The First NIR Transmission Spectrum of HIP 41378 f, a Low-Mass Temperate Jovian World in a Multi-Planet System

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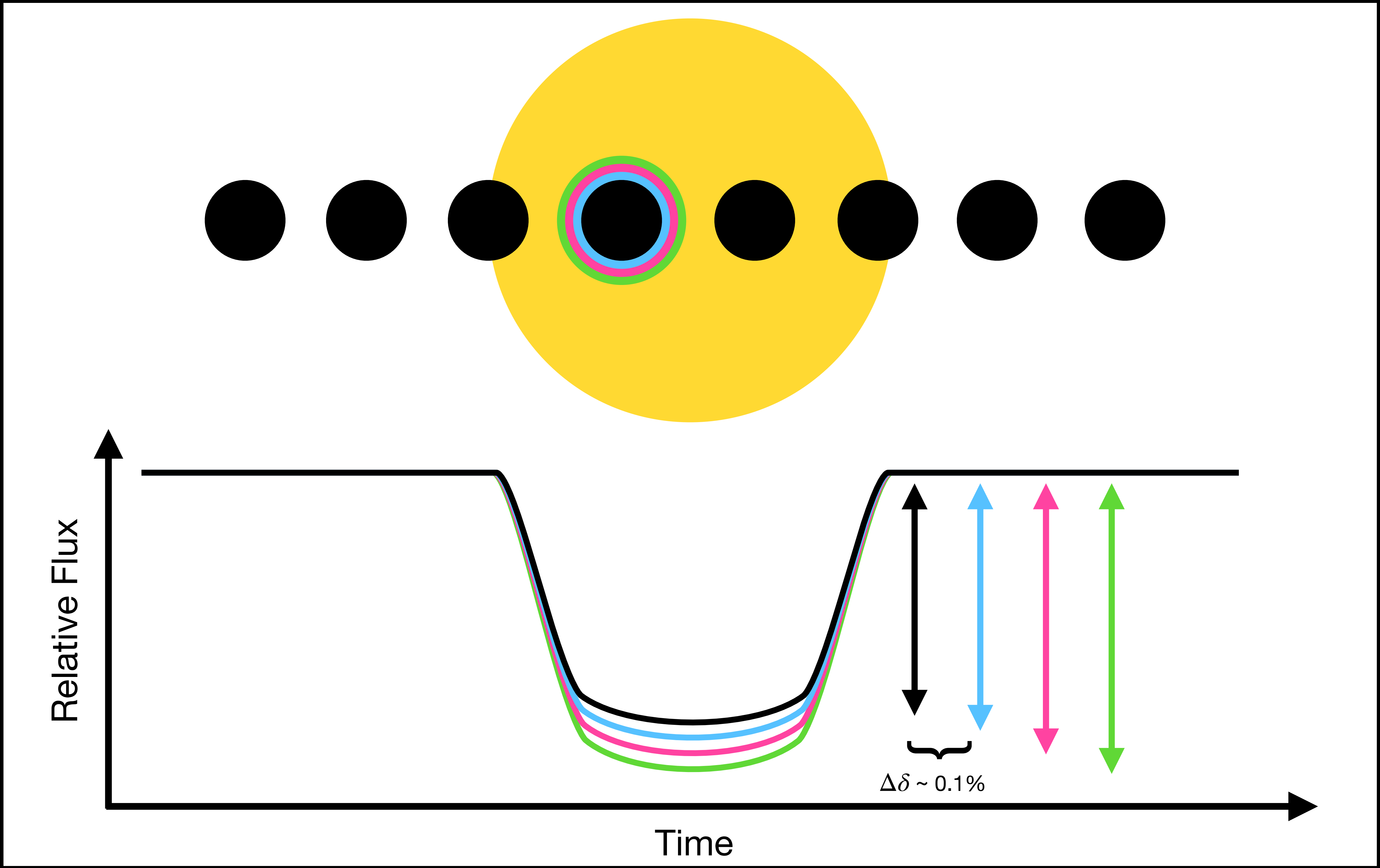
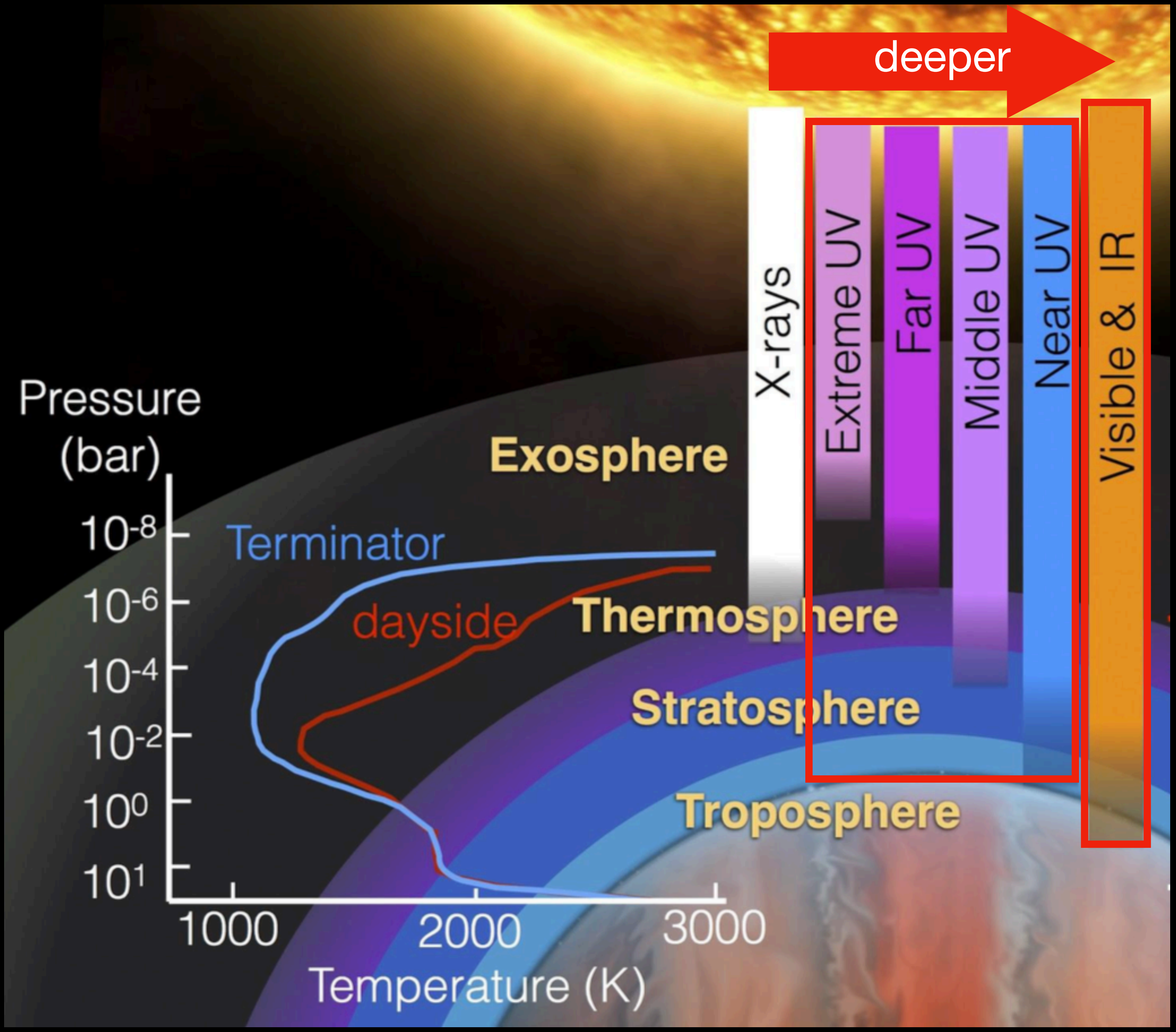
Image Credit: M. Weiss

We study exoplanet atmospheres with transmission spectroscopy



Multi-wavelength observations probe different atmospheric layers

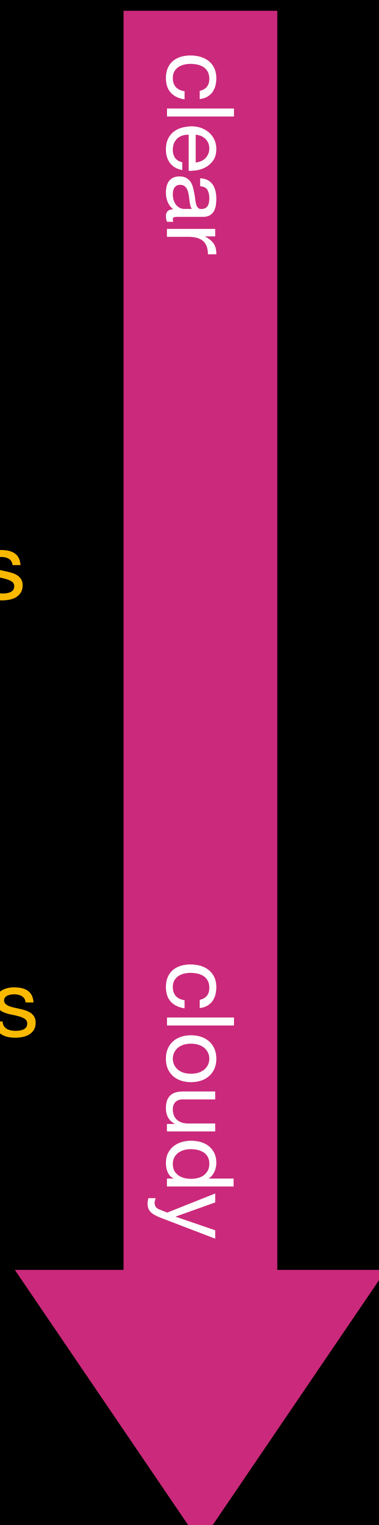


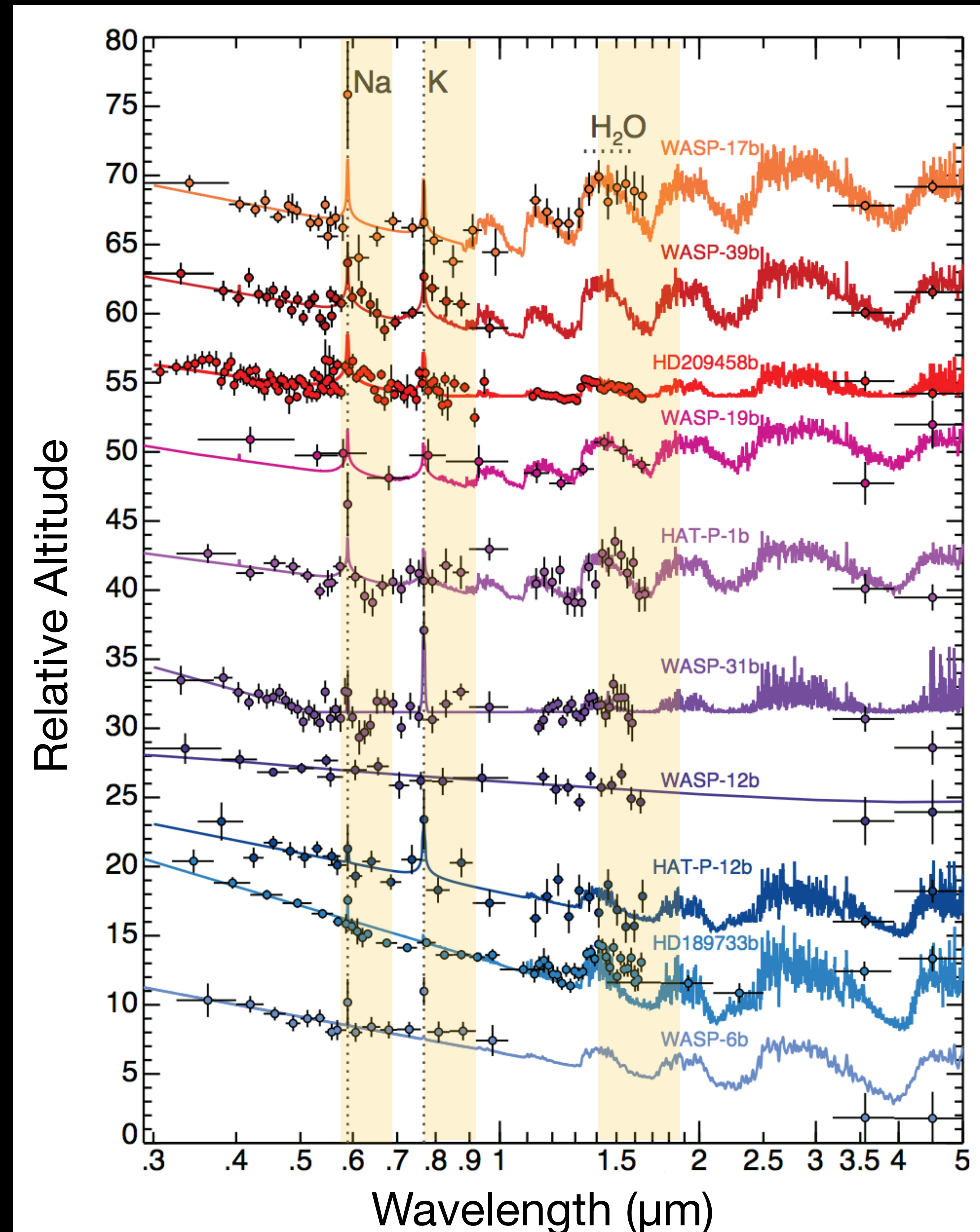
Credit: David Sing; Lavvas et al. (2014)

Hot Jupiters have a diversity of atmospheres

We are now pushing to:

- smaller planets
- cooler worlds (T_{eq} <1000 K)
- extreme or unusual planets

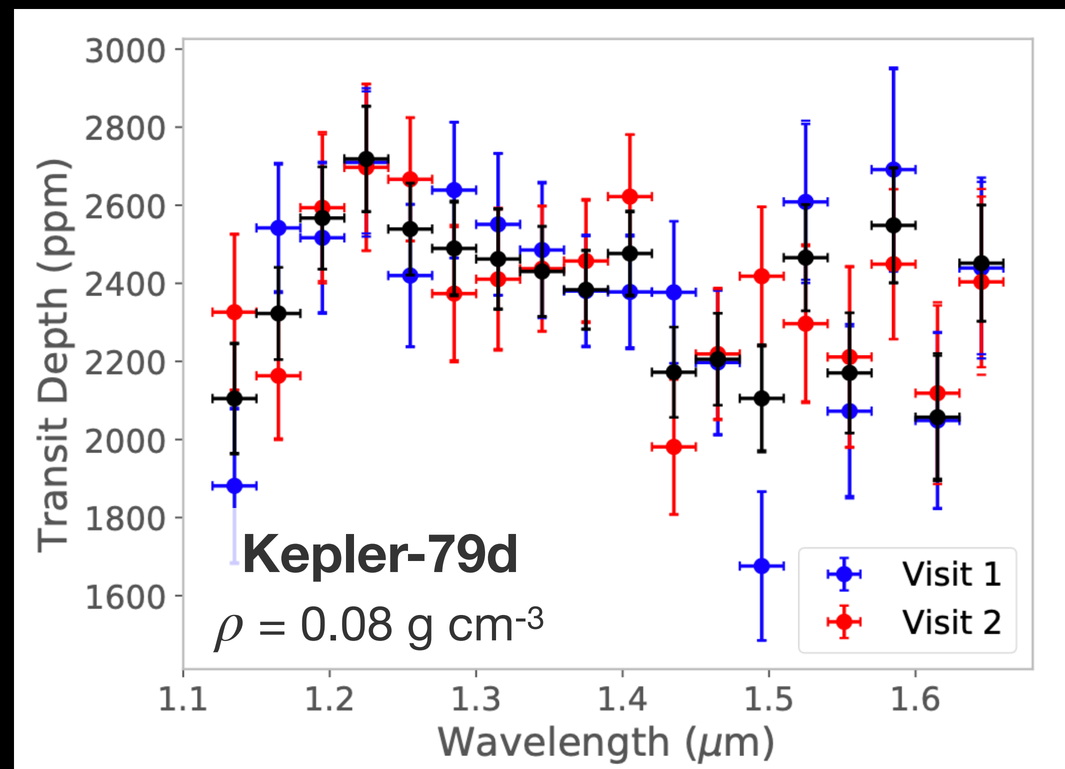


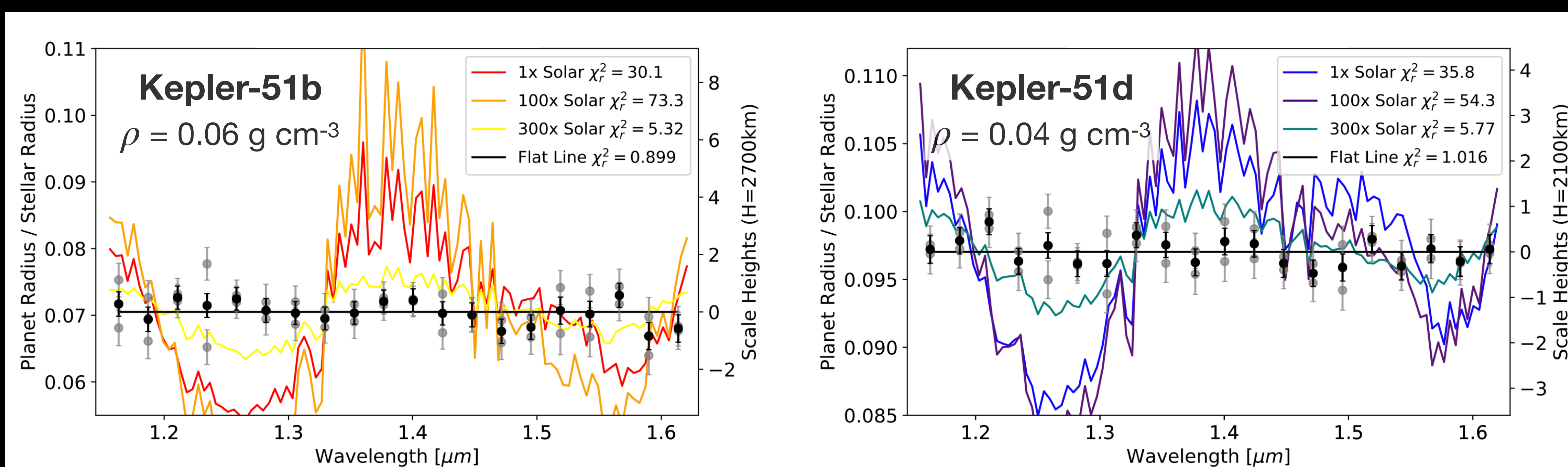


Sing et al. (2016)

Low-density planets have flat & featureless transmission spectra

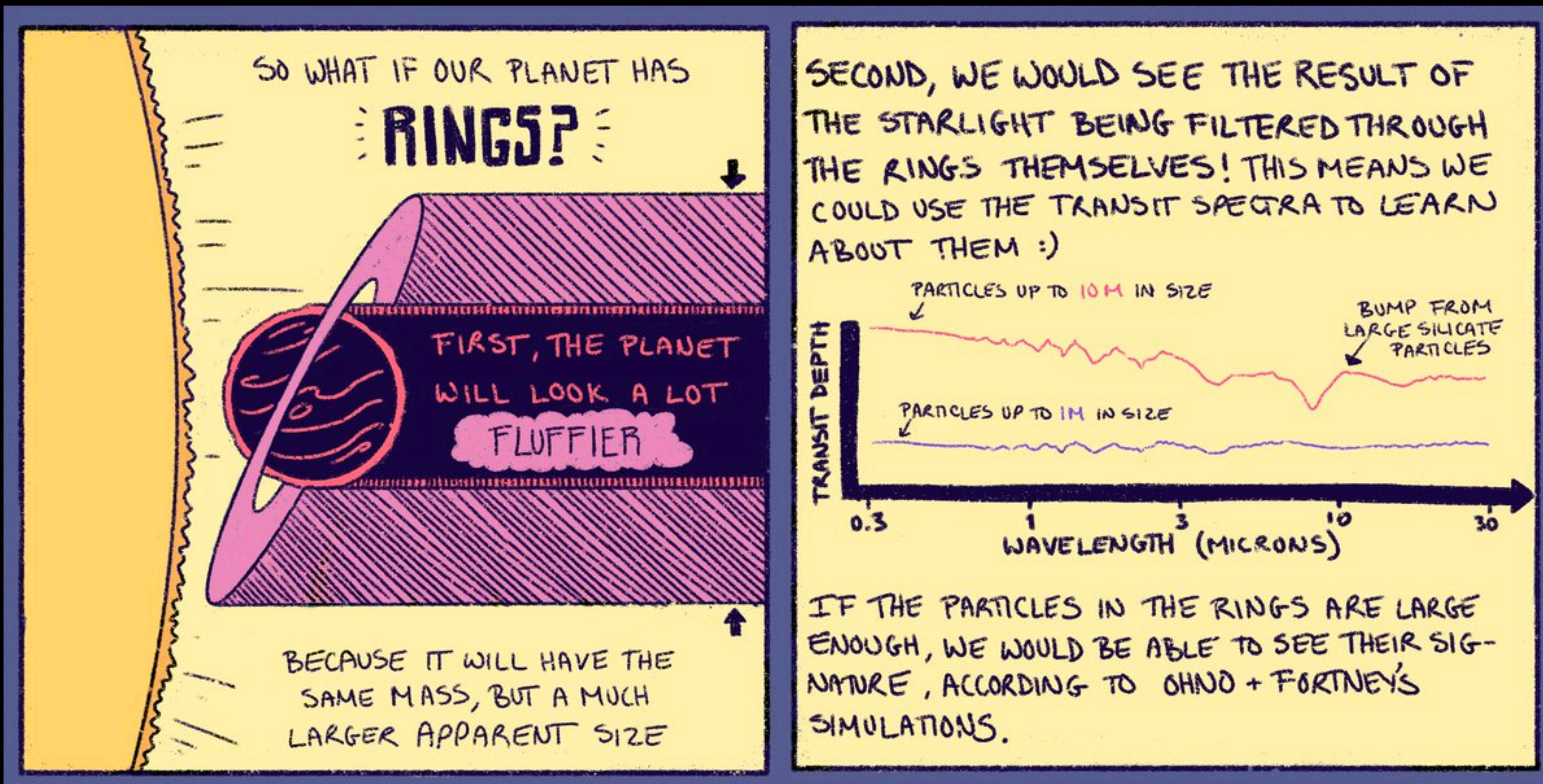
"super-puffs"





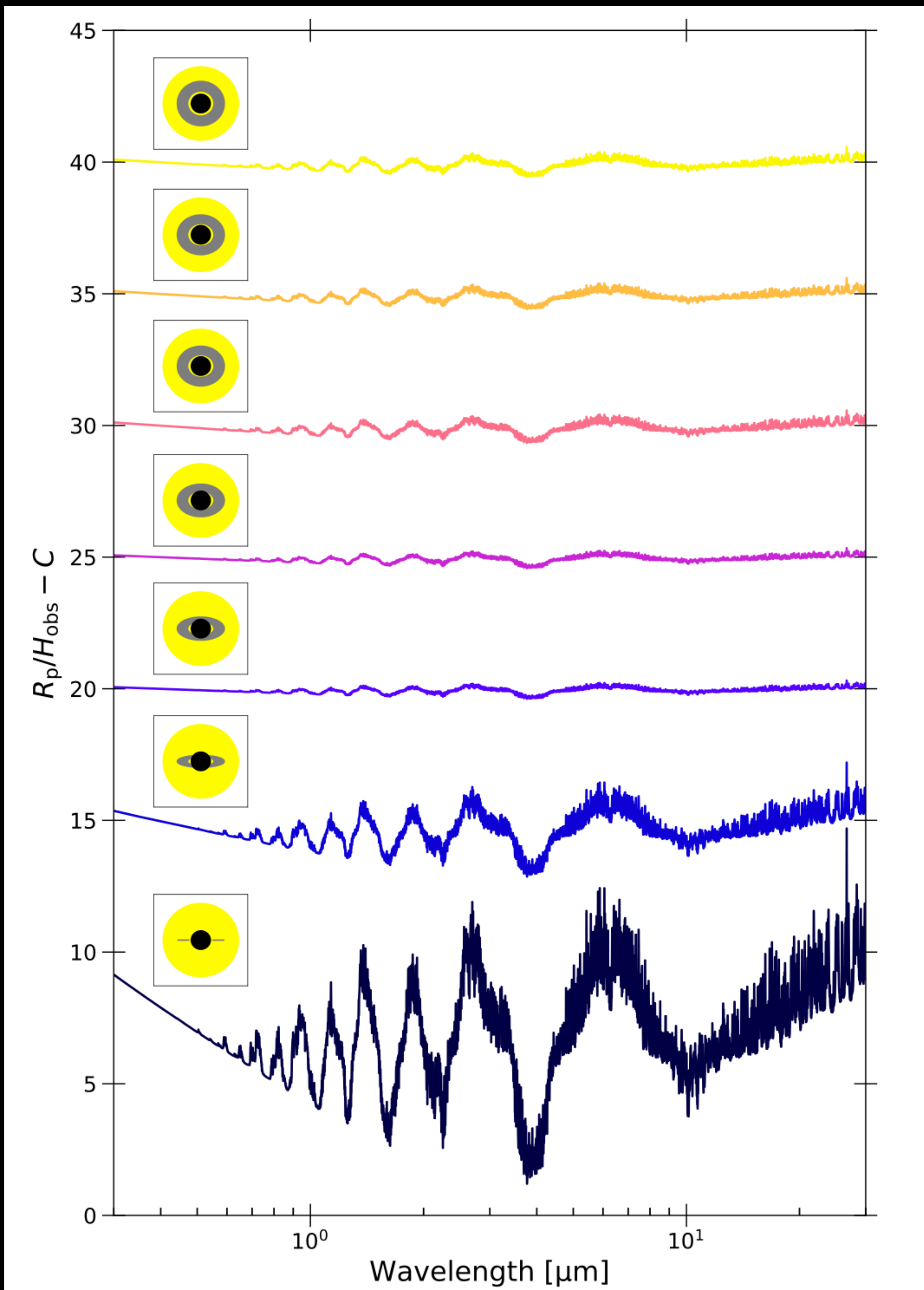
Chachan et al. (2020); Libby-Roberts et al. (2020)

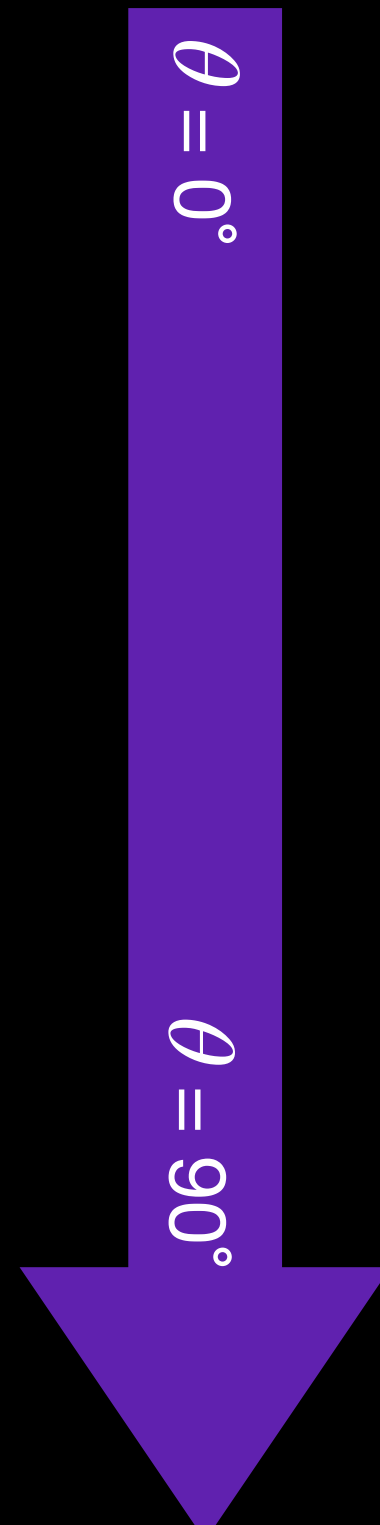
Rings inflate a planet's measured radius



Ohno & Fortney (in review); Image Credit: Ell Bogat

Rings inflate a planet's measured radius and flatten spectral features





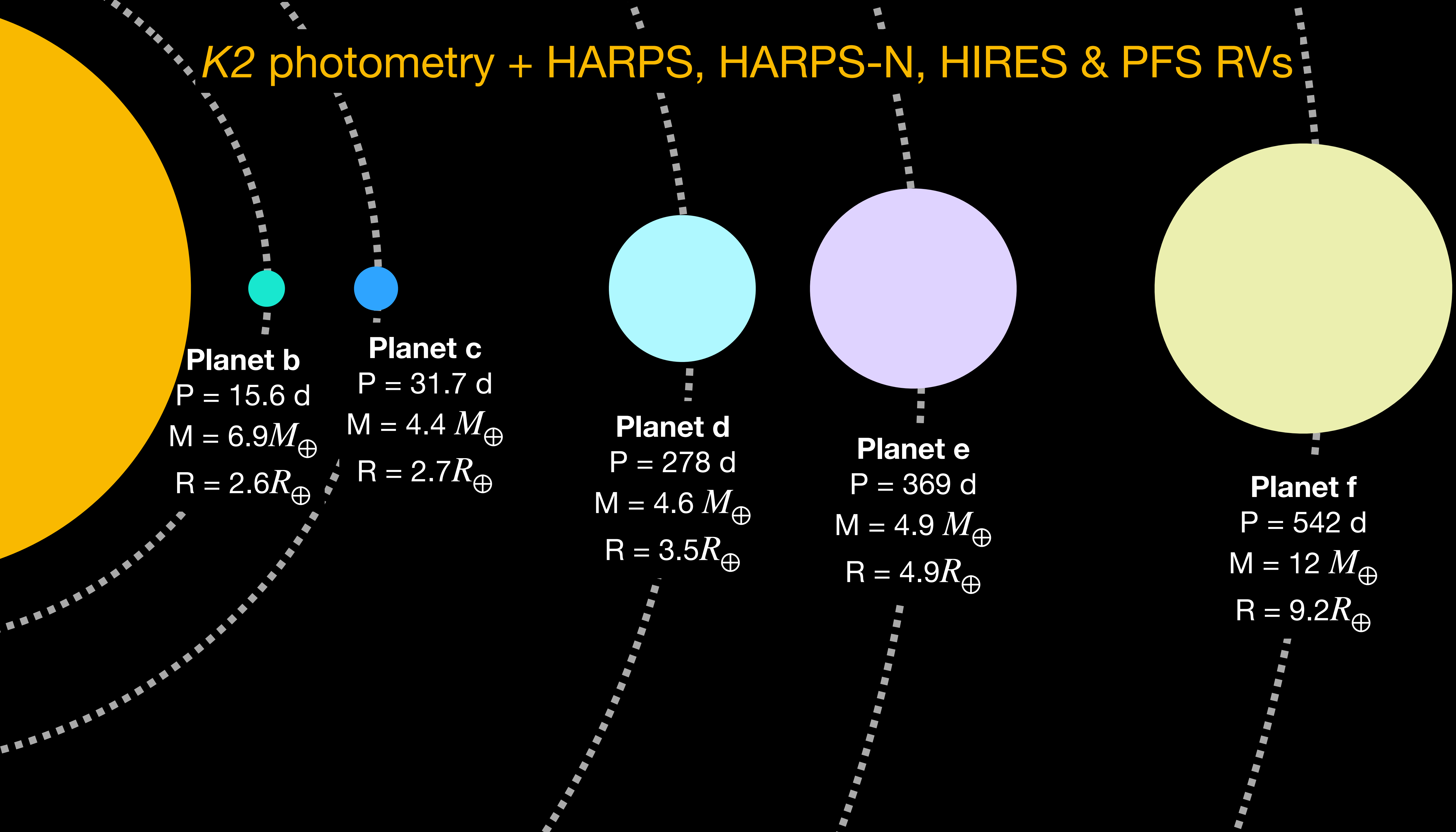
higher R_{obs} , smaller spectral features

lower R_{obs} , larger spectral features

Ohno & Fortney (in review)

The HIP 41378 system hosts (at least) 5 transiting planets

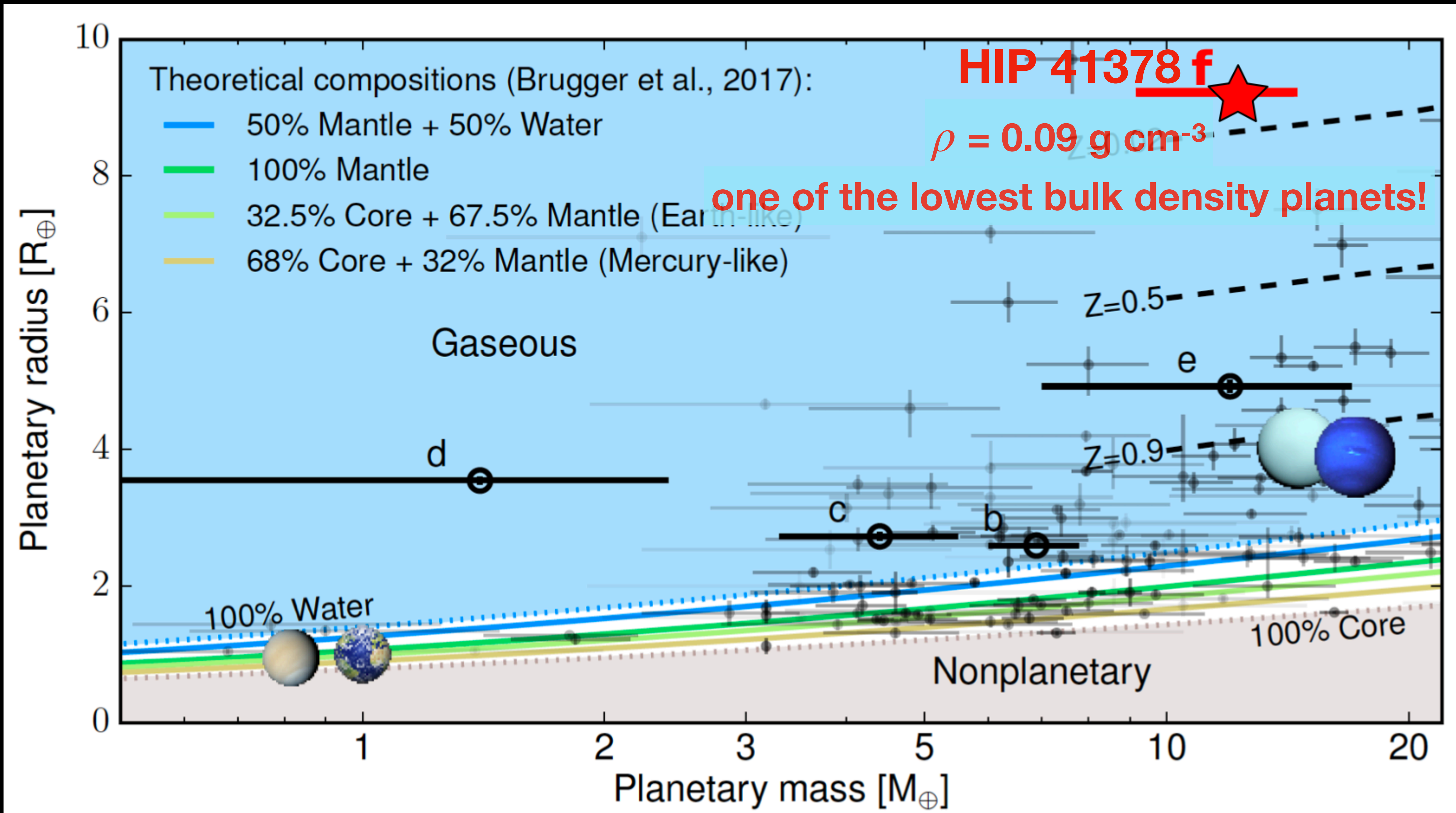
K2 photometry + HARPS, HARPS-N, HIRES & PFS RVs



***not to scale!**

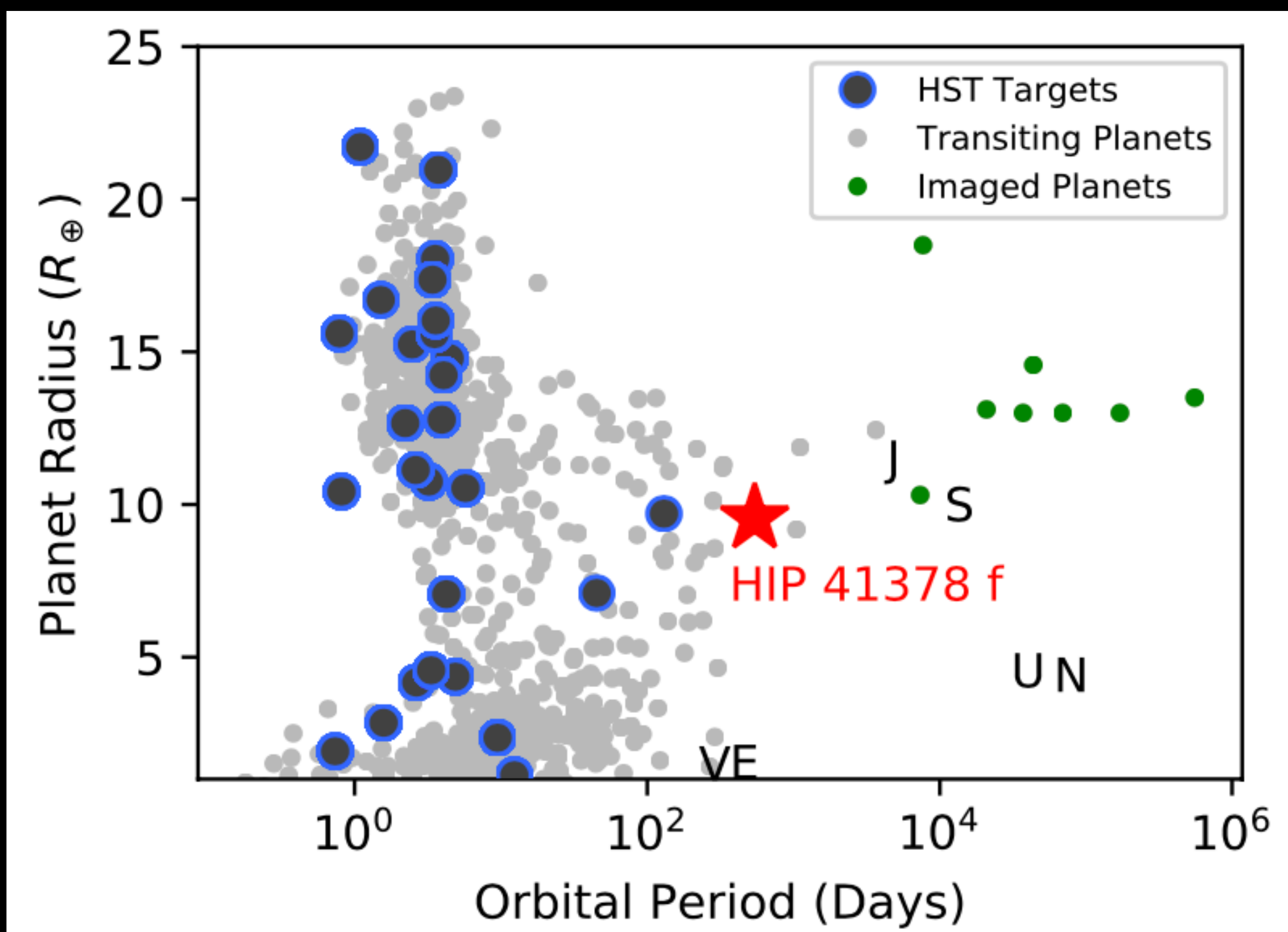
Vanderburg et al. (2016); Santerne et al. (2019)

HIP 41378 f: a cool, low-mass temperate giant planet



adapted from Santerne et al. (2019)

HIP 41378 f bridges the gap between imaged planets, hot Jupiters, and the Solar System giants



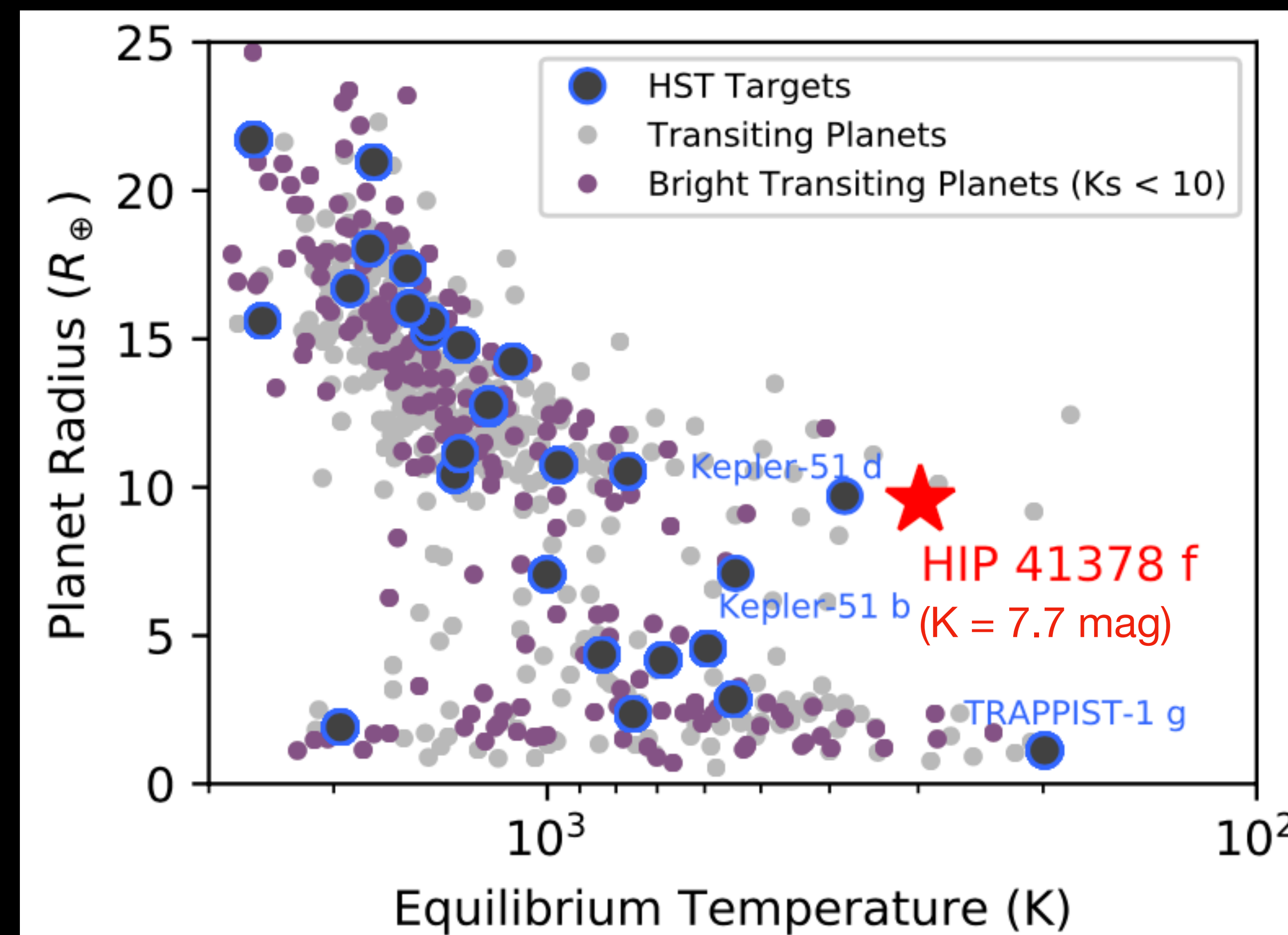
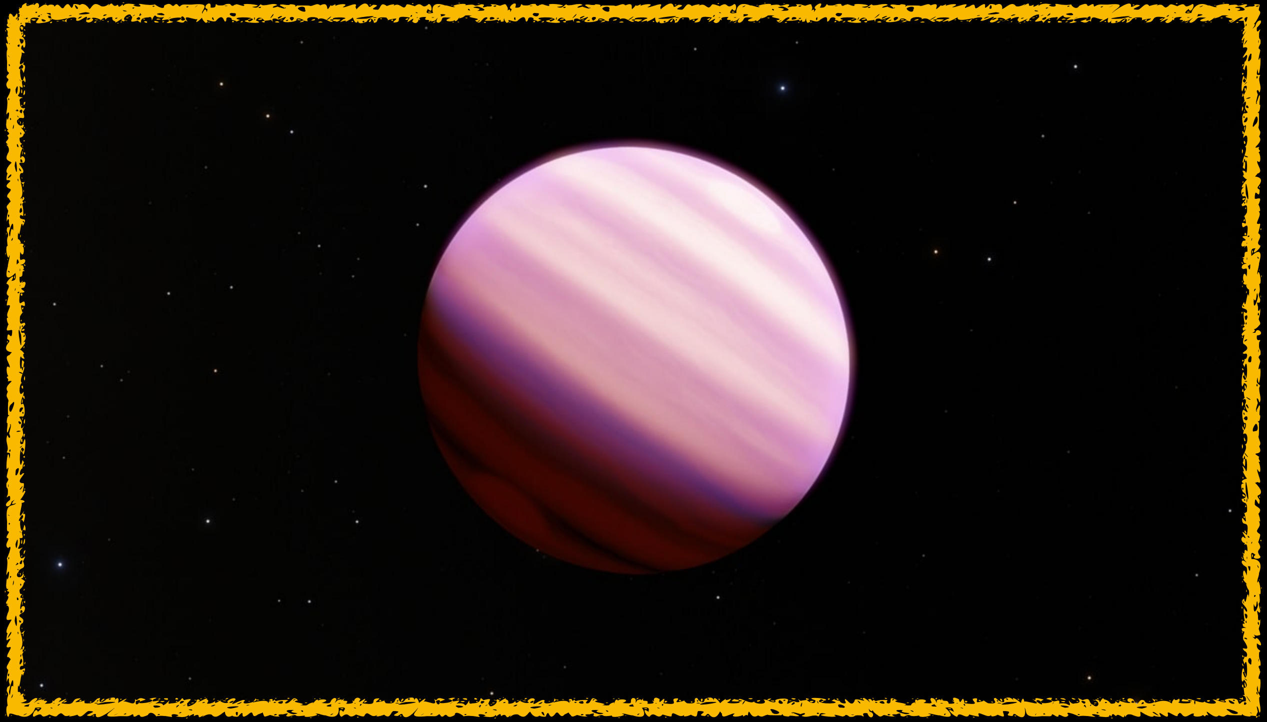
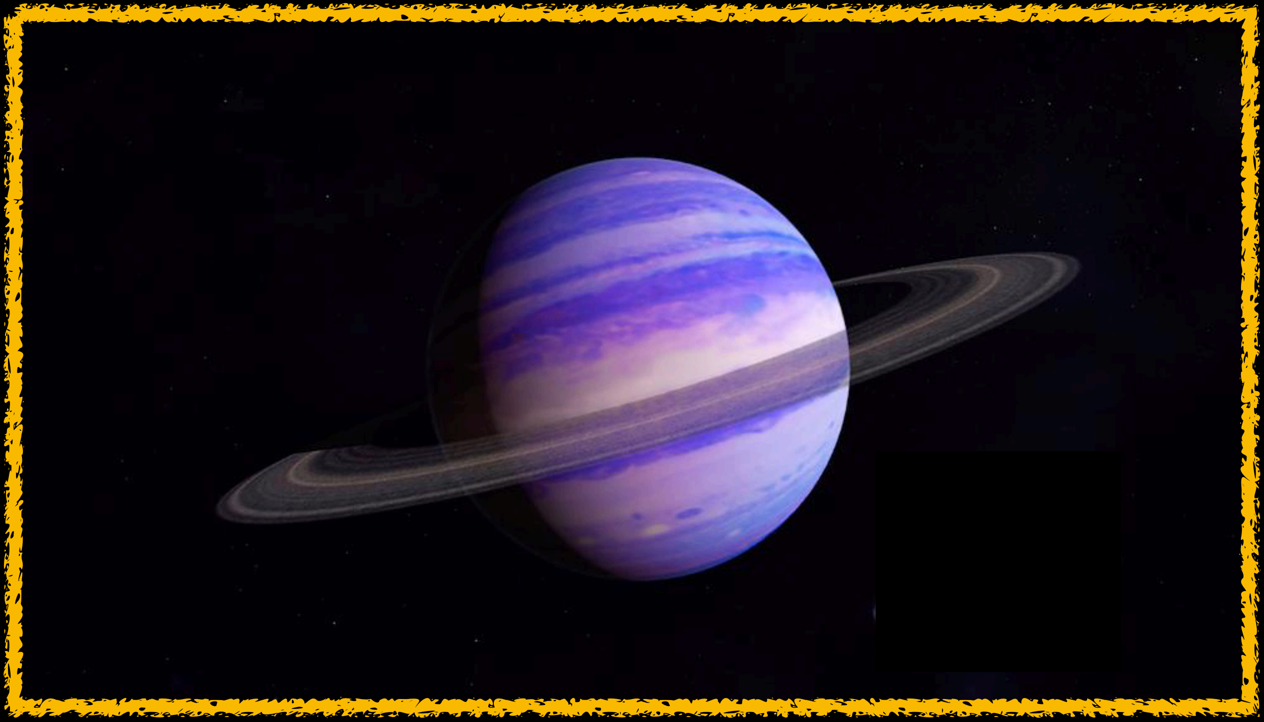


Figure Credit: C. Dressing

HIP 41378 f is one of the lowest bulk density planets discovered to-date

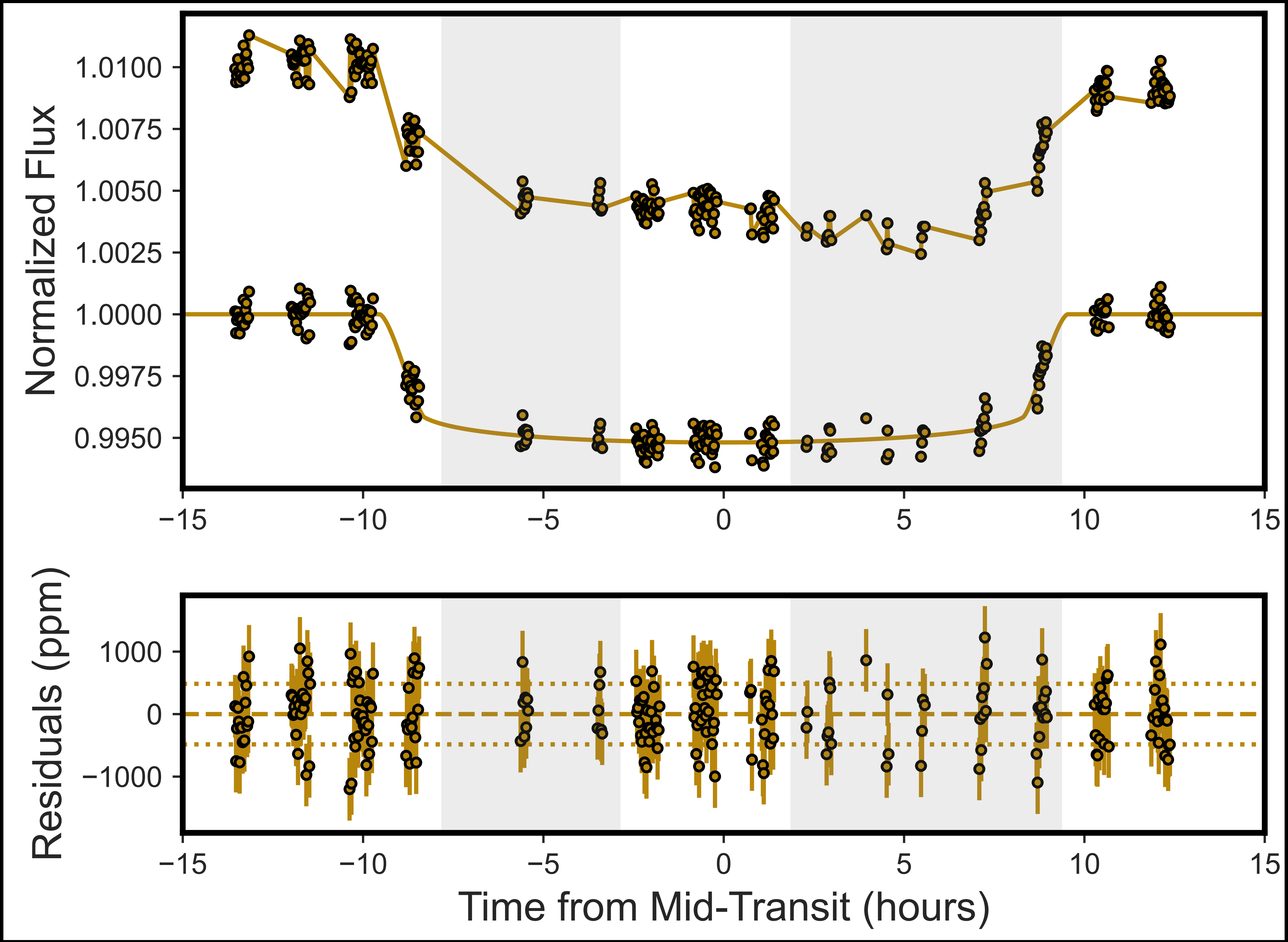


super-puff?



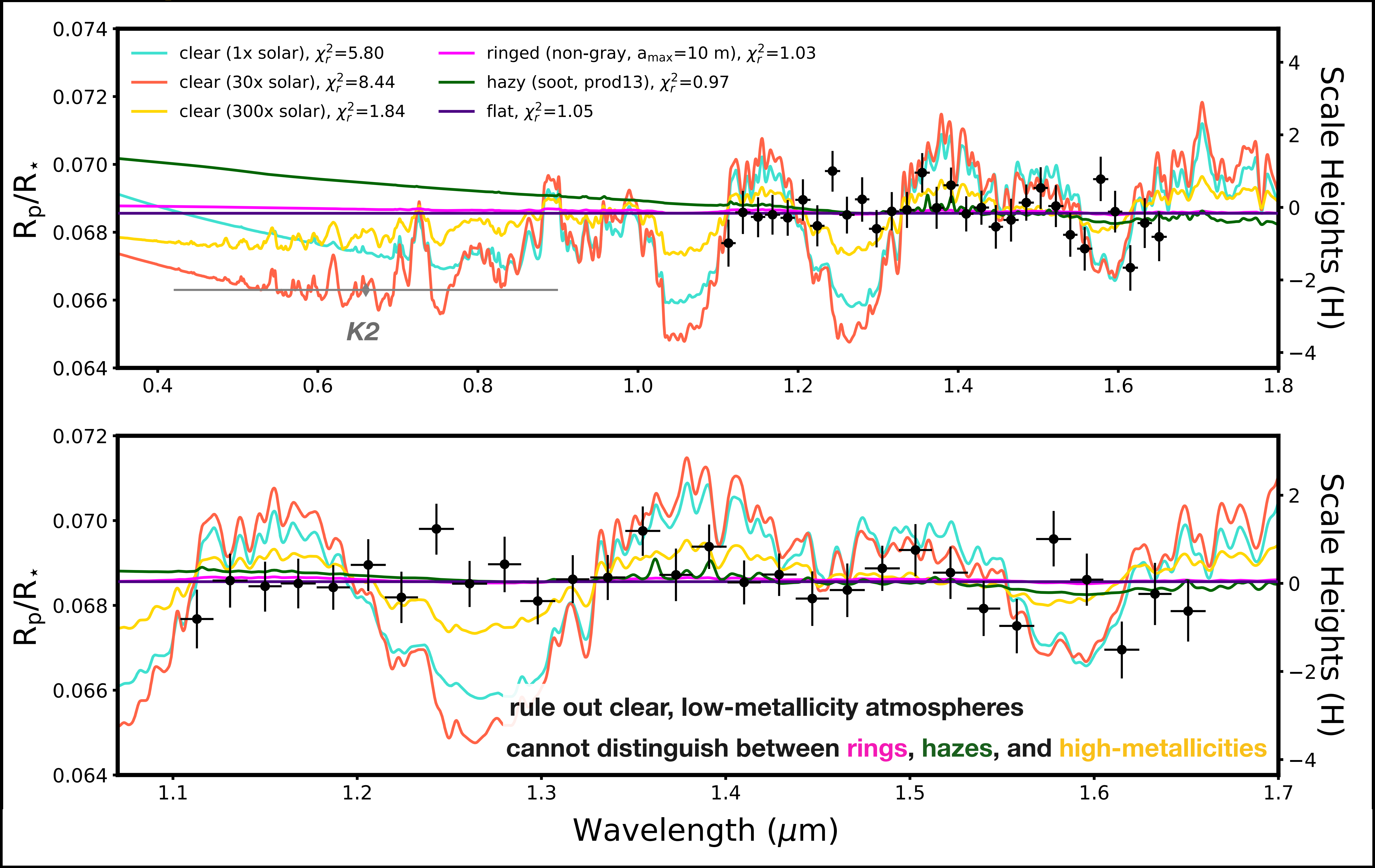
ringed planet?

HST/WFC3 transit of HIP 41378 f



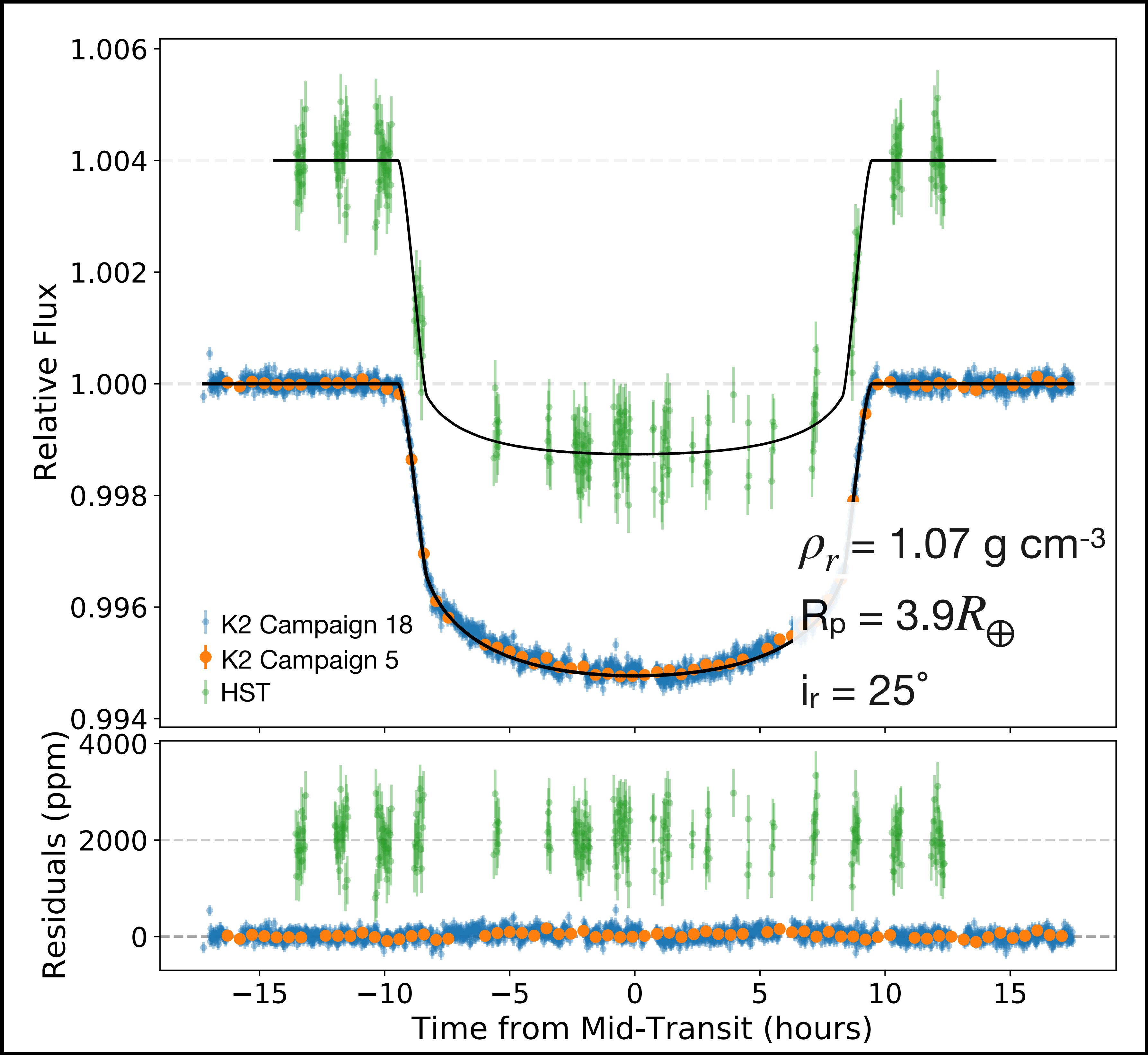
Alam et al. (in review)

The near-infrared HST transmission spectrum of HIP 41378 f is featureless!



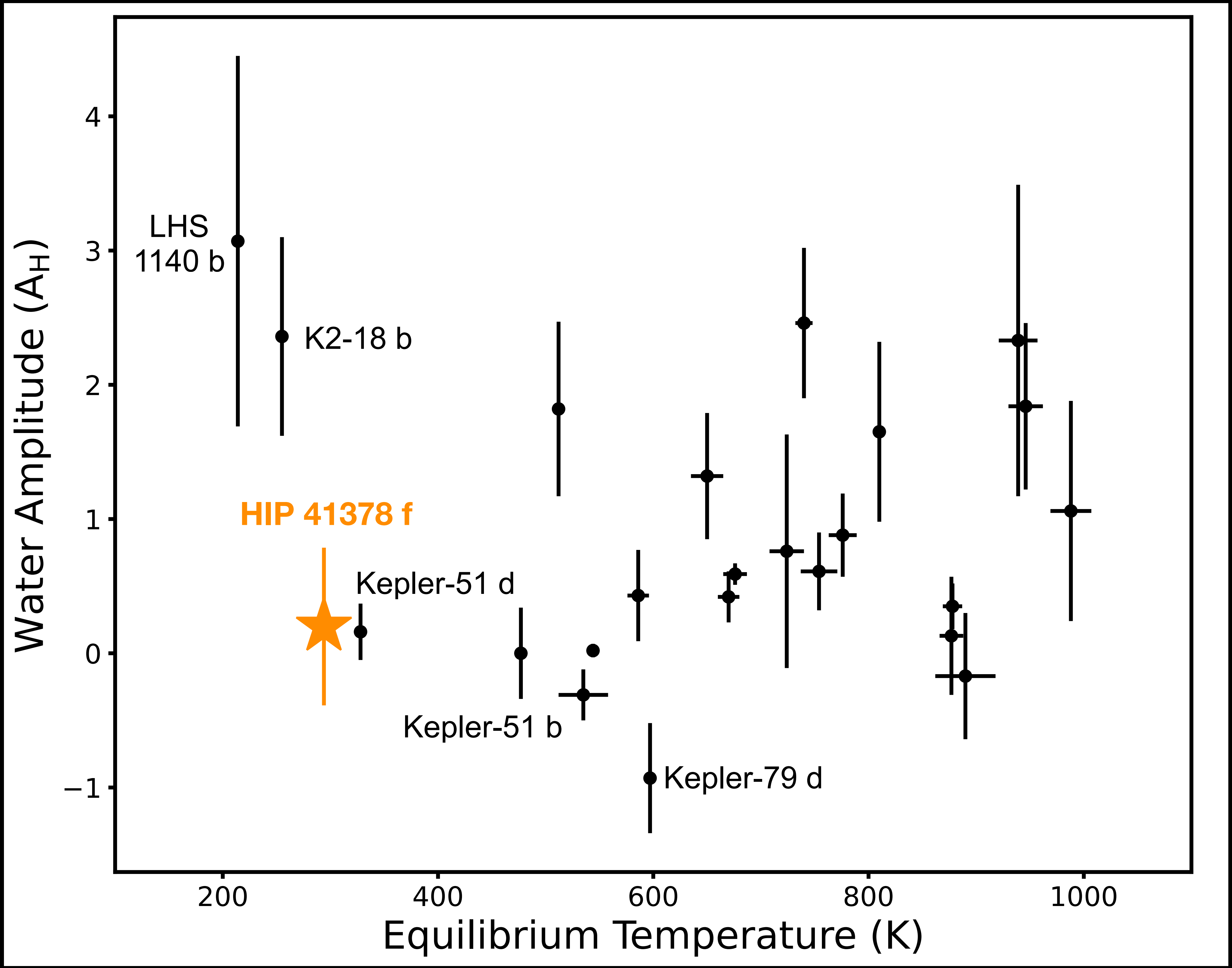
Alam et al. (in review)

We constrain the composition of putative ring particles



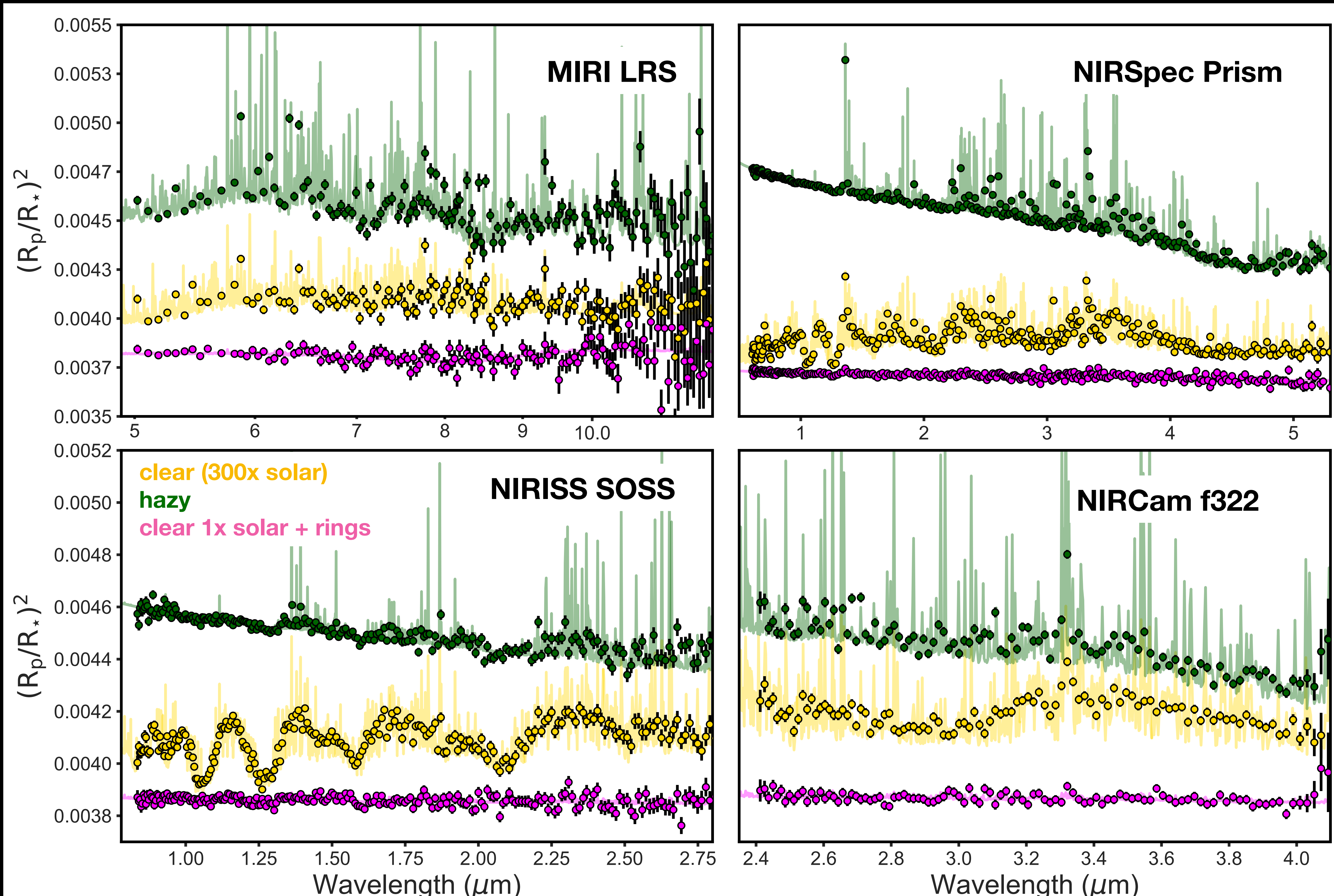
Alam et al. (in review)

Placing HIP 41378 f in context



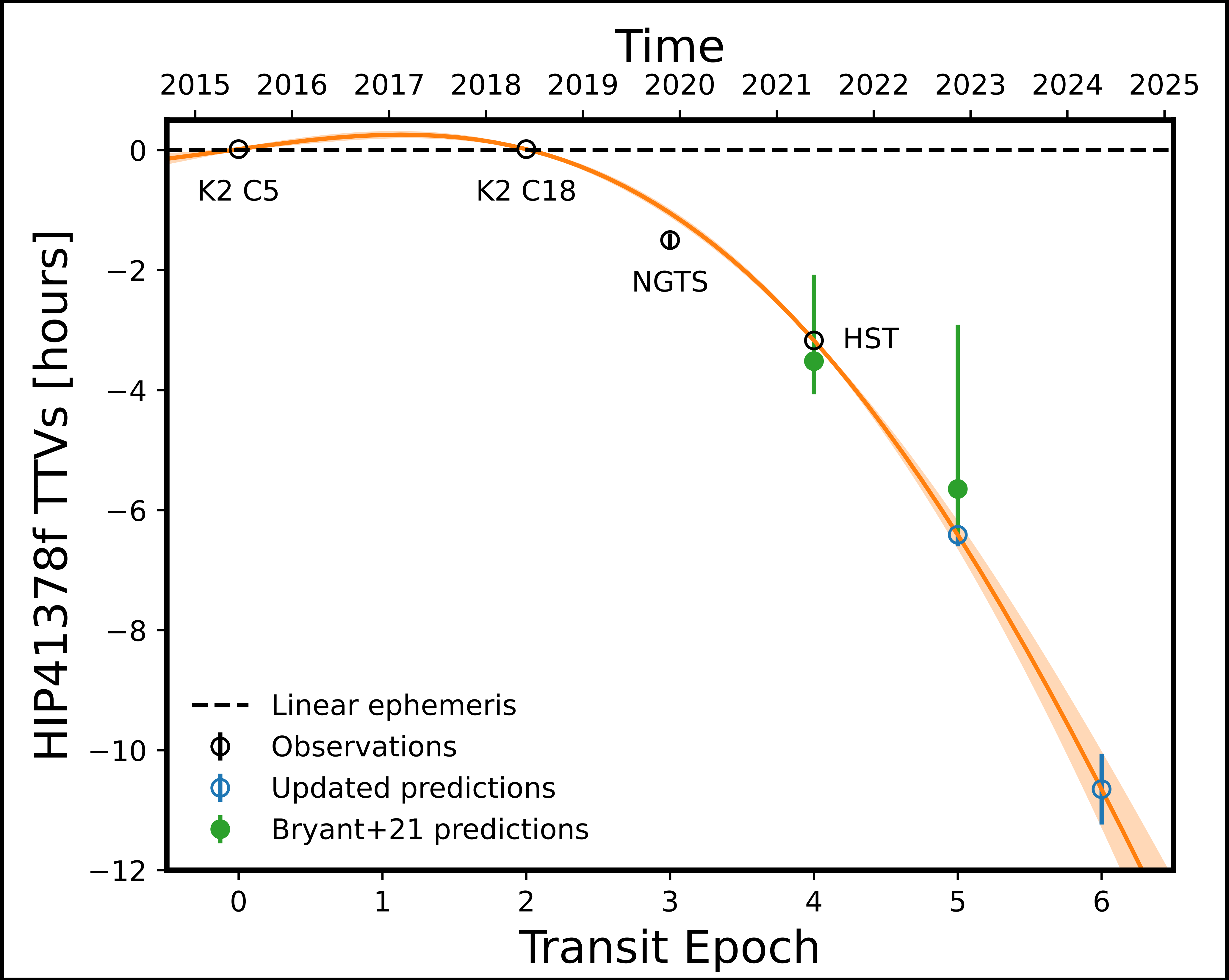
Crossfield & Kreidberg (2017); Libby-Roberts et al. (2020); Yu et al. (2021); Dymont et. al (2021); Alam et al. (in review)

JWST can distinguish between hazes, rings, and high-metallicity atmospheres



Alam et al. (in review)

Predicting future transits



Alam et al. (in review)

Conclusions

- The HST/WFC3 transmission spectrum of HIP 41378 f is featureless.
- Flat spectra may be a population property of ultra-low density planets.
- We cannot distinguish between high-metallicities, high-altitude hazes, or rings with HST — but JWST can!
- Let’s observe this planet with JWST!