

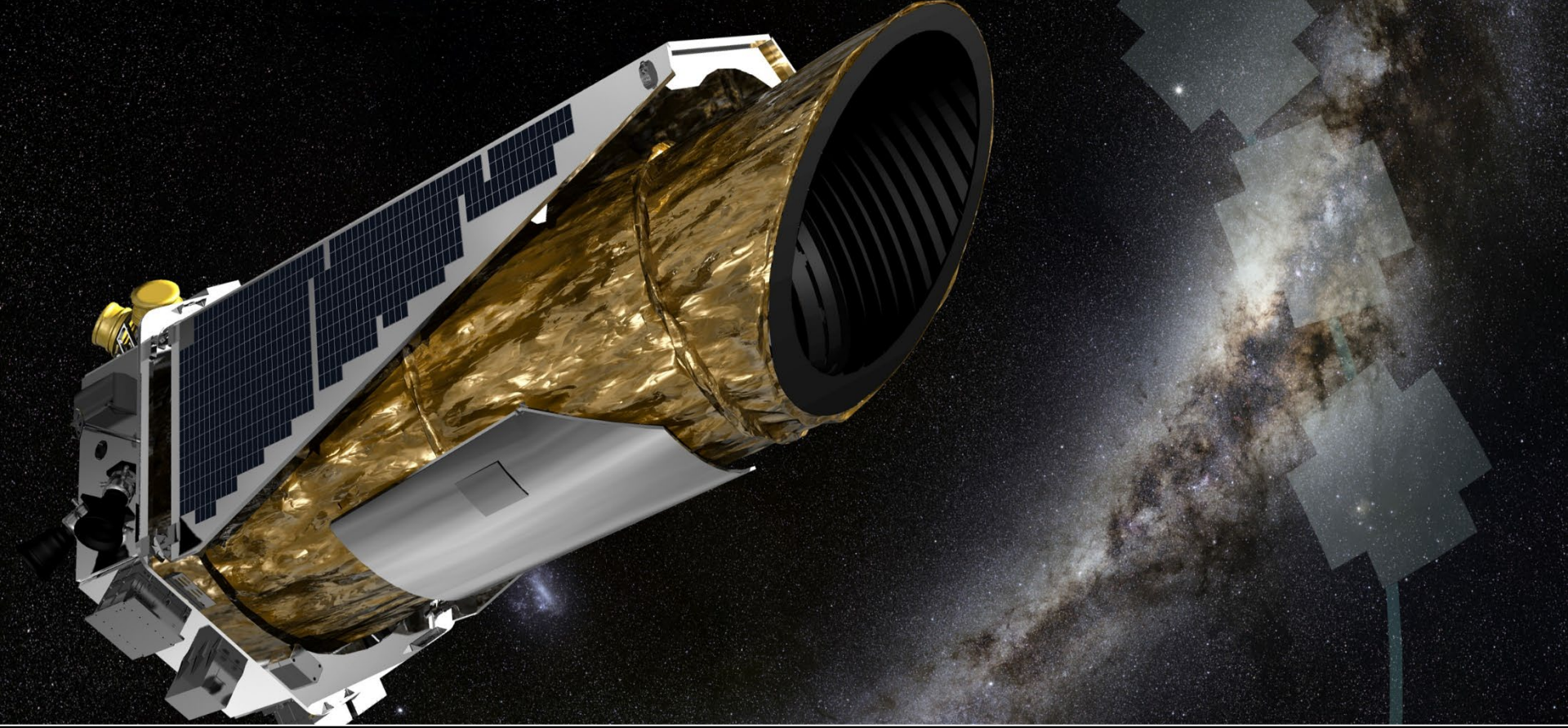


The Search for Life and Earth 2.0

Jonathan Crass
Assistant Research Professor



Are we alone?



Searching for Exoplanets

Searching for Exoplanets

- There are four major techniques for searching for the exoplanets:

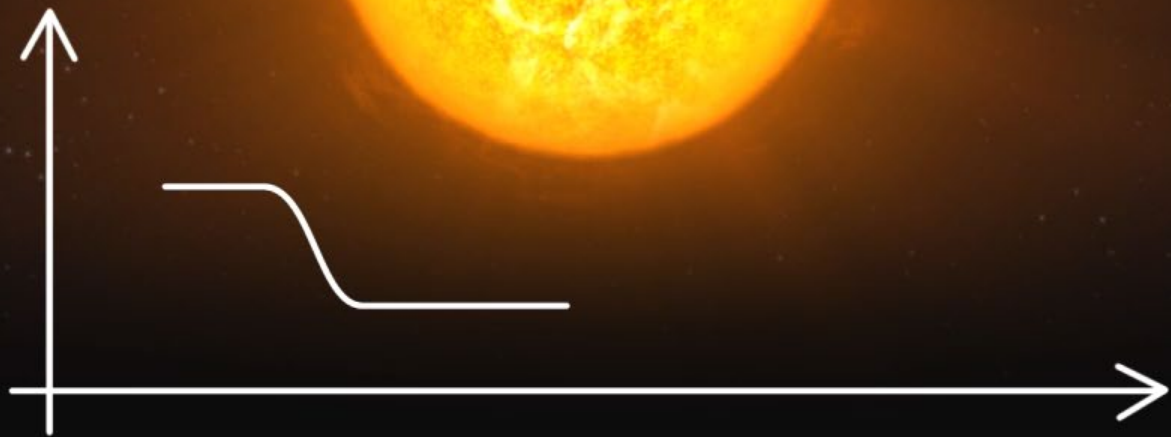
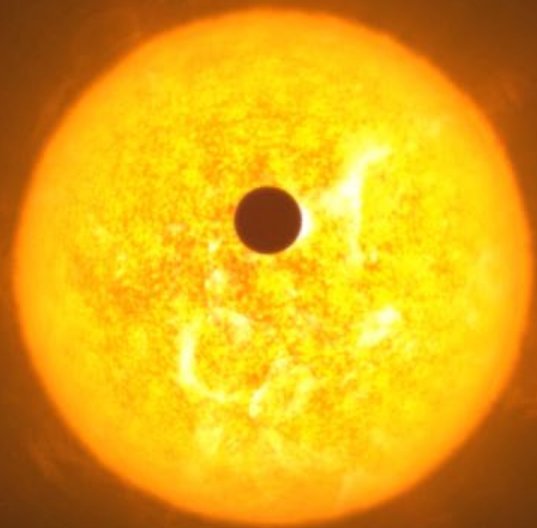
Transit Technique

Radial Velocity Technique

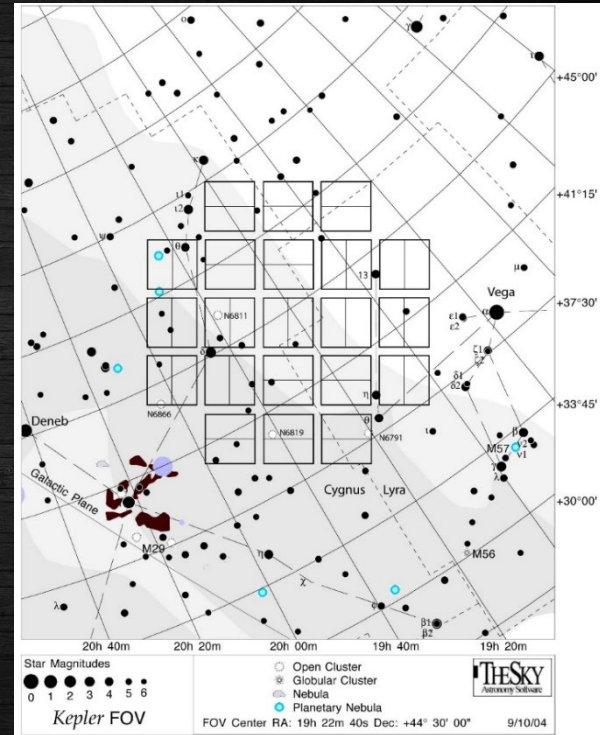
Gravitational Microlensing

Direct Imaging

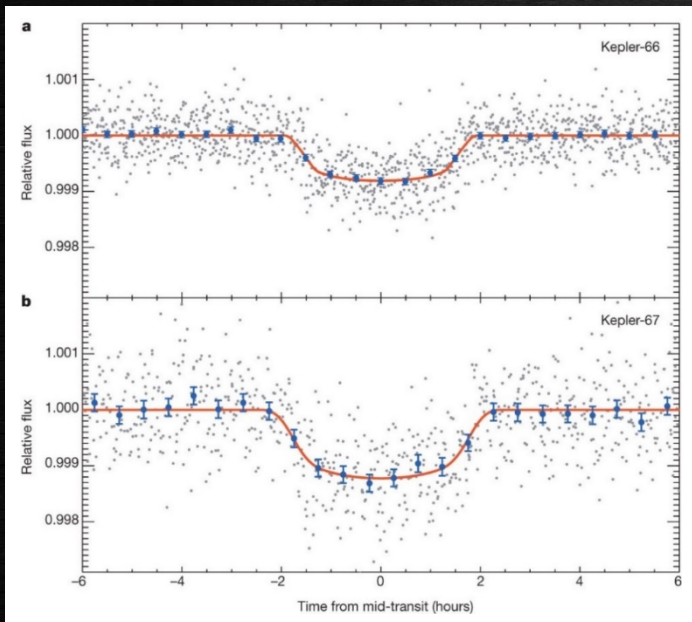




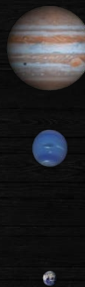
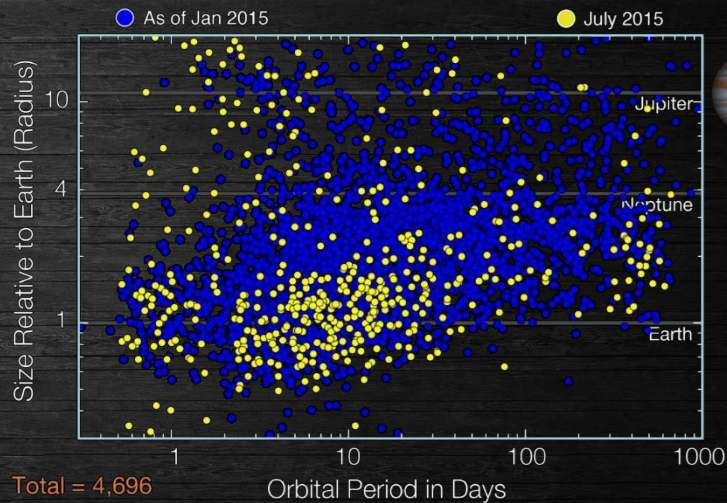
The Kepler Mission

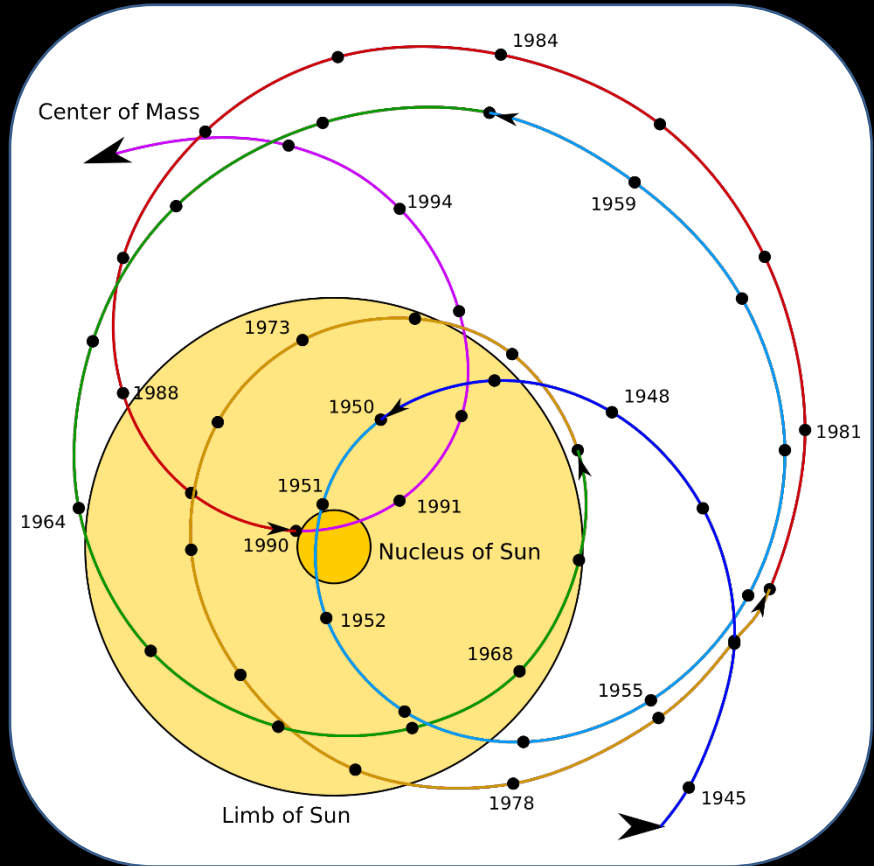
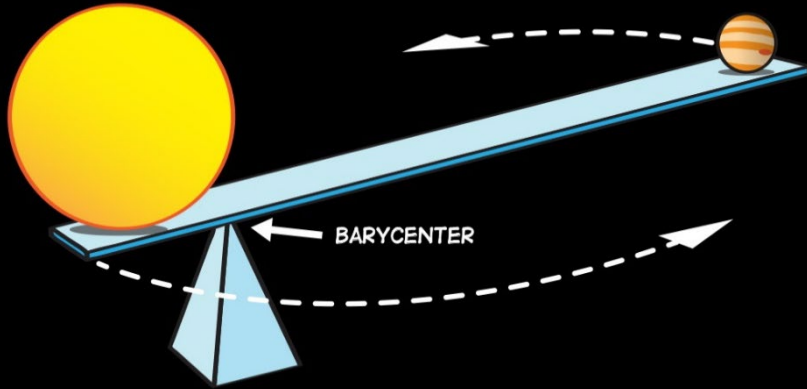


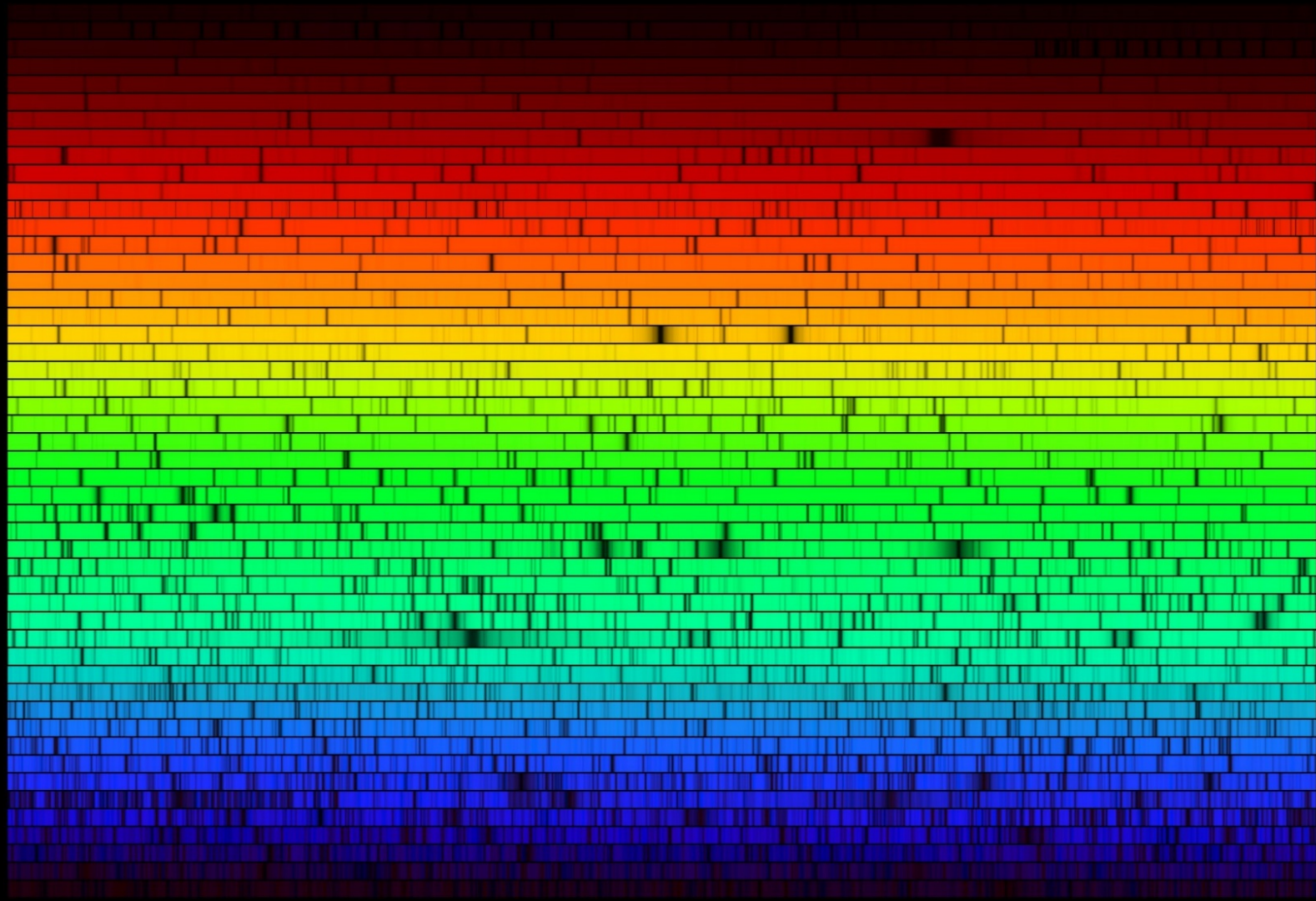
The Kepler Mission



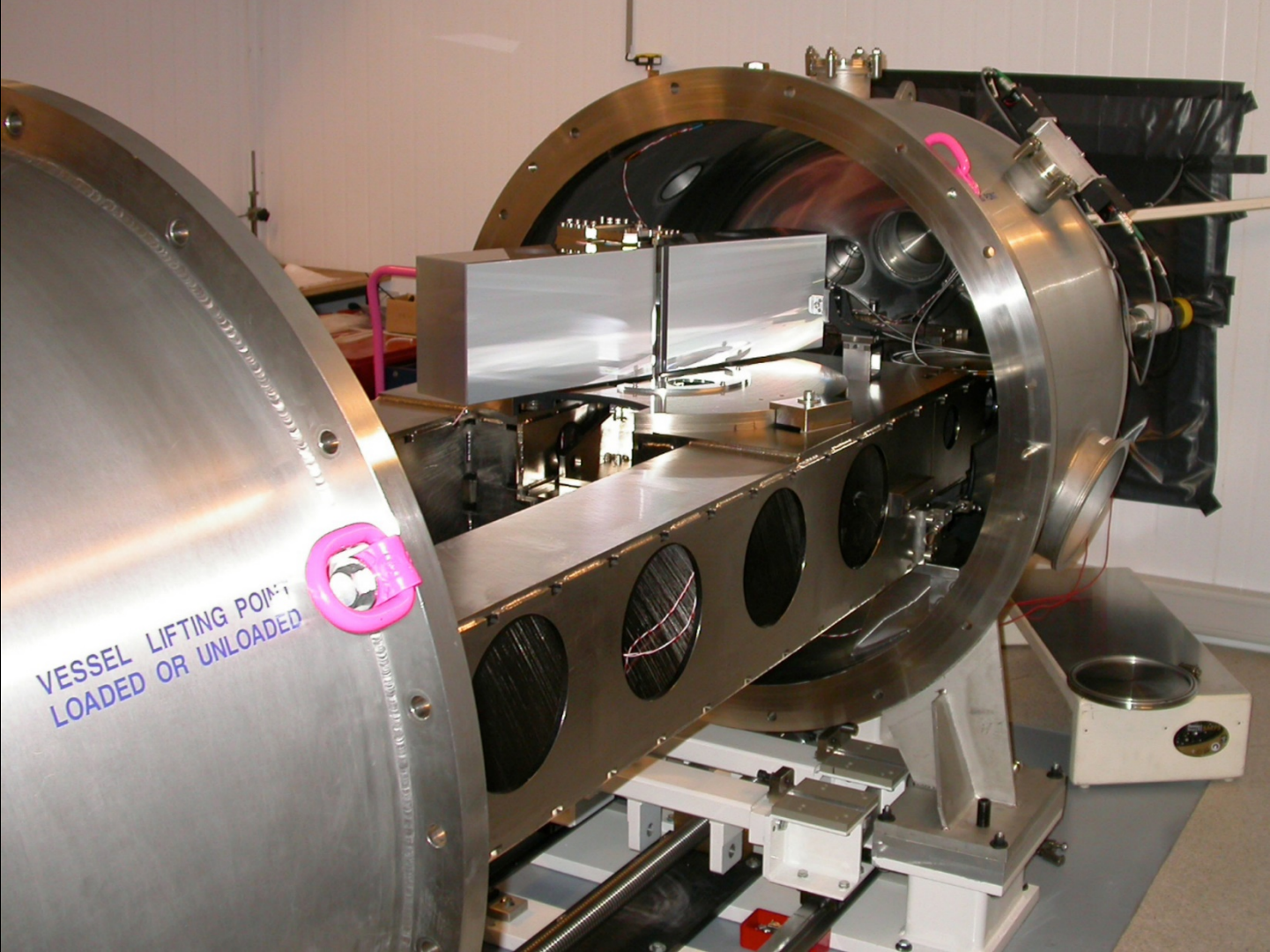
New Kepler Planet Candidates
As of July 23, 2015





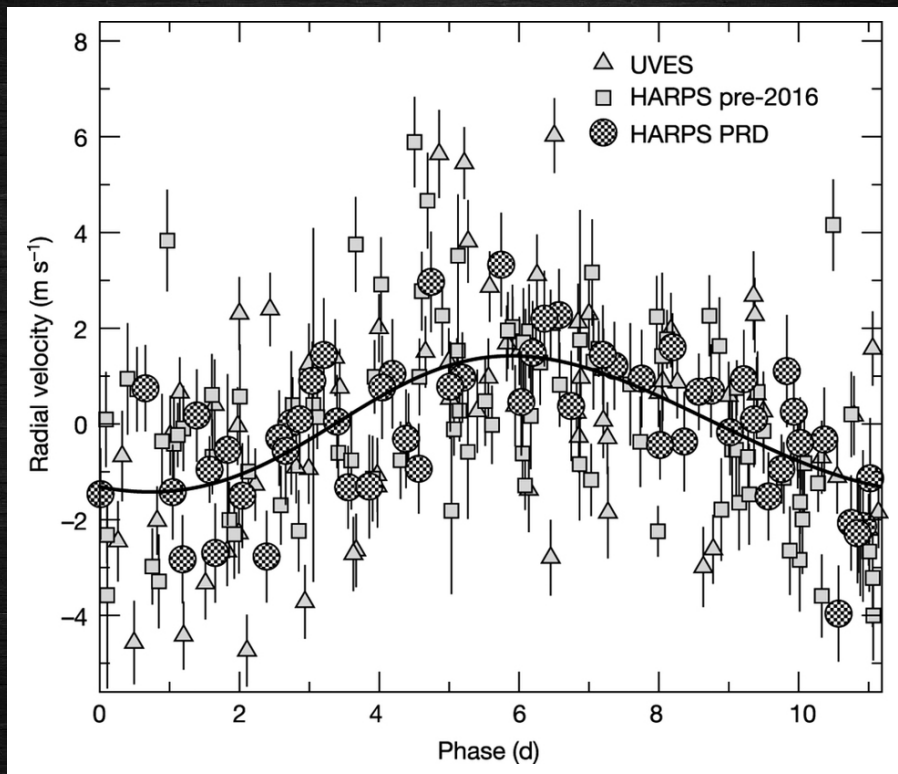




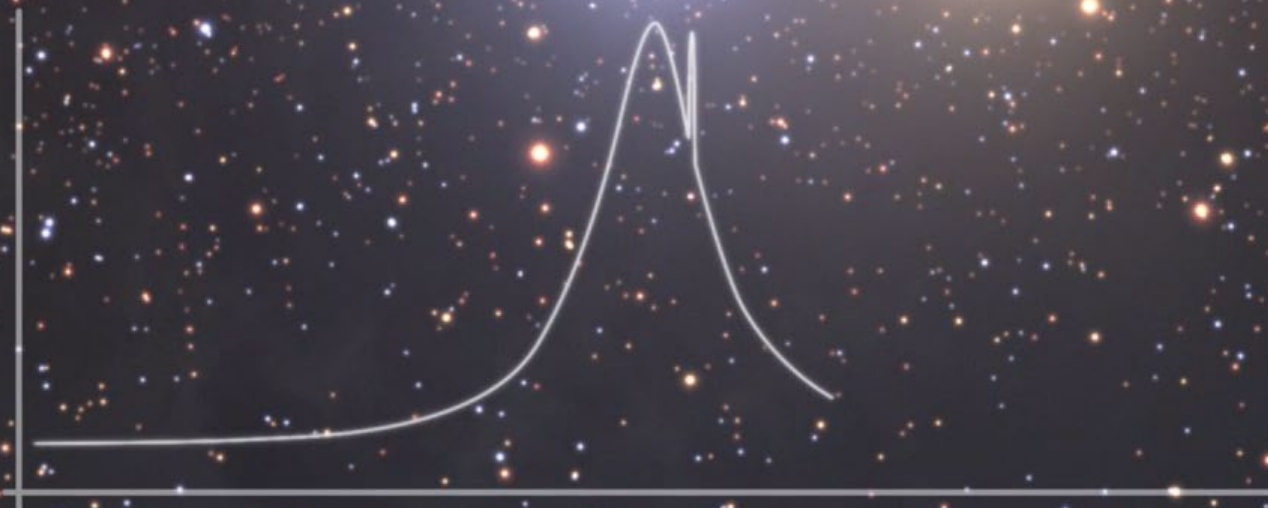


VESSEL LIFTING POINT
LOADED OR UNLOADED

Proxima Centauri b



Brightness





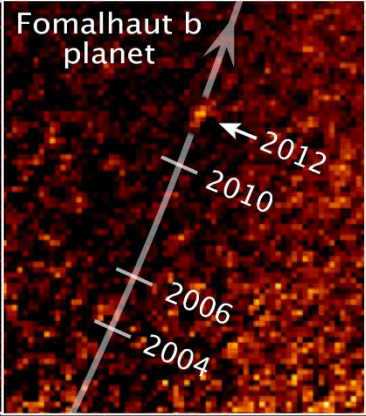
Fomalhaut

HST STIS/CCD

Halo

Scattered starlight "noise"

Dust ring

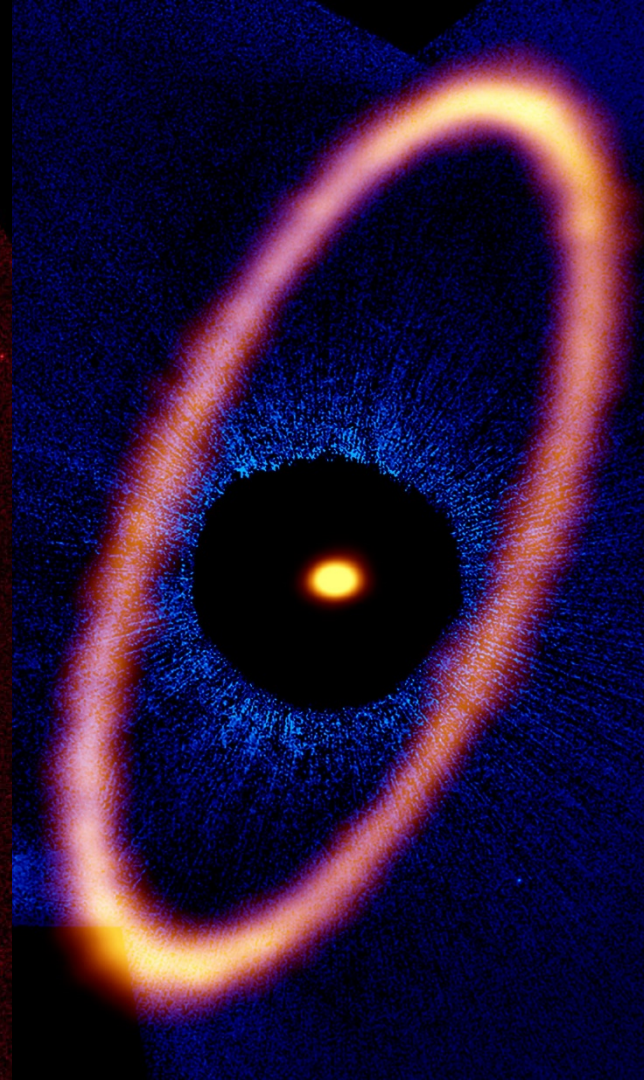
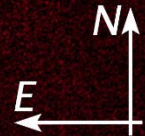


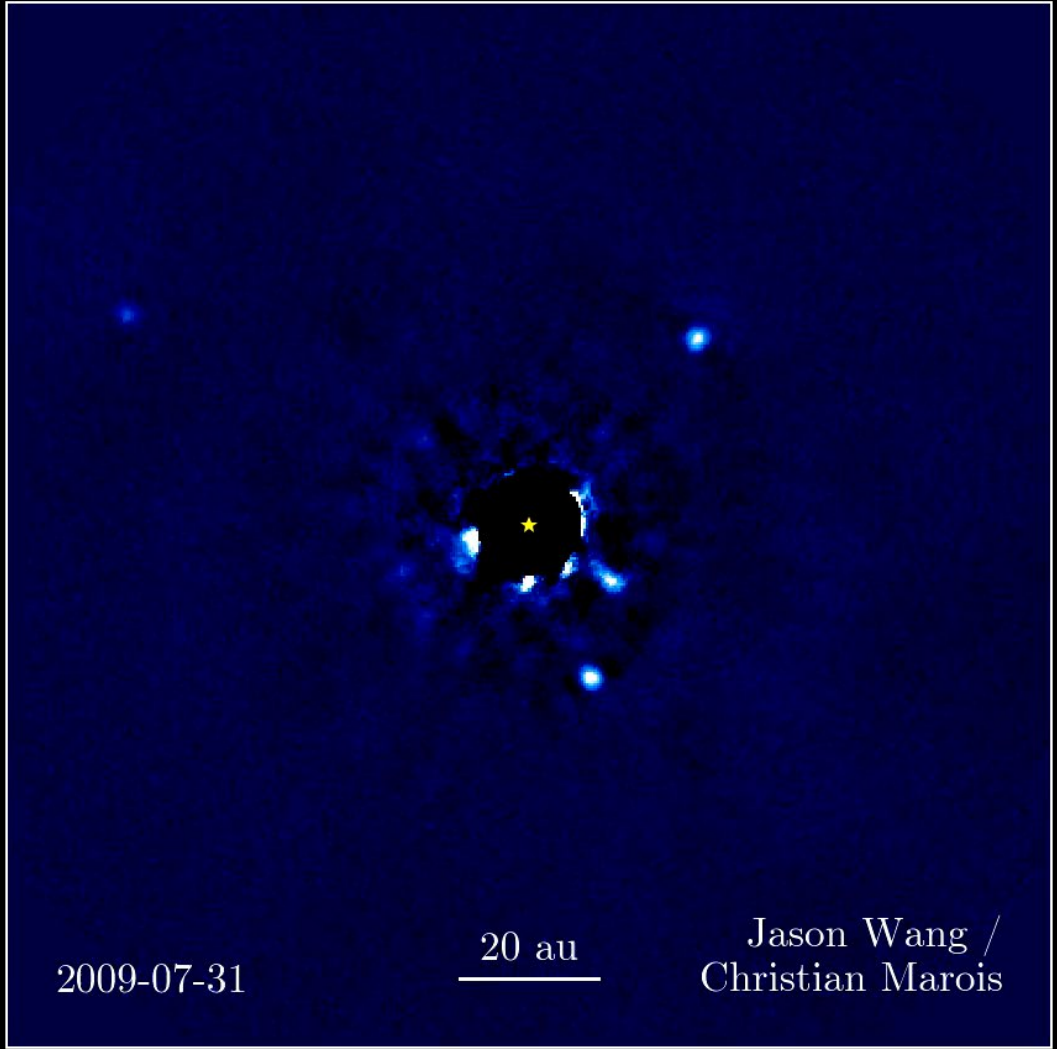
Location of Fomalhaut

Center of Dust Ring

No data

100 AU 13"





2009-07-31

20 au

Jason Wang /
Christian Marois

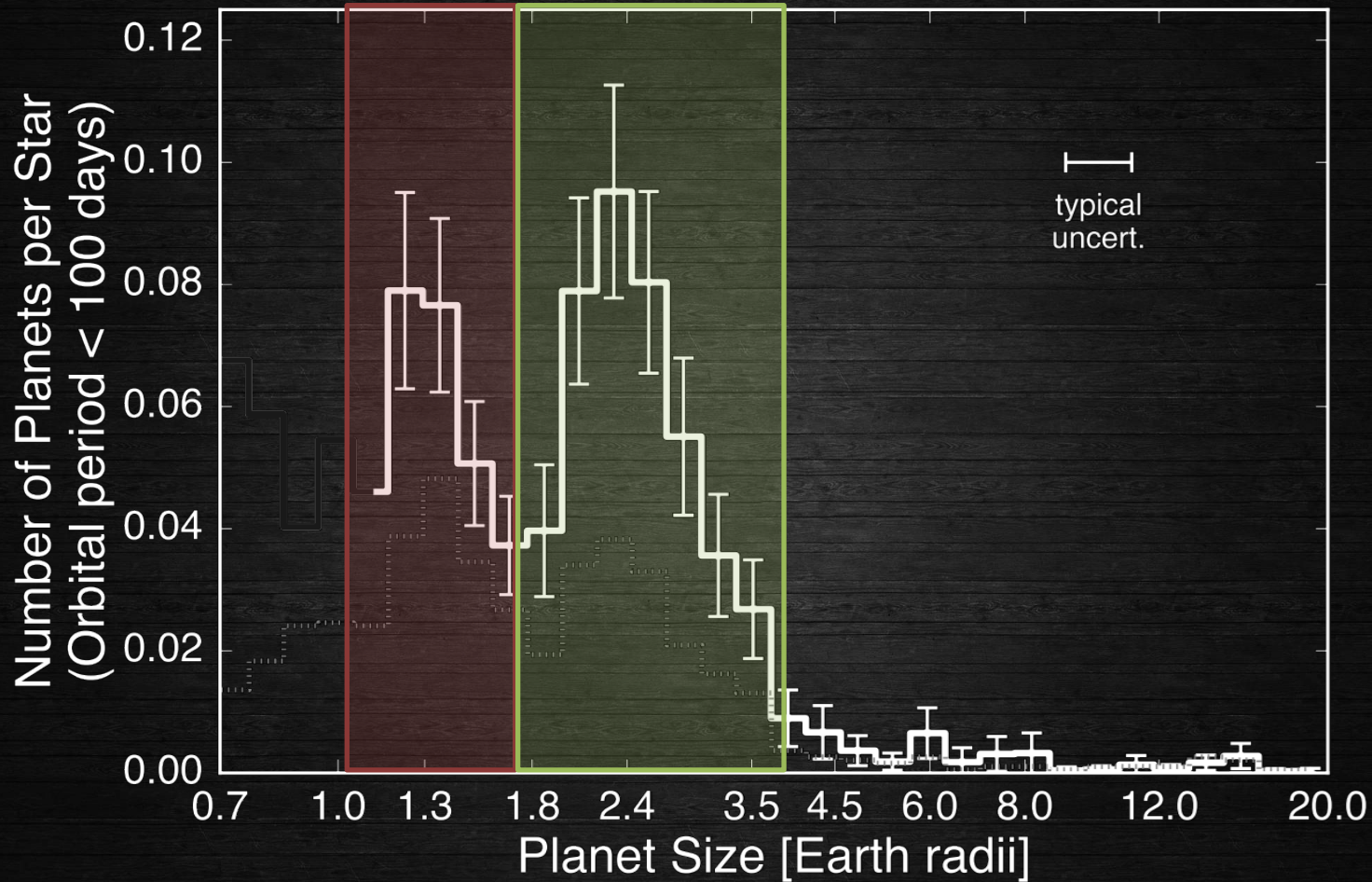
A very new field...

- 1988 - A possible planetary detection...
- 1992 – The discovery of a planet around a Pulsar
- 1995 – The discovery of a planet around the sun-like star: 51 Pegasi.
- 2016 - Earth-Size Planet in Habitable Zone: Proxima Centauri
- 2017 – 7 Earth-Size Planets around a single star: TRAPPIST-1

4,569 confirmed planets

3,442 discovered by transit method
897 discovered by radial velocity
54 discovered by imaging

118 discovered by microlensing
58 discovered using other methods





Are we alone?



The signatures of life

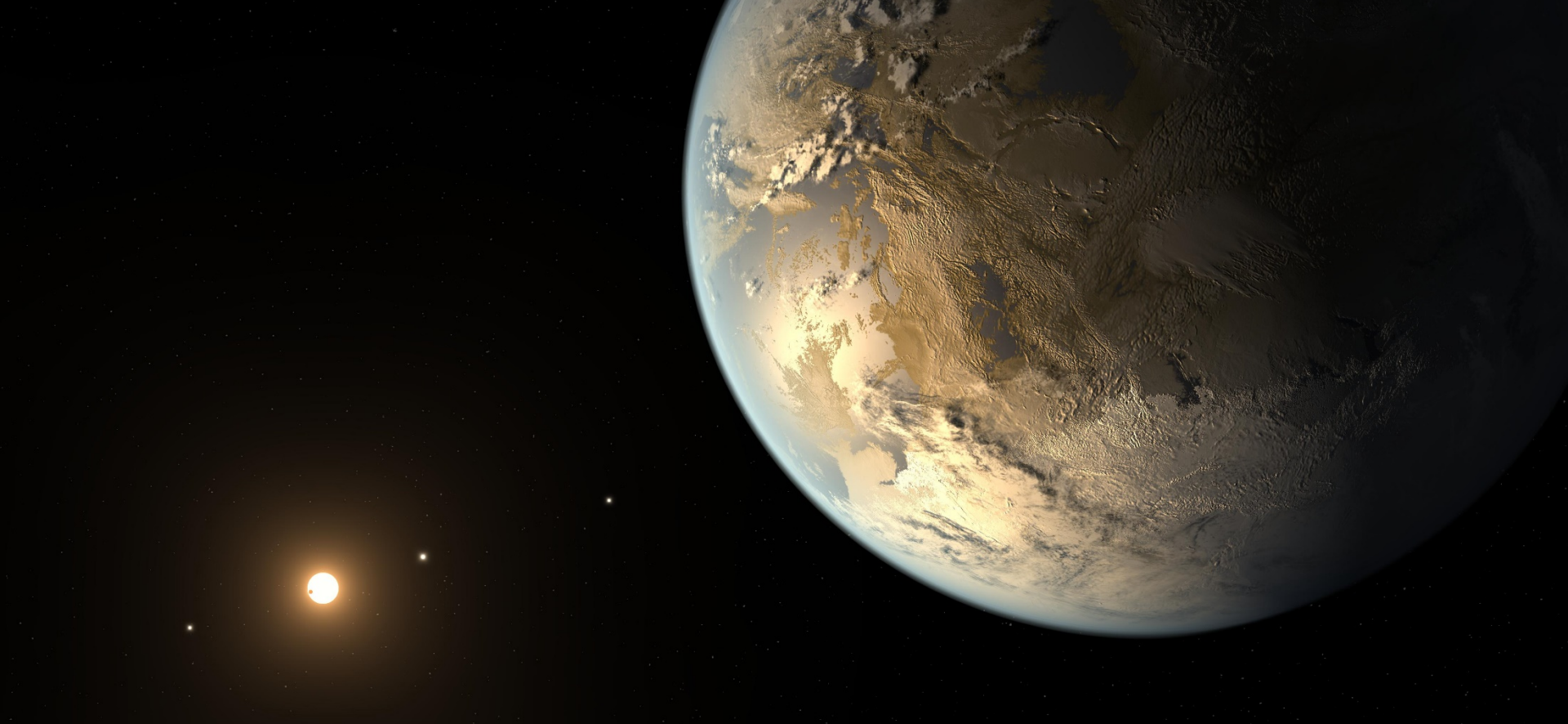
- "Organic Molecules"
 - Oxygen
 - Methane



Communication from another world

$$N = R^* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

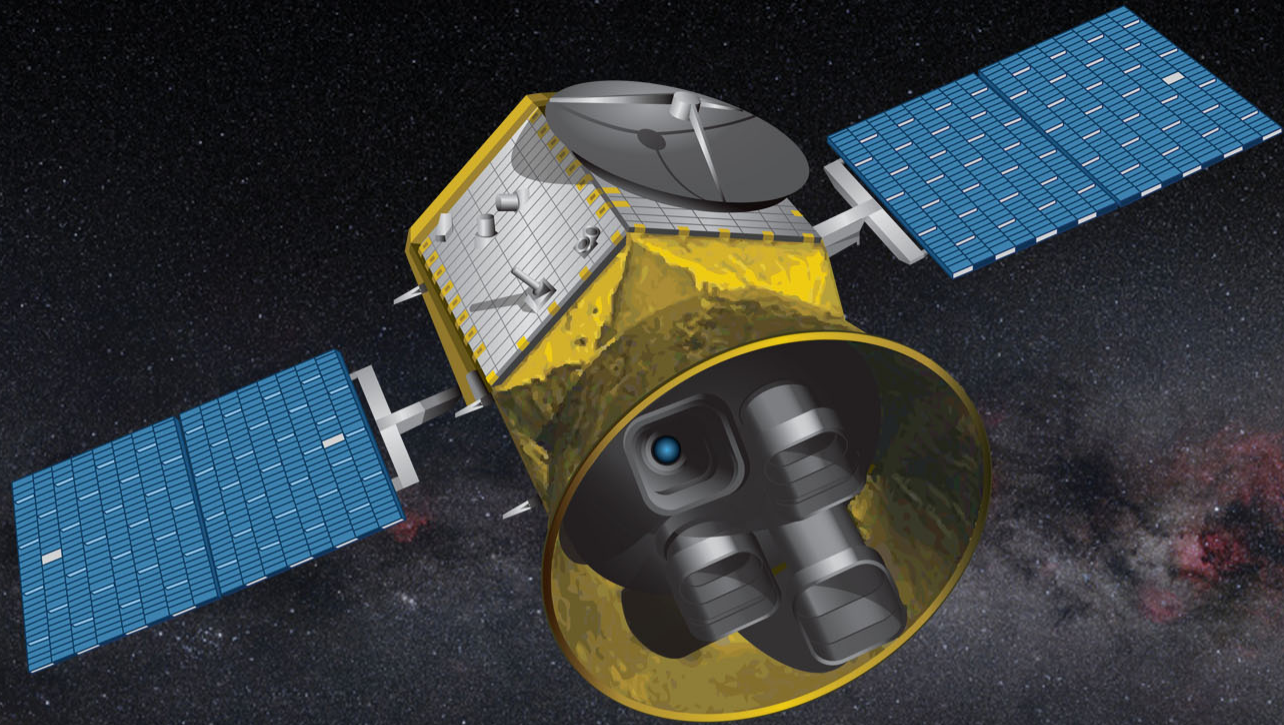
The Drake Equation



The Future

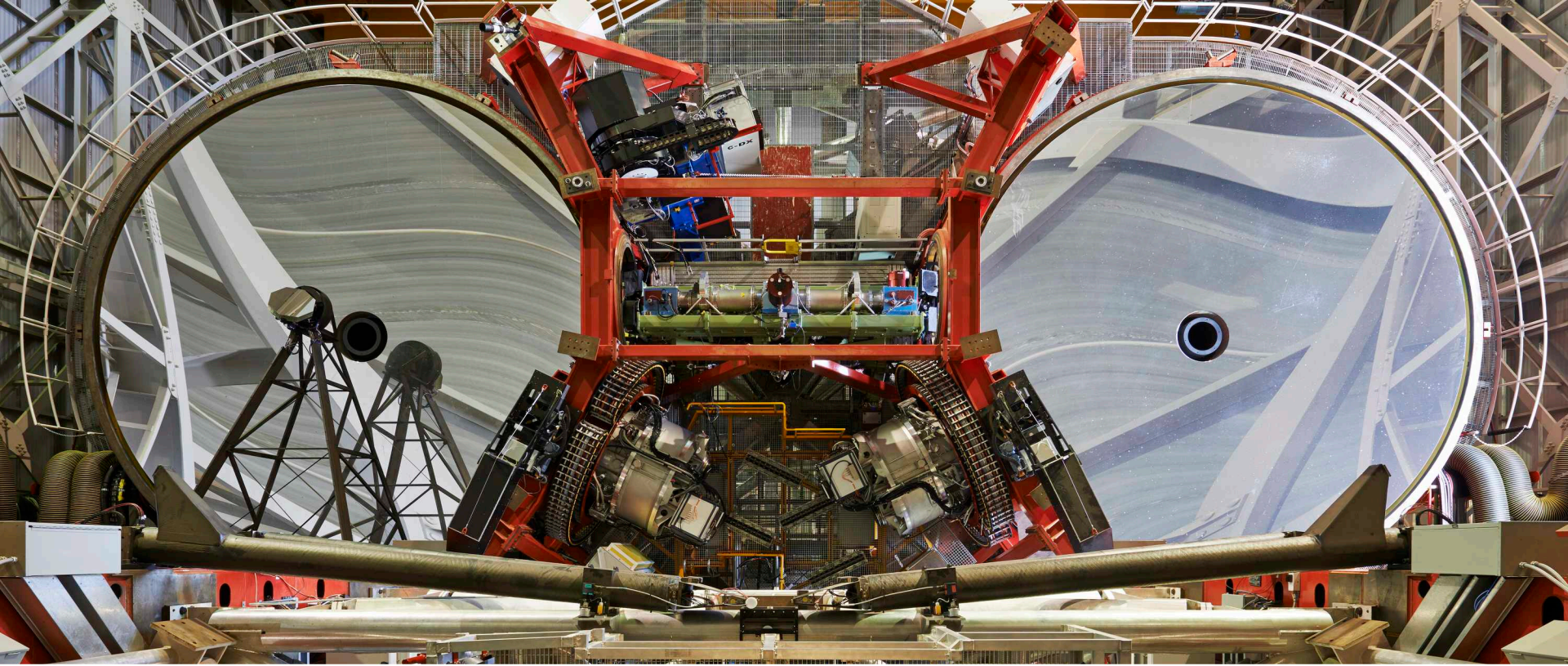
The unanswered questions

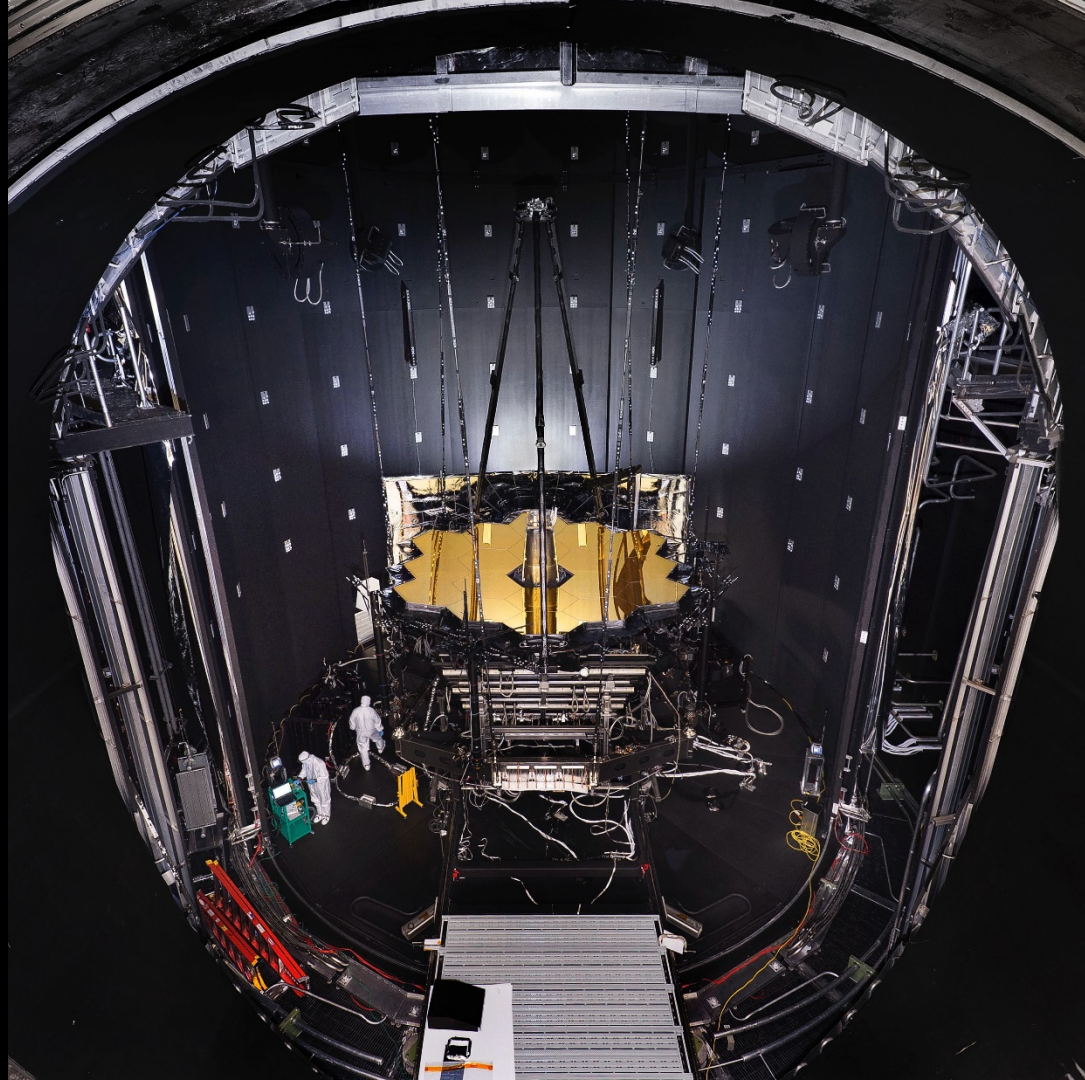
- Is our Solar System special?
- How do exoplanets form?
- What are exoplanets made of?
- Do they show signatures of life?

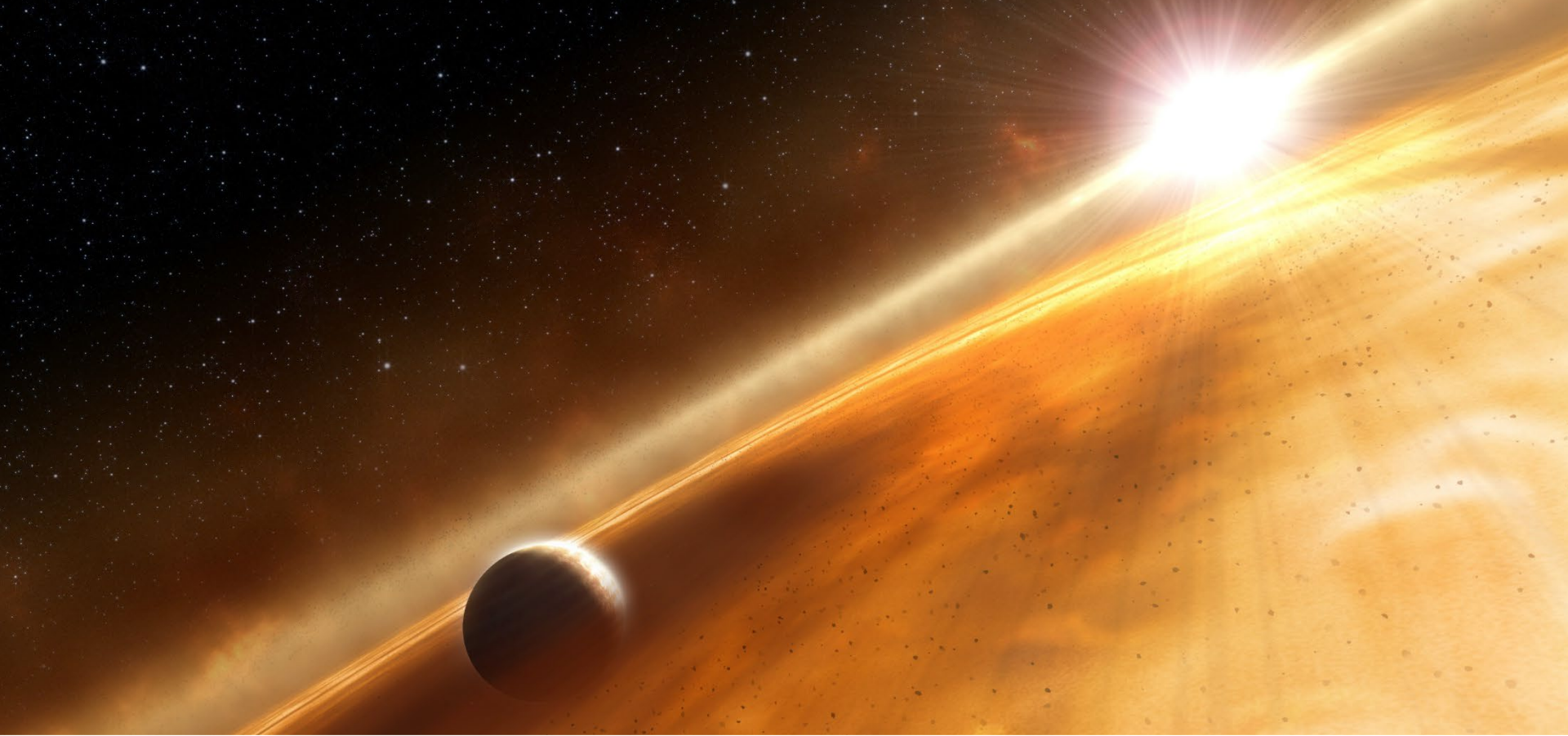


TRANSITING EXOPLANET SURVEY SATELLITE

*DISCOVERING NEW EARTHS AND SUPER-EARTHS
IN THE SOLAR NEIGHBORHOOD*







Summary