Properties of Light

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Opening Discussion

- Have you seen anything interesting in the news?
- What did we talk about last class?

Minute Essay Comments

- Math is not hard.
- The Sun actually moves in a rather complex manner due to the pulls from all the objects orbiting it.
- Making an ellipse.
- Waving flag on the Moon.
- Circular motions, momentum, and torque.
- Energy and units it is measured in.
- Potential energy, what you need to do work.

Material Interaction with Light

- Light interacts with material in 4 different ways. A single material can interact in several of these ways at once.
  - Emission: Object can emit light. We'll see how this happens later on.
  - Absorption: Objects can absorb light that strikes them. This adds energy to the object.
  - Transmission: Light might pass through the object.
  - Reflection: Light might bounce off the object. This can be like off a mirror or through scattering.

Details of Interactions

- Objects actually do all four of these at once to different parts of the spectrum. We'll talk more about the spectrum next class.
- For example, you do the following:
  - You emit infrared light because of the temperature of your skin.
  - You absorb light in many frequencies including the visible parts that aren't part of your skin and hair color.
  - You transmit both high and low energy light.
  - You reflect the light that other see when they look at you.

Light as Waves and Particles

- Newton did a simple experiment to show that when light is broken into a spectrum, the rainbow is a property of the light, not a property of the prism. He introduced the "corpuscle" theory of light saying it was made of small particles that carried the different colors.
- Later experiments show that light comes in little "chunks" called photons that have particular energies.
- Light is also a wave though as can be seen in double slit experiments.

Nature of Waves

- A lot of the things we care about with light deal with the wave nature of light so it is worth understanding that a bit better.
- You are all familiar with the idea of waves in general. I have seen them in water for various reasons. You have also seen waves in thin materials like a rope of sheet. Sound is also a wave.
- Waves normally transport energy through a medium without transporting the medium itself. The medium is only displaced in an oscillating pattern. Light doesn't have a medium.

Properties of Waves

- The distance between peaks or troughs in a wave is called the wavelength.
- As the wave moves past, the number of peaks that move past per unit time is the frequency. We typically measure frequency in Hertz (1 hz=1 s^{-1}).
- The speed of the wave is how fast a peak moves through the medium.
- These values are related by speed=wavelength*frequency or $s = \lambda * f$

Nature of Light

- Light doesn't propagate through a medium, instead it is an electric wave perpendicular to a magnetic wave that propagate together. Changes in one drive changes in the other.
- Light in a vacuum always has the same speed so if you are given a wavelength you can easily find a frequency or the other way around.
- Light at a given frequency can also be shown to be carried in bundles of a specific energy. These bundles are called photons and the energy is given by $E = h * f = \frac{hc}{\lambda}$
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- Plank's Constant h=6.626*10^{-34} J*s

Minute Essay

- People who have studied art have learned things like mixing yellow and blue makes green. These rules don't work in computer graphics. Why do you think that is? To figure this out, consider what paints are doing to make the color you see and compare that to what happens to the light coming off a computer screen.