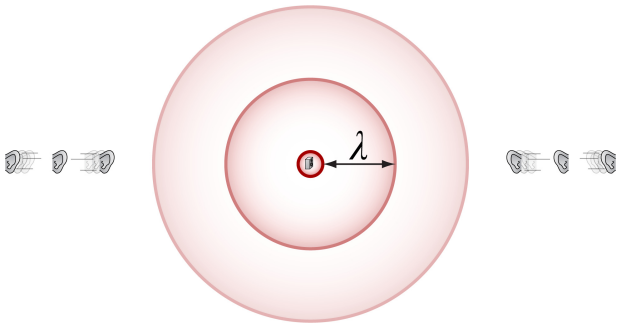
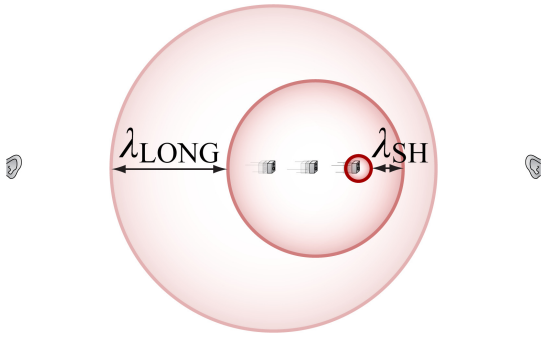
Galilean Doppler effect (for Honors Physics)

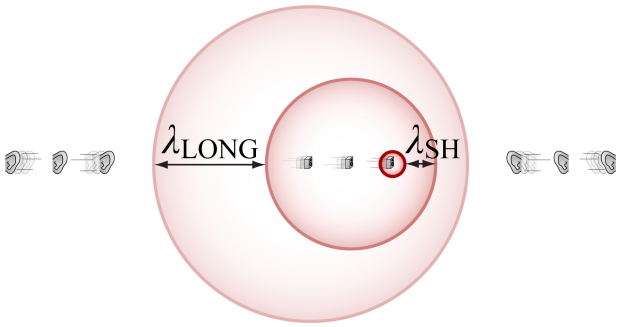
Stationary source and moving observer – an observer who approaches a stationary wave source passes through more wave crests in a given interval of time than an observer who remains stationary. The number of wave cycles that an observer encounters during a given interval of time divided by the duration of that interval of time is the observed frequency. Thus, the observed frequency is greater for an observer who approaches the stationary wave source than for a stationary observer.



Moving source and stationary observer – when a wave source is moving, the location at which a wave crest shell is emitted is different from the location at which the previous wave crest shell was emitted. Successive wave crest shells can be bunched together in front of the wave source and spread apart behind the wave source. A stationary observer being approached by the moving wave source is thus presented a short-wavelength (high-frequency) wave.



Moving source and moving observer – the observed frequency can be simultaneously affected by both wave source motion and observer motion. “Approaching” motion of either object increases the observed frequency. “Receding” motion of either object decreases the observed frequency.



$$v = \lambda f$$

$$\frac{v_{\text{WAVE}} + v_{\text{OBS,APPROACH}}}{v_{\text{WAVE}} - v_{\text{SRC,APPROACH}}} = \frac{\lambda_{\text{SH}} f_{\text{OBS}}}{\lambda_{\text{SH}} f_{\text{SRC}}}$$

$$f_{\text{OBS}} = f_{\text{SRC}} \left(\frac{v_{\text{WAVE}} + v_{\text{OBS,APPROACH}}}{v_{\text{WAVE}} - v_{\text{SRC,APPROACH}}} \right)$$