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# The Concept of Mass Based on Accelerated Conservation of Energy within Asymmetric Space-Time Phases

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Agaddin Khanlar Mamedov

Additional information is available at the end of the chapter

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## Abstract

This chapter presents a new look to the conservation laws and suggests a model for discrete non-uniform localization of energy portions (quanta's) within conjugated space and time phases. The model connects electromagnetism with the space-time and shows that electromagnetic energy is the Planck's scale product of the generation of asymmetric space and time phases. In the reverse order, at the Black Hole's scale with complete consumption of electromagnetic energy, decay of space-time frame takes place with accumulation of energy in virtual space phase, which translates energy to the background in the form of gravitation. Huge amounts of negative energy accumulated within background space leads to the generation of elementary space-time unit, which carries non-uniform energy conservation in the form of electromagnetic energy. Translation of background uniform energy, accumulated within minimum space, to the non-uniform energy conservation phase generates a non-baryonic heavy particle, which is the precursor of the ingredients of elementary space-time frame of matter. The background spontaneous symmetry break is a phenomenon, related to the discrete translation of uniform energy conservation phase to the phase of non-uniform conservation, carried by electromagnetic field within asymmetric space-time unit.

**Keywords:** generation of mass, conservation of energy, origin of space-time

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## 1. Introduction

The topic related to the generation of mass by elementary particles is a very important area of particle physics. The recent discovery of Higgs boson is a big triumph for theoretical physics.

However, many questions related to Standard Model of particle physics are waiting for answers, such as locality of elementary particles in space-time frame and its connection with the principles of quantum mechanics.

In our previous papers [1–4], we showed that discrete performance of space-time frame is the necessary background for unification of quantum physics with the relativity theory. In the present paper, we will expand our analysis on non-uniform conservation of energy to show that the space-time phenomenon arises from the non-uniform conservation of energy to carry locality of photons within space and time frame. The non-uniform conservation of energy becomes the only reason for generation of mass and gravity within asymmetric boundaries of space-time frame to eliminate singularities from physical laws.

In this paper, we will describe that the elementary particles appear as an energy portions, distributed within conjugated asymmetric space-time fields, where energy contents of space and time phases generate different particles, such as bosons and leptons, emerging from the asymmetric background translation of space-time phases and energy content of the space-time frame. On this basis, we will discuss performance of space-time as an energy-mass carrying non-invariant field, generated from background coupling of space and time ingredients of light photons.

## 2. The concept of mass

Mechanism of symmetry breaking and generation of mass is the main problem of particle physics. Three independent groups, Higgs [5], Englert and Brout [6], and Guralnik et al. [7–10], published mechanisms on how particles get mass. All three, starting from very different viewpoints, proposed essentially the same mechanism based on spontaneous symmetry breaking. It postulates that matter obtains mass by interacting with a field, known as Higgs field.

In accordance with that mechanism, universe is filled with remarkable new Higgs field and Higgs boson of the field gives mass to gauge bosons and to all other particles. The mass of the Higgs particle itself is not explained in the theory, but appears as a free parameter [10]. Higgs mechanism does not describe how Higgs boson itself gets a mass and the origin of mass in all its forms is not clear [10, 11]. A standard model does not involve gravity therefore, the primary role of mass in this model is not known. The reason why spontaneous symmetry breaking causes and leads to generation of mass remains one of the questions of quantum physics [12–18].

It is necessary to note that the concept of mass needs understanding of the true nature of space-time. The space-time phenomenon was the hot subject of long debates between Newtonian and Leibniz physics [19, 20]. Later, Kant analyzed Newtonian and Leibniz space-time concepts within his metaphysical principles. Kant's metaphysical understanding of space-time was close to the Newtonian absolute space and time representation. In accordance with Kant's metaphysics, "space and time are substances in their own right (as Newtonian absolute space) and they exist independently of all objects and relations" [19].

Leibniz's view on space and time was different [20]. By Leibniz's opinion, the space-time is "inhere" in objects and relations [19], which is close to Einstein's representation of space-time [21, 22].

In accordance with Einstein's general relativity theory, space and time are relative and consist in the form of space-time unit. The gravitational force between masses leads to the warping of space-time. However, Einstein's space-time is geometric and does not give explanation as to where space-time comes from.

Zeeya, in his paper published in nature [23], very correctly concluded that, "many researchers believe that physics will not be complete until it can explain not just the behavior of space and time, but where these entities come from."

Raamsdonk [23] suggested, "In some sense, quantum entanglement and space-time are the same thing." By Maldacena's opinion "quantum is the most fundamental and space-time emerges from it [23]. However, Barbour [24] believes that if time is removed from the foundation of physics, we shall not all suddenly feel that the flow of time has ceased".

Therefore, our present knowledge does not give any information about the origin of space-time and what we know is only our representation of space, produced from Euclidean geometry.

Description of locality of a matter and energy within space-time frame is the main problem for unification of physical laws. First, for description of mass it is necessary to understand the main principle of Newton's law: when a system having constant velocity tends to continue its constant velocity in a straight line. Where does a system get this behavior from and what are the energy resources that a system uses for motion in space with the non-vanishing constant velocity in straight line in infinite time? It is clear that conservation of energy at this particular condition of Newton's physics becomes a very abstract concept.

If a system tends to keep its constant velocity in straight line in infinite time during its motion in abstract space, as Newton's first law states, it has to consume constant amount of energy to carry a body within space in time independent infinite uniform motion otherwise it cannot keep constant velocity.

Newton's first law is valid only in inertial frame of reference, but the inertial frame itself needs condition to be in a state of uniform motion. We can expand the above-mentioned discussion on energy resources for uniform motion of time independent inertial frame as well, which also has to follow principles of energy conservation. Here appears one important question, which needs clarification. If different frames of reference have different uniform velocities, there should not be any preference in selection of the particular reference frame. In this case, translation from one reference frame with constant velocity to another one with the other constant velocity will change space-time coordinates and produce acceleration, which will vary with the variation of reference frames. The difference between inertial frames with different uniform velocities appears in the form of different space-time frame and generation of some identity, which we call mass.

From an energy point of view, when different inertial frames have the same velocity, they are not energetically different inertial frames. In accordance with the energy conservation

principle, frame of references comprise the set of space-time coordinates and the difference between such a frame of reference has to be related to the energy, distributed in space-time structure of that reference frames. As we have shown [1–4], to be the same reference frame, these frames should have the same energy/momentum relation. It is clear that when energy applied to the systems is completely consumed, all reference frames moved from some state of constant velocity by application of energy, and have to “fall back” to the initial state for restoration of energy. In this case [1–4], there should be a uniform “gravitational free fall” for all of the reference frames to the initial state, which is the only reference frame, produced by the non-uniform conservation of energy. This statement is the modification of Newton’s second law, where the uniform acceleration is explained through the cancelation of each other’s ingredients in the formula of  $F/m$ .

In our earlier papers, we showed [1–4] that conservation of energy does not exist without localization in space-time frame and the localization has to be non-uniform. It is easy to show that the space and time are the resulting non-unitary portions of non-uniform distribution of energy, consumed in space phase (forming mass) and restored in time phase:

$$\frac{\frac{\Delta S}{S_1}}{\frac{\Delta t}{t_1}} = \frac{E_{ap} - E_s}{E_s} \quad (1)$$

where  $E_{ap}$  is the applied energy, and  $E_s$  is the local energy of a body. When carrying of energy, the parameters  $\Delta S/S_1$  and  $\Delta t/t_1$  represent the changes of space and time variables in relation to their local values as spinning of the change around their local state, respectively. The detailed features of the model will be explained later. Model (1) can be written as follows:

$$\frac{\frac{\Delta S}{S_1}}{\frac{\Delta t}{t_1}} = \frac{E_{ap}}{E_s} - 1 \quad (2)$$

$$\frac{\frac{S_1}{t_1} + \frac{\Delta S}{\Delta t}}{\frac{S_1}{t_1}} = \frac{E_{ap}}{E_s} \quad (3)$$

We will consider that due to the carrying of energy, the space and time phases are energetic fields, having all the behavior that is a characteristic for any energy field. The special feature of the model (3) is that acceleration as a phenomenon appears as the change of space-time in relation to the initial local space-time position. The special feature of this approach is that the effect of the action is determined as the result of exchange interaction (Eqs. (1) and (2)). When  $E_{ap} - E_s \neq 0$ , change of velocity is proportional to the applied energy ( $E_{ap}$ ) and while at  $E_{ap} = 0$ , “inertial” and “local” energy contents of different masses cancel each other.

This concept is completely different from Newton’s acceleration, which describes acceleration as the derivative of the velocity or second-order derivative of space-time in abstract space within universal time.

The left side of Eq. (3) shows addition of change of a position to the initial space-time frame in the form of acceleration. The right side of Eq. (3), in the form of non-unitary energy portion, is the relation of the energy of a force carrier field to the initial energy content of a body of the space-time frame.

Equation (3) at  $\Delta S/\Delta t = 0$ , could be considered as the symmetry of an energy carrier field with the energy of a particle or unification of energy-mass relation within space-time frame. In this case, use of equivalence between energy and mass of a particle in simple form is not an approximation. Later, we will show that during exchange interaction,  $E_{ap}$  and  $E_s$  may exchange their behavior, and  $E_s$  of Eq. (3) describes inertial energy of a particle, which at background state of space-time frame is equivalent to the mass. Using this principle in conversion of entities, we can get the equation of classic physics:

$$\mathbf{a} = \frac{\mathbf{F}}{\mathbf{m}} \quad (4)$$

In accordance with Eqs. ((1)–(3)), the portion of energy, consumed for locality of a zero mass virtual particle in space-time frame, can be described as “transformation of energy to mass,” which presents the non-uniform conservation of energy within energy-mass relations. The non-consumed portion of energy determines the local strength of the “force carrier particle.” This approach explains the nature of mass in more details than that of Newtonian inertia of a body. Here, mass appears as the response of an initial local energy state of a body to the change of its space-time frame, which appears as an exchange interaction with the applied energy. On this basis, mass in the dynamical model (3) changes with the content of the energy portion, which is consumed in the space-time frame of a particle.

Description of an event as a change of velocity in relation to the local initial space-time frame gives more information on the dynamics of an event and nature of mass than that of description of force as a change of the momentum or double change of space-time with the non-vanishing mass in the abstract space within change of universal time.

The effect of a force is the action and the local initial content of the energy of a body (Eq. (1)) describes conservation of action through the action-response exchange relation, while Newton’s effect of force does not involve action-response exchange relation that is why Newtonian response appears in the form of independent uniform inertia. That is why action in Newton’s formulation is not conserved. Model (1) describes the response of a system in exchange interaction  $(E_{ap} - E_s)/E_s$  in the form of  $E_s$ , which appears as the carrier of dynamic inertia (or gravitational mass) of a body to the non-uniform flux of the available portion of energy to the space-time field.

It is necessary to note that presently there is no complete theory of dynamics, which may describe change phenomenon where action is conserved. The action is the integral of a Lagrangian over time between the initial and final time of the system. For the action integral to be well defined, the trajectory should have its boundary simultaneously in time and space. However, Lagrangian action principle does not cover these requirements, therefore is not a complete theory for analysis of the simultaneous change of variables and cannot be a proper law for conservation of energy. Feynman applied Lagrangian action to quantum mechanics.

However, Feynman's Lagrangian action is not conserved and even modified Lagrangian for strong interactions needs renormalization [25].

Another important feature of the model (3) is that from classic physics position it is possible to get limitation of velocity by the speed of light, which cannot follow from Newton's second law and does not need special relativity formulation. When energy of a body is equal to the light energy ( $E_{ap}/E_s = 1$ ),  $\Delta S/\Delta t$  parameter in Eq. (3) became zero, and therefore there is no change of velocity in relation to the initial state (background state) and there is no acceleration. Besides that, with the expansion of space (1) and accumulation of energy in space in the form of mass, more energy is required to move a body with the same velocity therefore a body never can reach the speed of light.

It is the boundary of maximum velocity. Such an outcome from Eq. (3) on the limitation of maximum velocity to the speed of light is completely different from principles of special relativity. Model (3) describing the velocity in relation to the initial local space-time frame and the relation of the action energy to the initial energy content of a particle in the form of exchange interaction unifies  $F/m$  formulation of classic physics and  $E/m$  relation of special relativity. Model (3) shows that if a particle will have velocity equals to the speed of light, there will be no acceleration and universe will not undergo the change.

The above-mentioned analysis of model (1) reveals one very important question: a particle to feel the effect of force or effect of any type of field should have minimum non-zero mass, otherwise a particle will not have limited velocity.

It is necessary to explain one question, which has no explanation in the special relativity theory. The question is why there should be a maximum velocity, which is limited by the speed of light. In accordance with our concept, maximum velocity of light is necessary to hold conservation of energy, elimination of infinite energy and space-time singularity. In addition, the finite maximum velocity limit needed for translation of space-time variables to each other through  $\Delta S/\Delta t$ . Without boundary velocity, there cannot be finite space-time frame and no energy conservation. It is obvious that boundary of light velocity leads to the boundary of space-time frame, which correlates this boundary through translation of variables.

Based on model (1), we may analyze energy-mass equivalence and the concept why energy conversion to mass is needed. This question has a connection to the discussion given above. Our concept shows that there is no static Noether's conservation of energy [26], and only non-uniform conversion of energy from one form to another can hold conservation principle. The non-invariance of energy-mass relation is the only way for conservation of energy during its conversion from one form to another, which is carried within non-uniform space-time frame. This is an alternative approach on the existence of mass and energy-mass equivalence for limitation of velocity to the speed of light. This approach is different from the relativity concept of increase of relativistic mass with the increase of velocity.

### 3. Generation of classic space-time field model

The new concept, which we present, involves conjugation of the change of a function ( $\Delta f$ ) with the local value which is the relative locality of a particle ( $f_n$ ). In this formulation, the reciprocal

discrete transform within change ( $\Delta f$ ) and function ( $f_n$ ) can be generalized within boundary of canonical variables. In this case, we have a purpose eliminating problem of classic physics and quantum mechanics, which describes an event as a change of state of something without relation to something itself. The formulation  $(\Delta f)/f_1$  is useful while it allows description of an interaction of a body and force carrying field through exchange interaction.

The formulation  $(\Delta f)/f_1$  has also “quantum mechanics behavior:” the new classic operator in the form of  $(\Delta f)/f_1$  describes change (spinning or vibration) of the function around dynamical initial locality to repeat its origin. Similarly, the operator  $\Delta S/S_1$  describes the fluctuation of space around its origin due to the applied force, while operator  $\Delta t/t_1$  describes the fluctuation of time about instant of action. On this basis, space and time phases, which carry energy, get features of an energetic field.

In the conjugated space-time field, a position of a particle, located within space-time frame is not a point; it exists within very certain discrete non-virtual space-time manifold, commuting dynamic energy, and is distributed within space and time fields.

In accordance with the non-uniform energy conservation concept, the space-time is the resulting non-unitary inner product of energy distribution, which comprises portions of energy consumed in space phase (event mass) and restored in time phase.

$$\frac{\frac{\Delta S}{S_1}}{\frac{\Delta t}{t_1}} = \frac{E_{ap} - E_s}{E_s} \quad (5)$$

$$\frac{\Delta S}{\Delta t} = \frac{S_1}{t_1} \left( \frac{E_{ap}}{E_s} - 1 \right) \quad (6)$$

$$\lambda = \frac{E_{ap}}{E_s} - 1 \quad (7)$$

at  $\lambda = 1$ ,  $E_{ap} = 2E_s$ .

where  $S_1$  and  $t_1$  are the space and time variables corresponding to the dynamic local boundary,  $E_{ap}$  and  $E_s$  are the energies of action and under action systems of interaction at conditions corresponding to the local boundaries of  $S_1$  and  $t_1$ . In accordance with model (5), energy portion inserted to the space-time frame, travels through wave of exchange interaction, which determines the exact pathway of a particle. The right side of the model describes the frequency of energy consumption by the matter particles, while the left side shows the frequency of the change of space and time waves fields. The entities  $\Delta t$ ,  $t_1$  and  $\Delta S$ ,  $S_1$  perform as the same identities of energy carrier, existing differently in the opposite phases.

Model (5) treats the matter field through space phase, while antimatter field with the time phase which couples in space-time unit carries the non-uniform conservation of energy. Later, we will show in detail how the boundary mapped space-time frame, involving limitation of maximum velocity to the speed of light is the requirement for conservation of energy. Model (5) presents the boundary of space-time by the local position, dynamically growing in

accordance with the available portion of energy. In a simple form, if there is a local position, there should be a boundary of the change of the energy that carries a space-time field.

The left side of model (5) involves the dynamic conservation of space-time frame as the non-unitary “grains,” while the right side shows the non-uniform conservation of energy-mass exchange relation, carrying the dynamic flux of energy portion to the local  $\mathbf{S}_1/t_1$  metric of space-time frame (6). The gradient of energy in relation to the initial state  $(\mathbf{E}_{ap} - \mathbf{E}_s)/\mathbf{E}_s$  as an equivalent form of space-time “grains” becomes the non-unitary quanta, which describe change of local space-time frame as an exchange interaction of a particle with the applied force. The portion of energy, distributed in space and time phases, determines the strength of a force and repulsive reaction of a matter.

The model of non-uniform energy conservation (5) shows that space-time is the energetic field, which carries localization of energy conservation within dynamical space-time frame. The space-time, which has to carry conservation of energy, generates a non-virtual local frame, and moves it relative to the state of energy restoration.

The condition  $\mathbf{E}_{ap} = 0$  of model (5) is the background state of discrete space-time field, where asymmetric space and time variables, for holding of conservation cycles, undergoes to the discrete translation as the portions of energy in the different fields. At this state, all types of the interactions discretely unified.

In accordance with model (5), energy appears as the non-uniform inner product of coupling of space and time fields (right-handed translation) and in reverse order, the origin of space-time variables is the decay of space-time into virtual space and time entities (left-handed translation), with the discrete restoration of energy at background state. This is the non-uniform non-static conversion of energy from one form to another. On this basis, time appears as the product and boundary of the discrete non-Noetherian dynamic conservation of energy, carrying energy within space-time frame.

Time takes its origin only from discrete energy conservation cycle and starts when energy, accumulated in time phase, translated to the formation and expansion of space-time frame with exchange interaction, controlling the boundary of space-time framework. Due to the relation of motion to the discrete local frame of space-time, description of time only by unitary intervals leads to the uncertainty.

Model (5) eliminates singularity in space-time frame and energy: the zero boundary of energy  $\mathbf{E}_{ap} = 0$  and its product zero time instant ( $t_1$ , frequency) cancel each other. The zero  $\mathbf{E}_s$  and its product zero space ( $\mathbf{S}_1$ ) similarly cancel each other, which generates singularity free dynamic model of an event.

## 4. Gravity

Model (5) shows that when the entire available energy portion is consumed for expansion of space ( $\mathbf{E}_{ap} = 0$ ), space-time decays which has to radiate energy, accumulated in the space-time frame (negative  $\lambda = -1$ ). In this case, the energy, consumed in space-time frame of any scale,

has to move to the initial state through translation of asymmetric boundaries of space-time variables. While space and time are the phase fields of energy conservation, translation of variables presenting conversion of energy from one form to another became an obvious event. The space-time frame in this case decays to virtual space and time field particles moving to the background state, where generation of new space-time frame takes place.

In accordance with these principles, gravity is not a space-time geometric curvature itself, but a result of discrete non-uniform conservation of energy, localized within finite space-time field. The parameter  $(E_{ap}/E_s - 1)$  of Eq. (6), in the form of energy-mass exchange interaction, generates gravity for controlling of space-time and energy boundaries. Therefore, gravity is not a result of simple existence of energy itself in space-time, but it is the result of non-uniform conservation of energy through space-time field.

The right side of model (5) as the energy-momentum content of space-time frame leads to the “warping of space-time structure” as general relativity suggests.

The flux of energy to space-time frame expands Planck scale space in direction of localization of background energy in the expanded space-time frame. The non-uniform conservation of energy (5) involves two space-time structures: non-uniform conservation of energy in differential form within discrete, non-virtual space-time frame and in integral form when space-time decays to virtual space and time phases with restoration of energy at background state with the continuous spectrum ( $E_{ap} = 0$ ) of uniform conservation. At this condition, there is no exchange interaction and the difference between inertial and gravitational masses disappears. Therefore, the key ingredient of the space-time is not the gravity itself, but non-uniform conservation of energy, which generates mechanism (gravity) restoring energy at its origin. On this basis, gravity appears as the gradient of the energy between background vacuum state and the condition where energy portion transformed to the local space-time phase with generation of space mass.

In the non-uniform energy conservation concept, energy and mass appear as two forms of the same unit, distributed differently within asymmetric coordinates of space-time field. This approach is different from special relativity concept, which connects energy-mass relation with the uniform speed of light. Without mass, there is no non-virtual space-time frame, which has to carry conservation energy. At the background state, emerged non-virtual space-time frame leads to the consumption of energy and growth of the non-virtual space-time frame of the matter.

The statement of general relativity (GR) that “space-time of GR is the gravitational field” [27] does not explain origin of space-time. GR does not explain why space-time has to involve gravity and curvature if its space-time has no boundary. These questions have direct connection with the classic physics concept of inertia, which does not explain why a body resists in its uniform motion to the applied force. In accordance with Eq. (5), the dynamics of a body is the result of the coupling of energy with the space-time frame: a body has a tendency to keep its local state, but it cannot hold this state uniformly because energy applied to a system is non-uniformly conserved. This leads to the growth of the internal force of inertia (called gravitation), which has a trend to return a system uniformly back to the energy restoration state.

At  $E_{ap} = 0$  of model (5), the space-time field undergoes to the decay which leads to the loss of the information, generated by the energy flux. Therefore, generation of a new cycle of space-time frame is the generation of new event and “an event when it travels backward does not meet with itself” because an event returns with the loss of space-time information. Without space-time frame, there is no ordinary matter to carry information.

It is necessary to note very important statement of special relativity (SR) that space and time do not exist separately, but form a four-dimensional space-time unit. In accordance with the principles of SR, conservation of energy has to be valid in “flat space-time.” This statement of SR is based on Minkowski concept [28] of a flat four-dimensional space-time frame. Special relativity describes energy-mass equivalence through uniform relation  $E = mc^2$  (or  $E_o = mc^2$ ), but conservation of energy-mass relation within non-uniform space-time field eliminates invariant features of the conservation laws. The additional statements of SR such as “space contraction” and “time delay” do not explain mass-velocity relation, while these supplementary concepts follow from Lorentz’s invariant translation principles.

In accordance with the non-uniform energy conservation model (5), “flat space-time” without mass does not comprise a frame of the non-virtual space-time and cannot carry any information on energy conservation. On this basis, model (5) treats mass as a discrete space-time field of energy-mass unit of non-uniform conservation of energy.

Different phases of energy conservation in space-time field appear as the virtual fields of different entities, such as particles and antiparticles, representing energy-mass relationship. Light energy exists through conservation between two fields, which appears in the form of particles with positive and antiparticles with negative energy states. However, positive and negative energy states do not follow invariant translations to each other. At  $E_{app} = 0$ , model (5) describes negative energy solution of antimatter, while  $E_{app} - E_s > 0$  represents positive energy solution of matter being localized within space-time frame. The condition when energy content of local state ( $E_{app} - E_s$ ) is equal to the energy content of background state  $E_s$  ( $E_{ap} = 2E_s$ ) describes space-time symmetry or symmetry of matter-antimatter particles.

Our concept describes space-time in a new representation, responsible for symmetry breaking. The space-time is the product of energy distribution within two phases, which in reverse order is the carrier of energy conservation. The “warping of space-time with energy and matter in it,” suggested by general relativity, is the requirement of cyclic performance of space-time for conservation of energy and matter.

At background Planck scale, the space-time appears within annihilation of space and time phases in the form of matter and antimatter annihilation. This transformation leads to the consumption of photons energy by generated space-time frame with formation of matter and expansion of it in space-time frame. In accordance with our concept, spontaneous symmetry breaking is the change of time phase to space-time frame with the generation of mass, carrying discrete conservation of energy.

As follows from model (7), one energy carrier particle is in symmetry with the two matter carrying particles which forms three particles tandem (three particles distribution of quarks in proton and neutron). This is the necessary condition for symmetrical existence of a matter.

The antimatter having no space-time frame is the “dark” ingredient of energy phase of Higgs field. Running Eq. (6) at  $E_{ap} = 0$  to background Planck scale generates phase translation of “dark” ingredient of energy to the visible space-time matter. Dark energy does not carry space-time frame. It has only time phase in the form of condensate, which after interaction with the generated space-time frame forms vector bosons with integer spin. Photon energy is the reversed reflection from space-time frame. Photon transforms to electron/positron pairs, which absorbs photon to produce vector bosons as the precursors of quarks.

It is necessary to note that the non-invariant translation of variables of space-time gives alternative mechanism for generation of spin property of particles. In accordance with quantum mechanics, the spin number is the quantum state where fermions are half spin particles and have to follow Pauli Exclusion Principle. This means that one fermionic particle can occupy only one quantum energy state. Quantum theory suggests that spin appears as the momentum of a particle around its own axis.

Model (5) suggests that the spin is the space-time phenomenon, which appears in the form of energy-mass and action-response relation  $(E_{ap} - E_s)/E_s$ . Conservation of energy takes place through its distribution within space-time phases, which generates energy-mass exchange relation. Consumption of energy in right-handed space expansion is carried by electromagnetic energy, while accumulation of energy in space-time frame is in the form of mass that moves the space-time in the left-handed direction. The opposite forces of exchange interaction curves space-time and produce angular momentum, rotating particles of space-time frame around local position.

The spin as the identity is the “face” of a particle: every particle with its energy content can have only one local space-time structure. Fermion has “face” as a particle of baryonic structure that exists within non-virtual space-time frame in discrete symmetry at  $E_s = 1/2E_{ap}$  (7) of nuclear. This structure generates half spin number for fermionic particles. Model (7) shows that half spin behavior of fermions  $E_s = 1/2E_{ap}$  and spin one performance of bosons is generated from exchange interactions to carry discrete symmetry through translation of energy to space-time field. The full recovery of discrete symmetry of a fermionic particle involves two pieces of full cycle between discrete exchanges of quarks within **n-p** frame.

In the absence of  $E_{ap}$ , ( $E_s = 0$ ) all the particles lose space-time frame and spin: helicity becomes the dynamical behavior for conservation of energy at the origin. Later, we will show that without helicity of neutrinos space-time cannot restore energy conservation at background state.

Based on model (5), we can explain the quantum level particle-antiparticle interactions in deterministic way. At  $E_{ap} = 0$ , particle radiates energy and loses its space-time field (virtual for non-baryonic particles, non-virtual for baryonic particles), where two states of energy merge together forming neutral particle. This is the phenomenon which divides fermionic particles “face” between two states.

From non-uniform conservation of energy follows, that gravitation together with the electro-weak force holds nuclear stability in discrete mode. On this basis, all the forces unified within three families: decomposition of strong force generates weak and gravitation forces and

coupling of these forces in reverse order in cyclic mode re-generates strong force. Later, we will describe these forces in detail.

## 5. Unification of quantum mechanics and relativity

It is easy to show that the non-uniform conservation of energy has to be the ground concept for unification of relativity and quantum physics. Starting from the basic statement of general physics that energy conserved through its conversion from one form to another, we will arrive to the concept that a dynamical event of energy conversion has to have locality within finite space and time coordinates. In principle, the features of energy conservation during its conversion from one form to another are clear from Planck's black body radiation, which changes the frequency of energy with radiation. Change of frequency of radiation is the result of non-uniform locality of energy within space-time field.

The non-uniform conservation of energy leads to the collapse of the concepts on uniformly moving different reference frames in relation of which all physical laws are valid. It is clear that even light cannot be the reference frame, while light energy is non-uniformly conserved.

In this case, the question "in relation to what background state all physical laws are the same" appears to be a big problem for physics. General relativity, describing space-time "as a geometrical structure, curved by existence in it energy and matter," does not produce a reference frame and mechanism of space-time behavior, while mathematical formulation of GR has no background state. The theory of special relativity, describing constant speed of light in vacuum, does not help much; while within non-uniform conservation of energy in space-time, light is not a space-time independent uniformly moving reference frame.

Within principles of non-uniform conservation of energy, the concept of uniform reference frames without uniform energy resources has no meaning at all. The main problem of quantum mechanics and relativity is the reference frame: we cannot determine the position and momentum at the same time because when we determine momentum, position also will change and its change will be uncertain.

Therefore, the problem described by quantum mechanics appears due to the absence of local position and deterministic formulation of local position by dynamical laws of classic physics. The general relativity has the same problem. The importance of local position arises from the non-uniform conservation of energy, localized in space-time field through change of space and time coordinates of a local position.

Here, it is necessary to give analysis of uncertainty principles in more detail, where changes in position and momentum shown as a change of simple gradients. Description of space-time frame and dynamical events only through gradients of energy and space-time variables or tensors leads to the problems, associated with the loss of local positions (boundary) of space-time field, carrying distribution of energy. The boundary or local position is the energy density of the phase field. The same question related to the change of momentum, which also needs

description in the form of exchange interaction relative to the local momentum of a particle. It is clear that in case of mathematical formulation of dynamical events, involving a local position of a particle in space-time field and its local energy content, the prediction of quantum mechanics could be completely different.

In accordance with the non-uniform energy conservation principle, coupling of local space-time field and local energy state of a particle is the necessary approach for elimination of singularity and for removal of renormalization from particle physics theories. Without involvement of local position and exchange interaction, it is impossible to get mathematic formulation of conservation laws.

It is necessary to note that Dirac's relativistic quantum theory [29] on existence of an antiparticle appeared due to the uncertainty in position. Dirac suggested that uncertainty in position can be solved if there will be another particle (antiparticle) with the different position to maintain the balance for conservation of quantum number. However, conservation of energy, involving coupling of local position with the energy flux to the space-time frame leads naturally to the existence of oppositely charged particles.

The concept of non-uniform conservation of energy explains why charges are needed. Coupling of space and time variables within elementary space-time frame of baryonic particle and distribution of energy in extended space-time structure takes place through involvement of charged particles. However, restoration of energy at origin takes place through decay of space-time field and translation of energy in the form of neutral current to the initial background state. The energy is restored at the origin ( $E_{ap} = 0$ ) when phase difference, leading to the generation of charges, disappears (5). Conservation of energy through phase difference is the origin of generation of discrete performance of physical laws.

In accordance with model (5), relation of an event to local position of space-time is not separable from the energy flux to space-time frame because local position, which undergoes to the growth, is the product of energy distribution in space-time frame. In reverse order, change in relation to the energy flux also is not separable from the local position, while the outcome of energy flux determined by the consumption of energy in dynamical local position.

Therefore, change of velocity is the product of conjugation of local space-time position of a particle with the exchange interactions, generated from the energy flux to space-time field. This is the deterministic physical law of nature. Without conjugation of local position and energy resources through exchange interactions within space-time field of a particle there is no conservation of energy and there is no correct concept of mass. The position and momentum conjugate of uncertainty principle does not involve resources of action that is why its outcome is uncertain.

In accordance with the quantum field theory, during short time intervals violation of energy conservation is restored. The common view on this statement is that conservation of energy can be temporarily violated and energy can be borrowed from the universe as long as it is returned within a short duration of time. However, Griffiths [30] showed that "this principle is based on the false axiom that the energy of the universe is an exactly known parameter at all times."

The general view of quantum mechanics on conservation of energy is that the energy-time uncertainty has a meaning that a state of a body that exists only for a short time cannot have a definite energy because to have a definite energy, the frequency of a state must be accurately defined. It is easy to show that model (5), which conjugates energy flux of exchange interactions and local position of a state, covers the above-mentioned requirements.

In accordance with the non-uniform conservation of energy, the deterministic state of a body requires description of an event in the form of exchange interaction, comprising action-response conservation. The parameter  $(\mathbf{E}_{ap} - \mathbf{E}_s)/\mathbf{E}_s$  of model (5) describes exchange interaction that conjugates with the local space-time frame for generation of deterministic path of a particle. In quantum field theory, the space-time metric does not vary with the flux of energy. However, our concept presents dynamical space-time metric, which is the dynamical local space-time field.

It is clear that an event can have its own reference frame if its energy-mass conservation is described by the true mathematical space-time formulation. Model (5) involves interaction of an event space-time field with its own reference frame. The condition  $\mathbf{E}_s \neq \mathbf{0}$  describes an acceleration of event dynamics in relation to the initial condition, while the condition  $\mathbf{E}_{ap} = 0$  is the uniform translation of an event to the initial state. In this case, the laws of classic and relativistic classic physics unified with the quantum mechanics within singularity free deterministic physical frame of non-uniform conservation of energy. In the absence of the energy flux “moving in space became equivalent to the moving relative to the space,” which restores the classic physics concept of relation of a motion to the space “ether.”

Thus, the non-uniform conservation of energy comprises the acceleration of space expansion in forward direction and uniform backward process of energy restoration at the initial state.

## 6. Unification of space-time frame with the electromagnetism

While energy is non-uniformly conserved within space-time frame with asymmetric boundaries, unification of electromagnetism with the space-time frame becomes an obvious concept. The multiple  $\mathbf{S}_1/t_1 (\mathbf{E}_{ap}/\mathbf{E}_s - \mathbf{1})$  of model (6) is the combination of electromagnetic field  $(\mathbf{E}_{ap}/\mathbf{E}_s - \mathbf{1})$ , which describes flux of the energy to the space-time frame and local position in space-time, where  $\mathbf{S}_1/t_1$  metric is not fixed and changes with the change of the energy flux field. The energy flux  $(\mathbf{E}_{ap}/\mathbf{E}_s - \mathbf{1})$  is not uniform and presents local energy portion, remained from the exchange interactions with the particle. That is why electromagnetism is not Galilean invariant. Due to the coupling of the local energy portion with the local space-time position the multiple  $\mathbf{S}_1/t_1 (\mathbf{E}_{ap}/\mathbf{E}_s - \mathbf{1})$ , as a deterministic function, describes trajectory of a particle. In the multiple  $\mathbf{S}_1/t_1 (\mathbf{E}_{ap}/\mathbf{E}_s - \mathbf{1})$ , the space-time and energy-mass relation have reciprocal relations: the non-uniformity of energy-mass relation generates asymmetry of space-time variables and in reverse order, asymmetric space-time leads to the non-uniformity of energy-mass relation.

The asymmetric boundaries of space-time variables allow only global conservation laws. On this basis, during discrete non-uniform conservation of energy in space-time frame the change

of energy is non-invariant translation, therefore cannot give local symmetry of general relativity or even any type of invariant translations. In dynamical events, comprising non-uniform conservation of energy within space-time frame cannot be any static state of rest or uniform motion, accepted as a reference frame. The static energy conservation law does not fit with the conservation of finite amount of energy. Without coupling of local energy state and local space-time frame, energy conservation in GR is approximate and leads to the singularity.

With the increase of energy of a body  $E_s$  (classic inertial energy/mass content of a body), the space-time unit requires more energy flux to keep the initial action of exchange interactions. This principle appears as a trapping of more energy by the space phase leading to the "acceleration of space expansion;" but in reality, it is the acceleration of energy conservation. Consumption of energy and expansion of space leads to the condition, where any amount of energy trapped in space-time "black hole" structure. When all available portion of energy is consumed, ( $E_{act} = 0$ ), the energy trapped in the space-time frame, has to be radiated back to the initial state through translation of asymmetric energy conservation phases. The frame called "black hole" is the boundary of space-time frame, where the entire portion of energy is going to be consumed. At  $E_{ap} = 0$ , the local discreteness of electromagnetism is invariant with the global discreteness of gravity which is the integral equivalent of Maxwell's differential invariance  $dF = 0$ .

Model (5) shows that for inversion of space-time from one local frame to its previous state more energy portion than locally available is necessary to apply, therefore the temporal Galilean transformation is non-invariant. This prediction of model (6) is the alternative to the statement of special relativity that with the increase of mass of a particle, more energy is necessary to apply to get constant velocity. This effect is the internal "gravitational property" of energy conversion from one form to another within space-time frame, which can be called "acceleration of non-uniform conservation of energy."

Acceleration of non-uniform conservation of energy arises from exchange interaction and conservation itself produces the exchange interaction. With the growth of space-time frame and consumption of energy, more flux of energy required to keep the local state. In reverse order, when space-time collapses, more energy portion than locally available is necessary to apply to stop decay of space-time of matter, moving to the background to start a new cycle of discrete conservation of energy.

In relativity theory, the concept of mass is the part of energy-momentum tensor; but in model (5), mass is the part of energy-momentum exchange interactions ( $E_{ap}/E_s - 1$ ), coupled with the local position of space-time. The positive value of exchange interaction plays a role of right-handed Lagrangian.

In accordance with the non-uniform conservation of energy, the main problem of conservation laws is the description of energy conservation in Lagrangian or Hamiltonian in the form of sum of energies. Energy exists and conserved as a waves, passing through space and time fields with formation of different energy density within these phases. That is the reason why model (5) describes an event dynamics through exchange interaction of the energy portions, distributed in space and time waves.  $E_{ap} - E_s$  describes the available portion of energy in

time phase, while  $E_s$  presents the portion of energy consumed in space phase. The condition  $(E_{ap} - E_s)/E_s \geq 1$  comprises positive electromagnetic energy, while  $E_{ap} = 0$  leads to the negative energy solution.

The rate of acceleration of energy conservation has a trend to approach the background speed of light. That is why any event has a trend to move to the maximum velocity through minimum space and maximum available portion of energy.

The origin of matter in GR has no connection with the space-time frame and GR's space-time cannot remove matter from its structure and return to the background space-time state, while GR has no background state. However, the non-uniform energy conservation concept shows that any space-time frame, which does not involve mass, is not able to be the energy carrier.

The non-uniform conservation of energy in space-time frame gives very specific concept of mass: the mass is the energy density in space field. As follows from model (5), discrete non-uniform energy conservation may generate only non-invariant dynamical mass in the form of location of energy in the certain space-time frame. The energy flux  $(E_{ap}/E_s - 1)$  determines the density of energy in space phase, therefore mass changes with the change of frequency of the energy conservation. Thus, space is the materialization phase of energy, while time phase destroys everything material and returns the space matter discretely to the initial state, carrying the phenomenon, called "Poincare paradox" [31].

The discrete, non-uniform conservation of energy, leading to the non-invariance of action-response parity of energy-mass relation within space-time field and asymmetry of their boundaries is the missing quantity in the equation of general relativity.

Due to the discrete non-uniform conservation, energy as the resulting quantity of exchange interactions, distributed within dynamic space-time phases, has no meaning as the static quantity. This is the "quantization" of discrete non-uniform energy conservation, which makes all of the interactions as the "classic resulting quantity," having the same meaning of quanta.

The forces of virtual space-time frame at  $\lambda = -1$  annihilates each other as the electromagnetism and gravity, but in the non-virtual space-time frame they get a new feature—action-response parity of exchange interactions: electromagnetic force at long distance generates gravity, but at short range with the weak force leads to the generation of strong nuclear force. Transformation of energy from space phase to time phase generates gravitational force, while transformation of energy from time phase to space phase generates electromagnetic interaction.

Later, we will describe the weak force in detail, which is needed for generation of discrete symmetry at minimum atomic space scale to make performance of atomic scale space-time grain stable.

## 7. Transformation of variables and conservation of energy

Here it is necessary to give Sean Carroll analysis of energy conservation who gave excellent comments on the conservation of energy in general relativity. By his opinion [32], "if energy and

momentum evolve in response to the behavior of space-time around it, as GR suggests, when space-time is not constant, energy will change in a completely unambiguous way. Therefore, you cannot find the energy or curvature of space-time at every point in space. Photons loss energy as space expands, so total energy decreases. It leads to the violation of energy conservation. Energy is not conserved because space-time changes.”

We will show that the problems of conservation of energy within energy-momentum and space-time framework, described by Carrol [32], cannot be solved without dynamical model, involving local asymmetric space-time position.

The non-uniform conservation of energy, which holds due to discrete space-time frame (5), is valid only through transformation of asymmetric space and time variables. Consumption of energy during non-uniform conservation in space phase (change of space in relation to the local position— $\Delta S/S_1$ ) generates its conjugate variable—gradient of time in the form of time arrow in relation to the local origin— $\Delta t/t_1$ . Generation of non-virtual space-time frame through coupling of its variables and translation of time phase energy to space-time frame leads to the non-uniform consumption of energy. Consumption of energy in space-time frame and decrease of frequency of photons energy leads to the decrease of frequency of change of local (instant) time.

If to apply Noether’s theorem to quantum physics, time translational antimatter-matter symmetry should be associated with the conservation of energy. However, quantum physics time independent antimatter-matter annihilation or classic space-time translations need application of continuous unlimited resources of energy to hold the continuous symmetry.

In accordance with model (6), conversion of energy from one phase to another is possible only if conversion takes place within asymmetric space-time translations. If there is no uniform energy resources, space-time translation in any local position will end in space phase. On this basis, matter-antimatter annihilation ends at the matter formation phase. The amount of energy repulsed after matter generation phase is less than initial amount of applied energy. That is why the repulsive energy in the form of electromagnetic force is not translational invariant.

Model (6) shows that at  $E_{ap} = 0$ , decay of space-time and contraction of space back to Planck’s scale generates negative energy of antimatter (called gravitational energy) which approaches to its maximum value (vacuum value) where takes place change of sign to positive energy, distributed in space- time frame with space expansion. The state of zero space has no sense while it leads to the runaway of energy to infinity. The state of minimum, non-zero space is needed for change of sign of negative energy of antimatter to positive energy of space-time frame of matter.

The condition when portion of energy, conserved in space phase is equal to the portion of energy of time phase (8), we can call this condition as uniform conservation of energy at background state of “super-symmetry.” At this condition, unlimited fluctuation should lead to the generation of unlimited amount of energy. On this basis, there cannot be a continuous uniform state of super-symmetry or even usual symmetry, which can exist on permanent basis. Therefore, the non-uniform conservation of energy does not allow existence of continuous symmetry.

Super-symmetry is a theory of particle physics that connects boson with integer spin and fermions with half integer spin. In accordance with this theory, “each particle from one group is associated with a particle from the other group known as super partner.”

The non-uniform energy conservation concept, as we described above, gives different requirement for symmetry: the symmetry is the condition where total spin numbers of particles, forming this symmetry is equal. It follows from the condition when energy portions, distributed within space and time phases are equal (8), which corresponds to the condition  $E_{act} = 2E_s$ . This state corresponds to the discrete symmetric performance of space-time grain containing three family quarks. The total spin numbers of bosons and fermions and triplet performance of quarks family arise from the discrete symmetry of space-time variables of baryonic frame at  $E_s = 1/2 E_{ap}$ .

Equation (5) at  $(E_{ap}/E_s - 1) \neq 1$  describes electromagnetic force, while condition  $E_s = 1/2 E_{ap}$  represents the strong force. Model (5) describes the identity of particles as bosons and fermions through exchange interactions. The energy flux makes position and momentum as separable variables; but at  $E_{ap} = 0$ , these variables merge together to form non-separable boson compensates of indistinguishable particles, occupying the same state.

The non-uniform conservation of energy requires existence of “three particles tandem” only in discrete mode. The Exclusion Principle on existence of a particle in a certain energy state does not consider energy conservation principle and does not involve time ingredient of the conserved energy to keep a particle at this energy state.

Therefore, photons, holding Bose-Einstein statistics, exist in discrete mode within three family particles frame, which appears in the form of three-color frame. Similar to the existence of bi-nuclear structure of matter, the antimatter structure of photons exists within discrete flavor of three colors ( $E_{ap} = 2E_s$ ), changing between two frames. Light photons travel through waves of space-time color flavors, alternating within two frames of three-color flavors. Therefore, change of photons’ frequency is not possible without the three family color flavors.

The space-time frame of non-uniform energy conservation explains classic physics clarification of light photons. The condition  $E_{ap} = 2E_s$ , produced from energy-mass exchange interaction shows that coupling of two identical half integer particles produces a particle with the integer spin, called boson. This prediction of model (5) corresponds to the quantum physics statement that the wave function of the identical half-integer spin particles changes sign when two particles swapped.

By quantum mechanics, two fermion particles cannot occupy the same quantum energy state. However, in accordance with the non-uniform energy conservation principles, two particles cannot exist unlimited time at the same position of these particles. The particle having certain space-time position may temporarily move and occupy the state of another particle through absorption or radiation of energy.

Here we may show that the non-uniform conservation of energy leads to the understanding of electron self-interaction problem as well. By literature information [33, 34], the electron mass and spin can be identified with the energy and angular momentum of the electromagnetic self-interaction.

However, as we showed earlier, the spin and mass, as the non-separable entities, arrive from the non-uniform conservation of energy in space-time field. The electron mass is not due to the electromagnetic self-interaction and its energy is not due to the potential self-energy; its energy, mass, and spin are results of the energy-mass exchange interaction that carried within space-time field.

Hestenes [34] showed that spin may arise from helical world line of space-time, but classical arguments do not produce the properties of spin. It is necessary to note that the above-mentioned approach describes quantum level interactions without space-time frame. For example, Dirac equation describes energy-momentum relation, spin, and position for a point particle.

The energy-momentum exchange interaction, coupled with the dynamical local space-time frame, eliminates point particle problem. Model (5), which describes conservation of energy in space-time field, is the wave function of energy distribution involving asymmetric space and time variables.

Formation and expansion of space-time takes place by the non-uniform electromagnetic force with the participation of charged particles, while decay of space-time field and delivery of the energy to the background takes place by neutral current of weak force. The weak force makes a distinction between left and right due to the non-uniformity in energy-mass exchange interaction during conversion of energy from one form to another. Conversion of energy from one form to another does not involve invariant translation.

The non-uniform conservation of energy requires two opposite motions: electromagnetic acceleration of energy consumption with the expansion of space-time frame, and decay of space-time frame with the uniform restoration of energy at background state by neutral current. In accordance with model (5), coupling of space-time variables generates separate charges and electromagnetic energy, while coupling of charges generates separate space-time variables moving uniformly to the background state.

The static continuous energy conservation described by Noether's theorem does not involve locality of an event and does not limit the boundary of the conserved quantity, therefore leads to the singularity in the dynamical laws of classic physics.

The traditional concept of continuous energy conservation, described by Noether's time independent frame "energy can be neither created and not be destroyed, but it transforms from one form to another" is not a complete theory, while it describes conservation of energy in the form of time independent symmetry in abstract space, similar to Newton's abstract space. It does not involve driving force of conservation and transformation of energy from one form to another in space-time frame that is why continuous conservation of energy within unlimited time is not a valid concept to use in dynamical laws.

Model (5) has a feature of quantum physics, while energy and the produced space-time entity within non-uniform energy distribution have discrete performance and are the non-continuum "quantum portions." Model (1) at  $\mathbf{E}_{ap} = \mathbf{0}$  describes restoration of energy and virtual asymmetric space and time products at background state. It is similar to the asymmetric wave equation of quantum mechanics:

at  $\mathbf{E}_{ap} = 0$ ,

$$\frac{\Delta S}{S_1} + \frac{\Delta t}{t_1} = 0 \quad (8)$$

In accordance with Eq. (8), the energy consumed in space phase is equal to the energy restored in time phase. The total energy in opposite phases is conserved  $\mathbf{E} = 0$ .

When energy is inserted to space-time frame for space expansion, one of time variables (instant of time) gets performance of space coordinate for expansion of space with the decrease of frequency of energy:  $(2;2) \rightarrow (3;1)$ . Generation of an event starts with the translation one of time variables to space variable. The arrow of time, which is due to the consumption of energy in space phase (appears as an energy  $\mathbf{E}_{ap} - \mathbf{E}_s$  gradient), generates thermodynamic arrow of heat loss. Decrease of energy frequency  $\mathbf{E}_{ap} - \mathbf{E}_s$  leads to the increase of time arrow  $\Delta t$ , which is the move from the past to the future, carrying energetic information of the past.

This is the mechanism of generation arrow of time. Therefore, the phenomenon called entropy is due to the translation of time phase energy to the space-time frame with the loss of frequency of energy. Due to the maximum frequency of time phase energy in the past and consumption of energy in space phase, the parameter called “entropy” has its minimum value in the past.

The condition  $(\mathbf{E}_{ap} - \mathbf{E}_s)/\mathbf{E}_s = 1$  of model (1) describes the minimum space-time frame, where the condition  $\mathbf{E}_{ap} = 2\mathbf{E}_s$  is in hold. This condition corresponds to the state where space-time frame exist as Planck’s scale unit, carrying energy portion in discrete symmetry. In this case, there is no difference in performance of time and space variables. However, this condition takes place only in discrete mode.

The background state  $\mathbf{E}_{ap} = 0$  of model (8) is the vacuum state of particle physics and classic field, where all the components of stress-energy tensor is zero. At  $\mathbf{E}_{ap} = 0$ , the space-time frame is broken to the separate space and time fields and there is no arrow of time. At  $\mathbf{E}_{ap} = 0$ , the gravitational energy appears as the separate force through inversion of variables. In this case, the entire energy portion, distributed in space phase (with negative sign) absorbed by the initial background state. On this basis, gravitation appears as energy-mass relation of asymmetric space-time variables rather than mass-mass relation of Newton’s physics.

## 8. Generation of mass

One of the main problems related to the generation of mass by spontaneous breakdown of continuous symmetry, given by Higgs mechanism, is that this mechanism does not connect generation of mass with the space-time locality of a particle, which gets mass and does not explain why background continuous symmetry has to be broken by un-natural way. The mechanism of mass generation also has to explain why collision experiments produce more matter particles than antimatter particles.

In this chapter, we will discuss how the non-uniform energy conservation concept is to be the alternative mechanism of mass generation. The non-uniform distribution of energy portions within asymmetric space and time phases requires generation of the fields with the different energetic properties (frequency and amplitude), which is the only way for carrying conservation of energy through these fields. Coupling of two fields with the different energetic properties as an energy consuming and energy restoration phases generates the non-virtual space-time frame, which appears to be the non-uniform conservation of energy through energy-mass exchange transformations ( $E_{ap}/E_s - 1$ ).

The background state of space-time frame is the relation of virtual asymmetric space and time phases, which proceeds conversion of energy from one form to another (8), through translation of asymmetric entities, such as  $\Delta S/S_1$ ,  $\Delta t/t_1$ , carrying energy portions as a virtual matter and antimatter particles.

We can describe the non-uniform background energy-mass translation by conversion of light photons to electron/positron pairs, which is well-known quantum mechanics translation event. Quantum mechanics states that during this translation, energy conservation is hold by fluctuations, such as particles borrow energy and after very short time return the borrowed energy back:

$$\gamma/\gamma = e^+/e^- \quad (9)$$

The energy-matter translation given by relation (9) does not count time phase of energy conservation and locality of the produced particles, while photons-leptons translation takes place in the abstract space. Equation (9) could be the discrete translation of energy in the form of infinite fluctuations of the background quantum state. It is clear that in this case there is no natural way for breaking of the continuous symmetry of discrete fluctuations, forming time independent infinite symmetry of matter-antimatter relations. Equation (9) does not reflect the borrowed time in the change of energy.

Conservation of energy requires a certain finite frame for locality that is why space and time cannot exist as separate variables. Formation of a particle within any time scale without locality in space phase leads to the missing of energy conservation. By Landau's opinion [35], infinite fluctuations of virtual matter-antimatter pairs should lead to the "Ultraviolet Catastrophe due to the accumulation of infinite amount of energy of collisions and it is impossible to prove the mathematical basis of elimination of "Ultraviolet Catastrophe."

On this basis, we replaced Eq. (9) with the relation:

$$\gamma/\gamma = -(e^+/e^- + \nu_e/\nu_e^-) \quad (10)$$

The right side of Eq. (10) involves additional identity in the form of neutrinos to cover missing part of energy conservation in time dependent frame. Equation (10) represents mechanism of energy conservation, which involves decay of energy into asymmetric space and time fields particles having different energy density. Conversion of light photons from one form to another for conservation needs generation of phase difference, which appears with the formation of  $e^+/e^- + \nu_e/\nu_e^-$  pairs.

The space field particles, comprising  $e^-/e^+$  pairs have more energy density, while time phase particles, comprising  $\nu_e/\nu_e^-$  pairs, have energy portions of high frequency. That is why the mass for neutrinos is significantly less than that of an electron's mass. The right-handed antineutrino and left-handed neutrino pair together with the electron/positron pair represent distribution of energy within virtual space and time phases. Due to the locality within space, close to Planck's size, performance of virtual matter particles became time dependent and it get velocity less than speed of light photons that is why parity translation (10) became non-invariant.

Generation of  $e^-/e^+ + \nu_e/\nu_e^-$  particles (10) is the translation of photons energy to virtual space and time phase particles which could be specified as an "empty space" particles. The "empty space" is the medium where  $e^-/e^+ + \nu_e/\nu_e^-$  particles form fluid with continuum spectrum. In the absence of energy flux,  $E_{ap} = 0$  (5), takes place loss of the virtual space frame (10) and translation of virtual particles backward to photons. However, particles before giving the "borrowed" energy back should loss localization in space phase and loss some portion of energy which has to go in parallel with the absorption of photons by  $e^-/e^+$  pairs. This phenomenon is the main feature of energy non-conservation during return of "borrowed" energy of quantum fluctuations. Generation of space phase and distribution of energy in space field leads to the non-uniform conservation of energy in space by absorption of photons by  $e^-/e^+$  pairs with formation of pairs of heavy bosons:

1. Generation of mass for bosons: passing of photons through  $e^+/e^- + \nu_e/\nu_e^-$  field

$$n\gamma\gamma + (e^+/e^- + \nu_e/\nu_e^-) = n\gamma\gamma + e^+/v_e(W^+) + e^-/v_e(W^-) \quad (11)$$

2. Generation of mass for leptons

$$n\gamma\gamma + e^+/v_e(W^+) + e^-/v_e(W^-) = (\text{udd...Gluons...ddu}) \quad (12)$$

In accordance with condition (10), the pair of leptons  $e^-/e^+ + \nu_e/\nu_e^-$  has a performance of virtual bosons (similar to the Nambu Goldstone bosons) and in the form of four leptons describes the "fermionic quanta" or virtual particles of space phase. From model (5) and Eqs. (10) and (11), it is followed that photons energy may be conserved only through exchange interaction with the non-zero mass particles.

The two pair of particles  $e^-/e^+ + \nu_e/\nu_e^-$  in the form of virtual neutral boson field is the alternative to the Higgs field which absorbing photons generates heavy W bosons.

Exchange interaction of  $\gamma\gamma$  photons with the  $e^-/e^+ + \nu_e/\nu_e^-$  particles lead to the observance of light which became a composite particle. When  $E_{ap} = 0$ , the leptons in the form of pair of particles  $e^-/e^+ + \nu_e/\nu_e^-$  do not form space-time frame and do not obey Pauli exclusive principle and perform as bosons condensate with the integer spin number. Composite fermions with bosonic "face" due to the absence of exchange interactions, has a performance similar to Bose-Einstein bosons condensate, which in the form of superconductive neutral fluid carry energy to the background state. The left side of Eq. (10) describes bosons superconductive fluid, while the right side presents superconductive fermionic medium.

At  $E_{ap} = 0$ , decay of the ordinary matter particles  $e^+/v_e + e^-/v_e^-$  takes place with the generation of gravitational force. The energy, released from the continuous decay of space-time frame, through longitudinal wave of neutral current  $e^+/e^- + v_e/v_e^-$  of complex bosons condensate moves to the background state. The absence of exchange interaction generates longitude wave.

In the absence of energy flux, decay of space-time frame leads pairing of electron/positron and neutrino/antineutrino pairs to composite bosons with continuous spectrum. The composite bosons do not obey Pauli Exclusion Principle and can occupy the same ground to form fluid, which gets peculiar properties of superconductivity.

The empty space is the medium where particles form fluid with continuous spectrum. They become as massless particles moving with superconductivity to the initial state. The uniform fluid motion of complex boson to the background state appears as the uniform gravitational field.

Addition of neutrinos to Eq. (9) replaces the concept of electron self-interaction. The condition of space expansion describes positive energy solution while consuming all the energy in space-time ( $E_{ap} = 0$ ) represents negative energy solution.

Separation of  $e^-/e^+ + v_e/v_e^-$  pairs and transformation to the frame of quarks  $e^+/v_e + e^-/v_e^-$  consumes huge amount of energy which makes produced  $W^+$ ,  $W^-$  bosons very heavy. However, heavy bosons are not a fermions because they do not have own non-virtual space-time frame. As in the case of Eq. (10), when there is no energy flux (absence of force carrier scalar bosons) to hold the condition of Eq. (11), due to the absence of non-virtual space-time frame,  $W^+$ ,  $W^-$  vector bosons have a trend to decay back to  $\gamma/\gamma$  photons in the form of beta decay. The  $W^+$ ,  $W^-$  bosons have a performance as left- and right-handed particles, which is why they are vector bosons. Generation of mass and its stable existence is possible if  $W^+$ ,  $W^-$  bosons could form a non-virtual space-time frame. On this basis, non-uniform conservation of energy requires translation of background asymmetric time phase energy to space-time frame, which leads to the generation of baryonic space-time structure. Here, it is necessary to give specifications: baryonic particles are the particles, which have space-time frame, and leptons are the particles, which in individual form have no space-time frame.

Energy of  $\gamma\gamma$  photons converted to energy of massive  $W^-$  and  $W^+$  vector bosons for generation of virtual space-time frame. In the second step, flux of the energy for generation of non-virtual space-time frame of quarks takes place within  $n-p$  structure. The energy of exchange interactions composes energy of gluons to hold discrete locality of quarks in the non-virtual space-time frame. The difference of the energy of  $W$  bosons and quarks in relation to quarks mass (at discrete symmetry energy-mass equivalence is in hold) becomes the energy flux for discrete exchange interactions. That is why quarks mass is less than that of  $W$  bosons. Due to the three body interactions ( $E_{act} = 2E_s$ ) which keeps discrete symmetry of  $n-p$  transformations (8), gluons participate in exchange interactions also in the form of non-zero mass particles in three family frame comprising of three-color structure.

Due to the existence of quarks family in proton-neutron frame in discrete mode, energy portion consumed from force carrier scalar in exchange interactions  $(E_{act} - E_s)/E_s$  generates the symmetric three particles frame of quarks. In the process of cyclic  $n-p$  transformations, the total energy conserved.

Generation of space-time frame of quarks through alignment of “empty space field” particles  $\mathbf{e}^+/\mathbf{e}^- + \mathbf{v}_e/\mathbf{v}_{e^-}$  to “Dirac particles”  $\mathbf{e}^+/\mathbf{v}_e + \mathbf{e}^-/\mathbf{v}_{e^-}$  requires huge amount of energy flux from force carrier scalar bosons. The decay of mass and translation of space-time energy back takes place at  $\mathbf{E}_{\text{act}} = \mathbf{0}$ , ( $\lambda = -1$ ) with transformation of  $\mathbf{e}^+/\mathbf{v}_e + \mathbf{e}^-/\mathbf{v}_{e^-}$  ingredients (Dirac particles) to the longitudinal wave of neutral current correlating the helicity of neutrinos with the negative Eigen value:

$$\mathbf{e}^+/\mathbf{v}_e(\mathbf{W}^+) + \mathbf{e}^-/\mathbf{v}_{e^-}(\mathbf{W}^-) \rightarrow (\mathbf{e}^+/\mathbf{e}^- + \mathbf{v}_e/\mathbf{v}_{e^-}) + \mathbf{Y}\mathbf{Y} \quad (13)$$

The transformations, described by Eqs. (10)–(13), are symmetrical only in discrete mode within closed loop. The absence of invariant translations between ingredients of Eqs. (10)–(13) is due to the non-uniform conservation of energy. In accordance with model (6), in the presence of energy for reverse translation, matter particle in exchange interaction  $(\mathbf{E}_{\text{act}} - \mathbf{E}_s)/\mathbf{E}_s$  should have more energy than that of force carrier scalar (gluons). Due to the same reason, it is impossible to separate quarks-antiquarks pairs. Separation of individual quarks is possible only at  $\mathbf{E}_{\text{act}} = \mathbf{0}$ , when three family space-time frame of proton collapses. This behavior of quarks describes color confinement phenomenon.

Model (5) explains the phenomenon called “nonlocality” or entanglement paradox of quantum mechanics. The function  $\mathbf{E}_{\text{ap}} - \mathbf{E}_s/\mathbf{E}_s$  of model (5), which describes action-response parity, is the origin of local action. At  $\mathbf{E}_{\text{ap}} = \mathbf{0}$ , particle has no space-time frame and has no certain locality. When particle has no space-time ( $\mathbf{E}_{\text{ap}} = \mathbf{0}$ ), all particles are the non-distinguishable ingredients of antimatter “condensate.”

At  $\mathbf{E}_{\text{ap}} - \mathbf{E}_s > \mathbf{0}$ , particle has its own space-time frame and therefore independent locality. The condition  $\mathbf{E}_{\text{ap}} = \mathbf{0}$ , eliminates action-response behavior of a particle which losing spin response moves to the background state with the velocity not less than speed of light.

You cannot isolate virtual space phase from virtual time phase that is why it is impossible to separate the quark-antiquark frame. Meson alone has no space-time frame that is why it is not observable as a separate particle, but it is a piece of non-virtual space-time frame of  $\mathbf{p}\text{-}\mathbf{n}$  frame, having a motion in baryon structure.

The exchange interaction of model (5)  $(\mathbf{E}_{\text{ap}} - \mathbf{E}_s)/\mathbf{E}_s$  explains why the weak interaction acts only on left-handed particles and right-handed antiparticles. The right-handed particles in exchange interactions lead to the expansion of space matter, while left-handed matter particles generate gravitational force to hold the boundary of the conserved energy. The non-invariant translation of a body to the initial state takes place with the decay of space-time frame and realignment of the neutrinos helicity with formation of neutral current. Composite bosons with the continuum spectrum comprise the phenomenon called gravitation.

The first step described by Eqs. (10) and (11) is the generation of non-zero mass virtual particles having virtual space-time frame, while the step (12) involves transformation of a lepton particles from virtual space-time manifold to the minimum grain of non-virtual space-time frame. That is why mechanism of generation of mass for space-time frame particles (quarks) and bosons is different.

From model (1), it follows that at zero value of  $\mathbf{E}_s$ , the space-time frame moves to the singularity. Therefore, the inertial energy of a particle in cyclic mode can never have zero value and

when more energy portion applied to the space-time frame, the gravitational mass added. The gravitational mass appears as the energy portion distributed in space-time frame to control conservation of energy within certain boundary of this frame.  $E_{ap}$  in energy flux  $(E_{ap} - E_s)/E_s$  is the bosonic part of the frame, while  $E_s$  is the fermionic ingredient of exchange interactions. The energy flux  $(E_{ap} - E_s)/E_s$  through coupling with the local position of space-time  $S_1/t_1$  describes interaction of bosonic and fermionic particles through exchange of energy. In case when interaction takes place between two fermions, the ingredients of the energy flux  $(E_{ap} - E_s)/E_s$  describes interaction of energy or mass content of these fermions. Therefore, model (5) connects all the interactions of particles physics.

Generation of mass is the combination of electromagnetic and weak forces. The electromagnetic force needed for generation of non-virtual space-time frame, while weak force is necessary to keep the existence of space-time frame of a matter "grain" through discrete symmetry, which requires violation of local CPT symmetry. Weak interactions are the result of non-uniform discrete conservation of energy, which takes place with translation of asymmetric boundaries of space-time phases, carrying non-uniform conservation of energy.

Now appears a question, why electromagnetic force is carried by charged particles, while neutral particles are responsible for gravitation. Charged bosons are needed for generation of non-zero mass quarks of space-time frame to carry conservation of energy in expansion phase of space, while neutral bosons are needed for translation of space-time energy back to the background state. At  $E_{ap} = 0$ , decay of space-time frame releases graviton in the form of neutral current back to the initial state.

Within non-uniform conservation of energy in space-time frame we may explain how space-time, carrying energy distribution may lead to the generation of chargers. The space-time to carry non-uniform conservation of energy leads to the formation of phase difference between space and time coordinates which appears in the form of charges.

In non-uniform conservation of energy, boundary of space and time variables is asymmetrically different, and background coupling of asymmetric space-time variables does not produce symmetrical particles-antiparticles pairs. At Planck scale, when space boundary is small, the left side of Eq. (8) has a huge trend to change and the duration of change at this scale is very small. Therefore, space and time variables, carrying the same portions of energy, have very asymmetric boundaries, which is the driving force for selection of the direction in non-uniform distribution of energy.

Due to this reason, the symmetry of strong force and permanent performance of the proton-neutron pairs is possible only through discrete uniform translation of scalar energy to the "three particles tandem of" space-time-energy frame (5).

Due to the requirement of discrete symmetry  $E_{ap} = 2E_s$ , neutrinos also exists in three family mode; Two types of neutrinos couple and produce third type neutrino; asymmetric decay of the third neutrino leads back to the realization of discrete symmetry of neutrino's existence. At  $E_{ap} = 0$ , neutrinos do not participate in electromagnetic force but at  $E_{ap} \neq 0$ , neutrino, being part of quark structure, participates in the discrete symmetry of baryon frame. The neutrino's mass is small for realization of neutron-proton discrete symmetry with high frequency.

The weak force is needed to hold permanent performance of the “space-time frame of elementary grain” of the matter in discrete mode within minimum space frame. The conservation of matter “grain” in the form of proton cannot hold continuous symmetry, while in this case there cannot be conservation of energy.

The discrete performance of three particles frame  $E_{ap} = 2E_s$  explains why there are three families of quarks. For generation of discrete stable performance of an **n-p** pair the energy flux to space-time frame of baryon quarks needs to meet the condition  $E_{ap} = 2E_s$ . The baryon alone is not stable therefore cannot be the fundamental matter: the two nucleons are coupled with the meson field **TB** (top-antibottom) to form three flavor structure of space-time frame  $E_{ap} = 2E_s$ . In this case, the **n-p** frame holds discrete symmetry with high frequency and **n-p** transformation event which “after the change looks the same” (8).

The non-uniform conservation concept explains “mass gap problem” of Yang-Mills theory [36], which states “quantum particles have positive mass with regard to the vacuum state.” The positive Eigen value of  $(E_{ap} - E_s)/E_s$  exchange interactions shows that “quantum” particle has a positive mass in relation to the vacuum while translation of time phase vacuum energy to the space-time frame generates positive Eigen value  $(E_{ap} - E_s)/E_s$  and positive mass. Conversion of mass to energy produces energy with negative sign and this process does not response to the change of time.

Description of the energy flux of model (6) in the form Eigen value  $(E_{ap}/E_s - E_s/E_s)$  involves two terms: the term  $E_{ap}/E_s$  describes performance of charged particles through electromagnetic flux of energy, while  $E_s/E_s$  involves neutral particles—neutrinos which have self-coupling performance and do not experience effect of forces.

Recently, due to the dark energy phenomenon of Universe, the subject of energy conservation got more attention. For example, Ref. [37] suggest that without dark energy and dark matter, Einstein’s gravitational field equations should not hold conservation of energy-momentum relation.

In accordance with the non-uniform energy conservation concept, we may give specification of ordinary and dark energy. The dark energy generated due to the non-invariant translation of ordinary energy to the virtual space-time frame. Ordinary matter exists when there is space-time frame; but when space-time frame decays, it disappears with the decay of space-time frame of ordinary matter. Dark matter is not a baryonic matter and has no non-virtual space-time frame. Matter may have observance when it has non-virtual space-time frame.

The non-uniform phenomenon of energy conservation and non-invariant weak interaction are the necessary laws of nature to give different shapes to the different events: without non-uniform conservation of energy and non-invariant exchange interaction, the events would form a non-separable dark matter without any shape and structure.

In accordance with model (5), both energy and matter to be observable should have space-time frame. In the background, energy and space-time are not observable. On this basis, the non-observable time phase energy has features of dark energy.

Thus, the space and time are the products of non-uniform energy conservation and in reverse order, energy and mass identities are the inner products of space-time discrete dynamics. This concept completely changes our views on the fundamental interactions and symmetrical laws

of nature. Therefore, nature requires description only within very precise energy conservation principles.

## 9. Conclusion

We replaced two pieces of conservation laws, comprising conservation of energy as uniformity in time and conservation of momentum as uniformity in space by the new conservation concept suggesting non-uniform conservation of energy within discrete space-time frame. We replaced particles concept of classic physics and wave equation of quantum physics by the boundary mapped discrete space-time frame, which carries the non-uniform conservation of energy. Uniform manifestation of energy in time and uniform manifestation of momentum in space is not possible within space-time frame, which carries energy conservation within the non-uniform framework.

Therefore, the energy-mass equivalence, limitation of velocity with the speed of light, breaking of background symmetry all originate from the non-uniform conservation of energy. The background state of discrete space-time frame describes quantum level interactions through discrete transformation of space-time variables to each other with generation of discrete virtual particle-antiparticle pairs. Consumption of energy from the background field leads to the formation of the "grain" of the non-virtual space-time frame with generation of mass, energy-momentum relation of general relativity and classic physics.

With the increase of energy portion consumed in space phase, it consumes more energy to continue its velocity that is why expansion of space is "accelerated," which is the result of non-uniform conservation of energy. Conservation of energy is accelerated which appears in the form of non-uniform distribution of energy within asymmetric space and time boundaries.

Our concept suggests that the laws of nature comprise simple deterministic formulation of space-time, which holds conservation of energy in a unique way through non-spontaneous background translations of space-time phases. The consumption of energy photons by the space-time matter with the expansion of space generates backup reaction, which becomes the origin of gravity.

Finally, discrete, non-invariant translation of asymmetric boundaries of space and time variables to each other for carrying energy portions is the deterministic mathematical beauty of energy conservation and discrete existence of nature.

## Author details

Agaddin Khanlar Mamedov

Address all correspondence to: [aghaddinm@gmail.com](mailto:aghaddinm@gmail.com)

Petrochemical Company, Technology Center, Sugar Land, Texas, USA

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