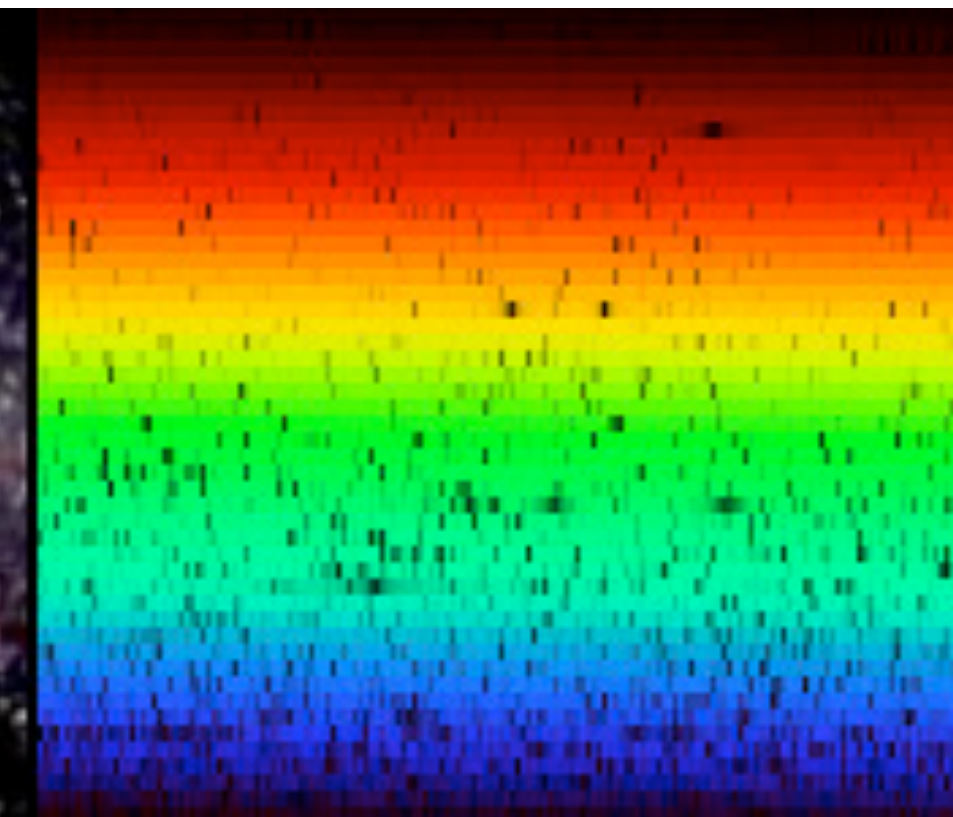




ASTR/PHYS 3070: Foundations Astronomy



Week 7 Thursday

Today's Agenda

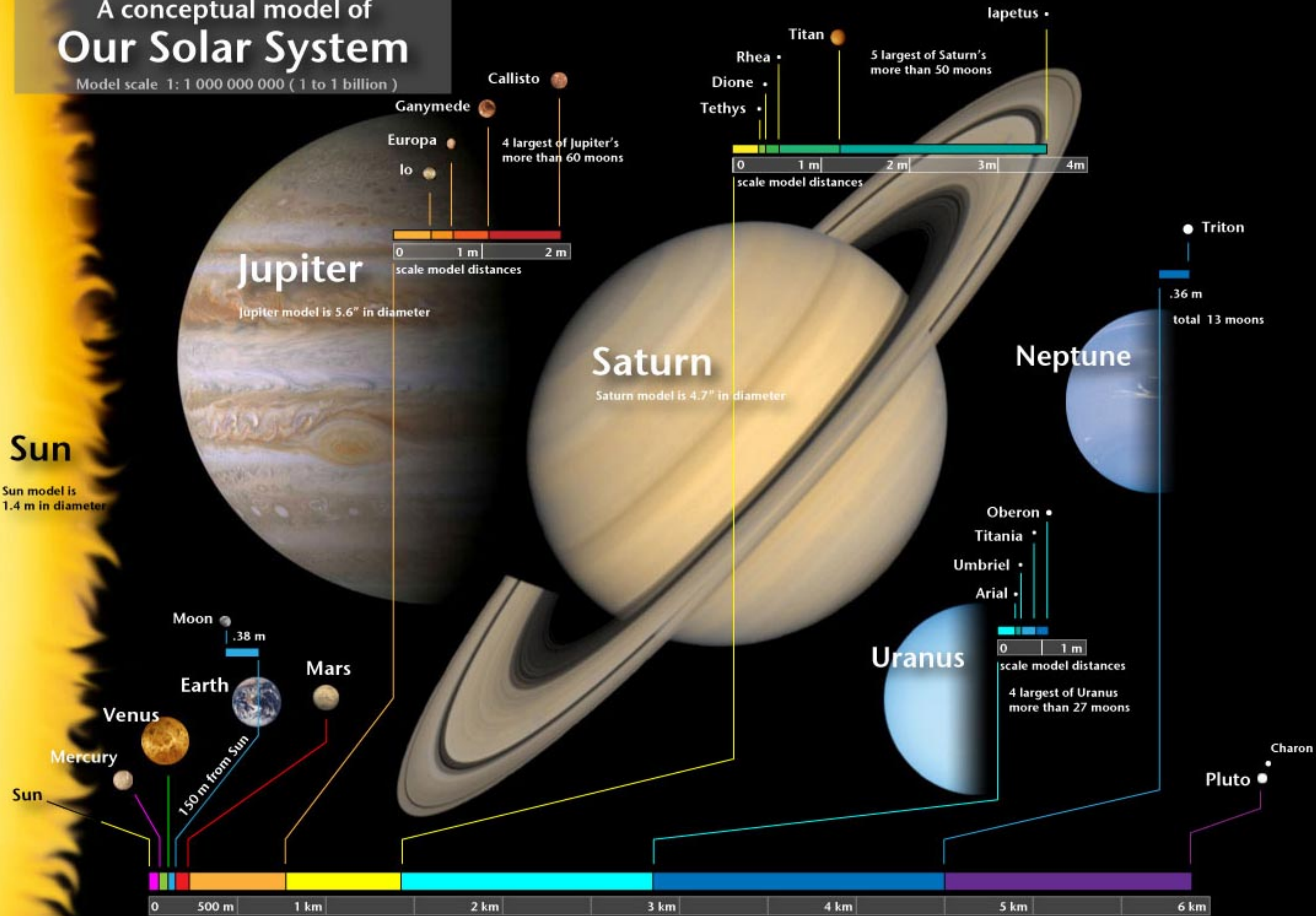
- Albedo
- Exoplanet detection methods
- Group Practice Problem!
- Exoplanet populations (if time)

Announcements / Reminders

- HW 5 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
 - The Generalized Landau Paradigm

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.

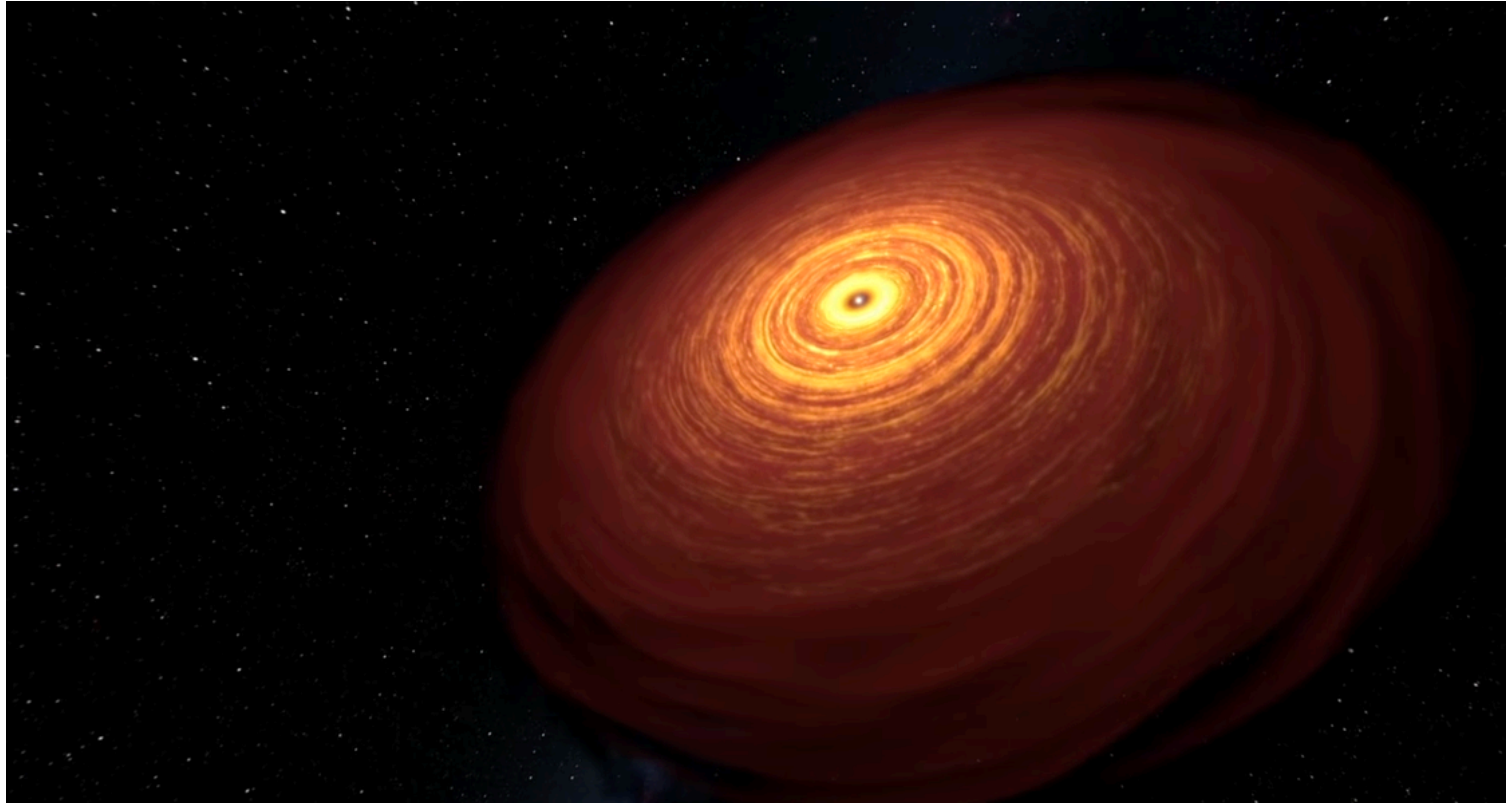
Oort Cloud
(origin of long-period comets)

Outer planets
& Kuiper belt

Inner planets
& asteroid belt

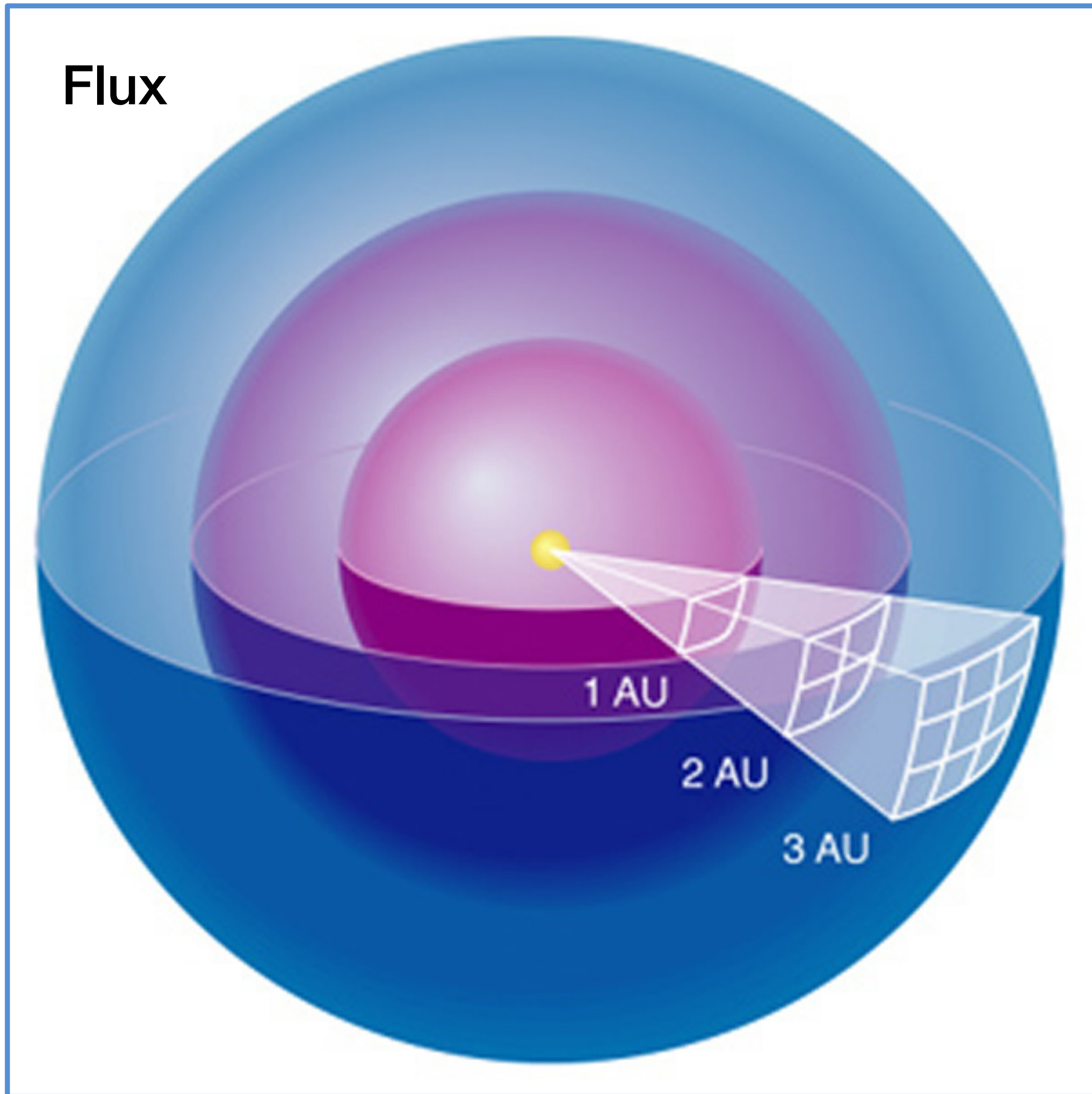


<https://www.youtube.com/watch?v=yXq1i3HlumA&feature=youtu.be>

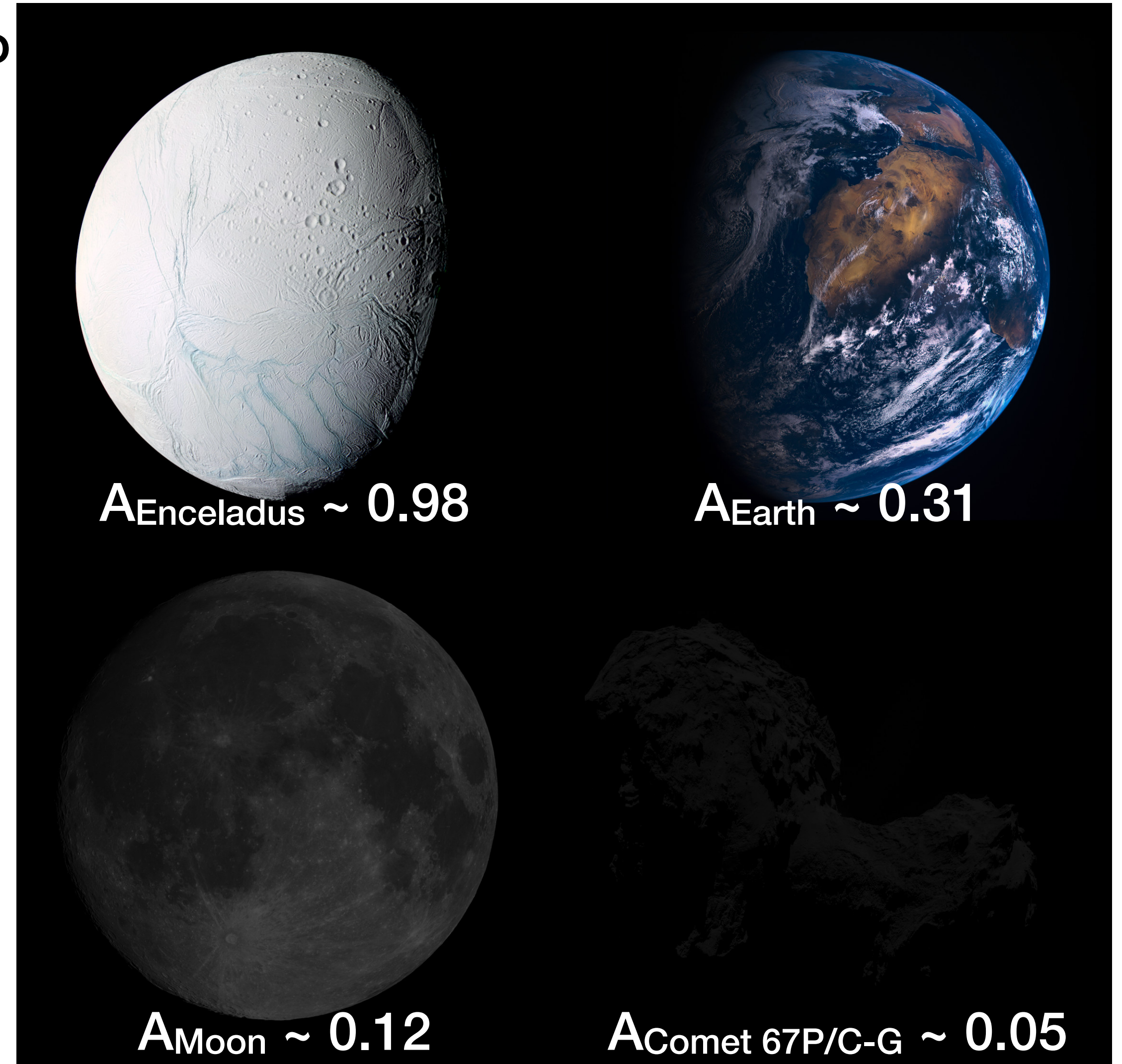


How do we learn about solar system objects?

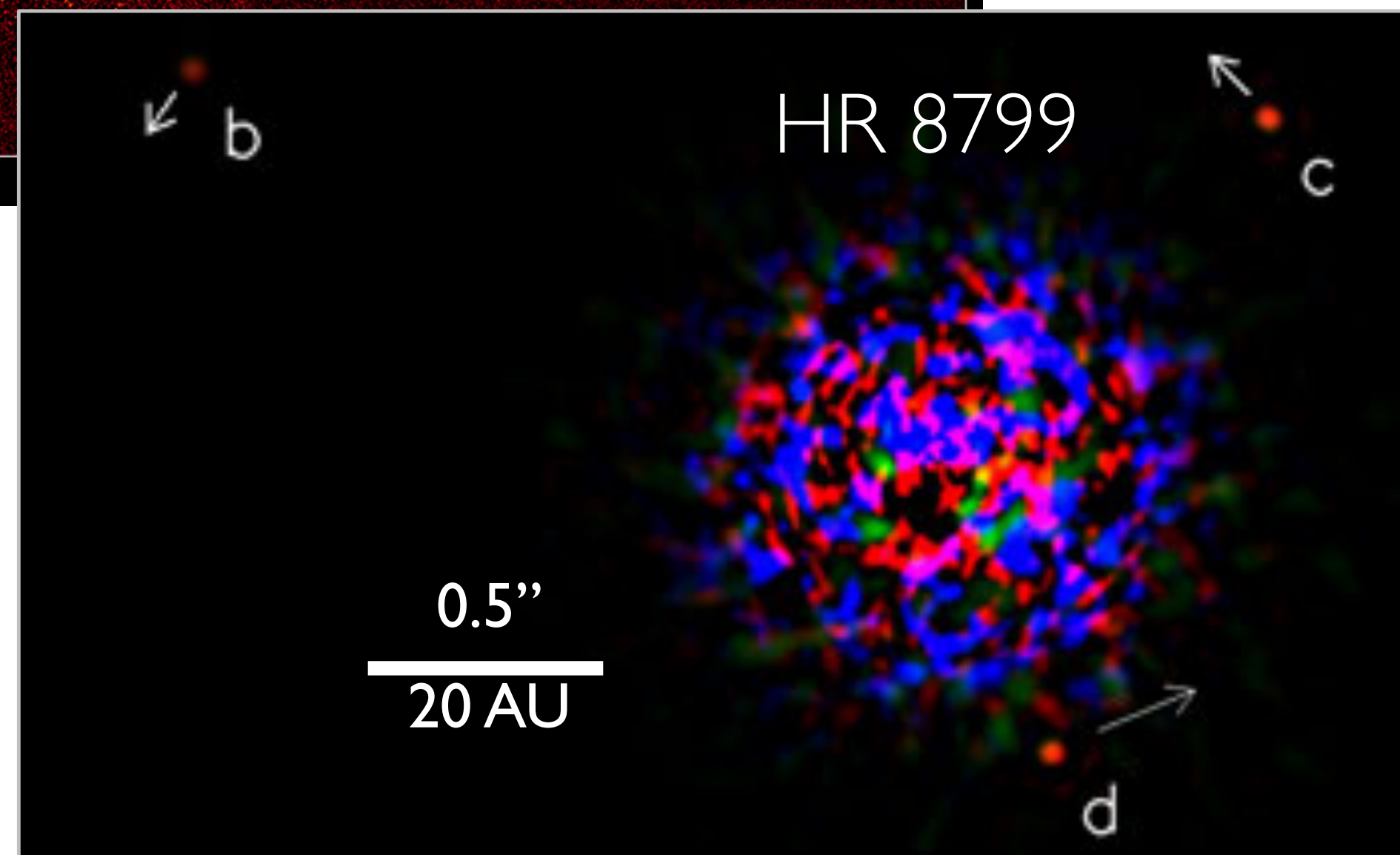
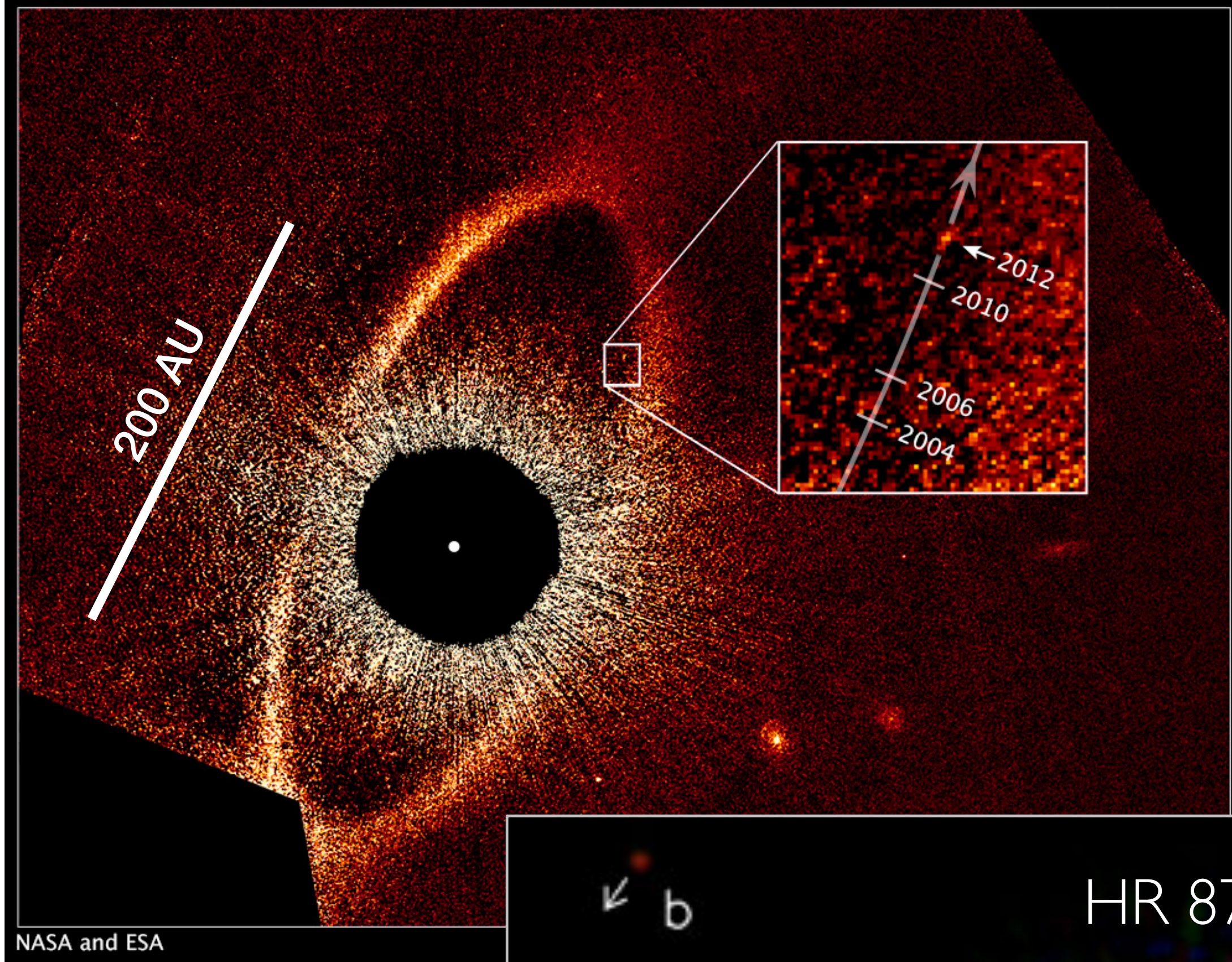
Flux



Albedo

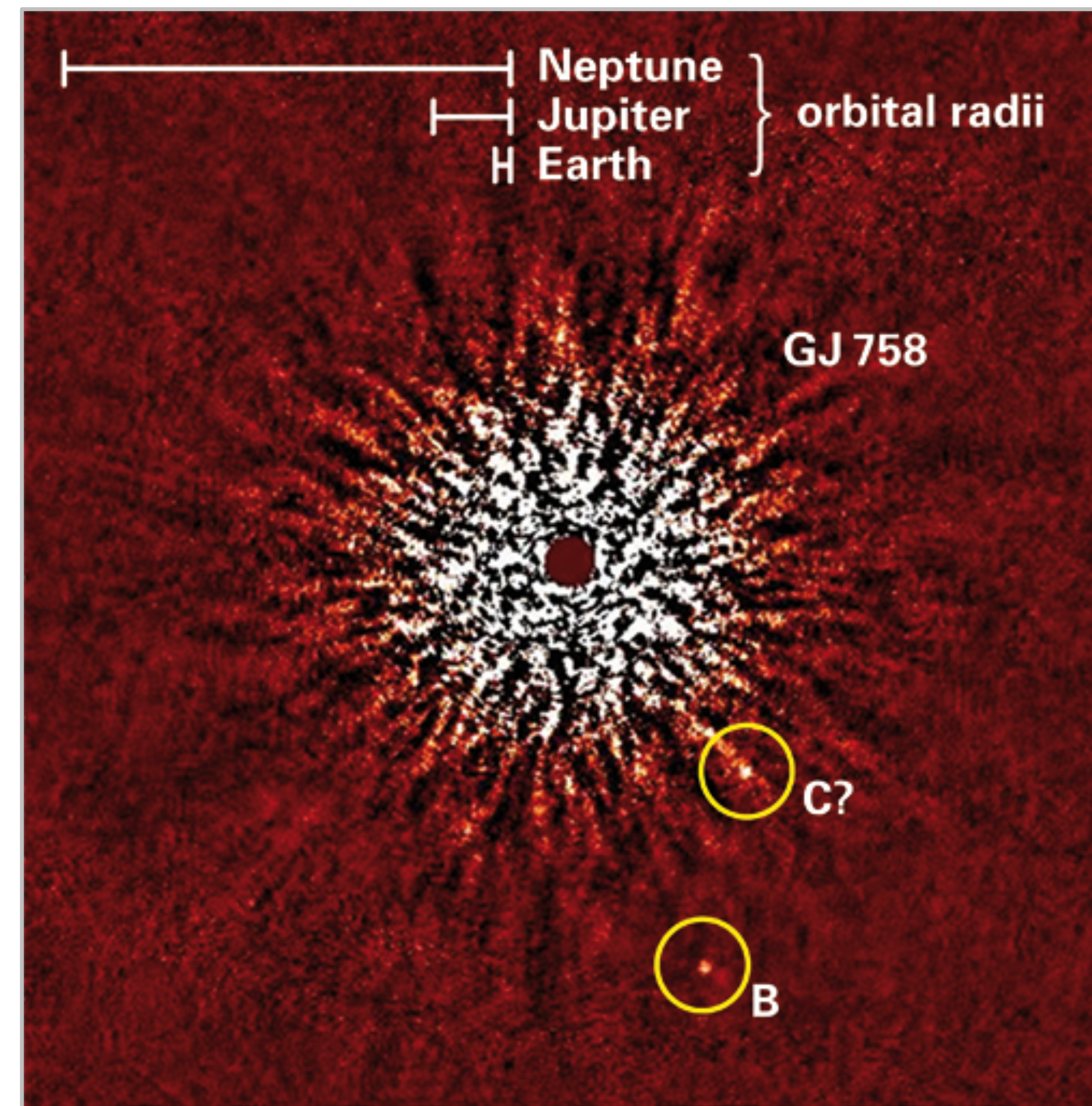


Detecting Exoplanets

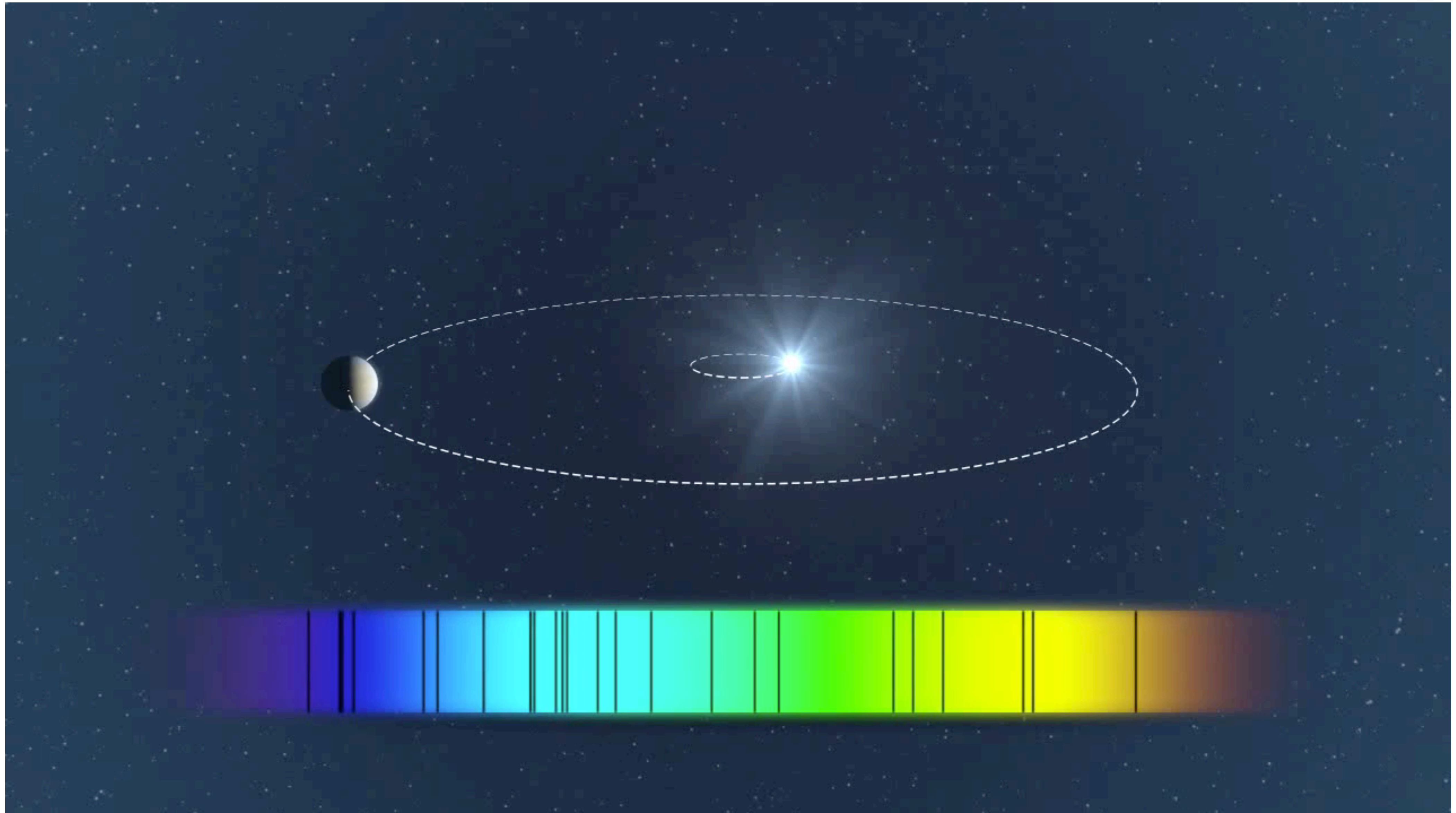


Direct Imaging

Planet millions of times fainter
Need to mask the starlight

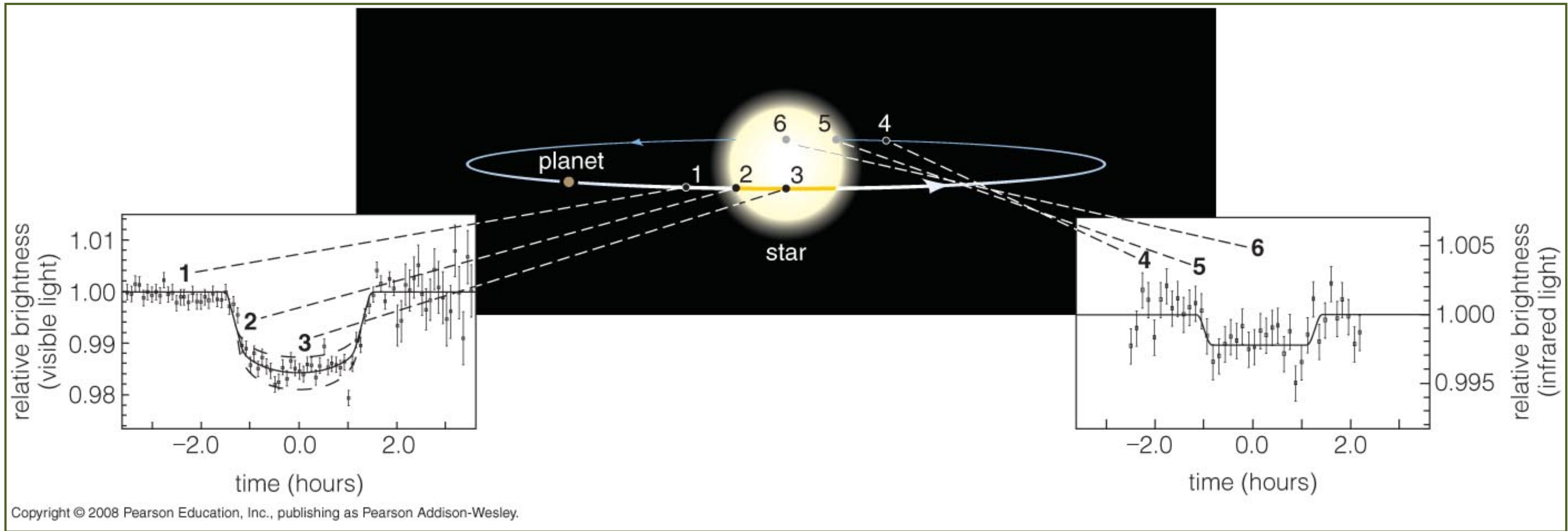


Can't see the planet, but can see the star



Transit Method

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



Exoplanet Group Problem

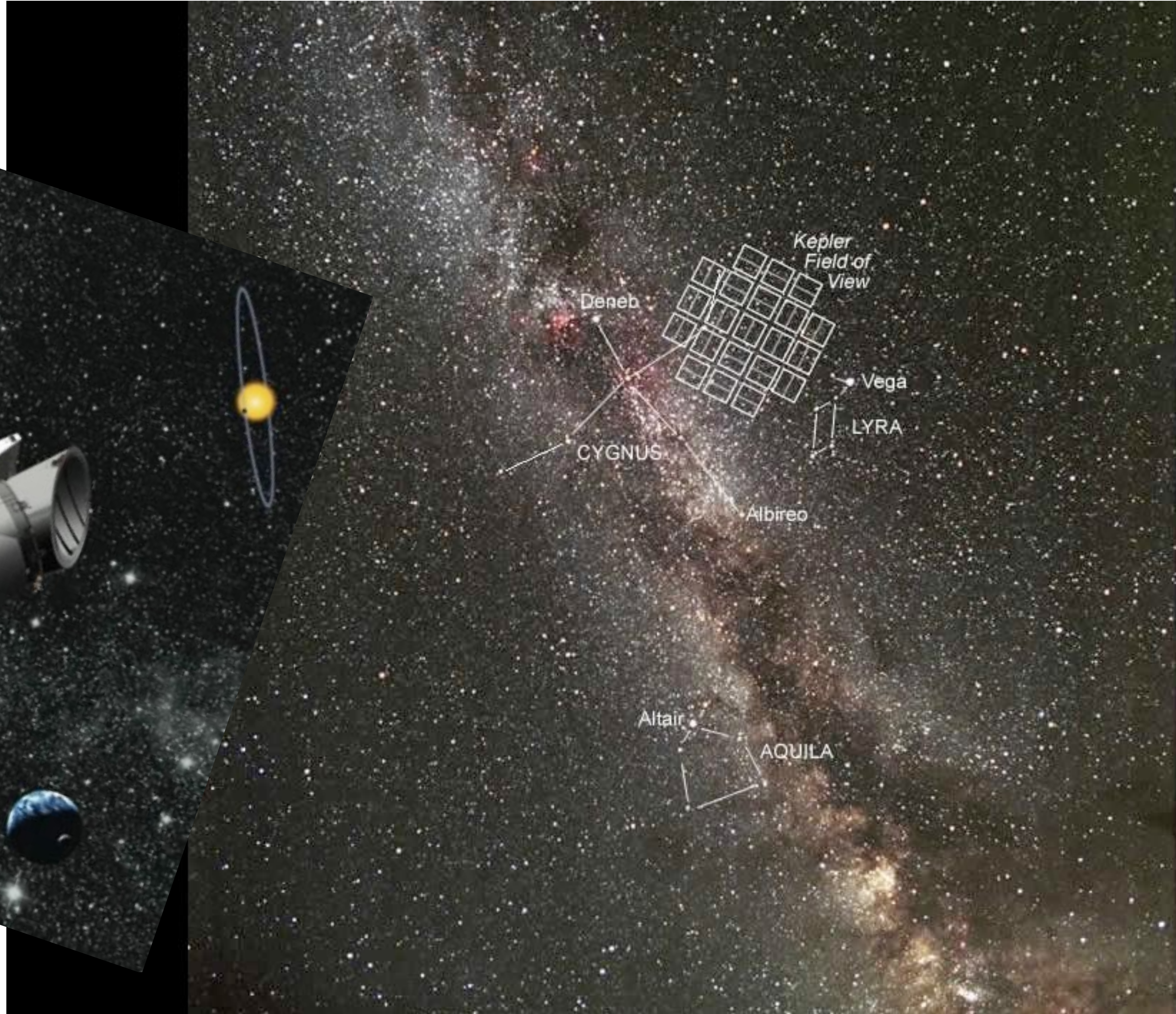
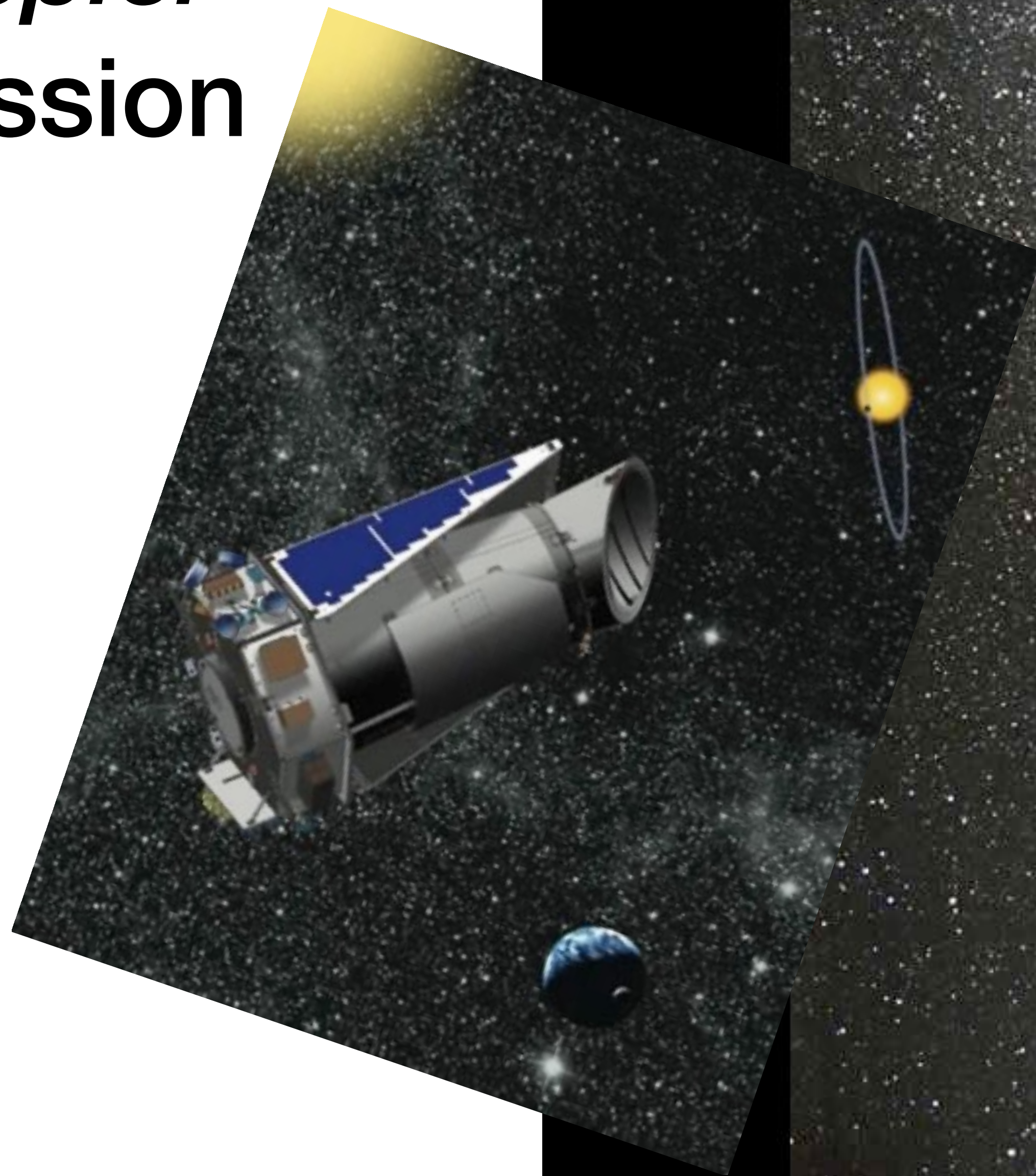
You monitor the radial velocity of a star with mass $M = 1.3 M_{\odot}$ over time and infer from the shifts in its spectral lines (which obey a regular sinusoidal variation with a period of 2.5 years and maximal shifts of $\pm 2 \times 10^{-3} \text{ \AA}$ in the $H\alpha$ line [$\lambda_0 = 6562.790 \text{ \AA}$]) that the star has an unseen companion.

What properties of the star or companion can you estimate or constrain?

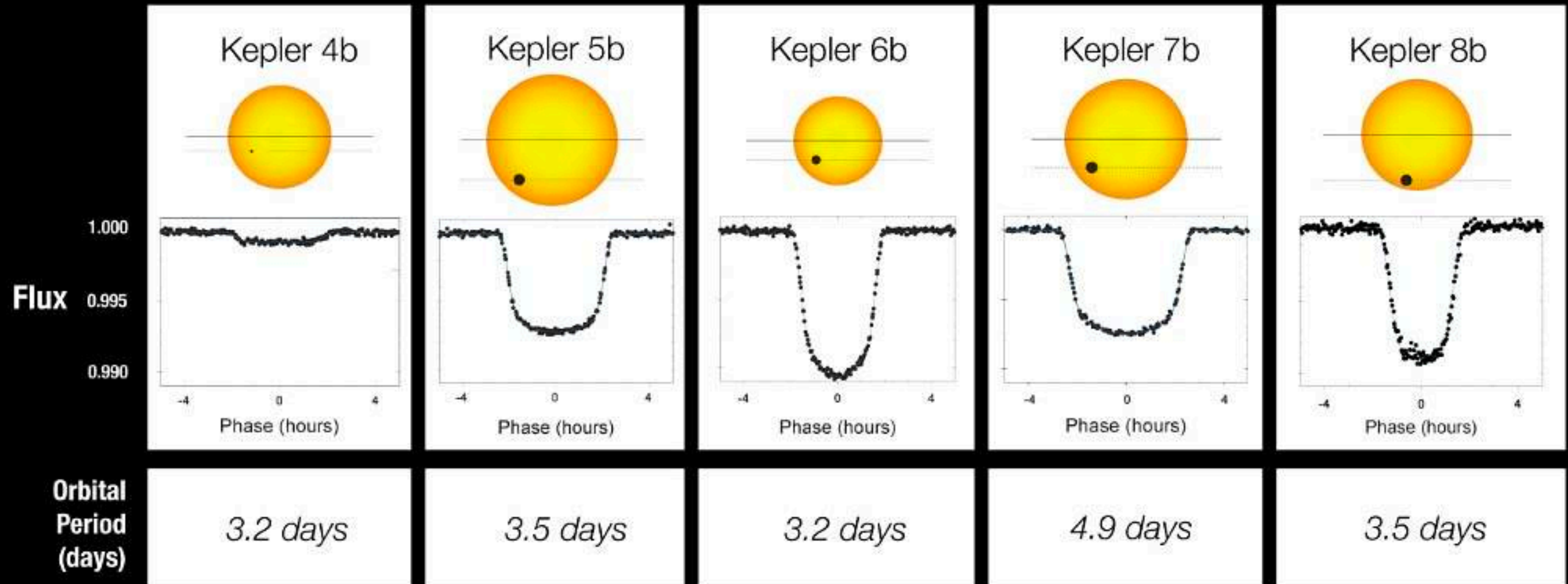
Estimate those properties.

If a dip in the star's light curve is observed coincident with when the line has its rest wavelength, does that affect the properties you can constrain? If so, how?

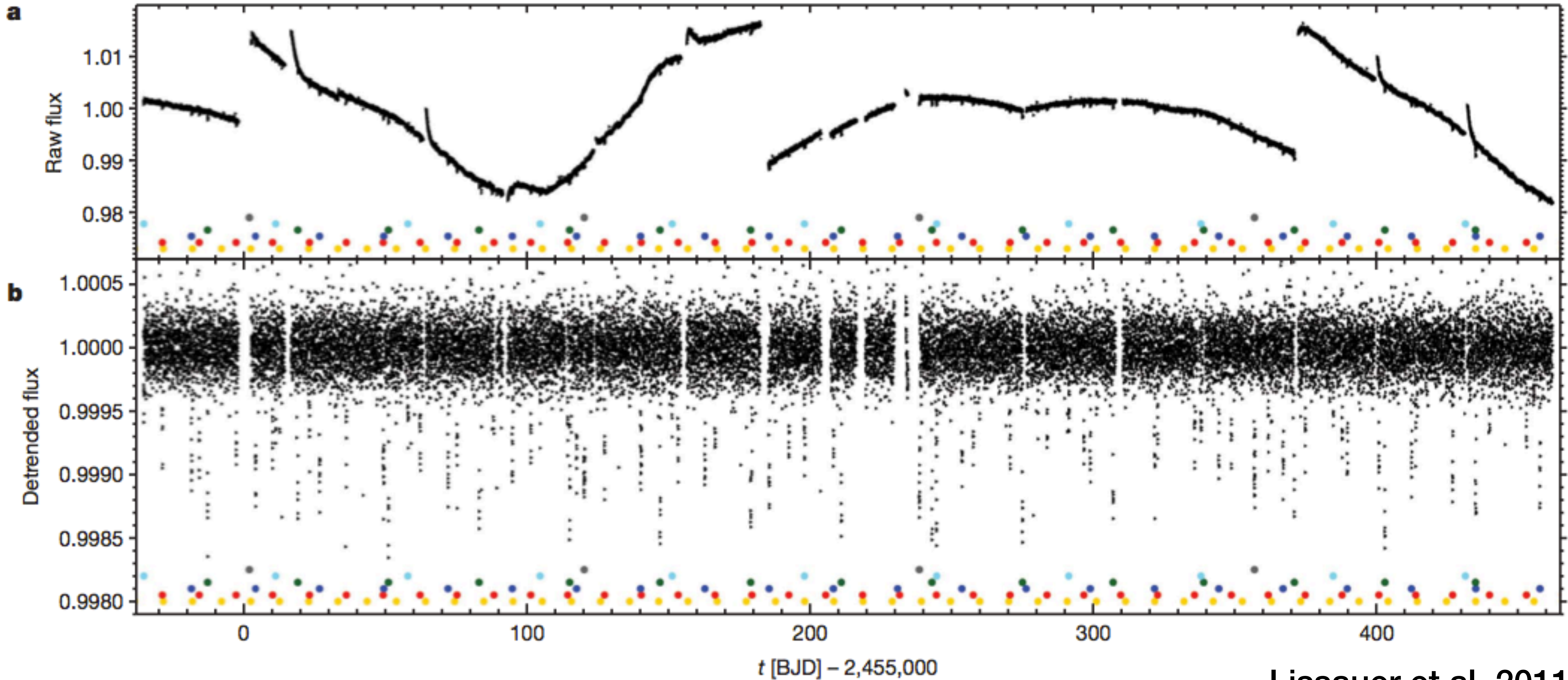
Kepler Mission



Transit Light Curves



Kepler-11 System (6 planets)



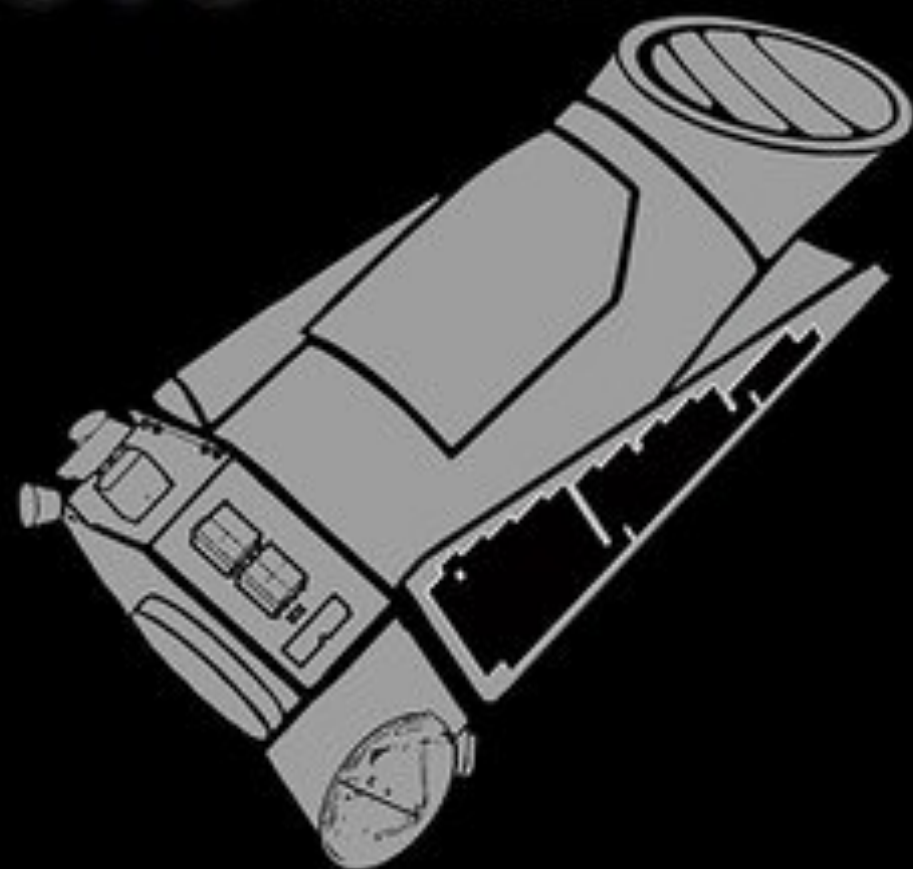
Lissauer et al. 2011

Kepler

BY THE NUMBERS



9.6 YEARS IN SPACE



530,506
STARS OBSERVED

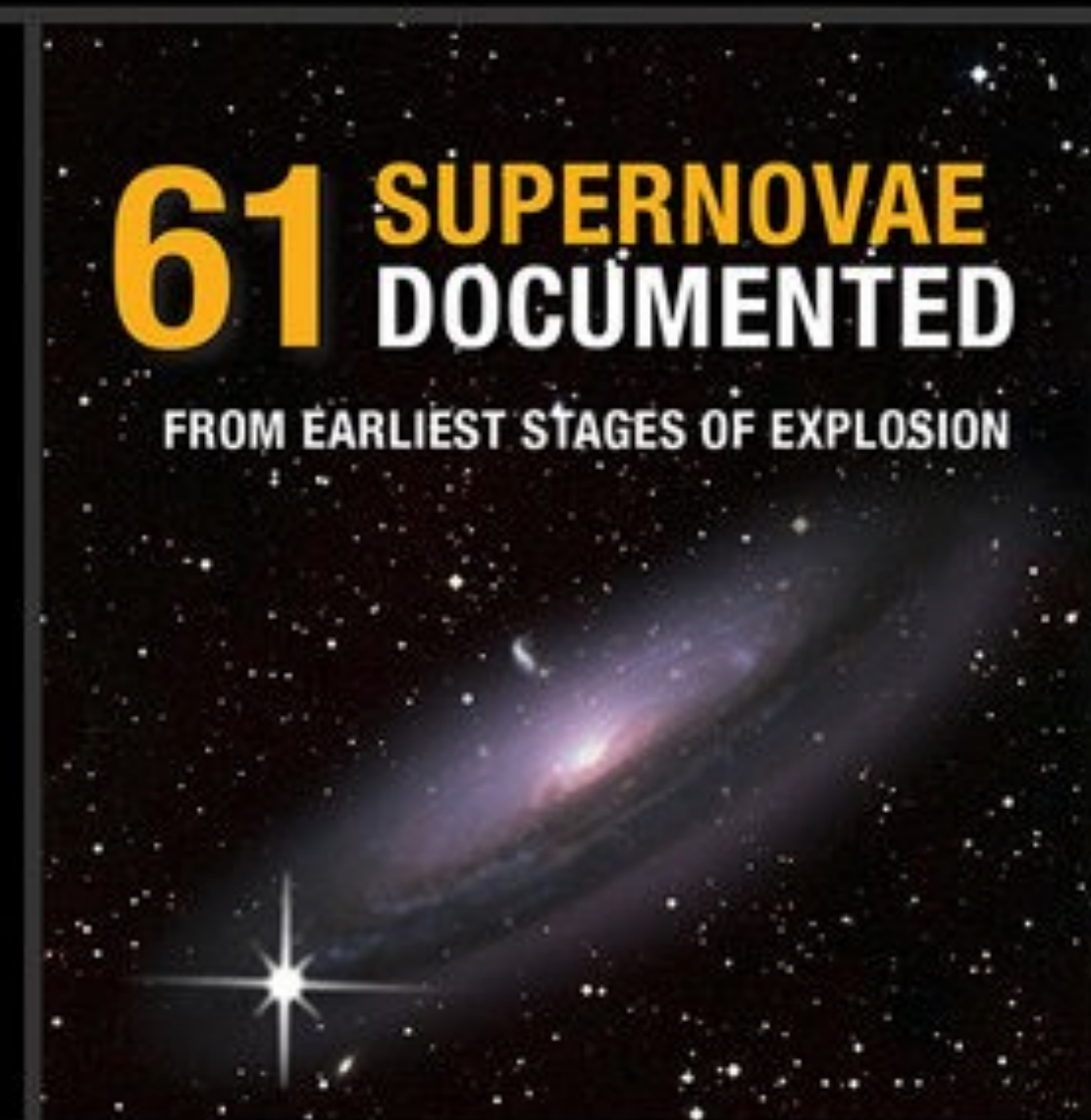


2,662
PLANETS CONFIRMED



61 SUPERNOVAE DOCUMENTED

FROM EARLIEST STAGES OF EXPLOSION



2 MISSIONS COMPLETED

678  SCIENCE DATA COLLECTED

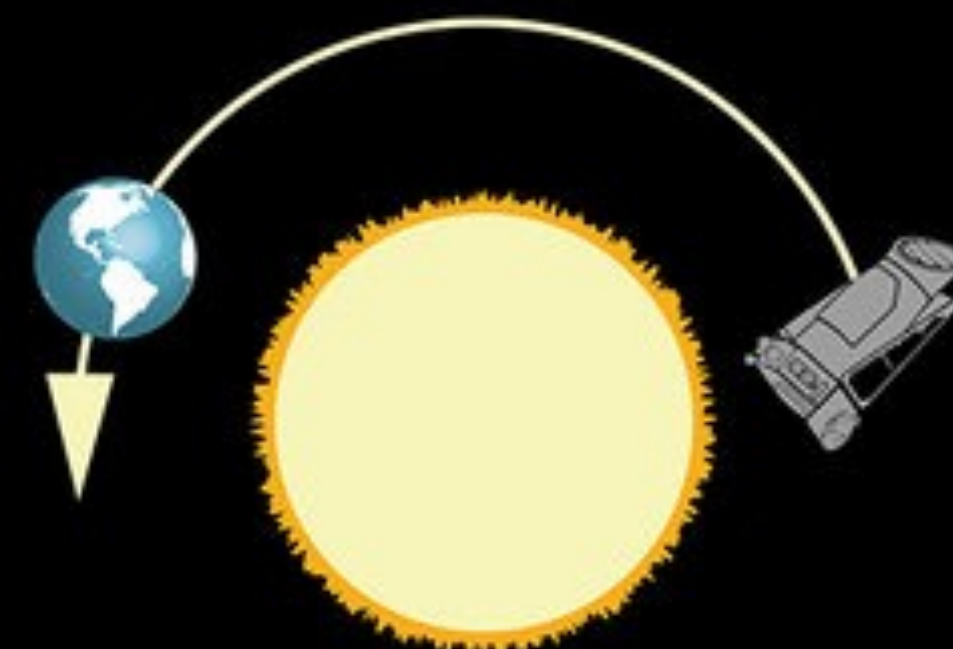
2,946 SCIENTIFIC PAPERS PUBLISHED

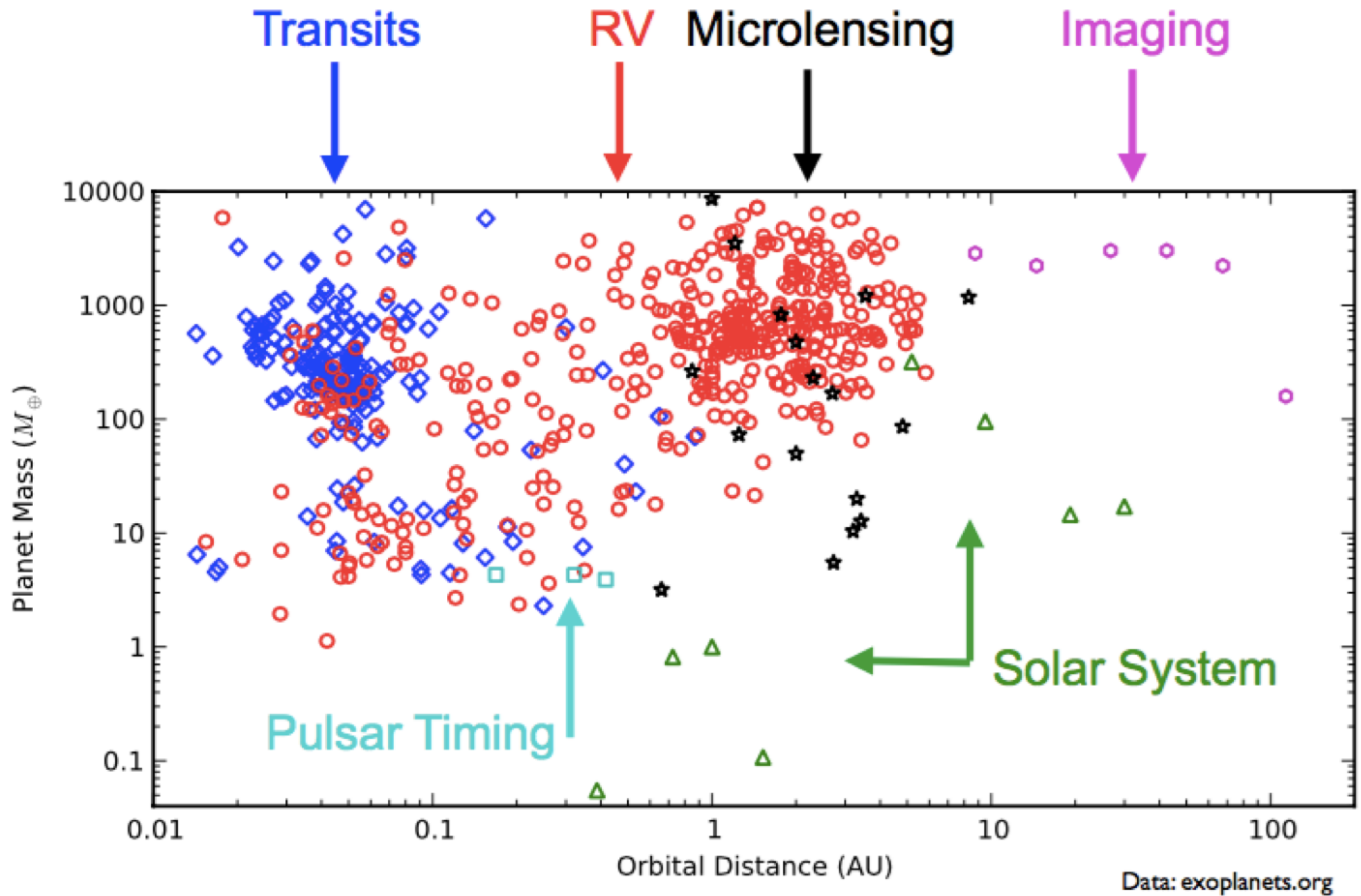
94 MILLION MILES AWAY

3.12 GALLONS FUEL USED



732,128
COMMANDS EXECUTED





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 last year)
 - 72% by Transit method
 - 19% by RV method
 - 2% by microlensing
 - 1% by direct imaging

exoplanets.nasa.gov

