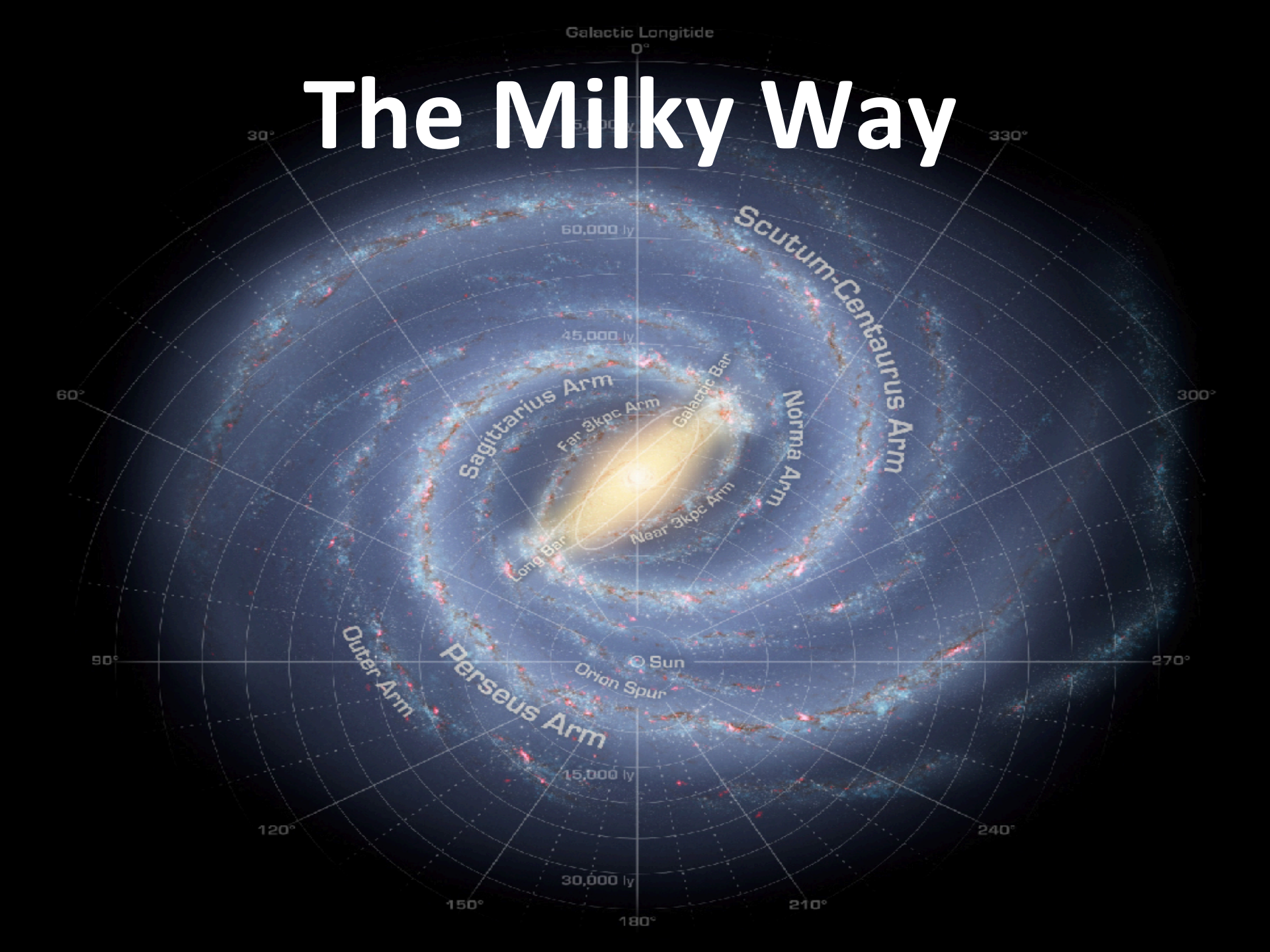
The Milky Way

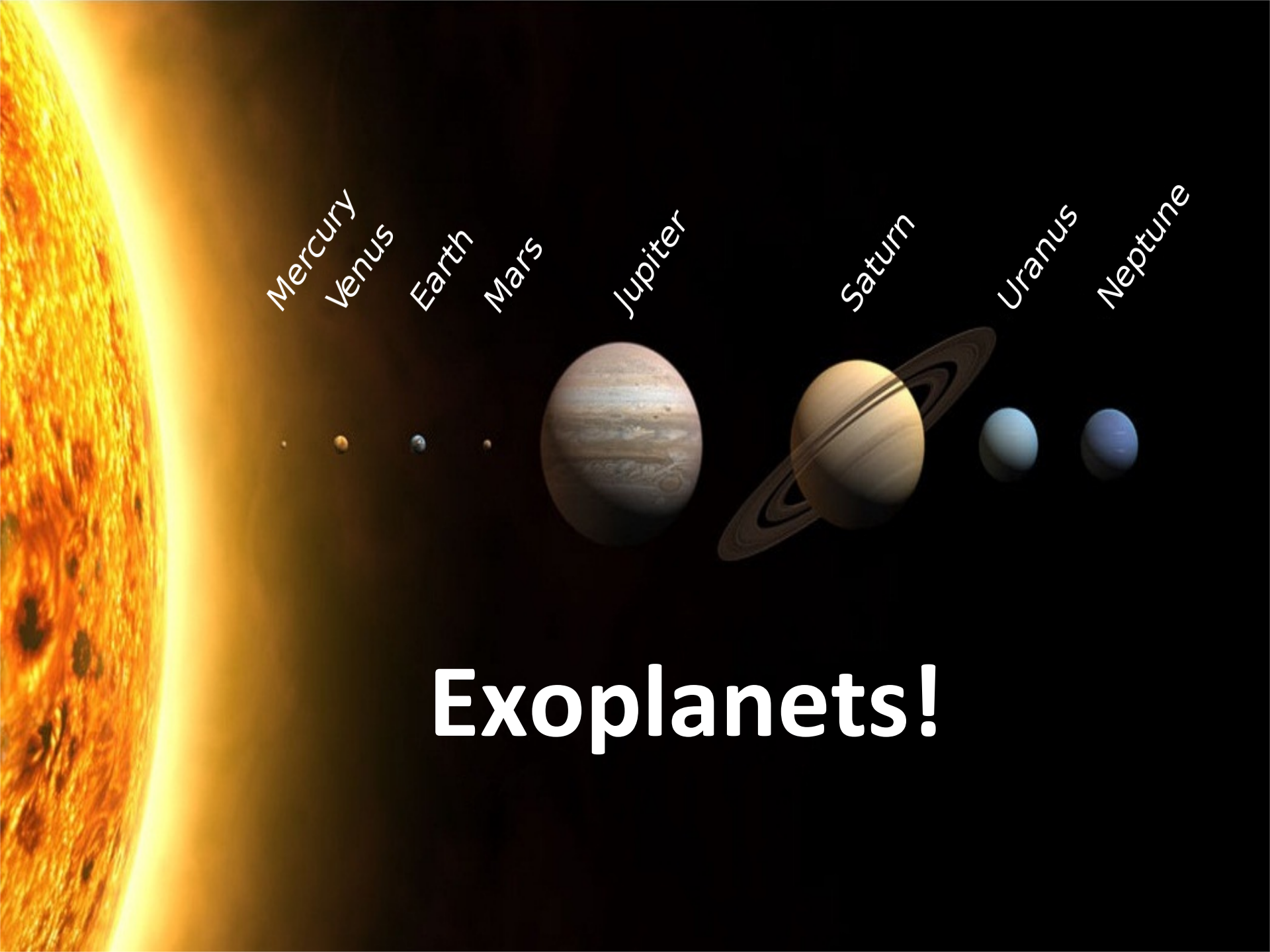


Oral Presentation

- Choose topic on sign-up sheet being passed around
  - Many options, or choose your own!
  - Some science, some biography or instruments

- April 11, 5 minutes
- Slides: must be emailed in pdf on April 10

- Homework due next week: questions?



Exoplanets!

Exoplanets

3926 confirmed exoplanets!

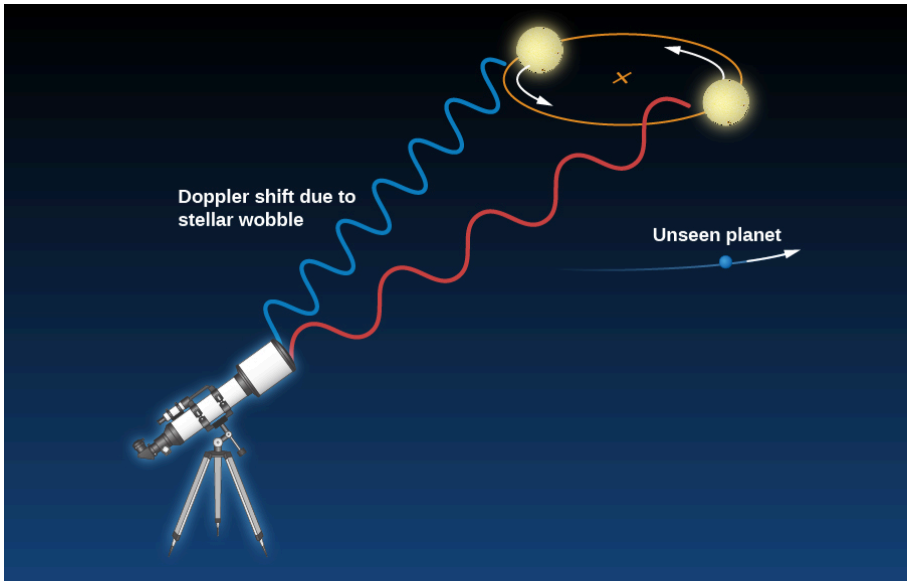
first detection around normal star: 1995

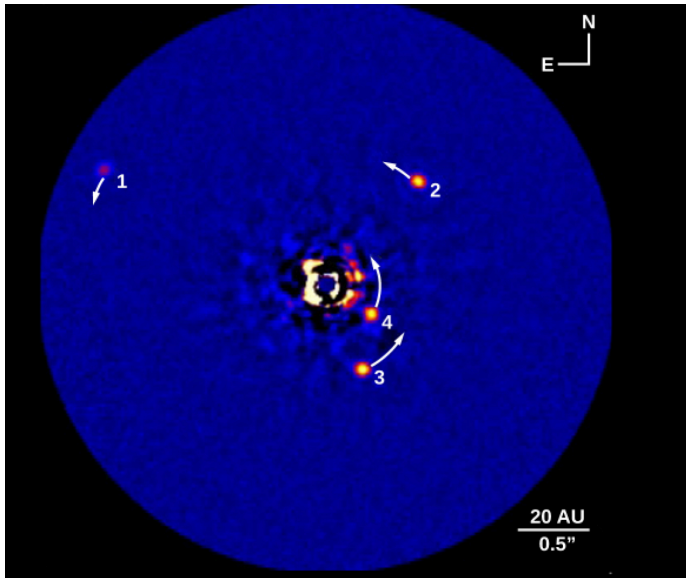
3000 more likely planets

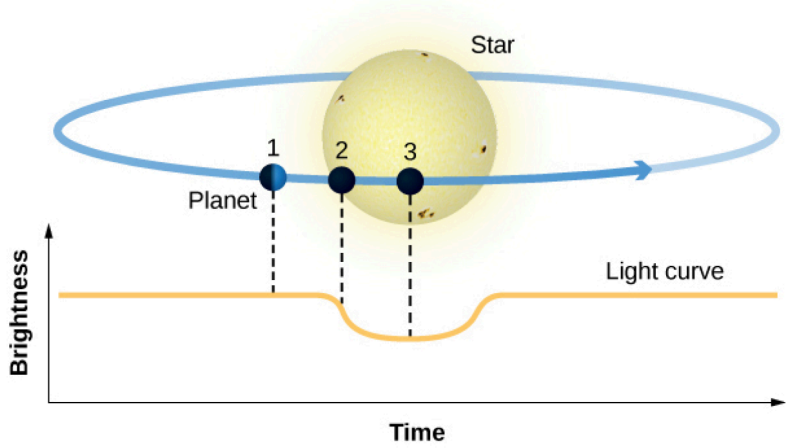
This is amazing!

Detection methods:

Radial Velocity
Transit
Direct Imaging





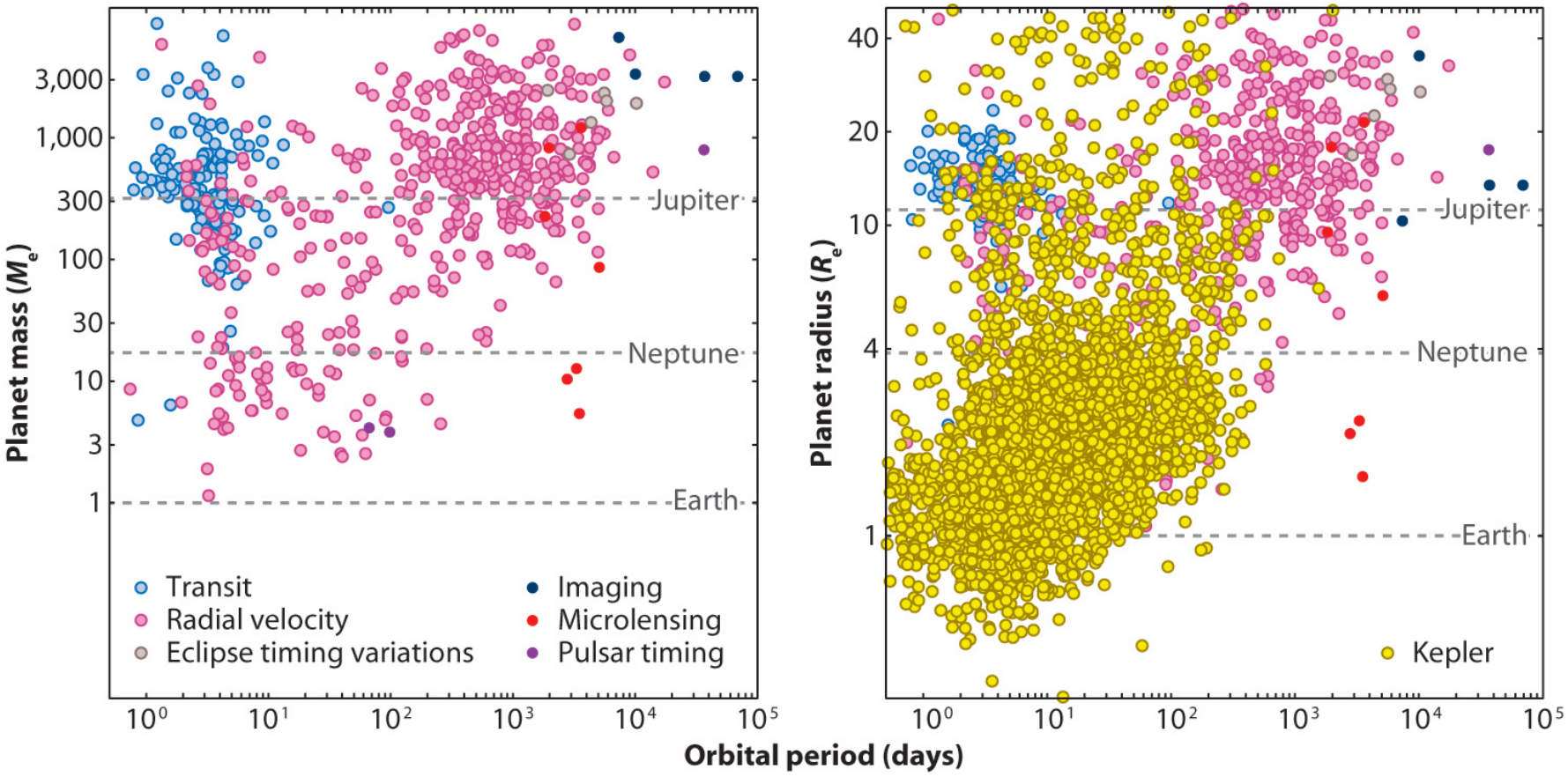


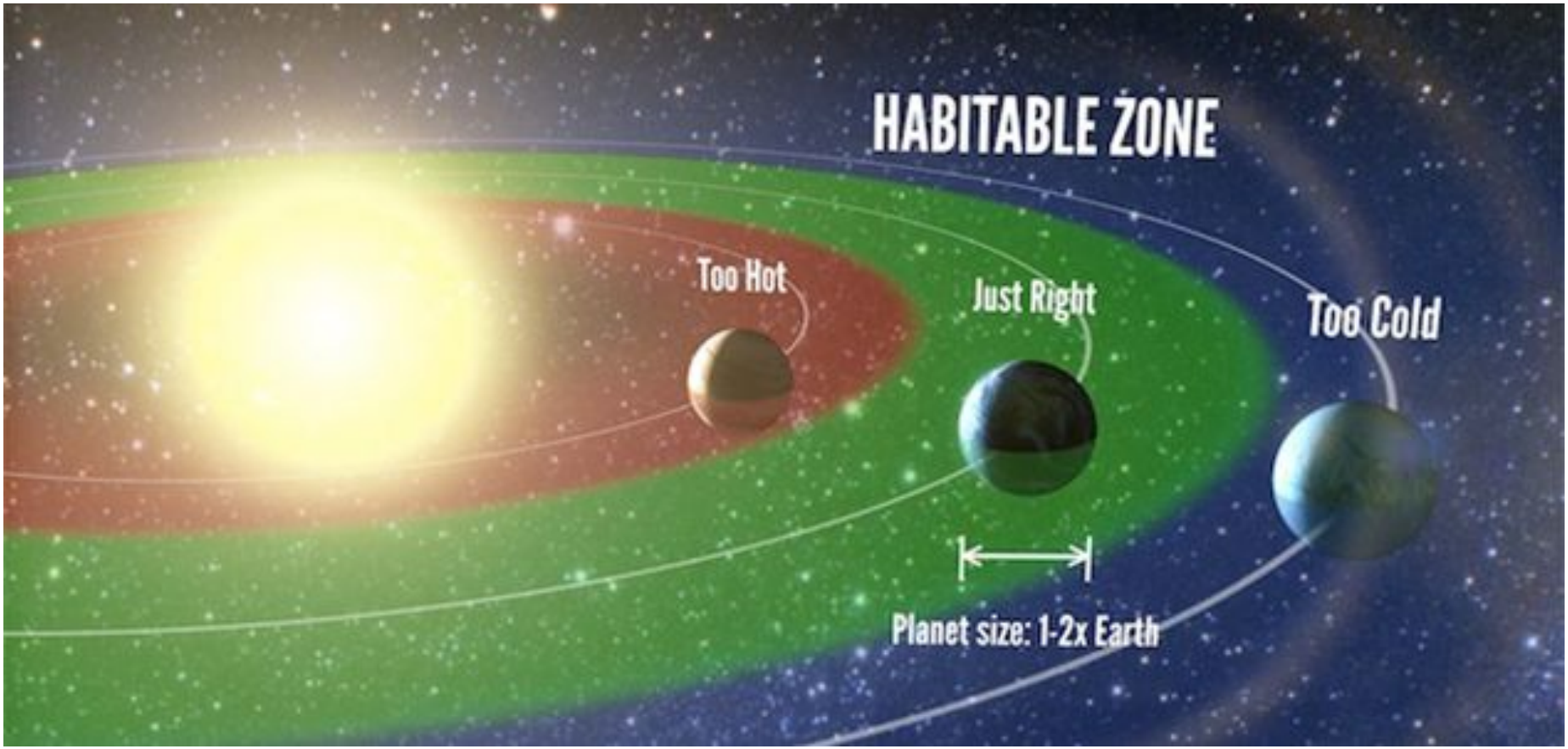
Biases of exoplanet detection methods?

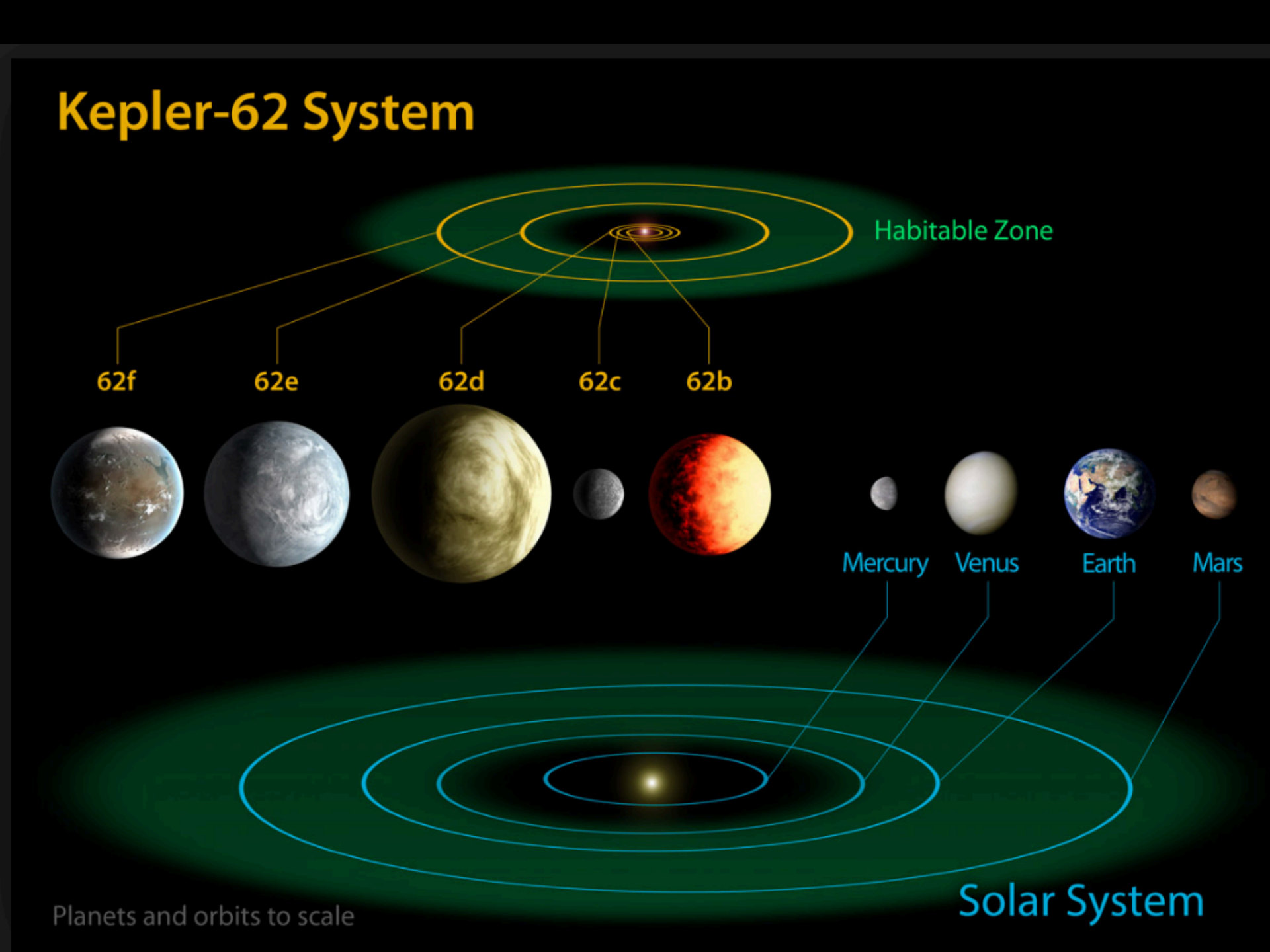
- Big planets
- Radial velocity, transit: close to the star
- Direct imaging: far from the star

- Close to us!

Exoplanets are common!




HABITABLE ZONE
Too Hot
Just Right
Too Cold
Planet size: 1-2x Earth


Kepler-62 System
Habitable Zone
62f
62e
62d
62c
62b
Mercury
Venus
Earth
Mars
Solar System
Planets and orbits to scale

Exoplanets: groups of 3-5

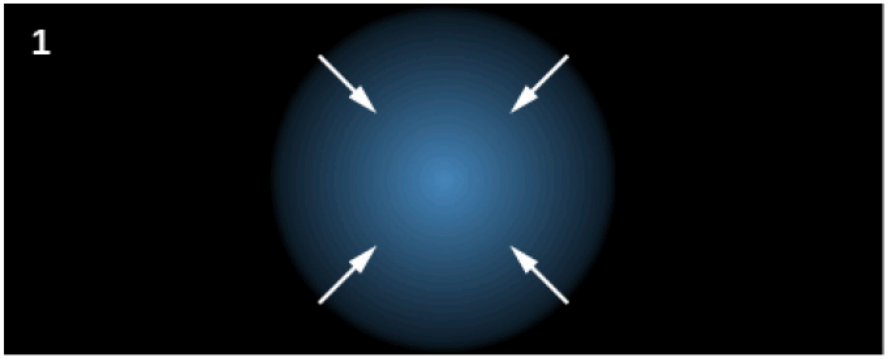
Properties & Difficulty
Radius of orbit: 1 (easy)
Atmospheric composition: 10 (very hard)
    water (extremely hard): 10
Mass of planet: 8 (hard) => 3 (actually not so hard)
Age of planet: 3 (in between) => not planet, but star: 3
Temperature: 6 (hard) / 3 for transit
Moons!: 5 => 11
Doppler – combination of mass/distance: 2
Rocky or gas giant planet: 7 => 2
Suitable for life (habitability): ~12
Planet size/radius: 1
Magnetic field: impossible
Rotation: easy => hard

- What would you want to know
- Rate those on 1=easy to measure, 10=hard to measure

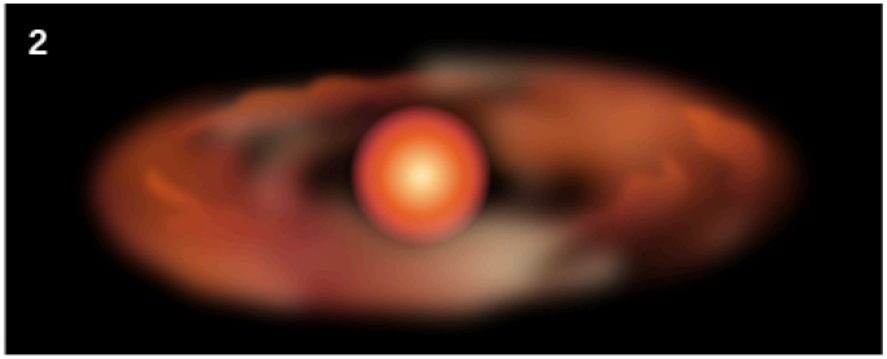
Exoplanet: a planet around any star other than our Sun

Planet Formation

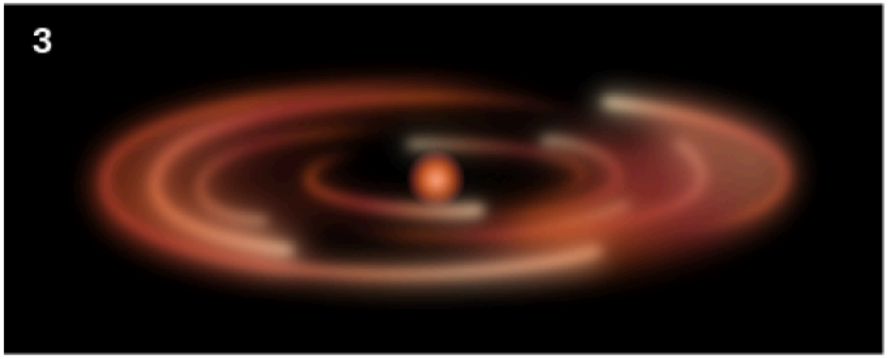
(last step in star formation, last class)



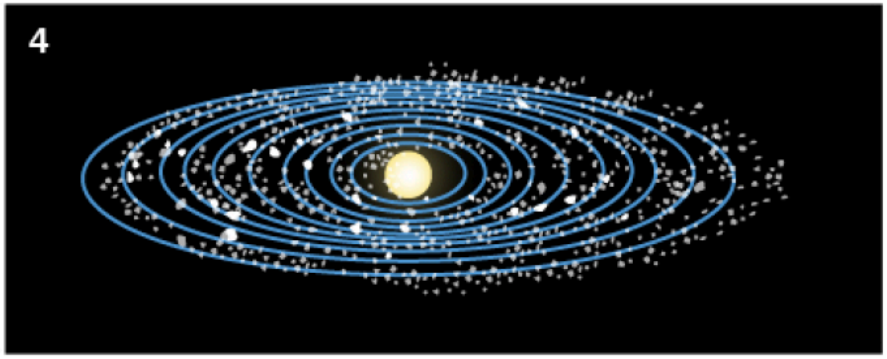
The solar nebula contracts.



As the nebula shrinks, its motion causes it to flatten.



The nebula is a disk of matter with a concentration near the center.



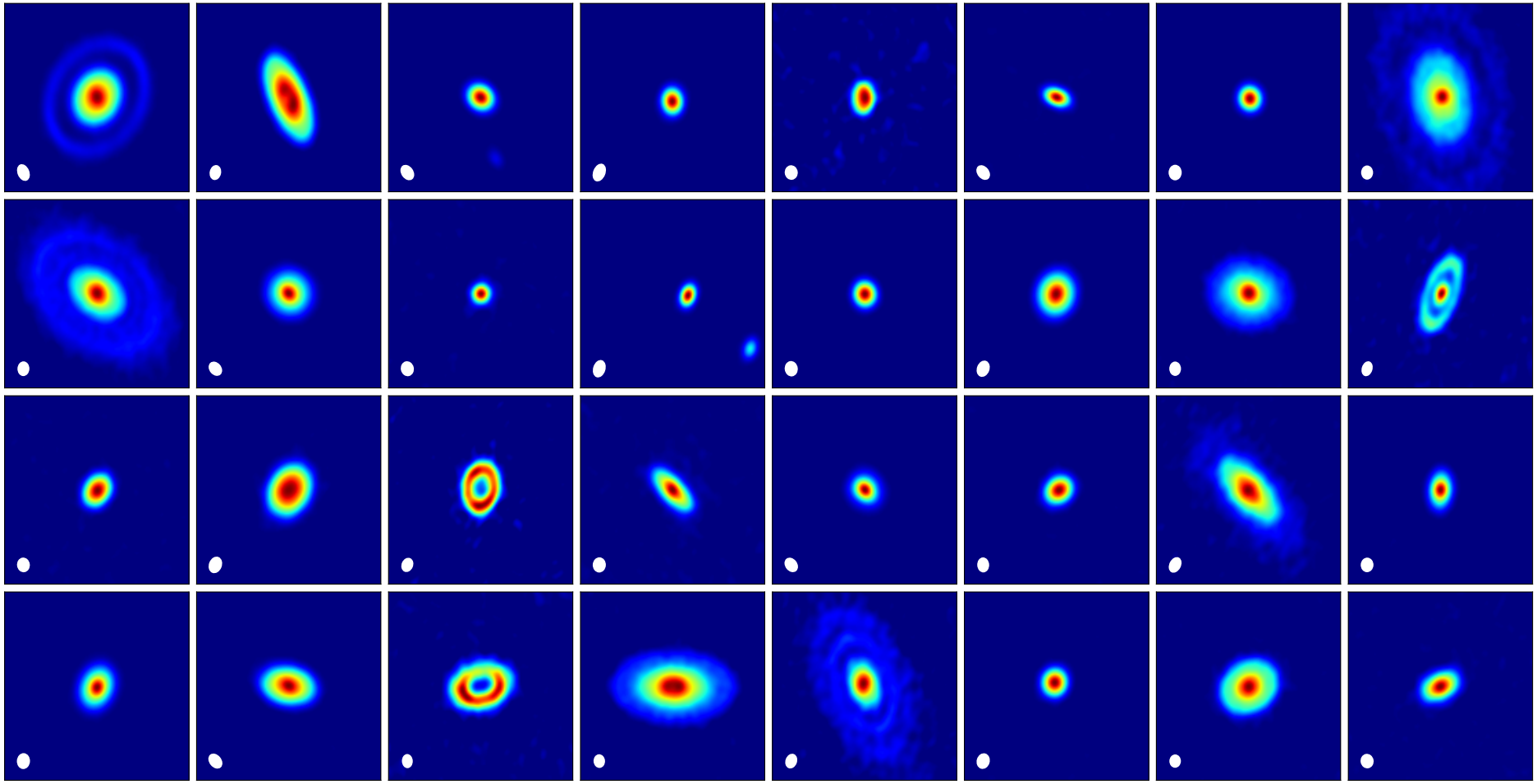
Formation of the protosun. Solid particles condense as the nebula cools, giving rise to the planetesimals, which are the building blocks of the planets.

Planets should form in disk and carve a gap

Image of a protoplanetary disk

Our own gallery of disks

(LONG Feng, PhD student)



Planet in a protoplanetary disk!