

# The hottest Jupiters transiting evolved stars

**Samuel Grunblatt, Nicholas Saunders, and many others**

**American Museum of Natural History/  
Flatiron Institute**

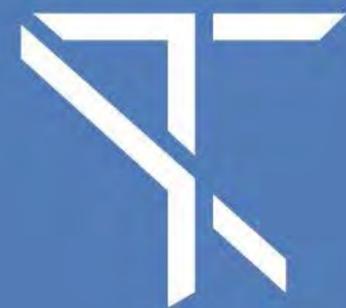


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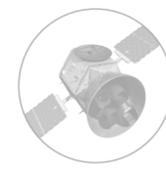
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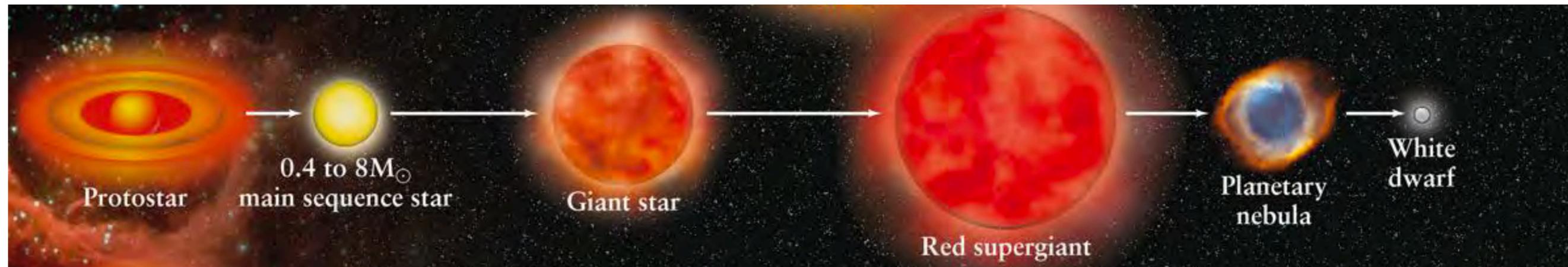


FLATIRON  
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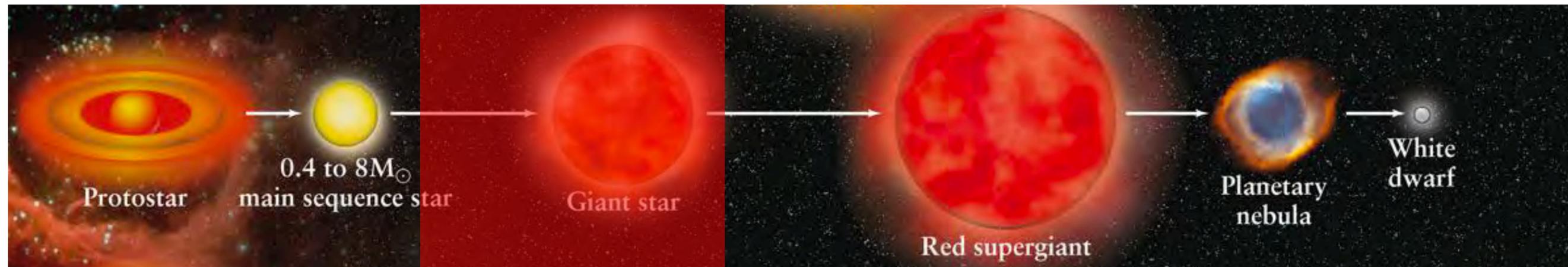


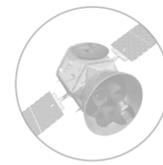
# Stellar evolution in 30 seconds:



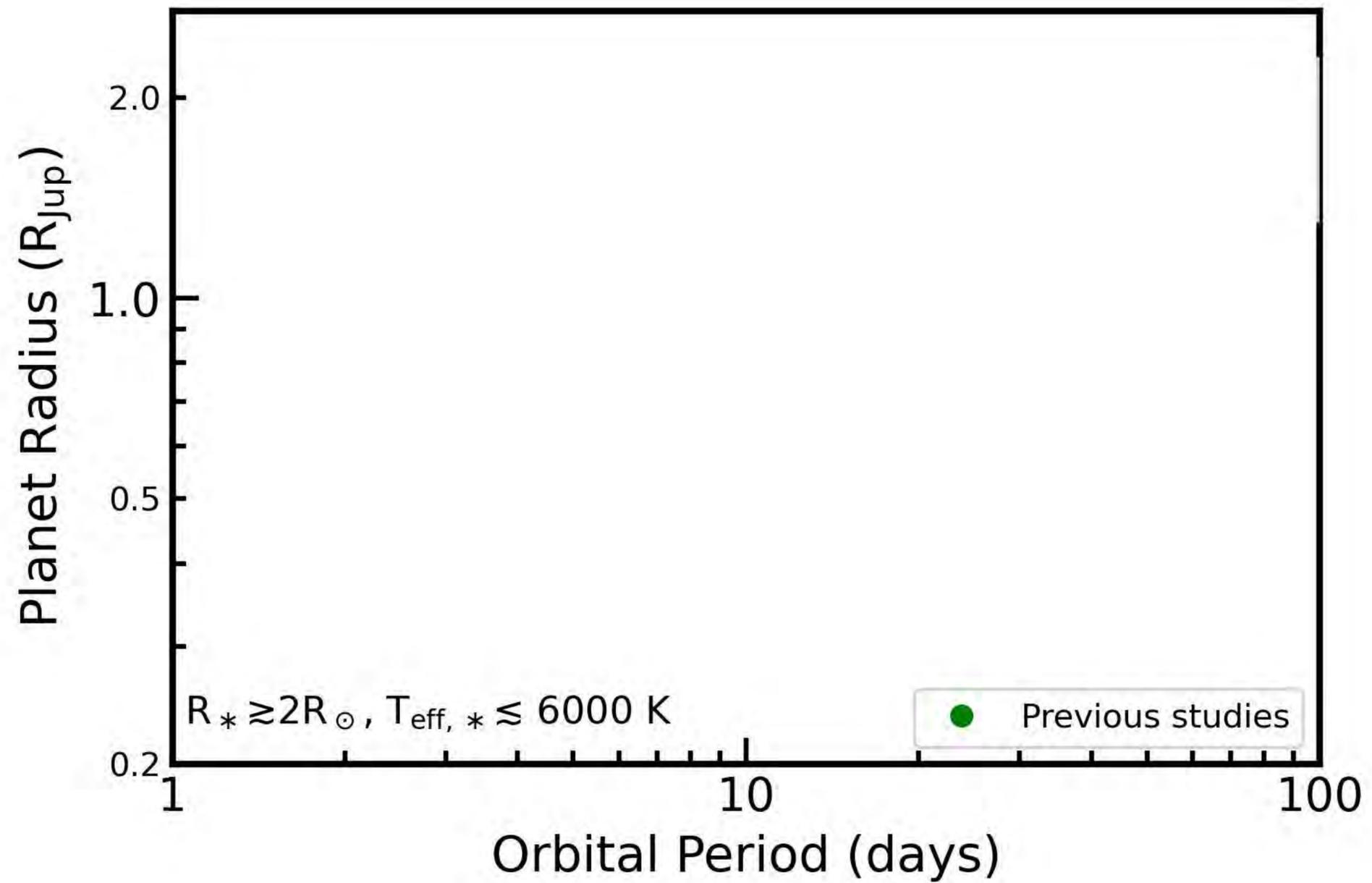


# Stellar evolution in 30 seconds:



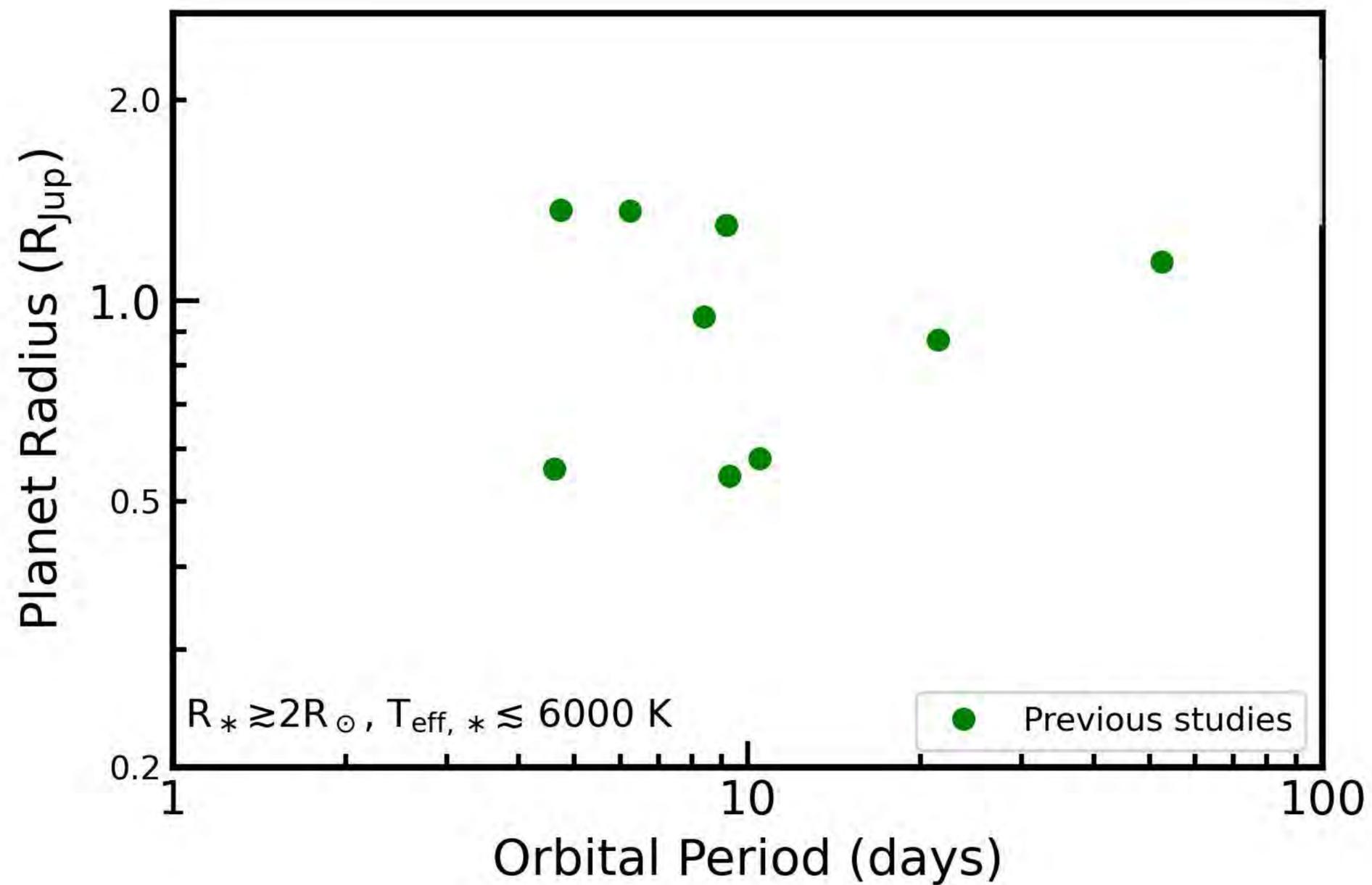


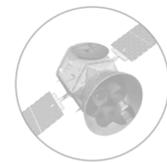
## 2013: no evidence for planets transiting evolved stars.



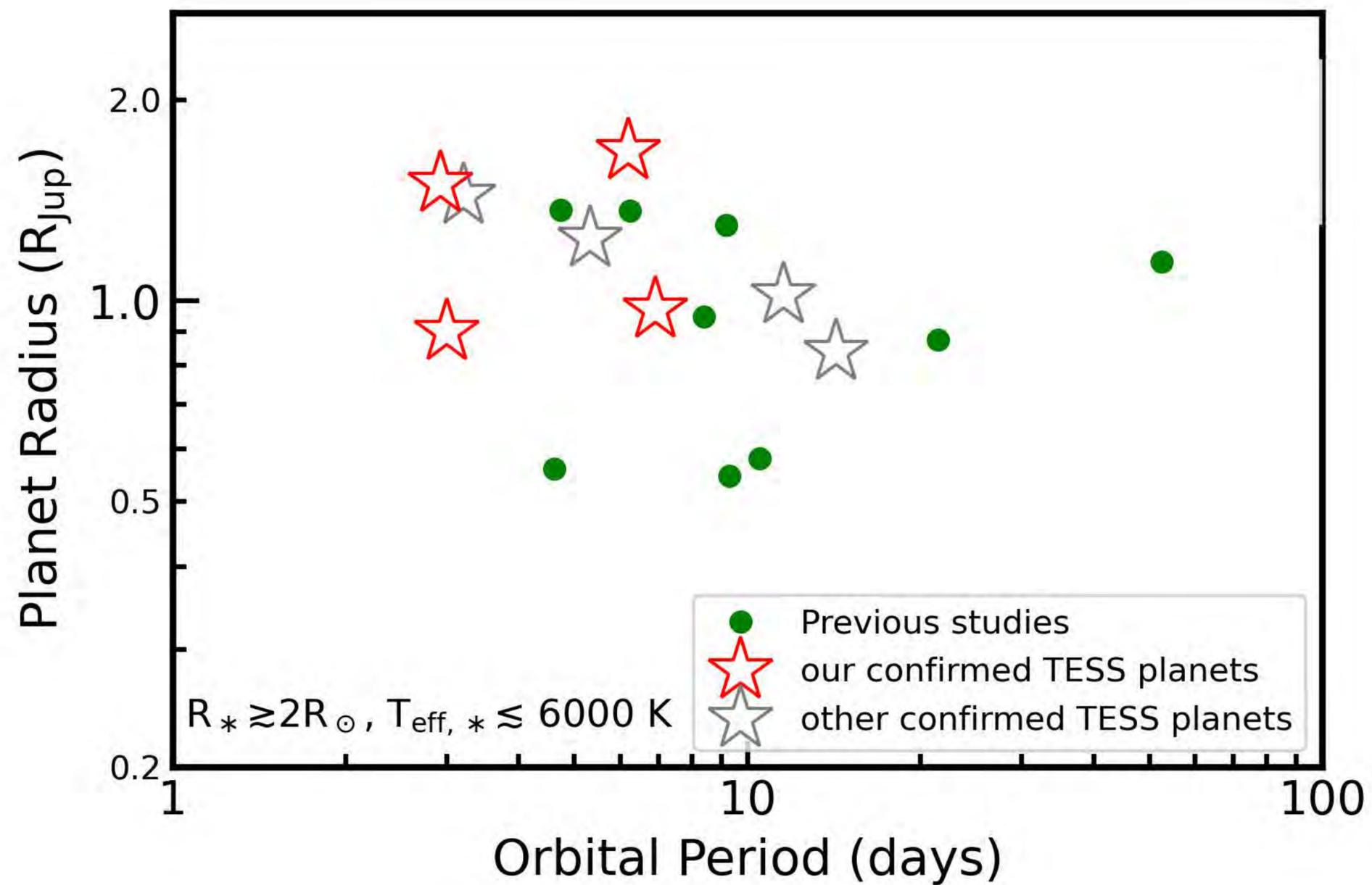


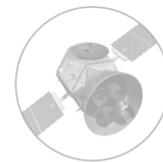
**2018: transiting planet surveys show planets transiting evolved stars exist.**



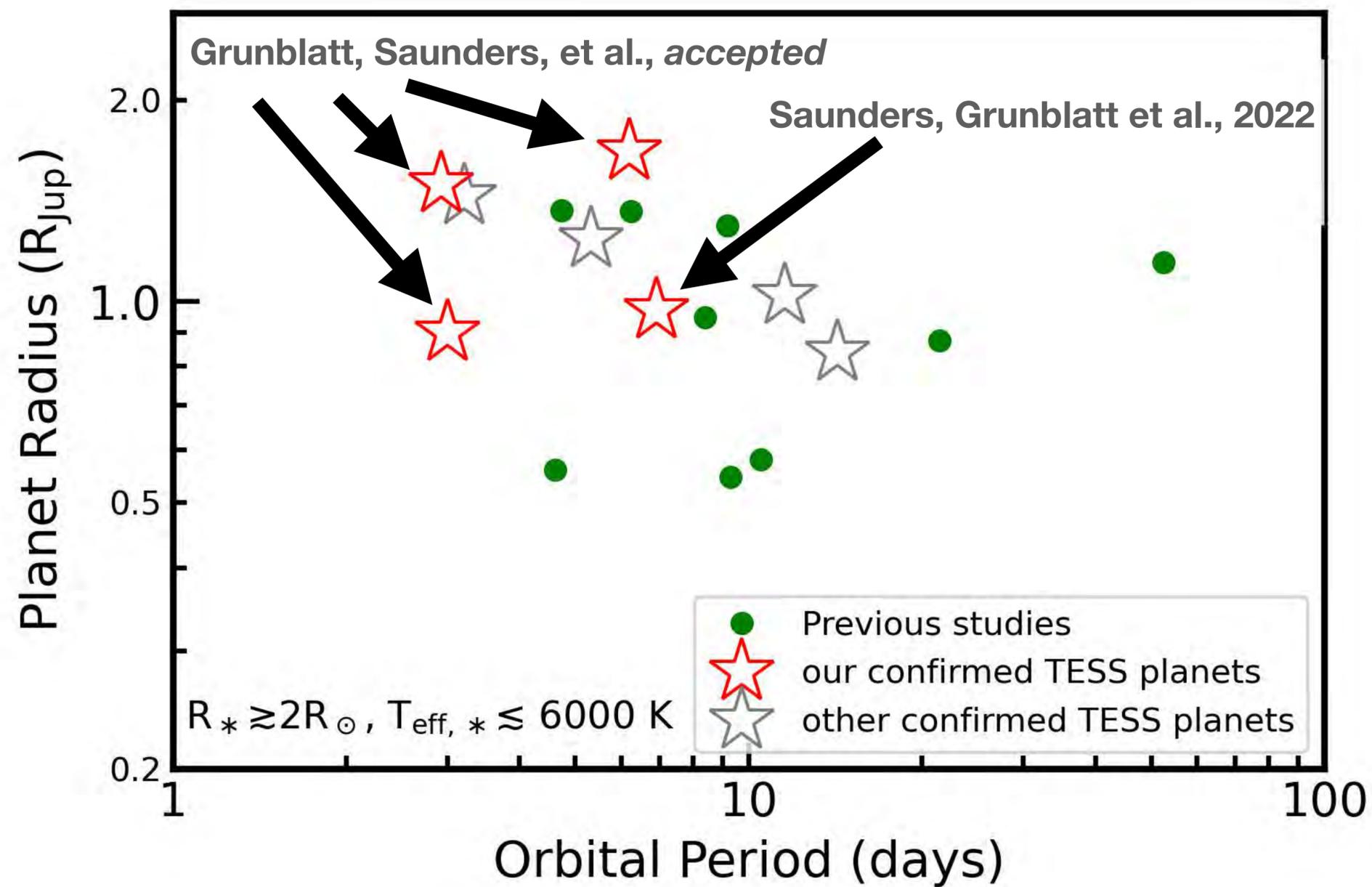


## 2022: TESS discoveries reveal the hottest planets orbiting evolved stars.



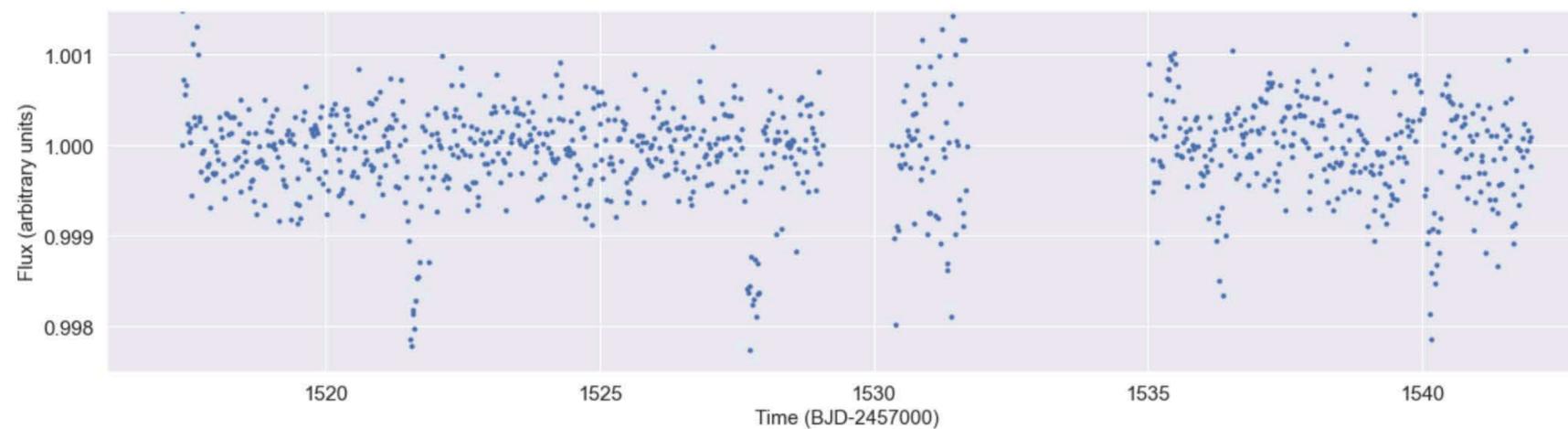
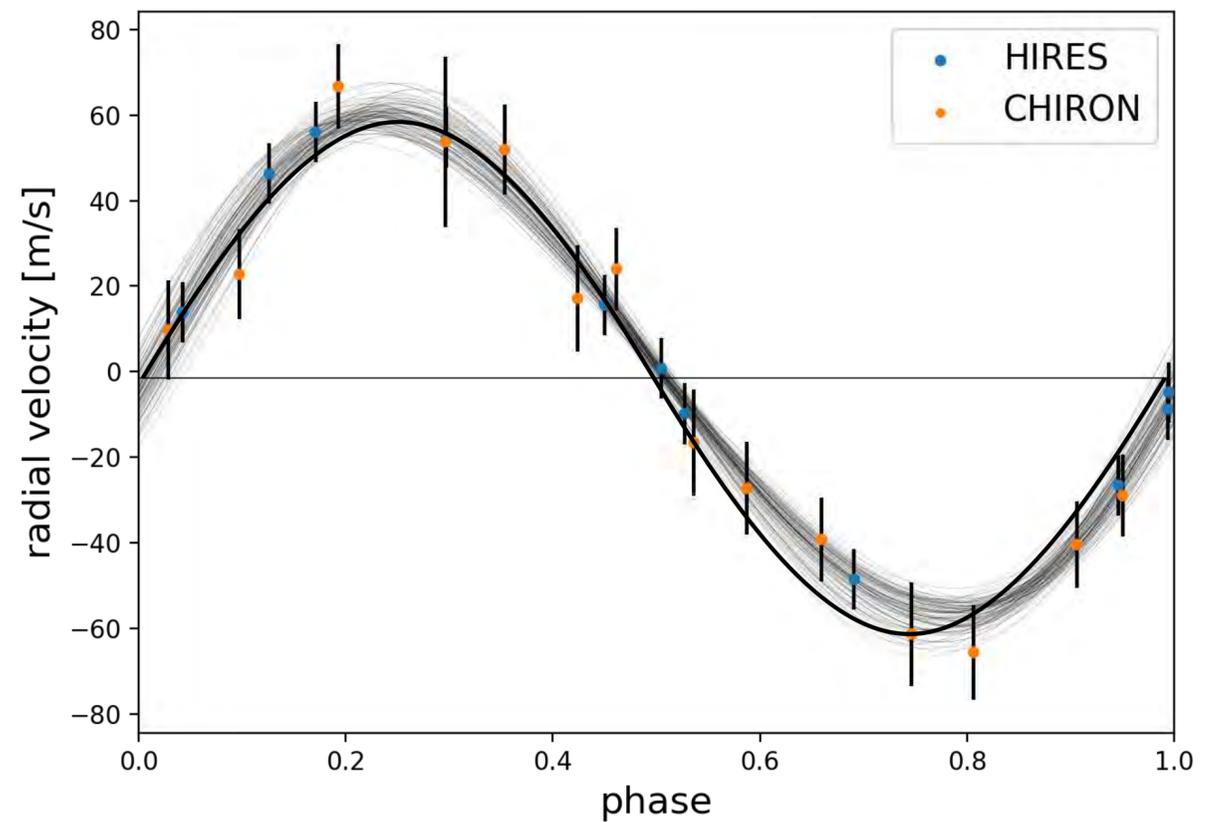
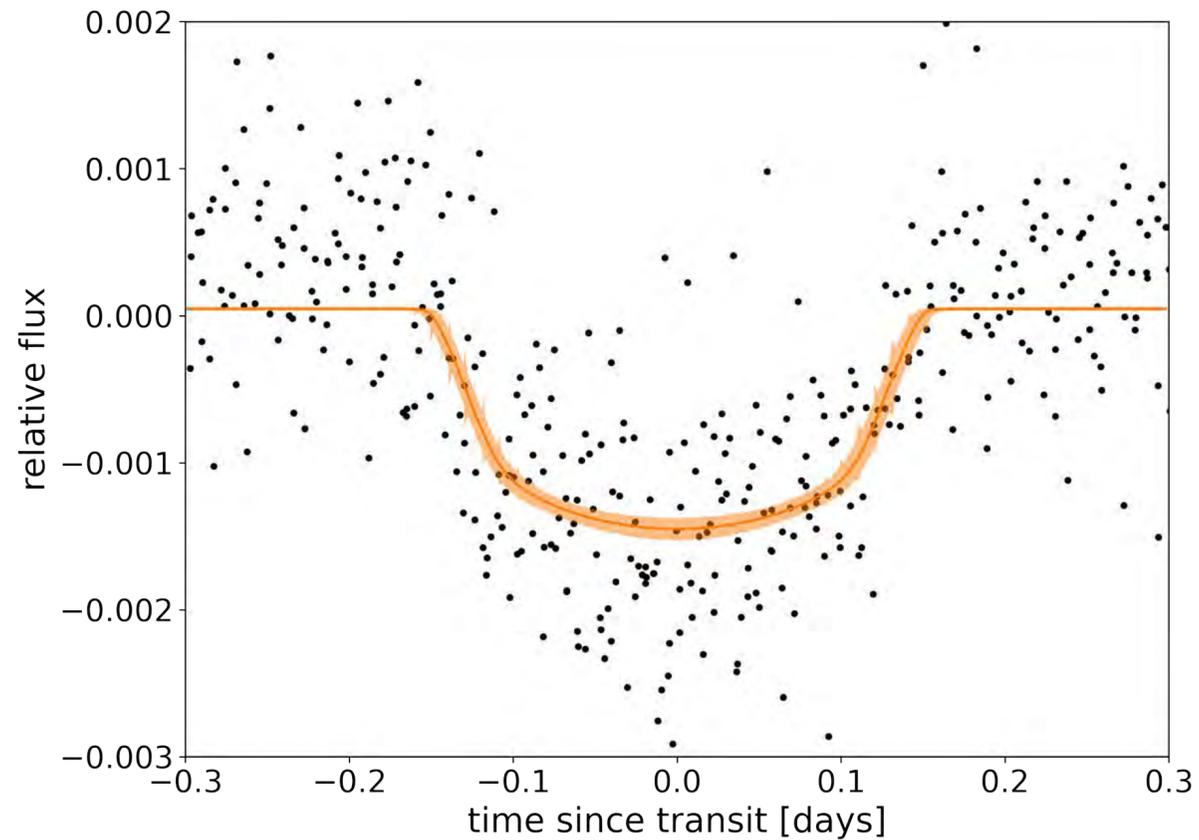


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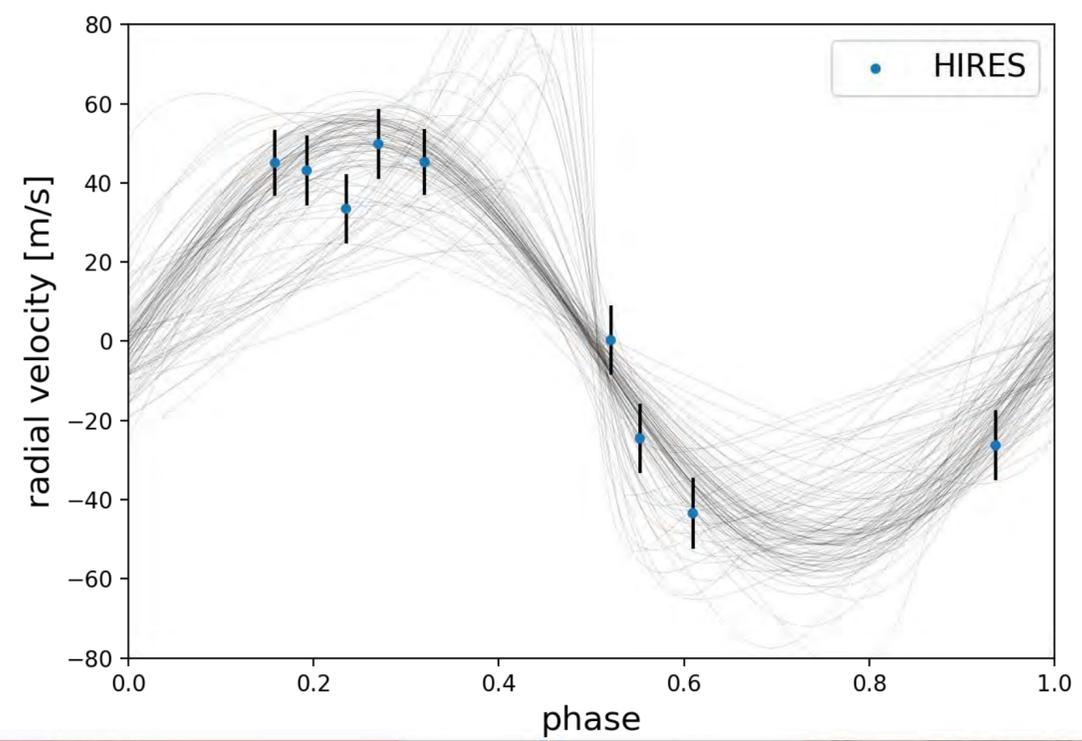
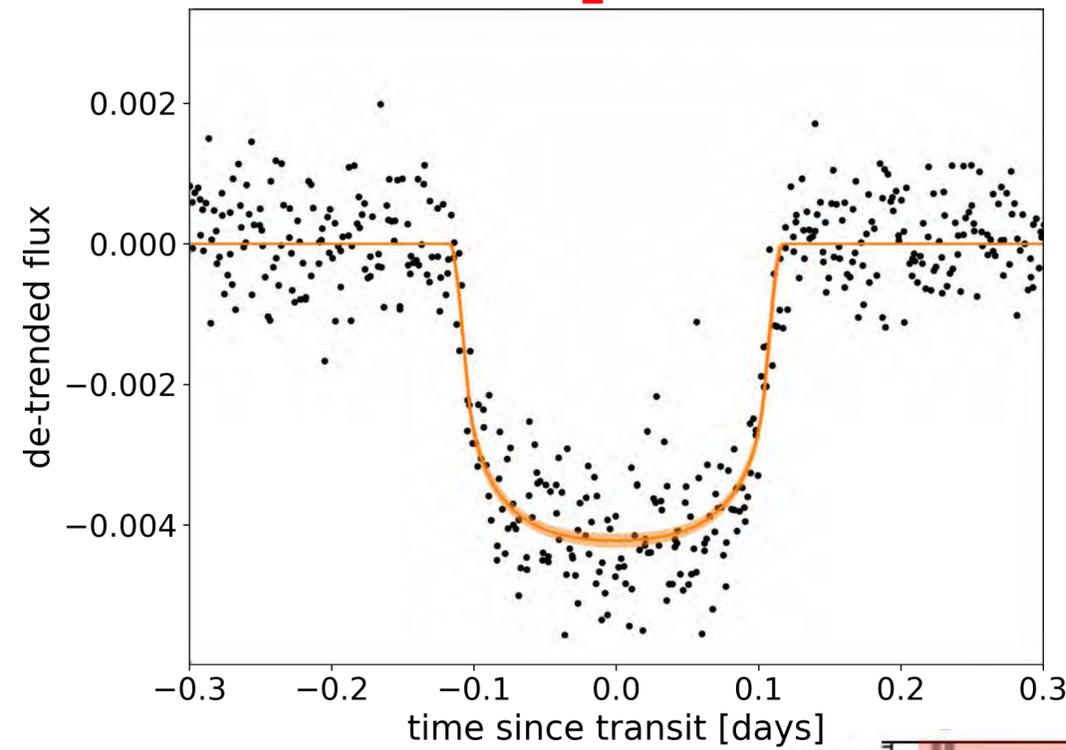
# TOI-2669b confirmed with only ~25 days of TESS data!

Possibly eccentric despite its short period—  
continuing a pattern in evolved systems (Grunblatt+ 2018)?

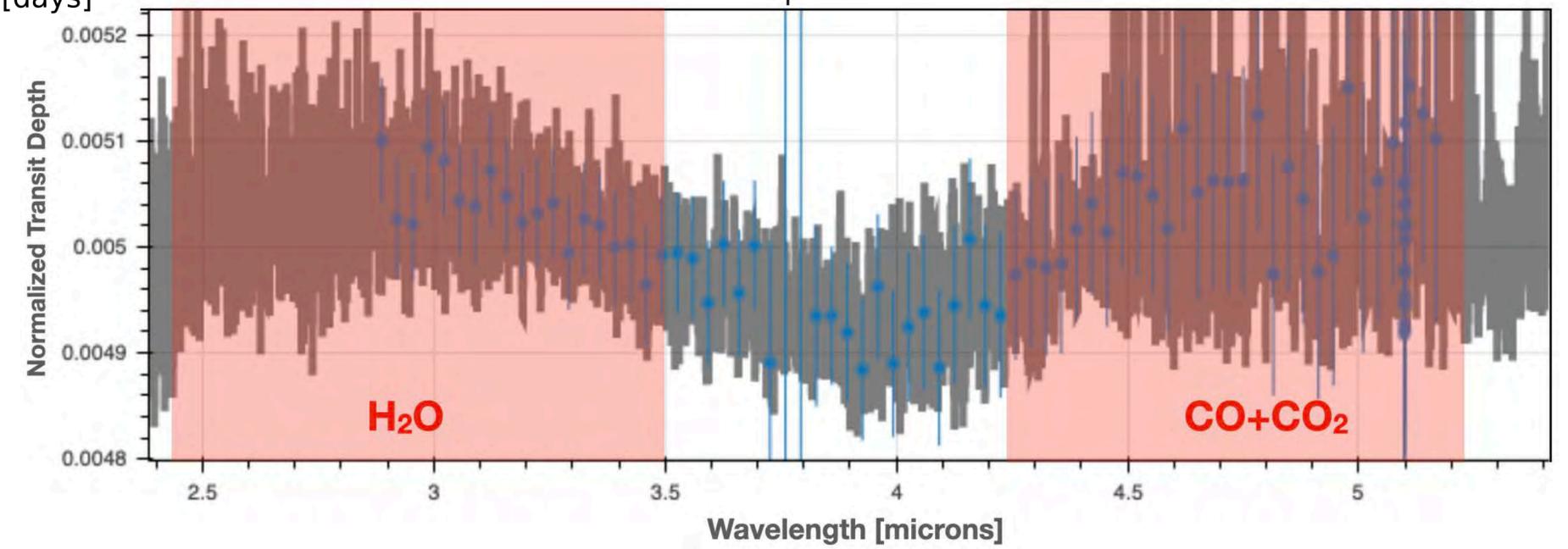




# TOI-4329b is the **best evolved planet for atmospheric characterization.**

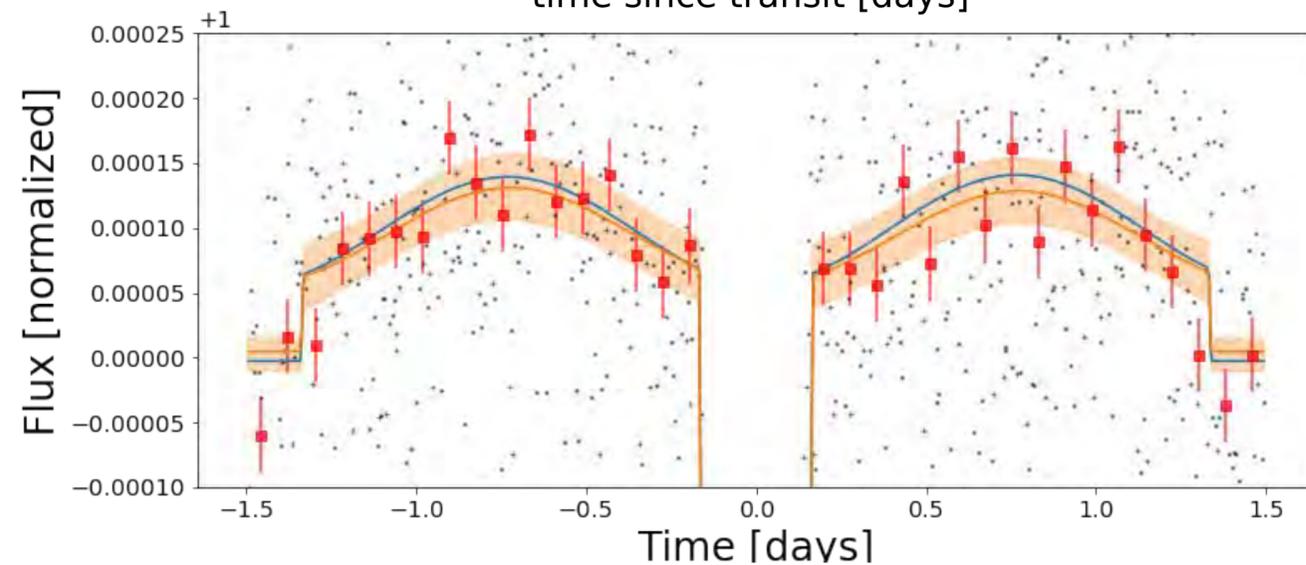
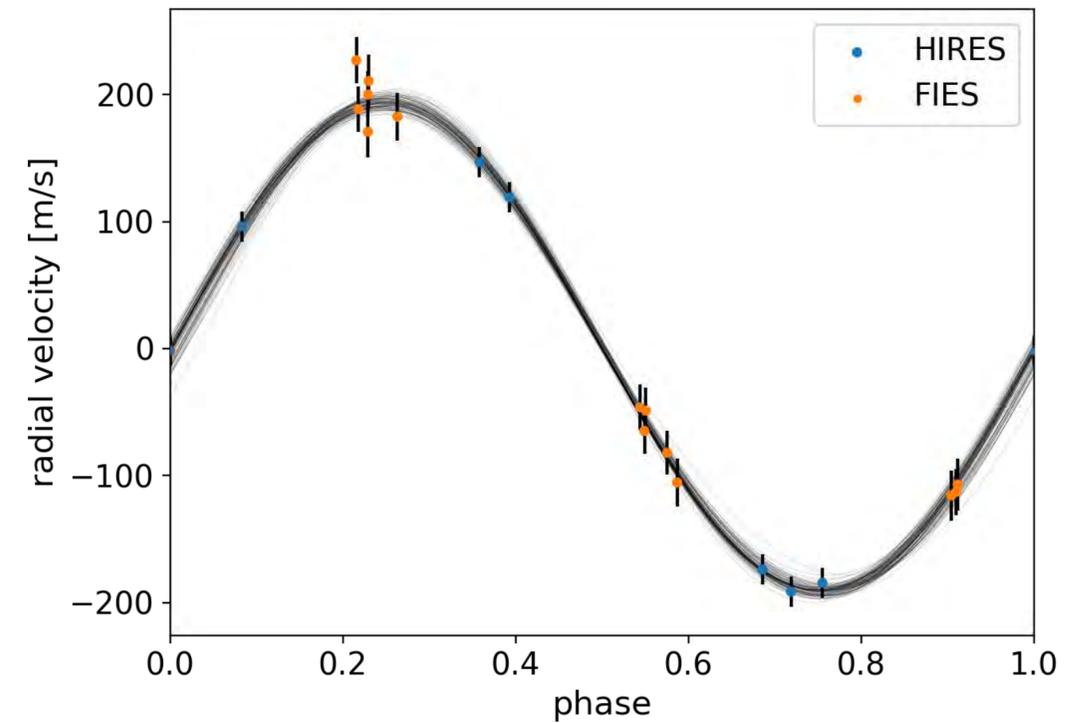
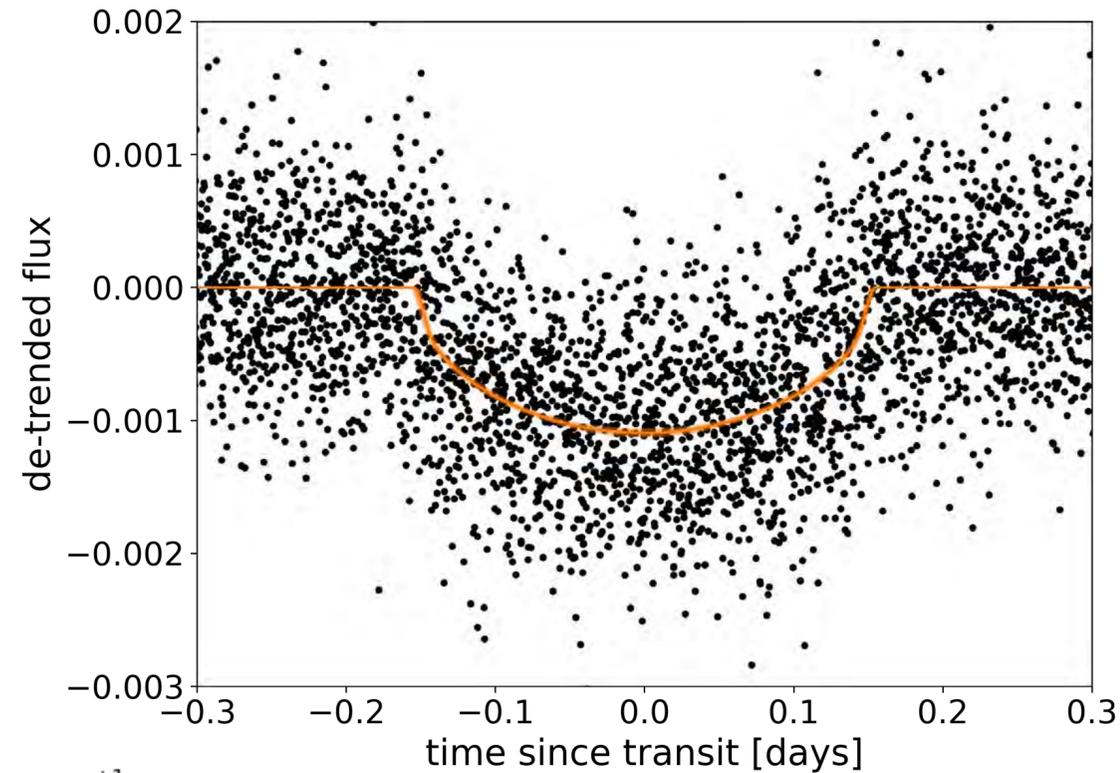


**JWST observations could detect water or CO2 in the planet's atmosphere, informing planetary migration models.**





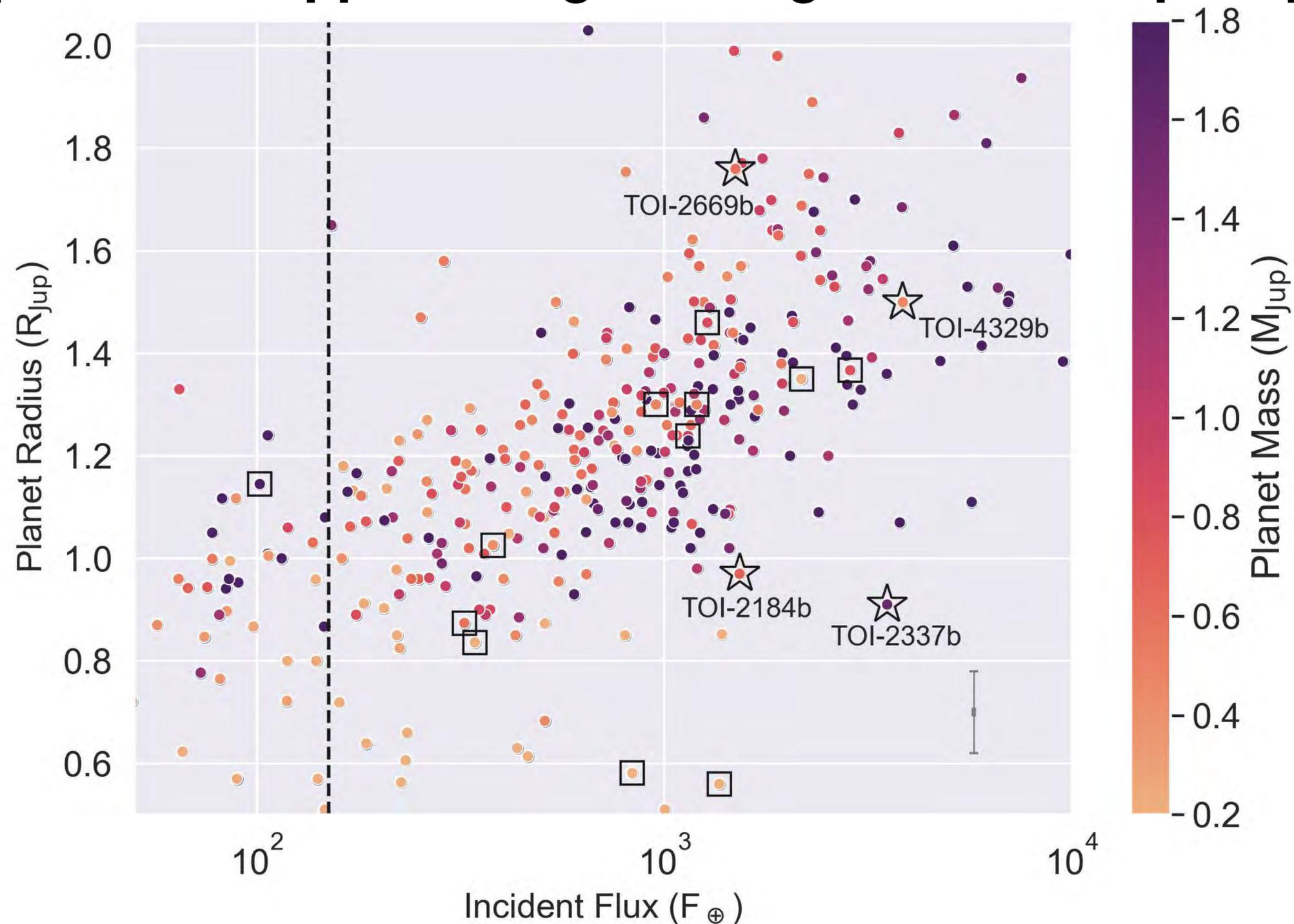
# TOI-2337b is a **very high density planet** given its temperature and orbital period.



**Variations in the out-of-transit light curve suggest additional star-planet interaction.**

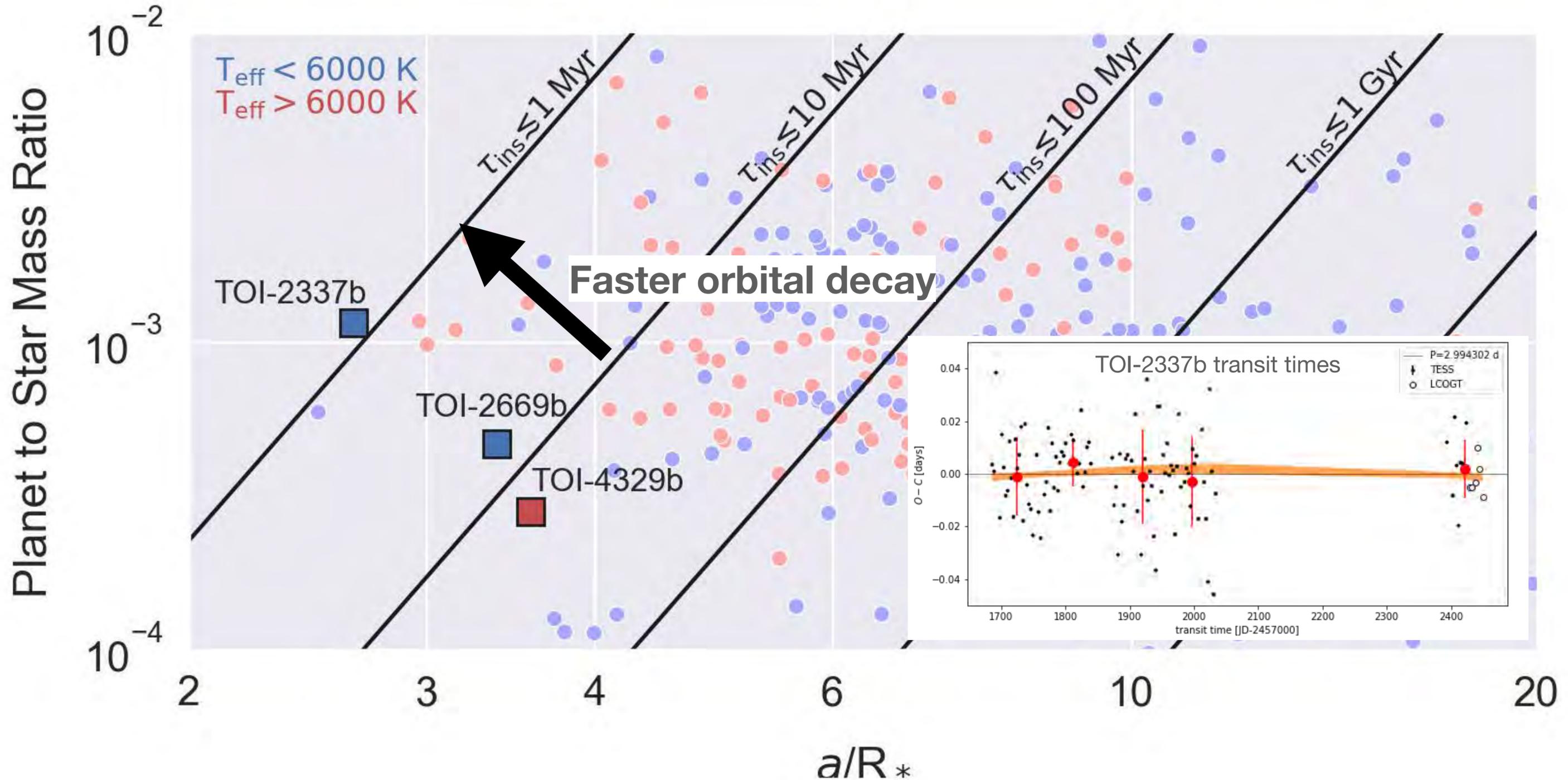
# Evolved hot Jupiters may be under-inflated.

Overall spread also appears larger than general hot Jupiter population.



# Orbital decay of evolved systems?

Not yet detectable, but continued TESS observations will test models.

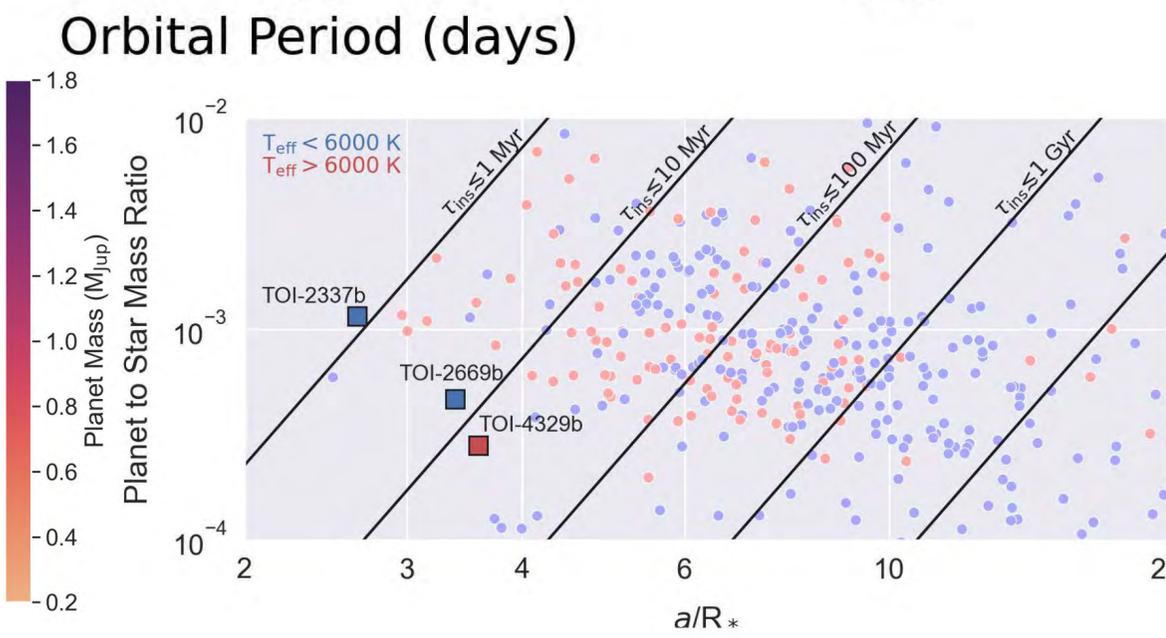
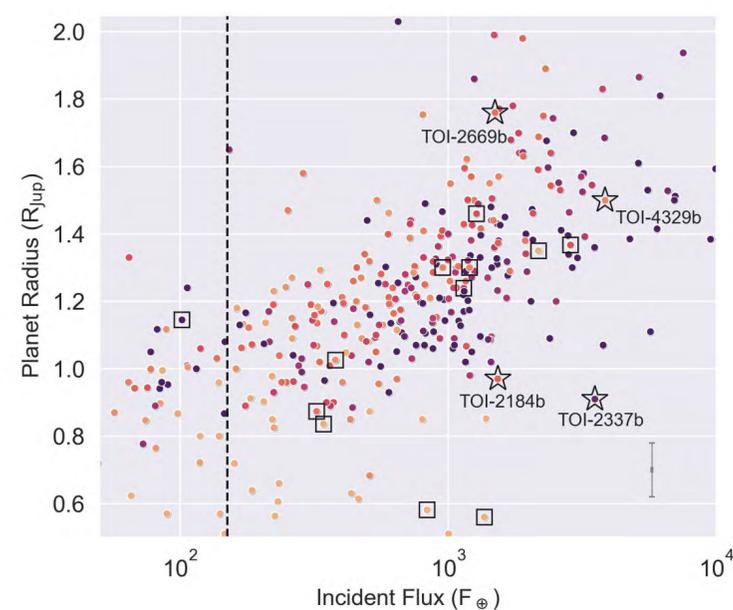
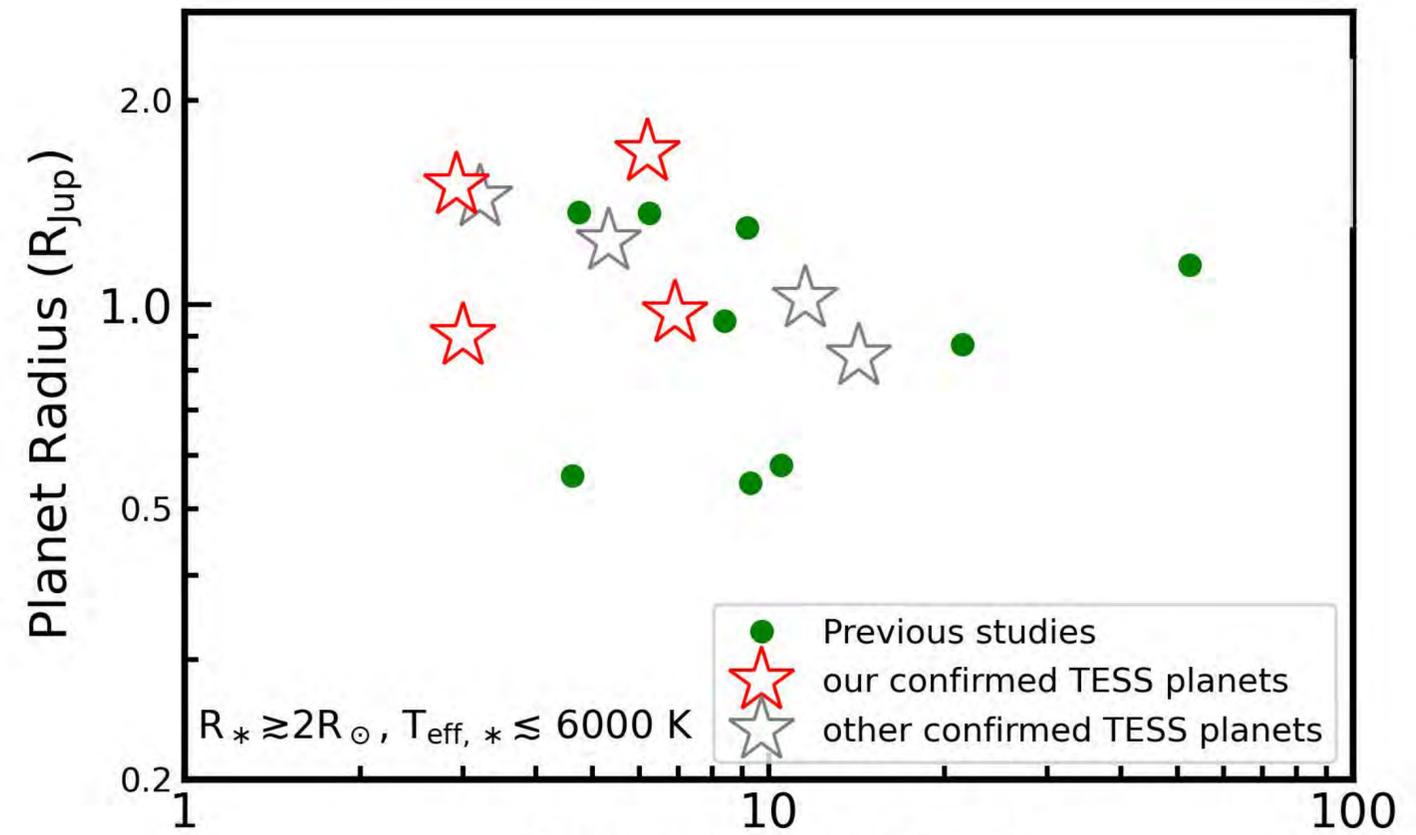




# TESS “Giants Transiting Giants” reveal mysteries of planet evolution.

- TESS is revolutionizing our understanding of planets transiting evolved stars, right now!
- Evolved hot Jupiters are inflated, but possibly less than similar temperature main sequence planets – related to unique origins?
- Tighter constraints on planetary orbital decay, planetary system architecture and atmospheric properties possible soon!

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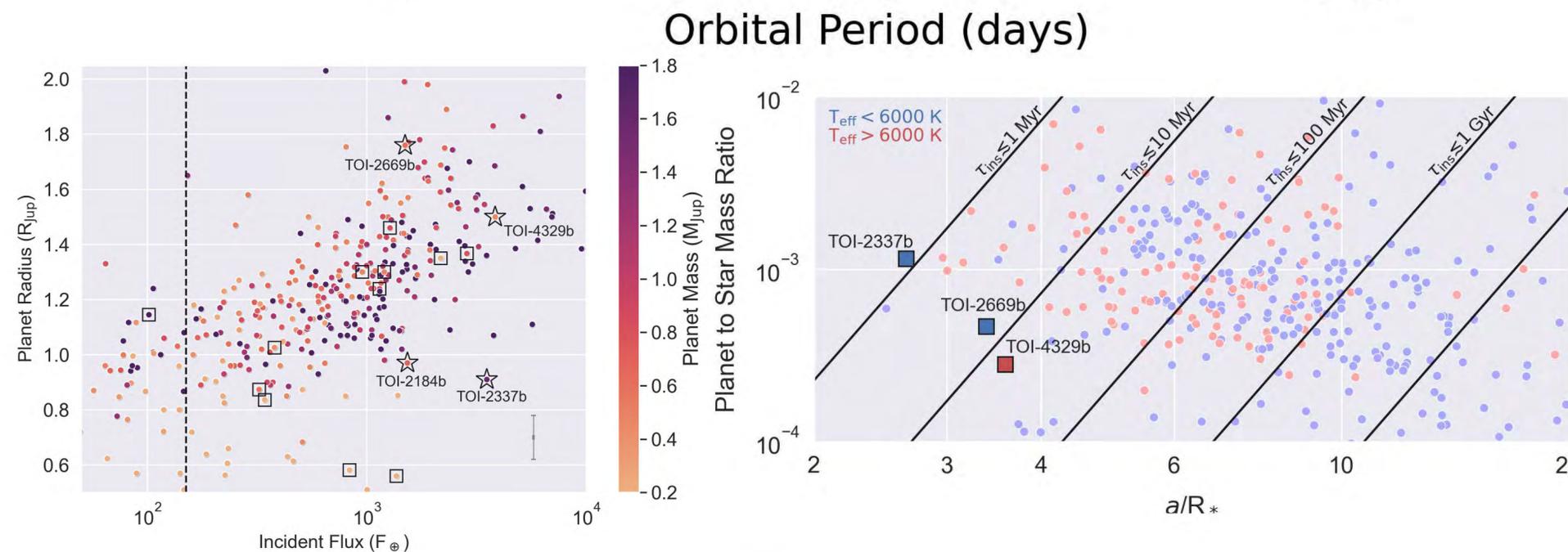
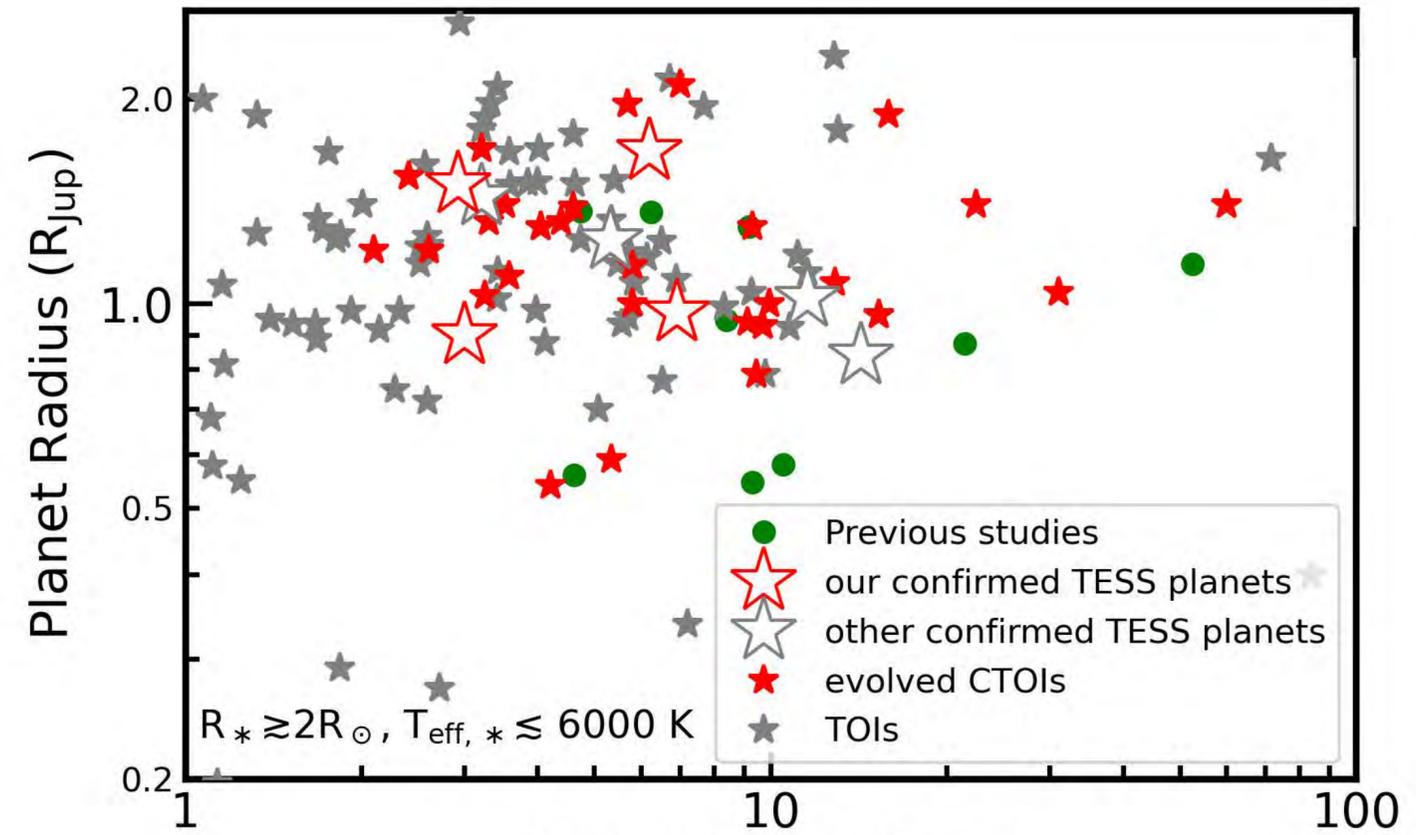




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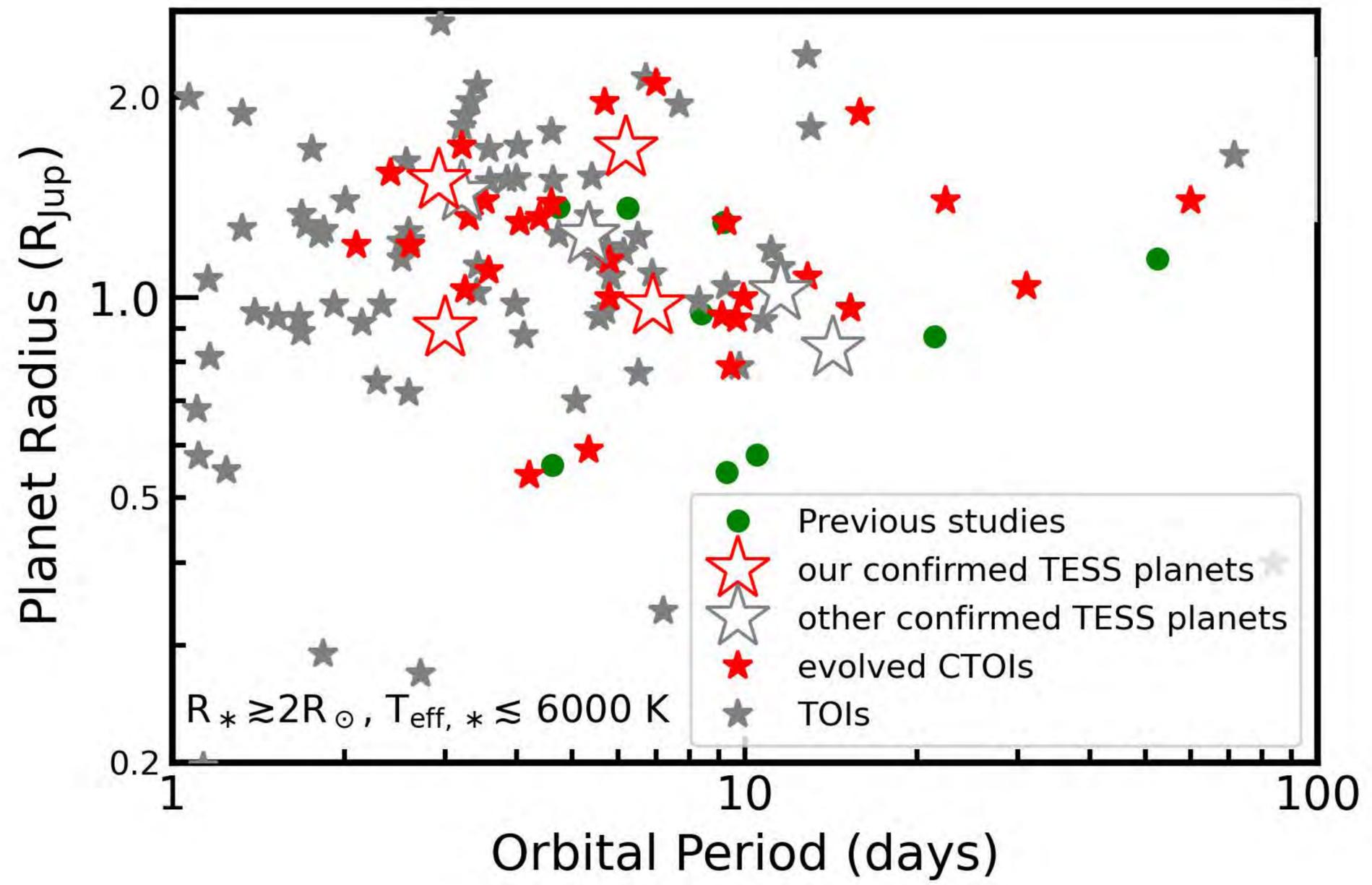
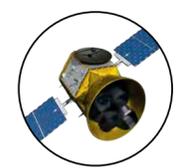
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**Questions?**

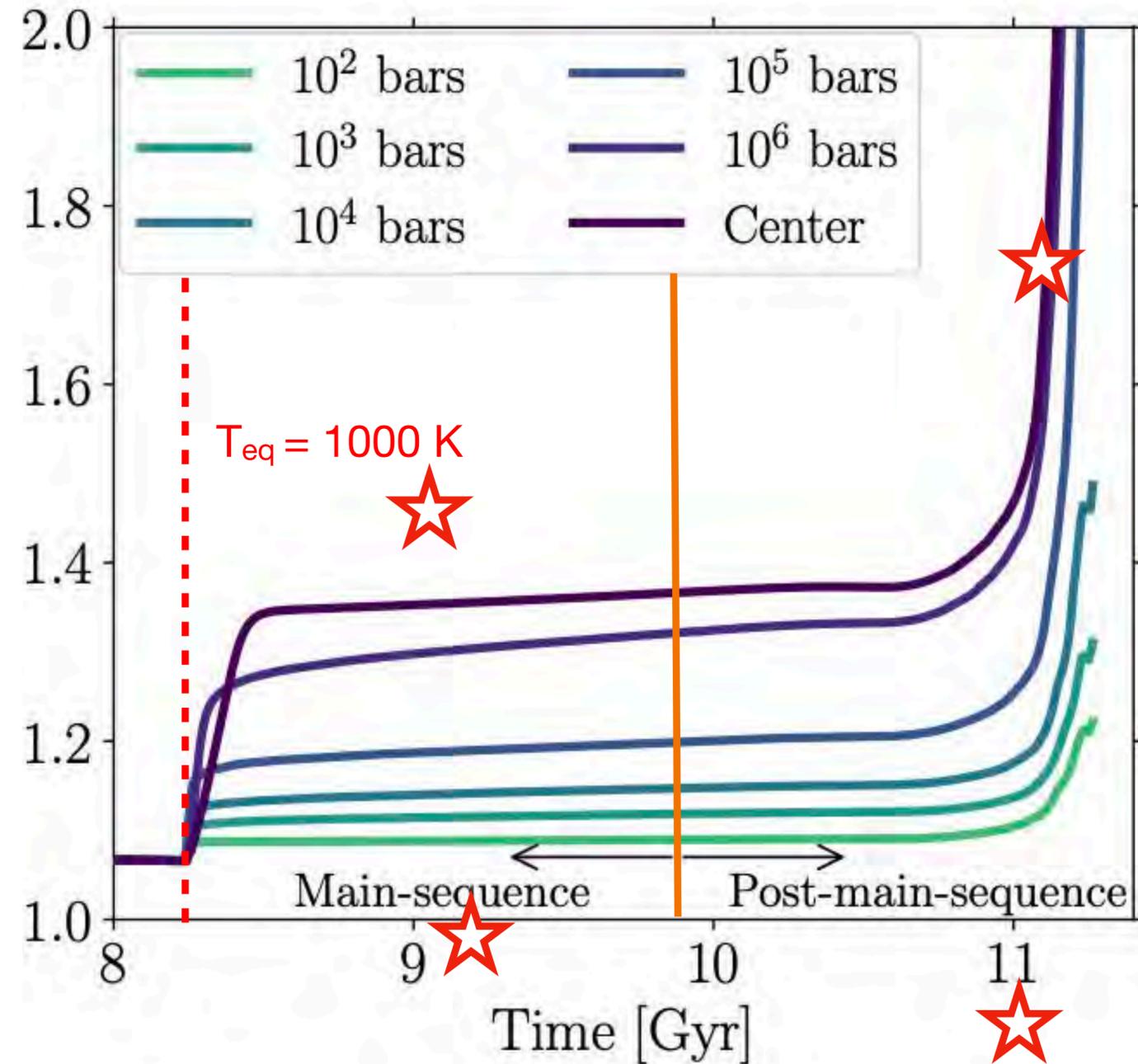
# Extra Slides





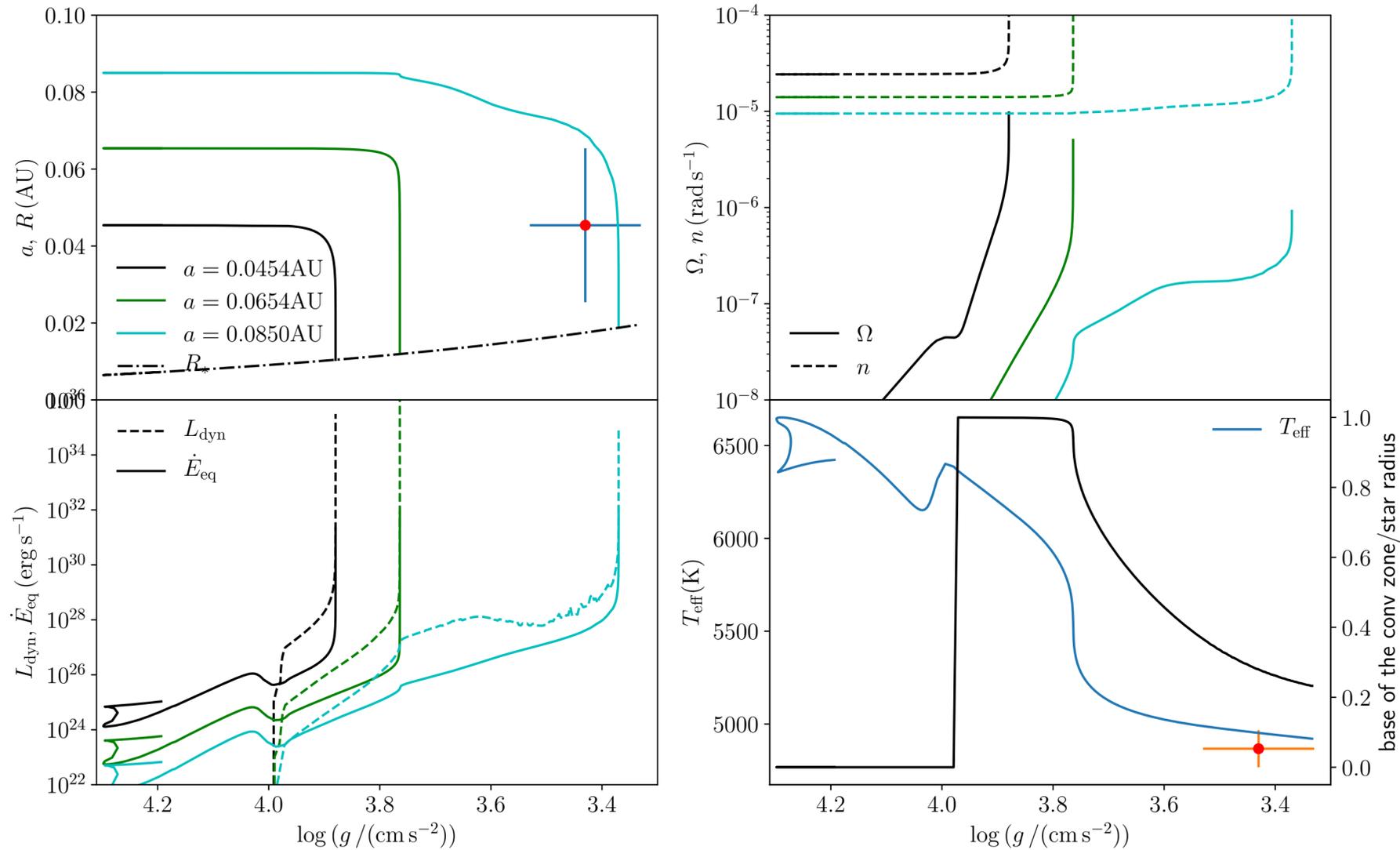
the new planets

Lack of inflation due to subgiant evolutionary state?  
Could test depth of heating in evolved systems.

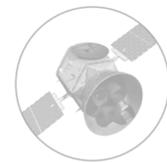


Komacek+ (2020)

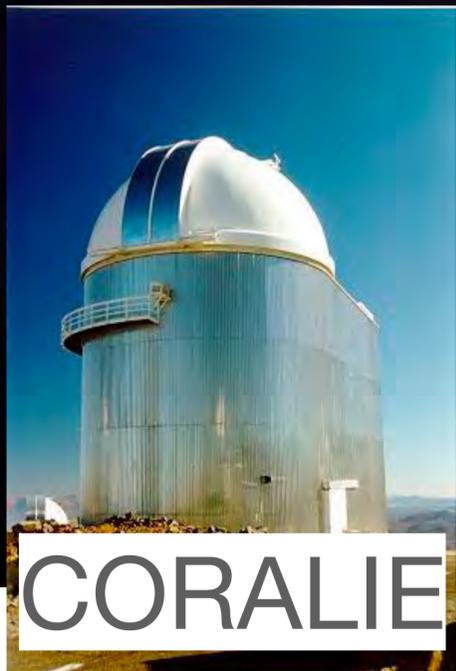
# Constraints on star/planet system evolution



$$Q'_\star = 9P\dot{P}^{-1} \frac{M_p}{M_\star} \left( \frac{R_\star}{a} \right)^5 \left( \omega_\star - \frac{2\pi}{P} \right)$$



A global RV effort,  
led by Keck/HIRES.



CORALIE



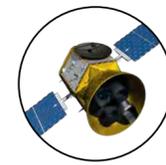
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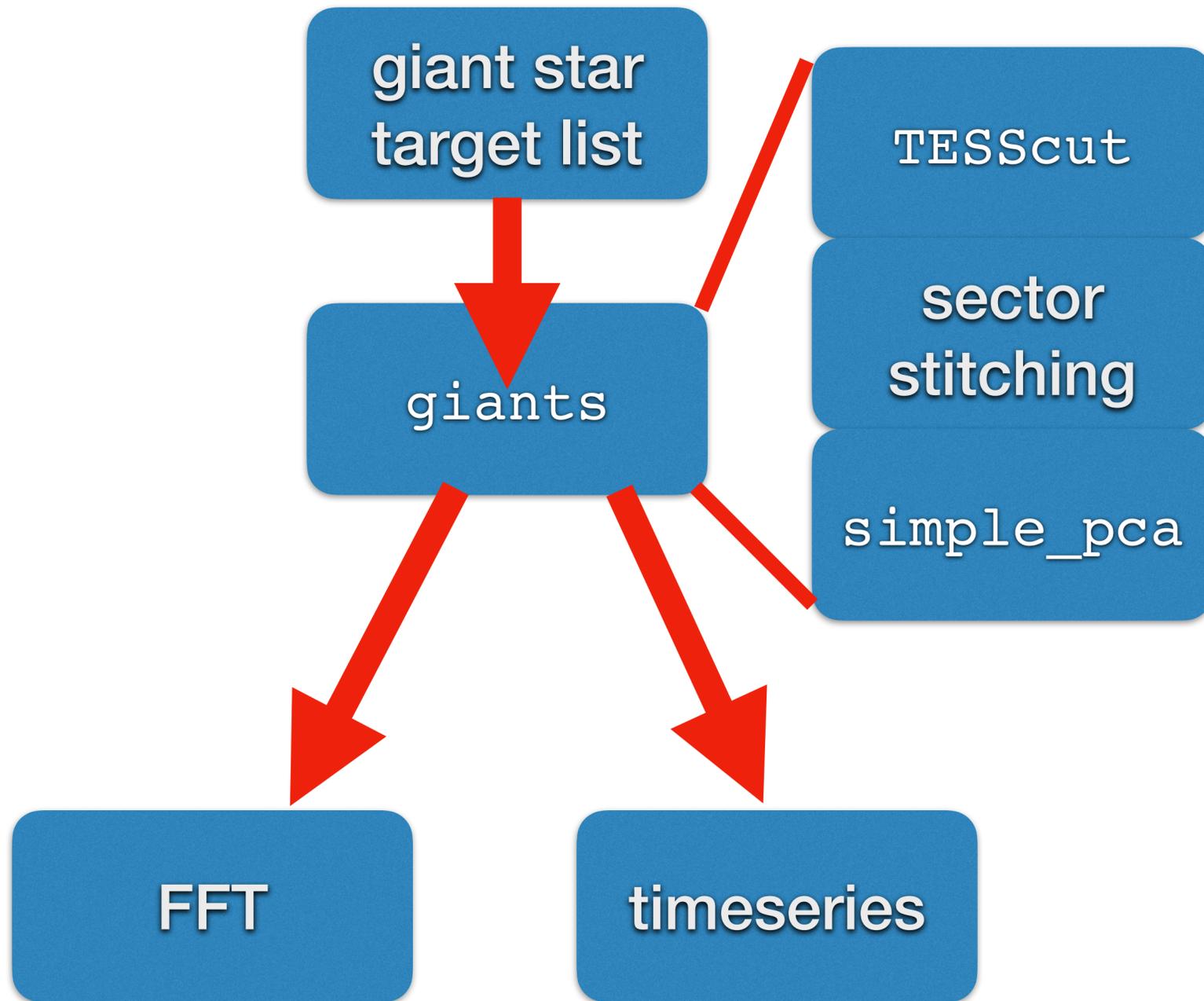
SALT



CHIRON



# Turning target lists into data products

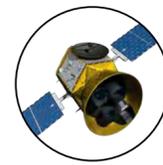


**Nick Saunders**

<https://github.com/nksaunders/giants>

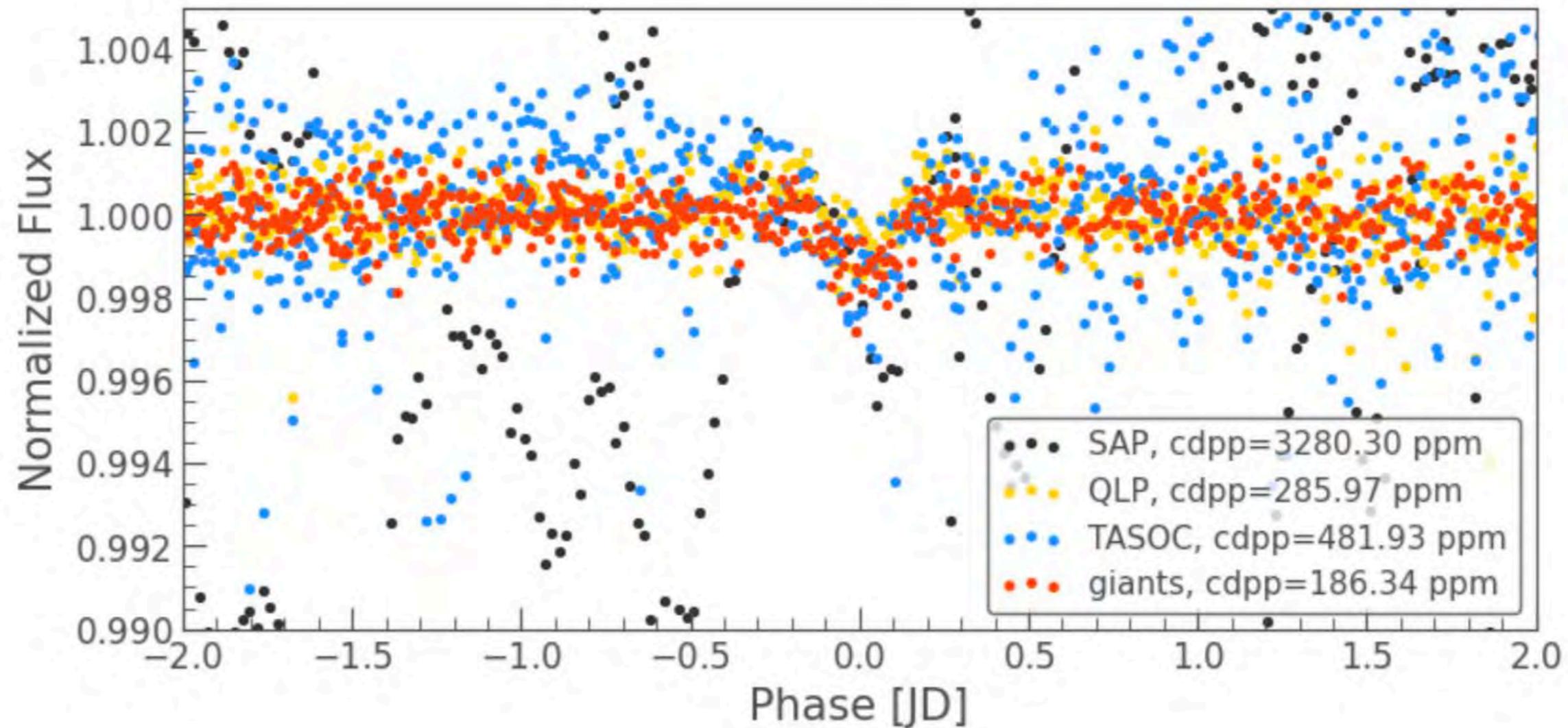
@nksaunders

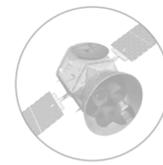




# The giants pipeline is finding planets with low SNR transits.

single sector, folded light curve





# Asteroseismology of TESS evolved planet hosts: only tentative detection so far, better with higher cadence data

**TOI-2669**

