**Definition**

Astigmatism results when an optical system is not symmetric about its optical axis. A cylindrical deformation of the wavefront results causing two line focal points. It can be defined as a longitudinal shift in image position with ray direction.

The cone of rays from a point object off-axis strikes the lens asymmetrically, producing images at two different focal planes. The image varies from a sagittal (radial) to a tangential line, depending upon the focal position of the image plane. This results in line images that are perpendicular to each other.

**Notes**

1) The shape of the wavefront is not affected by field, but the magnitude of the aberration is.
2) Astigmatism is more sensitive to field than is coma.
3) If the stop is at the lens, then “lens bending” has no effect.
4) A “circle of least confusion” exists between the two line foci.

**Formulas**

Wavefront Aberration: \( W_{222} \cdot r^2 \rho^2 \cos^2 \phi \)

Seidel Coefficient: \( S_{III} = - \sum_{All \ Surfaces} y_i \Delta \frac{\mu_i}{n_i} \)

Relation: \( W_{222} = \frac{1}{2} S_{III} \)

**Point Spread Function**

**Minimizing and Correcting**

1) Reduce the FOV.
2) Balance aberrations.