

## Flat Piston

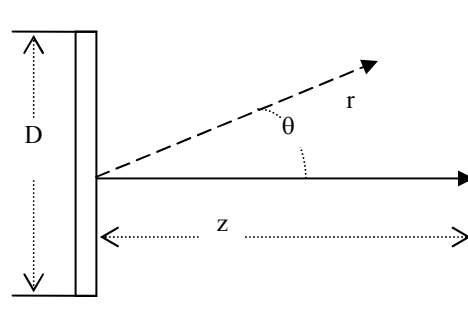
- Near (Fresnel), Far (Fraunhofer) zone transition

$$Z = \frac{D^2}{4\lambda}$$

D: diameter of the piston aperture.

- Intensity with depth along the z-axis in far field:

$$I(z) = \frac{\pi D^2}{4\lambda z^2} I(0)$$



- General amplitude equation along the z-axis:

$$A(z) = \frac{-2}{k} u_0 \sin \frac{k(\sqrt{\frac{D^2}{4} + z^2} - z)}{2} e^{-jk(\sqrt{\frac{D^2}{4} + z^2} + z)/2}$$

- Directivity:

$$\phi(r, \theta) = -u_0 \frac{D^2 J_1(k \frac{D}{2} \sin \theta)}{4rk \frac{D}{2} \sin \theta} e^{-jkr}$$

- 3dB beam width:  $\theta = \frac{0.25\lambda}{D/2}$

## Focused Spherical Transducer:

- 3dB beam width:  $B = 1.02\lambda F_{\#}$ ,  $F_{\#} = \frac{Focus}{D}$
- Depth of focus:  $D_F = 7.1\lambda F_{\#}$