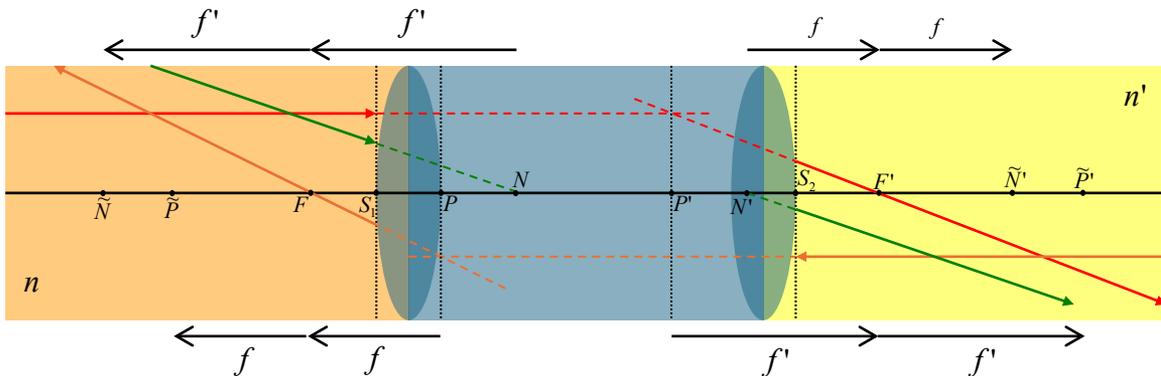


Cardinal Points



Variable Definitions

$F \equiv$ Focal Point Object	$P \equiv$ Object Principal Point	$N \equiv$ Object Nodal Point
$F' \equiv$ Focal Point Image	$P' \equiv$ Image Principal Point	$N' \equiv$ Image Nodal Point
$f \equiv$ Object Focal Length	$\tilde{P} \equiv$ Object Anti - Principal Point	$\tilde{N} \equiv$ Object Anti - Nodal Point
$f' \equiv$ Image Focal Length	$\tilde{P}' \equiv$ Image Anti - Principal Point	$\tilde{N}' \equiv$ Image Anti - Nodal Point

Focal Points and Lengths

Focal Point Object: The image of a point object at infinity on axis incident from the right.

Focal Point Image: The image of a point object at infinity on axis incident from the left.

Object Focal Length: The distance from the object focal point to the focal point object.

Image Focal Length: The distance from the image focal point to the focal point image.

$$f = \overline{PF} \quad f' = \overline{P'F'} \quad \text{Power}^{\mu} = -\frac{n}{f} = \frac{n'}{f'}$$

Principle Points

Principle Points: Conjugate points where the transverse magnification is unity ($m_y=+1$).

Anti-Principle Points: Conjugate points where the transverse magnification is negative one ($m_y=-1$).

Image Space Principle Point: The point where an input ray from the left appears to intersect the corresponding output ray on the right.

Object Space Principle Point: The point where an input ray from the right appears to intersect the corresponding output ray on the left.

Note: The principle and anti-principle points are symmetric about the focal point by the focal length.

$$\overline{F'\tilde{P}'} = \overline{P'F'} \quad \overline{P'\tilde{P}'} = 2f' \quad \overline{F\tilde{P}} = \overline{PF} \quad \overline{P\tilde{P}} = 2f$$

Nodal Points

Nodal Points: Conjugate points where the angular magnification is unity ($m_a=+1$).

Anti-Nodal Points: Conjugate points where the angular magnification is negative one ($m_a=-1$).

Nodal Ray: A ray entering the object space nodal point will emerge from the image space nodal point at the same angle.

Note: 1) The transverse magnification of the nodal planes is $m_y=n/n'$.

2) If $n=n'$, then the principle points and nodal points will coincide.

$$\text{Location: } \overline{PN} = \overline{P'N'} = \frac{n'-n}{\psi} = f + f' \quad \overline{N'F'} = -f \quad \overline{NF} = -f'$$

$$\overline{P\tilde{N}} = \overline{P'\tilde{N}'} = \frac{n'+n}{\psi} = f' \left(1 + \frac{n}{n'} \right) = -f \left(1 + \frac{n'}{n} \right) = R \left(\frac{n'+n}{n'-n} \right)$$