Phys 2426   2012-11-09   Lec 20

f_0 = source freq

Approach: $\frac{\Delta f}{f_0} = \frac{v_{car}}{v_{sound}} = \oplus$

$f = 4897\ Hz = f_s + \Delta f_1$

Departure: $\frac{\Delta f}{f_0} = \frac{v_{car}}{v_{sound}} = \ominus$

$f = 4513\ Hz = f_s + \Delta f_2 = f_s - \Delta f_1$

$f_0 = f_s = f_{avg} = 4705\ Hz$

↑ "original"

$\Delta f = 4897 - 4705 = 192\ Hz$

$\frac{\Delta f}{f_0} = \frac{v}{v_{wave}}$

$\frac{192}{4705} = \frac{v}{340\ m/s}$ $v = 13.9\ m/s$

$= 31\ mph$

Quirks: Approx works for $v_{rel} < 10\%\ v_{wave}$

Doppler Radar - wave freq shifts twice

$f_0 \rightarrow \frac{\Delta f}{f_0} = \frac{v}{c} \rightarrow f_1 = f_0 + \Delta f \rightarrow \frac{\Delta f}{f_1} = \frac{v}{c}$

$\approx f_2 = f_1 + \Delta f \rightarrow \boxed{f_2 = f_0 + 2\Delta f}$

2

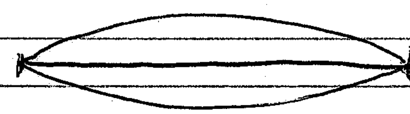
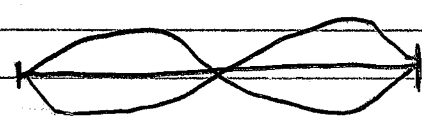
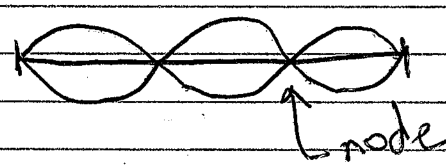
Standing Waves – Waves in a cavity bounce back and forth. When peaks reinforce each other, standing waves are formed.

$\mu = \frac{mass}{L}$

Cavity – any wave-carrying region with boundaries.

General Condition: $m\lambda = 2L$ (m → any integer)

$v = \sqrt{F_T/\mu}$

	m	λ		f
Fundamental	1	$2L$		$f_1 = \frac{v}{\lambda} = \frac{v}{2L}$
Harmonics ↓	2	L		$f_2 = 2f_1$
	3	$\frac{2L}{3}$		$f_3 = 3f_1$

Different Ends: $m\lambda = 4L$ (m = odd)

m	λ	f
1	$4L$	$f_1 = \frac{v}{4L}$
3	$4L/3$	$f_3 = 3f_1$