Phys 2110 - 4 12/7/11

Note Title 12/7/2011

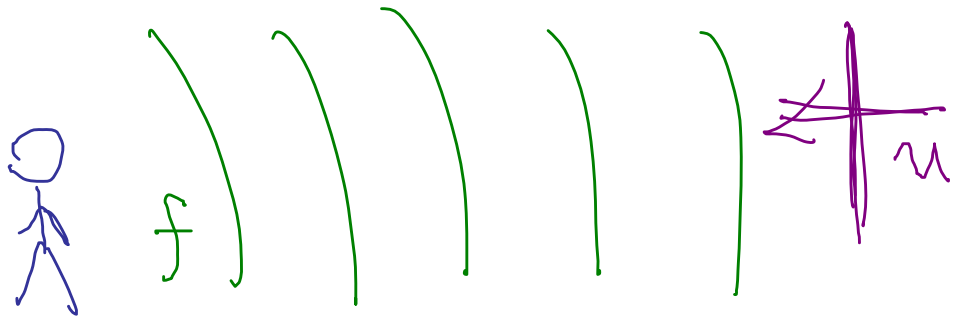
14.78 Ultrasound measures heartbeat

5.0 MHz ultrasound reflects off moving heart wall with 100 Hz freq shift. What is speed of heart wall. (Hint: You have two shifts to consider.)

$$f' = f\left(\frac{1 \pm u_o/v}{1 \mp u_s/v}\right)$$

u_o = speed obs

v = speed of sound



Observer on heart wall (?!) hears higher freq.
Echos it back, shift from being moving source.

Wall hears: $f\left(1+\frac{u}{v}\right) = f_1$ p. 254

Echos same but as a moving source

Man hears: $\frac{f_1}{\left(1-\frac{u}{v}\right)} = f\frac{\left(1+\frac{u}{v}\right)}{\left(1-\frac{u}{v}\right)} = f_2$

$$f_2 - f = 100\,Hz = f\left(\frac{1+\frac{v}{V}}{1-\frac{v}{V}}\right) - f$$

$$= f\left[\frac{1+x}{1-x} - 1\right] \qquad x = \frac{v}{V}$$

$$= 100\,Hz \qquad f = 5.0\,MHz$$

Solve for $x = 1\times10^{-5}$?

$$\longrightarrow \quad v = 15\,\frac{cm}{s}$$