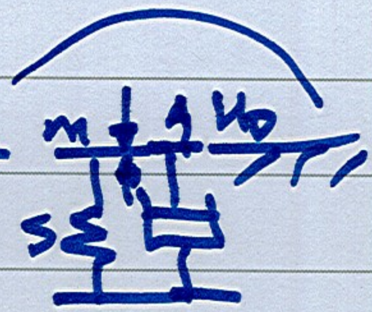
Radiation Impedance

$$z_r = \frac{f_{source}}{u_0} = R_r + jX_r$$

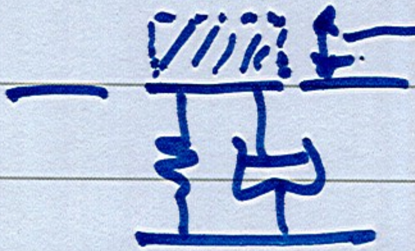


Added mass – has the effect of lowering natural freqs of l/s

<u>$ka \ll 1$</u>

$$X_r = \omega m_r$$

$$m_r = \pi a^2 \rho_0 \left(\frac{8a}{3\pi}\right)$$



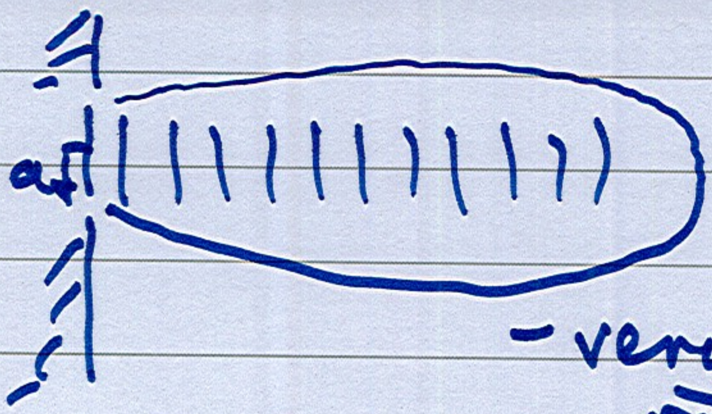
$$\omega_n = \sqrt{\frac{s}{m+m_r}}$$

when $ka \gg 1$ high frequency

$R_r \to \pi a^2 \rho_0 c$

$X_r \to 0$

$$\overline{\Pi} = \frac{1}{2}\rho_0 c \pi a^2 |u_0|^2$$ ✓

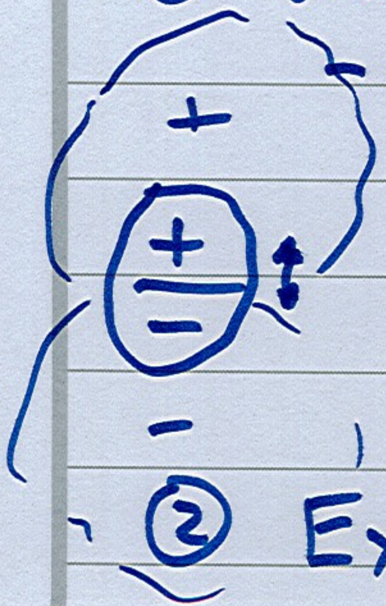


plane wave radiation from the source

- very efficient radiation

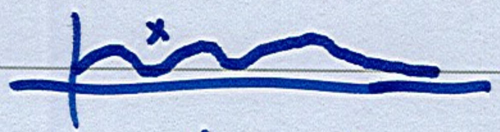
Book 7.1, 7.2, 7.4, 7.5 7.10

① Compact Sources $kD \ll 1$



- simple sources
  - monopoles - volume change
  - dipoles - point force
  - quadrupoles - point moment

② Extended Source $kD \not\ll 1$

- directional characteristics
  - interferences
- nearfield 

$ka \ll 1$ omnidirectional

$ka \gg 1$ directivity

Homework #5

7.1.4 Eqn 7.2.16

$$\Pi = \frac{1}{2}\pi \rho_0 c \left(\frac{Q}{\lambda}\right)^2$$

Π = 10 mW

$f = 400$ Hz

$$s = \frac{\rho - \rho_0}{\rho_0} \qquad p = \beta s$$

2. $\tilde{p}(r) = j\rho_0 c k Q \dfrac{e^{-jkr}}{4\pi r}$

Assume that Q is a real number

given Level in dB

$L_p = 10 \log_{10} \dfrac{p_{rms}^2}{p_{ref}^2} \longrightarrow p_{rms}^2 = \dfrac{\tilde{p}(r)\,\tilde{p}^*(r)}{2}$ ✓

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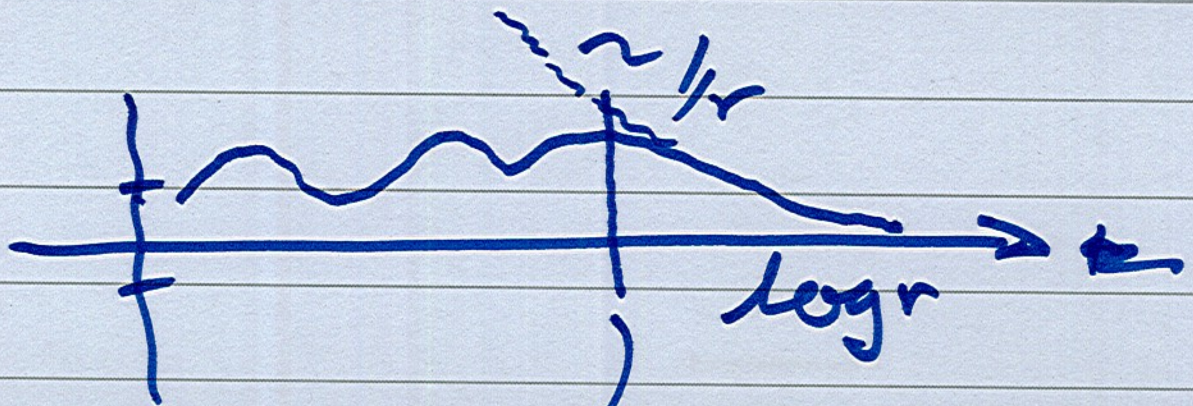
solve for Q

$Q = u_0 S$ ← surface area of sphere

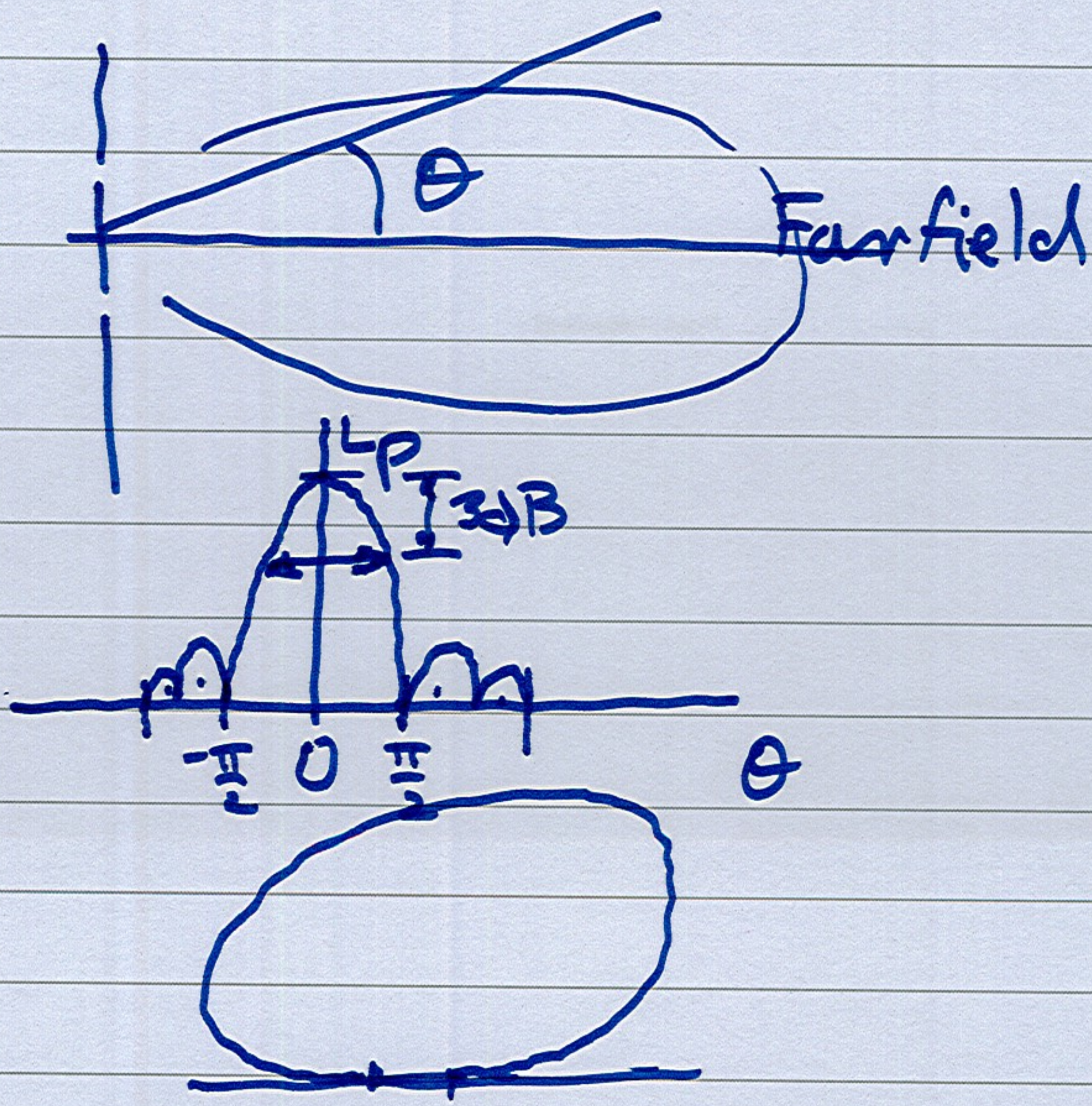
3



use the expression for on-axis sound pressure → p_{rms}

approx distance to transition point

4.



6.0 Room Acoustics

4.1 Introduce

Wallace Sabine

- discovered the empirical relation between reverberation time T, volume, V of a space and the total absorption area, A

$$T \propto \frac{V}{A}$$

- sound decays faster if absorption is increased
- sound decays more slowly if the volume is increased (since there is more time reflections

$T \propto \frac{V}{A}$ Derive this result using Energy Acoustics

Merrick epubs
Yangfan Liu

Energy Acoustics

- related space-averaged acoustic energy density in a space to the rate at which energy is added to the space & the rate at which energy is absorbed at the walls & furnishing & people.

Basis of the theory

- sufficient reflection to create a diffuse sound field
- sound equally likely to arrive from any direction
- energy density is instantaneously uniform
- total absorption in the space cannot be too large
- does not work at low freqs where standing waves occur