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Photons as Quantum Electron-Positron Composites

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It is important that we ask the question; what causes the rotating electric and magnetic fields produced by a photon? But when we do, it opens up the possibility that photons are composite particles, rather than elementary, as the most elementary way to produce rotating electromagnetic fields is with a rotating dipole. Additionally, we have the problem of what are the fields? And how do they collapse in an instant when a photon is absorbed? In the standard model, photons have electromagnetic fields and electromagnetic forces are mediated by virtual photons, which is somewhat circular and does not satisfy our need for a physical explanation. Current theory also does not explain in physical detail how photons are produced and absorbed. This paper considers the photons-as-quantum-dipoles model from standard quantum field theory to see what problems it solves. We find that it leads to answers to all these questions. Consequently, we must conclude that photons are composite particles consisting of quantum fluctuation particle pair dipoles and photons are not elementary.

1. Introduction

What causes photons to have rotating electric and magnetic fields? This is a question long left unasked and unexplained by physics. Yet, as physicists we are derelict in our responsibilities if we do not ask the question and our models failures, or at least incomplete, if they do not answer it.

But simply by asking the question, we open up the possibility that electrons are not elementary particles but, rather, a composite particle of some kind. At the very minimum it takes a rotating dipole to produce rotating electric and magnetic fields.

And then, something has to be responsible for making those fields, the electro-magnetic wave. Is there something that physically gives photons their wave nature? This is another often ignored question as physicists have become comfortable with the notion that the wave is simply part of photons' dual nature.

That approach is, however, problematic. Think about a photon that has been traveling billions of years. How far does its fields extend? How do those fields collapse in an instant when the photon is absorbed? When a photon is absorbed its energy is absorbed in an instant, while almost all of the energy in a photon's fields is outside the photon's light cone at that instant, as shown in Figure 1.

Half the energy of a photon is in the central part of the photon and half is in its fields. So, assuming the propagation rate is limited by the speed of light, during the last half-wavelength of a photon's existence, only the field energy within a half-wavelength can make it back to be absorbed. Consequently, the standard idea of a photon includes the inherent assumption that its electromagnetic fields propagate instantaneously, or at least at a rate many of orders of magnitude faster than the speed of light.

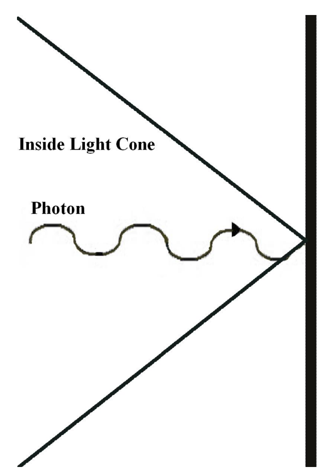

Fig. 1. A photon travels toward a wall where it is absorbed. The light cone shows the region from which the field energy of the photon can be absorbed assuming the field propagates at the speed of light.

The importance of the speed of light limit to relativity theory makes this an uncomfortable question to ask. But as physicists, it is a question we must ask and ultimately answer. It takes a nearly infinite rate of propagation of the electromagnetic fields for a photon to retain virtually all of its energy.

This problem is even more confusing when we consider that virtual photons are supposed to be the gauge bosons for the electromagnetic force. So, we have a case of pulling ourselves up by our own bootstraps, as it were. Consequently, the standard model contains no clear physical model for how electromagnetic fields propagate.

Furthermore, the standard model does not include explanations for how photons are produced and absorbed. According to standard models it just happens. Once again, as physicists, we can do better than that. We need to do better than that. It is our job to discover the underlying physical phenomena and provide a physical explanation that matches our observations, experiments, and successful equations.

Photons and virtual photons are the cornerstone of the table of elementary particles and, yet, when we think about the various problems with photon theory, we find it to be a cornerstone on the verge of crumbling. There are many questions that true physicists must be willing to ask and be able to answer for us to understand the physical nature of photons.

2. The Photon Dipole

The idea that a photon acts like a particle pair dipole is far from new. In mainstream quantum field theory, it is well known that a photon acts like a quantum electron-positron pair during half of a photon wavelength. This is commonly illustrated in a Feynman diagram as shown in Figure 2. In this manner, photons can be thought of as quantum electron-positron pair dipoles, which also give space polarizability.[1]

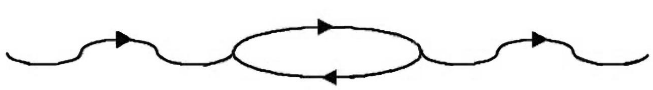

Fig. 2. A diagram of a photon with an electron-positron pair appearing in the center.

A quantum electron-positron pair has the energy of a Planck oscillator (**E=*hf*/2**). The energy (**E**) is equal to Plank's constant (***h***) times the frequency (***f***) divided by 2. The electromagnetic field carries the other half of the energy so it has the same total energy as a photon of **E=*hf***.

Note that the Planck oscillator energy is as low an energy as we can go for a given frequency. Consequently, the source of the photon's electric and magnetic fields cannot be anything more complex than a quantum particle pair dipole at the Planck energy.

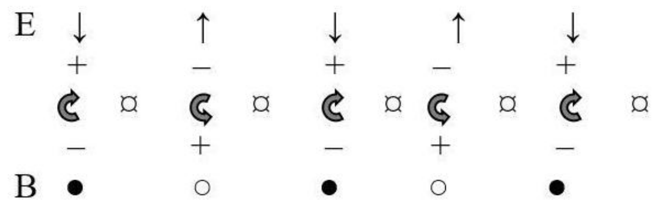

Fig. 3. A series of counter-rotating quantum electron-positron pairs produces rotating electric and magnetic fields identical to those of a photon.[2]

Planck oscillators have the same frequency, wavelength, and speed of light relationship as a photon. The dipole wavelength is equal to the distance traveled by a photon during a half-wavelength. Quantum electron-positron pairs can also rotate at the speed of light producing electromagnetic fields that are identical to that of a photon over the course of a half wavelength as illustrated in Figure 3.

Importantly, an electron-positron pair is electrically neutral. And, a quantum electron-positron pair is massless. Both of these properties are required in order to be consistent with the properties of a photon.

The quantum electron-positron dipole model of a photon is indistinguishable from a photon. This is recognized by most physicists who are experts in quantum field theory and, yet, few take time to consider the implications.

This leaves us with the question of whether photons are elementary and the electron-positron quantum fluctuations are a property of photons or whether the quantum vacuum fluctuations are elementary. We can note that electrons and positrons exist without a photon being present, which gives us a hint about the answer.

3. Virtual Photons

In order to tell which is elementary we must consider virtual photons. In the standard model, the quantum vacuum is said to be composed of virtual photons. Although in current theory, space may contain any quantum matter-antimatter particle pair. The importance of particle pairs in the theory is that the properties of pairs cancel so that a particle pair can come from nothing and return to nothing while effectively conserving the neutrality of space with respect to each particle property during their entire existence.

The most important of the conserved properties is energy. The energy of the quantum Planck oscillator is $\mathbf{E=}\boldsymbol{hf}\mathbf{/2}$. This can also be stated in relation to Heisenberg's uncertainty principle as $\mathbf{\Delta E \Delta}\boldsymbol{t}\mathbf{=}\boldsymbol{h}\mathbf{/2}$, which gives us the limit for how long a quantum fluctuation can exist. Any hypothetical quantum fluctuation that exceeds this energy and time constraint is not a quantum fluctuation and, therefore, violates the principle of conservation of energy.

A single photon's energy is $\mathbf{E=}\boldsymbol{hf}$ over a single wavelength including the field energy. So, the two-photon, or photon-antiphoton model of the quantum vacuum violates the principle of conservation of energy. Any combination of two photons has at least twice the energy allowed under Planck's theory. This fact invalidates the most popular model of the quantum vacuum.

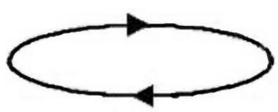

Fig. 4. A virtual photon is identical to a quantum electron-positron pair.

In order for a virtual photon to have the correct energy, $\mathbf{E=}\boldsymbol{hf}\mathbf{/2}$, and not exceed the time constraint required to conserve energy, it must be a single half-wavelength photon. Such a photon is identical to a quantum electron-positron pair. Consequently, the photon model of the quantum vacuum is identical to a quantum electron-positron model.

The single half-photon model of space has the inherent problem that it lacks an antimatter opposite to effectively neutralize its properties throughout its existence, except if it is a quantum electron-positron pair. Vacuum fluctuations cannot exist as a single particle without violating conservation principles related to each of its properties.

A quantum electron-positron pair does not violate conservation principles related to any of the particles' properties as each particle property is cancelled by its antimatter opposite. And, quantum particle pairs do not have mass-energy, as they do not exist long enough to have mass.

This tells us that space is filled with quantum electron-positron pairs rather than photons. To be complete, any other real matter-antimatter particle pair can also exist in space as a quantum particle pair. It is not clear, however, if other particle pairs can form other types of photons. But hypothetically speaking, it should be possible.

Note that space composed of quantum particle pairs is consistent with the Casimir effect, which is due to van der Waals forces. Van der Waals forces arise between dipoles, so space must be filled with electric charge dipoles of some kind.

4. Electric and Magnetic Fields

Since space is filled with dipoles, they must necessarily respond to electric and magnetic fields. Dipoles are polarized in the presence of electric charges. And dipoles rotate in response to charge motion and magnetic fields, such that each dipole becomes a tiny magnet.

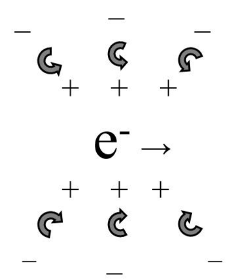

Fig. 5. As an electron moves through space nearby quantum dipoles are polarized and rotate.[2]

The patterns formed by electrically or magnetically polarized dipoles are no different from Faraday field lines. More importantly, polarized and rotating quantum dipoles are the Faraday fields.

As such, the electric and magnetic fields of a photon are also due to polarized and rotating quantum dipoles. We can therefore, do away with the notion of particle-wave duality. Electromagnetic waves travel through a medium, the quantum vacuum, and that medium and the waves through it are physically distinct from particles.

We can also recognize at this point that quantum particle pair dipoles mediate electromagnetic interactions rather than virtual photons.

5. Induction and Conservation Laws

When charges move or currents flow quantum dipoles rotate. Conversely, quantum dipole rotation leads to charge movement or current flow. This leads to magnetic self-induction. Understanding space as a sea of quantum dipoles gives us a better explanation of the underlying physical interactions.

Importantly, magnetic inertia requires that the field be maintained even though each quantum dipole is flashing in and out of existence very quickly. So, quantum dipoles must be induced such that they have the magnetic properties needed to maintain the magnetic field. Similarly, dipoles must be induced to conserve electric fields.

With regard to photons we can also consider that if there is a rotating electric and magnetic field typical of a certain photon wavelength, then that wavelength quantum dipole would necessarily be induced in the center of the fields, if one were not already present. So, even if we imagine a photon with a rotating electric and magnetic field and nothing in the center of those fields, a quantum dipole would be induced in the center. And that dipole will have the exact energy of the photon with the correct polarization.

This gives us a somewhat different way to look at photon propagation. Each successive quantum dipole along the path of a photon is induced into existence. Successive quantum dipoles counter-rotate so that angular momentum is conserved. Photon propagation is, therefore, a form of self-induction. And, photons are entirely composed of quantum dipoles.

6. Propagation Rate of Fields

Fields necessarily propagate through space dipole-to-dipole. They cannot physically propagate at an instantaneous rate. But the rate of propagation is also not limited to the speed of light as we know from the fact that a photon does not lose half its energy to its fields when it is absorbed. Rather, the field energy gets absorbed along with the energy of the central quantum particle pair dipole.

To be clear, it takes energy for fields to propagate and consequently the fields contain energy. The quantum dipoles in space cannot rotate to polarize or magnetize without some energy expenditure.

Why the difference between the speed of light and the propagation rate of fields? It comes down to degrees of rotation. The quantum dipoles within a photon must necessarily rotate 180 degrees, which takes its entire existence. The quantum field, on the other hand is filled with numerous dipoles, so only a small percentage need to rotate a small fraction of a degree to form a field. The quantum field is so dense with dipoles that even the greatest electric and magnetic fields easily propagate through space.

If, for example, quantum dipoles only need to rotate 10^{-20th} of a degree to establish a field, the field propagates at 1.8 x 10^{22} times the speed of light. The maximum rate of field propagation is presently unknown. It is by necessity of real physical interactions not infinite.

7. Production of Photons

By recognizing that photons are a series of quantum dipoles we can better understand how photons are produced and absorbed. Photons must be thought of as an electron-positron pair at the time of the interaction. We also know from experiment that photons are produced when a free electron and free positron annihilate, which is consistent with this analysis.

Therefore, we can expect photons form when an electron annihilates with a quantum positron from a quantum electron-positron dipole. Similarly, photons are absorbed when the positron from the quantum dipole within a photon annihilates with a stable electron. The following information in this section is covered in more detail in my paper "Quantum jumps as vacuum fluctuation particle pair interactions analogous to Hawking radiation."[2]

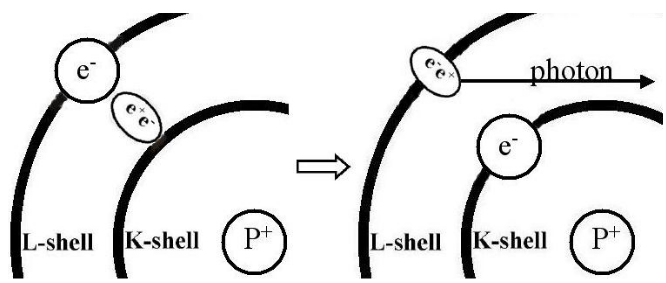

Fig. 6. A Bohr style hydrogen model showing an electron-positron vacuum fluctuation mediated electron shell transition

One typical interaction we must consider is an electron transition within an atom where an electron drops into a lower energy vacancy. This interaction is mediated by a quantum electron-positron pair where the quantum positron annihilates with the electron to form a photon that carries away the excess energy, while the quantum electron becomes stable, inheriting the mass-energy of the other electron, and occupies the lower energy state. This is illustrated in Figure 6.

Similarly, when a photon interacts with an orbital electron, the photon's quantum positron annihilates with the electron. The photon's quantum electron gains the mass-energy from the orbital electron that was annihilated in addition to retaining the photon's energy. The new electron is now stable and can escape from the atom or jump to a higher energy state.

In this manner, understanding that photons are composed of quantum dipoles leads to a physical explanation for how photon production and absorption interactions occur. The photon model alone, without consideration of its quantum dipoles, fails to yield a deeper understanding of these interactions.

8. Conclusion

By forcing ourselves to answer the question of where a photon's electromagnetic field comes from, we must consider that photons are composite particles made of dipoles. They are, therefore, not elementary. Based on their energy each half-wavelength, the Planck energy, photons are a series of quantum particle pair dipoles surrounded by a field of quantum particle pair dipoles.

By applying the Planck energy constraint to a virtual photon, we find that they too are not elementary but, rather, a composite particle made of a quantum particle pair. The standard photon pair model of the quantum vacuum exceeds the Planck energy limits, so they cannot physically exist without violating the principle of conservation of energy.

On the other hand, by acknowledging that space is filled with quantum particle pairs we better understand how electromagnetic fields propagate through space. It makes it clear that electromagnetic fields and waves are not intrinsic to particles, but are a property of the medium, the quantum vacuum, as is the photon in its entirety.

This explanation of the fields also allows us to understand how they propagate much faster than the speed of light so that photons do not lose a substantial amount of energy when they are absorbed.

And finally, it gives us a much clearer picture of how photons are produced and absorbed due to annihilation events between stable electrons and quantum positrons from quantum electron-positron pairs.

Physicists have known for more than 50 years that photons are equivalent to quantum electron-positron pairs, but they failed to extend that fundamental understanding to its logical conclusions. When we do, it becomes clear that photons and virtual photons are composite particles and they are not elementary.

References

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[2] Fleming, R., *The New Physics*, Self-Published, 2001.

[3] Fleming, R., (2017) "Quantum jumps as vacuum fluctuation particle pair interactions analogous to Hawking radiation." GSJournal.net, March 18, 2017. http://gsjournal.net/Science-Journals/Research%20Papers/View/6179