The Doppler Effect and the Big Bang

In the chapter "Sound," you learned that relative motion between the source of sound waves and an observer creates a frequency shift known as the Doppler effect. For visible light, the Doppler effect is observed as a change in color because the frequency of light waves determines color.

Frequency shifts

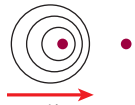
Of the colors of the visible spectrum, red light has the lowest frequency and violet light has the highest. When a source of light waves is moving toward an observer, the frequency detected is higher than the source frequency. This corresponds to a shift toward the blue end of the spectrum, which is called a *blue shift*. When a source of light waves is moving away from an observer, the observer detects a lower frequency, which corresponds to a shift toward the red end of the spectrum, called a *red shift*. Visible light is one form of electromagnetic radiation. Blue shift and red shift can occur with any type of electromagnetic radiation, not just visible light. **Table 1** illustrates blue shift and red shift.

In astronomy, the light from distant stars or galaxies is analyzed by a process called *spectroscopy*. In this process, starlight is passed through a prism or diffraction grating to produce a spectrum. Dark lines appear in the spectrum at specific frequencies determined by the elements present in the atmospheres of stars. When these lines are shifted toward the blue end of the spectrum, astronomers know the star is moving toward Earth; when the lines are shifted toward the red end, the star is moving away from Earth.

The expansion of the universe

As scientists began to study other galaxies with spectroscopy, the results were astonishing: nearly all of the galaxies that were observed exhibited a red shift,

Table 1 The Doppler Effect for Light

stationary source		
approaching source		
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