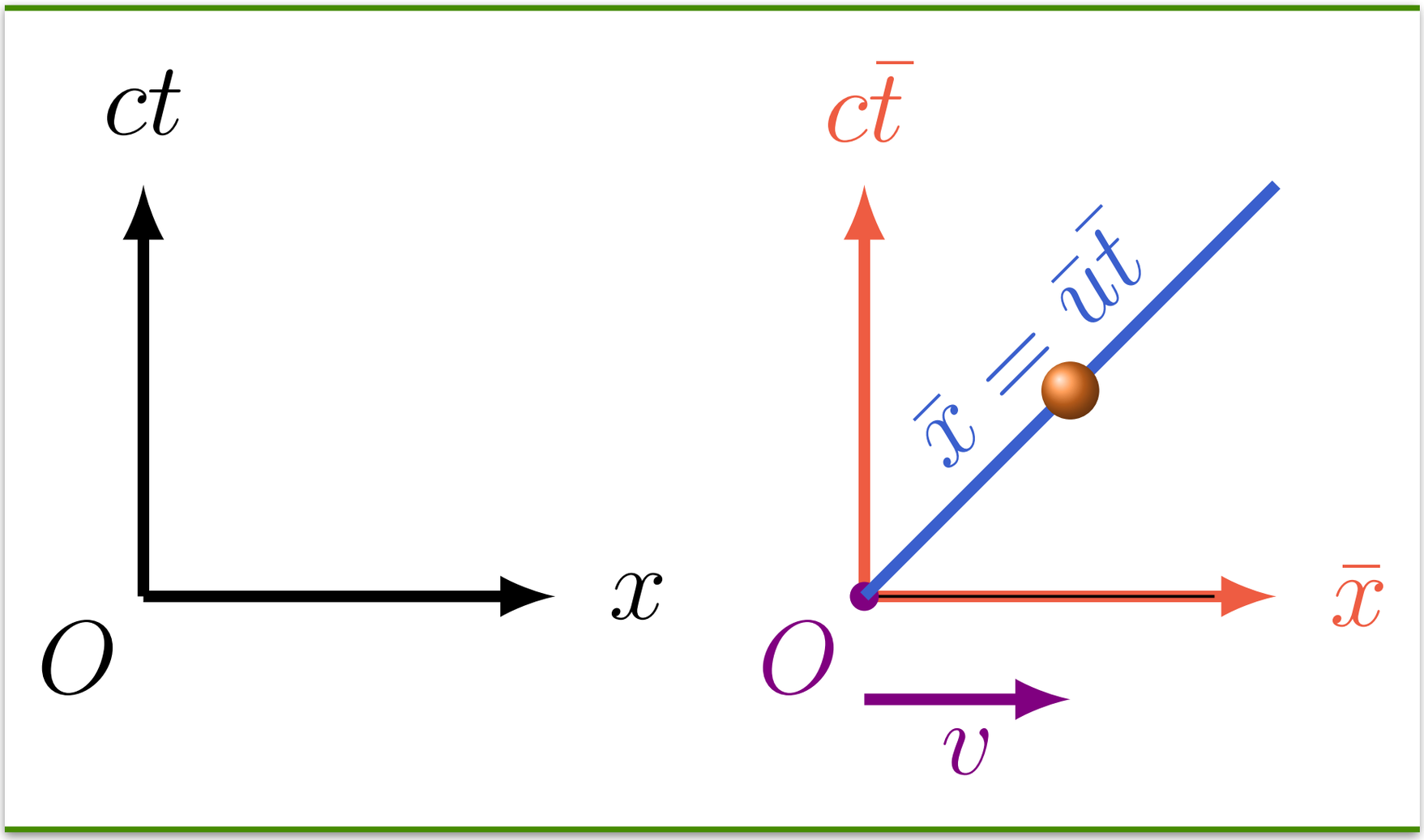
Eletromagnetismo Avançado

23 de outubro
Relatividade restrita

Velocidade

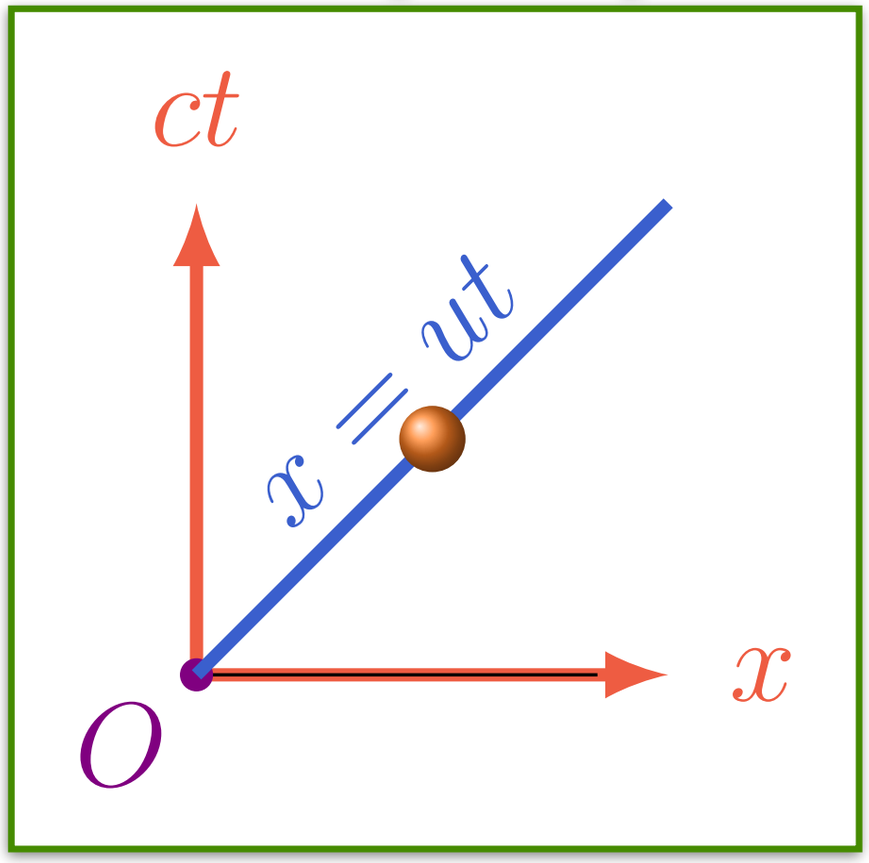


$$u = \frac{v + \bar{u}}{1 + \dfrac{v\bar{u}}{c^2}}$$

Velocidade própria

$$\eta^\mu = \frac{\mathrm{d}x^\mu}{\mathrm{d}\tau}$$

$$\begin{bmatrix} \eta^0 \\ \eta^1 \\ \eta^2 \\ \eta^3 \end{bmatrix} = \frac{1}{\sqrt{1 - \dfrac{u^2}{c^2}}} \begin{bmatrix} c \\ u^1 \\ u^2 \\ u^3 \end{bmatrix}$$

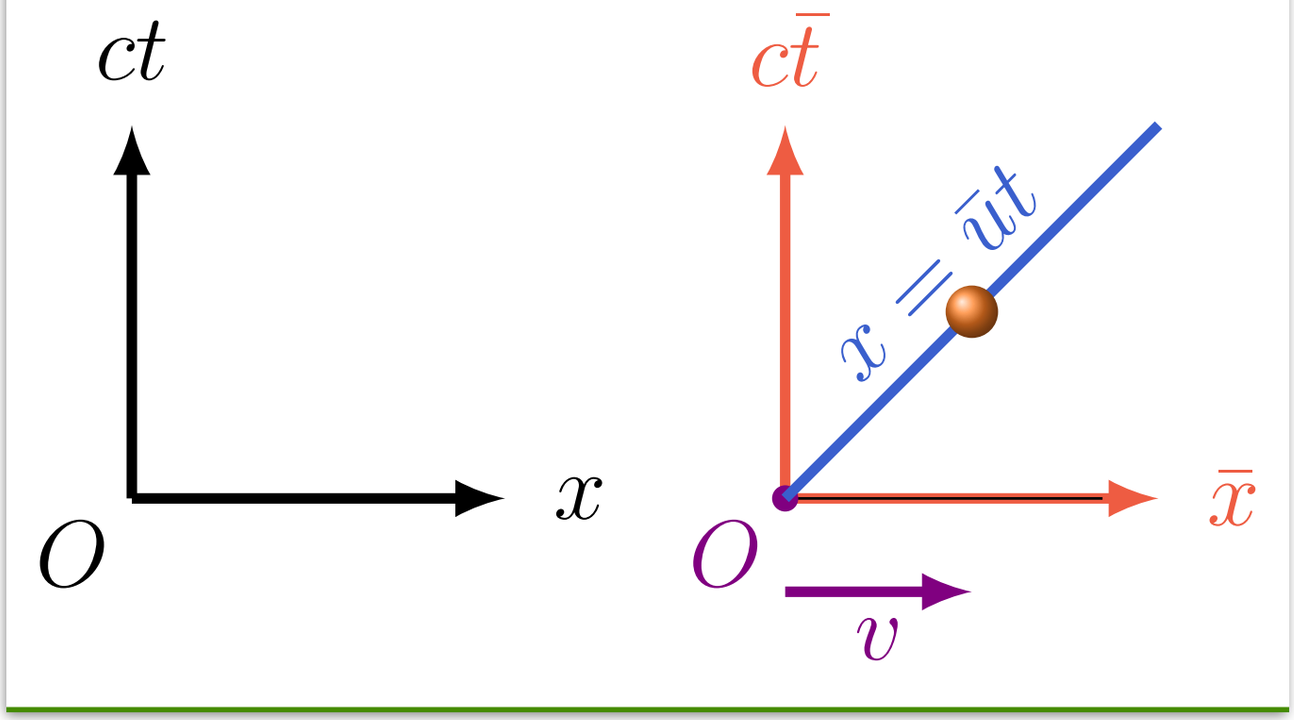


$$\eta_\mu \eta^\mu = -c^2$$

$$\vec{\eta} = \frac{\vec{u}}{\sqrt{1 - \dfrac{u^2}{c^2}}}$$

Pratique o que aprendeu

$$\vec{u} = ?$$



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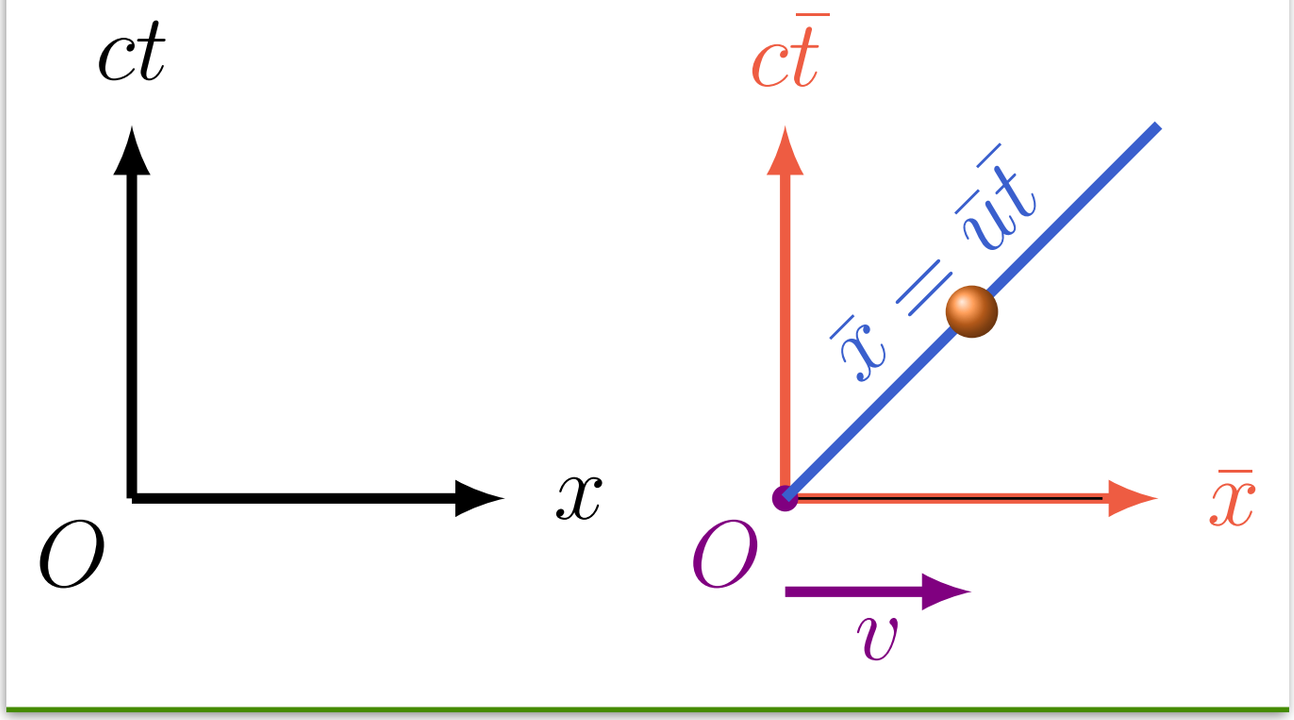

$$\eta^{\mu} = \frac{1}{\sqrt{1 - \dfrac{u^2}{c^2}}} \begin{bmatrix} c \\ u \end{bmatrix}$$

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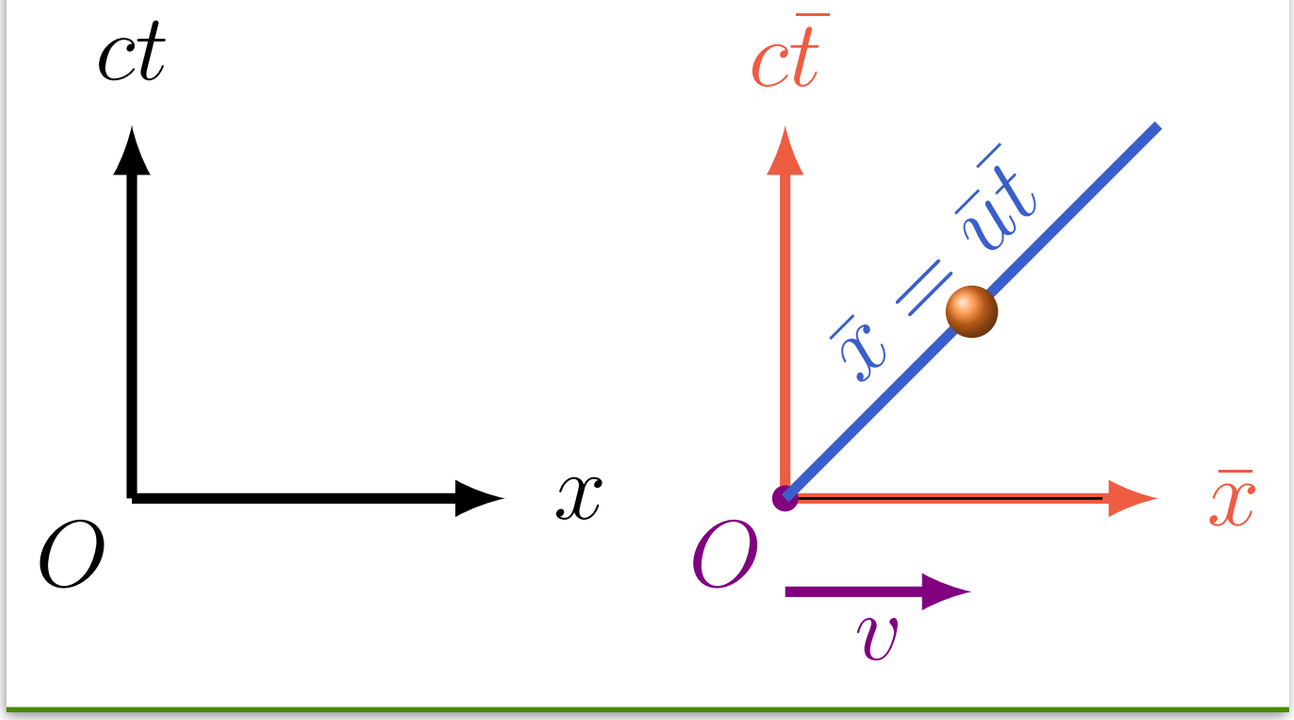

$$\eta^{\mu} = \frac{1}{\sqrt{1 - \dfrac{u^2}{c^2}}} \begin{bmatrix} c \\ u \end{bmatrix} = \begin{bmatrix} \cosh\theta \\ \sinh\theta \end{bmatrix}$$

$$\tanh\theta = \frac{u}{c}$$

$$\vec{\eta} = \frac{\vec{u}}{\sqrt{1 - \dfrac{u^2}{c^2}}}$$

Pratique o que aprendeu

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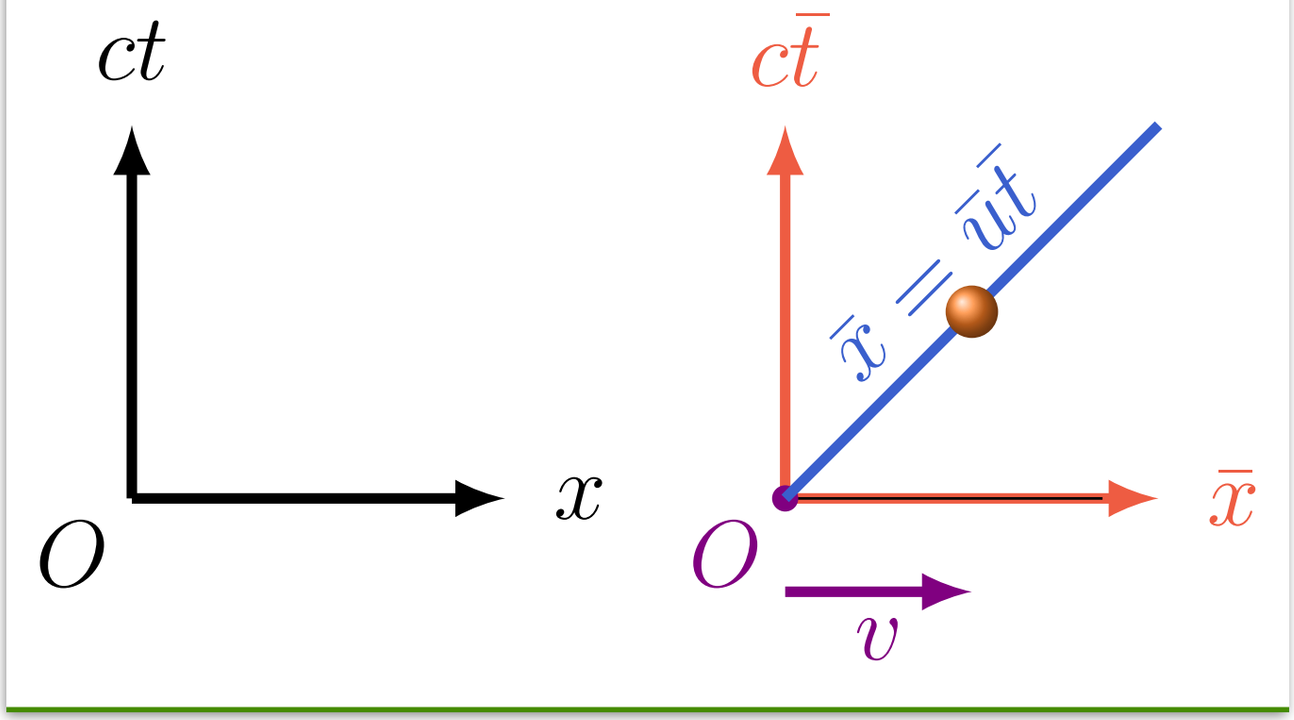

$$\tilde{\Lambda} = \begin{bmatrix} \cosh\alpha & \sinh\alpha \\ \sinh\alpha & \cosh\alpha \end{bmatrix}$$

$$\tanh\alpha = \frac{v}{c}$$

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Pratique o que aprendeu

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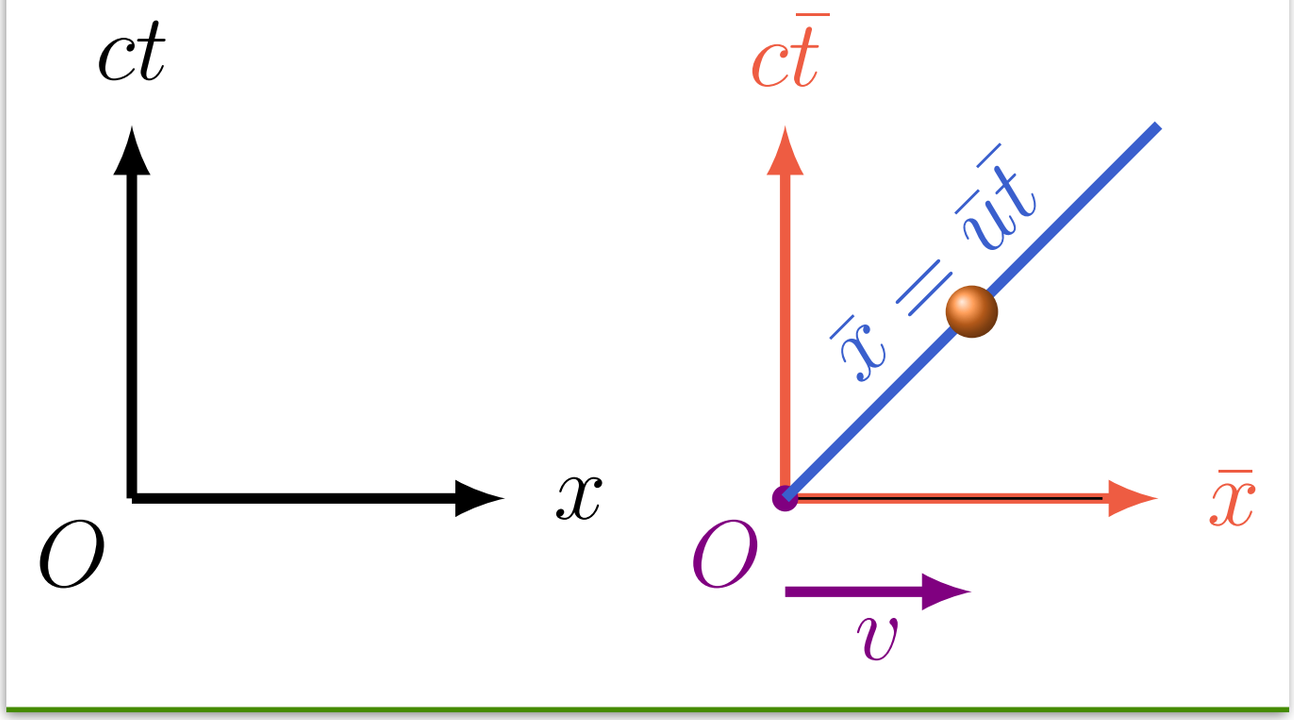

$$\eta^{\mu} = \tilde{\Lambda}^{\mu}_{\nu}\bar{\eta}^{\nu}$$

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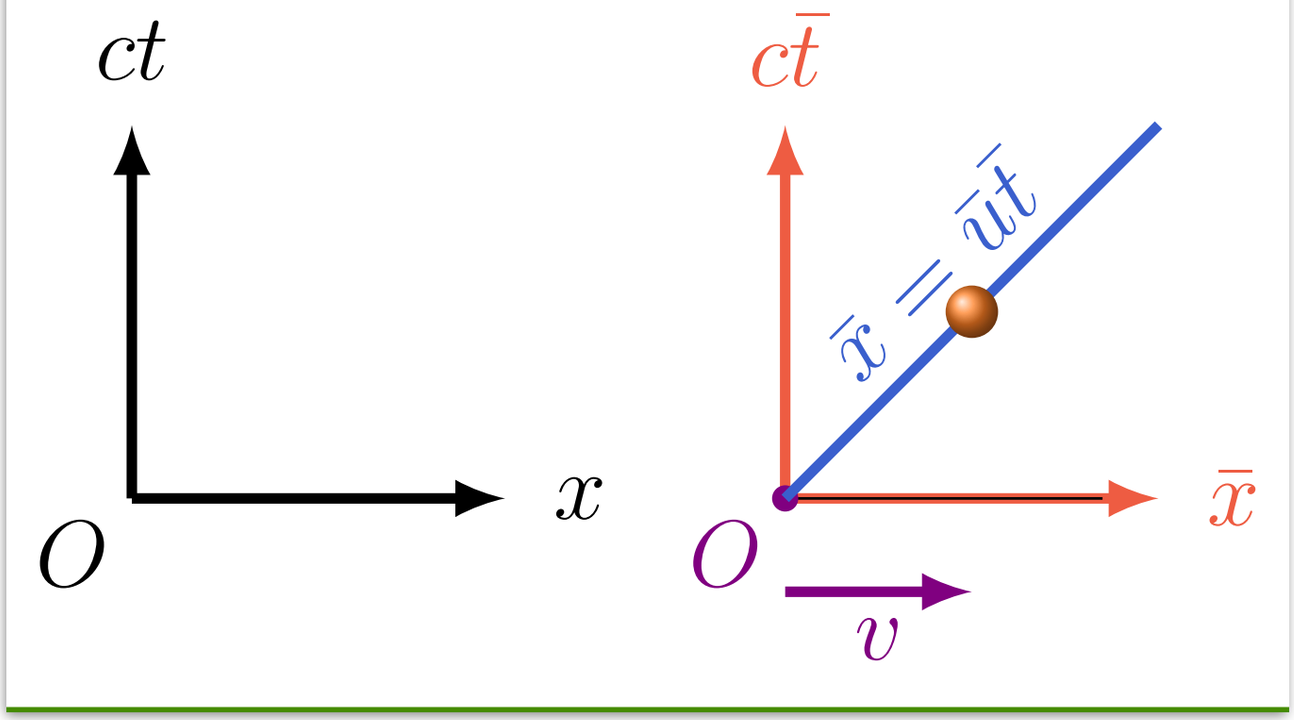

$$\eta^{\mu} = \tilde{\Lambda}^{\mu}_{\nu}\bar{\eta}^{\nu} \Rightarrow \quad \eta^{\mu} = \begin{bmatrix} \cosh(\bar{\theta} + \alpha) \\ \sinh(\bar{\theta} + \alpha) \end{bmatrix}$$

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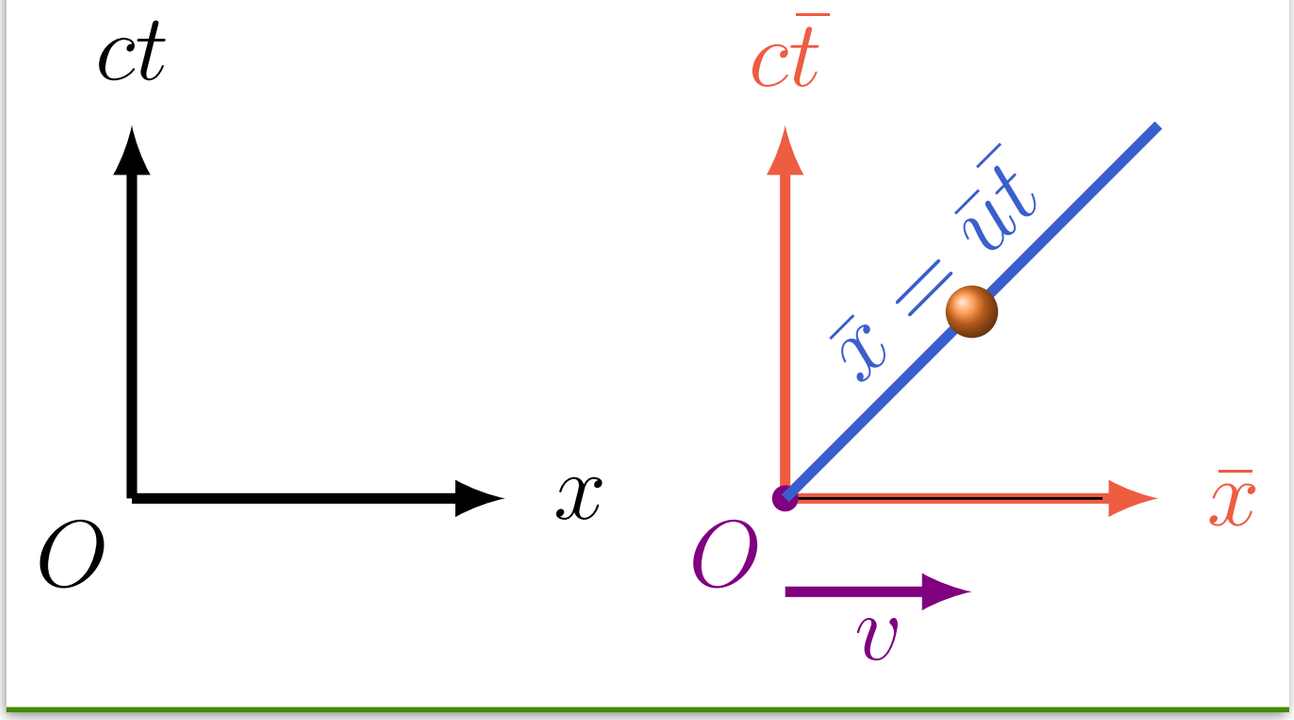

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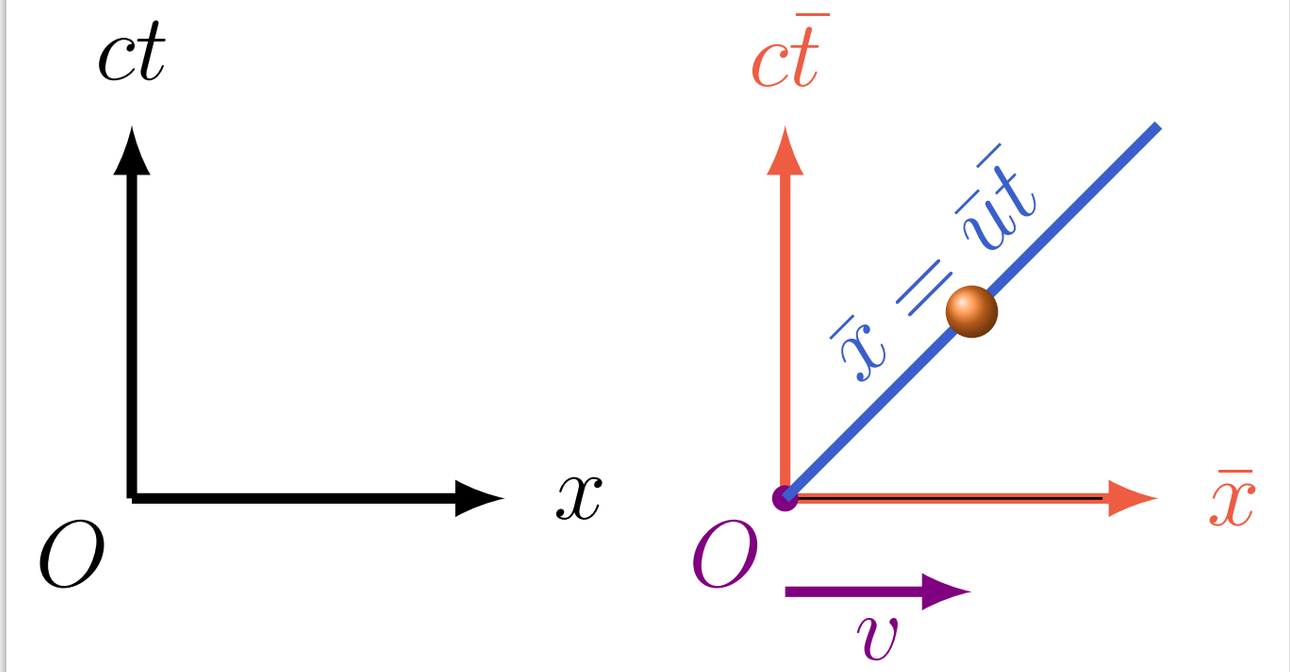

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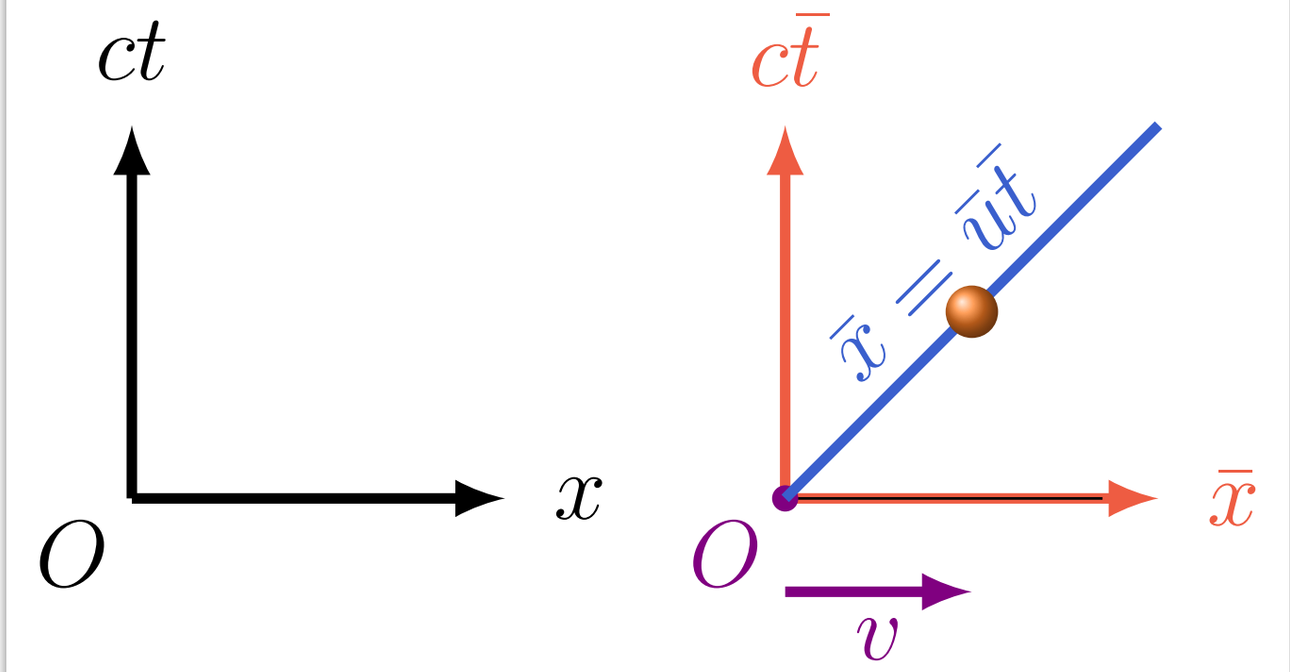

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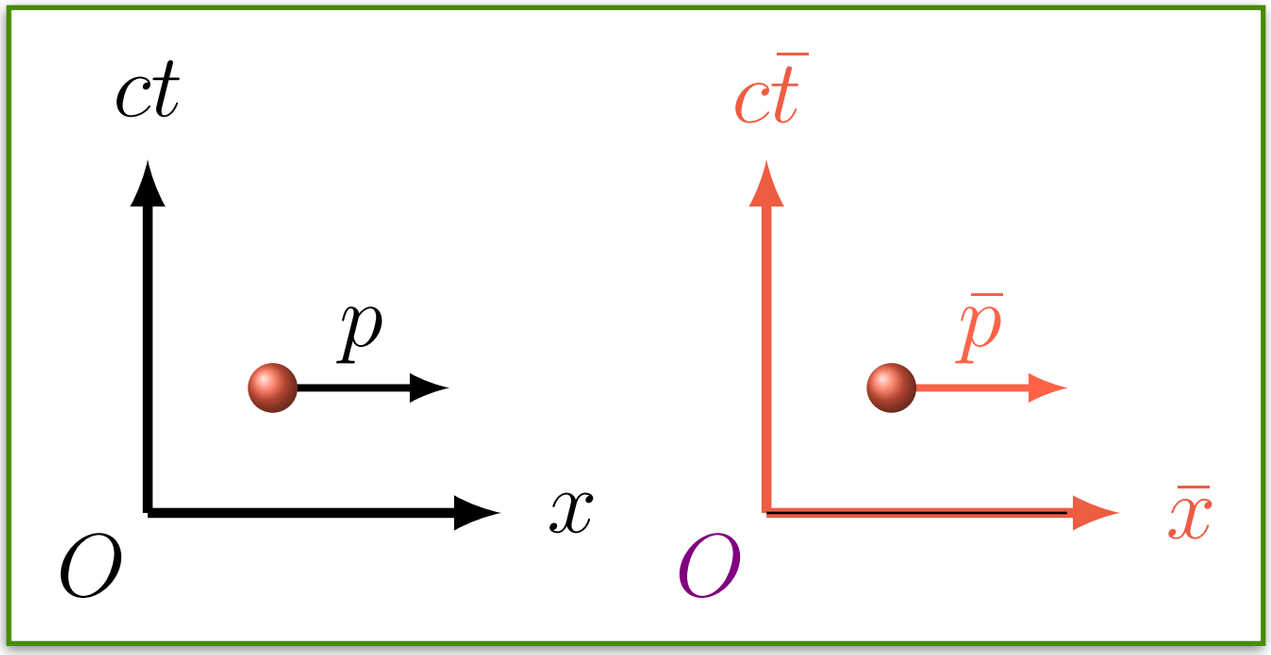
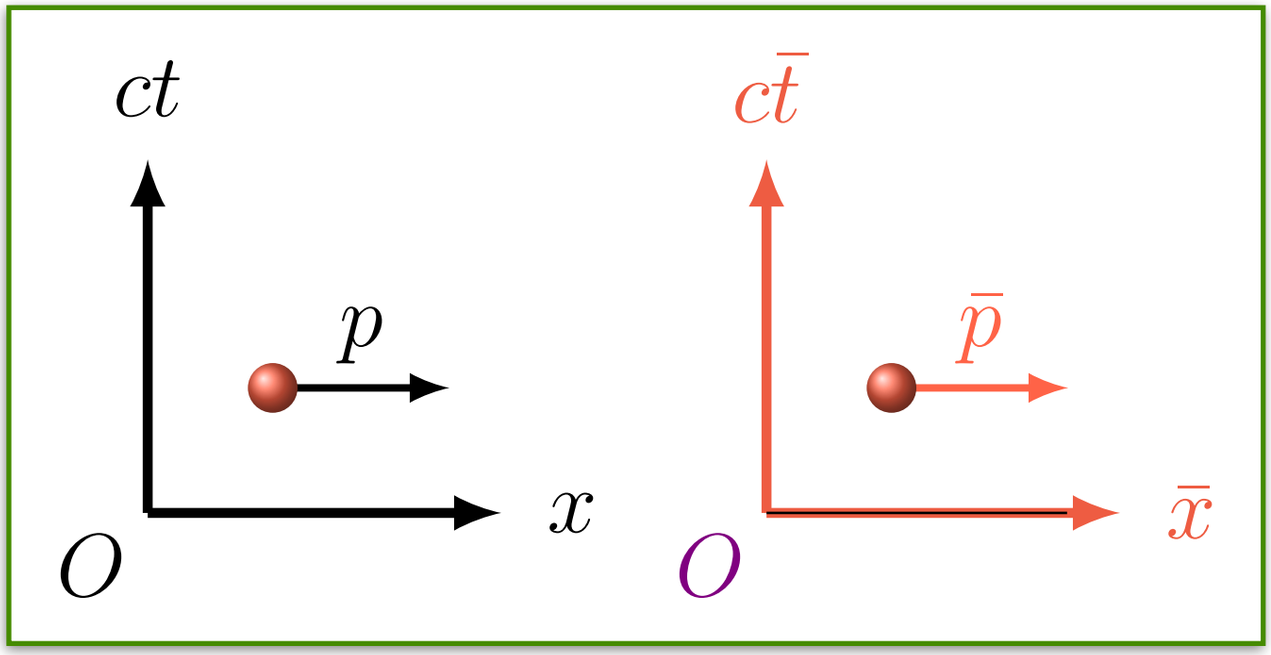
$$\tanh\theta = \frac{\dfrac{\bar{u}}{c} + \dfrac{v}{c}}{1 + \dfrac{\bar{u}v}{c^2}}$$

Momento



Momento

$$p^\mu = m\eta^\mu$$



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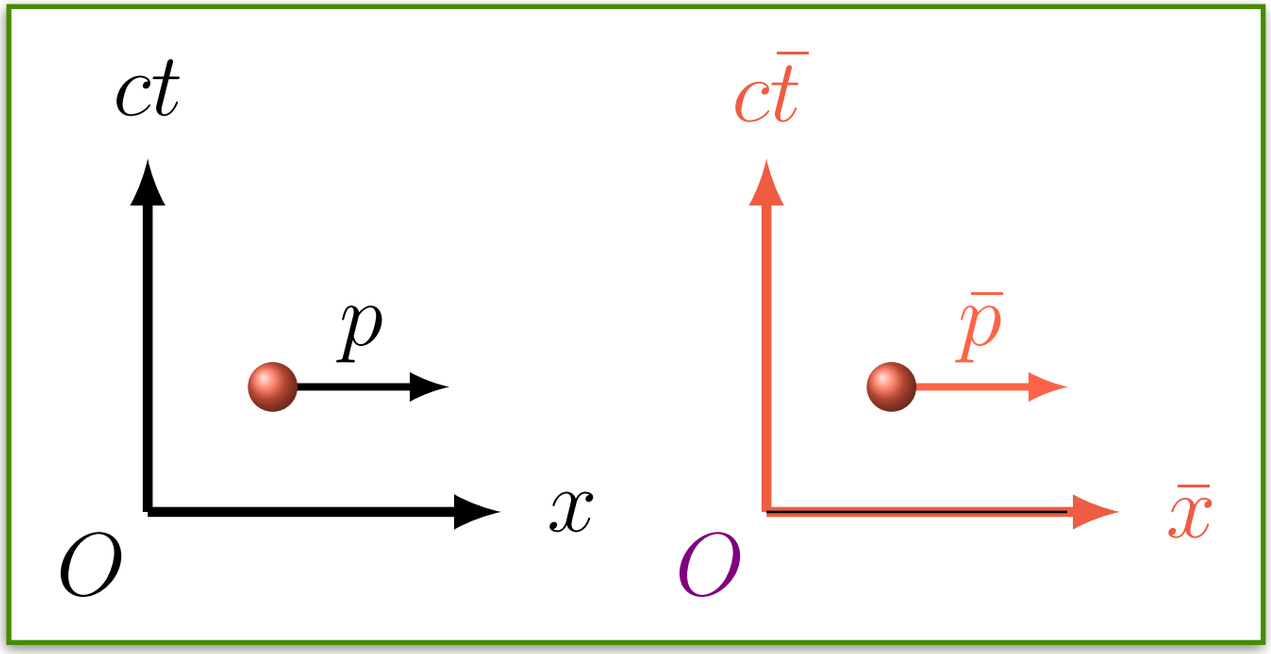
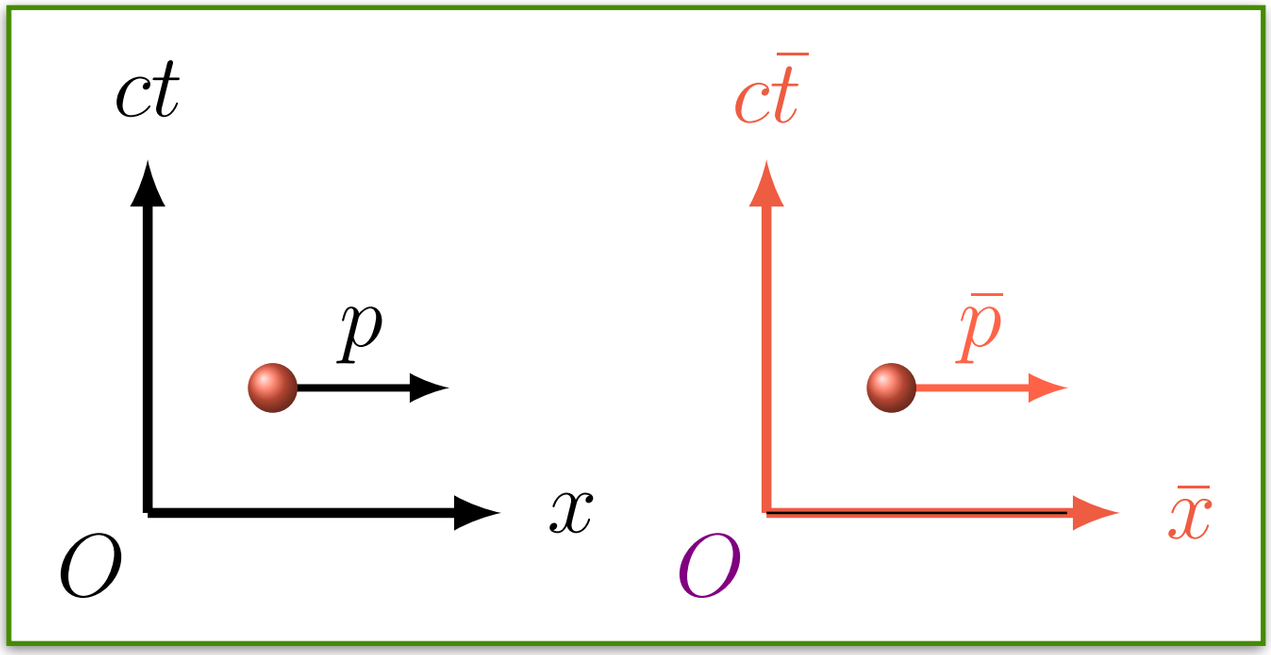
Garante conservação



Momento

$$p^\mu = m\eta^\mu$$

$$p^\mu = \frac{1}{\sqrt{1 - \dfrac{u^2}{c^2}}} \begin{bmatrix} mc \\ mu^1 \\ mu^2 \\ mu^3 \end{bmatrix}$$



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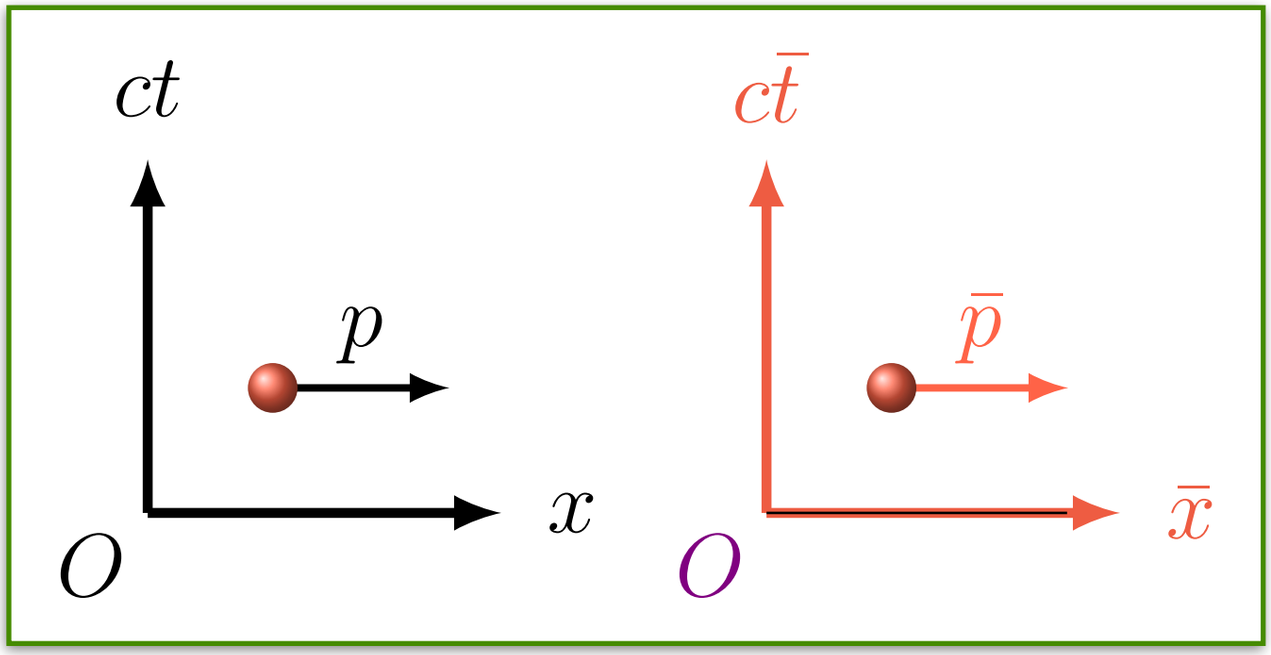

$$p^0 = \frac{mc}{\sqrt{1 - \dfrac{u^2}{c^2}}}$$

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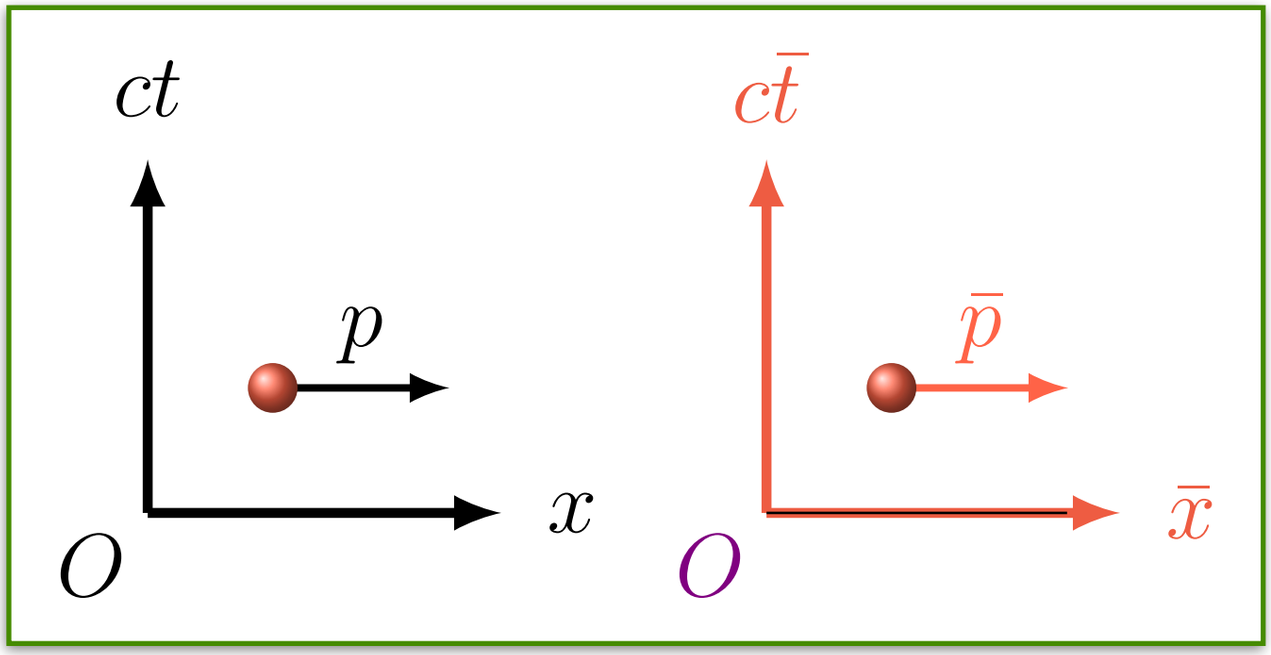

$$p^0 = \frac{mc}{\sqrt{1-\dfrac{u^2}{c^2}}} \approx mc + \frac{mu^2}{2c}$$

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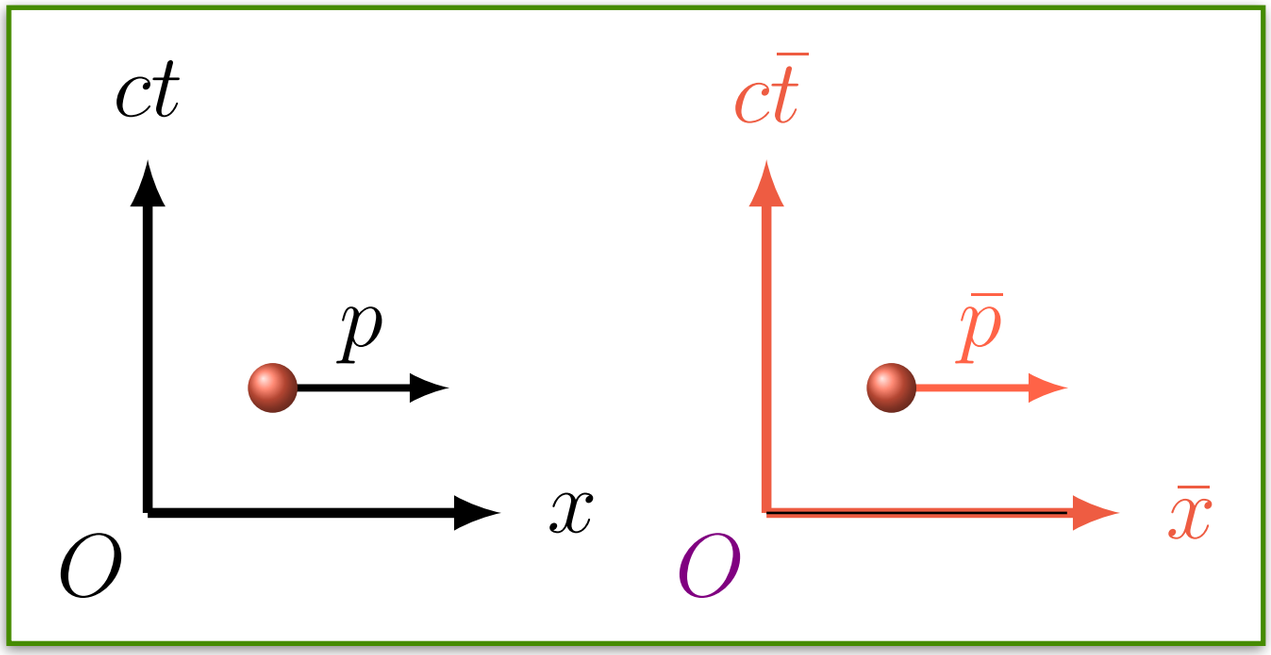

$$p^0 = \frac{mc}{\sqrt{1-\dfrac{u^2}{c^2}}} \approx mc + \frac{mu^2}{2c} = \frac{E}{c}$$

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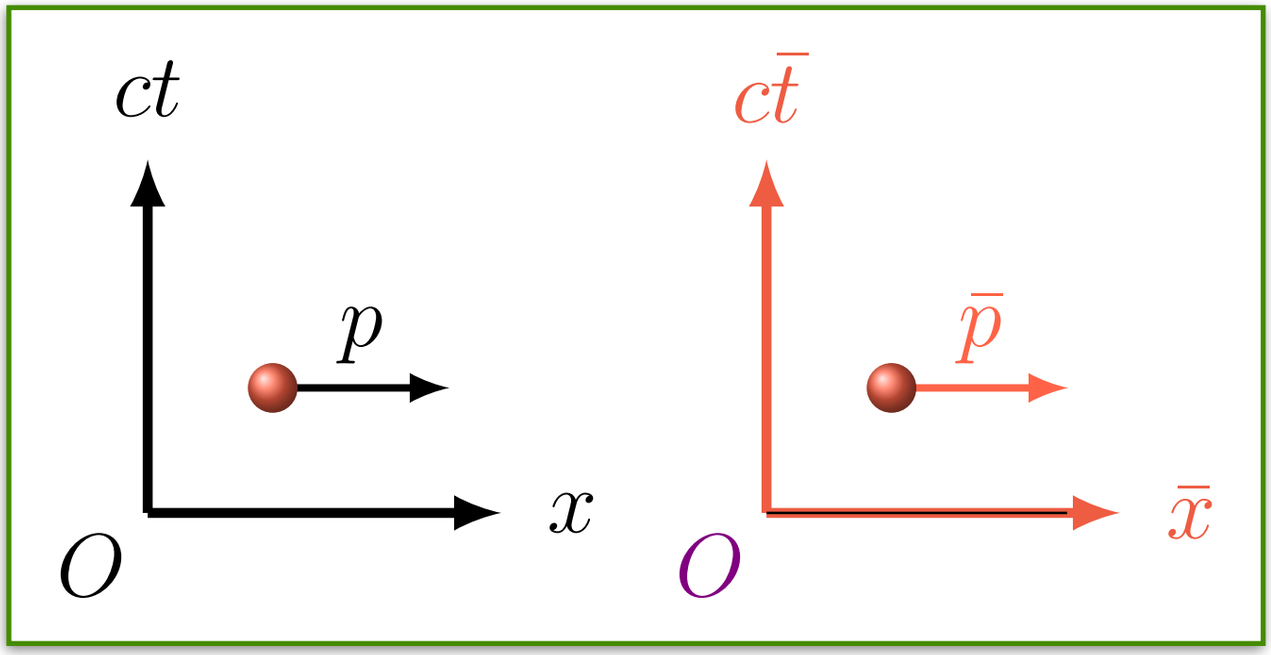

$$E = p^0 c$$

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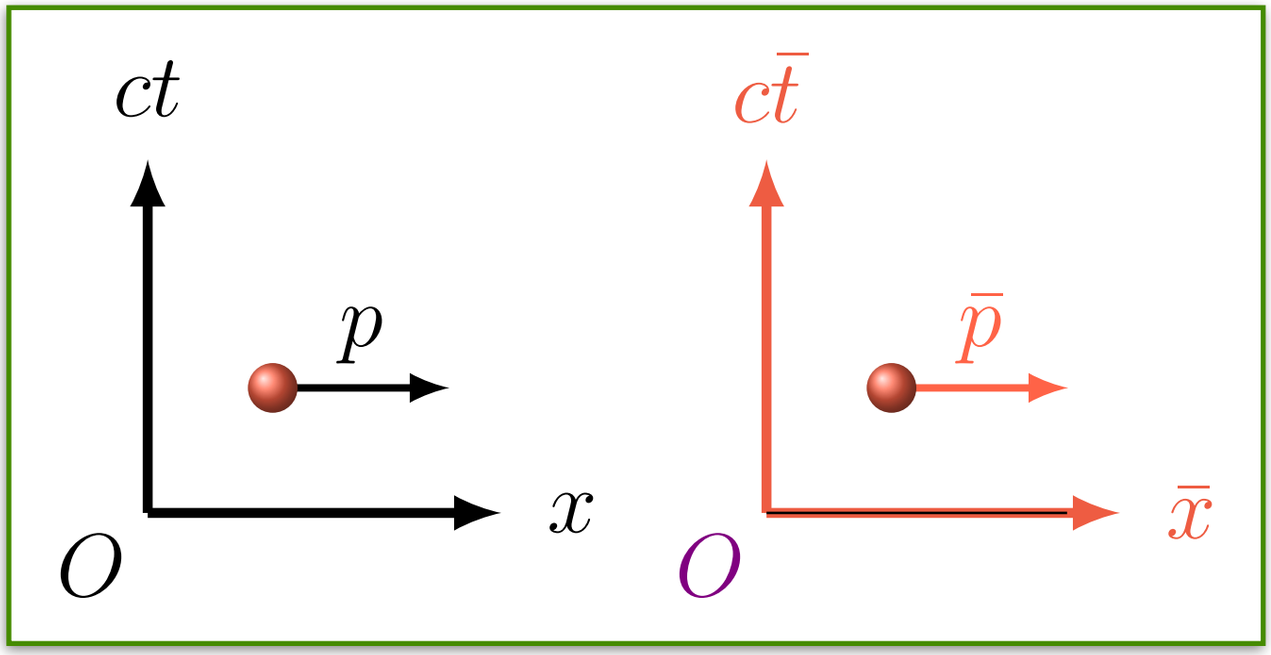

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$$E = \frac{mc^2}{\sqrt{1-\dfrac{u^2}{c^2}}}$$

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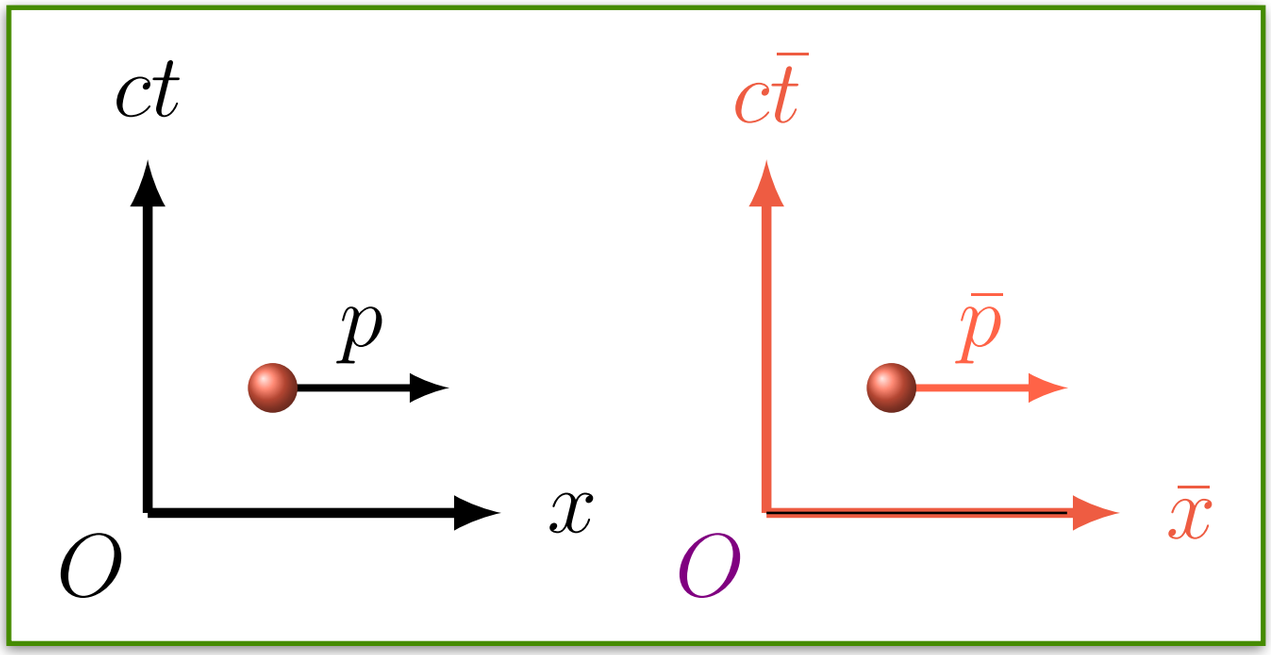

$$E = \frac{mc^2}{\sqrt{1-\dfrac{u^2}{c^2}}}$$

$$\vec{\mathbf{p}} = \frac{m\vec{\mathbf{u}}}{\sqrt{1-\dfrac{u^2}{c^2}}}$$