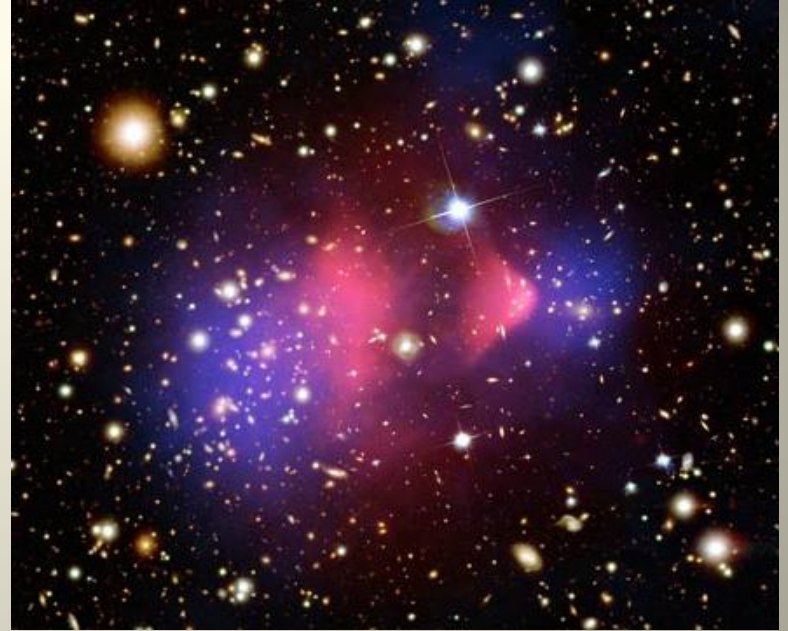


Welcome to Class 4:
Our Solar System
(and a bit of cosmology at the start)

Remember: sit only in the first 10
rows of the room

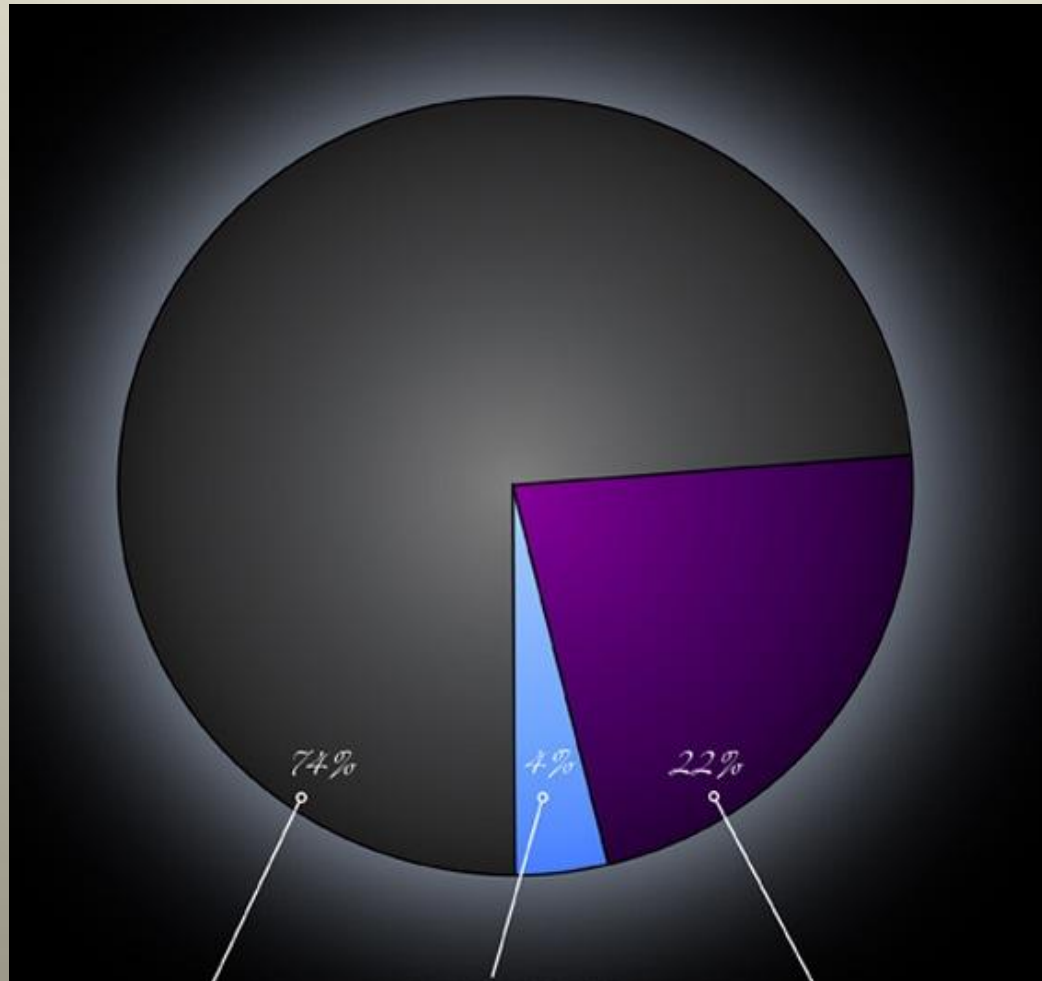
What is the difference
between dark ENERGY
and dark MATTER?



Is Earth unique, or might Earth-like
objects form elsewhere?

Remember: sit in the first 10 rows
of the room only

What is our Universe made up of?

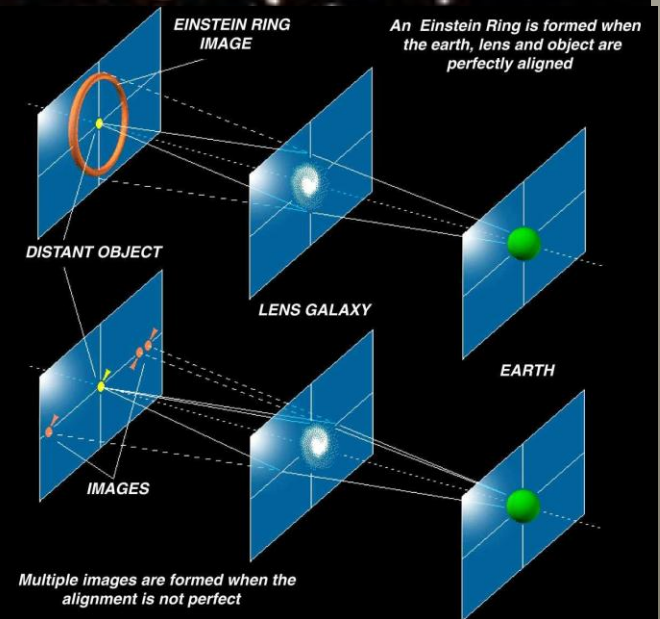
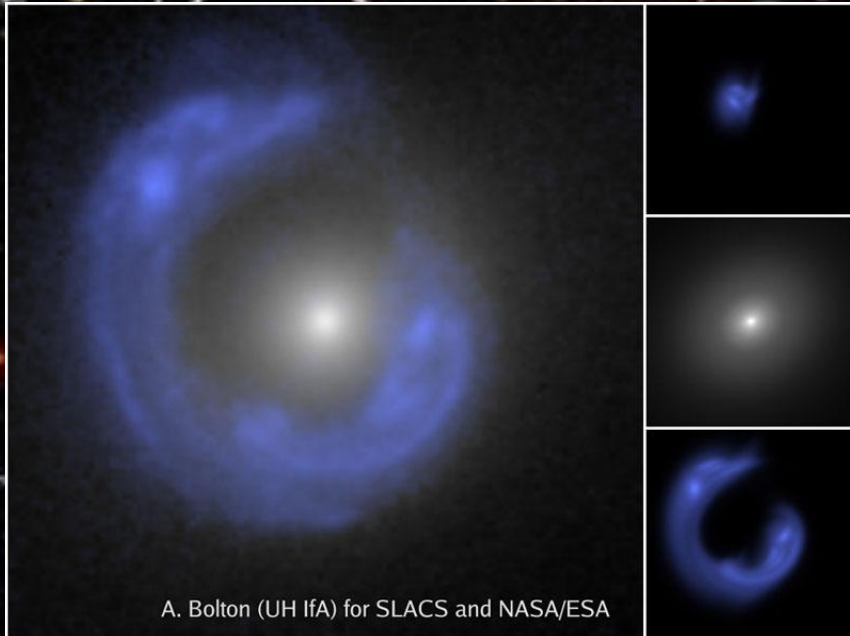


Dark Energy

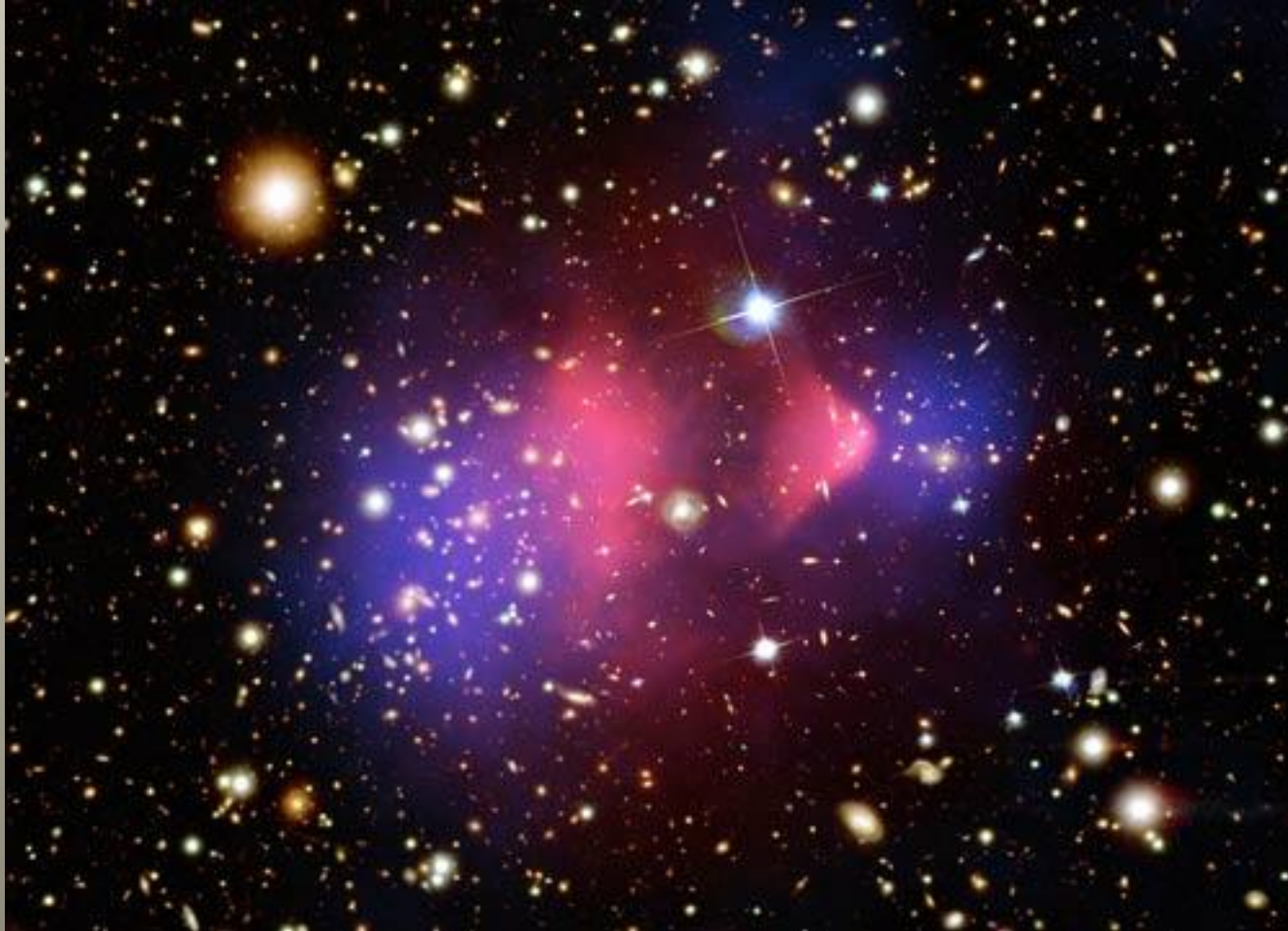
Normal Matter

Dark Matter

What evidence is there for dark matter?



Dark matter (Purple) vs. 'dark' Normal Matter (Pink)



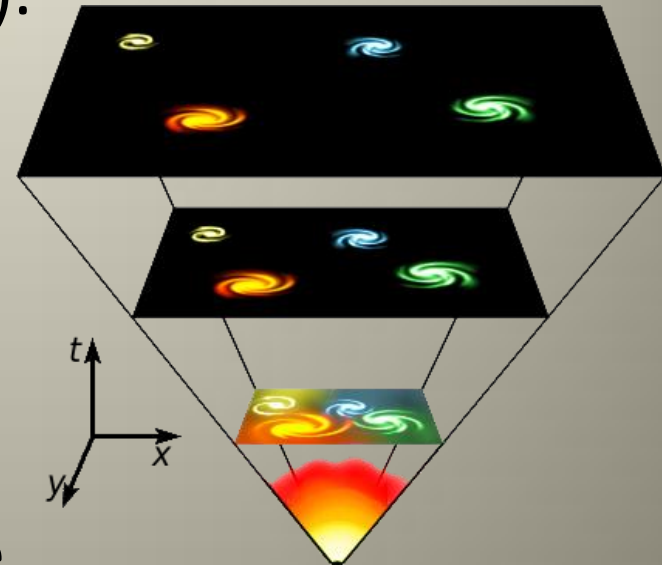
Cosmology: the study of the origin, structure and evolution of our universe

In 1929, Edwin Hubble announced other galaxies were ALL moving away from us (our galaxy).



Big Bang Theory:

The scientific theory that the universe emerged from a tremendously dense and hot state.



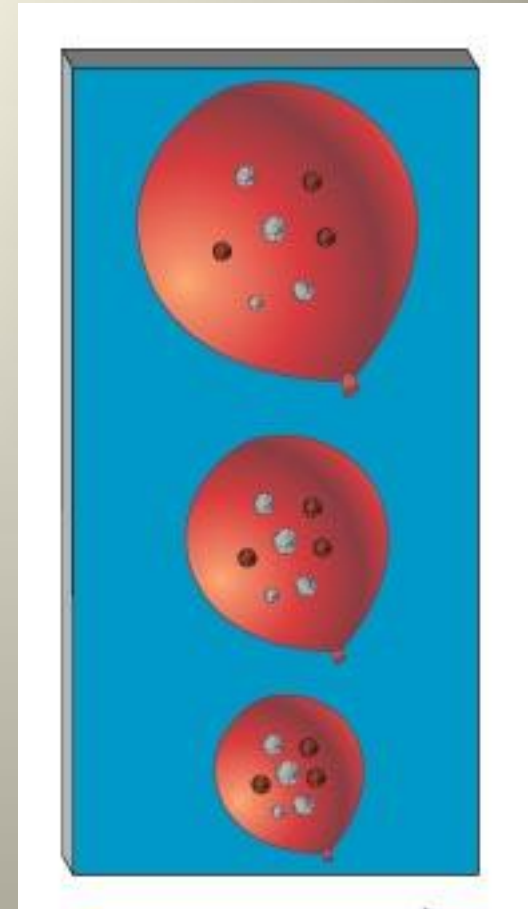
But is EVERYTHING expanding?

Which of the following is presently expanding from the Big Bang

1. Atoms in your body
2. Local Group Galaxies
3. Milky Way Galaxy
4. Distances between very distant galaxies

Big Bang Theory says:
the whole universe started
out more dense, hotter and
smaller

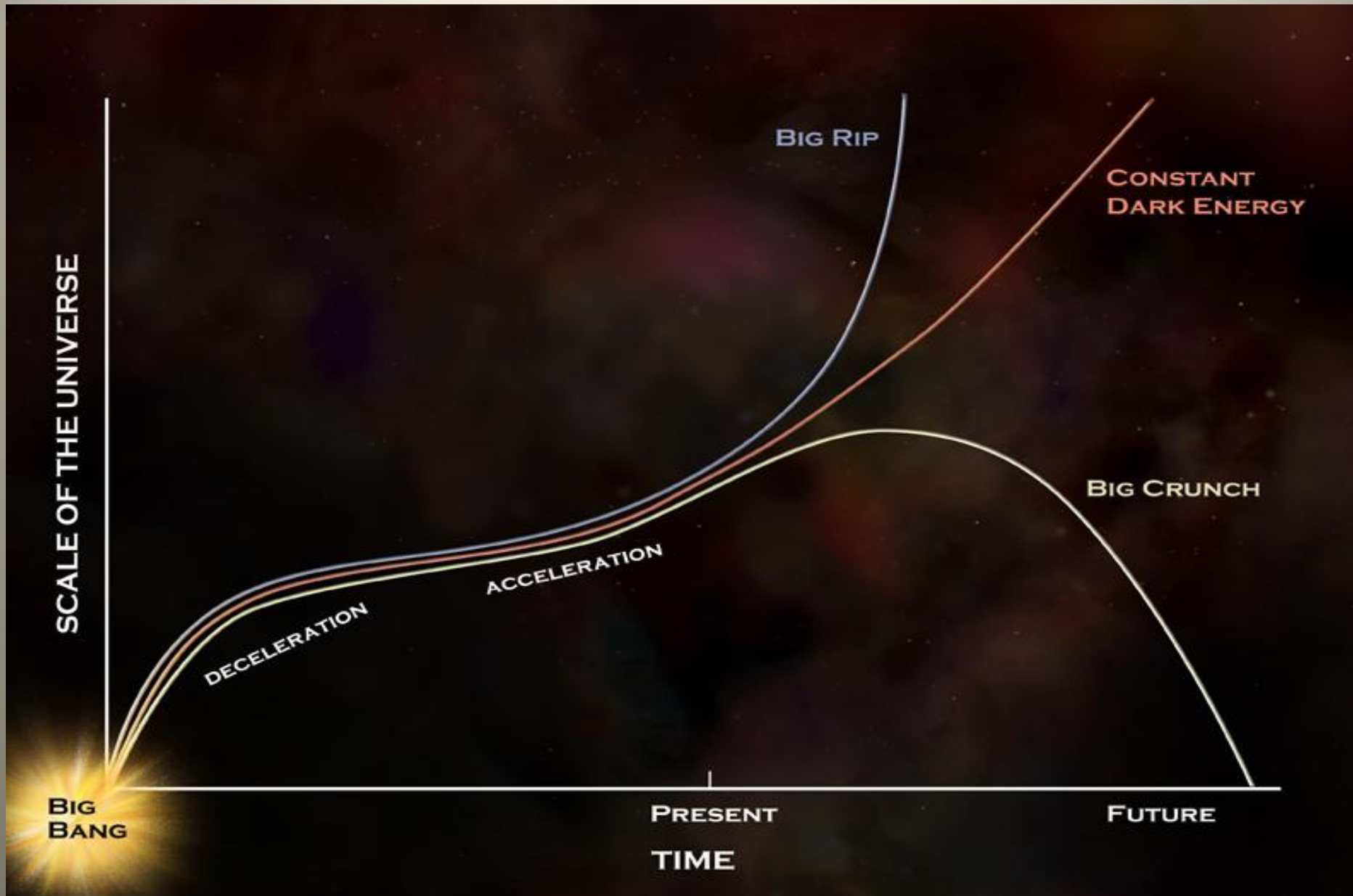
What evidence should we
see today of it having been
like this?



Which of the following is NOT evidence of the Big Bang?

1. Radiation from early hot phase
2. Discovery of the explosion point
3. Expanding universe
4. Relative abundance of simplest atoms.

What evidence is there for Dark Energy?



Discuss then answer with your PRS:
Which is not a 'Terrestrial' planet?

1. Saturn
2. Mercury
3. Mars
4. Venus
5. Earth

Working in groups, fill in this chart in your notes:

Characteristics	Terrestrial Planets	Jovian Planets
Location in Solar System		
Current Composition		
Mass (high or low?)		
Radius (large or small?)		
Distances between neighboring planets		

What same characteristics do all the planets have?

1. All the planets orbit in the same direction (counter-clockwise from North).
2. Nearly all the planets rotate in the same counter-clockwise direction.
3. All the planets lie in the same narrow 2-dimensional plane.
4. All the orbits are nearly circular.
5. The Sun is at the center and contains most of the mass of solar system.

The 'Nebular Theory'

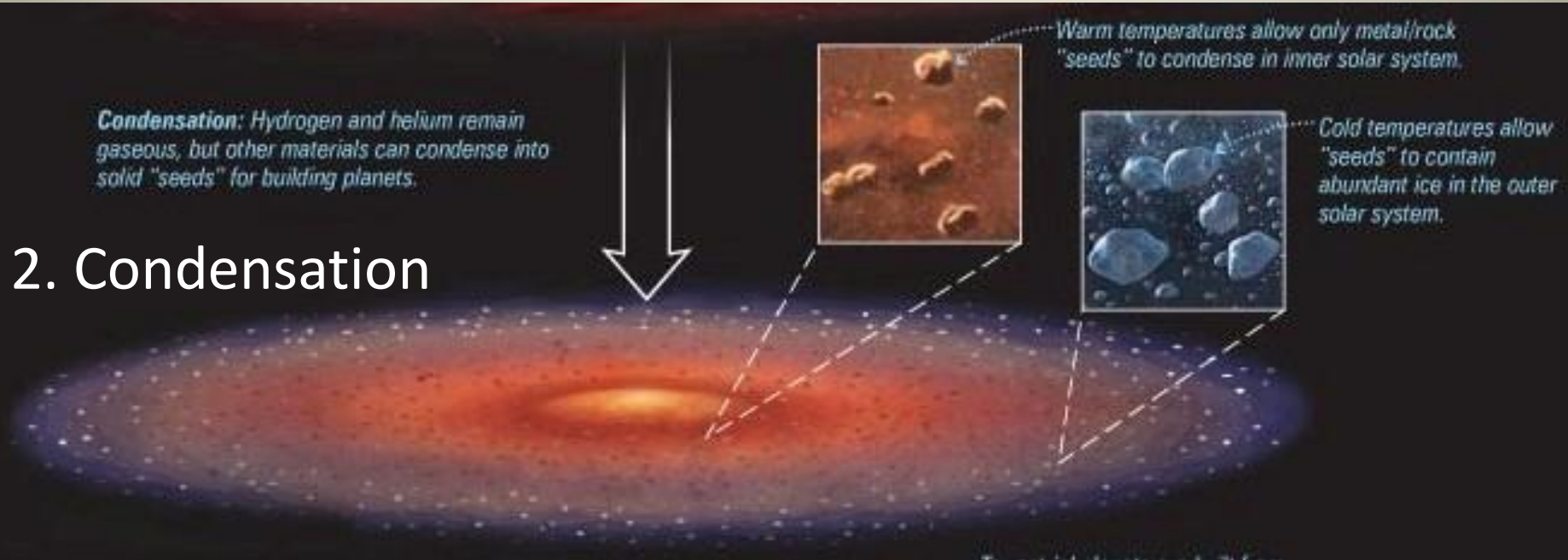
It was created to explain all observations: both the *differences* between the planets AND their *similarities*.

1. Contraction



Which characteristics does this stage explain?

The nebula center remains hot and dense,
the outer regions cool and tenuous



Which characteristics does this stage explain?

Planetesimals accrete to build up planets from the local material available

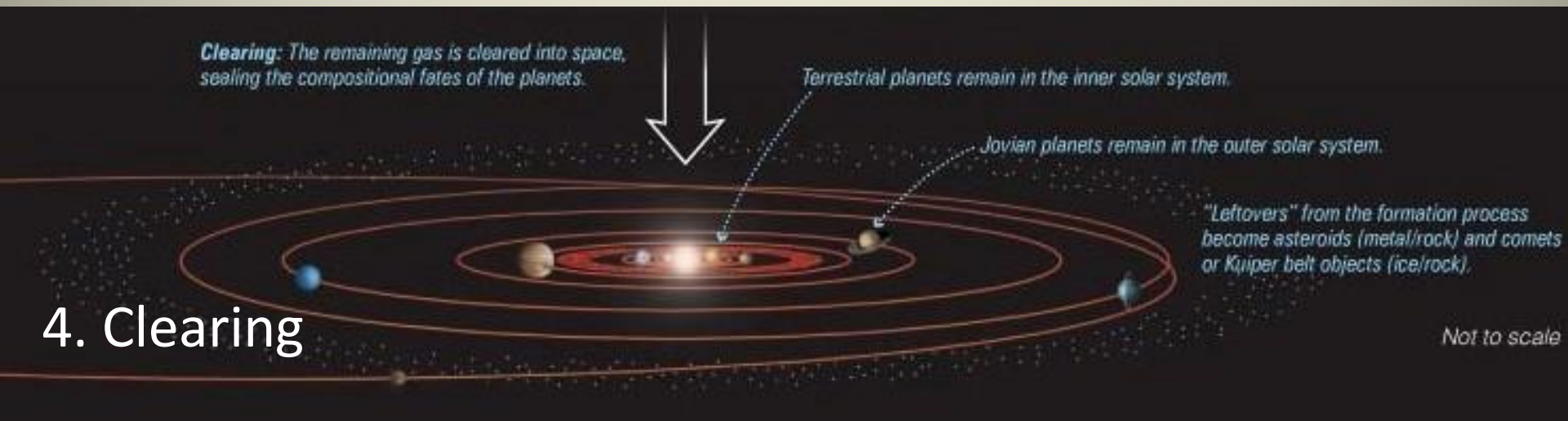
Accretion: Solid "seeds" collide and stick together. Larger ones attract others with their gravity, growing bigger still.

3. Accretion



Which characteristics does this stage explain?

The rest of the smaller debris is blown away once the Sun 'turns on'



Which characteristics does this stage explain?

How do we explain: Pluto? The Asteroid Belt? Comets?

Venus rotates BACKWARDS and Uranus rotates on its side!

PRS: What Solar System characteristic is not explained by the Nebular Theory?

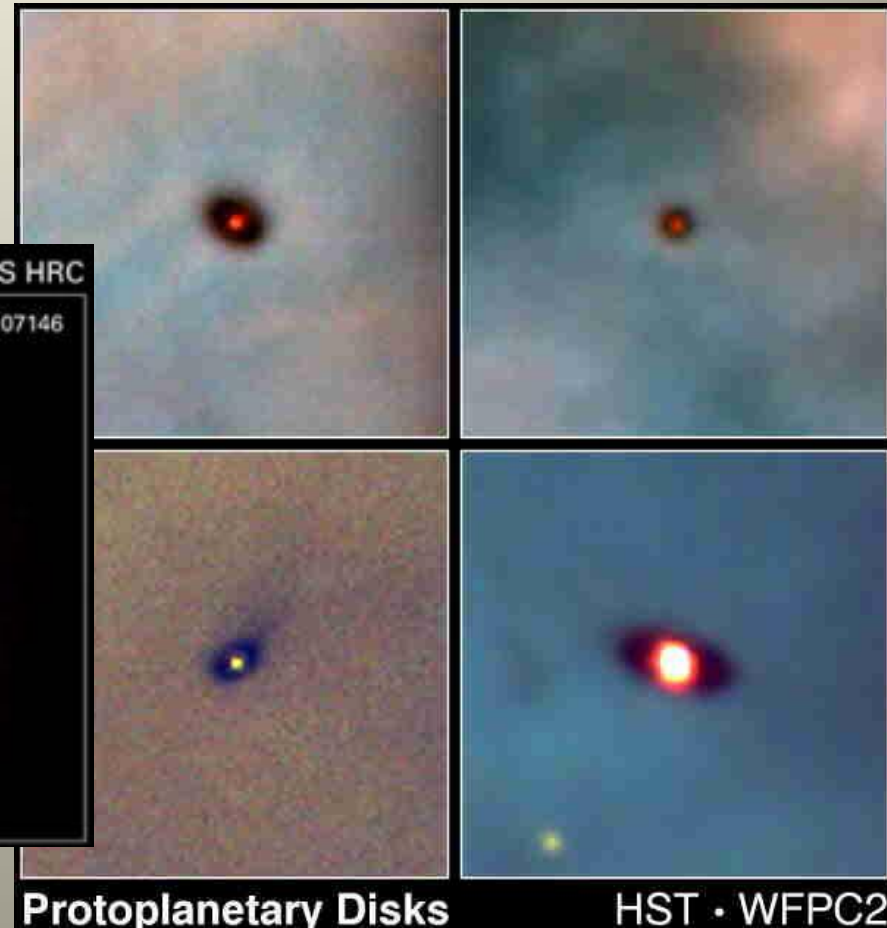
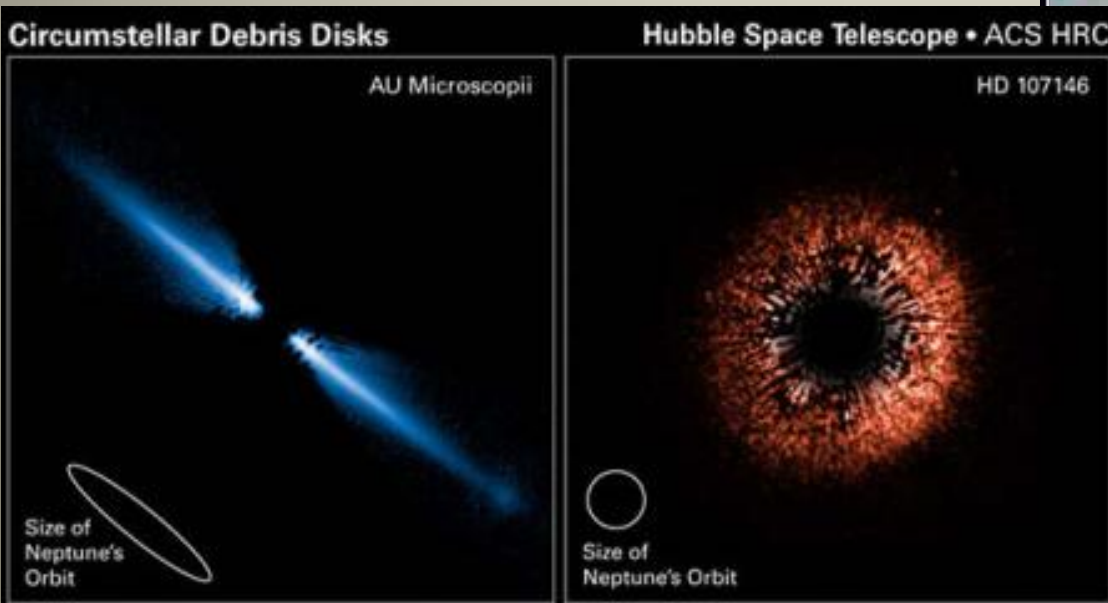
1. Planets orbit in the same direction
2. The inner planets are rocky
3. The sun lies at the center
4. The planets lie in a flat plane
5. Venus's backward revolution

PRS: Why did the Jovian planets get so big?

1. They formed planet `seeds' of rock, but also mixed with the very abundant ices available.
2. These massive rock/ice seeds formed larger planetesimals.
3. Their planetesimals grew very large very quickly, to capture H and He before the Sun turned on and blew it away.
4. All of the above.

What is the relevance of the 'Nebular Theory' for searching for life in the Universe?

With HST we see these disks around distant young stars.



Spread out in the room.

Put all your materials on the floor
and place your PRS clicker on the
table in front of you.

Take care that others can not
view your selection

1. What is most of our Universe made of?

1. Protons & Electrons
2. Normal Matter
3. Dark Matter
4. Dark Energy

2. If the universe continues on its present course it will..

1. Expand forever
2. Collapse to a small crunch
3. Expand for a time, but then fall back to a small crunch
4. The present course is uncertain.

The best answer is 1, as that is what our CURRENT understanding tells us.

Our Present course is certain, but our FUTURE course may change, which is why answer 4 is not as good an answer.

3. Which is not a stage in the Nebular Theory?

1. Contraction
2. Division
3. Condensation
4. Accretion
5. Clearing

4. In what stage do we see the two differing planetary compositions begin to form?

1. Contraction
2. Division
3. Condensation
4. Accretion
5. Clearing

5. Terrestrial and Jovian planets are similar in what characteristic?

1. Chemical Composition
2. Mass
3. Radius
4. **Orbital properties**

To do list for next class

- Refer to the class syllabus
- Read assigned pages in textbook and review study questions on objectives list
- Register and bring PRS transmitter to class
- Bring textbook to class (not mandatory)