The Motional Geometry of Matter

AN INFOPHYSICS MONOGRAPH

ON

WAVICLE KINEMATICS

BERNARDO SOTOMAYOR VALDIVIA

This monograph is an evolving document and is updated regularly.

You may click on the following link to obtain its newest version, *Motional Geometry*.

Revision published at ResearchGate, March 2016. Edition 1.0.1

The author is always grateful for constructive feedback through the network where you obtained this document.

INTRODUCTION

More than a hundred years ago, a series of discoveries, especially in physics, began to subtly (or maybe not) reveal some mysterious properties of matter, properties that in some fashion or other were not acceptable to our established way of perceiving Reality. Strangely enough, these properties were not taken seriously by science because they pointed to a reality that seemed too fantastical to be true, a reality that seemed to have no substance or permanence.

These so called *mysterious* properties matter, for lack of a better word, turn out to be fundamentally related to the following discoveries:

- ✓ The ambiguous wave-particle *duality*. As in de Broglie matter-waves and the Compton properties of particles.
- ✓ The *ubiquitous* appearance of the cycle constant ($\tau = 2\pi = C/r$) in *physical* mathematical relations.
- ✓ The *general applicability* of the Fourier Transform to represent/model physical motion and other natural processes.
- ✓ The Heisenberg Uncertainty Principle and its mysterious *constraint* between *conjugate* variables, momentum and position for example.
- ✓ Quantum Mechanics and its *collapse* of the wavefunction.
- ✓ The surprising mass-energy *equivalence*. As in Einstein's $E = mc^2$.
- ✓ The perplexing *isotropy* of the speed of light.
- ✓ The mind boggling *time dilation* and *length contraction* of Einstein's Special Relativity (SR).
- ✓ The contradictory *fabric* of SR/GR's spacetime and its *assignment of properties* to the void.
- ✓ The surprisingly *discrete* nature of atomic properties. As in Quantum Mechanics (QM).

Needless to say, no matter what science has tried in order to fit the above discoveries into our physical world, their implications continue to elude an intuitively acceptable explanation in material terms.

This monograph, although not necessarily in chronological order, is a recapitulation of previous monographs written by the author in an attempt at a single-source theoretical explanation/clarification for the above mentioned list of "mysterious" properties of matter, in terms of one fundamental set of properties, the motional geometry of matter[1].

WAVE-PARTICLE DUALITY

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

An object's behavior is defined by its properties. If the object's properties are categorized under some common set of characteristics, the categorization does not necessarily change the structure of the object. Consequently, in order to resolve confusion in this monograph, we will use the term *particle* to refer to an object's material

[1] Kinematics is sometimes referred to as the geometry of motion. Motional geometry is discussed later in its own section of this monograph.

properties and the term *wavicle*[2] when referring to its wave-packet properties. This distinction will allow us to ignore the question whether a particle is structurally matter or wave, rendering it irrelevant.

With the above in mind we can now discuss the motional geometry of matter in general, and of particles or wavicles in particular. We will come back in more detail to wavicles and their kinematics (their motional geometry) later on this monograph, but first, let's define what the property *motional geometry* means in this context.

MOTIONAL GEOMETRY

I am convinced, and will attempt to convince the reader, that most of the contemporary mysterious properties of natural objects are linked to the two fundamental properties of their state, which are, position (where the object is observed, relative to a set of coordinates) and displacement (the object's change of position, after a change of state). The behavior of those two fundamental properties constitutes a wavicle's motional geometry. In other words, the motional geometry of wavicles (their kinematics) is the set of principles that determine all possible trajectories of any wavicle, where a trajectory is defined as the graph of its sequence of displacements due to the sequence of its state changes (that is, wavicle motion). This is how we can assign spatial and temporal properties to wavicles or particles (matter) without assigning properties to empty space. If we consequently define the Universe (Reality) as, the conglomerate of wavicles and their properties, their motional geometry being one of them, we can then discuss, as much as we want, the motional geometry of the Universe, without assigning (or discussing) any properties belonging to what is the absence of wavicle motion, that is, the void, empty space, nothingness, zilch, etc.

Let's take a look at the mysterious property list above, one by one, in terms of the motional geometry of matter so that we can remove as much of their mystery as we can.

THE CYCLE CONSTANT ($\tau = 2\pi$)

According to [*Fundamental Constants Explored*], the most fundamental of all fundamental physical constants, is Tau[3] ($\tau = C/r = 2\pi$), the cycle constant. Tau (Greek letter τ) is the ratio of the circumference of a circle to its radius. Tau is the primary fundamental physical constant of nature because, as I have shown in other monographs, it:

- ✓ Establishes the relationship between space and time in the expression[4] (manifestation) method of Reality.
- ✓ Is fundamental in the expression of motion, in other words, the motional geometry of matter.
- ✓ Is unitless.
- ✓ Is universal.

There is not much else to be said about Tau ($\tau = 2\pi$) in this context, except that it is an essential factor in the manifestation of both, the spatial and temporal frequency properties of every object (wavicle) constituting our

[2] 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.

[3] The name and symbol Tau (τ) for the circle constant is used in agreement with the Tau Manifesto by Michael Hartl.

[4] Expression in this context refers to the transformation process utilized in the manifestation of Reality.

Reality. Nothing can be more fundamental than that. In other words, Tau is primary, fundamental and universal because of its role in the expression process of Reality.

If you ever asked yourself, why does a geometrical relation constant appear all over our studies of nature without a rational explanation? The rational explanation may be; because Tau is an essential factor in Reality's expression process.

Now you may be beginning to suspect what I meant in the Introduction by: *to subtly (or maybe not) reveal some mysterious properties of matter.* We will see in the following sections how Tau forms part of the definition of the Fourier transform and the transform's use in the expression, manifestation, synthesis, modeling (call it what you will) of the motional geometry of Reality.

The ubiquitous *appearance* of the cycle constant ($\tau = 2\pi$) in physical relations should have been the first heads-up to science of the use of circular functions in the manifestation of Reality.

THE FOURIER TRANSFORM

The contents of this Section were basically extracted from *Fundamental Constants Explored*.

The Fourier Transform is one of the most useful tools utilized in the physical sciences to represent natural processes, especially in QM. According to Bohm's book on Quantum Theory, he first makes reference as to the mathematical complexity required to understand QM and then places the minimum requirement for the reader to be at least familiar with Fourier analysis. In his own words about quantum theory,

> *The development of the special mathematical techniques that are necessary for obtaining quantitative results in complex problems should take place, for the most part, either in a mathematics course or in a special course concerned with the mathematics of quantum theory. It seems impossible however, to develop quantum concepts extensively without Fourier analysis.*

Fourier analysis is useful and ubiquitous, no doubt, but that doesn't necessarily mean that the Fourier transform is the construction transform of Reality. What I'm saying here on the one hand, is that Fourier analysis can be used to express some general function by means of simpler trigonometric functions. According to Wikipedia (Sept. 2014),

> ***In mathematics, Fourier analysis (English pronunciation: /ˈfʊərieɪ/) is the study of the way general functions may be represented or approximated by sums of simpler trigonometric functions… … while the operation of rebuilding the function from these pieces is known as Fourier synthesis.***

And on the other hand, Fourier synthesis can be used to reconstruct the original function from its analysis, so if we wanted to model Reality or its motional geometry, why not use Fourier synthesis? As a matter of fact, engineers use it to synthesize (construct) music, images, etc., so why not postulate it as the construction transform for Reality and see if we can model it?

We will see in the following sections how the Inverse Discrete Fourier Transform (IDFT) of the Infophysical Spacetime Model (ISM) wavefunction (1) in the spatial density domain can be used to model the motional geometry of wavicles in the displacement domain.

SCOPAL SCALE-CONSTANTS

Physicists and other scientists have been painfully aware of the rule-changing that Nature imposes on objects depending on their size (scale). Quarks have different behavior rules than nucleons, nucleons have different rules than electrons, and so do atoms with respect to the objects that we are used to deal with (stellar objects). This type of rule-changing appears to me as a haphazard way for Reality to behave, knowing its notorious efficiency everywhere else. The nesting of scopes to explain the rule-changing is an attempt to interpret some order into those scale differences, in terms of Informatics/Physics/Software (Infophysics[5]).

The following are general concepts and observations relating to the ISM's oscillating point-wavicles and their scopal behavior, extracted from *Matter-waves and Discrete-transitional Motion*:

- ✓ All of Reality's scopes and their objects are modeled by means of the ISM.
- ✓ Wavicles are oscillating points (wave packets) that are expressed, at all scopal levels, in accordance with the ISM, by means of the IDFT of their existence data[6].
- ✓ Wavicles and their discrete wavefunctions are real and not probability densities as postulated by QM.
- ✓ An abstract point can be an infrareal[7] point or a point-wavicle, depending on the scope.
- ✓ The spatial frequency[8] property —referred to as the *spatial density* property, in this monograph— of an oscillating point or a point-wavicle replaces the concept of physical mass or of a point-mass.
- ✓ The spatial density property (σ) of a wavicle is the number of spatial cycles per unit distance of an oscillating point and it's the same as the inverse of its wavelength $(\sigma = 1/\lambda)$.
- ✓ The temporal density property (f) of a wavicle is the number of temporal cycles per unit time of an oscillating point and it's the same as the inverse of its period $(f = 1/T)$.
- ✓ The temporal frequency property —or temporal density property— of an oscillating point or a point-wavicle is what we observe as physical energy.
- ✓ Special Relativity is the result of the coupling between the atomic and stellar scopes in terms of the angular velocities intrinsic to their Fourier transforms. According to the ISM, SR is not the result of a four dimensional spacetime or of the isotropy of the velocity of light in a vacuum.
- ✓ By the superposition principle, the spatial density of a composite wavicle —no matter how complex its structure— is the sum of the spatial density of its individual components. This property of wavicles facilitates their representation as point-wavicles at all scopal levels.

[5] Information Physics, the interpretation of physical science in terms of information theory.

[6] Infrareal data belonging to the state of a wavicle, which is by definition unobservable, until manifested by Reality's expression process.

[7] That which belongs to the infrastructure of Reality, a non-observable.

[8] Wikipedia, Oct. 2015, Spatial Frequency: *In mathematics, physics, and engineering, spatial frequency is a characteristic of any structure that is periodic across position in space. The spatial frequency is a measure of how often sinusoidal components (as determined by the Fourier transform) of the structure repeat per unit of distance.*

There is no doubt that matter behaves as SR predicts, but because Reality's objects appear to us to be rigid structures with permanent properties; we can't physically visualize their relativistic behavior. On the other hand, if we assume that all objects are waves, their relativistic properties become easier to rationally accept, but the difficulty arises when we attempt to explain how a conglomerate of wave packets can be as rigid as matter appears to be. There is the conundrum, are objects made out of rigid solid structures or are they malleable waves? As I explained before, the structural properties of matter are irrelevant to this discussion; this monograph is concerned only with matter's motional behavior.

Scopal scale-constants are infrareal because they belong to the infrastructure of Reality's expression process and are therefore not directly observable; nevertheless they should be calculable if the expression process is known. By assuming that the expression process is the IDFT, we can then use its functional characteristics, first to calculate scale-constants and then to verify them experimentally.

The stellar scopal scale-constant

The first attempt to calculate the stellar scopal scale-constant, although not done with that purpose, was established by Isaac Newton when he formulated his classical gravitational relation. The problem is that Big G, although we suspect it to contain some form of a stellar (classical) scale-constant —we suspect this from its relation to the gravitational forces in contrast to the other forces of Reality—, is a pure empirical constant, thus not revealing its composition. The fact that we call Big G a *coupling constant* attests to this suspicion.

Because scopal scale-constants are spatiotemporal (ST) relational constants —they relate space to time—, they appear to have velocity units; thus, they can be confused with velocities. In order to not confuse the stellar scopal constant with a velocity, we will refer to it, from here on, by the symbol A_γ, where the subscript γ alludes to Special Relativity. A_γ —whose value is presently unknown— is the ST scale-constant of the stellar scope and determines its motional extent. As explained above, the ST scale-constant is unitless, consequently, not a velocity or a speed.

Let's take a look at another ST scale-constant that can be confused with a speed.

The SI units ST scale-constant

The SI units ST scale-constant A_{SI} is an empirical ST scale-constant that is obtained by virtually placing a ruler on part of the stellar scope. Remember that, although we don't know the motional extent of the stellar scope, we don't need its whole extent to measure its spatiotemporal relation because of its curvature.

Without being aware of it, physicists over the last few centuries—since Ole Rømer, in 1676— may have also been measuring the SI units stellar scopal scale-constant ($A_{SI} = c_0$) by measuring the speed of light (c) in a vacuum. I use the word also, because the speed of light can be confused with c_0, which is not a speed but a constant infrareal value. I say may have, because the speed of light (c) and (c_0) may not have the same value. ***The SI units ST scale-constant c_0 is equivalent to the stellar ST scale-constant A_γ in terms of SI units.***

There's no doubt that the values of c and c_0 are very close to each other, because if that weren't the case, Special Relativity would have been proven false already, and it hasn't.

MASS-ENERGY EQUIVALENCE

The concept of mass is one of the fundamental particle properties of matter. It is a mathematical device invented by Isaac Newton in the 17th century as part of his second law of motion. Because of its usefulness in classical mechanics, it has become embedded into the modern scientific mind to such a point that motion seems unexplainable without it. Nonetheless, mass is one of those concepts that have been anthropomorphized beyond its usefulness. Until Einstein's General Relativity (GR), a particle's mass property was described as the *resistance* to change its state of motion; consequently the particle *required* being *pulled* or *pushed* by something in order for it to move, leading to the need for the concept of a force. Because a force needs some kind of medium, the concept of a force field was invented to carry it. That explanation has now changed to require the concept of force-carrier particles and to the assignment of a curvature to Einsteinian spacetime. Needless to say, the mathematics work well, technology advances, but as a physical theory GR remains flawed because it continues to assign properties to empty space, now called spacetime, which is made up of some kind of a fabric whose geometry (curvature) warps near masses.

Renaming the void to spacetime and assigning it properties apparently resolved something, but at the same time has created an enormous amount of rational confusion, leading to more fantastical implications than those that existed before GR.

In *Mass-Energy Unveiled* (as in removing the material veil), I examined the wavicle properties of matter and showed that they are equivalent in every way to its particle properties when converted from mass units to ST units, thus removing the concept of mass from all motional equations.

Table 1. -- Equivalent Particle/Wavicle Properties

Property of Matter	**Mass SI Units**	**ST SI Units**	**Equivalent Wavicle Property**	**Comment**
Length	$l = \lambda$	$\lambda = l$	λ	Length is equivalent to wavelength.
Velocity	v	v	v	Velocity is group velocity for wavicles.
ST scale-constant	c_0	c_0	c_0	Equivalent to the speed of light in a vacuum.
Mass	$m = \frac{h}{c_0}\sigma$	$\sigma = m\frac{c_0}{h}$	$\frac{\sigma}{c_0}$	Mass is proportional to wavicle spatial density (σ).
Momentum	$p = mv = h\sigma$	$\sigma = \frac{p}{h}$	σ	Momentum is proportional to spatial density.
Total Energy	$E = hf$	$f = \frac{E}{h}$	f	Energy is proportional to temporal density.
Mass Energy Equivalence	$E = mc_0{}^2$	$\lambda f = c_0$	$\lambda f = c_0$	Mass-energy equivalence is simply the ST relation.

ST Units = Spatiotemporal units, σ is spatial density (frequency), f is temporal density (frequency).

All the relations in Table (1) were obtained from the particle/wavicle conversion equation and the spatiotemporal (ST relation, as follows:

(1) $\frac{h}{m} = \lambda c_0$, this is the particle to wavicle unit conversion relation, where in SI units,
h is the Planck constant,
m is the particle mass,
λ is the equivalent wavicle wavelength and
c_0 is the ST scale-constant.

(2) $\lambda f = c_0$. This is the spatiotemporal (ST) relation.

As an example, Einstein's mass-energy equation can be simply derived by multiplying both sides of *Eq. (2)* by the ST scale-constant c_0,

(3) $\lambda c_0 f = {c_0}^2$, substituting for λc_0 of *Eq. (1)*,
(4) $hf = m{c_0}^2$, using $E = hf$ of Table (1),
(5) $E = m{c_0}^2$.

The reader may download *Mass-Energy Unveiled* to obtain a more detailed explanation of the particle/wavicle conversion relations in Table (1).

DE BROGLIE WAVES AND SPECIAL RELATIVITY

Based on experimental data that seemed to indicate that the speed of light was constant independently of direction and of the speed of its source[9], Albert Einstein published in 1905 his Special Relativity theory, where he established as one of its postulates the isotropy and constancy of the speed of light:

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

The above postulate (let's call it the isotropy postulate) has avoided verification, because the one-way speed of light is very difficult to measure, if not impossible, due to clock synchronization issues, thus a direct proof has not been established. Nonetheless, this is not the case with SR and some of its conclusions/predictions; therefore we can safely assume that the postulate is valid.

The isotropy of the speed of Light

The isotropy of the speed of light is experimental proof (or is implied by the hypothesis) that the curvature of the natural (in the absence of forces) motional geometry of wavicles is constant everywhere in all directions.

[9] Wikipedia Jan 2016, Michelson-Morley experiment.

DE BROGLIE WAVES

According to *Spacetime Unveiled*, an infophysical wavicle (Real object) can be modeled as the trace (the motion) of an oscillating infrareal point that forms a discrete wavefunction in the displacement domain. This model is equivalent to the QM wavefunction, except that the infophysical wavefunction is discrete and describes the wavicle's real 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 domain.

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

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

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

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

Discrete-transitional motion (DTM)

One very important implication of the stellar wavefunction is that all stellar objects must exhibit discrete motional properties and therefore all object interactions must be discrete-transitional. In other words, all motion and its related properties can only change as discrete-event transitions from one state of the wavefunction to another.

The transitional properties of an isolated stellar wavicle are derived from the SDS using Digital Signal Processing[10] (DSP) techniques as follows:

Transitional spatial density

As an example, from *Eq. (6)*, the stellar SDS for a single stationary wavicle is,

[10] Wikipedia, Oct. 2015: Digital signal processing. *Digital signal processing (DSP) is the numerical manipulation of signals, usually with the intention to measure, filter, produce or compress continuous analog signals. It is characterized by the use of digital signals to represent these signals as discrete time, discrete frequency, or other discrete domain signals in the form of a sequence of numbers or symbols to permit the digital processing of these signals.*

(7) $\Phi[k]=\left|\begin{matrix}\sigma_\alpha=\sigma_0, k=0\\ 0, k=1\ to\ A_\gamma-1\end{matrix}\right|$, where,

σ_α is its atomic spatial density,
σ_0 is its rest spatial density, which is equal to the atomic spatial density σ_α and
A_γ is the stellar ST constant.

From the same equation, the stellar spatial density spectrum for a wavicle in its k^{th} state is,

(8) $\Phi[k]=\left|\begin{matrix}\sigma_0, k=0\\ \frac{k\sigma_0}{A_\gamma cos(\theta_k)}, k=1\ to\ A_\gamma-1\end{matrix}\right|$, where,

k is the tangential velocity index,
θ_k is the k^{th} stellar apodization[11] angle $\theta_k=arcsin(\beta_k)$, where $\beta_k=\frac{k}{A_\gamma}=\frac{v_k}{c_0}$ and
$\gamma_k=\frac{1}{cos(\theta_k)}$ is the stellar cosine apodization function.

The amount of spatial density —the spatial density transaction— required for a wavicle to transition from its ground level $k=0$ state to a higher spatial density level k^{th}-state (velocity-state) is given by,

(9) $\sigma_k=\frac{k\sigma_0}{A_\gamma cos(\theta_k)}=\frac{v_k\sigma_0}{c_0 cos(\theta_k)}=\frac{\gamma_k\sigma_0 v_k}{c_0}=\sigma_0 tan(\theta_k)$.

Using the trig identity for $cos(\theta_k)$, substituting $sin(\theta_k)=v_k/c_0$ into *Eq. (9)* and converting to SI units by using $\sigma=\frac{mc_0}{h}$ from Table (1), we get,

(10) $\sigma_k=\frac{v_k m_0}{h\sqrt{1-\left(\frac{v_k}{c_0}\right)^2}}=\frac{p_k}{h}$, which is the relativistic de Broglie spatial density transaction required in order for a stellar isolated wavicle to transition from its ground (rest) state to velocity v_k, where,

v_k is discrete tangential velocity and
p_k is discrete relativistic tangential momentum.

Solving for p_k,

(11) $p_k=h\sigma_k$, which is the unit conversion relation between transitional spatial density and transitional momentum. Obviously, the equivalent of Einstein's equation on the corpuscular theory of light,

(12) $p_k=\frac{h}{\lambda_k}$.

The following table is a list of the discrete-transitional (kinetic) properties of matter.

Table 2. – de Broglie Discrete-transitional Motional Properties

Discrete Property	**Relations**	**Comment**
Angular displacement	$\beta_k=\frac{k}{A_\gamma}=\frac{v_k}{c_0}$	The angular displacement of the stellar wavefunction of a point wavicle.
Apodization angle	$\theta_k=arcsin(\beta_k)$	The relativistic apodization angle.

[11] Wikipedia, Oct, 2015: Apodization. *Apodization is an optical filtering technique, and its literal translation is "removing the foot". It is the technical term for changing the shape of a mathematical function, an electrical signal, an optical transmission or a mechanical structure.*

Apodization function	$\gamma_k = \dfrac{1}{cos(\theta_k)}$	The relativistic SDS apodization function of the stellar scope.
Transitional spatial density	$\sigma_k = \dfrac{k\sigma_0}{A_\gamma cos(\theta_k)} = \dfrac{v_k \sigma_0}{c_0 cos(\theta_k)} = \dfrac{\gamma_k \sigma_0 v_k}{c_0} = \sigma_0 tan(\theta_k)$	The transitional density is the amount of spatial density required for a wavicle to transition from level 0 to k.
Total spatial density	$\sigma = \sigma_0 + \sigma_k$	The total stellar spatial density of a wavicle, where σ_0 is the atomic (rest) spatial density.
Transitional mass	$m_k = \dfrac{v_k m_0}{c_0\sqrt{1-\left(\frac{v_k}{c_0}\right)^2}} = \dfrac{p_k}{c_0} = \dfrac{h\sigma_k}{c_0} = m_0 tan(\theta_k)$	The transitional mass of a wavicle is the mass increase induced by the increase in the transitional velocity of the wavicle.
Transitional momentum	$p_k = h\sigma_k = \dfrac{h}{\lambda_k}$	The unit conversion relation between transitional spatial density and relativistic transitional momentum
Transitional energy	$E_k = hc_0 \dfrac{v_k m_0}{h\sqrt{1-\left(\frac{v_k}{c_0}\right)^2}} = \dfrac{v_k m_0 c_0}{\sqrt{1-\left(\frac{v_k}{c_0}\right)^2}} = p_k c_0 = E_0(\gamma_k - 1)$	The relativistic kinetic energy of a stellar wavicle.
Total energy	$E = E_0 + E_k = E_0 + p_k c_0$	The total energy relation of a stellar wavicle, where E_0 is the atomic (rest) energy.
De Broglie wavelength	$\lambda_B = \lambda_k = \dfrac{h\sqrt{1-\left(\frac{v_k}{c_0}\right)^2}}{v_k m_0} = \dfrac{h}{p_k}$	The de Broglie wavelength is the effective wavelength of a transitioning particle at a constant velocity v_k.

Observations on de Broglie waves

- ✓ The stellar SDS —a one dimensional array of A_γ spectral spatial density points— is set to $\Phi[k] = \frac{k\sigma_0}{A_\gamma cos(\theta_k)}$ in order to account for what is observed as angular momentum, SR and de Broglie matter-waves by multiplying each spectral amplitude by the relativistic cosine apodization function γ_k.
- ✓ Notice that the subscript (k) in all motional relations of wavicles is used to remind us of ***the discrete nature of wavicle motion***.
- ✓ The angular velocity component introduced by discrete stellar motion increases the de Broglie spatial density (momentum) of a wavicle or conglomerate of wavicles, as a function of the tangent of the stellar apodization angle $\theta_k = arcsin(\beta_k)$, where $\beta_k = \frac{k}{A_\gamma} = \frac{v_k}{c_0}$ is the displacement angle of the stellar wavefunction.
- ✓ There is no need to postulate the isotropy of the speed of light or of a four dimensional spacetime to account and derive all of the SR relationships.
- ✓ There is no mention here of frames of reference, relative or absolute, because ***any spatial coordinate of the stellar scope <u>is</u> a frame of reference, which can be either relative or absolute, without conflict***.
- ✓ As you have probably noticed in all of the equations in this monograph, there is no mention of probability densities. This is because the stellar discrete wavefunction is a real function representing the sinusoidal oscillation of a point mass, not a probability density function as in QM. ***The infophysical wavicle is a real object and its discrete wavefunction is its real representation***.
- ✓ *Eq. (9)* shows very clearly how the stellar scope is coupled to the atomic scope of Reality. The coupling relationship implied by the de Broglie relations, obtained from the ISM, explains how, as a wavicle transitions to a higher angular velocity state, its total spatial density increases, thus accounting for Special Relativity.

- ✓ As shown by *Eq. (9)*, the coupling implied by the de Broglie relationship derived from the ISM, is the cause of Special Relativity and consequently defines the transitional properties of discrete motion within the stellar scope.
- ✓ Notice that there is no such thing as time dilation in this derivation of SR. The time dimension does not dilate; wavicle frequency increases thus increasing the frequency of clocks.
- ✓ Because of the constant curvature of the motional geometry of matter in all directions, the ST relation ($\lambda f = c_0$) also remains constant in all directions, therefore if wavicle frequency increases wavicle wavelength decreases (particle length contracts).
- ✓ As you can see in Table (1), because the wavicle wavelength decreases with velocity, spatial density, temporal density, mass, momentum and energy increase accordingly.
- ✓ *Eq. (10),* relates the transitional spatial density of a stellar wavicle to its momentum. As a consequence, momentum is also transitional.
- ✓ *Eq. (11)*, shows very clearly that ***the Planck constant is a conversion factor —not a fundamental constant— from spatiotemporal SI units to SI mass units***. The Planck constant relates wavicle temporal frequency to total classical energy, as well as, wavicle transitional spatial density to momentum.
- ✓ The de Broglie transitional energy E_k, as shown in Table (2), relate the stellar transitional (kinetic) energy of a point-wavicle (point-particle) to its relativistic momentum, as expected, since this was one of de Broglie's original assumptions.
- ✓ m_k From Table (2), relates the stellar transitional mass of a point-wavicle (point-particle) to its relativistic transitional momentum.
- ✓ It can also be clearly seen from m_k from Table (2), how a wavicle can gain mass under the action of gravity, thus gaining spatial density and energy.
- ✓ λ_B From Table (2) is the relativistic de Broglie wavelength relation. You may notice that Einstein's SR is not explicitly required, because ***relativity is intrinsically implied by the apodization of the discrete wavefunction of the stellar scope***.

IMPLICATIONS

The following implications of the stellar ISM/DTM were extracted from *Matter-waves and Discrete-transitional Motion*:

It has been shown in this monograph that the ISM/DTM hypothesis can be applied, so far, to a generalized understanding and integration for de Broglie matter-wave equivalence, Classical Mechanics and Relativistic Stellar Mechanics, all of which are clearly implied and whose mathematics promise to be simply developed from the hypothesis.

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

Obviously, the discrete stellar wavefunction needs still to be modeled with multiple wavicles in close proximity, 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 in the local scope.

The future of the DTM hypothesis in regards to Quantum and Stellar 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 the DTM, those are, extrapolated concepts on the infrastructure of the stellar Universe (scope), its motional geometry and the understanding of what we observe as kinetic energy.

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

ON EMPTY SPACE VS. SPACETIME

We hypothesize from the ISM that empty space is quiescent infraspace and spacetime objects (matter) are either static or travelling oscillations of infraspace (wave packets). From these two basic postulates and the DTM we can state the following implications:

1] *Empty space is quiescent infraspace*. Empty space is a one to one mapping onto infraspace and what we observe as empty space is the quiescent extent of infraspace. In other words, take your pick: space is the lack of motion, three dimensions, three degrees of motional freedom, zero properties, nothingness, the void, etc. In simple words, zilch!

2] *Matter/energy is spacetime*. The synthesis of infraspace and motion is what we observe as spacetime (matter). This is radically different from Einsteinian spacetime.

3] *Space does not have any properties*. If space is emptiness, the absence of spacetime, it cannot have properties of any kind. We can talk about the properties it doesn't have, but only in contrast to the properties of spacetime.

4] *Space does not have extent or geometry*. We can discuss the constraining volume of spacetime motion but not the volume of space. In other words, space itself does not have geometry but spacetime motion has. In contrast, the motional properties of spacetime are constrained to within a given region, thus constraining spacetime to 3-sphere motional geometry. Please refer to *Fig. (1)* in the sidebar.

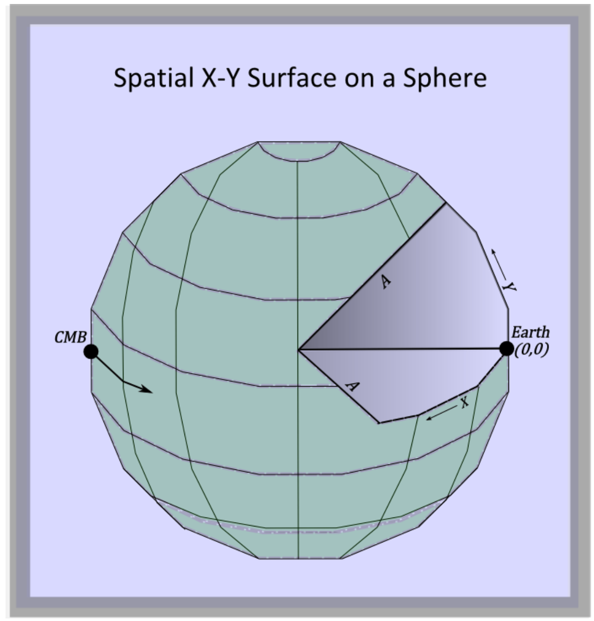

Fig. 1 - The above figure illustrates what we observe as the spatial X-Y plane, tiled onto a 2-spherical surface.

The CMB is shown as the radiation coming around from all the great-circles defined by the earth and its antipode (a CMB).

Think of the CMB as a form of "horizon" as observed through the curvature of the stellar scope. Any radiation coming from a point before the horizon is spherically lensed, while any radiation coming from behind the horizon is diffused.

The CMB is diffused light coming from behind the earth's antipode.

ON ROTATIONAL PROPERTIES AND MATTER-WAVE EQUIVALENCE

From the section on de Broglie matter-waves and the SDS of the stellar discrete wavefunction, we can extract the following implications:

5] An infophysical wavicle is a real object and its discrete wavefunction is its real representation.

6] A wavicle is the synthesis of space and motion on a three dimensional hypersurface, in a very similar way that an animation is the synthesis of space and motion on a two dimensional computer screen.

7] The stellar discrete wavefunction is defined by its spatial density spectrum (SDS).

8] *All stellar objects must exhibit discrete properties* and therefore all object interactions must be discrete-transitional. In other words, all motion and its related properties can only change as discrete-event transitions from one state of the stellar wavefunction to another.

9] The tangential velocity property of wavicles can only vary in minute discrete intervals (velocity quanta) of the order of 10^{-30} meters per second. All other wavicle transitional properties follow suit, as shown in the *Results* section of *Matter-waves and Discrete-transitional Motion*.

10] *All motion is rotational*; therefore transitional properties such as energy, momentum, mass, etc., are also rotational.

11] All matter (wavicles) will exhibit wave-like de Broglie properties, because of their rotational motion. This is not to say necessarily that material objects are waves, although they very well could be, but that the stellar discrete wavefunction determines the complete set of motional properties and containment of an isolated object residing within the stellar scope, wave or not.

12] The de Broglie wavelength is the effective wavelength (apodized wavelength) of a transitioning wavicle at a constant transitional velocity. In terms of relativistic mechanics we could say that, the de Broglie wavelength of a stellar object is the one-dimensional effective wavelength of the wave traced by a single point-mass, traversing a 3-spherical great-circle of the Universe.

13] The stellar discrete wavefunction describes the motional (displacement) behavior of all wavicles within the stellar scope.

14] *Wavicles exhibit three degrees of motional freedom only*. The circular nature of each spatial dimension restricts spacetime motion to a three dimensional hypersurface —to a 3-spherical motional geometry—.

ON COSMOLOGY AND MOTIONAL GEOMETRY

As we concluded in a previous section, it is not possible to discuss the properties of empty space, because *empty* space does not possess any properties. The concept of space is a mathematical device that represents the coordinates (degrees of motional freedom) for the allowable displacement of matter. With this in mind we can extract from the three dimensional stellar wavefunction the following statements on the geometry of stellar discrete-transitional motion:

15] If we define the Universe as *the 3-spherical region encapsulated by an infrareal fourth dimension*, we can include empty space and spacetime as its components. Under this definition the Universe becomes the region of possible spacetime motion —the observable Universe—, thus making it possible to refer to its properties. Properties, such as extent, motional geometry, total energy, total mass, etc.

16] *The containing region of stellar motion is defined by the 3D stellar discrete wavefunction.* In other words, *the possible extent of spacetime motion* is defined and expressed by the discrete wavefunction of the stellar scope.

17] *Two-dimensional stellar motion (please refer to Fig (1) above) is discrete-transitional and adheres to the surface of a sphere (a 2-sphere) of radius $\lambda_\gamma A_\gamma$, in the absence of gravity or other spatial density transactions.* This of course is a radical re-statement of Newton's first law of motion.

18] We can generalize *[17]* to conclude that the stellar scope's motional geometry —that which we call our observable universe—, is a 3-sphere (the hypersurface of a 4-dimensional sphere of radius $\lambda_\gamma A_\gamma$).

19] *The geometry of the region of stellar motion is a 3-sphere*. This means that, the constraining volume of spacetime motion is the three dimensional hypersurface —a 3-sphere— of a four dimensional spherical manifold whose fourth dimension is infrareal. By the way, except for the infrareal part, this was originally proposed by Albert Einstein in 1917.

20] The stellar scope is a 3-sphere that allows a frame of reference to be either relative or preferred, without conflict. This is because the origin and any other point are indistinguishable on a 3-sphere, in other words, any point on the hypersurface can be considered to be the scopal origin.

21] A static or absolute frame of reference is possible, but cannot be distinguished with certainty, because infraspace is not observable.

22] Under 3-sphere motional geometry the CMB cannot be used as an absolute frame of reference, because the earth's antipode moves with the earth.

23] *The CMB could be used to estimate the circumference (extent) of a great-circle of the Universe*. This needs to be done assuming a 3-spherical lensing motional geometry.

24] There is no need to postulate the constancy of the speed of light or of a four dimensional Einsteinian spacetime to account for and derive all of the SR relationships. Special Relativity is a direct result of the codependence between a wavicle's spatial properties and its transitional motion, namely the apodization of the stellar discrete wavefunction.

25] Different apodization functions would result in different stellar mechanics that would therefore evolve into different universes, some of which with unstable mechanics, resulting in collapsed or oscillating universes. Obviously, the stellar apodization function of our Universe has evolved, so far, into what appears to be, a stable steady-state.

26] A diluted Universe is not possible, because of 3-spherical motional geometry, but the same cannot be said about single or multiple Big Crunches under the influence of gravity. This implication still needs to be considered under gravitation at all the different scopes of Reality. Also, an oscillating stable Big Bang/Big Crunch needs to be considered.

27] *Time is not the fourth dimension*. The ISM/DTM do not postulate time —the number of expression cycles between two spacetime displacement events— as a dimension, time is postulated as a codependent property of space and motion. The fourth dimension, that which encapsulates 3-space, is postulated as another spatial dimension that is not observable (infrareal).

28] The Universe is a finite, compact, connected, 3-dimensional manifold without boundary. In other words the universe has the motional geometry of a 3-sphere.

29] A stellar object heading in any direction will close on itself coming back to the same point. That is why the earth seems to be in the center of the Universe. Also why the CMB is observed basically equidistant in any direction.

ON THE BIG BANG VS. 3-SPHERICAL MOTION

Obviously I'm treading on very sacred philosophical and cosmological grounds here, but the implications are there and we must follow through. I must confess that I personally dislike the Big Bang theory, because it implies the permanent existence of time. Whatever time is, it is part of Reality and therefore if Reality is transitory, then so is time —it had a beginning and may stop. Additionally, assuming that time existed before a transitory Reality, is not justifiable.

If Reality was created, then we can safely assume that so was time, therefore it does not make sense to ask if the Creator requires (or required) time in order to exist. Does the Creator require water in order to exist? This is obviously a nonsense question. If Reality was not created, then why the Big Bang? The generally accepted answer seems to be, *to explain the observed cosmological evidence*.

Nonetheless, I leave the reader with the following restlessness. What if all the Big Bang cosmological evidence can be explained by 3-spherical motional geometry?

I now take license to suggest some preliminary explanations:

- ✓ *Redshift of galaxies*. Explained in terms of 3-spherical lensing of motion. The 3-spherical motional geometry lenses incoming light in a similar way to gravitational lensing, thus magnifying (red shifting) the wavelength of light. Needless to say, the Doppler redshift of galaxies is the main evidence for an expanding universe. If the redshift is not a Doppler effect but a 3-spherical motional geometry lensing, then the Big Bang becomes questionable.
- ✓ *Expanding Universe*. The ISM/DTM hypothesis can include the Big Bang as one of our Universe's possible initial conditions. In this case, the Big Bang becomes the Big Break, as in a billiards table. By the way, other initial conditions are also possible, including steady-state conditions, any of which could have evolved into our, so far, apparently universal steady-state.
- ✓ *Mixture of elements*. In terms of a possible Big Break/Big Crunch or of steady state initial conditions.
- ✓ *Looking back in time*. In terms of a possible Big Break/Big Crunch.
- ✓ *The Common Microwave Background (CMB)*. In terms of antipodal light diffusion as explained in this monograph, etc.

REFERENCES

1. **Sotomayor V., Bernardo.** *Spacetime Unveiled.* Jinotepe : s.n., 2014. Infophysics Monograph. RPI No: 000749.

OTHER MONOGRAPHS WRITTEN BY THE AUTHOR

If you enjoyed this monograph, you are welcome to download the following monographs belonging to the *Reality Unveiled Collection:*

Reality Unveiled. The defining monograph for the *Reality Unveiled Collection*.

Spacetime Unveiled. The defining monograph for the Infophysical Spacetime Model (ISM).

Mass-Energy Unveiled. Einstein's $E = mc^2$ relation revisited in terms of the ISM.

Special Relativity Unveiled. Derives Einstein's Theory of Special Relativity (SR) in terms of the ISM.

Fundamental Constants Explored. On the criteria that should be considered in order to establish the legitimacy of a *fundamental* constant of Nature.

Matter-waves and Discrete-transitional Motion. A derivation of the de Broglie matter-waves transitional property relations and their discrete motion.

The Isotropy of the Speed of Light and its Implications. A discussion of Einstein's postulate regarding Special Relativity and its implications on the motional geometry of matter.

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.

Feedback

The author is always grateful for constructive feedback through the network where you obtained this document. If you detected any errors during your reading, before you send your feedback, please make sure you have downloaded the latest version at *Motional Geometry*, to make sure they have not been corrected already.

Thanks for your support,

Bernardo Sotomayor Valdivia.

###