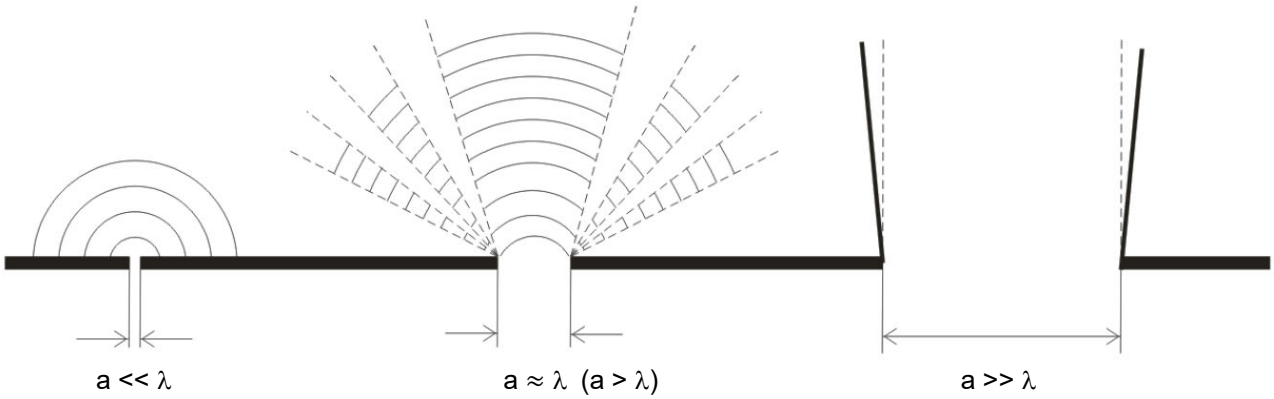
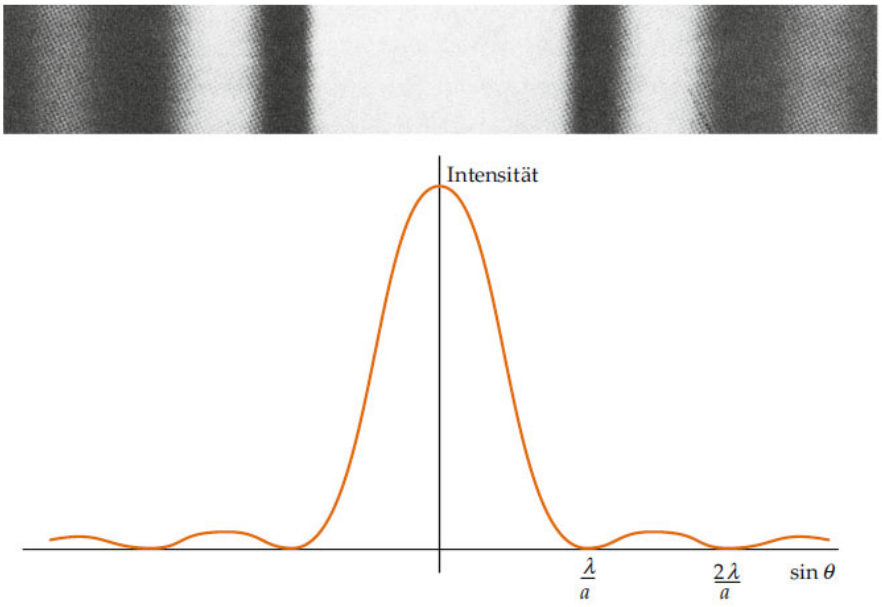
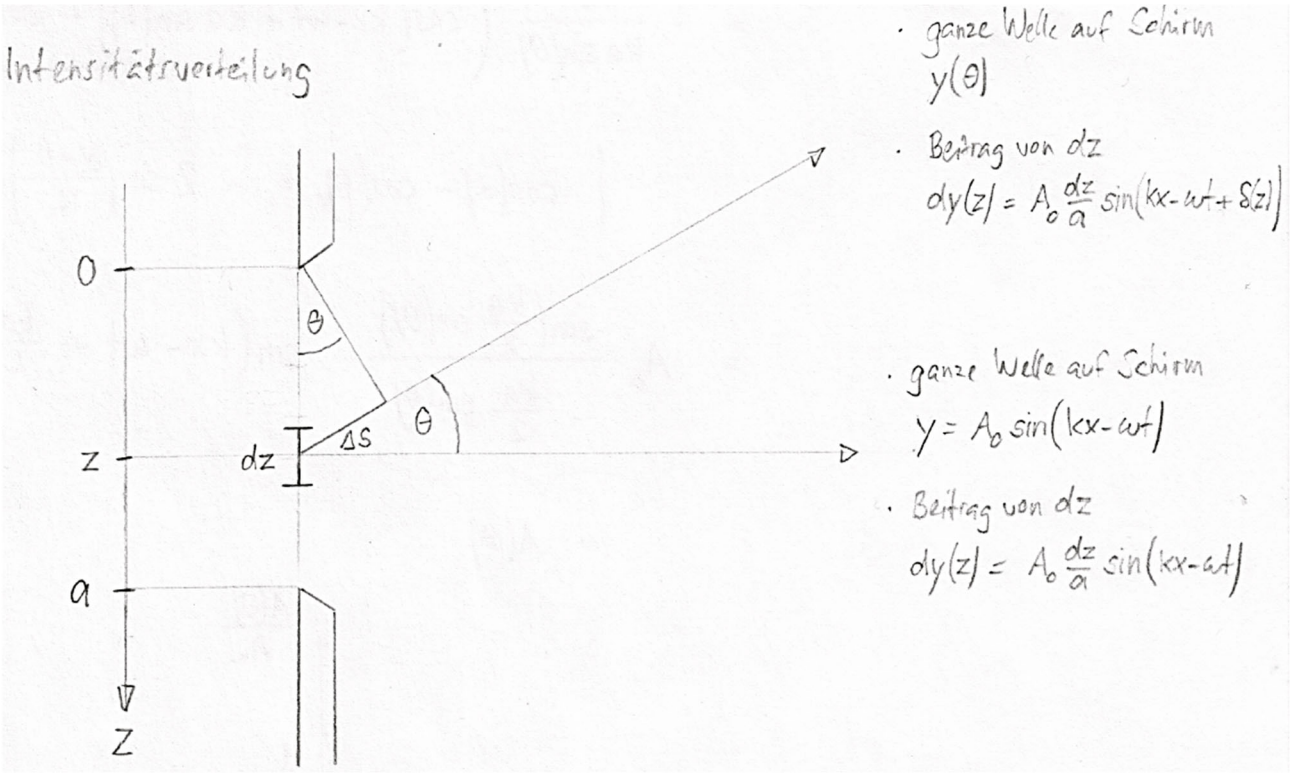
Beugung am Einzelspalt



a ≈ λ (a > λ)



Intensitätsverteilung



- ganze Welle auf Schirm
  $y(\theta)$
- Beitrag von dz
  $dy(z) = A_0 \frac{dz}{a} \sin(kx - \omega t + \delta(z))$
- ganze Welle auf Schirm
  $y = A_0 \sin(kx - \omega t)$
- Beitrag von dz
  $dy(z) = A_0 \frac{dz}{a} \sin(kx - \omega t)$

$$y(\theta) = \int_0^a dy(z)$$

$$dy(z) = A_0 \frac{dz}{a} \sin(kx - \omega t + \delta(z))$$

$$\delta(z) = \frac{2\pi}{\lambda} \Delta s(z)$$

$$= k \cdot \Delta s(z)$$

$$\sin(\theta) = \frac{\Delta s(z)}{z}$$

$$dy(z) = A_0 \frac{dz}{a} \sin(kx - \omega t + kz\sin(\theta))$$

$$y(\theta) = \int_0^a dy(z)$$

$$= \frac{A_0}{a} \int_0^a \sin\left(kx - \omega t + kz\sin(\theta)\right) dz$$

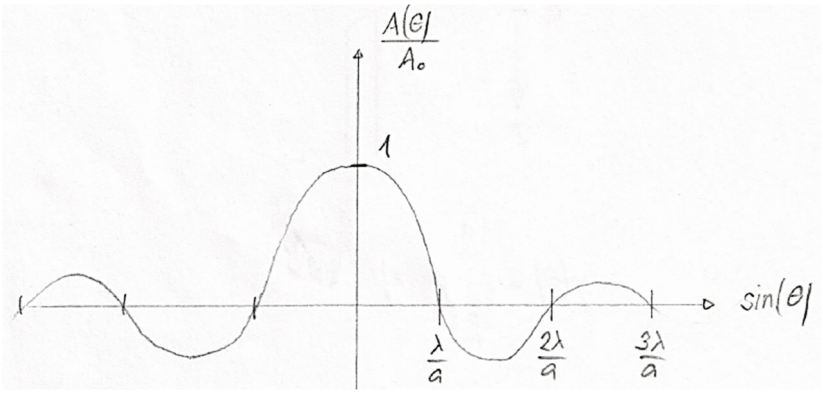
$$\left| \text{Subst.: } u := kx - \omega t + kz\sin(\theta) \right.$$

$$\vdots$$

$$= -\frac{A_0}{ka\cdot\sin(\theta)} \left(\cos\left(kx - \omega t + ka\sin(\theta)\right) - \cos\left(kx - \omega t\right) \right)$$

$$\left| \cos(\alpha) - \cos(\beta) = -2\sin\left(\frac{\alpha+\beta}{2}\right)\sin\left(\frac{\alpha-\beta}{2}\right) \right.$$

$$= \underbrace{A_0 \frac{\sin\left(\frac{ka}{2}\sin(\theta)\right)}{\frac{ka}{2}\sin(\theta)}}_{=: A(\theta)} \cdot \sin\left(kx - \omega t + \frac{ka}{2}\sin(\theta)\right)$$



Dunkelstellen : $\sin\left(\frac{ka}{2}\sin(\theta)\right) = 0$

$$\frac{ka}{2}\sin(\theta) = m\cdot\pi \qquad \left| \; k = \frac{2\pi}{\lambda} \right.$$

$$\sin(\theta) = m\cdot\frac{\lambda}{a}$$

Hellstellen : ... (Extremwertaufgabe, transzendente Gleichung)

$$\sin(\theta) = \begin{cases} 0 \\ \left(\frac{1}{2} + m\right)\cdot\frac{\lambda}{a} & (m \neq 0) \end{cases}$$