Graviton regarded as the Goldstone boson of symmetry breaking SO(4)/SO(3)

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This paper introduces the construction of spontaneous symmetry breaking When the Goldstone boson effective Laplaceman calculates the effective Laplaceman of the Goldstone boson with symmetry breaking SO(4)/SO(3). By the result we put the graviton regarded as the Goldstone boson of symmetry breaking SO(4)/SO(3).

I. INTRODUCTION

Spontaneous symmetry breaking is a kind of central symmetry breaking mechanism in physics, which has important applications in both condensed matter physics and elementary particle physics. Assuming that there is a continuous internal symmetry group G, if the theoretical vacuum state is in the Some symmetry groups G are variable under the action, then the symmetry group G undergoes spontaneous symmetry breaking, and the symmetry transformation that keeps the vacuum state unchanged constitutes an unbroken subgroup $HofG$.. Regarding spontaneous symmetry breaking $G/H, theGoldstone$ theorem states that for every broken continuous symmetry transformation generator there is a massless Goldstone boson corresponding to it. This paper introduces the construction of spontaneous symmetry breaking When the Goldstone boson effective Laplaceman calculates the effective Laplaceman of the Goldstone boson with symmetry breaking SO(4)/SO(3). By the result we put the graviton regarded as the Goldstone boson of symmetry breaking SO(4)/SO(3).[1–5]

II. NEW GRAVITATIONAL COUPLING EQUATION

We can pre-set the boundary conditions $\mu = y\omega$[8, 9].

Spherical quantum solution in vacuum state.

In this theory, the general relativity theory's field equation is written completely.

$$R_{\mu\nu} - \frac{1}{2} g_{\mu v} R = -\frac{8\pi G}{c^4} T_{\mu\nu} \tag{1}$$

The Ricci tensor is by $T_{\mu v} = 0$ in vacuum state.

$$R_{\mu v} = 0 \tag{2}$$

The proper time of spherical coordinates is

$$d\tau^2 = A(t,r)dt^2 - \frac{1}{c^2}\left[B(t,r)dr^2 + r^2 d\theta^2 + r^2 \ \sin\theta d\phi^2\right] \tag{3}$$

If we use Eq, we obtain the Ricci-tensor equations.

$$R_{tt} = -\frac{A''}{2B} + \frac{A'B'}{4B^2} - \frac{A'}{Br} + \frac{A'^2}{4AB} + \frac{\ddot{B}}{2B} - \frac{\dot{B}^2}{4B^2} - \frac{\dot{A}\dot{B}}{4AB} = 0 \tag{4}$$

$$R_{rr} = \frac{A''}{2A} - \frac{A'^2}{4A^2} - \frac{A'B'}{4AB} - \frac{B'}{Br} - \frac{\ddot{B}}{2A} + \frac{\dot{A}\dot{B}}{4A^2} + \frac{\dot{B}^2}{4AB} = 0, \tag{5}$$

$$R_{\theta\theta} = -1 + \frac{1}{B} - \frac{rB'}{2B^2} + \frac{rA'}{2AB} = 0, R_{\phi\phi} = R_{\theta\theta}\sin^2\theta = 0, R_{tr} = -\frac{\dot{B}}{Br} = 0, R_{t\theta} = R_{t\phi} = R_{r\theta} = R_{r\phi} = R_{\theta\phi} = 0 \tag{6}$$

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In this time, $' = \frac{\partial}{\partial r}$ $, \cdot = \frac{1}{c}\frac{\partial}{\partial t},$

$$\dot{B} = 0 \tag{7}$$

We see that,

$$\frac{R_{tt}}{A} + \frac{R_{rr}}{B} = -\frac{1}{Br}\left(\frac{A'}{A} + \frac{B'}{B}\right) = -\frac{(AB)'}{rAB^2} = 0 \tag{8}$$

Hence, we obtain this result.

$$A = \frac{1}{B} \tag{9}$$

If,

$$R_{\theta\theta} = -1 + \frac{1}{B} - \frac{rB'}{2B^2} + \frac{rA'}{2AB} = -1 + \left(\frac{r}{B}\right)' = 0 \tag{10}$$

If we solve the Eq,

$$\frac{r}{B} = r + C \to \frac{1}{B} = 1 + \frac{C}{r} \tag{11}$$

When r tends to infinity, and we set C=ye^{-y}, Therefore,

$$A = \frac{1}{B} = 1 - \frac{y}{r}\Sigma, \Sigma = e^{-y} \tag{12}$$

$$d\tau^2 = \left(1 - \frac{y}{r}\sum\right)dt^2 \tag{13}$$

In this time, if particles' mass are m_i, the fusion energy is e,

$$E = Mc^2 = m_1c^2 + m_2c^2 + \ldots + m_nc^2 + T. \tag{14}$$

III. CALCULATION OF EFFECTIVE LAPLACE QUANTITY FOR SYMMETRY BREAKING SO(4)/SO(3)

Calculate the effective Laplace quantity of the Goldstone boson of spontaneous symmetry breaking SO (4)/ SO(3) using the CCWZ method. There are 6 generators in the SO(4) group , its four-dimensional expression can be selected as follows:

$$\begin{aligned}
\boldsymbol{T}_1 = -\mathrm{i}\begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}, \boldsymbol{T}_2 = -\mathrm{i}\begin{pmatrix} 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}, \\
\boldsymbol{T}_3 = -\mathrm{i}\begin{pmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}, \boldsymbol{X}_1 = -\mathrm{i}\begin{pmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{pmatrix}, \\
\boldsymbol{X}_2 = -\mathrm{i}\begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \end{pmatrix}, \boldsymbol{X}_3 = -\mathrm{i}\begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & -1 & 0 \end{pmatrix}.
\end{aligned} \tag{15}$$

Without loss of generality, choose the vacuum state as $\begin{pmatrix} 0 & 0 & 0 & 1 \end{pmatrix}^{\mathrm{T}}$, then for this In the vacuum state, the broken group generators are X_1, X_2, X_3, and the last broken group generators are $\boldsymbol{T}_1, \boldsymbol{T}_2, \boldsymbol{T}_3$. These three unbroken generators generate a symmetric subgroup of SO(3).6 generators satisfy the commutation relation : $[\boldsymbol{T}_i, \boldsymbol{T}_j] = \mathrm{i}\varepsilon_{ijk}\boldsymbol{T}_k, [\boldsymbol{T}_i, \boldsymbol{X}_a] =$

$\mathrm{i}\varepsilon_{iab}\boldsymbol{T}_b, [\boldsymbol{X}_a, \boldsymbol{X}_b] = \mathrm{i}\varepsilon_{abi}\boldsymbol{T}_i$, where ε is the all-antisymmetric quantity. According to Goldstone's theorem, if there are 3 broken generators, 3 Goldstone boson fields must be generated, denoted as $\phi_a(a = 1, 2, 3)$. Let $\pi = \phi_a X_a = \phi_1 X_1 + \phi_2 X_2 + \phi_3 X_3, \phi^2 = \phi_1^2 + \phi_2^2 + \phi_3^2$, then the element in the coset SO(4)/SO(3) is $\xi = \exp(\mathrm{i}\pi/\sqrt{1 - \frac{y}{r}\sum})$, From formula (1), the Goldstone covariant derivative and the corresponding gauge field can be obtained respectively. Since the Goldstone covariant derivative is related to the broken generator, according to the generator commutation relationship, it can be known that only the even-numbered commutation can have each order Goldstone The covariant derivative is calculated as follows: Therefore, the general expression for the Goldstone covariant derivative is[5–7, 10]

$$D_\mu = \frac{1}{\sqrt{1 - \frac{y}{r}\sum}}\partial_\mu \phi_a \boldsymbol{X}_a + \left(\sin\frac{\phi}{\sqrt{1 - \frac{y}{r}\sum}} - \frac{\phi}{\sqrt{1 - \frac{y}{r}\sum}}\right)\partial_\mu\left(\frac{\phi_a}{\phi}\right)\boldsymbol{X}_a. \tag{16}$$

From formula , the effective amount of Goldstone boson can be obtained as:

$$\begin{aligned}\mathcal{L} =& \frac{\sqrt{1 - \frac{y}{r}\sum}^2}{2}\operatorname{Tr}\left(D^\mu D_\mu\right) = \\ &\sum_a\left[\partial_\mu\phi_a + \sqrt{1 - \frac{y}{r}\sum}\partial_\mu\left(\frac{\phi_a}{\phi}\right)\left(\sin\frac{\phi}{\sqrt{1 - \frac{y}{r}\sum}} - \frac{\phi}{\sqrt{1 - \frac{y}{r}\sum}}\right)\right]^2.\end{aligned} \tag{17}$$

IV. SUMMARY AND DISCUSSION

Spontaneous symmetry breaking is a kind of central symmetry breaking mechanism in physics, which has important applications in both condensed matter physics and elementary particle physics. This paper introduces the construction of spontaneous symmetry breaking When the Goldstone boson effective Laplaceman calculates the effective Laplaceman of the Goldstone boson with symmetry breaking SO(4)/SO(3). By the result we put the graviton It is regarded as the Goldstone boson of symmetry breaking SO(4)/SO(3).

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