



$$x = ct \cos \theta, t_1 = t, x' = ct' \cos \theta'$$

$$x' = \gamma (x - vt) = \gamma (ct \cos \theta - vt) = \gamma t (c \cos \theta - v)$$

$$t' = \gamma (t - \frac{v}{c^2} x) = \gamma (t - \frac{v}{c} t \cos \theta) = \gamma t (1 - \frac{v}{c} \cos \theta)$$

$$x' = ct' \cos \theta' \Rightarrow \gamma t (c \cos \theta - v) = c \cdot \gamma t (1 - \frac{v}{c} \cos \theta) \cos \theta'$$

$$\Rightarrow c \cos \theta - v = (c - v \cos \theta) \cos \theta'$$

$$\Rightarrow \cos \theta' = \frac{c \cos \theta - v}{c - v \cos \theta}$$

$$\cos \theta' = \frac{\cos \theta - \frac{v}{c}}{1 - \frac{v}{c} \cos \theta} = \frac{\cos \theta - \beta}{1 - \beta \cos \theta}$$