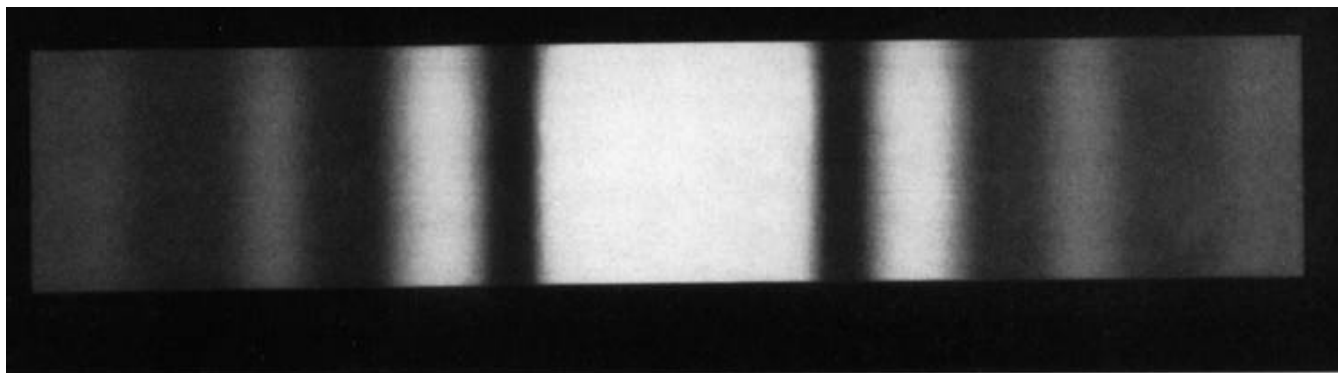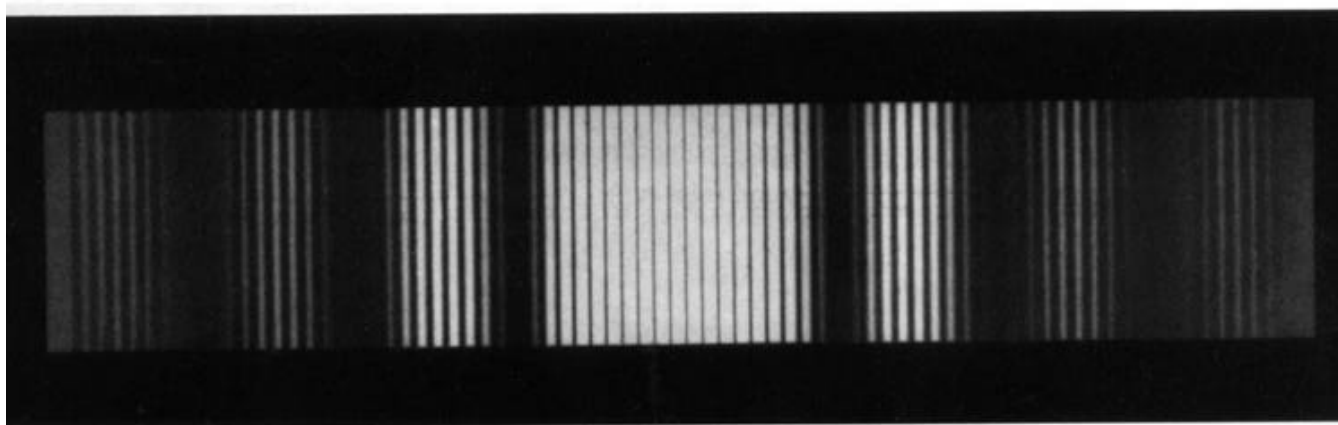# Far-Field, Fraunhofer Diffraction Patterns

Diffraction pattern formed by a single slit

Diffraction pattern formed by a pair of slits

Single and Double Slits

Far Field, Fraunhofer Diffraction Patterns

Diffraction image of a point source (square aperture)

Diffraction image of a point source (rectangular aperture)

Square aperture (left)   **Rectangular Aperture (right)**
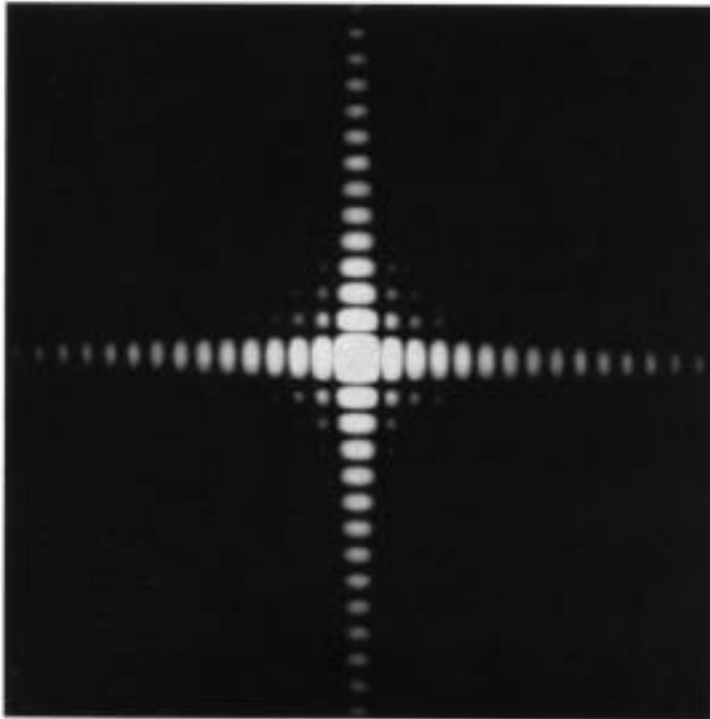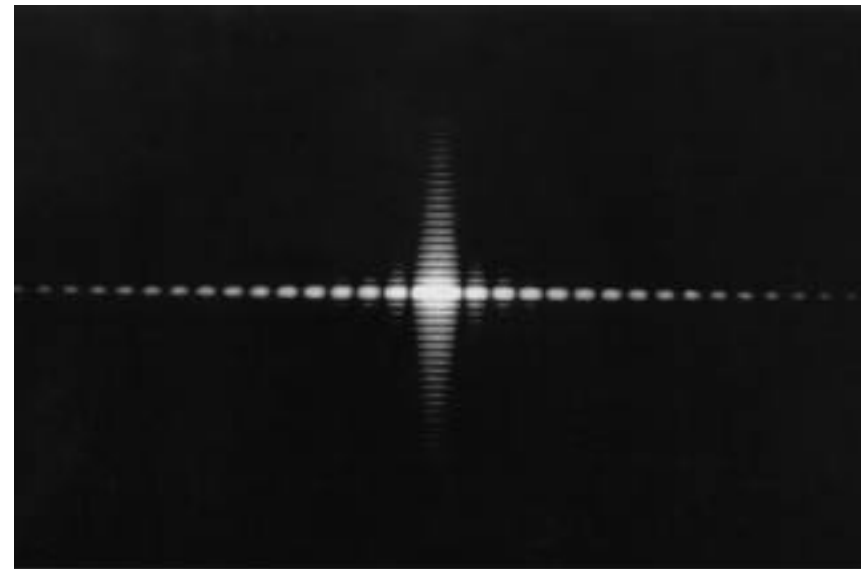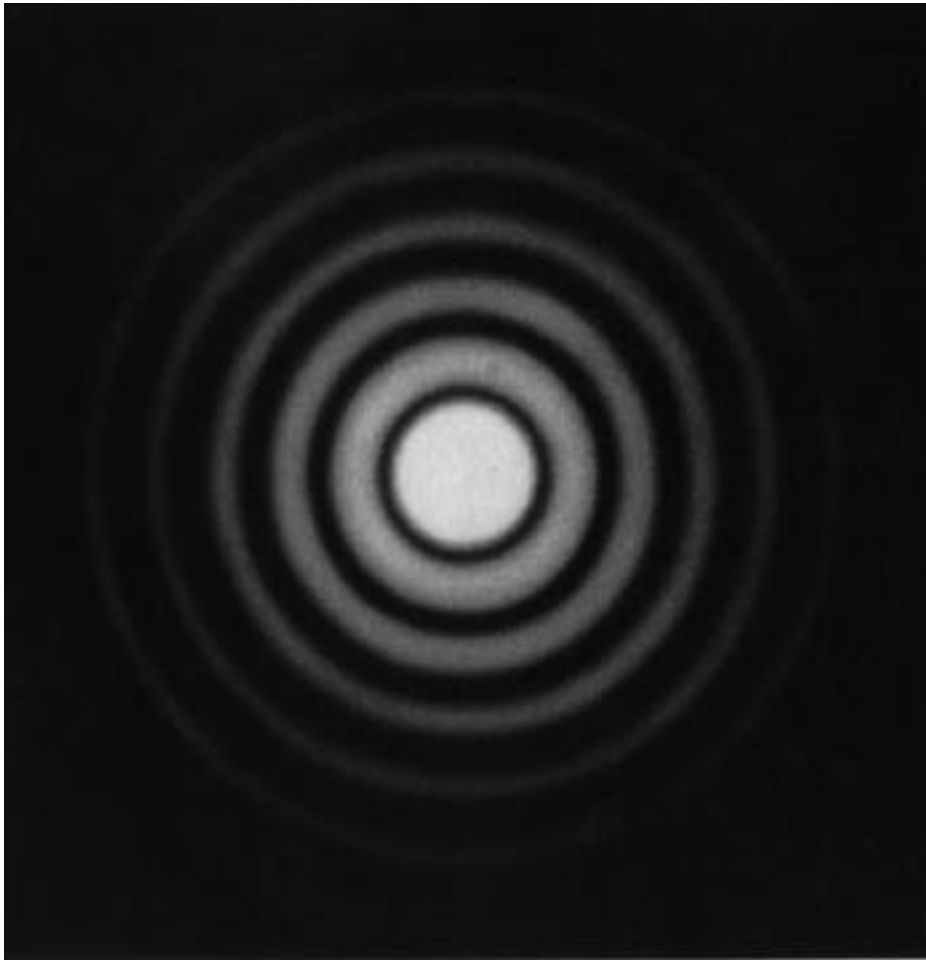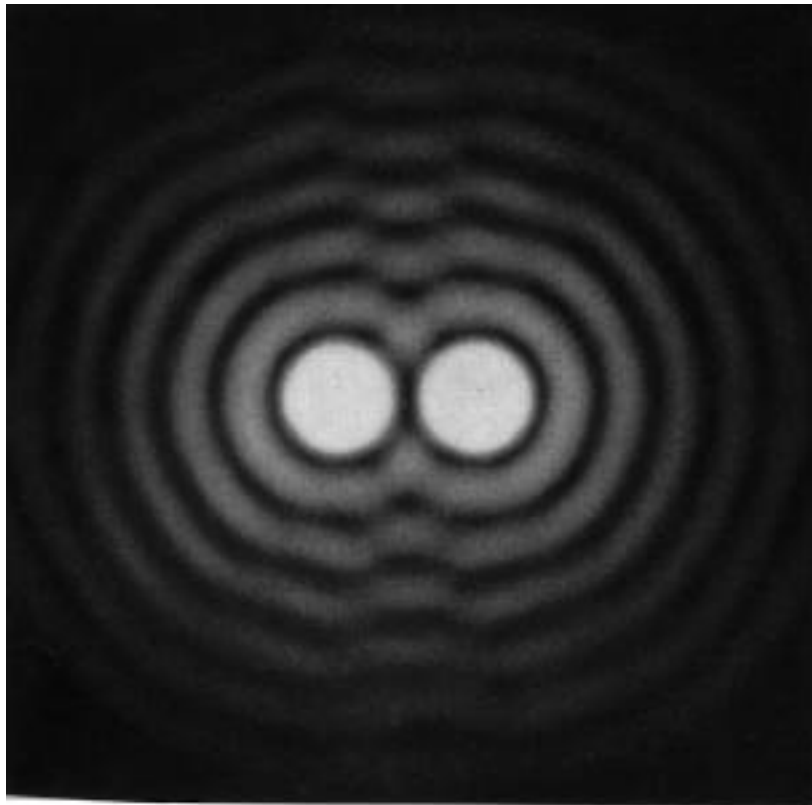
Far Field, Fraunhofer Diffraction Patterns

Diffraction image of a point source in the case of a circular aperture (the Airy disc)

Circular aperture.

Or, image of a point source (star) for an optical system with a circular aperture stop.

Rayleigh Resolution Limit

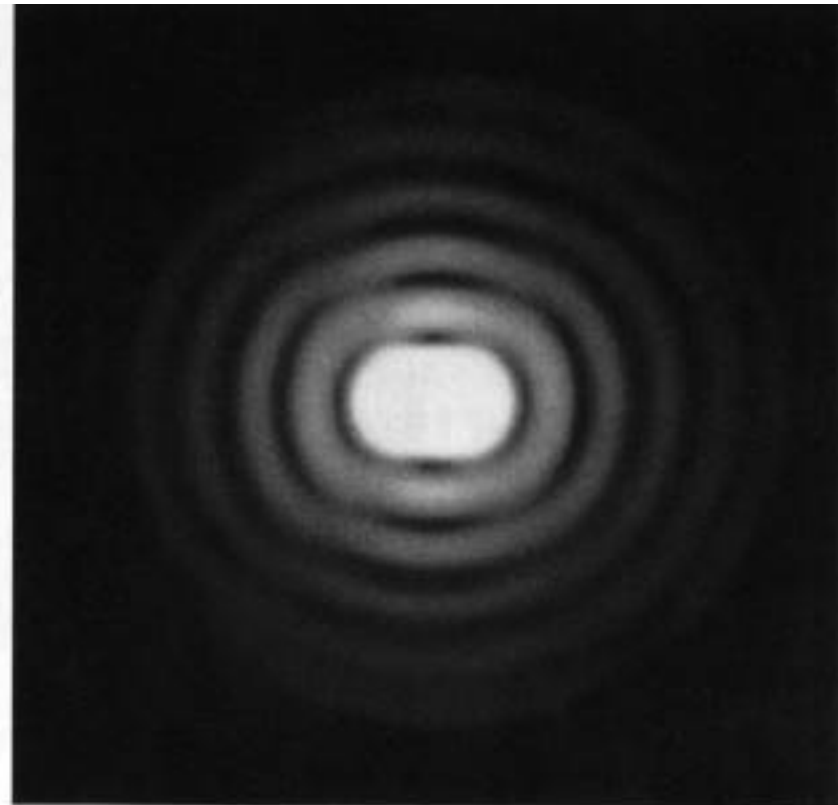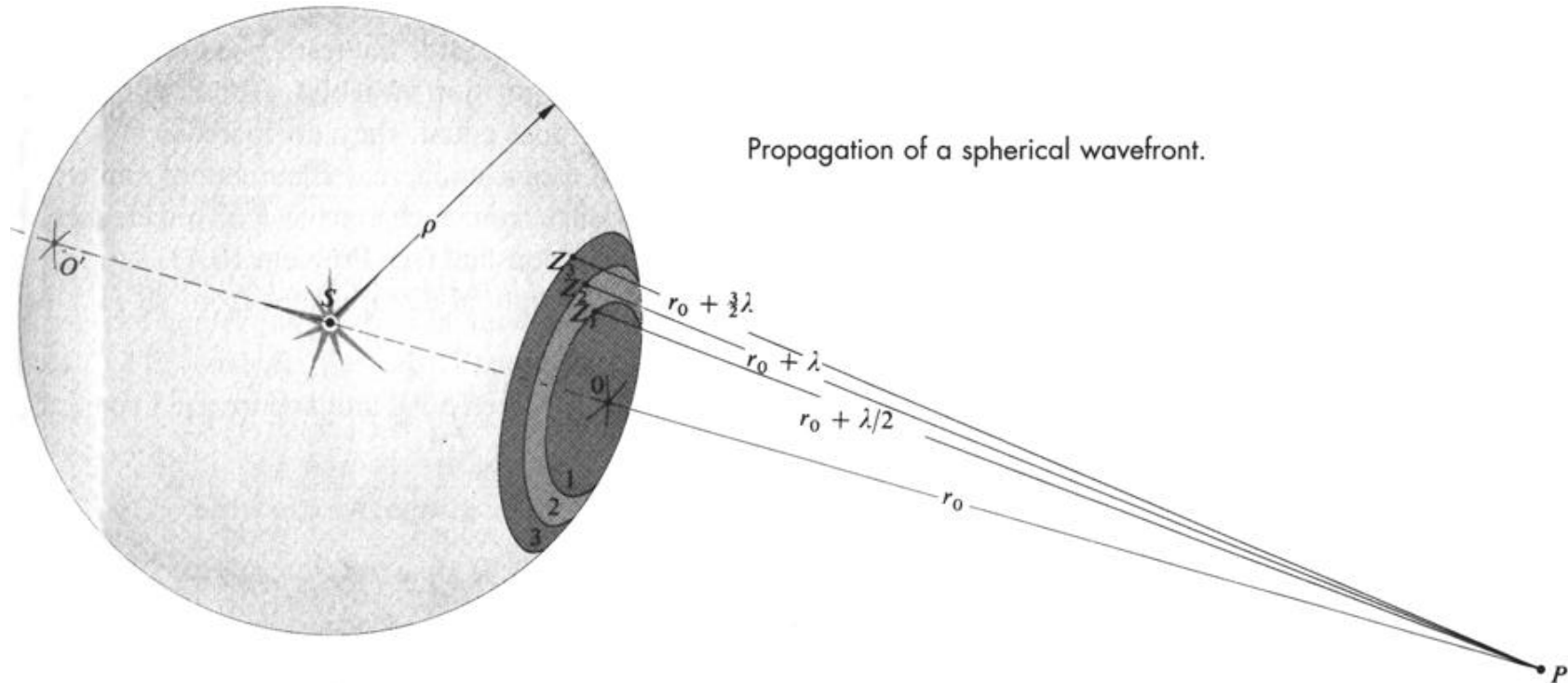Separated images of 2 incoherent point sources

Image of a pair of incoherent point sources at the limit of resolution

Two stars well separated (left)   **Two stars at Rayleigh limit (right)**

Fresnel Zones

Propagation of a spherical wavefront.

Each Fresnel zone boundary is defined by an extra increment of half-wavelength for the distance to an on-axis observation point.

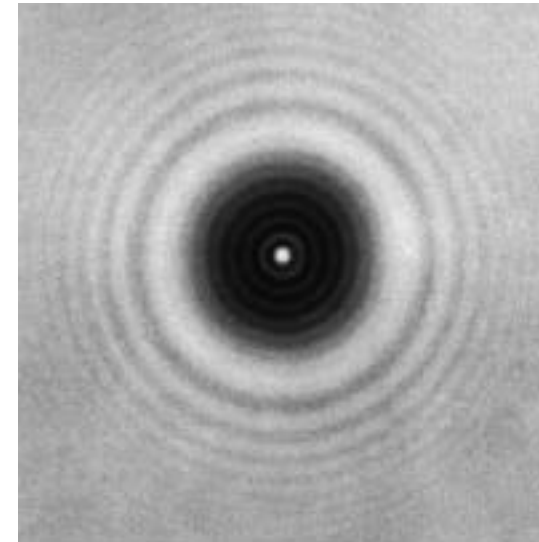# Fresnel Diffraction Behind a Circular Aperture

1. Circular aperture viewed on axis (symmetric Fresnel zones).

2. Circular aperture containing exactly 2 zones (below, left) = destructive interference

3. Effect of moving the observation point off axis. Observed intensity oscillates.

A circular aperture.
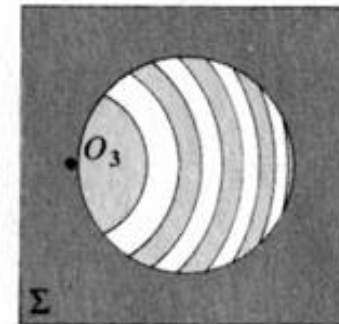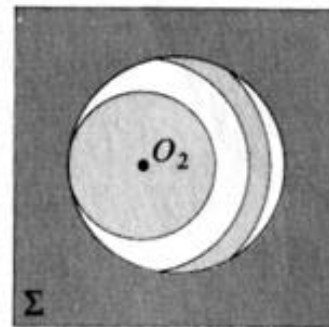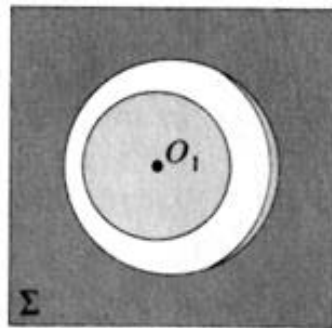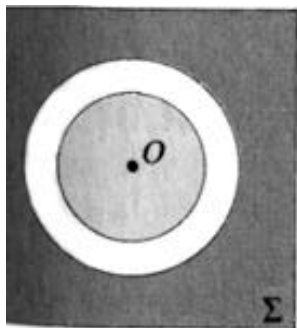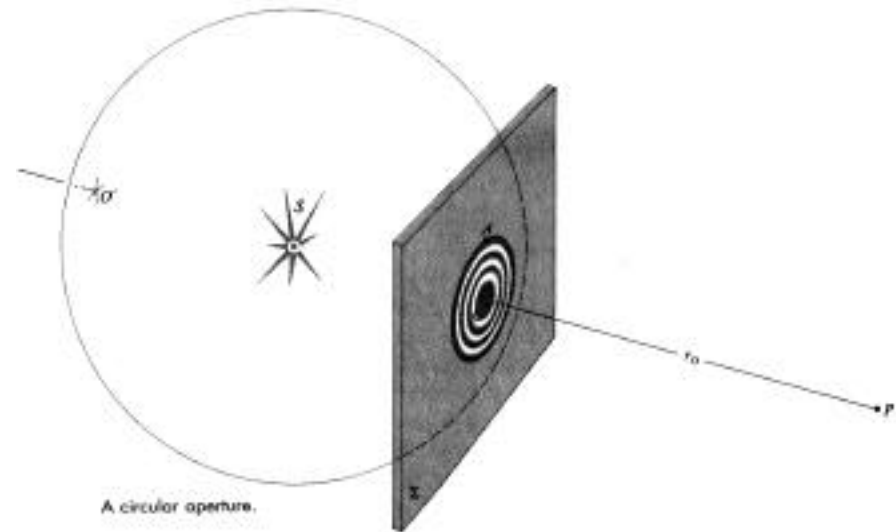
Near Field, Fresnel Diffraction
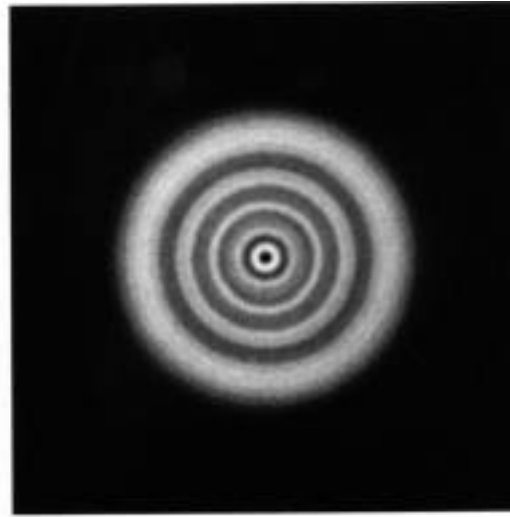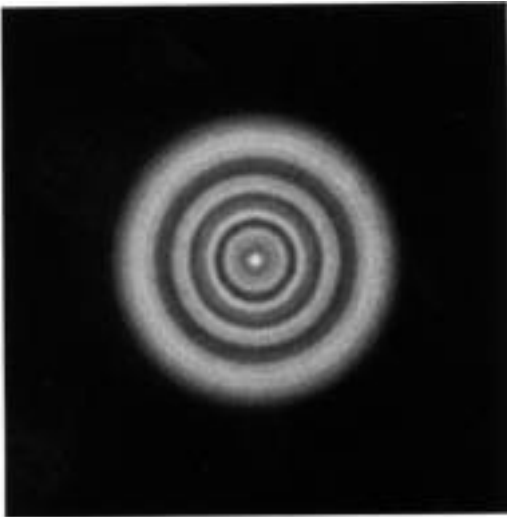
Diffraction by a circular aperture for two positions of the plane of observation

Diffraction by an opaque circular disc

Left two images: Fresnel diffraction at distances z behind a circular hole showing an on-axis bright spot (left) and a dark spot (center)

Shadow in the near field behind a circular opaque disk showing a bright spot on axis.

Fresnel Zone Plate as a Lens

1. Zone plate can be viewed as a grating diffraction +1 and -1 orders. One set converges to foci on axis.

2. More than one focus can exist where the center circle of the zone plate contains an odd integer number of actual Fresnel zones as seen from the on-axis observation point (focus).

Zone-plate foci.