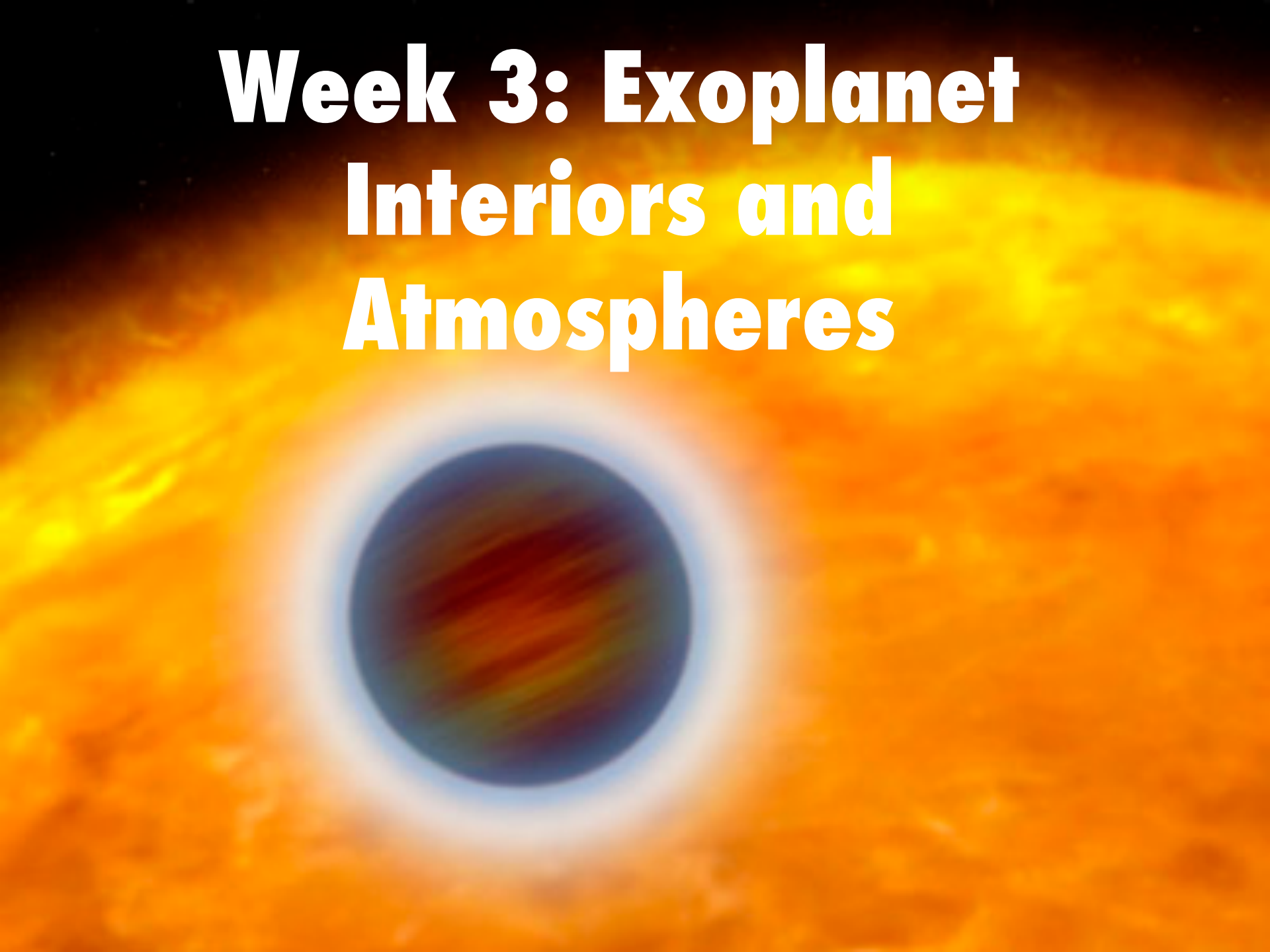
Week 3: Exoplanet Interiors and Atmospheres



Atmospheres

Primary vs. Secondary

Primary	Secondary
Jupiter	Earth
Saturn	Venus

Secondary Atmospheres

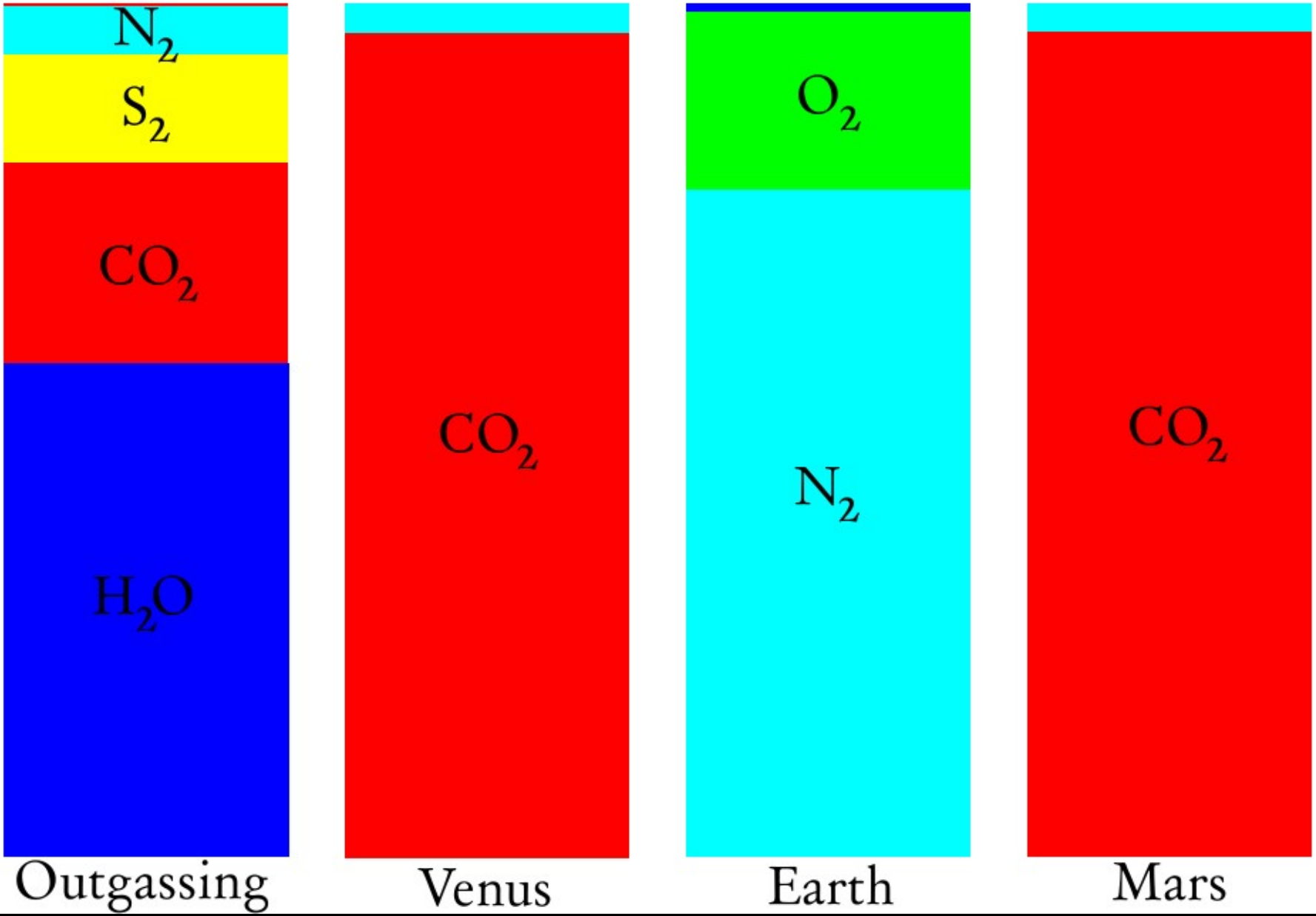
Sources

- outgassing (volcanic)
- evaporation & sublimation

Sinks

- condensation
- thermal escape
- solar wind stripping
- chemical rxns on surface

Terrestrial Atmospheres

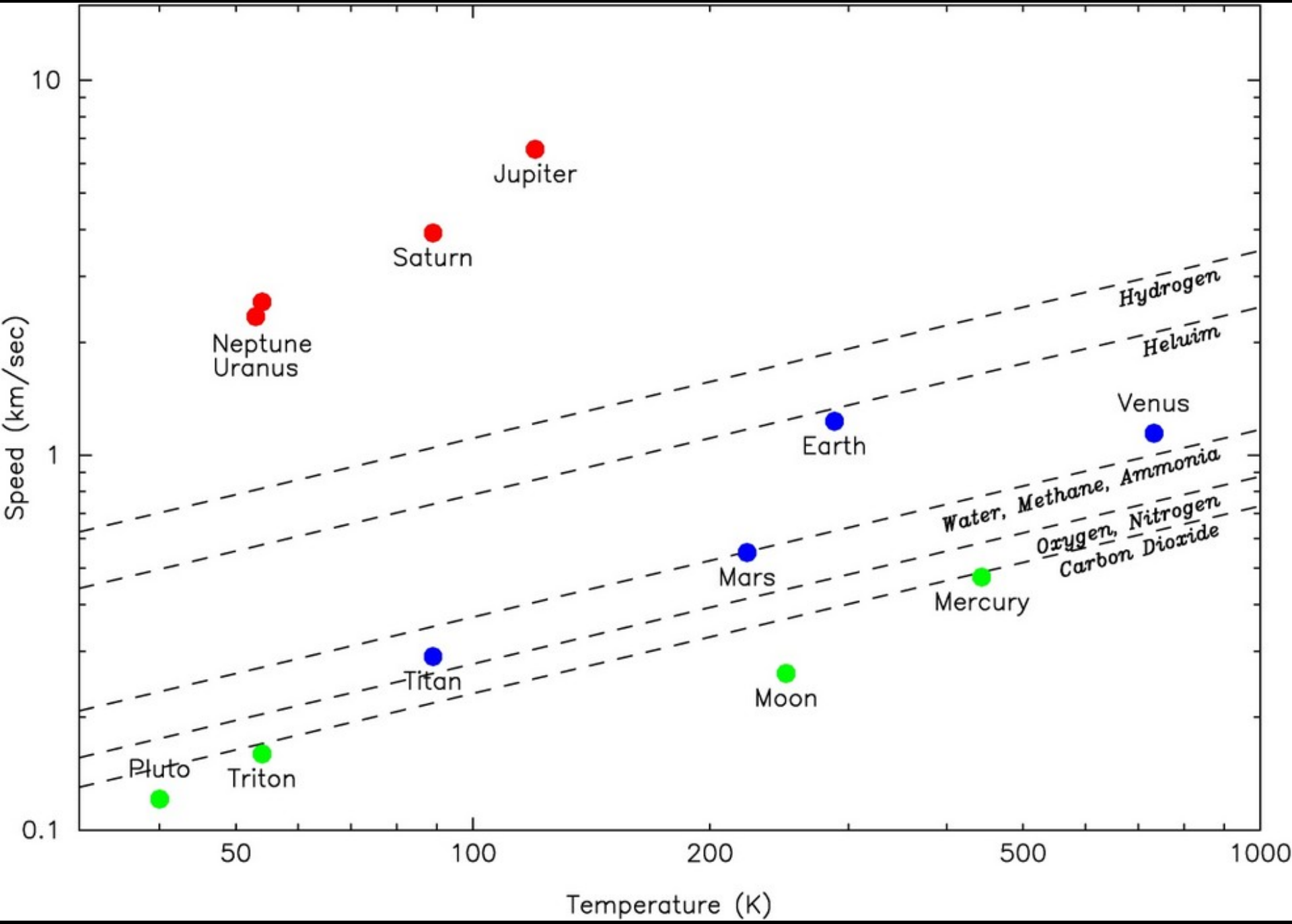


Atmospheric Escape

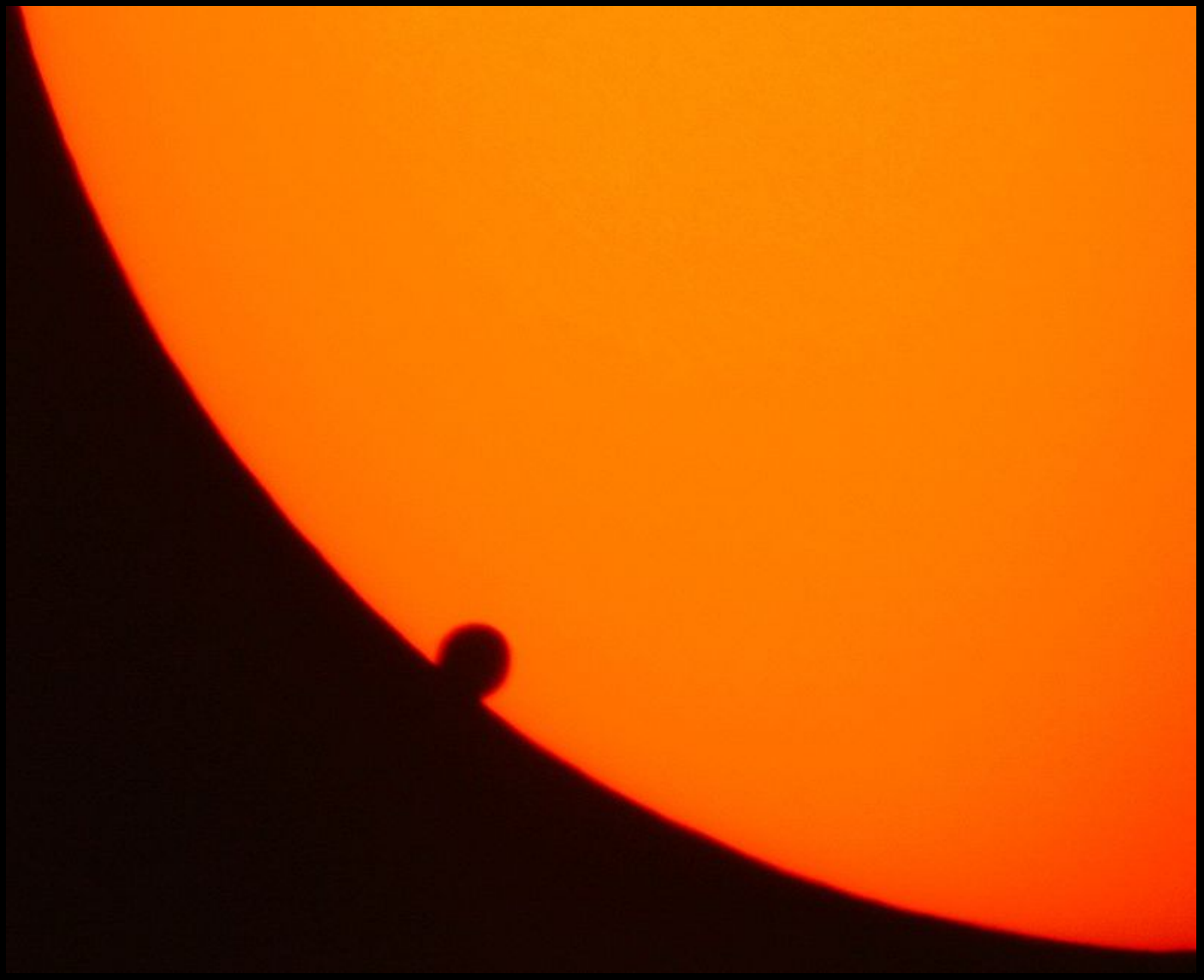
average thermal energy > escape velocity

$$v_{atom} \approx \sqrt{\frac{T}{m_{atom}}}$$

$$v_{esc} \approx \sqrt{\frac{M_{planet}}{r_{planet}}}$$

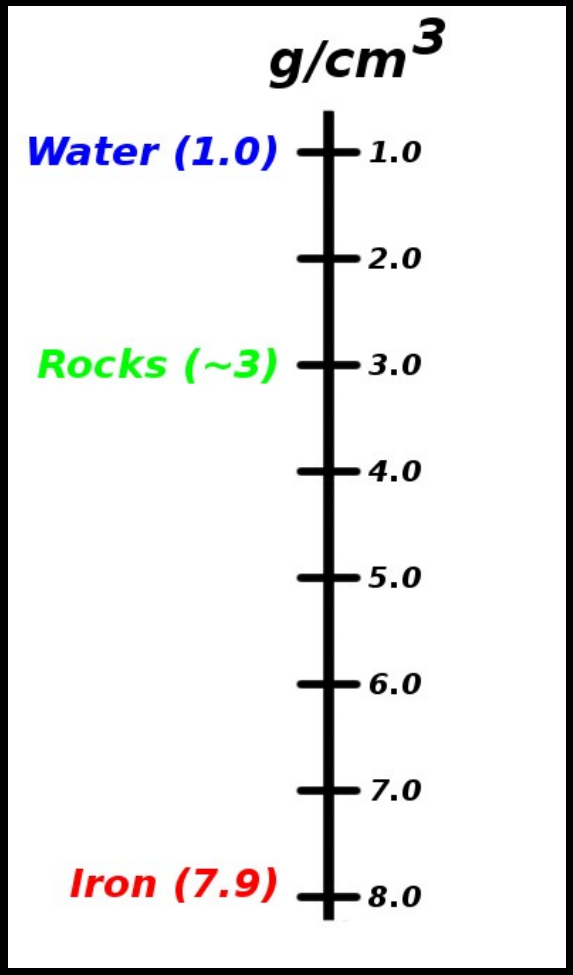

10
1
0.1
Speed (km/sec)
50
100
200
500
1000
Temperature (K)
Jupiter
Saturn
Neptune
Uranus
Earth
Venus
Mars
Mercury
Titan
Moon
Pluto
Triton
Hydrogen
Heluim
Water, Methane, Ammonia
Oxygen, Nitrogen
Carbon Dioxide

Detecting Exoplanet Atmospheres

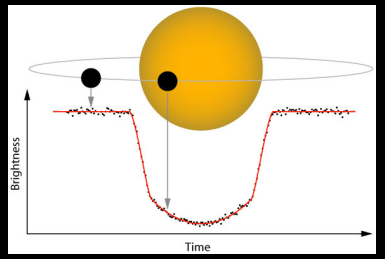


Planet Composition

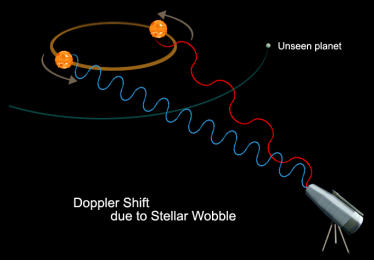
- Density = mass / volume
- Volume of sphere = 4/3*pi*r^3
- Expressed in g/cm^3



Planet Composition



Transit → Radius

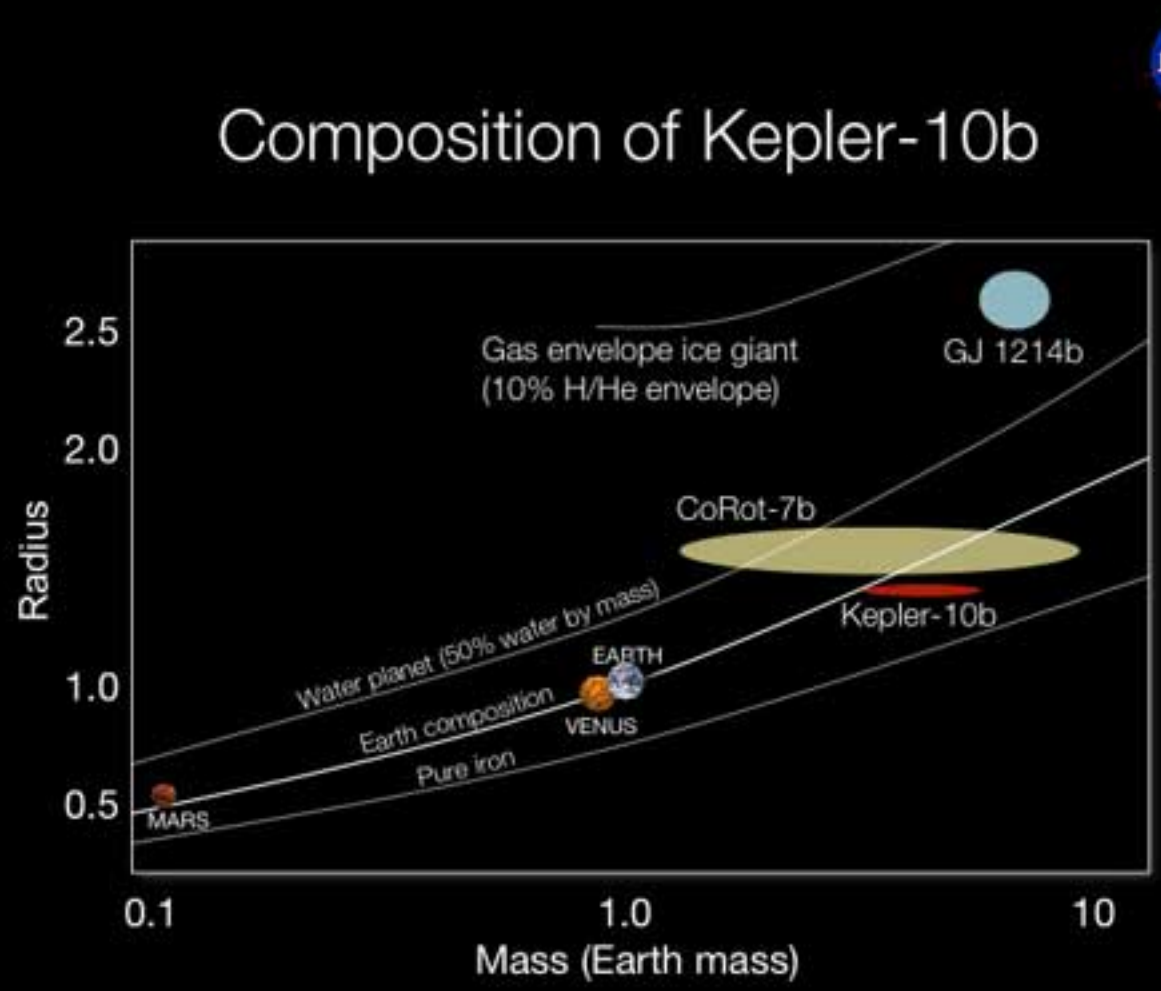


Radial Velocity → Mass

DENSITY

Planet Composition: Example

Earth Radius: 6.37 x 10^8 cm
Earth Mass: 5.97 x 10^27 g

Earth volume = (4/3)*pi*radius^3
= 1.08 x10^27 cm^3
Earth density = mass/volume
~5.5 g/cm^3

Planet Composition: Exoplanets