Phys 2310 Wed. Oct. 11, 2017
Today's Topics

- **Continue Chapter 33: Geometric Optics**
- **Homework this Week**
- **Reading for Next Time**

Homework this Week (HW #10)

Homework this week due Wed., Oct. 18:

Chapter 34: 34.2, 34.4, 34.5, 34.23, 34.26, 34.36, 34.39, 34.52, 34.57, 34.90

Supplementary: Aperture Stops

- **Note that all lenses have finite diameters (aperture stop)**
  - **Limits amount of light going through lens**
    - **It can larger or smaller than the lens aperture (see fig. 5.34, 5.35)**
- **Image plane also is finite (i.e., the detector): field stop**
  - **Limits size of image**
- **Internal stops in complex lens systems can help control the aberrations of the lens. Can also reduce illumination of the image plane as the off-axis angle increases (vignetting)**
  - **Useful for controlling stray light in infrared instruments**
- **We define the f#, or speed of a lens as f# = f/D**
  - **The smaller the number the higher the surface brightness of the image (and vice versa)**
  - **The smaller the f# the smaller the depth, or tolerance of focus**

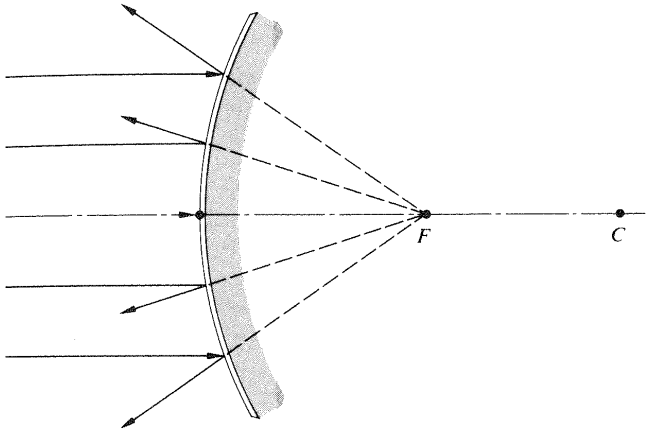
Chapter 34: Mirrors - I

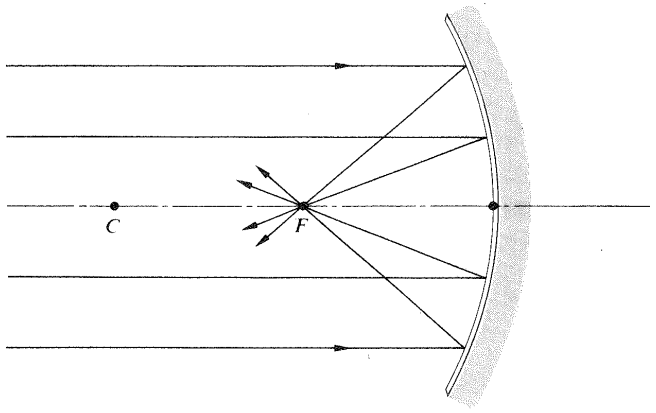
- Flat of Plane mirrors:
  - All images are virtual
  - Angle of reflection = angle of incidence
  - Object distance = image distance
  - Virtual images of mirrors are reversed but not inverted
  - Images from lenses are inverted but not reversed
  - Used in laser scanners, some digital projectors, and other instances where “beam steering” is needed

Chapter 34: Mirrors - II

- **Spherical Mirrors:**
  - **Images can also be formed by curved mirrors**
  - **Concave mirrors form real images**
  - **Convex mirrors form virtual images**
    - **Focal length = 2 x Radius of Curvature**

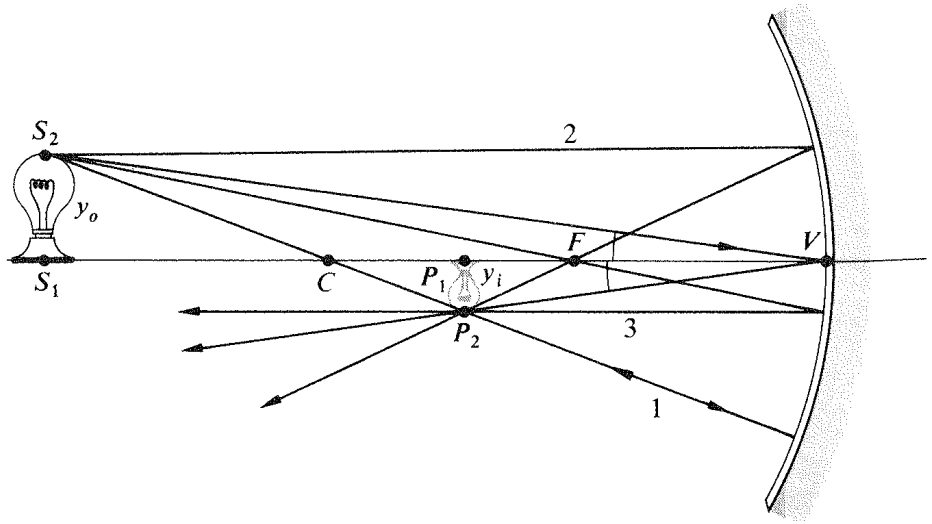
$$\frac{1}{s_o} + \frac{1}{s_i} = -\frac{2}{R}$$





- **Aspherical Mirrors:**
  - **From analytic geometry its clear the best axial image will be from a parabola not a sphere**

Chapter 34: Sign Conventions



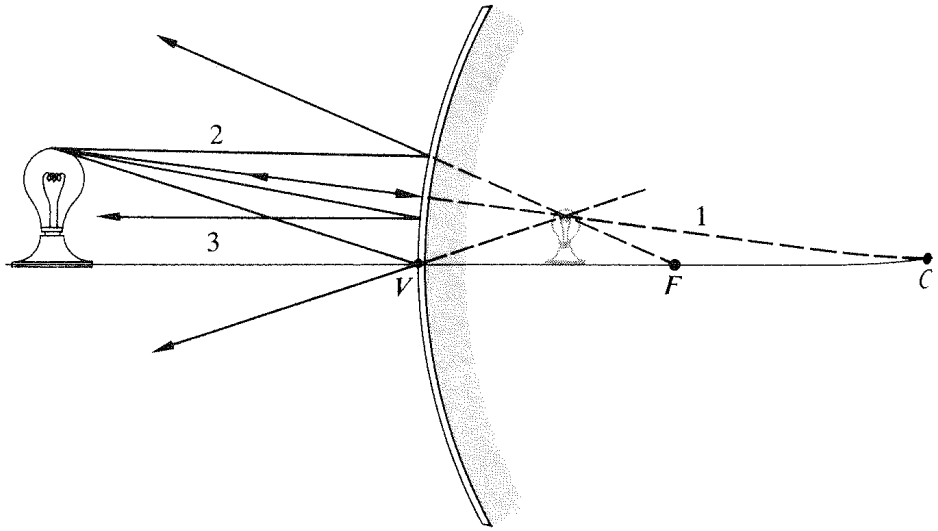


TABLE 5.4 Sign Convention for Spherical Mirrors

Quantity	Sign	
	+	−
s_o	Left of V, real object	Right of V, virtual object
s_i	Left of V, real image	Right of V, virtual image
f	Concave mirror	Convex mirror
R	C right of V, convex	C left of V, concave
y_o	Above axis, erect object	Below axis, inverted object
y_i	Above axis, erect image	Below axis, inverted image

Table 5.5 Images of Real Objects Formed by Spherical Mirrors

Concave

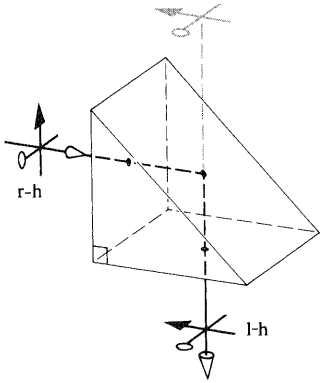
Object	Image			
Location	Type	Location	Orientation	Relative Size
$\infty > s_o > 2f$	Real	$f < s_i < 2f$	Inverted	Minified
$s_o = 2f$	Real	$s_i = 2f$	Inverted	Same size
$f < s_o < 2f$	Real	$\infty > s_i > 2f$	Inverted	Magnified
$s_o = f$		$\pm\infty$		
$s_o < f$	Virtual	$\lvert s_i\rvert > s_o$	Erect	Magnified

Convex

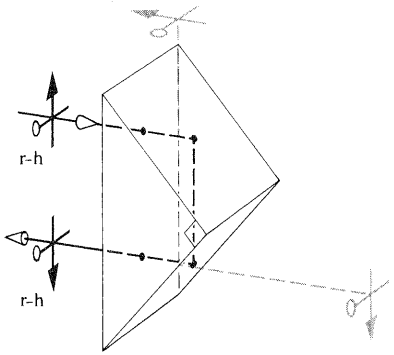
Object	Image			
Location	Type	Location	Orientation	Relative Size
Anywhere	Virtual	$\lvert s_i\rvert < \lvert f\rvert$, $s_o > \lvert s_i\rvert$	Erect	Minified

Chapter 34: Reflecting Prisms

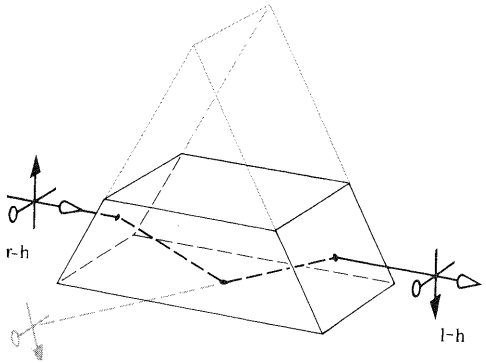
- **Prisms can be used to modify the path of light, not just disperse it.**
  - **Done via reflection (total internal or with silvered surfaces)**
- **Right Angle Prism**
  - **Deviates light by 90°**
- **Porro Prism**
  - **Right angle shape but deviates light by 180°**
- **Dove Prism**
  - **Used to rotate light beam**
- **Penta Prism**
  - **Used to invert light beam or image**



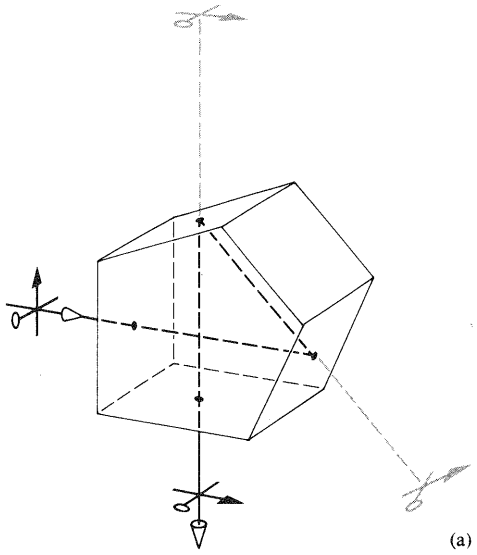
Right Angle



Porro



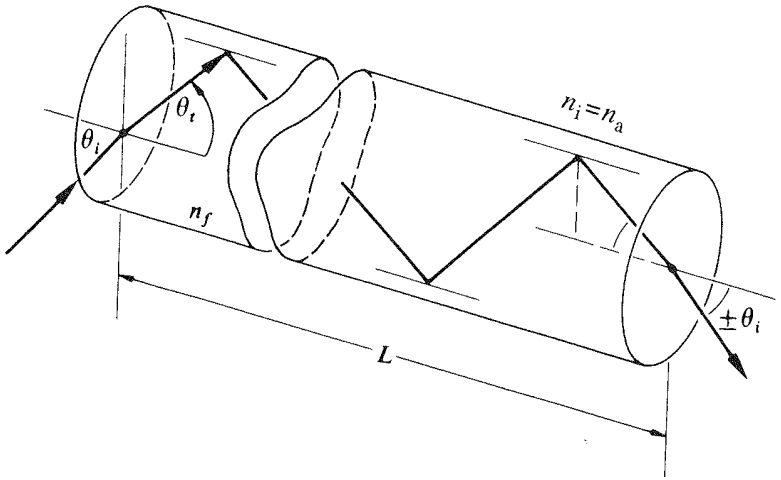
Dove



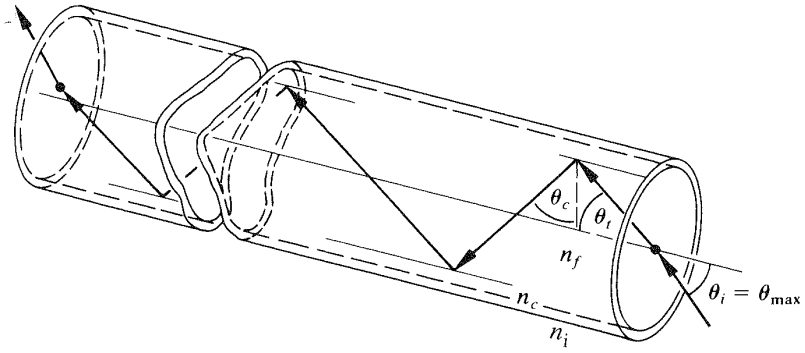
Penta

Chapter 34: Optical Fibers

- **Optical fibers are extremely useful in optical systems for directing light along a complex path to a particular point. In telecomunications this allows the transmission of information by fast optical switching of sold-state lasers.**
- **Low index outside creates total internal reflection if light enters at less than the critical angle (see text):**



$$\sin\theta_{\max} = \frac{1}{n_i}(n_f^2 - n_c^2)^{1/2}$$



Numerical aperture = $n_i \sin\theta_{max}$. Modern fibers are often made of gradient index material so the pulses are not spread by the range of OPL.

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Reading this Week

By Monday:

Finish Ch. 34