

Cosmic Ether Is the Unified Field of Physics

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ABSTRACT

Once we start viewing nature as a perpetually and logically evolving and a creative engineering system, the currently working physics theories present themselves as already unified by the energetic tension field, the Cosmic Ether (CE), known as the cosmic space. We identify this integrating power of CE first, by re-defining its action generating parameters as the electric-tension, ϵ_0^{-1} , and the magnetic-resistance, μ_0 , while re-deriving the Maxwell's wave equation using Newton's laws of motion in analogy with the mechanically stretched string and find that $c_0^2 = \epsilon_0^{-1}/\mu_0$. Then, replacement of c_0^2 by ϵ_0^{-1}/μ_0 and m_0 by Einstein's $E/c_0^2 = E(\mu_0/\epsilon_0^{-1})$, we find that almost all working physics theories are being energized by ϵ_0^{-1} and μ_0 . To complete the unification, we can now postulate that the particles are also perpetually propagating EM waves, but like ring lasers; they are spatially localized as complex self-looped in-phase (SLIP) EM waves. Because of their SLIP mode propagation, particles have miniscule but space-finite spatial structures and remain spatially stationary in the absence of any spatially influencing potential gradients (forces) in their vicinity generated by other SLIP particles. Intrinsic *harmonic phase* driven amplitude-amplitude interactions between SLIP particles are correctly modeled by Schrodinger's equation represented by ψ , and the energy exchange is given by $\psi^*\psi$. A separate wave-particle duality is an unnecessary postulate. Neglecting internal SLIP motions, the inertia of individual SLIP particles to spatial translation in the absence of other particles in their vicinity automatically accommodates Newton's laws of motion. The cosmic universality of Maxwellian wave velocity, and particles as SLIP modes, jointly accommodate the two key postulates of special relativity without the need for making time as the fourth dimension. Besides time is not an action generating parameter of any real object, neither it is a directly measurable parameter of any natural object. The entire observable universe, including we, are assemblies of SLIP particles. This is why the universe appears so *elusive* to us; but it is not an *illusion*. The stable and stationary Cosmic Ether holds 100% of the energy of the universe. Hence, we do not need to keep searching for Dark Energy and Dark Matter. To strengthen our key thesis, we re-expressed the key equations of physics in terms of ϵ_0^{-1} and μ_0 and presented our views of physics thinking that help harmonize Classical, Relativity, Quantum and Cosmology Physics. The assemblies of SLIP particles, or materials, reduce the effective local tensions of the stationary CE, which reduces the velocity of light inside a medium to $c^2 = \epsilon^{-1}/\mu \sim c^2/n$, where n is known as the refractive index of the material. A new applied field of metamaterials has been rapidly evolving, which adjusts ϵ^{-1} and μ by manipulating the material compositions and structures to the desired values. This is akin to playing with the local tension values of CE. To directly validate the existence of CE, we have proposed a one-way light pulse propagation experiment, rather than approaching Michelson's way of measuring the *ether drag*, which would always be a null result.

Keywords: Cosmic Ether, ether as the unifying field, ether as energetic tension field, $(1/\epsilon_0)$ -electric tension of ether, μ_0 -magnetic resistance of ether, particles as localized EM oscillating modes of ether, particles are Self-Looped In-Phase EM oscillations, or SLIP.

INTRODUCTION

The Methodology of Our Physics-Thinking That Guides the Paper

The concept of a unified field theory started with earnest from ancient times and has been an ongoing journey in physics [1-4]. The collective successes achieved by all our mathematical theories tell us that everything in this universe is evolving following causal, system-engineering rules. Therefore, to model nature, we need to think like system engineers – visualize the invisible *physical interaction processes* that nature is utilizing to maintain the ongoing perpetual and causally ordered evolution in the universe. This is an important anchoring concept to keep exploring the reality of nature. Evidence Based Science (EBS), or experimentally validated theory, has been stagnant for some time [5-9], because of our excessive reliance on the elegance and the beauty of mathematical theories, followed by pre-conceived rationalization of the observations, rather than spending time to imagine (visualize) the actual physical interaction processes. Let us mention the thinking of some major contributors in physics that we would try to emulate in this paper. Newton, as a *hands-on engineer* and as a creative mathematician, underscored the necessity of a physical medium intervening the Sun and all the planets to establish the gravitational potential gradient that keeps holding the planets. Effectively, Newton endorsed ether. Newton's contemporary, Huygens, gave the description of the *physical processes* behind the *perpetual* diffractive propagation of light waves as due to the persistent generation of secondary spherical wavelets out of every point on all the wave fronts [10] in an energetic tension medium, the ether. Huygens' postulate was formalized into a Huygens-Fresnel diffraction integral [11], later strengthened by Maxwell's wave equation, which has been guiding the sustained and continued growth of the fields of optical science and engineering. Maxwell's wave equation also formalized the need for ether with the physical properties, ϵ_0 and μ_0 such that $c_0^2 = 1/(\epsilon_0\mu_0)$. The purpose of this article is to elaborate the depth and the extent of these two ancient parameters of nature in our modern working theories, which modern physics has been neglecting by defining c_0 as the fundamental constant of nature.

During the late 1800's classical physics started to display its limitations in modeling the micro world. Then Planck triggered the concept of quantumness in energy exchange in the micro world by mathematically showing that the measured Blackbody Radiation curve can be matched analytically only if the surface molecules inside a blackbody cavity surface emit and absorb light as *frequency-guided* individual discrete quantum of energy $h\nu$. However, Planck gave us a very valuable guidance – identify the *primary physical parameter* ν that plays the key operational (engineering) role in triggering a particular phenomenon (dipole stimulation) to generate the measurable physical transformation. Avoid using any secondary parameter as the key guiding parameter to develop the main formalism. The author is making this paraphrase from Planck's book [12] where Planck underscored that he succeeded in deriving his desired expression only after he switched to using the frequency ν , instead of using wavelength λ , which was the custom in his time. Twenty-five years later, QM formalism proved him right. The primary action parameter for atomic and molecular energy exchange with light is driven by the

dipolar oscillation *generating frequencies* of the involved radiations, not the wavelength. The wavelength varies from medium to medium, but not the frequency.

Our intentions behind the construction of a model of the universe dictate how we frame the enquiring questions. And the structure of the enquiring question determines the answer we can arrive at. Since everything observable represents some form of physical transformations through physical interaction between different entities, our enquiries will be more successful if we view nature as a creative system engineer. Even the emergence of our creative thinking is an outcome of classical and quantum interactions among the neural cells in our brain. Therefore, using Planck's guidance, we should leverage our working equations to identify *what engineering tools nature is using to bring about actions that generate physical transformations* all around us. They are buried into the working equations as *interaction parameters* and/or "constants of nature", like the G in Gravitation, and ϵ_0, μ_0 in Electromagnetism, etc. Such parameters should also be graded as "primary", "secondar", "tertiary", etc., depending upon the gradation of the active roles played by the various interaction parameters in nature. For example, using Newton's 2nd law, we can re-derive (see Section 2) the velocity of light in the free space (Cosmic Ether) as $c_0^2 = \epsilon_0^{-1} / \mu_0$, where ϵ_0^{-1} is the electric tension and μ_0 is the magnetic resistance of the Cosmic Ether. Consequently, c_0 is a secondary parameter derived out of nature's action triggering parameters ϵ_0^{-1} & μ_0 ; c_0 should not be used as a fundamental operating parameter of nature. Similarly, we treat v in $v = \lambda / c$, as another action parameter since it facilitates all the light-matter dipolar stimulation and interaction processes, rather than media dependent λ . Nature's *engineering interaction processes* are buried into the structures of the working equations and are indicated by the *operators* within the equations by "+", "-", "/", " $\partial / \partial x$ ", " $\partial^2 / \partial t^2$ ", etc., etc.). These are not just abstract mathematical symbols in working equations but are logics to develop potential models for the physical *interaction processes* that are being experienced by the interacting physical entities before they transform into newer physical entities.

Explicit recognition of the active roles of algebraic parameters, and connected by mathematical interaction operators, have critically important roles in constructing successful mathematical equations that could model actual interaction processes taking place in a natural phenomenon. For example, Einstein's photoelectric equation was invented to model the energy balance (kinetic energy of the emitted photoelectrons), which was observed in the photoelectric data. That equation did not try to model the initial step of physical dipolar *amplitude* activation that gets induced on the quantum mechanically bound electron within the complex material matrix. This is why Einstein's photoelectric equation, while correctly accommodates the energy balancing conditions, cannot model the deeper level of interaction processes between EM waves and the quantum mechanically bound electrons with the complex material matrix.

Another major example is the equation for the Mathematical Superposition Principle (M-SP) as a simple summation of two or more amplitude signals. However, the Observable Superposition Effect (O-SE) has the correct prescription of the "square modulus" operation that models the real physical interaction process behind the energy exchange and observable data generation. But we need to enquire what physical entity would execute this "square modulus" operation?

Abstract mathematical equations cannot execute the physical operations implied by them. “Raw” superposed signals represented by mathematical symbols do not directly operate on each other in the absence of some compatible stimulating action between them (the “+” operation). For example, EM waves pass through each other unperturbed, which is known as Non-Interaction of Waves, or NIW [13]. Even elementary particles at low velocities, at best can scatter from each other without generating any O-SE. Our enquiry of nature is also profoundly limited by the instruments we can invent within the engineering rules allowed by nature. The phenomenon of M-SP can be measured in the radio and microwave regions leveraging the characteristic behavior of the frequency-tuned LCR-oscillators. But for high frequency optical waves, we have not fully developed optical LCR oscillators. In the optical domain, we use modern square-law obeying photodetector that can absorb light energy in discrete quantum while releasing quantum mechanically bound electrons as discrete events. When the light flux is high, the output photo electric current is continuous (flow of billions of electrons). When the light flux is extremely low, we can start counting individual current pulses out of the detector, consisting of many millions of electrons. Does that decisively prove the existence of Eisenstein’s “indivisible light quanta”, while defying the continued successes of classical optical theories and observations since young’s double-slit experiment in 1802? Even Einstein himself underscore before his death that his 1905 model for light was not correct [14]. The confusions can be resolved, and a deeper understanding of the physical processes can be revealed when we keep trying to visualization of the physical interaction processes, while enquiring for deeper physical roles of every parameter of every working equation. For example, currently it is not customary to incorporate explicitly the interaction parameter of the physical detector in the M-SE or O-SE equations. But to generate and register any data, we need to use a detector and hence incorporate its interaction parameter in the M-SE and O-SE equations [15, 16]. Theories cannot model nature correctly if they do not incorporate data generating *interaction parameters*, which is the engineering action tool of nature.

Concisely, we will be using the following three well-known approaches in exploring the rules of nature, which are not explicitly underscored now a days. (i) *Mathematics alone cannot give an objective and complete description of nature*. It is the best logical language to explore nature. But logic alone cannot guide us to derive a *complete* description of the reality of nature. Mathematical operators (grammar) should be utilized as visualizing tools to explore the invisible interaction processes in nature. (ii) *Non-Interaction of Waves*: Perpetually propagating waves always leverage a parent tension field as its state of excitations. But they do not interact (interfere) with each other directly while they propagate through each other. They can stimulate individually, or jointly, to generate superposition effect, when incident frequency succeeds in stimulating the physical entity. (iii) *Interaction Process Mapping Thinking (IPM-T)*. The Cosmosphere and the Biosphere are dynamically evolving *physical* systems. Therefore, nature is a creative system engineer, and we should keep thinking as “reverse engineers” to model her rules of operations.

In this paper, we will remain focused on demonstrating that ϵ_0^{-1} & μ_0 are two of the most important action generating engineering tools of nature that empowers all working theories of current physics.

Strengthening Our Concept-All Observables in the Universe are Diverse Oscillations of the Stationary Cosmic Ether

This paper is an extension of previous papers [4, 16], where we have presented the rationale that Cosmic Ether is a physically real, energetic tension field, holding 100% of the energy of the universe. We will show that most of our current working theories of physics are already energized by the two core properties of Cosmic Ether, ε_0^{-1} & μ_0 , which are the electric tension and the magnetic resistance, respectively. Hence Cosmic Ether is the unifying field of nature. This has remained buried under our current habits of mathematical representations, like the derived parameter c_0 as a “fundamental constant” of the universe, rather than replacing it by nature’s more fundamental action parameters ε_0^{-1} & μ_0 since $c_0^2 = \varepsilon_0^{-1} / \mu_0$. Similarly, we have been preserving the antiquated understanding of mass rather than appreciating that the “mass” is just an emergent inertial property of bundles of energies, already defined by Einstein as $m_0 = E_0 / c_0^2 = E_0 \mu_0 / \varepsilon_0^{-1}$. Cosmic space, as the Cosmic Ether, allows for the emergence of EM waves as the perpetually *propagating undulations* of its tension field. All macro material media also hold the characteristic EM tension fields but with the modified tension properties $c^2 = \varepsilon^{-1} / \mu \equiv c^2 / n_{r,i}^2$, where $n_{r,i}$ is defined as the refractive index of the medium. Therefore, material particles should also be some form of emergent properties of the Cosmic Ether. This is more strikingly obvious from the elementary particle scattering experiments where one can generate charge-less and mass-less Gamma waves out of an electron-positron pair $e^- + e^+ \rightarrow \gamma + \gamma$, or vice versa. Therefore, we are postulating that the elementary particles are localized Self-Looped In-Phase (SLIP) EM waves in the form of complex torus-modes, yet to be modeled mathematically, with quantized energies, $E = hf_{slp}$, and with built-in inertia to spatial translation. Further harmony in this postulate can be seen from the fact that classical Maxwell’s wave equation and the Schrodinger’s “wave” equation, both being second order differential equations, they naturally accommodate the Mathematical Superposition Principle (M-SP): Any linear combination of all the allowed solutions of the equation is also a solution of the parent equation. Classical optical engineering and sciences have been systematically thriving since young’s demonstration of the Observable Superposition Effect (O-SE) using his 1802 invention of generating O-SE fringes by sending Sun light through a double-slit structure. The quantum mechanical M-SP has also been playing key roles, both in the interpretations of the very quantum theory [17] and in the recent flurry of activities towards constructing quantum computers using QM M-SP [18]. Unfortunately, these latter developments do not underscore the engineering fact that it is the O-SE that generates the useful data; M-SP by itself does not generate data [15].

Our postulate of elementary particles as SLIP EM waves is strengthened further because by its very internal structure it represents wave-particle duality as a reality, rather than something mystical. SLIP eliminates the need for the postulate of the de Broglie Pilot Waves and the Schrodinger’s postulate that particles are “plane waves”. This last postulate is non-causal since a mathematical plane wave of infinite extent would require an infinite amount of energy.

The postulate of the SLIP particle directly accommodates Newton’s laws of motion. Since the SLIP’s are self-looped, the Cosmic Ether is already executing its natural tendency of perpetually

pushing the self-looped EM waves but confined only within a domain of femto meters. Therefore, one would need some external potential gradient (some force) to nudge them to undergo any spatial translation.

Would the lifetime of SLIP particles be limited by the optical diffraction spreading? The classical theory of diffractive spreading of EM waves tells us that the diffractive divergence is inversely proportional to the frequency of the EM waves. And we already know that Gamma EM wave packets, having the frequency range around 3×10^{18} to 3×10^{22} do not show diffractive spreading. Given the energy of the key particles, Electron and Proton, $E = hf_{slp}$, the value of $f_{slp} \geq 10^{22}$ Hz. Therefore, the spatial structure of the dynamic SLIP wavelets remains stable.

Inertial SLIP particles are always constrained to move along diverse potential gradients (forces) which they generate due to their internal motions and respond to gradients generated by others, depending upon the strength and the nature of the gradients. The strength of such gradients depends upon the number of the SLIP oscillators in the assembly. This “gradient” concept is simply a generalization of Einstein’s “curvature of space” that he used as the origin of gravity. This potential gradient is incorporated into the traditional Hamiltonian as “V” by Schrodinger. This is simply a snippet to appreciate that the Cosmic Ether of the cosmic space is nurturing and sustaining the evolving universe as diverse set of oscillations, mostly harmonic with weak anharmonicity requiring higher order terms, as in nonlinear optics and validated by Modified Newtonian Dynamics (MOND), which is a pragmatic alternative to postulates of Dark Energy and Dark Matter theories, yet to be validated [19].

Our purpose in this paper is to provide extensive examples and rationale to overcome the currently prevailing resistance to accepting the reality of Cosmic Ether as the primary electromagnetic tension field that facilitates the emergence of everything observable to us.

Flow of the Paper

All perpetual wave propagation requires a parent tension field, like air-pressure-tension field for sound waves, surface tension and gravitational tension of water for water waves, mechanically stretched wires in musical instruments to generate musical waves, etc. Maxwell’s wave equation and his differential calculus-based derivation of the velocity of light, $c_0^2 = (1 / \epsilon_0 \mu_0)$, does not identify what represents the built-in tension of the ether field and what provides the reactional resistance against the generation of the electric tension vector-amplitude. Even though Maxwell was the first one to mathematically integrate two major fields of physics, Electrostatics and Magnetostatics, he had accepted the old definitions for ϵ_0 as “electric permittivity” and for μ_0 as the “magnetic permeability”. In Section 2, to integrate Electromagnetism with Newtonian mechanics, we re-derive the velocity of EM wave using Newton’s two laws, the inertia of rest and the inertia of motion. Thereby, we re-define ϵ_0^{-1} as the electric tension and μ_0 as the magnetic resistance as the inherent properties of Cosmic Ether. Then the expression for the velocity of light becomes $c_0^2 = \epsilon_0^{-1} / \mu_0$. This structure matches the expression for all other wave velocities that leverage classical tension fields, $v^2 = (\text{Intrinsic Physical Tension}) / (\text{Resistance per unit displacement})$.

In section 3, we use the physics of light propagation to analyze why Michelson’s null experiment failed to validate the ether-drag by the Earth. We then use this knowledge to develop and propose a one-way light pulse propagation experiment that can directly validate the existence of ether, which is better executed in space.

Section 4 details the core of this paper. It explores the unifying roles of ϵ_0^{-1} & μ_0 throughout major physics theories. As summarized already in Section 1.2, we have proposed that the elementary particles arise as perpetually moving EM waves, but with a complex, and localized torus-like complex wave motion. The wave motion follows the SLIP mode, as already mentioned in Section 1.2. It is like a stable, two-way ring laser oscillations, but more complex that can generate externally perceived, resultant charge-like electric field lines out of the complex oscillations of the Maxwellian E-vector. We discuss in more detail how the SLIP model accommodates most of the quantum mechanical behaviors of particles and atoms and resolves wave-particle duality. We have also discussed that the measurable superposition effect, always registered by a finite size detector, must be a causal and local phenomenon, always requiring a physical detector that executes the square modulus operation. We cite examples to justify the emergence of gravity out of electromagnetism. Our Cosmic Ether model naturally accommodates the two key postulates of the special theory of relativity without the need for a four-dimensional universe.

Section 5 recaps the key points to conclude the paper.

EXCAVATING THE OPERATIONAL MEANING FOR ϵ_0 & μ_0 HIDDEN BEHIND THE PERPETUAL VELOCITY OF LIGHT

Integrating Concepts from Newton, Maxwell and Einstein to Define Cosmic Ether

Maxwell derived his wave equation by first reconstructing the integral forms of the already existing empirical laws from their integral representations to the differential calculus forms of the (i) modified Ampere’s law, (ii) Faraday’s law, (iii) Coulomb’s law, and (iv) the absence of magnetic monopole. His derivation gave the velocity of light as $c_0^2 = 1 / \epsilon_0 \mu_0$. These parameters ϵ_0 & μ_0 were already defined by his predecessors as electric permittivity and magnetic permeability of the *free space*, respectively. These descriptions do not clarify the operational origin, or the engineering lever property used by nature to generate the observed *perpetual velocity of EM waves* in the “free space”. Inspection of the wave equation for an ideal classical mechanical tension field, like that for a long-stretched string, does imply the emergence of a perpetually propagating wave, once the string is externally perturbed, provided there are no energy dissipating mechanism associated with the string. Accordingly, we will derive the EM wave equation emulating the procedure used for a mechanically stretched string. In other words, we will unite Newtonian particle mechanics (1st & 2nd law) with Electromagnetism and re-derive the Maxwell’s wave equation. We also justify the emergence of Newtonian inertia of “mass” out of the electromagnetic properties of Cosmic Ether, using Einstein’s mass-energy equivalence relation:

$$m_0 = E_0 / c_0^2 = E_0 \epsilon_0 \mu_0 \tag{1}$$

The mass-energy interconvertibility in the first part of Eq.1 is very well validated in the fields of chemistry and physics. The second part of Eq.1 is an identity relation from Maxwell's wave velocity. Accordingly, we feel confident that ε_0 & μ_0 , associated with a lump of energy E_0 , must play critical roles in the emergence of inertia of a material particle of mass m_0 .

Deriving EM Wave Equation with Mechanical Analogy to Define Operational Meaning for ε_0 & μ_0

We are now re-defining ε_0^{-1} as the "electric tension" in analogy with the mechanical tension "T" on a stretched string and μ_0 as "magnetic resistance" in analogy with the "inertia (or mass) per unit length" σ [20]. The choice will be apparent later. Our objective is to derive $c^2 = \varepsilon_0^{-1} / \mu_0$, just like for mechanical string-wave

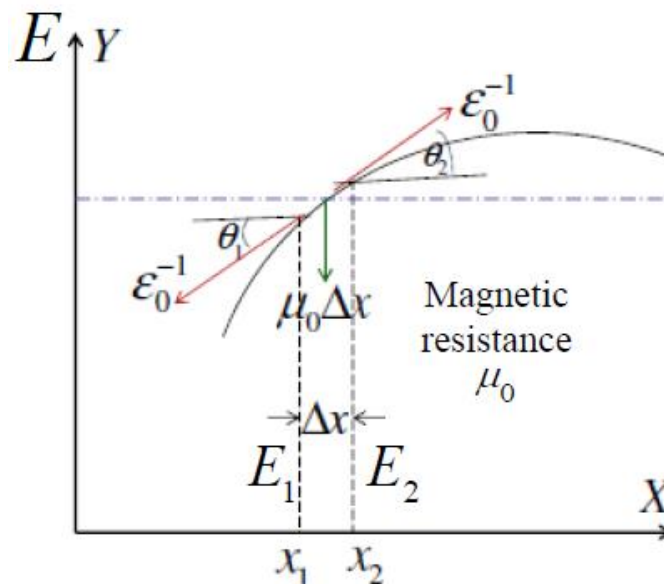


Figure. 1: Unifying classical electromagnetism with Newtonian mechanics by re-deriving Maxwell's wave equation using Newton's second law of motion. We have re-defined ε_0^{-1} as the electric tension and μ_0 as the magnetic resistance to increasing local electric current.

velocity, $v^2 = T / \sigma$, mechanical tension divided by the inertia of mass per unit length. Let us consider a one-dimensional segment of the 3D ether where a moving electric dipole has just triggered the emergence of electric fields E_1 & E_2 at the spatial locations x_1 & x_2 due to the local live electric tension ε_0^{-1} . Let us choose a small elemental spatial segment Δx of the electric tension field ε_0^{-1} as in Fig.1 triggered by a dipole with the emergent electric fields E_1 and E_2 at locations x_1 & x_2 . Then the component of the unbalanced force in the vertical direction would be $\varepsilon_0^{-1}(\sin \theta_2 - \sin \theta_1)$. The angles being very small, $\sin \theta_{2,1}$'s can be replaced by $\tan \theta_{2,1}$'s, and hence by $(\partial E_{2,1} / \partial x)$. Then the vertical unbalanced force, or the rate of change of the E-field along the x-direction can be expressed as $\varepsilon_0^{-1}(\partial E_2 / \partial x - \partial E_1 / \partial x)$. The horizontal unbalanced force would be

$\epsilon_0^{-1}(\cos \theta_2 - \cos \theta_1) \approx 0$, for small angle approximation. Then the final resultant unbalanced force is only the vertical force $\epsilon_0^{-1}(\partial E_2 / \partial x - \partial E_1 / \partial x)$. This emerging spatially varying E-field (current) generates $\mu_0 \Delta x$ quantity of temporally changing magnetic field for the element Δx . Then, by Newton's second law, the unbalanced force can be equated with the magnetic *inertial resistance* of this segment $\mu_0 \Delta x$ multiplied by the temporal acceleration $\partial^2 E / \partial t^2$ experienced by this segment of electric tension filled space:

$$\epsilon_0^{-1}(\partial E_2 / \partial x - \partial E_1 / \partial x) = (\mu_0 \Delta x)(\partial^2 E / \partial t^2) \tag{2}$$

By rearranging the parameters and by taking the limit $\Delta x \rightarrow 0$, we get the Maxwell's wave equation:

$$\epsilon_0^{-1} \lim_{\Delta x \rightarrow 0} \frac{1}{\Delta x} \left[\frac{\partial E_2}{\partial x} - \frac{\partial E_1}{\partial x} \right] = \mu_0 \frac{\partial^2 E}{\partial t^2} \Rightarrow \frac{\partial^2 E}{\partial t^2} = \frac{\epsilon_0^{-1}}{\mu_0} \frac{\partial^2 E}{\partial x^2} \equiv c_0^2 \frac{\partial^2 E}{\partial x^2} \tag{3}$$

Thus, by re-deriving Maxwell's wave Eq.3 in analogy with a classical stretched string, we have found the operational (functional) meaning behind the emergence of perpetual velocity of an EM wave in its parent tension field, the Cosmic Ether. Thus, when some form of a passive electric dipole is "plucked" by some suitable mechanism, an oscillating electric charge as an oscillating electric current is triggered, which is now opposed by an orthogonal and circular magnetic field, as per Ampere's law.

In general, an *energetic tension field tends to stay in its quiescent energetic state*. If a disturbance is introduced at a point by some external energy, the tension field at that point immediately pushes it away to all possible spherically accessible neighboring points so that it can come back to its original quiescent (equilibrium) state. This is Huygens' Principle. Then all the forward points execute the same actions to come back to their respective quiescent states. As if the space and time finite perturbation is forever searching out for energy sinks to eliminate it and perpetually propagating out as a harmonic wave. In the absence of any frequency resonant energy sink, the process continues perpetually. Hence, a disturbance introduced on an energetic tension field, will always generate a perpetually moving wave. This engineering process taking place behind wave propagation action, was first presented by Huygens in his book of 1690 while describing the propagation of EM waves in free space [10], although the mathematical wave equation was developed almost a century later by Maxwell. This natural action-picture is true for all tension fields: (i) mechanically stretched tension on a string, (ii) surface tension on a water surface, (iii) pressure tension in air, etc.

We can now underscore a few more inherent properties of Cosmic Ether. (i) Cosmic Ether cannot assimilate the energy delivered by one of its own (already existing) undulations which triggered the original deformation on the quiescent tension field due to its own intrinsic instability, or due to excitation triggered by some mutual interaction between already different stable entities. (ii) The consequence is our observed rule of the conservation of energy between existing undulations of the Cosmic Ether. (iii) The third observation is that a perturbed tension

field tends to execute only harmonic undulations, including multiples of the fundamental frequency. This is true for all classical tension fields also. This is why Fourier's integral theorem plays such a key role throughout all physical phenomena.

By integrating Newtonian mechanics into classical electromagnetism, we have now established the *physical reality* of the electromagnetic tension properties of free space as ε_0^{-1} & μ_0 , with the modified physical definition as "electric tension" and "magnetic resistance", which give us the operational meaning behind the generation of perpetually moving EM wave when triggered by the movement of an electric dipole within it. Had Maxwell introduced these re-definitions, Einstein would not have tried to do away with "Ether" in his 1905 paper on Special Relativity.

HOW TO EXPERIMENTALLY VALIDATE THE EXISTENCE OF COSMIC ETHER

The potentiality of the disbelief in the electromagnetic ether in physics started by the "null" results obtained by a series of Michelson-Morley experiments (MMX), starting from 1887 [14], while attempting to measure the *drag* of cosmic ether by the earth. Michelson did believe in the existence of an all-pervading electromagnetic ether. Unfortunately, since ancient times, *the belief has been that materials exist separately from ether*. That is why people believed that there must be an ether-drag against material bodies. In our model, particles being localized oscillations of the ether's intrinsic tension properties, their spatial translation movement should not create any drag of the *ether itself*.

The rejection of ether as a physical reality was triggered by two of Einstein's 1905 papers. His Special Relativity (SR) [21] paper eliminated the need for ether by defining c as a fundamental constant of nature, and his "photoelectric effect" paper [22], proposed light as "indivisible light quanta", as an elementary particle without requiring a tension field. Later Einstein tried to correct himself while defining gravity as a "curvature of space" through his theory of General Relativity. Space needs to have some physical properties (a medium), which can be "curved". However, the physics culture has been persisting that the cosmic space is a vacuum, filled with photons, elementary particles and vacuum fluctuations [23, and references there], besides observable macro galaxies with stars, built out of elementary particles. However, this picture does not explain how the photons always experience perpetual, and the highest possible velocity without the support from their emitters. These obvious contradictions, along with the re-definition of ε_0^{-1} & μ_0 in the last section as the *operational* cause behind the perpetual motion of EM waves packets, there is an urgent need to carry out new experiments for the direct validation of the existence of cosmic ether as an energetic physical tension field.

Why cannot MMX-Like Experiments Discern Either the Ether-Drag or the Absence of Ether?

To appreciate the limitations of the Michelson-Morely type of experiments (MMX), we need to pay close attention to the physical processes behind light propagation through material media and through material free ether. Huygens, contemporary of Newton, was the first one to frame the key postulate behind the propensity of waves to propagate perpetually leveraging an energetic parent tension field. Because the tension field keeps perpetually pushing away the waves, generated through some suitable perturbation of its quiescent energetic state. In his 1690 book [10] Huygens' postulated that this perpetual propagation of a wave is generated via

secondary wavelets *emanating out of every point on every wave front*. We usually measure the superposition effect of all these arrived secondary wavelets by some frequency resonant detector at any forward physical plane of our choice. Huygens explicitly mentioned that his model of wave propagation *process* requires a tension medium (ether) to propagate as its undulation (excitation). Section-2 above has strengthened and illustrated this requirement. Huygens also underscored that the secondary spherical wavelets do not interfere or modify each other's wave properties in the absence of some interacting medium. We have articulated this as Non-Interaction of Waves (NIW) [13, 24]. In 1817, Fresnel gave a simple and elegant mathematical integral representation of Huygens Principle, now known as the Huygens-Fresnel diffraction integral [11], which automatically embeds the NIW property. This is one of the two key mathematical foundations behind the continuous and sustained advancement of optical science and engineering, till today. There is a second foundational contribution that describes the physics behind the EM wave generation and propagation. It was formulated by Maxwell in 1864 [25]. It turns out that the Huygens-Fresnel diffraction integral, a linear summation of spherical waves, is a natural solution of Maxwell's wave equation, as it is a second order linear differential equation. Maxwell's complete set of equations has also established a Poynting vector, $\vec{S} = \vec{E} \times \vec{B}$. This vector \vec{S} on a wave front always remains orthogonal to the wave front, even when the wave front suffers tilted propagation due to tilted *refraction* in a new medium with different refractive indices (supporting different velocities).

Light also has another particularly important property. It always prefers to propagate through a structurally single mode medium of higher refractive index (or lower tension value and hence slower velocity), whenever it has that option. This is why we have been able to invent and implement fiber optic communication systems and send the optical signals through glass-fiber-core of higher refractive index, surrounded by a protective glass cladding of lower index. Light remains entrained within the core of the glass-fiber for tens of thousands of kilometers with very little loss. Ether has the refractive index of $n_0 = 1$ and air has the refractive index $n_{air} = 1.0003$, or $c_{air} = c_0 / 1.0003$.

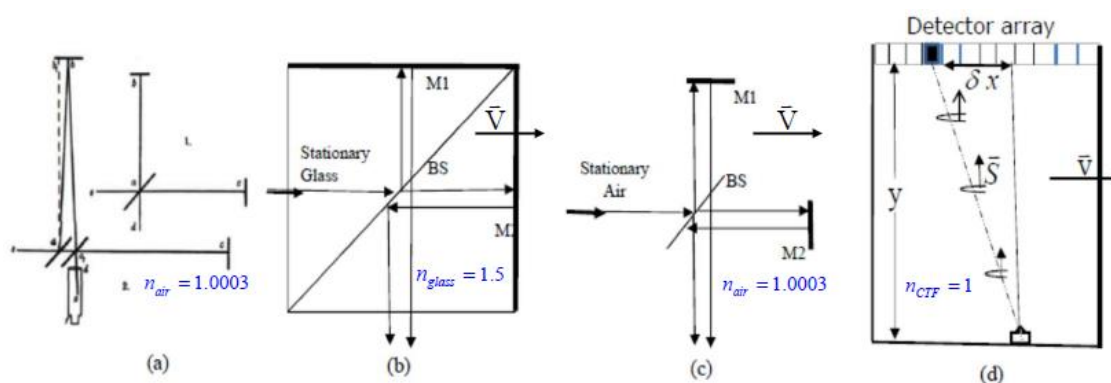


Figure 2: Michelson Interferometer in three versions. (a) Diagram from Michelson's original paper [26]. Notice the triangular longer up-down return path of the light beam compared to the horizontal straight re-tracing path. (b) Michelson interferometer built as a solid monolithic structure out of glass prisms, mirrors and a beam splitter. Zero fringe shift is obvious from equal return paths. (c) Michelson interferometer re-drawn with equal return paths because stationary air of refractive index 1.0003 entrains the light propagation, not the ether. (d) Shift

of light pulse in a one-way CTF-entrained propagation, when the apparatus moves transversely in vacuum.

Therefore, in the laboratory, the light beams will always be entrained by the stationary air surrounding any MMX interferometer, since air provides a lower tension (higher index) medium for light to propagate. Light propagation will not be entrained by the lower index stationary ether, through which the earth is moving. Hence, the propagation direction of the light beam vector $\vec{s} = \vec{E} \times \vec{B}$ in the MMX interferometer will always remain orthogonal to the pre-aligned mirrors, entrained by the laboratory air. The propagation path cannot be tilted, as was originally sketched by Michelson, shown in Fig.2a [3].

Fig.2b and 2c show slightly different versions of the same Michelson's interferometer to bring out the common-sense understanding that light beams will travel straight up and down, without getting tilted. Fig.2b is a monolithic rendition of the Michelson interferometer within a glass cube, with built-in mirrors and a beam splitter. Even if the cube experiences some velocity \vec{v} in the horizontal direction due to earth's orbital velocity, or in space on a satellite, there will be no fringe shift because the two light paths will remain identical, always entrained by the glass cube. The \vec{v} vector of the cube-prism cannot tilt the \vec{s} vector of light away from its vertical path since the \vec{s} vector is *entrained* by the assembly of the material dipoles of the glass prism of index $n_{\text{gls.}} = 1.5$. Within a material medium, \vec{s} can *no longer be under the control of the stationary or even the dragged ether*. However, there will be a negligibly small Fresnel Drag [18-see Ch.11, 21] of the light beam. Because of its effective miniscule value, we will neglect the Fresnel drag in air here. The intention behind Fig.2c is to underscore the same point, as we have done for Fig.2b, except that the interferometer is now residing within the stationary air of the laboratory environment. Fig.2c is equivalent to Fig.2a with the correction that the light beam propagation vectors remain orthogonal to the two mirrors, without suffering the tilt assumed by Michelson.

Thus, MMX type of experiments should always give null-fringe results. We do not need to assign a new property to nature that needs to trigger "length contraction" or "time dilation". If we assume that Michelson had believed ether entrained the light ray, and not the "thin" air in the laboratory, then the ether drag would have created an *apparent* tilted path for the arrival of the vertical ray and tilted return, just as Michelson's drawing in Fig 2a. However, then the physical tilt of the light beam would have caused a change in the spatial frequency of the observed fringes, *which was also never reported*.

Can We Validate the Existence of Stationary Ether? Building an Ether Sensor

In Section 2 we have established the deep significance for physics that we experimentally validate the cosmic space as a stationary energetic tension field. Experimental validation of Casimir Effect [27] does indicate that the space, in the nanometer domain, is not "empty". However, since the Casimir Effects have been measured only in the nanometer domains, these experiments cannot assure us of the existence of a stationary ether-like energetic tension field as the very foundation of our emergent universe. Therefore, Michelson's brilliant idea, of using the physics of light propagation over a macro distance, must be properly re-formulated. In this section, we take lessons from the limitations of the MMX experiments and propose a simpler new experiment to determine the existence of ether. Our design should be able to compare and

differentiate the measured outcomes of light propagation through some material medium and “completely” material-free ether space.

As mentioned earlier, the generic tendency of light is to choose to travel through the lower tension (higher index and lower velocity) media. Further, the Poynting vector, orthogonal to the collimated optical beam, preserves its spatial direction, while obeying the basic laws of reflection and refraction. This has been pictorially shown in Fig.2b, where the moving glass-cube-MMX preserves the orthogonal reflection of the return beams, instead of getting reflected at an angle.

We are proposing to test the presence of ether only by comparing the absence or presence of a shift in the arrival location of a *collimated light pulse through one-way travel path*, where the travel path is either filled with air as a medium ($n_{air} = 1.0003$), or is completely empty ($n_{ether} = 1$), inside a super-vacuum chamber, or on a deep space satellite. Let us now assume that the wavelength of light is λ . Then one can argue that if the average number of air molecules within a volume of λ^3 is statistically less than one, then the E-vector of the light beam would not experience a reduction in the effective tension value of that space. Light will now be guided as an undulation of the pure ether only, with minor amount of scattering of light from encounter with individual molecules.

We can now construct a quite simple ether-sensor consisting of a rigid box (see Fig.2d). The bottom of the box holds an LED that can send out individual pico second light pulses, on demand, vertically up to the top end. The top of the box, anchored rigidly with the LED base-structure, holds a detector array. It is designed to measure the lateral shift in the arrival position of the light pulse. If the box is full of air, the light pulse would always arrive exactly at the vertical location from the LED, even if we give the box a velocity orthogonal to the optical pulse propagation axis. However, when the box is completely free of air, either inside a super-vacuum chamber, or on a deep space satellite, a velocity of the box to the right and orthogonal to the light-pulse axis, would make the light pulse to arrive left-shifted on the detector array. This is because the Poynting vector orthogonal to the center of the original wave front of the light pulse will always follow its original straight-line trajectory inside any homogeneous medium. It is now moving through stationary ether, while the box is moving away to the right.

If the length of the bar is $L=1\text{m}$ long, then the arrival delay for the light pulse would be 3.33ns . Note that even though the dashed line of the apparent light path is tilted and longer, the light pulse travels the same vertical distance L , while the box moves to the right. Physics of this propagation process is depicted by the vertical Poynting vectors, drawn on the cartoon-pulses, always pointing *vertically up* (Fig.2d), while the box moves to the right.

Ether Sensor Inside a Super-Vacuum Chamber:

Let us assume that we are carrying out the experiment inside a super vacuum chamber leveraging earth’s orbital velocity of $v = 30\text{km/sec}$ by aligning the earth’s velocity vector orthogonal to the light-path-vector in the ether sensor. This would generate a lateral shift of:

$$\delta x = v\delta t = vL / c_{air} \approx 100\mu \tag{4}$$

Such a lateral displacement can be easily measured by an off-the-shelf linear detector array, or a position sensing quadrant detector. Several countries who are advanced in space technologies can conduct this experiment. They have large vacuum chambers with low pressure capability around 10^{-10} Torr, implying less than about 0.1 air molecule per micron cube at typical room temperature. The visible wavelength being around 0.5micron, a vacuum of 10^{-10} Torr satisfies the effective free-space condition. This terrestrial experiment in high vacuum chamber should also be able to establish that air in Michelson's experiment was keeping the light beam entrapped to straight path, instead of the tilted angular path assumed by Michelson, which consistently gave him the null fringe-shift results. One just need to slowly introduce air in the high vacuum chamber and observe that the light beam deflection reduces to zero at a certain pressure when there are a sizable number of air molecules per λ^3 . The determination of this number of air molecules would be a valuable parameter in studying the fundamental physics behind the emergence of refractive index and the need for a certain number of air molecules per λ^3 to generate an 'effective continuous medium' for EM waves. *It will also validate that the EM interaction cross section of Angstrom size atoms could be one or two orders of magnate larger than the λ^2 , especially when the optical frequency is in resonance with quantum level transition of the chosen gas* [28, 29].

If the experiment, when conducted very carefully with the desired free-space equivalent vacuum condition, shows no lateral shift of the light spot, one conclusion would be that the ether is being fully dragged around its surface by the massive earth. We doubt this outcome because in our model, ether is universally stationary. EM waves and particles are the excited states of its *various emergent potential gradients, not the physical field itself*. EM wave propagation does not make the ether move. Further, the movements of material parties (or bodies) should create only changes in appropriate potential gradients around them.

Ether Sensor on a Deep Space Satellite:

Let us assume that the orthogonal velocity of a possible deep space satellite is $v = 8km / sec$. Then the lateral displacement of the light spot would be:

$$\delta x = v\delta t = vL / c_0 = 26.7\mu \quad (5)$$

This is also accurately measurable using an off-the-shelf position sensing quadrant detector. Here also we are assuming that a satellite cannot drag stationary ether. In both the above experimental environments, one could employ a second identical ether sensor with *the light vector path always aligned parallel to the box-velocity vector*. Then this second sensor should always show zero lateral shift in the arrival of the light spot. This will provide us with extra confidence on the results of the experiments.

EXPLORING THE DIRECT UNIFYING ROLES OF ϵ_0^{-1} & μ_0 THROUGHOUT MAJOR PHYSICS THEORIES

In the introduction, we have presented the argument that $c_0 [= (1 / \epsilon_0\mu_0)^{-1/2} = (\epsilon_0^{-1} / \mu_0)^{-1/2}]$ is a *secondary* derived parameter. In section 2, we have re-derived Maxwell's wave equation while re-defining the primary *actionable parameters* of the cosmic ether as ϵ_0^{-1} & μ_0 , electric tension

and magnetic resistance, respectively. In this section, we show that these two actionable primary parameters are involved in all major theories of physics to validate our key assertion that the cosmic ether has already been functioning as the unifying field of physics.

Material Media are Also Energetic Tension Fields, a Modified Version of The Ether,
 ϵ^{-1} & μ

In section 2, after the derivation of Maxwell’s wave equation, emulating the energetic mechanical tension field of a stretched string, we have explained how a tension field tries to consistently push away the external perturbation and ends up generating a perpetually moving wave. Material media also perpetually push away EM waves when they are generated inside the media, or wave pulses are sent inside them. In fact, the core properties of the EM wave propagation, including diffraction, are *mathematically remarkably similar* in structure to those for the free space, except the values of the core tension parameters are modified by the aggregate properties of the material dipoles. The behavior of the Poynting vector remains the same. The velocity of EM waves becomes:

$$c_{med.}^2 = \epsilon_{med.}^{-1} / \mu_{med.} \equiv c_0^2 / n_{med.}^2 \tag{6}$$

For most material media, usually, $\mu_{med.} \approx 1$, giving rise to the well-known relation for the refractive index, $n_{med} \approx \epsilon_{med.}^{1/2}$, determined by the collective dipolar properties of the atoms and molecules within the media. One can then surmise that, functionally, the material media also behave as modified electromagnetic tension fields. *We are then guided to postulate that the electrons, protons and neutrons, which build the atoms, and then the material media, should also represent some forms of emergent properties of the same cosmic ether.* They only reduce the effective electromagnetic tension value, as shown in Eq.6.

Let us note from Eq.6 that the velocity of light waves is slower inside the material tension fields. Hence the material tension fields are weaker than the material-free Cosmic Ether. This is why material media offer an *alternate wave energy sink* for the ether. This is why, given the physical proximity, EM waves will always be *pushed* inside the lower tension (higher index) material media. In fact, the atoms and molecules, having quantum mechanical frequency-resonant energy levels, will always “*pull*” in the wave energy, while the EM tension fields will always tend to “*push*” in the wave energy, which is a perturbation to its quiescent state. This is a key point that we have utilized to explain as to why, in Michelson’s ether-drag cartoon, Fig.2 (a), the vertical light rays could not have been “*dragged*” by the ether! Because the light beam was entrained by the stationary air around Michelson’s laboratory table.

We should note that over the last fifty years, the field of optical science and engineering has been rapidly developing the new fields of Nanophotonics, Plasmonic Photonics and Metamaterials. They all are effectively playing with the modification of the effective local electric tension $\epsilon_{med.}^{-1}$ and the magnetic resistance $\mu_{med.}$ using diverse combination of materials and their physical size and structures, modeled by Maxwell’s equations [30-32], assuming materials are composed of atoms that are quantum mechanical.

Emergence of Particles, Quantumness, Charge and Superposition Effect Without Non-Locality

Particles are Localized Close-Looped In-Phase (SLIP) EM Modes:

We have already mentioned that the results of electron-positron, or Gamma-Gamma scattering experiments [28, 33], $e^- + e^+ \rightarrow \gamma + \gamma$, clearly indicate that charge and mass must be some form of emergent property out of the structure of the oscillations of the ether tension field. Quantum theories are functional field theories and ether is its energetic tension field. It also accommodates perpetually moving EM waves. SLIP particles are already solutions of the Maxwell's wave equation. But they are individually spatially stationary and almost "inert". They cannot trigger internal and external stimulation unless acted upon by another entity, or its extended potential gradient. Their spatial movement, internal excitations, interactions between particles and interactions with linear Maxwellian waves, has been modeled by Schrodinger's Eq.7.

$$i\hbar \frac{\partial \psi(x,t)}{\partial t} = -\frac{\hbar^2}{2m} \frac{\partial^2 \psi(x,t)}{\partial x^2} + V(x,t)\psi(x,t) = H(x,t)\psi(x,t); \text{ where } H(x,t) = KE + PE \quad (7)$$

For that we start with Maxwell's wave equation first. From our derivation-steps of Eq.3, we fully understand the *physical processes* behind the emergence of the perpetually propagating EM waves out of ether as a "mechanical" tension field. We have derived the velocity as $v^2 = [(\text{Mechanical tension}) / (\text{Resistance per unit length})]$. However, Maxwell's original derivation is based upon four differential equations, which had a prolonged period of empirical evolution since ancient times, separately as Magnetism and Electricity, and then mathematically, for a couple of centuries, before Maxwell's participation. The final forms of Maxwell's constituent

$$(i) \nabla \cdot \vec{E} = \frac{\rho}{\epsilon_0}; \quad (ii) \nabla \cdot \vec{B} = 0; \quad (iii) \nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}; \quad (iv) \nabla \times \vec{B} = \mu_0(\vec{J} + \epsilon_0 \frac{\partial \vec{E}}{\partial t}) \quad (8)$$

equations are shown in Eq.8. Then using the vector theorem, $\nabla \times \nabla \times \vec{E} = \nabla(\nabla \cdot \vec{E}) - \nabla^2 \vec{E}$, Maxwell derived Eq.3 directly as, $(\partial^2 \vec{E} / \partial t^2) = (1 / \epsilon_0 \mu_0)(\partial^2 \vec{E} / \partial x^2) \equiv c_0^2 (\partial^2 \vec{E} / \partial x^2)$ with $c_0^2 = (1 / \epsilon_0 \mu_0)$ instead of as $c_0^2 = (\epsilon_0^{-1} / \mu_0)$ that emulates classical velocity of waves in any mechanical tension field as, $v^2 = [(\text{Mechanical tension}) / (\text{Resistance per unit length})]$. Nonetheless, Maxwell's derivation of the velocity of light is solidly anchored on a set of equations that had evolved empirically and mathematically. Obviously, Maxwell's electromagnetism is not a complete theory, as no theory could, as per Godel's Incompleteness Theorem [34, 35]. However, it is also glaringly obvious that even though optical scientists and engineers keep using Maxwell's electromagnetism quite successfully, explanations for the transition of atom-emitted quantum energies into classical wave packets is still not well understood [].

In contrast, Schrodinger's Eq.7, although based upon a series "quantum phenomena", was more as a postulate-like proposition, rather than **directly integrating** a set of empirically validated mathematical relationships presented by the various quantum phenomena that evolved between 1900 and 1926, when his paper was published. Some of the key quantum events [36] are as follows. (i) 1901; Planck: Molecules inside a Blackbody surface emits and absorbs

electromagnetic energy in discrete quanta, $h\nu$. However, Planck did not declare that light propagates as $h\nu$ quanta. (ii) 1905; Einstein's photoelectron emission paper defined light constitutes of "indivisible light quanta" (energy $h\nu$, not wave amplitude). However, since Maxwell's equations and Huygens-Fresnel's diffraction integral continued to be the "staples" in optical science and engineering, we have become accustomed to accepting wave-particle duality, based simply upon what kind of experiments one is executing. (iii) 1913: Bohr: A model for the quantized Hydrogen atom was presented based on Rutherford's highly concentrated nucleus. The single electron can execute "planetary orbits" around the nucleus at discrete distances possessing discrete binding energies. It was difficult to extend the model for atoms with nucleus containing more than one proton. (iv) 1917; Einstein's A-B Coefficients: Einstein presented formalism to calculate the probabilities of spontaneous/stimulated emission and stimulated absorption by atoms. The concept of stimulated emission gave birth to Lasers during the early 1960's. (v) 1924; de Broglie published his proposition that elementary particles (electrons, etc.) can behave as wave packets with $\lambda = h / p$.

Thus, unlike Maxwell, Schrodinger did not get the needed guiding mathematical equations to formulate wave/particle dual model, to create a wave-like equation that can accommodate the necessary Mathematical Superposition Principle (M-SP), as per Bohr, Einstein and de Broglie. Schrodinger needed a second order differential equation for the particle to create a phase-dependent solution ψ . However, real particles do not keep moving spontaneously as EM waves. It needs a separate physical potential gradient $V(x,t)$ to make it move spatially. It requires a classical Hamiltonian-like function to accommodate its total energy as the sum of kinetic plus potential energy. Therefore, unlike naturally emerging wave equation for EM wave that moves perpetually without any additional force, Schrodinger's Eq.7, *does not* require $\partial^2\psi / \partial t^2$; the first derivative $\partial\psi / \partial t$ takes care of the temporal evolution of the particle under the influence of $V(x,t)$. However, the key problem of the Schrodinger equation is that it does not define the internal stable structures of the particle. That is what we have proposed in this paper – particles are electromagnetic SLIP waves, and we show that it strengthens the current theory while getting rid of the many unnecessary, noncausal and hence controversial postulates like wave-particle duality only for superposition experiments. SLIPs are always *wave-particle reality*, always space-confined, particle-like EM waves while obeying Schrodinger's equation. Thus, the SLIP model helps integrate classical and quantum physics.

These SLIP wave packets are perceived by the ether as if it is perpetually pushing away its perturbation, just like the linearly propagating waves, satisfying the core restoration property of any energetic tension field. Now, this SLIP wave loop has developed a natural tendency of inertia of motion, until it is subjected to some physical potential slope (gradient) in its vicinity; even stopping it would require a separate opposing potential gradient. We thus see *the natural propensity of particles to obey Newton's two laws of motion*. "Locality" of spatially localized particles is inherently undeniable. Living biological bodies thrive as locally confined physical entities while internally executing innumerable quantum-chemical interactions between the molecules within their bodies. Ontological reality should not be rejected because of our inherent incompleteness of all human constructed theories.

Further, Newton's third law of real physical action-interaction through energy exchange, guided by their potential gradient between the particles, must also be accepted as physical reality, which strengthens the *locality* defined by the physical range of the force. There is no mysterious wave-particle duality. The particles are structurally localized SLIP wave loops. Interactions are guided by distinct types of physical potential gradients around them, generated due to the internal complex EM wave motions. Newton's third law of action-reaction is built into these mutually influencing "potential gradients", as they equally try to influence each other.

The quantization of particle energies also emerges naturally from the famous relation, $E = hf_{slp}$. The stability, or the lifetime, of various particles are now determined by the degree of phase matching within the SLIP structure of wave propagation. Protons and electrons must have the most precisely phase-matched internal SLIP oscillations since we do not find them decay. The phase matching requirements for the self-looped oscillation also dictates that the energies of the stable particles cannot assume just any values. In fact, Greulich [26] has found an interesting *strongly linear* relation to express the energy of many particles with measurable lifetimes as the multiplication of an integer N with the ratio of the electron energy divided by the fine structure constant α , which we have re-expressed in the second part of Eq.8 in terms of SLIP wave frequencies:

$$E^{prt.} = N(E^{el.} / \alpha); \Rightarrow f_{slp}^{prt.} = (1 / \alpha) N f_{slp}^{el.} \quad (9)$$

One can notice some similarity with the closed-cavity longitudinal laser frequency modes that require modulo- 2π phase matching condition. For particles heavier than electrons, SLIP frequencies keep increasing linearly as some integral multiple, reduced by the inverse α - factor. This provides some extra corroboration that particles are perpetually propagating *localized* EM SLIP-modes of the ether, like a toroidal laser. However, the wave motions must be very much more complex and yet symmetric to be able to generate the required outward electric field "lines" of the right strength leveraging the oscillating electric charge (E-vector) of the EM wave and display the required quantized charge or generate neutrality and spin properties for different particles.

"Plane Wave" and "Pilot Wave" are Unnecessary and Have Been Adding Unnecessary Confusions for Almost a Century:

We should now clarify here that Schrodinger's complex amplitude representation, $\psi \propto a \exp[-i2\pi f_{slp} t]$, for a free particle should have never been interpreted as a "plane wave". The conservation law tells us that a "plane wave", existing for all time and spread over all space, cannot exist in this real world. We use the similar mathematical expression $\exp[\pm i2\pi ft]$ routinely to analyze the properties of classical pendulum, or of classical oscillating AC currents. Further, the oscillatory complex amplitude property, displayed by particles, does not require any separate guidance from de Broglie's "Pilot Waves" because they themselves are SLIP harmonic oscillators, containing the necessary complex amplitudes. Originally, the idea was introduced to accommodate the wave-like superposition effects shown by particles. Besides, de Broglie's postulate has a problem of built-in mathematical non-causality (Eq.10), since the postulated wavelength of the Pilot Wave diverges to infinity as the particle velocity tends to zero:

$$\lambda_k \equiv \frac{h}{p} \Rightarrow \lambda_k = \underset{L.t, v \rightarrow 0}{L.t.} \frac{h}{\underset{v \rightarrow 0}{m_0 v}} \rightarrow \infty \tag{10}$$

We have mentioned Planck’s advice in the introduction that it is important to identify the primary *action parameter* of natural entities to model their interaction processes. To model particle-particle superposition effects on “external” (“third party”) detecting molecules through Superposition Principle, we need to postulate that the particles acquire a different kinetic frequency f_k (different from internal SLIP frequency f_{slp}). In particle-particle interactions, including kinetic collisions, f_{slp} , or hf_{slp} play key roles while bringing about structural transformations. We now postulate a causal de Broglie kinetic frequency f_k , defined as $(1/2)mv^2 = hf_k$ which provides us with the necessary harmonic frequency and phase, $a \exp[-i2\pi f_k t]$, to model particle superposition phenomenon. The causality for the de Broglie frequency is preserved (Eq.11):

$$f_k \equiv \frac{m}{2h} v^2 \Rightarrow f_k = \underset{L.t, v \rightarrow 0}{L.t.} \frac{m}{2h} v^2 \rightarrow 0 \tag{11}$$

Recall that frequencies of oscillators are the primary characteristic parameters and are determined by the intrinsic tension property that promotes the physical oscillation.

Role of ϵ_0^{-1} & μ_0 in the Fine Structure Constant α & the Emergence of Charge:

We should first recognize that charge is an emergent property out of electromagnetism. While we have found that mathematically the sum of positive and negative charges is always conserved in particle-particle interactions, physically, the charges and “mass” can completely vanish, or emerge, as in the transformations in electron-positron conversion to a pair of Gamma, or vice-versa: $e^- + e^+ \square \gamma + \gamma$. We can create charged particles through scattering Gamma waves. Since γ waves are oscillations of the ether, then the charge-property displayed by e^- and e^+ has to emerge out of the E-vectors of the EM-SLIP modes.

Very precisely measured fine structure constant $\alpha = (1/137)$ [27] for elementary particles can be used to see the emergence of charge out ether tension properties:

$$\alpha = \frac{e^2}{2h \epsilon_0 c_0} = \frac{e^2}{2h (\epsilon_0^{-1} \mu_0)^{1/2}} \Rightarrow e^2 = 2\alpha h \frac{1}{(\epsilon_0^{-1} \mu_0)^{1/2}} \tag{12}$$

In the first part of the above Eq.12, we have re-expressed α in terms of the primary parameters ϵ_0^{-1} & μ_0 by replacing the secondary derived parameter c_0 . Then we have re-expressed the charge in terms of ϵ_0^{-1} & μ_0 , multiplied by the α -constant and Planck’s quantization constant h , two precisely measured constants of nature. It shows that the square of the quantized charge is inversely proportional to the square root of the product of the electric tension and the magnetic resistance, built into ether as its key intrinsic properties.

Notice that expressing the secondary parameter c_0 in terms of the constituent primary parameters brings back the role of the electric tension and the magnetic resistance in the formation of the elementary particles as SLIP waves. However, it tells us more. One now needs to visualize the physical processes behind the emergence of quantized charge. Similar approaches are being contemplated by many scientists [37, 38]. The approach and the development of the proper mathematical model for the complex internal motions of the SLIP waves should be guided by the necessity of deriving the quantized charges e^\pm for particles out of the dynamic $\pm E$ -vector oscillations, which effectively represents the emergence of oscillatory charge (a current), which facilitate the dipolar stimulations during light-matter interactions. One may need to emulate the DNA-Helix model and use two intertwined and oppositely propagating self-looped EM waves. The emergence of the oscillatory magnetic field and the intrinsic Poynting vector of the EM wave could guide us to generate the \pm charges, the spin and the angular momentum that we observe in many particles.

Another key point of this model is that the wave particle-duality (WPD) is no longer an elusive and mystical behavior. It is now physically real, and it is built-in structurally and permanently. WPD does not emerge only during some selected type of special superposition experiments. We do not need the considerable number of strange, and non-causal, quantum philosophical interpretations to “understand” O-SP’s. *Schrodinger’s ψ is not an abstract mathematical probability amplitude. It represents the physically real, oscillatory amplitude-state of a particle.*

Internal EM Frequencies of SLIP Particles:

The at-rest energies of the electron and the proton are 0.510 MeV, and 938.272 MeV, respectively. Then, using $E = hf_{slp}$, and $h = 4.135 \times 10^{-15} eV.s$, we get the frequencies of the propagating E -vector of the close-looped EM waves for the electron and proton as $f_{slp}^{el} = 1.233 \times 10^{20} s^{-1}$ and $f_{slp}^{pr} = 2.269 \times 10^{23} s^{-1}$, respectively. These oscillations for electrons and protons are in the high energy gamma-wave region, which do not spread out diffractively, unlike much lower frequency EM waves that diffract. This non-diffractive propensity of extremely high frequency EM waves allows for the formation of stable and localized SLIP wave propagation. It is well validated that the diffractive spread is inversely proportional to the frequency of the EM waves. It is built into Huygens-Fresnel diffraction integral [11]. However, when the particles collide against a heavy nucleus, or each other, they would break up into a pair of gamma radiations, or other stable and unstable SLIP particles. Now the propensity of “bosons” as intermediate transition particles is a natural consequence of breaking up the SLIP-wave modes as linearly propagating EM wave pulses.

Role of ϵ_0^{-1} & μ_0 in Determining the Quantized Energy Levels of Hydrogen Atom:

Let us note that the quantized energy levels E_n of Hydrogen atoms are also guided by ϵ_0^{-1} & μ_0 , again because the emergence of the inertial mass of electrons is due to its SLIP wave structure (Eq.13):

$$E_n = \frac{m_e e^4}{8\epsilon_0^2 h^2} \frac{1}{n^2} = \frac{(\epsilon_{el} E_0 \epsilon_0 \mu_0) e^4}{8h^2 \epsilon_0^2} \frac{1}{n^2} = (\epsilon_0^{-1} \mu_0) \frac{\epsilon_{el} E_0 e^4}{8h^2} \frac{1}{n^2} \quad (13)$$

We should also underscore that the dependence of discrete energy levels on inverse n^2 implies phase dependent propagation behavior of electrons around atomic nuclei, which is mathematically well captured by Schrodinger's wave equation.

Locality of Superposition Effects:

We have underscored in section 4.2.1 that wave-particle duality is a reality, not a mystery of nature, because particles are localized SLIP EM waves. Schrodinger's QM equation represents a logically self-consistent causal relation. There cannot be sudden emergence of non-causal and non-local phenomena only when we carefully set up specific arrangements to record Observable Superposition Effects (O-SE). Let us first underscore that the *linear Mathematical Superposition Principle (M-SP)*, $\Psi = \psi_1 + \psi_2$, is not an observable phenomenon, even though, as per SLIP-wave model for particles, Ψ is not just an abstract "Mathematical Probability Amplitude", it is a real physical *stimulated (excited) amplitude state*. However, the operator "+" as amplitude summation, implies only coexistence of two physical signals, *not an active interaction process*. Observable O-SE requires real data generation through real interaction with a physical detector that absorbs energy to create the data. We need an appropriate responsive detector that can execute the square modulus operation on both the *physically* superposed signals, $|\Psi|^2 = |\chi_1\psi_1 + \chi_2\psi_2|^2$, assisted by the physical characteristic χ_1 as the linear dipolar polarizability of the detecting molecules that guides the *interaction process and* as a consequence triggers the energy exchange from the stimulating *TWO signals* to the detector followed by data registration by a human-constructed "smart" instrument. Thus, M-SE evolves into registerable O-SE through two steps. First, the real physical amplitude-amplitude stimulations followed by the physical execution of the quadratic process of energy absorption out of all the stimulating signals. The very structure of the causal and logical structure of our working mathematics should not be defied just because we cannot directly and explicitly observe the physical process steps. This is where our imaginations must play critical roles to accept the mathematical logics when it works, instead of inventing non-causal interpretations while defying the built-in mathematical logic and distorting the realities using statistics [29, 39]. The physical signals ψ_1 and ψ_2 must be physically real and stimulate the detector simultaneously. Further, the detecting molecules must be resonant to the incident signal frequency. Further, the each one of the signals sent out follows their physical *laws of propagation and spatial evolution* from the source to the detector. EM waves diffractively spread out and particles follow linear trajectory in force-free region without any diffraction. SLIP particles do not diffract like the Maxwellian waves do. Therefore, the expression for the M-SP below (Eq. 14) is just a causal mathematical expression that we are sending two streams of signal through two slits on to a distant detector array that can interact with the particles on arrival. The "+" operator in the equation does not represent any particle-particle interaction. There is an unavoidable relative temporal delay τ between the arrival of two particles from the two slits:

$$p(\tau) = a_1 e^{i2\pi f_k(t+\tau)} + a_2 e^{i2\pi f_k t} \quad (14)$$

It is simply a mathematically correct statement that we are *intending* to send two streams of particles on to a "far-field" detector array. Their arrival from the two spatially separate slits on

to any specific off-axis point on the detector array will require traveling by different paths, while taking different travel times, assuming they have been pre-selected for the same velocity $(1/2)mv^2 = hf_k$. See section 4.2.1 for the definition of de Broglie frequency f_k that replaces de Broglie Pilot wavelength λ_k . The detectable (observable) energy distribution registered by a detector array with the amplitude stimulation parameter χ_1 is given by Eq.14:

$$|\Psi(\tau)|^2 = \left| \chi_1 a_1 e^{i2\pi f_k(t+\tau)} + \chi_1 a_2 e^{i2\pi f_k t} \right|^2 = \chi_1^2 [a_1^2 + a_2^2 + 2a_1 a_2 \cos 2\pi f_k \tau] \quad (15)$$

Now the operation “+” within the square modulus sign is executed by the detecting elements via the interaction parameter χ_1 . It is almost impossible for us to send exactly identical number of particles through both the slits with identical release times to make $a_1^2 = a_2^2 = a^2$ and generate pure cosine fringes with unit visibility, which is routinely assumed in making arguments in support of the magical “single particle” O-SE. The causally correct mathematical logic embedded in Eq.15 representing the detected “fringe intensity” (or particles number) variations defies the interpretation that a single particle can generate O-SE. The mathematical logic behind the presence of the cross-product $a_1 a_2$ in the interference implies that the detector accepts energy from both the particle beams (the literal meaning of the word ‘superposition’). We rely on the hard causality, built into our mathematics, to advance exploration of physics. The locality of superposition effect is dictated by the interaction process executed by the detectors [30-32]. Dark fringe locations are due to the resultant *null stimulations* induced on those detecting elements generated by multiple particles due to their mutual phase dependent stimulations. *Dark fringes are not due to non-arrival of particles in those locations* [39]. That is the literal meaning of the two terms within the sign of square modulus. We should not randomly defy mathematical logic whenever we are at a loss to explain the *invisible interaction processes* that generate the registered data through interactions with detectors. Wave-particle duality (WPD) is real because particles are truly SLIP wavelets carrying separate phases. However, WPD should not be misused to justify the non-causal belief that a single particle can generate interference effect, defying the very meaning of the phrase “superposition effect”! Stable elementary particles cannot make themselves appear or disappear based simply upon human constructed passive double-slit structure.

It is to be noted that as a practical engineer, one cannot arbitrarily normalize either the amplitude of Eq.14, or the energy of Eq.15. The registered data of Eq.15 can be normalized, but only for convenience of presentation of the data. We have not invented yet any tool to measure the amplitudes of particles (or SLIP wave packets). Therefore, we cannot conduct actual experiments where the interferometer decisively has amplitude for a single SLIP-particle.

Gravity and Electromagnetism are Emergent Properties of the Same Tension Properties ϵ_0^{-1} & μ_0 the Cosmic Ether

We know that all “material” particles and their assembly display gravitational attractive forces, as has been modeled by Newton as a simple inverse square law and by Einstein through more complex formalism as “curvature of space” (General Relativity). We also know that the inertial

property of a particle with Newtonian inertia (mass) can be expressed in terms of the particle's SLIP energy and ether properties (Eq.15):

$$m_0 = E_0 / c_0^2 = (hf_{slp})(\mu_0 / \epsilon_0^{-1}) \tag{15}$$

Newtonian mass display “gravitational curvature” around it as in Eq.16. Below, we have presented the macro mass as a summation of innumerable SLIP oscillators of quantum frequencies $f_{slp}^{(1,n)}$ and $f_{slp}^{(2,n)}$. The issue to notice is that the mutual gravitational force between two massive bodies is *inversely proportional to the square of both the distance and the electric tension of the ether* (Eq.16).

$$F = G \frac{m_1 m_2}{r^2} = \frac{Gh^2}{r^2} \left(\sum_n f_{slp}^{(1,n)} \cdot \sum_n f_{slp}^{(2,n)} \right) \frac{(\mu_0)^2}{(\epsilon_0^{-1})^2} \tag{16}$$

If the SLIP wave concept for particles is correct, then the correct mathematical closed-looped light propagation model should be able to generate the gravitational force or create the "curvature of space" (potential gradient) on the ether field. The strength of the concept of the “Curvatures of space” increases with the “closed-looped” frequencies (energies) of the particles and is directly sum-able to generate larger and larger gravitational attraction without the need for any phase terms, unlike for interactions between quantum particles or EM waves and particles. We do not need a separate theory of Quantum Gravity that can generate graviton for interaction through “exchange process”. Many authors now agree that gravity has electromagnetic origin [40, 41].

**Cosmology: Energy Conservation, Dark Energy, Dark Matter, Expanding Universe, etc
Hundred Percent of the Energy of the Universe is Held by the Cosmic Ether as it Tension:**

We have accepted that everything observable (measurable) by us consists of only diverse oscillations of the 3D Cosmic Ether. Hence the evolution we observe and study, both in the macro and the micro universe, consists of diverse interactions between these two types of Electromagnetic oscillations – propagating in closed loops (particles) and spreading diffractively (EM waves). These oscillating entities interact and undergo diverse physical transformation while always conserving the energy. Implication is that Cosmic Ether is a lossless tension field. So, we claim that 100% of the energy in this universe is held by Cosmic Ether [4, 13]. We do not know what has generated the tension field and what “substance” holds the tension filed. It could not be built out of some finer unknown particles like air molecules since air cannot sustain transverse waves. The EM waves are always almost transverse in nature, except in the immediate vicinity of the emitting sources.

Current cosmological theories describe that of the total energy density of the universe, Baryonic matter represents only ~5%, dark matter and dark energy supposed to consist of ~25% and ~70 %, respectively [42]. The energy density of propagating EM wave (photons) energy is negligible, only about ~0.005%. In our model, all the Baryonic (5%) matter consists of SLIP oscillations. Then ~95% of the energy remains un-manifested in the Cosmic Ether, *providing*

the stability of the dynamically evolving universe. In other words, for the ether model of the universe, there is no need for Dark energy and Dark Matter [43, 44].

One of the challenging issues faced by both the Newtonian Gravity and the Einsteinian General Relativity that they could not quantitatively explain the measured velocity-variation curves of the stars in many galaxies with their constituent galactic radial distances. This has been the origin of the hypothesis of Dark Energy and DarkMatter. However, an alternate polynomial approach, known as the Modified Newtonian Gravity (MOND), quantitatively accommodates the variable velocities of stars with their distances [see Fig.3 as an example].

Manheim’s Conformal Gravity (Eq.18) [45], has a four-term polynomial to accommodate the gravitational effect due to very complex distribution of stars in different galaxies using four fixed constants, β^* , γ^* , γ_0 and κ , for each galaxy. They have modeled experimental data for about two hundred different galaxies with reasonable accuracy. One of the best-case examples is shown in Fig.3. The solid dots with the error-bars represent experimental data, which was measured using Doppler frequency shifts for the galaxy UGC1230. The solid curve is the theoretical plot. (The dashed and dotted curves in Fig.3 correspond to using different terms, or combination of terms, from the Eq.18. Readers who are interested in Conformal Gravity, should consult ref.45 for further details.)

$$\frac{v_{Tot}^2}{R} \rightarrow \left[\frac{N^* \beta^* c_0^2}{R^2} + \frac{N^* \gamma^* c_0^2}{2} + \frac{\gamma_0 c_0^2}{2} - \kappa c_0^2 R \right] \tag{18}$$

We now re-write Eq.18 in terms of the key primary tension parameters of Cosmic Ether, using $c_0^2 = \epsilon_0^{-1} / \mu_0$, to underscore that the origin of gravitational force emerges out of electromagnetic ether due to the potential gradients (gravitational curvatures) generated by the assemblies of the closed looped SLIP waves.

$$\frac{v_{Tot}^2}{R} \rightarrow \left[\frac{\epsilon_0^{-1}}{\mu_0} \right] \left[\frac{N^* \beta^*}{R^2} + \frac{N^* \gamma^*}{2} + \frac{\gamma_0}{2} - \kappa R \right] \tag{19}$$

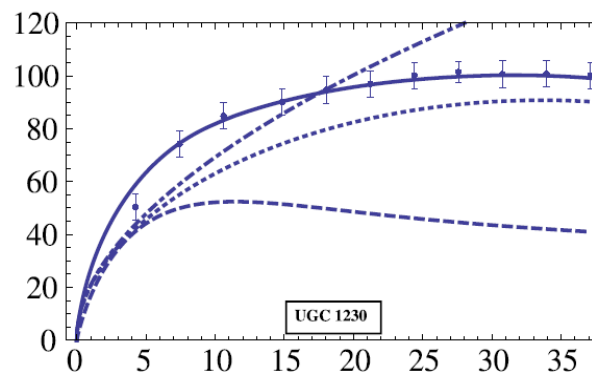


Figure 3: Strength of Conformal Gravity without the need for Dark Energy. Relative velocity distribution of stars with their distance from the center of the galaxy UGC 1230. The solid

computer plotted curve fits very well through the experimental data points with their error bars. This is a 3D model of gravity, and it does away with the need for Dark Matter [19, 45]. It is better than the 4D model of Einstein's gravity. (The dashed and dotted curves correspond to using different terms, or combination of terms, from the Eq.18; they are not relevant for our discussions in this paper.)

Cosmological Redshift is not a Doppler Effect:

Stationary ether model also contradicts the postulate that the Cosmological Redshift is a Doppler shift [46, 47] to support the belief that we have an expanding universe. For our universe to evolve causally and steadily through diverse interaction processes between matter-matter and matter-radiation, the values of the core tension parameters ε_0^{-1} & μ_0 must remain constant. Any major expansion would appreciably change these *tension* parameters and would have shown consequent changes in the values of these primary action parameters, and hence we would have experienced continuously changing laws of nature.

Further, the *physical processes* behind the emergence of Doppler Effect do not corroborate the physical processes behind the generation of Doppler Shifts. The so-called Doppler shifted spectral "Dark Lines" represent the absence of any physical signal. So "dark lines", possessing no physical signal, cannot experience any physical effect, like Doppler frequency shifts [48]. Let us briefly revisit the origin of the Doppler Effect. *The physically real and permanent frequency shift* of light as Doppler Effect happens due to the velocities of the signal-emitting individual atoms and molecules relative to the universally stationary ether. This *real* Doppler shifted signal then propagates perpetually through the stationary ether unchanged in its Doppler-shifted frequency. However, this same Doppler shifted signal would be perceived by a set of detectors as *apparent and different Doppler shifts*, if they are moving with different velocities relative to the same stationary ether. Source velocities and detector velocities both create separate Doppler frequency shifts, the former is real for all measurements, and the latter is apparent to a moving detector [48]. The Doppler effect is not a relativistic effect because the light emitting atoms/molecules in stars can never reach relativistic velocities, $v \sim c$. The spectral widths of the direct Doppler-Broadened spectral line-frequencies from atoms/molecules, whether observed on earth, or received from a very distant star, are always bounded by the Maxwell-Boltzmann thermal velocity distribution of the atoms/molecules. The thermal temperatures of the light emitting outer surfaces of stars are usually several thousand degrees, which can never give rise to relativistic velocities!

Let us explore further the physical conditions behind the "frequency shift" of the *dark lines* [48]. First, the white light, emanating out of high-temperature inner layer of the star, must pick up the dark-line signatures as the characteristic spectral absorption lines due to the cooler atoms and molecules of the outer layer. Then, the emergent white light with dark lines imprinted on it keeps propagating through the intervening cosmic space, before reaching us. Therefore, *the frequency shift of the dark line can happen only while the entire white light spectrum undergoes redshift during its travel through the galactic space before reaching us*. The physical processes that create this Cosmological Redshift must be some physical property of the intervening Cosmic Ether whose properties have been modified due to cosmic dust or other weak frequency-reduction processes. The Hubble Redshift, as was originally thought by Hubble, is a

slow distance-dependent frequency reducing phenomenon, not a Doppler Effect. Therefore, *as per our Cosmic Ether model, our universe is not expanding.*

The Two Postulates of Special Relativity (SR) are Automatic Consequence of the Cosmic Ether Model

Our model of Cosmic Ether as the physical medium in which the entire observable universe is manifest to us, automatically accommodates the two postulates of the Special Relativity as *causal consequences*, rather than as rationalizable starting postulates.

SR Postulate -1: Velocity of Light Is the Same in All Inertial Frames:

Since the entire universe constitutes *stationary* Cosmic Ether, Maxwell's wave equation automatically justifies the first postulate with the specific value of the velocity as $c_0 = (\epsilon_0^{-1} / \mu_0)^{1/2}$. A separate postulate is not necessary. However, we would like to restate our observations. The velocity of light is essentially determined by the effective electric tension and the magnetic resistance of the medium it is sustained by. The Cosmic Ether is universally stationary and hence c_0 is a constant everywhere in the cosmic space. In all other media $c_{med.}(\nu) = (\epsilon^{-1} / \mu)^{1/2} = c_0 / n_{med.}(\nu)$, where $n_{med.}(\nu)$ is the frequency-dependent refractive index of the medium. If the medium executes a velocity $v_{med.}$ relative to the stationary ether, its effective electromagnetic tension properties (or, the refractive index) changes and the effective velocity found to develop an extra "drag" of $\pm v_{med.}(1 - 1/n_{med.}^2)$, known as the Fresnel drag. Then the effective velocity becomes $c_{move.} = (c_0 / n_{med.}) \pm v_{med.}(1 - 1/n_{med.}^2)$, known as Fresnel Drag [49, 50].

Cosmic Ether is the only universal inertial rest reference frame for us. Planets, on which human-like species can conduct experiments, strictly speaking, may not truly be inertial rest frames. They are continuously executing diverse complex motions: axial rotations, elliptical orbital motions and their parental stars' galactic motions (rotations and translation). However, we must note that for material media, sufficiently dense galactic gas clouds, corona of stars, planetary atmosphere, bulk material media on planets, all have different effective and *reduced tension field strength* (higher refractive index) and have dispersive frequency-dependent velocities, $c_{med.}^2(\nu) = c_0^2 / n_{med.}^2(\nu)$. In these media, the velocities of EM waves are different. Further, if any of these media are in relative motion with respect to the stationary ether, then the velocity suffers from the Fresnel Drag.

SR Postulate -2: Laws of Physics are Same Everywhere in the Universe:

We have already underscored that our universe, emergent in the stationary Cosmic Ether, is the only inertial reference frame. The only observables are propagating diffractive EM waves and localized non-diffracting SLIP EM waves. They all are distinct kinds of excited states of the same stationary Cosmic Ether across the universe. They naturally must follow the same rules on planets in any star, in any galaxy of the entire observable universe. Therefore, the 2nd postulate is also causally built into our model for the Cosmic Ether. We do not need to postulate it separately.

Further, the atoms and the molecules, being assemblies of resonant oscillations of the same cosmic ether (SLIP modes), naturally would obey and display the same quantum mechanical behavior in all the stars, in all the galaxies. *This is also the obvious reason the theories, well-validated by experiments on earth, also corroborate the properties of atoms and molecules in all distant stars and their planets.* We should further note that the empty space between the atoms, and also within the atoms, is the same stationary Cosmic Ether, whether they are in the corona of a star, or in a discharge tube on earth. A separate SR theory in Physics is not of critical importance just to appreciate the universality of the laws of physics, as originally articulated by SR, which did not explicitly recognize Cosmic Ether as the stationary energetic tension field.

SR: Time as a New Dimension. The Running Time “t” is not a Physical Parameter of Any Natural System or Object:

Recall that we have underscored in the introduction the importance of “interaction process” and “primary actionable parameter” in modeling natural phenomena because nature is persistently evolving through diverse interaction processes where the interaction parameters usually define the strength of interactions. The running time, “t” does not fit into either of these characteristics. So, it does not make operational sense to assign running time “t” as the fourth dimension to nature (the universe) having equal footing with the 3D space. Running time “t” is an ingenious invention of human culture. We cannot lead our lives without it.

Let us examine how we measure the running time. We always use a standard *physical oscillator* that has a characteristic natural (resonant) frequency, f . Then we invert this frequency into a “period”, “dt” = “1/f”. Then we keep counting larger and larger number of periods to get a semblance of running time “t” = $N dt = N/f$. It is not an action guiding parameter of nature. Lifetimes of radio-active elements and unstable particles do represent various physical time intervals as time periods. So, the running time can be expressed as different multiples of their respective lifetimes. So, the running time “t” should be kept as a mathematically convenient parameter to keep track of evolution of natural phenomenon. However, we should not assign it the status of a primary action parameter of nature. We should note that, frequency being a primary physical parameter of physical oscillators, it can be physically “dilated” and “contracted” by applying appropriate changes in its immediate vicinity that can alter the physical parameter that influences the resonance frequency of the oscillator. Therefore, the universe should not be arbitrarily defined as physically four or multidimensional.

SUMMARY AND CONCLUSION

It was Einstein who initiated the overarching concept of “Unified Field Theory” after publishing his General Relativity. Till today, the subject of unification is not closed. All these attempts [1, 2] could be described as following the Newtonian successes of *finding the mathematical structure of the interacting forces* between the interacting particles and then unifying the diverse forces. So far Physics has succeeded in defining four forces of interactions - Gravity, Electromagnetism, Strong and Weak Nuclear forces. The “top-down” attempts have been continuing to unify all these four forces using wide ranges of ingenious mathematical creativity, as if nature must follow the rules set by the human invented language of mathematics. The author has presented a “bottom-up” approach of finding a common source of energy in the universe that can allow for the appearance and disappearance of observable electromagnetic waves and the particles while preserving the most important observed rule of nature: the

conservation of energy; besides accommodating interactions that exchange energy continuously as in classical interactions, or only discrete amounts of energies, as in quantum interactions. If EM waves and the elementary particles both are wave-like excited states of the same ether tension field, then 100% of the energy is always retained by the Cosmic Ether, even when the structures of the waves undergo transformations. Total energy of the interacting waves remains unaltered, as long as Cosmic Ether itself is lossless.

Our approach has been to start from the bottom up and postulate the origin of the universe such that the postulates behind the successful theories of physics would appear as causal and natural consequence of the very source of the energy and its consistent conservation in every interaction. It turns out that most early physicists had already postulated the existence of Cosmic Ether, including Newton. However, it was Maxwell's brilliance in differential and integral calculus that gave us the wave equation for Electromagnetic waves with an explicit expression for the velocity of light as $c_0^2 = 1/(\epsilon_0\mu_0)$, after unifying the existing observations of the separately developed fields of Electrostatics and Magnetostatics. These two separate fields had already defined the properties of nature's free space having the properties: ϵ_0 and μ_0 , which are dielectric permittivity and magnetic permeability, respectively. However, our attempt to find conceptual similarity between EM and Newtonian mechanics (Section 2) revealed that the unification of the mathematical structures of the velocity of all waves, based on tension-fields, requires that we re-define ϵ_0 and μ_0 such that ϵ_0^{-1} is the "electric tension" and μ_0 is the "magnetic resistance" of the Cosmic Ether.

We believe we can revitalize and accelerate our progress in modeling nature if we adopt the methodology of thinking, as articulated at the end of Section 1.1: (i) Mathematics alone cannot give us an objective and complete description of nature; (ii) Non-Interaction of Waves [13, 51] in the absence of responsive materials; (iii) Nature is three-dimensional, (iv) Interaction Process Mapping Thinking (IPM-T) [13, 52].

We must keep on iteratively re-structuring the basic set of postulates behind all our separate theories towards a single set of coherent and harmonious set of postulates. Then we should be able to recognize nature as an interrelated emergent system out of the same Cosmic Ether. This paper is an attempt in this direction, as we have explained through the logical emergence of Newton's laws of motions out of SLIP wavelets and the two postulates of Einstein's Special Relativity once we accept Cosmic Ether. We have demonstrated that the old ether is the best unifying field for our current state of physics theories. We ourselves are just bundles of oscillating, or dancing, excited states of the Cosmic Ether! However, we are still looking forward to further developments in physics thinking.

The key strength of the paper is that the postulate of particles as SLIP EM waves helps us model the observable universe as ontologically real, consisting of different kinds of emergent undulations out of the same tension field having the intrinsic "mechanical properties" somewhat similar to other macro mechanical tension fields, like (i) stretched-string tension field in a string, (ii) pressure tension field in air, (iii) surface & gravitational tension field in water, (iv) etc. Thus, the Classical and the Quantum Worlds, both are causally emergent *physical properties* out of the same Cosmic Ether field. However, our conceptualizing brain creates

information out of information gathered through our five biological sensors, and human constructed instruments, whose sensing capabilities are always limited and are not exactly same and perfectly accurate and reproducible. Further, all human brains also make slightly different and fuzzy interpretations, which cannot be characterized by “0” and “1”. However, these limitations and ignorance should not be interpreted as the universe being an *illusion*, as if it is built out of abstract mathematical information. However, the universe does appear as *elusive* because of our cloud of ignorance is receding too slowly for our individual life span. We have not yet constructed the exact mathematical descriptions of the various SLIP wavelets. We still have not figured out the intrinsic structure and the constituent “substance” that generates the physical properties of Cosmic Ether. Even though we cannot even fathom the physical extent of Cosmic Ether now, thousands of future generations will keep working on it, just as thousands of generations had worked on all the relevant issues in the past and guided us to evolve where we are today. The sphere of our ignorance is steadily receding, albeit a bit slower than our individual life span.

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