

# LA FISICA DELLE PARTICELLE

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# IL MODELLO STANDARD

Three Generations of Matter (Fermions)

	I	II	III	
mass →	2.4 MeV	1.27 GeV	171.2 GeV	0
charge →	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$	0
spin →	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1
name →	<b>u</b> up	<b>c</b> charm	<b>t</b> top	<b>γ</b> photon
Quarks	4.8 MeV	104 MeV	4.2 GeV	0
	$-\frac{1}{3}$	$-\frac{1}{3}$	$-\frac{1}{3}$	0
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1
	<b>d</b> down	<b>s</b> strange	<b>b</b> bottom	<b>g</b> gluon
Leptons	< 2.2 eV	< 0.17 MeV	< 15.5 MeV	91.2 GeV
	0	0	0	0
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1
	<b>ν<sub>e</sub></b> electron neutrino	<b>ν<sub>μ</sub></b> muon neutrino	<b>ν<sub>τ</sub></b> tau neutrino	<b>Z</b> weak force
	0.511 MeV	105.7 MeV	1.777 GeV	80.4 GeV
	-1	-1	-1	±1
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1
	<b>e</b> electron	<b>μ</b> muon	<b>τ</b> tau	<b>W<sup>±</sup></b> weak force
				Bosons (Forces)

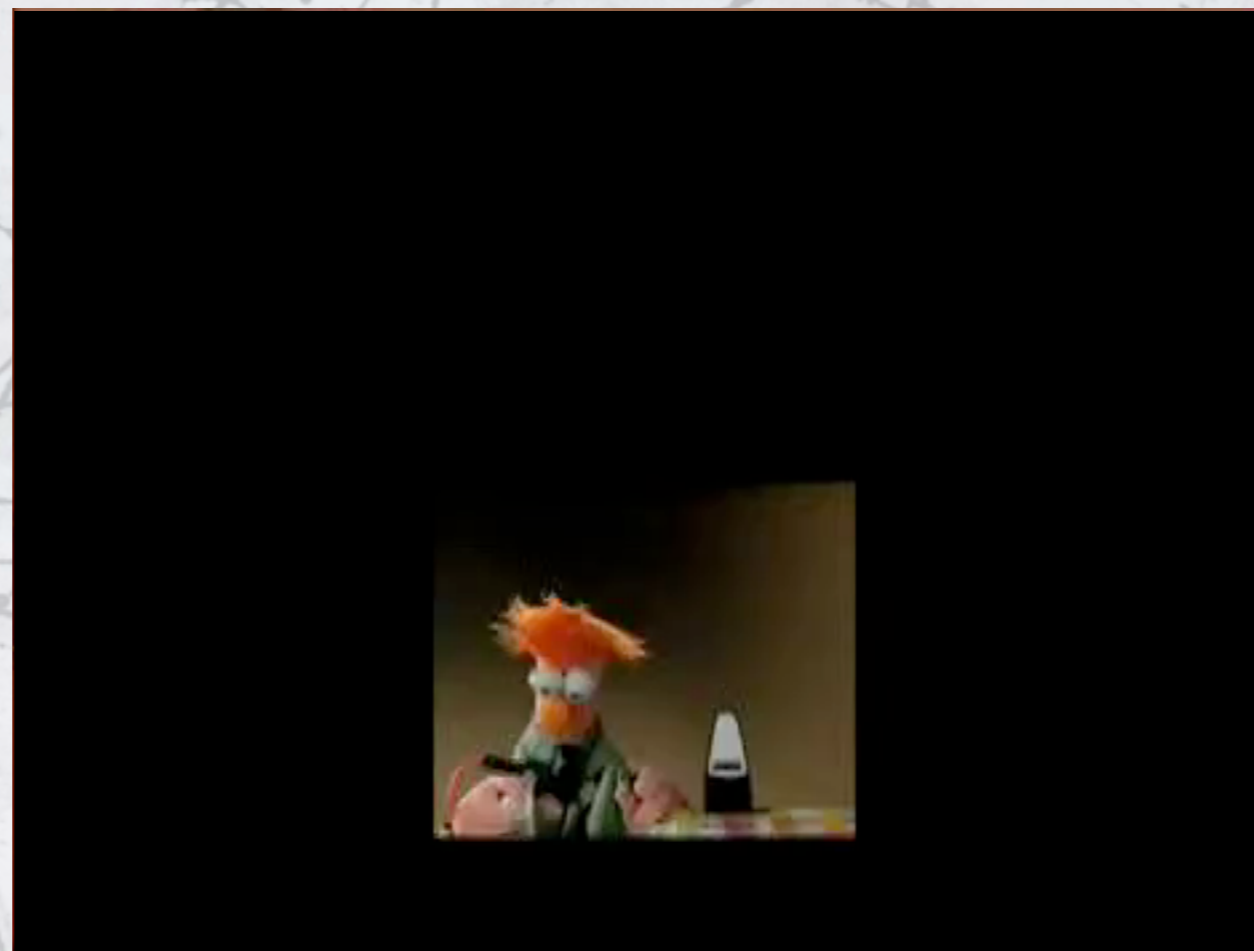
# LA FISICA DELLE PARTICELLE

Forze

Materia



# LE FORZE

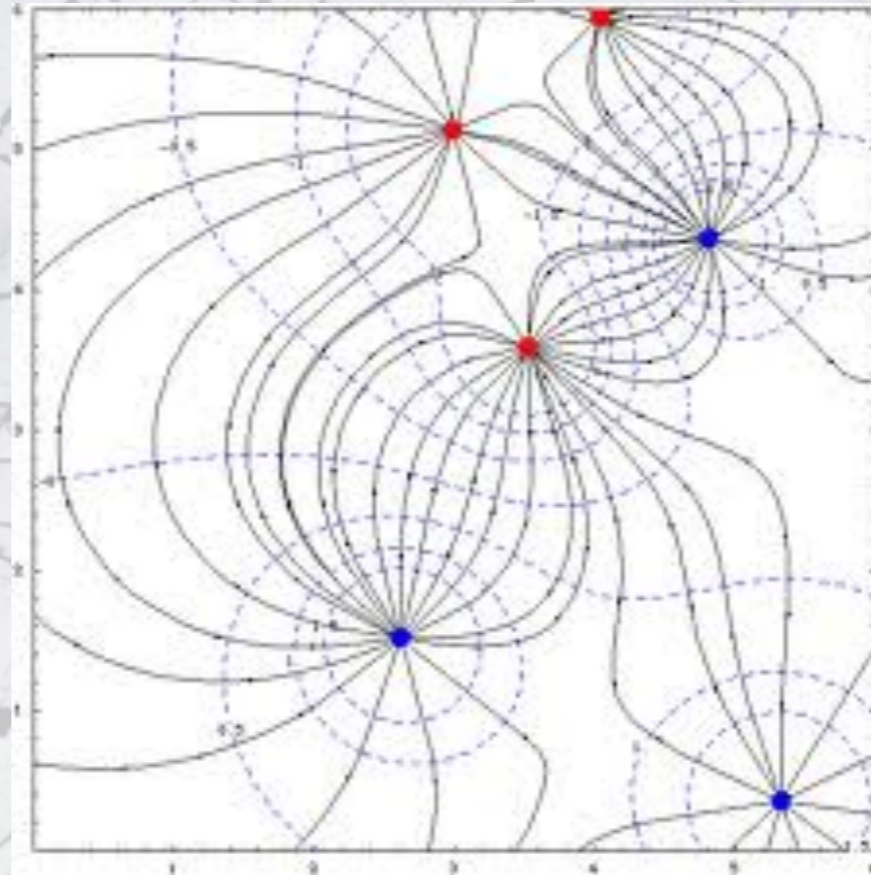


# LE FORZE

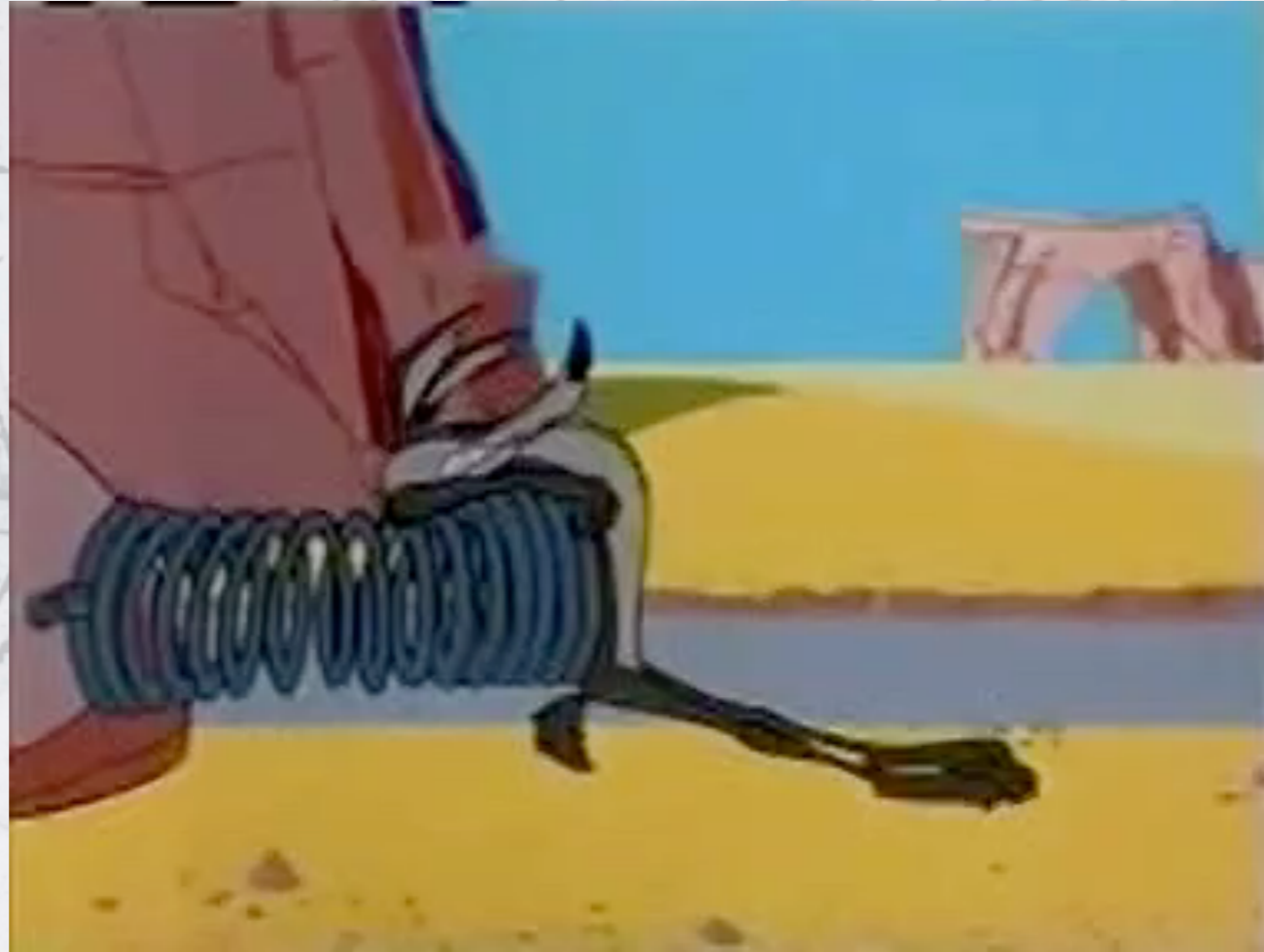


# Forze Fondamentali

# FORZE FONDAMENTALI



# FORZE NON FONDAMENTALI



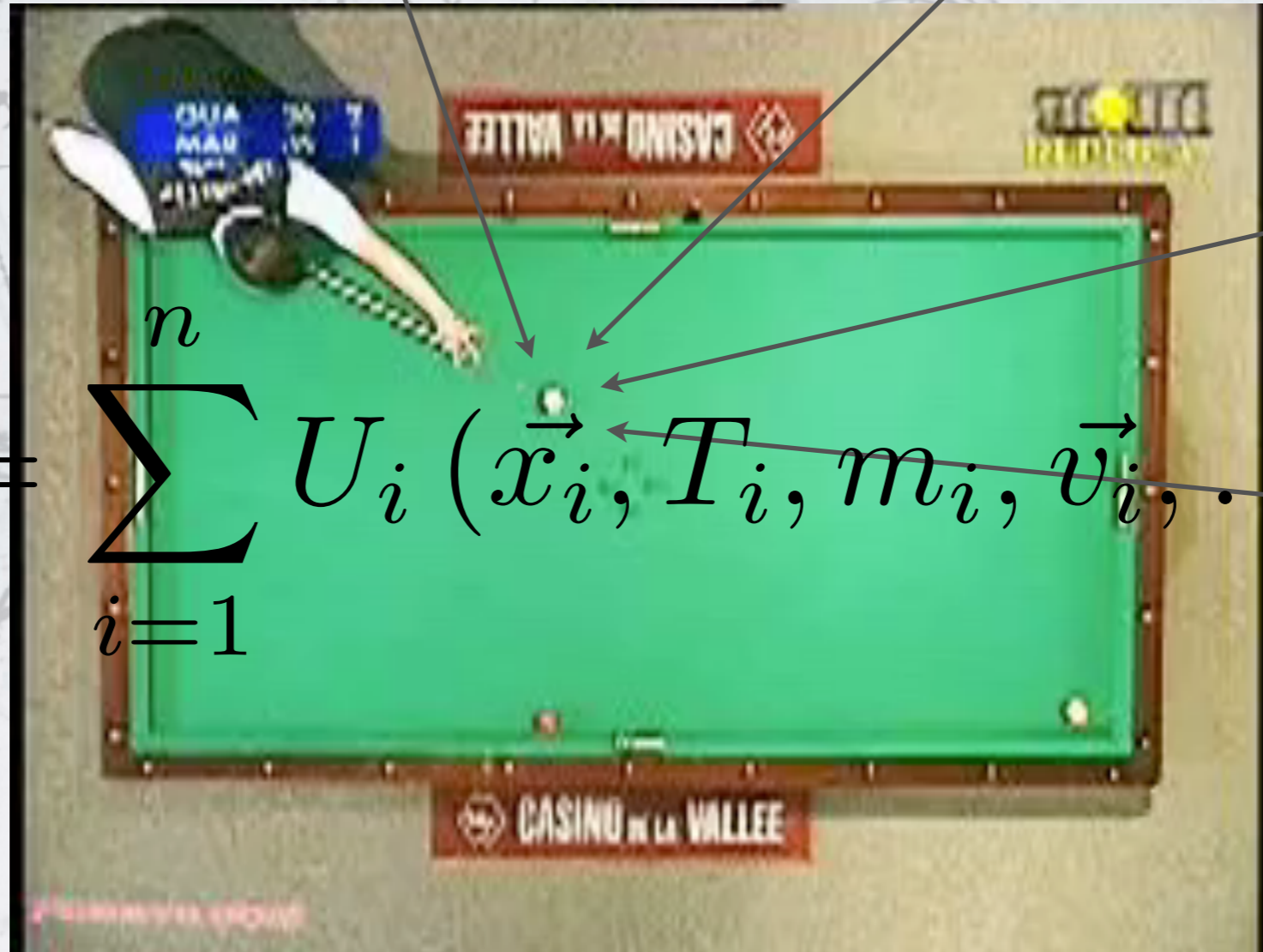
# PARTICELLE IN CAMPO

Posizione

Temperatura

Massa

Velocità



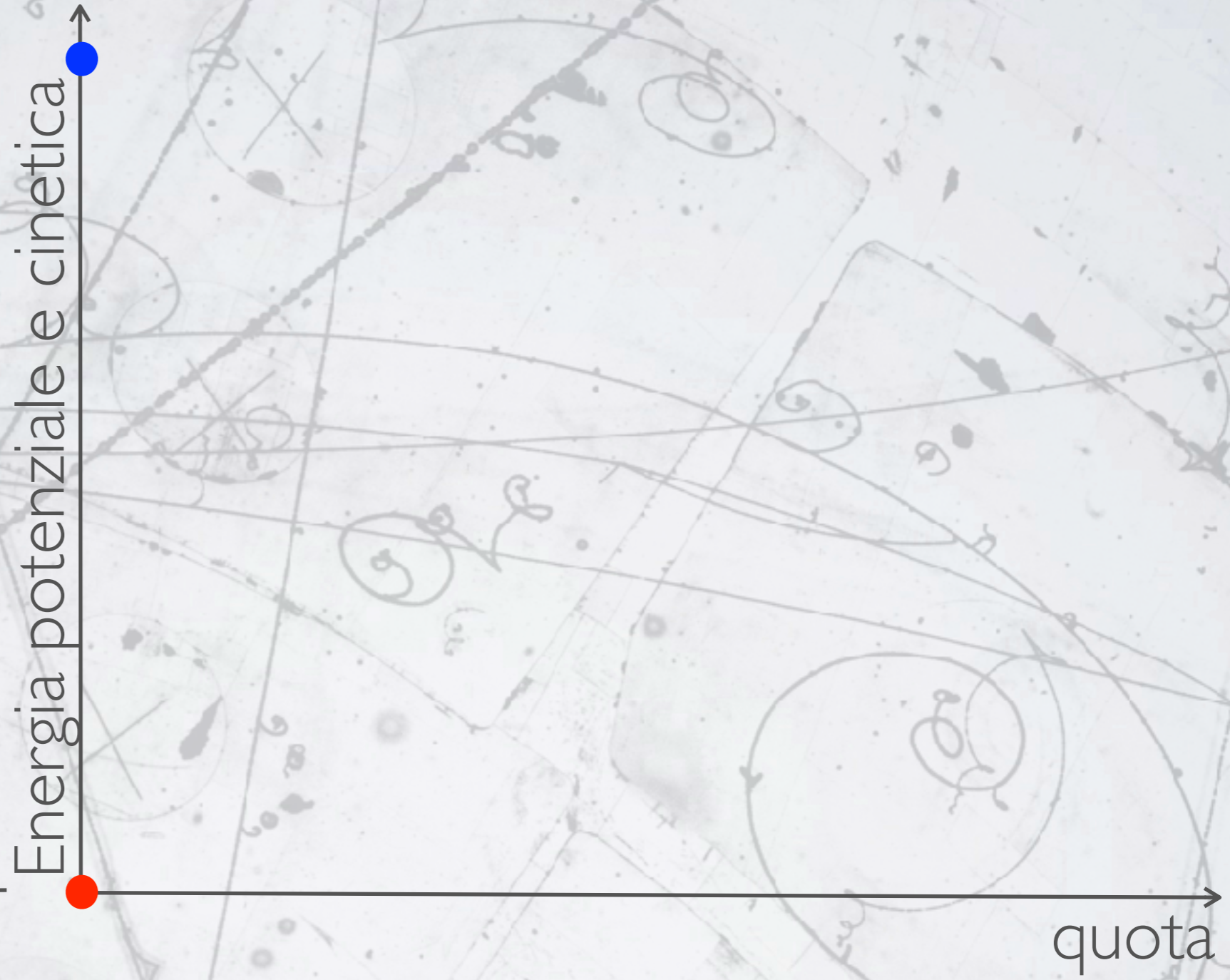
$$U = \sum_{i=1}^n U_i (\vec{x}_i, T_i, m_i, \vec{v}_i, \dots)$$

# SISTEMI ISOLATI

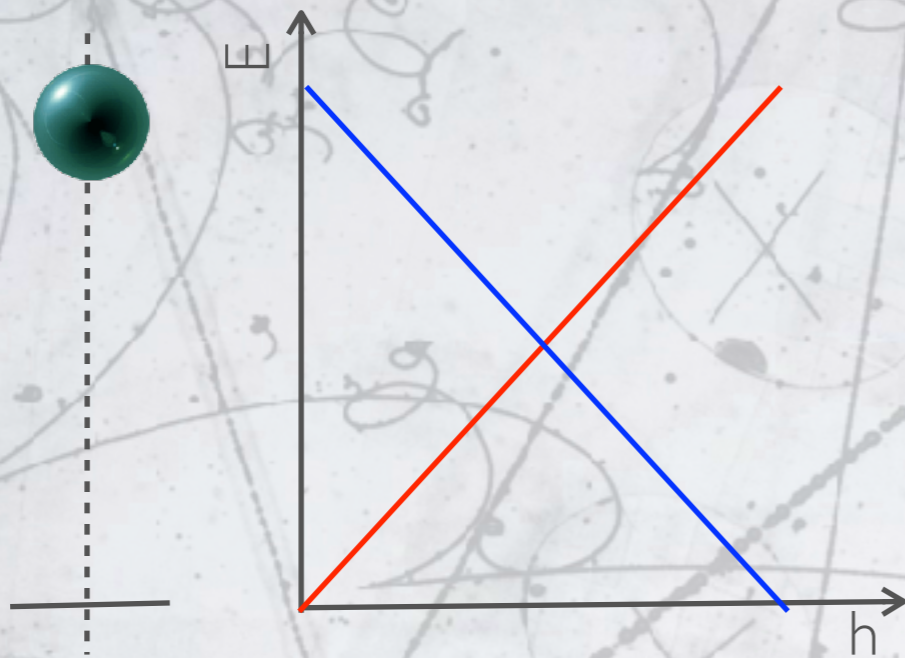
$$\vec{x}_i = x_i(t) \quad T_i = T_i(t) \quad m_i = m_i(t) \quad \vec{v}_i = v_i(t)$$

$$\Delta U = 0$$

# ESEMPIO



# ESEMPIO



$$\frac{1}{2}mv^2 + mgh = \text{cost}$$

$$mv \frac{dv}{dt} = mg \frac{dh}{dt} \Rightarrow m \cancel{v} a = mg \cancel{v} \Rightarrow mg = F$$

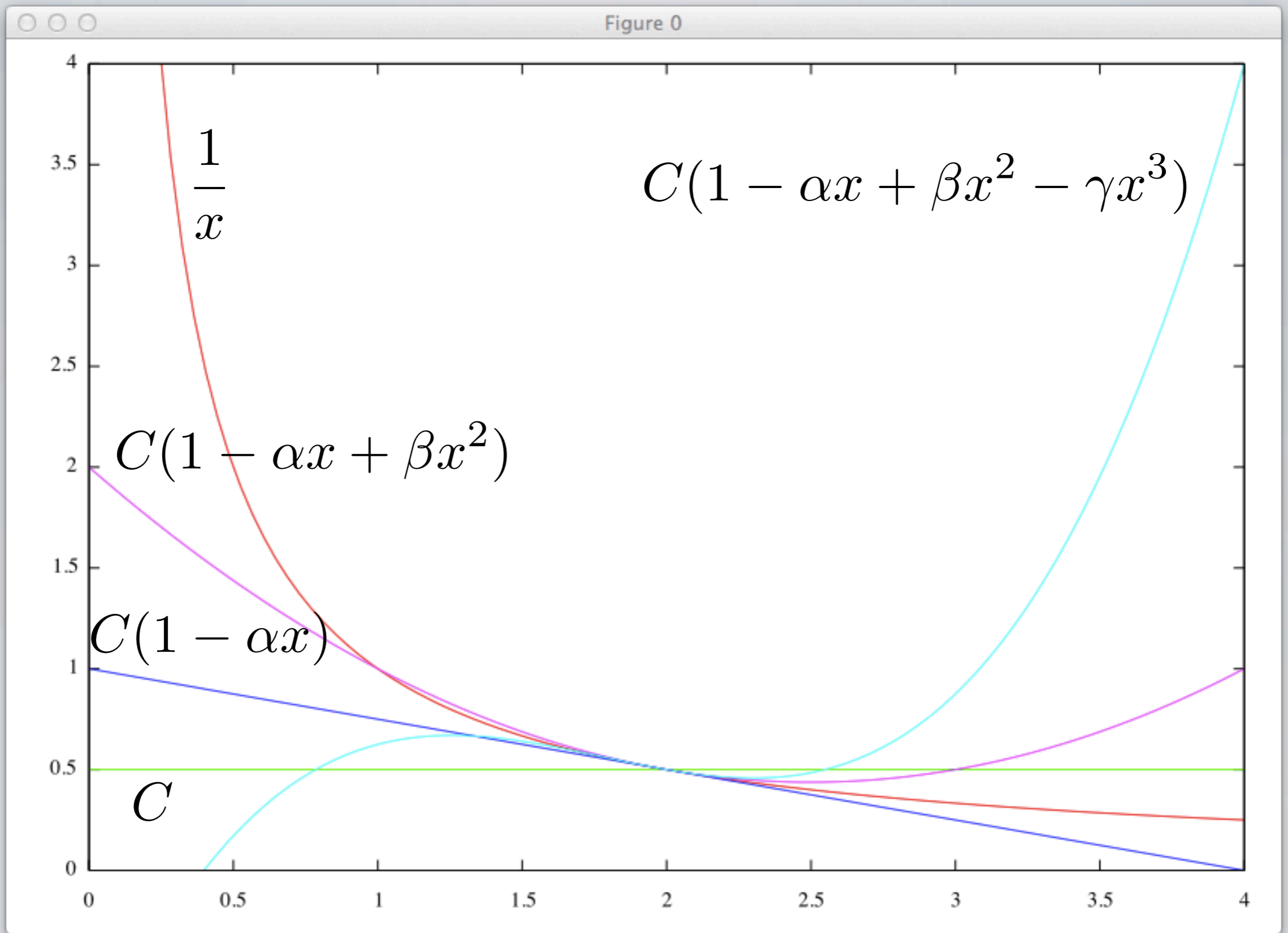
# POTENZIALI DEBOLI

$$U = mgh + C$$

# POTENZIALI DEBOLI

$$U = -G \frac{M}{r}$$

$$U = mgh + C$$



# POTENZIALI DEBOLI

$$U = -G \frac{M}{r} \simeq -G \frac{M}{r_0} \left( 1 + \frac{\delta r}{r_0} - \frac{\delta r^2}{r_0^2} + \dots \right)$$

$$U = -G \frac{M}{r}$$

$$U = mgh + C$$

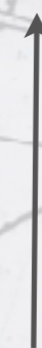
# L'EQUAZIONE DELL'UNIVERSO

Interazione



$$U = \alpha \bar{\psi} A \psi$$

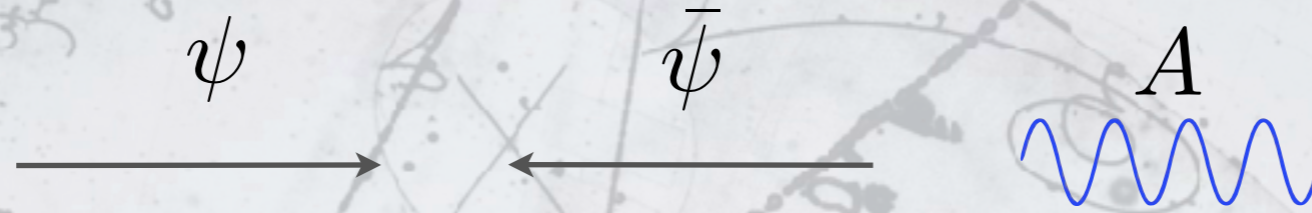
Particelle di materia



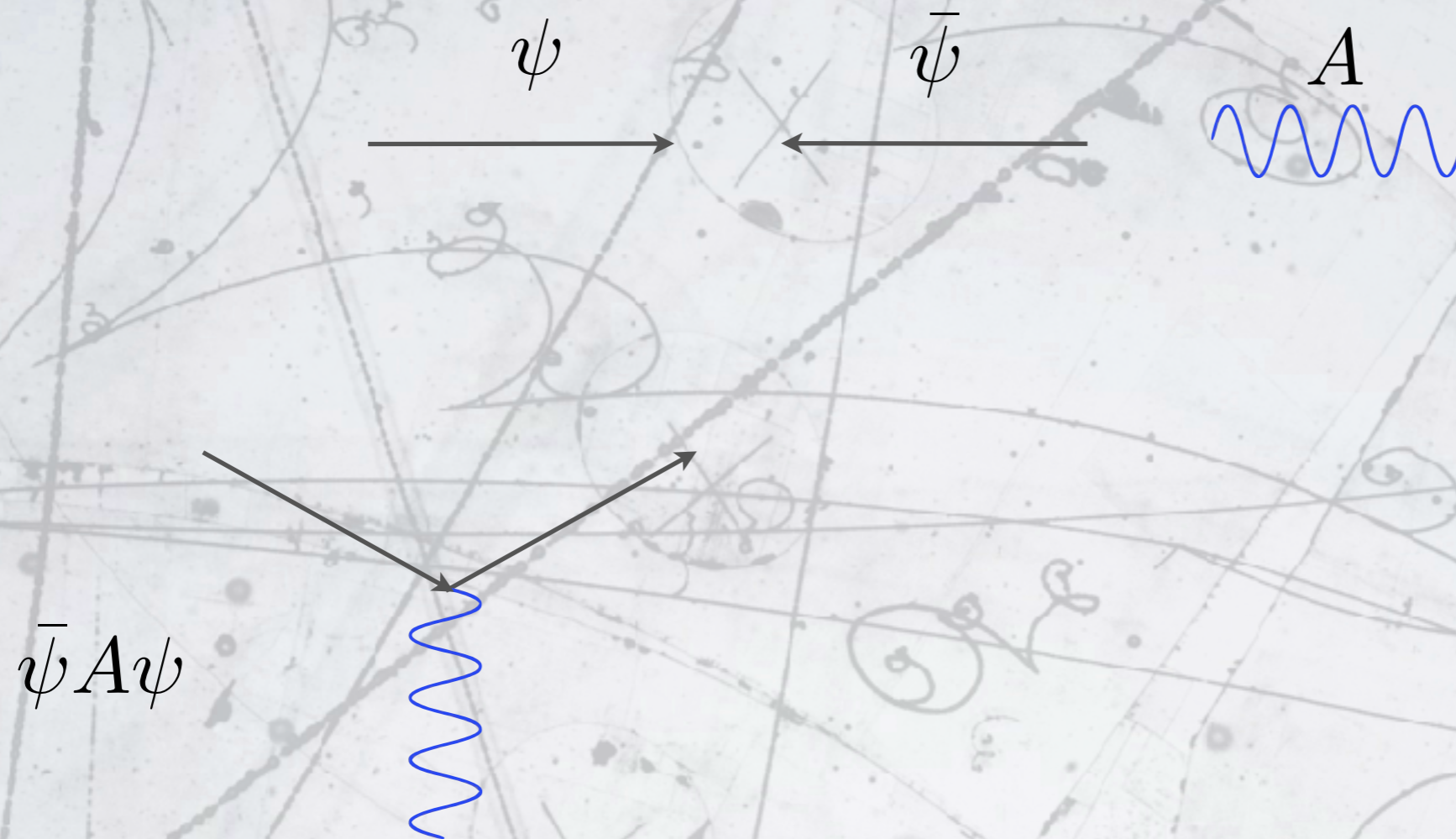
# L'EQ. APPROSSIMATA

$$U \simeq U_0 \left( 1 - \alpha \bar{\psi} A \psi + \frac{\alpha^2}{2} (\bar{\psi} A \psi)^2 + \dots \right)$$

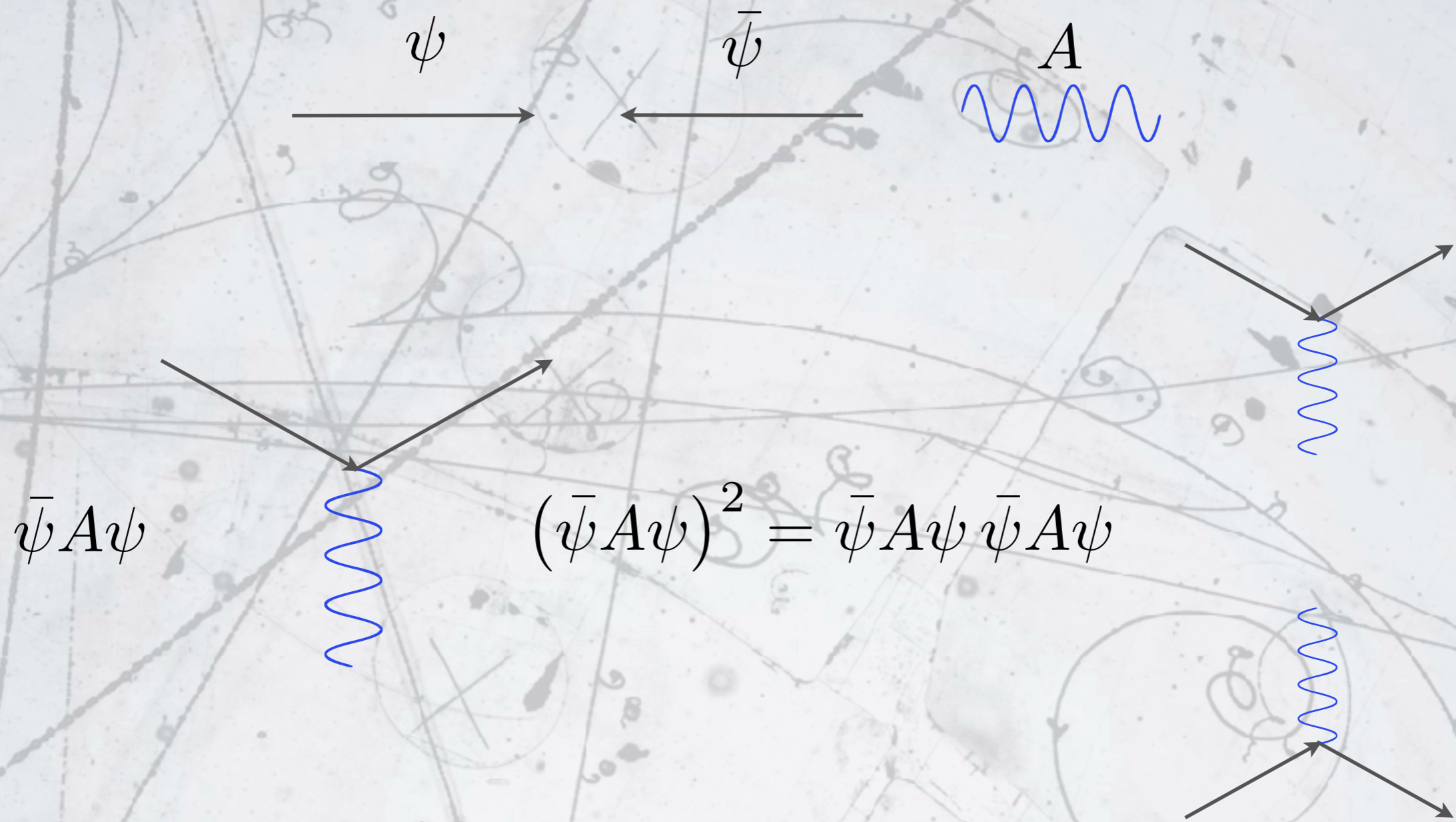
# DIAGRAMMI DI FEYNMAN



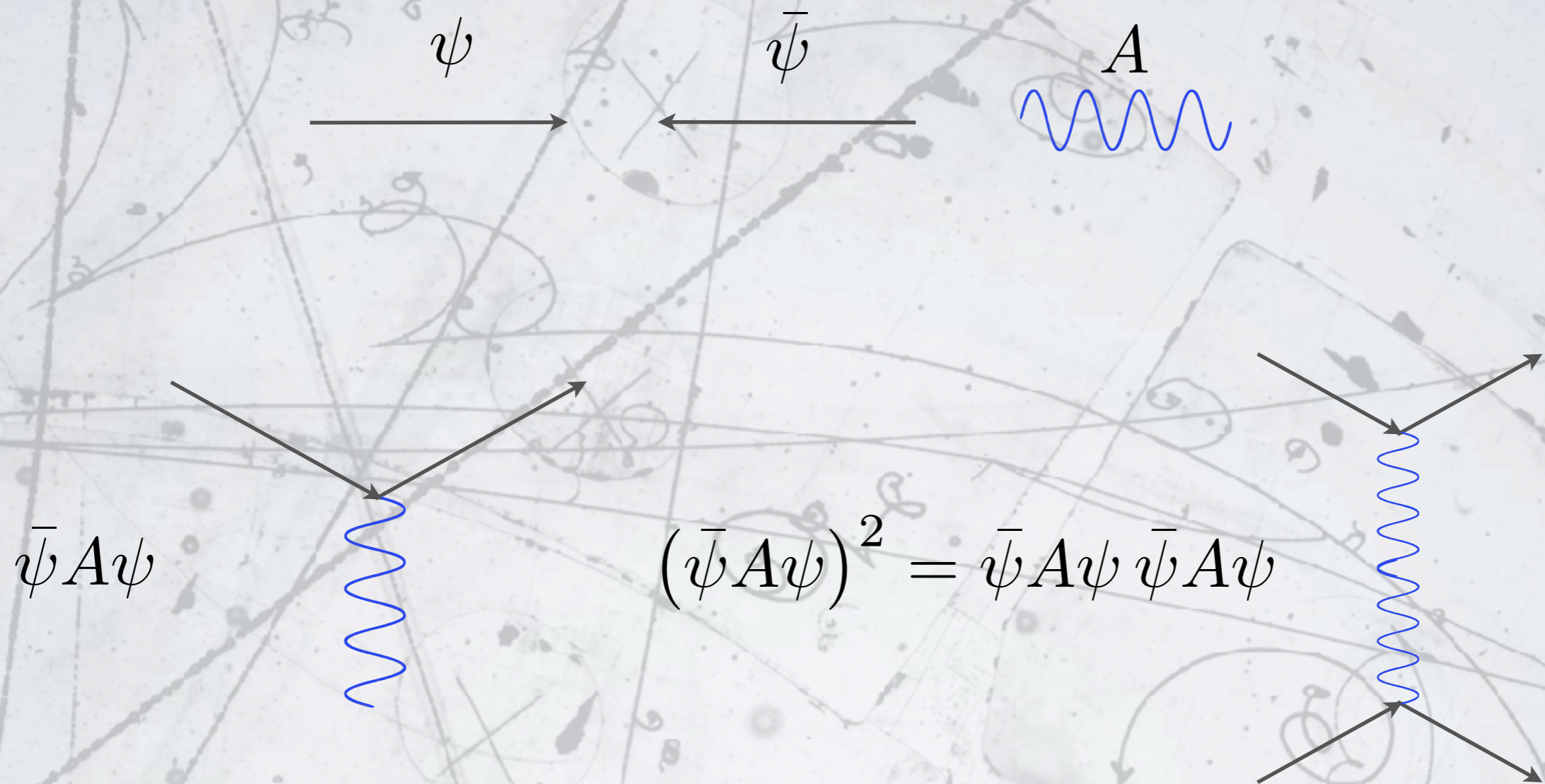
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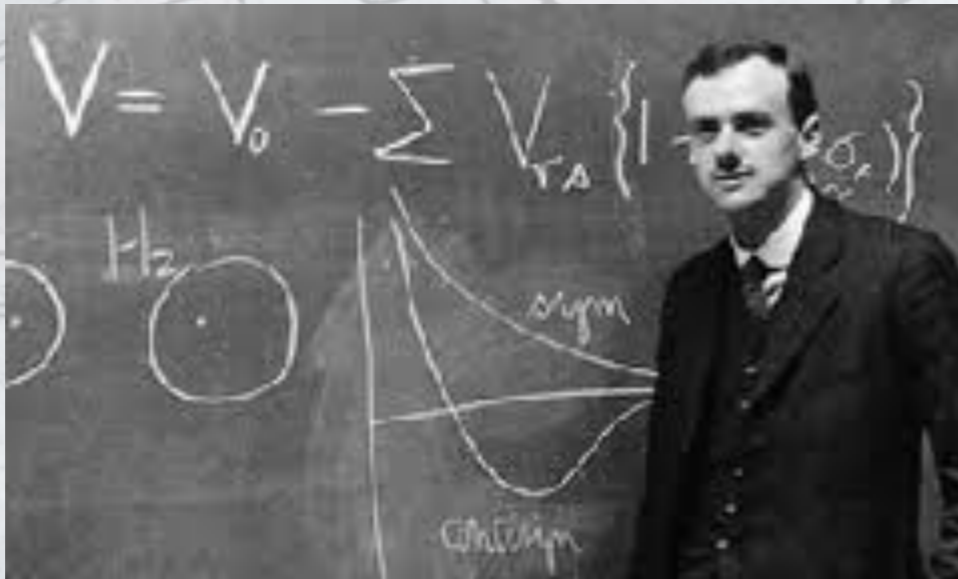
# DIAGRAMMI DI FEYNMAN



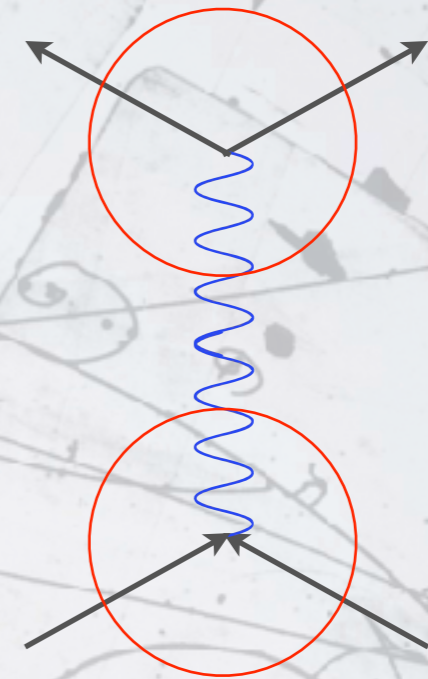
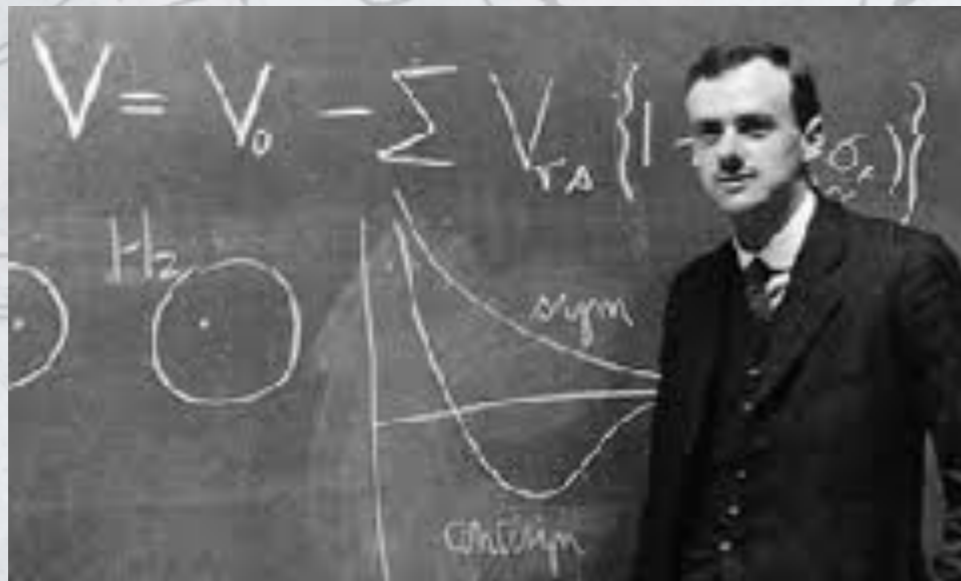
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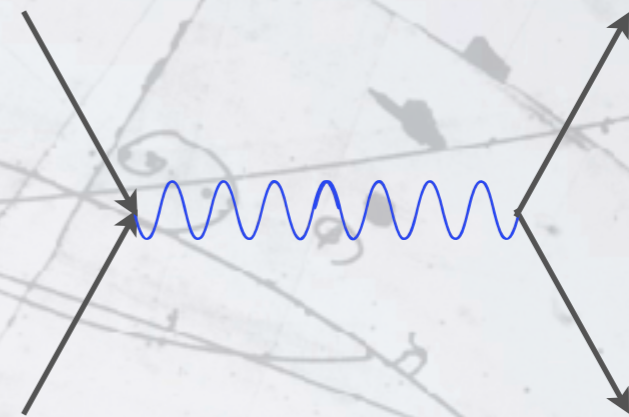
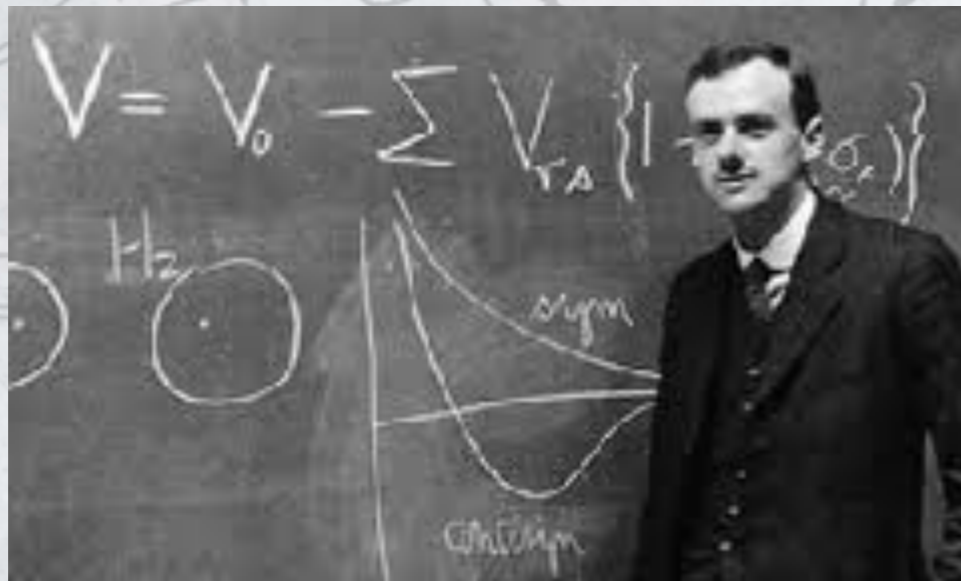
# LE ANTIPARTICELLE



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# I COLLISORI

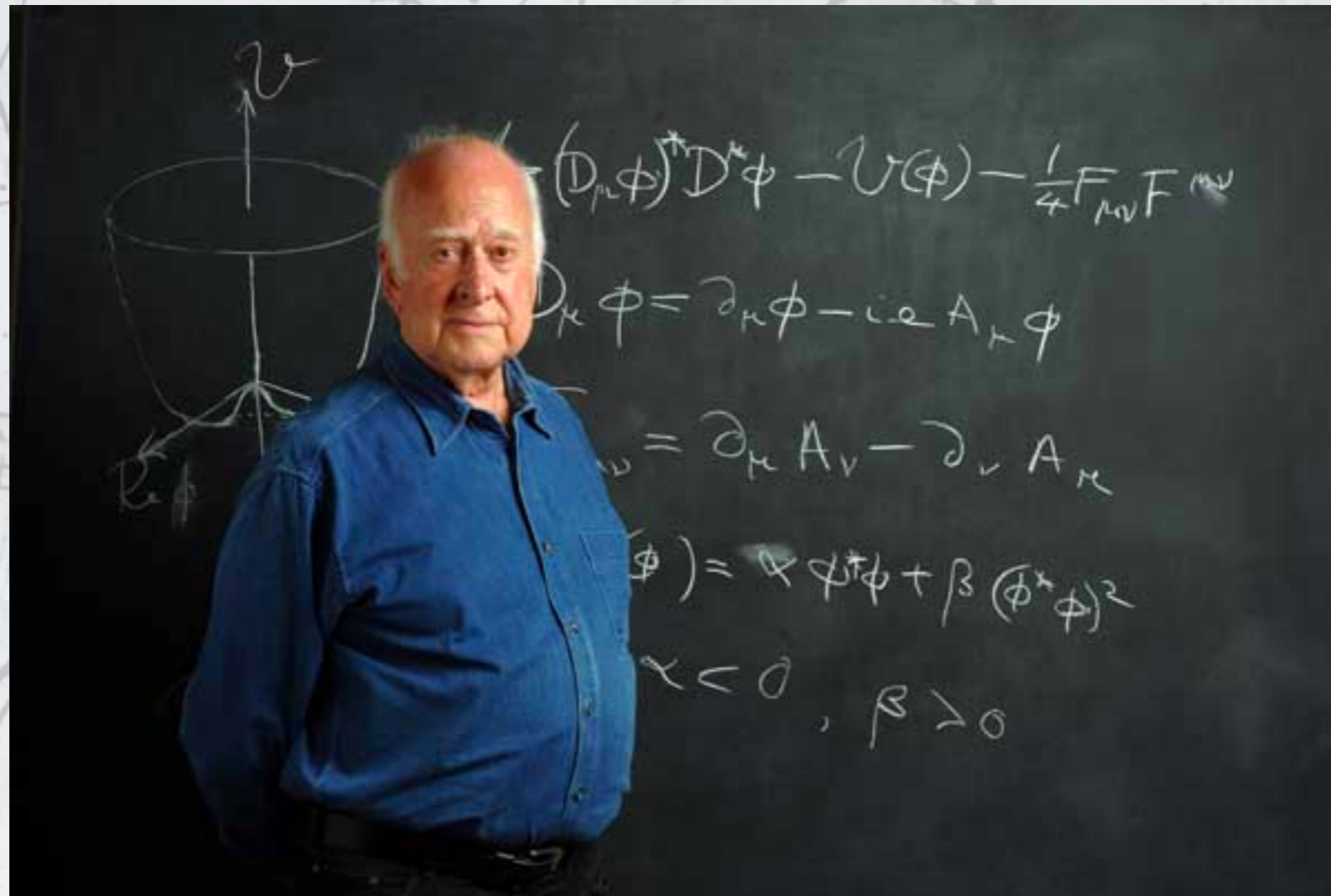


# IL MODELLO STANDARD

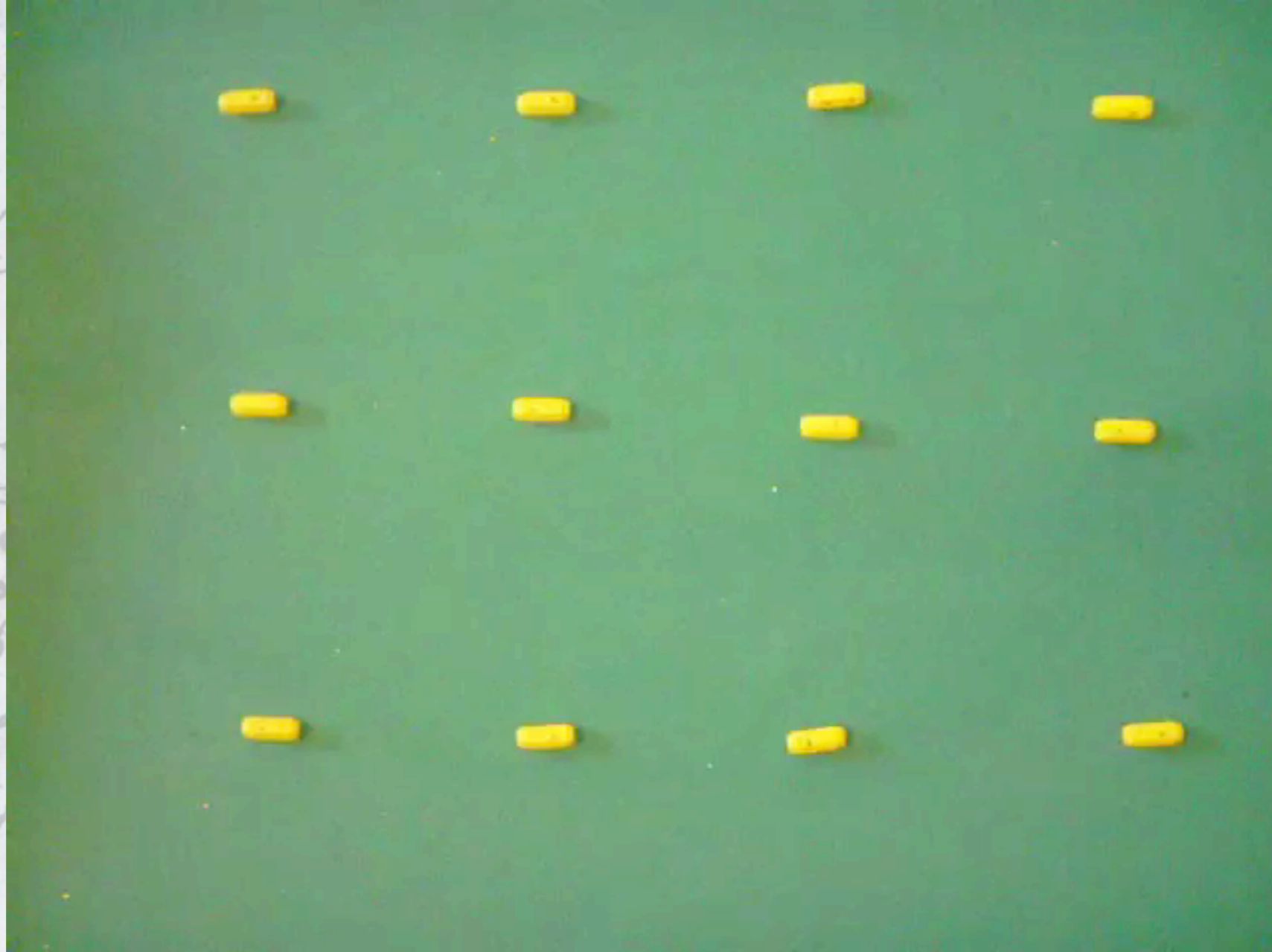
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	<b>e</b> electron	<b>μ</b> muon	<b>τ</b> tau	<b>W<sup>±</sup></b> weak force
				Bosons (Forces)

# IL BOSONE DI HIGGS

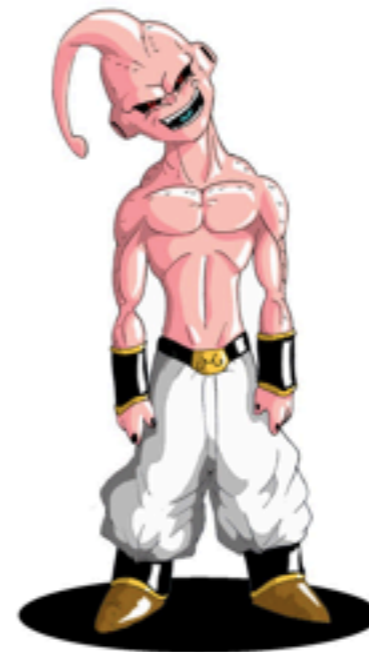




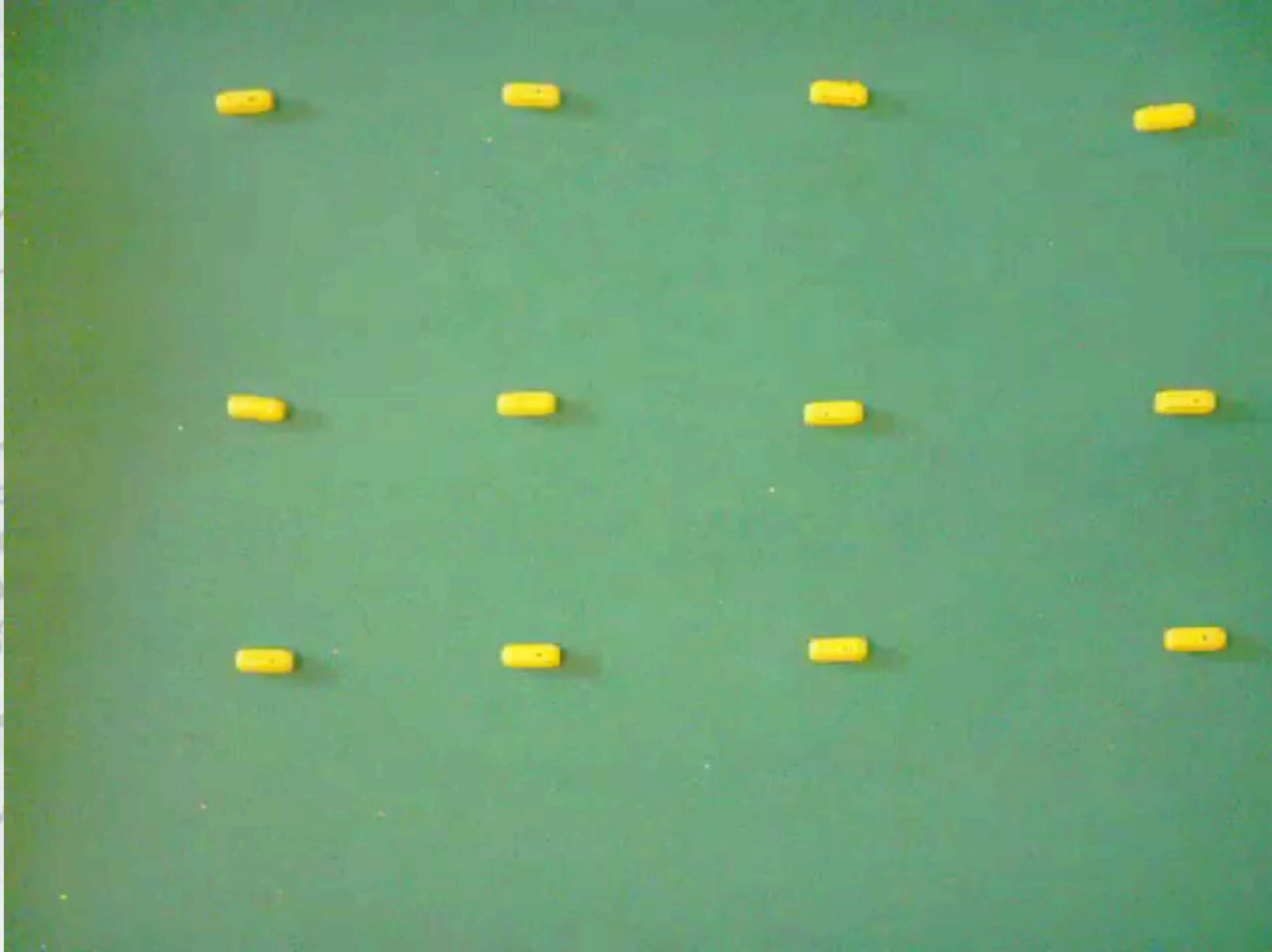


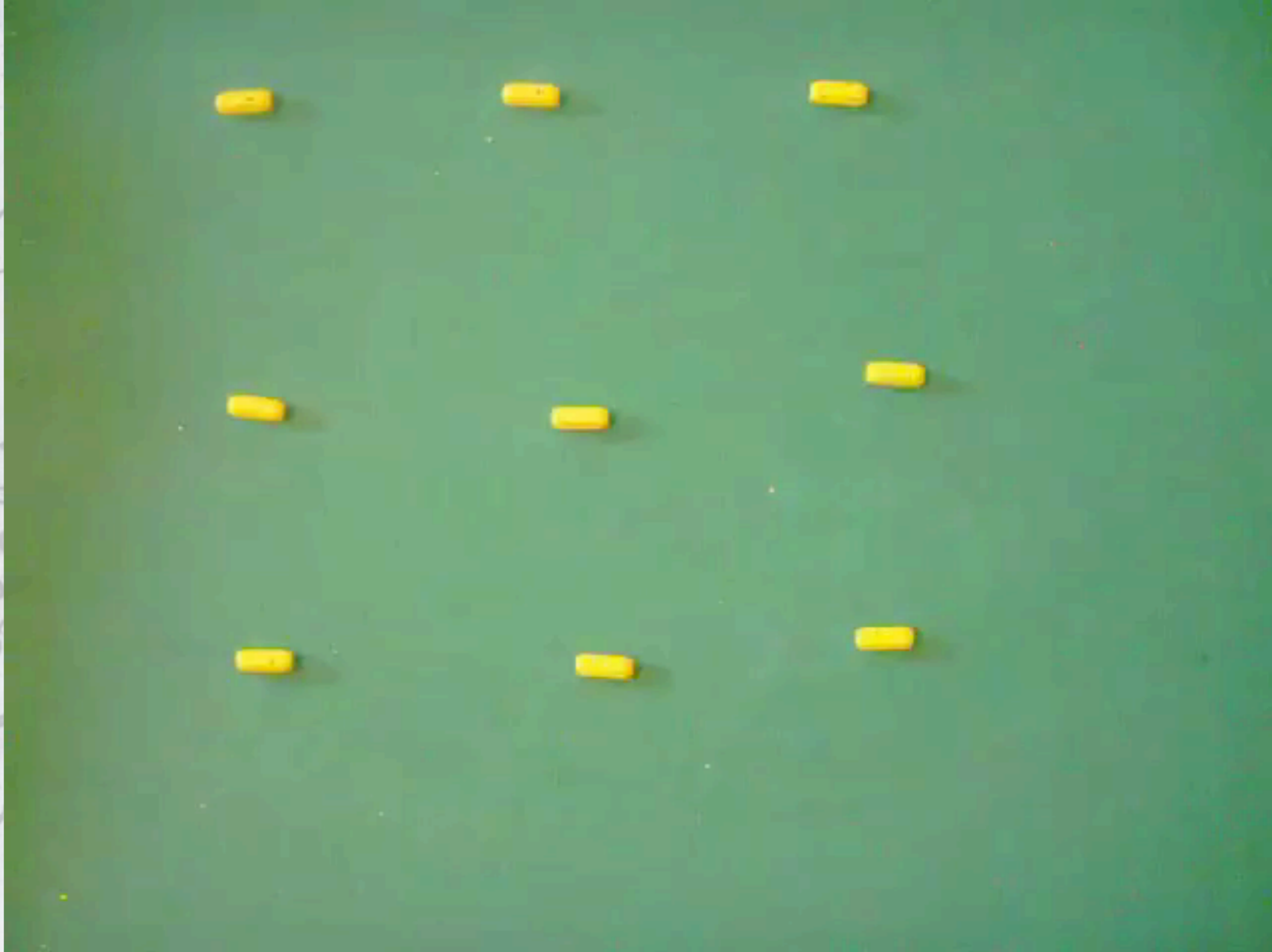


**muon**

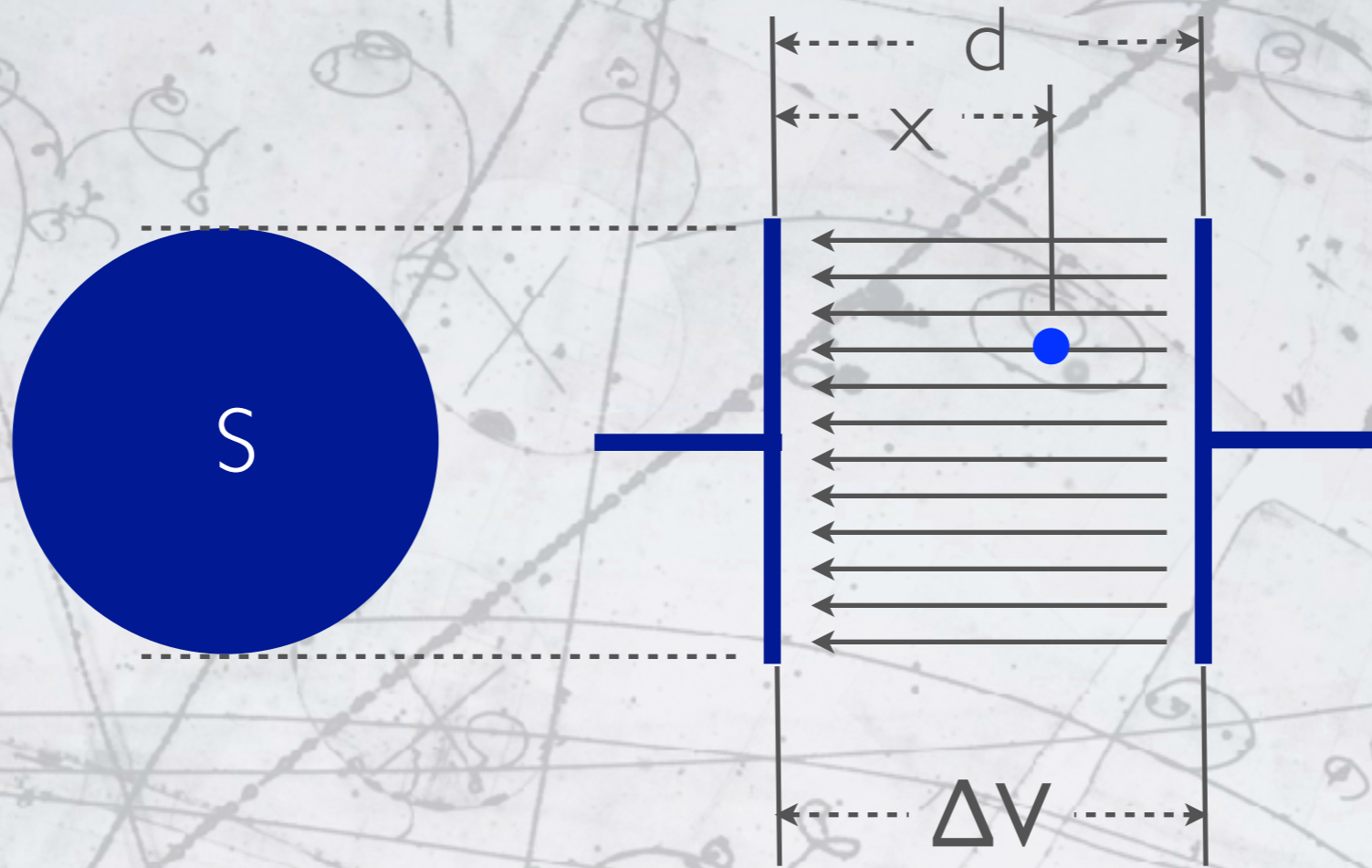


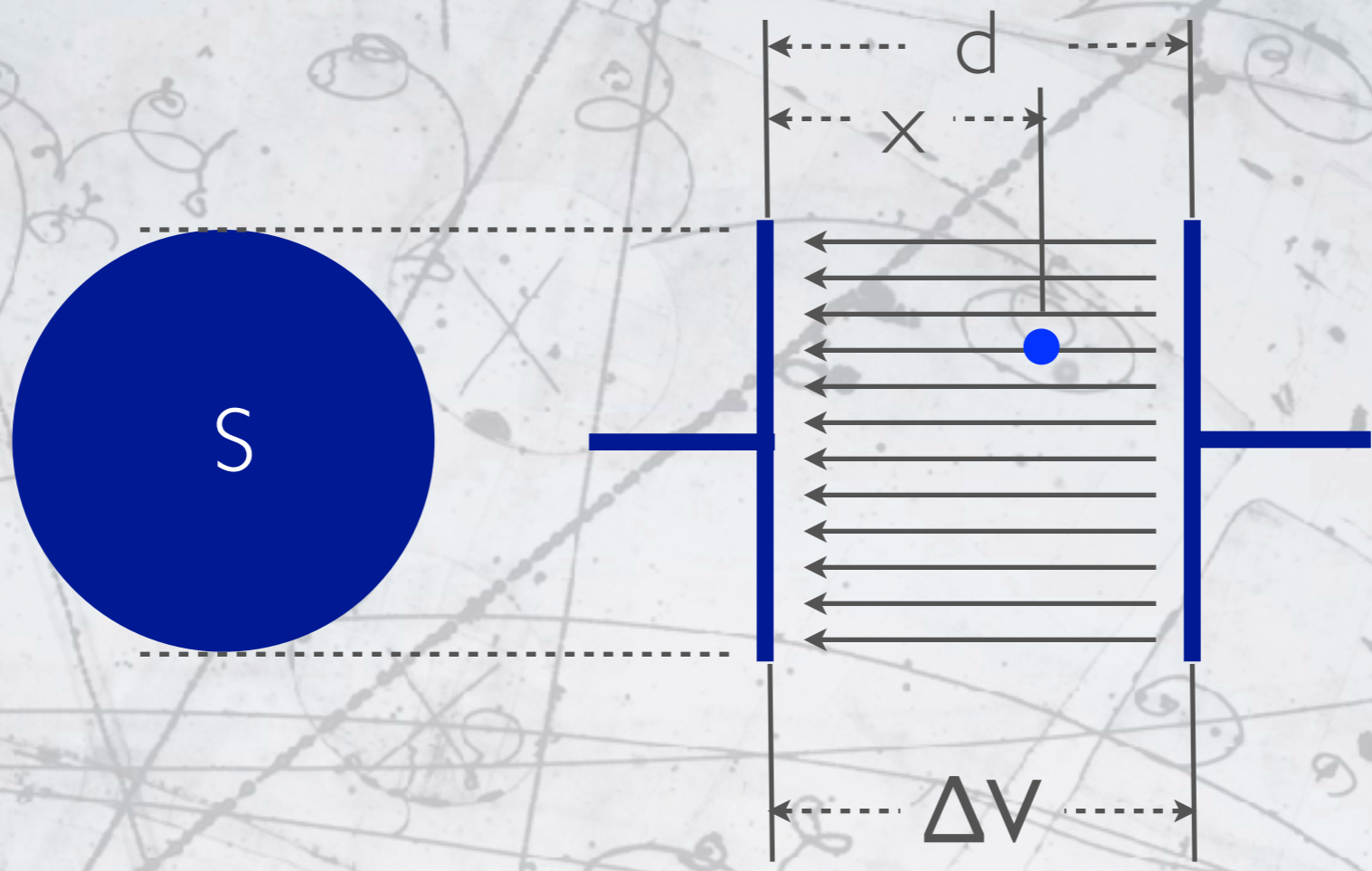
**electron**



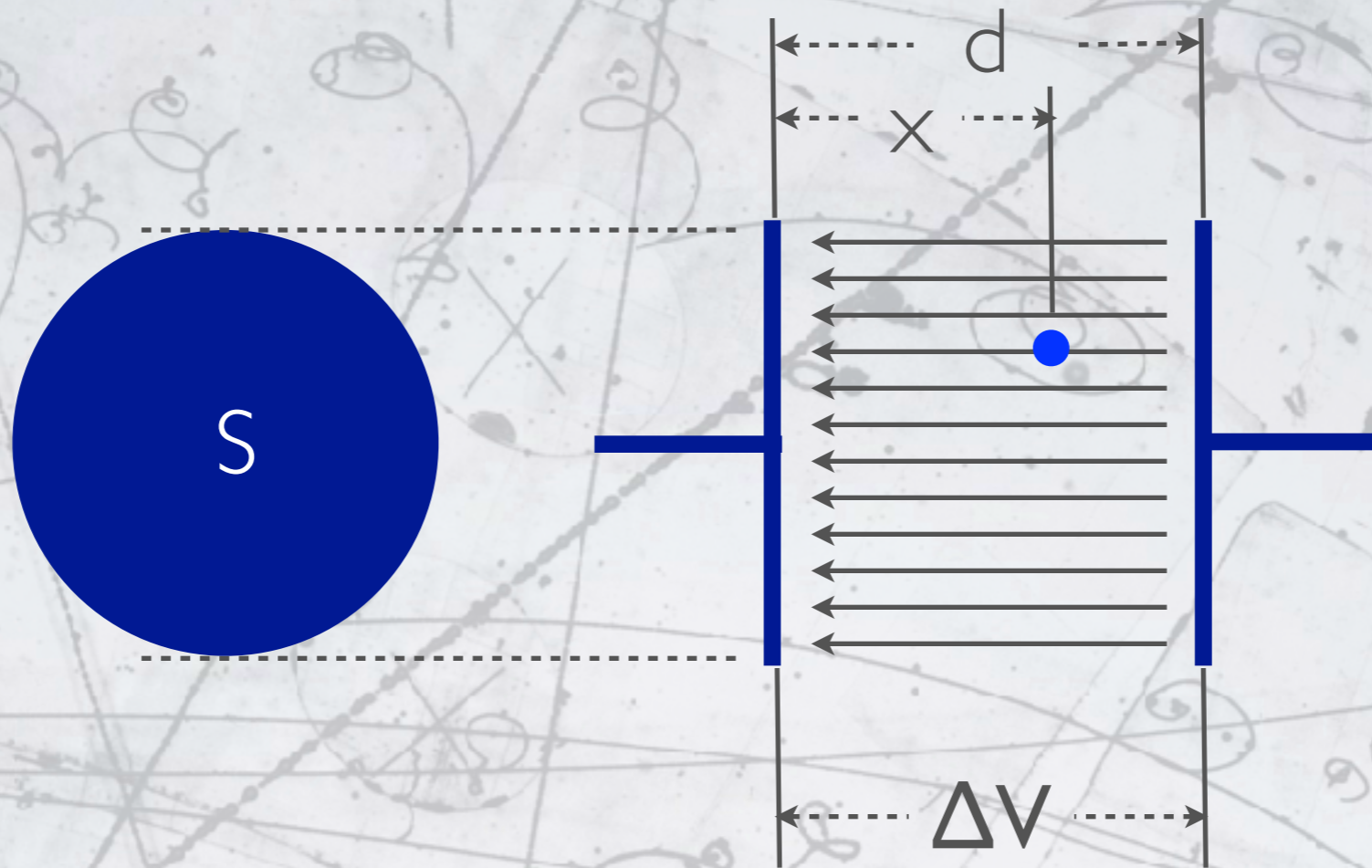






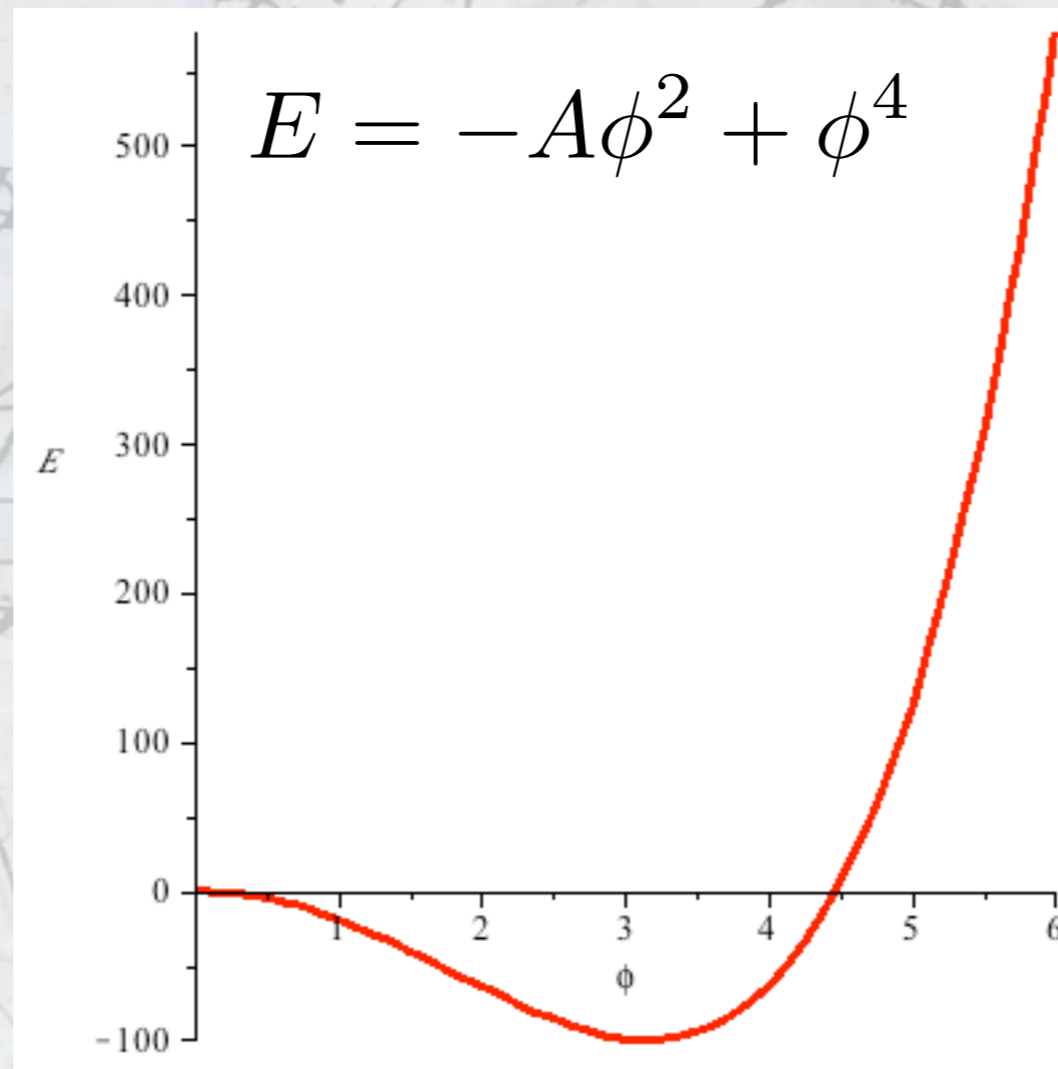


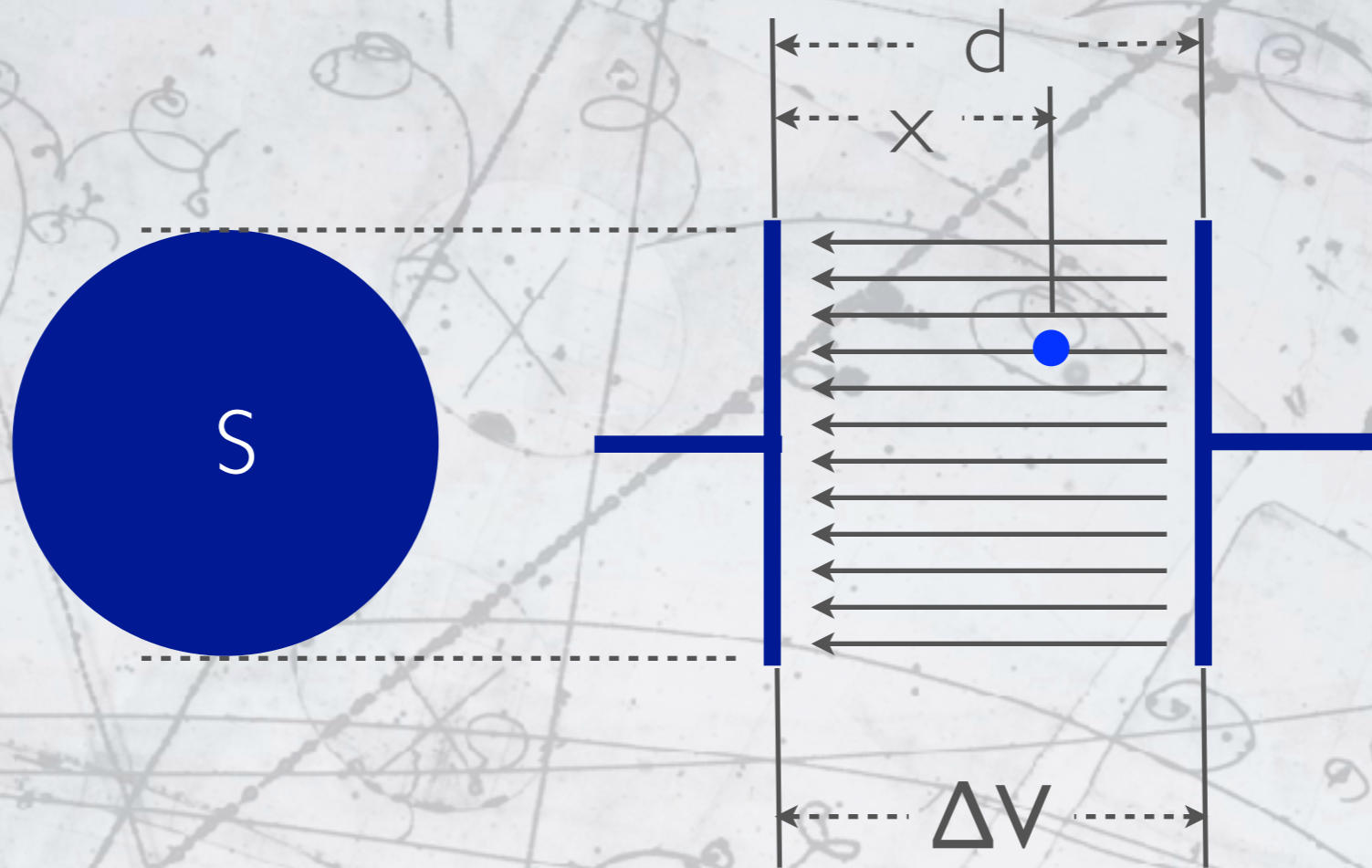
$$U = qV + \frac{\epsilon_0}{2} E^2$$



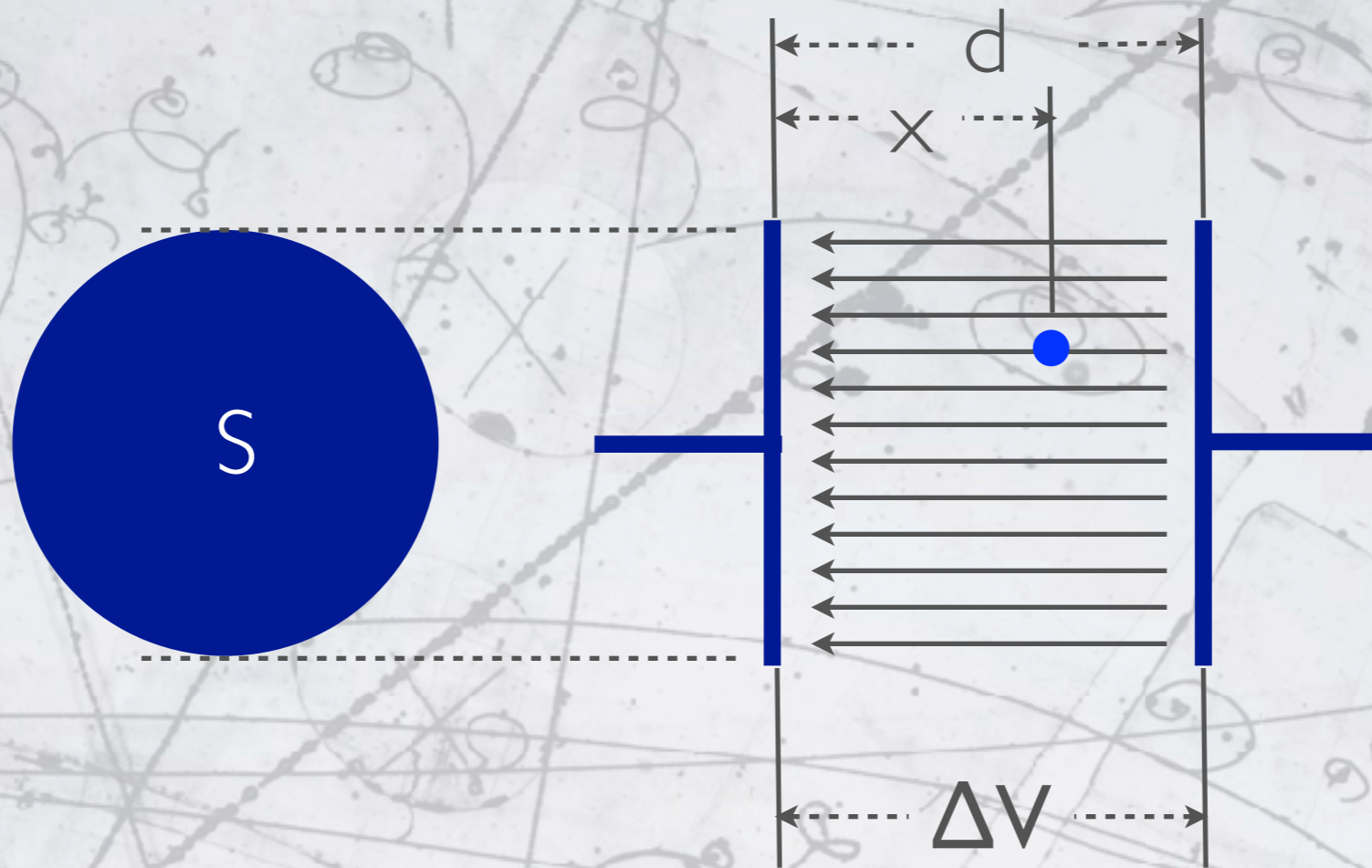
$$U = qV + \frac{\epsilon_0}{2} E^2 + m?c^2$$

# IL POTENZIALE DI HIGGS



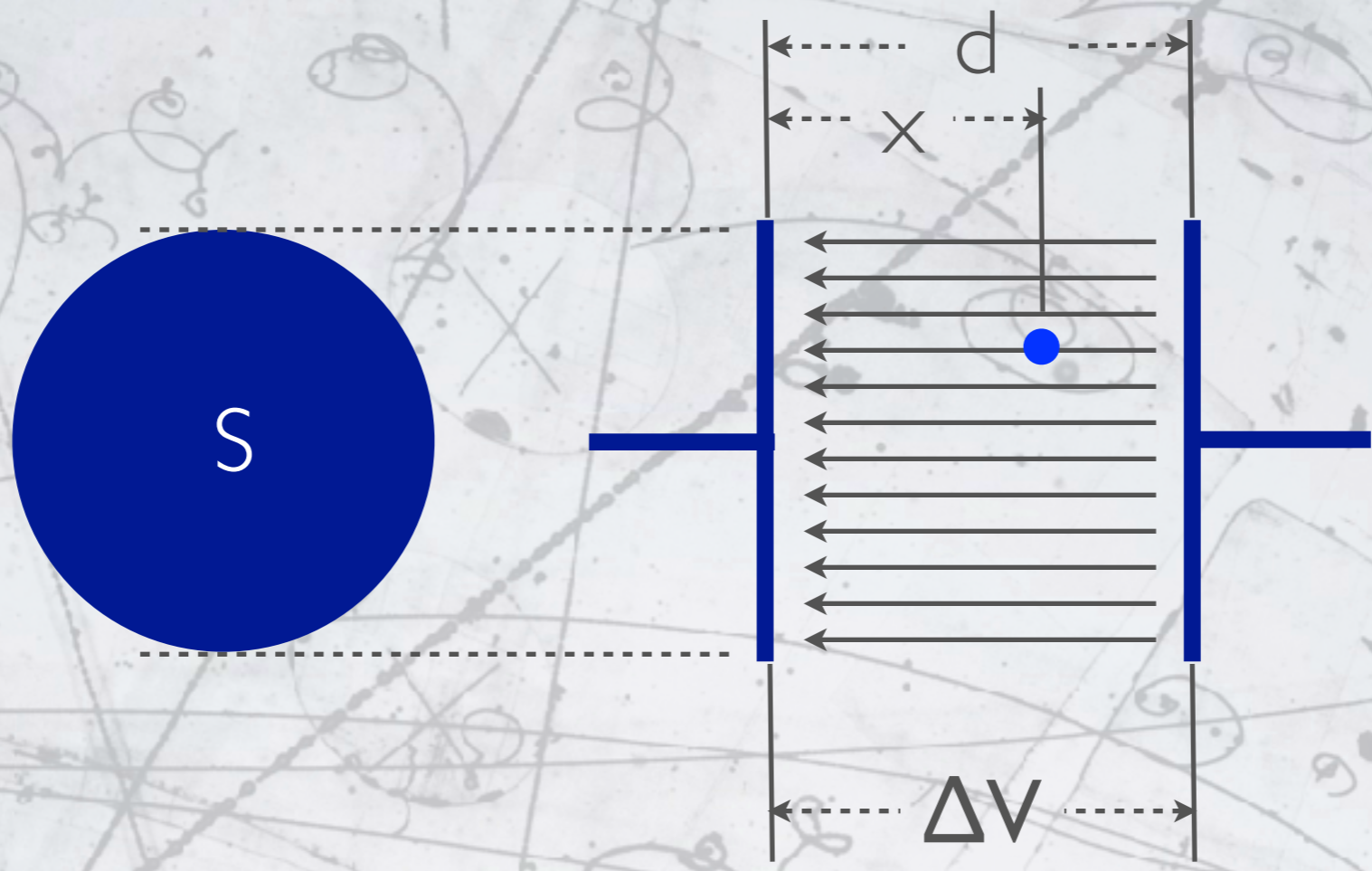


$$U = qV + \frac{\epsilon_0}{2} E^2 + a\Phi + b\phi^2 + c\phi^4$$

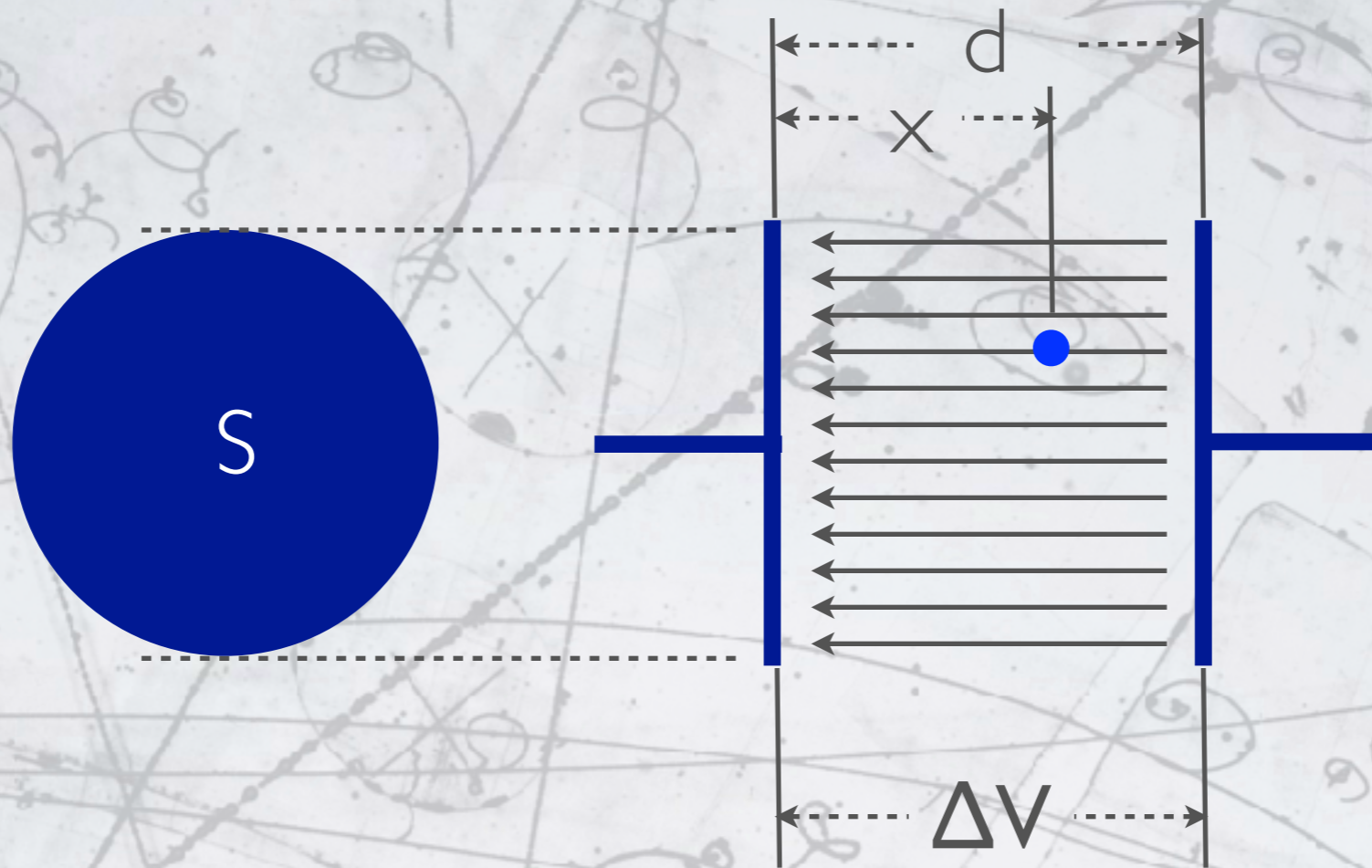


$$U = qV + \frac{\epsilon_0}{2} E^2 + a (\Phi_0 + \Psi) + b (\phi_0 + \eta)^2 + c\phi^4$$

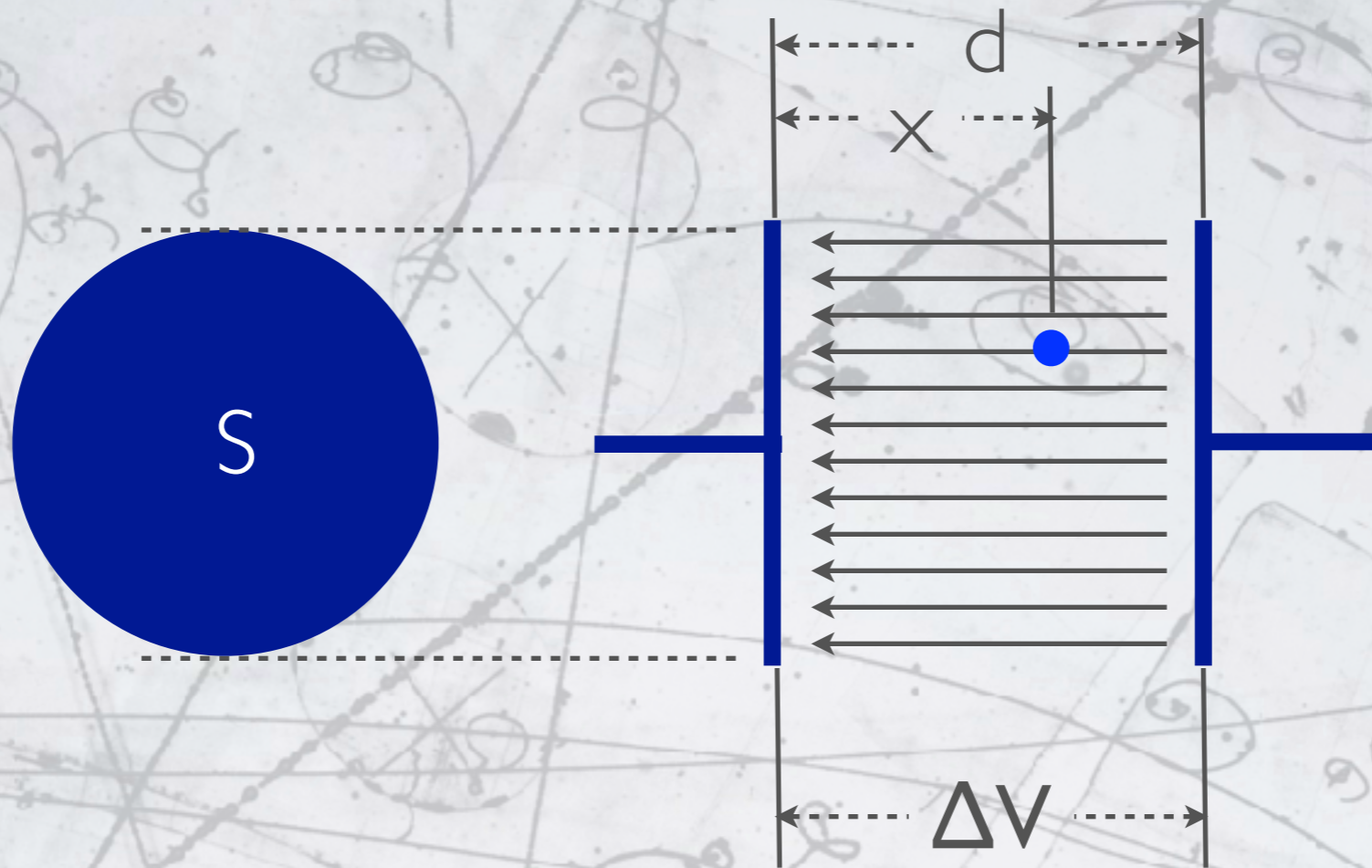
$mc^2$



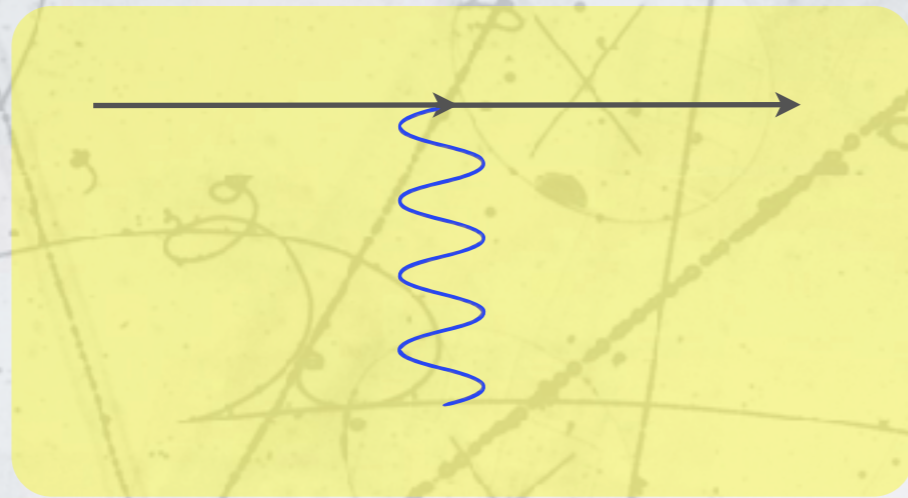
$$U = qV + \frac{\epsilon_0}{2} E^2 + a\Psi + mc^2 + b\eta^2 + 2b\phi_0\eta + c\phi^4$$



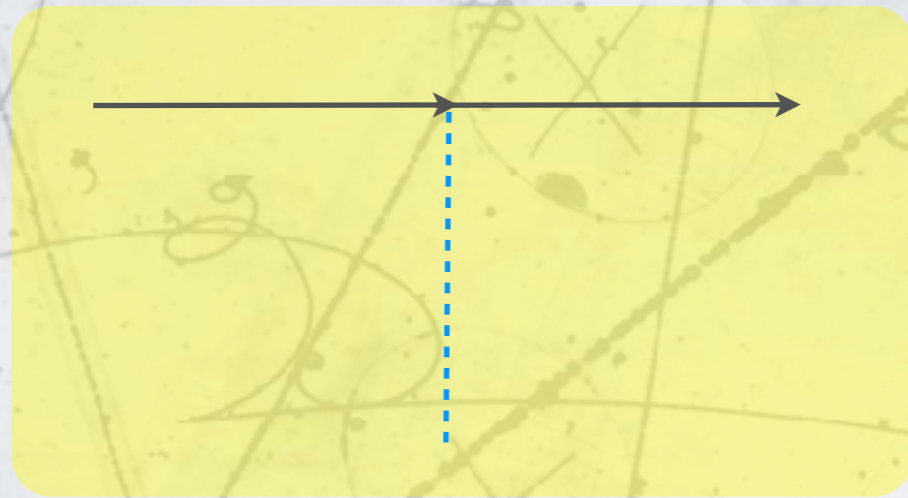
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$$U = qV + \frac{\epsilon_0}{2} E^2 + a\Psi + mc^2 + b\eta^2 + 2b\phi_0\eta + c\phi^4$$

# IL POTENZIALE DI HIGGS IN 3D

