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Generational Transitions of Charged Elementary Fermions and Intrinsic Dirac Spinors

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Abstract

In previous works, we have already laid the theoretical foundations that allow us to understand the different generations of elementary particles as particles generated from previous generations, which are susceptible, therefore, to establish a transit and a hierarchical generational order. In this work, we will carry out a more detailed and extended analysis, by which we will conceptualise more precisely the creation of particles and the space in which it occurs (quantum vacuum), and we will define (or recognise from a wavelet perspective) some of the fundamental parameters associated with each of the different particles of (anti)matter (spin, electric charge, phases, normalisation constants, size of the undulatory form, the Lorentz factors associated with the transitions), which will allow us to have a global idea of the material spectrum, order it and complete it. In addition, as a consequence of the order or phasic structure of the Standard Model already achieved, in which each particle occupies an established room, and that we can project possible transitions, we will be able to establish which spaces are without particles (as we have already done concerning a necessary common zero generation) or which new boundary positions could take the missing particles, if they exist, as happens with the fourth generation particles, which we studied and placed (predict their value) regardless of their dubious existence. On the other hand, we will connect the four solutions of the Dirac equation with the four possible states of this wave treatment associated with the phase function (intrinsic spinors), where each of them expresses in a well-defined and explicit way a type of (anti)materiality and a spin through, respectively, the envelopes and carriers of the wave packets.

Keywords

Standard Model, Wave Packet, Material Singularity, Symmetrisation of

Waves, Energetic Transmutation, Phasic States of Matter, Quantum Vacuum, Dark Matter, Spinors

1. Introduction

In this paper, we are going to formalise and break down some aspects of the necessary theoretical framework, introduced in [1], that allows us to understand the different generations of material particles (fermions) as particles generated from previous generations, susceptible, therefore, to transit from one generation to another, regardless of whether the observed phenomenologies, *i.e.* the particles themselves, do not use this mechanism preferentially, as occurs in decays of type $\mu \to e + \gamma$. This assumption leads us to invalidate (wrongly) the possibility of this relation ($\mu \equiv e + \gamma$), even if the almost non-existent probability of the process ($< 10^{-11}$) is truly motivated by some higher-order physical requirement, conservation of principles or quantum numbers, or a simple greater ease of transit through corpuscular forms [(anti)neutrinos] that may even be predefined in the waveforms of the process, a question that we will discuss when we deal with uncharged particles.

It is this deficient experimental proof of the fact that obscures precisely its foundation, which is none other than the wave nature of mass and kinetic energy, which can circumstantially recombine in a new and more massive generation, which occupies another phase or state and is placed at a phasic distance from the first. A recombination mechanism that not only explains the production and energetic relationship of the higher generations from the first, but the structural relationship of all the particles that make up our universe (Phasic Structure of the Standard Model [1]) through these phase relationships between them. A mechanism that is part of a more general mechanism which explains the energy structure of particles and the possibilities of exchange from some to other forms of energy through the energy transfer equation (ETE), since the creation of matter, expressed in this equation, contains all these forms, as developed in [2] and presented in Equation (32) of [1].

A creation (construction) of matter and energetic forms which, in addition, come from a single wave function, which is nothing but a symmetrized wave packet (SWP) shown in Equation (9) of [1], that is, from the symmetrization of this wave packet, as a suitable and perhaps unique formula to establish a bridge between the wave nature and the corpuscular nature, or, in other words, the same thing, of removing the physical impediments (real, not interpretative) to that connection, which is as much as admitting or validating, given that one is pre-existing and gives rise to the other, the uniqueness of the same and the primordial character of that symmetrical element. Consequently, what we have already demonstrated through previous works for electrons, and now we intend to extend, is that their elementary matter is constituted by two wave packets, one in an inverted or symmetrical position with respect to the other, which together form a SWP, whose energetic expression is the ETE. An expression or energetic balance of formation that accounts for a mass formed by the envelopes of the two wave packets, whose shape, according to the geometric expression developed for $R = r = a$ in Equation (17) of [2], is that of a toroid as shown in **Figure 1**, from which we reach that each of these envelopes is the half that remains on one side and the other of the radial axis in one of its rotational positions.

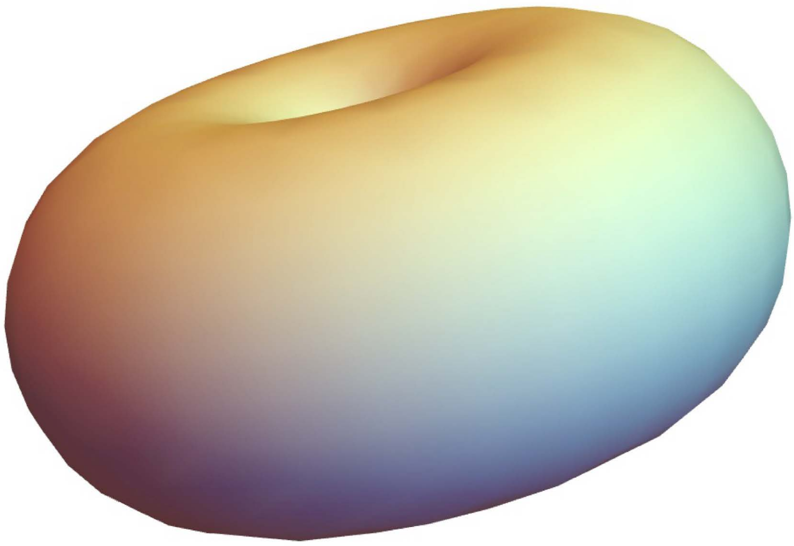

Figure 1. Toroid composed of two semitoroids by means of the envelopes of two wave packets, for $r^2 \times R = a^3 (R = r)$.

Here we start from that premise, which we will now formalize, detail and extend. To be more specific about the claims and the development we are going to follow, in the same way that in [2] we structured what we presented in the first block of [1], that is, concerning ETE, here we are going to structure what was said in the second block of [1] about generational changes, with a different motivation, or a reverse sense, given that in [2] we dispensed with the instrumentals details of the previous exposition in order to establish the theoretical framework, and here, on the contrary, we are going to establish that framework by addressing the details that were omitted in [1] (more oriented in this part towards presenting results and functional aspects that would allow us to have an overall view). Succinctly put, we try to present a theoretical body that, on the one hand, involves only charged particles, and that, on the other hand, complements what has already been said about them in previous works, leaving out of the study everything related to uncharged particles, even though the theoretical framework is capable and we have already said things about them in those previous works.

Putting together a body of theory from scratch is not an easy task, nor is it easy to capture sufficient attention, because the readership may show reservations or saturation in the face of so much argumentative proof, or disinterest, if they do not have some kind of evidence. This is why already the second block of [1] was articulated in a practical way as well, that is, presenting direct consequences and results. In this respect, we have to take into consideration that we are developing something new, and that this implies exposing it, formalising it, raising and resolving all possible questions and objections, and linking it to the current framework, without being able to take anything for granted and without being able to make use of external resources. This leads us to maintain a main thread while introducing a preview of some of its implications (both important and incidental) through recurrent discussions, to be dealt with later in a more formal and exhaustive manner. That is, it will lead us to leave nothing behind, as we will in fact do because of its significance about the appearance of the electric charge of particles created from corpuscular entities (dark matter) that initially lack it, which are presented as the initial state, zero generation, or quantum vacuum, on which the first generations are forged.

The main analysis, restricted to the fundamental charged particles, will allow us to contemplate and delimit the ambiguities of the proposed theoretical framework, a framework that already, in effect, allowed us to establish analytically, by a single equation (Equation (39) of [1]), the necessary existence of a zero generation common to all of them, that is, a particle $\mathfrak{M} = 171.87\ \text{eV}$, or equivalent energy entity, and the necessary connection with the other generations, which we will now expand to reach the true meaning of phase relationships, beyond their being reduced to a simple numerical ratio. This allows us to address the feasibility of a fourth generation (as regards these phases and their particles), as well as to find out or calculate the masses of the candidate particles, together with the masses of the existing ones, and all sorts of fundamental wave parameters or those attached to the dynamical processes that have taken place between generations.

On the other hand, this theoretical development, up to this point, will give rise for us to establish a connection between the applied formalism and the existing one, by a configuration comparable to the four-component Dirac spinor, which will allow us to resolve some intrinsic properties such as that of the spin, that is, to make them explicit (as we do with all the things we deal with), since it is represented by a wave function and not by an array, or as a solution to the duplicity or degeneration of a given energy value. On what we will content ourselves (as we anticipated) with raising the question, without dealing with it in its entirety, since the latter would require a very long development which would take us away from the object of this work.

2. Generational Transitions in Standard Model (Charged Leptons)

In [1], we have seen the three energy terms of the ETE put into play for the creation of an elementary particle, which, due to further considerations [concerning the degree of the exponent of the symmetrized wave packet (SWP) that originates it], turned out to be the most elementary and usual one, that is, an electron

($q=-1$). We have then seen there, and in more detail in [2], that the first and main of these terms corresponded to the expression of the kinetic energy of a particle, unlike the massive term of the wave expression, which is an explicit term of it, that is, not a simple one but one composed of internal variables, and also unlike the phase factor, which is the one that gives an account of the vibrational origin of the particle and truly governs all the transformations in it, that is, its generation, excitations, decays, and entanglements, as introduced in the above-mentioned references. A phase factor, $\sin[\Phi]=\sin\left[\Delta k\left(a\gamma^{-1}\right)\right]=\sin\left[2b^{-1}\left(a\gamma^{-1}\right)\right]$, which phase Φ, according to the a value,

$$a=\left(\frac{A^2\not{\hbar}}{m_r}\right)^{1/3}=b^{1/3}\left(\frac{\not{\hbar}}{\pi m_r}\right)^{1/3}, \tag{1}$$

derived from Equation (34) in [1], takes the form:

$$\begin{aligned}\Phi&=\left[2b^{-1}\left(b^{1/3}\left(\frac{\not{\hbar}}{\pi m_r}\right)^{1/3}\gamma^{-1}\right)\right]=\left[2b^{-2/3}\left(\left(\frac{\not{\hbar}}{\pi m_r}\right)^{1/3}\gamma^{-1}\right)\right]\\&=\left[\beta_i\left(\left(\frac{1}{m_r}\right)^{1/3}\gamma^{-1}\right)\right]\qquad\text{with}\quad \beta_i=2b^{-2/3}\left(\frac{\not{\hbar}}{\pi}\right)^{1/3}\end{aligned} \tag{2}$$

An expression that is analogous to Equation (36) of [1], on which, as we did there, we will simplify the notation, taking a generic $m=m_r$ and $\hbar=\not{\hbar}$ (the time unit always results simplified or integrated), without forgetting that $\not{\hbar}=\hbar[T]$ is what makes Equation (1) dimensionally homogeneous as seen in Equation (19) of [2], and what makes Equation (2) dimensionless.

A form (phase) that is shown as a boundary condition for the kinetic energy of the particle since for a given m (corresponding to a given pulse size a), there will be a given γ, that is, a speed υ that will cancel it out and that will depend on the real initial contour condition, which is none other than b or, what is the same, Δk of the wave packet as an input fixed parameter which, in turn, we can associate, as already indicated, with the length of coherence of the equivalent pulse, or finitude of the same [3].

Outline condition which may not be relevant (does not transcend corpuscularly) for the set of values of the sine function, and for this reason it is merely a phase function, but which can and does have this relevance, as we shall see, for states or points subject to the condition, for the zeros of the function ($\sin[\Phi]=0$), which corresponds to that imposed by the distribution function $\Gamma[\Phi]$ introduced in Equation (14) of [2].

A diversification of points that has to do with the fact that we can associate, as seen in Equations (16)-(18) of [2], different products $m_r\times V=m_r\left(\pi^2a^3\right)=\pi b\hbar$ with a specific value Δk, *i.e.* that to a group of waves (class of particles) characterized by a value Δk we can associate different particles (infinite a priori), characterized by the different generations of a class (a posteriori finite as a consequence of the finite number of zeros in an energy interval), like that of charged leptons, that is made up of e^-, μ and τ particles. And that also goes to the fact that these generations are generated in the strict sense through the cancellation of kinetic energy by cancelling this phase factor, when the conditions are met, highlighting that the particle, which seems inert, is alive inside, that is, that it has all the elements that make its creation, decay and general transformation possible, according to what was explained in [2] on energy transfer between terms.

We therefore need a condition that allows this, *i.e.* to formally establish these transition possibilities and set the parameters for them. A condition that, as we said and see in (2), has to do with the determination of the value b of the function, as a true condition, which we will establish initially, in a formal manner, through the following postulate, expressed in this case specifically for the leptons charged:

Postulate I. When the phase factor $\sin[\Phi]$ associated with the energetic form of an SWP, corresponding to an elementary particle, is cancelled out, transitions occur between the different generations of the classes of particles involved, or, properly speaking, phase changes.

In particular, we postulate that when this change of phase takes place the kinetic energy of that energy form (ETE) falls to zero and all of it is redistributed in the constitution of the new particle, as a consequence and evidence that both mass and its kinetic energy derive from the same physical reality, thus fulfilling:

$$E = m_2c^2 = m_1\gamma c^2 = m_1c^2\gamma = m_1c^2\frac{1}{\left(1-\upsilon^2/c^2\right)^{1/2}}, \tag{3}$$

where m_1 and m_2 are, respectively, the initial and final mass. In other words, the relativistic expression is fulfilled in an unusually real way, since it is the only case in which there is a real increase in mass as a consequence of relativistic velocities, and mass is created from inertial mass, and not just energy equivalence, made explicit by Lorentz factor γ. Consequently, with:

$$\sin[\Phi] = \sin\left[2b^{-2/3}\left(\left(\frac{\hbar}{\pi m}\right)^{1/3}\gamma^{-1}\right)\right] = 0, \tag{4}$$

and

$$\text{(a)}\quad 2b^{-2/3} = \left[2\left(\Delta k\right)^2\right]^{1/3} \equiv Z \quad \text{(b)}\quad \left(\frac{\hbar}{\pi m}\right)^{1/3} \equiv \delta, \tag{5}$$

defined, respectively, as *phase index* (Z) and *phase variation* (δ), is fulfilled sequentially, for each value of m:

$$\Phi = 2b^{-2/3}\delta\gamma^{-1} = Z\delta\gamma^{-1} = \pi, 2\pi\ \left(\phi_1,\phi_2\right) \equiv \phi \tag{6}$$

Being ϕ the real phase to be considered (we will do so from now on) or *effective phase*, that is, the one composed by a phase spectrum marked by the discrete elements in which the function Equation (4) is cancelled, of which we have initially considered only two (ϕ_1,ϕ_2), for the first two leptons (m_e, m_μ), in correspondence with the two possible transitions between the particles of the triad, generically named m_1, m_2, m_3, leaving for another section the study of a possible transition ϕ_3 to 4th generation by m_τ.

What we should define more precisely, or qualify, is that it is not just that the transitions are established at certain phase values (ϕ_1, ϕ_2), but that each fermion is associated with or develops per se in a certain phase $([\phi_1],[\phi_2])$, so that particles in their primordial state (m_1) unfold in the natural, continuous, and proper space of phase, the interval $[\phi_1]=[0,\pi]$ or $[\phi_1]=]\infty,\pi]$, (we will see), and that it is when it reaches the limit or singular value of the same $\phi_1=\pi$ that it jumps phase and m_2 appears. And that, similarly, m_2 unfolds in phase $[\phi_2]$, being for $\phi_2=2\pi$ when it jumps phase and m_3 appears, that it will unfold in a phase ϕ_3.

The cancellation sequence chosen is the natural sequence since it seems natural to start with the first non-trivial value where the function is cancelled, and continue with successive values. This sequence chosen is not only the natural sequence but it is the one that is naturally derived from the expression itself Equation (6) if with it we establish a ratio. Indeed, let the relationship:

$$\chi=\frac{\left[2b^{-2/3}\left(\left(\frac{\hbar}{\pi m_2}\right)^{1/3}\gamma_2^{-1}\right)\right]}{\left[2b^{-2/3}\left(\left(\frac{\hbar}{\pi m_1}\right)^{1/3}\gamma_1^{-1}\right)\right]}=\frac{\left[\cancel{\beta}\left(\frac{1}{m_2}\right)^{1/3}\gamma_2^{-1}\right]}{\left[\cancel{\beta}\left(\frac{1}{m_1}\right)^{1/3}\gamma_1^{-1}\right]}=\frac{\phi_2}{\phi_1}, \tag{7}$$

where ϕ_1 and ϕ_2 are the respective phases, which with γ_1^{-1} referred to m_1 and m_2, according to Equation (3), and γ_2^{-1} referred to m_2 and m_3, and in the consideration of a single value b (versus β), we can reduce to the form:

$$\chi=\frac{\phi_2}{\phi_1}=\frac{\left(\frac{m_2^2}{m_3^3}\right)^{1/3}\equiv\bar{\gamma}_2}{\left(\frac{m_2^3}{m_1^2}\right)^{1/3}\equiv\bar{\gamma}_1}=\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{1/3}, \tag{8}$$

in which it can be seen that, once the three masses of a class of particles are specified, the system is obliged to have a ratio between ϕ_2 and ϕ_1 determined, the *phase ratio* χ, regardless of any other consideration, variable, and the individual values of the phases. A ratio χ that, eliminating the shared factor π, is of natural numbers.

Then, when the value $\phi_1=\pi$ is determined by theoretical constraints (the cancellation of the phase factor at the first attainable value), the value $\phi_2=\chi\pi$ is determined, *i.e.* a certain sequence or progression of the phases. In our case, applying the known values to Equation (8) we obtain a value $\chi\approx 2$, thus demonstrating that the sequence Equation (6) is correct, except for deviations, giving rise to a value $\phi_2=2\pi$.

However, since substituting the values of the masses in Equation (8) results in $\chi=2.079\neq 2$, it is highlighted that the initial hypothesis regarding the uniqueness of b (the simplification applied) is not entirely correct and that on the contrary in Equation (7) there are values b_1 and b_2, close to each other, which absorb the deviation and make the expression,

$$\chi = \frac{\phi_2}{\phi_1} = \alpha\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{1/3} = \alpha \times \Re, \quad \text{with} \quad \alpha = \frac{2b_2^{-2/3}}{2b_1^{-2/3}}, \tag{9}$$

be exact ($\chi = 2$), as we saw in [1], and will develop shortly. An expression that, on the other hand, known α (which is generally $\alpha = 1$), establishes a relationship $\Re$ between the particles of a class. A relationship in a similar way to numerical formulas, such as Koide's, only that here, contrary (it is not a formula), physically justified by the condition imposed by Equation (4).

Taking the issue further, it is not that the values b_1 and b_2 absorb the deviation produced in Equation (8), but that the disregard of them in Equation (7) introduces that deviation, that is, that such values exist and condition through the expression Equation (9) the existing ratio $\Re$ between the particles as a consequence of the inescapable ratio χ between the phases.

In our case in particular, there is a defined value α, in fact, and defining values b_1, b_2, which we can calculate from the known values of the masses of the charged leptons. In particular, from Equation (5b), with $m_e = 0.511\ \text{MeV}/c^2$ and $\hbar = 6.582\text{E}-16\ \text{eV}\cdot\text{s}$, we obtain:

$$\delta_e = \left(\frac{(6.582\text{E}{-16})(9\text{E}16)}{(0.511\text{E}5)\pi}\right)^{1/3} = 3.33292 \times 10^{-2}.$$

From Equation (3) with the value $m_\mu = 105.658\ \text{MeV}/c^2$ and with $m_e = 0.511\ \text{MeV}/c^2$, we get:

$$\gamma_e = 206.767 \quad \Rightarrow \quad \gamma_e^{-1} = 4.8363 \times 10^{-3}$$

And from Equation (6), for $\phi_1 = \pi$, we finally get:

$$Z_1 = 2b_1^{-2/3} = 19511.456 \quad \overset{(5a)}{\Rightarrow} \quad b_1 = 1.03779 \times 10^{-6}.$$

Repeating the same process for the second transition, that is, for $\phi_2 = 2\pi$, and the corresponding masses, we obtain:

$$\delta_\mu = 5.6301 \times 10^{-3} \quad \text{and} \quad \gamma_\mu = 16.8168$$

And, finally:

$$Z_2 = 2b_2^{-2/3} = 18767.610 \quad \overset{(5a)}{\Rightarrow} \quad b_2 = 1.1001 \times 10^{-6}$$

A results that we present in a more orderly way in **Table 1**:

Table 1. Values for charged leptons ($q = -1$) and their transitions.

$Z_1 = 19511.456$ $b_1 = 1.038 \times 10^{-6}$	m_e (MeV)	δ_e	γ_e	m_μ (MeV)	$\phi_1 = \pi$
	0.511	0.033292	206.767	105.658	
$Z_2 = 18767.61$ $b_2 = 1.100 \times 10^{-6}$	m_μ (MeV)	δ_μ	γ_μ	m_τ (MeV)	$\phi_2 = 2\pi$
	105.658	0.00563	16.817	1776,840	

In where we see that, in a general way, we know the phase index Z and the initial mass corresponding to each row, we only have to apply Equation (5) and

Equation (6) in the form $\gamma = (Z\delta)/\phi$, and finally Equation (3), to reach the final column, which would allow us to move from one row to another, and present the data in a concatenated form from a single entry (as we did in Fig. 9 of [1] and we will do differently later). From there we can recover:

$$\frac{Z_2}{Z_1} = \alpha = \frac{18767.61}{19511.456} \cong 0.962 \tag{10}$$

and

$$\Re = \left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{1/3} \cong 2.079 \tag{11}$$

that meets exactly, as expected:

$$\chi = \frac{\Phi_2}{\Phi_1} = \alpha \times \Re = 0.962 \times 2.079 = 2 \quad \left(\propto \frac{2\pi}{1\pi} = \frac{2}{1}\right). \tag{12}$$

Different Phase Indices: Or When the Rule Becomes the Exception

The existence of two values of Z (versus b) corresponding to the respective phases is not an anomaly or deficiency in the representation of the reality we are presenting (even if it is only in the case at hand) but a consequence of the physical system itself that we simply have to recognise and integrate, as we have done, through the α; and an explicit consequence, according to Equation (23), Equation (24) and Equation (30) in [1], of the existence of two different constants of normalisation (A_1 y A_2), that is, one for each of the intervals or material phases, as detailed below:

$$\begin{aligned} B^2 \int_{-\infty}^{+\infty} [\zeta(x)]\mathrm{d}x &= A_0^2 \int_0^c [\zeta(\upsilon)]\mathrm{d}\upsilon \\ &\overset{\leftarrow S}{=} A_1^2 \int_0^c [\zeta_{f+\omega}(\upsilon)]\mathrm{d}\upsilon + A_1^2 \int_0^{\upsilon_1(c)} [\zeta_k(\upsilon)]\mathrm{d}\upsilon \\ &\overset{\leftarrow \pi}{=} A_2^2 \int_0^c [\zeta_{f+\omega}(\upsilon)]\mathrm{d}\upsilon + A_2^2 \int_0^{\upsilon_2(c)} [\zeta_k(\upsilon)]\mathrm{d}\upsilon \overset{\leftarrow 2\pi}{=} [\ldots] \end{aligned} \tag{13}$$

A differentiation of intervals that is not motivated by the phases themselves, nor by the difference or relationship between limiting velocities in the phases (which are always presented as such), but by the individual limits of these velocities, or more explicitly by the size of the integration interval and the alteration of the normalisation constant in the successive $\sin[\Phi] = 0$ [proportional to that expressed in Equation (10) for Z], as a function of this size, for values of υ significantly distant from c. As in our case with γ_μ for the muon, which moves away from the reference with respect to c, unlike what happens with γ_e for the electron.

A difference that, far from being overlooked, leads us to make a study of the circumstances and a comparative analysis of the results of the Lorentz factors γ_e and γ_μ, from which explicitly results the maximum velocity that each type of particle can reach in its phase:

$$\begin{aligned} \gamma_e &= 206.764 \Rightarrow \upsilon_1(c) = 0.999988c \\ \gamma_\mu &= 16.817 \quad \Rightarrow \upsilon_2(c) = 0.99823c, \end{aligned} \tag{14}$$

as we have reflected in Equation (13), where we can see that each phase change $(\phi_1, \phi_2, \cdots)$ corresponds to a previous velocity limit $(\upsilon_1, \upsilon_2, \cdots)$ at which the particle develops and that defines an interval or field of velocities $(\hat{\phi}_1, \hat{\phi}_2, \cdots)$, respect to the maximum velocity and the interval more general and complete $\hat{\phi}_0 \equiv [0, c[$ of the original phase ϕ_0, and a measure, in terms of the velocities, of the relative size of the phase in progress [2], which is, as we said, that defines the normalisation constant, or its relation to the previous one, seen through the different normalization constants in Equation (13), from which it also follows that we can no longer speak (except by default) of α, χ and $\Re$, but of α_i, χ_i and $\Re_i$, so that the results reached in Equations (10)-(12), corresponding to the first triad of masses, ascribed to the initial phase Φ_1 and the starting mass $m_1 = e$, would have to be called more specifically α_1, χ_1 and $\Re_1$, or directly $1 \equiv m_1$, if such specificity were needed.

While the connection of the limits of integration with the normalisation constants is obvious, it is not clear how they operate with each other. The only connection in this sense is reached through the normalisation process carried out in Equations (10)-(13) of [1] in which, passing to the complex plane, we passed to a two-dimensional scenario in which the solution is a pole, which is only half a circumference (π value), which leads us to think that this connection is established by a variable (trigonometric), referred to the same, which defines precisely a portion of this value, of the $\pi/2$, given that we can circumscribe these variables to a single quadrant. That is, what we say is that in $\upsilon_i(c) = \alpha_i c$, α_i is a sine, which represents an angle of a certain quadrant, that $\alpha_i = 1$, which corresponds to c, represents the whole quadrant, and that consequently the relation between the partial velocity (υ_i) and the total velocity (c), which is given by the sine, is the relation between the partial angle of the quadrant and the total angle of the quadrant. From there, that we can extrapolate these corresponding linear values α_i to angles, and more specifically to surfaces, is a consequence, as we said, of the extrapolation that exists through the complex calculus.

In our case, we find that $\gamma_e = 206.767$, with limit $\upsilon_1(c) = 0.999988c$, and $\gamma_\mu = 16.817$, with limit $\upsilon_2(c) = 0.99823c$, subtend with respect to c angles of $\theta_1 = 89.72$ and $\theta_2 = 86.59$ degrees respectively and, consequently, certain relations with respect to $\pm\pi/2$:

$$\theta_0^1 = \theta_1/\theta_0 = \theta_1/\theta_{\pi/2} = \frac{89.72^\circ}{90^\circ} \cong 0.997 \quad \text{(a)}$$

and (15)

$$\theta_0^2 = \theta_2/\theta_0 = \theta_2/\theta_{\pi/2} = \frac{86.59^\circ}{90^\circ} \cong 0.962 \quad \text{(b)}$$

In which Equation (15b), in the absence of further analysis, seems to meet the requirements and the intention in Equation (10), *i.e.* to establish and justify proportionality factor between the normalisation integrals and their corresponding indices of phase Z_i ($\rightarrow b_i$), while the result reached in Equation (15a) confronts us with the idea of recurrence already presented and, in particular, with the possible existence of a proportionality factor $\theta_0^1 \cong 1$ or transit over the previous phase Φ_0, which would give rise to the specific values α_0, χ_0, and $\Re_0$ of the significant variables. A proportionality factor θ_0^i which, as we can see, express a greater deviation the smaller the angle and the lower the speed at which the transition takes place, what, in practice (as we have already mentioned), means that in all cases it is $\alpha_i \simeq 1$, and that the case θ_0^2 for the electron, which we have just seen, can be considered a peculiarity and a simple subject of study.

Discussion 1 (Progression of Phase Indices Z)

It might be difficult to find another argumentation that could justify the result Equation (10), such as the one used on the proportionality factor θ_0^2 of Equation (15b), a result that, as we see, is reached at the margin or independently of the one reached in θ_0^1, which certainly may be contrary to some logic, since it is reached through the relation of a phase with the previous one, which is somehow represented by θ_0^1. That is to say, we see that although the proportionality factor of each phase is referred through Z_i to the preceding phase (Z_2/Z_1) it is not referred, however, through υ_i to the preceding phase but to the original $\upsilon_0 = c$, and that, consequently, the quantity α_1 that applies to Z_1, as a *coupling factor* between phases ($Z_2 = \alpha_1 Z_1$), depends exclusively on θ_0^2. In particular, we can appreciate that, according to the sequence established in Equation (13) and the value reached in Equation (10), we do not make $\theta_1^2 = 0.962 \times 0.997 \cong 0.960$ and that only Equation (15b) is effective.

This behavior makes it clear that it is not the kinetic term associated with $\widehat{\phi}_1$ that serves as a reference but, as it appears in Equation (13), the whole phase member, and in particular the first term (ζ_{f+w}, which accounts for the changes between mass and energy), which always belongs to $\widehat{\phi}_0$, that is, to the velocity field that rearranges the energy at the interface for $\sin[\Phi] = 0$, as we characterise schematically below.

$$A_0^2\left(\widehat{\phi}_0\right) \overset{\leftarrow S}{=} A_1^2\left(\widehat{\phi}_0 + \widehat{\phi}_1\right) \underset{\sin=0\rightarrow}{\overset{\leftarrow\pi}{=}} A_2^2\left(\widehat{\phi}_0\right) \underset{\leftarrow\sin=0}{\overset{2\pi\rightarrow}{=}} A_2^2\left(\widehat{\phi}_0 + \widehat{\phi}_2\right) \tag{16}$$

It becomes clear that in all phases there is a possible or reference velocity field $\widehat{\phi}_0 \equiv [0, c[$, corresponding to the maximum velocity, which is unique and universal for all systems (as derived from special relativity), and that in all of them there is a velocity field $\widehat{\phi}_i < \widehat{\phi}_0$ defined or specified actually by the phases themselves. And that it is the relationship between each of them and the first one that determines the evolution of the system parameters, such as the normalisation constants, being θ_0^2 ($\widehat{\phi}_2$ on $\widehat{\phi}_0$) and not θ_1^2 ($\widehat{\phi}_2$ on $\widehat{\phi}_1$), which determines it at the first phase change ($Z_1 \rightarrow Z_2$). This does not mean that $\widehat{\phi}_1$ does not affect the normalisation constant, it means that it does not have an effect on transit $Z_1 \rightarrow Z_2$ or on δZ, but that has it on Z_1 or, to put it better, that has had it to be configured as such Z_1.

Deepening on the latter and the explanation of the apparent paradox (although we could assume any result $\theta_0^2 \in [0.960, 0.965]$), the reason for the non-intervention of Equation (15a) in Equation (10), from a more instrumental point of view of the transit processes (S, ϕ_1), is that this equation is included in both transit processes (with a phase change θ_0^1 and two phase changes $\theta_0^1 x \theta_1^2 \rightarrow \theta_0^2$, respectively), and that the second transit carries over (in the normalisation constant itself) the transformations experienced by the first one so that all the phases are finally referred to the initial phase ϕ_0 subtended by the initial angle $\theta_0 = \pm\pi/2$. Consequently, the above does not mean that the influence of the previous velocity fields does not exist or disappears, but that it is integrated into the constant that we carry over to later phases. This can be reflected in Equation (13), written as follows:

$$\alpha_1 = \frac{Z_2}{Z_1} = \frac{Z_0\theta_1^2}{Z_0\theta_0^1} = \frac{Z_0\theta_0^1\theta_0^2}{Z_0\theta_0^1} = \frac{Z_1\theta_0^2}{Z_1} = \theta_0^2 = \frac{\theta_2}{\theta_0}, \tag{17}$$

Where we see that the angle of the denominator corresponding to the first transition (referred to ϕ_0 by default) acts as a normalisation factor in such a way that the second one, although referred to ϕ_1, is effectively referred to ϕ_0, making it clear, on the other hand, that we are indeed starting from that original value Z_0, that is, from a standard or unique wave packet for this class of particles, which makes our instrumental requirement a necessary condition with physical meaning. From there, since the values Z_1 and Z_2 are already known, all that remains in this case is to find the initial value Z_0 (associated to $\widehat{\phi}_0$) from Z_1 by Equation (15a), which we have already identified with the phase coupling factor α_0, specific to that transition.

$$Z_0 = \frac{Z_1}{\alpha_0} = \frac{19511.456}{0.997} = 19570.166 \tag{18}$$

3. Generational Transitions in Standard Model (Generalisation)

The SWP seen in Equation (9) of [1], which has given rise to all our development, can be put in a more general way for any electric charge by the following function $\Psi(x,t)$ and its corresponding energy development, for $M \equiv \left[\Delta k(\upsilon t - x)\right]$ and $N \equiv (w_0 t - k_0 x)$:

$$\begin{aligned}
\Psi(x,t) &= \frac{\Psi_1(x,t)+\Psi_2(x,t)}{\sqrt{2}} = (i)B\frac{e^{-i\left[(M/2)^{-q}+\varphi\right]}e^{-i(N)} - e^{i\left[(M/2)^{-q}+\varphi\right]}e^{i(N)}}{\sqrt{2}(\upsilon t - x)} \\
&= (i)B\frac{\vartheta_1^{(-q)}\phi^{-1} - \vartheta_2^{(-q)}\phi}{\sqrt{2}} \equiv \frac{(i)B}{\sqrt{2}}\left(\vartheta_1^{(-q)}\phi_1 - \vartheta_2^{(-q)}\phi_2\right) \equiv \frac{(i)B}{\sqrt{2}}(\xi_1 - \xi_2) \\
\to \bar{E} &= \frac{i^2B^2}{2}\left[\int \zeta^{(-q)}(\upsilon)\right] = \frac{B^2}{2}\left[\int\left(\zeta_2^{(-q)} - \zeta_1^{(-q)}\right)\right] \\
&= \frac{B^2}{2}\left[f(\xi_2 - \xi_1)\right] = \frac{B^2}{2}\left[f\left(\vartheta_2^{(-q)}\phi_2 - \vartheta_1^{(-q)}\phi_1\right)\right] \\
\Rightarrow \Psi(x,t) &= \frac{(i)B}{\sqrt{2}}(\xi_1 - \xi_2) = \frac{(i)B}{\sqrt{2}}\left(\vartheta_1^{(-q)}\phi_1 - \vartheta_2^{(-q)}\phi_2\right) \\
&\equiv \frac{B}{\sqrt{2}}\left(\vartheta_2^{(-q)}\phi_2 - \vartheta_1^{(-q)}\phi_1\right) \equiv \frac{B}{\sqrt{2}}\Im_s = \Psi_\Im(q),
\end{aligned} \tag{19}$$

where q is the value of the electrical charge and φ is the value of the initial phase difference, which for $q = -1$ and $\varphi = 0$ corresponds to the original function for charged leptons. From which we have defined the equivalent function

$\Psi_{\Im}(q)$, given that it reaches the same energy value, that it is real and that it maintains the same order of subscripts for both the function itself and the energy and its significant function $\Im_s = \left(\vartheta_2^{(-q)}\phi_2 - \vartheta_1^{(-q)}\phi_1\right)$, which we will explore later on.

We will say that $\Psi(x,t)$ is a generalised SWP if it meets the energy requirements that the original SWP met. In this case, it will allow us to generalize the process of the previous section for all the material particles of the Standard Model, and their correspondence according to the variables introduced for each of the classes of particles. A correspondence that we present through the following postulate.

Postulate II. All fermions of the Standard Model correspond and are therefore representable, with a single generalised SWP function defined for an appropriate value of electric charge q and an initial phase value φ.

For this postulate to be true in a general way, as it is for the case of leptons charged, we must carry out a treatment similar to these for particles with $q=-1/3$ and $q=2/3$, show that the wave function expresses the energy of the particle and, fundamentally, that gives rise to a phase factor that regulates transitions, fulfilling the first postulate. In fact, we could say that the particles will be associated with a generalized SWP, fulfilling the second postulate, if the first postulate is fulfilled with it.

Before discussing this question, it is worth pointing out an issue that the postulate establishes in a hidden or secondary way, which is not, which was already used through condition $\sin[\Phi]^{-q}=0$ in [1] to justify the quark transitions, and which is nothing more than the correspondence of the electric charge of the particle with the exponent of the SWP and the consequent identification of the physical meaning of this exponent. That is to say, although this exponent was previously assigned to the phase factor (without justifying its origin), and a utility was given to it, it is now that it is being assigned to the source function SWP, which entails a transcendent and inherent value of this exponent, a physical character, by establishing a clear correspondence between such an elementary and quantized magnitude as the electric charge and this discrete value that appears in the function of the charged particle.

3.1. Up-Type Quarks (2/3)

Following a similar development to that initiated in (14) of [1], we obtain, using the generalised wave function for $q=2/3$ and $\varphi=0$, an expression equivalent to Equation (19) and finally to Equation (26) of [1],

$$\zeta^{(-2/3)}(\upsilon)=\left[\frac{\hbar\upsilon\sin(\Phi)^{-2/3}}{a^3\gamma^{-3}}-\left(\frac{-2}{3\Phi^{5/6}}\right)\frac{\hbar\upsilon\Delta k\cos(\Phi)^{-2/3}}{2a^2\gamma^{-2}}\right]+\left[-\frac{\hbar\omega\cos(\Phi)^{-2/3}}{a^2\gamma^{-2}}\right], \quad (20)$$

except for the introduced exponent and the parenthesis or additional factor of the second term, consequence of the additional derivative of $d[f(\Phi)]$ with respect to $d(\Phi)$, in charge of that exponent This factor will undoubtedly affect how the energy of formation is reached for this type of particle, that is, it will introduce differences with respect to the energy transfer cycle seen for charged leptons, about which we cannot say much more at present. This is why we overlook it to focus on the change in behaviour of the term associated with kinetic energy, as a consequence of the exponent relative to charge q, since the term is comparable to the well-known corpuscular expression and can therefore provide us with more information about the underlying vibrational behaviour, performing an analysis similar to that developed with leptons, since it is fulfilled, similarly the Equations (30)-(32) of [1], and according to the previous energy balance of Equation (23):

$$E_k = A^2 \int \zeta_k(\upsilon)\mathrm{d}\upsilon = A^2\left(\frac{\hbar}{a^3}\right)\sin[\Phi]^{-2/3}\int \frac{\upsilon}{\gamma^{-3}}\mathrm{d}\upsilon, \tag{21}$$

with:

$$\sin[\Phi]^{-2/3} = \left[2b^{-2/3}\left(\left(\frac{\hbar}{\pi m}\right)^{1/3}\gamma^{-1}\right)\right]^{-2/3} = \left[2b^{-2/3}\delta\gamma^{-1}\right]^{-2/3}. \tag{22}$$

for which we can demand the following condition:

$$\sin[\Phi]^{-2/3} = 0, \tag{23}$$

As we did (dispensing with this development) in Equation (38) of [1], where we saw (and will now elaborate on) that it was satisfactory for:

$$[\Phi]^{-2/3} = \left[2b^{-2/3}\delta\gamma^{-1}\right]^{-2/3} = \left[Z\delta\gamma^{-1}\right]^{-2/3} = 2\pi, 3\pi \quad (\phi_1,\phi_2) = \phi, \tag{24}$$

where it is clearly shown, as we said in [2], that it could be $\phi = f(\Phi)$, as a more general case (associated with the exponent), and not necessarily $\phi = \Phi$, *i.e.* that the effective phase ϕ does not coincide with the phase Φ for the sequence.

A sequence that can be deduced from Equation (22), in an analogous way as we did for leptons with Equation (7) and Equation (9), both generalized in this case for any charge, and with the initial phase or particle of application discretionally defined by a number subscript or initial (if necessary) in the phase ratio χ, and the derived factors α and $\Re$.

$$\chi_1 = \frac{\phi_2}{\phi_1} = \frac{\left[\beta_2\left(\frac{1}{m_2}\right)^{1/3}\gamma_2^{-1}\right]^{-q}}{\left[\beta_1\left(\frac{1}{m_1}\right)^{1/3}\gamma_1^{-1}\right]^{-q}} = \frac{\left[\beta_2\left(\frac{m_2^2}{m_3^3}\right)^{1/3}\right]^{-q}}{\left[\beta_1\left(\frac{m_1^2}{m_2^3}\right)^{1/3}\right]^{-q}} = \left[\alpha_1\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{1/3}\right]^{-q} = \alpha_1^{-q}\times\Re_1^{-q}, \tag{25}$$

that for $q = 2/3$ results:

$$\chi_1 = \chi_u = \alpha^{-2/3}\left(\frac{m_c^5}{m_u^2 m_t^3}\right)^{-2/9} \simeq 1.5 \quad \left(\propto \frac{3\pi}{2\pi} = \frac{3}{2}\right), \tag{26}$$

for the estimated masses (and already presented in [1]), and chosen with some freedom (which we will justify later) with respect to the known values, for an estimate of $\hat{\alpha} = \alpha^{-2/3} = 1.005 \cong 1$, that is, of $\alpha = 0.9949$, established through the angles subtended by the velocities, which we can obtain from these masses and from Equation (3).

Indeed, if we stick to the tabulated experimental data [4]:

$$m_u = 2.16^{+0.49}_{-0.26}\ \text{MeV},\quad m_c = 1.27 \pm 0.02\ \text{GeV},\quad m_t = 172.9 \pm 0.4\ \text{GeV}, \tag{27}$$

results in a range of values, $[\chi] \simeq \Re_{m1}^{-2/3} = (1.43, 1.72)$, which contains the simple ratio of natural numbers reached in Equation (26) for χ_1, and only this (which excludes others such as $\chi = 1$ or $\chi = 2$), from the values of Equation (24). From there, we can estimate the value of the masses, among the possible ones, which preserve this simple ratio Equation (26), a requirement that the values specifically meet:

$$m_u = 2.07\ \text{MeV},\quad m_c = 1.27\ \text{GeV},\quad m_t = 172.9\ \text{GeV}, \tag{28}$$

and a spectrum over them, motivated by their margins of error, within the range of values of Equation (27).

In this case, only the measure of m_t, as well as the charged leptons, is obtained directly [and that is the coincident value in Equation (27) and Equation (28)], having from the other two only an estimate, which can be rectified and accommodated to Equation (26) by other means. As it is, in fact, by some of the other experimental measures if we take into consideration, since they are indirect, those that do not reach the highest probability (as presented in detail in Appendix B of [1]).

The objective of this Section was not to calculate the masses of the quarks but to show that the masses already calculated are governed or must be governed by the different physical expressions derived from Equation (19) and thereby verify that **Postulate II** is fulfilled for particles of this type, or, in other words, verify that it is possible to satisfy Equation (26) with existing data.

It will be the objective, however, later on, when, by incorporating an additional requirement, we can rectify these masses and adjust them completely using Equation (25), highlighting that the values of Equation (27), supplied or calculated by other methods, are not fully reliable, nor, consequently, the methodology used to achieve them.

Although it will be later when we approach and base this theoretical possibility we will nevertheless advance its results here (obtained in [1]) to show, now that we are talking about the masses of quarks, some correct data about them (para $\hat{\alpha} = 1$), according to Equation (26), for the two transitions of Equation (24):

$$m_u = 2.368 \pm 0.003\ \text{MeV},\quad m_c = 1.361 \pm 0.003\ \text{GeV},\quad m_t = 172.9 \pm 0.4\ \text{GeV} \tag{29}$$

which we present in **Table 2**, together with the other additional parameters for such transitions:

Table 2. Values for up-type quarks ($q = 2/3$) and their transitions.

$Z_1 = 1.828$ $b_1 = 3.619 \times 10^{-5}$	m_u (MeV)	δ_u	γ_u	m_c (MeV)	$\phi_1 = 2\pi$
	2.368793	0.01996	574.849	1361.698	
$Z_2 = 1.828$ $b_2 = 3.619 \times 10^{-5}$	m_c (MeV)	δ_c	γ_c	m_t (GeV)	$\phi_2 = 3\pi$
	1361.698	0.00240	127.010	172.95	

In which we see that now (as a more general case) we can indeed establish a relation or sequence on a single value $Z = Z_1 = Z_2$ (versus β) and an initial mass for each row, which is nothing more than that corresponding to each of the phases in Equation (25), which take this form:

$$\phi_i = \left[\beta_i \left(m_i^2 / m_{i+1}^3\right)^{1/3}\right]^{-q} = \left(\beta_i \overline{\gamma}_i\right)^{-q}, \tag{30}$$

by which m_{i+1} evolves from its initial value m_i to that other one in which the effective phase corresponding to the inertial mass is reached, which defines the initial mass of the next cycle, constituting the practical expression or verification of our postulates. A sole expression or sequence that accounts for the value of the particles of a class, and which is even continuous in sections if we make $\phi = \phi_i + \phi_{i-1}$, that is, if (taking $i = 2$) we establish it over the previous phase ($\phi_{i-1} = \phi_1$), as represented graphically in **Figure 2**:

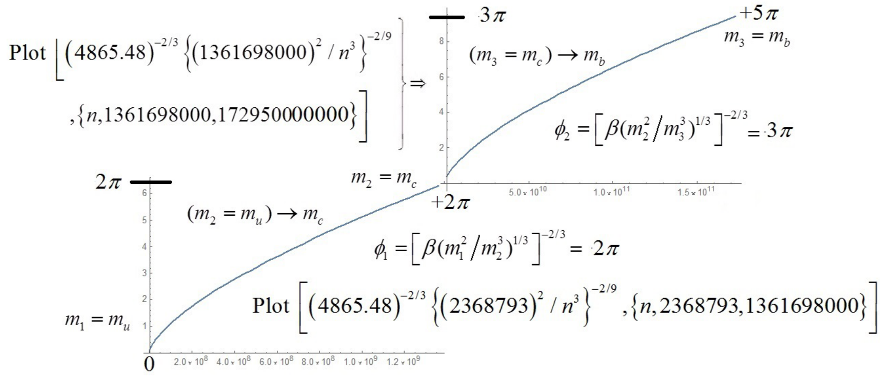

Figure 2. Transitions of phase for up-type quarks (2/3).

A previous phase ($\phi_{i-1} = \phi_1$) introduced for the purpose we have just indicated, which for ϕ_2 is none other than the initial phase φ incorporated in Equation (19), which will take the values of that phase $\varphi = \phi_1 = \Phi_1^{-q}$, while this of the previous phase $\varphi = \phi_0 = \Phi_0^{-q}$, corresponding to ϕ_1, will generally be zero ($\varphi_u = 0$), as for electrons ($\varphi_e = 0$). Being $\varphi_c = 2\pi$ the advance of the previous phase for the following transit (which for the corresponding lepton would be $\varphi_\mu = \pi$). It is understood that this is an interpretation or modelling of what is happening, being other than $\varphi_c = 0$ and $\varphi_\mu = 0$, which would make each phase, once the new mass is configured, start from the same situation, from the same phase (since $\widehat{\phi}_0 \equiv [0, c[$ is not exceeded).

The choice of one option or the other will depend, as discussed in [1], on whether we grant a different degree of materiality to each transit or whether, on the contrary, we restrict this division to what is already presented to us as material (corpuscle) and non-material (phase factor), which in itself depends on what nature itself has chosen as a path. Although the second (and third) generation particles that we detect (in our phase) respond to the second case, it may be that there is an undetectable universe of particles associated with the first one.

3.2. Down-Type Quarks (−1/3)

Similarly, for $q=-1/3$ we obtain:

$$\zeta^{(-1/3)}(\upsilon)=\left[\frac{\hbar\upsilon\sin(\Phi)^{1/3}}{a^3\gamma^{-3}}-\left(\frac{1}{3\Phi^{2/3}}\right)\frac{\hbar\upsilon\Delta k\cos(\Phi)^{1/3}}{2a^2\gamma^{-2}}\right]+\left[-\frac{\hbar\omega\cos(\Phi)^{1/3}}{a^2\gamma^{-2}}\right] \quad (31)$$

Restricting our analysis to kinetic energy, with

$$E_k=A^2\int\zeta_k(\upsilon)\mathrm{d}\upsilon=A^2\left(\frac{\hbar}{a^3}\right)\sin[\Phi]^{1/3}\int\frac{\upsilon}{\gamma^{-3}}\mathrm{d}\upsilon \quad (32)$$

and

$$\sin[\Phi]^{1/3}=\left[2b^{-2/3}\left(\left(\frac{\hbar}{\pi m}\right)^{1/3}\gamma^{-1}\right)\right]^{1/3}=\left[2b^{-2/3}\delta\gamma^{-1}\right]^{1/3}. \quad (33)$$

Fulfilling that:

$$\sin[\Phi]^{1/3}=0, \quad (34)$$

which, in this case, is given for:

$$[\Phi]^{1/3}=\left[2b^{-2/3}\delta\gamma^{-1}\right]^{1/3}=\left[Z\delta\gamma^{-1}\right]^{1/3}=2\pi,\pi\ (\phi_1,\phi_2)=\phi \quad (35)$$

A sequence that we will put in the equivalent form:

$$\phi=\left[2b^{-2/3}\delta\gamma^{-1}\right]^{1/3}=\left[Z\delta\gamma^{-1}\right]^{1/3}=4\pi,2\pi,\pi\ (\phi_1,\phi_2,\phi_3), \quad (36)$$

because it is a form that would allow the incorporation of $\phi_3=p\pi\ (:p\in\mathbb{N})$, that is, a third transition for the assumption of a fourth generation, which the other classes of particles by this particular (the increasing evolution of the effective phases ϕ) allow, as well as being backed up. In addition to being obliged or having no other choice, as we will see in Section 5, by the additional and unavoidable requirement, already mentioned above. We must also remember that, although there is no transition to the fourth generation, there is in all cases the phase $[\phi_3]$ interval in which the third generation takes place.

A sequence achieved for ϕ, which is demonstrated once again by simply replacing the approximate values of the masses in Equation (25), adapted in this case to the new exponent (1/3):

$$\chi_1=\chi_d=\frac{\phi_2}{\phi_1}=\alpha^{1/3}\left(\frac{m_s^5}{m_d^2m_b^3}\right)^{1/9}\simeq 0.5\quad\left(\propto\frac{1\pi}{2\pi}\right), \quad (37)$$

in which, with $\alpha=1.01295$ and $\hat{\alpha}=\alpha^{1/3}=1.0042$, the ratio χ_1 is left entirely to the masses, which for the listed values of the masses:

$$m_d=4.67^{+0.48}_{-0.17}\ \text{MeV},\ m_s=93^{+11}_{-5}\ \text{MeV},\ m_b=4.18^{+0.03}_{-0.02}\ \text{GeV}, \quad (38)$$

provides a range of values $[\chi]\simeq\Re_{m1}^{1/3}=(0.518,0.588)$.

A result deviating from that required in Equation (37), from which it follows that these masses must also be redefined with the additional condition, and, again, that the indirect calculation parameters used to obtain Equation (38) are not sufficiently balanced or achieved, here, with $\chi_1\notin[\chi]$, with even more justification.

As in the previous case and to present correct data of the masses, here where we are talking about them, we will make an advanced use, together with the application of Equation (36) and Equation (37), of these definition criteria, which results:

$$m_d = 5.395^{+19}_{-13} \text{ MeV}, \quad m_s = 83.88^{+0.49}_{-0.31} \text{ MeV}, \quad m_b = 4.18^{+0.03}_{-0.02} \text{ GeV}. \tag{39}$$

Values that also correspond to the measures listed experimentally [4], if we take into consideration those recorded that do not reach the highest probability (as presented in detail in Appendix B of [1]), which we present in **Table 3**, as in the previous cases, along with the others additional parameters for these transitions:

Table 3. Values for down-type quarks ($q = -1/3$) and their transitions.

$Z_1 = 2033106$ $b_1 = 9.757 \times 10^{-10}$	$m_d\,(\text{MeV})$	δ_d	γ_d	$m_s\,(\text{MeV})$	$\phi_1 = 4\pi$
	5.395	0.01517	15.5483	83.883	
$Z_2 = 2033106$ $b_2 = 9.757 \times 10^{-10}$	$m_s\,(\text{MeV})$	δ_s	γ_s	$m_b\,(\text{MeV})$	$\phi_2 = 2\pi$
	83.883	0.00608	49.619	4180.42	

Values that we can also achieve and represent by Equation (30), for $\varphi_d = 0$ and $\varphi_s = 4\pi$ (**Figure 3**):

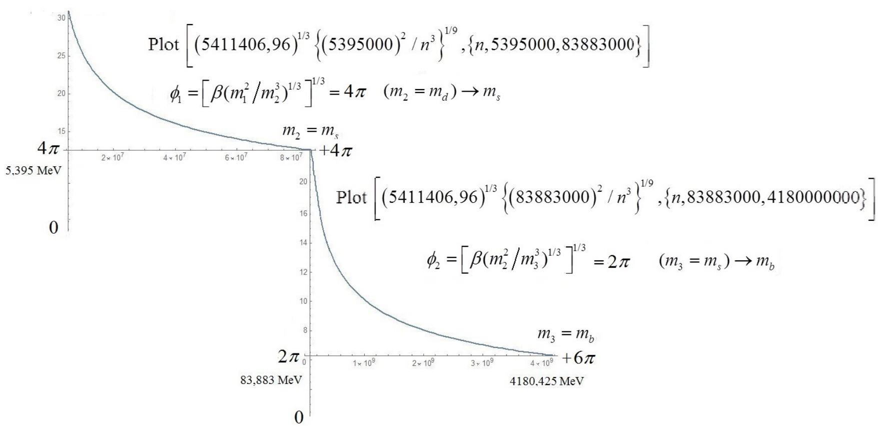

Figure 3. Transitions of phase for down-type quarks (−1/3).

And which, in a similar way to the previous one, are not only those corresponding to the exact values ϕ defined in Equation (36) but to the exact value χ, defined in Equation (37), that, together with the results of Equation (12) for **Table 1** and Equation (26) for **Table 2**, can be presented in a new table (**Table 4**).

Table 4. Phase, according to Equation (25), for each of the triads of values m_1, m_2, m_3, corresponding to the three generations of particles, for each of the three classes of charged particles.

Triad	Particle	Mass (MeV)	$\chi = \phi_2/\phi_1$
m_1	e	0.511	
m_2	μ	105.658	2/1
m_3	τ	1776.840	

Continued

m_1	u	2.368	
m_2	c	1361.698	3/2
m_3	t	172.950	
m_1	d	5.395	
m_2	s	83.883	1/2
m_3	b	4180.425	

Emphasizing that although the triad gives us a result χ that defines it, the true relationship of the particles is between them each two, that is, the one derived from the phase, or phasic situation between one and the next in the sequence, given by Equation (30).

4. Generational Transitions in Standard Model (Antiparticles)

It seems obvious, once all the particles are shown, to see or check if the antiparticles respond to this kind of scheme. It is easy to understand that if they do, they will do so by conserving the value of the mass with respect to the particles and by inverting the charge, that is, the sign of the exponent, into Equation (19) that represents it, which will give rise to a similar development, although affected by this change. That is, it will lead to results like the one reached in Appendix A of [1] for the leptons and then in Equation (20) and Equation (31) for the quarks, for the pertinent exponents, which, for what we are interested in, are already taken into account in Equation (25), allowing us to make a more abbreviated exposition of them.

4.1. Anti-Leptons (+1)

On Equation (25), the change of sign will mean that the ratio between phases is inverted, which in the case of leptons will be:

$$\bar{\chi} = \frac{\bar{\phi}_2}{\bar{\phi}_1} = \left[\alpha\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{1/3}\right]^{-1} = \alpha^{-1} \times \Re^{-1} = \hat{\alpha}\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{-1/3} = \frac{\phi_1}{\phi_2} = \chi^{-1} \tag{40}$$

Therefore, the following is fulfilled:

$$\chi\bar{\chi} = 1 \tag{41}$$

This gives a value $\bar{\chi} \approx 0.5$ which implies that the sequence applicable to the phase is:

$$\bar{\phi} = \left(2\bar{b}^{-2/3}\delta\gamma^{-1}\right)^{-1} = \left(\bar{Z}\delta\gamma^{-1}\right)^{-1} = 2\pi, \pi \ \left(\bar{\phi}_1, \bar{\phi}_2\right). \tag{42}$$

That is, this or a proportional one and, in any case, inverse to the one given for leptons in Equation (6). It is also possible to verify that:

$$\phi_1\bar{\phi}_1 = \phi_2\bar{\phi}_2 \tag{43}$$

From the sequences in Equation (6) and Equation (42) the corresponding value $\bar{Z}$ is quickly reached:

$$\frac{Z\delta}{\pi} = \gamma = 2\pi\bar{Z}\delta \quad \Rightarrow \frac{Z}{\bar{Z}} = (2\pi)\pi = 2\pi^2 \quad \Rightarrow \bar{Z} = 19.7392^{-1} Z \tag{44}$$

with which, applied to Equation (5a), we can obtain the associated value $\bar{b}$. Operative that is valid for both $\bar{Z}_1$ and $\bar{Z}_2$.

With the phase sequence in Equation (42) and the $\bar{Z}$ obtained by Equation (44) or manually (as we did with the particles through their masses), values for antiparticles are achieved that are completely in agreement with the associated particles, since neither the initial mass nor $\bar{\delta} = \delta$ changes through Equation (5b), whereas $\bar{\gamma} = \gamma$ as evidenced in Equation (44). Results that can be put into **Table 5**:

Table 5. Values for charged antileptons ($q = 1$) and their transitions.

$\bar{Z}_1 = 988.4619$ $\bar{b}_1 = 9.101 \times 10^{-5}$	$m_e(\text{MeV})$	δ_e	γ_e	$m_\mu(\text{MeV})$	$\bar{\phi}_1 = 2\pi$
	0.511	0.033292	206.764	105.658	
$\bar{Z}_2 = 950.778$ $\bar{b}_2 = 9.647 \times 10^{-5}$	$m_\mu(\text{MeV})$	δ_μ	γ_μ	$m_\tau(\text{MeV})$	$\bar{\phi}_2 = \pi$
	105.658	0.00563	16.817	1776,840	

From here:

$$\frac{\bar{Z}_2}{\bar{Z}_1} = \alpha = \frac{950.778}{988.4619} \cong 0.962 \tag{45}$$

Value α identical to that already found, and which also corresponds to the ratio of the angles subtended by the speeds associated with γ_e and γ_μ, with which it also complies:

$$\begin{aligned} \bar{\chi} &= \left[\alpha\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{1/3}\right]^{-1} = \alpha^{-1} \times \Re^{-1} = 0.962^{-1} \times 2.079^{-1} \\ &= 1.039 \times 0.481 = 0.5 = 2^{-1} = \alpha^{-1}\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{-1/3} \end{aligned} \tag{46}$$

That is, a product of inverse factors to those reached for the particles, with which an inverse value is reached for $\bar{\chi}$ to that reached with them, as we had already advanced, composed with the same factors α and $\Re$ (which do not change), fulfilling, on the other hand, the expectations regarding antileptons in the developed framework.

4.2. Type-Up Anti-Quarks (−2/3)

For these, in even more abbreviated form, we have:

$$\bar{\chi} = \frac{\bar{\phi}_2}{\bar{\phi}_1} = \left[\alpha\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{1/3}\right]^{2/3} = \alpha^{2/3} \times \Re^{2/3} = \hat{\alpha}\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{2/9} = \frac{\phi_1}{\phi_2} = \chi^{-1} \tag{47}$$

This gives a value $\bar{\chi} \simeq 2/3$, for $\hat{\alpha} \simeq 1$, which implies that the sequence applicable to the phase is:

$$[\Phi]^{2/3} = \left[2\bar{b}^{-2/3}\delta\gamma^{-1}\right]^{2/3} = \left[\bar{Z}\delta\gamma^{-1}\right]^{2/3} = 3\pi, 2\pi \ \left(\bar{\phi}_1, \bar{\phi}_2\right) = \bar{\phi} \tag{48}$$

that is, this one or a proportional one and, in any case, inverse to the one given for particles in Equation (24), which also fulfils Equation (43).

From the sequences in Equation (24) and Equation (48), the value $\bar{Z}$ associated with it is quickly reached:

$$\frac{Z\delta}{(3\pi)^{-3/2}} = \gamma = (2\pi)^{-3/2}\bar{Z}\delta \ \Rightarrow \frac{Z}{\bar{Z}} = \left(6\pi^2\right)^{-3/2} \ \Rightarrow \bar{Z} = 455.697Z \tag{49}$$

With the phase sequence of Equation (48) and the $\bar{Z}$ obtained by Equation (49) or manually (as we did with the particles through their masses), values for antiparticles are achieved that are fully in agreement with the associated particles, which we may reflect in **Table 6**:

Table 6. Values for up-type antiquarks ($q = -2/3$) and their transitions.

$\bar{Z}_1 = 833014.7$	m_u (MeV)	δ_u	γ_u	m_c (MeV)	$\bar{\phi}_1 = 3\pi$
$\bar{b}_1 = 3.7202 \times 10^{-9}$	2.368793	0.01996	574.849	1361.698	
$\bar{Z}_2 = 833014.7$	m_c (MeV)	δ_c	γ_c	m_t (GeV)	$\bar{\phi}_2 = 2\pi$
$\bar{b}_2 = 3.7202 \times 10^{-9}$	1361.698	0.00240	127.010	172.95	

4.3. Type-Down Anti-Quarks (+1/3)

Similarly, we have:

$$\bar{\chi} = \frac{\bar{\phi}_2}{\bar{\phi}_1} = \left[\alpha\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{1/3}\right]^{-1/3} = \alpha^{-1/3} \times \Re^{-1/3} = \hat{\alpha}\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{-1/9} = \frac{\phi_1}{\phi_2} = \chi^{-1} \tag{50}$$

This gives a value $\bar{\chi} \simeq 2$, for $\hat{\alpha} \simeq 1$, which implies that the sequence applicable to the phase is:

$$[\Phi]^{-1/3} = \left[2\bar{b}^{-2/3}\delta\gamma^{-1}\right]^{-1/3} = \left[\bar{Z}\delta\gamma^{-1}\right]^{-1/3} = \pi, 2\pi, 4\pi \ \left(\bar{\phi}_1, \bar{\phi}_2, \bar{\phi}_3\right) = \bar{\phi} \tag{51}$$

which is inverse to the one given for particles in Equation (36) and also fulfils Equation (43).

From the sequences in Equation (36) and Equation (51), the value $\bar{Z}$ associated with it is quickly reached:

$$\frac{Z\delta}{(4\pi)^3} = \gamma = \pi^3\bar{Z}\delta \ \Rightarrow \frac{Z}{\bar{Z}} = \left(4\pi^2\right)^3 \ \Rightarrow \bar{Z} = (61528.908)^{-1} Z \tag{52}$$

With the phase sequence in Equation (51) and the $\bar{Z}$ obtained by Equation (52) or manually (as we did with the particles through their masses), values for antiparticles are achieved that are completely in agreement with the associated particles, which we may put in **Table 7**:

Table 7. Values for down-type antiquarks ($q = 1/3$) and their transitions.

$\bar{Z}_1 = 33.0431$	$m_d\,(\mathrm{MeV})$	δ_d	γ_d	$m_s\,(\mathrm{MeV})$	$\phi_1 = \pi$
$\bar{b}_1 = 0.01489$	5.395	0.01517	15.5483	83.883	
$\bar{Z}_2 = 33.0431$	$m_s\,(\mathrm{MeV})$	δ_s	γ_s	$m_b\,(\mathrm{MeV})$	$\phi_2 = 2\pi$
$\bar{b}_2 = 0.01489$	83.883	0.00608	49.619	4180.42	

4.4. Discussion 2

We have to draw attention to the fact that the evolution of phases with a negative exponent (positive charge) is increasing and those with a positive exponent (negative charge) is decreasing, as shown, respectively, in Figure 2 and Figure 3, *i.e.* the phase value ϕ_i is reached, according to condition $\sin[\Phi]^{-q} = 0$, by an evolution of the phase from $\phi = 0$ or from $\phi \approx \infty$, as the case may be, giving rise to development intervals of the type $[\bar{\phi}_1] = [0, 2\pi]$ y $[\phi_1] =]\infty, \pi]$.

The treatment of this issue, in addition to being a very complex one and deserving a separate detailed study (as we will do in another paper), is practically irrelevant to our objectives now, so it is not necessary to dwell on it. Just to say in this respect, as an advance, that trying to explain why some phases are one way or another without the help of the particle that supports them makes no sense, that is to say, a phase without that support runs, without further ado, from one end of the universe to the other (from right to left, we could say) and without the possibility of establishing a point of reference on it. It is when we establish that reference (the particle) that we can say what happens up to it or what happens from it, regarding the phase, that is to say, when two differentiated movements of phase are established from the point of view of the particle.

Two distinct movements that we can differentiate graphically to the right ($|\leftarrow$) and left ($\leftarrow|$), respectively (as if they were two parts of the same continuous phase). The first starts from ∞ with the intention of carrying out the path $[\phi] =]\infty, 0]$ that finally only progresses to the values of phase change, that is, to the closest to the particle, and concretely to the first $[\phi_1] =]\infty, \pi]$. The second, starts from 0, with the intention of carrying out the path $[\bar{\phi}] = [0, \infty[$ that finally only progresses to the values of phase change and concretely to the first $[\bar{\phi}_1] = [0, 2\pi]$, as closest to the particle. It is these positions close to the particle that are reached or completed, either on one side or the other, because it is the proximity to the particle that is likely to constitute a state, regardless of whether the traveling wave has a plus or minus sign.

Consequently, from the point of view of the phase itself the intervals are those presented above, from the point of view of the particle the interval $[\bar{\phi}_1] = [0, 2\pi]$ does not change ($\leftarrow|$), but the other one does, since the reference for it is not that hypothetical infinity but itself ($|\rightarrow$), that is, $[\phi_1] =]\infty, \pi] \rightarrow [0, \pi]$.

With this in mind, we will identify, for clarity, the intervals of the phases ϕ_i for (anti)particle, in the form $[\phi_i] = [\bar{\phi}_i] = [0, \mathbb{N}\pi]$, on which we can eventually change the sign of the increasing (anti)phase (positive charge) if we want to emphasise that, it is on the left from zero value $[\phi_i] = [\bar{\phi}_i] = [0, -\infty[\rightarrow [0, -\mathbb{N}\pi]$.

5. The Four (Anti)Material States and the Spin: The Intrinsic Spinor

We have seen, in conclusion, that except for the values $\bar{Z}$ and $\bar{b}$, already highlighted, and the inverse order (decreasing instead of increasing due to the exponent) of the phasic sequence, and its related ratio $\bar{\chi}$, nothing changes through Equation (25) between particles and antiparticles. This is not to say that there cannot be properties, as indeed there are, that may vary from one type to another or, more specifically, between a given particle and its antiparticle, *i.e.*, not identifiable to the type of particle itself but to the correspondence of their states, which may even be linked (quantum entanglement). This is why, we can "venture" that the change of sign of the charge value given in the exponent of Equation (19) is not the only change of sign that can occur (as the only a priori way of altering this wave equation) concerning the allocation and differentiation of these states, and that, similarly, there could be to this effect an inversion of sign in one of the exponentials of the functions Ψ_1 and Ψ_2 of this equation, or in the two exponentials simultaneously.

Since we can venture, we will heuristically venture the possibilities of the mentioned changes to show that there is a mathematical diversity that can account for the diversity of the material world and its properties (which is akin to what is done in Physics for these cases), which we will then try to formalise.

According to this, we can appreciate that a change of sign in the two exponentials of both wave functions (the modulated wave ϑ_i and the wave phase ϕ_i) of the material SWP $\Psi_{\Im}(q)$ of Equation (19) for $q = -1$, would result in a change in the form $\vartheta_2\phi_2 - \vartheta_1\phi_1 \rightarrow \vartheta_1\phi_1 - \vartheta_2\phi_2$ (inverse in Ψ) and, consequently, in the form $f(\vartheta_2\phi_2 - \vartheta_1\phi_1) \rightarrow f(\vartheta_1\phi_1 - \vartheta_2\phi_2)$ for energy balance functions, that is, would lead to an exchange of these functions and an equation of inverse energetic sign with respect to the original function, $\bar{E}[f(\vartheta_1\phi_1 - \vartheta_2\phi_2)] = \bar{E}[-f(\vartheta_2\phi_2 - \vartheta_1\phi_1)]$, as detailed in **Annex A**, which could be interpreted physically as a structural exchange, or role reversal between the formants of the material toroid, which could characterise (among other properties) the antimaterial nature of the toroid.

Taking as a reference, or significant states, the configuration of the arguments of the material formation energy balance (which is what really interests us), $\Im_{\uparrow} \equiv (\vartheta_2\phi_2 - \vartheta_1\phi_1)$ of $\Psi_{\Im}$ is telling us that $\mathrm{e}^{-i\left[(M/2)^{-q}+\varphi\right]}$ builds on $\mathrm{e}^{i\left[(M/2)^{-q}+\varphi\right]}$, and $\bar{\Im}_{\downarrow} \equiv (\vartheta_1\phi_1 - \vartheta_2\phi_2)$ of $\Psi_{\Im}$ is telling us the opposite, *i.e.*, although in both cases there is a superposition of two wave packets to form a symmetrized wave, and therefore they are similar, the roles of the *incident wave* and *reflected wave* are interchanged from one case to the other for that formation, and that makes them different. As different as one has positive energy by the sign of the dominant exponential (which marks the computation), and the other, negative, characteristic of the antiparticles.

Concerning first representative case of particulates, another case (second case) would be one in which only the exponentials that carry the electric charge change sign (which are those that energetically constitute the particle), that is, that the $e^{\pm i(N)}$ wave phases do not do so or, equivalently, that only these phases of the function do so $\vartheta_2\phi_2 - \vartheta_1\phi_1 \to \vartheta_2\phi_1 - \vartheta_1\phi_2$ which would allow us to obtain the value $\Im_{\downarrow} \equiv (\vartheta_2\phi_1 - \vartheta_1\phi_2)$ from which we can then also obtain the anti-material particle $\bar{\Im}_{\uparrow} \equiv (\vartheta_1\phi_2 - \vartheta_2\phi_1)$ of negative dominant exponential by the same equivalence $\bar{E}[\vartheta_2\phi_1 - \vartheta_1\phi_2] = \bar{E}[-(\vartheta_1\phi_2 - \vartheta_2\phi_1)]$.

A result that we could have obtained even more directly through the wave packets presented in Equation (1a) of [2], with which a new starting equation with numerator $(\vartheta_2\phi_1 - \vartheta_1\phi_2)$ would have been obtained, analogously to what was done with Equation (1b) of [2] and has been replicated in this development to achieve Equation (19), with which we could have carried out the same energy calculation. That is to say, with this pair of equations, it is justified in origin and formalized what we have done by means of the trial, from which it would also have been possible to show that this second case is dissimilar energetically to the first, unless we rearrange it as we do in **Annex A**, in which as a result, and summed up, we have four energetic states $\bar{E} = \pm(\bar{E}_k + \bar{E}_f) \pm \bar{E}_\omega$, for which $\pm\bar{E}_\omega$ breaks the degeneracy of the parenthesis term (either positive or negative) and energetically differentiates the multiplicity.

The latter could be contradictory or confusing if we understand $\pm\bar{E}_\omega$ exclusively as an input energy that creates the particle, not if we understand it as a carrier-dependent energy that circulates in one sense or the reverse (by $\pm\omega_0$) in this creation process, and that is then present in the toroid as a simple carrier (retaining the sense, which will take on a rotational nature). In this way, the multiplicity, far from being contradictory or confusing, is finally advantageous because that multiplicity is the spin for each (anti)material state, *i.e.* that which breaks the energetic degeneracy by incorporating (literally in our case) another term with physical reality (the carrier initially associated to $\pm\bar{E}_\omega$), although it may be energetically irrelevant. This allows us to define more formally (from the generating functions of the wave packets ($\varphi^{(i)} \equiv \vartheta_2\phi_2, \vartheta_2\phi_1, \vartheta_1\phi_2, \vartheta_1\phi_1$) of the states $\Im \equiv \Im_s = \Im_{\uparrow}, \Im_{\downarrow}, \bar{\Im}_{\uparrow}, \bar{\Im}_{\downarrow}$ of the (anti)matter, and the four corresponding $\Psi_{\Im}$ wave functions, which was, although we have not said it explicitly, the objective, that is, to be able to represent or establish a correspondence with the 4-spinor [5], on which we will then go deeper, and, consequently, with the solutions $\psi_D^{(i)}$ of the Dirac equation, of which we provide a small glossary in **Annex B-(1)** for this purpose.

The difference, in a first comparison, lies in the fact that our spin state is not something intangible or ad hoc derived from the multiplicity created but the result of the combination of $\phi_2 - \phi_1$ signs or circulation of the two carriers in the toroid. In this sense, we can realize that the spin appears through the set of carriers of the two wave packets of the SWP but that there is no trace of them in the ETE as a consequence of the fact that in this energy balance the carriers are precisely the functions that cancel with their conjugate, that is why it does not appear in H_D

either. Only the spin is reflected in the Dirac environment by means of the Zitterbewegung [6], showing that although the Dirac equation does not speak of two combined wave packets (and this is its main shortcoming), the velocity operator derived from it shows its existence. It not only shows this combination of wave packets and the existence of spin, but also gives us indications through the factor $\exp(-2iHt/\hbar)$ that it is the result of the product of its two carriers, that is, that while energetically the carriers undergo a sum operation through the wave packets (which cancels them), dynamically and structurally they follow the form $e^{-i\omega_0 t}\times e^{-i\omega_0 t}$ that forms the spin, as we will develop in another work, which implies the joint participation of both wave packets, as expressed in $\Im$.

In reality, the Dirac equation speaks of two wave packets as well, but it does so surreptitiously through the bi-spinors $|U_A\rangle$ and $|U_B\rangle$. That is, what the Dirac equation does is to combine (without being aware of it) the two H corresponding to the two wave packets in a single H_D that satisfies the condition imposed by the relativistic energy expression, from which then logically result two bi-spinors and four possible states or, to put it better, two degenerate states susceptible of being differentiated. Each of the eigenstates of the energy function represented by the 4-spinor agrees with the corresponding $\Im$ state that we can consider an intrinsic spinor. "Intrinsic" because each solution carries its spin state implicitly, and because it is not a set of solutions formatted for the Dirac equation, but outside of it (of which it makes no use) and of the conditions imposed to reach it, from which the explicit wave function can be reached, for each of the four cases, and an energy expression E. An energy expression that implies the whole process of creation of the particle through the ETE, which is also part of that intrinsic and differentiated quality that will undoubtedly require another way of understanding the related H.

Without going into this energetic treatment, we could also separate the H corresponding to each of the wave packets of $\Im_\uparrow \equiv (\vartheta_2\phi_2 - \vartheta_1\phi_1)$, but it would not be for $\vartheta_2(1)$ and $\vartheta_1(1)$ but for $\vartheta_2\phi_2$ and $\vartheta_1\phi_1$, which will nevertheless give rise to the spin state $S_\uparrow$ in both wave packets as a consequence of the order $(\phi_2 - \phi_1)\to\phi_2\times\phi_1\to S_\uparrow$. Likewise, $\Im_\downarrow \equiv (\vartheta_2\phi_1 - \vartheta_1\phi_2)$ would not be $\vartheta_2(0)$ and $\vartheta_1(0)$ but $\vartheta_2\phi_1$ and $\vartheta_1\phi_2$, which however will give rise to the spin state $S_\downarrow$ in both wave packets as a consequence of the order $(\phi_1 - \phi_2)\to\phi_1\times\phi_{21}\to S_\downarrow$. The Dirac equation, in contrast, does not know about the generating functions $\varphi^{(i)} = \vartheta_2\phi_2, \vartheta_2\phi_1, \vartheta_1\phi_2, \vartheta_1\phi_1$ because it does not start from them but from an analytical treatment (hence the loss of information and the degeneracy) from which result the states $\vartheta_2(x), \vartheta_2(x), \vartheta_1(x), \vartheta_1(x)$ that finally reconfigures itself in $\varphi_D^{(i)} = \vartheta_2(1), \vartheta_2(0), \vartheta_1(1), \vartheta_1(0)$, that is, in something that accounts for the spin because it is evident that something is missing in that multiplicity.

In accordance with the above, and since the particle as such will be subject to a spin regardless of whether it is due to a composition, we could extract the spin from the SWP and consider $\Im_\uparrow \equiv (\vartheta_2\phi_2 - \vartheta_1\phi_1)\to(\vartheta_2 + \vartheta_1)(S_\uparrow)$ and $(\vartheta_2 + \vartheta_1)(S_\uparrow)\to\vartheta_2(1), \vartheta_1(1)$, *i.e.*, to establish the relationship primarily through the wave functions representing the envelopes of the wave packets, which makes them look more like $\varphi_D^{(i)}$. On the other hand, since $\vartheta_1 = \vartheta_2^{-1}$, we can make $\vartheta_1 = f(\vartheta_2) = u_2\vartheta_2$, from which we obtain $(\vartheta_2 + \vartheta_1) = \vartheta_2 + u_2\vartheta_2$. From there, we need only take $\vartheta_2 = |U_A\rangle$ and $u_2\vartheta_2 = u_2|U_A\rangle = |U_B\rangle$ to accommodate the SWP to the spinor and establish a correspondence between the two for the most general case $p \neq 0$ of the latter.

Once we know that the spinors tell us about the wave packets of the intrinsic spinors, and the form that the Spin has in each type of spinor, we have to be able to harmonize the two formalisms or representations. The first thing is to realize that the difference between one representation and the other lies in the fact that the Dirac solution, regardless of the nature of the spin, requires a proportionality between $|U_A\rangle$ and $|U_B\rangle$, which implies that both have the same configuration for the two-component vector (to which the spin is associated) for each solution, that the SWP does not seem to respect, since, although we can rescue the spin of $\Im$, the truth is that $\phi_2 \neq \phi_1$.

To do this we must first remember that the SWP is a wave packet and a symmetrized one or, in other words, a bi-spinor and an inverted one that is part of the same energy solution. An inversion that for $\varphi^{(i)}$ implies a change of arithmetic sign because it is traveled in the reverse sense, and also a change of sign in the carrier, *i.e.* in the phase function of the wave packet, which, as a consequence of the sense of travel, is presented in phase opposition. If in one case we have ϕ_2, in the other we will have $-\phi_2^{-1} = -\phi_1$. If we do not go through the toroid on both sides from one end of its diameter to the other, but we do it continuously following its circumference, we would find the same phase value, as found by H_D in its analysis. This makes one consideration or the other indistinguishable with respect to the relative orientation of the bi-spinors, and we have essentially established equivalence. Once the equivalence is established, we will see that the differences will be more omissions of H_D than defects of the intrinsic spinor which, as such, has greater prospectivity.

Going into detail of what has been said, for the other issue, the Dirac equation requires a proportionality between spinors in the form $u_2|U_A\rangle = |U_B\rangle$, which for the positive solution $S_{z+} \equiv S_\uparrow$ in the direction of the $z+$ axis is assimilated to $u_2|S_\uparrow\rangle = |S_\uparrow\rangle$, that is, to the existence of spin in each of them, also as a consequence of the use of the Pauli matrices. This requirement is fulfilled and is represented, for simplicity, by the eigenvector of $S_\uparrow$, although the only real requirement is that it be a two-component vector. That is, there is no reason to require and then ensure that such a vector is a spin, even if there is a correspondence ($S_{z+} \equiv S_\uparrow$) of their values.

Before answering whether state S_{z+} represents the spin or not, for which we would have to find the physical mechanism that promotes it, the question would be what need does H_D have to give the solution in two parts supported on the same state, which would be nothing but two different coefficients on the same wave function. What makes the wave functions different is not the coefficients but the fact that they have a wave function associated with them, such as that of the carrier, which distinguishes them. Everything would seem to indicate that H_D knows that he has to unfold in a matrix form to account for the different states, but that he presents them as equal because he is not able to realize that a geometrical inversion is taking place or to distinguish them through the carrier. That is, to some extent, the presence of two equal states would be alerting us that they are actually geometrically inverted and, once they are inverted, that they must be different things, that is, not two states that are the opposite of each other, and cancel each other out. If they are two different states, both two cannot be the spin but part of the spin.

In case it is not spin, the starting state in question must correspond to some particularity not otherwise characterized in the wave packet, such as the ϕ_2 carrier. In that case, we would need, since the components associated with "0" cancel out in the eigenvector of the 4-spinor, another pair of values to complement the non-zero value reached, by means of the second bi-spinor, which is just what the inversion of the bi-spinor provides. That is to say, by means of the inversion we make $u_2|S_{z+}\rangle = |S_{z+}\rangle \to u_2|S_{z-}\rangle = |S_{z-}\rangle$, which allows us to have another pair of states in charge of S_{z-}, which does the same with respect to ϕ_1. This allows us to have two distinct nonzero states representative of a defined physical particularity that can, in combination, represent a property such as spin if we are able to justify their foundation.

The above-mentioned comparison of both formalisms can be seen further developed for the two material states in **Annex B-(2)**, where we see that starting from the Dirac spinor we arrive at the intrinsic spinor (and vice versa) or, similarly, starting from an intermediate expression (the particle formed with the capacity to express its spin) we reach the two spinorial forms. A path that we can follow, as shown in an alternative way since, in the end, we only have four significant elements in each $\Im$, without forgetting that finally there are not even four but two, since the carrier is not something that we can join to the envelope at our whim which are two parts of the same solution.

As we said, what H_D does, as we said, is to separate the solution into two solutions, as when separating the hypotenuse of a right triangle into its two legs, which must then be recombined through the norm of the scalar product of the vector space, which is exactly what the SWP invites us to do naturally by means of its explicit summands. However, H_D makes an arbitrary separation of the wave function into two components without realizing that this separation and solution is a structural reality, and without being able to discern that this separation also involves the spin or, in other words, that the spin also has two components, associated, as the carriers, with their respective wave functions. This way of operating starts from a previous conceptual error, which is to associate a particle with a wave function. Once this association has been made, it is understandable to associate the spinor with the wave function in order to unfold the spinor by means of the Pauli spinor. That is to say, if the conceptual scheme does not include the fact that the wave function does not represent a particle but "a half", it is difficult to think that the associated spin part is not one but a half as well and that, consequently, two wave functions are needed to associate a complete spin state.

However, given that there are two wave packets in the SWP, and given that the Dirac equation establishes this separation and gives us some solutions, it seems appropriate to ask ourselves what the Dirac spinors are or what information they really give us, and where is the real need to have separated them, that is, that the solution is configured in two parts. For this, we are going to look at the explicit solution of the eigenvectors [7], and specifically at the positive one, which we have presented in **Annex B-(3)**.

In this case, for positive spinor of spin $S_\uparrow$, we have an element at $|U_A\rangle = pc$ value, and another at $|U_B\rangle = \varepsilon = E - m_o c^2$ value. It is now when we have to look again at the relativistic equation $E^2 = m^2c^4 = m_0^2c^4 + (pc)^2$ to realize that the square of $pc = |U_A\rangle$ is the term that completes this equation and that $|U_B\rangle$ does not appear, which pushes us, even apart from our development, to know the reason for this, that is to say, to know the development of $|U_B\rangle$ between the relativistic equation and the Dirac spinor.

The real importance of the relativistic equation is not that it is able to express the real evolution of energy in an environment of high velocities, since most of the time the non-relativistic limit is sought and it is still important, but that of expressing the duality of the energy that is proper to it. That is, on the one hand, we have the energy of the particle itself, if it exists, and on the other hand the non-corpuscular energy through pc, whether it is associated with the particle or not. Consequently, H must both account for the energy associated with m_o and be able to differentiate the case in which this additional energy is associated with m_o (and we would already speak of m) from the case in which it is not.

When it is not associated, all the additional energy (actually all of it) would be allocated to the spinor $|U_A\rangle$ for $p = E/c$ and $pc = (E/c)c$, otherwise, although there is still a significant part $|U_A\rangle = (pc)_A = (m\upsilon)c$, there is also a part $|U_B\rangle = (pc)_B = E - m_o c^2 \approx m\upsilon^2/2 = (m\upsilon)(\upsilon/2)$. Naturally, the eigenvectors are normalized $|\hat{U}_A\rangle + |\hat{U}_B\rangle = pc$, besides that they are equal to the value of the first one without normalization, that is, $pc = |U_A\rangle$, which is why we use it this way in the relativistic equation and that $|U_B\rangle$ does not appear, also showing that it is a simple exchange of energy between terms.

What the spinors express is that once the particle is formed the way in which p progresses varies according to $p = E/c \to m\upsilon$, differentiating its evolution in two parts, one that in spite of the change continues to progress under electromagnetic criteria, since they are wave packets, and another that restricts or transforms this typical wave progression into corpuscular. According to $\Im_\uparrow$, one resides in the development of the positive generating function or positive exponential wave packet, which we associate with $|U_A\rangle$, and the other with the negative generating function.

This is the reality of the two generating functions that make up the SWP, on which we can understand, in addition to what has already been said above, that we cannot dissociate the two wave packets in the particle or cancel one of them, although outside the SPW they are independent, and that we cannot eliminate the spin components of them or associate to them a proper spin of the particle (since each packet by itself is not), as would follow the treatment given by H_D for $p=0$, whereby the 4-spinor would represent the four states by means of a single, concrete and therefore decoupled element, *i.e.* $(+,\uparrow)$ in the first row of the first, $(+,\downarrow)$ in the second of the second, $(-,\uparrow)$ in the third of the third and $(-,\downarrow)$ in the fourth of the fourth.

This particularity leads us to revalidate the substantiality of the intrinsic spinors, *i.e.* to differentiate what the spinors in charge of H_D are, as energy eigenvectors $\varphi^{(i)}$, from what the generating functions are and offer, since the latter not only form the intrinsic spinors capable of representing the previous ones, in an intrinsic way or outside the formalism, but they conform the SWP, that is to say, they have a structural functionality, which Dirac's do not have (it is the difference of dealing with wave packets and not with vectors of an abstract space) being for this reason that they account for the particle and the energy exchange ascribed to it as evidenced by the ETE. As a consequence of this structural functionality, the $|U_B\rangle$ spinors do not vanish for $p=0$ and there is no real decoupling of the four states.

Beyond this structural scope, the spin components, being the carriers of the wave packets, cannot dissociate, as we said, from their respective envelopes or significant elements in the spinor, or cancel with them. That is, the suppression of one of the terms and the consequent decoupling of the spinor is impossible for $\Im_\uparrow \equiv (\vartheta_2\phi_2 - \vartheta_1\phi_1)$, and consequently for $(\vartheta_2-\vartheta_1)(S_\uparrow)$. In this case, as a consequence of having made $\vartheta_1\phi_1 = \vartheta_1(S_\uparrow)$, ϑ_1 has been given an independence and ability to decouple that it does not have. More specifically, if we have an envelope ϑ_1 isolated from the carrier and we say that this envelope ceases to exist for $p=0$, we will be saying that $\vartheta_1=0$, on the other hand, if we have this envelope with the carrier, and the envelope disappears, it means that there is no amplitude that stands out with respect to the carrier, *i.e.*, the result is $\vartheta_1\phi_1 \to \phi_1$.

The first treatment is the one done by the Dirac equation, although $\vartheta_2\phi_2 \neq \vartheta_2(S_\uparrow)$, and the second is the real one, since the envelopes of the wave packets always go on their carriers, something that taken to the abstract space of the wave functions can be adulterated. The carrier and, consequently the term, must always be present for the increase of that amplitude or for the referred segregation of the momentum, once it evolves and increases.

The decoupled Dirac spinors, as a consequence of this reduction, would make one think that the solutions are configured on simpler forms, that is, on the individualized generating functions $\varphi_D^{(i)}$, which represent half of the spinor, while the intrinsic spinors $\Im$, derived from real wave packets, show us that the particle always has the two terms because that is essentially its configuration, show us that the particle always has the two terms because that is essentially its configuration, *i.e.*, to become a particle for any p in state $\Im_\uparrow$ is essentially to carry out the transformation $\Im_{\uparrow} \equiv \left(\vartheta_2\phi_2 - \vartheta_1\phi_1\right) \to \left(\vartheta_2 - \vartheta_1\right)\left(S_{\uparrow}\right)$ that conforms on the one hand the mass and on the other the spin, not by alienation of the carrier but by their shared use.

We reached, in conclusion, wave functions and states that are differentiated by their material character (dependent on the amplitudes of the wave packets) and by the direction of motion within the formants, defined by the sign of the wave phase $\mathrm{e}^{\pm i(N)}$, *i.e.* by the carrier of the respective wave packets, so that we would finally have expressions $\Im_{\uparrow}$ and $\overline{\Im}_{\uparrow}$ for the particles and antiparticles, respectively, with one direction of motion, and the corresponding $\Im_{\downarrow}$ and $\overline{\Im}_{\downarrow}$ for the reverse direction of spin motion. A sense of motion that is nothing but the sense of motion of the wave phase of a quasi-standing wave packet (the wave and the reflected wave are the two formants), which we can appreciate as a rotational motion or perpetual angular motion. That is the spin. This rotation or circular circulation is what allows us to conceptualise spin as an angular momentum, associated with a certain corpuscular core, and that we can (have to) add its values to the kinetic angular momentum, that is, to assimilate them as elements of a single magnitude. The nature of this motion reveals the enigmatic character of this momentum and explains, insofar as it is linked to its internal dynamics: to its intrinsic character.

With this, we are showing wherein lies the quantization of spin and what must be incorporated into a system or eliminated from it to cause the quantum increase or decrease of its value, which is none other than the functional unit of matter SWP that transports said spin. To be more specific, we can understand that the spin s, and concretely its value $s = 1/2$ (where the number 2, as we will show in connection with the Zitterbewegung, is the number of wave packets), is that movement (momentum), in one direction or another, related to the SWP, regardless of the charge, which would lead us to the (not strange) idea that, in a general way, $s = 0, 1/2, 1, 3/2, 2, \cdots$ corresponds to the contributory or destructive (parallel or antiparallel) superposition of the spin of several of these functions $\Psi = \Psi^1 + \Psi^2 + \cdots$, whether they form a single toroid or not, in the same way as we understand it for the quarks in the particular case $s = 1/2 = 1/2 + 1/2 - 1/2$, as the resultant of three others of identical value, or for the $s = 0 = 1/2 - 1/2$ mesons.

From all this, we can conclude not only that the four functions $\Psi_{\Im}$ are formally comparable to the four Dirac functions $\psi_D^{(i)}$, and that they are able to form the four states attributable to any (anti)particle of $\psi^{(i)}$, which will certainly allow establishing a connection between our proposal and the current framework of physics, but, by the basis presented, we will be able to represent in the same scheme the states of the whole number of different (anti)quarks and charged (anti)leptons by adjusting two internal variables. That is, not only, as we have already done, concerning the masses of identically charged particles and their generational transitions, represented by those states, but the homogenization of spin for all types of charge and the differentiation of the (anti)material quality in them. Remarking that while the $\Psi_{\Im}$ functions reach this equating with the Dirac solutions, the $\Psi_{\Im}^{(-q)}$ functions for $q \neq \pm 1$ are an extension, since they account for the similar or charge-independent and charge-dependent. A charge dependence which, moreover, cannot be differentiated by means of a corpuscular energy treatment and which only becomes evident in the kinetics of the particle through the phase factor of the ETE.

This unification is already represented and overcome de facto in a single particle, on which we will go deeper below, now we have differentiated a charge-dependent source state for each of the four material states or ways of developing that particle, which supposes a formalization of the first stage of development of the mentioned particle and, consequently, a first stage of the formalization of the material scheme that we will propose later, although we will not develop it, that is, that of reaching a complete basis that formally connects that particle to those four states, and that is unique for all types of charge.

Treatment that would make it possible to achieve results that cannot be achieved with the current formalism (as evidenced by those already achieved), and other different projections, which undoubtedly represent a niche of study. As it is the same question regarding uncharged particles, which we will leave for another thematic block, but which will certainly have a justification within this same basis, given that they are functionally accessible from the charged particles of the same, as we have already seen [1].

6. The Material Precursor of the Materiality

We have postulated, and then substantiated theoretically, that particle generations are generated in the strict sense by cancelling kinetic energy through phase factor cancellation, giving rise to a particle from a preceding particle. We have also seen that the energy of formation, expressed by the second term of Equation (32) in [1], is nothing more than another process of energy generation or transfer that is not different really from the energy transfer established in the phase change between kinetics and mass-energy, except that in the case of formation, the energy starts from a third wave term in which the initial energy resides. The question is whether that initial energy that gives rise to the first generation particles is capable of being associated in turn with some energy E_i or even with an initial particle m_i defined by E_i, as we already pointed out in Equation (31) in [2], which would make the formation-symmetrization process something truly indistinguishable at first glance (if we are not able to differentiate them in some way) from the generational sequence.

Consequently, the question, that we are going to address now, is whether there are zero-generation particles m_i associated with each of the classes of particles, precursors of generational transit, and material origin (within the other non-corpuscular, and more general, that we are studying) of all matter. A zero generation to which initially, and correspondingly, we will associate the generator phase ϕ_0 prior to phase ϕ_1 of the first generation, as we did for the wave packet, being in all cases the significant final limit of the transition process of the former, which marks the initial limit of the latter. It is well understood that this correspondence established a priori between the corpuscular zero phase and the original wave phase (that is why we have called them both ϕ_0) can be broken, or not be fully equivalent, which could force us to differentiate them or break the ambiguity.

The equations are an exception to the prescribed specifications of this template. You will need to determine whether or not your equation should be typed using either the Times New Roman or the Symbol font (please no other font). Equations should be edited by Mathtype, not in text or graphic versions. You are suggested to use Mathtype 6.0 (or above version).

6.1. Particles

6.1.1. Electron

Firstly, we are going to calculate the mass m_i of a particle that can give rise to the electron when the phase is cancelled. From Equation (6), we have to:

$$\left[2b_e^{-2/3}\delta_e\gamma_e^{-1}\right]=\left[Z_e\delta_e\gamma_e^{-1}\right]=\phi_1=\pi\Rightarrow\gamma_e=\frac{Z_e\delta_e}{\pi}. \tag{53}$$

We are now looking for (taking $Z_i=Z_e$, which we will discuss later):

$$\left[2b_i^{-2/3}\delta_i\gamma_i^{-1}\right]_e=\left[Z_i\delta_i\gamma_i^{-1}\right]_e=\left[Z_e\delta_i\gamma_i^{-1}\right]=\phi_0. \tag{54}$$

With [analogue to Equation (5b):

$$\left(\frac{\hbar}{\pi m_i}\right)^{1/3}\equiv\delta_i. \tag{55}$$

Since, by Equation (3):

$$\delta_i=\left(\frac{\hbar}{\pi m_i}\right)^{1/3}=\left(\frac{\hbar}{\pi m_e\gamma_i^{-1}}\right)^{1/3}=\left(\frac{\hbar}{\pi m_e}\right)^{1/3}\gamma_i^{1/3}, \tag{56}$$

we have in Equation (54) that:

$$\left[Z_e\delta_i\gamma_i^{-1}\right]=\left[Z_e\left(\frac{\hbar}{\pi m_e}\right)^{1/3}\gamma_i^{1/3}\gamma_i^{-1}\right]=\left[Z_e\delta_e\gamma_i^{-2/3}\right]=\phi_0$$
$$\Rightarrow\gamma_i^{2/3}=\frac{Z_e\delta_e}{\phi_0}\Rightarrow\gamma_i=\left(\frac{Z_e\delta_e}{\phi_0}\right)^{3/2}. \tag{57}$$

In the absence of any other foundation, we can take a first approach:

$$\chi_0=\frac{\phi_1}{\phi_0}=1, \tag{58}$$

which is the one that would provide a less elevated γ_i value and consequently a m_i particle with a larger value and closer to m_e, which in addition to this way is positioned completely centred for the right and left transitions, and equidistant ($\phi_0=\phi_1=\pi$), although different in that, with $\hat{\phi}_0\neq\hat{\phi}_1$, they represent different velocity fields. It follows that:

$$\left[Z_e\delta_e\gamma_i^{-2/3}\right]=\pi\Rightarrow\gamma_i^{2/3}=\frac{Z_e\delta_e}{\pi}\Rightarrow\gamma_i=\left(\frac{Z_e\delta_e}{\pi}\right)^{3/2}=2973.20, \tag{59}$$

that we can relate clearly to the transition from the later or already known phase, and shown in Equation (53):

$$\gamma_i = \left(\frac{Z_e \delta_e}{\pi}\right)^{3/2} \overset{\text{(Eq.53)}}{=} (\gamma_e)^{3/2} = 207.76^{3/2} = 2973.20\,. \tag{60}$$

From this, and from Equation (3) and Equation (55), we obtain the initial mass m_i (of precise value, thanks to the known exact value of m_e) and the phase variation δ_i:

$$m_i = \frac{m_e}{\gamma_i} = 171.86851 \cong 171.87 \text{ eV} \tag{61}$$

and

$$\delta_i = \left(\frac{\hbar}{\pi m_i}\right)^{1/3} = \left(\frac{6.582\text{E}{-16} \times 9\text{E}16}{171.87\pi}\right)^{1/3} = 0.4787, \tag{62}$$

which, as expected, meets Equation (54) for $\phi_0 = \pi$:

$$\gamma_i = \left(\frac{Z_e \delta_i}{\pi}\right) = 2973.20. \tag{63}$$

Data that we can incorporate employing an initial row in **Table 1** that we already elaborated for the leptons, in which $Z_0 = Z_1$ ($b_0 = b_1$) for being $\hat{\alpha}_0 \simeq 1$, as it can be verified. Resulting (**Table 8**):

Table 8. Values for charged leptons, including zero generation, and their transitions.

$Z_0 = 19511.456$ $b_0 = 1.038 \times 10^{-6}$	$m_i\,(\text{eV})$	δ_i	γ_i	$m_e\,(\text{MeV})$	$\phi_0 = \pi$
	171.87	0.47872	2973.20	0.511	
$Z_1 = 19511.456$ $b_1 = 1.038 \times 10^{-6}$	$m_e\,(\text{MeV})$	δ_e	γ_e	$m_\mu\,(\text{MeV})$	$\phi_1 = \pi$
	0.511	0.033292	206.767	105.658	
$Z_2 = 18767.61$ $b_2 = 1.100 \times 10^{-6}$	$m_\mu\,(\text{MeV})$	δ_μ	γ_μ	$m_\tau\,(\text{MeV})$	$\phi_2 = 2\pi$
	105.658	0.00563	16.817	1,776,840	

We can realise that while in $[\phi_1] = [0, \pi]$, and analogously for $[\phi_2]$, we know that the significant, relevant and differential phase is the final one, and this is why we do $\phi_1 \equiv \pi \in [\phi_1]$ (as opposed to any other, which simply expresses the dynamics of the particle), we cannot have that certainty or make that clear identification in $[\phi_0] = [0, \pi]$ because there are two significant states, so that we would take $\phi_0 = \pi$ [according to Equation (58)] to represent the point at which $\sin[\Phi] = 0$ and $\phi_0 = 0$ to identify the phase value at which we find m_0, which is as singular or more singular than the previous one, on which, in principle, we will not have a previous interval that allows us to reference it directly, which gives rise to duplicity and possible ambiguity that we will have to break.

When we do $\phi_0 = \phi_1 = \pi$ in Equation (58), and consequently $\chi_0 = 1$, we are considering and relating two intervals $[\phi_0] = [0, \pi]$ and $[\phi_1] = [0, \pi]$ with no connection between them, except that of being one after the other from the point of view of phase transitions. They are two distinct phases with the possibility of generational transit, two different spaces, two disjoint intervals. That is to say, the fact that one follows the other and that from one we pass to the other, can create the illusion that there is a continuity and as a consequence of this we may want to assign to the final value of $[\phi_0]$ the same value $\phi = 0$ with which phase $[\phi_1]$ begins, which also corresponds to the rest of the particle in our natural reference system, but this is not so. The very idea of "phase transition" with "generational transition" indicates this: $[\phi_0]$ is a collapsing phase for $\phi_0 = \pi$, which disappears and passes to an initial state $\phi = 0$ which no longer belongs to $[\phi_0]$ but to $[\phi_1]$. Seen in another way, we might expect the sequence in which the generational transits occur to be $\phi = 0, \pi, 2\pi\ (\phi_0, \phi_1, \phi_2)$ and yet this is not the case given that $\sin[\Phi] = 0$ for $\Phi = 0$ would not make sense as a final state because there is no explicit development of Φ.

Expressing it reciprocally, it is this discontinuity that is telling us that the phase transition, as it has been expressed, corresponds to a generation jump involving two particles, m_e and m_i, and not the first of them by a SWP, resolving what was stated at the beginning of the section in this respect, that is, demonstrating that the transition to this first generation can be expressed by a generational change even though it is supported on a SWP.

We can, however, accommodate this representation and avoid the discontinuity by taking symmetrical phase intervals from that reference position, that is, by taking the general interval $[-\pi, \pi] \to [-\pi, 0] + [0, \pi]$, which allows us to establish a new interval of evolution $[\phi_0] \to [\not{\phi}_0] \equiv [0, -\pi]$, and a new starting point of that evolution (hence the inversion of the terms of the bracket), on which we can say more unequivocally that the starting phase is $\phi = 0$, only that in this case we would no longer take $\chi_0 = 1$ but $\chi_0 = -1$, which would lead us to $[\not{\phi}_0] = [0, -\pi] \to -(\not{\phi}_0) = \pi$. What we have done in this way is to simulate, in fact, a continuity between the intervals $[\phi_1]$ and $[\not{\phi}_0]$ at the interface point $\phi = \not{\phi}_0 = 0$, which thus becomes the centre of gravity of the process (instead of m_0), around which we can unfold in positive and negative directions the phases: $\phi = -\pi, \pi, 2\pi\ (\not{\phi}_0, \phi_1, \phi_2)$.

A continuity that would be coherent with a strictly electromagnetic process in $[\not{\phi}_0]$, that is, in which the corpuscular state reached is a sort of materialization of the wave in the symmetrization process $\left([\widehat{\not{\phi}_0}] =]c, 0]\right)$, and not a generational change, starting from an energy entity E_i equivalent to m_i, on which it may be interesting to recall what was said about the limits of the third term of the ETE seen in [2], where this duality was already anticipated. That is, the alternative corpuscular representation is the real wave representation. In this representation we are not establishing a sequence of phases but two distinct phases in $\phi = 0$, one immaterial and the other material (which then unfolds generationally). The two perspectives can coexist.

6.1.2. UP-Quark

Now, we are going to calculate the mass m_i of a particle that can give rise to Up-

Q when the phase is cancelled. From Equation (24) we have to:

$$\left[2b_u^{-2/3}\delta_u\gamma_u^{-1}\right]^{-2/3} = \left[Z_u\delta_u\gamma_u^{-1}\right]^{-2/3} = \phi_1 = 2\pi \Rightarrow \gamma_u = \frac{Z_u\delta_u}{(2\pi)^{-3/2}}. \tag{64}$$

We are now looking for:

$$\left[2b_i^{-2/3}\delta_i\gamma_i^{-1}\right]_u^{-2/3} = \left[Z_i\delta_i\gamma_i^{-1}\right]_u^{-2/3} = \left[Z_u\delta_i\gamma_i^{-1}\right]^{-2/3} = \phi_0 = 2\pi. \tag{65}$$

with (already defined):

$$\left(\frac{\hbar}{\pi m_i}\right)^{1/3} = \delta_i, \tag{66}$$

where we have taken $\chi_0 = 1$ and the same considerations regarding ϕ_0, that is, to give rise to a symmetrical phase transition for $\hat{\phi}_0 \neq \hat{\phi}_1$. Since:

$$\delta_i = \left(\frac{\hbar}{\pi m_i}\right)^{1/3} = \left(\frac{\hbar}{\pi m_u\gamma_i^{-1}}\right)^{1/3} = \left(\frac{\hbar}{\pi m_u}\right)^{1/3}\gamma_i^{1/3} \tag{67}$$

we have in Equation (65) that:

$$\left[Z_u\delta_i\gamma_i^{-1}\right]^{-2/3} = \left[Z_u\left(\frac{\hbar}{\pi m_u}\right)^{1/3}\gamma_i^{1/3}\gamma_i^{-1}\right]^{-2/3} = \left[Z_u\delta_u\gamma_i^{-2/3}\right]^{-2/3} = 2\pi, \tag{68}$$

from which results:

$$\left[Z_u\delta_u\gamma_i^{-2/3}\right]^{-2/3} = 2\pi \Rightarrow \gamma_i^{2/3} = \frac{Z_u\delta_u}{(2\pi)^{-3/2}} \Rightarrow \gamma_i = \left(\frac{Z_u\delta_u}{(2\pi)^{-3/2}}\right)^{3/2} = 13782.58, \tag{69}$$

that we can relate clearly to the transition from the later phase:

$$\gamma_i = \left(\frac{Z_u\delta_u}{(2\pi)^{-3/2}}\right)^{3/2} \overset{\text{(Eq.64)}}{=} (\gamma_u)^{3/2} = (574.85)^{3/2} = 13782.58. \tag{70}$$

From this, we obtain the initial mass m_i and δ_i:

$$m_i = \frac{m_u}{\gamma_i} = 171.87\ \text{eV}, \tag{71}$$

and

$$\delta_i = \left(\frac{\hbar}{\pi m_i}\right)^{1/3} = \left(\frac{6.582\text{E}-16\times 9\text{E}16}{171.87\pi}\right)^{1/3} = 0.4787, \tag{72}$$

which, as expected, meets Equation (65):

$$\gamma_i = \left(\frac{Z_u\delta_i}{(2\pi)^{-3/2}}\right) = 13782.58, \tag{73}$$

where it is verified not only that there is a mass m_i for the particle Up-Q, but that it is of the same value as that found for the electron, which we obtain together with a set of data that we can incorporate through a previous row in **Table 2**. This results in **Table 9**.

Table 9. Values for up-type quarks, including zero generation, and their transitions.

$Z_0 = 1.828$	$m_i\,(\text{eV})$	δ_i	γ_i	$m_u\,(\text{MeV})$	$\phi_0 = 2\pi$
$b_0 = 3.619 \times 10^{-5}$	171.87	0.47872	13782.58	2.368793	
$Z_1 = 1.828$	$m_u\,(\text{MeV})$	δ_u	γ_u	$m_c\,(\text{MeV})$	$\phi_1 = 2\pi$
$b_1 = 3.619 \times 10^{-5}$	2.368793	0.01996	574.849	1361.698	
$Z_2 = 1.828$	$m_c\,(\text{MeV})$	δ_c	γ_c	$m_t\,(\text{GeV})$	$\phi_2 = 3\pi$
$b_2 = 3.619 \times 10^{-5}$	1361.698	0.00240	127.010	172.95	

Results that even greatly exceed initial expectations, since the fact that two classes of families coincide at a point would be the equivalent of two numerical lines of integers or natural numbers intersecting at one of their points, only that the distance between their points (which determines the probability) is not of order zero but of the orders of magnitude defined by γ in each case. This is a matter that we will have the opportunity to outline. A question to which we will return.

6.1.3. DOWN-Quark

Finally, we are going to calculate the mass m_i of a particle that can give rise to Down-Q when the phase is cancelled. From Equation (34) we have to:

$$\left[2b_d^{-2/3}\delta_d\gamma_d^{-1}\right]^{1/3} = \left[Z_d\delta_d\gamma_d^{-1}\right]^{1/3} = \phi_1 = 4\pi \Rightarrow \gamma_d = \frac{Z_d\delta_d}{(4\pi)^3} \tag{74}$$

We are now looking for:

$$\left[2b_i^{-2/3}\delta_i\gamma_i^{-1}\right]_d^{1/3} = \left[Z_i\delta_i\gamma_i^{-1}\right]_d^{1/3} = \left[Z_d\delta_i\gamma_i^{-1}\right]^{1/3} = \phi_0, \tag{75}$$

with:

$$\left(\frac{\hbar}{\pi m_i}\right)^{1/3} \equiv \delta_i. \tag{76}$$

Equation (75) that in this case, we have presented by a generic ϕ_0 because the value $\phi_0 = 4\pi$, which would give rise to the result $\gamma_i = (\gamma_d)^{3/2}$, in a way equivalent to that obtained in Equation (60) and Equation (70), does not respond to the expectations of finding a m_i of the same order as a consequence of the small value of γ_d. This leads us to use another reasoning, that is, not to take for granted that $\phi_0 = \phi_1$ must be fulfilled and to ask ourselves if there is a value $\chi_0 = \phi_1/\phi_0$ that reaches the same particle $m_i = 171.87\ \text{eV}$, as a condition demanded and consistent with the other cases. This question is not difficult to answer if we take into account the expression Equation (25), which we can even put in a (generalised) form valid for any three particles:

$$\begin{aligned} \chi_1 = \frac{\phi_2}{\phi_1} = \left[\alpha_1\left(\frac{m_2^5}{m_1^2 m_3^3}\right)^{1/3}\right]^{-q} \Rightarrow \chi_n = \left[\alpha_n\left(\frac{m_{n+1}^5}{m_n^2 m_{n+2}^3}\right)^{1/3}\right]^{-q} \\ \Rightarrow \chi_0 = \left[\alpha_0\left(\frac{m_1^5}{m_0^2 m_2^3}\right)^{1/3}\right]^{-q} \overset{q=-1/3}{=} \left[\alpha_i\left(\frac{m_d^5}{m_i^2 m_s^3}\right)^{1/3}\right]^{1/3} = \alpha_i^{1/3} \times \Re_i^{1/3}, \end{aligned} \tag{77}$$

which is already satisfied in the preceding cases for its values, and which is satisfied in this case for $\chi_0 = 4$, from which it follows that $\phi_0 = \pi$. Being this way of operating the one that we use in fact to adjust the values in Equation (42) of [1], since we only have to substitute the values $\phi_0^1, \phi_0^2, \phi_0^3, \cdots = (1, 2, 3, \cdots) \times \pi$ and check the correct result, which in this case we also knew.

A result that also allows us to finally verify, as we advanced, that the sequence ϕ_1, ϕ_2 chosen in Equation (36) for this class of particles is the correct one since the one initially proposed in Equation (35) would take us to $\phi_0 = p\pi \; (: p \notin \mathbb{N})$. In this case, since,

$$\delta_i = \left(\frac{\hbar}{\pi m_i}\right)^{1/3} = \left(\frac{\hbar}{\pi m_d \gamma_i^{-1}}\right)^{1/3} = \left(\frac{\hbar}{\pi m_d}\right)^{1/3} \gamma_i^{1/3}, \tag{78}$$

in Equation (75) we have:

$$\left[Z_d \delta_i \gamma_i^{-1}\right]^{1/3} = \left[Z_d \left(\frac{\hbar}{\pi m_d}\right)^{1/3} \gamma_i^{1/3} \gamma_i^{-1}\right]^{1/3} = \left[Z_d \delta_d \gamma_i^{-2/3}\right]^{1/3} = \pi \tag{79}$$

From which results:

$$\left[Z_d \delta_d \gamma_i^{-2/3}\right]^{1/3} = \pi \Rightarrow \gamma_i^{2/3} = \frac{Z_d \delta_d}{\pi^3} \Rightarrow \gamma_i = \left(\frac{Z_d \delta_d}{\pi^3}\right)^{3/2} = 31390.28. \tag{80}$$

A value γ_i that, as in the previous cases, is reached without the need to consider the amplification of the subsequent phase ($\gamma_d = 15.54$ in this case for $\phi_1 = 4\pi$), but that, in the same way, can be put as a function of it:

$$\gamma_i = \left(\frac{Z_d \delta_d}{\pi^3}\right)^{3/2} = \left(\frac{Z_d \delta_d}{(1/4)^3 (4\pi)^3}\right)^{3/2} \overset{\text{(Eq.74)}}{=} 64^{3/2} \times \gamma_d^{3/2} = 31390.28 \tag{81}$$

From this, we obtain the initial mass m_i (already defined initially in this case) and δ_i:

$$m_i = \frac{m_d}{\gamma_i} = 171.87 \text{ eV}, \tag{82}$$

and

$$\delta_i = \left(\frac{\hbar}{\pi m_i}\right)^{1/3} = \left(\frac{6,582\text{E}{-16} \times 9\text{E}16}{171.87\pi}\right)^{1/3} = 0.4787, \tag{83}$$

which, as expected, meets Equation (75) for $\phi_0 = \pi$:

$$\gamma_i = \left(\frac{Z_d \delta_i}{\pi^3}\right) = 31390.28. \tag{84}$$

Verifying not only that there is a mass m_i for the Down-Q but that it is of the same value as that found for the electron and the Down-Q, which we obtain together with a set of data that we can incorporate by a previous row in **Table 3**. This results in **Table 10**.

Table 10. Values for down-type quarks, including zero generation, and their transitions.

$Z_0 = 2033106$ $b_0 = 9.757 \times 10^{-10}$	$m_i\,(\text{eV})$	δ_i	γ_i	$m_d\,(\text{MeV})$	$\phi_0 = \pi$
	171.87	0.47872	31390.28	5.395	
$Z_1 = 2033106$ $b_1 = 9.757 \times 10^{-10}$	$m_d\,(\text{MeV})$	δ_d	γ_d	$m_s\,(\text{MeV})$	$\phi_1 = 4\pi$
	5.395	0.01517	15.5483	83.883	
$Z_2 = 2033106$ $b_2 = 9.757 \times 10^{-10}$	$m_s\,(\text{MeV})$	δ_s	γ_s	$m_b\,(\text{MeV})$	$\phi_2 = 2\pi$
	83.883	0.00608	49.619	4180.42	

Results that, to begin with, allow us to present in **Table 11** (in an analogous way to the tabulation made in **Table 4** for the triads established between the different families of charged fermions) new triads between the two generationally inferior elements of the previous ones and the particle corresponding to the zero generation, which, being identical, It graphically evidences the achieved architecture and shows that all particles of all families proceed from a sole particle, or are massively connected via γ to it, which represents for the first ones a common precursor particle m_0 or zero generation, that we will henceforth identify as $\mathfrak{M} = 171.87\ \text{eV}$:

Table 11. Phase established, according to Equation (25), between the first two generations of particles m_1, m_2, for each of the three charged families, and a zero generation m_0 common to all of them, which we specifically name $\mathfrak{M}$.

Triad	Particle	Mass (MeV)	$\chi = \phi_2/\phi_1$
m_0	$\mathfrak{M}$	0.00017187	
m_1	e	0.511	1/1
m_2	μ	105.658	
m_0	$\mathfrak{M}$	0.00017187	
m_1	u	2.368	2/2
m_2	c	1.361.698	
m_0	$\mathfrak{M}$	0.00017187	
m_1	d	5.395	4/1
m_2	s	83.883	

The fact that the three classes of families converge at a single point would be the equivalent of two numerical lines of integers or natural numbers... Well, the uniqueness of this starting point has already been explained in Appendix D (and shown in Figure 11) of [1], since through Equation (77) we can define for each particle class all possible masses (not just one), $m_0^1, m_0^2, m_0^3, \cdots$, according to all possible phases, $\phi_0^1, \phi_0^2, \phi_0^3, \cdots$, and check that, apart from the phase shift π of one of them (which is only relevant for graphical purposes and which we could avoid if we wanted to, by varying Z and doing $\chi = 2/2 - 2/2 - 8/2$ on **Table 11**), there is only one possible point of convergence ($\mathfrak{M} = 171.87\ \text{eV}$) on the three numerical lines representing the kinetic evolution, or which we have converted into lines by logarithmic transposition (making the geometric concurrence of cut-off points more than a simile). And that it is unique not only because it is so de facto but because, in each of the branches, the next candidate point is not the next one on the line but a dispersed one that fulfils the function, just as the electron and the muon are dispersed on this line (the curve of the relativistic energy by means of the Lorentz factor).

That is to say, that one line cuts another in the plane is easy, but that this cut is produced on integer values of their lengths is not so easy, that they do it on points defined by a function, less so, and that three lines do it in the same circumstances, even less so. This is something that cannot be due to chance and is something that, on the contrary, shows that the unavoidable starting condition is that they start from the common point, and everything else, that is, the different ways of developing the phases from it, a consequence.

It is precisely this anticipated inescapable requirement and common starting point what has allowed us to define the masses of the other particles unequivocally (saving the ambiguity and indefiniteness of other methodologies), the different arrival points of the transitions (which are the starting points of the subsequent ones) and a single and well defined Z (except for deviation by $\alpha \neq 1$) common to each class of particles, that allow us to parameterize the evolution of the phases, and adjust them to each other, as we did in Equation (43) of [1], and which we then express in a more general way in Equation (30), *i.e.* into a single sequence, which accounts for the value of the particles in a class, through a single curve, as we represented in [1] and now reproduce here in **Figure 4**, extending to zero generation the typical curve of the family already presented in **Figure 3**.

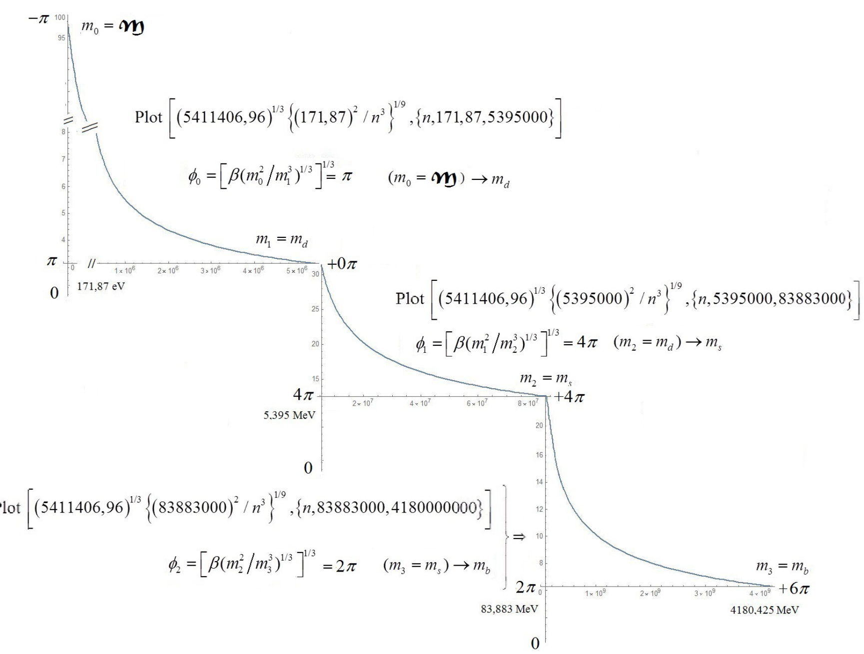

Figure 4. Transitions of phase for down-type quarks (−1/3), including zero phase.

We, therefore, have a curved path, defined (for all charge q) by the constant β_i as *curvature index* and a *curvature factor* $\overline{\gamma}_i$ [as defined in Equation (8)], that links all particles of a class from a common point (mass) and intermediate points to fully defined, predictable and ruled phasic distances ϕ_i, by which the masses of the particles are a multiple of each other (in units of π), which structure the spectrum of elementary particles, *i.e.* locate and order them according to a pattern and hierarchy, as shown in **Figure 5**.

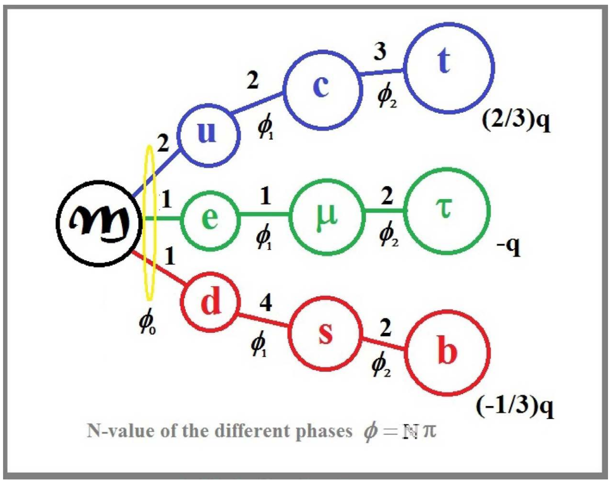

Figure 5. Phases diagram for $q = 2/3$ charge quarks, $q = -1/3$ charge quarks, and charged leptons. Each generation of a particle class is presented as a differentiated state of the same particle in its evolution or progress (of phase) from the fundamental state $\mathfrak{M}$.

Intermediate masses and hierarchies, defined by the successive γ_i values in which the inertial mass derived from the increase of kinetic energy coincides with the mass of the particle of the next generation, in which the kinetic energy falls to zero, and in which, since it cannot disappear, has to be transformed in the only way it can do so, that is, by recombining with pre-existing energy in the form of mass, transforming inertial mass into real mass, showing that both forms of energy are the same.

Figure 5 as we can see, is a restriction to charged particles only) of Figure 5 in [1], but which nevertheless highlights with the same strong and greater visual simplification the degree of convergence for the particles we are dealing with, which serves to point out that although we have always taken a positive phase advance (everything is on the right) it could have been reversed, *i.e.* that this positive or negative advance is irrelevant for everything we are dealing with, and will be so unless we can find some physical condition that makes necessary to differentiate it for some of the particle classes.

In conclusion, we have the complete description of the energy transformation mechanism and the physical expressions capable of representing said transformation, and, with the verification of our postulates, the corpuscular generation mechanism that gives rise to the different generations or families, which succinctly put, responds to a family of curves defined by Equation (3), which is the only physical equation that kinetically relates two masses (there is no other) in such a way that there is only one curve for each Z value and each pair of masses at the extremes of it, which coincide with the two contiguous generations. In which the second (which belongs to another curve or section of the same curve) represents the maximum inertial mass that the first can reach before collapsing due to the condition $\sin\left[\Phi\right]=0$, this being the true relationship between one and the other at the ends of the curve, which establishes a phasic particle phase diagram or table of exact phases (in units of π) in which the existence of a particle with mass is allowed (it is not outside those positions). As we said in the introduction, this does not mean that it is the preferred mechanism, which may even be invalidated by some condition and hence stability or absence of spontaneous transits, it means that there is an equivalence between states and possibility and transit that at least could be (explains it) the one used to reach the current state.

6.1.4. Discussion 3

Once this conclusion has been expressed, it is necessary at this point to make a precision regarding it and our object of study (our initial aim and final result) in this Section, with the purpose of eliminating ambiguities and apparent incoherencies derived from the dual nature, akin to the wave-corpuscle duality, present here more than anywhere else, which will also allow us to present new aspects of that dual reality, which we will develop in a more formal, and at the same time practical, way in a later and specific paper.

Originally we were talking about the SWP as a principle of materiality, that is, a single element as a principle of materiality which, once the initial conceptual difficulties have been overcome, does not pose any problem about the electric charge, since we have assumed it to be suitably diversified through the exponent, following the material reality. Here, however, we are already talking about m_0 as something material or quasi-material (as much as dark matter could be) with the same precursor function, which is problematic because we are talking about something that shares this material nature and which is either unrelated to the charge or has the capacity to present itself under the three (×2) original aspects or values of it.

This is the problematic. A problematic that, although it does not affect our theoretical treatment, since we can restrict convergence to the value of mass and to simply assuming that the process described is a corpuscular equivalence of the symmetrisation process (without a real basis beyond the confluence of the three branches in the same energy value), introduces an element of indefinition, given that we do not know whether the three differentiated particles m_i are equal, and truly form a sole m_0, or, on the contrary, are three different varieties of the same, according to the electrical charge, which would denote a constitution or internal construction, nothing desirable. A problematic that we will largely clear when we place the uncharged elementary particles in this frame (in the phase diagram) or when, to be more precise, let us tackle the study of the uncharged leptons (neutrinos) in the same, which will undoubtedly shed light on the issues raised, since, as we have already mentioned in [1], the process of neutrino generation (without charge) is also governed by this particle $\mathfrak{M}$, showing that it itself does not have it. And a problematic that we will overcome later definitely, however, when we develop the basis of intrinsic spinors presented and give it an alternative treatment, which in turn obeys an alternative treatment to everything we are dealing with, which we will now address in a preliminary and schematic way, in addition to other physical questions not sufficiently justified or known, by going to the most intimate nature of things.

One thing we would have to clarify beforehand for this purpose, is whether the transition from m_0 (as zero generation) to the first generation m_1 (according to $\chi_0 = \pm 1$) corresponds to the process of symmetrisation described (SWP), or whether, on the contrary, although correlated, they are two different things, in which case m_0 would no longer necessarily be a zero generation generating particle but something that, derived from this symmetrisation, could be as first generation as the rest of the elementary particles that make up our universe, which might not even be unique, but differentiated by the charge. That is to say, we have reached from ϕ_1 the particle m_0 by Equation (58) for leptons and we have preassigned it using ϕ_0 of this equation to a zero generation, but we could very well have done it to a certain distinct phase ϕ_{-1}, for which it would then be necessary to determine whether it is of first generation or not, depending on whether it belongs to our known material world or not. Question on which we can realise that, in the case of these neutrinos, although the phases that originate them and are brought into play in these phase relationships are sequentially earlier [1], they do not imply an earlier generation, and that they belong to the first generation, that is, to the one that forms (together with the charged fermions) our material world.

In spite of the well-reasoned approach, it is evident that in our case m_0 is directly related to the symmetrization process, since there is and must be an immaterial or zero generation particle m_i for each process, therefore free of charge. Nevertheless, this approach, far from being invalidated or sterile, could retain its integrity if we remove the disjunctive between one situation and the other and reformulate it in terms of whether an analogous particle m_0 of first generation can be given for the generational transit, that is to say, that its phase is not ϕ_0 but another that does not involve that pre-material space, such as ϕ_{-1}. For which we would also have to be able to guarantee in its case that it is distinct or, equivalently, that it is indeed of the first generation. The short answer to this is that it is possible and that its nature will be guaranteed if, as is the case, we do not reach it from ϕ_1 (even if it has a representation from there) but from ϕ_0. As a result, we will have two entities m_0, one of one generation and the other, one without charge and the other with it, and we will obtain the connection between the initial particles without charge and the first version of them with it, as we will see next.

We can approach the question in several ways. We are going to do it from the direct presentation of that hypothetical particle, which we can call $-m_0$. Indeed, we have found m_0 through $\chi_0 = \phi_1/\phi_0 = 1$ for m_1, but it is obvious that we can find another particle through $\chi_0 = \phi_1/\phi_{-1} = -1$, which, in principle, and due to the simple change of sign, would have to be analogous to m_0, related to it or be a different version. A different version can be nothing more than an alteration of the phase, a specialisation with respect to the charge or the (anti)material state, or a set of these things.

In this case, all that remains is to determine ϕ_{-1}. To begin with, the change of sign in χ_0 suggests that the phase involved is the opposite of the original $[\phi_0] = [0, \pi]$, that is, the same $[\not\phi_0] = [0, -\pi]$ that we use to differentiate the symmetrization of the corpuscular process, but established not on $\phi_0 = \pi$ ($\rightarrow \not\phi_0 = 0$), but on $\phi_0 = 0$ ($\not\phi_0 = -\pi$), which is the same as saying on the same particle m_0, since it is on this that the change is made until we find $-m_0$, and which is as much as to consider (to differentiate) the interval $[\not\phi_1] = [-\pi, 0]$, that is, a kind of symmetrical or reflected phase of $[\phi_0]$.

Consequently, we have m_1 in $\phi_0 = \pi$ and $-m_0$ in $\not\phi_1 = -\pi$. This makes us consider $-m_0$ as a particle at the same generational height as m_1, which means that we can no longer legitimately consider it as dark matter $\mathfrak{M}$, even though it is the same thing as m_0. We could say that, at best, m_0 and $-m_0$ are two different states ($\phi_0 = 0$ and $\not\phi_1 = -\pi$) of dark matter, one that is intrinsic (zero generation) and the other accidental (first generation), as a consequence of the phase reached (and the sign of the same). This will be interesting to characterize (anti)matter from dark matter, if we also take into account that we can make the same development and the same duplicity from antimatter, with $[\phi_0] = [0, -\pi]$, apart from the fact that m_0 may already implicitly carry this differentiation with respect to (anti)materiality (without electric charge) in the forms $+\mathfrak{M}$ and $-\mathfrak{M}$. That is, taken together, it would result in having an (anti)dark matter in the $\phi_0 = 0$ phase that could give rise to matter with electric charge in the $\not\phi_1 = -\pi$ phase and to matter with electric charge in $\not\phi_1 = \pi$. Those phases reached by $\pm m_0$ and their representative sign are two differentiated states with respect to m_0 that imply the expression of charge and (anti)materiality, insofar as the elevation to the first generation necessarily implies this differentiation, which is why $\pm m_0$ is halfway between m_0 and an (anti)particle m_1, or in other words, they are the pieces with which m_1 and $\bar{m}_1$ are constructed from m_0.

What we are saying in conclusion is that we could obtain two first-generation versions of m_0 (variations of a unique m_0 of zero generation), which we can call $+m_0$ and $-m_0$, and that this could be as much as having obtained the first expression or transformation of m_0 on the way to becoming an (anti)particle m_1 for any kind of charge, that is, the first corpuscular form (not in the SWP language that we have developed so far) on that way, which is nothing but a discretization of the material formation symmetrization process or recursive construction of matter on $\pm m_0$, *i.e.* on a binary basis or development of a single element (m_0) on $\pm\pi$. That is, in contrast to the symmetrization, which accounts for each type of charge by means of a type (exponent) of SWP, which prevents a higher degree of unification, the corpuscular form will allow us to constitute a basis for the formation of matter and to understand that formation from a corpuscular point of view, starting from m_0 as the only ingredient, and undifferentiated with respect to charge, logically reaching logically later that differentiation to construct and differentiate all charged elementary particles.

What we are saying by this proposition, already in a less cryptic form, which we will develop when we deal in depth with the intrinsic spinor, is that we will be able to represent any m by transitions of $\pm m_0$, that is, to carry out the phase transitions of all (anti)particles starting from a single corpuscular element $\pm m_0$, which also implies the existence of a pattern electric charge value in it (not six different values). With this, we will not only have a non-corpuscular convergence element m_0 for all the treated particles but a corpuscular convergence or unification $\pm m_0$ of them, that is, one that involves the material characteristics of those particles.

It only remains to add that, for both $+m_0$ and $-m_0$, there is no generational change, so we take Z_1. For m_0 we would also take Z_1, because although there is generational change it is not due to a corpuscular process but to a wave process, that is, on the one hand it is this wave process which generates Z_1 and, on the other, there is no previous corpuscular process with Z_0 which gives rise to m_0. In fact it is this common Z_1 value that we have used and which has allowed us to calculate m_i from m_1 in all cases, from which we deduce that Equation (18) is not applicable in these cases in which there is no generational change of a lower order.

6.2. Antiparticles

As we have seen, in the case of Down-Q (unlike the previous cases) the relationship of the Lorentz factors γ_i and γ_1, associated with the phases, is accompanied by a proportionality or scale factor, $\Theta = \left[64 = 4^3 = (\chi_0 \pi)^3 / \pi^3\right]^{3/2}$, as a consequence of the existence of ratio $\chi_0 = 4$ between the phases themselves. That is to say, although the value of γ_i depends exclusively on phase $\phi_0 = \pi$ in Equation (79), and not on $\phi_1 = 4\pi$, it is not alien to $\phi_1 = 4\pi$ since we can factor it or put it by units of γ_1 whose value depends on ϕ_1.

From this, we conclude that the value reached for a certain phase ϕ_0 is already indicating to us which phase ϕ_1 is valid, according to the scale factor Θ, between their respective values γ [as in Equation (60), Equation (70) and Equation (81)]. A result that we can put, in a general way, as:

$$\begin{aligned}\gamma_1 &= \left(\frac{Z\delta_2}{\phi_1^{-1/q}}\right)^{3/2} = \left(\frac{Z\delta_2}{\left[(\phi_1/\phi_2)(\phi_2)\right]^{-1/q}}\right)^{3/2} \\ &= \left(\frac{\phi_2}{\phi_1}\right)^{-(3/2q)}\left(\frac{Z\delta_2}{\phi_2^{-1/q}}\right)^{3/2} = \Theta \times \gamma_2^{3/2},\end{aligned} \tag{85}$$

Generalization that unifies the methodology used for the three cases seen (since it can be $\Theta = 1$) and any other, and that, consequently, we can use to obtain the

γ_x value of any phase as a function of the γ_{x+1} value of another phase [*i.e.*, the first of two contiguous ones, according to the transformation performed by Equation (56)], provided when both have the same Z value ($\hat{\alpha}=1$), such as, for example, γ_d in function of γ_s, where it is verified, with,

$$\phi_2 = \left[Z_s\delta_s\gamma_s^{-1}\right]^{1/3} = 2\pi \left(\Rightarrow \gamma_s = \frac{Z_s\delta_s}{(2\pi)^3}\right) \tag{86}$$

that:

$$\begin{aligned}\phi_1 &= \left[Z_s\delta_s\gamma_d^{-2/3}\right]^{1/3} = 4\pi \Rightarrow \gamma_d^{2/3} = \frac{Z_s\delta_s}{(4\pi)^3} \Rightarrow \gamma_d = \left(\frac{Z\delta_s}{(4\pi)^3}\right)^{3/2} \\ &= \left(\frac{Z\delta_s}{2^3(2\pi)^3}\right)^{3/2} \overset{(\text{Eq.85})}{=} (1/2)^{9/2}(\gamma_s)^{3/2} = 0.0442\times 49.83^{3/2} = 15.54\,.\end{aligned} \tag{87}$$

This case serves to exemplify the above, and to show us to what extent the sequence of phases is bound to be what it is, since, in fact, we cannot fill in a different sequence of phases ($\phi(\phi_1,\phi_2) = 4\pi, \pi$) with the same data:

$$\begin{aligned}15.54 = 0.0442\times 49.83^{3/2} = \gamma_d &= \left(\frac{Z\delta_s}{(4\pi)^3}\right)^{3/2} = \left(\frac{Z\delta_s}{4^3\pi^3}\right)^{3/2} \\ &\neq (1/4)^{9/2}(\gamma_s)^{3/2} = 0.0019\times 49.83^{3/2} \\ \Rightarrow \quad \left(\frac{Z\delta_s}{\pi^3}\right)^{3/2} &\neq (\gamma_s)^{3/2} \Rightarrow \phi_2 \neq \pi\end{aligned} \tag{88}$$

A case that also serves to show in a more simplified and rapid way that the same mass m_0 does the same function for all antiparticles, that is, for particles of equal mass and inverse charge, for which we only have to take into account the corresponding values of Z and the phase values of the first phases, each one corresponding to the phase of the last generation of the associated particle.

6.2.1. Positron

Indeed, analogously to Equation (57), with $\overline{\phi}_0 = \overline{\phi}_1 = 2\pi$, and the inverse charge, we have:

$$\begin{aligned}&\left[Z_{\bar{e}}\delta_{\bar{e}}\gamma_i^{-2/3}\right]^{-1} = 2\pi \Rightarrow \gamma_i^{2/3} = 2\pi Z_{\bar{e}}\delta_{\bar{e}} \Rightarrow \gamma_i = \left(2\pi Z_{\bar{e}}\delta_{\bar{e}}\right)^{3/2} \\ &\overset{(\text{Eq.85})}{=} (\gamma_{\bar{e}})^{3/2} = 206.76^{3/2} = 2973.20 \quad (\propto m_0), \quad \text{con } \Theta = 1,\end{aligned} \tag{89}$$

which for $\overline{\phi}_0 = \overline{\phi}_1 \neq 2\pi$ (if there is ϕ_3 for a fourth generation) is also valid ($\Rightarrow \Theta = cte$).

6.2.2. UP-Antiquark

In the same way, with Equation (68) for $\overline{\phi}_0 = \overline{\phi}_1 = 3\pi$, and the inverse charge, we have:

$$\begin{aligned}&\left[Z_{\bar{u}}\delta_{\bar{u}}\gamma_i^{-2/3}\right]^{2/3} = 3\pi \Rightarrow \gamma_i^{2/3} = (3\pi)^{-3/2} Z_{\bar{u}}\delta_{\bar{u}} \Rightarrow \gamma_i = \left[(3\pi)^{-3/2} Z_{\bar{u}}\delta_{\bar{u}}\right]^{3/2} \\ &\overset{(\text{Eq.85})}{=} (\gamma_{\bar{u}})^{3/2} = 574.85^{3/2} = 13782.58 \quad (\propto m_0), \quad \text{with } \Theta=1,\end{aligned} \tag{90}$$

which for $\overline{\phi}_0 = \overline{\phi}_1 \neq 3\pi$ (if there is ϕ_3 for a fourth generation) is also valid ($\Rightarrow \Theta = cte$).

6.2.3. DOWN-Antiquark

And similarly with (75) for $\overline{\phi}_0 = 4\pi$, $\overline{\phi}_1 = \pi$, and the inverse charge, we have:

$$\left[Z_{\bar{d}}\delta_{\bar{d}}\gamma_i^{-2/3}\right]^{-1/3} = 4\pi \Rightarrow \gamma_i^{2/3} = (4\pi)^3 Z_{\bar{d}}\delta_{\bar{d}} \Rightarrow \gamma_i = \left[(4\pi)^3 Z_{\bar{d}}\delta_{\bar{d}}\right]^{3/2} \overset{(\text{Eq.85})}{=} 64^{3/2}\left(\gamma_{\bar{d}}\right)^{3/2} = 64^{3/2} \times 15.54^{3/2} = 31390.28 \ \left(\propto m_0\right). \quad (91)$$

With which we obtain the most simplified form of $\overline{\chi}_0 = 1/4$, which satisfies $\chi_0\overline{\chi}_0 = 1$. Relation that we can write in a more specific way, and extend to the rest of the phase relations that involve the zero generation, according to the development of Equation (77) and Equation (41), according to **Table 12**.

Table 12. Phase ratios for the zero-generation (anti)particle, and its relationship.

$\chi_0^e = 1/1 = 1$	$\overline{\chi}_0^e = 2/2 = 1$	$\chi_0^e\overline{\chi}_0^e = 1$
$\chi_0^u = 2/2 = 1$	$\overline{\chi}_0^u = 3/3 = 1$	$\chi_0^u\overline{\chi}_0^u = 1$
$\chi_0^d = 4/1 = 4$	$\overline{\chi}_0^d = 1/4$	$\chi_0^d\overline{\chi}_0^d = 1$

Similar to the existing ones, as already mentioned, for the reference or default generation (the first one), according to **Table 13**.

Table 13. Phase ratios for the first-generation (anti)particle, and its relationship.

$\chi_e = 2/1 = 2$	$\overline{\chi}_e = 1/2$	$\chi_e\overline{\chi}_e = 1$
$\chi_u = 3/2$	$\overline{\chi}_u = 2/3$	$\chi_u\overline{\chi}_u = 1$
$\chi_d = 2/4 = 1/2$	$\overline{\chi}_d = 2/1 = 2$	$\chi_d\overline{\chi}_d = 1$

Emphasizing once again the symmetrical nature of all of them and their compact structural composition, and how, starting from m_0, fixed distances are established expressed in units of phase $\phi_0, \phi_1, \cdots$ between them, diversified and spaced according to the electric charge q. A composition that can also be fully represented by a sole relational expression, Equation (25), which being sole does nothing more than to validate the existence or real foundation of this scheme. Relation that for the most general case ($\hat{\alpha} \simeq 1$) we can identify as:

$$\boxed{\Re_m^{-q}}, \quad (92)$$

which not only tells us where the particles are located and the value of their masses, but is capable of making a projection or a prediction of which of them are possible, depending on whether they satisfy it or not, thus becoming a tool.

6.3. Quantum Vacuum, States and Operators

This structural composition, by which each of the particles is associated with a phase, makes the same "states" of a phase space. The idea of structure and state within it, that is, that of being a certain thing by virtue of where it is, due to the phase that represents it, is superior to the idea of progression and transformation by energy increase, since it would make conceptualize to all elementary particles as different states of a single thing, in such a way that energetic recombination would no longer be a mechanism that transforms one particle into another but one that changes its state, which is ultimately achieved with the change of phase. A mechanism of transformation which, consequently, does not necessarily have to be unique, that is to say, it does not necessarily have to be supported by the increase in energy, since the change of phase itself, which is the final result, could be given by vibrational modifications of another kind which, logically, we do not glimpse today.

Following on from this it is convenient to present what has been said in another way. We have established that there is a wave function that alone is capable of representing all particles, because it contains all relevant information about them, including the explicit definition of their masse. We have also said that with this wave function, we can establish an appropriate basis of states $|\mathfrak{I}\rangle$ to account for the diversity of particles concerning their (anti)material nature, spin, and charge. states $|\mathfrak{I}\rangle$ which we can promote to the category of operators, if we wish, on other basis states, which in the case of the electron would take the form $\mathfrak{I}|\Phi\rangle = |\mathfrak{I}_1\rangle = |e\rangle$, and similarly, $\mathfrak{I}_1|e\rangle = |\mu\rangle = |\mathfrak{I}_2\rangle$, and so on for the other generations and the other classes of particles. Operators that act as a creation-annihilation operator on these ground or application states, which for the initial $\mathfrak{I}$ operator is not really $|\Phi\rangle$ but $|\mathfrak{M}\rangle$. An application state $|\mathfrak{M}\rangle$ which we have here calculated recursively, and found to be the same for all the first generations (as we did in [1] in a more simplified form), from which it follows that the creation of the first generations by this operator is carried out on the same previous ground state, which has generally been identified with the quantum vacuum state $|0\rangle$.

What we are therefore saying is that the quantum vacuum state on which the operator (of which we have given the explicit form) for particle generation is applied is not the vacuum but a single quasi-material state $|\mathfrak{M}\rangle$ with a precise energy value, on which the operator acts, in effect, in its two facets, the annihilation of the previous state through (generally) the collapse condition of the phase factor ($\sin[\Phi]^{-q} = 0$) and the creation of the new state (SWP) through energy recombination in the form determined by the operator itself through the process of symmetrization. This quasi-material state, which we have identified here as $|\mathfrak{M}\rangle$, is of an unnoticed materiality that we can ascribe to dark matter (or underlying state of matter) of which we have given, through the concrete value of the particle $\mathfrak{M}$, an exact definition of its unit mass of interaction and conformation, susceptible of being tested and subjected to all the criteria of fulfilment or plausibility of expectations in this respect.

6.4. Discussion 4

We can use Equation (85), and in particular the same in the three cases [Equation 60), Equation (70) and Equation (81)] to show analytically that it is not possible to find from any other generation, nor for any $\phi_0^1, \phi_0^2, \phi_0^3, \cdots$ phase. If, for example, we try for $\phi_0^1 = \pi$ and $\phi_2 = 2\pi$, we have, according to Equation (60):

$$\gamma_i = \left(\frac{Z_\mu \delta_\mu}{\pi}\right)^{3/2} = \left(\frac{Z_\mu \delta_\mu}{(1/2)2\pi}\right)^{3/2} \overset{\text{(Eq.53)}}{=} 2^{3/2}(\gamma_\mu)^{3/2} \approx 34^{3/2} \approx 200 \tag{93}$$

where we can see that the result is of approximate form γ_e (*i.e.* $\phi_0^1 = \pi = \phi_1$), not being exact because we are not operating with a single value Z ($Z_e \neq Z_\mu$). If we do it with Equation (70), for $\phi_0^1 = \pi$ and $\phi_2 = 3\pi$:

$$\gamma_i = \left(\frac{Z_c \delta_c}{\pi^{-3/2}}\right)^{3/2} = \left(\frac{Z_c \delta_c}{(1/3)^{-3/2}(3\pi)^{-3/2}}\right)^{3/2} \overset{\text{(Eq.64)}}{=} (1/3)^{9/4}(\gamma_c)^{3/2} \approx 25^{3/2} \approx 125 \tag{94}$$

We can check that if, instead of $\phi_0^1 = \pi$, we had done $\phi_0^1 = 2\pi$, we would have found $\gamma_u = (2/3)^{9/4}(\gamma_c)^{3/2}$. Consequently, we have found γ_i for a supposed particle that can also be $\phi_0^1 = \pi = \phi_1$, because it is $\phi_2 \neq \pi$, a particle that does not exist, and that would have to, if it existed, transition to the same form that $\phi_1 = 2\pi$ does. And with Equation (81) for $\phi_0^1 = \pi$ and $\phi_2 = 2\pi$:

$$\gamma_i = \left(\frac{Z_s \delta_s}{\pi^3}\right)^{3/2} = \left(\frac{Z_s \delta_s}{(1/2)^3(2\pi)^3}\right)^{3/2} \overset{\text{(Eq.74)}}{=} 8^{3/2}(\gamma_s)^{3/2} \approx 400^{3/2} \approx 8000 \tag{95}$$

An assumption in which, as in the previous case, we would have a particle that does not exist or, to put it better, that could exist (as we shall see in the following section) to a fourth generation, with $\phi_2 = 2\pi$ and $\phi_3 = \pi$, and a very different result.

Regarding the possibility of finding m_0 from other positions, the three cases Equation (94-96) give small values for γ_i which would require large values for m_0, which do not improve much for $\phi_0^i > \pi$ through the scaling factor Θ in the first two cases (while decreasing γ of reference) and which even gets worse in the third one much more than γ improves. We saw that, in fact, the first two original systems [Equation (60), Equation (70)] that reach m_0 need a huge value of γ in the reference phase to match γ_i and the third system [Equation (81)] dispenses with this to some extent thanks to the multiplicative factor of the scaling factor.

The cases we have seen show that the only possibility of finding a particle m_0 is the one already developed previously, that is, to look for a previous phase (antecedent role), according to Equation (56), on a phase that we know to be of the first generation (consequent role) as this is the only way of not addressing previous generations (existing or not) and not addressing later generations, as happens when we invert the roles.

7. Fourth Generation

It is time to address the configuration of a fourth generation. By this, we are not claiming that it exists. In fact, as we saw in [1], a fourth generation would be incompatible in the case of neutrinos, an argument that we will extend to the rest of the particles in another context or work. Here we are simply calculating the values they would presumably have according to the known data, well understood that in some case, there could very well be two different configurations, which we cannot discriminate because we do not have experimental evidence of their masses.

This is a task that we undertake in order, in effect, to identify the masses that we could expect in this context and to prevent that, although this fourth generation does not exist structurally, an event could occur that involves them, given that the conditions that cause this impossibility are boundary conditions that could occasionally be crossed. Conditions by which even some of the third generation of particles could have their existence compromised. These conditions are the ones that make that for some types of particles there is a limited number of generations and not infinite, as it would follow from the expression of the massive coefficient, $m_x\left(\pi^2 a_x^3\right)=\pi b\hbar$, in which for a single b there is an infinite variety of possibilities or combinations $\left(m_x, a_x\right)$, as we have already said.

7.1. (Anti)Leptons (±1)

The sequence of Equation (6) involves two transitions for the charged ($q=-1$) leptons and therefore three generations. In case of taking a 4th generation, such a sequence could come in the form:

$$\begin{aligned}\phi &= 2b^{-2/3}\delta\gamma^{-1}=Z\delta\gamma^{-1}\\ &=\pi, 2\pi, 4\pi\ \left(\phi_1,\phi_2,\phi_3\right)\end{aligned} \tag{96}$$

On which we can directly obtain δ_τ by Equation (5b), to then calculate Z_3 and γ_τ which fulfil Equation (96) for $\phi_3=4\pi$, doing the latter by iteration, given that we do not have a reference value for the final mass nor for Z_3 ($\alpha\neq 1$), which also depends on γ_τ, from which we would finally obtain the result reflected in Table 14, which we have placed on the data already known from Table 1.

Table 14. Values for charged antileptons and their transitions (with fourth generation), for $\phi_3=4\pi$.

$Z_1=19511.456$ $b_1=1.038\times10^{-6}$	m_e (MeV)	δ_e	γ_e	m_μ (MeV)	$\phi_1=\pi$
	0.511	0.033292	206.767	105.658	
$Z_2=18767.61$ $b_2=1.100\times10^{-6}$	m_μ (MeV)	δ_μ	γ_μ	m_τ (MeV)	$\phi_2=2\pi$
	105.658	0.00563	16.817	1776,840	
$Z_3=14450$ $b_3=1.628\times10^{-6}$	m_τ (MeV)	δ_τ	γ_τ	$m_{\tau'}$ (MeV)	$\phi_3=4\pi$
	1776.840	0.00219	2.5269	4489.269	

Put differently, we can say that we have searched for a value Z_3 which gives rise to a velocity γ_τ which gives the same result in the corresponding Equation

(15b) as that obtained for α_2 with Z_3 itself (with respect to Z_2) in Equation (10), which guarantees the fulfilment of both equations.

We have said that the sequence could be given by Equation (96), but we are not sure of this, since it could also be:

$$\begin{aligned}\phi &= 2b^{-2/3}\delta\gamma^{-1} = Z\delta\gamma^{-1} \\ &= \pi, 2\pi, 3\pi \ (\phi_1, \phi_2, \phi_3),\end{aligned} \tag{97}$$

in which case we would have the following spread of data in the form (**Table 15**):

Table 15. Values for charged leptons and their transitions (with the fourth generation), for $\phi_3 = 3\pi$.

$Z_1 = 19511.456$	m_e (MeV)	δ_e	γ_e	m_μ (MeV)	$\phi_1 = \pi$
$b_1 = 1.038 \times 10^{-6}$	0.511	0.033292	206.767	105.658	
$Z_2 = 18767.61$	m_μ (MeV)	δ_μ	γ_μ	m_τ (MeV)	$\phi_2 = 2\pi$
$b_2 = 1.100 \times 10^{-6}$	105.658	0.00563	16.817	1776,840	
$Z_3 = 16100$	m_τ (MeV)	δ_τ	γ_τ	$m_{\tau'}$ (MeV)	$\phi_3 = 3\pi$
$b_3 = 1.384 \times 10^{-6}$	1776.840	0.00219	3.754	6670.175	

Analogously, the data developed according to Equation (42) contemplate two transitions for charged antileptons ($q = 1$) and, therefore, three generations, according to **Table 5**. Thereafter, in the case of taking a 4th generation in correspondence with Equation (96), that is:

$$\begin{aligned}\bar{\phi} &= \left(2\bar{b}^{-2/3}\delta\gamma^{-1}\right)^{-1} = \left(\bar{Z}\delta\gamma^{-1}\right)^{-1} \\ &= 4\pi, 2\pi, \pi \ (\bar{\phi}_1, \bar{\phi}_2, \bar{\phi}_3),\end{aligned} \tag{98}$$

would double the initial phase $\bar{\phi}_1$, giving rise to the changes per Equation (44) of $\bar{Z}_1$, $\bar{Z}_2$ and $\bar{Z}_3$ (halving them), and of the corresponding $\bar{b}$ values, but not the other data (analogous to the leptonic ones), as shown in **Table 16**:

Table 16. Values for charged antileptons and their transitions (with the fourth generation), for $\phi_3 = 4\pi \to \bar{\phi}_3 = \pi$.

$\bar{Z}_1 = 494.231$	m_e (MeV)	δ_e	γ_e	m_μ (MeV)	$\bar{\phi}_1 = 4\pi$
$\bar{b}_1 = 2.575 \times 10^{-4}$	0.511	0.033292	206.767	105.658	
$\bar{Z}_2 = 475.389$	m_μ (MeV)	δ_μ	γ_μ	m_τ (MeV)	$\bar{\phi}_2 = 2\pi$
$\bar{b}_2 = 2.728 \times 10^{-4}$	105.658	0.00563	16.817	1,776,840	
$\bar{Z}_3 = 366.023$	m_τ (MeV)	δ_τ	γ_τ	$m_{\tau'}$ (MeV)	$\bar{\phi}_3 = \pi$
$\bar{b}_3 = 4.039 \times 10^{-4}$	1776.840	0.00219	2.5269	4489.269	

Similarly, the implementation of the sequence Equation (97) for the leptons would force the anti-leptons to have the form:

$$\bar{\phi} = \left(2\bar{b}^{-2/3}\delta\gamma^{-1}\right)^{-1} = \left(\bar{Z}\delta\gamma^{-1}\right)^{-1} \\ = 6\pi, 3\pi, 2\pi \ \left(\bar{\phi}_1, \bar{\phi}_2, \bar{\phi}_3\right), \tag{99}$$

so that all relations Equation (41) and Equation (43) are still fulfilled, *i.e.*, it would have to have an inverse phase sequence different from the natural one, $\bar{\phi} = 3\pi, 2\pi, \pi$, on which the normalisation constant ($\bar{Z}, b$) would have to be adjusted again according to Equation (99), as we have presented in **Table 17**, the corpuscular data being the same as the leptonic data for this case.

Table 17. Values for charged antileptons and their transitions (with the fourth generation), for $\phi_3 = 3\pi \rightarrow \bar{\phi}_3 = 2\pi$.

$\bar{Z}_1 = 329.487$	$m_e\,(\mathrm{MeV})$	δ_e	γ_e	$m_\mu\,(\mathrm{MeV})$	$\bar{\phi}_1 = 6\pi$
$\bar{b}_1 = 4.731\times10^{-4}$	0.511	0.033292	206.767	105.658	
$\bar{Z}_2 = 316.926$	$m_\mu\,(\mathrm{MeV})$	δ_μ	γ_μ	$m_\tau\,(\mathrm{MeV})$	$\bar{\phi}_2 = 3\pi$
$\bar{b}_2 = 5.014\times10^{-4}$	105.658	0.00563	16.817	1,776,840	
$\bar{Z}_3 = 271.878$	$m_\tau\,(\mathrm{MeV})$	δ_τ	γ_τ	$m_{\tau'}\,(\mathrm{MeV})$	$\bar{\phi}_3 = 2\pi$
$\bar{b}_3 = 6.31\times10^{-4}$	1776.840	0.00219	3.754	6670.175	

It should be noted that the fact that there is no fourth generation does not mean that there is no phase ϕ_3 through which the third generation particle will pass, it means that it will not complete a defined phase value where $\sin[\Phi] = 0$, because there is some other limitation that prevents it from advancing to $\phi_3 = 3\pi$ or to $\phi_3 = 4\pi$, which will not allow us to determine in which of the two scenarios it is in, nor to apply with certainty expressions that are designed for these discrete states.

7.2. (Anti) Quarks (∓2/3)

The 4th generation of quarks would meet:

$$\phi = \left[2b^{-2/3}\delta\gamma^{-1}\right]^{1/3} = \left[Z\delta\gamma^{-1}\right]^{1/3} \\ = 2\pi, 3\pi, 6\pi \ (\phi_1, \phi_2, \phi_3), \tag{100}$$

with the result reflected in **Table 18** (on **Table 2**):

Table 18. Values for up-type quarks ($q = 2/3$) and their transitions (with the fourth generation).

$Z_1 = 1.828$	$m_u\,(\mathrm{MeV})$	δ_u	γ_u	$m_c\,(\mathrm{MeV})$	$\phi_1 = 2\pi$
$b_1 = 3.619\times10^{-5}$	2.368793	0.01996	574.849	1361.698	
$Z_2 = 1.828$	$m_c\,(\mathrm{MeV})$	δ_c	γ_c	$m_t\,(\mathrm{GeV})$	$\phi_2 = 3\pi$
$b_2 = 3.619\times10^{-5}$	1361.698	0.00240	127.010	172.95	
$Z_3 = 1.828$	$m_t\,(\mathrm{GeV})$	δ_t	γ_t	$m_{t'}\,(\mathrm{GeV})$	$\phi_3 = 6\pi$
$b_3 = 3.619\times10^{-5}$	172.95	0.000477	71.466	12360	

While for the antiquarks it would be:

$$\bar{\phi} = \left[2\bar{b}^{-2/3}\delta\gamma^{-1}\right]^{2/3} = \left[\bar{Z}\delta\gamma^{-1}\right]^{2/3}$$
$$= 3\pi, 2\pi, \pi \ \left(\bar{\phi}_1, \bar{\phi}_2, \bar{\phi}_3\right), \tag{101}$$

with the following additional data (on Table 6), according to Table 19:

Table 19. Values for Up-type antiquarks ($q = -2/3$) and their transitions (fourth generation).

$\bar{Z}_3 = 833014.7$ $\bar{b}_3 = 3.7202\times10^{-9}$	m_t (GeV)	δ_t	γ_t	$m_{t'}$ (GeV)	$\bar{\phi}_3 = \pi$
	172.95	0.000477	71.466	12360	

7.3. (Anti) Quarks (±1/3)

The 4th generation of quarks would meet:

$$\phi = \left[2b^{-2/3}\delta\gamma^{-1}\right]^{1/3} = \left[Z\delta\gamma^{-1}\right]^{1/3}$$
$$= 4\pi, 2\pi, \pi \ \left(\phi_1, \phi_2, \phi_3\right), \tag{102}$$

with the result reflected in Table 20 (on Table 3):

Table 20. Values for Down-type quarks ($q = -1/3$) and their transitions (with the fourth generation).

$Z_1 = 2033106$ $b_1 = 9.757\times10^{-10}$	m_d (MeV)	δ_d	γ_d	m_s (MeV)	$\phi_1 = 4\pi$
	5.395	0.01517	15.5483	83.883	
$Z_2 = 2033106$ $b_2 = 9.757\times10^{-10}$	m_s (MeV)	δ_s	γ_s	m_b (MeV)	$\phi_2 = 2\pi$
	83.883	0.00608	49.619	4180.42	
$Z_3 = 2033106$ $b_3 = 9.757\times10^{-10}$	m_b (MeV)	δ_b	γ_b	$m_{b'}$ (GeV)	$\phi_3 = \pi$
	4180.42	0.00165	108.339	452.905	

While for the antiquarks it would be:

$$\bar{\phi} = \left[2\bar{b}^{-2/3}\delta\gamma^{-1}\right]^{-1/3} = \left[\bar{Z}\delta\gamma^{-1}\right]^{-1/3}$$
$$= \pi, 2\pi, 4\pi \ \left(\bar{\phi}_1, \bar{\phi}_2, \bar{\phi}_3\right), \tag{103}$$

with the following additional data (on Table 7), according to Table 21:

Table 21. Values for Down-type antiquarks ($q = 1/3$) and their transitions (fourth generation).

$\bar{Z}_3 = 33.0431$ $\bar{b}_3 = 0.01489$	m_b (MeV)	δ_b	γ_b	$m_{b'}$ (GeV)	$\bar{\phi}_3 = 4\pi$
	4180.42	0.00165	108.339	452.905	

7.4. Discussion 5

Taking into account the data relating to a fourth generation, we can present the approximate Lorentz factors for the different phases of the matter particles in Table 22, to get an overview.

Table 22. Lorentz factor values for the different phases and particles.

$\phi(\phi_0,\phi_1,\phi_2,\phi_3)$	$\phi_0 = 2\pi$	2π	3π	6π
$\gamma(2/3)$ $\leftarrow\mid$	2973	574	127	71
$\phi(\phi_0,\phi_1,\phi_2,\phi_3)$	$\phi_0 = \pi$	π	2π	4π
$\gamma(-1)$ $\mid\leftarrow$	13782	206	16	2.5
$\phi(\phi_0,\phi_3,\phi_2,\phi_1)$	$\phi_0 = \pi$	π	2π	4π
$\gamma(-1/3)$ $\mid\leftarrow$	31390	108	49	15

On which we can speak of material phases more or less distant from the interface $\phi = 0 = \not\phi_0$ (between the symmetrical phases ϕ_0 and $\not\phi_1$), and note more reliably the decreasing direction of the progression, that is, that the more distant phases have a smaller γ, which increases as $\phi \to 0$. A behaviour which would lead us to assume an arrangement according to the phases if we had not seen another stronger arrangement according to the generations (**Figure 5**), even if this arrangement alters the monotony of this evolution in some of the cases and, consequently, the similarity or correspondence among these behaviours.

Going into detail, we see that the two negative charges, with a decreasing evolution of ϕ ($\mid\leftarrow$), have a different behaviour, since one of them (lepton) advances for the first generation from infinity to the phase closest to $\phi = 0$ (maximum γ), and then moves away in the following generations (decreasing generational phasic sequence), while the other stays in the furthest possible phase (minimum γ), and then continues to move closer in the following generations (increasing generational phasic sequence). The positive charge, like the lepton, progresses to the phase closest to $\phi = 0$, which is also the one that, as an increasing function of ϕ ($\leftarrow\mid$), it finds in the first term, and then moves away in the following generations.

We can fix this if we make some considerations or, to put it better, if we reconsider something that we have mistakenly taken by default: we have placed in **Table 22** the three types of particles as if they were priorities with respect to the antiparticles, but this is not the case. That is, we can substitute some element and make **Table 23**, in which, as we can see, the generational sequence of the anomalous case is inverted, and the other two cases are paired. In the same way that cases $\gamma(-2/3)$, $\gamma(1)$ and $\gamma(-1/3)$ are paired and inverted with respect to the three previous cases.

What we are saying, in conclusion, is that there is no anomaly in the generational phasic sequence of the (anti)particles if we differentiate the three material entities with decreasing generational phasic sequence from the increasing one. Far from this, we can also realise that through this differentiation, the one presented in **Table 23**, the total charge is zero, *i.e.*, that the joint generation of the three material entities differentiated in this way involves a conservation of charge with respect to the zero charge of $\mathfrak{M}$ that makes it more feasible as an expression of that generation than the one derived from **Table 22**.

Table 23. Lorentz factor values for the different (anti)particles with decreasing generational phasic sequence.

$\phi(\phi_0,\phi_1,\phi_2,\phi_3)$	$\phi_0^2 = 2\pi$	2π	3π	6π
$\gamma(2/3)$ $\leftarrow\vert$	2973	574	127	71
$\phi(\phi_0,\phi_1,\phi_2,\phi_3)$	$\phi_0^1 = \pi$	π	2π	4π
$\gamma(-1)$ $\vert\leftarrow$	13,782	206	16	2.5
$\bar{\phi}(\bar{\phi}_0,\bar{\phi}_1,\bar{\phi}_2,\bar{\phi}_3)$	$\bar{\phi}_0^3 = 4\pi$	π	2π	4π
$\gamma(1/3)$ $\leftarrow\vert$	31,390	108	49	15

There are interesting aspects, such as those related to the sequence of occupation of phase ϕ_0, which we have unfolded in form $\phi_0^1, \phi_0^2, \bar{\phi}_0^3$, which we will not address now. Aspects that would undoubtedly give rise to questions that we will be better able to raise and resolve when we present the basis of material generation, which will be based on these ideas and those already presented throughout the other discussions.

8. The Particles and Their Size

An essential and indispensable concept for the beginning of our development has been that of the proper length a, which however we have ignored throughout it, that is, we have not needed to know its values really since whatever they are, they will be, without us being able to compare it to any other reference. It will be later in this work that we will try to make use of these values, which, nevertheless, since we have presented all the particles here, we will now show them, in Tables 24-26, thus completing the exposition of them, including zero generation and a hypothetical fourth generation, which is easily done from Equation (1) and Equation (5b), since we already have the different values δ.

Table 24. Size a of (anti)leptons, for the generations presented.

−1	a_0	a_1	a_2	a_3	a_4
a	4.85E−03	**3.37E−04**	5.70E−05	2.22E−05	1.63E−05
$\bar{a}$	3.05E−02	2.12E−03	3.58E−04	1.40E−04	1.03E−04

Table 25. Size a of (anti)quarks $q = \mp 2/3$ for the generations presented.

2/3	a_0	a_1	a_2	a_3	a_4
a	7.42E−04	**3.09E−05**	3.72E−06	7.40E−07	1.78E−07
$\bar{a}$	4.75E−04	1.51E−05	6.03E−06	1.64E−06	3.44E−07

Table 26. Size a of (anti)quarks $q = \pm 1/3$ for the generations presented.

−1/3	a_0	a_1	a_2	a_3	a_4
a	4.75E−04	**1.51E−05**	6.03E−06	1.64E−06	3.44E−07
$\bar{a}$	1.18E−01	3.73E−03	1.50E−03	4.06E−04	8.53E−05

$$a_i = b^{1/3} \left(\frac{\hbar}{\pi m_i} \right)^{1/3} = b^{1/3} \delta_i, \tag{104}$$

Where we have highlighted the first generation particles, that is, those that make up our universe, on which it is evident that the distance itself (expressed in metres) and the size that can be associated with a particle with it, do not necessarily have to be correlated with the dimensional idea that we have of elementary particles, but to the size of the SWP package representing them.

9. Addendum to the Phasic Structure of the SM Charged Particles

Once all the SM charged particles have been introduced step by step and differentiated by categories, we can see more practically the real possibilities and the true fit of the data. For this purpose, we have placed all the data of the particle generations in an Excel calculation table [8], so that they can be easily reproduced and even investigated, breaking down in the case of leptons the three branches, corresponding to the different Z values, and carrying out, according to the explanation, the calculation of m_i from the first generation, and from there, recalculating the first generation (remember that we have two definitions of) and then the following ones by a relevant chain of equations, which were used to form the tables).

In addition to this, the phase ratio $\chi \simeq \Re_m^{-q}$ is verified for the four particles (two triads) of each class of particles, for which the values reached in the chain of equations have been used as input (indexed), and it can be observed that the modification of Z and m_1 (first generation) maintains the ratio marked by the phases, and that therefore χ does not vary, whatever their values. If we keep m_1 (the point of the curve) and change the constant Z (*i.e.* the curvature index β), this will give rise to other particles m_0, m_2 and m_3 with the proportion χ. If we modify m_1 maintaining Z, the other masses will be modified proportionally according to the equation of the curve ($\overline{\gamma}$).

Notwithstanding this, in the alternative (non-indexed) table, the value of the four particles can be changed manually and see how the change in the value of each of them, *i.e.* in χ, affects the equilibrium, and verify how delicate that equilibrium is, or how easy it is to corrupt or not to reach.

Finally, we have also reflected in [8] the details of the calculation of the particle size of the last section, obtaining in addition and in another way, from them and from Equation (104), the corresponding masses (as they appear in Equation (16) of [2]), that is,

$$m_i = \frac{\hbar b}{\pi a_i^3}, \tag{105}$$

and other related parameters.

The numerical relationships between all the particles are established in the aforementioned Excel table, which is conveniently represented in **Figure 5**. In addition to the data relating to the particles, we have the parameterised data (by means of the curvature factor $\overline{\gamma}_i$ and the curvature index β_i) relating to their evolution, which are also represented in **Figures 2-4**. The evolution is described, in short, by the curves of the Lorentz factor γ_i, which contains all the physics that we may wish to look for in the whole phenomenology, as we detailed in Appendix D of [1], where we also saw that they could be transformed into straight lines. As a consequence of this possibility of transformation, we can convert **Figures 2-4** into the corresponding branches of **Figure 5**, *i.e.* we could see that **Figure 5**, far from being a representation, is a simplification (without taking into account the scale factor associated with each phase) of the real (logarithmic) relationship between the particles. We are saying, therefore, that the real relation between the fundamental particles, that is, that of their chaotic masses, and apparently patternless, obeys such a simple configuration on $\mathfrak{M}$ as the one represented schematically in **Figure 5**.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Annex A

ENERGY STATES I - II

Corresponding to Equation (19), with the configuration $\Psi_{\Im}(q=-1)=f(\Im_{\uparrow})=f(\vartheta_2\phi_2-\vartheta_1\phi_1)$ of the final energy balance, for $M\equiv[\Delta k(\upsilon t-x)]$ and $N\equiv(w_0 t-k_0 x)$ we have:

$$\begin{aligned}\bar{E}&=\int\Psi^*(x,t)i\hbar\partial_t\Psi(x,t)\mathrm{d}x=(\bar{E}_1+\bar{E}_2)\\&=B^2\frac{\int(\zeta_2(x,t)-\zeta_1(x,t))\mathrm{d}x}{2}\\&=B^2\frac{f(\vartheta_2\phi_2-\vartheta_1\phi_1)}{2}=B^2\int\zeta(x,t)\mathrm{d}x,\end{aligned}\tag{A.1}$$

with ($\phi_2=\phi=\mathrm{e}^{i(N)}/\phi_1=\phi^{-1}=\mathrm{e}^{-i(N)}$)

$$\begin{aligned}\zeta_2(x,t)&=\Psi_2^*(x,t)i\hbar\partial_t\Psi_2(x,t)=\vartheta_2\phi_2^*i\hbar\partial_t(\vartheta_2\phi_2)\\&=\vartheta_2\phi^{-1}(x,t)i\hbar[\vartheta_2\partial_t\phi(x,t)+\phi(x,t)\partial_t\vartheta_2]\\&=\frac{\mathrm{e}^{i(M/2)}\mathrm{e}^{-i(N)}}{(\upsilon t-x)}i\hbar\left[\frac{\mathrm{e}^{i(M/2)}\mathrm{e}^{i(N)}}{(\upsilon t-x)}\left(i\omega_0+\frac{i\upsilon\Delta k}{2}\right)-\upsilon\frac{\mathrm{e}^{i(M/2)}\mathrm{e}^{i(N)}}{(\upsilon t-x)^2}\right]\\&=i\hbar\mathrm{e}^{i(M/2)}\left[\frac{\mathrm{e}^{i(M/2)}}{(\upsilon t-x)^2}\left(i\omega_0+\frac{i\upsilon\Delta k}{2}\right)+\frac{\mathrm{e}^{i(M/2)}}{(\upsilon t-x)^3}(-\upsilon)\right]\\&=\hbar\left(\frac{\mathrm{e}^{i(\upsilon t-x)\Delta k}}{(\upsilon t-x)^2}\left(-\omega_0-\frac{\upsilon\Delta k}{2}\right)+\frac{\mathrm{e}^{i(\upsilon t-x)\Delta k}}{(\upsilon t-x)^3}(-i\upsilon)\right)\Bigg],\end{aligned}\tag{A.2}$$

and

$$\begin{aligned}-\zeta_1(x,t)&=-\Psi_1^*(x,t)i\hbar\partial_t\Psi_1(x,t)=-\vartheta_1\phi_1^*i\hbar\partial_t(\vartheta_1\phi_1)\\&=-\vartheta_1\phi(x,t)i\hbar\left[\vartheta_1\partial_t\phi^{-1}(x,t)+\phi^{-1}(x,t)\partial_t\vartheta_1\right]\\&=-\frac{\mathrm{e}^{-i(M/2)}\mathrm{e}^{i(N)}}{(\upsilon t-x)}i\hbar\left[\frac{\mathrm{e}^{-i(M/2)}\mathrm{e}^{-i(N)}}{(\upsilon t-x)}\left(-i\omega_0-\frac{i\upsilon\Delta k}{2}\right)-\upsilon\frac{\mathrm{e}^{-i(M/2)}\mathrm{e}^{-i(N)}}{(\upsilon t-x)^2}\right]\\&=i\hbar\mathrm{e}^{-i(M/2)}\left[\frac{\mathrm{e}^{-i(M/2)}}{(\upsilon t-x)^2}\left(i\omega_0+\frac{i\upsilon\Delta k}{2}\right)-\frac{\mathrm{e}^{-i(M/2)}}{(\upsilon t-x)^3}(-\upsilon)\right]\\&=\hbar\left(\frac{\mathrm{e}^{-i(\upsilon t-x)\Delta k}}{(\upsilon t-x)^2}\left(-\omega_0-\frac{\upsilon\Delta k}{2}\right)-\frac{\mathrm{e}^{-i(\upsilon t-x)\Delta k}}{(\upsilon t-x)^3}(-i\upsilon)\right)\Bigg],\end{aligned}\tag{A.3}$$

that would give rise to the (FIRST ENERGY STATE):

$$\begin{aligned}\zeta(x,t)&=\frac{\zeta_2(x,t)-\zeta_1(x,t)}{2}\\&=\left[\frac{\hbar\upsilon\sin(\Delta k(\upsilon t-x))}{(\upsilon t-x)^3}-\frac{\hbar\upsilon\Delta k\cos(\Delta k(\upsilon t-x))}{2(\upsilon t-x)^2}\right]\\&\quad+\left[-\frac{\hbar\omega_0\cos(\Delta k(\upsilon t-x))}{(\upsilon t-x)^2}\right]\\&=\zeta^m(x,t)+\zeta^\omega(x,t),\end{aligned}\tag{A.4}$$

which in abbreviated form, and according to the change of constant associated with the change of variable and Equation (32) of [1] would be finally:

$$\begin{aligned}\bar{E} &= A^2\int \zeta^m(\upsilon)\mathrm{d}\upsilon + \zeta^\omega(\upsilon)\mathrm{d}\upsilon \\ &= A^2\int\left(\zeta_k(\upsilon)+\zeta_f(\upsilon)+\zeta_\omega(\upsilon)\right)\mathrm{d}\upsilon \\ &= \bar{E}_k + \bar{E}_f + \bar{E}_\omega = \left(\bar{E}_k+\bar{E}_f\right)+\bar{E}_\omega\end{aligned} \tag{A.5}$$

With $f(\Im_\downarrow) = f(\vartheta_1\phi_1 - \vartheta_2\phi_2) = -f(\vartheta_2\phi_2 - \vartheta_1\phi_1)$ of the (SECOND ENERGY STATE) we could have:

$$\begin{aligned}\bar{E} &= \int \Psi^*(x,t)i\hbar\partial_t\Psi(x,t)\mathrm{d}x = \left(\bar{E}_1+\bar{E}_2\right) \\ &= B^2\frac{\int\left(\zeta_1(x,t)-\zeta_2(x,t)\right)\mathrm{d}x}{2} \\ &= -B^2\frac{\int\left(\zeta_2(x,t)-\zeta_1(x,t)\right)\mathrm{d}x}{2} \\ &= -B^2\frac{f(\vartheta_2\phi_2-\vartheta_1\phi_1)}{2} = -B^2\int\zeta(x,t)\mathrm{d}x,\end{aligned} \tag{A.6}$$

which would result in:

$$\begin{aligned}\bar{E} &= -A^2\int \zeta^m(\upsilon)\mathrm{d}\upsilon + \zeta^\omega(\upsilon)\mathrm{d}\upsilon \\ &= -A^2\int\left(\zeta_k(\upsilon)+\zeta_f(\upsilon)+\zeta_\omega(\upsilon)\right)\mathrm{d}\upsilon \\ &= -\left(\bar{E}_k + \bar{E}_f + \bar{E}_\omega\right) = -\left(\bar{E}_k+\bar{E}_f\right)-\bar{E}_\omega\end{aligned} \tag{A.7}$$

ENERGY STATES III - IV

If now, instead of exchanging the two elements, we only exchange the carriers, that is, $f(\Im_\downarrow) = f(\vartheta_2\phi_1 - \vartheta_1\phi_2)$, the result is:

$$\begin{aligned}\bar{E} &= \int \Psi^*(x,t)i\hbar\partial_t\Psi(x,t)\mathrm{d}x = \left(\bar{E}_1+\bar{E}_2\right) \\ &= i^2B^2\frac{\left[\int\zeta_3(x,t)\mathrm{d}x - \int\zeta_4(x,t)\mathrm{d}x\right]}{\left(\sqrt{2}\right)^2} \\ &= B^2\frac{\int\left(\zeta_4(x,t)-\zeta_3(x,t)\right)\mathrm{d}x}{2} = B^2\frac{f(\vartheta_2\phi_1-\vartheta_1\phi_2)}{2} = B^2\int\zeta(x,t)\mathrm{d}x,\end{aligned} \tag{A.8}$$

With:

$$\begin{aligned}\zeta_4(x,t) &= \Psi_2^*(x,t)i\hbar\partial_t\Psi_2(x,t) = \vartheta_2\phi_2^*i\hbar\partial_t(\vartheta_2\phi_2) \\ &= \vartheta_2\phi^{-1}(x,t)i\hbar\left[\vartheta_2\partial_t\phi(x,t)+\phi(x,t)\partial_t\vartheta_2\right] \\ &= \frac{\mathrm{e}^{i(M/2)}\mathrm{e}^{i(N)}}{(\upsilon t-x)}i\hbar\left[\frac{\mathrm{e}^{i(M/2)}\mathrm{e}^{-i(N)}}{(\upsilon t-x)}\left(-i\omega_0+\frac{i\upsilon\Delta k}{2}\right)-\upsilon\frac{\mathrm{e}^{i(M/2)}\mathrm{e}^{-i(N)}}{(\upsilon t-x)^2}\right] \\ &= i\hbar\mathrm{e}^{i(M/2)}\left[\frac{\mathrm{e}^{i(M/2)}}{(\upsilon t-x)^2}\left(-i\omega_0+\frac{i\upsilon\Delta k}{2}\right)+\frac{\mathrm{e}^{i(M/2)}}{(\upsilon t-x)^3}(-\upsilon)\right] \\ &= \hbar\left(\frac{\mathrm{e}^{i(\upsilon t-x)\Delta k}}{(\upsilon t-x)^2}\left(\omega_0-\frac{\upsilon\Delta k}{2}\right)+\frac{\mathrm{e}^{i(\upsilon t-x)\Delta k}}{(\upsilon t-x)^3}(-i\upsilon)\right)\Bigg],\end{aligned} \tag{A.9}$$

and

$$\begin{aligned}
-\zeta_3(x,t) &= -\Psi_1^*(x,t)i\hbar\partial_t\Psi_1(x,t) = -\vartheta_1\phi_1^* i\hbar\partial_t(\vartheta_1\phi_1) \\
&= -\vartheta_1\phi(x,t)i\hbar\left[\vartheta_1\partial_t\phi^{-1}(x,t)+\phi^{-1}(x,t)\partial_t\vartheta_1\right] \\
&= -\frac{e^{-i(M/2)}e^{-i(N)}}{(\upsilon t-x)}i\hbar\left[\frac{e^{-i(M/2)}e^{i(N)}}{(\upsilon t-x)}\left(-i\omega_0-\frac{i\upsilon\Delta k}{2}\right)-\upsilon\frac{e^{-i(M/2)}e^{i(N)}}{(\upsilon t-x)^2}\right] \\
&= i\hbar e^{-i(M/2)}\left[\frac{e^{-i(M/2)}}{(\upsilon t-x)^2}\left(-i\omega_0+\frac{i\upsilon\Delta k}{2}\right)-\frac{e^{-i(M/2)}}{(\upsilon t-x)^3}(-\upsilon)\right] \\
&= \hbar\left(\frac{e^{-i(\upsilon t-x)\Delta k}}{(\upsilon t-x)^2}\left(\omega_0-\frac{\upsilon\Delta k}{2}\right)-\frac{e^{-i(\upsilon t-x)\Delta k}}{(\upsilon t-x)^3}(-i\upsilon)\right)\Bigg],
\end{aligned} \tag{A.10}$$

which would give rise to (THIRD ENERGETIC STATE):

$$\begin{aligned}
\zeta(x,t) &= \frac{\zeta_4(x,t)-\zeta_3(x,t)}{2} \\
&= \left[\frac{\hbar\upsilon\sin(\Delta k(\upsilon t-x))}{(\upsilon t-x)^3}-\frac{\hbar\upsilon\Delta k\cos(\Delta k(\upsilon t-x))}{2(\upsilon t-x)^2}\right] \\
&\quad+\left[\frac{\hbar\omega_0\cos(\Delta k(\upsilon t-x))}{(\upsilon t-x)^2}\right] \\
&= \zeta^m(x,t)+\zeta^\omega(x,t),
\end{aligned} \tag{A.11}$$

which would result in:

$$\begin{aligned}
\bar{E} &= A^2\int\zeta^m(\upsilon)d\upsilon+\zeta^\omega(\upsilon)d\upsilon \\
&= A^2\int\left(\zeta_k(\upsilon)+\zeta_f(\upsilon)+\zeta_\omega(\upsilon)\right)d\upsilon \\
&= \bar{E}_k+\bar{E}_f-\bar{E}_\omega=\left(\bar{E}_k+\bar{E}_f\right)-\bar{E}_\omega
\end{aligned} \tag{A.12}$$

We can see that with respect to the first state, the sign of the energy $\bar{E}_\omega$ changes here, which requires a reinterpretation of the equation. First of all it is evident that in all cases $\bar{E}_\omega=\bar{E}_f$ (with $\bar{E}_k=0$), as was shown in the comparison of the two functions [2], as a consequence of the fact that the particle is indeed created from that energy. The reinterpretation lies in the fact that we should not (and cannot because of the above) conceptualise the sign of $\bar{E}_\omega$ as a function of the sign $\bar{E}_\omega$, but take the latter as indicative of the angular motion of the carrier. In other words, we do not speak of incoming or outgoing energy but of the carrier rotating to the right or left in the toroid, which in the end also gives rise to an identifying sign in $\bar{E}_\omega$. The equation itself is telling us that the particles created through $\bar{E}_\omega$ have a sign in the circulation of the carriers in one direction or the other, as a result of the position or order of these carriers $\bar{E}_\omega$ in the energy balance.

If in the latter case we also reverse the roles (FOURTH ENERGY STATE) and take $f\left(\bar{\Im}_\uparrow\right)=f\left(\vartheta_1\phi_2-\vartheta_2\phi_1\right)=-f\left(\vartheta_2\phi_1-\vartheta_1\phi_2\right)$ we would have with respect to the previous case:

$$\begin{aligned}\bar{E} &= \int \Psi^*(x,t) i\hbar\partial_t \Psi(x,t)\mathrm{d}x = \left(\bar{E}_1 + \bar{E}_2\right) \\ &= B^2 \frac{\int\left(\zeta_3(x,t) - \zeta_4(x,t)\right)\mathrm{d}x}{2} \\ &= -B^2 \frac{\int\left(\zeta_4(x,t) - \zeta_3(x,t)\right)\mathrm{d}x}{2} \\ &= -B^2 \frac{f\left(\vartheta_2\phi_1 - \vartheta_1\phi_2\right)}{2} \\ &= -B^2 \int \zeta(x,t)\mathrm{d}x,\end{aligned} \tag{A.13}$$

which would result in:

$$\begin{aligned}\bar{E} &= -A^2 \int \zeta^m(\upsilon)\mathrm{d}\upsilon + \zeta^\omega(\upsilon)\mathrm{d}\upsilon \\ &= -A^2 \int\left(\zeta_k(\upsilon) + \zeta_f(\upsilon) + \zeta_\omega(\upsilon)\right)\mathrm{d}\upsilon \\ &= -\left(\bar{E}_k + \bar{E}_f - \bar{E}_\omega\right) \\ &= -\left(\bar{E}_k + \bar{E}_f\right) + \bar{E}_\omega\end{aligned} \tag{A.14}$$

That is to say, we have four states, two with positive energy, of which one has $\bar{E}_\omega$ and one has $-\bar{E}_\omega$, and two with negative energy, which also present these $\mp\bar{E}_\omega$ states with respect to the direction of motion of the carrier inside the toroid. A sense of motion that we can associate to the spin, since it is the spin that breaks the degeneracy of the energy states, being that it does so with a non-corpuscular energy that we associate to a different space or a different quantum property ($\pm\omega_0$) of matter.

Annex B

1 Glossary Dirac equation

$$H_D = c\alpha p + \beta m_o c^2 \qquad \alpha = \begin{bmatrix} 0 & \sigma_i \\ \sigma_i & 0 \end{bmatrix} \quad \beta = \begin{bmatrix} [1]^{2\times 2} & 0 \\ 0 & -[1]^{2\times 2} \end{bmatrix} \quad \sigma_i = \text{matrix Pauli}$$

$$H_D\psi = E\psi \quad \rightarrow \quad \begin{bmatrix} m_o c^2 [1]^{2\times 2} & c\sigma p \\ c\sigma p & -m_o c^2 [1]^{2\times 2} \end{bmatrix}\begin{bmatrix} U_A \\ U_B \end{bmatrix} = E\begin{bmatrix} U_A \\ U_B \end{bmatrix}$$

$$\left.\begin{array}{c} \left.\begin{array}{c} |U_A\rangle = \left\{\begin{pmatrix}1\\0\end{pmatrix}, \begin{pmatrix}0\\1\end{pmatrix}\right\} \\ |U_B\rangle = u_2 |U_A\rangle \end{array}\right] \\ \text{for} \\ \left[u_2 = \dfrac{c\sigma p}{E + m_o c^2}\right] \end{array}\right\} \Rightarrow \left\{\begin{array}{l} \psi_D^{(1)} = \left\{\begin{bmatrix} N\begin{pmatrix}1\\0\end{pmatrix} \\ Nu_2\begin{pmatrix}1\\0\end{pmatrix}\end{bmatrix}\right\} \mathrm{e}^{i\frac{px - Et}{\hbar}} \\ \psi_D^{(2)} = \left\{\begin{bmatrix} N\begin{pmatrix}0\\1\end{pmatrix} \\ Nu_2\begin{pmatrix}0\\1\end{pmatrix}\end{bmatrix}\right\} \mathrm{e}^{i\frac{px - Et}{\hbar}} \end{array}\right. ,$$

$$\left.\begin{array}{c}\left|U_B\right\rangle=\left\{\begin{pmatrix}1\\0\end{pmatrix},\begin{pmatrix}0\\1\end{pmatrix}\right\}\\ \left|U_A\right\rangle=u_1\left|U_B\right\rangle\\ \text{for}\\ \left[u_1=\dfrac{c\sigma p}{E-m_oc^2}\right]\end{array}\right\}\Rightarrow\left\{\begin{array}{l}\psi_D^{(3)}=\left\{\begin{bmatrix}Nu_1\begin{pmatrix}1\\0\end{pmatrix}\\ N\begin{pmatrix}1\\0\end{pmatrix}\end{bmatrix}\right\}e^{i\frac{px+Et}{\hbar}}\\ \psi_D^{(4)}=\left\{\begin{bmatrix}Nu_1\begin{pmatrix}0\\1\end{pmatrix}\\ N\begin{pmatrix}0\\1\end{pmatrix}\end{bmatrix}\right\}e^{i\frac{px+Et}{\hbar}}\end{array}\right., \tag{B.1}$$

2 Conversion between spinors and intrinsic spinors

$$\begin{array}{l}\begin{pmatrix}N\\Nu_2\end{pmatrix}S_\uparrow\left[\begin{array}{l}\begin{pmatrix}N\\Nu_2\end{pmatrix}\begin{pmatrix}S_{z+}\\S_{z+}\end{pmatrix}=\begin{pmatrix}NS_{z+}\\Nu_2S_{z+}\end{pmatrix}=N\begin{pmatrix}\left|U_A\right\rangle\\u_2\left|U_A\right\rangle\end{pmatrix}=N\begin{pmatrix}\left|U_A\right\rangle\\\left|U_B\right\rangle\end{pmatrix}\\ \begin{pmatrix}N\\-Nu_2\end{pmatrix}\begin{pmatrix}S_{z+}\\S_{z-}\end{pmatrix}=\begin{pmatrix}N\vartheta_2\\-Nu_2\vartheta_1\end{pmatrix}=\left(\vartheta_2\phi_2-\vartheta_1\phi_1\right)=\Im_\uparrow\equiv\begin{pmatrix}\vartheta_2\phi_2\\-\vartheta_1\phi_1\end{pmatrix}\end{array}\right.\\ \begin{pmatrix}N\\Nu_2\end{pmatrix}S_\downarrow\left[\begin{array}{l}\begin{pmatrix}N\\Nu_2\end{pmatrix}\begin{pmatrix}S_{z-}\\S_{z-}\end{pmatrix}=\begin{pmatrix}NS_{z-}\\Nu_2S_{z-}\end{pmatrix}=N\begin{pmatrix}\left|U_A\right\rangle\\u_2\left|U_A\right\rangle\end{pmatrix}=N\begin{pmatrix}\left|U_A\right\rangle\\\left|U_B\right\rangle\end{pmatrix}\\ \begin{pmatrix}N\\-Nu_2\end{pmatrix}\begin{pmatrix}S_{z-}\\S_{z+}\end{pmatrix}=\begin{pmatrix}N\vartheta_2\\-Nu_2\vartheta_1\end{pmatrix}=\left(\vartheta_2\phi_1-\vartheta_1\phi_2\right)=\Im_\downarrow\equiv\begin{pmatrix}\vartheta_2\phi_1\\-\vartheta_1\phi_2\end{pmatrix}\end{array}\right.\end{array} \tag{B.2}$$

A second representation of these developments can be found in Equation (B.3), where we have exchanged $S_\uparrow$ for $S_\Uparrow$ and $S_\downarrow$ for $S_\Downarrow$.

$$\begin{array}{l}\begin{pmatrix}N\\Nu_2\end{pmatrix}S_\uparrow\left[\begin{array}{l}\begin{pmatrix}N\\Nu_2\end{pmatrix}\begin{pmatrix}S_{z+}\\S_{z+}\end{pmatrix}=\begin{pmatrix}NS_{z+}\\Nu_2S_{z+}\end{pmatrix}=N\begin{pmatrix}\left|U_A\right\rangle\\u_2\left|U_A\right\rangle\end{pmatrix}=N\begin{pmatrix}\left|U_A\right\rangle\\\left|U_B\right\rangle\end{pmatrix}\\ S_\Uparrow\begin{pmatrix}N\\Nu_2\end{pmatrix}=\begin{pmatrix}\phi_2&\phi_1\end{pmatrix}\begin{pmatrix}N\\Nu_2\end{pmatrix}=\begin{pmatrix}\phi_2&\phi_1\end{pmatrix}\begin{pmatrix}\vartheta_2\\-\vartheta_1\end{pmatrix}=\left(\vartheta_2\phi_2-\vartheta_1\phi_1\right)=\Im_\uparrow\equiv\begin{pmatrix}\vartheta_2\phi_2\\-\vartheta_1\phi_1\end{pmatrix}\end{array}\right.\\ \begin{pmatrix}N\\Nu_2\end{pmatrix}S_\downarrow\left[\begin{array}{l}\begin{pmatrix}N\\Nu_2\end{pmatrix}\begin{pmatrix}S_{z-}\\S_{z-}\end{pmatrix}=\begin{pmatrix}NS_{z-}\\Nu_2S_{z-}\end{pmatrix}=N\begin{pmatrix}\left|U_A\right\rangle\\u_2\left|U_A\right\rangle\end{pmatrix}=N\begin{pmatrix}\left|U_A\right\rangle\\\left|U_B\right\rangle\end{pmatrix}\\ S_\Downarrow\begin{pmatrix}N\\Nu_2\end{pmatrix}=\begin{pmatrix}\phi_1&\phi_2\end{pmatrix}\begin{pmatrix}N\\Nu_2\end{pmatrix}=\begin{pmatrix}\phi_1&\phi_2\end{pmatrix}\begin{pmatrix}\vartheta_2\\-\vartheta_1\end{pmatrix}=\left(\vartheta_2\phi_1-\vartheta_1\phi_2\right)=\Im_\downarrow\equiv\begin{pmatrix}\vartheta_2\phi_1\\-\vartheta_1\phi_2\end{pmatrix}\end{array}\right.\end{array} \tag{B.3}$$

The change of notation indicates fundamentally that the spin is not part of the tensor product of two spaces, as in Equation (B.2), but of an inner product. For this product we do not use the eigenvectors of the Pauli matrices in the direction of motion, for the z axis, but in a different basis, which would be the one corresponding to those carriers, which is intrinsic to the physical system with the vectors $S_\Uparrow=\begin{pmatrix}\phi_2&\phi_1\end{pmatrix}$ and $S_\Downarrow=\begin{pmatrix}\phi_1&\phi_2\end{pmatrix}$, from which a transformation matrix would be derived. Vectors that would do nothing more than physically characterize by means of the carriers, in the form $1 \equiv e^{+i(N)}$ and $0 \equiv e^{-i(N)}$, the states of the base, from the combination of which one or the other direction in the circulation of these carriers is determined, which we can identify with an angular movement in the toroid and, consequently, with the two states of the intrinsic angular momentum that it embodies.

3 Eigenvectors for positive energy in direction $\mathbf{z}$:

$$\{\omega_1, \omega_2\} = \frac{1}{\sqrt{\varepsilon^2 + (pc)^2}} \left\{ \begin{bmatrix} pc \\ 0 \\ \varepsilon \\ 0 \end{bmatrix}, \begin{bmatrix} 0 \\ pc \\ 0 \\ -\varepsilon \end{bmatrix} \right\} \tag{B.4}$$