Some Remarks about Mathematical Structures in Science, Operator Version of General Laplace Principle of Equal Ignorance (GLPEI), Symmetry and too much Symmetry

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Abstract

It is suggested that the same form of equations in classical and quantum physics allow to elaborate the same algorithms to find their solutions if the free Fock space (FFS) is used. “The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics” is addressed on the example of the causality principle, (Sec.2). Notes on the role of the fields and their sources, and disposal of the excess of information are set out in Secs 3 and 5. Possible obstacles in constructing quantum gravity are discussed and remedies are proposed in Secs 4, 5 and 6. A connection of symmetries with the Laplace principle of equal ignorance (LPEI) and its operator generalization are considered in Sec.7. The classical and quantum vacuums related to isolation of a system are suggested, (Sec.8), [8].

Contents

Behind it all is surely an idea so simple, so beautiful, that when we grasp it - in a decade, a century, or a millenium - we will all say to each other, how could it have been otherwise?

John Archibald Wheeler (1986)

Introduction

From Wikipedia (2016), under the passwords: <Scalar field theory> and <Quantum field theory>, one can find the following sentences:

"Since they do not involve polarization complications, scalar fields are often the easiest to appreciate second quantization through. For this reason, scalar field theories are often used for purposes of introduction of novel concepts and techniques."

"The only fundamental scalar quantum field that has been observed in nature is the Higgs field. However, scalar quantum fields feature in the effective field theory descriptions of many physical phenomena."

"Quantum field theory (QFT) thus provides a unified framework for describing "field-like" objects (such as the electromagnetic field, whose excitations are photons) and "particle-like" objects (such as electrons, which are treated as excitations of an underlying electron field), so long as one can treat interactions as "perturbations" of free fields."

The paper's first aim is to **describe Nature by means of fields** as a fundamental ingredient of the theory.

The paper's second aim is just to better understand the role of symmetry and its relations to Laplace Principle of Equal Ignorance (LPEI) in quantization procedure.

The Free Fock Space (FFS) is an arena in which classical (statistical) and quantum phenomena are considered, see [5]. In this arena quantum and classical-statistical phenomena are indeed described in a very similar way reminding us that the two sets of phenomena are stemming from a common source of an uncertainty. There is also taken into account the simplicity principle and Poincare's approach to science.

In QFT there is a division of fields into two categories: one that describes fields created by sources and that which descibes sources. Both groups of fields are combined by the gauge symmetry. Any symmetry of the system, particularly gauge symmetry, promotes the formation of situations in which the Laplace principle of equal ignorance (LPEI) can be applied even in the case of the classical systems, [4]. It turns out that interaction between those two categories of fields is described by polynomials, see QED (quantum electrodynamics). We believe that by adding to that twofold gauge symmetric fields structure the nonlinear terms that describe self interaction divergences emerging in the nonrenormalizable perturbation theories and the closure problem can be removed, [5], [15], [16].

We would like to stress that the concept of a field and its source(s) is the basic notion of physics beginning with the 19th century. It is usefull not only for a description of the Newton force or electromagnetic phenomena, but also when we have to resigne from a precise description of particles motion like in quantum mechanics where the wave function can be treated as a field, the field of information about the system (wave function).

In the paper, as in the prewious works, we use n-point information (n-pi) in which similarity between time and space variables are incorporated. Nevertheless, we belive that time and space variables are different, [1, 2]. In fact, we are accepting the Poincare's point of view on the relationship of mathematics with physics expressed by the concept of **conventionalism** by means of which, following Poincare, we understand in a sense of convenience illustrated by two citations from Poincare papers:

"If, therefore, we were to discover negative parallaxes, or to prove that parallaxes are higher than a certain limit, we should have a choice between two conclusions: we could give up Euclidean geometry, or modify the laws of optics, and suppose that light is not rigorously propagated in a straight line (73)."

"If our experiences should be considerably different, the geometry of Euclid would no longer suffice to represent them conveniently, and we should choose a different geometry (Poincaré 1898)", e.g. Poincare symmetry:-). See also Sec.5.

In fact the concept of conventionalism is used every time when in the case of few alternative theories we are choosing the simplest one or we are or should do looking for such theory, see our remarks about the symmetry of equations of GRT (General Relativity Theory) in Sec.4.

At this point it is worth to notice that some people believe that at the fundamental level there is no symmetry at all, [2], and even if this is gradually changing with subsequent levels of description, we may not expect full GR symmetry for considered equations. In fact, a symmetry of considered equations is often broken by used initial and boundary conditions. So, it is not necessary to insist on such a large symmetry in equations. On the other hand, asymmetric equations, which make equations solving easier, not necessarily exclude the symmetric solutions, see previous author papers published in ResearchGate or ArXivs.

The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve. We should be grateful for it and hope that it will remain valid in future research and that it will extend, for better or for worse, to our pleasure, even though perhaps also to our bafflement, to wide branches of learning.

Eugene Wigner (1966)

1 Quantization, operator version of GLPEI, causality and symmetry

In [4] to calculate probability amplitudes we used the **generalized Laplace principle of equal ignorance** (GLPEI).

GLPEI relates a **dynamical characteristic of a system** with the **Laplace principle of equal ignorance** (LPEI) and a **probability feature** of the theory. In fact it can be used for any dynamical characteristic of classical or quantum system for which, when measuring a certain subset of its variables, the remaining variables are changing in an uncontrolled manner which can be expressed by using noncommuting variables. The equation (one side unitarity)

$$\hat{A}^*\hat{A} = \hat{I} \tag{1}$$

where $\hat{A}$ is a function or a matrix or an operator, $\hat{A}^*$Hermitian conjugate to $\hat{A}$ and $\hat{I}$ is unit function or matrix or operator, is some kind of operator version of GLPEI. A more restrictive the two side unitarity, or simply the unitarity condition, is described by equations:

$$\hat{A}^*\hat{A} \quad = \quad \hat{A}\hat{A}^* = \hat{I}. \tag{2}$$

The simplest structure, which guarantee two side unitarity is

$$\hat{A} = e^{i\hat{H}}, \tag{3}$$

where $\hat{H}^* = \hat{H} =$ is a Hermitian operator. In some sense, it is the most general and abstract exposition of GLPEI allowing simultaneosly to connect the above mantioned the **three features of theory**. We call this and similar formulas the **Laplace principle of equal ignorance operator** (LPEIO) or the **probability amplitude operator** (PAO).

We get the simplest equation to the operator $\hat{A}$ if it depends on a parametr t in the following way:

$$\hat{A} \equiv \hat{A}(t) = e^{-i\hat{H}t/\hbar}, \tag{4}$$

where $\hbar$ is a dimensional parameter, e.g. Planck constant:

$$i\hbar \frac{\partial}{\partial t}\hat{A} = \hat{H}\hat{A}. \tag{5}$$

Multiplying the above equation by a vector $|\Phi>$we get, for the vector $|\Psi(t)>= \hat{A}(t)|\Phi>; where\ |\Psi(0)>=|\Phi>$, the **Schrodinger equation**

$$i\hbar \frac{\partial}{\partial t}|\Psi>=\hat{H}|\Psi> \tag{6}$$

by means of which a more precise and differential knowledge about the system can be introduced and its evolution be described. Moreover, Eqs 4 to 6 express the **causality relations** for evolutions of the system. It is seen from

$$\hat{A}(t')\hat{A}(t) = \hat{A}(t'+t) \tag{7}$$

where t', t are arbitrary segments of time and $\hat{A}(t)$ desribes an evolution process in time segment t and the vectorthe

$$|\Psi(t)>=\hat{A}(t)|\Phi>;|\Psi(0)>=|\Phi> \tag{8}$$

can describe a state of the system at the time t. It is worth to notice that the linearity of Schrodinger equation satisfied by this vector like other linearities, see e.g. [8], [10] ,[5] are caused by impossibility of taking into account the precision of Newtonian description of considered phenomena. The particular solution is:

$$|\Psi(t)>=e^{(t/i\hbar)\cdot E}|\Phi>, \tag{9}$$

where $|\Phi>$is an eigenvector of the operator $\hat{H}$ with eigenvalue E. In classical physics E is an energy function of the system which depends on variables describing configurations of particles and their motions or, in the case of fiels, E depends on fields (functions), see [6]. Perhaps the quantum state of a given energy E corresponds to the classical situation in which about momenta and positions of the system, we can declare with equal probability that they correspond to the energy of that.

The two side unitarity 2, which leads to the structure 4 or equation 5, is very essential here because it leads to a connection of the physical characteristic of the system, in this case the energy of the system, with LPEI, and therefore with specific random situation (equal ignorance) , [4]. And according to my opinion - quantization is based on the occurrence of such a situation in the considered systems!

In particular, the symmetry of a system, especially the gauge symmetry, can be related to measurements or events with equal ignorance (EI).

Perhaps, in this sentence it is contained the mysterious fact that from (E)I one can describe the gauge symmetrical world!

In the case of **macrosystems,** the LPEI taks place for its **microstates.**

Let us repeat again that with the transition from the detailed description to less detailed, in which some details are lost, the **equation becomes linear** and this is associated to greater simplicity and symmetry.

It is not excluded that the **role played by** (G)LPEI and **operators** in a formation of QM sheds new light on the understanding of the miracle phenomenon of effectiveness of mathematics in the description of nature expressed in the above Wigner's quote !? With the help of operators we can say that so fundamental property as causality is tranfered to different entities and notions like variables and evolutions, which **may not commute and by this express directly or indirectly causation correlations,** 4. In fact, we have here some kind of ***distributed causality***.

LPEI is strangely linked with the Ernan McMullin's principle of indifference (2005), which is a continuation of Cartesian philosophy, that on the initial conditions leading to the current complexity of the Universe we should not impose any constraints.

2 Fields, information Fields. First and second quantization and a power of less detailed descriptions

Fields, in Newton's physics, do not play a significant role and in fact the main equations are Newton's equations for trajectories of material points. We can meet diametrically different situations in electrodynamisc with Maxweel's equations, where **configurations and motions of particles are only given in the form of defined scalar and vector field sources,** for which we have to solve Maxwel's equations for the electromagnetic fields. It is significant that in Maxwell's equations trajectories of the particles, which are the sources of the field, almost do not appear. It seems that Maxwell's equations are a precursor of quantum description of matter where detailed description of the motion of particles do not appear and trajectories are substituted by probability amplitudes which in fact are **fields (functions) of information** about a particle content of the system. It is the first quantization. The next milestep called the **second quantization**, which results from preserving the source structure of Maxwell's equations, is the assumption that the sources are given by formula 14 from which it is seen that the field substituting trajectories (wave function) interact with the field created by particles! See equations in QED. This is indeed incredible assumption and discovery perfectly confirmed by numerous experiments! From the foregoing, according to the QED equations, it appears that the **field of information -** represented by a wave function and the four-potential of electromagnetic fields - interact with each other. The history of science teaches us also about the flexibility of the field concept which is reflected in its various interpretations, see eg. electrodynamics. In fact, the field notion existed in the Newton era, in spite of his worries about the interaction between the masses at a distance what Einstein called it as spooky action at a distance.

We would like to draw attention to the fact that averaging or smoothing of the original quantities (filtration) is not only consistent with the experimental capabilities of human beings, but it is also an important tool to understand the reality. An example of this may be illustrated by the role of the GLPEI within the understanding of QM, see Sec.6, and in human history of too rigorous realization of certain ideas leading to many misfortunes.

3 Differential equations with an excess of symmetry and the equivalent hypothesis. Difficulties with quantization of general relativity (GR)

Symmetry of differential equations in physics are usually associated with some conservation laws as the energy, momentum or angular momentum conservations. They can also express very fundamental properties of physical systems as their independence on a choice of inertial reference frames. For example: Galileo and Lorenz transformations. In GR (General relativity) the property of independency of physical systems on any reference frame in space-time was elevated as a fundamental property of gravitation.

From Wikipedia, we can find that "Spacetime symmetries are features of spacetime that can be described as exhibiting some form of symmetry. The role of symmetry in physics is important in simplifying solutions to many problems. Spacetime symmetries are used in the study of exact solutions of Einstein's field equations of general relativity"

The common characteristic of symmetrical equations is that from an one solution one can generate the whole set of other solutions using the symmetry transformations. Is it good? Yes, it is and simultaneously it is not good: **there is a suspicion that the more symmetry equation has the more difficult to solve them**!, because difficulties connected with finding solutions are incorporated in the equation(s). It is seen in GR when in its **covariant** equations the nonpolynomial square root terms appear. Such terms are series challenge in the quantization procedure. But even in classical case the description of equations in the covariant form is not an universal method of their solving. So, we should look for simpler formulas descibing gravity itself and its interaction with other fields, [5].

In GR are used metrics which change radically the previous theoretical landscape! In this landscape there are spaces with curvature different from zero even in the absence of matter, which I think, it negates the principle of simplicity. It is probably a manifestation of too much symmetries in proposed equations or their description in a covariant way. As we know even equations of classical mechanics can be described in such a way, but it is not widely recommended method of solving them.

Once again, we want to emphasize that the symmetry of a solution can simplify search for the solution, because it reduces the space, [13]. In contrast, the symmetry equation may complicate the problem, because the equation become more complicated as is the case of the Newton gravity. In GR an excess of symmetry is introduced by the generalization of Galileo principle by demanding that not only in the inertial frames but in all reference frames equations have the same form.

Since too radical revolutions are not beneficial in human history, we put only a hypothesis that **to ingenious Einstein's GR approach,** which eliminates the concept of force and interaction by the geometrization description, **is equivalent** a less radical approach. We simply believe that the description with relevant gravitation field in the Minkowski space can replace the description of the GR in the 'free' curved spaces. In other words, we believe that concepts of force, interaction, are still a good reaserch programs. So, we prefere the Lorenz or Poincare invariant gravity albeit with a local gauge symmetry in the case when measurements of a certain subset of variables completely disturb a complementary subset of variables. In such a theory the **principle of simpicity** is incorporated into two places: First, when the Minkowski space is postulated, and secondly when the gravitational gauge field is introduced instead of curvature of the space. It seems that the gauge symmetry guarantees that certain global characteristics of the system like hamiltonian or lagrangian take arbitrary values when so called conjugate variables (e.g. momenta) take arbitrary values. If this correspond to physical situation in which measurement of a configuration of the system causes complete arbitrarines of its momenta, then GLPEI can be used. It seems that **successes of gauge theories show that on the fundamental level of matter we have such situation**. It is also possible that in such situation a combination of GR with QM will be more effective. See also [5], Sec.8.

It may be worth noting the possibility of the world in which not all the initial conditions permitted by current theories are acceptable which may lead to simple solutions expressed in the works on n-Body Choreography, [13].

4 Poincare's conventionalism as a good program of nature investigation?

Poincare's conventionalism is closly related to the simplicity principle. It allows to assume that the empty space is flat and can be treated as a base of description of the world. The appearance of matter can be regarded as a deviation from this assumption, or as a reason for the occurrence of a force field associated with the matter. I think, both approaches are equivalent, although there may be different levels of complexity. In fact, in both cases the curvature of space or rather spacetime depends on the measuring instruments. In both cases equations can be described in manifestly covariant ways for arbitrary reference frames. I also think that the most natural approache to gravity is this which uses the concept of field ($A_{\mu\nu}$) and its source ($\varrho_{\mu\nu}$) related to equation:

$$(\Box - m^2)A_{\mu\nu} = \varrho_{\mu\nu}$$

with differential operator $(\Box - m^2)$, for example: 4-vector gravitation potential field or geometric scalar theory of gravitation, *[9]*.

According to the **simplicity principle,** the source $\varrho_{\mu\nu}$ of gravitation field $A_{\mu\nu}$ can depend on $A_{\mu\nu}$and other fields by polynomial and other simple functions, [5]. In this way the symmetry of GR which bases on almost physical treatment of reference frames, and leads to too complicated equations (Einstein's equations), is removed.

Once more: According to Poincare philosophy - a description of the Universe is a matter of convention. In the famous Gauss test of Euclidean geometry, the observers assumed that light rays determine the stright lines (geodesics). In this way they wanted to prove or disprove Euclidean geometry. If, however, we postulate at the beginning Euclidean geometry then the **Gauss experiment would lead to changing the physics of light**. This may not be the most effective way of searching of nature but it is possible. This and similar examples allow us to come to conclusion that **effectiveness** is an important factor of any formalism aiming to describe nature and should be explicitly taken into account,

see http://plato.stanford.edu/entries/quantum-field-theory/. for

Another quote, this time from Einstein:

'Our experience hitherto justifies us in trusting that nature is the realization of the simplest that is mathematically conceivable', which illustrates Einstein's philosophy used even subconsciously, which is reflected in the Valentin Danci's work: "The Ninteen Postulates of Einstein's Relativity Theory" in ResearchGate (2017).

It can also be instructive quote the last sentences, and not only from [14]: "It took centuries to develop the extremely useful and successful physical concept of forces. One should not abandon it light-heartedly". We can similarly say about fields and their sources.

And quote from M. Heller's boook "Philosophy of Science" (2009) in Polish:

In science, there is a strong element of tacit agreement (convention) between researchers. "There is no bare facts" and "every fact is steeped in theory", and each theory contains many purely contractual elements.

5 Beam of light as a source of glory and the culprit of any lapses of cosmology and/or modified Newtonian dynamics (MOND)?

We assume that the photons with higher energy leave the beam of light quickly due to interaction with interstellar matter than photons with smaller energy. This simple hypothetical assumption of the light beam property makes the stars of the same physical properties but with a longer distance to us will send the light moved towards the infrared freqences proportional to the distance. This can be interpreted itself as a possible factor of the expansion of the World and explains also the ever faster moving away more distant stars. It seems to us that our assumtion can also explain the behaviour of stars in spiral galaxies. Of course, these are only suppositions, but based on directly seen the matter without recourse to invisible entities such as dark matter and energy, the properties of which may suggest that they simply do not exist! Very likely, the above explanation is not enough to describe all galaxies and their clusters. You may need to use a modified Newtonian dynamics (MOND) introduced by Mordehai Milgrom in 1983, with a modification depended on a scale of the objects?

In the quoted arguments we have used top down causation as in [4]!

6 Gauge Symmetric Field Theory with source structures

Not all features of a system can be (simultaneously or not) measured. It concerns not only physical systems. This may be due to system disturbances caused by measurement, or from its complexities. Fortunately, a variety of systems ranging from microscopic to macroscopic size, with the exception perhaps of the cosmos, are built with similar elements (elementary particles) which configurations and local relationships between them are expressed by the notion of field. We will assume that these fields are noncommuting because, as QM teach us, certain classical variables can not be simultaneosly measured. We can say that by measurements some information about them are lost. Nevertheless, shape of equations takes the form of classical equations

$$L[\ \tilde{x};\varphi] + \lambda N[\ \tilde{x};\varphi] + G(\ \tilde{x}) = 0 \tag{10}$$

with some problems of ordering of interacting (nonlinear) terms in the case of quantum fields

$$\varphi \to \hat{\varphi} \tag{11}$$

The field φ can describe an electromagnetic or hydromechanic equations of motion. Here the terms L and N describe a linear and nonlinear dependence on the field φ , the term G does not depend on φ and can describe an external force. To avoid excess of indexes, $\tilde{x}$ $\tilde{}$contains not only the space-time variables (space-time localization) but also subscripts and superscripts indexes denoting components of the field φ . In other words, $\tilde{x}$ may describe the external and internal particle variables . So we have:

$$\tilde{x} = (\vec{x}, t, ^{\eta,\theta,\vartheta,\ldots,}_{\mu,\nu,\xi,\ldots,},)\ and\ \varphi(\tilde{x}) \leftrightarrow \varphi^{\eta,\theta,\vartheta,\ldots}_{\mu,\nu,\xi,\ldots}(\vec{x},t) \leftrightarrow \varphi = (A^{\mu}, j^{\mu}, \psi, \bar{\psi}, \ldots) \tag{12}$$

.

The same form of equations in classical and quantum cases can be an indication that other classical structures can be preserved in quantum case, see also

[11]. I think that it was Dirac's inspiration when he discovered QED in which the famous relativistic invariant, classical equation

$$\Box \hat{A}^{\mu} = \hat{j}^{\mu} \tag{13}$$

was preserved with the brilliant quantum formula for the **source** (current) of the field $\hat{A}$:

$$\hat{j}^{\mu} = e\bar{\hat{\psi}}\gamma^{\mu}\hat{\psi}, \tag{14}$$

see QED. Like in classical ED (CED), Eq.13 is linear, however nonlinear is formula 14. Perhaps linearity of Eq.13 results from the **implicit averaging of currents** occurring in its right side which as in CED can be nonlinear functions of spacetime variables.

At this place we would like to notice that sometimes it is useful to use different letters instead of one super field φ .

The above two uncompleted equations are closed by adding the following equation

$$i\gamma^{\mu}\partial_{\mu}\hat{\psi} - m\hat{\psi} = e\gamma_{\mu}\hat{A}^{\mu}\hat{\psi} \tag{15}$$

whose form can be justified by the request of the **gauge symmetries** of theory and the simplicity principle.

The **gauge symmetry** and other symmetries are important, because symmetries make this that different "configurations" of the system are equivalent to each other. In other words, our descriptions of reality are relative and I think that this lack of absoluteness is expressing or creating our ignorance about the World, which increases with increasing of symmetry. It seems that the description of the World is based on equal ignorance (EI) events related to certain symmetries like gauge symmeries - due to which **physics does not depend on a choice of reference frame at every spacetime point.**

Limitation only to the polynomial interactions as in Eq.15 may be waived as a result of mathematical difficulties, namely the appearance of mathematical divergences or/and difficulty in closing the infinite chain of equations. These problems are partly considered in the author works, see for example: [15], [5].

7 The free Fock space (FFS) and Heisenberg's quantum algorithms. Vectors generating multitimes n-pi. Classical and quantum relative vacuum in FFS

FFS reconciles, in the description of the fundamental level of nature, two conflicting opinions on the symmetry , see [2] and others. Smolin thinks that there is no symmetry at a fundamental level. Using FFS we take advantage of lack of symmetry, but only for auxiliary quantities. Thus we do not exclude the possible symmetry of the system while enjoying the lack of symmetry of the auxiliary quantities leading to their one side reversibility.

In this paper we mainly consider theories which due to the nature of measurement contain no certain information in comparison with the full classical description. There is difference between radical lost of information for certain subset of variables (e.g. momnenta) and less radical lost of information in which all variables are known only in approximated way or are treated as random variables. These two cases are known as quantum and statistical cases. Nevertheless, both these cases can be described in the same FFS. Moreover, if we use Heisenberg representation of quantum theory, then **Heisenberg equations have the same form as classical Newton equations**. However, Heisenberg equations are for operators which are noncommuting quantities. This difference disappears if we write equations for n-point information (n-pi) which are tensor products of corresponding variables (fields). **In both cases the equations for n-pi are linear** which makes both can apply the same algorithms to solve relevant equations. These equations

$$\left(\hat{L} + \lambda\hat{N} + \hat{G}\right)|V>= \hat{P}_0\hat{L}|V> + \lambda\hat{P}_0\hat{N}|V> \equiv |0>_{info} \tag{16}$$

are described in more details in [5], where is also given a relation of the above equations to 10. The most important is here the fact that the equation 16, which is described in the FFS, see below this Section, reduces the difference between averaged or smoothed Newton's equations of classical mechanics and Heisenberg's equations of QM to the additional conditions only! The undoubted benefit from using the FFS is the fact that almost all operators present in Equations 16 **are explicitly right or left invertible**, see e.g. [5, 8]. This allows in many cases to convert the infinite chain of equations for the n-pi ($n = 0, ..., \infty$) to finite systems of equations ($n = 0, ..., a\ finite\ number$) that can be considered as the first step in the construction of new algorithms, which I propose to call the *Heisenberg's quantum algorithms*.

FFS differs from the Fock space (FS) by resignation from symmetries like permutation or anti-permutation symmetries of n-pi (n-point information) generated by vectors (generating vectors) (GF, GV) of the FS. In some sense it reminds us the abolition of the bonds, subject to the serfs and other co-existing during the transformation of feudal economy into a capitalist! In the FFS we operate with generating (formal) functionals:

$$V = \sum_n \int d\tilde{x}_{(n)} V(\tilde{x}_{(n)})\eta(\tilde{x}_{(n)}); \;\; \tilde{x}_{(n)} = (\tilde{x}_1, ..., \tilde{x}_n) \tag{17}$$

in which n-point functions (n-pf) $V(\tilde{x}_{(n)})$, hereinafter referred to as n-point information (n-pi), have physical interpretation, and n-point functions $\eta(\tilde{x}_{(n)})$ (not operators) are **auxiliary functions**. Word - formal - means here, the infinite series does not need to be convergent, and there is simply no physical meaning to it. Below we express it with the notion of vectors. For meaning of variable(s) $\tilde{x}$, see 12. It is worth noting that the functionals V are linear with respect to the function $\eta(\tilde{x}_{(n)})$. It is also noteworthy that great scientist and philosopher - Hoene-Wronski, saw in the infinite power series a mystical truth. In particular, when all n-pf are expressed by 1-pf $\eta(\tilde{x})$:

$$\eta(\tilde{x}_{(n)}) = \eta(\tilde{x}_1)\cdots\eta(\tilde{x}_n)) \tag{18}$$

then the information contained in the GF V is not partially lost only when the n-pf V are permutation symmetrical. It turns out that one can avoid that loss if in Eq.18 we substitute functions $\eta(\tilde{x})$ by operators $\hat{\eta}(\tilde{x})$ satisfying Cuntz relations:

$$\hat{\eta}(\tilde{x})\hat{\eta}^{\star}(\tilde{y}) = \delta(\tilde{x}-\tilde{y})\hat{I} \tag{19}$$

and additional restrictions that their exists a vector $|0>$ which it is not accompaned to any n-pi and an action of the operator $\hat{\eta}$ on this vector

$$\hat{\eta}(\tilde{x})|0>= 0 \tag{20}$$

The star over the operator means the linear operation called involution:

$$(\hat{\eta}^{\star}(\tilde{x}))^{\star} = \hat{\eta}(\tilde{x}) \tag{21}$$

They are named accordingly as the 'creation' ($\hat{\eta}^{\star}$) and the 'annihilation' ($\hat{\eta}$) operators, see[8]. In the FFS they **create or annihilate information** in the space-time points $\tilde{x}$, see 12.

Now we can substitute the GF by the generating vector (GV):

$$V \leftrightarrow |V>= \sum_n \int d\tilde{x}_{(n)}V(\tilde{x}_{(n)})\hat{\eta}^{\star}(\tilde{x}_1)\cdots\hat{\eta}^{\star}(\tilde{x}_n))|0> \tag{22}$$

in which, due to the noncommuting 19 of operators $\hat{\eta}^{\star}(\tilde{x})$ - any loss of information contained in functions $V(\tilde{x}_{(n)})$, called n-pi (n-point information), - do not take place. From formula 19 and 20, we have indeed:

$$V(\tilde{x}_{(n)}) =< 0|\hat{\eta}(\tilde{x}_1)\cdots\hat{\eta}(\tilde{x}_n)|V> . \tag{23}$$

But the most important is that operators appearing in Eq.16 are right or left invertible. This allows for useful transformations of Eq.16, see e.g. [5].

A characteristic feature of the Eq.16 is the presence of the vector $|0>_{info}$, which provides a full left- or right- invertibility of operators present in this equation. Since the vector $|0>_{info}$ is not accompanied by any local n-pi, we can conclude that it refers to the ***classical*** or ***quantum relative vacuum*** related to a considered isolated system. This vacuum is associated with the isolated physical system. In the case of the description of the universe it can be a space without matter that is emptiness, nothingness. In other words, when we say that the considered system is isolated from the rest of the world, the rest of the world is thus isolated from the system and is described by the vector $|0>_{info}$, [8].

The linear complex space constructed from generating vectors $|V>$, 22, we call the *free Fock space* (FFS). Vectors $|V>$ describe the multitimes correlation functions (n-pi) which from definition of an 'averaging' are related to the same processes. What about 'averaging' related to arbitrary processes (various initial and boundary conditions entering different products into <...>)?

8 The lesson of modern history of science. Operator version of GLPEI again, (Sec.2)

Very briefly, we can say that modern physics started from humane scales when Galileo with primitive clocks (pulse, hourglasses?) has been establishing the temporal relations for inclined planes and pendulums. Galileo died in 1642, the year in which Newton was born and who discovered three laws, Newton's laws, describing motion of **idealized** material bodies from observations of point planets. Classical mechanics describing macroscopic bodies: pendulums, inclined planes, missiles, the planets was created. We had to wait until three centuries before genius of people like Planck, Bohr, Schrodinger, Heisenberg, Dirac, Einstein and many others, reformulated the classic Newton's descriptions to descrbe the microscopic objects as atoms, molecules and subatomic particles. This reformulated description, at least in one of its variants, consists of an amazing trick replacing a finite number of functions describing the trajectories of a finite point objects by operators usually consisting of infinite number of functions. These, usually **noncommuting** mathematical objects, have a completely different interpretation in which classical trajectories do not appear. However, the **equations for these operators have the same form (structure) as their classical counterparts**!

Can we use the same trick to Einstein's equations of General Theory of Relativity? I see **three obstacles**:

- First, the equations (Einstein equations) are unnecessarily complicated, reasons of which were mentioned in Sec.4.
- Second, we do not posses a good, classical, a large scale gravity theory, which describes well astrophysical observations after the introduction of invisible objects directly, such as the dark matter and energy.
- Thirdly, in the various possible versions of quantum gravity is a problem of nonrenormalizability of theory.

I think these obstacles could be removed by request of the less symmetric theory limited to the Poincare group, by consideration of non-linear interactions which instead of creating divergences they remove them and finally by developing a large scale electromagnetic theory which appropriate averaging leads to the Maxwell theory.

It is not an easy task. It is possible that an appropriate arena to seek its implementation is the FFS with easily constructed right and left-invertible operators, which appear in Eq.16. It seems to me that the operation of filtering of overload information (**Big Data**), which is practiced in various fields of science, also can be useful in cosmology.

Guided by the principle of simplicity and cycles of time, [12] , I propose an intuitively imaginable model of the Universe:

From the beginning of one of the cycle of the Universe, [12], there was a Big Bang which, due to the Simplicity Principle, created a homogeneous energy fulfilling the entire Universe. Quanta of energy, due to instability of the gravitational attraction, began to create structures fulfilling the present Universe, which we try to describe in one or another way:-)

I would like to draw your attention once again to the role played by the simple function

$$e^{i\varphi}$$

in the expression of LPEI and binding this principle with a variety of dynamical quantities. In this it is important to express the probability with the help of complex amplitudes which satisfy the linear Schrodinger equation.

Finally, the purpose and at the same time the value of the present study is to provide an alternative descriptions of systems with many scales and incomplete data which include classical and quantum systems:-)

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