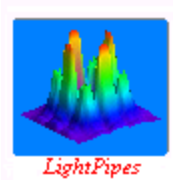


DIFFRACTION.

Round hole.

Here we demonstrate the diffraction caused by a round hole. Depending on the Fresnel number (number of Fresnel zones) we have Fresnel diffraction (Fresnel number > 1) or Fraunhofer difraction (Fresnel number <1).

$size \equiv 10 \cdot mm$ $nm \equiv 10^{-9} \cdot m$ $\lambda \equiv 632.8\,nm$ $N \equiv 300$

The radius of the hole $a := 1mm$

The hole is illuminated by a Gaussian beam from a HeNe laser:

$F := LPBegin\left(\frac{size}{m}, \frac{\lambda}{m}, N\right)$ $F := LPGaussHermite\left(0, 0, 1, \frac{size}{2m}, F\right)$

$F := LPCircAperture\left(\frac{a}{m}, 0, 0, F\right)$ $i := 0..8$ $z_i := 20cm + i \cdot 20cm$

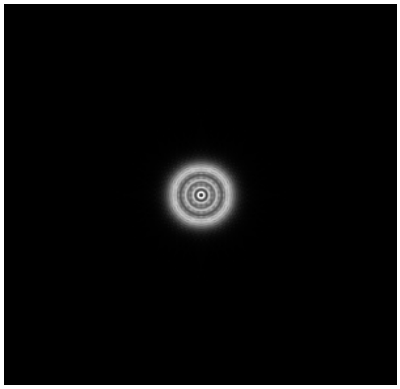
$FresnelNumber_i := \frac{a^2}{z_i \cdot \lambda}$

Depending on the Fresnel number we use the LPFresnel or LPForvard propagation routine:

$$F1_i := \begin{cases} LPFresnel\left(\frac{z_i}{m}, F\right) & \text{if } FresnelNumber_i \geq 10 \\ LPForvard\left(\frac{z_i}{m}, F\right) & \text{otherwise} \end{cases}$$

$I_i := LPIntensity\left(2, F1_i\right)$

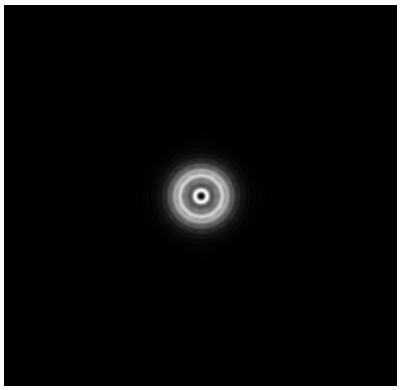
$z_0 = 20\,\text{cm}$ $\text{FresnelNumber}_0 = 7.901$

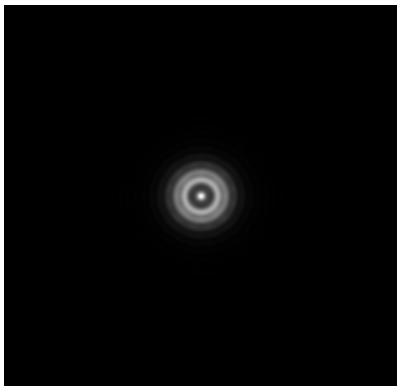


Diffraction pattern of a round hole

I_0

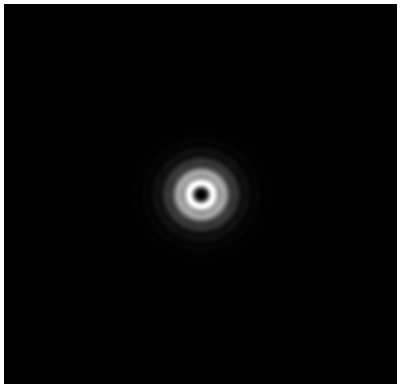
$z_1 = 40\,\text{cm}$ $\text{FresnelNumber}_1 = 3.951$ $z_2 = 60\,\text{cm}$ $\text{FresnelNumber}_2 = 2.634$



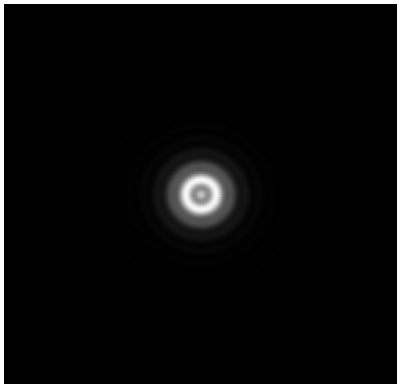


I_1 I_2

$z_3 = 80\,\text{cm}$ $\text{FresnelNumber}_3 = 1.975$ $z_4 = 100\,\text{cm}$ $\text{FresnelNumber}_4 = 1.58$

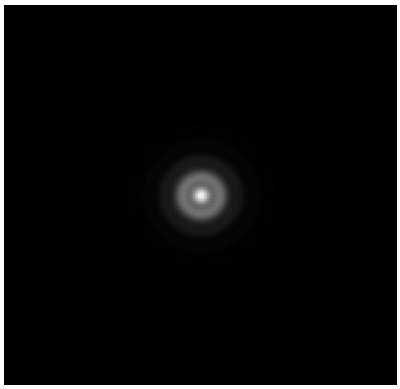


I_3

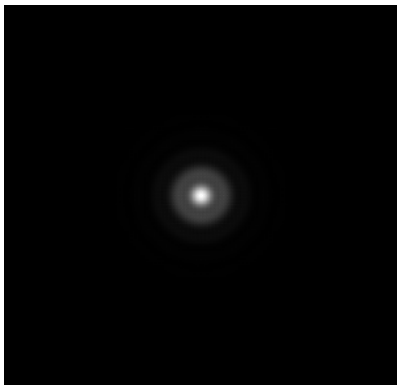


I_4

$z_5 = 120\,\text{cm}$ $\text{FresnelNumber}_5 = 1.317$ $z_6 = 140\,\text{cm}$ $\text{FresnelNumber}_6 = 1.129$

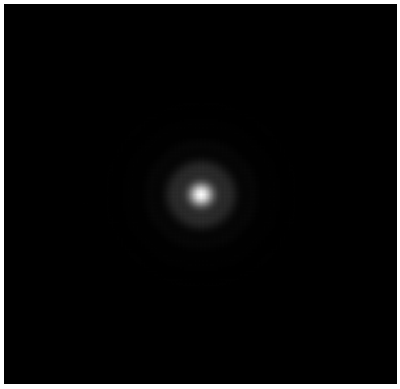


I_5

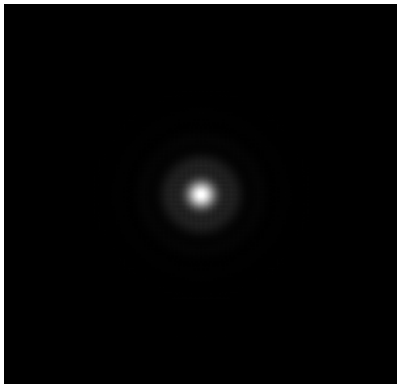


I_6

$z_7 = 160\,\text{cm}$ $\text{FresnelNumber}_7 = 0.988$ $z_8 = 180\,\text{cm}$ $\text{FresnelNumber}_8 = 0.878$



I_7



I_8