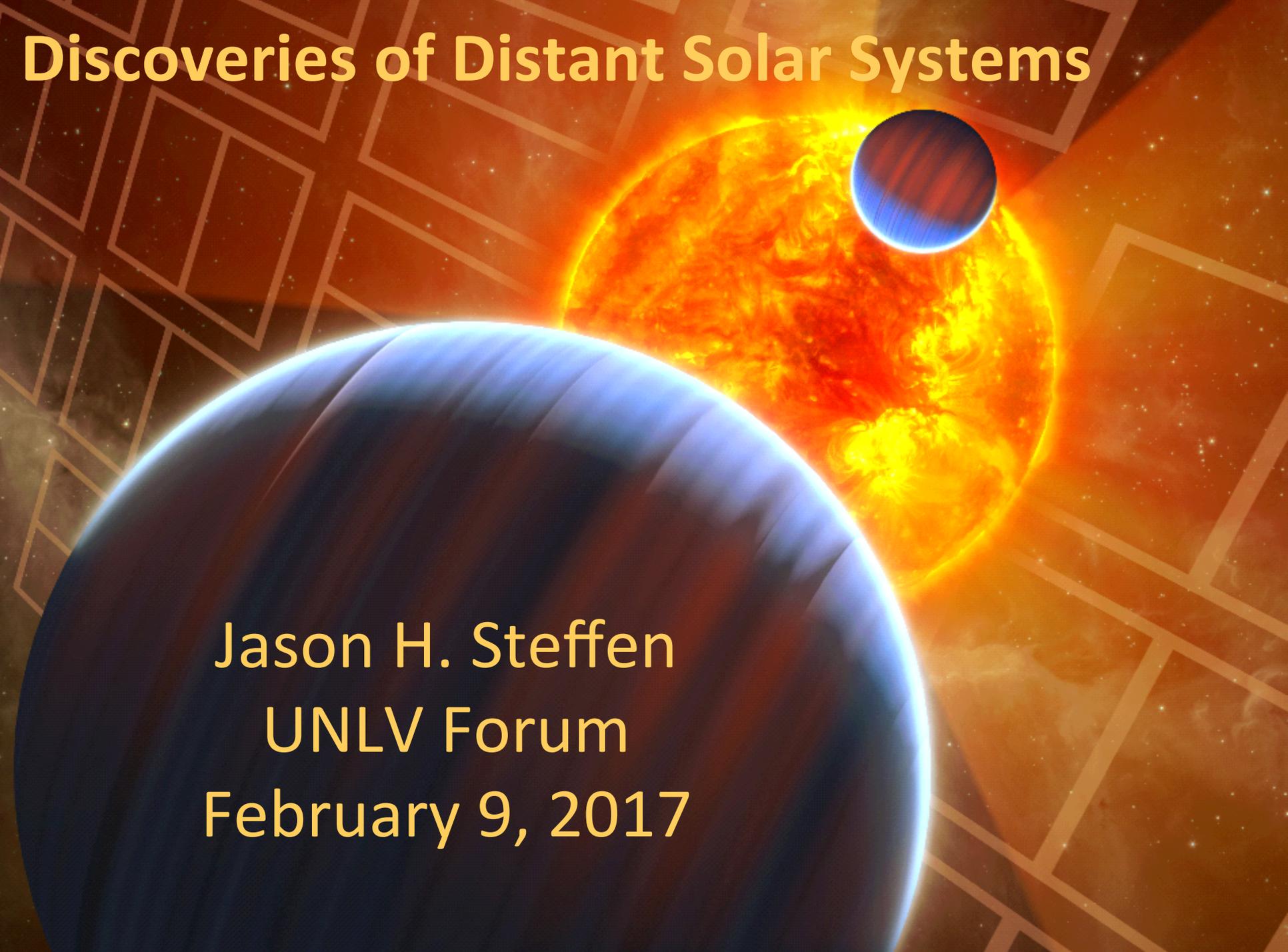


Discoveries of Distant Solar Systems



Jason H. Steffen
UNLV Forum
February 9, 2017

Hubble Deep Field

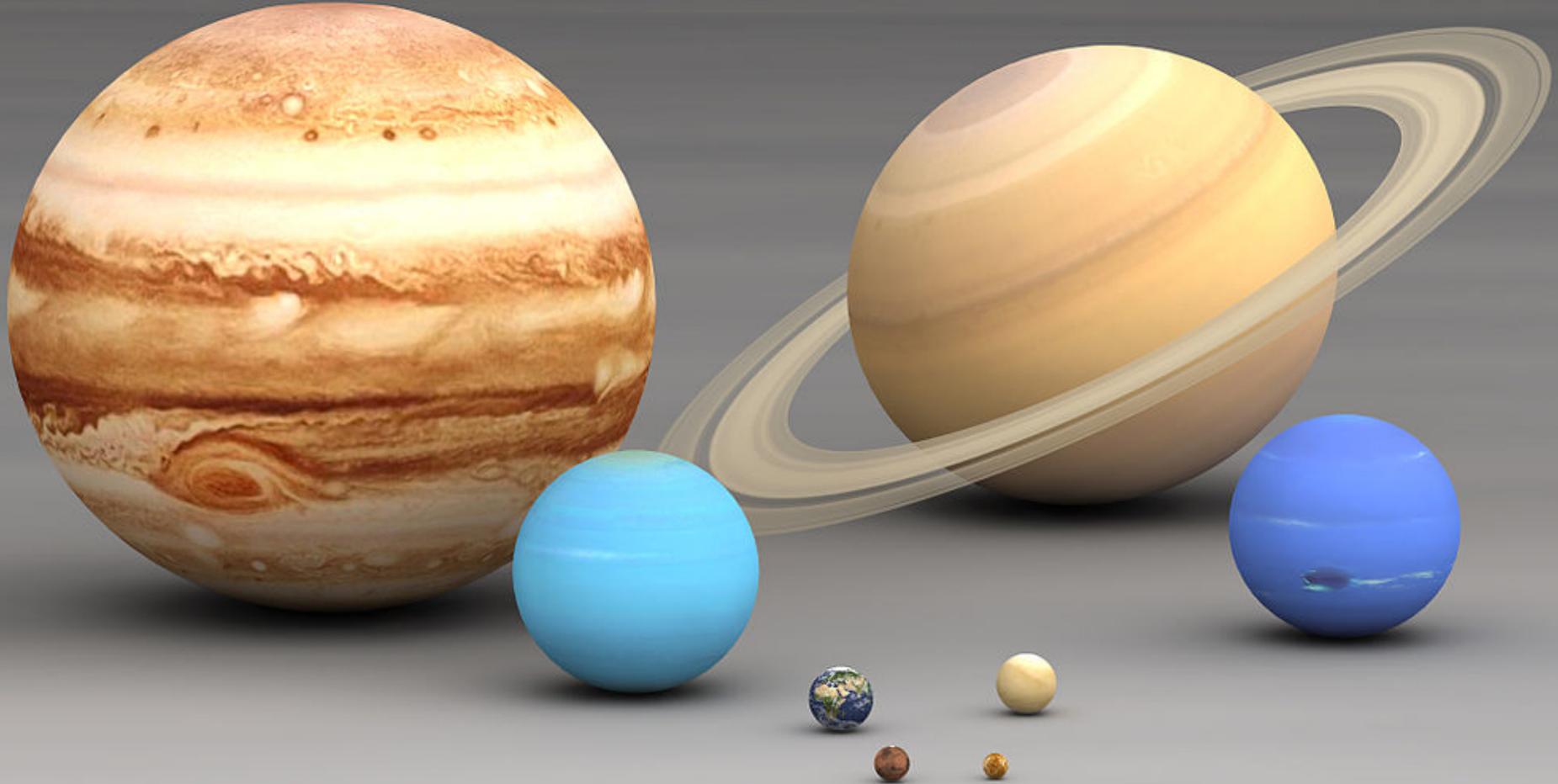


100,000,000,000,000,000,000,000 stars

100,000,000,000,000,000,000,000 stars



Different Kinds of Planets



Planets vs. Stars

Sun



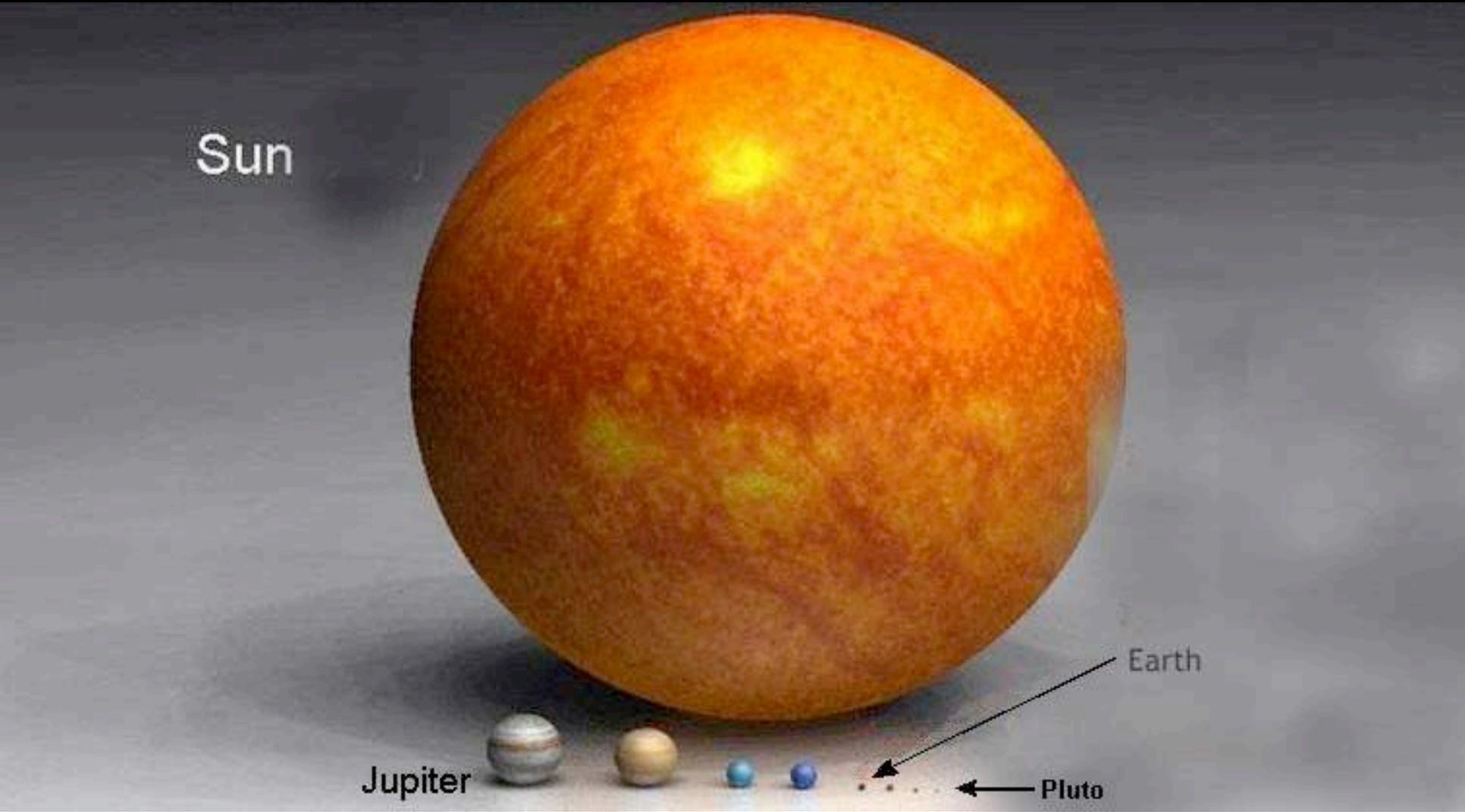
Jupiter



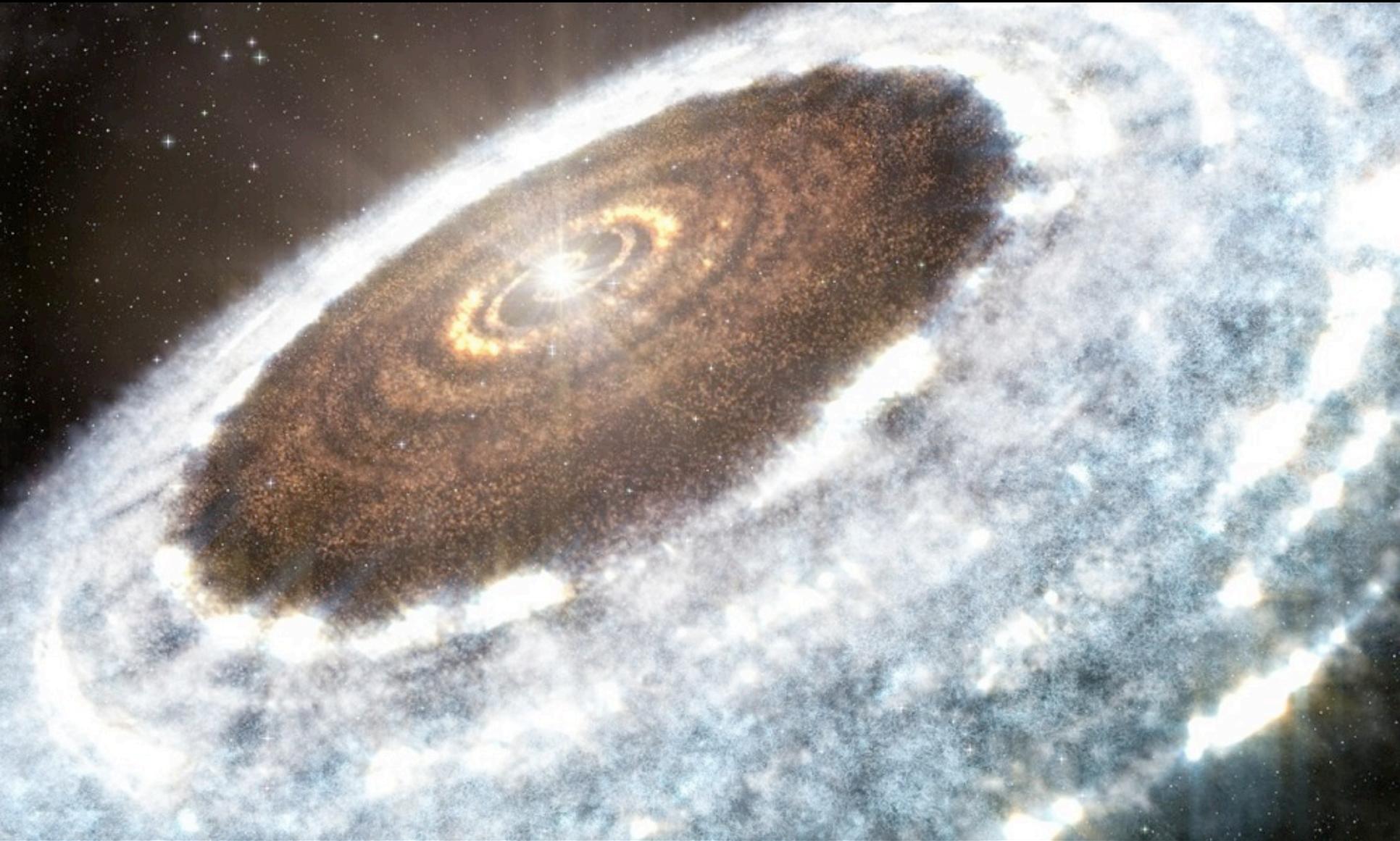
Earth



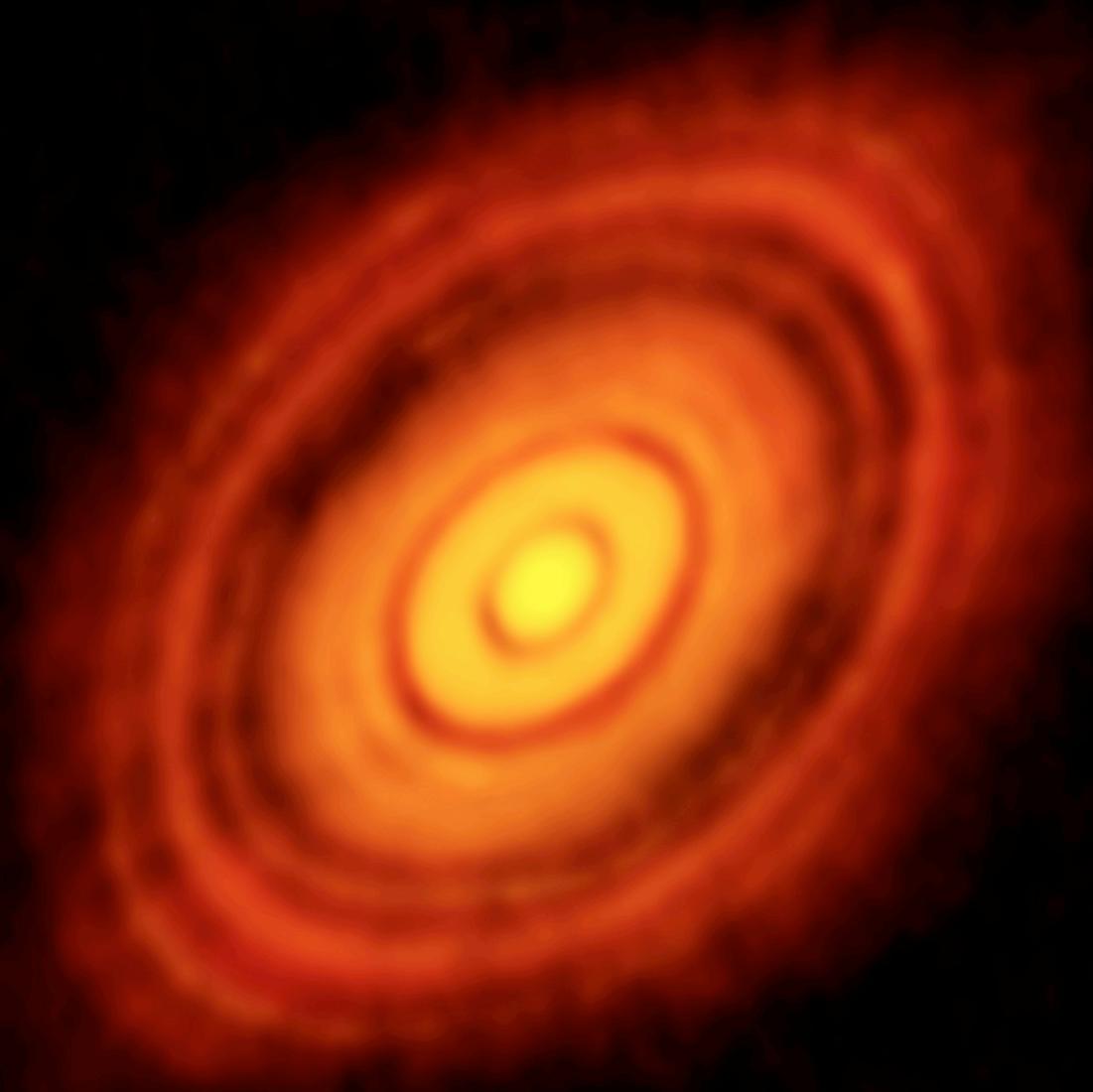
Pluto



Planet Formation



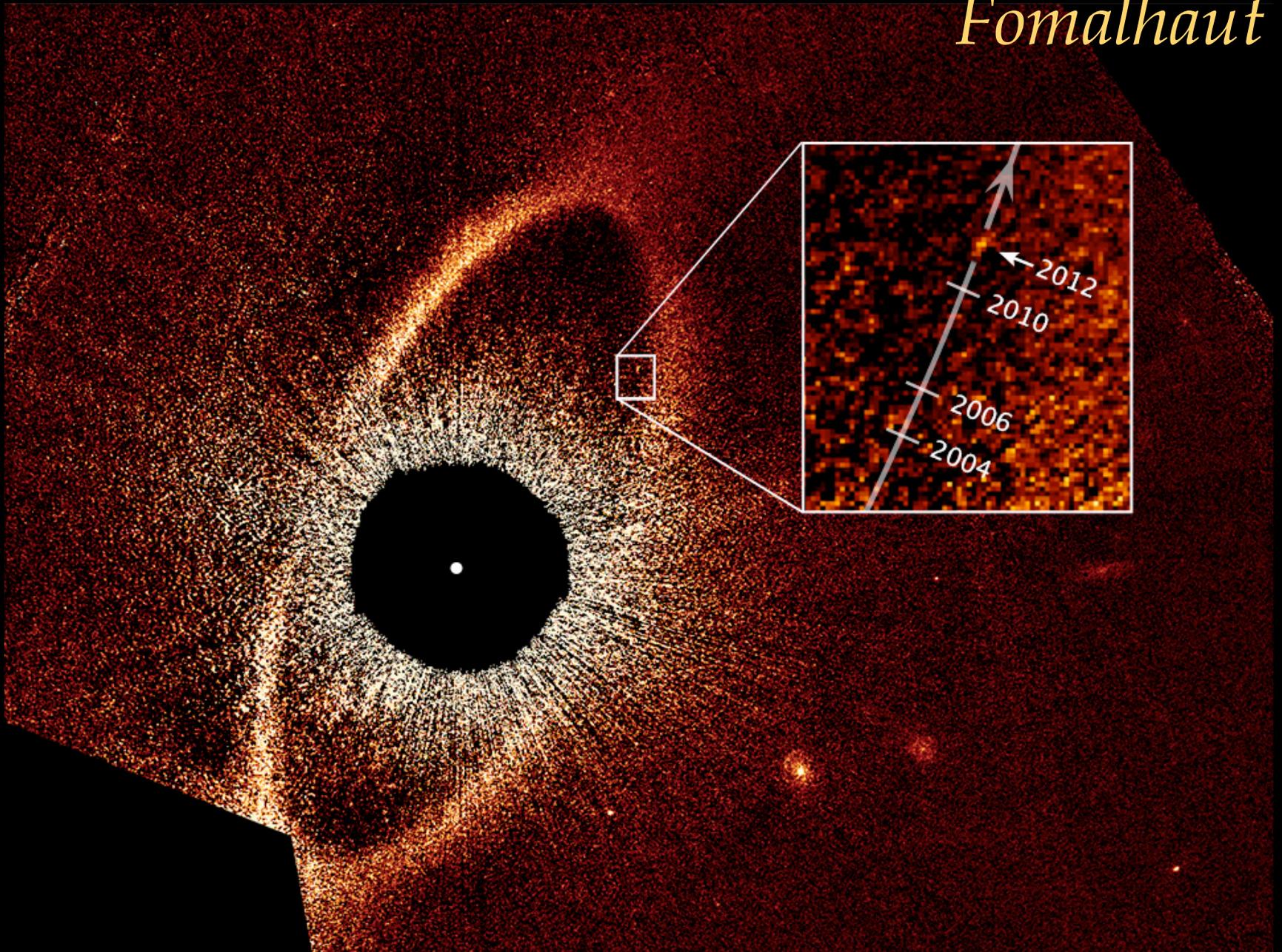
Planet Formation



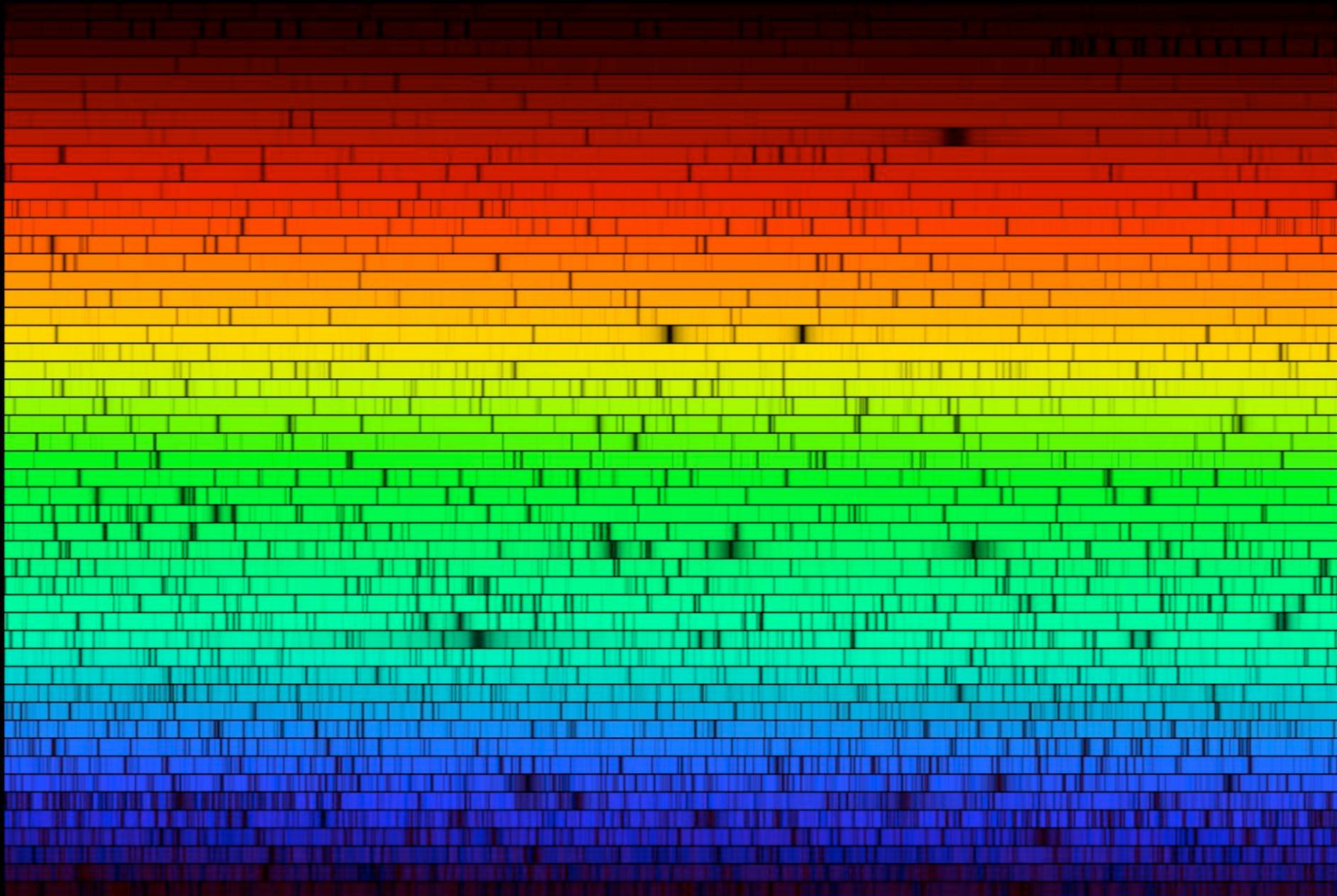
Looking for Planets



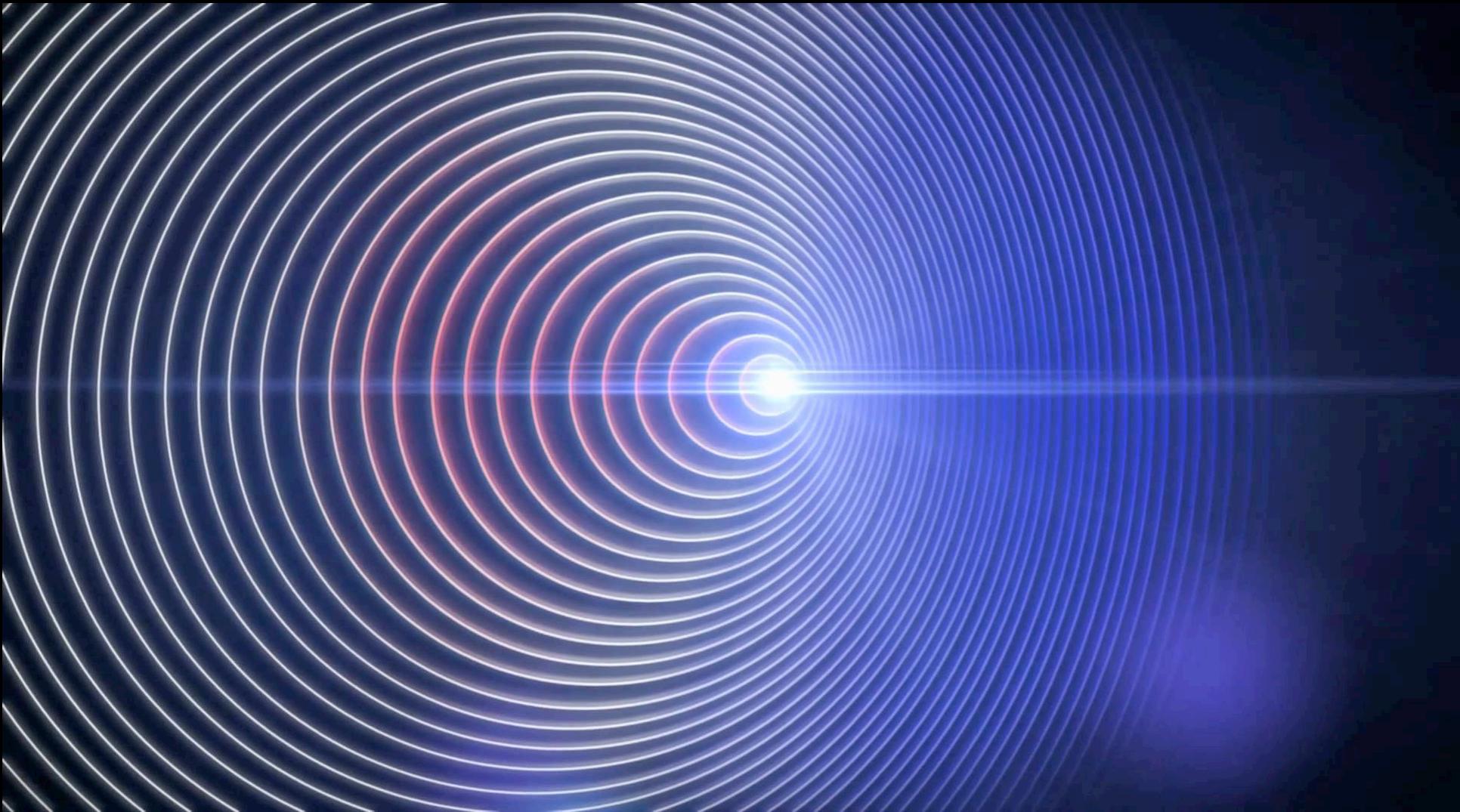
Fomalhaut b



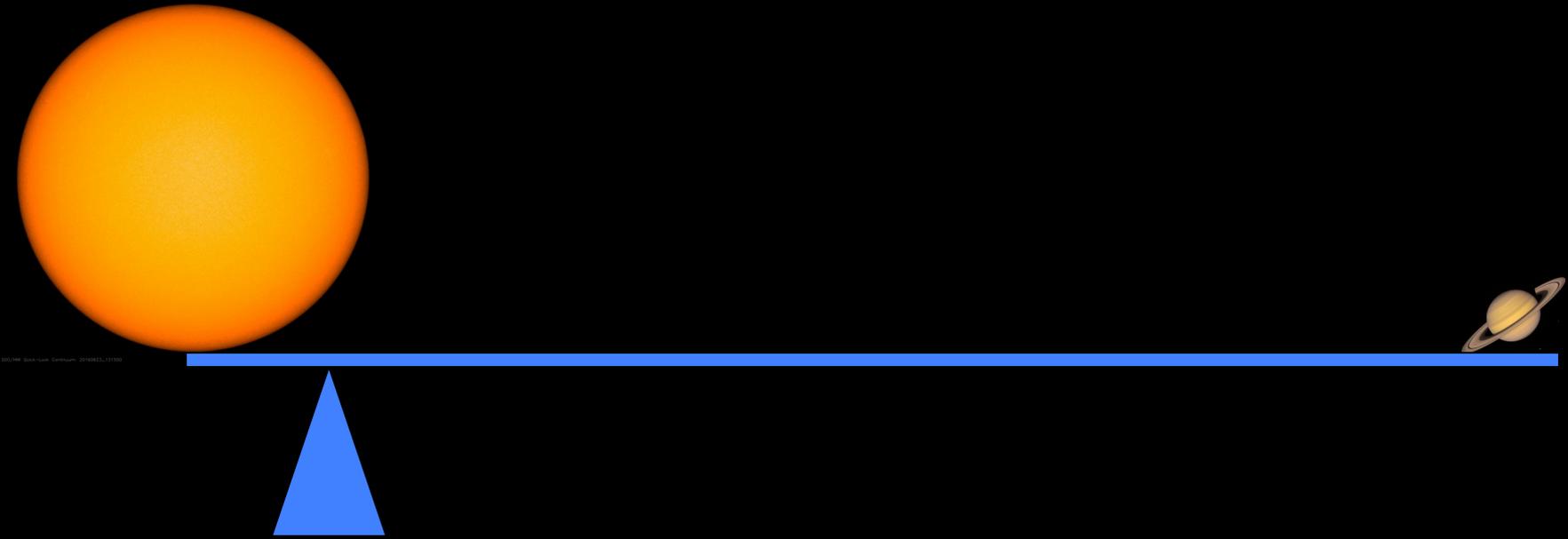
Solar Spectrum



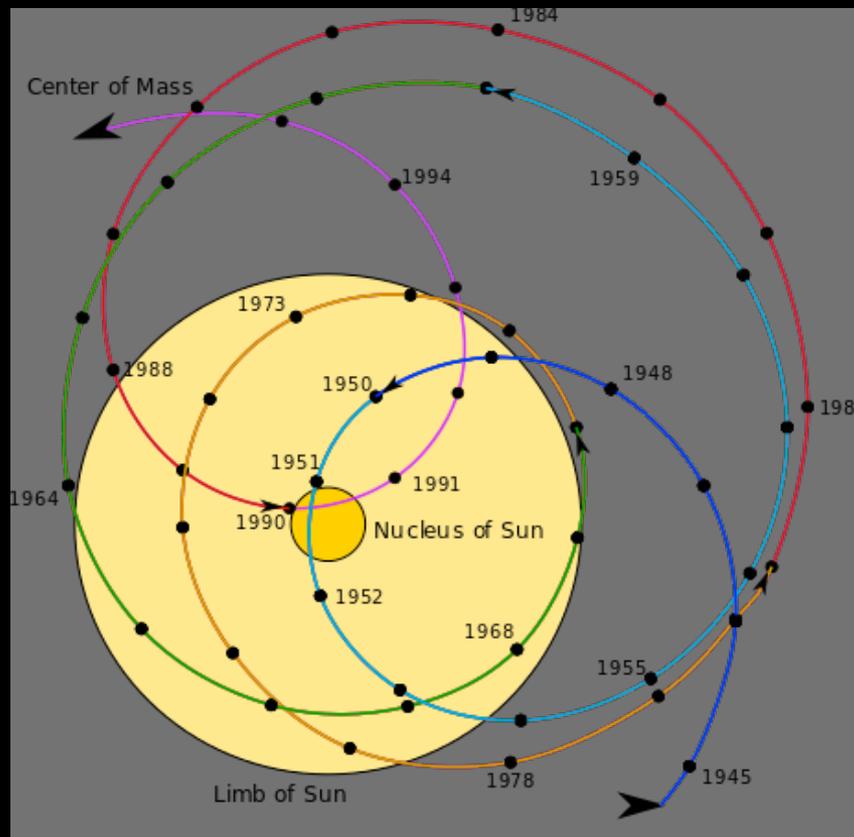
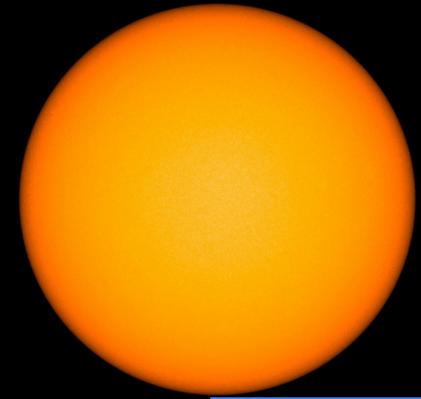
Planet Discoveries



Planetary Orbits

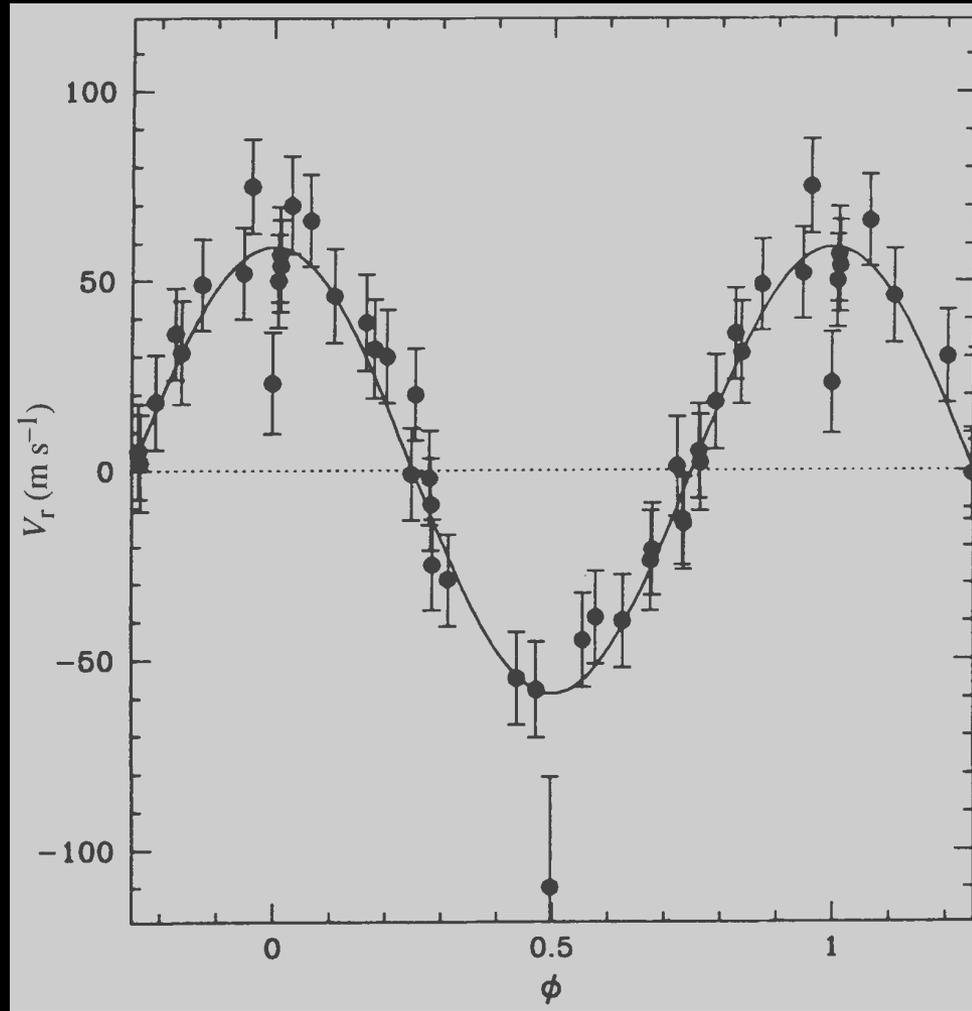


Planetary Orbits



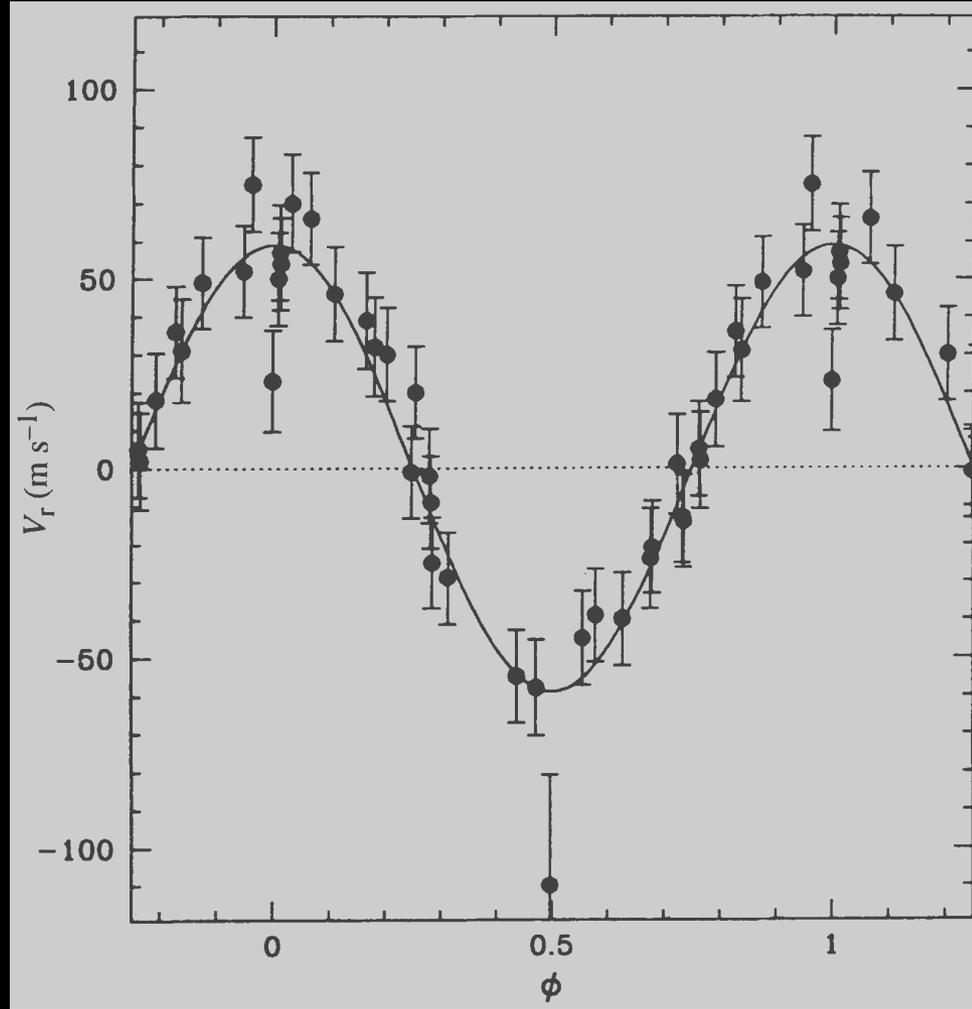


First Exoplanet from Doppler Measurements

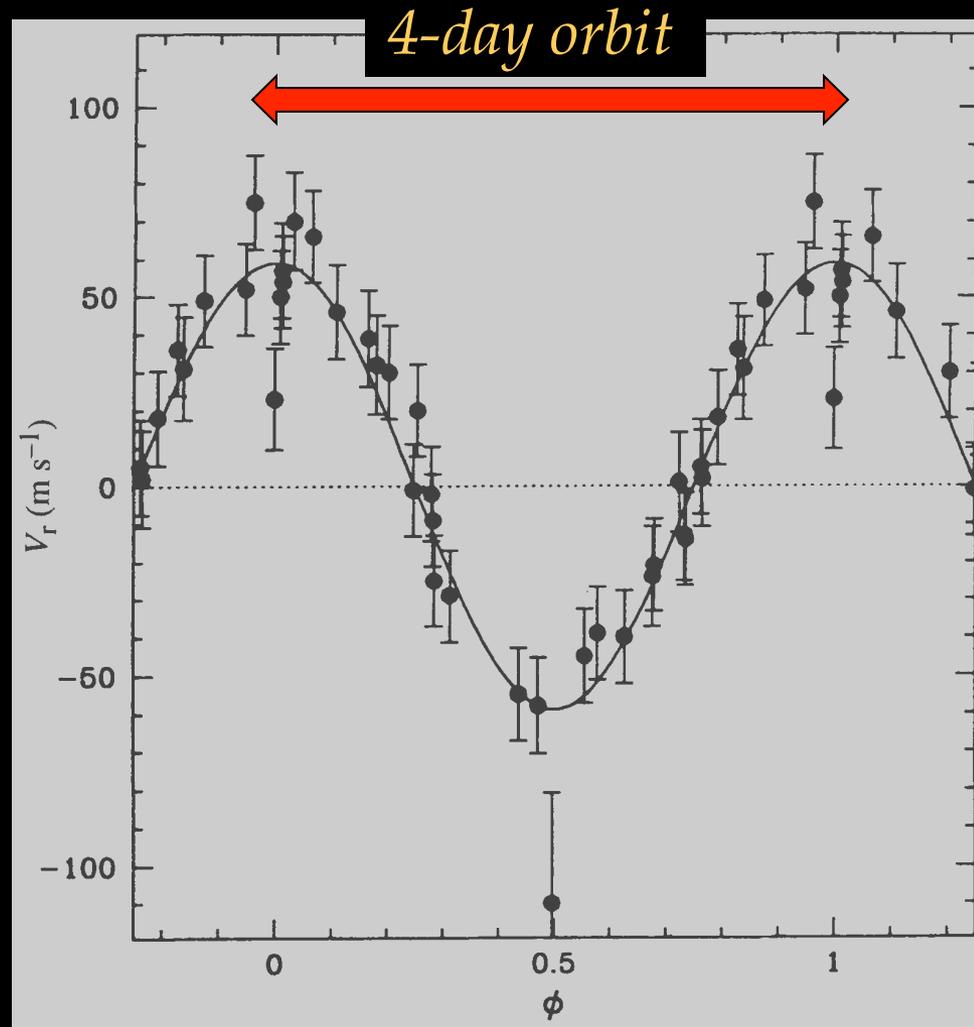


First Exoplanet from Doppler Measurements

*1/2 Jupiter
mass*

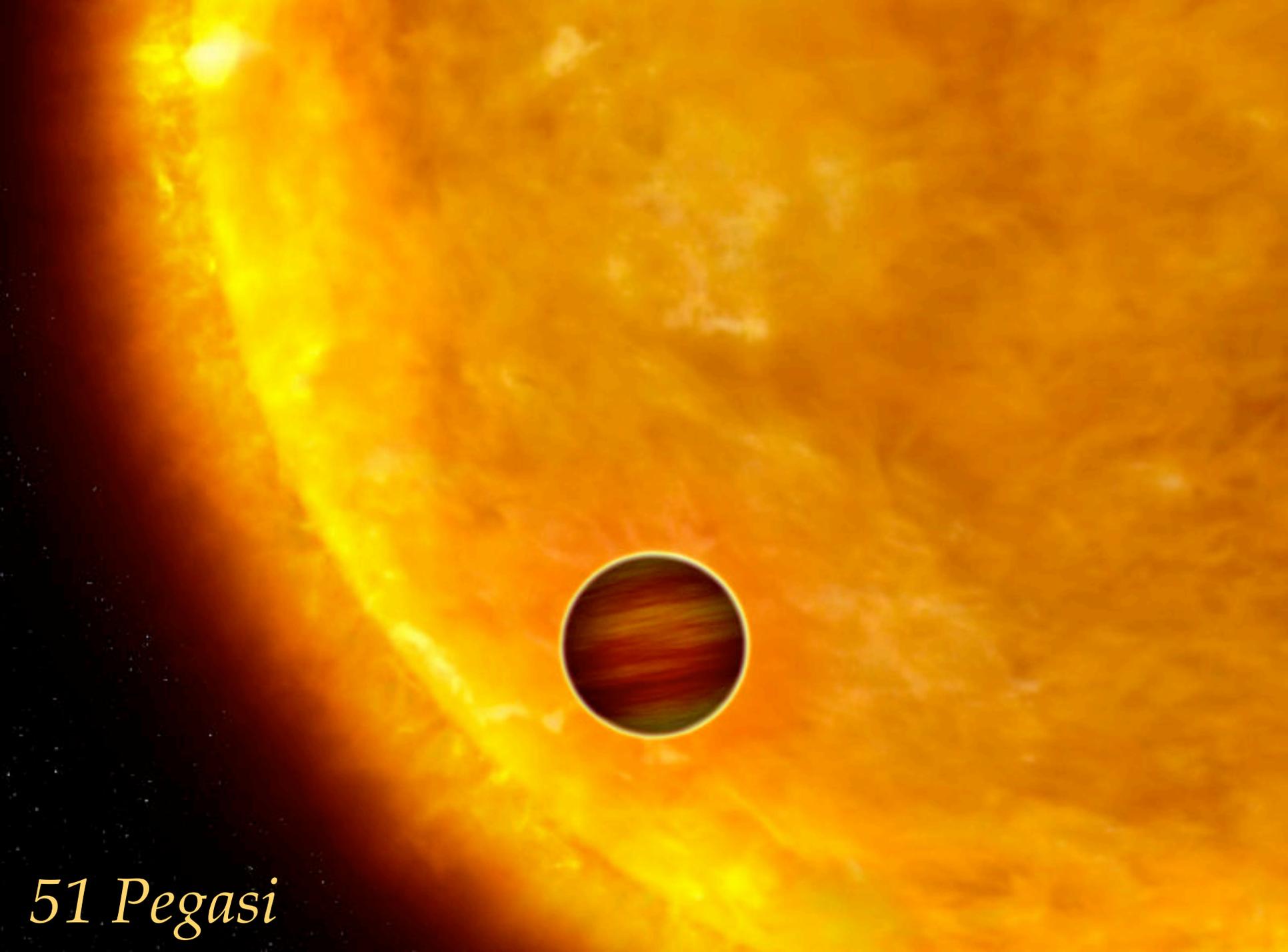


First Exoplanet from Doppler Measurements



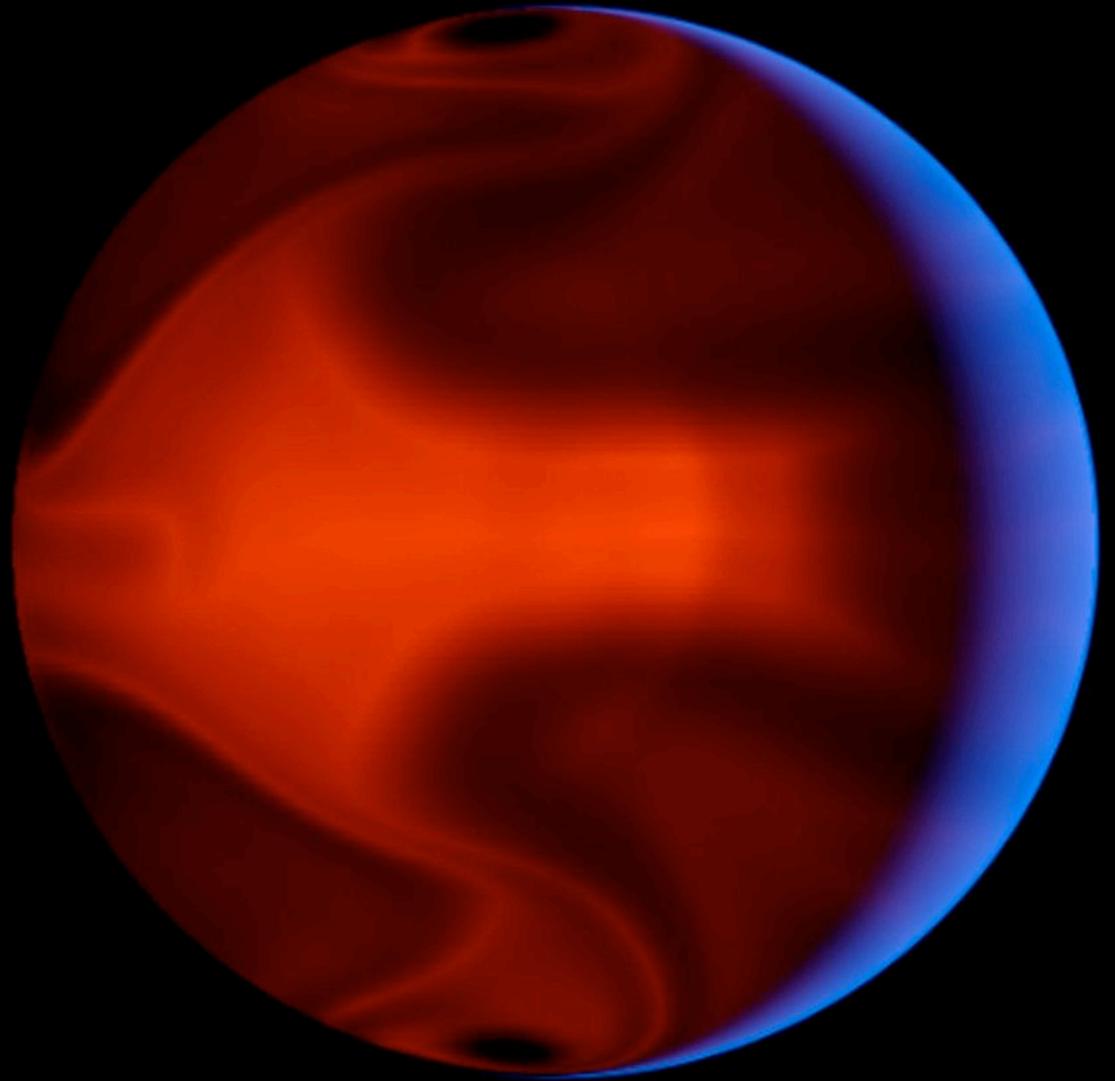
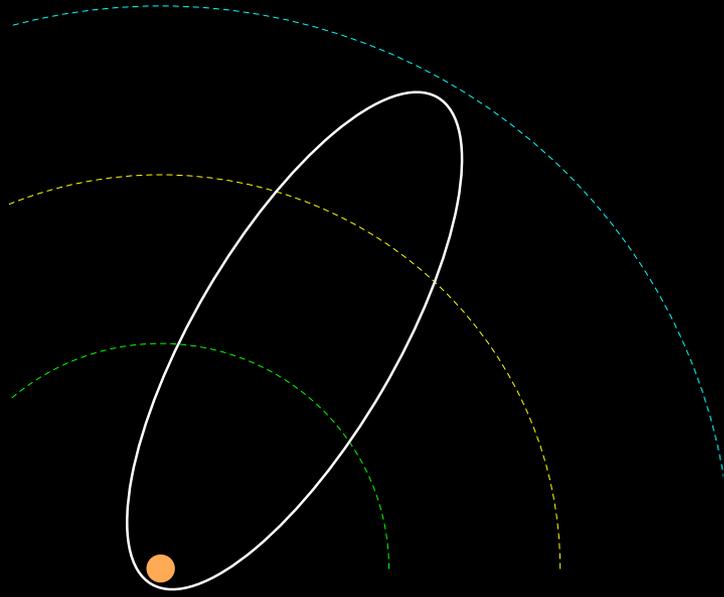
$\frac{1}{2}$ Jupiter
mass





51 Pegasi

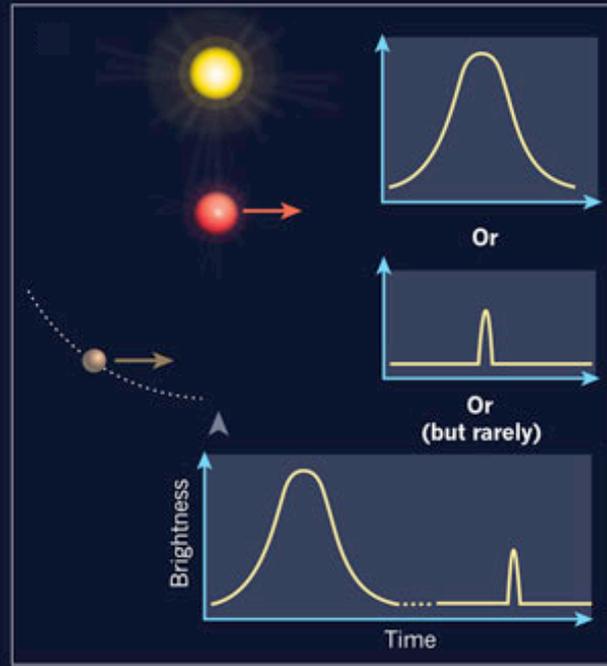
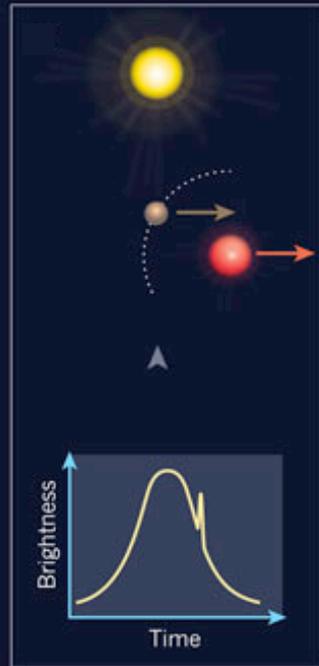
HD 80606



Gravitational Lensing



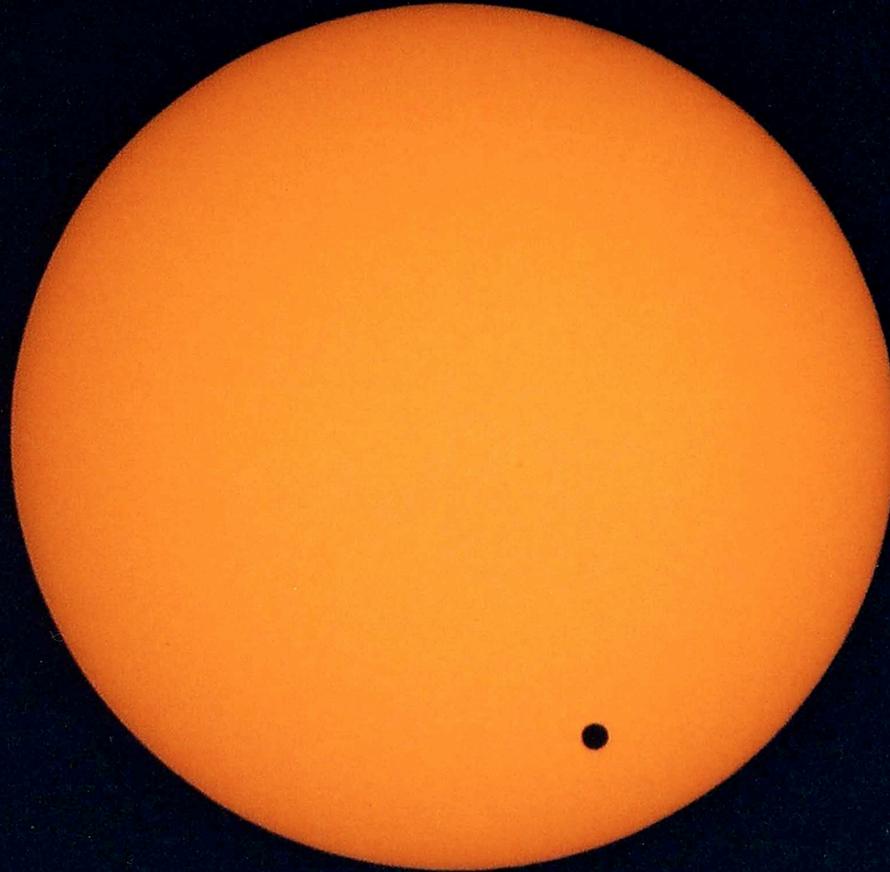
Gravitational micro-Lensing



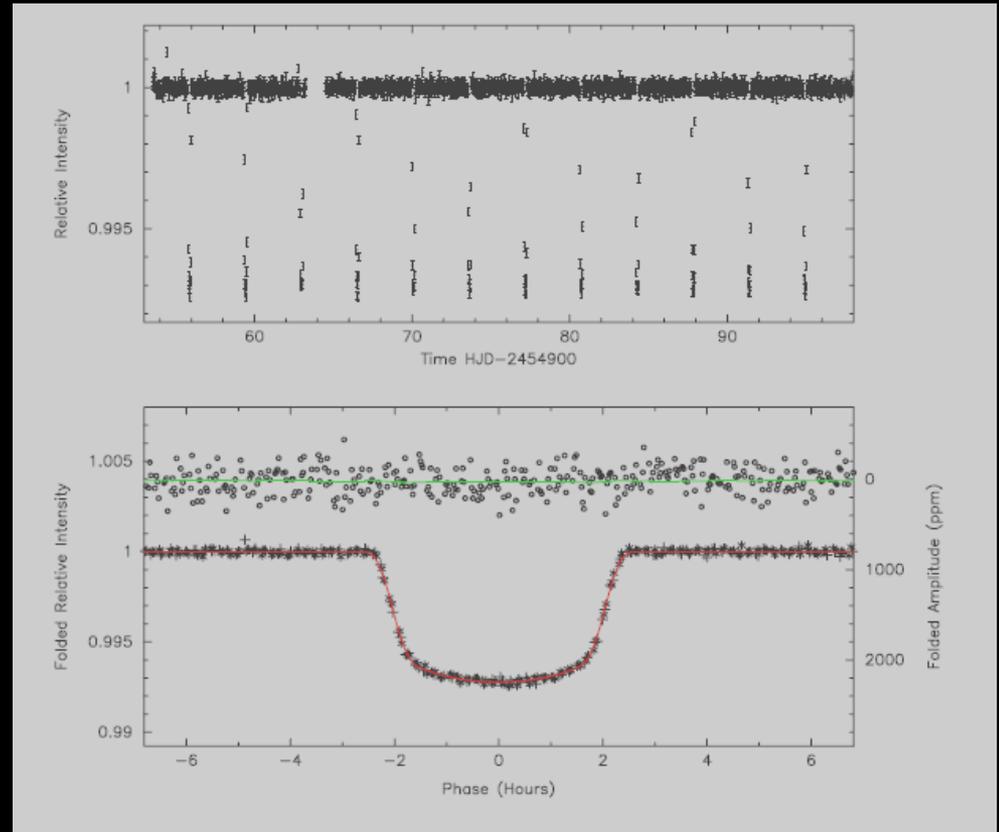
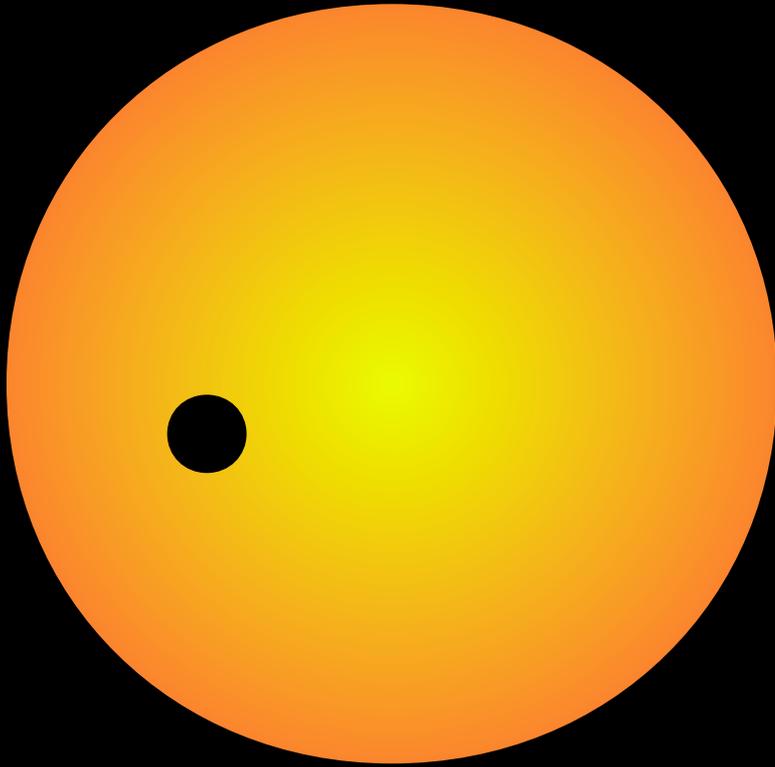
MOA-ip-3



Planetary Transits

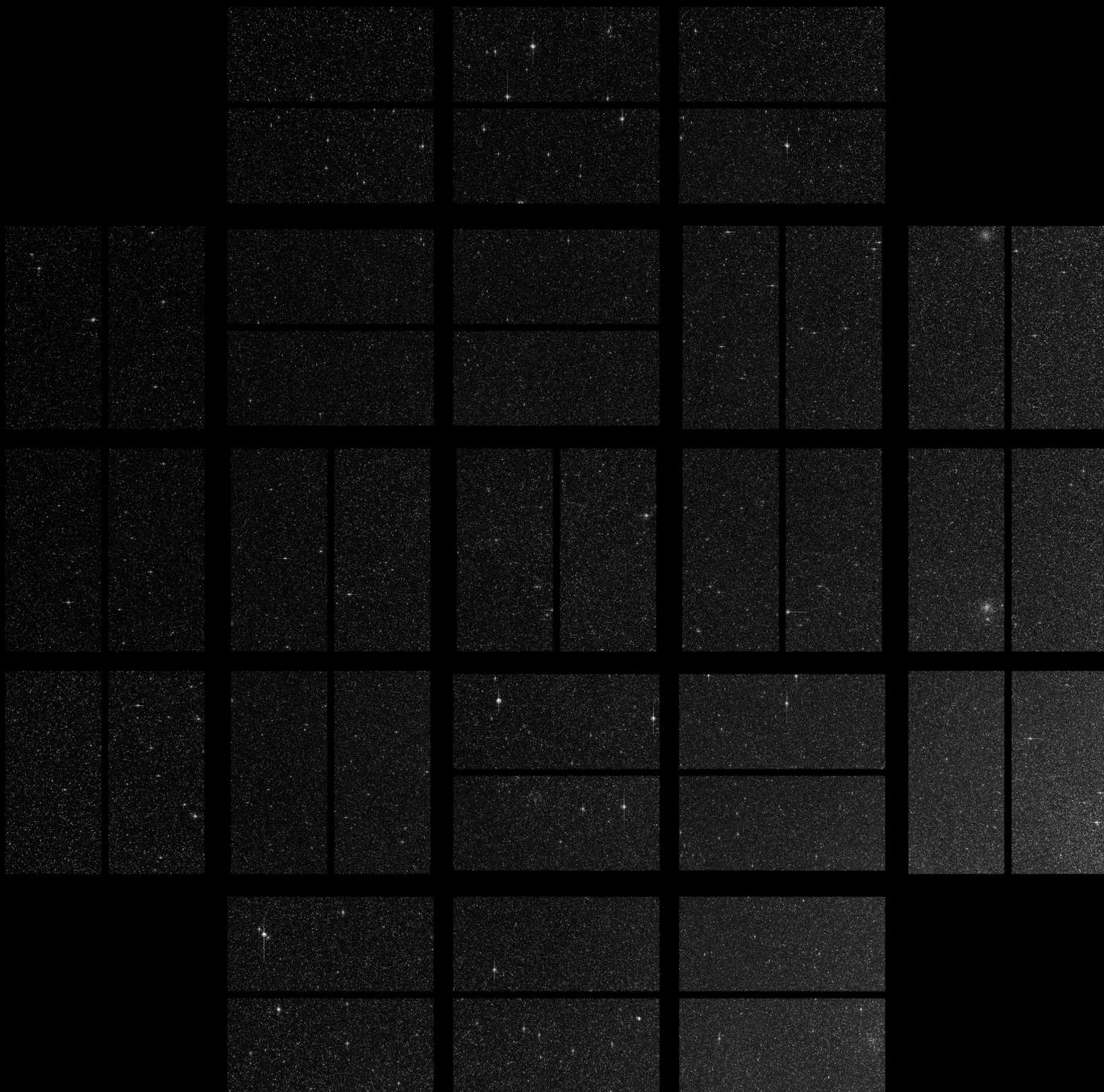


Planetary Transits

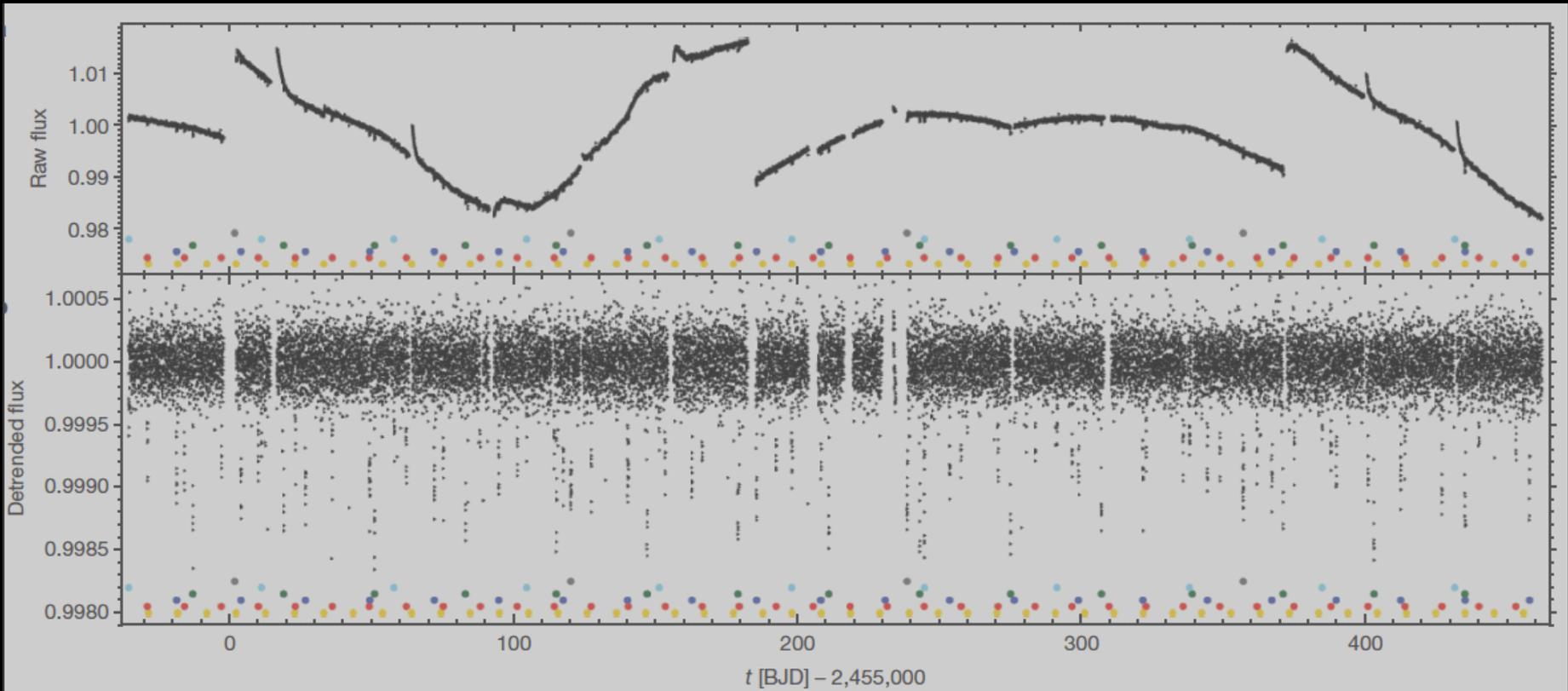


NASA Kepler Mission





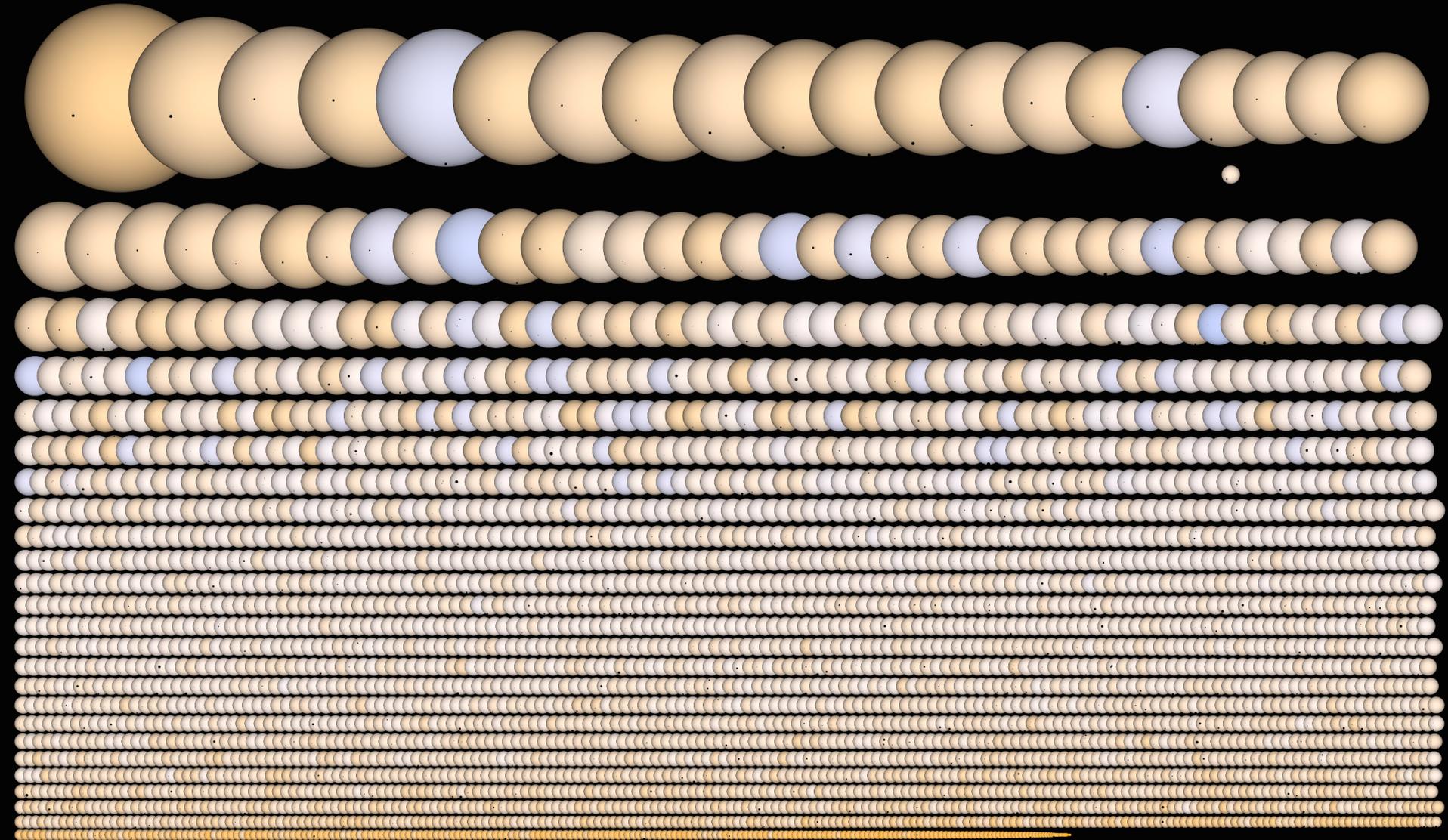
Data for Kepler 11



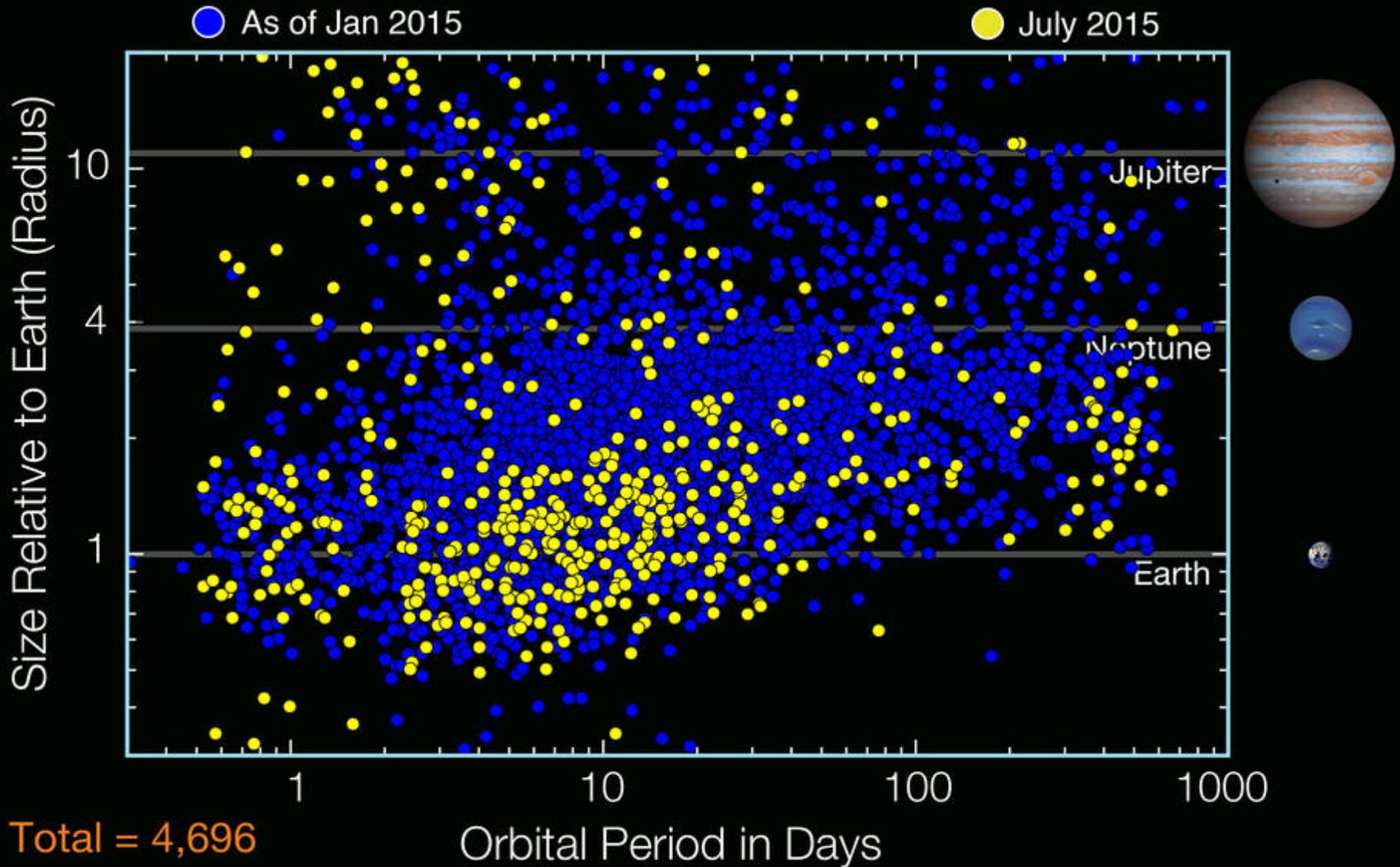
Kepler Data Processing



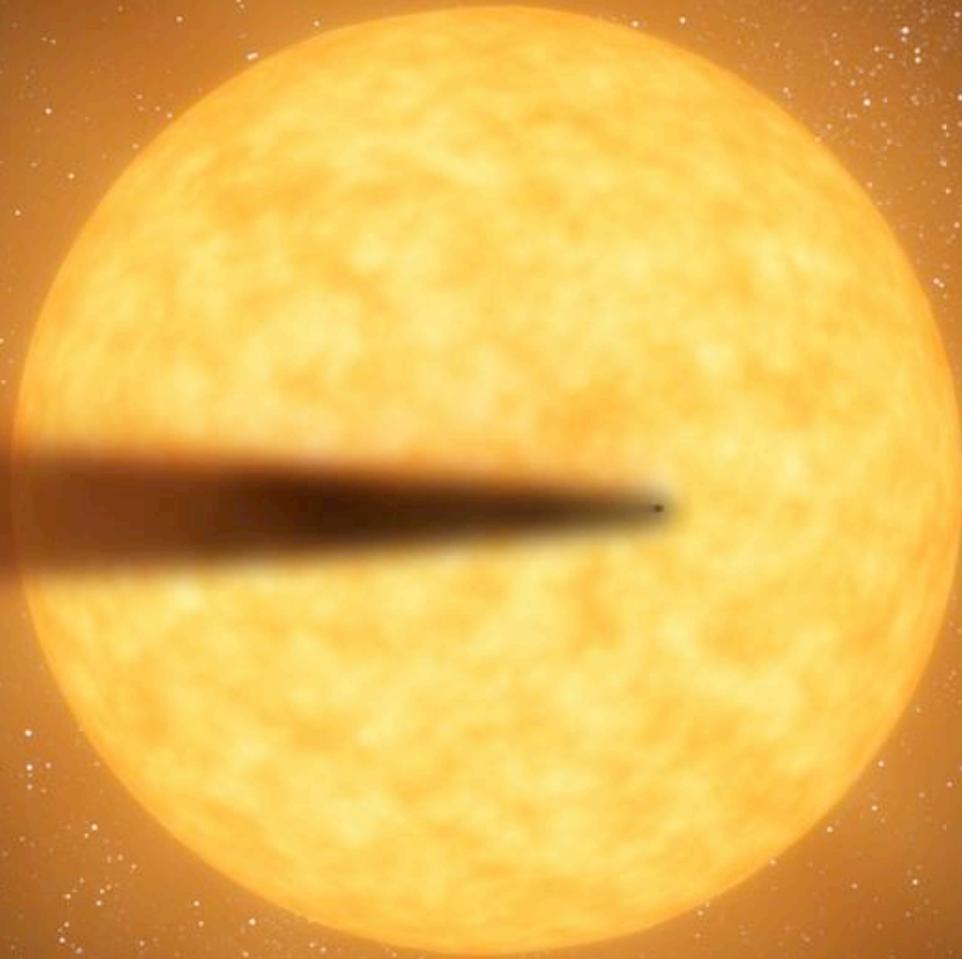
Kepler Planet Candidates



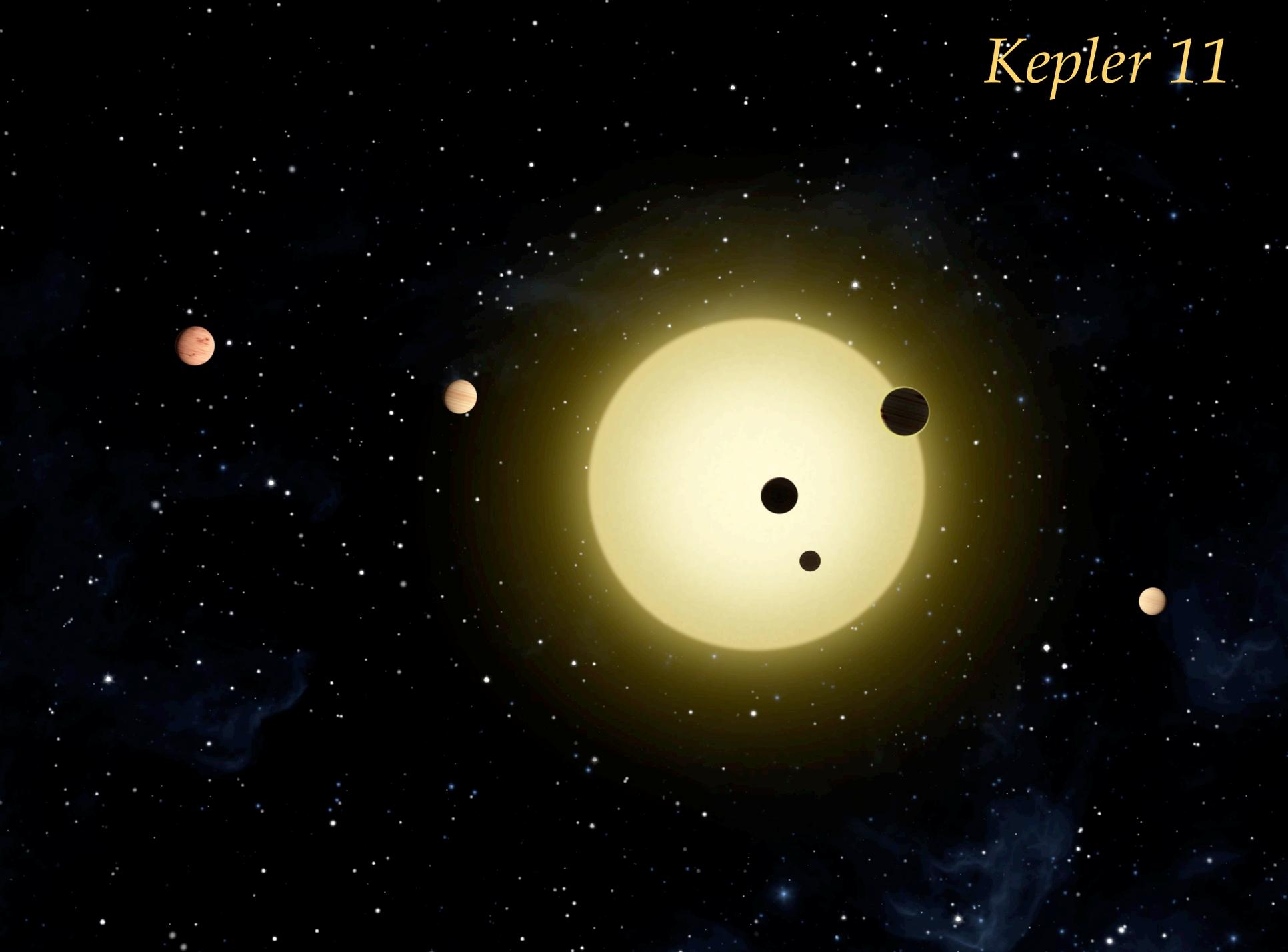
Kepler Planet Candidates



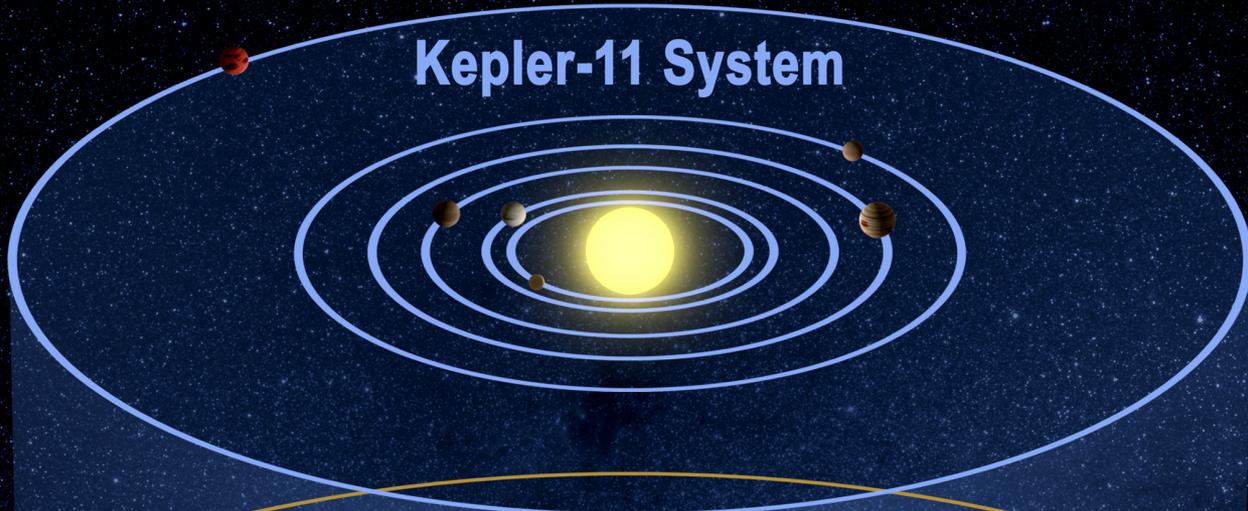
KIC 12557548



Kepler 11



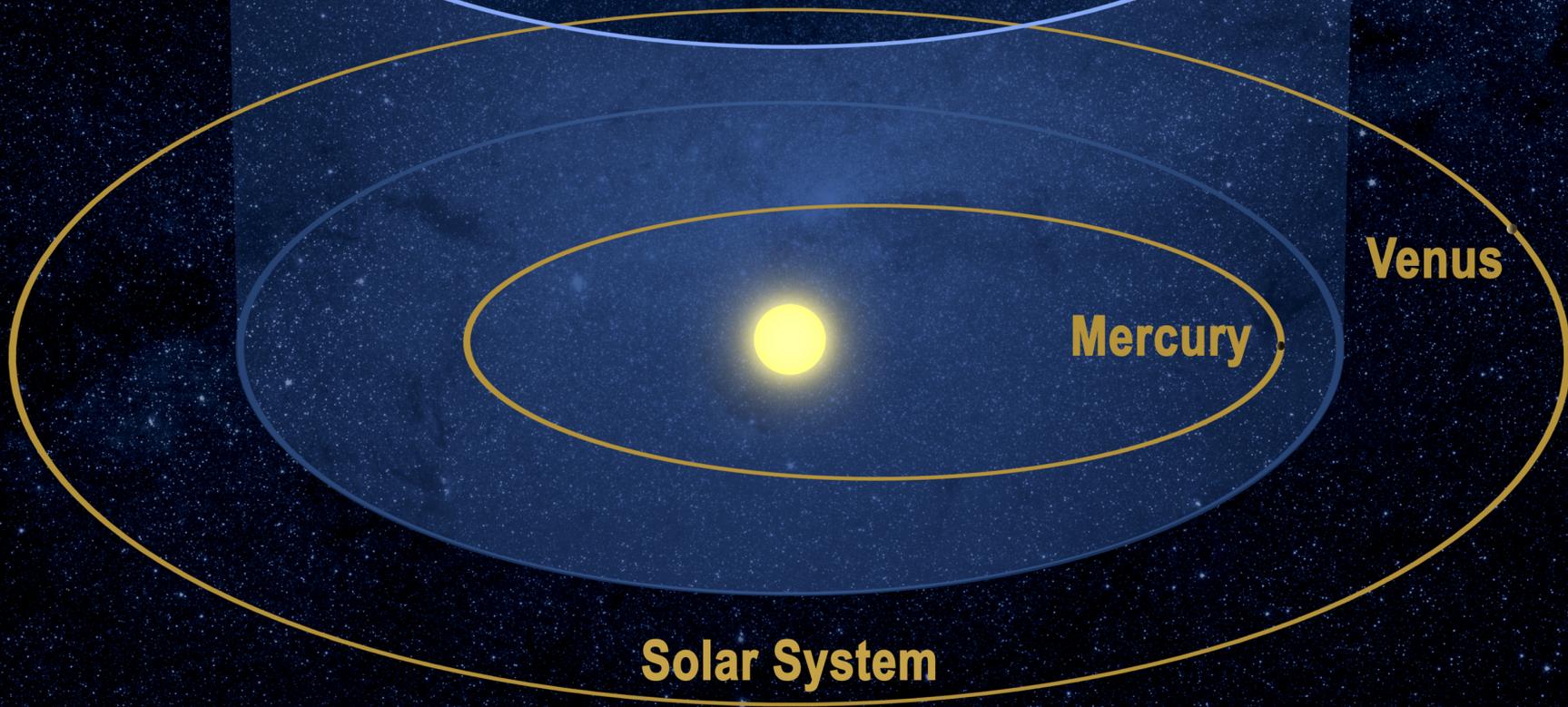
Kepler-11 System



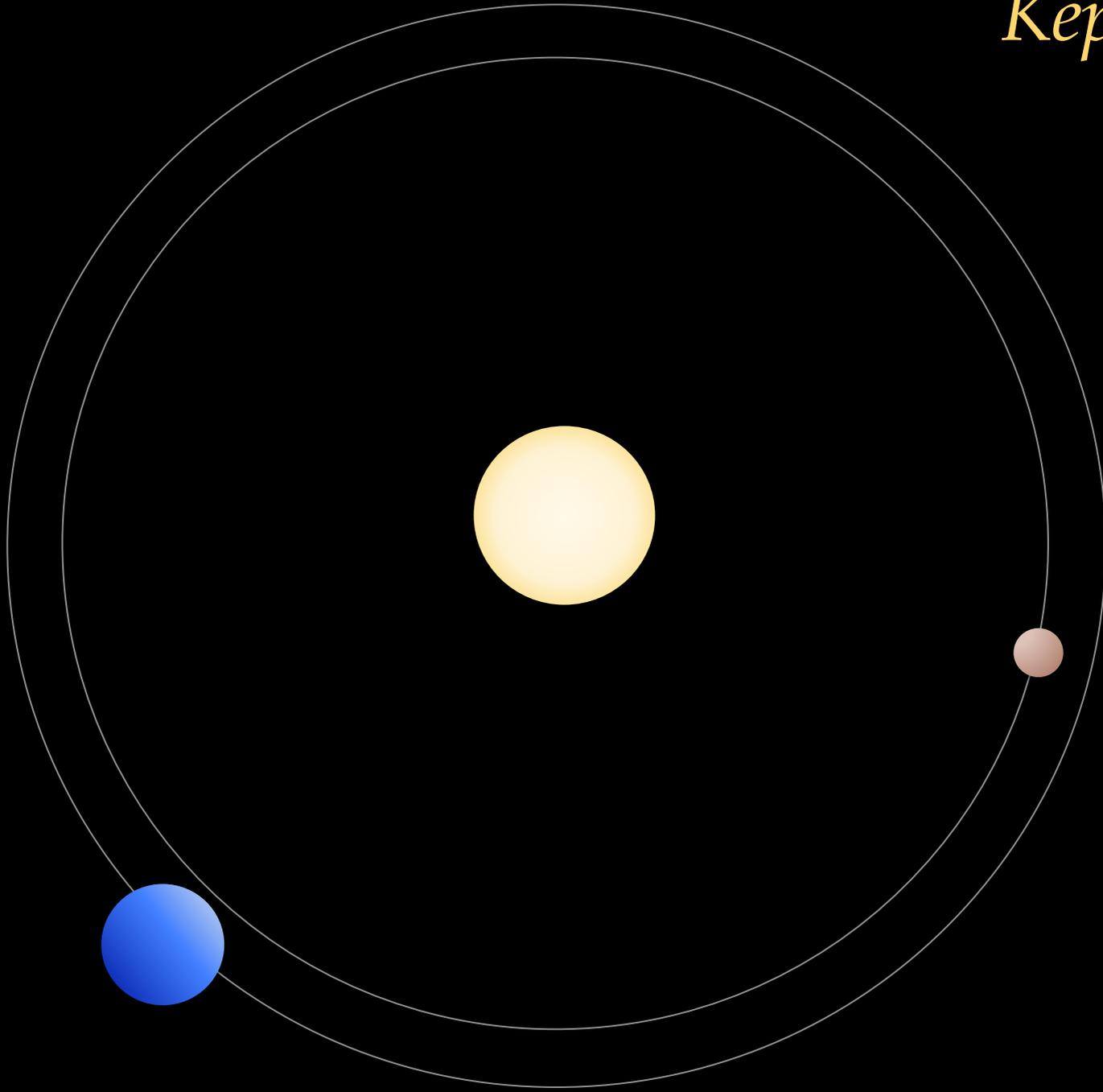
Venus

Mercury

Solar System



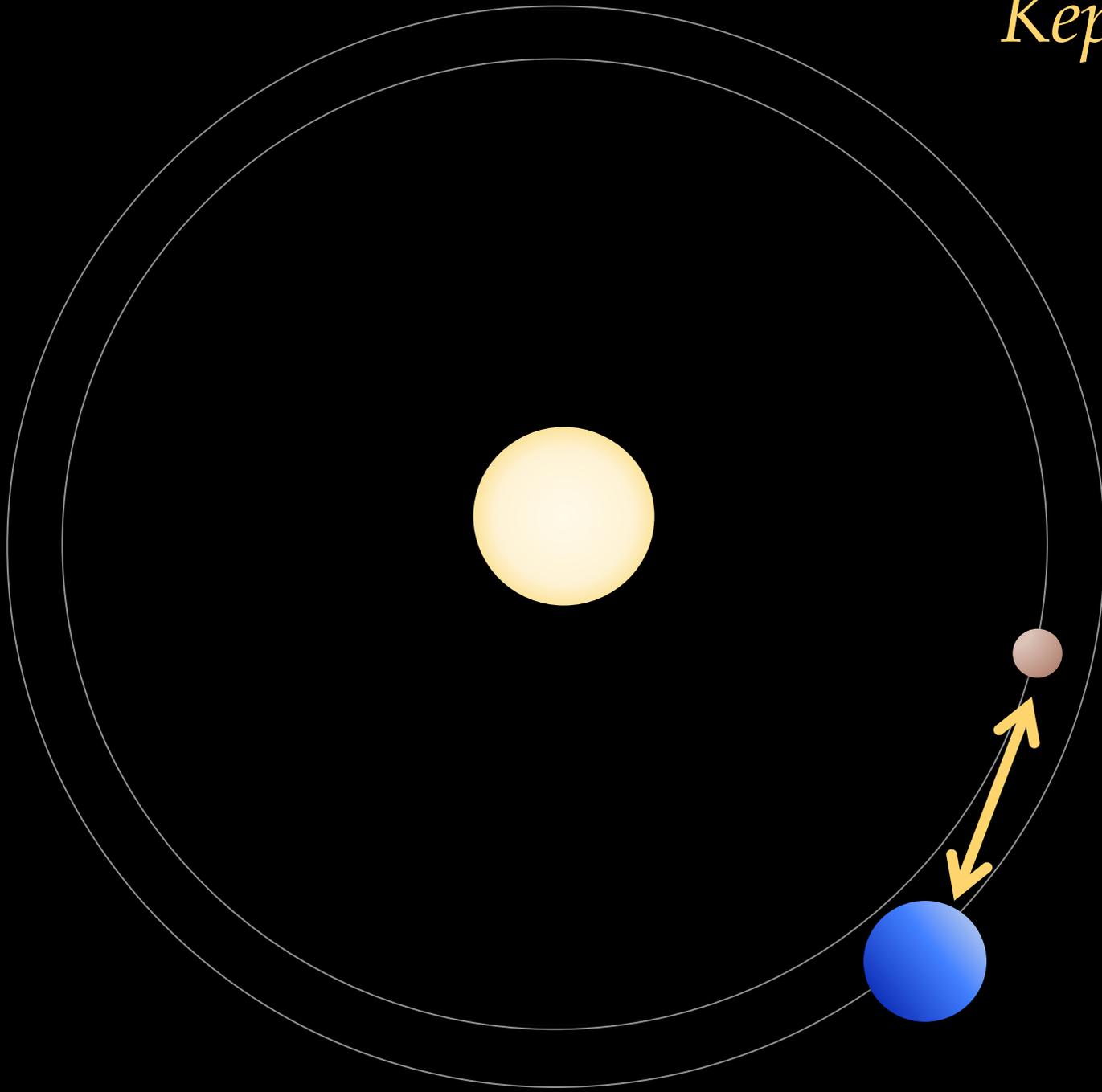
Kepler 36



Kepler 36



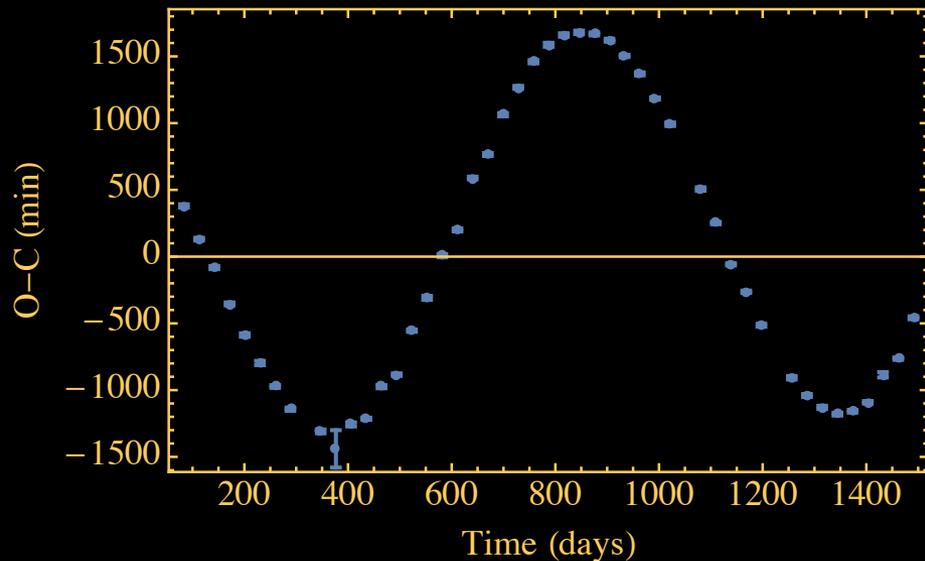
Kepler 36



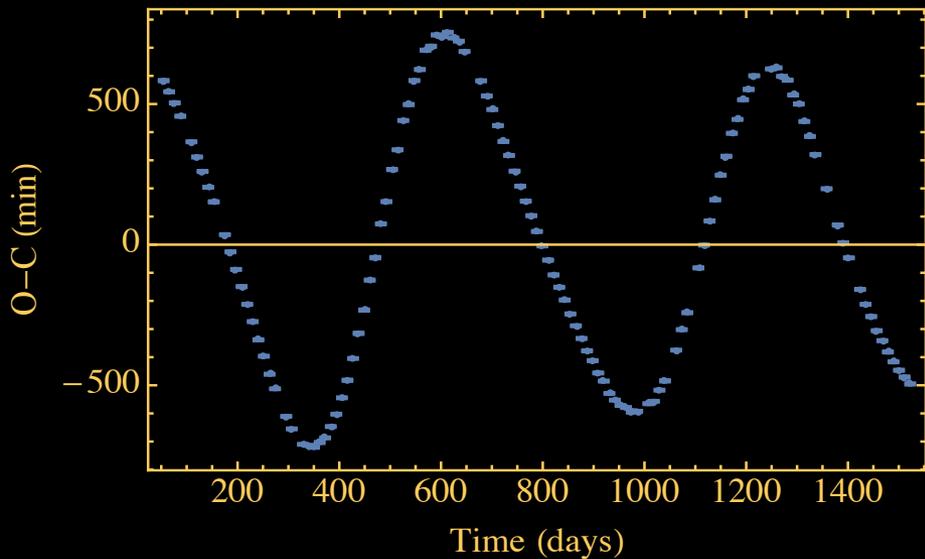
Transit Timing Variations

Deviations from a constant orbital period

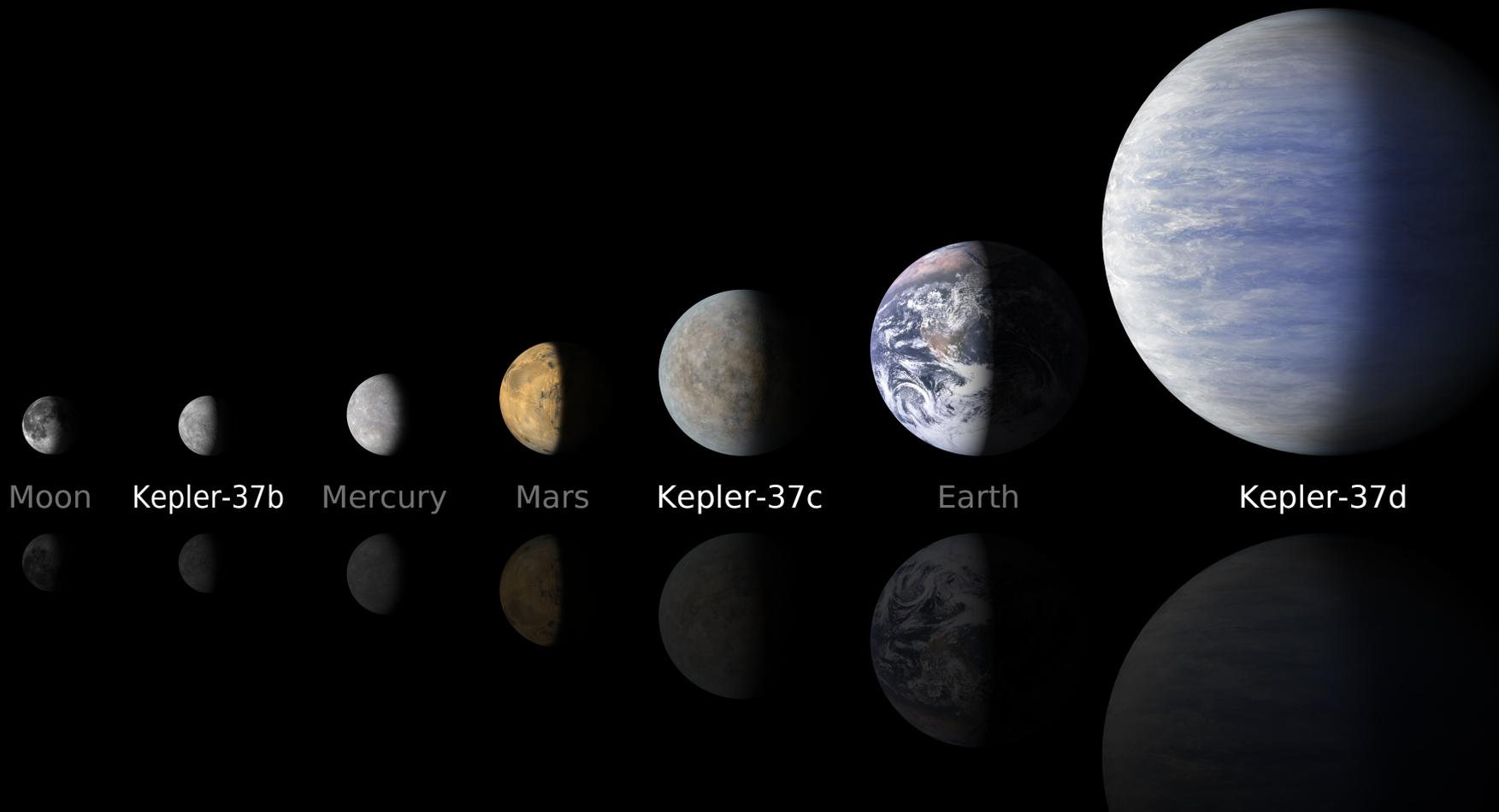
Kepler 30c



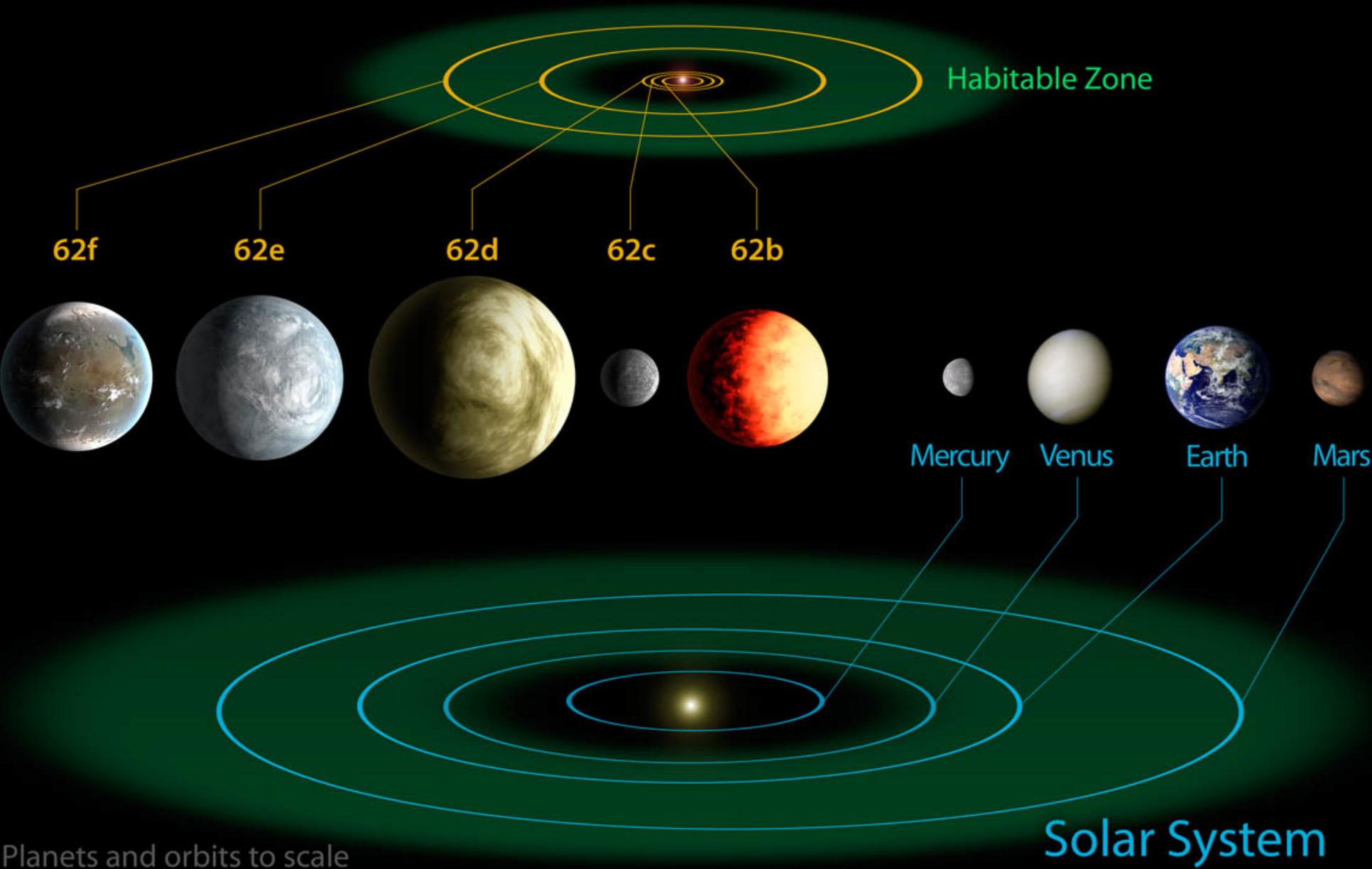
Kepler 88b



Kepler 37



Kepler 62



Binary Star Systems



Binary Star Systems



“Three out of every two stars are in a binary.”

— Cecilia Payne-Gaposchkin

Binary Star Systems

Nearest star: Alpha Centauri (triple system)

Brightest star: Sirius (binary system)

Famous star: Polaris (triple system)

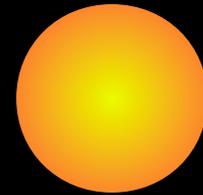
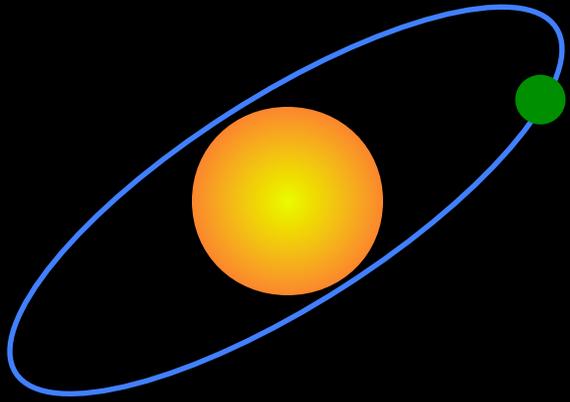
Binary Star Systems



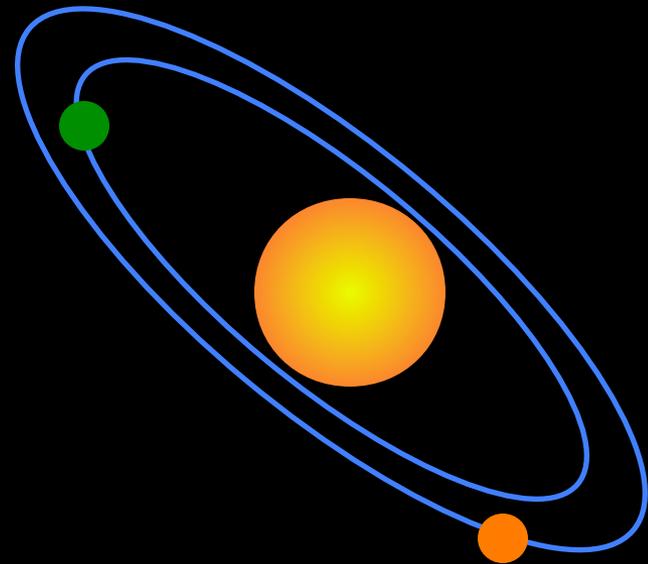
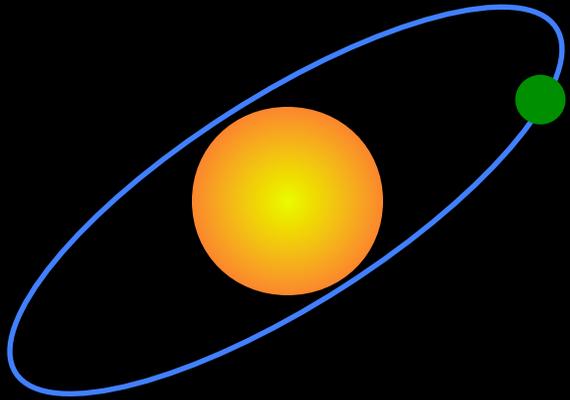
Binary Star Systems



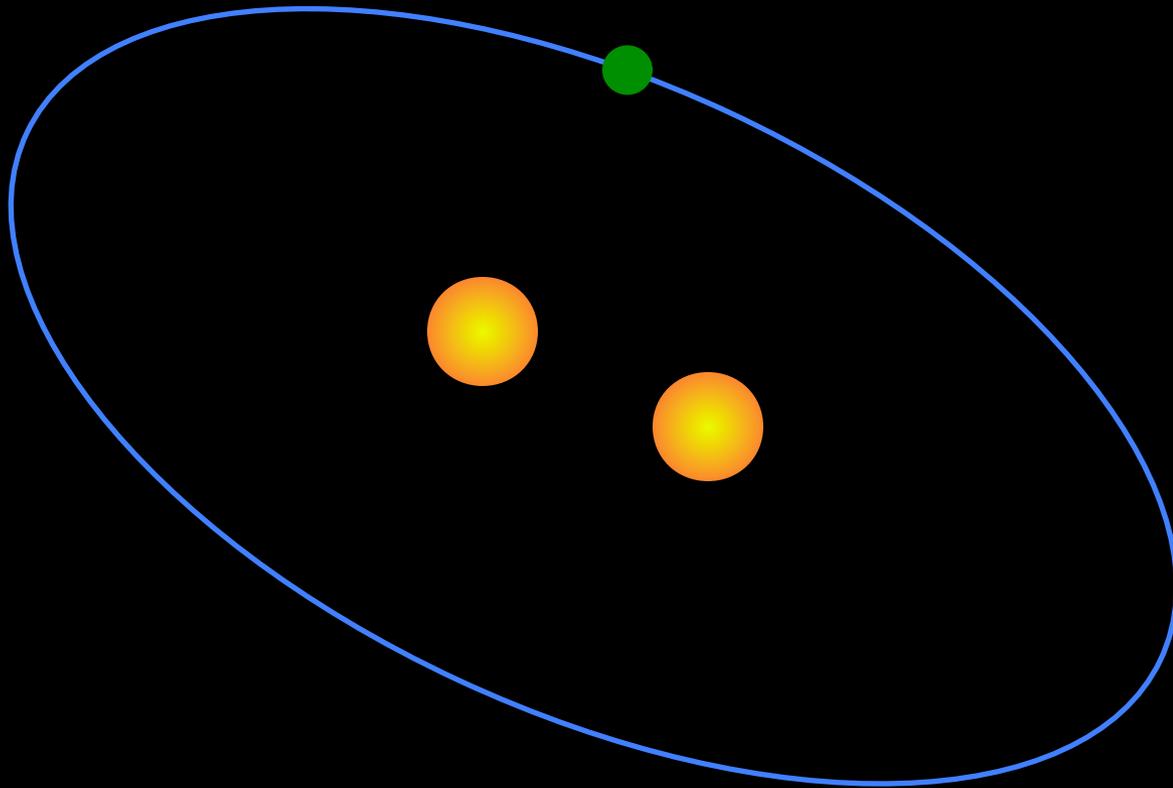
Binary Star Systems



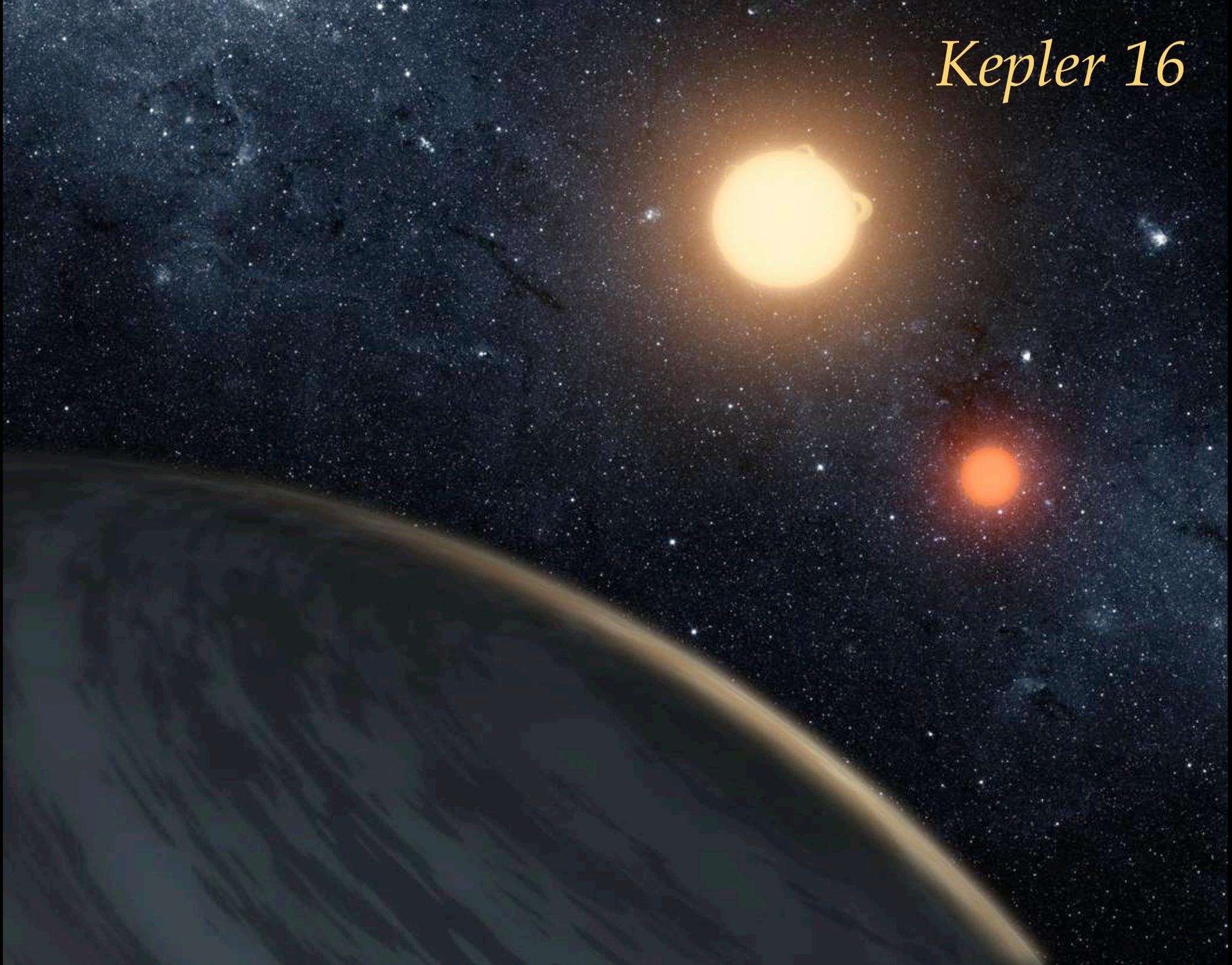
Binary Star Systems



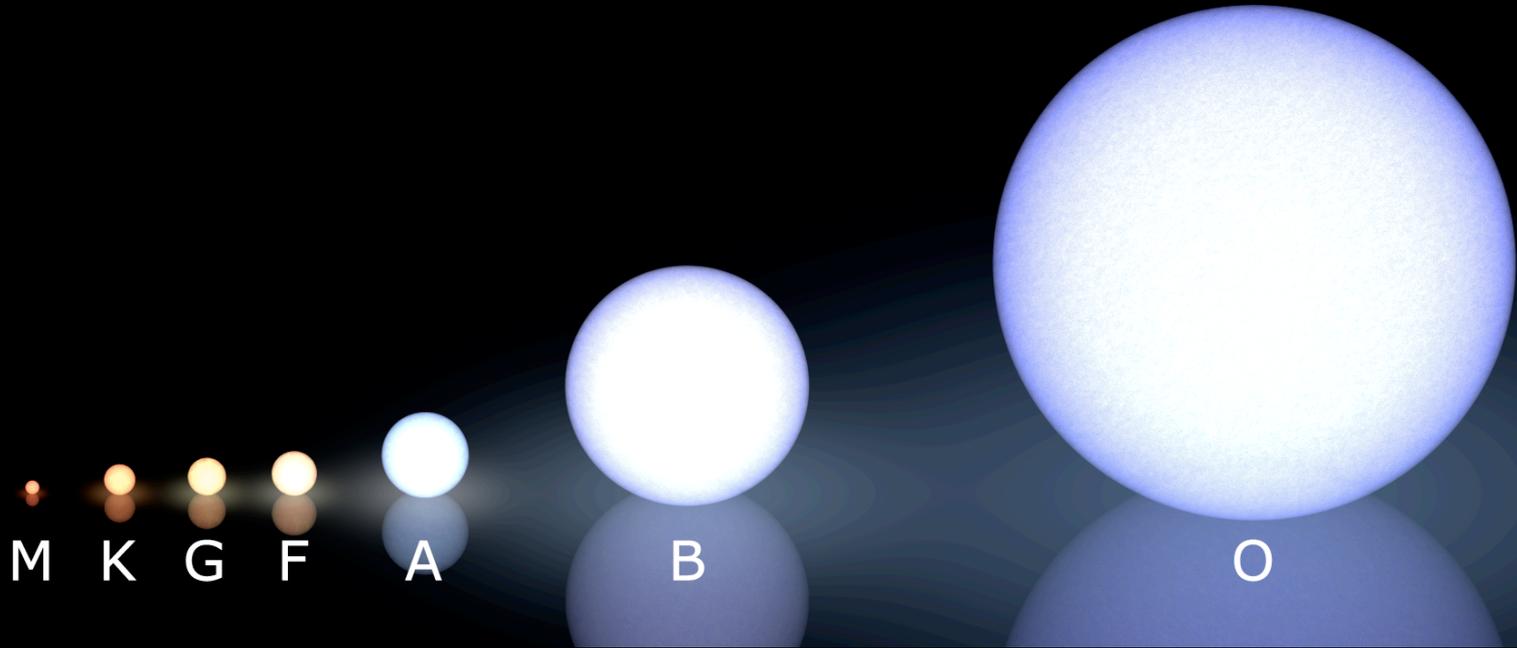
Binary Star Systems



Kepler 16



Different Kinds of Stars



Different Kinds of Stars



Sirius



Pollux

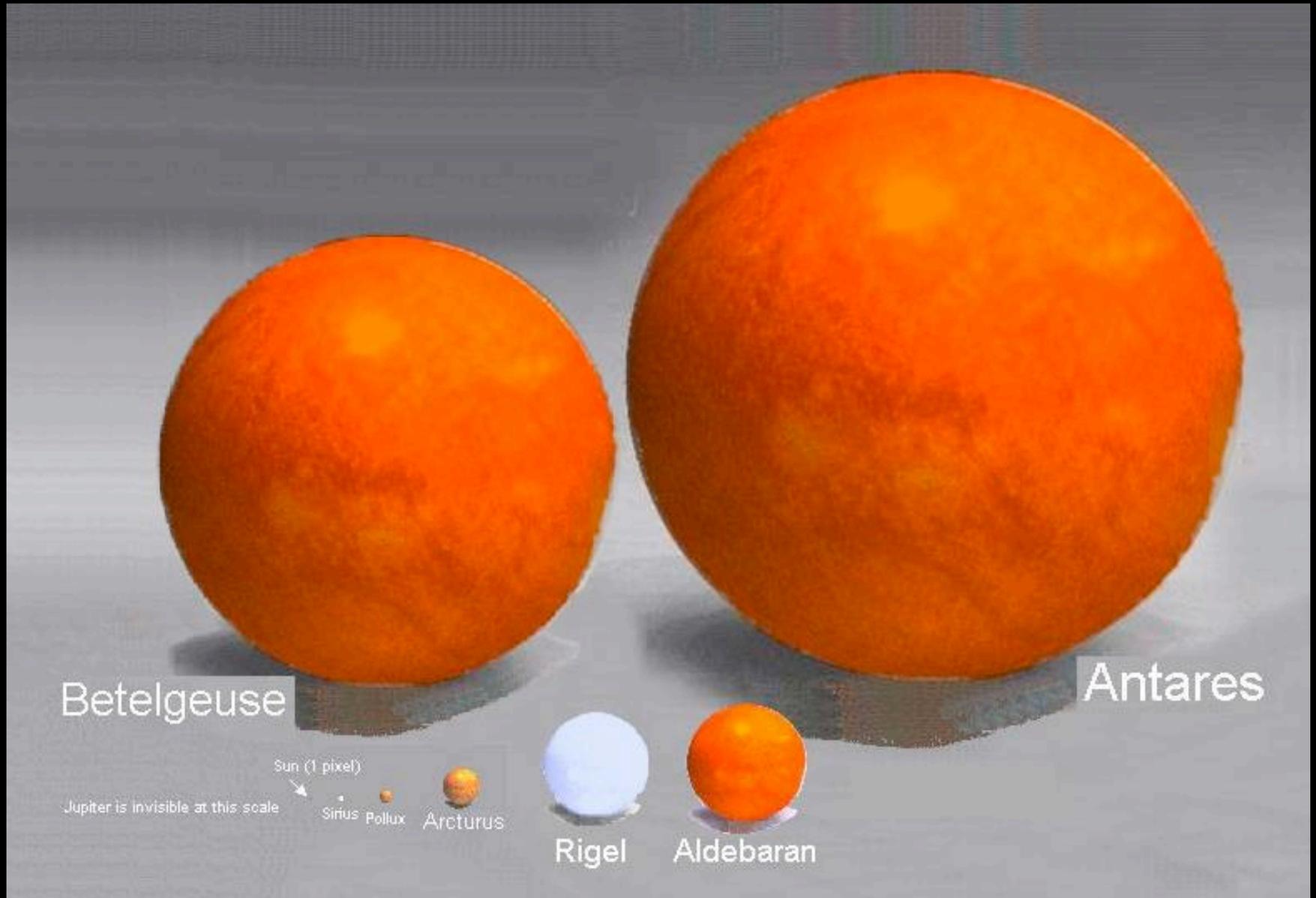


Arcturus

Jupiter is about 1 pixel in size

Earth is invisible at this scale

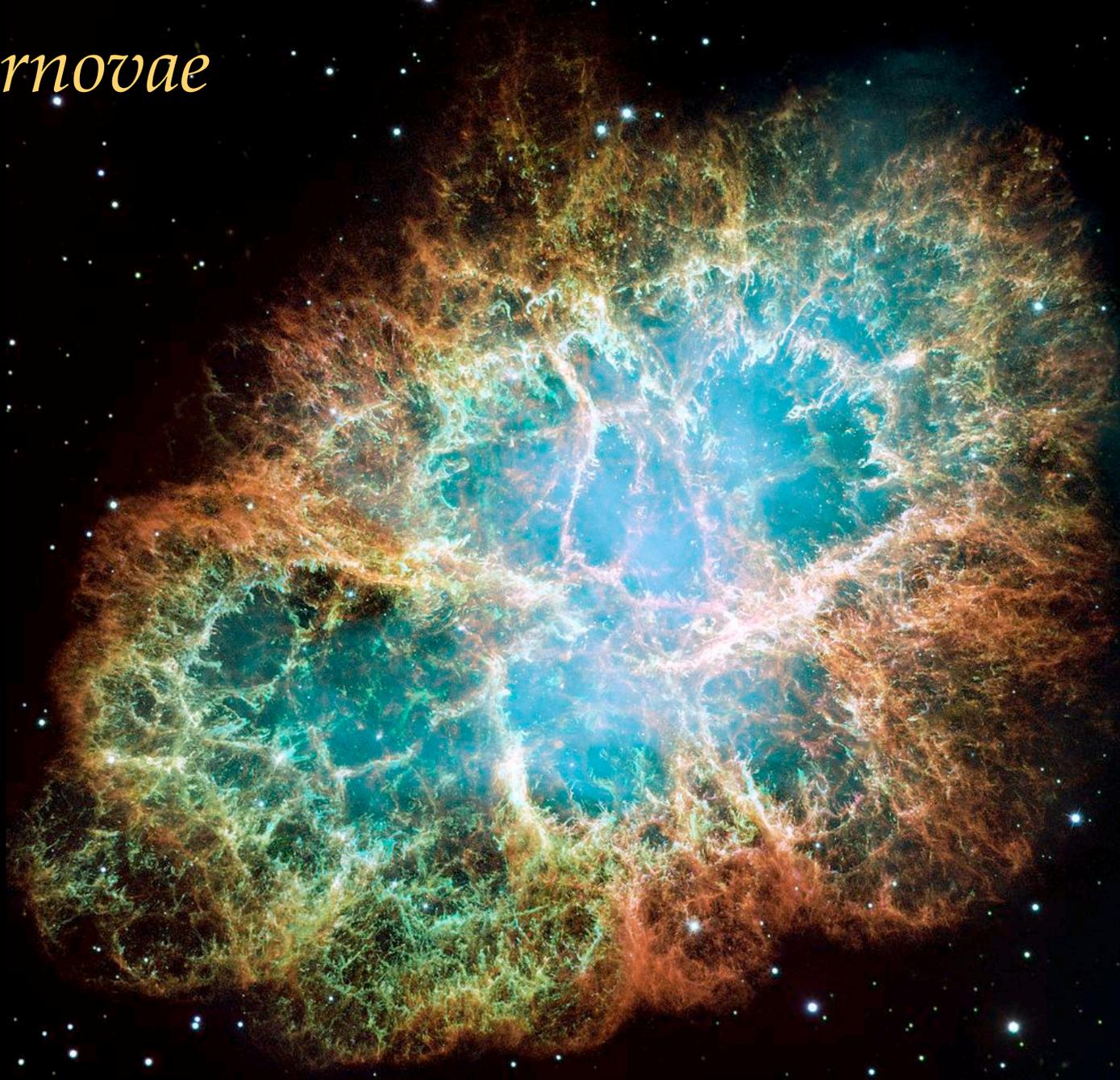
Different Kinds of Stars

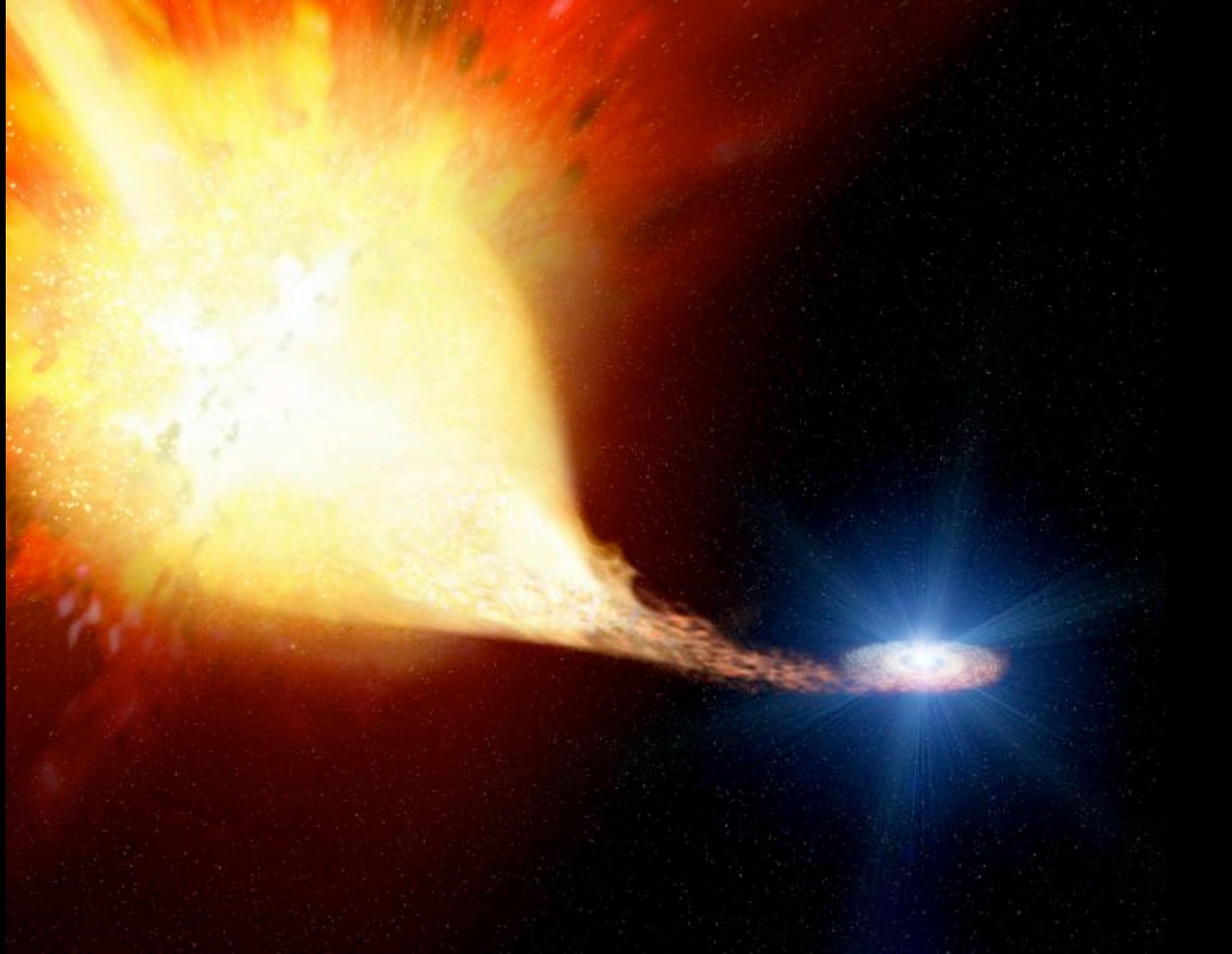


Supernovae



Supernovae





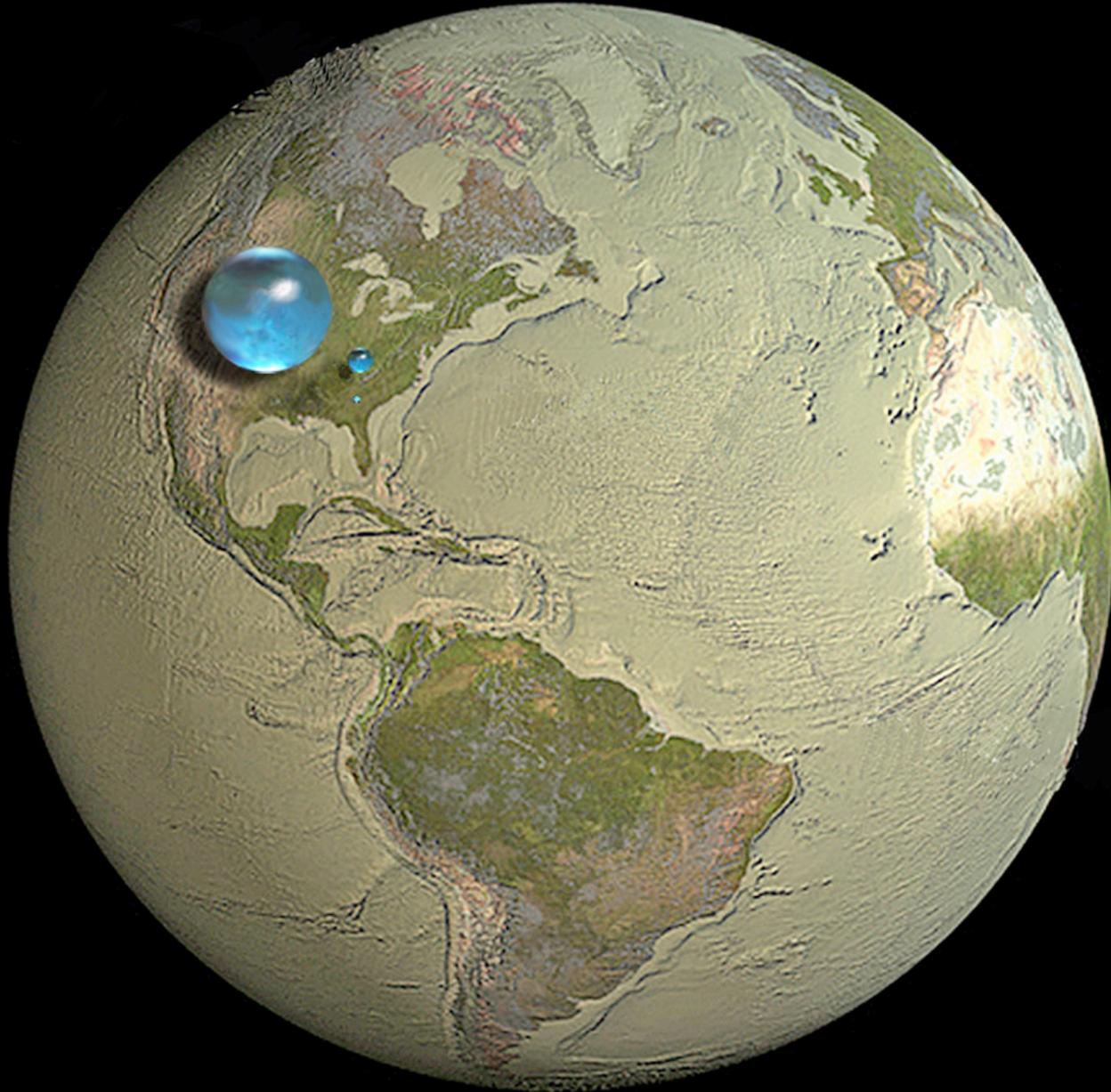
PSR B1257+12



Unique Planets



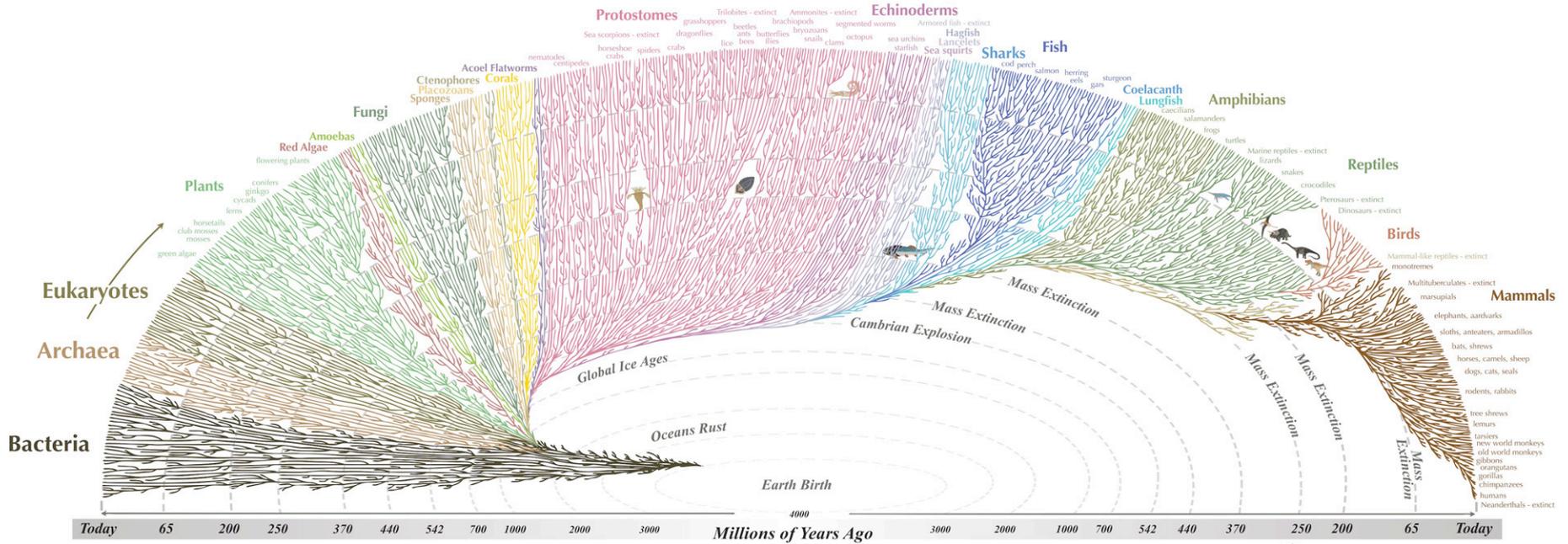
Water



Atmosphere



Life



All the major and many of the minor living branches of life are shown on this diagram, but only a few of those that have gone extinct are shown. Example: Dinosaurs - extinct 

Life

