

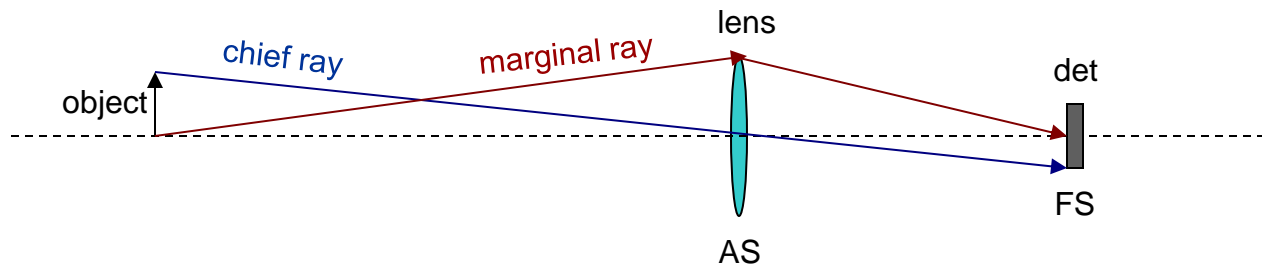


Aperture and Field Stops

Stops determine the light-collecting area and field of view of an optical system. We can find the stops by tracing two rays called the marginal (or axial) ray and chief (or principal) ray.

Aperture stop - limits the area over which light is collected.

Field stop - limits the angle from which light is collected (field of view).



Marginal (axial) ray

Ray from the axial point on the object, to the edge (or margin) of the aperture stop, and through the center of the field stop.

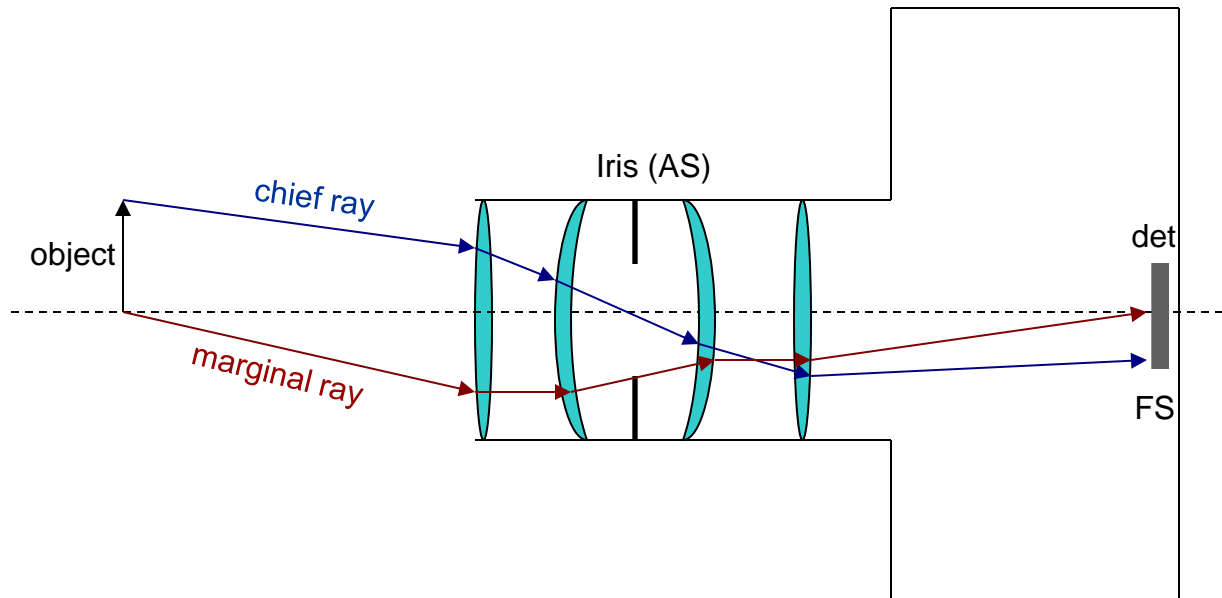
Chief (principal) ray

Ray from the top or bottom of the object, through the center of the aperture stop, and to the edge of the field stop.



Stops in a Camera

Nearly always in a camera, the aperture stop is an iris embedded somewhere within the lens system and the field stop is the film or detector (such as a CCD).



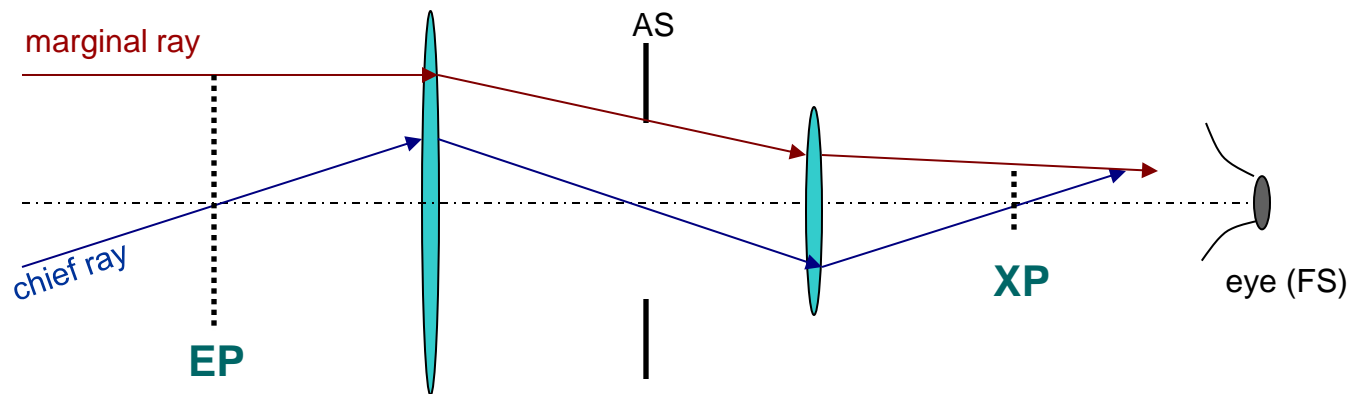
- marginal ray is limited by the iris, not by any of the lens elements.
- chief ray passes through center of iris (the aperture stop).
- chief ray angle in object space = “field of view” or “field angle”



Pupils

Entrance Pupil (EP) - image of the aperture stop in object space.

Exit Pupil (XP) – image of the aperture stop in image space.



To find optical power [W] collected by an optical system, multiply the incident irradiance [W/m^2] by the entrance pupil area.

Exit pupil determines area of image. A tiny exit pupil is hard to align with the eye in a telescope or binoculars.



Demonstration of Pupils with a Camera Lens

View a camera lens from the front and from the back to see the entrance and exit pupils. You are seeing the same iris from both sides, but it appears to be of different diameter because of the intervening optics.



Entrance pupil



Exit pupil