PROJECT 4

BUILD A PLANET

TRAPPIST 1-B

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INTRODUCTION

- As the universe came together following the Big Bang, the same dust and gas formed both the stars and the planets
- In other words, everything is made of star stuff (-: (including us)
- The composition of a planet's host star can help us determine certain characteristics of the planet
- We are going to model a chosen planet using the composition of its host star, find some characteristics, and then compare the mineralogy to Earth

MOTIVATION

- To calculate planet structures from mass-proportions and compare these numbers to their stellar equivalents
- Place the structure and composition in context of mineral proportions and orbital parameters
- Ultimately, we would like to further our understanding of the relationship between the composition of a host star and the rocky planets that may orbit it.
- Do they have the same composition? Different?
- What causes the similarities and differences?
- What effects does the composition of the host star have on the properties and characteristics of its planets?
- Lastly, what does this say about the relationship between the Sun and the Earth?

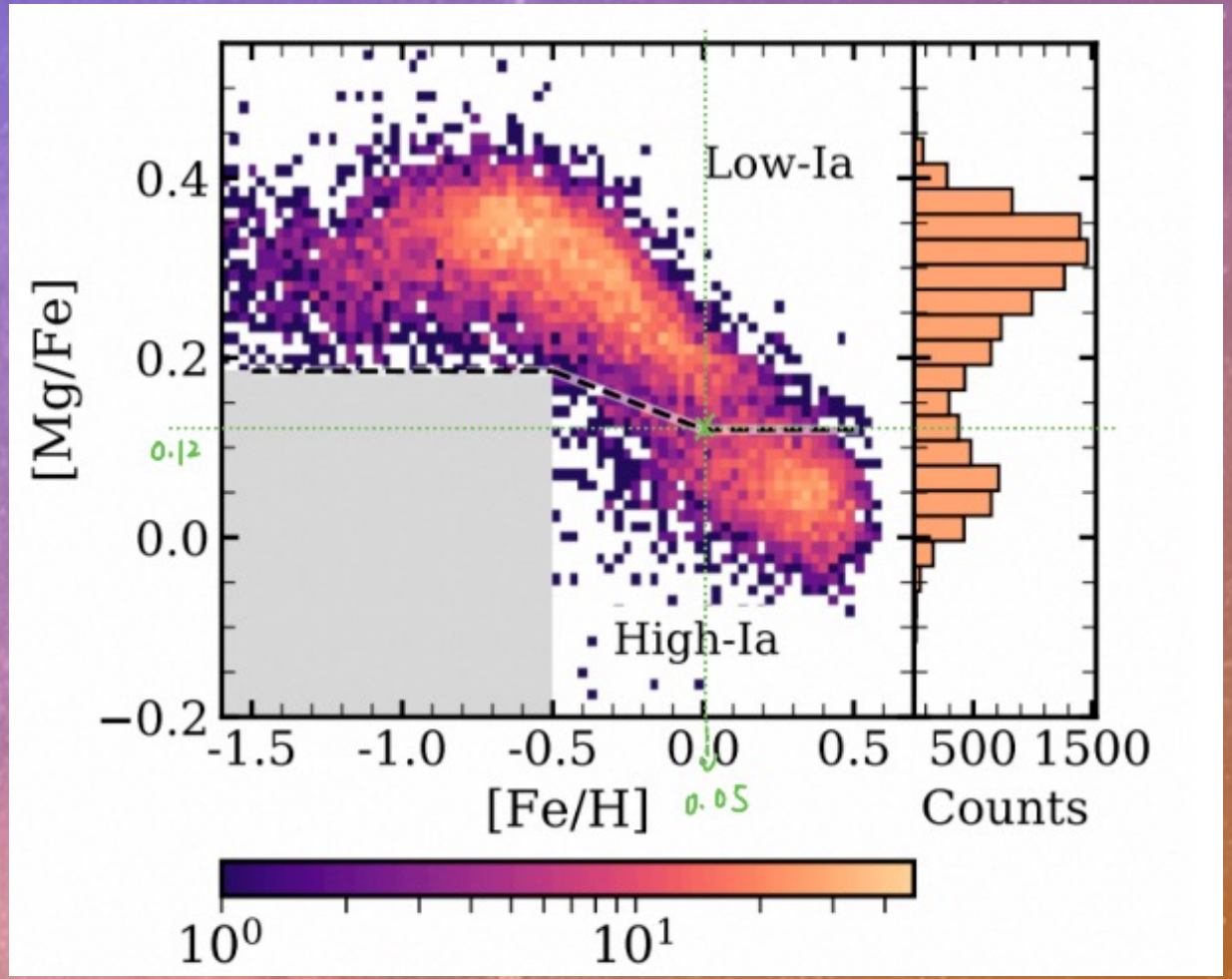
METHODS

- Element of Host Star

[Fe/H] :0.05350

[Mg/Fe] :0.12

[Fe/Mg] :-0.12



Griffith et al., 2022,

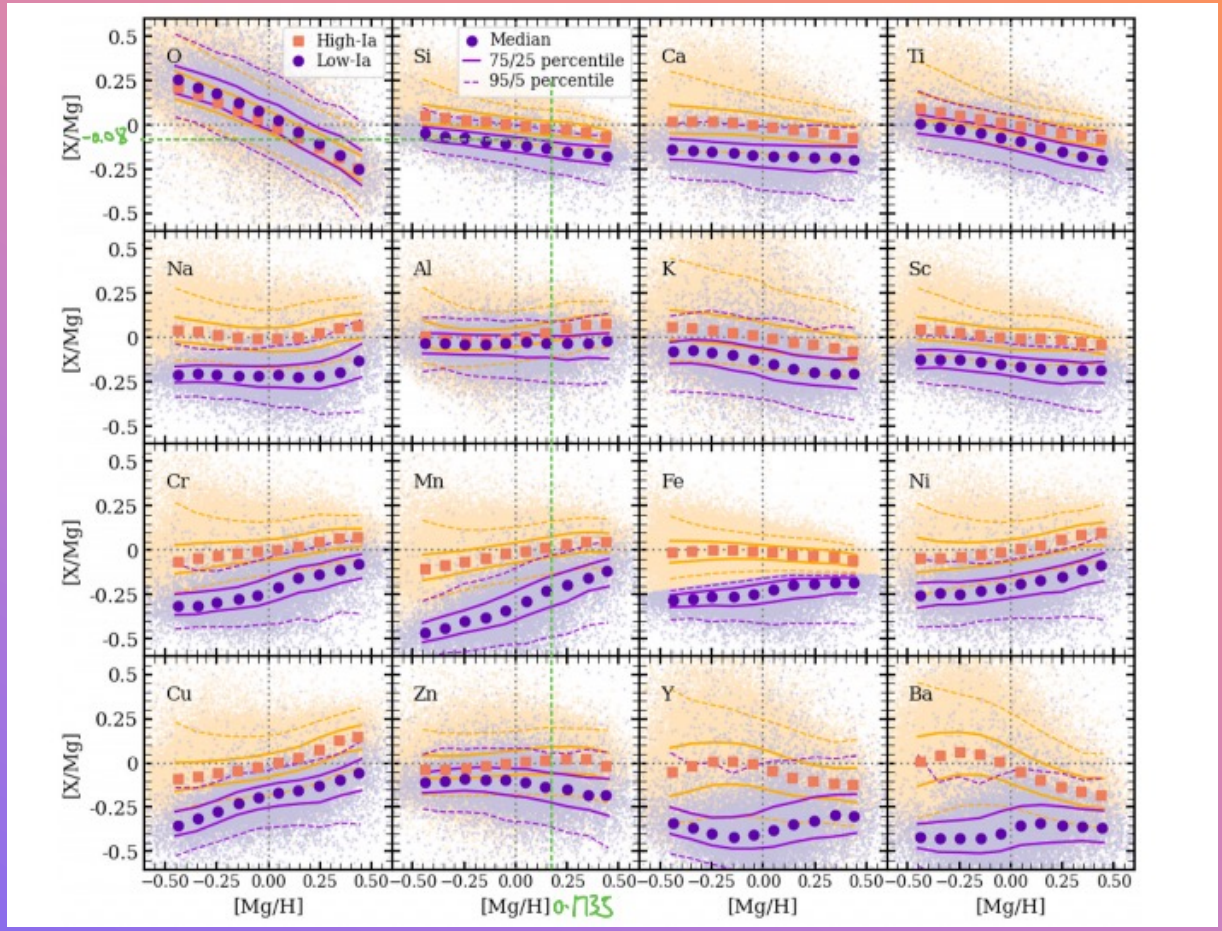
METHODS

Element of Host Star

[Mg/H]=[Mg/Fe]+[Fe/H]

= 0.1735

[Si/Mg] :-0.08



Griffith et al., 2022,

METHODS

Element of Host Star

$$[N/M] = \log \frac{N/M}{N_\odot/M_\odot}$$

$$N/M = N_\odot/M_\odot \cdot 10^{[N/M]}$$

Si/Mg=0.984983

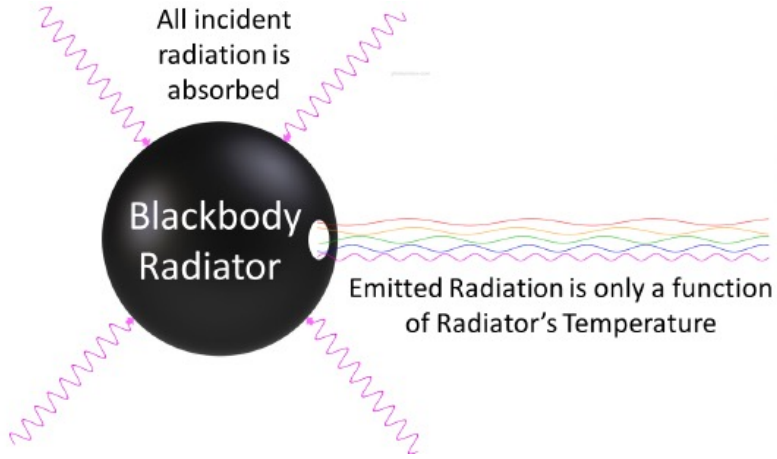
Fe/Mg=0.598877

Ca/Mg=0.07

Al/Mg=0.09

Surface Irradiation(Surface Flux)

From Exoplex: Planet Mass = 1.374 Earth masses, Planet Radius = 1.117 Earth radii



Luminosity from Blackbody Radiation

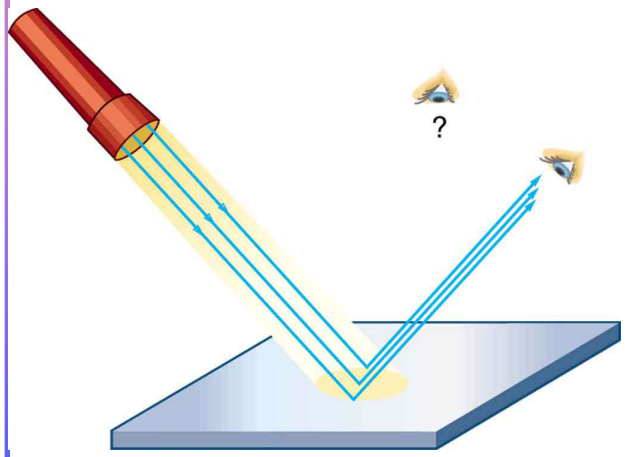
$$L_t = 4 \cdot r^2 \pi \cdot \sigma_{SB} \cdot T^4$$

9.0385e+17 W

Surface Flux

$$F = \frac{L_s + L_p}{4\pi r^2}$$

2835.21 W / m2



Luminosity from the Reflection of Star

$$L_s = 4 \cdot r_s^2 \pi \cdot \sigma_{SB} \cdot T_s^4$$

$$L_p = \frac{L_s}{4\pi a^2} \cdot \pi r^2$$

9.045e+17 W

UNCERTAINTIES

Based on NEA

+ Max Mass: 1.443 Earth masses
+ Normal Mass: 1.374 Earth masses
+ Min Mass: 1.305 Earth masses

Exoplex →

Max Radius: 1.133 Earth radii

Normal Radius: 1.117 Earth radii

Min Radius: 1.101 Earth radii

Density

Max Density: 5.45 g / cm3

Normal Density : 5.417 g / cm3

Min Density : 5.37 g / cm3

STRUCTURE MODEL

Generated by *Exoplex*

Si/Mg=0.984983

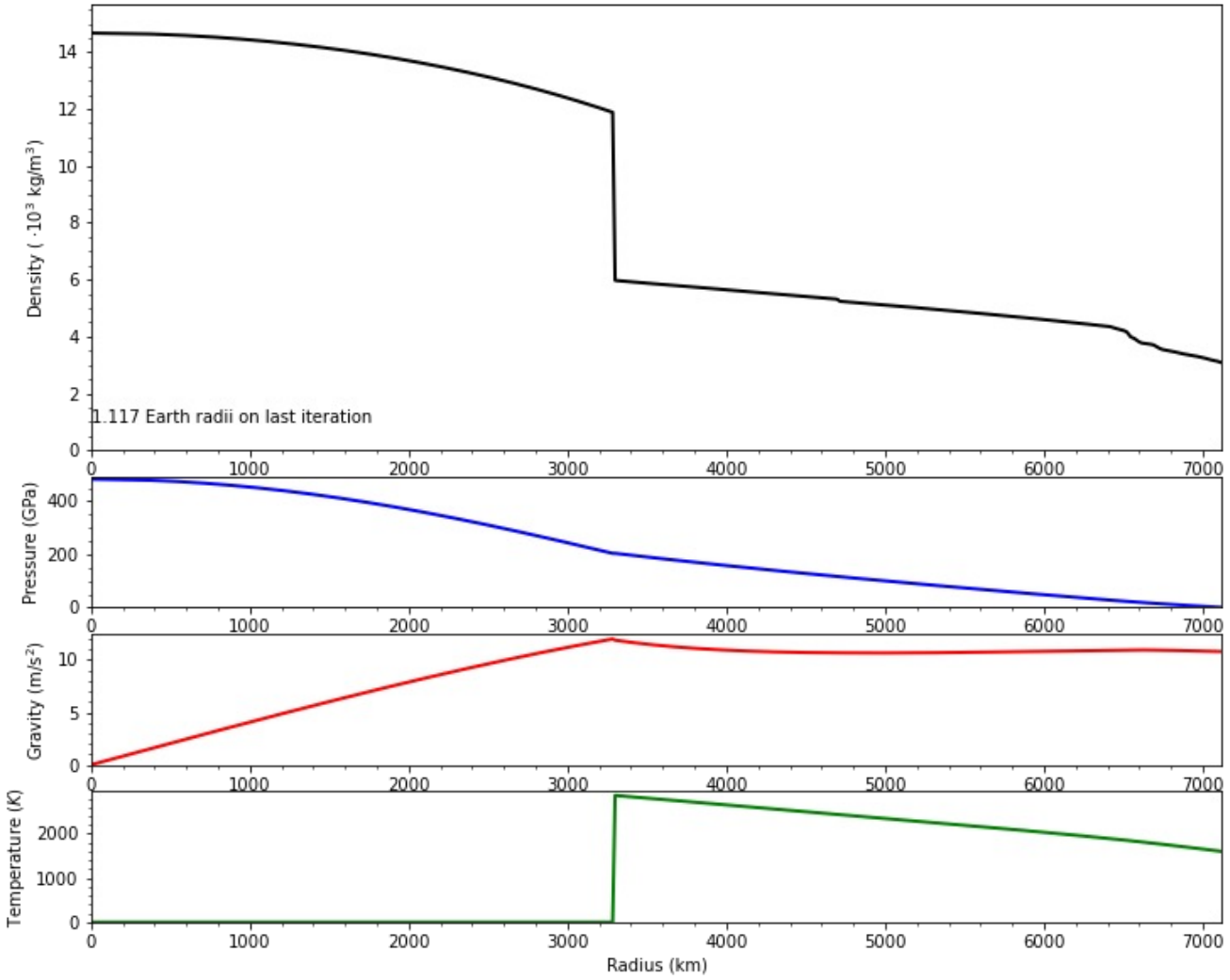
Fe/Mg=0.598877

Ca/Mg=0.07

Al/Mg=0.09

Planet Mass = 1.374 Earth masses

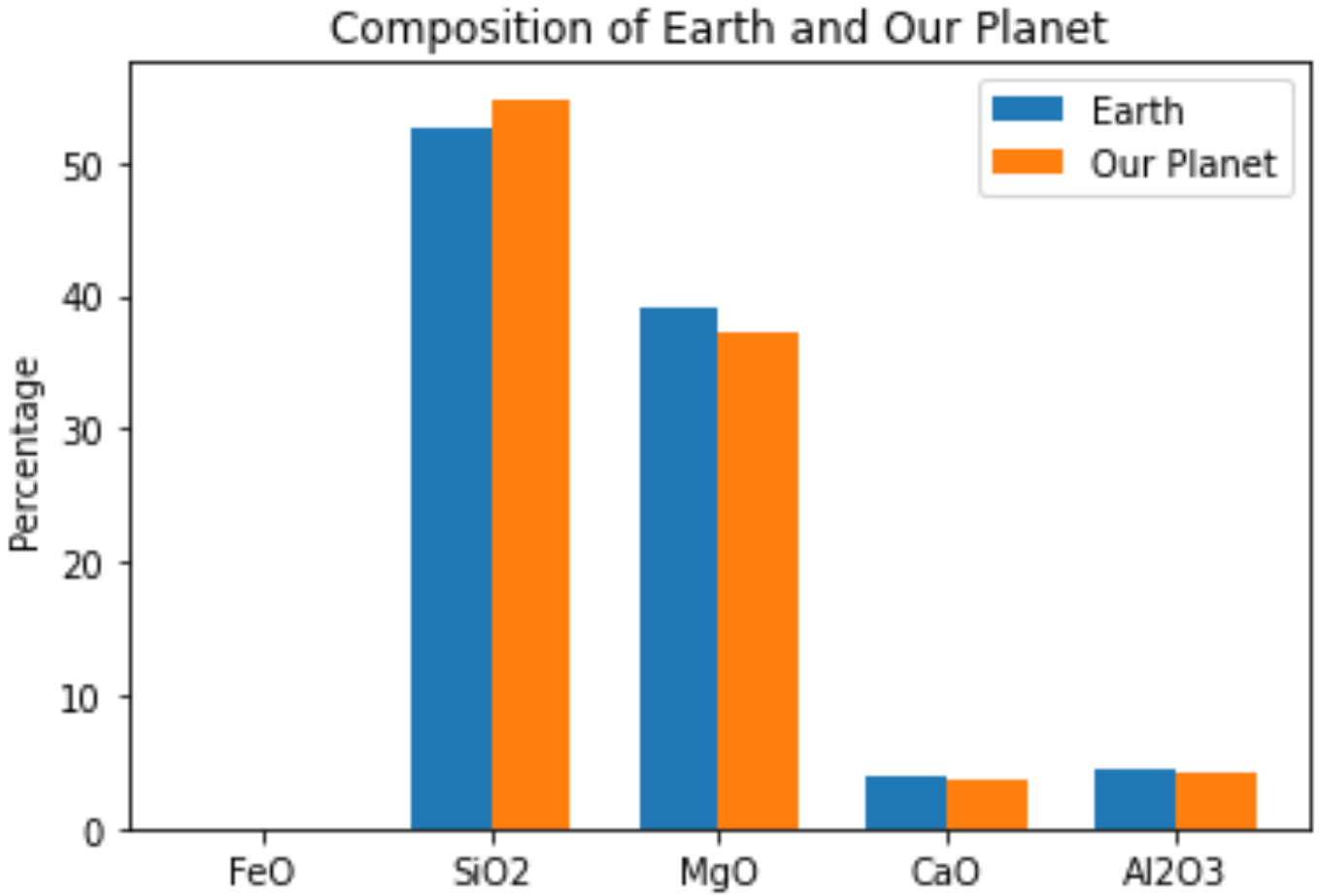
Planet Radius = 1.117 Earth radii



MANTLE MINERALOGY

Generated by *Exoplex*

Element	Earth(%)	Our planet(%)
FeO	0.0	0.0
SiO2	52.55	54.80
MgO	39.17	37.33
CaO	3.81	3.63
Al2O3	4.46	4.25



RESULTS:

Si/Mg: 0.984983

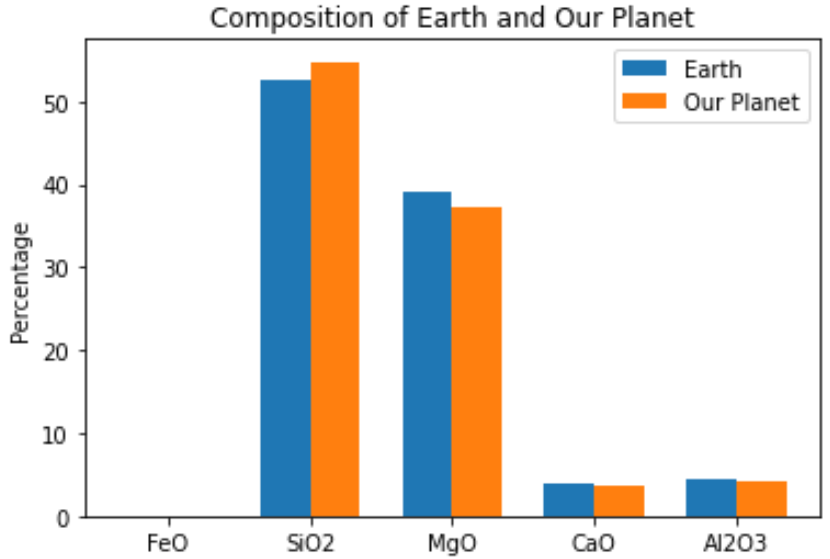
Fe/Mg: 0.598877

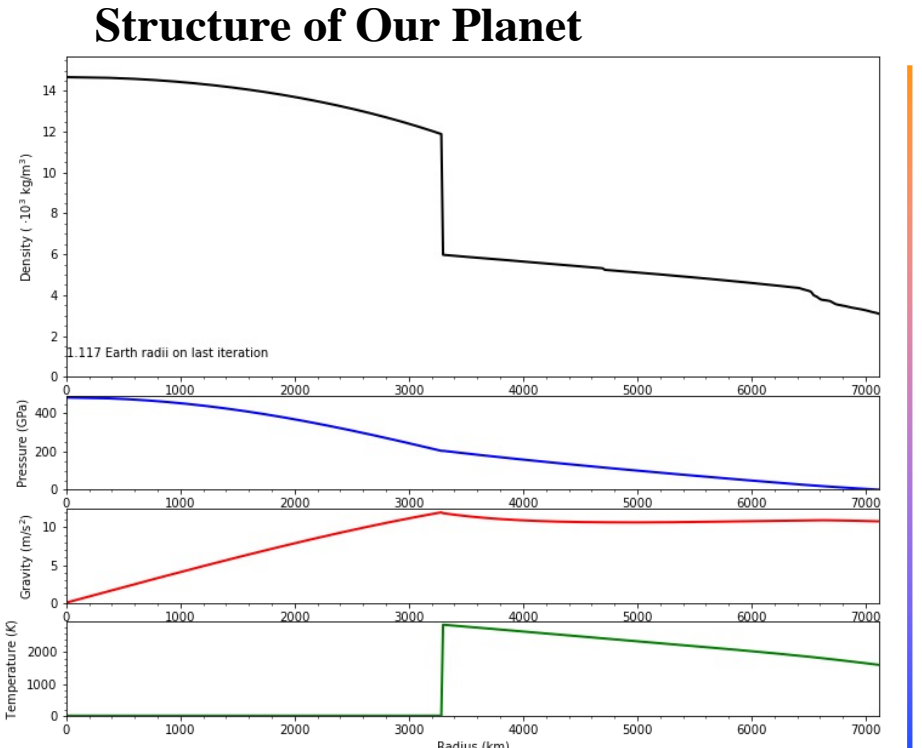
Surface Flux: 2835.21 W / m2

Planet Mass: 1.374 Earth Mass

Normal Density : 5.417 g / cm3

Planet Radius: 1.117 Earth Radii





QUESTIONS?

THANK YOU