AN UNIFIED FIELD PROPOSAL

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Abstract. In this paper i will explore idea that could be solution to unified field theory. It uses spin field matrix as model of elementary particles and from it predicts interaction between elementary particles that is solution to field equation that solution leads to geometry of space-time.

1. Spin field matrix

Spin field can be thought as sum of matrix elements. There are two basics states of energy that can describe any system, first one says that zero energy state is equal to zero $\Phi_0 = 0$ so system is massless. Second one says that energy levels are not equal- so system does evolve and have many possible energy states $\Phi_n \neq \Phi_{n-1} ... \neq \Phi_0$. I can write those as states of matrix that has all possible combination of those:

$$S_{nm} = \begin{bmatrix} +s_{11} & +s_{12} \\ -s_{21} & +s_{22} \\ +s_{31} & -s_{32} \\ -s_{41} & -s_{42} \end{bmatrix} \tag{1.1}$$

Where each component of that matrix can have value equal to zero, one or minus one. Sum of those matrix elements is equal to spin state number:

$$\sigma = \frac{1}{2} \sum_{n,m} S_{nm} \tag{1.2}$$

If i have a minus sign of symmetry it means its not fulfilled so the opposite is true, energy zero state is not equal to zero, all energy states are equal. Each elementary particle can be thought as state of that matrix. For example i can write photon and graviton as:

$$\hat{S}_\gamma = \begin{bmatrix} 1 & 1 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad \hat{S}_G = \begin{bmatrix} 1 & 1 \\ 0 & 0 \\ 0 & 0 \\ 1 & 1 \end{bmatrix} \tag{1.3}$$

And for each particle there is anti-particle that has opposite state and moves backwards in time compared to normal particle moving foward in time. So for photon and graviton those anti-particles are:

$$\hat{S}_{\overline{\gamma}} = \begin{bmatrix} -1 & -1 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad \hat{S}_{\overline{G}} = \begin{bmatrix} -1 & -1 \\ 0 & 0 \\ 0 & 0 \\ -1 & -1 \end{bmatrix} \tag{1.4}$$

So anti-photons have mass and only one energy state. Same with anti-gravitons, they have mass and one energy state. But this picture still lacks interaction and energy of that field. I need to define how those states interact. Before i move to it i can write anti-matter state as opposite state of sum of spin field matrix.

2. Elementary particles

From spin field matrix I can recover all Standard Model [1] particles and others not predicted by it.

$$H^0 = \begin{bmatrix} +1 & -1 \\ 0 & 0 \\ 0 & 0 \\ -1 & +1 \end{bmatrix} \quad Z^0 = \begin{bmatrix} -1 & -1 \\ 0 & 0 \\ 0 & 0 \\ +1 & -1 \end{bmatrix} \quad W^- = \begin{bmatrix} +1 & -1 \\ -1 & -1 \\ -1 & 0 \\ +1 & 0 \end{bmatrix} \tag{2.1}$$

$$g_1 = \begin{bmatrix} +1 & +1 \\ 0 & 0 \\ 0 & 0 \\ -1 & +1 \end{bmatrix} \quad g_2 = \begin{bmatrix} +1 & +1 \\ 0 & 0 \\ 0 & 0 \\ +1 & -1 \end{bmatrix} \quad g_3 = \begin{bmatrix} +1 & 0 \\ 0 & 0 \\ 0 & 0 \\ +1 & 0 \end{bmatrix} \tag{2.2}$$

$$e^- = \begin{bmatrix} 0 & 0 \\ -1 & +1 \\ -1 & 0 \\ 0 & 0 \end{bmatrix} \quad \mu^- = \begin{bmatrix} 0 & 0 \\ +1 & -1 \\ -1 & 0 \\ 0 & 0 \end{bmatrix} \quad \tau^- = \begin{bmatrix} 0 & 0 \\ -1 & -1 \\ +1 & 0 \\ 0 & 0 \end{bmatrix} \tag{2.3}$$

$$u = \begin{bmatrix} -1 & 0 \\ -1 & +1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad c = \begin{bmatrix} -1 & 0 \\ +1 & -1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad t = \begin{bmatrix} +1 & 0 \\ -1 & -1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \tag{2.4}$$

$$d = \begin{bmatrix} -1 & 0 \\ -1 & 0 \\ 0 & +1 \\ 0 & 0 \end{bmatrix} \quad s = \begin{bmatrix} -1 & 0 \\ +1 & 0 \\ 0 & -1 \\ 0 & 0 \end{bmatrix} \quad b = \begin{bmatrix} +1 & 0 \\ -1 & 0 \\ 0 & -1 \\ 0 & 0 \end{bmatrix} \tag{2.5}$$

$$\nu_e = \begin{bmatrix} -1 & +1 \\ 0 & 0 \\ 0 & 0 \\ -1 & 0 \end{bmatrix} \quad \nu_\mu = \begin{bmatrix} +1 & -1 \\ 0 & 0 \\ 0 & 0 \\ -1 & 0 \end{bmatrix} \quad \nu_\tau = \begin{bmatrix} -1 & -1 \\ 0 & 0 \\ 0 & 0 \\ +1 & 0 \end{bmatrix} \tag{2.6}$$

$$\gamma = \begin{bmatrix} +1 & +1 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad G = \begin{bmatrix} +1 & +1 \\ 0 & 0 \\ 0 & 0 \\ +1 & +1 \end{bmatrix} \tag{2.7}$$

Where additional particle here is graviton. Electric charge does work for spin matrix elements $s_{21}, s_{22}, s_{31}, s_{32}$ and its $2/3$ for same row entries and $1/3$ for row/column mix- where i count each pair as equal to $2/3$ or $1/3$ charge and it does not matter do they sum to minus two or zero or plus two. If there are mix elements charge is negative is there are only row elements it's positive. It's opposite way for anti-particles, if there are mix elements charge is positive if not it's negative.

3. Spin scalar field

Spin matrix can be understood not only as array of numbers but as scalar field of space-time. I will use notation $\sigma(x^0, x^a)$ for scalr field of spin, where it depends on time coordinate and space coordinate. First let's say i have many particles for them spin field can be written as:

$$\sigma(x^0, x^a) = \sum_i \sigma_i(x^0, x_i^a) + \sum_{i \neq j} \left(\sigma_i + \sigma_j\right)(x^0, x_i^a, x_j^a) \tag{3.1}$$

Where second summation term is interaction term. For any given instant of time spin field has to be conserved so spin field total number does not change:

$$\partial_0 \sigma(x^0, x^a) = 0 \tag{3.2}$$

Interaction term creates so called virtual particles, they connect two particles at some location and their state is equal to sum of spin numbers of interaction particles. They do it at same point of time so their interaction is instant. Next important idea of spin field is energy levels that are key futures of spin field matrix, energy of level of particle is equal to how often particle is emitted and how long is the interaction length in space. I can simply put it into one equation as:

$$\Phi = \sum_i \frac{\sigma_i(x^0 + dx^0, x^a) l_P}{dx^0} + \sum_{i \neq j} \frac{\left(\sigma_i + \sigma_j\right)(x^0 + dx^0, x^a) l_P}{r_{ij} dx^0} \tag{3.3}$$

Where r is length of interaction in space between particles, or between same particle. For same particle its that will be equal to one - it means that one particle moving in field is understood as moving in steps dx^0 and length $r = l_P$ that gives its energy. Last part is spin of field- it's a scalar field so i apply rotation operator to space-part of scalar function so i get:

$$\sigma(x^0, R_b^a x^b) = \sigma(x^0, x^a) \tag{3.4}$$

Where rotation operator is any three dimension direction in space rotation matrix. That operator has a an angle of rotation that is equal to:

$$\sigma\left(x^0, R_b^a \left(\pm 2\pi \Phi |\sigma|\right) x^b\right) = \sigma(x^0, x^a) \tag{3.5}$$

Now i have full view of scalar spin field now i can move to tensor field that will be created out of that scalar field:

$$\partial_0 \sigma_{\mu\nu}(x^0, x^a) = 0 \tag{3.6}$$

It means field value and its direction stays constant. I can write same for whole field with summation:

$$\sigma_{\mu\nu}(x^0, x^a) = \sum_i \sigma_{\mu\nu i}(x^0, x_i^a) + \sum_{i \neq j} \left(\sigma_{\mu\nu i} + \sigma_{\mu\nu j}\right)(x^0, x_i^a, x_j^a) \tag{3.7}$$

4. Field equation for a tensor field

Whole idea can be represented by simple tensor equation that states equality between energy and speed of movement in direction $\mu\nu$, where R is rotation matrix :

$$R^{\mu}_{\alpha}R^{\nu}_{\beta}K_{\mu\nu} = \kappa R^{\mu}_{\alpha}R^{\nu}_{\beta}T_{\mu\nu} \equiv g_{\alpha\beta} \tag{4.1}$$

$$K_{\mu\nu} = \begin{pmatrix} \frac{c^2}{\ddot{x}_{00}} & \frac{c^2}{\ddot{x}_{01}} & \frac{c^2}{\ddot{x}_{02}} & \frac{c^2}{\ddot{x}_{03}} \\ \frac{c^2}{\ddot{x}_{10}} & -\frac{\ddot{x}_{11}}{c^2} & -\frac{\ddot{x}_{12}}{c^2} & -\frac{\ddot{x}_{13}}{c^2} \\ \frac{c^2}{\ddot{x}_{20}} & -\frac{\ddot{x}_{21}}{c^2} & -\frac{\ddot{x}_{22}}{c^2} & -\frac{\ddot{x}_{23}}{c^2} \\ \frac{c^2}{\ddot{x}_{30}} & -\frac{\ddot{x}_{31}}{c^2} & -\frac{\ddot{x}_{32}}{c^2} & -\frac{\ddot{x}_{33}}{c^2} \end{pmatrix} \tag{4.2}$$

$$T_{\mu\nu} = \begin{pmatrix} \frac{1}{\Phi_{00}\hbar^2} & \frac{1}{\Phi_{01}\hbar^2} & \frac{1}{\Phi_{02}\hbar^2} & \frac{1}{\Phi_{03}\hbar^2} \\ \frac{1}{\Phi_{10}\hbar^2} & -\Phi_{11}\hbar^2c^2 & -\Phi_{12}\hbar^2c^2 & -\Phi_{13}\hbar^2c^2 \\ \frac{1}{\Phi_{20}\hbar^2} & -\Phi_{21}\hbar^2c^2 & -\Phi_{22}\hbar^2c^2 & -\Phi_{23}\hbar^2c^2 \\ \frac{1}{\Phi_{30}\hbar^2} & -\Phi_{31}\hbar^2c^2 & -\Phi_{32}\hbar^2c^2 & -\Phi_{33}\hbar^2c^2 \end{pmatrix} \tag{4.3}$$

I used most minus space-time metric signature in this equation. At measurement wave field changes from all possible path summed to one path, $g_{\alpha\beta}$ is metric tensor that is solution to field equation. Angle of rotation is equal to $\theta = \pm 2\pi\Phi|\sigma|$, where sign of rotation depends on spin state. Constant κ is just equal to one over reduced Planck constant squared. From it i can create a wave function that states all possible paths in space-time:

$$\Psi(\mathbf{x}) = \sum_s \sum_P \frac{1}{n(s)} \frac{\int_P g_{\mu\nu}dx^\mu dx^\nu}{\left(\sum_P \int_P g_{\mu\nu}dx^\mu dx^\nu\right)} \int_{P,s} g_{\mu\nu}dx^\mu dx^\nu \tag{4.4}$$

Where i take integral of some path P of space-time, then divide it by sum of all paths of space-time that represents probability and multiply it by that space-time integral over that path. Where $n(s)$ is number of all possible spin states, subscript s in integral means its spin state. Where energy components are:

$$\Phi_{\mu\nu} = \sum_i \frac{\sigma_{\mu\nu i}(x^0 + dx^0, x^a)l_P^2}{\left(dx^0\right)^2} + \sum_{i\neq j} \frac{\left(\sigma_{\mu\nu i} + \sigma_{\mu\nu j}\right)(x^0 + dx^0, x^a)l_P^2}{r_{ij}^2\left(dx^0\right)^2} \tag{4.5}$$

5. Field and anti-field relation

Conservation of spin field number can relate itself to both field and anti-field relation. Generally speaking both field and anti-field has to be conserved not only field itself. Field and anti-field can interact but from idea that field moves foward in time and anti-field backwards, in truth object that is a field can only see what is in a field and the opposite is true. Anti-field can only see what is going in anti-field but their relation or saying simply conservation of spin number applies to sum of both fields that can be expressed as:

$$\partial_0 \sigma_{\mu\nu}(x^0, x^a) + \partial_0 \overline{\sigma}_{\mu\nu}(x^0, x^a) = 0 \tag{5.1}$$

It means that if there is change in field that does not gives zero, there can be opposite change in anti-field so its sum does gives zero. For anti-field metric changes sign compared to field, i can write it as:

$$g_{\alpha\beta} = -\overline{g}_{\alpha\beta} \tag{5.2}$$

It means that wave function has to change sign , from positive to negative as well:

$$\Psi(\mathbf{x}) = -\overline{\Psi}(\mathbf{x}) \tag{5.3}$$

So i can write energy components same way with minus sign for anti-field:

$$\Phi_{\mu\nu} = -\overline{\Phi}_{\mu\nu} \tag{5.4}$$

All those equalities come from idea of anti-field. But what is exactly anti-field? It just anti-matter field. But spin field does not give well know anti-matter from Standard Model, for example a photon has an anti-particle that has mass, electron has an anti-electron that is massless. Spin field has two key idea zero energy state (is system massless or does it have an zero energy state so it is massive) and do all states of energy of a system are equal (if they are object can have only one energy state if not it can change it's energy states) many particles have combination of those so they can have both properties. This proposal of unified field is very simple yet it can predict dark matter particles that would be anti-photon and anti-graviton mostly, they would be very heavy close to Planck energy and have only one energy state, their interaction with light would be by Higgs field for anti-photon and by anti-photon for anti-graviton. It means that for anti-graviton light would bounce of those particles, same with anti-photon. Mass of anti-graviton and anti-photon should equal to Planck mass times fine structure constant. It comes from a fact that if i have two electrons that interact they produce in this model anti-photon, and its energy divided by distance should be responsible for electric interaction.

References

[1] https://www3.nd.edu/~cjessop/research/overview/particle_chart.pdf