Física da Praça Tahrir

Renato Doria
doria@aprendanet.com.br
Aprendanet Informática

Palestra em homenagem ao
60 aniversário do Prof.
José A. Helayël

Mapa Mundi

Fenômena (Invariância da Luz)	$\Leftrightarrow$ $\Updownarrow$	Númenon (Confinamento)
	Sacerdócio da Física	
400 bilhoões de galáxias	Quarks	Quarks em três cores
Quanta: a partir da invariância da luz	Leptons	Building blocks: a partir da cor
	QCD	
	SU(5)	

Fenômena (Invariância da luz)

1. Quanta

Spin, Massa, Cargas, C, P, T, CPT

2. Simetria Yang-Mills

$\omega^a \to \mathcal{L} = F_{\mu\nu}F^{\mu\nu} + \ldots$

3. Selos da Invariância da Luz

- Maxwell: Carga e Campo
- Einstein: Espaço e Tempo
- Wigner: Campo e Spin
- Conjunto: $(\frac{1}{2}, \frac{1}{2}) \leftrightarrow \{A^I_\mu\}$
- Evolução: $\mathcal{L} = \Delta\mathcal{L}$ (Entidades Conservadas)

Númenon (Confinamento)

1. Building Blocks

Pedras Coloridas : Δ

Spin $\frac{1}{2}$ Spin 0

$$\begin{array}{ccc} & \Delta \quad \Delta & \\ 3 & & \mathrm{III} \\ & \nabla \quad \nabla & \end{array}$$

$$3 \times \mathrm{III} = \underline{3} + \underline{6} \qquad \chi_i = f_{ijk}\phi^j\psi^k$$

$$\rightarrow$$

$$3 \times \overline{\mathrm{III}} = \underline{1} + \underline{8} \qquad \eta = \phi_i\psi^i$$

2. Nova Fenomenologia

Quarks Escalares, Gluons Massivos

Pés de Barro do Modelo Padrão

- Building blocks
- Quarks escalares
- Gluons massivos
- Simetria Yang-Mills
- QCD
- SU(5)
- QED
- Supersimetria
- Higgs: igual em importância a invariância da luz?

I. Introducão

Eletromagnetismo baseado baseado na carga elétrica sendo trocado por 4 bósons vetoriais:

- Fóton
- Fóton massivo
- 2 Fótons carregados

II. Lagrangiana

1. Simetria U(1)×SO(2)

Conjunto baseado no mesmo parâmetro α

1.1 U(1)

$$G^I_\mu \equiv \{G^1_\mu, G^2_\mu, G^3_\mu, G^4_\mu\}$$

$$G^{I\prime}_\mu = G^I_\mu + (\Omega^{-1})^I_1 \partial_\mu \alpha$$

$$\Omega^I_K (\Omega^{-1})^K_J = \delta^I_J$$

1.2 SO(2)

$$\begin{pmatrix} G_\mu^3 \\ G_\mu^4 \end{pmatrix}' = \begin{pmatrix} \cos q\alpha & \sin q\alpha \\ -\sin q\alpha & \cos q\alpha \end{pmatrix} \begin{pmatrix} G_\mu^3 \\ G_\mu^4 \end{pmatrix}$$

2. Notacão

- **Campos granulares**

$$G_{\mu\nu}^I = \partial_\mu G_\nu^I - \partial_\nu G_\mu^I, \quad S_{\mu\nu}^I = \partial_\mu G_\nu^I + \partial_\nu G_\mu^I$$

$$G^3_\mu = \frac{1}{\sqrt{2}}(W^+_\mu + W^-_\mu), \quad G^4_\mu = \frac{i}{\sqrt{2}}(W^+_\mu - W^-_\mu)$$

$$W^+_{\mu\nu} = \partial_\mu W^+_\nu - \partial_\nu W^+_\mu, \quad W^-_{\mu\nu} = \partial_\mu W^-_\nu - \partial_\nu W^-_\mu$$

- **Campos coletivos**

$$z_{[\mu\nu]} = \gamma_{[IJ]} G^I_\mu G^J_\nu, \quad z_{(\mu\nu)} = \gamma_{(IJ)} G^I_\mu G^J_\nu$$

$$\omega_{[\mu\nu]} = \tau_{[IJ]} G^I_\mu G^J_\nu, \quad \omega_{(\mu\nu)} = \tau_{(IJ)} G^I_\mu G^J_\nu$$

3. Lagrangiana

$$L = L_K + L_M + L_{GF} + L_I$$

3.1 Lagrangiana cinética

$$L_K = L_K^A + L_K^S$$

$$L_K^A = a_1 G_{\mu\nu}^1 G^{\mu\nu 1} + a_2 G_{\mu\nu}^2 G^{\mu\nu 2} + 2 W_{\mu\nu}^+ W^{\mu\nu -}$$

$$\begin{aligned} L_K^S =& b_{(11)} S^1_{\mu\nu} S^{\mu\nu 1} + b_{(22)} S^2_{\mu\nu} S^{\mu\nu 2} + b_{(12)} S^1_{\mu\nu} S^{\mu\nu 2} \\ &+ 2 b_{(33)} S^+_{\mu\nu} S^{\mu\nu -} + c_{(11)} S^{\mu 1}_{\mu} S^{\nu 1}_{\nu} + c_{(22)} S^{\mu 2}_{\mu} S^{\nu 2}_{\nu} \\ &+ c_{(12)} S^{\mu 1}_{\mu} S^{\nu 2}_{\nu} + 2 c_{(33)} S^{\mu +}_{\mu} S^{\nu -}_{\nu} \end{aligned}$$

3.2 Lagrangiana de massa

$$L_m = m^2_{IJ} G^I_\mu G^{\nu J}$$

3.3 Lagrangiana de gauge-fixing

$$L_{GF} = \frac{1}{2\xi} (\partial_\mu D^\mu + \sigma_i \partial_\mu X^{\mu i})^2$$

3.4 Lagrangiana de interacão

$$L_I = L_I^3 + L_I^4$$

$$L_I^3 = L_I^{3A} + L_I^{3S}$$

$$\begin{aligned} L_I^{3A} =& 4(b_1 G^1_{\mu\nu} + b_2 G^2_{\mu\nu}) \, {}^{[12]}_{z}{}^{\mu\nu} + 4b_3({}^{[-1]}_{z}{}^{\mu\nu} + {}^{[-2]}_{z}{}^{\mu\nu}) W^+_{\mu\nu} \\ &+ 4b_3({}^{[+1]}_{z}{}^{\mu\nu} + {}^{[+2]}_{z}{}^{\mu\nu}) W^-_{\mu\nu} + 4 \, {}^{[+-]}_{z}{}^{\mu\nu}(b_1 G^1_{\mu\nu} + b_2 G^2_{\mu\nu}) \\ &+ 4 \, {}^{(+-)}_{z}{}^{\mu\nu}(\beta_1 G^1_{\mu\nu} + \beta_2 G^2_{\mu\nu}) \end{aligned}$$

$$
\begin{aligned}
L_I^{3S} =& 2(\beta_1 S^1_{\mu\nu} + \beta_2 S^2_{\mu\nu})(\overset{(11)}{z}{}^{\mu\nu} + 2\,\overset{(11)}{z}{}^{\mu\nu} + \overset{(11)}{z}{}^{\mu\nu}) \\
&+2(\rho_1 S^{\mu 1}_{\mu} + \rho_2 S_m u^{\mu 2}(\overset{(11)}{z}{}^{\nu}_{\nu} + 2\,\overset{(12)}{z}{}^{\nu}_{\nu} + \overset{(22)}{z}{}^{\nu}_{\nu}) \\
&+2[(\beta_1 + 4\rho_1)S^{\mu 1}_{\mu} + (\beta_2 + 4\rho_2)S^{\mu 2}_{\mu}](\overset{(11)}{\omega}{}^{\nu}_{\nu} + 2\,\overset{(12)}{\omega}{}^{\nu}_{\nu} + \overset{(22)}{\omega}{}^{\nu}_{\nu}) \\
&+8\beta_3 \Re\{(\overset{(-1)}{z}{}^{\mu\nu} + \overset{(-2)}{z}{}^{\mu\nu})S^{+}_{\mu\nu}\} + 4\,\overset{+-3}{z}{}^{\mu\nu}(\beta_1 S^1_{\mu\nu} + \beta_2 S^2_{\mu\nu}) \\
&+8\rho_3 \Re\{\overset{(-1)}{z}{}^{\nu}_{\nu} S^{\mu+}_{\mu}\} + 8(\beta_3 + 4\rho_3)\Re\{\overset{(-1)}{\omega}{}^{\nu}_{\nu} S^{\mu+}_{\mu}\} \\
&+8\rho_3 \Re\{\overset{(-2)}{z}{}^{\nu}_{\nu} S^{\mu+}_{\mu}\} + 8(\beta_3 + 4\rho_3)\Re\{\overset{(-2)}{\omega}{}^{\nu}_{\nu} S^{\mu+}_{\mu}\} \\
&+4\,\overset{+-3}{z}{}^{\nu}_{\nu}(\rho_1 S^{\mu 1}_{\mu} + \rho_2 S^{\mu 2}_{\mu}) + 4(\beta_1 + 4\rho_1)\,\overset{+-3}{z}{}^{\nu}_{\nu} S^{\mu 1}_{\mu} \\
&+4(\beta_2 + 4\rho_2)\,\overset{+-3}{z}{}^{\nu}_{\nu} S^{\mu 2}_{\mu}
\end{aligned}
$$

$$L_4 = a_{PQRS} G^P_\mu G^Q_\nu G^{\mu R} G^{\nu S} \quad (\approx 70 \text{ termos})$$

"Médico de Almas"