

University of Virginia

Department of Physics

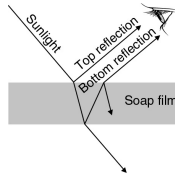
Physics 606: How Things Work II

Lecture #29 Slides:

Fluorescent Lights

Interference

- Light from different paths can interfere
 - Constructive – fields are in same direction
 - Destructive – fields are in opposite directions
- The two reflections from a film interfere
- Different colors may interfere differently



Reflection of Polarized Light

- Angled reflection varies for polarized light
- Fluctuating electric field parallel to surface
 - large fluctuating surface polarization
 - big reflection
- Electric field perpendicular to surface
 - small fluctuating surface polarization
 - small reflection

Polarized Sunlight

- Most glare is horizontally polarized light
- Polarizing sunglasses
 - block horizontally polarized light
 - block glare from horizontal surfaces
- Much of the blue sky is polarized light, too

Fluorescent Lamps

Question:

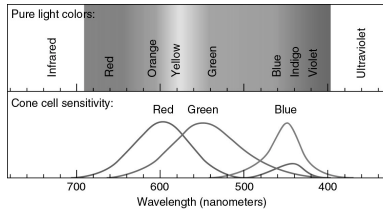
A fluorescent lamp tube is coated with a white powder on its inside surface. If that powder were not there, would the lamp appear brighter, dimmer, or about the same overall brightness, but with an unpleasantly bright white line near its center?

Observations About Fluorescents

- They often take a few moments to turn on
- They come in several variations of white
- They are often whiter than incandescent bulbs
- They last longer than incandescent bulbs
- They sometimes hum loudly
- They flicker before they fail completely

Seeing in Color

- Three groups of light sensing cone cells
- We perceive different colors when two or more type of cone cells respond at once

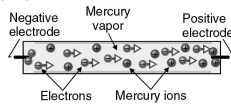


Problems with Thermal Light

- Temperature too low, too red
 - Incandescent light bulb, 2500°C
 - The sun, 5800°C
- Not energy efficient
 - Lots of invisible infrared light
 - Only a small fraction of thermal power is visible

Fluorescent Lamps 1

- Glass tube, low pressure gas, electrodes
- Inject free charges via temperature or high voltage
- Forms a plasma—a gas of charged particles
- Electric field produces current flow in plasma
- Collisions cause
 - electronic excitation in gas atoms
 - some ionization of gas atoms
- Excited atoms emit light through fluorescence

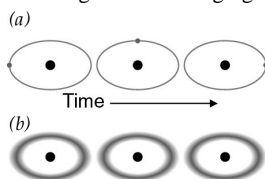


Atomic Structure

- In an atom, the electrons orbit the nucleus
- Only certain orbits are allowed—the orbitals
- Each orbital can have at most two electrons in it
- Orbital's energy = kinetic + potential
- Electrons normally reside in the lowest energy orbitals—the ground state
- Electrons can be excited to higher energy orbitals—excited states

Atomic Structure

- Electrons travel as waves
- Electron in an orbital doesn't emit light
- Electron emits light when changing orbitals



Light from Atoms

- Light
 - travels as a wave (a diffuse structure)
 - is emitted or absorbed as a particle (a photon)
- Photon energy = Planck constant · frequency
- An atom's orbitals have specific energy differences
- Energy differences establish photon energies
- An atom emits a specific spectrum of photons