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Hacking the Fine Structure Constant in Leptons Geometry

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Abstract

On the basis of a single field "below" the SM fields we first compute the leptons magnetic moment anomaly from the leptons masses without the help of quantum electrodynamics. Next, we compute the fine structure constant from the leptons masses using neither the anomaly nor QED. Here we begin to understand what it is.

Keywords: fine structure constant, leptons geometry, leptons magnetic moment, field below

1. Introduction

Particles physics has been dictated by field theories for many decades. The result is the standard model and its extensions. But those theories are based on generic mathematical frameworks that can accommodate an infinite number of free parameter-dependent universes. Is that physical? On the other hand, field theories are essentially based on couplings (and symmetries) between which little or no coherence is required; the current status is not surprising. Once this is understood, huge progress might come from understanding the origin of free parameters and symmetries. A simple angle of attack that seems available at present is to pay attention to the data itself and assume that there is now enough of it with sufficient precision for a pertinent analysis to be made. But then the "problem" must be hidden in mathematical abstractions from the very beginning of quantum physics.

Here we are not only ignorant; the risk is to being blinded by preconceptions because it is fairly easy to disregards the possibility that a theory is emergent. Then we restarted from the Bohr model and de Broglie's thesis (De Broglie, 1925) and tried a different route; using modern data we reached coherent results (Consiglio, 2013, 2014a, 2014b) (repeated briefly in addendum). In short, we showed that the mass spectrum is *entirely* coherent in numbers and geometry and *only* three types of resonances come naturally; for this we rely on a single equation, which was found reasoning close to the Poincaré stress (Poincaré, 1906):

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

Where all entities have a classical origin except D: 1) X is the reverse of a density. 2) K, P, and K are integral numbers. 3) D is a distance specific of the particle group (charged leptons, quarks, or massive bosons). 4) μ is a small self-energy that we compute for leptons. But now the equation has no less than 6 free parameters and we only have 12 masses and three particles groups to test it. Its relevance must be proven using additional criteria which can be of several kinds: 1) Small resonance numbers, 2) coherence of those within or between all particles groups, 3) geometrical coherence between and within particle groups, 4) coherent parameters X, D, and μ between groups, and finally 5) agreement with existing knowledge that is not only to compute particles mass.

Under the first four criteria, the formula was proven relevant and we showed (Consiglio, 2014a) that it suggests the existence of a unique field "below" the SM fields to which resonances "give" symmetry. In second analysis (Consiglio, 2014b), we show that the parameter X is constant and that the particle-group dependence of D is physically coherent; it leads to computing all masses coherently and a trivial approach to the bosons and top quark widths also gives perfect results. This last paper concludes that the known fields are emergent and it ends with the following conjecture.

A physical action is a product of currents of the field below. Conservation laws imply alternative algebras.

Hurwitz's theorem proves that multiplicative formulas for sums of squares can only occur in 1, 2, 4 and 8 dimensions (Dickson, 1919). Accordingly, there exits four division algebras; they are R (real numbers), C (complex numbers), H (quaternions) and O (octonions).

This theorem is of high importance in physics since the SM is built on three and only three symmetries as $U(1)_Y \times SU(2)_L \times SU(3)_C$ and it is known that the following are isomorphic: C to U(1), H to SU(2) and O to SU(3). The conjecture is appropriate as long as no other symmetry is discovered, but we just assume mathematically coherent limitations that explain why nothing else is observed.

In this paper, we use this conjecture to address the fifth criterion: We compute the electron and muon magnetic moment anomaly using resonance numbers, α, and geometry. Then, we find how to compute α from the leptons resonances given by the equation, and (of course) independently of the anomaly.

We must say, however, that our hack is incomplete in geometry, in particular where 4D and 3+1D rotations are addressed. We use 3D slices to picture 4D rotations and the 3+1D or 4D geometry is not clear (even though the two 3D pictures are simple enough) and it looks like the 4D geometry that comes is new. The method can be criticized but the results stand; firstly by precision, and secondly by simplicity in reasoning and equations. Our first purpose in this paper is to recover precision data to find new directions.

2. Method

2.1 The Field Below

According to de Broglie, each particle of energy is associated to a frequency given by the Plank-Einstein relation; then using the minimal Dirac (1993) $G_D = e/2\ \alpha$ we write:

$$E = h\,\nu = \frac{4\pi\ e\ G_D \nu}{c}$$

It suggests that a current G_D interfering with a charge e is an action which repetition is energy. The idea is indirectly suggested by Lochak (1995, 2007) who "recognizes" the symmetry of magnetism in the Dirac equation and finds a massless monopole equation – a magnetic current. Then, we assume that the electron wave is *also* a magnetic current (Consiglio, 2013). Comparing phases and using the de Broglie's analysis of the Bohr model led to the following equation:

$$g\ V = \frac{e\ c}{2} \tag{2}$$

where V is the de Broglie wave phase velocity, and g a charge associated to a constant magnetic current carried by the de Broglie wave. This result was shown coherent with a total magnetic current (de Broglie's standing wave) obeying the Dirac condition and with Bohr's energy levels. Now, we interpret (2) as the fundamental quantum that can also be oriented in the time direction, in which case we name it a time-current. Then it is trivial to get fractional charges from a breach in the time direction and 4D space ($V = c \pm v$), or 3+1D space ($V = c^2/v$) as it gives the same results. The up and down type quarks electric charges come from currents velocities "thru time" which are:

$$V_{Up} = \frac{4c}{3};\ V_{Down} = \frac{-2c}{3} \tag{3}$$

A time breach of this form is of interest when it comes to SU(3) in 4D space; since octonions can be generated as $O = H \oplus H$, it suggests two "superposed" 4D spaces giving the degrees of freedom of SU(3).

The elementary field constituent is given directly by equations (2 – 3) augmented with space-currents. Here the massive particles constituent is a time-current $\pm e\ c/2$ which manifests an electric charge dependent on its sign and its time direction, associated to or interfering with space-currents; merging two time-currents of opposite charges and directions gives an electron and the Dirac condition. A toy model based on this idea was instrumental to understand the field and compute the bosons masses; it is complete in the sense that no new particle appears (Consiglio, 2014b). Here we only need to picture leptons, for which we deduced differences in time-currents, two or four:

Electron: $[\uparrow^{-}\downarrow_{+}]$; Muon: $[\uparrow^{+}\uparrow^{-}\ \uparrow^{-}\downarrow_{+}]$; Tau: $[\downarrow_{+}\downarrow_{-}\uparrow^{-}\downarrow_{+}]$

where notations (up, down and charge) are trivial.

2.2 Method

The method relies on the use of equation (1) to analyze the mass spectrum structure the resonances. In this paper we present our calculus and equations in the same intuitive manner as the ideas and the logic came. This is the natural way but it is important first to outline the minimal ideas and principles that guide the reasoning:

- Geometry. Our reasoning and equations take place in a broken 4D space. It is explicit in (3) and results in a relative rotation of the symmetry of currents depending in their direction in time.

- Rotations in 4D are around a 2D plane which, for leptons, is defined by the time and the magnetic moment axis. We use two 3D slices in our calculus because we do not know what 4D rotation group is valid.
- Single current quantum. We assume a single quantum of current obeying equation (2) that applies in the time direction and possibly in space. We do not need to assume a different space current quantum.
- Action. This is the bottom line; we do not discuss energy/momentum that we consider emergent.

All the formulas below correspond to putting two orthogonal Poincaré cones in 4 dimensions; it gives cylinders where the currents trajectories are helicoids and action comes as products of currents plus some basic trigonometry. The logic will become clearer when used in the first part of the paper. So the principle here is minimalism.

- Measurable action. Measurable quantities are only differences which are related to action. The difference can be in rates of action (e.g. mass ratios) or a multiple of the quantum – which here corresponds to an integral number of rotations. It gives in particular the ratios *tan(x)/x*, or *y sin(x/y)* that we shall use, where *x* is a helicoid angle and *y = π/2 – x* is the complimentary angle. When comparing action it gives a general formula where *tan(x)* compares in action to *tan(n x)/n* where *n* is a number of turns.
- Inter-action. The systems we discuss are analyzed symmetrically along privileged orthogonal axis.
    - o Constant action rates give formulas like *sin(x) (π/2 – x) sin(x/(π/2 – x))* which relate to forces equilibrium between the angles *x, (π/2 – x),* and *x/(π/2 – x).*
    - o Reciprocal actions relates to currents translations along privileged rotation axis; it gives formulas like *sin(x)/sin(π/2 – x),* tangents, where *x* is the translation angle of the helicoid.

This part of the geometry is also explained Figure 2.

3. Action in Charged Leptons

3.1 Resonances

Table 1 shows charged leptons resonance numbers corresponding to equation (1); the equation parameters are:

$$\mu = 241.676610893\ eV/c^2 \tag{4.1}$$

$$D = 0.000853221892902 \tag{4.2}$$

$$X = 8.14512104162332\ KeV/c^2 \tag{4.3}$$

Table 1. Leptons resonances. (*) 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)

Using (4.1 – 4.3) we find an important coincidence that will be central to the discussion in this paper:

$$\frac{m_e - \mu}{\mu} \approx \frac{\sqrt{2}}{4\pi\,\alpha^2} \tag{5}$$

The match in (5) is not perfect (relative error 1.25 10^{-5}) but (4.1 – 4.2 – 4.3) are constrained by the leptons masses.

3.2 The Dirac Condition and Leptons Parameters, a Semi-Empirical Search

In a celebrated paper, Dirac (1993) 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:

$$e\,g = \frac{n\,\hbar\,c}{2} \tag{6}$$

It results in the elegant idea that the existence of magnetic poles fixes the electric charge and conversely. But 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 it comes that magnetic currents acting on *apparent* electric charges (or conversely) must obey the same condition.

But in our model *e* is an apparent electric charge and simultaneously a sum of magnetic currents; the latter must be taken into account in the condition as part of the total current; for any charged lepton it should be:

$$e\,(g+e)=\frac{n\,\hbar\,c}{2} \tag{7}$$

Now compare with our data. The fundamental resonance in equation (4.3) corresponds to a theoretical half electron, that is N = P = 1, probably K = 0, and a self-energy μ/2 that we shall first ignore. It gives, as per (1 – 4.3):

$$m\;=\frac{X}{1}=\;8.14512104162332\;KeV/c^2 \tag{8}$$

This mass is purely theoretical but fundamental and then it should be compared to μ which, in our model, comes from the interaction of the time-currents (not the apparent charges) and then, for an electron, from the product $e^2/4$. The rest of the electron mass (N = P = K = 2) is given by space currents and, according to our conjecture, it should also correspond to a product; then in (8) 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 the product G e/2.

Now we analyze how action (e G, G^2 and e^2) comes, and not energy for which we rely on resonances. It leads to comparing action and energy where frequencies are identical and it first gives the following correspondences:

$$(e\,G)/2 \leftrightarrow m \tag{9}$$

$$e^2/4 \leftrightarrow \mu \tag{10}$$

We divide (9) by (10), and in light of (7) we add e/2, which is the μ/2 that we first ignored in (8); we find:

$$\frac{2\,G}{e}=\frac{m}{\mu}\;\rightarrow\;4\,G\;+\;e\;=\;68.4051246542\;e\;\approx\;\frac{e}{2\,\alpha} \tag{11}$$

We recognize the modified Dirac condition in (7). The fine structure constant appears straightforwardly from the numbers in a form that gives or confirms the nature of the field. At first sight, the relative discrepancy ($-1.65\;10^{-3}$) seems acceptable since we analyze a hypothetical particle but we shall see how this numerical value holds.

There is a second aspect related to the Dirac condition which comes from the toy model and the charges e/3 and 2e/3 going respectively down and up the time and supposedly merged as the electron time-current; assume their individual self-interactions are squared charges:

$$(e/3)^2+\;(2e/3)^2\;\rightarrow\;\mu\,(1/3)^2\;+\;\mu\,(2/3)^2\;=\;5\,\mu/9 \tag{12}$$

Now compute from (9 – 12):

$$4(m\;+\;5\,\mu/9)/\mu\;=\;137.0324715\;\approx\;1/\alpha \tag{13}$$

The relative discrepancy with respect to α is $\approx 2.26\;10^{-5}$. The coincidence can be seen redundant with equation (11) as it is almost identical, but it comes from a different interaction and we shall see that this value also holds.

3.3 The Electron Mass and Spin

According to our conjecture, the electron mass comes from a product that we first write in complex form:

$$\left(G+i\frac{e}{2}\right)\left(G-i\frac{e}{2}\right)=\left(G^2+\frac{e^2}{4}\right)\rightarrow m_e \tag{14}$$

where *e/2* represents the currents, not the apparent charges. Now we write (15) in quaternion form:

$$\left(G+i\frac{e}{2}\right)\left(jG-k\frac{e}{2}\right)=j\left(G^2+\frac{e^2}{4}\right)+(-k\;+\;j)\frac{e\,G}{2} \tag{15}$$

The rationale for this equation is that in (3) the time-velocities are on each side of the light speed singularity. According to relativistic tachyon theory (Recami & Migneni, 1976) such currents *in space* will see the other rotated on a hyper-complex plane. Here we assume the same for time-currents (or O = H⊕H). We recognize in (15) the masses of (14) and then we multiply this equation by *–j* to get real numbers and the observable parts:

$$\left(G^2+\frac{e^2}{4}\right)-(i+1)\frac{e\,G}{2}\rightarrow m_e+angular\;momenta \tag{16}$$

We get the real squared charges of (14) and the rest is angular momentum that splits into two components; one is a real number like the mass and then observable – it is the magnetic moment.

The other is imaginary and unobservable; it is found along the time axis, like e/2 in (15); then it is a 4D-gyroscope which rate can be interpreted as the origin of inertia using special relativity. For convenience, we will name this component spin – even though it is not its usual form. Now we have e G = ħ c → G = 2 G_D; this is still coherent with (11).

Then we identify the squared charges in (16) with the masses in (5) as it should help understanding; it gives:

$$4\pi\ \alpha^2 G^2 \approx \sqrt{2}\frac{e^2}{4} \tag{17}$$

Substituting G = G_D, we get 1 = √2/4π which is ridiculous; hence the coincidence (5) does not relate to energy but to a relation between two physical actions. Multiplying each side of (17) by the Planck constant and using also (16) we get the following correspondence:

$$h \leftrightarrow \sqrt{2}\ \frac{\hbar}{2} = |(i\ +\ 1)\ \frac{e\,G}{2}| \tag{18}$$

which interpretation is obvious: An action *h* at each period of a lepton pulsation makes its spin and its magnetic moment; but (5) gives an approximate equality which seems incompatible in precision with the leptons masses.

Now in (16), the mass comes from a 4D rotation around a 2D plane defined by the spin and the magnetic moment. Since leptons have a so called magnetic moment anomaly those are not pure rotations, they must include a translation corresponding to a helicoid angle α around the time axis. Then around the magnetic moment axis it covers an angle (π/2 – α) (assuming Euclidian 4D space or SO(4)). Hence retroaction implies a second translation angle α/(π/2 – α). Now we can replace α^2 in (5) by two coefficients corresponding to those two angles:

$$4\pi\ (m-\mu) sin\ (\alpha) \left(\frac{\pi}{2}-\alpha\right) sin\left(\frac{2\alpha}{\pi-2\alpha}\right) = \mu\sqrt{2} \tag{19}$$

where *sin(α)/sin(π/2 – α)* corresponds to a ratio of action per volume element which must then be multiplied by the angle (π/2 – α) to get the full action. Using (4.1) we can compute the absolute error in (19); it reduces to 0.007 meV. It shows that the ratio (m – μ)/μ holds with a relative precision of 2.9 10^{-8}, which will be important, and agrees with current knowledge (precision) of the electron mass. (The case of other leptons is discussed section 6.4, where we take into account their resonance numbers and obtain the same precision.) The coefficient 4π in (19) shows that the phenomenon giving the angle α/(π/2 – α) is isotropic in 3D space. It is then the wave where the rotation is that of a magnetic current obeying $\mathbf{J_m} = -\nabla \times \mathbf{E}$ in standard notations.

Finally, the interactions of each apparent electric charge with its space and time-current lead to two hyper-complex planes which probably requires a formal treatment using octonions; but since we compute a physical action we shall use real numbers. Considering that each is a half-electron, and then a current G/2 interacting with two currents e/2, and self-interacting electric charges (e/3, 2e/3) it gives:

$$\left(\frac{Ge}{2}+\frac{5\,e^2}{9}\right) \to\ m+\frac{5\,\mu}{9} \tag{20}$$

which of course is identical to (13). Then we get:

$$\frac{(Ge/2+5\,e^2/9)}{e^2/4} = \frac{m+5\,\mu/9}{\mu} = \frac{1}{4\alpha}\times\frac{1}{1.000025742393} \tag{21}$$

This equation also gives an approximate equality with the fine structure constant. Together with (11), it suggests equilibrium where space currents interfere with the time currents and the apparent charges under distinct angles.

4. Leptons Magnetic Moment Anomaly

4.1 Wave Geometry

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 2π/α. Then over one Compton wavelength, we have:

$$\Delta\varphi_D = \alpha\ \Delta\varphi_C \tag{22.1}$$

where φ_D and φ_C are the de Broglie and Compton (standing wave) phases, and $\Delta\varphi_D$ and $\Delta\varphi_C$ are their changes in phases over any length. On the n^{th} orbit we find:

$$\Delta\varphi_D = \Delta\varphi_C \alpha/n \tag{22.2}$$

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.

In (16), 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 4-rotation of the time-current of an angle v/c = α which ratio to the space current changes in proportion of the tangent of this angle (adding the γ of special relativity). As stated in (22.1 – 22.2), the impact is a phase differential and now it depends on tan (α); it runs around the full Bohr orbit and then the instantaneous geometrical action term is *tan(α)/2π*. The action given by tan(α) 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:

$$a_0^e = \frac{tan\ (\alpha)}{2\pi} = \frac{(g - 2)}{2} \tag{23}$$

where we denote a and g the correction and the g-factor respectively. Compare with the first order quantum electrodynamics (QED) correction as found by Schwinger (1948), the well known α/2π. The difference is subtle; it comes from distinct manners to taking into account relativistic effects. In QED, the Dirac equation is relativistic but here we use the older relativistic manner initiated by de Broglie and it gives a different logic.

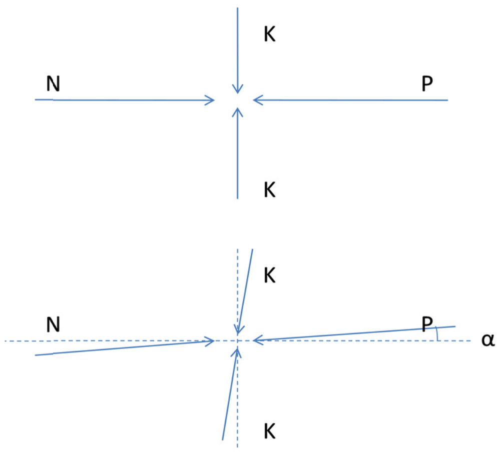

Figure 1. Resonance geometry on N, P, and K. An angle α appears as a relativistic shift on the first Bohr orbit. The time axis is vertical (K), and space is shown horizontally (N, P) (the magnetic moment axis is not shown)

Now consider that the angle between the space and time axis is π/2 and a helicoid of angle α corresponding to the time-current (along K in Figure 1). We get an angular ratio α/(π/2 – α), but it gives a ratio of reciprocal action equal to sin(α)/sin(π/2 – α) = tan(α); here we find a direct correspondence with the currents but not with α/2π; the coefficient tan(α) will lead, for the electron, all other coefficients to get the full correction related to the anomaly.

Now let us come back to the geometry of the equation (19), and to the angles in Figure 2.

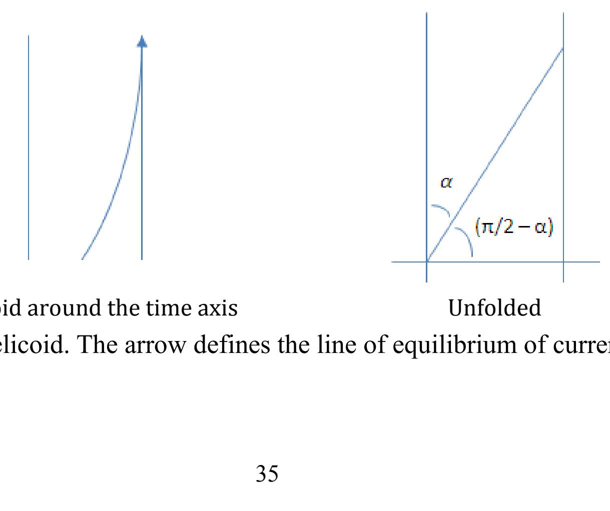

Figure 2. Currents helicoid. The arrow defines the line of equilibrium of currents interaction

Charged currents interact and the equation (1) was found assuming the existence of a pressure field: Space-currents (horizontal) receive a pressure dependent on $cos(\pi/2 - \alpha)$; time-currents (vertical) receive a pressure dependent on $cos(\alpha)$. Then $cos(\pi/2 - \alpha)/cos(\alpha) = tan(\alpha)$ is the ratio of action between space and time currents. In space, the pressure depends on $cos(\pi/2 - \alpha) = sin(\alpha)$ and implies a second translation angle $\alpha/(\pi/2 - \alpha)$ that applies to the solid angle 4π, "thru" the angle $(\pi/2 - \alpha)$, which is the amplitude of the space-currents. It gives (19), where the ratio of mass $(m - \mu)/\mu$ is pressure-dependent. Hence, time-currents are $\mu \leftrightarrow e^2/4$ and space-currents are $(m - \mu) \leftrightarrow G^2$.

4.2 Other Resonance Coefficients

In Figure 1, we depict the main characteristics of the geometry of the resonances found in Table 1: Two space-currents (corresponding to N = P) of opposite direction interfere and give the product NP in (1). Two or four time-currents corresponding to K interfere together and with the space currents and add the KD in (1). Logically, the main resonance NP corresponds to G^2 in equation (16) while K corresponds to $e^2/4$. Then the product NP makes the spin and the true space-resonance cycle is (NP – 2) K which is a product G^2e^2. The power available depends on the number of currents C while the mass μ is constant; then we divide this coefficient by the number of currents.

But the spin corresponds to a product G e, (the square root of G^2e^2,) and we get a spin-dependent coefficient where the spin relates to the apparent electric charges giving equation (22). It is:

$$E = \sqrt{\left(\frac{NP - 2}{C}\right) K} \tag{24.1}$$

In the direction of time (K in Figure 1), the same reasoning gives NK^2 for a product $e^2/4$. We get a spin-independent coefficient which then relates to equation (11) and the time-currents; it is:

$$F = \frac{NK^2}{4} \tag{24.2}$$

Now for the muon and tau the coefficient corresponding to the time current rotation is not α like in (23), but 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 cycle is NK. Now using (24) 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:

$$\varphi = \frac{tan(\frac{NK\alpha}{2})}{\frac{NK}{2}};\ a_0^{\mu\tau} = \frac{\varphi}{2\pi} \tag{24.3}$$

The correction mixes angles and resonance and fits with the interaction of current where action is angle-dependent; it is similar to (19) and it will be the general 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.

4.3 The Calculus for the Electron

Now we want to compute the anomaly but the resonance geometry of is not understood. Then we can only rely on our conjecture, on currents geometry, on the anomalous values in (11 – 21), and on minimal reasoning. We define:

- From (11): $\beta_1 = 1/(2 \times 68.4051246542)$.
- From (21): $\beta_2 = (\alpha \times 1.000025742393)$.
- $a_T = a_0\, a_1 a_2$ where a_0 is in (24), a_1 depends on β_2, a_2 on β_1 and a_T = (g – 2)/2 is the full correction.

According to our conjecture a_T is a product giving a measurable quantity where a_0 corresponds to the angle α in (23) or φ in (24.3), a_1 to the anomalous apparent electric charges (21), and a_2 to the anomalous currents interactions (11). Since β_1 and β_2 are deduced from the leptons masses, they are related to the tangent of some angles part of the resonance geometry (possibly to the rotation of space currents (β_2), with respect to time-currents (β_1) that must be bent by velocity in the same manner as in Figure 1). The anomaly is angular and differential and then a_1 and a_2 must be computed as the ratios involving an arctangent respectively of β_2 and 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 α in the standard theory and β_2 thru the resonance numbers. Now β_2 relates to the apparent electric charges giving the spin; then Y = E as defined in (24.1) and we get:

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

This is still incomplete because the translation angle α/2 of the time-currents also impacts the coefficient and subtracts from K. It might imply a tangent, or it might simply be an amplitude, but it will not impact the results precision significantly. Then, to simplify notations we write:

$$E = \sqrt{\left(\frac{NP-2}{C}\right)\left(K + \frac{\alpha}{2}\right)};\quad a_1^e = \frac{\tan(\alpha)\sqrt{2+\alpha/2}}{\tan^{-1}\left(\beta_2\sqrt{2+\alpha/2}\right)} \tag{25}$$

Now β_1 comes from the time-currents of the electron; we must make a similar correction but our reasoning must involve F defined in (24.2). Naturally, this correction will be similar in form to the equation above. The logic is:

- Firstly, the first order effect is null; it is a second order correction where the cross-products cancel.
- Secondly 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:

$$a_2^e = \frac{\tan(\alpha)\,F(1-\alpha^2)}{\tan^{-1}\left(\beta_1 F(1-\alpha^2)\right)};\quad a_2^e = \frac{\tan(\alpha)\,(2-2\alpha^2)}{\tan^{-1}\left(\beta_1(2-2\alpha^2)\right)} \tag{26}$$

Note that in the equations (25 – 26) 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 (23 – 25 – 26) we find:

$$g_T^e/2 = 1 + a_0 a_1 a_2 = 1.00115965218332 \tag{27}$$

The CODATA experimental value of the electron g/2 is:

$$g^e/2\ = 1.00115965218076\ (27) \tag{28}$$

From (19), the relative precision of the ratio (m – μ)/μ is 3 10^{-8}, and it applies to μ/X and then to β_1 and β_2; the relative error in a_T with respect to CODATA (29) is 2.6 10^{-9}. This is one order of magnitude better that we should expect from (19). *We see that our hack in reasoning and coefficients is effective for the electron.*

4.4 Muon and Tau

We get the equations needed to compute the muon anomaly using (24.1 – 24.2 – 24.3 – 25 – 26), and including the four currents given by the toy model and the resonance numbers in Table 1. We get:

$$g_T^\mu/2\ = 1.00116592081 \tag{29}$$

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

$$g^\mu/2 = 1.00116592091\ (54)\ (33) \tag{30}$$

The result is within uncertainty due to the lesser precision of experimental data. Our reasoning and coefficients are also effective for the muon, but with no additional hadronic corrections, as expected with a single field. Note that the SM prediction includes those but disagrees with experiment and results in a 2–4σ discrepancy. Typically:

$$a_{SM}^\mu - a_{Exp}^\mu = (2.8 \pm 0.8)\ 10^{-9} \tag{31}$$

The very short lifetime of the tau makes impossible at present to measure its anomaly. The SM prediction is:

$$g_{SM}^\tau/2\ = 1.00117721(5) \tag{32}$$

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

$$g_T^\tau/2\ = 1.001257893 \tag{33.1}$$

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 (see also section 6.2). It gives:

$$g_T^\tau/2\ = 1.001170374 \tag{33.2}$$

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

5. Cracking the Fine Structure Constant

5.1 Second View on Leptons Resonances

Our analysis of the resonances in Table 1 fits with the spin and magnetic moment, and two translation angles α/2 where (π/2 – α) is complimentary; the time axis and the magnetic moment define a 2D plane which is the axis of a 4D rotation augmented with translations.

But now we get a quasi-symmetrical picture that suggests the existence of a second view on the leptons resonances where a different mass μ' can be associated to an angle (π/2 – α); in rough approximation and using angular ratios, we should have: μ' = μ(π/2 – α) ≈ 378 eV/c^2. Of course geometry is not so simple since the symmetry between space and time is broken and this is what we want to check.

Starting with this approximate value and using equation (1), an empirical search targeting the same masses as in Table 1 (to all shown decimals) gives Table 2 and the coefficients in (34):

Table 2. 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)

Coefficients:

$$\mu' = 385.674928957\ eV/c^2 \tag{34.1}$$

$$D' = 0.0002255984538 \tag{34.2}$$

$$X' = 8.02160767375101\ KeV/c^2 \tag{34.3}$$

The resonance numbers are small and their logic is new as we get P' = K' instead of N = P, and N' = $2^{P'}$ except for electrons: N' = $2^{P'-1}$ = 2; this difference agrees with the definition of φ in (24.3) as compared to (23), and we also find N' = 2N – 2 which should hide the spin. Importantly, we get P' = K', which can only correspond to the spin and the magnetic moment axis, and those are consecutive numbers. Two coherent patterns together with small resonance numbers seem to confirm the existence of a second view on the same phenomenon – which is quite stunning. Now a few more verifications of coherence; first assume a modified Dirac condition is there, we empirically find:

$$3(X'/\mu' + 2) = 68.39664861 \approx 1/2\,\alpha \tag{35}$$

which is reminiscent of (11) with a different symmetry. Then searching a simple relation between D and D' gives:

$$D\sqrt{2} \approx 3\,D'\sqrt{3} \tag{36}$$

which compares the diagonal D of a cube, to that of its face which is 3D' with a discrepancy of 3%, about twice the difference on our prediction of μ'.

Finally, we get a better match with μ' = μ (π/2 + π α + α/π – 4 α^2) where the relative error is 5.4 10^{-7}; the formal difference with the initial idea is almost equivalent to adding 2 rotations in μ' and then removing the translation; it might not be a known rotation group – or the two views model the rotations in different spaces. On the other hand, this is expected since we instinctively analyze Table 1 using two 3D slices and space-time does not seem to work like that – from the expression of μ', there seem to be a double inversion. But now, one step back, the significance of the result is important: The translation and the rotation are absorbed in μ'. They must also split in the resonance numbers and the consequences are of high interest as we shall see.

5.2 Alpha

With a single field, α defines the "field of forces" at work in Table 1 in the space directions (N, P) while D corresponds to the time direction (K). But in Table 2, we find K' = P' and it puts on equal ground the time and the magnetic moment axis. The N's are orthogonal to those, but now they are pure harmonics and they depend on K'. It implies that α only influences N' and creates a unique resonance path (for all leptons) that depends only on integral numbers – including for currents and then it is necessarily 137.

But then α depends only on Pi, on 137, and on lengths defined by 1/N'.

Now we need to compute a path length in a four dimensions space which geometry is not well understood; but we can still reason on resonances, currents and lengths:

- Since e G is the spin, it is the natural unit: e G = 1 (it should be 1/2 but we will recover it from resonances), then $G = \sqrt{137} = 1/e$. This is coherent with (16) where the mass depends on squares; then there exist one direction where the path length is $L = 137 = G^2 = 1/e^2$, and another where it is $1/L = 1/137 = e^2 = 1/G^2$. But those lengths require a different treatment to take into account the dissymmetry between space and time.
- The path includes the spin as a 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 (or 16 from 2 × 8).
- The products (1/137) × (1/2) and (1/137) × (1/8) are squared lengths as the products of the path length 1/137 by the resonance lengths 1/2 and 1/8.

A path length giving α^{-1} must be Lorentz invariant; then it has the form of a pseudo-norm where the negative part comes from the resonances. We write:

$$\alpha^{-1} = \sqrt{137^2 + \pi^2 - \left(\frac{1}{137}\right)\left(\frac{1}{2} + \frac{1}{8}\right)} = 137.0359990745 \quad (37)$$

$$\alpha = 72\,973\,525\,697.88 \times 10^{-13} \quad (38)$$

Where CODATA gives:

$$\alpha = 72\,973\,525\,698\,(24) \times 10^{-13} \quad (39)$$

Then α^{-1} is computed as the pseudo-norm of a 3+1D path. In a geometrical view, what else could it be?

With the symmetry above, a product ab gives a length 1/ab. Then the length 137 comes from the apparent electric charges, the fractional terms from the space-currents and resonances, and π from their product. The simple pictures in Figure 3 can also help understanding the reasoning, in particular why it is 137 and 1/137.

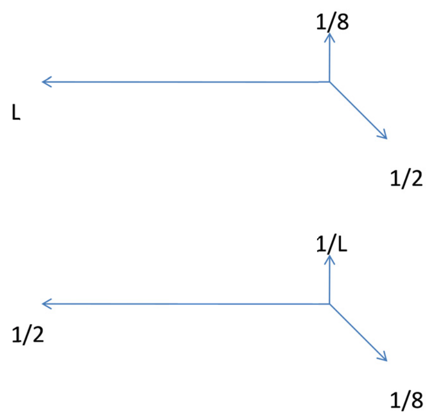

Figure 3. Resonance lengths of Table 2

We suppose e G = 1, and $G^2 = L = 1/e^2$; a squared current L gives a natural resonance length 1/L. Top picture: Three directions with resonance lengths (L, 1/2, 1/8). Bottom picture: Three directions with lengths (1/L, 1/2, 1/8). It is obvious that 1/L, 1/8 and 1/2 must be divisors of L for a resonance to exist in 4D. Similarly, according to (37), 1/L does not divide 1/2 or 1/8. We know from α and also from β_1 and β_2 that $L \approx 137$, then L = 137.

5.3 Proof in D and D'

Now that the trick is understood we can check D and D'. In equation (1), those are invariant and represent lengths; hence they are pseudo-norms of form similar to (37). But here we should also find information related to time-currents which will be evidences of a single field; in particular quarks and massive bosons resonance numbers (Consiglio, 2014b) which basis is 2, 3, 7, and 19 (see addendum).

We find the following empirical expressions:

$$D^{-1} = \sqrt{\left((7-3)\times(274+19)\right)^2 + 7\pi^2 - \frac{19\pi}{19-1}} \tag{40.1}$$

$$D'^{-1} = \sqrt{\left((19-3)\times(274+3)\right)^2 + 2\times(274+19+1)\pi^2 - \frac{3}{3-1}} \tag{40.2}$$

where the relative errors with respect to (4.1) and (34.2) are 9.6 10^{-10} and 8.3 10^{-10} respectively. (Note that the decomposition just works like a division; the left term is the closest square to 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 known numbers.)

Note that a few other interesting solutions exist for the negative terms in an acceptable precision range.

In those expressions, the proof of a single field is fivefold:

1) The identity in form of the three terms of the two expressions (including 7 = 3+3+1).
2) The decomposition into "known" numbers.
3) Finding 274 here is a direct and strong confirmation of 137 and 1/137 in equation (37).
4) The symmetry between those two expressions, as it includes two inversions, firstly between 274, 19, 3, and 7 (= 3+3+1) and, secondly, between sums and products.
5) In equation (1), D and D' have the dimension of 1/NP, and from the equation (37) it comes that the squared pseudo-norm giving α^{-2} also has the dimension of 1/NP. Then D (or D') and 1/NP are of opposite dimensions – which is coherent with the equation (1) and with the split in space and time currents.

It is now crystal clear that the two views address the same geometry and agree with the existence of a single field.

6. Questioning and Empirical Coincidences

In this section, we try to find some order in the integral numbers as they seem at first arbitrary.

6.1 Why 137?

Nothing appears to be fine-tuned in the mass spectrum (Consiglio, 2014b) and then we must question the origin of 137. Is it natural? Firstly, it elegantly follows the suite of primes 2, 3, 7, and 19 that entirely defines the quarks and massive bosons N, P, and K. Secondly it is a prime number and then it cannot be a product of currents – but it can split as a sum. Hence it is tempting to search some coherence with all known resonance numbers. Consider the suite N and P from all tables, including quarks and massive bosons in (Consiglio, 2014a, 2014b) (see also the addendum); and ignore 19/7 as it is a ratio of currents or replace it by 19 – 7 = 12 which is the massive bosons N and P. The list is:

- Leptons Table 1: N = P = 2, 5, 9. Table2: P = 2, 3, 4; N = 2, 8, 16. (All K = 2, 3, 4, 5 are already there.)
- Quarks P = 3, N = 2, 19/7 (→19 – 7 = 12), 7, 14, 19, 38. (K = –6 < 0, is excluded as it is not a path.)
- Massive bosons: N = P = 12 (= 19 – 7). (K = –2, –7, –19 are paths but already there, positive with quarks.)

Recall that the N and P represent the number of oscillations in a length 1; then sum the inverses which, from (1), represent the oscillation lengths:

$$\Sigma' = 1/2 + 1/3 + 1/4 + 1/5 + 1/7 + 1/8 + 1/9 + 1/12 + 1/14 + 1/16 + 1/19 + 1/38 \approx 1.966 < 2 \tag{41}$$

Now compute the sum:

$$\Sigma = 2 + 3 + 4 + 5 + 7 + 8 + 9 + 12 + 14 + 16 + 19 + 38 = 137 \tag{42}$$

This is quite shocking because 137 is a prime that cannot be a product of currents but it effectively splits as the sum of all.

Moreover the equations (41) and (42) show a peculiar symmetry between path lengths and resonance numbers, where: 1) All elementary oscillation length sum–up below the minimal resonance number. 2) All known resonance numbers coexist in the (same) universe and sum as 137; as though we can add no other.

Now 137 suddenly looks like a very fundamental number which is obviously related to bounded complexity, cutoff, and conservation; and it looks *at first* like the answer to 137 is (42).

6.2 Only 137?

In light of (41 – 42), of the existence of Tables 1 and 2, and of the inversion between (40.1) and (40.2), let us be curious and compute a pseudo-norm converse to (37), that is an inversion between space and time:

$$\gamma^{-1} = \sqrt{(8+2) \times 137 - \frac{1}{137^2} - \frac{1}{\pi^2}} = 37.0121416 \quad (43)$$

The coincidence is shocking as it gives a prime number $\gamma^{-1} \approx 37$ that immediately compares to $\alpha^{-1} \approx 137$ and it suggests a converse geometry based on dimensional inversion – similar to the inversion between (41) and (42).

Now compute the sums for each generation (excluding bosons); that is taking leptons N, P, K, and quarks N, P.

- First Generation:
  - Σ'(1) = 1/2 + 1/3 + 1/(19 – 7) ≈ 0.91 < 1.
  - Σ(1) = 2 + 3 + (19 – 7) = 17 = 37 – (2 × 10).
- Second generation:
  - Σ'(2) = 1/3 + 1/5 + 1/7 + 1/8 + 1/14 ≈ 0.87 < Σ'(1) < 1.
  - Σ(2) = 3 + 5 + 7 + 8 + 14 = 37.
- Third generation:
  - Σ'(3) = 1/3 + 1/4 + 1/5 + 1/9 + 1/16 + 1/19 + 1/38 ≈ 0.84 < Σ'(2) < 1.
  - Σ(3) = 3 + 4 + 5 + 9 + 16 + 19 + 38 = 94 = (2 × 37) + (2 × 10).

So it is similar to Σ' and Σ in (41 – 42) since each Σ'(n) is bounded by 1 and each Σ(n) relates to an integral number based on 37 and 10 (note that there are several other coincidences of the same kind). Hence it is not only 137 but also apparently 37, and it suggests that simple arithmetic is at work. Then we should easily find a direct correspondence between the numbers in Tables 1 and 2 since firstly α must be there in both cases and secondly we find the same integral numbers in D and D'. The resonance numbers are 2, 3, 4, 8, 16 in Table 2, and 2, 3, 5 and 9 in Table 1; the 2 and 3 are identical, we trivially find 5 + 3 = 8, and $4 = 2 + 2 = 2^2$ can be a sum or a product of currents; similarly, $16 = 4^2 = 5^2 - 3^2$ for the tau. Hence the correspondence is obvious and (37) is coherent with Table 1. It is interesting that only the tau uses squares in the two tables and that the link relates to the first primitive Pythagorean triple. It also justifies our lack of confidence for the tau magnetic moment as computed in (33.1).

6.3 And the Wave?

It is stated that (19) is the wave, but this equation is only valid with the electron mass. We must rewrite it for the muon and the tau in a manner similar to φ in (23.3), taking resonances into account. We write:

$$4\pi\,(m-\mu) sin\,(\alpha/R) \left(\frac{\pi}{2} - \alpha/Q\right) sin \left(\frac{2\alpha/Q}{\pi - 2\alpha/Q}\right) = \mu\sqrt{2} \quad (44)$$

where R and Q are unknown coefficients which depend on the resonance numbers, possibly 137 and other numbers, and *m* the associated lepton mass.

It is easy to find R from the relations between the resonance numbers in Tables 1 and 2 as found section 5.1. Since N and N' hold the spin it absorbs an angle α/2 (and α in the electron case); the spin is 1/2 and the non absorbed part is α/2 (and for the muon and the tau we have N+1 = 2K in Table 1 while N = K for the electron). We get:

$$R = \frac{N' - \alpha}{2} + 2 = N + 1 - \frac{\alpha}{2} \quad (45)$$

But it is another issue to get Q as it should not be related to the resonance numbers but rather to 137 as it deals with the other angle. Using (44 – 45), an empirical search for similar expressions involving "known" numbers gives:

$$Q^{\mu} = (1/4)(137 + 1 - (274 - 3 - 37/2)^{-1}) \quad (46.1)$$

$$Q^{\tau} = 2(137 + 37 + (137 - 137/74)^{-1}) \quad (46.2)$$

Using those, the equation (44) holds with precision better than $3\ 10^{-8}$, which is coherent with (19). The integral parts of those expressions are doubtless but we cannot use CODATA recommended values to get such precision. We use Table 1 as it gives leptons masses coherent with μ; the non-integral parts can be doubtful.

7. Discussion

In this section, we discuss two questions connected to the theory in this paper.

7.1 QED Calculus of Alpha at Order 10, Hacking β_1 and β_2

Aoyama, Hayakawa, Kinoshita, and Nio (2012) have computed the 10th order QED contribution to the electron anomaly:

$$a^{e}{}_{(\text{theory})} = 1\,159\,652\,181.78(77)\times 10^{-12} \tag{47}$$

A new value of α is also derived from theory and from existing measurement of the anomaly:

$$\alpha^{-1}{}_{(\text{Order }10)} = 137.035\,999\,173\ (35) \tag{48}$$

The resonances, the spin and the electric field are taken into account in (37); then we can only miss two currents, each corresponding to 1/274. Those are not part of the resonance, implying a positive coefficient which gives:

$$\alpha^{-1} = \sqrt{137^2 + \pi^2 + \frac{2}{274^2} - \left(\frac{1}{137}\right)\left(\frac{1}{2}+\frac{1}{8}\right)} = 137.035\,999\,172 \tag{49}$$

Now, re-computing the electron anomaly with this new value comes in very good agreement with CODATA, which is not very significant as it exceeds by three orders of magnitude the expected precision on β_1 and β_2. We do not understand why we should have such precision as it comes from the leptons masses which uncertainty is much larger. We need a better theory to conclude, but without theory we can still hack β_1 and β_2 which are close to α^{-1}. They should be pseudo norms and we can use the same method as for D and D'; by definition, they depend on each other thru X/μ and it adds one more constraint that, in principle, enables to computing more decimals. Relying on "known" numbers, an empirical search gives:

$$\beta_1 = \sqrt{137^2 - 5\,\pi^2 - \frac{1}{14}\times\left(37 - \frac{1}{2} + \frac{(1+1/137)}{137}\right)} \tag{50.1}$$

$$\beta_2 = \sqrt{137^2 + \pi^2 - \frac{4+\pi/137}{\pi+1}} \tag{50.2}$$

where the relative error with respect to the empirical values of β_1 and β_2 is $1.6\ 10^{-11}$. When X/μ is computed twice from those expressions the relative difference is $\approx 1.6\ 10^{-16}$, and the relative difference with (4) is $5.4\ 10^{-11}$. It is better than expected and coherent with the precision in (27) – which seems to confirm the validity of (50).

We see that β_2 holds the spin ($+\pi^2$ like α) as inferred, and β_1 seems to absorb it ($-5\pi^2$), which can also read $(2-7)\pi^2$ since we get $7\pi^2$ in D. Recall that β_2 is associated to the coefficient E in (24.1) which depends on (NP – 2)K where the term –2 corresponds to the spin absorption. The 7 has a double interest as we get 1/14 in front of the next term. Hence, this part seems coherent in geometry. At the opposite the negative terms must be incomplete.

Now with respect to the electron anomaly, (50) gives:

- Using $\alpha_{(\text{CODATA})}$ has no impact (the absolute error is *2.4* 10^{-12}).
- Using (49) gives for the electron: $a_T = 1\,159\,652\,180.72\times 10^{-12}$ which is well in range with CODATA uncertainty in (27) since the absolute difference is *0.04* 10^{-12}.
- With respect to a_e *(theory)* in (47), we find a difference of -1.06×10^{-12} which can be seen compatible; but interestingly, we now have a problem similar to the muon where the SM gives an overestimate.

Then, perhaps, QED is reaching a limit where (or just before) hadronic corrections are significant.

7.2 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. Now compute the energy ratio:

$$49.88/49.81 = 1.00140 \tag{51}$$

The fundamental difference between our analysis of the anomalous magnetic moment and QED is that we use resonances as the de Broglie wave 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 currents giving N P (while its *action* is given by the coefficients in equations (24.x)). For muons, it gives 25 and compares to 4 for electrons. Then, at first order, we must replace α by the following expression in the calculus of muons energy levels:

$$\varepsilon = \tan^{-1}\left(\frac{\tan(6.25\,\alpha)}{6.25}\right) = 0.0073024 \tag{52}$$

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 higher transition energies in proportions of:

$$\left(\frac{\varepsilon}{\alpha}\right)^2 = 1.00138 \tag{53}$$

which is in good agreement with measurement. 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: Since 4NP compares to 4 for an electron, the wave connection is equivalent to that of the electron and the Dirac equation is valid. Finally a discrepancy will come with any atom nucleus of odd charge but not with even charges. Hence this theory of leptons resonances can be tested further, for instance with lithium.

8. Conclusions

We first compute the electron and muon magnetic moment anomalies out of the leptons masses using only resonances, special relativity and the heretic deduction of a single field “below”. It requires no additional hadronic corrections for the muon in agreement with the existence of a unique field. The toy model also passes the test since it is used in several manners in this calculus – which is important as it relates to the nature of the field.

Then we compute the fine structure constant from the leptons resonances and geometry. It looks as though the long standing puzzle of its origin has a solution, incomplete at present, related to the dissymmetry between space and time since a pseudo-norm gives it a geometrical status complimentary to the velocity of light; say α and D are geometrical keys to pierce the light cone in the direction of time – quite a basic definition of mass.

Now the logical bet is that there is no free parameter at all and that the integral number based world that we deduce is *the* natural one in a broken 4D space. The next problem is to link in concepts to field theories but the way to do so does not appear straightforwardly and the field geometry is not well understood at present. A dimensional inversion seems to be there and, as far as we know, this is unheard of – maybe it comes from the true geometry of space-time.

We must mention, however, that 7, 19, and 37 are centered hexagonal numbers or cube differences; the next one is 61 and it is also the full SM particles count (including all types, charges, generations, and colors). It can hardly be a coincidence and it provides with a simple approach to studying the field as a whole; for instance, it is straightforward to put all particles on hexagonal centered spots where charges, generations, stability, oscillations and resonance numbers are organized in a coherent manner. In this picture, the field is a single system where the integral numbers 2, 7, and 19 are natural. Then, perhaps, this is the direction that we search.

Note: All numerical data in this paper were computed in an Excel spreadsheet provided as supplementary material; Microsoft guarantees 15 decimals which is sufficient for all our results. Still, we made a few verifications where the calculus requires high precision.

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Appendix – Quarks and Massive Bosons Resonances and Widths

A.1 Quarks

The parameter X is the same as in Table 1 (4), we ignore μ for lack of precision, and for D we use:

$$D_q = D\,(1 + \alpha) \quad \text{(A1)}$$

Table 3. Quarks resonances. (*) MeV/c^2, Top = measurement – ([1]) world average (The ATLAS, CDF, CMS and D0 Collaborations, 2013) – ([2]) CMS (The CMS Collaboration, 2014)

Particle	Model	Charge	P	N	K	Computed (*)	Estimate (*)
Up	$\uparrow^+$	2/3	3	2	–6	1.93	1.7 – 3.1
Down	$\downarrow_+$	1/3	3	19/7	–6	5.00	4.1 – 5.7
Strange	$\downarrow_+$	1/3	3	7	–6	106.4	80 – 130
Charm	$\uparrow^+\downarrow_-\ \downarrow_+$	2/3	3	14	–6	1,255	1180 – 1340
Bottom	$\downarrow_+\uparrow^-\uparrow^+$	1/3	3	19	–6	4,285	4130 – 4370
Top	$\uparrow^+\downarrow_+\downarrow_-\ \uparrow^+\uparrow^-$	2/3	3	38	–6	172,380	173,340 ±270 ±710 ([1])
							172,040 ±190 ±750 ([2])

The Table 3 gives the quarks computed masses (natural scheme). The top quark resonance width is currently estimated to 2 ± 0.5 GeV/c^2. With respect to the equation (1), the width is related to K, since this coefficient addresses the time-currents, because those are transformed or separated in any decay.

We showed that the quarks N are sub-harmonics of a fundamental circular resonance given by 266 = 2×7×19, where N is a circular resonance while P is radial.

Taking into account P = 3, orthogonal to N, leads to computing a mass using (K ± (3√2)/266) in (1) which gives a difference +1.97 GeV with respect to the pole mass in Table 3 (or –1.94 to depending on the sign of the correction). This mass is, with respect to the pole, the delta-energy at which the resonance breaks. It is then the top quark width, and the logic and calculus are in perfect agreement known principles.

A.2 Massive Bosons

The equation (1) is modified for massive bosons, as shown in equation (A2). The modification is initially empirical, but we later find its significance as related firstly (Consiglio, 2014a) to the difference between the Dirac and Klein-Gordon equations, and secondly (Consiglio, 2014b) to the phase lock between two resonances paths (as explained below):

$$m = \mu + \frac{X}{k\,\pi\,(1/NP + K\,D)^3} \qquad \text{(A2)}$$

Due to the large bosons mass, we neglect μ. We also use the same value of X as in Table 1. The massive bosons parameter D_x are deduced from the field analysis and depend on the time-currents, they are:

$$W^{\pm} \text{ and } Z^0 \rightarrow D_{WZ} = \alpha^2/(1+\alpha^2) + \alpha\, D/2(1-\alpha^2) - D^2/6(1+\alpha^2) = 5.62404904\ 10^{-5} \qquad \text{(A3.1)}$$

$$H^0 \rightarrow D_H = \alpha^2/(1+\alpha^2) + \alpha\, D/2(1-\alpha^2) - D^2/(1+\alpha^2) = 5.56338664\ 10^{-5} \qquad \text{(A3.2)}$$

where D is that of leptons (4.2). Then we find the equation to compute the parameter k in (A2) that corresponds to synchronizing two resonances; it is:

$$k^3\,\pi/144 = 266\,D_x\,(\pi/k)^{1/3} \qquad \text{(A4)}$$

where D_x addresses a specific bosons type. Finally we compute k using (A3.1 – A3.2); it gives:

$$k_{WZ} = 1.00128565 \qquad \text{(A5.1)}$$

$$k_H = 0.\ 998033312 \qquad \text{(A5.2)}$$

It leads to the masses predicted in Table 4, shown together with the SM prediction where relevant. *Note that no adjustment is possible; the coherence of geometry and coefficients makes the approach predictive and falsifiable*.

Table 4. Predicted Bosons Masses (*) MeV/c^2.

Particle	Model	P	N	K	NP	Computed (*)	Measured (*)	SM Prediction (*)
$W^{\pm}$	$\uparrow^{-}\downarrow_{+}$	12	12	–2	144	80,384.86	80,385 ±15	80,363±20
Z^0	$\uparrow^{+}\uparrow^{-}$ or $\downarrow_{+}\downarrow_{-}$	12	12	–7	144	91,187.56	91,187.6 ±2.1	91,187.4±2.1
H^0	$\uparrow^{+}\uparrow^{-}\ \downarrow_{+}\downarrow_{-}$	12	12	–19	144	125,206.55	125,36 ±37±18	None

Note that compared to (Consiglio, 2014b), we have incorporated in Table 4 the latest ATLAS result (ATLAS collaboration, 2014) for M_H. The most recent CMS result (CMS collaboration, 2014) is $M_H = 125.03^{+0.26+0.13}_{-0.27-0.15}$. Our prediction is still in range with both.

The resonance widths are computed in a manner similar to the top quark, but using the equation (A4) to understand the resonances. Let us simplify this equation using $k = 1$ and take its cube:

$$\pi^2/144^3 = 266^3\,D_x^3$$

Now using D = D_x/π gives:

$$\pi/144^3 = 266^3\,\pi^2\,D^3$$

The left-hand side is twice the volume of a 4-sphere of radius *1/144* divided by half its circumference:

$$\pi/144^3 = \pi^2\,(1/144)^4\,/\,(\pi/144)$$

The right-hand-side is twice the volume of a 4-sphere of radius *266 D* divided by its radius:

$$266^3\,\pi^2\,D^3 = \pi^2(266\,D)^4\,/\,(266\,D)$$

The two volumes are identical, and then *k* enables a phase lock between two resonance paths only for π/144 – K D (or 1/144 – K D_x) where K is a divisor of 266, that is K = 2, 7, or 19 like in Table 4. A length 266 D_x is connected to a length 1/144, and the connection happens in 4 dimensions.

Now in terms of resonance widths, the time-currents are assumed separated (unlike leptons) 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 $W^{\pm}$.

- With two currents the symmetry is loose, and on the path 1/144 it is sufficient that N and P hold on 1/2 phase to stabilize the system. It authorizes a phase shift (±1/2)(1/12) giving ΔK = ±1/24. The other path loops on 266 and the same reasoning applies; it adds ΔK = ±1.
- With 4 currents, the symmetry is complete; it requires that N and P hold together (ΔK = 1/144), and the tetrahedron has 6 lines of force that can break; it gives ΔK = 1/144/6. The other loop is not effective as a tetrahedron is fully constrained in three dimensions.

The resonance width is, like for the top quark, the difference in mass given (1) with respect to the pole when we include ΔK. We get:

- $W^{\pm}$ → K = (–2 + 1 + 1/24) → 2.085 GeV, a perfect match with measurement data.
- Z^0 → K = (–7 + 1 + 1/24) → 2.468 GeV, about 1% less than measurement data.
- H^0 → K = (–19 +1/(144×6)) → 4.11 MeV at 125.206 GeV. The SM predicts 4.21 MeV at 126 GeV and 4.15 MeV at 125.5 GeV; linear interpolation gives 4.11 MeV.

Hence, like for the top, the boson widths come straightforwardly from the resonance numbers and geometry.