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The Energy Origin of Mass

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Abstract

The concept of mass manifests in diverse forms, dimensions and configurations, and yet among all these manifestations, a unified origin is usually yearned for. This study aims to propose models that attribute the emergence of mass from fundamental quantities of physics, notably energy, space, and time. To this end, an operator is introduced, wherein these fundamental concepts serve as inputs, yielding functions that characterise mass. These functions are grounded in the domain of complex numbers, augmented by the incorporation of probabilistic elements, facilitating a nuanced depiction of mass modulation. Through investigation, it becomes apparent that a corollary energy field arises surrounding mass, facilitating its interactions within its surroundings. Ultimately, the comprehensive model of mass, inclusive of its associated field, gives rise to interactions with other masses, thereby engendering the genesis of larger and denser manifestations of mass, a phenomenon expounded within this framework.

Keywords

Energy, Energy Mass, Energy Field, Complex Probabilistic Mass

1. Introduction

The nature of mass has long intrigued individuals, prompting speculation regarding its constituent "material" or "substance". Predominantly acknowledged is the view that mass comprises particles organised in distinct configurations, with various models elucidating this structure. A fundamental inquiry arises: Can a frequency be identified to resonate with mass, thereby disassembling its constituent particles, or even more fundamentally, its constituent sub-particles? What phenomena would ensue in such a scenario? This paper embarks on addressing these queries by leveraging foundational principles and constructs of physics to formulate a model that engenders the generation of mass.

Initiating this endeavour necessitates the establishment of a model conducive to the desired outcome. Given the aim of discerning the composition of mass, a generic model termed the "Mass Generator" is introduced. Conceived with the objective of accepting inputs and yielding mass (m), it is crucial to underscore within this framework that m is construed as a derivative concept, rather than a fundamental entity. To ascertain the inputs requisite for the operation of the generator, fundamental principles of physics are invoked, thereby imbuing the Mass Generator with the capacity to synthesise m. A procedural framework is devised wherein the Mass Generator assumes a structured format, yielding a generic function. Pertinently, the incorporation of probability emerges as a pivotal consideration. Given its pervasive influence in myriad facets of existence, probability is integrated into the function via complex number theory, establishing a domain conducive to probabilistic approaches towards m generation.

The amalgamation of methodologies culminates in the subsequent segment of this study, wherein the implementation of the Mass Generator onto the exponential and Euler's functions of complex numbers yields models delineating m. For expediency in subsequent discourse, a concise symbol, denoted as m, is adopted to represent the generated outcomes. Initially, the execution of the Mass Generator engenders a generic model aligning with anticipated outcomes. However, detailed scrutiny necessitates further analysis due to predefined domains, ultimately reaffirming congruence between the outcomes of both procedures.

To elucidate the interaction of concepts underlying m generation and the internal processes therein, an in-depth analysis is undertaken. The resultant models not only enrich the present discourse, but also furnish valuable insights for subsequent research. Notably, factors are substituted with conceptual descriptors, shedding light on their interactions within m and their surroundings.

This elucidation of conceptual interactions propels exploration into previously unconsidered elements, notably the energy field. This field encapsulates the dynamics of m interaction with its ambient energy, with various components (e.g. divergence, curl, temporal variation) subjected to analysis, accompanied by the introduction of corresponding functions. It is evidenced that a direct correlation exists between the attributes of m and the energy field, dictating their behavioural characteristics.

Subsequently, m and the energy field coalesce into a unified conceptual framework denoted as [mass], or [m]. A mechanism is postulated to attribute the progression of [mass] from its nascent state to more intricate and expansive forms. Finally, considering the capacity of [masses] to assemble into complex configurations, a categorisation methodology is proposed to classify these emergent structures.

2. Methodology

In the methodology section, the foundational procedure is established, serving as the cornerstone upon which the models of m are constructed. Central to the generation of m is the establishment of an appropriate function, facilitated by the

Mass Generator. This function necessitates predefined inputs to initiate the process of *m* creation. These requisite parameters are gleaned from the foundational tenets of physics and are identified using the dimensional analysis. The construction of the Generator is predicated upon the utilisation of the exponential and Eulerian expressions within the domain of complex numbers, augmented by the incorporation of probabilistic elements. The employment of this generic function culminates in the formulation of models that approximate the essence of *m*.

2.1. The Mass Generator

To ascertain a mathematical model capable of generating *m*, the introduction of a function termed the Mass Generator (represented as *Gm*) becomes imperative. The primary objective of this function is to accept the parameters inherent to *m*, effect modifications upon them, and subsequently yield the resultant *m*. A schematic depiction of this process is presented below:

$$(x_i) \rightarrow Gm(x_i) \rightarrow m(x_i) \tag{1}$$

where x_i is a quantity that is used as input to the *Gm* operator and $m(x_i)$ is the output of the *Gm*, *i.e.* the *m* that is produced and is related to the initial quantity x_i.

Equation (1) points out that mass is a product quantity, thus other quantities of physics must be assumed as fundamental in order to be inserted in the *Gm* and interact for the formation of mass. As a guidance, it is observed that mass is linked to energy, e.g. when mass moves, it is assigned kinetic energy. So, there must be a relation between these quantities, *i.e.* $m = c_m \cdot \varepsilon$. Further, two basic definitions of physics are used so that the quantities can be assigned through their measuring units. These definitions are the definition of Joule and that of Newton.

"1 Joule is the quantity of energy produced if a force of 1 Newton displaces its center for 1 meter".

While the definition of Newton (Nt) is:

"1 Newton is the force that is produced of a mass of 1 kg is accelerated by 1 meter by square second".

Based on the analysis so far, the concepts that most match with the observation mentioned here above, basis their units, and can be assumed as the fundamental quantities that can be used as inputs to form the mass, are the time (*t*) the energy (*ε*) and the space ($\vec{s}$). Then, the introduction of the fundamental concepts in the Mass Generator presents a schematic approach as follows:

$$(\varepsilon, \vec{s}, t) \rightarrow Gm(\varepsilon, \vec{s}, t) \rightarrow m(\varepsilon, \vec{s}, t) \tag{2}$$

Considering that the concepts interact, probably within an entity {O}, the Mass Generator is:

$$Gm(e, \vec{s}, t) = g(m) \pmb{\times} g(t) \pmb{\times} g(\varepsilon) \tag{3}$$

In which relation, the functions $g(*)$ are referred to as the concepts generators and the symbol ($\pmb{\times}$) denotes the operator of interaction of concepts. The generators are the functions that describe the manner in which each concept completes and interacts with other concepts for the formation of m within the entity {O}.

2.2. The Complex Expression of Concepts

The examination of m is conducted within the domain of complex numbers, with particular emphasis on the exponential expression. This choice is predicated upon the expansive nature of the complex number set, encompassing a vast array of solutions. Utilising this comprehensive set ensures the inclusion of all potential outcomes. Conversely, restricting the analysis to a smaller field, such as the real numbers, may result in insufficient information and an incomplete depiction of the phenomenon under investigation. Besides, even if the wider field, *i.e.* $\mathbb{C}$, initially contains more terms than necessary, the mathematical procedure will guide towards removing the unnecessary ones.

The exponential expression of a complex number is expressed as $z(\vartheta)$ and is expressed as $z(\vartheta) = z_0 \mathrm{e}^{i\theta}$ [1]-[3], in which $z_0 \geq 0, \in \mathbb{R}$ and $\vartheta \in \mathbb{R}$ is described in (rad). For the purposes of studying the generator, let us use the exponential expression:

$$g(\bar{y}) = g_0 \mathrm{e}^{i\vartheta(\bar{y})}, \tag{4}$$

so that $g(\bar{y}) : \mathbb{R}^n \to \mathbb{C}, n \in \mathbb{N}$ wherein g_0 is the magnitude of the generator and $\vartheta(\bar{y})$ denotes the argument that is affected by the concept $\bar{y}$. The concept $\bar{y}$ is measured in a certain unit, *i.e.* (unit), so, let us say $\bar{c}$, must be used in order to be converted into (rad) a factor, so that:

$$\vartheta(\bar{y}) = \bar{c} \bullet \bar{y}, \tag{5}$$

in which $\bar{c}$ is measured in $\frac{\text{rad}}{\text{unit}}$.

Special attention is accorded to the Euler's function:

$$c(\bar{y}) = \mathrm{e}^{i\vartheta(\bar{y})}, \tag{6}$$

which, in this instance, is referred to as the contributor of concept $\bar{y}$. The function in question, denoted as $c(\bar{y})$ is a non-dimensional complex function. It serves as the foundation for the conversion of the conceptual entity represented as {O} into a constituent that actively participates in the formation of m. Moreover, it stands as the central function upon which the creation of other functions is predicated.

The contributor can apply both to scalar and vector concepts as long as the term reflecting the argument $\vartheta(\bar{y})$ is formed, as indicated in relation (5). Generally, the contributors can be elucidated as $c(\bar{y})$, so that $c(\bar{y}) : \mathbb{R}^n \to \mathbb{C}, n \in \mathbb{N}$. It is understood that when $n = 1$, it corresponds to a scalar concept. In this case, the contributor is expressed as:

$$c(y) = \mathrm{e}^{icy}, \tag{7}$$

in which c signifies a constant and y represents a scalar concept set in the domain $A = [y_1, y_m] \subseteq \mathbb{R}$ and $m \in \mathbb{N}$. In this respect, the contributor is set $c(y) : D \subseteq \mathbb{R} \to B \subseteq \mathbb{R}$. Implementing (5) to (6), for the case wherein the concept

$\bar{y}$ is a vector, the contributor can be expressed as:

$$c(\bar{y}) = \mathrm{e}^{i\bar{c}\bullet\bar{y}} \quad [4], \tag{8}$$

in which $\bar{c}$ is a vector with constant values, *i.e.* $\bar{c} = (c_1, c_2, \cdots, c_n) \in \mathbb{R}^n$ and $\bar{y}$ is set $\bar{y} = (y_1, y_2, \cdots, y_n) \in \mathbb{R}^n$. Then, the contributor is set $c(\bar{y}): D \subseteq \mathbb{R}^n \to B \subseteq \mathbb{C}$.

The Mass Generator can be expressed as follows:

$$Gm(\varepsilon, \bar{s}, t) = g_t \times g_\varepsilon \times g_{\bar{s}} \times \mathrm{e}^{i\left[(\omega t + \alpha\varepsilon + \bar{k}\bullet\bar{s}) + (\varphi(t) + \varphi(\varepsilon) + \varphi(\bar{s}))\right]} \tag{9}$$

The result is that the function that describes *m* is:

$$m(\varepsilon, \bar{s}, t) = g_t \times g_\varepsilon \times g_{\bar{s}} \times \mathrm{e}^{i\left[(\omega t + \alpha\varepsilon + \bar{k}\bullet\bar{s}) + (\varphi(t) + \varphi(\varepsilon) + \varphi(\bar{s}))\right]} \tag{10}$$

considering:

$$g_t \to \frac{1}{\omega^2} : (\mathrm{s}^2)$$

$$g_\varepsilon \to \frac{1}{\alpha} : (\mathrm{J})$$

$$g_{\bar{s}} \to k^2 : \left(\frac{1}{\mathrm{m}^2}\right)$$

2.3. The Introduction of Probability

In order to describe the generic model, let us analyse the proposed way to insert the probability by considering a function $f(x)$, so that $x \in D = [x_0, x_n] \subseteq \mathbb{R}$ and $f(x): D \to B$, so that $B = [f(x_0), f(x_n)] \subseteq \mathbb{C}$. If the factor $b \in \mathbb{R}$ is introduced in $f(x)$, the latter will be transformed to function $f(bx)$. The result will change in this case, but the type of function remains unchanged, and the function operates in the same pattern for the entire domain.

Probability is introduced via the parameter *b*, which is regarded as a random variable; *b* receives values from a sample space denoted as Ω_b and possesses the attributes of one. In this case, the domain *D* is separated in sub-domains, *i.e.* $D = d_0 \cup d_1 \cup \cdots \cup d_n$, so that $d_{i-1} = [x_{i-1}, x_i]$. In each sub-domain, the value of *b* changes. When $f(bx)$ begins to run the domain d_{i-1}, an experiment of luck takes place and *b* receives a value from Ω_b, which for this case is $b_{k_{i-1}}$. It receives the value b_{k_i} in the next sub-domain ($d_i = [x_i, x_{i+1}]$). Given that the domains are closed, during each field a different factor b applies during each domain. During d_{i-1} the factor is b_{k-1} and applies until the latest point, *i.e.* x_i and the value of the function is $f((b_{k-1})x_i)$. Meanwhile, in the domain d_i, the factor that applies through the entire domain is b_{k_i} different $b_{k_{i-1}}$ ($b_{k_i} \neq b_{k_{i+1}}$) and applies from the first possible value, *i.e.* x_i. So, the value at the first point of domain d_i is $f((b_k)x_i)$. However, $f((b_{k-1})x_i) \neq f((b_k)x_i)$ which means that there is a discontinuity at that point. Considering the use of open domain of the form $(x_i, x_{i+1}]$ is one way of avoiding this. In this scenario, the function $f((b_{i-1})x)$ can receive the value $f((b_{i-1})x_i)$ at point x_i, soit ends at $f((b_{i-1})x_i)$ (since $x_i \in (x_{i-1}, x_i]$). On the other hand, the function $f((b_i)x)$ starts from $f((b_{i-1})x_i)$. Continuity at this single point can be ensured because $f(bx)$ is set to the entire domain $D=\left[[x_0,x_1]\cup(x_1,x_2]\cup\cdots\cup(x_{n-1},x_n]\right]$, which can be separated as $D=\left[[x_0,x_1]\cup(x_1,x_2]\cup\cdots\cup(x_{n-1},x_n]\right]$.

Probability and Generators

The combination of the previous paragraphs allows for the elucidation of m as a probabilistic function. Each generator is described in the following manner:

Time generator:

- The parameter g_t represents a random variable with sample $\Omega_{g_t}:\Omega_{g_t}\to\left[g_{t,\min},g_{t,\max}\right]\subseteq\mathbb{R}$, where $\mathbb{R}$ is the set of real numbers, distribution $f(g_t)$, mean value μ_{g_t} and dispersion $\sigma_{g_t}^2$ [5]-[7].
- ω is a random variable with a sample space $\Omega_\omega:\Omega_\omega\to[\omega_{\min},\omega_{\max}]\subseteq\mathbb{R}^*$, where $\mathbb{R}$ is the set of real numbers, distribution $f(\omega)$, mean value μ_ω and dispersion σ_ω^2 [5]-[7].
- The time generator is set as $g(t):T\geq 0\subseteq\mathbb{R}\to\mathbb{C}$, so that $T=\left\{[t_0,t_1]\cup\cdots\cup(t_{k-1},t_k]\right\}$.

Space generator:

- The parameter $g_{\vec{s}}$ signifies a random variable with sample space $\Omega_{g_{\vec{s}}}:\Omega_{g_{\vec{s}}}\to\left[g_{\vec{s},\min},g_{\vec{s},\max}\right]\subseteq\mathbb{R}$, where $\mathbb{R}$ is the set of real numbers, distribution $f(g_{\vec{s}})$, mean value $\mu_{g_{\vec{s}}}$ and dispersion $\sigma_{g_{\vec{s}}}^2$ [5]-[7].
- $\vec{k}$ denotes a random variable with a sample space $\Omega_{\vec{k}}:\Omega_{\vec{k}}\to\left[\vec{k}_{\min},\vec{k}_{\max}\right]\subseteq\mathbb{R}^n$, where $\mathbb{R}$ is the set of real numbers, distribution $f(\vec{k})$, mean value $\mu_{\vec{k}}$ and dispersion $\sigma_{\vec{k}}^2$ and n is the number of dimensions of the space that $\vec{k}$ is set, $n\in\mathbb{N}$ [5]-[7].
- The space generator is set as $g(\vec{s}):S\subseteq\mathbb{R}^n\to\mathbb{C}$, so that $S=\left\{\left[x_{1,0},x_{1,2}\right]\cup\cdots\cup\left(x_{1,k-1},x_{1,k}\right]\times\cdots\times\left[x_{n,0},x_{n,1}\right]\cup\cdots\cup\left(x_{n,k-1},x_{n,k}\right]\right\}$.

Energy generator:

- The parameter g_ε signifies a random variable with sample space $\Omega_{g_\varepsilon}:\Omega_{g_\varepsilon}\to\left[g_{\varepsilon,\min},g_{\varepsilon,\max}\right]\subseteq\mathbb{R}$, where $\mathbb{R}$ is the set of real numbers, distribution $f(g_\varepsilon)$, mean value μ_{g_ε} and dispersion $\sigma_{g_\varepsilon}^2$ [5]-[7].
- α is a random variable with a sample space $\Omega_\alpha:\Omega_\alpha\to[\alpha_{\min},\alpha_{\max}]\subseteq\mathbb{R}^*$, where $\mathbb{R}$ is the set of real numbers, distribution $f(\alpha)$, mean value μ_α and dispersion σ_α^2 [5]-[7].
- The energy generator is set as $g(\varepsilon):\varepsilon\subseteq\mathbb{R}\to\mathbb{C}$, so that $\varepsilon=\left\{[\varepsilon_0,\varepsilon_1]\cup\cdots\cup(\varepsilon_{k-1},\varepsilon_k]\right\}$.

2.4. The Domain of Mass Generator Function

Let us consider a function $g(\theta)=g_0e^{i\theta}$. Following the steps so far, it can be inferred that $\theta=\omega\cdot t+\vec{k}\bullet\vec{s}+\alpha\cdot\varepsilon+\varphi_i$, and $g_0=g_t\times g_{\vec{s}}\times g_\varepsilon$, and the complex function is expressed as follows:

$$g(\varepsilon,\vec{s},t)=g_t\times g_{\vec{s}}\times g_\varepsilon\times e^{i\left(\omega\cdot t+\vec{k}\bullet\vec{s}+\alpha\cdot\varepsilon+\varphi_i\right)} \tag{11}$$

so that $g(\varepsilon,\vec{s},t):[\theta_0,\theta_N]\subset\mathbb{R}\to B\subset\mathbb{C}$, considering that: $t\in[t_0,t_k]\subset\mathbb{R},t_0\geq 0$ and $\varepsilon\in[\varepsilon_0,\varepsilon_k]\subset\mathbb{R}$ and $\vec{s}\in\left[x_{1,0},x_{1,k}\right]\times\left[x_{2,0},x_{2,k}\right]\times\cdots\times\left[x_{n,0},x_{n,k}\right]\subseteq\mathbb{R}^n$.

The domain to be examined is $\Theta=[\theta_0,\theta_n]$. When $g(\varepsilon,\vec{s},t)$ starts running in Θ, an experiment of luck takes place at the beginning of the domain and the parameters $g_t, g_{\vec{s}}, g_\varepsilon, \omega, \vec{k}, \alpha$ and φ_i take an initial value, *i.e.* $g_{t0}, g_{\vec{s}0}, g_{\varepsilon 0}, \omega_0, \vec{k}_0, \alpha_0$. Then, the domain's initial value is calculated as $\theta_0 = \omega_0 \cdot t_0 + \vec{k}_0 \bullet \vec{s}_0 + \alpha_0 \cdot \varepsilon_0 + \varphi_i$, having received the values $t_0, \vec{s}_0$ and ε_0, from *T*, *S* and $\mathcal{E}$. The initial value of $g(\theta)$ is:

$$g(\theta_0) = g_{t0} \times g_{\vec{s}0} \times g_{\varepsilon 0} \times \mathrm{e}^{i(\omega_0 \cdot t_0 + \vec{k}_0 \bullet \vec{s}_0 + \alpha_0 \cdot \varepsilon_0 + \varphi_i)} \tag{12}$$

As $g(\varepsilon, \vec{s}, t)$ continues running in Θ, it also runs the domains *T*, *S*, and $\mathcal{E}$, so that each parameter processes in this domain. During this process, experiments of luck are performed in the subdomains and the factors $g_t, g_{\vec{s}}, g_\varepsilon, \omega, \vec{k}$ and α receive varying values, as mentioned in Paragraph 2.3. In this context, the function $g(\theta)$ receives different values and takes its probabilistic form.

2.5. The Behaviour of Concepts

The integration of the contributor provides the behaviour function $\vec{b}(\vec{y})$, so that $\vec{b}(\vec{y}): \mathbb{R}^n \to \mathbb{C}^n, n \in \mathbb{N}$, which explicates how the concept acts within the place {O}. In the case that *n* = 1, the behaviour refers to scalar functions, which are calculated as follows for time and energy:

$$b(t) = -\frac{i}{\omega}\left(\mathrm{e}^{i\omega t} + \mathrm{e}^{i\omega t_1}\right), t \geq 0, \omega \in \mathbb{R} \text{ and } \omega \neq 0 \text{ and } t_1 \in \mathbb{R} \text{ for time} \tag{13}$$

and

$$b(\varepsilon) = -\frac{i}{\alpha}\left(\mathrm{e}^{i\alpha\varepsilon} + \mathrm{e}^{i\alpha\varepsilon_1}\right), \varepsilon \in \mathbb{R}, \alpha \in \mathbb{R} \text{ and } \alpha \neq 0 \text{ and } \varepsilon_1 \in \mathbb{R} \text{ for energy} \tag{14}$$

considering that the time contributor is $c(t) = \mathrm{e}^{i\omega t}$ and the energy contributor is $c(\varepsilon) = \mathrm{e}^{i\alpha\varepsilon}$.

The space behaviour is calculated after indefinite integration is implemented over the contributor on tis vector format, *i.e.*:

$$\vec{b}(\vec{s}) = \left(-i\frac{c_1}{k_1}\mathrm{e}^{i\vec{k} \bullet \vec{s}} + \gamma_1, -i\frac{c_2}{k_2}\mathrm{e}^{i\vec{k} \bullet \vec{s}} + \gamma_2, -i\frac{c_3}{k_3}\mathrm{e}^{i\vec{k} \bullet \vec{s}} + \gamma_3\right) \tag{15}$$

where c_1, c_2 and c_3 are constants so that c_1, c_2 and $c_3 \in \mathbb{R}$

2.6. The Generators of Concepts

The considerations outlined thus far provide insights into the direction that warrants attention for crafting a more intricate model of *m*. By employing relation (9) as a guiding principle and employing mathematical techniques like integration, the generation of each concept's generator can be computed based on its contributing factors.

2.6.1. The Energy Generator

Upon observing *m*, it becomes apparent that each individual unit possesses a distinct quantity. This observation prompts the consideration that a specific amount of energy is encapsulated within each *m* unit. To determine the total energy quantity, integration can be employed as a method of calculation.

Let us assume that the energy captured in a portion of *m* which is necessary for retaining this quantity of *m* lies between ε_1 and ε_2, thus creating a domain $\mathrm{E} = [\varepsilon_1, \varepsilon_2] \subseteq \mathbb{R}$. Therefore, the total energy is calculated as:

$$g(\varepsilon_c) = \int_{\varepsilon_1}^{\varepsilon_2} \mathrm{e}^{i\alpha\varepsilon} \mathrm{d}\varepsilon = \frac{i}{\alpha}\left(\mathrm{e}^{i\alpha\varepsilon_1} - \mathrm{e}^{i\alpha\varepsilon_2}\right), \alpha \in \mathbb{R} \setminus \{0\} \tag{16}$$

whereas a compact format is:

$$g(\varepsilon_c) = g_{\varepsilon,c} \mathrm{e}^{i\theta(\varepsilon_c)} \tag{17}$$

considering:

$$g_{\varepsilon,c} = \frac{2}{\alpha} \sin\left(\frac{\alpha}{2}(\varepsilon_2 - \varepsilon_1)\right), \alpha \in \mathbb{R} \setminus \{0\} \tag{18}$$

and

$$\theta(\varepsilon_c) = \frac{\alpha}{2}(\varepsilon_2 - \varepsilon_1) \tag{19}$$

Additionally, considering a domain $[\varepsilon_1, \varepsilon] \subseteq \mathrm{E}$, the generic model describing the movements of energy within E is:

$$g(\varepsilon) = g_\varepsilon \mathrm{e}^{i\theta(\varepsilon)} \tag{20}$$

considering:

$$g_\varepsilon = \frac{2}{\alpha} \sin\left(\frac{\alpha}{2}(\varepsilon - \varepsilon_1)\right), \alpha \in \mathbb{R} \setminus \{0\} \tag{21}$$

and

$$\theta(\varepsilon) = \frac{\alpha}{2}(\varepsilon + \varepsilon_1) \tag{22}$$

Some important findings emerge from both these relations:

- Though the energy is defined in domain $[\varepsilon_1, \varepsilon_2]$, the energy generator continues to follow the probabilistic model of Paragraph 2.1, so, the factor *α* changes at smaller domains since it takes values from its sample space.
- The domain that the function operates, and the integration applies is $[\varepsilon_1, \varepsilon_2]$, thus setting a minimum level of energy. The implication is that a minimum quantity of energy is required to create quantity of *m*. The value ε_1 can also be zero (0), which also yields a valid result. This means that it is possible to create this piece of *m* starting from null energy.
- The coefficient $\frac{1}{\alpha}$ is specific to this type of mass and expresses the unary energy of this mass. The probabilistic aspect remains as elucidated in Paragraph 2.1.
- Notably, the energy contributor, *c*(*ε*), in this case, expresses the derivative of the energy factor which essentially implies that there is a rate of energy change at the point of *m* creation.

2.6.2. The Time Generator

When observing *m*, it becomes evident that the influence of time extends beyond a confined time domain; rather, it manifests as a continuous phenomenon. Furthermore, there are instances where time exerts diminishing effects on certain types of m, a characteristic contingent upon the specific nature of the m in question. Given these observations, the deployment of the time generator is examined in a continuous manner, thereby precluding the application of definite integration.

The description provided in Equation (13) inadequately characterises the time generator, as the magnitude of g_t should be (s^2). Consequently, the time generator is computed through infinite integration over the behaviour of time, as follows:

$$g(t) = -\frac{1}{\omega^2}\left(\mathrm{e}^{i\omega t} - \omega^2 C_1' \mathrm{e}^{i\omega t_1} t - \omega^2 C_2' \mathrm{e}^{i\omega t_1}\right), t \geq 0 \tag{23}$$

$$C_1 = -\omega^2 C_1' \mathrm{e}^{i\omega t_1} t, C_1' \in \mathbb{R}\text{, so that } C_1' \text{ is measured in units of (s)} \tag{24}$$

$$C_2 = -\omega^2 C_2' \mathrm{e}^{i\omega t_1}, C_2' \in \mathbb{R} \text{ and } C_2' \geq 0\text{, so that } C_2' \text{ is measured in units of (s}^2\text{)} \tag{25}$$

Whereas a more compact format is:

$$g(t) = g_t \mathrm{e}^{i\theta(t)} \tag{26}$$

so that:

$$g_t = |g(t)| = \sqrt{\frac{1}{\omega^4} + (C_1' t + C_2)^2 - \frac{2}{\omega^2}(C_1' t + C_2')\cos(\omega(t - t_1))}, |g(t)| \geq 0 \tag{27}$$

and

$$\tan(\theta(t)) = \frac{\sin(\omega t) - \omega^2 (C_1' t + C_2')\sin(\omega t_1)}{\cos(\omega t) - \omega^2 (C_1' t + C_2')\cos(\omega t_1)} \tag{28}$$

2.6.3. The Space Generator

Mass is a scalar concept, which implies that the space generator must also be a scalar function. In addition, the correct unit must be applied so that m can be described properly. The behaviour of space is given in relation (15) and it is:

$$\vec{b}(\vec{s}) = \left(-i\frac{c_1}{k_1}\mathrm{e}^{i\vec{k}\cdot\vec{s}} + \gamma_1, -i\frac{c_2}{k_2}\mathrm{e}^{i\vec{k}\cdot\vec{s}} + \gamma_2, -i\frac{c_3}{k_3}\mathrm{e}^{i\vec{k}\cdot\vec{s}} + \gamma_3\right) \tag{29}$$

Put succinctly, to calculate the space generator, it is considered that the vector $\vec{b}(\vec{s})$, can derive form a scalar function considering [8]-[10]:

$$\vec{b}(\vec{s}) = \nabla G(\vec{s}) \tag{30}$$

in which $G(\vec{s})$ is a scalar function so that $G(\vec{s}): \mathbb{R}^3 \to \mathbb{C}$.

The space generator is calculated as a function extracted after indefinite integration over the behaviour $\vec{b}(\vec{s})$, *i.e.*:

$$g(\vec{s}) = -|\vec{\kappa}|^2 \mathrm{e}^{i\vec{k}\cdot\vec{s}} \tag{31}$$

where:

$$|\vec{\kappa}|^2 = \left(\frac{k_1^2 k_2^2 k_3^2}{k_1^2 k_2^2 + k_2^2 k_3^2 + k_3^2 k_1^2}\right) \tag{32}$$

whereas the generic format is:

$$g'(\vec{s}) = -g_{\vec{s}}{}' \mathrm{e}^{i\theta(\vec{s})} \tag{33}$$

so that:

$$g_{\vec{s}}{}' = |g(s)| = \frac{1}{\sqrt{c_\kappa^2 + \left(\lambda \vec{k} \bullet \vec{s} + \lambda_\nu\right)^2 - 2c_\kappa \lambda \left(\vec{k} \bullet \vec{s} + c_\lambda\right) \cos\left(\vec{k} \bullet (\vec{s} - \vec{s}_0)\right)}} \tag{34}$$

and

$$\tan\theta(\vec{s}) = \frac{-c_\kappa \sin\left(\vec{k} \bullet \vec{s}\right) + \lambda\left(\vec{k} \bullet \vec{s} + c_\lambda\right) \sin\left(\vec{k} \bullet \vec{s}_0\right)}{-c_\kappa \cos\left(\vec{k} \bullet \vec{s}\right) + \lambda\left(\vec{k} \bullet \vec{s} + c_\lambda\right) \cos\left(\vec{k} \bullet \vec{s}_0\right)} \tag{35}$$

A function $G(\vec{s})$ that that satisfies (34) is calculated as follows:

$$G(s) = -\left(\frac{k_1^2 k_2^2 + k_2^2 k_3^2 + k_3^2 k_1^2}{k_1^2 k_2^2 k_3^2}\right) \mathrm{e}^{i\vec{k} \bullet \vec{s}} \tag{36}$$

Whereas the generic format is:

$$G'(\vec{s}) = \left|G'(\vec{s})\right| \mathrm{e}^{i\theta_{\vec{s}}} \tag{37}$$

In which:

$$\left|G'(\vec{s})\right| = \sqrt{\left(c_\kappa\right)^2 + \left(\lambda \vec{k} \bullet \vec{s} + \lambda_\nu\right)^2 - 2c_\kappa \lambda \left(\vec{k} \bullet \vec{s} + c_\lambda\right) \cos\left(\vec{k} \bullet (\vec{s} - \vec{s}_0)\right)} \geq 0 \tag{38}$$

and

$$\tan\theta(\vec{s}) = \frac{-c_\kappa \sin\left(\vec{k} \bullet \vec{s}\right) + \lambda\left(\vec{k} \bullet \vec{s} + c_\lambda\right) \sin\left(\vec{k} \bullet \vec{s}_0\right)}{-c_\kappa \cos\left(\vec{k} \bullet \vec{s}\right) + \lambda\left(\vec{k} \bullet \vec{s} + c_\lambda\right) \cos\left(\vec{k} \bullet \vec{s}_0\right)} \tag{39}$$

and

$$c_\kappa = \left(\frac{k_1^2 k_2^2 + k_2^2 k_3^2 + k_3^2 k_1^2}{k_1^2 k_2^2 k_3^2}\right) \tag{40}$$

Finally, another function that must be included is $H(\vec{s})$, which is related to the inverted space contributor $ɔ(s) = \mathrm{e}^{-i\vec{k} \bullet \vec{s}}$ (41), $ɔ$: $A \subseteq \mathbb{R}^n \to D \subseteq \mathbb{C}$. It is then:

$$H(s) = \left(\frac{k_1^2 k_2^2 + k_2^2 k_3^2 + k_3^2 k_1^2}{k_1^2 k_2^2 k_3^2}\right) \mathrm{e}^{-i\vec{k} \bullet \vec{s}} \tag{42}$$

so that [8]-[10]:

$$\nabla^2 H(s) = \mathrm{e}^{-i\vec{k} \bullet \vec{s}} \tag{43}$$

While the generic format is as follows:

$$H'(\vec{s}) = h(\vec{s}) \mathrm{e}^{-i\theta(\vec{s})} \tag{44}$$

so that $h(\vec{s})$ is a scalar function assigned $\mathbb{R}^3 \to \mathbb{C}$.

In this case, it is:

$$\nabla^2 H'(\vec{s}) = \mathrm{e}^{-i\theta(\vec{s})} \sum_{\mathrm{a}=1}^{3} f_{\mathrm{a}} \tag{45}$$

considering:

$$f_{\mathrm{a}} = \mathrm{e}^{-i\theta(\vec{s})}\left(\frac{\partial^2}{\partial x_{\mathrm{a}}^2}h(\vec{s})+\frac{\partial}{\partial x_{\mathrm{a}}}h(\vec{s})\frac{\partial}{\partial x_{\mathrm{a}}}\left(-i\theta(s)\right)+h(\vec{s})\left(\frac{\partial}{\partial x_{\mathrm{a}}}\left(-i\theta(\vec{s})\right)\right)^2+h(\vec{s})\frac{\partial^2}{\partial x_{\mathrm{a}}^2}\left(-i\theta(\vec{s})\right)\right) \tag{46}$$

so that $a = 1, 2, 3$ in a 3-dimensional Euclidian space.

Finally:

$$\mathrm{e}^{-i\theta(\vec{s})} = \frac{1}{f(\vec{s})}\nabla^2 H'(\vec{s}), f(\vec{s}) \neq 0$$

so that:

$$f(\vec{s}) = \sum_{\mathrm{a}=1}^{n} f_{\mathrm{a}} \tag{47}$$

considering a n-dimensional space.

3. Results

The implementation of the methodology yields various expressions of *m*, alongside the identification of the energy field enveloping *m*. Additionally, a mechanism elucidating the composition of larger and denser forms of *m* is elucidated.

3.1. The Models of Mass

The objective of this section is to formulate the model of *m*. Following the elucidation of the methodology and the computation of the requisite factors and generators necessary for composing the model of *m*, this section amalgamates this information to construct the model. The section is divided into two parts: the first part considers the composition of *m* from its constituent components, while the second part explores the behaviour of *m* within specific constraints.

3.1.1. The Composition of the Model of Mass

Let us consider the formation of a specific quantity of *m*. This *m* component must embody a certain quantum of energy influenced by temporal interaction within space. Although time contributes to *m* creation and exerts an ongoing influence, it is not bound by any limitations and continues to affect *m* thereafter.

In this case, the generators are combined to create *m*:

$$m(\varepsilon,\vec{s},t) = g(t)\cdot g(\varepsilon)\cdot g(\vec{s}) \tag{48}$$

The outcome comprises the generation of several relationships delineating *m*, among which three are of paramount significance and are outlined below. The primary model, denoted as the general model, is expressed as:

$$m(\varepsilon,\vec{s},t) = |\mu_A|\mathrm{e}^{i\varphi_{\mu_A}} - |\mu_B|\mathrm{e}^{i\varphi_{\mu_B}} \tag{49}$$

considering:

$$|\mu_A(\varepsilon)| = \mu_{0,\varepsilon} = 2\frac{|\vec{\kappa}|^2}{\alpha\omega^2}\sin\left(\frac{\alpha}{2}(\varepsilon-\varepsilon_1)\right) \geq 0 \tag{50}$$

and

$$\varphi_{\mu_A} = \omega t - \vec{k} \bullet \vec{s} + \frac{\alpha}{2}\left(\varepsilon_1 + \varepsilon\right) + \varphi \tag{51}$$

Also:

$$\left|\mu_B\left(\varepsilon\right)\right| = 2\frac{\left|\vec{\kappa}\right|^2}{\alpha\omega^2}\sin\left(\frac{\alpha}{2}\left(\varepsilon - \varepsilon_1\right)\right)\omega^2\left(C_1' t + C_2'\right) \geq 0 \tag{52}$$

and

$$\varphi_{\mu_B} = \omega t_1 - \vec{k} \bullet \vec{s} + \frac{\alpha}{2}\left(\varepsilon_1 + \varepsilon\right) + \varphi \tag{53}$$

This format attributes the dual nature of *m*, encompassing both its particulate and wave manifestations, with the second component denoting fluctuations in space and energy, influenced continuously by the passage of time.

The second model is expressed as:

$$m\left(\varepsilon, \vec{s}, t\right) = \frac{1}{\left(\omega_\varepsilon - \omega_{s^2}\right)^2}\frac{\varepsilon_0}{s_0^2}\left(\mathrm{e}^{i\left(\omega_\varepsilon - \omega_{s^2}\right)t} - \left(\omega_\varepsilon - \omega_{s^2}\right)^2 \mathrm{e}^{i\left(\omega_\varepsilon - \omega_{s^2}\right)t_1}\left(C_1' t + C_2'\right)\right)\mathrm{e}^{i\left(\varphi - \vec{k} \bullet \vec{s}\right)} \tag{54}$$

This relation comprises the factor $\frac{1}{\left(\omega_\varepsilon - \omega_{s^2}\right)^2}$, which indicates that it is possible to tune *m*.

The generic formats describing *m* and are similar to what was expected are:

$$m\left(\varepsilon, \vec{s}, t\right) = \mu_{0,c}\mathrm{e}^{i\left(\theta\left(\varepsilon_c\right) + \theta\left(t\right) - \theta\left(\vec{s}\right) + \varphi\right)} \tag{55}$$

so that:

$$\mu_{0,c} = g_\varepsilon g_t g_{\vec{s}}' \geq 0 \tag{56}$$

The utilisaiton of the generic format of energy generator provides:

$$m\left(\varepsilon, \vec{s}, t\right) = \mu_{0,g}\mathrm{e}^{i\left(\theta\left(\varepsilon\right) + \theta\left(t\right) - \theta\left(\vec{s}\right) + \varphi\right)} \tag{57}$$

setting:

$$\mu_{0,g} = g_\varepsilon g_t g_{\vec{s}}' \geq 0 \tag{58}$$

The parameters that are introduced in the relations are:

$t \in \left[t_j, t_k\right] \subseteq \mathbb{R}$, where $t_j < t_k$ and $t_j \geq 0$.

$\vec{s} = \vec{s}\left(x_1, \cdots, x_n\right)$ set to $D = \left[x_{1,j}, x_{1,k}\right] \times \left[x_{2,j}, x_{2,k}\right] \times \cdots \times \left[x_{n,j}, x_{n,k}\right] \subseteq \mathbb{R}^n$.

$\varepsilon \in \left[\varepsilon_j, \varepsilon_k\right] \subseteq \mathbb{R}$, where $\varepsilon_j < \varepsilon_k$.

φ is a phase difference.

μ_0 is a random variable composed from the other random variables $\left(\omega, \vec{k}, \alpha, \varepsilon\right)$ with sample space $\Omega_{\mu_{0,\varepsilon}} : \Omega_{\mu_{0,\varepsilon}} \to \left[\mu_{0,\varepsilon,\min}, \mu_{0,\varepsilon,\max}\right] \subseteq \mathbb{R}^+$, where $\mathbb{R}$ the set of real numbers, distribution $f\left(\mu_{0,\varepsilon}\right)$, mean value $\mu_{\mu_{0,\varepsilon}}$, dispersion $\sigma_{\mu_{0,\varepsilon}}^2$, measured in (kg) and defined as $\mu_{0,\varepsilon} = 2\frac{\left|k\right|^2}{\alpha\omega^2}\sin\left(\frac{\alpha}{2}\left(\varepsilon_1 - \varepsilon\right)\right)$ and a summary of the probabilistic components is in the following manner:

ω represents a random variable with a sample space $\Omega_\omega : \Omega_\omega \to \left[\omega_{\min}, \omega_{\max}\right] \subseteq \mathbb{R}^*$, where $\mathbb{R}$ denotes the set of real numbers, distribution $f(\omega)$, mean value μ_ω and dispersion σ_ω^2 and measured in rad/s [5]-[7].

$\vec{k}$ denotes a random variable with a sample space $\Omega_{\vec{k}}:\Omega_{\vec{k}}\to\left[\vec{k}_{\min},\vec{k}_{\max}\right]\subseteq\mathbb{R}^n$, where n signifies the number of dimensions that the vector is set, distribution $f(\vec{k})$, mean value $\mu_{\vec{k}}$ and dispersion $\sigma_{\vec{k}}^2$ and measured in rad/m [5]-[7].

α is a random variable with a sample space $\Omega_\alpha:\Omega_\alpha\to[a_{\min},\alpha_{\max}]\subseteq\mathbb{R}^*$, where $\mathbb{R}$ is the set of real numbers, distribution $f(\alpha)$, mean value μ_α and dispersion σ_α^2 and measured in rad/J [5]-[7].

φ is a random variable with a sample space $\Omega_\varphi:\Omega_\varphi\to[\varphi_{\min},\varphi_{\max}]\subseteq\mathbb{R}$, where $\mathbb{R}$ signifies the set of real numbers, distribution $f(\varphi)$, mean value μ_φ and dispersion σ_φ^2 and measured in (rad) [5]-[7].

$C_1'\in\mathbb{R}$ and $C_2'\geq 0$ and $C_2'\in\mathbb{R}$.

The methodology employed thus far, involving the incorporation of complex numbers in the probabilistic m generation process, demonstrates that m can indeed arise from the interplay between time, space, and energy. The introduction of contributors has facilitated the integration of concepts into the m formation process, each contributing in a distinct manner. The energy contributor has been utilised to attribute the rate of change of the energy generator, leading to the establishment of a specific energy quantity within m through definite integration. The space generator functions as a scalar function, indicating the manner in which the spatial vector can be configured to participate in m formation. Lastly, the time contributor emerges as the second derivative of the time generator, essentially representing the acceleration of time, which consequently impacts the form and magnitude of m. m is depicted across various models, stemming from the initial interaction of generators and culminating in the most generic model akin to that considered in the methodology. This serves as validation of the initial premise.

At this infant level, m can be named as point energy mass (pem), in order to distinguish from the general concept of m.

Other conclusions drawn from the analysis thus far include:

- The factor ω is produced by the interaction of space and energy, which, in turn, is made apparent in the term $r_\omega=\dfrac{1}{\left(\omega_\varepsilon-\omega_{s^2}\right)^2}$ as proven in relation (54).

  When these values are equal, tuning between space and energy can occur, which results in m decomposition and the release of the energy forming it, thereby addressing one of the basic queries of this paper. Accordingly, the term $r_\alpha=\dfrac{1}{\alpha}$, can be analysed as $r_\alpha=\dfrac{1}{a_t+\alpha_{s^2}}$ and indicates that in case $\alpha_t=-\alpha_{s^2}$, a similar interaction can take place between space and time energy factors. The analysis of these two terms contributes to the evidence of the interaction between the concepts.
- As expressed in (49), m comprises two terms. The term μ_A denotes the rudimentary part of the formation which is the core of m and sustains the existence of m through energy, time, and space. On the other hand, the part μ_B is

affected by the constants C_1' and C_2' (which are specific for each m). Thus, if their values are nil, only then does the μ_A core part remain. However, depending on their values, their effect on the m might be form negligible to significant. Hence, this part might not affect the m at all, but in case the formation of the m is not rigid, the time might contribute to its swift decomposition.

- In order for a complex number to be valid, its magnitude must be equal or above zero, e.g. $g_0 \geq 0$. However, given that m is a continuous concept, it cannot be implemented solely on these domains. The appearance of negative values within certain domains should not be interpreted as a negation of magnitude, but rather as an attribution to the m itself. This phenomenon is understandable when considering that energy is distributed throughout each portion of m. Therefore, the transition between negative and positive values signifies an energy interaction between the m and its surrounding field.
- Regarding the magnitude of space in its generic format, as expressed in equation (34) and subsequently inserted into Equations (56) and (58), it indicates a reverse relationship between the m and space. This implies that the farther the distance from the m, the lesser the effect exerted by the m.
- The validity of the dual format (particular and wave) is corroborated through the expressions derived from the analysis.

The findings confirm that m is indeed produced through the interaction between energy, space, and time. Furthermore, it is demonstrated that it is feasible to manipulate the m such that it undergoes decomposition. However, it is imperative to note that certain conditions within the surrounding environment may be necessary to facilitate this decomposition, warranting further investigation.

3.1.2. The Components of Mass

Following the format provided in relation (49), the real and imaginary components of m can be expanded utilising the trigonometric format. The inclusion of the energy variable ε, in addition to the space and time variables, is the advantage of this form, since a value of energy ε randomly chosen from the domain $[\varepsilon_1,\varepsilon]:[\varepsilon_1,\varepsilon]\subseteq[\varepsilon_1,\varepsilon_2]$, is used. Based on this analysis, it becomes apparent that each part is composed of other parts.

The real part of (49) is:

$$\begin{aligned}&\operatorname{Re}\left[m\left(\varepsilon,\vec{s},t\right)\right]\\&=\mu_{0,\varepsilon}\left(\cos\left(\omega t-\vec{k}\bullet\vec{s}+\frac{\alpha}{2}\varepsilon+\varphi'\right)-\omega^2\left(C_1't+C_2'\right)\cos\left(\frac{\alpha}{2}\varepsilon-\vec{k}\bullet\vec{s}+\varphi''\right)\right)\end{aligned}\tag{59}$$

which can be analysed as follows:

$$\begin{aligned}\operatorname{Re}_m=\mu_{0\varepsilon}\Big\{&\cos(\omega t)\cos\left(\vec{k}\bullet\vec{s}\right)\cos\left(\frac{\alpha}{2}\varepsilon\right)\cos(\varphi')-\cos(\omega t)\cos\left(\vec{k}\bullet\vec{s}\right)\sin\left(\frac{\alpha}{2}\varepsilon\right)\sin(\varphi')\\&+\cos(\omega t)\sin\left(\vec{k}\bullet\vec{s}\right)\sin\left(\frac{\alpha}{2}\varepsilon\right)\cos(\varphi')+\cos(\omega t)\sin\left(\vec{k}\bullet\vec{s}\right)\cos\left(\frac{\alpha}{2}\varepsilon\right)\sin(\varphi')\\&+\sin(\omega t)\sin\left(\vec{k}\bullet\vec{s}\right)\cos\left(\frac{\alpha}{2}\varepsilon\right)\cos(\varphi')-\sin(\omega t)\sin\left(\vec{k}\bullet\vec{s}\right)\sin\left(\frac{\alpha}{2}\varepsilon\right)\sin(\varphi')\end{aligned}$$

$$\begin{aligned}&-\sin(\omega t)\cos(\vec{k}\bullet\vec{s})\sin\left(\frac{\alpha}{2}\varepsilon\right)\cos(\varphi')-\sin(\omega t)\cos(\vec{k}\bullet\vec{s})\cos\left(\frac{\alpha}{2}\varepsilon\right)\sin(\varphi')\\&-\omega^2(C_1't+C_2')\bigg[\cos(\vec{k}\bullet\vec{s})\cos\left(\frac{\alpha}{2}\varepsilon\right)\cos(\varphi'')+\cos(\vec{k}\bullet\vec{s})\sin\left(\frac{\alpha}{2}\varepsilon\right)\sin(\varphi'')\\&+\sin(\vec{k}\bullet\vec{s})\sin\left(\frac{\alpha}{2}\varepsilon\right)\cos(\varphi'')-\sin(\vec{k}\bullet\vec{s})\cos\left(\frac{\alpha}{2}\varepsilon\right)\sin(\varphi'')\bigg]\bigg]\bigg\}\end{aligned}\tag{60}$$

3.2. The Energy Field

Due to this dynamic and probabilistic approach, the m cannot be perceived as isolated from its environment; it must engage with it. This observation is evident from the movement of each component. This oscillatory behaviour indicates that the m not only transfers energy to the environment but also reacts to it. This interaction of the m with its environment can be conceptualised as an area surrounding the m within which energy is exchanged between the m and its surroundings.

Considering that the field emanates from the m as a consequence of its energy interaction with the environment, it becomes imperative to ascertain the characteristics of the field and identify potential correlations with the m.

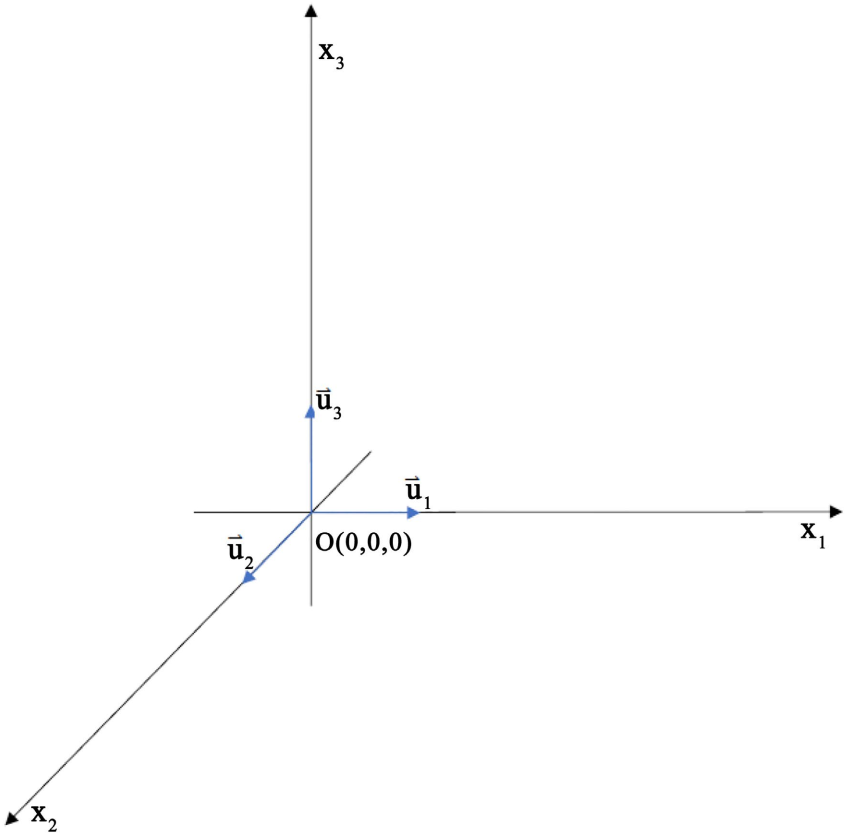

Figure 1. Presentation of a typical 3-dimensional Euclidian space.

The m is proven to be the source of an energy field ($\vec{\mathcal{F}}$) since it can be expressed as:

$$m\left(\varepsilon,\vec{s},t\right)=\varepsilon_0 c'\left(t,\vec{s}\right)\nabla^2\left(H'\left(\vec{s}\right)\right) \tag{61}$$

given:

$$\varepsilon_0=\frac{2}{\alpha}\sin\left(\frac{\alpha}{2}\left(\varepsilon_2-\varepsilon_1\right)\right)\mathrm{e}^{i\left(\frac{\alpha}{2}\left(\varepsilon_1+\varepsilon_2\right)\right)} \tag{62}$$

and

$$c'\left(t,\vec{s}\right)=\frac{1}{\omega^2}\frac{1}{f\left(\vec{s}\right)}g'_{\vec{s}}\left(\mathrm{e}^{i\omega t}-\omega^2\left(C'_1 t+C'_2\right)\mathrm{e}^{i\omega t_1}\right)\mathrm{e}^{i\varphi} \tag{63}$$

In this context, let us contemplate a scenario where, at a specific distance from the m and at a particular moment in time, the energy assumes a defined value. The most suitable function to articulate this relationship is the wave function, enabling the expression of energy in this region as a complex number utilising the exponential format, *i.e.*:

$$E\left(\vec{s},t\right)=E_0\mathrm{e}^{i\left(\omega_E t+\vec{k}_E\bullet\vec{s}_E+\varphi_E\right)} \tag{64}$$

Let us assume a point $\vec{s}=\left(x_1,x_2,x_2\right)$ in a Euclidian space $0x_1x_2x_3$, as described in **Figure 1**. The way in which the energy is transferred from the m to that point is through a field.

In a more generalised format, (64) can be expressed as:

$$E\left(\vec{s},t\right)=E_0\mathrm{e}^{i\left(\theta_E(t)+\theta_E(\vec{s})+\varphi_E\right)} \tag{65}$$

To devise a mathematical framework for delineating the interaction between the m and its environment, given that the m has been established as the origin of a field, it becomes imperative to introduce a novel parameter, called the "energy field" (or simply "field") which is defined by the symbol $\overrightarrow{\mathcal{F}}$. This concept elucidates the mechanism through which energy is generated by the m, dispersed into the surrounding space, and engages with the energy of the surrounding environment. This parameter takes the form of a vector, with measurement units denoting energy per unit length, that is, $[\overrightarrow{\mathcal{F}}]=\frac{E}{\vec{s}}=\frac{(\mathrm{J})}{(\mathrm{m})}=\frac{(\mathrm{kg})\cdot(\mathrm{m})}{\left(\mathrm{s}^2\right)}$, based on the S.I. system. It would not be unreasonable to infer that the field is the gradient of energy [11], that is:

$$\overrightarrow{\mathcal{F}}=\nabla E \tag{66}$$

The description of this field is premised on its characteristics, *i.e.* divergence, cult, time change, acceleration, and wave form. These characteristics have been summarised in **Table 1** and **Table 2**.

Table 1. The characteristics of the energy field based on the basic expression.

Size	Basic expression	Simplified model
Field	$\overrightarrow{\mathcal{F}}=\nabla E\left(\vec{s},t\right)$	$i\vec{k}_E E_0\mathrm{e}^{i\left(\omega_E t+\vec{k}_E\bullet s\right)}$ [11]

Continued

Divergence	$\nabla \bullet \overrightarrow{\mathcal{F}} = \frac{\mathrm{d}m^2}{\mathrm{d}t^2}$	$-\vec{k}_E^2 E_0 \mathrm{e}^{i\left(\omega_E t + \vec{k}_E \bullet \vec{s}\right)}$
Curl	$\nabla \times \overrightarrow{\mathcal{F}}$	0
Time change	$\frac{\mathrm{d}}{\mathrm{d}t} \overrightarrow{\mathcal{F}}$	$-\omega_E \vec{k}_E E_0 \mathrm{e}^{i\left(\omega_E t + \vec{k}_E \bullet \vec{s}\right)}$
Acceleration	$\frac{\mathrm{d}^2}{\mathrm{d}t^2} \overrightarrow{\mathcal{F}}$	$-i\omega_E^2 \vec{k}_E E_0 \mathrm{e}^{i\left(\omega_E t + \vec{k}_E \bullet \vec{s}\right)}$
Delta	$\nabla^2 \overrightarrow{\mathcal{F}}$	$-\vec{k}_E \vec{k}_E^2 E_0 \mathrm{e}^{i\left(\omega_E t + \vec{k}_E \bullet \vec{s}\right)}$
Wave form	$\frac{\mathrm{d}^2}{\mathrm{d}t^2} \overrightarrow{\mathcal{F}} - u^2 \nabla^2 \overrightarrow{\mathcal{F}} = 0$ [12]-[15]	$\frac{\mathrm{d}^2}{\mathrm{d}t^2} \overrightarrow{\mathcal{F}} - \frac{\omega_E^2}{\vec{k}_E^2} \nabla^2 \overrightarrow{\mathcal{F}} = 0$

Table 2. The characteristics of the energy field based on the generic model.

Size	Basic expression	Generic model ($\times E_0 \mathrm{e}^{i\left(\theta_E(t) + \theta_E(\vec{s}) + \varphi_E\right)}$)
Field	$\overrightarrow{\mathcal{F}} = \nabla E(\vec{s}, t)$	$i\nabla\left(\theta_E(\vec{s})\right)$
Divergence	$\nabla \bullet \overrightarrow{\mathcal{F}} = \frac{\mathrm{d}m^2}{\mathrm{d}t^2}$	$i\left(\sum_{\mathrm{a}=1}^{n}\left(\ddot{\theta}_{x_\mathrm{a}} + i\dot{\theta}_{x_\mathrm{a}}^2\right)\right)$
Curl	$\nabla \times \overrightarrow{\mathcal{F}}$	0
Time change	$\frac{\mathrm{d}}{\mathrm{d}t} \overrightarrow{\mathcal{F}}$	$-\dot{\theta}_E(t) \cdot \nabla\left(\theta_E(\vec{s})\right)$
Acceleration	$\frac{\mathrm{d}^2}{\mathrm{d}t^2} \overrightarrow{\mathcal{F}}$	$-\left(i\left(\dot{\theta}_E(t)\right)^2 + \ddot{\theta}_E(t)\right)\nabla\left(\theta_E(\vec{s})\right)$
Delta	$\nabla^2 \overrightarrow{\mathcal{F}}$	$i\left(\sum_{\mathrm{a}=1}^{n}\left(\dddot{\theta}_{x_\alpha} + 3i\ddot{\theta}_{x_\mathrm{a}} \cdot \dot{\theta}_{x_\mathrm{a}} - \theta_{x_\mathrm{a}}^3\right)\right)$
Wave form	$\frac{\mathrm{d}^2}{\mathrm{d}t^2} \overrightarrow{\mathcal{F}} - u^2 \nabla^2 \overrightarrow{\mathcal{F}} = 0$ [12]-[15]	$\nabla\left(\theta_E(\vec{s})\right)\left(i\left(\dot{\theta}_E(t)\right)^2 + \ddot{\theta}_E(t)\right)$ $- i\left(\sum_{\mathrm{a}=1}^{n}\left(\dddot{\theta}_{x_\alpha} + 3i\ddot{\theta}_{x_\mathrm{a}} \cdot \dot{\theta}_{x_\mathrm{a}} - \theta_{x_\mathrm{a}}^3\right)\right)c_u^2 = 0$

The factor c_u is measured in units of m/s. It is considered that $\vec{p}(\vec{s}) = \nabla\left(\theta_E(\vec{s})\right)$ and since the argument $\theta_E(\vec{s})$ is related to space it is equal to $\theta_E(\vec{s}) = \theta_E(x_1) + \theta_E(x_2) + \theta_E(x_3)$ or $\theta_E(s) = \theta_E(x_1) + \cdots + \theta_E(x_n)$ for a space of more than n dimensions.

It is possible to relate the field with m and their relation is as follows:

$$\overrightarrow{\mathcal{F}} = -i\vec{v}\omega^2 m_A(\varepsilon, \vec{s}, t) \tag{67}$$

considering that:

$$m_A = m_0\left(\mathrm{e}^{i\alpha\varepsilon_1} - \mathrm{e}^{i\alpha\varepsilon_2}\right)\mathrm{e}^{i\left(\omega t - \vec{k} \bullet \vec{s} + \varphi\right)} \tag{68}$$

Whereas utilising the generic generators of space and time:

$$\overrightarrow{\mathcal{F}} = \vec{v}_g \frac{1}{g_t} m(\varepsilon, \vec{s}, t), g_t \neq 0 \tag{69}$$

Using the trigonometric representation of complex numbers facilitates the dissection of the field into its constituent elements, yielding a total of 16 components. Each of these components attributes a distinct manner in which the m interacts with the environment.

$$\vec{C}_{\vec{f}_1} = \vec{f}_0 \cos(k_1x_1)\cos(k_2x_2)\cos(k_3x_3)\cos(\theta)\mathrm{e}^{i\omega t} \tag{70}$$

$$\vec{C}_{\vec{f}_2} = \vec{f}_0 \cos(k_1x_1)\cos(k_2x_2)\cos(k_3x_3)\sin(\theta)\mathrm{e}^{i\left(\omega t+\frac{\pi}{2}\right)} \tag{71}$$

$$\vec{C}_{\vec{f}_3} = -\vec{f}_0 \sin(k_1x_1)\sin(k_2x_2)\cos(k_3x_3)\cos(\theta)\mathrm{e}^{i\omega t} \tag{72}$$

$$\vec{C}_{\vec{f}_4} = -\vec{f}_0 \sin(k_1x_1)\sin(k_2x_2)\cos(k_3x_3)\sin(\theta)\mathrm{e}^{i\left(\omega t+\frac{\pi}{2}\right)} \tag{73}$$

$$\vec{C}_{\vec{f}_5} = -\vec{f}_0 \sin(k_1x_1)\cos(k_2x_2)\sin(k_3x_3)\cos(\theta)\mathrm{e}^{i\omega t} \tag{74}$$

$$\vec{C}_{\vec{f}_6} = -\vec{f}_0 \sin(k_1x_1)\cos(k_2x_2)\sin(k_3x_3)\sin(\theta)\mathrm{e}^{i\left(\omega t+\frac{\pi}{2}\right)} \tag{75}$$

$$\vec{C}_{\vec{f}_7} = -f_0 \cos(k_1x_1)\sin(k_2x_2)\sin(k_3x_3)\cos(\theta)\mathrm{e}^{i\omega t} \tag{76}$$

$$\vec{C}_{\vec{f}_8} = -\vec{f}_0 \cos(k_1x_1)\sin(k_2x_2)\sin(k_3x_3)\sin(\theta)\mathrm{e}^{i\left(\omega t+\frac{\pi}{2}\right)} \tag{77}$$

$$\vec{C}_{\vec{f}_9} = f_0 \cos(k_1x_1)\cos(k_2x_2)\sin(k_3x_3)\cos(\theta)\mathrm{e}^{i\left(\frac{\pi}{2}-\omega t\right)} \tag{78}$$

$$\vec{C}_{\vec{f}_{10}} = \vec{f}_0 \cos(k_1x_1)\cos(k_2x_2)\sin(k_3x_3)\sin(\theta)\mathrm{e}^{-i\omega t} \tag{79}$$

$$\vec{C}_{\vec{f}_{11}} = -f_0 \sin(k_1x_1)\sin(k_2x_2)\sin(k_3x_3)\cos(\theta)\mathrm{e}^{i\left(\frac{\pi}{2}-\omega t\right)} \tag{80}$$

$$\vec{C}_{\vec{f}_{12}} = -\vec{f}_0 \sin(k_1x_1)\sin(k_2x_2)\sin(k_3x_3)\sin(\theta)\mathrm{e}^{-i\omega t} \tag{81}$$

$$\vec{C}_{\vec{f}_{13}} = f_0 \sin(k_1x_1)\cos(k_2x_2)\cos(k_3x_3)\cos(\theta)\mathrm{e}^{i\left(\frac{\pi}{2}-\omega t\right)} \tag{82}$$

$$\vec{C}_{\vec{f}_{14}} = \vec{f}_0 \sin(k_1x_1)\cos(k_2x_2)\cos(k_3x_3)\sin(\theta)\mathrm{e}^{-i\omega t} \tag{83}$$

$$\vec{C}_{\vec{f}_{15}} = f_0 \cos(k_1x_1)\sin(k_2x_2)\cos(k_3x_3)\cos(\theta)\mathrm{e}^{i\left(\frac{\pi}{2}-\omega t\right)} \tag{84}$$

$$\vec{C}_{\vec{f}_{16}} = \vec{f}_0 \cos(k_1x_1)\sin(k_2x_2)\cos(k_3x_3)\cos(\theta)\mathrm{e}^{-i\omega t} \tag{85}$$

In order to generalise, it is noticed that the relations (70) up to (85) comprise three terms, the term $\vec{f}_0$ which is set as $\vec{f}_0 = \vec{v}\omega^2 m_A$, a second term which is related to space (*i.e.* k_1x_1, k_2x_2, k_3x_3) along with the exponential term related to time. If the term concerning space and phase difference is expressed as $q(\bar{s},\theta)$ and the exponential is expressed as $\mathrm{e}^{i\theta(t)}$, then a random component $\vec{C}_{\vec{f}_i}, 1 \le i \le 16$ and $i \in \mathbb{N}$, of a random m_j is expressed as:

$$\vec{C}_{\vec{f}_{ij}} = \vec{f}_{0j} q_{ij}(\bar{s},\theta)\mathrm{e}^{i\theta_{ij}(t)} \tag{86}$$

Correspondingly, as a result of the correlation between energy and field, energy can be dissected into 16 components, each directly proportional to the corresponding field components, *i.e.*:

$$\varepsilon_{ij} = \varepsilon_{0j} q_{ij}\left(\vec{s},\theta\right) \mathrm{e}^{i\theta_{ij}(t)} \tag{87}$$

3.3. The Compositions of Masses

A *m* along with its accompanying field is explicated as [mass] or [*m*] or complete energy mass (cem) and it is [*m*] = [*m*, $\overrightarrow{\mathcal{F}}$]. Numerous [masses] possess the capacity to interact, culminating in the creation of larger, denser, and more intricate forms of *m*. The mechanism governing this process is orchestrated by the fields, which serve as the initial point of interaction. The interaction between fields occurs through their respective components, where a specific component of one field reacts with the corresponding component of another [mass]. Subsequent interactions between the *m* are contingent upon the outcomes of this initial interaction.

The Mechanism of Synthesis of Masses

To examine the mechanism of composition, let us consider a total number of *k* masses [*m*] and a random mass [m_j] = [m_j , $\overrightarrow{\mathcal{F}_j}$], so that $1 \le j \le k$ and $j,k \in \mathbb{N}$. In addition, the letter *i* is assigned to characterise the component $\vec{C}_{\vec{f}_{ij}}$ of $\overrightarrow{\mathcal{F}_j}$, so that $1 \le i \le n = 16$, in which $i,n \in \mathbb{N}$, considering that $\vec{C}_{\vec{f}_{ij}} = \vec{f}_{0j} q_{ij}\left(\vec{s}\right) \mathrm{e}^{i\theta_{ij}(t)}$, as expressed in (86). There are the three cases that can be distinguished.

In the first case, the [masses] are added to form a new field and a new *m*, *i.e.*:

$$\vec{C}_{\vec{f}_{iT}} = \sum_{j=1}^{k} \vec{C}_{f_{ij}} \tag{88}$$

and

$$m_T = \sum_{j=1}^{k} m_j \tag{89}$$

A very scenario arises when two [masses] with a phase difference of π are combined, the result of which is zero. In a second scenario, the fields reach an equilibrium state. Then, a point, or a set of points (in an equilibrium state), in space and time denoted as $p\left(x_{\mathrm{a},p}, t_p\right)$ is identified through the relationship:

$$\sum_{j=1}^{k} \vec{C}_{\vec{f}_{ij}} = 0\,. \tag{90}$$

In this instance, a new *m* is not generated; instead, the existing *m* maintain their separation or orbit each other, contingent upon the outcome of the equilibrium state.

Finally, [masses] repel each other, implying that no new fields or *m* are created. In this case, the results of this synthesis are void, *i.e.*:

$$\sum_{j=1}^{k} \vec{C}_{\vec{f}_{ij}} = \varnothing \tag{91}$$

and

$$\sum_{j=1}^{k} m_j = \varnothing \tag{92}$$

What needs to be highlighted from this paragraph is that [masses] can react and form more complex forms of m under different conditions, such as forming a m with a new core or [masses] reaching an equilibrium state. Each new form of m possesses its own characteristics, yet it is influenced by the attributes of [mass]. In any scenario, the fundamental concepts—namely, energy, space, and time—are the primary elements that constitute each unit of m. Throughout the formation process, certain components may exhibit repulsion, yet the formation can still be accomplished. What remains unexplored at this juncture, prompting further investigation, are the conditions requisite for this composition. The outcome of this process is the amalgamation of various types, resulting in the formation of larger and more intricate forms of m, thereby necessitating categorisation of these forms.

4. Conclusions

The primary aim of this paper is to unravel the composition of m, the mechanisms governing its generation, the feasibility of tuning m, and the potential outcomes of such tuning. It was crucial to ascertain the concepts involved in this process and explore their interrelations. To address these inquiries, a foundational model named the Mass Generator was devised, structured upon fundamental physics definitions. The model was refined by incorporating the exponential expression of complex numbers, alongside introducing probabilistic elements and parameters. This approach unveiled an interplay between energy and space, mediated by the influence of time proving that the initial assumption is valid, and mass can indeed be produced through the interaction of these quantities. This outcome also denotes the importance and uniqueness of this paper and distinguishes it from similar ideas, because it describes the formation of mass through the contribution of the probabilistic movement of energy, space and time.

Building upon the basic model, a series of more specialised models were developed, shedding light on the direct correlation between energy and m. Another significant revelation from these models was the incorporation of the inverse square of frequency, indicative of the possibility to adjust energy and space in such a manner that the m could be disassembled and energy released.

During the analysis process, the models unveiled the presence of an energy field surrounding the m. It was demonstrated that the probabilistic movement of m indeed generates an energy field around it, facilitating interaction between captured energy and that of its environment. Further scrutiny revealed that within the m, multiple movements occur simultaneously, amounting to as many as 16 distinct movements. The field was shown to be intricately linked to the characteristics of m, giving rise to 16 individual fields that can be analysed. Consequently, a comprehensive model encompassing both m and field, termed [mass], was established.

With a thorough description of [mass] provided, a mechanism was devised to elucidate how multiple [masses] can be amalgamated to form more complex forms of [mass]. The interaction between m and fields was delineated, yielding the corresponding model. The synthesis of [masses] facilitates the creation of m categories, prompting a proposed categorisation process.

The developed models serve as invaluable tools in establishing a direct relationship between energy and m. Most significantly, they serve as a guide for manipulating m to release contained energy. Nonetheless, certain aspects necessitate further investigation, including practical approaches to m tuning and decomposition, as well as the requisite conditions for the formation of [mass] and the composition of various forms of m.

Conflicts of Interest

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

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