Study and Review Tools

mmary

I Radiation: Information n Space

s light?

t is the visible form of electromagnetic radiation, an electric and netic disturbance that transports energy at the speed of light. electromagnetic spectrum includes gamma rays, X rays, ultraviolet ation, visible light, infrared radiation, and radio waves.

can think of a particle of light, a photon, as a bundle of waves that sometimes as a particle and sometimes as a wave.

energy a photon carries depends on its wavelength. The wavelength isible light, usually measured in nanometers (10^{-9} m), ranges from nm to 700 nm. Infrared and radio photons have longer wavelengths carry less energy. Ultraviolet, X ray, and gamma-ray photons have ter wavelengths and carry more energy.

I Optical Telescopes

o telescopes work, and how are they limited?

nomers use telescopes to gather light, resolve fine detail, and nify the image. The first two of these three powers of the telescope end on the telescope's diameter. Consequently, astronomers strive uild telescopes with large diameters.

fracting telescope uses a lens to bend the light and focus it into mage. Because of chromatic aberration, refracting telescopes can- bring all colors to the same focus, resulting in color fringes around images. An achromatic lens partially corrects for this, but such es are expensive and cannot be made much larger than about 1 m iameter.

lecting telescopes use a mirror to focus the light and are less expen- than refracting telescopes of the same diameter. Also, reflecting scopes do not suffer from chromatic aberration. Most recently built e telescopes are reflectors.

nomers build observatories on high mountains for two reasons. bulence in Earth's atmosphere blurs the image of an astronomical scope, a phenomenon that astronomers refer to as seeing. Atop a ntain, the air is steady, and the seeing is better; the air on a moun- top is also thin and dry and is more transparent, especially in the ared.

metimes astronomical telescopes can be linked together to form an terferometer, which has a resolution equivalent to that of a telescope rge in diameter as the separation between the telescopes.

I Special Instruments

kind of instruments do astronomers use to record and analyze ?

many decades astronomers used photographic plates to record ages at the telescope, but modern electronic systems such as CCD meras have replaced photographic plates in most applications.

ectrographs using prisms or a grating spread starlight out according wavelength to form a spectrum revealing hundreds of spectral lines duced by atoms in the object being studied.

6-4 I Radio Telescopes

Why do astronomers use radio telescopes?

- Astronomers use radio telescopes for three reasons: They can detect cool hydrogen in space; they can see through dust clouds that block visible light; and they can detect certain objects invisible at other wavelengths.
- Most radio telescopes contain a dish reflector, an antenna, an amplifier, and a data recorder. Such a telescope can record the intensity of the radio energy coming from a spot on the sky. Scans of small regions are used to produce radio maps.
- Because of the long wavelength, radio telescopes have very poor resolution, and astronomers often link separate radio telescopes together to form a radio interferometer capable of resolving much finer detail.

6-5 I Astronomy from Space

Why must some telescopes go into space?

- Earth's atmosphere is transparent in two wavelength ranges called atmospheric windows, the visual window and the radio window. At other wavelengths, the atmosphere absorbs radiation. To observe at other wavelengths, telescopes must go into space.
- Earth's atmosphere distorts and blurs images. Telescopes in orbit are above this seeing distortion and are limited only by diffraction in their optics.
- Cosmic rays are not electromagnetic radiation; they are subatomic particles such as electrons and protons traveling at nearly the speed of light. They can best be studied from above Earth's atmosphere.

New Terms

electromagnetic radiation (p. 110)
wavelength (p. 110)
frequency (p. 111)
nanometer (nm) (p. 111)
Angstrom (Å) (p. 111)
photon (p. 111)
infrared radiation (p. 111)
ultraviolet radiation (p. 112)
atmospheric window (p. 112)
focal length (p. 114)
refracting telescope (p. 114)
reflecting telescope (p. 114)
primary lens, mirror (p. 114)
objective lens, mirror (p. 114)
eyepiece (p. 114)
chromatic aberration (p. 114)
achromatic lens (p. 114)
light-gathering power (p. 115)
resolving power (p. 115)
diffraction fringe (p. 115)
seeing (p. 115)
magnifying power (p. 116)
light pollution (p. 117)
prime focus (p. 120)
secondary mirror (p. 120)
Cassegrain focus (p. 120)
Newtonian focus (p. 120)
Schmidt-Cassegrain focus (p. 120)
sidereal drive (p. 121)
equatorial mounting (p. 121)
polar axis (p. 121)
alt azimuth mounting (p. 121)
active optics (p. 121)
adaptive optics (p. 121)
interferometry (p. 122)
charge-coupled device (CCD) (p. 123)
false-color image (p. 123)
spectrograph (p. 123)
grating (p. 124)
comparison spectrum (p. 124)
radio interferometer (p. 127)
cosmic ray (p. 132)