A stylized illustration of a solar system. In the center is a large planet with blue and yellow horizontal stripes. To its right is a planet with orange horizontal stripes and a ring system, with a small yellow moon above it. Below the central planet is a red planet. To the left of the red planet is a blue and green planet resembling Earth. In the bottom left is a small orange planet with craters. To the right of the red planet is a small blue planet. In the bottom right is a small orange planet with a ring. The background is dark blue with white stars and a curved horizon line.

Measuring Mass, Radius, and Density of GJ 436 b

Group 2:

Jacob Borison, Leandra Hogrefe, Andrew Miller, Karish Seebaluck

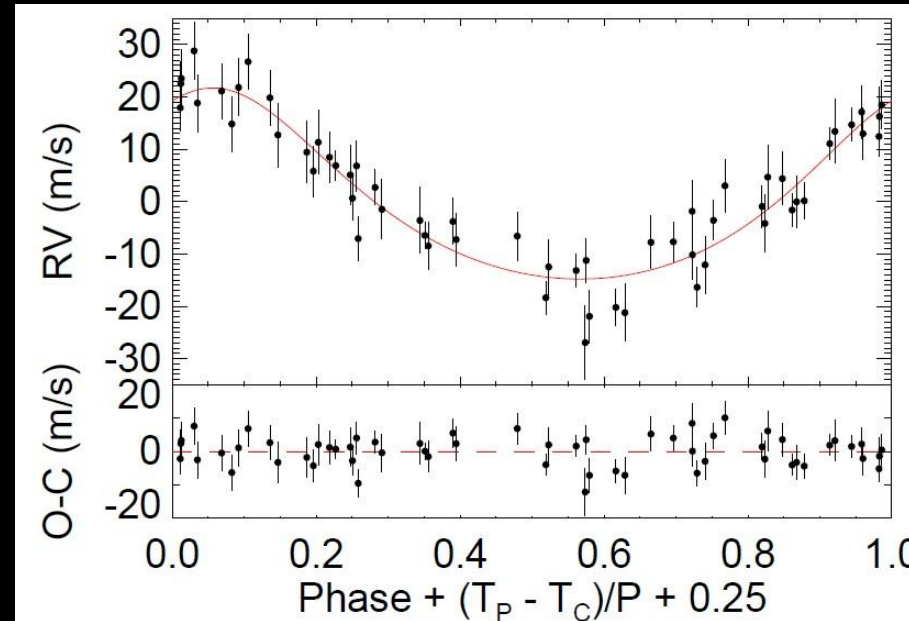
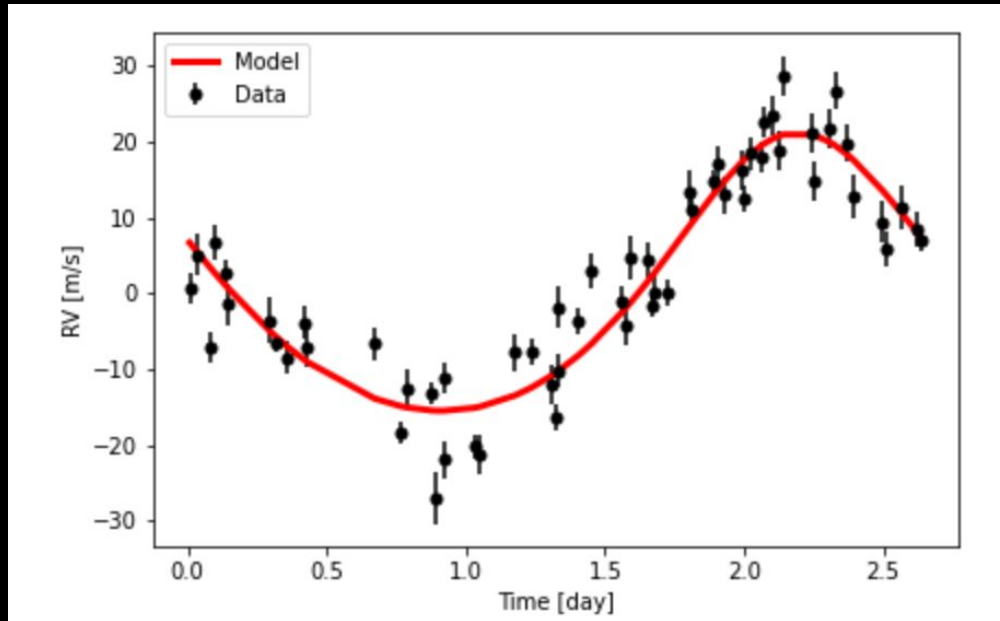
Motivations:

Meet GJ 436b!

- Orbits a red dwarf with $M = 0.41 M_{\text{Sun}}$
- Discovered in 2004 (Butler et al. 2004)
- Was the first Neptune-mass planet candidate discovered
- How can we determine the mass and radius of this planet?



Methods: Measuring Planet Mass with RV

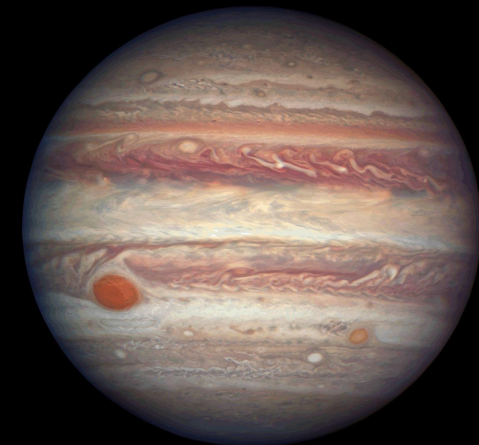


1 M_{\oplus}



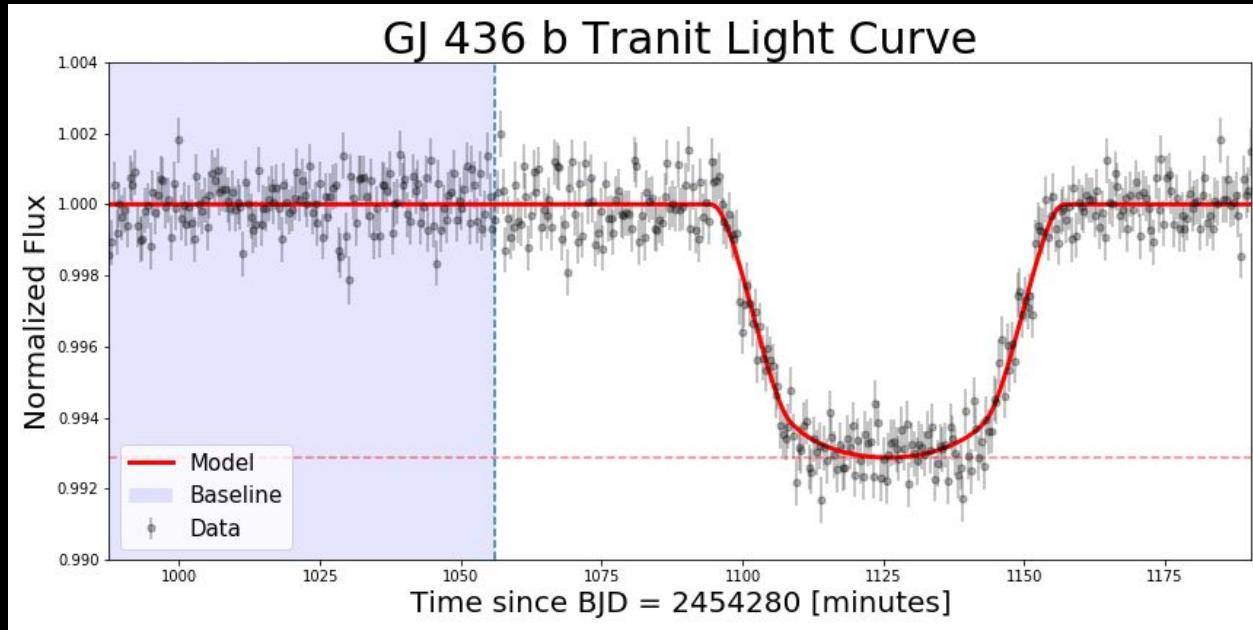
22.52 +/- 3.33 M_{\oplus}

Solar system data from <https://nssdc.gsfc.nasa.gov>



318 M_{\oplus}

Methods: Measuring Planet Radius with Transits



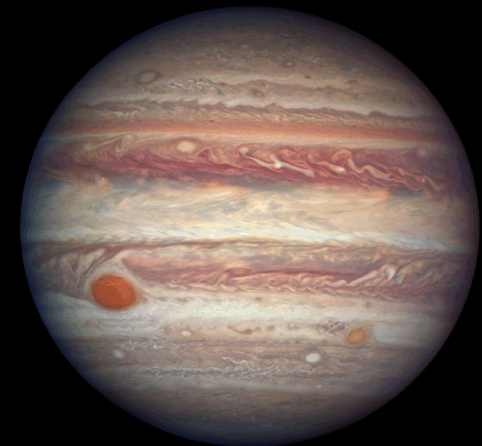
$$\bullet R = 24,979 \pm 71 \text{ km}$$



1 R_\oplus



3.9 R_\oplus

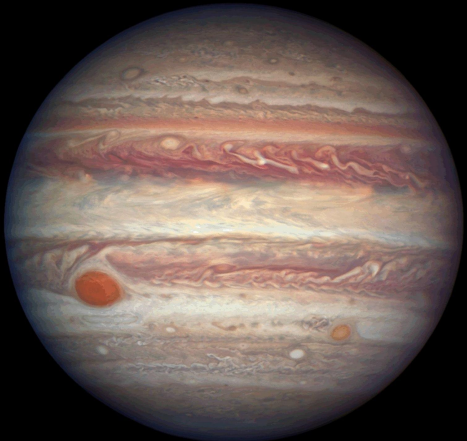


11 R_\oplus

Methods: Measuring Planet Density

$$\rho = \frac{3M_p}{4\pi R_p^3}$$

Fractional Uncertainty:
(Mass U/Mass) + 3(Radius U/Radius)



1326 kg/m³

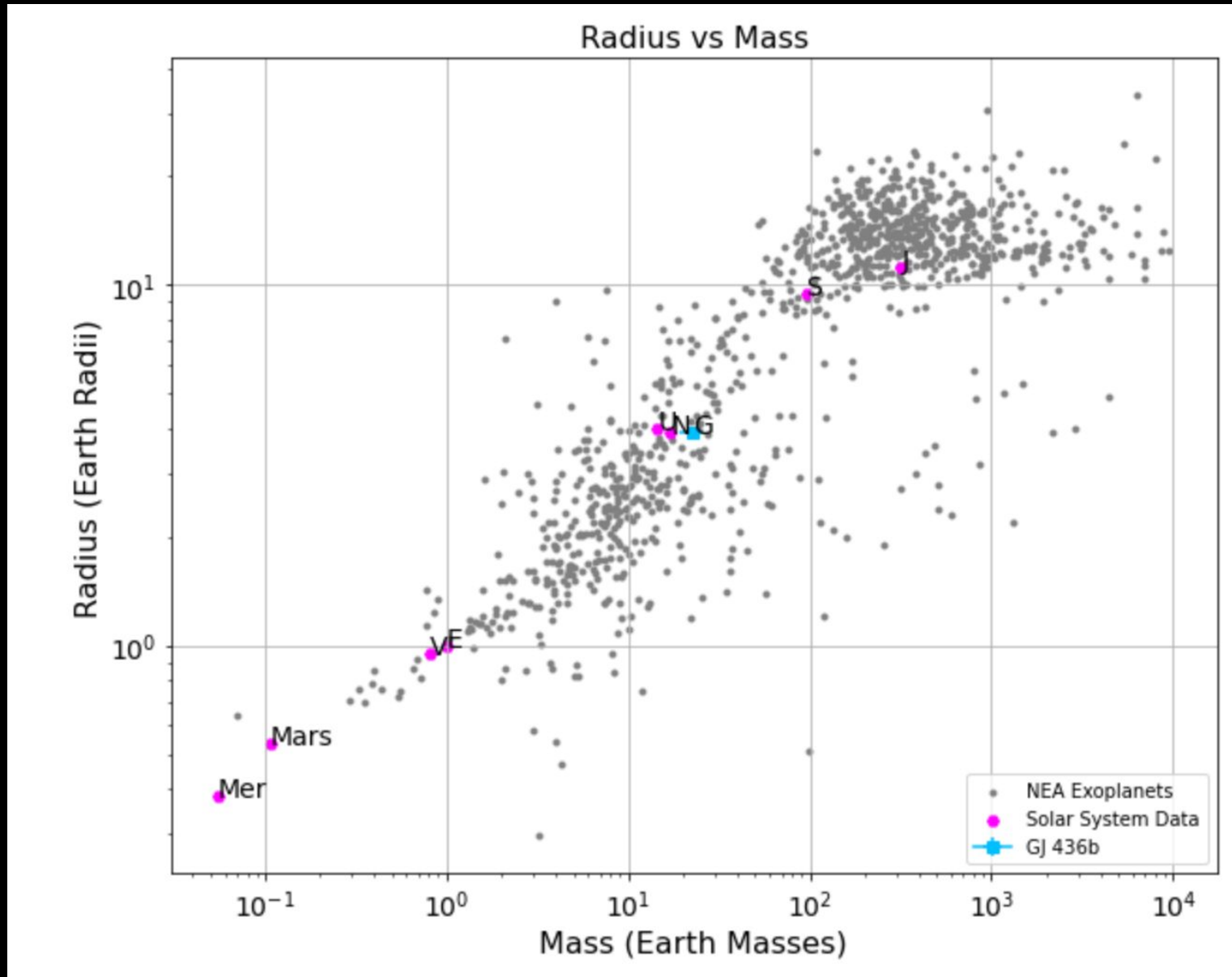


2061 +/- 479 kg/m³

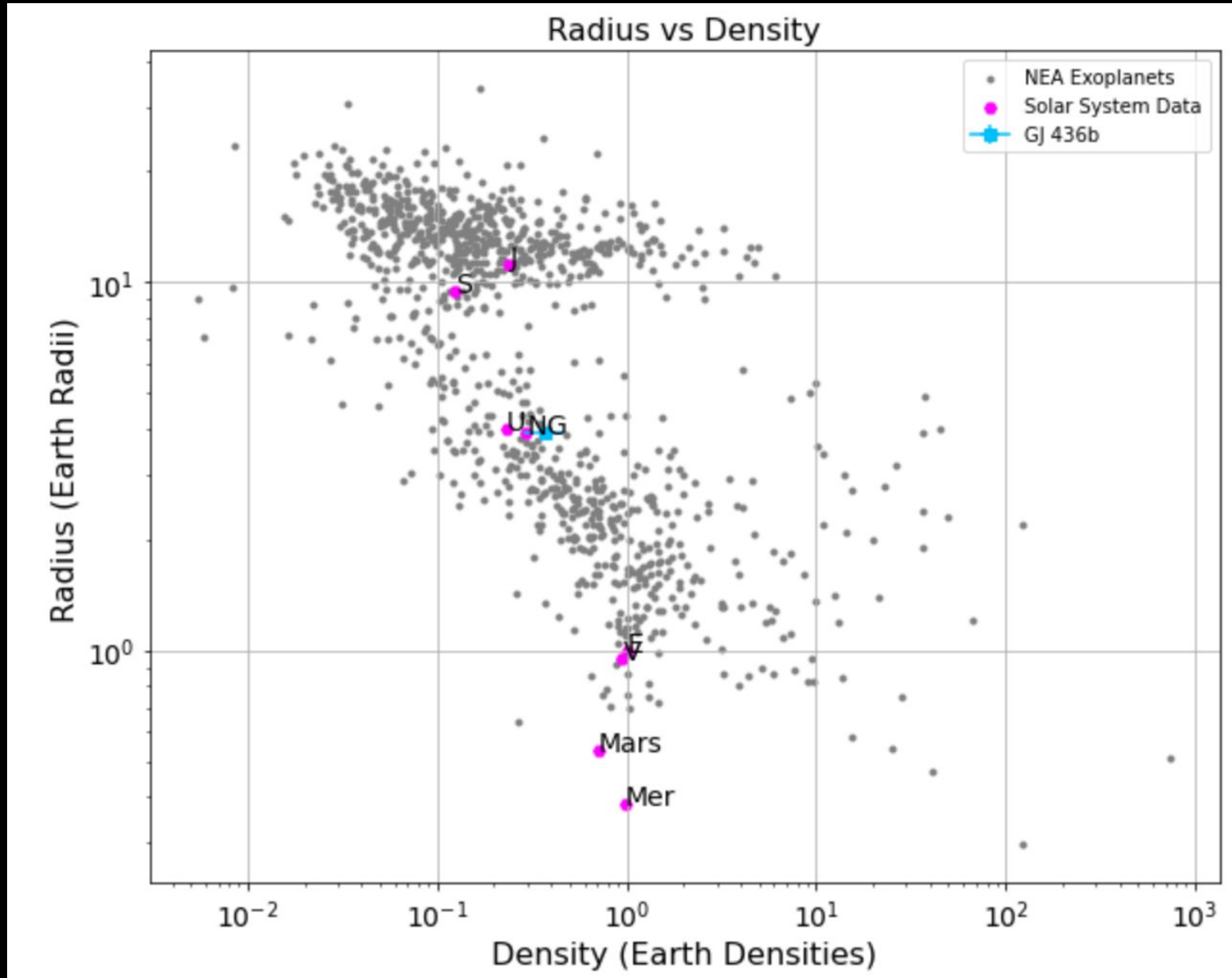


5513 kg/m³

Results: How does GJ 436b compare to other planets?

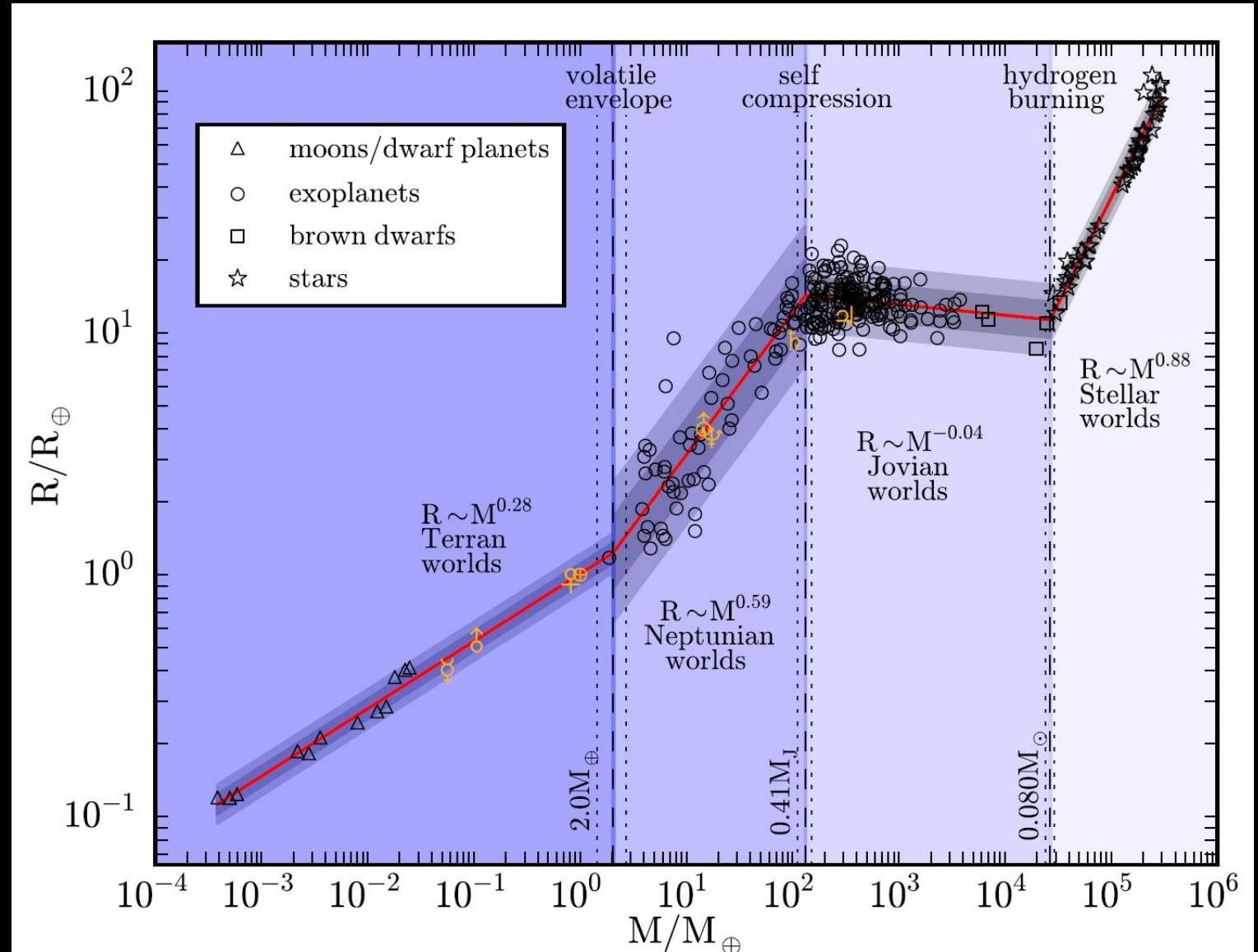


Results: How does GJ 436b compare to other planets?



Comparing with Chen & Kipping 2016

$$22.52^{(0.59)} = 6.2 \text{ Earth Radii}$$



“Probabilistic Forecasting of the Masses and Radii of Other Worlds,” Chen & Kipping 2016

Conclusions

- Constrained GJ 436b's mass and radius.
- Compare our measurements with other similar exoplanets
- Exoplanets detected via both the transit and radial velocity methods are incredibly important