Testing exoplanet evaporation with EvapMass

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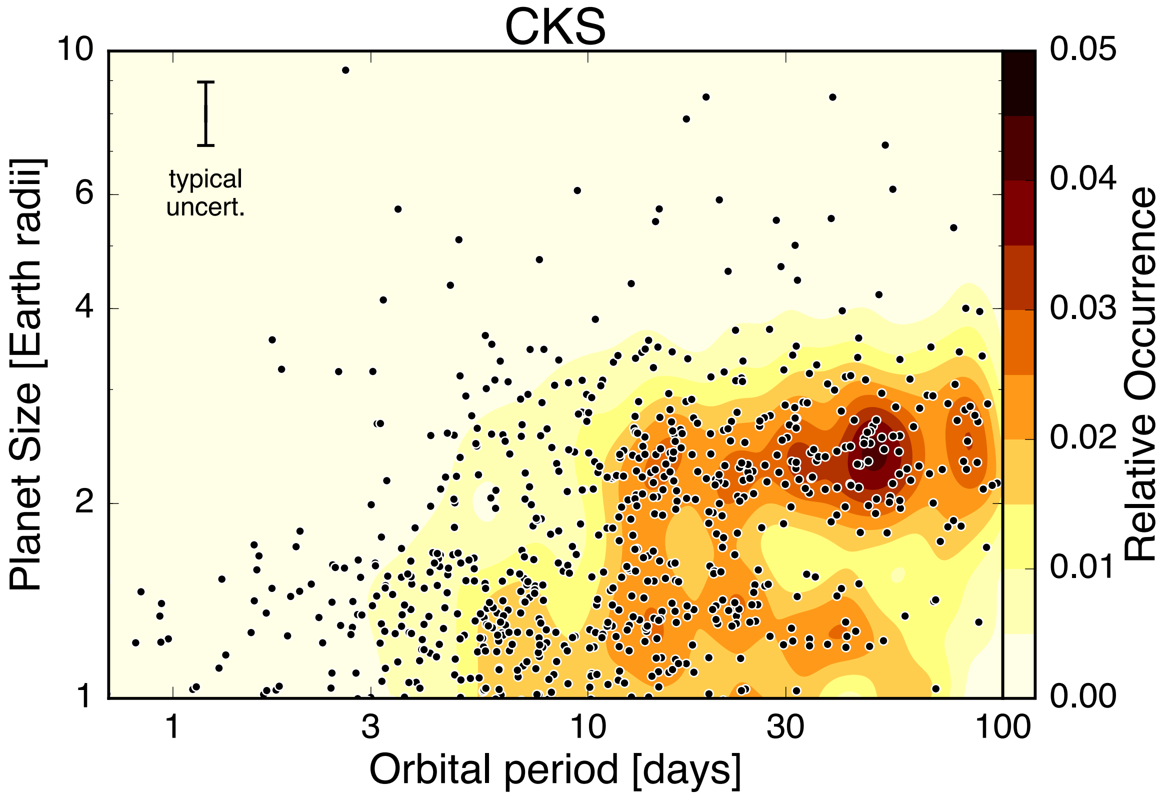
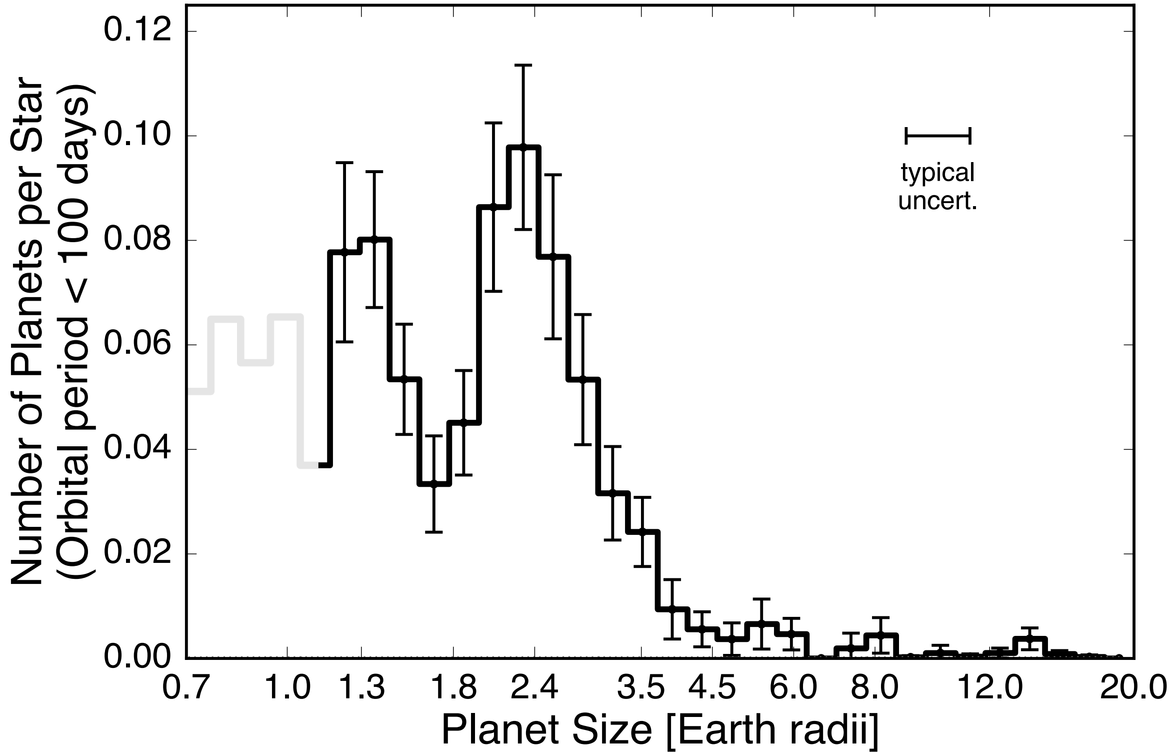
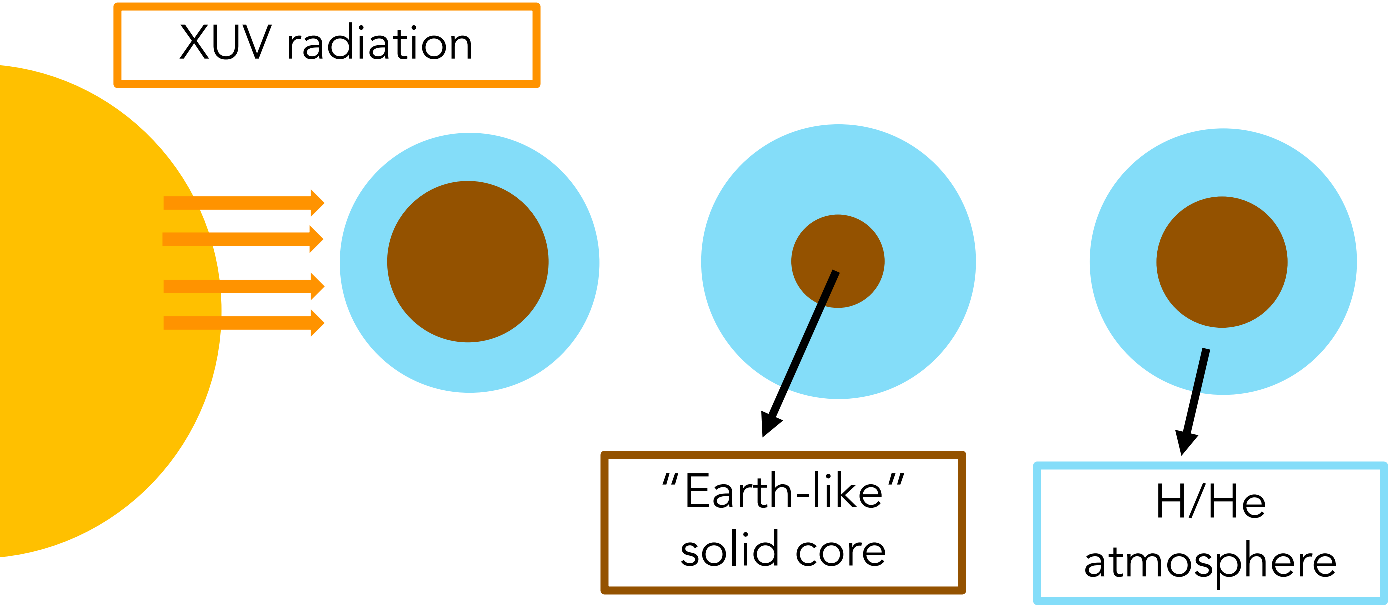
The radius valley

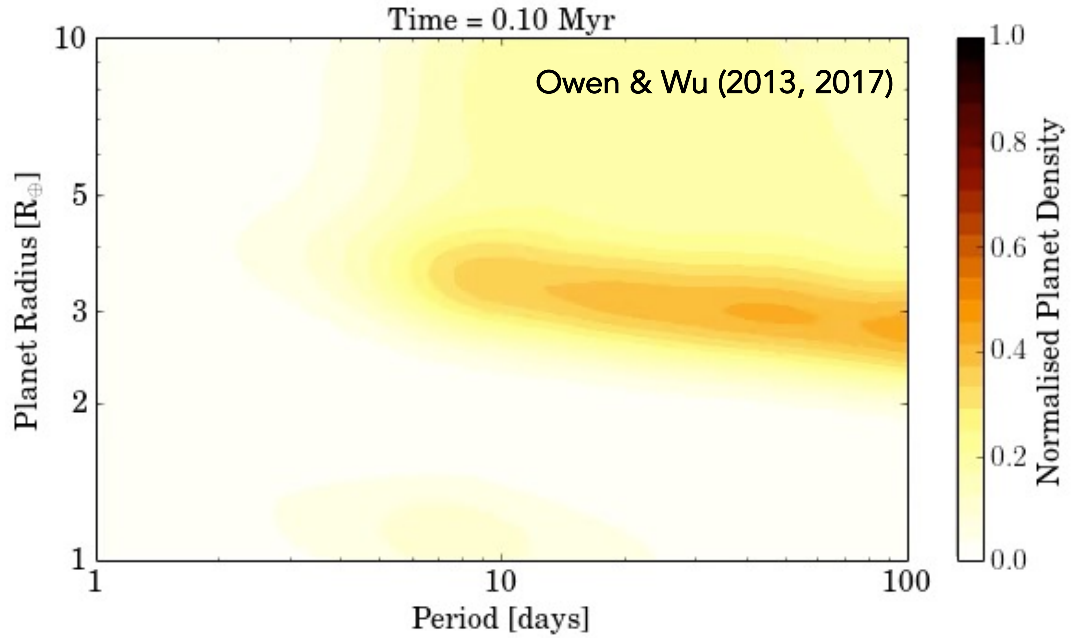




Fulton et al. (2017)

The photoevaporation model





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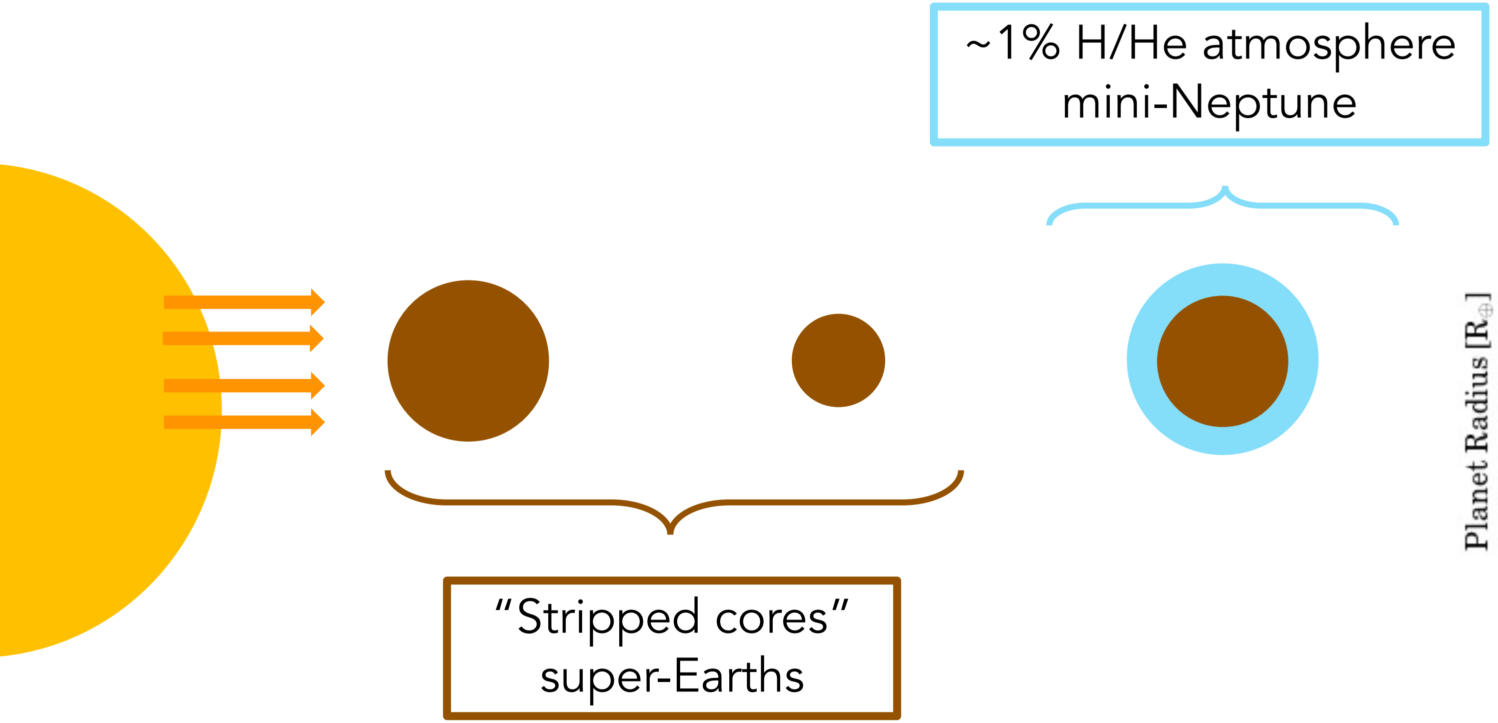
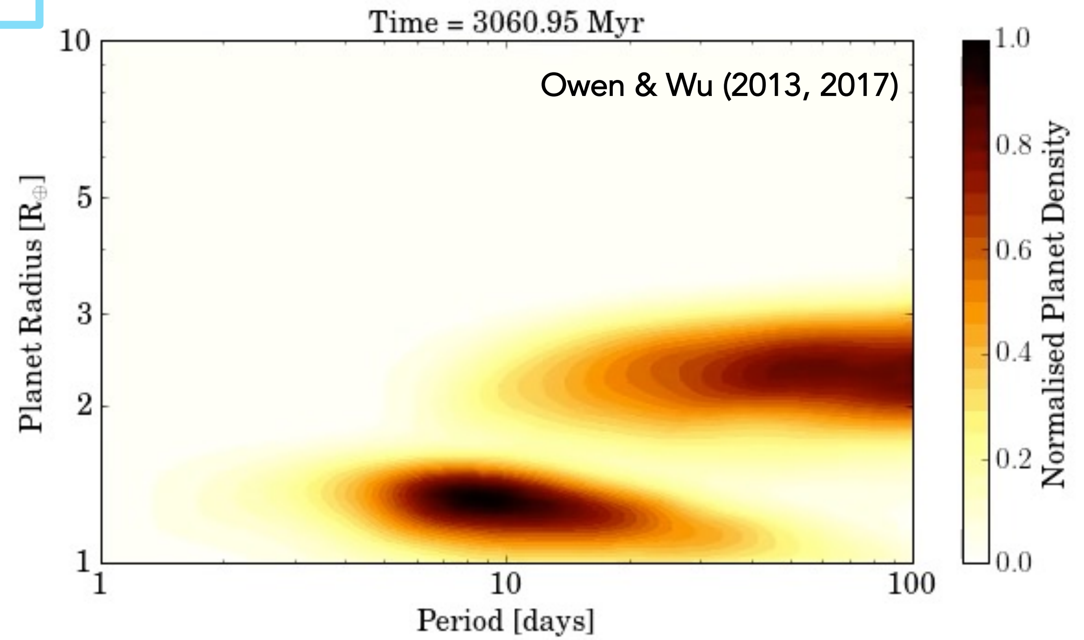
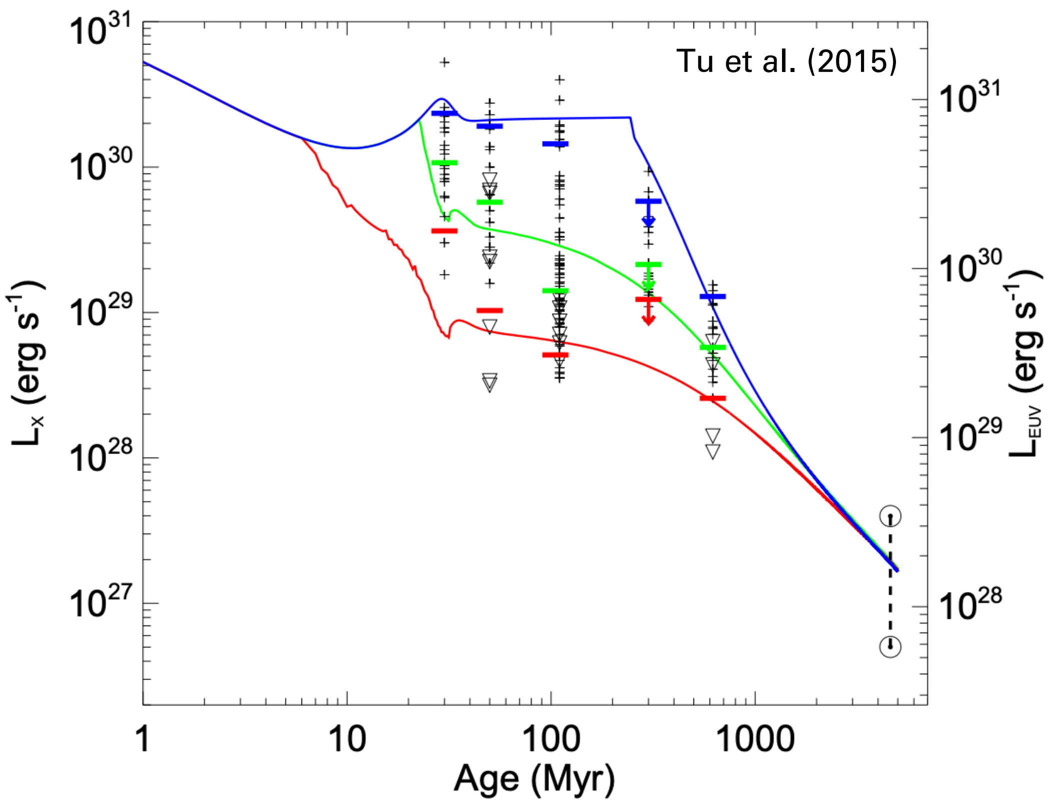


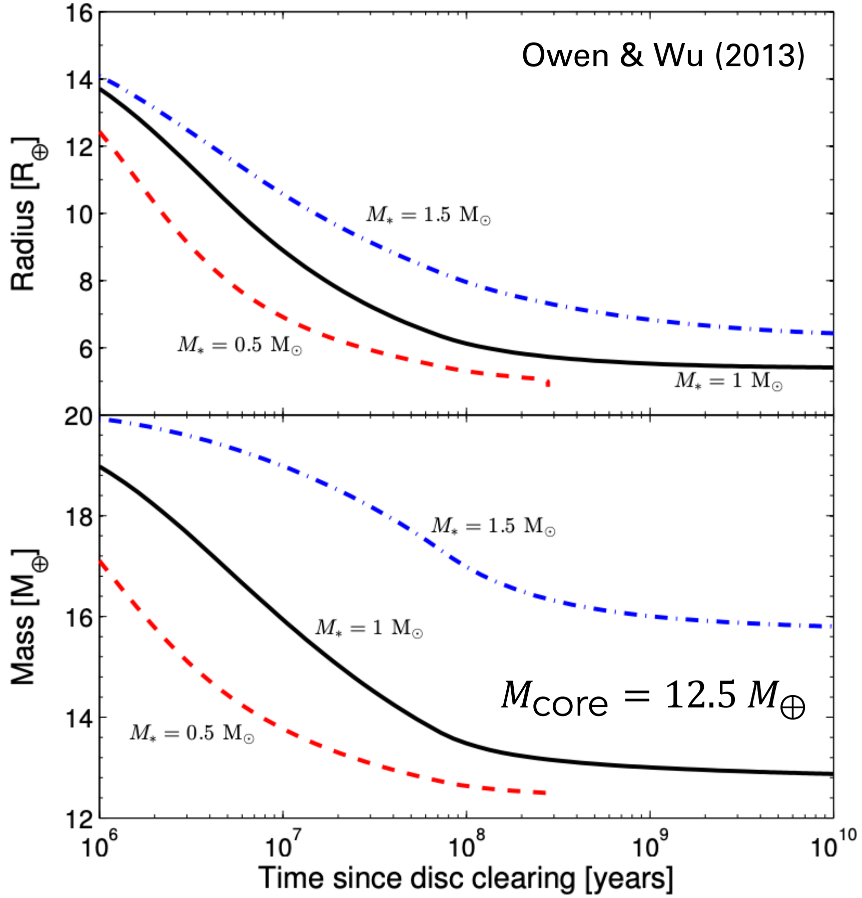


Testing photoevaporation: measure masses...

Problem: The mass-loss timescale is uncertain!

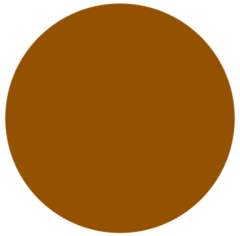
Evolution of the sun's X-ray luminosity over time



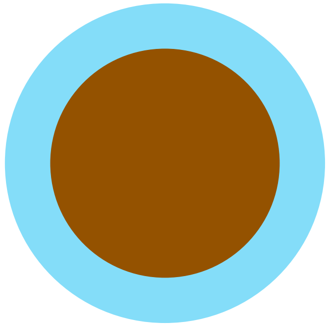


The solution: multitransiting systems – “multis”

super-Earth

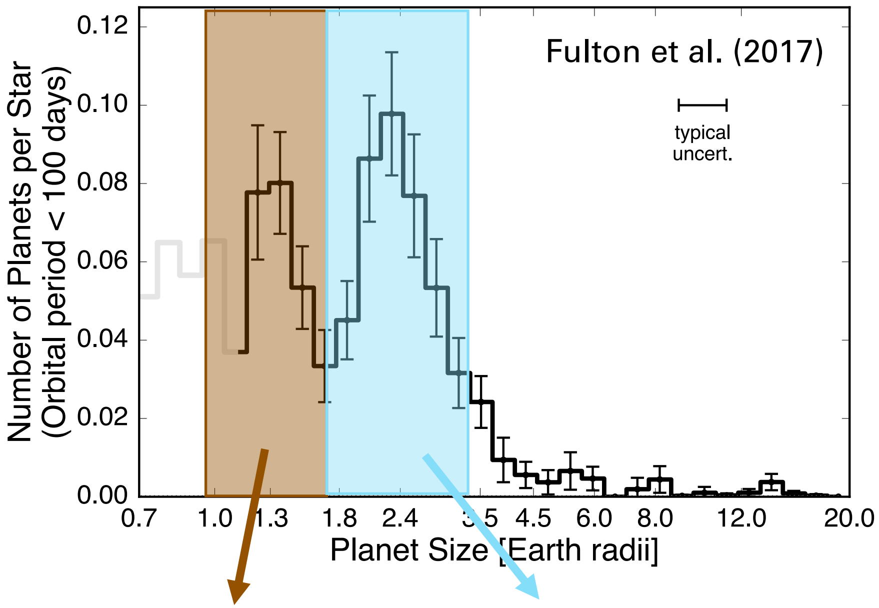


mini-Neptune



Constrain the uncertain mass-loss timescale

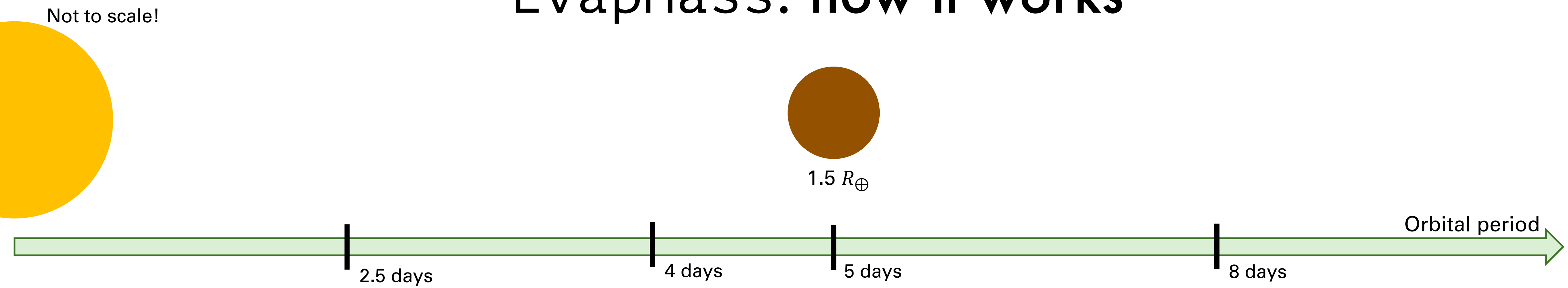
Predict minimum mass to be consistent with photoevaporation

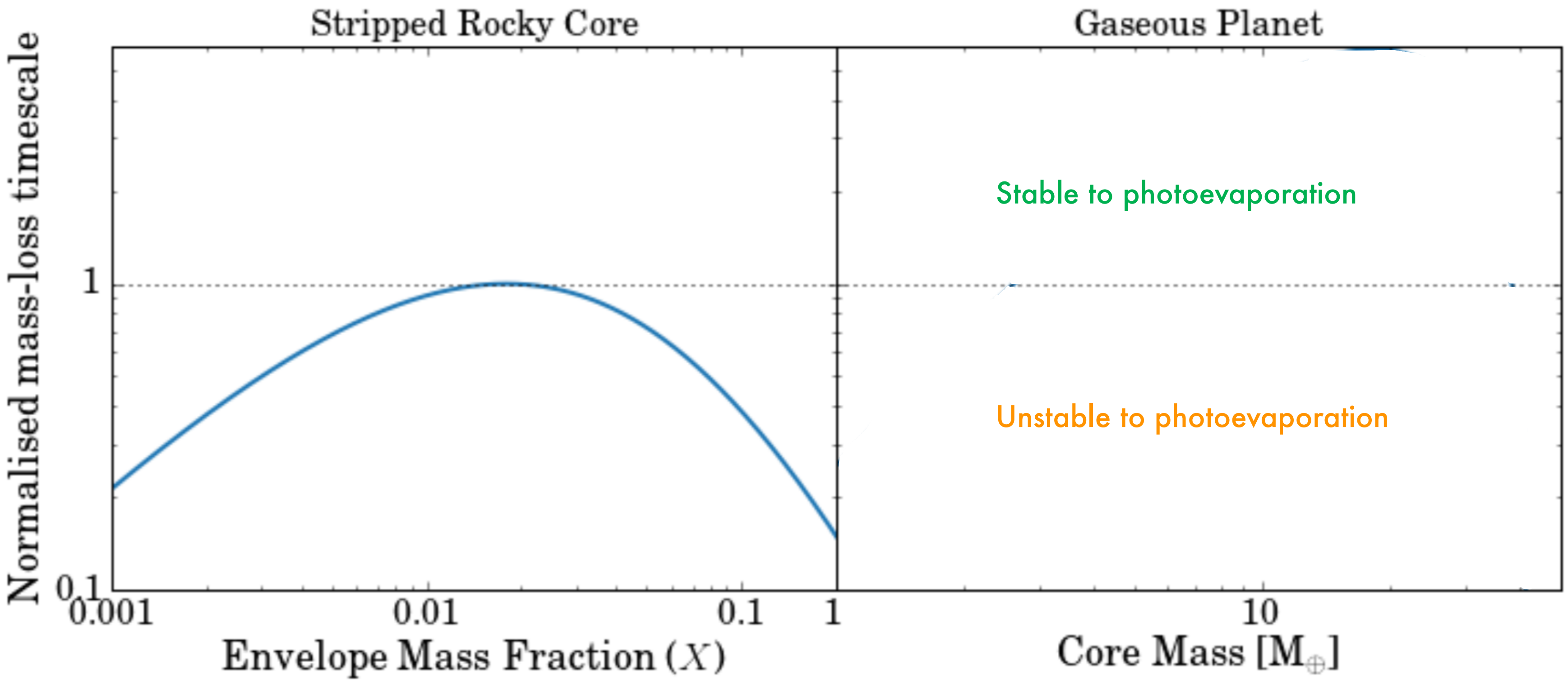


super-Earths

mini-Neptunes

EvapMass: how it works





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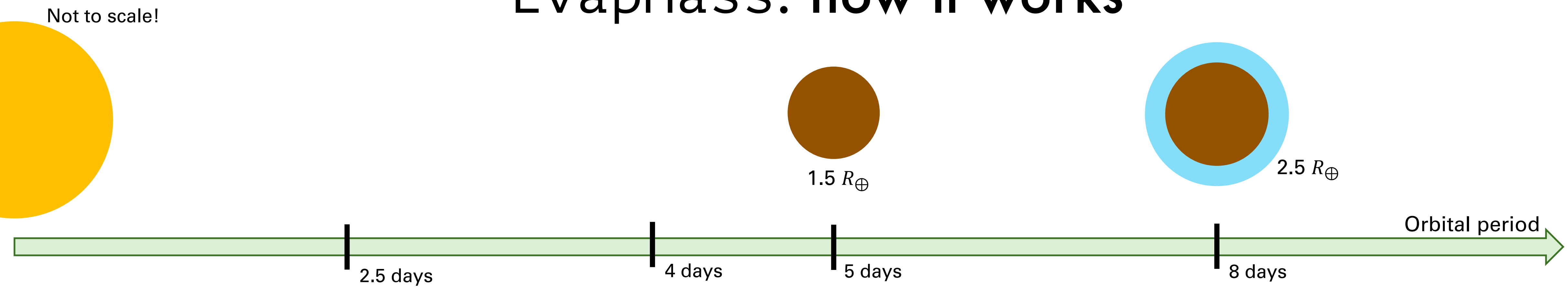

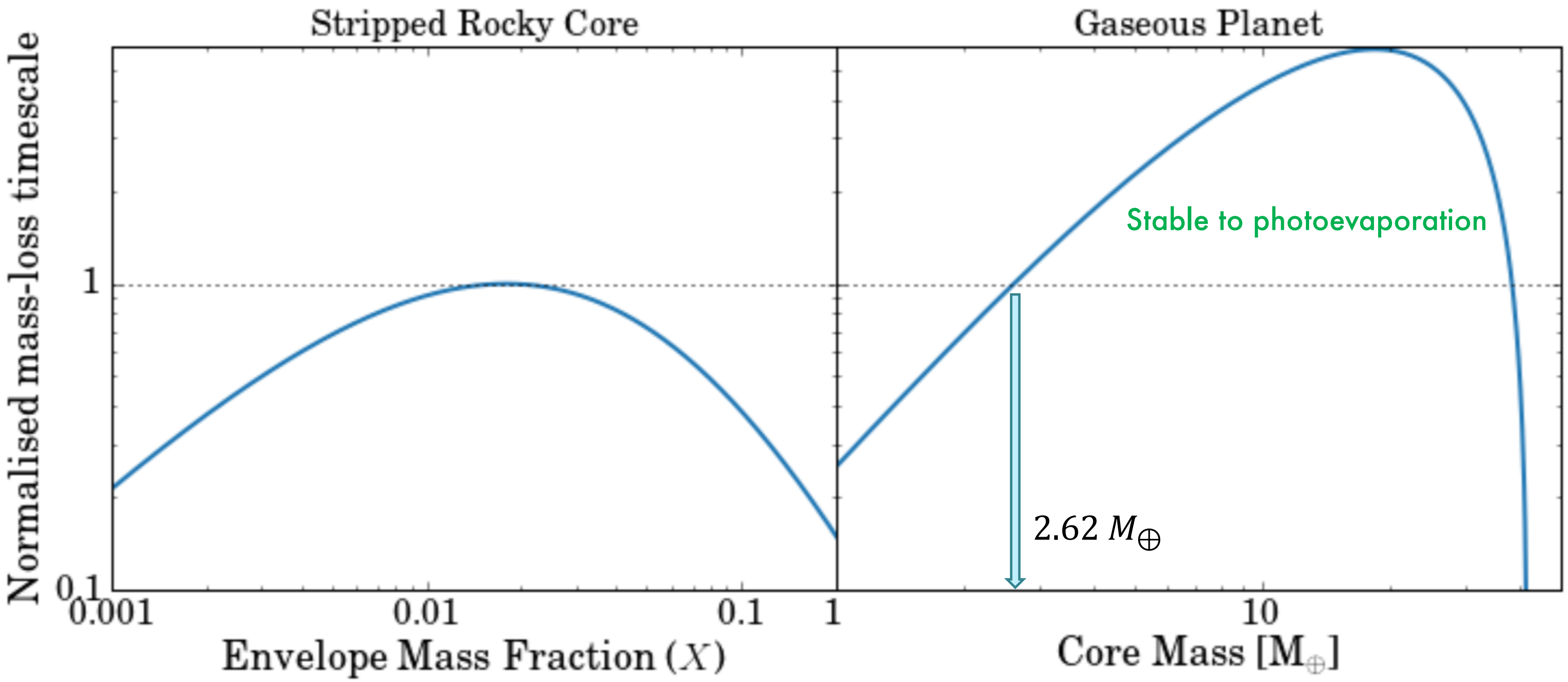

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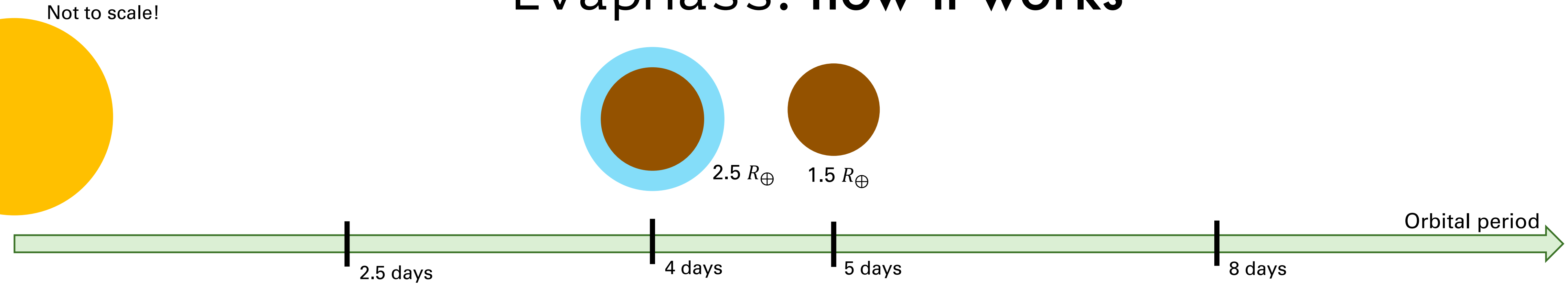

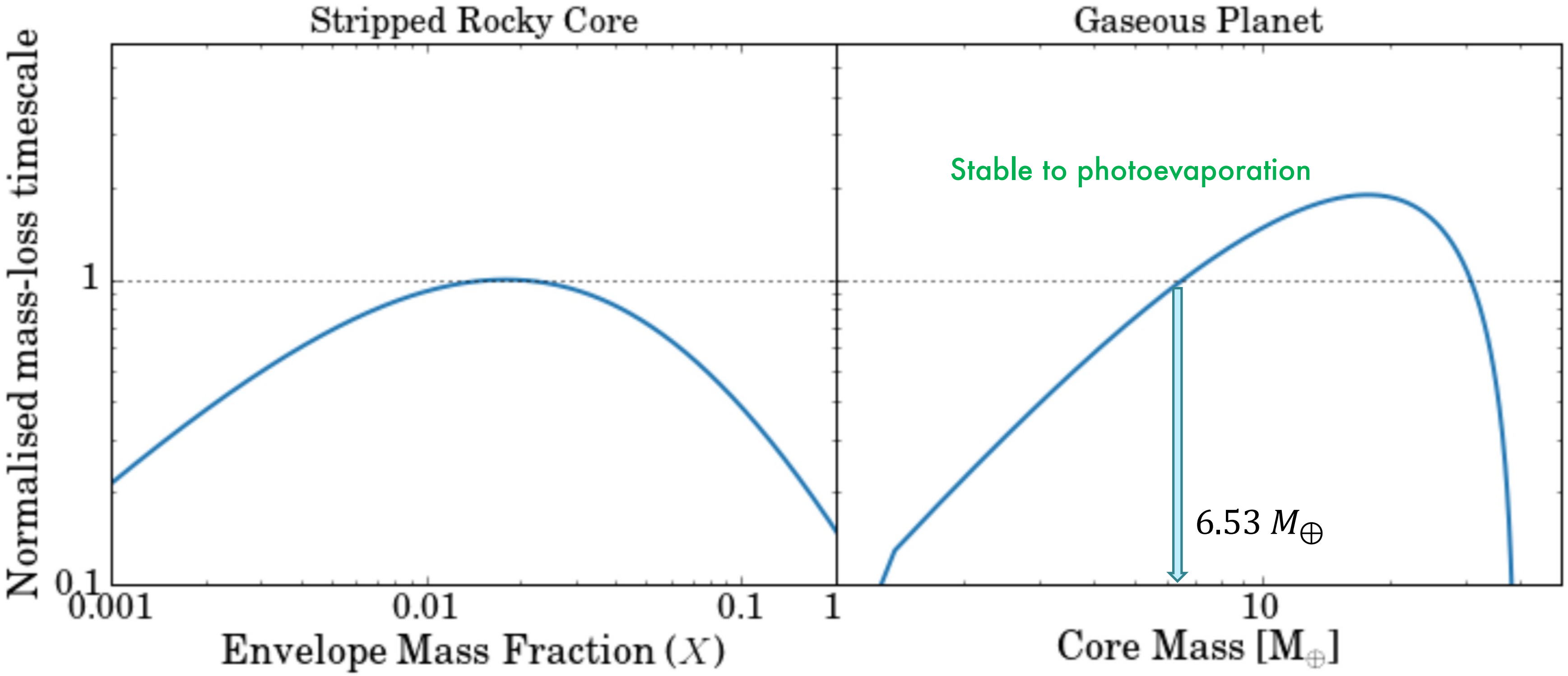

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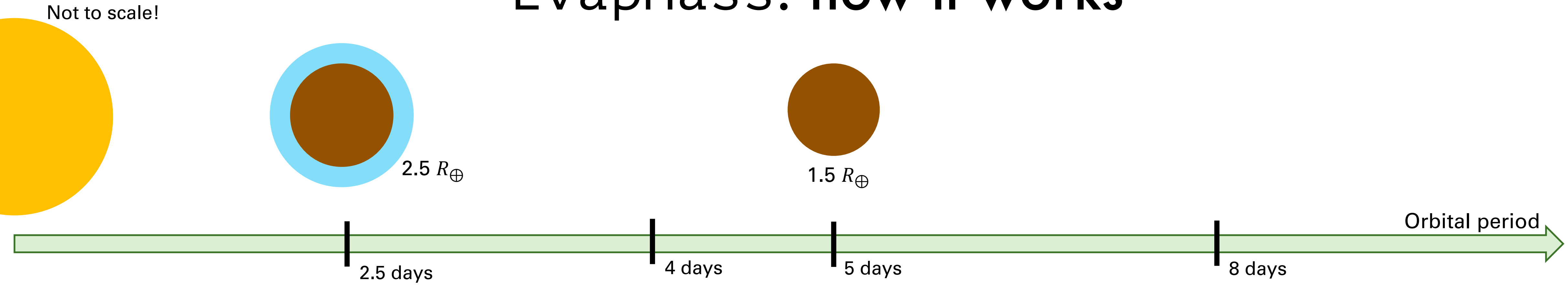
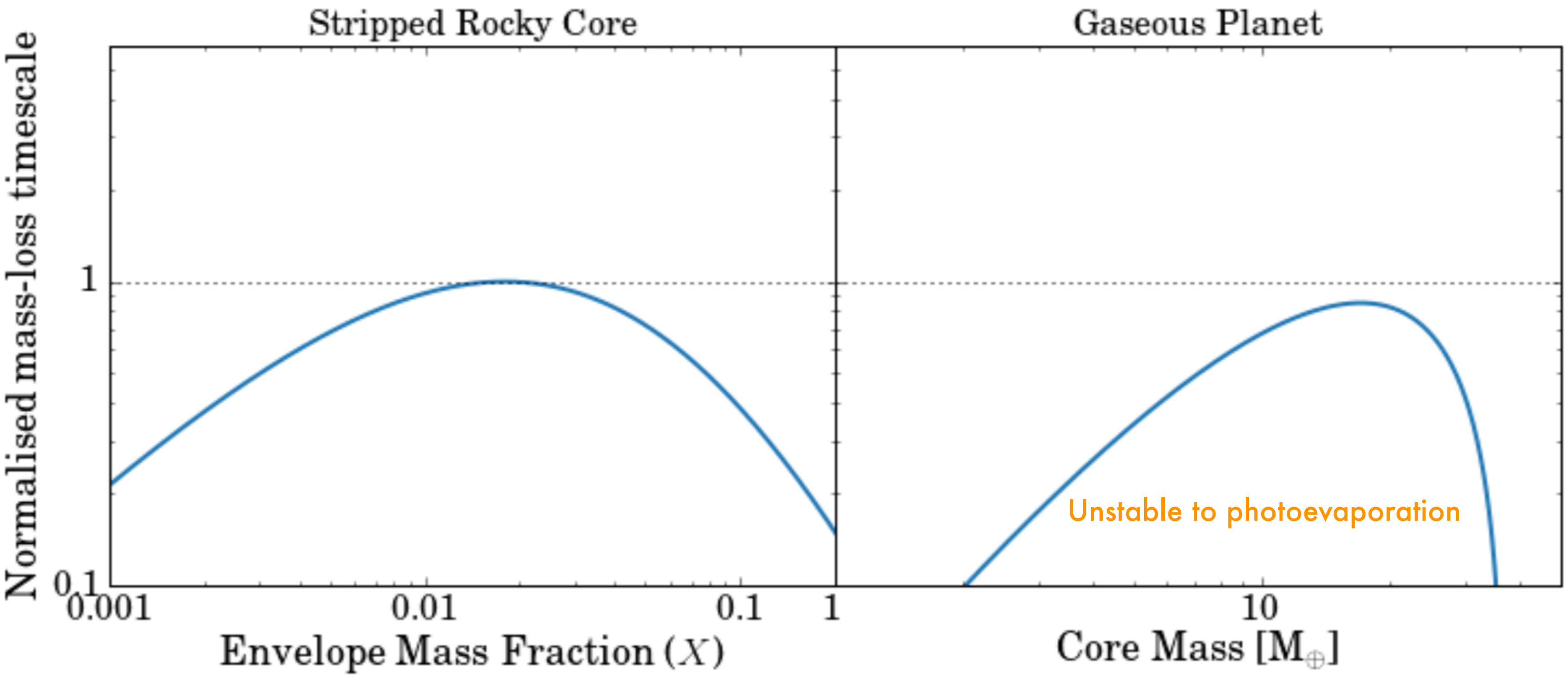
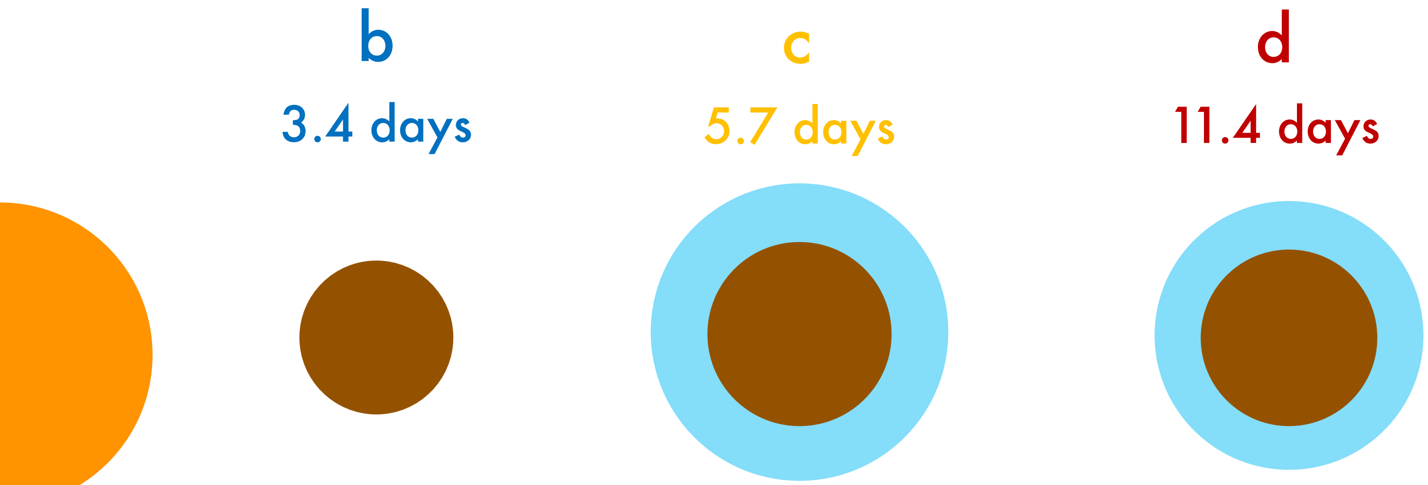




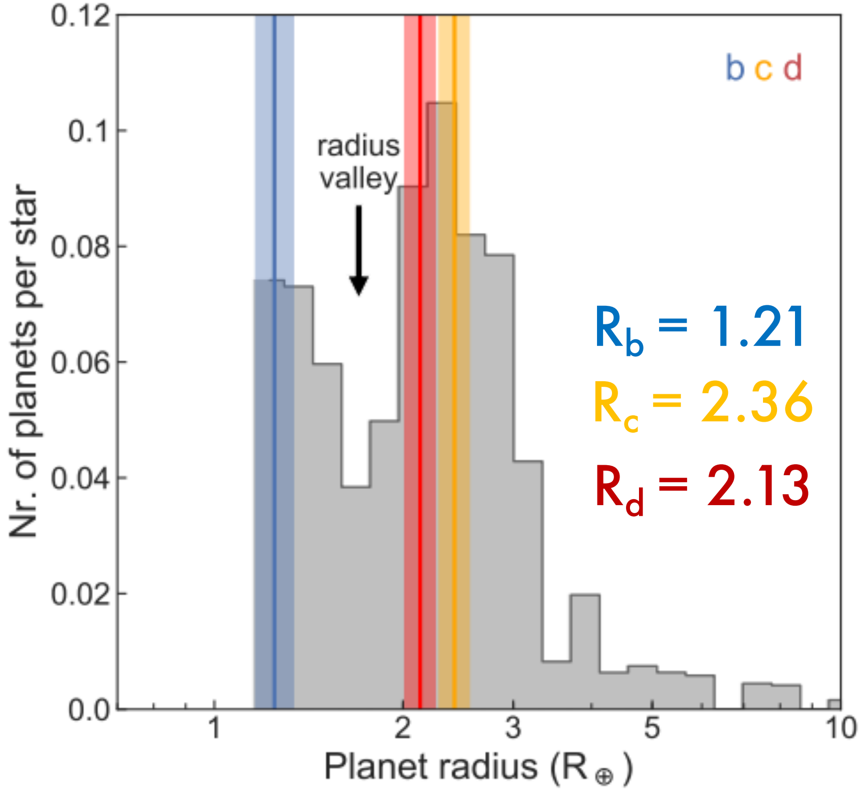
EvapMass in action: TOI-270



Planet	b	c	d
Minimum core mass ($M_\oplus$)	n/a	1.60	0.76
Measured mass* ($M_\oplus$)	1.58 ± 0.26	6.15 ± 0.37	4.78 ± 0.43
Planetary density* (g/cm^3)	4.97 ± 0.94	2.60 ± 0.26	2.72 ± 0.33

*Van Eylen et al. (2021)

Günther et al. (2019)



So, you want to use EvapMass?

Do not forget:

- You need a **multitransiting system** – planets above and below the radius valley.

- You should **carefully choose the location of the radius valley** - see Van Eylen et al. (2018, 2021):
  - FGK stars: ~1.8 $R_\oplus$ (default)
  - M dwarfs: ~1.5 $R_\oplus$

- You can **pick the mass-loss efficiency parameter**. The default follows Owen and Jackson (2012).

Simply clone the repository and follow the README file.

https://github.com/jo276/EvapMass

So, you want to use EvapMass?

Outputs:

- **Predict the minimum mass for mini-Neptunes** in multitransiting systems according to photoevaporation.

- If masses are measured, **can test planets against photoevaporation.**
  - If the minimum mass of the mini-Neptune is smaller than the measured mass, the planet is consistent with photoevaporation.

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EvapMass

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MARIE CURIE ACTIONS