

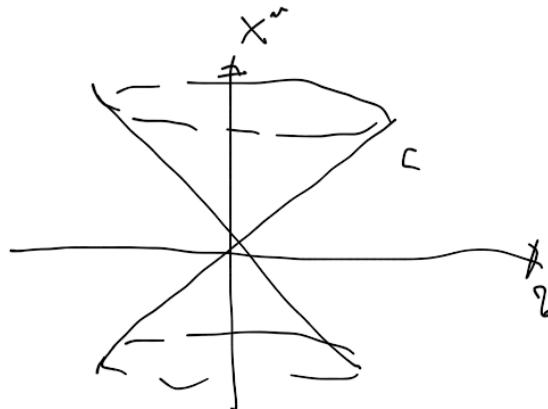
Energia - Monto

$$U^m = \frac{dx^m}{d\tau} \quad ; \quad U = U^m c_m$$

$$U^2 = U \cdot U \quad ; \quad dS^2 = g_{\mu\nu} dx^\mu dx^\nu$$

$$d\tau^2 = -\frac{dS^2}{c^2} \quad \Rightarrow \quad -c^2 d\tau^2 = g_{\mu\nu} dx^\mu dx^\nu$$

$$U^2 = U^m U_m = -c^2$$



Con el tiempo
de los demás mundo.

$$P^m = m U^m ; \quad P^m P_m = m^2 U_m U^m$$

$$P^m P_m = -m^2 c^2$$

$$p^\mu = \left(\frac{E}{c}, p^i \right)$$

$$p^i = 0 \quad \Rightarrow \quad -\frac{E^2}{c^2} = -mc^2$$

$$E = mc^2$$

$$ds^2 = -c^2 d\tau^2 = -c^2 dt^2 + dx^2 + dy^2 + dz^2$$

$$\frac{db}{dt} = \left(1 - \frac{v^2}{c^2} \right)^{1/2}$$

$$u^\mu = \frac{dx^\mu}{d\tau} = \frac{dx^\mu}{dt} \frac{dt}{d\tau} = \gamma v^\mu$$

$$p^\mu = \gamma m v^\mu \quad ; \quad v^0 = c$$

$$p^* = \frac{E}{c} \quad ; \quad \boxed{E = \gamma m c^2}$$

$$[P = P^{\mu} e_{\mu} \quad ; \quad \frac{dP}{d\tau} = U^{\nu} \nabla_{\nu} P^{\mu} e_{\mu}]$$

$$\nabla_{\nu} P^{\mu} = \frac{\partial P^{\mu}}{\partial x^{\nu}} + \Gamma_{\alpha\nu}^{\mu} P^{\alpha}$$

$$P = \bigcup_{\alpha}$$

$$U^{\nu} \nabla_{\nu} P^{\mu} = \frac{d}{d\tau} (n U^{\mu}) + \Gamma_{\alpha\nu}^{\mu} m U^{\alpha} U^{\nu}$$

$$\boxed{\frac{d^2 x^{\mu}}{d\tau^2} + \Gamma_{\alpha\nu}^{\mu} \frac{dx^{\alpha}}{d\tau} \frac{dx^{\nu}}{d\tau} = 0}$$

$$\tilde{P}_{\alpha\nu}^1 = 0$$

$$\frac{d^2 X^\mu}{d \tilde{b}^2} = 0 \quad \Rightarrow \quad \text{Eq. de rotar.}$$

$$\tilde{F} = \frac{d \tilde{P}}{d \tilde{b}} = F^\mu \mathcal{E}_\mu$$

$$\boxed{F^\mu = \tilde{v}^\nu \nabla_\nu \tilde{P}^\mu}$$

- Recuperando a notação 3D

$$\vec{P} = p^i \mathcal{E}_i \quad ; \quad \vec{P} = \left(\frac{E}{c}, \vec{p} \right)$$

$$p^\mu p_\mu = -m^2 c^2$$

$$p^0 p_0 + p^i p_i = -m^2 c^2 \quad ; \quad p_0 = -P^0$$

$$-\frac{E^2}{c^2} + \vec{P} \cdot \vec{P} = -m^2 c^2$$

$$\vec{p} \cdot \vec{p} = p^2$$

$$-\frac{E^2}{c^2} + p^2 = m^2 c^2$$

$$E = c \left(m^2 c^2 + p^2 \right)^{1/2}$$