On the Absorber and the Nature of Energy

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Abstract

Here we show that free parameters are inexistent in physics; their values are geometrical. This result originates in a resonance concept in absorber theory. The conceptual leap is that we do consider energy in all forms as a composite resonance process involving only currents.

We first address the mass and coupling parameters of the standard model of particles physics, deduce their origin, their form, and the valid resonances from group theory arguments and geometry; then we show the coherence of the mass spectrum with the predictions and we compute the fine structure constant from geometry and SU(2). We also address the CKM and PMNS matrices, and show that they come from the same resonances.

Next we show how gravitation comes from the absorber and we end-up with a complete reversal in concepts; we find that the origin of energy and gravitation is linear cosmos expansion. The link with quantum physics is rather trivial and it first shows that the wave is momentum. The resulting gravitational force gives an acceleration H c at galaxies borders but not in the solar system; it is compatible with the absence of dark matter.

Keywords: Field naturalness, free parameters, self-quantization, resonances, gravitation, cosmology.

1. Introduction

In a celebrated paper, Dirac [10] showed that the existence of magnetic poles and quantum mechanics impose symmetrical quantization of magnetic and electric charges. This is the very first attempt to explain the observation of a universal quantum. Since then other theories were produced in which the magnetic charge differs. But even though charges have definite symmetry nothing imposes the charge ratio; namely the fine structure constant α.

It is widely believed at present time that the standard model (SM) of particles physics is part of a wider theory in which its free parameters are calculable – but free in essence. One can see the seeds of this line of thoughts in Dirac's demonstration: once the idea is extended to all known fields, it structures the logical constraints in such a manner that the full set of equations can be solved.

However, despite the effectiveness of the theory, the present situation may be similar to pre-quantum physics, when a lot of chemistry was known but not the origin of electrons energy levels. Paralleling this historical situation the path to reductionism has been postponed. In this paper we show that it has probably been missed and we do recover it.

But what could be the problem with modern theories? Essentially, and boldly paraphrasing Feynman, they leave no room at the bottom. Let us take an example with the SM framework and imagine that a muon is not just a fat electron. Field theory implies that it interacts with more fields. Then any deviation from the SM will be seen as a distinct field – which implies a new symmetry and observable resonances. It leaves plenty of room for more fields and its particles, but absolutely none for a different framework; the concept is complete and then stuck. It cannot evolve; this is a dead locked situation which can only be opened on acceptable conceptual grounds, hardly from new experimental data, and provided that the new theory gives really new insights. Of course it is required that the next mathematical concept will include the SM framework or an appropriate correspondence; but this can be more deadlocks, in particular if the path to reductionism has been missed.

Finally, it seems (admittedly) that the SM free parameters may possibly be *computed* using a new zoo of particles, but in general it is not envisioned that they can be *deduced* from a weaker concept. The difference is of importance between computing and deduction; in the former case, parameters are free and for instance at some calculable equilibrium, in the latter case the parameters values are constrained by something weaker than known principles.

On practical grounds, the problem is the following list of parameters, including neutrino mixing which is not part of the SM "official" version (since oscillations are not permitted):

Parameters	Type
9 leptons and quarks masses	Mass
Higgs boson mass	Mass
Higgs field v.e.v.	Energy
Three gauge couplings, g1, g2, g3	Couplings
Four CKM matrix coefficients	3 angles, 1 phase
Four PMNS matrix coefficients	3 angles, 1 phase
QCD vacuum phase (≈ 0)	Phase

It is trivial to state that the SM is very efficient to modeling interactions, but according to the list above it does not tell us anything about why energy manifests into a limited set of specific forms which interact under three symmetries. Consequently the true question may be to understand what energy is, how it is formed, including why it interacts with three symmetries, not only to describe and parameterize interactions – which eventually is what the SM does. Then, in order to really understand we cannot count on any known framework and we cannot even use energy, momentum or the usual conservation laws.

But then what can we do? We can first find an origin to the bulk of the SM parameters and subjacent quantities which are the 12 leptons, quarks and bosons masses. For this we are free from the SM concepts and mathematical developments; we mean entirely free. The only criteria of acceptability are coherence in logic and phenomenology. Next, *if we succeed*, we must analyze the results and understand what it is telling us. Finally, we will need to recover the SM or a correspondence but not directly its mathematical developments since those are sterile when it comes to explain free parameters values, or even to understand what they really. Hence, it is appropriate and probably unavoidable to use methods non-conformant with the known habits, techniques, principles and the usual concepts. In any case, we need to explore those parameters and the only accepted method at hand is the use of parameter space which, if not physical, is a natural result of the supposed dead-lock.

In a non-conventional way, and in a manner similar to the Feynman-Wheeler absorber [27, 28] theory, we first showed [5 - 6] from a unique mass equation that the elementary particles mass spectrum is not random; the abovementioned 12 masses are in close *logical* and quantitative agreement, not in simple equilibrium; they depend on a unique field, two couplings, an amplitude parameter, plus a few integral resonances. But until now the origin of those couplings and integral numbers is unknown; this is problematic since we do not really solve the problem but it begins to look very much like a solution exists.

In this paper, we first define weak premises with which the theory fits. Then we show how the matter field symmetries are limited by those premises and deduce the possible forms of couplings. Next, using the mass equation, we show how the fundamental resonances decay straightforwardly from group theory arguments and finally that the mass spectrum and couplings depend on the three known symmetries and, up to known decimals, on nothing else.

Hence, the object of this paper is to present the theory in a logical "constructive" manner, starting from premises up to phenomenology. A large part of the results and reasoning presented here were previously published but not embedded together in a consistent top-down logic – in particular the origin of the couplings form and of the integral resonances was not understood; all stages are presented in length and in logical order to make the paper self-consistent. The initial research approach is exploratory, it is still visible, and the methodology, its objectives and rationale are explained step by step.

Finally, this paper also includes a new exploratory part where we try to find-out logical SM extensions; for this we study the absorber on its natural scale which is cosmological. It shows how special relativity can decay from group theory and couplings (or resonances), and it gives a form of gravitation that does not need punctual carrier particles.

In this way, the theory is physically incompatible with the accepted interpretations of general relativity but gives acceptable results without dark matter; we find an acceleration $H\ c$ at the galaxy borders and we show why it cannot exist in the solar system. Most importantly, it also enables to *deduce* and compute the amount of visible and dark energies from the gravitational constant and the Hubble parameter. But in facts, it shows that dark matter is inexistent and dark energy is the "free part" of the resonant absorber; its ratio to the visible energies is just a 4D geometrical resonance factor ($4\pi^2/1$) relative to the visible energy density in a thick 4D membrane. Next, it enables to connect gravitation and quantum physics in a new manner and uncovers the origin of energy and of the wave. Finally, we recover the resonance numbers from the membrane 4D geometry.

This paper is structured as follows:

In section 2, we discuss theory. We first recall the main features of the Feynman-Wheeler absorber and Cramer's transactional interpretation of quantum mechanics and discuss the essential leaps needed to complete the theory. Then we define the theoretical approach and the premises at the top of the theory. Essentially we define a minima the area and its contents. Then analysis leads to logical predictions concerning the possible form of couplings, the symmetries giving observable punctual charges, and what we may expect concerning higher symmetry groups.

In section 3, we first discuss the mass equation; its analysis and group theory arguments enable to *deduce* the possible resonances for each group and the resonance forms. Then we use it to analyze the elementary particles mass spectrum and show its coherence with the predictions (including those in section 2).

In section 4, we structure the field according to the ideas emerging from the results in sections 2 and 3 and some earlier adjacent work that we repeat in short.

In section 5, we discuss leptons. We first compute the electron and muon magnetic moment anomalies directly from resonances and special relativity; that is to say without using quantum electrodynamics (QED). Next, we find how to compute the fine structure constant from the resonances – still without the use of QED. Surprisingly, we find how spin is represented in the mass equation.

In section 6, we discuss the CKM and PMNS matrices. This analysis is incomplete and not fully conclusive but it shows that the two matrices are in close relation with four quarks resonances as hypothesized in section 4.

In section 7, we first show that we have enough results to prove that the SM is valid in this framework. Then we search logical extensions to the SM.

In sections 8 and 9, we discuss special relativity and gravitation to show how both fit (or emerge) naturally from the resonant absorber concept. We also find links with quantum physics and recover from cosmological geometry the possible particles resonance numbers found in section 3. The section 9 is of special interest as it shows that energy is just a process.

The sections 10 and 11 are a discussion and the conclusion.

Since the theory as it stands ranges from masses and charges quantization to cosmology and gravitation, each section includes specific conclusions. As mentioned before, most sections also include a description of the specific method, of its rationale, and of the objectives.

2. Premises, Theory, and Conjecture

2.1 The Absorber

According to Wikipedia, *the Wheeler-Feynman absorber theory (WFAT) [27, 28] is an interpretation of* electrodynamics *derived from the assumption that the solutions of the electromagnetic field equations must be invariant under* time reversal *symmetry, as are the field equations themselves. Indeed, there is no apparent reason for the time-reversal symmetry breaking which singles out a preferential time direction and thus makes a distinction between past and future. A time-reversal invariant theory is more logical and elegant. Another key principle, resulting from this interpretation and reminiscent of* Mach's principle *due to* Tetrode*, is that elementary particles are not self-interacting. This immediately removes the problem of* self-energies.

The main equations go as follows:

$$E_{sym}(x,t) = \sum_n \frac{E_n^{ret}(x,t) + E_n^{adv}(x,t)}{2} \tag{2.1}$$

where the symmetric energy E_{sym} is the sum of the energy exchanged by all particles of the universe in the form of advanced and retarded waves (E^{adv} and E^{ret} respectively). Then they observe that if the following relation is a solution of the Maxwell equations, it can be used to obtain the total field:

$$E_{free}(x,t) = \sum_n \frac{E_n^{ret}(x,t) - E_n^{adv}(x,t)}{2} = 0 \tag{2.2}$$

$$E_{tot}(x,t) = E_{sym}(x,t) + E_{free}(x,t) = \sum_n E_n^{ret}(x,t) \tag{2.3}$$

And the total field is now causal. This zero free field is the central idea.

Next, Dirac proposes the following interpretation of the damping field:

$$E_{damping}(x_j,t) = \frac{E_j^{ret}(x_j,t) - E_j^{adv}(x_j,t)}{2} \tag{2.4}$$

which leads to:

$$E_{tot}\left(x_j,t\right) = \sum_{n\neq j} E_n^{ret}\left(x_j,t\right) + E_{damping}(x_j,t) \tag{2.5}$$

Now the damping force is obtained without the need for self-interaction (which leads to divergences) and gives significance to Dirac’s interpretation.

With respect to the object of this paper, we can make two remarks on the absorber theory:

- Firstly, it is based on fully symmetrical energy exchanges in space and time; then, even though it uses time-symmetrical equations to obtain a time dissymmetry, it does not give us a mechanism by which all particles have quantized energies (not all random or variable and not all equal).
- A second remark is sometimes forgotten but it is one of the main interests of the concept; the theory is based on the idea that a particle exists, that is essentially some sort of punctual thing or structure moving in space. We must then deduce that the exchanges of energy are not made of particles otherwise the idea is useless. The advanced and retarded components are some “radiations” not observable as punctual particles but they correspond to a transfer of some kind which must lead to quantized masses.

We have to take those two remarks into account.

The transactional interpretation of quantum mechanics (TIQM) was first proposed by Cramer [9]; it is complimentary to the energetic aspects developed by Wheeler and Feynman. Instead of addressing exchanges between particles, it discusses symmetrical exchanges thru time between different objects.

According to Wikipedia: *In TIQM, the source emits a usual (retarded) wave forward in time, but it also emits an advanced wave backward in time; furthermore, the receiver, who is later in time, also emits an advanced wave backward in time and a retarded wave forward in time. The* phases *of these waves are such that the retarded wave emitted by the receiver cancels the retarded wave emitted by the sender, with the result that there is no net wave after the absorption time. The advanced wave emitted by the receiver also cancels the advanced wave emitted by the sender, so that there is no net wave before the emitting time either.*

This interpretation removes the problem of the observer of the Copenhagen interpretation, and explains quite naturally the mysteries of quantum mechanics (including entanglement, among others).

But the main remark here is opposite: the theory is non-local and fully atemporal and it becomes difficult to imagine how the observer can remain temporal; Cramer states that an initial even must trigger causation but even then the question of the pace of time remains – it is not instantaneous. Then one way or another a dissymmetry of time must exist. A second remark is reminiscent of that on the absorber; information exchange suggests a physical carrier which is out of the scope of quantum mechanics as it mostly discusses wave *functions* and operators, not the nature of the wave.

Now there is good reason to separate energies in some exchanges between particles (WFAT) and some time-oriented self-interaction (TIQM). We write:

$$E_{tot}(x_j,t) = E_j\varphi_{abs}(x_j,t) \ + E_j\varphi_{time}(x_j,t) \tag{2.6}$$

Where φ_{abs} is some absorbed flux of unknown nature, and φ_{time} is some self-interacting flux which conserves some of the characteristics of the particle. In this way, φ_{time} is a conserved proportion of the particle energy and it synchronizes the states of the particle thru different epochs. Then, and more importantly, it can also synchronize entangled particles "at the source", still permanently and as a function of events as they arise – but not before.

For instance, consider two entangled photons p1 and p2 emitted in A, and p2 measured in B; The advanced and retarded φ_{time} of each will always interact in A thru φ_{abs}, and synchronize the state of the two photons – which can then be undetermined all along their path. When p1 is absorbed in B the state of p2 is instantly frozen. The only criterion of acceptability for this equation is that the past "exists" now.

Both fluxes φ_{abs} and φ_{time} can have the same nature and may only be distinguished by their orientation in space and time. In this way, there is no reason that the proportions of φ_{abs} and φ_{time} are particle-independent (which is not the case in (2.5)); at the opposite, it can open a road to mass quantization. It also lets open the possibility that they host not only information but also some charges or currents.

2.2 Theoretical Approach

Difficult mathematical problems are often solved when generalized. It means weaker premises extending the routes by which the problem can be solved, or made part of a wider concept where a solution is sometimes trivial.

In physics, there is an observable universe and only one; then, inasmuch as we search the path to reductionism we cannot try a mathematical extension or generalization for it would imply unobserved quantities or degrees of freedom. At the opposite, we can try to find a minimal definition of space and its contents. The intention here is then to define premises which are weak enough to open new possibilities concerning the origin of the known laws, parameters, etc.; we mean that if we can remove redundancy or non-unitary constraints the problem will be simplified and some solutions may become obvious. We want firstly to understand what energy is but we cannot use any known concepts, principles or laws. Still we need to define an area and some minimal contents and properties. The motivations for the definition below must be understood from the previous subsection and also the remainder of this paper as it comes not like a-priori but as a global picture emerging from earlier results.

We first define the area and contents. It requires three premises.

P1: The fundamental area is 4D (a-priori) Euclidian space that evolves; it has its own time which is not used as a dimension (we do not know what it is). The evolution is a-priori random and manifests in the form of currents.

P2: A current is a symmetrical exchange between two points or areas A and B. The exchange is quantifiable but scale-independent. Scale independence states that between any A and B, the exchanged quantity is only relative.

P3: Scale instantiation states that the currents field is defined by a local density. For any volume surrounding A, the sum of all exchanges between this volume and all points in and out of this volume is limited. This quantity is not absolute but only differences exist between two points or areas (ratios or maybe differences).

A scenario is needed to explain currents; it only needs to agree in concept with the absorber as defined in (2.6). We shall start with the following:

- At $t = 0$, in a given area, an interaction of currents arises that shows a perfect mathematical stability.
- At any time $t > 0$, this area expands to neighboring points. This expansion defines a boundary which is 3-dimensional; it is the observable universe where charges are currents crossing the boundary.
- We do not define $t < 0$.

But this is just a scenario that will be used as a guideline and strongly amended. It is not a premise of the theory.

Next we define the properties of currents:

P4: Free currents are neutral and dissociate in the presence of a charge.

P5: A charge in 3+1D, is the effect of a dissociated current going up or down the time, we name it a time-current.

P6: A physical action is a sum and/or a product of currents; it includes self-interaction.

P7: Currents-charge interactions are 4D chiral, they include some 4-rotations.

2.3 Conjecture

In 4 dimensions symmetry exists and, using currents and charges, resonances can also exist; they can define structures and can be observable in 3+1D. But essentially we do not have anything else to discuss; then our premises are minimal enough to impose the following conjecture:

The observable reality defines itself in the form of resonances which quantize currents.

Hence, accordingly, only 3+1D quantities related to resonances can be measured and all relevant free parameters of the SMs of particle physics and cosmology can be deduced and computed logically and coherently using the premises above. This conjecture relates directly to the equation (2.6) and extends the concept; but now we cannot even envision to quantizing charges and masses separately.

2.4 Symmetries

We implicitly assume, like any theory, that the observable reality is coherently calculable. It includes the principle of universality of laws.

From premises P4, P5, P6, only U(1), SU(2), and SU(3) make punctual charges calculable. The demonstration is trivial from the above premises. Consider that two charges x and y exists, then we may need to compute the impact of y on the self-interaction of x; it is equal to the action on x of the interaction of x and y (action-reaction), then:

$$(x\ x)\ y - x\ (x\ y) = 0$$

This is the definition of alternative algebra; according to Hurwitz theorem [13], only four exist which are R real numbers, C complex numbers isomorphic to U(1), H quaternions to SU(2), and O octonions to SU(3).

A specific case arises with $(x\ X) = 1$, or more generally $(x\ X)$ unitary. In this case the impact of $(x\ X)$ on any other quantity of the same group does not change its amplitude. Then X addresses conservation laws and observables quantities; we call X the monopole of x (or abusively the amplitude X is the monopole).

One of the premises limits the acceptable algebras or symmetries, but only when we discuss charges interactions. It does not mean that higher symmetries are not physical but only that they do not make a charge. They can still impose physical constraints, for instance by inclusion of charge-making symmetries.

2.5 Lengths (4D), Pseudo-norms (3+1D), and Couplings

We want to understand how pseudo-norms and couplings may appear from 4 to 3+1 dimensions.

Pseudo-norms: We assume 4D Euclidean space where a membrane of velocity V_t exist; the direction of this velocity is locally orthogonal to the observable 3D space where photons propagate. Then we have for photon propagation in 4D:

$$v^2 = c^2 + V_t^2 \rightarrow v^2 - V_t^2 = c^2 = const.$$

It implies that V_t/c is physically constrained and may be calculable, but all we know is $v > c$. For a pseudo-norm to exist, it is sufficient that photons and massive objects propagate "with (in 1D) and within (in 3D)" the membrane. It does not imply the invariance of c or such things; it just implies pseudo-norms and a preferred "causal" direction.

Couplings: In a classical way, a 4D resonance has paths of definite lengths, where currents are conserved and phases repeat. It means 4-paths L which unique property is that each path loops at a self-defined set of points of origin; this is $\int dL(r,t) = constant$, with $\int d\boldsymbol{L}(r,t) = \boldsymbol{0}$. Those paths define some currents and the first constant integral defines a sort of coupling and the second, if continuous, defines a classical trajectory.

On this basis we need to evaluate a 4D resonance which is measured in 3+1D. It depends on a path length which includes a 3-space component of length R and a time component T (the period of the resonance); the resonance loops on itself periodically in space and also in time.

Its apparent 3-length (its projection on 3-space) will then be $L^2 = R^2 - T^2$, which is just a pseudo-norm and concerns photons. Then for the loop to exist and manifest mass it must include some rotation which is seen circular in 3D and give some spherical symmetry to particles (without which it is not 3+1D); we get a very general formula:

$$L^2 = R^2 + n\,\pi^2 - T^2 \tag{0}$$

where n is a definite integral number and, this is important, all quantities are scale-independent; L, R, π and T are relative. Then L defines a unitless constant of nature and then some known unitless constants should obey the relation (0) – (thus the number).

Last, and even more important, L and the relation (0) must be linked to conservation and then to a charge, to its monopole, and to resonances. A time-current x and its monopole $X = |x|^{-1}$ give three action terms $X\,x$, X^2 and x^2 and then relative lengths X^2 and x^2 and one rotation; it implies:

$$R^2 = X^2 = X\,|x|^{-1}$$

Now trivially since $|x|\,X = 1$ we have for any 4D current x and its monopole X:

$$|x| = \sqrt{R^{-1}}\ ;\ X = \sqrt{R}$$

But now R is an integral number because resonance implies phase lock and R^{-1} must be an integral divisor of R:

R is an integral number.

Inasmuch as R depends on X, then T depends on x and then on $1/R$, and we want to write $T^2 = R^{-2}$, but the resonance would be a simple loop and accept $T = R = 1$ with minimal symmetry U(1) and $n = 0$. Then it must be something more complex based on sums and products.

Moreover, if $n > 1$, then R cannot be divided by n, otherwise L would be reducible. More generally, the values of R, T, and n must be such that (0) is not reducible.

Conversely R defines currents ratios in 4D while L defines observable charges ratios in 3+1D. Then 4D currents products and ratios are $|x\,X| = 1$, and $|X / x| = R$, and for a 3+1D charge q and its classical monopole Q we also have $|q\,Q| = 1$, and $|Q / q| = L$, and then charges and currents are linked, physically distinct, and not numerically equal:

In 4D, currents are integral N or opposite N^{-1} while in 3+1D, charges are real.

Hence, and finally, L is the length of a 4-loop seen from 3+1D; it defines the 3+1D theoretical charge to monopole ratio and then L^{-1} is a coupling constant which, from scale independence, is *constant* (not scale-running).

L^{-1} is a coupling constant in 3+1 dimensions.

Importantly, since (0) cannot be reduced, L is minimal and the coupling L^{-1} is maximal.

Our premises and scenario result in distinguishing charges (3+1D) and currents (4D). It introduces integral numbers in 4D quantities related to the 3+1D couplings and the field resonances – which are physically linked.

This is already an important theoretical result which addresses the premises of physical theories in general; because here, scale-independence, geometry and resonances induce the impossibility of fine-tuning. Although an infinite choice is still possible among integral numbers we also find limiting constraints related to reducibility.

2.6 Resonances

Before discussing elementary particles masses we need to find a resonance equation; this is done in the next section where we address the known spectrum in details. But we can already state that the mass spectrum as it is known at present must enable to computing all related field couplings, to understand what they are, and that they should be identifiable in the equation. We can also state that a second component of a good resonance equation includes one or several integral numbers, and since those numbers combine with couplings they must be related to symmetry groups. Therefore those numbers should be predictable in the reasoning to the mass equation and depend on its geometry.

In 3+1D, we should identify two couplings and probably no more for we have only two types of dimensions (actually one preferred direction in 4D). Those should “oppose” space and time and show some inverse numerical relations corresponding to conversely quantized currents or charges.

Secondly, our scenario includes a 3+1D emergent space that we will denote a membrane, which can be for instance a phase transition, a condensate, or more probably something else; in any case, 3+1D is observed. The 3-space must, one way or another, maintain its integrity as it does not disperse at random in 4D and then a constraining process or mechanism exists permanently, but this process cannot be 3-dimensional. In absence of any other concept, it may be considered a 4D resonance which requires some symmetry; then, if it exists, we may be able to identify some pertinent traces of this resonance. Those traces may be in some cosmological data or in the micro-scale via some field characteristics.

Finally, using our premises and scenario, we can already indentify three possible kinds of resonances:

- Known particles taken individually, which are resonances locally observable in 3+1D and have charges.
- Particles resonances must be linked coherently, and then thru a global process. The particles spectrum *as a whole* is then linked by resonances, and then by symmetry, since its integrity is maintained.
- A 3+1D membrane that does not disperse, which is defined by a general 4D process (and successive membranes may exist in 4D, making $t < 0$ irrelevant).

By default, those should correspond to distinct symmetry groups included appropriately in each other.

The logic of this analysis should not be seen as a mathematical generalization but only as a manner to identify distinct levels of action and observation.

Now this is the theory; let us see how it comes in the real world.

3. Elementary Particles Mass

3.1Method

In this section, we first derive a mass equation and analyze its properties. As we shall see, the equation has 5 degrees of freedom (3 integral and 2 real) which we shall try to reduce. We first address the equation alone and understand how its integral parameters are constrained. It is first developed according to the following plan:

Hypothesis → Equation → Analysis → Predictions/reduction

Then we find an empirical fit with the mass spectrum and verify the predictions concerning integral parameters:

Equation → Empirical Fit (→ Verify predictions)

We apply the equation to all known elementary particles groups. At this point two degrees of freedom will remain, and then we need further analysis, which is done as follows:

Equation Parameters → Correlation/coincidences → Analysis → Coherence/Reduction → Verification

Here the 2 real parameters of the equation are analyzed to understand their origin or significance; this is done partly in this section and finalized in sections 5 and 6. The verifications relate to known quantities.

3.2 Deriving a Mass Equation

We want to find a resonance equation that fits with the equation (2.6) but where resonances appear. We assume that the wave is a physical exchange at the origin of mass. Energy exchange is momentum, and it gives a pressure field that "cages" the particle charges and some associated self-energy. Following the Cramer interpretation of quantum mechanics we assume that the self-energy is a time-current that hosts the query/response wave. The initial idea is similar to the Poincaré stress [24] though not identical as we split the particle. Roughly speaking, we cage a photon-like current in a box – caged momentum increases the box total energy.

The relation $E = h\,\nu$ as used in de Broglie's thesis [1] for massive particles suggests some form of resonance and the standard theory heavily uses the concept. Moreover, the Compton wavelength $\lambda_C = h/m\,c$ when compared to the de Broglie wavelength $\lambda_D = h/m\,v$ gives a form of symmetry where the light-speed singularity has the role of a mirror that directly applies to velocity (de Broglie's $Vv = c^2$). Here we suspect or use a free field mirror: c or c^2.

From scale-independence it is sufficient to use a length 1 (which can be anything but should relate to the free field mirror c^2) and the mass equation will be identically valid for any length. In the one dimensional case, the pressure is a simple force, and resonance implies an integral number N such that we have:

$$m \;=\; \mu + X\,N$$

where m is the particle mass, and X is a constant. The quantity μ represents a massless self-energy that necessarily propagates, and it implies a double resonance. Hence the actual resonance number is a product $N\,P$, with P an integral number, and we get:

$$m \;=\; \mu + X\,N\,P$$

Caging a massless particle requires symmetry, a repelling force that opposes the particle self-energy and the pressure field, that is precisely the first resonance wall ($1/NP$) and the self-energy μ. There must be a residual distance $d \neq 0$ between the first resonance wall and the current μ at which the force applies. It gives:

$$m \;=\; \mu + X\,(d + (NP)^{-1})^{-1}$$

Now the distance d also depends on $1/NP$ because energy comes from the distance ($d + 1/NP$) and it is equivalent to a potential; actually two potentials that sum or subtract, one is $1/NP$ and the other is d. A potential is quantized; $1/NP$ is already quantized in a reverse manner, and then d is also quantized. Then we use $d = K\,D$, with K an integral number and D a length. Last, the resonance lives in three dimensions and we get a cube:

$$m = \mu + \frac{X}{(1/NP +\ K\,D)^3} \tag{1}$$

Note that the equation can be reduced to 5 degrees of freedom by division by μ. It gives:

$$\frac{m}{\mu} = 1 + \frac{X/\mu}{(1/NP +\ K\,D)^3}$$

This first ensures scale independence and gives a natural unitless quantity (or mass unit 1). We will use the original form (1) in the next sections, but we must remember that a natural unit emerges.

Now let us discuss the equation geometry; contrary to the one-dimensional problem, we have more degrees of freedom in the resonance and the paths associated to N and P can have different geometries:

- Case 1: A double radial resonance. It needs identical inbound and outbound currents, then N = P, and it gives a stationary wave. Then it should address leptons and the Poincare stress in which case we should have K D > 0, with K increasing with mass as 1/N P reduces.
- Case 2: A double circular resonance: The resonance geometry is conserved when we invert rotation axis; hence it must be identified to SU(2) and by symmetry N = P. But we should change (1) with $X \rightarrow X/k\,\pi$ with k an integral number; this is because compared to the first case even though the resonance is circular the pressure is still applied to its geometrical center. The equation becomes:

$$m = \mu + \frac{X}{k\,\pi\,(1/NP + \,K\,D)^3} \tag{3.1}$$

- Case 3: A mixed resonance implies $N \neq P$ with a geometrical constraint between π, N and P since we must have a phase lock between the two paths; logically we should get approximate equalities like:

$$N\,P\,\pi \approx an\ integral\ number \tag{3.2}$$

  The last known symmetry is SU(3) and then quarks should correspond to this type of resonance. If D is related to the strong force, we should have KD < 0 (ideally constant if related to asymptotic freedom).

Hence this resonance concept implies three modes that we must identify to the known particles families; in the best case, particles interactions manifest as the resonance geometry and do not need to originate in separate fields.

3.3 Natural Resonances and Polarity

According to our reasoning on couplings, the resonances N and P should come straight from the equation geometry and group theory while, in the best case, all real parameters are related to couplings obeying (0). Here, we shall use 1, 2, 3 to denote U(1), SU(2) and SU(3) respectively and discuss free currents dissociation (P4) in the resonance equation. In the following reasoning one must just keep in mind that SU(3) ⊃ SU(2) ⊃ U(1).

a) At the core of a particle resonance, time currents give a charge Q constant; its polarity is p (in 1, 2, 3). In any sphere centered on Q the sum of charges is Q. The total currents separation in a scale-independent 3-sphere depends on a cube, say n^3 and it is neutral.
b) In the radial case, with a radial resonance number P, on each layer of the resonance the radial action is layer independent, then the radial coefficient of separation in $1/n^2$ for each layer ($1 \leq n \leq$ P), then $P = n$. The polarity of Q is p and defines the interaction of the particle which is also radial, then on the radial path $n = p = P$. Here P defines a radial exchange of action and polarity.
c) On a circular path, with a resonance number N, the resonance has N circular sectors which, contrary to the radial path, have identical action and action coefficients. Then $N = n^3$ on this path. Since this number does not define the radial interaction of the particle, any subgroup of p is acceptable, then $1 \leq n \leq p$.

We get the following suites of numbers:

- On a radial path the polarity is p, and $P = p$ = 1, 2, or 3;
- On a circular path n: $1 \leq n \leq p \rightarrow N = n^3$; n = 1 → 1, 2 → 8, 3 → 27.

But the latter is a static rotation, not a resonance as needed. With geometry, symmetries and currents (and nothing else), the unique manner is to combine two symmetries. Say in the volume 1, we have two or more symmetries at work; a structural point of equilibrium and an oscillation needs some transformation.

Therefore, on the circular path a particle (Q + resonance) is seen as a transformer in $n \leq p$ and the subgroups of n, which coefficients are given by symmetry and are the same for n and its subgroup (by identity of total action). Hence, on circular paths we get cubes differences: 8 – 1 = 7, and 27 – 8 = 19, and those come from transformers that we shall denote SU(2)/U(1) and SU(3)/SU(2) where a group and its sub-group combine in an oscillator. Importantly, there is nothing in this reasoning preventing more complex oscillators; for instance 19 – 7 = 12 for a double circular resonance (or even 7 – 2 = 5 if radial and circular interact), or even multiplications.

The group U(1) gives $1^3 - 1 = 0$, and this mechanism has a special form. In this case and in this case only, the resonance is 1, the particle mass is null and the equation (1) does not apply; it is a massless field.

Finally, we get, from geometry and group theory arguments a predicted suite of resonance numbers (1, 2, 3, 7, 19). They come from three couples (p, p^3), $1 \leq p \leq 3$, which we will denote "pure" since p is the polarity of Q.

It is also of interest that the three groups are included in larger ones, since:

$$SU(n) \supset SU(p) \times SU(n-p) \times U(1), \text{for } p > 1 \text{ and } (n-p) > 1$$

Then inasmuch as our premises are based on a 4D area we may also find in 3+1D quantities the cubes differences *37* for $n = 4$, $p = 2$, and *61* for $n = 5$, $p = 3$ since both contain the used symmetries. But those numbers cannot be associated to a resonance of the equation since no punctual charge can be associated to SU(4) and SU(5). Hence, they may be part of a general equilibrium in which the known symmetries fit; they can participate to the field but they cannot generate their own isolated particles.

3.2 Massive Particles Resonances

Reduction method: The equation has 5 degrees of freedom (3 integral and 2 real) and we just reduced the list of possible resonances (N and P). But we also want to understand the real parameters where couplings should logically appear. Then in the equations (1) and (3.1) we will suppose X and μ constant and apply the equation by logical groups (leptons, quarks and massive bosons) where only D is group-dependent.

Simultaneously, we want to reduce the three empirical parameters D and then we try to express those in a coherent manner because this is where couplings should be or combine. It prepares an analysis that will be needed for understanding bosons mass.

It will first look like we add more degrees of freedom since we separate particles in three groups and authorize different coefficients, but it will show the right method since we finally understand the interaction and all three parameters D of the equation.

3.2.1 Leptons

The Table 1 shows charged leptons resonances. It uses very small numbers, N = P, and shows a regular pattern. The empirical equation parameters are hereafter (L = natural lengths unit = scale independence.):

$$\mu = 241.676611 \ eV;\ D_e = 0.00085322189 \ L;\ X = 8.145121041623 \ KeV \ L^3 \tag{3.3}$$

Table 1. Electrons, muon, tau. (*) MeV/c^2

Particle	P	N	K	Computed (*)	Measured (*)
Electron	2	2	2	0.510 998 9280	0.510 998 928 (11)
Muon	5	5	3	105.658 37150	105.658 3715 (35)
Tau	9	9	5	1776.840	1776.82 (16)

In N and P, we expect 2 on the radial path, and 7 (or 8) on a circular one as it relates to SU(2), but it is not immediate: The number 2 is there and we have: 5 = 7 – 2, and 9 = 7 + 2. Then SU(2)/U(1) combines with SU(2). All resonances are doubly radial in 2 and we find those of the muon and tau also "doubly mixed" with 7.

Using α, the fine structure constant, we define a new constant that will be later used:

$$A_S = D_e/\alpha = 0.1169221145 \tag{3.4}$$

The name A_S is chosen for its value is reminiscent of the strong force coupling (we just search coherence) and the position of D in the equation is also reminiscent of the strong force. It is easy to guess:

$$\alpha_{S(MZ)} = A_S\,(1 + \alpha\,\sqrt{3}) = D_e\,(1/\alpha + \sqrt{3}) = 0.118399$$

where the term √3 should be geometrical and related to SU(3), but the scale M_Z is unexplained.

3.2.2 Quarks

Using X and μ constant from (3.3) the quarks resonances are shown Table 2 (masses in the natural scheme) where a regular pattern is obvious. The parameter D is slightly different from (3.3) to compute those masses:

$$D_q = D_e\,(1 + \alpha) = A_S\,(\alpha + \alpha^2) \tag{3.5}$$

(Using D_e exactly like for leptons the top quark mass is out of range as it gives ~ 167 GeV, and a difference exists.)

Table 2. Quarks resonances. (*) MeV/c^2, Top = direct measurement – ([1]) The ATLAS, CDF, CMS and D0 Collaborations (2013). See also CMS (2014b).

Particle	Charge	P	N	K	Computed (*)	Estimate 2011 (*)
Up	2/3	3	2	–6	1.93	1.7 – 3.1
Down	1/3	3	19/7	–6	5.00	4.1 – 5.7
Strange	1/3	3	7	–6	106.4	80 – 130
Charm	2/3	3	14	–6	1,255	1180 – 1340
Bottom	1/3	3	19	–6	4,285	4130 – 4370
Top	2/3	3	38	–6	172,380	172,040 ±190 ±750 ([1])

Note that quarks masses are not published any more in the natural scheme; the estimates above are dated 2011 except for the top.

We get $N \neq P$ as expected, but we get P and K constant which is surprisingly simple. The constancy of K = –6 is reminiscent of asymptotic freedom and then also agrees with a possible connection between D_e and α_S. Interestingly, varying K by ±1 gives computed quarks masses out of uncertainty range for the four heaviest.

It is trivial to verify the approximate relations with $NP\pi$ (3.2) for the second and third generations; they are:

$$c, s\!: 7 \times 3\pi \approx 65.97 \approx 66 / 1.0004025$$

$$t, b\!: 19 \times 3\pi \approx 179.07 \approx 179 \times 1.0003954$$

It is also interesting that between 1 and 19 no other integral number come close to verifying (3.2).

The numbers P = 3, and N = 7 or 19 are those expected, and the multiplication of N by 2 in the second and third generations corresponds to the ratio of electric charges (1/3, 2/3). We find that the second generation corresponds to the SU(2)/U(1) subgroups of SU(3), giving N = 7; while the third corresponds to SU(3)/SU(2) where N = 19. But for the first generation we have a problem; the down quark needs a fraction N = 19/7 which is barely acceptable, and we notice that the relations with (3.2) match with 2π for the *d* and also indirectly for the *u* instead of 3π for the other quarks. This point will be discussed later with the Cabibbo angle and related to quarks mixing.

$$d\!: (19/7) \times 2 \times \pi \approx 17 \times 1.0032$$

$$u\!: 2 \times 3\pi \approx 18.85 \approx 19 / 1.008$$

Interestingly, it looks like Table 2 has no degree of freedom, since all predicted numbers are used, and parameters are constrained or constant except D_q which is different from Table 1.

3.2.3 Massive Bosons

Using the SM we naturally assume that the $W^{\pm}$, Z^0 and H^0 acquire their masses from the same potential; using (1), it corresponds to the same resonance, that is on the circular path N = P = constant, and only the radial K varies (like if paralleling the SM, the mass μ of each boson falls at distinct heights in the Higgs potential).

A factor $k\,\pi$ at the denominator of (3.1) is needed since the resonance is supposed circular, but we do not find a perfect fit with *k* integral. We need a factor $k \approx 1$; it seems at first that we add a degree of freedom but we shall show that it is a geometrical constraint. The analysis of those masses is iterative and leads to important reasoning which is repeated in length. In practice:

a) A first cut of the fit gives the resonance numbers, which are N = P = 12, and K = –2, –7, –19 for the $W^{\pm}$, Z^0, and H^0 respectively. It immediately suggests the same fundamental geometry as quarks and leptons, then the same fundamental field and locally built potentials.

b) The empirical value of D for massive bosons is first approximated as $D_b \approx \alpha^2 (1 + A_S/2 - A_S^2/6)$; it suggests an interaction term that depends on α and D_e which we have computed with precision.

But now we have enough information to model the interaction; the equations (3.4) suggest:

- Two types of charges corresponding to the mass μ: E and C (electric and color) on which D depends.
- A free field (charges X), and the pressure is given by interactions: X×X, E×X, and C×X, hence D_b includes 3 terms, but the expression of D_b is incomplete as we do not compute all masses with precision.

On this basis, classification and trivial identification gives Table 3. It shows how the coefficients D work: Each individual interaction adds a piece of coefficient in D_b – like simple potentials adding or subtracting. But we can only compute a radial distance (which gives a radial strength), not the orientation of the force which can still be symmetry-dependent.

Table 3. Classification and minimal interpretation of the coefficients.

Line	Origin	Coefficient	Interaction	Interpretation	Logic
1	D_e *(3.4)*	αA_S	$X\times E$		Leptons charge
2	D_q *(3)*	αA_S	$X\times E$		Leptons → Quarks
3	D_q	$\alpha\times(\alpha A_S)$	$X\times C$	$X\times C = X\times(X\times E)$	Quarks charge
4	D_b	α^2	$X\times X$		
5	D_b	$\alpha\times(\alpha A_S)/2$	$X\times C$	$X\times C = X\times(X\times E)$	Quarks → Bosons
6	D_b	$-(\alpha A_S)\times(\alpha A_S)/6$	$(X\times E)\times(E\times X)$		Leptons → Bosons

Interpretational details are given hereafter (referring to the line of the table 3) and lead to understanding.

Leptons – Line 1; charge E.

$X\times E \rightarrow \alpha A_S$: There is only one elementary interaction; it just gives us its coefficient.

Quarks – Lines 2 and 3; charges E and C.

$X\times E \rightarrow \alpha A_S$: Same as electrons, and independent of the quark electric charge. It suggests that it is not directly the electric charge that gives the coefficient, but “something” constant.

$X\times(X\times E) \rightarrow \alpha\times(\alpha A_S)$: This is logically the coefficient for color charge; it shows that color is not a specific distinct charge but that it has the same nature and quantum as X.

Massive Bosons – Lines 4, 5, and 6: charges E and C.

The interaction is a little more complex. We found the same coefficients for the $W^\pm$ and the Z^0. One is electrically neutral and not the other. Still, we find coefficients related to electricity and color charge, and then those bosons are made of two fractional electric charges and two color charges. Then it is:

$X\times X \rightarrow \alpha^2$: The interaction of two charges X gives a distance α^2. This is the force on the resonance path that other interactions will augment or reduce – they are secondary forces or loops going thru this path.

$(X\times X)\times E \rightarrow \alpha\times(\alpha A_S)/2$: The coefficient $\alpha^2 A_S$ comes with quarks color charge; it also shows that the inner circulation of a massive boson is equivalent to that of two quarks, and different of that of a lepton. The 1/2 comes from the presence of separated charges.

$(X\times E)\times(E\times X) \rightarrow -(\alpha A_S)\times(\alpha A_S)/6$: This coefficient corresponds to the effect of the main resonance on separate electric charges. We recognize $D_e = \alpha A_S$ from the leptons, but *1/6* is new.

At this point, we understand what is going on and we can logically deduce all missing terms in the expression of D_b using α and A_S. For this, we need to complete the series of interaction loops with the free field X:

$X\times X\times X \rightarrow -\alpha^4$: Since $X\times X \rightarrow \alpha^2$ positive, and $K < 0$, the force in $X\times X$ is compressive and then whatever the sign of the X charge we put in between, the effect is the same, it reduces the main resonance and then the coefficient is negative $-\alpha^4$. Similarly, we must add additional loops ($X\times X\times X\times X\times$etc.); it gives a simple series converging to $\alpha^2\,\Sigma(-1^n)\alpha^{2n} = \alpha^2/(1+\alpha^2)$.

Similarly, each interaction must be augmented with any number of X; then the coefficient $-A_S^2/6$ is multiplied by $\Sigma(-1^n)\alpha^{2n} = 1/(1+\alpha^2)$ and the coefficient $A_S/2$ by $\Sigma\,\alpha^{2n} = 1/(1-\alpha^2)$.

The series make a small difference in D_b which is far from negligible when it comes to computing masses. The coefficient D_b for the $W^\pm$ and Z^0 is then:

$$D_{WZ} = \alpha^2\,(1/(1+\alpha^2) + A_S/2(1-\alpha^2) - A_S^2/6(1+\alpha^2)) = 5.62404904\ 10^{-5} \tag{3.6}$$

But it cannot be identical for the H^0, because its spin is not 1. Assuming it holds four charges frozen in a tetrahedral manner, the last interaction term is six times stronger:

$$D_H = \alpha^2\,(1/(1+\alpha^2) + A_S/2(1-\alpha^2) - A_S^2/(1+\alpha^2)) = 5.56338664\ 10^{-5} \tag{3.7}$$

It may also include additional loops thru the tetrahedron. The strength of a line linking two charges is 1/6, and a tetrahedron has 6 lines of force. It gives the first A_S^2 then this action propagates thru 6 lines and it gives 6 A_S^4. But it is not a free field, and then we may or may not use an infinite number of loops. We get, in second approximation:

$$D_H = \alpha^2 (1/(1 + \alpha^2) + A_S/2(1 - \alpha^2) - A_S^2 (1 + 6A_S^2)/(1 + \alpha^2)) = 5.55741566\ 10^{-5} \qquad (3.8)$$

Now let us come back to the coefficient k in (3.1). A first empirical fit gives:

$$k = 1.00127$$

In Table 4, we have $N = P$, and then those two resonances have the same orientation with opposite paths, but we find K in $\{-2, -7, -19\}$ the same numbers as for the quarks N which resonance is mixed. This is a double circular resonance and the length $K\ D_b$ is subtracted from the resonance radius. Consequently, there is a geometrical constraint between the length D_b and the circular path π/NP. Taking only the circular path into account and keeping the constraint coming from the radius, D_b should be a divisor of $\pi/NP = \pi/144$, a division that must hold with any K in Table 3. Since all Ks are primes numbers the constraint applies to their product. In this simplified picture (that cannot hold) we should have:

$$(\pi/144)/D_b = 2\times7\times19 \rightarrow \pi/144 = 266\ D_b$$

Now D_b is radial and a 3-sphere volume depends on the cube of its radius. Then we must use $D_b\ \pi^{1/3}$ on the right hand side; it gives a modified equation that is close to hold:

$$\pi/144 = 266\ D_b\ \pi^{1/3}$$

Last, π is multiplied by k in (3.1), and this equation addresses a volume; hence we must use its cube on the left hand side, and reduce π accordingly on the right-hand side; in this way we get comparable quantities and it gives:

$$k^3\ \pi/144 = 266\ D_b\ (\pi/k)^{1/3} \qquad (3.9)$$

Actually, we find an error of 10^{-5} with respect to the initial fit (empirical values) of D_d and k; that is:

$$k^3\ \pi/144 = 1.0000136 \times 266\ D_b\ (\pi/k)^{1/3}$$

Hence the interaction term D_b actually constrains k thru the resonance geometry. Now, the two sides of (3.9) represent lengths, and then taking their cube we get volumes. It gives:

$$(266\ D_b)^3 = k^{10}\ \pi^2\ (1/144)^3 \qquad (3.10)$$

It equates the volume of a 3-cube of edge $266\ D_b$ on the left hand-side to that of a 4-sphere ($V_4 = \pi^2 R^4/2$) divided by half its radius on the other side, where a correction $k^{10} \approx 1.013$ is needed for cubing the sphere. Hence D_b is an interaction term in 4D, k is geometrical, and (3.10) links a radial and a circular path in 4D. With respect to the premises of the theory, it is important that this 4D connection is identified. Now we compute k:

$$(3.6) \rightarrow k_{WZ} = 1.00128565 \qquad (3.11.1)$$

$$(3.7) \rightarrow k_H = 0.\ 998033312 \qquad (3.11.2)$$

$$(3.8) \rightarrow k_H = 0.\ 997711845 \qquad (3.11.3)$$

It gives Table 4, where the coefficient X is unchanged (masses in natural scheme); the last two lines correspond to the two study cases for D_H and k_H.

Table 4. Predicted Bosons Masses (*) MeV/c^2. (2) ATLAS-CMS (2015); see also ATLAS (2014), CMS (2014a).

Particle	P	N	K	Computed (*)	Measured (*)	SM Prediction (*)
$W^{\pm}$ (3.11.1)	12	12	–2	80,384.86	80,385 ±15	80,363 ±20
Z^0 (3.11.1)	12	12	–7	91,187.56	91,187.6 ±2.1	91,187.4 ±2.1
H^0 (3.11.2)	12	12	–19	125,206	125,090 ±240(2)	None
H^0 (3.11.3)	12	12	–19	125,094	125,090 ±240(2)	None

Independently of M_H the results in this table are quite miraculous because after understanding the interaction and some geometry, we compute the weak force bosons masses in agreement with measurement, and better than the SM for the $W^{\pm}$. We get an effective unified theory of resonances but only two force coefficients, α and D_e (or A_S), and X/μ and m/μ exist – but nothing specific to the weak force or the Higgs field except resonance geometry.

Last, we can better analyze the resonance in Table 4. Consider the length $2\times 7\times 19 = 266$. A phase lock between the radial and circular paths and the $K = -7$ and -19 imply two circular path lengths which are $L_1 = 2\pi\,(1 - 7/266)$, and $L_2 = 2\pi\,(1 - 19/266)$. Those are compatible if and only if $A\,L_1 = B\,L_2$, with A and B integral numbers. We must solve the following equation:

$$A \times 2\pi\,(266 - 7)/266 = B \times 2\pi\,(266 - 19)/266$$

The trivial solution is:

$$A = 266 - 19 = 247;\; B = 266 - 7 = 259$$

We get:

$$B - A = 12;\; A \times 2\pi\,(266 - 7)/266 = B \times 2\pi\,(266 - 19)/266 = 240 \times 2\pi + \pi \tag{3.12}$$

The main resonance number, *12*, appears on the left hand side of (3.12); it comes from phase coherence between the circular path and the working spots on the radius and we naturally get $N = P = A - B = 12$ which then depends only on K (we use only 7 and 19, but 2 is not a problem since 12 is even).

Finally all numbers and parameters in Table 4 are constrained or given by the fit to electrons and quarks and the main resonance is a full mix. We have two forces (α and D_e or A_S) and no specific coupling in the electroweak and Higgs sectors; this result seems in high disagreement with the SM concept.

3.3 Resonances Widths and Particles Lifetime

The expression (1) is a resonance equation and the computed masses correspond to the poles of the resonances. Here it looks like we have a first sight into a substructure of massive elementary particles. Since the structure is some resonance geometry it should be possible to compute resonance widths, and then lifetimes; in any case, if those resonances are right, the widths *must* be part of the resonances, and, *a-minima* they should just be the size of the resonance "slots". For this we have to understand the phase coherence between multiple resonance paths.

3.3.1 Bosons Widths

Recall that the bosons charges are found separated and organized in a symmetrical manner; in 3D, it is a tetrahedron for the H^0 and a simple straight line for the Z^0 and $W^\pm$.

For the weak force bosons:

- With two currents the symmetry is loose, and on the circular path *1/144* it suffices that N and P hold on *1/2* phase to stabilize the system. It authorizes a phase shift $(\pm 1/2)(1/12)$ giving on the radial part $\Delta K = \pm 1/24$.
- In the radial direction, we have *266* slots, and the same reasoning applies; it adds $\Delta K = \pm 2\times(1/2)$.

For the H^0:

- With 4 currents, the symmetry is fully constrained in 3D; then N and P hold together ($\Delta K = 1/144$).
- A tetrahedron has 6 lines of force that can break; hence the width is given by $\Delta K = 1/144/6$.
- Other loops add nothing as a tetrahedron is fully constrained in 3D.

On this basis, the resonance width is the difference in mass ΔM given by (1) with respect to the pole in Table 4 when we use K + ΔK in (1) to compute the particle mass M + ΔM. We get:

- $W^\pm \rightarrow \Delta K = (1 + 1/24) \rightarrow \Delta M = 2.085$ *GeV*, a perfect match with experiment *(2.085 ±0.042 GeV)*.
- $Z^0 \rightarrow \Delta K = (1 + 1/24) \rightarrow \Delta M = 2.468$ *GeV*, 1% less than expected (*2.4952 ±0.0023 GeV*).
- $H^0 \rightarrow \Delta K = 1/(144\times 6) \rightarrow \Delta M = 4.11$ *MeV* at *125.206 GeV*, which agrees with the SM prediction.

Hence, the widths come straightforwardly from the resonance geometry. But the Z^0 width is out of range and this can only be due to the difference in charges with the $W^\pm$ that we ignored. Now reasoning simply:

- $W^\pm$: The charges –e/3 and 2e/3 (or opposite) repel each other with a force coefficient $2e^2/9$.
- Z^0: The charges e/3 and –e/3 (or 2e/3 and –2e/3) attract each other, the force coefficient is $e^2/9$ or $4\,e^2/9$.

The difference in inner charges between the Z^0 and the $W^\pm$ gives a difference in forces which is:

$$2e^2/9 + e^2/9 = e^2/3 \quad Or: \quad 2e^2/9 + 4e^2/9 = 2\,e^2/3$$

It implies that the forces cannot be balanced in the same manner for the two bosons. Assuming the $W^{\pm}$ width computed value is exact, we need an additional coefficient to compute the Z^0 width. Since the forces in the calculus of D_b depend on charges, from the equations above the missing coefficient is *1.5/137* or *1.5 α*. It gives:

$$Z^0 \rightarrow \Delta K = (1 + 1/24 + 1.5/137) \rightarrow \Delta M = 2.4946\ GeV$$

which agrees with the SM prediction and experimental data. Unfortunately, it is not possible from this result to distinguish between the possible charges e/3 or 2e/3 for the Z^0, because a factor 2 can also relate to 1/2 phase (for instance) – but the *1.5* seems valid and means fractional charges. Moreover the experimental precision for the $W^{\pm}$ and Z^0 width differs by one order of magnitude; hence our reasoning, which is differential, is only valid inasmuch as we get a perfect match with the central value for the $W^{\pm}$ and if this value is better than its uncertainty.

3.3.2 The Top Quark Width

Quarks are sub-harmonics of a high resonance $N = 2 \times 7 \times 19 = 266$ on the circular path. This is the physical constraint and then also the resonances to break; it suggests $(K + 1/266)$ and the same problem as for bosons: The width comes from the de-synchronization of two paths. The resonance corresponding to $P = 3$ is on the other path and requires a phase lock with the N; it increases the coefficient proportionally to $P = 3$ thus reducing stability; the coefficient is now $(K + 3/266)$. But the resonance is mixed with two orthogonal paths; the path length is then possibly multiplied by $\sqrt{2}$; hence the width is either:

$$K = (-6 + 3\sqrt{2}/266) \rightarrow 1.97\ GeV$$

$$K = (-6 + 3/266) \rightarrow 1.5\ GeV$$

Compare with experimental data: *2.0 ±0.5 GeV* or *1.5 ±0.5 GeV* depending on sources.

3.3.3 Leptons Widths

The bosons and top quark widths are just the size of the working "spots" in the resonance geometry; but the resonance to break is always circular. Leptons are a double radial resonance on 2, which cannot be broken, but also include a second path in the case of the muon and tau as we find N = P = (7 – 2) or (7 + 2); then the problem is not the same as before. The first point is to distinguish two cases:

- The electron has no circular path and then it is stable.
- The muon and tau should have a circular path building their resonance and then they are unstable.

Then as we expect from the standard theory, the stability of the muon and tau are the same problem. Those two particles need to be destabilized on the 7. But 7 comes from (8 – 1), and it implies a direct link with U(1) which has no rotation. So, we are back at square one; we can only compute the leptons widths in the same manner as the SM.

3.4 Charges Ratios

Now we have a single field and it is interesting to estimate charges ratios, but we can only compute their radial effect, not the forces orientation; from Table 3 the distances building D are in reverse proportions of charges.

For an electron K = 2 and for quarks, K = – 6, and $D_e \approx D_q$ then this assumption seems appropriate for a down-type quark but maybe not for an up-type. From Table 3 and the parameters D, taking into account the differences in K, since $X \times E \rightarrow 2\ D_e$ for the electron and $X \times C \rightarrow -6\ \alpha\ D_e$ we get:

$$\frac{C}{E} = \frac{2\ D_e}{6\ \alpha\ D_e} \rightarrow C = \frac{E}{3\ \alpha}$$

which has a clear scent of a 3+1D monopole though not magnetic but color – which, importantly, does not depend on the quark electric charge since the coefficient 3 is constant for quarks.

In Table 3, we also have $X \times X \rightarrow \alpha^2$ and $X \times C \rightarrow 6\ \alpha\ D_e$, and we find:

$$\frac{C}{X} = \frac{\alpha^2}{6\ \alpha\ D_e} = \frac{\alpha}{6\ D_e} = 1.4254503 \approx \sqrt{2}$$

which is in range of 1 and compatible with a single field; it looks geometrical.

3.5 Conclusion

With 5 degrees of freedom (or 4 if we impose N = P), it is not surprising that the Table 1 can be found from the leptons masses; even though the resonances numbers are small and structured this table is not much significant in itself. At the opposite, even considering the uncertainty on quarks masses, it is not possible that the fit in Table 2 exists for quarks if those masses are random. In facts, this table shows only one possible degree of freedom which is $D_e \rightarrow D_q$. Next, the logic developed from the identifications in Table 3 lead to compute the bosons masses precisely from coherent couplings and geometry, and the equation (3.10) imposes 4D resonances (which will be important in the remainder of the analysis). Last, the bosons widths are computed and all integral resonance numbers and geometrical aspects fit with the known symmetries and predictions. Hence there is absolutely no randomness in the elementary particles mass spectrum, and the theory and the equation (1) are valid up to known decimals.

Then in first conclusion, we state that our conjecture is verified for the elementary particles mass spectrum, and:

1) The spectrum is structured from two constants α and D_e (or A_S), which then relate to the fundamental field and then logically to some characteristics of the supposed membrane.
2) *Independently of premises, it shows that a single field exists which is probably broken by the course of time – hence the breach is purely geometrical.* (It gives a part of the premises.)
3) The fact that we find only two constants there (including α), plus X constant is significant. It shows that the fundamental interaction can be split at most in two geometrical pieces. Their orientations are orthogonal and then space and time; therefore:
    a. The coupling D_e is universal as it appears in all parameters D.
    b. The coupling α relates to the free 3+1D field and cancels in D_e only, not for quarks and bosons.
    c. They combine in a 4D manner for massive bosons as per (3.10) and for quarks.
4) The standard model weak force coupling constant can be computed from the results in this section; it is then emergent and fully determined by resonances – but not yet α and D_e which are fundamental and identified to the two expected couplings.

Inasmuch as the mass spectrum is entirely defined from symmetries, the SM Lagrangians are completely determined if all electric and color charges come from identical radial resonances and action – which appears to be the case since we find P = N = 2, 7 – 2 and 7 + 2 for leptons (where the 7 is necessarily the impact of a mixed resonance) and P = 3 for quarks – plus of course the parameter *X = constant*. The weak force is emergent and also entirely defined. (Incidentally, the muon and tau widths can then be computed with the SM techniques.)

Now we need a similar exercise on couplings and other verifications concerning charges and currents; even though charge ratios are coherent with our initial deductions we did not discuss 4D currents and 3+1D charges. We still need to quantize currents.

It seems difficult to imagine any relation with quantum mechanics, non-locality and such things. The reason is that we use a very classical concept with a single length = 1 to perform the analysis; the reader may have in mind some scale linked to the Compton wavelength or even the Plank scale. But as we shall see later this picture is completely wrong.

4. What Next?

At this point we understand the resonances numbers and the coefficients D, but this is 3+1D. We find two coupling constants which are computed but not fully understood; we could use a fit to the equation (0) right away but then what would that prove? On the other hand, we infer that the field is structured in two manners: from time-currents and from symmetries; then before discussing the other SM parameters we shall structure the field accordingly. We still try to understand what it is, not only to give a limited parameterized description.

Essentially, this is at first some try-and-error conceptual guesswork for which we do not have much input. So the initial method is the following:

Guesswork → Coherent Models → Equations → Verifications

We shall test our models with respect to existing data; it concerns intrinsic particles properties, not interactions for which the SM exists. The purpose is to make models as simple and coherent and as possible, and then check if the coherence is sufficient to enforce additional properties that can be explored (the normal way in theory).

Of course, the field structures relate to the premises and some of their consequences were presented before. Still, for clarity, we repeat the initial reasoning step by step.

4.1 A Toy Model

Rationale: The same parameter X or X/μ is used for all masses, including leptons; but the leptons resonance numbers are not in obvious relation with those of quarks and bosons. Denoting N(x) and K(x) the resonance N and K of a particle x, we have:

$$N(e) = K(W) = 2$$

$$N(\mu) = K(Z) - K(W) = 7 - 2$$

$$N(\tau) = K(Z) + K(W) = 7 + 2$$

Then we can model an electron with the same "contents" as the W and add a Z for the muon and tau; once extended to other massive particles it gives the following:

- Leptons: e^-: $[\uparrow^-\downarrow_+]$; μ^-: $[\uparrow^-\downarrow_+\uparrow^-\uparrow^+]$; τ^-: $[\uparrow^-\downarrow_+\downarrow_-\downarrow_+]$.
- Bosons: Z^0 can be: $[\uparrow^+\uparrow^-]$ or $[\downarrow_+\downarrow_-]$; $W^\pm$: $[\uparrow^+\downarrow_-]$ and $[\uparrow^-\downarrow_+]$; H^0: $[\uparrow^+\uparrow^-\downarrow_+\downarrow_-]$.
- Quarks: t^+: $[\uparrow^+\downarrow_-\downarrow_+\uparrow^-\uparrow^+]$; b^-: $[\downarrow_+\uparrow^-\uparrow^+]$; c^+: $[\uparrow^+\downarrow_-\downarrow_+]$; s^-: $[\downarrow_+]$.

where the notations are trivial for up-time and down-time currents charges and directions (the sign is the current, not the apparent electric charge); those model the time-currents. The idea of 4-dimensions of space is part of our premises, but it is also coherent with the equation (3.10) that connects the radius and the circumference of a 4-sphere. Incidentally, we get rid of the embarrassing notion of generation; a muon is not "just a fat electron".

It is trivial to show that the model enables to picture the leptons and quarks decays of the SM; essentially:

- Leptons decays output the currents of a Z to give a lighter lepton and a neutrino.
- Quarks decays output the currents of a W to transmute, the W output a lepton and a neutrino.

We do not model the *u* and *d*, firstly because N(d) = 19/7 = N(t)/N(c) = N(b)/N(s) suggests mixing (and complimentarily N(u) = 2 = N(t)/N(b) = N(c)/N(s)), but also because if we extend the model with the same decay logic we get the same time-currents for the *s* and *d*. Additionally, the SM gives a weak isospin to the *u* and *d* while the others are granted a specific flavor number – which shows two categories of quarks.

It is known that electrons (and other leptons) are not composite of quarks, and then the notation above is abusive as it is, we should use $e^- = [\updownarrow^-_+]$, because when currents are separated (bosons and quarks), a second charge appears.

The initial idea leading to this scheme come from an analysis of the Bohr model and de Broglie's thesis [2] which we shall now repeat in short and then relate to the model above (it will show part of the rationale to the premises in section 2).

Note that with respect to the charges ratios in section 3.4, we come close to saying that the elementary currents are also monopoles, but it might be short-sighted since what we see in 3+1D is just a projection of 4D currents. If one cannot isolate a monopole (or at least discriminate its location) then it is not a particle.

4.2 Quantizing the Electron Wave

Here we model the electron with a charge e and its wave as a magnetic current that we denote $\beta\, \boldsymbol{X}(r, t)$, where β is magnetic and $\boldsymbol{X}(r, t)$ a unitary function; conversely, an element of the wave is defined by a charge g, and an electric current $\xi\, \boldsymbol{Y}(r, t)$ where $\boldsymbol{Y}(r, t)$ is a possibly different unitary function and ξ is electric. The ratios between charges and currents should be identical for an electron and a wave element; since the coupling of a charge with the field "is" the charge, the coefficients do not depend on the type of charge. This leads to the following equality:

$$\xi / g = \beta / e \rightarrow g\, \beta = e\, \xi \tag{4.1}$$

Now as we model the wave as successive individual charges, it is natural that symmetry exists in its simplest form of action-reaction. Using classical electromagnetism, the electron will be seen with a fixed electric charge and a velocity-dependent magnetic field; conversely a wave element will be seen with a velocity-dependent charge and a constant current. The symmetry of interaction implies:

$$g\, \beta\, \boldsymbol{X}(r, t) = -\, e\, \xi\, \boldsymbol{Y}(r, t) \tag{4.2}$$

This equation addresses the force exerted on an element of the electron wave; then this force, which is $g\, \beta$, except from some numerical coefficients, is opposed to the classical force exerted by a wave element on the electric charge of the electron, which is proportional to $e\, \xi$, and the coefficients are the same. Equation (4.2) implies (4.1) since basically the reasoning is the same.

Let us now look at the Bohr orbits of the hydrogen atom as the interaction of an electron wave with a proton; g and ξ are unknown, but the change in phase of the electron wave in its interaction with an electron corresponds to a phase shift π, as it is related to the electron spin. On the other hand, the change in phase of the de Broglie wave around a proton is $\pi(2n+1)$ for any orbit, and includes one π related to spin. The latter is $2\pi\, n$ and depends on $\alpha\, e\, \beta$, the former gives π and depends on $e\, \xi$, and then:

$$\alpha\, e\, \beta = 2n\, e\, \xi \tag{4.3}$$

Both parts of this equality are related to phase quantities which can be compared, and the coefficient α is solely on the left hand side. It gives an inversion of the coefficients with respect to Dirac's monopole theory: α is in front of $e\, \beta$, and the $2n$ in front of $e\, \xi$. The equation (4.3) gives $\xi = \alpha\, \beta / 2n$, and then substituting in (3.12), we have:

$$g = \alpha\, e / 2n \tag{4.4}$$

Using $n = 3$, we find $g = \alpha\, e/6$ which is Mikhaïlov estimate of the elementary monopole charge. The series in (4.4) is in the range of the fuzzy magnetic charges systematically detected by Mikhaïlov [18, 19,20, 21, 22], Ehrenhaft [14, 15], Schedling [26] and Ferber [16] in similar experiments. Now the quantity g corresponds to one period of the electron pulsation, and to the de Broglie wavelength. But we have n de Broglie wavelengths on the n^{th} orbit; then, since the de Broglie wave phase velocity is proportional to n in the Bohr model, it implies that β and ξ are constant. Moreover, the de Broglie wave phase velocity is $V(n) = n\, c/\alpha$, and then $g(n)\, V(n) = e\, c/2$. One could say that this is just half the magnetic field ($B = e\, v/c$); so much the better, because it defines quanta of charges and currents in a classical relativistic manner. We can see this charge as the electron currents in the tachyon domain. Finally, extending to de Broglie's $V = c^2/v$, we get:

$$g\, V = e\, c / 2 \tag{4.5}$$

which is the relativistic transformation of a tachyon monopole; not a punctual particle but the "mirror image" of the electron as seen in all directions thru the light-speed mirror, and this is what the equation (1) is about.

4.3 Relating the Toy Model with our Premises on Space and Time

Using (4.5), we get quarks electric charges in agreement with the toy model assuming that the 3 + 1 D space-time is progressing in 4D with a constant velocity: using $\boldsymbol{V} = (V_t, 0, 0, 0)$, it gives, by Galilean addition $V_t = c/3$ (which seems unacceptable, but it is not as obvious as it seems).

The interesting point is that the same velocity $V_t = c/3$ also comes from (4.5) using de Broglie's $Vv = c^2$; it means that on this basis a direct and simple connection is possible between a 4D space and 3+1D space. But the 4D space must be augmented with its own time (which is not necessarily a dimension) because the 3+1D slice propagates. Hence the connection is not purely mathematical but physical. It is even doubly physical as it comes with a unique quantum. It also agrees with the Cramer interpretation of quantum mechanics which is necessary since we assume in our reasoning to the equation (1) that the time-currents are permanent and host the query and response waves for massive particles.

Here the observable space is a moving 3D slice in which observation happen and from/to which quantum decoherence propagates:

- The present is fuzzy and frozen by measurement or interaction, it is seen as a building process similar to a phase transition from quantum states coherence to decoherence. Quantum coherence is permanent between past, present and future, but it only needs to be frozen by interactions since before then only undetermined states amplitudes exist.
- The past is coherent and preserved, but still active. The future is undetermined. It is not necessarily needed that time-currents are localized in the past and future. The only need is that information exists.

This picture needs at least a long paper in itself, so we shall only explain here some parts of the rationale and how we see it. It is likely that some of those ideas exist in the (old) literature, but probably not assembled in this manner.

4.3.1 Acceptability of $V_t = c/3$

Classically, we represent the light cone using $c = 1$ like in the Figure 1 but with the angle $\theta = \pi/4$. In 4D Euclidean space we imagine naturally a particle with velocity in time $c\sqrt{2}$, in such a manner that a photon emitted and then reflected back to the same point will meet it at the right epoch. But in facts, we do not discuss particles but extended currents, in which case the angle θ can be anything and only depends on quantization.

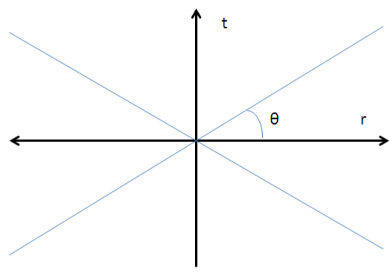

Figure 1. Light cone (blue) and velocity in the time direction (angle θ).

4.3.2 Rationale for a Unique Quantum of Current

One of the shocking mysteries for the early quantum physicists was the existence of constants of action h and angular momentum $\hbar/2$; even though their existence are well-known and not questionable, the question of their origin, of their necessarily physical interplay and the origin of their universality are still open. One minimal explanation is the existence of a unique quantum. It is also interesting to show coherence with our idea of currents. A current between A and B can be any quantity, but the equation (4.5) imposes a definite action term which is:

$$e\, g = e^2\, \alpha/2\, n$$

It is opposite to the Dirac condition but once multiplied by the number of Compton wavelengths around the Bohr orbit (the round trip of the wave) it gives $e^2/2$; next, one more multiplication corresponds to the round trip of the electron and gives $n\, \hbar\, c/2$ which is half the electron angular momentum and the Dirac condition. But the quantization of angular momentum is universal; then we state, with respect to our logic, that the electron "is the monopole of its wave and conversely" and it defines the resonance of the electron when around a proton.

4.3.3 Chirality

The SM is a chiral left-handed theory, an aspect which is purely phenomenological and has no admitted explanation at this time (in the SM). Here, the down-time currents are faster than light while the up-time slower. Then, there can be an apparent inversion of charge and/or chirality between up-type and down-type currents as seen from the 3D plane. At least two solutions seem plausible:

- Firstly, a simple inversion: We can just assume that the chirality of currents is just inverted on each side of the light-speed singularity.
- Secondly, and oppositely, assuming charge = chirality, the inversion remains and the concept can be reduced.

We face the interesting possibility that 4-space is a solid object where observable particles are only movement.

4.3.4 Time and Symmetry

The question is to understand how and why we measure space-time (3 + 1 dimensions), why a pseudo-norm exists. Because simultaneously, wave equations give a ψ (r, t) which is interpreted as a density of probability, and field theory requires some integrals to the infinites in space and time to compute probabilities. The interplay of 3+1D and 4D looks like a contradiction; even though efficient mathematical treatments exist, this is one of the core conceptual problems between the quantum and relativistic worlds. Our premises provide with a coherent explanation which is probably minimal: both exist and 3+1D lives in 4D – the Minkowski time co-ordinate is more or less a mere imitation.

It is important that in this model the CPT theorem is valid in 4D where C, P and T are respected separately and CPT altogether (as it includes an inversion of currents direction, of the sign of their charge, of chirality, and of the velocity V_t); but not if we revert only V_t (which only inverts the apparent electric charges), it is not even T symmetric in 3+1D where time symmetry is then naturally broken. For instance, if we only reverse V_t a charm quark becomes a bottom, and they do not have the same mass (and reversing a top does not give a strange). Consequently this toy model has more interest than it seems at first sight. It is reductionist as in contains only 4 types of time-currents but it contains more relevant information that was inserted blindly.

4.4 Picturing the Field Structure

Now we want to map the field in 2 dimensions. The possible gain is that if we use a good system of coordinates (or constraints,) the resulting map may contain more information than we initially put in, because premises require that the resonances modes/geometry and numbers define all particles entirely, including charges, couplings, and then interaction. The rationale to the used map is the following:

- The resonance numbers of quarks and massive bosons are 2, 7, 19 and 12 (= 19 – 7). They also relate to symmetries and leptons. Then we should order particles "by resonance".
- A 2D map needs one more constraint; we shall use the electric charge as it will impose some symmetry.
- The resonance numbers 7, 19, are cube differences but also centered hexagonal numbers and 37 and 61 are the next two, but 61 is also the full SM particles count. Then it may be of interest to organize the field spectrum in a centered hexagonal manner but we have neither 37 nor 61 in the resonance tables.

The manner that fits is to use 19 core states and 42 mixes. It gives Figure 2, where we picture the core field (19 fundamental states) where 42 (= 61 – 19) SM states are mixes and pushed to some more external layers. The organization is based on electric charge and resonance "sectors" (respectively left and right brackets on the figure). One first puts leptons and bosons around the symmetry of electricity; then we need to add 4 objects (T, B, C, S) which complement the external layer. The other 42 SM states constitute the last layers (rings 37 and 61); they are seen as mixed states of (T, B, C, S), which resonances are now necessarily the same as four quarks (t, b, c, s) – due to their position on the map.

Importantly, we do not search a mathematical group that copes with the field geometry firstly because groups are already melted in the resonances. We only try to find an elegant and minimal picture which geometry relates simultaneously to charges and resonances. Then we will try to use it to analyze mixings and other quantities – if the picture is good enough *and the field natural*, it should contain more information than just charges and resonances.

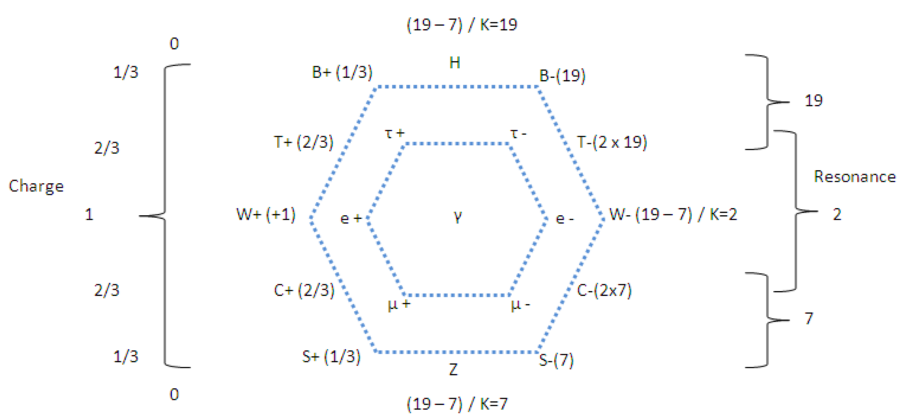

Figure 2. Core field structure, from electric charge (left half) and resonance (right half).

Eventually, the resulting structure is already a little richer than this:

- We put the photon field (γ) at the center as its resonance is 1, this is the free field.
- It splits in e^+/e^-, which resonance is 2, this is SU(2). The ring 7 includes the μ and τ, and their resonances (N = P) are 7 – 2 and 7 + 2 respectively. This is SU(2) combining with itself.
- The ring 19 connects to the ring 7 at the bottom and uses the resonance 19 only on the upper part. The electroweak bosons of the SM only occupy the lower part of the picture (where 19 is absent in K but still present in N = P = 12 = 19 – 7). The upper part is similar but not symmetrical to the lower one.
- We do not know where to put neutrinos – which are known to mix and/or oscillate.
- The map almost looks like an inversion of the real field: The range (lifetime) and/or confinement of core particles is in rough reverse proportion of their distance to the center. The free field is at the center (we do not consider neutrinos but only the core field).
- There is a mirror-broken correspondence between the lower and upper part of the field; in particular for the bosons field: (Z^0, $W^{\pm}$, γ) on the lower part, and (H^0, $W^{\pm}$, γ) on the upper part.
- This map shows a simple form of structural self-definition which agrees with all previous results:
    - The symmetries SU(5) and SU(4) may come with the two external layers (their cube differences are 61 for SU(5)/SU(4) and 37 for SU(4)/SU(3)).
    - And U(1), SU(2) and SU(3) come with the central layers (1 for U(1), and cubes differences 7, and 19 for the SU(2)/U(1) and SU(3)/SU(2)).
    - Then for each layer of the core field, the number of "inner particles" is the main resonance number appearing with this layer.

This structure is a little bizarre but it works at all levels of the SM field. It looks as though the number of particles on a given layer defines a resonance number; if so, it is the self-interaction of the field that defines all resonances and it does so at each level.

This map is also coherent with the toy model. It is easy to draw the currents for each particle and check that the currents of neighboring particles are related to each other, and also between resonances sectors.

It is also important that the dissymmetry of time appears in the map and in the toy model in compatible manners. In particular, the two extremes are the Z^0 which currents are up *or* down while those of the H^0 are up *and* down.

5. Leptons, the Parameters X and μ, and the Fine Structure Constant

Now we want to test the models, to check if they work and to what extent – but we also seek directions. A direct manner is to solve some physical problems which solution is known, but in a manner that agrees with the premises of the theory and using the results in the previous section; we need then to compute some existing precision data without any use of the standard theory. We start with leptons where best precision exists.

There are at present, four additional precision "intrinsic" quantities known for leptons. Those are the electron and muon magnetic moment anomalies (g – 2), their spin, and of course the fine structure constant. In this section we show how the definition of particles provided by the toy model enables to computing the (g – 2) and α with high precision in a much simpler manner than the standard theory; and quite surprisingly we find how the spin is represented in the equation (1). The method is similar to those in the previous section. It is based on four coincidences and their analysis.

5.1 Coincidences

At first we just grab the coincidences that seem significant. The analysis of the parameters D was productive and we now pay attention to the parameters X and μ which are universal and computed with high precision from the leptons masses, they address the free 3+1D field and then the coupling α.

5.1.1 Lamb Shift, Bethe's Equation

Bethe [1] computes the hydrogen Lamb shift; he gets:

$$\Delta E = (\alpha^5 m_e\, c^2/6\pi)\ \log\, (m_e^2\, c^2/8.9\ \alpha^2\, m_e^2\, c^2) \tag{5.1}$$

where m_e is the electron mass; the expression in the logarithm depends on the cutoff and gives a ratio between the electron's absorption and self-interaction and then in our model μ and $(m_e - \mu)$ respectively; but according to the mass-equation, self-interaction and absorption may be reversed with respect to QED, we find:

$$\frac{m_e - \mu}{\mu} = \frac{1}{8.8857\ \alpha^2} \tag{5.2}$$

The relative difference with respect to Bethe's result is $1.6 \cdot 10^{-3}$ (or $2 \cdot 10^{-4}$ for ΔE) and then μ seems relevant with respect to Bethe's analysis. We notice another coincidence with the same quantities:

$$\frac{m_e - \mu}{\mu} \approx \frac{\sqrt{2}}{4\pi\, \alpha^2} \tag{5.3}$$

The relative error in (5.3) is $\approx 1.25 \cdot 10^{-5}$ and it gives a difference in mass $\Delta\mu \approx 3\ meV$, which is well within uncertainty of the electron mass precision ($\pm\ 11\ meV$). Consequently, since Bethe's paper is seen as the very first step to QED, X and μ should be fundamental quantities directly link to QED.

5.1.2 The Dirac Condition and the Parameters X and μ

Dirac [10] analyzes the possibility of existence of magnetic monopoles using quantum mechanics. Based on the mathematical properties of the electron wave function interpreted as a density of probability of presence, he shows that a monopole is compatible with the existence of quantum mechanics in Hamiltonian form if and only if the so called Dirac condition is respected:

$$e\ g = \frac{n\ \hbar\ c}{2} \rightarrow \frac{g}{e} = \frac{1}{2\alpha} \tag{5.4}$$

It results in the elegant idea that the existence of magnetic poles fixes the electric charge and conversely.

Here we assume that the electron wave is a physical magnetic current; since Dirac's demonstration is based on the "fields of force" acting on the electron wave then magnetic currents acting on electric charges must obey the same condition. But in our model e is an *apparent* charge (say e_e) and also a sum of time-currents (say e_m) and its monopole that we will denote g_m. Both must be taken into account in the condition as part of the total current; then for any charged lepton it should be:

$$e_e\ (g_m + e_m) = \frac{n\ \hbar\ c}{2} \tag{5.5}$$

Now compare with our data and assume $e_m = e_e$. The fundamental resonance in equation (1) corresponds to a theoretical half electron, that is N = P = 1, K = 0, and a self-energy μ/2 that we shall first ignore.

It gives, as per (1 – 3.3):

$$m = \frac{X}{1} = 8.14512104162332\,\frac{KeV}{c^2} \tag{5.6}$$

This mass must be compared to μ as it comes from the interaction of the time-currents (not the apparent charges) and then, for an electron, as the product $e^2/4$. The rest of the electron mass (N = P = K = 2) is given by the pressure field and it should also correspond to a product; then in (5.7) the numbers (N = P = 1) correspond to a hypothetical particle where a current G is interacting with *e/2* which mass is given by an action corresponding to *G e/2*.

Now we analyze how actions come, but not energy for which we rely on resonances. In the hypothetical resonance above, it corresponds to the products *e G* and $e^2/4$, where G^2 is absent. It leads to a correspondence between action and energy, where frequencies are identical, and it first gives the following correspondences:

$$(e\,G)/2 \leftrightarrow m;\ e^2/4 \leftrightarrow \mu \tag{5.7}$$

We divide the expressions in (5.7), and in light of (5.5) we add *e/2*, which is the *μ/2* that we first ignored; we find:

$$\frac{2\,G}{e} = \frac{m}{\mu} \rightarrow 4\,G + e = 68.4051246542\,e \approx \frac{e}{2\,\alpha} \tag{5.8}$$

We recognize the modified Dirac condition in (5.5). The fine structure constant appears straightforwardly from the equation parameters but the result seems approximate. At first the relative discrepancy ($-1.65\ 10^{-3}$) seems acceptable since we analyze a hypothetical particle but we shall see that this numerical value holds precisely.

There is a second aspect related to the Dirac condition which comes from the toy model and the apparent electric charges *e/3* and *2e/3* going respectively down and up the time; according to premises their individual self interactions are squared charges. Once again, we can link action and energy:

$$(e/3)^2 + (2e/3)^2 \rightarrow \mu\,(1/3)^2 + \mu\,(2/3)^2 = 5\,\mu/9 \tag{5.9}$$

Now from (5.6):

$$4(m + 5\,\mu/9)/\mu = 137.0324715 \approx 1/\alpha \tag{5.10}$$

The relative discrepancy with respect to α is $\approx 2.26\ 10^{-5}$. The coincidence can be seen redundant with the equation (5.8) as it is almost identical, but it comes from a different interaction and we shall see that this complimentary value also holds precisely.

5.2 The Electron Mass and Spin, Rough Analysis of the Coincidences

A physical action is a product of charges or currents (P6); then we analyze action and not energy. Accordingly, the electron mass comes as a repeated action (E = h ν); action is a product that we first write in complex form:

$$\left(G + i\frac{e}{2}\right)\left(G - i\frac{e}{2}\right) = \left(G^2 + \frac{e^2}{4}\right) \rightarrow m_e \tag{5.11}$$

where *e/2* represents the currents, not the apparent charges. Now we write (5.11) in quaternion form:

$$\left(G + i\frac{e}{2}\right)\left(G + k\frac{e}{2}\right) = \left(G^2 + j\frac{e^2}{4}\right) + (k + i)\frac{e\,G}{2} \tag{5.12}$$

The rationale for this equation is that the time-velocities are on each side of the light speed singularity. According to relativistic tachyon theory (Recami & Migneni, 1976) such currents *in 3+1D space* will see the other rotated on a hyper-complex plane. Here we assume the same for time-currents. Note that G is real and not rotated as it corresponds to currents in 3-space. We recognize in (5.12) the masses of (5.11) and then we can identify:

$$\left(G^2 + j\frac{e^2}{4}\right) + (k + i)\frac{e\,G}{2} \rightarrow m_e + angular\ momenta \tag{5.13}$$

Angular momentum splits into two components on orthogonal axis. Then one is the magnetic moment and the other is along the time axis; we will denote it the "spin". Now we (wrongly) identify the squared charges in (5.13) with the masses in (5.3); it gives:

$$4\pi\,\alpha^2 G^2 \approx e^2\sqrt{2}/4$$

Substituting G with a Dirac charge, we get $1 \approx \sqrt{2/4\pi}$ which is ridiculous but looks like a geometrical ratio where G^2 is 3D while $e^2/4$ is 1D; hence the coincidence (5.3) does not relate to energy but to a relation between two physical actions. Multiplying each side by the Planck constant we get the following correspondence:

$$h \leftrightarrow \sqrt{2}\,\frac{\hbar}{2} = |(i + 1)\,\frac{e\,G}{2}| \tag{5.14}$$

which interpretation is obvious: A repeated action h is energy ($E = h\,\nu$) and it makes the leptons spin and magnetic moment. Hence assuming magnetic currents we find that the quantities output by the equation are in rough algebraic and good numerical agreement with the model. We guess that the resonances should enable to computing the leptons magnetic moment anomaly. By the way, we now understand that the mass μ represents the particle spin.

5.3 Leptons Magnetic Moment Anomaly

We have no wave equation, only resonance numbers and special relativity. But the resonances must "construct" the leptons waves; unlike the classical wave equations this construction is not unique but lepton-dependent. Even for the electron it seems hardly possible to make an exact link with the Dirac equation which, according to the equation (1), should be incomplete; consequently we go back to de Broglie's thesis which is fully relativistic. Note that we now assume special relativity in which we shall melt the resonances. The 3+1D emergence is not proven at this point but we just try to figure-out if it the resonance concept can lead to recover known results.

5.3.1 De Broglie Wave Geometry

In his thesis, de Broglie uses a standing wave, that we will denote the Compton wave, and finds a phase wave (now known as the de Broglie wave) as a result of the relativistic transformation of the former.

The change in phase of the de Broglie wave over the first Bohr orbit of a hydrogen atom is 2π, while the Compton wavelength change in phase over this orbit is $2\pi/\alpha$. Then over any number of Compton wavelengths, we have:

$$\Delta\varphi_D = \alpha\,\Delta\varphi_C \tag{5.15}$$

where $\Delta\varphi_D$ and $\Delta\varphi_C$ are the changes in phases of the de Broglie and Compton waves. On the n^{th} orbit we find:

$$\Delta\varphi_D = \Delta\varphi_C\alpha/n \tag{5.16}$$

There are n de Broglie wavelengths around the n^{th} Bohr orbit and we get a constant angular differential term α. The same reasoning applies in the case of a nucleus of charge Z e and gives the same value. Hence, considering that the de Broglie wave defines the motion of the electron this term is universal in the Bohr model.

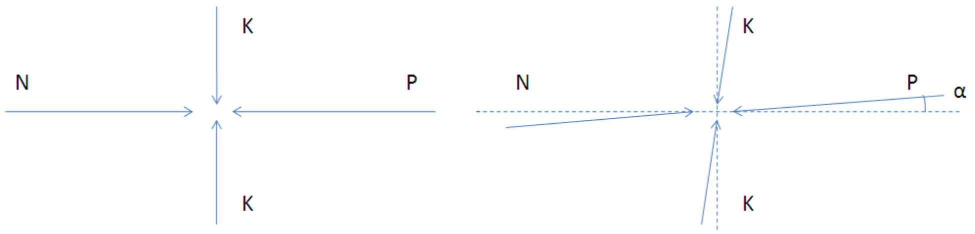

Figure 3. Resonance geometry on N, P, and K. Left: an electron seen at rest, K on the time axis, N and P in 3-space. Right: An angle α appears as a relativistic shift on the first Bohr orbit when axes are bent by velocity.

In (5.13), the spin comes with the magnetic moment from a product of quaternions. When an electron is at rest they are on orthogonal axis and of equal amplitude. But when the electron is on the first orbit there is a rotation of the time-current of an angle $v/c = \alpha$ which ratio to the space current changes in proportion of the tangent of this angle (adding the γ of special relativity). As stated, the impact is a phase differential and now it depends on $tan\ (\alpha)$; it runs around the full Bohr orbit and then the instantaneous geometrical action term is $tan(\alpha)/2\pi$. The action given by $tan(\alpha)$ is that of a resonance going around the full Bohr orbit and it must cycle on $1/2$ quantum (or $n + 1/2$ quanta on the n^{th} orbit); hence the first correction term to the electron magnetic moment is:

$$a_0^e = \frac{tan\ (\alpha)}{2\pi} = \frac{(g - 2)}{2} \tag{5.17}$$

where we denote a and g the correction and the g-factor respectively.

Compare with the first order QED correction as found by Schwinger [37], the well known *α/2π*. The difference is subtle; it comes from distinct manners to taking into account relativistic effects. Here we use a pure relativistic picture and it suggests that taking into account the particle resonances and special relativity in a perfect manner should give an analytical solution. In facts, the difference is that we consider the electron as a 4-gyroscope which axis is bent by velocity according to special relativity. This axis (a plane) is shown with the resonances N, P, K in Figure 3.

Now consider that the angle between Euclidean 3-space and time is *π/2* and a helicoid of angle α corresponding to the time-current (along K in Figure 3). We get an angular ratio *α/(π/2 – α)* which gives a ratio of reciprocal action (or pressure) equal to *sin(α)/sin(π/2 – α) = tan(α)*; here again we find a direct correspondence with the currents and pressure but not with *α/2π*; hence the coefficient *tan(α)* will lead, for the electron, all other coefficients to compute the anomaly.

The existence of this angle and this ratio of action can be verified as it also corresponds to the coincidence (5.3); after appropriate replacements of α^2 by two coefficients corresponding to those two angles, (5.3) gives:

$$4\pi\ (m-\mu)sin\ (\alpha)\left[(\pi/2-\alpha)sin\left(\frac{\alpha}{\pi/2-\alpha}\right)\right]=\mu\sqrt{2}$$

which holds with a relative precision of $2.9\ 10^{-8}$ instead of $1.25\cdot10^{-5}$ for (5.3).

Let us come back to the geometry of the equation (5.10), and to the angles in Figure 4. They correspond simultaneously of our ideas of time currents and to the first Bohr orbit.

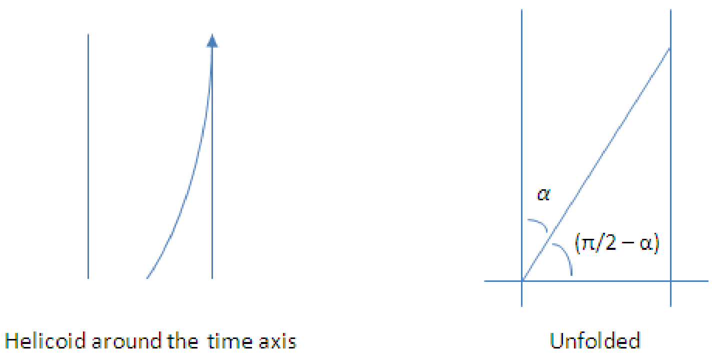

Figure 4. Currents helicoid. The arrow defines the line of equilibrium of currents interaction.

In Figure 3, space-currents are horizontal (3-space) and time-currents vertical (time axis), and the equation (1) was found assuming the existence of a pressure field in 3-space. From Figure 4, space-currents receive a pressure dependent on *cos(π/2 – α)*; time-currents receive a pressure dependent on *cos(α)*. Then *cos(π/2 – α)/cos(α) = tan(α)* is the ratio of action between space and time currents. In space, the pressure depends on *cos(π/2 – α) = sin(α)* and implies a second translation angle *α/(π/2 – α)* that applies to the solid angle *4π*, "thru" the angle *(π/2 – α)*. It gives (5.13), where the time-currents are $\mu \leftrightarrow e^2/4$ and the space-currents are $(m-\mu) \leftrightarrow G^2$.

Then the construction given by the two figures above is consistent with special relativity and with the equations developed in the coincidences analysis.

5.3.2 Other Resonance Coefficients

Then in (1) the resonance NP corresponds to G^2 in (5.13) while K corresponds to $e^2/4$. The product NP makes the spin and the space-resonance cycle is (NP – 2) K which is a product $G^2\ e^2$ while the spin is given by *G e.*

Action depends on the number of currents C (which is lepton-dependent) while the mass μ is constant; then we divide this coefficient by the number of currents.

The spin corresponds to a product *G e* (the square root of G^2e^2) and then we get a spin-dependent coefficient *where the spin relates to the interaction of the currents and the apparent electric charges*. It is:

$$E=\sqrt{\left(\frac{NP-2}{C}\right)K} \tag{5.18}$$

In the direction of time (K in Figure 3), the same reasoning gives NK^2 for a product $e^2/4$. We get a spin independent coefficient which relates only to the currents (and does not need a square root); it is:

$$F = \frac{NK^2}{4} \tag{5.19}$$

The coefficients above are valid for an electron but for the muon and tau the coefficient a_0 corresponding to the time current rotation is not α like in (5.17), it depends on the resonance numbers. The electron is the special case because all resonance numbers are identical and even (N = P = K = 2) and then all phases are identical.

For the muon and the tau, N = P and K are odd and prime with each other, and then the action cycle is NK. Using (5.18) for an electron, the cycle uses N = K = 2 and its angle should be written 2 α/2. Then for a muon and a tau the corresponding coefficient is then:

$$\varphi = \frac{tan\,(\frac{NK\alpha}{2})}{\frac{NK}{2}};\ a_0^{\mu\tau} = \frac{\varphi}{2\pi} \tag{5.20}$$

The expression mixes angles and resonance and fits with the interaction of current where action is angle-dependent; it will be the geometric form used in this section. We introduce the angle α/2 which we now consider as the physical angle of each time-current – it gives α for two currents of opposite directions taken together.

5.3.3 The Electron

The analysis above introduces chirality and we want to compute the anomaly from the following picture: The electron is seen as a rotation in 4D and then the rotation axis is a plane. A plane is defined by 2 vectors and a 4D rotation has the following mathematical property: in all cases, two orthogonal planes exist which are conserved by the rotation. The identifications are then obvious with a) the rotation axis is a plane defined by the time and magnetic moment axis and b) the angles in the previous section define two planes conserved by the rotation. Here the rotation is said double since we find distinct angles α and (π/2 – α). The conserved planes intersect at a single point where the resonances apply, and it defines the punctual particle (and we do not need to introduce anything else special at this place). The planes intersection point also moves in the direction of time.

Hence, the time and the magnetic moment 1D axis intersect at the punctual particle. One plane is orthogonal and hosts the leptons resonances N = P, and K is on the other axis. Finally those two planes are lepton-independent and their translation and the associated angles define entirely the seemingly anomalous values in (5.8 – 5.10) as they are also lepton-independent. Consequently, the lepton-dependent resonances imply different magnetic moment anomalies. Therefore we can reverse-compute the anomaly from those two quantities. We define:

- From (5.8): $4\times(X/\mu + 1/2) = \beta_1^{-1} = 136.810249308395$
- From (5.10): $4\times(X/\mu + 5/9) = \beta_2^{-1} = 137.032471530617$

In Euclidean space, the Dirac equation gives $g = 2$ and then the correction is entirely related to relativistic shifts. That is to say that in the electron frame, space is seen Euclidean and resonances are not deformed. Hence the total correction a_T is a product $a_T = a_0\, a_1\, a_2$ giving a measurable quantity where a_0 corresponds to the angle α in (5.17) or φ in (5.20), a_1 to the action of the apparent electric charges (5.10), and a_2 to currents interactions (5.8), we write:

- $a_T = a_0\, a_1 a_2$ = (g – 2)/2 is the full correction ,where a_0 is in (5.17), a_1 depends on β_2, and a_2 on β_1.

Since β_1 and β_2 are deduced from the leptons masses, they are related to the tangent of some angles part of the 4-resonance geometry (in the same manner as we get $tan(\alpha)/2\pi$). The anomaly is angular and differential and then a_1 and a_2 must be computed as ratios involving α and some arctangents involving respectively β_2 or β_1, and resonance numbers.

Therefore for the electron the first correction term a_1^e is given by an expression of following form:

$$\frac{\tan(\alpha)\,Y}{\tan^{-1}(\beta_2 Y)} \rightarrow a_1^e$$

It links an action given by the angle α and another one given by β_2 and the anomaly relates to their ratio.

Now β_2 relates to the apparent electric charges giving the spin; then Y = E as defined in (5.18) and we get:

$$\frac{\tan(\alpha)\,E}{\tan^{-1}(\beta_2 E)} \rightarrow a_1^e$$

The translation angle α/2 also impacts the coefficient and subtracts from K. It might imply a sine or a tangent, or it might simply be some amplitude, but the difference will not impact the results significantly. Then we write:

$$E \to \sqrt{\left(\frac{NP-2}{C}\right)\left(K+\frac{\alpha}{2}\right)}; \quad a_1^e = \frac{\tan(\alpha)\sqrt{2+\alpha/2}}{\tan^{-1}\left(\beta_2\sqrt{2+\alpha/2}\right)} \tag{5.21}$$

Now β_1 comes from the time-currents of the electron; we must make a similar reasoning involving F defined in (5.19). Naturally, this correction will be similar in form to the equation above. The logic is:

- The first order effect is null; it is second order where the cross-products cancel.
- The angle must be α instead of α/2 since the two angles α/2 on the axis of K sum up.

It gives, for an electron:

$$a_2^e = \frac{\tan(\alpha)\,F(1-\alpha^2)}{\tan^{-1}\left(\beta_1 F(1-\alpha^2)\right)} = \frac{\tan(\alpha)\,(2-2\alpha^2)}{\tan^{-1}\left(\beta_1(2-2\alpha^2)\right)} \tag{5.22}$$

Note that in the equations (27 – 28) the angle α/2 affects K and $-2\alpha^2$ affects K^2; it is actually the same geometry where only K is impacted.

Now from (25 – 27 – 28) and using the value of α in CODATA (1014) we find:

$$g_T^e/2 = 1 + a_0 a_1 a_2 = 1.00115965218077 \tag{5.23}$$

Which is compatible with CODATA (2014) experimental value:

$$g^e/2 = 1.00115965218091(26) \tag{5.24}$$

The relative precision of the ratio (m – μ)/μ is $3\ 10^{-8}$, and it applies to μ/X and then directly to β_1 and β_2; the error is squared. The relative error in (5.23) with respect to CODATA (5.24) is $2.6\ 10^{-13}$. This is two orders of magnitude better than we should expect from the leptons masses precision.

5.3.4 The Muon and Tau

We get the equations needed to compute the muon anomaly in the same manner as for the electron but using (5.20) and including in (5.21) the four currents given by the toy model and the resonance numbers in Table 1. We get:

$$g_T^\mu/2 = 1.00116592081 \tag{5.25}$$

while the CODATA (2014) experimental value of *g/2* for a muon is:

$$g^\mu/2 = 1.00116592089\ (63) \tag{5.26}$$

The result is well within experimental uncertainty and coherent with the precision reached for the electron; but unlike the electron, it agrees with the precision on the leptons masses. Importantly, the SM prediction disagrees with a 2–4σ discrepancy. Typically:

$$a_{SM}^\mu - a_{Exp}^\mu = (2.8 \pm 0.8)\ 10^{-9} \tag{5.27}$$

The very short lifetime of the tau makes impossible at present to measure its (g – 2). The SM prediction is:

$$g_{SM}^\tau/2 = 1.00117721(5) \tag{5.28}$$

Using the same equations and the resonance numbers in Table 1 we get:

$$g_T^\tau/2 = 1.00125789 \tag{5.29}$$

But on the other hand, in the tau resonance, N = P = 9 is not a prime number and then, perhaps, we should use 3 instead of 9 in the equations to compute its anomaly (we will find a second reason later in this section). It gives:

$$g_T^\tau/2 = 1.00117037 \tag{5.30}$$

where the difference with the SM prediction is more coherent with that of muons.

5.4 Cracking the Fine Structure Constant

5.4.1 A Second View on Leptons Resonances

Our analysis of the resonances in Table 1 fits with the supposed geometry, and two complimentary angles α and $(\pi/2 - \alpha)$. But now we get a quasi-symmetrical picture that suggests the existence of a second view on the leptons resonances where the resonance numbers P and K can be associated to the time and magnetic moment axis while N corresponds to an orthogonal plane.

In rough approximation and using angular ratios, we should have a different mass: $\mu' = \mu\ (\pi/2 - \alpha) \approx 378\ eV/c^2$. Starting with this approximate value and using the equation (1), an empirical search targeting the same masses as in Table 1 (to all shown decimals) gives Table 5 and the coefficients in (5.31):

Table 5. Second view on leptons resonance. (*) MeV/c^2

Particle	P’	N’	K’	Computed (*)	Measured (*)
Electron	2	2	2	0.510 998 9280	0.510 998 928 (11)
Muon	3	8	3	105.658 37150	105.658 3715 (35)
Tau	4	16	4	1776.840	1776.82 (16)

$$\mu' = 385.674928957\ eV/c^2 \tag{5.31}$$

$$D' = 0.0002255984538 \tag{5.31}$$

$$X' = 8.02160767375101\ KeV/c^2 \tag{5.31}$$

With 5 degrees of freedom, it is not surprising that another set of resonances exist – even though we get P’ ≠ N’. But at the opposite, if those masses were not linked as inferred we should never find such structured numbers in the two tables. In particular we find P’ = K’ and those are consecutive minimal integral numbers and the proximity to the predicted mass μ’ is also significant. This is the same rotation where mass is expressed with respect to a field or field orientation different from the one used in Table 1. Hence, in the SM parlance, Table 1 corresponds to SU(3)×SU(2)×U(1) and Table 5 is QED – and we can even state that the existence of this second view is expected by the standard theory.

We find more connections with the Table 1. The resonance numbers are still very small and we find $N' = 2^{P'}$ except for electrons: $N' = 2^{P'-1} = 2$; this difference agrees with the definition of φ in (5.20) as compared to (5.17), and we find N’ = 2N – 2 which should hide the spin. We get the same numbers for the electron, it suggests that the cube in SU(2) “phase locks” simultaneously in two different manners.

But the most interesting point is that we find in N’ the numbers 2 and 8 which are the pure resonances of SU(2) which are not mixed for the electron and the muon, and their product 16 for the tau. It first justifies our doubts for the initial calculus of the tau (g – 2).

5.4.2 Alpha

Since we find the pure resonances of SU(2), α defines the “field of forces” at work in Table 5 for N’. The K’ = P’ put on equal ground the time and the magnetic moment axis which then work coherently in this view and cancel. It implies, using (0) that the resonance terms of α are directly visible in N’ and creates a unique resonance path for all leptons that depends only on geometrical and integral numbers. But then α depends only on Pi, 137, 1/2, and 1/8.

Now a straightforward argument gives exactly 137: The electromagnetic field is the only free field; hence any lepton resonance interferes simultaneously and permanently with all currents corresponding to the N and P as found in all tables except the fractional quark mixture (19/7). Now taking all integral N, N’ and P, P’ from all tables, we get a seemingly absurd suite of numbers that sums to:

$$\Sigma = 2 + 3 + 4 + 5 + 7 + 8 + 9 + 12 + 14 + 16 + 19 + 38 = 137 \tag{5.32}$$

We interpret this number as the 4D monopole. Here the ratio *G/e* is not fine-tuned but a consequence that locks the field in a permanent state. It looks as though a set of constraining equation exists to which this suite of number is a solution and, if so, it is doubtful that any other solution can exist. In other words and identically, with respect to the reasoning on groups and couplings, the number 137 is unavoidable; it is not just a romantic number, but the 4D monopole of the field and it imposes 1/137 as the sum of the leptons time-currents and then 1/274 as the elementary current (in 4D).

But this monopole is not a particle, it is the matter field, and importantly it copes with the monopole X integral in 4D in our reasoning on groups and couplings. Since we identified color charge to the X-field (|X| = |C| in Table 3) it is logical that α also appears in the whole matter field thru the expressions of D_q, D_b and X/μ. This is a single field which is its unique monopole – and the rest of it is just resonances and geometry.

Now using the expression (0) we need a 4D path which will be seen as a pseudo-norm in 3+1D. It includes:

- Two lengths which are 137 and 1/137.
- A half rotation (spin) which length is π.
- The resonances 1/2 and 1/8 relate to 1/137 because this one is unitary (while 137 is composite); then the resonance lengths in the time direction are 1/2 and 1/8, it gives (1/137)(1/2 + 1/8).

Now reasoning on 4D currents:

- Since e G is the spin, it is the natural unit: e G = 1, then G = √137 = 1/e. This is coherent with (5.13) where action depends on squares; then there exist one direction where the path length is L = 137 = G/e, and another where it is 1/L = 1/137 = e/G. But those lengths require a different treatment.
- The path includes the spin as a half rotation of radius (e G/2 = 1/2) which length is then π.
- The N' in Table 2 are 2, 8, and 16; but the latter is the product of the formers, so the resonance path must include as a minimum 1/2 and 1/8 for the 1/16 to exist as a product. The products (1/137) × (1/2) and (1/137) × (1/8) are squared lengths as the products of 1/137 by the resonance lengths 1/2 and 1/8.

The two reasoning are identical or equivalent; then in agreement with the relation (0) we write:

$$\alpha^{-1} = \sqrt{137^2 + \pi^2 - \left(\frac{1}{137}\right)\left(\frac{1}{2} + \frac{1}{8}\right)} = 137.0359990745$$

$$\alpha = 72\ 973\ 525\ 698 \times 10^{-13}$$

Where CODATA (2012) gives the same value to all decimals, but not CODATA (2014). Then our reasoning may miss something which can only be the "size" of the time-current; we write, rather empirically:

$$\alpha^{-1} = \sqrt{137^2 + \pi^2 + \frac{1}{274^2} - \left(\frac{1}{137}\right)\left(\frac{1}{2} + \frac{1}{8}\right)} = 137.0359990123 \tag{5.33}$$

$$\alpha = 72\ 973\ 525\ 672 \times 10^{-13} \tag{5.34}$$

which is compatible with CODATA (2014):

$$\alpha_{(2014)} = 72\ 973\ 525\ 664\ (17) \times 10^{-13}$$

A third argument giving 137 is similar to our discussion on the equation (0), and a phase lock on the resonance length 137, as it must be a multiple of 1/2, 1/8 (and 1/16) and 1/137, while its inverse 1/137 must not be an integral divisor of 1/2 (and then 1/8 and 1/16) or any other resonance. In the same way, and more generally, 137 is a prime number that cannot split as a product, hence α is maximal. *The free field has maximal coupling*; one may expect the opposite from the smallness of α. Therefore, contrary to QED, α is not an absorption probability but a definite scale-independent 4D interaction path; it is a true coupling in a mechanical sense. Consequently the density of probability given by the quantum mechanical wave functions addresses a physical scalar density. Once normalized it simply defines the shape of the particle mass which is no other than its density of interaction with the field; this is a clean link between field theory, quantum mechanics, and some more classical physics. It does not change QED equations where α systematically comes as an amplitude coefficient (at the elementary level of the calculus).

Here we compute α and logic suggests that it is unavoidable; but we also find a topological monopole, a look-alike of field theory in strength and almost in concept but also the Dirac condition. Considering all charges *e*, *e/3* and *2e/3*, and a unique monopole *G*:

- In the leptons cases the electric charge gives $e\ G = 1$ (Schwinger monopole);
- In the fundamental currents $e_m\ G = 1/2$ (Dirac condition);
- For quarks $q\ G = 1/3$ and *2/3*.

But this monopole is not an observable particle – except of course that it is the matter field and we never observed anything else. *In this view, it is normal to find the solution to the big equation "within" the SM field and with no need for a new particles zoo; it cannot be elsewhere*. It appears actively self-quantizing and it suggests that active self-quantization is nature's main job if not its only one. It is not a quantization fixed at a given epoch; the field is producing its own integrity thru a permanent process.

5.4.3 Rotations

Now, inasmuch as α is a 4D circular path seen in 3+1D and obeys (0), the couplings D' (5.31) and D_e (3.3) should also verify this equation but in a complimentary manner with respect to currents and resonances; hence they should also be expressed as pseudo-norms for which we find the following empirical expressions (where extract the rotations and maximize symmetry):

$$D_e{}^{-1} = \sqrt{\left((7-3)\times(274+19)\right)^2 + 7\pi^2 - \frac{19\pi}{19-1}} \tag{5.35}$$

$$D'^{-1} = \sqrt{\left((19-3)\times(274+3)\right)^2 + 2\times(274+19+1)\pi^2 - \frac{3}{3-1}} \tag{5.36}$$

The relative errors with respect to their empirical values are 9.6 10^{-10} and 8.3 10^{-10} respectively. Those expressions are not reducible.

There is not trick in the decomposition to integral numbers as it just works like a division; the left term is the closest square to the empirical value of D^{-2} from which it is subtracted; the middle term is the division of the rest by π^2 that gives a small residual term. Then we search to express all terms with resonance numbers. It is logically expected to find 3, 7 and 19 because those are complimentary to α and are at part of Σ = 137. We also find 274 in the main term which is the elementary the time-current.

The symmetry of the larger terms shows a melting. It looks as though all terms are "packing" the resonances 3 and 19 in the time-currents in two different manners – simultaneously – like the Tables 1 and 5 do the same job for 2, 7 and 8 in N, N'. In (5.35), we get 7π and then the rotational part is SU(2).

The absence of 7 in (5.36) is also of interest as this resonance is not "packed" in D', because it relates to Table 5 which is pure SU(2) in N'. Still, we get 16 = 19 – 3 in the main term, which all N' are sub-harmonics. Those expressions need further decoding which is far from trivial because it must also address in details the geometry of currents giving the Tables 1 and 5 and find the correspondences.

Finally, we can use the same trick with β_1 and β_2; at this point of the analysis, we strongly suspect that only pseudo-norms like (0) and integral resonances are physical. It gives:

$$\beta_1 = \sqrt{137^2 - 5\,\pi^2 - \frac{1}{14}\times\left(37 - \frac{1}{2} + \frac{(1+1/137)}{137}\right)} \tag{5.37}$$

$$\beta_2 = \sqrt{137^2 + \pi^2 - \frac{4+\pi/137}{\pi+1}} \tag{5.38}$$

which hold at 1.6 10^{-11}; but now β_1 and β_2 are complimentary since their rotation parts are of opposite signs ($-5\pi^2$ versus π^2) which denotes a point of equilibrium. (Note that we get 37 in β_1, though it may be artificial.)

5.6 On the Proton Charge Radius Conundrum

The muonic hydrogen Lamb shift was measured by Pohl et al. (2011) using a laser to force a state transition from $2S_{1/2}{}^{F=1}$ to $2P_{3/2}{}^{F=2}$; it gives a central laser frequency of 49.88 THz (Pohl et al., 2011, Figure 4), while using CODATA (2006) the expected value is 49.81 THz.

The standard theory provides with no solution at present. Now we just compute the energy ratio:

$$49.88/49.81 = 1.00140 \tag{5.39}$$

The fundamental difference between our analysis of the leptons anomalous magnetic moment and QED is that we use the resonances (Table 1) as coefficients *of action*. But we get odd resonance numbers for the muon and even for the electron. If those are physical the Dirac equation is not applicable as-is to muonic orbitals. By definition, the phase of a lepton wave depends on the space resonances giving the product $N P$. For electrons, $N P = 4$ and $K = 2$, and the wave connection over one orbit agrees with de Broglie. But for muons, it gives $N P = 25$ which compares to *4* for electrons; the wave connection is different. Now 25/4 = 6.25 and, at first order, we must replace α by the following expression in the calculus of muons energy levels:

$$\varepsilon = \tan^{-1}\left(\frac{\tan(6.25\,\alpha)}{6.25}\right) = 0.0073024 \tag{5.40}$$

which makes a huge difference since we must use its square ε^2 to compute energy levels (just replace α^2 in the Bohr model or α in the Dirac equation). It gives lower energy levels and then higher transition energies in proportions of:

$$\left(\frac{\varepsilon}{\alpha}\right)^2 = 1.00138 \tag{5.41}$$

which is in good agreement with experiment.

The next issue is to understand why the same effect does not appear with helium. In this case the energy loss given by standard equations is multiplied by 4 and then we have to multiply by 4 the phase coefficient 6.25 which becomes an integral number: Then 4NP still compares to 4 for an electron, the wave connections are equivalent and the Dirac equation is valid.

Finally a discrepancy will come with any nucleus of odd charge but not with even charges. Hence, in principle, this part of the theory can be tested further, for instance with lithium.

5.5 Conclusion

Essentially, we find some validity in the toy model and to 3+1D in 4D when computing the magnetic moment anomaly. Considering the toy model, this confirmation is weak as it addresses only two particles. But at the opposite the idea 3+1D in 4D is strongly confirmed, because it is used and needed all along this calculus. Without it there is no way to compute the magnetic moment anomaly or α in a geometrical manner.

The equation (0) is valid inasmuch as it fits with the calculus of α (5.33) (consider also precision and simplicity) and also D_e (5.35) and D' (5.36) and because of the obvious symmetry between those two expressions. Considering that we have only two couplings to address we cannot expect more; still, it is important that α is not computed blindly from (0) and our reasoning on resonance numbers but deduced from the resonances in Table 5 and the 4D monopole 137 which must be seen as the interaction of the full massive matter field.

The 3+1D monopole is not a separate particle but it appears as quarks color and it is not electromagnetic. It explains a lot of things, to begin with fruitless attempts to detecting a free Dirac monopole.

It also explains the structure of coupling found in section 3 (α and D_e); essentially α is the free field coupling, which stress is manifested in quarks masses thru $D_q = D_e\,(1 + \alpha)$, but cancels in the leptons mass coefficient D_e.

In this view, the monopole is in SU(3) but it comes from its included instances of SU(2) and U(1) – while it is expected in the $SU(2)_{EM}$ and U(1) domains. Then we find an inverted suite of charge quantization, including the monopole in (4.5).

Here we state that our conjecture is verified concerning coupling constants in 3+1D, the 3+1D charges and the fundamental current and its monopole in 4D.

For the purpose of the next sections we shall evaluate the conjecture in part as a postulate. The deductive logic is partly broken but we now have enough precision results for this.

6. Mixings

6.1 The Cabibbo-Kobayashi-Maskawa (CKM) matrix

Let us first discuss the main missing group of quarks parameters; that is the CKM matrix in Table 6.

Table 6. The Cabibbo-Kobayashi-Maskawa (CKM) matrix (Particle Data Group, 2014).

Vud = 0.97427 (14)	*Vus = 0.22536 (61)*	*Vub = 0.00355 (15)*
Vcd = 0.22522 (61)	*Vcs = 0.97343 (15)*	*Vcb = 0.0414 (12)*
Vtd = 0.00886 (32)	*Vts = 0.0405 (11)*	*Vtb = 0.99914 (5)*

(Uncertainty is minimized, taking the smallest value when non-symmetrical).

In equation (1) the mass of a quark *q* depends on a radius $R_q = (1/3N - 6\ D_q)$, *which actually defines a potential* from a single variable *N*. Hence the quarks decay probabilities should depend on those radiuses. The second aspect is that between potential wells, we must have different routes which depend on the full field structure. Last, still using the field map, the quarks field is defined by four objects. Hence the CKM depends on the R_q, on some mixing, and simultaneously some coefficients related to the field structure. So the problem is not simple, and needs to be split in independent pieces – as much as possible.

- Firstly, we discuss the resonances of a single field; then we cannot consider any resonance (particle) or piece of resonance as an entity separate from the rest of the field. For instance, the number 7 in a quark resonance "is the same thing" as the number 7 in a muon, or in the 12 = 19 – 7 of bosons or even as the 1 of a photon since it can take any amplitude and 1 = 7/7. Then, logically, a common number between two states defines a common affinity and then a branching fraction.
- Secondly, some decay routes are not permitted for known conservation reasons, even if a branching fraction exists due to common resonances. Those routes must then be considered "sterile branching fractions" and come like as many routes to conserve the particle.
- Thirdly, we must introduce potentials as coefficients (ratios of R_q) to each individual branching fraction. Logically, the larger the potential difference the lesser the decay probability – this is because of our analysis of leptons where energy is the rate of a gyroscope which changes in decays.

The logic above approximately defines the procedure to follow in the analysis; but we find mixing that we shall first discuss independently (and only the Cabibbo angle).

6.1.1 The Cabibbo Angle

We first verify the form of the mixing:

$$\mathrm{N(u)} = 2 = \mathrm{N(t)/N(b)} = \mathrm{N(c)/N(s)} \tag{6.1}$$

$$\mathrm{N(d)} = 19/7 = \mathrm{N(t)}/2\ \mathrm{N(s)} = 2\ \mathrm{N(b)/N(c)} \tag{6.2}$$

where N(q) denotes the resonance number N of the quark q. Here, the fractional resonance N(d) = 19/7 is rather insightful, and N(u) = 2 as well. Except for some ad hoc coefficient, a ratio of resonances is a product of lengths. Then we define from (6.1 – 6.2) a simple sum of lengths products:

$$\mathrm{A} = (\mathrm{R_b\,R_c}) + (\mathrm{R_t\,R_s}) \tag{6.3}$$

$$\mathrm{B} = (\mathrm{R_t\,R_b}) + (\mathrm{R_c\,R_s}) \tag{6.4}$$

Now compute the following expression, where the ad hoc coefficient cancels:

$$\tan^{-1}((\mathrm{A/B})/2) = 12.94^{\mathrm{o}} \tag{6.5}$$

The Cabibbo angle is $\theta_C \approx 13.02^o$, the difference with (6.5) is *–0.08 degrees* (≈ 0.18% with respect to an average random angle of 45$^{\mathrm{o}}$). The factor *2* in (6.5) corresponds to equating the charges in (6.2).

6.1.2 Branching and Potentials

The previous section agrees with the inferred form of the mix, but for a complete verification we need to compute the full matrix. Here we will distinguish couplings related to resonances, branching fractions related to the field structure, and potentials (the R_q).

According to the logic developed to explain the quarks resonance numbers (3, 7, 19), this coupling should correspond to common resonances. Hence in the Table 7 we first decompose the resonances of each fundamental state (T, B, C, S) and mixes.

Table 7. Resonances and Coefficients.

	19=27–8	*7=8–1*	*19 / 7*	*2*
T	*X*	–	–	–
B	*X*	–	–	
C		*X*		–
S		*X*		
u	–	–		*X*
d	–	–	*X*	

The first line of the table means that T is based on the resonance 38 = 2((27 – 1) – (8 – 1)), which includes all symmetries. Once put in a geometrical picture, the table means:

- 19 = (27 – 1) – (8 – 1) → Two circular resonances exchanging action and running after each other.
- 7 = (8 – 1) → One circular resonances.
- 2 = 2 x/x → Any doubled circular resonance (T or C) and the monopole (1/B or 1/S) exchanging action.
- 19/7 = (27 – 8)/(8 – 1) → Two circular resonances exchanging action, one is the monopole of the other.

The *t* and *b* include 19 = (27 – 1) – (8 – 1); they are perfectly coupled in two resonances; the only difference is the electric charge. Then resonances give the branching amplitude *2* on *3*:

- *t → b = 2/3 = 1 – 1/3*

The *s* includes 7 = (8 – 1) which is SU(2) and it couples with any other of the 37 states of the field (including photons which resonance is 1, leptons and neutrinos, but indifferent in colors and then reducing the field to 37 states). There is one possible route among 37 from the *t* to the *s*:

- *t → s = 1/37*

The *t* and *d* common point is the mix which gives a weak hypercharge in the standard theory. It means that they couple in the fundamental currents which charge is *1/137* times lesser than color:

- *t → (d/137) × a*

where *a* is an unknown coefficient to be found empirically. This is the structural part, now let us discuss potentials. The *t* decays also depend on potentials given by the radiuses R_d, R_s, R_b. We define a function *ft*:

$$\mathrm{ft}(q) = R_q/(R_d + R_s + R_b) \tag{6.6}$$

Now applying the branching amplitude we find:

$$\mathrm{Vtb}^2 = 1 - \mathrm{ft}(b)^2/3 \tag{6.7}$$

$$\mathrm{Vts}^2 = \mathrm{ft}(s)^2/37 \tag{6.8}$$

which are right to known decimals (see Table 8). For the *d*, we use R_d/137 as it is the currents ratio, we get $a = \pi$.

$$\mathrm{Vtd}^2 = \mathrm{ft}(d/137)^2 \times \pi \tag{6.9}$$

For the remaining coefficients of the last column we use a similar function *fb* that does not take the *t* into account:

$$\mathrm{fb}(q) = R_q/(R_u + R_c) \tag{6.10}$$

The branching fractions are b → c = 1/2, and b → u/137; from which we empirically find:

$$\mathrm{Vub}^2 = \mathrm{fb}(u/137)^2/\pi \tag{6.11}$$

$$\mathrm{Vcb}^2 = \mathrm{fb}(c)^2/2\pi \tag{6.12}$$

With the expressions above, the precision obtained for *Vcb* is in the same range as for the top quark decays, but it is barely in the standard uncertainty range for *Vub* and a similar error exists in *Vtd*; this is expected since the *u* and *d* are mixed states. Then we need empirical corrections for those coefficients; the following holds:

$$\mathrm{Vtd}^2 = \mathrm{ft}(\mathrm{d}/137)^2 \times \pi \times (1 + 1/137) \tag{6.13}$$

$$\mathrm{Vub}^2 = \mathrm{fb}(\mathrm{u}/137)^2 \times (1 - 1/14)/\pi \tag{6.14}$$

The Cabibbo angle links together two un-mixed states (*c* to *s*). It should then be possible to compute *Vcs* in a manner similar to the coefficients on the *t* row and the *b* column. Hence we define:

$$\mathrm{fc}(q) = R_q/(R_s + R_d) \tag{6.15}$$

An empirical search gives:

$$\mathrm{Vcs}^2 = 1 - \mathrm{fc}(s)^2 \times (3/4) \times (1 - (1/137) \times (1 - 1/7)) = (0.97344)^2 \tag{6.16}$$

$$\mathrm{Vcd}^2 = (\mathrm{fc}(\mathrm{d}/\pi)^2 \times (1 - (1/4)(1/\pi - 1/37)) = (0.22522)^2 \tag{6.17}$$

The coefficients 1/4 and 3/4 seem complimentary and sum to 1.

We could now fill the full matrix as it is unitary, but for a complete analysis we define:

$$\mathrm{fs}(q) = R_q/(R_s + R_u) \tag{6.18}$$

And we empirically find:

$$\mathrm{Vcs}^2 = 1 - \mathrm{fs}(c)^2 \times (6/5) \times (1 + (1/137) \times (1 + 1/7/137)) = (0.97343)^2 \tag{6.19}$$

$$\mathrm{Vus}^2 = \mathrm{fs}(\mathrm{d}/\pi)^2 \times (4/5) \times (1 - 1/14/137) = (0.22538)^2 \tag{6.20}$$

The coefficients 6/5 and 4/5 seem complimentary and sum to 2. The ratio to 1 in (6.16 – 6.17) agrees with the mixing ratio in (6.5).

Now since we have two almost equal results for Vcs, we compute it as the mid-point between (6.16) and (6.19), and we complement Vud in the same manner. Taking all results into account it gives Table 8 where the number in parenthesis is the difference with the central value in Table 7.

Table 8. Resulting CKM matrix.

Vud = 0.97427 (0)	*Vus = 0.22538 (+2)*	*Vub = 0.00356 (+1)*
Vcd = 0.22522 (0)	*Vcs = 0.97343 (+1)*	*Vcb = 0.0413 (–1)*
Vtd = 0.00886 (0)	*Vts = 0.0405 (0)*	*Vtb = 0.99914 (0)*

The matrix normalization holds at better than $3\ 10^{-5}$, and all Vij are within 1/15th of the standard uncertainty.

Interestingly, the angular way gives simple expressions in the main mix, and at the opposite the branching / potential way is straightforward for the rest of the matrix and gives complex expressions for the mix.

Note that removing all coefficients 1/7 and 1/14 leave most Vij within 1/5th of uncertainty (we are enforcing more precision than needed). Those are not very significant but necessary for the matrix normalization. Note also that all corrections come in 1/7 or 1/14 and 1/137 which come from SU(2) and the time-currents.

6.1.2 Picturing the Quarks Field

The Figures 5 shows how quarks are produced on rings 37 and 61 from T, B, C, S.

This figure is, on purpose, reminiscent of the dissymmetry of matter and anti-matter; it suggests that the mixing dissymmetry effects exceed those expected with the standard model, and the dissymmetry does not require a different amount of (positive or negative) fundamental objects (T, B, C, S) to be created. It only requires that energy is not distributed symmetrically in a scheme that preserves electric neutrality.

Note that we have elected to define the map from electric charge continuity; a second option exist which is the currents sign, in which case the second and third generation are symmetrical (all quarks on the right or left side, and all anti-quarks on the other side) while the first generation is not (the u^+ and d^- come on the different sides). It shows that the map can be made to picture coherently the dissymmetry of matter and anti-matter.

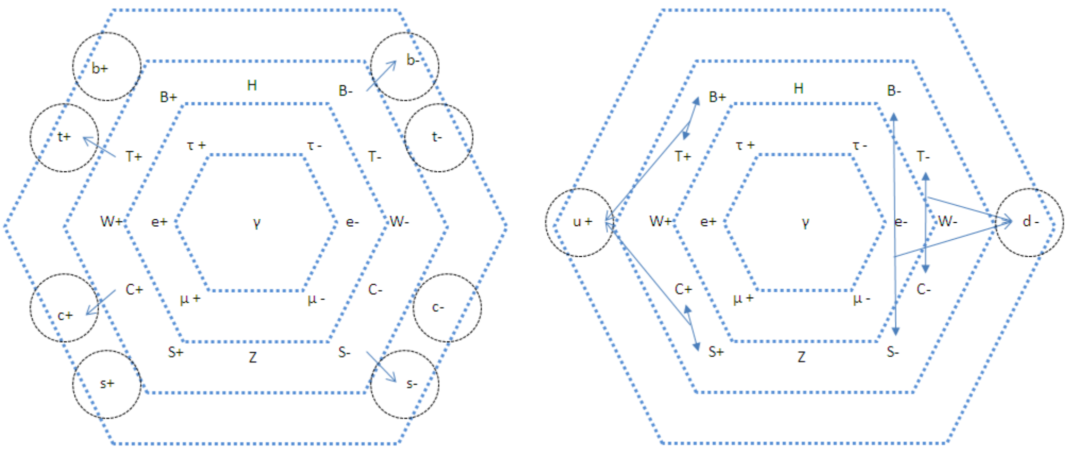

Figure 5. No mixing for *t*, *b*, *c*, and *s* quarks (left). Mixing to the *u* and *d* quarks (right).

6.2 The Pontecorvo–Maki–Nakagawa–Sakata (PMNS) matrix

We shall now discuss the PMNS matrix in Table 9; it is computed from the Particles Data Group (2014).

Table 9. The squared PMNS matrix. (Uncertainty is in the range 1 – 2%.)

$Ue_1^2 = 0.6818$	$Ue_2^2 = 0.2955$	$Ue_3^2 = 0.0227$
$U\mu_1^2 = 0.3077$	$U\mu_2^2 = 0.6906$	$U\mu_3^2 = 0.0017$
$U\tau_1^2 = 0.0105$	$U\tau_2^2 = 0.0139$	$U\tau_3^2 = 0.9756$

6.2.1 The Up-Left Corner Angle

We first notice a pattern similar to the CKM matrix where most of the mixing is in the up-left corner.

$$\cos^{-1}(\mathrm{U_{e1}}) = 34.34^{\mathrm{o}} \tag{6.21}$$

$$\sin^{-1}(\mathrm{U_{e2}}) = 32.93^{\mathrm{o}} \tag{6.22}$$

$$\sin^{-1}(\mathrm{U_{\mu 1}}) = 33.69^{\mathrm{o}} \tag{6.23}$$

$$\cos^{-1}(\mathrm{U_{\mu 2}}) = 33.80^{\mathrm{o}} \tag{6.24}$$

It denotes a large almost equal mixing in electrons and muon neutrinos with an average angle ≈ 33.7$^{\mathrm{o}}$. Then we guess mixes and correction similar to the CKM. The mixing angle should be the arc-tangent of a ratio of lengths products; the neutrino resonance must be 1 as their mass is null or close, and they are electrically neutral. Those two conditions leave no choice since N(t) N(s)/N(b) N(c) = 1 is minimal; now compute:

$$\tan^{-1}\left(\frac{\mathrm{R_t R_s}}{\mathrm{R_b R_c}}\right) = 33.6\,^{\mathrm{o}} = \theta_{12} \tag{6.25}$$

which agrees with (6.21, 6.22, 6.23, 6.24); but it works at the opposite of quarks mixing where a product of resonances gives a ratio of lengths. This point is of high importance, because it implies a form of inductance and then oscillations; this inductance must then be systematic. Now we find empirical corrections as follows:

$$\tan^{-1}\left(\frac{\mathrm{R_t R_s}}{\mathrm{R_b R_c}} \times \left(1 + \frac{4}{137}\right)\right) = 34.36^{\mathrm{o}} \to \mathrm{U_{e1}} \tag{6.26}$$

$$\tan^{-1}\left(\frac{\mathrm{R_t R_s}}{\mathrm{R_b R_c}} \times \left(1 - \frac{3}{137} - \frac{1}{274}\right)\right) = 32.92^{\mathrm{o}} \to \mathrm{U_{e2}} \tag{6.27}$$

$$\tan^{-1}\left(\frac{\mathrm{R_t R_s}}{\mathrm{R_b R_c}} \times \left(1 + \frac{1}{274}\right)\right) = 33.70^{\mathrm{o}} \to \mathrm{U_{\mu 1}} \tag{6.28}$$

$$\tan^{-1}\left(\frac{\mathrm{R_t R_s}}{\mathrm{R_b R_c}} \times \left(1 + \frac{1}{137}\right)\right) = 33.79^{\mathrm{o}} \to \mathrm{U_{\mu 2}} \tag{6.29}$$

6.2.2 Other Matrix Elements

For the other points the inversion (ratio/product) and the form of those expressions suggest that among the four mixing states the T has a specific role which then opposes the S. But basically we use the same potentials as for the CKM; we find inductance instead of resonance then we can repeat its form as used for the CKM, except for the squared potentials which become simple ratios; we find:

$$1-\frac{1/\mathrm{R_t}}{(2/\mathrm{R_b}+2/\mathrm{R_c}+2/\mathrm{R_s})}=0.97541=\mathrm{U}_{\tau3}^2 \tag{6.30}$$

$$\frac{1}{21}\times\frac{\mathrm{R_c}}{2\ \mathrm{R_s}}=0.01046=\mathrm{U}_{\tau1}^2 \tag{6.31}$$

$$\frac{1}{21}\times\frac{\mathrm{R_b}}{\mathrm{R_s}}=0.01389=\mathrm{U}_{\tau2}^2 \tag{6.32}$$

The term 1/21 is shown separately, as it is reminiscent of the quarks resonance P = 3 and N = 7. The equation (6.30) can also be written in a more complex form, we just chose the simplest.

Logically (because of neutrinos oscillations and inferring symmetrical inductance), the right-hand column shows a direct symmetry with (6.31 – 6.32), where an interesting point is the 1/14 defining the oscillation amplitude:

$$\frac{1}{21}\times\left(\frac{\mathrm{R_c}}{2\ \mathrm{R_s}}+\frac{\mathrm{R_b}}{\mathrm{R_s}}\right)\left(1-\frac{1}{14}\right)=0.02261=\mathrm{U}_{e3}^2 \tag{6.33}$$

$$\frac{1}{21}\times\left(\frac{\mathrm{R_c}}{2\ \mathrm{R_s}}+\frac{\mathrm{R_b}}{\mathrm{R_s}}\right)\left(\frac{1}{14}\right)=0.001738=\mathrm{U}_{\mu3}^2 \tag{6.34}$$

Using those values gives appropriate results and the squared matrix normalization error is $5.4\ 10^{-4}$. The absolute error on the individual squared matrix elements with respect to Table 9 is lesser than $4\ 10^{-4}$ as shown in Table 10.

Table 10. Computed PNMS squared matrix.

$Ue_1^2 = 0.6814\ (-4)$	$Ue_2^2 = 0.2954\ (-1)$	$Ue_3^2 = 0.0226\ (-1)$
$U\mu_1^2 = 0.3078\ (1)$	$U\mu_2^2 = 0.6907\ (1)$	$U\mu_3^2 = 0.0017\ (0)$
$U\tau_1^2 = 0.0105\ (0)$	$U\tau_2^2 = 0.0139\ (0)$	$U\tau_3^2 = 0.9754\ (-2)$

Compared to quarks, the mixing mechanism is different but based on the same potentials and objects. Moreover the same dissymmetry seems to exist as for quarks since we find the same corrections terms 1/14 and 1/137. Here the two dissymmetry related to 137 and 14 seem "orthogonal" as they do not melt in the coefficients. The Figure 6 pictures half the mixing.

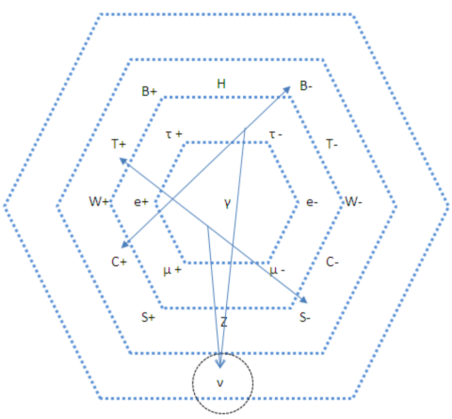

Figure 6, Neutrinos mixing (basic case)

6.3 Gluons

Eight gluons must replace the eight objects and anti-objects (T, B, C, S) in the sum 61 as they are already accounted for as quarks. They are massless and should be defined with resonances =1 from T, B, C, and S, with the missing mixes; that is T+T–, T–T+, B+B–, etc., where each radius divides itself and gives a resonance 1.

This is presented in Figure 7, where we have 4 composites, at first seen opposite depending if we look from one side of the map or from the other.

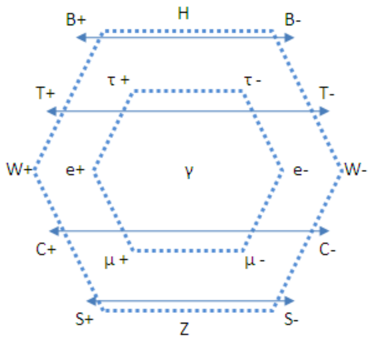

Figure 7, Gluons

But we must not forget the dissymmetry of time. That is to say that the half-inverted map in Figure 8 is probably complimentary when it comes to representing gluons.

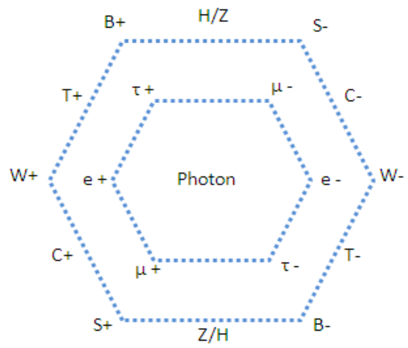

Figure 8, Field map imposing time-dissymmetry.

6.4 Conclusion

In this section, we showed that the resonances enable to computing straightforwardly the main angles in the PMNS and CKM matrices with good precision in (6.5) and (6.25). This is the first important point as it comes coherently with the rest of the analysis. Then our conjecture is verified for this part of the two matrices.

The elements of the CKM matrice are finally computed differently and we use empirical corrections; the deductive logic is incomplete but the corrections seem appropriate, firstly by the homogeneity in form of the equations, secondly by the symmetry in the coefficients, and thirdly maybe by the precision reached.

The PMNS matrix elements are computed in a mixed manner; the symmetry of the coefficients shows that the terms 1/137 (time-currents) and 1/14 (SU(2)) probably correspond to some inductance. If so, the oscillation frequency is proportional to the neutrino energy and the inductance coefficients are constant and only depend on the symmetries at play. Considering also the creation of neutrinos ($W \rightarrow l + \nu_l$) we find some numerical coherence with the resonances in Table 1; the muon and tau resonances are 7 – 2 and 7 + 2 respectively and the terms 1/14 in the PMNS coefficients calculus above should relate to the same difference in the resonances.

In facts, the symmetries and homogeneity in the coefficients and in the corrections indicate that we have probably well cornered the problem. But there is not yet enough understanding of the field to finalize the analysis.

Still, our conjecture is at least partly verified by this analysis. As a postulate, it seems efficient.

Even though those two matrices are not the core problem, it is of particular importance that neutrinos oscillations suggest a form of inductance and that it comes systematically with 2, and 7 as it corresponds to SU(2) (we mean the coefficients 2 and 1/14 and 1/21, and the latter mixes with SU(3) but only concerns the tau neutrino), because such a phenomenon is hardly compatible with the usual interpretations of special relativity. At the opposite, it is permitted within the premises of this theory inasmuch as the observable time is an imitation. It is also coherent with the origin of the resonance numbers 19 and 7 as the effects of a transformer; this is a confirmation of the effectiveness this concept and we cannot expect more from the known particles spectrum without a better understanding of currents.

7. Linking to the SM and Possible Extensions

7.1 The Standard Model

Now we need to link to the SM and show that it is included in this theory. At first sight it looks like a difficult task for many technical reasons, most of which have become conceptual prerequisites; for instance, we find coupling *constants*, not running, which apply directly and invariantly in the distances *D* and then at all rest energies up to the top quark mass. We do not use any quantum or gauge field concept. We do not address chirality (not directly). We get no virtual particles; we need no radiative corrections, no infinites, no renormalization, and so on...

Hence the work seems huge to recover; even desperate as we stated in introduction that we are entirely free from the SM concepts. In fact, we need to demonstrate that a calculable universe filled with charges and currents based on U(1), SU(2) and SU(3), where all resonances are imposed (Tables 1, 2, and 4,) plus a resonance =1 for photons and neutrinos (or maybe ≈1), where special relativity emerges or exists and where couplings are also imposed, includes the standard theory. Well, it looks like all constraints are there and the SM is the only solution. In particular since all masses, couplings and symmetries are there, we get the three SM Lagrangians and its particles contents – which is the SM, except for symmetry breaking and a separate Higgs field which we do not need.

Still, one of the nightmares is the absence of virtual particles and associated infinite series of corrections. Now suppose that our result is right or close enough, it just means that the two sub-fields (α and D_e) are "orthogonal" and combine in a very direct manner, which is trivial to see in 4D quantities and in the expressions of all coefficients D. If so, it is obvious that *some* calculus can be largely simplified. Next, it means, at least in the few cases we solve, that the infinite series of field theory are a method of successive approximations and compensation similar in form and results to limited developments which grow as a function of precision. Then using orthogonal sub-fields, some calculus will be infinitely simpler and some problems may be solved analytically.

The point is of importance so let us repeat the same argument taking the opposite perspective. The SM includes four sub-fields in its present form; assuming the two couplings α and D_e independent, it implies that the SM fields are not and then overlap or that their definition is unnatural and too restricted; in both cases, it implies corrections in all SM calculus. Here it is a logical impossibility to figure-out the corrections simplify.

In facts, the really missing point is the emergence or necessity of special relativity; we have to take it for granted.

7.2 Extensions

Now let us explore the two extensions we suspect. Here we apply the initial step of the same method; we track coincidences – even those that seem absurd – to seek logical coherence. It is necessary to track the integral numbers 37 and 61 as they define two rings in the field map for which we do not get any resonance number. As discussed before they may correspond to something more global. It seems that the SM matter field taken as a whole is in SU(5) → $5^3 - 4^3 = 61$ SM states, as a unique global resonance. We have:

$$SU(5) \supset SU(3) \times SU(2) \times U(1)$$

Only those three symmetries can manifest charges, hence SU(5) includes all resonance modes. In facts, the elaboration of the field map (including all figures in the previous section) can now be seen as a method to construct the SM field resonances; that is considering that all SM "punctual" states come from the expression above.

In this way, the 61 SM states must be seen as participating equally to a global resonance and the monopole 137 is the total exchange when considering separation. The number 61 comes from cubes differences and then from the mass equation which is not relevant to evaluate the number of states in the expression above. But on the other hand, cubes differences come from a transformer in 3D space and this part of the reasoning is relevant at any scale: A transformer in SU(5)/SU(4) has a full set of 61 "charges". Those charges are different inasmuch as they fit in lower symmetries. In the same manner, the core field has 19 states and comes with SU(3)/SU(2) in which the tables 1, 2, and 4 use the same coefficients; SU(2)/U(1) comes with 7 states in the inner ring and U(1) has one resonance.

Hence we do not use a mathematical generalization to higher symmetry groups but we get a more general concept which seems physically coherent. This structure is recurring and now it calls for SU(4) → $4^3 - 3^3 = 37$ which is in SU(4)/SU(3); it cannot give a charge or a particle resonance. But:

$$SU(4) \supset SU(2) \times SU(2) \times U(1)$$

In this way, the two instances of SU(2) necessary to the expression above can be seen as Tables 1 and 5.

We also found 37 a couple of times in secondary quantities, in particular in the CKM for the coefficient Vts^2 which links the two extremes quarks masses (excluding the *u* and *d* mixes). But this number is also found empirically in different manners to which we can try some interpretations, for instance:

a) In the resonances spectrum:

If this symmetry is present it may correspond to a partial sum in the same manner as the monopole 137. This sum should not be random but relate to the field map directly. Now compute for each generation the sums of leptons N, P, K, and quarks N and P (since K is constant for quarks it is not significant). We find:

$$\Sigma(2) = 3 + 5 + 7 + 8 + 14 = 37$$

$$\Sigma(3) = 3 + 4 + 5 + 9 + 16 + 19 + 38 = 94 = (2 \times 37) + (2 \times 10)$$

Next, the first generation but using 19 – 7 for the *d* quark instead of 19/7 as it is a mix:

$$\Sigma(1) = 2 + 3 + (19 - 7) = 17 = 37 - (2 \times 10)$$

Interestingly $10 = \sqrt{137 - 37}$; then if 137 is understood as a currents ratio and a squared current, 37 should be something equivalent but orthogonal and complimentary.

b) Then reversing the terms in the pseudo-norm giving α we compute:

$$\sigma = \sqrt{(8+2) \times 137 - \frac{1}{137^2} - \frac{1}{\pi^2}} = 37.0121416 \tag{7.1}$$

Since here 37 comes from SU(2) like α, which is associated to 7, we must check 7 π σ = 814×1.000074, and it reduces to 814 = 2 × 11 × 37. Hence this number seems to loop on itself and the inversion of the expression calls for an inversion of resonance N → 1/N or equivalently of distances r → 1/r.

c) Then it should also address the velocity $V_t = c/3$:

Using $V_t = 1$ and then c = 3 in 3+1D, we get a squared velocity $v^2 = c^2 + V_t^2 = 10 = \sqrt{137 - 37}$ as seen in 4D (as shown Figure 9 which is reversible). Since 137 versus 37 corresponds to an inversion of pseudo-norms, and the actual current is $\sqrt{137}$, squared velocities become like unitless. Hence c^2 is a fundamental quantity, but not *c* – which is perfect with respect to the line element in special relativity. But also, c^2 comes as a pseudo-norm defined by the monopole 137 and the resonance (or the converse monopole) 37.

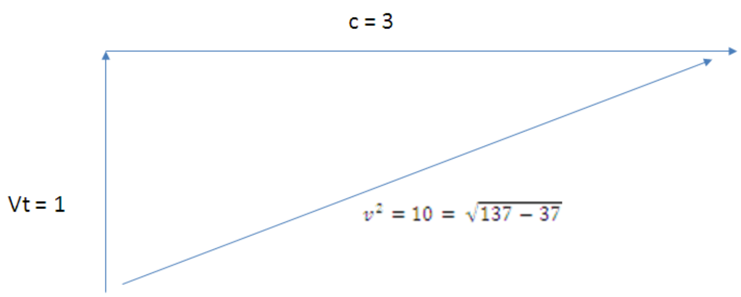

Figure 9, Velocities in 4D

Here 3+1D is not a phase transition but a thick membrane “shepherded” by symmetries in a manner similar to particles resonances if considered structures. In this view, it is interesting that the monopole can also be written as:

$$137 = 2 + 3 + 7 + 8 + 19 + 37 + 61$$

where we get the symmetries (2 and 3), all cubes differences including SU(5) and SU(4) and two instances of SU(2) with 7 and 8.

The next development suggested is the decay of special relativity from group + resonances theory.

d) Then 37 should also be in the leptons wave:

The equation (5.3) holds only for the electron. We must rewrite it in a more general manner where the masses of the muons and tau fit and the correction must relate to φ in (5.20).

Taking resonances into account, we write:

$$4\pi\,(m-\mu) sin\,(\alpha/R)\left(\frac{\pi}{2}-\alpha/Q\right) sin\left(\frac{\alpha/Q}{\pi/2-\alpha/Q}\right)=\mu\sqrt{2} \tag{7.2}$$

where R and Q are new coefficients dividing α (they should depend on the particle resonance numbers plus possibly 137 and other numbers,) and *m* is the associated lepton mass.

It is easy to deduce R from the relations between the resonance numbers in Tables 1 and 5. The N and N' hold the spin and absorb an angle α/2.Then we write (only for the muon and tau):

$$R\;=\frac{N'-\alpha}{2}+2=N+1-\frac{\alpha}{2} \tag{7.3}$$

But it is another issue to get Q as it should not be related to other numbers. An empirical fit gives:

$$Q^{\mu}=(1/4)(137+1-(274-3-37/2)^{-1}) \tag{7.4}$$

$$Q^{\tau}=2(137+37+(137-137/74)^{-1}) \tag{7.5}$$

Using those, the equation (7.3) holds with precision better than $3\ 10^{-8}$ which is coherent with the electron (5.3). Here we get the number 37 three more times, and considering the origin of (7.2), it addresses the geometry of the lepton wave which is related to free space.

Those arguments are weak and mostly coincidental then maybe we just see what we want to see; still, they draw a coherent picture according to which the field equilibrium uses those two symmetries but only in fully constraining manners appearing in secondary quantities, in free space, in the full matter field or some subsets.

But it can be verified by precision tests: Some small but measurable deviations with respect to the SM predictions should appear which can be solved using additional symmetries for which no new particle will be found. Hence sooner or later field theory may need sterile symmetries – a contradiction.

a) In bizarrely mixed resonances?

However, we may expect some additional states which mass depends on *SU(2)×SU(2)×U(1)*, but still based on the same charges and currents as *SU(3)×SU(2)×U(1)*, and then on the same geometry.

It is easy to show that nothing more should come in the leptons and quarks domains. So let us look at bosons where we know N = P = 144 and we can only act on K which is in direct relation with 266. Moreover we can (in an ideal case) imagine the hypothetical particle contents, deduce its *K* and compute the little *k* used in (3.1). The first exercise is to take the other divisors of 266: *K = –14 → ~ 110 GeV; K = –38 → ~ 230 GeV; K = –133 → m < 0.*

The latter is not physical and the formers were apparently excluded by the LHC, but those would use normal resonances and be in *SU(3)×SU(2)×U(1)*. They should not exist if as the field map is complete. Here, –14 would be a double Z^0, which is already a H^0 and –38 would be a double H^0. Then what of a double $W^{\pm}$ with charge ±2 e, this one would have the internal geometry of the H^0 (tetrahedron), but inherit of the resonance 2 of a $W^{\pm}$, then K = –38. But with two identical current pairs, each can be in resonance with the other and it looks like a Z resonance. Let us add K = –7, then K = –38 – 7 = –45.

K = –45 → ~ 300 GeV (with charge ±2 e) (7.6)

A second example of interest is K = –144 + 61 = –83, as it also verifies K = 266 – K – 137 + 37. It would mean a complete harmony with respect to the field as a whole (–144 + 61) in-sync with all symmetries (144 and 266) and 137 and 37 are acceptable here since K is not a resonance length.

K = –83 → 1.8 ~ 2.3 TeV (7.7)

Unfortunately, its contents cannot be deduced easily and at this energy the equation (3.1) is very sensitive to D which is current-dependent. Considering the full coherence in K this resonance may even hold multiple solutions with distinct expressions of D.

The latter case was chosen in CERN unconfirmed results [34] in the computed mass ranges.

The purpose here is not to make predictions but only to show that the system is not entirely closed.

7.3 Conclusion

Firstly, the field is “below” and compatible with the standard model of particle physics. There can hardly be a better confirmation of the premises validity.

Secondly, the suite of coincidences in this section was found bit by bit and can now be assembled in a seemingly coherent manner – though we get nothing significant, representative or predictive. We just get converging coincidences; those may or may not define a workable context.

The next step is to take the most general aspect (c) and properly write the connections in mathematical form. It requires progressive theoretical work for which a first cut is provided in the next two sections and concerns essentially gravitation; the interest is when we can recover coherently some experimental data from simple theory; it normally means that we are on good tracks. Essentially, we shall assume that a higher resonance exists.

8. Special Relativity (SR)

In this section, we assume Euclidean space, (maybe a rest frame) and we reduce the problem of mass to the existence of a pseudo-norm giving a unique coupling constant. (We only discuss “free systems”, not quarks.) The general irreducible form is:

$$\alpha^2 = R^2 + \pi^2 - (1/R)(\Sigma 1/Pi) \tag{8.1}$$

This loop addresses a massive particle resonance which is associated to the lengths *R, 1/R* and $1/P_i$ in a scale-independent manner. Now we need to consider the resonance *1* of velocity *c* which is given by:

$$\varepsilon^2 = c^2t^2 - r^2 = (c\,t - r)(c\,t\ +\ r) \tag{8.2}$$

It contains a causal and an anti-causal component; those are classically the advanced and retarded waves. The main difference is that (8.1) cannot be written in the form of a simple product of *equal* advanced and retarded components. In our treatment of leptons the equations (5.12 – 5.13) do but incompletely as they ignore the apparent charges *e/3* and *2e/3*. If we find how to complete those equations (maybe using sums) the expression will not be symmetrical and exhibit a complimentary difference between the effects of causal and anti-causal components.

It shows that Galilean space is forbidden by the existence of those two equations (which is obvious) as the inner quantities in (8.1) must transform, and some of the inner quantities in the two equations should transform identically. Inasmuch as (8.2) imposes causality, this is special relativity but the opposite is not true; assuming only SR we have (8.2) but no mass and then no observer. The bottom line is then that (8.1) and (8.2) must exist in the same “medium”; therefore special relativity as observed “is mass” and come from resonances in U(1) and SU(2). In facts, from the concept giving (8.1), this coupling equation makes all observable masses, and the coupling must be observer-independent. Then for massive objects the equation (8.2) needs to be written in energy and momentum; using an invariant mass leads, as we know, to the Dirac equation which can be derived from:

$$\big(c\,t - r\big)(c\,t\ +\ r) \rightarrow (E - pc)(E + pc) \tag{8.3}$$

But then the constancy of *c* addresses resonances, not the constancy of the one-way velocity of light with respect to the observer – the old origin of special relativity – which is experimentally violated. It is important that this theory provides a solution to this confusion, from two equations and with no need for additional interpretation.

In conclusion we face two possibilities:

- *The origin of SR in 4D space could be the existence of two kinds of resonances – which eventually resumes to the existence of two pseudo-norms of different forms.*
- *A fifth dimension can be added giving 4+1D space where SR exist, or simple 5D space where the interplay of resonances create the illusion of 4+1D.*

By the way, the first possibility also gives the 4D and 3+1D monopoles and the light-speed mirror c^2, because writing (8.1) with the same quantities as (8.2) we get:

$$\alpha^2 = R^2 + \pi^2 - (c/R)(\Sigma\ 1/cP_i) \tag{8.4}$$

where the quantities *c/R* is a frequency (s^{-1}) and $1/cP_i$ relates to an acceleration where dimensionality is inverted (s/m^2). Alternately:

$$\alpha^2 = R^2 + \pi^2 - (1/c\ R)(\Sigma\ c/P_i) \tag{8.5}$$

where units are inverted in the negative term. That is to say that this coupling should come with a dimensional inversion. It leaves (8.2) invariant and transforms (8.1) into the converse pseudo-norm giving σ ~ 37 in (7.1) from α ~ 137 in (5.33).

Inversion of dimensionality can be seen already in de Broglie’s thesis and in extensions of special relativity (ref and references therein). Using de Broglie’s $V\,v = c^2$, the Lorentz transformation is still valid for the de Broglie wave for which $V > c$, and the formulas giving the transformation of energy and momentum are inverted (Refs. and references therein), but also charges and currents. For $v < c$, we see in 3+1D a quantum of electric charge, and simultaneously a quantum of current, which velocity is $V = c^2/v$ in (4.5). The charge quantum is identical and then it comes from the same coupling but in opposite dimensions. Last, it is obvious to show that the de Broglie wave phase velocity does not enable causality violations (Ref.) – even if it transfers information, or even if it does transfer some quantities related to energy, momentum, or action.

9. Scale Instantiation

9.1 The Absorber and Cosmology

The standard model of cosmology is based on general relativity theory (GRT). The idea is that the cosmos is self-contained (no outer realm), and internal metric expansion. Therefore it requires a unique event at its beginning, the so called big bang, causing the conceptual problem of its origin. Here we assume that the cosmos is part of a wider 4-dimensional area of existence where a resonance has the following effects:

- A central point exists surrounded by a volume of radius *D*. We call it the emitter.
- A new cosmos or membrane is emitted periodically; it has the same constant thickness *D*.
- The membrane progression is radial; the emitter produces more membranes and so on.

This picture is similar to a particle wave; it is a simple manner to solve the problem of the existence of a big-bang and expansion; the laws of physics cannot apply identically below the radius *D*, and the membrane thickness, if large enough, also avoids the problem of inflation.

9.2 Gravitation and Energy

We know from experimental gravitation physics that clocks at different heights in the field have different rates. It is said that it defines the context in which the rest of physics lives. According to Mach's principle or absorber theory, it implies only a local variation of the density of interaction. Here those variations must come from a definite physical mechanism which must find its origin in interaction.

Let us first discuss the mechanism. Denoting the field g, we need it to vary according to $1/r$, as it addresses energy:

$$g(r) \ = \ g^{\infty}(1 - \ k\, M/r) \tag{9.1}$$

The pulsation of a photon is constant on a free fall path. This is also true for massive system; then constant energy implies constant pulsation and wavelength. Consequently fixed measurements instruments pulsation and wavelengths vary depending on their position in the field – hence the equivalent metric is then given by $g(r)$.

Classically, the Newton potential reads:

$$\Gamma \ = \ \Gamma^0 - \ k\, M \ / \ r \tag{9.2}$$

And Γ^0 is usually an arbitrary constant; the energy of a mass m is:

$$E = E^0 - k\, m\, M/r \tag{9.3}$$

But energy is the absorber and then the constant is $\Gamma^0 = c^2$. We write:

$$E \ = \ m\,(c^2 - \ k\, M \ / \ r) \tag{9.4}$$

In a relativistic manner we can for instance define a variable c^*, use invariant masses and write:

$$c^{*2} = \ c^2 - \ 2G\, M \ / \ r \tag{9.5}$$

In GRT, the line element $d\tau^2$ is considered constant, and the metric is inner to 3-space. Here we consider a 4D Euclidean frame; then we can and must write:

$$c^{*2}\, d\tau^2 \ \leftrightarrow \ c^2 d\tau^2 \tag{9.6}$$

which defines a change of reference. The left-hand side is a hypothetical view "from outside" where light-speed varies, while the right-hand side is valid for an inner observer of the membranes. Since frequencies and lengths evolve conversely in the gravitational field, we write:

$$c^2 d\tau^2 = \ c^{*2} dt^2 - \left(\frac{c^2}{c^{*2}}\right)(dx^2 + \ dy^2 + \ dz^2) \tag{9.7}$$

Substituting from (9.5) this is the Schwarzschild metric; since pulsations and lengths evolve conversely, any observer will measure c constant at its location. The concept is different from general relativity (GRT) but this equation is experimentally verified exactly in the same manner – that is to say uniquely in the solar system since all other verifications lead to suppose the existence of dark matter.

Consequently, time-symmetrical currents can give an origin to metric theories of gravitation.

9.3 Dark Energy and Matter Density

The absorber concerns the total time-symmetrical currents within the event horizon, say $M_A c^2$ the absorber "free" mass/energy. Equilibrium exists in the absorber process, and then the currents interfering with a mass m depend on m/M_A (m gives and takes its own share; this is just conservation). Hence this is Mach's principle and the equation (9.4) can first be written:

$$E_m/(M_A c^2) = m/M_A \times (1 - GM/rc^2)$$

This equation seems useless, but it is unbalanced and the negative term on the right-hand side should use M/M_A instead of G since gravitation is proportional to the mass M. The visible universe radius is $R_U = c/H$ and then, by symmetry of the absorber process, we write:

$$E_m/(M_A c^2) = (m/M_A)(1 - MR_U/M_A r) \tag{9.8}$$

This is the Newton potential but the standard cosmological model is based on GRT which gives a factor *2GM* like in (9.5 – 9.6), then in the standard theory the absorber free energy will be estimated from:

$$R_U/2M_A = G/c^2 \tag{9.9}$$

Using c, G and H we can now compute the absorber free energy; we find:

$$M_A = R_U c^2/2G = 9.790 \times 10^{52} Kg \tag{9.10}$$

Now considering visible energies $M_V c^2$, the ratio M_V/M_A is a geometrical constant. This constant links a 4-volume and a linear interaction; it is then $4\pi^2/1$. Then the factor *2* in (9.9) becomes $4\pi^2$ in 3+1D where visible energies M_V interact. It gives:

$$M_A/M_V = 2\pi^2 \rightarrow M_V = 4.453 \times 10^{51} Kg \tag{9.11}$$

Summing (9.10 – 9.11), we get the total energy M_U of the universe:

$$M_U = M_A + M_V = 9.236 \times 10^{52} Kg \tag{9.12}$$

It corresponds to a density $\rho = 9.91\times10^{-27} Kg/m^3$ and the visible matter (9.9) is *4.82%* of the total. The benchmark at this time is the Plank mission results [37] which gives $\rho = 9.90\times10^{-27} Kg/m^3$ and *4.9%* of visible energy. Hence according to the standard model of cosmology we get three valid quantities in (9.10 – 9.11 – 9.12) which are *deduced* from the absorber symmetry and depend on geometry, c, G and $H = 1/T$. We do not get any dark matter, and assuming those results are significant we cannot afford any – though it could still be part of M_A.

But the absorber concept is different. There is no need to distinguish between two or three kinds of energies and this separation is artificial. There is one single kind of energy, it is the visible field and the geometrical factor $4\pi^2$ used in the calculus is just a geometrical factor.

With the results in this section we face two possibilities: a) the ΛCDM model parameters are tuned to match a linear expansion; this tuning results in (4.2) but misinterprets dark matter; or b) A simple coincidence.

One way to make our mind is to build a theory and check if it works without dark matter.

9.4 The Short Range Gravitational Field

In (9.8) it appears that either G or M_V is variable; if we consider M_V constant, then G is scale-dependent in reverse proportions of R_U. In standard physics, one uses G, c and masses constant; we can then use the same constant quantities and it should give the differences between the Newton theory and the gravitational field given by our equations, at least a short range. In this section we consider that only t evolves and $T >> t > 0$; it is linked to the Hubble factor H or R_U since we have:

$$H(T)\ R_U(T) = constant = c \rightarrow H(T) = c/(R_0 + c\ T) \approx 1/T \tag{9.13}$$

where $R_0 = R_U(T = 0)$ and T is the elapsed time since the separation of our membrane (the date when M_V is fixed). Then from (9.13):

$$4\pi^2 GM_V/(R_0 + cT) = c^2$$

where all quantities are constant except T. At any time $T - t$, denoting $R_U = R_U(T)$ we can also write:

$$4\pi^2 GM_V/(R_U - ct) = c^2 \tag{9.14}$$

Hence R_0 is useless and may be illusory, since only (9.14) "now" is verifiable.

With $c\,t \rightarrow r$ we introduce retarded causality in the field (which is not part of Newton's theory). Now all is constant except t and we take a second order limited development on t; using (9.13 – 9.14) and denoting $H(T) = H$, we get:

$$(4\pi^2 GM_V H/c)(1 + Hr/c - H^2r^2/c^2) = c^2 \tag{9.15}$$

After removing the factor $4\,\pi^2$ in front of $G\,M/\,r$ the potential becomes:

$$\Gamma = \Gamma^0 - GM/r - 4\pi^2 GMH/c + 4\pi^2 GMH^2 r/c^2 \tag{9.16}$$

Let us analyze how this potential works:

- It adds a constant negative energy term ($-G\ M\ H/c$) with no gravitational impact. It is then the contribution of the mass M to the constant c^2; here M must be summed to M_V and $4\,\pi^2\,M_V = 2M_A$. Using (9.9) it gives a negative constant $-c^2$ on the right-hand side. It gives:

  $$\Gamma = \Gamma^{\mathbf{0}} - c^2 - GM/r + GMH^2r/c^2$$

  Then $c^{\,2} = \Gamma^{\,0}$ is immediate and the physical origin of energy is now the expansion rate.

- The next term is then of identical nature and we just replace $M \rightarrow M_V$ in this expression. Using (9.9) again it gives $4\,\pi^2\,G\,M_V\,H^{\,2}\,r\,/c^2 = H\,r\,c$ which gives an acceleration $H\,c$. We get:

  $$\Gamma = \Gamma^{\mathbf{0}} - c^{\mathbf{2}} - GM/r + Hrc \tag{9.17}$$

- But $c^2 = \Gamma^{\,0}$ and $\Gamma < 0$; then we choose to write:

  $$\Gamma/c^{\mathbf{2}} = \boldsymbol{c}^{\mathbf{2}} - MR_U/2M_A r + r/R_U \tag{9.18}$$

It is well-known that stars at galaxies borders experience an anomalous centripetal acceleration in the range $H\,c$. This acceleration is the origin of the dark matter hypothesis by Oort in 1932.

Here the potential c^2 and the acceleration $H\,c$ are the effects of expansion and causality; it must be seen as the origin of energy and then the known problem of conservation related to this acceleration is inexistent.

A second classical objection is that this anomaly is not observed in the solar system; however, the absorber is the origin of mass and the immediate consequence is that it transform in acceleration. We can directly transform the currents g; that is, with acceleration $H\,c$ in any direction, a transformation L of currents exists verifying:

$$L(Hc, g(T - r/c)) = g(T) \tag{9.19}$$

The following transformation holds:

$$g(T - r/c) \times (1 + Hr/c) = g(T) \tag{9.20}$$

Because once extended to any acceleration A in place of $H\,c$, and replacing $r \rightarrow ct$, the non relativistic case gives:

$$\frac{g(T-t)A}{c} = \frac{g(T) - g(T-t)}{t}$$

This equation is also a time derivative, hence:

$$gA/c = dg/dt \tag{9.21}$$

It shows that a current obeying (9.20) creates resistance to acceleration and also that mass increases with velocity.

The equation (9.20) is equivalent to the equation (9.14) but now showing a symmetrical situation where currents transform in acceleration. This calculus shows, by symmetry that if a cosmological acceleration of the sun and its satellites exists in the direction of the galaxy core, it results in a time-symmetrical current, and then no second cosmological acceleration of its satellites can exist directed to the sun. The same result applies to planets' satellites.

9.5 Energy and the Quantum World

In this section, we shall use the Plank units and the Schwarzschild radius as they appear useful to the discussion, but for convenience we shall use h instead of $\hbar$ in the definition of these units:

$$M_P = (h\,c/G)^{1/2};\ l_P = (h\,G/c^3)^{1/2};\ t_P = (h\,G/c^5)^{1/2};\ R_S = 2Gm/c^2$$

The equation (9.9) is equivalent to saying that the visible universe is defined by the Schwarzschild radius of M_A. The Plank mass has a unique property, its Schwarzschild radius and wavelength are equal; it is then pivotal to link gravitation and quantum physics.

Then using (9.9) we first write:

$$2M_A/M_P^2 = 4\pi^2 M_V/M_P^2 = (R_U c^2/G)(G/hc) = R_U c/h \tag{9.22}$$

A similar equation can be written for any material system of mass m using its Schwarzschild radius:

$$2m/M_P^2 = R_S c/h$$

Hence, one could think that (9.22) is nothing new, but this is a nice result firstly because this equation uses M_A and R_U, and not M_U or M_V as we may expect. Importantly, it shows that any mass m and M_A are connected by the same mechanism, but in a complimentary or reciprocal manner. Here is a second equation giving unitless ratios:

$$2M_A/M_P = (R_U c^2/G)(G/hc)^{1/2} = R_U/l_p = T/t_p \tag{9.23}$$

It expresses the same link of the absorber with quantum physics; the system of units $\{2M_A, R_U, T\}$ is the time integral of the Plank system $\{M_P, l_P, t_P\}$. Again, a similar equation can be written with any mass m, but not with M_V or M_U. Now using $h = c = G = 1$ we have $M_P = t_p = l_p = 1$, and the only evolving quantities are:

$$T = R_U = 2\ M_A = 4\pi^2 M_V \tag{9.24}$$

In the most natural system of units the cosmos energy is trivial and it appears to evolve. However, at each time interval $t_p = 1$ the cosmos extends of a length $l_p = 1$, and this is true in any system of units. In facts, the cosmos expands exactly of one Compton wavelength of any massive system during one period of its pulsation (this is just $\lambda = h\ c/E$). The system $\{2M_A, R_U, T\}$ is just a time integral, and a quantum system of units is its differential.

Consequently, the link with the quantum world is also trivial: *Expansion gives an action h at each period of any system pulsation. It gives a very natural origin to the basics of quantum physic where energy is a time differential.*

Here we find identity of wave and energy, in perfect agreement with the conclusions of the previous section.

The Plank mass appears pivotal in (9.22 – 9.23) then we model the absorber with an evolving field φ given by:

$$2M_A M_\varphi = M_P^2 \rightarrow E_\varphi = hc/R_U \approx 0.95 \times 10^{-32} eV \tag{9.25}$$

This equation is the inverse of (9.22). This is the energy of a field of wavelength R_U, and it is causal by definition. Its energy is proportional to $1/R_U$ and evolves; it is then scale-dependent and it is legitimate to write:

$$E_\varphi(r) = hc/r\,; P_\varphi(r) = h/r \tag{9.26}$$

which addresses identically a hypothetical cosmos of radius r, and the field at a distant r of any mass. This equation addresses the invariance of the field.

An isotropically expanding membrane defines a frame which is moving at velocity $v = c\ r/R_U$ at distance r from the attractive body M; then, paralleling de Broglie, we notice:

$$h/M_\varphi v = r\,; h/M_\varphi(r)v = R_U \tag{9.27}$$

$$P_\varphi(r) = M_\varphi R_U c/r = M_\varphi c^2/v \tag{9.28}$$

The equation (9.27) is the de Broglie wavelength and in (9.28) momentum transfers like the phase of the wave.

In the ΛCDM model, the dark energy field has negative pressure equal and opposite to its energy density; similarly, the equation (9.18) gives a negative energy at short range; the negative part in equation (9.28) should correspond to negative momentum exchange; the momentum quantum is given by the de Broglie wave phase velocity $V = c^2/v$, and from $E = h\ \nu$ this emission has the Compton frequency of its source, and it is valid for any massive particle or system. The negative pressure in (9.28) must also be understood as the gravitational field since:

$$\frac{G}{c^2} = \frac{1}{P_\varphi(R_U)} \times \frac{1}{\nu_A(T)} \tag{9.30.1}$$

$$F = -\frac{P_\varphi(r)^2}{P_\varphi(R_U)} \times \frac{\nu_M(T)\nu_m(T)}{\nu_A(T)} = -GMm/r^2 \tag{9.30.2}$$

$$\frac{\Gamma}{c^2} = 1 - \frac{P_\varphi(r)}{P_\varphi(R_U)} \times \frac{\nu_M(T)}{\nu_A(T)} = \Gamma^0 - \frac{GM}{r} \tag{9.30.3}$$

where notations are trivial for the Compton frequencies of the masses m, M, and $2M_A$.

The equations (9.30.2 – 9.30.3) are approximate because we do not introduce causality. We could use fixed mass and a limited development (9.15) but with little interest. The masses at the numerator of (9.30) evolve in proportion of time. Using (6.9) and a distance $r = c\,t$ constant; at the time T the retarded and advanced momentum from M will be felt by m like $P_\varphi(r)\nu_M(T-t)$ and $P_\varphi(r)\nu_M(T+t)$ a proportion of m. Recall also $\nu_M(T) = kT$, then we write:

$$\frac{\Gamma_{damping}}{c^2} = -\frac{P_\varphi(r)\nu_M(T-t) - P_\varphi(r)\nu_M(T+t)}{P_\varphi(R_U)\nu_A(T)} = \frac{P_\varphi(r)\nu_M(t)}{P_\varphi(R_U)\nu_A(T)} = \frac{\nu_M(T)}{\nu_A(T)} \to 1 \qquad (9.31.1)$$

This part gives the participation of M to the potential c^2 which we integrate like in (9.17). The sum gives:

$$\frac{\Gamma_{retarded}}{c^2} = -\frac{P_\varphi(r)\nu_M(T-t) + P_\varphi(r)\nu_M(T+t)}{2\,P_\varphi(R_U)\nu_A(T)} = -\frac{P_\varphi(r)\nu_M(T)}{P_\varphi(R_U)\nu_A(T)} \qquad (9.31.2)$$

The sum of the two components includes the gradient and constant c^2, but we miss the acceleration Hc. A similar exercise on forces is not difficult but a little long; it starts with the retarded and advanced forces:

$$\frac{F_{ret}}{c^2} = -\frac{P_\varphi(r)\nu_M(T-t) \times P_\varphi(r)\nu_m(T)}{2\,P_\varphi(R_U)\nu_A(T)}$$

Where we extract the part related to $v(t)$; it gives, once integrated:

$$\Delta F = \frac{P_\varphi(r)\nu_M(t) \times P_\varphi(r)\,\nu_m(t)}{P_\varphi(R_U)\nu_A(T)} = \frac{\nu_M(T) \times h\,\nu_m(T)}{\nu_A(T)R_U} \to Hc\,m(T) \qquad (9.31.3)$$

Which is the acceleration $H\,c$, hence it is the field in (9.18). *But using the potential gives an incomplete result.*

9.6 The Plank Scale Potential

At the Plank scale, from (9.9), the field energy is given by:

$$E_\varphi(l_p) = hc/l_p = M_P c^2 \qquad (9.32)$$

This is the expected result in particles physics. But here the field is dependent on its source and this energy level does not pervade all space, the potential is c^2 and just multiplied by the Plank mass.

Then, and more subtly, from (9.18) and using (9.9), the main terms of the field potential ($c^2 - GM/r$) cancel exactly at the Plank scale (in (9.18), just use $M \to M_P$, $r \to l_P$), and the residual Plank scale potential is utterly small:

$$\Gamma = l_p c^2/R_U = Hl_p c \approx 2.8 \times 10^{-44}\ m^2/s^2 \qquad (9.33)$$

The set of equations in this section show the coherence of the classical field discussed in section 5 with the quantum world because the only equation introduced is $E\,t = h$ or equivalently $P = h/r$, the rest is just playing with the Plank units, expansion and causality which give the same results as in section 5. Importantly, it goes straight to the de Broglie wave and the two products at the numerator of (9.30.2) are a property of charge.

9.7 Black Holes and the Poincaré Stress

At the Schwarzschild radius the field potential limited development reads:

$$\Gamma/c^2 = 1 - 1 + R_S/R_U \qquad (9.33)$$

Hence this theory is compatible with the existence of black holes, which is trivial, but also with their stability since R_S/R_U is a constant quantity (considering G constant the black hole mass evolves like R_U).

Recall also that the exchanges are time-symmetrical and on the light cone (not deformed like the GRT geodesics); the momentum field in (6.8) does not follow the trajectories of photons and there will be no black holes inflation or deflation (which is a major problem in pushing gravity).

At the Compton wavelength of a particle it reads:

$$\Gamma/c^2 = 1 - R_S/2\lambda + \lambda/R_U \qquad (9.34)$$

which implies symmetry and suggests equilibrium. This equation can be interpreted as the Poincaré stress and it is of interest to test its solution as it is the unique and fundamental mass in the field; but we need to remove the factor 2 as it comes from GRT:

$$0 = -R_S/2\lambda + \lambda/R_U \to m = 8.25 \times 10^{-34} Kg \qquad (9.35)$$

The difference with $\mu/2$ in (3.3) is *4.5%* – which is not bad at all. The relation with (5.31) is empirical but seems related to electric self-interaction, $\mu'/3 \approx 5\ m/9$ and holds at *0.06%*, compatible with the uncertainty on R_U.

9.8 Cosmological Resonances

Recall that the currents are back and forth in time; then cosmological-scale resonance geometry is based on two lengths, R_U which is variable, and R_0 which we suppose fixed.

The particles resonances and the ratio M_A/M_V are constant, and gravitation depends on R_U/r, not on $1/r$. It shows that we can and must consider a simple 4-sphere of circumference R_U and thickness R_0, and it comes as if the observable membrane occupies a 4-volume V in which the resonances happen; it is:

$$V = 4\pi^2 R_U^4 - 4\pi^2 (R_U - R_0)^4 \tag{9.35}$$

The resonance loop or connection depends on R_U in all space directions and on R_0 in the time direction which is orthogonal. Phase coherence must exist between those two directions, and one could think naively that it depends directly on R_U/R_0 and varies; but it is a 4-volume resonance as shown by the coefficient linking M_A and M_V. Then using $R_0 = 1$ and $R_U = x$, we first write:

$$x^4 - (x - p/n)^4 = 0 \tag{9.36}$$

This expression, where p/n is the resonance ratio in the direction of time, just states that the resonance is independent of R_U, and holds with any ratio $R_U/R_0 = x$. It gives the equations to solve for the resonance to hold since its roots will give lengths ratios R_U/R_0 where the 4-resonance repeats periodically in the two directions – adding one particle wavelength to R_U. Hence any root of the equation will be a valid resonance.

As a result, all roots of the equations must be linked straightforwardly to integral resonance numbers that were found in section 3 (not the leptons Table 5 as it uses different coefficients). It has the following solutions.

$$p/n \ \rightarrow x = p/2n,\ x = p(1-i)/2n,\ x = p(1+i)/2n \tag{9.37}$$

Then it is straightforward that any resonance number can hold with the ratio p/n = *space/time*. It addresses firstly the free field and then massless particles.

A second case needs to be considered which depends on the parity of the space connection; because in this case, the resonance can loop spatially with no additional constraints in the time direction. We need to solve:

$$P = 4x^3 - 6x^2 + 4x - 1 \tag{9.38}$$

$$P = 0 \rightarrow x = 1/2,\ x = (1-i)/2,\ x = (1+i)/2 \tag{9.38.1}$$

This is firstly the free field and the electron, where $x=1/2$ gives N = P = 2, and $(1 \pm i)/2$ gives K = 2, synchronous.

$$P = 1 \rightarrow x = 1,\ x = (1 - i\sqrt{7})/4,\ x = (1 + i\sqrt{7})/4 \tag{9.38.2}$$

Combined with (9.34.1), this is likely the muon and tau, and $x = 1$ is massless.

$$P = -1 \rightarrow x = 0,\ x = (3 - i\sqrt{7})/4,\ x = (3 + i\sqrt{7})/4 \tag{9.38.3}$$

It seems to address the quarks domain with the main radial resonance 3, and the 7 of SU(2)/U(1). But we miss the resonance 19 which may only be valid with (9.36).

It is interesting to check the converse equations as it may correspond to dimensional inversion.

$$P = 4x^{-3} - 6x^{-2} + 4x^{-1} - 1 \tag{9.39}$$

$$P = 0 \rightarrow x = 2,\ x = (1-i),\ x = (1+i) \tag{9.39.1}$$

It still looks like the free field and the electron, with a direct correspondence to the roots of (9.33).

$$P = 1 \rightarrow x = 1,\ x = (1 - i\sqrt{7})/2,\ x = (1 + i\sqrt{7})/2 \tag{9.39.2}$$

It still looks like the muon and tau, and compared to (9.34.2) the complex roots are doubled.

$$P = -1 \rightarrow x = (3 - i\sqrt{7})/4,\ x = (3 + i\sqrt{7})/4 \tag{9.39.3}$$

It has the same roots as (9.34.3). So it looks like the solutions above relates to the resonance numbers in the tables 1, 2, and 4, and all loops may close. In facts, we need to look at the expression of D_e in (5.35), where we find that the number *19* comes with the time axis and *7* with the rotation, which is coherent with the solutions above. The expression of *D'* in (9.36) does not appear in contradiction.

On conceptual grounds, with cosmological resonances we can still consider variable masses or G a scale factor. But once again variable masses seem more appropriate since the extent of the resonance evolves like the radius R_U.

9.9 Cosmological Oscillations and Linear Expansion

A membrane of this kind has thickness and the emission of the next membranes must be imprinted in the observable cosmos geometry; this imprint must be damped in proportions of the number of membranes existing between the emitter and ours.

The oscillation recently observed by Ringermacher and Mead [35] corresponds to 7 minima and 6.5 ± 0.5 phases. The amplitude of the oscillations increases with distance and they find the presence of second and third harmonics.

Here we interpret the minima as successive membrane emissions (big bangs), and ≈ 6.5 visible oscillation phases for 7 membranes correspond to ~50% of our membrane emission logically invisible, as a contraction phase preceding its emission. It suggests that ~ *T/6.5* corresponds to a fundamental period or ratio.

Now we want to understand the observation of 1A supernova since this secondary candle leads to accelerated expansion. The Chandrasekhar limit gives the mass of the type 1A supernova on which luminosity depends:

$$M_{limit} = k\, M_P^3/(\mu_e m_h)^2$$

where k is a constant factor, M_p the Plank mass, μ_e the average molecular weight per electron, and m_h the mass of a hydrogen atom. The previous section shows that it is natural to consider the Plank units constant and masses variable increasing with time. Then the mass of a hydrogen atom increases with time and M_{limit} decreases according to its square. Hence M_{limit} evolves like $1/T^2$, which does not make any sense. Then in this equation the electric charge evolves and intervenes in reverse proportions of μ_e and then $\mu_e\, m_h$ is constant.

It means that the field is also at the origin of all charges interaction, which is coherent with the rest of this paper. The field is “below” the known fields and forces and it is still correct to state the gravitational field described here defines the context. Hence M_{limit} is constant; the expression is time independent and then also the emission luminosity. Now assume linear expansion (plus or minus oscillations). Then photons will disperse more than with a decelerating expansion. Hence a linear expansion is in qualitative agreement with observation. As we know from Perlmutter & al [7] and more recent works it is very close to linear.

Finally the notion of variable energy also applies to photons and other massless particles (resonances 1). Photons redshift is exactly compensated by their energy increase; but at the same time the mass of the receptor has increased in the same proportions; so the redshift distances measurements are still valid. In this way, it seems that the only possible physical evidence of this proportionality is the acceleration *H c.*

Alternately, one may also consider constant masses and charges with G a scale factor depending on the expansion; results are identical but it seems more natural and elegant to considering the field invariant. At this stage of the analysis it is a question of theoretical choice which is not needed.

9.10 Conclusion

From the results in this section, we state that our conjecture is verified in gravitation and cosmology. As a postulate it immediately implies or leads to most of the results above.

The economy of the solution presented here appears maximal, on *conceptual and physical* grounds. We find that the de Broglie wave is momentum, results from expansion which is also at the origin of gravitation and energy, and necessarily of particles interactions. We end-up with two conceptual inversions:

a) Instead of understanding gravitation and expansion as an effect of energy and its distribution, we find that energy and gravitation are immediate effects of the expansion.

b) Instead of a curvature we build a causal Newton/de Broglie theory where wavelengths and frequencies depend on the potential.

Now, it is also legitimate to state that the particles resonances exist, act on cosmological-scale and then enable quantum non-locality.

This situation is of high interest since the predicted dark matter and dark energy fields have no intrinsic motivations in particles physics. They can also be seen as the most economical solution *within the GRT and QFT frameworks.* We mean that the first economy is theoretical but the hypothesis cost is huge.

10. Discussion

Before concluding this paper we need a status of the theory and a few remarks on the method and motivations, and also on the true nature of the problem we discuss. Those are just general discussions but it seems important to explain where the theory stands and where it comes from.

10.1 Five Great Problems

Incidentally, and we must say unexpectedly, it turns-out that the equation (1) leads step by step to address as a whole the so called five great problems in physics. So let us review the outcome and the status of the solutions point by point and in logical order.

Problem 2: *Resolve the problems in the foundations of quantum mechanics, either by making sense of the theory as it stands or by inventing a new theory that does make sense.*

Status: Solved. Universe-scale resonance and the inexistence of a punctual particle imply that quantum information is not local. The separation in space time-currents works and it shows that TIQM is valid.

Problem 4: *Explain how the values of the free constants in the SM of particles physics are chosen in nature.*

Status: Explained. They are not "chosen" or "free" but most probably unavoidable, and we understand their origin. Not all parameters are deduced yet but all known sectors are addressed coherently and from a unique concept (including quarks and neutrinos mixings even though the work is incomplete).

Problem 3: *Determine whether or not the various particles and forces can be unified in a theory that explains them all as manifestations of a single, fundamental entity.*

Status: Unified. This problem addresses 3+1D physics, particles and forces. All symmetries, coupling constants, and masses decay from the resonance concept, a single type of currents and the symmetry of time. Taken together, it gives the SM Lagrangians for electromagnetism and QCD, but the weak force is emergent and a separate Higgs field is not needed. The fundamental entity is the resonant absorber and it includes gravitation.

Problem 1: *Combine General relativity and Quantum Theory into a single theory that can claim to be the complete theory of nature. This is called the problem of Quantum gravity.*

Status: Explained. The problem as stated is inexistent and combining theories is not appropriate. We find from a unique approach that gravitation and quantum theories are distinct views of the underlying physics. This paper solves the true problem which is actually the origin and the nature of the wave and energy.

Problem 5: *Explain dark matter and dark energy. Or, if they don't exist, determine how and why gravity is modified on large scales. More generally, explain why the constants of the standard model of cosmology, including dark energy, have the values they do.*

Status: Explained. The solution departs strongly from existing concepts and simplifies gravitation theory. The main related calculi fit with observation: visible energy density and the acceleration $H c$; the solution also agrees with oscillations. The true problem is not to modify gravity but to understand what energy is.

Now considering that all known domains are addressed coherently, we state that the conjecture is effectively verified in nature, and it addresses the next level of "more fundamental" physics.

It appears from the above discussion that the physical problem is artificially split, and four of the five problem statements are based on preconceptions (chosen constants, to unify forces, combining theories, modified gravity…). Admittedly, taking a historical perspective this is a logical status; but now we can discuss the true problems which are firstly conceptual.

10.2 On Method, Motivations and the True Problems

The usual methods and techniques are not applicable to this work except for the scientific method in a very general manner (observation → hypothesis → verifications). Firstly, any modern physical framework imposes its own preconceptions in a very strong and limiting manner; first proof is that most field theory textbooks include a section titled "how to build a theory" – or so – which eventually needs empirical parameterization. Hence parameters freedom is a property of this framework. String and loop theories face a similar problem – though in a different manner as the problem may have a mathematical solution but seemingly not accessible using known data. Metric theories state that gravitation defines the context but are sterile when it comes to the real question (how?) and cosmology also has its free parameters. Hence those techniques always ignore the problem we discuss and cannot even face it directly; they take it for inexistent or unsolvable at their scale and this is the first conceptual problem.

This is a situation where a paradigm shift is needed but we find at the opposite that it still addresses the latest most major ones, namely the Plank constant and the origin of the de Broglie wave. Here, despite the existence of this constant and of quantum theory, we find that the second conceptual problem is the very old belief or well hidden assumption that energy is fundamental. In this analysis we use the opposite assumption (P6: sums and products); this is the essential leap and it is rather difficult to understand why it is still needed after all this time. As a result, and with respect to the results in this paper, the last (maybe) 100 years of accumulation of knowledge in physical sciences are based on some conceptual incompleteness. Considering the problem of interpretation of quantum mechanics, is that a real surprise? The only insight here is to guess conceptual incompleteness because the standard theory works. Consequently, the methods of analysis used to build the theory in this paper are empirical and exploratory and it can only rely on repeated experimental results.

Considering also that we have only 3 + 3 + 6 mass samples to analyze, it is doubtful that any other practicable way to prove their coherence can exist at present. It is also unlikely to find any ground in modern theories leading to suspect the existence of a mass equation, not to mention its demonstration “down from field theory” or any other of the reader’s choice. That is to say that once the equation is known and fit to leptons and quarks masses the method is probably unique and the motivation immediate: the Tables 1 and 2 are too simple, too coherent, and too structured to be ignored. They hold 9 free SM parameters that speak coherently of masses and couplings. Here we must face the facts and analyze each and every piece of the equation, all empirical values, and understand what it is telling us; all this with and within known decimals. This is the object of this study.

Last, caricaturing the present state of mathematical physics, it seems that unification remains improvable, that the free parameters are not a problem in physics, and that almost any symmetry can be relevant, but we find at the opposite that “limitation of symmetry → no free parameters → full unification” is workable and verifiable.

This is where this paper stands.

11. Conclusion

Now what have we done? We have found a solution to the core of the free parameters puzzle in a fully coherent manner; ranging from symmetries to particles mass, couplings and gravitation. It needs neither highly innovative concepts nor complex mathematics, but mostly a change in perspective. This situation is atypical but logical as it shows that the founders of relativity and quantum physics jumped some steps of the ladder of knowledge. In any case, they did not have enough data to take another route. A few decades later theoretical physics was stuck.

Now of course it needs a better mathematical treatment for the theory in its present state is incomplete and a little inelegant; but it is obvious that the standard models of particles physics and a new cosmology need to be decayed from a weaker and wider theory where a unique field and mechanism exists.

In our views, the most important point in this paper is to opens a new practicable road according to which energy in all form is the by-product of a geometrical process involving only currents and geometry.

A concept and a process, not a primary quantity, and this is important because a process can be understood, not only modeled and parameterized; then if we better understand the process we get a chance to find more tricks to use or harness it.

We find that the wave is momentum and interact with charges; contrary to the standard theories, it could have new applications in the domains of propulsion and energy production. It might even not be very difficult to find how. In particular, *all* in this paper is compatible with the stunning results reported by Podkletnov [38, 39] and Poher [40]; despite all critics, the absence of public replication and possibly hidden information, those may well be real measurements.

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