On the Constancy of the Speed of Light

AN INFOPHYSICS MONOGRAPH

ON

SPECIAL RELATIVITY

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ABSTRACT

In this monograph, digital signal processing (DSP) techniques are used together with the infophysical spacetime model (ISM) of Reality in order to find theoretical answers to the following questions: Why is the speed of light in a vacuum a constant? Why that particular speed and not any other? Is the speed of light a fundamental constant of Reality? Has it always been so? Can it change in the future?

The Nyquist-Shannon Sampling Theorem is used to determine the scales of the cosmic wavefunction in the motional and displacement domains, thus obtaining the spatial and temporal sampling relations of Reality. The results are then applied to obtain a list of theoretical implications that propose answers to the questions mentioned above and to other related questions.

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INTRODUCCION

In 1905, Albert Einstein introduced in his Special Relativity Theory (SRT), as his second postulate, the constancy of the speed of light in a vacuum, which according to Wikipedia, April 2016 states:

> *The speed of light in a vacuum is the same for all observers, regardless of the motion of the light source.*

Once stated as a postulate, the constancy of the speed of light does not require an explanation; consequently Einstein left it at that. Nevertheless, outside the mathematical derivation of SRT and setting aside the geometric aspects of isotropy, the following questions remain:

[1] Why is the speed of light in a vacuum (c) a constant?
[2] Why that particular speed (c) and not any other?
[3] Is the speed of light a fundamental constant of Reality?
[4] Has it always been so?
[5] Can it change in the future?

If you notice all of the above questions have to do with Parmenidean permanence, that is, that all of Reality's fundamental objects have permanent properties and although those properties may have had a beginning, they have been the same since and will remain the same till the end of time.

The speed of light is seen as some permanent parameter (fundamental constant) that somehow has been essential and will continue to be essential to the existence of Reality and its behavior. In other words, if the speed of light were not a constant or not that particular constant, Reality would be different and life on earth would then be different or possibly nonexistent. Obviously, the same can be said for any of the other so called fundamental constants of Reality, including the Planck constant, Alpha constant, etc.

The subject of this monograph is a theoretic attempt to answer *Questions [1] to [5]*, but before we can continue with our explanations, we need first to describe some of the properties of Reality's fundamental objects.

THE STRUCTURAL AND BEHAVIORAL PROPERTIES OF MATTER

It is a physical fact that matter sometimes behaves like particles and other times as waves. There is no doubt that Compton and de Broglie matter-waves are a reality. That fact has been demonstrated in innumerable experiments since their proposal in 1922 by Arthur Compton and in 1924 by Louis de Broglie, respectively.

An object's behavior is defined by its properties

If an object's properties are categorized under some common set of characteristics, the categorization does not necessarily change the structure of that object (i.e. its structural properties). Consequently, in order to resolve confusion in this monograph, we will use the term *particle* to refer to an object's material (structural) properties and the term *wavicle*[1] when referring to its wave-packet (motional behavioral) properties. This distinction will allow us, in the context of this monograph, to put aside the question whether Reality objects are made structurally out of matter, waves or both.

THE WAVICLE EXPRESSION PRINCIPLE

In order to continue with the discourse of this monograph let's restate the Infophysical Spacetime Model's (ISM) Wavicle Expression Principle (WEP), which is:

> *Wavicles are expressed (manifested) by means of an orthogonal transformation, the inverse direct Fourier transform (Inverse DFT).*
>
> *The expression process is analogous to the playback of digital signals such as music and video recordings that are reconstructed from the digital sampling of their original analog version.*

Please notice that the process of *expression* is used in this monograph's context to mean *the behavioral manifestation of Reality's objects* (wavicles).

Although wavicles are not sampled signals, they are expressed in accordance to the Nyquist-Shannon Sampling Theorem — as applied in the field of Digital Signal Processing (DSP) — and their expression is therefore subject to it.

According to Wikipedia May 2016:

> *In the field of digital signal processing, the sampling theorem is a fundamental bridge between continuous-time signals (often called "analog signals") and discrete-time signals (often called "digital signals"). It establishes a sufficient condition for a sample rate that permits a discrete sequence of samples to capture all the information from a continuous-time signal of finite bandwidth.*

Additionally, the ISM assumes that the motional properties of wavicles are discrete-transitional[2], as proposed in Matter-waves and Discrete-transitional Motion (DTM).

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[1] The term *wavicle* in this context refers to the wave properties of objects, as in de Broglie matter-waves. The term *wavicle* was coined by Arthur Eddington in 1928.

[2] Motion is the *transition* of one wavicle's state to another in *discrete* temporal and spatial intervals.

THE SPEED OF LIGHT

In terms of the WEP and the Sampling Theorem, the maximum spatial frequency of an expressible wavicle must be less than one half of Reality's sampling rate. This maximum spatial frequency is referred to as the Nyquist spatial frequency. It therefore becomes justifiable to look into velocity relationships in terms of the Nyquist spatial frequency of Reality, consequently, we start with the basic relation between wave velocity and frequency as it applies to Reality's sampling rate:

(1) $\lambda_S f_S = \frac{f_S}{\sigma_S} = V_S$, where,
λ_S is the sampling spatial interval (sampling wavelength) of Reality,
f_S is Reality's temporal sampling rate,
σ_S is the spatial density[3] (frequency) sampling rate. The sampling rate must be at least twice the maximum manifestable wavicle spatial density, i.e., at least twice the Nyquist density (σ_N) of a uniquely expressible wavicle.
V_S is Reality's spatiotemporal scale-constant (also its maximum wavicle velocity).

If we restate *Eq. (1)* in terms of Reality's Nyquist frequencies,

(2) $V_S = \lambda_S f_S = 2\lambda_S \frac{f_S}{2} = \lambda_N f_N = \frac{f_N}{\sigma_N}$, where,
λ_N is the Nyquist wavelength of Reality,
σ_N is the Nyquist spatial density of Reality,
and f_N is its Nyquist temporal frequency.

We can say then, that V_S is the spatiotemporal scale-constant of the cosmic scope[4], which is better known in physical terms as *the speed of light in a vacuum* (c) or more clearly, in terms of the ISM, as the *spatiotemporal scale-constant of the cosmic scope* (c_0) *in SI units.* In infophysical terms,

(3) $V_S = c_0 = c$, are identical versions of the spatiotemporal scale-constant of Reality's cosmic scope.

In a DSP system, once a sampling interval (λ_S) and a temporal sampling rate (f_S) have been chosen, a wavicle is not expressible uniquely unless its wavelength is larger than twice the sampling interval,

(4) $(\lambda_w \geq \lambda_N = 2\lambda_S)$, where,
λ_w is the wavicle's wavelength.

Also, its frequency must be less than 1/2 the sampling rate,

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[3] Notice that I use the term *spatial density* vs. *spatial frequency* to avoid introducing the concept of time that the term *frequency* connotes and also attach a sense of substance to the spatial density property. The latter is justified because the spatial density property of a wavicle is directly proportional to its momentum, which is a mass oriented property.

[4] According to the ISM, scopes are regions of Reality that define the behavior of its wavicles and its wavefunctions according to each scope's displacement and motional scales. There are four scopes that constitute Reality, the subnuclear, nuclear, atomic and cosmic scopes, where the cosmic scope is what we can observe directly (our macro world). From the Informatics point of view, the wavefunctions at each scope are software classes, as in object oriented programming.

(5) $(f_w \leq f_N = 1/2 f_S)$, where,
f_w is the wavicle's temporal frequency and f_N is the Nyquist frequency.

Its speed cannot exceed the spatiotemporal scale-constant of the system,

(6) $(v_w \leq V_S = \lambda_S f_S = c_0)$.

Observations on *Eq. (1) through Eq. (6)*

Notice that $V_S = c = c_0$ are equivalent and although they have units of speed (m/s), they really represent the constant that defines the relation between the scales of space and time. In other words, what we measure as *the speed of light in a vacuum* is really the spatiotemporal scale-constant of the cosmic scope.

Special Relativity, as presented by Einstein, establishes a constraint on the motional geometry of the macro domain, which in infophysical terms means that the theory belongs to the cosmic scope of Reality. Consequently, SRT is a constraint applied to the cosmic wavefunction's spatial density spectrum.

One important implication of *Eq. (1)* is that the smallest length (smallest de Broglie wavelength) expressible in the cosmic scope must be at least twice the cosmic spatial sampling interval. Also, the sampling rate of the cosmic scope limits the maximum wavicle spatial density, manifestable uniquely, at 1/2 the cosmic sampling rate.

It follows from *Eq. (3)* and *Eq. (6)* that the product of the properties $(\lambda_w f_w)$ of an expressible cosmic wavicle must always be equal to the cosmic spatiotemporal scale-constant $(V_S = c_0)$, which is a constraint placed by the Sampling Theorem, which in turn is based on the Inverse DFT.

THE WAVICLE PROPERTIES OF MATTER

As we discussed before, there are two basic aspects to the physics of Reality, the study of the structural properties of matter and the study of its motional geometry. If we set aside the structural properties of matter, we are left with the motional geometry of point-traces, in which case, it makes no difference whether the trace is made by the motion of a point-particle or that of a point-wavicle.

In this monograph we address the wavicle (Compton and de Broglie) motional properties of matter —as they relate to the constancy of the speed of light— using the unconventional way of studying Reality from the informatics point of view, where the motional properties of matter are viewed as pure information (infophysics), which models Reality using the Infophysical Spacetime Model (ISM).
According to the ISM, matter is a spatiotemporal process, that is, an oscillatory property of infraspace[5] that is expressed by an orthogonal process. A process which in turn is responsible for

[5] Infraspace is defined as a non-observable medium on which spatial coordinates are demarked. Think of infraspace as an empty canvas on which some graphic is to be drawn, much like a computer screen, where motion is the basis observable.

the manifestation of wavicle motion (the synthesis of space + time = motion, which is perceived as matter).
Reality then becomes a subject of the science of Informatics (Information Theory) and of its principles, theories and techniques, such as, discreteness, the Nyquist-Shannon Sampling Theorem, Digital Signal Processing (DSP) techniques and the Discrete Fourier Transform (DFT). As you may know, the informatics point of view is not new; it has been suggested by many physicists and is part of a new science I refer to as Information Physics (Infophysics), sometimes referred to in the literature as Digital Physics).

THE COSMIC SPATIAL AND TEMPORAL SAMPLING INTERVALS

We can assume for now, as we did in Matter-waves and Discrete-transitional Motion, that the smallest free wavicle of the cosmic scope is the free electron, thus setting the cosmic scope's sampling interval at,

(7) $\lambda_S \leq \frac{\lambda_e}{2} = 1.21x10^{-12}\ meters/sample$, where,

(8) λ_e is the Compton wavelength of the free electron. This is a reasonable assumption because the smallest de Broglie wavelength of a cosmic free wavicle would require the highest spatial definition in order to be expressible.

The cosmic scope's sampling relations

Substituting the value of λ_S in *Eq. (1)* and solving for f_S, we have,

(9) $f_S \geq \frac{V_S}{\lambda_S} = \frac{c_0}{\lambda_S} = 2.47x10^{20}\ samples/second.$

This is our first approximation to the *temporal sampling rate of the cosmic scope*

Using $T_S = \frac{1}{f_S}$, we get,

(10) $T_S \leq 4.05x10^{-21} seconds/sample.$

This is our first approximation to the *sampling period of the cosmic scope*. We can also think of T_S as the *temporal resolution* of the macro world.

Using $\sigma_S = \frac{1}{\lambda_S}$, we get,

(11) $\sigma_S \geq 2\sigma_e = 8.24x10^{11}\ samples/meter.$

This is the sampling spatial density of the cosmic scope. We can think of σ_S as our first approximation to the *spatial density resolution* of the macro world.

The Nyquist properties of wavicles

The Nyquist properties of a cosmic wavicle are the spatiotemporal properties that determine its unique expression (without aliasing[6]). From the Sampling Theorem,

(12) $\sigma_e = \frac{\sigma_S}{2} = \sigma_N$.
This is the Nyquist spatial density of the cosmic scope,

(13) $\lambda_e = 2\lambda_S = \lambda_N$.
This is the Nyquist wavelength of the cosmic scope and

(14) $f_e = \frac{f_S}{2} = f_N$.
This is the Nyquist temporal frequency of the cosmic scope.

Observations on *Eqs. (7)* to *(14)*

Eqs. (7) to (11) give us a starting set of values for the sampling spatiotemporal properties of the cosmic scope and *Eqs. (12) to (14)* are the corresponding properties of the Nyquist wavicle of the cosmic scope.

The Nyquist wavicle of the cosmic scope is chosen to be the free electron. This is because, as explained before, a wavicle with a shorter wavelength cannot be expressed uniquely.

THE COSMIC WAVEFUNCTION

According to *Spacetime Unveiled*, an infophysical wavicle (Real object) can be modeled as the trace (the motion) of an oscillating *infrareal*[7] point that forms a discrete wavefunction in the displacement domain. This model is similar to the QM wavefunction, except that the infophysical wavefunction is discrete and describes the wavicle's real spatial displacement, not its probability density.

The discrete wavefunction in the displacement domain is obtained by taking the Inverse Discrete Fourier Transform (IDFT) of the wavefunction's spatial density spectrum (SDS) in the spatial density (motional) domain.

From *Matter-waves and Discrete-transitional Motion*, the cosmic SDS is given by,

(15) $$\Phi[k] = \left| \begin{matrix} \sigma_0, for\ k = 0 \\ \frac{k\sigma_0}{A_\gamma\sqrt{1-\left(\frac{k}{A_\gamma}\right)^2}}, for\ k = 1\ to\ A_\gamma - 1 \end{matrix} \right|$$, where,

$\Phi[k]$is a one dimensional array of spatial density amplitudes representing an idealized discrete wavefunction of the cosmic scope containing a single point wavicle in the absence of gravity,
k is the discrete cosmic wavefunction's tangential velocity index,
σ_0 is its discrete rest spatial density, which is equal to the atomic (Compton) spatial

[6] Wikipedia June 2016. *"In signal processing and related disciplines, aliasing is an effect that causes different signals to become indistinguishable (or aliases of one another) when sampled."*
[7] An entity that belongs to the infrastructure of Reality and is, by definition, not observable.

density σ_α and

A_γ[8] is the discrete cosmic spatiotemporal scale-constant.

This is not to say that material objects are waves, but that the cosmic wavefunction represents the complete set of the wavicle properties and containment of an isolated object residing within the cosmic scope. In other words, the cosmic wavefunction establishes the governing motional principles by which an object of Reality must abide when observed within the cosmic scope, which includes its wavicle properties as well.

Wavicle spatial density (frequency)

We start with the spatial density relativistic relation of the cosmic Spatial Density Spectrum,

(16) $\sigma_k = \frac{k\sigma_0}{A_\gamma\sqrt{1-\left(\frac{k}{A_\gamma}\right)^2}}$, where,

σ_k is the k^{th} spatial density amplitude of a moving wavicle.

Converting to spatiotemporal SI Units using $\frac{k}{A_\gamma} = \frac{v}{c_0}$ and substituting $\sigma = mc_0/h$, we get,

(17) $\sigma_v = \frac{v\sigma_0}{c_0\sqrt{1-\left(\frac{v}{c_0}\right)^2}} = \frac{vm_0}{h\sqrt{1-\left(\frac{v}{c_0}\right)^2}} = \frac{p_v}{h}$, where,

σ_v is the spatial density amplitude of the wavicle moving with velocity v.

σ_0 is the rest spatial density of the wavicle, which is equal to the atomic (Compton) spatial density σ_α,

c_0 is the cosmic spatiotemporal scale-constant in SI units and

p_v is the relativistic wavicle momentum.

Eq. (17) is the de Broglie relativistic spatial density relation.

Wavicle wavelength

Substituting $\sigma = \frac{1}{\lambda}$ in *Eq. (17)* and solving for λ_v,

(18) $\lambda_v = \frac{h}{p_v}$, which is the de Broglie relativistic wavelength relation.

CALCULATING THE NYQUIST VELOCITY OF REALITY

We know that the momentum of a cosmic wavicle (de Broglie matter-wave) relates to its spatial density according to *Eq. (17)* above, consequently we should be able to obtain an approximation to the Nyquist velocity of Reality by restating it in terms of the relativistic spatial density of the Nyquist wavicle, the free electron, as follows,

[8] The cosmic scale-constant was chosen, as a first approximation, to be the fourth cardinal integer of the Combinatorial Hierarchy of A.F. Parker-Rhodes.

(19) $\sigma_{RS} = 2\sigma_N \geq \frac{v_N \sigma_e}{c_0\sqrt{1-\left(\frac{v_N}{c_0}\right)^2}}$, where,

σ_{RS} is the relativistic sampling density of Reality,
σ_N is the Nyquist spatial density of Reality,
v_N is the Nyquist velocity of Reality and
σ_e is the Compton spatial density of the free electron.

In *Eq. (12)* above we established, by definition, that the Nyquist spatial density of Reality is equal to the Compton spatial density of the free electron, therefore substituting σ_N in *Eq. (19)*, we have,

(20) $2 \geq \frac{v_N}{c_0\sqrt{1-\left(\frac{v_N}{c_0}\right)^2}}$, squaring both sides and solving for v_N, we get,

(21) $v_N \leq \frac{2c_0}{\sqrt{5}} = .89c_0$, which is our first calculation of the Nyquist velocity of Reality.

The cosmic spatial density relativistic sampling interval

Obviously, because of relativistic effects and the fact that larger velocities than v_N have been observed, the Nyquist velocity of Reality must be very close to the speed of light, which our first calculated value $v_N \leq .89c_0$ is obviously not. Consequently, we need to go back to *Eq. (16)* so that we can calculate the minimum relativistic spatial density sampling rate required, so that *Eq. (16)* holds true for the closest velocity to c attainable.

(22) $\sigma_{RS} = 2F\sigma_N = \frac{k\sigma_N}{A_\gamma\sqrt{1-\left(\frac{k}{A_\gamma}\right)^2}}$, where,

σ_N is the Nyquist spatial density of the cosmic scope and
$2F$ is the factor we must multiply σ_N by, to obtain the relativistic minimum sampling rate required and,
σ_{RS} is the minimum relativistic spatial sampling rate of the cosmic scope.

Setting $k = A_\gamma - 1$, which is the maximum defined velocity index of the SDS, we get,

(23) $2F = \frac{A_\gamma - 1}{A_\gamma\sqrt{1-\left(\frac{A_\gamma - 1}{A_\gamma}\right)^2}}$, squaring both sides and expanding,

(24) $4F^2 = \frac{(A_\gamma - 1)^2}{A_\gamma{}^2-(A_\gamma - 1)^2} = \frac{A_\gamma{}^2 - 2A_\gamma + 1}{A_\gamma{}^2 - (A_\gamma{}^2 - 2A_\gamma + 1)} = \frac{A_\gamma{}^2 - (2A_\gamma - 1)}{2A_\gamma - 1} = \frac{A_\gamma{}^2}{2A_\gamma - 1} - \frac{2A_\gamma - 1}{2A_\gamma - 1} = \frac{A_\gamma{}^2}{2A_\gamma - 1} - 1$

Since $A_\gamma \gg 1$, we can ignore the $-1s$. Solving for F^2 and taking the square root of both sides we get,

(25) $F \geq \sqrt{\frac{A_\gamma}{2}}$.

Plugging our result back into *Eq. (22)*,

(26) $\sigma_{RS} \geq 2\sqrt{\frac{A_\gamma}{2}}\sigma_N = \sqrt{2A_\gamma}\sigma_N$, and,

(27) $\lambda_{RS} \leq \frac{1}{\sigma_{RS}} \leq \frac{\lambda_N}{\sqrt{2A_\gamma}}$.

If we assume, once again, that the Nyquist wavicle of the cosmic scope is the free electron, we get,

(28) $\sigma_{RS} \geq \sqrt{2A_\gamma}\sigma_e = 2^{64}\sigma_e = 7.60x10^{30}\ samples/meter$, which is the minimum relativistic spatial sampling rate of the cosmic scope and

(29) $\lambda_{RS} \leq \frac{1}{\sigma_S} = 2^{-64}\lambda_e = 1.32x10^{-31}\ meters$, which establishes an upper limit for the relativistic spatial sampling interval of the cosmic scope, where, the dimensionless value for $\sqrt{2A_\gamma} \cong 2^{64}$ is obtained from,

(30) $A_\gamma = 2^{127} + 136 \cong 2^{127}$. Since $2A_\gamma \cong 2^{128}$ then $\sqrt{2A_\gamma} \cong 2^{64}$

IMPLICATIONS FROM THIS MONOGRAPH

As you can see from *Eq. (15)*, the cosmic wavefunction is defined for $k = 0$ to $k = A_\gamma - 1$, which implies that:

[1] A wavicle at velocity index $k = A_\gamma$ $(v = c)$ is undefined and therefore cannot be expressed within the cosmic scope. This can be interpreted to mean that:

a. It is impossible for a wavicle to reach the speed of light or,
b. If a wavicle reaches velocity c, it no longer belongs to the cosmic scope and:
    i. It remains in some form of limbo until another transaction brings it back or,
    ii. It moves up one scope in the scopal hierarchy, if such hyper-cosmic scope exists.

[2] The value of $\lambda_{RS} \leq 1.32x10^{-31}\ m$ of *Eq. (29)*, establishes an upper limit for the smallest observable length of the cosmic scope, which is in the order of 2,300 times larger than the Planck length,

(31) $l_P = \frac{\lambda_e}{2\pi\sqrt{A_G}} = 5.72947x10^{-35}\ m.$

You may notice the similarity between *Eq. (27)* and *Eq. (31)* regarding their relationship between the free electron's Compton wavelength λ_e, the cosmic scale-constant A_γ and the gravitational coupling constant $\alpha_G = 1/A_G$, respectively.

Remember that $\lambda_{RS} \leq \frac{\lambda_e}{\sqrt{2A_\gamma}}$ establishes an upper limit for the smallest spatial interval of the cosmic scope, leaving plenty of resolution for lower levels of the combinatorial hierarchy, such as the atomic scope and below, where $l_P = \frac{\lambda_e}{2\pi\sqrt{A_G}}$ may apply. I say may, because α_G is an experimentally calculated value.

Also, because λ_S is the resolution of the cosmic wavefunction in the displacement domain of the DFT, the maximum displacement (the extent) of the atomic scope is,

(32) $X_\gamma \leq \lambda_S(A_\gamma - 1) = \frac{\lambda_e}{2}(2^{127} + 135) \cong \lambda_e 2^{126}$.

From *Eq. (32)*,

[3] The maximum extent of the observable Universe (the cosmic scope) is, $X_\gamma \leq \lambda_e 2^{126} = 2.06\text{x}10^{26}\ meters$ or $2.18x10^{10}\ ligthyears$, which is **of the same order of magnitude as the accepted value**.

[4] The high resolution (compression) of the motional domain (spatial density) scale is due to the <u>chosen</u> asymmetric normalization of the DFT $\frac{1}{A_\gamma}$ and the relativistic apodization function $\frac{1}{\sqrt{1-\left(\frac{k}{A_\gamma}\right)^2}}$ applied to the cosmic wavefunction's SDS. Both <u>choices</u> of course fit wavicle behavior and predict the scales of Reality extremely well (I'm tempted to say almost exactly!).

[5] The theoretical prediction of de Broglie momentum relation (*Eq. (17))* by infophysical means is one more theoretical indication that Reality can be modeled as a DSP system.

ANSWERING THE ORIGINAL QUESTIONS

Question [1]: Why is the speed of light in a vacuum (c) a constant? Because c is not a speed, but a spatiotemporal scale-constant. In other words, what we measure as the speed of light is the relationship (in SI units) between the space and time scales of the cosmic scope (its spatiotemporal scale-constant).

Question [2]: Why that particular speed (c) and not any other? Because we are here and we can measure it. If the cosmic scale constant had a different value, the Universe would be different and we might not be here to measure c.

Question [3]: Is the speed of light a fundamental constant of Reality? Yes, it is a scopal scale-constant.

Question [4]: Has it always been so? Very probably yes.

Question [5]: Can it change in the future? It could, but probably not.

OTHER IMPLICATIONS

From the above answers we can propose that,

[6] The constancy of the speed of light is a very strong indication that:

a. Our reality may be immaterial or,
b. Reality abides by the Nyquist-Shannon sampling theorem as if it were some form of DSP system.

Since matter obviously <u>does</u> exist, because we perceive it; the concept of *matter* needs to be redefined in order for the adjectives *material* and *immaterial* to make any sense. The following is a list of definitions from the ISM.

[7] *Space is a matrix of coordinate points demarking infraspace*. This of course says nothing about *infraspace*; because infraspace is not observable (it is infrareal).

a. We can think of infraspace as an empty canvas on which some graphic is to be drawn.
b. The coordinate points are also infrareal, which means that *space is also infrareal*.
c. Each point in space is the binary representation of existence/non-existence (1/0).
d. The three dimensions (directions) of 3-space are the discriminate (exclusive OR) combinatorial possibilities of existence/non-existence (00, 10, 11). In other words, *direction* is the synthesis *(combinatorial discrimination)* of existence and non-existence.
e. The interval between two contiguous spatial points is called a *spixel*.

[8] *Time is a one dimensional matrix of coordinate points demarking infratime*.
a. Time is also infrareal.
b. The interval between two contiguous temporal points is called a *tixel*.

[9] *Motion is the synthesis of 3-space and time (spacetime)*.
a. Motion is Reality's basis observable; material or not.
b. Spacetime, in the context of the ISM, is not to be confused with Minkowsky space-time as in SRT. Minkowsky space-time is like a 4-dimensional fabric within which matter moves, while spacetime, according to the ISM, is the same as and is totally equivalent to matter.

[10]*What we perceive as matter <u>is</u> motion <u>is</u> spacetime*.
[11]*Reality <u>is</u> spacetime <u>is</u> motion*.
[12]Under the new definition of matter as stated here,
a. *Reality is material, i.e. motion perceived as matter.*
b. *Photons are informational (spatial density) transactions.*
c. *Empty space is immaterial, i.e. motionless, quiescent infraspace.*
d. *Time is also immaterial. What we observe as time is the synthesis of infraspace and infratime (motion).*
e. *Our basis observable is motion. In other words, Reality is motion, we are motion and we can only interact (transact) with other motion.*

I must make clear that all relativistic kinematic relations developed in this monograph assume a <u>single isolated wavicle</u> contained within the cosmic scope in the absence of forces. Also, a single isolated wavicle implies that all spatial density (informational) transactions must be conducted with wavicles from scopes external to the cosmic scope, neither of which is a real situation.

Obviously, the discrete cosmic wavefunction needs still to be modeled with multiple wavicles within close proximity to each other in order to consider intra-scopal spatial density transactions (forces), such as gravity. Nevertheless, this line of thought leads to the possibility of inter-scopal transactions, in which case the intra-scopal spatial density (mass, energy, momentum) conservation principle wouldn't necessarily hold within the local scope.

The future of the ISM/DTM hypothesis in regards to Quantum and Cosmic Gravity is very promising and it's to be treated in two forthcoming monographs by the author.

There are at least three very important classes of implications extractable from ISM, those are, extrapolated concepts on the infrastructure of the cosmic Universe (scope), its motional geometry and the understanding of what we observe as kinetic energy and momentum.

Finally, a clear understanding of what is observable (real) vs. what is non-observable (infrareal) to us is naturally emerging from the ISM/DTM hypothesis.

OTHER MONOGRAPHS WRITTEN BY THE AUTHOR

If you enjoyed this monograph, you are welcome to download, from my ResearchGate profile, other monographs belonging to the *Reality Unveiled Collection*.

About the Author

Bernardo Sotomayor Valdivia is an independent scientific researcher born in León, Nicaragua. He has degrees in Physics and Systems Engineering, as well as advanced studies in Information Systems. He participated in the US space program, including the Viking program at Jet Propulsion Laboratory, NASA, in Pasadena CA and was for many years Chief Technology Officer for various start-ups in e-commerce within the US. He now writes on Infrarealism and Infophysics.

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Thanks for your support,

Bernardo Sotomayor Valdivia

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