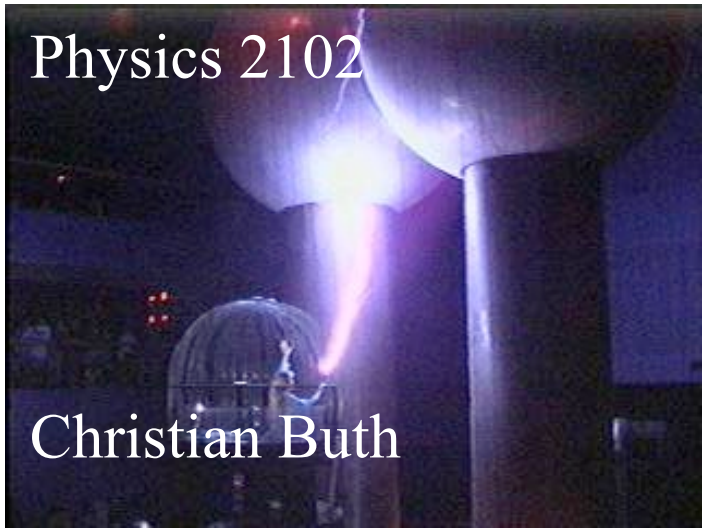


Lecture 36

Geometrical optics 2

04/17/2009

Review

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

Reflection: $\theta_1' = \theta_1$

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

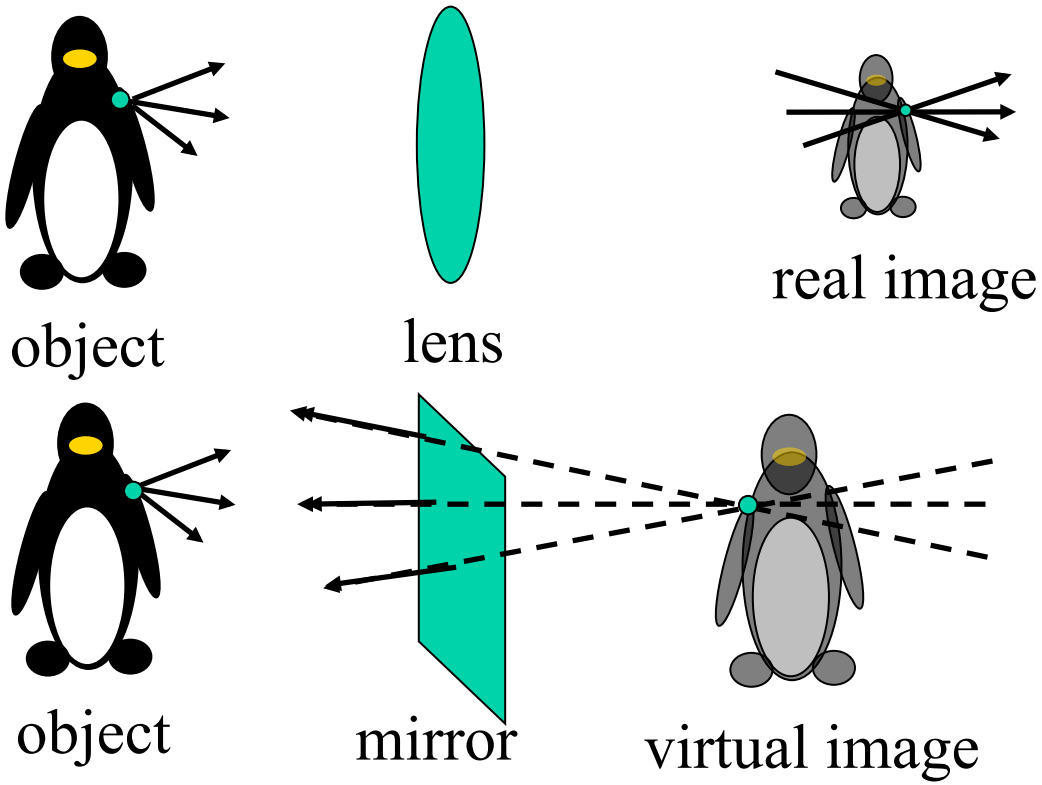
- Light of different wavelengths is refracted differently → **chromatic dispersion**
- **Total internal reflection**:

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

- **Polarization** by reflection:

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

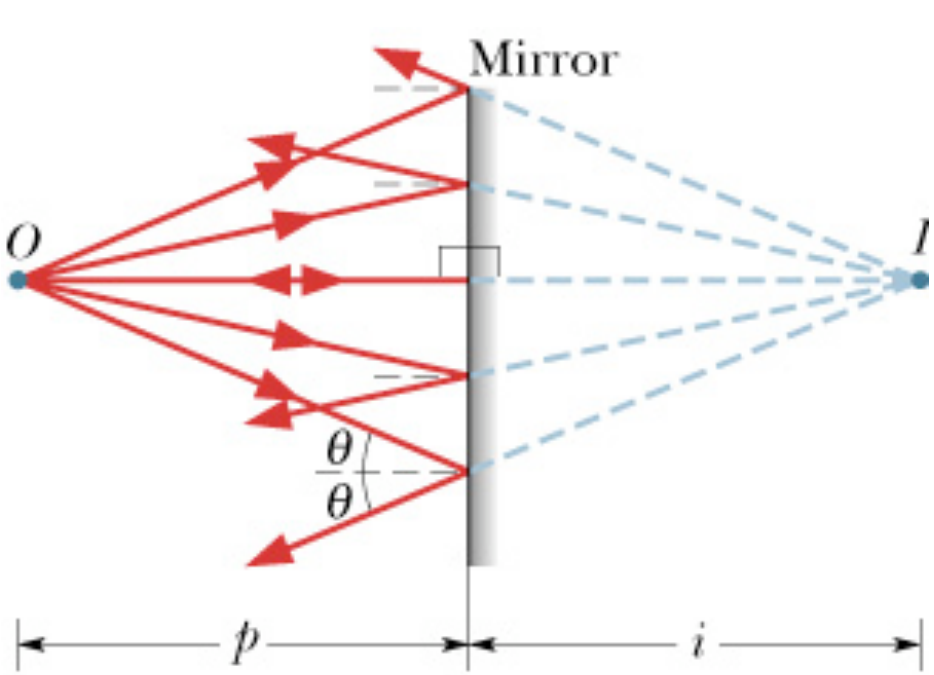
Two Types of Images

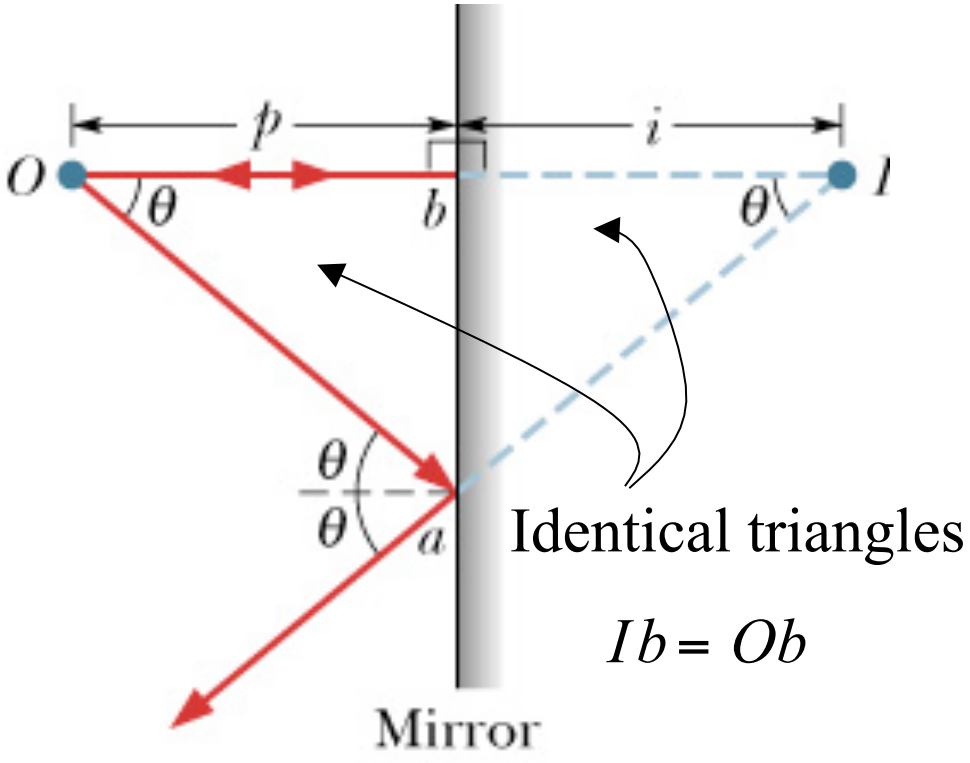


- **Image**: A reproduction derived from light
- **Real Image**: Light rays actually pass through image, really exist in space (or on a screen for example) whether you are looking or not
- **Virtual Image**: No light rays actually pass through image. Only appear to be coming from image. Image only exists when rays are traced back to perceived location of source

Plane Mirrors and Point Object

- **Plane mirror** is a flat reflecting surface

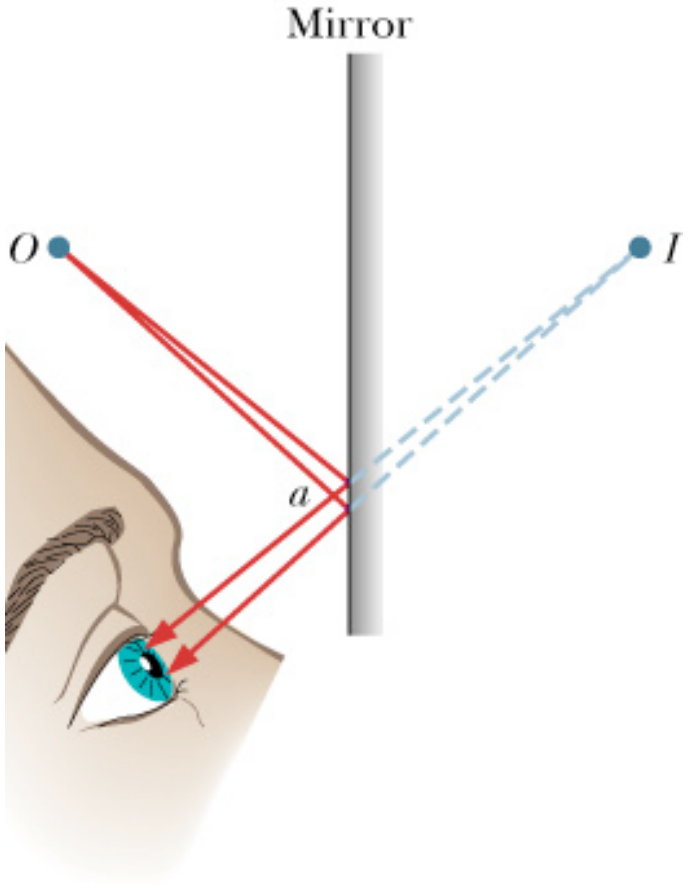




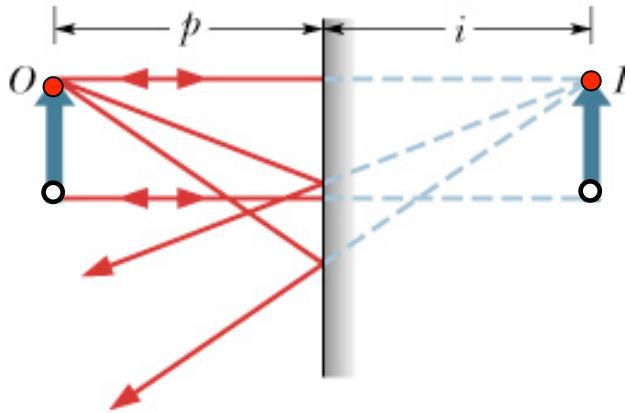
Plane Mirror: $i = -p$

Since I is a virtual image, $i < 0$

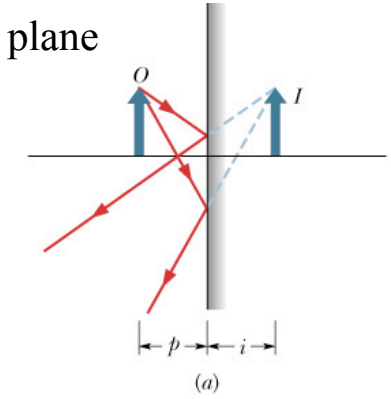
Plane Mirrors and Extended Object

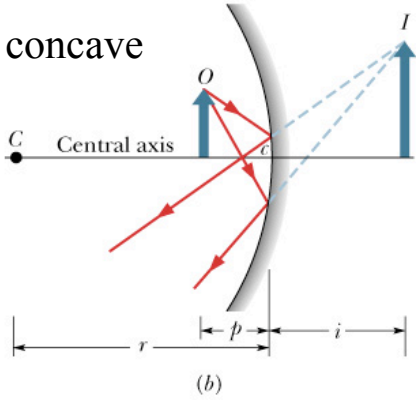


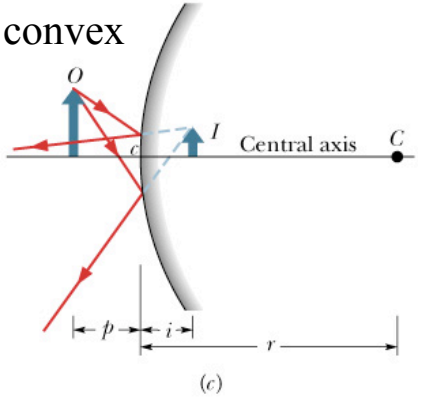
• Each point source of light in the extended object is mapped to a point in the image



Making a Spherical Mirror







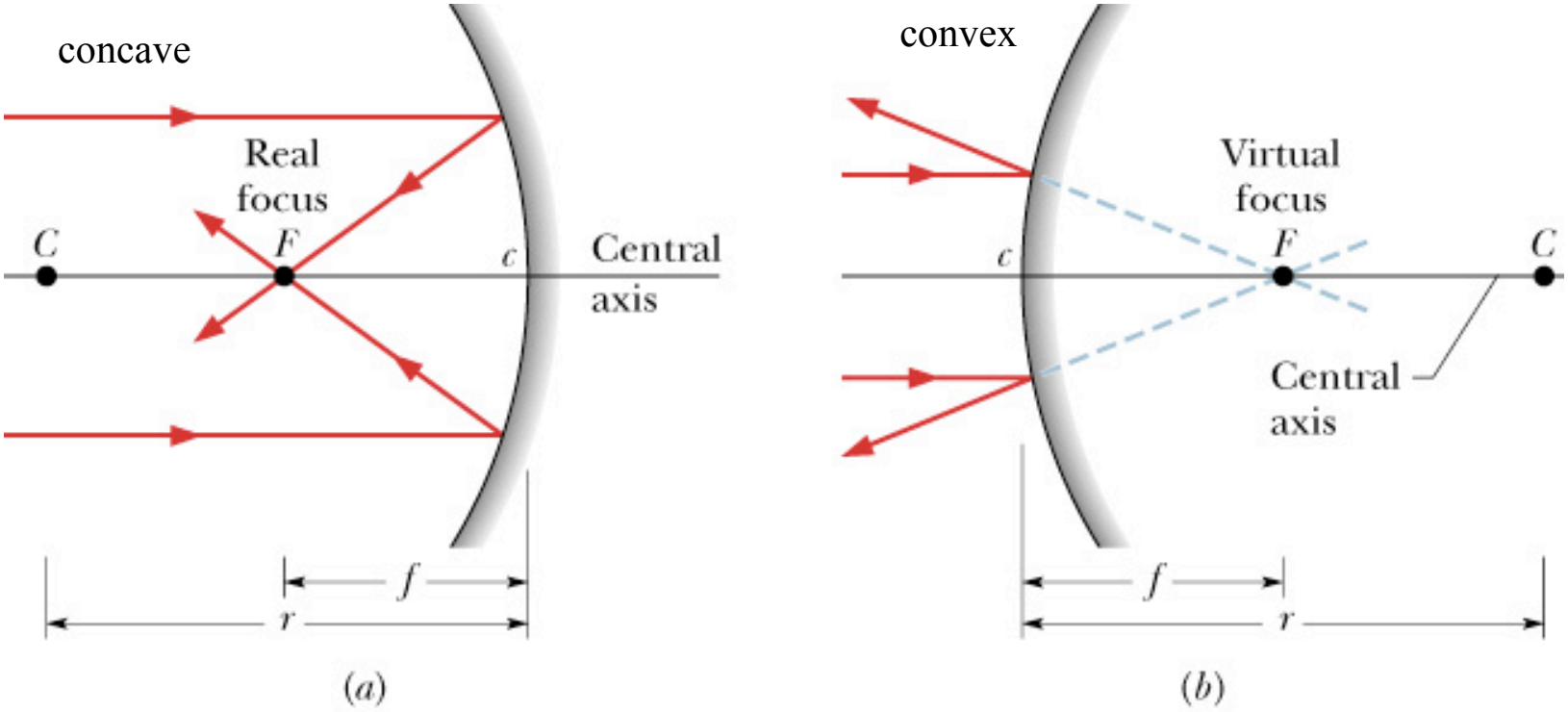
Plane mirror → concave mirror

1. Center of curvature C:
   in front at infinity → in front but closer
2. Field of view
   wide → smaller
3. Image
   $i=-p \rightarrow |i|>p$
4. Image height
   image height = object height → image height > object height

Plane mirror → convex mirror

1. Center of curvature C:
   in front at infinity → behind mirror and closer
2. Field of view
   wide → larger
3. Image
   $i=-p \rightarrow |i|<p$
4. Image height
   image height = object height → image height < object height

Focal Points of Spherical Mirrors

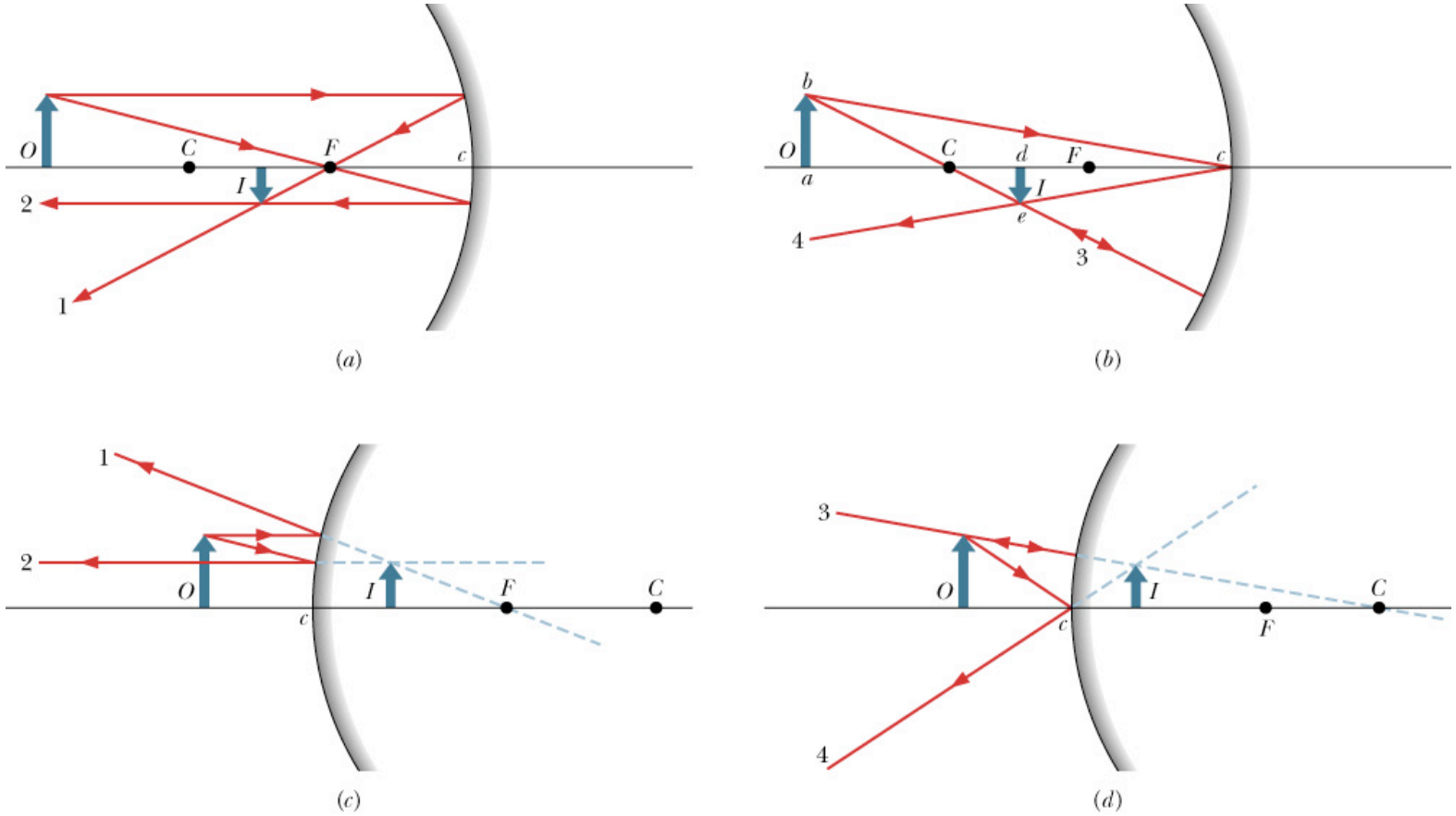


Spherical Mirror: $f = \frac{1}{2} r$

$r > 0$ for concave (real focal point)

$r < 0$ for convex (virtual focal point)

Locating Images by Drawing Rays



1. A ray that is parallel to central axis reflects through ***F.***
2. A ray that reflects from mirror after passing through ***F*** emerges parallel to central axis.
3. A ray that reflects from mirror after passing through ***C*** returns along itself.
4. A ray that reflects from mirror after passing through ***c*** is reflected symmetrically about the central axis.

Summary

- **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: $f = \frac{1}{2}r$