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The Intrinsic Electron with Its Properties Such as Inner Structure and Self-Mass Is in Conflict with Quantum Field Theory

Victor Vaguine

The Center for Ontological Quantum Studies, Texas, USA
Email: vvaguine@gmail.com

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Abstract

The quantum field theory (QFT) is one of branches of the Standard Model. According to QFT, quantum fields are the primary entities and particles are the excitations of these fields, coming in discrete lumps with no inner structures and with properties assigned by declaration. Such view is in conflict with the observed vacuum energy density, 140 orders of magnitudes less than required by the QFT. In addition, such view is challenged by Aphysical Quantum Mechanics (AQM), a deeper quantum theory. According to AQM, the fundamental understanding of quantum reality is expanded by the addition of two fundamental categories, aphysical and elementary consciousness of elementary particles. Based on AQM and as an example, the total ontology of the intrinsic (fundamental) electron is presented with its inner structure of perfect geometry consisting of the physical charged c-ring and aphysical cylinder, and with its properties such as self-mass, spin, magneto-electrostatic field configuration and magnetic moment. The position parameter in the inner structure demonstrates that there are no two identical intrinsic electrons in the Universe thus placing a question mark over the QFT principle of indistinguishability.

Keywords

Quantum Reality, Physical-Aphysical, Intrinsic Electron, Charged C-Ring, Aphysical Cylinder, Elementary Consciousness, Position Parameter, Constant *U*, Ontology, Self-Mass, Indistinguishable, Inner Structure

1. Introduction

Electron, one of the most studied elementary particles, was discovered in 1897 by J.J. Thomson. Today it has many properties discovered and experimentally

measured, such as mass, electric charge, spin, magnetic moment, anomaly in magnetic moment, stability, and quantum properties such as interference and diffraction.

In 1947, the anomaly in the electron magnetic moment was experimentally discovered by Polykarp Kush and his group [1]. The discovery has had a disproportional impact on the development and progress of quantum electrodynamics (QED) and particle physics. Over the few decades since, the ongoing improvement in experimental technique has increased the accuracy in the experimental determination of the anomaly to eleven-digit places.

In 1987, Dehmelt's group performed experiments with individual electrons trapped in a Penning type device [2]. An individual electron can be trapped in a confined space for hours, days, even weeks, and subjected to extremely accurate measurements of its magnetic moment and other parameters. Observation of a single electron in a Penning trap suggests the electron size of 10^{-20} meters and a possible inner structure.

Over those decades since 1947, theoretical studies of electron have been proceeding in parallel with experimental work. There is an obvious question, what are the theoretical achievements and how is the electron presented by the theorists, for example by Frank Wilczek, a Nobel prize winner, considered one of the world's most eminent theoretical physicists and a firm believer in the Standard Model of particle physics?

Wilczek states "In quantum field theory, particles are not the primary reality. Relativity and locality demand that fields, not particles, are the primary reality. According to quantum theory, the excitations of these fields come in discrete lumps. These lumps are what we recognize as particles. Indeed, what we call particles are simply the form in which low-energy excitations of quantum fields appear. Thus, all electrons are precisely alike because all are excitations of the same underlying Ur-stuff, the electron field. The same logic, of course, applies to photons or quarks, or even to composite objects such as atomic nuclei, atoms, or molecules." ([3], page 197).

Here is "a small" problem. So far, no one has observed quantum fields. What has been observed experimentally are free random classical electromagnetic waves, generated by electrical charges through the universe and possibly free gravitational waves.

Observed vacuum energy density is very close to zero, or 140 orders of magnitude less than what is required for the existence of quantum fields, such as the Higgs field, the quantum electrodynamic fields (QED), and some other quantum fields for all other elementary and not so elementary particles [4]. However, the Standard Model (SM) assumes the existence of quantum fields such as the Higgs field, QED fields, and all other quantum fields despite the fact that these fields have never been observed. This is in reverse to Copenhagen positivism that states what cannot be observed does not exist.

There is another observation: All principal parameters of the intrinsic electronsuch as electric charge, mass, spin and magnetic moment are found experi-

mentally and introduced into theory by proclamation.

Here I present the intrinsic electron with all its properties such as the inner structure consisting of the aphysical cylinder and the physical charged c-ring, self-mass and its origin, spin, magnetic momentum, and other properties, all derived theoretically on the basis of Aphysical Quantum Mechanics (AQM), a deeper quantum theory.

2. The AQM Expansion of Fundamental Understanding of Quantum Reality into Additional Dimensions: The Aphysical Category and the Elementary Consciousness

Aphysical Quantum Mechanics (AQM) is deeper and more profound quantum theory. It is new physics beyond the Standard Model [5] [6] [7].

AQM explains fundamental understanding of the quantum reality by introducing, in addition to the physical category, two more fundamental categories: the aphysical category and the elementary consciousness of elementary particles (see Figure 1).

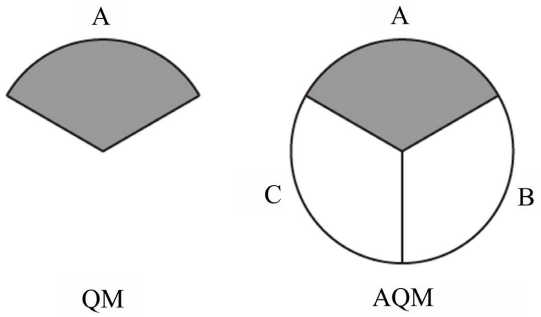

Figure 1. Quantum Reality: QM vs AQM. A—physical category, B—aphysical category, and C—elementary consciousness of elementary particles.

There is no way to comprehend the quantum reality and to solve all quantum enigmas without these two fundamental categories. Each elementary particle consists of physical substance (self-mass) with all its properties and the aphysical substance with all its properties. The ratio between the physical substance (p_s) and the aphysical substance (a_s) is defined as the universal constant U:

$$U = p_s / a_s \ .$$

The universal constant U is preserved in any and all interactions of elementary particles. Elementary consciousness resides in the physical substance and is proportional to the physical substance. It is a challenging concept to comprehend. Although a piece of rock has immeasurably larger physical substance than a single elementary particle, for it consists of billions and billions of incoherent elementary particles, its elementary consciousness is hardly noticeable. A rock is dumb.

The aphysical substance and elementary consciousness solves all quantum enigmas, such as "collapse of wave function", wave-particle duality, non-radiating orbital electron, interference, diffraction and many others. The subject is beyond this paper and is presented in great details in [5] [6] [7].

3. The Inner Structure of the Intrinsic Electron and Electrostatic-Magnetostatic Field Configuration

The pre-AQM physics does not tell us much about fundamentals of the electron. Surprisingly, from the time the electron was discovered in 1897, it was left mostly theoretically unexplored. In spite of extensive scientific effort over many-many decades to find the electron size, the inner structure, and the origin of self-mass, not much progress has been made. SM presents the electron as a fundamental fermion of electromagnetism with no size, no inner structure, and no constituents. This is another example of SM fundamental misconception.

According to AQM, the particle commonly known as electron is a composite elementary particle, consisting of two constituents: the intrinsic electron $\hat{e}^-$ and the neutrino ν. The symbol (^) indicates intrinsic.

In the quest toward ever-smaller entities and basic inner structures, the intrinsic electron, as the fundamental fermion of electromagnetism, represents the last level. Beyond facing us is the unknown reality.

AQM expands our fundamental understanding of the electron and brings forth a plethora of new properties.

The principal constituent of the electron is the intrinsic (fundamental) electron. As shown in **Figure 2**, the intrinsic electron inner structure consists of the physical charged c-ring, the aphysical cylinder, and the elementary consciousness residing in the c-ring, where l_c is the length of the c-ring, L_a is the length of the aphysical cylinder, and PP is the position parameter. Both, l_c and L_a are constants of fundamental significance as Planck constant, electric charge, and the speed of light. The inner structure of the intrinsic electron has perfect geometry.

Electrostatic and magnetostatic field configuration for the intrinsic electron is shown in **Figure 3**. As shown in [8], electrostatic and magnetostatic energies are equal, $E_E = E_H$. Immediately, a question arises "what length of the c-ring is to be assumed?"

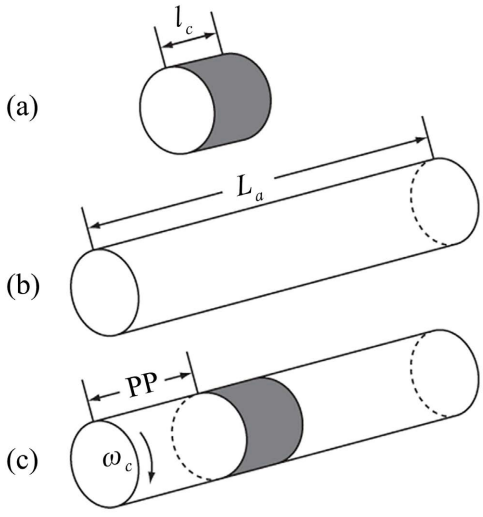

Figure 2. The intrinsic electron inner structure. (a) The charged c-ring, (b) The aphysical cylinder, (c) The inner structure with the position parameter PP.

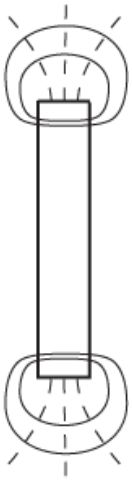

Figure 3. Electrostatic and magnetostatic field configuration for the intrinsic electron.

With respect to the c-ring length l_c for the intrinsic electron, Nature assigns only one specific value. The c-ring length l_c is a fundamental constant. One cannot derive theoretically fundamental constants, such as the speed of light in the vacuum c, Planck constant h, or elementary electric charge e. All of them are found experimentally. The c-ring length can be derived on basis of general Compton conditions, Planck constant, and available experimental data, such as intrinsic electron self-mass [8].

The question of the c-ring length is even more profound. What are c-ring lengths of the intrinsic muon or the intrinsic tau? And what are c-ring lengths for the intrinsic electron with fractional electric charges $-\frac{1}{3}e$ or $-\frac{2}{3}e$?

At first sight, it appears that the intrinsic electron is stable. Electrostatic repulsive outward force applied to c-ring surface is balanced by magnetostatic inward pinch force over the entire surface of the c-ring.

This is only apparent stability. It appears that the c-ring is stable with any value of Compton radius and corresponding value of self-energy. That only means that c-ring is not stable at all. The intrinsic electron is looking for opportunity to quickly release energy and create other inner structures. As the fundamental fermion, the intrinsic electron does not decay but cannot exist by itself in a stable state. In a specific pathway scenario, by releasing part of its self-energy within 10^{-22} - 10^{-25} seconds, the intrinsic electron creates a neutrino-antineutrino pair, acquires a neutrino as a partner, releases antineutrino and in combination with the neutrino, provides conditions for temporary stability and temporary lifetime, in cases of tau or muon, or acquires permanent stability and infinite lifetime in case of electron.

4. The Position Parameter of the Intrinsic Electron Is in Conflict with the Quantum Field Theory Principle of Indistinguishability

Wilczek states "Undoubtedly the single most profound fact about Nature that

quantum field theory uniquely explains *the existence of different, yet indistinguishable, copies of elementary particles*. Two electrons anywhere in the Universe, whatever their origin or history, are observed to have exactly the same properties" ([3], page 335) (emphasis is mine).

The above statement is in complete contradiction with AQM which said that there are no any two elementary particles of any class in Nature that are *indistinguishable*.

In case of the intrinsic electron, it is demonstrated by the existence of *the position parameter*.

As one can see from **Figure 2**, the position of the charged c-ring along the aphysical cylinder axis is defined as the position parameter (PP). There are no two intrinsic electrons with the same value of the position parameter in Nature. The quantum fields principle of the indistinguishability of particles in each class is not valid.

The value of the constant I_c is exact. Even a tiny deviation from the correct value of I_c would result in a deviation from the established value of the Planck constant and would create a conflict between the intrinsic electron and the photon.

5. Summary: Complete AQM Definition of the Intrinsic Electron Properties

The intrinsic electron $\hat{e}^-$ is the fundamental fermion of electromagnetism. It is the exclusive carrier of negative electric charge and, similarly, the intrinsic positron $\hat{e}^+$ is the exclusive carrier of positive electric charge. Both, $\hat{e}^-$ and $\hat{e}^+$, are antiparticles of each other.

The exclusivity means that, if, in a more complex particle, one detects electric charge then one of components in the inner structure of such a particle is an intrinsic electron. The inner structure of the intrinsic electron consists of the physical charged c-ring, the aphysical cylinder, and elementary consciousness residing in the c-ring.

The surface of the intrinsic electron is made of a single elementary unit of negative electric charge ($-e$) with uniform charge density distribution. The intrinsic electron has two fields: electrostatic and magnetostatic. The fields are described by classical electrodynamics.

The General Compton Conditions are especially applicable to the intrinsic electron: self-energy $E_p = \hbar\omega_c \times 2$, self-mass $m_{\hat{e}} = \hbar\omega_c / c^2 \times 2$, electrostatic energy $E_E = \frac{1}{2}E_p$, magnetostatic energy $E_H = \frac{1}{2}E_p$, magnetic moment $M_{\hat{e}} = \frac{e\hbar}{4m_H}$, where $m_H = \frac{1}{2}m_{\hat{e}}$. Repulsive electrostatic force is balanced by magnetostatic pinch force over the entire c-ring surface.

Self-mass of the intrinsic electron is 100% electro-magnetostatic. Spin is the generator of self-mass.

The intrinsic electron spin is equal to $\hbar/2$. Only its magnetostatic self-energy

E_H or one half of its total self-energy $E_{\hat{e}}$ contributes to intrinsic electron spin. That is the ontological explanation of a long-standing enigma why fermions have spin one-half.

The aphysical General Compton Conditions are applicable to the aphysical cylinder as "imitation" of the physical General Compton Conditions with total aphysical substance $a_s = p_s / U$, where U is the universal constant.

The length of the c-ring l_c and the length of the aphysical cylinder L_a are fundamental constants (to be determined).

A free intrinsic electron expands radially almost with the speed of light, releasing its energy within the range of 10^{-22} - 10^{-25} seconds and producing other composite inner structures such as tau, muon or electron.

Along its pathway from high energy level to low energy level with intermediate energy releases, creating other inner structures, the intrinsic electron finally arrives to *the ground energy level*—the electron, where the intrinsic electron together with its partner, the electron neutrino, are trapped "forever" with the total self-energy of 0.511 MeV. There are no free intrinsic electrons in existence *below the ground energy level*.

The AQM c-ring model of the intrinsic electron is mathematically accurate, requiring no approximation [8].

Each individual intrinsic electron has a unique position parameter.

Electric charge is a special state of matter, not yet recognized by science. By itself, electric charge has neither self-energy, or gravitation, or inertia.

In particle physics, W boson must be replaced by the intrinsic electron. Boson inner structure does not allow boson to carry charge [5] [6] [7]. Charge means fermionic inner structure. *The theory of electroweak interactions is scientifically invalid*.

Conflicts of Interest

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

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Appendix

Attachment A: Some More Discussion about the Universal Constant *U*

The relation between physical matter and aphysical matter is defined by the Universal Constant U in a form of the following postulate:

Every elementary particle has physical matter (*physical substance* P_S) *and aphysical matter* (*aphysical substance* A_S) *with ratio*

$$U = P_s / A_s ,$$

where U is the universal constant, and with elementary consciousness residing always in physical matter [5].

In my view, a postulate in fundamental physics is a scientifically educated guess. If applied, it allows one to explain a range of existing problems in physics without running into conflict.

Historically, as a rule, postulates are not immediately supported by experimental confirmation for the required technology and experimental technique might not exist or developed.

Here is a historical example of the law of conservation of energy.

Some inklings of the conservation of substance go back to centuries BCE. Beginning with Newton and Leibniz, the conservation law was experimentally verified initially in mechanical dynamics and then as science has developed, in thermodynamics, electromagnetism, chemistry, nuclear & particle physics, and cosmology, although some research is still in progress.

The universal constant U can explain and dramatically simplify a wide variety of remaining problems and issues in quantum physics, including such quantum enigmas as "collapse" of wavefunction, particle with multiple trajectories simultaneously, wave-particle duality, double-slit experiment, interference and diffraction.

Here are a few examples of how it works and simplifies the mind-boggling complexity of existing quantum mathematical formalism.

Surprisingly, there are some immediate applications of the constant U concept to resolve longstanding quantum enigmas.

As an example, let us consider the double-slit experiment.

Richard Feynman approach is well-known and accepted by theorists as "the sum over histories" [9].

According to Feynman, each individual electron (or photon, or generally, particle) is traveling from the source through two slits to a given point on the detection screen, traversing every possible trajectory simultaneously, in fact, *infinite* number of trajectories through the right slit and through the left slit. In sum, it produces a statistical result with some approximation, never mind mind-boggling mathematics. It is not by chance that Richard Feynman, a Nobel laureate in physics, declares, "I can safely say nobody understand quantum mechanics" [10].

As a contrast to "the sum over histories", let us consider the double-slit experiment using the concept of the universal constant U and elementary conscious-

ness. We use photon rather than electron. Photon as more versatile particle allows us to demonstrate some cosmological aspect as well. The photon inner structure is shown in Figure A1.

Photon directed from the source (typically a low intensity laser beam) goes simultaneously through both slits: slit I as aphysical fraction (a-fraction) and slit II as "host" consisting of intact physical substance and balance of aphysical substance. The physical substance, such as the photon energy c-ring or the electron charged c-ring, is never divided between slits. The energy c-ring and the charged c-ring are indivisible. One might say that the division of photon aphysical substance is a violation the universal constant U. However, it is not the case since the host and the a-fraction are connected by the link. The host reasserts its property of the a-fraction via the link. The universal constant U remains unchanged (Figure A2).

Let us assume that we conduct the double-slit experiment without the detection screen in space. In such a case both the host and the a-fraction are traveling with the speed of light on divergent trajectories with their link intact.

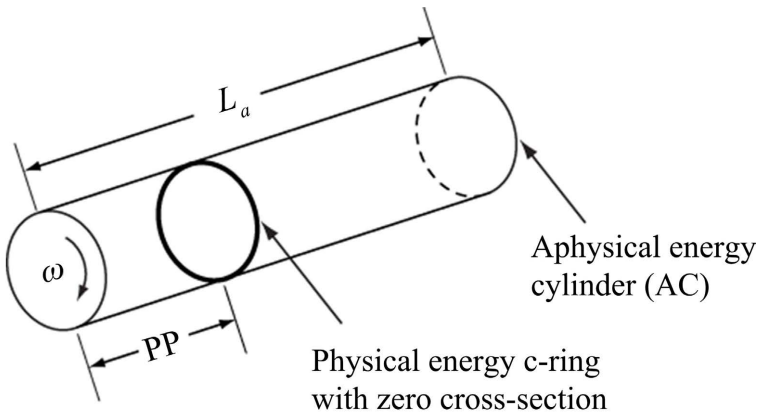

Figure A1. Photon inner structure.

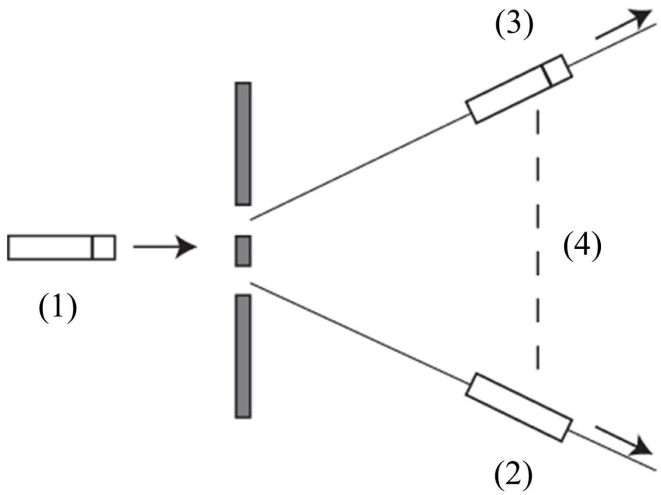

Figure A2. The double slit experiment: full-fledged photon (1), the a-fraction (2), the host (3), the link (4).

As shown in [7], the cross-section of photon-photon interaction is zero. Therefore, the travelers, the host and the a-fraction, are not disturbed by the cosmic microwave background radiation. For them the universe is almost transparent. In principle, they can be separated by billions of light years, gradually and proportionally losing energy due to space expansion with their link intact.

Here are three possible scenarios:

Scenario 1: the a-fraction encounters another aphysical entity. Their aphysical-aphysical interaction is elastic, resulting in change of directions for both, and the link still remains intact.

Scenario 2: the a-fraction encounters a physical entity (fermion, atom, molecule, or a piece of rock). In an instance before the a-fraction is about to interact with the physical entity, the host instantaneously recalls the a-fraction and transforms itself into the full-fledged photon.

Scenario 3: the host encounters a physical entity, in an instant before the host interacts with the physical entity, it instantaneously recalls the a-fraction, reconstructing itself into the full-fledged photon, and then proceeds with the physical-physical interaction.

In none of these scenarios there is a violation of the universal constant U.

In the case of the multi-slits experiment, there are several a-fractions, each connected to the host by its individual link. In such a case, the scenario 3 is applied demonstrating the "collapse" of wavefunction. A system of a-fractions and their host is called *self-entanglement* [5].

Let us consider quantum diffraction, such as the diffraction of an electron on a ideal thin crystal of Nickel. In such a case depending on the thickness of the crystal, there can be thousands or even millions of a-fractions produced and connected to the host by their individual links.

The universal constant U is preserved.

As the host approaches a detector, in an instant it recalls all a-fractions, instantaneously transforms itself into the full-fledged electron, and then proceeds with physical-physical interaction.

As one concludes, interference and reflection are the result of the aphysical-aphysical interaction with physical substance as a passive entity.

The physical substance has no wave properties. It is the aphysical substance of the photon interacting aphysically with the aphysical substance of the optical structure such as multi-slits or crystal produces optical effect. This is the explanation of wave-particle duality. Quantum optics should be called *aphysical quantum optics*.

This is also the explanation of wave-particle duality.

Direct experimental confirmation of aphysical substance requires the development of aphysical technology and aphysical detectors.

Attachment B: The W-Boson Is in Fact the Intrinsic Electron

The charged c-ring does not exist by itself. It is a part of fermionic inner struc-

ture. The charged c-ring is the fermionic c-ring. The energy c-ring is the bosonic c-ring.

The intrinsic electron is the fundamental (basic) fermion. Its inner structure in addition to the charged c-ring includes the aphysical cylinder (see **Figure B1**).

For several decades the intrinsic electron (symbol $\hat{e}^-$) has been misidentified as the W^- boson, and symmetrically, the intrinsic positron $\hat{e}^+$ as the W^+ boson.

To state that the W^- boson carries electric charge is the same as to state that the W^- boson has both the bosonic inner structure and the fermionic inner structure which is a misconception.

An example of a real bosonic inner structure is the photon shown in **Figure A1**. It consists of the physical energy c-ring with zero cross-section and the aphysical cylinder.

The boson travels always with the speed of light, therefore, the zero cross-section of the energy c-ring is result of ultimate relativistic contractions, both radially and longitudinally.

It is an impossibility for the fermion to travel with the speed of light thus W-boson is not a boson. It is the intrinsic electron or the intrinsic positron.

In future physics literature and text books, the W boson must be replaced by the intrinsic electron or the intrinsic positron. It is a massive undertaking.

The intrinsic electron by itself is unstable and is always looking for an opportunity to find a pathway to reduce its self-mass and acquire greater stability. That is the law of physics.

As an example, **Figure B2** shows how intrinsic electron goes through the transformation along a leptonic pathway from tau to muon and then to electron as its final destination, stopping along the way for a short rest as tau with lifetime of 2.9×10^{-13} sec, then as muon with lifetime of 2.2×10^{-6} sec and finally as electron for infinity.

The electron is a composite fermion consisting of intrinsic electron and electron neutrino.

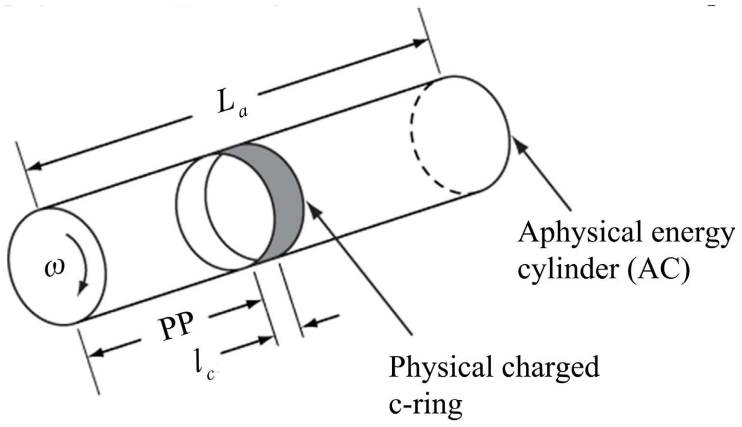

Figure B1. The inner structure of the intrinsic electron.

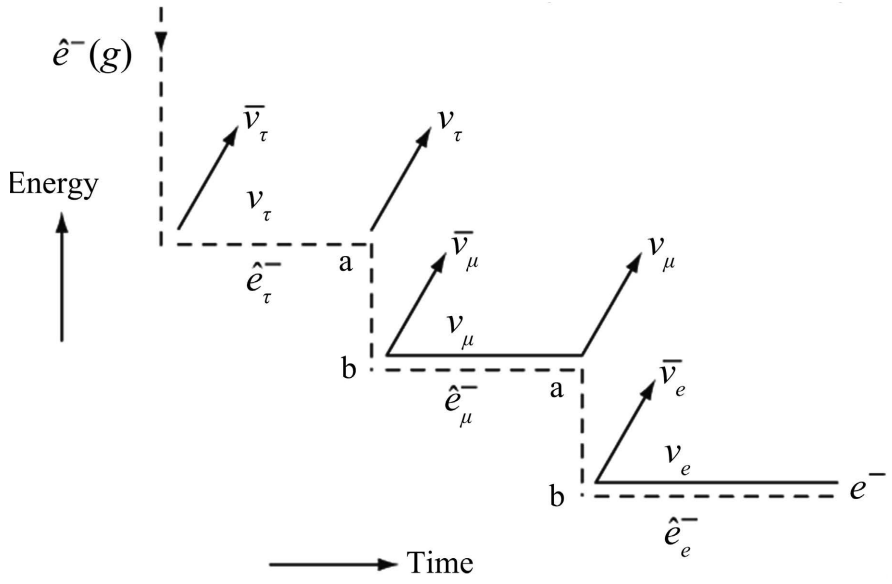

Figure B2. The leptonic pathway of decays and transformations for the intrinsic electron (for details see [8], pages 170-173).

No one has ever observed decay of the electron.

Can the intrinsic electron be stable by itself?

Yes, if somehow its self-mass is brought below 0.5 MeV where it has no available pathway. To accomplish this task the intrinsic electron must be separated "gently" from electron neutrino in the electron inner structure without adding self-mass. It is a challenge for particle physics in the future.