

CONCEPT: THE DOPPLER EFFECT

- **Doppler Effect** = *shift* in the frequency YOU hear (f_{listener} or f_L) from the frequency of the sound source (f_{sound} or f_s).
 - It occurs when a sound source (e.g. siren) or listener (e.g. you) are _____ relative to each other.

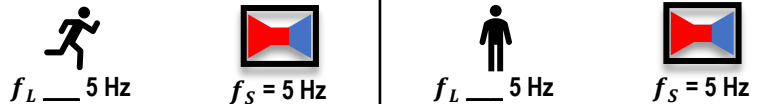
$$f_{\text{listener}} = \frac{v \pm v_L}{v \pm v_S} f_{\text{source}}, \text{ where } v = \text{speed of sound} = +343\text{m/s}; v_L = \text{velocity of listener}; v_S = \text{velocity of source}$$

NO RELATIVE MOTION - NO DOPPLER EFFECT



- If nothing moves, $f_{\text{listener}} = f_{\text{source}}$

RELATIVE MOTION - DOPPLER EFFECT



- If listener & source move toward each other, $f_{\text{listener}} > f_{\text{source}}$



- If listener & source move away from each other, $f_{\text{listener}} < f_{\text{source}}$

EXAMPLE: The alarm of a car at rest produces sound waves of frequency 550 Hz. You're riding on a motorcycle, traveling directly towards it, and you hear an observed frequency of 600 Hz. How fast must you be traveling?



- The direction of positive is ALWAYS from *listener* to *source*.