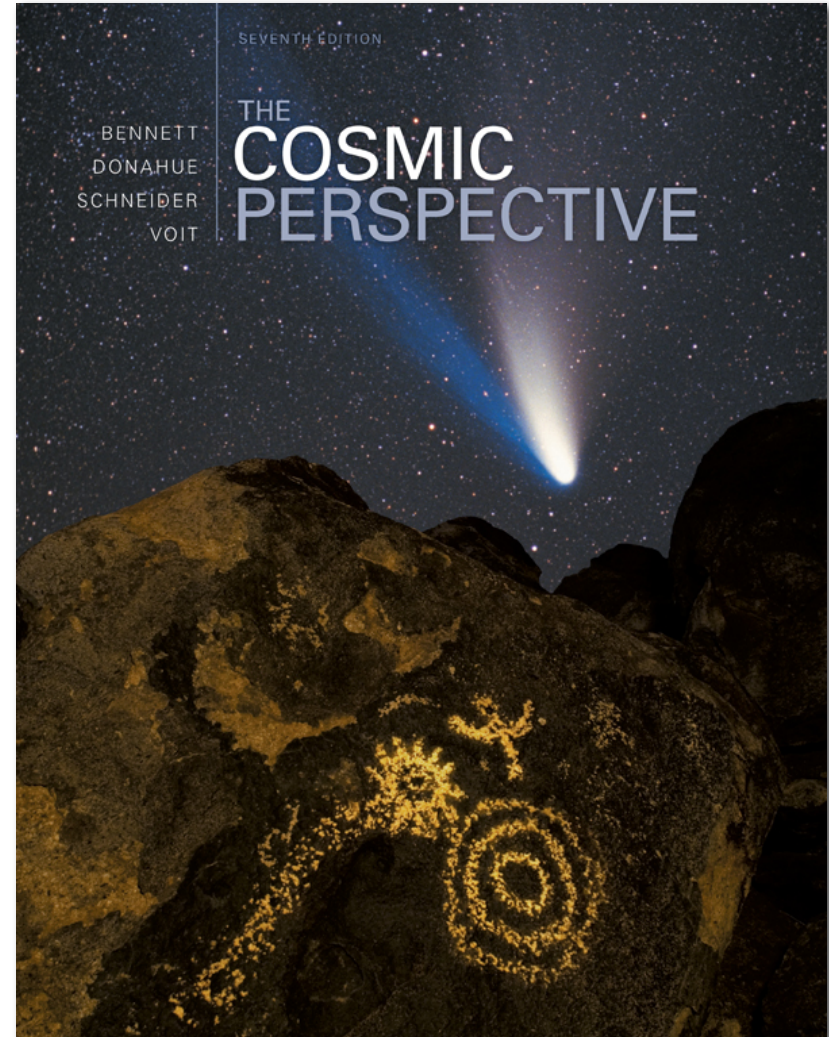


The Cosmic Perspective

Seventh Edition

Formation of the Solar System



8.1 The Search for Origins

- How did we arrive at a theory of solar system formation?
- Where did the solar system come from?

Chapter 8

In order to be successful, a theory of the formation of the solar system must explain

- a) the orderly patterns of motion of objects.
- b) why planets fall into two major categories (terrestrial and jovian).
- c) why comets reside in the Kuiper belt and Oort cloud.
- d) the exceptions to the general rules.
- e) all of the above

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Which of the following is *not* a problem for the *close encounter hypothesis* for the origin of the planets?

- a) It relies on an improbable event (a very close encounter between the Sun and another star).
- b) It predicts that planetary systems are rare.
- c) It fails to explain the orbits of the planets.
- d) It fails to explain the existence of two types of planets.
- e) none of the above (all are problems with the *close encounter hypothesis*)

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8.2 Explaining the Major Features of the Solar System

- What caused the orderly patterns of motion in our solar system?
- Why are there two major types of planets?
- Where did the asteroids and comets come from?
- How do we explain "exceptions to the rules"?

What is the origin of the elements that made up the protoplanetary nebula?

- a) They were produced in the big bang.
- b) They were formed inside stars or supernovae that exploded before the solar system formed.
- c) They were produced in the Sun's early strong solar wind.
- d) They were formed inside the Sun shortly after its formation and blown out by its early strong solar wind.
- e) They were formed by fusion at the time of the formation of the Milky Way galaxy.

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Why was the protoplanetary nebula flat?

- a) Nebulae form in a variety of shapes, and ours happened to be disk-shaped.
- b) The nebula became flat due to gravitational contraction along its axis.
- c) It flattened as a result of collisions between particles in the nebula.
- d) The force of a nearby supernova flattened the nebula.

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Which of the following processes did *not* contribute to orderly motions in the solar system?

- a) As the nebula shrank, conservation of angular momentum resulted in an increased spin rate.
- b) Collisions between particles canceled out random motions.
- c) Hotter temperatures closer to the Sun and cooler temperatures farther from the Sun caused different materials to condense at different distances from the Sun.
- d) none of the above (all contributed to orderly motions)

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Which lists the ingredients of the solar nebula in order of increasing abundance?

- a) metals, rocks, hydrogen compounds
- b) rocks, metals, hydrogen compounds
- c) hydrogen compounds, metals, rocks
- d) metals, hydrogen compounds, rocks
- e) hydrogen compounds, rocks, metals

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Why are the planets closest to the Sun more dense than those farther from the Sun?

- a) Dense objects sink toward the Sun while less dense objects are less strongly bound by the Sun's gravity.
- b) Jupiter scattered denser planets inward and less dense objects outward.
- c) Only dense materials could condense close to the Sun.
- d) The heat at that proximity to the Sun makes it difficult for them to think.

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Where did hydrogen and helium gas condense in the protoplanetary nebula?

- a) throughout the solar system
- b) only inside the frost line
- c) only outside the frost line
- d) nowhere

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How did the small particles that condensed in the solar nebula accrete to grow into planetesimals?

- a) They collided gently and stuck together through electrostatic forces.
- b) They collided gently and stuck together through magnetic forces.
- c) They collided gently and stuck together through the gravitational force.
- d) They collided forcefully so that they stuck together through mechanical forces.

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How did the formation of jovian planets differ from the formation of terrestrial planets?

- a) The jovian planetesimals were larger than those that made terrestrial planets.
- b) The jovian planetesimals became large enough to gravitationally capture hydrogen and helium from the nebula.
- c) The jovian planetesimals formed by direct collapse of the gas in the solar nebula rather than accretion of planetesimals.
- d) The jovian planetesimals were icier than those that made terrestrial planets.
- e) A and D

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What condensed beyond the frost line?

- a) hydrogen compounds
- b) rocks
- c) metals
- d) all of the above

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Why does the Sun rotate slowly today?

- a) The rate of the Sun's rotation is a consequence of the solar nebula's initial angular momentum.
- b) The Sun transferred angular momentum to the planets through torques when the planets formed.
- c) The Sun transferred angular momentum to charged particles in the solar wind.
- d) The Sun gradually slowed down as material flowed into it through the solar nebula.

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Why did planet formation eventually end?

- a) The solar wind removed the remaining nebular gas.
- b) There were no more planetesimals left.
- c) All gas was captured by the jovian planets.
- d) The planets migrated to orbits farther from the Sun where there was not any gas or planetesimals.

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What happened to most of the mass originally in the asteroid belt?

- a) It became part of Mars.
- b) It became part of Jupiter.
- c) It was scattered into the Oort cloud.
- d) Some of it crashed into the inner planets while some was ejected from the solar system.
- e) It is still in the asteroid belt.

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Why do some of Jupiter's moons orbit in the opposite direction of Jupiter's rotation?

- a) They are captured planetesimals that encountered Jupiter in such a way that they ended up orbiting backward.
- b) When moons form in a circumplanetary nebula they have roughly equal probability of orbiting forward and backward.
- c) Jupiter's strong tidal force caused the orbits to evolve into backward orbits.
- d) Jupiter's rotation is backward due to a giant impact, so its forward-orbiting moons are orbiting in the opposite direction of Jupiter's spin.
- e) Jupiter does *not* have any moons orbiting backward.

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Which of the following features of the solar system can be explained by giant impacts?

- a) The existence of Mars's two small moons.
- b) The existence of Earth's large moon.
- c) The backward orbit of Neptune's moon Triton.
- d) The large number of objects in the asteroid belt.
- e) all of the above

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Which of the following characteristics of the solar system would we not necessarily expect to find around other stars?

- a) a distant disk of comets like the Kuiper belt
- b) jovian planets
- c) a terrestrial planet with a large moon
- d) an Oort cloud of comets

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8.3 The Age of the Solar System

- How do we measure the age of a rock?
- How do we know the age of the solar system?

Radiometric dating can be used to determine the amount of time since

- a) a rock most recently solidified.
- b) a rock first solidified.
- c) the elements in a rock were formed inside stars or a supernova.
- d) the big bang.

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How old are the oldest meteorites?

- a) 3.95 billion years
- b) 3.85 billion years
- c) 4.35 billion years
- d) 4.55 billion years
- e) 5.45 billion years

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How do we verify the validity of radiometric dating?

- a) Some archeological artifacts have dates on them.
- b) We use multiple radiometric techniques to see if the same ages are found.
- c) Both A and B.
- d) None of the above.

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