Venuses in the Habitable Zone: The Case of Kepler-69

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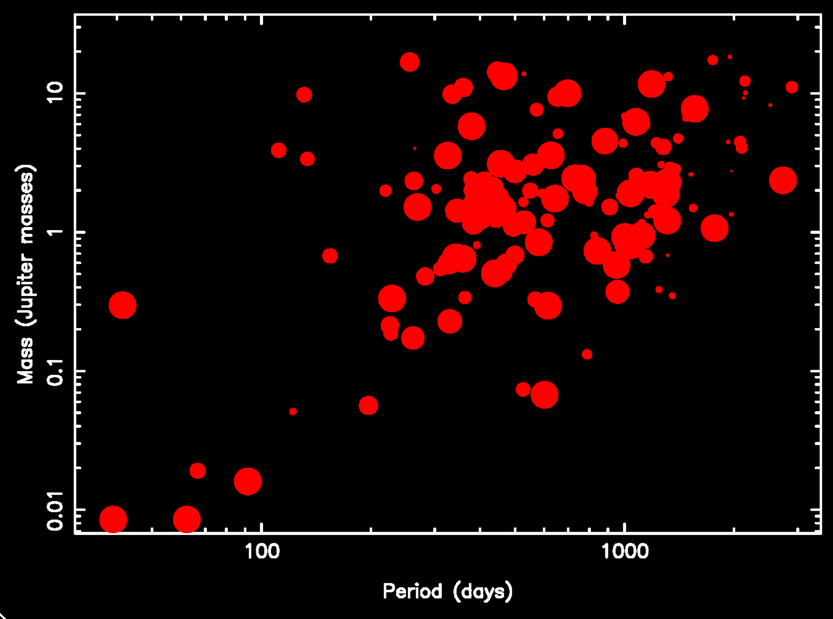
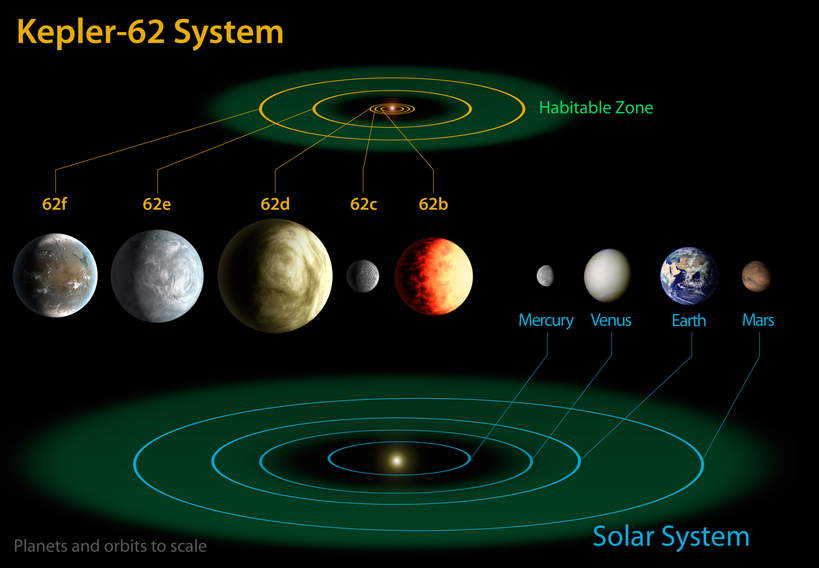
(see Kane, Barclay, Gelino, 2013, ApJ, 770, L20)



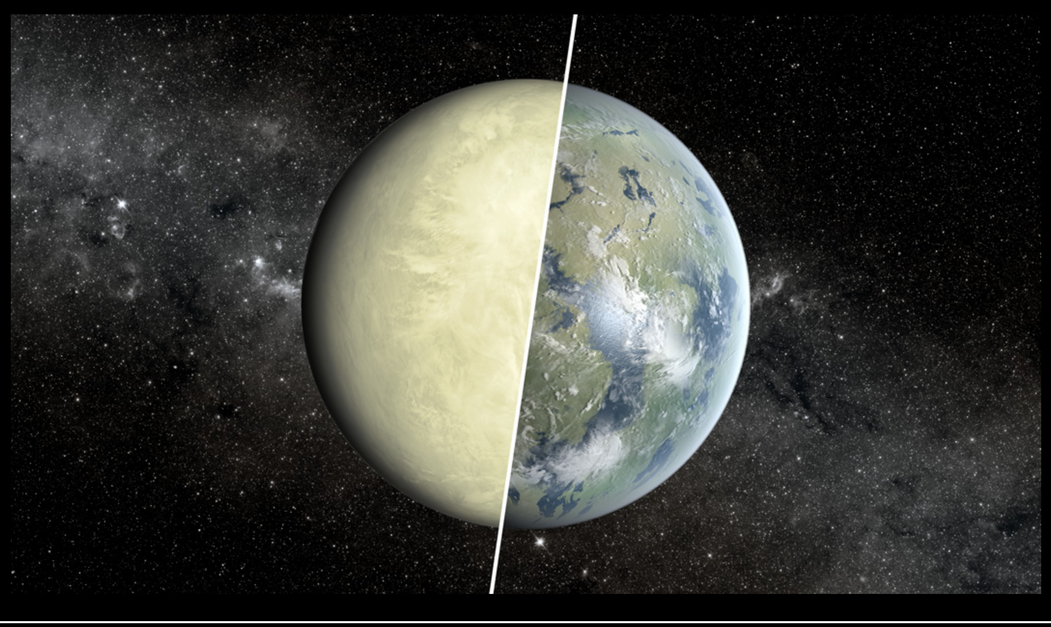
The Habitable Zone

- *The Habitable Zone (HZ) is defined as the region around a star where liquid water can exist on the surface of a planet with sufficient atmospheric pressure.*
- *As sensitivity to smaller size and larger orbital period improves, more terrestrial planets are being detected in their HZ. The figure at left shows the mass/period distribution of HZ planets where the size of the points linearly increases with the percentage of time spent in the HZ.*
- *Kepler mission data have been used to discover numerous planets of terrestrial size which lie within the HZ of their host stars, such as the Kepler-62 system (right).*

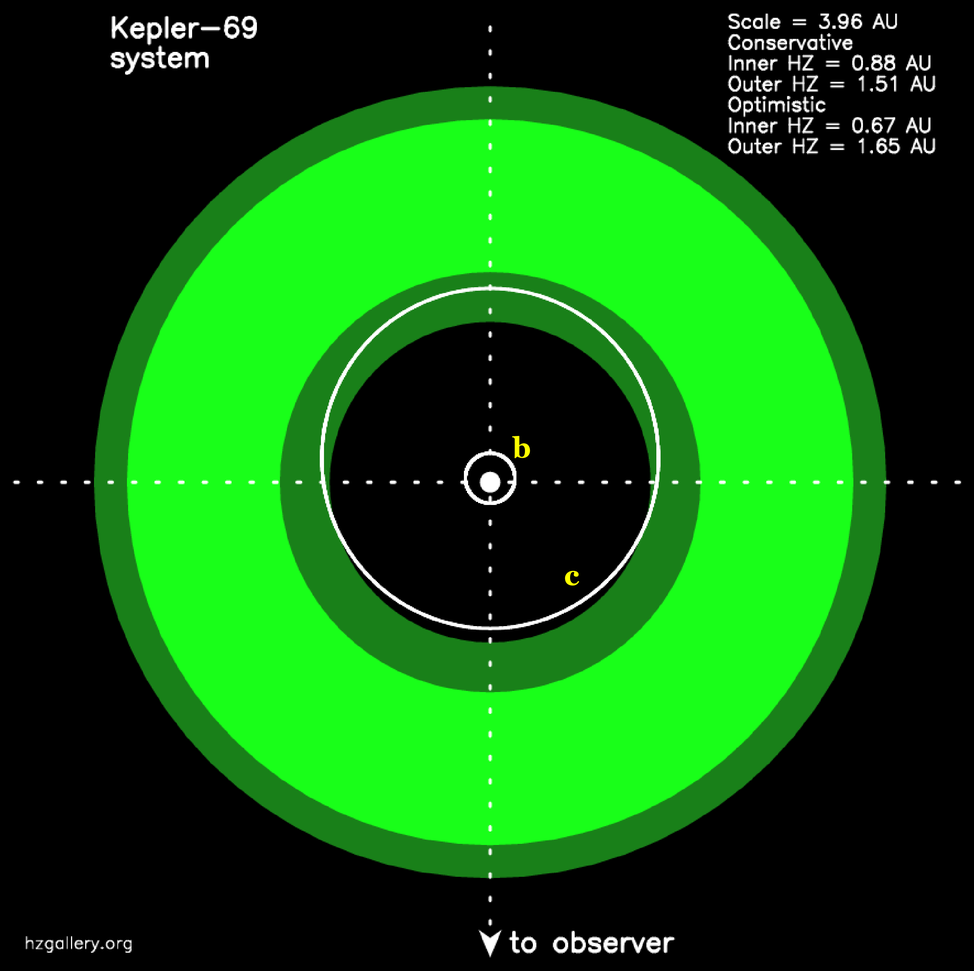


The Venus/Earth Degeneracy

Along the pathway to determining eta Earth, Kepler will first provide insights into the frequency of Mercury and Venus analogs. Since Venus and Earth are almost the same size, the Venus analogs will emerge earlier than the Earth analogs due to the increased geometric transit probability.

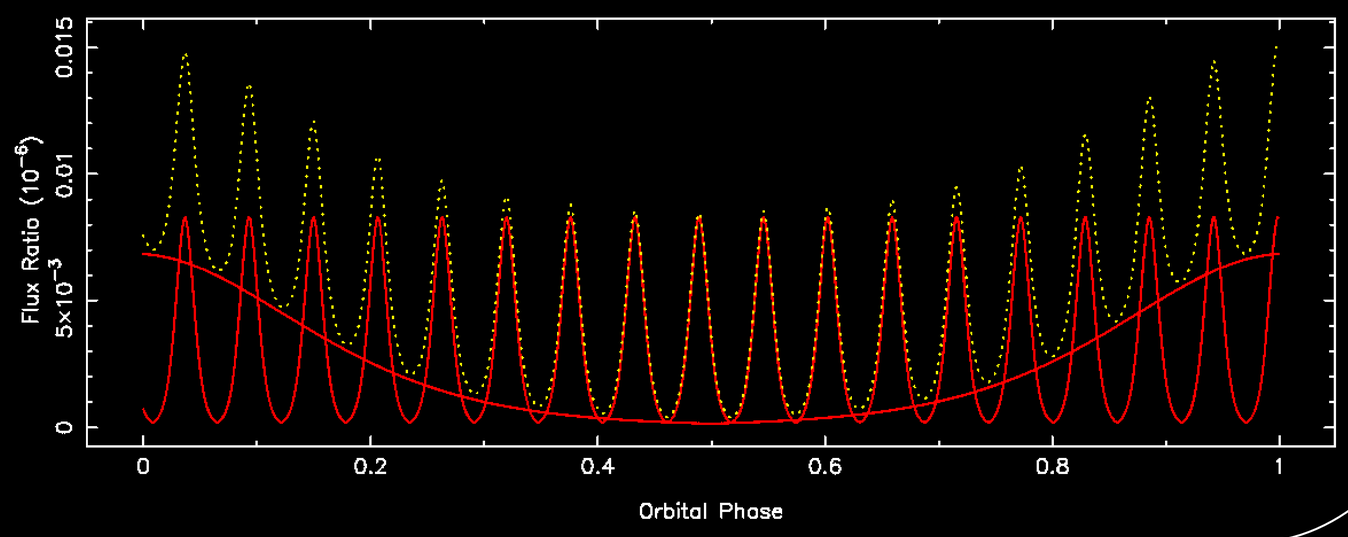


The question of how common Earth-like planets are relies on also studying how frequently terrestrial planets diverge into Venusian-type evolutionary pathways which may place heavy constraints upon habitability prospects. Detection of super-Venusian atmospheres will shed light on where the divergence originates.



A Super-Venus in the Kepler-69 System

- *The Kepler-69 system contains two detected planets with orbital periods of 13.7 (b) and 242 (c) days. The left figure shows the extent of the HZ and that the c planet (which receives a similar amount of flux as Venus does from the Sun) skims the HZ and is likely a super-Venus.*
- *The figure below shows a potential test of a highly reflective upper cloud layer for Kepler-69c. This uses the phase variations of the system to detect the high albedo where the red lines are the phase variations of each planet and the yellow dotted line is the combined phase variations.*



References:

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- Kane & Gelino, 2010, ApJ, 724, 818
- Kane & Gelino, 2012, PASP, 124, 323
- Kane & Gelino, 2013, ApJ, 762, 129
- Kane, Barclay, & Gelino, 2013, ApJ, 770, L20

Also check out the Habitable Zone Gallery
http://www.hzgallery.org