Toward a Geometric-Informational Unification of Physical Reality

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Article

Toward a Geometric-Informational Unification of Physical Reality

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Abstract

The paper introduces a fundamental shift in the representation of physical reality, moving from a particle-based paradigm to a Recursive Complex Representation of 5 scaling levels (RCR) of a "hypophenomenal" geometric model. A unique scaling base ξ is defined that is deduced from the Planck constant h and the gravitational constant G. The model posits that space is not a static container but a Plenum (David Bohm's name for vacuum) of Planck contiguous cells (P-cells) whose vibrations constitute the fundamental energy of the universe. Masses are "trapped light", viewed as localized vibrational resonances of the signal c that maintain a portion of the signal within contiguous groups of P-cells, and can propagate along the plenum by keeping their internal vibrational configuration. The fine-structure constant α acts within a universal renormalizing factor, strictly related to the scaling factor $\xi = (GL_P)^{\frac{1}{5}}$. Experimental masses, across 60 orders of magnitude (from the neutrino to the Sun) are retrieved from their ξ logarithmic localization with respect to Planck's mass. The fundamental equations of Planck, Einstein, and de Broglie are not independent postulates, but natural geometric emergences of the signal's vibrational dynamics. Gravitational force and constant G are formulated in terms of matter aggregation and dynamic curvature of the signal in the Plenum.

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1. Epiphenomena and Hypophenomena

The crisis of classical physics and the birth of quantum mechanics is essentially based on the dichotomy between macroscopic and microscopic physical reality. Passing from a macro scale to a micro scale, the observer realizes that he/she cannot pretend to describe the physical reality by searching for how things are, but he/she can only search for the best way to represent a reality in which phenomena are observed as a manifestation of an underlying reality that is not accessible to observation. Namely, a microscopic phenomenon has an intrinsic dual nature consisting of an observable component, which we call an **epiphenomenon**, and an associated hidden component, which we call **hypophenomenon**. The long debate about the existence of hidden variables [1,2] is partly an ill-posed problem, because it is the very nature of microscopic phenomena to posit, just in the observation act, a hidden reality that we can only mathematically represent. Any representation can be evaluated in terms of adequacy, utility, and knowledge unification about the physical reality, without any pretension of definitive knowledge. This is the reason for the increase in mathematical abstraction in the quantum theories. It is a logical necessity, which requires a new perspective under which to consider physical theories as products of cognitive acts where the observer is not only a passive subject collecting data to explain, but an active part in the informational process of collecting and interpreting data [20] through a rational and formal filter that can dramatically change the resulting comprehension. The representation component is not only a language, but it is also the basis of a decoding, a second-order reality of mathematical nature, defining the essence of the meaning assigned to phenomena. The idea of hyperspaces in physical representation was introduced and developed by many approaches [8,22], and currently is a central perspective toward a deeper understanding of physical phenomenology.

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2. The Recursive Complex Representation

Let us consider a Cartesian plane P, which we call the reference plane. We associate with any point (x, y) in this plane a circle C of center (x, y) and a radius $1/k$, where 1 is the unit of plane P. This means that the circle is drawn as a circle in the reference plane, but inside it, the unit of measure is $1/k$. We repeat the same scaling procedure for any point of the circle C at a distance $1/k^2$ from the border of the circle. Again, inside any second-order circle, we repeat the scaling procedure, yielding circles of radius $1/k^3$. Proceeding to higher scaling levels yields a hyperspace, which we call the Recursive Scaling Representation of the initial space P.

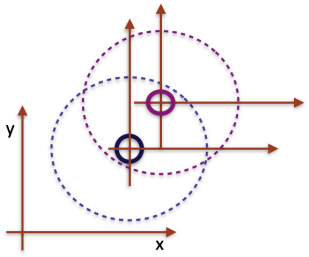

Figure 1. A Recursive scaling representation with two microscopic levels. The lower small circle of radius ξ is $1/\xi$-amplified into the corresponding discontinuous circle (with the same center). The higher circle of radius ξ^2 is inside the first small circle, but it is drawn within the amplified circle, and then it is $1/\xi^2$-amplified into the corresponding discontinuous circle.

In the following, we apply this recursive scaling procedure to the $\mathbb{R}^3$ physical space, with five recursive levels of nested complex planes C_5, C_4, C_3, C_2, C_1, which are appropriate for representing ondulatory phenomena [11]. The scaling factor ξ is the geometric mean, along the five scaling levels, of the product of GL_P where $G = 6.6743 \times 10^{-11}$ is the gravitational constant and L_P is the Planck length $L_P = \sqrt{\frac{hG}{c^3}} = 1,61610^{-35}$:

$$\xi = (G \cdot L_p)^{1/5} = 1.01537233 \times 10^{-9} \tag{1}$$

The five circles determine a torus of volume:

$$(2\pi\xi)(2\pi\xi^2)(2\pi\xi^3)(2\pi\xi^4)(2\pi\xi^5) = 32\pi^5\xi^{15}$$

around the Planck seed, a 5-hypersphere of radius L_P. This geometric model of Recursive Complex Representation (RCR) yields the hyperspace $\mathbb{R}^3 \times \mathbb{C}^5$ of 13 dimensions, where the complex subspace represents the hypophenomenal component, and $\mathbb{R}^3$ the epiphenomenal component. The microscopic *vacuum* hyperspace $\mathbb{C}^5$ with the associated macroscopic space $\mathbb{R}^3$, following Bohm's suggestion, is viewed as the *Plenum*, where matter is a manifestation of its vibrational energy generated by Planck's seed and propagated through all the scaling levels.

The original inspiration of the ξ scaling factor of the $\mathbb{C}^5$ hypophenomenal hyperspace was the elementary observation that the product Gh has dimension L^5T^{-3}, that is, the mass dimension present in both G and h disappears in the product. This suggests that as mass disappears, it could emerge in the interaction of the two respective levels to which the gravitational constant G and the Planck constant h, respectively, refer.

The choice of the five levels is based on the particle ontology. The C_1 circle, the closest to Planck's seed, is a region of pure signal transmitted to C_2, C_3, C_4, where particles of different kinds emerge, while C_5 is the region of pure signal-transmitting particles in $\mathbb{R}^3$. The base ξ acts as the singular geometric invariant that is a bridge between hypophenomenal and epiphenomenal reality.

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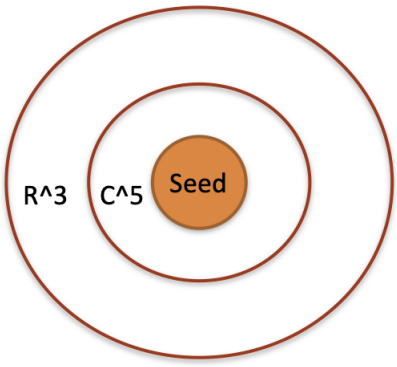

Figure 2. An abstract representation of RCR hyperspace: the center is the *Planck seed*, the ring around it is the $\mathbb{C}^5$ torus of the five complex scaling circles, and the external ring is the $\mathbb{R}^3$ macroscopic physical space.

3. The Ondulatory Nature of Mass

The intrinsic duality linking particles and waves is expressed in terms of vibrations and vibrational aggregates of plenum, which is a grid of Planck cells, i.e., products of circles of radius L_P, that compose the whole hyperspace.

The *Planck seed*, which we may denote C_0, is the inaccessible region inside the complex torus that generates wave signals that are transmitted to the cells of the hypophenomenal torus. In some aggregates of contiguous P-cells, a portion of the signals circulates internally, while a part of it goes outside of the aggregate (see Figure 3). If the vectorial sum of the external signals of the P-cell aggregate moves the whole aggregate through the plenum in such a way that the internal vibration propagates along the P-cell lattice, by maintaining its form and phase, when it reaches the epiphenomenal space $\mathbb{R}^3$ emerges as an observable entity, that is, a particle. The signal circulating into the P-cell aggregate is what determines its mass, but it is not an object; it is a vibrationally stable configuration that moves at some external speed $v \leq c$, where c is the light velocity. This means that masses are not individual phenomena, but expressions of a *holomovement*, according to an intuition that is central in David Bohm's vision of physical reality [1–3,17]. Therefore, mass is essentially a trapped signal transmitted by space, and, symmetrically, space is the medium that transmits signals through the fixed lattice of vibrating P-cells, acting as elastic balls that irradiate their vibrations.

In this model, phenomenal reality emerges from only two fundamental dimensions: *Length (L)* and *Signal* ($S \equiv c$). Mass has dimension S, momentum has dimension S^2, energy has dimension S^3, and time L/S. It is a construct of the observer's interaction with the signal flow. The finiteness of S (of velocity c) is necessary to prevent spatial collapse, because a space where a signal flows at an infinite speed vanishes the true notion of space, making it a single point. In conclusion, using brackets to denote dimensionality:

$$[m] = S, \quad [p] = S^2, \quad [E] = S^3, \quad [T] = L/S, \quad [Gh] = L^5T^{-3} = L^2S^3 \tag{2}$$

This is a remarkable dimensional progression where all physical phenomena are revealed as manifestations of the fundamental signal ($S \equiv c$). This sequence demonstrates how information scales from a point-like resonance to a volumetric energy density. The dilution of microscopic curvature along the complex planes, from the Planck seed to the epiphenomenal space, spanning 46 decimal orders, creates the macroscopic phenomenon of Gravity. We will go back to gravitation in the following sections.

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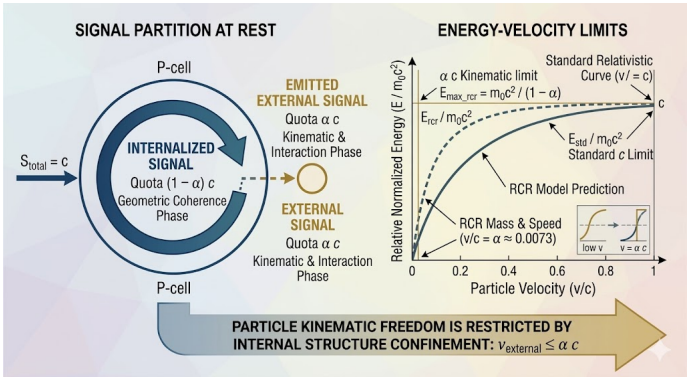

Figure 3. A particle trapping internal signal.

4. Numerical Deformation and Renormalization

Let us consider the following exp-log function, where M_P is the Planck mass:

$$M_P \cdot \xi^{\log_{\xi}(m/M_P)}$$

According to the definition of logarithm, it coincides with the identity function, transforming a mass m into itself. However, when we compute it according to the standard (IEEE 754) precision, we get a value different from m, that is, the choice of ξ introduces a *numerical deformation* in the mapping of masses (see Table 1) [19]. The computation of the exp-log function projects m in an "expanded" mass $[m]$. The interesting fact is that we can retrieve the value m, with a precision at the seventh decimal digit, along sixty decimal orders going from the Neutrino to the Sun by multiplying $[m]$ by the factor $(1-\alpha)$, where α is the **fine-structure constant**.

Table 1. Mass Projection by $[\,]_{\approx}$ Mapping ($\xi_{exp} = 1.01537233 \cdot 10^{-9}$).

Entity	Exp. Mass m (kg)	Geom. Mass $[m]$ (kg)	Ratio $m/[m]$
Sun ($M_{\odot}$)	1.98847e30	2.003088e30	0.9927026
Earth ($M_{\oplus}$)	5.97220e24	6.016102e24	0.9927026
Top Quark	3.07341e-25	3.096001e-25	0.9927026
Higgs Boson (H^0)	2.23011e-25	2.246503e-25	0.9927026
Z Boson	1.62556e-25	1.637508e-25	0.9927026
W Boson	1.43231e-25	1.442835e-25	0.9927026
Neutron (n)	1.674927e-27	1.687239e-27	0.9927026
Proton (p)	1.672621e-27	1.684914e-27	0.9927026
Muon (μ)	1.883531e-28	1.897376e-28	0.9927026
Electron (e^-)	9.109383e-31	9.176346e-31	0.9927026
Neutrino (limit)	1.782661e-37	1.795765e-37	0.9927026

Table 2. Mass Exponents of ξ and Geometric Projections.

Entity	Exp. Mass m (kg)	ξ Exponent	Geom. Mass $[m]$ (kg)
Sun ($M_{\odot}$)	1.98847e30	-4.2040441	2.003088e30
Earth ($M_{\oplus}$)	5.97220e24	-3.6191753	6.016102e24
Top Quark	3.07341e-25	1.8601248	3.096001e-25
Higgs Boson (H^0)	2.23011e-25	1.8754160	2.246503e-25
Z Boson	1.62556e-25	1.8907310	1.637508e-25
W Boson	1.43231e-25	1.8968366	1.442835e-25
Neutron (n)	1.674927e-27	2.1032549	1.687239e-27
Proton (p)	1.672621e-27	2.1033671	1.684914e-27
Muon (μ)	1.883531e-28	2.2088591	1.897376e-28
Electron (e^-)	9.109383e-31	2.4740152	9.176346e-31
Neutrino (limit)	1.782661e-37	3.1256338	1.795765e-37

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The Operational Projection Operator

To resolve the tautological nature of the expression $M_P \cdot \xi^{\log_\xi(m/M_P)} \equiv m$, we introduce the *Discrete Projection Operator* $[\ ]_\approx$. This notation signifies that the operation is not performed in an idealized infinite-precision field, but within the *Hypophenomenal Grid* defined by the base ξ:

$$m \mapsto \left[M_P \cdot \xi^{\log_\xi(m/M_P)}\right]_\approx \tag{3}$$

The brackets $[\dots]_\approx$ indicate an operation constrained by the *16th decimal digit precision*, which acts as the *Informational Horizon* of the RCR model. Due to the extreme smallness of the base $\xi \approx 10^{-9}$, this finite-resolution projection induces a systematic numerical overshoot. In the following, we use the following abbreviations:

$$\left[M_P \cdot \xi^{\log_\xi(m/M_P)}\right]_\approx \equiv [Elog(m,\xi)]_\approx \equiv [m,\xi]_\approx \tag{4}$$

In this framework:

- The m inside the brackets represents the *Experimental Mass*.
- The bracketed result abbreviated by $[m]$, is the *Expanded Mass*, for which:

$$(1-\alpha)[m] = m$$

- The fine-structure constant α [16] then acts as the *Renormalizing Factor* to retrieve the physical mass m.

By using this notation, we clarify that the identity is broken by the *informational granularity of space itself*, transforming a mathematical tautology into a predictive physical law.

In classical mathematics, a 16-digit truncation is a source of error. In our hypophenomenal framework, this truncation is the *generative mechanism of interaction*. Conversely, by accepting the 16th digit as a *physical boundary*, the formula $m \approx [m,\xi]_\approx \cdot (1-\alpha)$ ceases to be an approximation. As we will show, we reach extreme precision because we are operating at the *intrinsic quantization limit of space-time*. The "noise" of truncation is revealed to be the very "signal" of the fine-structure constant, confirming that the universe does not compute to infinity, but *tunes* its mass aggregates to the resonance of α at the edge of the Planckian pixel.

5. Mass Levels and α Quotas

We can distinguish three main levels of mass:

- Experimental mass m is the value we measure experimentally;
- Augmented or geometrical mass $[m]$ is the $[m,\xi]_\approx$ value that localizes the mass in the logarithmic scale of base ξ;
- The internal mass m_0 is the kernel of the P-aggregate apart from the external signals that we explain in the next point.

An equation links masses m_0 and m, which is analgous to the equation linking m to $[m]$:

$$m_0 = m(1-\alpha) \tag{5}$$

therefore:

$$m = \frac{m_0}{1-\alpha} \tag{6}$$

whence, by expanding $\frac{1}{1-\alpha}$ in Taylor series, we have:

$$m = m_0(1+\alpha+\alpha^2+\alpha^3+\dots) \tag{7}$$

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The signal quotas on the right member represent infinite levels of the particle ondulatory architecture: the pure mass, the interaction and communication quotas α^{n+1} that could correspond to the pilot wave in the de Broglie-Bohm vision [1,2]. These quotas are likely related to specific features, such as charge and spin. Massless particles are pure signals without any internal quotas, which express transmission and interactions among different kinds of matter.

Thus, in RCR, the pilot wave is not a separate entity but the *advanced sensory quota* of the Signal. It propagates through the ξ-grid ahead of the primary aggregate

$$m_0$$

probing the local curvature and ensuring phase-locking. Therefore, quotas α^{n+1} adjust the aggregate's "step" (λ) to the background Plenum. The mass is thus a *self-guiding vibrational package*, where the "hidden variables" are revealed as the higher-order harmonics of the internal Signal partition. In the following, we show that this organization of masses is crucial for understanding the deep logic of physical interactions. Particles are mostly closed vibrational systemd propagating in the plenum, but also partially open and dissipating energy in their environment.

6. Derivation of (ξ, α) Informational Coupling

The relationship between the fine-structure constant α and the scaling base ξ can be derived by analyzing the limit case where the experimental mass equals the Planck mass ($m = M_P$). From our primary scaling formula:

$$m = M_P(1-\alpha)[\xi^x]_{\approx} \tag{8}$$

where $x = \log_{\xi}(m/M_P)$. In the specific case where $m = M_P$, a singular value Φ must exist such that the identity holds under the informational constraint $[\dots]_{\approx}$:

$$1 = (1-\alpha)[\xi^{\Phi}]_{\approx} \tag{9}$$

$$(1-\alpha)^{-1} = [\xi^{\Phi}]_{\approx} \tag{10}$$

Solving for the exponent Φ, we obtain:

$$\Phi = \left[\frac{-\ln(1-\alpha)}{\ln(\xi)}\right]_{\approx} \tag{11}$$

Substituting Φ back into the scaling equation yields the *Fundamental* (ξ, α) *Coupling Equation*:

$$(1-\alpha) = \left[\xi^{\frac{\ln(1-\alpha)}{\ln(\xi)}}\right]_{\approx} \tag{12}$$

This derivation proves that α is the deterministic numerical residue required to renormalize the geometric deformation induced by the base ξ. The fine-structure constant is thus revealed as the "informational bridge" that allows the Planck-scale signal to stabilize into phenomenal mass without violating the discrete resolution of the hypophenomenal lattice.

The parameter ϕ represents the *Informational Distortion Factor*. It indicates that the manifest reality is shifted from the pure geometric projection. The base ξ provides the scale, while $\ln(\xi)$ acts as the regulator of the signal's internal resonance. This relationship confirms that α is a derived geometric property of the 5-plane complex architecture, specifically the point where the signal's "leakage" meets the quantization limit of the Planck cell.

Logical Proof of the Uniqueness of (ξ, α) *Coupling*

The numerical evidence shows that for $\xi = 1.01537233 \times 10^{-9}$, the ratio $m/[m]$ is exactly $(1-\alpha)$ for all tested masses, up to the seventh decimal digit, from the Neutrino to the Sun. Any variation in the base disrupts this *Perfect Coupling*.

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Since α is a fixed property of the signal's internal circulation, the base ξ must be the *singular geometric coordinate* of the hypophenomenal grid. A different base would imply that the "braking" of the signal varies with mass, which contradicts the observed constancy of the fine-structure constant. Therefore, ξ and α are uniquely and inextricably linked in the architecture of matter.

We argue that the renormalization factor $(1-\alpha)$ is a fixed physical invariant, and only the specific geometric base ξ can satisfy the scaling identity across the entire mass spectrum.

Let us assume an alternative base $\xi' = \xi + \delta$, then the fundamental scaling law with respect to ξ and ξ' gives different values, because $[Elog(m,x)]_{\approx}$ is an increasing monotone function with respect to x, being a composition of increasing monotone functions:

$$[Elog(m,\xi)]_{\approx} \neq [m,\xi']_{\approx}$$

Consequently, from $[Elog(m,\xi)]_{\approx} = (1-\alpha)/m$ it follows that:

$$[Elog(m,\xi')]_{\approx} \neq \frac{1-\alpha}{m}$$

Therefore, the renormalization factor $(1-\alpha) \approx 0.992703$ is uniquely coupled to the specific base $\xi = 1.01537233 \times 10^{-9}$. When using arbitrary bases such as $\xi_A = 10^{-9}$ or $\xi_B = 3 \times 10^{-9}$, the ratio $m/[m]$ exhibits a scale-dependent drift, proving that the geometric deformation is not a generic logarithmic artifact. This numerical evidence shows that ξ is a *singular geometric invariant* of the hypophenomenal architecture.

7. Planck, Einstein, and de Broglie's Equations

By unifying Planck and Einstein's equations $E = mc^2$ and $E = h\nu$, any mass vibrational aggregate is defined by its fundamental frequency [7,12], that is, by equating energy, we define the intrinsic "beat" of matter:

$$\nu = \frac{mc^2}{h} \tag{13}$$

Matter is a standing wave of signal circulating within an aggregate of contiguous P-cells.

In the RCR framework, gravity and matter emerge from the same reality: *space curvature*. At the ultramicroscopic level, it is the origin of matter creation, while at the macroscopic level, after more than 46 orders of magnitude, it is the origin of orbits required by the gravitational field, which seem to be produced by matter attraction. The other features of particles (charge, spin, ...) are probably associated with specific aspects of the internally circulating signal, and of course, developments of the RCR perspective need to be developed to reach a complete model of particles and their interactions.

A mass particle is not a discrete point-mass but a localized standing wave—a "resonance node"—within the Plenum. This perspective reverses Einstein's view, according to which matter curves space; instead, space curvature is the origin of matter creation and attraction.

Massless particles such as photons or gluons are open aggregates that do not close any internal signal, but determine only signal transmission at the maximum velocity c.

De Broglie's Particle Wavelength

When a vibrational resonance aggregate (a particle) moves through the P-cell grid with momentum p, it must maintain its phase identity to prevent the standing wave from dissolving. In this framework, the *de Broglie wavelength* λ is not an abstract probability wave, but the *spatial synchronization step* required for the internal signal circulation.

To ensure that the internal "beating" (ν_0) remains coherent with the external "stepping" (ν_{prop}), the aggregate must complete exactly one internal cycle while translating across the distance λ.

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We show that de Broglie's equation is a consequence, according to Equation (13), of the synchronization between the time of a complete rotation of the internal signal of the particle and its propagation step. Namely:

$$\nu = \frac{mc^2}{h}$$

This means that the time of a complete cycle of the vibrational internal state of the particle is:

$$\frac{h}{mc^2}$$

Then the length μ of the signal rotation (along a closed path of P-cells) is:

$$\mu = c\tau = \frac{h}{mc}$$

Now, if v is the propagation velocity of the particle and λ is the propagation step of its movement during the period of the internal signal rotation, we put:

$$c\mu = v\lambda$$

This equation expresses the *synchronization proportion* connecting the internal vibration of the particle with its external propagation in the plenum:

$$v : c = \mu : \lambda \tag{14}$$

Therefore, being $c\mu = \frac{h}{m}$, we have:

$$\frac{h}{m} = v\lambda$$

This equation gives de Broglie's equation ($p = mv$):

$$\lambda = \frac{h}{p} \tag{15}$$

This identity proves that λ is the specific spatial interval required to maintain phase synchronization with the Plenum during translation.

Einstein's Mass-Energy Equivalence

Now, we go further by proving that, in the RCR model, also Einstein's $E = mc^2$ is a consequence of Planck's $E = h\nu$. Namely, the quantum action h is $mc\mu$ where the momentum mc is multiplied by the length μ, and $\nu = c/\mu$ therefore $E = h\nu$ becomes:

$$E = mc\mu \times c/\mu$$

that is:

$$E = mc^2$$

As the momentum $p = mv$ increases (meaning a larger quota of the signal is dedicated to translation), the spatial step λ must decrease to ensure the high-frequency internal oscillations remain in phase with the grid. If the particle did not respect this λ-step, the internal signal circulation would dephase, leading to the immediate instability and dissolution of the mass aggregate. Thus, matter—from an electron to a complex gold atom—is a *self-stabilizing frequency package* that stays "locked" into the ξ-grid through the de Broglie resonance.

Mass is a trapped signal. For this reason, it is ambivalent because the more m, the less velocity it can reach, by adding energy to it.

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This aspect is apparent when we compare the identification of m "from the outside", in terms of de Broglie's equation:

$$m = h/\lambda v$$

with m in terms of the internal wavelength μ:

$$m = h/\mu c$$

In both cases, we get a representation of the quantum action h:

$$h = mv\lambda = mc\mu$$

But the proportion between velocities and wavelengths is inverse:

$$\frac{v}{c} = \frac{\mu}{\lambda}$$

that is, m corresponds to the fraction of v/c, and inversely, to the fraction λ/μ between the external and internal wavelengths.

Adding kinetic energy E to a mass m, its propagation speed increases inversely to the amount of m, while the internal signal energy is directly proportional to m. For this reason, the wavelengths λ and μ are in the opposite ratio of their corresponding velocities v and c.

The synchronization proportion is the basis for both the above RCR deductions of de Broglie's and Einstein's equations.

Reasoning *a posteriori*, what RCR claims is implicit in Plack's and Einstein's equations put together, because these equations say that *energy is vibration* and *mass is energy*, therefore *mass is vibration* too.

In the above equations, we used m to be consistent with the usual notation. However, it would be more appropriate to use m_0 to remark that the mass has to be considered as the *rest mass*.

The frequency ν of the equation $\nu = mc^2/h$ represents the rotation of the RCR "mass", as the measure of the "cost" of the signal to maintain stationarity against the background tension of the P-cell grid.

In this RCR framework, the energy-momentum relationship is not a relativistic postulate, but the direct result of the partition of the signal's total frequency ν_{tot}. We define the total frequency of a mass aggregate as the quadratic sum of its internal standing component and its external propagation component:

$$\nu_{tot}^2 = \nu_0^2 + \nu_{prop}^2 \tag{16}$$

Each frequency component represents a specific allocation of the signal (c) within the P-cell grid:

- *Internal Frequency (ν_0):* The signal circulating stationarily within the aggregate (rest mass). From the Planck-Einstein relation $E_0 = h\nu_0$ and $E_0 = mc^2$, we have:

$$\nu_0 = \frac{mc^2}{h} \tag{17}$$

- *Propagation Frequency (ν_{prop}):* The signal translating between cells (momentum). Given the wave relation $\nu_{prop} = c/\lambda$ and the de Broglie identity $\lambda = h/p$:

$$\nu_{prop} = \frac{c}{\lambda} = \frac{pc}{h} \tag{18}$$

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Einstein's Energy-Momentum Equation

By substituting these vibrational identities into the initial Pythagorean equation:

$$\left(\frac{E}{h}\right)^2 = \left(\frac{mc^2}{h}\right)^2 + \left(\frac{pc}{h}\right)^2 \tag{19}$$

Multiplying the entire expression by h^2, the informational scaling constant h cancels out, revealing the fundamental energy-momentum relationship:

$$E^2 = (mc^2)^2 + (pc)^2 \tag{20}$$

This derivation shows that mass is the energy of the signal's "beating time" within the signal, whereas momentum is the energy of the signal's "stepping through space". The total energy E is the hypotenuse of these two vibrational efforts.

The RCR vision demonstrates that the fundamental equations of modern physics—previously treated as independent postulates—emerge naturally from the geometric-informational dynamics of the signal (c) within the P-cell grid.

The RCR framework thus dissolves the separation between matter, energy, and space, showing that all physical constants are numerical signatures of a single, recursive informational architecture.

8. The Schrödinger Equation as Signal Diffusion

Starting from the fundamental Pythagorean identity of frequencies:

$$\nu_{tot} = \sqrt{\nu_0^2 + \nu_{prop}^2} = \nu_0\sqrt{1 + \left(\frac{\nu_{prop}}{\nu_0}\right)^2} \tag{21}$$

For stable matter (where the translational signal quota is much smaller than the internal beating, $\nu_{prop} \ll \nu_0$), we apply a Taylor expansion to the root square function above:

$$\nu_{tot} \approx \nu_0\left(1 + \frac{1}{2}\frac{\nu_{prop}^2}{\nu_0^2}\right) = \nu_0 + \frac{\nu_{prop}^2}{2\nu_0} \tag{22}$$

Multiplying by the informational scaling constant h and substituting the RCR vibrational identities ($\nu_0 = mc^2/h$ and $\nu_{prop} = pc/h$):

$$E \approx mc^2 + \frac{(pc/h)^2}{2(mc^2/h)} \cdot h = mc^2 + \frac{p^2}{2m} \tag{23}$$

If in the equation above, we add the *interferometric equilibrium* between a specific mass aggregate Ψ and the complex vibrational background V of the Plenum, then we have the refractive response of a wave package to maintain coherence with background signals, where $p = h/\lambda$ is, according to deBroglie's quation, the moment of the particle:

$$E\Psi = \left[mc^2 + \frac{h^2}{\lambda^2 2m} + V\right]\Psi \tag{24}$$

This is essentially the Schrödinger equation, in the RCR setting, which describes the evolution of the signal in the interaction between the trapped quota, its propagation, and the external flow traversing the ξ-grid in the region of the specific interaction that the equation describes.

The RCR framework opens the possibility of a radical revision of the epistemological foundation of quantum mechanics and particle standard theory [15], which is out of the scope of this paper and could be a topic of future investigations. When Schrödinger discovered his famous equation, he

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followed a physical intuition considering Ψ as a physical wave; the same conviction is behind the idea of a pilot wave. The probabilistic approach inaugurated by Max Born [4], which is now standard in quantum theory, was a sort of pragmatic compromise giving a formal justification to the mathematical apparatus of the theory, by letting out a physical model explaining quantum phenomenology. The approach of RCR, where particles *are* waves, discloses a new perspective of physical relevance, where Ψ returns to be seen as a physical wave.

The most intriguing quantum effect of entanglement is a natural consequence of the ondulatory viewpoint of RCR. Namely, two entangled particles are only an epiphenomenal manifestation of a common originating wave at the hypophenomenal level that emerges at the epiphenomenal level into two wave particles localized in different spatial regions. [6,13,21].

9. Deducing G Constant from α

The definition (1) of ξ implies the equation:

$$L_p = \frac{\xi^5}{G}$$

and the standard definition of L_p is:

$$L_p = \sqrt{\frac{\hbar G}{c^3}}$$

therefore:

$$G = \frac{L_p^2 c^3}{\hbar} = \frac{\xi^{10} c^3}{G^2 \hbar}$$

$$G^3 = \frac{\xi^{10} c^3}{\hbar}$$

$$G = \sqrt[3]{\frac{\xi^{10} c^3}{\hbar}}$$

Now we notice that the value of ξ was obtained from the value of α according to the fundamental equations 8, 12. This means that we can deduce G from ξ, that is, from α. Namely, putting $\xi = 1,0153723 \times 10^{-9}$

$$\xi^{10} \approx (1,0153723 \times 10^{-9})^{10} \approx 1,16455 \times 10^{-90}$$

$$c^3 \approx 2,697 \times 10^{25}$$

$$\hbar \approx 1,054 \times 10^{-34}$$

$$G = \sqrt[3]{\frac{1,16455 \times 10^{-90} \cdot 2,697 \times 10^{25}}{1,054 \times 10^{-34}}} \approx \sqrt[3]{2,979 \times 10^{-31}} \approx \mathbf{6,678 \times 10^{-11}}$$

The shift from the CODATA 6.6743 to the RCR 6.678 probably represents the noise in torsion-balance measurements [18]. However, this derivation of G makes it more evident that masses are not essential for defining gravity; rather, they are a consequence of it. In the RCR system (of dimensions L, S), the constant G is a flux ($1/2^5$ is a constant of dimension L^2T).

From the standard definition of L_p and the definition of ξ:

$$L_p = \sqrt{\frac{\hbar G}{c^3}}$$

$$G = \frac{\xi^5}{L_p}$$

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whence:

$$L_p = \sqrt{\frac{\hbar}{c^3} \cdot \left(\frac{\xi^5}{L_p}\right)}$$

that is:

$$L_p^3 = \frac{\hbar \xi^5}{c^3}$$

from which:

$$L_p = \sqrt[3]{\frac{\hbar \xi^5}{c^3}}$$

Using values:

$\xi = 1,01537233 \times 10^{-9}$
$\hbar \approx 1,0545718 \times 10^{-34}$
$c \approx 299.792.458$

We have:

$\xi^5 \approx 1,079144 \times 10^{-45}$

$\frac{\hbar \xi^5}{c^3} \approx \frac{1,0545718 \times 10^{-34} \cdot 1,079144 \times 10^{-45}}{2,697259 \times 10^{25}} \approx 4,2190 \times 10^{-105}$

$L_p = \sqrt[3]{4,2190 \times 10^{-105}} \approx \mathbf{1,6158 \times 10^{-35}}$ m

The value $1,6158 \cdots \times 10^{-35}$ differs from the CODATA value (1,61625) only 0,02%.

With G defined only in terms of ξ, the gravitational constant is no longer an empirical variable but a 5th-order ratio of the factor ξ (ξ is defined in terms of α by the fundamental equations 8, 12):

10. Matter-Gravitation Uncertainty

If we put $\xi = 1,01518$, we reach a complete precision with the CODATA value of G, but we lose the perfect prediction of the experimental masses obtained in Table 1. This suggests that the *true* value of ξ is between the *gravitational value* $\xi_G = 1,01518$ and the *matter value* $\xi_M = 1,0137$, predicting all the particle experimental masses from the geometric ξ exponents and $(1 - \alpha)$ correction. The associated values of Φ are:

$\xi_M = 1,01537233 \times 10^{-9}$:

$$\Phi_M = \frac{\ln(0,992702647443)}{\ln(1,01537233 \times 10^{-9})} \approx \mathbf{0,000353683525} \ldots$$

$\xi_G = 1,01518000 \times 10^{-9}$:

$$\Phi_G = \frac{\ln(0,992702647443)}{\ln(1,01518000 \times 10^{-9})} \approx \mathbf{0,000353686846} \ldots$$

The source parameter ξ exists in a state of "metrological uncertainty" between two primary eigenstates:

- **Matter Eigenstate (ξ_M):** Optimized for the hierarchical consistency of particle masses (10^{-37} to 10^{-25} kg) with a precision of 10^{-7}.
- **Gravitational Eigenstate (ξ_G):** Optimized for the global projection of the gravitational constant G to match experimental CODATA values.

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The RCR model successfully maps the masses of fundamental particles with a precision of 10^{-7} using the invariant coupling $(1-\alpha) = \xi^{\Phi}$ with solution (ξ_M, Φ_M). The probability of this coherence occurring by chance across such a vast scale –covering the Planck mass to the cosmological horizon– is infinitesimally small. Moreover, historically, measurements of G have exhibited persistent nonconvergence, with discrepancies between laboratories exceeding their individual uncertainty budgets [10].

The internal coherence of the RCR model dictates that the fundamental source ξ must remain locked to the fine structure constant α. Since α is known to a precision of 10^{-10}, the mass eigenstate (ξ_M, Φ_M) is the only state that satisfies the condition of absolute vacuum stability. Consequently, any discrepancy in G must be attributed to a projection lag rather than a failure of the scaling law.

We propose that the RCR mass-derived ξ_M be adopted as the primary standard for universal scaling. The "Gravity-Matter Uncertainty" is resolved by acknowledging that our current measurement of the cosmos is slightly out of focus, and that the true geometry of the Manifold is revealed by the weight of the electron, not the torsion of a balance.

In conclusion, the constant ξ results as the "bridge" between G, L_p, and α. Interestingly, there is a *discriminating constant* very close to $2\pi \times 10^{25}$:

$$K = 6.28114 \times 10^{25} \quad [L^{-2/5}T^{-1/5}] \tag{25}$$

providing the numerical values of G and L_p:

$$G = K\xi^4 \quad \text{(Gravitation Constant)} \tag{26.1}$$

$$L_p = \frac{\xi}{K} \quad \text{(Planck Length)} \tag{26.2}$$

$$L_p(RCR) = \frac{\xi_M}{K} = \frac{1,01537233 \times 10^{-9}}{6,28224250 \times 10^{25}} = \mathbf{1,61625500 \times 10^{-35}}\ \text{m}$$

If we insert this value in the formula $G = \frac{L_p^2 c^3}{\hbar}$ (following from L_p definition), then we get:

$$L_p^2 = (1,61625500 \times 10^{-35})^2 = 2,61227922 \times 10^{-70}\ \text{m}^2$$

$$c^3 = 2,69440024 \times 10^{25}\ \text{m}^3/\text{s}^3$$

$$G = \frac{(2,61227922 \times 10^{-70}) \cdot (2,69440024 \times 10^{25})}{1,054571817 \times 10^{-34}}$$

$$G = \frac{7,03852575 \times 10^{-45}}{1,054571817 \times 10^{-34}} = \mathbf{6,674301 \times 10^{-11}}$$

a value almost equal to the CODATA value of G.

Now, let us compute G by using the formula $G = K \cdot \xi_M^4$

$$\xi_M^4 = (1,01537233 \times 10^{-9})^4 \approx 1,0629737 \times 10^{-36}$$

$$G = (6,28224250 \times 10^{25}) \cdot (1,0629737 \times 10^{-36})$$

$$G = \mathbf{6,67784 \times 10^{-11}}\ \text{m}^3\ \text{kg}^{-1}\ \text{s}^{-2}$$

When $\xi = \xi_M$, then $L_p = \xi/K = 1,61625500 \times 10^{-35}$ (almost perfectly equal to the CODATA value) and $G = 6,67431 \times 10^{-11}$ (or $6,67784 \times 10^{-11}$ in the secon case).

When $\xi = \xi_G$, then $L_p = \xi/K = 1,61596 \times 10^{-35}$ and $G = \xi^5/L_p = 6,67077 \times 10^{-11}$

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These computations put in evidence the fragility of these evaluations (see [10] in this regard), and again, that ξ_M is closer to the *true* value. The value of G obtained by means of K is close to the value obtained by using the equation $G = \sqrt[3]{\frac{\xi^{10}c^3}{\hbar}} = 6,678 \times 10^{-11}$, considered above. Moreover, both values are impressively close to the following value of geometrical nature, related to Lenz's characterization of the ratio proton/electron mass ($6\pi^5$) [9]:

$$G = (6 \cdot \pi^5/5)^5 \cdot 10^{-23} = 6,678 \cdot 10^{-11}$$

Now, by using the characterization obtained for G and L_p, we have:

$$G \cdot L_p = \sqrt[3]{\frac{\xi^{10}c^3}{\hbar} \cdot \frac{\xi^5\hbar}{c^3}} = \sqrt[3]{\xi^{15}} = \xi^5$$

$$G \cdot \left(\frac{\xi}{K}\right) = \xi^5 \implies G = K\xi^4 \text{ and } L_p = \xi/K$$

$$L_p = \frac{\xi}{K} = \frac{\xi^{5/3}\hbar^{1/3}}{c}$$

$$K = \frac{\xi \cdot c}{\xi^{5/3}\hbar^{1/3}} = \frac{c}{\xi^{2/3}\hbar^{1/3}} = \frac{c}{\sqrt[3]{\xi^2\hbar}}$$

Therefore: $K = 6,28114 \times 10^{25} \approx 2\pi \times 10^{25} \approx 6,2831 \times 10^{25}$
$L_p = 1,6165 \times 10^{-35} \approx 1,6162 \times 10^{-35}$ $\approx$99,98% CODATA L_p
$G = 6,6766 \times 10^{-11} \approx 6,6743 \times 10^{-11}$.

The following Table 3 summarizes the RCR constants (ξ_M is chosen, while G is according to CODATA).

Table 3. RCR Manifold Tuning: Fundamental Constants.

Constant	Symbol	Value (LS / SIA Units)
Scaling Factor	ξ	$1.0153723300000000 \times 10^{-9}$ $[(L^3T^{-1})^{\frac{1}{5}}]$
(G, L_p) Coupling Factor	K	6.28114×10^{25} $[(L^2T^{-1})^{\frac{1}{5}}]$
Fine Structure	α	$7.29735256 \times 10^{-3}$
Plenum Correction	$(1-\alpha)$	0.9927026474
Planck Mass	M_p	2.176434×10^{-8} kg
Gravitational Constant	G	6.67430×10^{-11} $m^3kg^{-1}s^{-2}$
Planck Length	L_p	1.616255×10^{-35} m
(ξ, α) Coupling Exponent	Φ	0, 00035368

11. Toward a Field Unification

The RCR framework suggests a broader framework for representing the whole physical reality. Everything is a wave, and the ondulatory mechanics is not only a theory, but the universal key to decoding phenomena.

From de Broglie:

$$\lambda = h/mv$$

This means that increasing v, the wavelength λ decreases, but by the synchronization proportion:

$$\frac{v}{c} = \frac{\mu}{\lambda}$$

Therefore, μ also decreases when the velocity v increases and λ decreases. At the same time

$$h = m\mu c$$

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tells us that when μ decreases the mass increases. This phenomenon is in line with the relativistic effect of the mass increase with velocity. However, from the synchronization equation, we derive that

$$\mu = \lambda \frac{v}{c}$$

Whence, as v approaches c, μ approaches λ, the particle collapses by losing the difference between its internal and external reality. This explains why masses cannot reach the velocity c.

Particles are waves, and all movements are not into the space, but are of the whole space, that is, holomovements of waves propagating vibrations in a rigid grid of P cells. In this scenario, what are the forces? They are interactions of waves. In this vision, a mass m is the integration of infinite components reverberating its vibrating closed nucleus m_0, according to the formula already given:

$$m = m_0(1 + \alpha, +\alpha^2 + \ldots) = m_0 \sum_{i=0,\infty} \alpha^i$$

In a first approximation, what we call forces are effects of aggregation, integration, repulsion, or disaggregation of masses, arising from phase or antiphase relationships among specific α components, within the dynamic context in which waves are localized in plenum regions. In very general terms, a force appears when a wave coupling gradient, with respect to the axis r connecting centers, activates an interaction between two waves, or a wave and an already established wave complex:

$$F \propto \nabla \left(m_1 \sum_{i=0,\infty} \alpha^i \cdot m_2 \sum_{j=0,\infty} \alpha^j \right)$$

a force pushes in the direction where ∇ decreases, toward a stationary configuration of the region around the interacting particles. Minimum action, conservation, symmetry, and stability are general descriptive principles that meet in a perspective where the interaction is intrinsic to the nature of the wave, as an intrinsic form of information and energy that connects different spatial localizations.

The "Stability-by-Aggregation" Principle

Stability is redefined here as signal phase stability: the capacity of the signal to maintain a constant phase relationship within the series $m = m_0 \sum \alpha^i$. In this perspective, the interaction is not an external force, but the result of the resonance between the "radiative fields" of the involved masses, governed by the stability of their respective α terms.

In any case, wave aggregation and disaggregation are the basic mechanisms underlying wave phenomenology, and the signal phase stability is the essence of plenum dynamics.

The first form of aggregation is mass formation, which can be viewed as the basic aggregative mechanism of P cells within a closed, contiguous region that shares a signal connecting them and remains confined to that region. But this signal locking is never perfect, and a part of vibrational activity is reverberating outside with α quotas of the above equations. These are a sort of skin or a "dynamic membrane" with which particles interact with the plenum and among them. By means of these quotas, a particle defines its identity in its dynamic equilibrium with the plenum.

However, particles become elements of further aggregations at other levels of spatial organization. This is the principle on which different forces act in combining particles up to atoms and molecules.

The fundamental role of aggregation has a very natural reason, which relates it to stability. Namely, particles reverberate α quotes, that is, they are closed but in a minimal part are open. This means that a flow of energy always goes outside their aggregate. This implies that a constant dissipation of energy should lead to their disappearance. When they become part of bigger aggregative structures interacting among them, the dissipation is strongly reduced because the energy remains internally exchanged within the second-level aggregate. This schema is iterated many times along all the aggregative levels of matter: parts aggregate to survive from atoms to stars. In conclusion, pilot waves are the deep reason for aggregation.

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A particle is a dissipative system: it constantly "leaks" its integrity to the surrounding medium, not by breaking, but by wearing away under the relentless friction of the currents. This is the fate of an isolated particle whose α quotes radiate outward, slowly draining the aggregate's internal energy. However, when the pilot waves (the gyres) guide these fragments together, they achieve a "second-level" stability. By interlocking, they internalize the energy that was previously lost to the sea; the "leaks" become the very hooks that bind the components together. Matter, therefore, is an evolutionary response to the Plenum's friction: parts aggregate into atoms and stars not merely to coexist, but to survive the exhaustion of their own signal, turning a constant dissipation into a shared, stationary resonance.

A detailed analysis of the fundamental forces underlying this ondulatory vision is beyond the scope of this paper. It requires refining many aspects and details, but surely nuclear forces involve the most internal part m_0 of a mass m, electrodynamical forces are surely related to the two components $m_0(\alpha, \alpha^2)$. At the same time, gravitation pertains to the higher-order components.

12. The Mystery of G

In a recent paper [10] about the gravitational constant, the experimental difficulties in the experimental determination of the value of G are addressed. After 10 years of intense studies for a precise determination of G, we are far from a univocal evaluation, and an imprecision around 2% is always present among different laboratories using different methods (torsion balances or atomic interferometry). Moreover, no theory exists connecting G to other basic constants (c, h, α).

In this section, we develop an analysis of this constant within RCR by suggesting a possible explanation of the difficulties that G posits. However, this analysis has a more general relevance, because it shows that forces are not external entities acting on particles, rather they originate in the internal ondulatory notion of particle and its interactions with the plenum and the other particles and signals populating it.

Let us consider a particular case of gravitational force between two identical elementary masses m with Compton length L. Assume that these masses are at a distance equal to L (they are touching). According to Newton's theory, the force is given by:

$$\frac{Gm^2}{L^2}$$

The Planck force of the plenum is:

$$\frac{c^4}{G}$$

This force connects the Planck cells of the plenum. However, when we compare the ratio between the electrodynamical force and the gravitational force, we get a value of 10^{38}. This corresponds to an interaction involving only the α quotes of order α^9. This suggests that the gravitational force uniting the two masses m is:

$$\frac{(c\alpha^9)^4}{G\Phi}$$

where Φ is the diffusion factor, which is equal to the Fibonacci number (the golden ratio). Namely, the force acting on the two masses is interpreted as the product of two fluxes

$$\frac{(c\alpha^9)^4}{G\Phi} = \frac{(c\alpha^9)^2}{\sqrt{G\Phi}} \frac{(c\alpha^9)^2}{\sqrt{G\Phi}}$$

Where the flux of signals crossing the plenum when encountering the two masses goes around them, and in the equilibrium condition, they unite, due to the signal depression between them, which,

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according to Venturi's effect (with respect to Bernoulli's "hydrodynamic pressure"), exerts a force that unites them. This force is equal to Newton's force, then:

$$\frac{Gm^2}{L^2} = \frac{(c\alpha^9)^4}{G\Phi} \tag{27}$$

$$G^2 = \frac{(c\alpha^9)^4 L^2}{m^2\Phi} \tag{28}$$

The above equation shows that G depends on the mass m we are using in its evaluation. This means that a more correct way to express it is the following:

$$G(m) = \sqrt{\frac{(c\alpha^9)^4 L^2}{m^2\Phi}} \tag{29}$$

$$G(m) = \frac{c^2\alpha^{18}L}{m\sqrt{\Phi}} \tag{30}$$

In this interpretation, gravity is a force different from the others, because it does not involve a strong interaction between particles; it is a collective statistical phenomenon directly related to the action of plenum and to vibrational signals, which are a pervasive flux embracing all phenomena occurring in it. Moreover, there is no sharp distinction between the plenum and the vibrational aggregates populating it, because they are also sources of vibrations. The weakness of gravity is expressed by the very small α-quota involved in the gravitational interaction of masses and explains the reason why the macroscopic effect of gravity requires great numbers of aggregated particles. In this vision, it is not the curvature that aggregates masses; rather, its aggregation, according to a general principle of RCR, gives greater stability to the aggregate's components and, according to the dynamical curvature of the signal, pushes aggregates to unite into a single aggregate.

The Table 4 clearly shows that the value of G depends on the mass to which it refers. In other words, G is not a constant, even if it varies in a very narrow interval, and different masses experience different gravitational impedances of the plenum.

Table 4. Calculated G valuesusing Formula (30). Lead is the closest value to the standard value.

Element	**Ratio L/m (m/kg)**	**$G(m)$ (10^{-11} units)**	**Dev. from G_{std}**
Hydrogen (^{1}H)	7.90×10^{11}	8.651	+29.62%
Potassium (^{39}K)	6.48×10^{11}	7.096	+6.32%
Iron (^{56}Fe)	6.31×10^{11}	6.910	+3.54%
Copper (^{63}Cu)	6.26×10^{11}	6.855	+2.71%
Zinc (^{64}Zn)	6.25×10^{11}	6.844	+2.55%
Mercury (^{200}Hg)	6.09×10^{11}	6.669	−0.07%
Silicon (^{28}Si)	6.53×10^{11}	7.151	+7.13%
Platinum (^{195}Pt)	6.11×10^{11}	6.702	+0.39%
Gold (^{197}Au)	6.10×10^{11}	6.689	+0.22%
Lead (^{208}Pb)	6.09×10^{11}	**6.671**	−0.06%
Uranium (^{238}U)	6.02×10^{11}	6.592	−1.26%
Standard G	-	**6.674**	**0.00%**

13. Conclusions

In 1924, Luis de Broglie [5] proposed a fundamental equation that was the starting point of quantum ondulatory mechanics described by Schrödinger's wave equation [14]: to any particle of mass m and velocity v, a wave is associated with a length $\lambda = h/mv$. In this paper, this vision is extended by claiming that *a mass is a wave* with two components: the internal one of a signal trapped inside an aggregate of contiguous Planck cells, and an external wave moving, at a velocity v, propagating a stable vibrational state in the space. Moreover, de Broglie's equation follows from the

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need to synchronize the internal and external signals. Minor "informational components", correspond to the high-order powers of α terms in Taylor's series, which extend the internal mass m_0 to guide a particle of mass m in its propagation through the grid of vibrating Planck cells.

In this vision, the different forces/fields of physics could be unified as different expressions of wave interactions concerning different levels of the vibrational architecture of masses. Nuclear forces are probably related to wave interference at the level of the internal signal m_0; electrodynamical force involves α and α^2 quotas, while gravitational mass aggregation is probably related to α^{n+3} quotas.

In the scenario of a hyperspace of epiphenomenal and hypophenomenal components, where waves are holomovements of vibrational cells, the paper posits the strict link between masses and gravitation. Both are expressions of space curvature, at different levels.

Microscopic space curvature at the Planck scale is the creator of matter, while the constant G is the macroscopic dilution of this curvature across five complex planes underlying the observable space. The precision of the $(1-\alpha)$ coupling confirms that mass is the informational residue of the signal's internal resonance within the hypophenomenal grid. A profound implication of this model is that its "implausible" predictive power arises from the *structural limitation of its numerical resolution*. The 16th decimal digit is not a computational constraint, but as the *Informational Horizon of the Planck Cell*. From the neutrino to the Sun, the resonance of ξ and α provides the underlying logic of all the fundamental masses.

The microscopic space curvature and its vibrational nature are the origin of matter; G is the measure of its macroscopic expansion. The S^1, S^2, S^3 dimensions of matter, momentum, and energy, respectively, make the universe a pure informational code where the observer, at the lower-energy L/S time-stream, perceives the recursive harmonics of the signal as the solid reality of the material world.

Aggregation is the universal principle of RCR. Particles, which are dissipative entities emanating signals, stabilize their configurations by exchanging signals among them within aggregates of components that internalize signals, avoiding their dispersion and the consequent end of their existence. A new interpretation of gravitation in the RCR framework explains the "mistery" of G and the difficulties of its precise determination.

The RCR theory opens the possibility of revisiting quantum concepts in a new perspective where waves return to be seen as real physical waves, rather than probability waves. Of course, this is a topic for future investigation.

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