# An Episode with a Particle Physics Expert

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**Abstract**

A description of the particle physicists religious-like working style.

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# 1 Background

For more than 50 years the particle physics activity runs under the rule stipulating that it is strictly forbidden to discuss the possibility that there are errors in existing theories. The dictum "shut up and calculate" stems from this policy (readers may search the web for this "instruction".) This religious-like atmosphere results in the present state, where the Standard Model of particle physics (SM) is full of errors. Hence, the kind of people who flourish in the present particle physics community learn things by heart without having a genuine understanding of the internal logic of their theories.

This is a quite harsh statement. Therefore, I wish to substantiate it with a simple example. The primary element of the current field theory is the Lagrangian density. For example, an important mainstream textbook says: "All field theories used in current theories of elementary particles have Lagrangians of this form" (see [1], p. 300). I completely agree that this is the right course. The Lagrangian density of different interactions takes a different form.

Consider two important theories that describe the electromagnetic fields and the electron, called Maxwellian electrodynamics and the Dirac theory, respectively. These are quite correct theories, and modern industry is based on them. Fig. 1 illustrates the relations between crucial elements of each of these theories: A Lagrangian density; differential equations that are derived from the Lagrangian density; solutions of the differential equations; relevant experiments that fit the solutions.

All physicists and probably some mathematicians, chemists, and engineers have studied these theories. These people feel that they have studies solid reliable theories.

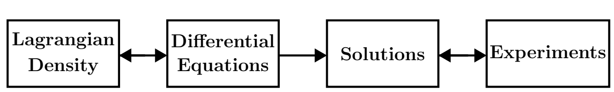


Figure 1: *The structure of a coherent field theory (see text).*

Particle physicists study the electroweak theory, and they should recognize that this theory has a completely different status:

F.1 Most textbooks do not show the full Lagrangian density of the electroweak theory.

F.2 No textbook shows the explicit form of the electroweak differential equations.

F.3 Obviously, no textbook shows solutions to these unknown equations.

F.4 Obviously, no textbook shows that the solutions to the unknown electroweak differential equations fit experiment.

F.5 Apparently, members of the particle physics community are very happy with this unfortunate plight. Indeed, quite a few of them make declarations like this: "The Standard Model: The most successful theory ever" [2, 3]. Another example is taken from a textbook: "Remarkably, the Standard Model provides a successful description of all current experimental data and represents one of the triumphs of modern physics" (see [4], p.1). Furthermore, the Wikipedia policy represents the current consensus. As a matter of fact, as of April 2021, this grave situation of the electroweak theory is not mentioned on the Wikipedia list of unsolved problems in physics [5].

These facts substantiate my assertion that particle physicists study their theories in a religious-like form, and they do not strive to find logical coherence between elements of their theories. The events that are described below provide another example that substantiates my claim.

## 2 Meeting a Particle Physics Expert

Recently I've exchanged several emails with a particle physics expert, called herein X. I do not mention his name because I wish to remove all personal aspects from the discussion. A reputable source says that X is regarded as a brilliant and arising young particle physicist who has been awarded many prizes.

## 2.1 Problem A

I've sent to X a problem: The electroweak theory regards the $W^{\pm}$ particles as elementary charge-carrying particles. Can you please explain why unlike the Dirac electron theory, the electroweak theory violates Maxwellian electrodynamics because it is unable to provide an explicit expression for the $W^{\pm}$ 4-current that satisfies the continuity equation? (The full email is [6].) Readers should note that particle's density is the 0-component of its 4-current.

X has found a simple answer which says: There is no problem with the $W^{\pm}$ particles because they are unstable! (See his email [7].)

I was very surprised at his answer, and I'm quite sure that it is his own invention and it cannot be found in textbooks. I've told him that the muon negates his assertion: "The muon and the W have some common properties: They are electrically charged particles; they are unstable; they decay due to weak interactions." The Dirac theory provides a coherent expression for the muon density. Furthermore, "people who have built muon accelerators"... used its density "for the beam construction and the particle's acceleration." Hence, why the electroweak theory should not do the same for the $W^{\pm}$? (The full text is here: [8].)

These arguments have not convinced X, and he restates:

> "The muon current you wrote is not conserved and neither is any W boson current that one can write (whether it is the one that couples to electromagnetism or any other improved current). Therefore I do not understand what is the issue that you are bringing up. BTW this material is completely standard since the early 70s."

Here I wish to add two fundamental argument that support my opinion.

A.1 This is a theoretical argument. The inhomogeneous Maxwell equations are (see [9], p. 79; [10], p. 551)

$$F^{\mu\nu}_{\ ,\nu} = -4\pi j^{\mu}. \tag{1}$$

Taking the 4-divergence of (1), one uses the antisymmetry of the electromagnetic fields tensor and proves the continuity equation of the charge-carrying particle

$$F^{\mu\nu}_{\ ,\nu,\mu} = -4\pi j^{\mu}_{,\mu} = 0. \tag{2}$$

These arguments prove that Maxwell equations of the electromagnetic fields *impose* the continuity equation on every theory of an elementary charge-carrying particle (see also [1], p. 341). Hence,

| |
|---|
| Every theory of a charge-carrying elementary particle must satisfy the continuity equation. A violation of the continuity equation means a violation of Maxwell equations. |

The continuity equation is studied in an undergraduate course on electrodynamics.

The muon carries an electric charge. Hence, its theory must prove that it satisfies the continuity equation (2). The Dirac equation of the muon is OK.

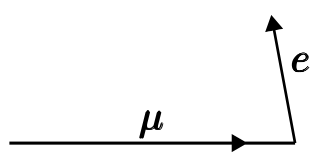


Figure 2: *An illustration of a muon decay (see text).*

A.2 Let us turn to the muon experimental aspects. This information is included in an elementary particles undergraduate course. Fig. 2 illustrates the tracks seen in the photographic emulsion of the first experimental muon detection (see [11], p. 4). The full muon track is seen until it decays. Its decay is an instantaneous process, and the track of the outgoing electron makes an angle with the muon's track. (Each of the two outgoing neutrinos is a chargeless particle and it is unseen in the photograph.) *These data prove that before decaying, the muon behaves like an ordinary charged Dirac particle.* Its charge is the same as that of the electron. Hence, it satisfies Maxwellian electrodynamics. It means that it satisfies the continuity equation (2). As stated above, the Dirac equation is OK.

**My Conclusion:** A brilliant and arising young particle physicist who has been awarded many prizes does not know very important physical properties of Maxwell equations and the muon.

## 2.2 Problem B

Here is another excerpt from what I've sent to him. It refers to the electromagnetic interaction term of the Lagrangian density of the electroweak theory of the $W^\pm$. I've told him that the quadratic factor of the 4-potential of an electromagnetic interaction term like

$$\mathcal{L}_{int} = a\phi^\dagger \chi A A \tag{3}$$

violate Maxwellian electrodynamics. Variables of (3) are: $a$ is a numerical constant, $\phi$, $\chi$ denote quantum functions of an electrically charged particles, $A$ is the electromagnetic 4-potential, and the indices that show how this expression is contracted and produces a Lorentz scalar are suppressed. The electromagnetic interaction term of the electroweak theory of the $W^\pm$ takes the form of (3), where $\phi$, $\chi$ are entries of the $W$ 4-vector.

The reason for my assertion is quite simple: The Euler-Lagrange equation of the rth quantum function is

$$\frac{\partial \mathcal{L}}{\partial \psi_r} - \frac{\partial}{\partial x^\mu}\frac{\partial \mathcal{L}}{\partial(\partial \psi_r/\partial x^\mu)} = 0, \tag{4}$$

(see e.g. [1], p. 300; [12], p. 15). Here $\psi_r$ denotes the generalized coordinates of the Lagrangian density. In electrodynamics, components of the 4-potential $A_\mu$ are regarded as the generalized coordinates of the Lagrangian density (see [9], p. 78; [10],

p. 596). Hence, an application of the derivative operator of the first term of the Euler-Lagrange equation (4) to the interaction term of (3) yields equations of the electromagnetic fields that explicitly depend on the 4-potential $A_\mu$. This is a sheer violation of gauge invariance.

He has responded with contradictory declarations:

> "There are quadratic pieces in the Standard Model for similar reasons. This does not contradict anything and it does not contradict the gauge invariance of Maxwell theory."

He emphasizes his argument and states:

> "Lagrangians containing quadratic fields in $A_\mu$ are pervasive and we know why they are correct. In the theory of superconductivity this is the basic thing you learn in the first course on the topic:
>
> $$L = |\partial\Phi - A_\mu\Phi|^2 + V(|\Phi|). \tag{5}$$
>
> Please check the first equation on the Wikipedia page for superconductivity
> `https://en.wikipedia.org/wiki/GinzburgLandau_theory`
> Expanding it out you see it has a quadratic piece in A. It contradicts nothing – it is as established part of physics as classical mechanics. There are quadratic pieces in the Standard Model for similar reasons. This does not contradict anything and it does not contradict the gauge invariance of Maxwell theory. I teach it to graduate students in *University Y* and this has been standard material for at least 100 years."
> (Remark: University Y belongs to the top 10 in the ranking list of US universities.) "

A straightforward examination of this quotation from X's arguments, proves these matters:

P.1 I use an elementary derivative operation and prove an inherent error of the electroweak theory.

P.2 X demonstrates his religious-like style and quotes from his "holy-scripts". He argues that there is no problem with the SM just because the same error exists in many places.

**My Conclusion:** A brilliant and arising young physicist who has been awarded many prizes ignores a straightforward solid argument that uses fundamental laws of math. He is absolutely sure that he is right just because the same error exists in other SM places.

### 2.3 Problem C

I've asked his opinion on the proof that QCD has been constructed on an erroneous basis and sent him [13]. He has not answered to this problem and terminated the correspondence.

**My Conclusion:** A brilliant and arising young physicist who has been awarded many prizes cannot refute a 2-page proof showing the erroneous basis of QCD.

## 3 Conclusions

A brilliant and arising young physicist who has been awarded many prizes is extremely eager to prove the error-free structure of the SM. In so doing he makes terrible errors. This is another example that illustrates my claim about the religious-like behavior of members of the particle physics community. They never admit that there is a flaw in their theories; they study the SM by heart; they do not care about the logical coherence of their theories.

Similar remarks on the pernicious aspects of the religious-like activity of particle physicists have been published by another person, who tells that he is a qualified particle physicists [14].

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