

4.1: Introduction to Optical Aberrations

We have hitherto made the assumption that a lens or a curved mirror is able to form a point image of a point object. This may be approximately true if the depth of the mirror or the thickness of the lens is small compared with other distances, and if the angle that all rays make with axis of the mirror or lens is small, and if we are using monochromatic light. Usually none of these conditions is satisfied exactly, and consequently the image formed by a lens or curved mirror suffers from several aberrations.

There are five *geometrical* aberrations, given the names

- Spherical aberration
- Astigmatism
- Coma
- Curvature of field
- Distortion (pincushion or barrel distortion).

In addition, unless we are using monochromatic light, lenses (but not mirrors) exhibit *chromatic aberration* (longitudinal and transverse).

It may be possible to minimize some of these aberrations by careful choice of the radii of curvature of a lens system (“bending the lens”), although the condition for minimizing one aberration may be different from minimizing another. Consequently some sort of compromise must be reached, which may depend on which aberrations are important, and which are not so important, for a particular application.

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