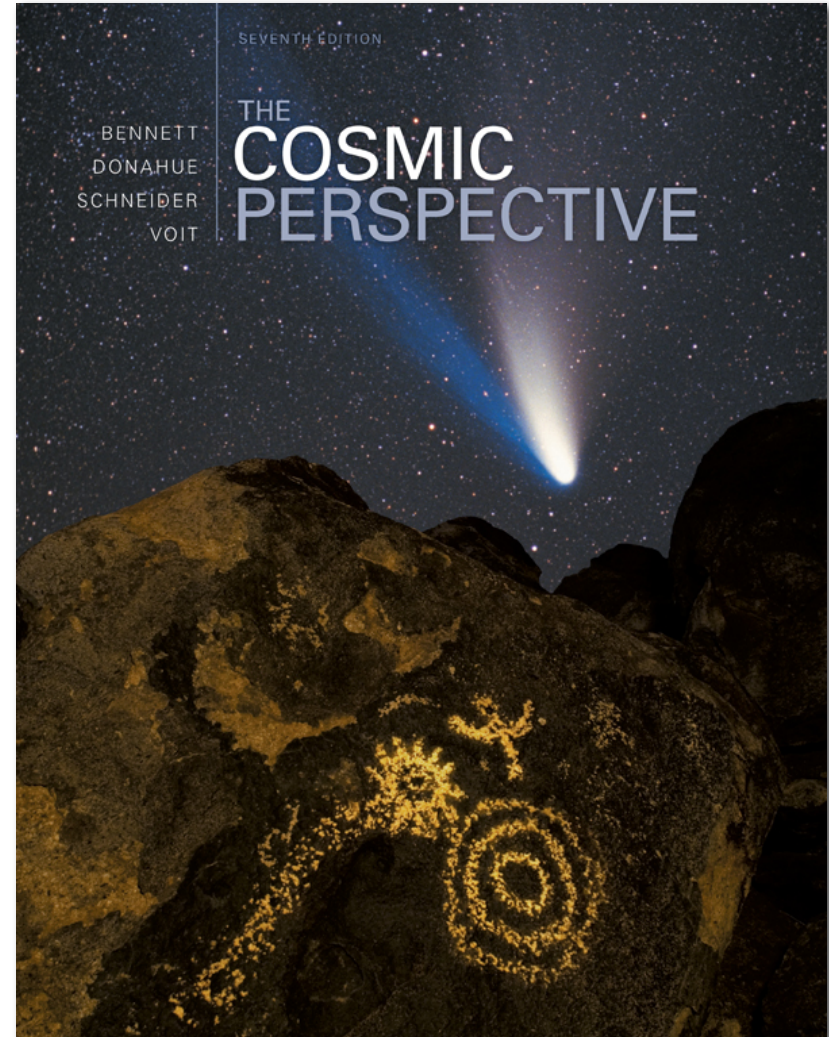


The Cosmic Perspective

Seventh Edition

**Light and Matter:
Reading
Messages from
the Cosmos**



When light approaches matter, it can

- a) be *absorbed* by the atoms in the matter.
- b) be *transmitted* through the matter.
- c) bounce off the matter, and be *reflected*.
- d) any of the above
- e) Only B or C

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What is light?

- a) a wave, like sound only much faster
- b) a particle (each one is a *photon*)
- c) the absence of dark.
- d) a kind of energy we *model* with some of the properties of waves and some properties of particles
- e) the sensation you feel when hit by energy, visible or invisible

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- e) the sensation you feel when hit by energy, visible or invisible

How can light behave as both a wave and a particle?

- a) It doesn't really.
- b) It really is *both* a wave and a particle.
- c) Light and small objects such as atoms behave in ways we never see in everyday objects, so we can't describe them in everyday terms.
- d) This is what *quantum mechanics* describes.
- e) C and D

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What is the electromagnetic spectrum?

- a) light of all different wavelengths
- b) light of all different energies
- c) radiation, some of which is dangerous, and some of which is harmless
- d) all of the above

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- b) light of all different energies
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Compared to red light, blue light has

- a) shorter wavelengths.
- b) longer wavelengths.
- c) higher energy photons.
- d) A and C
- e) none of the above

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Which of the following lists the different kinds of light in order from shortest to longest wavelength?

- a) visible light, ultraviolet, infrared, radio, microwaves, X rays, gamma rays
- b) gamma rays, X rays, ultraviolet, visible, infrared, radio
- c) x rays, ultraviolet, visible, infrared, radio, gamma rays
- d) ultraviolet, visible light, infrared, gamma rays, X rays

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We can't see infrared, but we can perceive it as

- a) heat.
- b) sound.
- c) static.

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Which travels fastest?

- a) X rays
- b) ultraviolet light
- c) visible light
- d) radio waves
- e) They all travel at the same speed.

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Which is likely to originate from the hottest (most energetic) object?

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What happens to thermal radiation (a continuous spectrum) if you make the source hotter?

- a) It produces more energy at all wavelengths.
- b) The *peak* of the spectrum shifts redward.
- c) The *peak* of the spectrum shifts blueward.
- d) A and B
- e) A and C

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What happens to thermal radiation (a continuous spectrum) if you make the source twice as hot?

- a) twice as much energy is emitted
- b) 4 times as much energy is emitted
- c) 8 times as much energy is emitted
- d) 16 times as much energy is emitted

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- d) 16 times as much energy is emitted**

What is found in the nucleus of atoms?

- a) protons with a + charge
- b) neutrons with no charge
- c) electrons with a – charge
- d) all of the above
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Chapter 5

What does the 12 in ^{12}C (pronounced “carbon twelve”) mean?

- a) This is the twelfth element in the periodic table.
- b) The atom has 12 protons in its nucleus.
- c) The atom has 6 protons and 6 neutrons in its nucleus.
- d) The atom has 12 electrons.
- e) none of the above

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How is the isotope ^{14}C different from ^{12}C ?

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- c) It has more electrons.
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Chapter 5

In what ways is an electron orbiting the nucleus of an atom like a planet orbiting the Sun?

- a) Both are held in orbit by a force.
- b) The smallest orbits are the most tightly held.
- c) If you give an electron or a planet more energy, it will move to a bigger orbit.
- d) If you give an electron or a planet enough energy, it can break free.
- e) all of the above

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In what ways is an electron orbiting the nucleus of an atom different from a planet orbiting the Sun?

- a) The central force is the electromagnetic force, not gravity.
- b) Not all orbits are allowed (they are *quantized*).
- c) An electron can *jump* or make a *transition* from one orbital to another.
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When an electron in an atom jumps from a high-energy orbital to a lower-energy one, what happens?

- a) a photon of light is emitted
- b) a photon of light is absorbed
- c) the atom's temperature changes
- d) the atom changes color
- e) none of the above

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What can cause an electron to jump from a low-energy orbital to a higher-energy one?

- a) a photon of light is emitted
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What's the difference in what you see when visible light of different energies enters your eye?

- a) You see a range of brightnesses.
- b) You see different colors.
- c) Your eye feels different temperatures.
- d) More energetic light makes you blink.
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What kind of spectrum does hot gas produce?

- a) emission line
- b) absorption line
- c) continuous
- d) infrared
- e) ultraviolet

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What kind of spectrum does a hot solid produce?

- a) emission line
- b) absorption line
- c) continuous
- d) infrared
- e) ultraviolet

What kind of spectrum does a hot solid produce?

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- b) absorption line
- c) continuous**
- d) infrared
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Chapter 5

If all the colors (a continuous spectrum) pass *through* a gas, what kind of spectrum do you get?

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- b) absorption line
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The visible spectrum of the Sun is a(n)

- a) emission line spectrum.
- b) absorption line spectrum.
- c) continuous spectrum.
- d) Doppler shifted spectrum.
- e) none of the above

The visible spectrum of the Sun is a(n)

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- b) absorption line spectrum.**
- c) continuous spectrum.
- d) Doppler shifted spectrum.
- e) none of the above

Suppose you observed the spectrum of sunlight reflected from Mars. Compared to the spectrum of the Sun observed directly, it would have

- a) more emission lines.
- b) more absorption lines.
- c) more energy in the red part of the spectrum.
- d) A and C
- e) B and C

Chapter 5

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Chapter 5

Since each element has a different number of protons and electrons and a different pattern of orbitals,

- a) gasses made of different elements have different patterns of emission and absorption lines.
- b) each element's spectrum is unique.
- c) we can tell what a gas is made of from by looking at its spectrum.
- d) all of the above
- e) A and B

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In a continuous spectrum, what controls how much energy comes out in different colors (more red or more blue light)?

- a) what the object is made of
- b) how hot the object is
- c) A and B
- d) none of the above

Chapter 5

In a continuous spectrum, what controls how much energy comes out in different colors (more red or more blue light)?

- a) what the object is made of
- b) how hot the object is**
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- d) none of the above

What determines a star's color?

- a) what the star is made of
- b) how hot the star is
- c) A and B
- d) none of the above

What determines a star's color?

- a) what the star is made of
- b) how hot the star is**
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- d) none of the above

The hottest star is one that appears

- a) orange.
- b) red.
- c) yellow.
- d) white or bluish-white.
- e) They are all the same temperature; they just look different colors.

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The hottest shirt is one that appears

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The hottest shirt is one that appears

- a) orange.
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What controls the color of a shirt, a planet, or anything that shines by *reflecting* light?

- a) its temperature
- b) how well it reflects light of different colors
- c) the color of the light hitting it
- d) B and C
- e) A, B, and C

What controls the color of a shirt, a planet, or anything that shines by *reflecting* light?

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The spectrum of a hot solid does not tell you anything about what it is made of.

- a) true
- b) false

The spectrum of a hot solid does not tell you anything about what it is made of.

a) true

b) false

By looking at the light of a hot, solid object, you can tell

- a) its temperature.
- b) what it is made of.
- c) both A and B
- d) none of the above

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If a source of light is moving away from you, its spectrum will be

- a) shifted to shorter wavelengths (blueshifted).
- b) shifted to longer wavelengths (redshifted).
- c) unaffected.

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Does the Doppler shift affect sound?

- a) yes
- b) no

Does the Doppler shift affect sound?

a) yes

b) no

Can the Doppler shift be measured with invisible light?

- a) yes
- b) no

Can the Doppler shift be measured with invisible light?

a) yes

b) no

We should not expect to see an visible emission line spectrum from a very cold cloud of hydrogen gas because

- a) hydrogen gas does not have any visible emission lines.
- b) the gas is too cold for collisions to bump electrons up from the ground state (lowest energy level).
- c) hydrogen gas is transparent to optical light.
- d) emission lines are only found in hot objects.
- e) cold objects only produce absorption lines.

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Chapter 5

If the Sun's surface became much hotter (while the Sun's size remained the same), it would emit more ultraviolet light but less visible light than it currently emits.

- a) Yes, because the visible light would be absorbed by the Sun's warmer surface.
- b) Yes, because the Sun's warmer surface would emit more ultraviolet light and less visible light.
- c) No, the Sun's warmer surface would emit less light at all wavelengths.
- d) No, the Sun's warmer surface would emit more light at all wavelengths.
- e) No, because if the Sun's size remained the same, the amount of light emitted would remain the same at all wavelengths.

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If you had X-ray vision, then you could read an entire book without turning any pages.

- a) Yes, but you would not be able to differentiate between different optical colors.
- b) Yes, but all the pages would merge into one.
- c) No, a book doesn't emit X-rays so you wouldn't see anything.
- d) No, the X-rays would be absorbed by the book and you would not be able to read past the cover.
- e) No, the words would not stand out so you would just see blank pages.

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Chapter 5

If a distant galaxy has a substantial redshift (as viewed from our galaxy), then anyone living in that galaxy would see a substantial redshift in a spectrum of the Milky Way Galaxy.

- a) Yes, and the redshifts would be the same.
- b) Yes, but we would measure a higher redshift than they would.
- c) Yes, but we would measure a lower redshift than they would.
- d) No, they would not measure a redshift toward us.
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