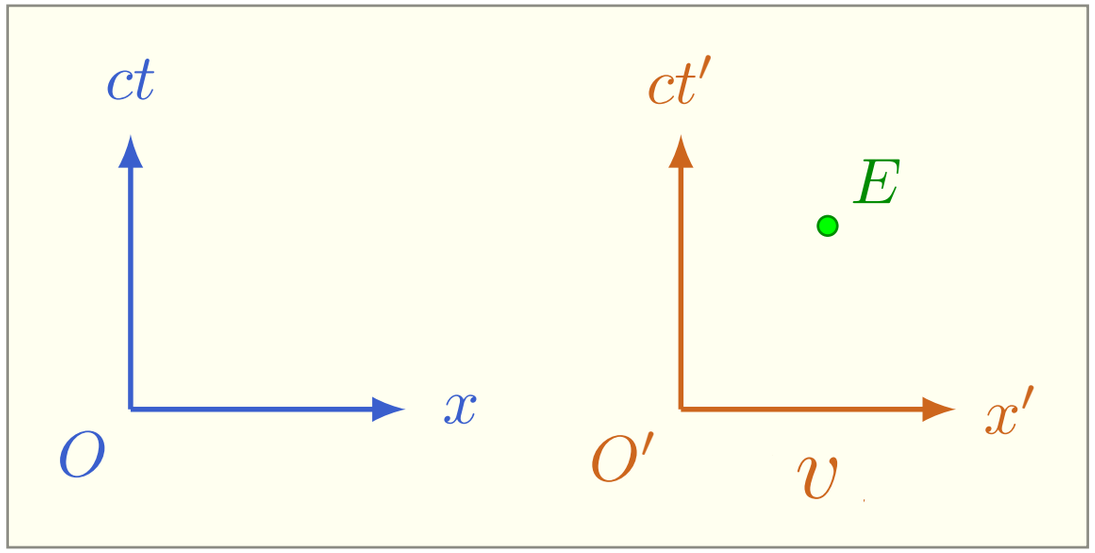
Física IV

15 de dezembro

Dinâmica relativístico

Transformação de Lorentz

$$\begin{bmatrix} ct' \\ x' \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} ct \\ x \end{bmatrix}$$



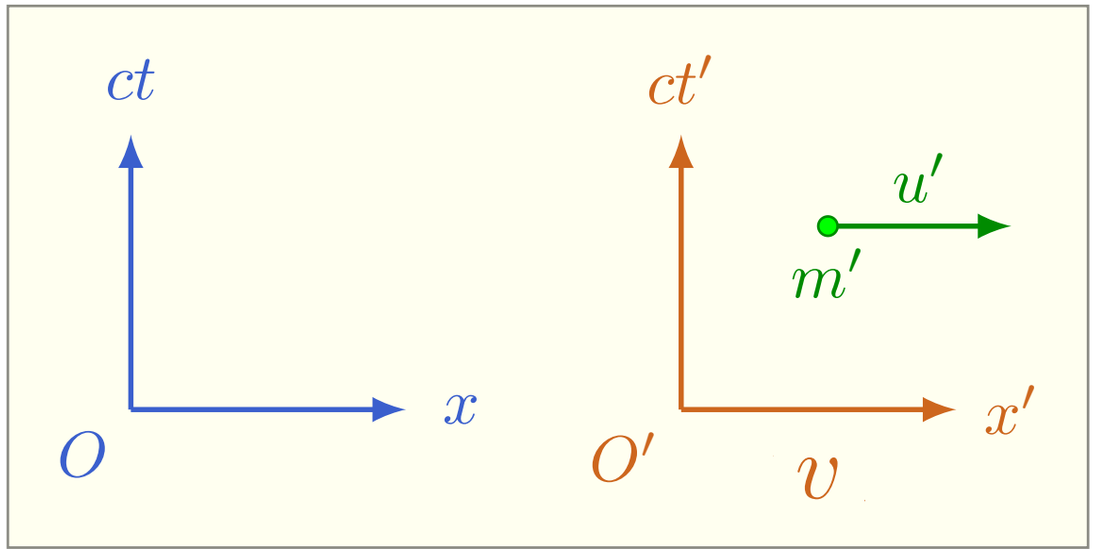
Relatividade restrita

Dinâmica

$$\begin{bmatrix} ct' \\ x' \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} ct \\ x \end{bmatrix}$$

$O \Rightarrow \vec{p}, E$

$O' \Rightarrow \vec{p}', E'$

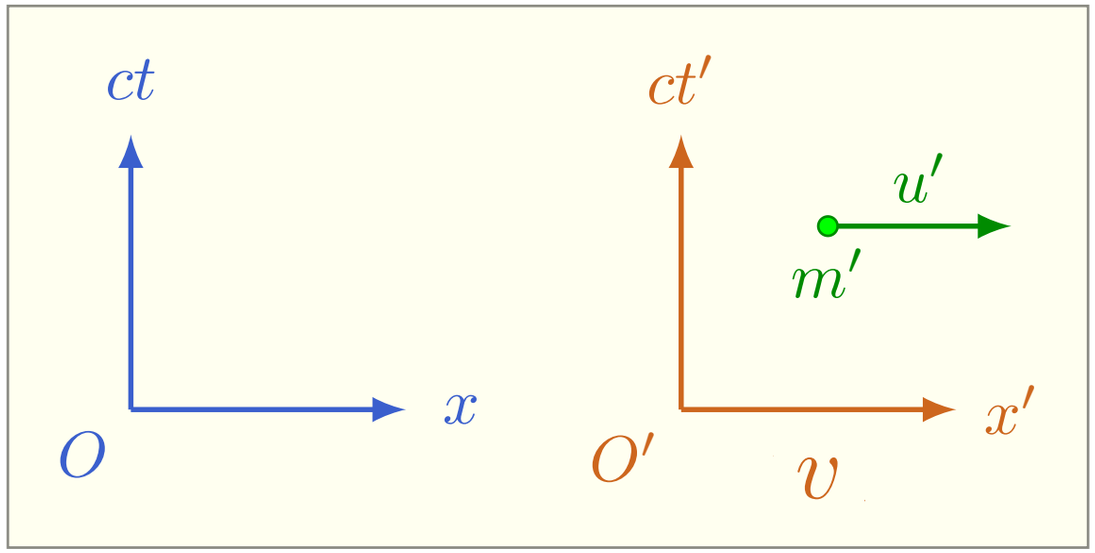


Dinâmica relativístico
A pergunta do Marvin

$$O \Rightarrow \vec{p}, E$$

$$O' \Rightarrow \vec{p}', E'$$

?



Vetores $\vec{r} = x\hat{x} + y\hat{y} + z\hat{z}$

$$\vec{p} = p_x\hat{x} + p_y\hat{y} + p_z\hat{z}$$

Escalares $|\vec{r}| = \sqrt{x^2 + y^2 + y^2}$

t, E

Dinâmica relativístico
A pergunta do Marvin

$$O \Rightarrow \vec{p}, E$$

$$O' \Rightarrow \vec{p}', E'$$

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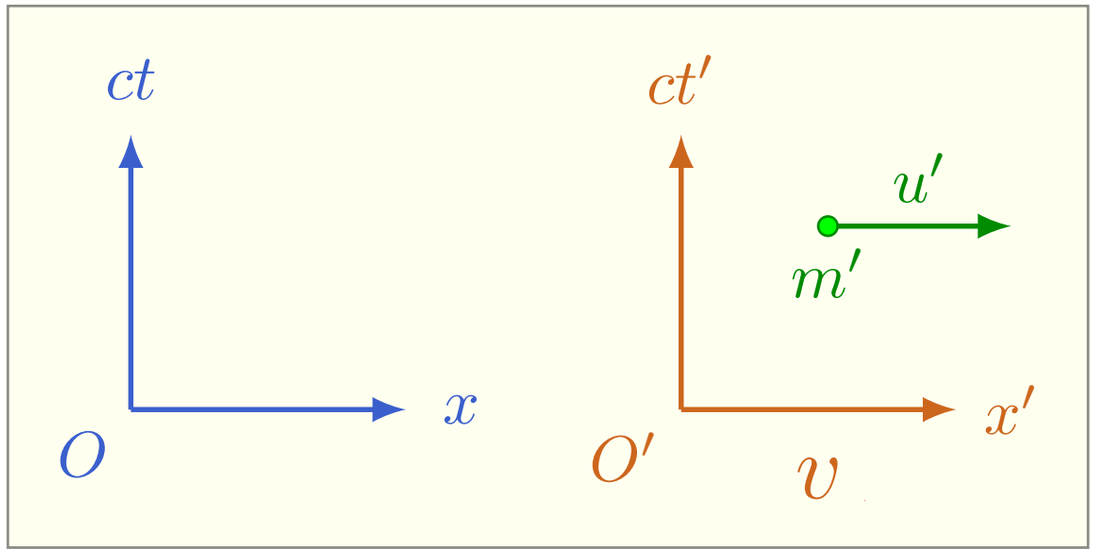


Vetores $\vec{r} = x\hat{x} + y\hat{y} + z\hat{z}$

$$\vec{p} = p_x\hat{x} + p_y\hat{y} + p_z\hat{z}$$

Quadrivetores

Escalares $|\vec{r}| = \sqrt{x^2 + y^2 + y^2}$

$[x, y, z, ct]$

~~t, E~~

$s^2 \equiv x^2 + y^2 + z^2 - c^2t^2$

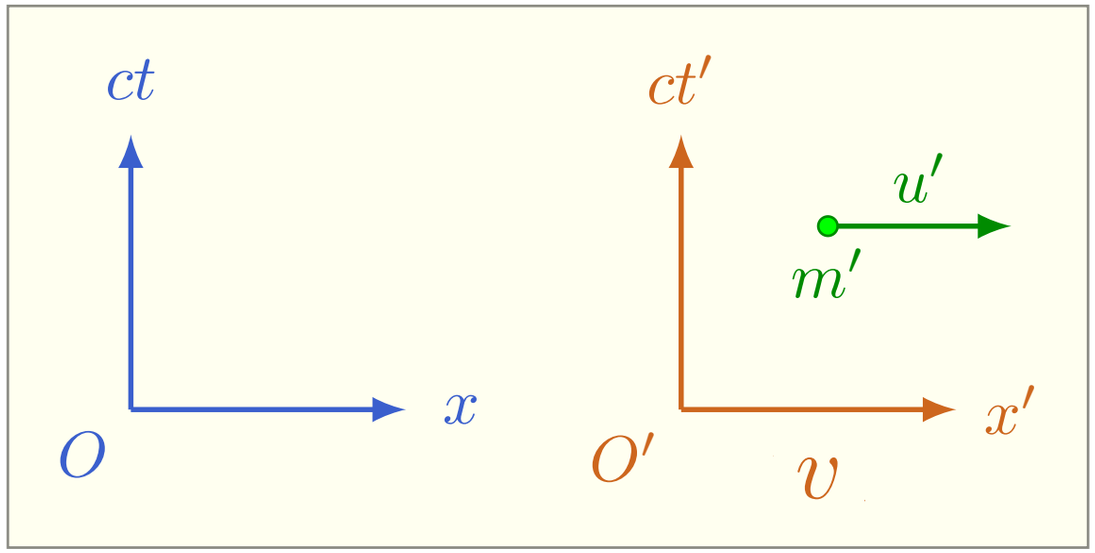
$[p_x, p_y, p_z, \frac{E}{c}]$

Relatividade restrita

Dinâmica

$O \Rightarrow \vec{p}, E$

$O' \Rightarrow \vec{p}', E'$



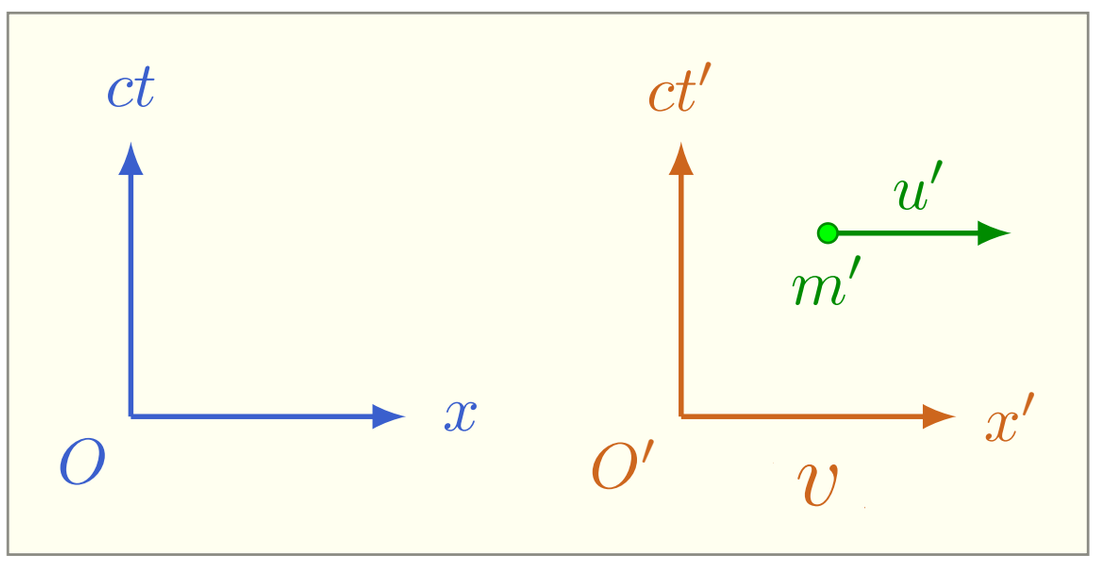
$$\begin{bmatrix} E' \\ p'c \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} E \\ pc \end{bmatrix} \qquad \left(\tanh(a) = \frac{v}{c} \right)$$

$$\left(\tanh(a) = \frac{v}{c}\right)$$

Relatividade restrita

Dinâmica

$$\begin{bmatrix} E' \\ p'c \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} E \\ pc \end{bmatrix}$$



$$u' = 0 \Rightarrow \begin{cases} p = mv \\ p' = 0 \end{cases}$$

$$\begin{bmatrix} E' \\ 0 \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} E \\ mvc \end{bmatrix}$$

$$\left(\tanh(a) = \frac{v}{c}\right)$$

Relatividade restrita

Dinâmica

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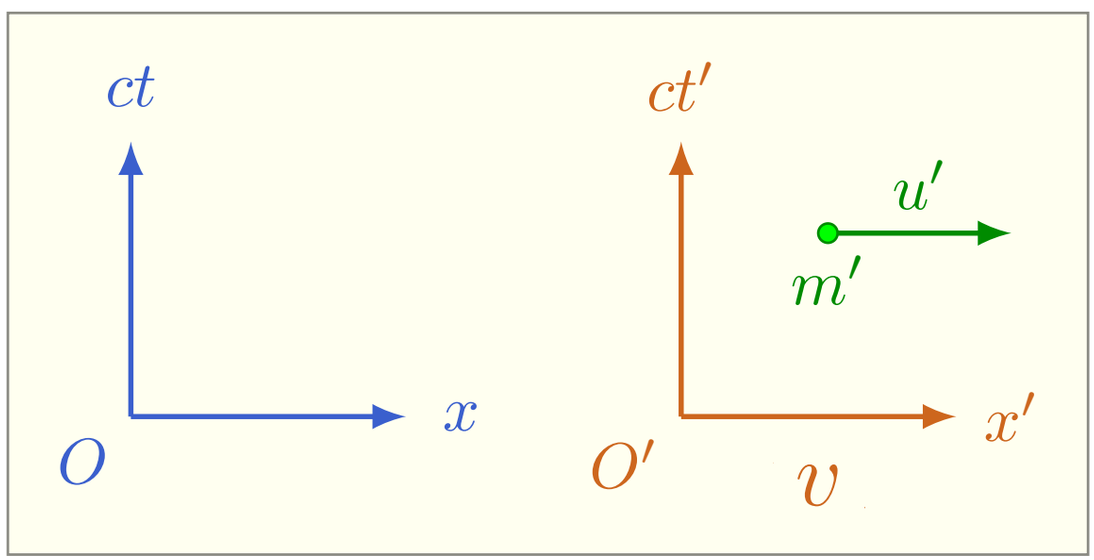


$$0 = -\sinh(a)\,E + mvc\cosh(a) \quad \Rightarrow \tanh(a)\,E = mvc$$

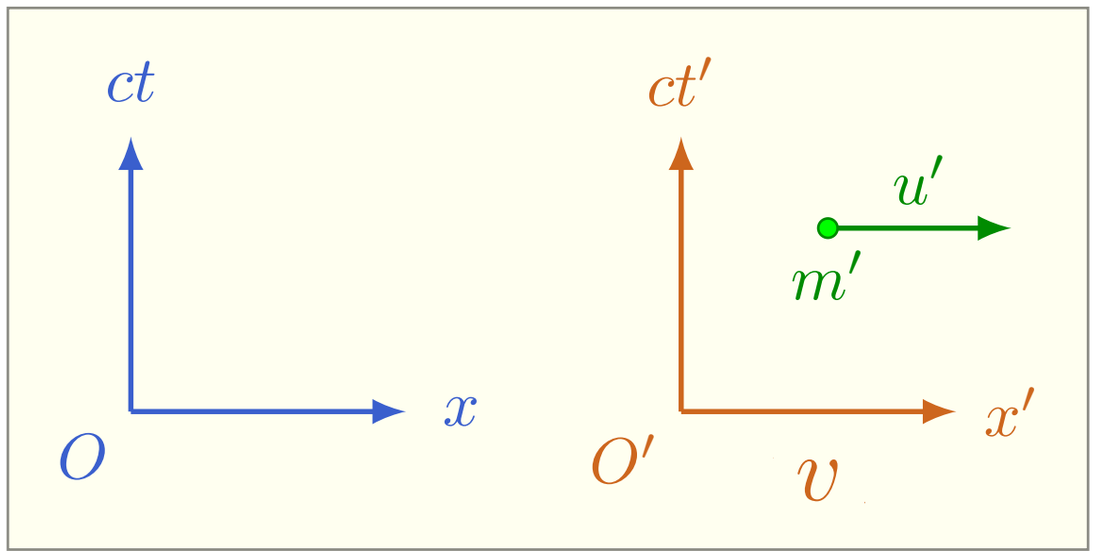
$$E = mc^2$$

$$\left(\tanh(a) = \frac{v}{c}\right)$$

Relatividade restrita

Dinâmica

$$\begin{bmatrix} E' \\ p'c \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} E \\ pc \end{bmatrix}$$



$$\begin{bmatrix} E' \\ 0 \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} E \\ mvc \end{bmatrix}$$

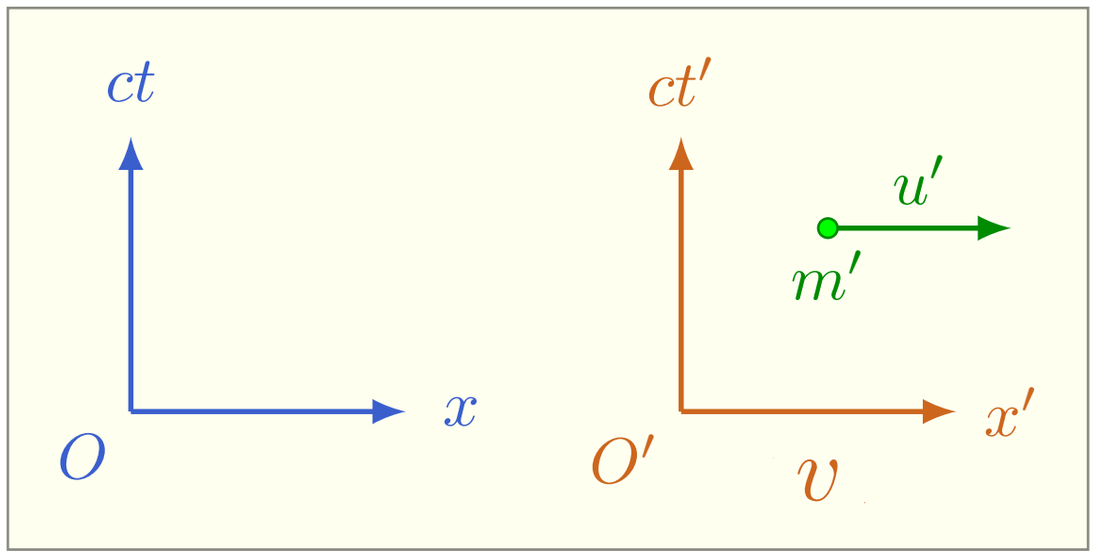
$$E' = \cosh(a)\, E - \sinh(a)\, mvc$$

$$\left(\tanh(a) = \frac{v}{c}\right)$$

Relatividade restrita

Dinâmica

$$\begin{bmatrix} E' \\ p'c \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} E \\ pc \end{bmatrix}$$



$$\begin{bmatrix} E' \\ 0 \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} E \\ mvc \end{bmatrix}$$

$$E' = \cosh(a)\,E - \sinh(a)\,mvc \qquad \Rightarrow E' = \cosh(a)\left(E - \tanh(a)\,mvc\right)$$

$$\tanh(a) = \frac{v}{c}$$

$$E' = \cosh(a)\left(E - \tanh(a)\, mvc\right)$$

$$\tanh(a) = \frac{v}{c}$$

$$E' = \cosh(a)\left(E - \tanh(a)\, mvc\right)$$

$$m'c^2 = \cosh(a)\left(mc^2 - mv^2\right)$$

$$\tanh(a) = \frac{v}{c}$$

$$E' = \cosh(a)\left(E - \tanh(a)\, mvc\right)$$

$$m'c^2 = \cosh(a)\left(mc^2 - mv^2\right)$$

$$m' = \cosh(a)\, m\left(1 - \frac{v^2}{c^2}\right)$$

$$\tanh(a) = \frac{v}{c}$$

$$E' = \cosh(a)\left(E - \tanh(a)\, mvc\right)$$

$$m'c^2 = \cosh(a)\left(mc^2 - mv^2\right)$$

$$m' = \cosh(a)\, m\left(1 - \frac{v^2}{c^2}\right)$$

$$\cosh(a) = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$m' = m\sqrt{1 - \frac{v^2}{c^2}}$$

$$\left(\tanh(a) = \frac{v}{c}\right)$$

Relatividade restrita

Dinâmica

$$\begin{bmatrix} E' \\ p'c' \end{bmatrix} = \begin{bmatrix} \cosh(a) & -\sinh(a) \\ -\sinh(a) & \cosh(a) \end{bmatrix} \begin{bmatrix} E \\ pc \end{bmatrix}$$

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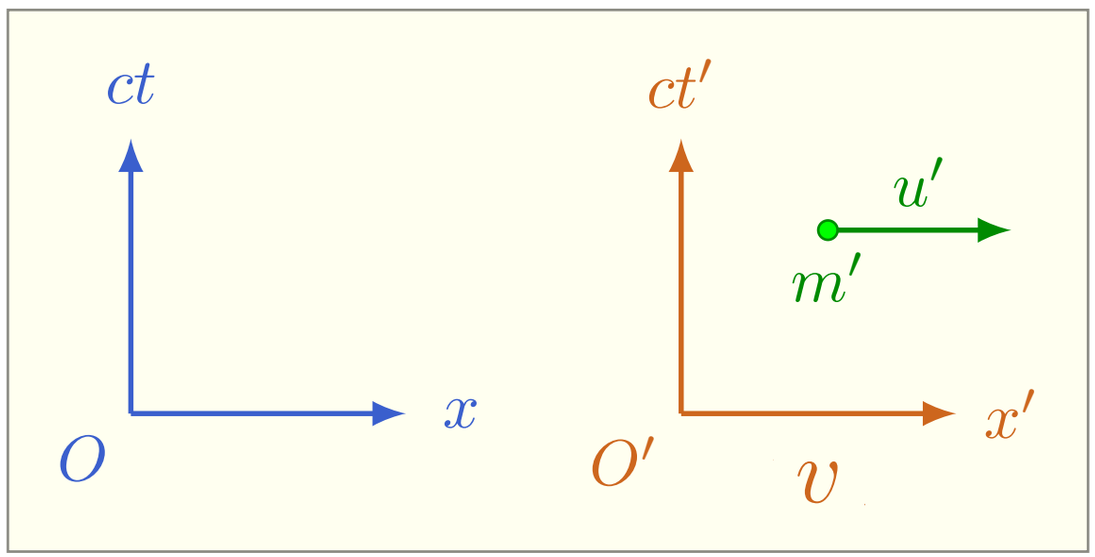

$$E' = \cosh(a)\,E - \sinh(a)\,mvc$$

$$m = \frac{m'}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$\left(\tanh(a) = \frac{v}{c}\right)$$

Relatividade restrita

Dinâmica

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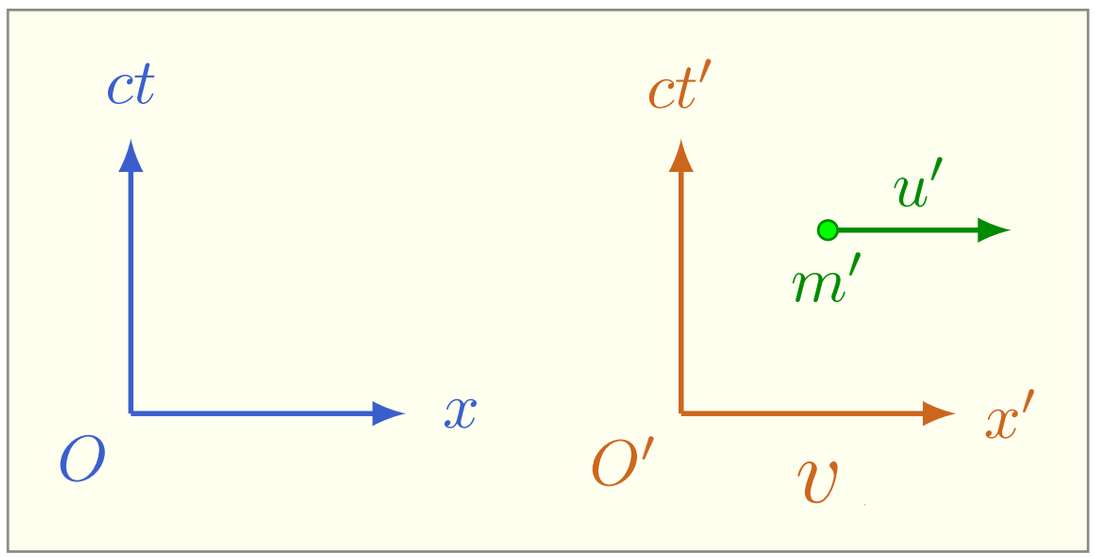


$$E' = \cosh(a)\,E - \sinh(a)\,mvc$$

massa em repouso

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

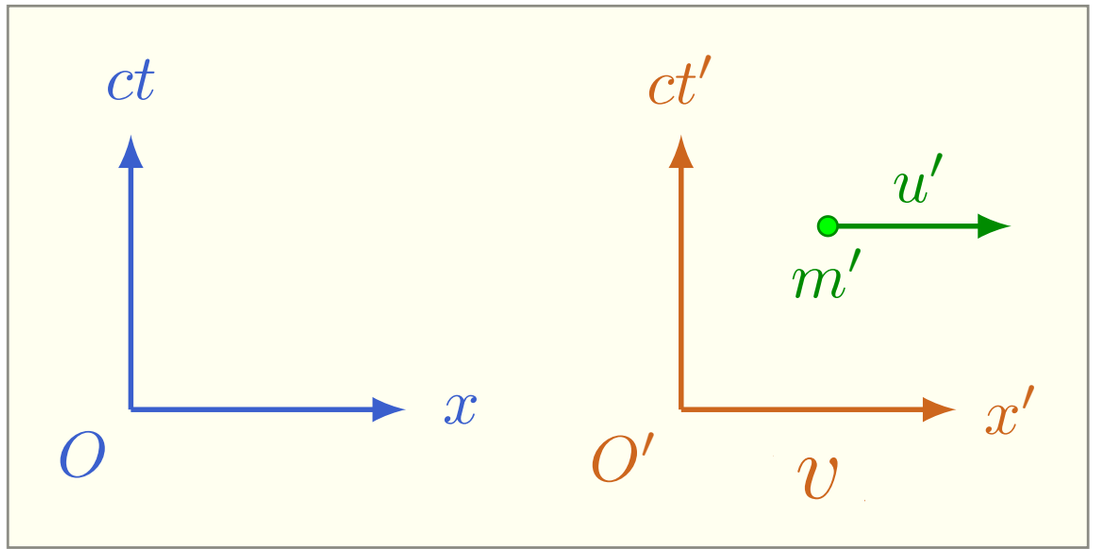
Relatividade restrita

Dinâmica

$$m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$E = mc^2$$

$$E = m_0c^2(1 - \frac{v^2}{c^2})^{-1/2}$$



$$E = m_0c^2(1 + \frac{1}{2}\frac{v^2}{c^2} + \ldots)$$

$$E = m_0c^2 + \frac{1}{2}m_0v^2 + \ldots$$