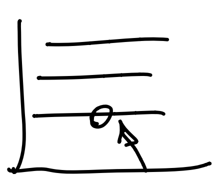
FISICA NUCLEARE E SUBNUCLEARE

DI COSA E' FATTO L'UNIVERSO?

PARTICELLA

- se non si può più dividere

DO ENERGIA AL "CANDIDATO PARTICELLA" E VEDO SE VA TUTTA IN MOVIMENTO OPPURE NO

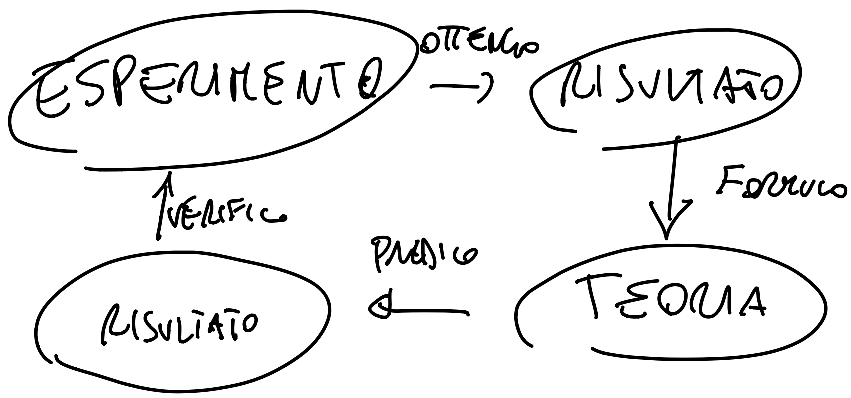


$E = h\nu$

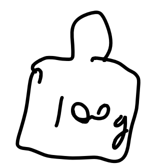
se $E > 13.6$ eV

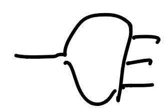
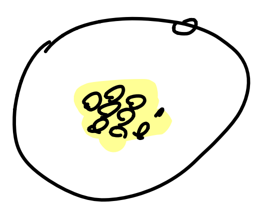
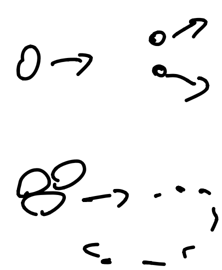
$\rightarrow$ estirpo l'e^-

$\Rightarrow$ H non era una particella



Forze

- GRAVITAZIONE 

- EM 
- FORTE 
- DEBOLE 

- $\vec{F} = G \frac{m_1 m_2}{r^2} \hat{r}$

- Michelson-Morley

  c = cost & <u>invariante</u>

- $i\hbar \frac{\partial |\psi\rangle}{\partial t} = H |\psi\rangle$

$$\Delta p \, \Delta x \geq \frac{\hbar}{2}$$

DEVO APPLICARE MQ

aumentare p (alte energie)

Tecnologia

MQR

RELATIVITA' SPECIALE

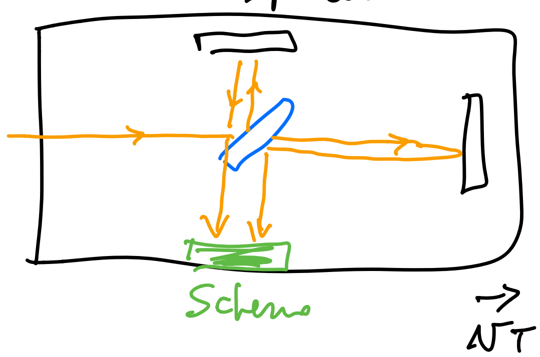
in Schroedinger

$$H \to p^2/2m$$

$$\vec{p} = -i\hbar\vec{\nabla}$$

$\boxed{\text{RELATIVITA'}}$

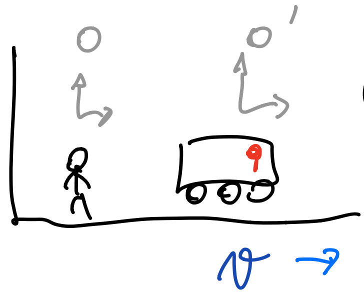
Michelson



CAMMINO // a $\vec{v}_T$: $c \pm v$

$\perp$: $c = c$

$$\boxed{c = 3 \cdot 10^8 \ m/s \quad \text{IN OGNI SIST. DI RIF.}}$$



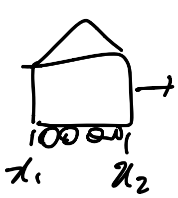
GALILEO
$$\begin{cases} x' = x - vt \\ t' = t \end{cases}$$

LORENTZ
$$\begin{cases} x' = (x - vt)\dfrac{1}{\sqrt{1 - v^2/c^2}} \\ t' = \left(t - \dfrac{v}{c^2}x\right)\dfrac{1}{\sqrt{1 - v^2/c^2}} \\ y' = y \\ z' = z \end{cases}$$

$$\beta = v/c$$

$$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}} = \frac{1}{\sqrt{1 - \beta^2}}$$

— CONTRAZIONE DELLE LUNGHEZZA



$$\begin{cases} x_1' = (x_1 - vt)\dfrac{1}{\sqrt{1 - v^2/c^2}} \\ x_2' = (x_2 - vt)\dfrac{1}{\sqrt{1 - v^2/c^2}} \end{cases}$$

$$\Delta x' = x_2' - x_1' = \Delta x \cdot \frac{1}{\sqrt{1 - v^2/c^2}} \equiv \Delta x \cdot \gamma$$

$$\Delta x = \frac{\Delta x'}{\gamma}$$] NEL RIF. DELL'OGGETTO

$$V = \frac{V}{\gamma}$$

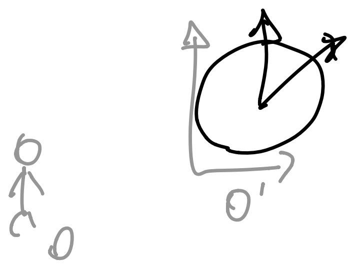
$$\rho = \rho \cdot \gamma$$

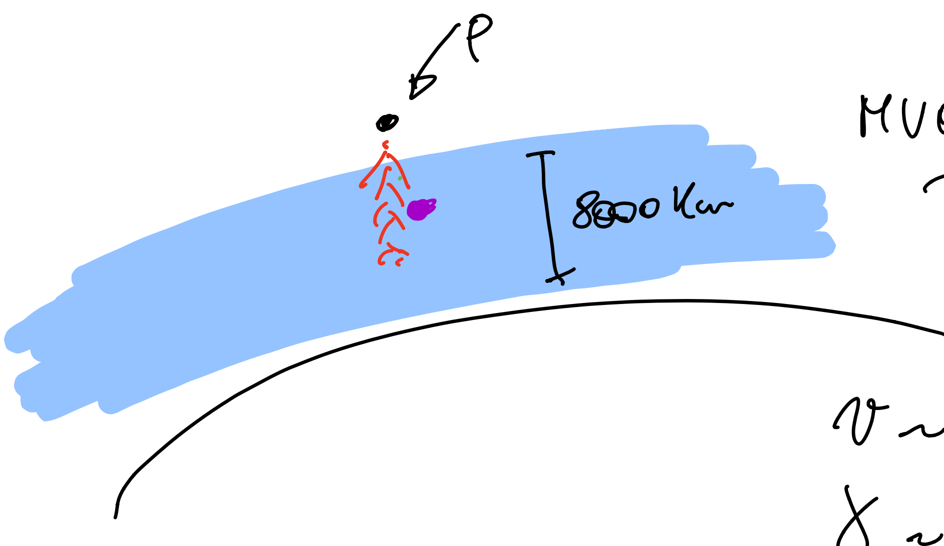
– DILATAZIONE DEI TEMPI

$$t = \left(t' + \frac{v}{c^2} x\right) \cdot \gamma$$

$$\Delta t = \Delta t' \cdot \gamma + \frac{v}{c^2} \gamma \cdot \Delta x'$$

$$= \Delta t' \gamma$$





MUONE

$$\tau = 2.2 \mu s$$

$$v \sim 0.998 c$$

$$\gamma \simeq 15$$

GALILEO: $\Delta x = v \cdot \tau = 600 m$

LORENTZ: $\Delta x = v \cdot \gamma \cdot \tau = 10\,km$

SPAZIO-TEMPO

- Galileo: $(\Delta x)^2$

- Lorentz:

$t \to ct$

$$\begin{cases} x' = \gamma x - \beta\gamma t \cdot c \\ ct' = \gamma ct - \beta\gamma x \end{cases}$$

D^2:

$$\begin{cases} (x')^2 = \gamma^2 x^2 + \beta^2\gamma^2 (ct)^2 - 2\beta\gamma^2 xct \\ (ct')^2 = \gamma^2 (ct)^2 + \beta^2\gamma^2 x^2 - 2\beta\gamma^2 xct \end{cases}$$

$$(ct')^2 - (x')^2 = -\left[\gamma^2 x^2 + \beta^2\gamma^2 (ct)^2\right] + \left[\gamma^2 (ct)^2 + \beta^2\gamma^2 x^2\right]$$

$$= (ct)^2\left[\gamma^2 - \beta^2\gamma^2\right] - (x)^2\left[\gamma^2 - \beta^2\gamma^2\right]$$

$$= \left[(ct)^2 - (x)^2\right]\left[\gamma^2 - \beta^2\gamma^2\right]$$

$$\gamma^2 - \beta^2\gamma^2 = \gamma^2(1-\beta^2) = \left(\frac{1}{\sqrt{1-\beta^2}}\right)^2 (1-\beta^2) = 1$$

$$\Delta s^2 = c\Delta t^2 - \Delta x^2$$ $\Rightarrow$ è invariante

$$ds^2 = c\,dt^2 - dx^2$$

$\downarrow$ aggiungendo y e z

$$ds^2 = c\,dt^2 - dx^2 - dy^2 - dz^2$$

$$d\tau = \frac{ds}{c}$$ TEMPO PROPRIO

$P \rightarrow$ rappresentato con COORDINATE

$$\underline{\underline{ds^2}} = \underline{A} \cdot \underline{B}$$

A, B vettori contravarianti

$$x^\mu = \begin{pmatrix} x^0 \\ x^1 \\ x^2 \\ x^3 \end{pmatrix}$$

$x^0 = ct$
$x^1 = x$
$x^2 = y$
$x^3 = z$

vettore covariante

$$x_\mu = \begin{pmatrix} x_0 \\ x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

$$x_0 = ct$$
$$x_1 = -x$$
$$x_2 = -y$$
$$x_3 = -z$$