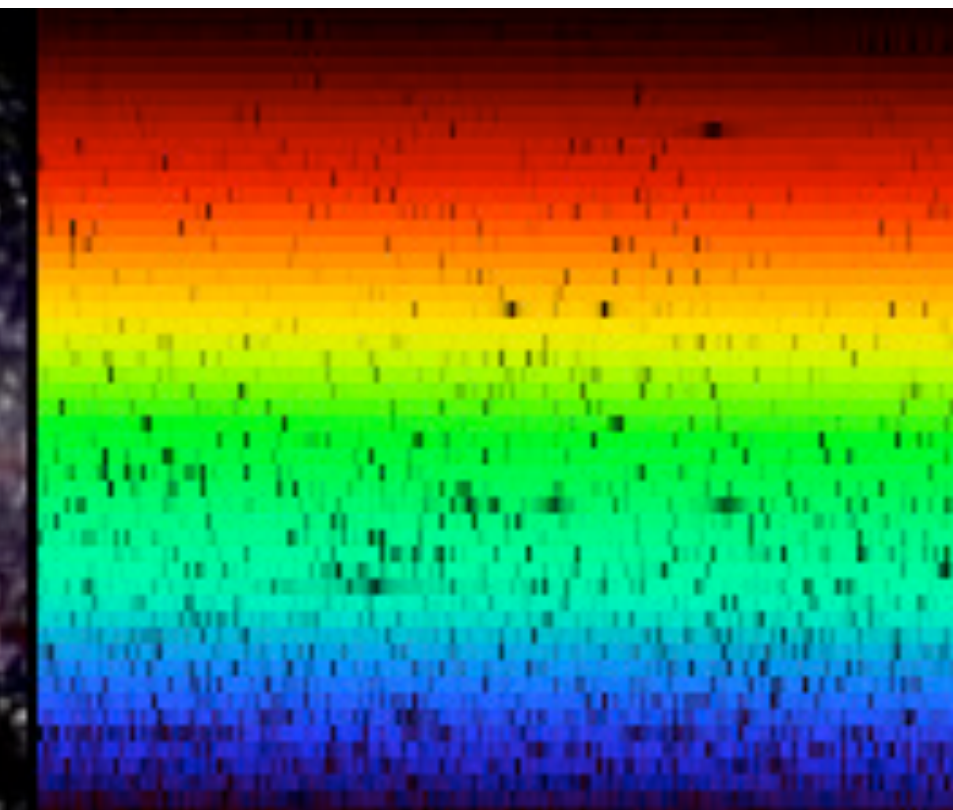




# ASTR/PHYS 3070: Foundations Astronomy



## Week 7 Tuesday

### Today's Agenda

- Project PSA / Midterm 1 Results
- Observing “invisible” light
- Sun / Solar System
- Albedo

### Announcements / Reminders

- HW 5 available, due Friday 1min before midnight
- Read Chapters 7.1, 8.1-2, 11.1-2, 12.3-4
  - Ch. 13 for after fall break, which is next week!
- HEAP talk at 4pm on Thursday
  - From Big to Huge: Pathway to Neutrino Discoveries
- Colloquium at 2pm on Friday
  - whatever John McGreevy from UCSD does...

# Communicating Science Project

<https://www.astro.utah.edu/~wik/courses/astr3070fall2021/projects.html>



**ASTR/PHYS 3070:  
Foundations Astronomy**

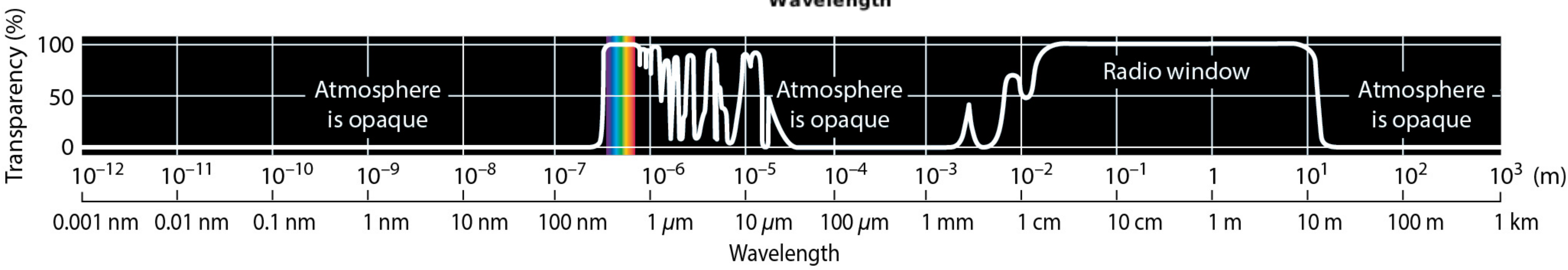
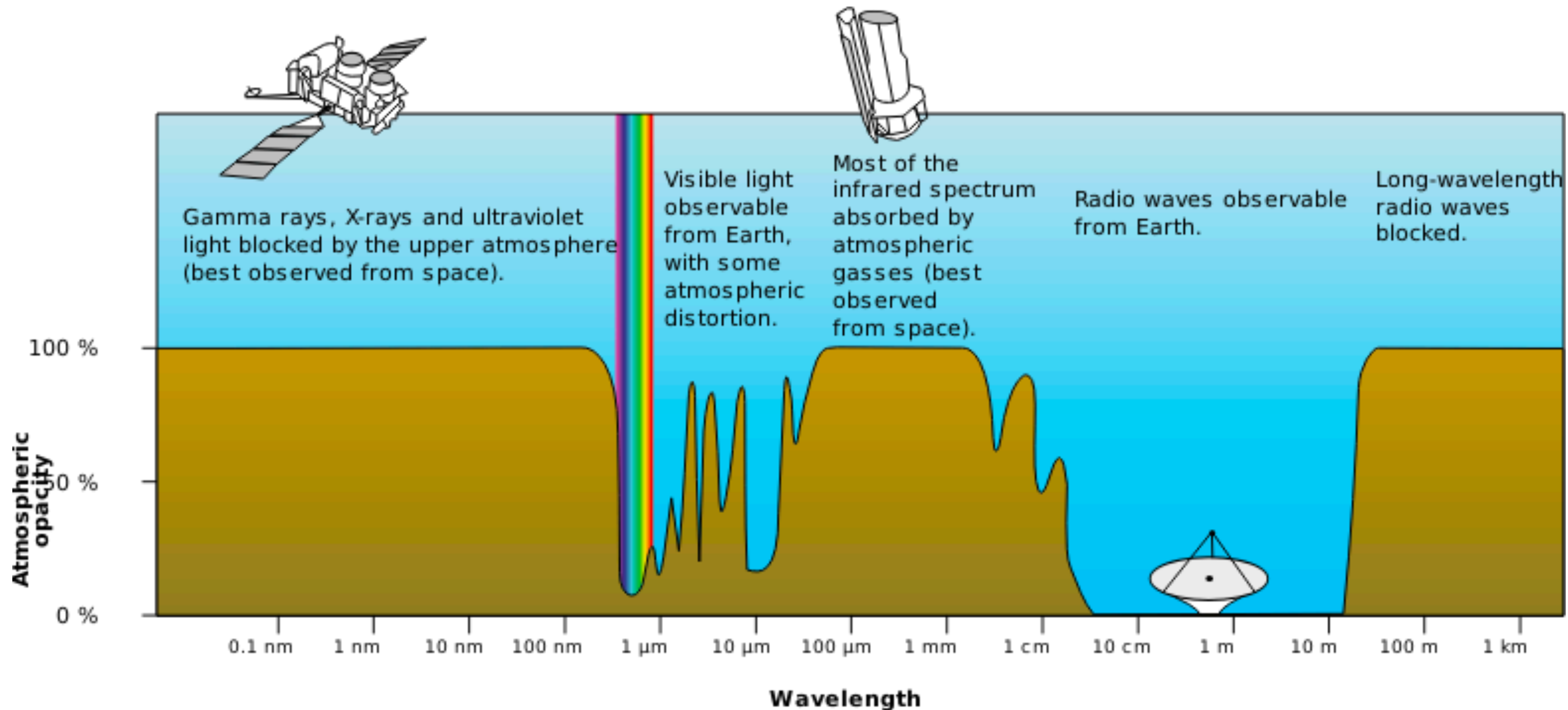
[Syllabus](#)   [Lectures](#)   [Assignments](#)   [Projects](#)   [Courses](#)

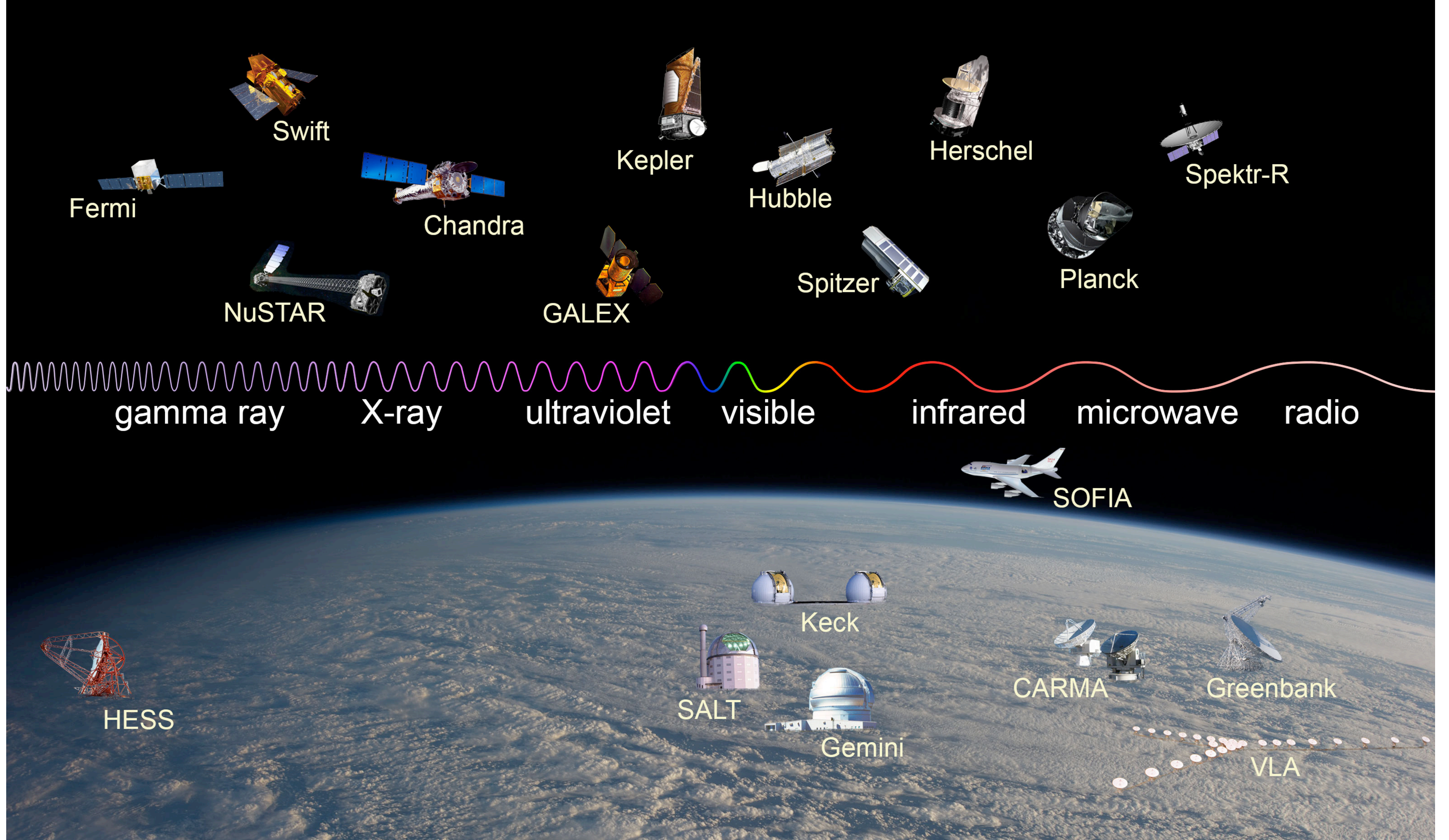
## Communicating Science Project

During the last week of the semester, each student or group will give a short presentation of their Communicating Science project. The topic and scope will be approved by the instructor ahead of time, as part of homework questions and through one-on-one meetings to discuss the project.

### Summary

Students will (1) choose an astrophysical concept and (2) design a method of explaining the concept to a non-scientist who has not taken the class. This method may take one of many forms, but should be aimed at teaching the concept at a non-specialist level.

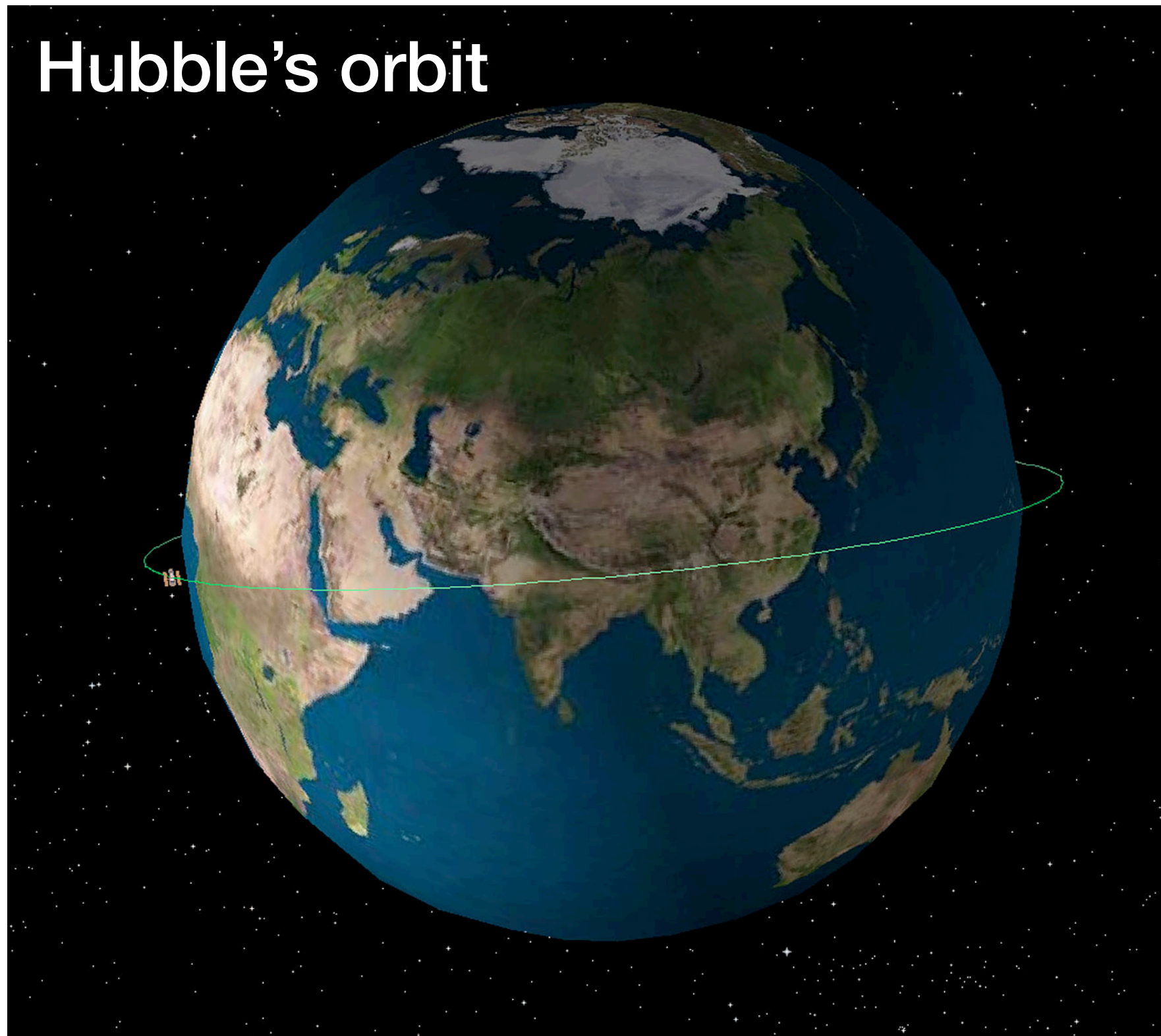




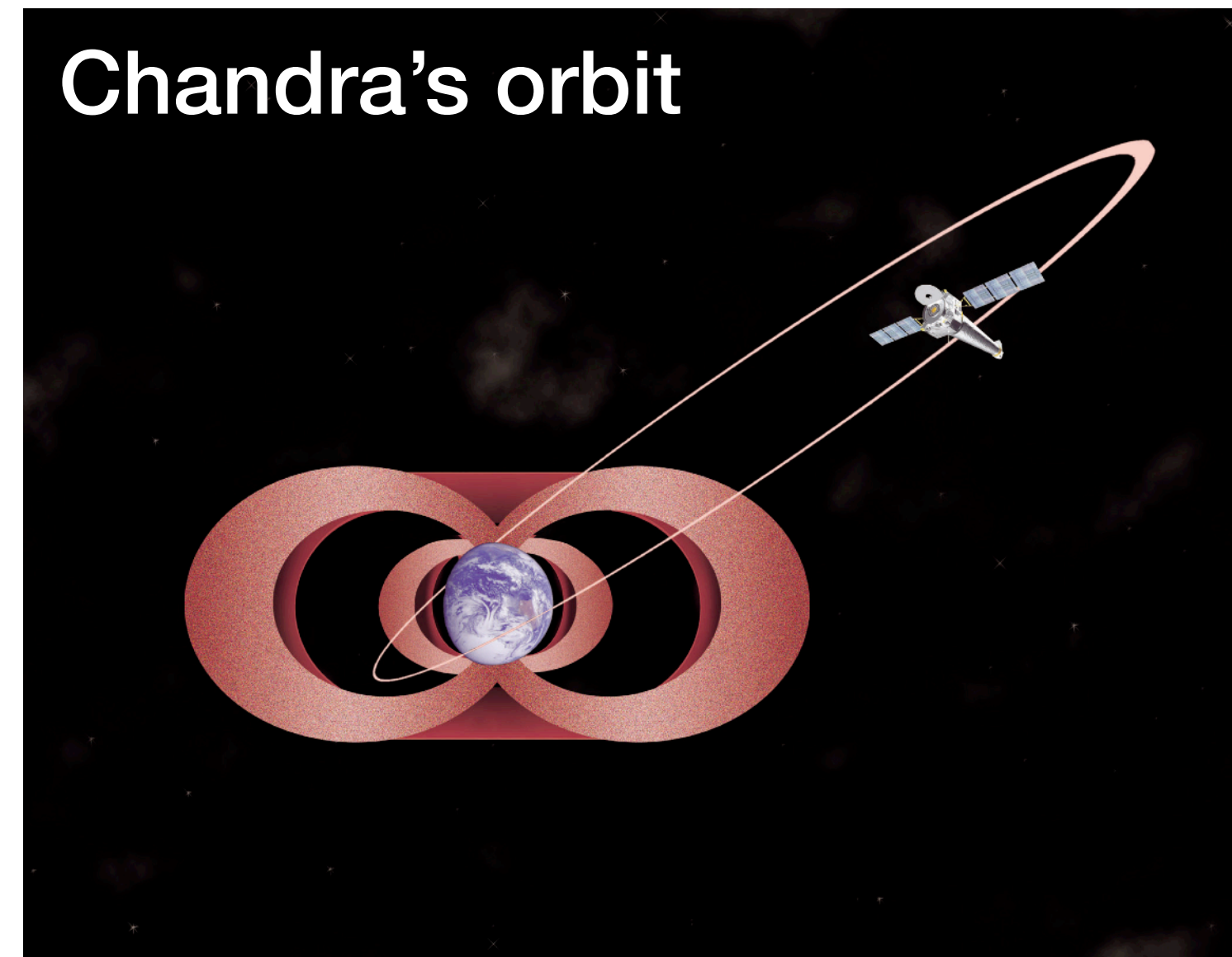
# 3 Misconceptions about Telescopes in Space

- From space, objects can be observed continuously, even during the day
- The sky is much darker in space than on the Earth
- Observations from space are not affected by weather

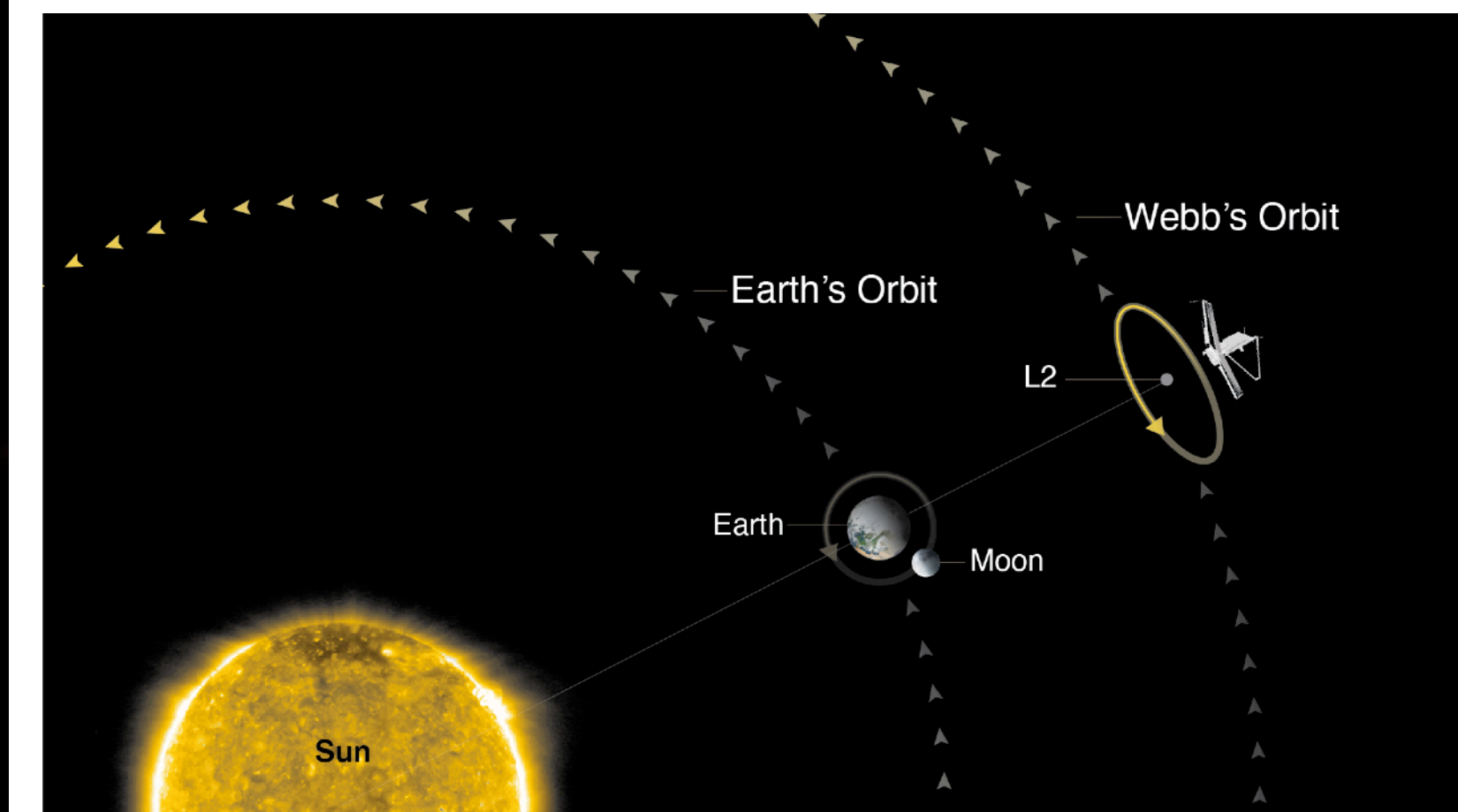
Hubble's orbit



Chandra's orbit



JWST's orbit

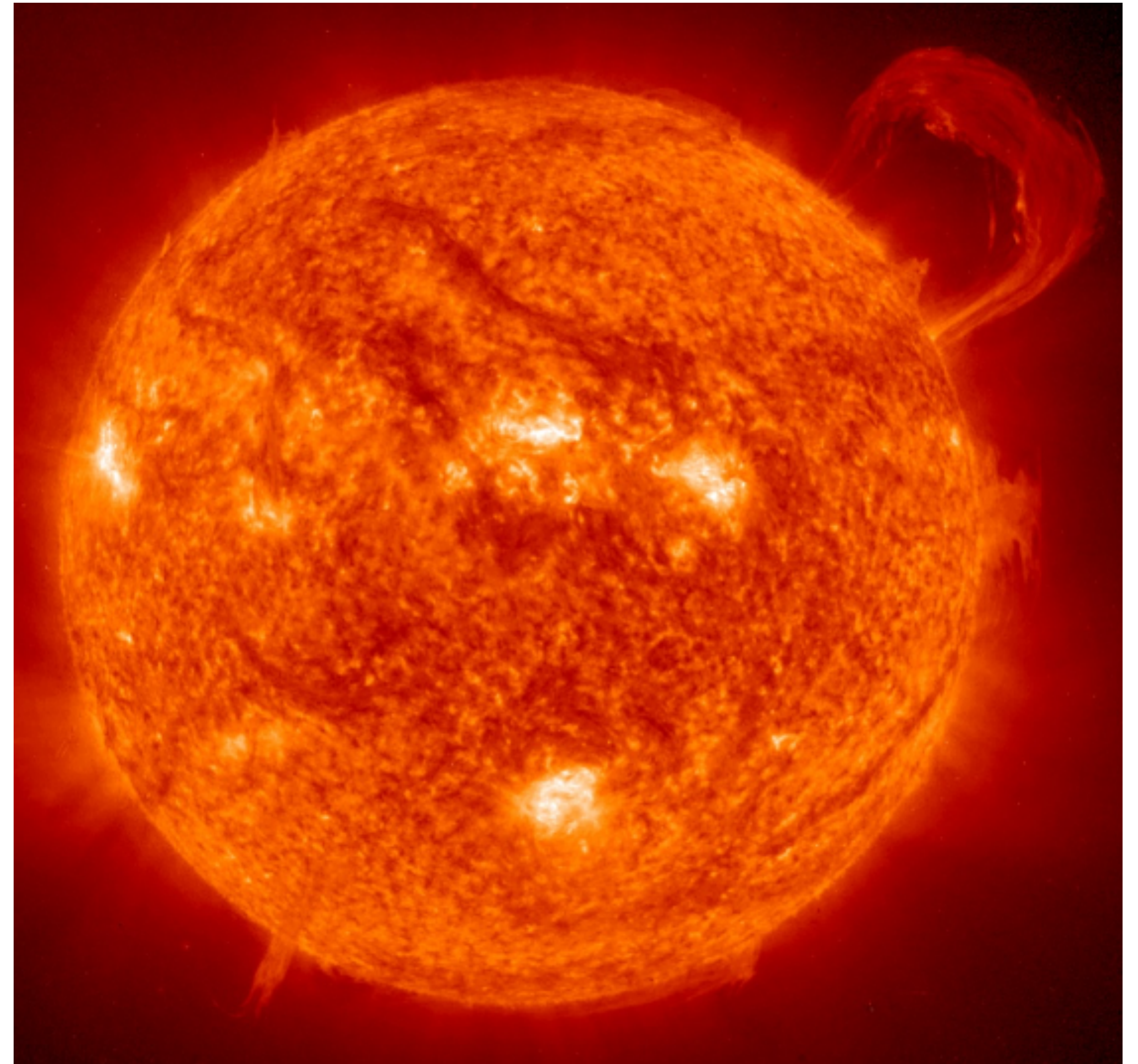


# Sun / Solar System

# Solar System

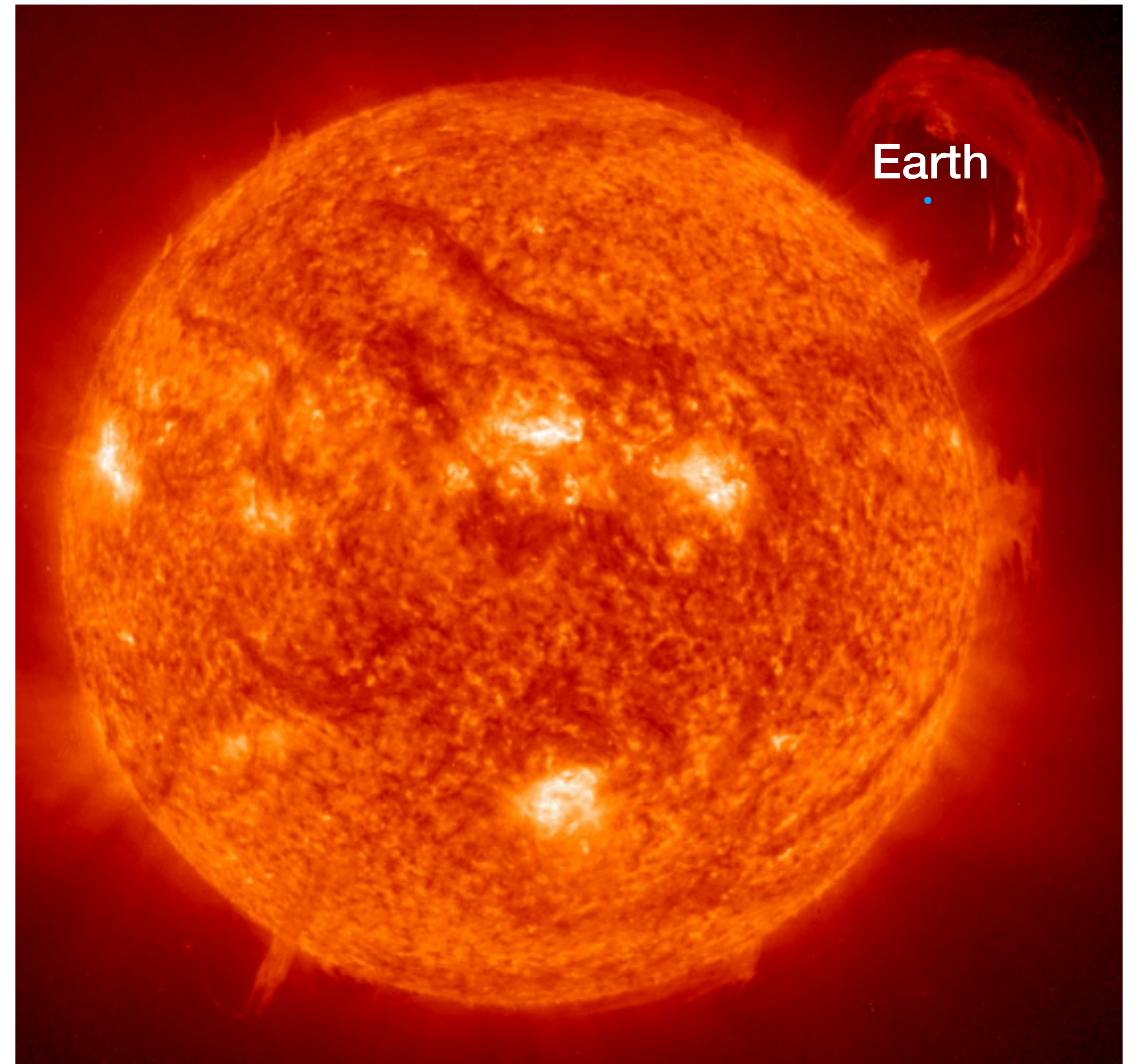
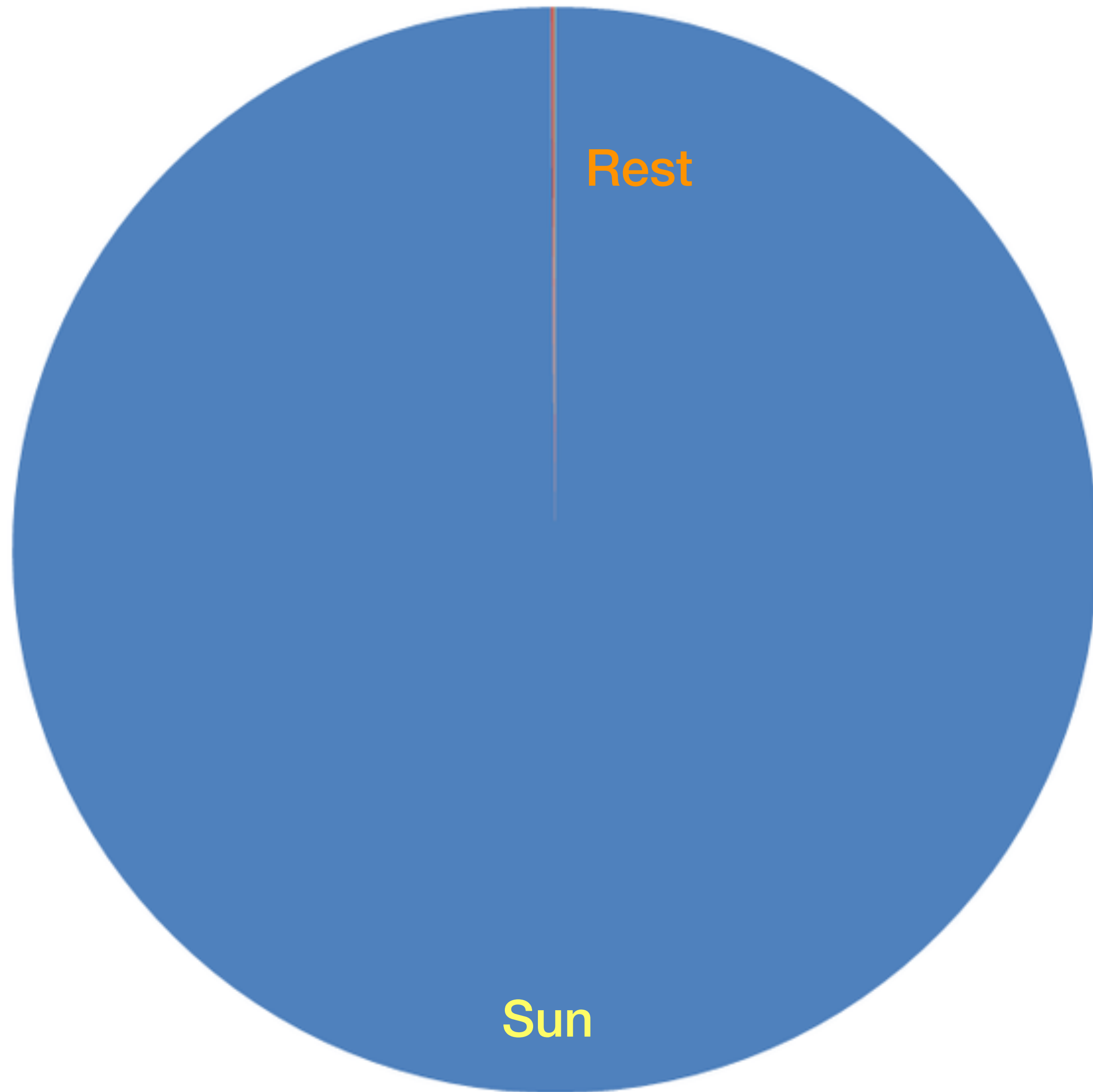


# Mass Fractions





# Mass Fractions



# Structure of the Sun

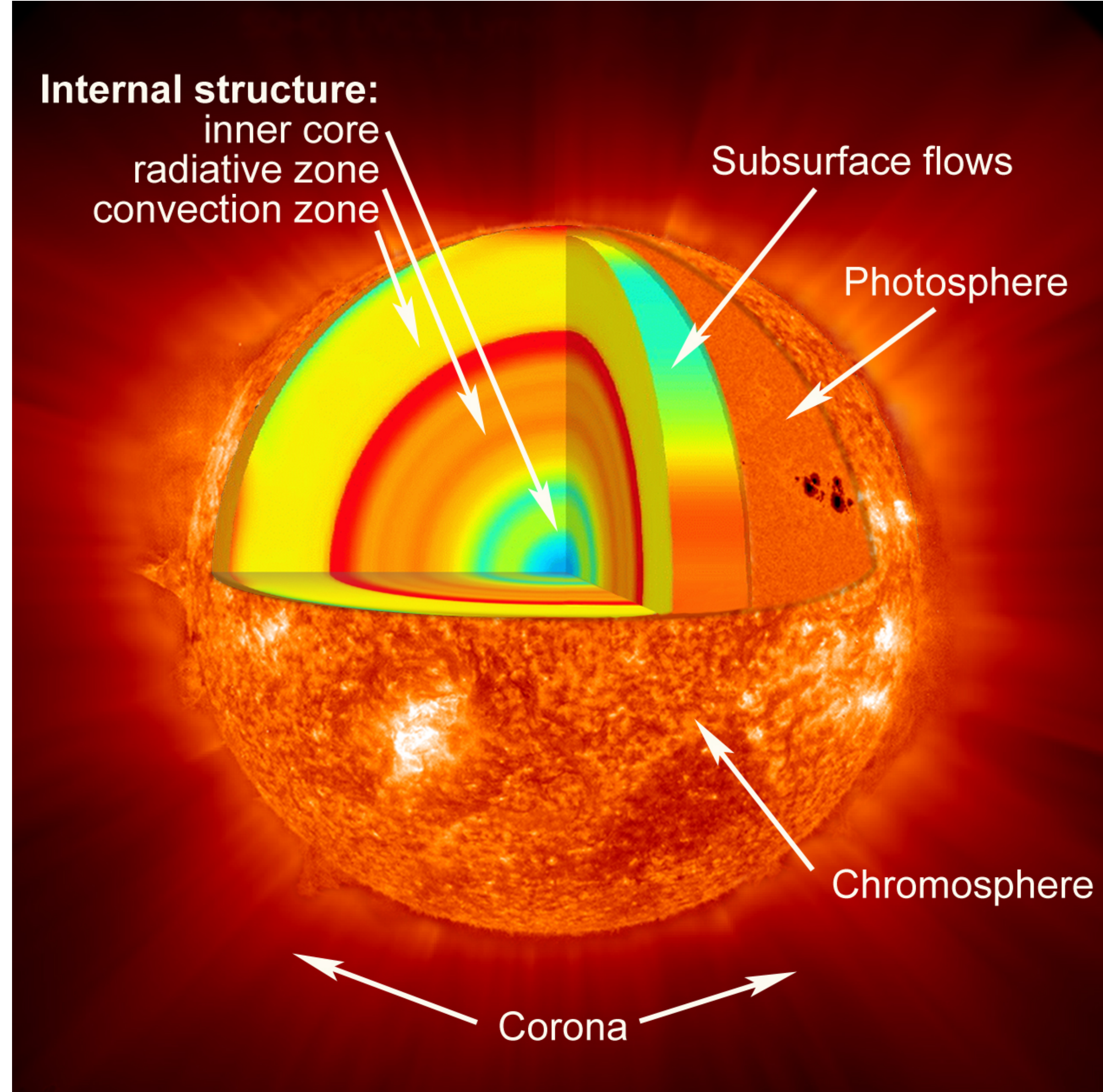
**Core:**

**~15 million K**

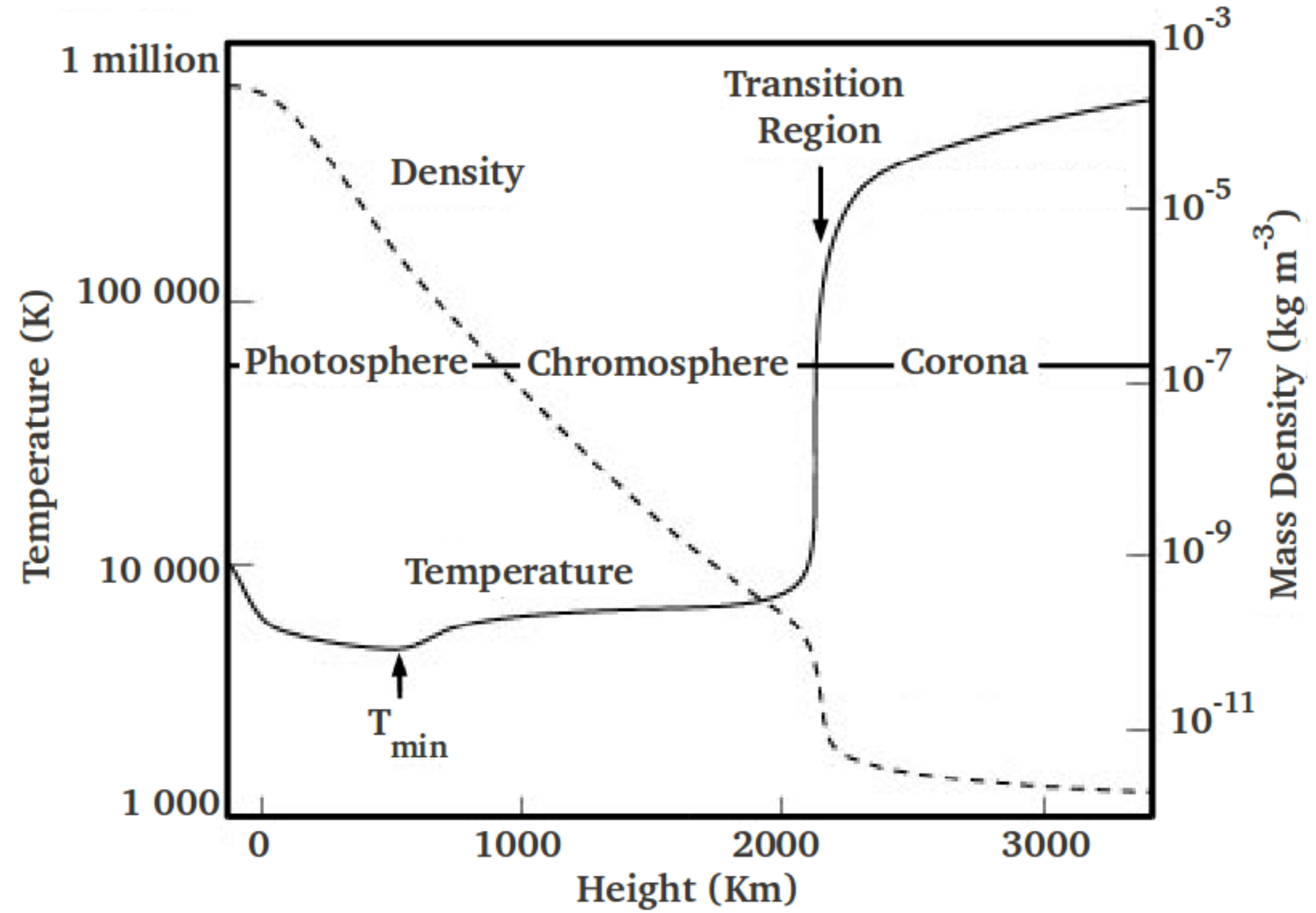
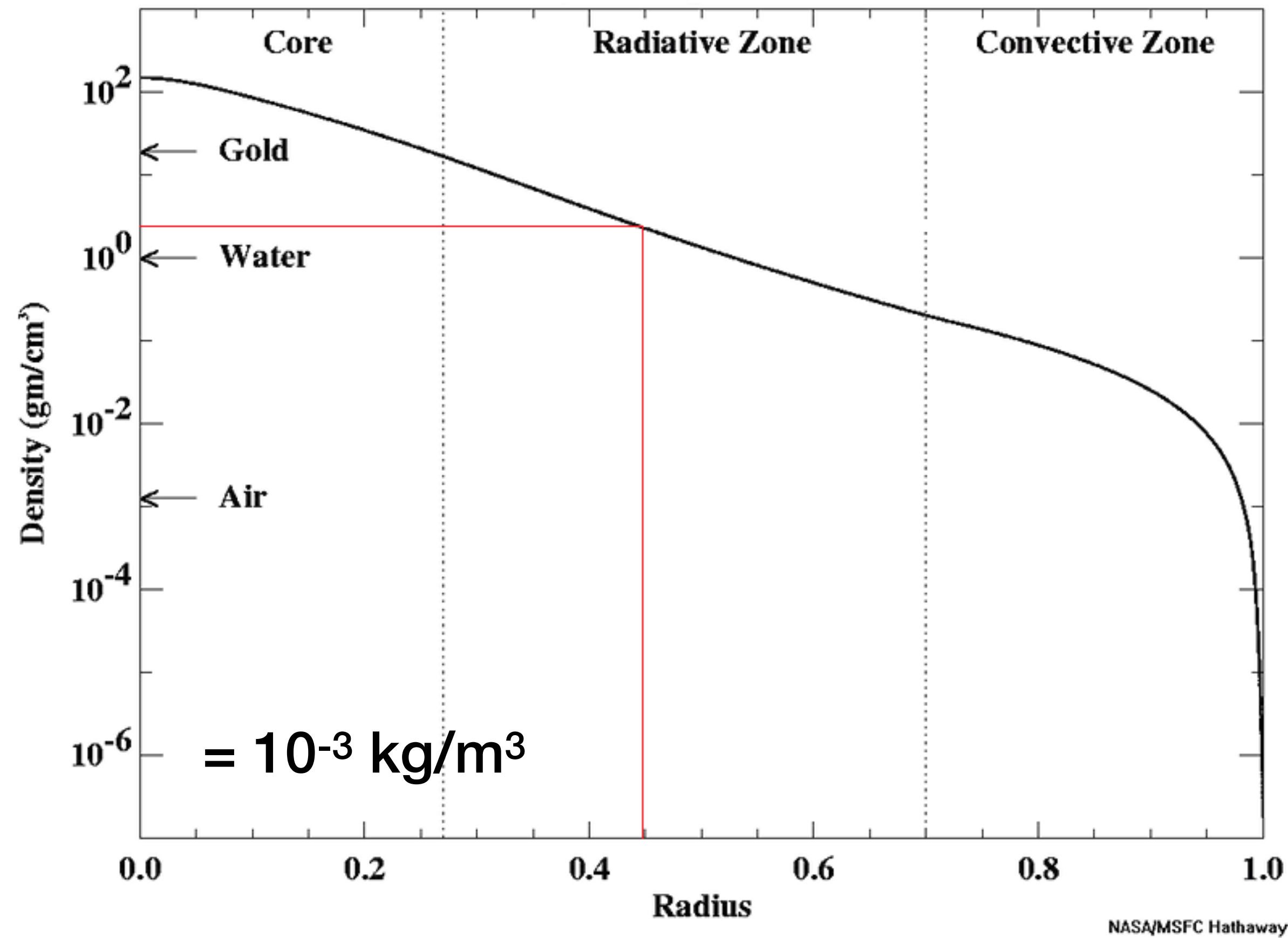
**H → He fusion produces Sun's photons**

**Photons take ~100,000 years to travel through the Sun, then take 8 min to reach the Earth**

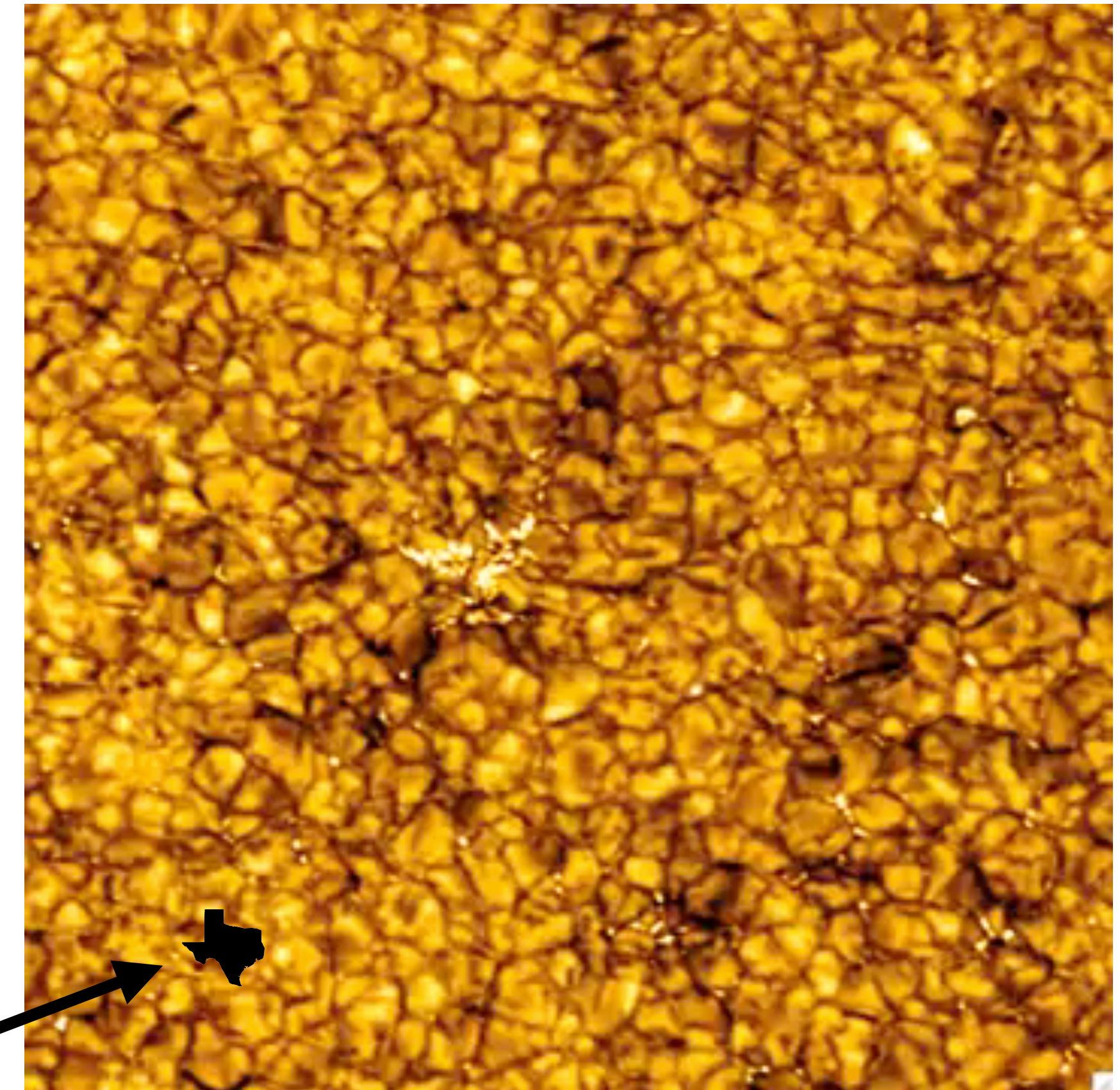
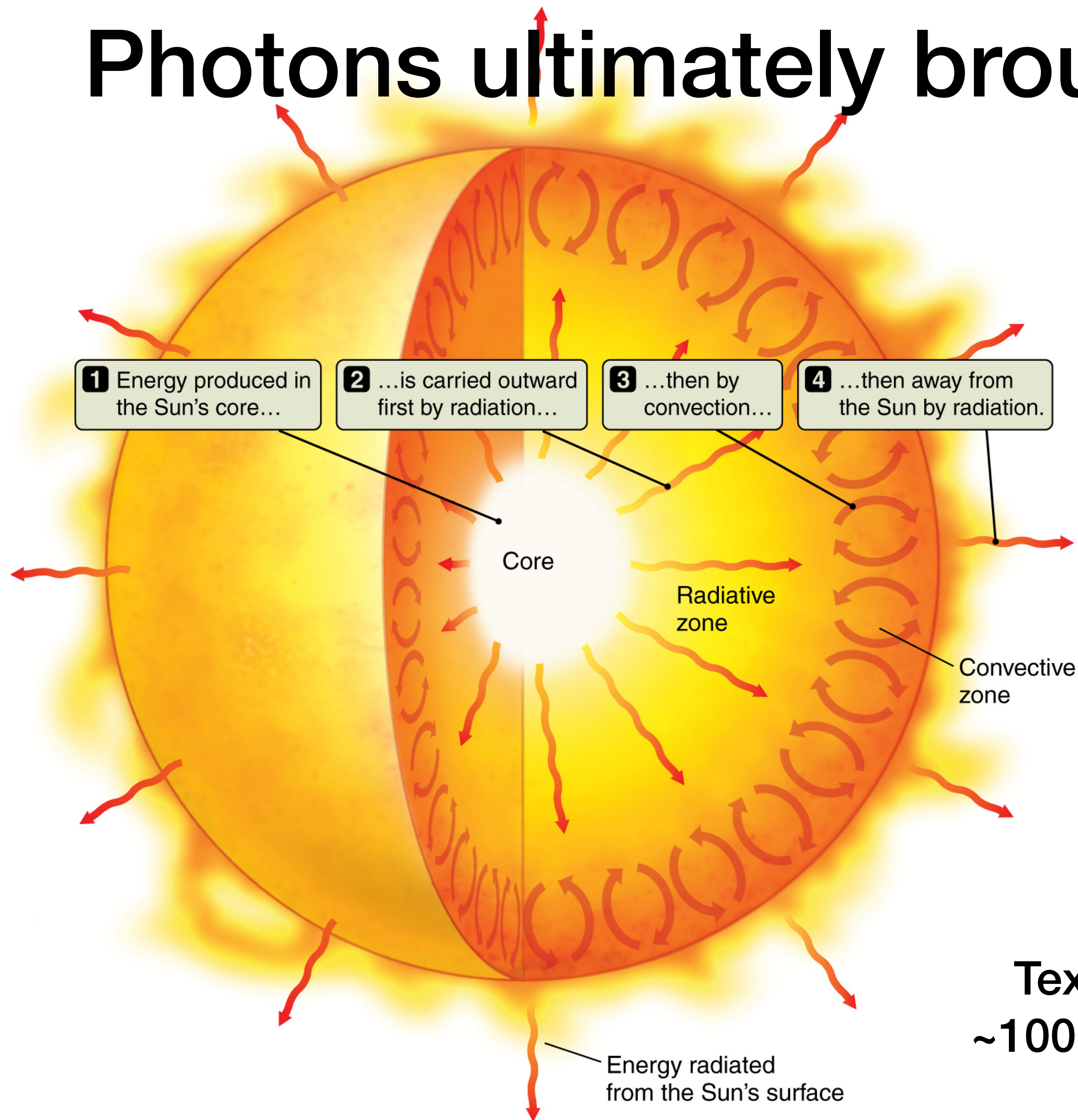
**Temperature decreases outside the core until it falls to 5780 K at the "surface"**



# Temperature & Density Profiles of the Sun



# Photons ultimately brought by convection cells

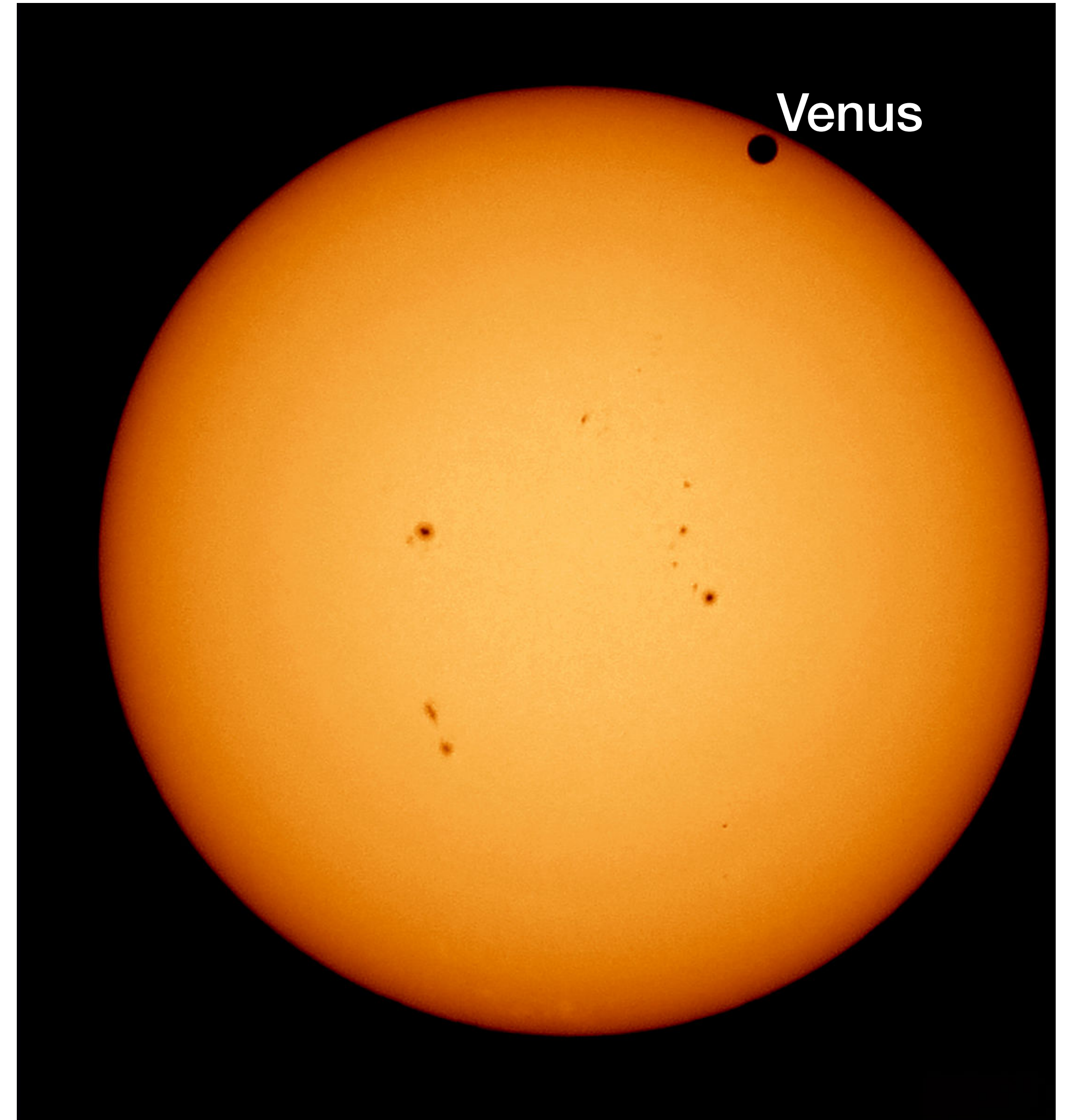
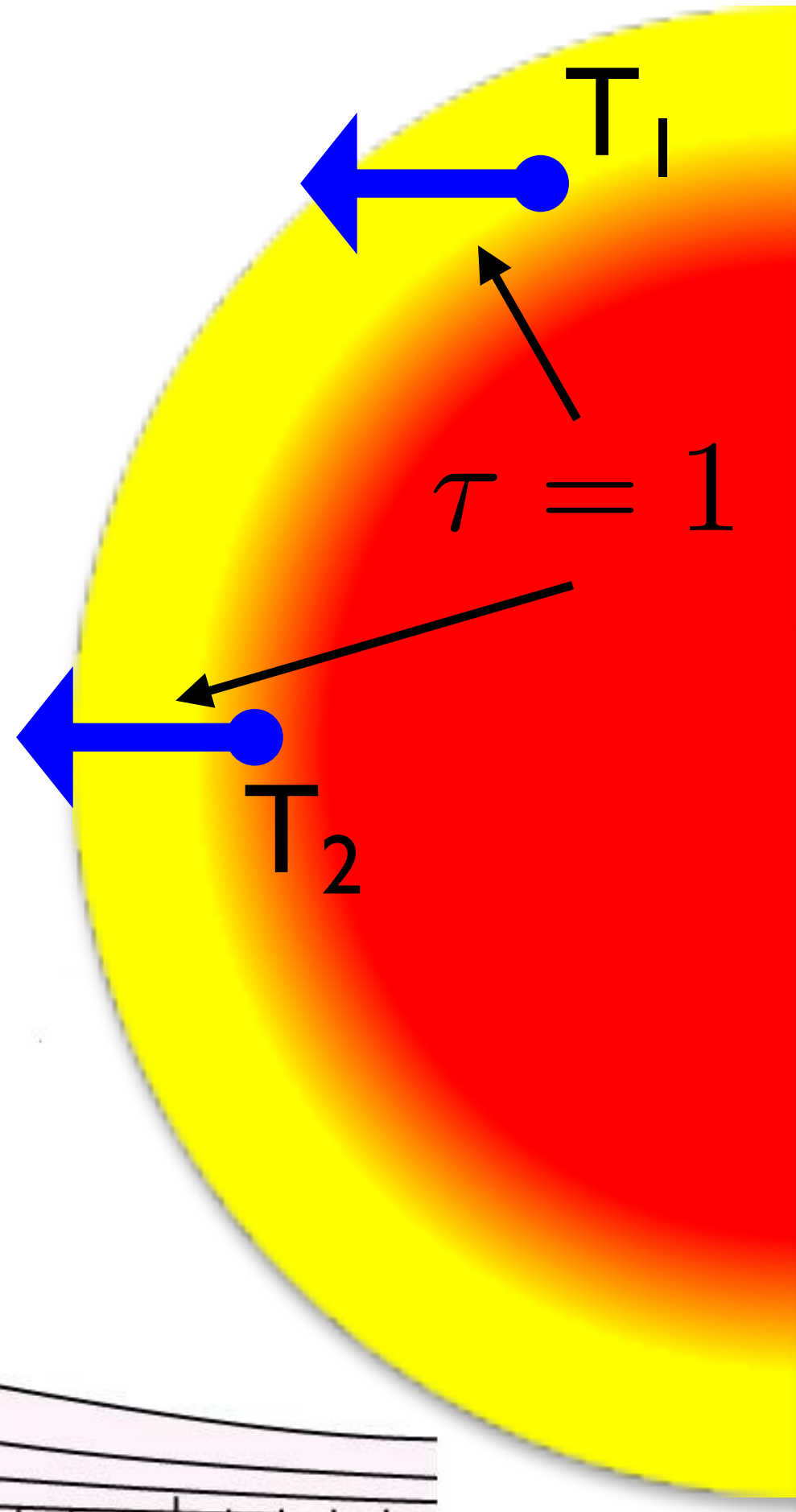
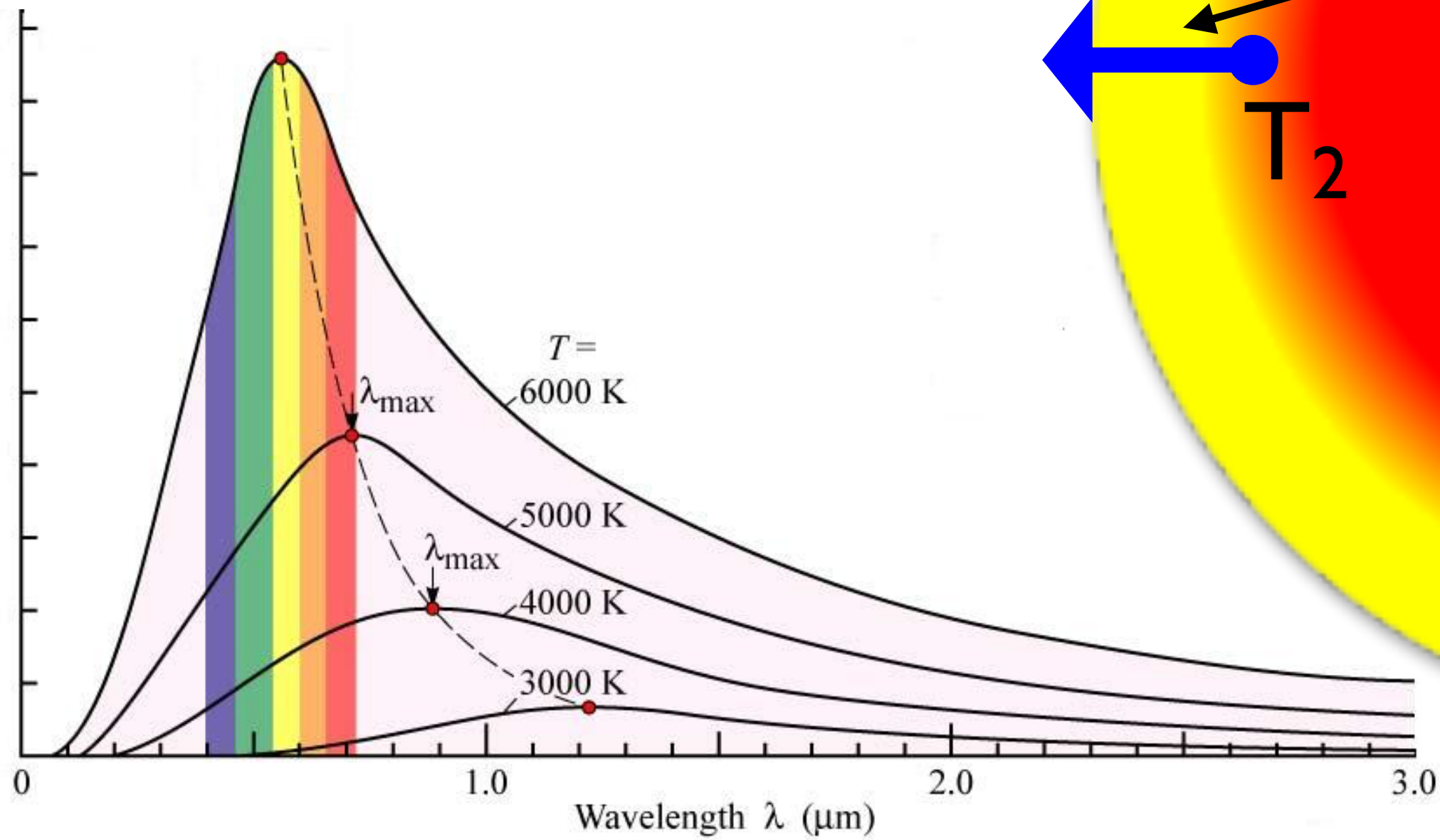


Texas  
~1000 km

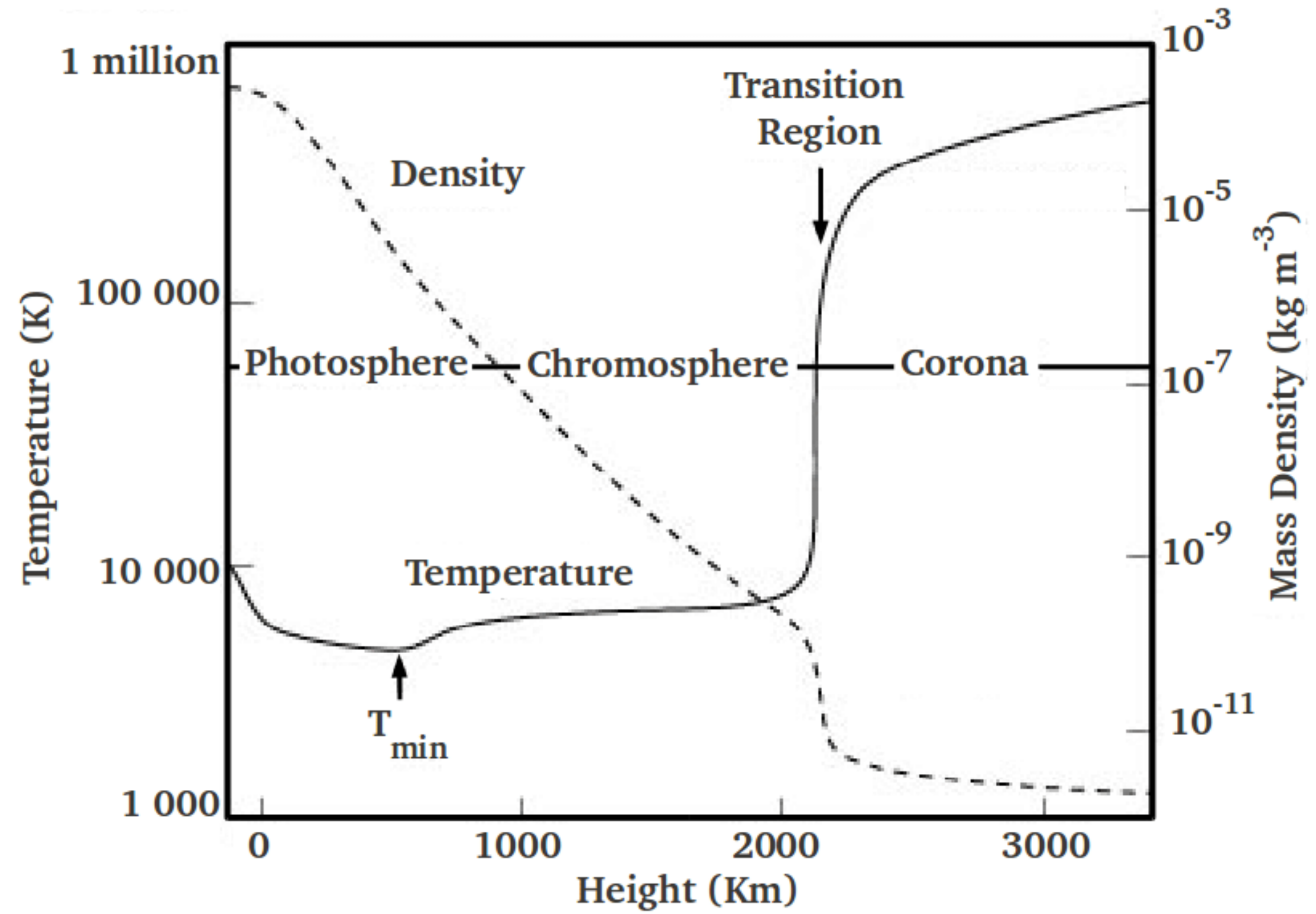
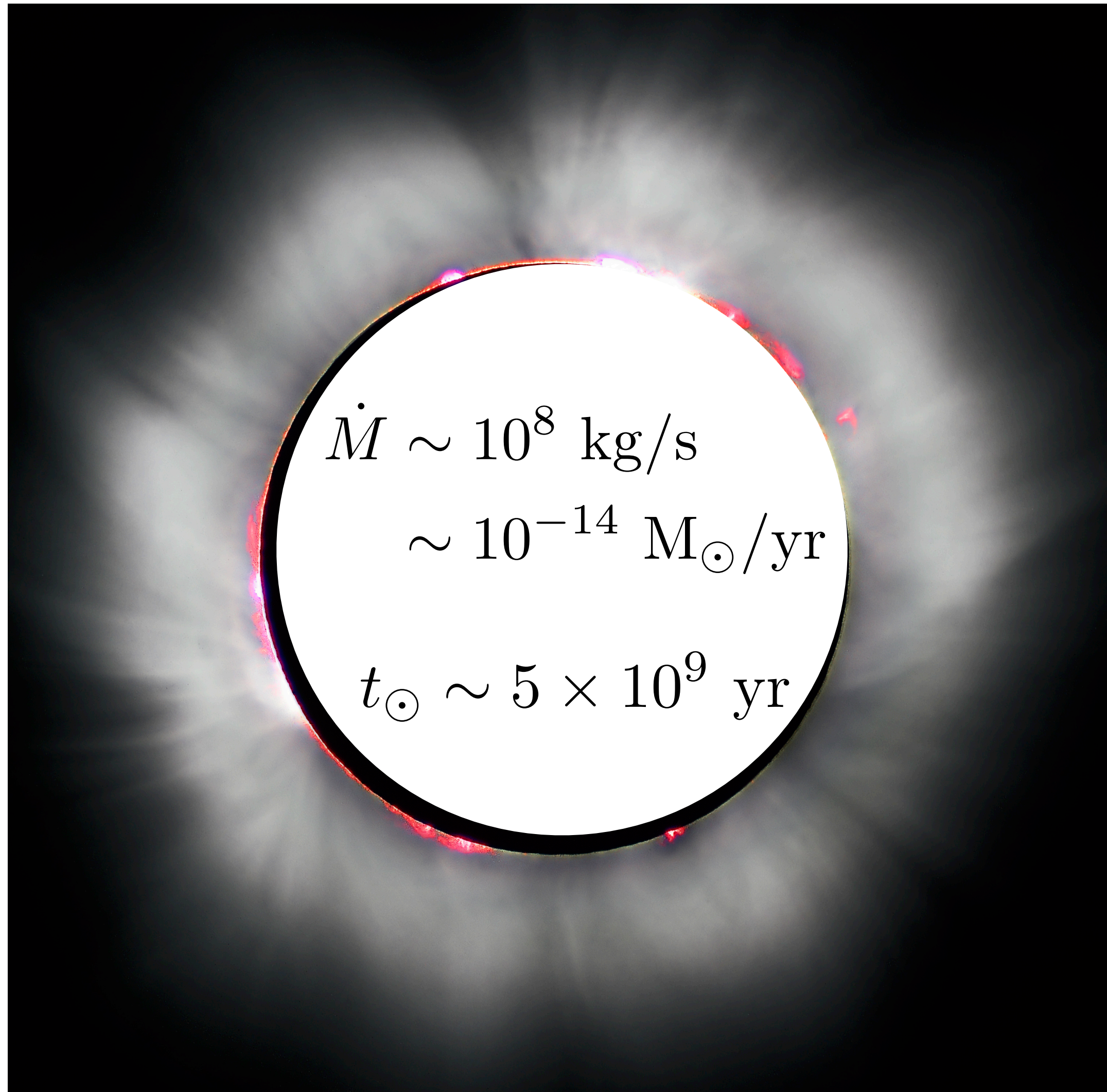
[https://www.youtube.com/watch?v=W\\_Scoj4HqCQ](https://www.youtube.com/watch?v=W_Scoj4HqCQ)

# Photosphere: Limb Darkening

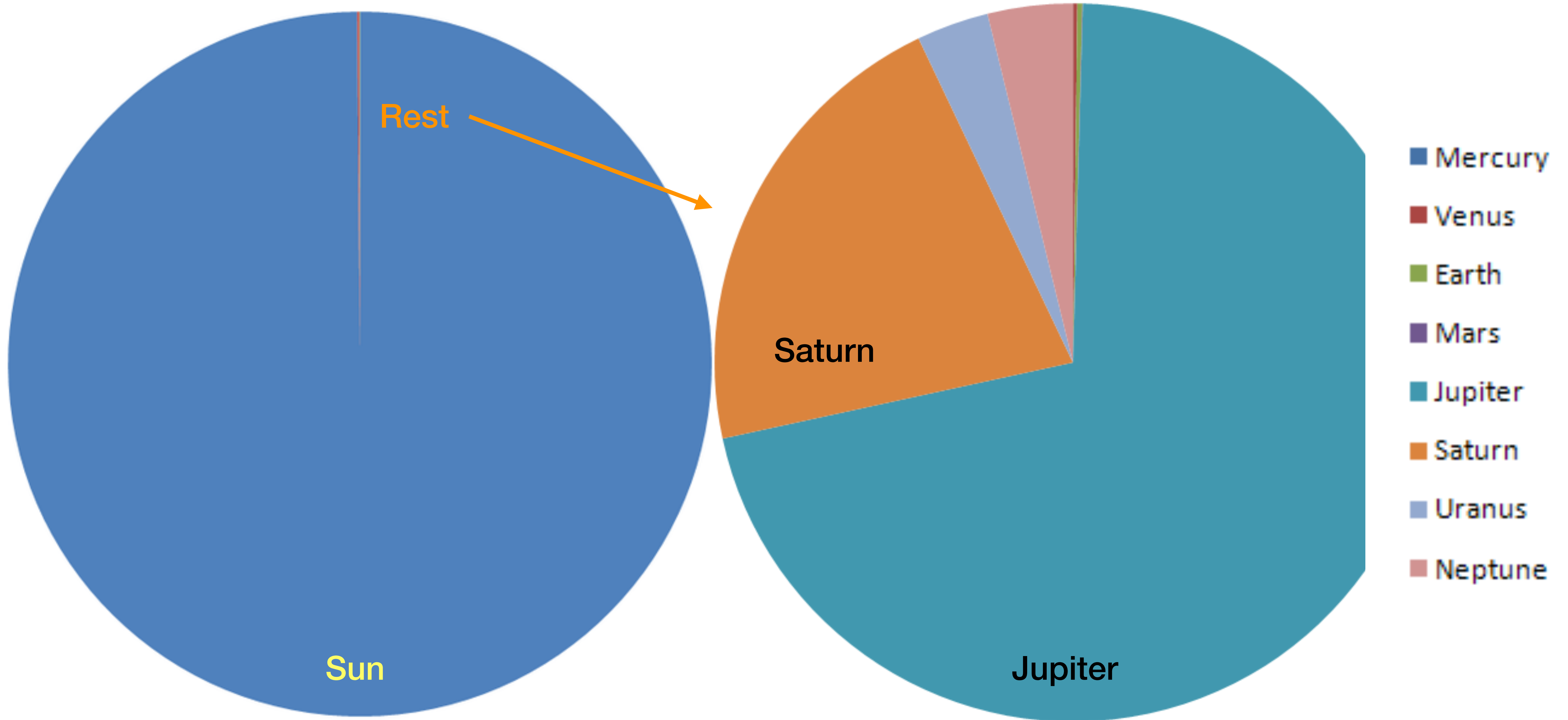
$$T_2 > T_1$$
$$I_\lambda(T_2) > I_\lambda(T_1)$$



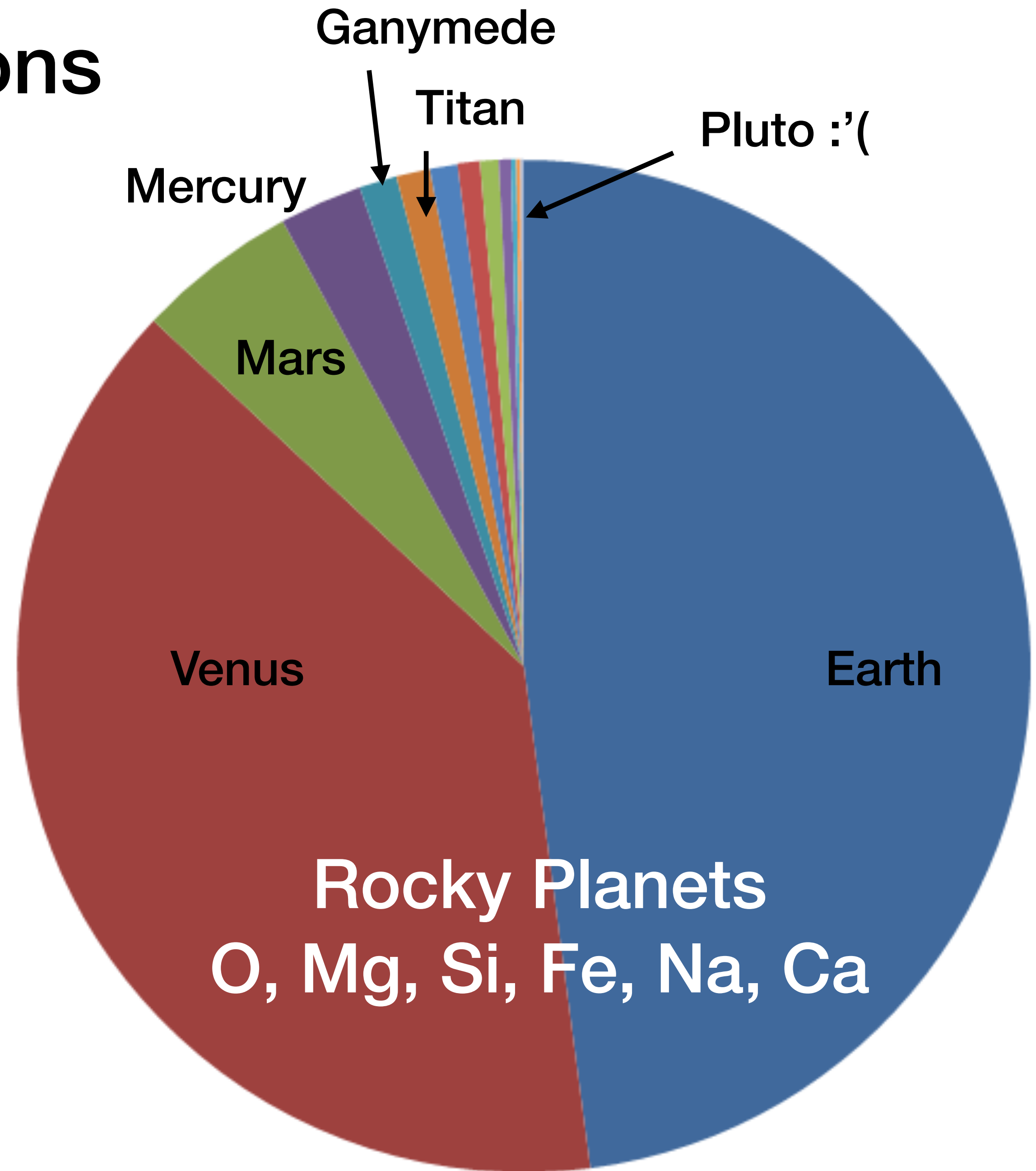
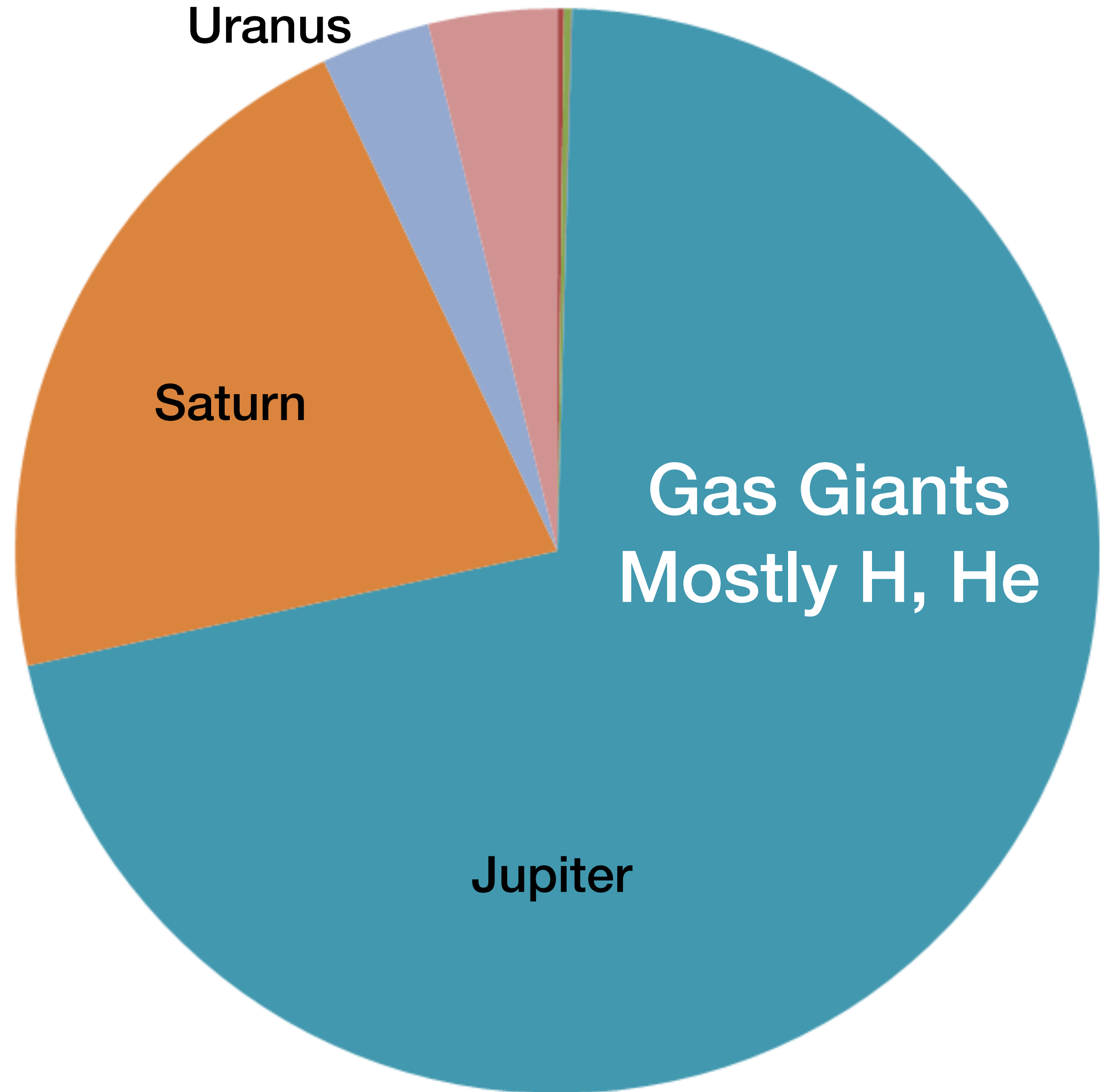
# Corona: high T allows particles to reach $v_{\text{esc}}$



# Mass Fractions



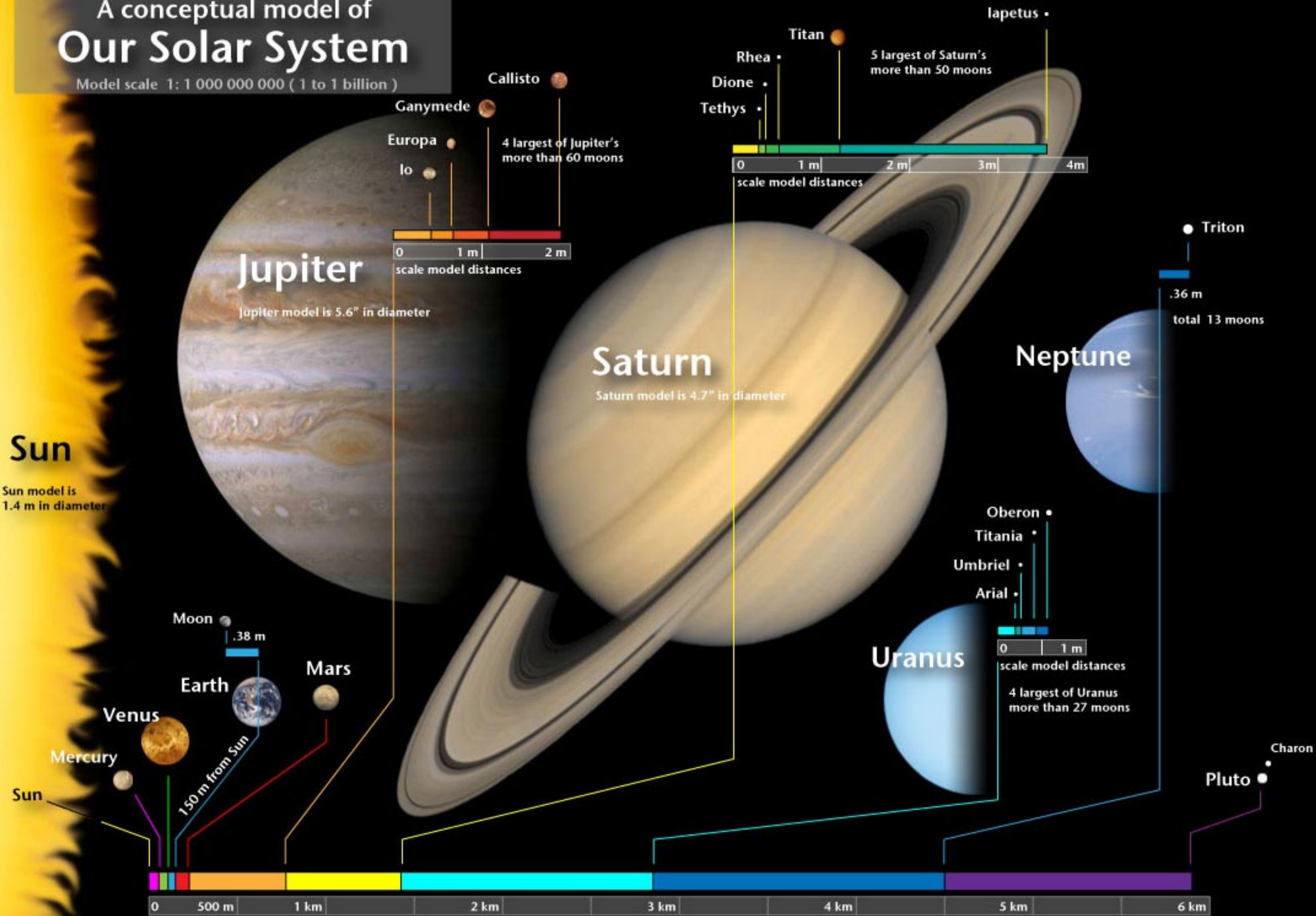
# Mass Fractions





# A conceptual model of Our Solar System

Model scale 1: 1 000 000 000 ( 1 to 1 billion )



Interplanetary distance scale. The orbit of model Pluto (just 2.3 mm across) averages almost 6 kilometers from the model Sun.

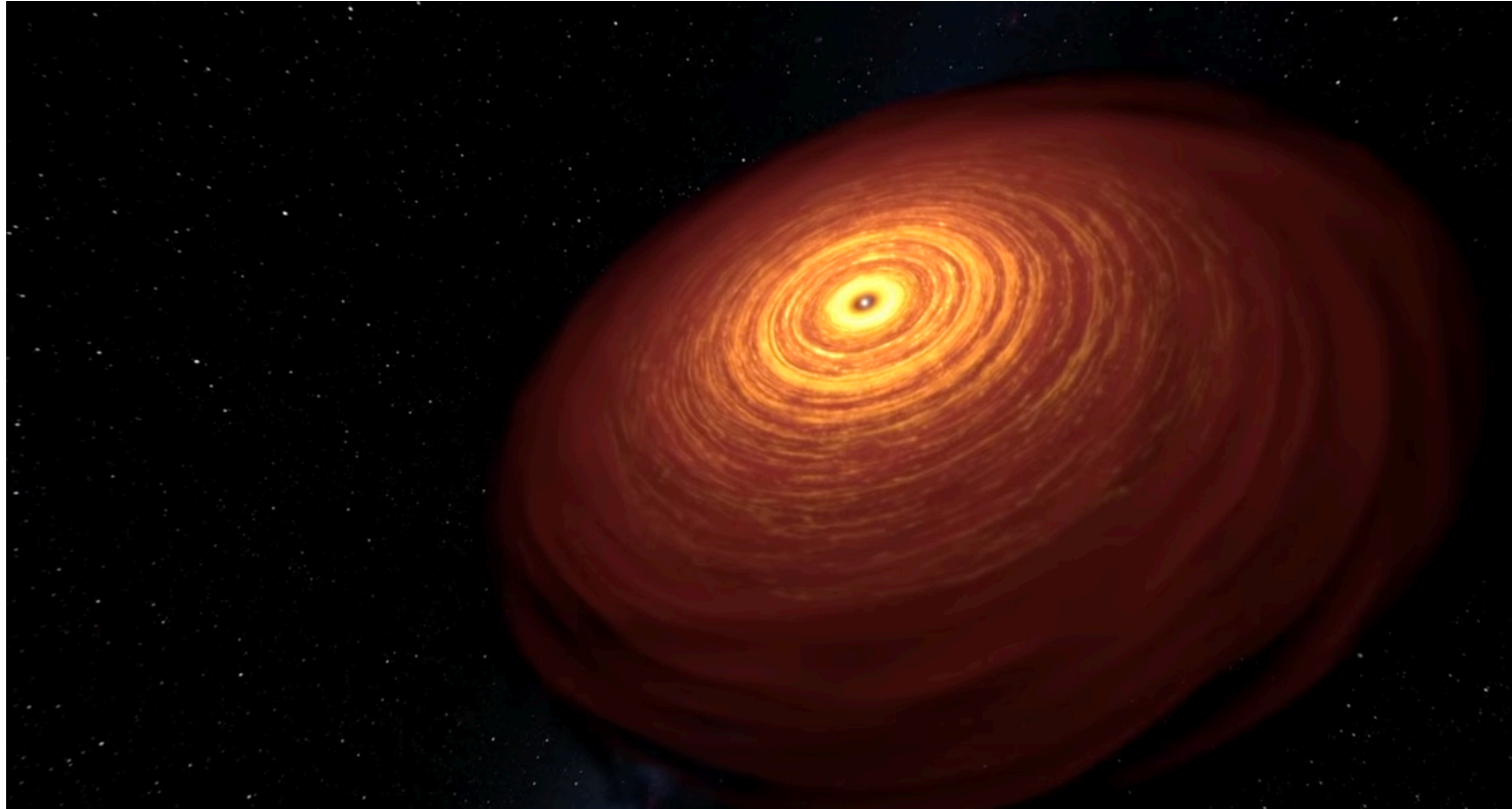
Oort Cloud  
(origin of long-period comets)

Outer planets  
& Kuiper belt

Inner planets  
& asteroid belt

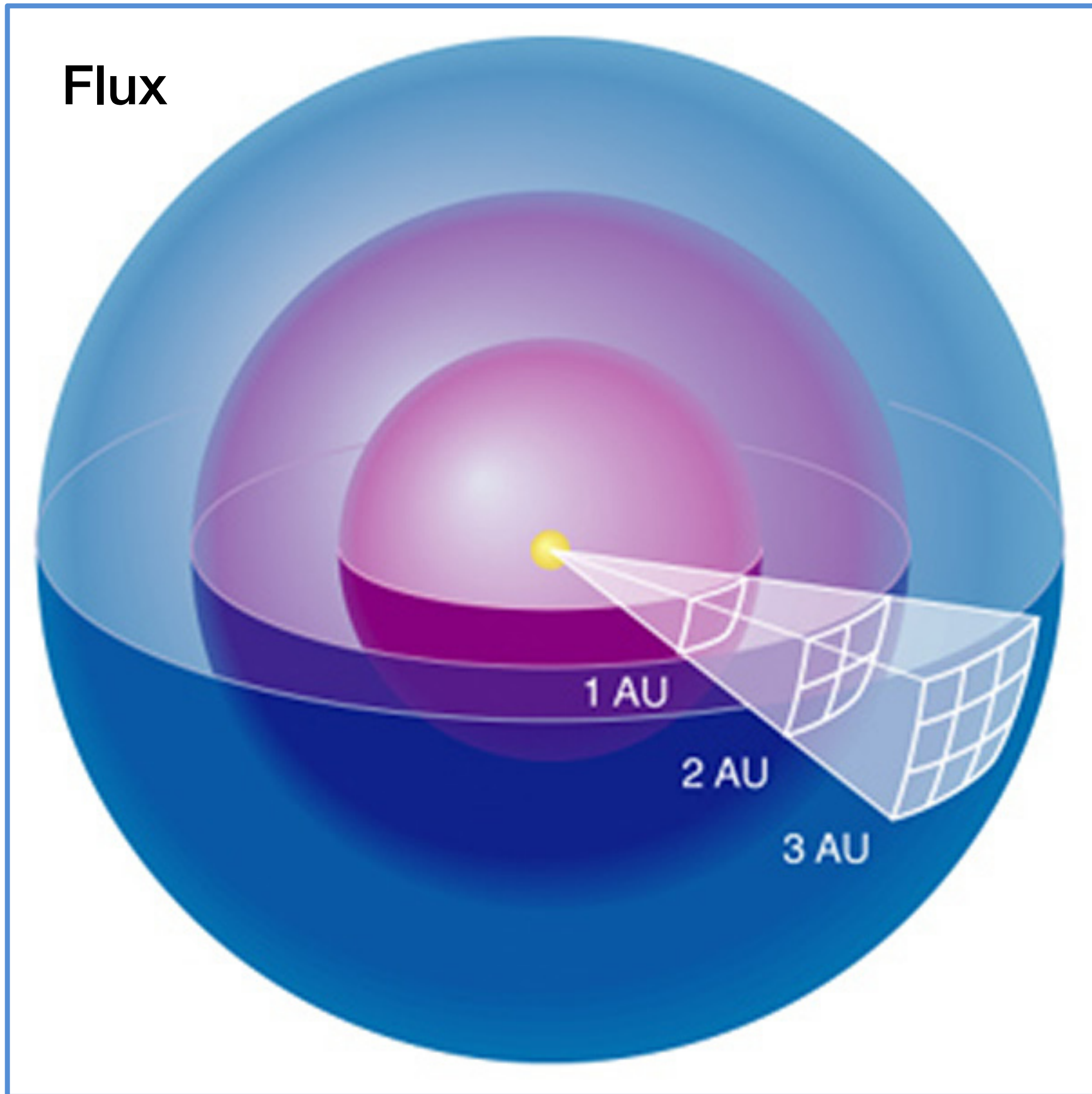


<https://www.youtube.com/watch?v=yXq1i3HlumA&feature=youtu.be>

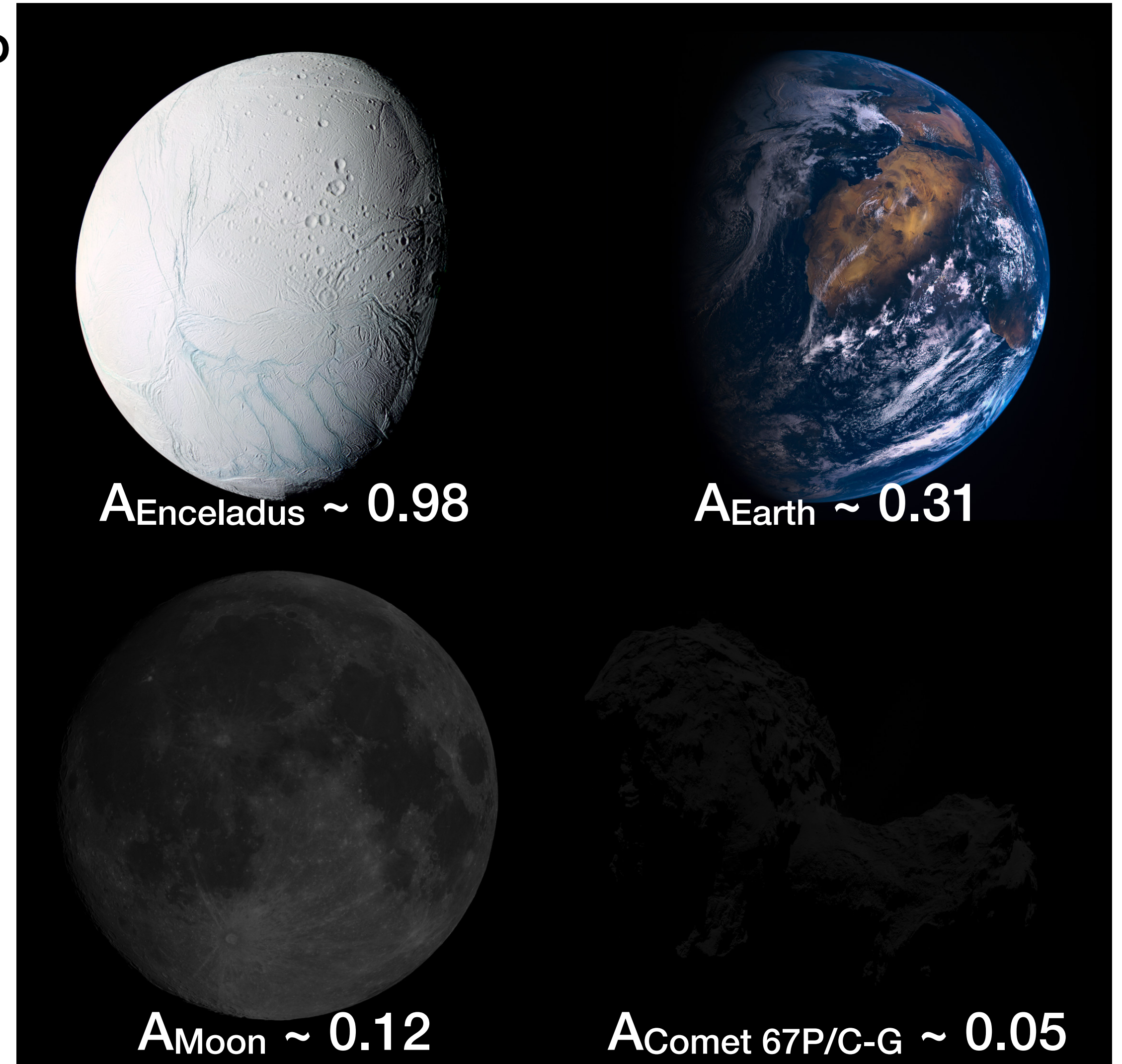


# How do we learn about solar system objects?

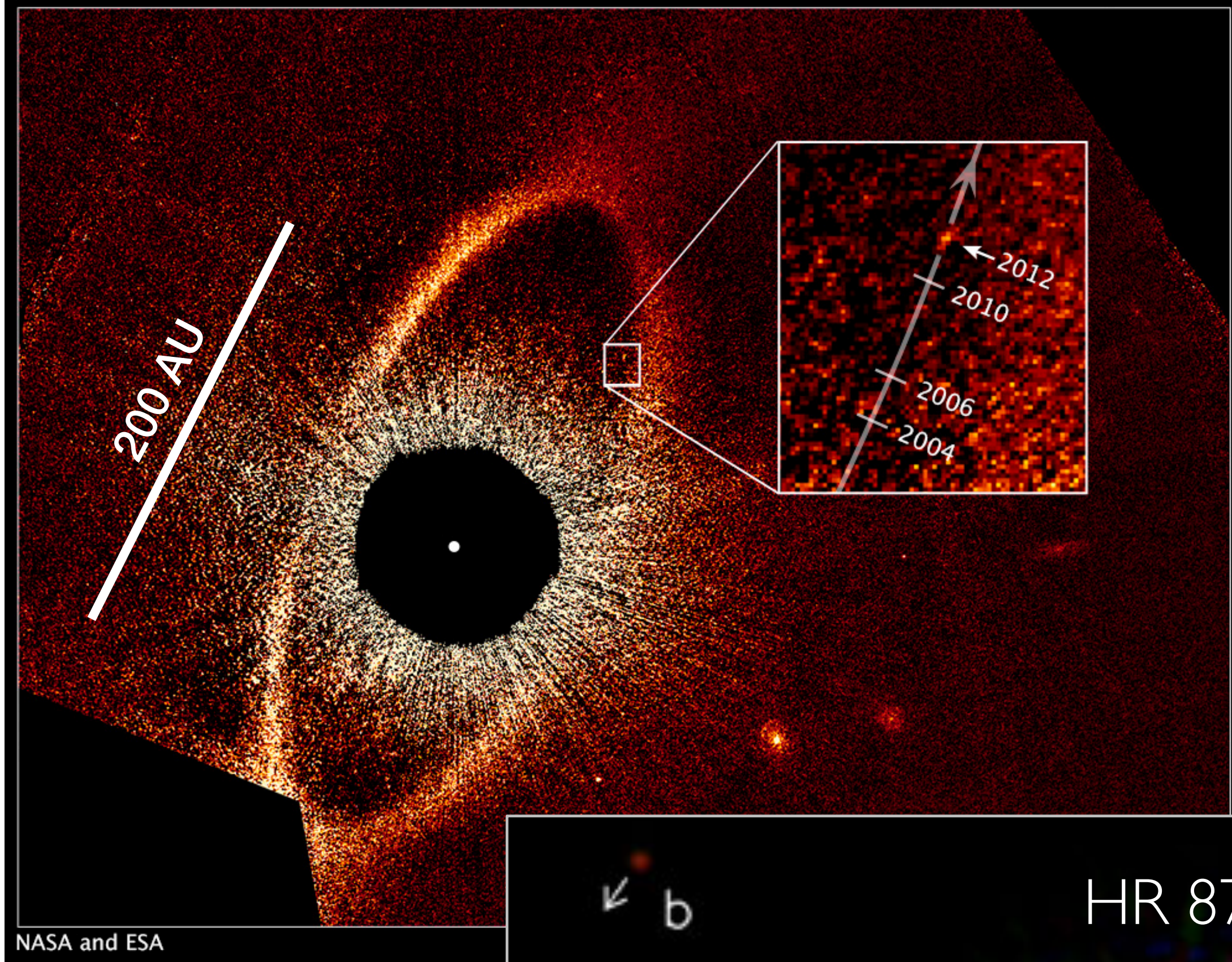
Flux



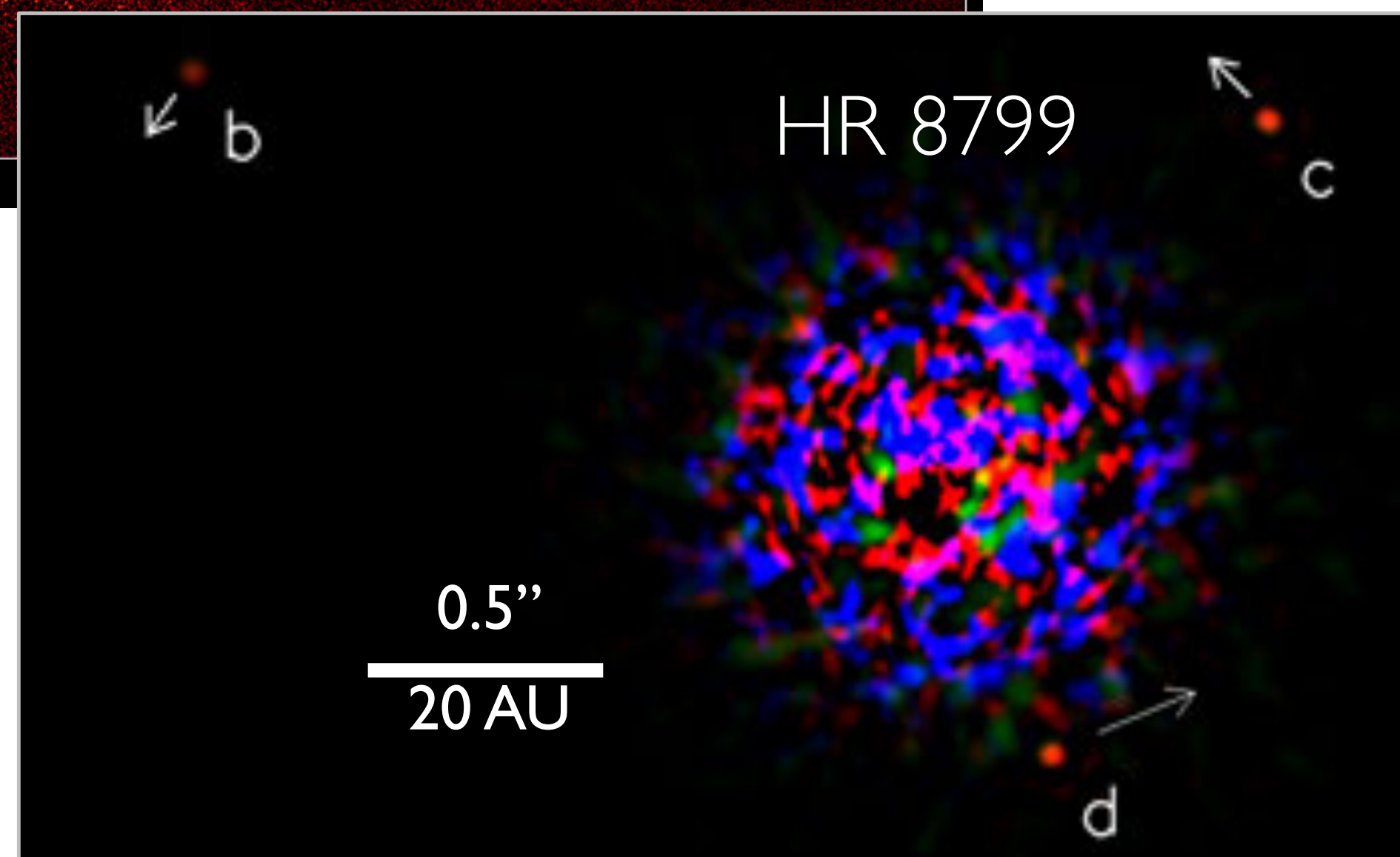
Albedo



# Detecting Exoplanets

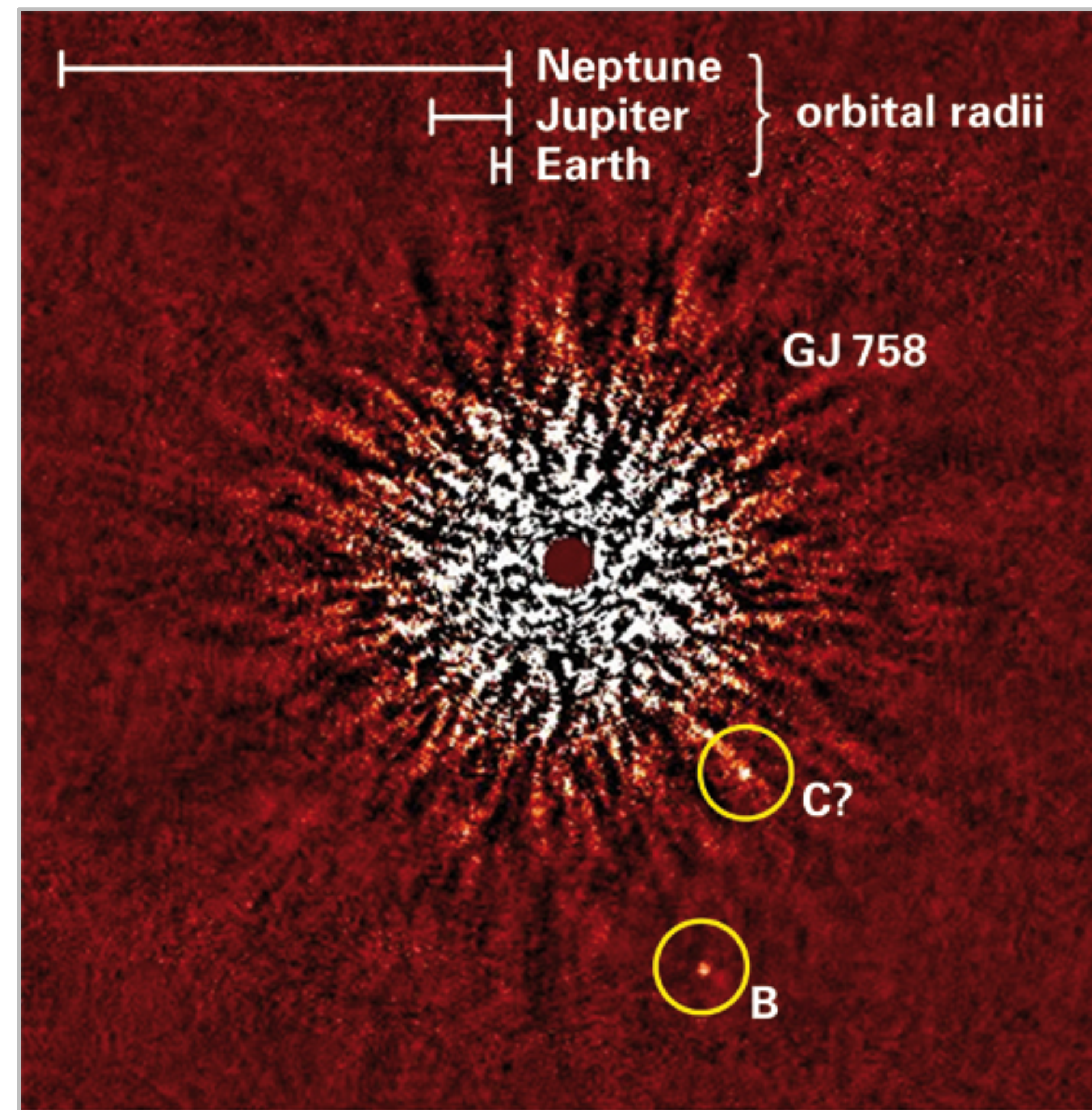


NASA and ESA

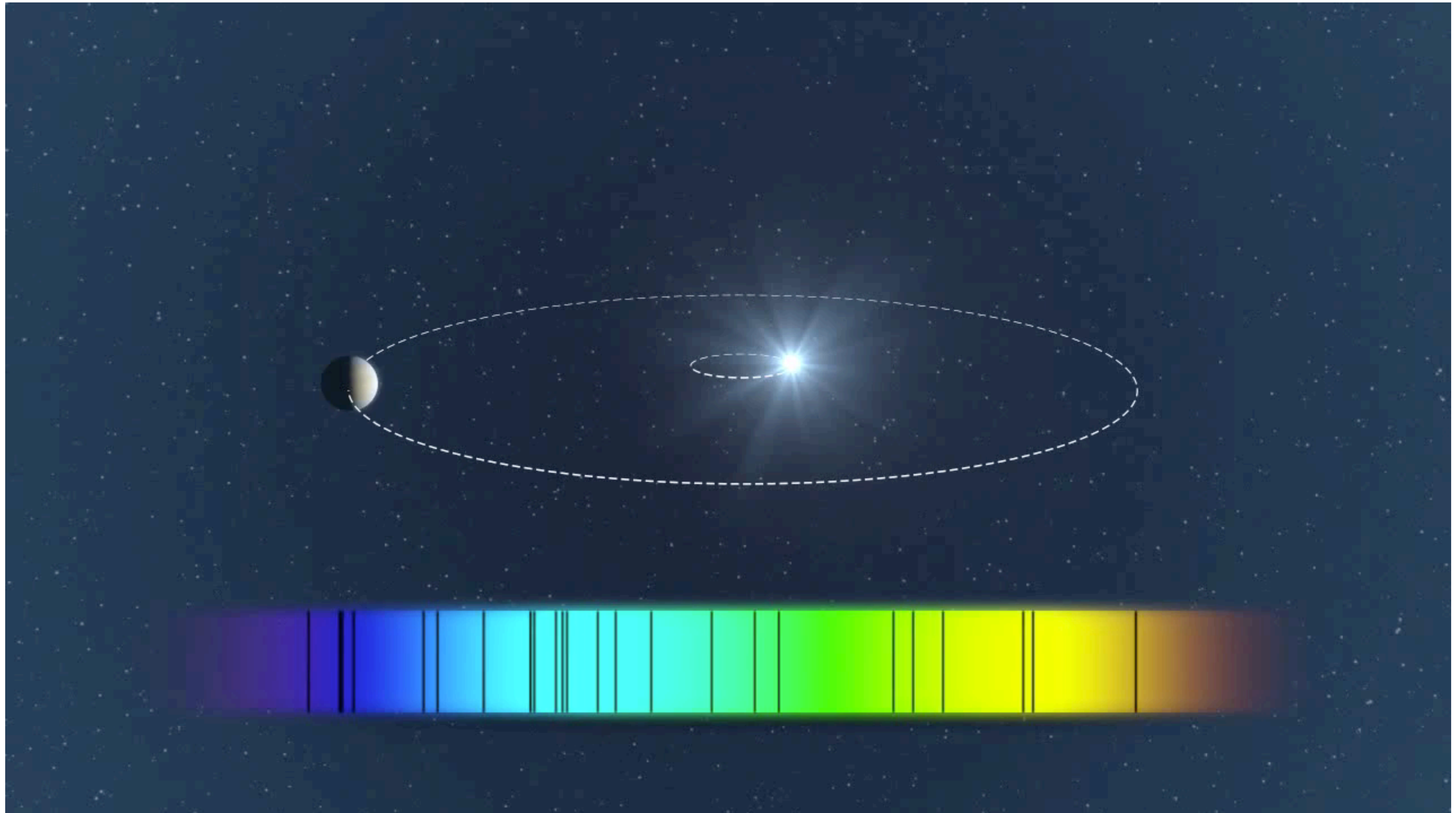


# Direct Imaging

Planet millions of times fainter  
Need to mask the starlight

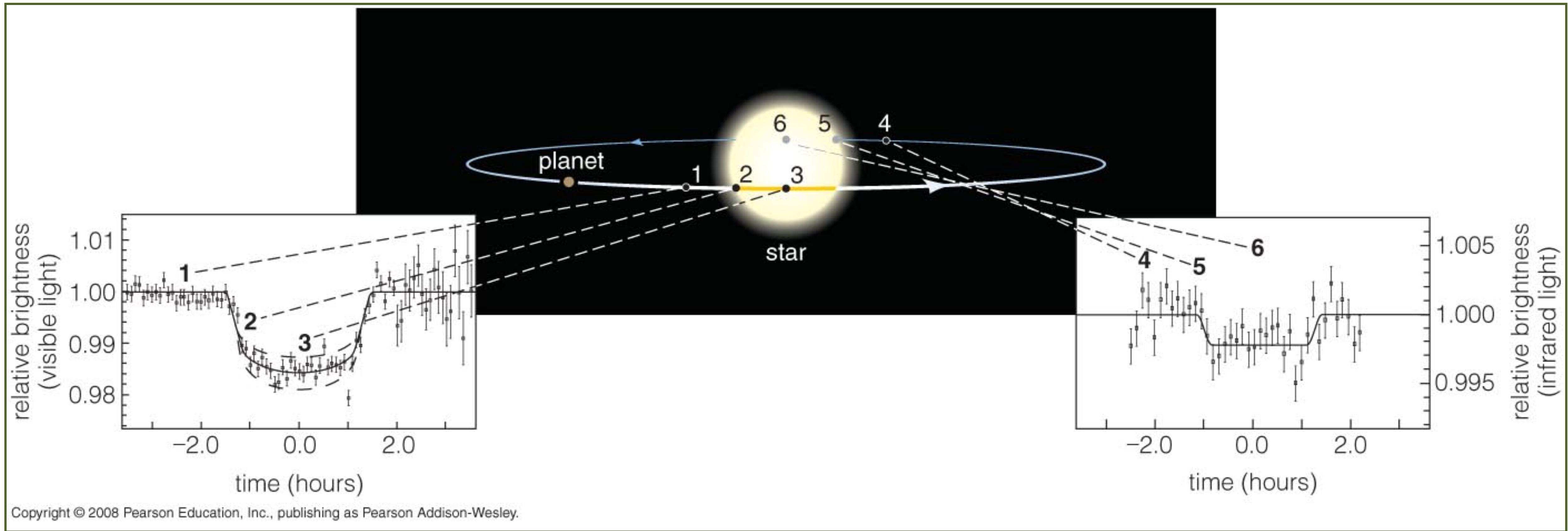


# Can't see the planet, but can see the star



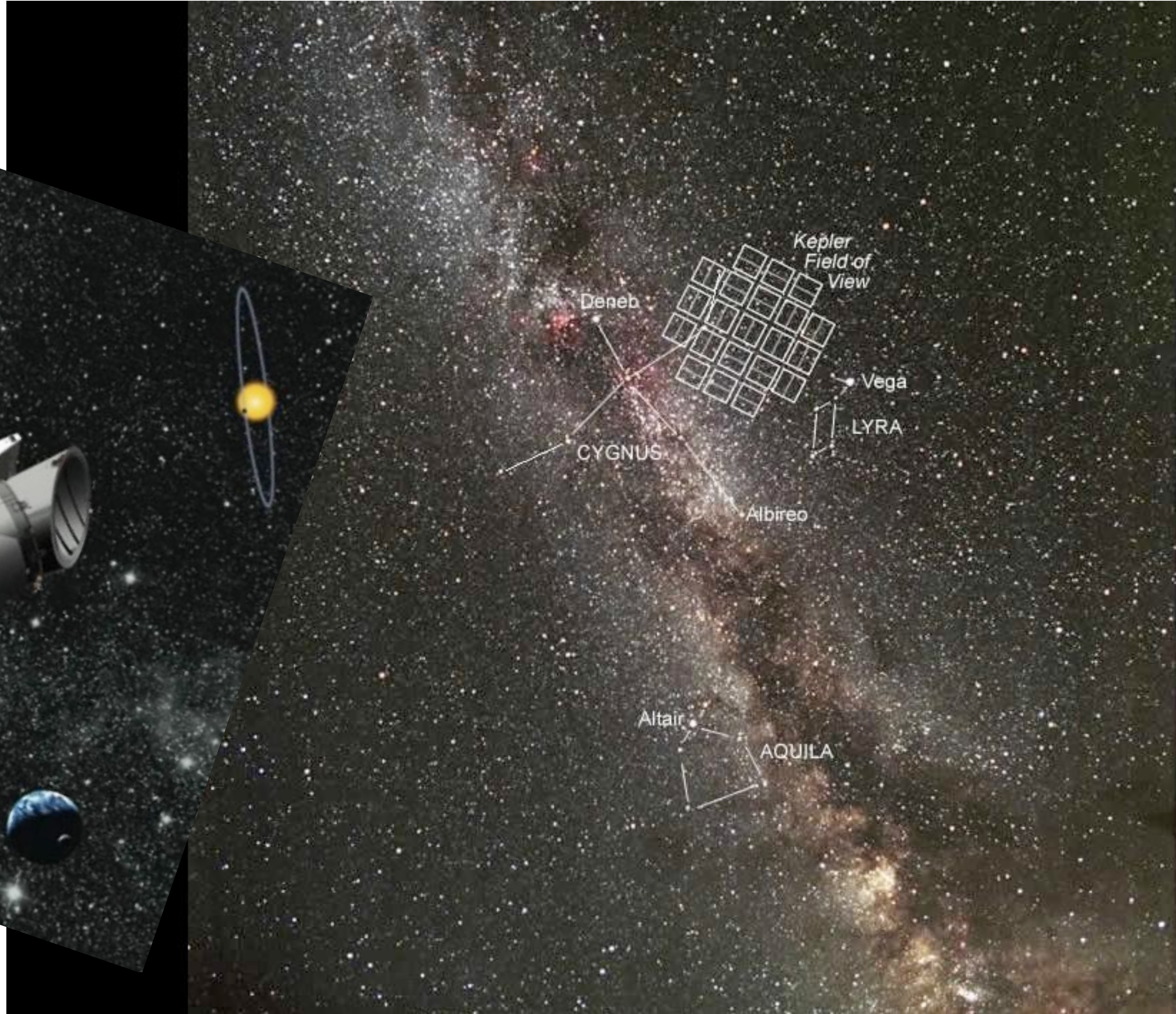
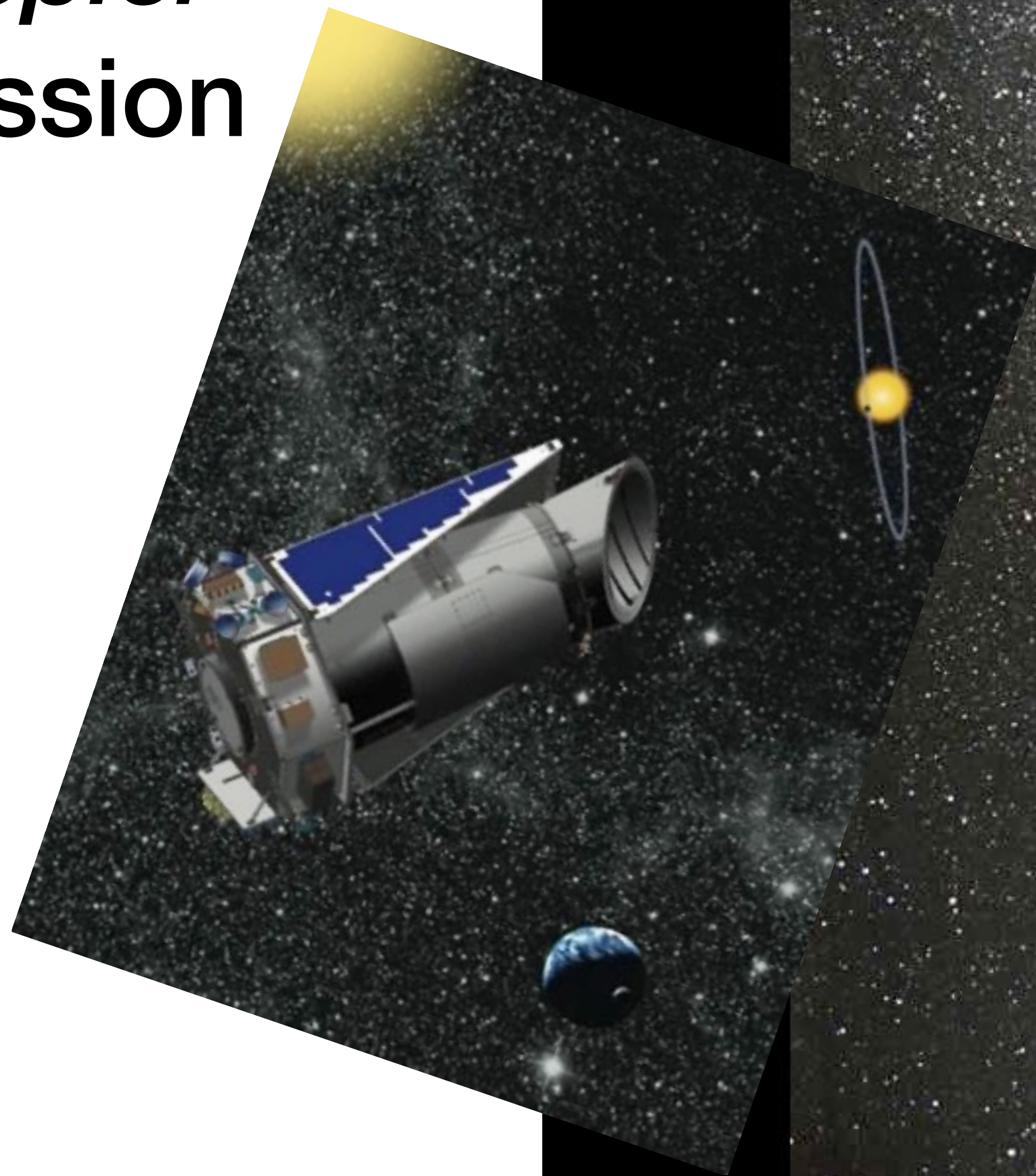
# Transit Method

Starlight is blocked by the planet, reducing the amount of light detected from the star

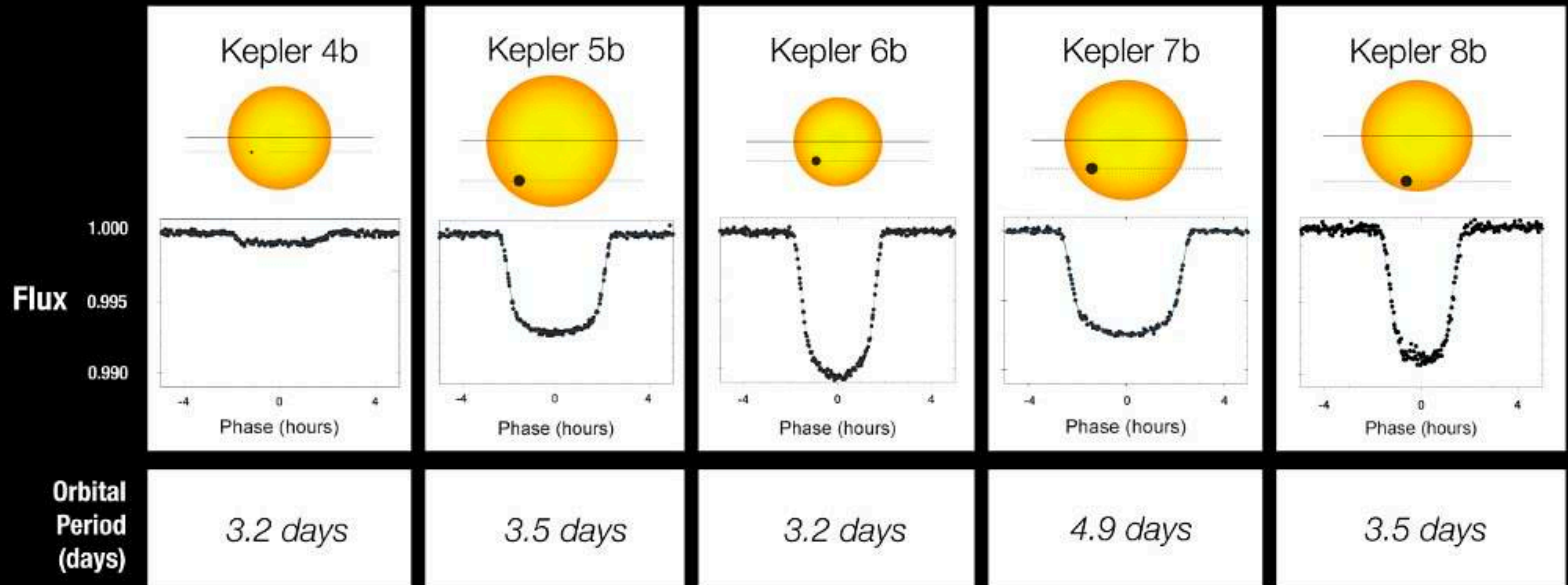




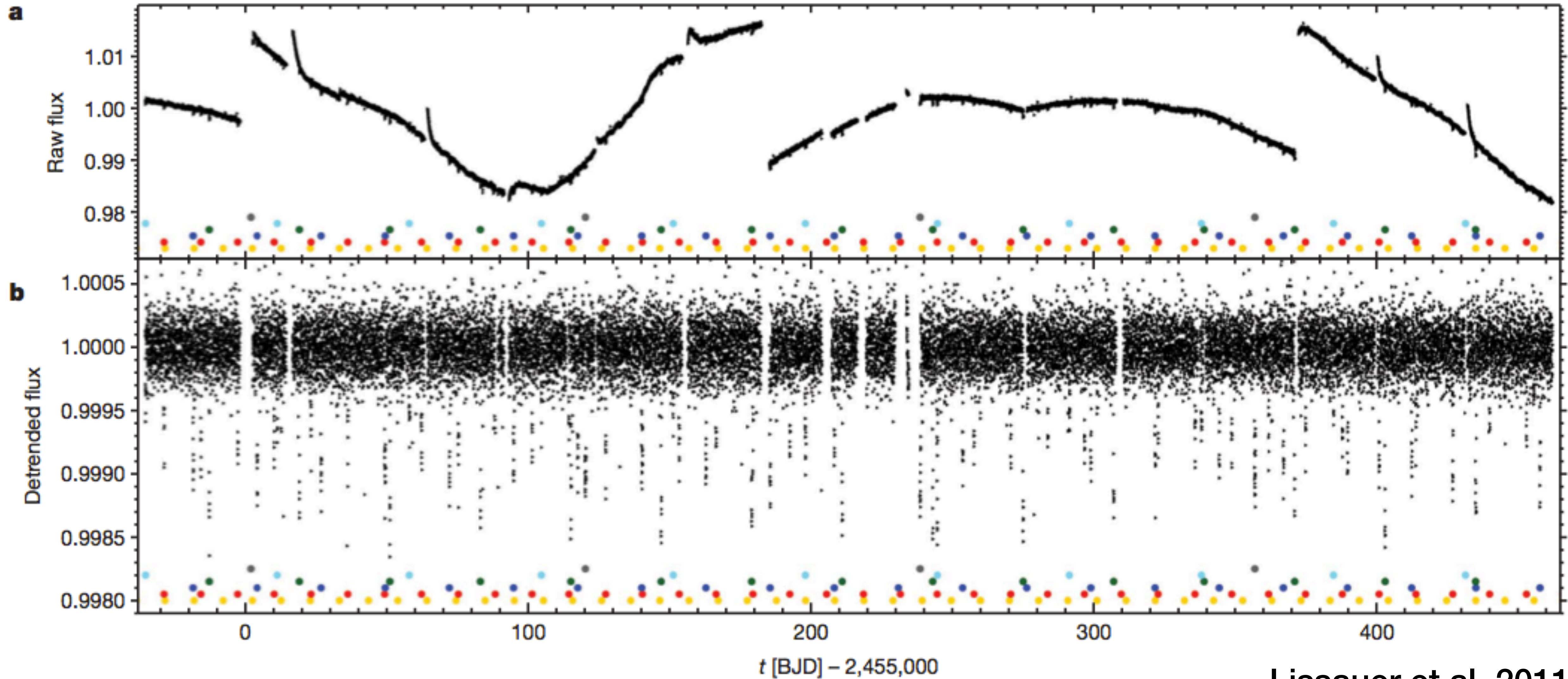
# Kepler Mission



# Transit Light Curves



# Kepler-11 System (6 planets)



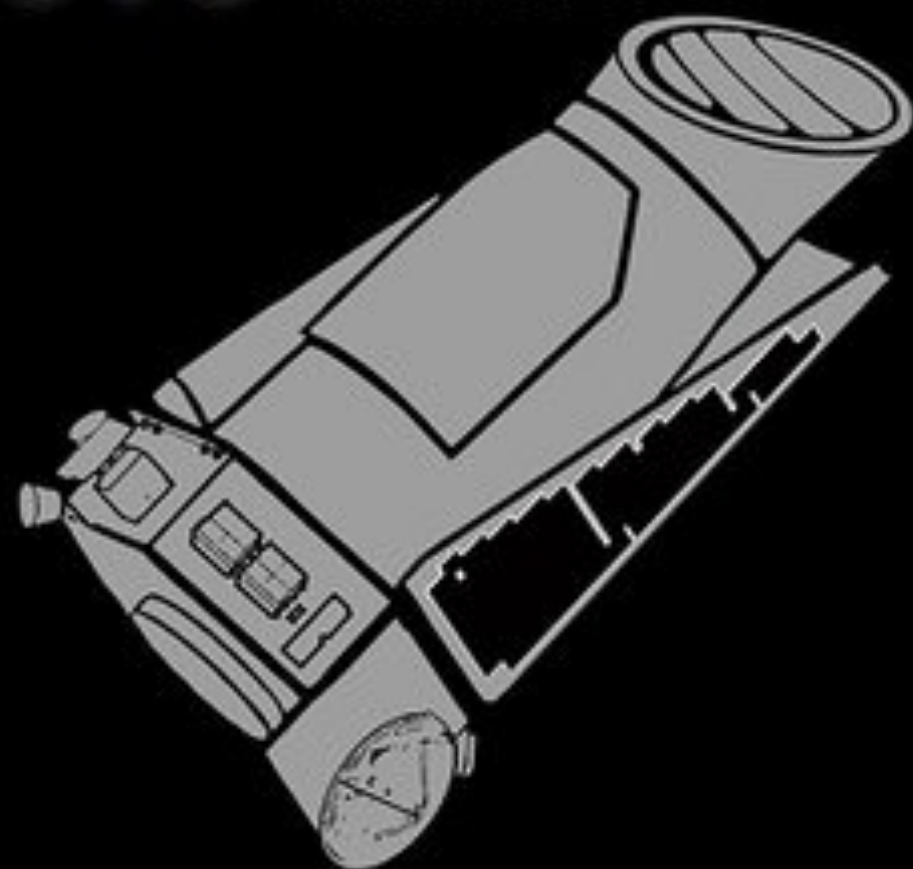
Lissauer et al. 2011

# Kepler

BY THE NUMBERS



**9.6** YEARS IN SPACE



**530,506**  
STARS OBSERVED

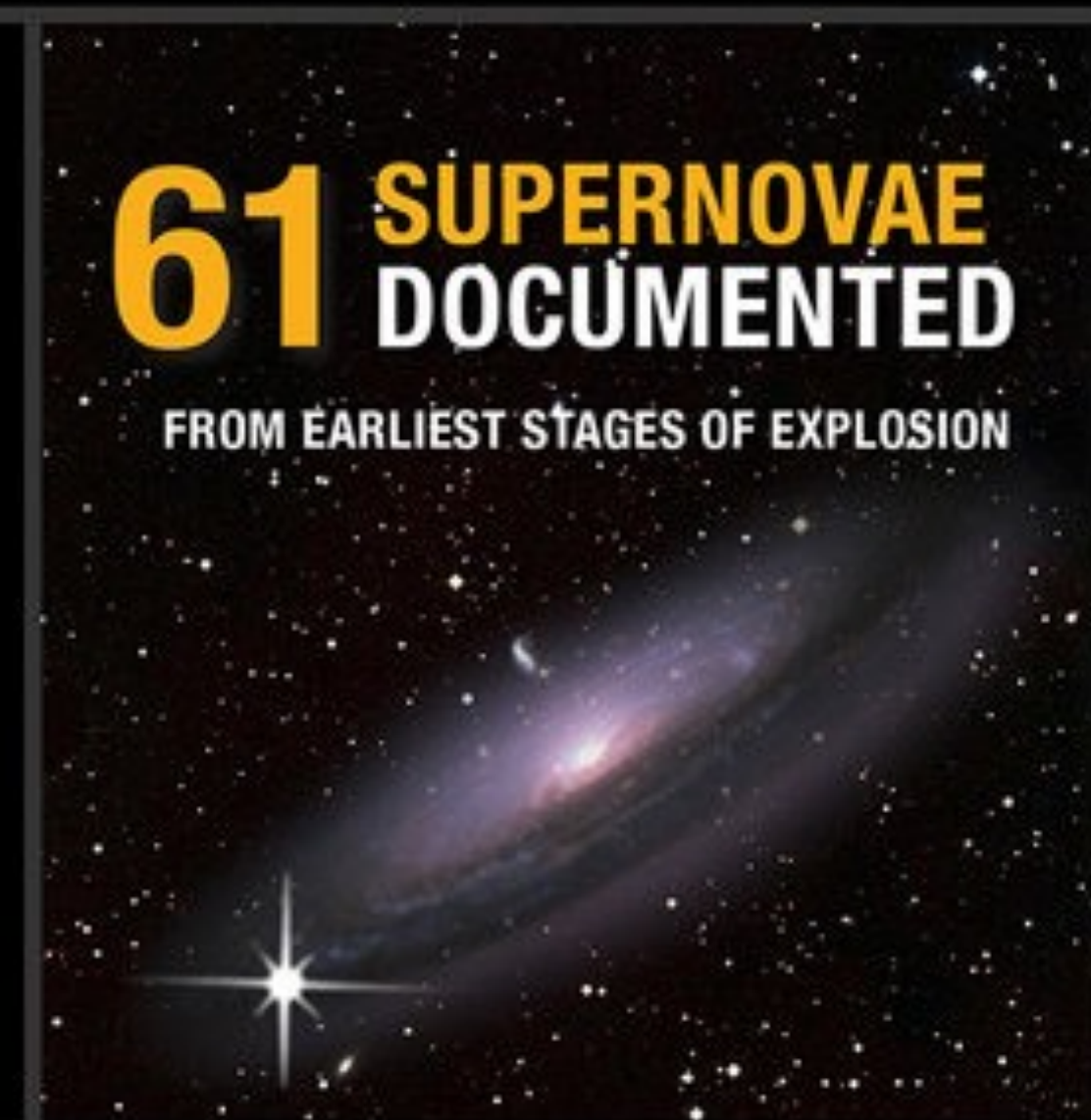


**2,662**  
PLANETS CONFIRMED



**61** SUPERNOVAE DOCUMENTED

FROM EARLIEST STAGES OF EXPLOSION



**2** MISSIONS COMPLETED

**678**  SCIENCE DATA COLLECTED

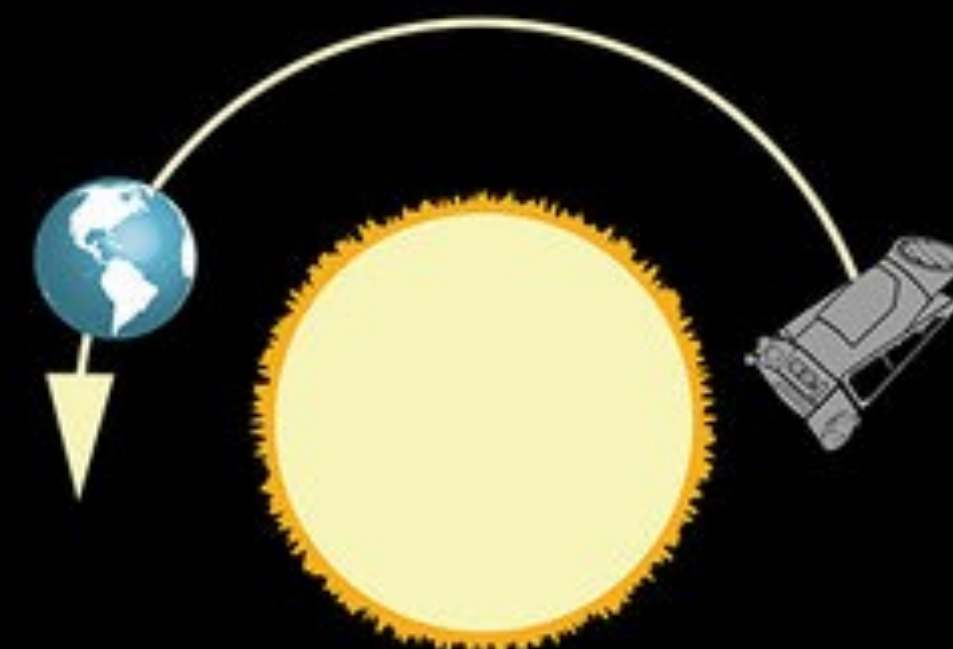
**2,946** SCIENTIFIC PAPERS PUBLISHED

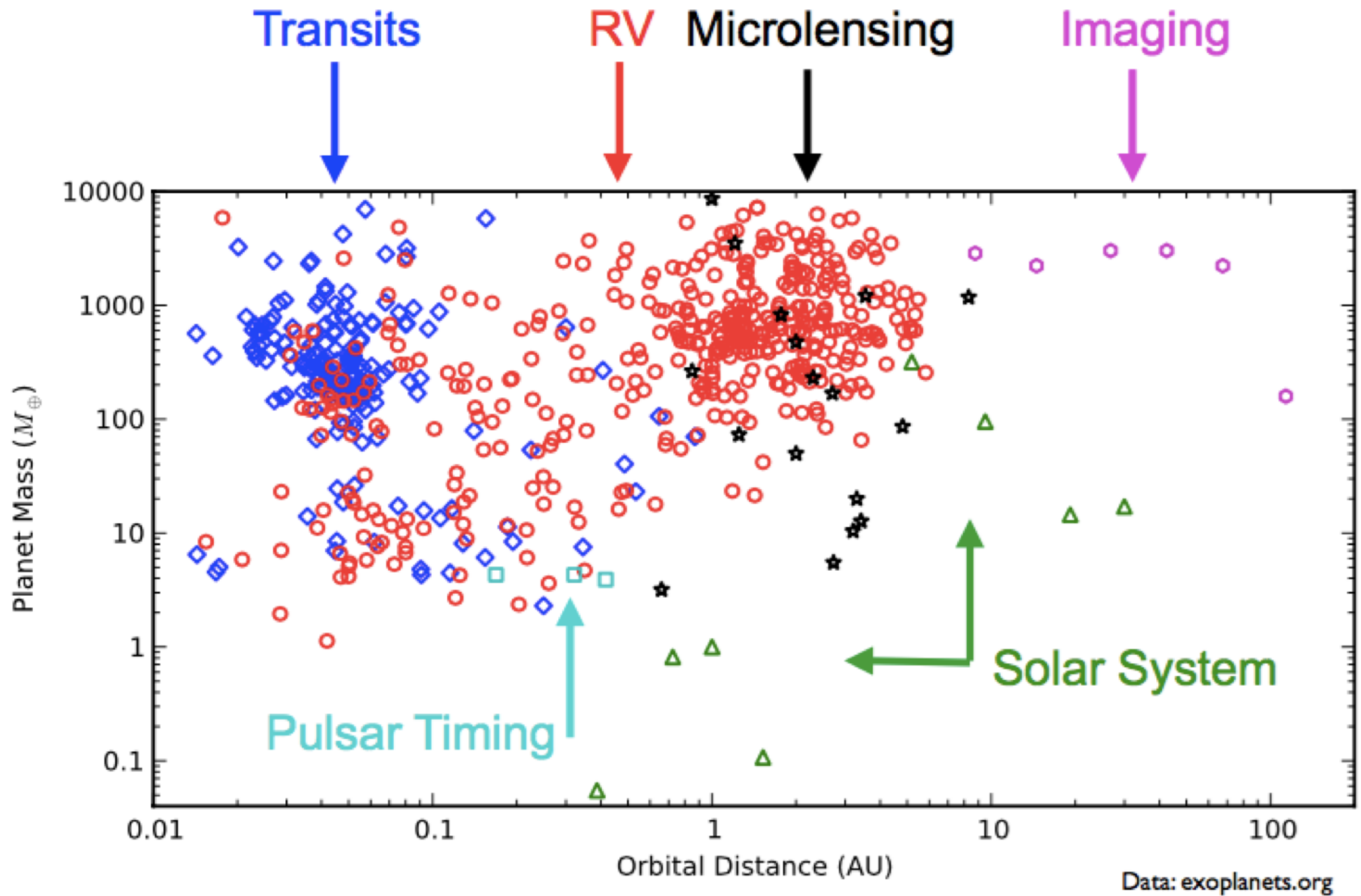
**94** MILLION MILES AWAY

**3.12** GALLONS FUEL USED



**732,128**  
COMMANDS EXECUTED





Data: exoplanets.org

# What do we know about planets in general?

- Planets are more numerous in the Galaxy than stars!
- Smaller, rocky planets are common (20-50% of stars should have at least 1)
- Solar system is a little weird
  - Most common planet is b/t Earth and Neptune in mass
  - Many systems are more compact than the solar system
- 4277 confirmed planets (as of Saturday)
  - 72% by Transit method
  - 19% by RV method
  - 2% by microlensing
  - 1% by direct imaging

exoplanets.nasa.gov

