Phys 2110-4 4/24/13

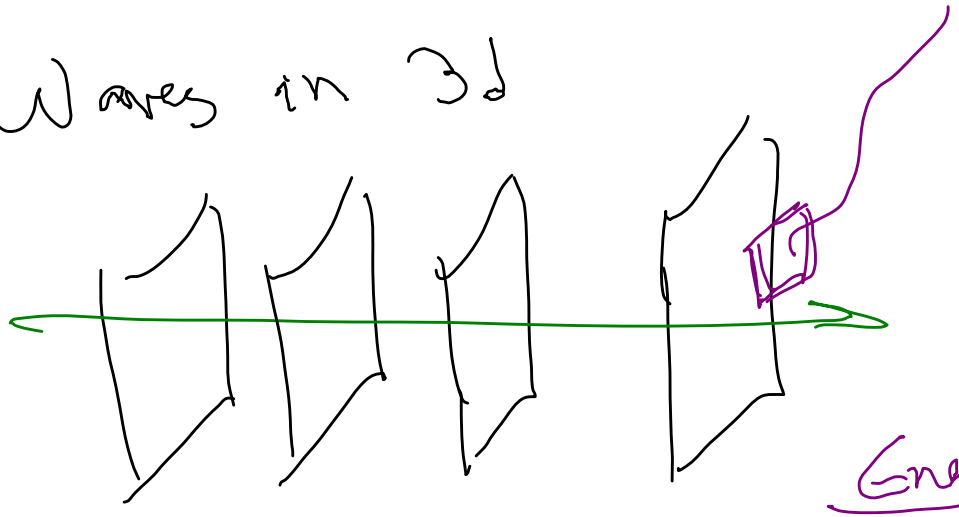
Note Title 4/24/2013

Waves

$\lambda f = v$

Harmonic waves

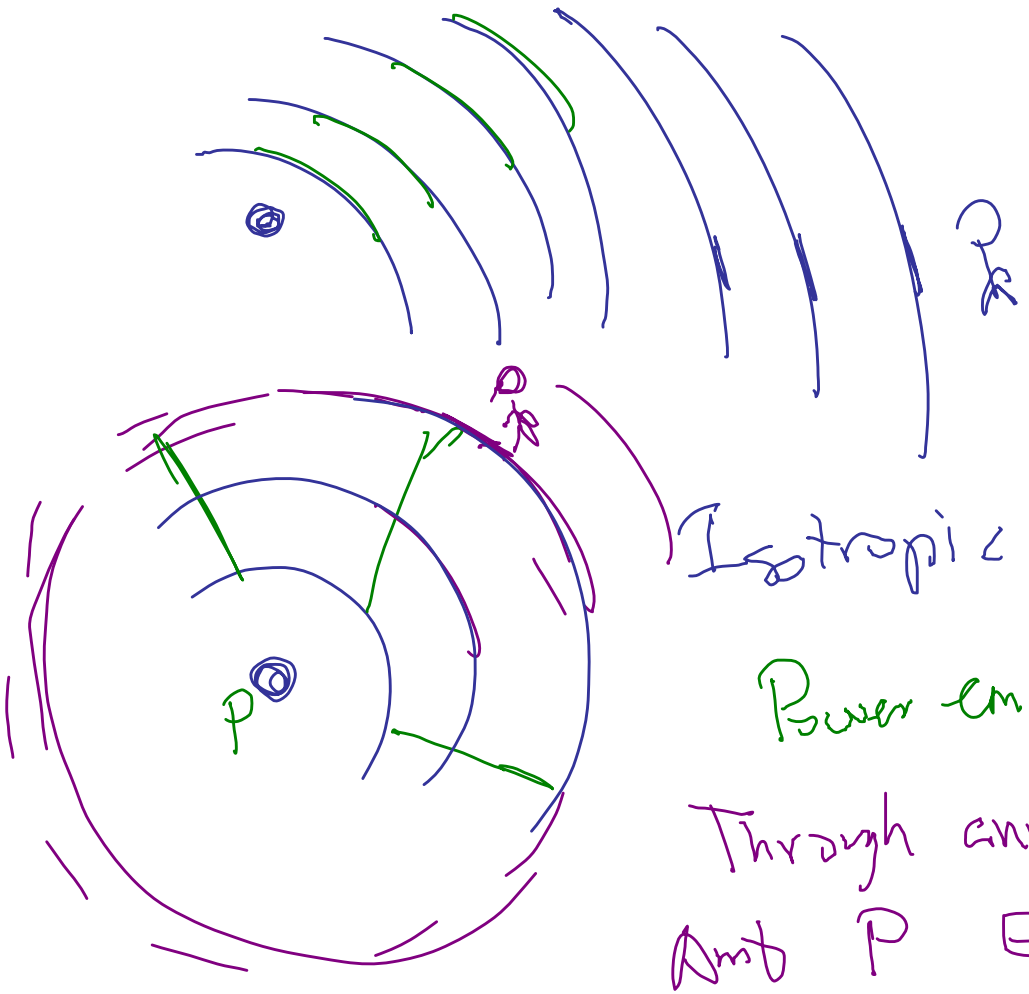
Waves in 3d



p. 230

Measure of strength of wave

$$\frac{\text{Energy}}{\text{Time Area}} = \left[\frac{W}{m^2}\right] = I$$



At long distances, point source results in plane wave, roughly.

Isotropic radiator

Power emitted P

Through any given sph surface, radius r

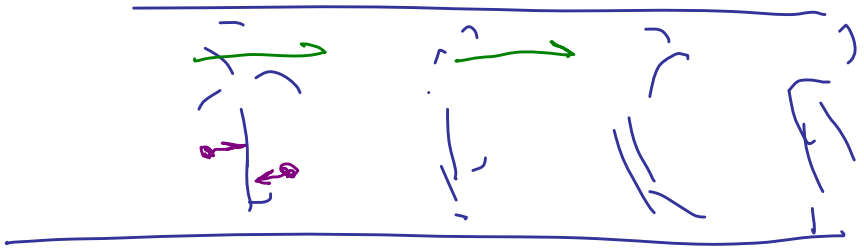
Amt P Et passes.

$$I = \frac{P}{4\pi r^2}$$

Isotrop source, Intensity $\propto 1/r^2$

At distance r, usually $I \propto A^2$ $\quad A \propto 1/r$

Sound Waves



Regions of compression
rarefaction.

Speed of sound

$$v = \sqrt{\frac{\gamma P}{\rho}}$$

γ single number, depends on molecule type in gas (& temp)

$\gamma = 7/5$ P pressure, N/m^2 ρ = mass density of gas

0 C $v \approx 330 \frac{m}{s}$

26 C $v \approx 343 \frac{m}{s}$

Human hearing:

$20 Hz - 20,000 Hz$

Cuts off high end w/ age.

Intensity what is its intensity, I

Lowest value audible

$I_0 = 10^{-12} \frac{W}{m^2}$

Max $I = 110 \frac{W}{m^2}$

speech $10^{-6} \frac{W}{m^2}$

See p. 230

Huge range in I's $\log_{10}$

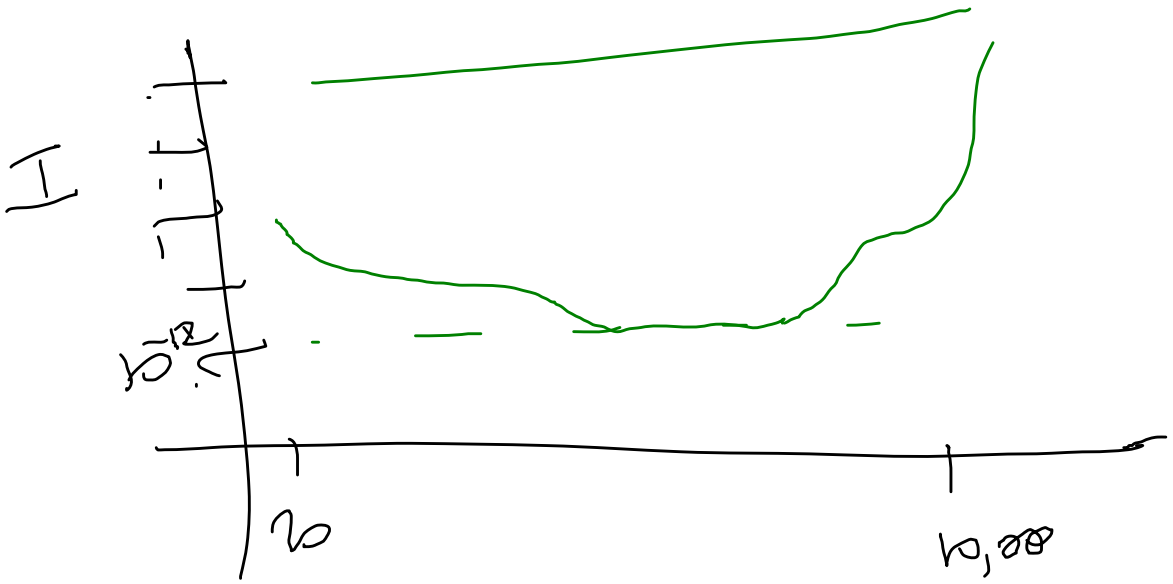
Convenient

$$\beta = 10 \cdot \log_{10}\left(\frac{I}{I_0}\right)$$ decibels

$I_0 = 10^{-12}\ \frac{W}{m^2}$

Barely audible: $\beta = 0$ Too loud $\beta \approx 100$

Fig 14.15

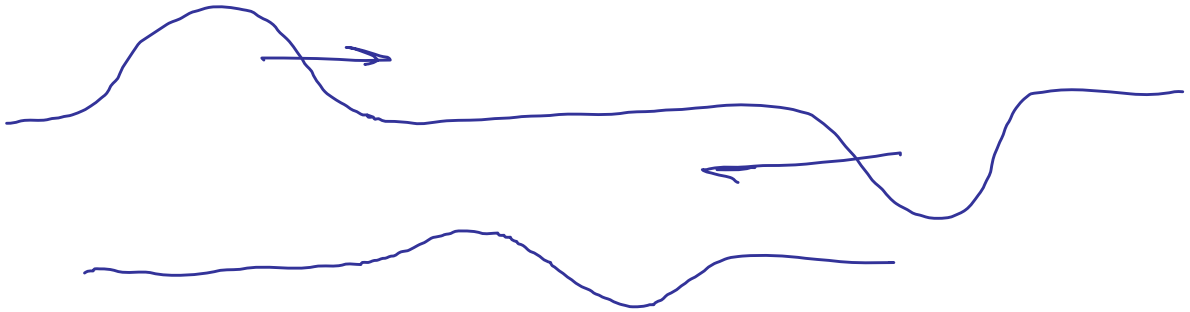


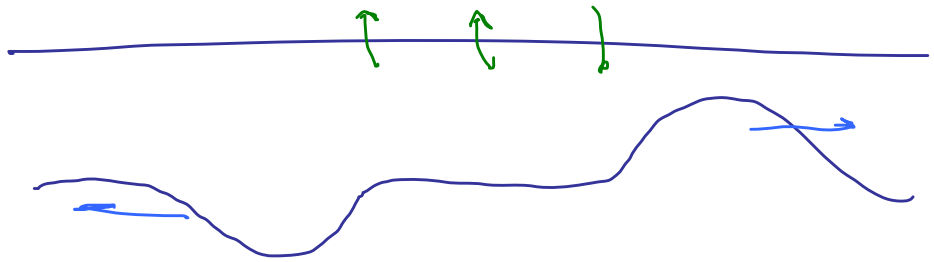
Interference

Waves add together

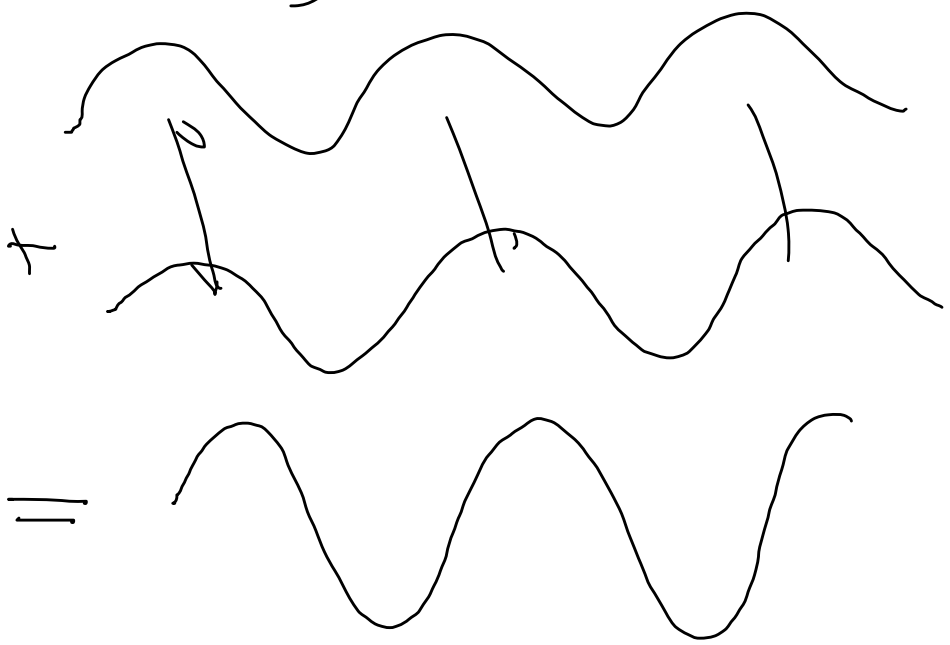
Principle of superposition.

Pulses pass through each other.

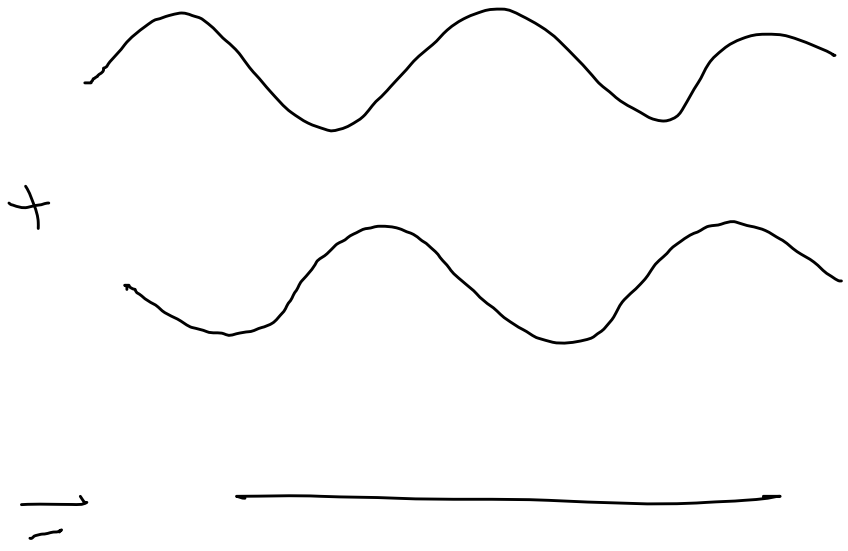




Adding harmonic waves (Interference)

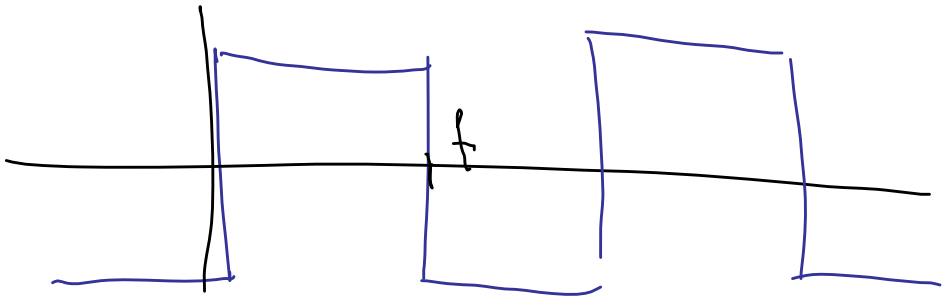


Constructive interference

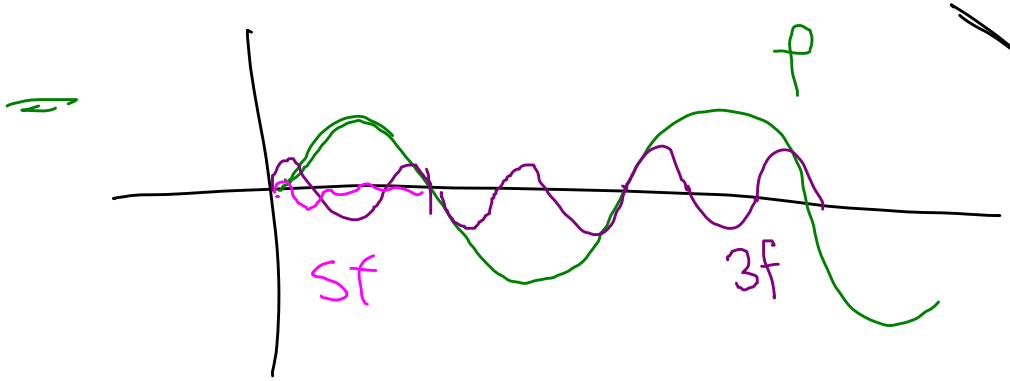


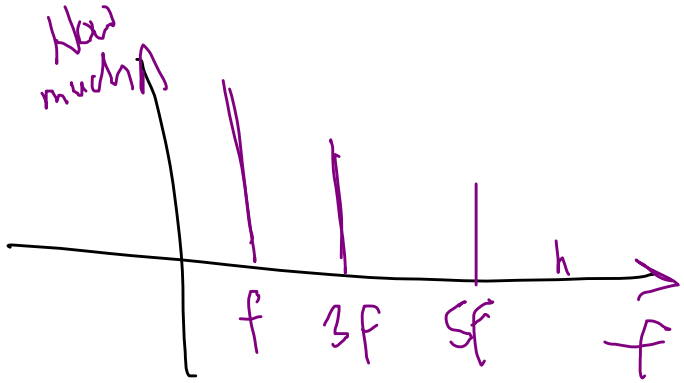
Destructive Interference.

Fourier decomposition

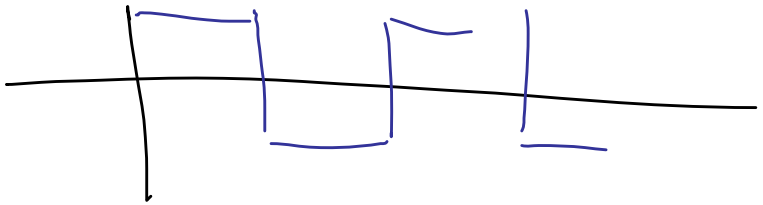


Any-shaped wave can written as a sum of harmonic.

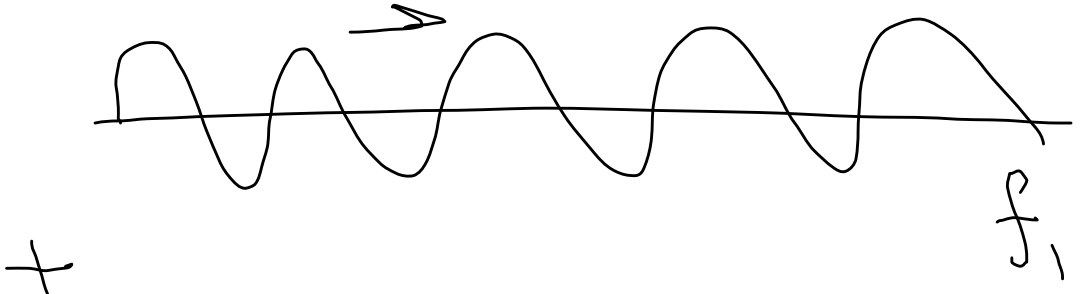




All:



Beats



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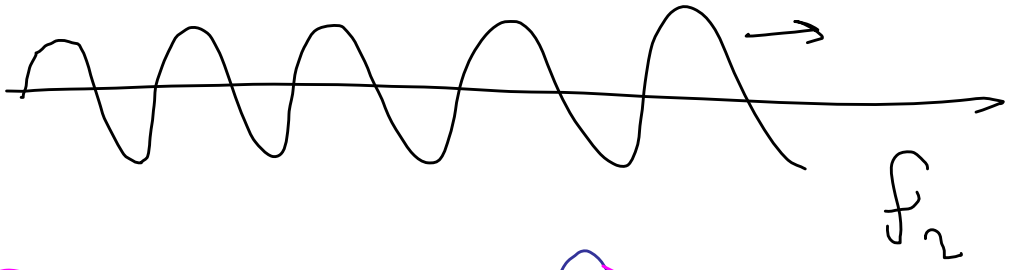

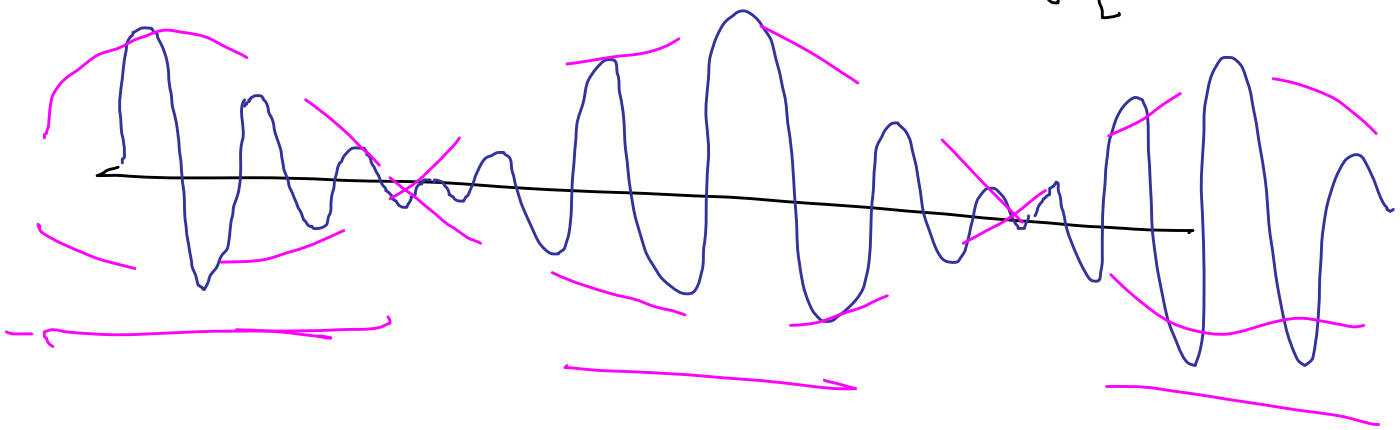

Slightly diff freq's

Hear same tone

Pulse rate $= |f_1 - f_2|$

Beats Beat freq.