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Compatibility Problems with the Electroweak Quantum Function

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Abstract

This work analyzes the mathematical coherence of the electroweak theory. Quantum electrodynamics proves that the Dirac electron quantum function ψ has four degrees of freedom. This theory has solid experimental support. Furthermore, the rank of the matrix $\left(1\pm\gamma^5\right)$ is 2. Therefore, the electroweak theory that uses the product of this matrix and the Dirac electron function: $\psi_{weak}=\left(1\pm\gamma^5\right)\psi$ has a mathematically erroneous structure because ψ_{weak} assigns only two degrees of freedom to the function of the same electron. An independent analysis supports this assertion because it shows a different argument that refutes the mathematical structure of the electroweak theory.

Subject Areas

Mathematics

Keywords

Mathematical Coherence of Physical Theories, the Dirac Electron Theory of QED, the Electroweak Theory, Mathematically Real Quantum Functions

1. Introduction

The present work adheres to the generally agreed principle that Wigner described in his article entitled *The Unreasonable Effectiveness of Mathematics in the Natural Sciences* [1]. An analogous approach was stated by Dirac who said "I want to emphasize the necessity for a sound mathematical basis for any fundamental physical theory" [2]. In this publication, Dirac continues and says: "The need for putting the mathematics first comes from its more rigid nature. One can tinker with one's physical or philosophical ideas to adapt them to fit the mathematics. But the mathematics cannot be tinkered with. It is subject to completely rigid rules and is harshly restricted by strict logic."

The present analysis utilizes this principle and examines the coherence of the electroweak theory which is the weak interactions sector of the standard model of particle physics (see [3], p. 3). A particular examination analyzes the factor $\left(1 \pm \gamma^5\right)$ that the electroweak theory frequently uses.

The important relationships between quantum field theories (QFT) and quantum mechanics (QM) are clearly stated in Weinberg's well-known textbook: "First, some good news: quantum field theory is based on the same quantum mechanics that was invented by Schroedinger, Heisenberg, Pauli, Born, and others in 1925-26, and has been used ever since in atomic, molecular, nuclear, and condensed matter physics" (see [4], p. 49). This statement makes sense because the transition between the validity domains of QFT and that of QM is carried out by a *continuous* decrease of the system's energy and in many cases the experimenter can control this process. Below, this issue is called *the Weinberg correspondence principle.*

Units where $\hbar = c = 1$ are used. The metric is diagonal and its entries are (1, −1, −1, −1). The second section explains how contradictions arise from the electroweak treatment of the Dirac four components' quantum function. The third section discusses issues that support the result of the second section. The last section summarizes this work.

2. Effects of Tiny Perturbation

The primary topic of this work examines how weak interactions affect the Dirac electronic function ψ in the case where electromagnetic interactions do not vanish. Consider the quantum electrodynamics (QED) electron theory (see [5], p. 78). This is an excellent theory and this reference continues and states on the same page: "That such a simple Lagrangian can account for nearly all observed phenomena from macroscopic scales down to 10^{-13} cm is rather astonishing". Following this impressive description, let us consider the electron's bound states of the hydrogen atom (see e.g., [6], Section 4.4). As stated above, the Dirac equation of the electron's electromagnetic interaction yields very good values. Furthermore, real experiments are not free of the large number of neutrinos (from the sun, etc.) that interact weakly with the electron. It means that in earth laboratories, the weak interactions are indeed extremely weak with respect to the electromagnetic interaction. This argument says that weak interaction effects of the electron can be treated by means of the quantum mechanical *perturbation theory.* Here the electron's weak interactions are regarded as an extremely small perturbation and the Fermi golden rule can be used. It shows that the appropriate second power of the Hamiltonian's matrix element plays the primary role (see e.g., [7], p. 58).

Let us examine the electroweak theory. This theory uses the product of the matrix $\left(1 \pm \gamma^5\right)$ and the electron's quantum function (see e.g., [8], p. 305; [9], p.

292). The γ^5 matrix representation (see [6], p. 283) shows

$$1 \pm \gamma^5 = \begin{pmatrix} 1 & 0 & \pm 1 & 0 \\ 0 & 1 & 0 & \pm 1 \\ \pm 1 & 0 & 1 & 0 \\ 0 & \pm 1 & 0 & 1 \end{pmatrix}, \quad (1)$$

where the ±1 entries of (1) denote the γ^5 matrix. The third line of (1) is proportional to its first line and the fourth line of this matrix is proportional to its second line. Therefore, (1) is a rank 2 matrix. Consider the electroweak function of the electron.

$$\psi_{weak} \equiv \left(1 \pm \gamma^5\right)\psi. \quad (2)$$

The rank 2 of the matrix (1) means that the electroweak theory uses a wave function ψ_{weak} whose components have two degrees of freedom.

The fundamental analysis of the Dirac equation proves that the Dirac electron's function has four independent components (see e.g., [6], p. 8). These four components yield very good results for the hydrogen atom, although the experiment does not remove the neutrino's weak interaction effects. It means that a theoretical explanation of the electron's interactions requires *four components* of the electron's wave function ψ. Therefore, the electroweak theory is inherently unacceptable because its quantum function of the electron has only two degrees of freedom.

Another aspect illuminates the physical issue that this discussion examines. Consider an electronic state of the hydrogen atom and a neutrino that approaches the system from infinity. Here the electromagnetic interactions dominate the electronic state, and the electron-neutrino weak interaction increases continuously from zero to a quite small value. Obviously, this slight continuous process cannot produce a discontinuous jump that reduces the four degrees of freedom of the QED electron's function ψ to the electroweak function which has only two degrees of freedom. This is an intrinsic error of the electroweak theory.

3. A Supporting Argument

A rule of thumb says that an erroneous mathematical structure has more than one specific error. It turns out that the electroweak theory belongs to this category. The following argument shows this issue.

Historically, the de Broglie principle is regarded as a milestone in the development of quantum theories. This principle says that a massive particle behaves like a wave, and experiments prove its validity. Let us examine how this principle applies to mathematically real quantum functions of an elementary particle $\psi(x)$. The de Broglie principle means that the mathematically real coefficients of the following factors describe the mathematical form of a free particle that moves in the *x*-direction (see [10], p. 18)

$$\cos(kx - \omega t), \ \sin(kx - \omega t), \quad (3)$$

where k and ω are the standard quantum notation of the particle's momentum and energy, respectively.

Let a and b denote mathematically real coefficients and the required mathematically real function is

$$\begin{aligned}\Phi(t,x) &= a\sin(kx-\omega t)+b\cos(kx-\omega t)\\ &= A\sin(kx-\omega t-\delta).\end{aligned} \tag{4}$$

Let us examine this mathematically real function of an elementary massive particle in its rest frame. Here $k=0$ and (4) reduces to this form

$$\Phi(t,x) = -A\sin(\omega t+\delta). \tag{5}$$

This result means that for every integer n, there is an instant t when $\omega t+\delta = n\pi$. At this instant, the quantum function (5) vanishes throughout the entire three-dimensional space and the elementary particle vanishes. This is a contradiction that violates energy conservation because a massive particle carries energy. Far-reaching results follow this outcome and one of them pertains to the current discussion: The electroweak theory says that the quantum function of the Z particle takes a mathematically real form (see e.g., [5], p. 701). Hence, the foregoing analysis proves that the electroweak theory of the Z particle is wrong. This independent erroneous outcome supports the electroweak error of Section 2 which is the primary assertion of this work.

It turns out that the Weinberg correspondence principle yields the same contradiction. Indeed, the Schroedinger equation is

$$i\frac{\partial\psi}{\partial t} = \frac{-1}{2m}\nabla^2\psi + V\psi, \tag{6}$$

where V denotes the potential of the external force (see [10], p. 21). If ψ is mathematically real then the left-hand side of (6) is pure imaginary and the right-hand side of this equation is mathematically real. Hence, in the case where the quantum function is mathematically real, the Schroedinger function must vanish throughout the entire spatial space, and the particle is destroyed. Therefore, the Weinberg correspondence principle means that the electroweak theory is wrong. This outcome justifies the conclusion of Section 2.

4. Summary

The rank 2 of the matrix $(1\pm\gamma^5)$ proves that the electroweak theory depends on an erroneous mathematical structure. Indeed, the electroweak theory uses the product of this matrix and the Dirac electronic function ψ. This product casts the electronic quantum function to an expression that has two degrees of freedom. This is a contradiction because textbooks prove that the Dirac electronic function requires four degrees of freedom. An analysis of the de Broglie principle substantiates this conclusion.

Conflicts of Interest

The author declares no conflicts of interest.

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