The Helicon: A New Preon Model

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A new preon model is presented as an extension of the semiclassical Helical Solenoid Electron Model that was previously proposed by the author. This helicon model assumes as postulates both the Atomic Principle and the equality between matter and electric charge. These postulates lead us to a radical reinterpretation of the concepts of antimatter and dark matter and form a new framework for future preon theories.

1 Introduction

According to the Atomic Principle, "matter is composed of indivisible, indestructible and immutable elementary particles." This principle has guided the greatest successes in the history of science [2]. However, the currently-accepted Standard Model of Particle Physics (SM) does not comply with this principle since most of this model's elementary particles are unstable, and all of them can be created or destroyed by matter-antimatter interactions. In concurrence with Kalman [3], we consider the current state of particle physics to be anomalous. We propose that the Atomic Principle is an unrenounceable postulate. Any fundamental theory of elementary particles should strictly respect this principle. If necessary, we should reinterpret the experimental results and discard any theory that does not strictly comply with the Atomic Principle.

The large number of elementary particles described by the SM and the regularities of their properties suggest that there is a lower level of matter organization. In 1974, Pati and Salam [11] proposed that both leptons and quarks were composite particles formed by fundamental particles called preons. To date, no preon model has attracted the general interest of the particle physics community. However, preon models have continued to evolve with new proposals, including those by Terazawa (1977) [12], Harari (the Rishon Model, 1979) [13], Mandelbaum (the Haplon Model, 1981) [14], Dehmelt (the Cosmon Model, 1989) [15], Kalman and d'Souza (the Primon Model, 1992) [17], Dunge and Fredriksson (1997) [16], Bilson-Thompson (the Helon Model, 2005) [18], Yershov (the Y-particle Model, 2006) [19] and Lucas (the Intertwining Charged Fibers Model, 2006) [20].

The objective of this paper is to propose a new preon model as an extension of the Helical Solenoid Model of the electron [1] that is applicable to any subatomic particle and that strictly complies with the Atomic Principle. The Helicoidal Solenoid Model is a semiclassical model that proposes that the electron is a point-like electric charge that moves at the speed of light following a helical solenoid trajectory with an angular momentum equal to the reduced Planck constant. This model assumes that the Zitterbewegung is the mechanism that causes the helical movement of the electron (spin) and its corresponding magnetic moment.

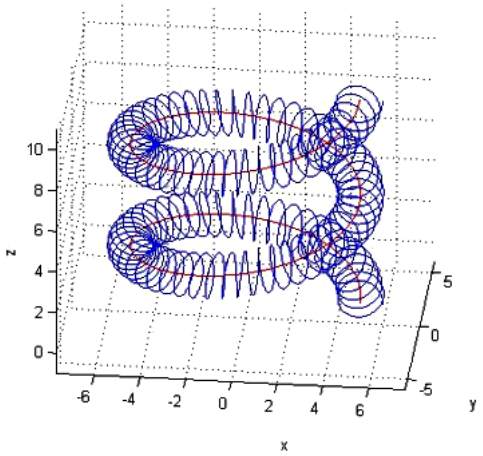

Fig. 1: Trajectory of the electron in the Helical Solenoid Model.

2 Nuclear Forces

The main challenge for preon theories is to explain the force that holds the preons together. Quantum Chromodynamics (QCD) defines a strong nuclear force based on the existence of gluons, but this theory is incompatible with the preon hypothesis. To date, it has not been possible to identify an extension of the QCD theoretical basis that would allow for the incorporation of a substructure common to both leptons and quarks. In addition, all attempts to expand the QCD theory involve an exponential increase in mathematical complexity, the opposite of what is intended with preon theories. Therefore, a preon theory that is compatible with the Atomic Principle will be, predictably, incompatible with QCD.

We are not bothered by this incompatibility because we start from a semiclassical Helical Solenoid Model that is incompatible in fundamental aspects with many of the modern dominant theories (Quantum Mechanics (QM), Quantum Electrodynamics (QED) and Quantum Chromodynamics (QCD)). This is not an insurmountable problem since it is well known that mutually incompatible theories can explain

the same experimental results and, in certain cases, may even be useful. For example, the Bohr-Sommerfeld model was surpassed by QM but, nevertheless, produces the same results for the fine structure of the hydrogen atom.

In 1986, Barut [4] proposed that nuclear forces are manifestations of electromagnetic forces at very short distances. While electric fields decrease with the square of the distance, magnetic fields decrease with the cube of the distance. Magnetic forces are dominant over very small distances, but their influence decreases rapidly with respect to electrical forces as distances expand

$$F_{mag} \propto \frac{1}{R^3} , \tag{1}$$

$$F_{elec} \propto \frac{1}{R^2} . \tag{2}$$

This hypothesis is shared by Pati [5], the creator of the first preon theory, and by other lesser-known researchers such as Schaeffer [6], Dallacasa [7], Cook [8], Kaliambos [9], Kanarev [10] and Lucas [20].

Historically, it has been assumed that magnetic forces at the subatomic level are negligible, but in our Helical Solenoid Model, the magnetic field density at the center of the nucleon is enormous, about 100 trillion tesla. This magnetic field density is thousands of times greater than that of a neutron star. A magnetic field of these proportions must necessarily produce significant effects

$$R = \lambda\!\!\!^{-}_N = \frac{\hbar}{m_N c} = 2.103 \times 10^{-16} \text{ m}, \tag{3}$$

$$f = \frac{v_r}{2\pi R} = \frac{c}{2\pi \lambda\!\!\!^{-}_N} = 2.268 \times 10^{23} \text{ Hz}, \tag{4}$$

$$B = \frac{\mu_0 I}{2R} = \frac{\mu_0 e f}{2\lambda\!\!\!^{-}_N} = 1.088 \times 10^{14} \text{ T}. \tag{5}$$

In our preon model, we do not contemplate the existence of particles that mediate nuclear forces, such as gluons. Instead, we assume that elementary particles interact with each other through their respective electromagnetic fields. While it is outside the present work to explain the physical nature of photons, we conclude that photons (i) are not particles of matter, (ii) are not composed of preons and (iii) do not have to comply with the Atomic Principle. Therefore, photons can be created (by emission) and destroyed (by absorption) without any limitations. Many theories have tried to explain the photon as the union of an electron and a positron, however, all the experiments conducted to date are consistent with the idea that a photon transports electromagnetic energy but does not carry any type of electrical or magnetic charge.

3 Topology

The SM assumes that fermions are point particles and that it is impossible for a point particle to be formed by other point subparticles. For this reason, the more advanced preon models, such as those proposed by Bilson-Thompson [18], Yershov [19] and Lucas [20], describe preons and fermions as structures with a determined topology. In most cases, the proposed topology is toroidal or helical. This topology is suggested by the helical and chiral properties of the subatomic particles. The helical topology allows the composite particles to establish different structures that can be analyzed using knot theory (e.g., Rañada [21]) or braid theory (e.g., Bilson-Thompson [18]). The different combinations would give rise to the various symmetries of the subatomic particles, such as the conservation of the color charge.

The experimental data obtained in particle colliders suggest that fermions are point particles, so we need a model that can combine both point and helical topologies. Our Helical Solenoid Model [1] proposes a dynamic point-particle model, in which a point particle always moves at the speed of light in a closed path. This allows the advantages of the point particle to be combined with helical topology (which corresponds to the particle's trajectory).

In the Helical Solenoid Model, several point particles can form a single helical structure. For example, several particles could share the same closed trajectory in an equidistant fashion or they could share the trajectory in the same plane but with different radii. Finally, Lucas's Intertwining Charged Fibers Model [20] illustrates graphically how several helical paths could interlink with each other, giving rise to different subatomic particles.

4 Matter

In classical physics, matter is any substance that has mass and volume (i.e., that occupies space). This definition is valid for all matter composed of atoms, but when we analyze the subatomic particles that make up the atoms, this definition loses its meaning. In the SM, mass is considered only one form of energy, and the subatomic particles are considered quantum entities that do not have a definite volume or size. In this framework, matter no longer has a precise definition nor is it considered a fundamental concept.

But, to apply the Atomic Principle, matter must have a precise definition and be considered a fundamental concept. To define the concept of matter, we need to identify a fundamental property that strictly complies with three requirements: it must be absolute (the amount of matter cannot depend on the observer or the reference system), conserved (the amount of matter must be retained in any iteration) and quantified (the amount of matter must be composed of whole units).

Mass is an indicator of the kinetic energy and electromagnetic potential associated with the internal structure of each subatomic particle. But, as a property of matter, mass does not meet any of the three requirements. Only one property of matter satisfies the test, the electric charge. Therefore, we propose a new postulate: Electric charge is the fundamental

property of matter.

All matter is composed of unitary electric charges. Phrased in a different manner, matter is everything that is composed of electric charges. Consequently, our second postulate is that matter and electric charge represent exactly the same thing. This postulate has important implications. It implies that all neutral particles must necessarily be composite particles of an equal number of negative and positive electric charge particles. Combining this postulate with the Atomic Principle, we conclude that all subatomic particles must be composed of a whole number of fundamental electric charges.

We also assume the validity of the minimalist hypothesis that postulates that all matter is composed of only two fundamental particles, the positive fundamental electric charge and the negative fundamental electric charge. In our model, we call these elementary particles helicons (H^+ and H^-), to differentiate them from those discussed in other preon models and to emphasize the relationship of this elementary particle with the Helical Solenoid Model. The three preon models that we consider the most advanced (Bilson-Thompson, Yershov and Lucas) concur with this minimalist hypothesis of only two fundamental particles.

All the preon models we have analyzed treat the mass of subatomic particles as an additive property. The greater the number of components in each subatomic particle and the more complex its internal structure, the greater the particle's mass. These models all group elementary particles into several sublevels of organization, forming increasingly complex structures. These models also assume that hadrons have a much more complex structure than leptons. The exact composition of each subatomic particle depends on the proposed preon model. We do not propose any particular organization scheme for subatomic particles; their composition should explain the value of the masses of each subatomic particle and explain all known modes of decay.

5 Antimatter

The concept of antimatter originated in 1898 when Schuster [22] speculated that there were particles with negative gravitational mass. Since antimatter would have negative gravity, antimatter would have a propensity to join together and separate from the matter of positive masses. Over time, antimatter would separate from matter, forming atoms, molecules or even stars and entire galaxies of antimatter. The difficulty occurs in the analysis of negative inertial mass. Negative inertial mass is a strange concept in physics; it causes serious problems and contradictions with the principles of conservation of energy and movement. For example, according to these theories, the more a particle of negative inertial mass accelerates, the more energy is created. In 1905, Einstein demonstrated that mass is only an expression of a particle's energy, implying that negative mass would be equivalent to negative energy.

In 1928, Dirac presented his electron equation, a relativistic half-integer spin version of the Schrodinger Equation, that correctly predicted the value of the electron's magnetic moment and the fine structure of the hydrogen atom. The Dirac Equation elegantly solved the main problems plaguing QM at that time. However, the Dirac Equation created new problems, since it predicted quantum electron states with negative energy. To resolve these issues, Dirac proposed the extravagant "sea of Dirac," where empty space would be formed by an infinite sea of negative energy particles that would occupy all the negative energy quantum states. In 1930, Dirac [23] proposed that there could be "gaps" in this "sea" of negative energy states. These "gaps" would be observed as a particle of positive energy with a positive charge, otherwise known as protons.

Oppenheimer [24] criticized Dirac's proton hypothesis. The positively charged particle predicted by Dirac could not be the proton since it would have the same mass as the electron; they would then annihilate each other upon contact, making the hydrogen atom unstable. Coincidentally, in 1932, while analyzing traces of cosmic rays in a cloud chamber, Anderson identified a particle with a positive electric charge and a mass identical to the mass of the electron that he called a positron. The positron corresponded with the particle predicted by Dirac, confirming the validity of his equation. In 1933, he was awarded the Nobel Prize for the discovery of antimatter.

However, there are many inconsistencies in antimatter theory that have been overlooked. According to Schuster, by definition, antimatter would have a negative mass, which does not happen with the positron. In addition, Dirac's antimatter is a consequence of his "sea of Dirac" theory, an implausible hypothesis that has been ruled out by modern physics. In reality, the current concept of antimatter is the result of a temporal coincidence between Dirac's hypothesis and Anderson's experiments, combined with a factual misinterpretation.

If we set aside the Dirac hypothesis and analyze the positron identified in Anderson's experiments, we find an unstable particle that is identical to the electron but with a positive charge. When a positron comes into contact with an electron, a large amount of energy is emitted, and neither the electron nor the positron presence is longer detected. The currently accepted explanation for this phenomenon is that there is a mutual annihilation of the positron with the electron, but this explanation is not supported by theory or experience. The annihilation theory is only applicable to particles with negative mass, but both the electron and the positron have positive masses. However, if we rely on experience, when a positive electric particle joins a negative electric particle, the result is a neutral electric particle (and radiation emission). There is a similar occurrence when an anion is attached to a cation, forming a neutral molecule, or when an electron is attached to a proton, forming a hydrogen atom.

Instead of mutual annihilation, a more logical explanation

of the matter-antimatter interaction is the creation of neutral matter. This alternative explanation complies with the principles of conservation of electric charge and conservation of matter. According to our postulates, the electric charge is neither created nor destroyed, so the result of the electron-positron interaction must be the creation of one or several neutral particles that are currently unknown. Symmetrically, the creation of an electron-positron pair from energy would also not be possible. Instead, one or more of these unknown neutral particles would need to intervene, in addition to the necessary energy. Therefore, we should not call these processes of creation or annihilation of matter but of decomposition and aggregation of matter.

According to our interpretation, antimatter is characterized by having a topology that is symmetric to the topology of matter. Due to this symmetry, when particles of matter and antimatter come into contact, they have a strong tendency to decompose and reorder, producing simpler neutral particles. However, there is an asymmetry in the universe by which negative helicons tend to organize into simple subatomic structures (electrons), while positive helicons tend to organize into complex subatomic structures (protons and neutrons). This asymmetry in helicon grouping tendencies means that some structures are more common (electrons, protons and neutrons), while other structures form less frequently and decompose rapidly (antimatter). This asymmetry can be explained by assuming that the positive helicon is not exactly symmetric to the negative helicon, but that there is a slight asymmetry in some property of the helicon that causes this predisposition for different grouping tendencies.

The three preon models that we consider the most advanced (Bilson-Thompson, Yershov and Lucas) agree that antimatter is formed by positive and negative preons, in the same fashion as matter, and they reject the possibility of antipreons. Our interpretation of the matter-antimatter interaction is also consistent with Lucas's Intertwining Charged Fibers Model.

6 Dark Matter

Continuing with our minimalist hypothesis, a positive helicon bound to a negative helicon would result in a neutral particle ($H^o = H^+ + H^-$). This neutral particle would be the simplest possible composite particle; therefore, it should be the most abundant stable particle in the universe. The rest of the particles should be produced with a much lower probability. What we currently consider to be empty space would actually be space that is full of neutral particles. The hypothesis of an empty space full of neutral particles is not unusual for physics. Most of the matter in the universe is currently considered to be dark matter that does not correspond to known matter. The electromagnetic properties of this quantum vacuum could also be caused by a sea of neutral particles. We propose the term etheron for the neutral particle that is formed by the binding of a positive helicon to a negative helicon, to emphasize that the etherons form a sea that covers the entire universe, like the old concept of ether. In this case, the sea of etherons is not a fluid of a substance that is different from matter but a sea of neutral particles of ordinary matter.

An indirect consequence of the Sea of Etherons Hypothesis is the recovery of the Principle of Causality or Laplace's Principle of Causal Determinism, according to which every effect has a cause. According to this theory, apparently random processes, such as the disintegration of atomic nuclei or the decay of subatomic particles, are not in reality random processes but are instead determined by collisions with particles from the sea of etherons. Etherons have mass, so their spatial distribution should not be homogeneous. This allows us to establish the first experimentally testable hypothesis of this model: the average lifetime of atoms and subatomic particles must be different in different parts of the universe.

And there is experimental evidence: unexpected and unexplained fluctuations in the decay rates of ^{32}Si and ^{226}Ra have been reported and evidence of correlations between nuclear decay rates and Earth-Sun distance has been found (Jenkins-Fishbach effect [25]).

7 Conclusions

We are convinced of the validity of the Helical Solenoid Model's applicability to the electron, and we believe that this model can be extended to all subatomic particles. We must dispense with the mathematical and conceptual complexities of the SM and the theories that support it (QM, QED and QCD).

As a basis for our preon model, we postulate that the Atomic Principle should be strictly followed and that the fundamental property of matter is the electric charge. From there, we assume the minimalist hypothesis of only two fundamental particles, the negative helicon (H^-) and the positive helicon (H^+). These two point-like particles always move at the speed of light following a helical movement. When several helicons are combined, they form a subatomic particle. There is an asymmetry between the negative helicon and the positive helicon that leads to a propensity of the negative helicons to organize into simple structures (electrons), while the positive helicons tend to organize into complex structures (protons and neutrons). This asymmetry causes opposing structures to be generated with much less probability, as these structures are easily disorganized upon contact with a symmetric structure (matter-antimatter iteration). The union of a negative helicon and a positive helicon forms an etheron, the simplest and most abundant stable particle in the universe. What we know as empty space is actually replete with these neutral particles, forming a sea of etherons. Collisions of particles of matter with particles from the sea of etherons are the cause of many phenomena that are considered random, including:

- Spontaneous disintegration of atomic nuclei;

- Spontaneous disintegration of subatomic particles;
- Antimatter interactions;
- Gravitational dark matter; and
- Quantum effects of vacuum, as the Casimir effect.

Since etherons have mass, their distribution in the universe is not perfectly homogeneous. This allows us to make an experimentally verifiable prediction: the average lifetimes of atomic particles and atomic nuclei must be different in different parts of the universe. Experimental evidence has been reported in this matter [25].

This proposed preon model based on the helicon is not complete since the composition of each subatomic particle is not indicated, nor is the calculation of its masses or its modes of decay. Our main objective was to provide a framework based on new principles and a radical reinterpretation of the facts. We leave for other researchers the job of proposing a complete preon theory based on this framework, highlighting three preon models (Bilson-Thompson, Yershov and Lucas) that we believe are close enough to achieve this target and that can serve as inspiration for others.

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