

Part 6

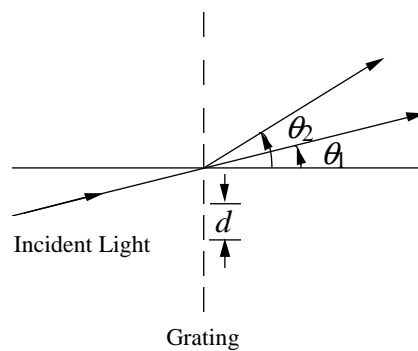
Diffraction Gratings and Zone Plates

- Grating Equation
- Grating Efficiency
- Zone Plates

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Grating Equation

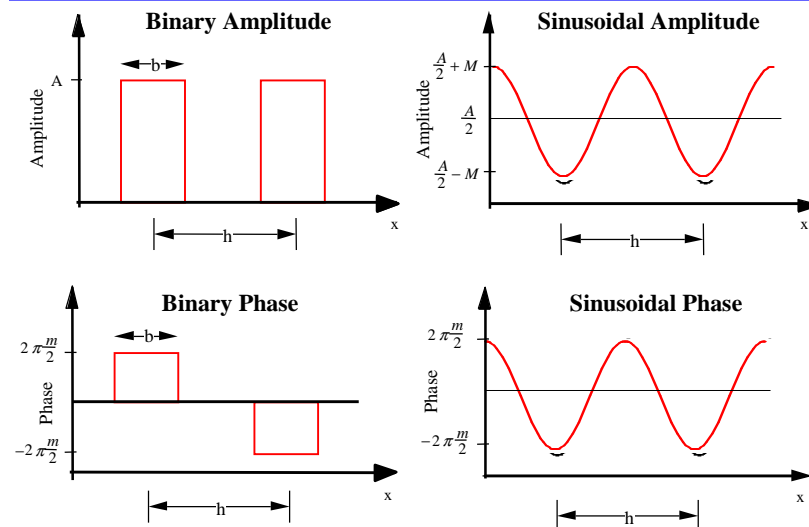


$$d(\sin \theta_1 - \sin \theta_2) = m\lambda$$

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Grating Types



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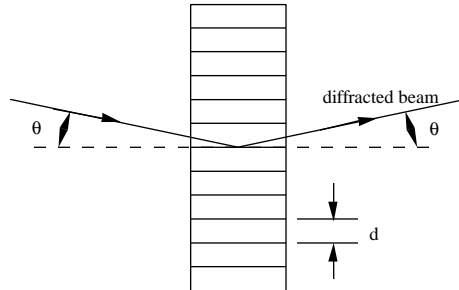
Thin Grating Functions and Efficiency

Grating Type	Transmission (h=period)	Diffraction Efficiency	Maximum First-Order Efficiency
Amplitude Binary	$A \text{ rect} \left[\frac{x}{b} \right]$	$\left[A \frac{\sin(n\pi \frac{b}{h})}{n\pi} \right]^2$	$\left(\frac{A}{\pi} \right)^2$ if $A = 1, \frac{b}{h} = \frac{1}{2}$
Amplitude Sinusoidal	$\frac{A}{2} \left[1 + M \cos 2\pi \frac{x}{h} \right]$	0 order = $\left[\frac{A}{2} \right]^2$ ± 1 order = $\left[\frac{AM}{4} \right]^2$	$\frac{1}{16}$ if $A = M = 1$
Phase Binary	$e^{i2\pi m/2}$ if $-\frac{h}{2} - \frac{b}{2} \leq x \leq -\frac{h}{2} + \frac{b}{2}$ $e^{-i2\pi m/2}$ if $\frac{h}{2} - \frac{b}{2} \leq x \leq \frac{h}{2} + \frac{b}{2}$	0 order = $\left(\frac{e}{h} \right)^2 4 \cos^2(m\pi)$ $\pm n$ order = $\frac{4 \sin^2 \left(\frac{e}{h} n\pi \right)}{(n\pi)^2} \sin^2(m\pi)$	$\left(\frac{e}{\pi} \right)^2$ if $m = 1/2, \frac{b}{h} = 1/2$
Phase Sinusoidal	$e^{i2\pi \frac{m}{2} \cos 2\pi x/h}$	$\left[J_n \left(2\pi \frac{m}{2} \right) \right]^2$	34% if $m = 0.57$

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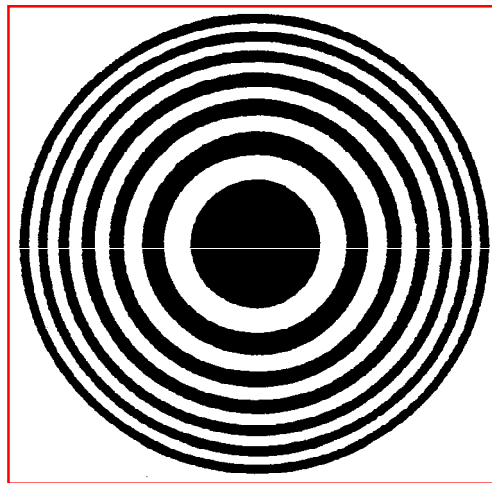
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Thick Bragg Volume Grating

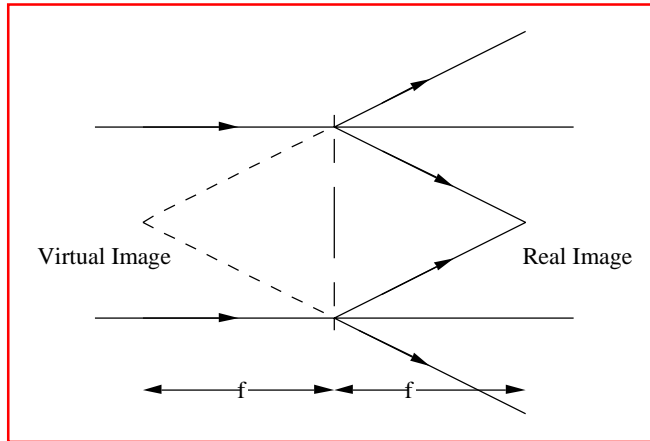


For good efficiency $2d \sin\theta = m\lambda$
Efficiency can approach 100%

Fresnel Zone Plate



Focal Properties of Fresnel Zone Plate



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