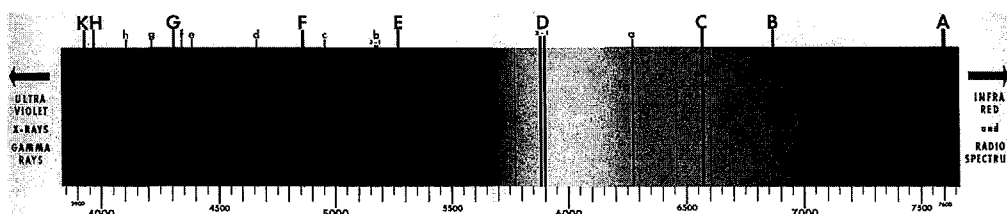


Big Bang Theory Evidence

Most scientists agree that the universe began some 12 to 15 billion years ago in what has come to be known as the Big Bang (a term coined by an English astrophysicist Fred Hoyle making fun of George Lemaître's 1927 theory, but the name was so catchy it stuck).

Stars are made of gases that emit specific wavelengths within the electromagnetic spectrum based on their chemical composition. Each gas emits specific wavelengths that are unique to that element. Scientists study the spectrum of electromagnetic radiation coming from the stars and they can infer which elements are in the star – its composition. This pattern of spectrum or colored lines can be used to identify the star like a fingerprint or bar code.

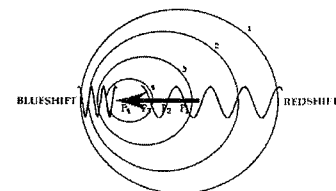
The Sun's spectral bar code of elements



DOPPLER EFFECT

In 1842, a man named Doppler discovered that sound waves change pitch or frequency as the source approaches, passes and recedes from an observer. Although first discovered for sound waves, the Doppler Effect holds true for all types of waves including light (and other electromagnetic waves).

1. When a light source moves away from you, it “stretches” the waves
 - a. This increases the wavelength of the light that reaches our eyes.
Red end of Visible Light Spectrum
2. When a light source moves towards you, it “compresses” the waves – wavelength shorter.
 - a. This decreases the wavelength of light that reaches our eyes.
Blue End of Visible Light Spectrum



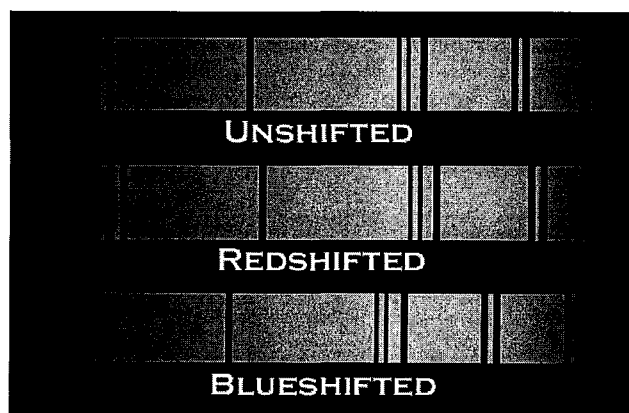
DOPPLER RED SHIFT/BLUE SHIFT

- ❖ In 1929, Edwin Hubble observed that spectral lines in distant galaxies (not the Milky Way Galaxy) were considerably Red Shifted.
- ❖ The spectral lines (fingerprint or bar code) of stars coming towards Earth were shifted to the blue light end of the spectrum (shorter wavelength)
- ❖ The spectral lines (fingerprint or bar code) of stars going away from Earth were shifted to red light end of the spectrum (longer wavelength)

At rest - standard spectrum

Moving away

Moving towards



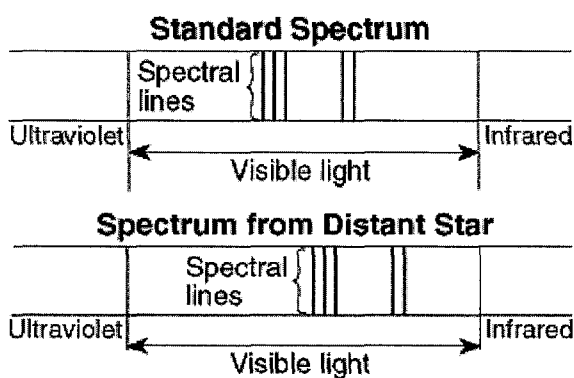
In a Doppler red shift, the observed wavelengths of light from distant celestial objects appear closer to the red end of the spectrum than light from similar nearby celestial objects. The explanation for the red shift is that the universe is presently

- A) contracting, only
- B) alternating between contracting and expanding
- C) remaining constant in size
- D) expanding, only

Starlight from distant galaxies provides evidence that the universe is expanding because this starlight shows a shift in wavelength toward the

- A) gamma-ray end of the electromagnetic spectrum
- B) blue-light end of the visible spectrum
- C) red-light end of the visible spectrum
- D) ultraviolet-ray end of the electromagnetic spectrum

The diagram below shows a standard spectrum compared to a spectrum produced from a distant star.



Which conclusion can be made by comparing the standard spectrum to the spectrum produced from this distant star?

- A) The star's spectral lines have shifted toward the ultraviolet end of the spectrum and the star is moving toward Earth.
- B) The star's spectral lines have shifted toward the infrared end of the spectrum and the star is moving away from Earth.
- C) The star's spectral lines have shifted toward the infrared end of the spectrum and the star is moving toward Earth.
- D) The star's spectral lines have shifted toward the ultraviolet end of the spectrum and the star is moving away from Earth.