

Lect. 19, Apr. 8, 2010

(1)

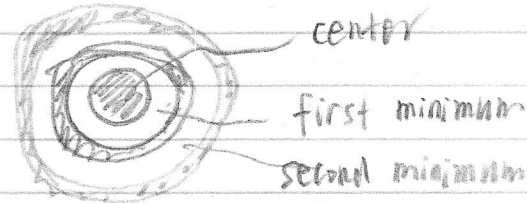
Diffraction by a circular aperture (Ch 18-3)

Aperture $r=a$

Diffraction Pattern



Circular symmetry



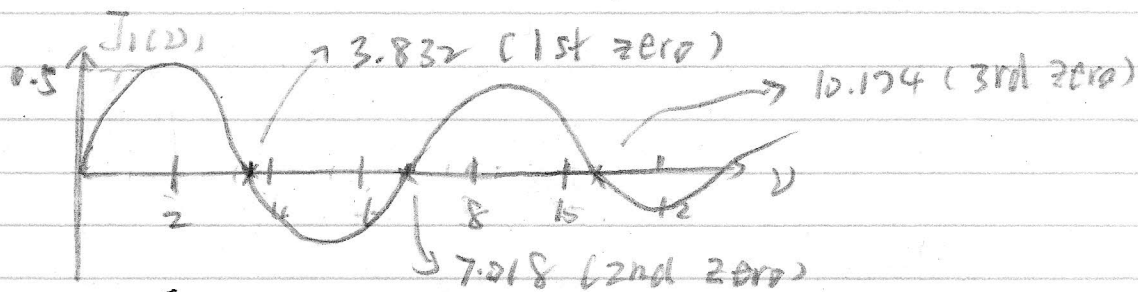
Called "Airy Pattern"

Using two-dimensional Fourier transform,
Airy pattern can be derived as

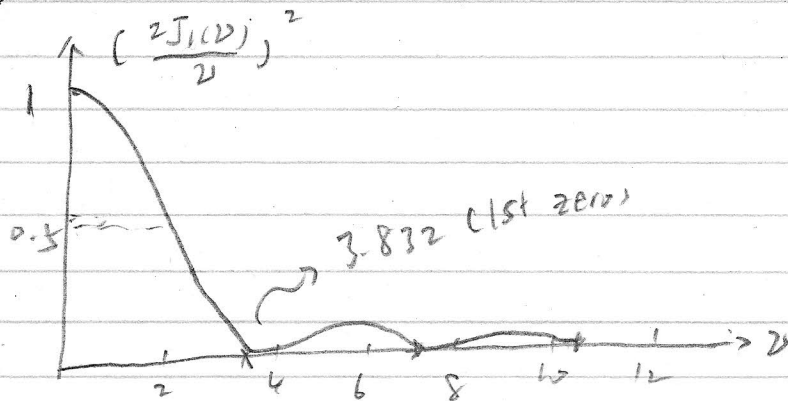
$$I = I_0 \left[\frac{2J_1(\nu)}{\nu} \right]^2$$

$\nu = \frac{2\pi}{\lambda} a \sin \theta$: phase difference between the center and the edge of the circle for a given θ

$J_1(\nu)$: the Bessel function of the first order



$$\lim_{\nu \rightarrow 0} \frac{2J_1(\nu)}{\nu} = 1$$



(continued)

First dark ring: $D = 3.832$

$$\sin \theta = \frac{D\lambda}{2\pi a} = \frac{D\lambda}{\pi b}$$

$$\sin \theta_1 = \frac{3.832}{\pi} \frac{\lambda}{b} = 1.22 \frac{\lambda}{b} \quad \dots \quad (25)$$

Note: mistake of 0.61 in the book

Thus, the size of the angular divergence:

$$\Delta \theta = \theta_1 = 1.22 \frac{\lambda}{b}$$

