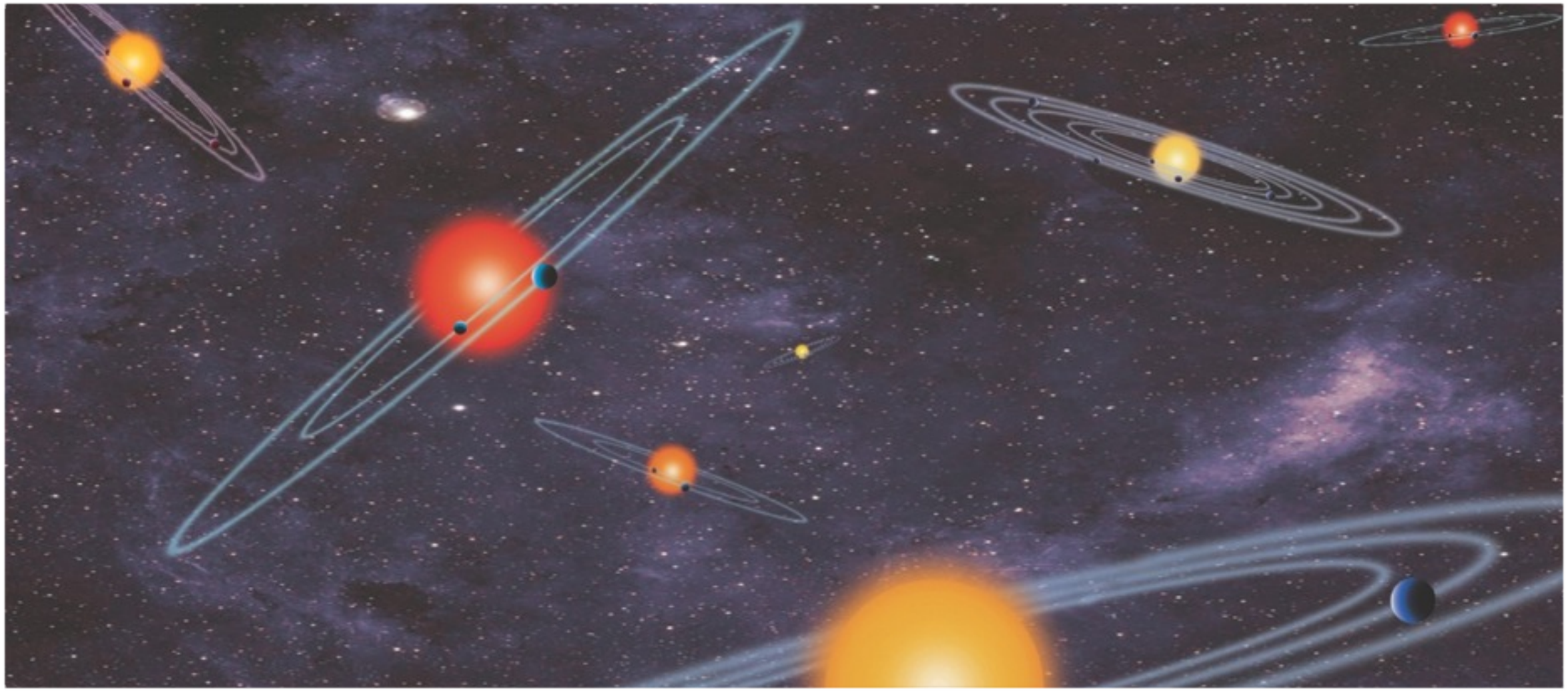


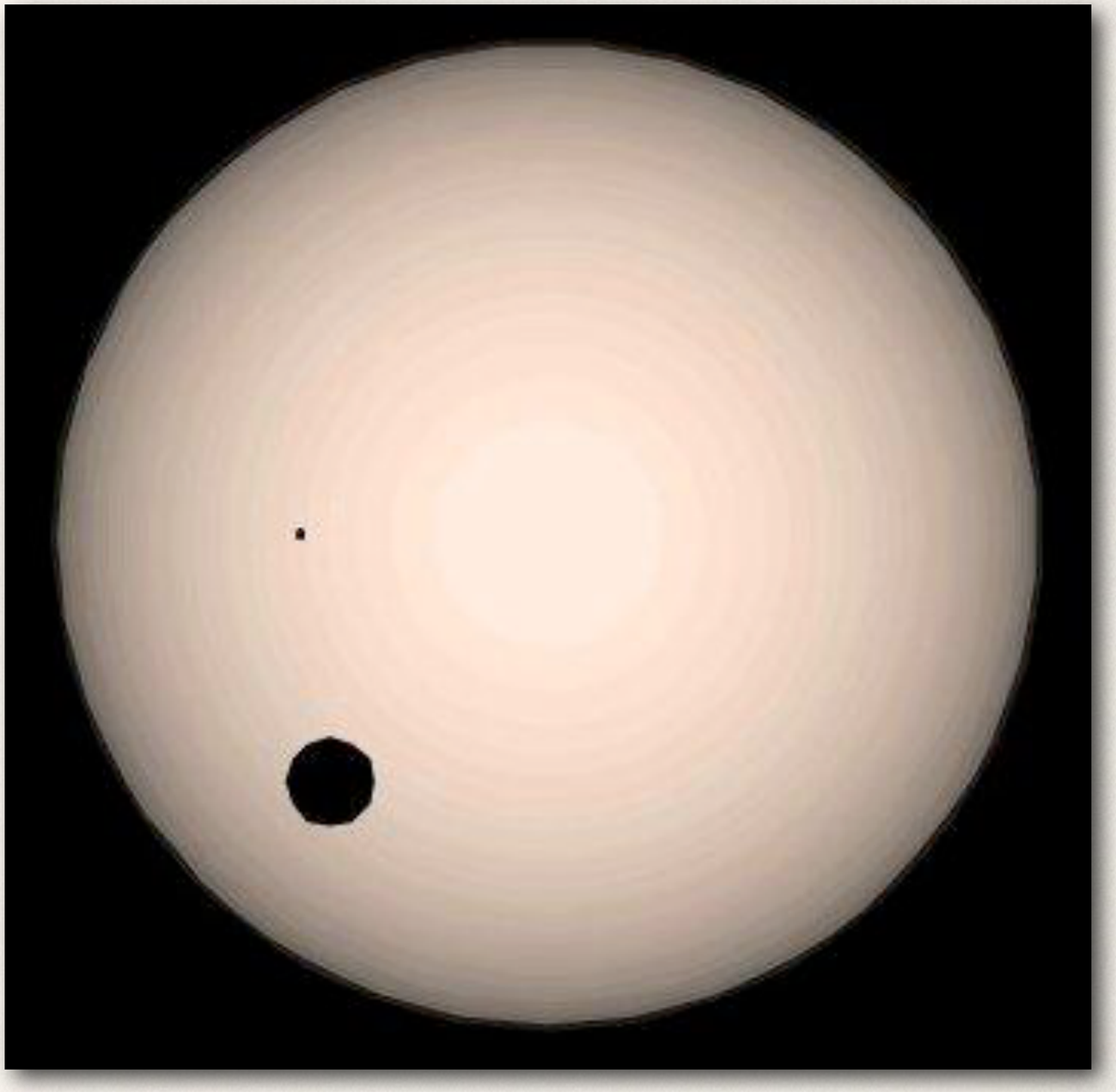
October 20, 2015

Targets of Opportunity

Jason F Rowe
jason@astro.umontreal.ca

Overview

- Kepler Targets
  - Kepler-10b
    - thermal / reflection / rotation
  - Kepler-62e,f
    - long term TTVs / masses
  - validation of HZ planets

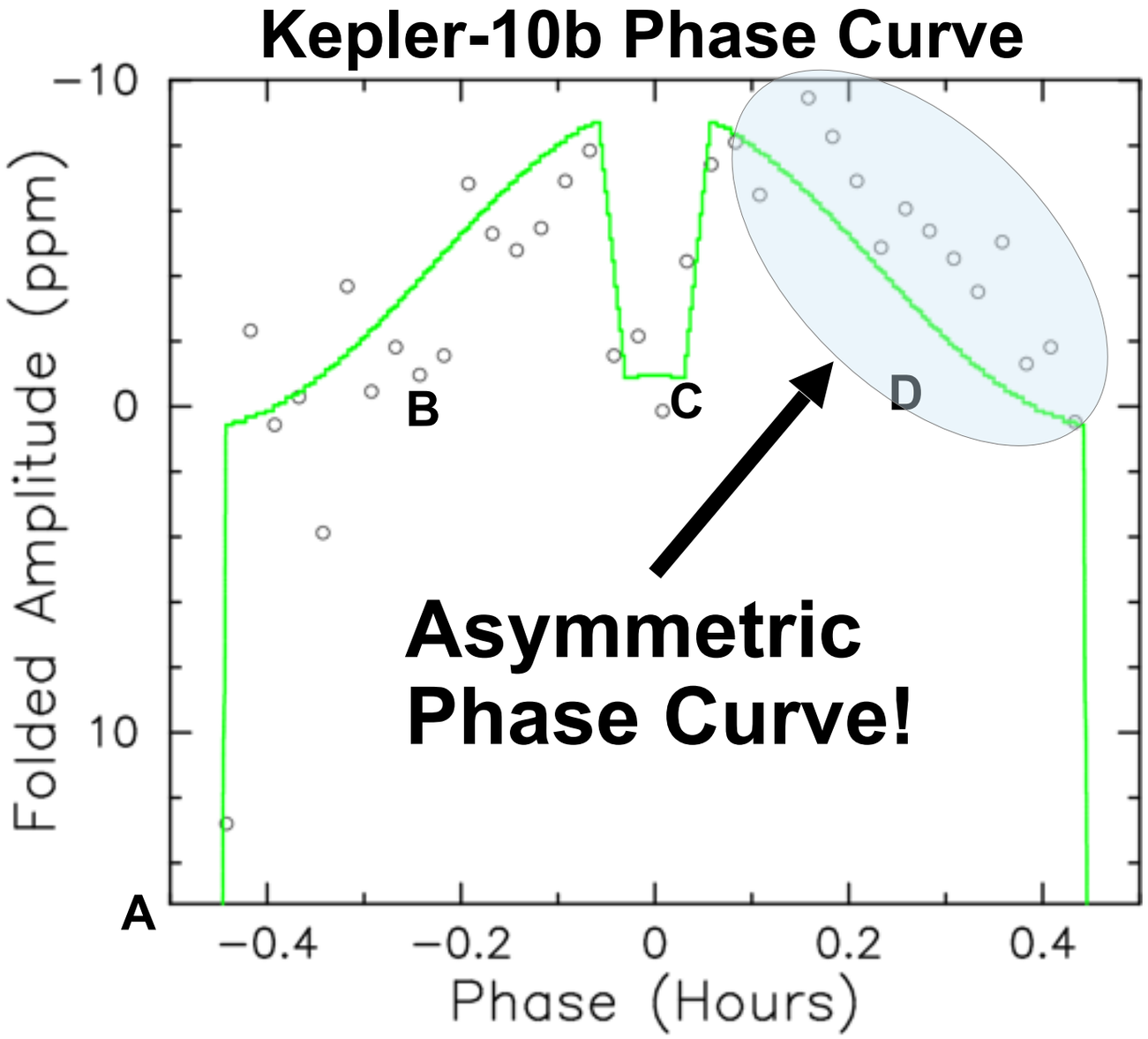


Size of Jupiter and Earth
Relative to the Sun

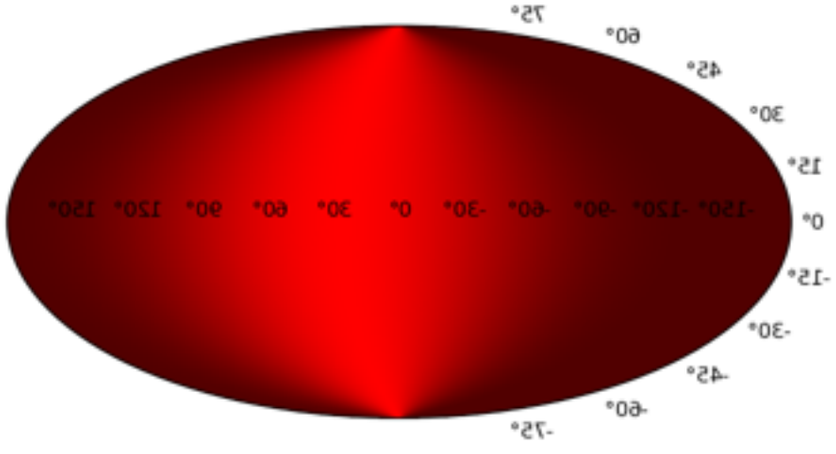
Kepler-10b

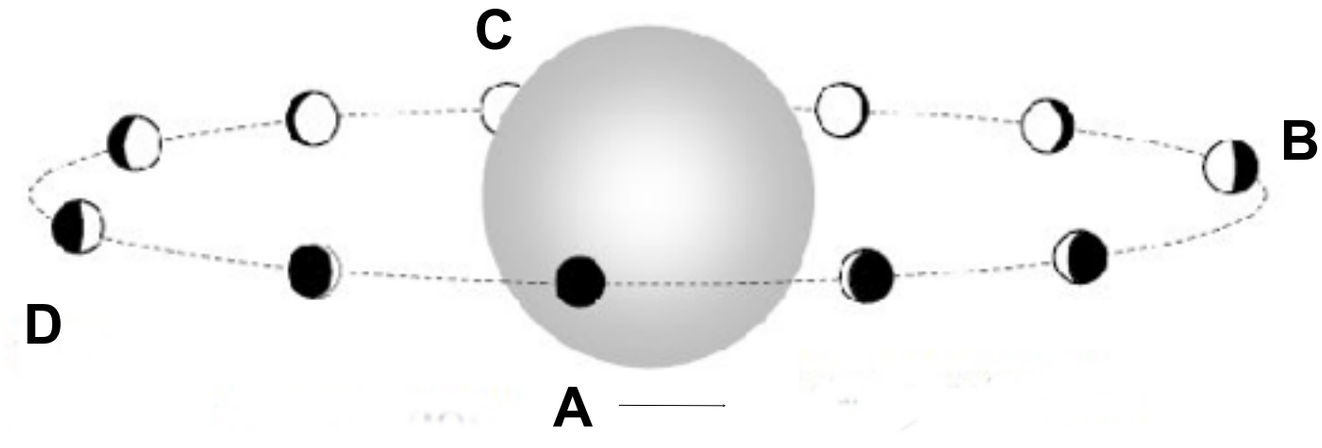
- Period 0.8d
- Mass ~ 5 Mearth
- Radius ~ 1.4 Rearth
- Density 8 g/cm^3
- Occultation < 10 ppm

- Planet brightest around point 'D'
- 'Western Hemisphere is **brighter**



Surface Brightness Map as Seen at Point C

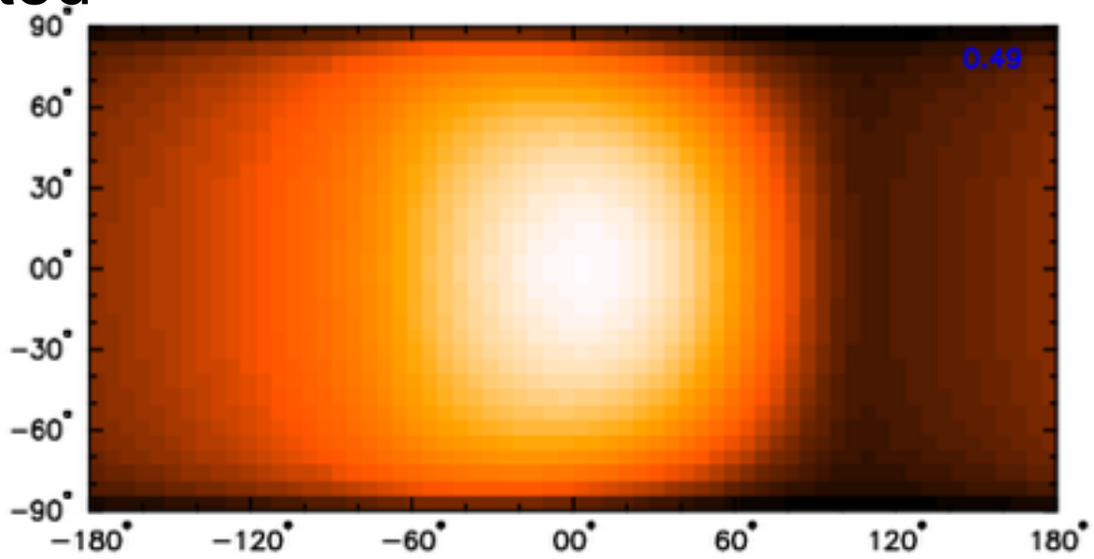




Models with Rotation or Obliquity

- weak (no) atmosphere model
- conduction/heat capacity surface dominated

Surface Brightness Map

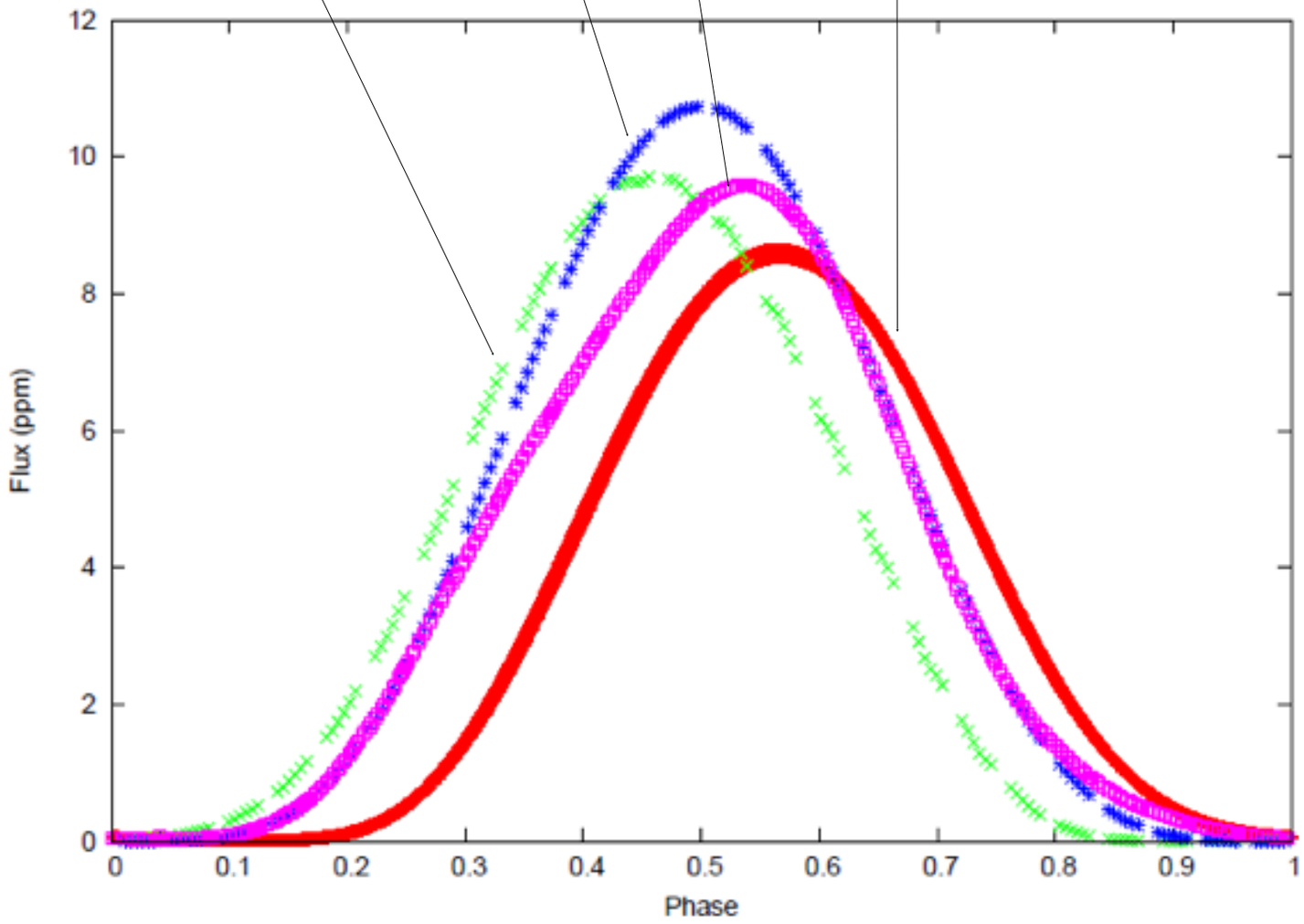


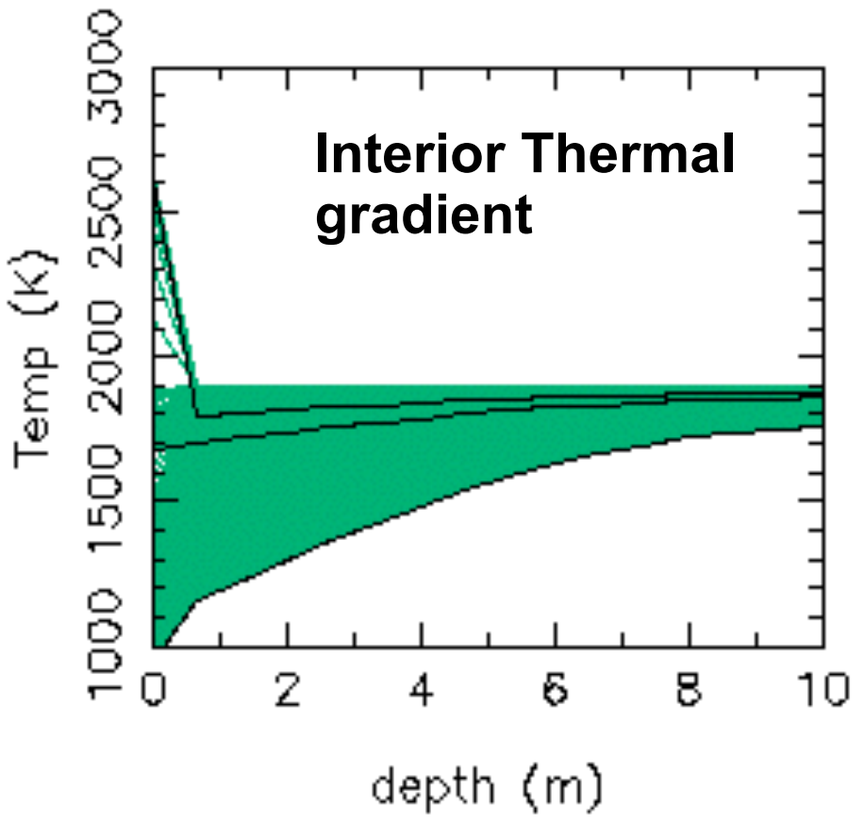
no rotation (tidally locked) (blue)

obliquity (40 deg) (magneta)

prograde rotation (green)

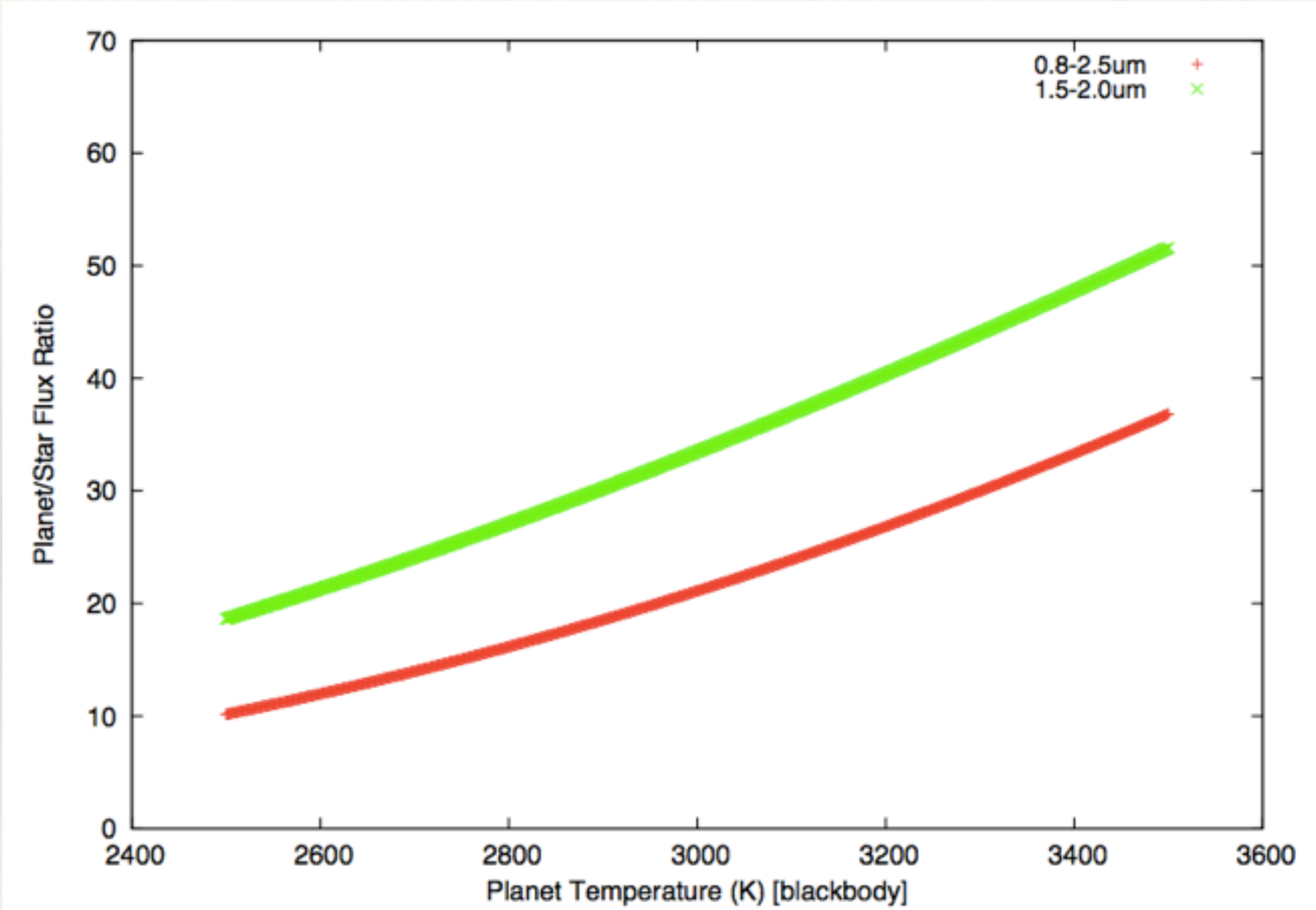
retrograde rotation (red)





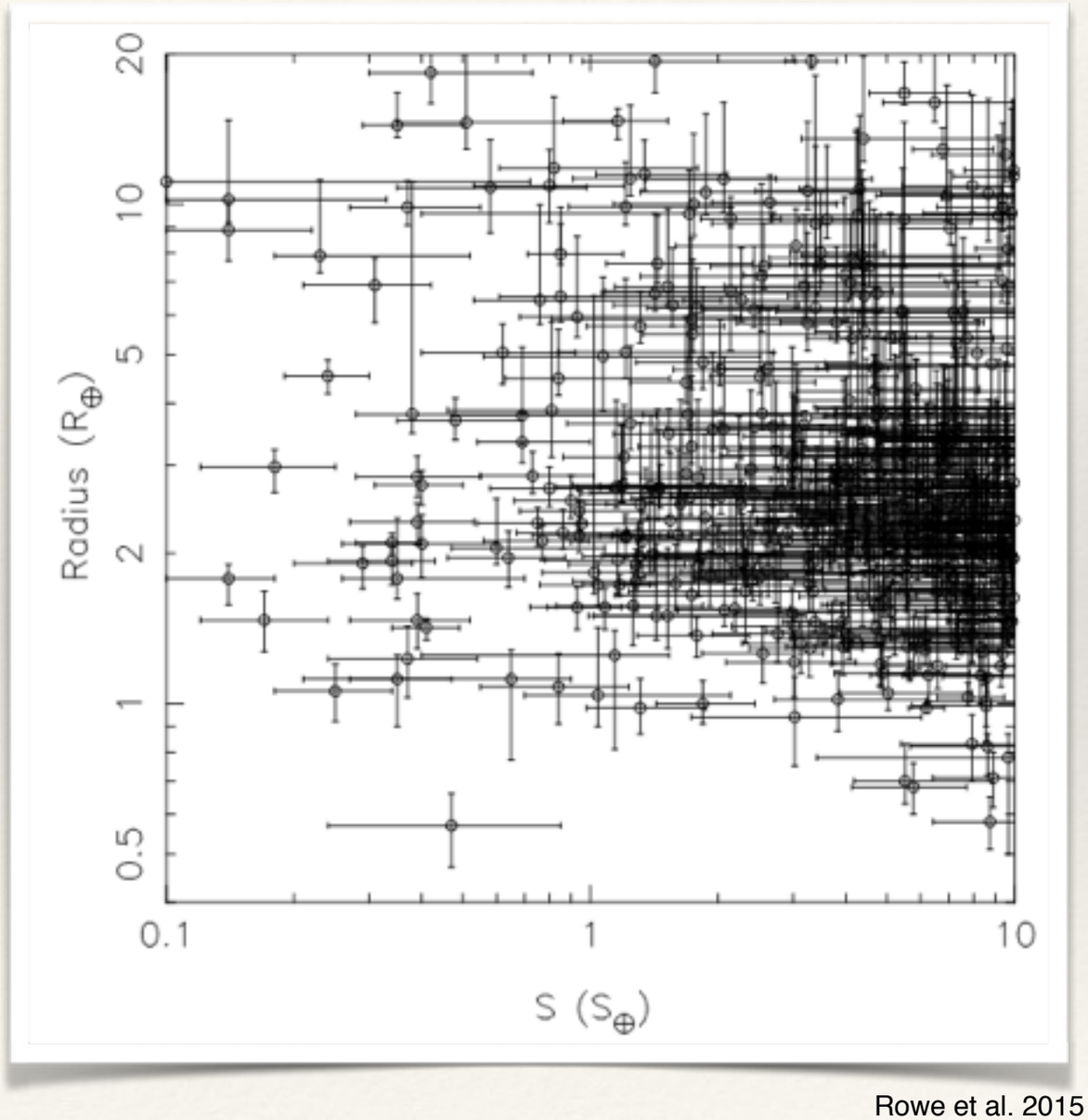
Breaking the Degeneracy

- We have observations in optical.
- JWST phase-curve variations break degeneracy
  - 10 ppm ~ 250 K
- g=11.38, J=9.9, H=9.6, K=9.5
- T* ~ 5700 K



Habitable Zone Candidates

- Earth-sized Planets in the HZ are common!
- Kepler has found many examples, such as Kepler-186f
- Validation of HZ planets around cool stars can be difficult
  - binarity is a problem

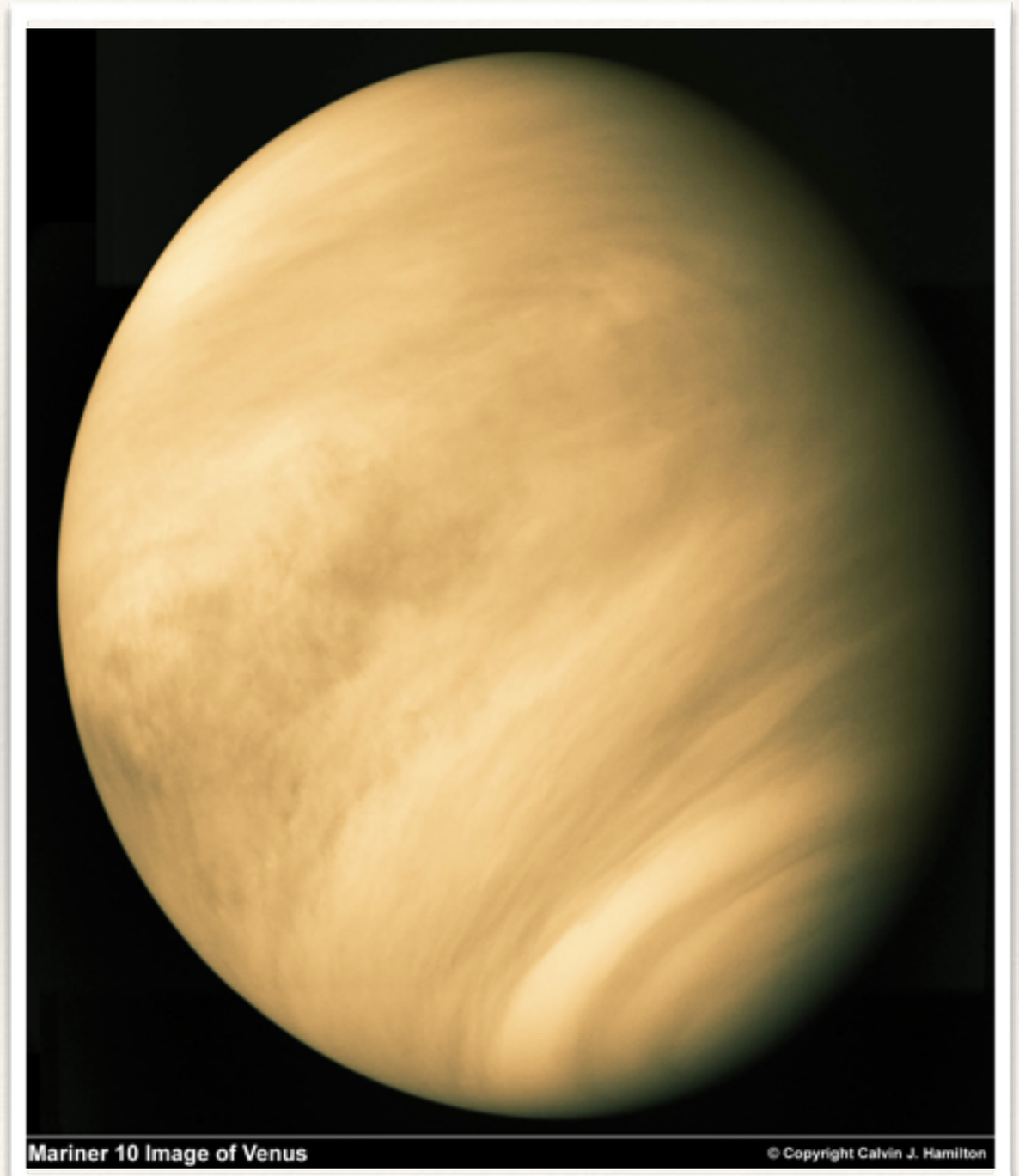


Rowe et al. 2015

KOI-3138

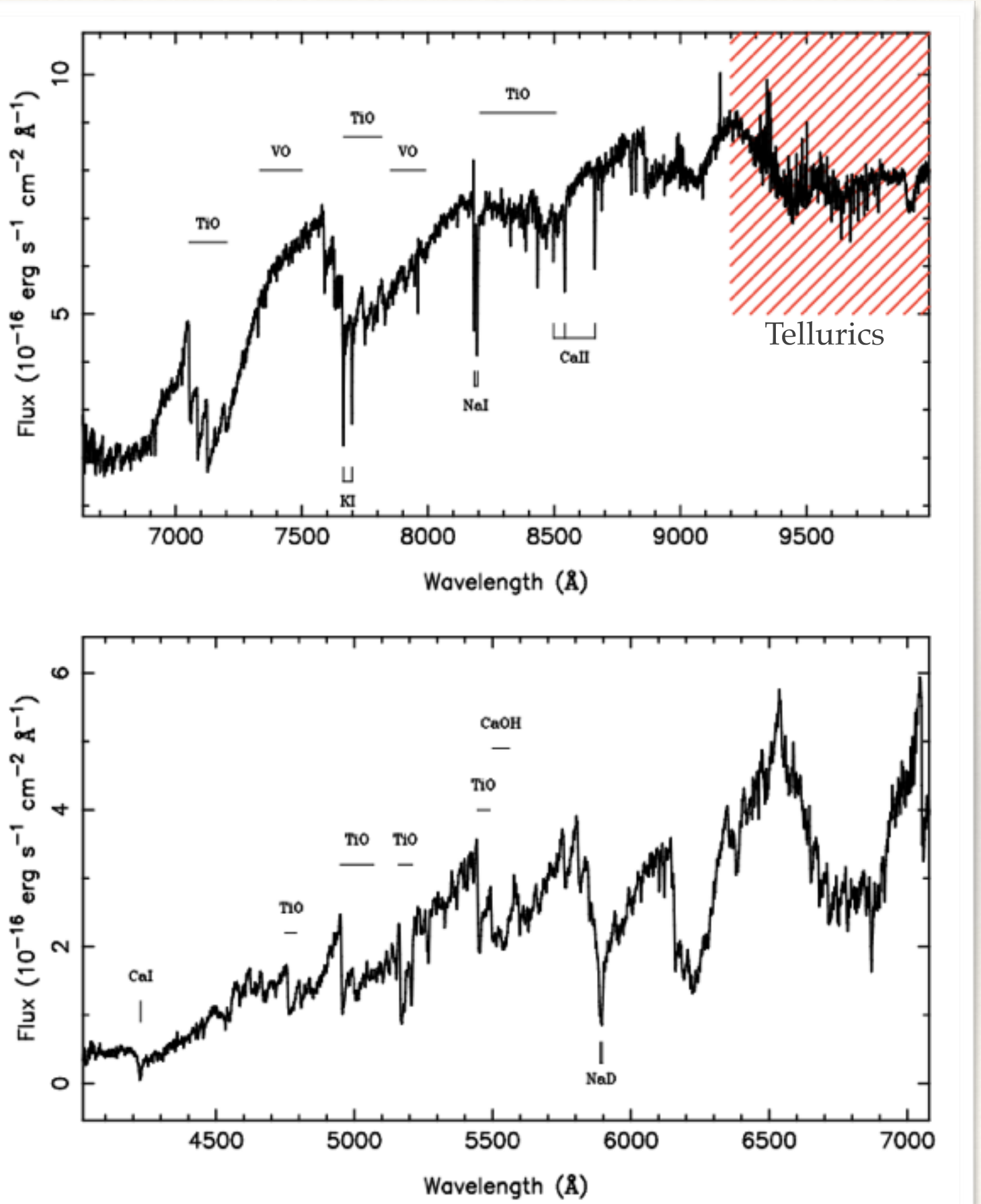
- g=18.2, J=13.4, H=12.8, K=12.5
  - high-proper motion
    - 0.157” /year (Lepine & Shara 2005)
  - potentially thick disk

- Originally classified as a cool M8 dwarf



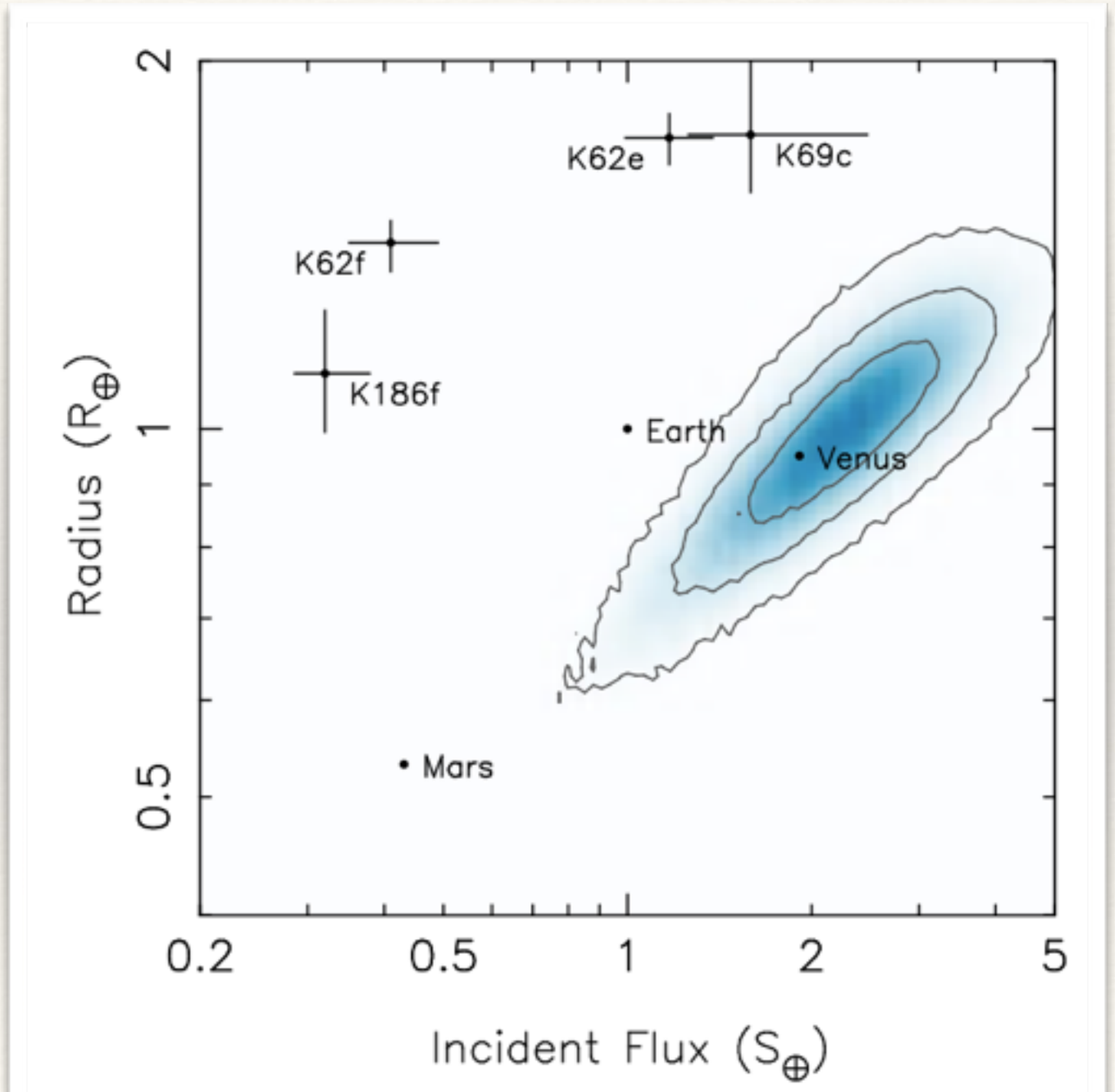
Spectra

- DBSP Palomar Spectrum
  - ~0.8 A/pixel
  - 4000-10000 Angstrom
  - it's an M-dwarf
    - TiO bands
  - ~M5V (3250±50 K)



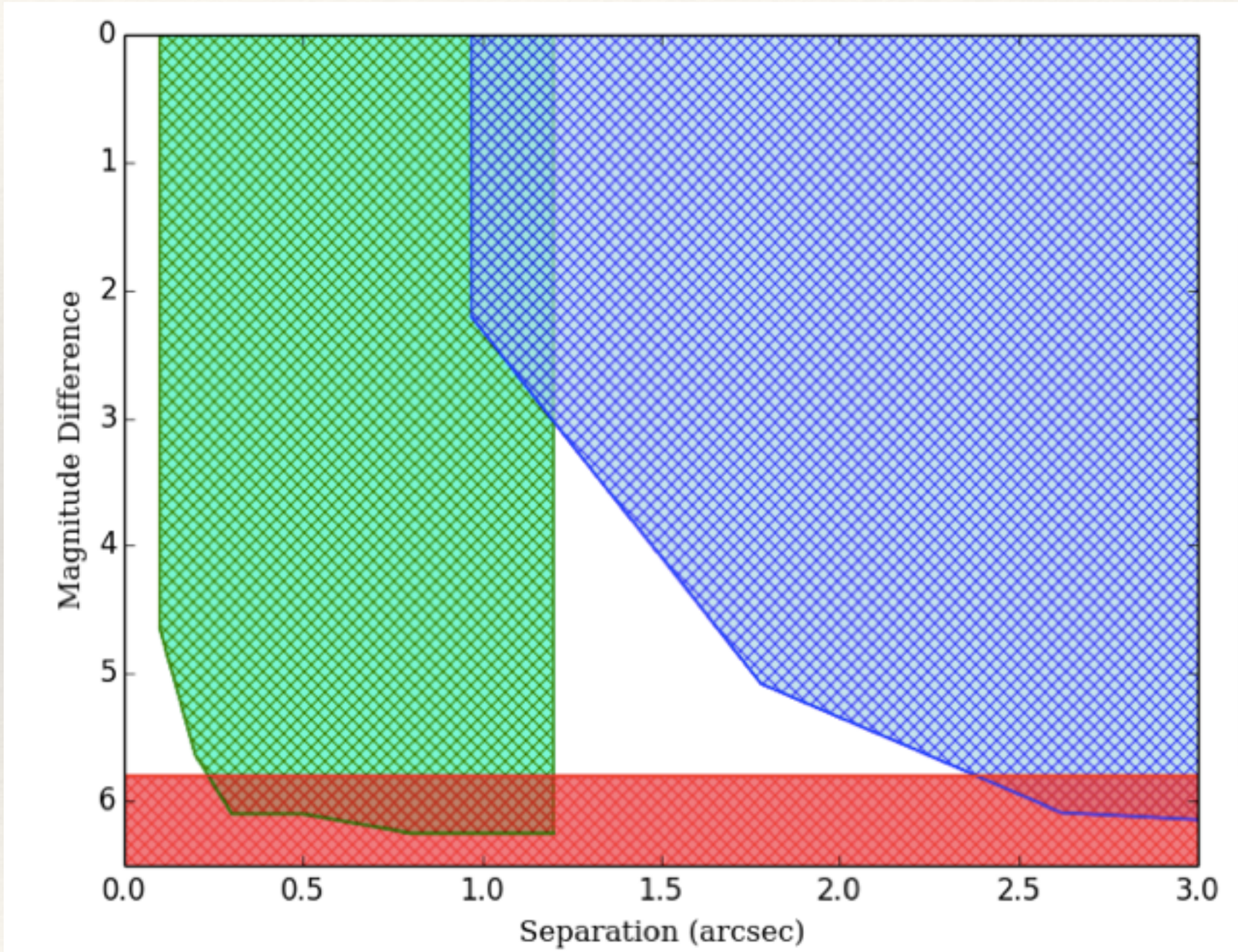
Kepler-3138b

- KOI-3138b
  - M5V - 3250K
- KOI-3138.01
  - Rp = 1.1+/-0.15 Rearth
  - S = 2.3 +/- 0.7 Searth
- Good match to “Venus-2.0”



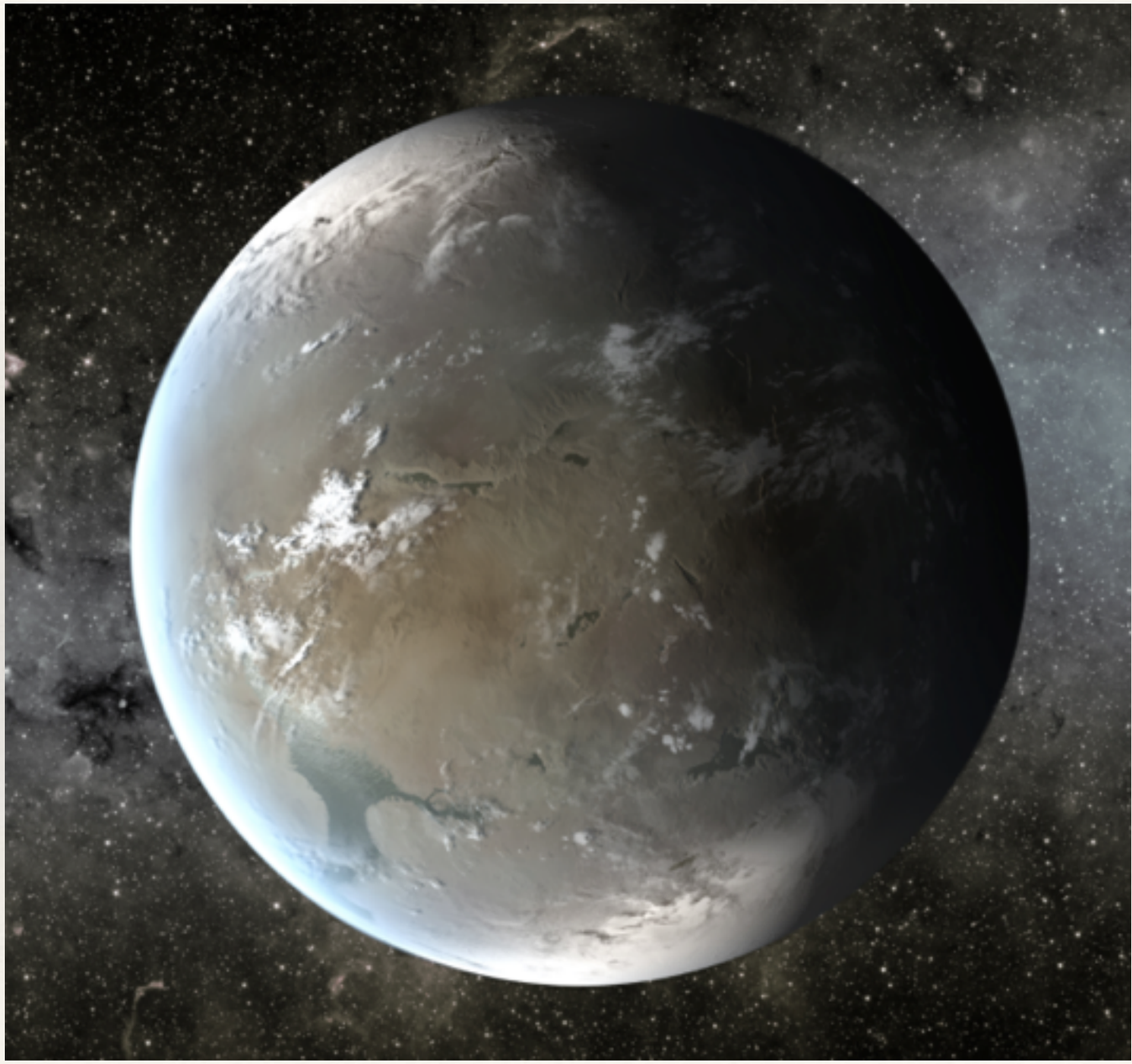
Transit-Depth Validation

- Validation on a single-planet system usually requires Follow-up Observations (FOP)
  - High resolution
  - RVs (km/s)
  - transit colours
- set limits on dilution to rule out hierarchical triples with brown-dwarfs



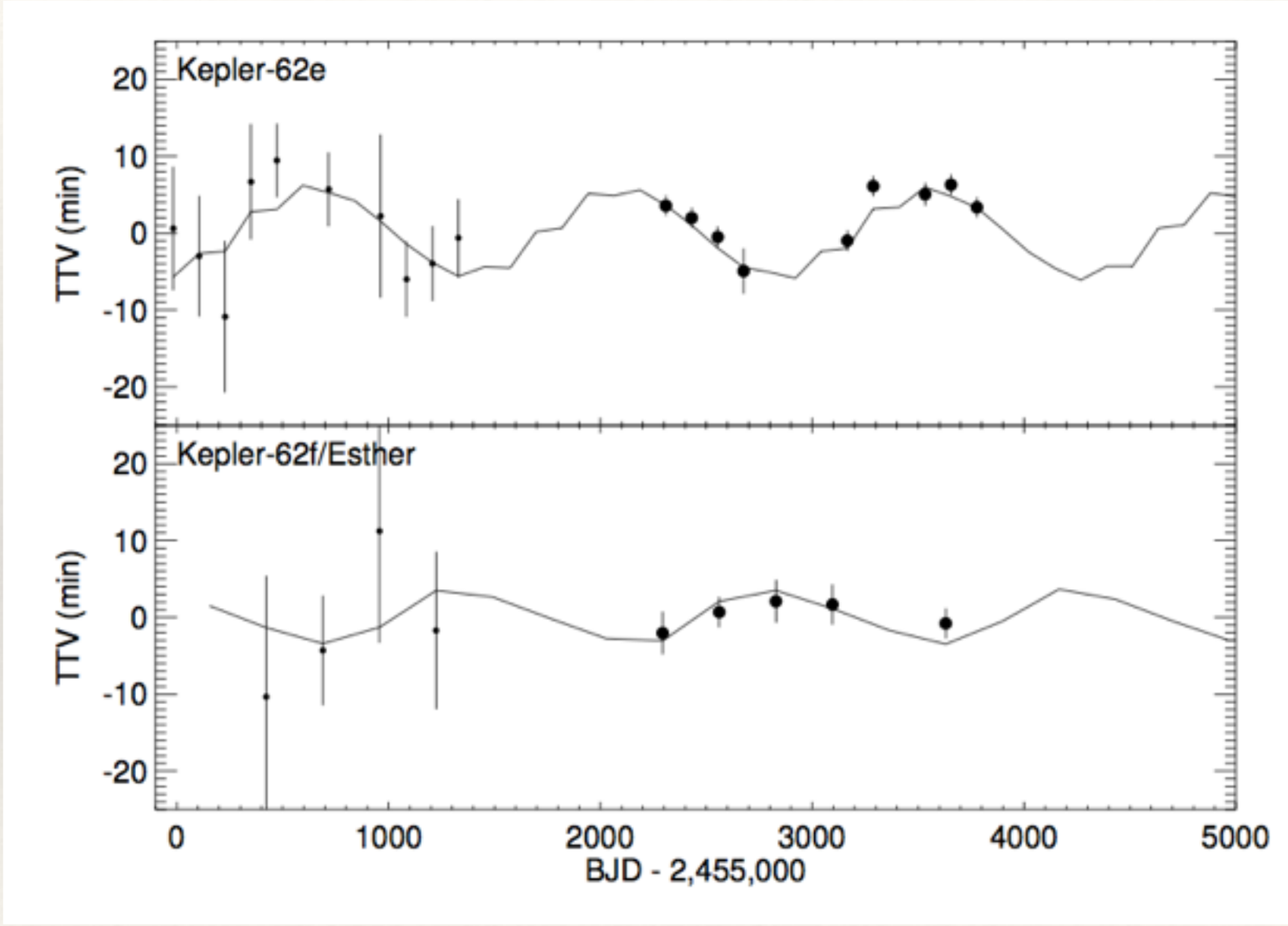
Kepler-62e/f Photodynamics

- g=14.4, J=12.3, H=11.7, K=11.7
  - Super-Earth Habitable Zone planets (1.6 - 1.8 Rearth)
  - Periods: 122d, 267d
  - Tstar ~ 4950 K
- masses are unknown



Transit-timing variations

- Simulation with 4-Mearth
  - black dots are expected HST performance
- 62e: Tdep=740ppm Tdur=7.2 hours
- 62f: Tdep=500ppm Tdur=7.9 hours



Eric Agol

Summary

- Thermal/Reflectivity of highly irradiated planets
- Validation of HZ planets with appropriate FOP
- Extended Transit Timing Measurements of Long-Period HZ planets
- Todo: **Realistic (red/white) noise models and exposure time requirements**
  - pass the *Mr. T* test.