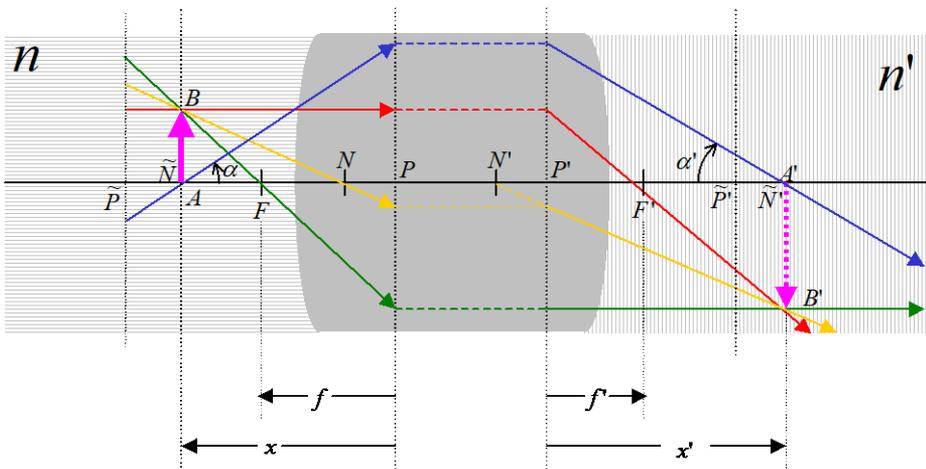# Gaussian Optics Framework

Power

$$C = -\frac{n}{f} = \frac{n'}{f'}$$

Distance Design Formula

$$x = f'\left(\frac{1}{m_y}\frac{n}{n'} - 1\right)$$

General Gaussian Concepts

1) The principal and anti- principal points are symmetric about the focal point on their respective space by the focal length. The nodal and anti-nodal points are also symmetric about the focal point by the conjugate focal length.

2) If n=n', then the principal and nodal points will coincide as will the anti- principal and anti-nodal points.

3) For thin lenses and single surfaces, the principal and nodal points are located at the lens or surface while the anti-principal and anti-nodal points are located at twice the focal length from the principal planes.

At the Principal Planes,

$$m_y = +1 \qquad m_\alpha = (m_\alpha)_0 = -\frac{f}{f'} = \frac{n}{n'}$$

At the Nodal Points

$$m_\alpha = +1$$

At the Anti-Principal Planes

$$m_y = -1 \qquad (m_\alpha)_{-0} = \frac{f}{f'} = -\frac{n}{n'}$$

At the Anti-Nodal Points

$$m_\alpha = -1$$

At the conjugate points A and A'

Imaging Equation: $\dfrac{n'}{x'} = \dfrac{n}{x} + \dfrac{n'}{f'}$

Optical Invariance: $ny\alpha = n'\,y'\,\alpha'$

Newton's Equation: $m_y = \dfrac{y'}{y} = -\dfrac{f}{\overline{FA}} = -\dfrac{\overline{F'A'}}{f'}$

Transverse Magnification: $m_y = \dfrac{y'}{y} = \dfrac{x'}{x}\dfrac{n}{n'} = -\dfrac{1}{m_\alpha}\dfrac{n}{n'} = \dfrac{1}{m_x}\dfrac{x}{x'} = -\dfrac{m_\alpha}{m_x}$

Angular Magnification: $m_\alpha = \dfrac{\alpha'}{\alpha} = -\dfrac{x}{x'} = -\dfrac{1}{m_y}\dfrac{n}{n'} = -m_x\dfrac{x'}{x}\dfrac{n}{n'} = -m_x m_y$

Axial Magnification: $m_x = \dfrac{dx}{dx'} = \dfrac{n}{n'}\left(\dfrac{x}{x'}\right)^2 = \dfrac{1}{m_y}\dfrac{x}{x'} = -m_\alpha\dfrac{x}{x'}\dfrac{n'}{n} = -\dfrac{m_\alpha}{m_y}$