The Standard Model vs. Physical Facts

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Dynamical sectors of the Standard Model of particle physics are critically analyzed. It is proved that quantum electrodynamics, quantum chromodynamics, and the electroweak theory are inconsistent with fundamental physical principles. More than two examples apply to each of these theories, and any of these examples substantiate the unacceptable status of the relevant theory. Unfortunately, the mainstream particle physics literature ignores this situation and glorifies the Standard Model as an excellent scientific theory.

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1   INTRODUCTION

W. Thomson (Lord Kelvin) was a prominent 19th-century physicist. In a famous article, he draws attention to two unsettled problems (called clouds) of theoretical physics of his time [1]. The article's title is *Nineteenth-Century Clouds over the Dynamical Theory of Heat and Light.* It mentions two unsettled problems: the motion of the earth through an elastic solid ether, and the partition of energy between degrees of freedom of molecules. The meaning of his article is that it is more important to solve these problems rather than proceeding forward on a doubtful basis. One may infer that Lord Kelvin has regarded the topic of his article as an important issue because he states that the article is an extension of a lecture that he has delivered one year earlier. His article and the previous lecture are examples of an open presentation of unsettled scientific problems of his time.

Today we know that the ether related problems have been settled by special relativity (see e.g. [2]). The second problem has been settled by quantum mechanics. Here the quantum of vibrational energy is too high (see e.g [3], p. 299), and this degree of freedom is practically inactive for the relevant temperature. These theories are regarded as crucial elements of contemporary theoretical physics. Obviously, the above-mentioned work of Lord Kelvin is an effort to draw the attention of other scientists. In so doing he has directly or indirectly contributed to the progress of physics.

The discussion presented below is dedicated to a critical examination of the contemporary theoretical physics of elementary particles. The Standard Model (SM) of particle physics comprises theories of three kinds of interactions – electrodynamics, strong interactions, and weak interactions. The corresponding theories of these interactions are called Quantum Electrodynamics (QED), Quantum Chromodynamics (QCD) and the electroweak theory, respectively. Each of these theories is a specific case of a general theory which is called Quantum Field Theory (QFT).

This work uses units where $\hbar = c = 1$. Greek indices run from 0 to 3. The relativistic metric is diagonal and its entries are (1,-1,-1,-1). A standard notation is used, and most formulas take the standard form of a relativistic covariant expression. The second section describes some principles that are used in this work. The third section examines electrodynamics. The fourth section examines QCD, and the fifth section examines the electroweak theory. Another SM problem is discussed in the sixth section. The seventh section contains examples of unjustified SM glorification that are included in mainstream publication. The last section summarizes this work.

2   PHYSICAL PRINCIPLES

Physics is a mature science and a physical theory has a mathematical structure. Hence, an acceptable physical theory must be consistent with these general requirements:

1. It must explain well-established experimental results that belong to its validity domain.

2. It must have a consistent mathematical structure.

Besides these issues, a theory of a quantum particle must abide by some principles that are regarded as vital physical elements. The following principles are used later in this work:

P.1 It is now recognized that the variational principle is a vital element of a quantum theory of an elementary particle. This principle uses a Lagrangian density whose form is $\mathcal{L}(\psi(x), \psi(x),_\mu)$. Here are two quotations that support this approach: "All field theories used in current theories of elementary particles have Lagrangians of this form" (see [4], p. 300). The variational principle is "the foundation on which virtually all modern theories are predicated" (see [5], p. 353). Solutions of the Euler-Lagrange equations of a given Lagrangian density describe the time-evolution of a quantum system.

P.2 The Noether theorem is an important element of this theoretical structure. This theorem connects between symmetries of a Lagrangian density and conservation laws that the relevant theory satisfies. For

example, the Noether theorem proves that a Lagrangian density that does not depend explicitly on the space-time coordinates yields a theory that conserves energy, momentum, and angular momentum (see [6], pp. 17-19). An important part of the proof of the Noether theorem is that the quantum function $\psi(x)$ satisfies the Euler-Lagrange equations of the Lagrangian density.

P.3 The correspondence between QFT and quantum mechanics is stated by S. Weinberg: "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 principle can also be found in pp. 1-6 of [7]. Hereafter, this relationship is called "the Weinberg correspondence principle".

3 PROBLEMS WITH ELECTRO-DYNAMICS

Several unsettled problems of electrodynamics are presented below.

1. *Problems with Gauge Transformations.* The Lagrangian density of a Dirac electron and electro-magnetic fields

$$\mathcal{L}_{QED} = \bar{\psi}[\gamma^\mu i\partial_\mu - m]\psi$$
$$-\frac{1}{16\pi}F^{\mu\nu}F_{\mu\nu} - e\bar{\psi}\gamma^\mu A_\mu\psi \quad (1)$$

is a primary QED expression. The first term of (1) represents a free Dirac particle, the second term represents free electromagnetic fields, and the last term represents the interaction between a Dirac charged particle and electromagnetic fields (see [6], p. 84, [8], p. 78). Every variable of (1) depends on the four space-time coordinates $x \equiv (t, x, y, z)$, and they take the form $\psi(x)$, $F^{\mu\nu}(x)$, $A_\mu(x)$.

Gauge transformation is a crucial element of the present QED structure (see [8], p. 78). This transformation relies on a gauge function $\Lambda(x)$. It alters the electromagnetic 4-potential $A_\mu(x)$ and the Dirac function $\psi(x)$ of a charged particle:

$$A_\mu(x) \to A_\mu(x) + \Lambda(x)_{,\mu};$$
$$\psi(x) \to \exp(ie\Lambda(x))\psi(x), \quad (2)$$

(see [4], p. 345, [8], p. 78). An important element of the following analysis is the fact that the gauge function $\Lambda(x)$ is an *arbitrary* function of the four space-time coordinates (see [4], p. 342, [8], p. 482, after (15.1). The arbitrariness of the gauge function $\Lambda(x)$ means that it may take different values at different space-time points. This feature of the gauge transformation (2) means that the phase of the Dirac particle *changes locally* under a gauge transformation (see [8], p. 78).

Textbooks argue that the gauge transformation (2) is a theoretically consistent operation because it does not alter the Lagrangian density (1) (see e.g. [8], p. 483, after (15.8)). However, this property is just a necessary condition, and other theoretical requirements should also be satisfied. And indeed, an examination of the corresponding Hamiltonian proves that contradictions arise from the gauge transformation (2) (see e.g. [9]).

The following argument provides a straightforward illustration of inherent gauge inconsistency. Let us examine the power series expansion of the exponential factor of the gauge transformation (2), which is a sum of powers of $ie\Lambda(x)$. Here i is a dimensionless pure number, and in the unit system used herein also the electric charge e is a dimensionless pure number. Hence, dimensional consistency of a sum of terms says that the gauge function $\Lambda(x)$ should be dimensionless. Moreover, in a relativistic theory it must also be a Lorentz scalar. These requirements are inconsistent with the definition of $\Lambda(x)$ as *an arbitrary function of the space-time coordinates.*

2. *Problems with the Electromagnetic Energy-Momentum Tensor.* The

Lagrangian density of free electromagnetic fields is

$$\mathcal{L}_{EM} = -\frac{1}{16\pi} F^{\mu\nu}(x) F_{\mu\nu}(x). \quad (3)$$

(see [10], p. 86, [11], p. 601). An application of the Noether theorem to (3) yields the energy-momentum tensor

$$T^{\mu\nu} = \frac{\partial \mathcal{L}}{\partial \psi_{,\nu}} g^{\mu\alpha} \psi_{,\alpha} - g^{\mu\nu} \mathcal{L} \quad (4)$$

(see [6], p. 18, [8], p. 310, [10], p. 83). This tensor satisfies energy-momentum conservation

$$T^{\mu\nu}_{,\nu} = 0. \quad (5)$$

In order to examine angular momentum conservation, one must define a consistent expression for angular momentum. Textbooks prove that a symmetric energy-momentum tensor $T^{\mu\nu} = T^{\nu\mu}$ is required for this end (see [10], p. 84, [11], p. 604). It turns out that an application of the general Noether expression (4) to the electromagnetic Lagrangian density (3) yields a nonsymmetric quantity.

Considering this state of affairs, one may ask the following questions:

Q.1 What is the physically acceptable expression for the energy-momentum tensor of electromagnetic fields?

Q.2 What is wrong with the electromagnetic Lagrangian density (3) and/or the Noether expression for the energy-momentum tensor (4), which is the reason for the incorrect result?

Textbooks address question Q.1 and show that if the divergenceless tensor

$$\Delta T^{\mu\nu} = \frac{1}{4\pi} (A^\mu F^{\nu\lambda})_{,\lambda} \quad (6)$$

is added then the physically consistent energy-momentum tensor

$$T^{\mu\nu} = \frac{1}{4\pi} (g^{\mu\alpha} F_{\alpha\beta} F^{\beta\nu} + \frac{1}{4} g^{\mu\nu} F_{\alpha\beta} F^{\alpha\beta}). \quad (7)$$

is obtained (see [10], p. 87, [11], p. 605).

Unfortunately, textbooks devote no effort to find a solution to question Q.2. The next item shows an explicit QED error, and in so doing, it substantiates the Q.2 claim of inconsistency of the present QED structure.

3. *Problems with the 4-potential of radiation fields.* The interaction term of the electromagnetic Lagrangian density (1) depends on the 4-potential $A_\mu(x)$, where x denotes the local space-time coordinates. Consider the Lienard-Wiechert 4-potential of a charge q that belongs to a radiating system (see [10], p. 174 or [11], p. 656)

$$A^\mu(x) = q \frac{v^\mu}{R_\alpha v^\alpha}. \quad (8)$$

Here R^α denotes the 4-vector from the retarded space-time position of the charge x'^α_q to the field point x^α

$$R^\alpha = (t - t', x - x', y - y', z - z'), \quad (9)$$

and v^α is the retarded 4-velocity of the charge. The retarded coordinates of a charge q are the solution of

$$R^\alpha R_\alpha = 0 \quad (10)$$

(see [10], p. 174 or [11], p. 655). Hence, the 4-potential of the radiation emitted from the given system is the sum

$$A^\mu_{Total} = \sum_i q_i \frac{v^\mu_i}{R_{i\alpha} v^\alpha_i}, \quad (11)$$

where the index i runs on all charges of the radiating system.

Derivatives of this 4-potential define uniquely the radiation fields tensor (see [10], p. 65 or [11], p. 550)

$$F_{\mu\nu} = A_{\nu,\mu} - A_{\mu,\nu}. \quad (12)$$

These derivatives depend not only on the local coordinates but also on the retarded coordinates and the retarded velocity of each charge q_i of the radiating system. On the other hand, the QED Lagrangian density (1) treats the 4-potential $A_\mu(x)$ as a function of the local space-time coordinates and ignores the retarded quantities. This outcome proves that the 4-potential $A_\mu(x)$ of the QED Lagrangian density (1) is mathematically wrong.

A further discussion of this topic has been published elsewhere [12, 13, 14].

4 PROBLEMS WITH QUANTUM CHROMODYNAMICS

The QCD theory is the SM sector of strong interactions. Several problems of this theory are discussed below.

SI.1 *QCD and the nuclear force.* The similarity between the nuclear structure and that of a liquid drop is an important nuclear property (see [15], p. 139). Another aspect of this issue is the striking resemblance between the graph of the potential between two neutral molecules (see [16], p. 16) and that of two nucleons (see [15], p. 97). These graphs look like that of fig. 1.

These similarities indicate that the laws of the force that binds quarks and forms nucleons are similar to the laws of the well-known electromagnetic force, which binds together nuclei and electrons. The inconsistency of this quite self-evident conclusion with QCD is stated by F. Wilczek: "Ironically, from the perspective of QCD, the foundations of nuclear physics appear distinctly unsound" [17].

Wilczek refers to a model where nucleon constituents are enclosed within a bag and says: "But why don't the separate proton and neutron bags in a complex nucleus merge into one common bag? On the face of it, the one-bag arrangement has a lot going for it. It would allow quarks and gluons free access to a larger region of space, and so save on the energetic cost of localizing their quantum-mechanical wavefunctions. But in such a merger, protons and neutrons would lose their individual identities, and our traditional, quite successful model of atomic nuclei would crumble. What prevents that calamity?"

Wilczek thinks that the paper [18] makes a serious step towards a solution of this QCD dilemma. This paper describes a QCD calculation where mesons are used as carriers of the interaction between nucleons. However, the following arguments prove that the calculation of [18] cannot be regarded as a consistent theoretical approach. Indeed, a force like that of Yukawa depends on a quantum function whose form is $\phi(x)$, where x denotes the four space-time coordinates [19]. By contrast, it is already well-known that mesons are quark-antiquark bound states. Hence, the form of their wave function is $\Phi(\boldsymbol{r}_1, \boldsymbol{r}_2, t)$, where $\boldsymbol{r}_1$, $\boldsymbol{r}_2$ are the quark and the antiquark spatial coordinates, respectively. Therefore, mesons cannot be a force-carrying particle, simply because the corresponding functions have a different number of degrees of freedom.

It means that what Wilczek calls a QCD calamity still has no theoretical explanation. Similarly, the bag concept has no sound theoretical basis and theoretical textbooks do not discuss it.

These arguments mean that the above-mentioned QCD calamity is still alive and kicking.
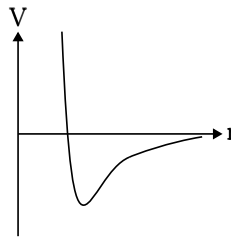

Fig. 1. The distance-dependence of the potential (see text).

SI.2 *QCD and the EMC effect.* Quarks of a nucleon are enclosed inside its volume, and this finite volume means that these quarks have a Fermi motion. The EMC effect [20] compares

the momentum associated with the quarks' Fermi motion of nucleons of the deuteron with the corresponding quantity of the iron nucleus. The uncertainty principle and results of the EMC effect provide information on the volume that encloses the nucleon's quarks, where the nucleons are bound inside a nucleus. This experiment shows that this volume increases with the number of nucleons in a nucleus [20]. This result is inconsistent with previous QCD calculations [20]. On the other hand, like the case of item SI.1, it is analogous to the electronic behavior in atoms and molecules [21].

More than 30 years have elapsed but QCD still has no explanation for the EMC effect. A recent review article says: "The fact that the origin of the nuclear modification of quark distributions is still a matter of some controversy thirty years after the original observation only emphasizes the magnitude of the problem QCD presents" [22].

SI.3 *The Proton's antiquarks spatial distribution.* The literature shows the momentum distribution of nucleon's quarks and antiquarks as functions of Bjorken x (see [23], p. 281, [24], p. 203, [25], p. 202). It turns out that the width of the quark's momentum is significantly larger than that of antiquarks. Using the Heisenberg uncertainty relations, one concludes that the nucleon's antiquarks are enclosed in a significantly larger volume relative to that of quarks.

Pions demonstrate a completely different phenomenon. Indeed, each meson is a quark-antiquark bound state, and the charge radius of π^+ is somewhat smaller than that of the proton [26]. Hence a problem arises: why a single quark of a pion can hold tightly an antiquark, whereas the proton's quarks cannot do that for its antiquarks. The fact that SM textbooks do not discuss this effect means that the SM cannot explain it.

SI.4 *The proton-proton cross section*. The electron-proton scattering data show that "the cross section for electron-proton elastic scattering decreases rapidly with energy. Consequently, high-energy $e^- p$ interactions are dominated by inelastic scattering processes where the proton breaks up" (see [25], p. 178). The proton-proton ($p - p$) scattering data show completely different properties. Here the elastic cross section *begins to increase with energy!* Moreover, the elastic cross section takes a uniform portion of about 1/6 of the total cross section (see the $p - p$ data on p. 10 of [26]).

Here are QCD problems that follow the previous information:

p-p.1 In nearly all cases, a quark that is heavily struck by an electron produces an inelastic event where the proton breaks up, and the total cross section decreases with the increase of energy. On the other hand, in the case of a high energy $p - p$ collision, a quark that is heavily struck by a quark of the other proton produces an effect where elastic and total cross sections increase with energy. What is the physical reason for the different scattering effects of $e - p$ and $p - p$?

p-p.2 An increase of the collision energy means a smaller wave-length of the colliding particles, and the collision is affected by a smaller spatial region (see [25], p. 161). On the other hand, the QCD asymptotic freedom says that the intensity of strong interaction decreases with the decrease of the quark-quark distance (see [5], p. 68). Hence, the QCD asymptotic freedom is inconsistent with the increase of the $p - p$ cross section with energy.

The SM literature does not discuss these contradictions.

SI.5 *Polarized proton experiments.* An article by A. D. Krisch describes experiments with polarized proton scattering. The results show that at higher energy a difference arises between the parallel spin data and the antiparallel spin data [27].

Here is a description of the meaning of these results: "In particular, the theory that is now called QCD, has been unable to deal with this data: Glashow once called this experiment 'the thorn in the side of QCD.' In his summary talk at Blois 2005, Stan Brodsky called this result 'one of the unsolved mysteries of hadron physics.' "

Krisch continues and reports that "some theorists seemed quite unhappy" with the results of polarized experiments, and that QCD experts have expected that "QCD might not work for elastic scattering". The biased and unscientific approach of mainstream people to this issue is inferred from Krisch's statement: "Thus, one result of our experiments was to make both elastic scattering experiments and spin experiments unpopular in some circles."

Other QCD inconsistencies are discussed here [28, 29].

5 PROBLEMS WITH THE ELECTROWEAK THEORY

The electroweak theory claims that it provides explanations for electromagnetic processes and weak interaction processes [8, 30]. The following items show that this statement is full of problems.

WI.1 The electroweak theory regards the $W^\pm$ bosons as two electrically charged elementary particles. As such, these $W^\pm$ should abide by the laws of Maxwellian electrodynamics. One of these laws says that electric charge is conserved. It turns out that unlike the case of the Dirac electron, and although the electroweak theory is nearly 50 years old, this theory still has no expression that proves charge conservation of its $W^\pm$.

Remark: The Noether theorem does not hold for this case because it yields an interaction term that depends quadratically on the electromagnetic 4-potential.

As a matter of fact, electroweak textbooks do not mention this serious contradiction.

WI.2 *Problems with mathematically real wave functions of massive particles.* The de-Broglie principle says that the wave-length of a massive quantum particle depends on its linear momentum. Here the undulating factor of a quantum function is a linear combination of these functions

$$\sin(\mathbf{k} \cdot \mathbf{x} - \omega t), \ \cos(\mathbf{k} \cdot \mathbf{x} - \omega t), \ \exp \pm(\mathbf{k} \cdot \mathbf{x} - \omega t) \tag{13}$$

(see [3], p. 18). Mathematically real functions can be written as a linear combination of the first and the second functions of (13). Hence, a real wave function of a free massive particle moving along the positive x-direction takes the form

$$\psi(t, x) = A \sin(kx - \omega t - \delta), \tag{14}$$

where A is a real normalization factor and δ is a real constant. The free quantum particle that is analyzed here is massive, and it has a rest frame. In this frame the particle's linear momentum is $p = k = 0$, and its wave function (14) reduces to the form

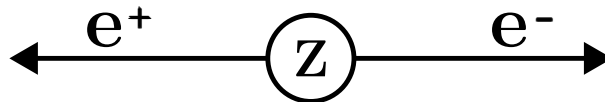$$\psi(t, x) = A \sin(-\omega t - \delta). \tag{15}$$

Fig. 2. The electron-positron Z decay.

It follows that for every integer n, the real wave function (15) vanishes identically throughout the entire 3-dimensional space at the instant t when $\omega t + \delta = n\pi$. This result means that at these instants the particle disappears throughout the entire universe. This result is shown in the literature for the case of a real Klein-Gordon particle (see [31], pp. 41-43).

Conclusion: density, whose spatial integral equals unity, cannot be defined for such a particle.

The electroweak Z boson is described by a mathematically real function (see [30], p. 307). Hence, its disappearance from the entire universe is inconsistent with the Weinberg correspondence principle of section 2. The same argument holds for the Higgs boson (see [8], p. 715).

It can be shown that this discrepancy is closely connected to the real world. Consider the pure leptonic decay of the Z boson [26] (see fig. 2). The e^+, e^- leptons are detected by appropriated devices. Their space-time position and momentum indicate that they have been produced at a very small space-time region and they have the energy of the Z boson. A theory that explains this experiment must provide a consistent expression for the Z density.

SM textbooks do not discuss this serious problem in general and the Z boson density problem in particular.

WI.3 *The idea of massless neutrino.* The electroweak theory has been constructed on the assumption of a massless neutrino. Here are few quotations that substantiate this claim: "Neutrino masses are exactly zero in the Standard Model" (see [32], p. 533). "Two-component left-handed massless neutrino fields play crucial role in the determination of the charged current structure of the Standard Model" (see the Abstract of [33]). It follows that "the massless neutrino must imply a combination $(1 + \gamma^5)$ or $(1 - \gamma^5)$ for the neutrino interactions" [34]. And indeed, the factors $(1 \pm \gamma^5)$ are used in expressions of weak interactions of spin-1/2 particles (see e.g. [30], chapter 21.3).

Contrary to the foregoing assumption, it is now recognized that the neutrino is a massive particle [35]. Furthermore, a modification like $(1 \pm \lambda\gamma^5)$ where $\lambda > 0$ is a real number, is unacceptable for a massive Dirac particle [36].

Electroweak textbooks do not solve this serious problem.

6 OTHER SM PROBLEMS

The Hard Photon-Nucleon Interaction.

Experiments that have been carried out many years ago prove that "the limiting photon total cross sections on neutrons and protons are nearly the same, indicating that the photon interaction does not depend primarily on the charge of the target" (see the review article [37], p. 269). The cross-section data of [26], p. 15 is a recent documentation of this effect. This is an example of isospin symmetry, which shows the charge-independence of hadronic processes. It means that a hard photon-nucleon scattering is outside the electromagnetic domain. Therefore, the effect belongs to the combined electromagnetic and strong interactions SM sectors.

Fig. 3 illustrates an SM problem. Scattering experiments have been carried out for every pair of particles that are shown in fig. 3. The electron-photon scattering (called Compton scattering) is discussed in relevant QED textbooks (see e.g. [8], pp. 158-167, [24], pp. 141-144). The same is true with the electron-nucleon deep inelastic scattering (see e.g. [8], pp. 475-480, 555-563 and 621-647, [24], chapter 8). By contrast, textbooks refrain from a discussion of the case of a hard photon scattered on a nucleon. Here experimental data do exist, but textbooks do not discuss this effect.

Remark: Some articles argue that ideas like Vector Meson Dominance (VMD) explain the effect. VMD states that a physical photon is a combination of a pure electromagnetic photon and a spin-1 meson.

Well-established theoretical arguments refute this idea. For example, the photon moves at the speed of light and its spin-1 has two components of helicity. By contrast, mesons are massive particles, and a spin-1 meson has three components of angular momentum. Hence, VMD violates angular momentum conservation. This outcome can also be obtained from Wigner's analysis of the irreducible representations of the inhomogeneous Lorentz group [4, 38, 39, 40] (also called the Poincare group). Here is a quotation that describes the remarkable significance of Wigner's work: "It is difficult to overestimate the importance of this paper, which will certainly stand as one of the great intellectual achievements of our century" (see [40], p. 149). These theoretical VMD drawbacks are probably the reason for its omission from textbooks.

Conclusion: The photon is an important element of electrodynamics, and the proton and the neutron are the best-known hadrons. Experimental data of photon-nucleon scattering have been obtained more than half a century ago. Despite this evidence, SM textbooks provide no explanation for hard photon-nucleon interaction. Therefore, it is concluded that the SM cannot explain this effect.
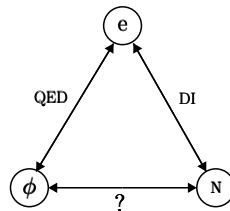

Fig. 3. Three kinds of scattering experiments. Notation: e-electron, ϕ-photon, N-nucleon, QED-quantum electrodynamics, DI-deep inelastic scattering (see text).

7 UNJUSTIFIED GLORIFICA-TION

It is shown above that the SM suffers many contradictions. Unfortunately, these contradictions are practically ignored by the mainstream community. Furthermore, the present mainstream literature contains many unjustified SM glorification that ignore its inherent contradictions. Several examples of this issue are presented below. They refer only to textbooks and to publications of research centers.

1. "At various points in our discussion, we have noted that these theories have passed stringent quantitative experimental tests." ("these theories" == SM). (see [8], p. 781).

2. "Since 1978, when the Standard Model achieved the status of 'orthodoxy', it has met every experimental test" (see [5], p. 3).

3. "Remarkably, the Standard Model provides a successful description of all current experimental data and represents one of the triumphs of modern physics" (see [25], p. 1).

4. "We have mentioned several times that the Standard Model appears to be in complete agreement with all measurements. In fact, with the exception of the surprising result that neutrinos possess finite mass, there have been no confirmed deviations between data and predictions of the Model" (see [41], p. 345).

5. "The standard model describes everything we know about the smallest building blocks of nature yet observed. It's the most accurate theory ever developed, in any field." (see the CERN publication [42]).

6. "The Standard Model: The most successful theory ever" (see the Fermilab publications [43, 44]).

8 CONCLUDING REMARKS

Drawing attention to unsettled theoretical problems may contribute to the progress of physics because it encourages people to find a better understanding of a particular issue. Lord Kelvin's description of unsettled physical problems of his time is mentioned above as an example of this kind of scientific activity. The present work points out many unsettled problems that belong to the SM sectors: electrodynamics, QCD and the electroweak theory. It is stated clearly that the present mainstream literature does not follow Lord Kelvin's legacy. On the contrary, this literature ignores the inherent contradictions of SM theories. It follows that people are unaware of these dilemmas, and as a result, they do not try to solve any of them. Many examples of unjustified SM glorification intensify this unfavorable situation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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