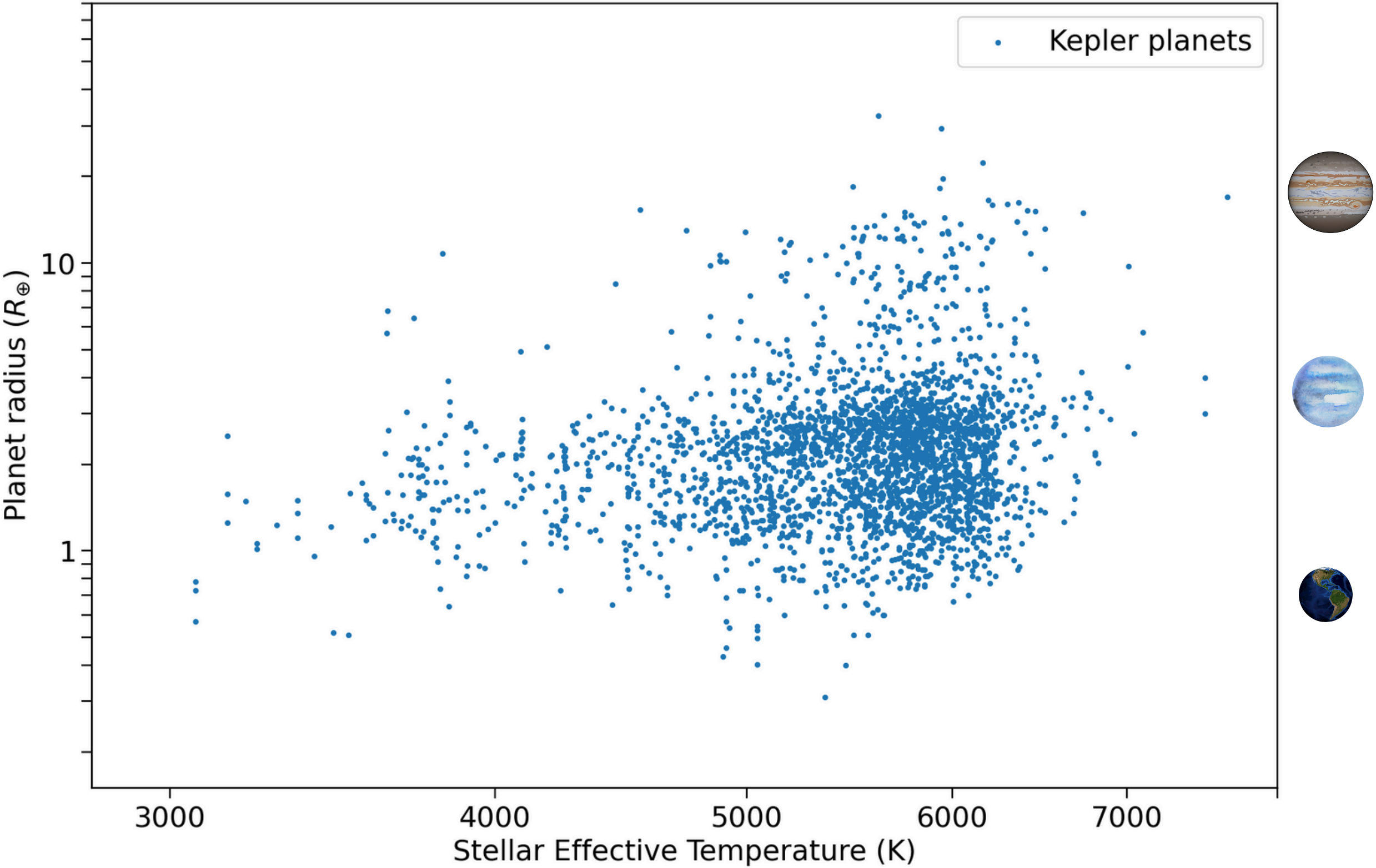
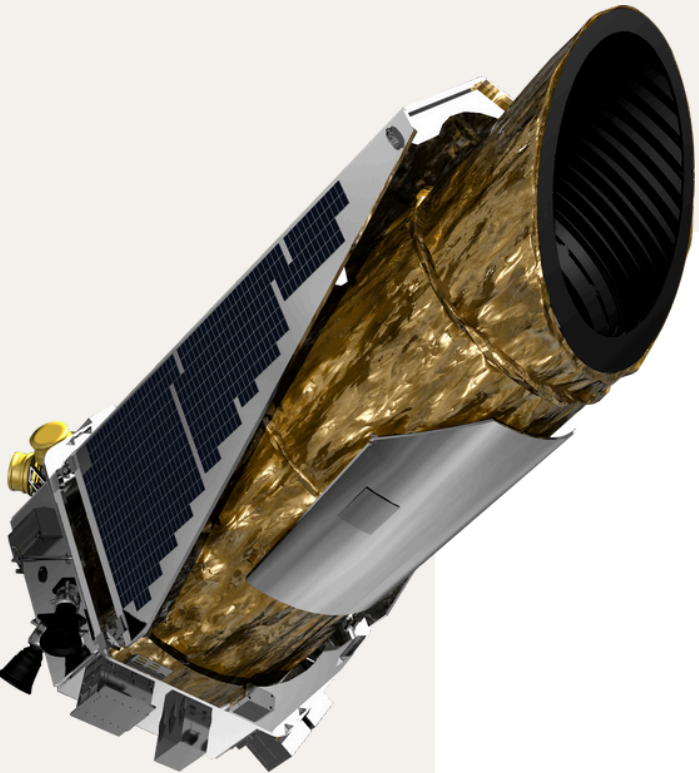


# TESS Insights into the Impact of Stellar Mass on the Exoplanet Radius Valley.

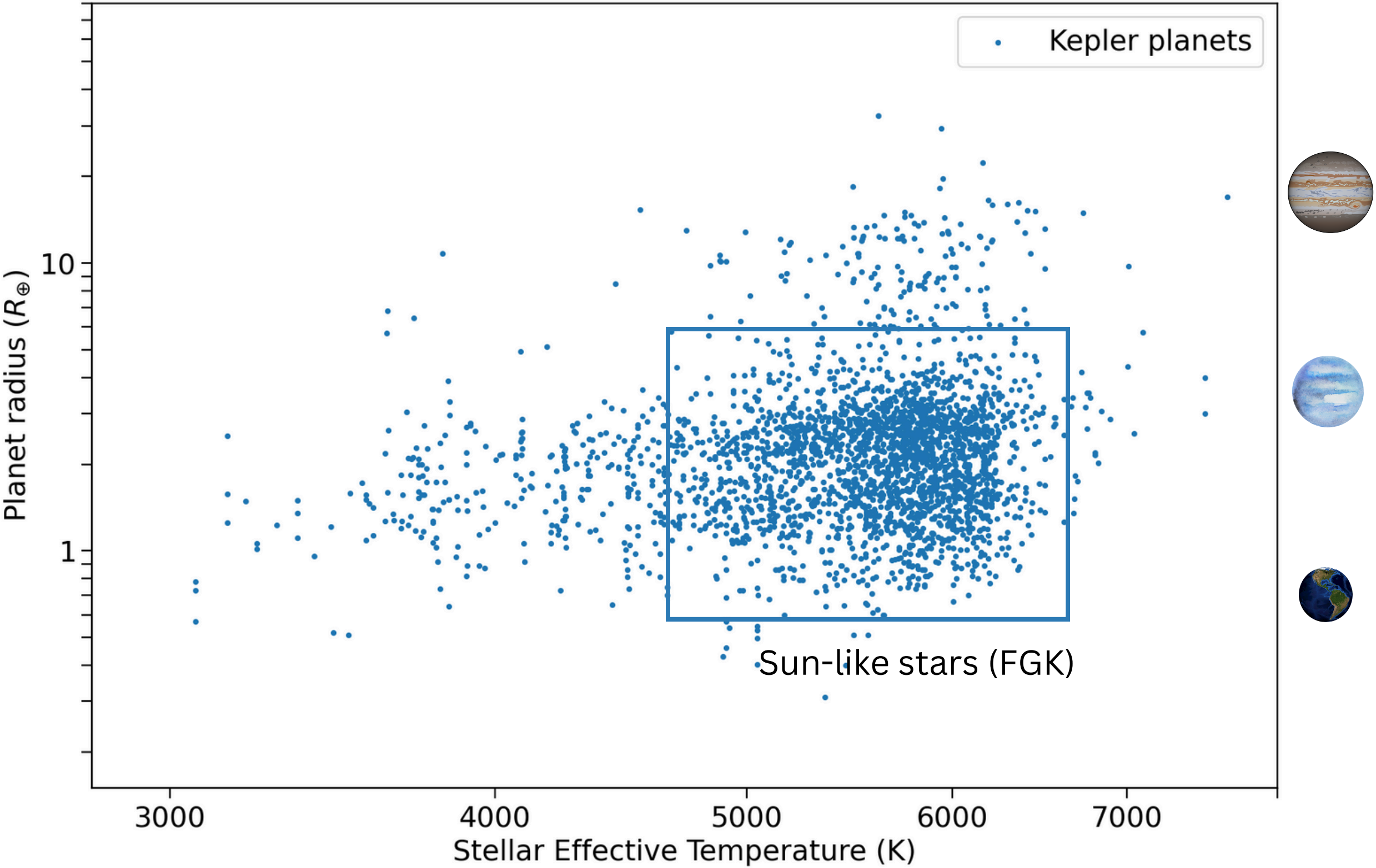
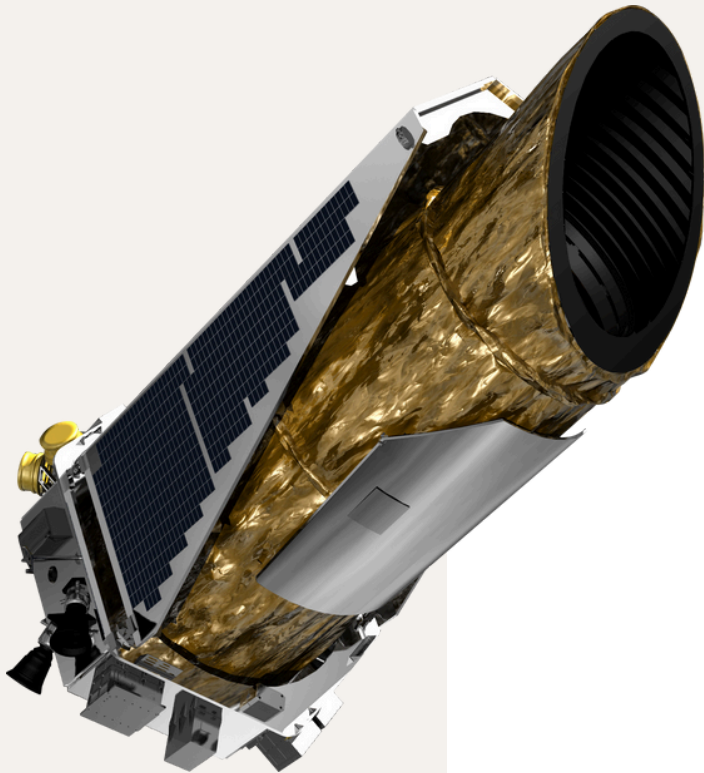
Harshitha M Parashivamurthy  
PhD candidate  
University of Chile

Advisor: Gijs D Mulders

# Kepler Exoplanet Discoveries



# Kepler Exoplanet Discoveries

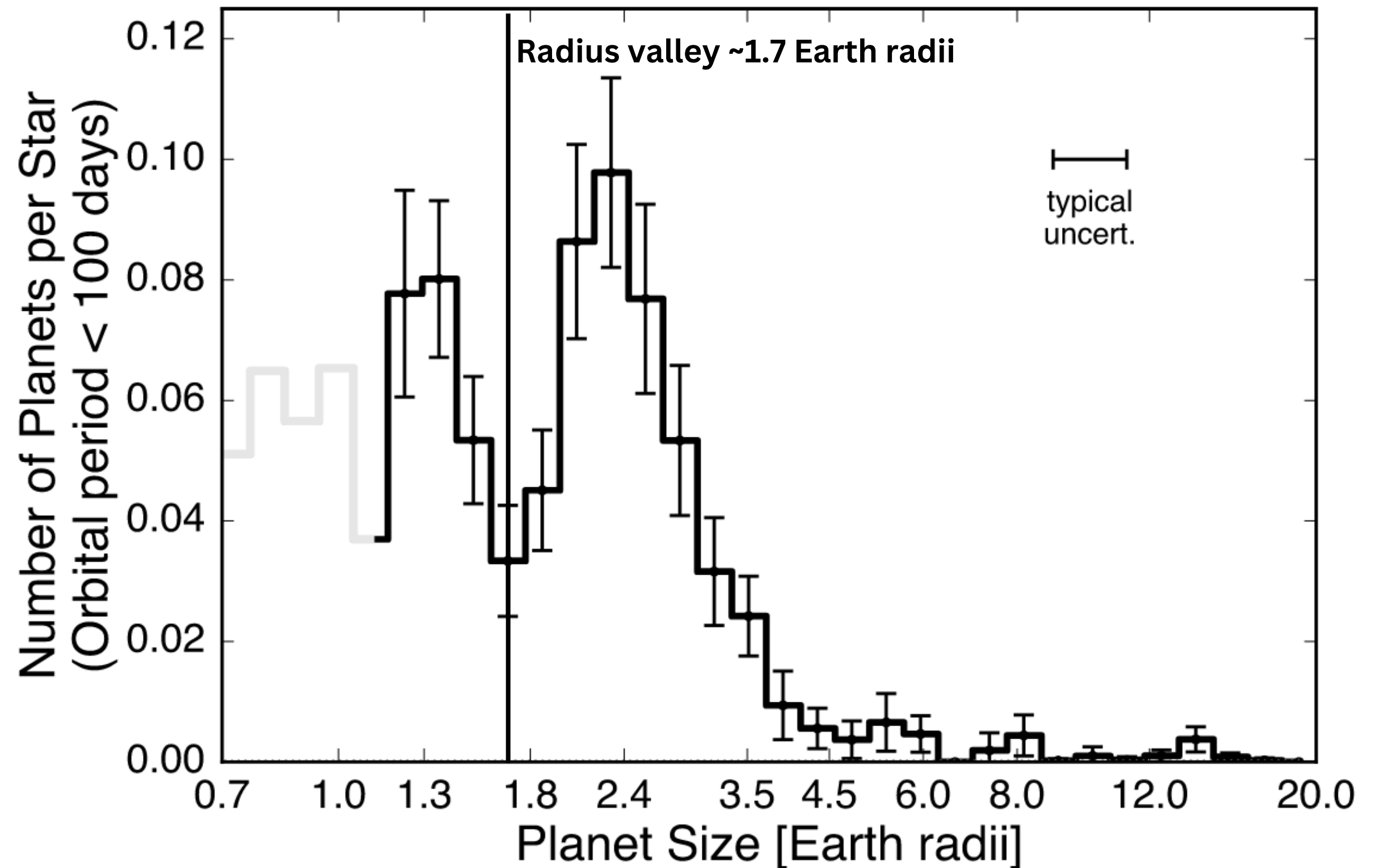


# Radius Valley

A Gap in the Radius Distribution of Kepler Planets.

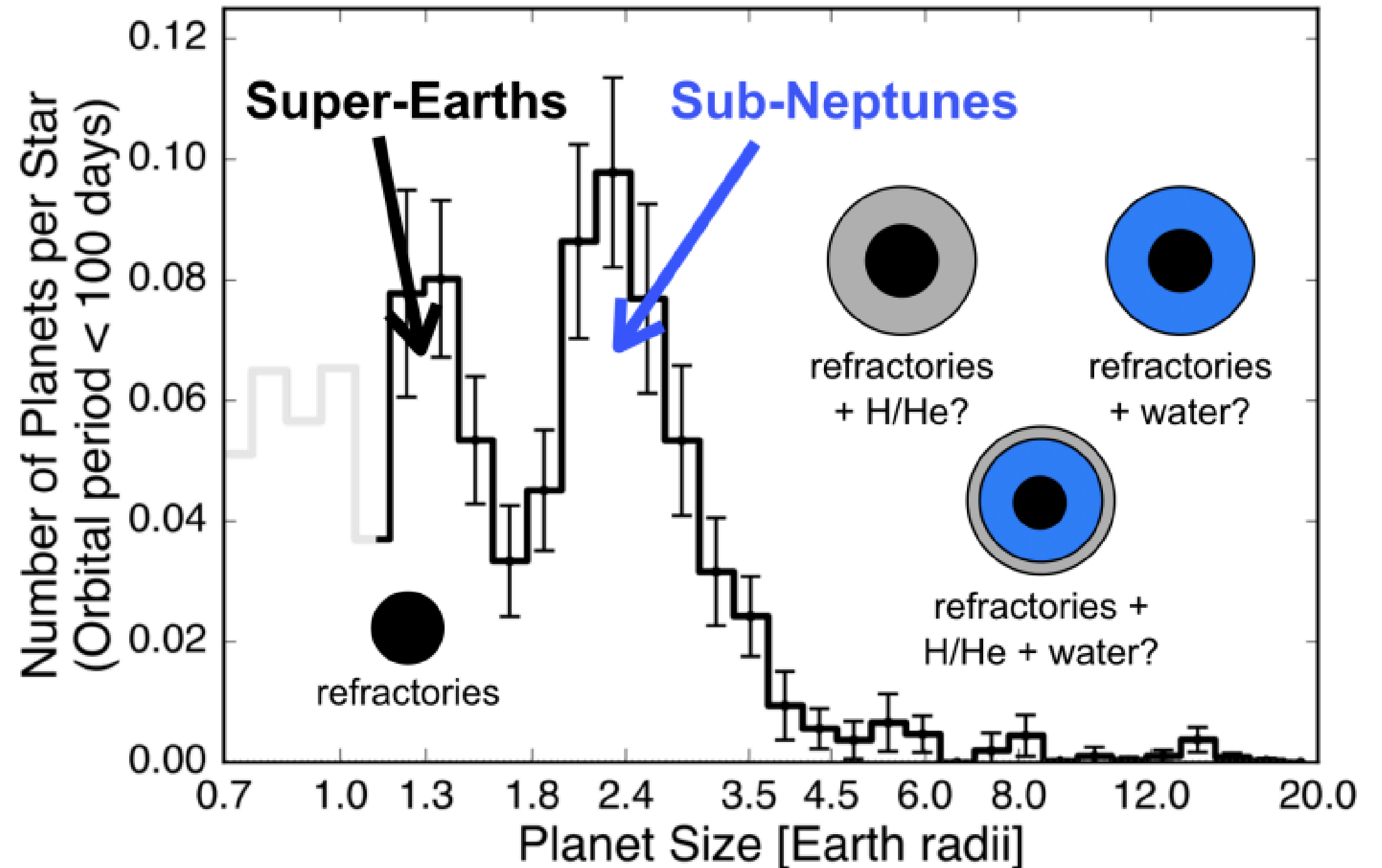
Fulton+ 2017

The radius valley was revealed, once the stellar sample was adopted from the California-Kepler Survey.



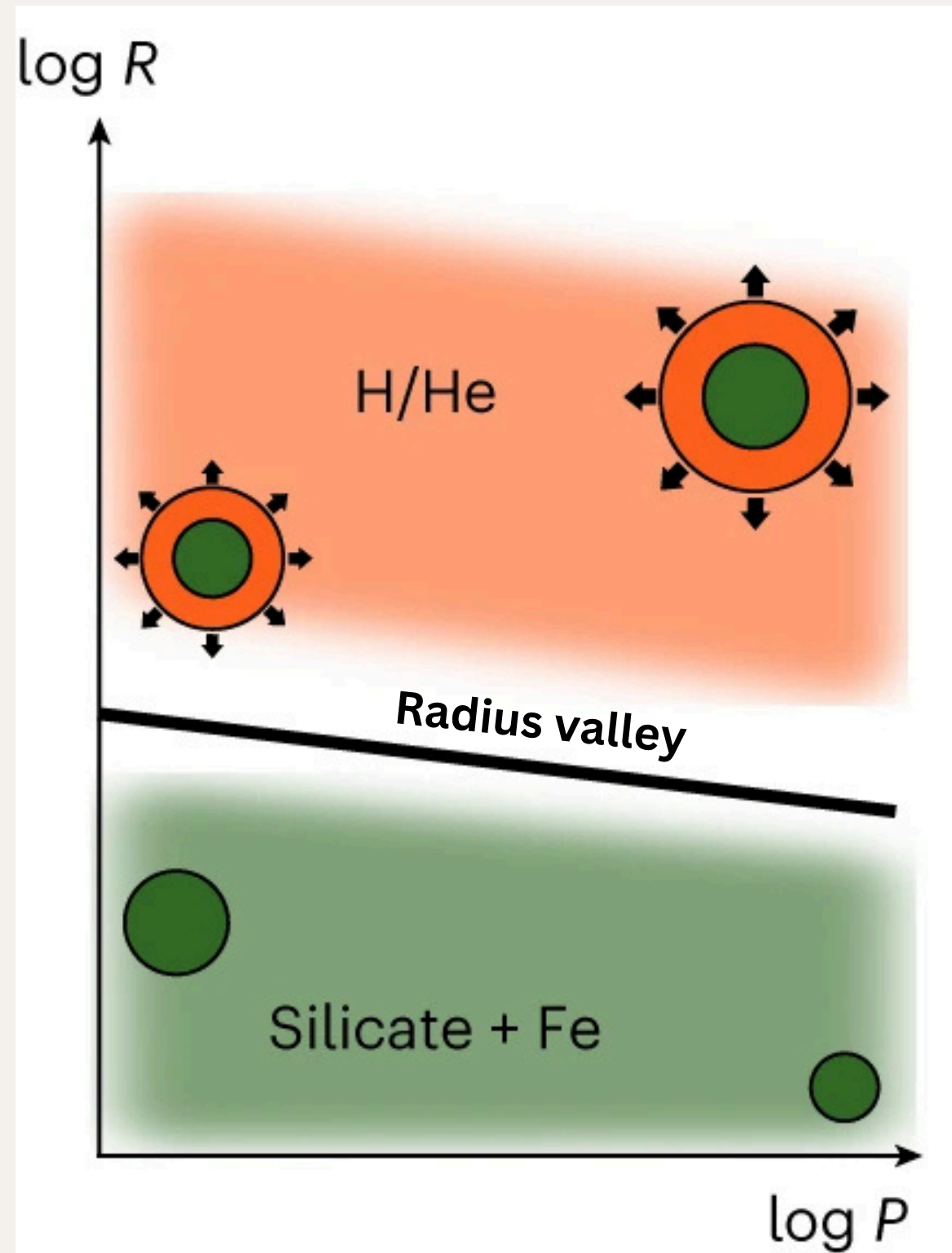
# Radius Valley

A Gap in the Radius Distribution of Kepler Planets.





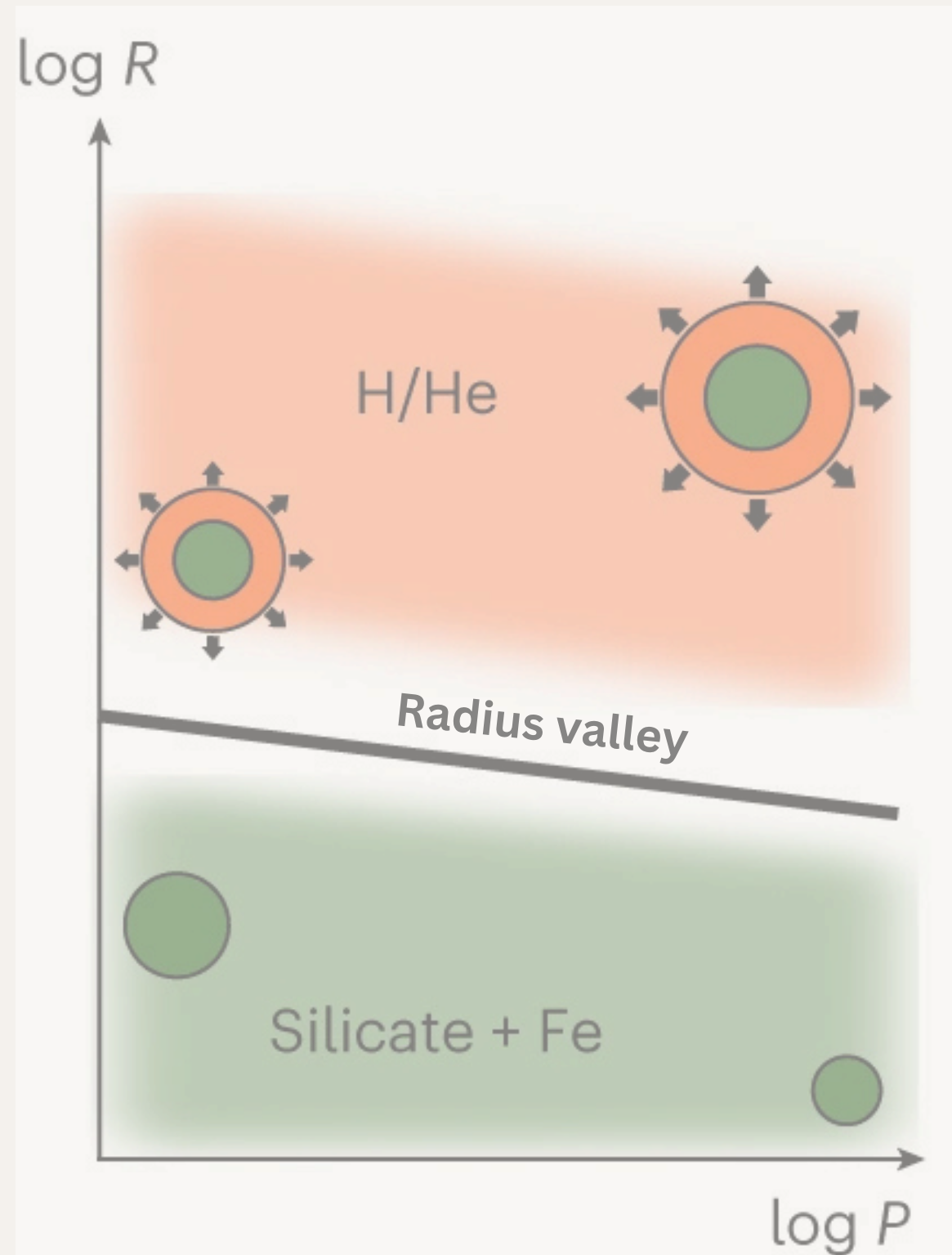
# Causes for Radius Valley



Atmospheric mass-loss

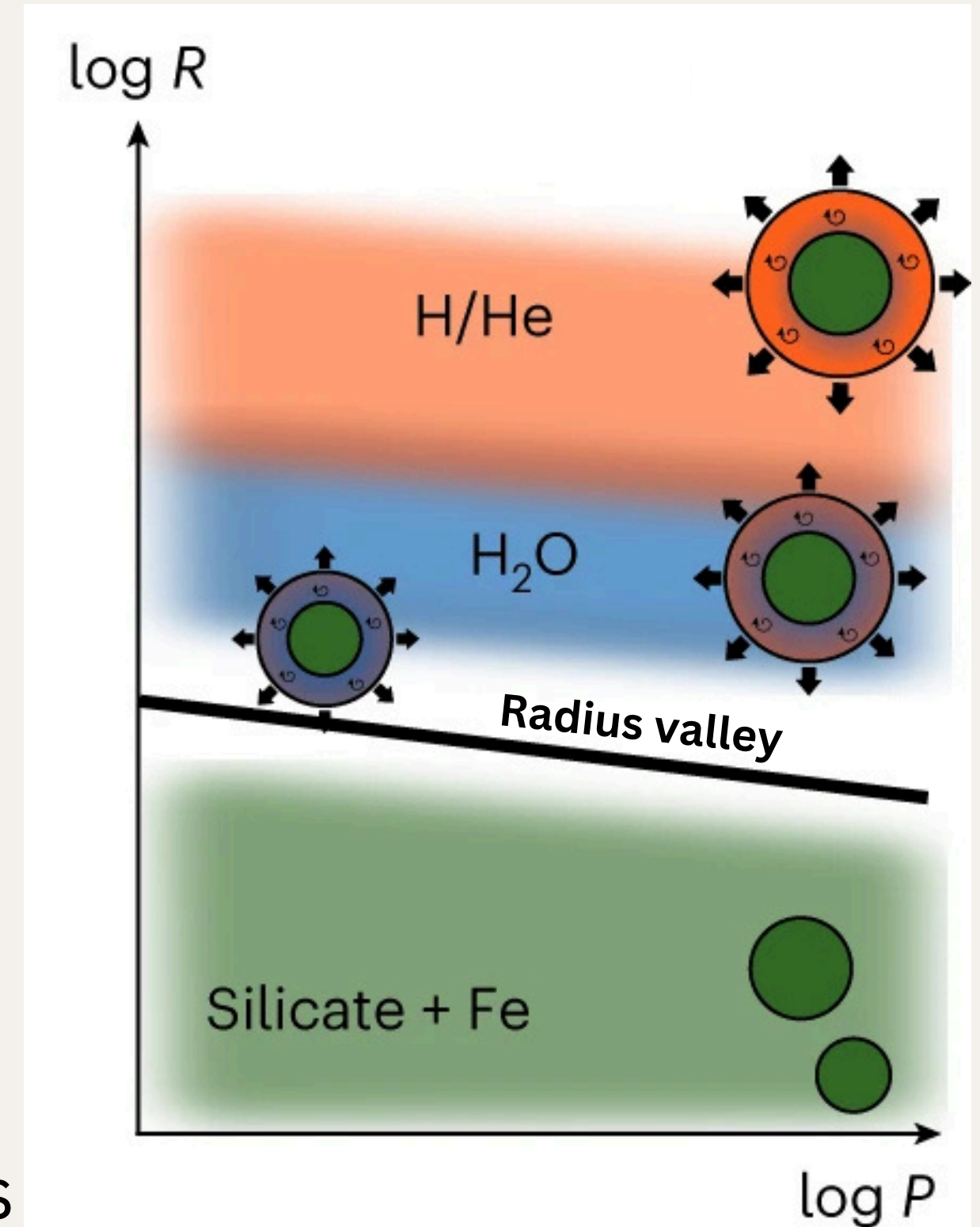
- Photoevaporation
- Core-Powered mass loss

# Causes for Radius Valley

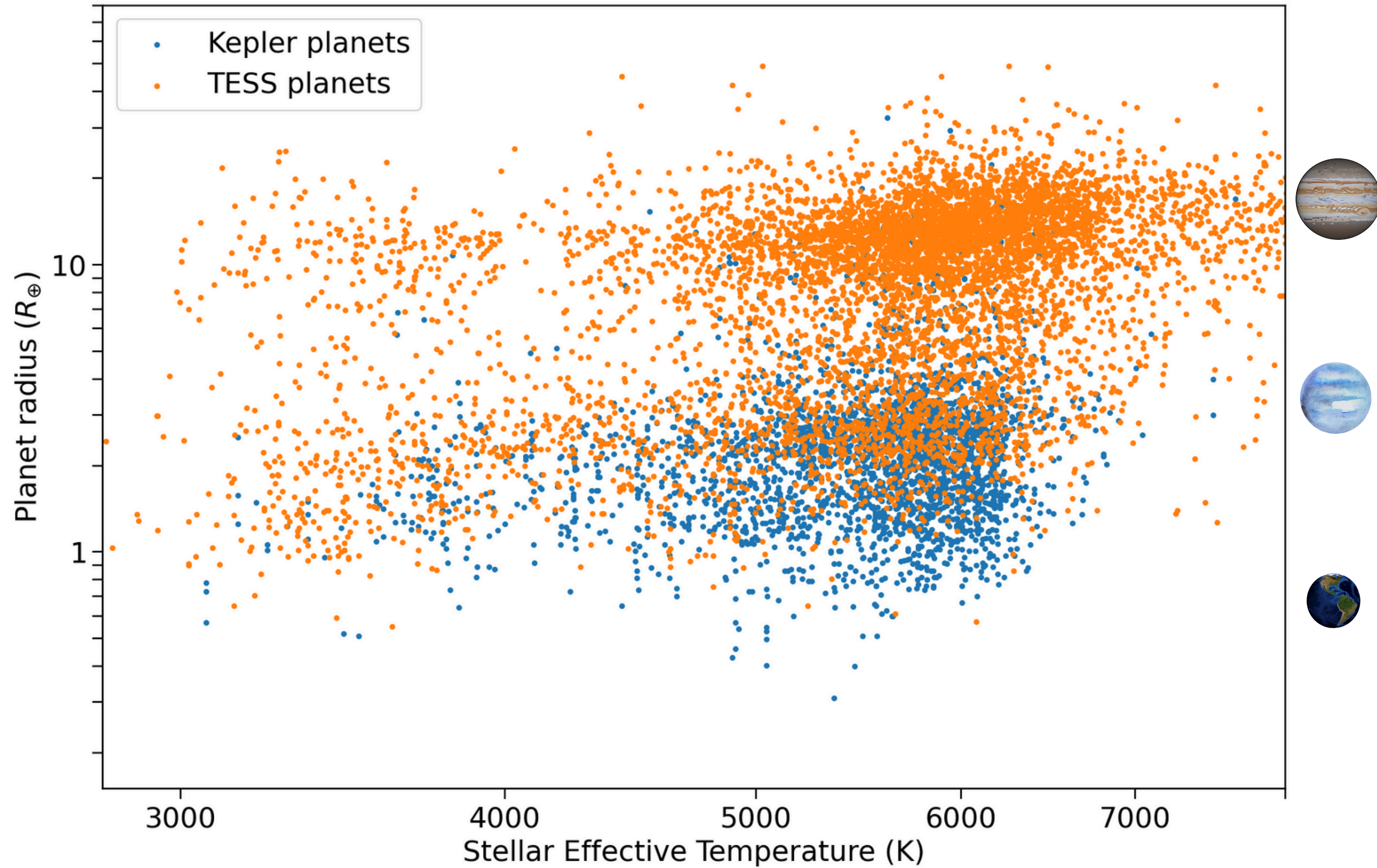


- Atmospheric mass-loss models
- Photoevaporation
  - Core-Powered mass loss

Presence of water worlds

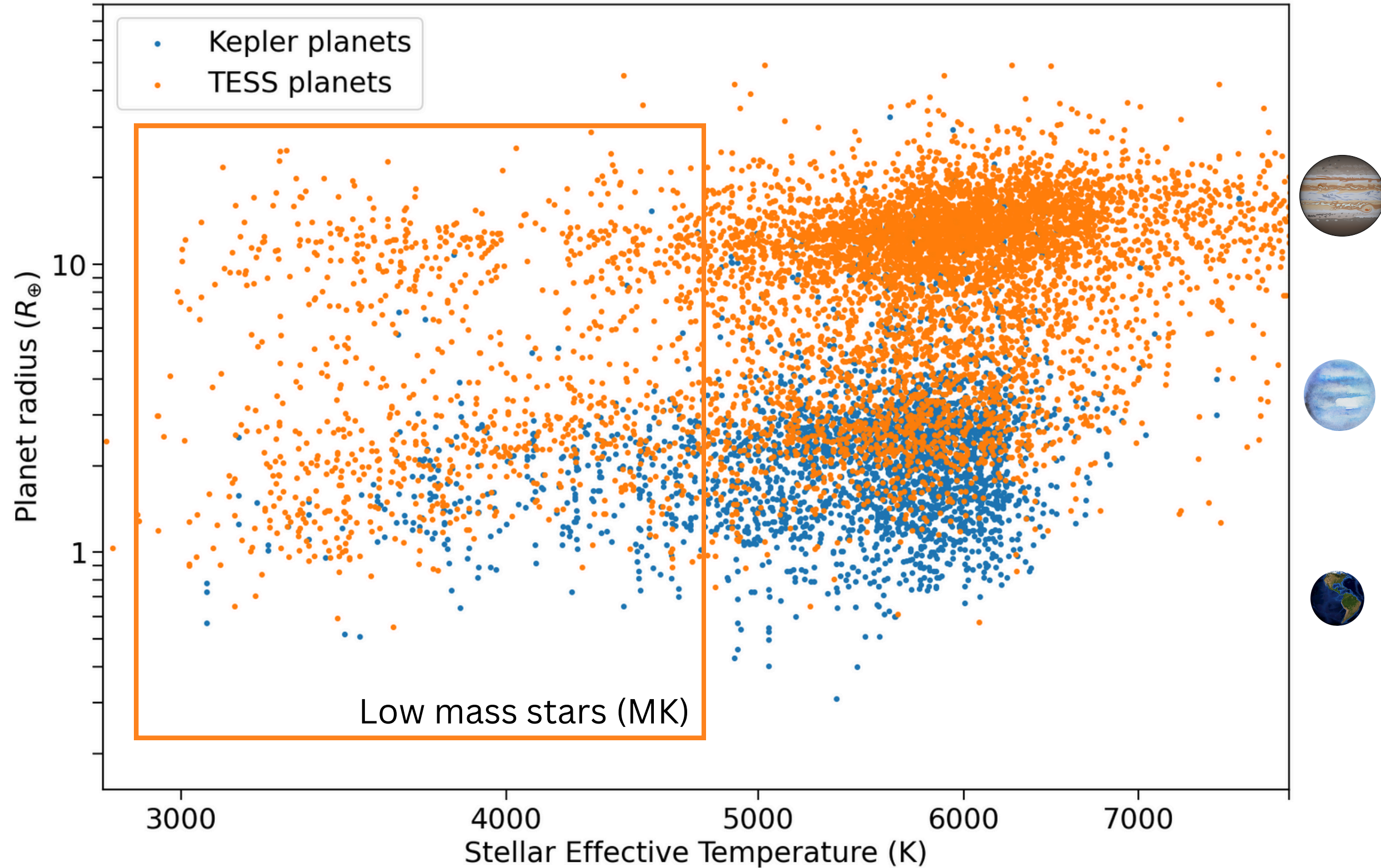


# TESS Exoplanet Discoveries

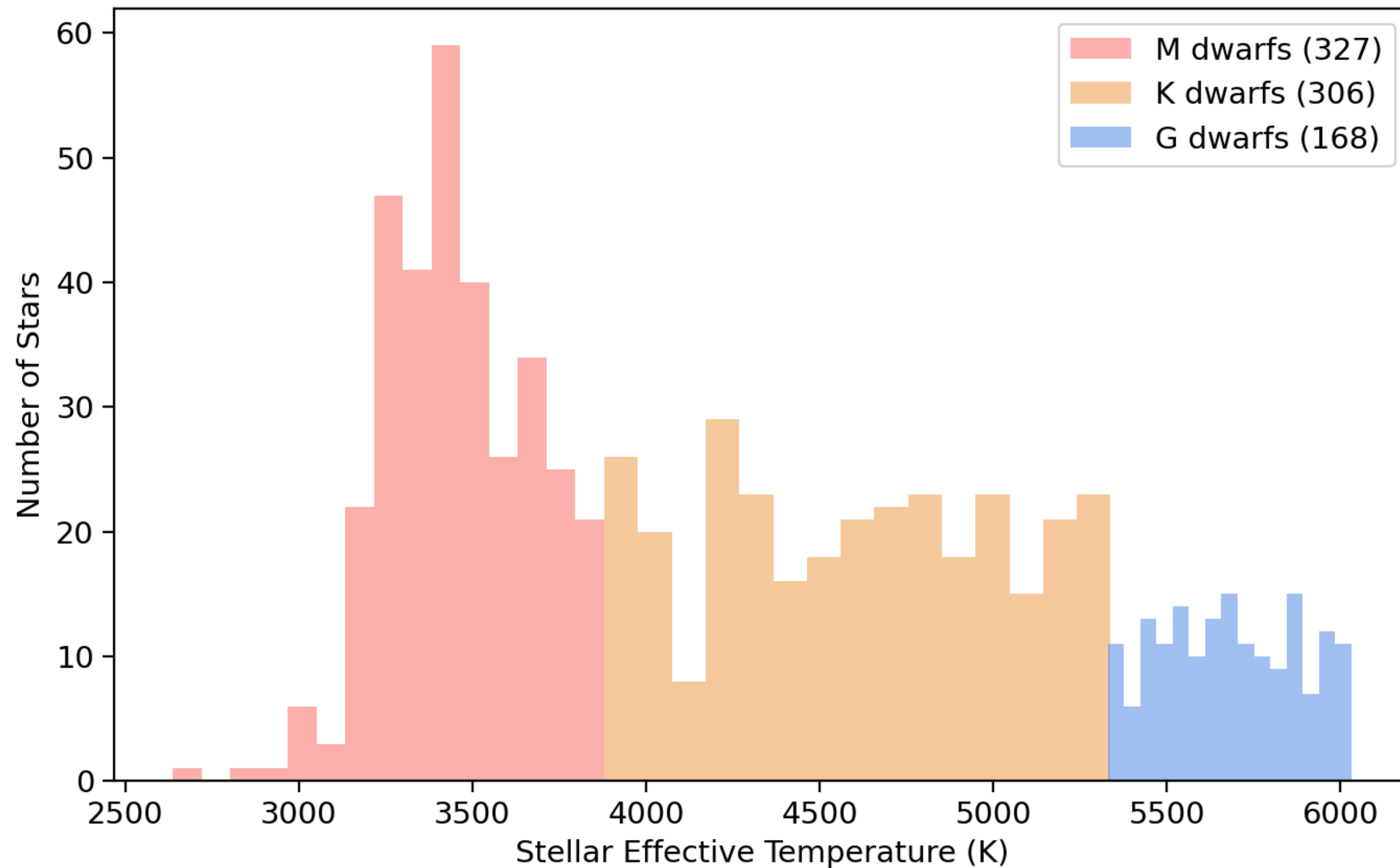




# TESS Exoplanet Discoveries

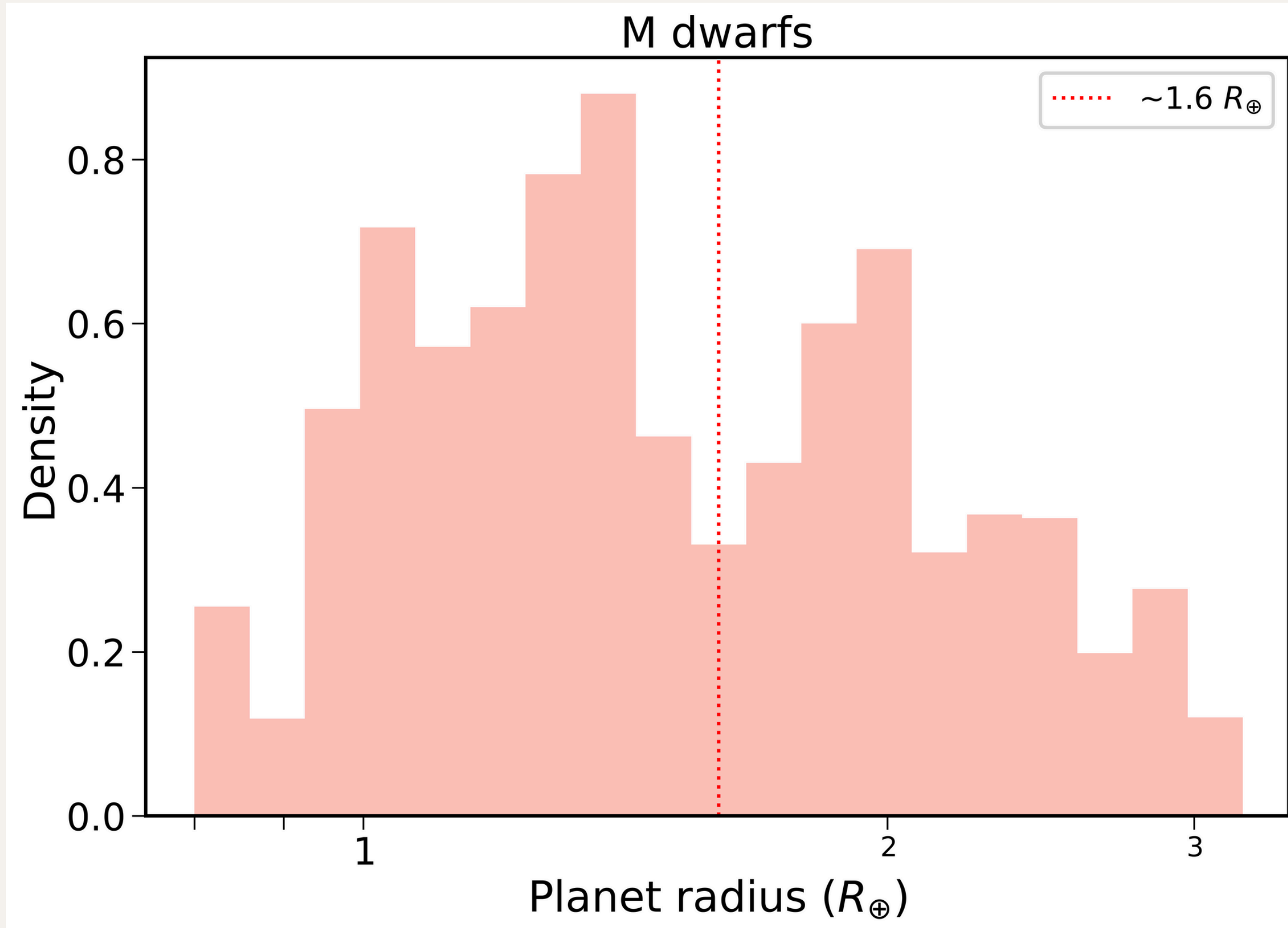


# Sample of low mass stars



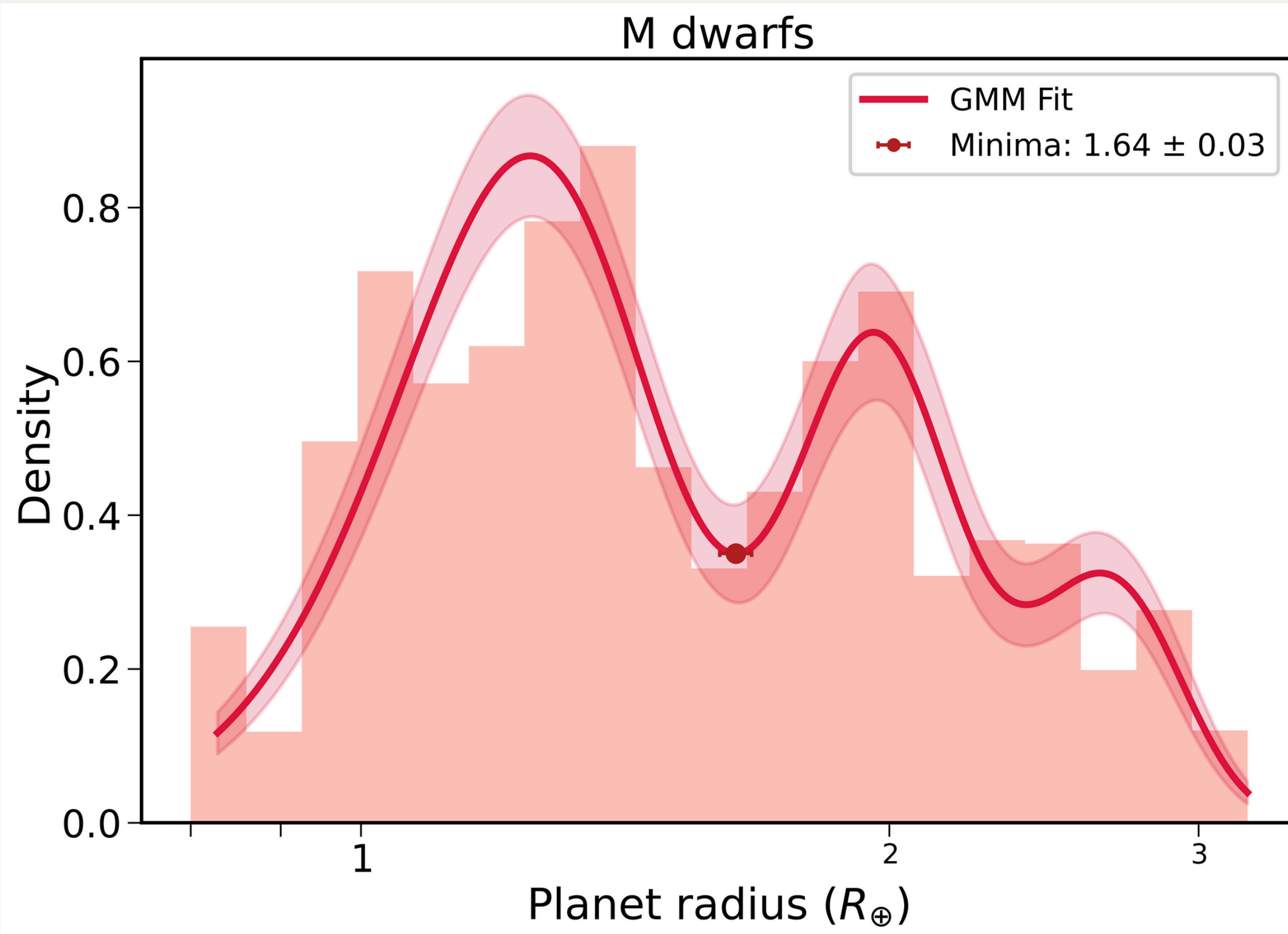
TESS candidates updated with Bioverse (Hardegree-Ullman+ 2023) GAIA DR3 stellar parameters.

# Planet Radii distribution: M dwarfs



Histogram of Planet radii of TESS M dwarfs.

# Gaussian Mixture Model (GMM)

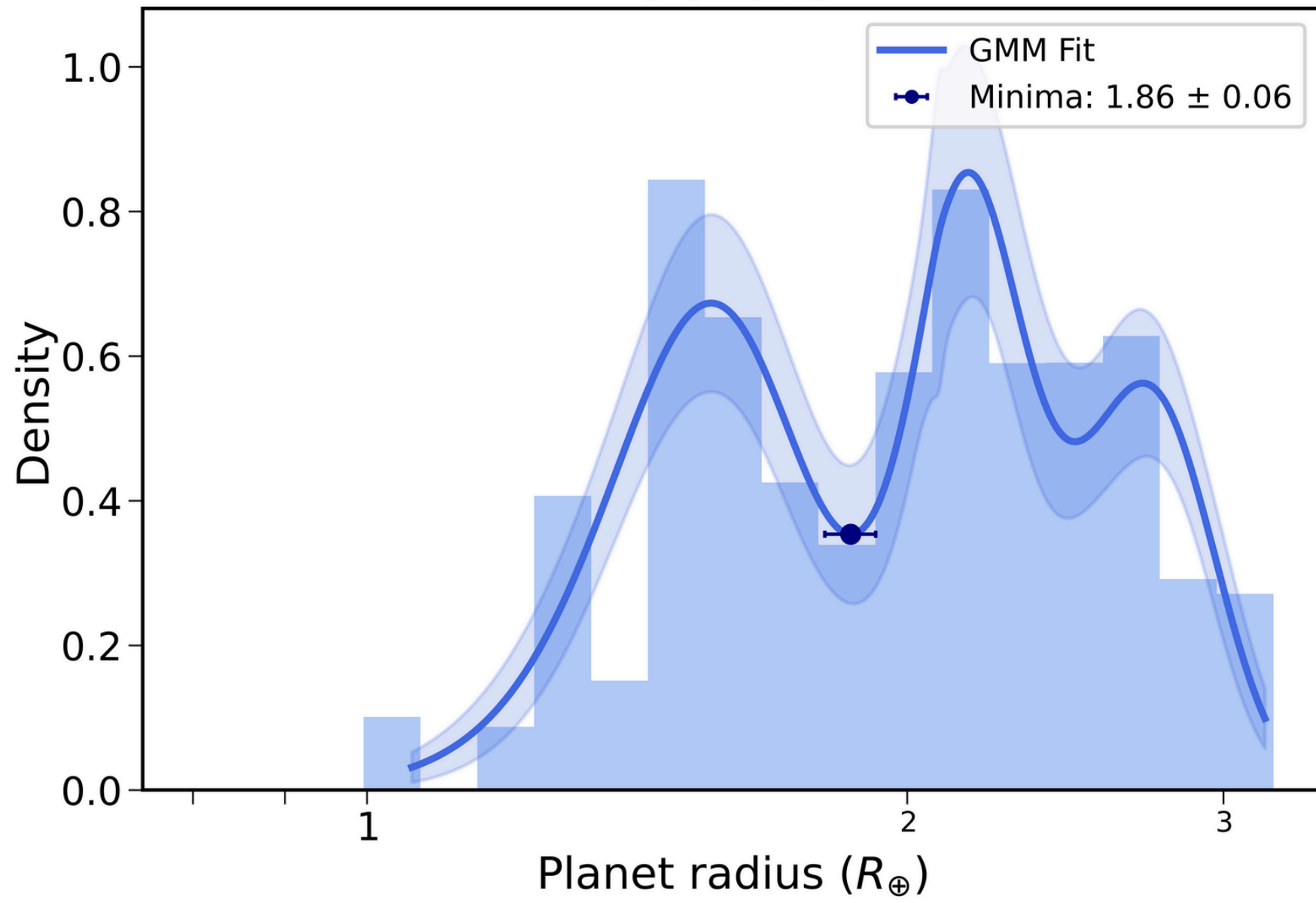


A clear radius valley is observed among the M dwarfs.

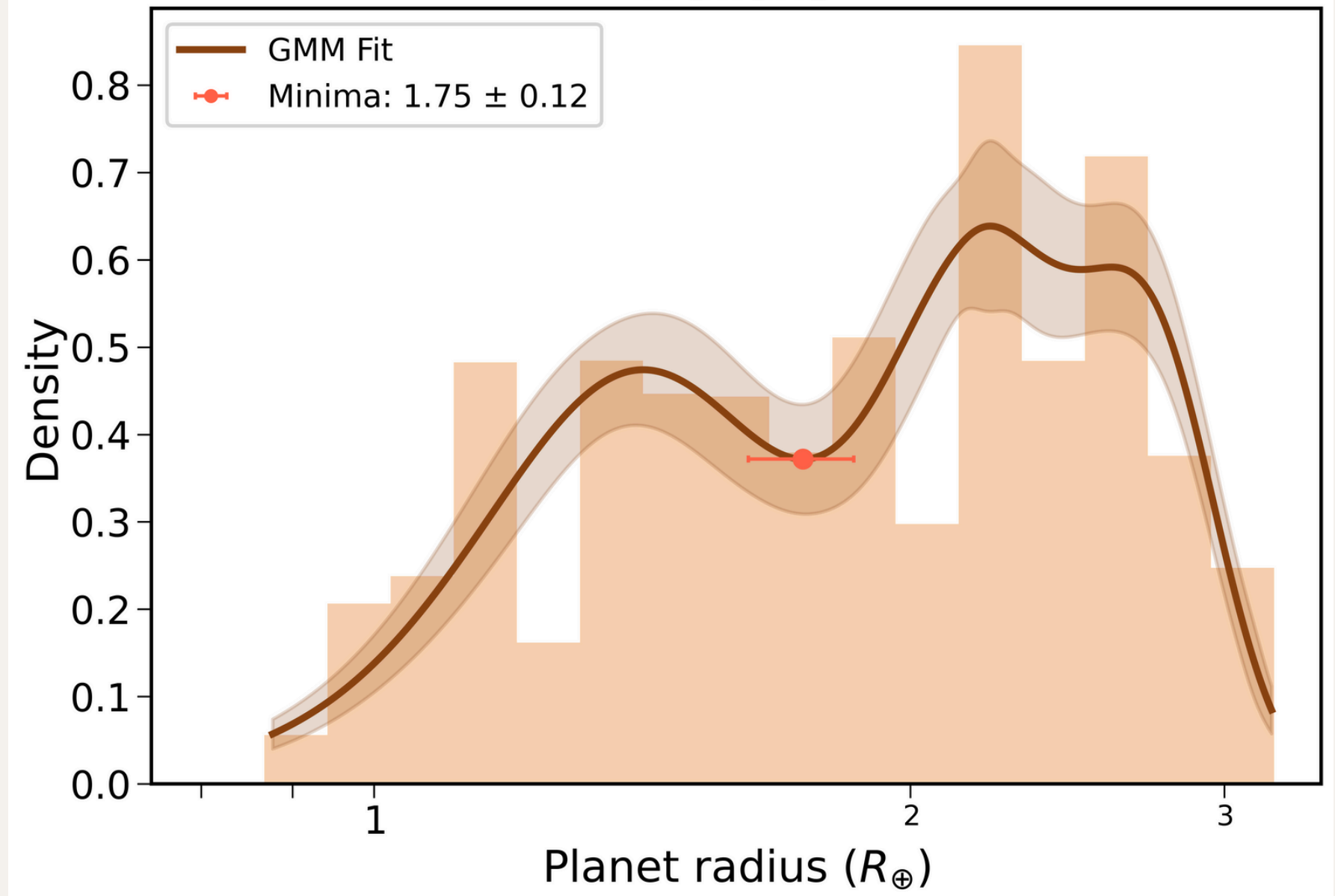


# Planet Radii distribution: G & K dwarfs

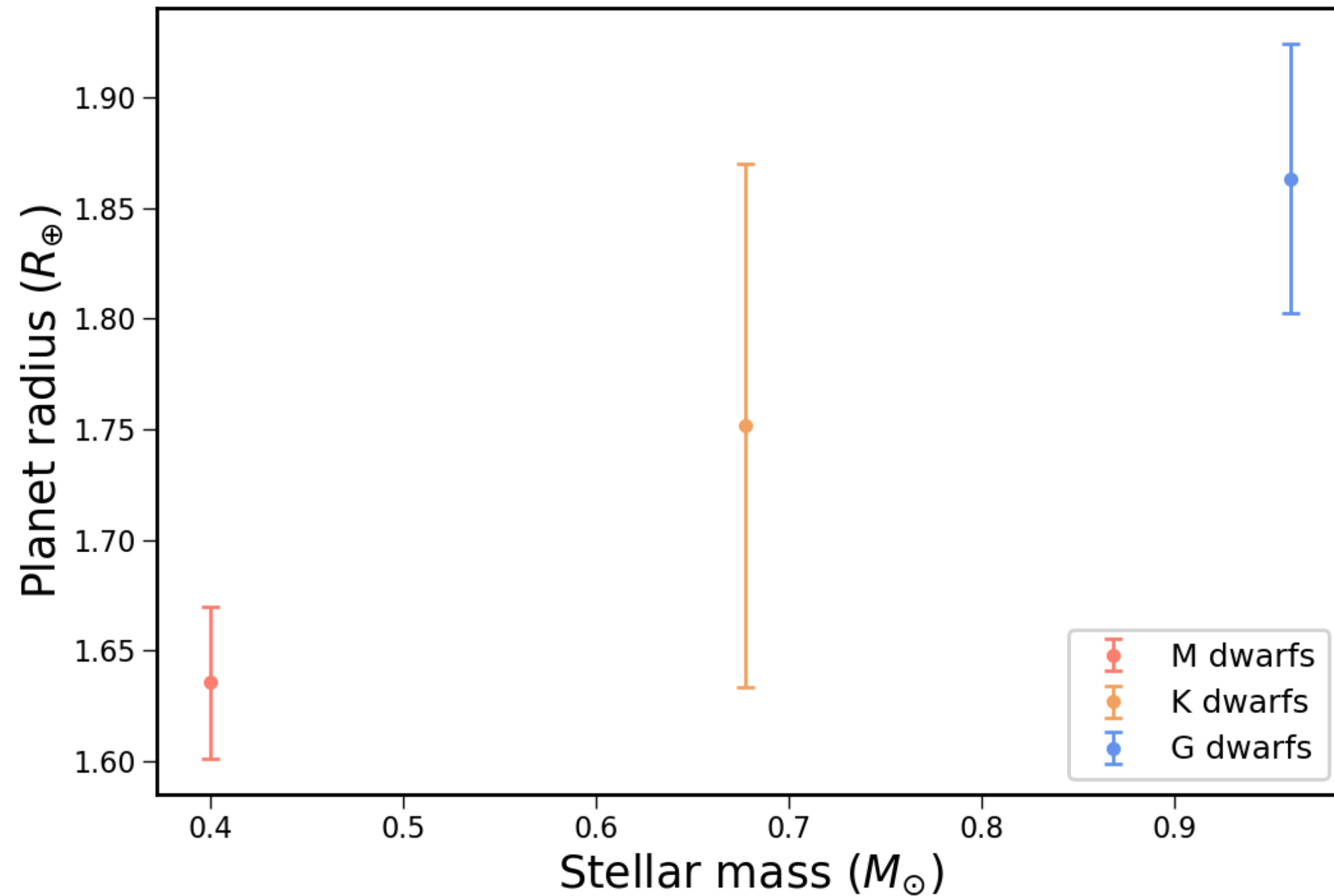
G dwarfs



K dwarfs



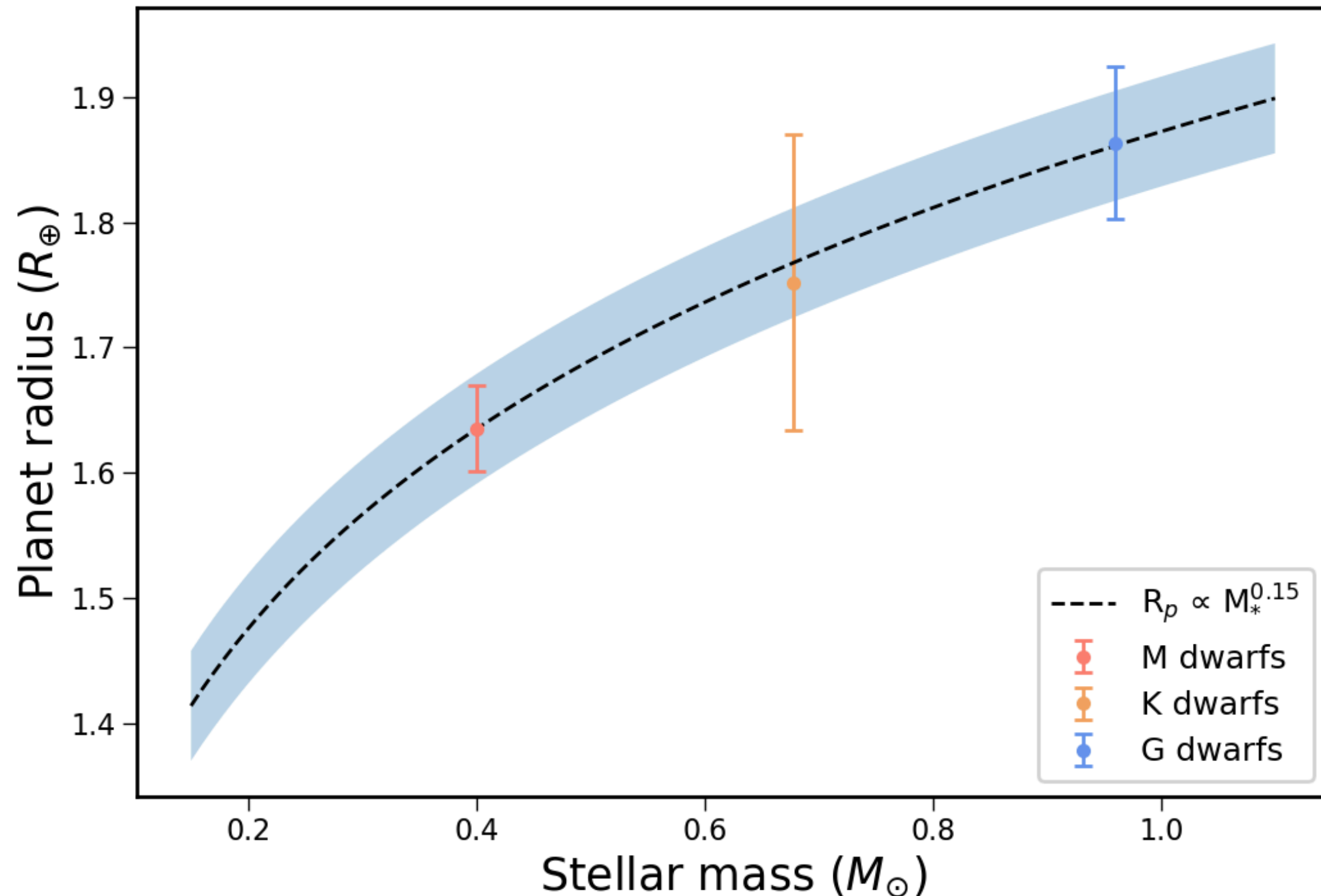
# Planet size scaling with stellar mass



The value of the radius valley increases with stellar mass.

# Planet size scaling with stellar mass

Parashivamurthy+ 2025 submitted



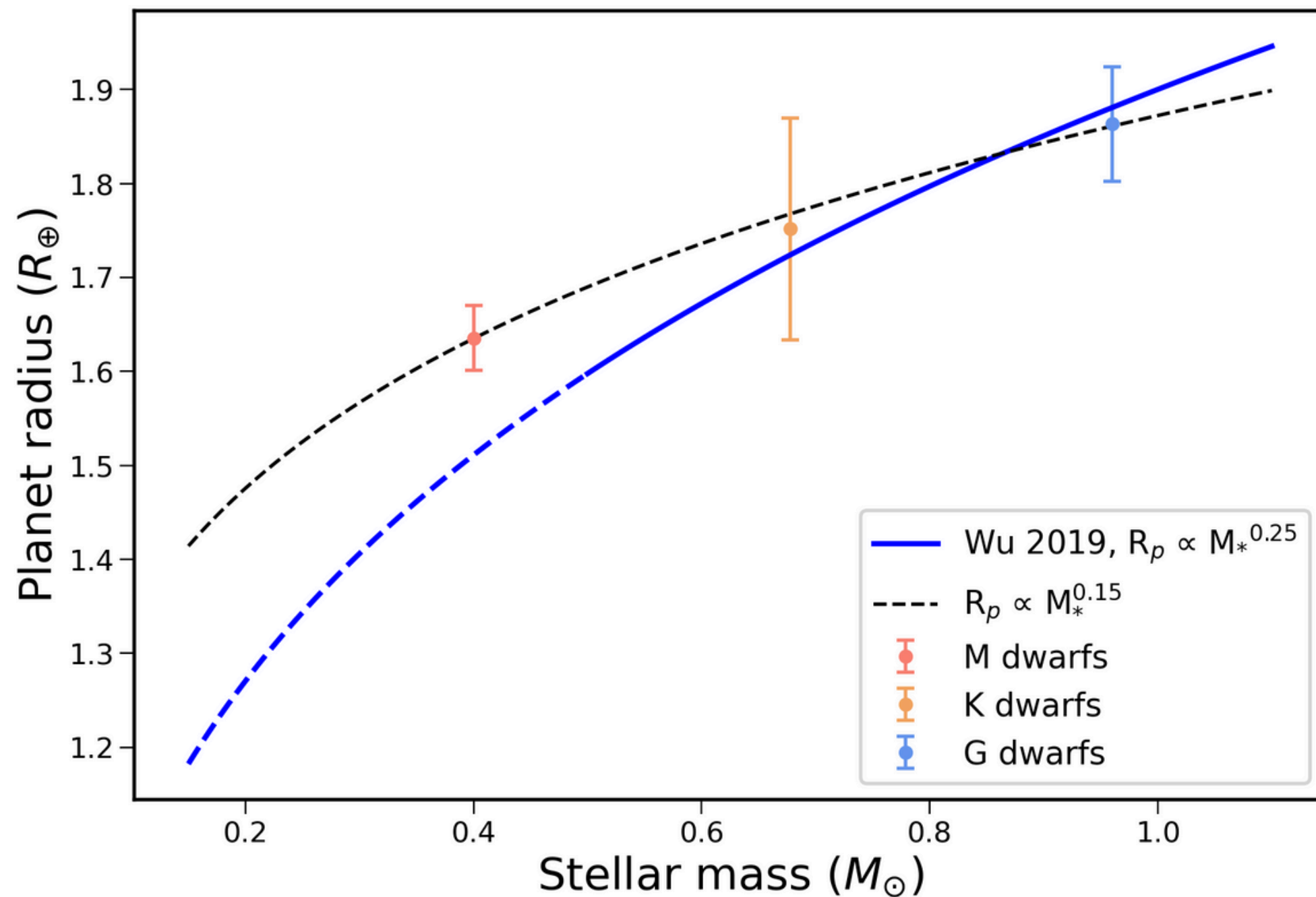
The planet size depend on the stellar mass through a power-law scaling:

$$R_{\text{valley}} = 1.87 * M_*^{\beta}$$

where,  $\beta = 0.148 \pm 0.0438$ .

# Planet size scaling with stellar mass

Parashivamurthy+ 2025 submitted

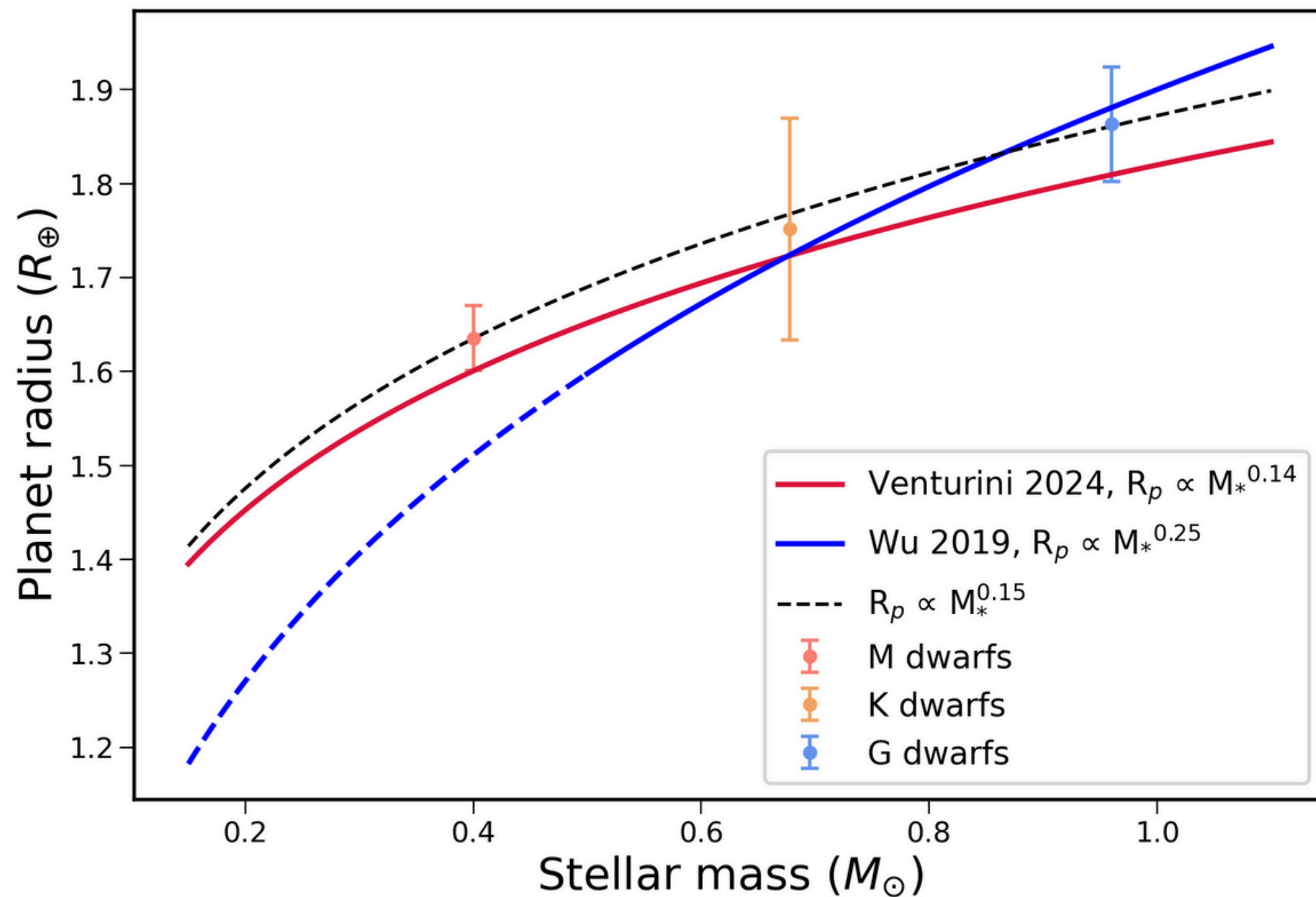


Wu 2019, explains the linear dependence through photoevaporation for FGK type stars.



# Planet size scaling with stellar mass

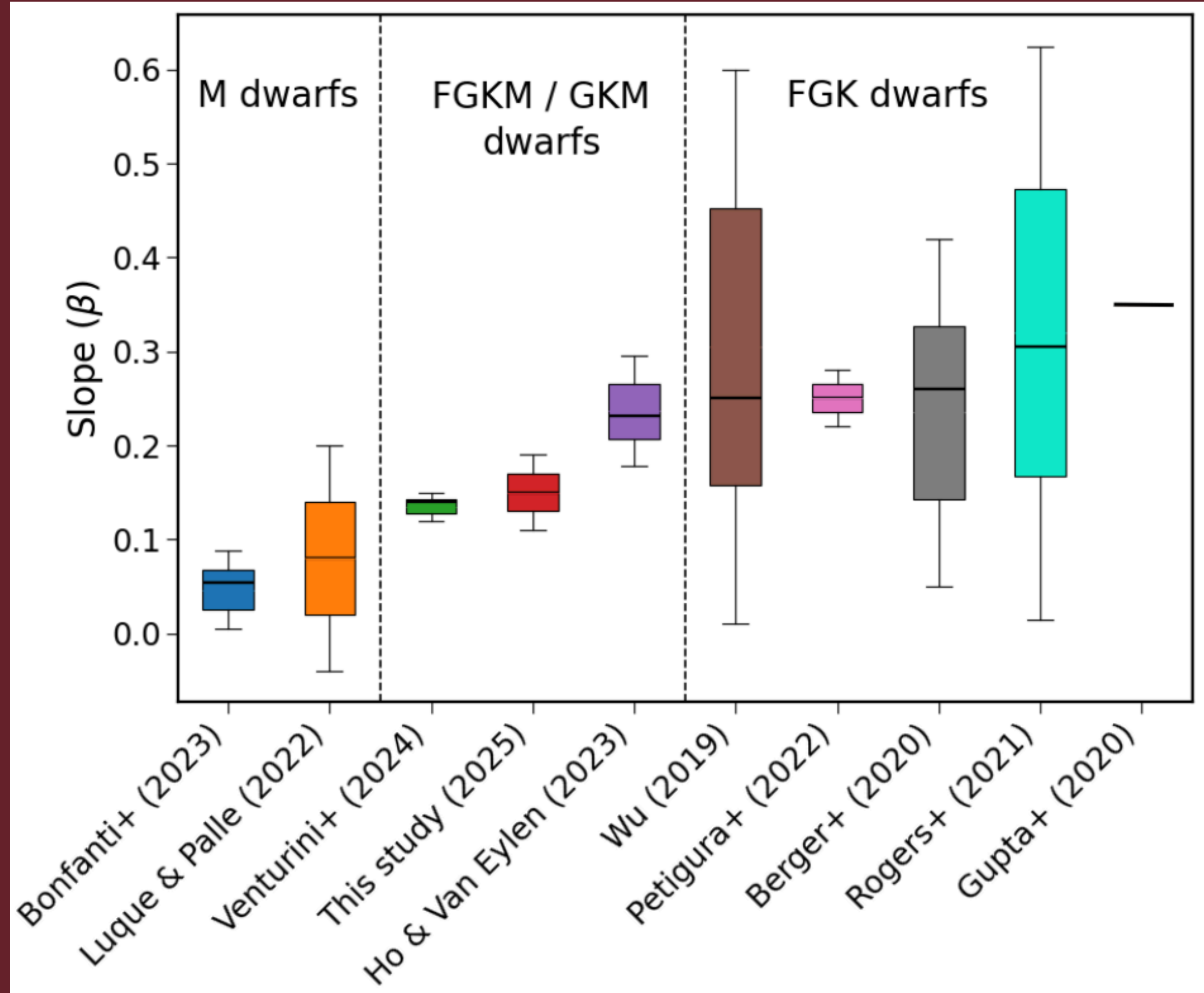
Parashivamurthy+ 2025 submitted



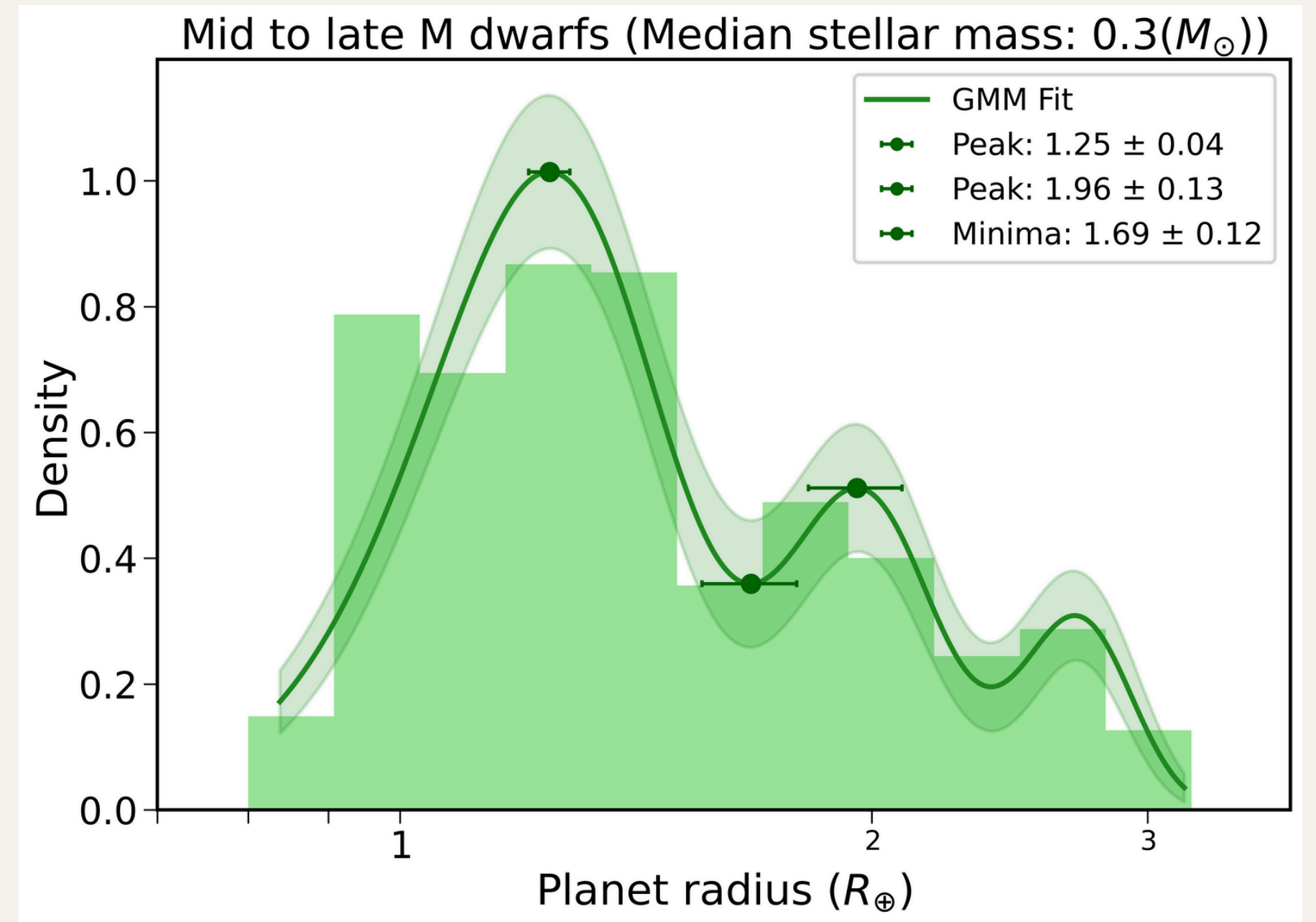
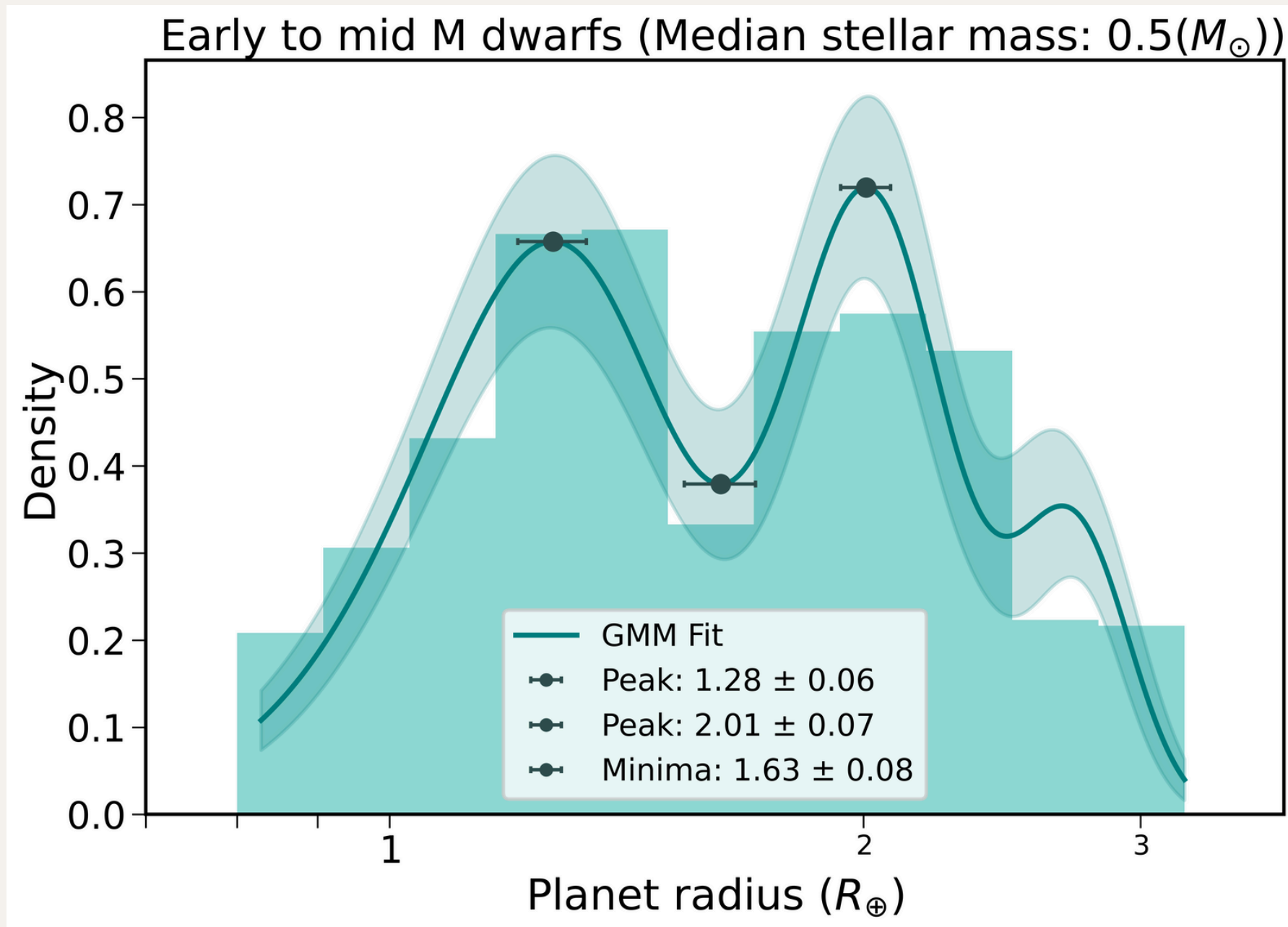
Models that include water worlds (pebble-based planet formation models from Venturini+ 2024) are more consistent with our observations.

# In the literature...

Slope values from various studies, grouped by stellar types.

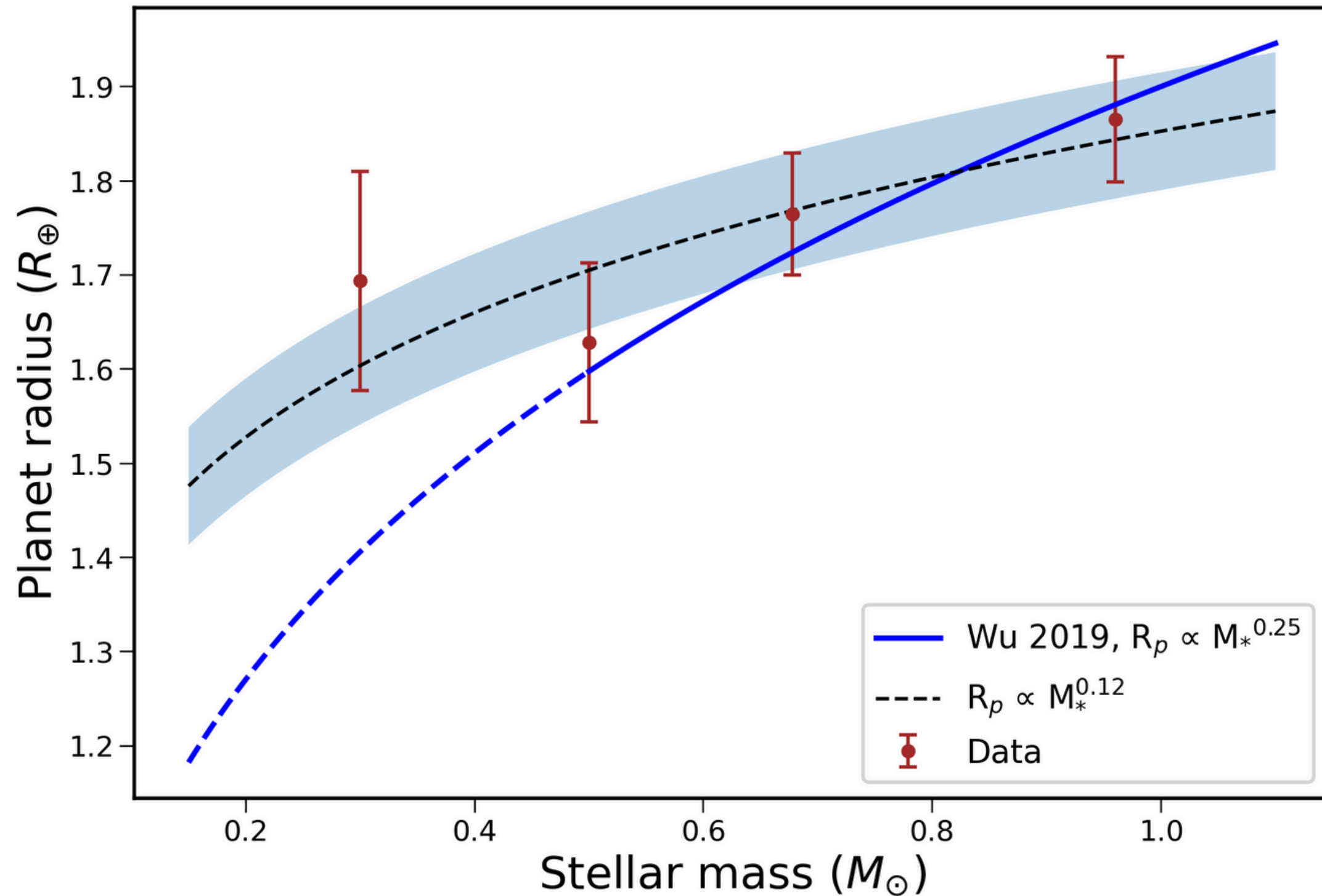


# Radius valley among M dwarfs.



# Updated slope with all data points

Parashivamurthy+ 2025 submitted



The linear dependence between the planet size and stellar mass is not seen among the M dwarfs.



# SUMMARY

- We used the bioverse catalog to define a TESS low mass star sample with updated GAIA DR3 stellar parameters, to ***refine the planet radii***.
- We observe ***a clear bimodal planet radii distribution among the M dwarfs***.
- Observed a ***mass-scaling relationship between the planet size and stellar mass*** among the MKG stellar types.
- The scaling/location of the radius valley among the low mass stars might indicate ***the presence of water worlds or the need to refine planet formation and evolution models***.
- However, among the M dwarfs, the scaling is not clearly observed yet.

# Thank you

harshitha@das.uchile.cl

Know thy star, Know thy planet 2  
February 4, 2025



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FÍSICAS Y MATEMÁTICAS  
UNIVERSIDAD DE CHILE

