Doppler effect

Grancoli 6.ed: 12-7 (p. 930 for light)

Sound	v'	λ	f	
Moving source Still observer	not changed	$\lambda' = \lambda(1 \mp \frac{v_s}{v})$	(1) $f' = f \frac{1}{1 \mp \frac{v_s}{v}}$	$-$: S→O $+$: ←S O
Moving observer Still source	changed	$\lambda' = \lambda$	(2) $f' = f(1 \pm \frac{v_0}{v})$	$+$ S ←O $-$ S O→
Both moving			$f' = f \frac{v \pm v_0}{v \mp v_s}$	

v' = relative velocity between sound waves and observer.

v = absolute velocity of waves

v_s = velocity of source

v_0 = velocity of observer

If $v_0 << v$ and $v_s << v$ the two formulas (1) and (2) leads to approximately the same result.

(Math: $\frac{1}{1 \mp x} \approx 1 \pm x$ if $x << 1$)

Light: c always constant, even if relative velocity!

$$\lambda' = \lambda \sqrt{\frac{1 + \frac{v}{c}}{1 - \frac{v}{c}}}$$ with v velocity of observer or source.

$$\Delta f \approx \frac{v}{c} f \quad \text{if } v << c.$$

($\Delta f > 0$ if comming closer, $\Delta f < 0$ if comming farther)