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Properties of Superfluid Free Space

Discovering Thoughts, Inventing Future

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By Wenzhong David Zhang

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Keywords: *superfluid free space, dynamic polarization, the hubble constant, fine-structure constant, fluctuation-dissipation, relaxation, cosmic microwave background radiation, mach's principle, non-local hidden variables.*

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I. Introduction

For the light, a beam of photons, the widely accepted plane electromagnetic wave functions, derived from Maxwell's equations under the ideal assumption of lossless free space, suggest that the light can propagate indefinitely through the free space without energy dissipation. Hence, the cosmic redshift could only be explained as Space Expansion without any direct evidence, except cosmic redshift itself, the Big Bang cosmology has been developed based on the hypothetical Space Expansion, together with a simplified version of Einstein's General Relativity under several assumptions. In reality, electromagnetic force is a long-range force, there are interactions between propagating electromagnetic waves and dynamic pairs of positive and negative elementary charges distributed in free space. The interactions are extremely weak; hence, they are widely neglected. The neglected tiny part of the energy dissipation of the weak electromagnetic interactions has been derived from Maxwell's equations rigorously, the connection between the Hubble constant and the extremely tiny conductivity of the free space as an integrated dynamic grand medium is elucidated[1]. The Hubble constant is identified as the intrinsic relaxation frequency constant of the integrated dynamic grand medium of free space. Quantitative value for the tiny conductivity of free space as an integrated dynamic grand medium is determined theoretically. Amazingly, it is derived that the total electrical resistance of the whole observable Universe, as a cubic shape confined to the Hubble length, is equivalent to the well-determined impedance of free space. The energy dissipation of a monochromatic electromagnetic wave propagating through the integrated dynamic grand medium of free space per cycle, as derived from Poynting's theorem, is shown to be approximately the product of the Planck constant and the Hubble constant[1]. This result aligns precisely with the energy dissipation of a photon particle propagating through free space with an extremely tiny frictional force per cycle, derived from a lightly damped oscillator model[1,2]. Based on the progresses have been made, this perspective review invites a rethinking of established physical theories by incorporating innovative interpretations of photon dynamics, dynamically polarizable superfluid free space properties and some fundamental constants. Central to this work is the understanding that free space is a dynamically polarisable superfluid grand medium with an intrinsic relaxation frequency, which influences the behaviour of photons across cosmic distances. By integrating concepts such as dynamic superfluid free space polarization, fluctuation-dissipation, and the behaviour of Cosmic Microwave Background Radiation, this perspective review provides a comprehensive approach to re-examining how we view the Universe.

II. Photon Behaviour and the Interpretation of the Planck Constant from a Mechanical Perspective

The exploration begins with reinterpreting the Planck constant through a mechanical framework,

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viewing photons as harmonic oscillators with rotational symmetry[3]. This treatment emphasizes the relationship between a photon's energy equivalent inertial mass, oscillation frequency and spatial displacement, connected through conserved mechanical angular momentum because of rotational symmetry. This interpretation not only provides a deeper understanding of quantum mechanics but extends its relevance to macrocosmic scales, offering a unifying approach that links quantum behaviours with classical physics. This mechanical perspective on photon dynamics enhances our understanding of the wave-particle duality inherent in photons. All photons possess equal mechanical angular momentum because of their rotational symmetry, their propagation and interactions within various media can be explained using the model of the cycloid motion of harmonic oscillators. The cycloid model treats the particle aspect and the wave aspect of photons on an equal footing, the trajectory of particles is approximately determinable and it is possible to be verified experimentally. The implications of these findings resonate across disciplines, reinforcing the Planck constant's role, or more widely the conservation of angular momentum vectors because of rotational symmetries, as a universal connector between energy, frequency and space. The reduced Planck constant is an angular momentum, which is mutually determined by the harmonic oscillator with rotational symmetry and the dynamically polarizable superfluid free space around it, and they interact with each other. The Planck constant is not only important for advancing our understanding on the foundation of modern quantum physics for microcosms, it is also relevant to the current study of cosmology[3-5].

III. Mixed Two-Fluid Photons and the Superfluidity of Free Space

The innovative concept of mixed two-fluid photons posits that some photons can behave like a coherence quantum liquid under specific conditions[6]. Drawing inspiration from Bose-Einstein condensation in superfluid helium, it is suggested that a subset of photons at certain wavelengths and densities can enter a state of minimal interaction and collective behaviour, akin to superfluidity, which forms the so-called superfluid free space. Superfluid free space as a medium contributes to photon behaviour through its polarizable, dynamic nature.

The theory of mixed two-fluid photons is supported by observations of deep absorption profiles in radio background spectra and the behaviour of the cosmic microwave background radiation. These findings indicate that photons do not travel unimpeded but interact weakly with dynamically polarizable superfluid free space they traverse. Free space as a dynamically polarizable superfluid medium that resemble quantum coherence seen in superfluid systems, is a perfect black body radiator under perturbations.

IV. Revisiting the Fine-Structure Constant: Implications for Dynamically Polarizable Superfluid Free Space and Photon Behaviour

The fine-structure constant (α), a dimensionless value integral to electromagnetism, gains new significance under the dynamic elementary dipole model. In this model, twin particles with opposite elementary charges in stable orbital motions form a structure integral to electromagnetic and mechanical interactions[7]. Photons with internal structures composed of twin particles with opposite elementary charges, create dynamic elementary dipoles with their energy equivalent inertial mass-centre propagating at light speed. This model not only provides a foundation for deriving the fine structure constant α but also integrates it with the broader properties of the dynamically polarizable superfluid free space.

This model links the fine structure constant α to the dynamic polarization of superfluid free space and the electromagnetic interactions that occur between particles and their fields. This connection reinforces the concept that superfluid free space's dynamic polarizability is essential to the behaviour of photons and their interactions. By viewing photons as entities embedded in a dynamic polarizable superfluid medium that inherently interacts with them, this model offers an explanation for the wave-particle duality that extends beyond the standard quantum model. A step further, dynamically polarizable free space filled with superfluid state of fermion-antifermion fields would be able to provide the vehicles for strong, electromagnetic, weak, and gravitational interactions, thus form a foundation for a unified field theory[8].

V. Dynamic Superfluid Free Space Polarization, Its Role in Photon Interaction and Beyond

One of the most compelling contributions is the detailed examination of superfluid free space as a dynamically polarizable medium filled with dynamic elementary dipoles[1-3,6-10]. This concept challenges the classical view of free space as an inert vacuum and proposes that dynamic superfluid free space inherently possesses electric, magnetic and mechanical polarizability. The notion of dynamic superfluid free space polarization aligns with quantum field theory, where vacuum fluctuations and transient particle appearances are accepted phenomena. The perspective on superfluid free space as a dynamically polarizable medium explains how photons can interact with their surroundings over astronomical scales. The

dynamic polarization of superfluid free space results in subtle but meaningful interactions with photons, influencing their energy dissipation and behaviour. This insight is crucial for understanding how light travels through the universe and how it might be impacted by the fluctuating properties of dynamically polarizable superfluid free space itself.

The concept of dynamic superfluid free space polarization can be extended beyond photon interactions to include gravitational effects. The weak but persistent electromagnetic properties of dynamically polarizable superfluid free space suggest that photons, as they propagate, experience slight shifts in energy and momentum due to interactions with this dynamically polarized superfluid medium. This interaction may also influence gravitational redshift and the bending of light near massive celestial bodies. By incorporating dynamic polarization into gravitational models, the behaviours of light in the presence of massive objects shall be able to be explained simply. This could lead to refinements in our understanding of light-matter interactions and the gravitational lensing effects observed in astrophysical studies.

VI. Cosmic Microwave Background Radiation as Evidence of Polarizable Superfluid Free Space Dynamics

The cosmic microwave background radiation is not the relic radiation of the Big Bang, but the evidence of an ongoing interaction between relatively moving particles and the dynamically polarizable nature of superfluid free space[1,2,6-10]. The cosmic microwave background radiation is tied to the behaviour of relatively moving particles in dynamically polarizable superfluid free space characterized by extremely weak conductivity and polarization. The energy distribution and temperature of the cosmic microwave background radiation can be explained by considering the fluctuation-dissipation theorem, which describes how systems in dynamic thermal equilibrium respond to external perturbations. This approach implies that the cosmic microwave background radiation is part of a continuous interaction where relatively moving particles dissipate or absorb energy as they propagate through the dynamically polarized superfluid free space. The classical concept of a perfect blackbody is extended to include dynamically polarized superfluid free space itself. While traditional blackbody models apply to idealized material bodies, the superfluidity in dynamically polarisable free space introduces the possibility that the universe as a whole, under specific conditions, functions as an ideal blackbody. This redefinition implies that dynamically polarizable superfluid free space can absorb and re-emit radiation seamlessly, achieving a dynamic state where energy is conserved and uniformly redistributed over a cosmic scale, which supports the blackbody spectrum that characterizes the cosmic microwave background radiation.

The consistent temperature of the cosmic microwave background radiation, at around 2.7 K, fits within the predictions about the behaviour of relatively moving particles interacting with a weakly polarized dynamic superfluid free space. This uniformity, coupled with the fluctuation-dissipation process, suggests that the cosmic microwave background radiation is part of an ongoing dynamic equilibrium maintained by the integrated grand superfluid free space's properties. This perspective offers new avenues for interpreting the cosmic microwave background radiation's minute fluctuations, potentially explaining anomalies observed in its power spectrum[11] through the lens of dynamic superfluid free space polarization and energy dissipation react to external perturbations.

VII. The Fluctuation-Dissipation and its Impact on Photon Propagation, The Interplay between Cosmic Microwave Background Radiation and Fluctuation-Dissipation

The fluctuation-dissipation theorem is a cornerstone in understanding how systems in dynamic equilibrium react to external forces[12-13]. This concept is applied to the behaviour of photons in dynamically polarizable superfluid free space, proposing that the energy dissipation experienced by photons is part of a natural interactive fluctuation-dissipation process[1,2,6-10]. This framework challenges the notion that free space is frictionless, suggesting instead that it acts as an extremely low-loss viscous superfluid medium where energy dissipation, although minimal, is measurable over a cosmic distance.

The lightly damped oscillator model supports this idea, demonstrating how the weak friction of dynamically polarizable superfluid free space contributes to photon energy loss. This energy dissipation aligns with the Hubble constant reinterpreted as a measure of dynamically polarizable superfluid free space's intrinsic relaxation frequency. By associating the energy dissipated per cycle of a photon with approximately the product of the Planck constant and the Hubble constant, a bridge between the fluctuation-dissipation process and observable cosmic phenomena is built up. It is suggested that the cosmic microwave background radiation is an ongoing signature of fluctuation-dissipation interactions in dynamically polarizable superfluid free space as a grand medium. It is proposed that as photons traverse the dynamically polarized and weakly conductive superfluid medium of free space, their energy is subtly dissipated, contributing to the uniform temperature and spectrum observed in

the cosmic microwave background radiation. This view integrates the cosmic microwave background radiation into a broader framework where dynamically polarizable superfluid free space as a grand medium itself participates actively in maintaining dynamic thermal equilibrium through weak photon interactions.

The fluctuation-dissipation theorem helps explain why the cosmic microwave background radiation exhibits such a consistent temperature across vast regions of the sky. This uniformity results from the energy exchange between relatively moving particles and the dynamically polarizable medium of superfluid free space as a grand medium, which acts as a thermal reservoir. The dynamic polarization-induced fluctuation enables superfluid free space to respond to energy inputs, maintaining a dynamic equilibrium that aligns with the observed cosmic microwave background radiation characteristics. The fluctuation-dissipation process allows the superfluid nature of free space to maintain a uniform temperature profile across cosmic scales, underpinning the stable blackbody spectrum of the cosmic microwave background radiation.

VIII. Rethinking the Hubble Constant: Mechanical and Electromagnetic Perspectives

Rather than traditionally associated with the rate of cosmic expansion, the Hubble constant represents deeper, mechanical and electromagnetic aspects of dynamically polarizable superfluid free space. Dynamically polarizable superfluid free space's minimal but non-zero conductivity and non-zero frictional force result in energy dissipation that can be quantified [1,2,6-10]. Three different methods have been developed, which can derive that the energy dissipation of a photon propagating through free space per cycle is approximately the product of the Planck constant and the Hubble constant. This interpretation aligns with a broader understanding of superfluid free space as an integrated dynamic grand medium, characterized by polarization and electromagnetic interactions.

Dynamically polarizable superfluid free space, when viewed as a grand medium, exhibits properties akin to a subtle resistive material with an extremely weak conductivity, which helps in the application of Maxwell's equations in a rigorous way to photons propagating, to derive some novel and interesting results. This framework suggests that the cosmic redshift observed in distant galaxies can be attributed to photon energy loss in a dynamically polarized, weakly interacting superfluid free space as an integrated dynamic grand medium, rather than to an expanding universe. This perspective challenges the Big Bang model's reliance on space expansion as the driver of redshift. This interpretation aligns with the concept of dynamically polarizable superfluid free space as an ideal blackbody, suggesting that the large-scale structure and energy dissipation properties of dynamically polarizable superfluid free space maintain the cosmic microwave background radiation's uniform spectrum.

IX. Mach's Principle, Elementary Super Photon Theory, Universal Coupling and Interconnectedness

Mach's Principle posits that the properties of any local system are influenced by the large-scale distribution of matter and energy across the universe[14-15]. The theory of dynamic free space polarization and superfluidity provides a new interpretation of Mach's Principle, suggesting that dynamically polarizable superfluid free space itself acts as a grand medium linking all matter and energy across cosmic distances. Elementary Super Photon Theory extends Mach's Principle by proposing that photons lose small energy fragments, called Elementary Super Photons, as they traverse free space. These fragments form a universal and coherence quantum liquid "thermal bath" that enables dynamic interaction among all particles. The Universal Gravitational Constant is thus seen as a coupling constant representing each particle's relationship with the cosmic field of Elementary Super Photons as an integrated grand medium[2]. This theory aligns with Mach's Principle, suggesting that local properties of relatively moving particles are influenced by the cosmic energy field, with dynamically polarizable superfluid free space acting as a grand medium for continuous and dynamic energy exchange. In this light, the perplexing nature of non-local hidden variables in quantum mechanics may become clearer as well.

The dynamically polarizable superfluid model of free space implies that the cosmic microwave background radiation is a Machian equilibrium state sustained by the universe's energy distribution. In this view, the cosmic microwave background radiation reflects the fluctuation of cosmic energy field on the influence of relatively moving particles, embodying Mach's Principle in maintaining dynamic equilibrium across cosmic scales. The cosmic microwave background radiation's uniformity reflects a cosmic balance upheld by the dynamically polarizable superfluid properties of free space, which acts as an ideal blackbody in re-emitting absorbed energy.

The Tully-Fisher relation illustrates Mach's Principle in the Elementary Super Photon theory, where a galaxy's rotation and mass are influenced by the cosmic energy field. The dynamically polarizable superfluid nature of free space allows galaxies to interact with the universal coherence quantum liquid photon bath, maintaining dynamic equilibrium with the universe's cosmic energy field. This interpretation realizes Mach's Principle by showing how galactic rotation and structure are dynamically linked to the entire cosmic energy field.

The Elementary Super Photon theory represents a transformative perspective on universal inter connectedness, expanding Mach's Principle by treating dynamically polarizable superfluid free space as a grand medium with ideal blackbody properties. This framework suggests that all matter and energy are linked through a cosmic energy field, enabling dynamic equilibrium across the universe. By interpreting the Hubble Constant, cosmic microwave background radiation, and gravitational effects through dynamically polarizable superfluid free space as a grand medium, the theory provides a cohesive framework that challenges conventional models of cosmic expansion, proposing instead that the properties of dynamically polarizable superfluid free space and relatively moving particles' behaviour, and dynamic energy exchanging between them maintain cosmic balance.

The cosmic microwave background radiation's blackbody spectrum is not a relic from the Big Bang but a steady-state result of dynamically polarizable superfluid free space behaving as an ideal blackbody emitter. This dynamic equilibrium within dynamically polarizable superfluid free space as a grand medium, governed by Mach's Principle, sustains a unified cosmic energy field that influences local and universal phenomena alike.

X. Critiquing Established Cosmological Models, The Elementary Super Photon Theory and Beyond

The new advancements challenge the Big Bang and Expanding Space models by proposing that cosmic redshift can be explained through energy dissipation rather than space expansion[1,2,6-10]. This interpretation finds roots in the Tired Light hypothesis, which posits that photons lose energy as they travel, leading to redshift without invoking cosmic inflation. The lightly damped oscillator model, along with the understanding of dynamic superfluid free space polarization and fluctuation-dissipation, offers a more mechanically and electromagnetically grounded explanation for this phenomenon, resolving the blurred image issue associated with the old Tired Light theory. This model also addresses limitations in traditional explanations for the Tully-Fisher relation and Modified Newtonian Dynamics. By framing gravitational interactions as emergent properties of dynamic photon energy and mass circulation, the forces observed in galaxies are reinterpreted, providing alternative insights into galactic rotation curves and gravitational behaviour.

The comprehensive nature of the theory necessitates further experimental and observational validation. Testing the mixed two-fluid photon hypothesis and the Elementary Super Photon theory could involve high-precision astronomical observations, laboratory experiments that replicate superfluid free space polarization conditions, and the direct and accurate measurement of the near zero conductivity and the extremely low viscous frictional force of dynamically polarizable superfluid free space. Theoretically, it has been demonstrated that a moving particle in vacuum experiences a resistive force akin to friction, and experimental technologies are proposed or in development to measure it through its effects[16-19]. Recently, it is reported that the vacuum friction force has been experimentally verified[20]. Observations made by advanced telescopes, such as the James Webb Space Telescope, may provide empirical support for the predictions regarding mature galaxies at extreme distances, potentially challenging the Big Bang model.

Additionally, the modified uncertainty principle invites new approaches to quantum experiments, promising breakthroughs in fields that require ultra-precise measurements. Actually, there are already a number of reported experimental evidences demonstrating the violation of Heisenberg's Uncertainty Principle[21-23]. Incorporating the concepts of dynamic superfluid free space polarization and fluctuation-dissipation could revolutionize methodologies in quantum physics, particle physics and cosmology.

XI. Theoretical and Practical Challenges

While the theories present a compelling reinterpreting of photon dynamics, the properties of dynamically polarizable superfluid free space, some physical constants and cosmic phenomena, they face challenges that must be addressed through further study and experimentation. The idea of superfluid free space as a polarizable, interactive medium and the energy dissipation implied by the Elementary Super Photon theory require rigorous empirical validation. Additionally, integrating these concepts with the broader framework of General Relativity and the Standard Model poses theoretical challenges that could redefine how these foundational theories interact.

Skeptics may point to the departure from conventional interpretations as a significant hurdle, questioning whether the integration of dynamic superfluid free space polarization and energy dissipation can withstand observational scrutiny. However, these very challenges open doors to interdisciplinary exploration that blends aspects of classical mechanics, quantum mechanics and electromagnetism.

XII. Conclusion: Toward a Unified Model of Photon Dynamics, Dynamically Polarizable Superfluid Free Space and Cosmology

The Elementary Super Photon theory represents an ambitious attempt to weave together the dynamic behaviour of photons, the properties of dynamically polarizable superfluid free space, and the observable features of the cosmos. By positioning dynamic superfluid free space as a polarizable, slightly conductive medium that actively interacts with relatively moving particles, the theory shifts our understanding of light, energy, space and cosmic phenomena. The implications for Cosmic Microwave Background Radiation, cosmic redshift, and the Hubble constant challenge conventional cosmological narratives and suggest new paths for theoretical and observational exploration. The integration of fluctuation-dissipation and dynamic superfluid free space polarization into the broader dialogue of physics encourages future research aimed at refining our grasp of the dynamics of relatively moving particles and dynamically polarizable superfluid free space itself.

By proposing that dynamically polarizable free space as a grand superfluid medium, can behave as an ideal blackbody emitter, this advancement presents a model where the universe's large-scale properties directly influence local behaviour through dynamic equilibrium and energy exchange, which aligns well with March's Principle and also non-local deterministic hidden variables in quantum mechanics. The redefinitions of the Hubble Constant, cosmic microwave background radiation and cosmic redshift, integrate cosmic phenomena into a coherent system, emphasizing dynamically polarizable superfluid free space's essential role in achieving ideal blackbody conditions that sustain observable cosmic harmony.

Whether through the validation of the Elementary Super Photon Theory, exploration of mixed two-fluid photon states, or advanced observations of the universe's deep structures, the theoretic advancements lay the groundwork for a richer, more connected understanding of our universe's fundamental nature.

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Author Declarations

Conflict of Interest

The authors have no conflicts to disclose.

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A Unified Approach for Determining Optical and Quantum Multilayer Thin Film Reflectance and Transmittance

By Richard P. Bocker

San Diego State University

Abstract- In this paper we present a unified approach for determining the reflectance and transmittance properties of single-layer and multilayer optical and quantum thin-film structures using a unified set of equations based on the similarity of classical Maxwell and newly formulated relativistic Dirac vector field equations. A review of these field equations and the corresponding wave equations is presented. Electromagnetic plane-wave and quantum mechanical matter-wave solutions that satisfy these equations and their properties are reviewed. Single-layer optical and quantum thin film analyses lead to a unified set of analytical equations that predict their reflectance and transmittance characteristics. A unified theory conversion table describes how to convert classical electrodynamic quantities into relativistic quantum mechanical quantities to use a set of unified equations. The unified approach was extended to multilayer optical and quantum mechanical thin-film structures. Numerical results are presented for single-layer and multilayer optical and quantum thin film architectures. MATLAB software was employed for computations and graphics.

Keywords: thin film optical filters, quantum wells-and-barriers, quantum tunneling, classical electrodynamics, relativistic quantum mechanics, maxwell field equations, relativistic dirac field equations, nanotechnology, theoretical physics, electromagnetic waves, matter waves, special theory of relativity.

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I. Introduction

This study presents a unified approach for predicting the reflectance R and transmittance T properties of multilayer optical thin films and multilayer quantum well-and-barrier structures using the same unified set of equations. Replacing certain classical electrodynamic quantities in these equations with certain relativistic quantum-mechanical quantities is required in this unified approach. See Table (1). The underlying key equations necessary for deriving these unified sets of equations are the Maxwell vector field [1] and newly developed relativistic Dirac vector field equations [2] and [3].

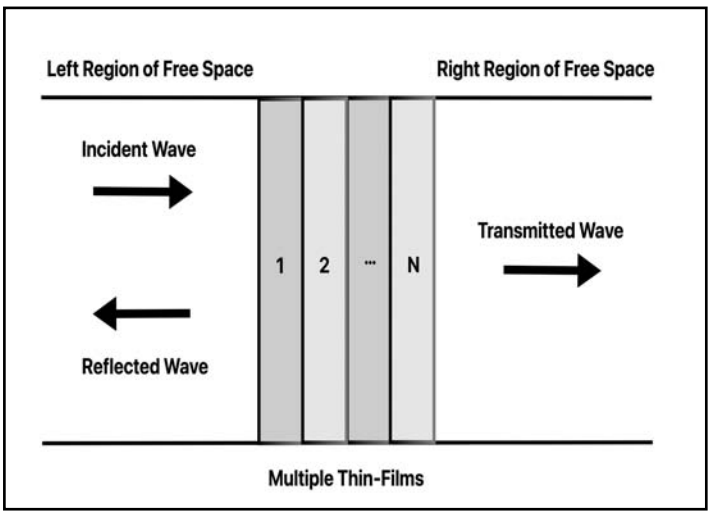

Figure 1: Multilayer Thin Film Structure Consisting of N Thin Films

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Figure 1 depicts an incident wave impinging on a multilayer thin-film structure at normal incidence. This gives rise to both a reflected wave and a transmitted wave. For the optical thin-film case, a photon and its associated electromagnetic wave serve the purpose. For the quantum thin-film case, an electron and its associated matter wave are the particle and wave of interest. R and T represent the probabilities a particle will be either reflected or transmitted. Assuming no absorption takes place within the thin film, then $R + T = 1$.

The emphasis of this study was on the analysis of a single thin film with parallel planar boundaries. The results for this case can then be easily generalized to handle multilayer thin-film structures consisting of N thin films. For a single optical thin film, the permittivity ϵ, permeability μ and thickness w are important properties of interest. For a single quantum thin film, the thickness w and potential energy U of electrons moving within the thin film are important quantities of interest.

Several figures depicting thin-film structures are included in this study: Multilayer Thin Film Structure Consisting of N Thin Films (1), Single Optical Thin Film (2), Single Quantum Thin Film (3), and Multilayer Thin Film Structure (6).

Reflectance and transmittance results are presented for a number of optical and quantum-mechanical single and multilayer thin-film structures. These include a 1-Layer Dielectric Thin Film Structure (4), 1-Layer Thin Film Quantum Barrier (5), 11-Layer High-Reflectance Mirror Structure (7), 15-Layer Long-Wave Band-Pass Optical Filter (8), 15-Layer Short-Wave Band-Pass Optical Filter (9), 15-Layer Narrow Band-Pass Optical Filter (10), 11-Layer Periodic Quantum Well-and-Barrier Structure (11), 3-Layer Well-and-Barrier Structure (12), 21-Layer Quantum Harmonic Oscillator Structure (13), and 3-Layer Nuclear Potential Well-and-Barrier Structure (14).

II. Review of the Vector Field Equations

a) Maxwell Vector Field Equations

In our investigation of an electromagnetic wave propagating through a single dielectric optical thin film, we assumed that the dielectric was Class A. Class A dielectrics are linear, homogeneous, and isotropic dielectrics. The dielectric is characterized by a scalar permittivity ϵ and a scalar permeability μ. The Maxwell vector field equations in Gaussian units [1] for a dielectric material are given by

$$\nabla \bullet \mathbf{E} = 0 \tag{1}$$

$$\nabla \bullet \mathbf{H} = 0 \tag{2}$$

$$\nabla \times \mathbf{E} + \frac{\mu}{c}\frac{\partial}{\partial t}\mathbf{H} = 0 \tag{3}$$

$$\nabla \times \mathbf{H} - \frac{\epsilon}{c}\frac{\partial}{\partial t}\mathbf{E} = 0 \ . \tag{4}$$

$\mathbf{E} = (E_1\ E_2\ E_3)$ represents the electric field vector and $\mathbf{H} = (H_1\ H_2\ H_3)$ is the magnetic field vector. The symbol c represents the speed of light in free space.

b) Dirac Vector Field Equations

In our investigation of a quantum mechanical matter wave propagating through a single quantum thin film, relativistic Dirac vector field equations played an important role. In the Gaussian units references [2] and [3], these equations are given by

$$\nabla \bullet \mathbf{U} = 0 \tag{5}$$

$$\nabla \bullet \mathbf{L} = 0 \tag{6}$$

$$\nabla \times \mathbf{U} + \frac{1}{c}\frac{\partial}{\partial t}\mathbf{L} + i\kappa\mathbf{L} = 0 \tag{7}$$

$$\nabla \times \mathbf{L} - \frac{1}{c}\frac{\partial}{\partial t}\mathbf{U} + i\kappa\mathbf{U} = 0 \ . \tag{8}$$

$\mathbf{U} = (U_1\ U_2\ U_3)$ is defined as the upper field vector and $\mathbf{L} = (L_1\ L_2\ L_3)$ is defined as the lower field vector. The imaginary quantity i represents the square root of minus one. The constant κ is defined as follows:

$$\kappa \equiv \frac{m_o c}{\hbar} = \frac{m_o c^2}{\hbar c} = \frac{E_o}{\hbar c} \ . \tag{9}$$

Here m_o represents the rest mass of the matter wave particle, E_o its rest mass energy and $\hbar$ is the reduced Planck's constant equal to Planck's constant h divided by 2π. Note the similarity between the Maxwell and Dirac vector field equations.

III. Review of the Wave Equations

a) Electromagnetic Wave Equations

From the Maxwell vector field equations, the following pair of electromagnetic wave equations for electric field **E** and magnetic field **H** can be easily obtained:

$$\nabla^2 \mathbf{E} - \frac{1}{v^2} \frac{\partial^2}{\partial t^2} \mathbf{E} = 0 \tag{10}$$

$$\nabla^2 \mathbf{H} - \frac{1}{v^2} \frac{\partial^2}{\partial t^2} \mathbf{H} = 0 \ . \tag{11}$$

The quantity $v = c/n$ represents the wave propagation speed through a dielectric medium. The refractive index n of the dielectric material is defined as follows:

$$n \equiv \sqrt{\mu\epsilon} \ . \tag{12}$$

b) Quantum Mechanical Wave Equations

Similarly, from the Dirac vector field equations, the following pair of quantum mechanical wave equations for the upper field **U** and lower field **L** can be obtained.

$$\nabla^2 \mathbf{U} - \frac{1}{c^2} \frac{\partial^2}{\partial t^2} \mathbf{U} = \kappa^2 \mathbf{U} \tag{13}$$

$$\nabla^2 \mathbf{L} - \frac{1}{c^2} \frac{\partial^2}{\partial t^2} \mathbf{L} = \kappa^2 \mathbf{L} \ . \tag{14}$$

These two quantum mechanical vector wave equations have the same form as the quantum mechanical Klein-Gordon equation.

IV. Review of the Plane Wave Solutions

a) Electromagnetic Plane Wave Solutions

To determine the reflection and transmission characteristics of a single optical thin film as a function of the wavelength λ of the incident electromagnetic wave, monochromatic plane-wave solutions [1] satisfying the Maxwell vector field equations and corresponding wave equations were employed:

$$\mathbf{E} = \mathbf{E_o} \exp\{i(\mathbf{k} \bullet \mathbf{r} - \omega t)\} \qquad \mathbf{H} = \mathbf{H_o} \exp\{i(\mathbf{k} \bullet \mathbf{r} - \omega t)\} \ . \tag{15}$$

The quantities $\mathbf{E}_o$ and $\mathbf{H}_o$ represent the maximum amplitude electric and magnetic field vectors, respectively; $\mathbf{k}$ and ω are the wave vector and angular frequency of the electromagnetic wave, respectively; $\mathbf{r}$ and t represent the position vector and instantaneous time, respectively. The magnitude of the wave vector $\mathbf{k}$ is known as the wavenumber k. Substituting equations (15) back into the Maxwell vector field equations and corresponding wave equations yields the following set of equations:

$$\mathbf{k} \bullet \mathbf{E_o} = 0 \qquad \mathbf{k} \bullet \mathbf{H_o} = 0 \tag{16}$$

$$\mathbf{k} \times \mathbf{E_o} = +\frac{\mu}{c}\, \omega\, \mathbf{H_o} \qquad \mathbf{k} \times \mathbf{H_o} = -\frac{\epsilon}{c}\, \omega\, \mathbf{E_o} \tag{17}$$

and

$$k^2 = \omega^2 / c^2 \ . \tag{18}$$

b) Quantum Mechanical Plane Wave Solutions

Similarly, plane-wave solutions satisfying the Dirac vector field equations and the corresponding wave equations were employed to determine the reflection and transmission properties of a single quantum thin film as a function of the kinetic energy K of the incident matter wave particle. That is

$$\mathbf{U} = \mathbf{U_o} \exp\{i(\mathbf{p} \bullet \mathbf{r} - Et)/\hbar\} \qquad \mathbf{L} = \mathbf{L_o} \exp\{i(\mathbf{p} \bullet \mathbf{r} - Et)/\hbar\} \ . \tag{19}$$

The quantities $\mathbf{U}_o$ and $\mathbf{L}_o$ represent the maximum amplitudes of the upper and lower field vectors, respectively, and $\mathbf{p}$ and E correspond to the linear momentum and total energy of the matter-wave particle, respectively. Substituting Equation (19) back into the Dirac vector field equations and corresponding wave equations yields the following set of equations:

$$\mathbf{p}c \bullet \mathbf{U_o} = 0 \qquad \mathbf{p}c \bullet \mathbf{L_o} = 0 \tag{20}$$

$$\mathbf{p}c \times \mathbf{U_o} = +E_o(\gamma - 1)\ \mathbf{L_o} \qquad \mathbf{p}c \times\ \mathbf{L_o} = -E_o(\gamma + 1)\ \mathbf{U_o} \tag{21}$$

and

$$E^2 = E_o^2 + p^2c^2\ . \tag{22}$$

V. Review of the Plane Wave Properties

a) Electromagnetic Plane Wave Properties

From equations (16) and (17), we find that the vectors $\mathbf{E_o}$, $\mathbf{H_o}$, and $\mathbf{k}$ are mutually perpendicular. That is

$$\mathbf{k} \perp \mathbf{E_o} \qquad \mathbf{E_o} \perp \mathbf{H_o} \qquad \mathbf{k} \perp \mathbf{H_o}$$

This electromagnetic wave is transverse. We also obtained important results for wave amplitudes.

$$\sqrt{\mu}\ H_o = \sqrt{\epsilon}\ E_o \tag{23}$$

or equivalently

$$H_o = Y E_o \qquad\qquad E_o = Z H_o \tag{24}$$

where the quantities Y and Z are the admittance and impedance of the dielectric material, respectively, defined by

$$Y \equiv \sqrt{\epsilon/\mu} \qquad\qquad Z \equiv \sqrt{\mu/\epsilon}\ . \tag{25}$$

b) Quantum Mechanical Plane Wave Properties

From equations (20) and (21), we find that vectors $\mathbf{U}_o$, $\mathbf{L}_o$, and $\mathbf{p}$c are mutually perpendicular. That is

$$\mathbf{p}c \perp \mathbf{U_o} \qquad \mathbf{U_o} \perp \mathbf{L_o} \qquad \mathbf{p}c \perp \mathbf{L_o}$$

This quantum-mechanical matter wave is transverse in nature. We also obtained important results for the wave amplitudes.

$$\sqrt{\gamma+1}\,U_o = \sqrt{\gamma-1}\,L_o\ . \tag{26}$$

From the special theory of relativity [4], the quantity γ in equations (21) and (26) is known as the Lorentz factor. It is related to the speed v of a relativistic moving particle by the following equation:

$$\gamma = \frac{1}{\sqrt{(1-\beta^2)}} \qquad \text{where} \qquad \beta = v/c\ . \tag{27}$$

β is known as the speed parameter.

VI. Thin Film Structures

a) Single Optical Thin Film

Figure (2) depicts a single optical thin film surrounded by free space with parallel planar surfaces. The thin film has thickness w and is composed of a Class A dielectric material with permittivity ϵ and permeability μ. Other quantities useful for characterizing thin films are the index of refraction n, admittance Y and impedance Z, where

$$n = \sqrt{\mu\epsilon} \qquad Y = \sqrt{\epsilon/\mu} \qquad Z = \sqrt{\mu/\epsilon}\ . \tag{28}$$

Notably, the permittivity and permeability of free space are both equal to unity when the Gaussian units are used.

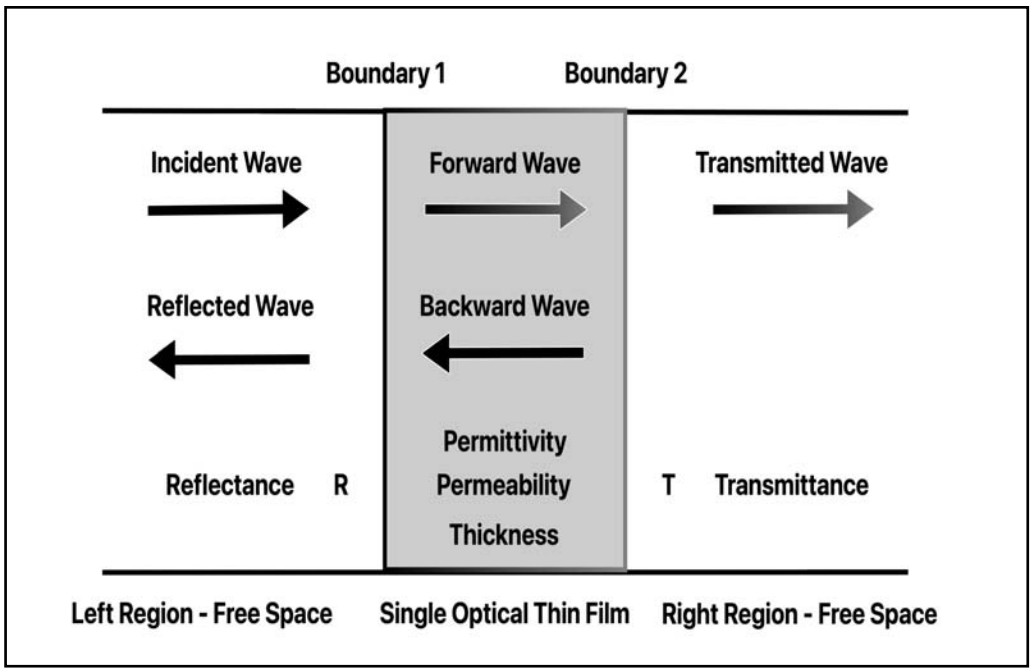

Figure 2: Single Optical Thin Film

An incident electromagnetic wave, with wavelength λ, strikes the optical thin film at normal incidence, giving rise to both reflected and transmitted waves. Our primary goal is to determine mathematical formulae for predicting the reflectance R and transmittance T of the optical thin film as a function of the wavelength λ and quantities w, n, Y and Z. The fundamental equations used in the mathematical analysis are the Maxwell vector field equations.

b) Single Quantum Thin Film

Figure (3) depicts a single quantum thin film surrounded by free space with parallel planar surfaces. The only two quantities of interest in describing a quantum thin film are its thickness w and the electrical potential V externally applied to the thin film. The potential energy U, of an electron in the presence of an electrical potential V, is given by $U = eV$, where e is the elementary charge.

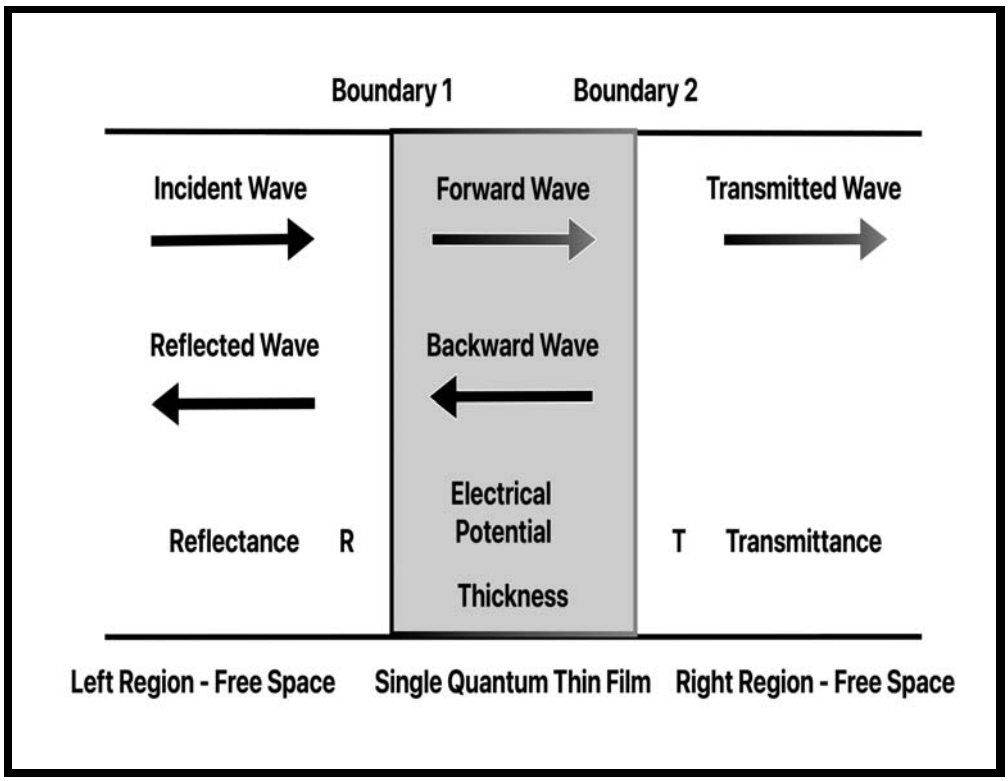

Figure 3: Single Quantum Thin Film

An incident quantum mechanical matter wave particle, having kinetic energy K, strikes the quantum thin film at normal incidence giving rise to both a reflected and a transmitted matter wave. Our primary goal is to determine mathematical formulae for predicting the reflectance R and transmittance T of the quantum thin film as a function of the kinetic energy K and its potential energy U. The fundamental equations to be used in the mathematical analysis are the relativistic Dirac vector field equations.

VII. Mathematical Analysis

a) Optical Thin Film Analysis

i. *Electromagnetic Waves*

As shown in Figure (2), five electromagnetic waves were considered. In the left region, we have the incident (E_i, H_i) and reflected (E_r, H_r) waves. Within the optical thin film, we have forward (E_f, H_f) waves and backward (E_b, H_b) waves. In the right region, we only have the transmitted (E_t, H_t) wave. Equation (23) allows us to express the following relationship between the electromagnetic wave electric and magnetic wave amplitudes:

Left Region: Incident and Reflected Waves

$$\sqrt{\epsilon_L}\, E_i = \sqrt{\mu_L}\, H_i \qquad \sqrt{\epsilon_L}\, E_r = \sqrt{\mu_L}\, H_r \tag{29}$$

Optical Thin Film: Forward and Backward Propagating Waves

$$\sqrt{\epsilon_F}\, E_f = \sqrt{\mu_F}\, H_f \qquad \sqrt{\epsilon_F}\, E_b = \sqrt{\mu_F}\, H_b \tag{30}$$

Right Region: Transmitted Wave

$$\sqrt{\epsilon_R}\, E_t = \sqrt{\mu_R}\, H_t \tag{31}$$

The subscripts L, R and F refer to the left, right and optical thin film, respectively.

ii. *Optical Thin Film Boundary Conditions*

Recall that the incident electromagnetic wave impinges on the thin film at a normal incidence. The electric and magnetic vectors are perpendicular (transverse waves) to the direction of wave propagation. At each of the two planar boundaries separating the various regions, the tangential components of the electric and magnetic field vectors are continuous across the boundary [1]. Mathematically, this implies that:

Boundary 1 on the Left

$$E_i + E_r = E_f + E_b \tag{32}$$

$$H_i - H_r = H_f - H_b \tag{33}$$

Boundary 2 on the Right

$$E_f \exp\{+i\phi\} + E_b \exp\{-i\phi\} = E_t \tag{34}$$

$$H_f \exp\{+i\phi\} - H_b \exp\{-i\phi\} = H_t \tag{35}$$

The phase angle ϕ, associated with the optical thin film [5] depends on three quantities: the index of refraction $n = \sqrt{\mu\epsilon}$ of the thin film, the thickness w of the thin film and the wavelength λ of the incident electromagnetic wave. The mathematical expression for ϕ is given by

$$\phi = knw \qquad \text{where} \qquad k = 2\pi/\lambda \ . \tag{36}$$

Using equations (29), (30), and (31), we can express the magnitude of the magnetic field amplitudes in terms of the electric field amplitudes. That is

Boundary 1 on the Left

$$E_i + E_r = E_f + E_b \tag{37}$$

$$Y_L E_i - Y_L E_r = Y_F E_f - Y_F E_b \tag{38}$$

Boundary 2 on the Right

$$E_f \exp\{+i\phi\} + E_b \exp\{-i\phi\} = E_t \tag{39}$$

$$Y_F E_f \exp\{+i\phi\} - Y_F E_b \exp\{-i\phi\} = Y_R E_t \tag{40}$$

From these four equations, with little algebra, we can eliminate the E_f and E_b fields, leaving two equations that involve the three fields E_r, E_t and E_i. The following ratios can be determined from the remaining two equations.

$$r = E_r/E_i \qquad \text{and} \qquad t = E_t/E_i \ . \tag{41}$$

The quantities r and t represent the reflectivity and transmissivity of the optical thin films, respectively.

iii. *Optical Thin Film Reflectivity and Transmissivity*

The final mathematical formulae for the reflectivity r and transmissivity t of a single optical thin film are given by:

$$r = \frac{Y_F(Y_L - Y_R)\cos\phi + (Y_F^2 - Y_L Y_R)\ i\sin\phi}{Y_F(Y_L + Y_R)\cos\phi - (Y_F^2 + Y_L Y_R)\ i\sin\phi} \tag{42}$$

$$t = \frac{2Y_F Y_L}{Y_F(Y_L + Y_R)\cos\phi - (Y_F^2 + Y_L Y_R)\ i\sin\phi}\ . \tag{43}$$

To compute the reflectance R and transmittance T of the optical thin films, the following equations were used.

$$R = r^* r \qquad \text{and} \qquad T = t^* t\ . \tag{44}$$

The superscript symbol (*) implies the complex conjugate operation.

b) Quantum Thin Film Analysis

Recall that the traditional Maxwell vector field equations (1) through (4) are similar in structure to the newly formulated relativistic Dirac vector field equations (5) through (8). Using the same mathematical analysis procedure for the single-quantum thin-film case leads to equations (42), (43), and (44) to describe the reflection and transmission characteristics of the single-quantum thin film.

Several physical quantities for the optical thin-film case must be replaced by certain physical quantities for the quantum thin-film case. A conversion table summarizing the details of changing certain classical electrodynamic quantities to relativistic quantum-mechanical quantities, is presented in Table 1.

Table 1: Unified Approach Conversion Table

Dielectric Material Properties	**Classical Electromagnetic Theory**		**Relativistic Quantum Theory**
Electric Field	$\mathbf{E}$	$\Longrightarrow$	$\mathbf{U}$
Magnetic Field	$\mathbf{H}$	$\Longrightarrow$	$\mathbf{L}$
Permittivity	$1 \leqslant \epsilon$	$\Longrightarrow$	$(\gamma + 1)$
Permeability	$1 \leqslant \mu$	$\Longrightarrow$	$(\gamma - 1)$
Refractive Index	$n = \sqrt{\mu\epsilon}$	$\Longrightarrow$	$\sqrt{\gamma^2 - 1}$
Admittance	$Y = \sqrt{\epsilon/\mu}$	$\Longrightarrow$	$\sqrt{(\gamma + 1)/(\gamma - 1)}$
Impedance	$Z = \sqrt{\mu/\epsilon}$	$\Longrightarrow$	$\sqrt{(\gamma - 1)/(\gamma + 1)}$
Thickness	$0 < w$	$\Longrightarrow$	$0 < w$
Wavenumber	$k = 2\pi/\lambda$	$\Longrightarrow$	$k = E_o/\hbar c$
Phase Factor	$\phi = knw$	$\Longrightarrow$	$\phi = knw$

Notice the wavenumber k, in the relativistic quantum theory column, is the same constant κ defined in equation (9) and appearing in the Dirac vector field equations (7) and (8). Two examples of reflectance and transmittance graphs for a single optical thin film and a single quantum barrier thin film are presented in Figures (4) and (5), respectively.

Single Dielectric Optical Thin Film Example

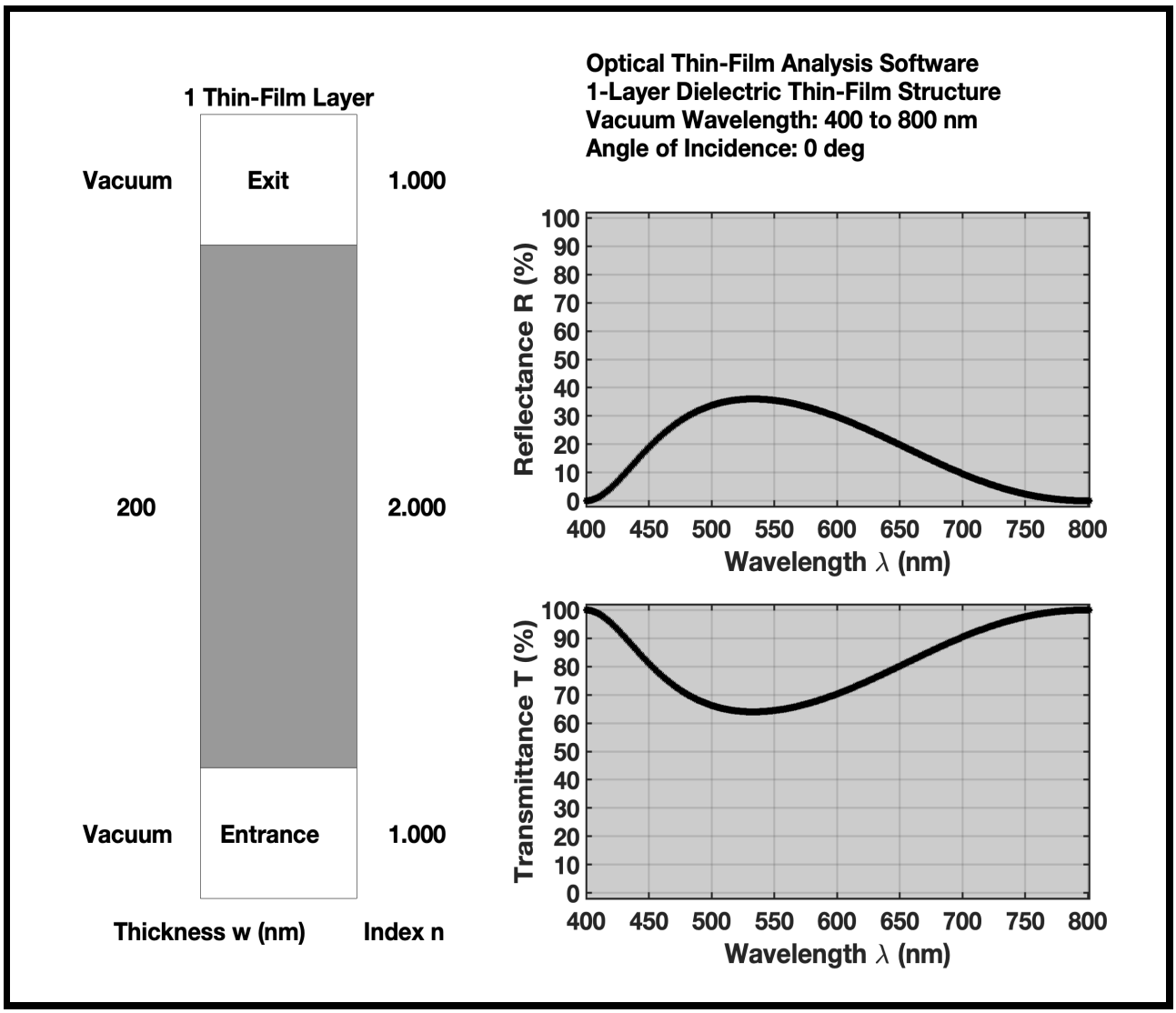

Figure 4: 1-Layer Dielectric Thin Film Structure

Referring to Figure (2), the left and right free space (vacuum) region's permittivity $\epsilon_L = \epsilon_R = 1$ and permeability $\mu_L = \mu_R = 1$. According to Table 1, the refractive index $n_L = n_R = 1$, the admittance $Y_L = Y_R = 1$ and the impedance $Z_L = Z_R = 1$ for both of these free space regions as well. The optical thin film has a permittivity $\epsilon_F = 4$ and a permeability $\mu_F = 1$. This implies the refractive index $n_F = 2$, the admittance $Y_F = 2$ and the impedance $Z_F = 1/2$. The optical thin-film thickness $w = 200$ nm. The wavelength λ of the incident electromagnetic wave was varied between 400 nm to 800 nm. Equations (42), (43) and (44) were used to evaluate the reflectance R and transmittance T as a function of the wavelength λ using MATLAB computer software, reference [6]. The left hand side of Figure (4) depicts the optical thin-film structure.

Single Thin Film Quantum Barrier Example

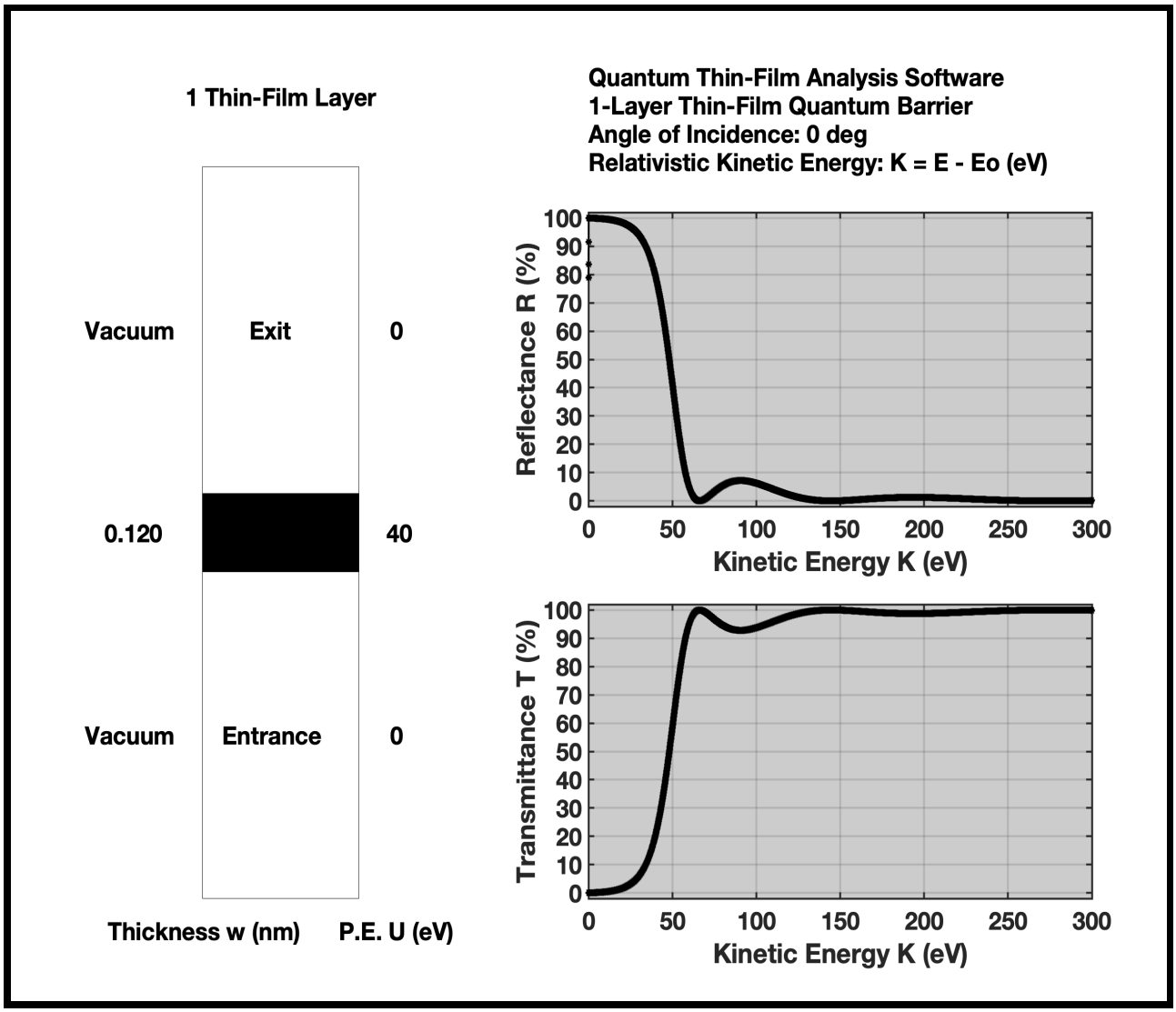

Figure 5: 1-Layer Thin Film Quantum Barrier

Referring to Figure (3), an electron, whose kinetic energy K_L varies between 0 eV and 300 eV, impinges upon a single quantum barrier at normal incidence. The left and right free space region's potential energy $U_L = U_R = 0$. The potential energy of the quantum barrier $U_F = 40$ eV and its thickness $w = 0.120$ nm. With the help of Table 1 and equations (42) through (43), the reflectance R and transmittance T plots are shown in Figure(5). The Lorentz factor for each region is determined using the equation $\gamma_x = (E - U_x)/E_o$ where the total energy of the electron is given by $E = E_o + K_x + U_x$. Here $x = L, R$ or F for the left, right or quantum thin-film regions. Once the Lorentz factors are determined, then the various quantities listed in the relativistic quantum theory column of Table 1, may be computed. The results presented in Figure(5) are in agreement with those presented in reference [7].

VIII. Multilayer Thin Film Structures

a) Multilayer Thin Film Diagram

Figure (6) depicts a multilayer thin-film structure consisting of N thin films with parallel planar boundaries. An incident electromagnetic wave or a quantum mechanical matter wave strikes a multilayer thin-film structure at normal incidence, resulting in reflected and transmitted waves. Equations for predicting the reflectance R and transmittance T of the multilayer thin-film structure are presented.

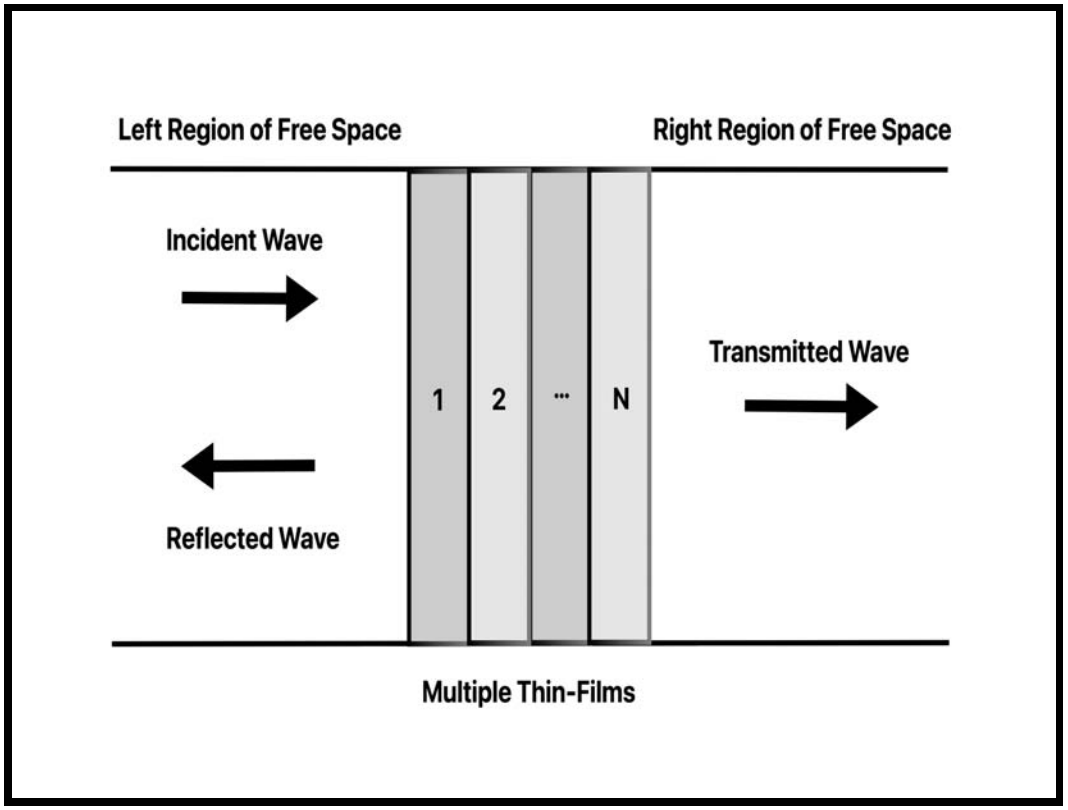

Figure 6: Multilayer Thin Film Structure

b) Matrix Representation

The key matrix equation for this section is given by

$$\mathbf{Y_R}\,|\mathbf{\Psi_R}\rangle = \mathbf{M}\;\mathbf{Y_L}\,|\mathbf{\Psi_L}\rangle \tag{45}$$

or equivalently

$$|\mathbf{\Psi_R}\rangle = \frac{1}{2}\,\mathbf{Z_R}\;\mathbf{M}\;\mathbf{Y_L}\,|\mathbf{\Psi_L}\rangle\,. \tag{46}$$

The 2-by-2 matrix $\mathbf{M}$ contains all information about the thin-film structure, where

$$\mathbf{M} = \mathbf{M_N} \cdots \mathbf{M_3 M_2 M_1} \ . \tag{47}$$

Each 2-by-2 matrix $\mathbf{M_n}$, for $n = 1, 2, 3...N$, is defined by

$$\mathbf{M_n} \equiv \begin{bmatrix} \cos\phi_n & Z_n \ i\sin\phi_n \\ Y_n \ i\sin\phi_n & \cos\phi_n \end{bmatrix} \ . \tag{48}$$

This equation indicates properties of the nth thin film must be known, namely ϕ_n Y_n and Z_n, the phase angle, admittance, and impedance of the nth thin film, respectively. From Table 1, the admittance Y_n and the impedance Z_n are related by $Z_n = 1/Y_n$.

The electric-field magnitudes E_i, E_r and E_t for the incident, reflected, and transmitted waves, respectively, are the elements of the wave vectors

$$|\mathbf{\Psi_R}\rangle \equiv \begin{bmatrix} E_t \\ 0 \end{bmatrix} \qquad \text{and} \qquad |\mathbf{\Psi_L}\rangle \equiv \begin{bmatrix} E_i \\ E_r \end{bmatrix} \ . \tag{49}$$

The remaining three matrices $\mathbf{Y_R}$, $\mathbf{Z_R}$ and $\mathbf{Y_L}$ are defined by

$$\mathbf{Y_R} \equiv \begin{bmatrix} +1 & +1 \\ +Y_R & -Y_R \end{bmatrix} \qquad \mathbf{Z_R} \equiv \begin{bmatrix} +1 & +Z_R \\ +1 & -Z_R \end{bmatrix} \qquad \mathbf{Y_L} \equiv \begin{bmatrix} +1 & +1 \\ +Y_L & -Y_L \end{bmatrix} \ . \tag{50}$$

Once the matrices $\mathbf{Y_R}$, $\mathbf{Z_R}$, $\mathbf{Y_L}$ and $\mathbf{M_n}$ for all n values have been determined, as listed in Table 1, the reflectivity r and transmissivity t can be determined. Finally, the reflectance R and transmittance T are given by

$$R = r^* r \qquad \text{and} \qquad T = t^* t \ . \tag{51}$$

In the following two sections, reflectance R and transmittance T graphs, based on numerical computer computations, are presented for a number of different optical thin-film structures as well as quantum thin-film structures. MATLAB computer software was employed for both computations and graphics.

IX. Optical Thin Film Graphical Results

The reflectance and transmittance characteristics of four different multilayer optical thin-film structures are presented in this section based on the formalism of Maxwell vector field equations. Each thin film in the multilayer structure is characterized by having a constant index of refraction n and thickness w. For these four examples, the permeability constant $\mu = 1$ and the permittivity constant $\epsilon = n^2$.

a) 11-Layer High-Reflectance Mirror Structure

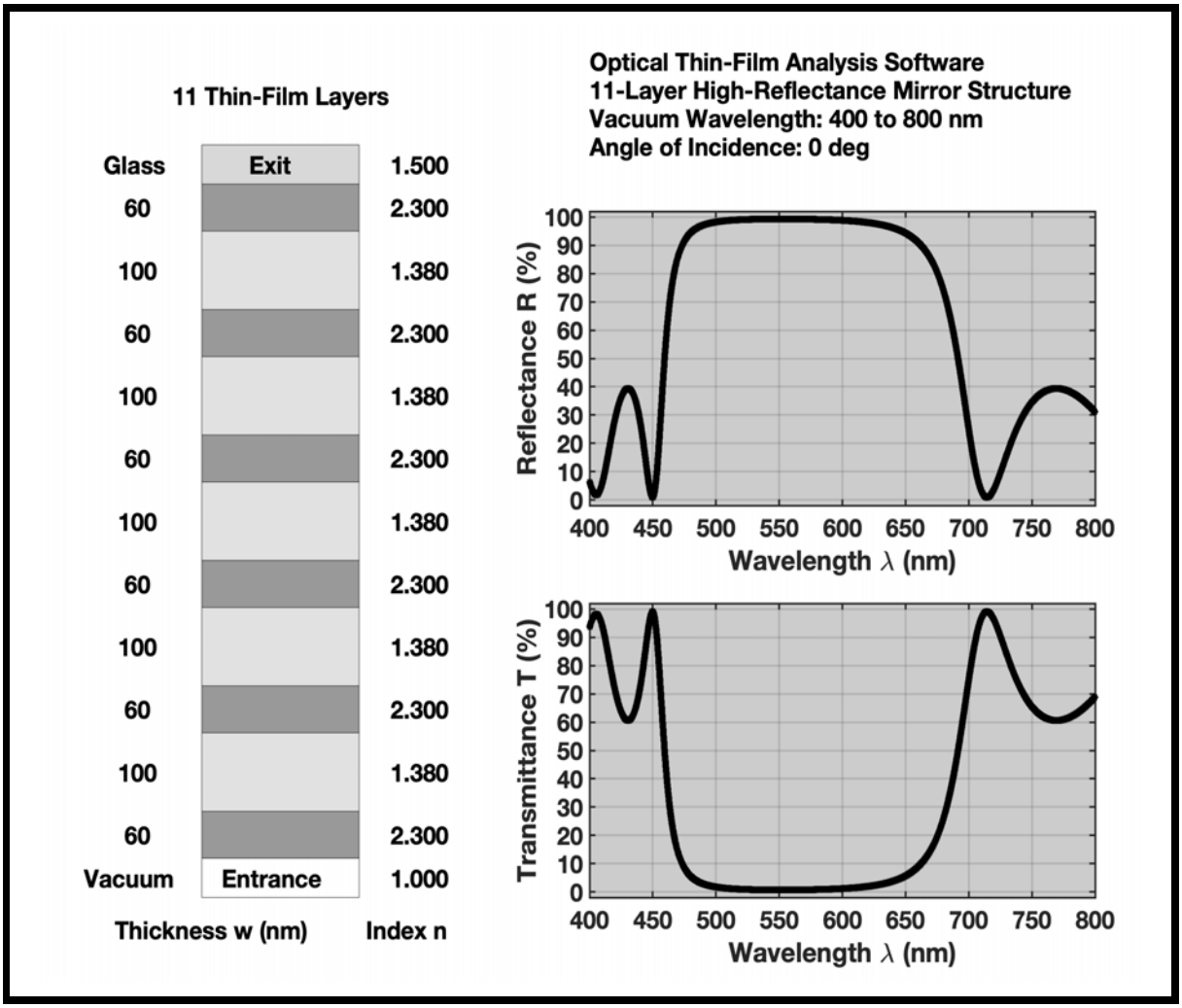

Figure 7: 11-Layer High-Reflectance Mirror Structure

The results shown in Figure (7), correspond to light whose wavelength varies between 400 nm and 800 nm, incident upon an 11-layer high-reflectance mirror structure. The left portion of this figure depicts the multilayer structure physical properties. The results are in excellent agreement with those published in reference [5].

b) 15-Layer Long-Wave Band-Pass Optical Filter

Reference [5] provides an excellent discussion of band-pass optical filters. The next two examples represent long- and short-wave band-pass optical filters, respectively.

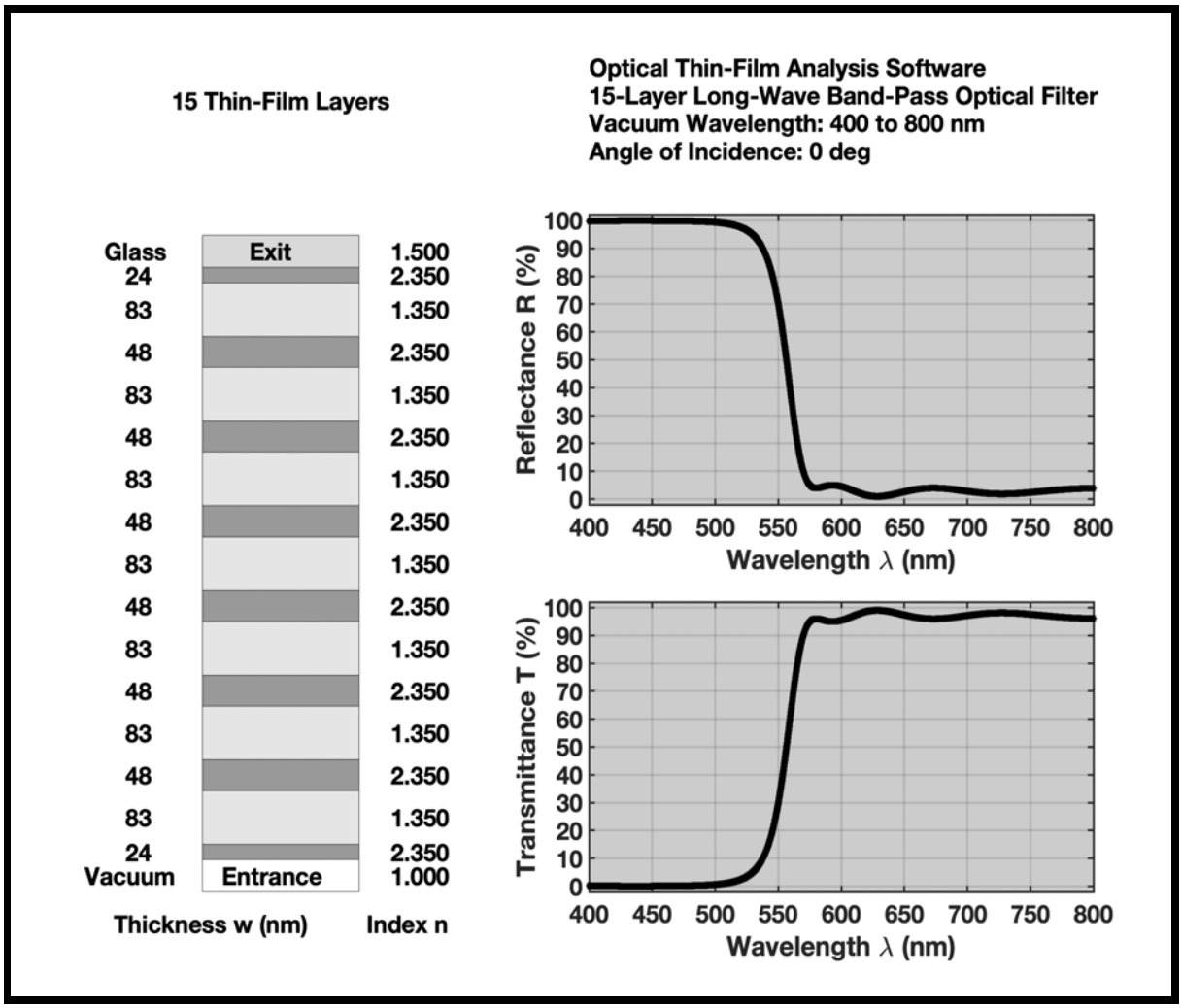

Figure 8: 15-Layer Long-Wave Band-Pass Optical Filter

This example is that of a 15-layer long-wave band-pass optical filter as shown in Figure (8). The wavelength of the incident light was varied between 400 nm and 800 nm. Again, the results are in excellent agreement with those presented in [5].

c) 15-Layer Short-Wave Band-Pass Optical Filter

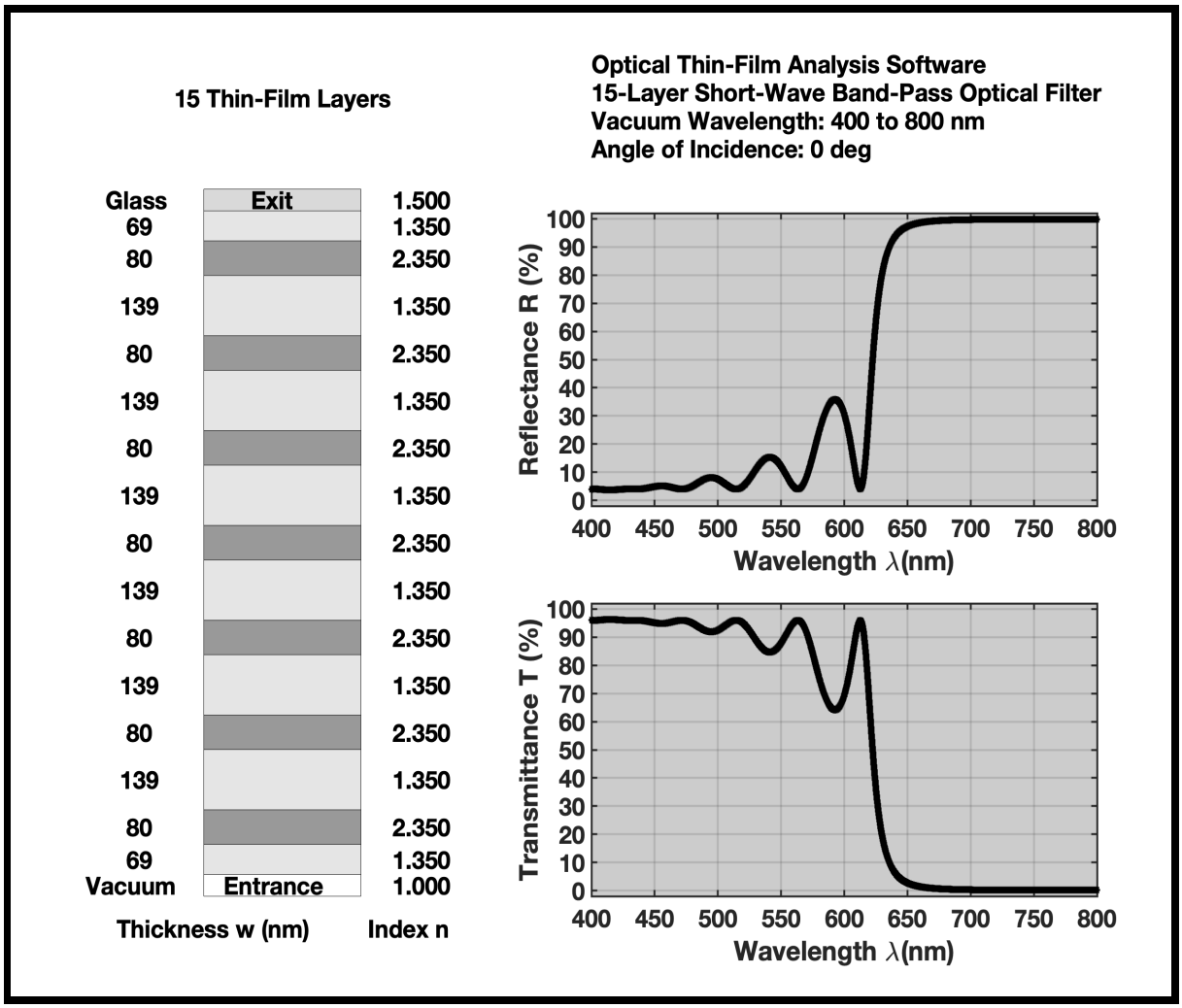

Figure 9: 15-Layer Short-Wave Band-Pass Optical Filter

In Figure (9) is shown a 15-layer short-wave band pass optical filter. The wavelength of the incident light was varied between 400 nm and 800 nm. The results are in excellent agreement with those presented in [5].

d) 15-Layer Narrow Band-Pass Optical Filter

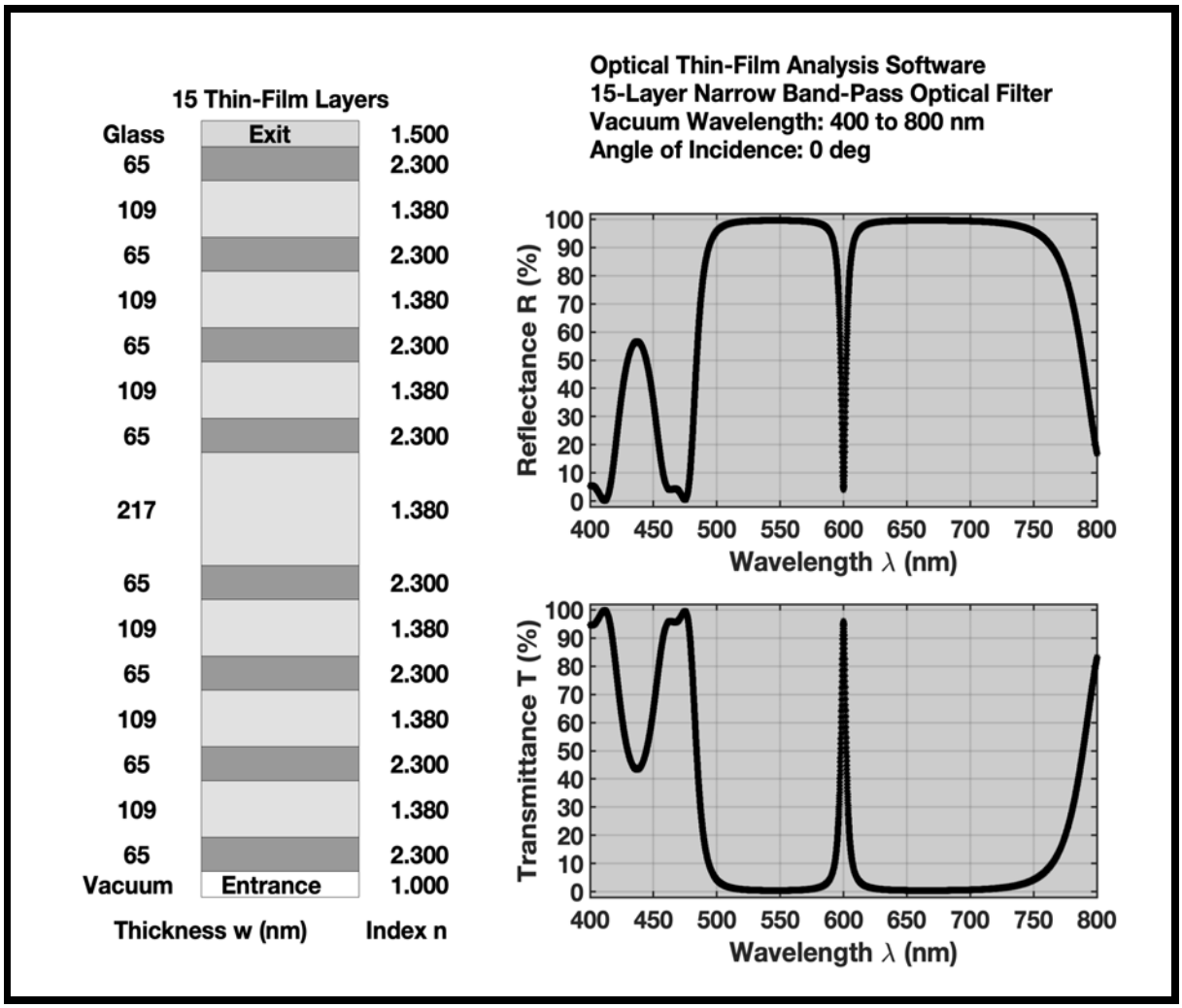

Figure 10: 15-Layer Narrow Band-Pass Optical Filter

This example is that of a 15-layer narrow band-pass optical filter centered at approximately 600 nm. The wavelength of the incident light was varied between 400 nm and 800 nm. The results shown in Figure (10) are in excellent agreement with those presented in reference [5].

X. Quantum Thin Film Graphical Results

The reflectance and transmittance characteristics of four different multilayer quantum wells and barrier structures are presented in this section, based on the relativistic Dirac vector field equation formalism. Each thin film in the multilayer structure was characterized by the potential energy U and thickness w.

a) 11-Layer Periodic Well-and-Barrier Structure

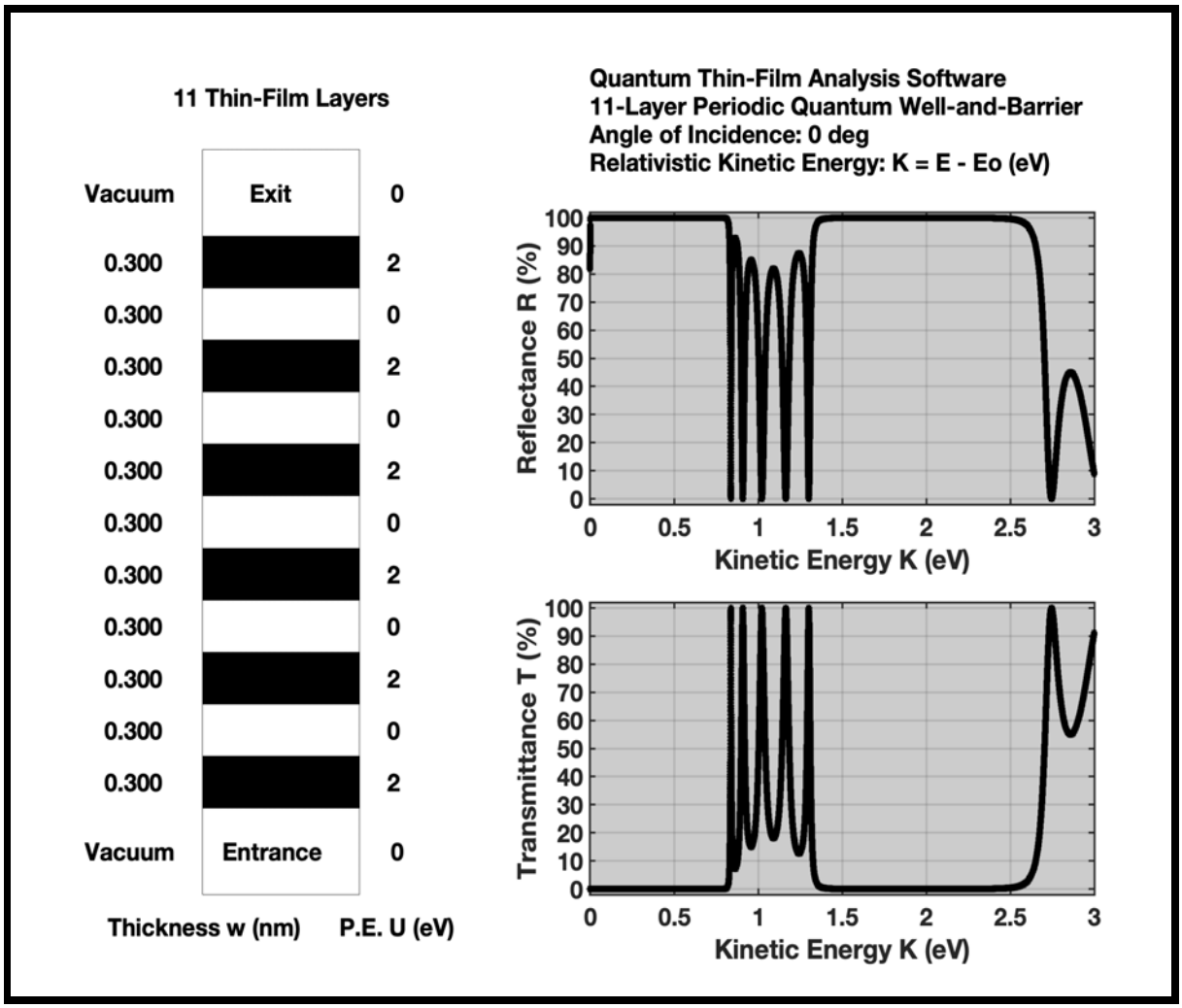

Figure 11: 11-Layer Periodic Quantum Well-and-Barrier Structure

In this example we consider a non-relativistic electron whose kinetic energy K was varied between 0 eV and 3 eV impinging upon an 11-layer periodic quantum well-and-barrier structure. Each thin film in the structure has a thickness of 0.300 nm. The electron has a rest-mass energy equal to 0.511 MeV. The results of our numerical computations are presented in the Figure (11). These results are in excellent agreement with results published in the literature [8] based on non-relativistic quantum theory.

b) 3-Layer Quantum Well-and-Barrier Structure

In this example, the energy levels of a rectangular potential well are determined by casting the problem into one involving a potential well surrounded by two identical quantum barriers. Electron tunneling through the 3-layer quantum well-and-barrier structure occurs at kinetic energies corresponding to or near the energies of the quantum well.

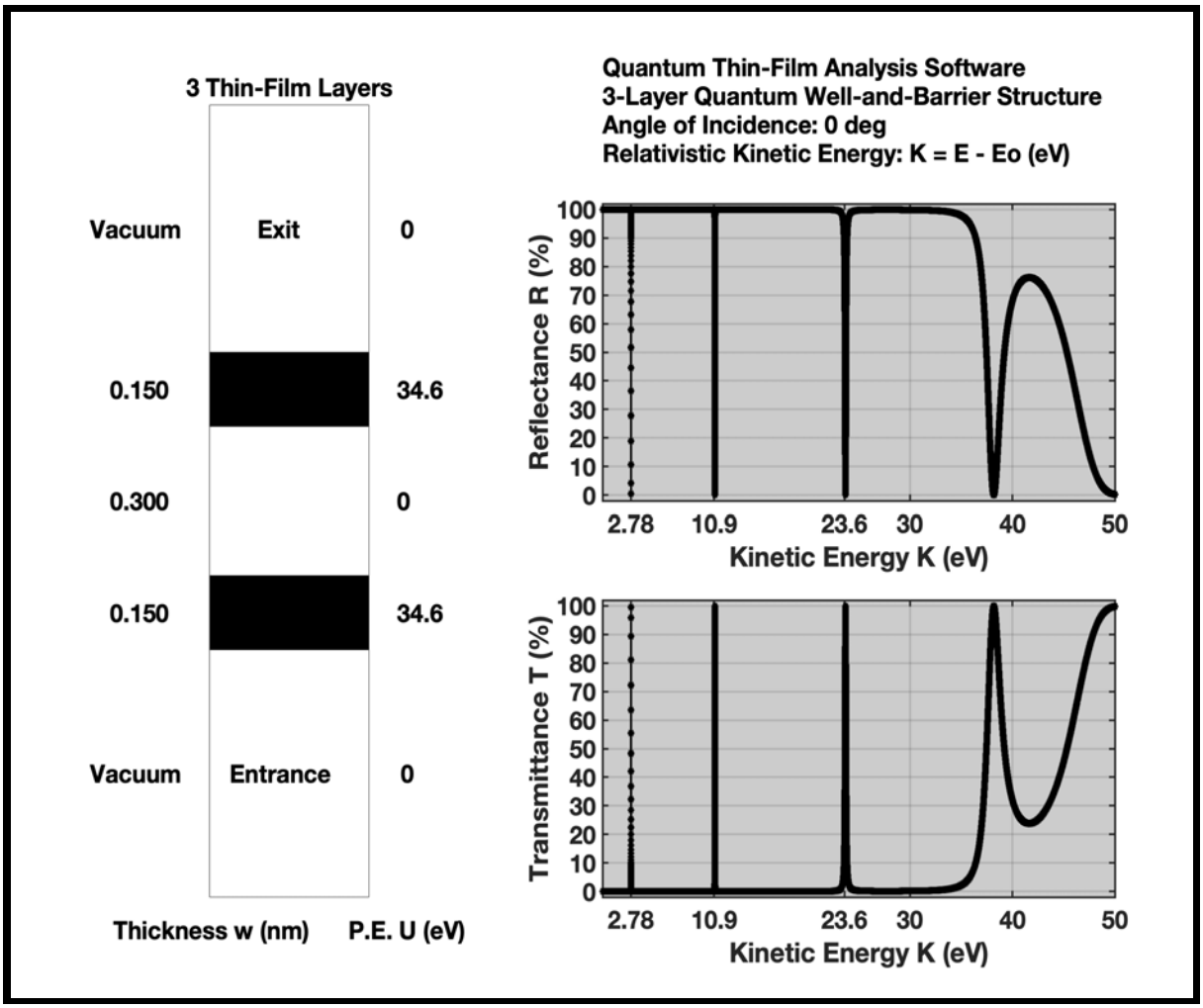

Figure 12: 3-Layer Quantum Well-and-Barrier Structure

For this case, a non-relativistic electron whose kinetic energy varied between 0 eV and 50 eV impinges upon the quantum well-and-barrier structure as shown in Figure (12). The well has a width of 0.300 nm. Each barrier has a width of 0.150 nm and a height of 34.6 eV. If the barrier thicknesses are increased, this narrows the sharpness of the reflection and transmission spikes but not their location. In this case, the quantum well has 3-energy levels: 2.76 eV, 10.9 eV and 23.6 eV. The results obtained are in excellent agreement with the material presented in reference [9] on a finite potential well.

c) 21-Layer Quantum Harmonic Oscillator Structure

In this example, the quantum harmonic oscillator problem is converted into a multilayer quantum well-and-barrier problem. The goal was to determine the energy levels of a quantum harmonic oscillator characterized by a potential energy $\frac{1}{2}kx^2$ where k is the spring constant and m is the mass of the attached particle.

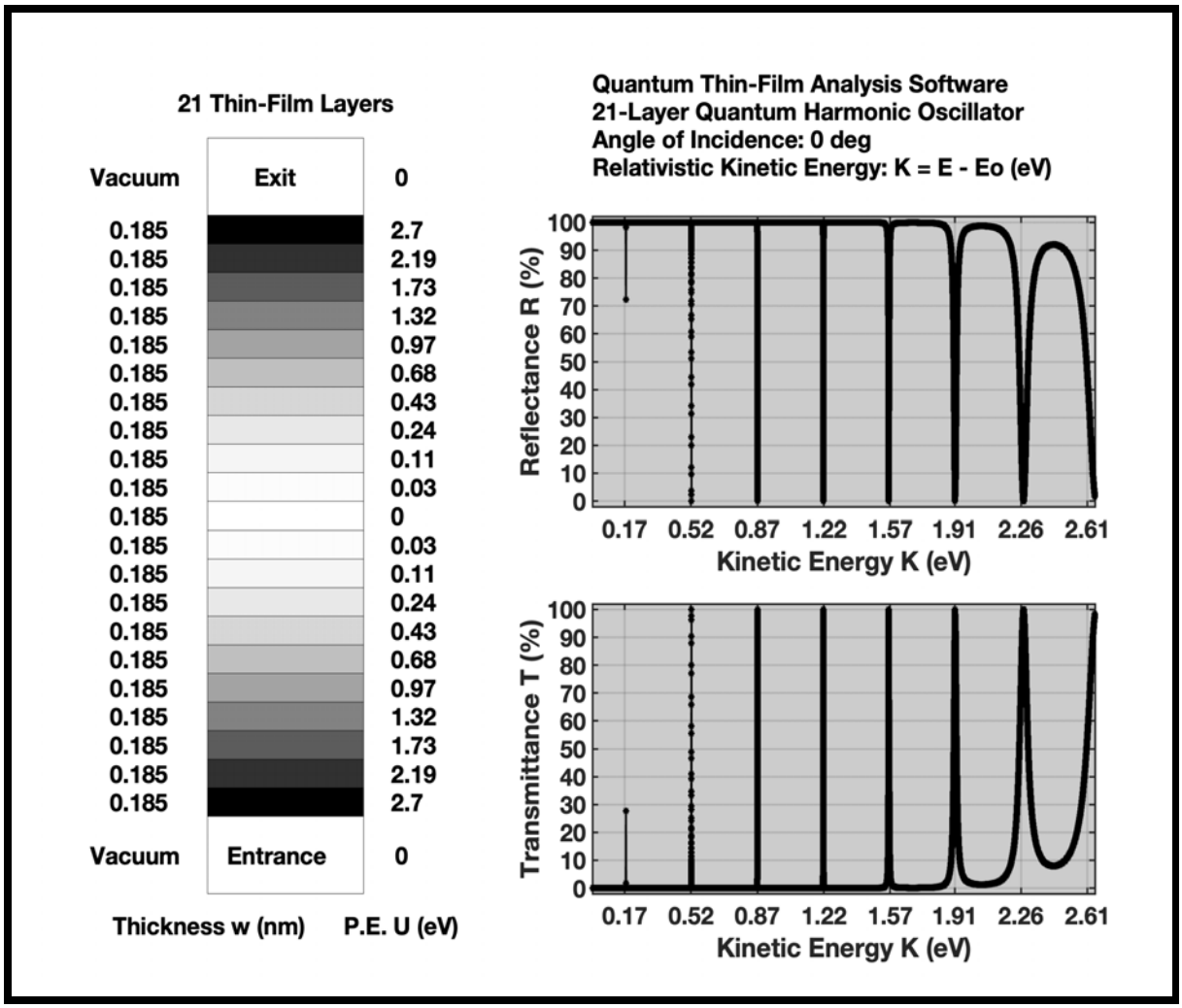

Figure 13: 21-Layer Quantum Harmonic Oscillator Structure

In particular, the spring constant $k = 2000$ N/m and the mass $m = 2$ x 10^{-26} kg. The corresponding angular frequency ω is given by $\omega = \sqrt{k/m} = 3.16$ x 10^{14} rad/s. The energy levels of the harmonic oscillator are given by

$$E_n = \hbar\omega(n + 1/2) \tag{52}$$

where $\hbar$ is reduced Planck's constant. The truncated multilayer quantum well-and-barrier total width $w = 3.88$ nm. The structure is depicted in Figure (13). The

kinetic energy K of the incident particle was varied between 0 eV and 2.65 eV. The eight energy levels associated with this truncated quantum well-and-barrier structure were correctly predicted, as shown in the graphs above and in agreement with the theory presented in reference [10].

d) 3-Layer Nuclear Potential Well-and-Barrier Structure

Again, the Dirac vector field equations are a set of relativistic field equations, whereas the Schrödinger wave equation is a non-relativistic equation. The next example concerns the predicted energy levels of a 3-layer nuclear potential well structure [11].

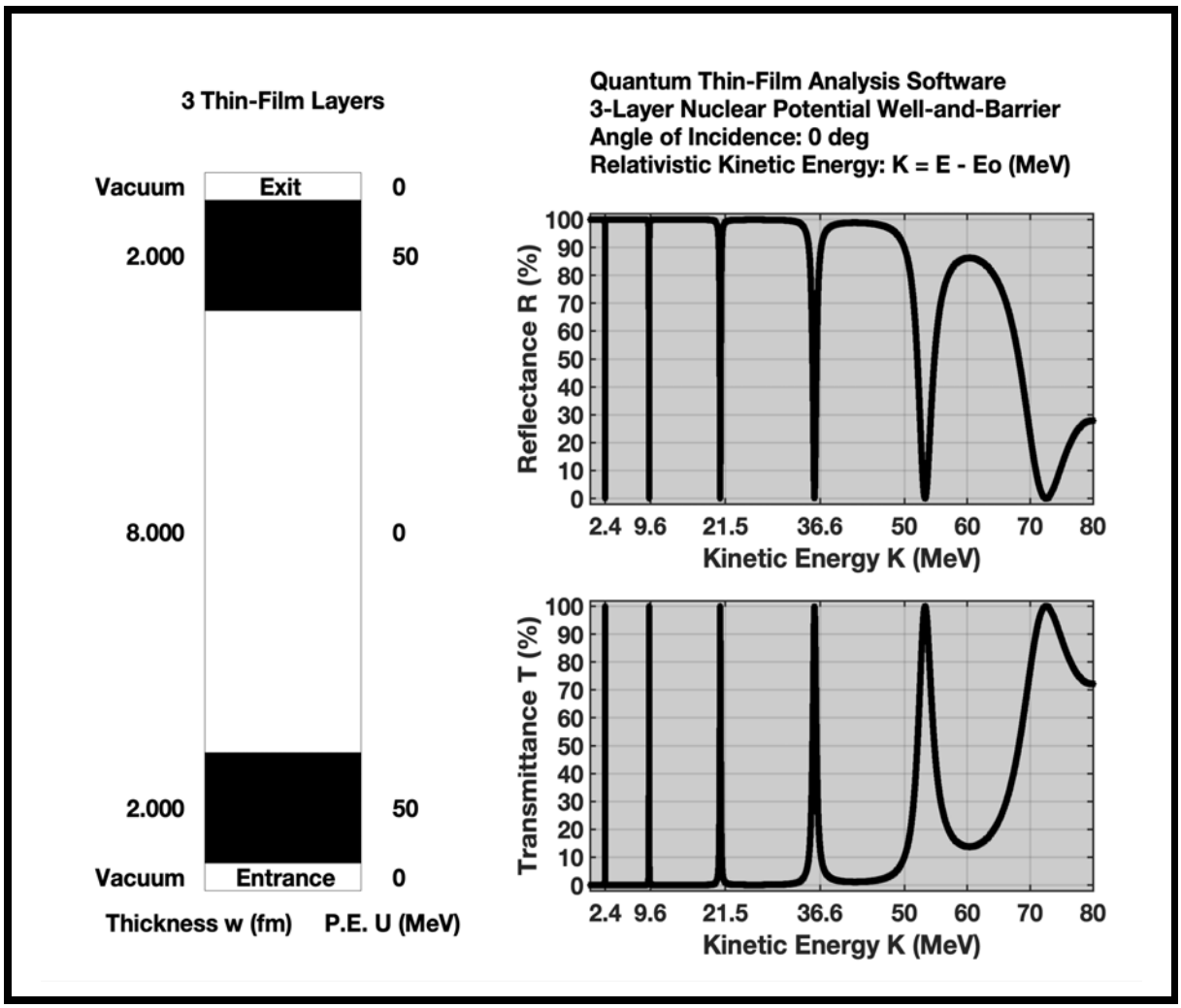

Figure 14: 3-Layer Nuclear Potential Well-and-Barrier Structure

Here again the problem was converted into quantum well-and-barrier problem. This time a neutron, whose rest mass energy is 939.6 MeV, was used as the incident particle. Its kinetic energy K was varied between 1 MeV and 80 MeV. At 80 MeV the neutron has a speed $v = 0.39c$ and a Lorentz factor of $\gamma = 1.085$, certainly considered relativistic. The nuclear potential well has a width $w = 8.00$ fm. Each of the two identical surrounding quantum barriers have a width of 2.00 fm and potential energy levels $U = 50$ MeV. The four energy levels of the nuclear potential well were correctly predicted: 2.4 MeV, 9.6 MeV, 21.5 MeV and 36.6 MeV as shown in Figure (14). These predictions are in excellent agreement with reference [11].

XI. Summary and Conclusions

1. The traditional Maxwell vector field equations in Gaussian units [1] and the newly formulated relativistic Dirac vector field equations in Gaussian units [2] and [3] serve as the underlying equations for the formulation of a unified approach for determining the transmission and reflection properties of multilayer optical and quantum thin-film structures. Based on the similarity between these two sets of field equations, the formulation of a unified approach is straightforward.

2. In particular, using the Maxwell vector field equations describing a dielectric material, a pair of analytical equations is used to predict the reflectance R and transmittance T of a single thin-film layer, for the case of normal incidence of an electromagnetic wave. The reflectance R and transmittance T represent the probabilities that a single photon, associated with the electromagnetic wave, is either reflected or transmitted through the thin-film layer.

3. Similarly, using the Dirac vector field equations, a pair of analytical equations can be used to predict the reflectance R and transmittance T properties of a single quantum barrier in the case of the normal incidence of a quantum mechanical matter wave. Reflectance R and transmittance T represent the probabilities that a single particle (electron or neutron) associated with the matter wave will be either reflected or transmitted through the quantum barrier.

4. Upon comparing the classical electromagnetic and relativistic quantum mechanical equations for predicting reflectance R and transmittance T, it is clear that these equations are identical. The only difference is that certain classical electromagnetic quantities can be replaced by suitable relativistic quantum mechanical quantities. Table 1: Unified Approach Conversion Table.

5. The single thin-film approach has been generalized to handle multilayer thin-film structures. Using the information in Table 1, a computer program using MATLAB computational and graphics software was developed to determine the reflection and transmission characteristics of either multilayer optical thin-film structures or multilayer quantum well-and-barrier structures. Predictions based on this unified approach and computer software development were tested thoroughly. The results were compared with those published in the literature and showed excellent agreement.

6. Several figures depicting thin-film structures were included in this study: Multilayer Thin Film Structure Consisting of N Thin Films (1), Single Optical Thin Film (2), Single Quantum Thin Film (3), and Multilayer Thin Film Structure (6).

7. Reflectance and transmittance results were presented for a number of optical and quantum-mechanical single and multilayer thin-film structures. These include: 1-Layer Dielectric Thin Film Structure (4), 1-Layer Thin Film Quantum Barrier (5), 11-Layer High-Reflectance Mirror Structure (7), 15-Layer Long-Wave Band-Pass Optical Filter (8), 15-Layer Short-Wave Band-Pass Optical Filter (9), 15-Layer Narrow Band-Pass Optical Filter (10), 11-Layer Periodic Quantum Well-and-Barrier Structure (11), 3-Layer Well-and-Barrier Structure (12), 21-Layer Quantum Harmonic Oscillator Structure (13), and 3-Layer Nuclear Potential Well-and-Barrier Structure (14).

8. Because of the similarity between the classical Maxwell vector field and relativistic Dirac vector field equations, researchers now have an alternative method for analyzing the nature of similar physical phenomena in the optical and quantum regimes.

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Theory of Space Quantization (TSQ) - A Paradigm Shift in the Newton's Laws of Motion

By Nishant Sahdev, Nabamita Roy & Chinmoy Bhattacharya

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Abstract- The newly discovered Theory of Space Quantization (TSQ) is a unifying theory that brings together conventional Newtonian physics, thermodynamics, quantum physics, quantum mechanics, theories of gravitation, and the theories of relativity under a single framework, while also reshaping them. All these theories were proposed without considering 'thermodynamics' and the quantized nature of 'space-time' or 'time-space' in the universe.

Keywords: theory of space quantization (TSQ), quantized time-space, thermodynamic consistency, newtonian physics limitations.

GJSFR-A Classification: LCC: QC174.13

Strictly as per the compliance and regulations of:

Theory of Space Quantization (TSQ) - A Paradigm Shift in the Newton's Laws of Motion

Nishant Sahdev [α], Nabamita Roy [σ] & Chinmoy Bhattacharya [ρ]

Abstract- The newly discovered Theory of Space Quantization (TSQ) is a unifying theory that brings together conventional Newtonian physics, thermodynamics, quantum physics, quantum mechanics, theories of gravitation, and the theories of relativity under a single framework, while also reshaping them. All these theories were proposed without considering 'thermodynamics' and the quantized nature of 'space-time' or 'time-space' in the universe.

The space ahead is a hybridized space (a hybrid of direct space and inverse or reciprocal space). The direct space and reciprocal space have three-dimensional (3D) and inverse 3D lattice structures, respectively, with the lattice points referred to as 'space points.' If the average distances between two consecutive space points in the direct space and reciprocal space are denoted as D and l, respectively, then the distance between two consecutive space points in the hybridized space (R) is given by:

$$R = (D \times l)^{1/2}$$

The 'space-time' of the universe is quantized, and all the physical variables of the universe (such as entropy, force, energy, electromagnetic waves, space expansion, order, time, mass, space inversion, etc.) exist in the form of packets. These packets have been exemplified in TSQ in a tripartite manner with respect to their topology, the physics of their formation, and their mathematical integrity. Furthermore, TSQ has been formulated and presented to the global scientific community, prioritizing the non-violation of thermodynamic principles. It also embodies 'time' and 'mass,' transitioning them from their abstract states within the context of the quantized 'time-space' of the universe.

Newton's laws of motion and the equations of motion are based on the physical variable 'acceleration' (defined as velocity per unit time). However, this suffers from the problem of circularity in its definition, as 'velocity' itself is dependent on time (distance per unit time). Consequently, the physical significance of 'acceleration' becomes ambiguous because time is inherently imposed on velocity.

The physical variable 'force' is defined as the product of 'mass' and 'acceleration.' If the mass remains constant and 'acceleration' becomes exceedingly large, the energy would tend toward infinity (since energy = force × distance). This is because, under conditions of very large acceleration, both the force and the distance would also become very large. Such a scenario violates the conservation of energy and, by extension, the principles of thermodynamics.

Moreover, everything in the universe is intrinsically connected to the 'time-space' fabric of the cosmos. Any movement or motion—be it an object, a vehicle, a planet, a star, or a person—exerts an impact on the surrounding 'time-space' of the universe. Therefore, formulating laws or theories of motion while disregarding 'time-space' and thermodynamics leads to incomplete solutions.

The major inconsistencies in the Newton's laws of motion are the following:

- The acceleration parameter f, cannot attain any uniform constant value as per the mathematical formula of the same [(S/t^2), S is the distance and t being the time)]
- While deriving the mathematical equation, Force = (mass x acceleration) , the principle of conservation of momentum proposed by Newton only, had been violated.
- In the above said expression of 'force' , both the 'mass' and 'acceleration' parameters have been considered to be variable and which violates the conservation of energy indeed as cited above.
- The impact of a moving object on the 'time-space' of the universe has been fully ignored.
- Neither the 'time' nor the 'mass' had been defined in regard to their physics of formation, mathematical identity and geometry (or dimension and topology).
- The kinetics of the motion of an object has been related to 'force' and 'distance' principally, ignoring the thermodynamics of the motion in regard to the position and energy of the moving object.

The recently proposed TSQ has the following redeeming features:

- Any physical variable of the universe is represented by a 'quantum' or 'packet' that belongs either to the direct space or the inverse space (reciprocal space) of the universe. These variables are defined in terms of their topology, mathematical identity, and the physics of their evolution in space. The space quanta of 'time' (t), 'temperature' (T), and 'mass' (m) are also defined in this tripartite manner. The following new equations involving energy (E) and volume quantum (V) have been derived and proposed:

$$Tt = 1 \quad \text{(a)}$$

$$mV = 3 \quad \text{(b)}$$

$$E = 3V \quad \text{(c)}$$

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$$mE = 9 \quad (d)$$

The above equations establish the 'time-temperature', 'mass-volume', 'energy-volume' and 'mass-energy' equivalences of the universe.

The special theory of relativity equation of Einstein relating mass and energy in the form of, $E = mC^2$ converges to equation (c) above, which is $(E/V) = 3$, or the energy density of space is constant. Einstein developed the said equation considering the 'space-time' as a continuum but when the concept of space quantization as in the form of as that of TSQ is being considered, the equation loses its significance and does converge to the constancy of the energy density of the 'space-time' of the universe.

- 'Time' is an attractive inverse pull back force which is holding the universe and 'temperature' is the push forward force which is responsible for converting 'time' vis-à-vis energy or heat to work. While 'time 'being a pullback force is holding the integrated form of 'energy' (in the shape of a 3D sphere) from being converted to work, the 'temperature' being the push forward force, takes the said integrated form of energy to the differential form of it and that is what 'work' is.
- For the first time in the history of science, time and mass have been defined concerning the inverse curvature of space in the forms of a '2D saddle' and a '3D saddle,' respectively. The mathematical formulas for 'time' and 'mass' are [$t = (3/4\pi r^2)$ and $m = (9/4\pi r^3)$], where r represents the radius of the 3D energy space quantum.
- The three principal dimensions length, mass and time (usually denoted by L, M and T respectively) have been placed in classical physics such that they appear to be independent among each other. If this be so, the universe could have taken up any dimensions or shapes of desire in the form of $L^x M^y T^z$ (where x, y and z stand for integers) but it is not so. In TSQ it has been proved through the interrelations of the topologies or the geometries of the said space quantum of L, M & T:

$$MT^{-2} = L$$

As a result, neither of the three physical variables of the universe are independent among each other. None of the said physical variables can be 'boundless' and the universe cannot attain any shape of its desire.

- Gravitation in TSQ is shown to be a property of space and not the property of any baryonic or celestial object of the universe. While an equilibrium does exist between the space expansion ($= 16\pi^2r^5/9$) and the space inversion ($=9/16\pi^2r^5$), the gravitation is arising out of the overlapping of the two such 'inverse space expansion' fields of two different 'inverse space expansion' quantum in the space itself.

$$\text{Phenomenon of gravitation} = (9/16\pi^2r^5) \times (9/16\pi^2r^5) = (81/16\pi^2r^{10})$$

The dimensionality of the phenomenon of gravitation reaches to inverse 10 dimensions and from this said space quantum all the physical variables or the dimensions of the universe has evolved out and this has been shown by an 'universal cosmological cycle' in TSQ. The universe has been shown to be of dimensionality of 10.

While Einstein intuitively arrived at a conclusion that the phenomenon of gravitation is the 'property of the space' only and gravitation is a phenomenon of 'acceleration', however, he could not demonstrate it in his 'General Theory of Relativity' (GTR) in the quantitative manner. It is the TSQ only which could reveal the mystery in the tripartite fashion in regard to the mathematical identity of gravitation, its topology and the spatial physics behind it.

In this research article the fundamental shortfalls of the work of Newton on physics of the motions have been identified as mentioned above, they have been readdressed to their proper regime and a new superseding theory of motion based on 'thermodynamics' and 'time-space' of the universe have been presented and which is to be considered as a paradigm shift in the Newton's Laws of Motion.

Keywords: theory of space quantization (TSQ), quantized time-space, thermodynamic consistency, newtonian physics limitations.

I. Introduction

The sacrosanct equation in physics is,

$$\text{Energy (E)} = \text{Force} \times \text{Distance} \quad (1)$$

The origin of the said mathematical relation is purely thermodynamic as shown below:

In thermodynamics, Energy is being expressed as the product of Pressure (P) and Volume (V). P is considered to be energy per unit volume and hence once it is multiplied by volume, the volume in the numerator and the denominator cancels out each other and what is left is Energy, E. Now when it is taken in the form of equation 1, it is broken up as

$$\text{Energy} = PV = P \times \text{Area} \times \text{Distance}\ [\text{Dimensionally, Volume} = L^3 = L^2 \times L = \text{Area} \times \text{Distance}] \quad (2)$$

$$\text{Energy} = E = \text{Force} \times \text{Distance}\ [\text{Pressure} \times \text{Area} = \text{Force}]$$

Now when the energy is constant then equation 1 takes the form:

$$\text{Force} = (\text{Energy}/\text{Distance}) \quad (3)$$

Or

$$\text{Force}(1/\text{Distance});\ \text{when energy is constant.} \quad (4)$$

The concept of the 'constancy of energy' of a moving object is being elaborated upon now. For example, if the movement of a vehicle is considered at any instant, the fuel must burn and supply the minimum energy required. This energy enables the vehicle to move, and as it moves, it converts heat or energy into work. The 'work done' by the vehicle is transferred to the surrounding space. Therefore, whatever energy the vehicle receives from the burning fuel is ultimately passed on to the surroundings. Hence, it is accurate to state that the vehicle moves under constant energy conditions since the change in the 'net energy' of the 'system' (the vehicle) and its surroundings (the space) remains the same before and after the vehicle's movement.

However, in classical physics or Newtonian theories of motion, the concept states that as the force applied to an object increases beyond a critical magnitude, the distance traveled by the object also increases. So, how can the constancy of energy be retained under the condition where the distance increases with increasing force?

The solution to this problem can be obtained only through the recently discovered 'Theory of Space Quantization' (TSQ), and the solution itself (as will be shown later in this article) indirectly establishes the fact that space is quantized, or that the 'time-space' of the universe must be quantized.

Another problem in classical and modern physics is that these streams focus mainly on distance, energy, and force to handle the mechanics of the motion of an object. Very little attention, however, was paid to understanding the physics of the evolution of 'time' and 'mass'. They existed for millions of years with the 'abstract' states of these two very principal physical variables of the universe: i) time and ii) mass. In dimensional analysis in physics, mass is represented as 'M' and time as 'T', since they are abstract concepts. The cosmological mystery of the universe could never be resolved until and unless mass and time are embodied. It is the TSQ that can embody these variables in a tripartite fashion (in regard to the physics of formation, topology, and mathematics). As a result, the traditional concepts of physics are undergoing a critical transformation toward a newer platform.

The positioning of 'time' in conjunction with 'motion' or 'movement' of the objects in physics is a bit ridiculous as is being explained now. At the starting point of the motion of an object velocity is considered to be zero, time (t) is considered to be zero and the distance travelled (S) is zero too. So how come the velocity (v = Distance /time) is zero. It becomes a mathematically undefined variable since zero divided by zero is undefined in mathematics. On the other hand, when an object travels a quite longer distance and t is also increasing and both t and S are tending to infinity, again the velocity mathematically becomes undefined (since infinity divided by infinity is undefined). So there must be a problem lying with the conception or positioning of 'time' and this will be discussed in more detail later in this article.

The positioning or the concept of time in TSQ has come out to be different on its own course during the shaping of TSQ. When a football match starts, the conventional practice is, it is being considered that the match is starting from t = 0 minutes and it gets over when t = 90 minutes. In TSQ the concept of time is just the opposite one. At the start of a football match it is considered t = 90 and as the match progresses time decays (as for example 90, 89, 88, 87 minutes..) to zero at the end point. The problem of defining the 'velocity' parameter in conventional physics as described in the previous paragraph is being eliminated this way in TSQ and this will be shown in the subsequent sections of this article.

The following two contrasting concepts of TSQ to that of the 'conventional physics' are of prime importance and needs to be conceptualized well to understand the content of this article:

- In conventional physics 'time' is monitored by the distance of a moving object. Higher the distance travelled, the time is considered to be higher. In contrast to that, in TSQ, 'distance' is monitored by 'time'. At the beginning of the travel of an object, 'time' (an inverse force) remains in the state of its high cohesive form and does hold the 'energy' and does not allow the same to pass on to the differential state in the form of 'force x distance'. Once the external force is being applied on the object, it does overcome the 'inverse force' or the 'time' and the object does move. As the object does continue its motion, the time decays and energy or heat is more and more being converted to work. Time becomes inversely proportional to distance

under such circumstance and as shown in equation (3), as the distance increases the force does decay too

The readers of this article are required to understand the fact that the TSQ philosophies of the 'quantization' phenomena vary to a large extent to that of the other theories like 'quantum physics', 'quantum mechanics' or the 'space-time' theories of Einstein (special and general theory of relativity, STR &GTR respectively). Table 1 below illustrates how the TSQ is being an unique one among all the said theories.

Table 1: Principle Concepts of TSQ vis-a-vis the other 'quantum/space-time' theories.

Quantum Physics/Quantum Mechanics	'Space-Time' Theories of STR/GTR	Theory of Space Quantization(TSQ)
Time has not been defined but considered to be a continuous function.	Time has not been defined, considered to be continuous but relativistic in regard to the velocity of the moving object or the inertial frame.	Time is an inverse squeezing force (discrete/quantized) holding the 'heat' or the 'energy' 3D quantum to pass out to the differential state in the form of 'force' quantum and 'distance/entropy' quantum as 'work'. The geometry of time has been proved to be a 2D-saddle.
Mass has not been defined and the mass of the microscopic particles only have been dealt with, in regard to their position of momentum in the form of 'Heisenberg's uncertainty principle', 'mass-wave duality' and 'conservation of momentum'.	Mass has not been defined and has been described in a very qualitative manner as 'warp of the space-time of the universe' and considered to be relativistic too.	Mass is quantized or discrete too and has been shown to exist in the form quantum of inverse 3D spherical (3D saddle) geometry. The conservation of momentum had been expressed as a product of the 'volume quantum' and 'mass quantum' and not in regard to 'mass' and 'velocity' as of conventional physics.
Electromagnetic waves and **energy** have been considered to be the same physical variable of the universe and are represented by 'photons' or 'packets of energy'. Only the mathematical identity has been expressed as , Energy (E) = h√ =(hC/λ), [h is Planck's constant, C is the velocity of light and √ is the frequency of the EM-wave.] but remained silent about the topology and the physics of generation of the so called 'photons'.	Energy (E) has been expressed as, $E = mC^2$ in STR [m stands for mass]. This is a continuous form of energy and when the mass is considered to be zero , the energy also becomes zero and when the mass increases, both the mass and energy boundlessly tend towards infinity violating both the 'principle of conservation of mass' and the 'principle of conservation of energy'.	'Energy' and 'EM-wave' are shown to be different physical variables of the universe (while the energy is 3-dimensional, EM-wave is 4-dimensional). The physical variables of the universe like entropy, force, energy, EM-wave, space expansion. do exist in the form of the integral multiple of 'π-space quantum' (2D circle or 3D circle) and the physical variables like order, time, mass, anti-EM wave, space inversion do exist in the form of the 'anti-π-space quantum' (2D or 3D saddles) The three physical variables energy, mass and volume (V) do exist in the form of space quantum, maintaining the following equivalences among themselves and none are boundless by their magnitude $mV = 3$ $mE = 9$ The physical significance of the above mentioned two mathematical equations are, i) when a quantum of mass interacts with a quantum of volume, 3 numbers of empty π-space quantum are being evolved in space. (as represented by mV =3), ii) when a quantum of mass does interact with a quantum of energy , 9 numbers of empty π- space quantum

		are being evolved in the space, (as mE =9).
A **universal wave function** ψ has been presented (whose physical significance could not however be described) and by applying the different quantum mechanical operators on the said wave function, the physical variables like energy, angular momentum, linear momentum ..etc… are being evaluated. The subject of '**time-space**' and '**gravitational physics**' have been fully excluded in quantum mechanics and this branch of physics turned into a 'mathematically dominating physics of the microscopic particles of the universe'.	The presentation of 'time-space' has been done in GTR through EFE's (Einstein Field Equations) and the concept of the 'curvature of space' in the form of Ricci curvature has been introduced. The space of the universe has been claimed to be 4 -dimensional (3 dimensions of space plus the one dimension of time). This was a very qualitative proposition since the topology of the distorted time space could not be described in the tripartite manner. The phenomenon of gravitation has been linked to the parameter 'acceleration' and has been claimed to be a phenomenon of space only. However, this was a very intuitive assumption made by Einstein but he could not furnish the right scientific logic behind this. The GTR had first put forward the concept of 'singularity'. However, why and how the singularity is arrived at the space -time could not be depicted and the concept remained in the state of being fragile till the discovery of the theory of space quantization	In the tripartite manner in TSQ it has been shown that there does exist an equilibrium between the 'direct space quantum' and the 'reciprocal space quantum' principally in the form of 'space-expansion' and 'space inversion' and the phenomenon of gravitation is a property of the space only and is arising out of the overlapping of the two 'inverse space expansion' fields. The dimensionality of the 'gravitation' is mathematically being proved to be inverse 10 dimensions. This is the point of 'singularity' and all the dimensions of the universe are being merged at this point in their reciprocal or inverse form. The 10 inverse dimensions at this point of singularity , however, decays or disintegrates in different steps (by emitting entropy or π space quantum) one after another and all the dimensions of the 'direct space' are being evolved one after the other too. This is represented in TSQ by a universal quantum cycle. All the cosmological phenomena of the universe do evolve from this said 'singularity'.

Acceleration Parameter of Newton's laws of motion

The acceleration (f) had been defined as:

$$f = (v/t) = (S/t) \times (1/t) = (S/t^2) \quad (5)$$

Table 1 below shows a case of examination that if for example, an object travelling (from an initial velocity, v=0 at t=0) with the uniform incremental velocity per unit of time of 10 cm (for example), whether the parameter (S/t^2) remain constant or not?

Table 2: S versus t data of a travelling object with uniform incremental velocity of 10 cm/per unit of time from the position of rest

t	v = (S/t)	S	(S/t^2)
0	0	-	-
1	10	10	10
2	20	30	7.5
3	30	60	6.7
4	40	100	6.25
5	50	150	6.0
6	60	210	5.8
7	70	280	5.7
8	80	360	5.6
9	90	450	5.55
10	100	550	5.50

The plot of (S/t^2) versus t of the data presented in Table 2 above is shown in Figure 1 below:

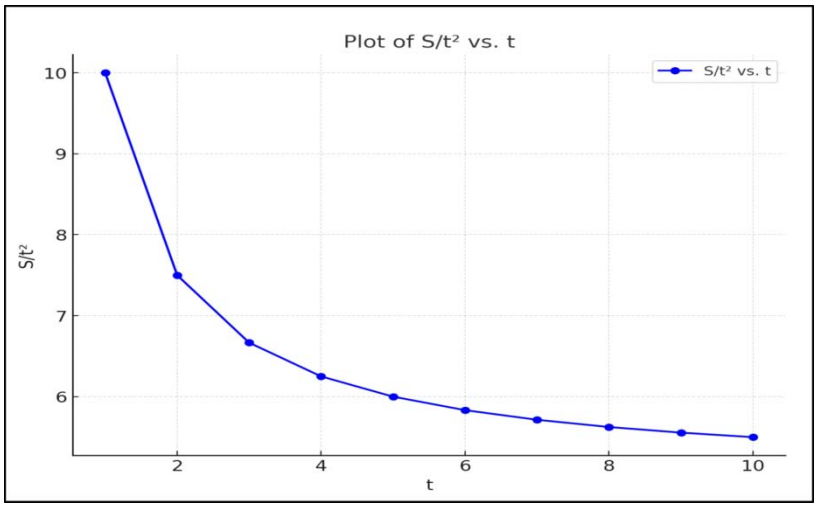

Figure 1: Typical plot of (S/t^2) versus t as per the data of Table 2

From the above Figure 1 and Table 2 it is clearly found that the manner the parameter acceleration f has been set in the Newton's laws of motions it cannot be a uniform or constant one. It does go on varying with time. Moreover, the value of f decreases continually and after a certain time it would be tending to zero. There is no way by which f can be a uniform acceleration parameter.

While it is very hard to draw up a physical significance of the f parameter of Newtonian physics as has been discussed at the beginning of this article, the way TSQ has looked at it, is very easy to comprehend. If for example a person has been asked to walk on a horizontal road path in the following manner: (assume that marks have been put on the road at equal to equal distances for each of the footsteps)

In the 1st unit of time the person has to walk X footsteps and in second unit the footsteps would be (X+ΔY), in 3rd unit of time it would be (X+2ΔY), 4th would be (X+3ΔY)…like this where ΔY is the incremental footsteps per unit of time. So each unit of time the incremental distance the person will cover over the previous unit of time would be equal to the distance of each footstep multiplied by. Now if the distance of each footstep be s on an average, the total distance (S) the person will cover in t unit of time would be:

$$S = [(sX)] + [(sX + s\Delta Y)] + [(sX) + (2s\Delta Y)] + [(sX) + (3s\Delta Y)] + [(sX) + (4s\Delta Y)] + \ldots\ldots\text{upto t terms} \quad (6)$$

$$\text{So } S = tsX + s\Delta Y\,(1+2+3+4+\ldots\ldots\ldots\ldots\ldots t) \quad (7)$$

$$\text{So } S = tsX + s\Delta Y\,[(t/2)\{2 + (t-1)\}] \quad (8)$$

$$\text{So } S = S_1 t + (1/2)\Delta S_{in}\, t^2 \quad (9)$$

($sX = S_1$, the distance travelled in the first unit of time and for large t, 1 neglected in equation 8 and $\Delta S_{in} = s\Delta Y/\Delta t) = \Delta L/\Delta t$ = Rate of incremental distance with time.

The equation (9) apparently looks to be dimensionally incorrect since the dimension of the LHS and the RHS of the said equation are not matching. However, it is to be noted that S in fact contains time t. The total distance S can be divided by total time to obtain an average distance S_{avg} such that $S = (S_{avg}\, xt)$ and hence equation 9 can be written as:

$$S = S_{avg}\, t = S_1 t + (1/2)\Delta S_{in}\, t^2 \quad (10)$$

Since $\Delta S_{in} = (s\Delta Y/\Delta t)$ the dimension of the LHS and RHS remains to be the same. As a matter of fact, Newton being fallen in the circle of dimensional matching of the RHS and LHS of his proposed three numbers of equations of motions had to introduce a fictitious physical variable in the form of (S/t^2). He did not think in the most rational way as is being done here and he had no option left than to do so.

So the following Newtonian equation of motions do lose their significances on the ground of the non-constancy of the parameter f (which is acceleration or retardation)

$$S = ut + 1/2ft^2 \quad (10a)$$

$$v = u + ft \quad (11)$$

$$v^2 = u^2 + 2fS \quad (12)$$

[where S is the distance travelled, t is time, u is the initial velocity, v is the velocity at time t and f stands for the uniform acceleration or retardation]

The identical equations equivalent to equation (11) and equation (12) would be derived now as per the new concept of TSQ. TSQ concept driven Equation (9) should replace the equation (10) above proposed by Newton.

The velocity changes in the following fashion

$$t=1 \qquad v_1 = (sX) \tag{12a}$$

$$t=2 \qquad v_2 = (sX + s\Delta Y) = (sX) + (s\Delta Y) \tag{12b}$$

$$t=3 \qquad v_3 = (sX + 2s\Delta Y) = (sX) + (2s\Delta Y) \tag{12c}$$

$$t=4 \qquad v_4 = (sX + 3s\Delta Y) = (sX) + (3s\Delta Y) \tag{12d}$$

So the general expression could be written as in case of large value of t:

$$v_t = (S_1 + (t\,\Delta S_{in}) \quad [S_1 = sX]$$

or

$$v_t = S_1 + t\Delta S_{in} \tag{13}$$

Equation (13) also does apparently look dimensionally incorrect. While developing a general expression of velocity [if the equations (12a) to (12d) are looked into] it is being revealed that v_t stands for the distance travelled for a single unit of time. So v_t in fact is a distance only. So one can write

$v_t = S(t) =$ Distance travelled in one unit of time after (t-1) unit of time is over $= S_1 + t\,\Delta S_{in}$

So the dimensionality is retained in equation (13) for the LHS and RHS and it can be re-written as:

$$\text{or} \quad v_t = S(t) = S_1 + t\,\Delta S_{in} \tag{14}$$

Newton's 3rd equation of motion in the form $v^2 = u^2 + 2fS$, [equation (12)] is a mathematical elimination exercise only and is not required at all. From equation (10) and (11) it can be written

$$v^2 = u^2 + 2fS = u^2 + 2f\,[\,ut + (1/2)\,ft^2] = u^2 + 2fut + f^2t^2 = (u + ft)^2$$

$$\text{so } v = u + ft$$

So from equation (10) and (11), the time variable t had been eliminated by Newton and another equation in the newer form free of t was presented. So this form of equation is not required at all since equation (11) and equation (12) are converging to each other.

Now squaring both sides of equation (13), one gets

$$v_t^2 = S_0^2 + 2S_0\Delta S_{in}t + t^2\Delta S_{in}^2$$

$$= S_0^2 + t\,\Delta S_{in}\,(2S_0 + t\,\Delta S_{in}) \tag{14}$$

Now when $t\,\Delta S_{in}$ is very small compared to $2S_0$, equation (14) reduces to:

$$v_t^2 = S_0^2 + 2S_0\Delta S_{in}\,t \tag{15}$$

When $2S_0$ is very small compared to $t\,\Delta S_{in}$, equation (14) reduces to:

$$v_t^2 = S_0^2 + t^2\,\Delta S_{in} \tag{16}$$

The typical plots of equation (10) and, equation (13), are shown below in Figure 2, Figure 3 respectively.

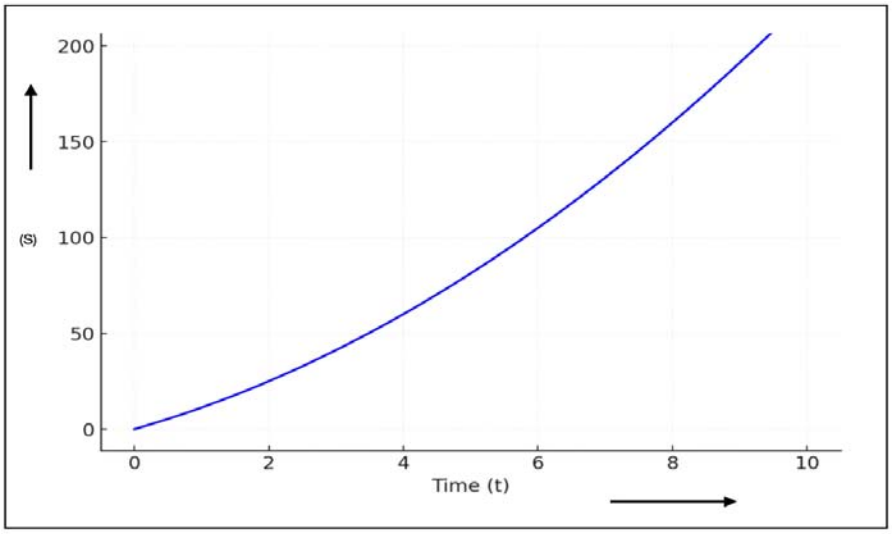

Figure 2: Typical plot of S versus t as per TSQ developed equation 10

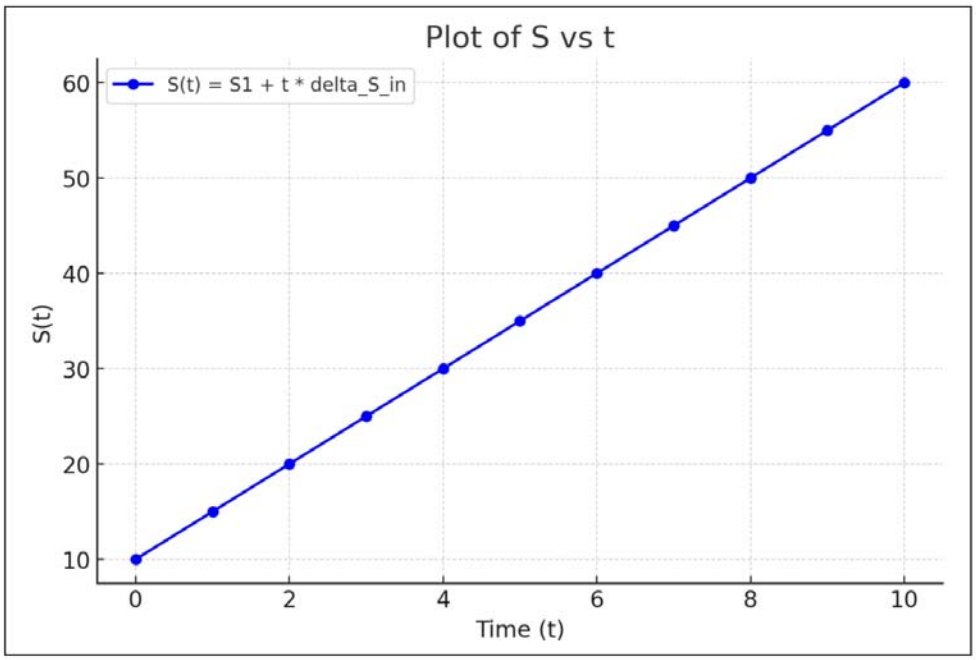

Figure 3: Typical plot of S(t) [= v (t)] versus t as per TSQ developed equation 13

Newton's second law of motion claimed that force is directly proportional to the rate of change of momentum. However, this appears to be a hypothesis of Newton since no scientific logic was being put against the evolution of such proportionality between the momentum and force. Also it is Sir Newton only who had proposed the 'law of conservation of momentum' and if it be so, how can the momentum be a variable too? Hence Newton's principle of conservation of momentum, while foundational, requires re-evaluation in the light of TSQ.

In TSQ [88, 89, 90, 91] the conservation of momentum had been established through the quantum concepts. A remarkable shift in the concept of the 'measurement tool of translation of a moving object' took place after the discovery of TSQ where the 'time' had been embodied. While conventionally, the 'time' is abstract and the 'measurement tool of translation' is the 'velocity parameter', in TSQ the said tool turned out to be the 'volume', which is being evolved from the impact of a moving object on the 'time- space' of the universe. So, the concept of 'velocity' shifted to the concept of 'volume'. The same is being discussed later in this article in more detail. The physical variable 'mass' does exist in the form of quantum of the reciprocal space of the universe and the physical variable 'volume' also does exist in the form of quantum of the direct space and hence the physical variable 'momentum' instead of

calculating by the product of 'mass' and 'velocity' needs to obtained multiplying mass by volume. In TSQ, it has been proved in tripartite manner that when a quantum of mass interacts with a quantum of 'volume', 3 numbers of π space quantum are formed. The mathematical statement of TSQ is:

$$mV = 3 \quad (17)$$

In equation m stands for mass and V stands for 'volume' and not being the velocity.

The diagrammatic presentation of equation (17) is being shown in Figure 6 below.

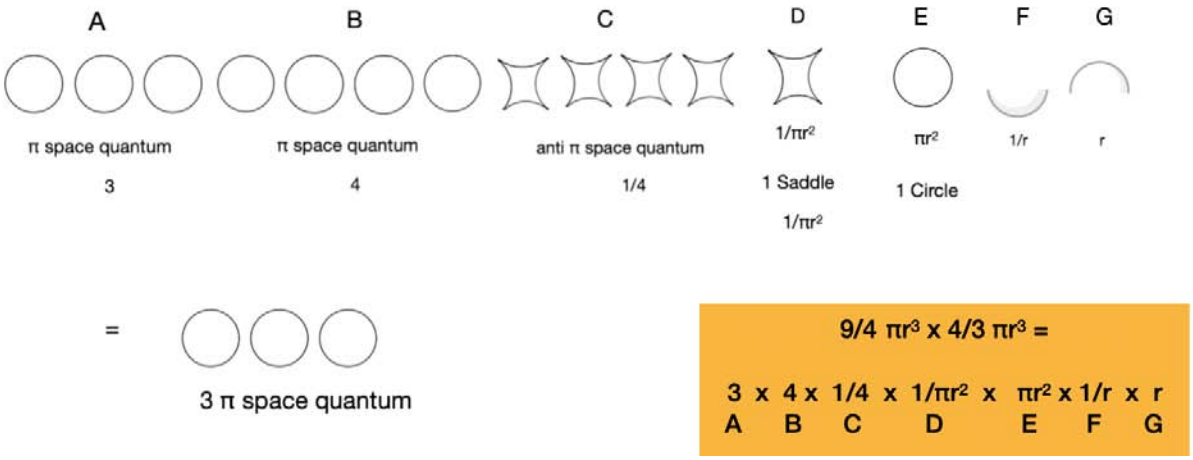

Figure 6: TSQ driven presentation of 'conservation of momentum'

Now in conventional physics the dimensionalities and the geometries or the topologies of the physical variables like time, mass, force, energy, entropy, Planck's constant, the universal gas constant, EM-wave, temperature etc are not known. However, TSQ has filled up this gap and has embodied all the said physical variables in the tripartite fashion (from the angle of physics, mathematics and topology).

- *Quantum Nature of Space and 'quantum entanglement'*

In the TSQ, the space ahead of us has been shown to exist in the following equilibrium

Direct Space ⇋ Inverse Space or Reciprocal Space

The space is composed of 'space points' and any event taking place in the direct space is reciprocated as an inverse event in the reciprocal space. In Figure 7, it is shown that if a circle is formed in the direct space from the adjoining of the space points then a 2D saddle would be formed in the reciprocal space as a reciprocation. The product of the areas of the circle and the 2D saddle would be unity as shown below:

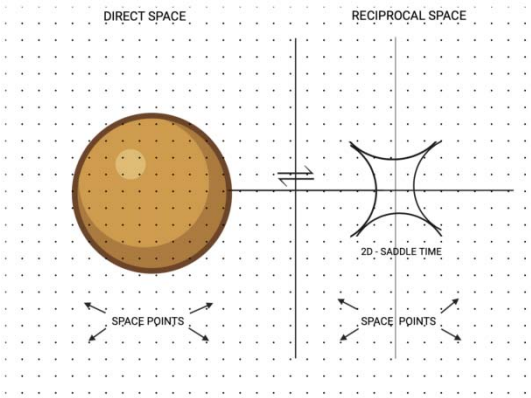

Figure 7: Direct space and reciprocal space equilibrium of universe

$$[\text{Area of the circle } (\pi r^2)] \times [\text{Area of the 2D saddle } (1/\pi r^2)] = 1.00 \quad (1)$$

The circle and the 2D-saddle are multiplicative inverse to each other since the product of the two is unity.

The physical variables like entropy, force, energy, EM-wave, space expansion etc in the forms of quantum (of different topology or geometry) belong to

the direct space of the universe and the physical variables like order, time, mass, squeezing EM-waves, space inversion in the similar fashion belong to the reciprocal space of the universe.

The geometries of all the space quantum as revealed through TSQ [88-100] are shown in Figure 8 below:

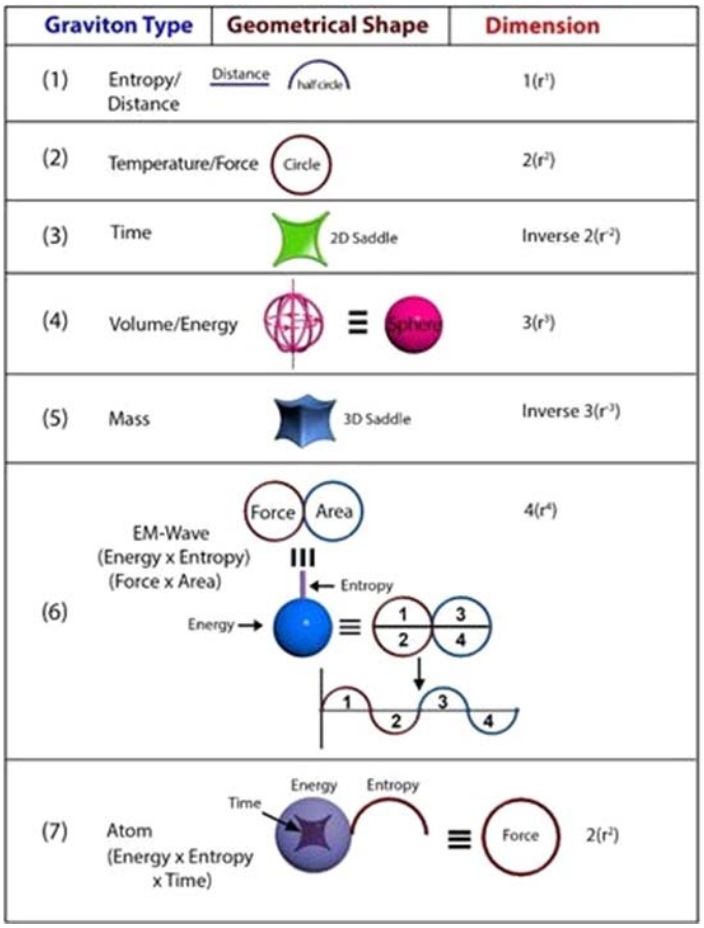

Figure 8: Geometries of all the space quantum

- *Evolution of the Dimension and Topology of 'Time' Variable of the Universe*

In TSQ any physical variable of the universe has to be defined in a tripartite fashion [88] in regard to its physics of formation, mathematical expression and the geometrical shape [98] as shown below in Figure 9:

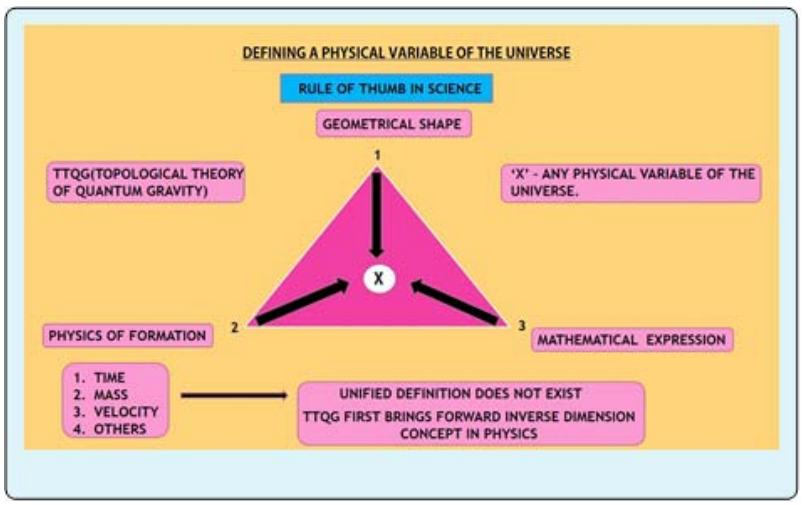

Figure 9: Physics of formation, mathematical expression and the geometrical shape

The theories of conventional physics though dealt with numerous physical variables but did never present any physical variable in the fashion as shown in Figure 9 above.

Regarding the 'time' variable it is to be noted that Energy, entropy and time are very much related to each other and the mathematical statement of the famous Heisenberg's uncertainty principle is Et =h (E stands for energy, t stands for time and h stands for Planck's constant) [88, 95]. It has been proved in TSQ [99] that the well-known Planck's constant is an entropy parameter only. So, (Energy x Time = Entropy). However, none of the research theories in physics has been able to define time in regard to energy and entropy. The underlying reason behind the same was the lack of the thinking in the line of quantized 'time-space' and the failure to link the subject thermodynamics with it.

The following are the salient principles of TSQ and which are to be noted as the starting point to learn what 'time' is? [88-101]

- Time is an attractive force quantum which is trying to hold the universe.
- Time is a pullback force (PBF) belonging to the reciprocal space of the universe.
- Temperature on the other hand is a push forward force (PFF) which is trying to elongate the universe and is a variable of the direct space.
- The geometry or topology of time is a 2D saddle
- The geometry or topology of temperature is a circle
- 'Time' and 'temperature' are arising out of 'quantum entanglement'.
- Time (t) and temperature (T) are multiplicative inverse to each other such that

$$Tt = 1.00$$

- Pressure is a dimensionless parameter and which is a hybrid of PBF and PFF, such that

$$P = (PPF \times PBF) = Tt = 1.00$$

- The index of equilibrium and non-equilibrium of any physical or chemical phenomena of the universe is related to the product of T and t : [88-101]

$Tt > 1.00$ - non-equilibrium

$Tt < 1.00$ - non-equilibrium

$Tt = 1.00$ - equilibrium

The equilibrium relationship between time and temperature in the form of Tt = 1.00 is being represented by Figure 10 below [88, 98]:

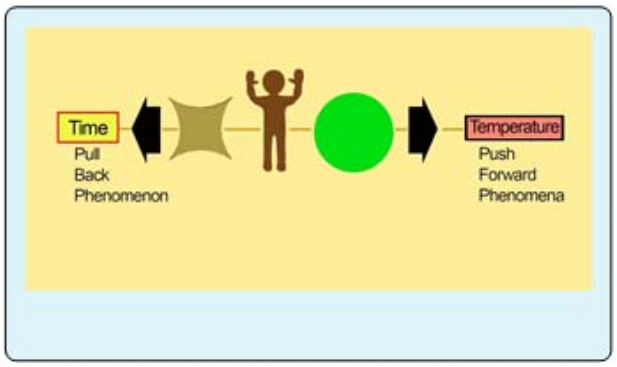

Figure 10: The equilibrium relationship between time and temperature

In TSQ energy is represented by a 3D sphere, time is a 2D saddle and entropy is a line segment and an atom being a 'quantum entanglement' and is being represented as (energy x entropy x time) as shown in Figure 11 below:

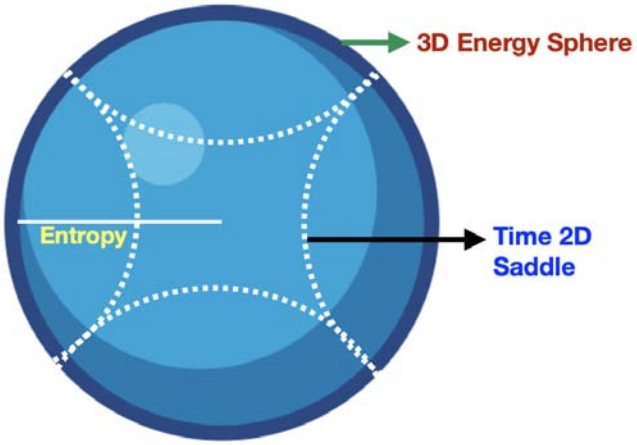

Figure 11: Typical representation of the quantum entanglement of an atom of TSQ as (Energy x Entropy x Time) and state of equilibrium Tt= 1.0

Now when the magnitude of energy is small, the sphere would be lower in size and the attractive pull of the 'time' 2D saddle will pull back the entropy line strongly and as a result the entropy would be under tension and would not be able to elongate. So the time saddle through the energy sphere will be pulling back entropy. So, time equated to 'how energy is pulling pack the entropy'. The mathematical representation of 'time' would be, (Figure 12)

$$\text{Time} = (\text{entropy} / \text{energy}) = (3r/ 4\pi r^3) = (3/4\pi r^2) = \text{2D saddle} \quad (18)$$

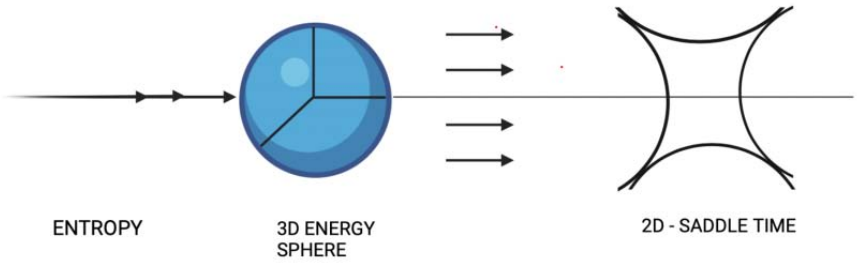

Figure 12: Manifestation of time quantum entanglement variable of the universe Tt <1

On the other hand when the energy sphere is larger in magnitude than in spite of the presence of the time attractive force, the energy sphere pushes forward the entropy line being the dominant force as shown in Figure 13 below:

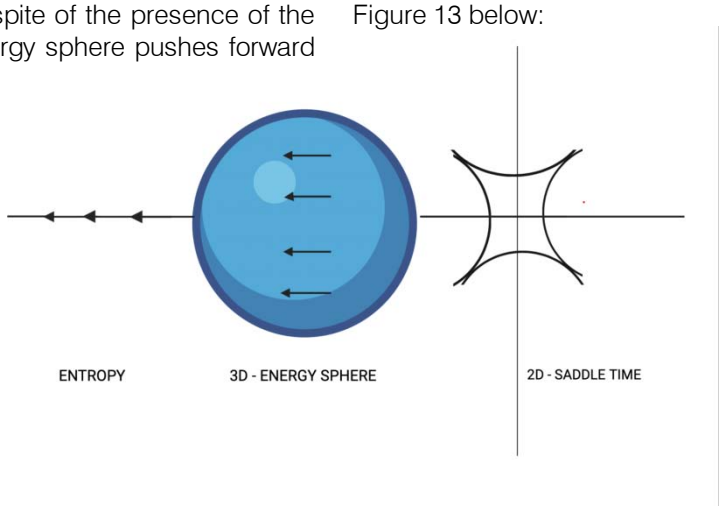

Figure 13: Manifestation of Temperature quantum entanglement variable of the universe, Tt > 1

So 'temperature' is being defined as 'how much or the extent to which the energy sphere pushes forward the 'entropy' and which is being mathematically represented by

$$\text{Temperature} = (\text{energy} /\text{entropy}) = (4\pi r^3/3r) = (4\pi r^2/3) = \text{Circle} \quad (19)$$

Both temperature and time are the quantum forces of the universe but these were unexplored earlier.

- Changing Concepts of Physics

The defining of time in TSQ has led to the following changes in the concept of conventional physics [88-101]:

(The main points are highlighted only):

- 'Velocity' merges with the concept of volume.
- 'Acceleration' is effectively a concept of 'space expansion' rather than a concept of incremental velocity. Its dimension reaches from 3D to 5D.
- EM-wave turns out to be a hybrid of two force circles in its integrated form and in the differential form it resembles a typical EM-wave profile.
- The phenomenon of gravitation emerges as the result of the overlapping of two 'inverse space expansion' fields and the dimension is inverse 10 dimension.
- Cold Nuclear fusion is not an experimental artifact but a real phenomenon of the universe and the dimension reaches to inverse 7 dimensions.

- All the cosmological and astronomical phenomena of the universe is being explained by a universal space quantum cycle [88] as is shown in Figure 14 below:

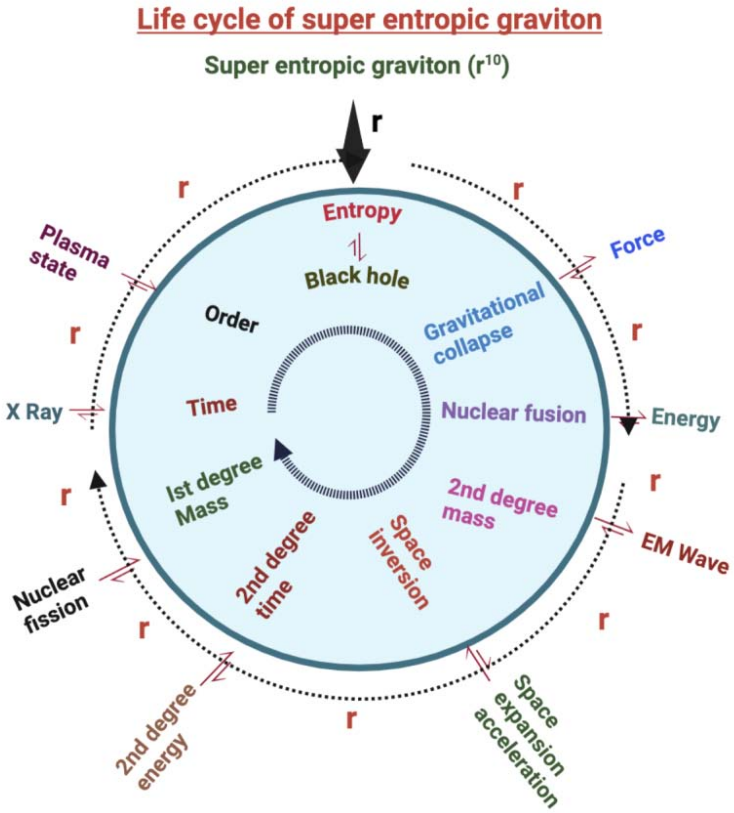

Figure 14: Presentation of universal space quantum cycle of the universe

- Changing Concept of 'Force' and 'Acceleration' of Newtonian Physics in regard to TSQ

From the discussions made in the previous three sections, it is to be understood that velocity (v) is in reality a concept of volume. Since v= (S/t) and in TSQ any distance in the universe is an entropy space quantum represented by r and a time quantum is being represented by a 2D saddle ($3/4\pi r^2$), hence

$$v = = [r/ (3/4\pi r^2)] = (4\pi r^3/3) = \text{volume} = V \qquad (20)$$

The concept of TSQ is, when anything does move from the position of rest, it has to overcome the time attractive force first and then it travels a distance and the combined effect of the two generate an impact on the space and a 'volume' is being evolved as shown mathematically through equation (20) above and is being shown topologically in Figure 15 below:

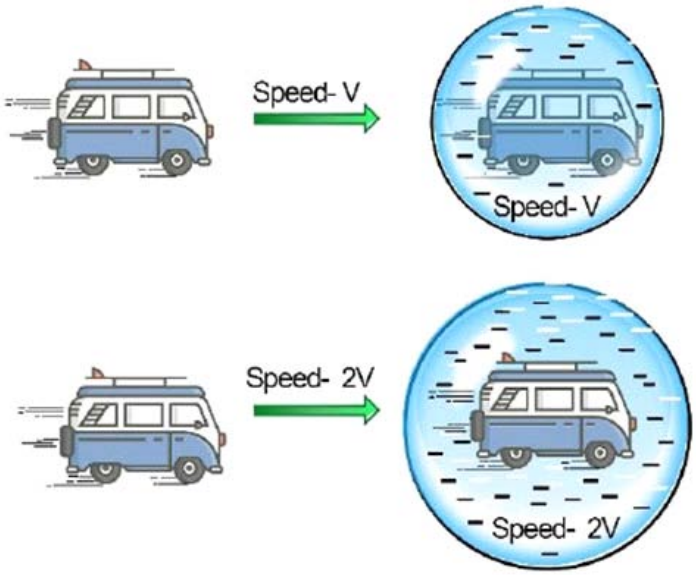

Figure 15: Pictorial Presentation of Creation of Volume as a function of the Speed of a Motor Vehicle

The above Figure (15) does also reveal the fact that as the distance covered as a function of time are being higher, more and more volumes are being evolved. In TSQ, the magnitudes of all the physical variables of the universe are expressed either in regard to length, area and volume (of the direct space) or in regard to the inverse length, inverse area or inverse volume (of the reciprocal space).

In TSQ it has been proved that the energy density of the universe is constant [88, 91] and the energy (E) is related to the volume (V) in the following manner as shown in equation (21) below:

$$E = 3V \tag{21}$$

So Energy density = (E/V) = 3.0 and is a constant. The physical significance of equation (21) is, an energy Quantum (3D sphere) is composed of three volume quantum [volume of each = $(4\pi r^3/3)$] over the three principal axis's x, y and z such that,

$$E = [(4\pi r^3/3) + (4\pi r^3/3) + (4\pi r^3/3)] = 4\pi r^3 \tag{22}$$

So by dimension Energy and Volume are the same. In Newtonian physics, the energy and volume have been allotted different dimension (dimensions of volume = L^3, dimension of energy = $M L^2 T^{-2}$) and those incorrect conclusions had been arrived due to the non-consideration of 'time-space' and 'thermodynamics' of the universe and the absence of a 'Theory of Space Quantization'. Classical physics had considered the three principal dimensions of the universe L, M and T are independent among each other. In TSQ, through the dimensional equivalency proof of energy and volume it has been firmly established that the said 3 physical variables of the universe are interlinked to each other in the following manner:

Dimension of Energy = Dimension of volume

Or, $$M L^2 T^{-2} = L^3$$

Or, $$MT^{-2} = L \tag{23}$$

It has been learnt in classical physics that Energy is sum of potential energy (PE) and kinetic energy (KE) such that,

$$\text{Energy (E)} = (PE) + (KE) \tag{24}$$

The above type of demarcation of energy had been made without justifying the same in the tripartite fashion as done in TSQ (see figure 9 above) and hence this is not acceptable. In TSQ, in a very much of tripartite manner it has been established that [95,100],

$$\text{Energy(E)} = (\text{Internal Energy, U}) + (\text{Volume Energy, PV})$$

$$E = (2PV) + (PV) \tag{25}$$

P is the pressure parameter and unlike the concept of classical physics (where pressure is equated to the energy per unit of volume) where its dimension had been put as, $M L^{-1} T^{-2}$, in TSQ, pressure is a dimensionless parameter being represented as,

Pressure, P = (push forward force x pull back force) = $(4\pi r^2/3)$ x $(3/4\pi r^2)$

= [Temperature(T) x Time (t)= 1,

So

$$P = Tt = 1 \quad (26)$$

If the classical physics dimension of pressure ($M\ L^{-1}\ T^{-2}$) is being looked upon in relation to the TSQ derived equation (23), one gets [94],

$$P = M\ L^{-1}\ T^{-2} = L \times L^{-1} = L^0 \quad (27)$$

So pressure turns out to be of zero dimension or dimensionless only. Under the condition of equilibrium when P = 1, (as shown in equation 26), the equation (25) takes the form:

E = (Internal Energy + Volume Energy) = (2V+V) (27a)

The ratio of internal energy to volume energy remains to be constant [100] for the movement of an object under constant pressure and equilibrium condition:

(Internal Energy: Volume Energy) = 2:1 (27b)

When the total energy decreases or increases, that is being equally distributed between 'internal energy' and 'volume energy' in the ratio of 2:1 as shown in equation (27b). The topology of Energy, E is shown below in Figure 16 in connection with the said two energies.

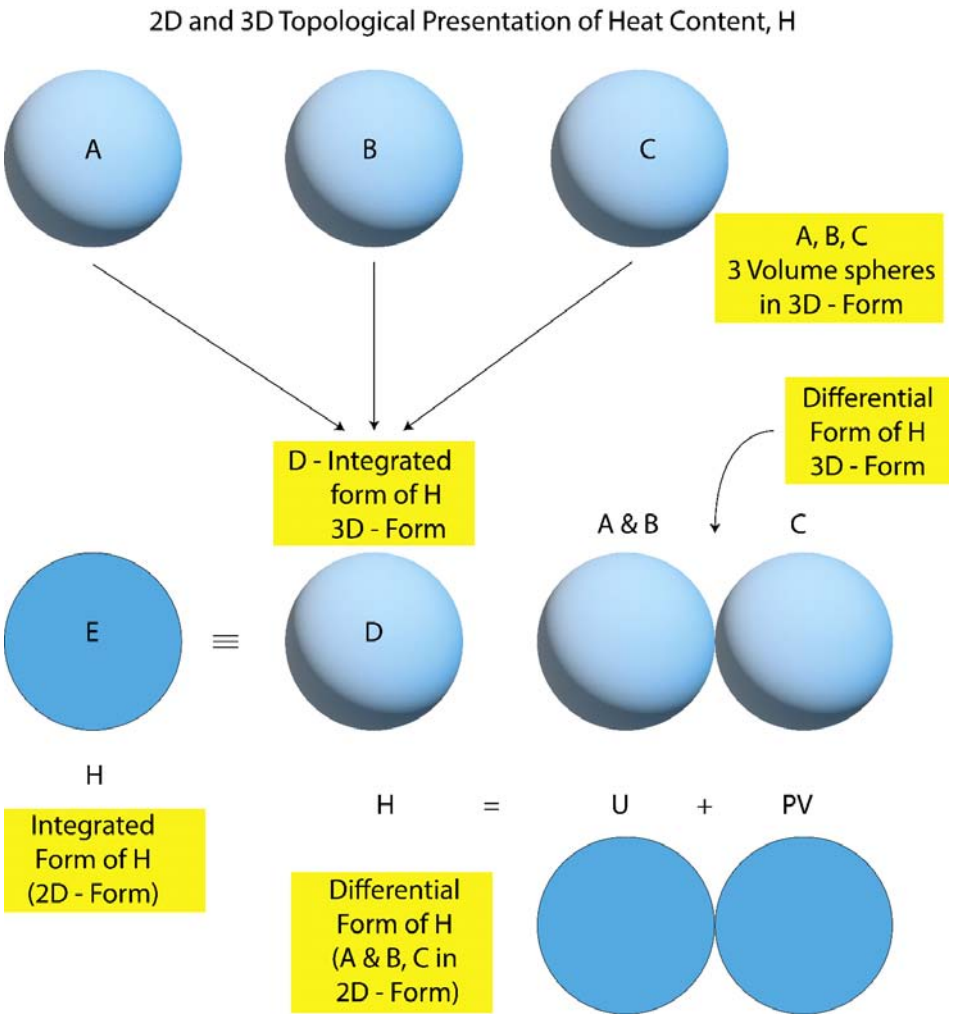

Figure 16: 2D and 3D presentation of 'Energy', E or H (in thermodynamic sense), 'Internal Energy', U and 'Volume energy, PV'

In TSQ, energy is a 3D sphere (integrated form) and 'work' is the differential form of energy [91, 100] in the form of 'Force' and 'distance' as shown in Figure 17 below:

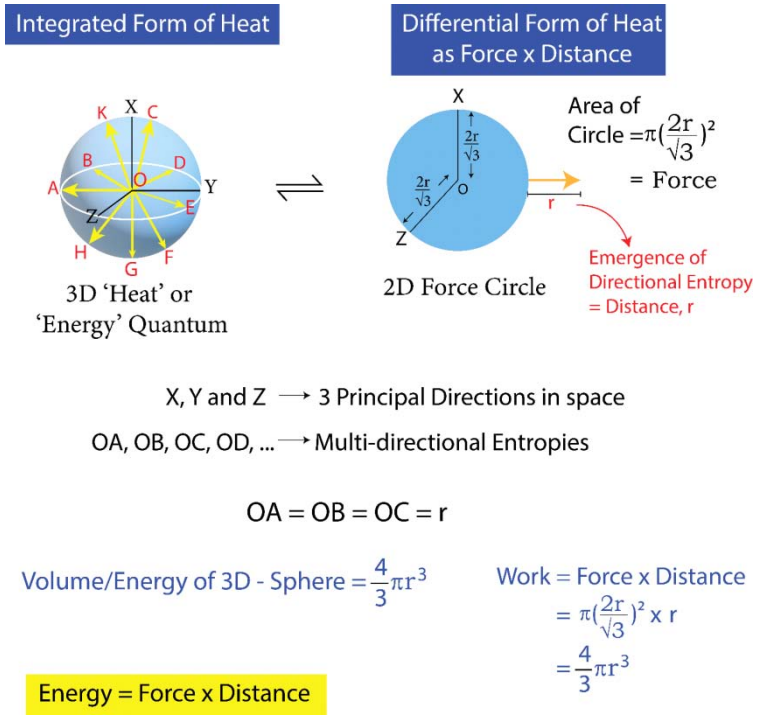

Figure 17: TSQ presentation of 'Integrated' and 'Differential' forms of heat

It is to be noted from Figure 17 that when a 3D energy sphere is compressed isothermally, the sphere transforms to a 2D circle (which is being the force) and out of the three dimensions of a 3D sphere , one of the dimensions come out from the sphere as a distance with a particular direction in the space. So the RHS of the figure 17 represents the differential form of energy (in the form of force and distance) and that is work. This type of representation of energy in regard to force and distance has been presented for the first time in the history of science. Only the TSQ could reveal it. Based on this diagram only the geometrical or topological proof of the three thermodynamic laws have also been presented.

- *Modified approach of the Second law of Newton to define 'Force'*

In the earlier sections, it has been commented that the approach of Newton to define force in regard to rate of change of momentum is a bit hypothetical and contradictory for the very valid reason of the standing of the 'principle of conservation of momentum' proposed by Newton. In TSQ, the phenomenon of conservation of momentum has been shown to be true in regard to the quantum nature of 'mass' and 'volume' and not by 'mass' and 'velocity' as Newton proposed.

Now here by two different approaches, the expression of 'force' will be derived, i) modified Newtonian approach ii) TSQ approach.

II. Modified Newtonian Approach

Unlike, Force being proportional to rate of change of momentum, as in Newtonian approach , in the modified Newtonian approach it is in fact proportional to the ($\Delta S_{in}/\Delta t$), (incremental distance per unit of time) and one has to go on increasing force to get consecutively higher multiple of ΔS_{in} in regard to time (as the example of walk of a person in 1st, 2nd, 3rd, 4th ……unit of time the ΔS_{in} has to change to ΔS_{in} to $2\Delta S_{in}$ to $3\Delta S_{in}$ to $4\Delta S_{in}$…like this)

Now ΔS_{in} = (incremental distance/time) = ($\Delta L/\Delta T$) (dimensionally, T stands for time and L for distance) and hence

$$\text{Force (F)} \quad (\Delta L/\Delta T) \tag{28}$$

Force can also be viewed as a physical variable which decays as the time increases (as per as the time concept of classical or Newtonian physics) since once a force is applied on an object to let it move and then if the force is being left , the object slows down and stops after travelling a certain distance.

$$F(1/T) \tag{29}$$

So force is a sort of compound physical variable of the universe and applying the theorem of joint variation for the relation of proportionalities as shown in (28) and (29) it can be written,

$$F(\Delta L/\Delta T)]/T \quad (30)$$

Now the constant of proportionality is the mass of the moving object, M, and hence it can be written,

$$F = [M (L_2 - L_1) / T] \ (1/ /\Delta T)$$

$$= [M \{(L_2/T - L_1/T)\} (1/ /\Delta T) \quad (31)$$

$[\{(L_2/T - L_1/T)\} = (v_2 - v_1)$, L_2 and L_1 and v_2 and v_1 stands for the final and initial distance and velocities respectively of the object].

As per TSQ, velocity stands for volume when the proper dimension of time is being considered and hence $(v_2 - v_1)$ should be equated to the change in volume (ΔV) and not the change in velocity, Δv.

So, $$F = M [(\Delta V) /\Delta T)] \quad (32)$$

$[(\Delta V) /\Delta T)]$ stands for rate of change of volume with time or rate of change of space expansion with time]
So, the final form of force,

$$F = (\text{mass x rate of space expansion with time}) \quad (33)$$

III. TSQ Approach to Define Force

For an object in motion, energy or heat is being converted to work more and more with a steady value of the $(\Delta S_{in}/\Delta t)$ parameter. While the accelerating motion of an object is considered, there occurs an expansion of space and the 'time frame' has to become less to less squeezing since as per the philosophy of TSQ, it is the time frame (space quantum, 2D saddle) only, which is holding the '3D energy sphere' to pass on to the differential form as 'force x distance' or 'work'. As the 'time' frame changes, the frame of 'mass' does also change [topologically mass is an inverse 3D saddle = (1/time) x (1/entropy) = $(1/\pi r^2)$ x (1/r) = ($1/\pi r^3$)]. So the 'time' and 'mass' both have to go on decreasing to generate more and more work and do not remain in the form of constant. Both the 'time frame' and 'mass frame' become broader or wider (but less squeezing) and that is what is the so-called 'relativistic effect' of Albert Einstein. In Figure 17a below, it is being shown how the 'time frame' becomes more broader and less squeezing (the squeezing strength of the 2D saddle/3D saddle is inversely proportional to its area, higher the area, less squeezing it is and lower the area, more squeezing it is) as the energy/heat is being converted to more and more to work.

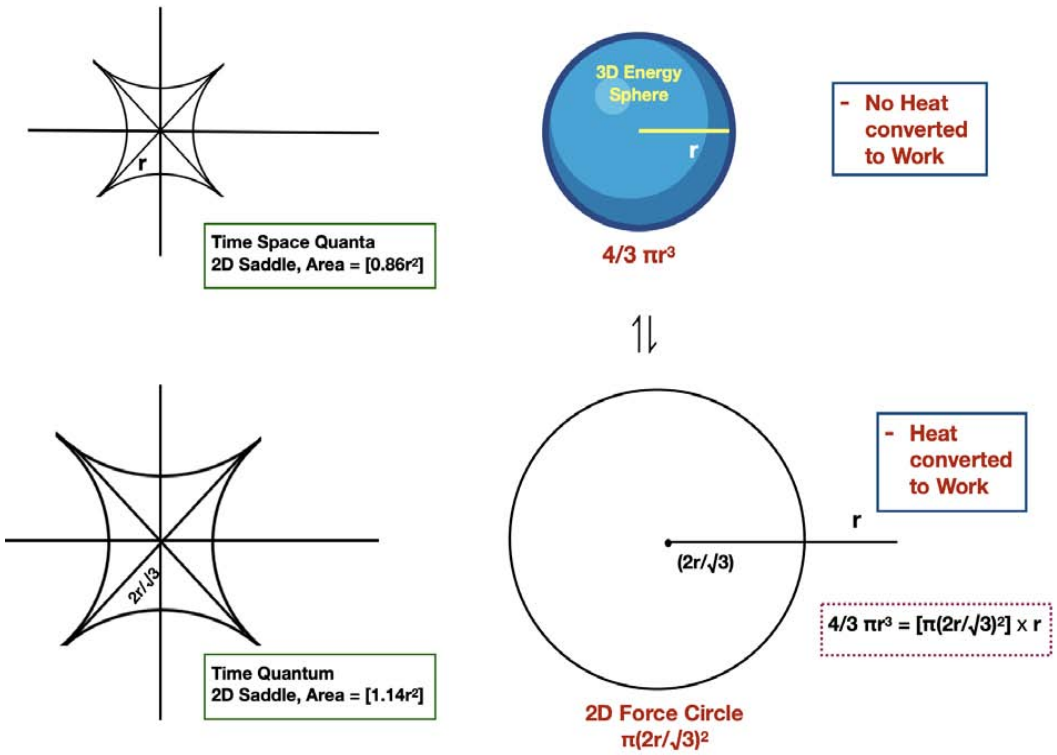

Figure 17a: Relativistic effect on 'time' when heat is being converted to work

So the 'force' under this 'relativistic' condition (non-constancy of the frame of mass and time) cannot not be expressed in regard to the 'absolute mass' or 'absolute time' as Newton did in his equation, expressing force as a product of mass and acceleration (S/t^2).

The most relevant reason why the Newton's expression of Force in regard to mass is not being suited for the moving objects is being explained below:

This can be understood by taking the example of heating a gas in a cylinder fitted with a piston. As the gas is being heated, the piston will try moving upwards but to keep the volume constant, more and more pressure has to be applied on the piston. As the pressure increases on the piston, the force would also go on increasing since force = (pressure on the piston) x (surface area of the piston). Now upon the application of heat on the gas, the molecules are being accelerated and exert more pressure/force on the piston. The heavier the molecules of the gas (higher be the mass of the molecules) it will exert more pressure/force on the piston. So under this condition,

- Force on the piston become directly proportional to the mass of the molecules
- Force on the piston become directly proportional to the acceleration of the molecules

So force on the piston = K x mass x acceleration

[K = constant = path length of the molecules= length of the cylinder from its base to the fixed positional point of the piston].

The form of equation above (as that of Newton) stands justified for any non-moving object whether it be a gas, liquid or solid. Newton had presented his equation, (force = mass x acceleration), but did not establish it through any example of a physical occurrence. However, the explanation/example given above is the best possible way to learn the physical significance of Force = mass x acceleration, and this way it is not being taught to the students of physics.

For a moving object in space upon the earth (for example an iron ball), in fact generates a mechanical wave, as is being explained now. The iron ball (or any object) has a certain volume when it rests (V_0 says and is equal to the volume of the space it does occupy or displace) and has a certain mass too. One has to apply a critical force to make the object moving and the magnitude of the force would be higher if the mass of the object is higher. The very instant of time when the object gets an inertia of motion, then its mass no longer remains to be the deciding factor for its further accelerating motion or movement. Under this circumstance, how much the space could be expanded with time in comparison to the above said V_0 becomes the true index of force of an accelerating object generating mechanical waves in the space. Higher the value of the ratio of (Rate of space expansion with time/V_0), higher would be the force and more and more it will go on accelerating.

In the game of football, one must be observing that the goal keeper is often taking the football in his own hand and making the ball rolling on the ground and another player kicks the ball in the state of its rolling. This way, kicking the football, makes a good rising of the ball above the ground level and it moves at a higher speed than a football being kicked at its position of rest. The football under the state of rolling (which has overcome its mass already) should be considered as a point in the space or a 'space -point', and the propagation of the said 'space point' in the manner as shown in Figure 17b below gives rise to the progression of 'mechanical wave' in the space.

Newton did not consider all the above said factors and his equation of force would be aligning to the random motion of the molecules of the non-moving objects within a closed system (as the case of heating a gas as cited above). For the directional motion of any object where energy is continually being converted to work, the Newtonian equation loses its significance and becomes a 'misfit' one.

In fact the movement of an object is arising out of the hybrid effect of 'force quantum' and 'energy quantum'. The hybrid effect of 'energy' and 'force' gives rise to the generation of 'mechanical waves' and it is the mechanical wave which spreads in space and there occurs an expansion of space. Its features resemble the propagation of EM-waves. As the force is being increased the space expands more and more with time as shown in Figure 17b below. While the magnitude of energy quantum remains to be constant, the magnitude of the force quantum increases consecutively with time. The geometry/characteristics of the progression of a mechanical wave should be mapped in regard to its, i) direction, ii) velocity and iii) velocity distribution as a function of time. So the 'mass' of the object is not a parameter of concern at all. Since velocity relates to volume in TSQ and the said 'velocity distribution as a function of time' would be related to the very logical reason there off to 'volume/space expansion as a function of time'.

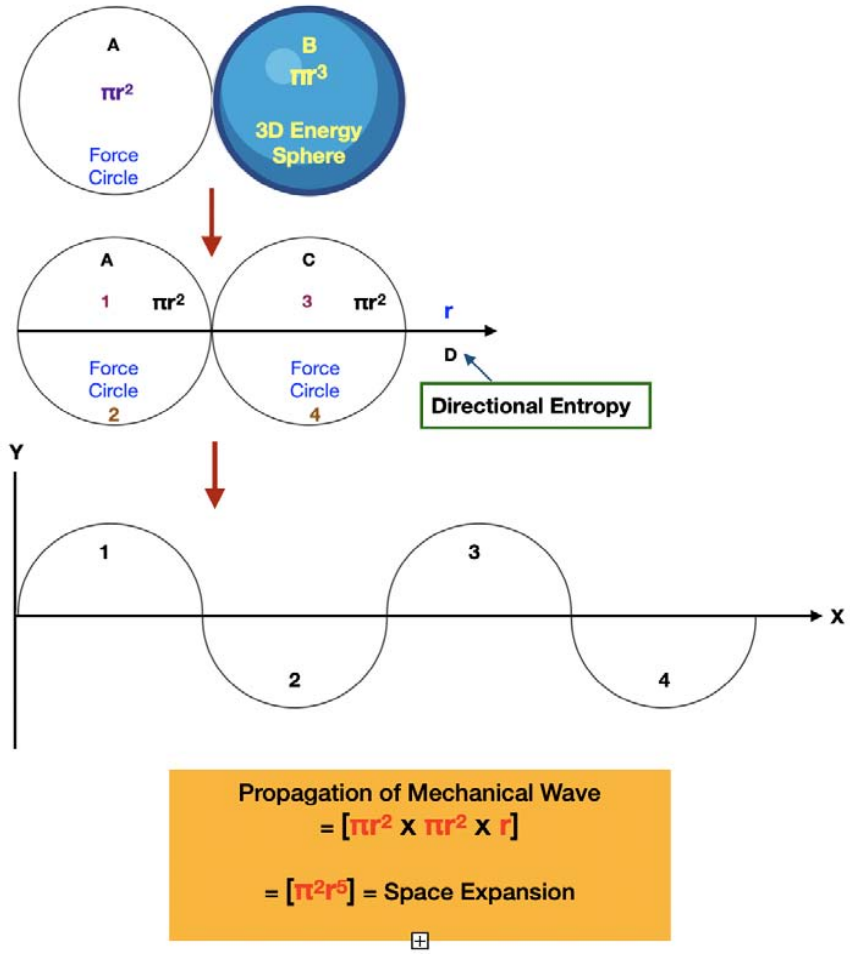

Figure 17b: Schematic presentation of Mechanical Wave in space as 'energy-entropy' hybrid

The force needs to be redefined in relation to 'rate of space expansion with time'. When an object is at rest, it displaces a volume equal to its own volume (V_0). As per the concept of TSQ, energy, $E = 3V_0$, and during the motion of the object, the proportion by which the space expands in relation to the original displaced volume (or energy) is the measure of force. So the force being redefined in TSQ as follows:

In the event of the moving of an object,

Rate of Space expansion (dV/dt) is directly proportional to the force when the initial energy/volume is a constant quantity.

So, Rate of Space expansion (dV/dt) = (force) x (original volume, V_0) (33a)

Force = $[1/V_0\ (dV/dt)]$ = Mechanical space expansion coefficient

= (Rate of Space expansion as a function of time/ volume or energy of the object at rest) (33b)

While the 'thermal expansion coefficient' (TEC) is,

$$TEC = [1/V_0(dV/dT)] \quad (33c)$$

It turns out from equation (33a) and equation (33b) that while the 'force' is being related to 'rate of change of volume with time', the TEC, is being related to 'rate of change of volume with temperature'. The TSQ approach derives an expression of 'force' (which unlike Newtonian approach is free of 'mass') in the form of 'mechanical space expansion coefficient' and which indeed is the 'force' of a moving object. This is altogether a new concept in physics.

Now let us examine the difference of the prediction of Newton vis-à-vis TSQ:

Newton expression for Force = F = (mass x acceleration) (34)

The differences between the two approaches [comparing the two equations (33) and (34)] are:

- In Newtonian expression both mass and acceleration are variables but in TSQ mass is being a constant for a particular object and space expansion is a variable.
- If both the mass and acceleration are increasing to a very large extent then force will be tending to very to very large or infinity and energy will be infinite and which is being a forbidden event on the ground of the law of conservation of energy. In TSQ, mass is a constant and even if the space expansion is increasing, the Force or energy will never be tending to infinity since the conjugate 'space inversion' quantum would not allow the same since there is an equilibrium existing between the two (see the universal space quantum cycle in Figure 14) which shows an equilibrium relationship between the two as [88]:

$$(\text{space expansion}) \times (\text{space inversion}) = \text{constant} \quad (35)$$

As a result none of them can attain a value of infinity. So space expansion might increase but after attaining a limiting value it has to decrease to maintain the constancy of the equation (35).

- In regard to dimension both the Newton's prediction and TSQ are the same and is equal to
  Force = MLT^{-2} but Newton's prediction is forbidden from the point of view of thermodynamics.

Since dimensionally both the predictions (Newton vis – a- vis TSQ) are the same, the topological presentation of 'Force' is shown in Figure 18 below [88]:

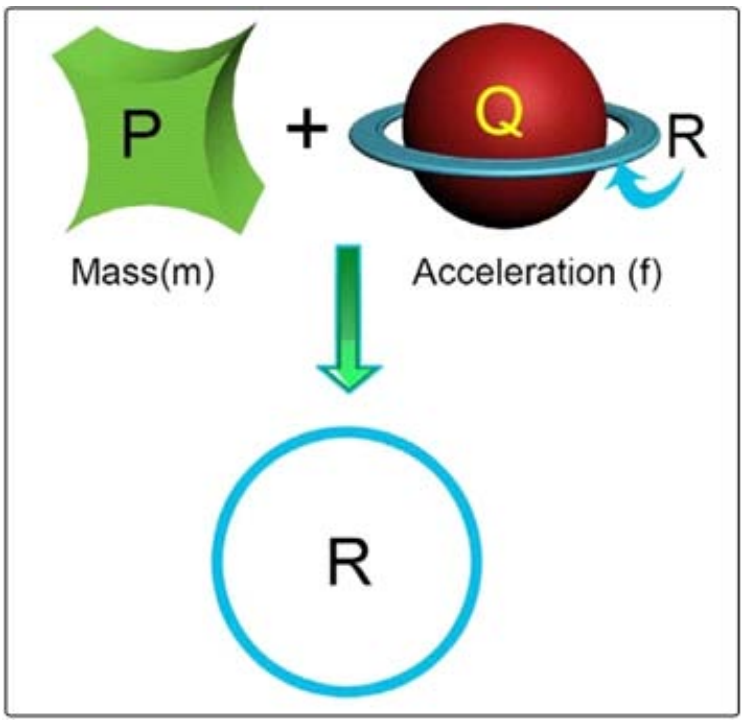

Figure 18: The topological presentation of Force = (mass x Space expansion) of TSQ or of Force = (mass x Acceleration) of Newton

In figure 18, the outer force circle R (of the acceleration/space expansion) will be pushing forward the inner 3D energy/volume sphere such that the space expansion occurs. So the dimensionality of space expansion or acceleration reaches to 5D (L^3 of the sphere x L^2 of the circle = L^5). The inverse 3D dimensionality of the mass quantum being multiplied by a 5D space expansion field creates a force circle R of 2D.

$$[\{\text{mass}, (1/L^3) \times \text{space expansion}, L^5\}] = L^2 = \text{Force Circle} \quad (36)$$

Newton's formula for 'force' in the form of mass and acceleration is suited for 'non-quantized' or 'continuous' sort of 'time-space' constitution of the universe but it does not stand suitably against the quantized 'time-space'. In TSQ depicted 'space-time' there occurs continually i) superposition, ii) exchange and iii) entanglement of the multi various space quantum among each other. The multi various space quantum do have distinct but differing geometrical shapes. So the 'force' does appear in the universe in the different forms of permutation-combination of the several space quantum and 'force' becomes the

resonance hybrid of the different forms of 'time- space'. The presentation of Force can be made in an altogether newer manner than that of Newton's formula of force. In TSQ, 'force' is a circle (πr^2) and a circle can be topologically represented in multiple ways as shown below:

Area of a circle of radius r = [(A sphere of radius r)/(4r/3)] = [$(4\pi r^3/)/(4r/3)$] = (πr^2)

= (A quantum of volume/ A quantum of Entropy) (36a)

Area of a circle of radius r = [(A circle of radius r)^2)/ [(A circle of radius r)] = [$(\pi r^2)^2/)/(\pi r^2)$] = (πr^2)

= [(A quantum of EM-wave) x (A quantum of Time)] (36b)

[(A circle of radius r)] = [(A 2D saddle of area $1/\pi r^2$) x (A sphere of radius r) x(3/4) x ([(A circle of radius r)]

= [$(1/\pi r^2)$ x (3/4)x $(4\pi r^3/3)$ x (πr^2)]

= (πr^2)]=[(A quantum of time) x (A quantum of space expansion) (36c)

[to note here that the mathematical expressions of the different physical space quantum of TSQ of equation (36a) to (36c) are as following:

Volume quantum = (πr^3)

EM – wave quantum = $(\pi^2 r^4)$

Time Quantum = $(1/\pi r^2)$

Space expansion = $(\pi^2 r^5)$

Entropy = (r) or (πr)

The quantum expression of equation (36a) to (36c) have been made on the above relations]

So, the three expressions of force (out of the innumerable possible expressions of Force in TSQ) are:

Force = (volume/entropy)

Force = (EM-wave x time)

Force = (Space expansion x time)

In TSQ, many to many expressions of force can be fabricated in the manner as shown above and in the language of organic chemistry it might be called the numerous 'isomeric topological forms of force'. The concept of the dynamics of motion in physics does flow altogether to a new horizon in TSQ than from the Newtonian concept where the 'time-space' is considered to be a continuous entity.

If the example of walking of a person as discussed at the beginning of the article is being relooked, it is to be noted that in each unit of time the person will be displacing more and more volume of the space and so side by side developing the kinetic equations of motion in regard to distance, the kinetic equations of motions are being required to be developed with respect to volume or Space expansion quantum. Proceeding in the same fashion as that for distance kinetics of motion, the following equations can be derived very straight forward in regard to space expansion as shown below:

$$V = V_{av}\, t = V_1 t + (1/2)\, \Delta V_{in}\, t^2 \quad (37)$$

or

$$V_t = V_1 + t\, \Delta V_{in} \quad (38)$$

In equations (37) and (38), the following points are to be noted

V_t=Total volume/space expansion generated in the journey of the object in time t.

V_1 =Volume/space expansion generated in the first unit of time.

ΔV_{in}= Rate of incremental volume with respect to time, $(\Delta V/\Delta t)$

V_{av} = Average volume generated for each step of the travel of the object.

Regarding the 'Kinetic Energy' parameter, the formula presented in Newtonian physics, KE = $(1/2)[mv^2]$, m, standing for mass and v stands for the velocity of the object, is not acceptable on the ground of the fact that the parameters like constant 'acceleration' or constant 'retardation' (based on which the KE expression as mentioned above had been derived) do not stand at all. In TSQ, the energy E = 3V and V represents the 'volume energy' and 2V represents the 'internal energy'. As a matter of fact it is very much required to come out from the concepts of 'potential energy' and 'kinetic energy' of classical or Newtonian Physics. These terms should be replaced with 'internal energy' and 'volume energy' respectively indeed.

The total volume generated by a moving body at any instant of time can be treated as the volume energy (or the so-called kinetic energy) to be obtained from equation (37) knowing the value of ΔV_{in}. So from a plot of V versus t, as per equation (37) the 'volume energy' at any point can be calculated. If an object is moving with a constant velocity for a time t, then its volume energy will be Vt, here t should be considered as

a multiple only. The change in internal energy will occur when an object is being distorted by mechanical process or by other processes and also it will depend on whether the process is being carried out 'isothermally' or 'adiabatically' or under the 'constant pressure' condition.

IV. Concept of Discontinuous Time Space of the Universe

As far as the literature of physics is considered, we often find quotes like 'the physical variables of the universe are not continuous but discrete or discontinuous' or 'the time- space of the universe is not continuous but discrete'. However, the traditional explanations given against the above quotes are:

- The physical variables are quantized.
- While in a continuous space the distance between two points are measured by distance in regard to arbitrary set units (like millimeter, centimeter or kilometer), in a discontinuous space the said distance would have to be counted in regard to numbers.
- A physical variable does grow with some gaps in between.

However, many people do not get clarity and fail to visualize the concept of discontinuous or discrete time-space. TSQ explanation of the discontinuous 'time-space' is given below (which will undoubtedly help the readers to visualize the concept of a discontinuous 'time-space' of the universe):

- When on a plain and straight road either a person walks down or a car does go on moving, it is being assumed that the movement is taking place linearly through a straight line. However, in reality the path of the movement is an up-down wavy one, which is being generated out of the phenomenon of the hybrid of 'force' and 'energy' space quantum associated with the person or the car. This is a mechanical wave and the geometry/topology of the said wave is being shown in Figure. and the person or the car should be treated as a 'point' of the space as if the 'space point' is moving along with the wave.
- The changes or the processes taking place in nature as a regular occurrence belong to either the transformation of heat to work or the transformation of work to heat. While an apple falling from a tree on the ground on the earth is an example of 'work being converted to heat', the event of a swimmer running and diving in a river, is an example of 'heat being converted to work' and for all such occurrences, the 'mechanical waves' do propagate in the space/nature and those are non-linear in nature and not being in the form of a linear straight line. So they are discontinuous in regard to their geometry in comparison to that of the geometry of a straight line.
- The above said mechanical waves do originate from the 'space quantum of the universe' and all the said space quantum are quantized in the sense as shown below in the following Table.

Table 4: Quantized vis -a- vis non-quantized physical variables of the universe

Physical Variable of the Universe	The general mathematical expression of classical physics	The general mathematical expression of TSQ
Distance	nr r is any arbitrary unit distance and n is a number of any real value.	$n\pi r$ r is the smallest possible length/entropy quantum of the universe and n is integer only The physical variables attain values like: πr , $2\pi r$, $3\pi r$, $4\pi r$ … respectively
Area	nr^2 r is any arbitrary unit distance and n is a number of any real value	$\pi (nr)^2$ r is the smallest possible length/entropy quantum of the universe and n is integer only The physical variables attain values like: πr^2, $4\pi r^2$, $9\pi r^2$, $16\pi r^2$ respectively.
Volume	nr^3 r is any arbitrary unit distance and n is a number of any real value.	$\pi (nr)^3$ r is the smallest possible length/entropy quantum of the universe and n is integer only The physical variables attain values like: πr^3, $\pi r\ 8^{\ 3}$, $\pi r\ 27^{\ 3}$, $64\pi r^3$….respectively.

The above description of the 'discrete or discontinuous time-space' of the universe being based on the logic and philosophy of TSQ embodies the concept of 'time-space' of the universe in the best possible manner than being presented previously in the literature in many other abstract manner.

- *Proof of the Quantized nature of the 'time-space' of TSQ*

In TSQ, the physical variables of the universe have been claimed to exist in the form 'space quantum' of different topologies or geometries. Though all the said physical variables in TSQ have been defined and explained in the tripartite manner in regard to the physics of their formation, their dimensionality or topologies and their mathematical derivations, a penultimate proof of any theory always makes its foot-hold stronger.

In a recently accepted article [101] to be published, (written by the authors of this current article), it has been proved that π is a universal spatial parameter (is evolved from space only) in the form of the smallest possible circle or smallest possible 3D sphere of the universe. The mechanism of formation of π space quantum has been described in the said article in regard to physics of formation, the underlying mathematics and the topology of π. However, it cannot be reproduced here, but here it is being shown how the different direct space quantum and reciprocal space quantum are evolved in space. In fact in the first publication of TSQ [88], it had been shown that there does exist a point of 'singularity' in the universe of inverse 10 dimensionality (which is arising out of the overlapping of the two numbers inverse acceleration fields) and from the disintegration of the said 'singularity' all the other space quantum/cosmological phenomenon has arisen out. (Figure 14 above).

The mathematical presentations of 'space expansion' (SE) and 'inverse space expansion' (ISE) of TSQ are:

$$SE = (16\,\pi^2\,r^5/9) \tag{38a}$$

$$ISE = (1/SE) = [1/(16\,\pi^2\,r^5/9)] = (9/16\,\pi^2\,r^5) \tag{38b}$$

$$\text{Singularity space quantum} = [ISE]^2 = (81/256\,\pi^4\,r^9) \tag{38c}$$

The formation of 'singularity' is being shown diagrammatically in Figure 18a below.

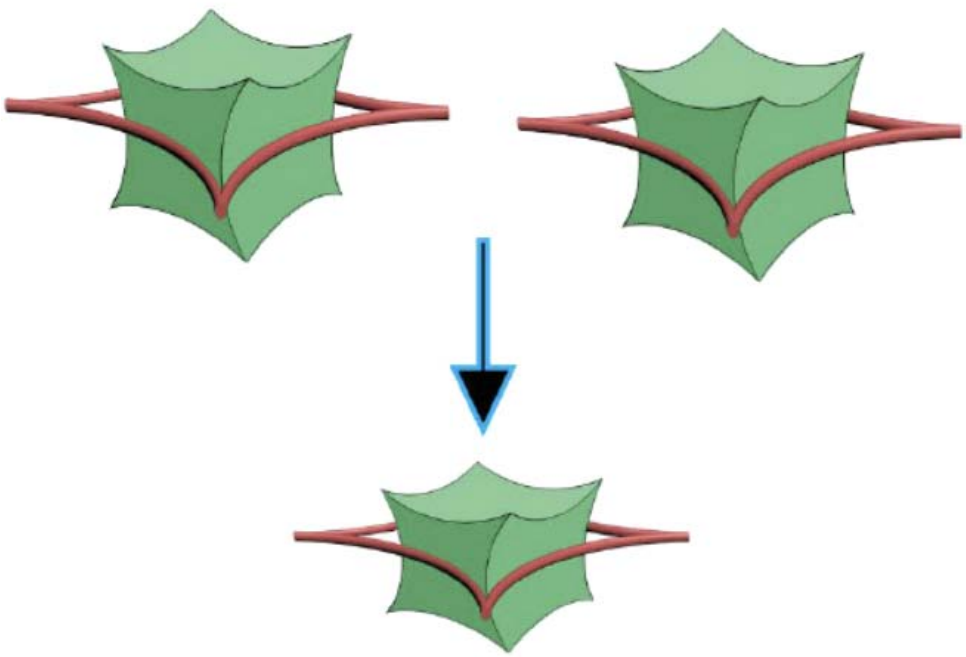

Figure 18a: Overlapping or Hybrid of 2 no. of Inverse acceleration fields to form the Singularity

In the Table 4 below, the consecutive disintegrations of the 'singularity' quantum are being shown. In each of the occasions of its disintegration, either one entropy quantum or a π space quantum each comes in the direct space upon inversion, and newer space quantum are being generated.

Table 4 Presentation of the Evolution of the Different Space Quantum from the 'Singularity'.

Table 4: Presentation of equilibrium between push forward space quantum and the pullback space quantum

Table 5: List of different conjugate 'push forward space quantum' and 'pull back space quantum' of the universe.

Table 5: 'Push forward Graviton-Pull back the Space Quantum conjugate pairs

The quantized nature of the inverse (in the forms of space quantum) can be seen through the naked eyes in the 'capillary rise' and 'capillary fall' experiments/phenomenon in simple laboratory experiments. On the macroscopic level, the quantum cannot be seen. One cannot expect to see, for example, the 'time' quantum or the '3D energy/volume sphere quantum' within a glass beaker holding a certain quantity of water as for example. The moment a capillary glass tube is being held on the surface of the water, a capillary rise is being observed. The upper meniscus of the water in the capillary is clearly being seen to be concave upwards by its geometry.

In case of doing this experiment replacing water with mercury, instead of capillary rise, a capillary fall is being noticed. Such 'capillary rise' and 'capillary fall' phenomenon are being explained in classical physics/physical chemistry through surface tension, contact angles between glass-air, glass- water/mercury and air-water/glass respectively and are a bit complicated. However, the TSQ interpretation is very simple and straightforward as being elaborated below:

- An atom in TSQ is a hybrid or entanglement of 'entropy' quantum, '2D saddle' 'time' quantum and '3D energy/volume' quantum as shown in Figure 11 to Figure 13.
- In case of water (which is much less cohesive than mercury), once the capillary tube is hold on the surface of water, an '3D energy quantum' pass on to its differential form in the form of 'force' and 'distance' (as shown in Figure 18b, LHS to RHS) and heat is being converted to work. So the '3D energy quantum' disintegrates and no longer exists in the water in the capillary. Under this circumstance, what is left is the '2D saddle time quantum'. A 2D saddle is concave upwards as shown in Figure 11 to Figure 13 and that is being observed at the upper meniscus of water level in the capillary.
- In case of mercury (which is much highly cohesive than water), once the capillary tube is being hold on the surface of mercury, the work in the form of 'force' and 'distance' integrates back to a '3D energy quantum' pass on to (as shown in Figure 18b, RHS to LHS) and work is being converted to heat. So the '3D energy quantum' in its integrated form does exist as a predominant one in the mercury in the capillary. Under this circumstance, it is the '3D energy sphere which makes the upper meniscus be convex upwards. However, this is very much observable through the naked eyes.

This phenomena are being shown schematically in Figure 18b below:

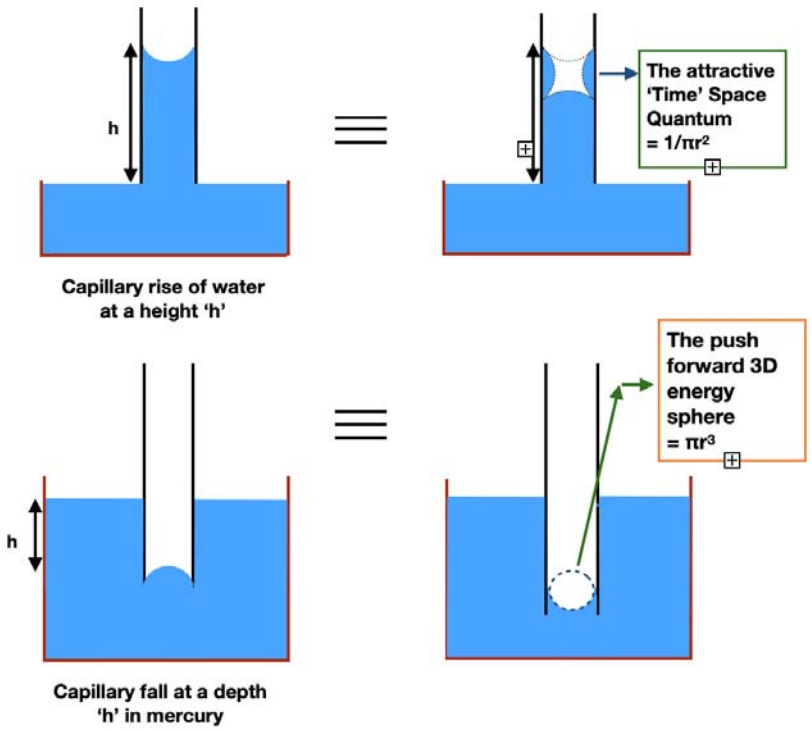

Figure 18b: 'Capillary-rise', 'Capillary-fall' and 'Quantum nature of Space'

The above described phenomenon of 'capillary rise' and 'capillary fall' and the TSQ showered explanation of the said phenomenon very firmly establishes the quantum nature of the 'time-space' of the universe. The explanation being given in conventional physics in the form of, 'in case of water, the adhesive force of water-glass interface is higher than cohesive force of water and that is reason the water meniscus is concave upwards' and 'in case of mercury, the adhesive force of mercury-glass interface is lower than cohesive force of mercury and that is reason the mercury meniscus is convex upwards'. are very fragile concepts indeed are not very convincing too though they are being taught from the higher school levels to the students? However, the text books should start re-explaining things in regard to the TSQ.

As shown in equation (4), force is inversely proportional to distance, when energy is constant. Since the expression of energy in the form of (force x distance) evolved from classical thermodynamics and classical physics, it is very much required to check whether the said inverse dependency of Force and distance could be derived from Classical physics or not.

The energetics of a moving object is required to be understood first. When a car moves, it is driven by energy which comes from the surroundings or space only (from the burning of fuel or the electricity from the transformer or battery), however, exactly the same amount of energy is being transferred back to the surroundings or space. The space thermodynamics is: 'Any energy taken from it has to be returned back to it or any energy given to it, the space will return it back'.

While a car moves, it generates volumes or energy and as a result the space gets back the energy that it had supplied for driving the car. The said deliveries and returns may not always be instantaneous. An apple tree has to impart some energy to the space to let an apple grow, attains its proper shape and ultimately be hanging from one of the branches of the tree. The moment the apple falls from the tree and hits the ground, the energy which was given to the space is being returned back.

The quantum representation of an apple falling from a tree is being illustrated below

When a tree grows: in each of the units of its infinitesimally small quantum growth, the heat or energy quantum does break -up into force and distance and the equilibrium as shown in Figure 17 shifts from the left to right (energy converted to the work) .

When an apple falls from the tree: The equilibrium as shown in Figure 17 does shift from the right to the left or the differential form of work (work done for the tree/apple to grow and hang) being integrated back to heat energy. In other words, the work is being converted back to heat or energy.

If for example n numbers of 'energy/heat quantum' are being used up (broken up into the differential form of force and distance), when the tree

does grow, exactly the n numbers of 'force' quantum will be integrated back to heat or energy. This is the TSQ interpretation of the 'apple falling from a tree'. This being is totally different from Newton's interpretation in the form of gravity/acceleration due to gravity.

When a football is kicked, the person kicking it puts some energy on the football and the person is gaining the energy from the space itself (by up -taking of foodstuff or energy drink) and the football while moving in the space, generates volume or energy and that's the way the space is getting back the energy. When the football falls on the ground the work done is returned back as heat resembling the event of an apple falling from a tree.

Throughout the entire universe every instance many to many movements are continually taking place (the movements of the stars and planets, in our earth there is happening the running around of the cars, the movements of the animal kingdom and human beings, the ships, the aero planes, the trains…etc.. in each and every corner round the clock). For all these happenings, the physical variables 'force' and 'distances' remain in a state of 'increasing – decreasing' but the energy (E) remains to be constant and it has to remain constant only otherwise there would be a situation of violation of the law of conservation of energy.

A thought of experiment to prove the existence of the quantized 'time-space' of the universe:

A thought off experiment of the compression and expansion of rubber ball is shown in Figure 18c and 18d below:

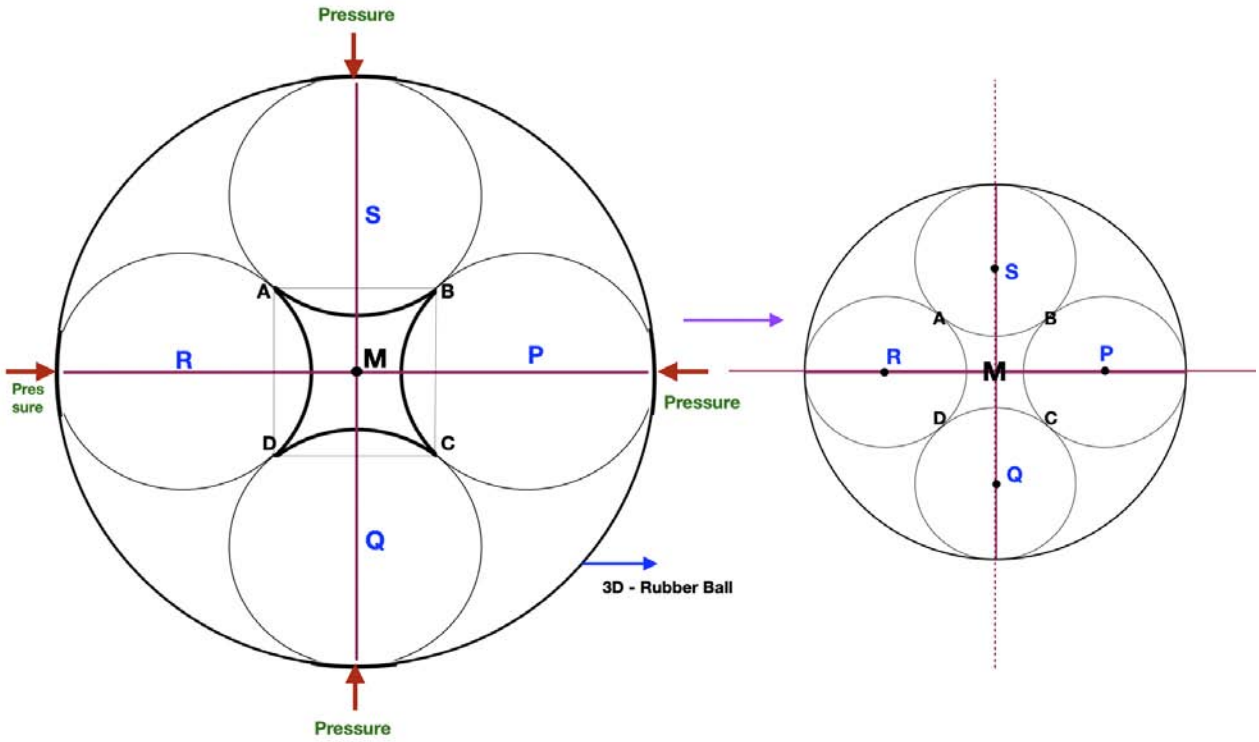

Figure 18c: Compression of an object to reduce its Volume (a presentation of quantum nature of the universe)

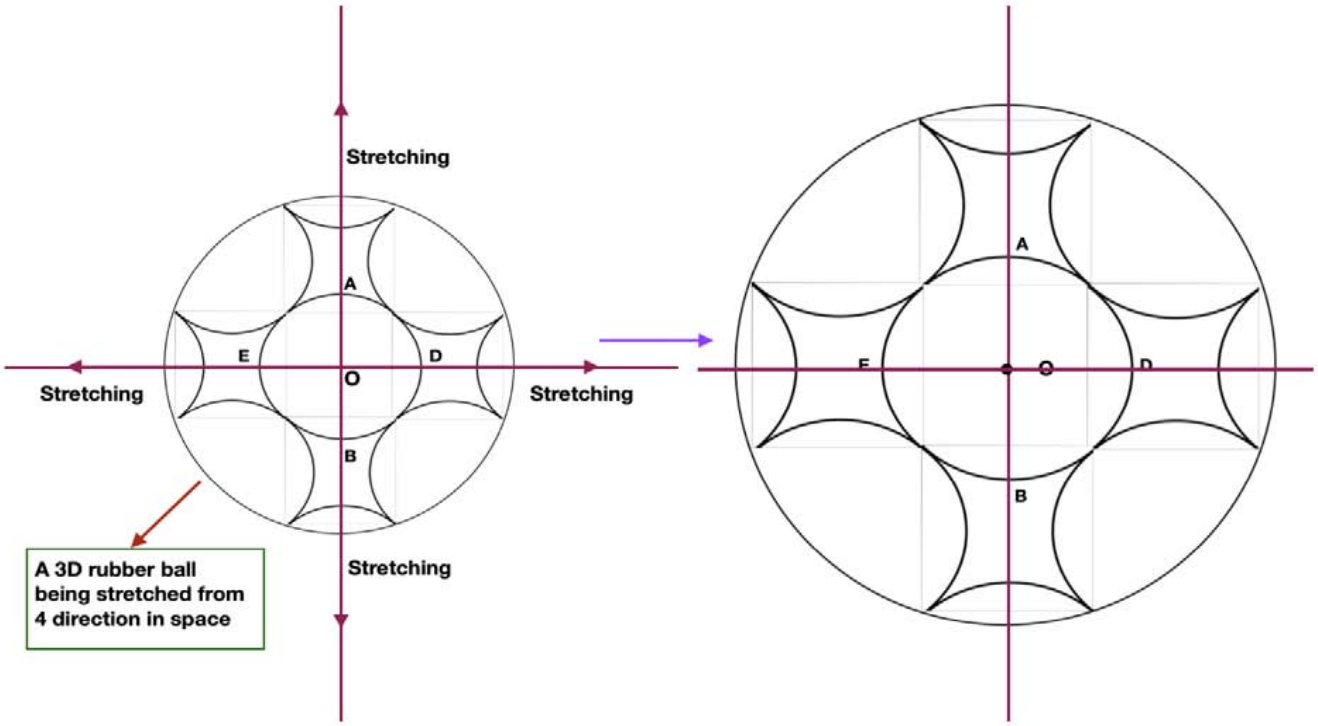

Figure 18d: Stretching of a 3D - object and enlarging the volume (a presentation of quantum nature of a space)

As shown in Figure 18c, when the rubber ball is being compressed from the 4 sides uniformly (through the x axes and y axes respectively as shown), as per Newton's 3rd law of motion it should not compress at all since 'action-reaction' forces through the axes's x and y should be cancelling each other. In reality, pressure compression is being done in the practical day-to -day life for sizing the thick metal sheet to a thinner by cold rolling process. Through Newtonian mechanics, however, explaining the physics of cold rolling process or pressure deformation (in the form of shrinkage) turns out to be difficult. TSQ demonstrates this phenomenon in regard to the quantum nature of the 'time-space' of the universe.

As shown in Figure 18c, while compressing the rubber ball, 4 numbers of quantum force circles are getting involved (2 each in x and y axis respectively as shown) and when the alignment/orientation of the said 4 numbers of quantum (P, Q, R & S) attain the shown conformation (in space) as being shown in Figure 18c, a reciprocal squeezing 2D saddle quantum (M) is being formed. This squeezing/attractive 2D saddle quantum becomes responsible for the contraction of the rubber ball. If this reciprocal space quantum would not have been existing in nature/space, compression volume reduction or cold rolling of metal sheet were not at all possible.

In figure 18d, the reverse event of compression, which is the expansion of the rubber ball, is being shown by applying 'pull back force' from the 4 different directions. In this case, at a certain specific orientation/ alignment of the 4 numbers of squeezing pull back forces, (2D saddles) a push forward space quantum is being evolved and this only makes the expansion of the rubber ball a possible event.

From the above experiments, it is being revealed that the space has to be a quantized one and otherwise the physical/mechanical 'expansion-compression', cold rolling, wire-drawing, size reduction by grinding would not have been made possible. From the above experiments the following conclusions can be drawn regarding the 'time-space' of the universe.

- The baryonic matter of the universe belongs to the 'hybridized space' which is the hybrid of 'push forward space quantum' (of direct space) and 'pull back space quantum' (of the indirect or reciprocal space). The so-called 'matter' is the co-existence of the 'direct space' and the 'reciprocal space'. An atom is represented in TSQ as a hybrid of energy, entropy and time. Energy and entropy belong to the 'direct space' and the 'time' belongs to the reciprocal space.
- Often, we use the two words 'mass' and 'matter' interchangeably However, this is a wrong notion. Mass belongs to the 'reciprocal space' and the typical example of mass is a 'black hole'. In fact, any mass which is being considered alone

separated from matter belongs to the category of 'black hole'.

- 'Energy' or 'volume' belongs to the direct space. When energy alone is being considered which is being separated from matter is the 'dark energy'. When a fuel is burnt, energy is converted to work. The said work (differential form of heat) passes on to the space and which is what 'dark-energy' is. It is 'dark' in the sense that it no longer belongs to a matter.
- The 'push forward' and the 'pull back' space quantum are interconvertible among each other (Figure 18a and 18b). Only due to the said 'interconvertibility' phenomenon existing in the 'time-space', the sun is rising, waves are crashing in the sea, the clouds roar, the rain is falling, the days in the universe are being counted with its chest full of hope.

In classical physics, energy expression in regard to the Newton's second law of motion is:

$$\text{force} = \text{mass x acceleration}$$

$$= M\,L\,T^{-2} \qquad (39)$$

Or, $$\text{force} = (E/C^2)\,L\,T^{-2} \qquad (40)$$

[Since as Einstein mass – energy equivalence mathematical expression $E = MC^2$, M is the mass and C is the velocity of light and is a constant]

So from equation (40), one can write, when E is constant too,

$$\text{Force}\ L\,T^{-2} \qquad (41)$$

So from equation (41), Force being inversely proportional to Distance (L or S) is not being proved.

While it remains to be true that force is inversely proportional to distance when energy is constant but by Newtonian physics it can never be explained.

V. TSQ only can Explain it through Physics, Mathematics and Geometry as Discussed below

- Physics – 'Energy' is the integrated form and the 'work done' is the differential form of energy as already discussed.
- Mathematics – Energy(E) is $(4\pi r^3)$ and it can be broken into force part and distance part as

$$E = \pi\,(2r/\sqrt{3})^2 \text{ x } 3r$$

Or $$E = \pi R_1^2 \text{ x } R_2 \quad [R_1 = (2r/\sqrt{3}),\ R_2 = 3r] \qquad (42)$$

In equation (42), πR_1^2 stands for 'force' and R_2 stands for distance. When the energy is decreasing both R_1 and R_2 decreases maintaining the ratio of the two as shown in equation (42) and the reverse is being true when E is increasing. But when E becomes constant, the dimensions R_1 and R_2 adjusts each other in a manner such that E remains to be constant though force and distance both would be varying. For converting force more and more to distances R_1 decreases but R_2 increases disproportionately but the product of 'force' and 'distance' remains to be constant. For converting distance more and more to force R_2 decreases and R_1 increases disproportionately but the product of 'force' and distance remain constant. The first example of distance increasing is the event of heat or energy being differentiated to 'work' and the second example of distance decreasing is the integrating of 'work' to heat or energy.

Table 6 below shows the changing profile of 'force and distance' when energy remains constant and is transformed to 'work. Table 7 below shows the changing profile of 'force and distance' when work remains constant and is transformed to 'energy'. Newtonian physics paid more attention to dimensional matching of the RHS and LHS of the proposed equations of motion and put a very little focus on thermodynamics and embodying the principal physical variables 'time' and 'mass'.

Table 6: Variation of 'force' and 'distance' when energy is constant – 'energy to work'

Energy = $(4\pi R_1^2) \times R_2$	Distance = R_2	R_1	Force = $(4\pi R_1^2)$
1000	1	9	1000
1000	2	6.3	500
1000	3	5.1	333
1000	4	4.5	222
1000	5	4	200
1000	6	3.6	167
1000	7	3.4	143
1000	8	3 .15	125
1000	9	3	111
1000	10	2.9	100

Table 7: Variation of 'force' and 'distance' when energy is constant – 'work to energy'

Energy = $(4\pi R_1^2) \times R_2$	Distance = R_2	R_1	Force = $(4\pi R_1^2)$
1000	10	2.9	1000
1000	9	3	500
1000	8	3.15	333
1000	7	3.4	222
1000	6	3.6	200
1000	5	4	167
1000	4	4.5	143
1000	3	5.1	125
1000	2	6.3	111
1000	1	9	100

- *Topology* In figure 19 below, it is being shown why and how the force is inversely proportional to distance when energy is constant.

Figure 20 shows the graphical representation of force $(4\pi R_1^2)$ against distance (R_2) for 'energy' to work and 'work' to energy respectively.

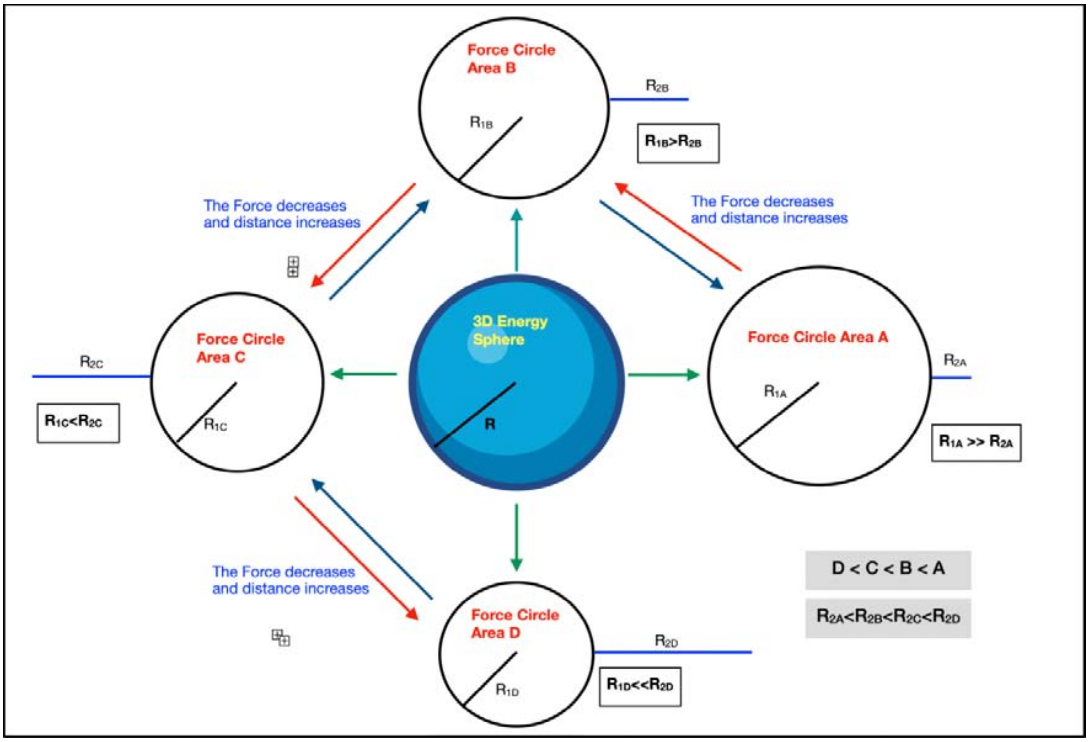

Figure 19: Schematic presentation of data of Table 2 and Table 3, to show the inverse relationship of 'Force' and 'Distance' when 'Energy' is constant

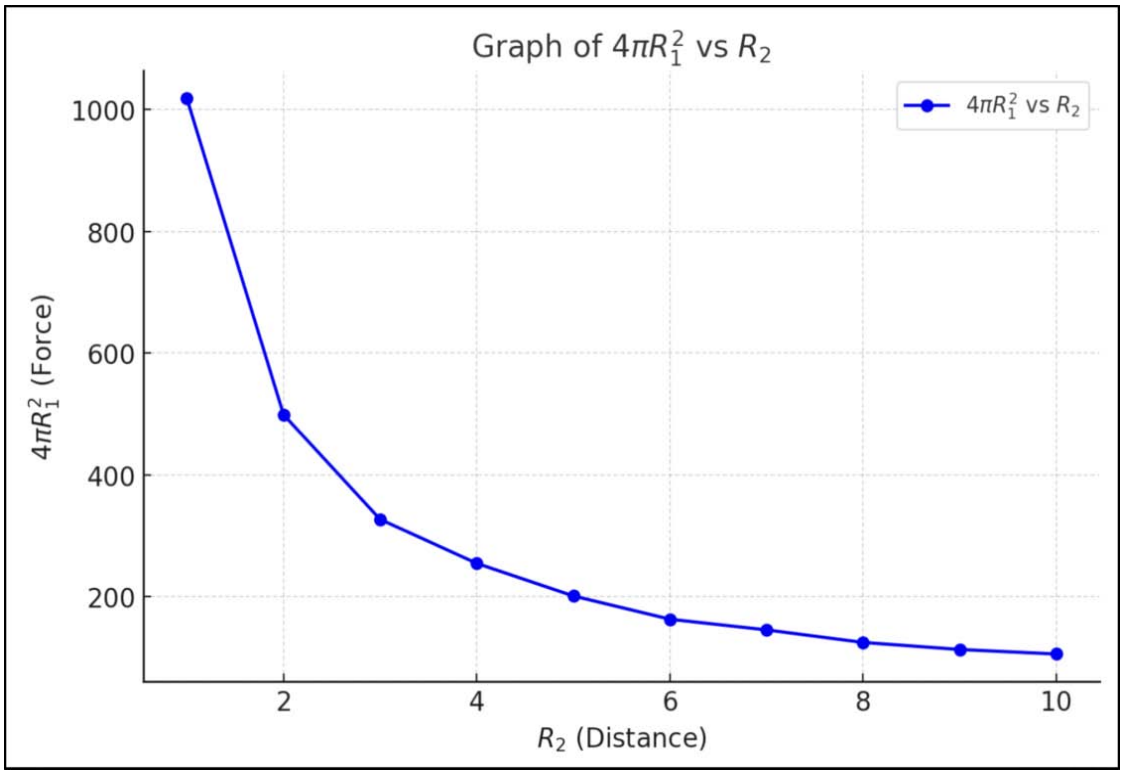

Figure 20: Graphical representation of the variation of Force and Distance as per the data of Table 3

So it is shown that only quantized nature of the space (in the forms of various spaces of the direct space and the reciprocal space) can only explain the 'Force', 'distance' and 'energy' relationship. This as well stamps TSQ as a very realistic theory of the universe.

TSQ shows how 'force' is being converted to distance. While it is said that 'energy' is the integrated form and work is its 'differential form', continuing with this concept, it can be stated that 'force' is the integrated form and 'distance' is the differential form of force.

What is happening in case of incremental motion of an object that at the beginning first unit of time, a certain force is put on the object and when the said force is to a large extent converted to distance (since complete conversion of force into distance is not possible like the one 'heat cannot be completely converted to work, what the second law of thermodynamics is, and a certain part of force has to retained), the higher magnitude of force has to be applied at the second unit of time for the increment of the distance of travel to happen. When this force is converted to distance, yet another higher amount of force than the second unit of time has to be exerted on the moving body for the 3rd unit of time and this would continue so. This kinetics and thermodynamics of motion of TSQ is a superseding theory over the Newtonian mechanics of motion.

The equations of motions as derived in this article equation (14), equation (37) and equation (38) if is recapitulated, they are:

$$V_t = S(t) = S(1) + t\Delta S_{in} \quad (14)$$

$$V = V_{av}\, t = V_1 t + (1/2)\, \Delta V_{in}\, t^2 \quad (37)$$

$$V_t = V_1 + t\, \Delta V_{in} \quad (38)$$

The expansion in volume (or space expansion) takes place in the direction of motion of the moving object as shown in Figure 20a below.

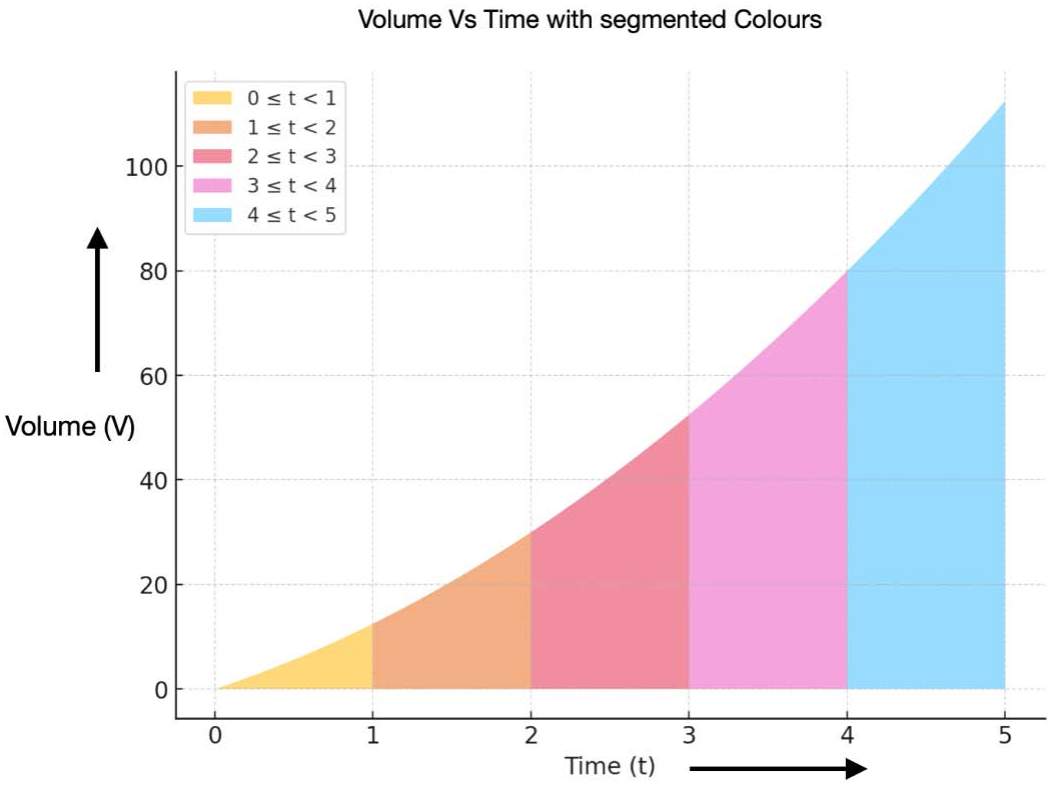

Figure 20a: Presentation of incremental volume generation with time of a moving object (Equation 37)

Now if for example, $V_1 = 100$, $\Delta V_{in} = 10$, S (1) = u = 20, $\Delta S_{in} = 5$ are considered, the values V_t, S (t), Force (F) and instantaneous energies E for four different values of t (1,2, 3 and 4) are shown in Table 8 below:

Table 8: Kinetic and energetics data of a moving object as per equation (13a), equation (37) and equation (38) [$V_1 = 100$, $\Delta V_{in} = 10$, S (1) = u = 20, $\Delta S_{in} = 5$]

t	S(t)	V (t)	Force (F)	Energy = $3V_t$ = [F x S(t)]
1	20	100	15	300
2	25	110	13.2	330
3	30	120	12.0	360
4	35	130	11.1	390

The t, S(t), V(t), F are being considered in an arbitrary scale of choice.

The following points to note:

- At Every unit of time, energy given to the moving object = energy returned back to the space by the moving object.
- The energy of the 'moving object + the surroundings or space' at each unit of time remains constant.
- At the completion of one unit of time, a relatively higher energy (and vis-à-vis force) is applied on the moving object at the beginning of the next unit of time, such that it can cover more distance.

From the data shown in Table 8, it is found that the value of force F is decreasing with time. In fact at the beginning of an unit of time over the previous unit of time, the energy remains in the form of (E x1) [where E stands for force, F and 1 stands for a single unit of distance but upon completion of the said unit of time E falls (or F falls) but the distance is being increased. This is shown in Table 9 below:

Table 9: The pattern of 'fall off' of the hybrid of 'Force and distance' in a single unit of time as per data of Table 8

t	Energy (E)	Hybrid of Force and Distance (beginning of t_{th} unit) (Force x Distance)		Hybrid of Force and Distance (end of t_{th} unit) (Force x Distance)	
1	300	300	1	15	20
2	330	330	1	13.2	25
3	360	360	1	12	30
4	390	390	1	11.1	35

From the data given in Table 8, it is clearly understood as the time progresses, the force starting initially with higher and higher values and ending up with more and more lower values but dissipating to more and more higher distances.

The topological presentation of data of Table 8, Table 9 is shown in Figure 21 below.

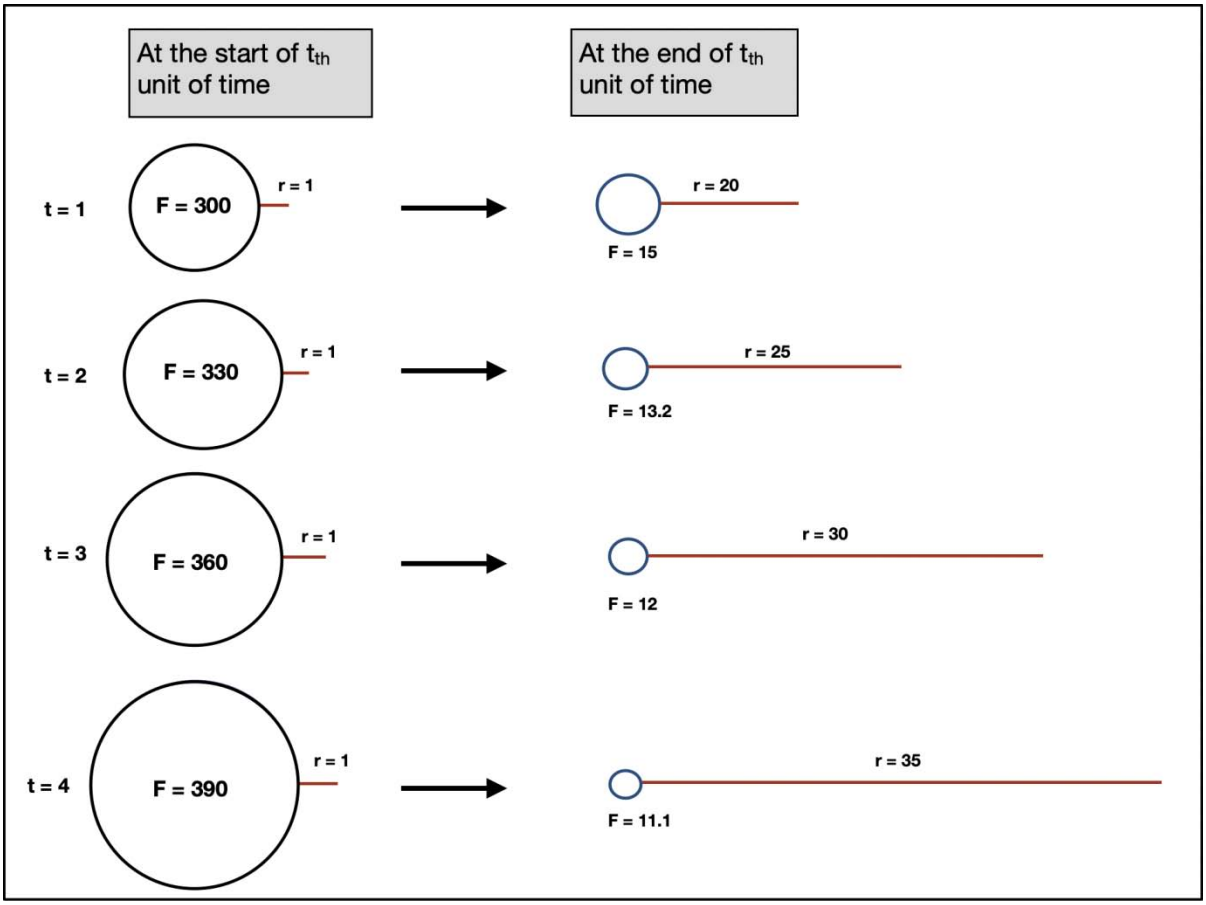

Figure 21: Schematic presentation of how the force is dissipated more and more to distance. (Table 5)

This kinetics and thermodynamics of motion of TSQ is a superseding theory over the Newtonian mechanics of motion.

- *Superseding Laws in Physics*

The three laws of motion of Newton are required to be given together newer shapes in regard to the quantum entanglement character of time, mass, volume, energy, work..etc… and the demerits of the three laws of Newton are being discussed below with a brief introduction of what the quantum entanglement [88-100] is:

The schematic representation of quantum entanglement phenomena has been shown in this article

in Figures 11 to Figure 13 (the interactions among the space quantum of 'energy', 'entropy' and 'time'. From the said figures, it is clearly understood that neither of the three said variables 'energy', 'entropy' and 'time' cannot change alone. If the entropy changes, it makes the energy to change and energy in turn makes the 'time frame' to change (since they are topologically and mathematically connected). If the length of the 'entropy' quantum be r, then energy would be ($4\pi r^3$) and time would be ($3/4\pi r^2$) and so any change in magnitude of either of the said three space quantum will automatically impose the changes on the other two. So Figure 11 to Figure 13 are the representations of typical 'quantum entanglement'.

In this connection of the demerits of Newton's laws of motion and 'quantum entanglement' the concepts of 'space expansion', the 'integrated form of energy', the 'differential form of energy' and 'force - decaying with time' (which already been discussed in the earlier sections) need to be recapitulated with some further addition of the concepts.

The 'space expansion' (acceleration of Newton's law) phenomenon had been schematically shown in Figure 15 and Figure 18. In Figure 18, it is being shown, a red color 3D volume/energy sphere is surrounded by a blue color force circle. In fact this is what space expansion is and the physical significance of the same is, the force circle is pushing forward the 3D sphere and as a result the volume of the sphere increases and that is what the 'space expansion' is. While a moving object is speeding up , it is exerting more and more force on the space and the space for the time being (instantaneously) become more dense (towards the direction of the motion) but percolates the force to more and more distances in the space and as a result the space expands towards the direction of the motion (Figure 15). Concrete evidence to support this phenomenon is, the vibration of earth associated with a very highly speeding train can be felt from a long distance from the path of travel of the train. While a plane is taking off from a place, the said vibration reaches very far from the point of takeoff.

While an object moves, energy is being converted to work. Energy is the 'integrated 3D sphere form' and work is the differential form of energy (as being shown in Figure 17, the mathematics of energy and work being shown too) and when the energy is being converted to work, the volume of the space increases as shown in the newly developed equation (38), or $V_t = V_1 + t\,\Delta V_{in}$.

Another example of very much practically realizable 'space expansion' and 'space -inversion' phenomenon is the swinging of a vertical spring pendulum up and down. When the pendulum bob moves downwards towards the surface of the earth, it is a 'push forward force' and the gaping of the sections of the spring increases. This leads to space expansion. On the contrary, when the pendulum bob does move upwards, it does squeeze the space (the sections of springs get quenched) and this leads to 'space-inversion'.

The phenomenon of 'force decaying with time' could be understood from the data presented in Table 2 in this article. From the data presented in Table 2, it could be followed, as the time increases, the distance of travel increases and as the distance increases, the force decreases. So with increase in time, the force does decay.

VI. The Demerits of the Three Laws of Motion of Newton are the Following

- *1st law:* 1st law of Newton stated 'an object at rest will remain at rest forever until and unless some external force applied on it and a moving body will continue moving forever along a straight line with constant velocity'. It has not been made clear by him whether he is talking about space or a planet like our earth. As a matter of fact, the space quantum is in continual movements and hence none of the baryonic matter of the universe belong to a state of 'rest.' Regarding a moving object, if it is in space (where the atmosphere does not exist) it will simply float around. On a planet like earth, forever moving of the object is thermodynamically forbidden since it would require a continuous energy supply of infinite amount. While proposing the first law, Newton might have considered the space to be a vacuum one. However, this would not be a situation of the reality of the universe.
- *2nd law:* The 2nd law of Newton states force is directly proportional to the rate of change of momentum. In this article this law has been discussed in detail and the demerits have been highlighted.
- *3rd law:* The version of the 3rd law of Newton is an incomplete one in the sense that the law is talking about an effect without explaining the cause behind the same. The law in the form 'to every action there is an equal and opposite reaction' is a breakthrough verdict in science but the reasons behind the said 'action – reaction' occurrences had not been established through thermodynamic logic since the said 'action-reaction' is related to force, distance, energy, work-done.etc. and all the said variables are thermodynamic one. Another very important parameter apart from the above said physical variables is 'time'. The occurrence of 'action-reaction' is related very much to 'time'. When 'time' gets involved with a subject, the 'space' would obviously be involved and which makes us remember the popular proverb 'when one pulls the ear the head will come too'. Over and above,

Newton did not think or remained silent about 'time-space 'in connection with his 3rd law of motion.

The most updated and superseding version of the 1st law of Newton would be as below:

'The 'time-space' of the universe is an equilibrium entity of the direct quantized space and the reciprocal quantized space and the quantum space are entangled among each other'.

The most updated and superseding version of the 2nd law of Newton would be as below:

'A mechanical wave remains associated with the movement of an accelerating object which is a hybrid of 'force' and 'energy/volume' and the mechanical wave spreads to the space resembling the progression of the electromagnetic waves. There occurs a 'space expansion' while an object moves arising out of the impact of the mechanical wave associated with the object on the space. The 'force' is being defined as 'the mechanical space expansion coefficient, being expressed as, Force = $[1/V_0 (dV/dt)]$, V_0 is volume of the object at rest and (dV/dt) stands for the 'rate of space expansion with time'.

Regarding the 3rd law of Newton it is to be understood very much that the simultaneous 'action-reaction' is an occurrence which people do feel in everyday life. If a bullet is shot from a gun , the gun moves backwards , if a ball is dropped on a floor it re-bounces, if a person slaps another person, that person feels pain and in return the person slapping feels a pain too. The existence of the reverse pain or force is a hard reality of the universe and no one can deny it. However, Newton's verdict of equality of action and reaction force is an ideal one. The force of action does not remain confined to the point of hit of the substrate. It gets absorbed in the sense it gets spread all over the directions in the substrate and the average width or the depth of the spread varies from substrate to substrate. If two identical rubber balls are dropped from the same height on two floors of different hardness, the ball hitting the harder floor will bounce to a higher height than the other ball hitting a comparatively softer floor. If a person rolls on a bed which is hard, the reaction force in fact would be assisting the person to roll easily. On the other hand if a person tries to roll on sand at the shore of a sea, rolling would not be steady since the force of action is percolated very fast over all the directions and the reaction force will be reduced to a large extent throughout the area of the contact between the body of the person and the sand. If two identical solid iron balls (as for example) are dropped from the same height on water and a high viscous jelly like substance being kept in two identical vessels respectively, (the densities of both the water and jelly are more or less equal and which is much lower than iron) the iron ball falling on water will instantaneously sink to the bottom but the iron ball falling on the jelly will slowly move to the bottom. The action force to a very fast rate dissipates over all the directions in water but in case of jelly the action force is confined to a lesser width or depth and the reaction force develops faster and becomes higher in magnitude than in water. The 'action-reaction' force also depends on and varies a lot on the material of construction. If a hammer made of iron is being hit on another substrate made of iron too , the 'action- reaction' force will develop proportionally but with the same level of force the same iron hammer is being hit on a substrate made of rubber the 'action -reaction' force will act disproportionately. To get the best 'action-reaction' one has to choose the two substrates having the same material of construction. The following factors regarding 'action-reaction' occurrence are very important:

- Material of construction
- Difference between the compressive strength and the toughness of the two substrates
- The surface area of contact between the two substrates
- The duration of the force of action
- The mass of the two substrates
- The temperature of the substrates

While all the above factors are very important, the readers of this article have to pay attention to the point no. (iv) since from this only the conception of a 'reversible process 'and an 'irreversible process' could be well built-up. For example, let the case of compression of a real gas be studied. When a real gas (in a cylinder with a piston on it) is compressed suddenly, the duration of the action force is very little and as a result of that the molecules of the gas do not get the sufficient time for the reaction force to develop to the maximum possible level (though to a certain extent the reaction force is developed) and as a result of that, with the lesser work done on the system, the gas can be compressed. This is an example of an irreversible process. It is called 'irreversible' in the sense the reversible or the opposing forces are not being allowed to develop in the right way. On the contrary, when the same gas would be compressed slowly, the molecules would to a large extent would get the opportunity to develop the opposing or the reverse force. This is the reason the slow compression or slow expansion processes are being called reversible processes. So when a gas is reversibly compressed, much more work has to be done than the irreversible process. In thermodynamics it is taught that for a reversible expansion of a gas the work done is maximum. This statement in fact confuses many students why one will spend more energy upon conducting a reversible process. However, the inner meaning of this needs to be understood. This statement tries to establish the fact that to extract maximum work output from a system as much as possible, reversible expansion is the only route.

Summing up all the above discussions, it can be concluded that 'action -reaction' might be equal in some cases but the process has to be conducted infinite time and which is practically not possible. However, the opposing nature of 'action -reaction' is true but the equality of the two is an 'idealism' or a myth and is not a real occurrence in the practical life of the universe.

VII. The Superseding Newton's Third Law is being Stated below

'The 'quantum-entangled' 'time-space' of the universe is composed of different types of space quantum in the forms of 'push forward' and 'pull-back' space quantum. To every 'push forward' quantum, there exists a 'pull back' quantum in equilibrium with it, called its conjugate space quantum. The said push forward space quantum and the pullback conjugate space quantum belong to the direct space and the reciprocal space of the universe respectively. The 'time'(t), 'température'(T) and the 'pressure'(P) are related among each other as:

$$\text{Push Forward force (T) x Pull Back Force (t)} = P \quad (42)$$

The above equation (42) is the mathematical representation of 'quantum entanglement' of the 'time-space' and the occurrence of any equilibrium or the non-equilibrium of any physical process in the universe are controlled by the following condition between t and T:

$$Tt = P = 1 \quad \text{- equilibrium situation, t and T are multiplicative inverse to each other} \quad (43)$$

$$Tt = P > 1 \text{ – non-equilibrium situation, T is dominating over t} \quad (44)$$

$$Tt = P < 1 \text{ – non-equilibrium situation, t is dominating over T} \quad (45)$$

Any 'spontaneous process' of the universe begins with a non-equilibrium state, with either (Tt >1) or (Tt<1) and it ends up with the onset of an equilibrium state with (Tt) = 1. If a person holding in his hand a rubber ball at a certain height above the ground loosens his fingers, the ball starts falling spontaneously and instantaneously a non-equilibrium situation is evolved out with either (Tt >1 or Tt<1). When the ball drops on the ground it bounces and ultimately comes to a position of rest or equilibrium with Tt = 1. This remains to be true for any spontaneous process of the universe.

- *TSQ Driven Geometric Mean Concept of 'Temperature' and 'Time'*

Regarding the 'temperature' (force) and 'time' (inverse force) TSQ have very clearly established the fact that in our universe, neither the 'temperature' nor the 'time' can be boundless. The quantum entanglement of 'time' and 'temperature' are in turn arising out of the following two quantum entanglement: [88, 99]

$$\begin{aligned} \text{Temperature} &= [(\text{space expansion}) \times (\text{order})]^{1/2} \\ &= [(\text{3D sphere x circle}) \times (\text{inverse distance})] \\ &= [(4\pi r^3/3) \times (4\pi r^2/3)] \times (3/4\pi r)] \\ &= [(4\pi r^2/3)(\text{Figure 22}) \end{aligned} \quad (46)$$

$$\begin{aligned} \text{Time} &= [(\text{space inversion}) \times (\text{entropy})]^{1/2} \\ &= [(\text{3D saddle x 2D saddle}) \times (\text{distance})] \\ &= [(3/4\pi r^3) \times (3/4\pi r^2)] \times (3/4\pi r)] \\ &= [(3/4\pi r^2) \text{ (Figure 23)} \end{aligned} \quad (47)$$

It is known to us that the geometric mean (GM) of two variables, as for example, x and y, is $GM = (xy)^{1/2}$ and hence the temperature remains to be a 'geometric mean' of 'space expansion' and 'order' (inverse curvature distance of the reciprocal space). While the space expansion would be trying to be very large, the order will pull it back and as a result, the space cannot expand boundlessly. So mathematically it sounds very logical to state 'Temperature is the geometric mean (as shown in Figure 22) of 'Space expansion' and 'order'.

The time remains to a geometric mean of 'space inversion' and 'entropy' (the curvature distance

of the direct space). While the space inversion will try to reach a very large magnitude, the entropy will push it forward and the space cannot squeeze boundlessly. (as shown in Figure 23). So mathematically it sounds very logical too, to state 'Time is the geometric mean (as shown in Figure 23) of 'Space inversion 'and 'entropy'.

Figure 22: TSQ Driven Geometric mean concept of 'Temperature' (circle of the LHS of the figure)

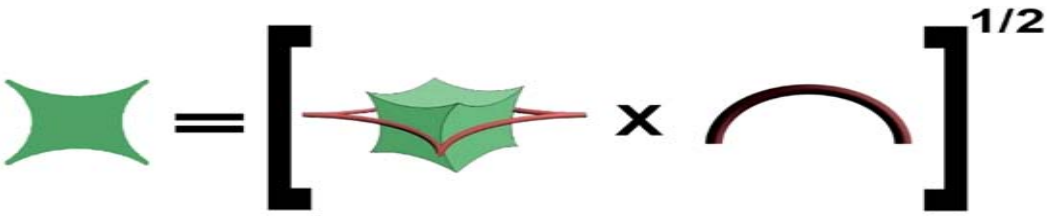

Figure 23: TSQ Driven Geometric mean concept of 'Time' (2D saddle of the LHS of the figure)

VIII. Conclusion

The subject of modern physics of the world will be enriched and further updated with this superseding TSQ propositions in science. This is a 'ground-breaking' theory and the entire subject of physics over time will get altogether new shape. In fact the TSQ is a new discovery in Science and the new findings of TSQ and the inherent new concepts offered by TSQ are innumerable and describing all those in a single article, however, is not possible. The readers of this article have to go through the reference cited in this article exclusively of the TSQ (reference no. 88-99) to develop an overall idea about the logic and philosophy of TSQ and its vast implications in Physics, Chemistry and Mathematics. The said three streams of science will reappear in altogether newer shape sooner or later depending on the level of active interests and attention being paid by the global scientific community realizing the profound underlying significance of the theory, test it and refine the same wherever felt so.

Table 9 below lists the following:

- The major shortcomings/inconsistencies of the theories of conventional physics
- The key contribution of TSQ in physics
- The contribution of this review cum research article.

Table 10: Conventional Physics vis-à-vis Theory of Space Quantization

Physical variable/phenomenon of concern	Shortcomings of the theories of conventional physics	The contribution of TSQ in physics	The contribution of this article in physics
'Entropy'	Entropy has been described as the 'degree of randomness' and mathe-matically being defined as energy per unit of temperature. People fail to correlate the said' degree of randomness' with the mathematical expression. People find entropy to some extent abstract.	Entropy has been defined in the tripartite manner in TSQ and it has been shown to exist as a space quantum. Entropy has been shown to exist in the two forms : a. Directional entropy b. Multidirectional entropy.	The energetics of motion of a moving object is related to the (force x distance) or (force x directional entropy). A Moving object continuously goes on generating directional entropies.

'Time'/'Temperature'	Neither the 'time' nor the 'temperature' had been embodied in regard to 'time-space' of the universe.	Both 'time'(t) and 'temperature'(T) have been embodied in regard to the 'time-space' of the universe. They have been shown to be multiplicative inverse to each other in the form : $Tt = 1$	Through a unique concept in physics 'time' and 'temperature' has been shown to be related to each other in the form of 'thermal expansion coefficient' (TEC) and 'Mechanical Space expansion coefficient(MEC): $TEC = [1/V_0 (dV/dT)]$ $MEC = 1/V_0 (dV/dt)]$ Where V_0 and V stand for the volume.
'Mass'	Mass has been projected as a continuous entity of the universe but its topology, dimension and physics of formation could not be explained.	Mass has been embodied as a hybrid of 'time' and 'inverse of entropy''. It is shown to be the inverse of volume. Topologically mass is shown to be an 'inverse 3D saddle' of inverse 3-dimensional geometry.	The mass of an object is an important parameter when the object is at rest position. Once a critical force is applied to overcome the mass and the object is being taken in the form of 'motion', the mass no longer remains to be a factor for the 'acceleration' of the object.
'Velocity'	Velocity in conventional physics has been put as a vector quantity and being defined as, (distance/time). Since 'time' is abstract in conventional physics, the topology of velocity could not be revealed.	Time being embodied, the concept of 'velocity' in conventional physics does merge to the concept of 'volume'.	A 'space expansion' does take place in the direction of the moving object.
'Acceleration'	Acceleration being defined as, $[(distance/(time)^2]$ or (velocity/time), is an ambiguous physical variable of the universe since velocity itself is dependent on time.	Acceleration has been shown to be a 'space expansion' phenomena and the conventional expression of Newton's acceleration does take the form of: 'incremental distance' per unit of time'.	Acceleration for a moving object generates a mechanical wave in space and its propagation resembles the propagation of 'electro-magnetic' waves. The dimensionality reaches to 5.
'Space Expansion'	Time-space was not at all considered in Newtonian physics.	'acceleration' is 'space expansion' and 'space expansion' is acceleration.	Newton's expression of acceleration in the form of (force/mass) is valid for a non-moving object where under constant volume, the molecules of the object are accelerated (as for example by heat). For an accelerated object the above equation is not the right equation.
'Force'	Force being defined as the product of mass and acceleration. Neither the mass nor the acceleration being defined in the right fashion.	Force being represented by a 2D circle space quantum.	The Force of a moving object being defined as 'mechanical space expansion coefficient
'Conservation of momentum'	The product of mass and velocity has been considered to be constant without emphasizing the physics, mathematics and the topology of the phenomenon of conservation of	The mass and volume both being the quantum of the space. When a quantum of mass interacts with a quantum of volume, three numbers of π space quantum are being	The phenomenon of conservation of momentum has been topologically presented.

	momentum.	developed. The conservation of mass has been shown to be true in regard to mass and volume and not in regard to mass and velocity	
'Gravitation'	Gravitation has been expressed by an empirical mathematical formula by Newton in the form of force (F) acting between the two masses m_1 and m_2 in the following form [$F = (Gm_1 m_2/r^2)$ (i) Or, $(Fxr) = (Gm_1 m_2/r)$] (ii) r being the distance of separation between the masses and G the gravitational constant. In the situation of r tending to zero, the RHS of the equation ii) tending to infinity and the LHS become zero and which is not being acceptable.	Gravitation is a phenomenon of the 'time-space' only (not the property of matter) and is arising out of the overlapping of the two 'inverse space expansion' space quantum and which is the 'singularity' of inverse 10 dimensionality. It is the 'singularity' which upon its disintegration generates all the space quantum and the all cosmological cycle. This is being shown by an universal graviton cycle in TSQ	The falling of an apple from a tree is purely thermodynamic in origin. [Energy taken up from the space while the tree grows an apple = energy given back to the space when the apple falls from the tree]
'Potential Energy'	Potential energy of an object has been defined as (m xg xh) m is the mass of the object, g the acceleration due to gravity and h is the height above the earth. While an object is taken upwards, the energy is being converted to work. So the energy of the object cannot increase	The concept of 'potential energy' has been replaced by 'internal energy' in TSQ. It has been shown in TSQ, while taking an object from the earth surface to a higher height, the internal energy decreases.	
Kinetic Energy	Kinetic energy has been shown to be [$(1/2)\ mv^2$], v being the velocity of a moving object.	The concept of kinetic energy has been replaced by the concept of 'volume energy' in TSQ	The 'volume energy in fact is related to the rate of space expansion with time, (dV/dt) for a moving object
'Quantum Nature of the 'Time -space'	The variables like mass, energy, velocity, Force, time all are being considered continuous.	The variables like mass, energy, velocity, Force, time are all being considered 'discrete' or 'quantized' in TSQ.	It is the quantum nature of the space which is responsible for the physical processes like compression, expansion, cold roll milling of metals, the capillary rise and capillary fall phenomenon of the universe. The space quantum particles are inter convertible among each other. A so-called atom of physics is a quantum entanglement of 'energy', 'entropy' and 'time'.
'Newton's Laws of Motion'	The Newton's laws of motion: 1st law thermodynamically unjustified 2nd law: The mathematical formula of 2nd law in the form of [force = mass x acceleration] is not applicable for a moving object since the	-	All the three laws of Newton have been re-formulated based on the quantum entanglement of the space quantum and the 'Force' on a moving body has been shown to be a 'mechanical space expansion coefficient'.

	propagation of an object in space is a progression of 'mechanical wave'. 3rd law of Newton: The equality of action -reaction force is an idealism and never being true.		
'Newton's equations of motion'	None of the equations do stand in the right stead due to the following reasons: a. The parameter 'acceleration' is ambiguous. b. The 'acceleration parameter', f, can never be an uniform one.	-	The parameter 'acceleration' has been redefined in the form of 'incremental distance per unit of time' and all the three equations of motion of Newton has been rederived in newer forms.
'Dimensionality of the universe	The universe dimensionality was not at all being discussed.	The universe's dimen-sionality has been proved to be 10 dimensional in TSQ. The said dimensionality has been shown to evolved from the decay or disintegration of a 'singularity'	-
Convergence of 2nd law of thermodynamics and Heisenberg's uncertainty principle to the same point	The 2nd law of thermodynamics and the Hiesenberg's uncertainty principle has been presented such that it appeared that the two theories have no link to each other.	2nd law of thermodynamics and the 'Heisenberg's uncertainty principle has been shown to be the same to each other and both of them converge to (energy x time) = Planck's constant = entropy.	-
'Geometric proof of all the 3 laws of thermo-dynamics'	The 3 laws have been presented in the form of being sacrosanct. No attempt was however being taken to prove them topologically.	The very distinct 'topological' or 'geometrical' proof has been given of the three laws of thermo-dynamics.	-
'physical significance of quantum mechanical wave function ψ and the quantum mechanical operators'	The physical significance of the wave function could not be furnished in TSQ	The physical significance of the wave function of quantum mechanics has been presented in regard to the 'force quantum' of TSQ. The physical significance of all the quantum mechanical operators have been provided.	-
'Embodying the Planck dimensions of the physical variables of the universe in the form of different space quantum'	Max Planck had presented the dimensions of the physical variables of the universe in the form of continuous 'time-space'	TSQ have transformed all the Planck dimensions from continuous to the quantum form	-
'TSQ driven new theory of Color Physics'	The theory of color in the conventional physics is based on the continuous type of 'time-space' and the tristimulus value of color is being defined by an integral expression which is a hybrid of i) relative reflectance ii) Energy of the source of light and the iii) three color matching functions.	In TSQ, the color phenomenon has been shown to arise out from the hybrid of the space quantum and the color of light and the color of the object has been defined separately as: Color of object = (mass x time)	-

	The dimensionality of color could not be evaluated.	Color of light wave = (energy x temperature. The dimensionality of color in the light wave is 5 dimensional and the object color is inverse 5 dimensional. The Planck black Body radiation curve has been explained in regard to 'spectral power distribution (SPD)' and the 'mass-wave duality' of conventional physics has been described topologically with diagrammatic presen-tations.	
'Theory of Space Quantization and Quantum Level understanding of the thermodynamic laws and heat engines'	The 'Carnot Engine' in conventional physics has been presented without highlighting the geometrical profiles of the 'isothermal' and 'adiabatic' processes. It is being stated that the carnot engine does go on generating entropy in each of its cycles of operation but it has not been shown quantitatively. The formula for calculating the efficiency of an engine is not standing at the right stead.	In TSQ, the geometrical profiles of 'isothermal' and 'adiabatic' processes have been revealed. How a Carnot Engine is generating work in the form of (Force x directional entropy) has been shown. The proper formula for calculating the 'efficiency' of the Carnot engine has been given.	-

The authors of this article feel very much that the people being 'entrenched in traditional scientific paradigms of the last 300-400 years' should come out of it and should join hands with the authors to explore further, test and refine the newly discovered TSQ and reveal all the mysteries of the universe.

Dedication

This review cum research article is being dedicated to the god father of Science, late Sir Isaac Newton.

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The Fundamental Forces and their Unification

By Changming Wang

Abstract- This paper introduces the concept of unity, defined as matter or a system with its maximum energy limit. Unity is proposed as the origin of inertia and mass due to its resistance to change. Unity force is defined as matter's tendency of being unity, expressed as attracting while energy sharing in a unity or repelling while excess-energy releasing out of the unity. Mass is a special case of unity force: when in unity, matter's unity force Fu equals its rest mass M: Fu = M. The statement that matter has mass and energy means that matter has a unity force using its energy to maintain its unity. Matter's unity force Fu also equals its weight with its unity centre Wu: Fu = Wu. Unity force is proposed as the fundamental force underlying all known natural forces. Strong force and weak force are the same unity force, with every two protons sharing energy with one electron in atomic nuclei in their respective situations. Electromagnetism results from electron waves releasing excess-energy for dynamic unity that can be aligned and intensified by outside forces. Unity force is also proposed to replace gravity. The paper also challenges certain misconceptions in contemporary physics.

Keywords: *matter, mass and energy, energy limit, energy sharing, excess-energy releasing, unity, the laws of unity, unity force, weight, unity centre, fundamental force.*

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I. Introduction

In physics, the fundamental forces are interactions in nature that are not currently known to be reducible to more basic interactions. All the known forces of nature can be traced to the fundamental forces.

According to current knowledge, there are four fundamental forces[1]: 1) strong force; 2) weak force; 3) electromagnetism; 4) gravity. Gravity and electromagnetism are long-range forces that can be seen directly in everyday life. Strong force and weak force are subatomic forces that govern nuclear forces inside atoms.

Physicists have been trying hard to unify these four fundamental forces, to find a theory of everything[2], so that a single set of rules can be used to describe the universe. Two theories come close to the goal:

1. General relativity[3] is the geometric theory of gravitation published by Albert Einstein in 1915 and is the current description of gravitation in modern physics, trying to understand the universe on a large scale: planets, stars, and galaxies.
2. Quantum mechanics[4], specifically, the Standard Model[5] of particle physics is the theory describing three non-gravitational forces - electromagnetic, weak, and strong interactions, and classifying all known elementary particles.

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But combining general relativity with quantum mechanics is a major hurdle. Trying to get over the hurdle, two more theories come close:

1. Supersymmetry[2], a complex mathematical framework based on the theory of group transformations, trying to understand the fundamentals of particles, to address internal inconsistencies in the Standard Model of particle physics, and to provide a self-consistent quantum theory unifying all particles and forces in nature.
2. String theory[2], which regards all particles as extended one-dimensional "strings" with preferred patterns of vibration, through which a particle of unique mass and force charge is created. String theory proposes six or seven more dimensions of spacetime on top of the four common dimensions of space and time.

I have a better way, which is to find a "more" fundamental force of all the "fundamental" forces.

II. The Principles of Matter - The Laws of Unity

In the Principles of Matter[6] published in the Global Journal of Science Frontier Research 24(A5), I proposed that matter or a system tends to adjust its energy to a certain level, called the minimum energy requirement. In this updated version, that energy level is called energy limit, and the previously minimum energy formation is renamed unity. Therefore, the Principles of Matter are also called:

The Laws of Unity

1. Concepts and their definitions:
   1) Matter is any substance that has mass and energy. Matter's energy is scalar, not vector, and is always more than absolute zero[6].
   2) Energy limit is the maximum energy limit of matter or a system in its situation.
   3) Excess-energy is the energy that is over the energy limit.
   4) Unity is matter or a system with its energy limit.
   5) Free particles are matter or systems with excess-energy.
   6) Unity centre is the centre of unity. For example, a nucleus is the centre of the atom unity; the sun is the centre of the solar unity (system).
2. *Unity force:* matter's tendency of being unity, expressed as attracting while energy sharing in a unity or repelling while excess-energy releasing out of the unity.

1) Matter attracts other matter to share energy while its energy is below its energy limit (attracting while energy sharing), until being a new unity.
2) A free particle repels other matter while releasing its excess-energy (repelling while excess-energy releasing), until being unity.
3) Breaking a unity requires strong enough initial energy. Then, a new unity begins in the new situation. The more energy is shared in a unity, the more initial energy is required to break the unity.

3. Dynamic unity: matter or a system moves to be unity, expressed as two distinct types of oscillations:
   1) Matter of a unity oscillates around (orbits) the unity centre to share energy, like electrons orbit an atomic nucleus, or planets orbit a star. The orbit is the equilibrium of its unity force.
   2) A free particle oscillates away or about the energy source to release its excess-energy, forming particle waves.
      a. An almost massless particle such as a photon or neutrino oscillates away as light, visible or invisible, depending on its frequency[7].
      b. A larger particle like an electron oscillates away or about the energy source, manifesting as magnetic waves, and in turn oscillates away a photon as light.

Based on the Laws of Unity, I propose:

1. Matter or a system is intrinsically attracting while energy sharing to be a unity. After getting excess-energy from outside forces, matter oscillates away from the unity, becoming a free particle, repelling while excess-energy releasing to be unity again.
2. Matter exists in various states such as gas, liquid, solid, plasma, in different situations; the transition of the state is the process of becoming a unity in each situation.
3. Oscillations of free particles form particle waves (wave-particle duality). Some particles' oscillations are not apparent because their masses are so large that their energy-mass ratios are low[7].
4. As a kind of particle waves, electromagnetic waves are oscillations of free electrons to release excess-energy for dynamic unity, that in turn oscillate away photons as light.
5. Breaking a unity requires strong enough initial energy, and that required initial energy is inertia, which can be measured as mass. That is, unity's resistance to change is the origin of inertia and mass.
6. Scientists are no strangers to unity force: mass is a special case of unity force. When in a unity, matter's unity force Fu equals its rest mass M: Fu = M.
7. The statement that matter has mass and energy means that matter has a unity force using its energy to maintain its unity.
8. People are no strangers to unity force: weight is also a special case of unity force. When in a unity, matter's unity force Fu also equals its weight with its unity centre Wu: Fu = Wu. In our daily life, weight is matter's unity force with Earth, so that all our activities are mostly challenges to unity forces with Earth, like walking, running, jumping, driving, flying, and working.

Unity force will be proved as the fundamental force of all the other natural forces, and the Laws of Unity as the only rules followed by all the other "fundamental" forces.

III. Strong Force

Before 1964, physicists were uncertain as to how the atomic nucleus bonds together. Their knowledge was that the nucleus was composed of protons and neutrons and that protons had positive electric charge, while neutrons were electrically neutral. But positive charges would repel one another, causing the nucleus to break up, which was not the case, which also motivated physicists to seek a deeper understanding of the forces at play within the nucleus.

In 1964, Murray Gell-Mann and George Zweig separately proposed the quark model, leading to the theory of quantum chromodynamics[8], which states that protons and neutrons were composed of elementary particles called "quarks" that carry a "colour" charge; that force-carrier particles called "gluons" transmit the strong force between quarks that carry "colour", where different colour is attracting and same colour is repelling, just like the idea of electric charges.

While quantum chromodynamics is widely accepted, I am looking into the very beginning - the Big Bang, for the origin of the strong force and a deeper perspective.

The Big Bang model[9] describes how the universe began by expanding from a single point of infinite density and heat, known as the singularity, 13.8 billion years ago.

As the universe expanded and cooled, matter formed, as free protons, electrons, photons, and neutrinos (base particles).

Then, each proton shared energy with a neutrino as a proton unity:

$$p + \nu \rightarrow p\nu, \text{ where } p = \text{proton}, \nu = \text{neutrino}.$$

Each electron shared energy with a photon as an electron unity:

$$e + \gamma \rightarrow e\gamma, \text{ where } e = \text{electron}, \gamma = \text{photon}.$$

Proton unities and electron unities are called base unities.

By then, the universe had expanded into many big chunks of matter, one of them was our Milky Way.

And the big chunks of matter had also expanded into many smaller chunks of matter, one of which was our solar system.

In the centre of each chunk of matter, those base unities were so dense and hot, and their energy limits were raised so high, they became attracting and energy sharing. That is, the environment was perfect for matter to share energy, to fuse.

The nuclear fusion in the centre (fusion centre) is mainly through proton-proton chain reaction[10], in which four protons combine to form one helium nucleus, shown as the following simplified steps:

1. Two proton unities and two electron unities share energy to form a hydrogen-2 nucleus called deuterium, releasing a high-energy neutrino (ν^+), a high-energy electron (e^+ or positron) and a high-energy photon (γ^+ or gamma ray):

$$2\,p\nu + 2\,e\gamma \rightarrow {}^2p\nu e\gamma + \nu^+ + e^+ + \gamma^+$$

2. The deuterium ${}^2p\nu e\gamma$ shares energy with another proton unity to form a helium-3 nucleus, releasing another high-energy photon (γ^+ or gamma ray):

$${}^2p\nu e\gamma + p\nu \rightarrow {}^3p^2\nu e + \gamma^+$$

3. Two helium-3 nuclei share energy to form one helium-4 nucleus and release two proton unities to continue the process:

$${}^3p^2\nu e + {}^3p^2\nu e \rightarrow {}^4p^2\nu^2 e + 2\,p\nu$$

4. The helium-4 nucleus, ${}^4p^2\nu^2 e = 2({}^2p\nu e)$, becomes repelling while releasing the excess-energy mentioned above and moves out of the fusion centre to the outer core as the nucleus unity and the product of the fusion.
5. Or the helium-4 nucleus $2({}^2p\nu e)$ shares more energy with other nuclei or proton unities to form an even tighter unity of heavier nucleus: $n({}^2p\nu e)$, where atomic number $n > 2$, if the situation permits.
6. Therefore, in a newly formed nucleus unity from nuclear fusion, every electron shares energy with two protons and one neutrino: $n({}^2p\nu e)$, where the atomic number $n >= 2$. This is how strong force originates and works. No need for quantum chromodynamics[8].
7. A hydrogen nucleus absent from nuclear fusion has only one proton unity ($p\nu$).
8. Most fusion centres release their excess-energy (nuclear decay) through releasing high-energy neutrinos, electrons, and photons:
   1) The high-energy neutrinos (ν^+) and high-energy photons (γ^+) carry their energy away directly.
   2) The high-energy electrons (e^+) transfer their energy to normal electron unities ($e\gamma$) that in turn transfer the energy to their bonded photons (no "annihilation"), producing gamma rays (γ^+):

$$e^+ + e\gamma \rightarrow 2\,e + \gamma^+$$

   The process of high-energy photons (gamma rays) carrying away the excess-energy is called gamma decay.
9. The rest, extra-large fusion centres could not release their excess-energy in the inner core but use it instead for even tighter energy sharing of heavier elements. Without repelling, this leads to black holes with much stronger attraction forces of their respective galaxies.

At this point, the rotation caused by the Big Bang and then intensified by the unity force of the nuclear fusion, made the chunks into disks.

Around 380,000 years after the Big Bang, the position of our solar system in the Milky Way had almost settled. The centre of each disk was still the fusion centre, pulling most of the material toward the centre to form the star, producing the cosmic microwave background radiation and light.

At the edge of each disk, some much smaller fusion centres were also pulling materials toward them that eventually formed the planets, so that most planets had and still have their moons. The products of the nuclear fusions would move to the outer cores and then form mantles and crusts of the planets or flow out through the cracks of the mantles and crusts caused by their nuclear fusions, causing (earth-) quakes and volcanoes.

Out of these fusion centres in the disks, the temperatures were eventually cool enough for the nuclei to capture electrons, forming the first atoms and making the cosmos transparent, bringing the dawn of the universe:

1. Each single proton unity absent from nuclear fusion, attracts and shares energy with an electron unity in the orbit, forming a hydrogen atom: $(p\nu) + (e\gamma)$. This step produces most of the light elements in the current universe.
2. Each of the helium-4 nuclei created in the fusion centres and moved out shares energy with two electron unities in its orbit, forming a helium atom: $2({}^2p\nu e) + 2(e\gamma)$.
3. The heavier nuclei form atom unities the same way, with the same numbers of protons and electrons: $n({}^2p\nu e) + n(e\gamma)$, where atomic number $n > 2$.

So, I propose:

1. The universe is formed of four base particles: proton, electron, photon, and neutrino, produced from the Big Bang. Immediately, a proton and a neutrino form a proton unity; an electron and a photon form an electron unity (base unities). Then the unity force produced more kinds of elements from these base unities.
2. Most fusion centres with excess-energy releasing form stars and planets.
3. The rest, extra-large fusion centres with inner cores unable to release excess-energy as a repelling

force, form black holes with much stronger attraction forces of their respective galaxies.

4. No gravity, nor gravitational collapse, is needed to draw matter (particles) together, because particles were dense and hot in the first place when created. The high density and high temperature were perfect for nuclear fusions.
5. "Positron" here is re-defined as high-energy electron, not the original meaning of "positively charged electron".
6. An atom is formed of the same numbers of protons and electrons sharing energy together: n(^{2}pνe) + n(eγ), n >= 2; the same way as a hydrogen atom: (pν) + (eγ).

IV. Weak Force

Nuclear decay (radioactive decay) is when an unstable atomic nucleus loses energy through emission of high-energy electrons, neutrinos, or photons. Three of the most common types of decay are alpha, beta, and gamma decay.

We already discussed gamma decay as losing very-high-energy photons (γ^+ gamma rays) in nuclear fusion in the last section.

Beta decay happens through the weak force, which is our focus of this section.

As proposed in the last section of Strong Force, nuclei are created in nuclear fusion by every two protons sharing energy with one electron as a nucleus unity n(^{2}pνe), n >= 2, so that one particle shows as proton (p) and the other particle shows as neutron (p + e).

According to the Laws of Unity, breaking a unity requires strong enough initial energy.

In the case of beta decay, the strong enough initial energy mostly comes from random sources of the environment, including high-energy photons (γ^+ gamma rays, X-rays), cosmic rays, high-energy neutrinos or high-energy electrons from other beta decays.

In those unstable nuclei (easily broken unities), the strong enough initial energy cause two types of beta decays:

1. Beta minus decay. Initial random energy breaks free an electron shared with two protons, causing one more proton and one less neutron. That broken-free electron carries the excess-energy away, becoming a high-energy electron (e^+ positron). Then the positron either transfers the excess-energy to a photon (X-ray) or joins another nucleus to create a beta-plus decay and becomes a normal electron again.

   An example of beta-minus decay is the decay of carbon-14 into nitrogen-14 with a half-life of about 5,730 years[11]. In which, carbon-14 (^{6}C) has an electron broken free with high energy, adding one proton and reducing one neutron, becoming nitrogen-14 (^{7}N). The atomic number is increased because only protons are counted in the periodic table.
2. Beta plus decay. That broken-free electron with high energy (e^+ positron) mentioned above can join a nucleus. Since it is high-energy, it can break the original unity, forming a new unity with two protons, causing one less proton and one more neutron, releasing the excess-energy to a neutrino or a photon (X-ray).

   An example of beta-plus decay is the decay of magnesium-23 into sodium-23 with a half-life of about 11.3 seconds[12], in which one high energy electron joins a nucleus of magnesium-23 (^{12}Mg), reducing one proton and adding one neutron, making it into sodium-23 (^{11}Na). The atomic number is decreased because only protons are counted in the periodic table.

So, I propose:

1. Strong force and weak force both originate from nuclear fusion, being the same unity force, with every two protons sharing energy with one electron in nuclei, in their respective situations: strong force happens in the nuclear fusion, weak force happens in the unstable nuclei after nuclear fusion.
2. As proposed before, "positron" here is re-defined as a high-energy electron. When a positron meets a normal electron, energy transfers from the positron to the normal electron; after energy transfer, the positron becomes a normal electron (e).
3. When a normal electron (e) gets energy from a positron,
   1) with very-high energy from a nuclear fusion, the normal electron transfers that very-high energy to its bonded photon and breaks it free as a very-high-energy photon (gamma-ray) in a strong force.
   2) with high energy from a beta decay, the normal electron transfers that high energy to its bonded photon and breaks it free as a high-energy photon (X-ray) in a weak force.
4. Beta decays are evidence that atomic nuclei are composed of every two protons sharing energy with one electron as a unity, except a hydrogen nucleus, which has only one proton and can only share energy with one electron in its orbit. Beta decays are also evidence that quantum chromodynamics is unnecessary.
5. All nuclear decays (not only beta decay) are processes of breaking original unities by initial energy and forming new unities in new situations.

V. Electromagnetism

According to current knowledge, electromagnetism[13] occurs between any two charged particles. Electric forces cause an attraction between particles with opposite charges and repulsion between

particles with the same charge. Magnetism is an interaction that occurs between charged particles in relative motion.

According to the Laws of Unity:

1. Electrons are either attracting in an atom unity or repelling out of the atom unity.
2. Free particles with mass like electrons oscillate away or about the energy source to release excess-energy for dynamic unity, manifesting as magnetic waves:
    1) In most materials, the magnetic waves cancel each other due to random orientations.
    2) In other materials, like iron, many magnetic waves are already aligned in the same direction when created, showing a stronger magnetic field.

So, I propose:

1. Electromagnetism results from free electrons' oscillations to release excess-energy to be dynamic unity, manifesting as magnetic waves that can be aligned and intensified by outside forces.
2. An electrical conductor is: 1) a material, usually a metal, whose outermost electron of any atom can be easily broken free by an electric force, 2) an electrolyte with many free electrons, like battery electrolyte and organic tissues, or 3) a state of plasma filled with free electrons.
3. In an electrical conductor, outside forces can align and intensify the magnetic waves of the free electrons and cause those electrons to flow from high energy to low energy, which is why electromagnetic waves and electric currents happen simultaneously.
    1) Strong magnetic fields align and intensify the magnetic waves of the free electrons, which in turn align and energize the electrons. Outside energy can then cause the electrons to flow from high energy to low energy.
    2) Electric forces align and energize the free electrons, causing them to flow from high energy (voltage) to low energy (voltage), which in turn align and intensify their magnetic waves.
4. These aligned and intensified electromagnetic waves in turn oscillate away the photons bonded with the electrons, causing photon waves (light).
5. The movements of matter (not only electrons) from high energy to low energy are caused by the potential difference, but the fundamental reason is the dynamic unity.

VI. Gravity

In 1666, Isaac Newton famously observed an apple falling from a tree, which inspired him to formulate the law of universal gravitation[14], which states that every particle attracts every other particle in the universe with a force F equal to G (the gravitational constant) multiplied by the product of the masses of the two particles (m_1 and m_2) and divided by the square of the distance R: $F = G(m_1 \times m_2)/R^2$.

So, Newton attributed the cause of gravitation to the masses of particles. But he acknowledged that how the force was propagated was unknown.

Newton's law was later superseded by Albert Einstein's theory of general relativity[3]:

1. General relativity is the geometric theory of gravitation, providing a description of gravity as a geometric property of spacetime.
2. General relativity's spacetime curvature propagates at the speed of light while Newtonian gravity assumes an instantaneous force acting at a distance.
3. General relativity explains gravitational time dilation, frame-dragging, and relativistic effects that Newtonian physics cannot.

According to the Laws of Unity, matter's unity force is replacing gravity. The reasons:

1. Gravity is passive. Unity force is active with two types of actions.
   Gravity is passive. That is why Newton could not find how the gravitational force is propagated, and Einstein had to conjure up the spacetime curvature for gravity to work.
   Unity force is matter's intrinsic tendency of being unity, expressed as actively attracting while energy sharing in a unity or actively repelling while excess-energy releasing out of the unity.

   For example,
    1) In an atom, the electrons and the nucleus attract each other to share energy, but when the outermost electron gets excess-energy, it repels and oscillates out of the atom, travelling with other free electrons as a member of the current, until transferring the excess-energy and becoming attracting again in a new atom.
    2) In fusion centres, protons and electrons are attracting while fusing into helium-4 nuclei (energy sharing). But when those helium-4 nuclei release the excess-energy, they are repelling and moving out of the centres to outer cores. The net force of each fusion centre shows attracting because energy sharing is the primary process.
    3) In a star system, planets oscillate around their star, attracting while energy sharing, until they get too close to their star and becoming energy-excessive, and becoming repelling while excess-energy releasing, leading to their path of respective orbits (equilibria).
2. Between two free particles, there is no attraction, only repulsion, proving that the concept of gravity is a misconception.

In the system of Earth, for example, gravitational attraction is supposed to happen between any two particles, which is not the case. In fact, attraction only happens between a particle and Earth, which is exactly how the unity force works: between a member of the unity and the unity centre. Therefore, in a unity, matter's unity force Fu equals its unity weight Wu: Fu = Wu.

3. Unity is the origin of inertia and mass.
   Both Newton and Einstein have attributed gravity to mass, while mass originates from unity. To be precise, mass is a special case of unity force: when in a unity, matter's unity force Fu equals its rest mass M: Fu = M.
4. Unity force is the fundamental force of all the other natural forces.
   As shown in this paper, the other natural forces are specific aspects of unity force, or unity force in specific situations, and caused by unity force, they all follow the same Laws of Unity, no need for gravity.
   Currently, when considering and studying the other three "fundamental" forces, gravity is already omitted, also proving that the concept of gravity is a misconception.
5. According to the Strong Force section of this paper: No gravity, nor gravitational collapse, is needed to draw matter (particles) together, because particles were dense and hot in the first place when created. The high density and high temperature were perfect for nuclear fusions. And the nuclear fusions, as a unity force, keep pulling matter (particles) towards them.
   According to the formation of our Universe[6] that I proposed in the Global Journal of Science Frontier Research 24(A5): In the star systems, energy sharing, instead of gravitation, is the force to keep the systems the way they are.

VII. Conclusion

1. Unity is matter or a system with its energy limit. Unity is proposed to be the origin of inertia and mass due to its resistance to change.
2. Unity force is matter's tendency of being unity, expressed as attracting while energy sharing in a unity or repelling while excess-energy releasing out of the unity.
3. Scientists are no strangers to unity force: mass is a special case of unity force. When in a unity, matter's unity force Fu equals its rest mass M: Fu = M.
4. The statement that matter has mass and energy means that matter has a unity force using its energy to maintain its unity.
5. People are no strangers to unity force: weight is also a special case of unity force. When in a unity, matter's unity force Fu also equals its weight with its unity centre Wu: Fu = Wu. In our daily life, weight is matter's unity force with Earth, so that all our activities are mostly challenges to unity forces with Earth, like walking, running, jumping, driving, flying, and working.
6. Between two free particles, there is no attraction, only repulsion, proving that the concept of gravity is a misconception. All the other three "fundamental" forces omit gravity, also proving that the concept of gravity is a misconception.
7. Strong force and weak force both originate from nuclear fusion, being the same unity force, with every two protons sharing energy with one electron in nuclei in their respective situations:
   1) The situation of strong force is in nuclear fusion, where very-high-energy neutrinos (ν^+), electrons (e^+ positrons) and photons (γ^+) are released as excess-energy (nuclear decay).
   2) The situation of weak force is in the unstable nuclei after nuclear fusion, where a high-energy electron (e^+ positron) is broken out (beta minus decay) or breaks in (beta plus decay), also with excess-energy releasing (ν^+ or e^+).
8. Electromagnetism results from free electrons' oscillations to release excess-energy for dynamic unity, manifesting as magnetic waves that can be aligned and intensified by outside forces.
9. According to the Principles of Matter, matter's energy is scalar, not vector. Any "antimatter" or "opposite charge" is a misconception, including the concept of "negatively or positively charged" electrons, "oppositely charged" particles, "quantum chromodynamics", and the idea of "annihilation".
10. Unity force is the fundamental force of all the other natural forces, shaping the universe the way it is.

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Cosmos-Vida-Consciência, A View of the Micro and Macro Worlds of the Universe

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Abstract- The intended objective of reinforcing the hypotheses previously formulated by the author has been fully achieved, and has been exceeded by providing new insight, when reviewing the topic of the Big Bang in the topic Discussion and Conclusions. Below are the conclusions reached, which summarize the author's thinking.

1. Added new support for the suggested hypothesis of the extension of the validity of Darwin's Law, given by a recently published paper experimentally proving the occurrence of evolution before the emergence of biological life. Becoming universal, Darwin's Law would govern the evolution not only of biological beings, but of all existing structures and all the precepts and laws that govern them, with the predominance of the fittest.
2. Reinforcement of the hypothesis formulated about the existence of order in chaos, with a recently published paper experimentally proving this fact. The paper shows clouds of electrons preferentially traveling along paths considered to be true quantum scars.

Keywords: *cosmos, life, consciousness, singularities, big bang.*

GJSFR-A Classification: *LCC: QB991.C66*

Strictly as per the compliance and regulations of:

Cosmos-Vida-Consciência, A View of the Micro and Macro Worlds of the Universe

Cosmos-Vida-Consciência, Uma Visão Dos Micro E Macro Mundos Do Universo

Elcio Fabio Soares Pereira

Abstract- The intended objective of reinforcing the hypotheses previously formulated by the author has been fully achieved, and has been exceeded by providing new insight, when reviewing the topic of the Big Bang in the topic Discussion and Conclusions. Below are the conclusions reached, which summarize the author's thinking.

1. Added new support for the suggested hypothesis of the extension of the validity of Darwin's Law, given by a recently published paper experimentally proving the occurrence of evolution before the emergence of biological life. Becoming universal, Darwin's Law would govern the evolution not only of biological beings, but of all existing structures and all the precepts and laws that govern them, with the predominance of the fittest.
2. Reinforcement of the hypothesis formulated about the existence of order in chaos, with a recently published paper experimentally proving this fact. The paper shows clouds of electrons preferentially traveling along paths considered to be true quantum scars.
3. Next, the authors hypothesized in the first paper in this line of research that the quantum vacuum arose from a "nothing", which in their words was a homogeneous nothing, without any structure and in total equilibrium, at a temperature of absolute zero degrees and that perhaps, because it was unstable, it could have broken up, casually granulated itself, thus giving rise to the quantum vacuum, which could explain the essentially granular nature of quantum mechanics (1), This hypothesis is reinforced by recently published work only considering "nothing" to be a true vacuum (8).
4. It has been suggested that the physical processes responsible for Poincaré Resonances are the processes occurring in the recently proposed regularity singularities, which are also involved in loop quantum gravity occurring in grains of space or at the vertices of a spin network. These processes would be responsible for the creation, propagation and annulment of correlations in addition to the creation of matter.
5. It has been suggested that galaxies are objects similar to biological bodies, these similarities extending to various aspects reflected in a variety such as that shown by biological beings.

Keywords: cosmos, life, consciousness, singularities, big bang.

Resumo- Alcançado plenamente o objetivo pretendido de reforçar hipóteses formuladas anteriormente pelo autor, sendo ultrapassado ao possibilitar novo insight, quando da revisão do tema Big Bang no tópico Discussão e Conclusões. A seguir as conclusões a que se chegou, que resumem o pensamento do autor.

1. Acrescentada nova sustentação para a hipótese sugerida da extensão da validade da Lei de Darwin, dada por um trabalho recentemente publicado comprovando experimentalmente a ocorrência da evolução antes do surgimento da vida biológica. A Lei de Darwin passando a universal, governaria a evolução não apenas dos seres biológicos mas de todas as estruturas existentes e de todos os preceitos e leis que as regem, com a predominância das mais aptas.
2. Reforçada hipótese formulada sobre a existência de ordem no caos, com um trabalho recentemente publicado comprovando experimentalmente este fato. No trabalho são mostradas nuvens de elétrons percorrendo preferencialmente caminhos considerados como verdadeiras cicatrizes quânticas.
3. A seguir a hipótese feita pelos autores no primeiro trabalho nesta linha de pesquisa de que o vácuo quântico tenha surgido de um "nada", que em suas palavras era um nada homogêneo, sem qualquer estrutura e em total equilíbrio, numa temperatura de zero grau absoluto e que talvez, por ser instável, possa ter-se quebrado, se granulado casualmente, dando origem então ao vácuo quântico o que poderia explicar o caráter essencialmente granular da mecânica quântica (1), Esta hipótese é reforçada por trabalho recentemente publicado apenas considerando-se ser o "nada" um vácuo verdadeiro (8).
4. Sugerido serem os processos físicos responsáveis pelas Ressonâncias de Poincaré os processos ocorrendo nas singularidades de regularidade propostas recentemente, estando os mesmos também envolvidos na gravidade quântica em loop ocorrendo nos grãos de espaço ou nos vértices de uma rede de spins. Estes processos seriam os responsáveis pela criação, propagação e anulação de correlações além da criação de matéria.
5. Sugerido serem as galáxias objetos similares a corpos biológicos, estas similaridades estendendo-se a diversos aspectos refletidos numa variedade como a mostrada pelos seres biológicos.

Palavras-chave: cosmos, vida, consciência, singularidades, big bang.

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I. Introdução

O objetivo pretendido neste trabalho foi de revisar alguns temas abordados em trabalhos anteriores, procurando reforçar com novos conhecimentos teóricos e experimentais obtidos de trabalhos recentemente publicados, seus argumentos e indícios utilizados na formulação de suas hipóteses.

Este procedimento é seguido buscando com o aumento da viabilidade de suas hipóteses atraírem a atenção de pesquisadores para os temas abordados. A realização destas pesquisas não é fácil devida tanto à necessidade de ter-se um maior embasamento teórico quanto ao custo da tecnologia demandada.

Apresenta resumidamente algumas considerações sobre o cosmos como preâmbulo para introdução de uma nova idéia que, mesmo sendo altamente especulativa, julgou merecer ser proposta.

São revistos os temas Big Bang, Ressonâncias de Poincaré, Singularidades e Cosmos, sendo focado na discussão aspectos considerado importantes pelo autor, desde que relacionados a artigos já publicados pelo mesmo.

II. Discussão E Conclusões

a) Big Bang

Se o Big Bang, considerado o início dos tempos foi uma explosão colossal de matéria infinitamente condensada, tem-se que pressupor obrigatoriamente que, antes da ocorrência de tal colossal explosão existia esta matéria infinitamente condensada ou uma matéria com algum meio pelo qual pudesse ser infinitamente condensada.

Continuando com este raciocínio, para existência desta matéria seriam necessárias leis que lhe dessem estabilidade e provocassem sua compressão. Estas leis teriam que existir antes ou surgirem conjuntamente com a formação desta matéria. Em ambos os casos, estas leis e matéria envolvidas nesta colossal explosão do Big Bang teriam que ser eternas ou terem surgidas antes ou durante o início deste nosso universo, supondo que este tenha se iniciado com o Big Bang.

O que ocorreu foi determinado pelas leis físicas e matemáticas existentes quando da explosão. Fica parecendo que tudo depende destas leis, o passado e o futuro deste universo.

Em trabalho anterior (1), foi sugerida a extensão da validade da Lei de Darwin para evolução dos seres biológicos. Com a extensão sugerida, a Lei de Darwin passando a universal, governaria a evolução não apenas dos seres biológicos mas de todas as estruturas existentes e de todos os preceitos e leis que as regem, com a predominância das mais aptas.

Reforçando a hipótese da extensão da Lei de Darwin, um trabalho recentemente publicado comprovou experimentalmente a ocorrência de evolução antes do aparecimento da vida biológica (2).

São freqüentes as questões sobre como surgiram as leis físicas e matemáticas caso estas não sejam consideradas eternas e sobre o que realmente explodiu no Big Bang, se uma matéria infinitamente condensada que me parece ser a hipótese mais aceita, uma porção comprimida do espaço ou um "nada" que talvez pudesse ser considerado como um vácuo verdadeiro.

Com relação ao surgimento das leis físicas e matemáticas e admitindo-se não serem as mesmas eternas, foi sugerida criação das mesmas, como descrito em trabalhos anteriores (3,4), com a hipótese da existência de uma Consciência Primária do Universo formada nos moldes da consciência humana e que conteria todas estas leis. A formação desta consciência pode ter ocorrido antes ou nos instantes iniciais do universo após o Big Bang, instantes estes que parecem ocultar muitos segredos.

Com relação ao que realmente explodiu no Big Bang, talvez seja mais sensato considerar como sugerido pelo autor (6) e outros pesquisadores, que o Big Bang tenha sido um evento ocorrido num dado tempo e espaço, talvez num processo similar a uma mudança de fase ao invés de ser considerado como o início de tudo. Seria a passagem de um universo em contração que, chegando a um determinado ponto, recomeçaria numa explosão cósmica um novo universo em expansão.

Nota-se certa ambigüidade considerando-se este evento como a passagem de um universo a outro, isto se devendo ao fato de que universo significa tudo que existe, o que englobaria ambos os universos referidos. Esta ambigüidade é novamente abordada pelo autor no tópico relativo ao cosmos.

Sendo o Big Bang o início de tudo, existia antes de sua ocorrência o caos, conforme sugerido pelo autor. Este caos foi considerado como rico em informações implicando na existência de muita ordem por mais que isto possa parecer contraditório (5).

Um trabalho recentemente publicado comprovou experimentalmente a existência de ordem no caos. Neste trabalho são mostradas nuvens de elétrons percorrendo preferencialmente caminhos considerados como verdadeiras cicatrizes quânticas (7).

A hipótese da existência de um vácuo quântico primordial é hoje aceita por grande contingente de pesquisadores, uma delas apresentada em trabalho recentemente publicado (8). O autor apresentou, em seu primeiro trabalho nesta linha de pesquisa, a sugestão de que o vácuo quântico tenha surgido de um "nada", hipótese reforçada pela consideração de ser o "nada" um vácuo verdadeiro (1).

Parece ser inegável a necessidade de leis físicas e matemáticas para estabilidade da matéria,

estabilidade cuja duração varia com a matéria sendo considerada. Na visão do autor, o universo primordial governado pela mecânica quântica não continha inicialmente matéria condensada que teria surgido após ou concomitantemente com as leis necessárias para sua estabilização.

Conforme o autor, considerando-se que as leis físicas e matemáticas não sejam eternas e que sejam necessárias para formação da matéria, torna-se necessário a existência de um organismo cognitivo antes do surgimento da vida como a conhecemos e que, seja lá o que for este organismo, seja o mesmo capaz de recebendo sinais quaisquer, transformá-los em informações com significado, como por exemplo, no conjunto das leis físicas e matemáticas (5).

b) Ressonâncias de Poincaré

São apresentadas a seguir algumas propriedades das Ressonâncias de Poincaré, todas já comentadas em trabalhos anteriores (9, 10), sendo realçadas a seguir devido à grande importância atribuída pelo autor às mesmas. Como se sabe elas podem criar, destruir ou propagar correlações entre partículas, causando divergências, ou seja, levando ao surgimento de infinitudes nos pontos onde ocorrem, que também como se sabe, constituem fenômenos não locais somente produzidos por sistemas de ondas persistentes, ou seja, sistemas com um fluxo contínuo de ondas. Ocorrem nos pontos de interferência de duas ondas toda vez que a relação de suas freqüências seja um número inteiro, sendo este um processo aleatório e independente de qualquer observador.

Foi formulada a hipótese de que o processo do colapso das ondas quânticas possa também ser causado pelas Ressonâncias de Poincaré, que ocasionariam a perda da coerência de suas sobreposições promovendo a redução destas ondas, com a sugestão de que estas ressonâncias sejam processos físicos similares aos processos ocorrendo nas sinapses entre neurônios no cérebro humano. Acredita estarem estes processos envolvidos na formação das consciências Primária Universal e Humana, sendo também responsáveis pela extensão desta última no decorrer de sua breve existência.

Elas desempenham um papel fundamental na física. O avanço da matemática com o uso de operadores e de diversas outras ferramentas tornou possível solucionar o problema da não integrabilidade dos sistemas onde ocorrem estas ressonâncias que, por suas ações de criação, propagação e anulação de correlações, quebram a simetria do tempo, ou seja, dão origem à flecha do tempo, responsável pelos processos irreversíveis que dão origem a tudo que existe no universo. Uma detalhada discussão matemática destes tópicos é apresentada por Prigogine (11), mostrando que, em termos físicos, a incorporação das ressonâncias de Poincaré numa descrição estatística da realidade promove o aparecimento de termos difusivos que tornam a probabilidade o objeto central tanto da mecânica clássica quanto da mecânica quântica. Com isto, fica descartada a necessidade de considerar-se as amplitudes de probabilidades e o problema físico da redução das ondas na mecânica quântica.

As Ressonâncias de Poincaré, sendo um processo genuinamente físico e responsável pela redução do estado quântico, ou seja, pelo colapso das ondas quânticas, parecem preencher um dos pré-requisitos citados por Penrose (12) para a existência de uma consciência.

c) Singularidades

Na visão do autor, as singularidades estão intimamente ligadas às Ressonâncias de Poincaré, justificando o realce dado no item anterior às suas propriedades.

O termo singularidade designa fenômenos que ocorrem toda vez que a curvatura do espaço-tempo atinge valores extremos.

Parece que as singularidades ocorrem nas Ressonâncias de Poincaré, nos Buracos Negros e no Big Bang.

Sempre pareceu ao autor que, os processos considerados nos estudos da gravidade quântica em loop na tentativa de acoplar a teoria quântica com a teoria da relatividade, processos que parecem ocorrer nos grãos de espaço ou nos vértices de uma rede de spins com dimensões da escala de Planck, seriam os processos físicos responsáveis pelas Ressonâncias de Poincaré.

Sempre que pensava a respeito, surgia o problema da censura cósmica proposta por Penrose (12), impedindo que tal hipótese pudesse ser considerada, desde que tudo se passava como se houvesse o surgimento de inumeráveis pequenos buracos negros, que com seus horizontes de eventos, impediriam que processos como a criação, propagação de correlações e outros pudessem ocorrer e serem visualizados.

Conforme demonstrado recentemente por Moritz Reintjes, Zeke Vogler e Blake Temple (13), o espaço-tempo não é localmente plano em um ponto onde duas ondas de choque colidem, ocasionando um novo tipo de singularidade na relatividade geral, chamada pelos mesmos de singularidades de regularidades. De acordo com os mesmos, para esta singularidade não existiria um horizonte de eventos. Eles estão na busca de manifestações desta singularidade, dos efeitos que possam ser detectados no mundo real. Sugerem que poderia haver criação de matéria causada por esta singularidade e que este aporte de matéria poderia talvez até eliminar a necessidade da existência da matéria escura do universo.

Sendo comprovada a existência destas singularidades de regularidade e sendo estas consideradas os processos envolvidos na gravidade quântica em loop, deixa de existir qualquer motivo que impeça sejam estes os processos físicos responsáveis pelas Ressonâncias de Poincaré, responsáveis pela criação, propagação, anulação de correlações e de criação de matéria.

Contudo, tais processos não deixam ainda de serem considerados como caixas pretas, no sentido de não ter-se o conhecimento "do como" o que acontece nestas caixas pretas acontecem.

O autor tem uma forte intuição de que o que acontece nesta caixa preta seja algo similar ao que acontece nas sinapses ocorrendo entre neurônios num cérebro, razão pela qual acredita que um conhecimento mais profundo do que ocorre no cérebro ajudará muito no entendimento do que acontece no universo.

Não se sabe praticamente nada quanto às singularidades que ocorrem nos Buracos Negros e sobre estes, o que se pode dizer é que existem, fato comprovado pelos desvios da luz ocasionados pelo efeito de sua gravidade.

Existem suposições de que a matéria que cai num buraco negro vai progressivamente sendo afunilada pela ação da imensa gravidade, sendo até sugerido por alguns estudiosos que haveria uma grande ejeção de energia para balancear com a matéria absorvida. Seria esta energia ejetada a energia escura do universo?

São apresentadas no tópico seguinte algumas considerações do mundo macro do universo, julgadas necessárias como preâmbulo para apresentação de novos insights do autor.

d) Cosmos

O autor confessa ser mais leigo com relação ao cosmos do que aos vários outros temas abordados.

As galáxias são sistemas massivos compostos por estrelas, planetas e sistemas solares, gás interestelar, poeira cósmica, matéria e energia escura além das galáxias obscuras. Elas são unidades fundamentais do Universo observável.

Existem diversos tipos de galáxias como as espirais, as elípticas e outras irregulares, cada uma com características distintas.

À medida que nossa tecnologia melhora e novas descobertas são feitas, muda a estimativa do número total de galáxias. Uma estimativa conservadora de pelo menos dois trilhões de galáxias no universo observável é baseada em observações disponíveis e extrapolações, um numero provavelmente imensamente maior do que o de seres biológicos existentes em nosso planeta terra.

Universo é o termo usado para designar tudo o que existe, incluindo todas as galáxias com tudo o que as compõem, incluindo a matéria e a energia escura.

Umas das razões o levaram a abordar este tópico, foi a ambigüidade existente quando se considera o Big Bang como um evento de passagem de um universo em contração a outro em expansão.

O autor considera, assim como outros pesquisadores, que o Big Bang seja realmente um evento ao invés de ser o fato bruto do início de tudo, só que, ao invés de ser a passagem de um universo em contração a outro em expansão, seja considerado como um evento envolvendo morte e nascimento de galáxias, eliminando assim a ambigüidade decorrente da admissão da existência de dois universos.

Outros indícios que acredita poderem ser apresentados para corroborar a idéia de ser o Big Bang um evento relacionado à morte e nascimento de galáxias seriam as freqüentes dúvidas surgidas com relação à idade e tamanho de diversas galáxias e dos valores obtidos para a taxa de expansão de Huble, dúvidas estas decorrentes de não serem os valores obtidos condizentes com as teorias existentes e que, me parece, não existiriam com a hipótese sugerida da morte e nascimento de galáxias ocorrendo em eventos como o do Big Bang.

Um último indício, este altamente especulativo, tem a ver com a hipótese sugerida pelo autor da existência de similaridades entre as sinapses no cérebro com as Ressonâncias de Poincaré e entre os neurônios com as ondas eletromagnéticas (9).

Esta idéia implica na suposição da existência de um palco, ou melhor, de um corpo onde tais sinapses cósmicas pudessem ocorrer. Reforçando esta idéia altamente especulativa, imagens obtidas do universo com telescópios de maior poder de resolução mostram a existência de filamentos que causaram ao autor uma primeira impressão de ser esta teia cósmica semelhante a uma rede de neurônios no cérebro. Tudo não passou, contudo de uma primeira impressão que foi substituída pouco tempo depois pela suposição de que esta teia cósmica com seus filamentos assemelhava-se mais ao sistema vascular de um organismo biológico, possibilitando o transporte de poeira cósmica e plasma dentre outras possíveis matérias.

Acredita que tecnologias mais avançadas propiciando maiores resoluções irão talvez revelar, inicialmente em laboratórios e talvez até no espaço uma outra rede numa escala de Planck, esta sim, sendo o palco das sinapses cósmicas ocasionadas pelas colisões de ondas produzindo as ressonâncias de Poincaré nas singularidades de regularidades, tudo isto não deixando de reforçar, na opinião do autor, a teoria da gravidade quântica em loop.

Os indícios apresentados nos parágrafos acima levaram o autor a conjecturar que as galáxias sejam objetos similares a corpos biológicos, estas similaridades estendendo a diversos aspectos refletindo numa variedade como a mostrada pelos seres biológicos.

Na visão do autor, uma galáxia seria o molusco imaginado por Einstein em sua teoria da relatividade geral.

A aplicação sistemática das leis físicas e matemáticas a todas as situações existentes podem gerar, acredita, estruturas novas e interessantes, situações novas ainda não existentes, mostrando a criatividade inerente ao universo que criou todas as coisas belas incluindo a própria vida e que pode criar coisas ainda inexistentes e nem imaginadas devido à sua quase infinita criatividade. Deve-se ter sempre em mente que nem as próprias leis físicas são eternas, estando sujeitas elas também a mudanças como tudo o mais no universo.

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Nature of Arrhythmia in the Cyclicity Activity of Sun

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Abstract- The dynamics of fluctuations in the intensity of galactic cosmic rays (CR) are studied at different phases of the solar cycle. In the previously introduced parameter of CR fluctuations on rotation No 2597 (January 2024), a precursor (https://www.forshock.ru/ predlong.html) of the beginning of the maximum of the *new* 25th cycle was registered. Taking into account the lead time of the medium-term forecast $\Delta\tau=2(\pm1)$ of the solar rotations, the beginning of the maximum of the 25th cycle was expected for February-March 2024. The indicator (marker) of the beginning of the maximum of the new 25th cycle is a significantly *low - diagnostic* value of the CR fluctuation parameter on rotation No *2599*, in *March* 2024, which was confirmed by the results of operative monitoring.

The question of further development of the new 25th cycle remains relevant. CR data (https://cosmicrays.oulu.fi/) indicate a sharp and deep (≈20%) decrease in CR intensity at the end of the 24th cycle, comparable to ... cycle 21 in the early 80s (1982). Most likely, the 11-year cyclicity of the Sun is restored, possibly at a level above average. Obviously, this indicates a LOCAL nature of the failure in cycles 23-24. The previously established conservatism or invariance of the binary relationship "amplitude-duration" of the 11-year cycle is violated in the two previous cycles 23 and 24. The maximum area ("*energy content*" or *luminosity* - "*solar constant*") occurs in cycle 23, with a subsequent significant decrease in energy content - luminosity of cycle 24. Nevertheless, the INVARIANT with the characteristic scale of the duration of the "physical" 22-year cycle is preserved. In this case, after a local failure of the 11-year cyclicity in the 23-24 cycles, the 11-year cyclicity in the new 25 cycle should be restored!

GJSFR-A Classification: *LCC: QB529, QB506*

Nature of Arrhythmia in the Cyclicity Activity of Sun

Kozlov V. V. [α], Kozlov V. I. [σ], Kozlov D. V. [ρ] & Yakovlev D. V. [ω]

Abstract- The dynamics of fluctuations in the intensity of galactic cosmic rays (CR) are studied at different phases of the solar cycle. In the previously introduced parameter of CR fluctuations on rotation No 2597 (January 2024), a precursor (https://www.forshock.ru/ predlong.html) of the beginning of the maximum of the *new* 25th cycle was registered. Taking into account the lead time of the medium-term forecast $\Delta\tau=2(\pm1)$ of the solar rotations, the beginning of the maximum of the 25th cycle was expected for February-March 2024. The indicator (marker) of the beginning of the maximum of the new 25th cycle is a significantly *low* - *diagnostic* value of the CR fluctuation parameter on rotation No *2599*, in *March* 2024, which was confirmed by the results of operative monitoring.

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It is important to note that the Lorenz system (according to G.V. Kuklin et al.) is capable of describing various stages of the system's evolution: from the emergence of convection - the appearance of self-oscillations (11-year cyclicity) when the critical temperature value is exceeded, to the disappearance of self-oscillations (entering to the *chaotic* regime of the "*strange attractor*") when the temperature decreases. As it happened during the "*Maunder* minimum", essentially - a parametric "*phase catastrophe*". There are, obviously - extremal cases.

There is also an intermediate situation or ARRHYTHMIA in the cyclic activity of the Sun: a "local" failure, when the invariant of the 22-year cycle is preserved (modern cycles 23-24 and 19-20) and a "*global*" failure, when the invariant of the 22-year cycle is violated ("*Dalton* minimum" and "*Gleissberg* minimum"). At the same time, both the emergence and violation of cyclicity are organically linked by a common approach to the cyclic activity of the Sun as a mechanism for regulating energy. In this, in our opinion, lies the nature of solar cyclicity, 11-year and 22-year: solar cyclicity is nothing other than a self-oscillating mechanism of "release" - regulation of energy (in the convective zone) of the Sun, *stabilizing* its temperature.

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I. Introduction

The situation in the solar wind during the period of maximum solar activity, when the probability of sporadic phenomena (flares, shock waves, etc.) is high, can be defined as "*crisis*". And therefore it is quite natural to apply the concept of crisis phenomena to describe the process as a whole, namely, to use the "Theory of Continuous Media Failure" or "Reliability Theory". In this case, the *highest* moments of the distribution function are used in the analysis. More precisely, the generalized three-parameter Weibull-Gnedenko distribution is used [1] (Appendix 1). To calculate the PROBABILITY of achieving the critical value of the cosmic ray (CR) count rate, it is necessary to estimate the shape parameter "c" of the Weibull-Gnedenko empirical distribution, which determines the degree of DEVIATION of the approximating function of the empirical histogram from the normal distribution.

The approximating function of the empirical (integral) histogram of the CR count rate is found by the least squares method. The average values of the CR count rate for each bin interval of the empirical distribution function (integral histogram) will be grouped in the vicinity of the fitted straight line, but in a new coordinate grid (after the procedure of double logarithmization and substitution of variables). In this case, the tangent of the slope of the straight line fitted by the least squares method and the free term give the relationships necessary for estimating the sought-after shape and scale parameters. The shape parameter "c" is the *key* parameter: when it reaches a *critical* value, the parameter value is determined as a *predictor* of entering a critical, essentially transient, regime. The scale parameter is determined by the average value of the empirical histogram of the CR count rate distribution.

Thus, the procedure for extracting a useful precursor signal from a noise-like signal is reduced to finding the Risk function (by definition, the CR fluctuation PARAMETER) of the Weibull-Gnedenko distribution describing the experimental (integrated) histograms of five-minute CR count rate values. This allows extracting a useful predictor signal from Gaussian noise: Gaussian noise is contained, simply put, in the "linear" part of the Risk function, and the desired predictor signal is in the

nonlinear part. The desired, nonlinear component of the predictor signal is formed when the calculated probability of the CRITICAL value of the analyzed variable (CR fluctuation parameter) is exceeded, i.e. when P>Pcr.

II. Method

A test calculation of the Risk function, when a whole series of the most extreme events of solar cycle 23 (October 2003) was observed – Appendix 2. The calculation was carried out for 7 solar rotations: first, for 5 rotations 2318-2322 preceding the extreme events on rotations 2323-2324, and then directly during the specified active phase of the solar cycle. From the calculation results it follows that significant (P>0.5) values of the maximum of the Risk function – *predictor*, were detected in July-August 2003 (rotations *2320-2321*). In this regard, the time interval falling on rotations 2320-2321 during which the predictors were detected is defined as - the *transitional* regime to the *extreme* active phase of the solar cycle in October-November 2003 (rotations 2323-2324). Thus, we can conclude that the ideology of *crisis* situations, in this case, has proven itself to be successful.

An example of calculating the Risk function on a smaller (*semi-diurnal*) scale of averaging the count rate and the corresponding values of the CR fluctuation parameter is shown in Fig. 1. In the *complete absence* of spots on the visible hemisphere of the Sun, on January *1*, 2008, a CR *predictor* from a "behind-the-limb" source was registered. According to data from the Stereo-A spacecraft, on December 31, 2008, two large C8-class X-ray flares were observed on the side of the Sun invisible from Earth. Both flares were accompanied by a coronal mass ejection (CME). A possible source of these X-ray flares could be active region (AR) № 978. This was the only source observed during the previous solar rotation (https://spaceweather.com/archive.php?day=01&month=01&year=2008&view=view), which reappeared on the eastern limb of the Sun only on *January 2*. 2008. The decrease in the CR count rate began from 4.I.2008 to 5.I.2008. The clearly expressed *low*, in fact - the MARKER of the shock wave, i.e. - the *diagnostic* value of the CR fluctuation parameter registered from *4*.I.2008 to *5*.I.2008 (Fig. 1) definitely indicates the registration of the shock wave at the specified time. Thus, the proposed approach shows a fairly *high* efficiency both on the 27-day averaging scale and on a smaller, semi-daily averaging scale.

III. Results

At Figure 2 shows the results of calculating the CR fluctuation parameter for the previous 24th and the beginning of the new 25th cycle. A clearly expressed increase in activity was observed in July 2023: *medium-term predictors* were registered on rotations No. 2590, 2592 and *2597*. Of greatest interest is the precursor on rotation *2597* (4-31.01.2024). Taking into account the forecast lead time $\Delta\tau=2$ (±1 rotation) of the Sun's rotations, an increase in activity should be expected on rotation *2599* (±1 rotation), i.e. in *February-April* 2024. Rotation No. 2599 corresponds to the penultimate (bottom right) point of the CR fluctuation parameter - a *diagnostic* or *marker* in red. From this it follows that the indicator of the beginning of the maximum of the new 25th cycle can be considered rotations No. *2599* (*March* 2024).

Indeed, starting from the 3rd ten-day period of February 2024, large X-ray flares of class *X*1.8 (02/21/2024), *X*1.7 and *X*6.3 (02/22/2024) were registered in AO 3590. Before AR 3590 left for the solar hemisphere invisible from Earth, on February 28-29 https://spaceweather.com/images2024/28feb24/filament_CME.gif a flare of a long and complex structure of class M was observed, accompanied by a series of CME.

The *beginning* of the maximum of the 25th solar cycle from late April to May, which began in the 3rd ten-day period of *February* 2024, is becoming more active: this was manifested in the increased activity of both hemispheres of the Sun simultaneously. An illustration of this is the appearance of so-called (https://spaceweather.com/images2024/05may24/acticity_teal.gif) "*sympathetic*" flares. First, "paired" - in the northern and southern hemispheres), and then serial (https://spaceweather.com/images2024/06may24/m4p5_anim_opt.gif) events registered on the entire visible hemisphere of the Sun *simultaneously*!

Thus, in the first ten-day period of May, a "paired" (in the form of 2 semi-diurnal values) *predictor* in the CR fluctuation parameter for May *5-6*, 2024 was obtained (Fig. 3). The specified predictor was obtained at the beginning of the day on May 6, and already on the 2nd day - May *8*, according to the ACE spacecraft (USA), an increase in the flux of low-energy protons in a wide energy range began - "*storm*" particles Appendix 3, which usually *precede* the arrival of shock waves in the Earth's orbit. The high power of this event is most likely due to the *cumulative* effect [2] (Appendix 4), according to foreign terminology: "*cannibal* effect" [3].

High solar activity in May 2024 continued in October-November. This follows from the results of the subsequent *medium-term* forecast (Fig. 4). The "double" *predictor* is registered on rotations No. *2602-2603* in May-June 2024. Indeed, after $\Delta\tau=2(\pm1$ rotation) of the Sun's rotations, starting in *August* (rotation No. *2605*) 2024, a long and deep *decline* in the CR intensity began. This is also indicated by the relatively *low* (markers), *diagnostic* average-rotation values of the fluctuation parameter on the extreme rotations No. *2607-2608*.

The medium-term forecast is confirmed by the results of *operative* monitoring (Fig. 5). Indeed, the

"double" values of the CR fluctuation parameter from October *4* to *5* and from October *8* to *9*, 2024 exceed the "cosmic noise" region, thus being predictors of shock waves. On the contrary, the extremely *low* values of the CR fluctuation parameter on October *5-6* and October *10-11* are MARKERS of the registration of shocks in the Earth's orbit, which is confirmed by the results of modeling in the *NOAA* Space Weather Prediction Center (Appendix 5-6). It follows that in October-November 2024 (rotations *2607-2608*) the MAXIMUM of the new 25th cycle is registered!

IV. The Nature of Arrhythmia of Solar Cyclicity

Earlier, in [4], it was established that the higher the cycle amplitude at the maximum, the shorter the duration of the polarity reversal process, after the completion of which the CR restoration begins. And, conversely, the lower the cycle amplitude, the longer the polarity reversal phase. The *inverse* dependence of the field inversion process duration on the cycle amplitude revealed by the CR indicates the possible presence of the Invariant of the binary relationship of the 11-year cycle characteristics "amplitude-duration".

We analyzed the relationship between variations in the amplitude and duration of the solar cycle using the language of phase portraits on a complex phase plane using an analytical signal - Fig. 6. The area of the "phase portrait" has the dimension of ACTION, with the dimension of "energy *x* time" (a "*phase volume*"). In this sense, for a fixed (in time) cycle, its area is a characteristic of *energy-capacity*, the change in which from cycle to cycle can be traced, for example, by the change in the relative variation in the solar *luminosity*, i.e. by the relative variation (https://www.sws.bom.gov.au/Educational/2/1/12) 11-year variability of the "*solar constant*".

Below is an estimate of the *areas* of the phase portraits of solar cycles 21-24, i.e. the characteristics of their *energy-capacity*. The analysis was carried out using the average-annual values of the CR fluctuation parameter. The areas of cycles 21 and 22 are practically identical (Fig. 7). The constancy (invariance) of the area, as a characteristic of energy-capacity, indicates the conservatism or constancy of the area of the 11-year cycle in time (*time symmetry*) during two consecutive cycles 21 and 22. Conservatism or invariance (in the sense of the binary relationship "amplitude-duration") is violated for the two subsequent cycles 23 and 24.

Violation of the conservatism of the system means the presence of 11-year cycles with different *energy-capacity*, i.e. with different *areas*. This is observed in cycles 23 and 24. The maximum area occurs in cycle 23, with a subsequent clear decline in area in cycle 24, starting in 2006 (Fig. 7). It is noteworthy that the relative variation in solar luminosity, as a possible characteristic of the energy intensity of the cycle, also began to decrease in cycle 24, in fact, starting in the same 2006. https://www.sws.bom.gov.au/Educational/2/1/12.

On the other hand, averaging the areas of *pairs* of adjacent 11-year cycles (starting with 21) preserves the invariance of the areas of pairs of 11-year cycles: 21-22 and 23-24, i.e. the *invariance* of the areas of adjacent 22-year cycles or their energy-capacities is *preserved*. This means conservatism (time symmetry) of the dynamic system (the Sun) in a broad sense, i.e. the presence of an INVARIANT with a characteristic scale of the duration of the *22*-year cycle. In this case, after a failure of the 11-year cyclicity in the 23-24 cycles, the 11-year cyclicity of solar activity in the next 25 cycle should be *restored*!

In turn, this should mean the fulfillment of the following physical criterion: the level of CR *background radiation* in the minimum of the current cycle 25 should be significantly *lower* than the level of background radiation in the minimum of the previous 24 cycle [5]. In turn, this will mean the fulfillment of the Gnevyshev-Olya rule. This is exactly the situation we observe now if we compare the CR count rate *minima* in 2014 and 2024 (in *yellow ovals* in Fig. 2 and Fig. 4). In this case, the value of the current data for 2024 is difficult to overestimate. Their comparison with similar data for 2014 indicates that the failure of the 11-year cyclicity in cycles 23-24 can be confidently attributed to a *local* failure.

The conclusion about the local nature of the failure in cycles 23-24 is confirmed by the data https://www.sidc.be/SILSO/dayssnplot of flare activity, as well as by the data of subsequent CR monitoring. Indeed, the CR data indicate a sharp and deep (≈20%) *decrease* in the GCR intensity at the *end* of current cycle (Fig. 4), comparable only, as minimum, with cycle … *21* in the early 80s (1982): https://cosmicrays.oulu.fi/. In fig. 8 shows the results of calculating the "phase portraits" of four solar cycles No. 19-22 calculated from the average annual values of Wolf numbers [6]. At the top is the time course of the average annual values of Wolf numbers. The numbers of the corresponding cycles are shown. Cycle *19* has the largest area. The *largest* area of the *19* cycle is a *predictor* of a LOCAL failure of the 11-year cyclicity in the 19-20th cycles, which occurred in the modern era - the era of the "Space Era". Then, in the 21-22nd cycles, the cyclicity of solar activity is *restored*.

It is important to note that the Lorenz system (according to G.V. Kuklin et al. [7]) is capable of describing various stages of the system's evolution: from the emergence of convection - the appearance of self-oscillations (11-year cyclicity) when the critical temperature value is exceeded, to the disappearance of self-oscillations (entering to the *chaotic* regime of the "*strange attractor*") when the temperature decreases. As it happened during the "*Maunder* minimum", essentially

a parametric "*phase catastrophe*". There are, obviously - extremal cases.

There is also an intermediate situation or ARRHYTHMIA in the cyclic activity of the Sun: a "*local*" failure, when the invariant of the 22-year cycle is preserved (modern cycles *23-24* and *19-20*) and a "*global*" failure, when the invariant of the 22-year cycle is violated ("*Dalton* minimum" – Fig. 9) and "*Gleissberg* minimum"). At the same time, both the emergence and violation of cyclicity are organically linked by a common approach to the cyclic activity of the Sun as a mechanism for regulating energy. In this, in our opinion, lies the nature of solar cyclicity, 11-year and 22-year: solar cyclicity is nothing other than a self-oscillating mechanism of "release" - *regulation* of energy (in the convective zone) of the Sun, *stabilizing* its temperature.

V. Conclusions

- In the parameter of CR fluctuations, a predictor to the beginning of the maximum of the new 25th solar activity cycle was obtained. Taking into account the value of the forecast lead time $\Delta\tau=2(\pm1$ rotation) of the Sun's rotations, the beginning of the maximum of the 25th cycle was *predicted* for the *2597*-th rotation (±1 rotation), i.e. in *February-April* 2024. The indicator - marker of the *beginning* of the maximum of the new 25th cycle is a significantly *low* value of the CR fluctuation parameter on the rotation No. *2599*, in *March* 2024.
- This is confirmed by the results of the operative forecast on May *5-6*, as well as October *4-5* and 7-8, 2024, the registration of "*storm*" particles (*preceding* the arrival of shock waves to the Earth's orbit) and the *fact* of the passage of shock waves of the Earth's orbit by the registration of the *marker* - an extremely *low*, *diagnostic* value in the CR fluctuation parameter on May *10-11*, as well as *5-6* and 10-11, October 2024.
- The failure in the 23-24 cycles can be confidently attributed to a LOCAL failure, i.e. the 11-year cyclicity of solar activity, begin from the 25th cycle, should be *restore*!
- ARRHYTHMIA in the cyclic activity of the Sun: a "*local*" failure, when the invariant of the 22-year cycle is preserved (modern cycles *23-24* and *19-20* and a "*global*" failure, when the invariant of the 22-year cycle is violated ("*Dalton* minimum" and "*Gleissberg* minimum").
- The nature of solar cyclicity (11-year and 22-year) from the standpoint of the INVARIANT of the 22nd cycle: solar cyclicity is nothing more than a self-oscillating mechanism of "release" - *regulating* the energy (in the convective zone) of the Sun, *stabilizing* its temperature.

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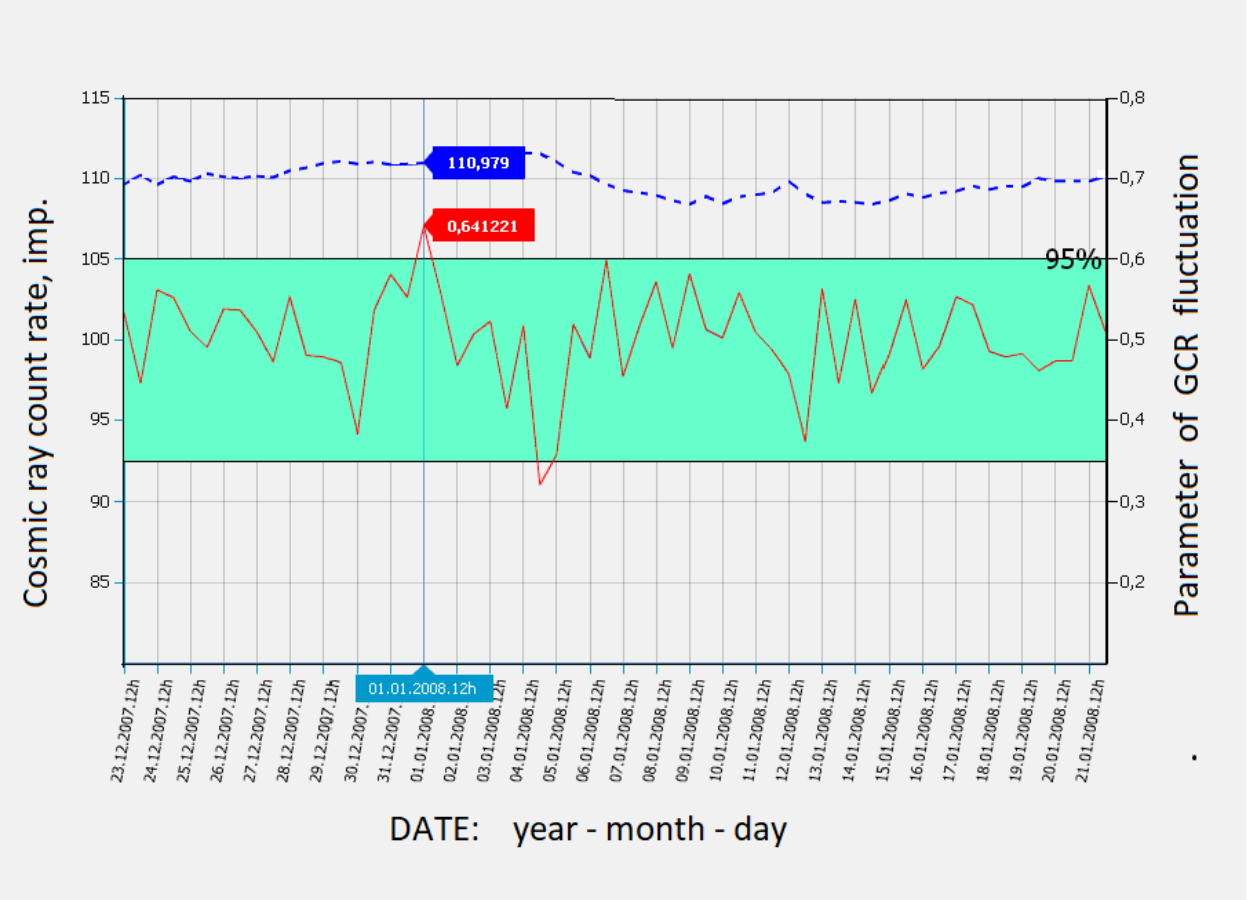


Fig. 1: TEST – calculation of *predictor* in CR during the appearance on the visible hemisphere of the Sun as the *only* source of activity. Results of calculation of the CR fluctuation parameter from December 2007 to January 2008 have been obtained using the Cyber-FORSHOCK *robotic expert system*. The scale on the right corresponds to the values of probability or parameter of fluctuations shown by the(solid curve; the scale on the left corresponds to the count rate in the pulses per 5 minutes (averaged over 12 hours) by data of the neutron monitor at the Oulu station (Finland) shown by the dotted curve. The parameter values placed in the interval: 0.35<P<0.60 - the "cosmic noise" region. On the lower scale the date and time are plotted.

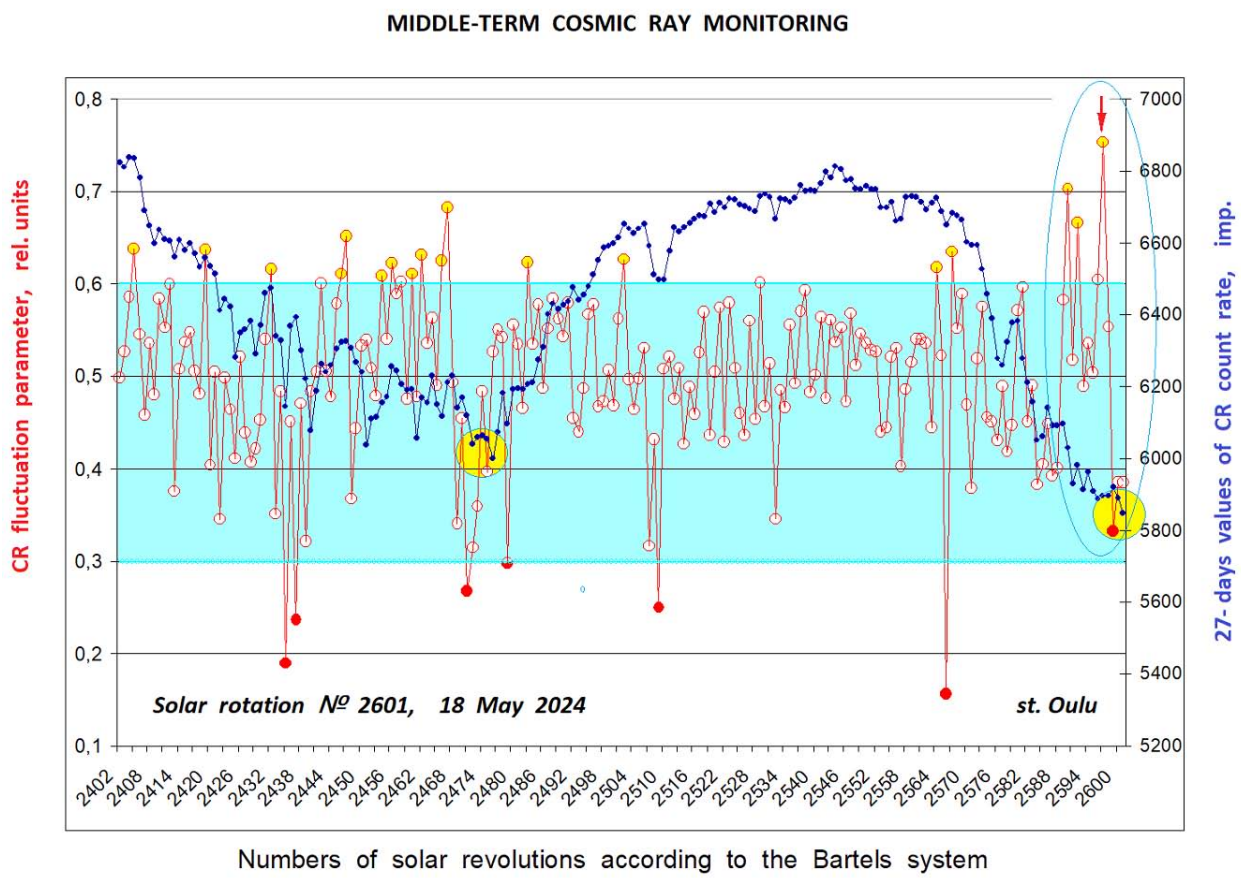


Fig. 2: Cosmic ray count rate at the Oulu (Finland) in pulses per 5 minutes averaged over 7776 points of 5-min values during each solar rotation shown by the blue dotted curve, scale on the right. 27-day values of the CR fluctuation parameter in relative units shown by the red solid curve, scale on the left. The 90% significance level is shown. The CR fluctuation parameter values exceeding the "cosmic noise" area (shown by green) are precursors of the increase of solar activity. The *precursor* of the beginning of the 25th cycle maximum (the late on the right, shown by the vertical red arrow) - is registered on the № *2597* rotation. And, on the contrary, a sufficiently low value of the CR fluctuation parameter (the penultimate point in red, the № *2599* rotation, *March* 2024) is defined as - a MARKER of the *beginning* of the new 25th cycle maximum.

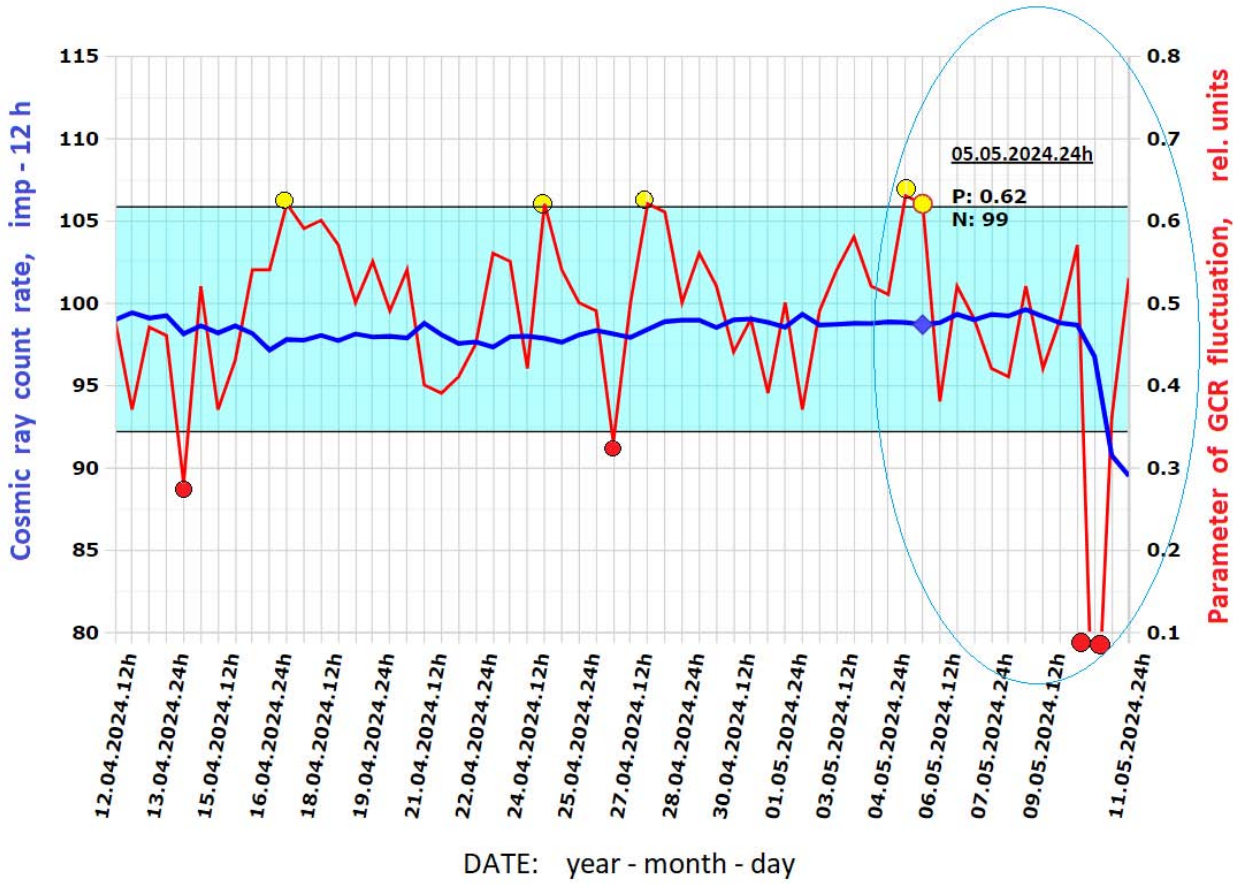


Fig. 3: Results of operational monitoring of cosmic rays in April-May 2024. The scale on the right (the red curve) corresponds to the values of the CR fluctuation parameter; the scale on the left (the blue curve) corresponds to the count rate in pulses per 5 minutes (averaged over 12 hours) by the neutron monitor data from the Oulu (Finland). The parameter values in the interval of $0.35<P<0.60$ are the "cosmic noise" area (shown in green). On the lower scale the date and time are plotted. The "paired" values of the CR fluctuation parameter from *5* to *6* May, 2024 exceed the "cosmic noise" region and, therefore, the "paired" parameter of CR fluctuations is a *predictor* of shock. On the contrary, the extremely *low* values of the CR fluctuation parameter from *10* to *11* May are a *marker* of shock registration at the Earth's orbit.

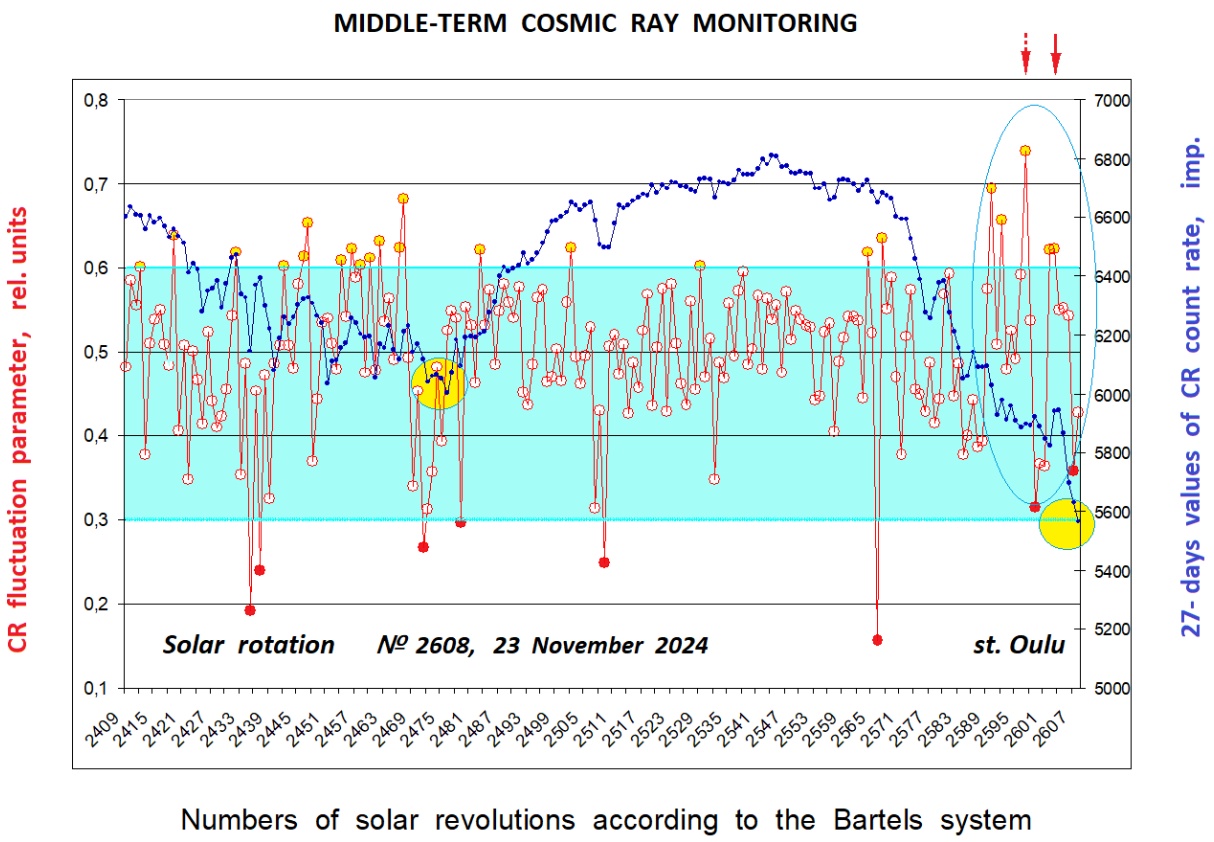


Fig. 4: Cosmic ray count rate at Oulu station (Finland) in pulses per 5 minutes, averaged over 7776 points of 5-min values during each solar rotation - blue dotted curve, scale on the right for the time interval starting from the 2409-2608 rotation. 27-day values of the CR fluctuation parameter in relative units - solid red curve, scale on the left. 90% significance level is shown. CR fluctuation parameter values exeeding the "cosmic noise" region (shown in green) are harbingers of increased solar activity. The precursor of the beginning of the maximum of the 25th cycle - the one on the far right (shown by the vertical arrow - dotted red line) is registered on the rotation № *2597*. The subsequent "double" precursor is registered on rotations № *2602-2603* in *May-June* 2024. On the contrary, a fairly *low* - *diagnostic* value of the CR fluctuation parameter (the penultimate point in red, rotation № *2599*, *March* 2024, as well as on the last two rotations *2607-2608*), is defined as - a *marker* of the MAXIMUM of the new 25th cycle.

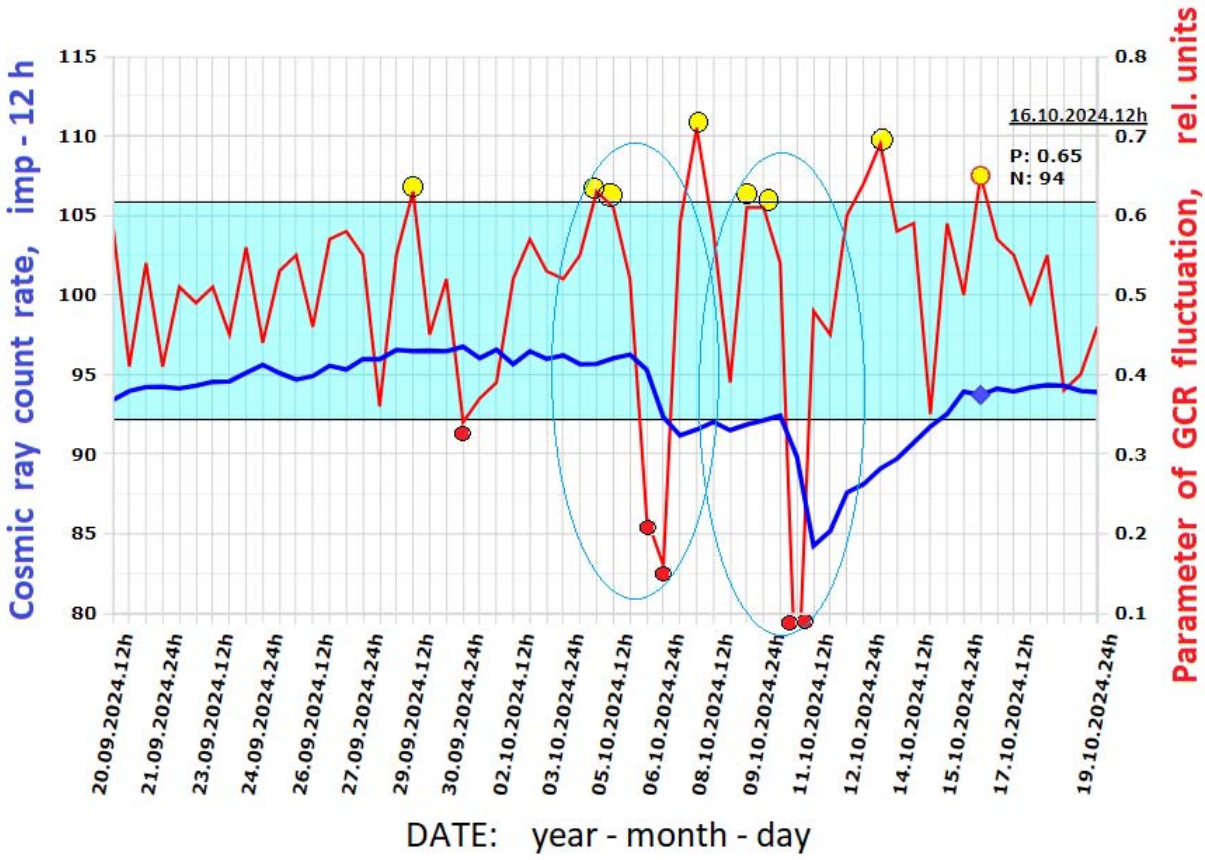


Fig. 5: Results of operative monitoring in September - October 2024. Along the ordinate axis: the scale on the right (red curve) – values of the CR fluctuation parameter; the scale on the left (blue curve) – count rate in pulses per 5 minutes (averaged over 12 hours) according to data from the neutron monitor of the Oulu station (Finland). The parameter values included in the interval: $0.35<P<0.60$ – the "cosmic noise" region (shown in green). Along the abscissa axis – date: year – month – day – hour. The "double" values of the CR fluctuation parameter from October *4* to *5* and from October *8* to *9* of this year exceed the "cosmic noise" region and, therefore, the "*double*" parameter of CR fluctuations is a *predictor* of shock. On the contrary, the extremely *low* values of the CR fluctuation parameter from *5-6* and *10-11* October are MARKERS of the registration of shocks in the Earth's orbit.

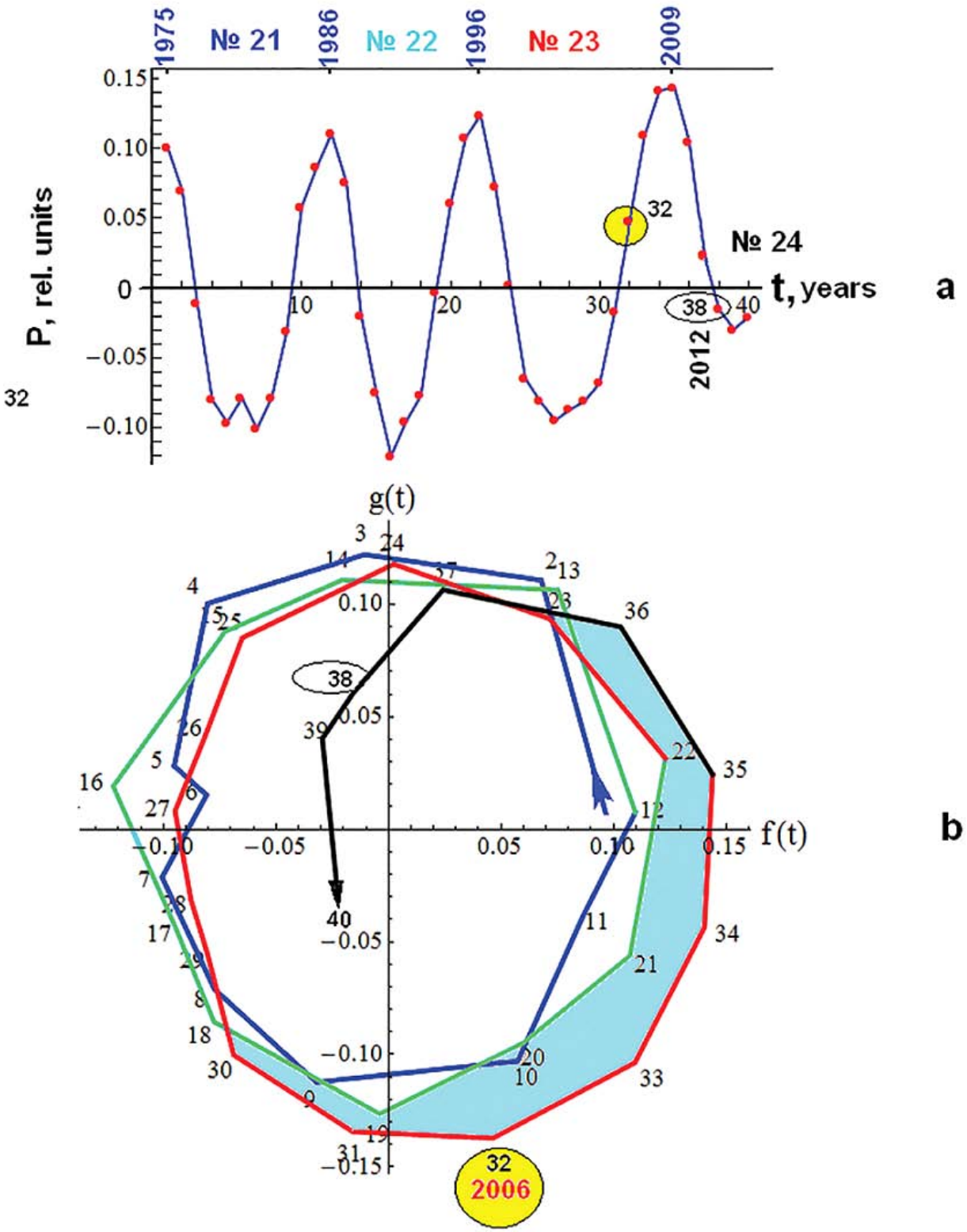


Fig. 6: "Phase portraits" of the last 4 cycles No. 21-24 (for 1975-2014) calculated by the annual average values of the cosmic ray fluctuation parameter. At the top there is the time dependence of the annual average values of the cosmic ray fluctuation parameter. The numbers of the corresponding cycles are shown. The 23rd cycle has the largest area. The *largest* area of the *23*rd cycle is a precursor of an extraordinary disruption of the 11-year cyclicity, i. e. a *predictor* of the LOCAL failure of the 24th cycle.

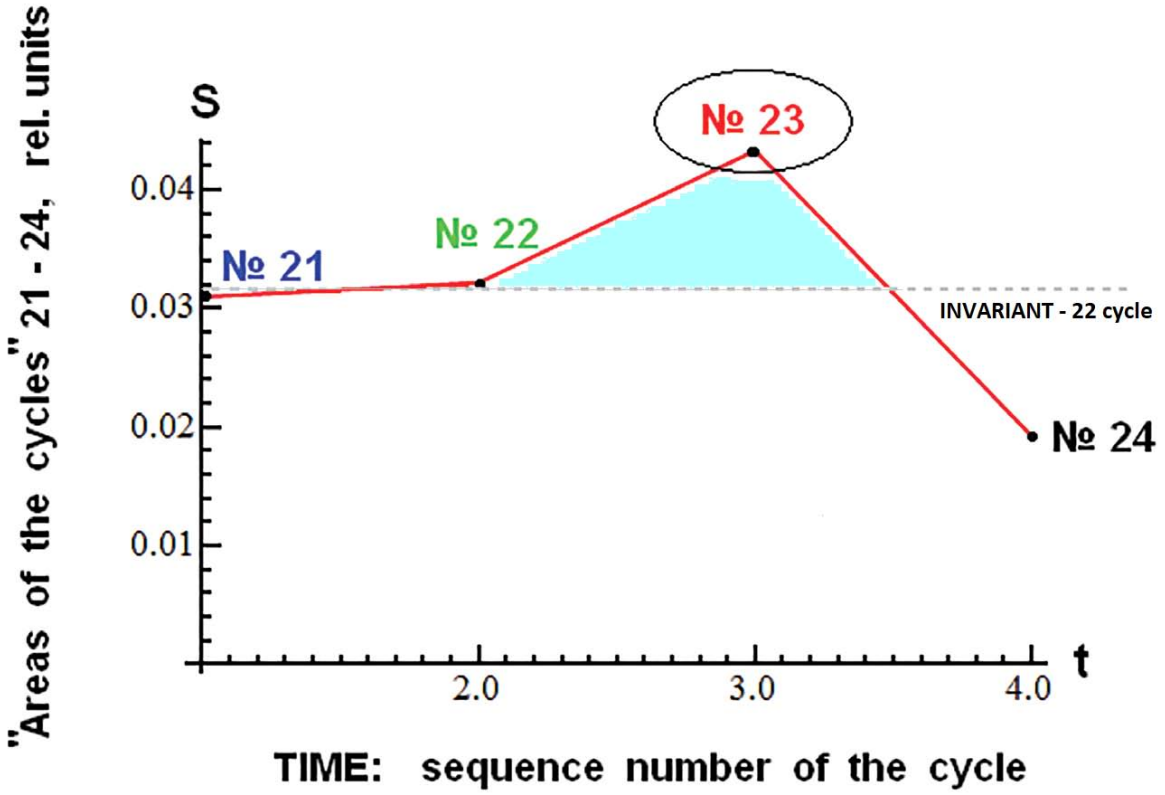


Fig. 7: Estimation of the areas swept under the curves of the 21-24 cycles of 11-year duration (for 1975-2014) by their "phase portraits" calculated by the annual average values of the CR fluctuation parameter. The horizontal line (shown by dots) represents the level of constancy of the average value of the areas of pairs of the adjacent 11-year cycles, i. e. the INVARIANT level of the 22-year cycle. The 23rd cycle has the largest area. The *largest* area of the 23rd cycle is a *predictor* of LOCAL failure of the 11-year cyclicity.

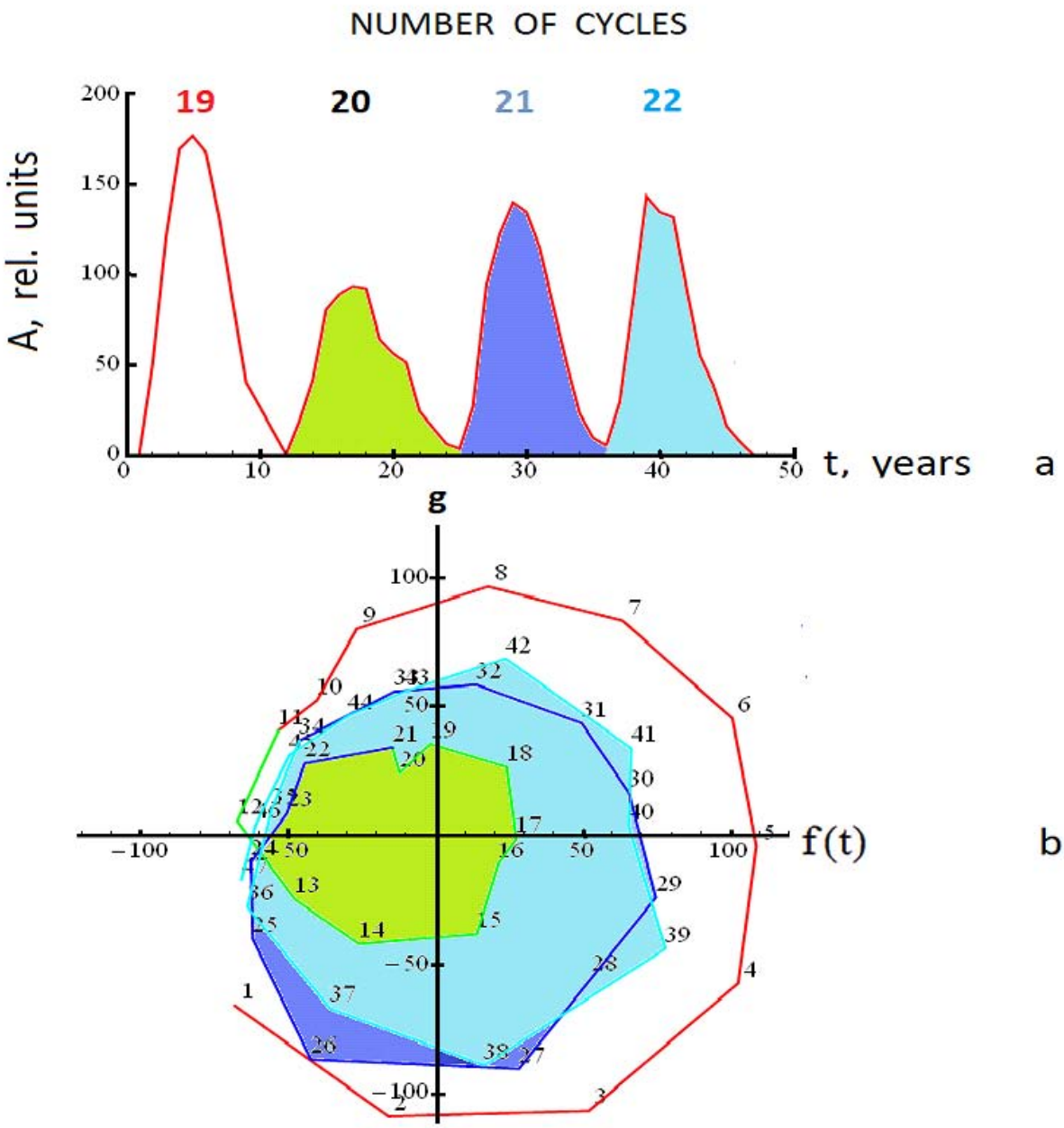


Fig. 8: "Phase portraits" of the 4 cycles № 19-22, calculated by the annual average values of number Wolf. At the top there is the time dependence of the annual average values of number Wolf. The numbers of the corresponding cycles are shown. The 19 cycle has the largest area. The *largest* area of the 19 cycle is a precursor of a non-ordinary disruption of the 11-year cyclicity, i. e. a *predictor* of the LOCAL failure non-ordinary disruption of the 19-20 cycles.

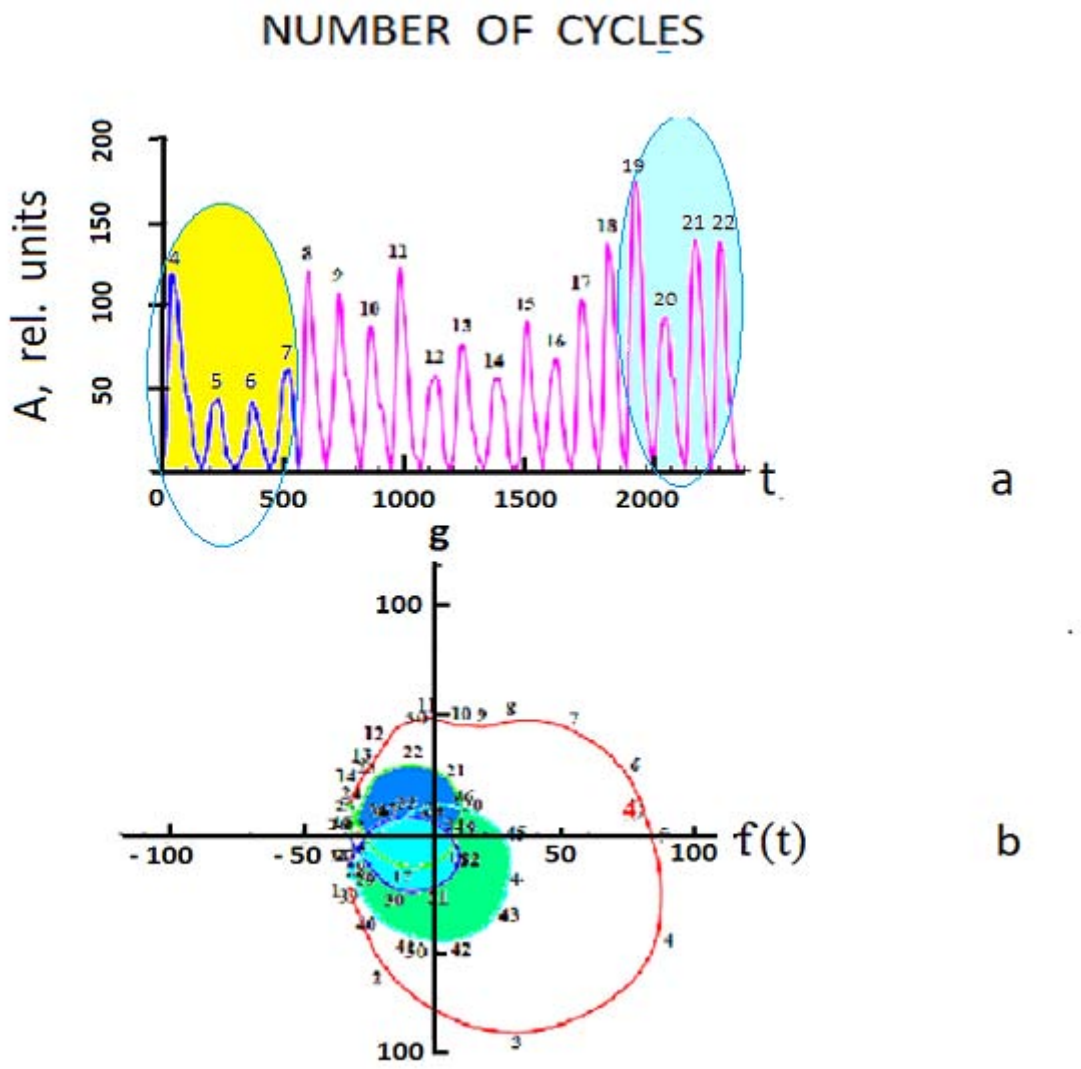


Fig. 9: "Phase portraits" of the 4 cycles No. 4-7 calculated by the annual average values of number Wolf during the "*DALTON* minimum". At the top there is the time dependence of the annual average values of number Wolf. The numbers of the corresponding cycles are shown. The 4 cycle has the largest area. The *largest* area of the 4 cycle is a *predictor* of essentially - a *GLOBAL failure*, when was the INVARIANT of the 22-year cycle is *violated*.

Weibull distribution function:

$$F(x) = 1 - \exp\{-[(x-\theta)/b]^{c}\}$$

where

$\theta < x$, $b > 0$, $c > 0$

b - scale parameter

c - shape parameter

θ - pozition parameter

Distribution function density:

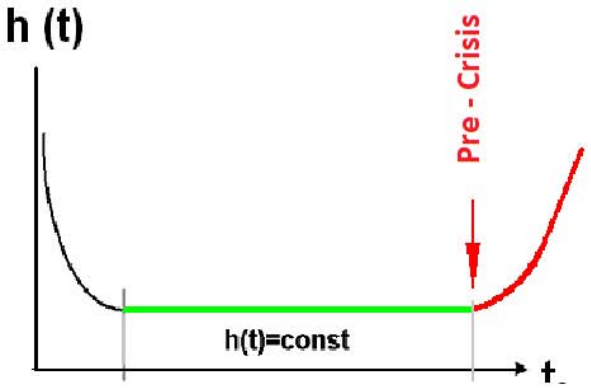
$$f(x) = c/b * [(x-\theta)/b]^{c-1} * \exp\{-[(x-\theta)/b]^{c}\}$$

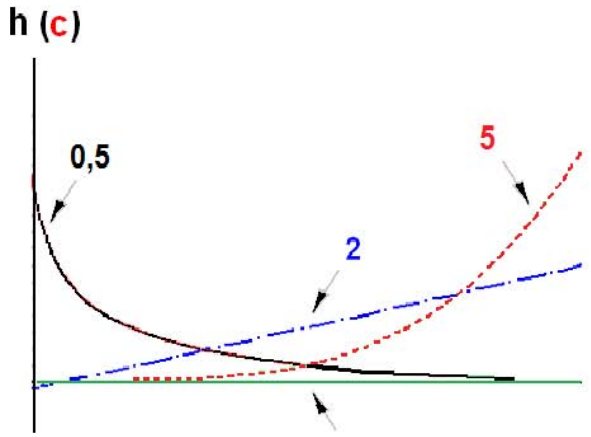
Reliability function:

$$R(x) = 1 - F(x)$$

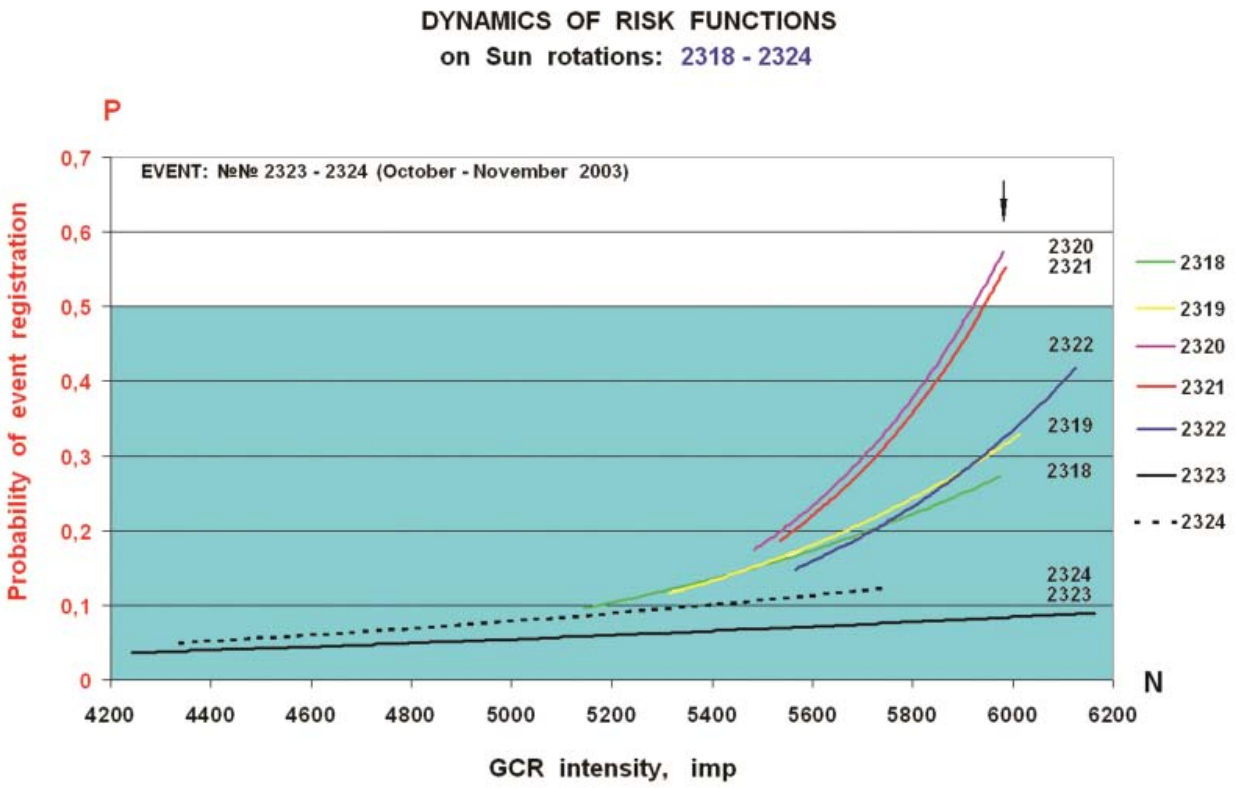
Hazard function:

$$h(x) = f(x)/R(x) = [c * (x-\theta)^{(c-1)}] / b^{c}$$

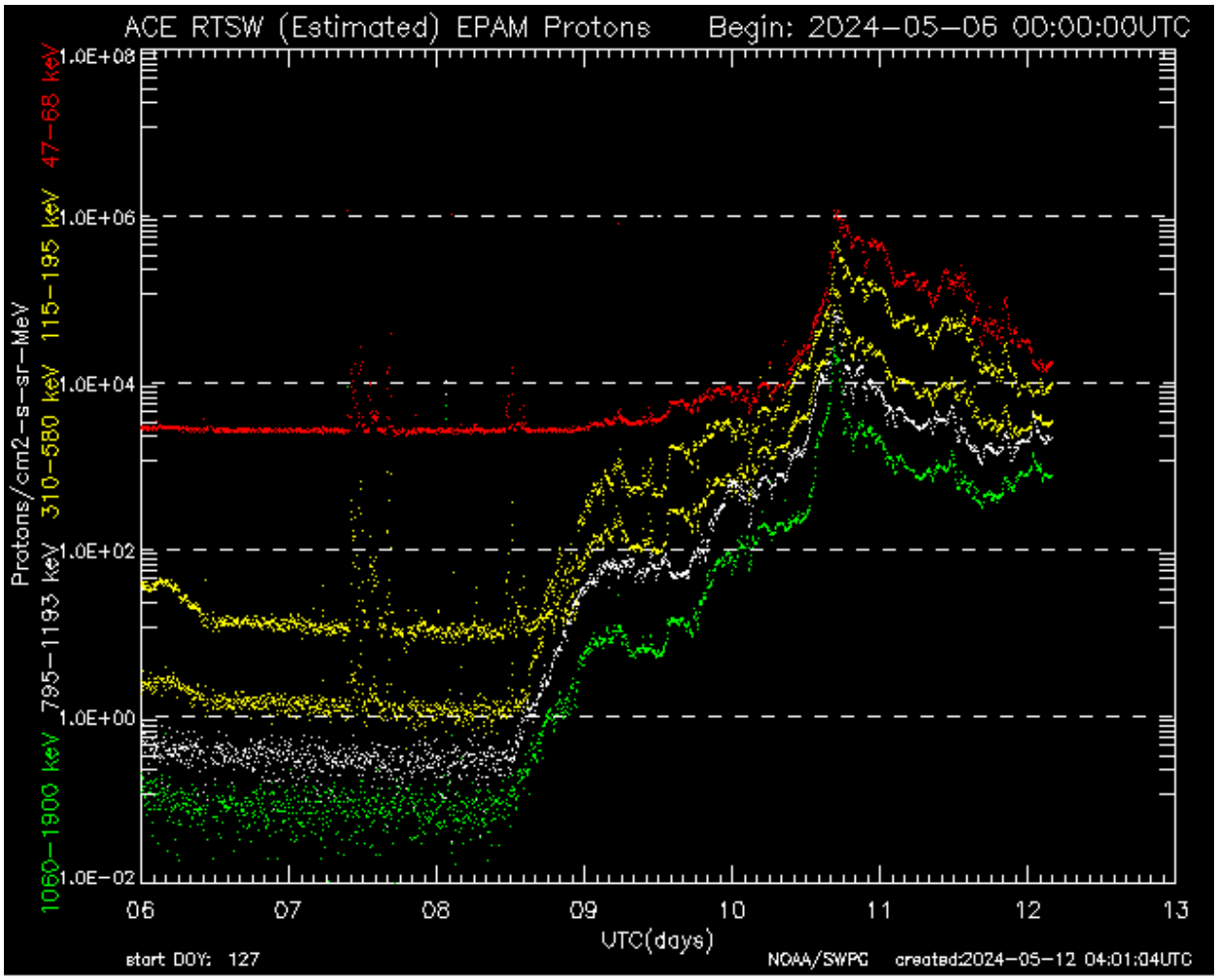




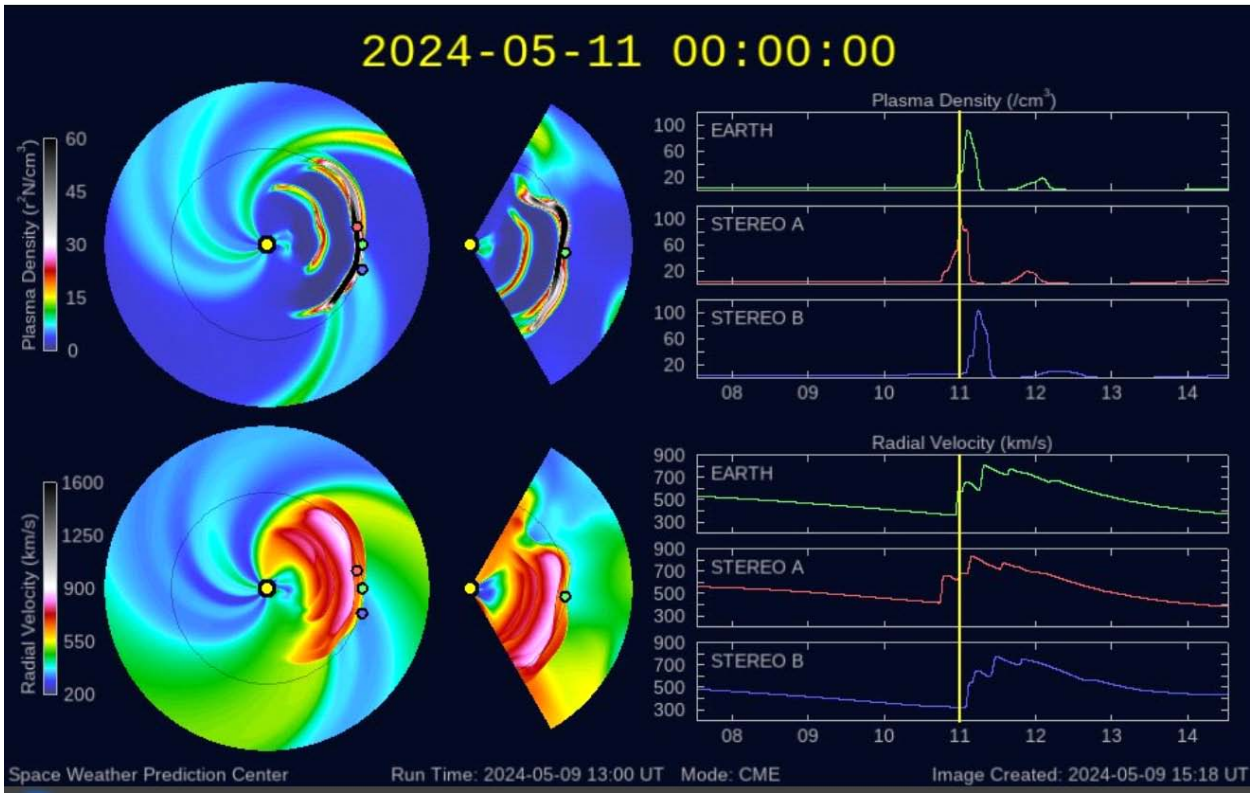
Appendix 1: Mathematical expressions (and corresponding function graphs) used to calculate the CR fluctuation PARAMETER based on the parameter values of the shape (c), scale (b) and shift (Θ). The rapidly decreasing value of the Risk function at the value of shape parameter c=0.5 corresponds to the "break-in" period of a complex dynamic system. The horizontal line of the Risk function (green) corresponds to the "normal" operation mode of the system. The value of parameter of the shape c>3 and higher (c=5) is the reaching of *pre-crisis* state of the dynamic system (a mode before the pre-catastrophe) shown by the red section of Risk function curve.



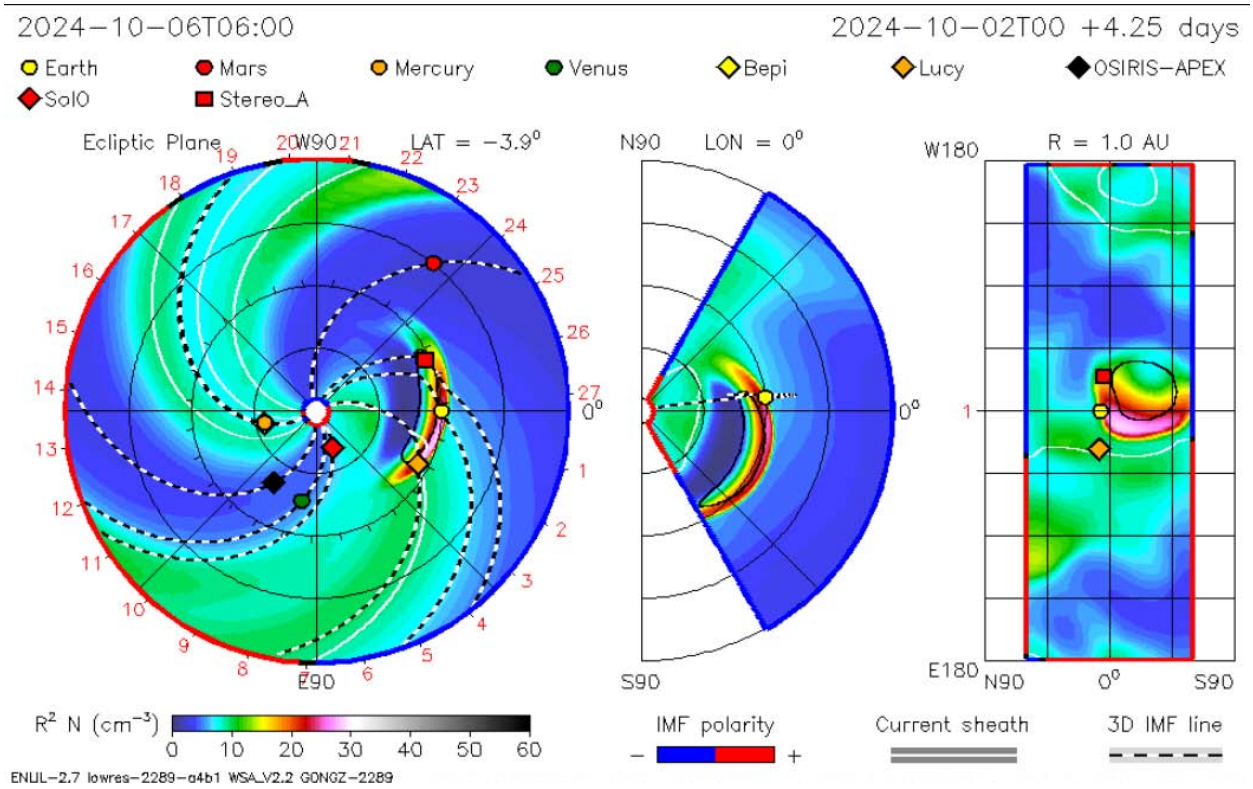
Appendix 2: The calculation of parameter fluctuations CR (function RISK) was carried out for 7 solar rotations: first, for 5 rotations 2318-2322 *preceding* the *extreme* events on rotations *2323-2324*, and then directly during the specified active phase of the solar cycle. From the calculation results it follows that significant (P>0.5) values of the maximum of the Risk function – *predictor*, were detected in July-August 2003 (rotations 2320-2321).



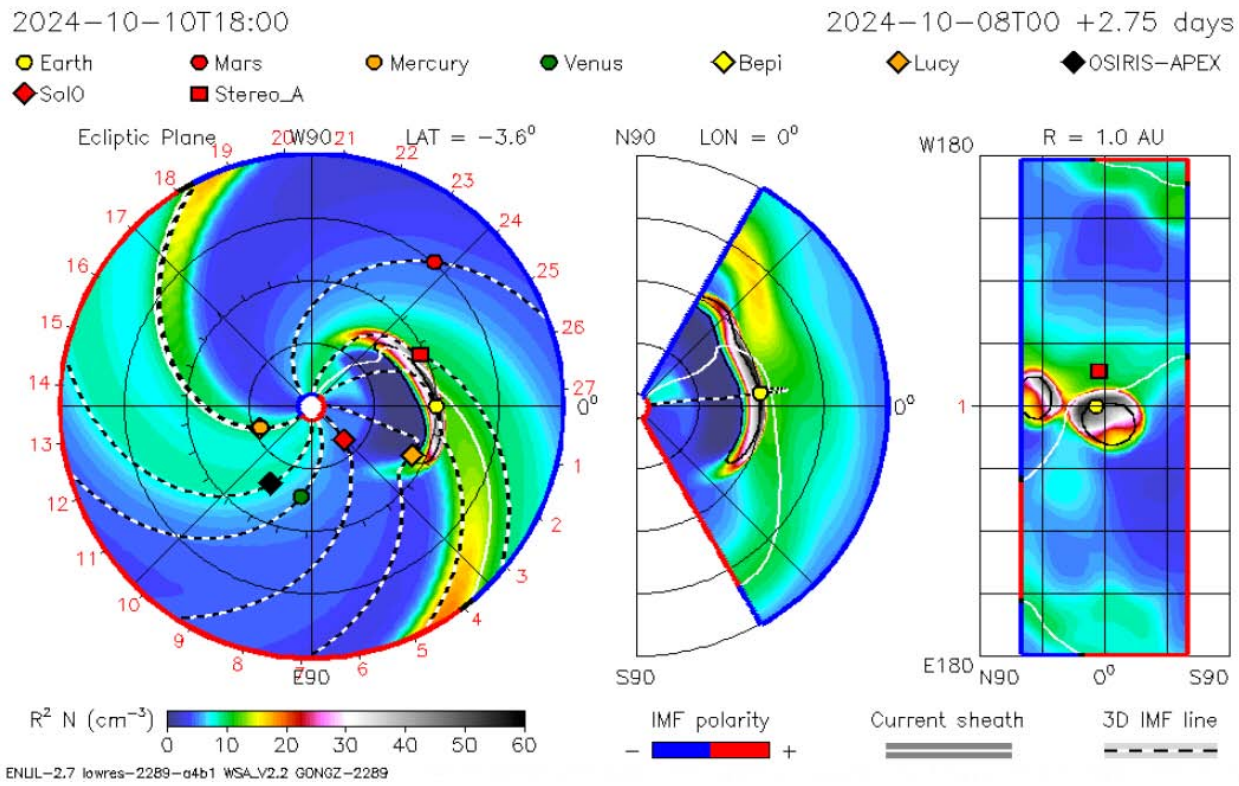
Appendix 3: Fluxes of "storm" particles with the energy ε ≈ 50-2000 keV by the data from the ACE spacecraft for May 6-12, 2024



Appendix 4: Results of simulation of the situation on May 8-11, 2024 at the NOAA Space Weather Prediction Center. The shock wave crosses the Earth's orbit for May 10-11 that confirms the presence of marker in the CR. The marker is the extremely low diagnostic value of the CR fluctuation parameter. The simulation results are a good illustration of *cumulative* effect ("*cannibal effect*" according to foreign terminology) of the shock interaction.



Appendix 5: Results of simulation of the situation on *October 4-6*, 2024 at the *NOAA Space Weather Prediction Center*. The shock wave crosses the Earth's orbit for *October 5-6* that confirms the presence of marker in the CR. The *marker* is the extremely *low* diagnostic value of the CR fluctuation parameter.



Appendix 6: Results of simulation of the situation on *October 8-11*, 2024 at the *NOAA Space Weather Prediction Center*. The shock wave crosses the Earth's orbit for *October 10-11* that confirms the presence of marker in the CR. The *marker* is the extremely *low* diagnostic value of the CR fluctuation parameter

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Fellow of Science Frontier Research Council

FELLOW OF SCIENCE FRONTIER RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.

Benefits

To the institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A FSFRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Fellows can reach out to other members or researchers directly. They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Receive a print ed copy of a certificate

Fellows receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Fellows can use the honored title of membership. The “FSFRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FSFRC or William Walldroff, M.S., FSFRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Fellow members of FSFRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.

Career | Credibility | Reputation

Future Work

Get discounts on the future publications

Fellows receive discounts on future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career | Financial

GJ Internal Account

Unlimited forward of Emails

Fellows get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example,
john [AT] globaljournals [DOT] org.

Career | Credibility | Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows and associates receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

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Earn 60% of sales proceeds

Fellows can publish articles (limited) without any fees. Also, they can earn up to 60% of sales proceeds from the sale of reference/review books/literature/ publishing of research paper. The FSFRC member can decide its price and we can help in making the right decision.

Exclusive | Financial

Reviewers

Get a remuneration of 15% of author fees

Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

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Become a member of the Editorial Board

Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

Career | Credibility | Exclusive | Reputation

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Get access to scientific museums and observatories across the globe

All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.

ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL

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Organize seminar/conference

Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

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Exclusive

Publishing Articles & Books

Earn 30-40% of sales proceeds

Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Exclusive | Financial

Reviewers

Get a remuneration of 15% of author fees

Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 2 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 5 GB free secure cloud access for storing research files.

Associate	Fellow	Research Group	Basic
$4800 **lifetime designation**	$6800 **lifetime designation**	$12500.00 **organizational**	APC **per article**
Certificate, LoR and Momento **2** discounted publishing/year **Gradation** of Research **10** research contacts/day **1 GB** Cloud Storage **GJ** Community Access	**Certificate,** LoR and Momento **Unlimited** discounted publishing/year **Gradation** of Research **Unlimited** research contacts/day **5 GB** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**Certificates,** LoRs and Momentos **Unlimited** free publishing/year **Gradation** of Research **Unlimited** research contacts/day **Unlimited** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**GJ** Community Access

Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

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Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

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Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

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Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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