$$\left[1 - \frac{u_t^2}{c^2}\right]\left[At + \gamma_{u_0} u_0\right]^2 = u_t^2$$

$$\left(At + \gamma_{u_0} u_0\right)^2 = u_t^2\left[1 + \left[\frac{\quad}{c^2}\right]^2\right]$$

$$u_t = \frac{dx}{dt}$$

$$\int dx = \int \left[\qquad \right] dt$$

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$$\int \frac{dp}{\sqrt{p}} = \int p^{-1/2}\, dp$$

$$= 2p^{1/2}$$

$$\frac{c^2}{A}\sqrt{1+\frac{(At+\gamma_{u_0}u_0)^2}{c^2}}\,\Bigg|_0^t$$

$$\Big[\quad\Big] - \frac{c^2}{A}\sqrt{1+\left(\frac{\gamma_{u_0}u_0}{c}\right)^2}$$

$$\begin{bmatrix} \gamma_{u'} F_x' \\ \gamma_{u'} F_y' \\ \gamma_{u'} F_z' \\ i\gamma_{u'} \dfrac{\vec{F}' \cdot \vec{u}'}{c} \end{bmatrix} = \begin{bmatrix} \gamma & 0 & 0 & i\beta\gamma \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -i\beta\gamma & 0 & 0 & \gamma \end{bmatrix} \begin{bmatrix} \gamma_u F_x \\ \gamma_u F_y \\ \gamma_u F_z \\ i\gamma_u \dfrac{\vec{F} \cdot \vec{u}}{c} \end{bmatrix}$$