$$x(\text{car}) \quad = \quad L + vt$$

$$\begin{aligned} x(\text{wave 1}) &= cT + ct \\ x(\text{wave 2}) &= 2cT + ct \\ x(\text{wave 3}) &= 3cT + ct \end{aligned}$$

Event 2 : wave 2 meets car $\quad x_2 =$ $\qquad\qquad$ $t_2 =$

Event 1 : wave 1 meets car $\quad x_1 =$ $\qquad\qquad$ $t_1 =$

$$T' \quad = \quad t'_1 - t'_2$$

$$\frac{1}{f} \quad = \quad T \quad = \quad t_1 - t_2$$

$$T' \quad = \quad T \, \frac{\sqrt{1+\beta}}{\sqrt{1-\beta}}$$

$$f' \quad = \quad \frac{1}{T'} \quad = \quad \frac{1}{T} \, \frac{\sqrt{1-\beta}}{\sqrt{1+\beta}}$$

$$f_{\text{obs}} = \quad f_{\text{source}} \, \frac{\sqrt{1-\beta}}{\sqrt{1+\beta}}$$

$$f' \quad \simeq \quad f\Big(\qquad\qquad \Big)$$

$$f' \quad \simeq \quad f\Big(1 - \frac{v}{c}\Big)$$

Event 2 : wave 2 meets car $\quad x'_2 =$

$t'_2 =$

Event 1 : wave 1 meets car $\quad x'_1 =$

$t'_1 =$

$$\frac{1}{f'} \quad = \quad T' \quad = \quad t'_1 - t'_2$$

$$\begin{aligned} v_s &= f\lambda \\ c &= f\lambda \end{aligned}$$

$$f = \frac{1}{T}$$

$$T = \frac{1}{f}$$

$$(\Delta t)_{\text{car}} = \frac{1}{\gamma}\,(\Delta t)_{\text{Fred}}$$

$$T_{\text{car}} = \frac{1}{\gamma}\,T_{\text{Fred}}$$

$$f_{\text{car}} = \gamma\, f_{\text{Fred}}$$

$$f_{\text{source}} = \gamma\, f_{\text{obs}}$$

$$f_{\text{obs}} = \frac{1}{\gamma}\, f_{\text{source}}$$

$$\lambda_{\text{obs}} = \lambda_{\text{source}}\, \frac{\sqrt{1+\beta}}{\sqrt{1-\beta}}$$

$$\lambda_{\text{obs}} \simeq \lambda_{\text{source}}\, (1+\beta)^{1/2}\, (1-\beta)^{-1/2}$$