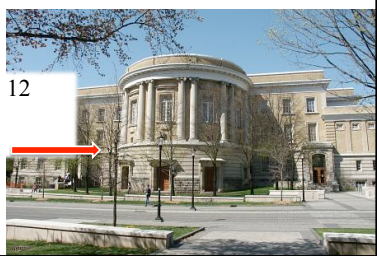
PHY132H1F Introduction to Physics II
Class 8 – **Outline:**

- Finishing up Chapter 25
- Review of Chs 20, 21, 23, 24, 25

Test Tuesday Oct. 12
6:00pm-7:30pm
SF 3201



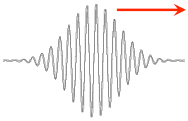
Last time: The Photon Model of Electromagnetic Waves

$$E_{\text{photon}} = hf$$

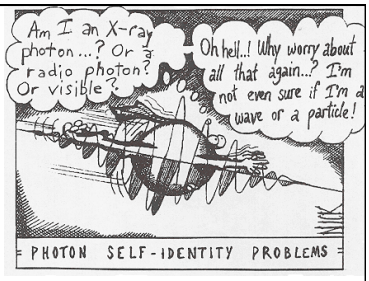
where f is the frequency of the electromagnetic waves, and h is a *universal constant* called **Planck's constant.** The value of Planck's constant is $h = 6.63 \times 10^{-34}$ J s.

Which has more energy?

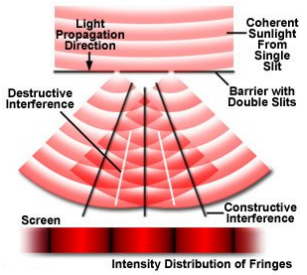
A. A red photon.
B. A green photon.
C. A blue photon.



The Wave / Particle Duality



- Some experiments, such as the double-slit experiment, clearly show that Electromagnetic Radiation is a WAVE. It interferes and it has a frequency and wavelength.
- Other experiments, such as the photoelectric effect, clearly show that Electromagnetic Radiation is a STREAM OF PARTICLES. It is granular and the individual point-particles have position and velocity.



Double Slit Experiment

- The bright fringes in a double-slit experiment are places where the waves from each slit interfere constructively. The dark fringes correspond to destructive interference from the two slits.
- When you count photons, you find that photons are ***more likely*** to fall at the location of the bright fringes then at the dark fringes. When enough have fallen, you see the same pattern as you predict for waves.
- This works even if you let the photons go through the slits ***one at a time!***

Double Slit Experiment

- Also, the double slit experiment works if you use electrons instead of photons. The wavelength of electrons is usually smaller, though, so the fringes are very close together.
- Also, it works with protons, neutrons and helium nuclei. Again, the fringes are very closely spaced, so it's more difficult to do the experiment as the mass of the particles increases.
- But we believe that it would work with bullets, baseballs and even people. They would all constructively and destructively interfere if passed through a double slit.

The de Broglie Wavelength

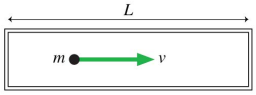
De Broglie postulated that a particle of mass m and momentum $p = mv$ has a wavelength

$$\lambda = \frac{h}{p}$$

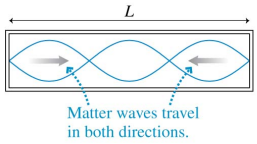
where h is Planck's constant. This wavelength for material particles is now called the **de Broglie wavelength.** It depends *inversely* on the particle's momentum, so the largest wave effects will occur for particles having the smallest momentum.

FIGURE 25.16 A particle of mass m confined in a box of length L.

(a) A classical particle of mass m bounces back and forth between the ends.

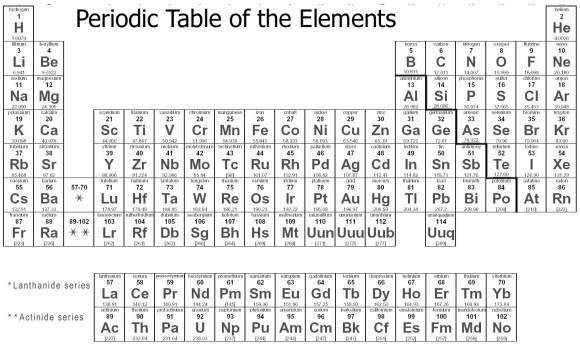


(b) Matter waves moving in opposite directions create standing waves.



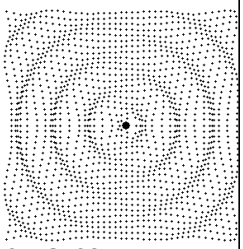
An atom is like a "box" for an electron. The electron is confined, and forms a standing wave based on its de Broglie wavelength.

Periodic Table of the Elements



The Periodic Table is one of the predictions of Quantum Physics

Ch.20



- One-dimensional waves
- Sinusoidal Waves
- Waves in 2-D and 3-D
- Spherical waves and plane waves
- Power and Intensity of Waves (Decibels)
- The Doppler Effect

Valerie is standing by the side of the road. A police car with a siren that has a frequency of f_0 is driving down the road towards her at a constant velocity. As it drives toward her, she hears a frequency, f.

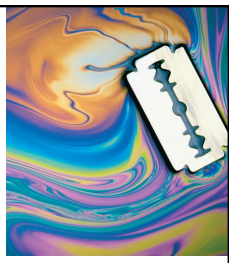
A. $f > f_0$
B. $f < f_0$
C. $f = f_0$

Valerie is standing by the side of the road. A police car with a siren that has a frequency of f_0 is driving down the road towards her at a constant velocity. As it drives toward her, she hears a frequency, f.

A. f is constant.
B. f is not constant: it decreases with time.
C. f is not constant: it increases with time.

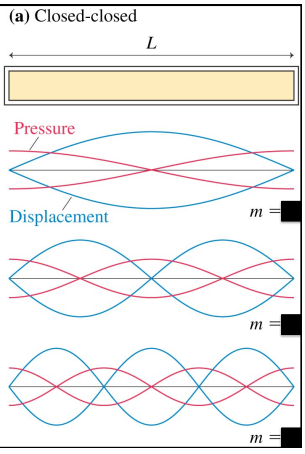
Ch.21

- Principle of Superposition
- Standing Waves on a String
- Standing Sound Waves in closed-closed, open-open, and closed-open tubes
- Wave Interference
- Beats



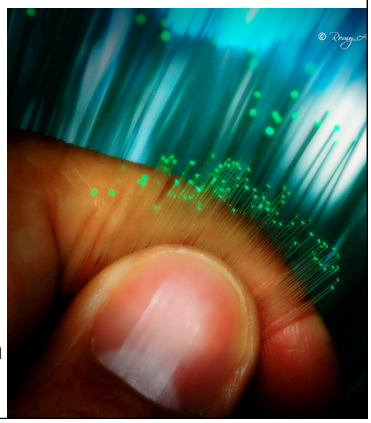
From top to bottom, what are the mode numbers of these standing sound waves?

A. $m = 1, m = 2, m = 3$
B. $m = 2, m = 3, m = 4$
C. $m = 2, m = 4, m = 6$
D. $m = 1, m = 3, m = 5$
E. $m = 3, m = 5, m = 7$



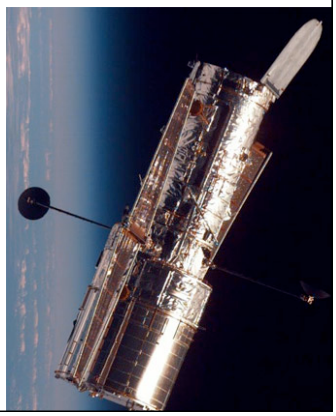
Ch.23

- Reflection and Refraction
- Fibre-Optics
- Colour and Dispersion
- Thin Lens Equation
- Image Formation



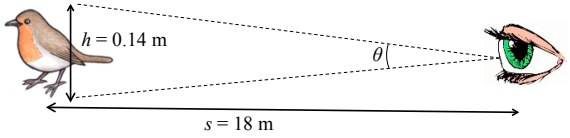
Ch.24

- Lenses Used in Combination
- Vision
- Telescopes
- Microscopes



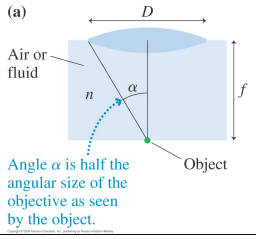
End of Chapter Problem 24.15

- You use your 8× binoculars to focus on a 14 cm long bird in a tree 18 m away from you. What angle (in degrees) does the image of the warbler subtend on your retina?



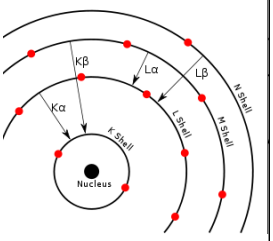
End of Chapter Problem 24.19

- A 20× microscope objective is designed for use in an oil immersion microscope with a 16 cm tube length. The lens is marked NA = 0.90. What is the diameter of the objective lens?



Ch.25

- The Hydrogen Atom
- Photons
- The de Broglie wavelength
- Quantum Physics



Before The Test:

- The test on Tuesday, Oct. 12 will cover Chapters 20 – 25 (excluding Ch.22).

- Try the suggested end-of-chapter problems for Chapter 25

See you Tuesday Evening at 6:00 in **SF 3201.**