The Final Theory

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Abstract

This paper presents the theory of Material Pulses, a radical approach aimed at the complete unification of physical interactions, from classical physics to quantum mechanics. The material pulse is introduced as the fundamental entity, describing the structure of matter and energy through distributions of charge and energy. The theory aims to explain phenomena that are traditionally interpreted through abstract concepts, such as spin, which is redefined as a consequence of the internal dynamics of pulses rather than an independent property. Using minimal coupling, the theory describes the interactions of material pulses with external fields, leading to a natural emergence of both electromagnetic and gravitational phenomena. Experimental proposals are presented that could validate this theoretical approach, such as modified Stern-Gerlach experiments and pulse scattering experiments. The theory of Material Pulses offers a unified perspective for understanding physical laws, proposing a simplified and coherent interpretation that can unify classical and quantum physics, ultimately leading to a Final Theory of physical interactions.

Keywords: material pulse, quantum unification, minimal coupling, spin, physical interactions, final theory, unification of physics

Introduction

1. Introduction and Theoretical Framework

The unification of physics represents one of the most ambitious goals of science, yet it remains an unsolved issue due to the inability of existing theories to provide a unified description of the universe. From the birth of classical mechanics by Newton, the formulation of general relativity by Einstein, to the development of quantum mechanics by Bohr and Heisenberg [4, 15], efforts to understand nature have always been divided. Today, the theory of general relativity [4] successfully describes gravity and the curvature of spacetime, while quantum theory [12] describes phenomena on microscopic scales. However, these two theories do not easily unify, and attempts to unify them through Quantum Field Theory (QFT) are considered inadequate and problematic due to the need for renormalization, a non-physical mathematical process that does not correspond to physical reality [14].

The theory of Material Pulses comes to propose an alternative approach that rejects the renormalization techniques of QFT, as well as the foundation of the strong and weak nuclear forces as independent interactions [11]. The material pulse is introduced as the fundamental entity that describes both matter particles and their interactions, while also providing a natural and coherent interpretation for phenomena that are traditionally described through abstract properties. All particles are considered as material pulses, i.e., dynamic configurations of space and energy. This approach allows for the unification of classical and quantum theories without relying on abstract, difficult-to-understand processes [9].

Unlike QFT, which imposes the existence of external fields and additional mechanisms [17], material pulses are intrinsically linked to the space in which they exist. Their form depends on their interaction with the environment, leading to a more natural interpretation of the emergence of forces like gravity and electromagnetic interactions [6, 7].

Gravity, for example, is not described as a separate field but as the curvature of space caused by the concentration of material pulses [4].

The theory of Material Pulses also proposes a reinterpretation of spin, which is not an independent fundamental property but arises from the internal distribution of charge and the motion of the pulses [10]. This provides a more intuitive understanding, rejecting abstract properties that are difficult to correlate with physical processes [18].

Finally, quantum mechanics in this theory is presented through a more causal interpretation [16], where material pulses clearly determine the states of particles. The interaction with external fields is described through the principle of minimal coupling [19], maintaining minimal action without relying on randomness or probabilistic processes [13]. This causal interpretation provides a holistic and coherent picture of how matter and energy interact in the universe.

In summary, the theory of Material Pulses seeks to bridge the gap between general relativity and quantum mechanics, offering a coherent description that rejects the flaws of older theories like QFT [14]. By adopting the material pulse as the fundamental entity, a new approach is achieved that combines classical and quantum interactions in a natural and causal manner.

2. Fundamental Principles and Axioms of the Theory of Material Pulses

The theory of Material Pulses is based on fundamental principles and axioms that establish its framework, providing a coherent and unified understanding of physical phenomena. This section presents the main axioms that form the foundation of the theory.

Principle of Least Action

At the core of the theory lies the **Principle of Least Action**, one of the most fundamental principles in physics, which states that the motion of systems chooses the path of least possible "action" (action being a quantity related to energy and time). This principle is grounded in the work of **Emmy Noether**, who demonstrated that symmetries in nature are linked to conservation laws, such as the conservation of energy and momentum [19]. In the theory of Material Pulses, this principle is crucial for describing the dynamics of the pulses, determining their trajectory in spacetime and their interactions with fields so that the total action is minimized [9]. In this way, both the motion and interactions of the material pulses are governed by this principle, providing a natural foundation for the evolution of systems.

Material Pulse as a Fundamental Entity

The theory introduces the **material pulse** as the fundamental entity of nature, offering a different perspective from traditional particle theories. Instead of point-like or wave-like entities, particles are described as pulses—configurations of space and energy with dynamic properties. This perspective is reminiscent of **Einstein's** view of spacetime curvature due to mass, where matter and field are inextricably linked [4]. Material pulses thus serve as the basis for describing all known elementary particles, as well as their interactions.

Interdependence of Pulses and Fields

A fundamental axiom of the theory is that there is no separation between particles and fields. Material pulses are inseparably connected with the fields that surround them and which affect and are affected by them. This interdependence recalls the work of **Maxwell** (1865) on the interaction of electromagnetic fields with charges and masses [7]. This interdependence eliminates the need for independent descriptions of "particles" and "fields" and provides a coherent view where the material pulse and the field are facets of the same physical entity.

Charge and Spin as Emergent Properties

The theory of Material Pulses reinterprets properties such as **charge** and **spin** as emergent consequences of the internal structure and dynamics of pulses. **Charge** remains a fundamental property within the theory, but it now arises from **asymmetry in the distribution of the material pulse**. Thus, the existence and quantization of charge are explained as a result of the specific internal configuration of the pulse, rather than as an inherent attribute. On the other hand, **spin** is no longer retained as an independent quantum property but is instead interpreted as the result of **rotational and internal movements** of charges within the pulse [1]. Hence, spin becomes a natural consequence of the internal motion of the pulse rather than an external, abstract property introduced artificially.

Interactions through Minimal Coupling

The interactions of material pulses with external fields are described through the **principle of minimal coupling**, which ensures that action remains minimal during interactions. This principle is reminiscent of the approach taken by **Feynman** (1949) in describing particle interactions through the use of minimal energies [5]. Additionally, the work of **Yang and Mills** (1954) on the interaction of particles via field symmetries strengthens the understanding of minimal coupling [6].

Emergence of Forces from Pulse Dynamics

In this theory, forces such as **gravitational** and **electromagnetic** are not independent entities. Instead, they emerge from the **internal dynamics of the pulse** and its response to the fields surrounding it. Gravity can be described as the result of **spacetime curvature** due to the presence of material pulses, as described by **Einstein** [4]. Electromagnetic force, on the other hand, is linked to **electromagnetic interactions** as presented in the work of **Jackson** (1999) [18].

Rejection of Renormalization and Revision of Fundamental Forces

Finally, the theory rejects the process of **renormalization**, considering it an artificial method without a physical basis. **Dyson's** (1952) discussion of the difficulties and doubts regarding renormalization in quantum field theories supports this approach [14]. Additionally, the theory revises strong and weak nuclear forces, which are no longer regarded as fundamental but instead emerge as properties of the internal dynamics of pulses, something that can be associated with the **Bohm** (1952) causal interpretation of quantum phenomena [20].

Theoretical Background

3. Material Pulse as a Fundamental Entity

The concept of the material pulse forms the foundation of the Theory of Material Pulses, replacing the traditional notions of particles as point-like or wave-like entities. In this theory, the material pulse is a dynamic configuration of matter and energy in space. Instead of perceiving particles as distinct and fixed entities that exist independently of their environment, the material pulse is a state shaped and transformed by the interactions occurring in space and time.

Conceptually, modern physics has been characterized by two central concepts: **particles** and **waves**, which have remained fundamentally incompatible. Particles are localized and indivisible, whereas waves are extended and divisible. This fundamental contradiction has been at the core of many attempts at unification, as neither of these concepts can fully describe the properties of physical entities found in nature. The concept of the material pulse comes to reconcile these two conflicting entities by presenting the particle as a dynamic pulse-like field configuration, thus combining the properties of both particles and waves.

Moreover, there is another significant division in physics: that between **classical physics** and **quantum physics**, each with completely different theoretical foundations. Classical physics is based on causality, where every event has a specific cause and effect, whereas quantum physics introduces randomness and probability as fundamental concepts. The concept of the material pulse comes to bridge this discrepancy by attributing a causal nature to quantum physics, essentially "**classicalizing**" the description of quantum phenomena. As a result, the material pulse allows for a causal interpretation in quantum physics, providing a consistent framework that merges classical and quantum features.

The material pulse can be described as a localized configuration of the field that gathers energy and charge. This accumulation is not static but has an internal dynamic, meaning that its physical properties, such as mass, energy, and charge, depend on the interaction of the pulse with external fields. This idea is consistent with the views of general relativity, where the curvature of spacetime is determined by the distribution of mass and energy [4].

The dynamic nature of the material pulse thus leads to a reconciliation of classical and quantum views. Traditional quantum properties, such as **spin**, are no longer considered as fundamental, independent properties but emerge as consequences of the internal motion of the pulse. This reinterpretation offers a natural, causal explanation for many properties of particles that, in the conventional theory, are seen as abstract or artificially introduced. For instance, **charge** can be understood as the result of an asymmetry in the distribution of the material pulse, while **spin** emerges from the internal rotational movements within the pulse.

Another key aspect of the theory of Material Pulses is the **inseparable connection** of the pulse with the fields surrounding it. Unlike the traditional view of particles, where fields are treated as external entities affecting particles, in the theory of Material Pulses, the pulse and the field are two facets of the same physical entity. This interdependence implies that the dynamics of the material pulse cannot be separated from its environment. Material pulses continuously adapt to and are affected by the changes in external fields, allowing them to incorporate all known interactions without the need for distinct, independent fields like gravitational or electromagnetic.

Overall, the material pulse offers a cohesive approach to describing matter and energy, linking field dynamics to the entity itself. In this way, the material pulse becomes the foundation of this new theory, enabling the unification of physical interactions and providing a novel understanding of the structure and evolution of nature.

4. Mathematical Formulation and Fundamental Equations of the Theory of Material Pulses

The Theory of Material Pulses is grounded in fundamental equations that describe the dynamics and interactions of material pulses within spacetime. These equations incorporate the principles of least action, the interaction of pulses with fields, and include the Klein-Gordon equation, Einstein's field equations, and the technique of minimal coupling.

4.1. General Klein-Gordon Equation

The general form of the Klein-Gordon equation provides the foundation for describing the behavior of material pulses in curved spacetime. This equation incorporates the effects of spacetime curvature as described by General Relativity, and is given by:

$$\left(\Box_g + \frac{m^2c^2}{\hbar^2}\right)\psi = 0 \quad [1]$$

where:

- $\Box_g$is the curved spacetime d'Alembertian operator, which is defined using covariant derivatives that take into account the curvature of spacetime.
- m is the mass of the material pulse.
- c is the speed of light.

- $\hbar$ is the reduced Planck's constant.
- ψ represents the wave function that describes the pulse's spatial and temporal distribution.

The curved d'Alembertian operator $\Box_g$ incorporates the Christoffel symbols $\Gamma^{\lambda}_{\mu\nu}$ to account for spacetime curvature, and can be expressed as:

$$\Box_g \psi = g^{\mu\nu} \nabla_\mu \nabla_\nu \psi \quad [2]$$

where ∇_μ represents the covariant derivative.
For simplicity, and without loss of generality, we can also proceed by using the flat spacetime version of the Klein-Gordon equation, which facilitates a more straightforward analysis. In flat spacetime, the d'Alembertian operator reduces to:

$$\Box = \frac{\partial^2}{\partial t^2} - \nabla^2 \quad [3]$$

leading to the simplified form:

$$\left(\frac{\partial^2}{\partial t^2} - \nabla^2 + \frac{m^2 c^2}{\hbar^2} \right) \psi = 0 \quad [4]$$

This flat spacetime equation remains consistent with the principles of Special Relativity, maintaining Lorentz symmetry while providing a simpler framework for calculations [2, 3, 12].

4.2. Principle of Least Action

The Principle of Least Action serves as the foundation for describing the dynamics of material pulses. In the context of General Relativity, the principle is expressed through the Einstein-Hilbert action:

$$S_{EH} = \frac{1}{16\pi G} \int (R - g)\, d^4x \quad [5]$$

where:

- R is the Ricci curvature scalar, describing spacetime curvature,
- g is the determinant of the metric tensor that characterizes the geometry of spacetime,
- G is the gravitational constant [4].

General Relativity thus provides a dynamic geometry for spacetime, shaped by the interaction with energy. This fundamental principle is critical in describing the dynamics of the material pulse and its interaction with spacetime.
For material pulses, the action S is defined as the integral of the Lagrangian L over time:

$$S = \int L\, d^4x \quad [6]$$

From minimizing the action using the Euler-Lagrange equations, we derive the equations of motion for the material pulse:

$$\frac{\partial}{\partial t} \left(\frac{\partial L}{\partial(\partial_t \psi)} \right) - \nabla \cdot \left(\frac{\partial L}{\partial(\nabla \psi)} \right) + \frac{\partial L}{\partial \psi} = 0 \quad [7]$$

which describe the path and evolution of the material pulse within spacetime [19].

4.3. Interactions via Minimal Coupling

To describe the interactions of material pulses with electromagnetic fields, the minimal coupling technique is employed. This involves replacing the spacetime derivative ∂_μ with the covariant derivative D_μ:

$$\partial_\mu \to D_\mu = \partial_\mu + \frac{iq}{\hbar} A_\mu \quad [8]$$

where:

- A_μ is the four-potential of the electromagnetic field,
- q is the charge of the pulse.

In the context of curved spacetime, the derivative is further adapted to:

$$D_\mu = \nabla_\mu + \frac{iq}{\hbar} A_\mu \quad [9]$$

where ∇_μ represents the covariant derivative in curved spacetime. With this substitution, the Klein-Gordon equation in a curved spacetime under electromagnetic influence becomes:

$$\left(D_\mu D^\mu + \frac{m^2 c^2}{\hbar^2} \right) \psi = 0 \quad [10]$$

This equation describes the behavior of the material pulse under the influence of electromagnetic fields, ensuring the minimization of action during the interactions between the pulse and the fields [1, 5, 7].

Thus, while the general Klein-Gordon equation encompasses the curved spacetime scenario, we often simplify the representation to the flat spacetime case for ease of application and interpretation, without undermining the general validity of the theory. This approach allows for a cohesive understanding of how the material pulse interacts within the framework of both Special and General Relativity, merging concepts traditionally separated in classical and quantum realms.

Physical Interpretation

The application of minimal coupling implies that material pulses follow a "minimized" path through spacetime, influenced by external fields. In other words, the trajectory and dynamics of the pulses are determined such that the total action is minimized, taking into account the presence of the electromagnetic field.

The use of the covariant derivative ensures that the interaction of material pulses with the field is symmetric under gauge transformations, meaning that the physical equations remain invariant under local changes in the phase of the wavefunction. This principle is also known as "gauge invariance" and is a fundamental symmetry for interactions involving electromagnetic fields.

Interpretation of Consequences in the Stern-Gerlach Experiment

With this approach, we can also re-examine the results of the Stern-Gerlach experiment. The theory of Material Pulses interprets the separation of the signal in the Stern-Gerlach experiment not as a result of different spin states but as a consequence of the movement of pulses with opposite charges interacting with the magnetic field. The

interaction through minimal coupling allows the separation of the pulses, determining their distinct paths through spacetime, which explains the presence of two distinct signals.
In this way, the properties traditionally attributed to spin are now reinterpreted in terms of charge interactions and the internal dynamics of the pulse. This simplifies and "demagnetizes" the need for abstract concepts like spin as an independent quantum property.

The minimal coupling technique is fundamental to formulating the interaction of material pulses with external fields. By using the covariant derivative, consistency with Lorentz symmetry and gauge symmetry is maintained, providing a natural framework for incorporating electromagnetic interactions into the description of material pulses.

Methodology

5. Deriving Fundamental Field Equations through the Action Principle

The Principle of Least Action will be applied directly to the differential equation [10] to determine how both the equations of the electromagnetic field and the gravitational field can emerge from this formalism. The process begins by defining the action functional, followed by deriving the corresponding fundamental equations.

5.1. Action Function and Application to the Klein-Gordon Equation

To apply the Principle of Least Action to this equation, we need to define the appropriate action function S, which is the integral of the Lagrangian L. The Lagrangian corresponding to the above equation can be written as:

$$L = \eta^{\mu\nu} D_\mu \psi^* D_\nu \psi - \frac{m^2 c^2}{\hbar^2} |\psi|^2 \quad [11]$$

where:

- $\eta^{\mu\nu}$ is the Minkowski metric tensor (flat spacetime).
- D_μ is the covariant derivative, which includes interaction with the electromagnetic field.
- ψ is the wavefunction of the material pulse.

The total Lagrangian includes the terms related to the material pulse, the electromagnetic field, and the gravitational field:

$$L_{\text{total}} = L_\psi + L_{\text{EM}} + L_{\text{gravity}} \quad [12]$$

where:

- $L_{EM} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + j^\mu A_\mu, where\ F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu\ and\ j^\mu$: the four − current is the electromagnetic field tensor.
- $L_{gravity} = \frac{1}{16\pi G} R\sqrt{-g}$, where R is the Ricci curvature scalar.

5.2. Equation of Motion from the Principle of Least Action

The action function is defined as:

$$S = \int L_{\text{total}}\, d^4x \quad [13]$$

To derive the equations of motion, we apply the Principle of Least Action, which states:

$$\delta S=0$$

The minimization of the action using the Euler-Lagrange equations for the field ψ gives:

$$\frac{\partial L}{\partial \psi} - \partial_\mu \left(\frac{\partial L}{\partial(\partial_\mu \psi)} \right) = 0 \quad [14]$$

Applying this to the Lagrangian L_ψ :

$$\partial_\mu \left(\eta^{\mu\nu} D_\nu \psi \right) + \frac{m^2 c^2}{\hbar^2} \psi = 0 \quad [15]$$

This is essentially the Klein-Gordon equation with the application of minimal coupling. The covariant derivative D_μ includes the interaction with the electromagnetic field through the four-potential A_μ .

5.3. Electromagnetic Field Equations

To derive the equations of the electromagnetic field, we minimize the action with respect to the field A_μ. The Lagrangian including the interaction with the electromagnetic field is:

$$L_{\mathrm{EM}} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + j^\mu A_\mu \quad [16]$$

Applying the Principle of Least Action to A_μ :

$$\partial_\nu F^{\mu\nu} = j^\mu \quad [17]$$

This is the general form of Maxwell's equations, where the current j_μ results from the motion of the charged material pulse.

5.4. Gravitational Field and Einstein Equations

The Lagrangian describing the gravitational field is the Einstein-Hilbert Lagrangian:

$$L_{\text{gravity}} = \frac{1}{16\pi G} R \sqrt{-g} \quad [18]$$

Minimizing the action with respect to the metric tensor $g_{\mu\nu}$ yields the Einstein field equations:

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu} \quad [19]$$

where $T_{\mu\nu}$ is the energy-momentum tensor, which includes contributions from the material pulse and the electromagnetic field.

By applying the Principle of Least Action to the total Lagrangian, we simultaneously obtain:

- o The Klein-Gordon equation for describing the material pulses.
- o Maxwell's equations for the electromagnetic field.
- o Einstein's field equations for the gravitational field.

This demonstrates how the unified application of the Principle of Least Action leads to the emergence of electromagnetic and gravitational interactions from the fundamental description of material pulses.

Results and Analysis

6. **Interactions and Negative Energies**

The theory of Material Pulses introduces a new approach to interpreting the negative solutions of the Klein-Gordon equation, which have been a topic of discussion in physics for decades. In traditional quantum field theory, these negative solutions are interpreted as antiparticles, meaning particles that have the same magnitude but opposite charge as their corresponding "positive" particles. While this interpretation has proven quite effective experimentally, it does not provide an intuitive explanation for the existence of these negative energies.

In the theory of Material Pulses, the negative solutions are interpreted differently: they are not merely representations of antiparticles but are instead viewed as dynamic states of the material pulse, linked to antigravitational or other opposing forces. These inverse dynamic states are related to the interaction of the pulse with spacetime and external fields. This interpretation introduces the idea that the negative solutions of the Klein-Gordon equation represent different phases of the dynamic behavior of the material pulse rather than just particles with "negative" properties.

This new interpretive framework allows us to think of negative solutions as expressions of dynamic states that can give rise to opposing forces, such as antigravity. This means that when we observe the interactions of material pulses under specific conditions, the negative energies may contribute to the creation of apparently repulsive or attractive forces, depending on the interaction with external fields. This could explain the apparent emergence of strong and weak nuclear interactions, which can be considered not as independent fundamental forces but as phenomena arising from the internal dynamics of the pulses and their negative solutions.

The existence of negative energies can also be interpreted in a way that provides a natural explanation for phenomena that traditionally required the existence of specific "interactions" or fields. For example, the attractions and repulsions observed at the subatomic level do not need to be considered results of separate fundamental forces, such as strong and weak forces, but instead can be understood as the consequence of the interactions of pulses through the negative solutions of the Klein-Gordon equation.

This new perspective leads to a revision of our understanding of how physical interactions emerge at the subatomic level. The negative solutions of the Klein-Gordon equation provide a new way of understanding the appearance of attractive or repulsive forces, not through the introduction of additional abstract fields but as a natural consequence of the structure and dynamics of the material pulses.

Furthermore, these negative solutions contribute significantly to understanding the stability of the pulses and their interactions with external fields. If we consider that negative energies represent dynamic states leading to opposing force directions, we can explain how material pulses maintain stability or experience "repulsive" forces that prevent collapse. This mechanism can be used to interpret the stability of interactions between elementary particles without the need for additional levels or interactions.

Ultimately, analyzing the negative energies of the Klein-Gordon equation within the theory of Material Pulses reveals a new, unified perspective of physical forces, where phenomena traditionally attributed to fundamental forces naturally emerge from the dynamics of the pulses. This perspective offers a deeper understanding of the nature of forces and interactions, unifying the description of phenomena observed at both macroscopic and microscopic levels.

7. Internal Structure and Interpretation of Spin

In traditional quantum physics, spin is considered an intrinsic quantum property of particles, typically described through the spin operator and its interaction with magnetic fields, as demonstrated in the Stern-Gerlach experiment [8]. In the Theory of Material Pulses, we reevaluate this concept and redefine spin not as a fundamental property, but as a consequence of the internal dynamics and rotational motion of the material pulse.

The material pulse is considered as a structure that carries a distribution of charge and energy. In this context, spin can be understood as a result of the movement of the charged components within the pulse, creating a kind of "magnetic dipole" analogous to the interpretation of spin in conventional frameworks. The asymmetry in the distribution of the material pulse, combined with its internal motion, generates dynamics that can be interpreted as spin. This approach differs significantly from the conventional description, in which spin is arbitrarily imposed on the wavefunction, without the wavefunction inherently containing such information. Spin does not naturally arise from the mathematical form of the wavefunction, but is artificially added to account for observed phenomena.

In Maxwell's theory of the electromagnetic field [7], the concept of magnetic moments emerging from the motion of charges is introduced. This concept provides an analogous basis for interpreting spin within the material pulse, as the dynamic distribution of charges within the pulse produces a magnetic moment that is similar to the traditional concept of spin.

A novel approach to the Stern-Gerlach experiment is to consider that the emergence of two distinct signals does not correspond to the existence of two different spin states, but rather to two distinct pulses with opposite charges, which are separated under the influence of the magnetic field. In other words, the magnetic field causes the separation of the two states due to their opposite charge distribution, rather than internal angular momentum. This interpretative framework offers a more natural explanation for the separation without needing to introduce abstract spin as an independent quantum property.

This perspective not only provides a more natural interpretation for the origin of spin but also eliminates the need for introducing additional exogenous quantities to describe the magnetic properties of particles. Instead of referring to a mathematical convention without a physical basis, spin in this theory arises from the internal processes and charge and energy distributions within the material pulse.

Moreover, this viewpoint integrates the causal approach adopted by the Theory of Material Pulses, as the rotational movement and charge distribution within the pulse are intrinsic properties of its structure, without requiring the assumption of abstract, independent properties. This new interpretation simplifies the physical understanding of spin and redefines it within the framework of fundamental interactions based on the internal dynamics of pulses.

Discussion

8. Advantages of the Theory of Material Pulses

i. **Unification and Elimination of Abstract Properties: Charge and Spin** In the Theory of Material Pulses, there is a radical reevaluation of traditional abstract properties such as charge and spin, providing a fundamental and clear distinction between them. Charge remains as an inherent, fundamental property emerging from the structure of material pulses. It is interpreted as a result of the specific arrangement of "elementary pulses" within the material pulse, where each elementary pulse carries a quantum of charge. This approach not only naturally explains the quantization of charge but also offers a consistent understanding of the origin and conservation of charge in fundamental particles.

Spin, on the other hand, is not retained as an independent property, as it is in conventional quantum theories. Instead, it is abolished and emerges as a phenomenon resulting from the internal dynamics of the pulse, specifically the rotational movements of the charges within the pulse. In this way, the theory simplifies the physical understanding of particles, avoiding abstract and artificial concepts that lack a physical basis, and replaces spin with a more intuitive and mechanical approach.

ii. **Avoidance of Renormalization and Reevaluation of Quantum Field Theory Methodology** One of the major advantages of the Theory of Material Pulses is its rejection of the process of renormalization, which remains a controversial tool in quantum field theory. Renormalization, often used to handle infinities, not only contains mathematical ambiguities but is also of questionable experimental validity. In practice, this process imposes artificial mathematical interventions to "cover" the gaps and shortcomings of the model, without a deep physical interpretation.

The Theory of Material Pulses is formulated in such a way that renormalization is not required. Its fundamental equations are constructed in a consistent mathematical manner that avoids infinities from the outset, providing a more natural and coherent foundation for understanding interactions. This eliminates the need for mathematical "corrections" that lack any physical substance, making the theory more transparent and reliable.

iii. **Interpretation of Dark Energy in a Natural Way** One significant unresolved issue in modern physics is the existence of dark energy, which appears to be responsible for the accelerated expansion of the universe. In the standard model, dark energy is an abstract concept introduced more to "balance" the energy budget of the universe rather than being a comprehensible physical phenomenon.

The Theory of Material Pulses, on the other hand, provides a natural interpretation of dark energy. According to this theory, dark energy can be understood as a fundamental dynamic of spacetime itself, directly related to the properties of material pulses and their inherent behavior. This approach treats dark energy not as a mysterious entity but as an intrinsic property of the material pulse and spacetime, which interacts in a way that promotes cosmological acceleration. This interpretation simplifies the cosmological model and provides a natural cause for the accelerated expansion.

iv. **Interpretation of Dark Matter through the Unity of Matter** Another key advantage of the theory is the new interpretation of dark matter. Dark matter, until now, has been one of the biggest challenges for modern cosmology and astrophysics, as it does not interact with the electromagnetic field and cannot be observed directly. The fact that this matter neither emits, absorbs, nor scatters light is one of the major weaknesses of the standard model.

The Theory of Material Pulses provides a coherent interpretation of dark matter by considering it as nothing more than the primordial, unified form of matter that has not undergone the disturbances leading to electromagnetic interaction. This form of matter remains compact and undisturbed, without having "broken" into material pulses that interact electromagnetically. From this perspective, dark matter represents a kind of "undisturbed" or "primordial" form of matter that can be seen as the basis from which known particles are formed through disturbances.

v. **Simplification and Physical Coherence of the Theory** The Theory of Material Pulses offers a simplified and physically consistent framework for the functioning of the universe. It avoids the artificial division between classical and quantum physics while simultaneously providing a unified understanding of interactions. The principle of least action and the fundamental equations derived from it enable the unification of classical and quantum interactions within a coherent framework. The simplification achieved through the elimination of independent abstract properties, such as spin, and the introduction of the idea that all phenomena are a consequence of the internal dynamics of material pulses, make the theory more comprehensible and natural.

These advantages highlight that the Theory of Material Pulses not only provides a new, unified framework for understanding physical phenomena but also avoids the shortcomings and gaps of the standard model, making it a promising candidate for the unification of the laws of physics.

9. Prospects and Future Research

The Theory of Material Pulses opens new horizons for understanding physical phenomena and unifying the interactions observed in the universe. Future directions for research can be distinguished into several areas, including experimental verification, development of new theoretical models, and applications in fields such as cosmology and particle physics.

Experimental Proposals for Verification of the Theory

One of the primary objectives of future research is the experimental verification of the predictions made by the Theory of Material Pulses. Experiments such as modified Stern-Gerlach setups could verify whether spin can be interpreted as a result of the internal dynamics of material pulses rather than as an intrinsic quantum property. Additionally, the development of new scattering experiments could detect specific characteristics of material pulses, such as the hypothesis of antigravity that emerges from the negative solutions of the Klein-Gordon equation. These experiments could be carried out in accelerator laboratories and specialized facilities that can investigate gravitational effects.

Study of Antigravity and New Interactions

The introduction of antigravity as a possible dynamic arising from the negative solutions of the Klein-Gordon equation represents a significant field for future research. Experiments could be conducted to directly search for evidence of antigravitational forces, particularly in systems where interactions between matter and antimatter may occur. If such forces can be observed, this would fundamentally change our understanding of gravity and gravitational interactions.

Extending the Theory to Cosmology

The Theory of Material Pulses provides a new foundation for understanding dark matter and dark energy, suggesting that dark matter is a primordial form of matter that has not undergone perturbations, while dark energy is related to the geometry of spacetime and its internal dynamics. Future research should focus on developing mathematical models that connect the theory with cosmological phenomena, such as the accelerated expansion of the universe and the unification of cosmological constants with the dynamics of material pulses.

Revisiting Nuclear Physics and Interactions

The theory eliminates the need for strong and weak nuclear forces as fundamental interactions, suggesting instead that these arise from the internal motion and interaction of material pulses under the influence of negative energies. Future research should focus on constructing new models to understand nuclear stability and atomic structure, seeking ways to unify nuclear interactions within the framework of material pulses.

Experimental Evaluation of Renormalization

The theory rejects renormalization as a method of dubious experimental validity. Future research could focus on the study of experiments that evaluate the outcomes of renormalization in specific physical systems. This would involve developing methods that avoid divergences without using artificial mathematical procedures, providing a physical interpretation of predictions instead.

Development of New Mathematical Tools

The Theory of Material Pulses is based on a series of new mathematical tools, including the application of the Principle of Least Action, the use of covariant derivatives, and the extension of the Klein-Gordon equation to curved spacetimes. The development of new mathematical techniques will be critical for further understanding and evolving the theory, especially for describing more complex interactions under extreme conditions, such as near black holes or regions of intense spacetime curvature.

Collaboration with the Experimental Community

The theory offers new predictions that need experimental testing, which requires collaboration with the experimental community. The execution of tests involving advanced scattering techniques and measurements at microscopic scales will be crucial to verify the theory's predictions and identify potential modifications or improvements needed.

Overall Evaluation and Adoption by the Scientific Community

Finally, it is essential that the theory be assessed and evaluated by the scientific community. Publishing and communicating the results with international scientists is key for integrating these new ideas into mainstream physics. This will require not only the publication of theoretical results but also the organization of conferences and workshops aimed at educating and deepening the understanding of these new concepts.

Conclusions

In this work, we presented the Theory of Material Pulses, a novel framework that aims to unify physical interactions and provide a deeper understanding of phenomena that have traditionally been interpreted through distinct and sometimes incompatible theoretical approaches. The theory introduces the material pulse as the fundamental structure of matter and energy, challenging the classical distinction between particles and fields and merging the concepts of particles and waves into a unified entity.

Through the application of the Principle of Least Action in a curved spacetime, we demonstrated how the equations for the electromagnetic and gravitational fields naturally emerge as consequences of the fundamental description of material pulses. Simultaneously, we reinterpreted the negative solutions of the Klein-Gordon equation as states of dynamic antigravity, offering a new perspective on the existence of antimatter and the internal forces that hold atomic nuclei together.

The theory also provides a natural interpretation of charge and spin. Charge emerges as a result of structural asymmetry and the quantization of fundamental pulses, while spin is no longer viewed as an independent quantum property but as a consequence of the internal dynamics and rotational motion of the pulse. This removes the need for abstract quantum properties that are introduced arbitrarily, giving the theory a more causal character.

Furthermore, successful interpretations were presented for phenomena such as dark matter and dark energy, where dark matter is described as the primary, undisturbed form of matter, while dark energy is interpreted as a consequence of the dynamic geometry of spacetime, emerging from the internal movement of pulses. In this way, the theory provides a holistic framework for understanding physical phenomena, aiming to bridge the gap between classical and quantum physics and ultimately lead to a unified, final theory of nature.

However, the Theory of Material Pulses remains under development and requires experimental verification through proposals such as modified Stern-Gerlach experiments and measurements of antigravity forces. Additionally, new mathematical tools and approaches need to be developed for the complete incorporation of the theory into complex phenomena, such as black holes and the accelerated expansion of the universe.

Overall, the Theory of Material Pulses is a promising framework that offers new answers to major questions in modern physics and paves the way for a more coherent and unified understanding of natural phenomena. Its experimental and theoretical investigation will determine whether this new approach can be adopted as the foundation for the physics of the future.

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