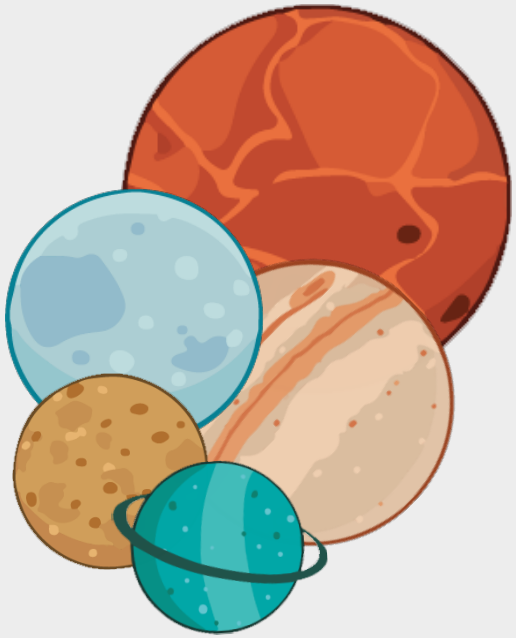
HUNTING FOR ALIEN WORLDS: **HOW TO FIND** ***EXOPLANETS***



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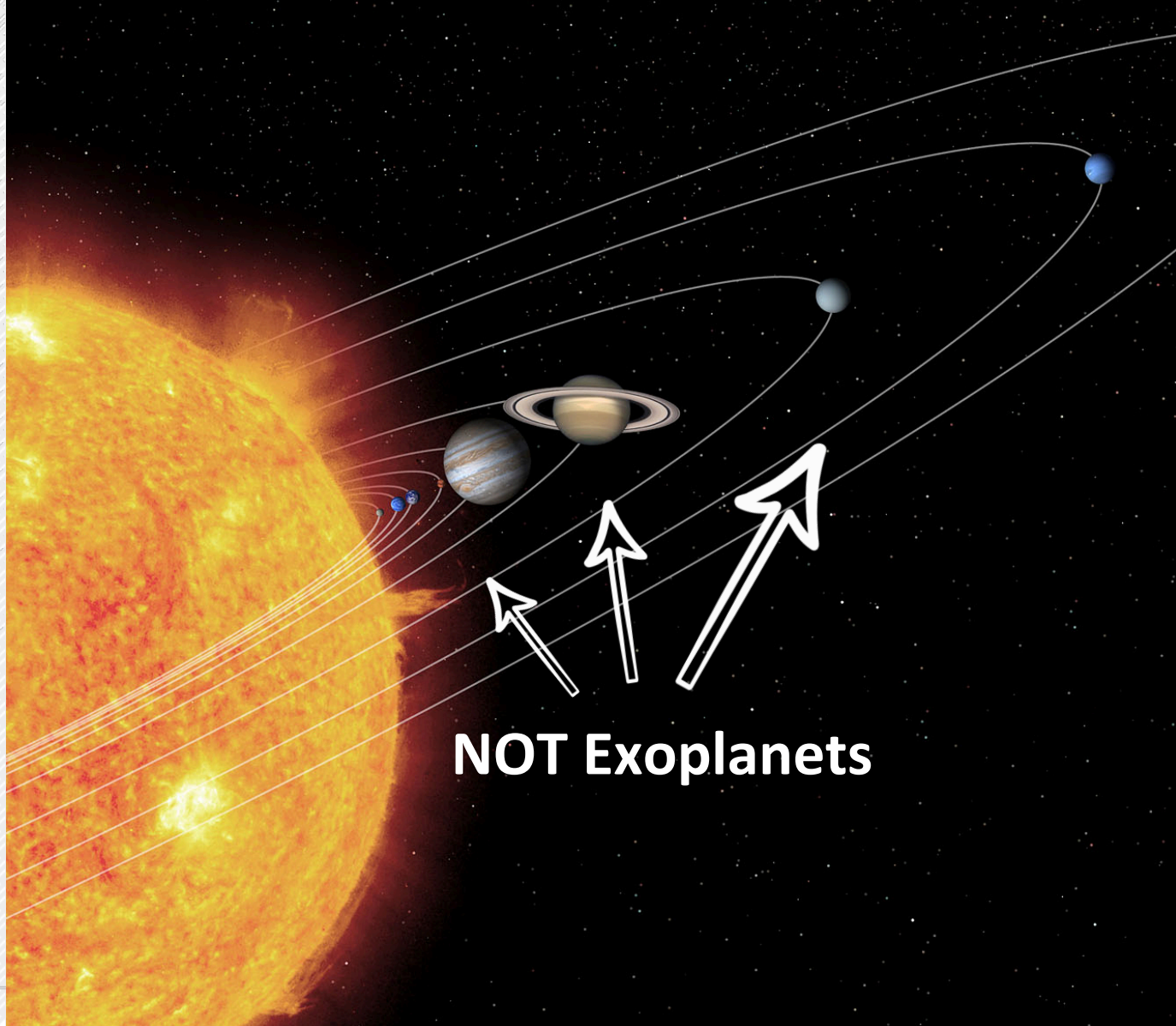
THE CONOCOPHILLIPS SCIENCE EXPERIENCE

WHAT ARE EXOPLANETS?

DETAILS

Exoplanets are planets that are found outside of our own Solar System



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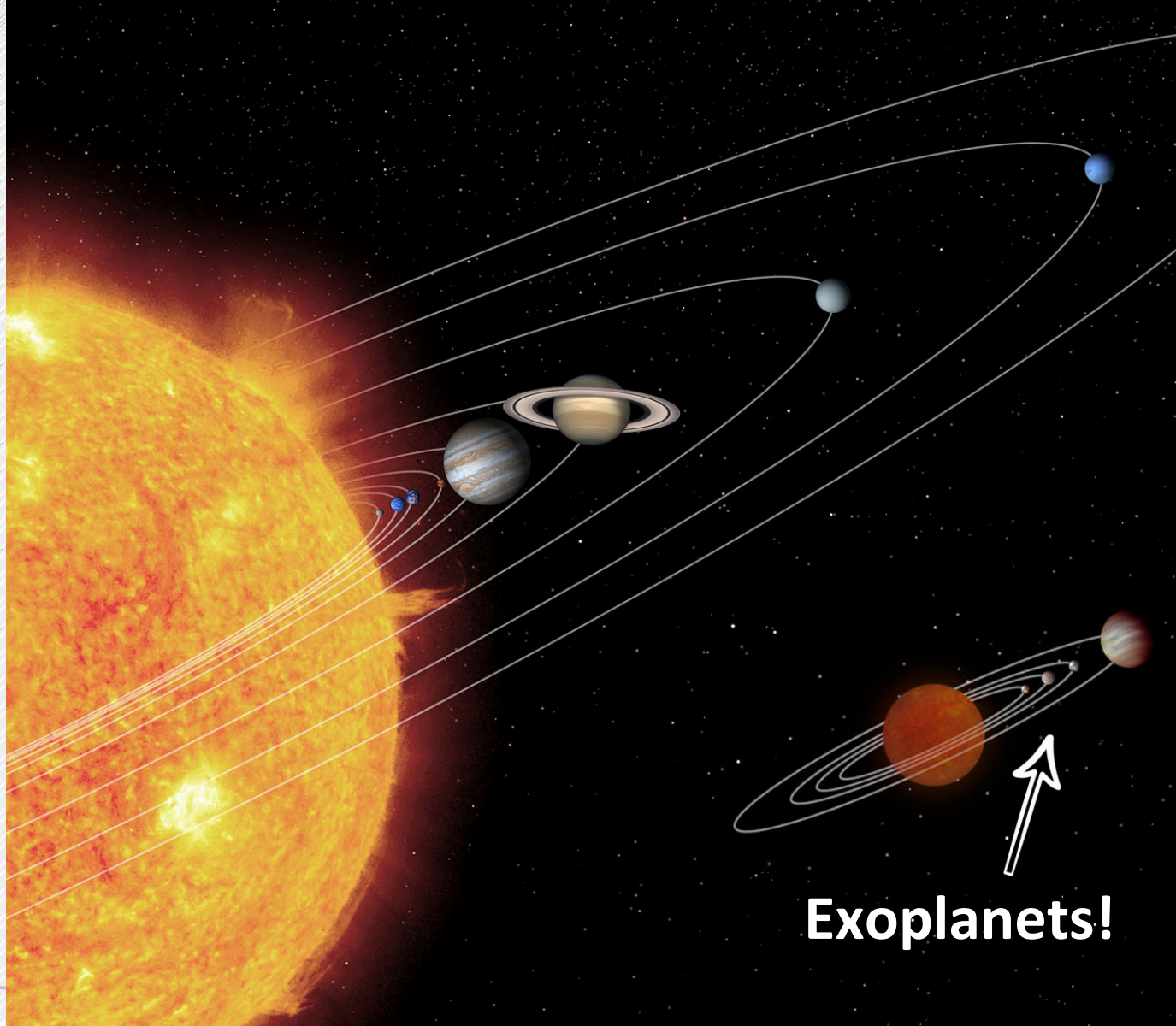

HOW ARE THEY FOUND?

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TRANSIT
"WINK" METHOD

DETAILS

This method relies on a star-planet system that has their orbits aligned in such a way that, as seen from Earth, the planet travels between us and the star and temporarily blocks some of the light from the star once every orbit.

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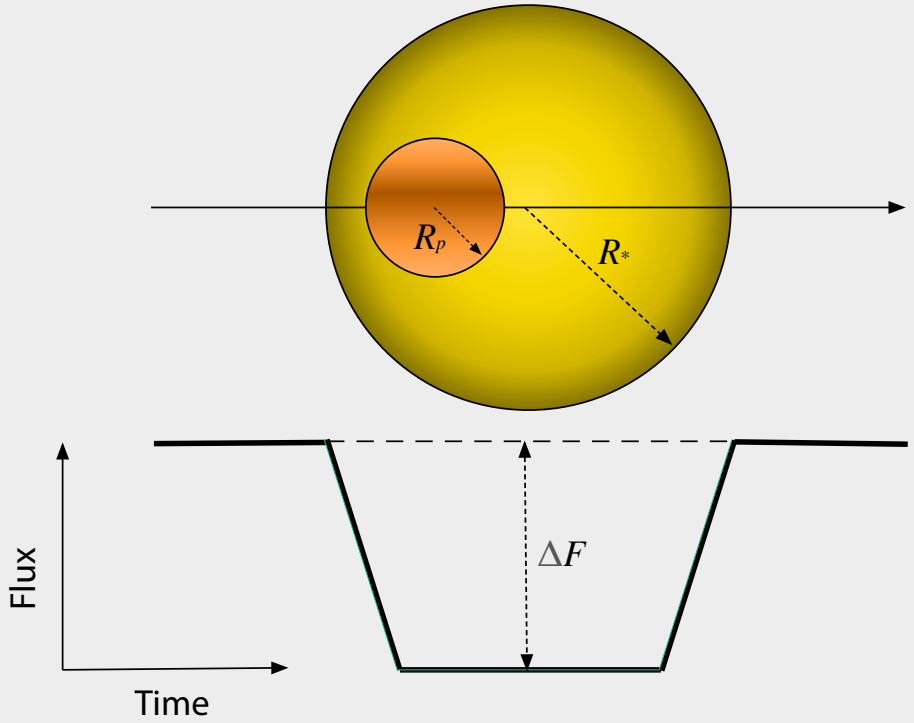
TRANSIT
"WINK" METHOD

DETAILS

The dip in light in proportional to the size of the exoplanet and its host star



Dip of Light

$$\Delta F \approx \left(\frac{R_p}{R_*}\right)^2$$

$$\left(\frac{R_J}{R_\odot}\right)^2 \approx 1\%$$

Jupiter

$$\left(\frac{R_\oplus}{R_\odot}\right)^2 \approx 10^{-2}\%$$

Earth

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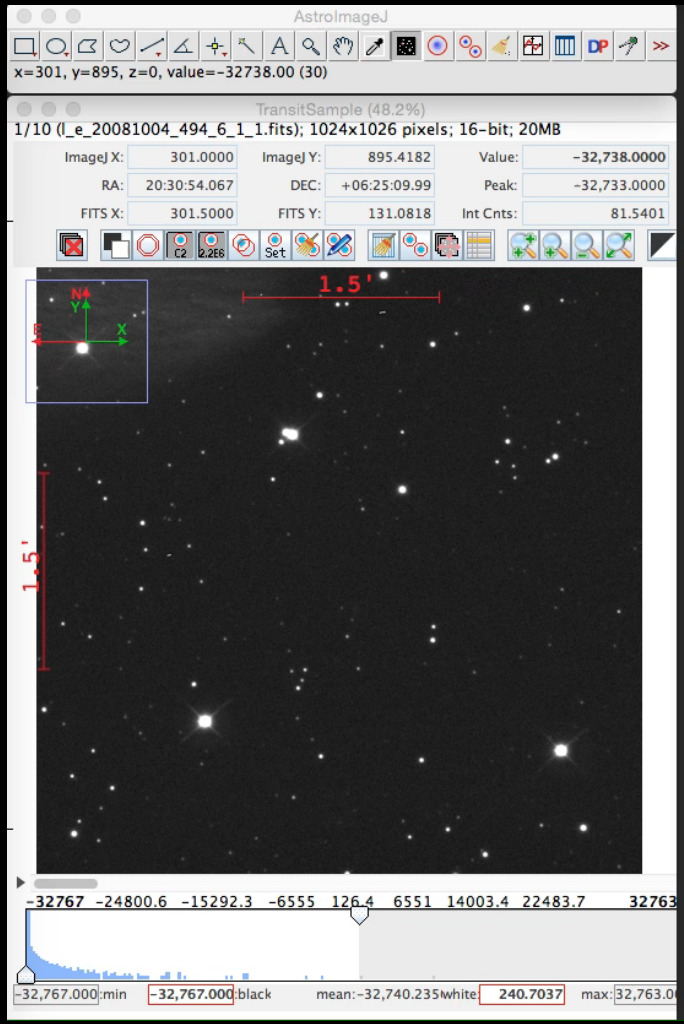
YOUR TASK!

DETAILS

1) **Analyse images from telescopes**
2) Plot a light curve of the exoplanet



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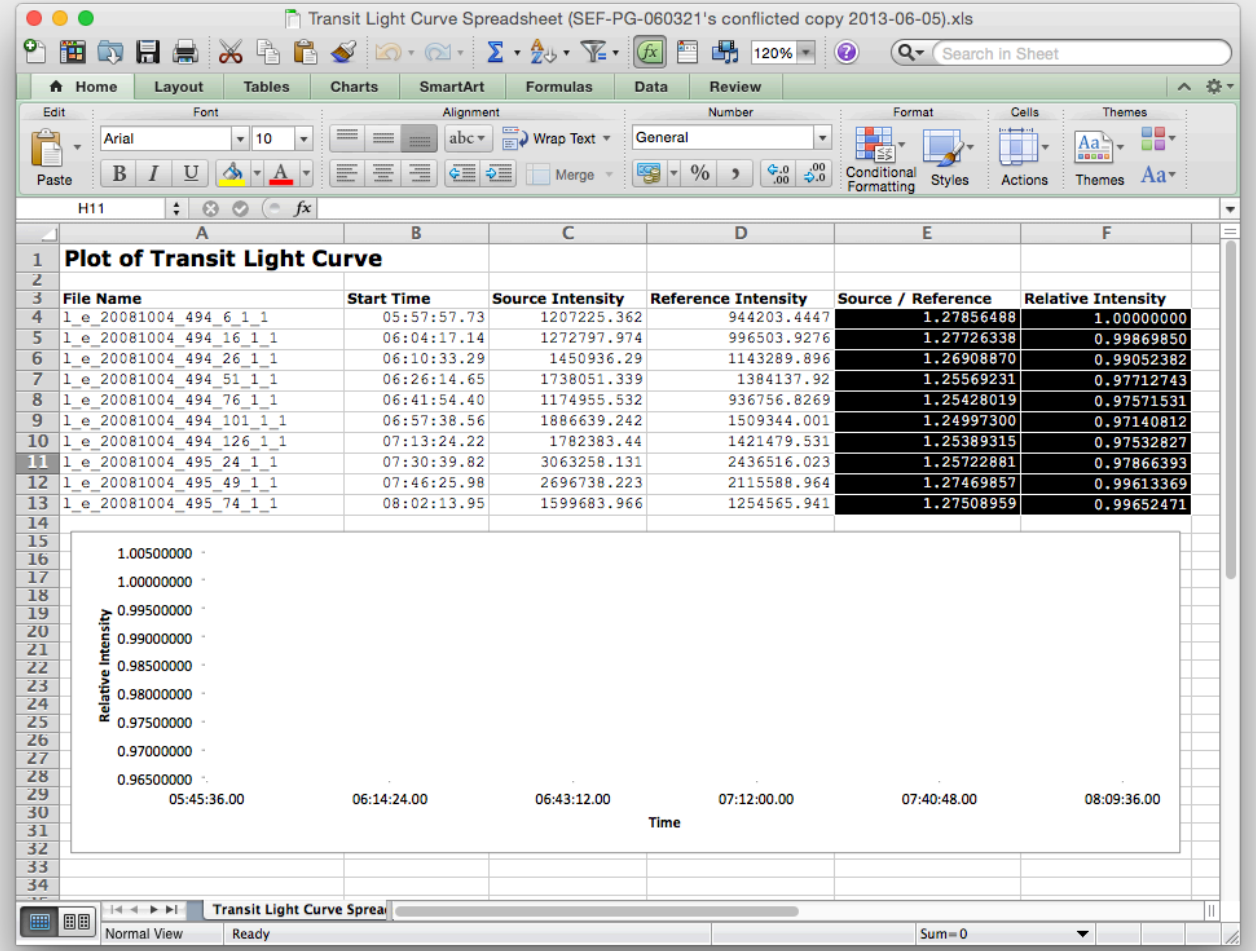

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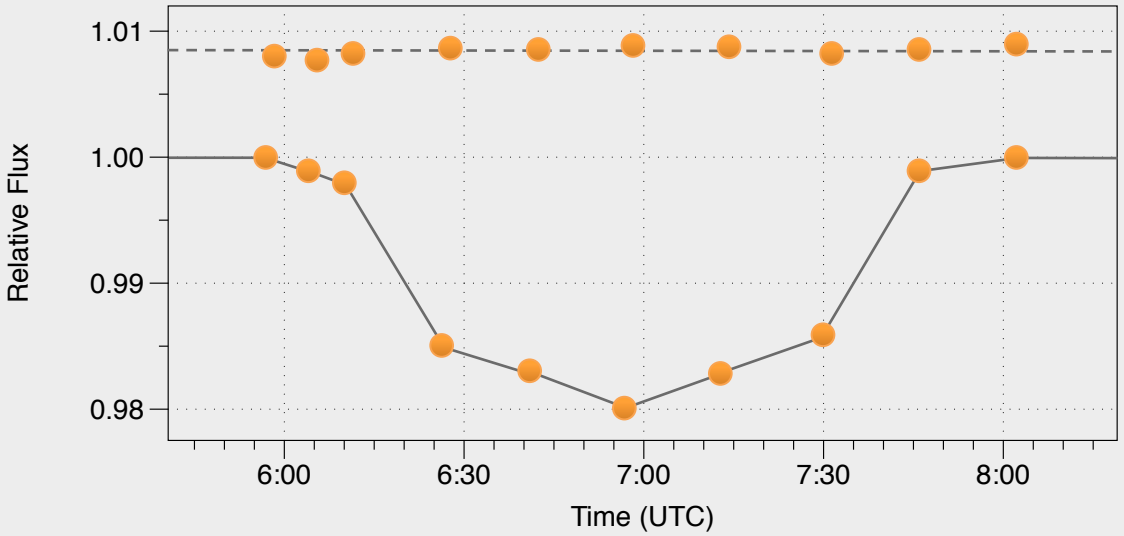
TASK
RESULTS

DETAILS

Exoplanet and stellar observables are extracted from the information encoded in the transit light curve by way of stellar classification and geometric analysis



$$\frac{L_*}{L_\odot} = \left(\frac{M_*}{M_\odot}\right)^4 \rightarrow M_* = M_\odot \left(\frac{L_*}{L_\odot}\right)^{1/4} = 0.84\, M_\odot$$

$$T \approx \frac{P}{\pi}\left[\left(\frac{R_*}{a}\right)^2 - \cos^2 i\right]^{1/2} \rightarrow R_* \approx \frac{T\pi a}{P} = 0.73 R_\odot$$

$$\Delta F \approx \left(\frac{R_p}{R_*}\right)^2 \rightarrow R_p \approx \sqrt{\Delta F} R_* = 1.05 R_J$$

$$\frac{a^3}{P^2} = \frac{G\left(M_* + M_p\right)}{4\pi^2} \rightarrow a \approx \left(GM_*\left(\frac{P}{2\pi}\right)^2\right)^{1/3} = 0.031 \text{ AU}$$

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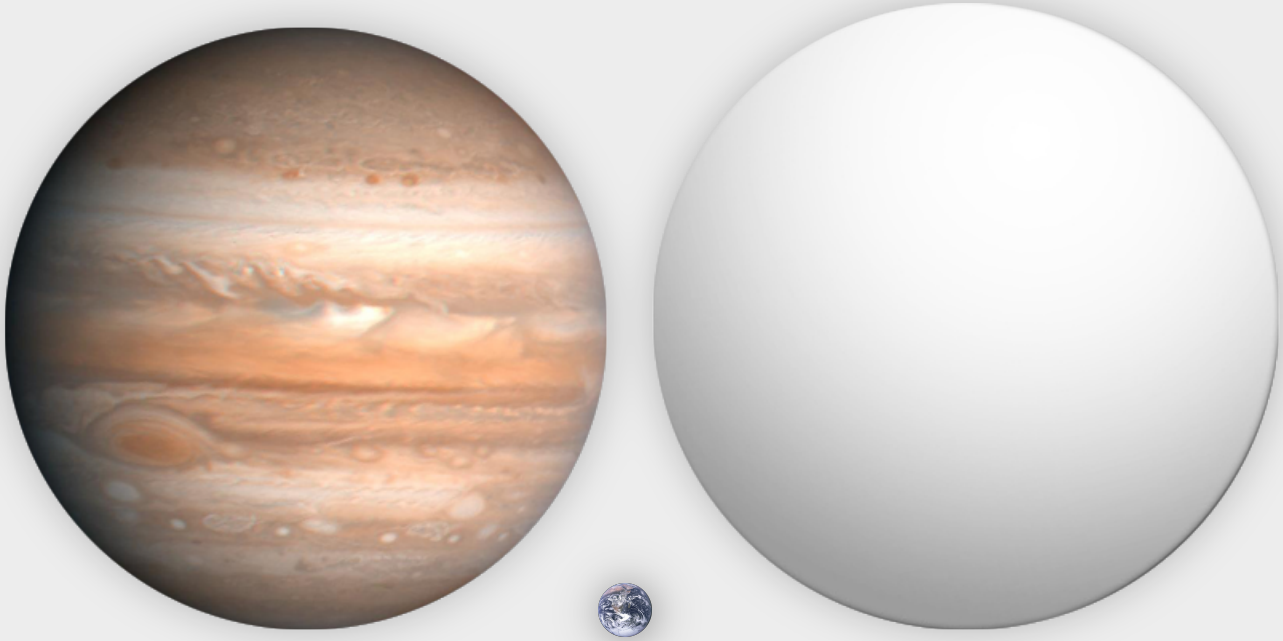
EXOPLANET WASP-2B

DETAILS

WASP-2b was detected in 2004 by the Super-WASP transit survey and later found to be a gas giant with a mass, size and composition similar to Jupiter



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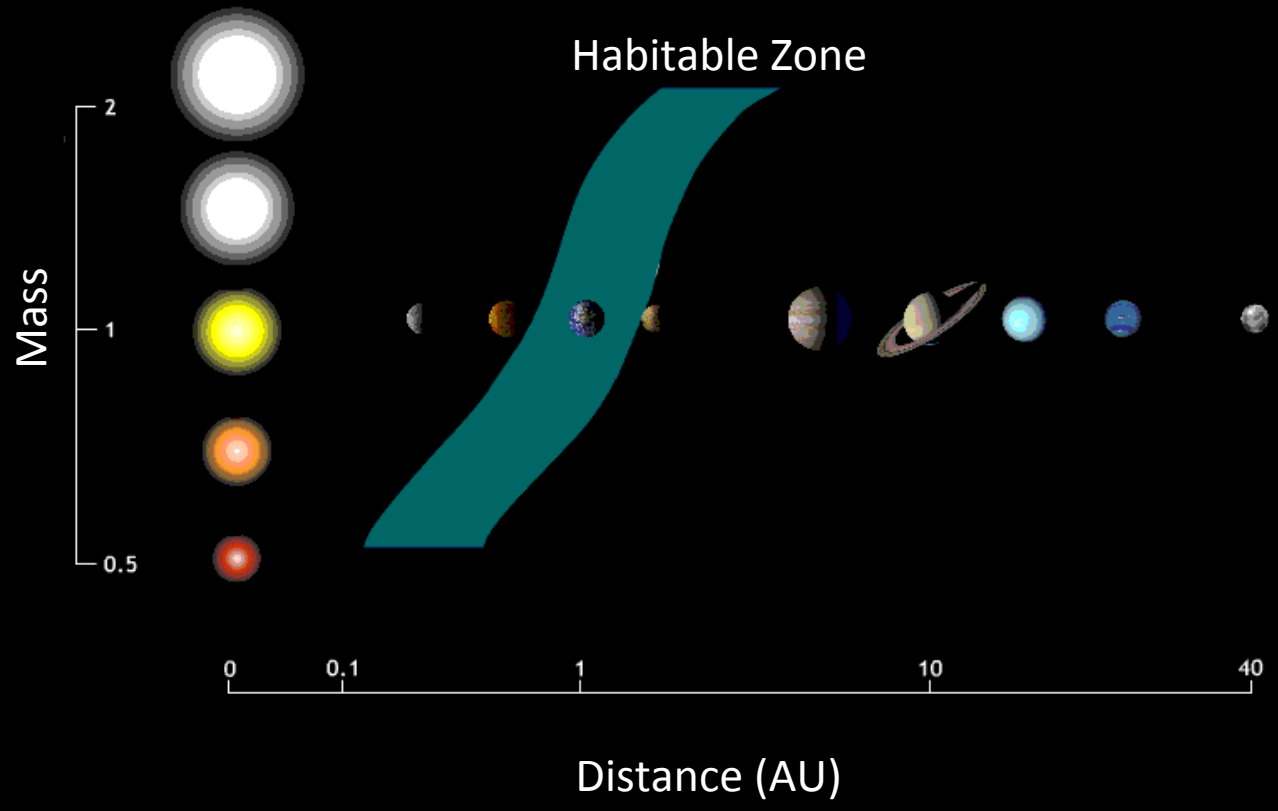
EXOPLANET WASP-2B

DETAILS

Is WASP-2b habitable?



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EXOPLANET WASP-2B

DETAILS

Is WASP-2b habitable?

Parameter	Calculated	Accepted Values
WASP-2 Mass	$0.84 \pm 0.10\ M_{\odot}$	$0.85 \pm 0.10\ M_{\odot}$
WASP-2 Radius	$0.73 \pm 0.10\ R_{\odot}$	$0.78 \pm 0.06\ R_{\odot}$
WASP-2b Radius	$1.05 \pm 0.27\ R_{J}$	$0.96 \pm 0.30\ R_{J}$
Orbital Distance	0.031 ± 0.001 AU	0.031 ± 0.001 AU

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EXOPLANET WASP-2B

DETAILS

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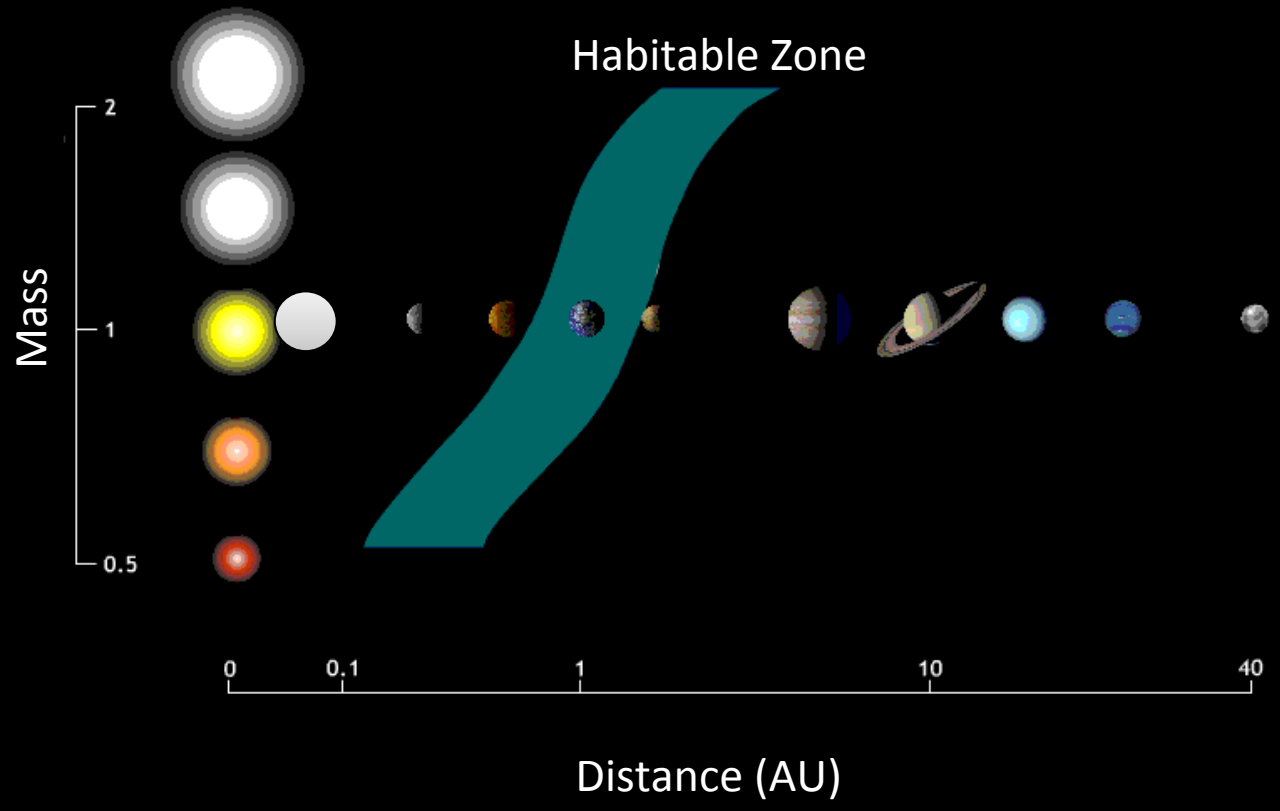

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EXOPLANET WASP-2B

DETAILS

Is WASP-2b habitable?

Too close to star and too hot!

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UNIQUE EXOPLANETS

DETAILS

Kepler-78b is similar in size and mass to Earth, but orbits around its parent star in an 8.5-hour orbit.

Imagine a planet where it could be your birthday, Christmas and New Year's Eve every day!

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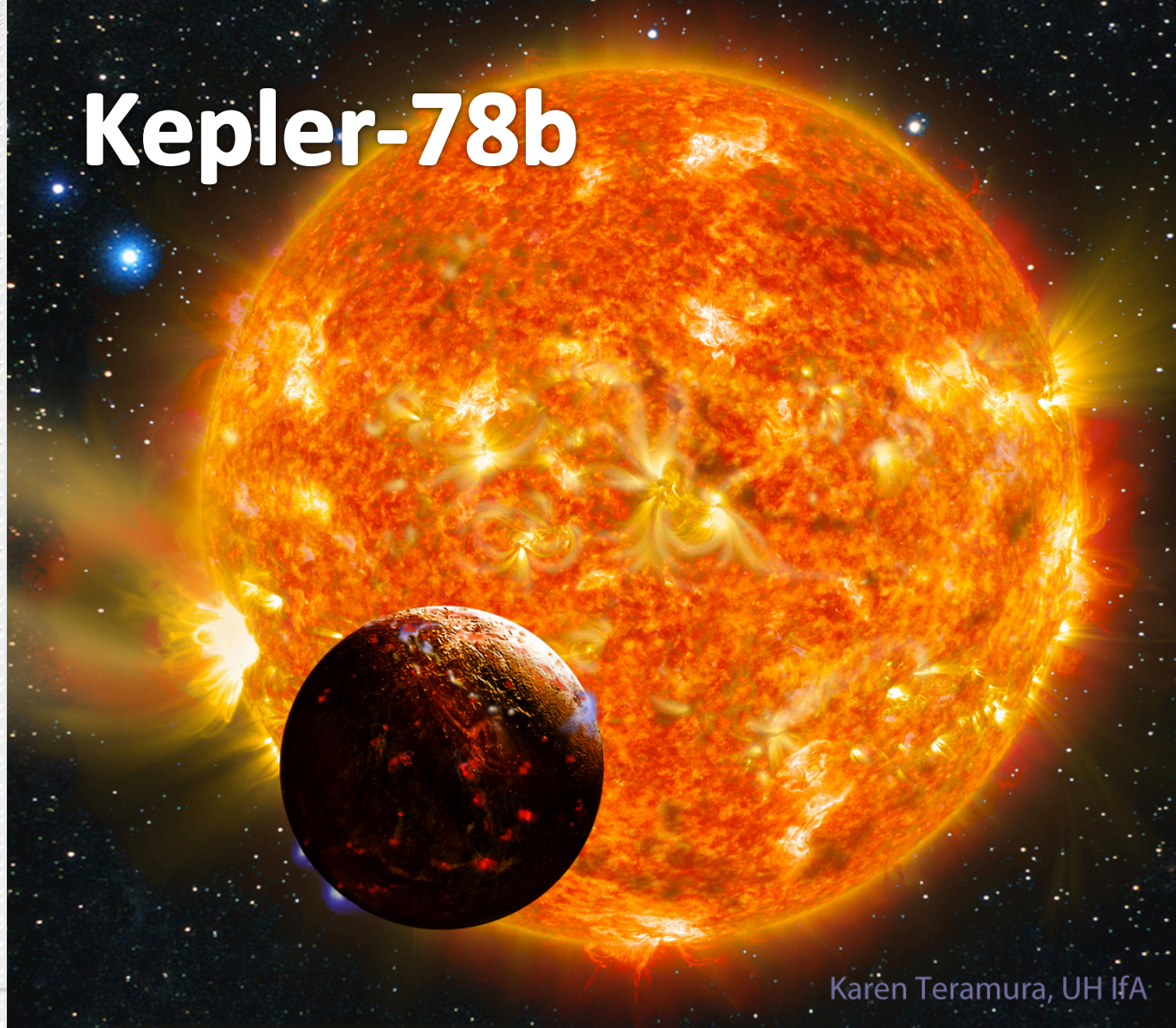

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UNIQUE EXOPLANETS

DETAILS

Due to the absence of reflective clouds, TrES-2b is darker than a piece of coal and only reflects about 1% of its light!

In addition to this, the planet is also tidally locked, which means one side always faces the star - perpetual daytime!

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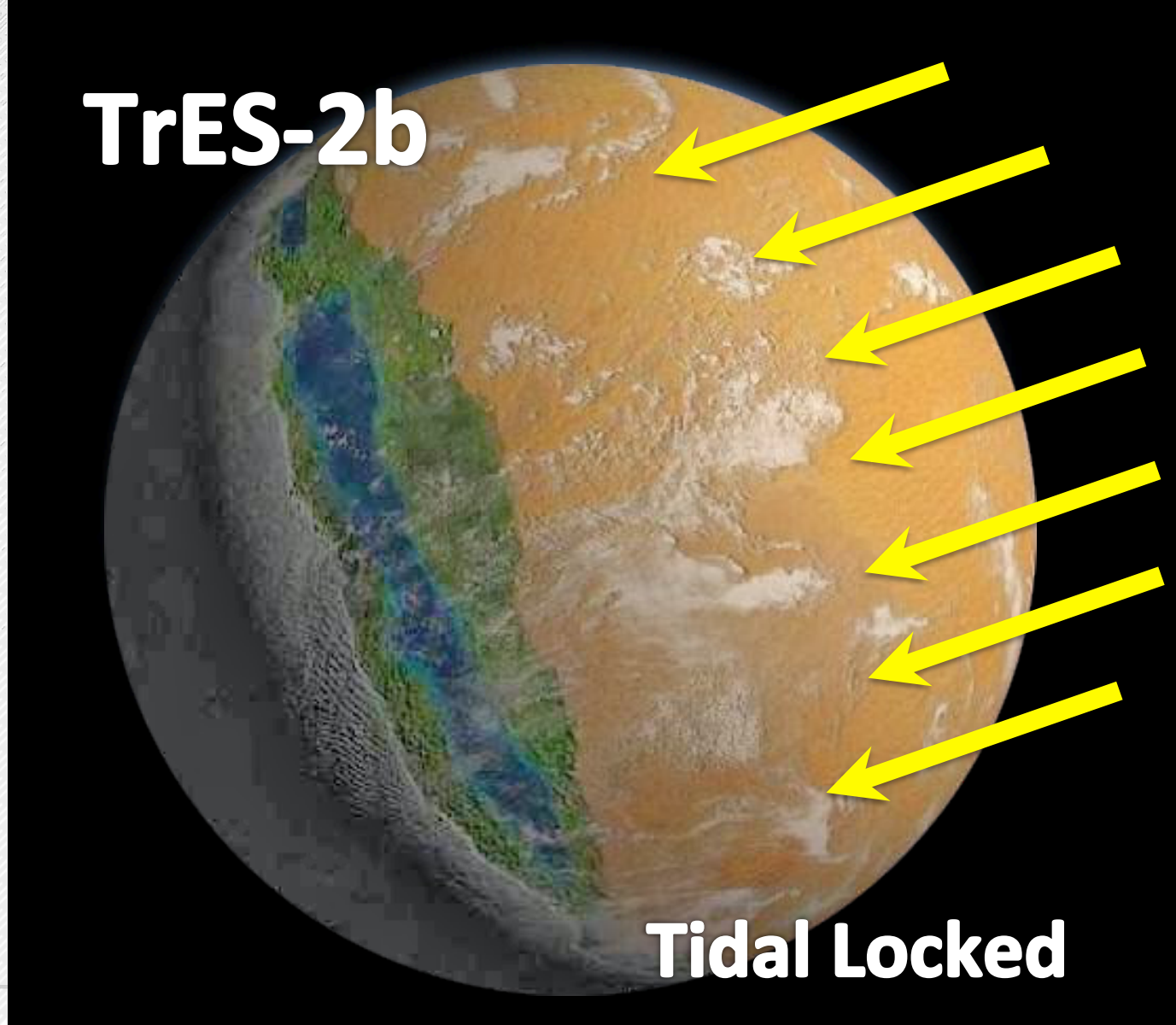

UNIQUE EXOPLANETS

DETAILS

A Saturn-sized planet that takes 221 days to orbit around binary stars.

If Kepler-16b was habitable and you could stand on its surface, you'd cast two shadows!

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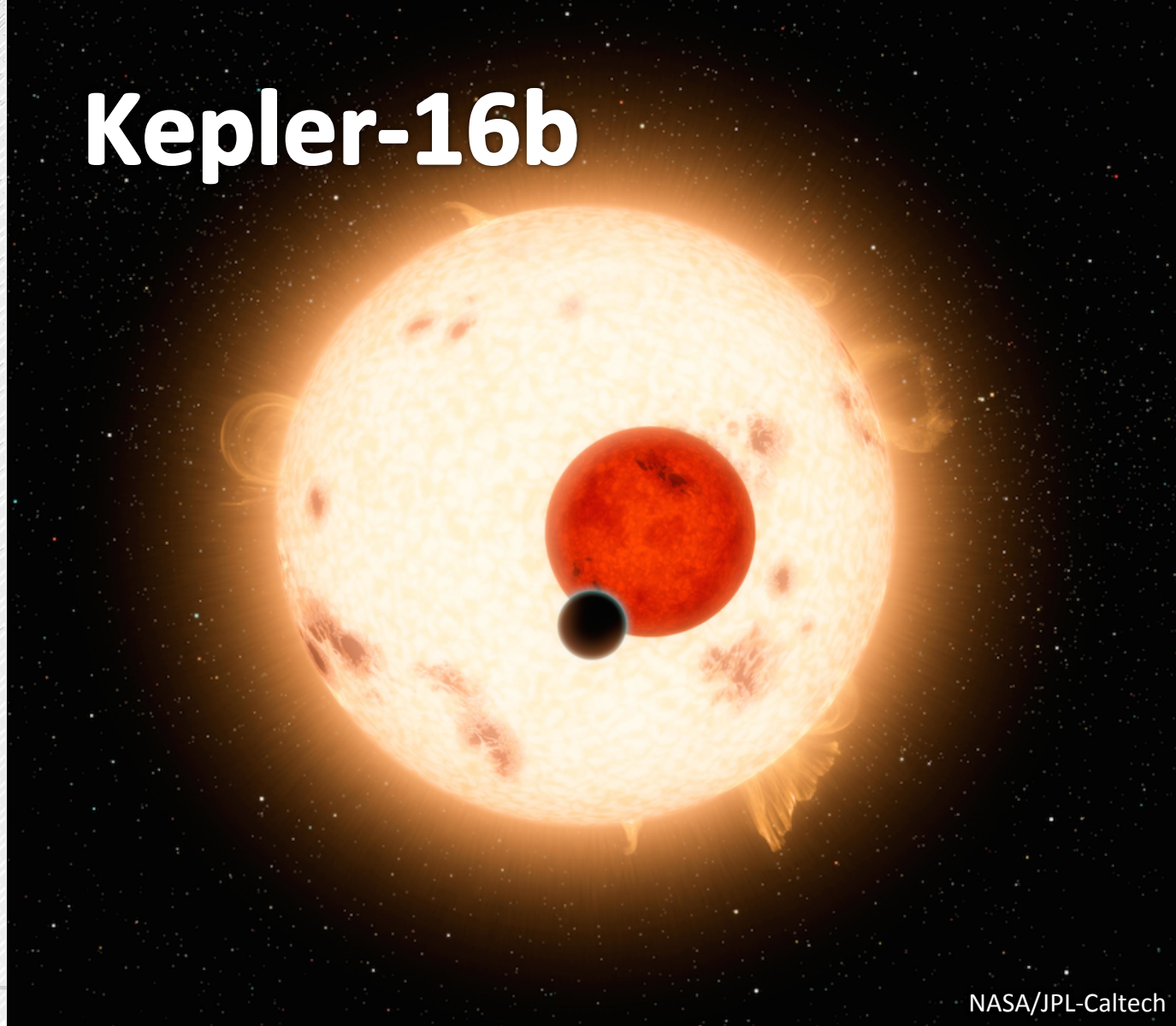

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HOW MANY?

DETAILS

Astronomers estimate that our galaxy, the Milky Way, is home to at least 100 billion planets.

Our Galaxy

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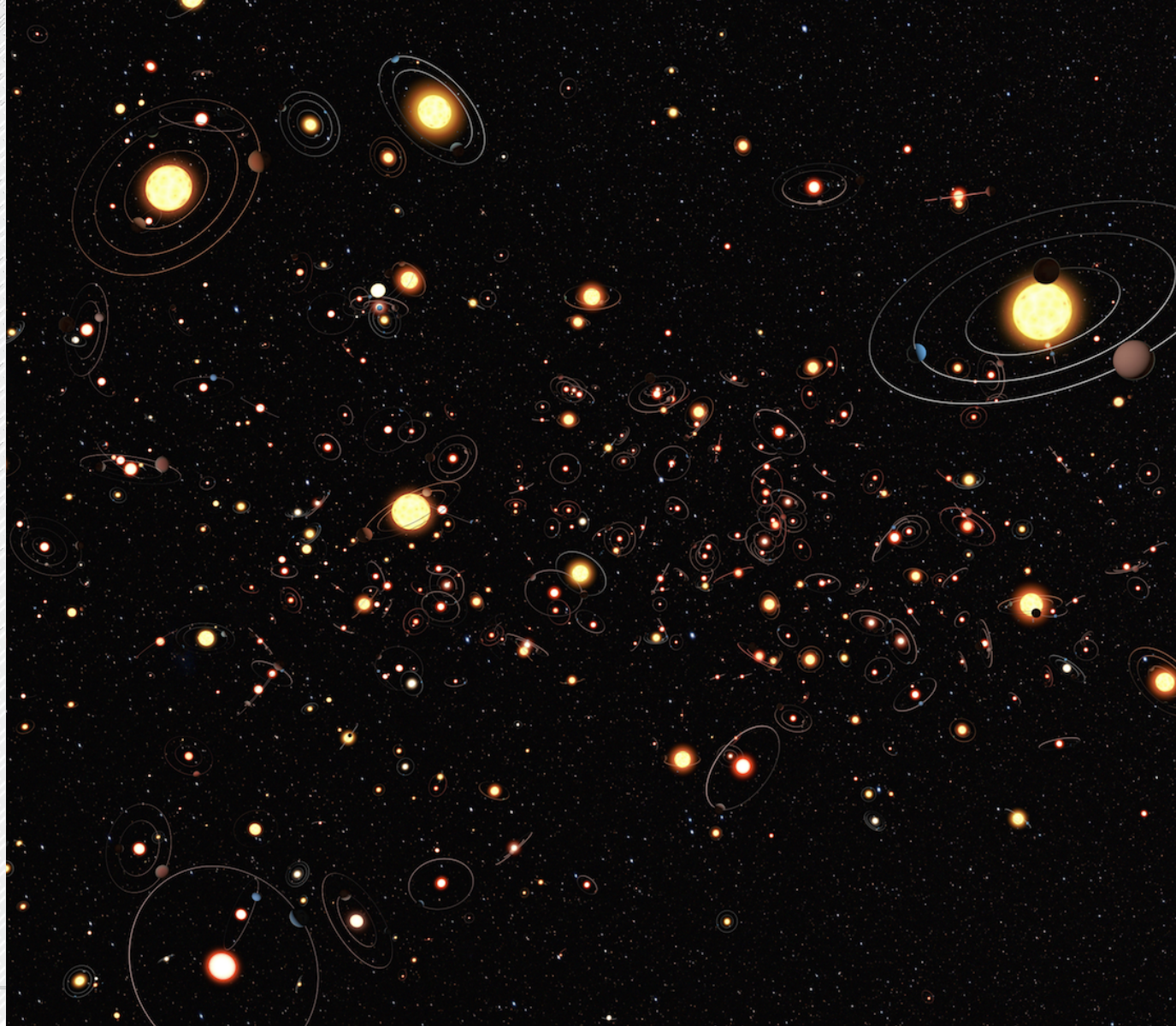

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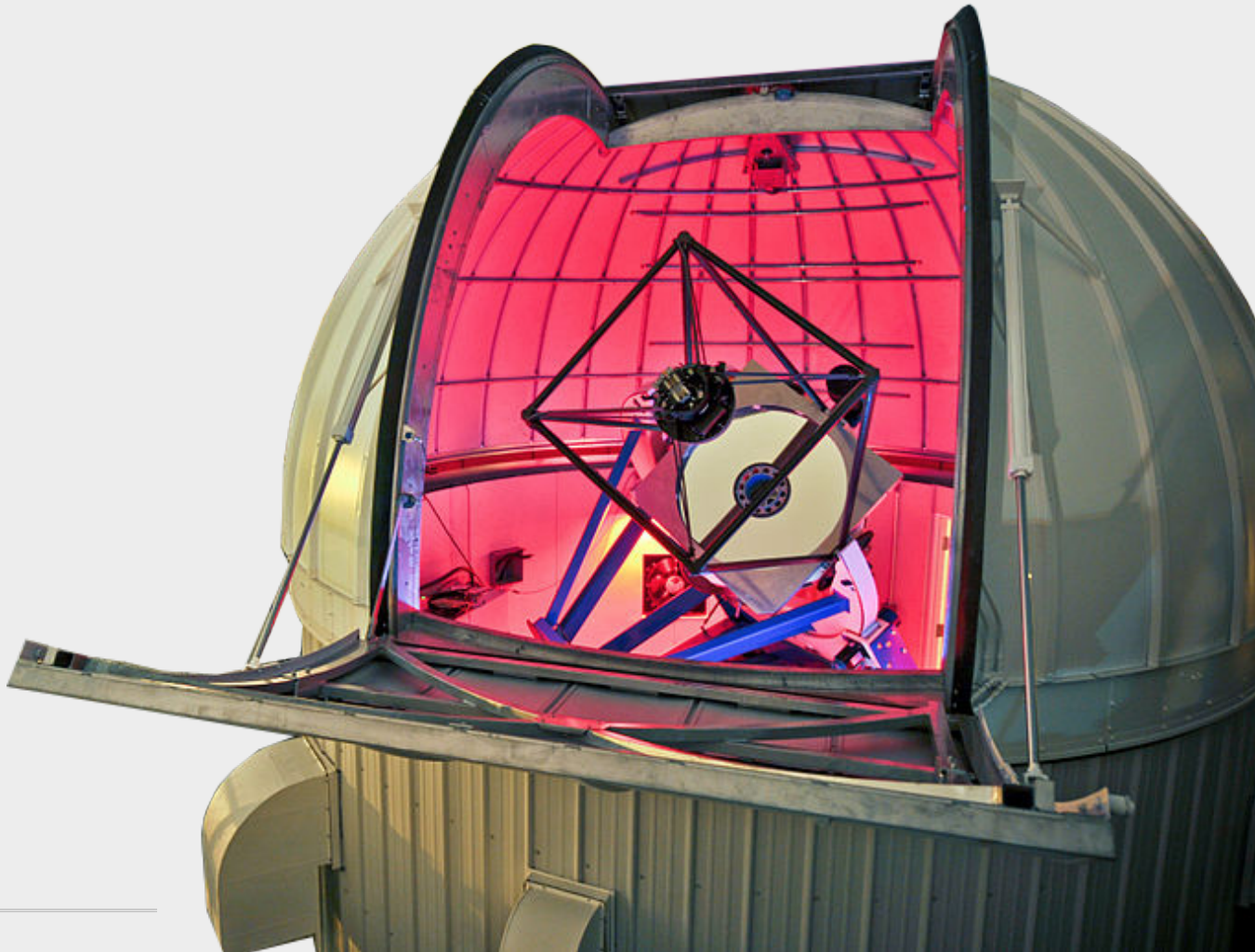
GROUND SEARCHES

DETAILS

Ground-based telescopes have to contend with the obscuration and instability of our own atmosphere, limiting them primarily to the detection of larger planets.



Faulkes Telescope North
located on Haleakala in Maui

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GROUND SEARCHES

DETAILS

Adaptive optics are being incorporated into existing and next generation telescopes as a means to improve the performance of optical systems by reducing the effects of atmospheric distortion.

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The planned European Extremely Large Telescope

European Southern Observatory (ESO)

SPACE SEARCHES

DETAILS

By extending transit surveys to space, the limitations associated with Earth's atmosphere can be completely bypassed, allowing for uninterrupted, high resolution observations.

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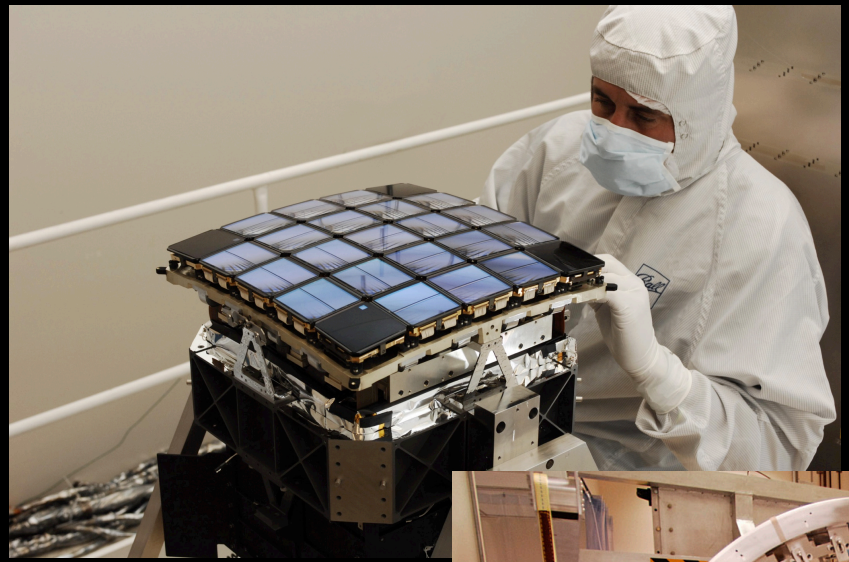
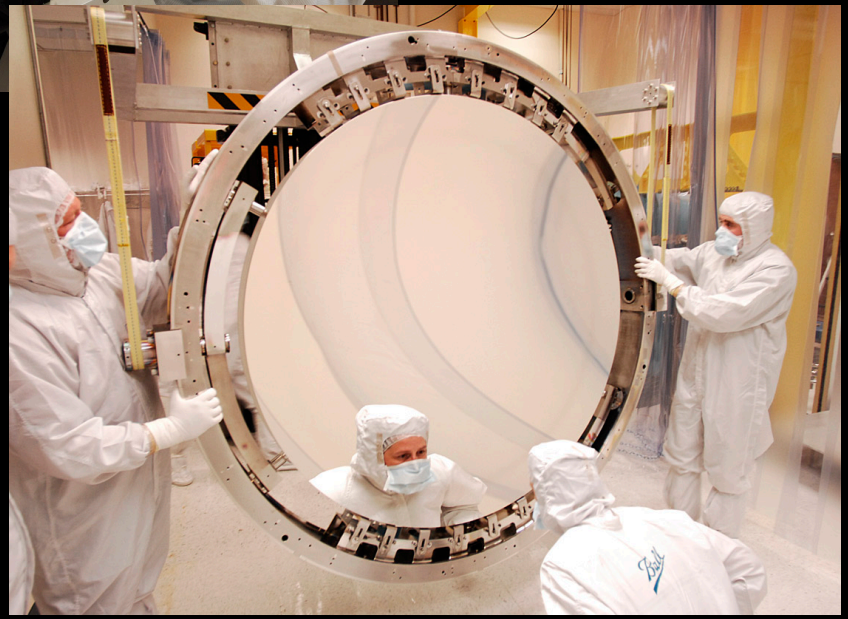
KEPLER TELESCOPE

DETAILS

Launched March 2009 into a heliocentric orbit and tasked with monitoring a field in the Cygnus-Lyra region to detect Earth-like planets. Kepler uses a 1m aperture telescope and an array of 42 CCDs to perform observations.





NASA/Ames Research Center/Kepler Mission

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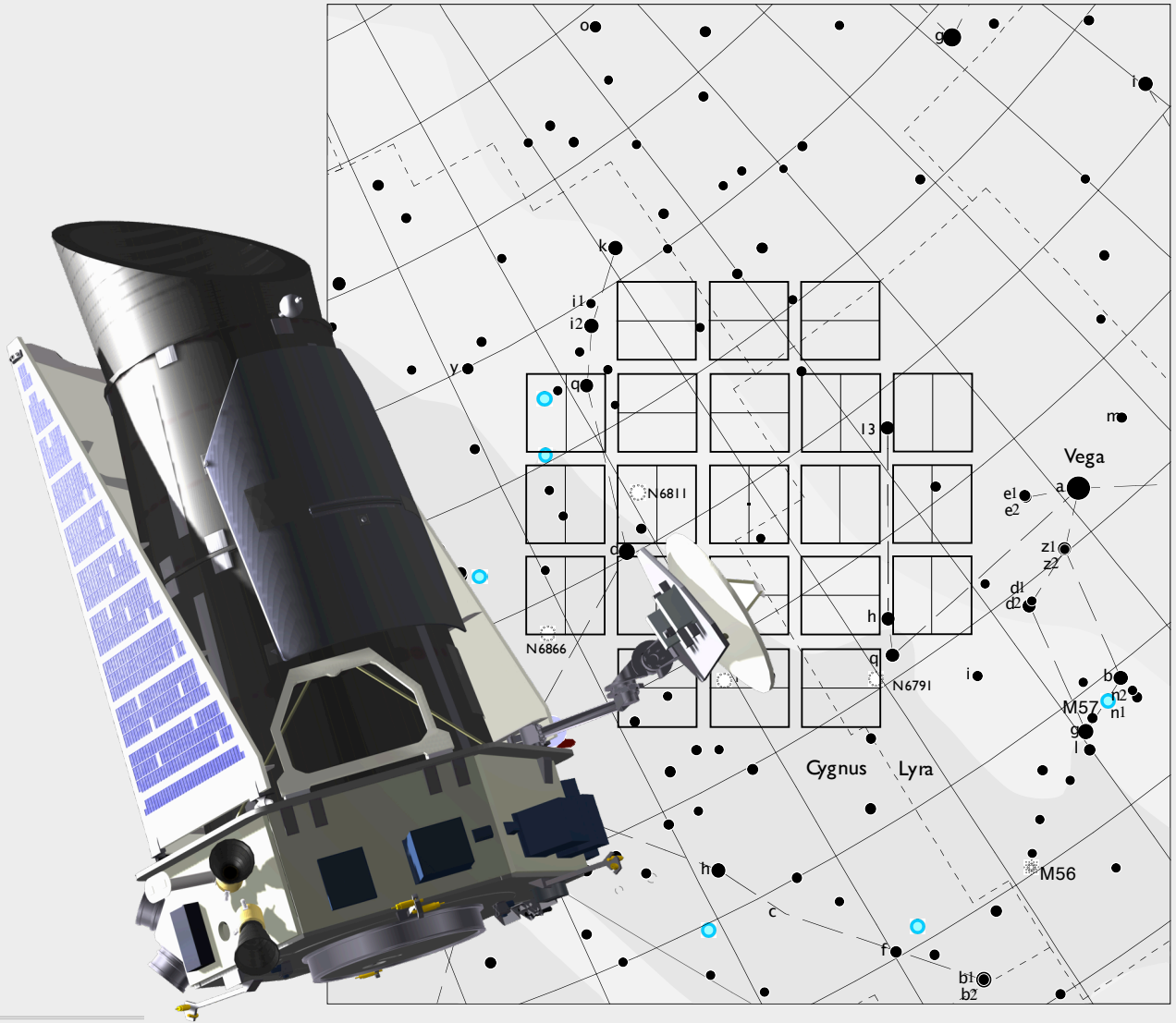

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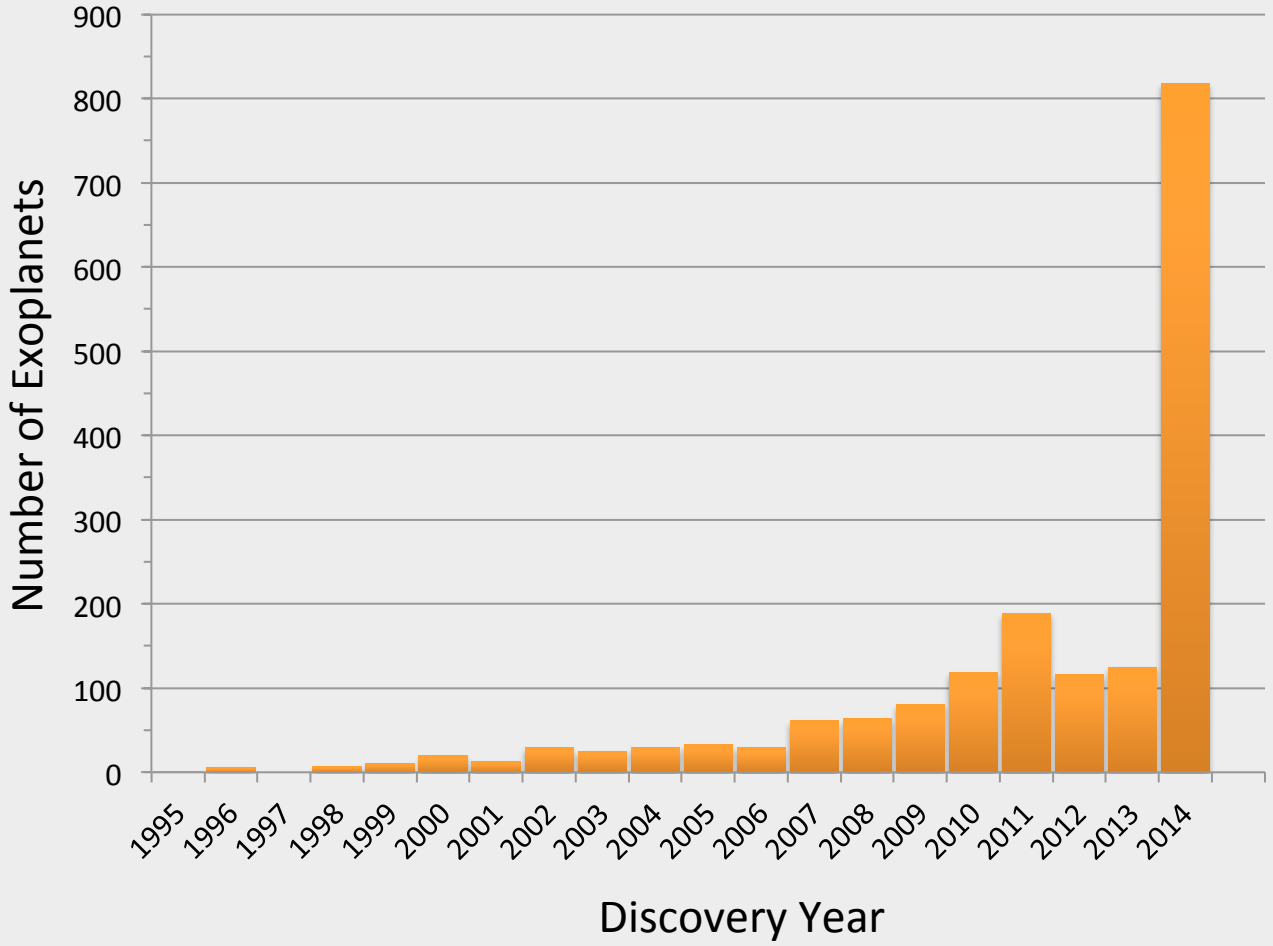
EXOPLANET DETECTIONS

DETAILS

The first exoplanet, orbiting a Solar-type star, was discovered in 1995. As of last Friday, there have been 1,795 confirmed exoplanet detections. Kepler is responsible for 1,000 of them!



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LOOKING FOR MORE?

DETAILS

Head to

web.science.mq.edu.au/~mcowley/education/exoplanet/

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