## 1.6 The Doppler Effect

· relative speed

$u$: a receiver speed (moving away)
$c$: a source speed
$\nu$: a source frequency
$\nu'$: an observed frequency by $u$.

$$\nu' = \nu\left(\frac{c}{c+u}\right) = \nu\left(1 - \frac{u}{c} + \frac{u^2}{c^2} + \cdots\right) \sim u\left(1 - \frac{u}{c}\right)$$

* Taylor Expansion

$$(1+x)^{-1} = 1 + (-1)x + \frac{1}{2!}(-1)(-2)x^2 + \cdots$$

For the case of moving toward,

$$\nu' = \nu\left(1 + \frac{u}{c}\right)$$

In general,

$c$: the velocity of wave in the medium
$v_r$: the velocity of the receiver relative to the medium
$v_s$: " source "

→ if $v_s > 0$, moving away from the receiver

$f_0$: the frequency at rest.

$$f = f_0\left(\frac{c \pm v_r}{c \pm v_s}\right)$$

If $v_r$ & $v_s \ll c$, $f = f_0\left(1 + \frac{\Delta v}{c}\right)$,

$\Delta v = v_r - v_s$