SPIN CONNECTION FIELD HYPOTHESIS

TOMASZ KOBIERZYCKI
KOBIERZYCKITOMASZ@GMAIL.COM
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Abstract. In this short paper i presented a simple mathematical model that can be solution to quantum gravity problem. It uses connection as mathematical model and spin field matrix that represents possible particles.

1. Basic ideas

I will assume all units are Planck units [1]. From it comes that speed of light is equal to one, I take one unit of space and divide it by one unit of time so I get speed of light equal to one, this holds for all composite units. I can have any number as unit of space and time as long as they both can be written in form n/m where n, m are natural number and n is less or equal to m- so it do not have to be speed only as natural number of space units divided by time units. But distance between two particles or their interaction length can't be less than one unit of space or time and it always has to be natural number. Goal of quantum gravity is to explain how gravity works on level of elementary particles, here idea is that first i write everything in Planck units, then second i use quantized this way field. Field i will use here is spin number field that takes spin number. I can define antimatter [2] states for sigma states with bar over that states as just normal state but with negative, where anti-matter particles move backwards in time and backwards in space compared to normal particles:

$$\overline{\sigma} = -\sigma \tag{1.1}$$

Now i have defined base units and field i will be working with i can move to define equation of motion that govern field. Those equation are second postulate first is quantization of units second is that field does obey field equation. Speed of light limit here does not imply and there are no Lorentz transformation. I will be using as mathematical model connections that are fully define in section field equation. From spin field matrix I can get all Standard Model particles and graviton i don't present other particles that can be create out of spin field matrix.

2. Field equation

Equation of movement in field is second postulate and to create them i need to introduce mathematical objects of field that are connections of field, first i define connection itself for position that can have sixteen direction. I can write that position as $x^{\mu\nu}$ where μ, ν represent direction - first and second one, $F^{\mu\nu}\left(x^{\mu\nu}+A^{\mu\nu}\right)$ where $A^{\mu\nu}$ is some psuedo-tensor:

$$\begin{cases} F^{\mu\nu}\left(x^{\mu\nu}+A^{\mu\nu}\right) \mapsto \tilde{F}^{\mu\nu}\left(\tilde{x}^{\mu\nu}+x^{\mu\nu}+\tilde{A}^{\mu\nu}\right) \\ F^{\mu\nu}\left(x^{\mu\nu}+A^{\mu\nu}\right) = x^{\mu\nu}\left(x^{\mu\nu}\right)+A^{\mu\nu}\left(x^{\mu\nu}\right) \\ \tilde{F}^{\mu\nu}\left(\tilde{x}^{\mu\nu}+x^{\mu\nu}+\tilde{A}^{\mu\nu}\right) = \tilde{x}^{\mu\nu}\left(\tilde{x}^{\mu\nu}+x^{\mu\nu}\right)+\tilde{A}^{\mu\nu}\left(\tilde{x}^{\mu\nu}+x^{\mu\nu}\right) \end{cases} \tag{2.1}$$

So it means i take a point of field and move it to another point where one point have one value another one has another- it points in direction but it does not have direction like vectors have. Second thing is that connection of field are not quantum objects- in quantum mechanics i need to have probability number for each possible state. I will use new object that uses connection field i will call it $\Psi_P^{\alpha\beta}$ and its equal to:

$$\sum_P \Psi_P^{\alpha\beta} = \sum_P \frac{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma}{\sum_P \int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma} F^{\alpha\beta}\left(x^{\alpha\beta}+\sigma_{\alpha\beta}T^{\alpha\beta}\right) \tag{2.2}$$

Where i added two new objects, first one is spin field covariant pseudo tensor $\sigma_{\alpha\beta}$ that gives each direction os spin number and energy contravariant pseudo tensor $T^{\alpha\beta}$. But both of them don't have indexes as field $\mu\nu$ but indexes $\alpha\beta$ those new indexes are rotated in space indexes that i can write for each element of connection field as:

$$x^{\alpha\beta} = \frac{1}{2}R_\mu^\alpha \delta_\nu^\beta x^{\mu\nu} + \frac{1}{2}\delta_\mu^\alpha R_\nu^\beta x^{\mu\nu} \tag{2.3}$$

$$\sigma_{\alpha\beta}T^{\alpha\beta} = \frac{1}{2}\delta_\alpha^\mu \delta_\beta^\nu \sigma_{\mu\nu} R_\mu^\alpha \delta_\nu^\beta T^{\mu\nu} + \frac{1}{2}\delta_\alpha^\mu \delta_\beta^\nu \sigma_{\mu\nu} \delta_\mu^\alpha R_\nu^\beta T^{\mu\nu} \tag{2.4}$$

Where i use rotation operators of normal three dimensions [3] space with no rotation in time direction. In field equation for object $\Psi_P^{\alpha\beta}$ I used integral over whole space X^4 that represents each possible time direction and all possible vectors that can be rotated in space so it generates sphere as space. That equation tells that probability of each path of a field is equal to integral over that path P divided by sum of all integrals over all possible paths, where i sum all vectors along that path and using dot product get length squared of final vector. Those equation lack only spin to be complete. I can write rotation angle change for each part of connection field as equal to its value where it does have a base rotation angle but its not affected in change of it:

$$\Delta\theta = 2\pi\sigma_{\mu\nu}T^{\mu\nu} \tag{2.5}$$

3. Energy and simplest solutions

Energy is a scalar, and i can write simple relation between scalar energy and scalar spin number and its tensor parts:

$$\sigma E = \sigma_{\mu\nu} T^{\mu\nu} \tag{3.1}$$

This relation has to be fulfilled. Now i can move to simplest solution for gravity [4] system only, i will use energy written as $\frac{M}{r}$ where M is mass and r is radius, all its written in Planck units so i can write it in normal units as $\frac{Ml_P}{m_P r}$ where subscript P means Planck unit. Graviton has spin two so i have to multiply it by two so i get $\frac{2M}{r}$ i can write now energy relation as:

$$\sigma E = \frac{2Ml_P}{m_P r} = \frac{2M}{r} = \sigma_{\mu\nu} T^{\mu\nu} \tag{3.2}$$

Now i can assume that it does not move in time only in radius direction so i get:

$$\frac{2M}{r} = \sigma_{rr} T^{rr} \tag{3.3}$$

$$0 = \sigma_{tt} T^{tt} = \sigma_{tr} T^{tr} = \sigma_{rt} T^{rt} \tag{3.4}$$

It's easy to see that when i have a photon at event horizon of a black hole it will move foward in time but not move in space so this model predicts correctly for a black hole an event horizon. I can write a state of photon that was emitted to move outside the horizon as:

$$\begin{bmatrix} n(n) & 0 \\ 0 & n(n) \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & -n(n) \end{bmatrix} = \begin{bmatrix} n(n) & 0 \\ 0 & 0 \end{bmatrix} \tag{3.5}$$

So that photon does not move outside the horizon if it was emitted at some angle it will eventually fall to singularity. Limit of distance between two objects is one it's one Planck length so when i get a photon reach that distance gravity has to repel that photon so it goes back to event horizon and stays- its simplest model of singularity. I can write that state as:

$$\begin{bmatrix} n(n) & 0 \\ 0 & -n(-n) \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & 2n(-n) \end{bmatrix} = \begin{bmatrix} n(n) & 0 \\ 0 & n(n) \end{bmatrix} \tag{3.6}$$

Where now photon moves first towards the singularity so that's why i have minus sign at rr component. When it goes to event horizon graviton acts on it so it stay at event horizon.

$$\begin{bmatrix} n(n) & 0 \\ 0 & n(n) \end{bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & -n(n) \end{bmatrix} = \begin{bmatrix} n(n) & 0 \\ 0 & 0 \end{bmatrix} \tag{3.7}$$

4. 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 $E_0 = 0$ so system is massless. Second one says that energy levels are not equal- so system does evolve and have many possible energy states $E_n \neq E_{n-1} ... \neq E_0$. I can write those as states of matrix that has all possible combination of those:

$$S_{nm} = \begin{bmatrix} +s_{11} & +s_{12} \\ -s_{21} & +s_{22} \\ +s_{31} & -s_{32} \\ -s_{41} & -s_{42} \end{bmatrix} \tag{4.1}$$

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:

$$\sigma = \frac{1}{2} \sum_{n,m} S_{nm} \tag{4.2}$$

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 [5] as:

$$\hat{S}_\gamma = \begin{bmatrix} 1 & 1 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad \hat{S}_G = \begin{bmatrix} 1 & 1 \\ 0 & 0 \\ 0 & 0 \\ 1 & 1 \end{bmatrix} \tag{4.3}$$

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:

$$\hat{S}_{\overline{\gamma}} = \begin{bmatrix} -1 & -1 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad \hat{S}_{\overline{G}} = \begin{bmatrix} -1 & -1 \\ 0 & 0 \\ 0 & 0 \\ -1 & -1 \end{bmatrix} \tag{4.4}$$

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:

$$\overline{\sigma} = -\frac{1}{2} \sum_{n,m} S_{nm} \tag{4.5}$$

5. Measurement

Measurement is key idea in all physics- in quantum physics measurement [6] change state of wave function from all possible states to one state. Now i can write it all i have wave spin field before measurement and after measurement , where before measurement i sum all paths P after measurement all paths reduce to one path:

$$\sum_P \Psi_P^{\alpha\beta} = \sum_P \frac{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma}{\sum_P \int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma} F^{\alpha\beta}\left(x^{\alpha\beta} + \sigma_{\alpha\beta}T^{\alpha\beta}\right) \quad (5.1)$$

$$\Psi^{\alpha\beta} = \frac{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma}{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma} F^{\alpha\beta}\left(x^{\alpha\beta} + \sigma_{\alpha\beta}T^{\alpha\beta}\right) \quad (5.2)$$

Now for spin i can have two possible outcomes- positive rotation angle and negative rotation angle that are both solution to change in angle. For bosons I can write before spin measurement and after, where N is number of all states:

$$\Psi^{\alpha\beta} = \frac{1}{N}\sum_{B=-|\sigma_1|}^{|\sigma_1|} \frac{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma}{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma} F_B^{\alpha\beta}\left(x^{\alpha\beta} + \sigma_{\alpha\beta}T^{\alpha\beta}\right) \quad (5.3)$$

$$\Psi^{\alpha\beta} = \frac{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma}{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma} F_B^{\alpha\beta}\left(x^{\alpha\beta} + \sigma_{\alpha\beta}T^{\alpha\beta}\right) \quad (5.4)$$

Where B after measurement represents one possible state for particle not sum of all states. Now for fermions [7] I can do same where I sum over states that are not integers, so for example if i have only one half spin number i will sum two states minus one half and plus one half:

$$\Psi^{\alpha\beta} = \frac{1}{N}\sum_{F=-|\sigma_1|\notin Z}^{|\sigma_1|\notin Z} \frac{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma}{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma} F_F^{\alpha\beta}\left(x^{\alpha\beta} + \sigma_{\alpha\beta}T^{\alpha\beta}\right) \quad (5.5)$$

$$\Psi^{\alpha\beta} = \frac{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma}{\int_{P\in X^4} dx^\gamma \cdot \int_{P\in X^4} dx^\gamma} F_F^{\alpha\beta}\left(x^{\alpha\beta} + \sigma_{\alpha\beta}T^{\alpha\beta}\right) \quad (5.6)$$

6. Elementary particles

From spin field matrix I can recover all Standard Model [8] particles and others not predicted by it.

$$H^0 = \begin{bmatrix} +1 & -1 \\ 0 & 0 \\ 0 & 0 \\ -1 & +1 \end{bmatrix} \quad Z^0 = \begin{bmatrix} -1 & -1 \\ 0 & 0 \\ 0 & 0 \\ +1 & -1 \end{bmatrix} \quad W^- = \begin{bmatrix} +1 & -1 \\ -1 & -1 \\ -1 & 0 \\ +1 & 0 \end{bmatrix} \tag{6.1}$$

$$g_1 = \begin{bmatrix} +1 & +1 \\ 0 & 0 \\ 0 & 0 \\ -1 & +1 \end{bmatrix} \quad g_2 = \begin{bmatrix} +1 & +1 \\ 0 & 0 \\ 0 & 0 \\ +1 & -1 \end{bmatrix} \quad g_3 = \begin{bmatrix} +1 & 0 \\ 0 & 0 \\ 0 & 0 \\ +1 & 0 \end{bmatrix} \tag{6.2}$$

$$e^- = \begin{bmatrix} 0 & 0 \\ -1 & +1 \\ -1 & 0 \\ 0 & 0 \end{bmatrix} \quad \mu^- = \begin{bmatrix} 0 & 0 \\ +1 & -1 \\ -1 & 0 \\ 0 & 0 \end{bmatrix} \quad \tau^- = \begin{bmatrix} 0 & 0 \\ -1 & -1 \\ +1 & 0 \\ 0 & 0 \end{bmatrix} \tag{6.3}$$

$$u = \begin{bmatrix} -1 & 0 \\ -1 & +1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad c = \begin{bmatrix} +1 & 0 \\ -1 & -1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad t = \begin{bmatrix} -1 & 0 \\ +1 & -1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \tag{6.4}$$

$$d = \begin{bmatrix} -1 & 0 \\ -1 & 0 \\ 0 & +1 \\ 0 & 0 \end{bmatrix} \quad s = \begin{bmatrix} +1 & 0 \\ -1 & 0 \\ 0 & -1 \\ 0 & 0 \end{bmatrix} \quad b = \begin{bmatrix} -1 & 0 \\ +1 & 0 \\ 0 & -1 \\ 0 & 0 \end{bmatrix} \tag{6.5}$$

$$\nu_e = \begin{bmatrix} -1 & +1 \\ 0 & 0 \\ 0 & 0 \\ -1 & 0 \end{bmatrix} \quad \nu_\mu = \begin{bmatrix} +1 & -1 \\ 0 & 0 \\ 0 & 0 \\ -1 & 0 \end{bmatrix} \quad \nu_\tau = \begin{bmatrix} -1 & -1 \\ 0 & 0 \\ 0 & 0 \\ +1 & 0 \end{bmatrix} \tag{6.6}$$

$$\gamma = \begin{bmatrix} +1 & +1 \\ 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \quad G = \begin{bmatrix} +1 & +1 \\ 0 & 0 \\ 0 & 0 \\ +1 & +1 \end{bmatrix} \tag{6.7}$$

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.

7. Space-time of connections

Connections are pseudo-tensors of second order that transform as tensors from one base to another and transform like two vectors when rotated. Space-time is all connections of light cones emitted from given point with point of any given other connection. There are unit connections that behave like light cones - i will denote them with U and u, for no energy those unit connections have to obey equation:

$$\eta_{\alpha\beta}U^{\alpha\beta}\left(u^{\alpha\beta}\right)=0 \tag{7.1}$$

Where $\eta_{\alpha\beta}$ is metric tensor for flat space-time, so called Minkowski tensor [9]. All unit connection that reach a point of any other connection define space-time for that connection at given point. Where there is energy i need to change it to another equation:

$$g_{\alpha\beta}U^{\alpha\beta}\left(u^{\alpha\beta}+\sigma_{\alpha\beta}T^{\alpha\beta}\right)=0 \tag{7.2}$$

Where now metric tensor is equal to with metric signature [10] $(+---)$:

$$g_{\alpha\beta}=\begin{pmatrix}1 & 1 & 1 & 1\\ 1 & -1 & -1 & -1\\ 1 & -1 & -1 & -1\\ 1 & -1 & -1 & -1\end{pmatrix} \tag{7.3}$$

If energy for non-diagonal elements is not equal to zero that metric tensor gives that energy a sign depending on its a time or space direction. Each signal that can reach a connection defines what casually can influence it. It's build from all signal that reach any point of given connection where I emit connection from each point of space-time. Connection moves in one unit of time and one unit of space for given part moving that way it can reach connection when it moves to connection point. Light cones are not one move of connection but all possible moves. From it there is build a casual structure of events. Point of space-time for connections is define as grid can only have natural numbers values for time and space. But for objects that have other that natural numbers values it can be written as n/m as i pointed before so grid for them is divided this way with n/m steps not natural number of steps- each steps moves grid by n/m, but from need of steps to be a natural number object moves by n steps in time m so grid is divided into steps but each step can be only a natural number of steps n in natural number of time m. This way space-time is constructed out of connections.

8. Transformation of connections

In this section I will define how to transform connections, first I start with derivative operator for connections, I can define that operator as:

$$\partial_{\alpha\beta}F^{\alpha\beta}\left(x^{\alpha\beta}+\sigma_{\alpha\beta}T^{\alpha\beta}\right)$$
$$=\sum_{\alpha,\beta}\tilde{F}^{\alpha\beta}\left(x^{\alpha\beta}+\tilde{x}^{\alpha\beta}+\tilde{\sigma}_{\alpha\beta}\tilde{T}^{\alpha\beta}\right)-F^{\alpha\beta}\left(x^{\alpha\beta}+\sigma_{\alpha\beta}T^{\alpha\beta}\right) \tag{8.1}$$

Where those are parts of connections are defined in second section. Next part is how connections transform from one vector basis to another, base is always normal Cartesian coordinate system with Planck units, but i can move to any other coordinate system as long as it follows transformation rule:

$$x^{\mu\nu}=\frac{1}{2}\partial^{\mu}_{\gamma}\delta^{\nu}_{\delta}x^{\gamma\delta}+\frac{1}{2}\delta^{\mu}_{\gamma}\partial^{\nu}_{\delta}x^{\gamma\delta} \tag{8.2}$$

$$\partial^{\mu}_{\gamma}=\frac{\partial x^{\mu}}{\partial x^{\gamma}} \tag{8.3}$$

$$\partial^{\nu}_{\delta}=\frac{\partial x^{\nu}}{\partial x^{\delta}} \tag{8.4}$$

From it i need to calculate norm of pseudo-tensor that is equal to:

$$\|x^{\mu\nu}\|=\sqrt{\sum_{\mu,\nu}\left(\delta^{\mu}_{\gamma}\delta^{\nu}_{\delta}x^{\gamma\delta}\right)^2} \tag{8.5}$$

So connection parts transform as two vectors summed, same does apply to rotations as written in second section. When i sum those vectors their length is half of their total lengths. Norm of connection parts is equal to sum of all connection parts threat as sixteen dimensional vector in Euclidean space with time. For many systems derivative operator is defined as sum of all systems, from it follows conservation law:

$$\partial_{\alpha\beta}F^{\alpha\beta}\left(x^{\alpha\beta}_{(1)}+\sigma_{\alpha\beta(1)}T^{\alpha\beta}_{(1)};...;x^{\alpha\beta}_{(n)}+\sigma_{\alpha\beta(n)}T^{\alpha\beta}_{(n)}\right)$$
$$=\sum_{k=1}^{n}\sum_{\alpha,\beta}\tilde{F}^{\alpha\beta}\left(x^{\alpha\beta}_{k}+\tilde{x}^{\alpha\beta}_{k}+\tilde{\sigma}_{\alpha\beta k}\tilde{T}^{\alpha\beta}_{k}\right)-F^{\alpha\beta}\left(x^{\alpha\beta}_{k}+\sigma_{\alpha\beta k}T^{\alpha\beta}_{k}\right) \tag{8.6}$$

$$\partial_{\alpha\beta}F^{\alpha\beta}\left(x^{\alpha\beta}_{(1)}+\sigma_{\alpha\beta(1)}T^{\alpha\beta}_{(1)};...;x^{\alpha\beta}_{(n)}+\sigma_{\alpha\beta(n)}T^{\alpha\beta}_{(n)}\right)=0 \tag{8.7}$$

9. Many particles systems

Many particle systems are key in physics, first i need to write field in terms of many particles. I will use subscript to denote particles:

$$F_1^{\alpha\beta}...F_n^{\alpha\beta} = F_{1...n}^{\alpha\beta} = F^{\alpha\beta}\left(x_{(1)}^{\alpha\beta} + \sigma_{\alpha\beta(1)}T_{(1)}^{\alpha\beta}; ...; x_{(n)}^{\alpha\beta} + \sigma_{\alpha\beta(n)}T_{(n)}^{\alpha\beta}\right) \tag{9.1}$$

It means i threat each particle as being independent of all other particles. Conservation laws now apply to all particles not just one that i can write as:

$$\partial_{\alpha\beta}F^{\alpha\beta}\left(x_{(1)}^{\alpha\beta} + \sigma_{\alpha\beta(1)}T_{(1)}^{\alpha\beta}; ...; x_{(n)}^{\alpha\beta} + \sigma_{\alpha\beta(n)}T_{(n)}^{\alpha\beta}\right) = 0 \tag{9.2}$$

Probabilities now are multiply for each individual particle:

$$\prod_{m=1}^{n}\sum_{P_m}\Psi_{P_m}^{\alpha\beta} = \prod_{m=1}^{n}\sum_{P_m}\frac{\int_{P_m\in X^4}dx^\gamma\cdot\int_{P_m\in X^4}dx^\gamma}{\sum_{P_m}\int_{P_m\in X^4}dx^\gamma\cdot\int_{P\in X^4}dx^\gamma}F_m^{\alpha\beta} \tag{9.3}$$

I can write all those conservation laws for anti-field as:

$$\partial_{\alpha\beta}\overline{F}^{\alpha\beta}\left(\overline{x}_{(1)}^{\alpha\beta} + \overline{\sigma}_{\alpha\beta(1)}\overline{T}_{(1)}^{\alpha\beta}; ...; \overline{x}_{(n)}^{\alpha\beta} + \overline{\sigma}_{\alpha\beta(n)}\overline{T}_{(n)}^{\alpha\beta}\right) = 0 \tag{9.4}$$

And finally relation between field and anti-field:

$$\begin{aligned} &F^{\alpha\beta}\left(x_{(1)}^{\alpha\beta} + \sigma_{\alpha\beta(1)}T_{(1)}^{\alpha\beta}; ...; x_{(n)}^{\alpha\beta} + \sigma_{\alpha\beta(n)}T_{(n)}^{\alpha\beta}\right) \\ &= -\overline{F}^{\alpha\beta}\left(\overline{x}_{(1)}^{\alpha\beta} + \overline{\sigma}_{\alpha\beta(1)}\overline{T}_{(1)}^{\alpha\beta}; ...; \overline{x}_{(n)}^{\alpha\beta} + \overline{\sigma}_{\alpha\beta(n)}\overline{T}_{(n)}^{\alpha\beta}\right) \end{aligned} \tag{9.5}$$

Spin probabilities are now sum of each particle spin probability multiplied by all rest particles:

$$\prod_{m=1}^{n}\sum_{P_m}\Psi_{P_m}^{\alpha\beta} = \prod_{m=1}^{n}\sum_{P_m}\sum_{B_m=-|\sigma_m|}^{|\sigma_m|}\frac{1}{N_m}\frac{\int_{P_m\in X^4}dx^\gamma\cdot\int_{P_m\in X^4}dx^\gamma}{\sum_{P_m}\int_{P_m\in X^4}dx^\gamma\cdot\int_{P\in X^4}dx^\gamma}F_{B_m}^{\alpha\beta} \tag{9.6}$$

$$\prod_{m=1}^{n}\sum_{P_m}\Psi_{P_m}^{\alpha\beta} = \prod_{m=1}^{n}\sum_{P_m}\sum_{F_m=-|\sigma_m|\notin Z}^{|\sigma_m|\notin Z}\frac{1}{N_m}\frac{\int_{P_m\in X^4}dx^\gamma\cdot\int_{P_m\in X^4}dx^\gamma}{\sum_{P_m}\int_{P_m\in X^4}dx^\gamma\cdot\int_{P\in X^4}dx^\gamma}F_{F_m}^{\alpha\beta} \tag{9.7}$$

Where i written both for bosons and fermions, B_m is bosons state and F_m is fermion states.

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