

# Experimental Physics 3 - Em-Waves, Optics, Quantum mechanics

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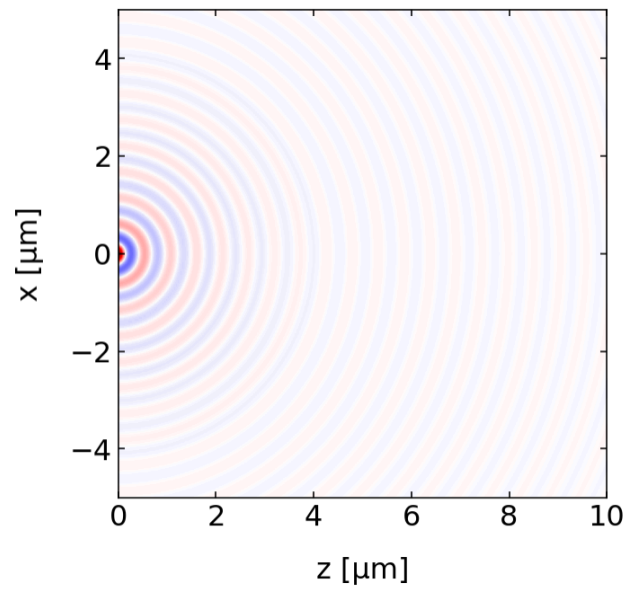
## Lecture 11

## 2.3 Diffraction

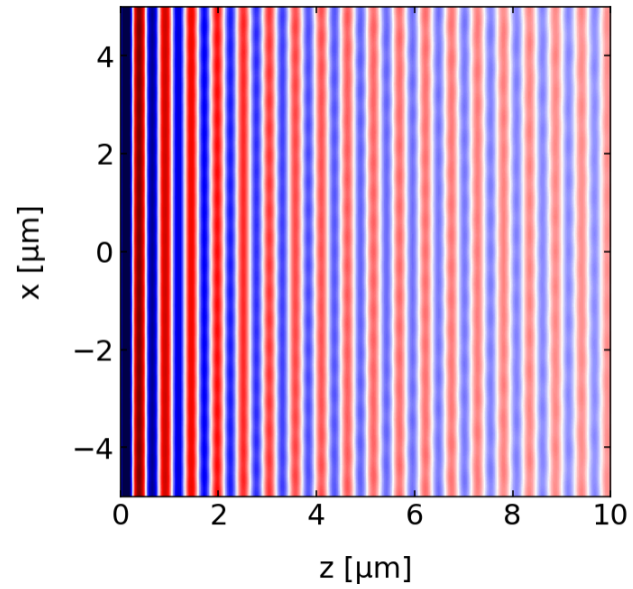
## 2.3.1 Huygens Principle

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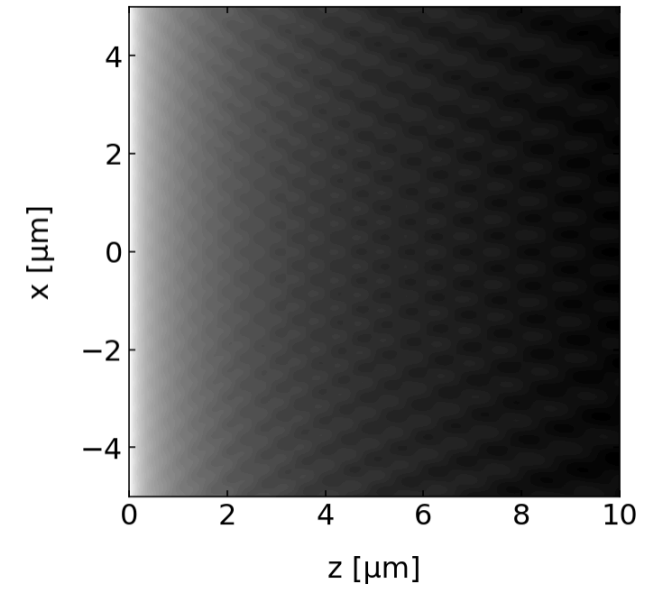
single spherical wave



500 spherical waves

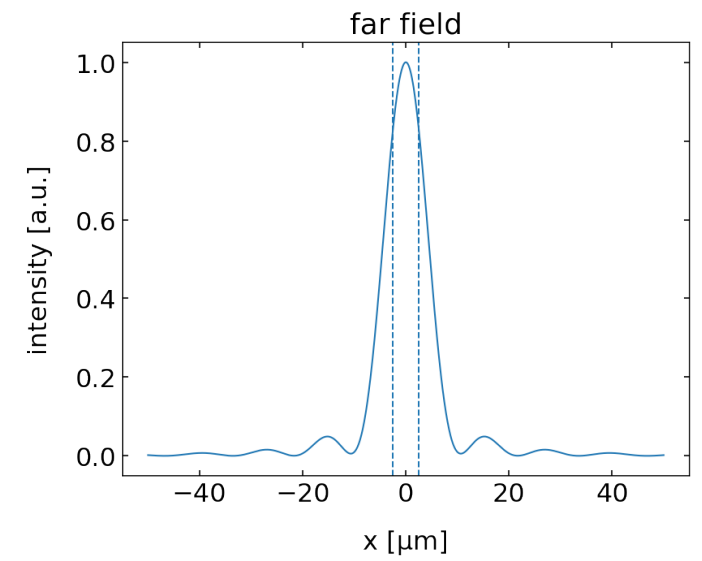
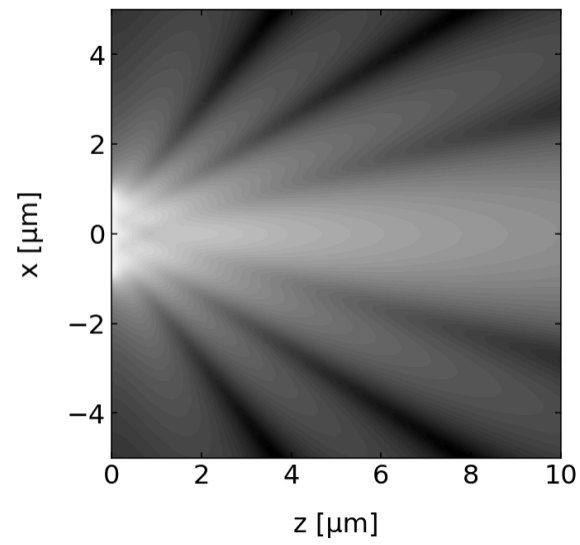
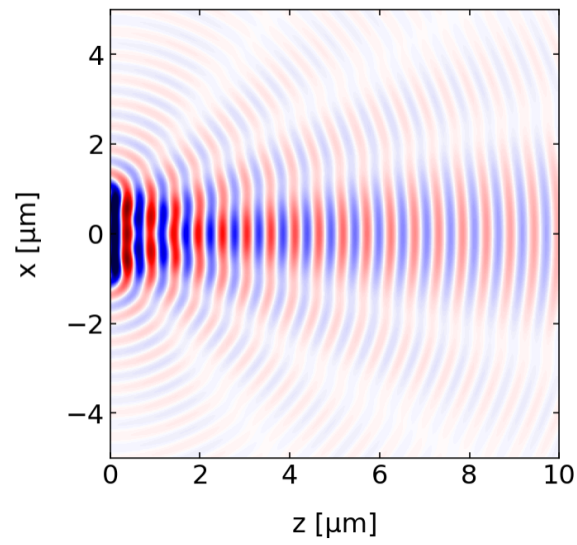


Intensity

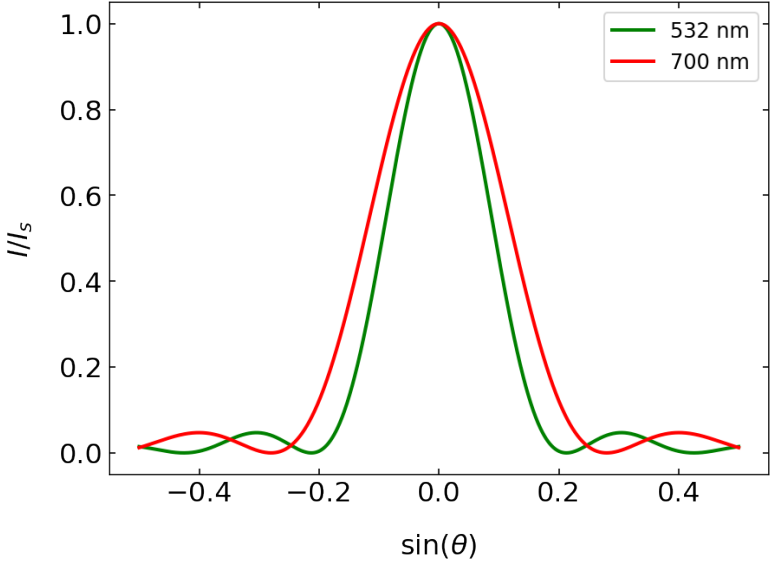
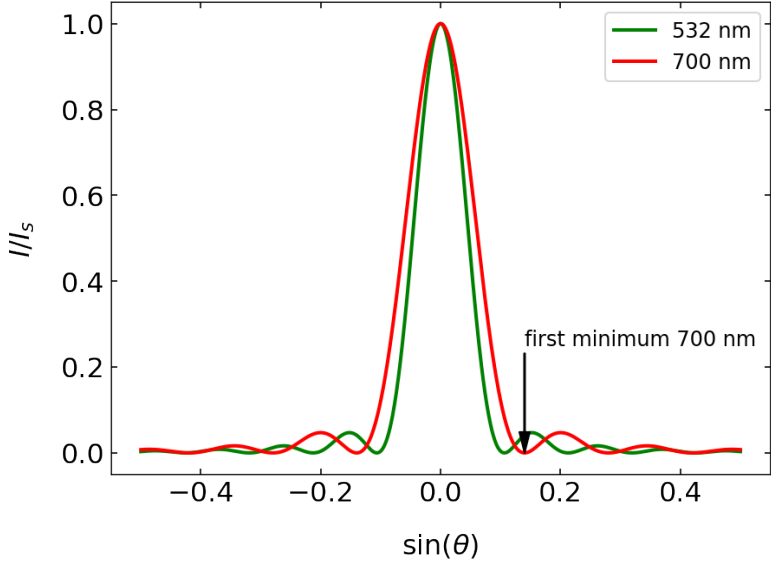


## 2.3.2 Single Slit

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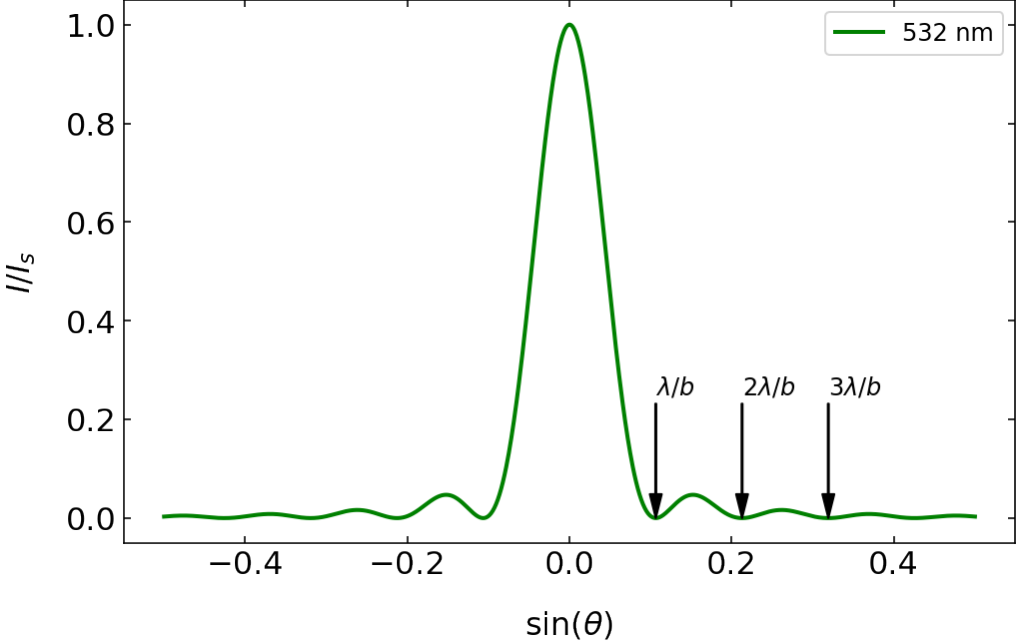


# Single Slit Diffraction

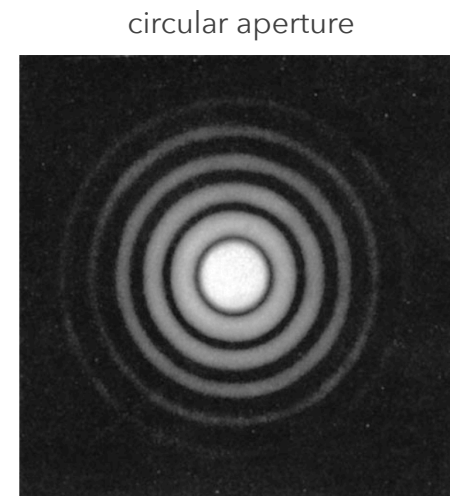
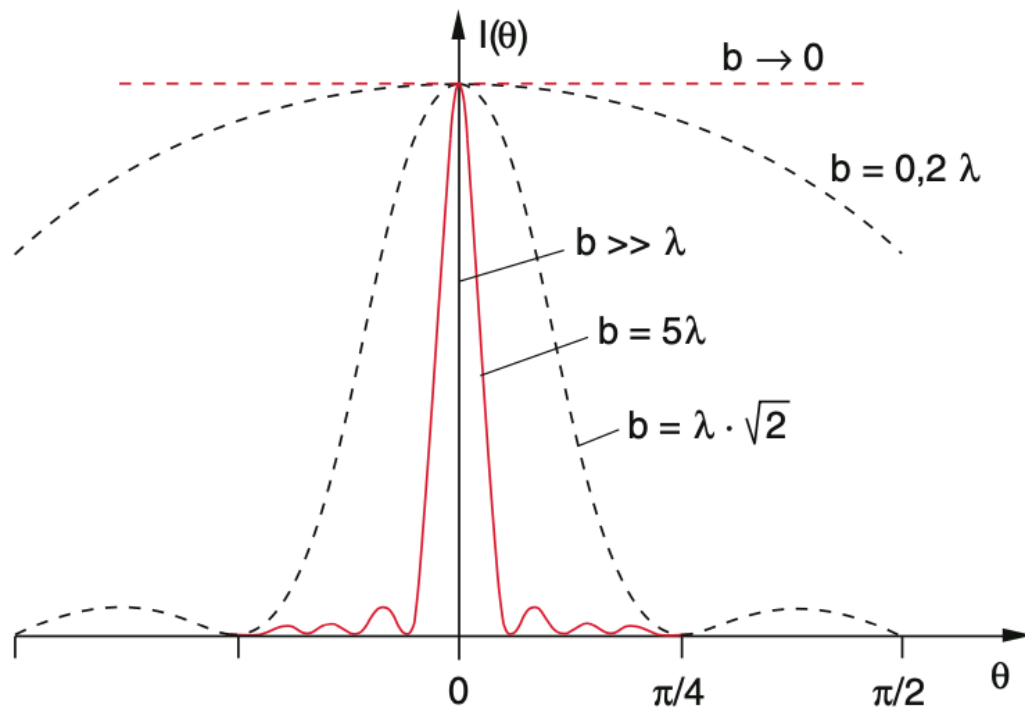


# Single Slit Diffraction

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# Single Slit Diffraction - Circular Aperture



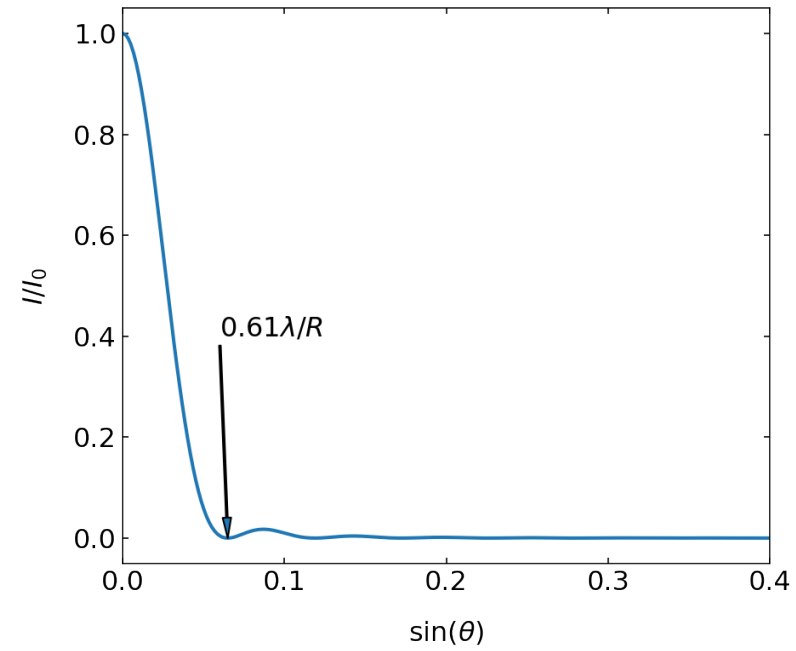
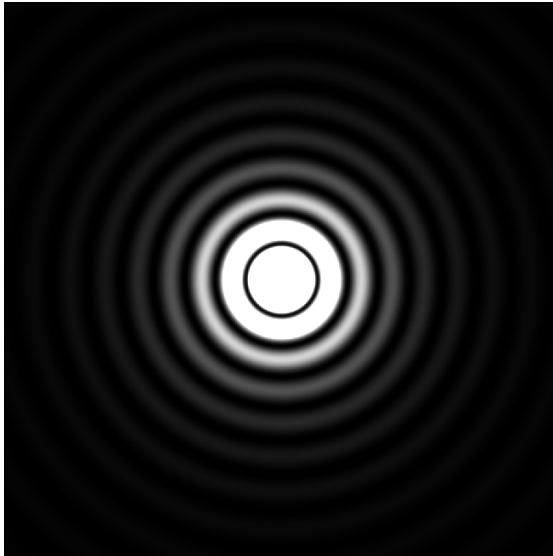
$$I(\theta) = I_0 \left( \frac{2J_1(x)}{x} \right)^2$$

$J_1(x)$  Bessel function of first kind

$$x = \frac{2\pi}{\lambda} R \sin(\theta)$$

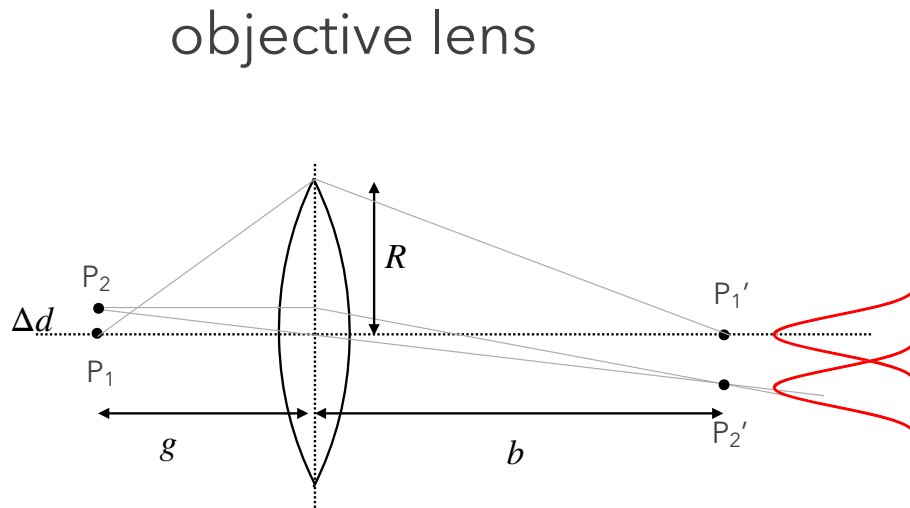
# Single Slit Diffraction - Circular Aperture

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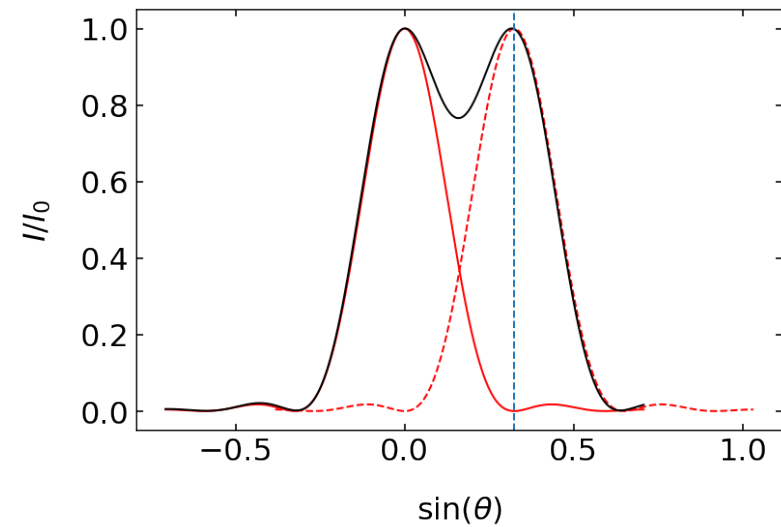




# Resolution of a Microscope



lens is magnifying object and aperture!

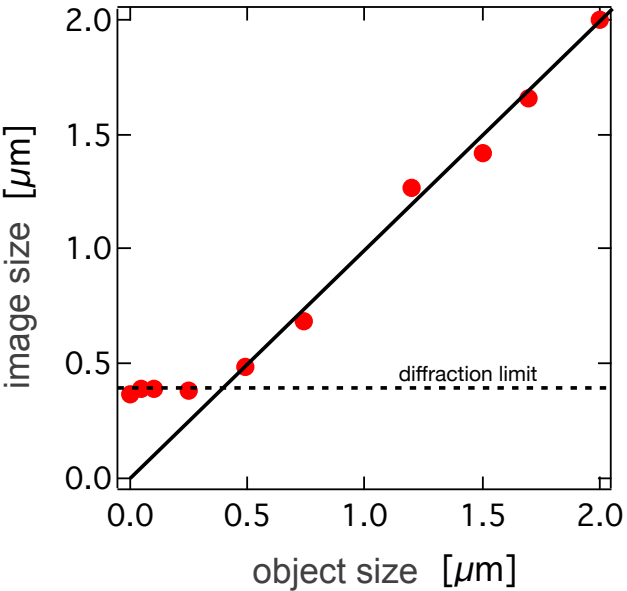
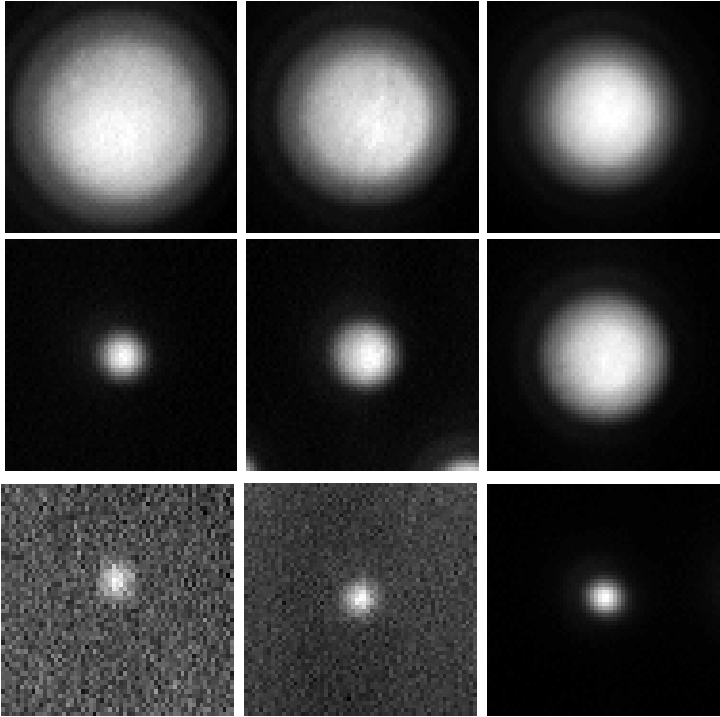


Rayleigh resolution criterium

$$\Delta d = 0.61 \frac{\lambda}{NA}$$

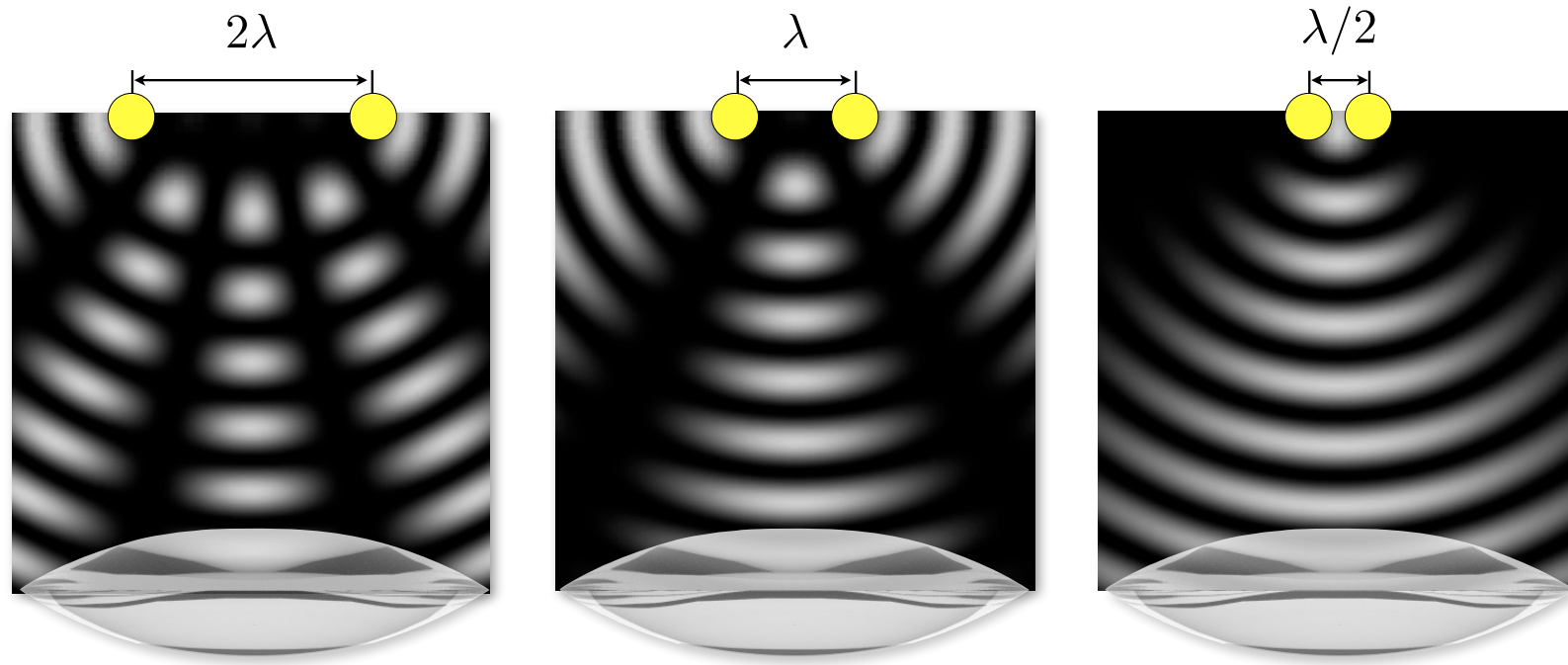
# Diffraction Limit - Optical Microscopy

single PS particle with 600 nm emission



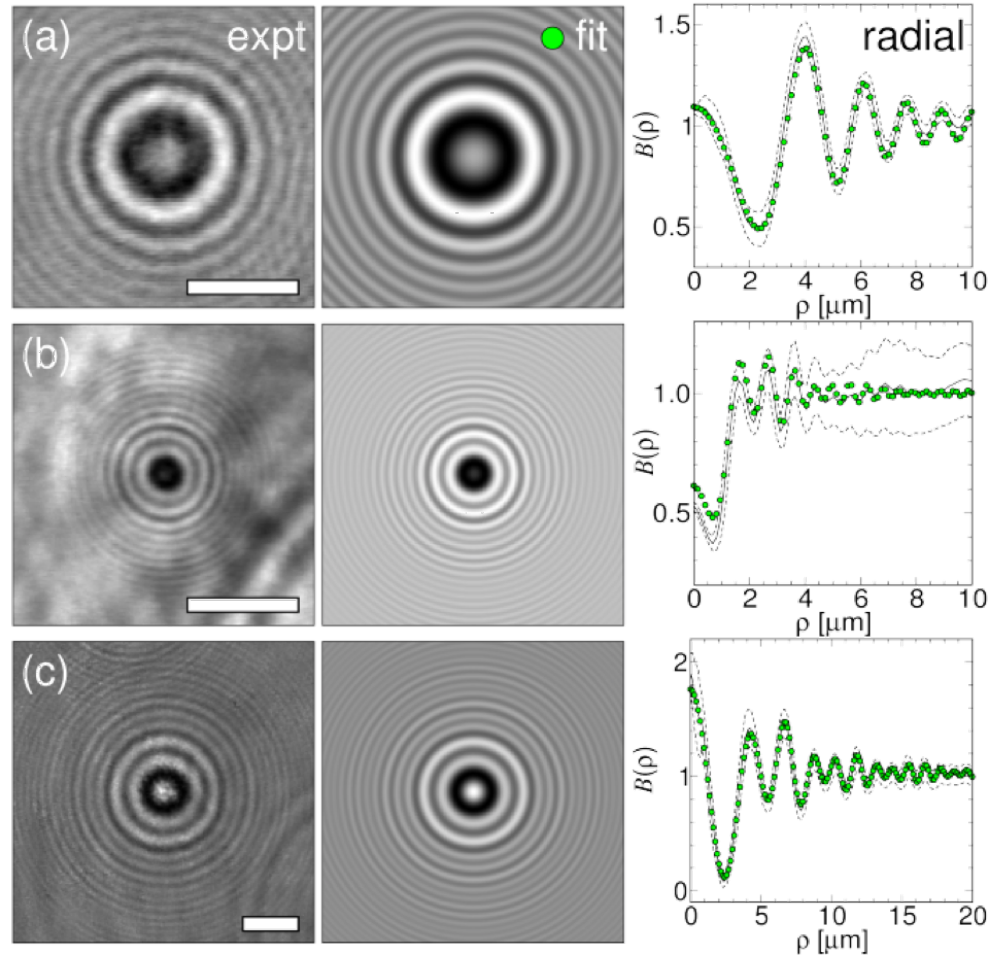
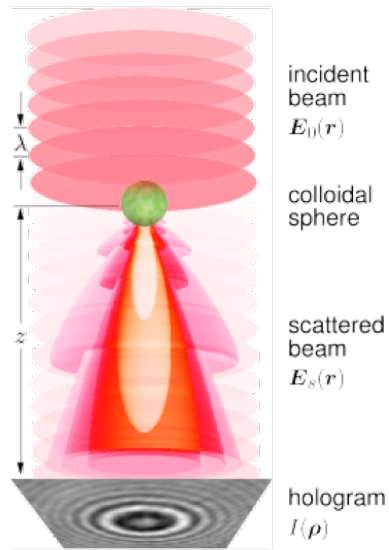
# Microscope Resolution - Abbe

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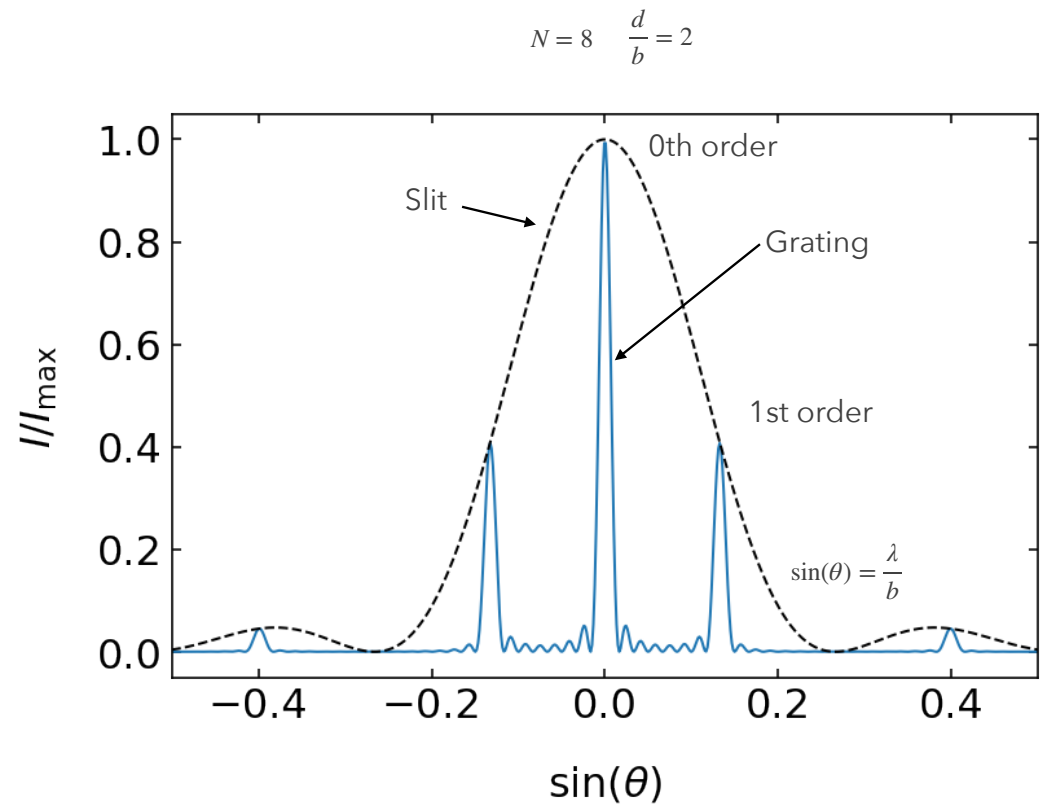
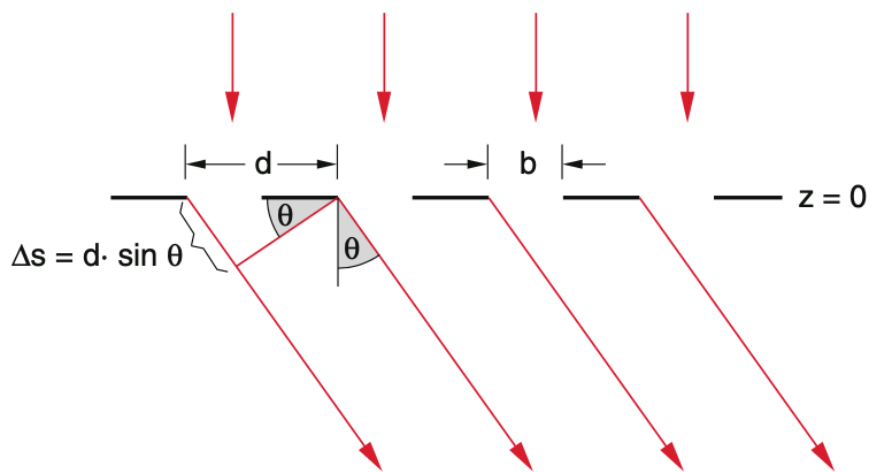


$$\Delta x_{min} \approx \frac{\lambda}{NA} \quad NA = n \sin(\theta)$$

# Application Holographic Microscopy

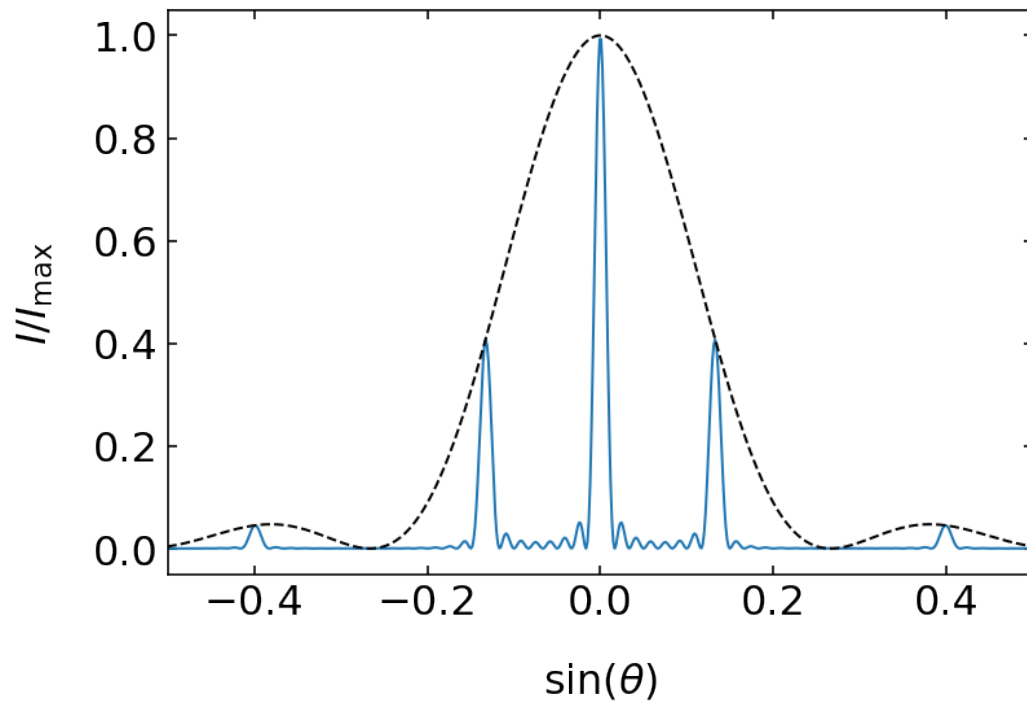


# Diffraction Grating

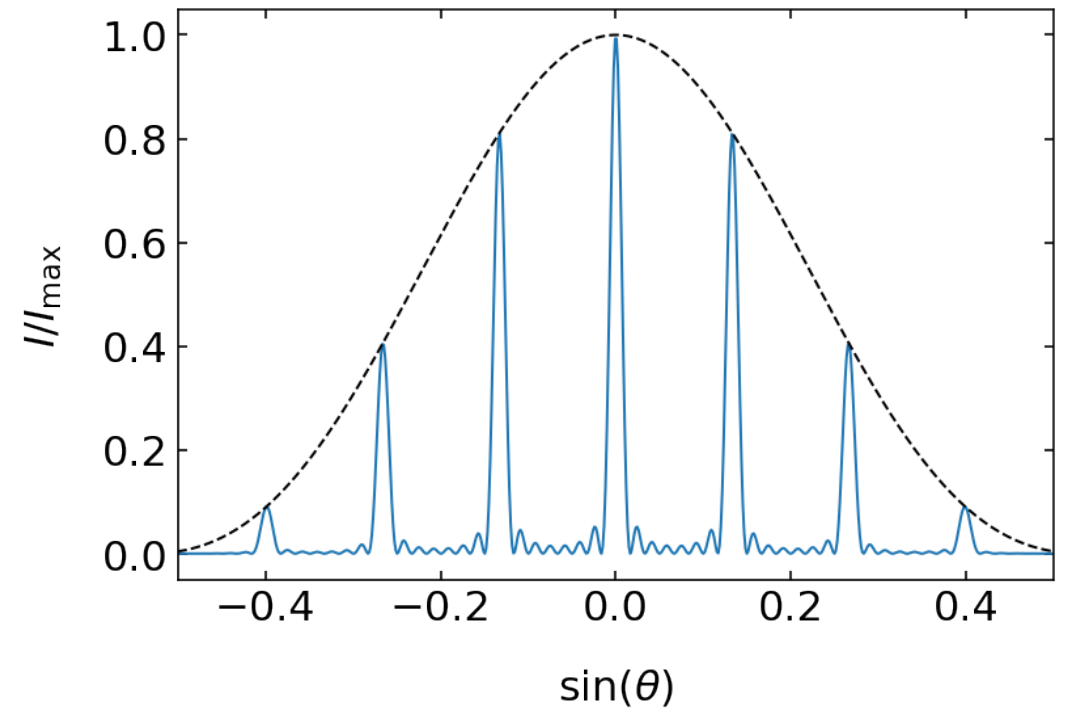


# Diffraction Grating

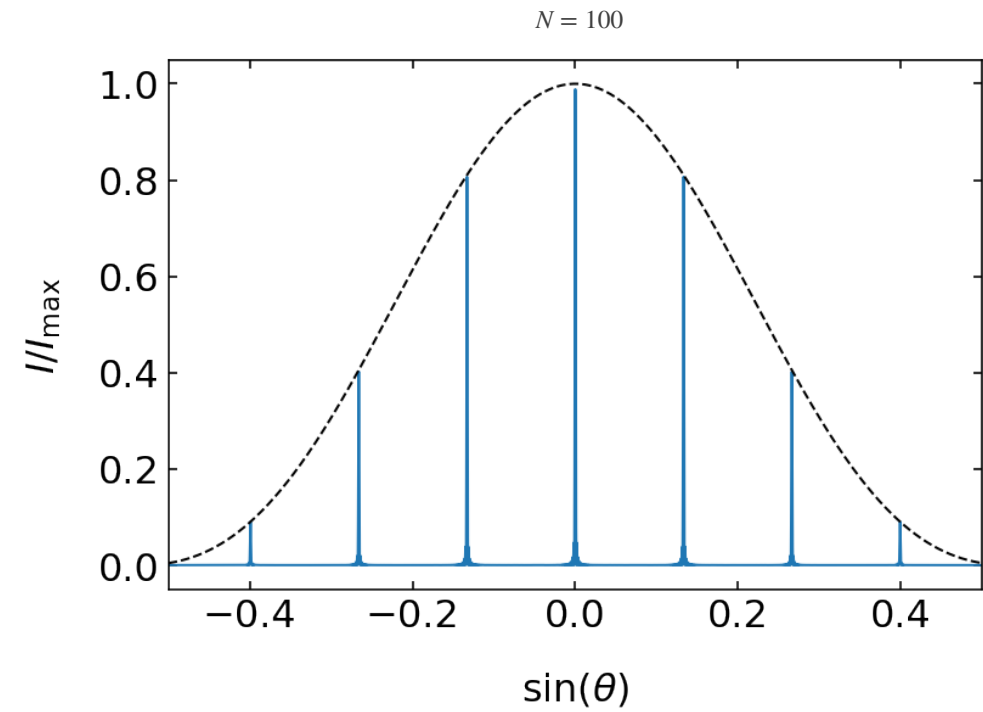
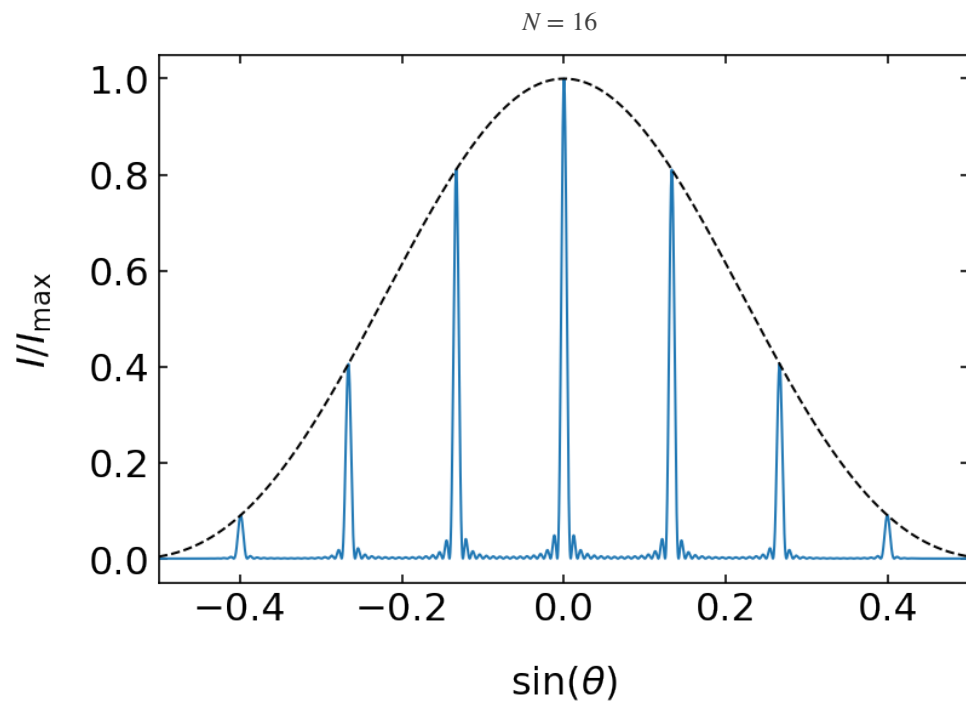
$$N = 8 \quad \frac{d}{b} = 2$$



$$N = 8 \quad \frac{d}{b} = 4$$

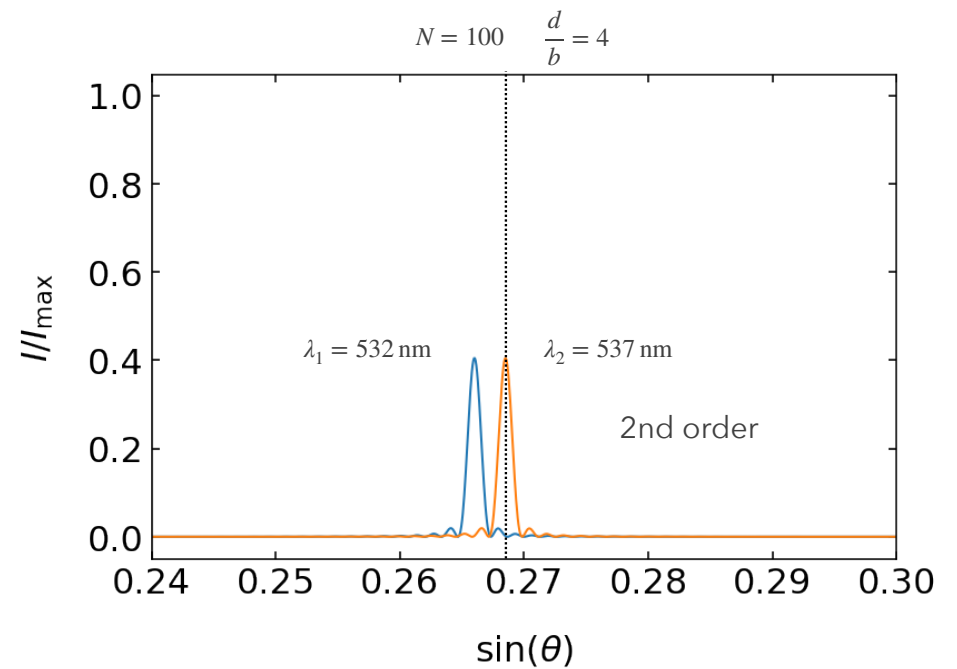
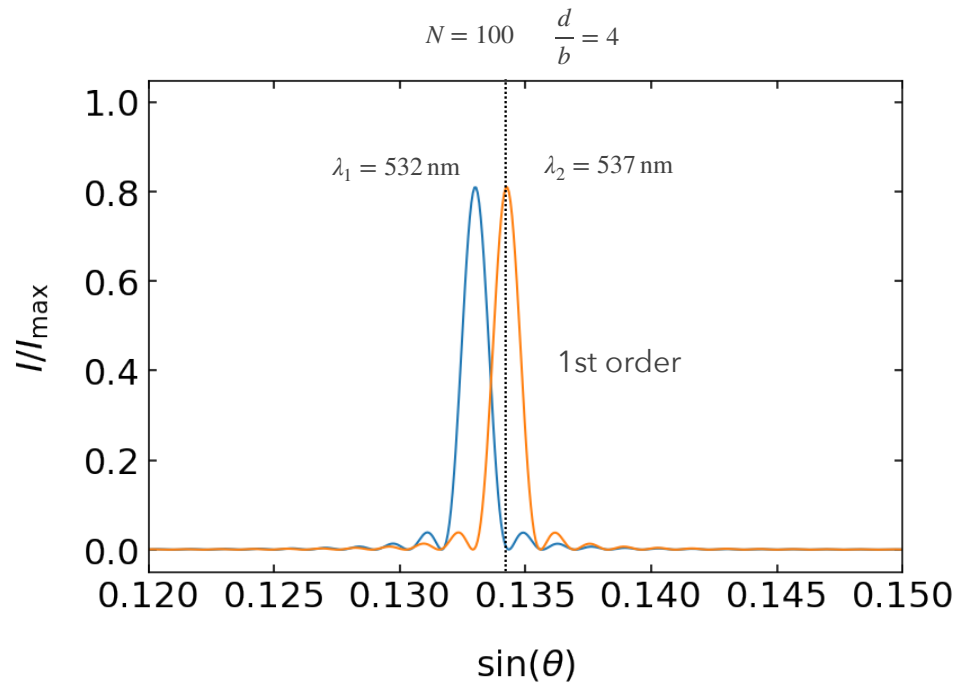


# Diffraction Grating



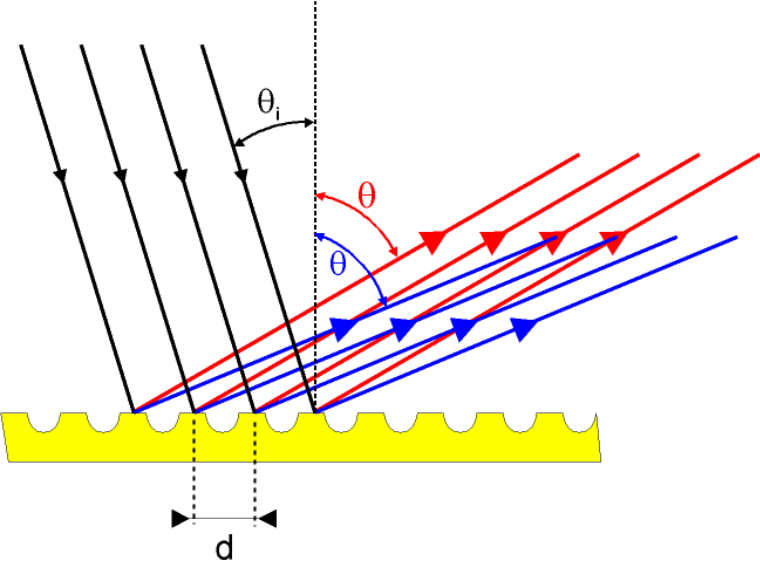
$$\sin(\theta) = \frac{\lambda}{Nd}$$

# Diffraction Grating - Spectral Resolution

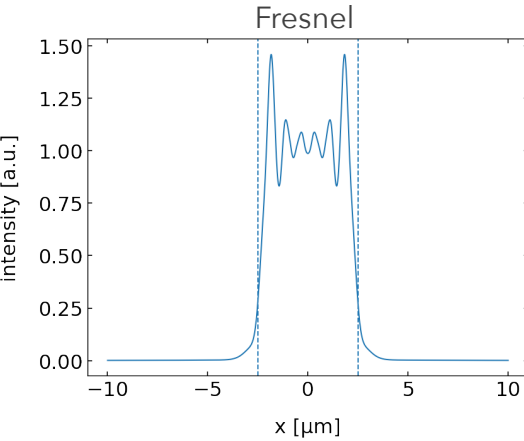
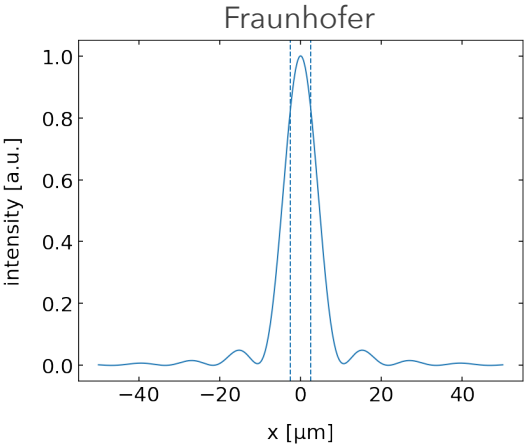
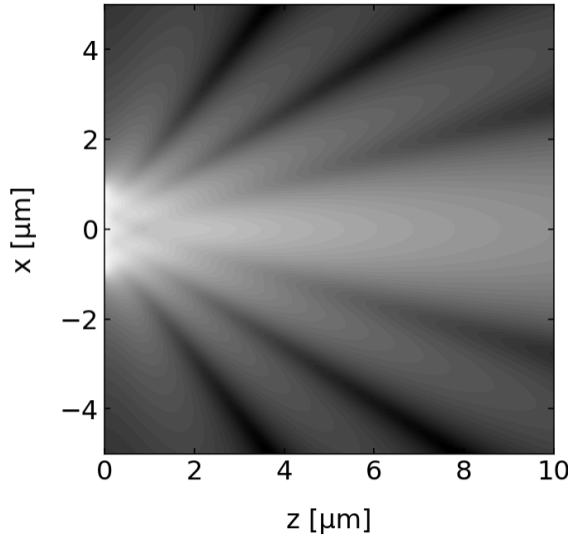
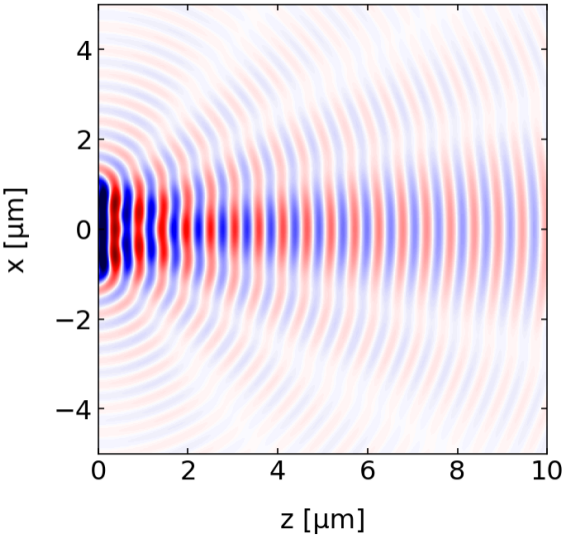




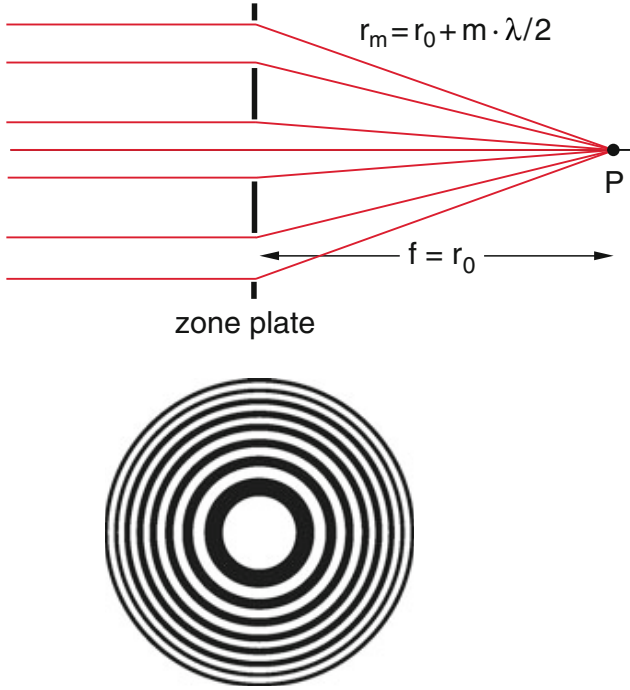
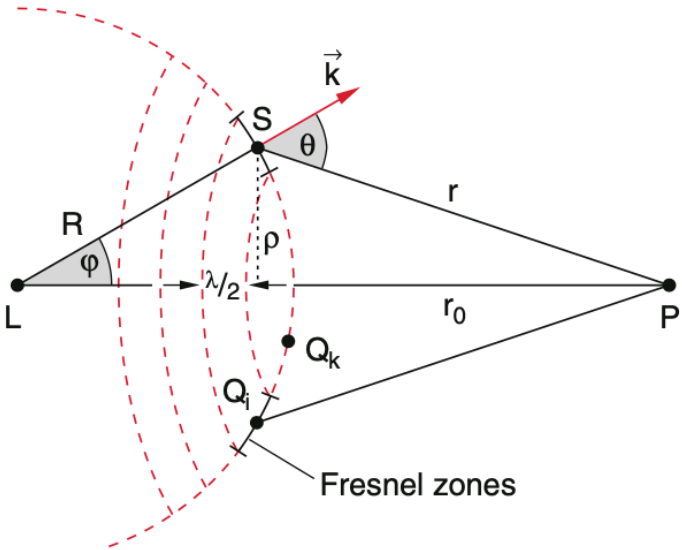
# Gratings



# Fraunhofer / Fresnel Diffraction

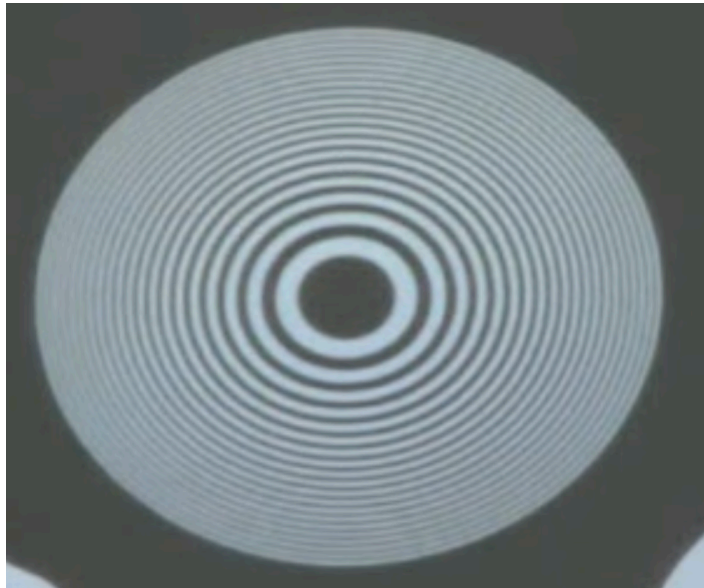


# Fresnel Zones



# Fresnel Zone Plate

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# Fresnel Zone Plate

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