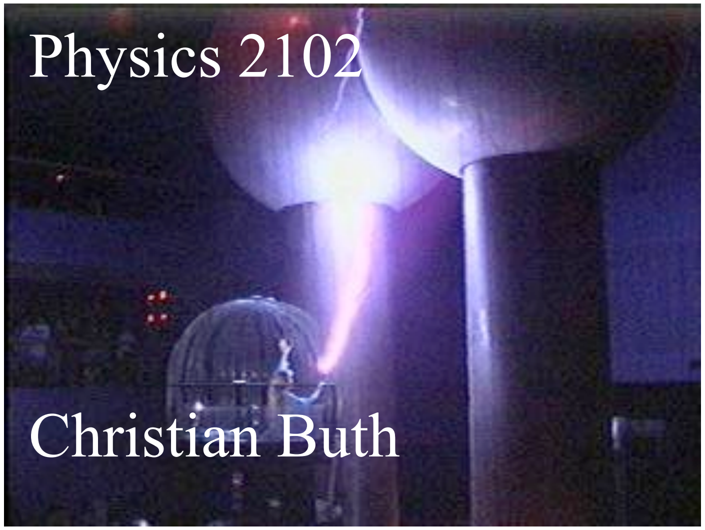
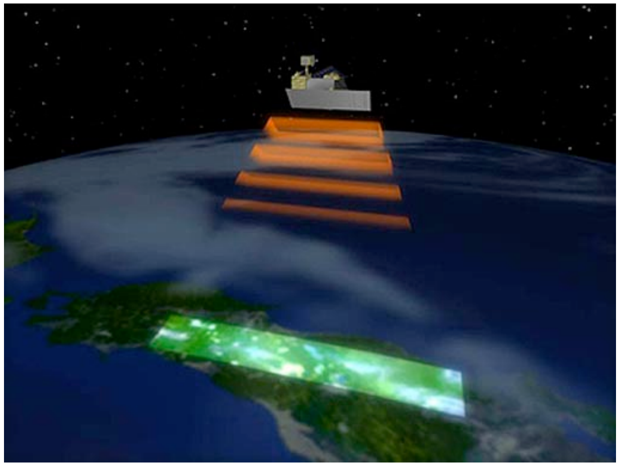
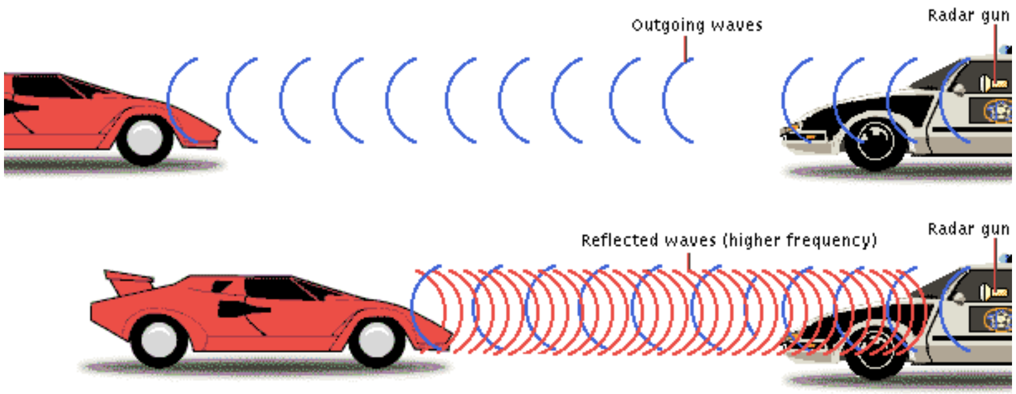


Lecture 42

Review 33-41

05/01/2009





PHYS2102 FINAL EXAM!

5:30–7:30PM FRI 08 MAY 2009

Buth's Section 6 in Lockett 6
(together with Section 3, last name I-Z)

YOU MUST BRING YOUR STUDENT ID!

The exam will cover chapters 21 through 36, as covered in homework sets 1 to 14. The formula sheet for the exam can be found here:
http://www.phys.lsu.edu/classes/spring2009/phys2102/formulasheet.pdf

THERE WILL BE A REVIEW SESSION 5:30–6:30PM WED 06 MAY 2009 in Nicholson 130

Lecture 33

- Maxwell's laws: **electromagnetic (EM) waves** (in vacuum)
- EM waves travel at the **speed of light**, are transversal
- ***E***, ***B*** are **perpendicular**; form right-handed coordinate system with propagation direction and vary sinusoidally
- **Poynting Vector *S***: energy in propagation direction

$$\vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B}$$

Lecture 34

- Variation of power of **spherical waves**

$$I = \frac{\text{power}}{\text{area}} = \frac{P_S}{4\pi r^2}$$

- **Radiation pressure**:

$$p_r = \frac{I}{c} \text{ (total absorption)}, \quad p_r = \frac{2I}{c} \text{ (total reflection)}$$

- **Unpolarized** light through polarizer: $I=I_0/2$
- When polarized light hits a polarizer:

$$I = I_0 \cos^2 \theta$$

Lecture 35

- Law of **reflection** and **Snell's law:**

Reflection: $\theta_1' = \theta_1$

Refraction: $n_2 \sin\theta_2 = n_1 \sin\theta_1$

- Light of different wavelengths is refracted differently → **chromatic dispersion**
- **Total internal reflection**:

Critical Angle: $\theta_c = \sin^{-1}\dfrac{n_2}{n_1}$

- **Polarization** by reflection:

Brewster Angle: $\theta_B = \tan^{-1}\dfrac{n_2}{n_1}$

Lecture 36

- **Real image** can be projected on a screen
- **Virtual image** exists only for observer
- **Plane mirror** is a flat reflecting surface

Plane Mirror: $i = -p$

- Convex mirrors make objects **smaller**
- Concave mirrors make objects **larger**

Spherical Mirror: $f = \frac{1}{2}r$

Lecture 37

- Extended objects from spherical mirrors and lenses are located by **drawing rays**

Spherical Mirror: $\dfrac{1}{p}+\dfrac{1}{i}=\dfrac{1}{f}$

Lateral Magnification: $|m|=\dfrac{h'}{h}$

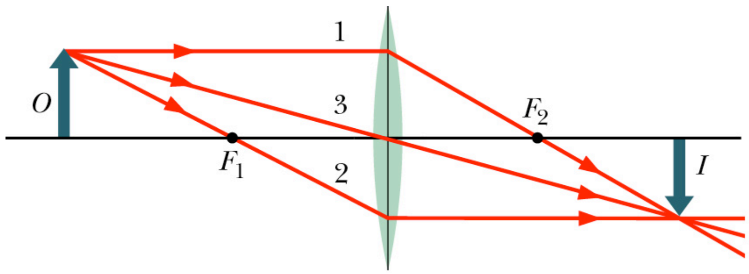
Lateral Magnification: $m=-\dfrac{i}{p}$

Spherical Refracting Surface: $\dfrac{n_1}{p}+\dfrac{n_2}{i}=\dfrac{n_2-n_1}{r}$

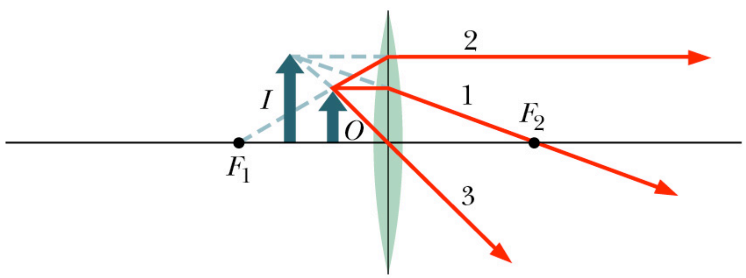
Thin Lens: $\dfrac{1}{f}=\dfrac{1}{p}+\dfrac{1}{i}$

Thin Lens in Air: $\dfrac{1}{f}=(n-1)\left(\dfrac{1}{r_1}-\dfrac{1}{r_2}\right)$

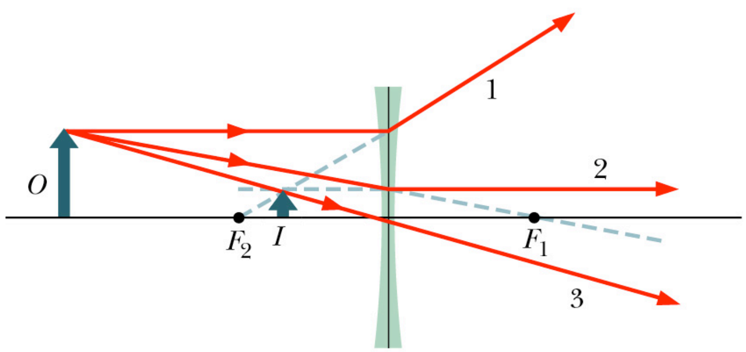
Locating Images of Extended Objects by Drawing Rays



(a)



(b)



(c)

- A ray of direction initially parallel to the axis will pass through the focal point.
- A ray that initially has a direction that passes through the focal point will emerge parallel to the central axis.
- A ray going through the center of the lens will be undeflected.
- The image of a point appears where all rays emanating from a point intersect.

Lecture 38

- Magnifying lens

Simple Magnifier: $m_\theta \approx \dfrac{25\ \text{cm}}{f}$

- Microscope and telescope combination of an **objective** and an **eyepiece**
- Magnification of microscope and telescope

$$M = m m_\theta = -\frac{s}{f_{ob}} \frac{25cm}{f_{ey}}$$

$$m = -\frac{f_{ob}}{f_{ey}}$$

Lecture 39 / 1

- **Huygen's principle**: All points in a wavefront serve as point sources of spherical secondary waves
- The frequency of light in a medium is the same as it is in vacuum

Index of Refraction: $n = \frac{c}{v}$

- Wavelength changes

$$\lambda_n = \lambda \frac{v_n}{c} = \frac{\lambda}{n}$$

Lecture 39 / 2

- **Diffraction** of light occurs at openings of the order of the wave length of the light
- **Double slit experiment**:

Maxima-bright fringes:

$$d \sin\theta = m\lambda \quad \text{for } m = 0, 1, 2, \ldots$$

Minima-dark fringes: $d \sin\theta = \left(m + \tfrac{1}{2}\right)\lambda \quad \text{for } m = 0, 1, 2, \ldots$

Lecture 40

- Interference only for coherent light, i.e., with a **phase relationship** that is time independent
- **Intensity** in double-slit interference:

$$I = 4I_0 \cos^2 \tfrac{1}{2}\phi$$

$$\phi = \frac{2\pi d}{\lambda} \sin\theta$$

- Use Huygens' Principle to find positions of **diffraction minima** of a single slit by subdividing the aperture

$$a \sin\theta = m\lambda, \quad \text{for } m = 1, 2, 3\ldots \quad \text{(minima-dark fringes)}$$

Lecture 41

- To predict the interference pattern of a multi-slit system, we must combine interference and diffraction effects.
- **Rayleigh's Criterion** for separability of two points
- Intensity in single-slit diffraction:

$$I(\theta) = I_m \left(\frac{\sin\alpha}{\alpha}\right)^2$$

$$\text{where } \alpha = \frac{1}{2}\phi = \frac{\pi a}{\lambda}\sin\theta \qquad (36\text{-}6)$$

- Double-slit diffraction:

$$I(\theta) = I_m \left(\cos^2\beta\right)\left(\frac{\sin\alpha}{\alpha}\right)^2 \quad \text{(double slit)}$$