

# On Fundamentals of Physical Science with Quantum State and Gravitation

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**Abstract** Fundamental laws of *Physical science* are based on *Symmetry*, *Possibility* and five *Elementary principles*. The concept of *Lethargy*, like energy, has been introduced by me as being equivalent of the rest mass of an elementary particle, which the particle assumes when it enters into the state of *Nothingness*, which is the absence of all matter and space. Whereas strong, weak and electromagnetic interactions are always mediated by particle exchange, gravitation is a phenomenon instead of an interaction, which is self-activated in view of the property of mass only when the amount of *Quantum gravitational mass* is present in space as a medium having the electromagnetic property. Elementary particles are produced by spontaneous generation out of nothingness while annihilation and decay of elementary particles occur along with their entering into and coming out of the state of nothingness. Our observable universe is an integral part of one greater universe having identical laws of physical science. Dark matter consists of an elementary matter particle with high spin angular momentum and low angular frequency, while the pressure factor in outer space having extremely low mass density contributes to creation of new space out of the state of nothingness, making up for the negative volume having lethargy resulting in the observed accelerating expansion of space.

**Keywords** Symmetry, Lethargy, Nothingness, Quantum state, Gravitation

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## 1. Introduction

This treatise is a continuation of my two earlier ones on fundamentals of motion of a particle in space and motion under gravitation [1] [2]. The present attempt is aimed at introducing two new concepts of *Lethargy* and *Nothingness*, which together with all other accepted norms will form the basis on which Physical science has been founded. While there is an abundance of laws and analytical formulations to applications in various areas of physical science, quite surprisingly yet justifiably these are based only on a handful of fundamental concepts in key areas of our understanding of nature and their rightful uses alone in physical science result in revealing the truth that we are seeking.

Most advances in our understanding of the physical world have been achieved by identifying and eliminating contradictions and reconciling with improved understandings coupled with experimental observations, where applicable, however, in every case being related back to the fundamentals and their more refined and fine-tuned applications.

In this treatise I have used minimal analytical relationships only, however, I have put forward the ideas based on logical

relationship. Mathematics does not lie yet does not reveal the truth and while staying abstract and incorrupt it sets up beyond doubt what is conceptually correct that one needs conjure up first. I have left it out for the moment.

## 2. Golden Rules and Elementary Principles

### 2.1. Golden Rules of Physical Science

From conception till today the history of physical science tells us that all physical phenomena, characteristics, hypotheses and laws including their analytical relationships between and among physical quantities obey the following two golden rules:

- Symmetry
- Possibility

Nature possesses an inherent symmetry and allows all possible ways for physical processes to take place. Therefore, even any unknown or yet unexplained phenomenon or characteristic may be comprehended by applying one or both of these two golden rules. Starting from the simple and the most basic phenomena e.g. translation as forward and reverse, clockwise and anti-clockwise rotation, attraction and repulsion, annihilation and decay, three dimensions of space and equivalence of space and time with respect to motion; many more complicated relationships may be found by observing the inherent symmetry and seeking out every

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way that seems possible. In our subsequent analysis we shall follow the same covenant in identifying any new phenomenon and its suitability.

## 2.2. Elementary Principles of Physical Science

In addition to the above two golden rules of physical science, nature adheres to five *Elementary principles* as stated below:

- Constituent principle
- Causality principle
- Covariance principle
- Invariance principle
- Equiprobability principle

Broadly speaking, these are the five fundamental principles behind all physical phenomena and their governing laws, without exception. In simple words they are like saying that the macro rises out of the micro domain, nothing happens without reason, some are everywhere same, some are forever same and there are always equal chances. By suitably observing and judiciously applying one or more of these elementary principles, all physical processes and the rules characterizing them can be explained and even a hitherto unknown phenomenon may be identified. Once again we will follow the same notion in our subsequent analysis in this treatise.

## 2.3. Basic Characteristics

Moreover, every physical concept, conjecture, hypothesis or every law in physical science along with its analytical formulation should bear the hallmark of the following three *basic characteristics*:

- Necessary and sufficient: Optimum
- Dynamical: Evolving over time
- Approximate: Best-fitting for now

This also means that there is always an option open for fine-tuning in the future.

Furthermore, they are invariably and necessarily founded on a set of assumptions and axioms comprising the fundamental principles, which are also subject to the above basic characteristics. Often two contradictory or competing theories making successful similar practical predictions are based on fundamentally disparate principles, thereby falsifying one or both the theories, and calling for revising the set of principles to start with.

Startlingly, most of the profound theories in physical science have been founded on deceptively simple postulates, since simplicity is direct and free from aberrations. In this treatise our primary attempt has been to adhere to this concept throughout only.

# 3. Concepts of Lethargy and Nothingness

## 3.1. Lethargy as Equivalent of a Physical Quantity

We first consider the inverse of speed ( $v$ ) and define this

as a physical quantity to be called as *slowness* ( $1/v$ ). This is the parameter that generates time coupled with space during any motion that takes place. Taking into account the theoretical limit of speed in nature ( $c$ ) we define this parameter as *Quantum slowness* being the inverse of that speed ( $1/c$ ). This is the limiting slowness by which motion can take place in nature.

Now starting with the mass-energy relationship with usual notations ( $E = mc^2$ ) we may observe by following the symmetry and then define a new parameter as *Lethargy* ( $L_e = m/c^2$ ). This is the property which mass acquires by being converted by the square of the quantum slowness factor. There is another way of looking at this as follows.

Again by using usual notations, we have the Maxwell's relation ( $1/c^2 = \epsilon\mu$ ) and accordingly we may write lethargy as ( $L_e = m * \epsilon\mu$ ) and energy as ( $E = m/\epsilon\mu$ ). So we may infer that lethargy is produced when mass is coupled with the combined electric and magnetic constants of nature and similarly decoupling of mass transforms it into energy.

Let us look at the following interaction relationships between two electric charges and combining them we arrive at the above Maxwell's relation:

- Coulomb's relation ( $F = q^2/\epsilon r^2$ ): Space rated interaction
- Ampere's relation ( $F = \mu q^2/t^2$ ): Time rated interaction

However, both the electric constant ( $\epsilon$ ) and the magnetic constant ( $\mu$ ) of nature are merely two constants of proportionality having defined numerical values only, and so by combining them we would like to arrive at a new-look property of space to be called as the *Electromagnetic parameter* ( $E_{pm} = \epsilon\mu$ ) which is also the square of the quantum slowness factor, which is an intrinsic property of space, as defined herein by us earlier, that creates time as and when motion takes place in space. Accordingly, we may redefine both energy ( $E = m/E_{pm}$ ) and lethargy ( $L_e = m * E_{pm}$ ) by using this property of space.

We may note here that on an elementary level this quantum slowness factor of space which is intrinsically related to the electromagnetic parameter of space or that of any intervening medium between two electric charges is responsible for arriving at the magnitude of the strength of electromagnetic interaction, which depends on the motion of the interchanging photons causing the interaction in the first place.

## 3.2. Nothingness as a State of Nature

There must be a source of anything that comes into being and that source must not depend on anything else and at the same time it must be present at all times, before and after time comes into effect. This is the state of *Nothingness*. So at all times including in the so-called beginning, there is only nothingness, which is the absence of anything and everything: *Without any matter or even space*.

This also means no motion, energy, momentum or time. The isometry of space and time will breakdown and entropy will cease to exist. The only property that is attributable to

nothingness is lethargy ( $m/c^2$ ), having the mathematical form defined hereinabove. When two elementary particles truly annihilate, they must get together into total disappearance from existence in any other form. This is possible only when they transform into nothingness having their entire mass-energy being turned into lethargy. Space occupied by them will become non-existent, and all motion will cease to exist and flow of time will therefore stop. All quantum numbers will also disappear. However, this does not mean to violate the dictum of *no demise ad nihil* because herewith they will only change into a state of nothingness without actually being destroyed permanently.

This state of nothingness may exist from an infinite beginning to an infinite end without violating the corresponding principle that no finite being can become infinite and vice versa. On the other hand, if elementary particles may disappear into nothingness, they may also appear only out of nothingness without violating the principle of causality or time reversal. This also does not in any way mean *creation ex nihilo* because in nature nothingness is actually a state in existence in an absolute form.

So we may consider that elementary particles are first created spontaneously out of nothingness, which being in motion then create space and time and the corresponding quantum field. More numbers and varieties of elementary particles are created which interact to produce composite particles, which then create matter objects. Particles may collide and annihilate going back into the state of nothingness and reappear as other particles. This process goes on and on over time with particles being always in motion in space both as elementary and composites.

Now let us try to correlate the above state of nothingness to physical reality by looking at various physical phenomena and characteristics of nature by way of seeking a proof for the existence of nothingness.

- *Elementary particles of the same type are identical:* This is possible when they are produced from the same source by the same process and with the same recipe, and at all times. Nothingness meets all these criteria and so at all times elementary particles are primarily created out of nothingness only.
- *Particles and anti-particles:* Elementary particles are produced simultaneously as pairs of particles/anti-particles spontaneously out of nothingness, which is a direct vindication of the existence of the state of nothingness.
- *Conservation of total energy:* Since nothingness acts as the only primary source and the ultimate destination of all the mass-energy of elementary particles, while their motion-energy and position-energy are frame dependent; in every physical process that takes place total energy will remain unaltered, as is always the case.
- *Particle/anti-particle annihilation:* With head on collision or starting from rest, the particle/anti-particle

pair loses all its properties except mass-energy, which is converted into lethargy as both particles enter into nothingness and thereafter only new particles can come out of the state of nothingness.

- *Particle decay:* A decaying elementary particle first enters into nothingness losing all its properties except mass-energy which is transformed into lethargy and then a new particle or particles may come out with mass-energy equivalent of respective amount of lethargy and in case the decaying particle has an electric charge then the field at the point where it enters into nothingness retains the charge which is carried away later by one of the new particles that emerge.
- *Quantum entanglement:* The two entangled particles are separated by nothingness allowing information to travel between them instantaneously with simultaneity because the state of nothingness offers no medium separating the two entangled particles. Moreover, each particle may act as either the source or the destination for the other particle in reciprocity with only nothingness between them, so it may appear to influence the past through an action in the future.
- *Quantum tunneling:* This becomes possible in a seemly situation due to the state of nothingness allowing a particle to enter into and reappear out of nothingness.
- *Constituent principle:* This is compatible with the state of nothingness since all matter is composed of and must end up into elementary constituent particles only that may appear out of and disappear into nothingness.
- *Causality principle:* This is compatible with the state of nothingness as there must be a cause for an elementary particle to primarily come into existence, which is the spontaneous production phenomenon out of nothingness.
- *Covariance principle:* This is compatible with the state of nothingness, as it exists equally and uniformly anywhere and everywhere.
- *Invariance principle:* This is compatible with nothingness as it exhibits symmetry.
- *Equiprobability principle:* This is compatible with the state of nothingness, since it always exists as a possibility.

### 3.3. More on Lethargy and Nothingness

Quantum field theory envisages energy content in vacuum, which is otherwise devoid of all matter. However, since energy can manifest only in transit [1] and as being piggyback on matter particles in motion, we may observe a fine contradiction herein. On the other hand, the vacuum therein is nothing but the old-fashioned space only. On the contrary, I would like to introduce the concepts of *lethargy* as against energy and of *nothingness* as an all-purpose state of nature with much more than a customary vacuum may offer. While bereft of any analytical, observational or experimental data, information and facts, these concepts may

sound metaphysical and bordering swanky and stretching imagination to the limit, however, keeping an eye on symmetry and possibility and yet not exceeding the constraints of logic, I have proposed the concepts combining quantum state of nature with cosmology with their logical applications in physical science. As an aside, this brings to memory Pauli's sensitive remarks: *It is not even wrong*.

Vacuum of the quantum field belongs to space and is a part of the universe, and therefore, is subject to all the logical manacles of finiteness, boundary and of big bang or if-any pre-big bang scenario as also of deep versus virtual reality and so on and so forth; with no clear solutions or answers to these enduring queries. Conversely, the concept of nothingness provides a continuity discounting infinity and periphery and beyond big bang cosmology. Likewise lethargy offers a logical riposte to the beginning and end of life of an elementary particle with a solitary dimension not turning into any measurable physical quantity in terms of the three necessary and sufficient conventional dimensions of space, mass and time yet containing all three and unfolding and liberating them, as applicable.

### 3.4. Creation of Elementary Particles out of Nothingness

Nothingness may be viewed as a sum-total of two equal and opposite, cancelling one another when they meet. A pair of an elementary particle and an anti-particle may rightly qualify for this. Therefore, it may be equally plausible that they may be created out of nothingness only. Now there are only two ways of creation, spontaneous and assisted. Also only transcendental entities may be conceived logically possible to be created out of nothingness, as it is otherwise devoid of everything else. So we may postulate that some such entity may be spontaneously created out of nothingness, which on creation assumes the property of a physical quantity, albeit two equal and opposite, following the rubrics of symmetry, possibility and causality among others.

*Electro-magnetism* is a transcendental entity, which is associated with a field along with another similar entity called the *speed* of its propagation, and also the *space* as the medium allowing this to happen. Taking into consideration lethargy ( $L_e = m * \epsilon\mu$ ) as the sole property of nothingness and mass ( $m$ ) of a particle as the result of electric and magnetic energy being in oscillatory transition inside an amount of space thus forming the particle [1], we may unreservedly postulate that a spontaneous decoupling of lethargy simultaneously produces a particle with mass and the electromagnetic field along with space. This may be vindicated by the fact that every such creation results in a particle and anti-particle pair and in reciprocity the annihilation of the pair converts the energy into lethargy, needing no particle or medium, as the sole plausible property of nothingness.

The concepts of both lethargy and nothingness are abstract in nature with no direct observation or physical measurement being possible. As regards nothingness we cannot devise an experiment to prove what does not exist. Similarly for

lethargy we may only indirectly justify the property assuming that decoupling of it produces particle mass and energy. However, the postulate that elementary particles go in and out of nothingness during the process of transformation into other elementary particles due to annihilation or decay, may call for an experimental observation of the values of mass, momentum and energy before and after the transformation, perhaps through a controlled experiment and in a collider such as the LHC, which may be a too futuristic yet a worthy feasible trial. As an aside, the state of nothingness may be visualized as a *black box* in an open system where outputs may be obtained as spontaneous creations or as assisted creations due to stimuli (or inputs). So an observer may devise an experiment with a control input as a stimulus in order to observe and interpret the output.

Another stimulating corollary may be derived out of the above. The quantum state of nature appears to be the direct consequence of un-assisted spontaneous creation of elementary particles out of nothingness, limiting the dimensions to the minimum only. Starting with the fundamental physical entities like quantum length, quantum action and quantum slowness, nature provides for each and every other physical quantity a quantum characteristic by virtue of its being related to the primary creation out of nothingness and precisely adhering to the constituent principle thereafter. So upon creation, an elementary particle is born free, undertakes a motion with quantum slowness going through all possible transformations and unions with other similar particles.

Once created out of nothingness, the elementary particles of all equiprobable and possible characteristics, resulting in being both stable and unstable particles, continue through the processes of annihilation, decay etc. transforming into other elementary and composite particles as well, while obeying the principles of probability and permutation and combination only [1] [2]. This is the reason it takes billions of years to set into a formalism of its own, although every change that takes place is due to the effect of an exogenous cause in local proximity. Thus is created the fabric of matter and space and often unleashing the inherent energy due to high-energy collision and scattering.

While spontaneous creation out of nothingness will always produce a pair of particle/anti-particle, there may be production of a single particle or anti-particle only, in case of assisted creation. At any time after creation a particle or an anti-particle, (from now on we will mention particle only for simplicity), may enter into nothingness, as a purely natural probabilistic affinity or before or after being a product of annihilation, decay, transmutation, radioactivity or any other particle-particle interaction causing a new particle or particles to emerge with equal or different mass value and other related attributes; which all are considered as cases of assisted creation, with causal relation between the particle and the state of nothingness, which may accommodate a differential mass value as well, without violating the

conservation principle. However, any electric charge carried by a particle will be retained in the field at the point where it enters into nothingness and will thereafter be carried away by a new particle created out of nothingness. In this way, all elementary particles will continue to have an in-out relation with the state of nothingness, embracing each and every form of particle interaction at any stage after being created spontaneously. Moreover, when a particle, elementary or composite, undertakes motion in space it exchanges its position with a virtual particle coming out of nothingness, as an assisted creation by virtue of the motion of the particle, resulting in a dual wave-particle quantum motion [1].

So we may summarize the above particle/anti-particle creation as follows noting that the propensity for creation of a particle is either spontaneity or assistance due to the effect of interaction and motion.

- Spontaneous creation of particle/anti-particle pair out of nothingness
- Natural annihilation of particle/anti-particle going into nothingness
- Natural decay of unstable particles going into nothingness
- Assisted creation of particle out of nothingness following annihilation, decay etc.
- Assisted creation of virtual particle out of nothingness due to motion of a particle

### 3.5. Weak Interaction and Nothingness

Elementary particles undergo decay by weak interaction alone changing into other elementary particles mediated by Bose-particles. Moreover, unlike other interactions, the result of a weak interaction does not convert the new particles to a lower potential energy state or a bound state. However, the intermediate Bose-particles, with their higher mass-energy values, seem to contradict with the law of conservation of energy as also weak interactions do violate P-symmetry and CP-symmetry.

These may seem possible and be justified by considering that elementary particles undergoing through weak interactions do so by moving in and out of the state of nothingness, whereas for all other interactions the interacting particles remain in space outside the state of nothingness. Unlike other interactions, in case of weak interactions, there is a need of additional mass and energy, in the form of intermediate Bose-particles, for the decay of both elementary and composite particles, and in every case the same is provided by the state of nothingness as an assisted creation of the Bose-particles, which may also go into nothingness resulting into formation of new elementary particles, again as assisted creation out of nothingness, without involving any binding energy. Similarly, a violation of any rule stands as the evidence of the presence of freedom to defy and the existence of possibility to go by in a way other than that allowed by the rule. This is fully compatible with the state of nothingness, but not within the space outside of nothingness.

## 4. Quantum State, Interactions and Other Phenomena

### 4.1. Quantum State of Nature

The quantum state of nature characterized by the quantum state of matter and of every other physical quantity known to physical science is an essential and intrinsic feature being a requirement rather than a surprise, and is in complete compliance with the abovementioned golden rules and elementary principles. Considerable knowledge is already available in the respective areas of Quantum electrodynamics (QED), Quantum chromodynamics (QCD) and Quantum field theory (QFT).

Therefore, herein we will only mention the basic quantum properties applicable to our analysis. These are based on Planck units taking into consideration usual notations of reduced Planck constant ( $\hbar$ ), gravitational constant ( $G$ ) and speed of light ( $c$ ).

- Quantum action ( $\hbar$ )
- Quantum slowness ( $1/c$ )
- Quantum length ( $l_p = \sqrt{\hbar G c}/c^2$ )
- Quantum time ( $t_p = \sqrt{\hbar G c}/c^3$ )
- Quantum gravitational mass ( $M_p = \sqrt{\hbar G c}/G$ )

Note that in spite of the quantum nature of every physical quantity, we have not considered quantum mass, energy or momentum, as there cannot exist any, whereas we have redefined Planck mass ( $M_p$ ) by a new name of *Quantum gravitational mass*, the reasons for which will be explained later in this treatise.

Moreover, we have expressed the analytical form of each of quantum length, quantum time and quantum gravitational mass as a constant multiple of a new physical quantity, to be called as *Quantum gravitational momentum* ( $Q_{gm} = \sqrt{\hbar G c}$ ), having the dimension  $[Q_{gm}] = [L^3 T^{-2}]$ , the second time rate of change of volume and this aspect will also be explained later in this treatise. As an aside, the term momentum is used here as being the *generator of motion* for gravitation, in apparent symmetry.

Also we may note that the same quantity can be written as ( $Q_{gm} = M_p * G$ ) in consideration of symmetry with the conventional expression of momentum.

### 4.2. Quantum Interactions and Other Phenomena

At the elementary particle level, we are already familiar with all three quantum interactions e.g. electromagnetic interaction, strong interaction and weak interaction; having the symmetry that they are invariably mediated by exchange of quantum particles carrying energy and momentum between and among the interacting massive particles.

In case of electromagnetic interaction, the mediating particle is photon, which is generated out of nothingness by virtue of the excitation caused by the electric charge carried by the interacting particle, and being independent of the interacting particle its speed is always governed by the electromagnetic property of space, through which it travels

and thereby it attains the corresponding constant speed independent of the frame of reference and independent of the speed of the interacting particle.

The uncertainty principle is an outcome of the elementary particles coming out of and going into the state of nothingness whereby they may appear anywhere in space with all other state properties remaining the same or may even appear with additional energy out of the lethargy contained therein only to be returned to nothingness at a later stage. An elementary particle in motion gets surrounded by multiple virtual particles coming out of nothingness, by virtue of its position and motion along with its state properties at that point of the field thus created in space, and as the particle in motion exchanges its position with an arbitrary adjacent virtual particle it may also enter into nothingness and reappear at any other point in space within the field. This happens again due to the golden rules of symmetry and possibility and thereby the uncertainty principle is invoked.

Let us once again consider the case of quantum electrical charges. Take a particle with an amount of elementary electrical charge and free from any other exogenous interaction and it will have symmetry all around it with no motion. Now take two particles with equal and opposite (or similar) electrical charges ( $q$ ) separated by a spatial distance ( $r$ ) and also free from any other exogenous interaction. Then the symmetry will be interrupted and they will have mutual interaction through the exchange of photons. But again from symmetry only the effect of interaction of one over the other will be uniformly distributed along the distance ( $r$ ) so that the strength of the mutual interaction will be proportional to  $(q/r)$  and the resultant effect will be  $(q^2/r^2)$  and we will arrive at Coulomb's relation defining the Electric constant ( $\epsilon$ ). Similarly, with a time rated relation (instead of space rated relation as above) we will arrive at Ampere's relation  $(q^2/t^2)$  defining the Magnetic constant ( $\mu$ ). Since quantum space and time are interrelated by the quantum slowness factor ( $1/c$ ) we see that the above two relations are interchangeable meaning they are the manifestation of the same combined electromagnetic effect due to two electric charges interacting between them and we arrive at the physical significance of the parameter  $(1/c^2)$  which will affect the motion of the photons since the actual slowness factor will depend on the dielectric property of the intervening medium separating the charged particles.

For strong and weak interactions, following the symmetry, respective mediating particles are generated out of nothingness and they carry the energy and momentum causing the interactions between and among the interacting particles.

Nothingness is the only abode of all elementary particles e.g. Bose-particles and Fermi-particles. Also elementary particles only can be produced due to spontaneous decoupling of lethargy into mass and by further decoupling of mass into energy. Elementary particles only can get into nothingness and come out of nothingness carrying energy

and momentum.

All processes of particle annihilation and decay are mediated through the state of nothingness. While both Bose-particles and Fermi-particles can enter into nothingness and come out of nothingness as new particles at the end of the respective process, only Bose-particles can carry energy and momentum during the intermediate stage, as they alone disobey the exclusion principle.

Nothingness has only one dimension, which is lethargy, and therefore all other dimensions get folded up as the elementary particles enter into the state of nothingness and the total mass-energy and the motion-energy of one particle relative to the other, get converted into lethargy of the state of nothingness. The following dimensional analysis will show how all three fundamental dimensions of nature are folded into lethargy.

- Lethargy ( $L_e = m/c^2$ )
- $[L_e] = [M * L^{-2} * T^2]$

So when matter particles are generated by spontaneous creation of elementary particles out of nothingness, all three principal dimensions of nature get unfolded creating space, time and motion of matter particles carrying energy and momentum. Sometimes decay through Bose-particles causes generation of new particles being more massive than the initial particles, and this is possible because they gather additional mass out of the lethargy of nothingness and later either give back to nothingness or change into other particles having lower mass values.

## 5. Gravitation as a Phenomenon Instead of Interaction

A single and isolated neutral (i.e. uncharged) massive particle or a system of closely-held similar particles, having no other particle in its vicinity will forever remain stationary at its place in space (its motion-energy, if any, being frame dependent only), in absence of any other exogenous interaction, which in other words is to say that it shall not experience any gravity [2].

Before proceeding further, borrowing data from the previous article, let us set up the following two interesting quantum relations.

- $l_p = (M_p/c^2) * G$
- $l_p = Q_{gm}/c^2$

The first relation tells us that the Quantum length is achieved as the product of lethargy of Quantum gravitational mass and the Gravitational constant. The second relation states that the same Quantum length can be achieved by the Quantum gravitational momentum multiplied by the square of the Quantum slowness factor, having a notable symmetry with the mass-energy relation ( $E/c^2 = m$ ).

The latter relation can further be extended in saying that when coupled with the Electromagnetic parameter, the Quantum gravitational momentum results into Quantum length ( $l_p = Q_{gm} * E_{pm}$ ), implying a motion simply due to

the property of mass and in relation with the electromagnetic property of space, in absence of any other exogenous interaction or exchange of mediating particles carrying energy and momentum.

For the same reasons cited above, we have earlier named the respective quantities as *Quantum gravitational mass* and *Quantum gravitational momentum*.

Now if another similar particle or a system of closely-held similar particles appears in its vicinity, the symmetry will be broken and in case they form a common mass-center with a mass value equal to Quantum gravitational mass ( $M_p$ ) we may presume that each will tend to gravitate towards the common mass-center. This is the fundamental principle of gravitation, which is therefore, a phenomenon instead of an interaction, and it is self-actuated due to the particle having the property of mass in conjunction with the electromagnetic property of space.

Let us consider the case of two neutral particles with equal mass ( $m$ ) separated by a spatial distance ( $r$ ) with no other exogenous effects. As an individual particle each will have no motion but in the vicinity of one another, the symmetry will be broken and they will have mutual effects of one upon the other. By the same logic as for the charged particles, the effect of each on the other will be proportional to  $(m/r)$  and the resultant combined effect as  $(m^2/r^2)$  since no other property of the particle will be involved (being absent actually) and the combined effect will be the relation defining the Gravitational constant ( $G$ ) as being merely a proportionality constant. There will, however, be no time rated relation with the (intrinsic) mass values of the particles (unlike the case of electric charges which are subject to vary with both time and space).

Logically there cannot be any exchange of particles (like photons) carrying energy and momentum. So instead of creating an interaction, the mutual effects will result in self-generated motion of the particles in order to create a new symmetry, which will be nothing but the particles moving towards each other (*same like falling freely through space towards each other*) with the desire to end up in a common mass-center similar to a single particle in space. So this will result in a so-called gravitational attraction which will be purely due to the particles having their intrinsic property of mass and in the true sense gravitation shall not be an interaction like other forms of interaction (by particle exchange) but it will be a self-generated motion through space having the property of the electromagnetic parameter.

An identical inference can be drawn by considering Raychadhuri equation which relates the second time rate of volume change of the imaginary sphere comprising the above two particles at the ends of a diameter, which will undergo a reduction in length as multiples of the Quantum length in the same proportion as the mass value of the common mass-center of the above sphere relates to Quantum gravitational mass.

Now when a large number of such particles or group of particles are in the vicinity of one another, each such mass-center will tend to gravitate to another similar

mass-center, of which it is a constituent and this will go on and on as a result of which the locus of the path of any such particle or group of particles will appear as a curved path in space-time akin to the geodesic path formulated under General Relativity (GR). *This is therefore a quantum explanation of GR.*

As a corollary to the above mentioned observation, we may note that for any particle, elementary or composite, free from any exogenous interaction, if the mass of the particle is less than Planck mass or Quantum gravitational mass ( $M_p$ ), then instead of a translatory motion in a definite direction purely under gravitation the particle will still undergo a *jittery motion* only, characteristic of the quantum state of the particle. This vindicates the fact that every elementary particle has a mass and the archetypical fidgety motion of the particle is due to self-gravitational effect in view of its having the property of mass only, since in free space every direction is equiprobable.

A continuation of thinking along a similar line may allow us to find an answer for the subtle spectacle of *neutrino oscillation*. In order to explain this phenomenon, the theory stipulates that an observed neutrino flavor state is a superposition of different mass eigenstates, which alternate over long distances of their travel through space. While the neutrino with its virtually imperceptible mass travels in a stream of particles over enormous distances, it undergoes continuous mutual attrition as also intermittent scattering with other particles it meets along its way, as a result of which some of the neutrino particles routinely endure changes in the values of their intrinsic angular frequency, thereby converting them into neutrinos with higher or lower mass scale in view of the analytical relationship with usual notations ( $S/c^2 = m/\omega$ ) [1]. Unlike any other elementary particle this is possible in case of a neutrino only having a non-zero yet tiny mass value, being neutral and as a Fermi-particle having a half-integer spin.

The nature of space and its composition has long been considered as an unsolved dilemma. I have envisioned space as being created by the motion of a particle, which, at any instance is essentially a linear translatory motion in a definite direction. This linear transition along any arbitrarily oriented axis in space may be logically conceived as being equivalent of an apparent simultaneous motion in any three mutually perpendicular directions, and therefore, arguably an infinite number of, yet equiprobable, such mutually perpendicular axes may be perceived together to create the *hollow of a space*.

The phenomenon of gravitation or more precisely self-gravitation is the primary cause of motion of a particle having a mass, independent of any other superimposed exogenous interaction, which creates space and consequently time too. Depending on the nature and all other attributes of the particle, a field is created in space, and then it may interact with other particles present in its vicinity. In simple words, we are continuously *falling through space under gravitation* and creating space along our way.

## 6. Additional Principles and Tools

### 6.1. Deep Reality Physics and Other Principles

Physical science adheres strictly to logical principles only whereas mathematics is often oblivious to them. So the principles of *deep reality physics* do play the dominant role in describing nature perceived by our real senses and obeying the five elementary principles mentioned earlier. This makes scientific theories falsifiable, and based on organized knowledge alone, apart from a class of preternatural axioms and beliefs. From these concepts ensue following additional corollaries.

- No true action at a distance
- No creation ex nihilo
- No demise ad nihil
- A finite cannot become an infinite
- Material entities do not occupy the same space at the same time
- Nature possesses no singularities
- Black holes cannot exist
- Big Bang cannot be a physical reality (yet mini bang [2] can be)
- Extra dimensions are unneeded to describe physical reality

An additional point of view is elaborated herein. Quantum field theory often deals with the motion of a point scalar charge, a point electric charge or a point mass, *equivalent of a black hole*, in spacetime thus approaching singularity in view of the geometrical representation. Whereas if we may look at the *quantum motion* of the particle to be over a quantum length ( $l_p$ ) for a quantum time ( $t_p$ ) in view of the limiting value of quantum slowness ( $1/c$ ) and ending in a quantum action ( $\hbar$ ) while considering the particle to be of extended version [1] having an intrinsic linear dimension ( $r$ ) instead of being a mathematical point, we may avoid singularity at all times. Considering a particle to be always in motion and the concept of motion as valid only when the particle undertakes a motion covering the quantum length in space, we may avoid the particle assuming a stationary point position or singularity in spacetime.

### 6.2. Randomness, Probability and Statistics in Physical Science

Physical science, as we know of, is an integral part of the much larger and wider subject of *natural science* comprising each and every aspect of nature in our universe. On the other hand it is physical science alone that truly deals with the fundamental principles of nature that govern the natural science as a whole. Apparently speaking, physical science deals with inanimate objects of nature only and is considered to be a distinct branch of its own away from the biological or the life science. However, in a way similar to the biological evaluation process in nature, all physical phenomena and configurations have been arrived at following the two golden rules of symmetry and possibility in association with the five elementary principles of physics. *The universe is an evolution grown out of the state of nothingness over a period*

*of time.*

The apparent *randomness* of nature may be fully contained within the above sphere of knowledge. Starting from the simple tossing of an even coin to generation of random numbers, or radioactive decay, every physical phenomenon, which otherwise appears as random, is governed by the above. In essence randomness itself is a law of nature arising out of abiding by the above rules and principles. As such the quantum world exhibits its random nature in every way feasible.

*Probability* plays another important role in physical science as it determines analytically the outcomes of expected behaviors, experiments and observations which, otherwise are beyond comprehension in view of apparent inaccessibility to the true ingredients of the causality principle that decree all of them. It is an analytical tool to ascertain a reasonable certainty out of inherent and intrinsic uncertainty of nature.

Similarly, *statistics and statistical laws* applied to physical science are aimed at predicting results out of a large number of observations obeying varying inherent and analogous yet apparently anomalous rules otherwise beyond conception. This ranges from application to numerous data analysis in case of particle colliders in the micro world through enormous extrapolations in the field of cosmology.

Therefore, taking into consideration the above, we may sum up that physical science is inherently an exact science, however, with its essential quantum limits making up and coming up with the overall macro structure of nature, it is in the process governed by laws which are only apparently known to us.

## 7. Universe, Dark Matter and Dark Energy

### 7.1. Universe

There is one universe; by definition it has to be one only containing the entirety, in dynamical balance unlike a steady state as a misnomer, with the state of nothingness that lies within it and beyond it as well. Like every other matter particle and space it contains therein the universe at any instant of time has to be finite albeit like the series of integer numbers it may be as large as it can be and varying too with time. The concept of a boundary does not apply for the universe, which is either matter interspersed within space or it is space intervening matter. Space cannot and so does not undergo any expansion, as it is not comprised of anything to expand by, yet new space is created out of nothingness by the motion of matter particles, much akin to a piston moving into an empty cylinder creating new space behind it, and similarly space can be annihilated as well by the similar motion of particles entering into nothingness like the retracting piston.

This universe or more precisely *the universe*, also has to be much larger than our *observable universe*, which is a part of it only and is contained within it and must be in every way similar to our observable universe, with the same form of

matter and space and laws that govern the physical science, which is also equally applicable, in a way that our observable universe is only a part of it that we can merely observe but in every other way an integral part of it. The perceived isotropy and homogeneity averaged out over a spatial distance of three hundred light years is fairly consistent with a gas mixture or a solution, and any point at the edge of our observable universe may likewise be considered as the center of another observable universe, in every way similar to ours, whereas the universe as a whole remains a much larger encompass with the realm of its own finiteness and apparent form sans a boundary. The *acceleration of the universe* or the so-called the *expansion of the universe* should be considered as limited to our observable universe only, while the universe as a whole is like one giant particle with all matter and space contained in it situated out of nothingness.

## 7.2. Dark Matter

Considering gravitation only as a phenomenon, instead of an interaction, in which a massive object *falls through space* under gravity, we should agree with the inverse square law for particles, when free from every other exogenous effect, to be true at one extreme whereas for extended and more massive objects in space, we should go by the stipulations of general relativity. However, both may appear as approximate in explaining certain critical observations made such as the galaxy rotation curves which demand the presence of hereto undetected *dark matter* while an alternative theory MOND provides a modified version of the inverse square law, which cannot be ruled out too and should be considered as correctly pointing out the flexibility required and must be taken in tandem with the presence of dark matter.

Applying the golden rules of symmetry and possibility, we may logically accept that the intervening space between the galaxy center and the outer sphere of rotating stars should certainly be filled with some kind of matter particles only, even if not demanded by observational facts of rotation curves; the amount of which depending on the amount of mass being located at the center and around its immediate periphery and therefore not prevalent in smaller solar-like sub-systems. Dark matter, which is essentially transparent matter, has cast a dark cloud in the horizon of knowledge about our universe and so we take a look at it since the universe comprises mostly of dark matter only, providing for the large-scale gravity. The essential characteristics of dark matter in view of our findings of formation of matter particles [1] require the following.

- A massive matter particle so as to exert necessary gravitational effect
- An elementary matter particle as it is grown out of nothingness
- A Fermi-particle only so as to exist as matter particle
- With very high mass yet with low angular frequency so it is stable
- With high spin angular momentum to account for large mass

- Allowing incident photons to pass through not interacting or offering resistance (due to low angular frequency) making the particles transparent to visible light

The above features arise out of the following analytical relationships [1] among the particle's mass ( $m$ ), angular frequency ( $\omega$ ), intrinsic linear dimension ( $r$ ) and the speed of light ( $c$ ) in relation to its spin angular momentum ( $S$ ).

- $S = m * r^2 * \omega$
- $S/c = m * r$
- $S/c^2 = m/\omega$
- $c = \omega * r$

Dark matter is expected to be comprised of a new type of uncharged elementary Fermi-particles, beyond the third generation of particles in the Standard Model, with very large spin angular momentum and consequently being highly massive, yet with very low angular frequency and thus being extremely stable.

From the above analytical relationships it may be noted that the ratio of the spin angular momentum and mass of the particle ( $S/m$ ) may remain fairly unchanged like any other Fermi-particle of the first generation, along with the corresponding low angular frequency, thereby ensuring great stability of the particle; whereas both the spin angular momentum and the corresponding mass value of the particle may go up to any high.

When produced in a particle collider, the dark matter particles coming out with transverse momentum will accompany well-defined high-energy high-momentum tracks and will be all alone only without any other particles associated with them. So observers should look out for a similar situation to be detected.

As an aside, in my view, both in nature and in a particle collider, a multitude of particles well beyond the first three generations of particles as in the Standard Model are generally produced, albeit mostly being highly unstable continue to remain undetected, however, considering symmetry and possibility, there should be particles which are also extremely stable and these are the particles which manifest as dark matter particles in outer space and should be produced and detected by a particle collider experiment.

## 7.3. Dark Energy

Cosmological principle along with the Lambda-CDM model, in spite of their simplified yet logical assumptions portraying the cosmos, predicts a negative pressure ( $p = -\rho c^2$ ), with the usual notations, meaning that in outer space where the average mass density is a rarity, there exists a negative pressure or negative energy, named as *dark energy*, causing the observed accelerating expansion of space. Before proceeding further, we need to assume the principle of isotropy and homogeneity to be true, and so also the all encompassing presence of both dark matter and dark energy fairly uniformly throughout the universe, while being far more prevalent and so relevant in the outer cosmos inside the intergalactic space.

A look at the above relation suggests that we may rewrite it along with considering the negative sign in front of the volume factor instead of pressure as ( $p/c^2 = m/(-v)$ ) and then again using the notations for lethargy ( $L_e = m/c^2$ ) and combined electric and magnetic constants, as ( $p * \epsilon\mu = ((L_e/(-v))/\epsilon\mu)$ ) which implies that following the symmetry of mass-energy-lethargy relations formulated by us earlier, pressure coupled with electromagnetic parameter of space will give rise to an equivalence of lethargy per negative unit volume of space decoupled by electromagnetic parameter. Since lethargy is a property of nothingness which can also accommodate a negative volume albeit mathematically, being actually devoid of any space, we may infer that the universe undergoes through the process of creating new space out of nothingness to equate with the negative value and restoring the overall value to nil. In other words, in outer space where the mass density is extremely low, pressure has the effect of creating new space resulting in an accelerating expansion of the universe.

#### 7.4. The Universe Born out of Nothingness

The universe, comprised of all its matter and space, has been created out of the state of nothingness, which is the only source that exists without violating the causality principle and being independent of time as well. Spontaneous decoupling of lethargy of the state of nothingness creates elementary particles possessing mass, which along with simultaneous decoupling of mass into energy result in motion of the particles and in turn create space and the quantum field. Every other phenomenon, occurring thereafter, is *assisted* instead of being *spontaneous* bearing a causal relationship with one or more exogenous factors and in addition following the golden rules of symmetry and possibility.

For the same reason as above, there are several creation phenomena for *elementary particles only* out of nothingness that can take place as follows:

- Bose and Fermi-particles that may form into other composite particles
- Particles and anti-particles that may annihilate going back to nothingness
- Unstable particles, which may decay into other stable particles
- Stable particles of high mass value contributing primarily to gravitation
- Stable particles of low mass value contributing primarily to energy content
- Stable particles of very low mass value contributing primarily to radiation

Moreover, in accordance with the above scenario, we may now proceed to seek answers to the following lingering queries:

- *Baryon asymmetry*: Elementary particles/anti-particles are produced as pairs only simultaneously when spontaneously created out of nothingness, however, they are also generated singly due to particle decay and

other natural ways through the state of nothingness and are followed by partial annihilation causing imbalance and so over a very long run may result in an asymmetry as is observed presently

- *Smallness problem*: The cosmological constant of the classical vacuum of space assuming a miniscule non-zero value is due to creation of elementary particles of low mass value out of nothingness, which is devoid of energy, and so the energy density of vacuum must only be marginally above the nil value
- *Coincidence problem*: Since elementary particles are created spontaneously out of nothingness, the matter density and the vacuum energy density of space should be approximately equal at all times, the measured / observed enhanced differences over time being of probabilistic nature only
- *Flatness problem*: Taking into consideration of the state of nothingness being existent independent of time, and discounting big-bang and its associated early epoch concept, and since elementary particles are only created spontaneously out of nothingness, the curvature of space-time should be extremely small at all times except being locally of high value due to the presence of highly massive objects

In addition, we may look into the *Hierarchy problem* by first considering the fact that the minimum possible values of quantum length, slowness and time are the essential features to ensure the highest resolution in the fabric of nature and physical science. Then we consider gravitation as fundamentally a phenomenon, unlike say a weak interaction that is mediated by particle exchange. This is vindicated by the rationale that it comes into effect only with a minimum mass value of Planck mass ( $M_P$ ) and so the gravitational constant ( $G$ ) attains an extremely low value ensuring the value of Planck mass be quite high compared to, say proton or an elementary particle, and consequently the effective magnitude of Quantum gravitational momentum ( $Q_{gm} = \sqrt{\hbar G c}$ ) being the generator of gravitational motion is extremely low in relation to the strength of weak interaction.

## 8. Conclusions

Laws of physical science are founded on Symmetry and Possibility in nature also complying with five Elementary principles; and the universe is comprised of space and matter particles in continuous motion in space following the above laws. Lethargy is a property of matter equivalent of its rest mass and exhibits under the state of Nothingness, which is an absolute state of matter and space being the absence of everything except the solitary dimension of lethargy. Quantum state of matter is an essential feature of nature and all interactions occur at elementary particle levels while gravitation is a self-acting phenomenon of matter by virtue of having its property of mass and so gravitation is not an interaction mediated by particle exchange. Matter particles

are produced at first by generation of elementary particles by spontaneous creation out of nothingness and particle-antiparticle annihilation and decay occur at elementary particles level, which enter into and come out of the state of nothingness carrying energy and momentum.

Dark matter comprises of an elementary matter particle of the Fermi-particle class having a very high spin angular momentum and very low angular frequency, thereby being very stable and resulting in a high mass value contributing its gravitational effect while offering no resistance to impending photons and so appearing transparent to visible light. Dark energy, albeit a typical misnomer, refers to accelerating expansion of space caused by pressure in outer space having an extremely low mass density by creating new space out of nothingness as the galaxies move away from one another.

Our observable universe is an integral part of the one only universe containing the entirety. Nothingness is in the beginning and at the end of anything and everything that constitutes our universe, and the cycle ever goes on. Truth

remains unaltered even if not revealed or only partially be through bold and fanciful theories which are necessary and seem sufficient yet ever asking for new and more. Science has not yet found all the answers and so the anthropic query still lingers on, however, by turning religious and fancying in your belief in God you curb the power of your mind at His altar, while by *religiously following science* you may extend it beyond limit.

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## REFERENCES

- [1] Kalyan Deb, On Fundamentals of a Moving Particle in Space, available from: <http://article.sapub.org/10.5923.j.ijtmp.20140401.02.html>.
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