Time-Space, Probability, and Physics

G. Quznetsov
mailto: quznetso@gmail.com

February 3, 2020

Abstract

In this book, the Gentzen variant of the propositional logic is used to substantiate the space-time relations, including the Lorentz transformations. The logical foundations of probability theory, including Jacob Bernulli's Big Numbers Law and the statistical definition of probability, are also derived from this logic.

All concepts and statements of the Standard Model (except for the Higgs) are obtained as concepts and theorems of probability theory. The masses, spins, moments, energies of fermions are the parameters of the distribution of such a probability. The masses of the W and Z bosons are the results of the interaction of the probability flows into space-time.

Quark-gluon relations, including the phenomena of confinement and asymptotic freedom, are also a consequence of the properties of this probability.

The phenomenon of gravity with dark matter and dark energy is a continuation of these quark-gyonic relations.

For understanding of the maintenance of this book elementary knowledge in the field of linear algebra and the mathematical analysis is sufficient.

Introduction

The Manhattan Project began on September 17, 1943. It was attracted many outstanding physicists, many of whom were refugees from Europe. By the summer of 1945, the Americans had managed to build 3 atomic bombs, 2 of which were dropped on Hiroshima and Nagasaki, and a third had been tested shortly before.

And the atomic race began.

In the following years, the governments of many states allocated enormous sums of money to scientific organizations. Following these money, huge masses of easy luck seekers moved to physics.

They invented SUSY, WIMP, BIG BANG, HIGGS and other theories of the same kind.

Giant laboratory facilities were built and enormous human resources were attracted to experimentally confirm these theories.

Results of the LHC and other science giant laboratory work are describe in [Farewell to Higgs] (since 10 September 2008 till 14 February 2013: RUNI) and [Runii: no Susy, no Wimp, no Higgs, no New Physics] (from June 2015 to January 2018, RUNII)

Large Hadron Collider (LHC) worked since 10 September 2008 till 14 February 2013 RUNI. RUNII works from June 2015 for today. Huge resources have been spent, but did not receive any fundamentally new results - no superpartners, no extra dimensions, or gravitons, or black holes. no dark matter or dark energy, etc. etc .. As for the Higgs, the_rstly, there is no argument in favor of the fact that the particle 124.5 -126 GeV has some relation to the Higgs mechanism. Secondly, the Higgs held permeates the vacuum of space, which means that the mass of the Higgs vacuum and stability are closely linked. For a particle of mass near 126 GeV - enough to destroy the cosmos. The Standard Model of particle physics has not given an answer to the question of why the universe did not collapse after the Big Bang. Moreover, Nothing in Standard Model gives a precise value for the Higgs's own mass, and calculations from first principles, based on quantum theory, suggest it should be enormous—roughly a hundred million billion times higher than its measured value. Physicists have therefore introduced an ugly fudge factor into their equations (a process called "fine-tuning") to sidestep the problem. Third, all the known elementary bosons are gauge - it is photons, W- and Z-bosons and gluons. It is likely that the 125-126 particle is of some hadron multiplet.

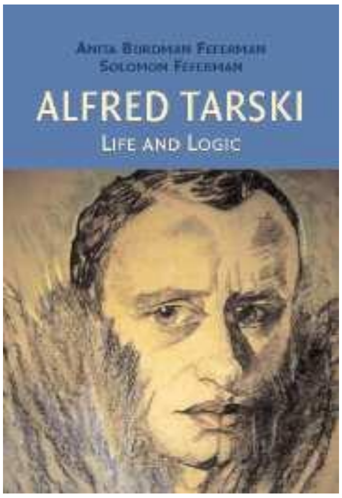
That is, in recent years, many theoretical physicists have studied what is not in the nature. It are SUSY, WIMP, Higgs, BIG BANG hypothesis, etc. On the other hand already in 2006 - 2007 the logic analysis of these subjects described in books [1], [2] it showed that all physical events are determined by well-known particles - leptons, quarks and gauge bosons.

"The Fundamental Theoretical Physics is the Part of the Probability Theory" contains development and continuation of ideas of these books.

For understanding of the maintenance of this book elementary knowledge in the field of linear algebra and the mathematical analysis is sufficient.

1. Truth

Science presents its ideas and results with language texts. Therefore, we will begin by considering narrative sentences:
By Alfred Tarski[1] [4. Tarski, A. The Semantic Conception of Truth and the Foundations of Semantics, Philoso phy and Phenomenological Research, 4, 1944.]:



A sentence «Θ» is true if and only if Θ .

For example, sentence «It is raining» is true if and only if it is raining.

A sentence «Θ» is false if and only if there is not that Θ.

For example, «2 + 3 = 4».

Still an example: Obviously, the following sentence isn't true and isn't false [4][2]:

[1] **Alfred Tarski** January 14, 1901 – October 26, 1983), born **Alfred Teitelbaum**, was a Polish-American logician and mathematician .

[2] **Liar paradox**, also called **Epimenides' paradox**, paradox derived from the statement attributed to the Cretan prophet Epimenides (6th century BCE) that all Cretans are liars.

«This sentence is false».

Those sentences which can be either true, or false, are called as *meaningful* sentences. The previous example sentence is *meaningless* sentence.

Further, we consider only meaningful sentences which are either true, or false.

2. Time and Space

Here I use numbering of definitions and theorems from book [1. pp.`9--52] which contains detailed proofs of all these theorems.

2.1. Recorders

Any information, received from physical devices, can be expressed by a text, made of sentences.

Let **â** be some object which is able to receive, save, and/or transmit an information. A set a of sentences, expressing an information of an object **â,** is called a recorder of this object. Thus, statement: “Sentence «A» is an element of the set **a**” denotes: “**â** has information that the event, expressed by sentence «A» took place”. In short: “**â** knows that A”. Or by designation: “a*•«A»”.

Obviously, the following conditions are satisfied:

I. For any **a** and for every *A*: false is that a* (A&(¬A)), thus, any recorder doesn’t contain a logical contradiction;

II. For every **a**, every *B*, and all *A*: if *B* is a logical consequence from *A*, and a**A*, then a

III. * For all **a**, **b** and for every *A*: if a*«**b****A*» then a**A*.

2.2. Time

Let’s consider finite (probably empty) path of symbols of form q•.

Def. 1.3.1: A path α is a *subpath* of a path β (design.:α << β) if α can be got from β by deletion of some (probably all) elements.

Designation: $(\alpha)^1$ is α, and $(\alpha)^{k+1}$ is α $(\alpha)^k$.

Therefore, if k ≤ l then $(\alpha)^k < (\alpha)^l$.

Def. 1.3.2: A path α is *equivalent* to a path β (design.: α ~ β) if α can be got from β by substitution of a subpath of form $(a\bullet)^k$ by a path of the same form $(a\bullet)^s$.

In this case:

III. If β ≺α or β ~α then for any K: if **a***•K then
$\mathbf{a}^*$ (K&(αA ⇒βA)).
Obviously, **III** is a refinement of condition *III.

Def. 1.3.3: A natural number *q* is *instant*, at which **a** registrates *B* according to κ-clock {$\mathbf{g}_0$,*A*,$\mathbf{b}_0$} (design.: *q* is
[a*B ↑ **a**,{g0, *A*, $\mathbf{b}_0$}) if:
1. for any *K*: if $\mathbf{a}^*K$ then

$$\mathbf{a}^\bullet\left(K\&\left(\mathbf{a}^\bullet B \Rightarrow \mathbf{a}^\bullet\left(\mathbf{g}_0^\bullet\mathbf{b}_0^\bullet\right)^q\mathbf{g}_0^\bullet A\right)\right)$$

and

$$\mathbf{a}^\bullet\left(K\&\left(\mathbf{a}^\bullet\left(\mathbf{g}_0^\bullet\mathbf{b}_0^\bullet\right)^{q+1}\mathbf{g}_0^\bullet A \Rightarrow \mathbf{a}^\bullet B\right)\right).$$

2.

$$\mathbf{a}^\bullet\left(\mathbf{a}^\bullet B\&\left(\neg\mathbf{a}^\bullet\left(\mathbf{g}_0^\bullet\mathbf{b}_0^\bullet\right)^{q+1}\mathbf{g}_0^\bullet A\right)\right).$$

Def. 1.3.4: κ-clocks {$\mathbf{g}_1$,*B* $\mathbf{b}_1$} and {$\mathbf{g}_2$ *B*,$\mathbf{b}_2$} have *the same direction* for **a** if the following condition is satisfied:
If

$$r = \left[\mathbf{a}^\bullet\left(\mathbf{g}_1^\bullet\mathbf{b}_1^\bullet\right)^q\mathbf{g}_1^\bullet B \uparrow \mathbf{a}, \{\mathbf{g}_2, B, \mathbf{b}_2\}\right],$$

$$s = \left[\mathbf{a}^\bullet\left(\mathbf{g}_1^\bullet\mathbf{b}_1^\bullet\right)^p\mathbf{g}_1^\bullet B \uparrow \mathbf{a}, \{\mathbf{g}_2, B, \mathbf{b}_2\}\right],$$

$$q < p,$$

then

$$r \leqslant s.$$

Th. 1.3.1: All κ-clocks have the same direction. Consequently, a recorder orders its sentences with respect to instants. Moreover, this order is linear and it doesn't matter according to which κ-clock it is established.

Def. 1.3.5: κ-clock $\{\mathbf{g}_2, B, \mathbf{b}_2\}$ is *k times more precise* than κ-clock $\{\mathbf{g}_1\ B, \mathbf{b}_1\}$ for recorder **a** if for every *C* the following condition is satisfied: if

$$q_1 = [\mathbf{a}^{\bullet} C \uparrow \mathbf{a}, \{\mathbf{g}_1, B, \mathbf{b}_1\}],$$

$$q_2 = [\mathbf{a}^{\bullet} C \uparrow \mathbf{a}, \{\mathbf{g}_2, B, \mathbf{b}_2\}],$$

then

$$q_1 < \tfrac{q_2}{k} < q_1 + 1.$$

Def 1.3.6: A sequence $\widetilde{\boldsymbol{H}}$ of κ-clocks:

$$\left\langle \{\mathbf{g}_0, A, \mathbf{b}_0\},\ \{\mathbf{g}_1, A, \mathbf{b}_2\}, \ldots, \left\{\mathbf{g}_j, A, \mathbf{b}_j\right\}, \ \ldots \right\rangle$$

Is called an *absolutely precise κ-clock* of a recorder **a** if for every *j* exists a natural number *kj* so that κ-clock $(\mathbf{g}_j, A\ \mathbf{b}_j)$ is *kj* times more precise than κ-clock $\{\mathbf{g}_{-j-1} A, \mathbf{b}_{j-1}\}$. In this case if

$$q_j = \left[\mathbf{a}^{\bullet} C \uparrow \mathbf{a}, \left\{\mathbf{g}_j, A, \mathbf{b}_j\right\}\right]$$

and

$$t = q_0 + \sum_{j=1}^{\infty} \frac{q_j - q_{j-1} \cdot k_j}{k_1 \cdot k_2 \cdot \ldots \cdot k_j},$$

then

$$t \text{ is } \left[\mathbf{a}^{\bullet} C \uparrow \mathbf{a}, \widetilde{H}\right].$$

2.3. *Space*

Def. 1.4.1: A number *t* is called a *time, measured by a recorder* **a** according to a κ-clock $\widetilde{\boldsymbol{H}}$, during which *a signal*
C did a path **a*αa*•**, design.:

$$t := \mathfrak{m}\left(\mathbf{a}\widetilde{H}\right)(\mathbf{a}^{\bullet}\alpha\mathbf{a}^{\bullet}C),$$

If

$$t = \left[\mathbf{a}^{\bullet}\alpha\mathbf{a}^{\bullet}C \uparrow \mathbf{a}, \widetilde{H}\right] - \left[\mathbf{a}^{\bullet}C \uparrow \mathbf{a}, \widetilde{H}\right].$$

Th. 1.4.1

$$\mathfrak{m}\left(\mathbf{a}\widetilde{H}\right)(\mathbf{a}^{\bullet}\alpha\mathbf{a}^{\bullet}C) \geqslant 0.$$

Def. 1.4.2:
1) for every recorder **a**: $(\mathbf{a}^*)^{\dagger} := (\mathbf{a}^*)$;
2) for all paths α and β: $(\alpha\beta)^{\dagger} = (\beta)^{\dagger} (\alpha)^{\dagger}$.

Def. 1.4.3: A set R̂ of recorders is an *internally stationary* system for a recorder a with a κ-clock $\widetilde{\boldsymbol{H}}$ (design.: $\mathfrak{R}$is
ISS(**a,** $\widetilde{\boldsymbol{H}}$)) if for all sentences *B* and *C*, for all elements $\mathbf{a}_1$ and $\mathbf{a}_2$ of set $\mathfrak{R}$ and for all paths α, made of elements of set $\mathfrak{R}$ the following conditions are satisfied:

Def. 1.4.4: A number *l* is called an **a**$\widetilde{\boldsymbol{H}}$(*B*)-*measure* of recorders $\mathbf{a}_1$ and $\mathbf{a}_2$, design.:

$$l = \ell\left(\mathbf{a}, \widetilde{H}, B\right)(\mathbf{a}_1, \mathbf{a}_2)$$

$$l = 0.5 \cdot \left(\left[\mathbf{a}^{\bullet}\mathbf{a}_1^{\bullet}\mathbf{a}_2^{\bullet}\mathbf{a}_1^{\bullet} B \uparrow \mathbf{a}, \widetilde{H}\right] - \left[\mathbf{a}^{\bullet}\mathbf{a}_1^{\bullet} B \uparrow \mathbf{a}, \widetilde{H}\right]\right).$$

if

Th. 1.4.3: If

$$\{\mathbf{a}, \mathbf{a}_1, \mathbf{a}_2, \mathbf{a}_3\} \text{ is } ISS\left(\mathbf{a}, \widetilde{H}\right)$$

thwn

1) $\ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_2) \geqslant 0;$
2) $\ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_1) = 0;$
3) $\ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_2) = \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_2, \mathbf{a}_1);$
4) $\ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_2) + \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_2, \mathbf{a}_3) \geqslant \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_3).$

Thus, all four axioms of the metrical space are accomplished for ℓ(**a** $\widetilde{\boldsymbol{H}}$) in an internally stationary system internally stationary system of recorders. Consequently, ℓ(**a** $\widetilde{?}$) is a distance length similitude in this space.

Def. 1.4.6: *B* took place in *the same place* as a1 for **a** (design.: $\natural$ (**a**) ($\mathbf{a}_1 B$)) if for every sequence α and for any
sentence *K* the following condition is satisfied: if $\mathbf{a}^{*}K$ then

$$\mathbf{a}^{\bullet}\left(K \& (\alpha B \Rightarrow \alpha \mathbf{a}_1^{\bullet} B)\right).$$

Th. 1.4.4:

$$\natural(\mathbf{a})\left(\mathbf{a}_1, \mathbf{a}_1^{\bullet} B\right).$$

Th. 1.4.5: If

$$\natural(\mathbf{a})(\mathbf{a}_1, B),$$

$$\natural(\mathbf{a})(\mathbf{a}_2, B),$$

then

$$\natural(\mathbf{a})(\mathbf{a}_2, \mathbf{a}_1^{\bullet} B).$$

Th. 1.4.6: If

$$\{\mathbf{a}, \mathbf{a}_1, \mathbf{a}_2\} \text{ is } ISS\left(\mathbf{a}, \widetilde{H}\right),$$

$$\natural(\mathbf{a})(\mathbf{a}_1, B),$$

$$\natural(\mathbf{a})(\mathbf{a}_2, B),$$

then

$$\ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_2) = 0.$$

Th. 1.4.7: If {$\mathbf{a}_1$, $\mathbf{a}_2$, $\mathbf{a}_3$} is *ISS*(**a**, $\widetilde{\boldsymbol{H}}$) and there exists sentence *B* such that

$$\natural(\mathbf{a})(\mathbf{a}_1, B),$$

$$\natural(\mathbf{a})(\mathbf{a}_2, B),$$

then

$$\ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_3, \mathbf{a}_2) = \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_3, \mathbf{a}_1).$$

Def. 1.4.7: A real number *t* is an *instant of a sentence B* in *frame of referen* ($\mathfrak{R}\mathbf{a}\widetilde{\boldsymbol{H}}$), design.:

$$t = \left[B \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right].$$

if

1. $$\mathfrak{R} \text{ is } ISS\left(\mathbf{a}, \widetilde{H}\right),$$

2. there exists a recorder **b** so that **b** ∈ $\mathcal{R}$ and $\natural(\mathbf{a})(\mathbf{b}, B),$
3. $$t = \left[\mathbf{a}^{\bullet} B \uparrow \mathbf{a}, \widetilde{H}\right] - \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}, \mathbf{b}).$$

Def. 1.4.8: A real number *z* is a *distance length* between *B* and *C* in a frame of reference ($\mathcal{R}\mathbf{a}\widetilde{\boldsymbol{H}}$, design.

$$z = \ell\left(\mathfrak{R}\mathbf{a}\widetilde{H}\right)(B, C),$$

If

1) $$\mathfrak{R} \text{ is } ISS\left(\mathbf{a}, \widetilde{H}\right),$$

2) there exist recorders $\mathbf{a}_1$ and $\mathbf{a}_2$ so that $\mathbf{a}_1 \in \mathfrak{R}$, $\mathbf{a}_2 \in \mathfrak{R}$,
♮ (**a**) ($\mathbf{a}_1$, *B*)) and ♮ (**a**) (a_2,*C*)),

$$\natural(\mathbf{a})(\mathbf{a}_1, B)) \text{ and } \natural(\mathbf{a})(\mathbf{a}_2, C)),$$

3) $$z = \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_2, \mathbf{a}_1).$$

According to Theorem 1.4.3 such distance length satisfies conditions of all axioms of a metric space.

Def. 1.4.1: A number *t* is called a time, measured by a recorder a according to a *κ*-clock $\widetilde{\boldsymbol{H}}$, during which a signal *C* did a path $a^{\bullet}\alpha a^{\bullet}$, design

$$t := \mathfrak{m}\left(\mathbf{a}\widetilde{H}\right)(\mathbf{a}^{\bullet}\alpha\mathbf{a}^{\bullet}C),$$

If

$$t = \left[\mathbf{a}^{\bullet}\alpha\mathbf{a}^{\bullet}C \uparrow \mathbf{a}, \widetilde{H}\right] - \left[\mathbf{a}^{\bullet}C \uparrow \mathbf{a}, \widetilde{H}\right].$$

Th. 1.4.1:

$$\mathfrak{m}\left(\mathbf{a}\widetilde{H}\right)\left(\mathbf{a}^{\bullet}\alpha\mathbf{a}^{\bullet}C\right) \geqslant 0.$$

Def. 1.4.3: A set $\mathfrak{R}$ of recorders is an internally stationary system for a recorder **a** with a *κ*-clock $\widetilde{\boldsymbol{H}}$ (design.: $\mathfrak{R}$ is *ISS*(**a**, $\widetilde{\boldsymbol{H}}$) if for all sentences *B* and *C*, for all elements $\mathbf{a}_1$ and $\mathbf{a}_2$ of set $\mathfrak{R}$, and for all paths α, made of elements of set $\mathfrak{R}$, the following conditions are satisfied:

1) $$\left[\mathbf{a}^{\bullet}\mathbf{a}_2^{\bullet}\mathbf{a}_1^{\bullet}C \uparrow \mathbf{a}, \widetilde{H}\right] - \left[\mathbf{a}^{\bullet}\mathbf{a}_1^{\bullet}C \uparrow \mathbf{a}, \widetilde{H}\right] = \\ = \left[\mathbf{a}^{\bullet}\mathbf{a}_2^{\bullet}\mathbf{a}_1^{\bullet}B \uparrow \mathbf{a}, \widetilde{H}\right] - \left[\mathbf{a}^{\bullet}\mathbf{a}_1^{\bullet}B \uparrow \mathbf{a}, \widetilde{H}\right];$$

2) $$\mathfrak{m}\left(\mathbf{a}\widetilde{H}\right)\left(\mathbf{a}^{\bullet}\alpha\mathbf{a}^{\bullet}C\right) = \mathfrak{m}\left(\mathbf{a}\widetilde{H}\right)\left(\mathbf{a}^{\bullet}\alpha^{\dagger}\mathbf{a}^{\bullet}C\right).$$

Th. 1.4.2:

$$\{\mathbf{a}\} - ISS\left(\mathbf{a}, \widetilde{H}\right).$$

Def. 1.4.4: A number *l* is called an **a** $\widetilde{\boldsymbol{H}}$ (*B*)-*measure of recorders* $\mathbf{a}_1$ and $\mathbf{a}_2$, design.:

$$l = \ell\left(\mathbf{a}, \widetilde{H}, B\right)(\mathbf{a}_1, \mathbf{a}_2)$$

Th. 1.4.3: If

$$\{\mathbf{a}, \mathbf{a}_1, \mathbf{a}_2, \mathbf{a}_3\} \text{ is } ISS\left(\mathbf{a}, \widetilde{H}\right)$$

then

$$1)\ \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_2) \geqslant 0;$$

$$2)\ \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_1) = 0;$$

$$3)\ \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_2) = \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_2, \mathbf{a}_1);$$

$$4)\ \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_2) + \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_2, \mathbf{a}_3) \geqslant \ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_3).$$

Thus, all four axioms of the metrical space are accomplished for $\ell(\mathbf{a}, \widetilde{\boldsymbol{H}})$ in an internally stationary system internally stationary system of recorders.
Consequently, $\ell(\mathbf{a}, \widetilde{\boldsymbol{H}})$ is a distance length similitude in this space.

Def. 1.4.6: *B* took place in the same place as $\mathbf{a}_1$ for **a** (design.: $\natural$ (**a**) ($\mathbf{a}_1$, *B*)) if for every sequence α and for any sentence *K* the following condition is satisfied: if $\mathbf{a}^{\bullet}K$ then $a^{\bullet}(K\&(\alpha B \Rightarrow \alpha \mathbf{a}_1^{\bullet} B)$.

Th. 1.4.4:

$$\natural(\mathbf{a})\left(\mathbf{a}_1, \mathbf{a}_1^{\bullet} B\right).$$

Th. 1.4.5: If

$$\natural(\mathbf{a})(\mathbf{a}_1, B), \quad (1)$$

$$\natural(\mathbf{a})(\mathbf{a}_2, B), \quad (2)$$

then

$$\natural(\mathbf{a})\left(\mathbf{a}_2, \mathbf{a}_1^{\bullet} B\right).$$

Th. 1.4.6: If

$$\{\mathbf{a}, \mathbf{a}_1, \mathbf{a}_2\} \text{ is } ISS\left(\mathbf{a}, \widetilde{H}\right),$$

$$\natural(\mathbf{a})(\mathbf{a}_1, B), \quad (3)$$

$$\natural(\mathbf{a})(\mathbf{a}_2, B), \quad (4)$$

then

$$\ell\left(\mathbf{a},\widetilde{H}\right)(\mathbf{a}_1,\mathbf{a}_2)=0.$$

Th. 1.4.7: If {$\mathbf{a}_1$, $\mathbf{a}_2$, $\mathbf{a}_3$} is *ISS*(**a**, $\widetilde{\boldsymbol{H}}$) and there exists sentence *B* such that

$$\natural(\mathbf{a})(\mathbf{a}_1,B), \tag{5}$$

$$\natural(\mathbf{a})(\mathbf{a}_2,B), \tag{6}$$

then

$$\ell\left(\mathbf{a},\widetilde{H}\right)(\mathbf{a}_3,\mathbf{a}_2)=\ell\left(\mathbf{a},\widetilde{H}\right)(\mathbf{a}_3,\mathbf{a}_1).$$

Def. 1.4.7: A real number *t* is an *instant of a sentence B* in frame of reference $\mathcal{R}\mathbf{a}\widetilde{\boldsymbol{H}}$, design

$$t=\left[B\mid\mathfrak{R}\mathbf{a}\widetilde{H}\right],$$

2.4. *Relativity*

Def. 1.5.1: Recorders $\mathbf{a}_1$ and $\mathbf{a}_2$ equally receive a signal about *B* for a recorder **a** if

$$\ll\natural(\mathbf{a})\left(\mathbf{a}_2,\mathbf{a}_1^{\bullet}B\right)\gg=\ll\natural(\mathbf{a})\left(\mathbf{a}_1,\mathbf{a}_2^{\bullet}B\right)\gg.$$

Def. 1.5.2: Set of recorders are called a *homogeneous space* of recorders, if all its elements equally receive all signals.

Def. 1.5.3: A real number *c* is an *information velocity* about *B* to the recorder $\mathbf{a}_1$ in a frame of reference $\mathcal{R}\mathbf{a}\widetilde{\boldsymbol{H}}$

$$c = \frac{\ell\left(\mathfrak{R}\mathbf{a}\widetilde{H}\right)\left(B, \mathbf{a}_1^\bullet B\right)}{\left[\mathbf{a}_1^\bullet B \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right] - \left[B \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right]}.$$

Th. 1.5.1: In all homogeneous spaces: c = 1.

That is in every homogenous space a propagation velocity of every information to every recorder for every frame reference equals to 1.

Th. 1.5.2: If $\mathcal{R}$ is a homogeneous space, then

$$\left[\mathbf{a}_1^\bullet B \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right] \geqslant \left[B \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right].$$

Consequently, in any homogeneous space any recorder finds out that *B* “took place” not earlier than *B* “actually take *place”. “Time” is irreversible.*

Th. 1.5.3: If $\mathbf{a}_1$ and $\mathbf{a}_2$ are elements of $\mathcal{R}$

$$\mathfrak{R} isISS\left(\mathbf{a}, \widetilde{H}\right),$$
$$p := \left[\mathbf{a}_1^\bullet B \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right],$$
$$q := \left[\mathbf{a}_2^\bullet \mathbf{a}_1^\bullet B \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right],$$
$$z := \ell\left(\mathfrak{R}\mathbf{a}\widetilde{H}\right)(\mathbf{a}_1, \mathbf{a}_2),$$

then z = q − p.

According to Urysohn’s[3] theorem [5]: any homogeneous space is homeomorphicto some set of points of real Hilbert space. If this homeomorphismis not Identical transformation,then $\mathcal{R}$ will represent a non- Euclidean

[3] **Pavel Samuilovich Urysohn** (Па́вел Самуи́лович Урысо́н) (February 3, 1898 – August 17, 1924) was a Soviet mathematician who is best known for his contributions in dimension theory, and for developing Urysohn's metrization theorem and Urysohn's lemma both of which are fundamental results in topology.

space. In this case in this "space-time" corresponding variant of General Relativity Theory can be constructed. Otherwise, $\mathcal{R}$ is Euclidean space. In this case there exists coordinates system Rμ such that the following condition is satisfied: for all elements $\mathbf{a}_1$ and $\mathbf{a}_2$ of set $\mathcal{R}$ there exist points $\mathbf{x}_1$ and $\mathbf{x}_2$ of system R^μ such that

$$\ell\left(\mathbf{a}, \widetilde{H}\right)(\mathbf{a}_k, \mathbf{a}_s) = \left(\sum_{j=1}^{\mu} \left(x_{s,j} - x_{k,j}\right)^2\right)^{0.5}.$$

In this case R^μ is called a *coordinates system* of frame of reference $\mathcal{R}\mathbf{a}\widetilde{H}$ and numbers $\langle x_{k,1}, x_{k,2}, \ldots, x_{k,\mu}\rangle$ are called *coordinates of recorder* $\mathbf{a}_k$ in R^μ.
A coordinates system of a frame of reference is specified accurate to transformations of shear, turn, and inversion.

Def. 1.5.4: Numbers $\langle x_1, x_2, \ldots, x_\mu\rangle$ are called *coordinates* of *B* in a coordinate system R^μ of a frame of reference $\mathcal{R}\mathbf{a}\widetilde{H}$ if there exists a recorder **b** such that

$$\mathbf{b} \in \mathfrak{R}, \natural(\mathbf{a})(\mathbf{b}, B)$$

and these numbers are the coordinates in R_μ of this recorder. μ

Th. 1.5.4: In a coordinate system R^μ of a frame of reference are called *coordinates* of *B* in a coordinate system R^μ of a frame of reference $\mathcal{R}\mathbf{a}\widetilde{H}$: if *z* is a distance length between *B* and *C*, coordinates of *B* are (b_1, b_2,… *b*μ), coordinates of *C* are (c_1, c_2,… *c*μ) then

$$z = \left(\sum_{j=1}^{\mu}\left(c_j - b_j\right)^2\right)^{0.5}.$$

Def. 1.5.5: Numbers $(x_1, x_2, \ldots, x_\mu)$ are called *coordinates of the recorder* **b** in the coordinate system R^μ at the instant *t* of the frame of reference $\mathcal{R}\mathbf{a}\widetilde{H}$ if for every *B* thecondition is satisfied: if

$$t = \left[\mathbf{b}^\bullet B \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right]$$

then coordinates of $\ll \mathbf{b}^\bullet B \gg$

in coordinate system R^μ offrame of reference $\mathcal{R}\mathbf{a}\widetilde{H}$ are the following: $(x_1, x_2, \ldots, x_\mu)$.

.

Let v be the real number such that $|v| < 1$.

Th. 1.5.5: In a coordinates system R^μ of a frame of reference $\mathcal{R}\mathbf{a}\widetilde{H}$: if in every instant t: coordinates of:

$$\mathbf{b} : \left\langle x_{\mathbf{b},1} + v \cdot t, x_{\mathbf{b},2}, x_{\mathbf{b},3}, \ldots, x_{\mathbf{b},\mu} \right\rangle,$$
$$\mathbf{g}_0 : \left\langle x_{0,1} + v \cdot t, x_{0,2}, x_{0,3}, \ldots, x_{0,\mu} \right\rangle,$$
$$\mathbf{b}_0 : \left\langle x_{0,1} + v \cdot t, x_{0,2} + l, x_{0,3}, \ldots, x_{0,\mu} \right\rangle,$$

and

$$t_C = \left[\mathbf{b}^\bullet C \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right],$$
$$t_D = \left[\mathbf{b}^\bullet D \mid \mathfrak{R}\mathbf{a}\widetilde{H}\right],$$
$$q_C = \left[\mathbf{b}^\bullet C \uparrow \mathbf{b}, \{\mathbf{g}_0, A, \mathbf{b}_0\}\right],$$
$$q_D = \left[\mathbf{b}^\bullet D \uparrow \mathbf{b}, \{\mathbf{g}_0, A, \mathbf{b}_0\}\right],$$

then

$$\lim_{l \to 0} 2 \cdot \frac{l}{\sqrt{(1 - v^2)}} \cdot \frac{q_D - q_C}{t_D - t_C} = 1.$$

Consequently, moving at speed v κ-clock are times slowerthan the one at rest.

Th. 1.5.6: Let: v ($|v| < 1$) and l be real numbers and k_i be natural ones.
Let in a coordinates system R^μ of a frame of reference $\mathcal{R}\mathbf{a}\widetilde{H}$: in each instant t coordinates of

$$\mathbf{b} : \left\langle x_{b,1} + v \cdot t, x_{b,2}, x_{b,3}, \ldots, x_{b,\mu} \right\rangle,$$

$$\mathbf{g}_j : \left\langle y_{j,1} + v \cdot t, y_{j,2}, y_{j,3}, \ldots, y_{j,\mu} \right\rangle,$$

$$\mathbf{u}_j : \left\langle y_{j,1} + v \cdot t, y_{j,2} + l/\left(k_1 \cdot \ldots \cdot k_j\right), y_{j,3}, \ldots, y_{j,\mu} \right\rangle,$$

for all

$$\mathbf{b}_i\text{: if } \mathbf{b}_i \in \Im,$$

then coordinates

$$\mathbf{b}_i : \left\langle x_{i,1} + v \cdot t, x_{i,2}, x_{i,3}, \ldots, x_{i,\mu} \right\rangle,$$

$$\widetilde{T} \text{ is } \left\langle \{\mathbf{g}_1, A, \mathbf{u}_1\},\ \{\mathbf{g}_2, A, \mathbf{u}_2\}, \ldots, \left\{\mathbf{g}_j, A, \mathbf{u}_j\right\}, \ldots \right\rangle.$$

In that case: $\mathcal{I}$ is *ISS*(**b**, $\tilde{T}$)

Therefore, a inner stability survives on a uniform straight line motion.

Th. 1.5.7: Let:

1) in a coordinates system R^{μ} of a frame of reference $\mathcal{R}\mathbf{a}\widetilde{\boldsymbol{H}}$ in every instant *t*:

$$\mathbf{b} : \left\langle x_{\mathbf{b},1} + v \cdot t, x_{\mathbf{b},2}, x_{\mathbf{b},3}, \ldots, x_{\mathbf{b},\mu} \right\rangle,$$

$$\mathbf{g}_j : \left\langle y_{j,1} + v \cdot t, y_{j,2}, y_{j,3}, \ldots, y_{j,\mu} \right\rangle,$$

$$\mathbf{u}_j : \left\langle y_{j,1} + v \cdot t, y_{j,2} + l/\left(k_1 \cdot \ldots \cdot k_j\right), y_{j,3}, \ldots, y_{j,\mu} \right\rangle,$$

for every recorder $\mathbf{q}_i$: if $\mathbf{q}_{i\,i} \in \mathcal{I}$ then coordinates of

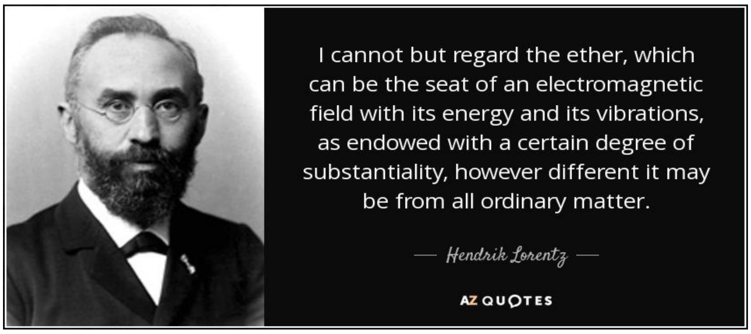
$$\mathbf{q}_i : \left\langle x_{i,1} + v \cdot t, x_{i,2}, x_{i,3}, \ldots, x_{i,\mu} \right\rangle,$$

$$\widetilde{T} \text{ is } \left\langle \{\mathbf{g}_1, A, \mathbf{u}_1\},\ \{\mathbf{g}_2, A, \mathbf{u}_2\}, \ldots, \left\{\mathbf{g}_j, A, \mathbf{u}_j\right\},\ \ldots \right\rangle,$$

$$
\begin{aligned}
&C : \left\langle C_1, C_2, C_3, \ldots, C_\mu \right\rangle, \\
&D : \left\langle D_1, D_2, D_3, \ldots, D_\mu \right\rangle, \\
&t_C = \left[C \mid \mathfrak{R}\mathbf{a}\widetilde{H} \right], \\
&t_D = \left[D \mid \mathfrak{R}\mathbf{a}\widetilde{H} \right];
\end{aligned}
$$

2) in a coordinates system $R^{\mu\prime}$ of a frame reference ($\mathscr{I}\,\mathbf{b}\tilde{T}$):

$$
\begin{aligned}
&C : \left\langle C'_1, C'_2, C'_3, \ldots, C'_\mu \right\rangle, \\
&D : \left\langle D'_1, D'_2, D'_3, \ldots, D'_\mu \right\rangle, \\
&t'_C = \left[C \mid \mathfrak{I}\mathbf{b}\widetilde{T} \right], \\
&t'_D = \left[D \mid \mathfrak{I}\mathbf{b}\widetilde{T} \right].
\end{aligned}
$$



In that case

$$
\begin{aligned}
t'_D - t'_C &= \frac{(t_D - t_C) - v\,(D_1 - C_1)}{\sqrt{1 - v^2}}, \\
D'_1 - C'_1 &= \frac{(D_1 - C_1) - v\,(t_D - t_C)}{\sqrt{1 - v^2}}.
\end{aligned}
$$

This is the Lorentz[4] spatial-temporal transformation.

Thus, if you have some set of objects, dealing with information, then “time” and “space” are inevitable. And it doesn’t matter whether this set is part our world or some other worlds, which don’t have a space-time structure initially.

[4] **Hendrik Antoon Lorentz** (18 July 1853 – 4 February 1928) was a Dutch physicist who shared the 1902 Nobel Prize

I call such “Time” the *Informational Time*. Since, we get our time together with our information system all other notions of time (thermodynamical time, cosmological time, psychological time, quantum time etc.) should be defined by that Informational Time

2.5. Matricies


Wolfgang Pauli

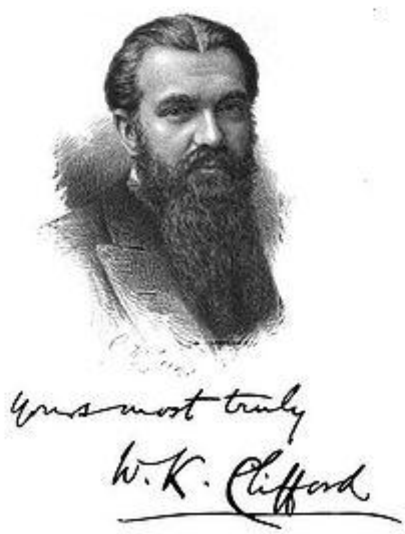
Let 1_n be an identical 4×4 matrix and 0_n is a 4×4 zero matrix.

$$1_2 := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, 0_2 := \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}, \beta^{[0]} := -\begin{bmatrix} 1_2 & 0_2 \\ 0_2 & 1_2 \end{bmatrix} = -1_4,$$

The Pauli[5] matrices:

$$\sigma_1 := \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}, \sigma_2 := \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}, \sigma_3 := \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}.$$

A set $\overline{C}$ of complex *n* x *n* matrices is called *a Clifford set of rank n* if the following conditions are fulfilled:



$$\begin{aligned} &if\ \alpha_k \in \overline{C}, \alpha_s \in \overline{C}\quad t\\ &if\ \alpha_k\alpha_s + \alpha_s\alpha_k = 2\\ &\text{for all elements}\,\alpha_s\end{aligned}$$

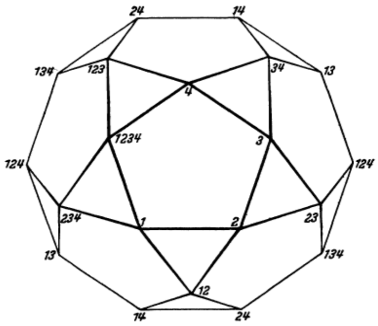


Abb. 1. Cliffordsche Zahlen.

If *n* = 4 then a Clifford[6] set either contains 3 matrices (*a Clifford triplet*) or contains 5 matrices (*a Clifford pentad*) [6].

Here exist only six Clifford pentads:

---

[5] **Wolfgang Ernst Pauli** (German: 25 April 1900 – 15 December 1958) was an Austrian theoretical physicit

[6] **William Kingdon Clifford** (4 May 1845 – 3 March 1879) was an English mathematician and philosopher.

one *light pentad β:*

$$\beta^{[k]} := \begin{bmatrix} \sigma_k & 0_2 \\ 0_2 & -\sigma_k \end{bmatrix} \; for\; k \in \{1,2,3\};$$

$$\gamma^{[0]} := \begin{bmatrix} 0_2 & 1_2 \\ 1_2 & 0_2 \end{bmatrix}, \beta^{[4]} := i \times \begin{bmatrix} 0_2 & 1_2 \\ -1_2 & 0_2 \end{bmatrix}.$$

three *chromatic pentads:*

the red pentad ζ:

$$\zeta^{[1]} := \begin{bmatrix} -\sigma_1 & 0_2 \\ 0_2 & \sigma_1 \end{bmatrix}, \zeta^{[2]} := \begin{bmatrix} \sigma_2 & 0_2 \\ 0_2 & \sigma_2 \end{bmatrix}, \zeta^{[3]} := \begin{bmatrix} -\sigma_3 & 0_2 \\ 0_2 & -\sigma_3 \end{bmatrix},$$

$$\gamma_\zeta{}^{[0]} := \begin{bmatrix} 0_2 & -\sigma_1 \\ -\sigma_1 & 0_2 \end{bmatrix}, \zeta^{[4]} := i \times \begin{bmatrix} 0_2 & \sigma_1 \\ -\sigma_1 & 0_2 \end{bmatrix};$$

the green pentad :

$$\eta^{[1]} := \begin{bmatrix} -\sigma_1 & 0_2 \\ 0_2 & -\sigma_1 \end{bmatrix}, \eta^{[2]} := \begin{bmatrix} -\sigma_2 & 0_2 \\ 0_2 & \sigma_2 \end{bmatrix}, \eta^{[3]} := \begin{bmatrix} \sigma_3 & 0_2 \\ 0_2 & \sigma_3 \end{bmatrix},$$

$$\gamma_\eta{}^{[0]} := \begin{bmatrix} 0_2 & -\sigma_2 \\ -\sigma_2 & 0_2 \end{bmatrix}, \eta^{[4]} := i \times \begin{bmatrix} 0_2 & \sigma_2 \\ -\sigma_2 & 0_2 \end{bmatrix};$$

$$\theta^{[1]} := \begin{bmatrix} \sigma_1 & 0_2 \\ 0_2 & \sigma_1 \end{bmatrix}, \theta^{[2]} := \begin{bmatrix} -\sigma_2 & 0_2 \\ 0_2 & -\sigma_2 \end{bmatrix}, \theta^{[3]} := \begin{bmatrix} -\sigma_3 & 0_2 \\ 0_2 & \sigma_3 \end{bmatrix},$$

the blue pentad Θ :

$$\gamma_\theta{}^{[0]} := \begin{bmatrix} 0_2 & -\sigma_3 \\ -\sigma_3 & 0_2 \end{bmatrix}, \theta^{[4]} := i \times \begin{bmatrix} 0_2 & \sigma_3 \\ -\sigma_3 & 0_2 \end{bmatrix};$$

two *gustatory pentads:*

the sweet pentad $\underline{\Delta}$:

$$\underline{\Delta}^{[1]} := \begin{bmatrix} 0_2 & -\sigma_1 \\ -\sigma_1 & 0_2 \end{bmatrix}, \underline{\Delta}^{[2]} := \begin{bmatrix} 0_2 & -\sigma_2 \\ -\sigma_2 & 0_2 \end{bmatrix}, \underline{\Delta}^{[3]} := \begin{bmatrix} 0_2 & -\sigma_3 \\ -\sigma_3 & 0_2 \end{bmatrix},$$

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

the bitter pentad Γ :

$$\underline{\Gamma}^{[1]} := i\begin{bmatrix} 0_2 & -\sigma_1 \\ \sigma_1 & 0_2 \end{bmatrix}, \underline{\Gamma}^{[2]} := i\begin{bmatrix} 0_2 & -\sigma_2 \\ \sigma_2 & 0_2 \end{bmatrix}, \underline{\Gamma}^{[3]} := i\begin{bmatrix} 0_2 & -\sigma_3 \\ \sigma_3 & 0_2 \end{bmatrix}, -$$

$$\underline{\Gamma}^{[0]} := \begin{bmatrix} -1_2 & 0_2 \\ 0_2 & 1_2 \end{bmatrix}, \underline{\Gamma}^{[4]} := \begin{bmatrix} 0_2 & 1_2 \\ 1_2 & 0_2 \end{bmatrix};$$

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

Let us consider an information space-time [1. Pp.19—52] encrypted into a Cartesian[7] coordinates system [1, pp.37,38]:

In this space-time an event *B* which is placed into coordinates point (t, **x**) is called the *dot event* $B(t, \mathbf{x})$ (here:

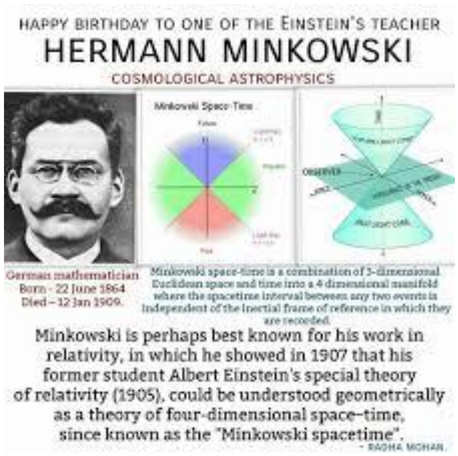
$$\mathbf{x} := (x_1; x_2; x_3),$$
$$x := (x_0; \mathbf{x})$$
$$t := x_0/c, \ (c = 299{,}792{,}458)$$

All dot events are *physics events* and all events which are received from physics events by operators "+", "·", or "┐" are *physics events*, too.

Let (t_A, $\mathbf{x}_A$) be coordinates of event *A* and (t_B, $\mathbf{x}_B$) be coordinates of event *B*.
In rhis case if

$$m(A; B\} = (t_B - t_A)^2 - (x_{B,1} - x_{A,1})^2 - (x_{B,2} - x_{A,2})^2 - (x_{B,3} - x_{A,3})^2$$

then m(*A*; *B*} is called *the Minkovski[8] interval* between events *A* and *B* [1, p.36].



A Minkovski interval is invariant under *the Cartesian transformation*:

[7] **René Descartes** March 1596 – 11 February 1650) was a French philosopher, mathematician, and scientist .

[8] **Hermann Minkowski** 22 June 1864 – 12 January 1909) was a German mathematician and professor at Königsberg, Zürich and Göttingen.

$x_k^{'} \to x_k \cdot \cos\alpha - x_j \sin\alpha,$
$x_j^{'} \to x_j \cdot \cos\alpha + x_k \sin\alpha$ $\quad for\, k \neq 0 \neq j.$ (a turnabout of the coordinates system for angle α)

And a Minkovski interval is invariant under *the Lorentz transformation* [1. p.52]:

$x_0^{'} \to x_0 \cdot \cosh\lambda - x_k \cdot \sinh\lambda, \quad x_k^{'} \to x_k \cdot \cosh\lambda - x_0 \cdot \sinh\lambda,$

Here:

$\cosh\lambda = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}, \ \sinh\lambda = \frac{\frac{v}{c}}{\sqrt{1-\frac{v^2}{c^2}}}$. (*v* is a velocity of the coordinates system).

If

$$\hat{C}(x) := \sum_{j=0}^{3} x_j \beta^{[j]} = \begin{bmatrix} x_0 + x_3 & x_1 - ix_2 & 0 & 0 \\ x_1 + ix_2 & x_0 - x_3 & 0 & 0 \\ 0 & 0 & x_0 - x_3 & -x_1 + ix_2 \\ 0 & 0 & -x_1 - ix_2 & x_0 + x_3 \end{bmatrix}$$

Then $\hat{C}(x)$ is the *clift* of the point ***x***.

Let. $U_{1,2} = \cos\lambda \cdot 1_4 + \sin\lambda \cdot \beta^{[1]} \cdot \beta^{[2]}$

That is:

$$U_{1,2} := \cos\lambda + \sin\lambda \cdot \begin{bmatrix} e^{-i\lambda} & 0 & 0 & 0 \\ 0 & e^{i\lambda} & 0 & 0 \\ 0 & 0 & e^{-i\lambda} & 0 \\ 0 & 0 & 0 & e^{i\lambda} \end{bmatrix}$$

.†

In this case:

$$U_{1,2}^{\dagger} \hat{C} U_{1,2} = \begin{bmatrix} x_0 + x_3 & x_1' - ix_2' & 0 & 0 \\ x_1' + ix_2' & x_0 - x_3 & 0 & 0 \\ 0 & 0 & x_0 - x_3 & -x_1' + ix_2' \\ 0 & 0 & -x_1' - ix_2' & x_0 + x_3 \end{bmatrix} /$$

Here:

$$x_1' = x_1 \cos 2\lambda + x_2 \sin 2\lambda;$$
$$x_2' = x_2 \cos 2\lambda - x_1 \sin 2\lambda.$$

Therefore, $U_{1,2}$ rotates of the coordinates system in the plane x_1Ox_2 on an angle 2λ.

Similar, $U_{2,3} = \cos\lambda \cdot 1_4 + \sin\lambda \cdot \beta^{[2]} \cdot \beta^{[3]}$ ($U_{2,3} = \begin{bmatrix} \cos\lambda & i\sin\lambda & 0 & 0 \\ i\sin\lambda & \cos\lambda & 0 & 0 \\ 0 & 0 & \cos\lambda & i\sin\lambda \\ 0 & 0 & i\sin\lambda & \cos\lambda \end{bmatrix}$).

$U_{2,3}$ rotates of the coordinates system in the plane x_2Ox_3 on an angle 2λ. And

$$U_{1,3} = \cos\lambda \cdot 1_4 + \sin\lambda \cdot \beta^{[1]} \cdot \beta^{[3]} \quad (U_{1,3} = \begin{bmatrix} \cos\lambda & -\sin\lambda & 0 & 0 \\ \cos\lambda & \cos\lambda & 0 & 0 \\ 0 & 0 & \cos\lambda & -\cos\lambda \\ 0 & 0 & \cos\lambda & \cos\lambda \end{bmatrix})$$

$U_{1,3}$ rotates of the coordinates system in the plane x_1Ox_3 on an angle 2λ.

Hence, $U_{1,2}$, $U_{2,3}$, $U_{1,3}$ correspond to all Cartesian rotations.

Let $U_{0,1} := \cosh\lambda \cdot 1_4 + \sinh\lambda \cdot \beta^{[0]} \cdot \beta^{[1]}$.
In that case:

$$U_{0.1}^{\dagger}\hat{C}U_{0,1} = \begin{bmatrix} x_0'+x_3 & x_1'-ix_2 & 0 & 0 \\ x_1'+ix_2 & x_0'-x_3 & 0 & 0 \\ 0 & 0 & x_0'-x_3 & -x_1'+ix_2 \\ 0 & 0 & -x_1'-ix_2 & x_0'+x_3 \end{bmatrix}.$$

Here: $x_0' = x_0\cosh\lambda - x_1\cosh\lambda$; $x_1' = x_1\cosh\lambda - x_0\cosh\lambda$.

Therefore, $U_{0,1}$ moves the coordinates system on the direction Ox_1 with velocity v = c·tanh λ.

Similar,

$$U_{0,2} := \cosh\lambda \cdot 1_4 + \sinh\lambda \cdot \beta^{[0]} \cdot \beta^{[2]}; \ (U_{0,2} = \begin{bmatrix} \cosh\lambda & i\sin\lambda & 0 & 0 \\ -i\sin\lambda & \cosh\lambda & 0 & 0 \\ 0 & 0 & \cosh\lambda & -i\sin\lambda \\ 0 & 0 & i\sin\lambda & \cosh\lambda \end{bmatrix}).$$

That is , $U_{0,2}$ moves the coordinates system on the direction Ox_2 with velocity v = c·tanh λ.

And let

$$U_{0,3} := \cosh\lambda \cdot 1_4 + \sinh\lambda \cdot \beta^{[0]} \cdot \beta^{[3]}; \ (U_{0,3} = \begin{bmatrix} e^{-\lambda} & 8 & 0 & 0 \\ 0 & e^{\lambda} & 0 & 0 \\ 0 & 0 & e^{-\lambda} & 0 \\ 0 & 0 & 0 & e^{\lambda} \end{bmatrix}).$$

$U_{0,3}$ moves the coordinates system on the direction Ox_3 with velocity v = c·tanh λ.

Therefore, $U_{0,1}$, $U_{0,1}$, $U_{0,1}$ are correspond to all 3 Lorentz transformations. And

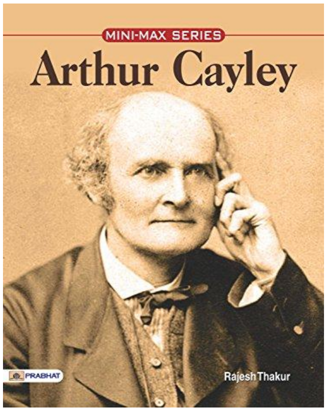
$U_{0,1}$, $U_{0,1}$, $U_{0,1}$, $U_{1,2}$, $U_{2,3}$, $U_{1,3}$ correspond to the Poincare transformations.

Two more matrices exist here. which do not change the clift

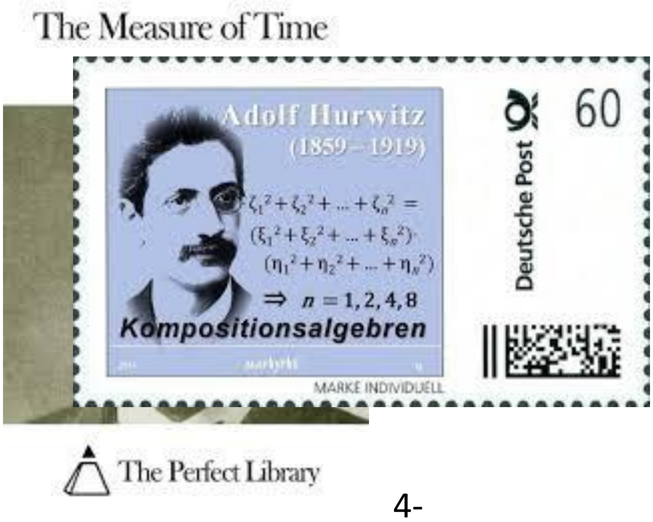
$$\tilde{U} := \begin{bmatrix} e^{i\lambda} & 0 & 0 & 0 \\ 0 & e^{i\lambda} & 0 & 0 \\ 0 & 0 & e^{i2\lambda} & 0 \\ 0 & 0 & 0 & e^{i2\lambda} \end{bmatrix} \text{ and } \hat{U} := \begin{bmatrix} e^{\lambda} & 0 & 0 & 0 \\ 0 & e^{\lambda} & 0 & 0 \\ 0 & 0 & e^{2\lambda} & 0 \\ 0 & 0 & 0 & e^{2\lambda} \end{bmatrix}.\dagger$$

Here:

$\tilde{U}^{\dagger}\hat{C}\tilde{U} = \hat{C}$ and $\tilde{U}^{-1}\hat{C}\tilde{U} = \hat{C}$.



All this space-time structure can be formulated in terms of the theory of hypercomplex numbers [7]. The Cailey[9] and Hurwitz[10] theorems give the explanation of the dimensionality of our time-space [8].



4-

[9] **Arthur Cayley** 16 August 1821 – 26 January 1895) was a prolific British mathematician who worked mostly on algebra.

[10] **Adolf Hurwitz** (German: 26 March 1859 – 18 November 1919) was a German **mathematician** who worked on algebra, analysis, geometry and number theory.

3. Probability

Here we follow the ideas of Jaynes[11] that the notion of probability theory is extended logic [9]

There is the evident nigh affinity between the classical probability function and the Boolean function of the classical propositional logic [10]. These functions are differed by the range of value, only. That is if the range of values of the Booleanfunction shall be expanded from the two-elements set {0; 1} to the segment [0; 1] of the real numeric axis then the logical analog of the Bernoulli Large Number Law [11] can be deduced from the logical axioms..

3.1. *Propositional logic*

Def. 3: Sentences *A* and *B* are *equal* (*A* = *B*) if *A* is true if and only if *B* is true.

Def. 4: The sentence *C* is called *a conjunction* of sentences *A* and *B* (denote: *C* = (*A*&*B*)) if *C* is true, if and only if *A* is true and *B* is true. *A* and *B* are called *conjuncts* of this conjunction.

Def. 5: The sentence *C* is called *a negation* of sentences *A* (denote: *C* = (¬*A*)) if *C* is true, if and only if *A* is not true.

Let A_0 be a set of sentences each of which is either false or true. In this part only elements of A_0 are considered.

<u>Natural Propositional Logic</u>

1. Further I set out the version of the Gentzen[12] Natural Propositional calculus (NPC) [12]:

Expression «Sentence *C* is a logical consequence of the list of sentences Γ» will be written as the following: «Γ ⊢ *C*». Such expressions are called *sequences*. Elements of list Γ are called *hypothesizes*.

[11] **Edwin Thompson Jaynes** (July 5, 1922 – April 30, 1998) was the Wayman Crow Distinguished Professor of Physics at Washington University in St. Louis.

[12] **Gerhard Karl Erich Gentzen** (November 24, 1909 – August 4, 1945) was a German mathematician and logician. He made major contributions to the foundations of mathematics, proo theory, especially on natural deduction and sequent calculus. He died of starvation in a Soviet prison camp in Prague in 1945, having been interned as a German national after the Secon World War

Def. 6:

1) A sequence of the form $C \vdash C$ is called NPC-axiom.
2) A sequences of form $\Gamma \vdash A$ and $\Gamma \vdash B$ is obtained from a sequence of form $\Gamma \vdash (A\&B)$ by *the conjunction removing rule* (denote: R&).
3) A sequence of form $\Gamma_1,\Gamma_2 \vdash (A\&B)$ is obtained from a sequence of form $\Gamma_1 \vdash A$ and a sequence of form $\Gamma_2 \vdash B$ by *the conjunction inputting rule* (denote: I&).
4) A sequence of form $\Gamma \vdash C$ is obtained from a sequence of form $\Gamma \vdash (\neg (\neg C))$ by *the negation removing* rule (denote: R¬).
5) A sequence of form $\Gamma_1,\Gamma_2 \vdash (\neg C)$ is obtained from a sequence of form $\Gamma_1,C \vdash A$ and from a sequence of form $\Gamma_2,C \vdash (\neg A)$ by *the negation inputting rule* (denote: I¬).
6) A finite string of sequences is called *a propositional natural deduction* if every element of this string either is NPC axiom or is received from preceding sequences by one of the deduction rules (R&, I&, R¬, I¬).

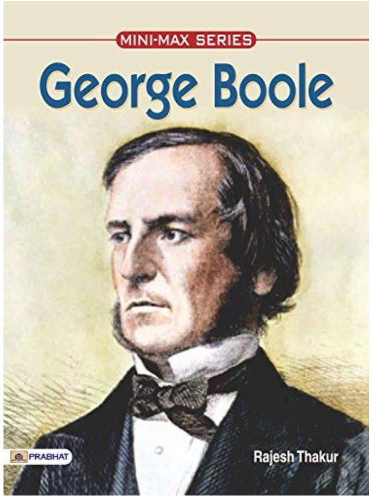
These logical rules look naturally in light of the previous definitions. Hence, if a sequence
$\Gamma \vdash A$ is contained in some natural propositional deduction, then sentence A follows logically from the list of hypotheses Γ.

Example 3:

1. $A \vdash A$, NPC-axiom;
2. $((\neg A)\&(\neg B)) \vdash ((\neg A)\&(\neg B))$, NPC-axiom;
3. $((\neg A)\&(\neg B)) \vdash (\neg A)$, R&, 2;
4. $A \vdash (\neg ((\neg A)\&(\neg B)))$, I¬, 1,3.

This string of sequences is a propositional natural deduction in accordance with point 6 of Def. 6 because every element of this string either is NPC axiom or is received from preceding sequences by one of the deduction rules (R&, I&, R¬, I¬). Since sequence $A \vdash (\neg$

- **Gerhard Karl Erich Gentzen** (November 24, 1909 – August 4, 1945) was a German mathematician and logician. He made major contributions to the foundations of mathematics, proof theory, especially on natural deduction and sequent calculus. He died in 1945 after the Second World War, because he was deprived of food after being arrested in Prague.



((¬*A*)&(¬*B*))) is contained in this deduction then sentence (¬ ((¬*A*)&(¬*B*))) follows logically from sentence *A*.

Example 4:

1. (*A*&(¬*A*)) ⊦ (*A*&(¬*A*)), NPC-axiom;
2. (*A*&(¬*A*)) ⊦ *A*, R&, 1;
3. (*A*&(¬*A*)) ⊦ (¬*A*), R&, 1;
4. ⊦ (¬ (*A*&(¬*A*))), I¬, 2,3.

This string is a propositional natural deduction, too. There sentence (¬ (*A*&(¬*A*))) follows logically from the empty list of hypothesizes. Such sentences are called *propositionally provable sentences.*

Boolean functions[13]

Def. 7: Let function g has the double-elements set {0; 1} as a range of reference and A_0 as a domain. And let

1) g(¬*A*) = 1 – g(*A*) for every sentence *A*;
2) g(*A*&*B*) = g(*A*) × g (*B*) for all sentences *A* and *B*;

In this case function g is *a Boolean function*.

Hence if g is a Boolean function then for every sentence *A*: $(g(A))^2 = g(A)$.

A Boolean function can be defined by the following table:

A	*B*	(¬*A*)	(*A*&*B*)
0	0	1	0
0	1	1	0
1	0	0	0
1	1	0	1

Such tables can be constructed for any sentence. For example:

A	*B*	*C*	(¬ ((¬(*A*&(¬*C*))) &((*A*&*B*) &(¬ *C*))))
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1

[13] **George Boole** ; 2 November 1815 – 8 December 1864) was a largely self-taught English mathematician, philosopher and logician, most of whose short career was spent as the first professor of mathematics at Queen' College, Cork in Ireland.

1	0	1	1
1	1	0	1
1	1	1	1

If g is a Boolean function then by Def.7:

$g(\neg\,((\neg(A\&(\neg C)))\,\&((A\&B)\,\&(\neg\,C)))) = 1 - g((\neg(A\&(\neg C)))\,\&((A\&B)\,\&(\neg\,C))) =$

$= 1 - g(\neg(A\&(\neg C)))\times g((A\&B)\,\&(\neg\,C)) = 1 - (1 - g(A\&(\neg C)))\times g(A\&B)\times g(\neg\,C) =$

$=1 - (1 - (g(A)\times g(\neg C)))\times g(A\&B)\times g(\neg\,C) =$

$=1 - (g(A\&B)\times g(\neg\,C) - g(A)\times g(\neg C)\times g(A\&B)\times g(\neg\,C)) =$

$=1 - (g(A\&B)\times g(\neg\,C) - g(A)\times g(A\&B)\times g(\neg\,C)) =$

$=1 - (\,g(A)\times g(B)\times g(\neg\,C) - g(A)\times\,g(A)\times g(B)\times g(\neg\,C)) =$

$=1 - (\,g(A)\times g(B)\times g(\neg\,C) - g(A)\,\times g(B)\times g(\neg\,C)) = 1.$

Therefore, for every Boolean function g:

$$g(\neg\,((\neg(A\&(\neg C)))\,\&((A\&B)\,\&(\neg\,C)))) = 1.$$

Such sentences are called *tautologies*.

Def. 8: A set $A_{0,0}$ of sentences is called *a basic set* if for every element A of $A_{0,0}$ there exist Boolean functions g_1 and g_2 such that the following conditions are fulfill:

1) $g_1\,(A) \neq g_2\,(A)$;
2) for every element B of set $A_{0,0}$: if $B \neq A$ then $g_1(B) = g_2(B)$.

Set $A_{0,0}$ does not contain conjunctions and negations of this set elements because if $(A\&B)\in A_{0,0}$, $A\in A_{0,0}$, and $B \in A_{0,0}$ then Boolean functions g_1 and g_2 exist such that

$g_1\,(A\&B) = 0$, $g_2\,(A\&B) = 1$,
$g_1\,(A) = g_2\,(A)$,
$g_1\,(B) = g_2\,(B)$.

But it is impossible. Similar argumentation is for and negations.

Def. 9: A set $[A_{0,0}]$ of sentences is called *a propositional closure* of the set $A_{0,0}$ if the following conditions are satisfied:

1) if $A\in A_{0,0}$ then $A\in [A_{0,0}]$;
2) if $A \in [A_{0,0}]$ then $(\neg A) \in [A_{0,0}]$;
3) if $A \in [A_{0,0}]$ and $B \in [A_{0,0}]$ then $(A\&B) \in [A_{0,0}]$;

4) there are no other elements of the set $[A_{0,0}]$ except the enumerated above.

Henceforth, $[A_{0,0}] = A_0$.

Th. 1: Each naturally propositionally proven sentence is a tautology[14].

Th. 2 (Laszlo Kalmar):[4] Each tautology is a naturally propositionally proven sentence.

Consequently, whole propositional logic is defined by a Boolean function.

Th. 3: Each naturally propositionally proven sentence is a true sentence.

Th. 4: Each tautology is the true sentence.

Probability

Further we consider set A (the set of all sensible sentences).

3.2. *Events*

Def. 10: A set B of sentences is called *event, expressed by sentence C*, if the following conditions are fulfilled:

$C \in$ B;
if $A \in$ B and $D \in$ B then $A = D$;
if $D \in$ B and $A = D$ then $A \in$ B.

In this case denote: B := $^\circ C$.

Def. 11: An event B *occurs* if here exists a true sentence A such that $A \in$ B.

Def. 12: Events A and B *equal* (denote: A = B) if A occurs if and only if B occurs.

Def. 13: Event C is called *product* of event A and event B (denote: C = (A· B)) if C occurs if and only if A occurs and B occurs.

[14] Please see the proofs in Appendix

Def. 14: Events C is called *complement* of event A (denote: C = (#A)) if C occurs if and only if A does not occur.

Def. 15: (A+B):= (#((#A)·(#B))). Event (A+ B) is called *sum* of event A and event B.

Therefore, the sum of event occurs if and only if there is at least one of the addends.

Def. 16: *The persistent event* (denote: T) is the event which contains a tautology.

Hence, T occurs by Th.4.

Def. 17: *The impossible event* (denote: F) is event which contains negation of a tautology.

Hence, F does not occur by Th.4, too.

3.3. *B-functions*

Def. 18: Let b(X) be any function defined on the set of events.

And let the real numbers segment [0; 1] is this function frame reference.

Let there exists an event C_0 such that $b(C_0) = 1$.

Let for all events *A* and *B*:

$$b(A\cdot B)+b(A\cdot(\#B)) = b(A).$$

In that case function b(X) is called *a B-function*.

By this definition:

$$b(A\cdot B) \leq b(A). \tag{p1}$$

Hence, $b(T\cdot C_0) \leq b(T)$. Because $T\cdot C_0 = C_0$ (by Def.13 and Def.16) then $b(C_0) \leq b(T)$. Because $b(C_0) = 1$ then

$$b(T) = 1. \tag{p2}$$

From Def.18: b(T·B)+b(T·(#B)) = b(T). Because T·D = D for any D by Def.13 and Def.16 then b(B)+b (#B) = b(T). Hence, by (p2): for any B:

$$b(B)+b\ (\#B)=1. \qquad (p3)$$

Therefore, b(T)+b (#T) =1. Hence, in accordance (p2) and in accordance Def.14, Def.16, and Def.17 : 1+b (F) =1. Therefore,

$$b\ (F) = 0. \qquad (p4)$$

In accordance with Def.18, Def.15, and (p3):

$b(A\cdot(B+C)) = b(A\cdot(\#((\#B)\cdot(\#C)))) = b(A) - b(A\cdot((\#B)\cdot(\#C))) = b(A) - b((\#C)\cdot((\#B)\cdot A)) =$

$= b(A) - (((\#B)\cdot A) - b(C\cdot((\#B)\cdot A))) = b(A) - ((\#B)\cdot A) + b(C\cdot((\#B)\cdot A)) =$

$= b(A\cdot B) + (A\cdot C) - b(A\cdot B\cdot C)).$

And

$b((A\cdot B)+(A\cdot C)) = b(\#((\#(A\cdot B))\cdot(\#(A\cdot C)))) = 1- b((\#(A\cdot B))\cdot(\#(A\cdot C))) =$

$= 1- (1-b(A\cdot B)) + (b(A\cdot C) - b(A\cdot B\cdot A\cdot C)) = b(A\cdot B)) + b(A\cdot C) - b(A\cdot B\cdot A\cdot C) =$

$= b(A\cdot B)) + b(A\cdot C) - b(A\cdot B\cdot C)$

because A·A = A in accordance with Def.13.

Therefore:

$$b(A\cdot(B+C)) = b(A\cdot B) + (A\cdot C) - b(A\cdot B\cdot C)) \qquad (p5)$$

and

$$b((A\cdot B)+(A\cdot C)) = b(A\cdot B)) + b(A\cdot C) - b(A\cdot B\cdot C). \qquad (p6)$$

Hence (distributivity):

$$b(A\cdot(B+C)) = b((A\cdot B)+(A\cdot C)). \qquad (p7)$$

If A = T then from (p5) and (p6) (*the addition formula of probabilities*):

$$b(B+C) = b(B) + b(C) - b(B\cdot C). \qquad (p8)$$

Def. 19: Events B and C are *antithetical* events if (B· C) = F.

From (p8) and (p4) for antithetical events B and C:

$$b(B+C) = b(B) + b(C). \quad (p9)$$

Def. 20: Events B and C are *independent for B-function* b events if b(B·C)= b(B)·b(B).

If events B and C are independent for B-function b events then:

$$b(B\cdot(\#C)) = b(B) – b(B\cdot C) = b(B) – b(B)\cdot b(C) = b(B)\cdot(1 – b(C)) = b(B)\cdot b(\#C).$$

Hence, if events B and C are independent for B-function b events then:

$$b(B\cdot(\#C)) = b(B)\cdot b(\#C). \quad (p10)$$

Let calculate:

$$b(A\cdot(\#A)\cdot C) = b(A\cdot C) – b(A\cdot A\cdot C) = b(A\cdot C) – b(A\cdot C) = 0. \quad (p11)$$

3.4. *Independent Tests*

Let **N** be the natural numbers set.

Def. 21: Let st(n) be a function such that st(n) has domain on **N** and has a range of values in the set of events.

In this case an event C is *a* [st]-*series of range r with V-number k* if C, r and k is subject to one of the following conditions:

1) r =1 and k = 1, C := st(1), or k = 0, C := (#st(1));
2) B is a [st]-series of range r –1 with V-number k – 1 and

$$C:= (B\cdot st(r)) ,$$

or B is a [st]-series of range r –1 with V-number k and

$$C:= (B\cdot(\#st(r))).$$

Let us denote a set of [st]-series of range r with V-number k as [st]($r; k$).

For example, if st(n) is event B_n then the following events:

$$(B_1\cdot B_2\cdot(\#B_3)), (B_1\cdot(\#B_2)\cdot B_3), ((\#B_1)\cdot B_2\cdot B_3)$$

are elements of [st](3;2), and

$$(B_1 \cdot B_2 \cdot (\# B_3) \cdot B_4 \cdot (\# B_5)) \in [st](5;3).$$

Def. 22: Def. 4.2.2: Function st(*n*) is *independent for B-function* b if:

$$b(st(1) \cdot st(2) \cdot \ldots \cdot st(k)) = b(st(1)) \cdot b(st(2)) \cdot \ldots \cdot b(st(k))$$

for any *k*.

Def. 23: Let st(*n*) has domain on the set of natural numbers and has range of values in the set of events.

In this case event C is called *a* [st]-*sum of range r with V-number k* (denote: C:= ŧ[st](*r*, *k*)) if C is a sum of all elements of [st](*r, k*).

For example, if st(*n*) is the sentence C_n then:

$((\# C_1) \cdot (\# C_2) \cdot (\# C_3))$ = ŧ[st] (3;0),

ŧ[st] (3;2) = $(((\# C_1) \cdot C_2 \cdot C_3) + (C_1 \cdot (\# C_2) \cdot C_3) + (C_1 \cdot C_2 \cdot (\# C_3))$,

ŧ[st] (3;1) = $((C_1 \cdot (\# C_2) \cdot (\# C_3)) + ((\# C_1) \cdot C_2 \cdot (\# C_3)) + ((\# C_1) \cdot (\# C_2) \cdot C_3))$,

$(C_1 \cdot C_2 \cdot C_3)$ = ŧ[st] (3;3).

Def. 24: Let a function $s_A(n)$ be defined on **N**, has range of values in the set of events, and be independent for a B-function b.

And let $s_A(n)$ satisfies the following condition: $b(s_A(n)) = b(A)$ for any *n*.

In that case the $[s_A]$-series of rank *r* with V-number *k* is called *series of r independent for B-function* b $[s_A]$-*tests of event* A *with result k*.

Def. 25: Function ⍰$_r[s_A]$ is called *a frequency of event A in* $[s_A]$-*series* if ⍰$_r[s_A]$ = *k/r* if and only if event ŧ$[s_A](r, k)$ occurs.

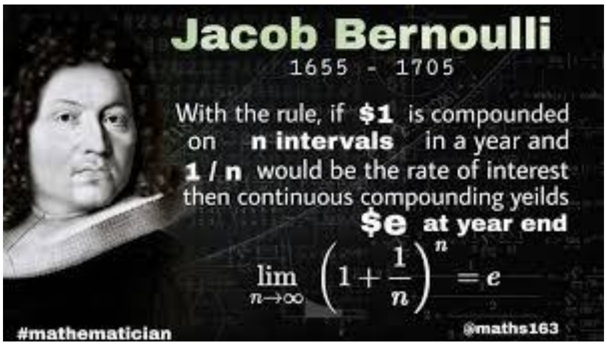
Hence,

°«⍰$_r(s_A)$ = *k/r*» = ŧ$[s_A](r, k)$. (p12)

Th. 5: (**the Bernoulli[15] Formula**) [13] If s(*n*) is independent for B-function b and there exists a real number *p* such that for all *n*: b(s(*n*)) = *p* then

15 **Jacob Bernoulli**[a] **James** or **Jacques**; 6 January 1655 27 December 1654] – 16 August 1705) was one of the many prominent mathematicians in the Bernoulli family.

$$\mathrm{b}\big(ŧ[\mathrm{s}](r,k)\big) = \frac{r!}{k!\,(r-k)!}p^k(1-p)^{r-k}.$$



Def. 26: Let a function s(n) be defined on **N** and has a range of values in the set of events.

In that case an event Ŧ[s](r,k,l) with natural r, k, l is defined in the following way:

1) Ŧ[s](r,k,k) := ŧ[s](r,k),

2) Ŧ[s](r,k,l + 1) := (Ŧ[s](r,k,l) + ŧ[s](r,l + 1)).

If a and b are real numbers, and $k - 1 < a \le k$ and $l \le b < l + 1$ then Ŧ[s](r,a,b) := Ŧ[s](r,k,l).

Th. 6: Ŧ[s_A](r,a,b) occurs if and only if $a/r \le \nu_r[\mathrm{s}_\mathrm{A}] \le b/r$.

Th.7: If s(n) is independent for a B-function b and there exists a real number p such that
b(s(n)) = p for all n then

$$\mathrm{b}\big(Ŧ[\mathrm{s}_\mathrm{A}](r,a,b)\big) = \sum_{a\le k\le b}\frac{r!}{k!\,(r-k)!}p^k(1-p)^{r-k}.$$

Th. 8: If s(n) is independent for a B-function b and there exists a real number p such that
b(s (r)) = p for all r then

$$\mathrm{b}\left(Ŧ[\mathrm{s}_\mathrm{A}]\big(\,r, r\cdot\ (p\ -\varepsilon), r\cdot\ (p\ +\ \varepsilon)\big)\right) \ge 1 - \frac{p\cdot(1-p)}{r\cdot\varepsilon^2}$$

for every positive real number ε.

Hence, in accordance with Th.6:

$$\mathrm{b}(°"p - \varepsilon \le \nu_r[\mathrm{s}_\mathrm{A}] \le p + \varepsilon") \ge 1 - \frac{p\cdot(1-p)}{r\cdot\varepsilon^2}.$$

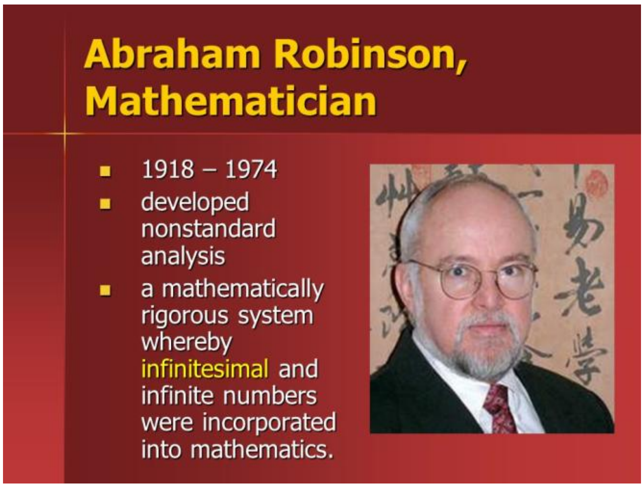
The right part of this inequality doesn't depend on sequence s. Hence it can be rewritted as the following:

$$b(°"p - \varepsilon \leq \nu_r[A] \leq p + \varepsilon") \geq 1 - \frac{p \cdot (1-p)}{r \cdot \varepsilon^2}. \qquad (p13)$$

3.5. *Function of Probability*

Nonstandard Numbers

Further some variant of the Robinson non-standard analysis (for instant [6]) is required:



Def. 27: A *n-part-set* **S** of **N** is defined recursively as follows:

1) $\mathbf{S}_1 = \{1\}$;
2) $S_{(n+1)} = \mathbf{S}_n \cup \{n + 1\}$.

Def. 28: If $\mathbf{S}_n$ is a *n*-part-set of **N** and **A** $\subseteq$ **N** then $\|\mathbf{A}\cap\mathbf{S}_n\|$ is quantity of elements of set $\mathbf{A}\cap\mathbf{S}_n$, and if $\varpi_n(\mathbf{A}) := \|\mathbf{A} \cap \mathbf{S}_n\|/n$ then $\varpi_n(\mathbf{A})$ is called *a frequency* of set **A** on the *n*-part-set $\mathbf{S}_n$.

Because $\varpi_n(\mathbf{N}) = \|\mathbf{N} \cap \mathbf{S}_n\|/n = n/n$ then

$$\varpi_n(\mathbf{N}) = 1. \qquad (s1)$$

Becaus $\varpi_n(\mathbf{A} \cap \mathbf{B}) + \varpi_n((\boldsymbol{N} - \boldsymbol{A}) \cap \mathbf{B}) = \|(\mathbf{A} \cap \mathbf{B}) \cap \mathbf{S}_n\|/n +$
$+ \|((\boldsymbol{N} - \boldsymbol{A}) \cap \mathbf{B}) \cap \mathbf{S}_n\|/n$ then

$$\varpi_n(\mathbf{A} \cap \mathbf{B}) + \varpi_n((\boldsymbol{N} - \boldsymbol{A}) \cap \mathbf{B}) = \varpi_n(\mathbf{B}). \qquad (s2)$$

Hence,

$\varpi_n(\mathbf{A} \cap \mathbf{N}) + \varpi_n((\boldsymbol{N} - \boldsymbol{A}) \cap \mathbf{N}) = \varpi_n(\mathbf{N})$ and because for any **A**: $(\mathbf{A} \cap \mathbf{N}) = \boldsymbol{A}$ then

$$\varpi_n(\mathbf{A}) + \varpi_n(\boldsymbol{N} - \boldsymbol{A}) = 1. \qquad (s3)$$

Therefore, $\varpi_n(\mathbf{N}) + \varpi_n(\boldsymbol{N} - \boldsymbol{N}) = 1$. That is $\varpi_n(\mathbf{N}) + \varpi_n(\varnothing) = 1$.

Hence,

$$\varpi_n(\varnothing) = 0. \tag{s4}$$

Def.29: If ”lim” is the Cauchy-Weierstrass ”limit” then:

$$\boldsymbol{\Phi}ix := \left\{\mathbf{A}{\subseteq}\mathbf{N} \mid \lim_{n\to\infty} \varpi_n(\mathbf{A}) = 1\right\}.$$

Hence, in accordance with (s1)

$$\mathbf{N}{\in}\ \boldsymbol{\Phi}ix \text{ and } \varnothing \notin \boldsymbol{\Phi}ix. \tag{s5}$$

If $\mathbf{B}{\in}\ \boldsymbol{\Phi}ix$ then $\lim_{n\to\infty} \varpi_n(\mathbf{N} - \mathbf{B}) = 0$. In accordance with (s2):

$\varpi_n(\mathbf{A} \cap (\mathbf{N} - \mathbf{B})) \le \varpi_n(\mathbf{N} - \mathbf{B})$. Therefore, $\lim_{n\to\infty} \varpi_n(\mathbf{A} \cap (\mathbf{N} - \mathbf{B})) = 0$. Hence,

$\lim_{n\to\infty} \varpi_n(\mathbf{A} \cap \mathbf{B}) = \lim_{n\to\infty} \varpi_n(\mathbf{A})$.

Therefore, if $\mathbf{B}{\in}\ \boldsymbol{\Phi}ix$ and $\mathbf{A}{\in}\ \boldsymbol{\Phi}ix$ then $(\mathbf{A} \cap \mathbf{B}) \in \boldsymbol{\Phi}ix$. (s6)

Moreover,

$$\text{if } \mathbf{A}{\in}\ \boldsymbol{\Phi}ix \text{ and } \mathbf{A}{\subseteq}\mathbf{B} \text{ then } \mathbf{B}{\in}\ \boldsymbol{\Phi}ix. \tag{s7}$$

Therefore, in accordance with (s5), (s6), (s7), $\boldsymbol{\Phi}ix$ is *a filter* (for instance, [6], p.45), but
$\boldsymbol{\Phi}ix$ is not an ultrafilter because there exist subsets $\mathbf{A}$ of $\mathbf{N}$ such that $\mathbf{A} \notin \boldsymbol{\Phi}ix$ and
$(\mathbf{N} - \mathbf{A}) \notin \boldsymbol{\Phi}ix$.

Def. 30: A series of real numbers $\langle r_n\rangle$ and $\langle s_n\rangle$ are *Q-equivalent* (denote: $\langle r_n\rangle \sim \langle s_n\rangle$) if

$$\{n \in\mathbf{N} \mid r_n = s_n\} \in \boldsymbol{\Phi}ix.$$

Hence, if r, s,u are series of real numbers then r ~ r; if r ~ s then s ~ r; and if r ~ s, and
s ~u then r ~u. Therefore, «~» is *an equivalence relation*.

Def. 31: *A Q-number* is a set of Q-equivalent series of real numbers.

That is if ***a*** is a Q-number and r∈ ***a*** and s ∈ ***a*** then r ~ s; and if r∈ ***a***, and r ~ s then s ∈ ***a***.

Def. 32: A Q-number ***b*** is *a standard Q-number b* if *b* is some real number and there exists a series $\langle r_n \rangle$ such that $\langle r_n \rangle \in$ ***b***, and

$$\{n \in \mathbf{N} \mid r_n = b\} \in \mathbf{\Phi}ix.$$

In this case ***b*** := *b.*

Def. 33: Q-numbers ***a*** and ***b*** *equal* (denote: ***a*** = ***b***) if ***a*** ⊆ ***b*** and ***b*** ⊆ ***a***.

Def. 34: Q-number ***c*** is *sum* of Q-number ***a*** and Q-number *b* (denote: ***c*** = ***a*** + ***b***) if there exist series of real numbers $\langle r_n \rangle$, $\langle s_n \rangle$, $\langle u_n \rangle$ such that $\langle r_n \rangle \in$ ***a***, $\langle s_n \rangle \in$ ***b***, $\langle u_n \rangle \in$ ***c***, and

$$\{n \in \mathbf{N} \mid r_n + s_n = u_n\} \in \mathbf{\Phi}ix.$$

If *a* is a real number then *a* + ***b*** = ***a*** + ***b*** where ***a*** is standard Q-number *a*.

Def. 35: Q-number ***c*** is *product* of Q-number ***a*** and Q-number ***b*** (denote: ***c*** = ***a*** · ***b***) if there exist series of real numbers $\langle r_n \rangle$, $\langle s_n \rangle$, $\langle u_n \rangle$ such that $\langle r_n \rangle \in$ ***a***, $\langle s_n \rangle \in$ ***b***, $\langle u_n \rangle \in$ ***c***, and

$$\{n \in \mathbf{N} \mid r_n \cdot s_n = u_n\} \in \mathbf{\Phi}ix.$$

Hence, ***a*** – ***b*** = ***a*** + (–1) · ***b*** = ***a*** + (***-1***) · ***b***. And

$$"\boldsymbol{c} = \frac{\boldsymbol{a}}{\boldsymbol{b}}" := "\boldsymbol{a} = \boldsymbol{b} \cdot \boldsymbol{c}".$$

Def. 36: A Q-number $\boldsymbol{x}$ is called *an infinitesimal Q-number* if there exists a series of real numbers $\langle x_n \rangle$ such that $\langle x_n \rangle \in \boldsymbol{x}$, and for all natural numbers *m*:

$$\{n \in \boldsymbol{N} \mid |x_n| < \frac{1}{m}\} \in \mathbf{\Phi}ix.$$

Denote by **I** the set of all infinitesimal Q-numbers.

Def. 37: Q-numbers $\boldsymbol{x}$ and $\boldsymbol{y}$ are *infinitely near* (denote: $\boldsymbol{x} \approx \boldsymbol{y}$) if either $(\boldsymbol{x} - \boldsymbol{y}) = 0$ or
$(\boldsymbol{x} - \boldsymbol{y}) \in \mathbf{I}$.

Def. 38: A Q-number $\boldsymbol{x}$ is called *an infinitely large Q-number* if there exists a series $\langle r_n \rangle$ of real numbers such that $\langle r_n \rangle \in \boldsymbol{x}$, and for every natural number m:

$$\{n \in \boldsymbol{N} \mid m < r_n\} \in \boldsymbol{\Phi}ix.$$

Let $\boldsymbol{n}$ be the Q-number which contains the following series

$$\langle n \rangle := 1,2,3,4,\dots,n,\dots .$$

Let m be some natural number.
In that case:

$$\lim_{n\to\infty} \varpi_n(\{n \in \boldsymbol{N} \mid m < n\}) = \lim_{n\to\infty} \frac{n-m}{n} = 1.$$

Hence, for any natural m:

$$\{n \in \boldsymbol{N} \mid m < n\} \in \boldsymbol{\Phi}ix.$$

Therefore, $\boldsymbol{n}$ is an infinitely large Q-number. Denote <u>*n*</u> *the natural infinity*.

Let a be a positive real number. In this case $a/\boldsymbol{n}$ contains the series $\langle a/n \rangle$. Let m be some natural number and let k be some natural number which is more than a. In that case if $n>mk$ then $(a/n) < 1/m$. That is for any natural number m:

$$\lim_{n\to\infty} \varpi_n\left(\{n \in \boldsymbol{N} \mid \frac{a}{n} < \frac{1}{m}\}\right) = \lim_{n\to\infty} \frac{n-mk}{n} = 1. \qquad \text{(s8)}$$

Therefore, $a/\boldsymbol{n}$ is an infinitesimal Q-number in accordance with Def.36.

Def. 39: Let A(x) be a sentence which contains a real number x. And let $\boldsymbol{r}$ be a Q-number. In that case event °A($\boldsymbol{r}$) occurs if and only if here a series $\langle r_n \rangle$ of real number exists for which the following conditions are fulfilled: $\langle r_n \rangle \in \boldsymbol{r}$ and

$$\{n \in \boldsymbol{N} \mid {}^\circ\mathrm{A}(r_n) \text{ occurs}\} \in \boldsymbol{\Phi}ix.$$

<u>P-functions</u>

Def. 40: A B-function $\mathcal{P}$ is called *P-function* if for every event A the following condition is fulfilled:

If $\mathcal{P}$(A) ≈ 1 then A occurs.

In accordance with (p13): for any natural number *n* and for positive real ε:

$$\mathcal{P}(°"p - \varepsilon \leq \nu_n[\mathrm{A}] \leq p + \varepsilon") \geq 1 - \frac{p \cdot (1-p)}{n \cdot \varepsilon^2}.$$

Hence,

$$\mathcal{P}(°"p - \varepsilon \leq \nu_{\boldsymbol{n}}[\mathrm{A}] \leq p + \varepsilon") \geq 1 - \frac{p \cdot (1-p)}{\boldsymbol{n} \cdot \varepsilon^2}.$$

Because in accordance with (s8) $((p \cdot (1-p))/(\boldsymbol{n} \cdot \varepsilon^2)) \in \mathbf{I}$ then in accordanse with
Def.37:

$$\mathcal{P}(°"p - \varepsilon \leq \nu_{\boldsymbol{n}}[\mathrm{A}] \leq p + \varepsilon") \approx 1.$$

Hence, event $°"p - \varepsilon \leq \nu_{\boldsymbol{n}}[\mathrm{A}] \leq p + \varepsilon"$ occurs.

Since $p = \mathcal{P}(\mathrm{A})$ then for all arbitrarily small real positive ε:

$$\mathcal{P}(\mathrm{A}) = \nu_{\boldsymbol{n}}[\mathrm{A}] \pm \varepsilon.$$

Consequently, this function has a statistical meaning. Therefore, *in all over the world there exists the only single such function because values of this function can be defined by repetition of independent tests experimentally*. Therefore, I call this function *the probability function* (proof of of the consistency see in [7]).

3.6. *Probability and Logic*

Let $\mathcal{P}$ be the probability function and let B be the set of events A such that either A occurs or (#A) occurs.

In this case if $\mathcal{P}(\mathrm{A}) = 1$ then A occurs, and (A · B) = B in accordance with Def.13. Consequently, if $\mathcal{P}(\mathrm{B}) = 1$ then $\mathcal{P}(\mathrm{A} \cdot \mathrm{B}) = 1$. Hence, in this case $(\mathrm{A} \cdot \mathrm{B}) = \mathcal{P}(\mathrm{A}) \cdot \mathcal{P}(\mathrm{B})$.

If $\mathcal{P}(\mathrm{A}) = 0$ then $\mathcal{P}(\mathrm{A} \cdot \mathrm{B}) = \mathcal{P}(\mathrm{A}) \cdot \mathcal{P}(\mathrm{B})$ because $\mathcal{P}(\mathrm{A} \cdot \mathrm{B}) \leq \mathcal{P}(\mathrm{A})$ in accordance with (p1).

Moreover in accordance with (p3): $\mathcal{P}(\#\mathrm{A}) = 1 - \mathcal{P}(\mathrm{A})$ since the function $\mathcal{P}$ is a B-function.

If event A occurs then (A · B) = B and (A · (#B)) = (#B). Hence,

$$\mathcal{P}(\mathrm{A} \cdot \mathrm{B}) + \mathcal{P}\big(\mathrm{A} \cdot (\#\mathrm{B})\big) = \mathcal{P}(\mathrm{A}) = \mathcal{P}(\mathrm{B}) + \mathcal{P}(\#\mathrm{B}) = 1.$$

Consequently, if an element A of B occurs then $\mathcal{P}(\mathrm{A})$ = 1. If A does not occurs then (#A) occurs. Hence, $\mathcal{P}(\#\mathrm{A})$ = 1 and because $\mathcal{P}(\mathrm{A}) + \mathcal{P}(\#\mathrm{A}) = 1$ then $\mathcal{P}(\mathrm{A})$ = 0.

Therefore, on B the range of values of $\mathcal{P}$ is the two-element set {0; 1} similar the Boolean function range of values.

Hence, on set B the probability function obeys definition of a Boolean function (Def.7).

Therefore, *the probability is logic of the events which have not occurred yet.*

Appendix

Lm. 1: If *g* is a Boolean function then every natural propositional deduction of sequence Γ ⊢ *A* satisfy the following condition: if *g*(*A*) = 0 then there exists a sentence *C* such that *C* ∈ Γ and
g(*C*) = 0.

Proof of Lm. 1: is realized by a recursion on number of sequences in the deduction of Γ ⊢ *A*:

1. Basis of recursion: Let the deduction of Γ ⊢ *A* contains 1 sequence.

In that case a form of this sequence is *A* ⊢ *A* in accordance with the propositional natural deduction definition (Def. 6). Hence in this case the lemma holds true.

2. Step of recursion: *The recursion assumption:* Let the lemma holds true for every deduction containing no more than *n* sequences.

Let the deduction of Γ ⊢ *A* contains *n* + 1 sequences.

In that case either this sequence is a NPC-axiom or Γ ⊢ *A* is obtained from previous sequences by one of deduction rules.

If Γ ⊢ *A* is a NPC-axiom then the proof is the same as for the recursion basis.

a) Let Γ ⊢ *A* be obtained from a previous sequence by *R*&.

In that case a form of this previous sequence is either the following Γ ⊢ (*A*&*B*) or is the following Γ ⊢ (*B*&*A*) in accordance with the definition of deduction. The deduction of this sequence contains no more than *n* elements. Hence the lemma holds true for this deduction in accordance with the recursion assumption. If g (*A*) = 0 then g (*A*&*B*) = 0 and g (*B*&*A*) = 0 in accordance with the Boolean function definition (Def. 2.10). Hence there exists a sentence C such that $C \in \Gamma$ and $g(C) = 0$ in accordance with the lemma.

Hence in that case the lemma holds true for the deduction of sequence $\Gamma \vdash A$.

b) Let $\Gamma \vdash A$ be obtained from previous sequences by I&.

In that case forms of these previous sequences are $\Gamma_1 \vdash B$ and $\Gamma_2 \vdash G$ with $\Gamma = \Gamma_1, \Gamma_2$ and $A = (B\&G)$ in accordance with the definition of deduction. The lemma holds true for deductions of sequences $\Gamma_1 \vdash B$ and $\Gamma_2 \vdash G$ in accordance with the recursion assumption because these deductions contain no more than n elements. In that case if $g(A) = 0$ then $g(B) = 0$ or $g(G) = 0$ in accordance with the Boolean function definition. Hence there exist a sentence C such that $g(C) = 0$ and $C \in \Gamma_1$ or $C \in \Gamma_2$.

Hence in that case the lemma holds true for the deduction of sequence $\Gamma \vdash A$.

c) Let $\Gamma \vdash A$ be obtained from a previous sequence by R¬.

In that case a form of this previous sequence is the following: $\Gamma \vdash (\neg (\neg A))$ in accordance with the definition of deduction. The lemma holds true for the deduction of this sequence in accordance with the recursion assumption because this deduction contains no more than n elements. If $g(A) = 0$ then $g(\neg (\neg A)) = 0$ in accordance with the Boolean function definition. Hence there exists a sentence C such that $C \in \Gamma$ and $g(C) = 0$.

Hence the lemma holds true for the deduction of sequence $\Gamma \vdash A$.

d) Let $\Gamma \vdash A$ be obtained from previous sequences by I¬.

In that case forms of these previous sequences are $\Gamma_1, G \vdash B$ and $\Gamma_2, G \vdash (\neg B)$ with $\Gamma = \Gamma_1$, Γ2, and $A = (\neg G)$ in accordance with the definition of deduction. The lemma holds true for the deductions of sequences $\Gamma_1, G \vdash B$ and $\Gamma_2, G \vdash (\neg B)$ in accordance with the recursion assumption because these deductions contain no more than n elements.

If g $(A) = 0$ then g $(G) = 1$ in accordance with the Boolean function definition.

Either g $(B) = 0$ or g $(\neg B) = 0$ by the same definition. Hence there exists a sentence C such that either $C \in \Gamma_1, G$ or $C \in \Gamma_2, G$ and $g(C) = 0$ in accordance with the recursion assumption.

Hence in that case the lemma holds true for the deduction of sequence $\Gamma \vdash A$.

The recursion step conclusion: Therefore, in each possible case, if the lemma holds true for a deduction contained no more than n elements then the lemma holds true for a deduction contained $n + 1$ elements.

The recursion conclusion: Therefore the lemma holds true for a deduction of any length■

Proof of Th. 1: If a sentence *A* is naturally propositionally proven then there exists a natural propositional deduction of form ⊢ *A*. Hence, for every Boolean function *g*: *g*(*A*) = 1 in accordance with Lm.1. Hence, sentence *A* is a tautology■

Designation 1: Let *g* be a Boolean function. In that case for every sentence *A*:

$$A^g := \begin{cases} A, if\ g(A) = 1; \\ (\neg A), if\ g(A) = 0. \end{cases}$$

Lm. 2: [4] Let $B_1;B_2,\ldots,B_k$ be elements of a basic set $A_{0,0}$ making up a sentence *A* by the logical connectors (¬, &).

Let *g* be any Boolean function.

In that case there exist a propositional natural deduction of sequence

$$B_1^g;B_2^g,\ldots,B_k^g \vdash A^g.$$

Proof of Lm. 2: is realized by a recursion on the number of the logical connectors in sentence *A*.

1.Basis of recursion: Let *A* does not contain the logical connectors.

In this case the following string of one sequence:

1. $A^g \vdash A^g$, NPC-axiom.

gives the proof of the lemma.

2. Step of recursion: <u>*The recursion assumption:*</u> <u>Let the lem-ma holds true for every sentence, containing no more than *n* logical connectors.</u>

Let sentence *A* contains *n* + 1 connector.

Let us consider all possible cases:

a) Let *A* = (¬*G*).

In that case the lemma holds true for *G* in accordance with the recursion assumption because *G* contains no more than *n* connectors. Hence, there exists a deduction of sequence

$$B_1^g;B_2^g,\ldots,B_k^g \vdash G^g, \qquad (1)$$

here $B_1;B_2,\ldots,B_k$ are elements of basic set making up sentence *G*.

Hence, $B_1;B_2,\ldots,B_k$ make up sentence *A*.

If g (*A*) = 1 then $A^g = A = (\neg G)$ in accordance with Designation 1.

In that case *g*(*G*) = 0 in accordance with the Boolean function definition. Hence, $G^g = (\neg G) = A$ in accordance with Designation 1.

Hence, in that case a form of sequence (1) is the following:

$$B_1^g;B_2^g,\ldots,B_k^g \vdash A^g.$$

Hence, in that case the lemma holds true.

If $g(A) = 0$ then $A^g = (\neg A) = (\neg (\neg G))$ .in accordance with Designation 1. In that case

g(G) = 1 in accordance with the Boolean function definition. Hence, $G^g = G$ in accordance with Designation 1.

Hence, in that case a form of sequence (1) is

$$B_1^g;B_2^g,\ldots,B_k^g \vdash G.$$

Let us continue the deduction of this sequence in the following way:

1. $B_1^g;B_2^g,\ldots,B_k^g \vdash G$
2. $(\neg G) \vdash (\neg G)$, NPC-axiom.
3. $B_1^g;B_2^g,\ldots,B_k^g \vdash (\neg (\neg G))$, I¬ from 1. and 2.

It is a deduction of sequence

$$B_1^g;B_2^g,\ldots,B_k^g \vdash A^g.$$

Hence, in that case the lemma holds true.

b) Let $A = (G\&R)$.

In that case the lemma holds true both for G and for R in accordance with the recursion assumption because G and R contain no more than n connectors. Hence, there exist deductions of sequences

$$B_1^g;B_2^g,\ldots,B_k^g \vdash G^g \quad (2)$$

and

$$B_1^g;B_2^g,\ldots,B_k^g \vdash R^g, \quad (3)$$

here $B_1;B_2,\ldots,B_k$ are elements of basic set making up sentences G and R. Hence $B_1;B_2,\ldots,B_k$ make up sentence A.

If $g(A) = 1$ then $A^g = A = (G\&R)$ in accordance with Designation 1.

In that case $g(G) = 1$ and $g(R) = 1$ in accordance with the Boolean function definition.

Hence, $G^g = G$ and $R^g = R$ in accordance with Designation 1.

Let us continue deductions of sequences (2) and (3) in the following way:

1. $B_1^g;B_2^g,\ldots,B_k^g \vdash G$, (2).
2. $B_1^g;B_2^g,\ldots,B_k^g \vdash R^g$, (3).
3. $B_1^g;B_2^g,\ldots,B_k^g \vdash (G\&R)$, I& from 1. and 2.

It is deduction of sequence

$$B_1^g;B_2^g,\dots,B_k^g \vdash A^g.$$

Hence, in that case the lemma holds true.

If g (A) = 0 then $A^g = (\neg A) = (\neg\, (G\&R))$ in accordance with Designation 1.

In that case $g(G) = 0$ or $g(R) = 0$ in accordance with the Boolean function definition.

Hence, $G^g = (\neg G)$ or $R^g = (\neg R)$ in accordance with Designation 1.

Let $G^g = (\neg G)$.

In that case let us continue a deduction of sequence (2) in the following way:

1. $B_1^g;B_2^g,\dots,B_k^g \vdash (\neg G)$, (2).
2. $(G\&R) \vdash (G\&R)$, NPC-axiom.
3. $(G\&R) \vdash G$, R& from 2.
4. $B_1^g;B_2^g,\dots,B_k^g \vdash (\neg\, (G\&R))$, I¬ from 1. and 3.

It is a deduction of sequence

$$B_1^g;B_2^g,\dots,B_k^g \vdash A^g.$$

Hence, in that case the lemma holds true.

The same result is received if $R^g = (\neg R)$.

The recursion step conclusion: If the lemma holds true for sentences contained no more than n connectors then the lemma holds true for sentences contained $n + 1$ connectors.

The recursion conclusion: The lemma holds true for sentences, containing any number connectors ■

Proof of Th. 2: Let sentence A be a tautology. That is for every Boolean function g: $g(A) = 1$.

Hence there exists a deduction for sequence

$$B_1^g;B_2^g,\dots,B_k^g \vdash A \tag{4}$$

for every Boolean function g in accordance with Lm. 2.

There exist Boolean functions g_1 and g_2 such that

$$g_1(B_1) = 0,\ g_2(B_1) = 1,$$
$$g_1\,(B_s) = g_2(B_s) \text{ for } s\in\{2,\dots, k\}.$$

in accordance with Def. 8 because all B_s ($s \in \{1; 2,\ldots, k\}$) are elements of the basic set.

Forms of sequences (4) for these Boolean functions are the following:

$$(\neg B_1), B_2^{g_1}, \ldots, B_k^{g_1} \vdash A, \quad (5)$$

$$B_1, B_2^{g_1}, \ldots, B_k^{g_1} \vdash A. \quad (6)$$

Let us continue deductions of these sequences in the following way:

1. $(\neg B_1), B_2^{g_1}, \ldots, B_k^{g_1} \vdash A$, (5),
2. $B_1, B_2^{g_1}, \ldots, B_k^{g_1} \vdash A$, (6),
3. $(\neg A) \vdash (\neg A)$, NPC-axiom.
4. $(\neg A), B_2^{g_1}, \ldots, B_k^{g_1} \vdash (\neg (\neg B_1))$, I¬ from 1. and 3.
5. $(\neg A), B_2^{g_1}, \ldots, B_k^{g_1} \vdash (\neg B_1)$, I¬ from 2. and 3.
6. $B_2^{g_1}, \ldots, B_k^{g_1} \vdash (\neg (\neg A))$, I¬ from 4. and 5.
7. $B_2^{g_1}, \ldots, B_k^{g_1} \vdash A$, R¬ from 6.

It is deduction of sequence

$$B_2^{g_1}, \ldots, B_k^{g_1} \vdash A.$$

This sequence is obtained from sequence (4) by deletion of first sentence from the hypothesizes list.

All rest hypothesizes are deleted from this list in the similar way.

Final sentence is the following:

$$\vdash A.$$

■

Lm. 3: Every natural propositional deduction of a sequence $\Gamma \vdash A$ satisfy the following condition: if A is not true then there exists a sentence C such that $C \in \Gamma$ and C is not true.

Proof of Lm. 3: is realized by a recursion on number of sequences in the deduction of $\Gamma \vdash A$:

1. Basis of recursion: Let the deduction of $\Gamma \vdash A$ contains 1 sequence.

In that case a form of this sequence is $A \vdash A$ in accordance with the propositional natural deduction definition. Hence in this case the lemma holds true.

2. Step of recursion: *The recursion assumption:* Let the lemma holds true for every deduction containing no more than *n* sequences.

Let the deduction of $\Gamma \vdash A$ contains $n + 1$ sequences.

In that case either this sequence is a NPC-axiom or $\Gamma \vdash A$ is obtained from previous sequences by one of deduction rules.

If $\Gamma \vdash A$ is a NPC-axiom then the proof is the same as for the recursion basis.

e) Let $\Gamma \vdash A$ be obtained from a previous sequence by *R*&.

In that case a form of this previous sequence is either the following $\Gamma \vdash (A\&B)$ or is the following $\Gamma \vdash (B\&A)$ in accordance with the definition of deduction. The deduction of this sequence contains no more than *n* elements. Hence the lemma holds true for this deduction in accordance with the recursion assumption. If *A* is not true then $(A\&B)$ is not true and $(B\&A)$ is not true. Hence there exists a sentence *C* such that $C \in \Gamma$ and *C* is not true in accordance with the lemma.

Hence in that case the lemma holds true for the deduction of sequence $\Gamma \vdash A$.

f) Let $\Gamma \vdash A$ be obtained from previous sequences by I&.

In that case forms of these previous sequences are $\Gamma_1 \vdash B$ and $\Gamma_2 \vdash G$ with $\Gamma = \Gamma_1,\Gamma_2$ and

$A = (B\&G)$ in accordance with the definition of deduction. The lemma holds true for deductions of sequences $\Gamma_1 \vdash B$ and $\Gamma_2 \vdash G$ in accordance with the recursion assumption because these deductions contain no more than *n* elements. In that case if *A* is not true then *B* is not true or *G* is not true. Hence there exist a sentence *C* such that *C* is not true and $C \in \Gamma_1$ or $C \in \Gamma_2$.

Hence in that case the lemma holds true for the deduction of sequence $\Gamma \vdash A$.

g) Let $\Gamma \vdash A$ be obtained from a previous sequence by R¬.

In that case a form of this previous sequence is the following: $\Gamma \vdash (\neg (\neg A))$ in accordance with the definition of deduction. The lemma holds true for the deduction of this sequence in accordance with the recursion assumption because this deduction contains no more than *n* elements. If *A* is not true then $(\neg (\neg A))$ is not true. Hence there exists a sentence *C* such that $C \in \Gamma$ and *C* is not true.

Hence the lemma holds true for the deduction of sequence $\Gamma \vdash A$.

h) Let $\Gamma \vdash A$ be obtained from previous sequences by I¬.

In that case forms of these previous sequences are $\Gamma_1,G \vdash B$ and $\Gamma_2,G \vdash (\neg B)$ with $\Gamma = \Gamma_1, \Gamma_2$, and $A = (\neg G)$ in accordance with the definition of deduction. The lemma holds true for the deductions of sequences $\Gamma_1,G \vdash B$ and $\Gamma_2,G \vdash (\neg B)$ in accordance with the recursion assumption because these deductions contain no more than *n* elements.

If *A* is not true then *G* is true.

Either *B* is not true or $(\neg B)$ is not true. Hence there exists a sentence *C* such that either $C \in \Gamma_1,G$ or $C \in \Gamma_2,G$ and *C* is not true in accordance with the recursion assumption.

Hence in that case the lemma holds true for the deduction of sequence Γ ⊢ *A*.

The recursion step conclusion: Therefore, in each possible case, if the lemma holds true for a deduction contained no more than *n* elements then the lemma holds true for a deduction contained *n* + 1 elements.

The recursion conclusion: Therefore the lemma holds true for a deduction of any length■

Proof of Th. 3: If a sentence *A* is naturally propositionally proven then there exists a natural propositional deduction of form ⊢*A* (deduction from the empty list of hypothesizes). Hence, *A* is true in accordance with Lm.3. ■

Proof of Th. 4: Each tautology is naturally propositionally proven sentence by Th. 2. Each naturally propositionally proven sentence is a true sentence by Th.3. Therefore, every tautology is the true sentence ■

Proof of Th. 5: If B∈[s](r,k) then b(B) = $p^k(1-p)^{r-k}$ in accordance with Def. 22 and with (p10).

Since [*s*](*r,k*) contains $r!/(k!(r-k)!)$ elements then this theorem hold true according with (p9), (p10), and (p11) ■

Proof of Th. 6: In accordance with Def. 26: there exist natural numbers *n* and *k* such that
$k-1 < a \leq k$ and $k + n \leq b < k + n + 1$, and Ŧ[s_A](r,a,b) := Ŧ[s_A]($r,k,k + n$).
The recursion on *n*:
Basis of recursion: Let *n* = 0.
In that case according Def. 25 and Def. 24:

Ŧ[s_A](r,k,k) = ŧ[s_A](r,k) = °«⍰$_r$(s_A) = k/r».

Step of recursion:
<u>*The recursion assumption:*</u> Let

Ŧ[s_A]($r,k,k + n$) = °«$k/r \leq$⍰$_r$[s_A] $\leq (k+n)/r$».

According to Def. 26:

Ŧ[s_A]($r,k,k + n + 1$) = Ŧ[s_A]($r,k,k + n$) + ŧ[s_A]($r,k + n + 1$).

According to the recursion assumption and according to Def. 25:

Ŧ[s_A]($r,k,k + n + 1$) = (°«$k/r \leq$⍰$_r$[s_A] $\leq (k+n)/r$» + °«⍰$_r$(s_A) = $(k+n + 1)/r$»).

Hence according to Def.15:

$$Ŧ[s_A](r,k,k+n+1) = (°«k/r \leq □_r[s_A] \leq (k+n+1)/r».$$

The recursion step conclusion: Therefore, if this theorem holds true for n then one holds true for $n + 1$.

The recursion conclusion: Therefore, this theorem holds true for any n ■

Proof of Th.7: It follows from Th.5 and (p9) at once ■

Proof of Th. 8: Because

$$\sum_{k=0}^{r}(k-rp)^2 \cdot \frac{r!}{k!\,(r-k)!}p^k(1-p)^{r-k} = r \cdot p \cdot (1-p)$$

then if

$$J := \{k \in \mathbf{N} \mid 0 \leq k \leq r \cdot (p-\varepsilon)\} \cup \{k \in \mathbf{N} \mid r \cdot (p+\varepsilon) \leq k \leq r\}$$

then

$$\sum_{k \in J}\frac{r!}{k!\,(r-k)!}p^k(1-p)^{r-k} \leq \frac{p \cdot (1-p)}{r \cdot \varepsilon^2}.$$

Hence this theorem holds true according to (p3) ■

4. Physics

Let $F_A(x)$ be *a Cumulative Distribution Function* of event A, i.e.:

$$F_A(x_0,x_1,x_2,x_3) := \mathrm{P}\left((X_{A,0} < x_0)\cdot(X_{A,1} < x_1)\cdot(X_{A,2} < x_2)\cdot(X_{A,3} < x_3)\right)$$

Here $\langle X_{A,0}, X_{A,1}, X_{A,2}, X_{A,3}\rangle$ are random coordinates of event A.:

Let:

$$j_0 :=, \frac{\partial^3 F}{\partial x_1 \partial x_2 \partial x_3} \quad j_1 := -\frac{\partial^3 F}{\partial x_0 \partial x_2 \partial x_3},\ j_2 := -\frac{\partial^3 F}{\partial x_0 \partial x_1 \partial x_3},\ j_3 := \frac{\partial^3 F}{\partial x_0 \partial x_1 \partial x_2}.$$

The vector $< j_0, j_1, j_2, j_3 >$ is *a probability current vector.*

If u_k := (j_k/j_0)c hen vector < u_1, u_2, u_3> is *a velocity of the probability propagation.* For example:

$$u_2 = \frac{j_2}{j_0}c = \frac{\left(-\frac{\partial^3 F}{\partial x_0 \partial x_1 \partial x_3}\right)c}{\left(\frac{\partial^3 F}{\partial x_1 \partial x_2 \partial x_3}\right)} \approx \left(-\frac{\Delta_{013}F}{\Delta_{123}F}\frac{\Delta x_2}{\Delta x_0}\right)c$$

A velocity of the probability propagation obey the following condition: (Traceable events) [1.pp.33—36] . $u_1^2 + u_2^2 + u_3^2 \le c^2$

For all probability current vector < j_0, j_1, j_2, j_3> a 4X1 complex matrix function ϕ exists which obeys to the following conditions [1. Pp.63—66]:

$$\frac{j_k}{c} = -\varphi^\dagger \beta^k \varphi \qquad (4*)$$

Because

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

then

$$\frac{\partial(\varphi^\dagger \varphi)}{\partial x_0} - \frac{\partial(\varphi^\dagger \beta^{[1]} \varphi)}{\partial x_1} - \frac{\partial(\varphi^\dagger \beta^{[2]} \varphi)}{\partial x_2} - \frac{\partial(\varphi^\dagger \beta^{[3]} \varphi)}{\partial x_3} = 0 .$$

Let

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

Hence:

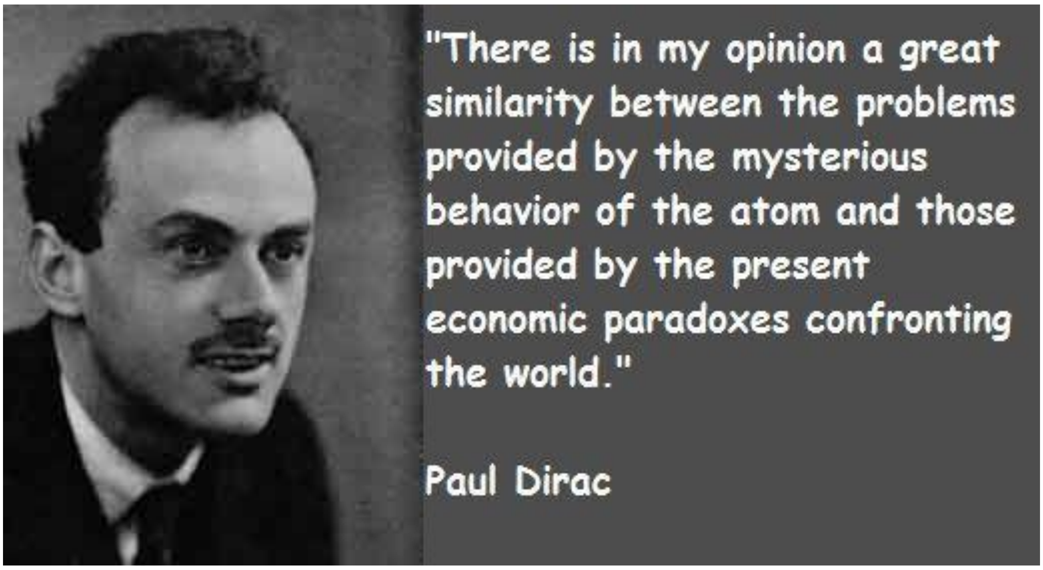
$$\varphi^+ \left(\hat{Q}^+ + \hat{Q}\right)\varphi = 0$$

$$\hat{Q}^+ = -\hat{Q}$$

Therefore, for every function φ here exists an operator $Q_{j,k}$, such that a dependence of φ on t is described by the following differential equation (equation of the Dirac[16] type): $\partial_t \varphi_j = c\sum_{k=1}^{4}\left(\sum_{s=1}^{3}\beta_{j,k}^{[s]}\partial_s + Q_{j,k}\right)\varphi_k$

16 **Paul Adrien Maurice Dirac**/ 8 August 1902 – 20 October 1984) was an English theoretical physicist who is regarded as one of the most significant physicists of the 20th century.

And $Q_{j,k}{*} = -Q_{jk,j}$.



If $\gamma^{[5}$

then this equation can be transformed to the following form [1. p.86]:

$$\left(-\left(\partial_0 - i\Theta_0 - i\mathrm{T}_0\gamma^{[5]}\right) + \sum_{k=1}^{3}\beta^{[k]}\left(\partial_k - i\Theta_k - i\mathrm{T}_k\gamma^{[5]}\right) + 2\left(iM_0\gamma^{[0]} + iM_4\beta^{[4]}\right)\right)\varphi +$$
$$+\left(-\left(\partial_0 - i\Theta_0 - i\mathrm{T}_0\gamma^{[5]}\right) - \sum_{k=1}^{3}\zeta^{[k]}\left(\partial_k - i\Theta_k - i\mathrm{T}_k\gamma^{[5]}\right) + 2\left(-iM_{\zeta,0}\gamma^{[0]} + iM_4\zeta^{[4]}\right)\right)\varphi +$$
$$+\left(-\left(\partial_0 - i\Theta_0 - i\mathrm{T}_0\gamma^{[5]}\right) - \sum_{k=1}^{3}\eta^{[k]}\left(\partial_k - i\Theta_k - i\mathrm{T}_k\gamma^{[5]}\right) + 2\left(-iM_{\eta,0}\gamma^{[0]} - iM_{\eta,4}\eta^{[4]}\right)\right)\varphi +$$
$$+\left(-\left(\partial_0 - i\Theta_0 - i\mathrm{T}_0\gamma^{[5]}\right) - \sum_{k=1}^{3}\theta^{[k]}\left(\partial_k - i\Theta_k - i\mathrm{T}_k\gamma^{[5]}\right) + 2\left(iM_{\theta,0}\gamma^{[0]} + iM_{\theta,4}\theta^{[4]}\right)\right)\varphi = 0$$

with real $M_0, M_4, M_{\varsigma,0}, M_{\varsigma,4}, M_{\eta,0}, M_{\eta,4}, M_{\theta.0}, M_{\theta,4}, \Theta_k, \Upsilon_k \ \left(k \in \{0,1,2,3\}\right)$

Because $\varsigma^{[k]} + \eta^{[k]} + \theta^{[k]} = -\beta^{[h]}$ with k ∈ (1,2,3) then:

$$\frac{1}{c}\partial_t\varphi - \left(i\Theta_0\beta^{[0]} + i\Upsilon_0\beta^{[0]}\gamma^{[5]}\right)\varphi = \begin{pmatrix} \sum_{\nu=1}^{3}\beta^{[\nu]}\left(\partial_\nu + i\Theta_\nu + i\Upsilon_\nu\gamma^{[5]}\right) + \\ +iM_0\gamma^{[0]} + iM_4\beta^{[4]} - \\ -iM_{\zeta,0}\gamma_\zeta^{[0]} + iM_{\zeta,4}\zeta^{[4]} - \\ -iM_{\eta,0}\gamma_\eta^{[0]} - iM_{\eta,4}\eta^{[4]} + \\ +iM_{\theta,0}\gamma_\theta^{[0]} + iM_{\theta,4}\theta^{[4]} \end{pmatrix}\varphi.$$

I call this equation as ***Basix Quant Equation***.

$M_0, M_4, M_{\varsigma,0}, M_{\varsigma,4}, M_{\eta,0}, M_{\eta,4}, M_{\theta.0}, M_{\theta,4}$

Here Θ_k and Υ_k are *gauge bosons* and
are *mass members.*

4.1. *Quarks and gluons*

The *quark model* was independently proposed by physicists Murray Gell-Mann[17] and George Zweig[18] in 1964.

If $M_0 = 0 = M_4$ then from Basix Quant Equation:

$$\left(\begin{array}{c}\sum_{k=0}^{3}\beta^{[k]}\left(-\mathrm{i}\partial_k+\Theta_k+\Upsilon_k\gamma^{[5]}\right)-\\ -M_{\zeta,0}\gamma_{\zeta}^{[0]}+M_{\zeta,4}\zeta^{[4]}+\\ -M_{\eta,0}\gamma_{\eta}^{[0]}-M_{\eta,4}\eta^{[4]}+\\ +M_{\theta,0}\gamma_{\theta}^{[0]}+M_{\theta,4}\theta^{[4]}\end{array}\right)\varphi=0.$$

I call this equation as the ***Quark Equation***.
Here:

$$\gamma_{\zeta}^{[0]}=-\left[\begin{array}{cccc}0&0&0&1\\0&0&1&0\\0&1&0&0\\1&0&0&0\end{array}\right],\quad \zeta^{[4]}=\left[\begin{array}{cccc}0&0&0&\mathrm{i}\\0&0&\mathrm{i}&0\\0&-\mathrm{i}&0&0\\-\mathrm{i}&0&0&0\end{array}\right]$$

are mass elements of red pentad

$$\gamma_{\eta}^{[0]}=\left[\begin{array}{cccc}0&0&0&\mathrm{i}\\0&0&-\mathrm{i}&0\\0&\mathrm{i}&0&0\\-\mathrm{i}&0&0&0\end{array}\right],\quad \eta^{[4]}=\left[\begin{array}{cccc}0&0&0&1\\0&0&-1&0\\0&-1&0&0\\1&0&0&0\end{array}\right]$$

are mass elements of green pentad.

$$\gamma_{\theta}^{[0]}=\left[\begin{array}{cccc}0&0&-1&0\\0&0&0&1\\-1&0&0&0\\0&1&0&0\end{array}\right],\quad \theta^{[4]}=\left[\begin{array}{cccc}0&0&\mathrm{i}&0\\0&0&0&-\mathrm{i}\\-\mathrm{i}&0&0&0\\0&\mathrm{i}&0&0\end{array}\right]$$

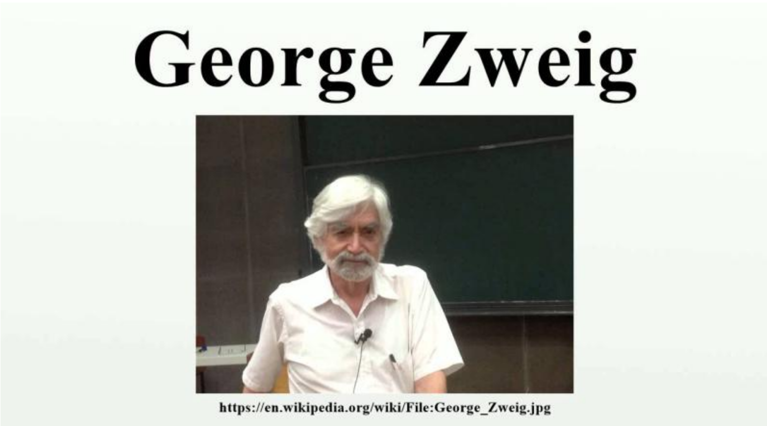
17 **Murray Gell-Mann** September 15, 1929 – May 24, 2019)[5][6] was an American physicist

18 **George Zweig** ; born May 30, 1937) is a Russian-American physicist.

mass elements of blue pentad.

I call:

- *$M_{\zeta,,0}$, $M_{\zeta,,4}$ red lower and upper mass member,*
- *$M_{\eta,0}$, $M_{\eta,,4}$ green lower and upper mass member,*
- *$M_{\vartheta,0}$, $M_{\vartheta,4}$ blue lower and upper mass member,*



The mass numbers of this equation form following matrix sum:

$$\widehat{M} := \begin{pmatrix} -M_{\zeta,0}\gamma_{\zeta}^{[0]} + M_{\zeta,4}\zeta^{[4]} - \\ -M_{\eta,0}\gamma_{\eta}^{[0]} - M_{\eta,4}\eta^{[4]} + \\ +M_{\theta,0}\gamma_{\theta}^{[0]} + M_{\theta,4}\theta^{[4]} \end{pmatrix} =$$

$$\begin{bmatrix} 0 & 0 & -M_{\theta,0} & M_{\zeta,\eta,0} \\ 0 & 0 & M^*_{\zeta,\eta,0} & M_{\theta,0} \\ -M_{\theta,0} & M_{\zeta,\eta,0} & 0 & 0 \\ M^*_{\zeta,\eta,0} & M_{\theta,0} & 0 & 0 \end{bmatrix} + \mathrm{i} \begin{bmatrix} 0 & 0 & M_{\theta,4} & M^*_{\zeta,\eta,4} \\ 0 & 0 & M_{\zeta,\eta,4} & -M_{\theta,4} \\ -M_{\theta,4} & -M^*_{\zeta,\eta,4} & 0 & 0 \\ -M_{\zeta,\eta,4} & M_{\theta,4} & 0 & 0 \end{bmatrix}$$

$M_{\zeta,\eta,0} := M_{\zeta,0} - \mathrm{i}M_{\eta,0}$ and $M_{\zeta,\eta,4} := M_{\zeta,4} - \mathrm{i}M_{\eta,4}$. With

Elements of these matrices can be rotated by the following octad elements/

$$\mathring{U} := \{U_{1,2}(\varsigma), U_{1,3}(\theta), U_{2,3}(\alpha), U_{0,1}(\sigma), U_{0,2}(\phi), U_{0,3}(\iota), \widetilde{U}(\chi), \hat{U}(\kappa)\}$$

where $\varsigma(t,\vec{x})$, $\theta(t,\vec{x})$, $\alpha(t,\vec{x})$, $\sigma(t,\vec{x})$, $\phi(t,\vec{x})$, $\iota(t,\vec{x})$, $\chi(t,\vec{x})$, $\kappa(t,\vec{x})$ are any real functions.

For example, if

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

then

$$\begin{aligned}
&M_{\zeta,0}' := M_{\zeta,0},\\
&M_{\eta,0}' := M_{\eta,0}\cos 2\alpha + M_{\theta,0}\sin 2\alpha,\\
&M_{\theta,0}' := M_{\theta,0}\cos 2\alpha - M_{\eta,0}\sin 2\alpha,\\
&M_{\zeta,4}' := M_{\zeta,4},\\
&M_{\eta,4}' := M_{\eta,4}\cos 2\alpha + M_{\theta,4}\sin 2\alpha,\\
&M_{\theta,4}' := M_{\theta,4}\cos 2\alpha - M_{\eta,4}\sin 2\alpha.
\end{aligned}$$

Therefore, matrix $U_{2,3}$ makes an oscillation between green and blue colors. And this transformation of Quark Equation bends time-space as the following:

$$\begin{aligned}
&\frac{\partial x_2}{\partial x_2'} = \cos 2\alpha,\\
&\frac{\partial x_3}{\partial x_2'} = -\sin 2\alpha,\\
&\frac{\partial x_2}{\partial x_3'} = -\sin 2\alpha,\\
&\frac{\partial x_3}{\partial x_3'} = \cos 2\alpha,\\
&\frac{\partial x_0}{\partial x_2'} = \frac{\partial x_1}{\partial x_2'} = \frac{\partial x_0}{\partial x_3'} = \frac{\partial x_1}{\partial x_3'} = 0.
\end{aligned} \qquad (16)$$

Therefore, the oscillation between blue and green colors bends the space in the x_2, x_3 directions.

One more example: if $\hat{M}'' := \begin{pmatrix} -iM_{\zeta,0}''\gamma^{[0]}{}_{\zeta} + iM_{\zeta,4}''\zeta^{[4]} - \\ -iM_{\eta,0}''\gamma^{[0]}{}_{\eta} - iM_{\eta,4}''\eta^{[4]} + \\ +iM_{\theta,0}''\gamma^{[0]}{}_{\theta} + iM_{\theta,4}''\theta^{[4]} \end{pmatrix} := U_{0,1}{}^{-1}(\sigma)\,\hat{M}\,U_{0,1}(\sigma)$

then

$$M_{\zeta,0}'':=M_{\zeta,0},$$
$$M_{\eta,0}'':=M_{\eta,0}\cosh 2\sigma-M_{\theta,4}\sinh 2\sigma,$$
$$M_{\theta,0}'':=M_{\theta,0}\cosh 2\sigma+M_{\eta,4}\sinh 2\sigma,$$
$$M_{\zeta,4}'':=M_{\zeta,4,}$$
$$M_{\eta,4}'':=M_{\eta,4}\cosh 2\sigma+M_{\theta,0}\sinh 2\sigma,$$
$$M_{\theta,4}'':=M_{\theta,4}\cosh 2\sigma-M_{\eta,0}\sinh 2\sigma.$$

Therefore, matrix $U_{0,1}$ makes an oscillation between green and blue colors with an oscillation between upper and lower mass members.. And this transformation of Quark Equation bends time-space as the following:

$$\frac{\partial x_1}{\partial x_1'}=\cosh 2\sigma,$$
$$\frac{\partial t}{\partial x_1'}=\frac{1}{c}\sinh 2\sigma,$$
$$\frac{\partial x_1}{\partial t'}=c\sinh 2\sigma, \qquad (17)$$
$$\frac{\partial t}{\partial t'}=\cosh 2\sigma,$$
$$\frac{\partial x_2}{\partial t'}=\frac{\partial x_3}{\partial t'}=\frac{\partial x_2}{\partial x_1'}=\frac{\partial x_3}{\partial x_1'}=0.$$

Therefore, the oscillation between blue and green colors with the oscillation between upper and lower mass members bends the space in the t, x_1 directions.

Such transformation with elements of set Ů add to equation Quark Equation gauge fields of the following shape: $U_{k,l}^{-1}(\xi)\partial_s U_{k,l}(\xi)$ where: $U_{k,l}(\xi)\in$ Ů. And for every element $U_{k,l}(\xi)$ of Ů exists [1. 0p.155--158] matrix $\Lambda_{k,l}$ such that

$$U_{k,l}^{-1}(\xi)\partial_s U_{k,l}(\xi)=\Lambda_{k,l}\partial_s(\xi)$$

and for every product U of Ů's elements real functions $G^r_s(t, x_1, x_2; x_3)$ exist such that [1. pp.158]

$$U^{-1}(\xi)\partial_s U(\xi)=\frac{g_3}{2}\sum_{r=1}^{8}\Lambda_r G^r{}_s$$

with some real constant g_3 (similar to 8 gluons).
Therefore, gluons are result of work of the Poinkare transformations – 8 gluons from 8 matrcies.

From (17): the oscillation between upper and lower mass members bends the space in the t, x_1 directions with

$$\frac{\partial t}{\partial t'} = \cosh 2\sigma,$$
$$\frac{\partial x_1}{\partial t'} = c \sinh 2\sigma.$$

Hence, if v is the velocity of a coordinate system <t',x_1'> in the coordinate system <t,x_1> then

Hence, if v is the velocity of a coordinate system <t',x_1'> in the coordinate system <t,x_1> then

$$\sinh 2\sigma = \frac{\left(\frac{v}{c}\right)}{\sqrt{1-\left(\frac{v}{c}\right)^2}}, \ \cosh 2\sigma = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}.$$

Therefore, $v = c \tanh 2\sigma$.

Let

$$2\sigma = \omega(x_1)\frac{t}{x_1} \quad \text{with} \quad \omega(x_1) := \frac{\lambda}{|x_1|}. \qquad (18)$$

where λ is a real constant with positive numerical value.

In this case:

$$v(t,x) = \mathrm{c}\tanh\left(\frac{\lambda}{|x|}\frac{t}{x}\right).$$

If g is an acceleration of system <t',x_1'> as respects to system <t,x_1> then

$$g(t,x_1) := \frac{\partial v}{\partial t} = \frac{c\,\omega(x_1)}{|x_1|\cosh^2\left(\omega(x_1)\frac{t}{x_1}\right)}.$$

Fig. 5 shows a dependency of this acceleration on x_1.

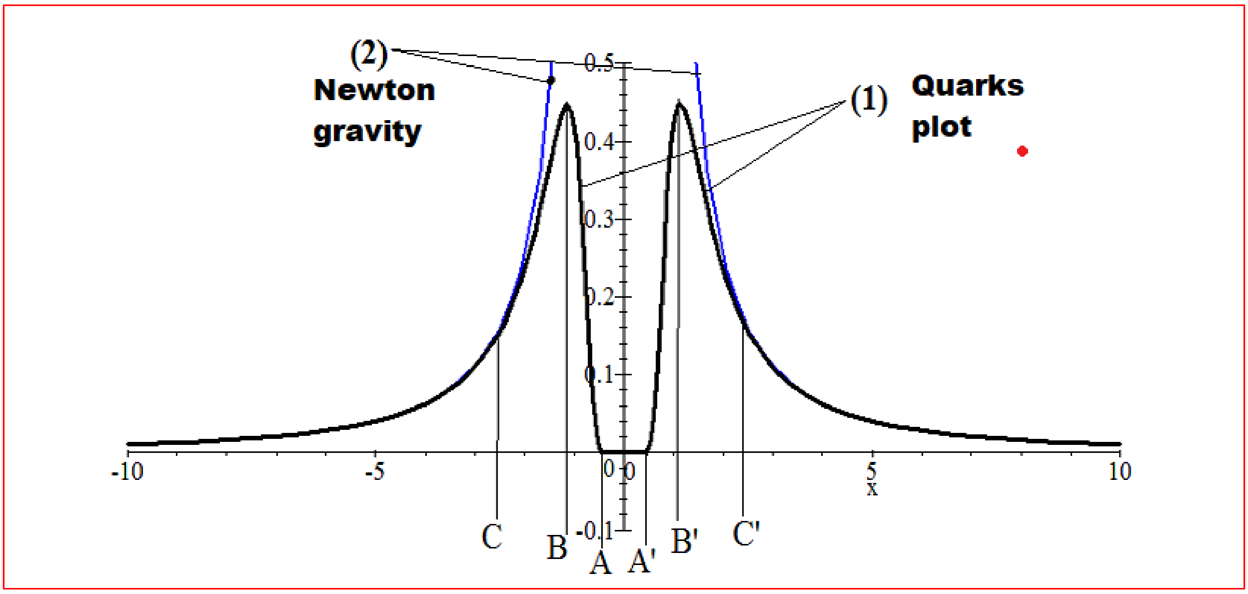
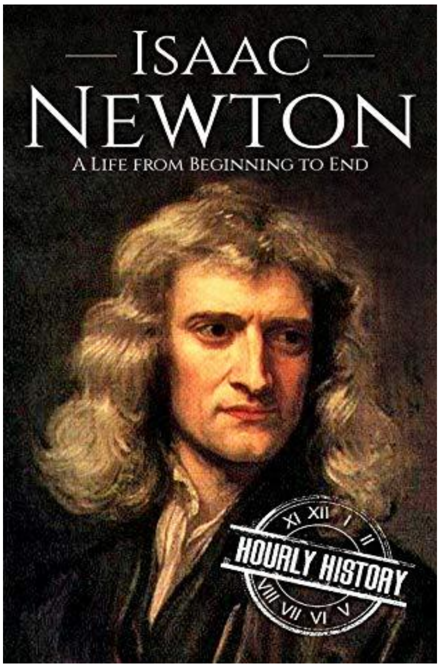


Fig. 5

- Hence, to the right from point *C′ and to the left from poin C the Newtonian gravitation*

law[19] is carried out. ($g(x_1) \approx \frac{\lambda}{x_1^{\,2}}$.)

- AA′ is the *Asymptotic Freedom*[20] *Zone.*
- CB and B′C′ is *the Confinement*[21] *Zone.*



[19] **Sir Isaac Newton** (25 December 1642 – 20 March was an English mathematician, physicist, astronomer, theologian, and author (described in his own day as a "natural philosopher") who is widely recognized as one of the most influential scientists of all time and as a key figure in the scientific revolution.

[20] Asymptotic freedom in QCD was discovered in 1973 by David Gross and Frank Wilczek,[1] and independently by David Politzer in the same year

[21] "Today, we know that there are many phenomena, especially confinement in QCD, that cannot be understood "David J. Gross, Proc Natl Acad Sci U S A. 2005 Jun 28; 102(26): 9099–9108. Published online 2005 Jun 20. doi: 10.1073/pnas.0503831102

4.2. *Dark Energy. Dark Matter*

In 1998 observations of Type Ia supernovae suggested that the expansion of the universe is accelerating. From [14]. In the past few years, these observations have been corroborated by several independent sources [15]

$V(r) = Hr$

where $V(r)$ is the velocity of expansion on the distance r, H is the Hubble's constant ($H \approx 2.3\times10^{-18}c^{-1}$ confirms the Hubble[22] constant. Retrieved on 2007-03-07.[16] This expansion is defined by the Hubble rule [17]

From (18):

$$v(t, x_1) = c \tanh\frac{\lambda t}{x_1^2}. \qquad (19)$$

Fig. 6 shows the dependency of the system <t',x_1'> velocity $v(t; x_1)$ on x_1 in system

[22] **Edwin Hubble**, in full **Edwin Powell Hubble**, (born November 20, 1889, Marshfield, Missoui, U.S.—died September 28, 1953, San Marino, California), American astronomer who played a crucial role in establishing the field of extragalactic astronomy and is generally regarded as the leading observational cosmologist of the 20th century.

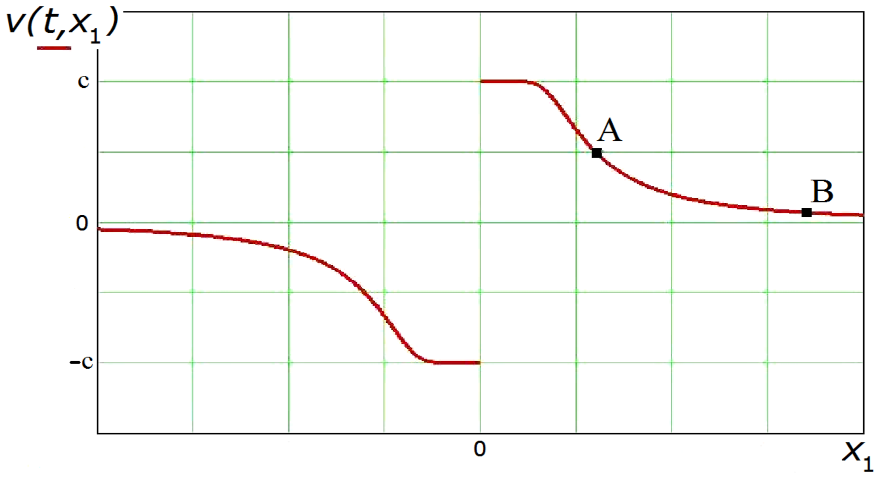


Fig. 6

Let a black hole be placed in a point *O* (Fig. 1). Then a tremendous number of quarks states oscillate in this point. These oscillations bend time-space and if *t* has some fixed volume, $x_1 > 0$, and $\Lambda := \lambda t$ then:

$$v(x_1) = c \tanh \frac{\Lambda}{x_1^2}. \qquad (20)$$

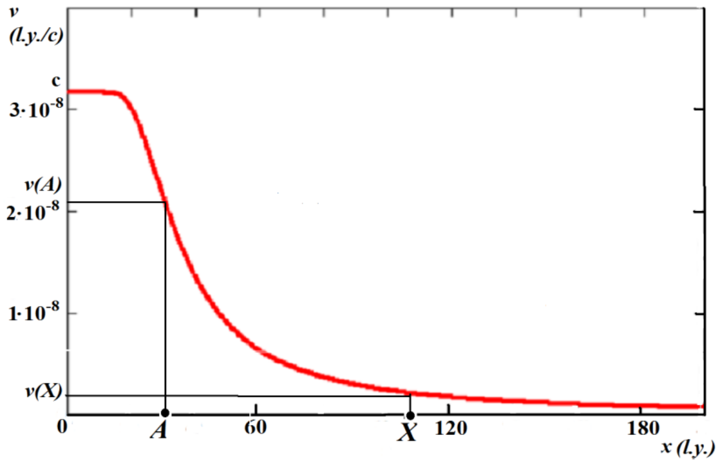


Fig. 7

A dependency of $v(x_1)$ (light years/c.) on x_1 (light years) with Λ = 741:907 is shown in Fig. 7.

Let a placed in a point *A* observer be stationary in the coordinate system $<t,x_1>$. Hence, in the coordinate system $<t',x_1'>$ this observer is flying to the left to the point *O* with velocity $-v(x_A)$. And point *X* is flying to the left to the point *O* with velocity $-v(x_1)$.

Consequently, the observer *A* sees that the point *X* flies away from him to the right with velocity

$$V_A(x_1) := c \tanh\left(\frac{\Lambda}{x_A^2} - \frac{\Lambda}{x_1^2}\right)$$

in accordance with the relativistic rule of addition of velocities.

Let $r := x_1 - x_A$ (i.e. r is a distance from A to X), and

$$V_A(r) := c \tanh\left(\frac{\Lambda}{x_A^2} - \frac{\Lambda}{(x_A^2 + r)}\right).$$

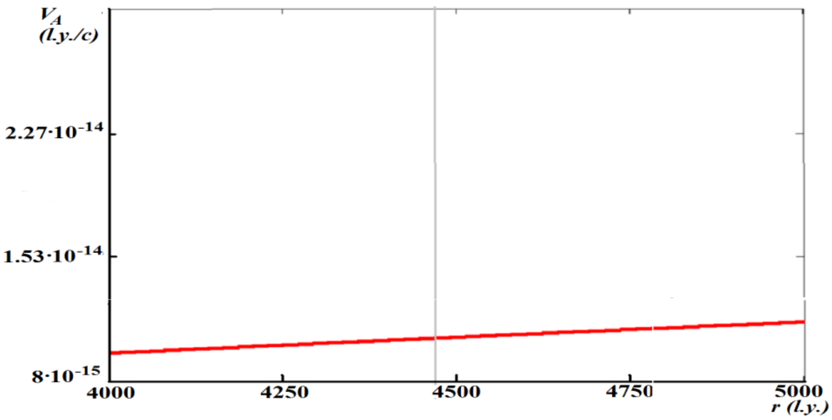


Fig.8

In that case Fig. 8 demonstrates the dependence of $V_A(r)$ on r with $x_A = 25\times10^3$ l.y. This picture shows that X runs from A with almost constant acceleration H.

Therefore, the phenomenon of the accelerated expansion of Universe is the result of the curvature of space-time that arises because the chromatic states oscillate.

In 1933, the astronomer Fritz Zwicky[23] was studying the motions of distant galaxies. Zwicky estimated the total mass of a group of galaxies by measuring their brightness. When he used a different method to compute the mass of the same cluster of galaxies, he came up with a number that was 400 times his original estimate This discrepancy in the observed and computed masses is now known as "the missing mass problem." Nobody did much with Zwicky's finding until the 1970's, when scientists began to realize that only large amounts of hidden mass could

FRITZ ZWICKY

[23] **Fritz Zwicky** February 14, 1898 – February 8, 1974) was a Swiss astronomer. He worked most of his life at the California Institute of Technology in the United States of America, where he made many important contributions in theoretical and observational astronomy.[2] In 1933, Zwicky was the first to use the virial theorem to infer the existence of unseen dark matter, describing it as "*dunkle (kalt) Materie*".[3][4]

explain many of their observations. Scientists also realize that the existence of some unseen mass would also support theories regarding the structure of the universe. Today, scientists are searching for the mysterious dark matter not only to explain the gravitational motions of galaxies, but also to validate current theories about the origin and the fate of the universe» [18] (Fig. 4 [19]).

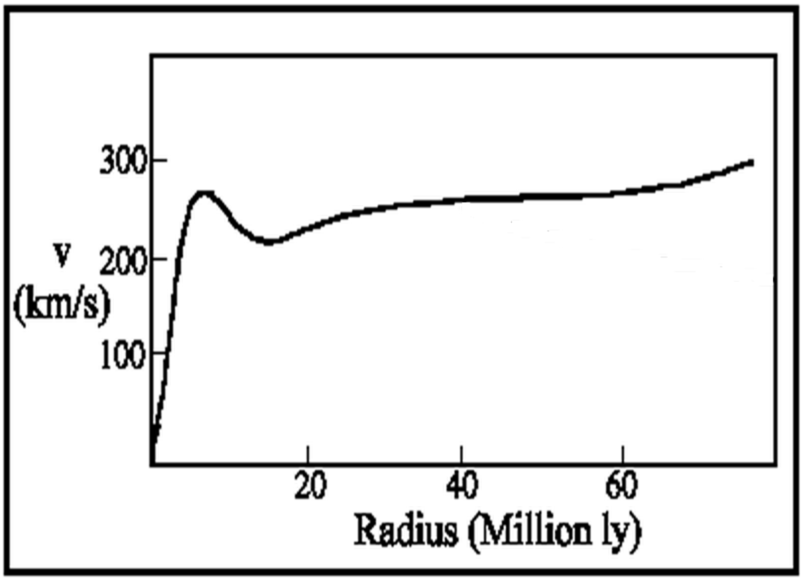


Fig.9 **.** *A rotation curve for a typical spiral galaxy. The solid line shows actual measurements(Hawley and Holcomb., 1998, p. 390)*

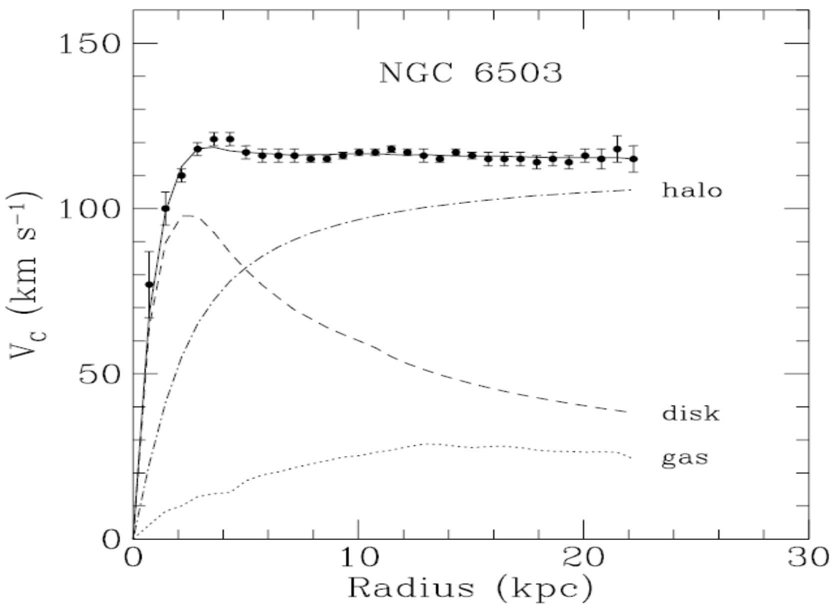


Fig.10

Rotation curve of NGC 6503. The dash-dotted lines are the contributions of dark matter [20]

[1. p.148]:

$$\frac{\partial}{\partial x'} = \cos 2\alpha \times \frac{\partial}{\partial x} - \sin 2\alpha \times \frac{\partial}{\partial y},$$
$$\frac{\partial}{\partial y'} = \cos 2\alpha \times \frac{\partial}{\partial y} + \sin 2\alpha \times \frac{\partial}{\partial x}.$$

Let $z = x + iy$ i.e $z = re^{i\theta}$. $z' = x' + iy'$.

Because linear velocity of the curved coordinate system ⟨x';y'⟩ into the initial system ⟨x;y⟩ is the following :

$$v = \left(\left(\frac{\partial x'}{\partial t} \right)^2 + \left(\frac{\partial y'}{\partial t} \right)^2 \right)^{\frac{1}{2}}$$ Then $v = \left| \frac{\partial z'}{\partial t} \right|$.

Let function z' be a holomorphic function. Hence, in accordance with the Cauchy-Riemann conditions the following equations are fulfilled:

$$= -\frac{\partial y'}{\partial x}.$$

Therefore, $dz' = e^{-i(2\alpha)} dz$ where 2α is an holomorphic function, too.

For example, let

$$2\alpha = \frac{1}{t}((y - x) - i(x + y))^2$$

Inthat case:

$$z' = \int \frac{((x+y) + i(y-x))^2}{t} dx + i \int \frac{((x+y) + i(y-x))^2}{t} dy$$

Let $k = y/x$. Hence,

$$z' = \int \exp\left(\frac{((x+kx) + i(kx - x))^2}{t} \right) dx + i \int \exp\left(\frac{\left(\left(\frac{y}{k} + y \right) + i\left(y - \frac{y}{k} \right) \right)^2}{t} \right) dy$$

Calculate

$$\int \exp\left(\frac{((x+kx) + i\,(kx - x))^2}{t} \right) dx == \frac{1}{2}\sqrt{\pi}\, \frac{\operatorname{erf}\left(x\sqrt{-\frac{1}{t}(2ik + 4k - 2i)} \right)}{\sqrt{-\frac{1}{t}(2ik + 4k - 2i)}},$$

$$i\int \exp\left(\frac{\left(\left(\frac{y}{k}+y\right)+i\left(y-\frac{y}{k}\right)\right)^2}{t}\right)dy=\frac{1}{2}\sqrt{\pi}\,\frac{\operatorname{erf}\left(y\sqrt{-\frac{1}{k^2t}\left(2ik^2+4k-2i\right)}\right)}{\sqrt{-\frac{1}{k^2t}\left(2ik^2+4k-2i\right)}}$$

$$\frac{\partial z'}{\partial t}=\frac{1}{-8i\sqrt{t}(k-i)^3\sqrt{-2i}}\left(\begin{array}{l}-4y(k-i)^2\sqrt{-\frac{1}{t}2i(k-i)^2}\,\exp\left(\frac{1}{k^2t}y^2 2i(k-i)^2\right)\\ +4ikx(k-i)^2\sqrt{-\frac{1}{k^2t}2i(k-i)^2}\,\exp\left(\frac{1}{t}x^2 2i(k-i)^2\right)\\ +i\sqrt{\pi}k^2t2i(k-i)^2\sqrt{\frac{1}{k^2t}}\,\operatorname{erf}\left(y\sqrt{-\frac{1}{k^2t}2i(k-i)^2}\right)\\ +\sqrt{\pi}kt2i(k-i)^2\sqrt{\frac{1}{k^2t^2}}\,\operatorname{erf}\left(x\sqrt{-\frac{1}{t}2i(k-i)^2}\right)\end{array}\right)$$

For large *t:*

$$\frac{\partial z'}{\partial t}=\frac{1}{-8i\sqrt{t}(k-i)^3\sqrt{-2i}}\left(i\sqrt{\pi}k^2t2i(k-i)^2\sqrt{\frac{1}{k^2t}}\,\operatorname{erf}\left(y\sqrt{-\frac{1}{k^2t}2i(k-i)^2}\right)\right)$$

Hence,

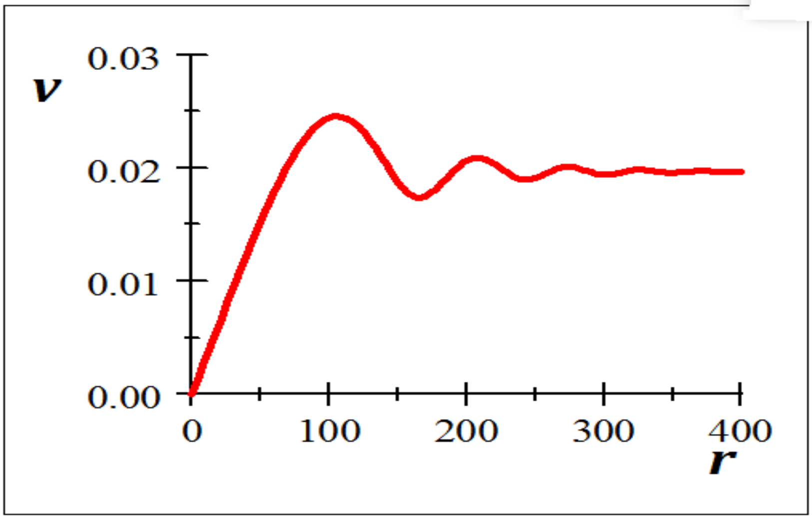
$$v\approx\left|\frac{1}{8}(1-i)k\sqrt{\pi}\,\frac{1}{k-i}\operatorname{erf}\left(\sqrt{-\frac{1}{t}2i(k-i)^2}\right)\right|$$

Because $k=\tan\theta,\quad x=r\cos\theta$

Then

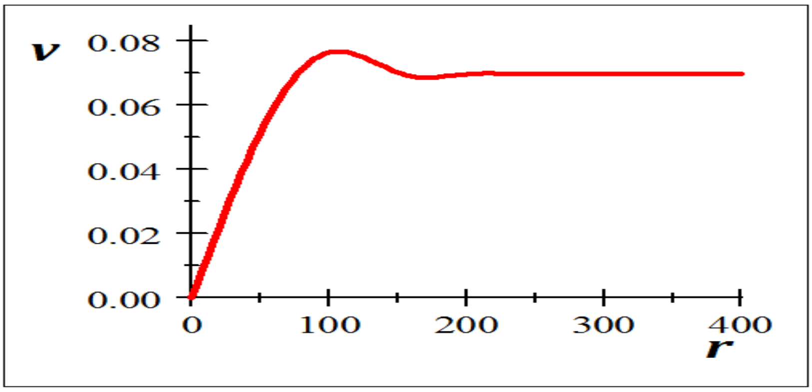
$$v\approx\left|\frac{1}{8}(1-i)(\tan\theta)\sqrt{\pi}\,\frac{1}{(\tan\theta)-i}\operatorname{erf}\left(r\,(\cos\theta)\sqrt{-\frac{1}{t}2i\,((\tan\theta)-i)^2}\right)\right|$$

For ϑ:=0.98π, *t*=10E4:



Compate with Fig.10.

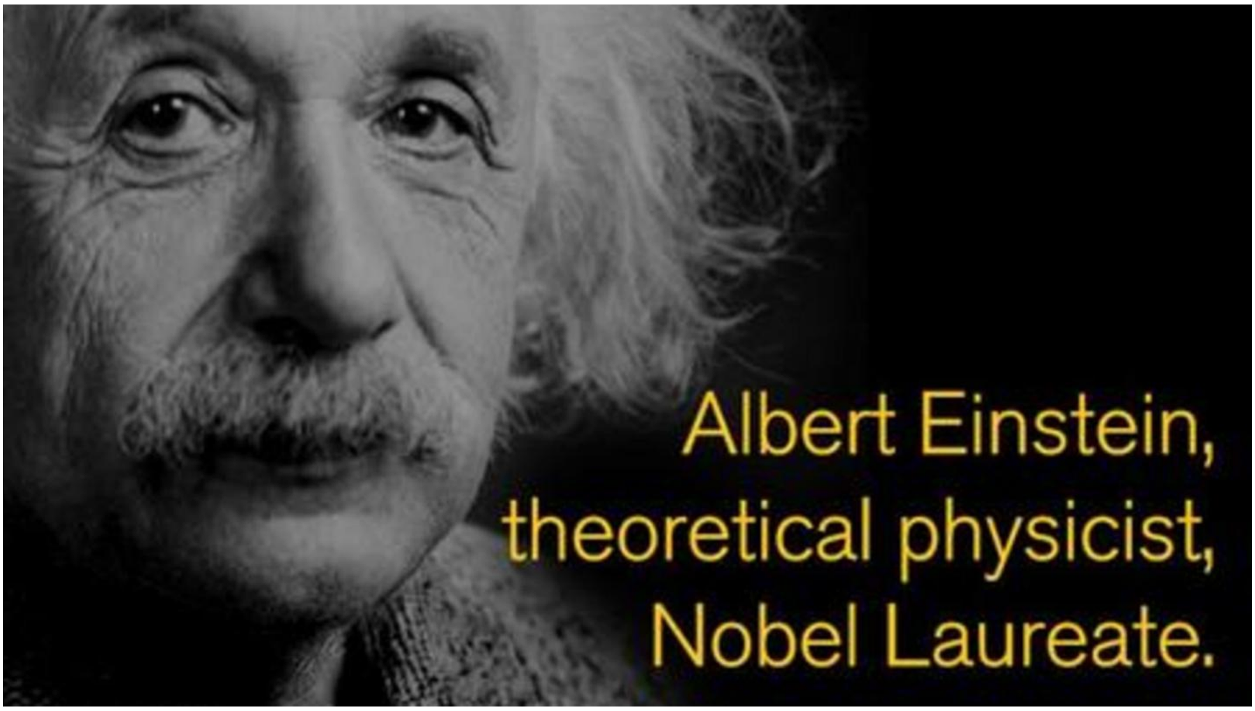
For ϑ = 13π/14. t = 10E4:



Compare with Fig.9.

Hence, Dark Matter and Dark Energy can be mirages in the space-time, which is curved by oscillations of chromatic states.

The idea of curved time-space belongs to Albert Einstein[24] (the General Relatively Theory. 1913).



4.3. *Leptons*

In 1963 American physicist Sheldon Glashow[25] proposed that the weak nuclear force and electricity and magnetism could arise from a partially unified electroweak theory. But "… there is major problem: all the fermions and gauge bosons are massless, while experiment shows otherwise".

Why not just add in mass terms explicitly? That will not work, since the associated terms break *SU*(2) or gauge invariances. For fermions, the mass term should be $m \overline{\psi} \psi$

$$m\overline{\psi}\,\psi = m\overline{\psi}\,(P_L + P_R)\psi = m\overline{\psi}\,P_L\,P_L\,\psi + m\overline{\psi}\,P_R\,P_R\,\psi = m\,(\overline{\psi}_R\,\psi_L + \overline{\psi}_L\,\psi_R).$$

24 **Albert Einstein** 14 March 1879 – 18 April 1955) was a German-born theoretical physicist

25 **Sheldon Lee Glashow** born December 5, 1932) is a Nobel Prize winning American theoretical physicit.

However, the left-handed fermion are put into *SU*(2) doublets and the right-handed ones into *SU*(2) singlets, so $\overline{\psi}_R \psi_L$ and $\overline{\psi}_L \psi_R$ are not *SU*(2) singlets and would not give an *SU*(2) invariant Lagrangian.

Similarly, the expected mass terms for the gauge bosons,

$$\frac{1}{2} m_B{}^2 B^\mu B_\mu$$

plus similar terms for other, are clearly not invariant under gauge transformations

$B_\mu \to B_\mu' = B_\mu - \partial_\mu \chi / g$, The only direct way to preserve the gauge invariance and *SU*(2) invariance of Lagrangian is to set $m = 0$ for all quarks, leptons and gauge bosons…. There is a way to solve this problem, called the Higgs mechanism" [21].

No. The Dirac Lagrangian for a free fermion can have of the following form:

$$L_f := \overline{\psi} \left(\beta^{[0]}\partial_0 + \beta^{[1]}\partial_1 + \beta^{[2]}\partial_2 + \beta^{[3]}\partial_3 + m\gamma^{[0]}\right) \psi.$$

Here matrices $\beta^{[1]}$, $\beta^{[2]}$, $\beta^{[3]}$, and $\gamma^{[0}$ anticommute among themselves.

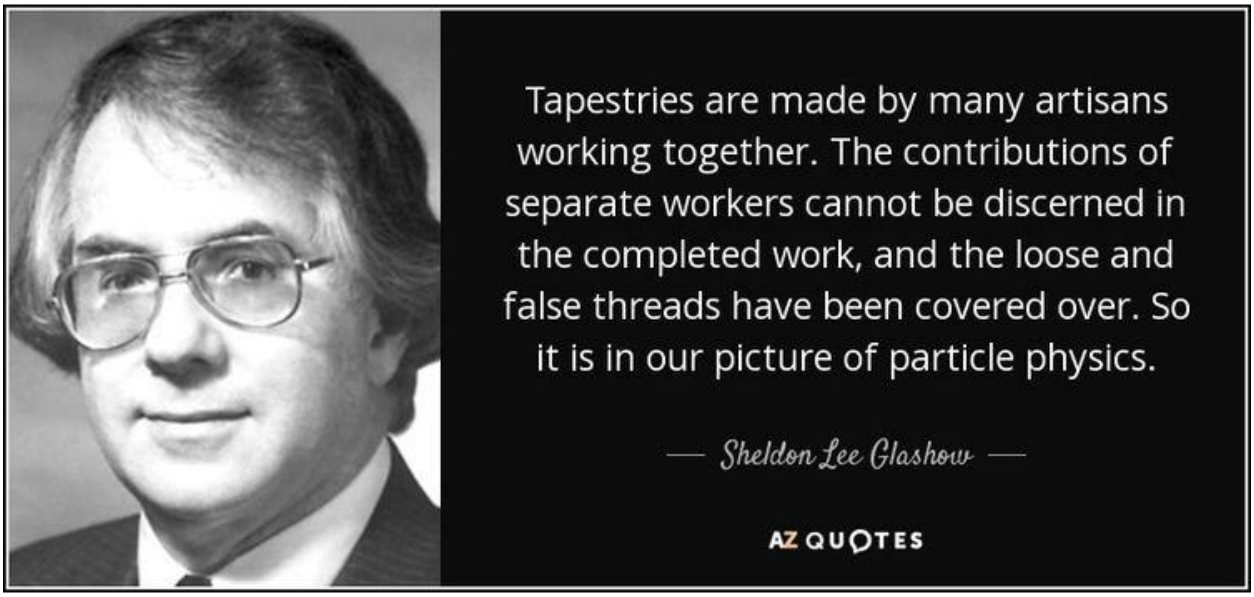
Indeed, this Lagrangian is not invariant under the *SU*(2) transformation. But it is beautiful and truncating its mass term is not good idea.

But The boson's existence was confirmed in 2012 by
the ATLAS and CMS collaborations based oncollisions in the LHC at CERN. Three particles with mass 124.5 - 126 GeV were found in CERN [18.
The ATLAS and CMS Collaborations, Combined Measurement of the Higgs Boson Mass in pp Collisions at s = 7 and 8 TeV with the ATLAS and CMS experiments.
http://arxiv.org/pdf/1503.07589] . And Rolf-Dieter Heuer and Fabiola Gianotti – supervisors of LHC – announce these particles as the higgs boson.

But no connection was found between the 124.5 - 126 GeV particle and the Higgs mechanism. There is no explanation of the stability of the universe in the Higgs field. Nothing in Standard Model gives a precisevalue for the Higgs's own mass, and calculations from first principles, based on quantum theory, suggest it should be enormous—roughly a hundred million billion times higher than its measured value. Physicists have therefore introduced an ugly fudge factor into their equations (a process called "fine-tuning") to sidestep the problem.

Besides, all the known elementary bosons are gauge - it is photons, W- and Z-bosons and gluons.

It is likely that the 125-126 particle is of some hadrons multiplet.



Let the Basix Quant Equation das not contain $M_{\varsigma,0}, M_{\varsigma,4}, M_{\eta,0}, M_{\eta,4}, M_{\theta.0}, M_{\theta,4}$:

And the following equation:

$$\left(\sum_{k=0}^{3} \beta^{[k]} \left(\mathrm{i}\partial_k - \Theta_k - \Upsilon_k \gamma^{[5]}\right) - M_0 \gamma^{[0]} - M_4 \beta^{[4]}\right) \widetilde{\varphi} = 0$$

Is called the ***Lepton Equation of Moving***.

If like (4*}:

$$\frac{j_5}{c} = -\varphi^{\dagger} \gamma^{[0]} \varphi; \quad \frac{j_4}{c} = -\varphi^{\dagger} \beta^{[4]} \varphi.$$

And

$$u_5 := \frac{j_5}{j_0}; \quad u_4 := \frac{j_4}{j_0}.$$

From [1. p.87]: $u_1^2 + u_1^2 + u_1^2 + u_1^2 + u_1^2 = c^2$.

Thus, of only all five elements of a Clifford pentad lends an entire kit of velocity components and, for completeness, yet two ”space” coordinates x_5 and x_4 should be added to our three x_1,x_2, x_3.

Let

$$\widetilde{\varphi}(t,x_1,x_2,x_3,x_5,x_4) := \varphi(t,x_1,x_2,x_3)\cdot$$
$$\cdot(\exp(\mathrm{i}(x_5M_0(t,x_1,x_2,x_3)+x_4M_4(t,x_1,x_2,x_3)))).$$

In this case the Lepton Equation of moving shape is the following:

$$\left(\sum_{k=0}^{3}\beta^{[0]}\left(\mathrm{i}\partial_k-\Theta_k-\Upsilon_k\gamma^{[5]}\right)-\gamma^{[0]}\mathrm{i}\partial_5-\beta^{[4]}\mathrm{i}\partial_4\right)\widetilde{\varphi}=0$$

This equation is the *differential form of Lepton Equation*.

B boson

Let g_1 be the positive real number and for $\mu\in\{0,1,2,3\}$: $F\mu$ and $B\mu$ be the solutions of the following system of the equations:

$$\left\{\begin{array}{c} -0.5g_1B_\mu+F_\mu=-\Theta_\mu-\Upsilon_\mu; \\ -g_1B_\mu+F_\mu=-\Theta_\mu+\Upsilon_\mu. \end{array}\right|$$

Let charge matrix be denoted as the following:

$$Y:=-\left[\begin{array}{cc} 1_2 & 0_2 \\ 0_2 & 2\cdot 1_2 \end{array}\right]$$

In this case:

$$-\Theta_\mu-\Upsilon_\mu\gamma^{[5]}=F_\mu+0.5g_1YB_\mu$$

Therefore, the differential form of Lepton Equation is:

$$\left(\sum_{k=0}^{3}\beta^{[k]}\left(\mathrm{i}\partial_k+F_k+0.5g_1YB_k\right)-\gamma^{[0]}\mathrm{i}\partial_5-\beta^{[4]}\mathrm{i}\partial_4\right)\widetilde{\varphi}=0$$

The following sum is the Lepton Hamiltonian[26]:

$$H_l = c\left(\sum_{k=1}^{3}\beta^{[k]}\left(\mathrm{i}\partial_k+F_k+0.5g_1YB_k\right)-\gamma^{[0]}\mathrm{i}\partial_5-\beta^{[4]}\mathrm{i}\partial_4\right)$$

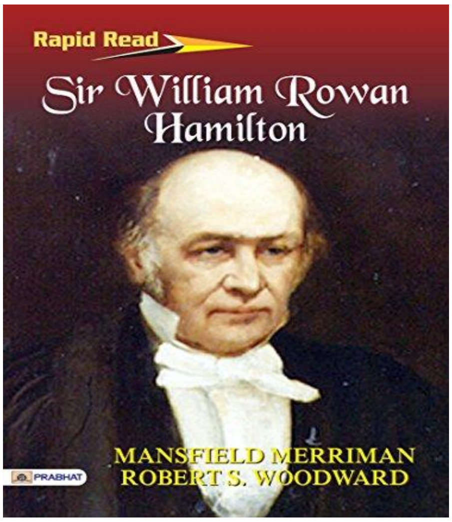
Let $\chi(t,x_1,x_2,x_3)$ be the real function and:

$$\widetilde{U}(\chi) := \begin{bmatrix} \exp\left(\mathrm{i}\frac{\chi}{2}\right)1_2 & 0_2 \\ 0_2 & \exp\left(\mathrm{i}\chi\right)1_2 \end{bmatrix}.$$

Because for $\mu \in \{0,1,2,3\}$ [1. pp.89—90]

$$\partial_\mu\widetilde{U} = -\mathrm{i}\frac{\partial_\mu\chi}{2}Y\widetilde{U}.$$

and



$$\begin{aligned}
\widetilde{U}^{\dagger}\gamma^{[0]}\widetilde{U} &= \gamma^{[0]}\cos\frac{\chi}{2}+\beta^{[4]}\sin\frac{\chi}{2},\\
\widetilde{U}^{\dagger}\beta^{[4]}\widetilde{U} &= \beta^{[4]}\cos\frac{\chi}{2}-\gamma^{[0]}\sin\frac{\chi}{2},\\
\widetilde{U}^{\dagger}\widetilde{U} &= 1_4,\\
\widetilde{U}^{\dagger}Y\widetilde{U} &= Y,\\
\beta^{[k]}\widetilde{U} &= \widetilde{U}\beta^{[k]}
\end{aligned}$$

Then the Lpton Equation of moving is invariant under the following transformations [1. pp.90—93]:

[26] **Sir William Rowan Hamilton** 1805 – 2 September 1865) was an Irish mathematician, Andrews Professor of Astronomy at Trinity College Dublin, and Royal Astronomer of Ireland.

$$x_4 \to x_4' = x_4 \cos\frac{\chi}{2} - x_5 \sin\frac{\chi}{2};$$
$$x_5 \to x_5' = x_5 \cos\frac{\chi}{2} + x_4 \sin\frac{\chi}{2};$$
$$x_\mu \to x_\mu' = x_\mu \text{ for } \mu \in \{0,1,2,3\};$$
$$\widetilde{\varphi} \to \widetilde{\varphi}' = \widetilde{U}\widetilde{\varphi},$$
$$B_\mu \to B_\mu' = B_\mu - \frac{1}{g_1}\partial_\mu \chi,$$
$$F_\mu \to F_\mu' = \widetilde{U} F_s \widetilde{U}^\dagger.$$

Therefore, $B\mu$ is like to the B-boson field of Standard Model[27] field

Electroweak Theory

if A is a 2×2-matrix then:

2. $A1_4 := \begin{bmatrix} A & 0_2 \\ 0_2 & A \end{bmatrix}$ and $1_4 A := \begin{bmatrix} A & 0_2 \\ 0_2 & A \end{bmatrix}$;
3. and if B is 4×4-matrix then:
4. $A+B := A^{1_4}+B$, $AB := A^{1_4}B$;

Let $U^{(-)}$ be a 8×8 matrix such that

for s $\in$ {0.1,2,3}

$$\left(U^{(-)}\widetilde{\varphi}, \beta^{[s]} U^{(-)}\widetilde{\varphi}\right) = -\frac{j_s}{c}$$

27 **Standard model**, the combination of two theories of particle physics into a single framework to describe all interactions of subatomic particles, except those due to gravity. The two components of the standard model are electroweak theory, which describes interactions via the electromagnetic and weak forces, and quantum chromodynamics, the theory of the strong nuclear force. Both these theories are gauge field theories, which describe the interactions between particles in terms of the exchange of intermediary “messenger” particles that have one unit of intrinsic angular momentum, or spin (Encyclopedia Britanica)

Here $\beta^{[s]} = \beta^{[s]}1_8$.

Such transformation has a matrix of the following shape [1. pp.110—113]:

$$U^{(-)} := \begin{bmatrix} (a+ib)\,1_2 & 0_2 & (c+ig)\,1_2 & 0_2 \\ 0_2 & 1_2 & 0_2 & 0_2 \\ (-c+ig)\,1_2 & 0_2 & (a-ib)\,1_2 & 0_2 \\ 0_2 & 0_2 & 0_2 & 1_2 \end{bmatrix}$$

With real *a,b,c,g* such that $a^2 + b^2 + c^2 + g^2 = 1$.

Let

$$\ell_\circ := \frac{1}{2\sqrt{(1-a^2)}} \begin{bmatrix} \left(b+\sqrt{(1-a^2)}\right) 1_4 & (q-\mathrm{i}c)\,1_4 \\ (q+\mathrm{i}c)\,1_4 & \left(\sqrt{(1-a^2)}-b\right) 1_4 \end{bmatrix}$$

$$\ell_* := \frac{1}{2\sqrt{(1-a^2)}} \begin{bmatrix} \left(\sqrt{(1-a^2)}-b\right) 1_4 & (-q+\mathrm{i}c)\,1_4 \\ (-q-\mathrm{i}c)\,1_4 & \left(b+\sqrt{(1-a^2)}\right) 1_4 \end{bmatrix}$$

These operators are fulfilled to the following conditions:

$$\ell_\circ \ell_\circ = \ell_\circ,\ \ell_* \ell_* = \ell_*;$$
$$\ell_\circ \ell_* = 0 = \ell_* \ell_\circ,$$
$$(\ell_\circ - \ell_*)(\ell_\circ - \ell_*) = 1_8,$$
$$\ell_\circ + \ell_* = 1_8,$$

$$\ell_\circ \gamma^{[0]} = \gamma^{[0]} \ell_\circ,\ \ell_* \gamma^{[0]} = \gamma^{[0]} \ell_*,$$
$$\ell_\circ \beta^{[4]} = \beta^{[4]} \ell_\circ,\ \ell_* \beta^{[4]} = \beta^{[4]} \ell_*$$

$$U^{(-)\dagger} \gamma^{[0]} U^{(-)} = a\gamma^{[0]} - (\ell_\circ - \ell_*)\sqrt{1-a^2}\beta^{[4]},$$
$$U^{(-)\dagger} \beta^{[4]} U^{(-)} = a\beta^{[4]} + (\ell_\circ - \ell_*)\sqrt{1-a^2}\gamma^{[0]}.$$

The Lepton Equation is invariant for the following global transformation [1. pp.113—114]:

$$\widetilde{\varphi} \to \widetilde{\varphi}' = U^{(-)} \widetilde{\varphi},$$
$$x_4 \to x_4' = (\ell_\circ + \ell_*) a x_4 + (\ell_\circ - \ell_*)\sqrt{1-a^2} x_5,$$
$$x_5 \to x_5' = (\ell_\circ + \ell_*) a x_5 - (\ell_\circ - \ell_*)\sqrt{1-a^2} x_4,$$
$$x_\mu \to x_\mu' = x_\mu.$$

7.2. W and Z bosons

Let g_2 be some positive real number. If design (here: a,b,c,q form $U^{(-)}$):

$$W_{0,\mu} := -2\frac{1}{g_2 q}\left(\begin{array}{c} q(\partial_\mu a)b - q(\partial_\mu b)a + (\partial_\mu c)q^2 + \\ +a(\partial_\mu a)c + b(\partial_\mu b)c + c^2(\partial_\mu c) \end{array}\right)$$
$$W_{1,\mu} := -2\frac{1}{g_2 q}\left(\begin{array}{c} (\partial_\mu a)a^2 - bq(\partial_\mu c) + a(\partial_\mu b)b + \\ +a(\partial_\mu c)c + q^2(\partial_\mu a) + c(\partial_\mu b)q \end{array}\right)$$
$$W_{2,\mu} := -2\frac{1}{g_2 q}\left(\begin{array}{c} q(\partial_\mu a)c - a(\partial_\mu a)b - b^2(\partial_\mu b) - \\ -c(\partial_\mu c)b - (\partial_\mu b)q^2 - (\partial_\mu c)qa \end{array}\right)$$

And

$$W_\mu := \begin{bmatrix} W_{0,\mu}1_2 & 0_2 & (W_{1,\mu} - \mathrm{i}W_{2,\mu})\,1_2 & 0_2 \\ 0_2 & 0_2 & 0_2 & 0_2 \\ (W_{1,\mu} + \mathrm{i}W_{2,\mu})\,1_2 & 0_2 & -W_{0,\mu}1_2 & 0_2 \\ 0_2 & 0_2 & 0_2 & 0_2 \end{bmatrix}$$

then

$$-\mathrm{i}\left(\partial_\mu U^{(-)}\right)U^{(-)\dagger} = \frac{1}{2}g_2 W_\mu,$$

and [1. pp.136—137]:

$$\boxed{\partial_\mu W_\nu - \partial_\nu W_\mu = \mathrm{i}\tfrac{g_2}{2}\left(W_\mu W_\nu - W_\nu W_\mu\right).}$$

Hence [1. pp.137—138],

$$\begin{aligned} \partial_\nu W_{0,\mu} &= \partial_\mu W_{0,\nu} - g_2\left(W_{1,\mu}W_{2,\nu} - W_{1,\nu}W_{2,\mu}\right), \\ \partial_\nu W_{1,\mu} &= \partial_\mu W_{1,\nu} - g_2\left(W_{2,\mu}W_{0,\nu} - W_{2,\nu}W_{0,\mu}\right), \\ \partial_\nu W_{2,\mu} &= \partial_\mu W_{2,\nu} - g_2\left(W_{0,\mu}W_{1,\nu} - W_{0,\nu}W_{1,\mu}\right). \end{aligned}$$

This system of differential equations has the following result [1. pp.137—141]:

This is the Klein-Gordon[28] equation of field $W_{0,\mu}$ with mass and with additional terms of the $W_{0,\mu}$ interactions with others components of W . You can receive similar equations for $W_{1,\mu}$ and for $W_{2,\mu}$

[28] The equation was named after the physicists Oskar Klein and Walter Gordon, who in 1926 proposed that it describes relativistic electrons

$$\left(-\frac{1}{c^2}\partial_t^2 + \sum_{s=1}^{3}\partial_s^2\right)\varphi = \frac{m^2c^2}{h^2}\varphi$$

$$\left(-\frac{1}{c^2}\partial_t^2+\sum_{s=1}^3\partial_s^2\right)W_{0,\mu}=g_2^2\left(\widetilde{W}_0^2-\sum_{s=1}^3\widetilde{W}_s^2\right)W_{0,\mu}+$$
$$+g_2^2\left(\sum_{s=1}^3\left\langle\widetilde{W}_s|\widetilde{W}_\mu\right\rangle W_{0,s}-\left\langle\widetilde{W}_0|\widetilde{W}_\mu\right\rangle W_{0,0}\right)$$
$$+g_2\left(\begin{array}{c}\left(\begin{array}{c}(\partial_\mu W_{1,0})W_{2,0}-W_{1,0}\partial_\mu W_{2,0}\\ +W_{1,\mu}(\partial_0 W_{2,0})-(\partial_0 W_{1,0})W_{2,\mu}\end{array}\right)\\ -\sum_{s=1}^3\left(\begin{array}{c}(\partial_\mu W_{1,s})W_{2,s}-W_{1,s}\partial_\mu W_{2,s}\\ +W_{1,\mu}(\partial_s W_{2,s})-(\partial_s W_{1,s})W_{2,\mu}\end{array}\right)\end{array}\right)$$
$$+\partial_\mu\sum_{s=1}^3\partial_s W_{0,s}-\partial_\mu\partial_0 W_{0,0}.$$

Here:

$$\widetilde{W}_\nu^2:=W_{0,\nu}W_{0,\nu}+W_{1,\nu}W_{1,\nu}+W_{2,\nu}W_{2,\nu}$$

$$\left\langle\widetilde{W}_\nu|\widetilde{W}_\mu\right\rangle:=W_{0,\nu}W_{0,\mu}+W_{1,\nu}W_{1,\mu}+W_{2,\mu}W_{2,\nu}=\left\langle\widetilde{W}_\nu|\widetilde{W}_\mu\right\rangle$$

$$\widetilde{W}_\mu=\begin{bmatrix}W_{0,\mu}\\ W_{1,\mu}\\ W_{2,\mu}\end{bmatrix}\text{ and }\widetilde{W}_\nu=\begin{bmatrix}W_{0,\nu}\\ W_{1,\nu}\\ W_{2,\nu}\end{bmatrix}$$

$$m=\frac{\mathrm{h}}{\mathrm{c}}g_2\sqrt{\widetilde{W}_0^2-\sum_{s=1}^3\widetilde{W}_s^2}$$

such ”mass”) is invariant for the Lorentz transformations and invariant for the transformations of turns, too [1. pp.141—142].

Let[29]

$$\alpha:=\arctan\frac{g_1}{g_2},$$
$$Z_\mu:=(W_{0,\mu}\cos\alpha-B_\mu\sin\alpha),$$
$$A_\mu:=(B_\mu\cos\alpha+W_{0,\mu}\sin\alpha).$$

[29] here α is the Weinberg Angle. The experimental value of sin2 α = 0.23124±0.00024 [19].

Like Standard Model [1. pp.142—143]:

$$m_Z = \frac{m_W}{\cos\alpha}$$

The Lepton Equation of moving under has the following form:

$$\left(\begin{array}{c} \sum_{\mu=0}^{3} \beta^{[\mu]} \mathrm{i} \left(\partial_\mu - \mathrm{i}0.5 g_1 B_\mu Y - \mathrm{i}\frac{1}{2} g_2 W_\mu\right) \\ +\gamma^{[0]} \mathrm{i}\partial_5 + \beta^{[4]} \mathrm{i}\partial_4 \end{array} \right) \widetilde{\varphi} = 0.$$

That is

$$\begin{array}{c} \sum_{\mu=0}^{3} \beta^{[\mu]} \mathrm{i} \times \\ \times \left(\left(\begin{array}{c} \partial_\mu - \mathrm{i}0.5 g_1 B_\mu \left(- \left[\begin{array}{cc} 1_2 & 0_2 \\ 0_2 & 2 \cdot 1_2 \end{array} \right] \right) - \\ -\mathrm{i}\frac{1}{2} g_2 \left[\begin{array}{cccc} W_{0,\mu} 1_2 & 0_2 & \left(W_{1,\mu} - \mathrm{i} W_{2,\mu}\right) 1_2 & 0_2 \\ 0_2 & 0_2 & 0_2 & 0_2 \\ \left(W_{1,\mu} + \mathrm{i} W_{2,\mu}\right) 1_2 & 0_2 & -W_{0,\mu} 1_2 & 0_2 \\ 0_2 & 0_2 & 0_2 & 0_2 \end{array} \right] \end{array} \right) \right. \\ \left. + \gamma^{[0]} \mathrm{i}\partial_5 + \beta^{[4]} \mathrm{i}\partial_4 \right) \\ \cdot \widetilde{\varphi} = 0. \end{array}$$

Here:

$$\begin{aligned} B_\mu &= \left(-Z_\mu \frac{g_1}{\sqrt{g_1^2 + g_2^2}} + A_\mu \frac{g_2}{\sqrt{g_1^2 + g_2^2}} \right), \\ W_{0,\mu} &= \left(Z_\mu \frac{g_2}{\sqrt{g_1^2 + g_2^2}} + A_\mu \frac{g_1}{\sqrt{g_1^2 + g_2^2}} \right). \end{aligned}$$

Let (e is the elementary charge[30]: e = 1.60217733×10^{-19} C).

$$e := \frac{g_1 g_2}{\sqrt{g_1^2 + g_2^2}},$$

And let

$$\widehat{Z}_\mu := Z_\mu \frac{1}{\sqrt{g_2^2 + g_1^2}} \begin{bmatrix} (g_2^2 + g_1^2)\, 1_2 & 0_2 & 0_2 & 0_2 \\ 0_2 & 2g_1^2 1_2 & 0_2 & 0_2 \\ 0_2 & 0_2 & (g_2^2 - g_1^2)\, 1_2 & 0_2 \\ 0_2 & 0_2 & 0_2 & 2g_1^2 1_2 \end{bmatrix}$$

$$\widehat{W}_\mu := g_2 \begin{bmatrix} 0_2 & 0_2 & (W_{1,\mu} - \mathrm{i}W_{2,\mu})\, 1_2 & 0_2 \\ 0_2 & 0_2 & 0_2 & 0_2 \\ (W_{1,\mu} + \mathrm{i}W_{2,\mu})\, 1_2 & 0_2 & 0_2 & 0_2 \\ 0_2 & 0_2 & 0_2 & 0_2 \cdot 1_2 \end{bmatrix},$$

$$\widehat{A}_\mu := A_\mu \begin{bmatrix} 0_2 & 0_2 & 0_2 & 0_2 \\ 0_2 & 1_2 & 0_2 & 0_2 \\ 0_2 & 0_2 & 1_2 & 0_2 \\ 0_2 & 0_2 & 0_2 & 1_2 \end{bmatrix}$$

In that case

$$\boxed{\left(\sum_{\mu=0}^{3} \beta^{[\mu]} \mathrm{i} \left(\partial_\mu + \mathrm{i}e\widehat{A}_\mu - \mathrm{i}0.5 \left(\widehat{Z}_\mu + \widehat{W}_\mu\right)\right) + \gamma^{[0]} \mathrm{i}\partial_5 + \beta^{[4]} \mathrm{i}\partial_4\right) \widetilde{\varphi} = 0.}$$

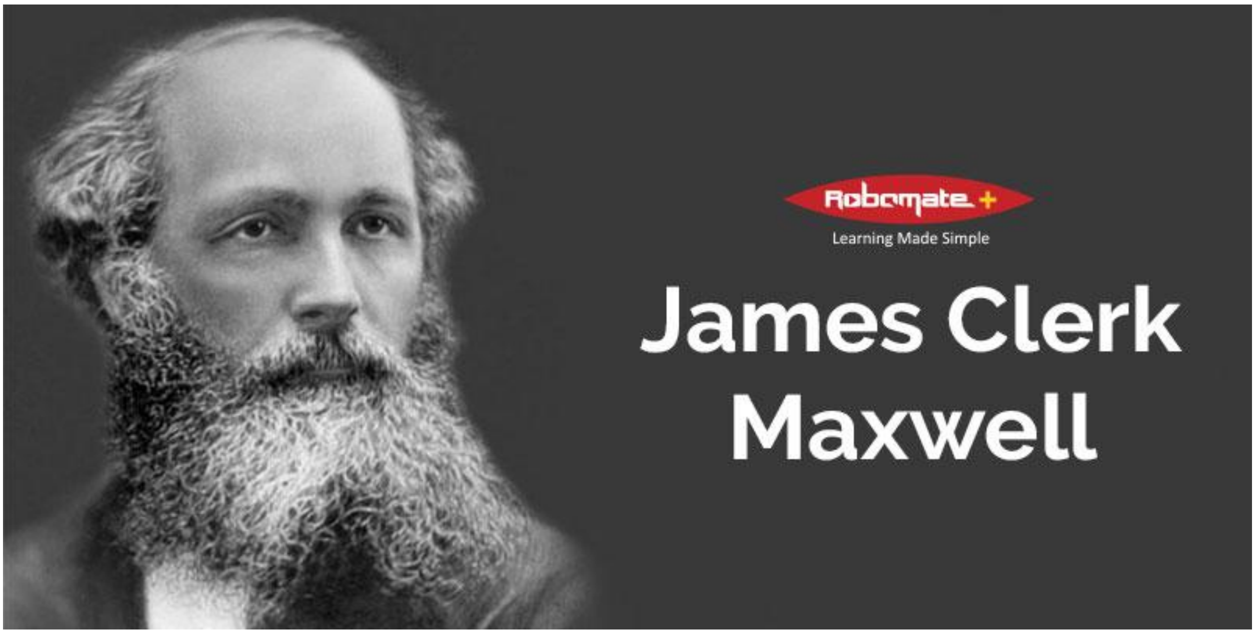
Let

[30] Sir Joseph John "J. J." Thomson, (18 December 1856 - 30 August 1940) was a British physicist. He is credited for the discovery of the electron and of isotopes, and the invention of the mass spectrometer.

$$\widetilde{\varphi} = \begin{bmatrix} \varphi_\nu \\ \overrightarrow{0}_2 \\ \varphi_{e,L} \\ \varphi_{e,R} \end{bmatrix}$$

In that case

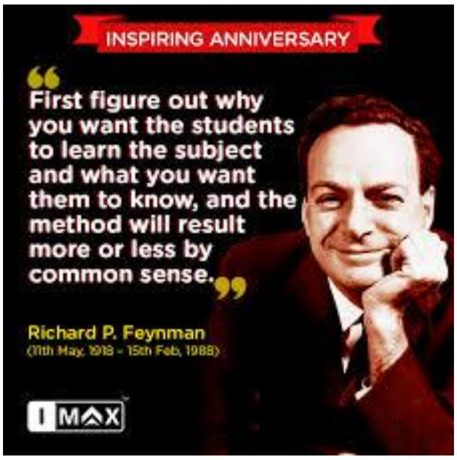
$$\boxed{\left(\begin{array}{c} \sum_{\mu=0}^{3} \beta^{[\mu]} \mathrm{i} \left(\partial_\mu \widetilde{\varphi} + \mathrm{i} A_\mu e \begin{bmatrix} \varphi_{e,L} \\ \varphi_{e,R} \end{bmatrix} - \mathrm{i}0.5 \left(\widehat{Z}_\mu + \widehat{W}_\mu \right) \widetilde{\varphi} \right) \\ + \left(\gamma^{[0]} \mathrm{i}\partial_5 + \beta^{[4]} \mathrm{i}\partial_4 \right) \widetilde{\varphi} \end{array} \right) = 0.}$$

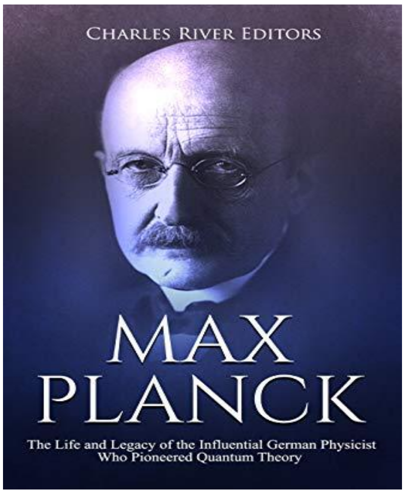


Here the vector field A_μ is the electromagnetic potential (**James Clerk Maxwell** (13 June 1831 – 5 November 1879) was a Scottish scientist in the field of mathematical physics. His most notable achievement was to formulate the classical theory of electromagnetic radiation, bringing together for the first time electricity, magnetism, and ligh as different manifestations of the same phenomenon. Maxwell's equations for electromagnetism have been called the "second great unification in physics after the first one realised by Isaac Newton.). And $\hat{Z}_\mu + \widehat{W}_\mu$ is the weak interaction potential (In 1933, Enrico Fermi[31] proposed the first theory of the weak interaction, known as Fermi's interaction. He

[31] **Enrico Fermi** 29 September 1901 – 28 November 1954) was an Italian–American physicist and the creator of the world's first nuclear reactor

suggested that beta decay could be explained by a four-fermion interaction, involving a contact force with no range.[3]. Evidently neutrinos do not involve in the electromagnetic interactions. **Richard Phillips Feynman**, May 11, 1918 – February 15, 1988) was an American theoretical physicist, known for his work in the path integral formulation of quantum mechanics, the theory of quantum electrodynamics.





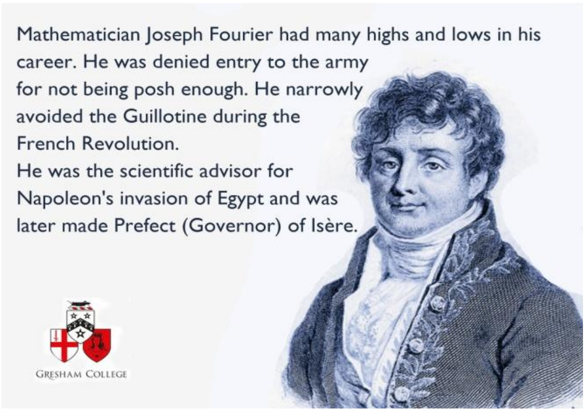
5. Planck

In 1900 Max Planck[32] discovered that our world is discrete. This is a recognition of the limitations of our space: : $|\mathbf{x}| \le \pi c/h$ ($h = 6.62607004 \times 10^{-34}$).

$$\phi_{\mathbf{n}}(\mathbf{x}) := \left(\frac{h}{2\pi c}\right)^{\frac{3}{2}} \exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(\mathbf{nx})\right)$$

Therefore, functions describing the processes of our world are represented by Fourier[33] series by basis:,

Here $\mathbf{nx} = n_1x_1 + n_2x_2 + n_3x_3$; n_1, n_2, n_3 are integer numbers.



5.1. Neutrino

Wolfgang Pauli postulated the neutrino in 1930 to explain the energy spectrum of beta decays, the decay of a neutron into a proton and an electron. Clyde Cowan, Frederick Reines found the neutrino experimentally in 1955. Enrico Fermi developed the first theory describing neutrino interactions and denoted this particles as neutrino in 1933. In 1962 Leon M. Lederman, Melvin Schwartz and Jack Steinberger showed that more than one type of neutrino exists. Bruno Pontecorvo suggested a practical method for investigating neutrino masses in 1957, over the subsequent 10 years he developed the mathematical formalism and the modern formulation of vacuum oscillations...

[32] **Max Karl Ernst Ludwig Planck** 23 April 1858 – 4 October 1947) was a German theoretical physicist whose discovery of energy quanta

[33] **Jean-Baptiste Joseph Fourier** (21 March 1768 – 16 May 1830) was a French mathematician and physicist born in Auxerre and best known for initiating the investigation of Fourier series,

Let

$$\widetilde{\varphi}(t,\mathbf{x},x_5,x_4)=$$
$$=\exp(-\mathrm{i}hs_0x_4)\sum_{r=1}^{4}\phi_{4,r}(t,\mathbf{x},0,s_0)\,\epsilon_r$$
$$+\exp(-\mathrm{i}hn_0x_5)\sum_{r=1}^{4}\phi_{5,r}(t,\mathbf{x},n_0,0)\,\epsilon_r$$

And Hamiltonian:

$$\widehat{H}_{0,4}\overset{Def.}{=}\sum_{r=1}^{3}\beta^{[r]}\mathrm{i}\partial_r+h\left(n_0\gamma^{[0]}+s_0\beta^{[4]}\right).$$

Let

$$\underline{u}_1(\mathbf{k})\overset{Def}{=}\frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}}\begin{bmatrix}0\\0\\0\\0\\\omega(\mathbf{k})+n+k_3\\k_1+\mathrm{i}k_2\\\omega(\mathbf{k})+n-k_3\\-k_1-\mathrm{i}k_2\end{bmatrix}$$

eigenvectors of this Hamiltonian:

$$\underline{u}_4(\mathbf{k})\overset{Def}{=}\frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}}\begin{bmatrix}0\\0\\0\\0\\k_1-\mathrm{i}k_2\\-\omega(\mathbf{k})-n-k_3\\k_1-\mathrm{i}k_2\\\omega(\mathbf{k})+n-k_3\end{bmatrix}$$ and

$$\underline{u}_2(\mathbf{k}) \overset{Def}{=} \frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}} \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ k_1 - \mathrm{i}k_2 \\ \omega(\mathbf{k}) + n - k_3 \\ -k_1 + \mathrm{i}k_2 \\ \omega(\mathbf{k}) + n + k_3 \end{bmatrix}$$

With eigenvalue:

$$\omega(\mathbf{k}) = \sqrt{\mathbf{k}^2 + n^2}$$

And eigenvectors

$$\underline{u}_3(\mathbf{k}) \overset{Def}{=} \frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}} \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ -\omega(\mathbf{k}) - n + k_3 \\ k_1 + \mathrm{i}k_2 \\ \omega(\mathbf{k}) + n + k_3 \\ k_1 + \mathrm{i}k_2 \end{bmatrix}$$

And

$$\underline{u}_4(\mathbf{k}) \overset{Def}{=} \frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}} \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ k_1 - \mathrm{i}k_2 \\ -\omega(\mathbf{k}) - n - k_3 \\ k_1 - \mathrm{i}k_2 \\ \omega(\mathbf{k}) + n - k_3 \end{bmatrix}$$

With eigenvalue $-\omega(\mathbf{k})$

Let

$$\widehat{H}'_{0,4} \overset{Def}{=} U^{(-)} \widehat{H}_{0,4} U^{(-)\dagger},$$
$$\underline{u}'_\mu(\mathbf{k}) \overset{Def}{=} U^{(-)} \underline{u}_\mu(\mathbf{k}) .$$

$$\underline{u}_1'(\mathbf{k}) = \frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}} \begin{bmatrix} (c+\mathrm{i}q)(\omega(\mathbf{k})+n+k_3) \\ (c+\mathrm{i}q)(k_1+\mathrm{i}k_2) \\ 0 \\ 0 \\ (a-\mathrm{i}b)(\omega(\mathbf{k})+n+k_3) \\ (a-\mathrm{i}b)(k_1+\mathrm{i}k_2) \\ \omega(\mathbf{k})+n-k_3 \\ -k_1-\mathrm{i}k_2 \end{bmatrix}$$

Tat is

$$\underline{u}_2'(\mathbf{k}) = \frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}} \begin{bmatrix} (c+\mathrm{i}q)(k_1-\mathrm{i}k_2) \\ (c+\mathrm{i}q)(\omega(\mathbf{k})+n-k_3) \\ 0 \\ 0 \\ (a-\mathrm{i}b)(k_1-\mathrm{i}k_2) \\ (a-\mathrm{i}b)(\omega(\mathbf{k})+n-k_3) \\ -k_1+\mathrm{i}k_2 \\ \omega(\mathbf{k})+n+k_3 \end{bmatrix}$$

$$\underline{u}_3'(\mathbf{k}) = \frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}} \begin{bmatrix} -(c+\mathrm{i}q)(\omega(\mathbf{k})+n-k_3) \\ (c+\mathrm{i}q)(k_1+\mathrm{i}k_2) \\ 0 \\ 0 \\ -(a-\mathrm{i}b)(\omega(\mathbf{k})+n-k_3) \\ (a-\mathrm{i}b)(k_1+\mathrm{i}k_2) \\ \omega(\mathbf{k})+n+k_3 \\ k_1+\mathrm{i}k_2 \end{bmatrix}$$

$$\underline{u}_4'(\mathbf{k}) = \frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}} \begin{bmatrix} (c+\mathrm{i}q)(k_1-\mathrm{i}k_2) \\ -(c+\mathrm{i}q)(\omega(\mathbf{k})+n+k_3) \\ 0 \\ 0 \\ (a-\mathrm{i}b)(k_1-\mathrm{i}k_2) \\ -(a-\mathrm{i}b)(\omega(\mathbf{k})+n+k_3) \\ k_1-\mathrm{i}k_2 \\ \omega(\mathbf{k})+n-k_3 \end{bmatrix}$$

Here $u_1'(\mathbf{k})$ and $u_2'(\mathbf{k})$ correspond to eigenvectors of $\widehat{H'}_{0,4}$ with eigenvalue $\omega(\mathbf{k})$, and $u_3'(\mathbf{k})$ and $u_4'(\mathbf{k})$ correspond to eigenvectors of $\widehat{H'}_{0,4}$ with eigenvalue $-\omega(\mathbf{k})$.

Let

$$\underline{v}_{(1)}(\mathbf{k}) = \frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}} \begin{bmatrix} 0 \\ 0 \\ -(c+\mathrm{i}q)(\omega(\mathbf{k})+n-k_3) \\ (c+\mathrm{i}q)(k_1+\mathrm{i}k_2) \\ \omega(\mathbf{k})+n+k_3 \\ k_1+\mathrm{i}k_2 \\ -(a-\mathrm{i}b)(\omega(\mathbf{k})+n-k_3) \\ (a-\mathrm{i}b)(k_1+\mathrm{i}k_2) \end{bmatrix}$$

$$\underline{v}_{(2)}(\mathbf{k}) = \frac{1}{2\sqrt{\omega(\mathbf{k})(\omega(\mathbf{k})+n)}} \begin{bmatrix} 0 \\ 0 \\ (c+\mathrm{i}q)(k_1-\mathrm{i}k_2) \\ -(c+\mathrm{i}q)(\omega(\mathbf{k})+n+k_3) \\ k_1-\mathrm{i}k_2 \\ \omega(\mathbf{k})+n-k_3 \\ (a-\mathrm{i}b)(k_1-\mathrm{i}k_2) \\ -(a-\mathrm{i}b)(\omega(\mathbf{k})+n+k_3) \end{bmatrix}$$

$\underline{u}_{(\alpha)}'(\mathbf{k})$ are denoted as *bi-n-leptonn* and $\underline{v}_{(\alpha)}(\mathbf{k})$ is are denoted as *bi-anti-n-leptonn basic vectors* with momentum **k** and spin index α.

Hence bi-anti-n-leptonn basic vectors are a result of acting of $U^{(+)}$ [1. P113].

Vectors

$$l_{n,(1)}(\mathbf{k}) = \begin{bmatrix} (a-\mathrm{i}b)(\omega(\mathbf{k})+n+k_3) \\ (a-\mathrm{i}b)(k_1+\mathrm{i}k_2) \\ \omega(\mathbf{k})+n-k_3 \\ -k_1-\mathrm{i}k_2 \end{bmatrix} \text{ and}$$

$$l_{n,(2)}(\mathbf{k}) = \begin{bmatrix} (a-\mathrm{i}b)(k_1-\mathrm{i}k_2) \\ (a-\mathrm{i}b)(\omega(\mathbf{k})+n-k_3) \\ -k_1+\mathrm{i}k_2 \\ \omega(\mathbf{k})+n+k_3 \end{bmatrix}$$

are denoted as leptonn components of *anti-bi-n-leptonn basic vectors*, and vectors

$$\nu_{n,(1)}(\mathbf{k}) = \begin{bmatrix} \omega(\mathbf{k})+n+k_3 \\ k_1+\mathrm{i}k_2 \\ 0 \\ 0 \end{bmatrix} \text{ and } \nu_{n,(2)}(\mathbf{k}) = \begin{bmatrix} k_1-\mathrm{i}k_2 \\ \omega(\mathbf{k})+n-k_3 \\ 0 \\ 0 \end{bmatrix}$$

are denoted as neutrinno components of *anti-bi-n-leptonn basic vectors*.

5.2. *Chrome of Barions*

Let here be entered new coordinates $y^{\beta}, z^{\beta}, y^{\zeta}, z^{\zeta}, y^{\eta}, z^{\eta}, y^{\theta}, z^{\theta}$:

L

$$[\varphi]\left(t,\mathbf{x},y^{\beta},z^{\beta},y^{\zeta},z^{\zeta},y^{\eta},z^{\eta},y^{\theta},z^{\theta}\right):=$$
$$:=\varphi(t,\mathbf{x})\times\exp\left(\mathrm{i}(y^{\beta}M_0+z^{\beta}M_4+y^{\zeta}M_{\zeta,0}+z^{\zeta}M_{\zeta,4}+\right.$$
$$\left.+y^{\eta}M_{\eta,0}+z^{\eta}M_{\eta,4}+y^{\theta}M_{\theta,0}+z^{\theta}M_{\theta,4})\right).$$

In this case the Basix Quanr Equation has the following differencial form:

$$\left(\sum_{\nu=0}^{3}\beta^{[\nu]}\left(\partial_{\nu}+\mathrm{i}\Theta_{\nu}+\mathrm{i}\Upsilon_{\nu}\gamma^{[5]}\right)+\right.$$
$$+\gamma^{[0]}\partial_y^{\beta}+\beta^{[4]}\partial_z^{\beta}-$$
$$-\gamma_{\zeta}^{[0]}\partial_y^{\zeta}+\zeta^{[4]}\partial_z^{\zeta}-$$
$$-\gamma_{\eta}^{[0]}\partial_y^{\eta}-\eta^{[4]}\partial_z^{\eta}+$$
$$\left.+\gamma_{\theta}^{[0]}\partial_y^{\theta}+\theta^{[4]}\partial_z^{\theta}\right)[\varphi]=0.$$

Hence,

$$[\varphi]\left(t,\mathbf{x},y^{\beta},z^{\beta},y^{\zeta},z^{\zeta},y^{\eta},z^{\eta},y^{\theta},z^{\theta}\right)=$$
$$\sum_{w,p_1,p_2,p_3,n^{\beta},s^{\beta},n^{\zeta},s^{\zeta},n^{\eta},s^{\eta},n^{\theta},s^{\theta}} c(w,p_1,p_2,p_3,n^{\beta},s^{\beta},$$
$$n^{\zeta},s^{\zeta},n^{\eta},s^{\eta},n^{\theta},s^{\theta})\times$$
$$\times\exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0+p_1x_1+p_2x_2+p_3x_3+\right.$$
$$+n^{\beta}y^{\beta}+s^{\beta}z^{\beta}\ +n^{\zeta}y^{\zeta}+s^{\zeta}z^{\zeta}+$$
$$\left.+n^{\eta}y^{\eta}+s^{\eta}z^{\eta}+n^{\theta}y^{\theta}+s^{\theta}z^{\theta})\right).$$

$$\sum_{\nu=0}^{3}\beta^{[\nu]}\left(\partial_{\nu}+\mathrm{i}\Theta_{\nu}+\mathrm{i}\Upsilon_{\nu}\gamma^{[5]}\right)[\varphi]+$$
$$+\gamma^{[0]}\partial_y^{\beta}[\varphi]+\beta^{[4]}\partial_z^{\beta}[\varphi]+$$
$$+\left(\begin{bmatrix}0&0&-\partial_y^{\theta}&\partial_y^{\zeta}-i\partial_y^{\eta}\\0&0&\partial_y^{\zeta}+i\partial_y^{\eta}&\partial_y^{\theta}\\-\partial_y^{\theta}&\partial_y^{\zeta}-i\partial_y^{\eta}&0&0\\\partial_y^{\zeta}+i\partial_y^{\eta}&\partial_y^{\theta}&0&0\end{bmatrix}+\right.$$
$$\left.\mathrm{i}\begin{bmatrix}0&0&\partial_z^{\theta}&\partial_z^{\zeta}+i\partial_z^{\eta}\\0&0&\partial_z^{\zeta}-i\partial_z^{\eta}&-\partial_z^{\theta}\\-\partial_z^{\theta}&-\partial_z^{\zeta}-i\partial_z^{\eta}&0&0\\-\partial_z^{\zeta}+i\partial_z^{\eta}&\partial_z^{\theta}&0&0\end{bmatrix}\right)$$
$$\times[\varphi]=0.$$

Let a Fourier transformation of

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

be the following:

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

$$\sum_{w,p_1,p_2,p_3,n^{\beta},s^{\beta},n^{\zeta},s^{\zeta},n^{\eta},s^{\eta},n^{\theta},s^{\theta}} c(w, p_1, p_2, p_3, n^{\beta}, s^{\beta},$$

$$n^{\zeta}, s^{\zeta}, n^{\eta}, s^{\eta}, n^{\theta}, s^{\theta}) \times$$

$$\times \exp\left(- \mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0 + p_1x_1 + p_2x_2 + p_3x_3 +\right.$$

$$+n^{\beta}y^{\beta} + s^{\beta}z^{\beta} + n^{\zeta}y^{\zeta} + s^{\zeta}z^{\zeta} +$$

$$\left.+n^{\eta}y^{\eta} + s^{\eta}z^{\eta} + n^{\theta}y^{\theta} + s^{\theta}z^{\theta})\right).$$

Let $\Theta_v = 0$ and $\Upsilon_v = 0$.

Let us design:

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

That is:

$$\begin{bmatrix} -\partial_0 + \partial_3 & \partial_1 - \mathrm{i}\partial_2 & \partial_y^\beta - \partial_y^\theta & \partial_y^\zeta - i\partial_y^\eta \\ \partial_1 + \mathrm{i}\partial_2 & -\partial_0 - \partial_3 & \partial_y^\zeta + i\partial_y^\eta & \partial_y^\beta + \partial_y^\theta \\ \partial_y^\beta - \partial_y^\theta & \partial_y^\zeta - i\partial_y^\eta & -\partial_0 - \partial_3 & -\partial_1 + \mathrm{i}\partial_2 \\ \partial_y^\zeta + i\partial_y^\eta & \partial_y^\beta + \partial_y^\theta & -\partial_1 - \mathrm{i}\partial_2 & -\partial_0 + \partial_3 \end{bmatrix}$$

$$+\mathrm{i}\begin{bmatrix} 0 & 0 & \partial_z^\beta + \partial_z^\theta & \partial_z^\zeta + i\partial_z^\eta \\ 0 & 0 & \partial_z^\zeta - i\partial_z^\eta & \partial_z^\beta - \partial_z^\theta \\ -\partial_z^\beta - \partial_z^\theta & -\partial_z^\zeta - i\partial_z^\eta & 0 & 0 \\ -\partial_z^\zeta + i\partial_z^\eta & -\partial_z^\beta + \partial^\theta & 0 & 0 \end{bmatrix}$$

$$G_0[\varphi] = -\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}} \sum_{w,p_1,p_2,p_3,n^\beta,s^\beta,n^\zeta,s^\zeta,n^\eta,s^\eta,n^\theta,s^\theta} \breve{g}(w,$$

$$p_1, p_2, p_3, n^\beta, s^\beta, n^\zeta, s^\zeta, n^\eta, s^\eta, n^\theta, s^\theta)$$

$$\sum_{k=0}^{3} c_k(w, p_1, p_2, p_3, n^\beta, s^\beta, n^\zeta, s^\zeta, n^\eta, s^\eta, n^\theta, s^\theta) \times$$

$$\times \exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0 + p_1x_1 + p_2x_2 + p_3x_3 + \right.$$

$$+n^\beta y^\beta + s^\beta z^\beta + n^\zeta y^\zeta + s^\zeta z^\zeta +$$

$$\left. +n^\eta y^\eta + s^\eta z^\eta + n^\theta y^\theta + s^\theta z^\theta) \right).$$

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 eigenvector of

$$c_k(w, p_1, p_2, p_3, n^\beta, s^\beta, n^\zeta, s^\zeta, n^\eta, s^\eta, n^\theta, s^\theta)$$

And
$$\check{g}(w, p_1, p_2, p_3, n^\beta, s^\beta, n^\zeta, s^\zeta, n^\eta, s^\eta, n^\theta, s^\theta) :=$$
$$:= \beta^{[0]}w + \beta^{[1]}p_1 + \beta^{[2]}p_2 + \beta^{[3]}p_3 +$$
$$+\gamma^{[0]}n^\beta + \beta^{[4]}s^\beta - \gamma_\zeta^{[0]}n^\zeta + \zeta^{[4]}s^\zeta -$$
$$-\gamma_\eta^{[0]}n^\eta - \eta^{[4]}s^\eta + \gamma_\theta^{[0]}n^\theta + \theta^{[4]}s^\theta.$$

Here

$\{c_0, c_1, c_2, c_3\}$

is an orthonormalized basis of the complex4-vectors space.
Functions

$$c_k(w, p_1, p_2, p_3, n^\beta, s^\beta, n^\zeta, s^\zeta, n^\eta, s^\eta, n^\theta, s^\theta) \times$$
$$\times \exp\left(- \mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0 + p_1x_1 + p_2x_2 + p_3x_3 + \right.$$
$$+n^\beta y^\beta + s^\beta z^\beta +$$
$$\left. +n^\zeta y^\zeta + s^\zeta z^\zeta + +n^\eta y^\eta + s^\eta z^\eta + n^\theta y^\theta + s^\theta z^\theta) \right)$$

are eigenvectors of operator G_0.

$$\varphi_y^\zeta := c(w, \mathbf{p}, f)\exp\left(- \mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0 + \mathbf{px} + \gamma_\zeta^{[0]}fy^\zeta)\right)$$

is a red lower chrome function,

$$\varphi_z^{\zeta} := c(w, \mathbf{p}, f)\exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0 + \mathbf{px} - \mathrm{i}\zeta^{[4]} f z^{\zeta})\right)$$

is a red upper chrome function,

$$\varphi_y^{\eta} := c(w, \mathbf{p}, f)\exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0 + \mathbf{px} + \gamma_{\eta}^{[0]} f y^{\eta})\right)$$

is a green lower chrome function,

$$\varphi_z^{\eta} := c(w, \mathbf{p}, , f)\exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0 + \mathbf{px} - \mathrm{i}\eta^{[4]} f z^{\eta})\right)$$

is a green upper chrome function,

$$\varphi_y^{\theta} := c(w, \mathbf{p}, f)\exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0 + \mathbf{px} + \gamma_{\theta}^{[0]} f y^{\theta})\right)$$

is a blue lower chrome function,

$$\varphi_z^{\theta} := c(w, \mathbf{p}, s^{\theta})\exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}(wx_0 + \mathbf{px} - \mathrm{i}\theta^{[4]} f z^{\theta})\right)$$

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,
$-\partial_y^{\eta}\partial_y^{\eta}$ is called a *green lower chrome* operator,
$-\partial_z^{\eta}\partial_z^{\eta}$ is a *green upper chrome* operator,
$-\partial_y^{\vartheta}\partial_y^{\vartheta}$ is called a *blue lower chrome* operator,
$-\partial_z^{\vartheta}\partial_z^{\vartheta}$ is a *blue upper chrome* operator.

For example, if φ_z^ζ is a red upper chrome function then

$$-\partial_y^\zeta\partial_y^\zeta\varphi_z^\zeta = -\partial_y^\eta\partial_y^\eta\varphi_z^\zeta = -\partial_z^\eta\partial_z^\eta\varphi_z^\zeta =$$
$$= -\partial_y^\theta\partial_y^\theta\varphi_z^\zeta = -\partial_z^\theta\partial_z^\theta\varphi_z^\zeta = 0$$

But

$$-\partial_z^\zeta\partial_z^\zeta\varphi_z^\zeta = -\left(\frac{\mathrm{h}}{\mathrm{c}}f\right)^2\varphi_z^\zeta.$$

Because $G_0\left[\varphi\right] = 0$ then

$$UG_0U^{-1}U\left[\varphi\right] = 0.$$

If

$$U = U_{1.2}\left(\alpha\right)$$

then

$$G_0 \rightarrow U_{1,2}\left(\alpha\right)G_0U_{1,2}^{-1}\left(\alpha\right)$$

and [φ] → $U_{1,2}$(α)[φ].

In this case:

$$\begin{aligned}
\partial_1 &\rightarrow \partial_1' := (\cos\alpha\cdot\partial_1 - \sin\alpha\cdot\partial_2),\\
\partial_2 &\rightarrow \partial_2' := (\cos\alpha\cdot\partial_2 + \sin\alpha\cdot\partial_1),\\
\partial_0 &\rightarrow \partial_0' := \partial_0,\\
\partial_3 &\rightarrow \partial_3' := \partial_3,\\
\partial_y^\beta &\rightarrow \partial_y^{\beta\prime} := \partial_y^\beta,\\
\partial_z^\beta &\rightarrow \partial_z^{\beta\prime} := \partial_z^\beta,\\
\partial_y^\zeta &\rightarrow \partial_y^{\zeta\prime} := \left(\cos\alpha\cdot\partial_y^\zeta - \sin\alpha\cdot\partial_y^\eta\right),\\
\partial_y^\eta &\rightarrow \partial_y^{\eta\prime} := \left(\cos\alpha\cdot\partial_y^\eta + \sin\alpha\cdot\partial_y^\zeta\right),\\
\partial_z^\zeta &\rightarrow \partial_z^{\zeta\prime} := \left(\cos\alpha\cdot\partial_z^\zeta + \sin\alpha\cdot\partial_z^\eta\right),\\
\partial_z^\eta &\rightarrow \partial_z^{\eta\prime} := \left(\cos\alpha\cdot\partial_z^\eta - \sin\alpha\cdot\partial_z^\zeta\right),\\
\partial_y^\theta &\rightarrow \partial_y^{\theta\prime} := \partial_y^\theta,\\
\partial_z^\theta &\rightarrow \partial_z^{\theta\prime} := \partial_z^\theta.
\end{aligned}$$

Therefore,

$$-\partial_z^{\zeta\prime}\partial_z^{\zeta\prime}\varphi_z^{\zeta} = \left(f\frac{\mathrm{h}}{\mathrm{c}}\cos\alpha\right)^2\cdot\varphi_z^{\zeta},$$

$$-\partial_z^{\eta\prime}\partial_z^{\eta\prime}\varphi_z^{\zeta} = \left(-\sin\alpha\cdot f\frac{\mathrm{h}}{\mathrm{c}}\right)^2\varphi_z^{\zeta}.$$

If $\alpha = -\frac{\pi}{2}$ Then

$$-\partial_z^{\zeta\prime}\partial_z^{\zeta\prime}\varphi_z^{\zeta} = 0,$$

$$-\partial_z^{\eta\prime}\partial_z^{\eta\prime}\varphi_z^{\zeta} = \left(f\frac{\mathrm{h}}{\mathrm{c}}\right)^2\varphi_z^{\zeta}.$$

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

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

.

In this cas

$$\begin{aligned}
&\partial_0 \rightarrow \partial_0' := \partial_0,\\
&\partial_1 \rightarrow \partial_1' := \partial_1,\\
&\partial_2 \rightarrow \partial_2' := (\cos\alpha\cdot\partial_2 + \sin\alpha\cdot\partial_3),\\
&\partial_3 \rightarrow \partial_3' := (\cos\alpha\cdot\partial_3 - \sin\alpha\cdot\partial_2),\\
&\partial_y^{\beta} \rightarrow \partial_y^{\beta\prime} := \partial_y^{\beta},\\
&\partial_y^{\zeta} \rightarrow \partial_y^{\zeta\prime} := \partial_y^{\zeta},\\
&\partial_y^{\eta} \rightarrow \partial_y^{\eta\prime} := \left(\cos\alpha\cdot\partial_y^{\eta} - \sin\alpha\cdot\partial_y^{\theta}\right),\\
&\partial_y^{\theta} \rightarrow \partial_y^{\theta\prime} := \left(\cos\alpha\cdot\partial_y^{\theta} + \sin\alpha\cdot\partial_y^{\eta}\right),\\
&\partial_z^{\beta} \rightarrow \partial_z^{\beta\prime} := \partial_z^{\beta},\\
&\partial_z^{\zeta} \rightarrow \partial_z^{\zeta\prime} := \partial_z^{\zeta},\\
&\partial_z^{\eta} \rightarrow \partial_z^{\eta\prime} := \left(\cos\alpha\cdot\partial_z^{\eta} - \sin\alpha\cdot\partial_z^{\theta}\right),\\
&\partial_z^{\theta} \rightarrow \partial_z^{\theta\prime} := \left(\cos\alpha\cdot\partial_z^{\theta} + \sin\alpha\cdot\partial_z^{\eta}\right).
\end{aligned}$$

Therefore, if φ_y^η is a green lower chrome function then

If

$$\alpha = -\frac{\pi}{2}$$

$$\begin{aligned} -\partial_z^{\eta\prime}\partial_z^{\eta\prime}\varphi_y^\eta &= 0, \\ -\partial_y^{\theta\prime}\partial_y^{\theta\prime}\varphi_y^\eta &= \left(\frac{\mathrm{h}}{\mathrm{c}}f\right)^2 \cdot \varphi_y^\eta. \end{aligned}$$

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

.

In this case:

$$\begin{aligned}
&\partial_0 \rightarrow \partial_0' := \partial_0, \\
&\partial_1 \rightarrow \partial_1' := (\cos\alpha \cdot \partial_1 - \sin\alpha \cdot \partial_3), \\
&\partial_2 \rightarrow \partial_2' := \partial_2, \\
&\partial_3 \rightarrow \partial_3' := (\cos\alpha \cdot \partial_3 + \sin\alpha \cdot \partial_1), \\
&\partial_y^\beta \rightarrow \partial_3' := \partial_y^\beta, \\
&\partial_y^\zeta \rightarrow \partial_y^{\zeta\prime} := \left(\cos\alpha \cdot \partial_y^\zeta + \sin\alpha \cdot \partial_y^\theta\right), \\
&\partial_y^\eta \rightarrow \partial_y^{\eta\prime} := \partial_y^\eta, \\
&\partial_y^\theta \rightarrow \partial_y^{\theta\prime} := \left(\cos\alpha \cdot \partial_y^\theta - \sin\alpha \cdot \partial_y^\zeta\right), \\
&\partial_z^\beta \rightarrow \partial_z^{\beta\prime} := \partial_z^\beta, \\
&\partial_z^\zeta \rightarrow \partial_z^{\zeta\prime} := \left(\cos\alpha \cdot \partial_z^\zeta - \sin\alpha \cdot \partial_z^\theta\right), \\
&\partial_z^\eta \rightarrow \partial_z^{\eta\prime} := \partial_z^\eta, \\
&\partial_z^\theta \rightarrow \partial_z^{\theta\prime} := \left(\cos\alpha \cdot \partial_z^\theta + \sin\alpha \cdot \partial_z^\zeta\right).
\end{aligned}$$

Therefore,

$$\begin{aligned} -\partial_z^{\eta\prime}\partial_z^{\eta\prime}\varphi_y^\eta &= \left(\frac{\mathrm{h}}{\mathrm{c}}\cos\alpha \cdot f\right)^2 \cdot \varphi_y^\eta, \\ -\partial_y^{\theta\prime}\partial_y^{\theta\prime}\varphi_y^\eta &= \left(\frac{\mathrm{h}}{\mathrm{c}}\sin\alpha \cdot f\right)^2 \cdot \varphi_y^\eta. \end{aligned}$$

$$-\partial_z^{\zeta\prime}\partial_z^{\zeta\prime}\varphi_z^{\zeta} \quad = \quad -\left(f\frac{\mathrm{h}}{\mathrm{c}}\cos\alpha\right)^2 \cdot \varphi_z^{\zeta},$$

$$-\partial_z^{\theta\prime}\partial_z^{\theta\prime}\varphi_z^{\zeta} \quad = \quad -\left(\sin\alpha \cdot f\frac{\mathrm{h}}{\mathrm{c}}\right)^2 \varphi_z^{\zeta}.$$

If α = π/2 then

$$\begin{aligned} -\partial_z^{\zeta\prime}\partial_z^{\zeta\prime}\varphi_z^{\zeta} &= 0, \\ -\partial_z^{\theta\prime}\partial_z^{\theta\prime}\varphi_z^{\zeta} &= -\left(f\frac{\mathrm{h}}{\mathrm{c}}\right)^2 \varphi_z^{\zeta}. \end{aligned}$$

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.

Let in the potential hole AA′ (Fig.5) there are three quarks φ_g^{ζ}, φ_g^{η}, φ_g^{ϑ}. Their general state function is determinant with elements of the following type:

$$\boldsymbol{\varphi_g^{\zeta\eta\vartheta} := \varphi_g^{\zeta}\,\varphi_g^{\eta}\,\varphi_g^{\vartheta}}.$$

In this case:

$$-\partial_y^{\zeta}\partial_y^{\zeta}\varphi_y^{\zeta\eta\theta} = \left(\frac{\mathrm{h}}{\mathrm{c}}f\right)^2 \varphi_y^{\zeta\eta\theta}$$

And under rotation $U_{1,2}(\alpha)$

$$\begin{aligned} -\partial_y^{\zeta\prime}\partial_y^{\zeta\prime}\varphi_y^{\zeta\eta\theta} &= \left(\frac{\mathrm{h}}{\mathrm{c}}f\right)^2 \left(\gamma_\zeta^{[0]}\cos\alpha - \gamma_\eta^{[0]}\sin\alpha\right)^2 \left(\varphi_y^\zeta\varphi_y^\eta\varphi_y^\theta\right) \\ &= \left(\frac{\mathrm{h}}{\mathrm{c}}f\right)^2 \varphi_y^{\zeta\eta\theta}. \end{aligned}$$

That is at such turns the quantity of red chrome remains

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

Baryons Δ^- = ddd, Δ^Ω = uuu, Ω^- = sss belong to such structures.

If $U = U_{1,0}(\alpha)$ then $G_0 \to U_{1,0}(\alpha)G_0U_{1,0}^{-1}(\alpha)$ and $[\varphi] \to U_{1,0}(\alpha)[\varphi]$.

In this case:

$$\begin{aligned}
\partial_0 &\to \partial_0' := (\cosh\alpha\cdot\partial_0 + \sinh\alpha\cdot\partial_1),\\
\partial_1 &\to \partial_1' := (\cosh\alpha\cdot\partial_1 + \sinh\alpha\cdot\partial_0),\\
\partial_2 &\to \partial_2' := \partial_2,\\
\partial_3 &\to \partial_3' := \partial_3,\\
\partial_y^\beta &\to \partial_y^{\beta\prime} := \partial_y^\beta,\\
\partial_y^\zeta &\to \partial_y^{\zeta\prime} := \partial_y^\zeta,\\
\partial_y^\eta &\to \partial_y^{\eta\prime} := \left(\cosh\alpha\cdot\partial_y^\eta - \sinh\alpha\cdot\partial_z^\theta\right),\\
\partial_y^\theta &\to \partial_y^{\theta\prime} := \left(\cosh\alpha\cdot\partial_y^\theta + \sinh\alpha\cdot\partial_z^\eta\right),\\
\partial_z^\beta &\to \partial_z^{\beta\prime} := \partial_z^\beta,\\
\partial_z^\zeta &\to \partial_z^{\zeta\prime} := \partial_z^\zeta,\\
\partial_z^\eta &\to \partial_z^{\eta\prime} := \left(\cosh\alpha\cdot\partial_z^\eta + \sinh\alpha\cdot\partial_y^\theta\right),\\
\partial_z^\theta &\to \partial_z^{\theta\prime} := \left(\cosh\alpha\cdot\partial_z^\theta - \sinh\alpha\cdot\partial_y^\eta\right).
\end{aligned}$$

Therefore,

$$\begin{aligned} -\partial_y^{\eta\prime}\partial_y^{\eta\prime}\varphi_y^\eta &= \left(1+\sinh^2\alpha\right)\cdot\left(\frac{\mathrm{h}}{\mathrm{c}}f\right)^2\varphi_y^\eta, \\ -\partial_z^{\theta\prime}\partial_z^{\theta\prime}\varphi_y^\eta &= \sinh^2\alpha\cdot\left(\frac{\mathrm{h}}{\mathrm{c}}f\right)^2\varphi_y^\eta. \end{aligned}$$

Similarly chromes and grades change for other states and under other Lorentz transformation.

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

Let

$$\varphi_{yz}^{\zeta\eta\theta} := \varphi_y^{\zeta}\varphi_y^{\eta}\varphi_y^{\theta}\varphi_z^{\zeta}\varphi_z^{\eta}\varphi_z^{\theta}.$$

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

$$-\partial_z^{\theta\prime}\partial_z^{\theta\prime}\varphi_{yz}^{\zeta\eta\theta} = -\left(\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}f\right)^2\varphi_{yz}^{\zeta\eta\theta}.$$

That is a magnitude of red chrome of this state doesn't depend on angle α.
This condition is satisfied for all chromes and under all Lorentz's transformations.

Pairs of baryons

$$\{p = uud, n = ddu\},$$
$$\left\{\Sigma^+ = uus, \Xi^0 = uss\right\},$$
$$\left\{\Delta^+ = uud, \Delta^0 = udd\right\}$$

belong to such structures

Therefore, Baryons represent one of ways of elimination of the chrome Noninvariancy under Cartesian and under Lorentz transformation

5.3. Creating and Annihilation Operators

Let Ặ be some unitary space. Let $\tilde{0}$ be the zero element of Ặ. That is any element $\tilde{F}$ of Ặ obeys to the following conditions:

$$0\widetilde{F} = \widetilde{0},\ \widetilde{0} + \widetilde{F} = \widetilde{F},\ \widetilde{0}^{\dagger}\widetilde{F} = \widetilde{F},\ \widetilde{0}^{\dagger} = \widetilde{0}.$$

Let $\hat{0}$ be the zero operator on Ặ. That is any element $\tilde{F}$ of Ặ obeys to the following condition:
$\hat{0}\tilde{F}$ = $0\tilde{F}$, and if $\hat{b}$ is any operator on Ặ then

$$\widehat{0} + \widehat{b} = \widehat{b} + \widehat{0} = \widehat{b},\ \widehat{0}\widehat{b} = \widehat{b}\widehat{0} = \widehat{0}.$$

Let $\hat{1}$ be the identy operator on Ặ. That is any element $\tilde{F}$ of Ặ obeys to the following condition:

$\hat{1}\,\tilde{F} = 1\,\tilde{F} = \tilde{F}$ and if $\hat{F}$ is any operator on Ặ then $\hat{1}\hat{F} = \hat{F}\hat{1} =$ ▯

Let linear operators $b_{s,k}$ ($s \in \{1,2,3,4\}$) act on all elements of this space. And let these operators fulfill the following conditions:

$$\left\{b^{\dagger}_{s,\mathbf{k}}, b_{s',\mathbf{k}'}\right\} := b^{\dagger}_{s,\mathbf{k}} b_{s',\mathbf{k}'} + b_{s',\mathbf{k}'} b^{\dagger}_{s,\mathbf{k}} = \left(\frac{1}{2\pi}\right)^{3} \delta_{\mathbf{k},\mathbf{k}'}\delta_{s,s'}\widehat{1},$$

$$\left\{b_{s,\mathbf{k}}, b_{s',\mathbf{k}'}\right\} = b_{s,\mathbf{k}} b_{s',\mathbf{k}'} + b_{s',\mathbf{k}'} b_{s,\mathbf{k}} = \left\{b^{\dagger}_{s,\mathbf{k}}, b^{\dagger}_{s',\mathbf{k}'}\right\} = \widehat{0}.$$

Hence,

$$b_{s,\mathbf{k}} b_{s,\mathbf{k}} = b^{\dagger}_{s,\mathbf{k}} b^{\dagger}_{s,\mathbf{k}} = \widehat{0}.$$

There exists element $\tilde{F}_0$ of Ặ such that $\tilde{F}_0^{\dagger} \cdot \tilde{F}_0 = 1$ and for any $b_{s,k}$: $b_{s,k}\tilde{F}_0 = \tilde{0}$. Hence, $\tilde{F}_0^{\dagger} b_{s,k}^{\dagger} = 0$.

Let

$$\psi_s(\mathbf{x}) := \sum_{\mathbf{k}} \sum_{r=1}^{4} b_{r,\mathbf{k}} e_{r,s}(\mathbf{k}) \exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}\mathbf{kx}\right).$$

Because

$$\sum_{r=1}^{4} e_{r,s}(\mathbf{k})\, e_{r,s'}(\mathbf{k}) = \delta_{s,s'}$$

And

$$\sum_{\mathbf{k}} \exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}\mathbf{k}\left(\mathbf{x}-\mathbf{x}'\right)\right) = \left(\frac{2\pi\mathrm{c}}{\mathrm{h}}\right)^{3} \delta\left(\mathbf{x}-\mathbf{x}'\right)$$

Then

$$\begin{aligned}\left\{\psi_s^{\dagger}(\mathbf{x}),\psi_{s'}\left(\mathbf{x}'\right)\right\} &:= \psi_s^{\dagger}(\mathbf{x})\psi_{s'}\left(\mathbf{x}'\right)+\psi_{s'}\left(\mathbf{x}'\right)\psi_s^{\dagger}(\mathbf{x}) \\ &= \delta\left(\mathbf{x}-\mathbf{x}'\right)\delta_{s,s'}\widehat{1}.\end{aligned}$$

And these operators obey the following conditions

$$\psi_s(\mathbf{x})\widetilde{F_0} = \widetilde{0},\ \left\{\psi_s(\mathbf{x}),\psi_{s'}(\mathbf{x}')\right\} = \left\{\psi_s^{\dagger}(\mathbf{x}),\psi_{s'}^{\dagger}(\mathbf{x}')\right\} = \widehat{0}.$$

Hence,

$$\psi_s(\mathbf{x})\psi_{s'}(\mathbf{x}') = \psi_s^{\dagger}(\mathbf{x})\psi_{s'}^{\dagger}(\mathbf{x}') = \widehat{0}.$$

Let

$$\Psi(t,\mathbf{x}) := \sum_{s=1}^{4} \varphi_s(t,\mathbf{x})\,\psi_s^{\dagger}(\mathbf{x})\,\widetilde{F_0}.$$

These function obey the following condition:

$$\psi_s(\mathbf{x})\widetilde{F_0} = \widetilde{0},\ \left\{\psi_s(\mathbf{x}),\psi_{s'}(\mathbf{x}')\right\} = \left\{\psi_s^{\dagger}(\mathbf{x}),\psi_{s'}^{\dagger}(\mathbf{x}')\right\} = \widehat{0}.$$

Hence,

$$\int d\mathbf{x}' \cdot \Psi^{\dagger}\left(t,\mathbf{x}'\right)\Psi(t,\mathbf{x}) = \rho(t,\mathbf{x}).$$

Here $\rho := j_0/c$.

Let a Fourier series of $\varphi_s(t,\mathbf{x})$ has the following form:

$$\varphi_s(t,\mathbf{x}) = \sum_{\mathbf{p}} \sum_{r=1}^{4} c_r(t,\mathbf{p}) e_{r,s}(\mathbf{p}) \exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}\mathbf{p}\mathbf{x}\right).$$

In this case

$$\underline{\Psi}(t,\mathbf{p}) := \left(\frac{2\pi\mathrm{c}}{\mathrm{h}}\right)^3 \sum_{r=1}^{4} c_r(t,\mathbf{p}) b_{r,\mathbf{p}}^{\dagger} \widetilde{F_0}.$$

$$\mathcal{H}_0(\mathbf{x}) := \psi^{\dagger}(\mathbf{x}) \widehat{H}_0 \psi(\mathbf{x})$$

then $\mathcal{H}_0(\mathbf{x})$ is called a *Hamiltonian* $\widehat{H}_0$ *density*.
Because

Then
$$\widehat{H}_0 \varphi(t,\mathbf{x}) = \mathrm{i}\frac{\partial}{\partial t}\varphi(t,\mathbf{x})$$

$$\int d\mathbf{x}' \cdot \mathcal{H}_0(\mathbf{x}') \Psi(t,\mathbf{x}) = \mathrm{i}\frac{\partial}{\partial t}\Psi(t,\mathbf{x}).$$

Therefote, if
$$\widehat{\mathbb{H}} := \int d\mathbf{x}' \cdot \mathcal{H}_0(\mathbf{x}')$$

then $\widehat{\mathbb{H}}$ acts similar to the Hamiltonian on space Ḁ.
And if
$$E_{\Psi}\left(\widetilde{F_0}\right) := \sum_{\mathbf{p}} \underline{\Psi}^{\dagger}(t,\mathbf{p}) \widehat{\mathbb{H}} \underline{\Psi}(t,\mathbf{p})$$

then $E_{\Psi}(\widetilde{\square}_0)$ is an energy of Ψ on vacuum $\widetilde{\square}_0$.
Let us consider operator

$$\widehat{N}_a(\mathbf{x}_0) := \psi_a^{\dagger}(\mathbf{x}_0)\,\psi_a(\mathbf{x}_0).$$

Let us calculate an average value of this operator:

$$\left\langle \widehat{N}_a(\mathbf{x}_0) \right\rangle_{\Psi} := \int_{\Omega} d\mathbf{x} \cdot \widehat{N}_a(\mathbf{x}_0)\,\rho(t,\mathbf{x}).$$

Hence,

$$\left\langle \widehat{N}_a(\mathbf{x}_0) \right\rangle_{\Psi} = \int_{\Omega} d\mathbf{x} \int_{\Omega} d\mathbf{x}' \cdot \Psi^{\dagger}(t,\mathbf{x}')\,\psi_a^{\dagger}(\mathbf{x}_0)\,\psi_a(\mathbf{x}_0)\,\Psi(t,\mathbf{x}).$$

Since

$$\Psi(t,\mathbf{x}) = \sum_{j=1}^{4} \varphi_j(t,\mathbf{x})\,\psi_j^{\dagger}(\mathbf{x})\,\widetilde{F}_0.$$

then

$$\left\langle \widehat{N}_a(\mathbf{x}_0) \right\rangle_{\Psi} =$$

$$\int_{\Omega} d\mathbf{x} \int_{\Omega} d\mathbf{x}' \cdot \sum_{s=1}^{4} \varphi_s^{*}(t,\mathbf{x}')\,\widetilde{F}_0^{\dagger}\psi_s(\mathbf{x}')\,\psi_a^{\dagger}(\mathbf{x}_0)\,\psi_a(\mathbf{x}_0) \sum_{j=1}^{4} \varphi_j(t,\mathbf{x})\,\psi_j^{\dagger}(\mathbf{x})\,\widetilde{F}_0 =$$

$$\int_{\Omega} d\mathbf{x} \int_{\Omega} d\mathbf{x}' \cdot \sum_{s=1}^{4} \sum_{j=1}^{4} \varphi_s^{*}(t,\mathbf{x}')\,\varphi_j(t,\mathbf{x})\,\widetilde{F}_0^{\dagger}\psi_s(\mathbf{x}')\,\psi_a^{\dagger}(\mathbf{x}_0)\,\psi_a(\mathbf{x}_0)\,\psi_j^{\dagger}(\mathbf{x})\,\widetilde{F}_0.$$

Since

$$\psi_a^{\dagger}(\mathbf{x}_0)\,\psi_s(\mathbf{x}') + \psi_s(\mathbf{x}')\,\psi_a^{\dagger}(\mathbf{x}_0) = \delta(\mathbf{x}_0 - \mathbf{x}')\,\delta_{s,a}\widehat{1}$$

then

$$\left\langle \widehat{N}_a(\mathbf{x}_0)\right\rangle_\Psi = \int_\Omega d\mathbf{x}\int_\Omega d\mathbf{x}' \cdot \sum_{s=1}^{4}\sum_{j=1}^{4} \varphi_s^*(t,\mathbf{x}')\,\varphi_j(t,\mathbf{x}) \cdot$$
$$\cdot \widetilde{F}_0^\dagger \left(\delta(\mathbf{x}_0-\mathbf{x}')\,\delta_{s,a}\widehat{1} - \psi_a^\dagger(\mathbf{x}_0)\,\psi_s(\mathbf{x}')\right)\psi_a(\mathbf{x}_0)\,\psi_j^\dagger(\mathbf{x})\,\widetilde{F}_0$$
$$= \int_\Omega d\mathbf{x}\int_\Omega d\mathbf{x}' \cdot \sum_{s=1}^{4}\sum_{j=1}^{4} \varphi_s^*(t,\mathbf{x}')\,\varphi_j(t,\mathbf{x}) \cdot$$
$$\cdot \left(\delta(\mathbf{x}_0-\mathbf{x}')\,\delta_{s,a}\widetilde{F}_0^\dagger\widehat{1} - \widetilde{F}_0^\dagger\psi_a^\dagger(\mathbf{x}_0)\,\psi_s(\mathbf{x}')\right)\psi_a(\mathbf{x}_0)\,\psi_j^\dagger(\mathbf{x})\,\widetilde{F}_0.$$

Since $F_0{}^\dagger \cdot \hat{1} = \tilde{F}_0{}^\dagger$ and $\tilde{F}_0{}^\dagger\psi_a{}^\dagger(\mathbf{x}_0) = 0$ then

$$\left\langle \widehat{N}_a(\mathbf{x}_0)\right\rangle_\Psi =$$
$$= \int_\Omega d\mathbf{x}\int_\Omega d\mathbf{x}' \cdot \sum_{s=1}^{4}\sum_{j=1}^{4} \varphi_s^*(t,\mathbf{x}')\,\varphi_j(t,\mathbf{x})\,\delta(\mathbf{x}_0-\mathbf{x}')\,\delta_{s,a}\widetilde{F}_0^\dagger\psi_a(\mathbf{x}_0)\,\psi_j^\dagger(\mathbf{x})\,\widetilde{F}_0.$$

According with properties of δ-function and δ:

$$\left\langle \widehat{N}_a(\mathbf{x}_0)\right\rangle_\Psi = \int_\Omega d\mathbf{x} \cdot \sum_{j=1}^{4} \varphi_a^*(t,\mathbf{x}_0)\,\varphi_j(t,\mathbf{x})\,\widetilde{F}_0^\dagger\psi_a(\mathbf{x}_0)\,\psi_j^\dagger(\mathbf{x})\,\widetilde{F}_0.$$

Since

$$\psi_j^\dagger(\mathbf{x})\,\psi_a(\mathbf{x}_0) + \psi_a(\mathbf{x}_0)\,\psi_j^\dagger(\mathbf{x}) = \delta(\mathbf{x}_0-\mathbf{x})\,\delta_{j,a}\widehat{1}$$

then

$$\left\langle \widehat{N}_a(\mathbf{x}_0)\right\rangle_{\Psi} =$$

$$\int_{\Omega} d\mathbf{x}\cdot\sum_{j=1}^{4}\varphi_a^*(t,\mathbf{x}_0)\varphi_j(t,\mathbf{x})\widetilde{F}_0^{\dagger}\left(\delta(\mathbf{x}_0-\mathbf{x})\delta_{j,a}\widehat{1}-\psi_j^{\dagger}(\mathbf{x})\psi_a(\mathbf{x}_0)\right)\widetilde{F}_0$$

$$\int_{\Omega} d\mathbf{x}\cdot\sum_{j=1}^{4}\varphi_a^*(t,\mathbf{x}_0)\varphi_j(t,\mathbf{x})\left(\delta(\mathbf{x}_0-\mathbf{x})\delta_{j,a}\widetilde{F}_0^{\dagger}\widehat{1}\widetilde{F}_0-\widetilde{F}_0^{\dagger}\psi_j^{\dagger}(\mathbf{x})\psi_a(\mathbf{x}_0)\widetilde{F}_0\right)$$

$$\int_{\Omega} d\mathbf{x}\cdot\sum_{j=1}^{4}\varphi_a^*(t,\mathbf{x}_0)\varphi_j(t,\mathbf{x})\left(\delta(\mathbf{x}_0-\mathbf{x})\delta_{j,a}\widetilde{F}_0^{\dagger}\widetilde{F}_0-\widetilde{0}^{\dagger}\widetilde{0}\right).$$

$$\int_{\Omega} d\mathbf{x}\cdot\sum_{j=1}^{4}\varphi_a^*(t,\mathbf{x}_0)\varphi_j(t,\mathbf{x})\left(\delta(\mathbf{x}_0-\mathbf{x})\delta_{j,a}1-0\right)$$

$$\int_{\Omega} d\mathbf{x}\cdot\sum_{j=1}^{4}\varphi_a^*(t,\mathbf{x}_0)\varphi_j(t,\mathbf{x})\delta(\mathbf{x}_0-\mathbf{x})\delta_{j,a}.$$

Thus:

$$\boxed{\left\langle \widehat{N}_a(\mathbf{x}_0)\right\rangle_{\Psi} = \varphi_a^*(t,\mathbf{x}_0)\varphi_a(t,\mathbf{x}_0).}$$

That is operator <$\widehat{N}_a(\mathbf{x}_0)$> brings the a-component of the event probability density.

Let Ψa $(t,\mathbf{x}) := \psi_a(\mathbf{x}_0)\Psi(t,\mathbf{x})$.

In that case

$$\left\langle \widehat{N}_a(\mathbf{x}_0)\right\rangle_{\Psi_a} = \int_{\Omega} d\mathbf{x}\int_{\Omega} d\mathbf{x}'\cdot\Psi^{\dagger}(t,\mathbf{x})\psi_a^{\dagger}(\mathbf{x}_0)\psi_a^{\dagger}(\mathbf{x}_0)\psi_a(\mathbf{x}_0)\psi_a(\mathbf{x}_0)\psi_a(\mathbf{x}_0)\Psi(t,\mathbf{x}).$$

Since

$$\psi_a(\mathbf{x}_0)\psi_a(\mathbf{x}_0) = \widehat{0}$$

Then

$$\left\langle \widehat{N}_a(\mathbf{x}_0)\right\rangle_{\Psi_a} = 0.$$

Therefore $\psi_a(\mathbf{x}_0)$ ”annihilates” the a of the event-probability density.

5.4. Particles and Antiparticles

Operator $\widehat{\mathbb{H}}$ obeys the following condition:

$$\widehat{\mathbb{H}} = \left(\frac{2\pi c}{h}\right)^3 \sum_{\mathbf{k}} h\omega(\mathbf{k}) \left(\sum_{r=1}^{2} b_{r,\mathbf{k}}^{\dagger} b_{r,\mathbf{k}} - \sum_{r=3}^{4} b_{r,\mathbf{k}}^{\dagger} b_{r,\mathbf{k}}\right).$$

This operator is not positive defined and in this case

$$E_{\Psi}\left(\widetilde{F_0}\right) = \left(\frac{2\pi c}{h}\right)^3 \sum_{\mathbf{p}} h\omega(\mathbf{p}) \left(\sum_{r=1}^{2} |c_r(t,\mathbf{p})|^2 - \sum_{r=3}^{4} |c_r(t,\mathbf{p})|^2\right).$$

This problem is usually solved in the following way [250. For instance, Peskin M. E., Schroeder D. V. An Introduction to Quantum Field Theory,
Perseus Books Publishing, L.L.C., 1995.p.54]:

Let

$$\begin{aligned} v_1(\mathbf{k}) &:= \gamma^{[0]} e_3(\mathbf{k}), \\ v_2(\mathbf{k}) &:= \gamma^{[0]} e_4(\mathbf{k}), \\ d_{1,\mathbf{k}} &:= -b_{3,-\mathbf{k}}^{\dagger}, \\ d_{2,\mathbf{k}} &:= -b_{4,-\mathbf{k}}^{\dagger}. \end{aligned}$$

Ln that case:

$$
\begin{aligned}
e_3(\mathbf{k}) &= -v_1(-\mathbf{k}), \\
e_4(\mathbf{k}) &= -v_2(-\mathbf{k}), \\
b_{3,\mathbf{k}} &= -d^{\dagger}_{1,-\mathbf{k}}, \\
b_{4,\mathbf{k}} &= -d^{\dagger}_{2,-\mathbf{k}}.
\end{aligned}
$$

Therefore The first term on the right side of this equality is positive defined. This term is taken as the desired Hamiltonian. The second term of this equality is infinity constant. And this infinity is deleted (?!) [22. p.58].

$$
\begin{aligned}
\psi_s(\mathbf{x}) \quad : &= \sum_{\mathbf{k}} \sum_{r=1}^{2} \left(b_{r,\mathbf{k}} e_{r,s}(\mathbf{k}) \exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}} \mathbf{kx} \right) + \right. \\
&\left. + d^{\dagger}_{r,\mathbf{k}} v_{r,s}(\mathbf{k}) \exp\left(\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}} \mathbf{kx} \right) \right)
\end{aligned}
$$

$$
\begin{aligned}
\widehat{\mathbb{H}} &= \left(\frac{2\pi \mathrm{c}}{\mathrm{h}} \right)^3 \sum_{\mathbf{k}} \mathrm{h}\omega(\mathbf{k}) \sum_{r=1}^{2} \left(b^{\dagger}_{r,\mathbf{k}} b_{r,\mathbf{k}} + d^{\dagger}_{r,\mathbf{k}} d_{r,\mathbf{k}} \right) \\
&- 2 \sum_{\mathbf{k}} \mathrm{h}\omega(\mathbf{k}) \widehat{1}.
\end{aligned}
$$

But in this case $d_{r,k}\tilde{F}_0 \neq \tilde{0}$. In order to satisfy such condition, the vacuum element $\tilde{F}_0$ must be replaced by the **following:**

$$
\widetilde{F_0} \to \widetilde{\Phi}_0 := \prod_{\mathbf{k}} \prod_{r=3}^{4} \left(\frac{2\pi \mathrm{c}}{\mathrm{h}} \right)^3 b^{\dagger}_{r,\mathbf{k}} \widetilde{F_0}.
$$

But in this case

$$
\psi_s(\mathbf{x}) \widetilde{\Phi}_0 \neq \widetilde{0}.
$$

In order to satisfy such condition, operators $\psi_s(\mathbf{x})$ must be replaced by the following

$$\psi_s(\mathbf{x}) \rightarrow \phi_s(\mathbf{x}) :=$$
$$:= \sum_{\mathbf{k}} \sum_{r=1}^{2} \left(b_{r,\mathbf{k}} e_{r,s}(\mathbf{k}) \exp\left(-\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}\mathbf{kx}\right) + d_{r,\mathbf{k}} v_r(\mathbf{k}) \exp\left(\mathrm{i}\frac{\mathrm{h}}{\mathrm{c}}\mathbf{kx}\right)\right).$$

Hence,

$$\widehat{\mathbb{H}} = \int d\mathbf{x} \cdot \mathcal{H}(\mathbf{x}) = \int d\mathbf{x} \cdot \phi^{\dagger}(\mathbf{x}) \widehat{H}_0 \phi(\mathbf{x}) =$$
$$= \left(\frac{2\pi\mathrm{c}}{\mathrm{h}}\right)^3 \sum_{\mathbf{k}} \mathrm{h}\omega(\mathbf{k}) \sum_{r=1}^{2} \left(b_{r,\mathbf{k}}^{\dagger} b_{r,\mathbf{k}} - d_{r,\mathbf{k}}^{\dagger} d_{r,\mathbf{k}}\right).$$

And again we get negative energy.

Let's consider the meaning of such energy: An event with positive energy transfers this energy photons which carries it on recorders observers. Observers know that this event occurs, not before it happens. But event with negative energy should absorb this energy from observers. Consequently, observers know that this event happens before it happens. This contradicts Theorem 1.5.2. Therefore, events with negative energy do not occur.

Hence, over vacuum ⍰̃$_0$ single fermions can exist, but there is no single antifermions.
A two-particle state is defined the following field operator [23]:

$$\psi_{s_1,s_2}(\mathbf{x},\mathbf{y}) := \begin{vmatrix} \phi_{s_1}(\mathbf{x}) & \phi_{s_2}(\mathbf{x}) \\ \phi_{s_1}(\mathbf{y}) & \phi_{s_2}(\mathbf{y}) \end{vmatrix}.$$

And condition isn't carried out

$$\int d\mathbf{x}' \cdot \mathcal{H}_0(\mathbf{x}') \Psi(t,\mathbf{x}) = \mathrm{i}\frac{\partial}{\partial t}\Psi(t,\mathbf{x}).$$

In that case:

$$\widehat{\mathbb{H}} = 2\mathrm{h}\left(\frac{2\pi\mathrm{c}}{\mathrm{h}}\right)^{6}\left(\widehat{\mathbb{H}}_a + \widehat{\mathbb{H}}_b\right)$$

Where

$$\begin{aligned}
\widehat{\mathbb{H}}_a \quad : \quad &= \sum_{\mathbf{k}}\sum_{\mathbf{p}}\left(\omega(\mathbf{k}) - \omega(\mathbf{p})\right)\sum_{r=1}^{2}\sum_{j=1}^{2} \times \\
&\times \left\{ v_j^{\dagger}(-\mathbf{k})\, v_j(-\mathbf{p})\, e_r^{\dagger}(\mathbf{p})\, e_r(\mathbf{k}) \times \right. \\
&\times \left(+b_{r,\mathbf{p}}^{\dagger} d_{j,-\mathbf{k}}^{\dagger} d_{j,-\mathbf{p}} b_{r,\mathbf{k}} \right) + \\
&+ \left(+d_{r,-\mathbf{p}}^{\dagger} b_{j,\mathbf{k}}^{\dagger} b_{j,\mathbf{k}} d_{r,-\mathbf{p}} \right) + \\
&+ v_j^{\dagger}(-\mathbf{p})\, v_j(-\mathbf{k})\, e_r^{\dagger}(\mathbf{k})\, e_r(\mathbf{p}) \times \\
&\times \left(-b_{r,\mathbf{k}}^{\dagger} d_{j,-\mathbf{p}}^{\dagger} d_{j,-\mathbf{k}} b_{r,\mathbf{p}} \right) + \\
&+ \left. \left(-b_{r,\mathbf{p}}^{\dagger} d_{j,-\mathbf{k}}^{\dagger} d_{j,-\mathbf{k}} b_{r,\mathbf{p}} \right) \right\}
\end{aligned}$$

And

$$\widehat{\mathbb{H}}_b \quad : \quad = \sum_{\mathbf{k}}\sum_{\mathbf{p}}\left(\omega(\mathbf{k}) + \omega(\mathbf{p})\right)\sum_{r=1}^{2}\sum_{j=1}^{2} \times$$

$$\times\left\{v_j^\dagger(-\mathbf{p})v_j(-\mathbf{k})v_r^\dagger(-\mathbf{k})v_r(-\mathbf{p})\times\right.$$
$$\times\left(-d_{r,-\mathbf{k}}^\dagger d_{j,-\mathbf{p}}^\dagger d_{j,-\mathbf{k}}d_{r,-\mathbf{p}}\right)+$$
$$+\left(-d_{r,-\mathbf{p}}^\dagger d_{j,-\mathbf{k}}^\dagger d_{j,-\mathbf{k}}d_{r,-\mathbf{p}}\right)$$
$$+e_r^\dagger(\mathbf{k})e_r(\mathbf{p})e_j^\dagger(\mathbf{p})e_j(\mathbf{k})\times$$
$$\times\left(+b_{r,\mathbf{k}}^\dagger b_{j,\mathbf{p}}^\dagger b_{j,\mathbf{k}}b_{r,\mathbf{p}}\right)+$$
$$\left.+\left(+b_{r,\mathbf{p}}^\dagger b_{j,\mathbf{k}}^\dagger b_{j,\mathbf{k}}b_{r,\mathbf{p}}\right)\right\}.$$

If velosities are small then the following formula is fair.

$$\widehat{\mathbb{H}}=4\mathrm{h}\left(\frac{2\pi\mathrm{c}}{\mathrm{h}}\right)^6\left(\widehat{\mathbb{H}}_a+\widehat{\mathbb{H}}_b\right)$$

Where

$$\begin{aligned}\widehat{\mathbb{H}}_a\quad:\quad&=\sum_{\mathbf{k}}\sum_{\mathbf{p}}(\omega(\mathbf{k})-\omega(\mathbf{p}))\times\\&\times\sum_{r=1}^{2}\sum_{j=1}^{2}\left(d_{j,-\mathbf{p}}^\dagger b_{r,\mathbf{k}}^\dagger b_{r,\mathbf{k}}d_{j,-\mathbf{p}}-b_{j,\mathbf{p}}^\dagger d_{r,-\mathbf{k}}^\dagger d_{r,-\mathbf{k}}b_{j,\mathbf{p}}\right)\end{aligned}$$

And

$$\widehat{\mathbb{H}}_b \quad : \quad = \sum_{\mathbf{k}} \sum_{\mathbf{p}} \left(\omega\left(\mathbf{k}\right) + \omega\left(\mathbf{p}\right)\right) \times$$
$$\times \sum_{j=1}^{2} \sum_{r=1}^{2} \left(b_{j,\mathbf{p}}^{\dagger} b_{r,\mathbf{k}}^{\dagger} b_{r,\mathbf{k}} b_{j,\mathbf{p}} - d_{j,-\mathbf{p}}^{\dagger} d_{r,-\mathbf{k}}^{\dagger} d_{r,-\mathbf{k}} d_{j,-\mathbf{p}}\right)$$

Therefore, in any case events with pairs of fermions and events with fermion antifermion pairs can occur, but events with pairs of antiftrmions can not happen. Therefore, an antifermion can exists only with a fermion.

Conclusion

Physics is a game of probabilities in space-time. Irreversible unidirectional time and metric space is an essential attribute of any information system, and probability is the logic of events that have not yet occurred.

Referebces

1. Gunn Quznetsov, Logical foundation of fundamental theoretical physics, LAMBERT Academic Publishing, 2013, ISBN-10: 365945088X, ISBN-13: 978-3659450884
2. 2 Gunn Quznetsov, Probabilistic Treatment of Gauge Theories, Nova Science Pub Inc, (2007).
3. 4. Tarski, A. The Semantic Conception of Truth and the Foundations of Semantics, Philoso phy and Phenomenological Research, 4, 1944
4. 5. Eubulides of Miletus, Liar paradox, . 4th century BCE
5. Urysohn P. Zum Metrisationsproblem. Math. Ann., 1925, v. 94, 309–315.
6. 3. [Madelung, E., *Die Mathematischen Hilfsmittel des Physikers. Springer* Verlag, (1957) p.29

7. 6. Gunn Quznetsov, Dimension of Physical Space. PROGRESS IN PHYSICS, Volume 10 (2014), Issue 4. (October), Pp. 226—227. http://www.ptep-online.com/2014/PP-39-07.PDF
8. 7. Kantor I.L.; Solodownikow A.S. Hyperkomplexe Zahlen. B. G. Teubner, Leipzig, 1978.
9. 8. Edwin Thompson Jaynes. *Probability Theory: The Logic of Science.* Cambridge University Press, (2003). ISBN 0-521-59271
10. Lyndon, R. *Notes on logic*, D. VAN NOSTRAND COMPANY, INC., 1966
11. Bernoulli, J. *Ars Conjectandi*, BASILEA, Impenfis THURNISORUM, Fratrum, 1713
12. Gentzen, G., Untersuchungen Uber das Logische Schliessen, *Math. Z.* **39**, (1934), pp. 176-210, 405-431
13. Gentzen, G., Untersuchungen Uber das Logische Schliessen, *Math. Z.* **39**, (1934), pp. 176-210, 405-431
14. 10. Riess A. et al. *Astronomical Journal*, 1998, v. 116, 1009–1038.
15. 11. Spergel D.N., et al. *The Astrophysical Journal Supplement Series*, 2003, September, v. 148, 175–194; Chaboyer B. and Krauss L.M. *Astrophys. J. Lett.*, 2002, v. 567, L45; Astier P., et al. *Astronomy and Astrophysics*, 2006, v. 447, 31–48; Wood-Vasey W.M., et al. *The Astrophysical Journal*, 2007, v. 666, no. 2, 694–715.] [12. Coles P., ed. Routledge critical dictionary of the new cosmology. Routledge, 2001, 202
16. http://www.universetoday.com/2006/08/08/chandra-confirms-thehubble-constant/
17. 12. Coles P., ed. Routledge critical dictionary of the new cosmology. Routledge, 2001, 202.
18. 14. Miller, Chris. Cosmic Hide and Seek: the Search for the Missing Mass.. http://www.eclipse.net/~cmmiller/DM/. And see Van Den Bergh, Sidney. The early history of Dark Matter. *preprint*, astro-ph/9904251
19. 15. Hawley, J.F. and K.A. Holcomb. *Foundations of modem cosmology*. Oxford University Press, New York, 1998.], Fig. 5 [16. K. G. Begeman, A. H. Broeils and R. H. Sanders, 1991, MNRAS, 249, 523.
20. K. G. Begeman, A. H. Broeils and R. H. Sanders, 1991, MNRAS, 249, 523
21. 17. Kane, *Modern Elementary Particle Physics*, Addison-Wesley Publ. Comp., (1993), p.93
22. For instance, Peskin M. E., Schroeder D. V. An Introduction to Quantum Field Theory, Perseus Books Publishing, L.L.C., 1995.
23. For instance, Ziman J. M. Elements of Advanced Quantum Theory, Cambridge, 1969, 32.

Content