Tuesday Nov 14

Agenda

• Announce:
  – Read Ch. 9
  – Part 2 of Projects due Thursday
  – No office hours tomorrow
  – Planetary Tutorial
  – Need dates of extra credit presentations
• Review Planet Formation
• “Welcome to Mars”

Saturn’s Hurricane

• First eyewall/hurricane observed on another planet
• Storm stays at Saturn’s south pole
• Yet more stunning info from Cassini
Earth’s Moon

- Moon rocks show composition w/r/t oxygen isotope same as Earth’s mantle
- Nickel-iron core not that big, consistent w/ formation from Earth’s mantle
- Scarcity of volatile/lighter elements consistent with being formed w/ lots of heat

Arguments Against the Theory

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1. Sun spinning too slowly, magnetic braking not well understood
2. Explanations of exceptions seem ad hoc…even a wrong theory can be “fixed up”
3. Exosolar planets aren’t where they’re supposed to be according to theory
Why do we think the inner (terrestrial) planets became more dense than the outer planets?

- In the collapsing solar nebula, denser materials sank toward the center
- The sun’s gravity pulled denser materials toward the center
- The inner nebula was so hot that only metals and rocks were able to condense
- The rotating disk in which the planets formed spun lighter elements outward by centrifugal force

What do we think the composition of the solar nebula was?

- About half hydrogen and helium, half heavier elements (iron, carbon, silicon, etc.)
- About 98% hydrogen and helium, and 2% heavier elements
- A less hydrogen and helium, more heavier elements

What do we think condensed out of the solar nebula?

- Hydrogen and helium
- Hydrogen compounds (water, methane, ammonia) where the nebula was cold (<150 K)
- Rocky material where the nebula was 500–1500 K (depending on the type of rock)
- Metal where the temperature was 1000–1500 K
- All except #1

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What do we think *first* caused tiny solid bits of material in the solar nebula to *accrete* and stick together?

- Gravity
- They were mostly made of sticky stuff
- Electrical forces (“static electricity”)
- Pressure

Why could the Jovian planets grow to be much larger than the terrestrial planets?

- They were further from the Sun and gravity was weaker
- They formed beyond the *frost line* where ices can condense so they included hydrogen compounds
- They were far enough from the Sun to escape the *heavy bombardment* that battered the early solar system

What is the “solar wind?”

- Strong radiation that comes from the Sun
- Similar to winds on earth but faster and stronger
- Similar to winds on earth but less dense and weaker
- Atoms and parts of atoms ejected from the Sun at high speed

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How do the “stellar winds” of young solar-type stars compare to the solar wind we see from the Sun today?

- Young stars don’t have winds
- Young stars have a less strong wind
- Young stars have much stronger winds

What do we think happened to the solar nebula after the planets formed?

- The gas was all used up
- The rest of the gas gradually drifted away
- The solar wind helped blow the gas away
- The gas is still there—we just can’t see it.

Where do asteroids come from?

- A planet between Mars and Jupiter that broke up
- They are escaped small moons
- Leftover planetesimals from the inner solar system
- Leftover planetesimals from the outer solar system
Could a solar system like ours have formed with the first generation of stars after the Big Bang?
1. Possibly - there is no physical reason why not.
2. No, there would not have been enough time to form planets.
3. No, the expansion of the Universe would have torn the solar system apart.
4. No, there would not have been enough metals and rock to form terrestrial planets.
5. No, the stars would have died by now.

What age would radiometric dating give for a chunk of recently solidified lava from Kilauea, an active volcano in Hawaii?
1. Zero.
2. The half life of potassium-40 (1.25 billion years).
3. The half-life of Uranium-238 (4.5 billion years).
4. The age of the solar system.
5. The age of the volcano.

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3. About 4 million years
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5. Around 14 billion years

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