Intrinsic Electron: the Inner Structure and Properties

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Abstract:

Properties of the intrinsic electron are described including the inner structure, definition of the c-ring, description of electromagnetic field configuration, determination of self-mass, spin and magnetic moment, issue of stability, and definition of the position parameter.

1. The Inner Structure of the Intrinsic Electron

Aphysical Quantum Mechanics (AQM) expands our fundamental understanding of the electron and brings forth a plethora of new properties (Refs. 1,2,3). 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 unexplored. In spite of extensive scientific effort over many decades to find the electron size, the inner structure, and the origin of self-mass, not much progress has been made. The Standard Model (SM) mistakenly presents the electron as a basic fermion of electromagnetism with no size, no inner structure, and no constituents. This is another example of SM fundamental misconception.

According to AQM, the electron is a composite elementary particle, consisting of three fundamental constituents: the intrinsic electron $\hat{e}^-$, the intrinsic neutrino $\hat{\nu}$ and the intrinsic antineutrino $\hat{\bar{\nu}}$ with opposite helicity.

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 electron. The first step toward finding the correct intrinsic electron inner structure is to begin with the correct classical electrodynamic structure. Surprisingly, for many decades it has been staring in our face in a form of the c-ring. As shown in Figure 1, the intrinsic electron inner structure consists of the physical energy c-ring, the aphysical energy 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 the same fundamental significance as Planck constant, electric charge, and the speed of light.

a)

b)

c)

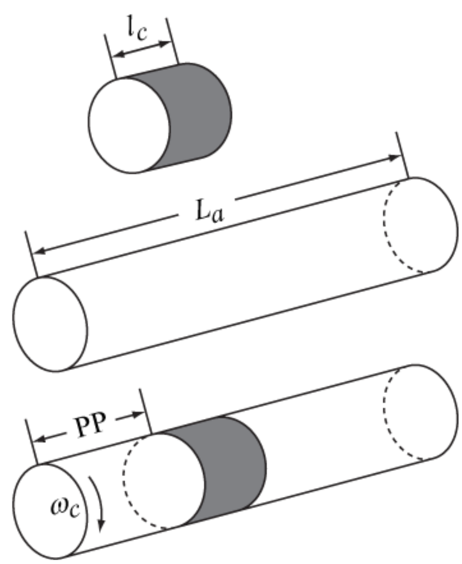

Figure 1
(with permission by ConsReality, Inc.)
The inner structure of the intrinsic electron:
a) the physical c-ring
b) the aphysical cylinder (AC)
c) the inner structure

The physical c-ring is a section of the hollow cylinder with zero wall thickness.

In case of fermions, the c-ring has non-zero length. In case of bosons, the length of the c-ring is zero.

I emphasize that there must be no confusion between “the ring” and “the c-ring”. Comparison between the c-ring and the ring is shown in Figure 2 (a,b). The ring (b) is not compatible with the intrinsic electron inner structure.

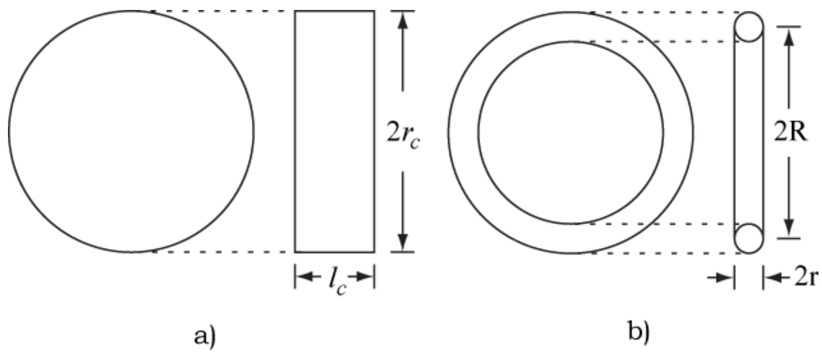

Figure 2 (a,b)
(with permission by ConsReality, Inc.)
Comparison of the c-ring (a) and the ring (b)
c-ring: $\omega_c = c/r_c$
Ring: $\omega = c/R$

The electrodynamic inner structure of the intrinsic electron is the physical c-ring. The c-ring consists of the cylindrical surface made from uniformly distributed electric charge *e*. The c-ring spins with the Compton angular velocity $\omega_c = c/r_c$ and peripheral linear velocity equal to the speed of light. In addition to classical electrodynamic properties, the c-ring also has some specific quantum properties, such as emission of real photons (called “virtual photons”), emission of synchrotron radiation photons, and radiation of electromagnetic energy.

2. General Compton Conditions as Basis for Design of the Intrinsic Electron

The Compton relation is well-known and defined at the relativistic limit of velocity $\upsilon = c$ as a relation between Compton angular velocity ω_c and Compton radius r_c:

$$\omega_c r_c = c$$

According to AQM, the Compton relation is as fundamental in elementary particle physics as Einstein’s formula $m = E / c^2$. *The Compton relation is incorporated into the inner structure of every elementary particle.*

According to QM, electron spin should not be considered in a classical sense as something actually spinning – spin is a quantum parameter found experimentally and assigned *by proclamation*.

AQM asserts that the classical-quantum divide does not exist. It does not imply that quantum physics can be reduced to classical physics. In AQM, spin is considered as something actually spinning and can be visualized in human mind. The intrinsic electron spin is derived mathematically from the AQM model in a straightforward way.

The Compton relation is only a first step in the right direction.

AQM expands the Compton relation to a more comprehensive *General Compton Conditions*. The Compton relation is a subset of the General Compton Conditions. All elementary particles, fundamental and composite, are explained on the basis of the General Compton Conditions adapted to each particular class of elementary particles and to each particular fundamental force. There is no exception to this rule.

Using the intrinsic electron as an example, I define the fundamental meaning of the General Compton Conditions as applied specifically to the intrinsic electron c-ring in a form of postulate.

The General Compton Conditions and their application to the intrinsic electron (prior the corset action):

The intrinsic electron c-ring spins with a classical Compton angular velocity:

$$\omega_c = c/r_c,$$

where r_c is a classical Compton radius.

- The c-ring produces electrostatic field and generates magnetostatic field. Under the General Compton Conditions, electrostatic energy E_E is equal to magnetostatic energy E_H:

$$E_E = E_H.$$

- Radial forces at the c-ring surface are balanced. Outward repulsive electrostatic pressure P_E is opposed equally by inward magnetostatic pinch pressure P_H over the entire c-ring surface:

$$P_E = -P_H.$$

- There are no repulsive or attractive tangential forces along the c-ring surface. All elements of electric charge rotate in parallel to each other at the speed of light.

- The c-ring surface is made of negative electric charge (–e) with uniform charge density distribution and zero thickness.
- Electric charge is a special state of matter not yet recognized by science. By itself, it has no self-mass, gravitation, or inertia. It exists under the General Compton Conditions.
- Under stress, the intrinsic electron radiates photons with exponential intensity and exponential energy relative to applied stress.
- If accelerated, the intrinsic electron radiates electromagnetic energy.

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

3. Electromagnetic Field Configuration of the Intrinsic Electron C-ring

The c-ring electromagnetic field configuration is described by classical electrodynamics. Boundary conditions are precisely defined. Negative electric charge is uniformly distributed on the surface of the c-ring producing electrostatic field. The c-ring spins with Compton angular velocity generating magnetostatic field. Electrostatic and magnetostatic field lines cross each other in space always perpendicular to each other, as shown in Figure 3.

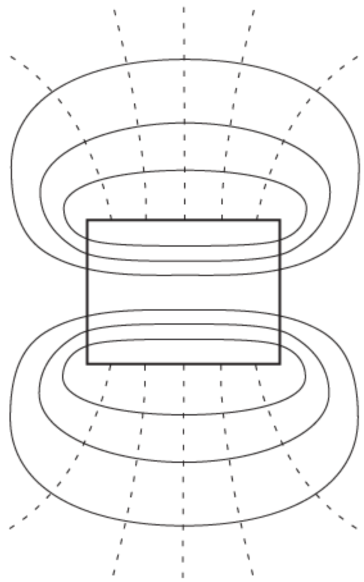

Figure 3
(with permission by ConsReality, Inc.)
Electrostatic and magnetostatic field configurations for the intrinsic electron c-ring

Using computation, one can demonstrate that electrostatic and magnetostatic energies are equal: $E_E = E_H$. Immediately, a question arises "what length of the c-ring is to be assumed?"

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 theoretically derive fundamental constants, such as the speed of light c in vacuum, Planck constant h, or elementary electric charge e. All of them are found experimentally. The c-ring length is also a fundamental constant. It can be derived on the basic of General Compton Conditions, Planck constant, and available experimental data, such as intrinsic electron self-mass.

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

4. Self-Mass (Self-Energy) of the Intrinsic Electron

In pre-AQM particle physics, the origin of self-mass (self-energy) for the electron has never been satisfactorily explained. As Pauli stated in 1945, "We will be considered the generation that left behind unsolved such essential problems as the electron self-energy." The explanation of the origin of electron self-mass on the basis of Higgs mechanism is a sign of desperation.

In AQM, under the General Compton Conditions, the c-ring electrostatic energy E_E and magnetostatic energy E_H are equal:

$$E_E = E_H$$

The total self-energy and self-mass of the intrinsic electron are:

$$E_{\hat{e}} = E_E + E_H$$

$$m_{\hat{e}} = m_E + m_H$$

Here is the basic formula for total physical self-energy and self-mass of the intrinsic electron:

$$E_{\hat{e}} = 2\hbar\omega_c,$$

and

$$m_{\hat{e}} = 2\hbar\omega_c / c^2$$

where ω_c is a classical Compton angular velocity of the c-ring.

Above relations provide the complete explanation for the c-ring physical self-energy and the origin of self-mass. *The intrinsic electron self-mass is 100% electromagnetism and can be computed.*

No Higgs mechanism is required.

5. Spin of the Intrinsic Electron

In the pre-AQM particle physics, a value of electron spin is found experimentally and assigned to the electron as quantum parameter *by proclamation.* AQM provides a straightforward calculation of the value of intrinsic electron spin

Here is a classical formula for spin calculation:

$$S = mvr$$

The physical properties of the c-ring can be expressed on the basis of classical electrodynamics. The c-ring electrostatic energy E_E does not contribute to spin.

The intrinsic electron spin is equal to ħ /2. Only magnetostatic self-energy E_H or one half of its total self-energy $E_{\hat{e}}$ contributes to intrinsic electron spin.

$$S_{\hat{e}} = \hbar/2$$

This is AQM explanation of why fermions have spin ħ /2.

In the case of bosons, the entire boson self-energy contributes to spin, resulting in spin ħ.

This also explains the fermion spin ½ enigma. In SM spin ½ does not return to its original state after rotation of 360 degrees, but only upon a rotation of twice 360 degrees, namely, 720 degrees. There is no ontology in such explanation. In AQM the electron Compton angular velocity is one half of the fermion velocity assumed in SM.

AQM explains that a classical Compton angular velocity of the c-ring produces only one half of fermion self-energy.

6. Magnetic Moment of the Intrinsic Electron

In classical electrodynamics, magnetic moment M is defined as $M = IA$, where I is total current and A is area. In the case of the c-ring:

$$I = \frac{e\omega_c}{2\pi} \; and \; A = \pi R^2 = \frac{\pi c^2}{\omega_c^2}$$

In terms of magnetostatic self-mass, the intrinsic electron magnetic moment is:

$$M = \tfrac{1}{4}\hbar \frac{e}{m_H},$$

or in terms of total self-mass m_e, the intrinsic electron moment is:

$$M = \frac{1}{2}\hbar \frac{e}{m_{\hat{e}}} = one\ Bohr\ magneton$$

The intrinsic electron is the fundamental fermion of electromagnetic force. It does not have “anomaly” in its magnetic moment. In any case, the so-called “anomaly” is another SM fundamental misconception.

7. Intrinsic Electron Gyromagnetic Ratio. AQM Asserts that the Classical- Quantum Divide Does Not Exist.

The gyromagnetic ratio is defined as M/S. In a classical example of the spinning cylinder with uniformly distributed electric charge Q on its surface and a total mass m, this is:

$$M/S = -Q/2m \qquad (*)$$

In the case of the intrinsic electron, the gyromagnetic ratio is (see 2-13):

$$M/S = -e/m_{\hat{e}} \qquad (**)$$

SM explains that discrepancy of factor two between (*) and (**) is an example of the classical-quantum divide. Such explanation is another misconception. So-called divide does not exist.

Here is the AQM explanation.

Intrinsic electron self-mass consists of two equal contributors: electrostatic self-mass m_E and magnetostatic self-mass m_H. Electrostatic self-mass does not contribute to spin or to magnetic moment. In this respect, it is a passive by-stander. Therefore, in formula (2-15) we should include only m_H:

$$M/S = -e/2m_H \qquad (***)$$

Comparing (*) and (***), one can see that in this particular case, the classical-quantum divide does not exist. Consideration of the g-factor is not required.

Conclusion: Gyromagnetic ratio of intrinsic electron in both, classical and quantum, presentations.

In classical presentation, $M/S = -Q/2m$ (A).

In quantum presentation, $M/S = -e/2m_H$ (B),

where $m_H = \hbar\omega_c/c^2$ is magnetostatic self-mass of the intrinsic electron. Only magnetostatic self-mass contributes to spin and magnetic moment of the intrinsic electron.

In this respect, the classical-quantum divide does not exist.

The gyromagnetic ratio (B) is valid for all intrinsic fermions representing fundamental forces: electromagnetism, weak, and strong.

A concept of g-factor becomes irrelevant.

8. Stability of the Intrinsic Electron

There is an equilibrium of electrostatic and magnetostatic forces over the entire surface of the c-ring.

Magnetic field on outer surface is $B_0 = 0$. Magnetic field on inner surface is

$$B_i = \mu_0 I \,, \qquad (1)$$

where $I = \dfrac{e\omega_c}{2\pi}$.

Surface electric charge density is defined as:

$$\sigma = \frac{e}{2\pi r_c l_c} \qquad (2)$$

where l_c is the length of the c-ring and $r_c = c/\omega_c$. Taking into consideration (1) and (2), we obtain magnetic field B_i on inner surface of c-ring

$$B = B_i = \mu_0 \sigma c \qquad (3)$$

Electric field E on outer surface is:

$$E = \frac{\sigma}{\varepsilon_0} \qquad (4)$$

Combining (2-19) and (2-20) we obtain

$$B = Ec \qquad (5)$$

Outward pressure on the surface is caused by electrostatic field and equal to:

$$P_E = \sigma E \qquad (6)$$

Inward pressure is caused by magnetostatic "pinch" and equal to:

$$P_B = -\sigma c B \qquad (7)$$

Taking into consideration (6) and (7), we obtain equilibrium of electromagnetostatic forces on the surface:

$$P_B = -P_E \qquad (8)$$

Tangential forces on the surface are also neutralized. All elements of electric charge are spinning in parallel to each other at the speed of light, thus neutralizing any repulsive or attractive tangential electric or magnetic forces.

At first glance, 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 any 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} to 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.

In contrast to historical classical electrodynamic models, the c-ring model is mathematically accurate, requiring no approximation for all fermions.

9. The Position Parameter of the Intrinsic Electron

The intrinsic electron consists of three components: the physical c-ring, the aphysical cylinder, and the elementary consciousness residing in the c-ring

The position of the c-ring along the aphysical cylinder axis is defined as the position parameter (PP), which is an irreducible quantum random parameter. There are no two intrinsic electrons with the same value of the position parameter.

10. How to Calculate the Length of the C-ring for the Intrinsic Electron.

The length of the c-ring of the intrinsic electron l_c is a fundamental constant. It belongs to the same class of fundamental constants as the speed of light *c*, the electric elementary charge *e*, the Planck constant *h* , and several others to be introduced and discussed in follow up Chapters. By definition, the fundamental constants cannot be theoretically derived. They are preset by Nature and must be found experimentally.

As the principal contributor to electron self-mass, intrinsic electron self-mass is experimentally established and known as m_e = 0.511MeV/c^2 (less the neutrino self-mass). The constant l_c can be computed under the general Compton conditions. This is a 100% classical electrodynamics problem which can be handled by undergraduates and graduates. It would be their important contribution to foundational physics.

Here is the explanation. The c-ring geometry, the electron charge distribution, and the boundary conditions are well defined. To solve the problem, one has to select a specific value of Compton c-ring radius r_c, the corresponding value of Compton angular velocity ω_c, and the corresponding self-mass m_e. Here is a well known point: $r_c = 2\times3.86\times10^{-13}$ *m*, $\omega_c = 3.87\times10^{20}$ *rad/sec*, $m_e = 0.511$ *MeV/c^2 (to be adjusted by neutrino self-mass)* corresponding to $E_p = \hbar\omega_c \times 2$.

The solution of this problem requires computation of the magnetostatic and electrostatic field distributions, their energy density, and total intrinsic electron energy for various values of l_c. By extrapolation, one can find the correct value of constant l_c corresponding to correct value of self-mass. The correct value of l_c defines the correct value of intrinsic electron self-mass. All other values of l_c correspond to different values of self-mass and different values of Planck constant.

The length of the intrinsic electron c-ring is independent of the c-ring self-mass. One can select any value of Compton angular velocity with corresponding self-mass $m_{\hat{e}} = 2\hbar\omega_c / c^2$. Then computation would result in the same value of l_c, as was found for "the known point". The length l_c is the same for the intrinsic electron, the intrinsic muon, and the intrinsic tau. Both, muon and tau represent higher energy excitation of the intrinsic electron as shown in Figure 4.

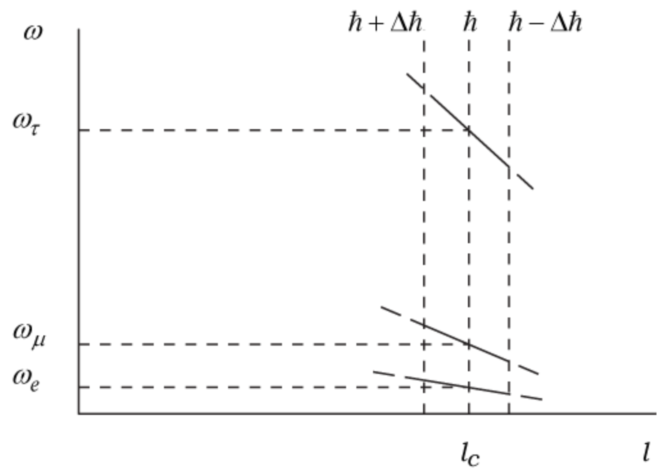

Figure 4
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It is assumed that electric charge is constant

The constants l_c and L_a are fundamental constants of the intrinsic electron.

The value of the constant l_c is exact. Even a tiny deviation from the correct value of l_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.

Summary

AQM complete definition of the intrinsic electron.

- The intrinsic electron $\hat{e}^-$ is the fundamental fermion of electromagnetism. It is the exclusive carrier of negative electric charge, just as 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 intrinsic electron inner structure consists of the physical energy c-ring, the aphysical energy 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 $m_{\hat{e}} = 2\hbar\omega_c/c^2$, 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.
- 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.
- The aphysical General Compton Conditions are applicable to the aphysical cylinder as "imitation" of the physical General Compton Conditions with total aphysical energy $E_a = E_p/U$, 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 with nearly the speed of light, releasing its energy in 10^{-22}-10^{-25} seconds, producing other inner structures, such as neutrino-antineutrino pairs, or quark-antiquark pairs.
- Along its pathway from high energy level to low energy level with intermediate energy releases, creating other inner structures, the intrinsic electron finally arrives at 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, including neutrino self-energy. During this process helicity of the intrinsic electron is unchanged.
- There are no free intrinsic electrons in existence below the ground energy level (this statement is a subject to experimental verification).
- The AQM c-ring model of the intrinsic electron is mathematically accurate, requiring no approximation.
- 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 no self-energy, or gravitation, or inertia.

References

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[3] Victor Vaguine, *The Second Quantum Revolution. Volume Three. Foundational Transformation of Quantum Electrodynamics. Two Branches of Electromagnetism.* ConsReality Press, 2021.