Probability and QCD

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Abstract

The probabilities of point events in space $3 + 1$ obey an equation of Dirac type.

Masses, moments, energies, spins, etc. are the parameters of the probability distribution of such events.

The terms and equations of quark-gluon theories turn out theoretically probabilistic terms and theorems. Confinement and asymptotic freedom are explained by behaviour of such probabilities. And here we have the probabilistic foundations of the theory of gravitation.

Knowledge of the elements of linear algebra and differential calculus is sufficient to understand the content of this article

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1 Introduction

In the study of the logical foundations of probability theory [1], I found that the terms and equations of the fundamental theoretical physics represent terms and theorems of the classical probability theory, more precisely, of that part of this theory, which considers the probability of dot events in the $3 + 1$ space-time.

In particular, all Standard Model’s formulas (higgs ones except) turn out theorems of such probability theory. And the masses, moments, energies, spins, etc. turn out parameters of probability distributions such events. The terms and the equations of the electroweak and of the quark-gluon theories turn out the theoretical-probabilistic terms and theorems.
Here the relation of a neutrino to his lepton becomes clear, the W and Z bosons masses turn out dynamic ones, the cause of the asymmetry between particles and antiparticles is the impossibility of the birth of single antiparticles. In addition, phenomena such as confinement and asymptotic freedom receive their probabilistic explanation. And here we have the logical foundations of the gravity theory with phenomena dark energy and dark matter.

The proposed article contains initial concepts and the results of the development of these ideas.

2 Propagation of probability

Let us consider dot events in the 3+1 space-time with coordinates:

\[ \mathbf{x} = (x_1, x_2, x_3), \]
\[ \mathbf{z} = (x_0, \mathbf{x}), \]
\[ \int d^{3+1} \mathbf{z} = \int dx_0 \int dx_1 \int dx_2 \int dx_3, \]
\[ \int d^3 \mathbf{y} = \int dy_1 \int dy_2 \int dy_3, \]
\[ t = \frac{x_0}{c}. \]

Sentence of type: \( \ll \text{Event } A \text{ occurs in point } \mathbf{z} \gg \) will be written the following way: \( \ll A(\mathbf{z}) \gg ^n \).

Events of type \( \circ \ll A(\mathbf{z}) \gg \) are called dot events. All dot events and all events received from dot events by operations of addition, multiplication and addition, are physical events.

\( A(D) \) means: \( \ll (A(\mathbf{z}) \wedge \circ \ll (\mathbf{z}) \in D \gg) \).

Let \( P \) be the probability function.

Let \( (X_{A,0}, X_{A,1}, X_{A,2}, X_{A,3}) \) be random coordinates of event \( A \).

Let \( F_A \) be a Cumulative Distribution Function i.e.:

\[ F_A(x_0, x_1, x_2, x_3) = P((X_{A,0} < x_0) \wedge (X_{A,1} < x_1) \wedge (X_{A,2} < x_2) \wedge (X_{A,3} < x_3)). \]

If

\[ j_0 = \frac{\partial^3 F}{\partial x_1 \partial x_2 \partial x_3}, \]
\[ j_1 = -\frac{\partial^3 F}{\partial x_0 \partial x_2 \partial x_3}, \]
\[ j_2 = -\frac{\partial^3 F}{\partial x_0 \partial x_1 \partial x_3}, \]
\[ j_3 = \frac{\partial^3 F}{\partial x_0 \partial x_1 \partial x_2}, \]

then \( (j_0, j_1, j_2, j_3) \) is a probability current vector of event.

If \( \rho := j_0/c \) then \( \rho \) is a a probability density function.
If \( u_A := jA/\rho_A \) then vector \( u_A \) is a velocity of the probability of \( A \) propagation.

(for example for \( u_2 \):

\[
u_2 = \frac{j_2}{\rho} = \left( -\frac{\partial^2 F}{\partial x_0 \partial x_2 \partial x_3} \right) c = \left( -\frac{\Delta_{013} F}{\Delta_{123} F} \Delta_{x_2} \right) c\]

)

Probability, for which \( u_1^2 + u_2^2 + u_3^2 \leq c \) are called traceable probability.

Denote:

\[
l_2 := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, \quad 0_2 := \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}, \quad \beta^{[0]} := -\begin{bmatrix} l_2 & 0_2 \\ 0_2 & l_2 \end{bmatrix} = -14,
\]

the Pauli matrices

\[
\sigma_1 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}, \quad \sigma_2 = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}, \quad \sigma_3 = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}.
\]

A set \( \tilde{C} \) of complex \( n \times n \) matrices is called a Clifford set of rank \( n \) if the following conditions are fulfilled:

if \( \alpha_k \in \tilde{C} \) and \( \alpha_r \in \tilde{C} \) then \( \alpha_k \alpha_r + \alpha_r \alpha_k = 2\delta_{k,r} \); if \( \alpha_k \alpha_r + \alpha_r \alpha_k = 2\delta_{k,r} \) for all elements \( \alpha_r \) of set \( \tilde{C} \) then \( \alpha_k \in \tilde{C} \).

If \( n = 4 \) then a Clifford set either contains 3 matrices (a Clifford triplet) or contains 5 matrices (a Clifford pentad).

Here exist only six Clifford pentads [3]: one light pentad \( \beta \):

\[
\beta^{[1]} := \begin{bmatrix} \sigma_1 & 0_2 \\ 0_2 & -\sigma_1 \end{bmatrix}, \quad \beta^{[2]} := \begin{bmatrix} \sigma_2 & 0_2 \\ 0_2 & -\sigma_2 \end{bmatrix}, \quad \beta^{[3]} := \begin{bmatrix} \sigma_3 & 0_2 \\ 0_2 & -\sigma_3 \end{bmatrix}, \quad (1)
\]

\[
\gamma^{[0]} := \begin{bmatrix} 0_2 & l_2 \\ l_2 & 0_2 \end{bmatrix}, \quad (2)
\]

\[
\beta^{[4]} := i \cdot \begin{bmatrix} 0_2 & l_2 \\ -l_2 & 0_2 \end{bmatrix}; \quad (3)
\]

three chromatic pentads:

the red pentad \( \zeta \):

\[
\zeta^{[1]} = \begin{bmatrix} -\sigma_1 & 0_2 \\ 0_2 & \sigma_1 \end{bmatrix}, \quad \zeta^{[2]} = \begin{bmatrix} \sigma_2 & 0_2 \\ 0_2 & \sigma_2 \end{bmatrix}, \quad \zeta^{[3]} = \begin{bmatrix} -\sigma_3 & 0_2 \\ 0_2 & -\sigma_3 \end{bmatrix}, \quad (4)
\]

\[
\gamma^{[0]}_{\tilde{\zeta}} := \begin{bmatrix} 0_2 & -\sigma_1 \\ -\sigma_1 & 0_2 \end{bmatrix}, \quad \zeta^{[4]} = i \begin{bmatrix} 0_2 & \sigma_1 \\ -\sigma_1 & 0_2 \end{bmatrix}; \quad (5)
\]

the green pentad \( \eta \):

\[
\eta^{[1]} = \begin{bmatrix} -\sigma_1 & 0_2 \\ 0_2 & -\sigma_1 \end{bmatrix}, \quad \eta^{[2]} = \begin{bmatrix} -\sigma_2 & 0_2 \\ 0_2 & -\sigma_2 \end{bmatrix}, \quad \eta^{[3]} = \begin{bmatrix} \sigma_3 & 0_2 \\ 0_2 & \sigma_3 \end{bmatrix}, \quad (6)
\]
\[ \gamma^{[0]}_0 = \begin{bmatrix} 0_2 & -\sigma_2 \\ -\sigma_2 & 0_2 \end{bmatrix}, \eta^{[4]} = i \begin{bmatrix} 0_2 & \sigma_2 \\ -\sigma_2 & 0_2 \end{bmatrix}; \quad (7) \]

the blue pentad \( \theta \):

\[ \theta^{[1]} = \begin{bmatrix} \sigma_1 & 0_2 \\ 0_2 & \sigma_1 \end{bmatrix}, \theta^{[2]} = \begin{bmatrix} -\sigma_2 & 0_2 \\ 0_2 & -\sigma_2 \end{bmatrix}, \theta^{[3]} = \begin{bmatrix} -\sigma_3 & 0_2 \\ 0_2 & \sigma_3 \end{bmatrix}, \quad (8) \]

\[ \gamma^{[0]}_\theta = \begin{bmatrix} 0_2 & -\sigma_3 \\ -\sigma_3 & 0_2 \end{bmatrix}, \theta^{[4]} = i \begin{bmatrix} 0_2 & \sigma_3 \\ -\sigma_3 & 0_2 \end{bmatrix}; \quad (9) \]

two gustatory pentads:

the sweet pentad \( \Delta \):

\[ \Delta^{[1]} = \begin{bmatrix} 0_2 & -\sigma_1 \\ -\sigma_1 & 0_2 \end{bmatrix}, \Delta^{[2]} = \begin{bmatrix} 0_2 & -\sigma_2 \\ -\sigma_2 & 0_2 \end{bmatrix}, \Delta^{[3]} = \begin{bmatrix} 0_2 & -\sigma_3 \\ -\sigma_3 & 0_2 \end{bmatrix}, \quad (10) \]

\[ \Delta^{[0]} = \begin{bmatrix} -1_2 & 0_2 \\ 0_2 & 1_2 \end{bmatrix}, \Delta^{[4]} = i \begin{bmatrix} 0_2 & 1_2 \\ -1_2 & 0_2 \end{bmatrix}; \]

the bitter pentad \( \Gamma \):

\[ \Gamma^{[1]} = i \begin{bmatrix} 0_2 & -\sigma_1 \\ \sigma_1 & 0_2 \end{bmatrix}, \Gamma^{[2]} = i \begin{bmatrix} 0_2 & -\sigma_2 \\ \sigma_2 & 0_2 \end{bmatrix}, \Gamma^{[3]} = i \begin{bmatrix} 0_2 & -\sigma_3 \\ \sigma_3 & 0_2 \end{bmatrix}, \quad (11) \]

\[ \Gamma^{[0]} = \begin{bmatrix} -1_2 & 0_2 \\ 0_2 & 1_2 \end{bmatrix}, \Gamma^{[4]} = \begin{bmatrix} 0_2 & 1_2 \\ 1_2 & 0_2 \end{bmatrix}. \]

Further we do not consider gustatory pentads since these pentads are not used yet in the contemporary physics.

Let \( \kappa := \sum_{s=0}^3 \beta^{[s]}x^s \).

If

\[ U_{0,1}(\sigma) := \begin{bmatrix} \cosh \sigma & -\sinh \sigma & 0 & 0 \\ -\sinh \sigma & \cosh \sigma & 0 & 0 \\ 0 & 0 & \cosh \sigma & \sinh \sigma \\ 0 & 0 & \sinh \sigma & \cosh \sigma \end{bmatrix} \]

then

\[ U_{0,1}^\dagger(\sigma) \kappa U_{0,1}(\sigma) = \]

\[ \beta^{[0]}(x_0 \cosh 2\sigma + x_1 \sinh 2\sigma) \]

\[ + \beta^{[1]}(x_1 \cosh 2\sigma + x_0 \sinh 2\sigma) \]

\[ + \beta^{[2]}x_2 + \beta^{[3]}x_3. \]

Hence, \( U_{0,1} \) makes the Lorentz transformation \((x_0, x_1)\):

\[ x_0 \rightarrow x_0' := x_0 \cosh 2\sigma + x_1 \sinh 2\sigma, \]

\[ x_1 \rightarrow x_1' := x_1 \cosh 2\sigma + x_0 \sinh 2\sigma, \]

\[ x_2 \rightarrow x_2', \]

\[ x_3 \rightarrow x_3'. \]
Similarly,

\[ U_{0,2} (\phi) := \begin{bmatrix} \cosh \phi & i \sinh \phi & 0 & 0 \\ -i \sinh \phi & \cosh \phi & 0 & 0 \\ 0 & 0 & \cosh \phi & -i \sinh \phi \\ 0 & 0 & i \sinh \phi & \cosh \phi \end{bmatrix} \] (11)

makes the Lorentz transformation \( \langle x_0, x_2 \rangle \) and

\[ U_{0,3} (\iota) := \begin{bmatrix} e^{i \iota} & 0 & 0 & 0 \\ 0 & e^{-i \iota} & 0 & 0 \\ 0 & 0 & e^{-i \iota} & 0 \\ 0 & 0 & 0 & e^{i \iota} \end{bmatrix} \] (12)

makes the Lorentz transformation \( \langle x_0, x_3 \rangle \).

If

\[ U_{1,3} (\vartheta) := \begin{bmatrix} \cos \vartheta & \sin \vartheta & 0 & 0 \\ -\sin \vartheta & \cos \vartheta & 0 & 0 \\ 0 & 0 & \cos \vartheta & \sin \vartheta \\ 0 & 0 & -\sin \vartheta & \cos \vartheta \end{bmatrix} \] (13)

then \( U_{1,3} (\vartheta) \) makes the cartesian turn \( \langle x_1, x_3 \rangle \):

\[
U_{1,3}^T (\vartheta) \rho U_{1,3} (\vartheta) = \beta[0] x_0 + \beta[1] (x_1 \cos 2\vartheta + x_3 \sin 2\vartheta) + \beta[2] x_2 + \beta[3] (x_3 \cos 2\vartheta - x_1 \sin 2\vartheta)
\]

Similarly,

\[ U_{1,2} (\varsigma) := \begin{bmatrix} e^{-i \varsigma} & 0 & 0 & 0 \\ 0 & e^{i \varsigma} & 0 & 0 \\ 0 & 0 & e^{-i \varsigma} & 0 \\ 0 & 0 & 0 & e^{i \varsigma} \end{bmatrix} \] (14)

makes the cartesian turn \( \langle x_1, x_2 \rangle \) and

\[ U_{2,3} (\alpha) := \begin{bmatrix} \cos \alpha & i \sin \alpha & 0 & 0 \\ i \sin \alpha & \cos \alpha & 0 & 0 \\ 0 & 0 & \cos \alpha & i \sin \alpha \\ 0 & 0 & i \sin \alpha & \cos \alpha \end{bmatrix} \] (15)

makes the cartesian turn \( \langle x_2, x_3 \rangle \).

Let us consider the following set of four real equations with eight real unknowns: \( b^2 \) with \( b > 0, \alpha, \beta, \chi, \theta, \gamma, \upsilon, \lambda \):

\[
\begin{align*}
b^2 &= \rho, \\
b^2 \left( \cos^2 (\alpha) \sin (2\beta) \cos (\theta - \gamma) - \sin^2 (\alpha) \sin (2\chi) \cos (\upsilon - \lambda) \right) &= -\frac{i \omega}{c}, \\
b^2 \left( \cos^2 (\alpha) \sin (2\beta) \sin (\theta - \gamma) - \sin^2 (\alpha) \sin (2\chi) \sin (\upsilon - \lambda) \right) &= -\frac{\lambda}{c}, \\
b^2 \left( \cos^2 (\alpha) \cos (2\beta) - \sin^2 (\alpha) \cos (2\chi) \right) &= -\frac{e}{c}.
\end{align*}
\] (16)
This set has solutions for any traceable $\rho$ and $j_{A,k}$. For example one of these solutions is the following:
1. A value of $b^2$ obtain from first equation.
2. Since
   \[ u_k = \frac{j_k}{\rho} \]
   then
   \[
   \begin{cases}
   \cos^2(\alpha) \sin(2\beta) \cos(\theta - \gamma) - \sin^2(\alpha) \sin(2\chi) \cos(v - \lambda) = -\frac{w_1}{c}, \\
   \cos^2(\alpha) \sin(2\beta) \sin(\theta - \gamma) - \sin^2(\alpha) \sin(2\chi) \sin(v - \lambda) = -\frac{w_2}{c}, \\
   \cos^2(\alpha) \cos(2\beta) - \sin^2(\alpha) \cos(2\chi) = -\frac{w_3}{c}.
   \end{cases}
   \]
3. Let $\beta = \chi$.
   In that case:
   \[
   \begin{cases}
   \cos^2(\alpha) \cos(\theta - \gamma) - \sin^2(\alpha) \cos(v - \lambda) \sin(2\beta) = -\frac{w_1}{c}, \\
   \cos^2(\alpha) \sin(\theta - \gamma) - \sin^2(\alpha) \sin(v - \lambda) \sin(2\beta) = -\frac{w_2}{c}, \\
   \cos^2(\alpha) - \sin^2(\alpha) \cos(2\beta) = -\frac{w_3}{c}.
   \end{cases}
   \]
4. Let $(\theta - \gamma) = (v - \lambda)$.
   In that case:
   \[
   \begin{cases}
   \cos(2\alpha) \cos(\theta - \gamma) \sin(2\beta) = -\frac{w_1}{c}, \\
   \cos(2\alpha) \sin(\theta - \gamma) \sin(2\beta) = -\frac{w_2}{c}, \\
   \cos(2\alpha) \cos(2\beta) = -\frac{w_3}{c}.
   \end{cases}
   \]
5. Let us raise to the second power the first and the second equations:
   \[
   \begin{cases}
   \cos^2(2\alpha) \cos^2(\theta - \gamma) \sin^2(2\beta) = \left(-\frac{w_1}{c}\right)^2, \\
   \cos^2(2\alpha) \sin^2(\theta - \gamma) \sin^2(2\beta) = \left(-\frac{w_2}{c}\right)^2, \\
   \cos(2\alpha) \cos(2\beta) = -\frac{w_3}{c},
   \end{cases}
   \]
   and let us summat these two equations:
   \[
   \begin{cases}
   \sin^2(2\beta) \cos^2(2\alpha) \left(\cos^2(\theta - \gamma) + \sin^2(\theta - \gamma)\right) = \left(-\frac{w_1}{c}\right)^2 + \left(-\frac{w_2}{c}\right)^2, \\
   \cos(2\alpha) \cos(2\beta) = -\frac{w_3}{c}.
   \end{cases}
   \]
   Hence:
   \[
   \begin{cases}
   \sin^2(2\beta) \cos^2(2\alpha) = \left(-\frac{w_1}{c}\right)^2 + \left(-\frac{w_2}{c}\right)^2, \\
   \cos(2\alpha) \cos(2\beta) = -\frac{w_3}{c}.
   \end{cases}
   \]
6. Let us raise to the second power the second equation and add this equation to the previous one:
   \[
   \begin{cases}
   \sin^2(2\beta) \cos^2(2\alpha) = \left(-\frac{w_1}{c}\right)^2 + \left(-\frac{w_2}{c}\right)^2, \\
   \cos^2(2\alpha) \cos^2(2\beta) = \left(-\frac{w_3}{c}\right)^2,
   \end{cases}
   \]
   \[
   \left(\sin^2(2\beta) + \cos^2(2\beta)\right) \cos^2(2\alpha) = \left(-\frac{w_1}{c}\right)^2 + \left(-\frac{w_2}{c}\right)^2 + \left(-\frac{w_3}{c}\right)^2,
   \]
   \[
   \]
\[ \cos^2(2\alpha) = \left(-\frac{u_1}{c}\right)^2 + \left(-\frac{u_2}{c}\right)^2 + \left(-\frac{u_3}{c}\right)^2, \]  

(17)

We receive \( \cos^2(2\alpha) \) (for trackable probabilities).

7. From

\[ \cos^2(2\alpha) \cos^2(2\beta) = \left(-\frac{u_1}{c}\right)^2 \]

we receive \( \cos^2(2\beta) \).

8. From

\[ \cos^2(2\alpha) \cos^2(\theta - \gamma) \sin^2(2\beta) = \left(-\frac{u_1}{c}\right)^2 \]

we receive \( \cos^2(\theta - \gamma) \).

If

\[ \varphi_1 := b \exp(i\gamma) \cos(\beta) \cos(\alpha), \]
\[ \varphi_2 := b \exp(i\theta) \sin(\beta) \cos(\alpha), \]
\[ \varphi_3 := b \exp(i\lambda) \cos(\chi) \sin(\alpha), \]
\[ \varphi_4 := b \exp(i\upsilon) \sin(\chi) \sin(\alpha) \]

(18)

then you can calculate that

\[ \rho = \sum_{s=1}^{4} \varphi_s^* \varphi_s, \]  

(19)

\[ \frac{j_0}{c} = -\sum_{k=1}^{4} \sum_{s=1}^{4} \varphi_s^* \beta_{s,k} \varphi_k \]

If \( \varphi' := U_{0,2} (\phi) \varphi \) then

\[ \rho' = \varphi'^\dagger \varphi' = \varphi'^\dagger U_{0,2} (\phi) U_{0,2} (\phi) \varphi = \rho \cosh 2\phi + \frac{j_2}{c} \sinh 2\phi \]

and

\[ \frac{j_2}{c} = -\varphi'^\dagger \beta^{[2]} \varphi' = -\varphi'^\dagger U_{0,2} (\phi) \beta^{[2]} U_{0,2} (\phi) \varphi = \frac{j_2}{c} \cosh 2\phi + \rho \sinh 2\phi. \]

Similarly \( U_{0,1} \) and \( U_{0,3} \) transform the 3+1 vector \((c\rho, j)\) by the Lorentz formulas and \( U_{1,2}, U_{1,3}, U_{2,3} \) transform this vector by the cartesian formulas.

Because

\[ \frac{\partial j_0}{\partial x_0} = \frac{\partial^4 F}{\partial x_0 \partial x_1 \partial x_2 \partial x_3} = -\frac{\partial j_1}{\partial x_1} = -\frac{\partial j_2}{\partial x_2} = \frac{\partial j_3}{\partial x_3} \]

then (Continuity equation):

\[ \frac{\partial \rho}{\partial x_0} + \frac{\partial j_1}{\partial x_1} + \frac{\partial j_2}{\partial x_2} + \frac{\partial j_3}{\partial x_3} = 0 \]

(20)
In that case:

\[
\begin{align*}
\frac{\partial}{\partial x_0} \left( \varphi^\dagger \varphi \right) - \frac{\partial}{\partial x_1} \left( \varphi^\dagger \beta^{[1]} \varphi \right) - \frac{\partial}{\partial x_2} \left( \varphi^\dagger \beta^{[2]} \varphi \right) - \frac{\partial}{\partial x_3} \left( \varphi^\dagger \beta^{[3]} \varphi \right) &= 0
\end{align*}
\]

\[
\begin{align*}
\frac{\partial}{\partial x_0} \varphi - \varphi^\dagger \frac{\partial}{\partial x_0} \varphi &= 0
\end{align*}
\]

Let

\[
\hat{Q} := \frac{\partial}{\partial x_0} - \sum_{s=1}^{3} \beta^{[s]} \frac{\partial}{\partial x_s}
\]

Hence,

\[
\varphi^\dagger \left( \hat{Q}^\dagger + \hat{Q} \right) \varphi = 0
\]

\[
\hat{Q}^\dagger = -\hat{Q}
\]

Therefore, for every function \( \varphi_j \) here exists an operator \( Q_{j,k} \) such that a dependence of \( \varphi_j \) on \( t \) is described by the following differential equations

\[
\partial_t \varphi_j = c \sum_{k=1}^{4} \left( \beta^{[1]}_{j,k} \varphi_1 + \beta^{[2]}_{j,k} \varphi_2 + \beta^{[3]}_{j,k} \varphi_3 + Q_{j,k} \right) \varphi_k.
\]

(23)

and \( Q^*_{j,k} = -Q_{k,j} \).

A matrix form of formula (23) is the following:

\[
\partial_t \varphi = c \left( \beta^{[1]} \varphi_1 + \beta^{[2]} \varphi_2 + \beta^{[3]} \varphi_3 + \hat{Q} \right) \varphi
\]

(24)

with

\[
\varphi = \begin{bmatrix} \varphi_1 \\ \varphi_2 \\ \varphi_3 \\ \varphi_4 \end{bmatrix}
\]
and

\[
\hat{Q} = \begin{bmatrix}
  i\vartheta_{1,1} & i\vartheta_{1,2} - \varpi_{1,2} & i\vartheta_{1,3} - \varpi_{1,3} & i\vartheta_{1,4} - \varpi_{1,4} \\
  i\vartheta_{1,2} + \varpi_{1,2} & i\vartheta_{2,2} & i\vartheta_{2,3} - \varpi_{2,3} & i\vartheta_{2,4} - \varpi_{2,4} \\
  i\vartheta_{1,3} + \varpi_{1,3} & i\vartheta_{2,3} + \varpi_{2,3} & i\vartheta_{3,3} & i\vartheta_{3,4} - \varpi_{3,4} \\
  i\vartheta_{1,4} + \varpi_{1,4} & i\vartheta_{2,4} + \varpi_{2,4} & i\vartheta_{3,4} + \varpi_{3,4} & i\vartheta_{4,4} \\
\end{bmatrix}
\]  

(25)

with \( \varpi_{x,k} = \text{Re} \, (Q_{x,k}) \) and \( \vartheta_{x,k} = \text{Im} \, (Q_{x,k}) \). Matrix \( \varphi \) is called a state vector of the event \( A \) probability. Let \( \vartheta_{x,k} \) and \( \varpi_{x,k} \) be terms of \( \hat{Q} \) and let \( \Theta_0, \Theta_3, \Upsilon_0 \) and \( \Upsilon_3 \) be a solution of the following equations set:

\[
\begin{align*}
-\Theta_0 + \Theta_3 - \Upsilon_0 + \Upsilon_3 &= \vartheta_{1,1}; \\
-\Theta_0 - \Theta_3 - \Upsilon_0 - \Upsilon_3 &= \vartheta_{2,2}; \\
-\Theta_0 - \Theta_3 + \Upsilon_0 + \Upsilon_3 &= \vartheta_{3,3}; \\
-\Theta_0 + \Theta_3 + \Upsilon_0 - \Upsilon_3 &= \vartheta_{4,4}.
\end{align*}
\]

\( \Theta_0, \Theta_3, \Upsilon_0, \Upsilon_3 \) are solutions of the following sets of equations:

\[
\begin{align*}
\Theta_1 + \Upsilon_1 &= \vartheta_{1,2}; \\
-\Theta_1 + \Upsilon_1 &= \vartheta_{3,4}; \\
\Theta_2 - \Upsilon_2 &= \varpi_{1,2}; \\
\Theta_4 - \Upsilon_4 &= \varpi_{3,4}; \\
M_0 + M_{\vartheta,0} &= \vartheta_{1,3}; \\
M_0 - M_{\vartheta,0} &= \vartheta_{2,4}; \\
M_\varphi + M_{\vartheta,4} &= \vartheta_{1,3}; \\
M_\varphi - M_{\vartheta,4} &= \vartheta_{2,4}; \\
M_{\varphi,0} - M_{\vartheta,4} &= \vartheta_{1,4}; \\
M_{\varphi,0} + M_{\vartheta,4} &= \vartheta_{2,3}; \\
M_{\varphi,4} - M_{\vartheta,0} &= \vartheta_{4,4}; \\
M_{\varphi,4} + M_{\vartheta,0} &= \varpi_{2,3}.
\end{align*}
\]

Thus the columns of \( \hat{Q} \) are the following:

the first and the second columns:

\[
\begin{align*}
-i\Theta_0 + i\Theta_3 - i\Upsilon_2 + i\Upsilon_0 &= i\Theta_1 + i\Upsilon_1 + \Theta_2 + \Upsilon_2, \\
i\Theta_1 + i\Upsilon_1 - \Theta_2 - \Upsilon_2 &= -i\Theta_0 - i\Theta_3 - i\Upsilon_0 - i\Upsilon_3, \\
iM_0 + iM_{\vartheta,0} + M_\varphi + M_{\vartheta,4} &= iM_{\varphi,0} + iM_{\varphi,4} + M_{\vartheta,0} + M_{\vartheta,4}, \\
iM_{\varphi,0} - iM_{\varphi,4} + M_{\varphi,4} - M_{\vartheta,0} &= iM_0 - iM_{\varphi,0} + M_\varphi - M_{\vartheta,4}.
\end{align*}
\]

the third and the fourth columns:

\[
\begin{align*}
iM_0 + iM_{\vartheta,0} - M_\varphi - M_{\vartheta,4} &= iM_{\varphi,0} - iM_{\varphi,4} - M_{\varphi,4} - M_{\vartheta,0}, \\
iM_{\varphi,0} + iM_{\varphi,4} - M_{\varphi,4} - M_{\vartheta,0} &= iM_0 - iM_{\varphi,0} - M_\varphi + M_{\vartheta,4}, \\
-i\Theta_0 - i\Theta_3 + i\Upsilon_0 + i\Upsilon_0 &= -i\Theta_1 + i\Upsilon_1 - \Theta_2 + \Upsilon_2, \\
-i\Theta_1 + i\Upsilon_1 + \Theta_2 - \Upsilon_2 &= -i\Theta_0 + i\Theta_3 + i\Upsilon_0 - i\Upsilon_3.
\end{align*}
\]

Hence,
Therefore, from (24):

\[
\frac{1}{c} \partial_k \varphi - \left( i \Theta_0 \beta^{[0]} + i \Upsilon_0 \beta^{[0]} \gamma^{[3]} \right) \varphi = \left( \sum_{i=1}^{3} \beta^{[i]} \left( \partial_k + i \Theta_i + i \Upsilon_i \gamma^{[5]} \right) + i M_0 \gamma^{[0]} + i M_4 \beta^{[4]} - i M_{\xi,0} \gamma^{[0]} + i M_{\xi,4} \zeta^{[4]} - i M_{\theta,0} \gamma^{[0]} - i M_{\theta,4} \vartheta^{[4]} + i M_{\theta,0} \gamma_{\theta}^{[0]} + i M_{\theta,4} \vartheta_{\theta}^{[4]} \right) \varphi.
\]  

(26)

with

\[
\gamma^{[3]} := \begin{bmatrix} 1_2 & 0_2 \\ 0_2 & -1_2 \end{bmatrix}.
\]  

(27)

Because

\[
\zeta^{[k]} + \vartheta^{[k]} + \vartheta^{[k]} = -\beta^{[k]}
\]  

with \(k \in \{1, 2, 3\}\) then from (24):

\[
\left( - \left( \partial_k + i \Theta_0 + i \Upsilon_0 \gamma^{[5]} \right) + \sum_{k=1}^{3} \beta^{[k]} \left( \partial_k + i \Theta_i + i \Upsilon_i \gamma^{[5]} \right) \right) \varphi +
\]

\[
+ \left( - \left( \partial_k + i \Theta_0 + i \Upsilon_0 \gamma^{[5]} \right) - \sum_{k=1}^{3} \zeta^{[k]} \left( \partial_k + i \Theta_i + i \Upsilon_i \gamma^{[5]} \right) \right) \varphi +
\]

\[
+ \left( \partial_k + i \Theta_0 + i \Upsilon_0 \gamma^{[5]} \right) - \sum_{k=1}^{3} \vartheta^{[k]} \left( \partial_k + i \Theta_i + i \Upsilon_i \gamma^{[5]} \right) \right) \varphi +
\]

\[
+ \left( \partial_k + i \Theta_0 + i \Upsilon_0 \gamma^{[5]} \right) - \sum_{k=1}^{3} \theta^{[k]} \left( \partial_k + i \Theta_i + i \Upsilon_i \gamma^{[5]} \right) \right) \varphi = 0.
\]  

(28)
3 Quarks and Gluons

The following part of (26):

\[
\left( \sum_{k=0}^{3} \beta^{[k]} \left( -i \delta_k + \Theta_k + \Upsilon_k \gamma^{[0]} \right) - M_{\zeta,0} \gamma^{[0]}_{\zeta} + M_{\zeta,4} \gamma^{[4]}_{\zeta} + M_{\eta,0} \gamma^{[0]}_{\eta} - M_{\eta,4} \gamma^{[4]}_{\eta} + M_{\theta,0} \gamma^{[0]}_{\theta} + M_{\theta,4} \theta^{[4]} \right) \varphi = 0. \tag{28}
\]

is called the chromatic equation of moving.

Here (5), (7), (9):

\[
\gamma^{[0]}_{\zeta} = \begin{bmatrix} 0 & 0 & 0 & i \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}, \quad \zeta^{[4]} = \begin{bmatrix} 0 & 0 & 0 & i \\ 0 & 0 & i & 0 \\ 0 & -i & 0 & 0 \\ -i & 0 & 0 & 0 \end{bmatrix}
\]

are mass elements of red pentad;

\[
\gamma^{[0]}_{\eta} = \begin{bmatrix} 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \\ -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}, \quad \eta^{[4]} = \begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & -1 & 0 \\ 0 & -1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}
\]

are mass elements of green pentad;

\[
\gamma^{[0]}_{\theta} = \begin{bmatrix} 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \\ -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}, \quad \theta^{[4]} = \begin{bmatrix} 0 & 0 & i & 0 \\ 0 & 0 & 0 & -i \\ -i & 0 & 0 & 0 \\ 0 & i & 0 & 0 \end{bmatrix}
\]

are mass elements of blue pentad.

I call:

• \( M_{\zeta,0}, M_{\zeta,4} \) red lower and upper mass members;
• \( M_{\eta,0}, M_{\eta,4} \) green lower and upper mass members;
• \( M_{\theta,0}, M_{\theta,4} \) blue lower and upper mass members.

The mass members of this equation form the following matrix sum:

\[
\hat{M} := \left( \begin{array}{c} - M_{\zeta,0} \gamma^{[0]}_{\zeta} + M_{\zeta,4} \gamma^{[4]}_{\zeta} \\ - M_{\eta,0} \gamma^{[0]}_{\eta} - M_{\eta,4} \gamma^{[4]}_{\eta} \\ + M_{\theta,0} \gamma^{[0]}_{\theta} + M_{\theta,4} \theta^{[4]} \end{array} \right)
\]

\[
= \begin{bmatrix} 0 & 0 & -M_{\theta,0} & M_{\zeta,4} \\ 0 & 0 & M_{\zeta,4} & M_{\theta,0} \\ -M_{\theta,0} & M_{\zeta,4} & 0 & 0 \\ M_{\zeta,4} & M_{\theta,0} & 0 & 0 \end{bmatrix} + i \begin{bmatrix} 0 & 0 & M_{\theta,4} & M_{\zeta,4} \\ 0 & 0 & M_{\zeta,4} & -M_{\theta,4} \\ -M_{\theta,4} & -M_{\zeta,4} & 0 & 0 \\ -M_{\zeta,4} & M_{\theta,4} & 0 & 0 \end{bmatrix}
\]

with \( M_{\zeta,0} := M_{\zeta,0} - iM_{\theta,0} \) and \( M_{\zeta,4} := M_{\zeta,4} - iM_{\theta,4} \).
Elements of these matrices can be turned by formula of shape \[4\]:

\[
\begin{align*}
\begin{bmatrix}
\cos \frac{\theta}{2} & \sin \frac{\theta}{2} \\
\sin \frac{\theta}{2} & \cos \frac{\theta}{2}
\end{bmatrix}
\begin{bmatrix}
Z & X - iY \\
X + iY & -Z
\end{bmatrix}
\begin{bmatrix}
\cos \frac{\theta}{2} & -i \sin \frac{\theta}{2} \\
i \sin \frac{\theta}{2} & \cos \frac{\theta}{2}
\end{bmatrix} =
\begin{bmatrix}
Z \cos \theta - Y \sin \theta & X - i \left(Y \cos \theta + Z \sin \theta\right) \\
X + i \left(Y \cos \theta + Z \sin \theta\right) & -Z \cos \theta + Y \sin \theta
\end{bmatrix}.
\end{align*}
\]

Hence, if:

\[
\hat{M}' := \begin{pmatrix}
-M_{\zeta,0}\gamma^{[0]} - M_{\zeta,4}\zeta^{[4]} & -M_{\eta,0}\gamma^{[0]} - M_{\eta,4}\eta^{[4]} \\
+M_{\eta,0}\gamma^{[0]} + M_{\eta,4}\eta^{[4]}
\end{pmatrix} := U_{2,3}^\dagger (\alpha) \hat{M} U_{2,3} (\alpha)
\]

then

\[
M'_{\zeta,0} = M_{\zeta,0},
M'_{\eta,0} = M_{\eta,0} \cos 2\alpha + M_{\eta,0} \sin 2\alpha,
M'_{\eta,0} = M_{\eta,0} \cos 2\alpha - M_{\eta,0} \sin 2\alpha,
M'_{\zeta,4} = M_{\zeta,4},
M'_{\eta,4} = M_{\eta,4} \cos 2\alpha + M_{\eta,4} \sin 2\alpha,
M'_{\eta,4} = M_{\eta,4} \cos 2\alpha - M_{\eta,4} \sin 2\alpha.
\]

Therefore, matrix \(U_{2,3} (\alpha)\) makes an oscillation between green and blue chromatics.

Let us consider equation \[26\] under transformation \(U_{2,3} (\alpha)\) where \(\alpha\) is an arbitrary real function of time-space variables \((\alpha = \alpha (t, x_1, x_2, x_3))\):

\[
U_{2,3}^\dagger (\alpha) \left(\frac{1}{c} \partial_t + i\Theta_0 + i\Theta_3 \gamma^{[3]}\right) U_{2,3} (\alpha) \varphi =
\]

\[
= U_{2,3}^\dagger (\alpha) \left(\sum_{\nu=1}^{3} \beta^{[\nu]} \left(\partial_\nu + i\Theta_\nu + i\Theta_3 \gamma^{[3]}\right) + iM_0 \gamma^{[0]} + iM_4 \beta^{[4]} + \hat{M}\right) U_{2,3} (\alpha) \varphi.
\]

Because

\[
U_{2,3}^\dagger (\alpha) U_{2,3} (\alpha) = 1_4,
U_{2,3}^\dagger (\alpha) \gamma^{[3]} U_{2,3} (\alpha) = \gamma^{[3]},
U_{2,3}^\dagger (\alpha) \gamma^{[0]} U_{2,3} (\alpha) = \gamma^{[0]},
U_{2,3}^\dagger (\alpha) \beta^{[4]} U_{2,3} (\alpha) = \beta^{[4]},
U_{2,3}^\dagger (\alpha) \beta^{[1]} = \beta^{[1]} U_{2,3}^\dagger (\alpha),
U_{2,3}^\dagger (\alpha) \beta^{[2]} = \left(\beta^{[2]} \cos 2\alpha + \beta^{[3]} \sin 2\alpha\right) U_{2,3}^\dagger (\alpha),
U_{2,3}^\dagger (\alpha) \beta^{[3]} = \left(\beta^{[3]} \cos 2\alpha - \beta^{[2]} \sin 2\alpha\right) U_{2,3}^\dagger (\alpha),
\]

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then

\[
\left( \frac{1}{c} \partial_t + U_{2,3}^\dagger (\alpha) \frac{1}{c} \partial_t U_{2,3} (\alpha) + i \Theta_0 + i \gamma[5] \right) \varphi = \left( \begin{array}{c}
\beta^{[1]} \left( \partial_t + U_{2,3}^\dagger (\alpha) \partial_t U_{2,3} (\alpha) + i \Theta_1 + i \gamma[5] \right) \\
+ \beta^{[2]} \left( \partial_t + U_{2,3}^\dagger (\alpha) \partial_t U_{2,3} (\alpha) + i \Theta_2 + i \gamma[5] \right) \\
+ \beta^{[3]} \left( \partial_t + U_{2,3}^\dagger (\alpha) \partial_t U_{2,3} (\alpha) + i \Theta_3 + i \gamma[5] \right)
\end{array} \right) \varphi.
\] (29)

Let \( x_2' \) and \( x_3' \) be elements of other coordinate system such that

\[
\begin{align*}
\partial_t' &= (\cos 2\alpha \cdot \partial_t - \sin 2\alpha \cdot \partial_1), \\
\partial_t' &= (\cos 2\alpha \cdot \partial_t + \sin 2\alpha \cdot \partial_2).
\end{align*}
\] (30)

Therefore, from (29):

\[
\left( \frac{1}{c} \partial_t + U_{2,3}^\dagger (\alpha) \frac{1}{c} \partial_t U_{2,3} (\alpha) + i \Theta_0 + i \gamma[5] \right) \varphi = \left( \begin{array}{c}
\beta^{[1]} \left( \partial_t + U_{2,3}^\dagger (\alpha) \partial_t U_{2,3} (\alpha) + i \Theta_1 + i \gamma[5] \right) \\
+ \beta^{[2]} \left( \partial_t + U_{2,3}^\dagger (\alpha) \partial_t U_{2,3} (\alpha) + i \Theta_2 + i \gamma[5] \right) \\
+ \beta^{[3]} \left( \partial_t + U_{2,3}^\dagger (\alpha) \partial_t U_{2,3} (\alpha) + i \Theta_3 + i \gamma[5] \right)
\end{array} \right) \varphi.
\]

\[
\begin{align*}
\Theta'_2 &:= \Theta_2 \cos 2\alpha - \Theta_3 \sin 2\alpha, \\
\Theta'_3 &:= \Theta_2 \sin 2\alpha + \Theta_3 \cos 2\alpha, \\
\gamma'_2 &:= \gamma_2 \cos 2\alpha - \gamma_3 \sin 2\alpha, \\
\gamma'_3 &:= \gamma_2 \sin 2\alpha + \gamma_3 \cos 2\alpha.
\end{align*}
\]

Therefore, the oscillation between blue and green chromatics curves the space in the \( x_2, x_3 \) directions.

Similarly, matrix \( U_{1,3} \) with an arbitrary real function \( \vartheta (t, x_1, x_2, x_3) \) describes the oscillation between blue and red chromatics which curves the space in the \( x_1, x_3 \) directions. And matrix \( U_{1,2} \) with an arbitrary real function \( \varsigma (t, x_1, x_2, x_3) \) describes the oscillation between green and red chromatics which curves the space in the \( x_1, x_2 \) directions.

Now, let

\[
\hat{M}' := \left( \begin{array}{c}
-M''_{\gamma,0}\varsigma^{[6]} + M''_{\gamma,0}\gamma^{[4]} \\
-M''_{\gamma,0}\gamma^{[6]} - M''_{\eta,0}\eta^{[4]} \\
+ M''_{\eta,0}\gamma^{[6]} + M''_{\eta,0}\eta^{[4]}
\end{array} \right) := U_{0,1}^\dagger (\sigma) \hat{M} U_{0,1} (\sigma)
\]
then:

\[
\begin{align*}
M''_{\zeta,0} &= M_{\zeta,0}, \\
M''_{\eta,0} &= (M_{\eta,0} \cosh 2\sigma - M_{\theta,4} \sinh 2\sigma), \\
M''_{\theta,0} &= M_{\theta,0} \cosh 2\sigma + M_{\eta,4} \sinh 2\sigma, \\
M''_{\zeta,4} &= M_{\zeta,4}, \\
M''_{\eta,4} &= M_{\eta,4} \cosh 2\sigma + M_{\theta,0} \sinh 2\sigma, \\
M''_{\theta,4} &= M_{\theta,4} \cosh 2\sigma - M_{\eta,0} \sinh 2\sigma.
\end{align*}
\]

Therefore, matrix \( U_{0,1} (\sigma) \) makes an oscillation between green and blue chromatics with an oscillation between upper and lower mass members.

Let us consider equation (26) under transformation \( U_{0,1} (\sigma) \) where \( \sigma \) is an arbitrary real function of time-space variables (\( \sigma = \sigma (t, x_1, x_2, x_3) \)):

\[
U_{0,1} (\sigma) \left( \frac{1}{c} \partial_t + i\Theta_0 + i\Upsilon_0 \gamma^5 \right) U_{0,1} (\sigma) \varphi =
\]

\[
= U_{0,1}^\dagger (\sigma) \left( \sum_{\nu=1}^{3} \beta^{[\nu]} \left( \partial_\nu + i\Theta_\nu + i\Upsilon_\nu \gamma^5 \right) + 
+ iM_0 \gamma^0 + iM_4 \beta^{[4]} + \vec{M} \right) U_{0,1} (\sigma) \varphi.
\]

Since:

\[
\begin{align*}
U_{0,1}^\dagger (\sigma) U_{0,1} (\sigma) &= (\cosh 2\sigma - \beta^{[1]} \sinh 2\sigma), \\
U_{0,1}^\dagger (\sigma) &= (\cosh 2\sigma + \beta^{[1]} \sinh 2\sigma) U_{0,1}^{-1} (\sigma), \\
U_{0,1}^\dagger (\sigma) \beta^{[1]} &= (\beta^{[1]} \cosh 2\sigma - \sinh 2\sigma) U_{0,1}^{-1} (\sigma), \\
U_{0,1}^\dagger (\sigma) \beta^{[2]} &= \beta^{[2]} U_{0,1}^{-1} (\sigma), \\
U_{0,1}^\dagger (\sigma) \beta^{[3]} &= \beta^{[3]} U_{0,1}^{-1} (\sigma), \\
U_{0,1}^\dagger (\sigma) \gamma^0 U_{0,1} (\sigma) &= \gamma^0, \\
U_{0,1}^\dagger (\sigma) \beta^{[4]} U_{0,1} (\sigma) &= \beta^{[4]}, \\
U_{0,1}^{-1} (\sigma) U_{0,1} (\sigma) &= 14, \\
U_{0,1}^\dagger (\sigma) \gamma^5 U_{0,1} (\sigma) &= \gamma^5, \\
U_{0,1}^\dagger (\sigma) \gamma^5 U_{0,1} (\sigma) &= \gamma^5 \left( \cosh 2\sigma - \beta^{[1]} \sinh 2\sigma \right).
\end{align*}
\]
then

\[
\begin{pmatrix}
U_{0,1}^{-1}(\sigma) \left( \cosh 2\sigma \cdot \frac{1}{c} \partial_t + \sinh 2\sigma \cdot \partial_1 \right) U_{0,1}(\sigma) \\
+ \left( \cosh 2\sigma \cdot \frac{1}{c} \partial_t + \sinh 2\sigma \cdot \partial_1 \right) \\
+ i (\Theta_0 \cosh 2\sigma + \Theta_1 \sinh 2\sigma) \\
+ i (\Upsilon_0 \cosh 2\sigma + \Upsilon_1 \sinh 2\sigma) \gamma^{[5]} - \\
U_{0,1}^{-1}(\sigma) \left( \cosh 2\sigma \cdot \partial_1 + \sinh 2\sigma \cdot \frac{1}{\c} \partial_1 \right) U_{0,1}(\sigma)
\end{pmatrix}
\]

\[ - \beta^{[3]} \begin{pmatrix}
\partial_1 + U_{0,1}^{-1}(\sigma) (\partial_2 U_{0,1}(\sigma)) + i \Theta_2 + \i \Upsilon_2 \gamma^{[3]} \\
- \beta^{[3]} \left( \partial_1 + U_{0,1}^{-1}(\sigma) (\partial_3 U_{0,1}(\sigma)) + i \Theta_3 + \i \Upsilon_3 \gamma^{[3]} \right)
\end{pmatrix}
\]

\[ - i M_\gamma^{[4]} - i M_4 \beta^{[4]} - \tilde{M}'' \]

\[ \varphi = 0. \quad (31) \]

Let \( t' \) and \( x'_1 \) be elements of other coordinate system such that:

\[
\begin{align*}
\frac{\partial x_1}{\partial x'_1} &= \cosh 2\sigma \\
\frac{\partial t}{\partial x'_1} &= \frac{1}{c} \sinh 2\sigma \\
\frac{\partial x_1}{\partial t'} &= c \sinh 2\sigma \\
\frac{\partial t}{\partial t'} &= \cosh 2\sigma \\
\frac{\partial x_2}{\partial t'} &= \frac{\partial x_3}{\partial t'} = \frac{\partial x_2}{\partial x'_1} = \frac{\partial x_3}{\partial x'_1} = 0
\end{align*}
\]

Hence:

\[ \partial'_t := \frac{\partial}{\partial t'} = \frac{\partial}{\partial t} \frac{\partial t}{\partial t'} + \frac{\partial}{\partial x_1} \frac{\partial x_1}{\partial t'} + \frac{\partial}{\partial x_2} \frac{\partial x_2}{\partial t'} + \frac{\partial}{\partial x_3} \frac{\partial x_3}{\partial t'} = \]

\[ = \cosh 2\sigma \cdot \frac{\partial}{\partial t} + c \sinh 2\sigma \cdot \frac{\partial}{\partial x_1} = \]

\[ = \cosh 2\sigma \cdot \partial_t + c \sinh 2\sigma \cdot \partial_1, \]

that is

\[ \frac{1}{c} \partial'_t = \cosh 2\sigma \cdot \partial_t + \sinh 2\sigma \cdot \partial_1 \]

and

\[ \partial'_t := \frac{\partial}{\partial x'_1} = \]

\[ = \frac{\partial}{\partial t} \frac{\partial t}{\partial x'_1} + \frac{\partial}{\partial x_1} \frac{\partial x_1}{\partial x'_1} + \frac{\partial}{\partial x_2} \frac{\partial x_2}{\partial x'_1} + \frac{\partial}{\partial x_3} \frac{\partial x_3}{\partial x'_1} = \]

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oscillation between upper and lower mass members curves the space in the
describes the oscillation between blue and red chromatics with the oscilla-
directions. And matrix $U$

Therefore, from (31):

$$\begin{aligned}
\beta^{[0]} \left( \frac{1}{2} \partial_t' + U_{0,1}^{-1} (\sigma) \frac{1}{2} \partial_t U_{0,1} (\sigma) + i \Theta''_0 + i \Upsilon''_0 \gamma^{[0]} \right) \\
+ \beta^{[1]} \left( \partial_t'' + U_{0,1}^{-1} (\sigma) \partial_t U_{0,1} (\sigma) + i \Theta''_1 + i \Upsilon''_1 \gamma^{[1]} \right) \\
+ \beta^{[2]} \left( \partial_2 + U_{0,1}^{-1} (\sigma) \partial_2 U_{0,1} (\sigma) + i \Theta_2 + i \Upsilon_2 \gamma^{[2]} \right) \\
+ \beta^{[3]} \left( \partial_3 + U_{0,1}^{-1} (\sigma) \partial_3 U_{0,1} (\sigma) + i \Theta_3 + i \Upsilon_3 \gamma^{[3]} \right) \\
+ i M_0 \gamma^{[0]} + i M_4 \gamma^{[4]} + \tilde{M}''
\end{aligned}$$

with

$$\begin{aligned}
\Theta''_0 &:= \Theta_0 \cosh \sigma + \Theta_1 \sinh \sigma, \\
\Theta''_1 &:= \Theta_1 \cosh \sigma + \Theta_0 \sinh \sigma, \\
\Upsilon''_0 &:= \Upsilon_0 \cosh \sigma + \Upsilon_0 \sigma \sinh \sigma, \\
\Upsilon''_1 &:= \Upsilon_1 \cosh \sigma + \Upsilon_1 \sigma \sinh \sigma.
\end{aligned}$$

Therefore, the oscillation between blue and green chromatics with the oscillation between upper and lower mass members curves the space in the $t, x_1$ directions.

Similarly, matrix $U_{0,2}$ with an arbitrary real function $\phi(t, x_1, x_2, x_3)$ describes the oscillation between blue and red chromatics with the oscillation between upper and lower mass members curves the space in the $t, x_2$ directions. And matrix $U_{0,3}$ with an arbitrary real function $\iota(t, x_1, x_2, x_3)$ describes the oscillation between green and red chromatics with the oscillation between upper and lower mass members curves the space in the $t, x_3$ directions.

Now let

$$\tilde{U} (\chi) := \begin{bmatrix} e^{ix} & 0 & 0 & 0 \\
0 & e^{ix} & 0 & 0 \\
0 & 0 & e^{2ix} & 0 \\
0 & 0 & 0 & e^{2ix} \end{bmatrix}$$

and

$$\tilde{M} := \begin{bmatrix} -M'_{\zeta,0} \gamma^{[0]} + M'_{\zeta,4} \gamma^{[4]} \\
-M'_{\eta,0} \gamma^{[0]} + M'_{\eta,4} \gamma^{[4]} \\
+ M'_{\zeta,0} \gamma^{[0]} + M'_{\zeta,4} \gamma^{[4]} \end{bmatrix} := \tilde{U}^\dagger (\chi) \tilde{M} \tilde{U} (\chi)$$

then:

$$\begin{aligned}
M'_{\zeta,0} &= (M_{\zeta,0} \cos \chi - M_{\zeta,4} \sin \chi), \\
M'_{\zeta,4} &= (M_{\zeta,4} \cos \chi + M_{\zeta,0} \sin \chi), \\
M'_{\eta,4} &= (M_{\eta,4} \cos \chi - M_{\eta,0} \sin \chi), \\
M'_{\eta,0} &= (M_{\eta,0} \cos \chi + M_{\eta,4} \sin \chi),
\end{aligned}$$
\[ M'_{\theta,0} = (M_{\theta,0} \cos \chi + M_{\theta,4} \sin \chi), \]
\[ M'_{\theta,4} = (M_{\theta,4} \cos \chi - M_{\theta,0} \sin \chi). \]

Therefore, matrix \( \tilde{U}(\chi) \) makes an oscillation between upper and lower mass members.

Let us consider equation (28) under transformation \( \tilde{U}(\chi) \) where \( \chi \) is an arbitrary real function of time-space variables \( (\chi = \chi(t, x_1, x_2, x_3)) \):

\[
\tilde{U}^\dagger(\chi) \left( \frac{1}{c} \partial_t + i \Theta_0 + i Y_0 \gamma^{[5]} \right) \tilde{U}(\chi) \varphi = \\
= \tilde{U}^\dagger(\chi) \left( \sum_{\nu = 1}^{3} \beta^{[\nu]} \left( \partial_\nu + i \Theta_\nu + i Y_\nu \gamma^{[5]} \right) + \tilde{M} \right) \tilde{U}(\chi) \varphi.
\]

Because

\[
\gamma^{[5]} \tilde{U}(\chi) = \tilde{U}(\chi) \gamma^{[5]},
\]
\[
\beta^{[1]} \tilde{U}(\chi) = \tilde{U}(\chi) \beta^{[1]},
\]
\[
\beta^{[2]} \tilde{U}(\chi) = \tilde{U}(\chi) \beta^{[2]},
\]
\[
\beta^{[3]} \tilde{U}(\chi) = \tilde{U}(\chi) \beta^{[3]},
\]

then

\[
\left( \frac{1}{c} \partial_t + \frac{1}{c} \tilde{U}^\dagger(\chi) \left( \partial_\nu \tilde{U}(\chi) \right) + i \Theta_0 + i Y_0 \gamma^{[5]} \right) \varphi = \\
= \left( \sum_{\nu = 1}^{3} \beta^{[\nu]} \left( \partial_\nu + \tilde{U}^\dagger(\chi) \left( \partial_\nu \tilde{U}(\chi) \right) + i \Theta_\nu + i Y_\nu \gamma^{[5]} \right) \tilde{U}^\dagger(\chi) \tilde{M} \tilde{U}(\chi) \right) \varphi.
\]

Now let:

\[
\tilde{U}(\kappa) := \left[ \begin{array}{cccc}
 e^\kappa & 0 & 0 & 0 \\
 0 & e^\kappa & 0 & 0 \\
 0 & 0 & e^{2\kappa} & 0 \\
 0 & 0 & 0 & e^{2\kappa}
\end{array} \right]
\]

and

\[
\tilde{M}' := \left( \begin{array}{cc}
 -M'_{\theta,0} \gamma^{[0]} - M'_{\theta,4} \gamma^{[4]} & \\
 -M'_{\theta,0} \gamma^{[0]} - M'_{\theta,4} \gamma^{[4]} +
\end{array} \begin{array}{cc}
 + M'_{\theta,0} \gamma^{[8]} + M'_{\theta,4} \theta^{[4]}
\end{array} \right) := \tilde{U}^{-1}(\kappa) \tilde{M} \tilde{U}(\kappa)
\]

then:

\[
M'_{\theta,0} = (M_{\theta,0} \cosh \kappa - i M_{\theta,4} \sinh \kappa),
\]
\[
M'_{\theta,4} = (M_{\theta,4} \cosh \kappa + i M_{\theta,0} \sinh \kappa),
\]
\[
M'_{\theta,0} = (M_{\theta,0} \cosh \kappa - i M_{\theta,4} \sinh \kappa),
\]
\[
M'_{\theta,4} = (M_{\theta,4} \cosh \kappa + i M_{\theta,0} \sinh \kappa),
\]
\[
M'_{\zeta,0} = (M_{\zeta,0} \cosh \kappa + i M_{\zeta,4} \sinh \kappa),
\]
\[
M'_{\zeta,4} = (M_{\zeta,4} \cosh \kappa - i M_{\zeta,0} \sinh \kappa).
\]
Therefore, matrix $\hat{U}(\kappa)$ makes an oscillation between upper and lower mass members, too.

Let us consider equation (28) under transformation $\hat{U}(\kappa)$ where $\kappa$ is an arbitrary real function of time-space variables ($\kappa = \kappa(t, x_1, x_2, x_3)$):

$$\hat{U}^{-1}(\kappa) \left( \frac{1}{c} \partial_t + i\Theta_0 + i\gamma^{[5]} \right) \hat{U}(\kappa) \varphi =$$

$$= \hat{U}^{-1}(\kappa) \left( \sum_{\nu=1}^{3} \beta^{[\nu]} \left( \partial_{\nu} + i\Theta_{\nu} + i\gamma^{[5]} \right) + \hat{M} \right) \hat{U}(\kappa) \varphi.$$

Because

$$\gamma^{[5]} \hat{U}(\kappa) = \hat{U}(\kappa) \gamma^{[5]},$$

$$\hat{U}^{-1}(\kappa) \beta^{[1]} = \beta^{[1]} \hat{U}^{-1}(\kappa),$$

$$\hat{U}^{-1}(\kappa) \beta^{[2]} = \beta^{[2]} \hat{U}^{-1}(\kappa),$$

$$\hat{U}^{-1}(\kappa) \beta^{[3]} = \beta^{[3]} \hat{U}^{-1}(\kappa),$$

$$\hat{U}^{-1}(\kappa) \hat{U}(\kappa) = 1_4,$$

then

$$\left( \frac{1}{c} \partial_t + \hat{U}^{-1}(\kappa) \left( \frac{1}{c} \partial_t \hat{U}(\kappa) + i\Theta_0 + i\gamma^{[5]} \right) \right) \varphi =$$

$$= \left( \sum_{\nu=1}^{3} \beta^{[\nu]} \left( \partial_{\nu} + \hat{U}^{-1}(\kappa) \left( \partial_{\nu} \hat{U}(\kappa) + i\Theta_{\nu} + i\gamma^{[5]} \right) + \hat{U}^{-1}(\kappa) \hat{M} \hat{U}(\kappa) \right) \varphi.$$

If denote:

$$\Lambda_1 := \begin{bmatrix} 0 & -1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{bmatrix},$$

$$\Lambda_2 := \begin{bmatrix} 0 & i & 0 & 0 \\ i & 0 & 0 & 0 \\ 0 & 0 & 0 & i \\ 0 & 0 & i & 0 \end{bmatrix},$$

$$\Lambda_3 := \begin{bmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & -1 & 0 \end{bmatrix},$$

$$\Lambda_4 := \begin{bmatrix} 0 & i & 0 & 0 \\ -i & 0 & 0 & 0 \\ 0 & 0 & 0 & -i \\ 0 & 0 & i & 0 \end{bmatrix}.$$
Let \( \tilde{U} \) be the following set:

\[
\tilde{U} := \{ U_{0,1}, U_{2,3}, U_{1,3}, U_{0,2}, U_{1,2}, U_{0,3}, \tilde{U}, \tilde{U} \}.
\]

Because

\[
\begin{align*}
U_{2,3}^{-1} (\alpha) \Lambda_1 U_{2,3} (\alpha) &= \Lambda_1 \\
U_{1,3}^{-1} (\theta) \Lambda_1 U_{1,3} (\theta) &= (\Lambda_1 \cos 2\theta + \Lambda_6 \sin 2\theta) \\
U_{0,2}^{-1} (\phi) \Lambda_1 U_{0,2} (\phi) &= (\Lambda_1 \cosh 2\phi - \Lambda_5 \sinh 2\phi) \\
U_{1,2}^{-1} (s) \Lambda_1 U_{1,2} (s) &= \Lambda_1 \cos 2s - \Lambda_4 \sin 2s \\
U_{0,3}^{-1} (t) \Lambda_1 U_{0,3} (t) &= \Lambda_1 \cosh 2t + \Lambda_3 \sinh 2t \\
\tilde{U}^{-1} (\kappa) \Lambda_1 \tilde{U} (\kappa) &= \Lambda_1 \\
\tilde{U}^{-1} (\chi) \Lambda_1 \tilde{U} (\chi) &= \Lambda_1
\end{align*}
\]
\[ \tilde{U}^{-1}(\chi) \Lambda_2 \tilde{U}(\chi) = \Lambda_2 \]
\[ \tilde{U}^{-1}(\kappa) \Lambda_2 \tilde{U}(\kappa) = \Lambda_2 \]
\[ U_{0,3}^{-1}(t) \Lambda_2 U_{0,3}(t) = \Lambda_2 \cosh 2t - \Lambda_4 \sinh 2t \]
\[ U_{1,2}^{-1}(s) \Lambda_2 U_{1,2}(s) = \Lambda_2 \cos 2s - \Lambda_3 \sin 2s \]
\[ U_{0,3}^{-1}(\phi) \Lambda_2 U_{0,3}(\phi) = \Lambda_2 \cosh 2\phi + \Lambda_6 \sinh 2\phi \]
\[ U_{1,3}^{-1}(\theta) \Lambda_2 U_{1,3}(\theta) = \Lambda_2 \cos 2\theta + \Lambda_5 \sin 2\theta \]
\[ U_{0,1}^{-1}(\sigma) \Lambda_2 U_{0,1}(\sigma) = \Lambda_2 \]

\[ U_{0,1}^{-1}(\sigma) \Lambda_3 U_{0,1}(\sigma) = \Lambda_3 \cosh 2\sigma - \Lambda_6 \sinh 2\sigma \]
\[ U_{2,3}^{-1}(\alpha) \Lambda_3 U_{2,3}(\alpha) = \Lambda_3 \cos 2\alpha - \Lambda_5 \sin 2\alpha \]
\[ U_{0,2}^{-1}(\phi) \Lambda_3 U_{0,2}(\phi) = \Lambda_3 \]
\[ U_{1,2}^{-1}(\kappa) \Lambda_3 U_{1,2}(\kappa) = \Lambda_3 \cos 2\kappa + \Lambda_2 \sin 2\kappa \]
\[ U_{0,3}^{-1}(t) \Lambda_3 U_{0,3}(t) = \Lambda_3 \cosh 2t + \Lambda_1 \sinh 2t \]
\[ \tilde{U}^{-1}(\kappa) \Lambda_3 \tilde{U}(\kappa) = \Lambda_3 \]
\[ \tilde{U}^{-1}(\chi) \Lambda_3 \tilde{U}(\chi) = \Lambda_3 \]

\[ U_{0,3}^{-1}(\sigma) \Lambda_4 U_{0,3}(\sigma) = \Lambda_4 \cosh 2\sigma - \Lambda_2 \sinh 2\sigma \]
\[ U_{1,2}^{-1}(s) \Lambda_4 U_{1,2}(s) = \Lambda_4 \cos 2s + \Lambda_1 \sin 2s \]
\[ U_{1,3}^{-1}(\theta) \Lambda_4 U_{1,3}(\theta) = \Lambda_4 \]
\[ U_{0,1}^{-1}(\sigma) \Lambda_4 U_{0,1}(\sigma) = \Lambda_4 \cosh 2\sigma + \Lambda_5 \sinh 2\sigma \]

\[ U_{0,1}^{-1}(\sigma) \Lambda_5 U_{0,1}(\sigma) = \Lambda_5 \cosh 2\sigma + \Lambda_4 \sinh 2\sigma \]
\[ U_{2,3}^{-1}(\alpha) \Lambda_5 U_{2,3}(\alpha) = \Lambda_5 \cos 2\alpha + \Lambda_3 \sin 2\alpha \]
\[ U_{1,3}^{-1}(\theta) \Lambda_5 U_{1,3}(\theta) = \Lambda_5 \cos 2\theta - \Lambda_2 \sin 2\theta \]
\[ U_{0,2}^{-1}(\phi) \Lambda_5 U_{0,2}(\phi) = \Lambda_5 \cosh 2\phi - \Lambda_1 \sinh 2\phi \]
\[ U_{0,3}^{-1}(t) \Lambda_5 U_{0,3}(t) = \Lambda_5 \]
\[ \tilde{U}^{-1}(\kappa) \Lambda_5 \tilde{U}(\kappa) = \Lambda_5 \]
\[ \tilde{U}^{-1}(\chi) \Lambda_5 \tilde{U}(\chi) = \Lambda_5 \]

\[ U_{0,1}^{-1}(\sigma) \Lambda_6 U_{0,1}(\sigma) = \Lambda_6 \]
\[ U_{1,2}^{-1}(s) \Lambda_6 U_{1,2}(s) = \Lambda_6 \]
\[ U_{0,2}^{-1}(\phi) \Lambda_6 U_{0,2}(\phi) = \Lambda_6 \cosh 2\phi + \Lambda_2 \sinh 2\phi \]
\[ U_{1,3}^{-1}(\theta) \Lambda_6 U_{1,3}(\theta) = \Lambda_6 \cos 2\theta - \Lambda_1 \sin 2\theta \]
\[ \dot{U}^{-1} (\chi) \Lambda_7 \dot{\tilde{U}} (\chi) = \Lambda_7 \]
\[ U_{0,1}^{-1} (\sigma) \Lambda_8 U_{0,1} (\sigma) = \Lambda_8 \]
\[ U_{0,1}^{-1} (\sigma) \Lambda_8 U_{0,1} (\sigma) = \Lambda_8 \]
\[ U_{0,1}^{-1} (\sigma) \Lambda_8 U_{0,1} (\sigma) = \Lambda_8 \]
\[ \tilde{U}^{-1} (\chi) \Lambda_7 \tilde{U} (\chi) = \Lambda_7 \]
\[ U_{0,1}^{-1} (\sigma) \Lambda_8 U_{0,1} (\sigma) = \Lambda_8 \]
\[ U_{0,1}^{-1} (\sigma) \Lambda_8 U_{0,1} (\sigma) = \Lambda_8 \]

then for every product \( U \) of \( \dot{U} \)'s elements real functions \( G_s^r (t, x_1, x_2, x_3) \)
exist such that
\[ U^{-1} (\partial_s U) = g_3 \sum_{r=1}^{8} \Lambda_r G_s^r \]
with some real constant \( g_3 \) (similar to 8 gluons).

### 3.1 Asymptotic Freedom, Confinement, Gravitation

From (32):

\[ \frac{\partial t}{\partial t'} = \cosh 2\sigma, \]
\[ \frac{\partial x}{\partial t'} = c \sinh 2\sigma. \]

Hence, if \( v \) is the velocity of a coordinate system \( \{ t', x' \} \) in the coordinate system \( \{ t, x \} \) then

\[ \sinh 2\sigma = \frac{\left( \frac{\partial x}{\partial t} \right)}{\sqrt{1 - \left( \frac{\partial x}{\partial t} \right)^2}}, \quad \cosh 2\sigma = \frac{1}{\sqrt{1 - \left( \frac{\partial x}{\partial t} \right)^2}}. \]

Therefore,
\[ v = c \tanh 2\sigma. \quad (34) \]

Let
\[ 2\sigma := \omega(x) \frac{t}{x}, \]
with
\[ \omega(x) = \frac{\lambda}{|x|}, \]
where \( \lambda \) is a real constant with positive numerical value.

In that case
\[ v(t, x) = c \tanh \left( \frac{\lambda}{|x|} \right). \quad (35) \]

and if \( g \) is an acceleration of system \( \{t', x'_1\} \) as respects to system \( \{t, x_1\} \) then
\[ g(t, x_1) = \frac{\partial v}{\partial t} = \frac{c\omega(x_1)}{\left( \cosh^2 \omega(x_1) \frac{1}{x_1} \right) x_1}. \quad (36) \]

Figure 1: the dependency of a system \( \{t', x'_1\} \) velocity \( v(t, x_1) \) on \( x_1 \) in system \( \{t, x_1\} \).

Figure 1 shows the dependency of a system \( \{t', x'_1\} \) velocity \( v(t, x_1) \) on \( x_1 \) in system \( \{t, x_1\} \).

This velocity in point A is not equal to one in point B. Hence, an oscillator, placed in B, has a nonzero velocity in respect to an observer, placed in point A. Therefore, from the Lorentz transformations, this oscillator frequency for observer, placed in point A, is less than own frequency of this oscillator (red shift).

Figure 2 shows the dependency of a system \( \{t', x'_1\} \) acceleration \( g(t, x_1) \) on \( x_1 \) in system \( \{t, x_1\} \).

If an object immovable in system \( \{t, x_1\} \) is placed in point \( K \) then in system \( \{t', x'_1\} \) this object must move to the left with acceleration \( g \) and
\[ g \simeq \frac{\lambda}{x'_1}. \]

I call:
Figure 2: the dependency of a system \( \{t', x_1' \} \) acceleration \( g(t, x_1) \) on \( x_1 \) in system \( \{t, x_1 \} \).

- interval from \( S \) to \( \infty \) the Newton Gravity Zone,
- interval from \( B \) to \( C \) the the Zone,
- and interval from \( C \) to \( D \) the Confinement Force Zone.

### 3.2 Baryon Chrome

Like coordinates \( x_5 \) and \( x_4 \) [1] here are entered new coordinates \( y^\beta, z^\beta, y^\zeta, z^\zeta, y^n, z^n, y^\theta, z^\theta \) such that

\[
\begin{align*}
\frac{-\pi c}{h} &\leq y^\beta \leq \frac{\pi c}{h}, \quad \frac{-\pi c}{h} \leq z^\beta \leq \frac{\pi c}{h}, \\
\frac{-\pi c}{h} &\leq y^\zeta \leq \frac{\pi c}{h}, \quad \frac{-\pi c}{h} \leq z^\zeta \leq \frac{\pi c}{h}, \\
\frac{-\pi c}{h} &\leq y^n \leq \frac{\pi c}{h}, \quad \frac{-\pi c}{h} \leq z^n \leq \frac{\pi c}{h}, \\
\frac{-\pi c}{h} &\leq y^\theta \leq \frac{\pi c}{h}, \quad \frac{-\pi c}{h} \leq z^\theta \leq \frac{\pi c}{h}.
\end{align*}
\]

and like \( \tilde{\varphi} \), [1] p.83 let:

\[
\varphi(t, x, y^\beta, z^\beta, y^\zeta, z^\zeta, y^n, z^n, y^\theta, z^\theta) := \varphi(t, x) \times \exp(i(y^\beta M_0 + z^\beta M_4 + y^\zeta M_{\zeta,0} + z^\zeta M_{\zeta,4} + y^n M_{n,0} + z^n M_{n,4} + y^\theta M_{\theta,0} + z^\theta M_{\theta,4})),
\]
In this case if
\[
\left( [\varphi] , [\chi] \right) := \int_{-\pi c}^{\pi c} dy \int_{-\pi c}^{\pi c} dz \int_{-\pi c}^{\pi c} dy \int_{-\pi c}^{\pi c} dz \times
\]
\[
\times [\varphi]^T [\chi]
\]
(38)
then
\[
\left( [\varphi] , [\varphi] \right) = \rho A,
\]
\[
\left( [\varphi] , \beta^{[\cdot]} [\varphi] \right) = -\frac{j A_{\cdot k}}{c}.
\]

and in this case from (28):
\[
\left( \sum_{\nu=0}^{3} \beta^{[\nu]} \left( \partial_{\nu} + i \Theta_{\nu} + i \gamma^{[\nu]} \right) + \right.
\]
\[
\left. + \gamma^{[0]} \partial_{y}^{[\nu]} + \beta^{[4]} \partial_{x}^{[\nu]} - \gamma^{[0]} \partial_{y}^{[\nu]} + \zeta^{[4]} \partial_{x}^{[\nu]} - \gamma^{[0]} \partial_{y}^{[\nu]} - \eta^{[4]} \partial_{x}^{[\nu]} + \right.
\]
\[
\left. \gamma^{[0]} \partial_{y}^{[\nu]} + \theta^{[4]} \partial_{x}^{[\nu]} \right) [\varphi] = 0
\]
(40)

Because
\[
\gamma^{[0]}_{\eta} = \left[ \begin{array}{cccc} 0 & 0 & 0 & i \\ 0 & 0 & -i & 0 \\ 0 & i & 0 & 0 \\ -i & 0 & 0 & 0 \end{array} \right], \quad \eta^{[4]} = i \left[ \begin{array}{cccc} 0 & 0 & 0 & -i \\ 0 & 0 & i & 0 \\ 0 & i & 0 & 0 \\ -i & 0 & 0 & 0 \end{array} \right] ;
\]
(41)
\[
\gamma^{[0]}_{\phi} = \left[ \begin{array}{cccc} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{array} \right], \quad \theta^{[4]} = i \left[ \begin{array}{cccc} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 \\ -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{array} \right] ;
\]
(42)
\[
\gamma^{[0]}_{\zeta} = \left[ \begin{array}{cccc} 0 & 0 & 0 & -1 \\ 0 & 0 & -1 & 0 \\ 0 & -1 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{array} \right], \quad \zeta^{[4]} = i \left[ \begin{array}{cccc} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \end{array} \right] ;
\]
(43)
then from \[40\]:

\[
\sum_{\nu=0}^{3} \beta^{[\nu]} \left( \partial_\nu + i \Theta_\nu + i \Upsilon_\nu \gamma^{[\nu]} \right) [\varphi] + \gamma^{[0]} \partial_y^0 [\varphi] + \beta^{[4]} \partial_z^0 [\varphi] +
\]

\[
\begin{pmatrix}
0 & 0 & -\partial_x^0 & -i\partial_y^0 \\
0 & 0 & \partial_y^0 & i\partial_y^0 \\
-\partial_y^0 & \partial_y^0 & 0 & 0 \\
-\partial_x^0 & -\partial_x^0 & 0 & 0
\end{pmatrix}
\]

\[
+ \left( \begin{array}{cccc}
\partial_x^0 & \partial_x^0 & 0 & 0 \\
\partial_y^0 & \partial_y^0 & 0 & 0 \\
-\partial_y^0 & -\partial_y^0 & 0 & 0 \\
-\partial_x^0 & -\partial_x^0 & 0 & 0
\end{array} \right) \times [\varphi] = 0. \tag{44}
\]

Let a Fourier transformation of

\[
[\varphi] \left( t, \mathbf{x}, y^\beta, z^\beta, y^\zeta, z^\zeta, y^n, z^n, y^\theta, z^\theta \right)
\]

be the following:

\[
\begin{align*}
[\varphi] \left( t, \mathbf{x}, y^\beta, z^\beta, y^\zeta, z^\zeta, y^n, z^n, y^\theta, z^\theta \right) & = \\
& = \sum_{w,p_1,p_2,p_3,n^\beta, z^\beta, n^\zeta, z^\zeta, n^n, z^n, n^\theta, z^\theta} c(w, p_1, p_2, p_3, n^\beta, \\
& \times \exp(-i\frac{hc}{c}(w x_0 + p_1 x_1 + p_2 x_2 + p_3 x_3 + \\
& + n^\beta y^\beta + z^\beta + n^\zeta y^\zeta + z^\zeta + \\
& + n^n y^n + z^n + n^\theta y^\theta + z^\theta)) \times \tag{45}
\end{align*}
\]

Let in \[44\] \( \Theta_\nu = 0 \) and \( \Upsilon_\nu = 0 \).

Let us designate:

\[
G_0 := \left( \sum_{\nu=0}^{3} \beta^{[\nu]} \partial_\nu + \gamma^{[0]} \partial_y^0 + \beta^{[4]} \partial_z^0 - \gamma^{[0]} \partial_y^0 + \zeta^{[4]} \partial_z^0 - \gamma^{[0]} \partial_y^0 - \eta^{[4]} \partial_z^0 + \gamma^{[0]} \partial_y^0 + \theta^{[4]} \partial_z^0 \right). \tag{46}
\]

that is:

\[
G_0 = \left( \begin{array}{cccc}
-\partial_0 + \partial_3 & \partial_1 - i \partial_2 & \partial_x^0 - \partial_y^0 & \partial_x^0 - i \partial_y^0 \\
\partial_1 + i \partial_2 & -\partial_0 - \partial_3 & \partial_y^0 + i \partial_y^0 & \partial_y^0 + \partial_y^0 \\
\partial_x^0 - \partial_y^0 & \partial_y^0 - i \partial_y^0 & -\partial_0 - \partial_3 & -\partial_0 + \partial_3 \\
\partial_x^0 + i \partial_y^0 & \partial_y^0 + \partial_y^0 & -\partial_0 - \partial_3 & -\partial_0 + \partial_3 \\
0 & 0 & \partial_x^0 + \partial_y^0 & \partial_x^0 - \partial_y^0 \\
0 & 0 & \partial_x^0 - i \partial_y^0 & \partial_x^0 + \partial_y^0 \\
-\partial_x^0 - \partial_y^0 & -\partial_x^0 - i \partial_y^0 & 0 & 0 \\
-\partial_x^0 + i \partial_y^0 & -\partial_x^0 + \partial_y^0 & 0 & 0
\end{array} \right) \tag{47}
\]
$G_0[\varphi] = -\frac{i}{c} \sum_{w, p_1, p_2, p_3, n_1, n_2, n_3, s_1, s_2, s_3, n_\theta, s_\theta} \hat{g}(w, p_1, p_2, p_3, n_\beta, s_\beta, n_\zeta, s_\zeta, n_\eta, s_\eta, n_\theta, s_\theta) \times$

\[ \sum_{k=0}^{3} c_k(w, p_1, p_2, p_3, n_\beta, s_\beta, n_\zeta, s_\zeta, n_\eta, s_\eta, n_\theta, s_\theta) \times \exp(-\frac{i}{c}(wx_0 + p_1x_1 + p_2x_2 + p_3x_3 + n_\beta y^\beta + s_\beta z^\beta + n_\zeta y^\zeta + s_\zeta z^\zeta + n_\eta y^\eta + s_\eta z^\eta + n_\theta y^\theta + s_\theta z^\theta)). \] (48)

Here $c_k(w, p_1, p_2, p_3, n_\beta, s_\beta, n_\zeta, s_\zeta, n_\eta, s_\eta, n_\theta, s_\theta)$ is an eigenvector of $G_0$.

$\phi_\zeta := c(w, p, f) \exp(-\frac{i}{c}(wx_0 + px + \gamma_\zeta[0] fy^\zeta))$

is a red lower chrome function,

$\varphi_\zeta := c(w, p, f) \exp(-\frac{i}{c}(wx_0 + px - i\gamma_\zeta[4] fz^\zeta))$

is a red upper chrome function,
\[ \varphi^0_y := c(w, p, f) \exp(-\frac{i}{\hbar} (wx_0 + px + \gamma^0_y fy^0)) \]

is a green lower chrome function,

\[ \varphi^0_z := c(w, p, f) \exp(-\frac{i}{\hbar} (wx_0 + px - i\eta[f] fy^0)) \]

is a green upper chrome function,

\[ \varphi^\theta_y := c(w, p, f) \exp(-\frac{i}{\hbar} (wx_0 + px + \gamma^\theta_y fy^\theta)) \]

is a blue lower function,

\[ \varphi^\theta_z := c(w, p, s^\theta) \exp(-\frac{i}{\hbar} (wx_0 + px - i\theta[f] fz^\theta)) \]

is a blue upper chrome function.

Operator \(-\partial^y_{\zeta} \partial^y_{\zeta}\) is called a red lower chrome operator, \(-\partial^z_{\zeta} \partial^z_{\zeta}\) is a red upper chrome operator,

\(-\partial^y_{\eta} \partial^z_{\eta}\) is called a green lower chrome operator, \(-\partial^y_{\eta} \partial^y_{\eta}\) is a green upper chrome operator,

\(-\partial^z_{\eta} \partial^z_{\eta}\) is called a blue lower chrome operator, \(-\partial^z_{\theta} \partial^z_{\theta}\) is a blue upper chrome operator.

For example, if \(\varphi^\zeta_z\) is a red upper chrome function then

\[ -\partial^y_{\zeta} \partial^z_{\zeta} \varphi^\zeta_z = -\partial^y_{\eta} \partial^z_{\eta} \varphi^\zeta_z = -\partial^z_{\eta} \partial^y_{\eta} \varphi^\zeta_z = 0 \]

but

\[ -\partial^z_{\eta} \partial^y_{\eta} \varphi^\zeta_z = -\left(\frac{\hbar}{\gamma} \right)^2 \varphi^\zeta_z. \]

Because \(G_0[\varphi] = 0\)

then

\( U G_0 U^{-1} U \left[ \varphi \right] = 0 \)

If \(U = U_{1,2}(\alpha)\) then \(G_0 \to U_{1,2}(\alpha) G_0 U_{1,2}^{-1}(\alpha)\) and \([\varphi] \to U_{1,2}(\alpha) [\varphi]\).

In this case:

\[ \partial_1 \to \partial'_1 := (\cos \alpha \cdot \partial_1 - \sin \alpha \cdot \partial_2), \]
\[ \partial_2 \to \partial'_2 := (\cos \alpha \cdot \partial_2 + \sin \alpha \cdot \partial_1), \]
\[ \partial_0 \to \partial'_0 := \partial_0, \]
\[ \partial_3 \to \partial'_3 := \partial_3, \]
\[ \partial^0_y \to \partial'^0_y := \partial^0_y, \]
\[ \partial^0_z \to \partial'^0_z := \partial^0_z, \]
\[ \partial^v_y \to \partial'^v_y := (\cos \alpha \cdot \partial^v_y + \sin \alpha \cdot \partial^0_y), \]
\[ \partial^v_z \to \partial'^v_z := (\cos \alpha \cdot \partial^v_z + \sin \alpha \cdot \partial^0_z), \]
\[ \partial^v_\eta \to \partial'^v_\eta := (\cos \alpha \cdot \partial^v_\eta - \sin \alpha \cdot \partial^0_\eta), \]
\[ \partial^v_\theta \to \partial'^v_\theta := (\cos \alpha \cdot \partial^v_\theta - \sin \alpha \cdot \partial^0_\theta). \]
\[ \partial_0^\rho \to \partial_0^{\rho} := \partial_0^\rho. \]

Therefore,

\[
-\partial_0^{\rho} \partial_0^{\rho} \varphi_2^\zeta = \left( \frac{h}{c} \cos \alpha \right)^2 \cdot \varphi_2^\zeta,
\]

\[
-\partial_0^{\rho} \partial_0^{\rho} \varphi_2^\zeta = \left( -\sin \alpha \cdot \frac{h}{c} \right)^2 \varphi_2^\zeta.
\]

If \( \alpha = -\frac{\pi}{7} \) then

\[
-\partial^\zeta_0 \partial_0^{\zeta} \varphi_2^\zeta = 0,
\]

\[
-\partial^{\rho_0} \partial_0^{\rho} \varphi_2^\zeta = \left( \frac{h}{c} \right)^2 \varphi_2^\zeta.
\]

That is under such rotation the red state becomes the green state.

If \( U = U_{3,2} (\alpha) \) then \( G_0 \to U_{3,2} (\alpha) G_0 U_{3,2}^{-1} (\alpha) \) and \( [\varphi] \to U_{3,2} (\alpha) [\varphi] \).

In this case:

\[ \partial_0 \to \partial_0' := \partial_0, \]
\[ \partial_1 \to \partial_1' := \partial_1, \]
\[ \partial_2 \to \partial_2' := (\cos \alpha \cdot \partial_2 + \sin \alpha \cdot \partial_3), \]
\[ \partial_3 \to \partial_3' := (\cos \alpha \cdot \partial_3 - \sin \alpha \cdot \partial_2), \]
\[ \partial_0^\rho \to \partial_0^{\rho'} := \partial_0^\rho, \]
\[ \partial_0^\sigma \to \partial_0^{\sigma'} := \partial_0^\sigma, \]
\[ \partial_0^\eta \to \partial_0^{\eta'} := \left( \cos \alpha \cdot \partial_0^\eta - \sin \alpha \cdot \partial_0^\rho \right), \]
\[ \partial_0^\nu \to \partial_0^{\nu'} := \left( \cos \alpha \cdot \partial_0^\nu + \sin \alpha \cdot \partial_0^\rho \right), \]
\[ \partial_2^\zeta \to \partial_2^{\zeta'} := \partial_2^\zeta, \]
\[ \partial_3^\zeta \to \partial_3^{\zeta'} := \partial_3^\zeta, \]
\[ \partial_1^\zeta \to \partial_1^{\zeta'} := \left( \cos \alpha \cdot \partial_1^\zeta - \sin \alpha \cdot \partial_1^\rho \right), \]
\[ \partial_0^\zeta \to \partial_0^{\zeta'} := \left( \cos \alpha \cdot \partial_0^\zeta + \sin \alpha \cdot \partial_0^\rho \right). \]

Therefore, if \( \varphi_y^\eta \) is a green lower chrome function then

\[
-\partial_2^{\rho} \partial_2^{\rho} \varphi_y^\eta = \left( \frac{h}{c} \cos \alpha \cdot f \right)^2 \cdot \varphi_y^\eta,
\]

\[
-\partial_0^{\rho} \partial_0^{\rho} \varphi_y^\eta = \left( \frac{h}{c} \sin \alpha \cdot f \right)^2 \cdot \varphi_y^\eta.
\]

If \( \alpha = \pi/2 \) then

\[
-\partial_0^{\rho} \partial_0^{\rho} \varphi_y^\eta = 0,
\]

\[
-\partial_0^{\rho} \partial_0^{\rho} \varphi_y^\eta = \left( \frac{h}{c} \right)^2 \cdot \varphi_y^\eta.
\]

That is under such rotation the green state becomes blue state.

If \( U = U_{3,1} (\alpha) \) then \( G_0 \to U_{3,1} (\alpha) G_0 U_{3,1}^{-1} (\alpha) \) and \( [\varphi] \to U_{3,1} (\alpha) [\varphi] \).

In this case:

\[ \partial_0 \to \partial_0' := \partial_0, \]
\[ \partial_1 \to \partial_1' := (\cos \alpha \cdot \partial_1 - \sin \alpha \cdot \partial_3), \]
\[ \partial_2 \to \partial_2' := \partial_2, \]
\[ \partial_3 \to \partial_3' := (\cos \alpha \cdot \partial_3 + \sin \alpha \cdot \partial_1), \]

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\[ \begin{align*}
\partial^a_y \rightarrow \partial^a_y' & := \partial^a_y, \\
\partial^b_y \rightarrow \partial^b_y' & := (\cos \alpha \cdot \partial^b_y + \sin \alpha \cdot \partial^a_y), \\
\partial^c_y \rightarrow \partial^c_y' & := \partial^c_y, \\
\partial^d_y \rightarrow \partial^d_y' & := (\cos \alpha \cdot \partial^d_y - \sin \alpha \cdot \partial^c_y), \\
\partial^e_y \rightarrow \partial^e_y' & := \partial^e_y, \\
\partial^f_y \rightarrow \partial^f_y' & := (\cos \alpha \cdot \partial^f_y - \sin \alpha \cdot \partial^d_y), \\
\partial^g_y \rightarrow \partial^g_y' & := \partial^g_y, \\
\partial^h_y \rightarrow \partial^h_y' & := \partial^h_y, \\
\partial^i_y \rightarrow \partial^i_y' & := (\cos \alpha \cdot \partial^i_y + \sin \alpha \cdot \partial^g_y).
\end{align*} \]

Therefore,
\[ \begin{align*}
-\partial^b_y' \partial^b_y' \varphi \zeta' & = -\left( f \frac{h}{c} \cos \alpha \right)^2 \varphi \zeta', \\
-\partial^d_y' \partial^d_y' \varphi \zeta' & = -\left( \sin \alpha \cdot f \frac{h}{c} \right)^2 \varphi \zeta'.
\end{align*} \]

If \( \alpha = \pi/2 \) then
\[ \begin{align*}
-\partial^b_y' \partial^b_y' \varphi \zeta' & = 0, \\
-\partial^d_y' \partial^d_y' \varphi \zeta' & = -\left( f \frac{h}{c} \right)^2 \varphi \zeta'.
\end{align*} \]

That is under such rotation the red state becomes the blue state. Thus at the Cartesian turns chrome of a state is changed.

One of ways of elimination of this noninvariancy consists in the following. Calculations give the grounds to assume that some oscillations of quarks states bend time-space in such a way that acceleration of the bent system in relation to initial system submits to the following law (Figure 3):

\[ g(t, x) = c \lambda/ \left( x^2 \cosh^2 \left( \lambda t/x^2 \right) \right). \]

Here the acceleration plot is line (1) and the line (2) is plot of \( \lambda/x^2 \).

Hence, to the right from point \( C' \) and to the left from point \( C \) the Newtonian gravitation law is carried out.
AA′ is the Asymptotic Freedom Zone.

CB and B′C′ is the Confinement Zone.

Let in the potential hole AA′ there are three quarks \( \varphi_1^\gamma, \varphi_2^\gamma, \varphi_3^\gamma \). Their general state function is determinant with elements of the following type: \( \varphi_1^\gamma := \varphi_1^\gamma \varphi_2^\gamma \varphi_3^\gamma \). In this case:

\[
-\partial^2_y \partial^\gamma_y \varphi_1^\gamma = \left( \frac{\hbar}{c} \right)^2 \varphi_1^\gamma
\]

and under rotation \( U_{1,2} (\alpha) \):

\[
-\partial^2_y \partial^\gamma_y \varphi_1^\gamma = \left( \frac{\hbar}{c} \right)^2 \varphi_1^\gamma
\]

That is at such turns the quantity of red chrome remains.

As and for all other Cartesian turns and for all other chromes.

Baryons \( \Delta^{-} = \text{ddd}, \Delta^{++} = \text{uuu}, \Omega^{-} = \text{sss} \) belong to such structures.

If \( U = U_{1,0} (\alpha) \) then \( G_0 \rightarrow U_{1,0}^{-1} (\alpha) G_0 U_{1,0}^{-1} (\alpha) \) and \([\varphi] \rightarrow U_{1,0} (\alpha) [\varphi] \).

In this case:

\[
\partial_0 \rightarrow \partial_0 := (\cosh \alpha \cdot \partial_0 + \sinh \alpha \cdot \partial_1), \\
\partial_1 \rightarrow \partial_1 := (\cosh \alpha \cdot \partial_1 + \sinh \alpha \cdot \partial_0), \\
\partial_2 \rightarrow \partial_2 := \partial_2, \\
\partial_3 \rightarrow \partial_3 := \partial_3, \\
\partial_2^\gamma \rightarrow \partial_2^\gamma := \partial_2^\gamma, \\
\partial_2^\gamma \rightarrow \partial_2^\gamma := \partial_2^\gamma.
\]

Therefore,

\[
-\partial_2^{\gamma^2} \partial_2^{\gamma^2} \varphi_2^\gamma = \left( 1 + \sinh^2 \alpha \right) \left( \frac{\hbar}{c} \right)^2 \varphi_2^\gamma
\]

Similarly, it is valid for other states and under other Lorentz transformation.

One of ways of elimination of this noninvariancy is the following:

Let

\[
\varphi_{yz}^{\gamma} := \varphi_{y}^{\gamma} \varphi_{z}^{\gamma} \varphi_{y}^{\gamma} \varphi_{z}^{\gamma} \varphi_{yz}^{\gamma}.
\]

Under transformation \( U_{1,0} (\alpha) \):

\[
-\partial_2^{\gamma^2} \partial_2^{\gamma^2} \varphi_{yz}^{\gamma} = - \left( \frac{\hbar}{c} \right)^2 \varphi_{yz}^{\gamma}.
\]
That is a magnitude of red chrome of this state doesn’t depend on angle $\alpha$.
This condition is satisfied for all chromes and under all Lorentz’s transformations.

Pairs of baryons

$$
\begin{align*}
\{ p = uud, n = ddu \}, \\
\{ \Sigma^+ = uus, \Xi^0 = uss \}, \\
\{ \Delta^+ = uud, \Delta^0 = udd \}
\end{align*}
$$

belong to such structures.

Baryons represent one of ways of elimination of the chrome noninvariancy under Cartesian’s and under Lorentz’s transformations.

4 Conclusion

The Quark Theory is a part of the Probability Theory

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