Electro-Strong interaction

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Here, I will propose electro-strong interaction to solve the problem of gluon mass based on standard model. Based on Yang-Mills standard model:

$$\mathrm{Fuv} = \partial \mathrm{uAv} - \partial \mathrm{vAu} - [\mathrm{Au}, \mathrm{Av}]$$

QHD formula is：

$$\mathrm{U(SU(2))} = \exp\,[\mathrm{ig} \sum_{j=1}^{8} F_j\, G_j(x)]$$

Thus：

$$\partial^{\mu} = \partial^{\mu} + \mathrm{igF} * G(x)$$

Besides，F = 1 / 2λ，λ is GelMann matrix

$$\lambda_1 = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\lambda_2 = \begin{bmatrix} 0 & -i & 0 \\ i & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\lambda_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\lambda_4 = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

$$\lambda_5 = \begin{bmatrix} 0 & 0 & -i \\ 0 & 0 & 0 \\ i & 0 & 0 \end{bmatrix}$$

$$\lambda_6 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

$$\lambda_7 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & -i \\ 0 & i & 0 \end{bmatrix}$$

$$\lambda_8 = \frac{1}{\sqrt{3}} \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -2 \end{bmatrix}$$

For Photon, there is an additional matrix：

$$\lambda_9 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

We let R or R> =（ 1,0,0 ）, B or B> =（ 0,1,0 ）, and G or G> =（ 0,0,1 ）。Then, the whole matrix is ：

$$\begin{bmatrix} r\bar{r} & b\bar{r} & g\bar{r} \\ r\bar{b} & b\bar{b} & g\bar{b} \\ r\bar{g} & b\bar{g} & g\bar{g} \end{bmatrix}$$

Besides, every matrix has the corresponding gluon or photon：

$$G_1 = \frac{1}{\sqrt{2}}\left(r\bar{b} + b\bar{r}\right)$$

$$G_2 = \frac{i}{\sqrt{2}}\left(r\bar{b} - b\bar{r}\right)$$

$$G_3 = \frac{1}{\sqrt{2}}\left(r\bar{r} - b\bar{b}\right)$$

$$G_4 = \frac{1}{\sqrt{2}}(r\bar{g} + g\bar{r})$$

$$G_5 = \frac{i}{\sqrt{2}}(r\bar{g} - g\bar{r})$$

$$G_6 = \frac{1}{\sqrt{2}}\left(g\bar{b} + b\bar{g}\right)$$

$$G_7 = \frac{i}{\sqrt{2}}\left(b\bar{g} - g\bar{b}\right)$$

$$G_8 = \frac{1}{\sqrt{6}}\left(r\bar{r} + b\bar{b} - 2g\bar{g}\right)$$

Besides, photon boson is：

$$B = G_9 = \frac{1}{\sqrt{3}}\left(r\bar{r} + b\bar{b} + g\bar{g}\right)$$

Thus, there are nine bosons (8 gluons and 1 photon) as a whole 3x3 matrix to interact with Higgs bosons. We will use a complex scaler field for the Higgs boson. The Higgs field is:

$$\varphi(x) \equiv \frac{1}{\sqrt{2}}\begin{pmatrix}\varphi 1 + i\varphi 2\\ \varphi 3 + i\varphi 4\\ \varphi 5 + i\varphi 6\end{pmatrix}$$

And, $\varphi 1 = \varphi 2 = \varphi 3 = \varphi 4 = \varphi 6 = 0$ and $\varphi 5 = v$

。

Then, the Higgs represents as (0,0,V / $\sqrt{2}$)

Langragian is：

$$L(\varphi) = (\partial_v\varphi)(\partial^v\varphi) - \mu^2(\varphi(x))^2 - \lambda(\varphi(x))^4$$

Then

$$\frac{1}{4}\left|\left[\left(ig\lambda G(x)\right) * \varphi(x)\right]^{+}\left[\left(ig\lambda G(x)\right) * \varphi(x)\right]\right| =$$

$$\mathbf{\frac{1}{8}\left(\frac{1}{\sqrt{2}}gv(G_4 - iG_5), \frac{1}{\sqrt{2}}\,gv(G_6 - iG_7), v\left(\frac{1}{\sqrt{3}}kB - \frac{\sqrt{2}}{\sqrt{3}}gG_8\right)\right)}$$

$$\mathbf{\times\left(\frac{1}{\sqrt{2}}gv(G_4 + iG_5), \frac{1}{\sqrt{2}}\,gv(G_6 + iG_7), v\left(\frac{1}{\sqrt{3}}kB - \frac{\sqrt{2}}{\sqrt{3}}gG_8\right)\right)}$$

We set $G^4 = 1/\sqrt{2}(G_4 + iG_5)$, $G^5 = 1/\sqrt{2}(G_4 - iG_5)$ and we get G^6 和 G^7。

We let $\sqrt{2}/\sqrt{3}\boldsymbol{g}$=g'' and $1/\sqrt{3}k = g'$。Then, we will get：

G^{8u}= $(\ g'B^u - g''G_8^u\ ) / \sqrt{(\ g'^2 + g''^2\ )}$ and

A^u= $(\ g'G_8^u + g''B^u\ ) / \sqrt{(\ g'^2 + g''^2\ )}$

Like electro-weak theory, we get G8 mass:

$$mG^8 = \frac{v\sqrt{g'^2 + g''^2}}{\sqrt{2}}$$

We get G^8field and photon：

$$G^8 = \frac{g'}{\sqrt{g''^2 + g'^2}} B - \frac{g''}{\sqrt{g''^2 + g'^2}} G_8 = B \sin\theta - G_8 \cos\theta$$

$$A = \frac{g'}{\sqrt{g''^2 + g'^2}} G_8 + \frac{g''}{\sqrt{g''^2 + g'^2}} B$$
$$= G_8 \sin\theta \quad + B \cos\theta$$

Besides, the new gluon mass for G^1、G^2 和 G^3 is still zero. Because mass term is 1/2M^2Vu，gluon mass for G^4、G^5、G^6 和 G^7 is 1/2vg(v/2)。Because of symmetry breaking, G^8mass term is 1/4$M^2G^{8u}G_{8u}$ and G^8 gluon becomes gg(v/√2). And,

$$\frac{1}{\sqrt{2}}(G_1 - iG_2) = r\bar{b} \quad , \quad \frac{1}{\sqrt{2}}(G_1 + iG_2) = b\bar{r}$$ etc

Thus, we get eight new gluons：RB , BR , RR / BB , BG , GB , GR , RG and GG. And, RR / BB is:

$$\frac{1}{\sqrt{2}}(r\bar{r} - b\bar{b})$$

If α-ratio is 1，we will get

$$\sin\theta = \frac{1}{\sqrt{3}}$$

$$\cos\theta = \frac{\sqrt{2}}{\sqrt{3}}$$

Thus,

$$G^8 = g\bar{g}$$

$$A = \frac{1}{\sqrt{2}}(r\bar{r} + b\bar{b})$$

This equation solves the problem of Yang-Mills mass gap. That is the reason why neutron or proton is heavier than inside quarks. Via electro-strong interaction, we get five green-color related massive gluons $G^{4\text{-}8}$: $b\underline{g}$, $g\underline{b}$, $g\underline{r}$, $r\underline{g}$, and $g\underline{g}$. Besides, we have non-massive bosons: λ1, λ2, λ3,& A. The later four gluons can interact with Higgs boson $(0,V/\sqrt{2})$ and get v/2 mass of $r\underline{b}$ and $b\underline{r}$ as well as $v/\sqrt{2}$ mass of $b\underline{b}$, and non-massive $r\underline{r}$. Finally, we get eight massive gluons to mediate short-distance strong force. Thus, we united electromagnetism and strong force.。