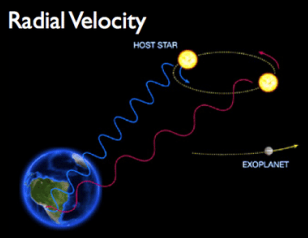
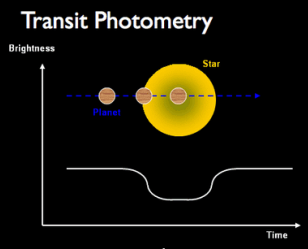
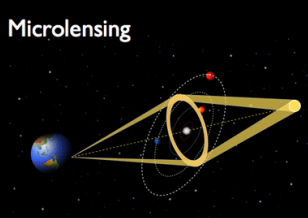
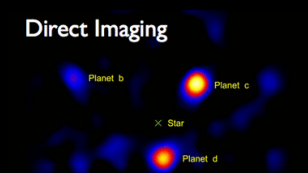
Exoplanets









Peterborough Astronomical Association

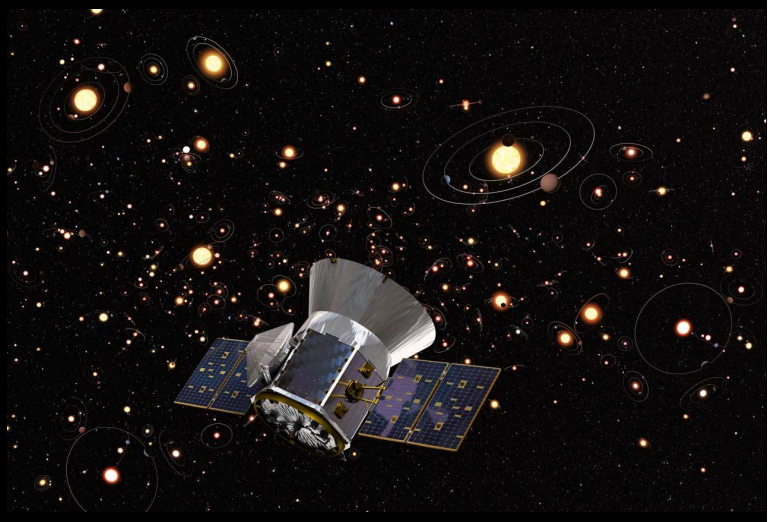
Novice Astronomy Class # 22

May 3, 2024

Brett Hardy

What is an Exoplanet?

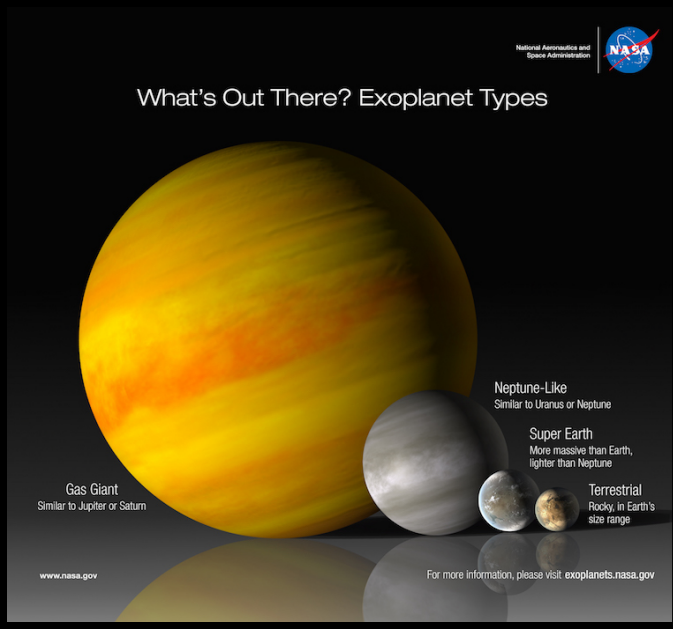
- Planet in orbit around another Star
- 51 Pegasi b
- > 4,000



ESA, M. Kornmesser (ESO), Aaron E. Lepsch (ADNET Systems Inc.), Britt Griswold (Maslow Media Group), NASA's Goddard Space Flight Center and Cornell University

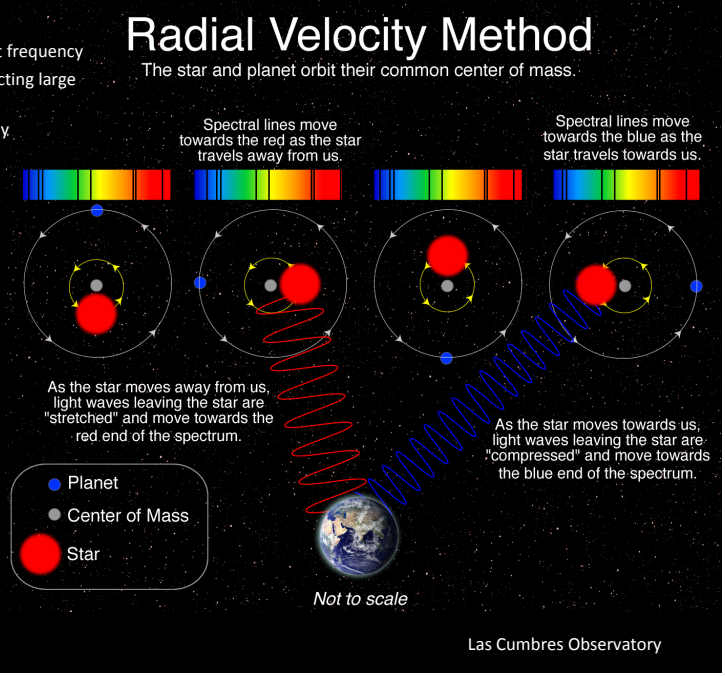
Types of Exoplanets

- Hot Jupiters
- Ice Giants
- Super Earths
- Terrestrial



Radial Velocity

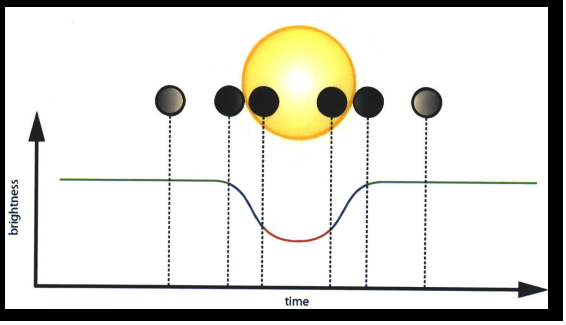
- Wobble effects light frequency
- Biased toward detecting large planets
- Effective up to 100 ly
- 820 planets



Transit Method

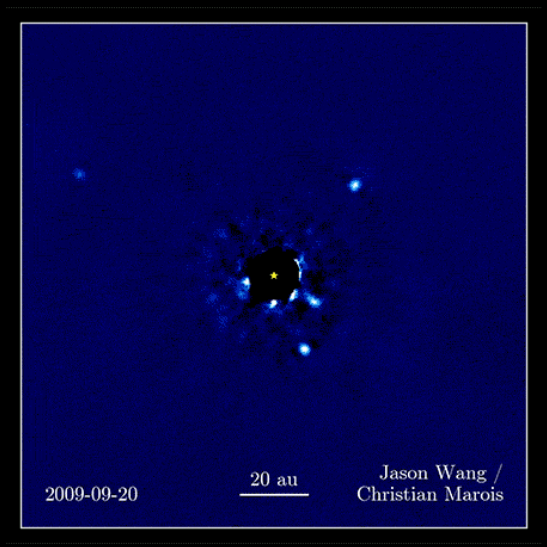
- Transiting planet blocks small portion of light
- Directly indicates exoplanet size and distance
- Atmosphere detection
- Effective for hundreds of ly
- 3,261 planets
- Kepler Space Telescope
- Transiting Exoplanet Survey Satellite - TESS

NASA



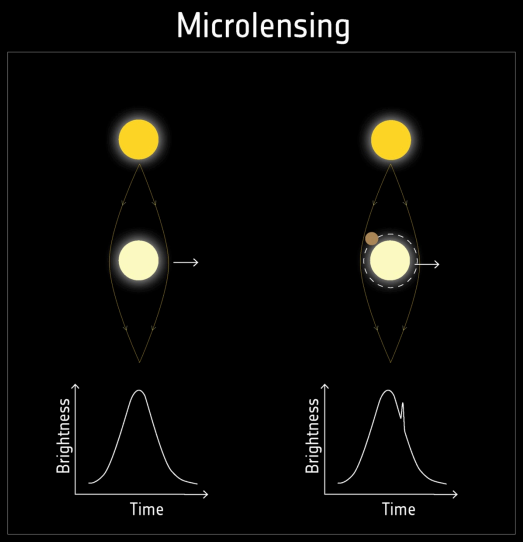
Direct Imaging

- Coronagraph
- HR8799 in Pegasus
- 129 ly away
- 30 million years old
- 4 visible planets
- All larger than Jupiter
- Orbit from 40-400 years
- Keck Telescope
- 7 images from 2009 – 2016
- 51 planets



Gravitational Microlensing

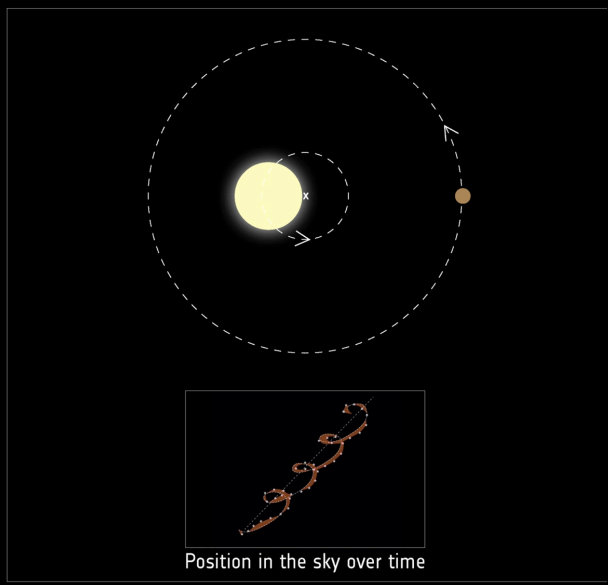
- Capable of finding the smallest & farthest exoplanets
- Passage of one star in front of another distant star
- "Rogue" planets
- Effective for thousands of ly
- Optical Gravitational Lensing Experiment (OGLE)
- 98 planets



ESA

Astrometry

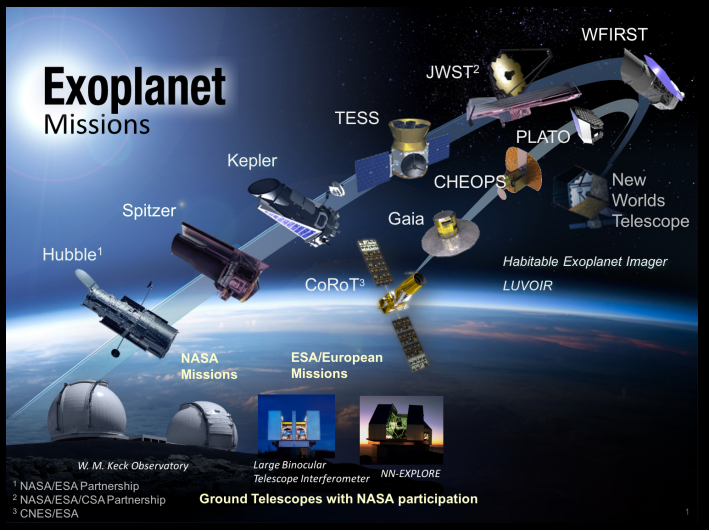
- Measuring Star positions to detect exoplanets
- Extremely challenging method
- 1 planet



ESA

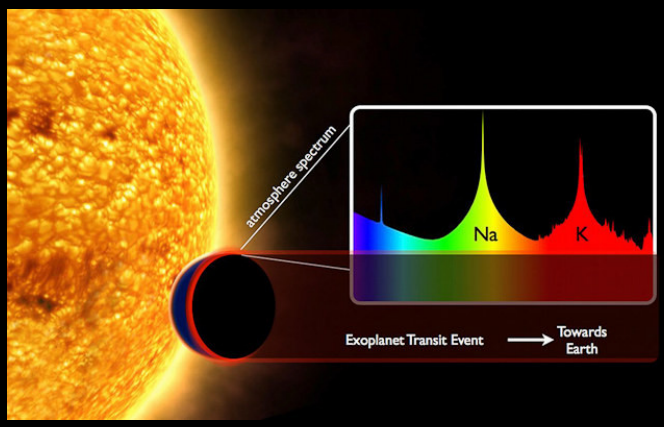
Characterizing Exoplanets

- Size
- Orbital period
- Mass
- Density
- Distance from Star



Characterizing Exoplanets

- Planetary atmospheres
- Transit Method & Direct Imaging

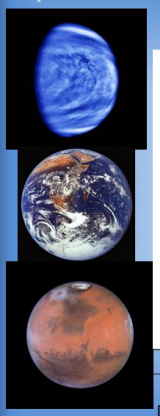


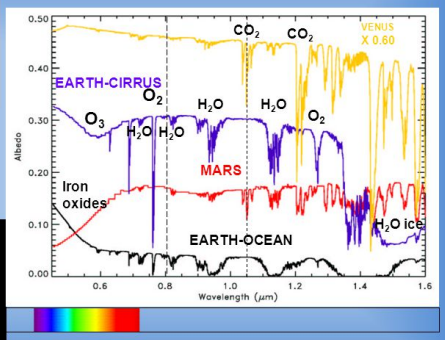
European Southern Observatory

Characterizing Exoplanets

- Biomarkers
- Must be in a gaseous state
- Biotic VS abiotic formation

Spectroscopy: detecting biomarkers



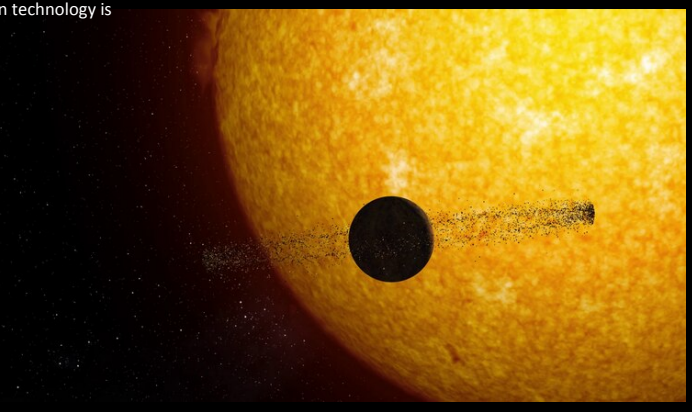


Detecting atmospheric oxygen and water likely indicates life
(because very few non-biological processes can sustain an oxygen atmosphere)

Ref: R. Hanel, GSFC

Characterizing Exoplanets

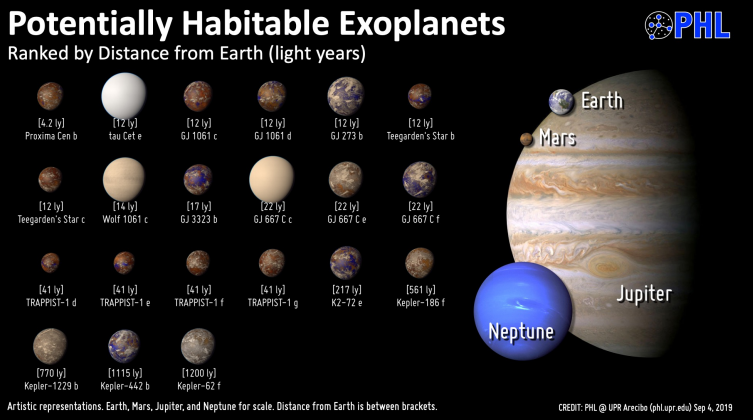
- Technomarkers
- Current detection technology is limited
- Radio message
- Clarke Exobelt
- Dyson Sphere



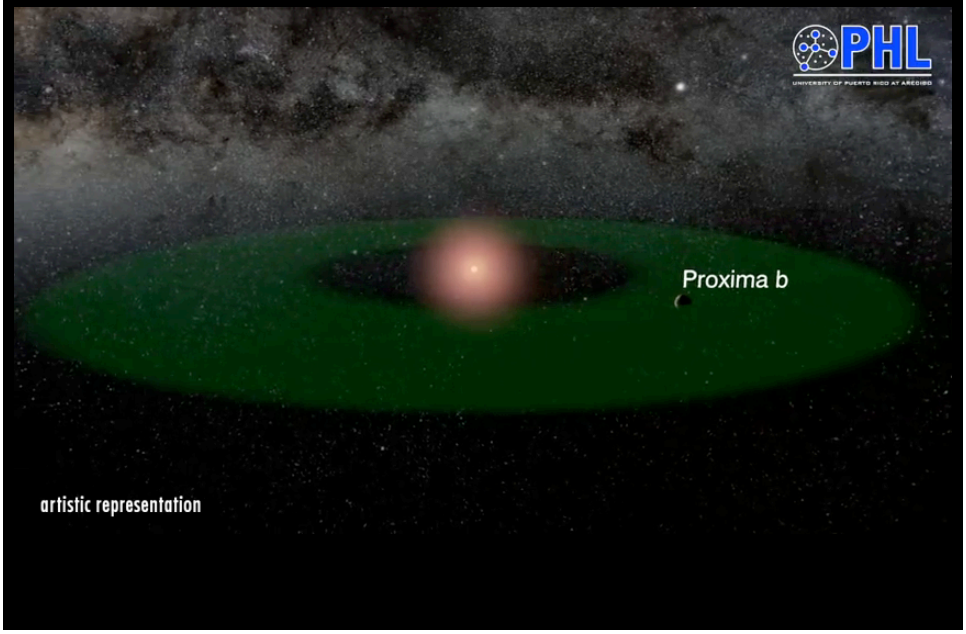
Hector Socas-Navarro

Potentially Habitable Exoplanets

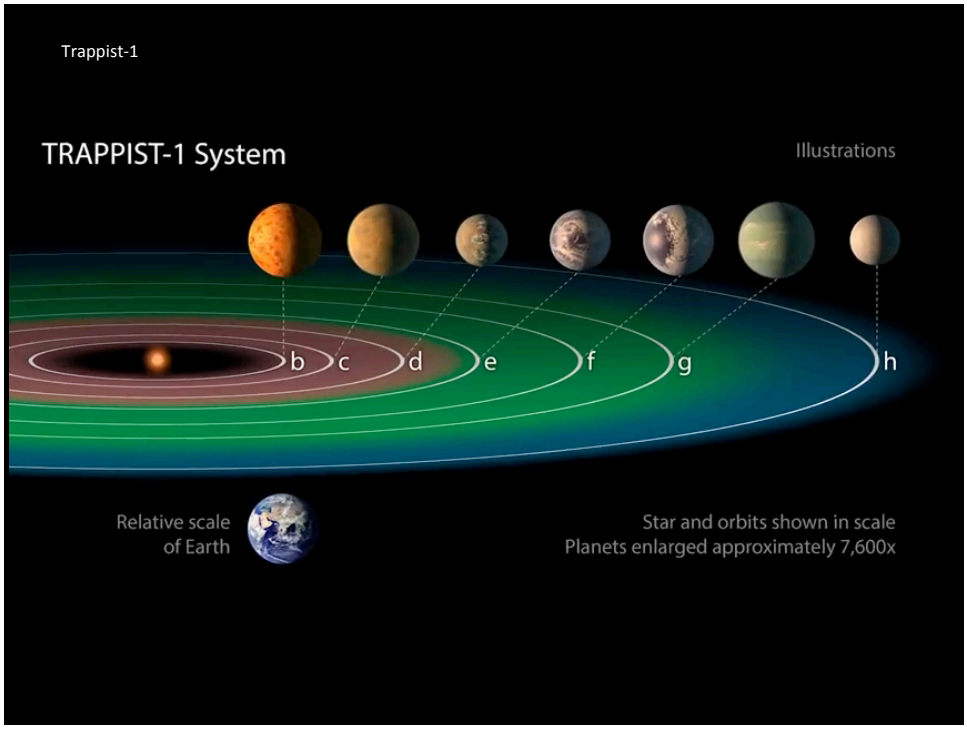
- Habitable Zone
- Stellar Type



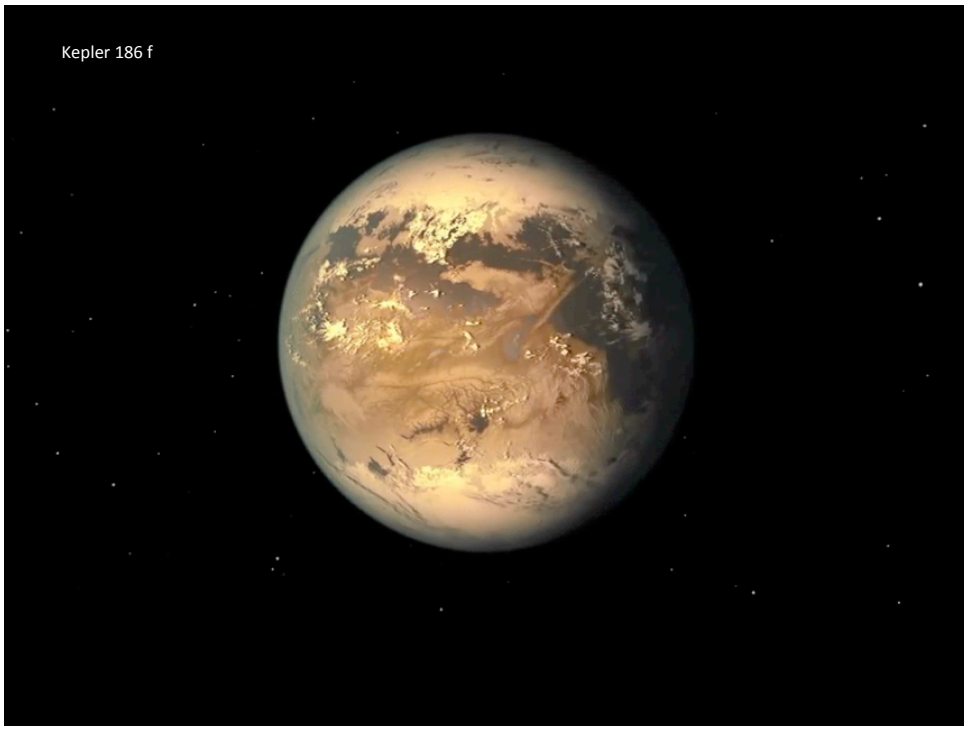
Proxima b



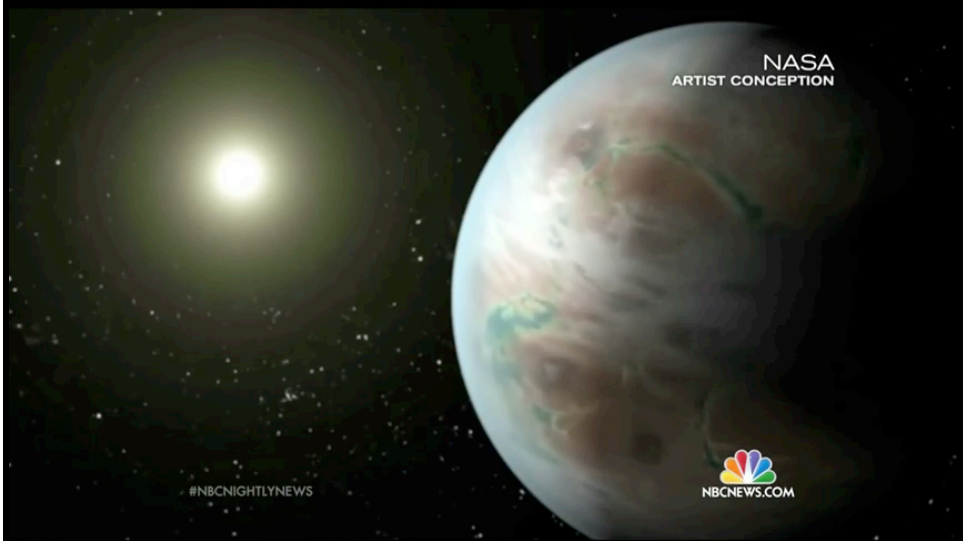
Trappist-1



Kepler 186 f

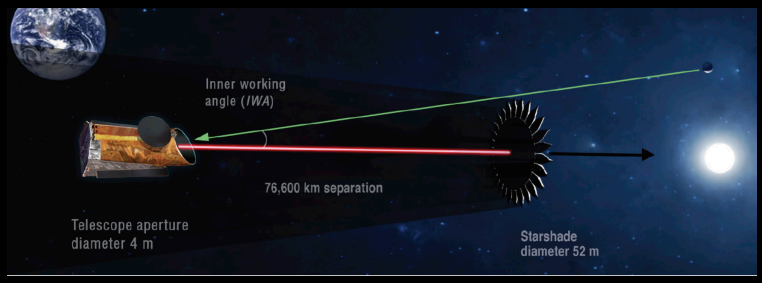


Kepler 452 b



Future Detection

- James Webb Space Telescope
- Starshade Space Telescopes



Next Month Novice Class # 23