$A^\mu = a^\mu e^{ik\cdot x}$ onda di una sorgente a velocità $\bar{\beta} = (\beta, 0, 0)$

$k \cdot x = k^\mu x_\mu = kt - \bar{k}\cdot\bar{x} = \frac{\omega}{c} t - \bar{k}\cdot\bar{x}$ con $k = \frac{\omega}{c} = \frac{2\pi}{\lambda}$

$k^\mu = \Lambda^\mu{}_\nu k'^\nu \rightarrow$ $k^0 = \gamma(k'^0 - \beta k'^1)$ $\quad k^2 = k'^2$

$k^1 = \gamma(k'^1 - \beta k'^0)$ $\quad k^3 = k'^3$

$k^0 = k = \frac{\omega}{c} = \gamma\left(\frac{\omega'^0}{c} - \beta k'^1\right)$

$= \gamma\left(\frac{\omega'^0}{c} - \beta \frac{\omega}{c}\cos\alpha\right)$

$\begin{cases} k^1 = k\cos\alpha = \frac{\omega}{c}\cos\alpha \\ \alpha = \widehat{\bar{k}\,\bar{\beta}} \end{cases}$

$\Rightarrow$ $\boxed{\omega = \gamma\,\omega'(1 - \beta\cos\alpha)}$ Effetto Doppler