Toward the Fields Origin

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Here I continue my analysis of particles mass and couplings, and show *why and how* the full SM particles spectrum exists and must exist; that it constitutes a mechanically coherent system of resonances, and *how* it is compatible with GR and cosmology.

1 Introduction

Here I show *why* the SM mass spectrum must exist, and *how* it comes to be what it is. This paper follows [1] where I use a mass equation to analyze the SM elementary particles mass spectrum, and [3] where I discuss cosmological density parameters and their history. It is structured as follows:

In Section 2, for the reader's convenience I first recall my main results related to particles mass; then I recall some of my results in cosmology.

In Section 3, I complement the analysis provided in [1] and show that the couplings and the resonances constitute a coherent system where each particle is a double sub-harmonic of the Planck mass.

Section 4 is the important one as it gives an origin to the SM particles; I show *why and how* the Planck mass imply the SM particles resonances, including also mass-less particles. It shows that this theory is about the very foundations of the physical world.

In Section 5, I show that the mass-resonance equation is compatible with cosmology and general relativity (GR). This is not trivial at all as it is based on the cube of a length, which seems in contradiction with the linear relation between wavelengths and energy. Doing so I show an effective symmetry of scale in GR and cosmology (which is already in [3]).

In Section 6, I discuss the fine structure constant; its interpretation in QED and its position in the field as depicted here.

When reading this paper, please keep in mind that each and every parameter of the standard theories which are analyzed here, when computed from the equations I give are well in the ranges given by CODATA (2014) and the Planck mission results [4], with no exception (the values needed to compute all quantities are provided).

2 Previous results, in very short

2.1 Particles resonances

In [1] and the references therein, I found a mass equation that comes in two slightly different instances; one for leptons and quarks:

$$m = \frac{X}{\left(\frac{1}{NP} + KD\right)^3} + \mu, \tag{1}$$

where N, P, K are integral numbers, X and μ are constant real parameters, and D is a real parameter which is particle group dependent; and one for massive bosons:

$$m = m_e \times \frac{\left(\frac{1}{N_e P_e} + K_e D_e\right)^3}{k \pi \left(\frac{1}{N_b P_b} + K_b D_b\right)^3}, \tag{2}$$

with index e for the electron and index b for a boson. The little k introduced at the denominator is computed using the following equation, which is deduced from their resonances geometry:

$$k^3 \pi / 144 = 266 \, D_b \, (\pi/k)^{1/3}. \tag{3}$$

The numerical values for X and μ are of little interest here, but the relations between the different D is critical. At first, I evaluate D_e, X, and μ fitting the equation to the leptons masses.

$$X = 8.1451213299073 \, \text{KeV}.$$

$$\mu = 241.676619539 \, \text{eV}.$$

The fit is optimal in the sense that I take the smallest possible N, P, and K. Then for quarks I need to use the fine structure constant to modify the D:

$$D_q = D_e \, (1 + \alpha),$$

and finally, after modeling the field interactions related to the D and partly understanding the resonance substructure, I deduce for the Z and W bosons:

$$D_{WZ} = \frac{\alpha^2}{1 + \alpha^2} + \frac{D_e}{2(1 - \alpha^2)} - \frac{D_e^2}{6(1 + \alpha^2)},$$

and for the H^0:

$$D_H = \frac{\alpha^2}{1 + \alpha^2} + \frac{D_e}{2(1 - \alpha^2)} - \frac{D_e^2}{1 + \alpha^2}.$$

This set of parameters corresponds to the fundamental field because all particles masses are computed with X, μ, D_e, and α, which are constants. The form of the resonance is particle group dependent (leptons, quarks and massive bosons), and the coefficients of the resonances are particle dependent.

Empirical fit targeting minimal N and P gives the resonances in Tables 1, 2, and 3 where very simple patterns appear; stunningly for quarks and bosons only one resonance parameter is variable (N for quarks, and K for bosons).

Table 1: Electron, muon, tau in MeV/c².

-	P = N	K	Computed	Measured
e	2	2	0.510 998 9461	0.510 998 9461(31)
μ	5	3	105.658 3752	105.658 3745(24)
τ	9	5	1 776.84	1 776.82(16)

Table 2: Quarks resonances in MeV/c².

-	P	N	K	Computed	Estimate
u	3	2	−6	1.93	1.7 - 3.1
d	3	19/7	−6	5.00	4.1 - 5.7
s	3	7	−6	106.4	80 - 130
c	3	14	−6	1,255	1,180 - 1,340
b	3	19	−6	4,285	4,130 - 4,370
t	3	38	−6	172,380	172,040 ±190 ± 750

Please note that the up quark resonance is $2 = 38/19 = 14/7$, and that of the down is $19/7 = 38/14$; in both cases we have two resonances giving the same mass. This will be useful later and quite stunning. Note also that the single variable resonance parameter of quarks, which is N, depends on 2, 7, and 19. It is the same for bosons in Table 3, but with K.

Table 3: Bosons resonances in MeV/c².

-	P = N	K	Computed	Measured
$W^{\pm}$	12	−2	80, 384.9	80, 385 ± 15
Z^0	12	−7	91, 187.56	91, 187.6 ± 2.1
H^0	12	−19	125, 206	125.090 ± 240

Last, the three bosons widths are computed from resonance geometry and substructure in coherence with the Ds. They come as a difference in mass with a hypothetical particle where their K is shifted as follows:

$$K \rightarrow K + 1 + 1/24, \tag{4}$$

in the case of the W and Z, and for the H^0:

$$K \rightarrow K + 1/144/6. \tag{5}$$

The three Tables above correspond to the fundamental field, but there is also an adjacent field, where leptons also ring as shown in Table 4. It comes with the constraint P=K instead of P=N in Table 1. It uses different parameters (index α):

$$X_{\alpha} = 8.02160795579 \, \text{keV/c}^2, \tag{6}$$

$$\mu_{\alpha} = \mu \left(\frac{\pi}{2} + \frac{\pi}{137} + \left(\frac{2\pi}{137} \right)^2 \right). \tag{7}$$

Table 4: Second view on electron, muon, tau in MeV/c².

-	P=K	N	Computed	Measured
e	2	2	0.510 998 9461	0.510 998 9461(31)
μ	3	8	105.658 3752	105.658 3745(24)
τ	4	16	1 776.84	1 776.82(16)

Expressions giving D_e, D_{α}, and α are given in the next subsection.

Now looking at the different resonances in the Tables 1, 2, 3, and 4, and keeping all distinct numbers except fractions we get two sums which will play a singular role; firstly with the Ns and Ps, we compute the sum of all integral resonances in the space domain:

$$\Sigma_{N,P} = 2 + 3 + 4 + 5 + 7 + 8 + 9 + 12 + 14 + 16 + 19 + 38 = 137. \tag{8}$$

Then the sum of all possible shifts in K, increasing or reducing the resonance lengths. The term $266 = 2 \times 7 \times 19$ is related to the bosons' little k and is the product of their Ks.

$$\Sigma_K = (2 \times 7 \times 19) + 2 + 3 + 4 + 5 - 6 = 274. \tag{9}$$

Finding 137 here is not only reminiscent of the fine structure constant; the sum can be exponentiated in order to separate the 12 terms into distinct independent oscillators. Then it also suggests that the SM mass spectrum is defined by N and P being sub-harmonic components of a high mass, logically the Planck mass and, conversely in K, that a second sub-harmonic system exist which is orthogonal. For simplicity I shall denote this "dual sub-harmonic".

2.2 Couplings

Based on the idea of sub-harmonics, I have deduced the reduced Planck mass resonance in [1], but the deduction is incomplete as I do not find an exact value for the lesser term of its specific coupling D_p. Now I use the following value:

$$D_p = \frac{1}{\sqrt{137^2 - 19\pi^2 + \frac{4\pi}{19}}}. \tag{10}$$

The first reason is that, if compared to the calculus of the fine structure constant in [2], the lesser term in (10) represents a spin 2 current - i.e. not a particle - and secondly the computed Planck mass is perfectly centered in error bars:

$$M_p = \sqrt{\frac{\hbar c}{8\pi G}} = \frac{X}{\left(D_p^4 + \frac{D_e}{266^2} \right)^3}. \tag{11}$$

Last, the expression (10) (together with (12) hereafter) will later be shown exact at least up to 15 decimal places. Other couplings have the same form as (10) which was generalized

after computing α firstly from the leptons resonance and then from the Bohr model in [1], and [2].

They are:

$$D_e = \frac{1}{\sqrt{(4 \times (274 + 19))^2 + 7\pi^2 - \dfrac{19\pi}{19 - 1}}} \,, \qquad (12)$$

$$D_\alpha = \frac{1}{\sqrt{(16 \times (274 + 3))^2 + 2 \times (274 + 19 + 1)\pi^2 - \dfrac{19}{4\pi}}} \,, \qquad (13)$$

where $\frac{19}{4\pi}$ is best guess. And of course:

$$\alpha = \frac{1}{\sqrt{137^2 + \pi^2 - \dfrac{1}{137.5} \times \dfrac{1}{2} \times \left(1 + \dfrac{1}{4}\right)}} \,, \qquad (14)$$

where the lesser terms may be incomplete, but lead to a value in agreement with CODATA (2014).

2.3 Energy and cosmology

Based on the results in the previous subsection it becomes relevant to suppose that no freedom exist in the field parameters. It naturally raise the question of cosmological data; in particular the densities of matter, dark matter and the elusive dark energy. In [3], assuming that the universe has permanent critical density, like it has now, and that its observable radius R_U recesses at the speed of light, I have shown that the cosmological term Λ is not constant but:

$$\Lambda \approx \frac{2\pi}{3 R_U^2} \,, \qquad (15)$$

where $R_U = c\,T$, with T the universe age; and secondly that the dark and visible energies obey the following proportionality relation, at any epoch:

$$\rho_D = 2\pi^2 \rho_V = \frac{2\pi^2}{2\pi^2 + 1} \rho_T = \frac{11}{8} \rho_{DE} = \frac{11}{3} \rho_{DM} \,, \qquad (16)$$

where:

— ρ_V, is the "visible" energy density,

— ρ_{DE}, is the dark energy density,

— ρ_{DM}, is the (cold) dark matter density,

— ρ_T, is the total energy density, $\rho_T = \rho_{DM} + \rho_{DE} + \rho_V$

and

— $\rho_D = \rho_{DM} + \rho_{DE}$ is the total dark fields density.

Those two relation imply that all energy densities related to mass evolve like $1/R_U^2$; it will be used as argument in the following sections. Several other results come from the same hypothesis:

— MOND is GR weak field approximation in a universe where energy and space-time expand linearly together,

— The MOND parameter value is $a_0 = H\,c/2\pi$,

— Discrepancy between the Hubble parameter measured locally (SN1A) and measured from events close to the event horizon (CMB and BAO), by a factor $\approx 1 + 1/2\pi^2$.

— The discrepancy creates the illusion of accelerated expansion.

— The reduction of wavelengths also creates the illusion of an initial inflation, since when $t \to 0$ wavelengths become infinitely large.

Where all quantities are calculable, computed, epoch dependent, and agree with experimental data (except for the inflation factor which I could not compute).

3 Couplings and particles mass

In this section I first discuss correlations between coupling coefficients; then between couplings and particles resonances.

3.1 Melting resonances and gearings

The template for a coupling coefficient is:

$$D = \frac{1}{\sqrt{A^2 + B\pi^2 + C}} \,.$$

where each term on the right-hand side represent a length, and one of the coefficients B and C is negative. They are evaluated by simple division for D_e (12) and D_α (13) after their values are fit to experimental data (leptons masses). Note that α (14) is computed differently but the same method would hold, and D_p (10) is first logically deduced, and then verified by computing the Planck mass from (11).

Examination of the four coupling formulas shows identical and look-alike coefficients in distinct places; the same component appears sometimes as a straight line (in A), sometimes in the rotation (in B), and sometimes in C which, at least in α, is the inverse of a rotation length from which the term π^2 at the denominator is removed. Then each coupling represents a specific piece or view of a unique movement, where (part of) the movement has a numerically isolated effect; and this requires identification. Firstly:

— The term $275 = (137 + 1/2) \times 1/2$ in α (14) represents the same "physical object" as in $275 + 19$ in D_α (13). I shall not give a definition of "physical object".

— This same term $275 + 19$ in D_α represents the same "physical object" as $274 + 19$ in D_e (12).

— The increment $274 \to 275$ is found to come from the round trip of the electron around the proton when computing α in [2].

Here the same object represented by 274 can be seen as a piece of rotation (when multiplied by π^2), a part of a simple length, and of an inverted length. Therefore it is irrelevant to believe in distinct "forces". The coupling system above is a single movement, a unique clockwork and each coupling is a length seen from a specific perspective.

Secondly, the same term 137 is in α (14) and D_p (10). It also represents a single "physical object".

— So 274 and 137 are the bottom line of the couplings - but we have 19 associated to 274 as a kind of excess.

— The excess may be understood as a mutual interaction between D_p and D_e; the former requiring 19 rotations of negative length (like a shortcut), meaning that the length 137 is reduced by the excess in 274 + 19 - and/or conversely.

Thirdly, by extension, all the terms 19, 19π, and $-19\pi^2$ also refer to a "single object".

Finally, the gearing components are three cube differences 1, 7, and 19 in α (14), D_e (12), and D_p (10) respectively, that is to say in the fundamental field; D_α is not fundamental and the exception to this rule.

This being said, the term $19 - 1$ at the denominator in D_e (12) is of high interest because like for the $1/275$ in α it must be understood as a rotation where the $1/\pi^2$ is removed, hence we should read $19\pi^2 - 1\pi^2$. Therefore, by the same identifications, it means that the term π^2 in α (14) is subtracted from $19\pi^2$ in D_p (10). Together with the terms 137 in the same formulas, this is more than a connection between the fundamental field and electromagnetism. It can be said that the coupling D_e has the role of "flushing" π^2, and then α out of the fundamental field - hence a single movement.

On the practical grounds of testability and technology, those two coefficients are very important outputs; because anything that we can do with electromagnetic forces has a corresponding effect in the fundamental field where, obviously, D_p is a very strong share of the unified super-force. We discuss the geometry of couplings that include a gearing, that is to say a simple clockwork which it is necessarily reversible. So I'll bet that the fundamental field, which is not gravity and actually much stronger than electromagnetism, can be manipulated... with electrons.

3.2 Resonances and couplings

The coherence between the coupling coefficients and the particles resonances is very impressive, to begin with the rotation terms in D_e and D_p, namely $-19\pi^2$ and $7\pi^2$:

— Quarks masses as computed in Table 2 depend on a single variable number N, which values are in {2, 19/7, 7, 14, 19, 38} and therefore only combine 2, 7, and 19.

— The ratio of the resonance term N is 2 between the charm and strange on the one hand, and the top and bottom on the other hand. It is interesting that it is also the ratios of their electric charge.

— Bosons resonances also depend only on 2, 7, and 19 for K but also for N = P = 12 = 19-7.

— A high term $266 = 2\times7\times19$ appears twice; to compute the bosons' little k and to compute the Planck mass. We logically assume that it is the simplest expression of the unified super-force.

— Finally, even though this is a little less direct, the leptons resonances in Table 1 can be written 5 = 7-2 for the muon, and 9 = 7+2 for the tau - thus combining a radial resonance 2 of the electron with the rotation term of D_e.

The second aspect is given in the equations (8) and (9)

with the sums $\Sigma_{N,P} = 137$ and $\Sigma_K = 274$. It probably means that the SM field is complete and that there is no other particles to discover (except of course if more resonances exist with the same numbers). As mentioned before, my interpretation is that the SM massive particles spectrum is a set of dual sub-harmonics of the Planck mass. But interestingly, for two reasons, the Planck mass is not a particle:

— Firstly, $D_p^4 < D_e/266^2$, where the opposite relation (>) is verified by all particles, as required by the equation.

— Secondly, it combines two couplings instead of one and the resonances (N, P).

I may even give a third reason, which is that in quantum theory it should be the natural unit of mass where the gravitational coupling is 1, which has no reason to be a particle.

4 On the SM fields origin

At this point using the sums $\Sigma_{N,P} = 137$ and $\Sigma_K = 274$, I have deduced the equations (10) and (11) and computed the Planck mass under the assumption that it depends a minima on its sub-harmonics. But there should rather be a physical reason for the sub-harmonics to depend on the Planck mass, otherwise the construction seems absurd. Hence the next question: Can we find a *physical* origin to the SM particles spectrum in the Planck mass equations without knowing the dual sub-harmonic system and its components (i.e. the sums to 137 and 274)? To solve this question we shall assume the Planck mass equation (11) and the values of D_e and D_p with infinite precision.

Here the theoretical situation is unique and rather fantastic, because everything in the field now depend on two quantities: D_p and D_e. In effect, the adjacent field and α are flushed out of the fundamental field defined by those two quantities. In principle we have reached the bottom and the only way to create a resonance is by combining D_p and D_e; as said this unique and fantastic. But how do we get the SM spectrum? and why should we get it?

The Planck mass in (11) includes two ringing lengths D_p^4 and $D_e/266^2$. It is a resonant system from which we know very little but: a) a resonance implies perfectly balanced oscillating "forces" and b) since this is GR we can guess that either M_p defines the light cone or, at the opposite, that the light cone defines it. So assume that the ringing lengths are the effects of a single "force" that rests on the light cone; it splits in two components which are necessarily space (3D) and time (1D) and correspond to the coefficients D_p^4 and $D_e/266^2$ respectively. Those are orthogonal and simple projections, proportional to the sine and cosine of the "force" amplitude, so we have a physical angle ϕ:

$$\phi = \arctan\left(\frac{D_e}{266^2 \times D_p^4}\right) = 1.33509... \approx \frac{4}{3}. \qquad (17)$$

But now by construction of the equation we compare a simple 3-volume associated to D_p^4 to a length associated to $D_e/266^2$.

Since the Planck mass equation uses D_e and $K > 0$, it rings like a lepton of spin 1/2, and then a change in phase π of this resonance is associated to one unit of volume $4\pi/3$; and since this is the Planck mass, this change in phase also defines the units of time and length. Hence comparing the effect of the "force" (the change in phase) to the volume to which the "force" applies (the unit of volume) we get a ratio:

$$\psi = \frac{\left(\dfrac{4\pi}{3}\right)}{\pi} = \frac{4}{3} \qquad (18)$$

which is *almost equal* to ϕ in (17) where the volume corresponds to D_p^4 and the change in phase to the length $D_e/266^2$. This ratio is expressed in unit of m^3/rad, and it links the phase of quantum theory to the volume of the mass equation. But *almost equal* means a difference where a perfect match is mandatory: now the difference $\phi - \psi$ is significant! We need a physical correction to (17) that gives exactly 4/3 and does not modify the Planck mass. And since we have reached the bottom, there is nothing else remaining but D_p and $D_e/266^2$ to implement the correction. Hence:

1) All we can do is add in (17) more currents of type D_p interfering with $D_e/266^2$, giving a suite of $h_i\, D_p^i\, D_e/266^2$, with h_i a harmonic coefficient.

2) The field is entirely defined by the particles resonances, including all charges, masses, etc, then each h_i should be a known term that we can recognize.

3) The suite of h_i should also include the mass-less field, and all resonances that we do not know of.

Then from the point 1) above, and in coherence with the two others, the correction has a very simple form:

$$4/3 = \arctan\left(\frac{D_e \sum\limits_{i=0}^{\infty} h_i\, D_p^i}{266^2 \times D_p^4}\right), \qquad (19)$$

with $h_0 = +1$ for the Planck mass.

Now we want to solve this equation, and for this we have a few criteria enabling to proceed by successive approximation on i growing ($i = 1$, then $i = 2$, etc...):

a) As a must, since $D_p \approx 1/137$, we expect a gain at order i of roughly two decimals compared to the order $i - 1$.

b) As a guideline, the result should be natural and then the effect of the correction at order i should be in the range of the optimum - but not equal. The optimum at order i being the value of h_i where the equality is verified with $h_j = 0$ for $j > i$.

c) As a result, each h_i should represent resonance(s). Here we can safely recognize what we know.

On this basis, the interesting part is for $0 < i < 8$:

— $h_1 = -1$,
— $h_2 = -7$,
— $h_3 = +25$,
— $h_4 = -81$,
— $h_5 = +(7 + 14 + 19 + 38 + \frac{38}{19} + \frac{14}{7} + \frac{38}{14} + \frac{19}{7}) \times 2\pi$,

— $h_6 = -556 = -(137 \times 4 + 8)$,
— $h_7 = -216 = -144 \times \frac{3}{2}$,

As we shall see this suite includes the entire SM particles spectrum.

The relative distance of each h_i to the optimum is given in Table 5 for each step.

Table 5: Optimum vs h_i value.

Order	Value	Δ vs optimum
h_1	1	< 6%
h_2	7	< 2.5%
h_3	25	< 2.5%
h_4	81	< 5%
h_5	≈ 549.33	< 0.8%
h_6	556	< 0.3%
h_7	216	< 0.3%

The difference with 4/3 is now $\approx 3 \times 10^{-16}$, which is in the expected range for i=7, and each h_i is close to the optimum. The connection of this series to the particles resonances in Tables 1, 2, and 3 and to the SM spectrum is almost trivial:

a) At first we find the Muon and Tau products NP (25 and 81) from Table 1, for i = 3 and i = 4 respectively. One could wonder why we are not closer to the optimum; but recall the constraint N=P for these resonances (see [1]). In both cases, we have the closest square to the optimum.

b) Then at i=5 the sum of all quarks circular resonances multiplied by 2π (- meaning that each number here represents a resonance length or its inverse). It includes, and then confirms, the fractional resonance as guessed in [1] and recalled in section 2.1 following Table 2. Here the optimum is ≈ 554, but considering the factor 2π, the relevant part is less than 1 point away from its optimum.

c) For i=7 we find the product NP=144 of the bosons double circular resonances, but multiplied by 3 (for 3 bosons) and divided by 2 (possibly because it should be divided by 2π, but those masses are already divided by π in (2)).

d) It leads to understanding the other terms as it must include also the SM mass-less particles as resonances of coefficient 1 [*], to which the mass equation does not apply:

— $h_1 = -1$, the photon,
— $h_2 = -7 = -(4 + 3)$, by similarity with h_3, h_4, and quarks'sum h_5, it splits into the electron NP=4 plus 3 mass-less neutrinos,
— $h_6 = -(137 \times 4 + 8)$, the expected UFO, 137 with 4 resonances, plus 8 mass-less gluons.

Finally, we have found all the resonances in N and P of the Tables 1, 2, and 3 (except for 3), but we also find $K \approx i$:

— $h_2 \to$ electron, $K = 2$ (Tables 1 and 4).
— $h_3 \to$ muon, $K = 3$ (Tables 1 and 4).

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[*]Like a photon can be seen to ring 1 to 1 in E and B in Maxwell theory

— $h_4 \rightarrow$ tau, $K = 4$ (Table 4) and $K = 5$ (Table 1).

— $h_5 \rightarrow$ quarks, $K = -6$ (Table 2).

— $h_6 \rightarrow$ no known massive particles.

— $h_7 \rightarrow 2 \times 7 \times 19$, bosons' K in {-2, -7, -19} (Table 3), but also from $1/266^2$.

Here we have a perfect ordering and some interesting aspects emerge:

a) We notice that with h_4 the tau is exceptional; firstly it takes two K (one in the fundamental field and one in the adjacent field) and coincidentally, it is here that the D_p^i at the numerator of (19) cancels the D_p^4 at the denominator.

b) Identically, it is with the next coefficient, when $i > 4$, that the Ks become negative (quarks and bosons). So we have a clear border which is between h_4 and h_5.

c) This is also where the fine structure constant appears in the Ds for quarks and bosons.

d) The second exception is the bosons $266 = 2 \times 7 \times 19$ used in Σ_K; it is coherent with the term $1/266^2$.

So we see *why and how* the SM spectrum is there; it shows that this theory is not another parametric model. Here the Planck mass, space-time, and the SM spectrum are neither independent nor separable, but three aspects of the same unity. Incidentally, it also shows that the expressions giving D_p and D_e are exact at least up to the 15th decimal.

But now, this leads to a few obvious deductions, some of which can be tested:

1) Three neutrino, no more,

2) Three charged lepton, no more,

3) Neutrinos ranks with the electron in h_2, which means something very odd in the field symmetry (or symmetries),

4) No quark of higher mass (than the top),

5) Quarks mixing disagree with the standard concept as we have 8 physical resonances but only 6 masses,

6) No additional boson (i.e. a single Higgs, no Z'),

7) One new resonance, 137, ranking with gluons in h_6.

The resonance 137 corresponds to $\Sigma_{N,P} = 137$ as the full massive matter field resonance; but locally, it could also be a kind of mass-less monopole à la Lochak [5] carrying the matter field signature. It comes in 4 instances, like this monopole, and it is consistent with the fourth power of D_p in (11).

5 Scale symmetry and compatibility with GR

The mass equation depends linearly on the inverse of a volume at the denominator (initially a volume at the numerator); then if we simply apply the metric variations in the gravitational field to this volume, the equation is obviously incompatible with Einstein's theory of general relativity. But GR assumes that particles *have* mass, which we know is wrong; and also, on the basis of the previous section, we can mean that this incompatibility is certainly due to the incompleteness of GR and even SR - think of the Planck mass relations to a) the light cone, b) the units of length/time and volume, and c) the SM particles spectrum. So let us come back to the

origin of the equation as shown in [1] and find *how* it can be compatible with GR already.

I start in 1 dimension and consider 2 identical propagating waves crossing each other, giving:

$$m = X N^2 \,, \tag{20}$$

with N an integral number representing the number of oscillations crossing each other within a generic length "1", and X a constant of unit kg.m^{-1}. So the N^2 represents a length (or $1/N^2$ an inverted length). But for a resonance to exist we need a mirror which is not part of the resonance but has energy:

$$m = X N^2 + \mu \,, \tag{21}$$

Then I add the quantized length K D, repeated each time two oscillations cross:

$$m = \frac{X}{\dfrac{1}{N^2} + KD} + \mu \,, \tag{22}$$

with K an integral number and D a constant of unit m^{-1}. Finally, in 3 dimensions I take the cube and get the inverse of a volume at the denominator:

$$m = \frac{X}{\left(\dfrac{1}{NP} + KD\right)^3} + \mu \,, \tag{23}$$

where the unit of X changes to kg.m^{-3}, and $N^2 \rightarrow NP$, where N and P are two integral that may be different since we now also have a rotational degree of freedom. Hence this equation is incompatible with GR by construction. But now in [3], I found the equations (15) and (16) which imply that all relevant densities evolve like $\Lambda \sim 1/R_U^2$; *and then the density X follows the same law*, that is:

$$X = \frac{const.}{R_U^2}. \tag{24}$$

Here there is no absolute length and the only reference length to consider is R_U; the hypothetical length "1" introduced in (20) is then $\sim R_U$, the volume at the numerator of (1) and (2) is $\sim R_U^3$, and then mass is proportional to $R_U^3/R_U^2 = R_U$. Provided the universe does not create particles permanently, this is the hypothesis in [3]; so the equation is a fit with my results in cosmology.

In addition it is now evident *how* the mass equation is compatible with GR, because if we vary the position of a particle in the gravitational field, its wavelength also varies and it will "see" R_U in reverse proportions to this variation: the lesser (resp. the higher) a particle energy in the gravitational field, the longer (resp. the shorter) is wavelength for a given observer, the lesser (resp. the higher) the universe age ($R_U = cT$) it "see". Hence a beautiful symmetry of scale which applies only to massive particles and shows the universality of the result: at any place and any epoch, a particle rest mass is proportional to the universe age it locally sense with Λ or dark energy.

6   The fine structure constant

Firstly what is it? In QED, it is the probability for an electron to absorb or emit a virtual photon. But here it is computed in [3] as a relative length that depends on the electron resonance, its spin, and $\Sigma_{N,P} = 137$. As per (14) it includes:

- An amplitude 2/137, where 137 is the sum of all massive particles resonances except the up and down quark. Then the electron is 2/137 parts of the field.

- Spin 1/2 gives π^2, half a turn for one unit of 137, but also $275 = (137 + 1/2) \times 2$, where the spin appears as the factor 2 to get a full turn 2π; the term 1/2 is geometrical.

- An additional component 1/4 which corresponds firstly to the muon resonance 8 in Table 4 (giving $(137 + 1/2) \times 8$), but also I believe to the compositeness of the electron (in the form of 2 distinct currents).

So α is firstly how much the electron gears the field, how much it contributes to the field resonance; its share of the job; and not the opposite like in QED. This interaction is permanent, and not a probability. So, with respect to QED and its methods of calculus, what difference does it make? Absolutely none as long as symmetry remains. The field can even fluctuate, randomly or not.

Secondly, where is it? The answer is not obvious since we have only two harmonics of Table 4 in the expression (14) giving α, and nothing about it in Table 1. But we also have the sum $\Sigma_{N,P} = 137$ and the equation (7) linking μ and μ_α which is also based on π and 137. This link does not use X or X_α, so we can guess that α is in their difference. Since it is unit-less let us compute:

$$\frac{X + X_\alpha}{X - X_\alpha} \approx 131\,, \qquad (25)$$

which we find in the expected range. Trying to invert the angle μ/μ_α in (7) to complement the clockwork, I eventually found an expression that holds at about $5\,10^{-9}$ with:

$$\frac{2\pi\,(X + X_\alpha)}{X\,(1 - \alpha) - X_\alpha\,(1 + \alpha)} = 137^2 - 137\,\pi + \frac{2}{137.5}\left(1 + \frac{1}{4}\right), \quad (26)$$

which is symmetrical in X, X_α, and α. From the reasoning in the previous sections and the form of this expression, it looks like this quantity represents the remainder of D_p^2 once α has been flushed out of the fundamental field.

7   Conclusion

I think I have shown that talking *free* parameters is blunt lie. I think I have also shown that piling up ad-hoc quantum fields to match anything is not such a great idea. Here the field is unique and its parameters are structurally coherent from α to Z^0 (necessarily including all other useful letters in between, even though I miss a few). It has the beauty of self definition, of self generation, and above all that of the necessarily unique: here there is only one, not even two. No two things of different nature; no particles "in" space. No vibrating thingy

but only paths and dimensions - and then structures appear naturally by geometrical necessity; only structures from constraint, no freedom. How could it be less?

8   Addendum: what next?

Since the fit in section 4 is not perfect and despite the fact that the sets of {N, P} and {K} seem complete from the sums $\Sigma_{N,P}$ and Σ_K, we may try to continue the sequence of h_i and guess more resonances requiring more particles. I shall discuss two cases; I first assume that the SM is complete and as a second case I assume a graviton.

Assume the SM complete; then, following the suite of h_i in section 4 it was easy to fit down to a residual error of 3.88×10^{-43} (which is ridiculous) without introducing new quantities/resonances but only some mixes, inversions, widths, and a few numbers in π. I had to stop here because the h_i are decreasing rapidly down to $h_{17} \approx 0.00052$, which is much smaller than $D_p \approx 0.00734$.

Here is what I first found with possible correspondence:

— $h_8 = 156 = -(137 + 19) = -(144 + 12)$, no comment,
— $h_9 = -(38 + 19 - 1)$, t + b - 1 (Table 2),
— $h_{10} = -(\pi^2)$, geometry,
— $h_{11} = -(12 - 7/12)$, bosons N (Table 3) + 7/12 (new?),
— $h_{12} = -((7 + 1)/(14 + 1))$, (s + 1)/(c + 1) (Table 2),
— $h_{13} = -(3/4)$, inverse of 4/3,
— $h_{14} = -(1 + 1/24)$, W and Z bosons width (4),
— $h_{15} = -(1/7 + 4/(274 + 19 + 1))$, inverse of the rotation of D_e and that of D_α times 8,
— $h_{16} = -(1/(144 \times 6) + 1/((274 + 19) \times (16)))$, Higgs boson width (5) + inverse of D_e main coefficient times 4,
— $h_{17} = -(\pi^2/137^2)$, geometry, maybe from μ/μ_α (7).

It shows that I cannot predict any observable in this manner. But on the other hand, each expression above is so obviously related to a number used elsewhere that I wonder if the series may be right. The Table 6 gives the value or range of each harmonic coefficient and its distance to the optimum at each step. Now not only each harmonic stays close to the optimum, but the h_i seems to quickly converge to zero.

Table 6: Optimum vs h_i value.

Order	Value	Δ vs optimum (%)
h_8	156	< 0.5%
h_9	56	< 0.2%
h_{10}	≈ 9.87	< 0.9%
h_{11}	≈ 11.4	< 0.04%
h_{12}	≈ 0.533	< 1.1%
h_{13}	≈ 0.750	< 1.1%
h_{14}	≈ 1.042	< 0.12%
h_{15}	≈ 0.156	< 0.01%
h_{16}	≈ 0.00137	< 0.3%
h_{17}	≈ 0.000526	< 0.7%

Now assume a graviton; it requires to add a resonance "1", and the first place that makes sense is to add a massless boson in h_7 with: $h_7 = -217 = -(144 \times \frac{3}{2} + 1)$, and it can represent either the graviton or the photon (if misplaced in h_1); the residual error at order 7 is $< 4\,10^{-17}$ (instead of $3\,10^{-16}$) and its distance to the optimum is $< 0.06\%$. Then $h_8 \approx -(2\pi^2 + \frac{1}{\pi})$, with a residual error $< 7.5\,10^{-20}$ and a distance $< 0.2\%$ to the optimum. The terms in h_8 address 4-geometry with $2\pi^2$ the surface of a 4-sphere of radius unity, and the inverse of a change in phase π.

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