The Electromagnetic Spectrum

CHAPTER 27 & 28 EXCERPTS
Why the sky is blue?
Red Shift - Blue Shift?
Red Sunsets, Red Sunrises

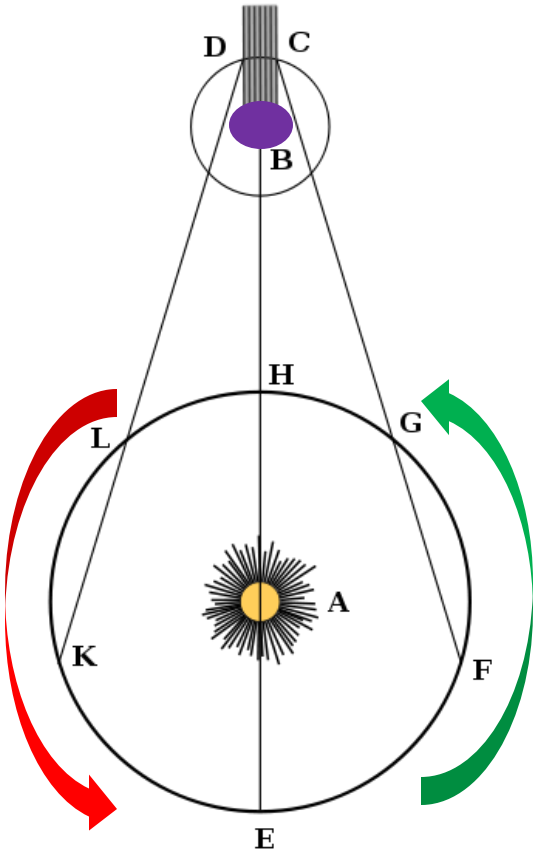
THE ELECTROMAGNETIC SPECTRUM:

- Light is energy due primarily to accelerating electrons.
- Light travels as an electric wave and a magnetic wave.
- The spectrum is a continuous range of waves from radio waves to gamma waves.
- Light has a “dual” nature in that it consists of particles called photons and travels as a wave.
- Vibrations of energy, not material.
- Light can travel through a vacuum, which means it does not need a “medium” or material to travel through. (Electromagnetic Wave)

SPEED OF LIGHT:

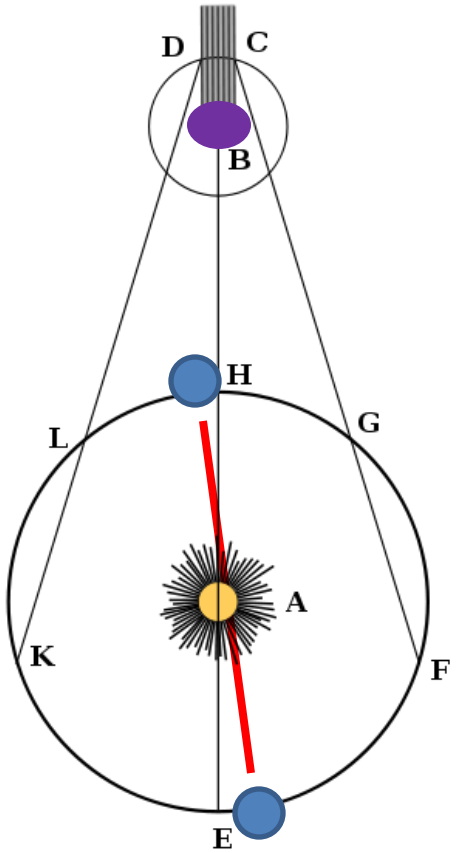
- The speed of light is a “universal” constant represented by “c”.
- “c” is equal to 3.0×10^8 m/sec
- Light takes ~ 8minutes to travel from the sun to the Earth.
- A “light year” is the ***distance*** light travels in one year.

Olaus Roemer: Danish Astronomer



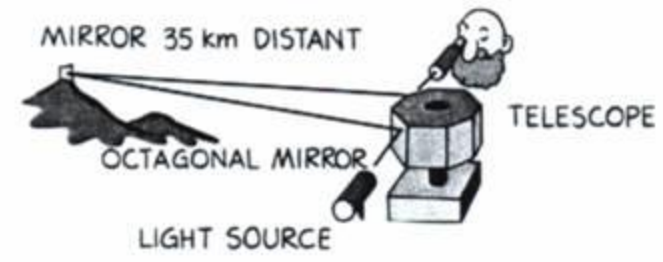
- Measures the periods of **Jupiter's moon.**
- Observed the "period" of the eclipse **(D)** and reappearance **(C)** of **(B)** **Jupiter's moon *Io*** from different locations *(E, F, G, H, L, K)* in Earth's orbit around the Sun **(A).**
- As Earth **moved towards** Jupiter, the periods were shorter by 22 minutes.
- As Earth **moved away** from Jupiter, the periods were longer by 22 minutes.
- What was the reason for the change in time?

Christian Huygens: Dutch Astronomer



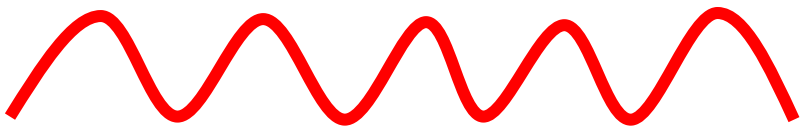
- Determines that the reason for the time discrepancy of when ***Io*** could be seen was because the light arrived at a different time.
- In other words, the time it took the light to travel to the **Earth** depended on where the **Earth** was in its orbit around the sun.
- It is now known that the difference in the **distance** from point **H** to point **E** is 300,000,000 km.
- The time to travel this distance is 1000 seconds.
- Speed = distance / time
- Speed = 300,000 km/sec
  - $(3.0 \times 10^8 \text{m/sec})$

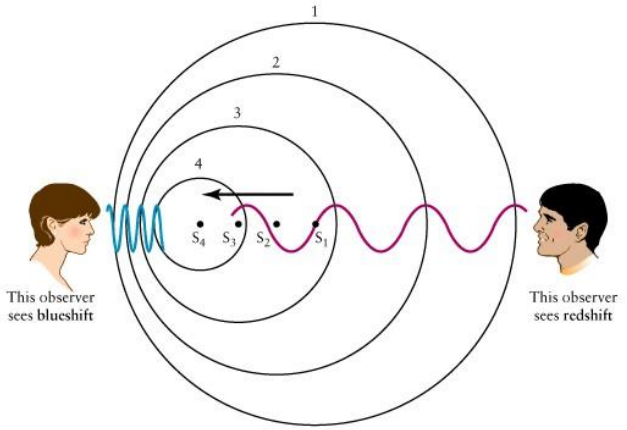
Albert Michelson: American Physicist

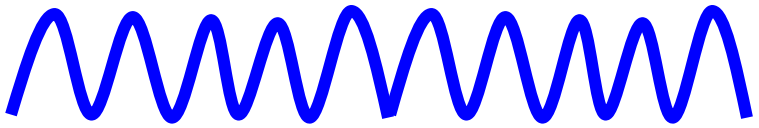


- Places a stationary mirror on top of a mountain 35 km away.
- Has an octagonal mirror with a light source that can rotate.
- Sends a light beam to the mirror.
- Views the reflected light through a telescope as the revolving mirror rotates
- When the speed of the moving mirror is correct, the reflected light from the mirror on the mountain will be seen through the eyepiece.
- The time for the light to be reflected and the time for the mirror to spin the correct rotation (1/8 of a turn) was the same.
- Knowing the distance the light traveled and the time it took, he calculated the value for the speed of light.

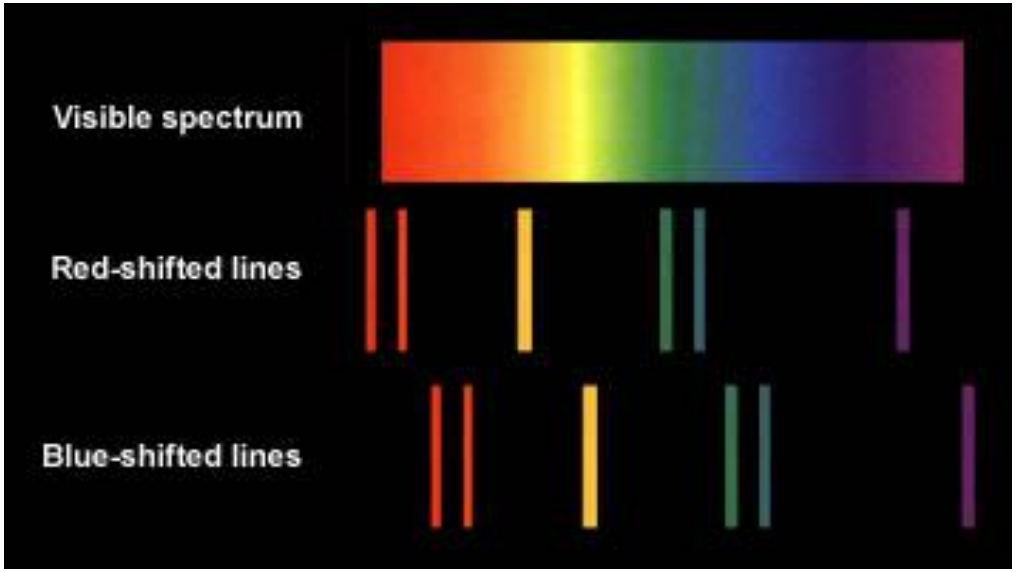
RED SHIFT AND BLUE SHIFT:

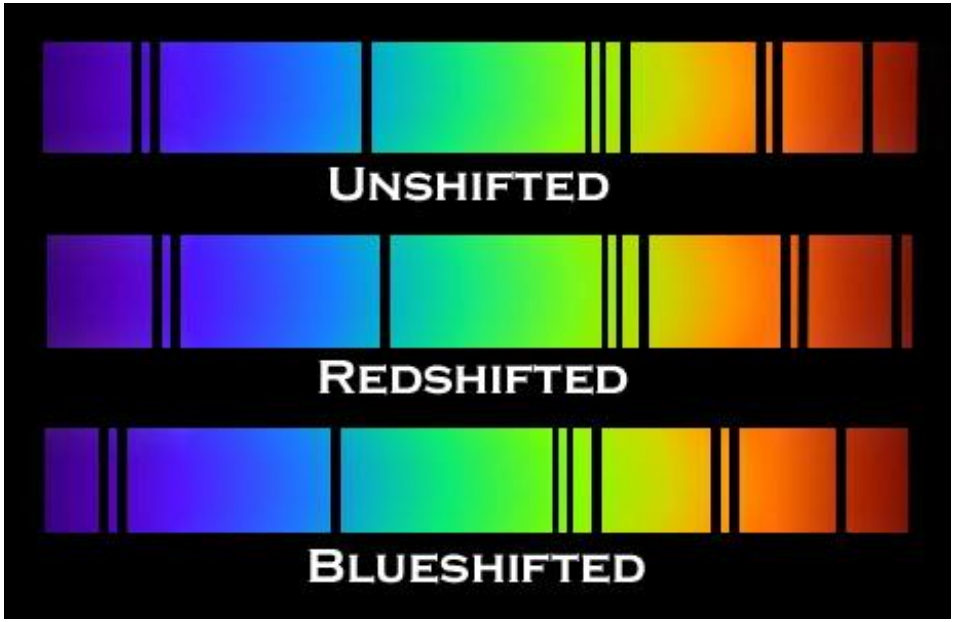






- As a light source moves closer, there is an apparent increase of frequency producing shorter wavelengths.
- As a light source moves farther away, there is an apparent decrease of frequency producing longer wavelengths.
- Red light waves are longer; blue light waves are shorter.
- What colors should you expect to see if a star moves away from you and towards you?



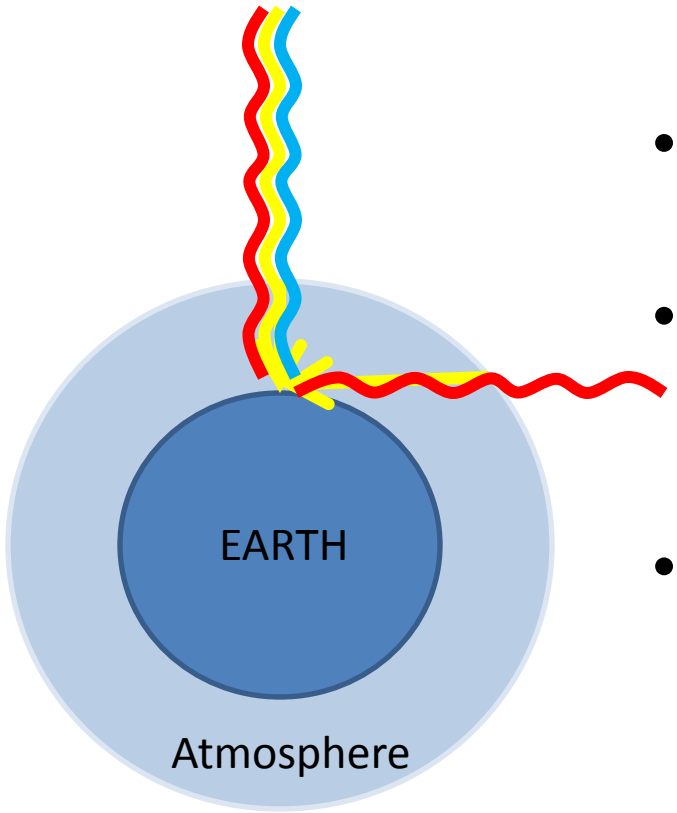


http://mail.colonial.net/~hkaiter/aa_newest_images/dopp-shifts-spectra.jpg

Blue Sky:

- Molecules that make up the atmosphere are energized and scattered by the sun.
- When light hits these energized and scattered molecules, the light waves themselves are re-emitted are scattered in all directions as well.
- Higher frequency light scatters better than low frequency light.
- Violet light scatters the best, but our eyes are more sensitive to blue light so we see a blue sky.

RED SUNSETS:



- Red is a lower frequency color and does not scatter as well as higher frequency colors.
- With less scattering, it can pass through the atmosphere.
- At sunset and sunrise, all light waves pass through a thicker atmosphere.
- Only the longer, lower frequency waves are able to pass through the atmosphere.

The end…