Quark string of elementary particle

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Abstract

This paper suggests quark combination of elementary particle based on AdS/CFT correspondence[1]. Through this, we can define quark conservation law and majonara particle. Tension of closed string which diverge to infinity confine quarks as in color confinement of strong interaction.

1 Structure of quark string

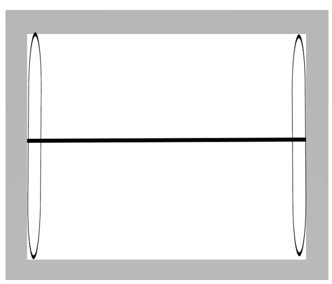


Figure 1: Non-vibrating state of open string is straight line with two D-brane[2]

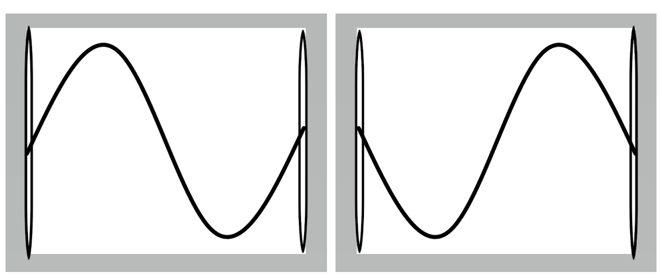
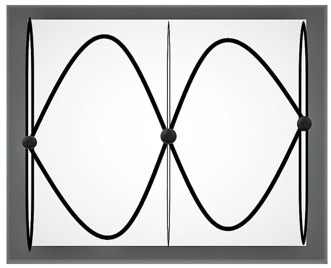
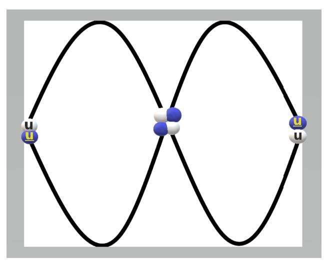


Figure 2: Vibrating state of open string

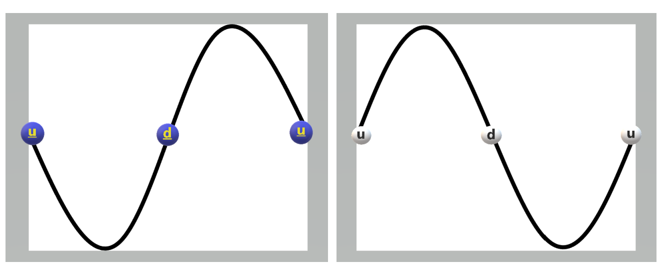
Two open strings interact and become a closed string.



A closed string disintegrate from D-brane and generate quark on lattice. State of $q\overline{q}$ pair of open string generate four quarks of two $q\overline{q}$ pairs on edges of a closed string. By interact of strings, quark of different style are generated in center lattice.

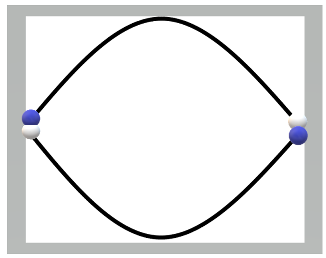


Disintegrated a closed string disintegrate istelf to L and $\overline{L}$. For example, quark string of electron and positron are shown to below picture.



But in reality, it will be changed into close string.

An open string of two quarks; gauge boson is made as below picture.



Tension of string which comfine quarks will be introduced at chapter 4.

2 Quark combination of elementary particle

A photon is a string of two edges. In pair production, $0 \longleftrightarrow q\overline{q}$ where quarks are generated from lattices of a closed string.

Lepton consists of three quarks (total spin : $\pm\frac{1}{2}$) is given by

$$L_e \begin{cases} e^- * \overline{uud} \\ e^+ * uud \\ 0(\nu) * \overline{udd} \\ 0(\overline{\nu}) * udd \end{cases}$$

These quark combinations are make possible of quark conservation law in particle disintegration. It replaces quark style conversion ability of W boson with quark conservation law by added quark combinations of W boson and leptons.

Define the quark conservation box as $\begin{pmatrix} u & d \\ \overline{u} & \overline{d} \end{pmatrix}$.

In case of β^- decay[3] :

$$n \longrightarrow p + \overline{\nu} + e^-$$

where the quark conservation box is $\begin{pmatrix} u & d \\ \overline{u} & \overline{d} \end{pmatrix}$, quark conservation is given by

$n \begin{pmatrix} 1 & 2 \\ 0 & 0 \end{pmatrix} \longrightarrow p + \overline{\nu} + e^- \begin{pmatrix} 3 & 3 \\ 2 & 1 \end{pmatrix}$,

and $\begin{pmatrix} 3 & 3 \\ 2 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 2 \\ 0 & 0 \end{pmatrix}$ because of $0 \leftrightarrow q\overline{q}$

In case of pion decay[4],

$$\pi^- \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \longrightarrow \mu^- + \overline{\nu}_\mu \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$$\pi^+ \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \longrightarrow \mu^+ + \nu_\mu \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\pi^0 \begin{pmatrix} 1 & 0 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ 0 & 1 \end{pmatrix} [5] \longrightarrow \gamma + \gamma \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix} = \gamma' \begin{pmatrix} 1 & 0 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ 0 & 1 \end{pmatrix}$$

Also we get quark system of W boson,

$$W_e \begin{cases} e^- * \overline{u}d \\ e^+ * u\overline{d} \end{cases}$$

$$W^- \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \longrightarrow e^- + \overline{\nu}_e \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$$W^+ \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \longrightarrow e^+ + \nu_e \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

3 Majonara particle

Antiparticle is the structure of antiquarks which are symmetry to particle. It gives quark condition of majonara particle

$$AB = \overline{AB}$$

where B is $\overline{A}$. Thus, For the two quarks system, majonara particle is given by

$$A\overline{A} = \overline{A}A.$$

It means non-charge gauge bosons are antiparticle themselves.

Possible quark combinations of three quarks fermion are given by

$$[aab, \overline{aab}, aaa, \overline{aaa}, bbb, \overline{bbb}, abb, \overline{abb}]$$

where a is $+\frac{2}{3}$ quark and b is $-\frac{1}{3}$ quark. In short, fermion cannot be majonara particle because its quarks number is odd, while majonara particle consist of a pair of particle-antiparticle.

4 Tension of quark confinement

Describe the motion of a particle scattered on lattice. If we consider only grativitational field, it will be described as projectile motion.

$$x = (v_0 \cos\alpha)t$$

$$y = -\tfrac{1}{2}gt^2 + (v_0 \sin\alpha)$$

Writing x as a function of t,

$$t = \tfrac{x}{v_0 \cos\alpha}.$$

If we insert this value of t in the equation for y, we obtain

$$y = -\tfrac{g}{2{v_0}^2\cos^2\alpha}\left(x - \tfrac{{v_0}^2 \sin\alpha\cos\alpha}{g}\right)^2 + \tfrac{{v_0}^2\sin^2\alpha}{2g},$$

and the vertex is

$$\left(\frac{{v_0}^2 \sin\alpha\ cos\alpha}{g}, \frac{{v_0}^2\sin^2\alpha}{2g}\right).$$

Assume that scattered particle follow the principle of least action[6]. Angle α of closed string is adjusted to specific value to scatter a particle most far from lattice in most low energy. Most far distance from lattice, in case of distance from lattice to vertex r is given by

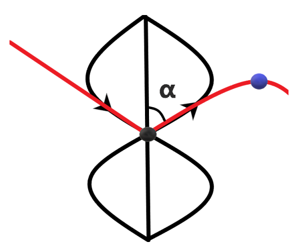
$$r = \tfrac{{v_0}^2\sqrt{\sin 2\alpha + \sin^2\alpha}}{2g},$$

and α is $\frac{\pi}{4}$ for the max value of r.

Tension of closed string is given by

$$T = \tfrac{\sin^4\alpha}{d^2\cos 2\alpha}[7]$$

where d is length of closed string.



According to the principle of least action, closed string maintain its angle to $\frac{\pi}{4}$ until it interact with other strings. Thus,

$$T \longrightarrow \infty,$$

closed string confine quarks.

5 References

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