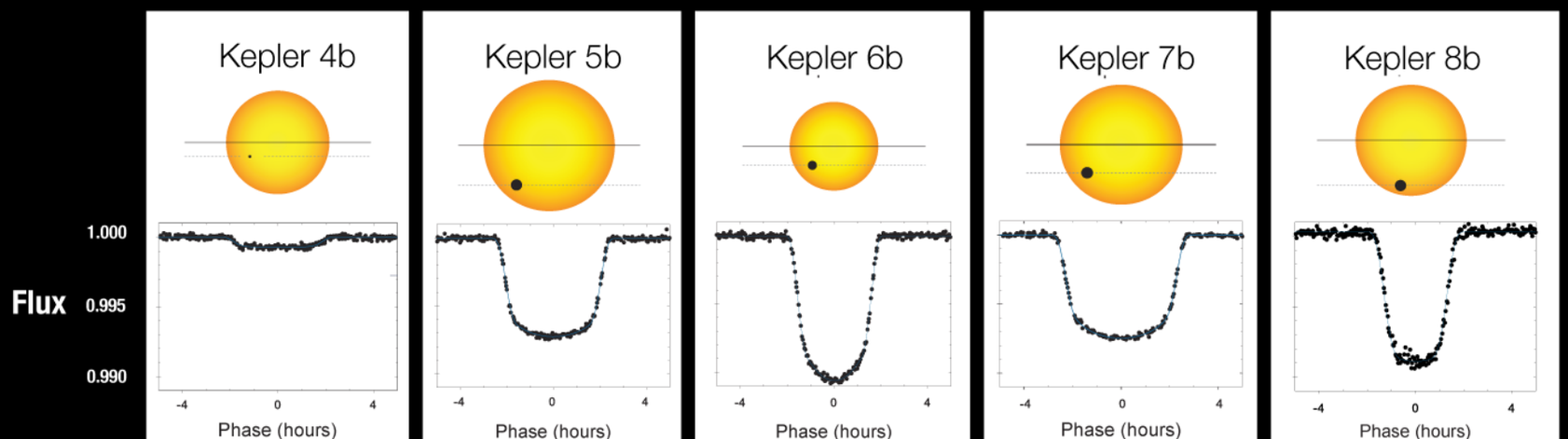
Astro 16: class 24

Tuesday, December 2, 2014

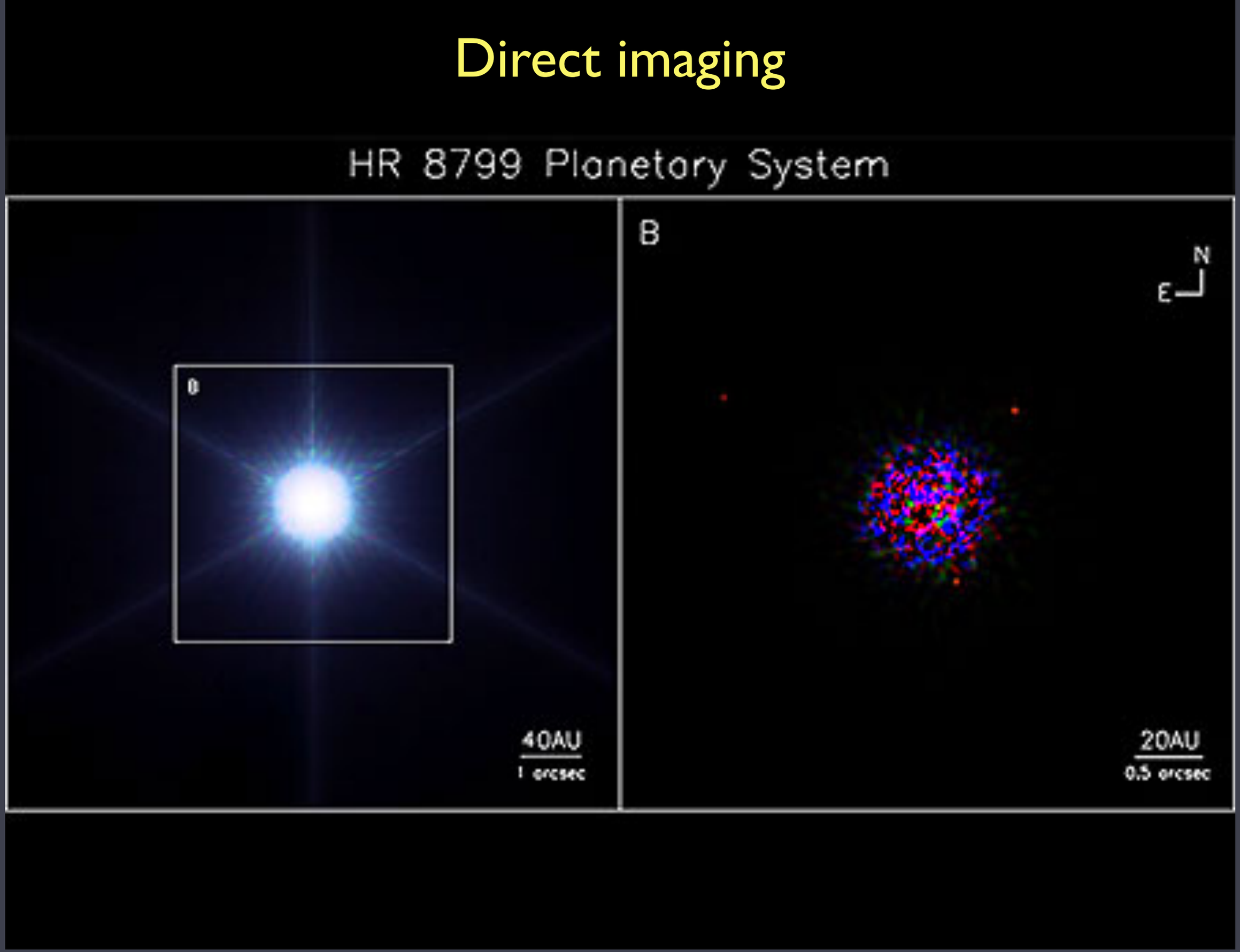
Transit Light Curves



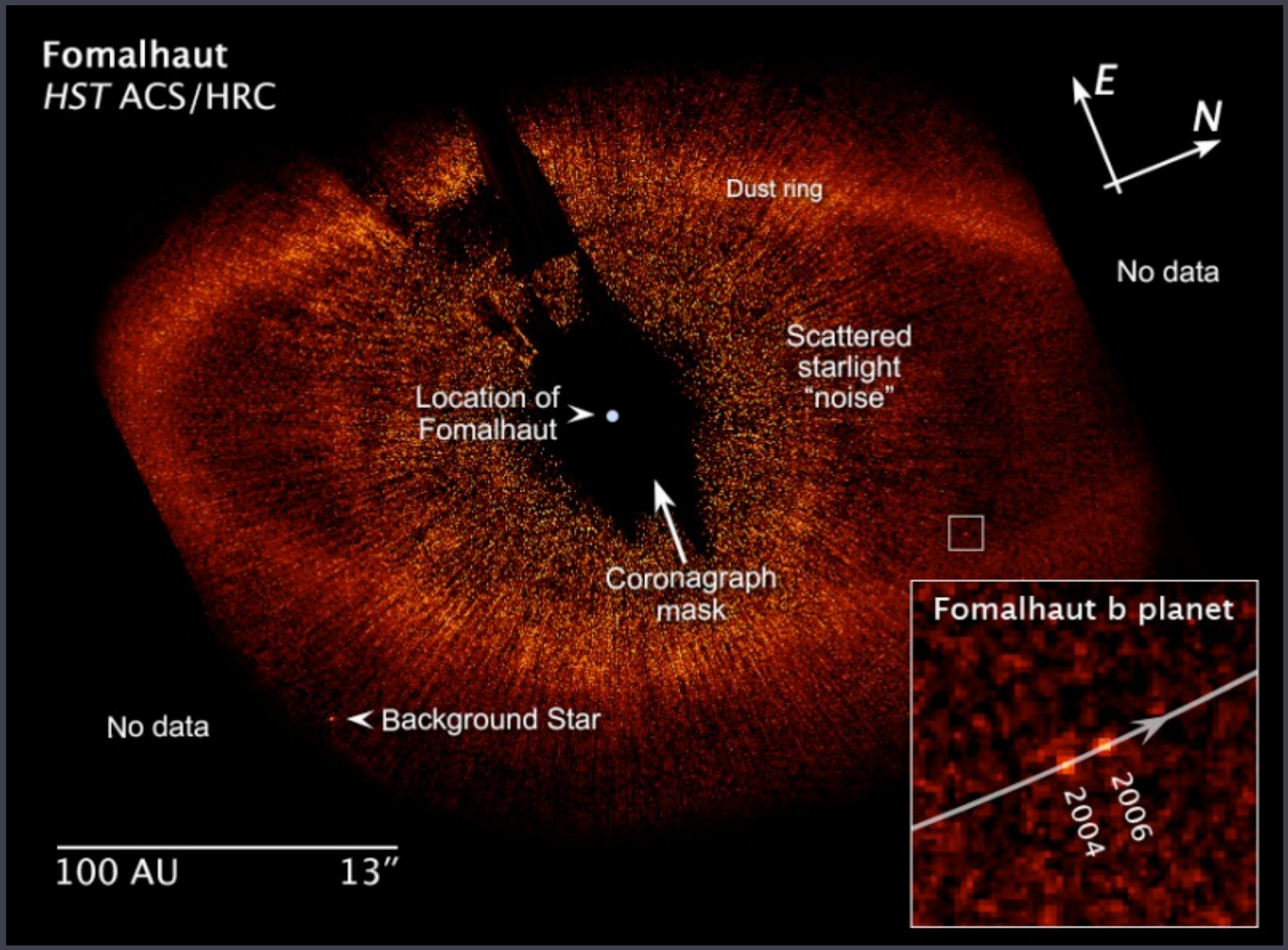
	Kepler 4b	Kepler 5b	Kepler 6b	Kepler 7b	Kepler 8b
Orbital Period (days)	*3.2 days*	*3.5 days*	*3.2 days*	*4.9 days*	*3.5 days*
Size (R_E)	*4.31*	*18.8*	*15.0*	*16.9*	*18.3*

Planets (and moons) shine by reflected sun/star-light

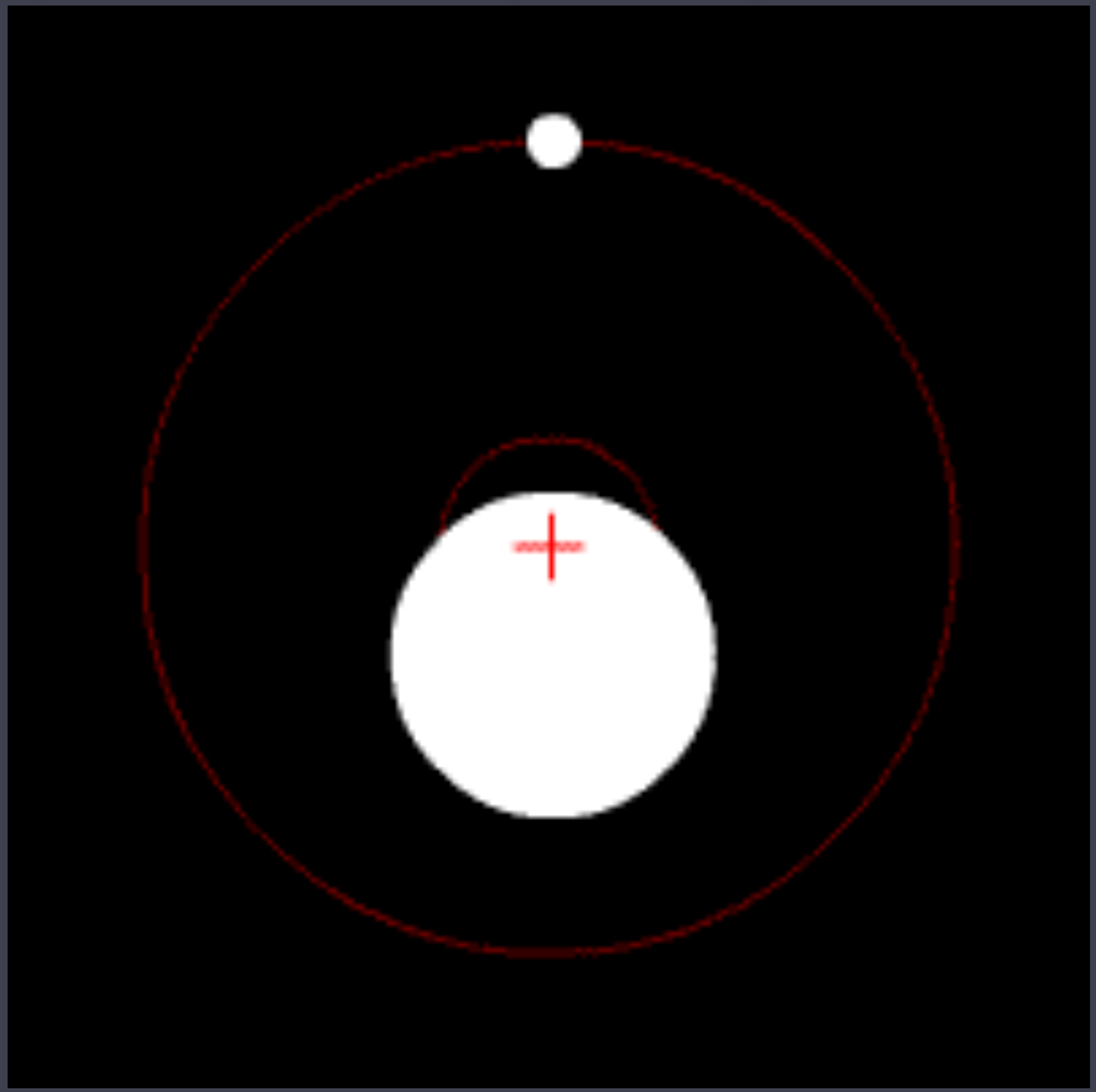
Direct imaging



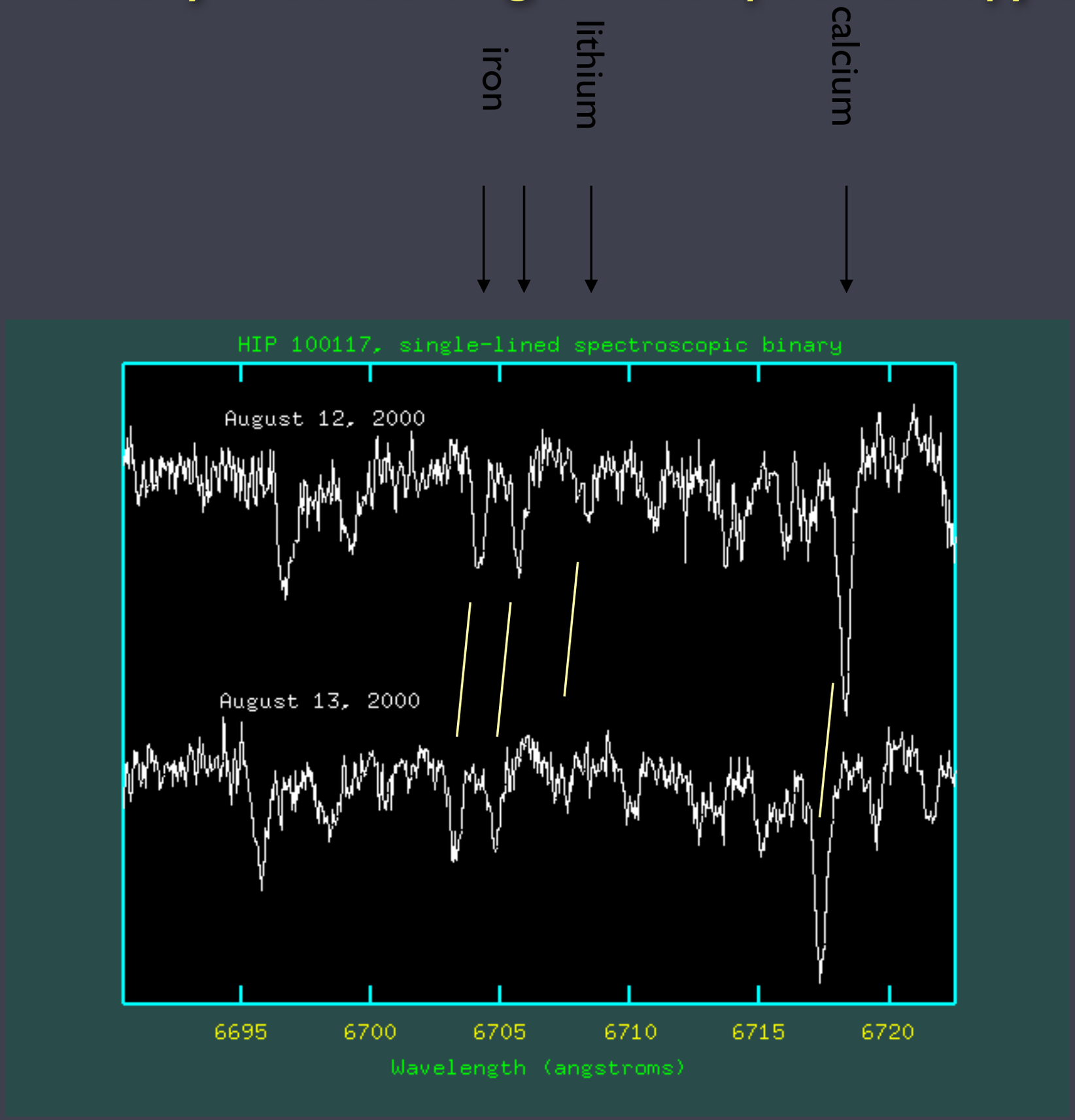
Fomalhaut b - is it a planet?



Center of mass: common orbital motion: more massive object moves too (but its speed is small)



Radial velocity method: single-lined spectroscopy binary



Venus transiting the Sun

Tranist...*plus* a "secondary eclipse"

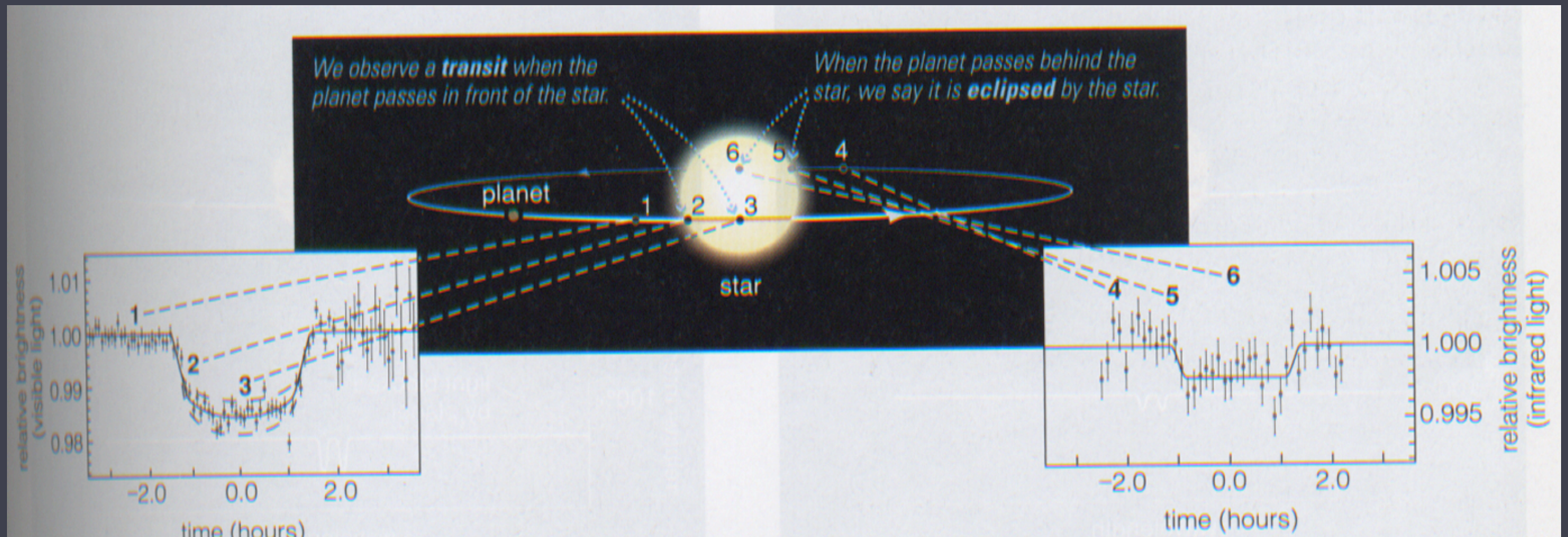
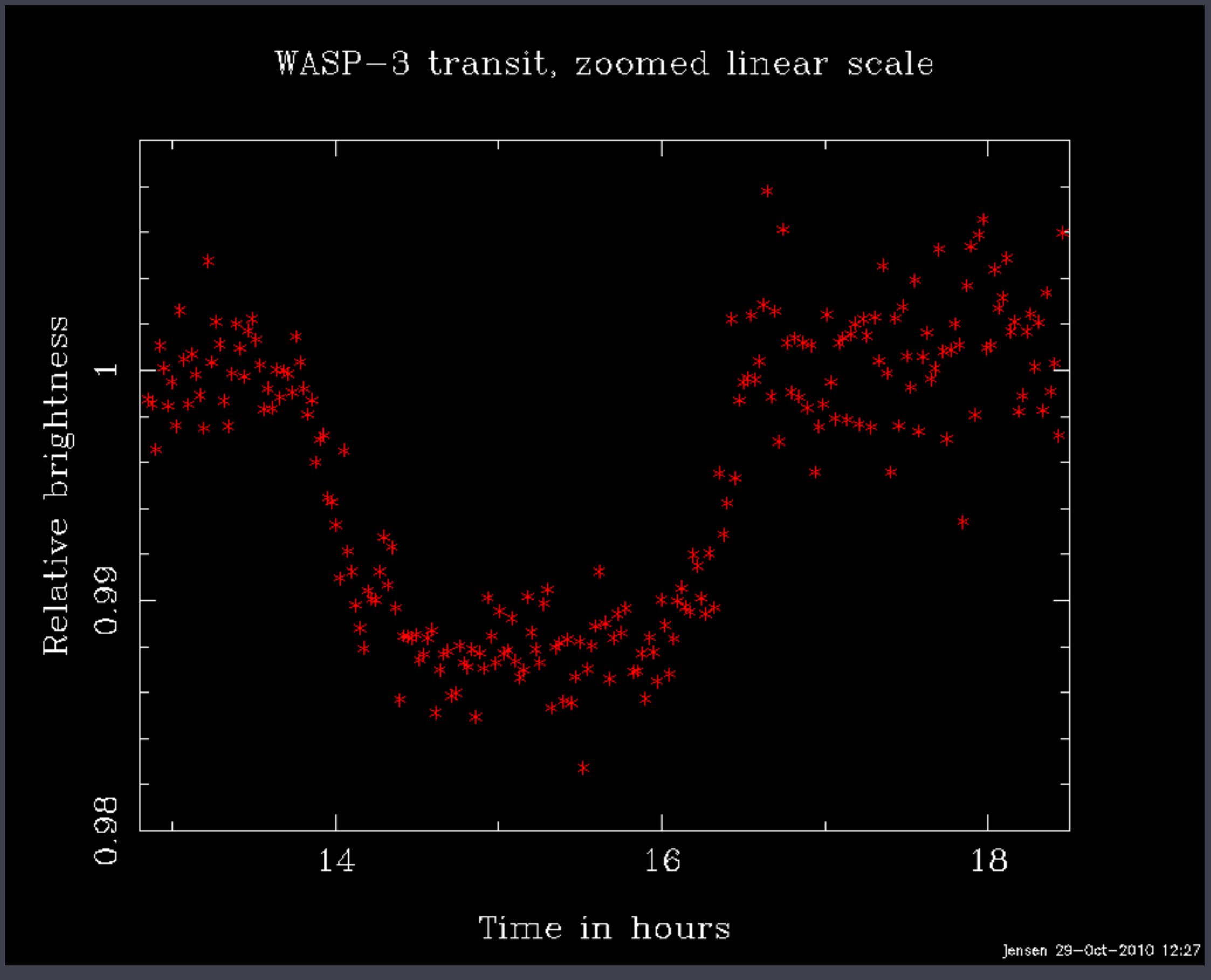
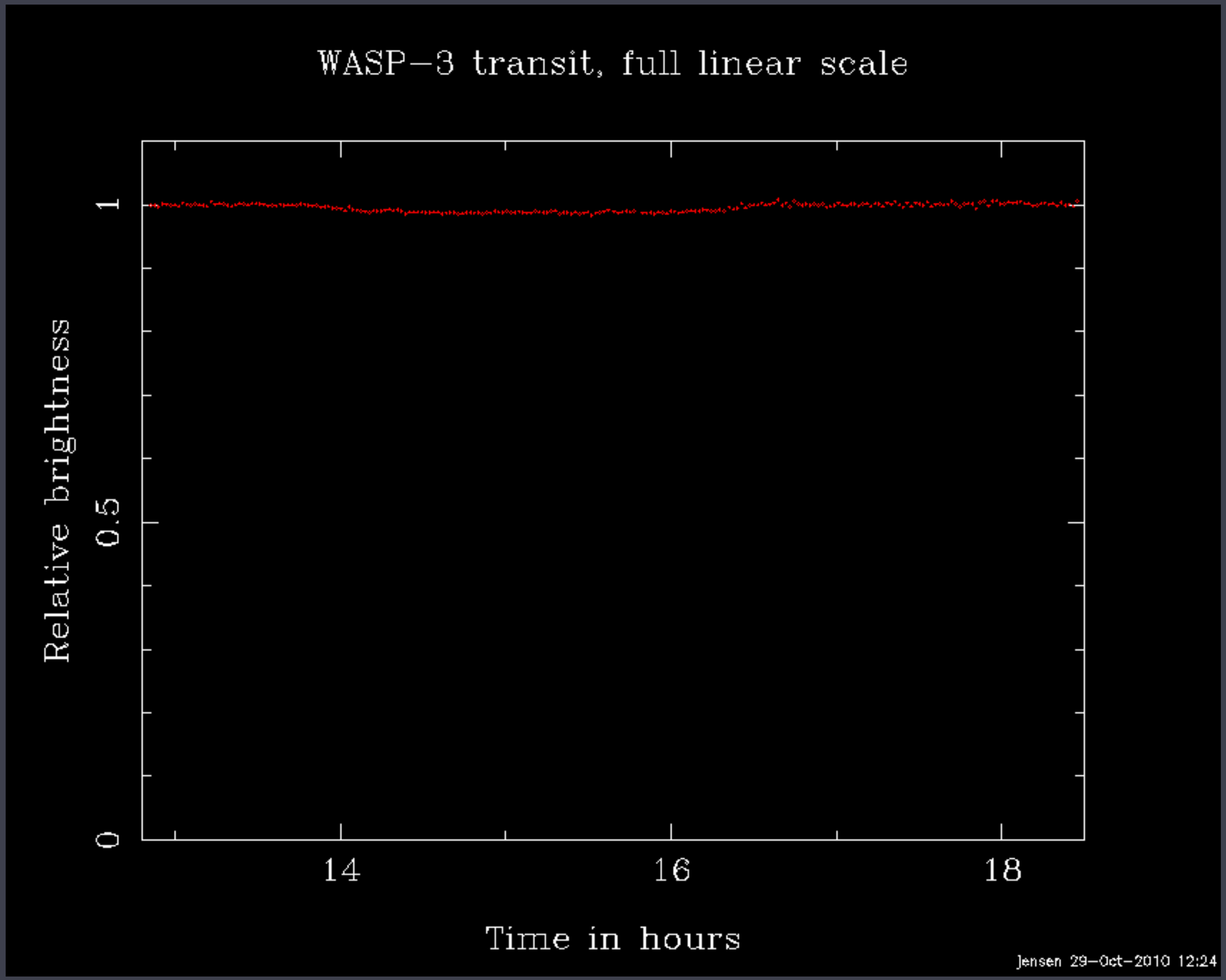
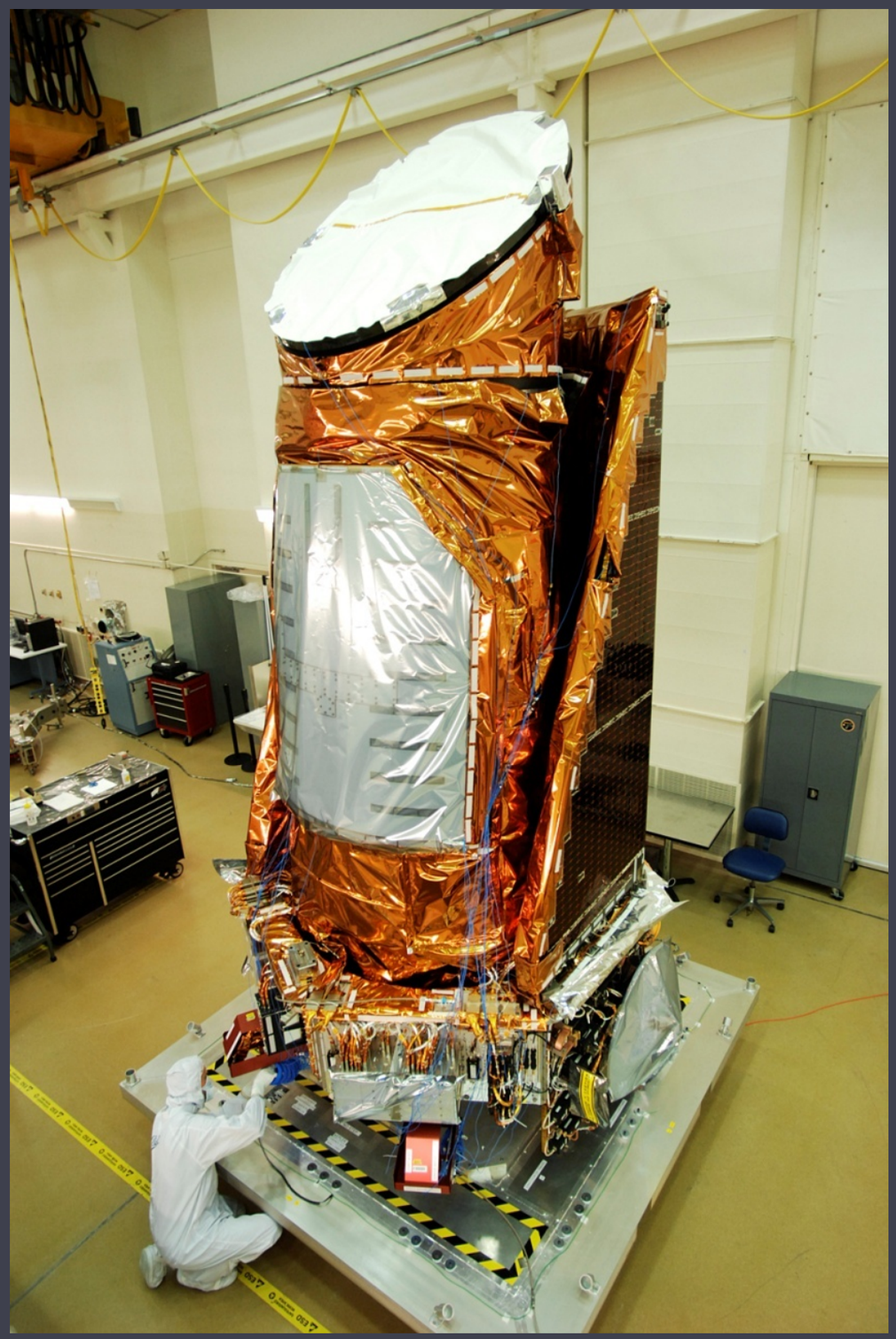


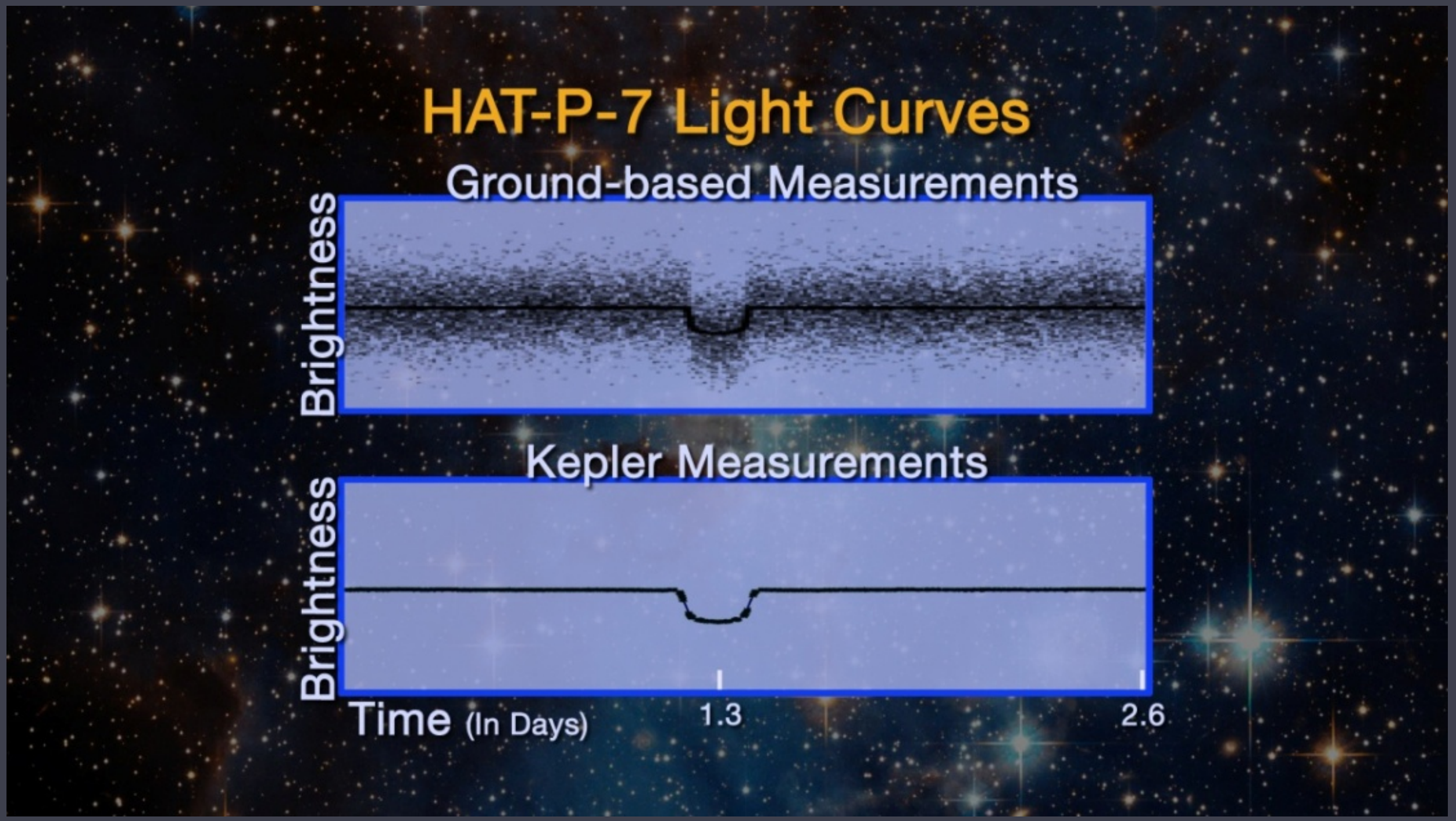
Figure 13.7 Interactive Figure The artist's conception (center) shows the planet orbiting the star HD209458. The graphs show how the star's brightness changes during transits and eclipses, which each occur once with every $3\frac{1}{2}$-day orbit. During a transit, the star's brightness drops for about 2 hours by 1.7%, which tells us how the planet's radius compares to the radius of its star. During an eclipse, the infrared signal drops by 0.25%, which tells us about the planet's thermal emission.


WASP−3 transit, zoomed linear scale
Relative brightness
1
0.99
0.98
14
16
18
Time in hours
Jensen 29−Oct−2010 12:27


WASP-3 transit, full linear scale
Relative brightness
1
0.5
0
14
16
18
Time in hours
Jensen 29-Oct-2010 12:24

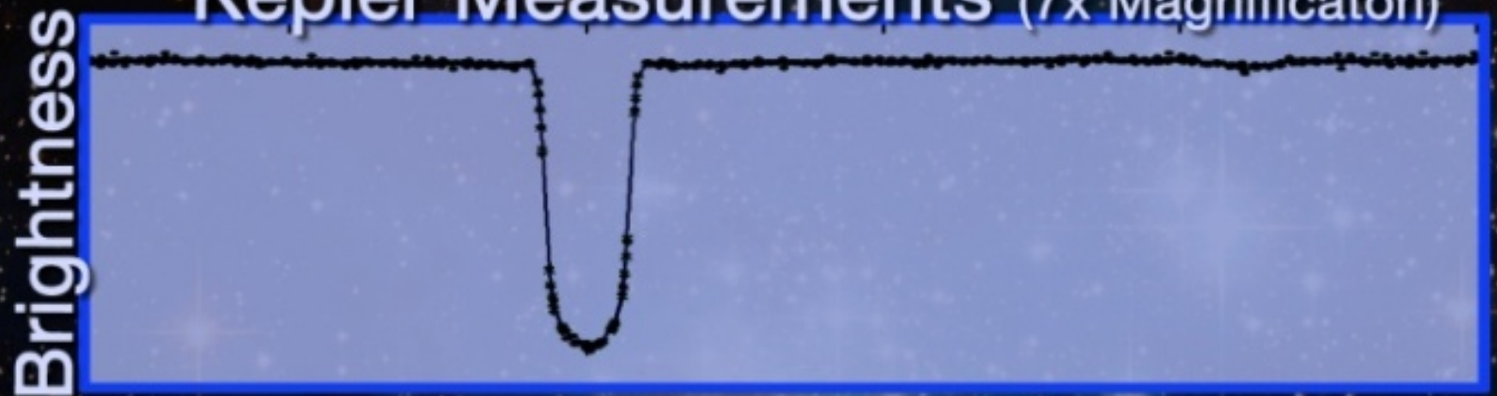
Kepler Mission (2009)



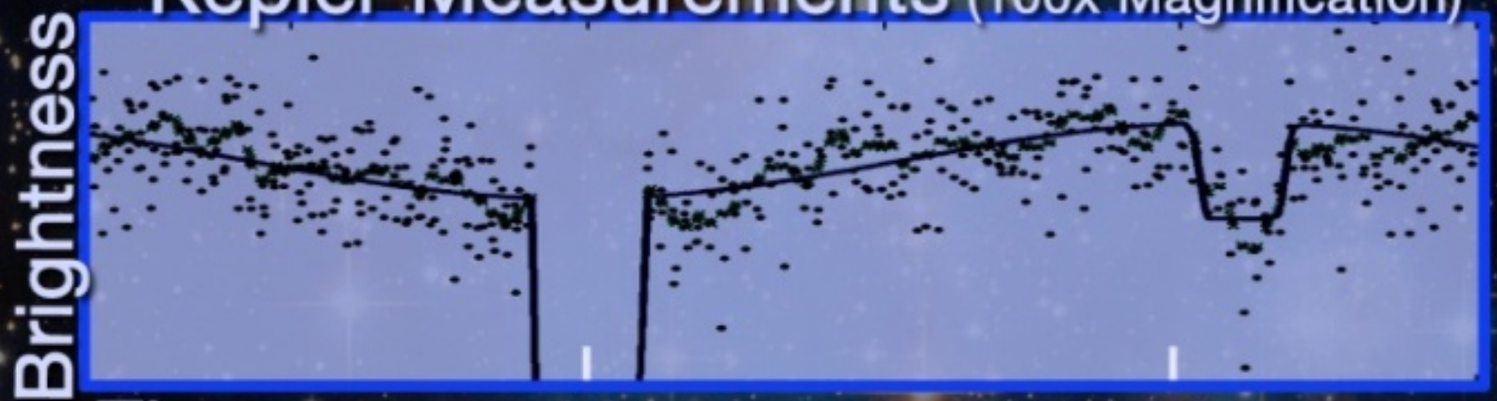

HAT-P-7 Light Curves
Ground-based Measurements
Brightness
Kepler Measurements
Brightness
Time (In Days)
1.3
2.6

HAT-P-7 Light Curves

Kepler Measurements (7x Magnificaton)

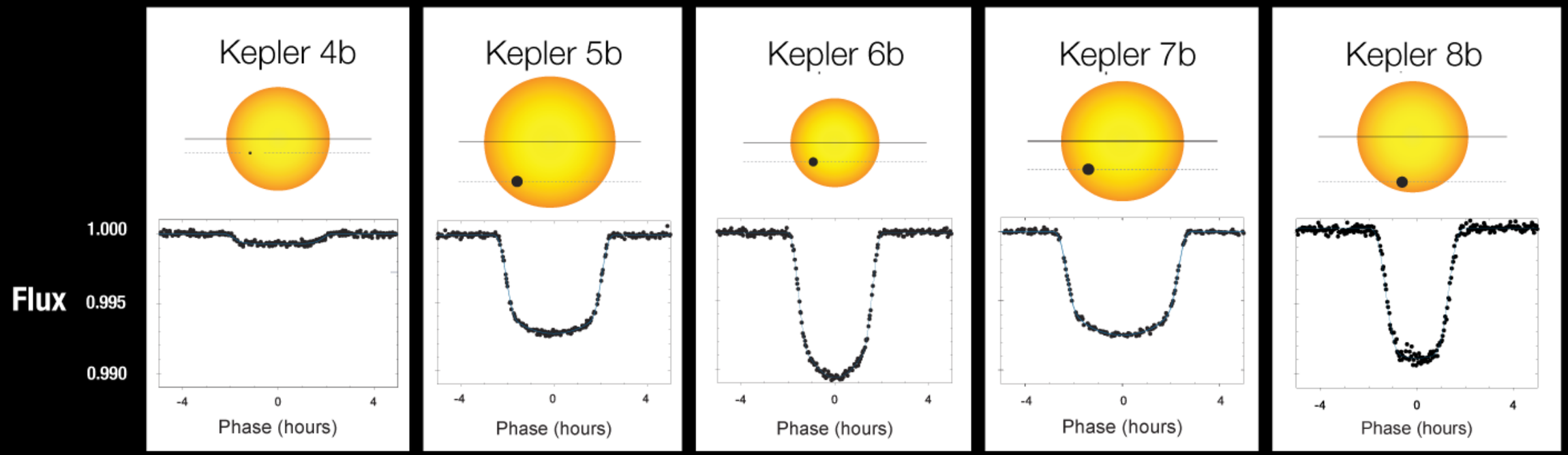


Kepler Measurements (100x Magnification)



Venus at different positions in its orbit: exoplanets should also reflect a small - and varying - fraction of their host star's light

Transit Light Curves



	Kepler 4b	Kepler 5b	Kepler 6b	Kepler 7b	Kepler 8b
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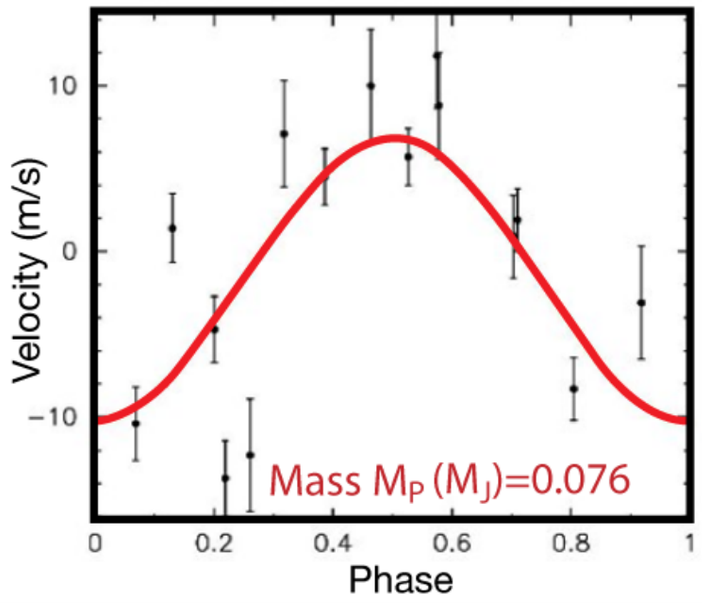
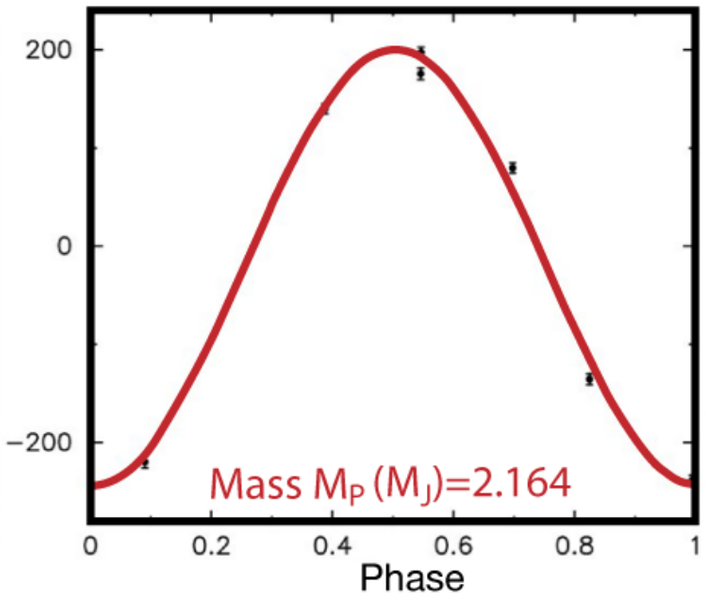
Radial Velocity of Host Stars

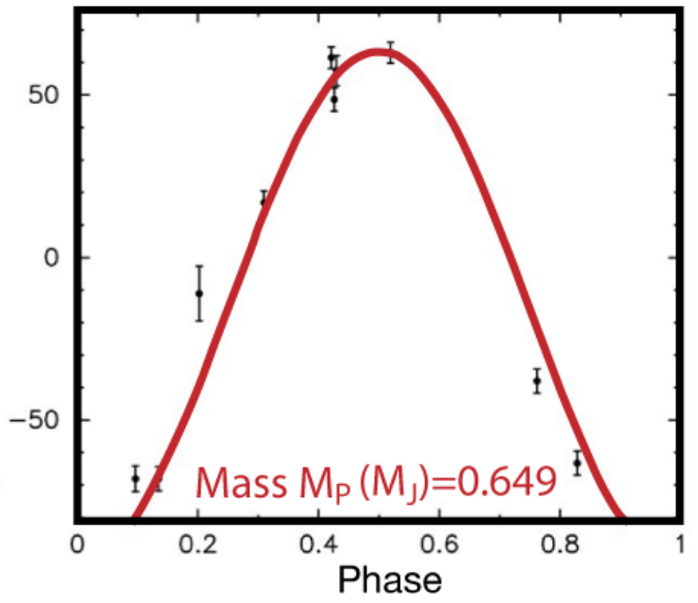
Kepler 4b



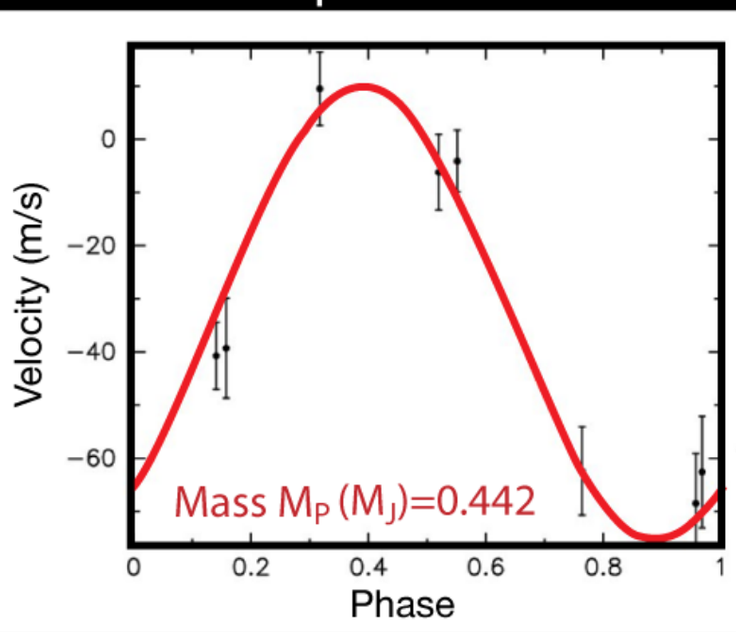
Kepler 5b



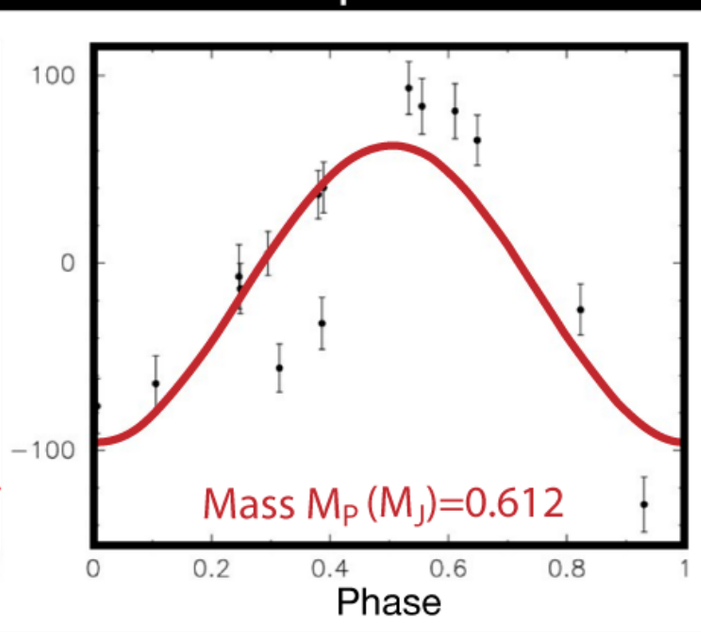
Kepler 6b



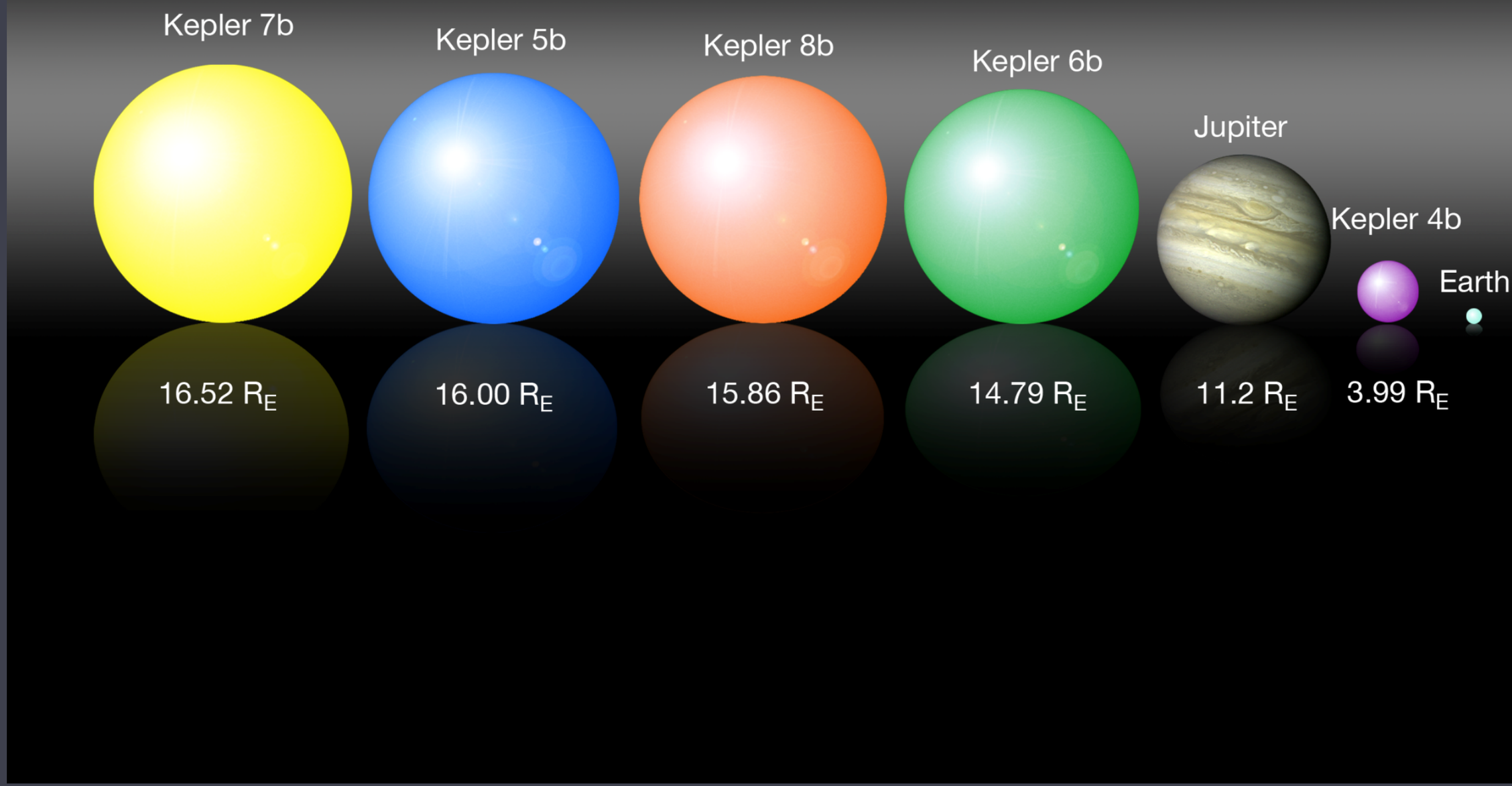
Kepler 7b



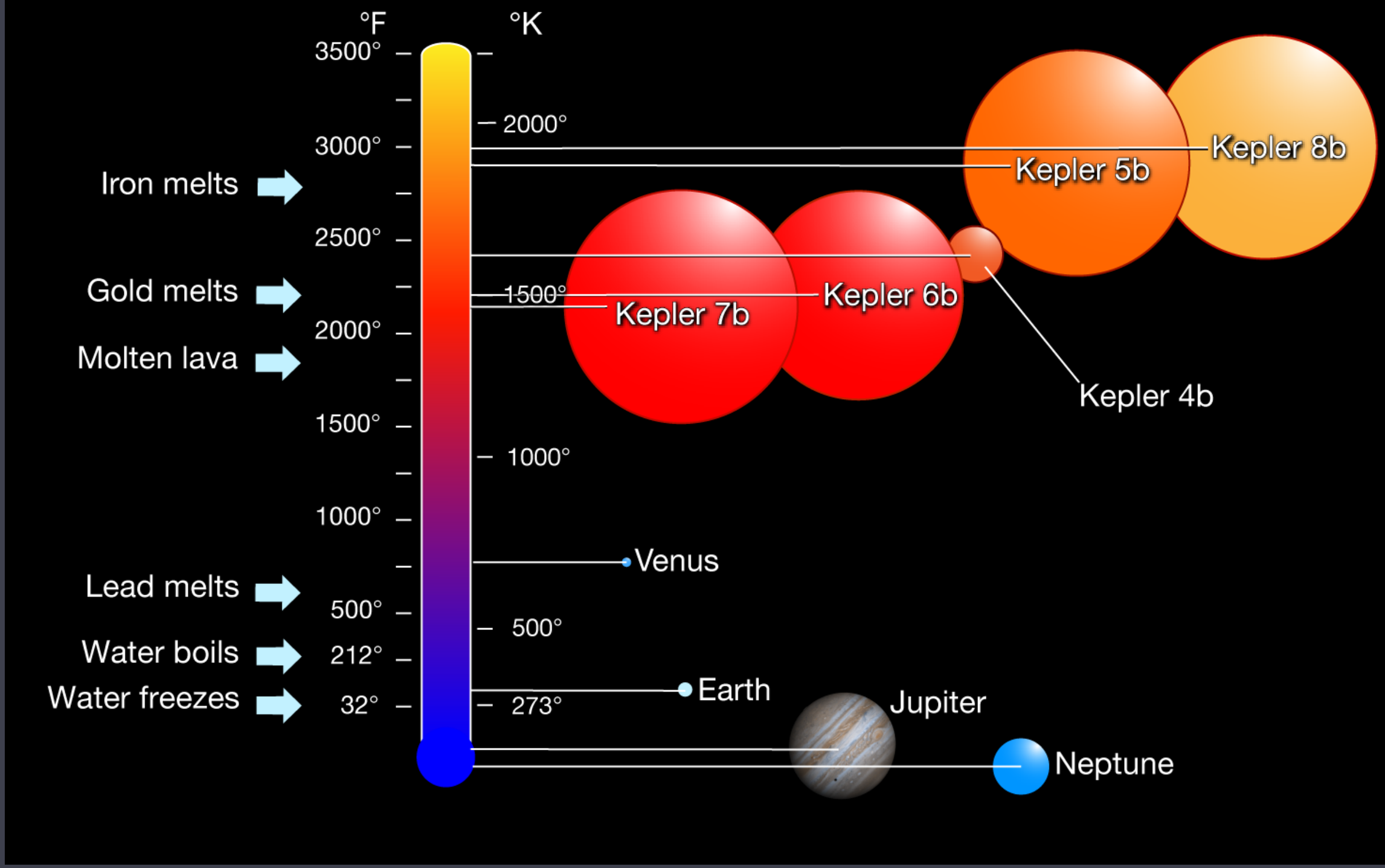
Kepler 8b



Planet Size

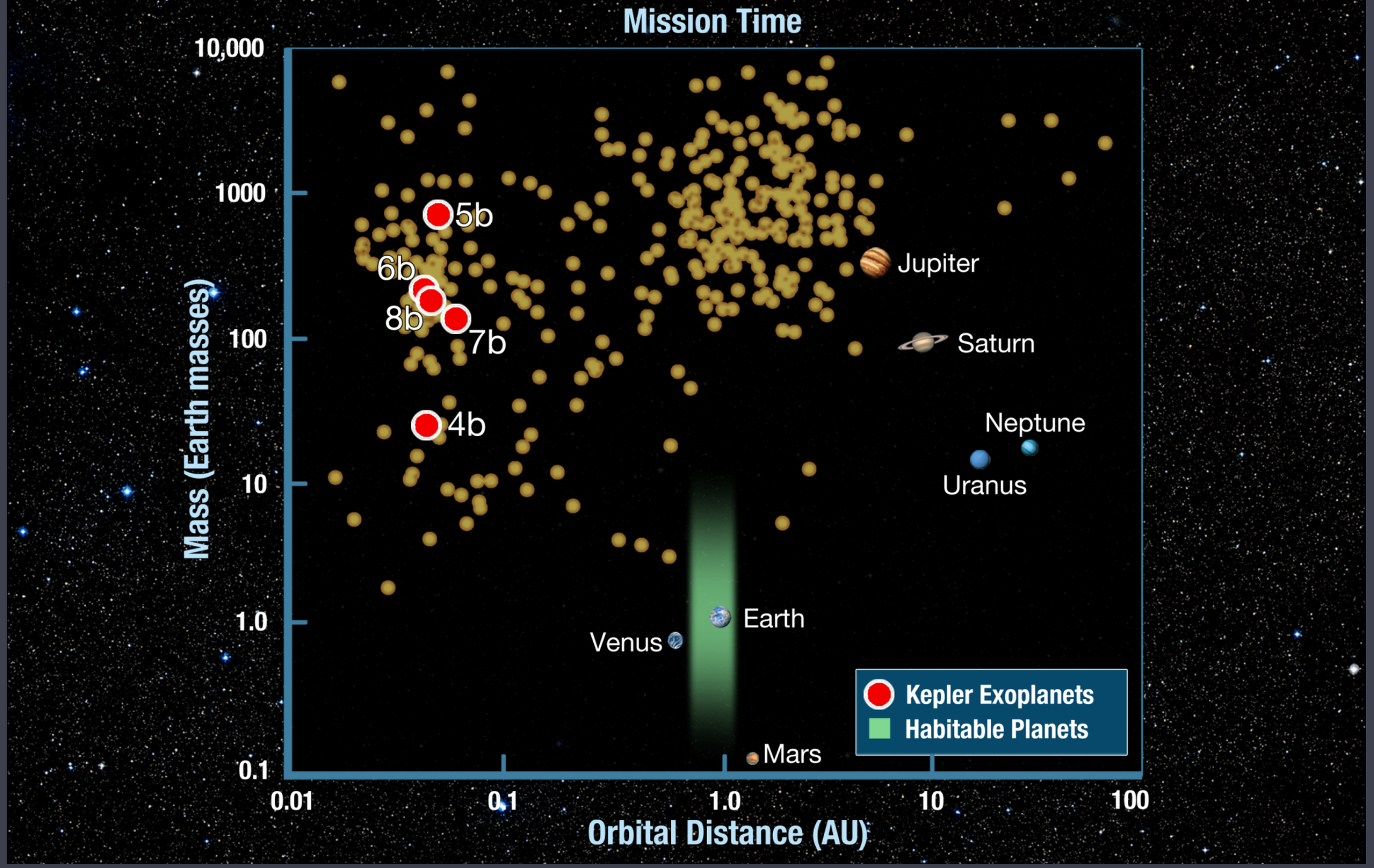

Kepler 7b
Kepler 5b
Kepler 8b
Kepler 6b
Jupiter
Kepler 4b
Earth
16.52 R_E
16.00 R_E
15.86 R_E
14.79 R_E
11.2 R_E
3.99 R_E

Planet Temperature & Size

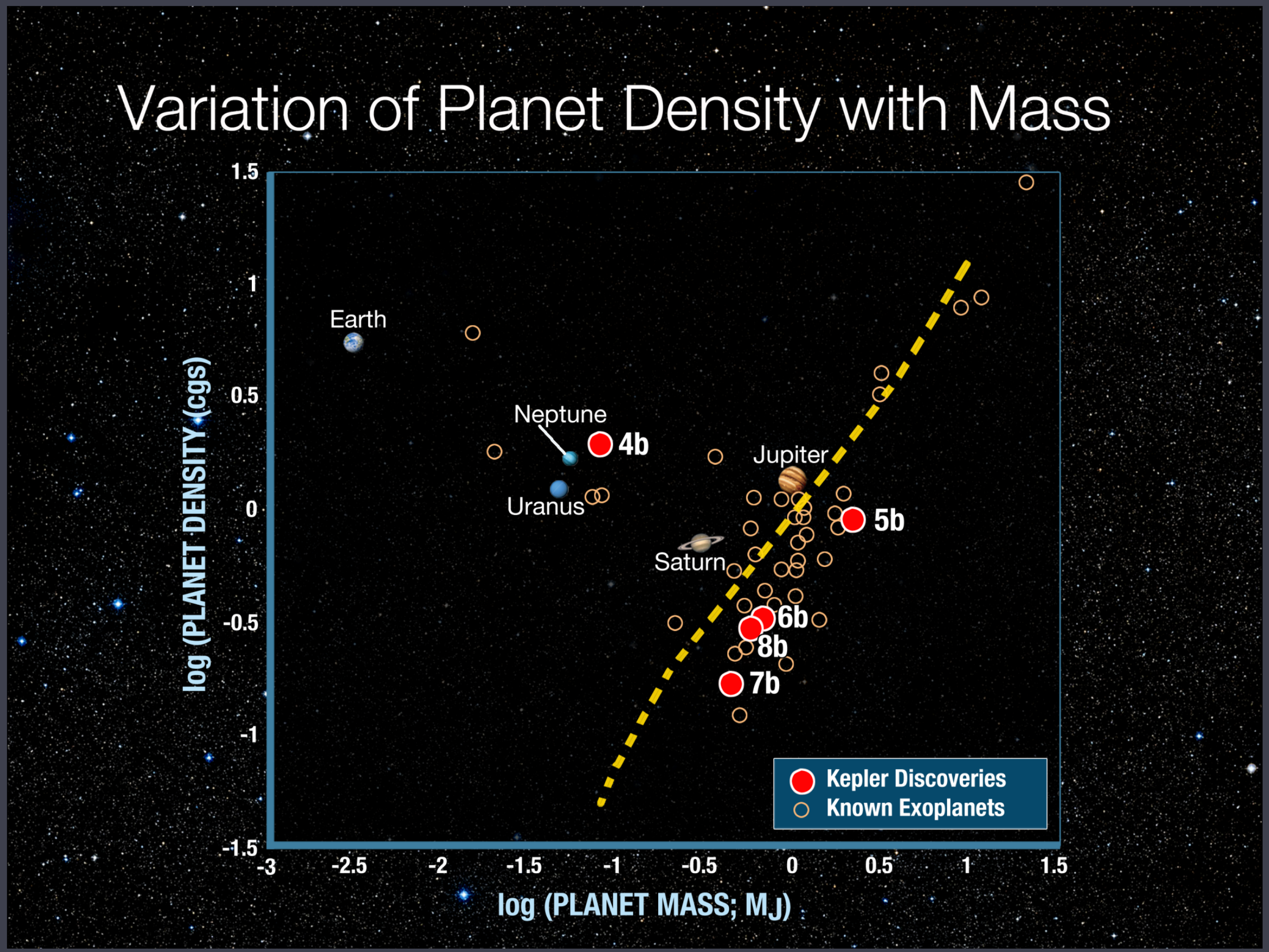


First Five Planet Discoveries

Made with First 43 Days of Data



Variation of Planet Density with Mass



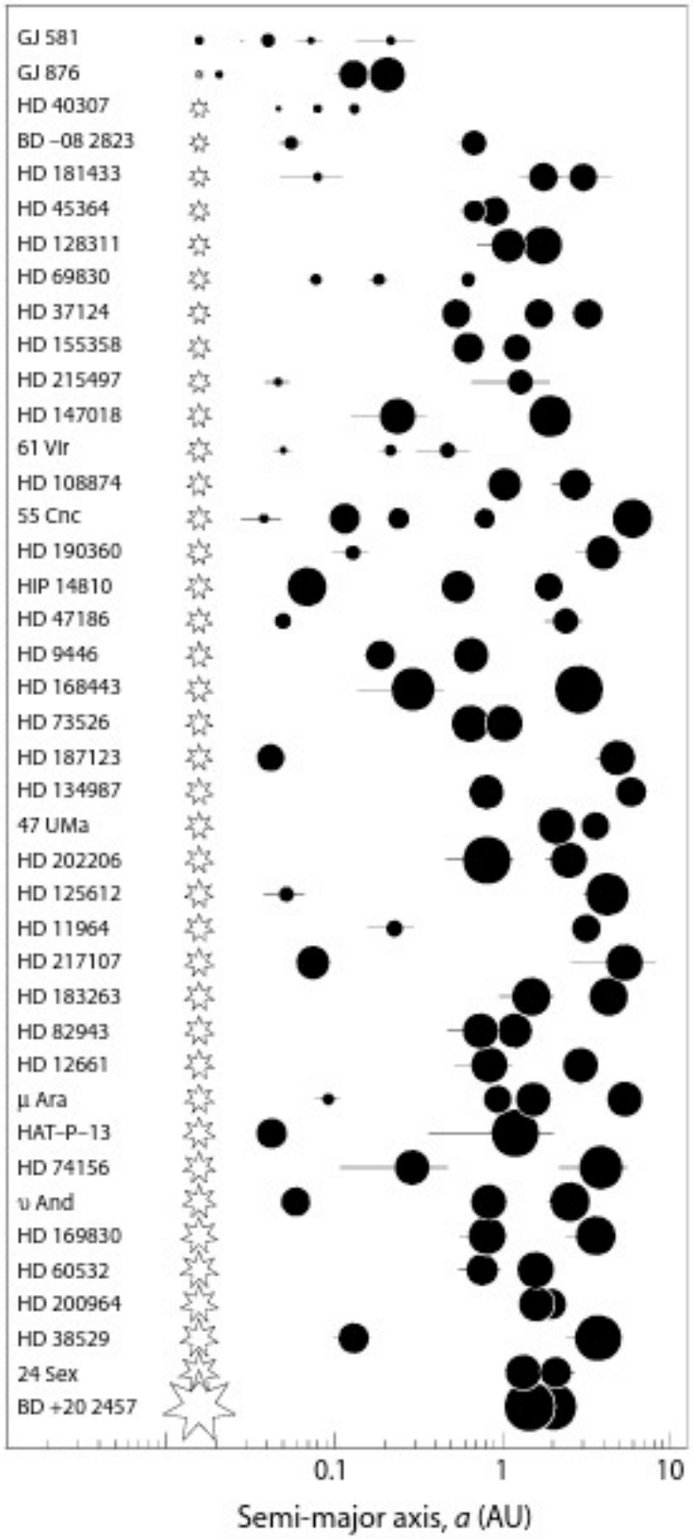


Figure 2.29: Multiple planet systems, ordered by host star mass (indicated at left with size proportional to $M_\star$, ranging from $0.31 M_\odot$ for GJ 581 to $2.8 M_\odot$ for BD+20° 2457). Each planet in the system is shown to the right, with sizes proportional to $\log M_\mathrm{p}$ (ranging from about $0.01 - 20 M_\mathrm{J}$). Horizontal bars through the planets indicate maximum and minimum star–planet distance based on their eccentricities. Data are for 97 planets in 41 systems from `exoplanets.org`*, 2010–11–01. From a concept by Marcy et al. (2008, Figure 13).*

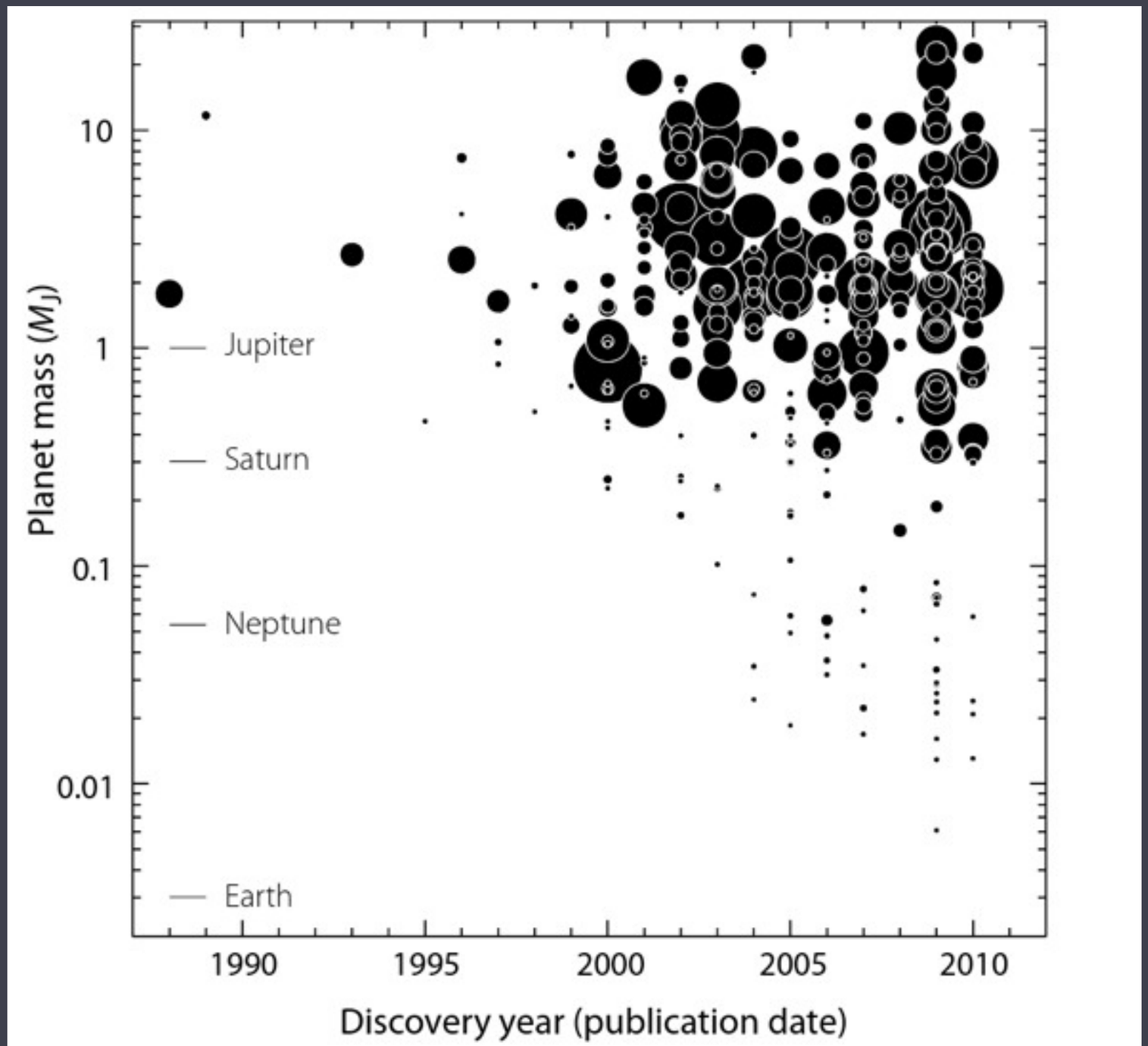
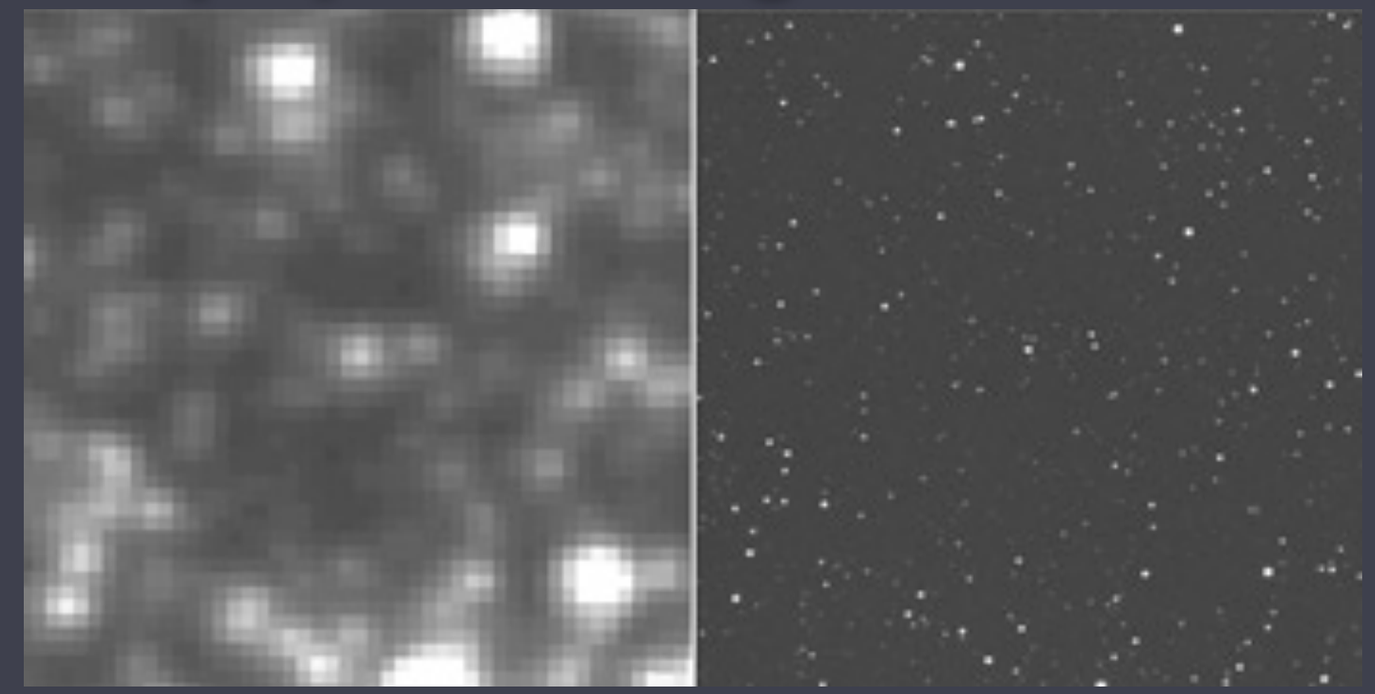
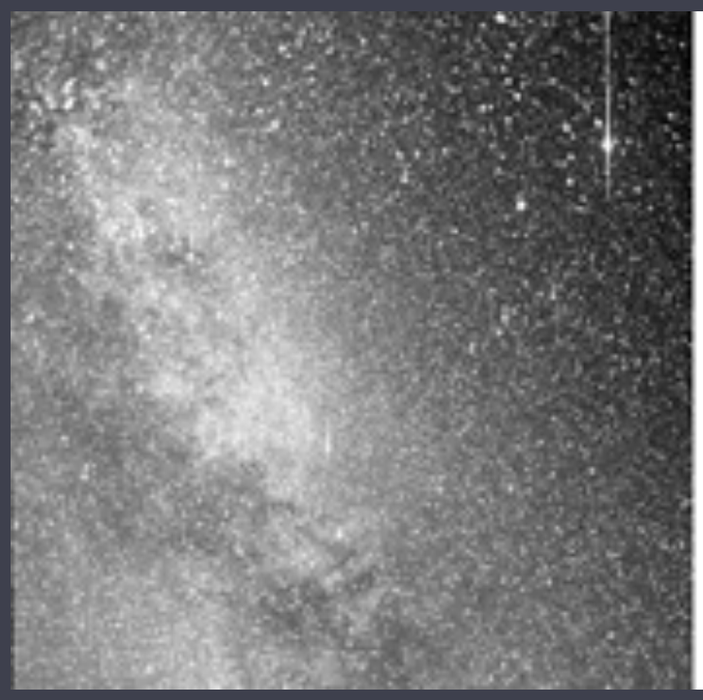


Figure 2.17: Planets discovered by radial velocity measurements, according to mass and year of discovery. Circle sizes are proportional to the semi-major axis a. Data are for 383 planets from `exoplanets.org`*, 2010–11–01.*

KELT project involving our observatory





Top: The view from KELT (left) and the Van de Kamp telescope (right). KELT's image has much lower resolution, registering multiple stars as just a single pixel. The KELT team believed the centermost star might be part of a planetary system, but observers from Swarthmore found that a stellar eclipse was occuring in the background, dropping overall brightness of the pixel to one percent, a figure which typically indicates a planetary eclipse.
Bottom: The KELTs' low resolution is a trade-off for its larger field of view. The image on the left shows what the KELTs capture in a single frame; the much smaller image on the right is a single frame from the Van de Kamp telescope. Both images were taken from the same portion of the sky.