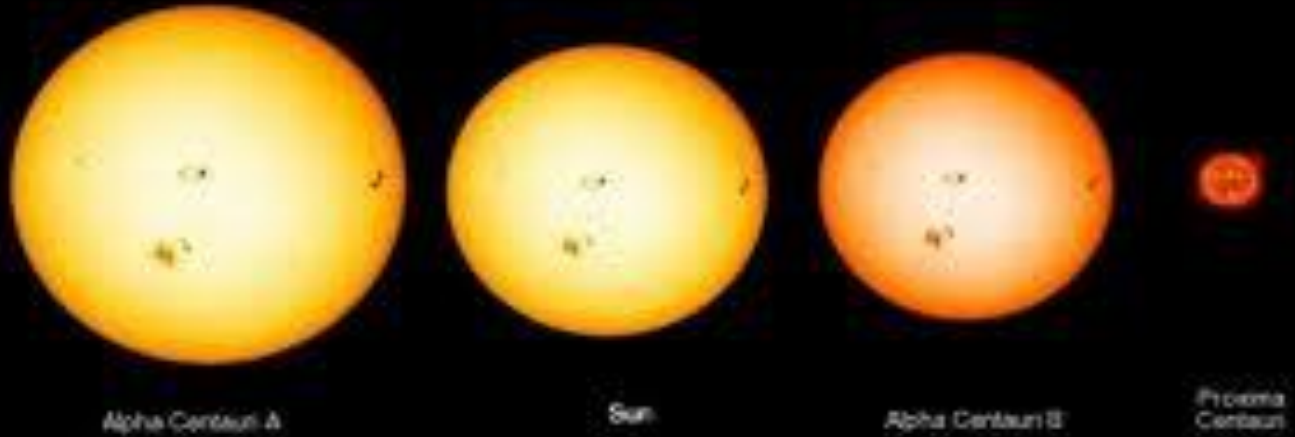
ALPHA CENTAURI



BREAKTHROUGH INITIATIVES

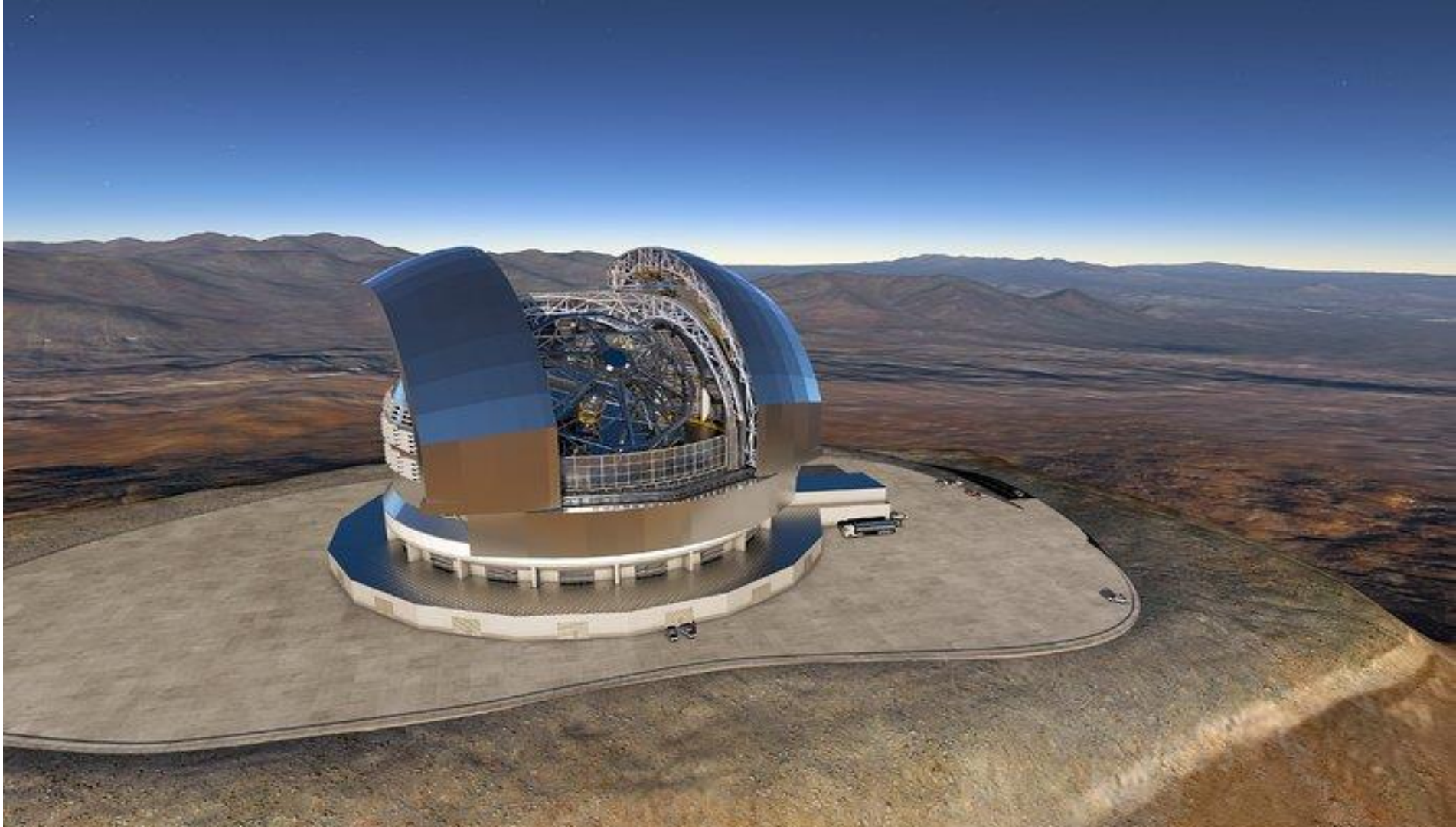
Dr. S. PETE WORDEN - CHAIRMAN, BREAKTHROUGH PRIZE FOUNDATION - PETE@BREAKTHROUGHPRIZE.ORG


Crux
Musca
Proxima
Centaurus
Circinus


Alpha Centauri A
Sun
Alpha Centauri B
Proxima Centauri


BREAKTHROUGH
WATCH

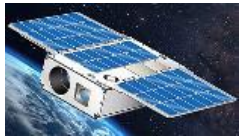

ESO



Toliman Proposed Program

BREAKTHROUGH INITIATIVES

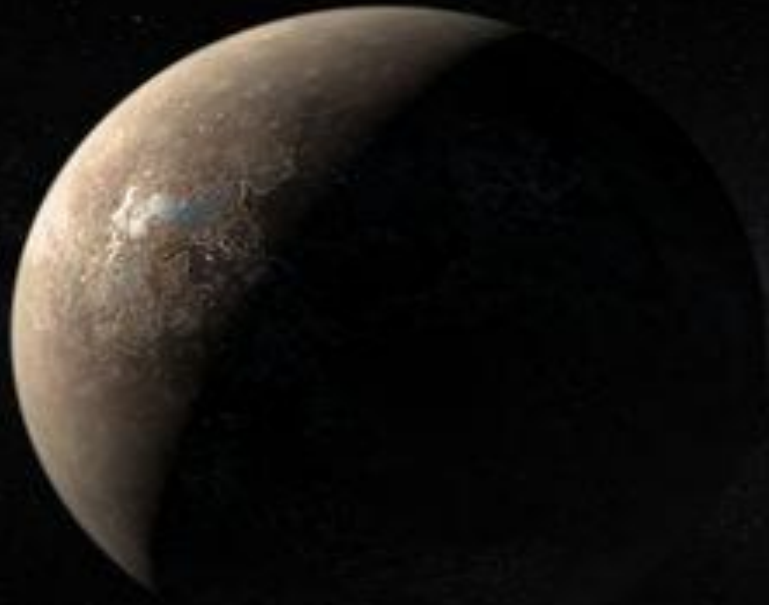
- Toliboy ($1,000K-Class)
  - Target Super Earths around Alpha Centuri and 61 Cygni
  - 9 cm F20 telescope, LEO mission
  - Launch 2019, mission length one year
- Toliman ($10,000K-Class)
  - Target Earth size planets, Alpha Centuri, 61 Cygni, 70 Ophiuchi, 36 Ophiuchi, Rho-Eridani, Xi Ursae Majoris
  - 30 cm F20 telescope, GEO mission
  - Launch 2021, mission length: three years
  - Possible Partners ASI, JAXA, NASA
- Toliman Follow On ($100,000K-Class)
  - Target Earths size planets within 15 Light Years
  - 100 cm class Chronograph telescope, GEO
  - Launch 2025, mission length: five years
  - Possible partners ESA, ASI, JAXA, NASA



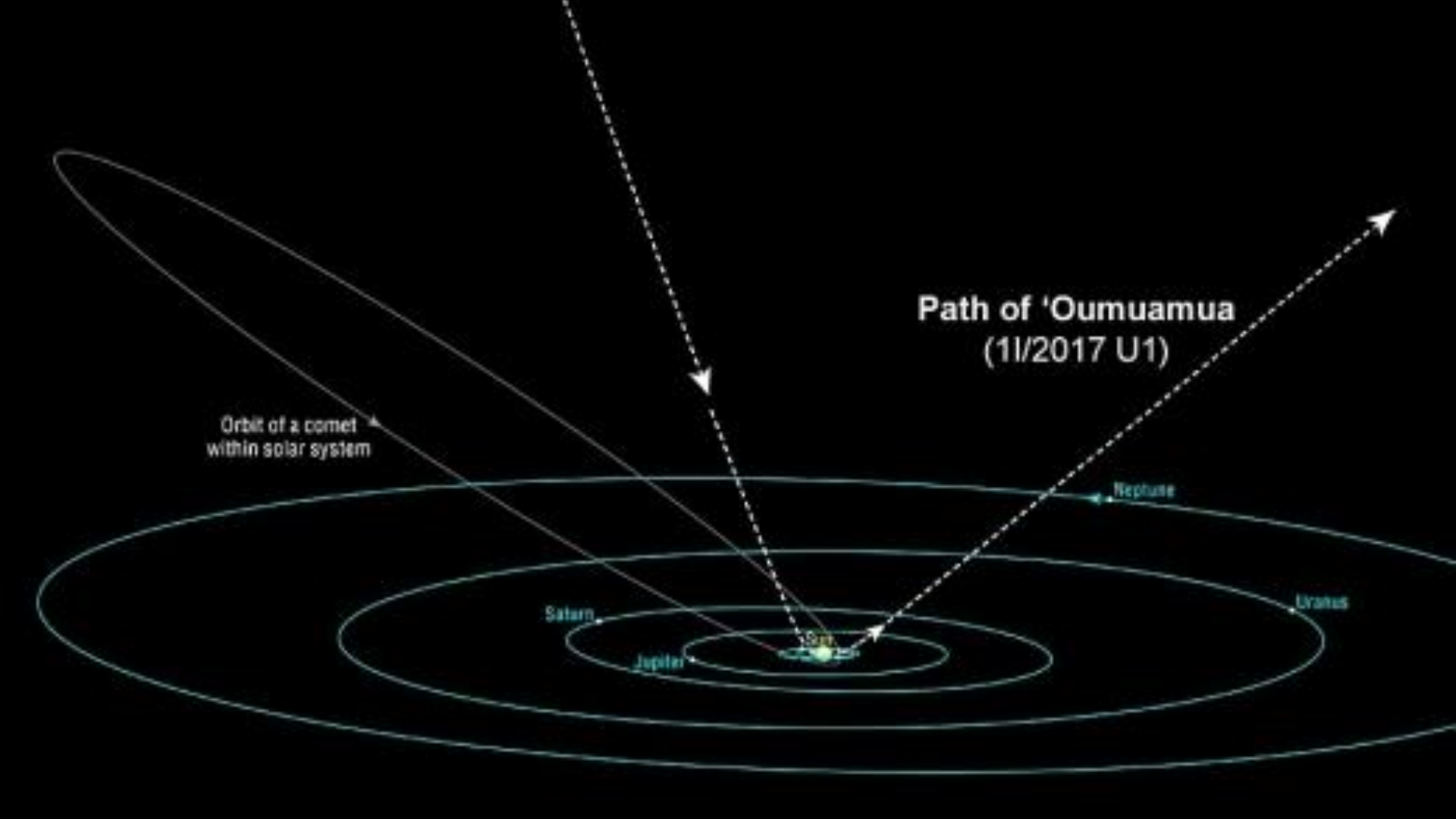
2019 CONFERENCE, APRIL 11-12, University of California, Berkeley

“Panspermia”

- Migration of Life in the Universe
- Search for Extraterrestrial Genomes
- Emigration of Earth Life



PANSPERMIA: LIFE FROM SPACE


Path of 'Oumuamua
(1I/2017 U1)
Orbit of a comet
within solar system
Neptune
Uranus
Saturn
Jupiter
Sun

'Oumuamua is a lightsail, floating in interstellar space as a debris from an advanced technological equipment

a fully operational probe sent *intentionally* to Earth

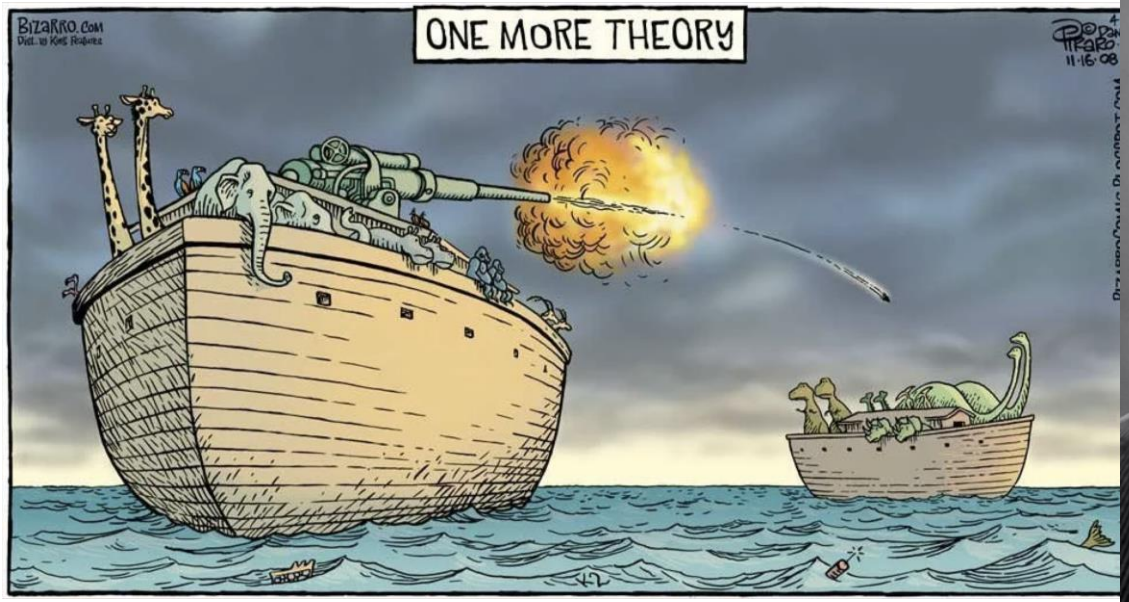
Directed panspermia

- Proposed by the late Nobel prize winner Professor Francis Crick, OM FRS, along with British chemist Leslie Orgel in 1973
- the intentional spreading of the seeds of life to other planets by an advanced extraterrestrial civilization, or the intentional spreading of the seeds of life from Earth to other planets by humans

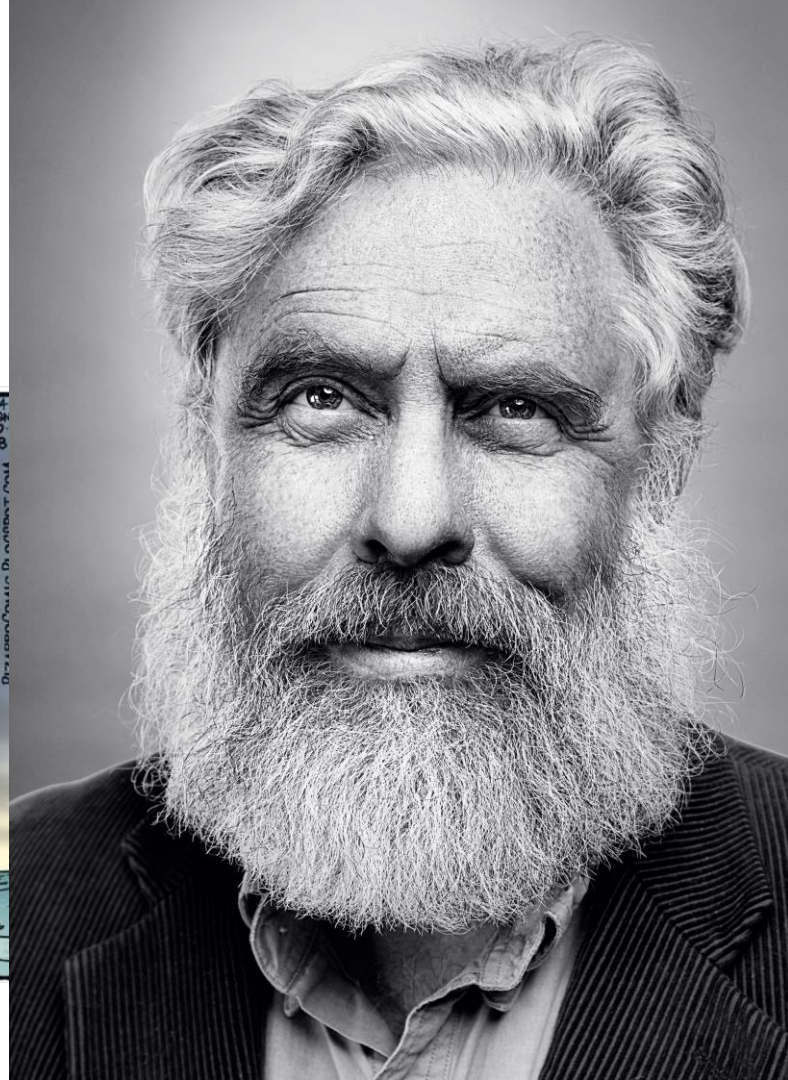
DIRECTED PANSPERMIA – POSSIBLE WITH BREAKTHROUGH STARSHOT TECHNOLOGY IN THIS CENTURY?

21st Century Panspermia Ark: 1e7 species + 8e9 people = 3e-4 g

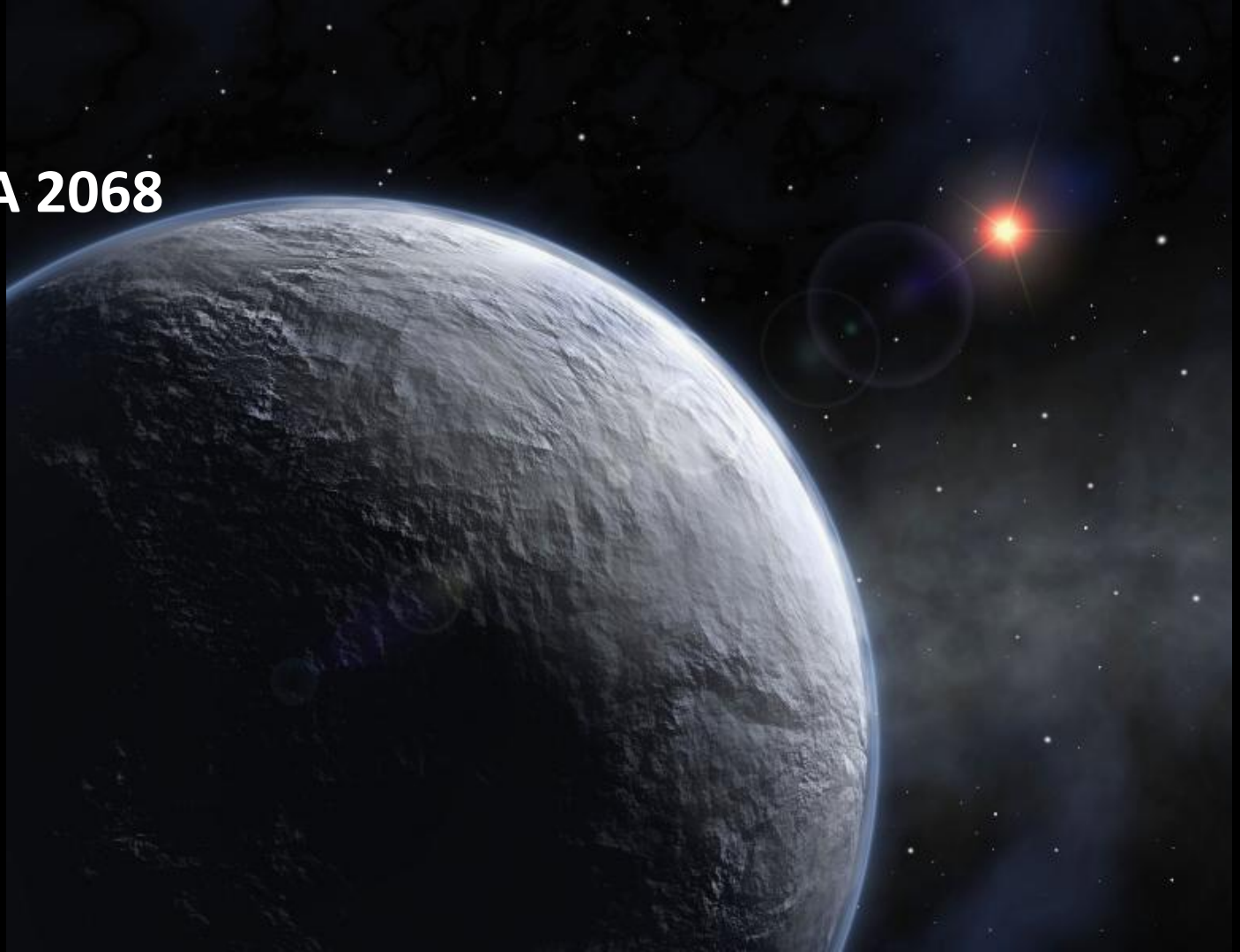
Previous Ark: 3e3 species + 8 people = 2.4e10 g



18 factors of ten … some assembly required



CIRCA 2068



CIRCA 3000?