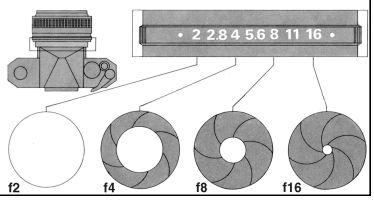
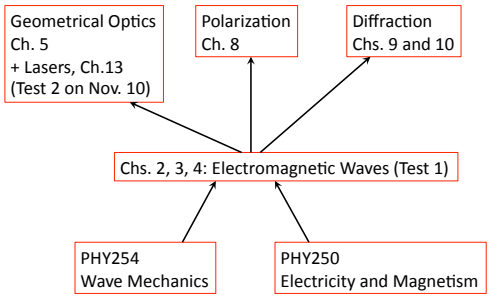
PHY385-H1F Introductory Optics

Class 10 – Outline: Sections 5.3, 5.4

- Aperture Stops
- Entrance Pupil, Exit Pupil
- Chief Ray and Marginal Rays
- Relative aperture, f-number, lens speed.
- Mirrors

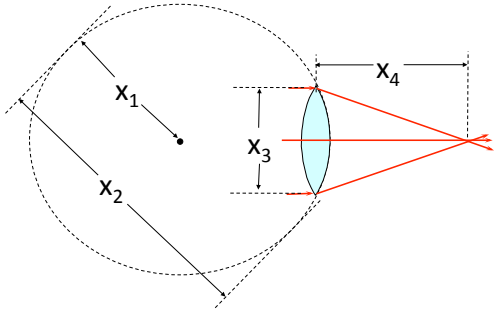


This Course



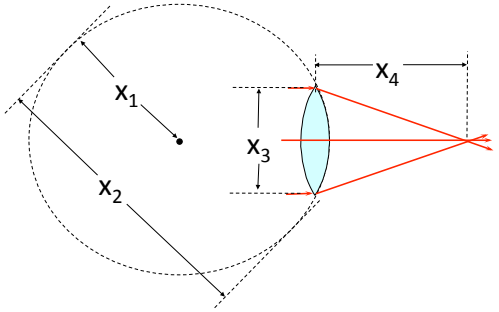
Finger Vote!!!

Which distance is the Diameter, D, of the Lens?



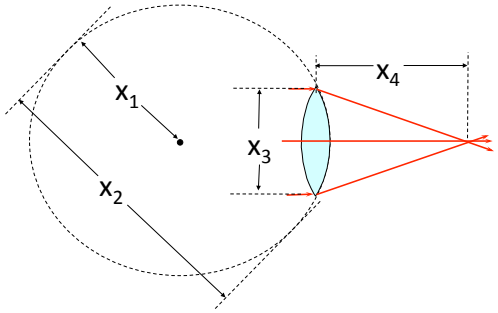
Finger Vote!!!

Which distance is the Focal Length, f, of the Lens?



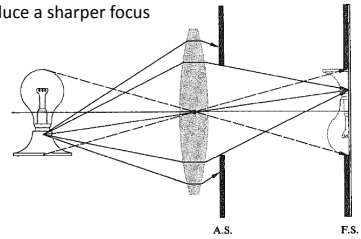
Finger Vote!!!

Which distance is the Radius of curvature, R_1 or R_2, of the Lens?

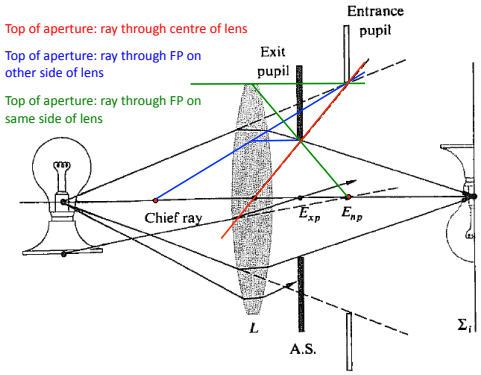


Aperture Stop

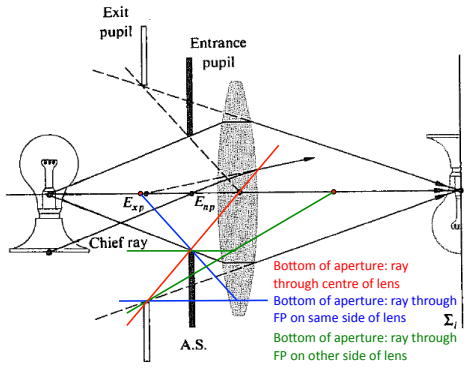
- The **Aperture Stop** Determines the ray cone angle, or equivalently the brightness, at an image point
- The limiting size of the image is called the **field stop**, which determines the field of view
- A smaller aperture stop on a lens admits less light, but can produce a sharper focus



Entrance, Exit Pupil: Rear Aperture Stop

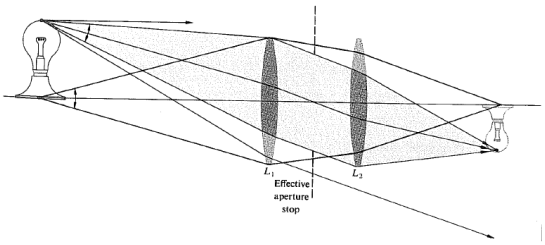


Entrance, Exit Pupil: Front Aperture Stop



- For every point on the object, we can sketch the chief ray and two marginal rays.
- Chief Ray always intersects the optical axis at the A.S.
- Marginal rays always intersect the edges of the A.S.
- Rays emerge from the object point, and converge at the image point.
- Rays may only bend when passing through a lens.
- Rays passing through the centre of a lens don't bend.

Vignetting



The effective aperture stop is somewhat smaller for rays from the edge of the object than it is for rays from an object point on the optic axis.

The image gets fainter toward the edges.

- The total amount of light collected by the lens is proportional to D^2
- The image area of an extended object is proportional to f^2
- So the flux density at the image plane varies as $(D/f)^2$
- D/f is called "relative aperture"
- f/D is called the "f-number" (ie F1.4, F2, F16, etc)
- $(f/D)^2$ is called the "speed". The higher the speed, the shorter an exposure time you need for the same image brightness.
- That's why f-numbers tend to increase by factors of $\sqrt{2}$ on cameras – for each step you have to double the exposure time

Hobby Eberly Telescope (HET) in West Texas.

4th largest telescope in the world.

9.2 m diameter reflecting telescope.

Mirror is spherical in shape.