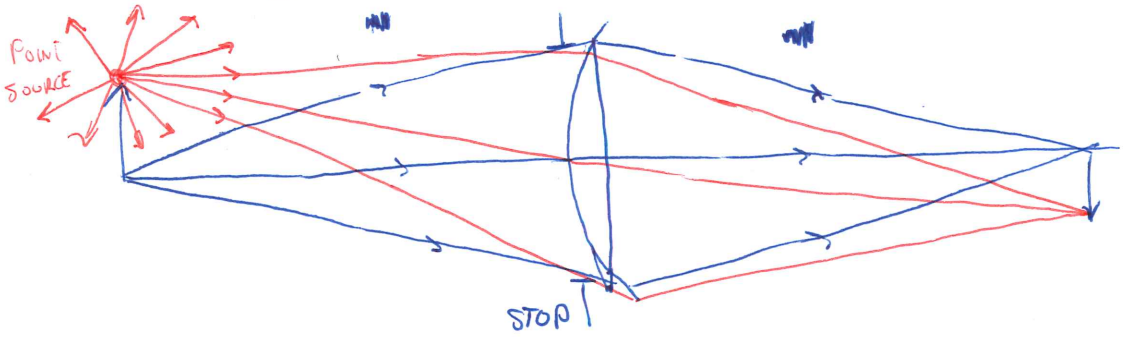
1.2

1.2.1

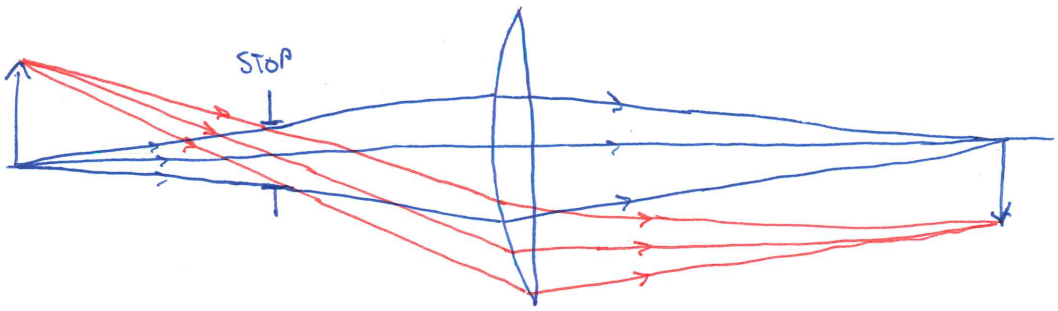
Aperture Stop - Mask within the system that limits the size of the bundle of rays passing through the system. The mask is typically a circular opening, but not an absolute requirement.

For our single surface, the aperture can be placed at the surface



If we consider a single point on the object as a point source with some intensity, the aperture stop limits the light captured from this point. The ray bundles from each point on the objet appear to pivot around the aperture stop.

The aperture stop does not need to be located at the surface. Consider the figure below

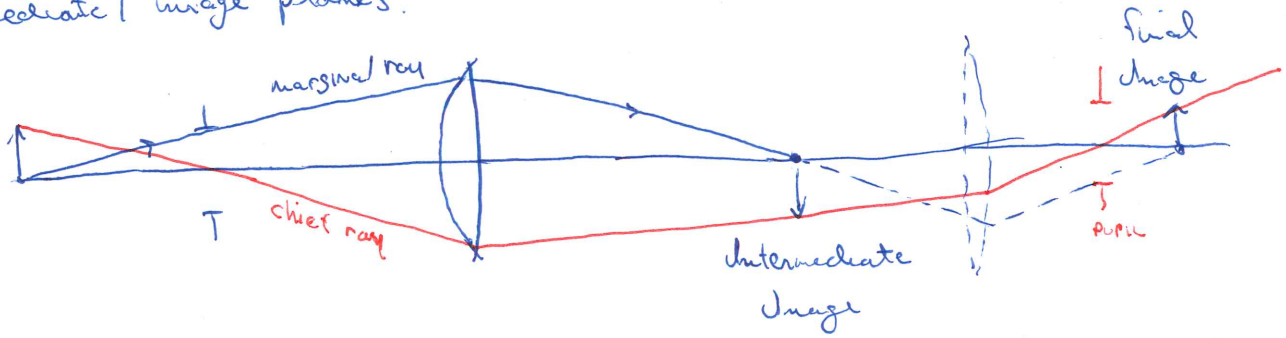


Moving the aperture stop changes where the bundle of rays passes through an optical surface.

1.2.2 Marginal Ray

In regards to the aperture stop, we define several special rays that provide useful information regarding the optical system. The first is call the Marginal Ray

Definition The Marginal Ray is defined as a ray that starts on-axis at the object and passes through the edge of the aperture stop. Note that this ray intersects the optical axis at the final (and also intermediate) image planes.



ASIDE: We are often interested in knowing the location of intermediate image planes. First, suppose one of our optical surfaces is located at the intermediate image plane. Any dust or surface imperfections in this plane will get mapped to the final image plane. Second, suppose we want to superimpose something onto the image. We can place a mask at the intermediate image plane to do this.

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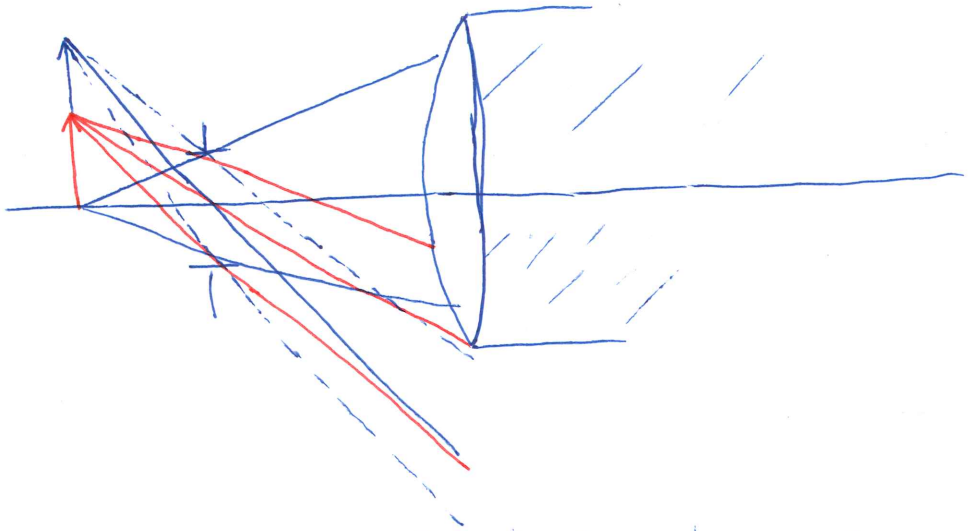
1.2.3 Chief Ray

A second special ray defined with regard to the aperture stop is the chief ray (pricipal ray)

Definition The Chief Ray is defined as a ray that starts at the edge of an object and passes through the center of the aperture stop. Whenever the chief ray crosses the axis, is called a pupil plane. The size of the pupil is given by the height of the marginal ray at that plane.

1.2.4 Vignetting



Vignetting occurs when a surface besides the aperture stop limits the size of the bundle of rays entering the system. The result is a fall-off in the intensity of the image.

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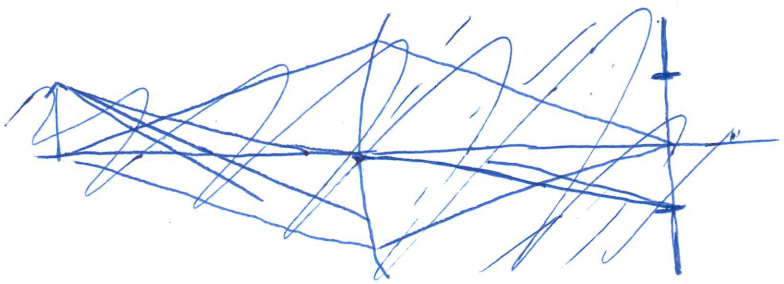
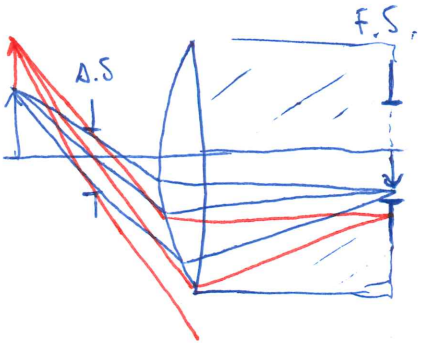
Vignetting can be a specification of a system. eg. "must exceed 50% vignetting at the edge of the field.

1.2.5 Field Stop

Definition: The Field Stop is a mask limits the size of the object that can be used with the optical system. It is used often to provide control over the degree of vignetting. The mask can be located at any intermediate or final image plane.





1.2.5.1 Image Sensor as Field Stop

Often the final image sensor serves as the field stop of the system. In other words, the sensor dimensions dictate the dimensions of the object that can be imaged. This field stop is typically rectangular, so height and width of object may differ

1.2.5.1.1 Standard CCD/CMOS sensor dimension

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Show ~~Size~~ Table

Go to Point Grey website www.ptgrey.com

e.g. Dragonfly 2

Sony 1/3" progressive scan CCD

Resolution 648 x 488, 1033 x 776 or 1296 x 964 pixels

How are different resolutions obtained with same sensor dimension?

From table 1/3" sensor is 4.8 x 3.6 mm

$$\frac{4.8\text{ mm}}{648} = 0.0074 = 7.4\ \mu\text{m}$$

Similarly

$$\frac{4.8}{1033} = 4.65\ \mu\text{m}$$

$$\frac{4.8}{1296} = 3.75\ \mu\text{m}$$