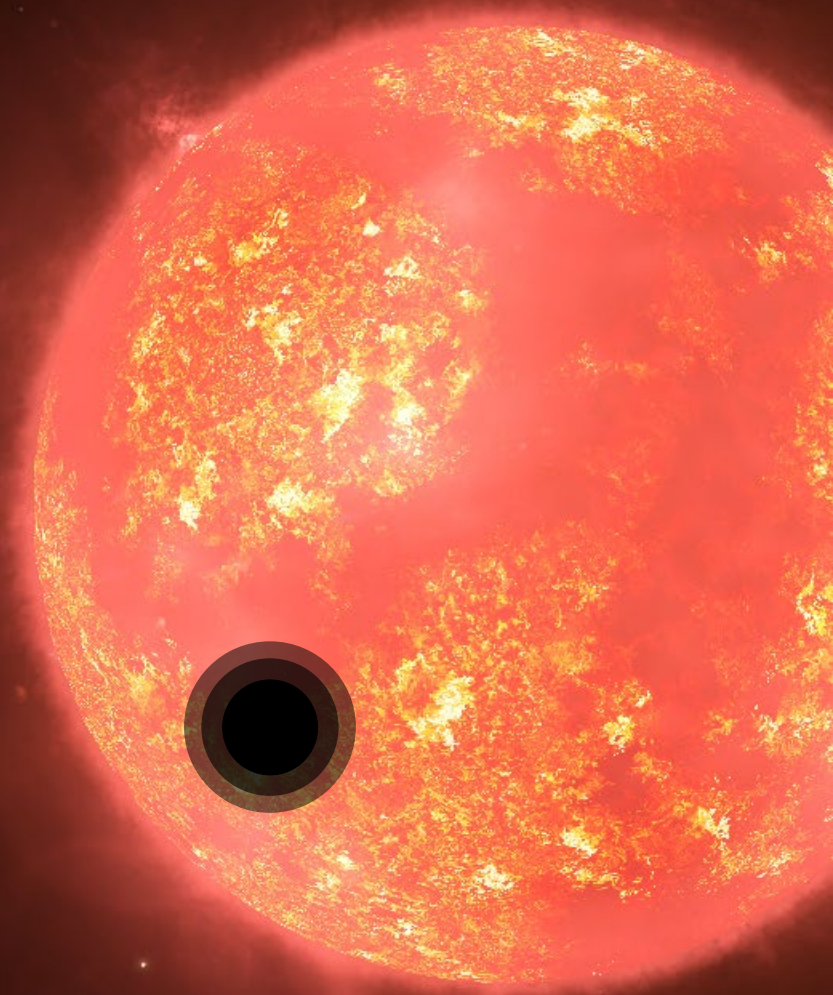


Fun With Transmission Spectroscopy

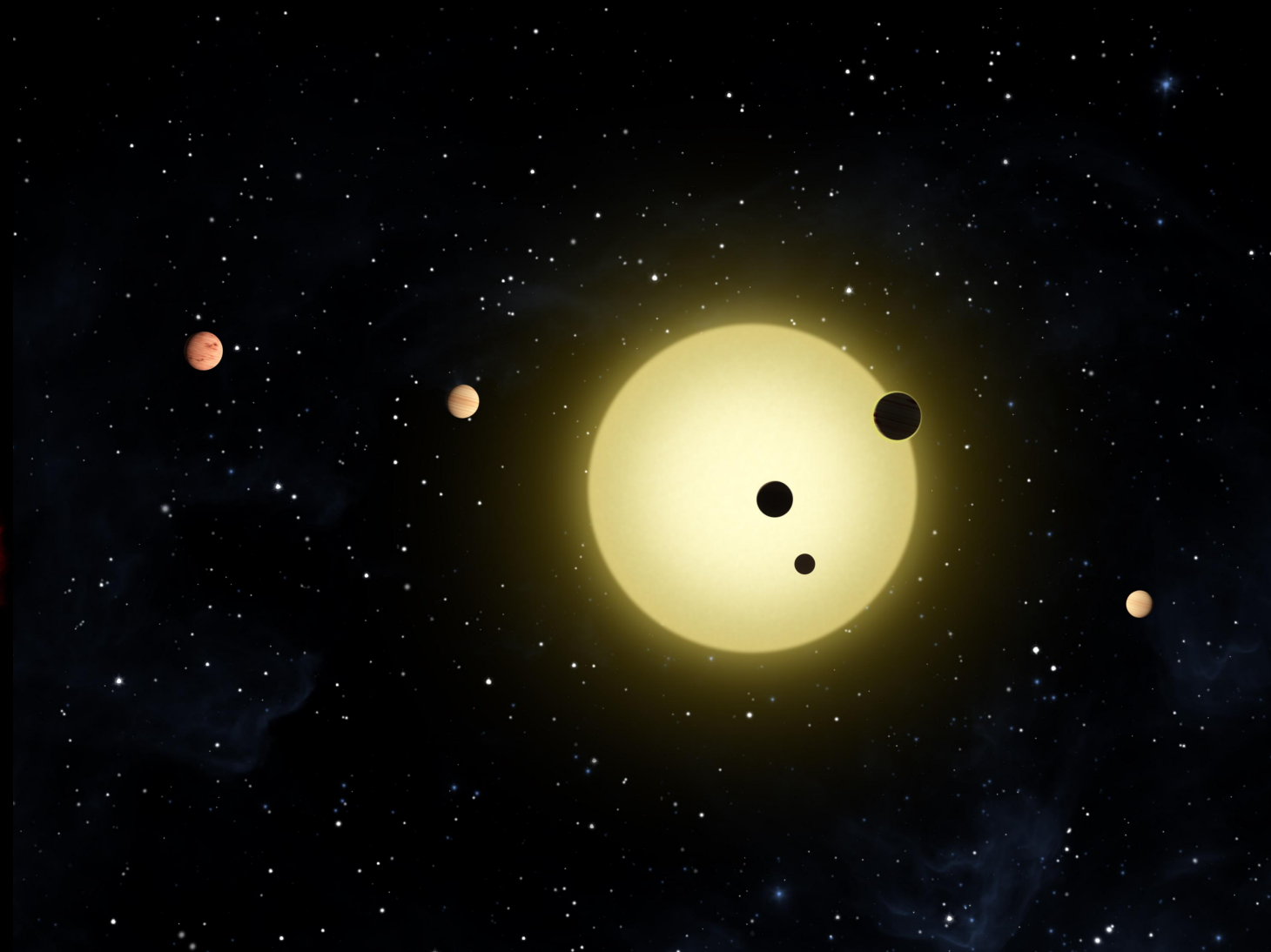
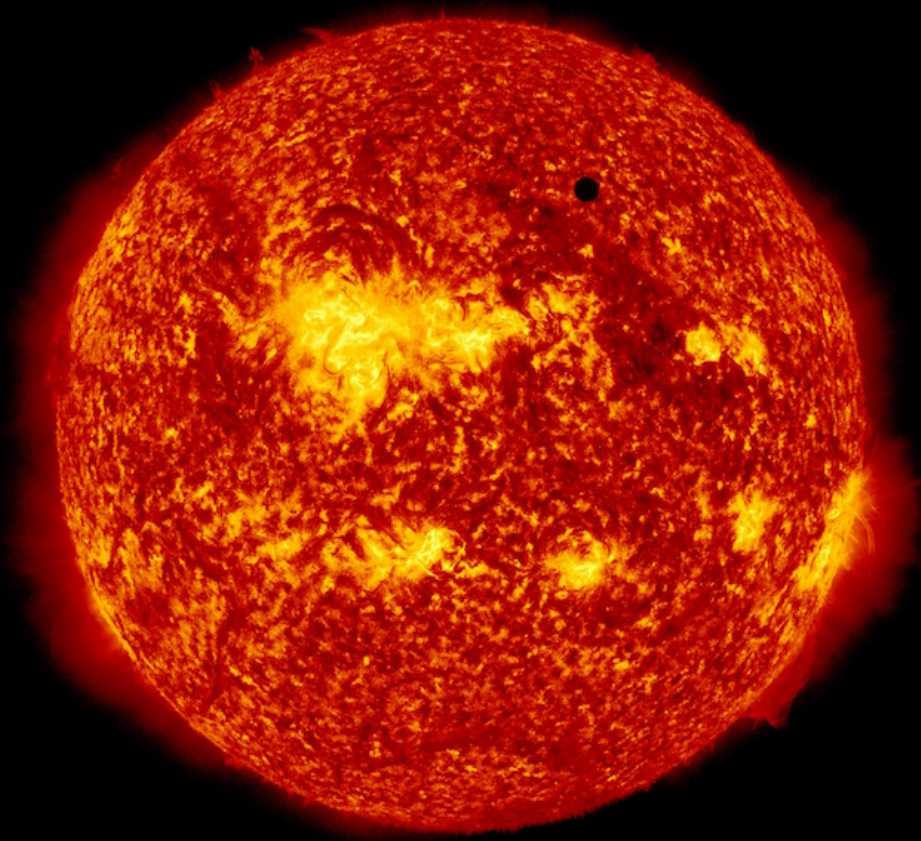
Yoni Brande

jbrande@ku.edu

 [@YoniAstro](https://twitter.com/YoniAstro)

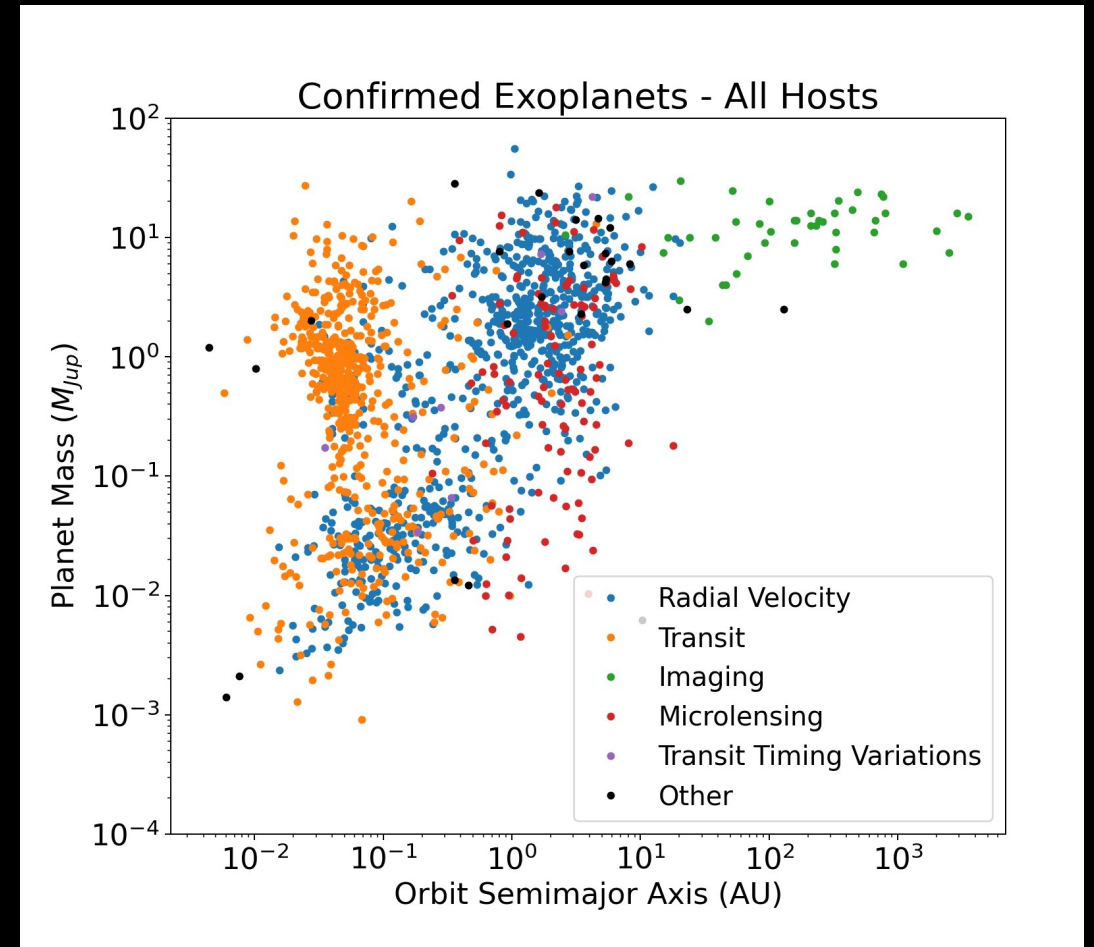


What is an Exoplanet?



Science Motivation

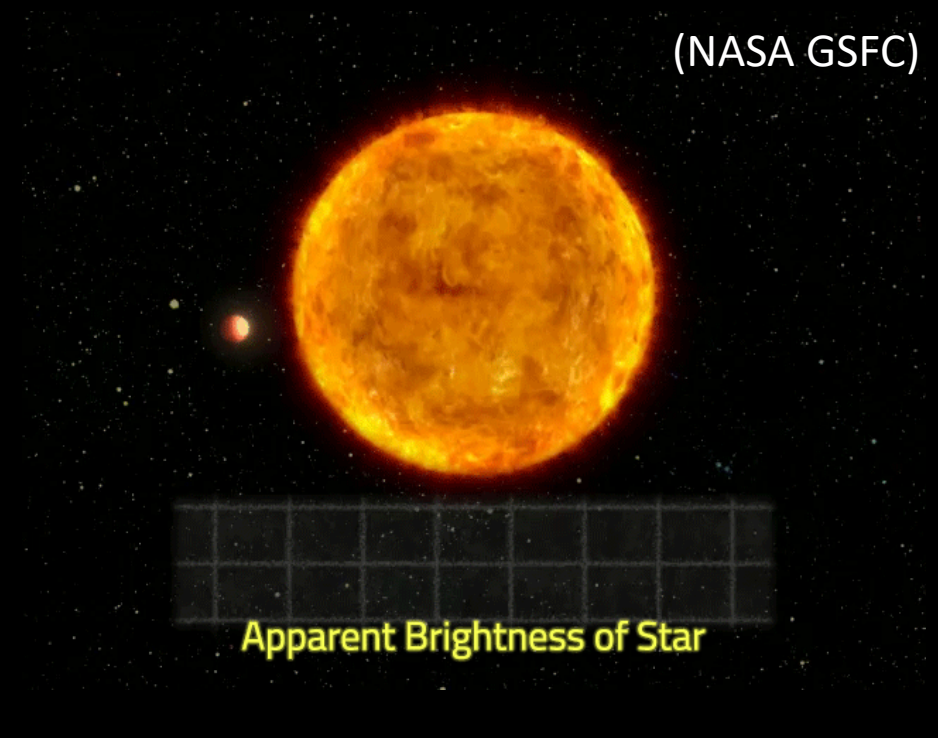
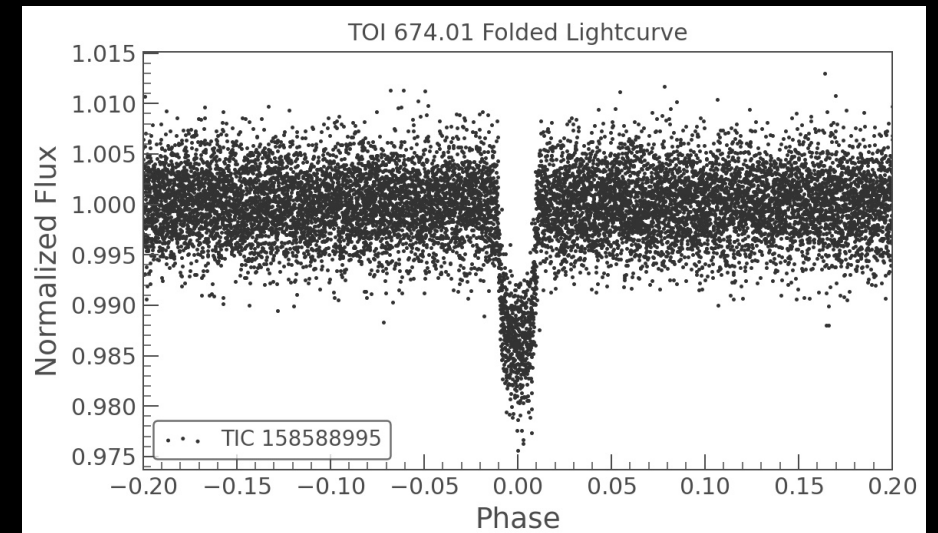
- How do planets form?
- Do different stars form different planets?
- How can we explain systems that don't fit our current understanding?
- All of these -> what are planets made of?
- Can't answer without data!



(NASA GSFC)

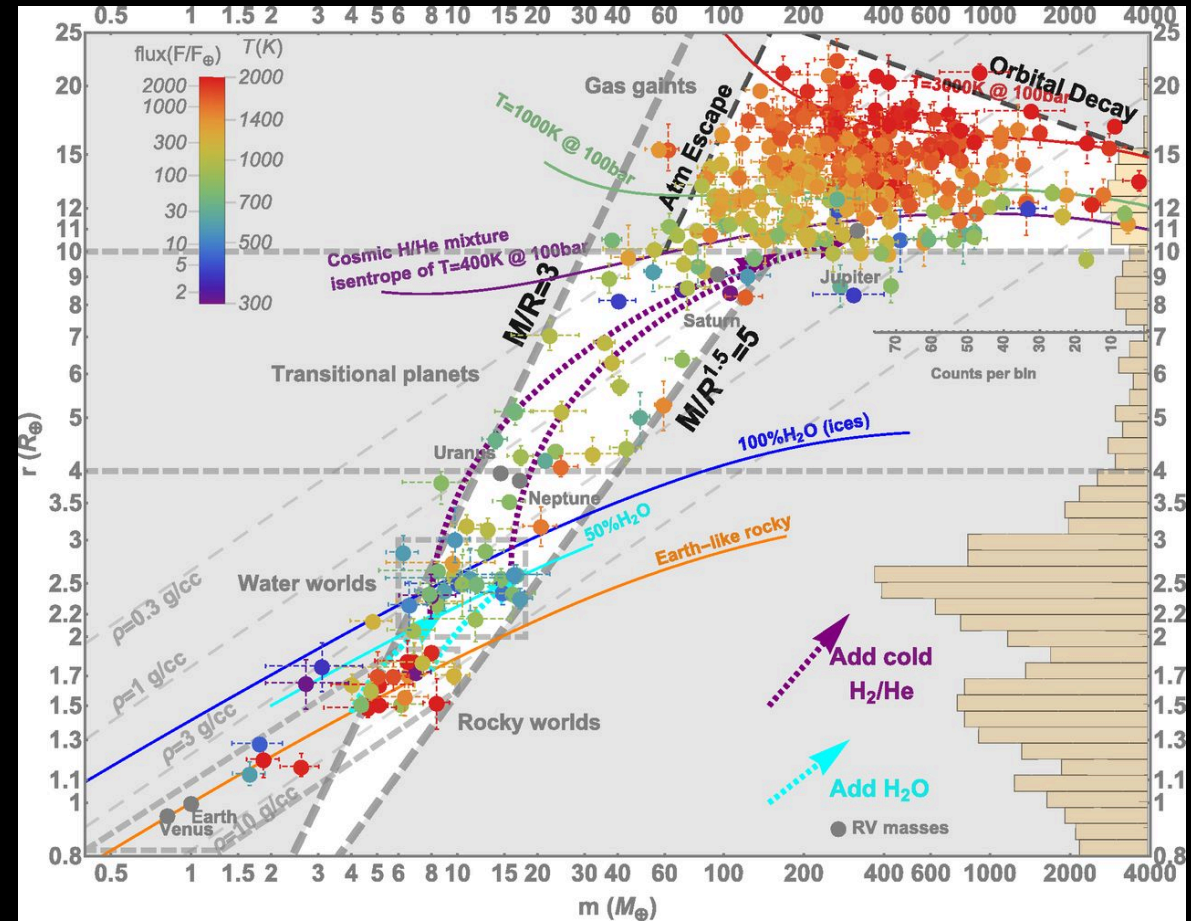
Transits

- Indirect detection, measure the brightness of a host star and look for variations
- Short, periodic signals can indicate exoplanets
- Need to rule out false positives
- Often combined with other methods
- Precision photometry can find very small planets
- Requires very specific orbital orientations



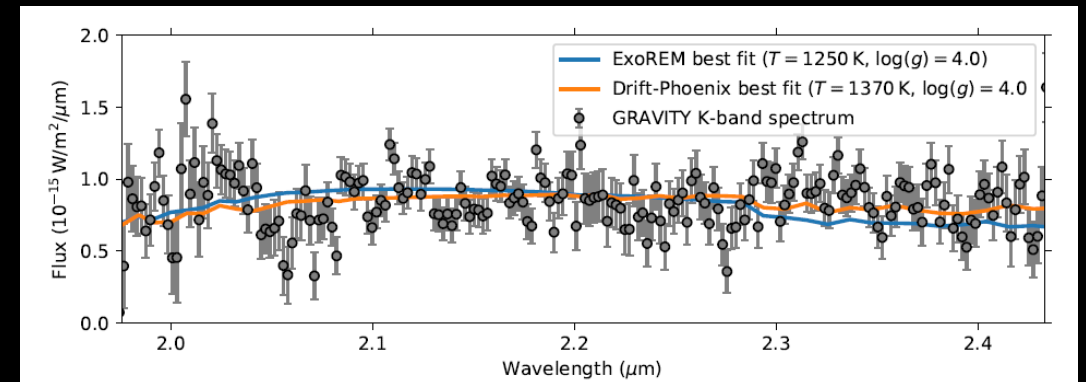
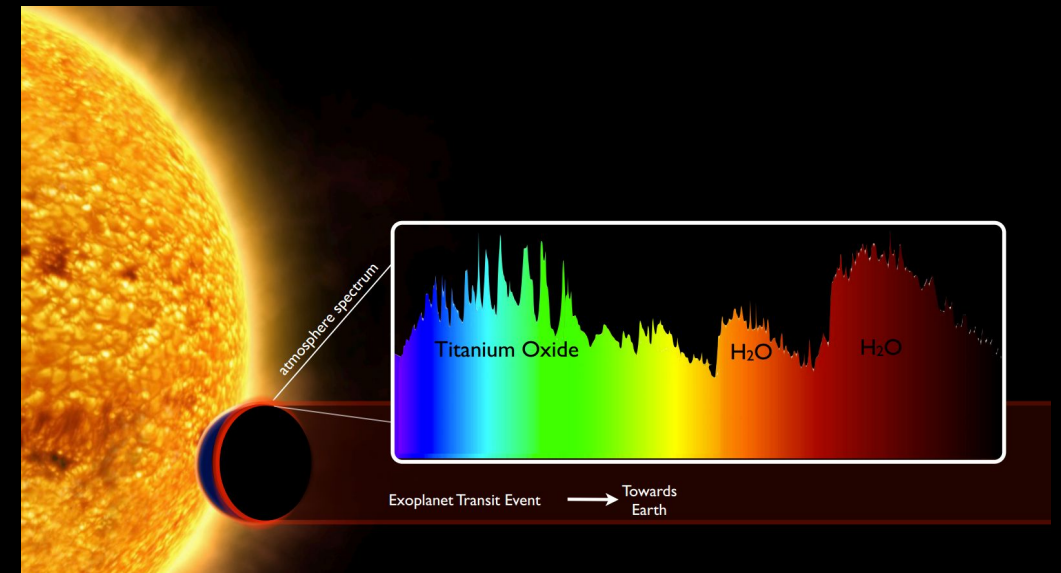
Planet Characterization

- We can combine methods like Transits/RVs to understand more about a planet
- Radius + Mass \rightarrow density \rightarrow bulk composition
- Useful for interpreting other observations like transit spectroscopy

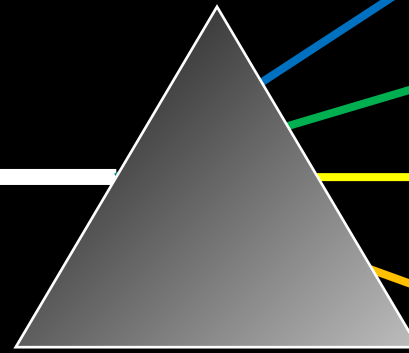
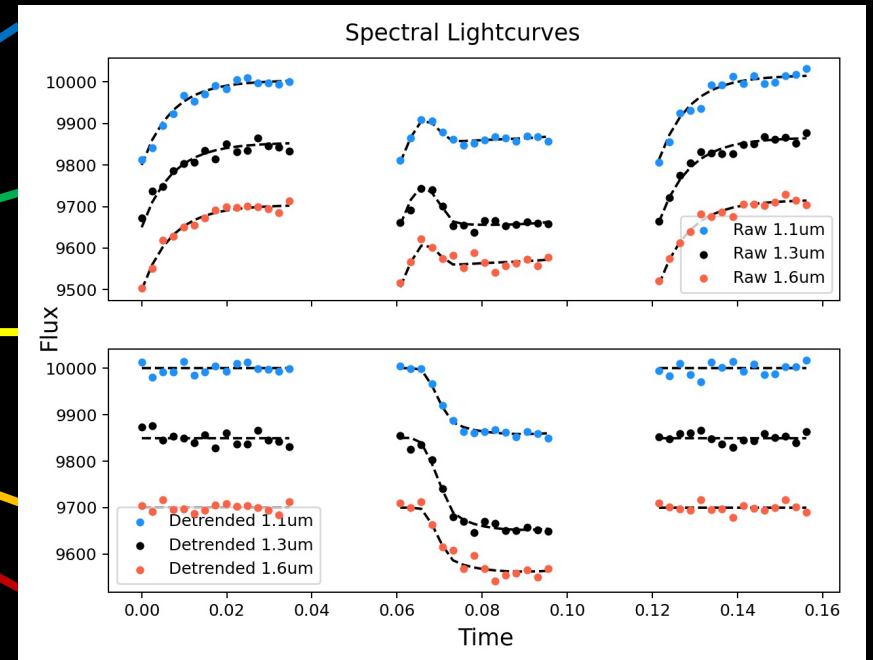
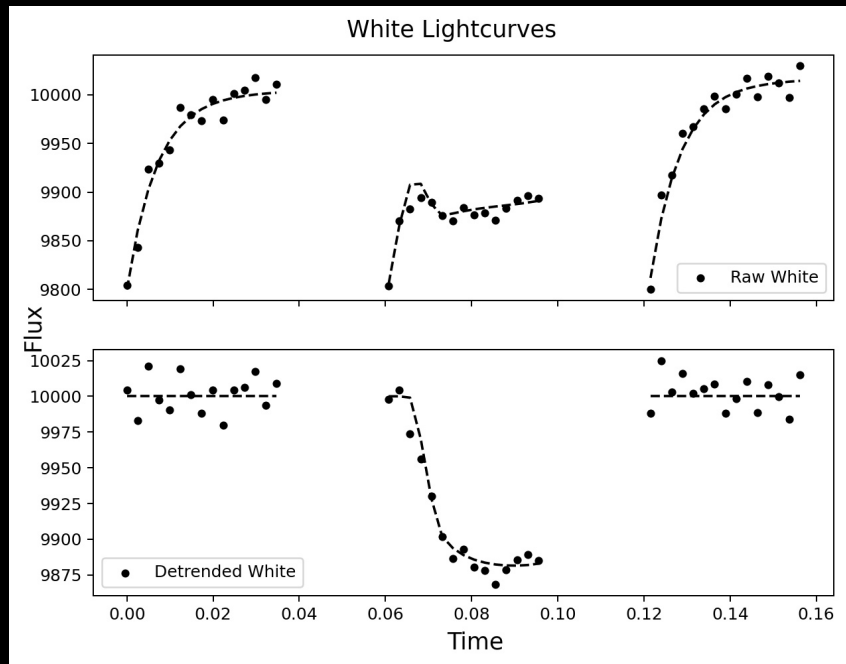


Planet Characterization

- Transit spectroscopy shows absorbing species in atmosphere
- Often hard to interpret without good stellar spectra, planet atmosphere models
- Spectroscopy also possible from direct imaging, but needs specific targets



What am I doing, anyway?

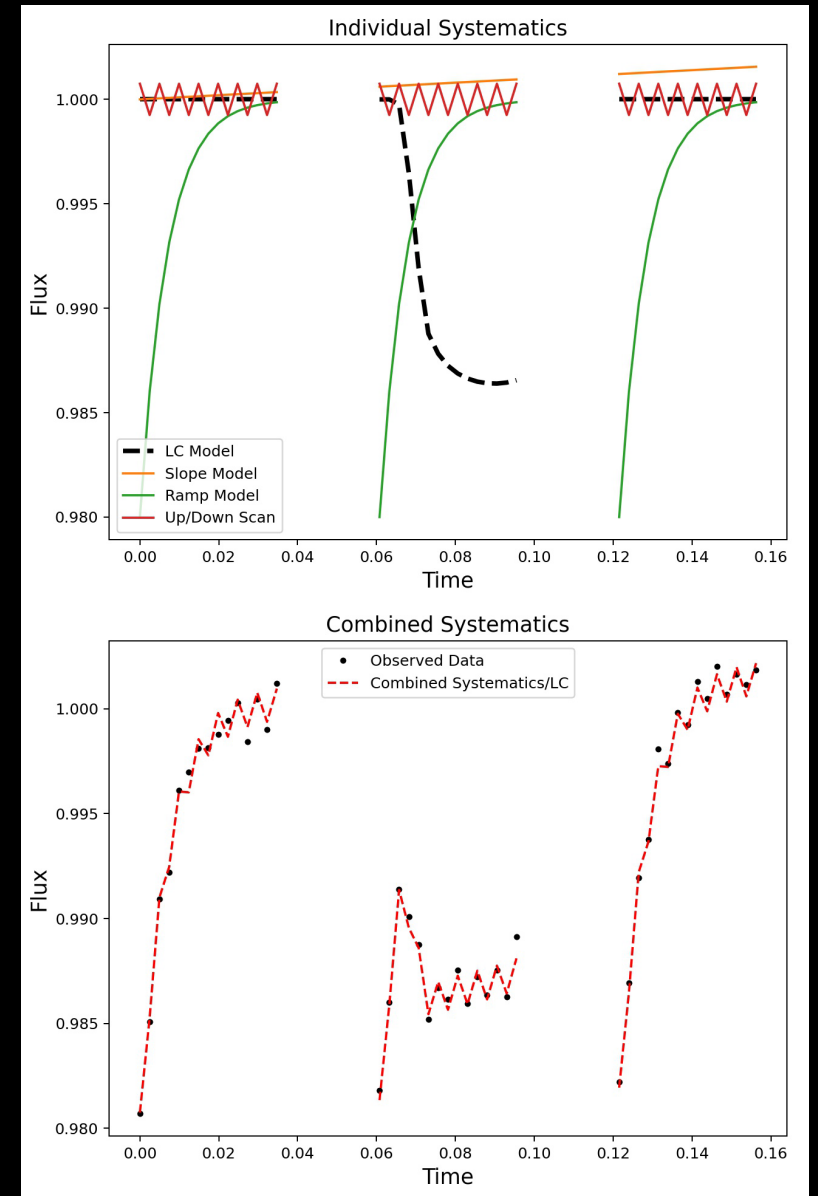


What am I doing, anyway?

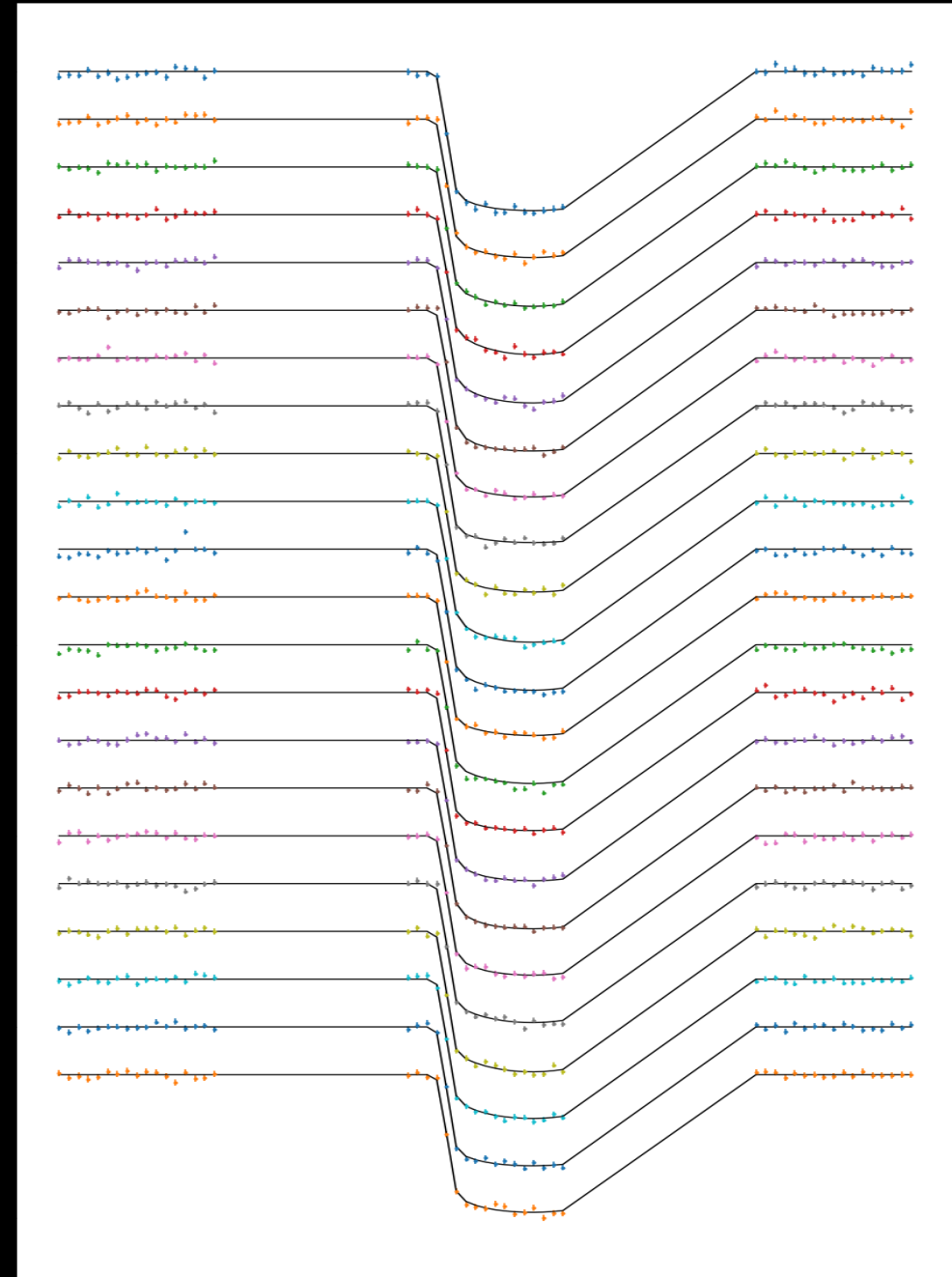
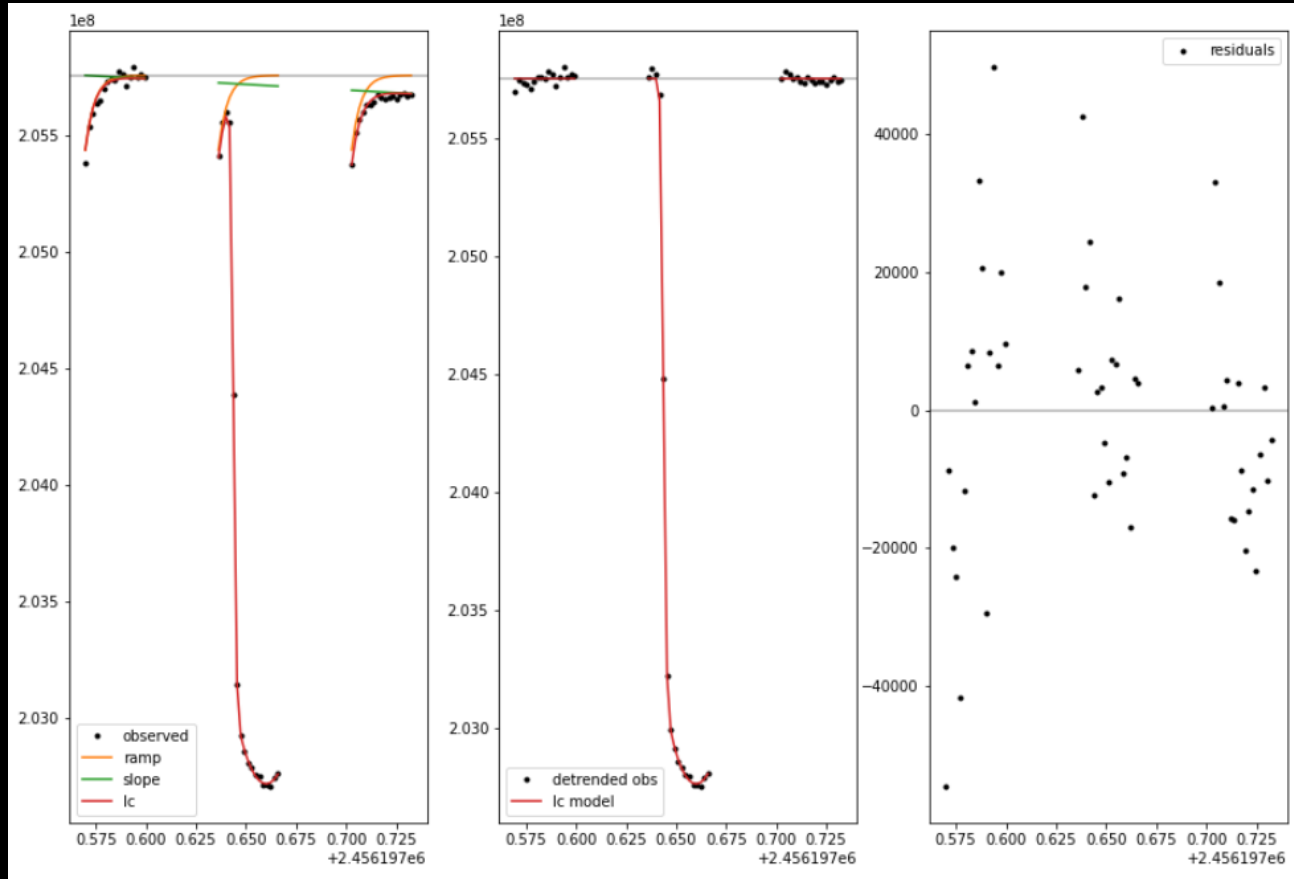
- Lightcurve modeling
 - “true” transit model
 - “true” systematics model
 - Fit components from Kreidberg+ 2014, need to fit for every spectral band
- MCMC sampling over (possibly very) large hierarchical models -> want speedy sampling
- exoplanet – improved sampling performance with Hamiltonian Monte-Carlo, “new” to astrophysics



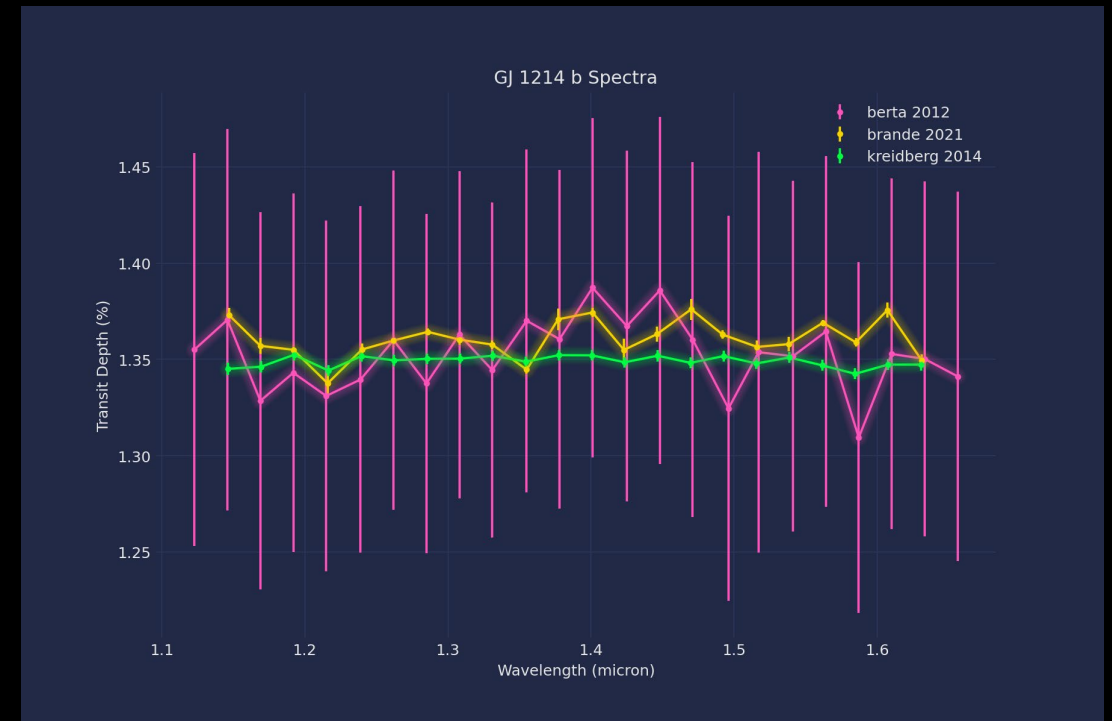
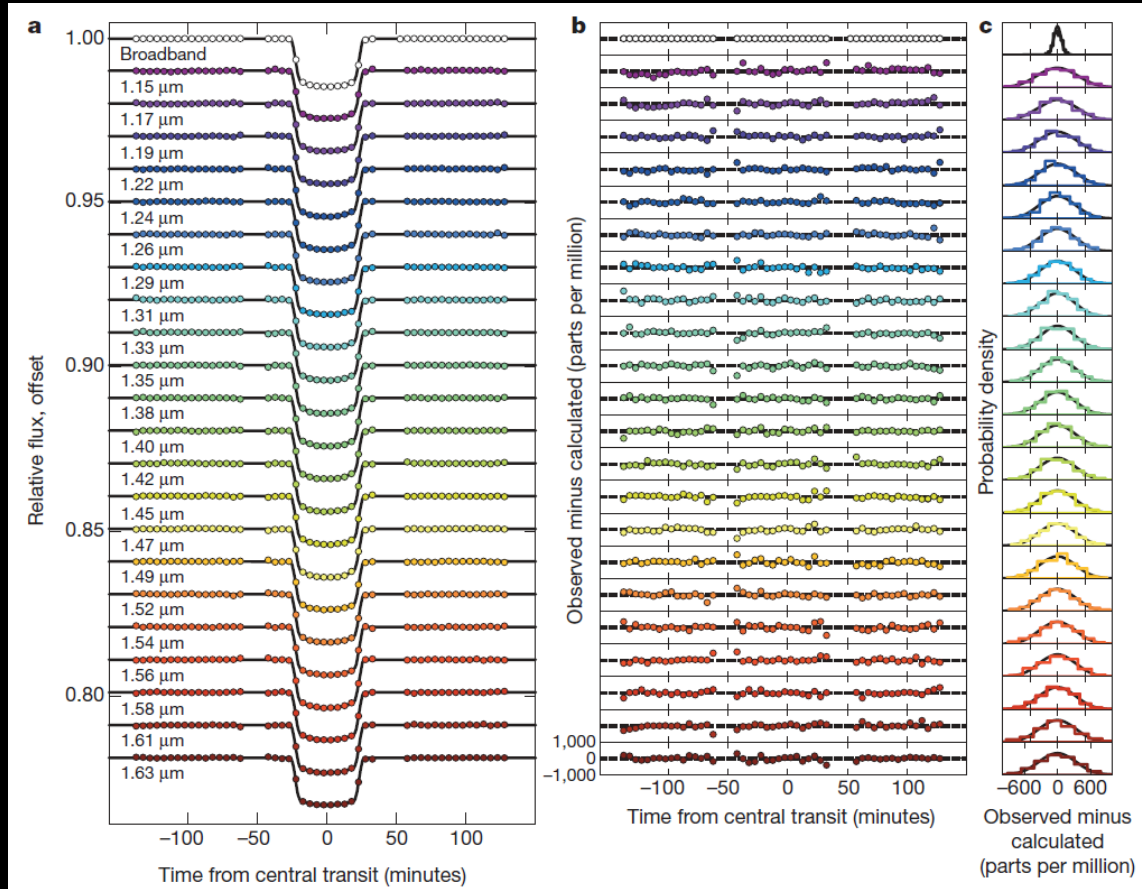
exoplanet (Foreman-Mackey+ 2019)
docs.exoplanet.codes



Real Data! GJ 1214 b



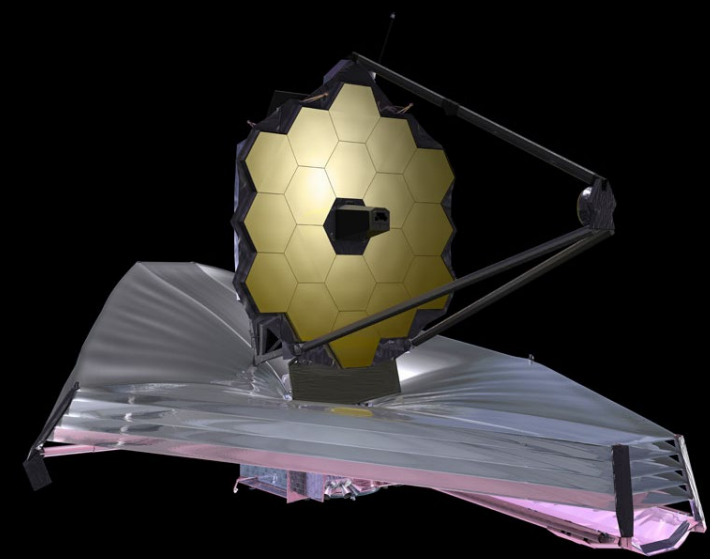
GJ 1214 b – Flat Spectra, Thick Clouds



Kreidberg+ 2014

Next steps

- Continue validating code
- Work on spectral lightcurve extraction
- HST IR spectra of other new exoplanets
- NASA IRTF infrared spectra next month!
- JWST? Who knows!
- Helium escape, atmospheric erosion? -> tracing EUV flux from host star
- General interest – H₂O in temperate planet atmospheres -> “habitable” zone
- Find good spectral retrieval codes to interpret results



(NASA)

