

How would photons describe natural phenomena based upon their physical experiences?

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ABSTRACT

The question posed in the title represents an impossible approach to scientific investigation, but the approach is like a subjectivist. Obviously, photons cannot express their views; neither can we ask directly any scientific questions to the photons. The purpose is to draw the attention of the reader that even our strongly mathematically driven scientific enterprise is full of subjectivism when we start dissecting our thinking process. First, we frame questions in our mind to understand a natural phenomenon we have been observing. Let us not forget that framing the question determines the answer. The answers guide us to frame the foundational hypotheses to build a theory to “explain” the phenomenon under study. Our mind is a product of biological evolutionary requirements; which is further re-programmed by strong human social cultures. In other words, human constructed theories cannot spontaneously become rigorously objective, unless we consciously make them so. We need to develop a methodology of scientific thinking that will automatically force us to make repeated iterative corrections in generating questions as objectively as possible. Those questions will then guide us to re-construct the foundational hypotheses and re-frame the working theories. We are proposing that we add Interaction Process Mapping Epistemology (IPM-E) as a necessary extra thinking tool; which will complement the prevailing Measurable Data Modeling Epistemology (MDM-E). We believe that ongoing interaction processes in nature represent reality ontology. So the iterative application of IPM-E, along with MDM-E, will keep us along the route of ontological reality. We apply this prescription to reveal the universal property, Non-Interaction of Waves, which we have been neglecting for centuries. Using this property, we demonstrate that a large number of ad hoc hypotheses from Classical-, QM-, Relativity- and Astro-Physics can be easily modified to make physics more causal and understandable through common sense logics.

Keywords: Non-Interaction of Waves; NIW-property; Interaction Process Mapping Epistemology, Measurable Data Modeling Epistemology; Hubble red shift; Classical vs. relativistic Doppler shifts; CMBR; Non-causal Fourier theorem

1. INTRODUCTION

Why is the title-question framed for photons, and not for electrons or protons? (a) Photons can bring accurate information about the original or secondary “parents” as in QM, Astrophysics, and to optical sensors because they propagate through free space and materials (except frequency dependent absorbing materials); and through each other without changing their information content (without interacting). (b) Photons can deliver information as in optical communication. And (c) photons can deliver energy as in laser material processing. In contrast, propagation characteristics of particles are quite restricted due to their mutual interaction propensities. So, our story will be woven based upon photons’ mutual non-interacting properties, in contrast to interacting particles.

But, how would photons describe terrestrial and cosmological phenomena based upon their physical experiences? Of course, photons do not possess the biological complexity and intelligence to express their opinions. But we can use our imaginations to visualize the experience of photons! Framing such a title-question is rather counter to our apparent rigorous scientific culture where we supposed to ask only impersonal objective questions to discover laws of nature; which are impersonal. We create our opinions about natural objects and phenomena and express them as if they are the final objective reality of nature. The purpose of framing such a title-question is to draw the attention of the readers that all of our scientific conclusions are effectively *subjective* when we carefully dissect the processes through which we derive our scientific conclusions. All organized bodies of knowledge in all branches, so far created by us, are *necessarily incomplete* as they are framed based upon *insufficient knowledge* of the deeply interconnected and complex universe. Attempts to develop the final theory of physics to explain all natural phenomena with a single unified field theory started

almost a century ago by Einstein. But, we do not have a unified consensus opinion as to whether we are even heading along the right path [1-10]. We have not yet succeeded in constructing a set of thinking *human logics* that gives us a direct access to the *cosmic logics* that frame the operating rules behind all natural phenomena in spite of our well-developed *mathematical logics*. That is all the more reason to try to develop a methodology of thinking that can iteratively guide us along a path to keep on moving towards understanding the ontological reality that lies behind our observable universe. We need to explicitly recognize that our current mathematical and measurement tools are not sufficient to guarantee that we are definitely following the path for continued discovery of the ontological realities of the universe. We do not even know for certainty that the universe as observable to us, through our current state of technologies and the current state of thinking, really represent the totality of the ontological universe.

We only observe various physical transformations in nature. Down select and organize them into a logically inter-related set by framing questions using human mental logics to discover some conceptual continuity among them. The product of these logical questions evolve into a set of foundational hypotheses; which then help us construct a cause-effect relating equation using mathematical logics (equation) for quantitative validation of observed and predicted data. Our survival needs and the dreams of our enquiring minds is to fully understand the cosmic logics, which nature play with to make our observable universe persistently changing, yet with remarkable orderliness. With sustained and staggering amount of successes achieved by our mathematical theories, especially, over the past four hundred years, we have accepted our working theories as a vindication of our perceived objectivity built into our working equations. *Is our perceived objectivity really objective?*

(i) Starting platform of ignorance: We are forced start from a platform of ignorance. We do not know for sure any of the cosmic logics that are behind the rules that drive the cosmic evolution. So, we start with a limited set of observations, while excluding those observations that do not show strong correlations. These selections and exclusions corroborate the beginning of the insertion of our subjective judgments by different thinkers into scientific investigations.

(ii) Evolutionary diversity: Our thinking logics are full of diversity; which has been a necessary component behind our successful evolution driven by the diversity of distresses and competitions for our survival. Even though our thinking logics emerge out of objective (albeit statistical) quantum mechanical rules behind molecular interactions in our neural network, the diversity of opinions (decisions) we make; are effectively subjective. Framing the question determines the answer we can construct. Our mind is an emergent property of the 100 billion neural cells. This emergent property is a product of biological evolutionary requirements and further heavily influenced by strong human social cultures. In other words, human constructed theories cannot spontaneously become *rigorously objective*.

(iii) “Measurement Problem” as “Incomplete Information Problem”: Consistent validation of working theories by measurable data cannot assure us that we have already discovered the right path to follow along indefinitely. We cannot devise a set of experiments that can provide us exhaustively with all the necessary information to completely understand the interactants under investigation. We cannot design an instrument that definitely possesses 100% fidelity to register (or display) all the information as measurable data. We are forced to start on a platform of ignorance. And our measuring instruments further slow us down by not providing us with complete information about anything we study.

(iv) Limits of mathematical theories: Mathematical rules are products of human neural networks designed by evolution with the primary purpose of biological survival within diversity of given stressful physical and cultural environments. Single cells, alone and as collective systems, both in the plant and animal kingdoms, display staggering degrees of biological intelligence to survive and thrive. We must not minimize this staggering degree of biological intelligences as nothing but *intuition* just because we still have not succeeded in fathoming this intelligence. Biological intelligence, held by non-humans, is not capable of documenting the logics behind their successful actions and how they are correcting their failures. Einstein underscored that, “It is the theory which decides what we can observe.” This is quoted by Werner Heisenberg [11]. It is the subjective interpretations assigned by human minds to the various symbolic parameters and the symbolic operators in our equations that dictate us what we can measure and how we should design our experiments. Examples abound both in classical and quantum physics. We still measure mass of particles and search for mass-providing particles, even though mass-defects in historically early chemical reactions and modern nuclear reactions have demonstrated that energy is more an immutable property in the material world rather than the mass. Every one now knows for over a century that this concept brings out broader conceptual unity in physics than the concept of mass. We never try to measure Schrodinger’s ψ because it has been interpreted as abstract mathematical probability amplitude only; as if it is an unphysical parameter. However, it represents the physical internal harmonic undulation of a particle when stimulated by another agent during an interaction before they jointly find quantum compatibility to exchange

energy. These internal harmonic undulations do not represent *infinite plane waves*! Even the single event (data point) cannot validate QM because of the inherent statistical nature of the micro universe [12]. *If we want to map reality of nature, then we should pay attention that parameters and the operators we use in the starting relation of a theory equating cause and effect, should reflect real physical measurable parameter and the operators should corroborate allowed force(s) of interactions, respectively.*

(v) Artificial dichotomy between classical and quantum mechanics: Today's knowledge tells us that biological lives of single and multi-cellular lives are driven essentially by chemical reactions. Chemical reactions follow rules formulated of quantum mechanics. Macro classical living biological bodies exemplify some important successes of quantum mechanics. Thus, classical and quantum mechanics form a clear undivided continuum. Intrinsically statistical outcome of any individual QM transition does not make QM non-local. Causal assembly of protons, neutrons and electrons form atoms, then molecules, then cells and their assemblies make the macro biological bodies. These are well defined local bodies. So, particles at the foundational level cannot be non-local waves. They are localized harmonic undulations; but their structures are still elusive to us. Waves, as structured by wave equations, must persistently propagate away from the regions of their origins without the need for any separate force to initiate its perpetual movement. The perpetual movement is provided by the sustaining tension field [13]. Schrodinger's "wave equation" always requires a separate term of *potential gradient to move a particle* since they really are not waves. Besides, there is nothing revolutionary behind the various mathematical tools used by quantum mechanics; neither are they different from mathematics used by classical physics. The key uniqueness in QM is that particles are resonant entities holding a specific amount of energy for their stability [13,14]. Their assemblies must also form newer forms of resonant entities to minimize the overall total energy contained in the new systems. Thus, atoms and molecules can have resonant states holding different but discrete amounts of energy. Consequently, the energy exchanges between quantum atoms and molecules are discrete (quantized). This is in contrast to the classical (un-quantized) oscillators. When they interact, allowed by resonance; they can exchange energy continuously; as in macro bodies connected by mechanical springs. There is no revolutionary jump between micro and macro bodies. The micro universe appears to be more elusive than the macro bodies only because of our evolutionary psychology. We think and perceive that we can touch and feel our bodies, but not the electrons and protons. Molecules of my fingers can hold a cup of coffee; but they really do not physically touch the molecules of the cup! Molecular fields prevent each other from penetrating each other, generating the sensation of perceived rigidity. At the foundational level, the sense of rigidity is a profound illusion we are holding on to. This is contrary to our existing scientific knowledge. Both micro and macro bodies still should be recognized as equally elusive; because we still do not know a lot about them. The deeper 3D visualizable models for atoms and molecules are still elusive to us. This we must insist on overcoming by not accepting that the current QM is the complete theory and the final theory!

(vi) Invisible interaction processes: We should now recognize that our current approach of developing working theories validated by experiments, do not represent the final path towards exploring ontological reality in nature. Validation of a theory by measured data does not assure us of certainty of the theory. [3,15] Discrepancy in the data does not provide any deeper insight, beyond some doubt, as to how to correct the foundational hypotheses used to construct the theory. Thus, the current methodology of theory construction, *Measurable Data Modeling Epistemology (MDM-E)*, does not provide us with a referent platform that has assured connection with the ontological reality to generate consistent and frequent feedback loop for iterative improvement in our foundational hypotheses towards ontological reality until we faced clear breakdown in those hypotheses while modeling newly observed phenomena. This is the most likely reason why our progress has been going through so many scientific revolutions requiring major paradigm shifts [16]. We need to find some referent platform with clear connection with the ontological reality so that we can gather more frequent feedback for steady and iterative correction without waiting for disruptive breakdowns and consequent revolutions. We need to construct a methodology of thinking that is evolutionary, rather than revolutionary. We believe that physical *interaction processes*; which are behind the generation of measurable data as physical transformation in the interactants we study, *represent much closer connection to ontological reality than the generated data*. Unfortunately, interaction processes are not directly visible to us because of the subtle nature of the origin of EM waves and particles, which make up the observable universe for us. Fortunately, we now possess highly evolved imagination and visualizing capability to construct images of the invisible interaction processes going on in nature.

(vii) Add IPM-E over our existing MDM-E: Our position is that we need to add in our scientific repertoire the Interaction Process Mapping Epistemology (IPM-E), over and above the existing Measurable data Modeling Epistemology (MDM-E), as the extra new tool to challenge our foundational hypotheses and implement frequent iterative corrections using the process mapping as the referent platform, or the path towards ontological reality. IPM-E is not alien to us [13]. Even though it was never named as such, *IPM-E has been an intuitive evolution-congruent skill*

applied by all species, from single cells to multi cellular humans. Our survival and evolution require taking persistent and pro-active actions that *emulate nature allowed physical processes*, whether they are at the molecular level or through the invention of complex tools and technologies. Our forefather from million years past and present-day engineers have been assuring our successful evolution through persistent engineering innovations without waiting for understanding complex mathematics and elegant theories. Of course, mathematics itself is a powerful thinking tool invented not too long ago. And it has facilitated our technological evolution at a much faster pace than in the past. Our communication engineers have ushered in the Knowledge Age with great success in the human culture in less than a century. Foundation behind the communication technology is to (a) generate, (b) manipulate, (c) propagate and (iv) detect electrons and photons. Still, we are ignorant about the ontological reality behind the origin and structure of electrons and photons!

Thus, iterative application of IPM-E, over and above the prevailing MDM-E, will make us both evolution-congruent and avoid repeated disruptive scientific revolutions.

2. NON-INTERACTION OF WAVES & THE PHOTON MODEL

2.1 Non-Interaction of Waves (NIW-property) [17]

We have underscored that we need to pay closer attention in visualizing the invisible physical processes behind the emergence of diverse natural phenomena. In this section we briefly summarize Non-Interaction of Waves, or the NIW-property. We believe we have been benignly neglecting to formally accept this phenomenon for centuries most likely because we have been too focused on our highly successful Measurable Data Modeling Epistemology (MDM-E). This is an important physical property of all propagating waves in the linear domain in the absence of some interacting detector (observable medium). Derivation of the wave equation for a string under mechanical tension can help us appreciate this point provided we appreciate that the input perturbation on the string, which triggers a propagating wave, must be within the string's linear restoration capability. Then only the solution is a harmonic propagating wave. Let us try to visualize the physical processes behind the emergence of this propagating wave. The string under tension is not able to absorb (assimilate) the external perturbation energy, and yet, the displaced region wants to come back to its original state of equilibrium. The string does this by allowing the displaced region to come back to its original state of equilibrium by pushing the perturbed energy on to the next region; then the next region does the same. This perpetual physical process of handing over the perturbing energy to the next neighboring region, is at the root of perpetual wave propagation (velocity). Waves represent a physically perturbed state of a tension field. They do not have separate physical existence. Perpetual translation of a physically disturbed region through the vast unperturbed tension field, makes the wave appear as if it has independent existence. The tension field is held by a substrate; in this case, the mechanical string under mechanical tension. This same logic applies to sound wave as oscillation of pressure tension field held by air; water waves as oscillation of the surface tension field held by water. It is easier to observe and visualize two dimensional water waves crossing through each other. Only at the physical region of superposition, the superposed waves show accentuated or reduced amplitudes of oscillation; because the water surface is visible to us. However, beyond the superposition domain, all the propagating waves emerge out preserving their original characteristics, as if, they have never encountered each other. However, whenever the sum total wave amplitude exceeds the linear restoration regime of the surface tension field, the waves break up and some energy is dissipated. As long as the sum total perturbed displacement is within the linear restoration regime of the tension field, each wave preserves its independence. This is Non-Interaction Waves (NIW). This is true for all propagating waves that are oscillation of some tension field.

For EM waves, the necessary medium holding the tension field used to be assumed as the ether with tension properties ϵ_0 and μ_0 required by the velocity $c = (\epsilon_0 \mu_0)^{-1/2}$. Since propagating waves are excited states of a tension field, we should refrain from characterizing EM waves as “indivisible photon quanta”. Unfortunately, it was difficult to prove the existence of novel material with unusually large tension properties that can accommodate the highest possible velocity of light $c = 3 \times 10^{10} \text{ cm / s}$. Further, Michelson-Morley type of interferometric experiments could not find any “drag” from such a material. The solution is to accept that the necessary tension field exists on its own, rather than being held by a separate substrate substance. Let us call this field, Complex Tension Field (CTF). Linear perturbations by various oscillating dipoles facilitate the generation of EM waves, which is then sustained by the CTF with the velocity c . The drag of particles by this novel field is eliminated with the hypothesis that stable particles are localized, self-looped, resonant oscillations of this same CTF triggered by high energy non-linear process. Hence these particles “remain at rest until acted upon by some force”. The forces themselves are generated as different kinds of secondary potential gradients in the CTF created around the particles due to their various kinds of resonant oscillations [13].

Even though we have been neglecting this universal NIW-property for all waves for centuries, past observations, many working theories related to EM waves, and some recent experiments, do corroborate its validity for EM waves. Here we present a very brief summary that supports the NIW-property for EM waves.

(i). **Al Hyathem (~1080)** carried out a brilliantly simple experiment by imaging a set of candles by a pinhole camera. He blocked and un-blocked different candles and found the remaining images always remained unperturbed. Accordingly he concluded that light from different candles do not interact while crossing through the pinhole [18].

(ii). **Huygens secondary wavelets (~1600)** [19] is still the foundational hypothesis of modern optical science and engineering. Each perturbed point of the tension field functions as the source of secondary wavelets. Restoring energy of the tension field provides energy to push away the perturbation.

(iii). **Huygens-Fresnel diffraction integral (~1800)** [19]: Fresnel provided the mathematical structure for the now known defecation integral in their joint name. As the secondary wave lets evolve and diffractively spread, they co-propagate and cross-propagate through each other without perturbing each other. Only when one inserts a detector at a specific plane, the detector carries out the quadratic energy absorption process registering the diffractive energy distribution in that particular plane.

(iv). **Maxwell's wave equation (1864)**: It accepts all linear combinations of sinusoidal harmonic waves as its solution. Like HF diffraction integral, the implication is that within the linear domain, all waves can co-exist and propagate through each other unperturbed.

(v). **Michelson's Fourier transform spectrometry (late 1800)** [20]: One of the greatest contributions in the precision instrumental spectrometry was made by Michelson. He found that once he assumed non-interaction between waves of different frequencies, he could analyze the interferograms to extract the spectral information of the multi frequency source quite precisely using mathematical Fourier transform. Since detectors carry out the superposition effects as absorbed energy through its quadratic process, the integration time of the detector determines the quality of the fringes. Modern very fast detectors can register superposition effects due to different frequencies. Fortunately, Michelson did not face this problem because he used very long time integrating photographic plates. But his failure of recognizing that detectors carry out the superposition effects, he failed to generalize the NIW-property for light.

(vi). **Planck's Blackbody radiation formula (1900)**: Consider first the Maxwell-Boltzmann statistics applied to the atoms or molecules enclosed inside a thermally stabilized box. Under the steady state equilibrium condition their velocity distribution formula provides the quantitative values of velocities of the molecules, which is well validated through Doppler broadening of the spontaneously emitted spectrum. The state of equilibrium for the velocity distribution is achieved through the physical process of random collisions between the atoms. The frequency distribution of thermal EM radiation under similar statistical equilibrium condition inside an enclosed blackbody box was derived by Planck. He was forced to recognize that the emission and absorption of EM radiation take place as discrete energy packets. But, he always believed that after emission, photon wave packets propagate by spreading out diffractively. Spontaneous emission is always statistically random. Their multiple reflections from the enclosed cavity wall, while spreading out diffractively, facilitate the statistically accountable stimulated absorption of the radiation by the surface molecules. Einstein in 1917 separately derived this statistical emission and absorption behavior through his famous "A and B coefficients". Diffractively spreading wave packets inside the blackbody cavity follow HF principle without interacting with each other. If they interacted, blackbody thermal energy distribution would have been different [14].

(vii). **Bose's quantum mechanical derivation of Blackbody radiation (1924)**: Bose, of the fame Bose-Einstein statistics, re-derived Planck's radiation formula as "fully quantum mechanical" by treating the photons as indivisible energy quanta, as Einstein originally proposed. Bose had to invent a new statistical counting method for the photons as *identical particles that can be put in the same box without changing the number*. This, of course implies photons do not interact with each other. But, Bose missed the opportunity to recognize the NIW-property [14].

(viii). **Dirac's EM field quantization (1929)**: After successfully quantizing the EM radiation field that corroborates Einstein's assertion that photons are indivisible quanta, Dirac realized that "different photons do not interfere". He discovered the NIW-property like Michelson but ignored it. To accommodate the classical mistake, that waves by themselves interfere to create new energy distribution (fringes), Dirac posited that "a photon interferes only with itself". This is a causally self-contradictory proposal. If photons are stable elementary particles, how can they make themselves appear and disappear without any real force of interaction between them? [14]

(ix). **C. Roychoudhuri's experiment with a tilted Fabry-Perot (1975) and heterodyne (2006):** The author carefully analyzed superposition effects due to a parallel set of laser beams generated by a tilted Fabry-Perot and focused on to a glass with flat back surface and grounded forward surface. The first flat surface reflected all the convergent beams as a set of divergent beams, as per law of reflection, clearly indicating that the waves at the convergent focused spot did not interact with each other. But the grounded back-surface generated fringes displaying spatially separated longitudinal spectral modes of the laser. Tiny lumps of silica molecule on the ground surface each responded to the local resultant electric vector and hence scattered light according to the superposition effect [21]. In a more recent experiment, the author superposed amplitude modulated and CW laser beams of different frequencies and demonstrated that amplitude modulation does not generate new Fourier frequencies. Thus, establishing that this elegant and mathematically correct theorem, based on the summation of wave amplitudes, do not represent interference of waves. The physical reality of the NIW-property is valid [17].

(x). **Dong-Ik Lee's experiment (2003):** Lee carried out an experiment using multiple Rb-vapor tubes through which different combination of tunable laser beam pairs of different frequencies were sent. The result again shows that the Fourier theorem for two beam summation does not work in the real world. The collinearly superposed laser beams of two different frequencies do not generate a new optical frequency as the mean of the sum of the two frequencies whose amplitude is modulated by the mean of the difference frequency [22]. RF waves, received by a broad band LCR circuit, do display current according to Fourier summation theorem. This is because the “free” conduction electrons respond linearly to the sum of all the simultaneously present oscillating potential difference and swish back and forth in the circuit accordingly. In this case, the physical process, of linear response of the conduction electrons to the potential gradient followed by continuous energy transfer, is correctly mapped by the Fourier theorem and hence the model works. For atoms, the energy transfer is a discrete (quantized) quadratic step, preceded by amplitude-amplitude stimulation. Fourier theorem does not map this process.

2.2 Photons as diffractively spreading wave packet

We have accepted Maxwell's wave equation representing the propagation of EM waves for well over a century. The equation covers the entire range of frequencies from very long radio waves all the way to gamma rays, always with the same velocity $c = (\epsilon_0 \mu_0)^{-1/2}$. We know that the generators of propagating waves do not provide this wave velocity; the supporting tension field does. From radio, to infrared, to visible, to X-ray, we have been successfully using the same ancient Huygens-Fresnel (HF) diffraction integral with continued successes to analyze and design various telescopes and other relevant instruments, for this entire range. Optical science and engineering cannot thrive without this HF integral. And quantum mechanics has not given us any better model to design and analyze propagating waves, including recently thriving fields of nano photonics and plasmonic photonics. However, gamma rays in large voluminous detectors do show non-diffractive *bullet-like* properties as they keep on delivering part of their energy in new particle generation through successive successful collisions with protons and nucleons in the detector. Thus, instead of thinking of all EM waves as bullet-like, we should *look for new physics as to why EM waves at the extreme frequency range, like 10^{18} to 10^{20} Hz, become non-diffractive*. It is worth noticing that (HF) integral does have the built-in prediction that the far-field divergence of EM waves is inversely proportional to the frequency of the wave. But, why does it become completely non-diffractive? Note also that these mass-less and charge-less gamma rays facilitate the generation of particles with charges and masses. Thus, exploring the deeper *invisible physical processes* behind the generation and destruction of electron-positron pair would be of great value.

We do need to recognize that during emission and absorptions, atoms and molecules release discrete (quantum cup full) of energy due to their quantum level transitions [23]. But they (below gamma ray frequencies) evolve into diffractively spreading wave packets. This was also Planck's assumption, in spite of being the father of quantized energy exchange between the atoms and molecules on the surface of blackbody cavities, as mentioned earlier. (This is the item (vi) in the above section 2.1). After the release of the *quantum cup-full of energy*, it emerges as a photon wave packet, as sketched out in Fig.1 [14,24].

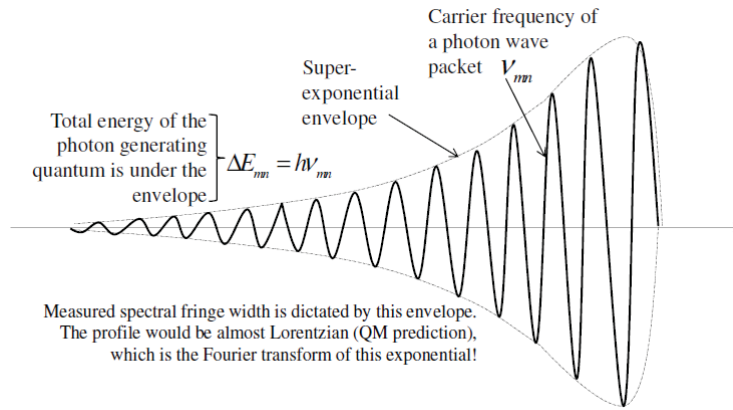


Figure 1. Visualization of a spontaneously emitted photon wave packet that is congruent with the observed (i) spectrometric behavior, (ii) QM prescribed carrier frequency, and (iii) QM prescribed energy content in the wave packet [24].

2.3 Applying Occam's razor guided by photons' view!

We identify here a good number of foundational hypotheses from Classical-, QM-, Relativity- and Astro-Physics that can be safely modified or removed to make physics more causal and understandable through common sense logics guided by the *process visualizing approach* or IPM-E. Of course, it is the imagination of the author talking in the name of photons as he imagines their physical experiences!

(i) Replace Dark Energy by CTF: Dirac, in 1932, while predicting the existence of positron, found that “vacuum” possesses energy. In section 2.1, we have proposed that this vacuum, or the entire cosmic space, is a Complex Tension Field (CTF) [13,14], which accommodates both propagating EM waves and resonant localized particles along with forces as secondary gradients. This is a better approach to develop a unified field theory.

(ii) Replace Einstein's “indivisible quanta” by Planck's divisible classical wave packet. This has already been elaborated in the above sections. We just need to remember that all electrons are quantum particles and their binding energies (transition levels) are always quantized. So, we can only have discrete number of electrons released during observation of photoelectric effects. That does not establish that EM waves have to be quantized. Besides, quantum entities can absorb the required discrete amounts of energies out of classical kinetic energy of other particles while colliding with them. The discrete “cup-full” of quantum energy does not have to be provided by an exactly matched quantum donor. This is not at all a requirement in the quantum formalism[13,14].

(iii) Replace Dirac's statement, “A photon interferes only with itself”, by “A detector's simultaneous stimulations due to multiple excitations engender superposition effect”. This should be obvious to readers who are willing to accept the NIW-property of EM waves. If EM waves do not interfere (interact); a photon, being EM wave, albeit being *quantized* by Dirac, its fundamental natural propensity must remain same; which is non-interference with self or with others. This has been detailed in these references [13,14].

(iv) Replace Dirac's photon as an “Infinite Fourier mode of the vacuum” by “Classical time-finite wave-packet” as undulation of the Complex Tension Field (CTF) excited by electrical dipoles like radio antennas, atoms and molecules (see Fig.1). Fourier modes, existing in all space and time, are non-causal signals. It should not be used to develop causal physics theories[13,14].

(v) Replace Born's interpretation of ψ with reality. Instead of accepting ψ as abstract mathematical probability amplitude, we prefer to assign it the ontological reality as the real physical undulation strength of some internal structure of particles when stimulated by other particles or radiations [12].

(vi) Drop “Bell's In-equality theorem” as the guide to accept completeness of QM formalism. Use of Bell's theorem to validate completeness of QM assumes Dirac's “..photon interferes only with itself”. Since the NIW-property invalidates that, Bell's theorem has very little logical value to support Copenhagen Interpretation [14].

(vii) Drop “wave-particle duality” by separate physical realities for waves and for particles as manifestations of the same CTF [13]. Neither waves nor particles have separate identity or existence except as excited “modes” of the same CTF. The particles as resonant oscillations of CTF is strengthened by findings that rest energies of particles can be expressed as integral multiples of electron energy together with the fine-structure constant for particles [13,25]. Superposition effects due to multiple superposed EM waves are generated due to the quantum mechanical joint response of the detecting dipoles. Same way, the superposition effects due to the simultaneous presence of multiple stimulating particles on the detecting quantum mechanical dipoles generate particle-superposition effects. Discrete quantum events can be accounted for without postulate of duality [26]. IPM-E helps us appreciate that we do not need any wave-particle duality.

(viii) Redefine range of “entanglement” and accept the need for real physical interactions to observe any measurable effect. We know that measurable data is due to some physical transformations in the interactants induced through some physical interaction between them guided by some distance dependent physical force operating between them. So, interactants can be entangled with each other within the allowed range of the force of interaction. Beyond that range the interactants are completely free of mutual physical influence and hence un-entangled. As far as photons are concerned, they are always un-entangled because of the NIW-property even when they are crossing through each other [14].

(ix) Replace “Relativistic Doppler Effect” by “Classical Doppler Effect”. The physical process behind stimulated emission due to the presence of many in-phase spontaneously emitted wave packets becomes operative only when the atom-to-be-stimulated perceives the carrier frequency of the waves as identical to the required QM-allowed transition frequency. Since all stimulated emissions are Doppler shifted due to finite velocity of the atoms during emission, the atom-to-be-stimulated can undo this Doppler shift only if it is moving with the identical *vectorial velocity* (or, zero relative velocity) as those atoms were moving during spontaneous emission. Thus, emitting and detecting atoms are separately and precisely sensitive to their relative velocities with respect to the stationary CTF. In gaseous state, the inter-atomic space is the same cosmic vacuum (CTF) as it is every everywhere else and atoms perceive their absolute velocities with respect to this stationary CTF. Doppler effect for EM waves, moving as undulation of the CTF, must follow the same mathematical expressions as Doppler shifts for sound waves moving through stationary pressure-tension field held by air [27,28].

(x) CMBR as statistically homogenized radiation emitted by diffuse materials at 2.3^0K . In the item (vi) of Section 2.1 we have described the role of diffractive spreading of spontaneous emission in creating homogenized EM field, which then causes stimulated absorption by recipient atoms and molecules; which is then re-emitted as spontaneous emission again. In an enclosed blackbody cavity, multiple reflections from the enclosing wall play the role of radiation homogenization through repeated absorption and emission. At present, the Cosmic Microwave Background Radiation (CMBR), which mimics remarkably well the Planck’s radiation formula at 2.3^0K , is explained as “relic radiation” from the “big bang” time, losing frequency due to expansion of the space. The above section already challenges the Hubble redshift as Doppler shift, which is used in support of expanding universe. It is then natural to look for alternate explanation for the CMBR, other than expanding space. We posit here that CMBR is not a “relic radiation”, but a “live” and current blackbody radiation generated by the scattered material all over the universe, which are at 2.3^0K . The homogenization of the CMBR in every direction is happening due to diffractive spreading of all the emitted radiations and repeated sequential absorption and emission by this thinly spread materials all across the cosmic space [14].

(xi) Hubble’s cosmological redshift is due to a new phenomenon; it is not a Relativistic Doppler Shift. Hubble’s cosmological redshift is a distance dependent frequency reduction of star light propagating through vast cosmological distances. Based on the argument presented in the above paragraph, the real Doppler frequency shift (absorption broadening) by the atoms in the star-corona takes place at the time of stimulated absorption of inner-core white light by these moving corona-atoms. This absorption broadening then remains essentially unchanged during propagation of white light through vast cosmological distances. So, the frequency reduction of the background “white light” must be taking place during this long propagation. We have explained this phenomenon as very weak distance dependent frequency reduction by the CTF [27,28].

(xii) Develop new mathematical logics and tools to replace Fourier transform (FT) technique. As per our proposed IPM-E, mathematical equations must be structured with parameters and operators that closely represent directly measurable properties of interactants being modeled. The parameters should be connected by mathematical operators that represent real force of interaction. Respect for cause-effect equality is presumed through the use of “equality” operator. The mathematical technique of using Fourier transform to model physical problems started almost two hundred years ago by Fourier. Slowly the use of FT proliferated in all branches of physics and engineering, which testifies the

broad utility of FT. In items (iii) and (iv) of this section, we have already argued that a Fourier monochromatic mode, existing in all space and time, represent a non-causal, non-physical signal. Summing the Fourier harmonic frequencies to generate localized optical pulses violate the NIW-property. Waves, being linearly excited states of some tension field, neither can they interact with each other, nor can they carry out the series of Fourier algorithm steps required by the Fourier integral: (a) Determine the phases and amplitudes. (b) Record these data in some memory. (c) Sum the different amplitudes with the right phases. And, then (d) let go the resultant new envelope function with a new mean carrier frequency. This is completely counter to our basic sense of causality and the IPM-E method we are proposing. Basic quantum mechanics and quantum field theories thrive by using non-causal Fourier transforms while applying novel mathematical assumptions and techniques to get rid of the non-causal divergences. FT is a non-causal tool developed by classical physics that has been employed by QM without serious scrutiny, which is at the core of built-in non-causality while interpreting QM. Just because of “excellent” successes of the current QM formalism, we should not assign the built-in non-causality in our theory as the fundamental behavior of nature. We should not tell nature how she ought to behave. We should continue to humbly keep on trying to discover how nature really behaves by utilizing the IPM-E provided tools. That FT makes definite incorrect predictions in optical measurements during light matter interaction processes have been mentioned in the items (ix) and (x) of section 2.1 [14]. Further detailed analyses will be presented elsewhere. [Note that Fraunhofer (far-field) diffraction pattern due to an aperture illuminated by a plane wave is correctly given by the Fourier transform of the aperture function. This because the Huygens-Fresnel integral, that models the diffractive process, morphs into a Fourier transform like integral under the far-field condition.]

(xiii) Replace Heisenberg’s “Uncertainty Principle” by “information retrieval problem” [14]. Irrespective of the detailed approach to the mathematical approaches [29], at the foundational level, the derivation requires the use of Fourier transform relation. We have already established that, irrespective of its mathematical correctness, elegance and wide successes in applications, it is a non-causal integral as it starts with the assumption that physical signals can exists over all space and the “space” can be real physical or mathematical. We should not assign “uncertainty” behavior on nature based upon human constructed successful theories, which are still work-in-progress and are full of human subjective interpretations. Progress in physics should not be assumed to be limited by our current mental states of inability to simultaneously measure a pair of “conjugate” parameters of physical objects!

(xiv) Replace de Broglie’s “pilot wave” by “internal harmonic frequency proportional to its kinetic energy [13]. Once the particles are appreciated as localized harmonic and resonant undulations of the CTF, the need for the ad hoc postulate of “Pilot Waves” becomes un-necessary. Mathematical expression for harmonic oscillation, like $\exp[i\omega t]$, can be used both for propagating waves, and for a *localized* classical macro pendulum. Particle accelerators have been exploiting the precisely localizable tracks in accelerators for wide ranges of particle-particle scattering experiments for well over a century. Changes in the internal harmonic undulations do not make the particles become less or more fuzzy.

(xv) Replace “4-D Space” by “3-D Space”. These issues have been discussed in [30]. Here, we will underscore again that measured data is due to physical transformation experienced by the interactants in our detector facilitated by some distance dependent force operating between them. Time is not a primary parameter; frequency is. We count and measure the frequency; invert it to derive a secondary parameter as *time interval*. The concept of quantitative running time has been first conceived by human minds out of the frequency of rotation of the earth around its axis and its frequency of revolution around the Sun. Much later thermodynamics has been brought into the picture through entropy. Galaxies, stars, all biological lives, have finite periods of longevity. But none of these physical entities can provide us with a parameter that is directly measurable as a universal running time. Wide successes of time-frequency Fourier theorem, of course, provides us with a sense of confidence that time can be treated as a primary parameter, even though it is not directly measurable.

There is another epistemological problem in using mathematical transformation from one mathematical space into another mathematical space. Physical interactions between physical interactants take place in real 3D space facilitated by some force existing in the 3D space. Physical forces do not operate in the mathematical spaces. So the author prefers to see the development of new and alternate mathematical tools to replace non-causal FT, and other similar mathematical transform techniques. At the current state of development of physics, we should not assign non-causality as an intrinsic property of nature.

3. SUMMARY & CONCLUSION

In light of the question posed in the title, here is the author's imagination as to what photons might say!

We do not see each other!

We do not experience each other!

We do not interact with each other!

We are not like particles!

We do not interfere with each other's businesses; unless the interaction processes are mediated by some material medium capable of resonating with our undulating E & B vectors!

We find nature to be self-consistent and causal!

On a more objective note, this article presented our view that our currently successful methodology of scientific investigation can be characterized as Measurable Data Modeling Epistemology (MDM-E). On dissection of this methodology, we find that our current theories and interpretations suffer from serious *subjectivism*. Analysis behind the neglect of the property, Non-Interaction of Waves (or NIW-property), valid universally for all waves, have helped us propose the Interaction Process Mapping Epistemology as a value added thinking tool over and above the existing MDM-E. We have also justified that IPM-E, in reality is an evolution congruent behavior that all species follow; we have been just neglecting this thinking tool by being over confident with the successes of our mathematical tools. We should recognize that all theories are work-in-progress. Then any cultural prevalence that subtly enforces us to accept a working postulate, or a working theory, as the ultimate and final knowledge for the humans, is effectively thwarting the natural propensity of human enquiring minds to persistently keep on evolving.

We have summarized the reasons why NIW-property should have been recognized centuries earlier had we not stayed focused exclusively on the MDM-E methodology of doing science. We have then leveraged the NIW-property of photon wave packets in conjunction with the proposed IPM-E methodology and listed a series of improvements that can be introduced in better understanding physics while eliminating existing non-causal assumptions.

Our eyes have been deceiving our deep thinking for several millennia as if we can really see the deeper ontological processes in nature. We do not see the real physical processes at the microscopic level, which are at the foundation of all evolutionary changes emerging as effects (changes) prompted by causes. It is critically important for us to explicitly recognize that we are blind in this respect; we do not see the subtle processes. So far, mathematics is the best walking-stick we have invented to explore nature. Wide ranges of utility and successes of mathematical logics, do not justify using this logic system as only and final logic system. Emergent intelligent behavior of biological systems, from single cells to multi-cellular humans (see Fig.2, [31]), have not been using mathematical equations to keep on evolving for over three billion years [14]. We still need to be looking for novel logics that can accommodate the emergence of both biological intelligence and the apparent observable "mechanical" universe.

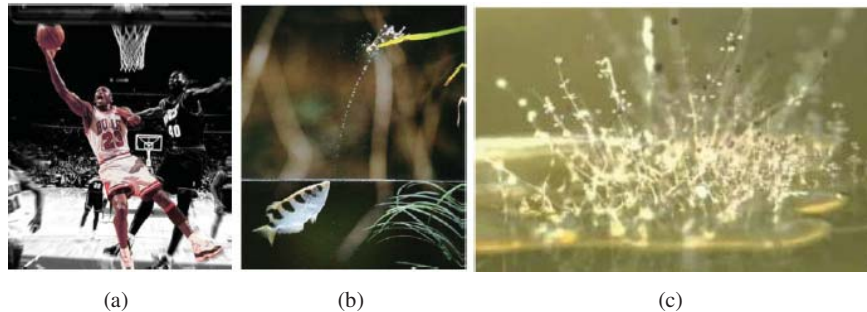


Figure 2. Do the large human neural network (a), or that of a tiny fish (b), use Newton's parabolic projectile equation while trying to determine in real time all the variable initial conditions? Do the slime mold (amoeba), without any neural network (c), collectively develop the rocket launching system engineering technology, besides Newton's 45-degree launching trick to achieve maximum launching distance?

Nature is causal at the invisible interaction process level. Nature has also given us highly evolved capability for *imaginings and visualizations*. We need to utilize these evolutionary advantages to anchor ourselves with the so-called ontological realities, the processes nature play with. If nature is really playing with mathematical tricks, our attempts to find unified field theory for almost hundred years would have yielded deeper understanding about the structure and origin of the basic three entities that constitute our observable universe: electrons, protons and photons. Nobody can yet claim that our understanding about them has increased significantly over the past 100 years. Yes, our technologies have been advancing at a faster pace than before. But, technology innovation requires fiddling with natural processes; and then emulating them in different combinations to create newer tools that can work only through nature-allowed PROCESSES. But, our brilliant engineers, since many million years past, have been carrying out these evolution-driven technology innovations without the need for understanding complex theories!

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