Diffraction Compendium

Single slit diffraction

$$I(\theta) = I_0 \left(\frac{\sin \alpha}{\alpha} \right)^2 \tag{1}$$

1. **Diffraction Minima:** $a \sin \theta_m = m\lambda$, $m = \pm 1, \pm 2, \pm 3, ...$
2. **Diffraction Maxima:** $\tan \alpha = \alpha$, or $\alpha = \pm 1.43\pi, \pm 2.59\pi, ...$

Double slit diffraction

$$\begin{aligned} I(\theta) &= 4I_0 \left(\frac{\sin \alpha}{\alpha} \right)^2 \cos^2 \beta \\ I_M &= 4I_0 \end{aligned} \tag{2}$$

1. **Two-slit diffraction maxima:** $d \sin \theta_m = m\lambda$, $m = 0, \pm 1, \pm 2, \pm 3, ...$
2. **Two-slit diffraction maxima:** $d \sin \theta_m = (m + \frac{1}{2})\lambda$, $m = 0, \pm 1, \pm 2, \pm 3, ...$
3. **Modulated** by the single slit interference above.

N-slit diffraction

$$\begin{aligned} I(\theta) &= I_0 \left(\frac{\sin \alpha}{\alpha} \right)^2 \left(\frac{\sin N\beta}{\sin \beta} \right)^2 \\ I_M &= N^2 I_0 \end{aligned} \tag{3}$$

1. **N-slit diffraction maxima:** $d \sin \theta_m = m\lambda$, $m = 0, \pm 1, \pm 2, \pm 3, ...$
2. **N-slit diffraction maxima:** $d \sin \theta_m = \frac{m}{N}\lambda$, $m = \pm 1, \pm 2, ..., \pm(N-1)$
3. **Modulated** by the single slit interference above.

θ	the angle between the normal and point P.
λ	the wavelength of the incident light.
a	the width of a single slit.
d	the separation between the center of two adjacent slits.
α	$\alpha = \frac{\pi a}{\lambda} \sin \theta$
β	$\beta = \frac{\pi d}{\lambda} \sin \theta$
I_M	the maximum intensity, $I(\theta = 0) = I_M$.
I_0	the maximum intensity which would be produced by a single slit.
N	the number of slits.

A missing order, or half-fringe, occurs when an N-slit maxima coincides with a minimum of the single single modulation.