New Theory of Classical Field Matter

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[Abstract] Mechanical wave is a medium conducted wave. **Mechanical wave is the phenomenon of the collective movement of many particles participating in vibration at the same time.** There are four kinds of classical field matter: electric field, magnetic field, light field and gravitational field, which are independent field matter respectively. This paper reveals that light wave is the emission wave of light particles, and its essence is particle. Photon is a field energy particle with phase property. This paper theoretically denies the superposition principle of single photon double-slit interference. A single photon cannot pass through the two slits at the same time, and a single photon can pass through one of the two slits in turn to achieve double-slit interference. **Light wave is the cumulative phenomenon of the individual movement of a single photon particle with phase property at different times.** Furthermore, a verification experiment to check the superposition principle of single photon double-slit interference is presented. Using a light shield to block one of the two slits in turn to ensure that each single photon can only pass through one of the two slits separately. Electric field wave, magnetic field wave and gravitational field wave have the characteristics of mechanical wave, and they must not be the emission wave of particles, it is more reasonable that they are medium conducted waves. The medium of electric field wave, magnetic field wave and gravitational field wave are electric field medium quantum, magnetic field medium quantum and gravitational field medium quantum respectively. This paper further proposes that the eccentric spin and eccentric plane vibration of the photon and energy fluctuation of vacuum field are the possible causes for the phase property of the photon.

[Key words] mechanical wave, medium, field matter, light wave, photon, phase property, single photon double-slit interference, superposition principle, electric field wave, magnetic field wave, gravitational field wave, electric field medium quantum, magnetic field medium quantum, gravitational field medium quantum

1. Introduction

In philosophy, we define matter as an objective existence. Thus, we can define physical matter as an objective existence with energy. Physical matter can be further divided into solid matter and field matter. Solid matter includes various forms of macro-objects and all micro-particles and elementary particles. The velocity of solid matter is less than C. There are only four kinds of field matter: the electric field, magnetic field, light field and gravitational field. The velocity of field matter in vacuum is constant C.

Maxwell's equations provide an important theoretical basis for modern physics. However, recent studies[1] have proven that two of the four Maxwell's equations are wrong. A changing electric field in a vacuum cannot excite a magnetic field, and a changing magnetic field cannot excite an electric field. "Electromagnetic waves" do not exist in the physical world. Light is not an "electromagnetic wave", and light is light field itself. Electric field, magnetic field and light field are the position characteristics, velocity characteristics and acceleration characteristics of charge respectively. Therefore, the speed of electric field, magnetic field and light field in vacuum is equal, which is reasonable and self-consistent. Electric field, magnetic field and light field can not be directly excited and transformed. Electric field, magnetic field and light

field are independent field matters respectively.

Physics is facing great challenges and opportunities, and the classical field matter and quantum world need to be significantly revised.

2. Mechanical wave

Mechanical wave is the propagation process of mechanical vibration in the medium, such as sound wave, water wave, etc.; To generate mechanical waves, there must first be a vibrating object, which is called the wave source. In addition to the wave source, elastic medium is also needed. In the elastic medium, the particles are connected with each other by elastic force, and the particles are involved in the vibration in turn, so that the vibration state can spread out and form waves. It can be seen that wave source and elastic medium are two necessary conditions for mechanical wave generation. For example, when a person speaks, his vocal cord will vibrate. The vocal cord is the wave source, and air is the medium for transmitting sound. Sound cannot propagate in a vacuum.

Mechanical wave is a kind of medium conduction wave, which is the propagation process of mechanical vibration in the medium, and has the characteristics of reflection, refraction, diffraction and interference. **Mechanical wave is the phenomenon of the collective movement of many particles participating in vibration at the same time.** The physical principle of mechanical wave is Newton's classical dynamics, and there is no new physical fundamental principle for mechanical wave. For example, sound wave is the phenomenon of the collective movement of many air molecular particles.

3. Light field and single photon double-slit interference

In 1690, Huygens proposed the wave principle of light, but this theory was soon replaced by Newton's particle theory of light, which believed that light was composed of tiny particles.

In the early 19th century, Thomas Young's light wave double-slit interference experiment provided a new experimental basis for Huygens' wave theory of light. In 1865, Maxwell introduced the "displacement current" hypothesis, theoretically predicted that light was "electromagnetic wave", then Huygens' wave theory of light was re-accepted.

In 1905, Einstein solved the riddle of the photoelectric effect, and established the wave-particle duality of light. In 1924, De Broglie put forward the "material wave" hypothesis, which believed that all matter has wave-particle duality. According to this hypothesis, electrons also have wave phenomena such as interference and diffraction, which was confirmed by electron diffraction experiments later.

Photons have wave-particle duality. Are photons particles or waves in essence?

Regarding mechanical waves, their reflection, refraction, diffraction, interference and other wave characteristics are only the phenomenon of the collective movement of many particles participating in vibration at the same time. The essence of mechanical wave is the movement

of particles, and there is no new physical fundamental principle for mechanical wave.

When two strong beams of light cross vertically, photons do not collide and emit outward from the beams. This shows that the photons in the beam are independent of each other, and the volume of the photon itself is relatively very small to the space between photons. Thus, the beam is particle flow of photons, and the essence of photons is particle and photons are a kind of field energy particles with phase property. The wave characteristics of photons are only the movement phenomenon of their phase property. Based on the particle essence and phase property of photons, the light double-slit interference experiment will be discussed below.

The double-slit interference is the most important experiment to prove the light wave characteristics. Without losing generality, a laser source S is set to emit a parallel laser beam, which passes through two parallel slits S_1 and S_2. The parallel beam emitted by S forms a pair of coherent light sources with the same initial phase and the same intensity at the double slits S_1 and S_2. The coherent light causes the detection screen E behind the double slits to display bright and dark interference fringes. The experimental device is shown in Figure 3.1.

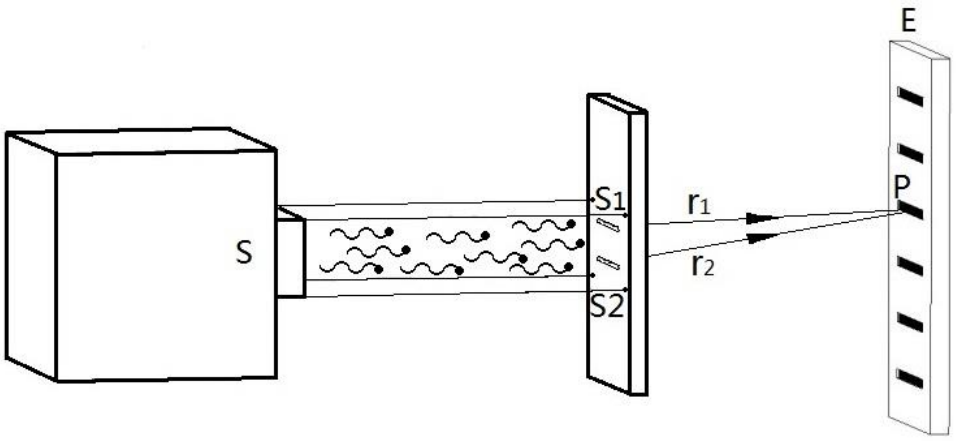

Fig. 3.1 Light beam double-slit interference experiment

Suppose the power of the laser source S is 1.0w, the cross-section size of the beam is 1mmx6mm, the cross-section size of the double-slits S1 and S2 is 0.02mmx4mm respectively, and the photon wavelength λ= 570nm, its frequency γ= 5.26×10^{14}hz. The energy of one photon.

$$E_\gamma = h\gamma$$
$$= 6.626\times10^{-34} \times 5.26\times10^{14}$$

$$E_\gamma = 3.487\times10^{-19}\ J$$

Number of photons emitted by 1.0w laser source in 1 second:

$$N_\gamma = 1/ E_\gamma$$
$$=1/（3.487\times10^{-19})$$

$$N_\gamma = 2.868\times10^{18}$$

Number of photons emitted through slit 0.02mmx4mm in 1 second:

$n_\gamma = N_\gamma$（0.02x4）/（1x6）

$= 2.868 \times 10^{18} \times 0.00333$

$n_\gamma = 9.56 \times 10^{15}$

Our visual retention time of light is 0.05 to 0.2 seconds, set the visual retention time to 0.1 seconds. The number of photons passing through two slits of 0.02mmx4mm in 0.1 seconds

$n_{\gamma 0} = 1.912 \times 10^{15}$ （3-1）

In quantum mechanics, the single photon double-slit interference experiment is one of the most important fundamental experiments, and its most mysterious and controversial part is: which of the slits S_1 and S_2 does a single photon pass through to the detection screen E? Based on the superposition principle, quantum mechanics considers that a single photon passes through the slit S_1 and S_2 at the same time.

Based on the particle essence and phase property of photons, we will further discuss the single photon double-slit interference experiment below.

As shown in Figure 3.2, the laser source S is set to emit photons one by one. the wavelength of photon λ=570nm, the cross-section size of the double-slits S_1 and S_2 is 0.02mmx4mm respectively, which is the same as that of experiment in Figure 3.1. Without losing generality, let the laser source S emit a photon every 1 pico-second (10^{12} photons are emitted in 1 second), and the photons pass through the double slits S_1 and S_2 in turn by different symmetrical paths. The photons passing through the slit S_1 is p_1 (i) { i=1,3,5,7...}, and one photon p_1 (i) passes through the slit S_1 every 2 pico-seconds. The photons passing through the slit S_2 are p_2 (j) {j=2,4,6,8...}, and one photon p_2 (j) passes through the slit S_2 every 2 pico-seconds. The initial phases of photons p_1 (i) and p_2 (j) at the double-slit S_1 and S_2 are the same.

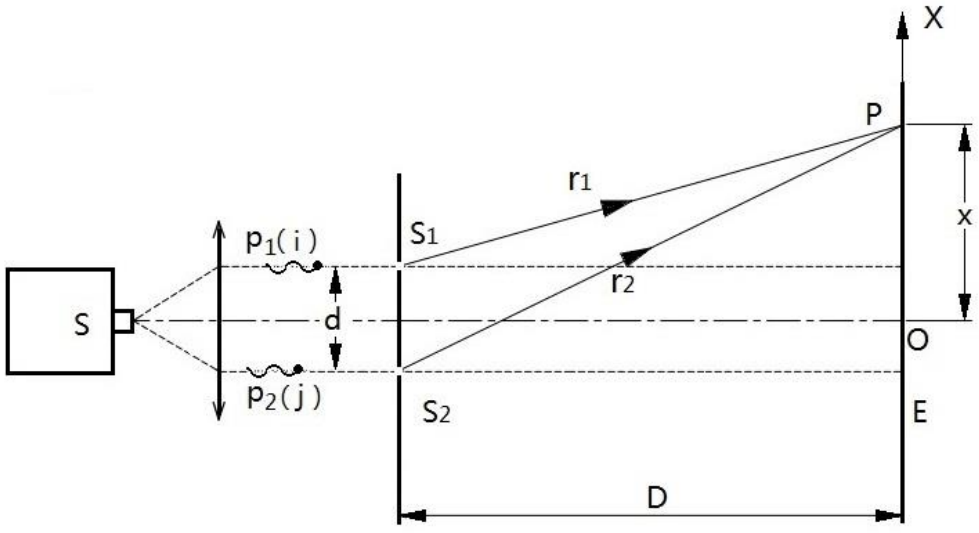

Fig. 3.2 Single photon double-slit interference

Suppose the distance between S_1 and S_2 is d, the distance between the double-slit screen and the detection screen E is D。Taking O as the origin, establish the coordinate axis X，select a point P (OP=x) on the X axis, and the distances from point P to double slits S_1 and S_2 are r_1 and r_2, respectively. The optical path difference of photons p_1 (i) and p_2 (j) from S_1 and S_2 to point P is

$$\Delta r = r_2 - r_1 \qquad (3\text{-}2)$$

According to figure 3-2

$$r_1^2 = D^2 + (x - d/2)^2; \quad r_2^2 = D^2 + (x + d/2)^2$$

Therefore

$$r_2^2 - r_1^2 = (r_2 - r_1)(r_2 + r_1) = 2 x d \qquad (3\text{-}3)$$

Due to D>>d, then $r_2 + r_1 \approx 2D$，According to equations（3-2）and（3-3）

$$\Delta r = r_2 - r_1 = x d/D$$

Suppose the wavelength of photons p_1(i) and p_2(j) is λ, the conditions for the interference enhancement

$$\Delta r = x d/D = k\lambda$$

That is

$$x = k(D/d)\lambda, \quad k=0, \pm 1, \pm 2, \ldots$$

The positions where the interference between photons p1 (i) and p2 (j) is strengthened are the bright stripes of light. When k=0, then x=0, that is, the origin O is the center of the bright stripe, which is called the central bright stripe. When k=±1, ±2, then x=±(D/d)λ, ±2(D/d)λ, the corresponding bright stripes are the first level bright stripe and the second level bright stripe respectively.

If the wavelength of photons p_1(i) and p_2(j) is λ, the conditions for the interference reduction:

$$\Delta r = x d/D = (2k+1)(\lambda/2)$$

That is

$$x = (2k+1)(D/2d)\lambda, \quad k=0, \pm 1, \pm 2, \ldots$$

When k= 0, ±1, then x=±(D/2d) λ, ±(3D/2d) λ, the corresponding dark stripes are the zero level dark stripe and the first level dark stripe respectively. The bright and dark stripes are arranged at intervals, and the distance between the centers of two adjacent bright stripes (or dark stripes)

$$\Delta x = (D/d)\lambda$$

According to equation (3-1), the number of photons to be emitted by the laser source S, $n_{\gamma 0}$ =1.912 $x10^{15}$, while the laser source S can emit 10^{12} photons per second. Therefore, the time required for this experiment

$$T = 1.912 \times 10^{15}/10^{12}$$

$$T = 1912 \text{ second}$$

According to the above analysis, the single photon double-slit interference experiment shown in Figure 3.2, a single photon passes through the double slits S_1 and S_2 in turn. There is no superposition principle, and a single photon cannot pass through slits S_1 and S_2 at the same time.

Without losing generality, if the structural parameters of the single photon double-slit interference experiment in Figure 3.2 and those of the parallel beam double-slit interference experiment in Figure 3.1 are the same, the exposure time of the single photon double-slit interference experiment is 1912 seconds and the exposure time of the parallel beam double-slit interference experiment is 0.1 seconds, then the interference fringes obtained by the two experiments on the detection screen E are the same.

Regarding the parallel beam double-slit interference experiment shown in Figure 3.1, suppose that a high-sensitivity camera can observe the photons, and take a snapshot of the double-slit every 10^{-16} seconds, it can be observed that the photons pass through the double slits one by one. That is, continuous beam double-slit interference is also single photon double-slit interference.

For the single photon double-slit interference in Figure 3.2, according to the superposition principle of quantum mechanical, when a single photon $p_1(i)$ passes through the slit S_1, it will generate superposition effect, and $p_1(i)$ passes through slit S_1 and slit S_2 at the same time. Similarly, when a single photon $p_2(j)$ passes through the slit S_2, it will generate superposition effect, and $p_2(j)$ passes through slit S_2 and slit S_1 at the same time.

To ensure the experiment in Figure 3.2, a single photon passes through the double slits S_1 and S_2 respectively in turn. We make the following improvements to the experiment in Figure 3.2: First, use the light shield B_2 to block the slit S_2, and only the slit S_1 is opened. The laser source S emits a photon every 1 pico-second, which can only pass through the slit S_1. The laser source S emits 9.56 x10^{14} photons to the slit S_1 in turn, as shown in Figure 3.3A.

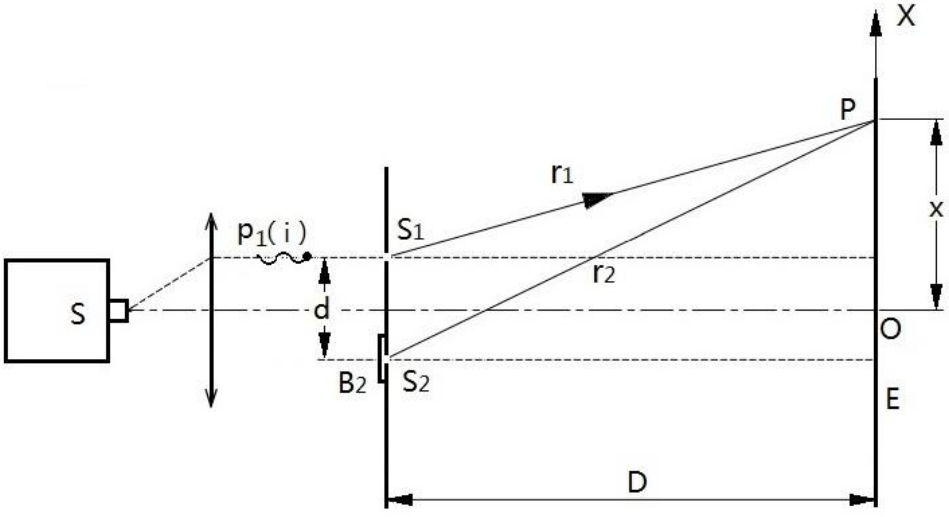

Fig. 3.3A Single photon double-slit interference (S_2 blocked)

Then open the slit S_2, block slit S_1 with the light shield B_1. The laser source S emits a photon every 1 picosecond, and the photon can only pass through the slit S_2. The laser source S emits 9.56 $x10^{14}$ photon to the slit S_2 in turn, as shown in Figure 3.3B. At this time, the interference fringes on the detection screen E should be the same as those in the experiment of Figure 3.2.

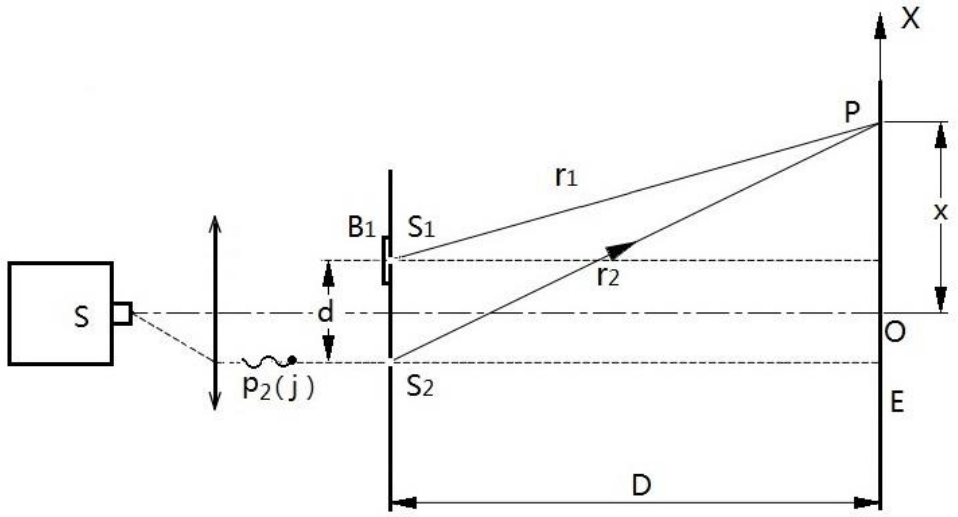

Figure 3.3B Single photon double-slit interference (S_1 blocked)

For the experiments in Figure 3.2 and Figure 3.3, we can use the existing single photon double-slit interference equipment in the laboratory. Step 1: According to the conventional process, open the slit S_1 and the slit S_2, conduct a single photon double slit interference experiment, save the interference fringes obtained on the detection screen E and record the experiment operation time T_S. Step 2: First, block the slit S_1 with a light shield and open the slit S_2, and use the same experimental process and operation time T_S in the step 1 to conduct the single photon double-slit interference experiment; Then, block the slit S_2 with a light shield and open the slit S_1, and use the same experimental process and operation time T_S in step 1 to conduct the single photon double-slit interference experiment again. Compare the interference fringes obtained from step 2 on the detection screen E with the interference fringes obtained from step 1 on the detection screen E. If their interference fringes are the same, then there is no superposition principle in the single photon double-slit interference experiment, that is, a single photon cannot pass through slit S_1 and slit S_2 at the same time.

For the verification experiments in Figure 3.2 and Figure 3.3, a simpler method is to set a light barrier B between the two slits S_1 and S_2 of the single photon double-slit interference device, so as to ensure that a single photon can only pass through one slit, as shown in Figure 3.4.

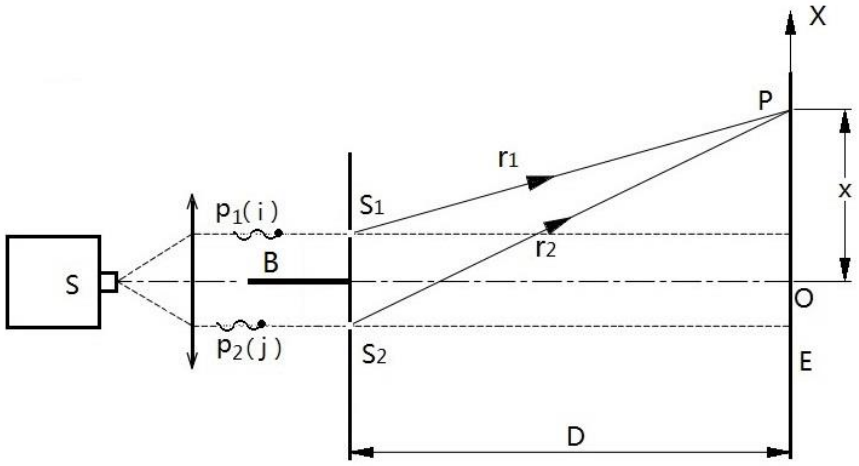

Figure 3.4 Single photon double-slit interference device with a light barrier

The above single photon double-slit interference experiments in Figure 3.2, Figure 3.3A, Figure 3.3B and Figure 3.4 are also applicable to other microscopic particles such as electrons.

To sum up, the essence of photon is particle, which is light particle with phase property. **Light wave is the cumulative phenomenon of the individual movement of a single photon particle with phase property at different times.** In the single photon double-slit interference experiment, a single photon cannot pass through the double slits at the same time, and a single photon passes through one of the slits in turn to achieve double-slit interference. There is no superposition principle in single photon double-slit interference experiment. The above theoretical views need specific experimental verification.

4. Electric field, magnetic field and gravitational field

Photons are light particles with phase property. Light field wave is the emission wave of light particles, and its propagation in vacuum does not need any medium. Regarding electric field wave, suppose there is a point charge, see Figure 4.1

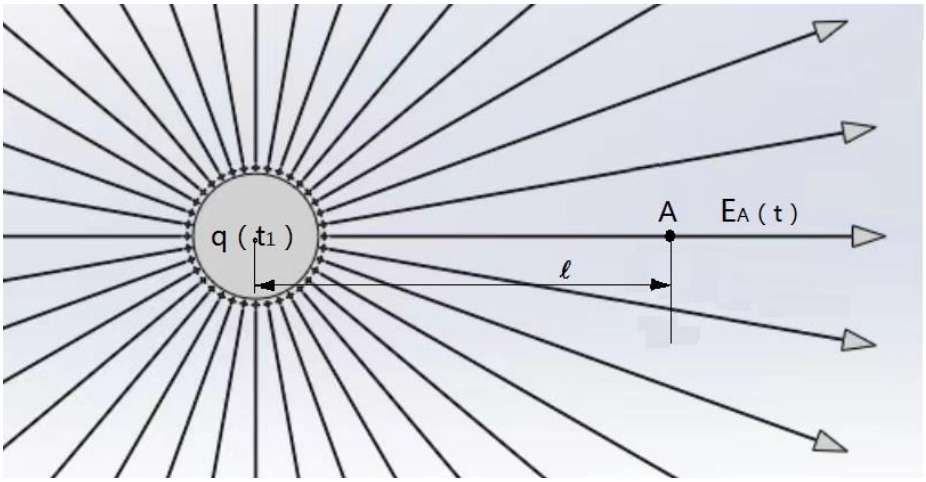

Figure 4.1 Electric field wave excited by periodically varying charge

Let the amount of charge q (t1) changes as a sine function:

$q(t_1) = q_0 \sin\omega t_1$

There is a point A in space, and the distance between point A and the point charge is l. Then, the electric field intensity at point A is:

$$\mathbf{E}_A(t) = \frac{q_0 \sin \omega t_1}{4 \pi \varepsilon_0 \ell^2} \mathbf{n}$$

where $t_1 = t - l/c$, C is the speed of the electric field, **n** is the unit vector and its direction is from the charge $q(t_1)$ to the point A. Thus, E_A (t) is the electric field wave varying as a sine function.

Mechanical wave is a medium conducted wave, and the propagation of mechanical wave needs medium. Light field wave is the emission wave of light particles, and the propagation of light field wave does not need medium. Is the electric field wave a particle emission wave or a medium conducted wave?

Assuming that the electric field wave is a particle emission wave, based on the conservation of energy, How long can the energy of a static electron be emitted in electric field quantum?
The static mass of an electron:

$m_e = 9.10956\times10^{-31}$kg

The energy of a static electron：

$p_e = m_e C^2 = 8.198\text{x}10^{-14}$J

The charge amount of an electron:

$e=1.602\text{x}10^{-19}$ C

The electric field intensity at the spherical surface，where r=1m away from the electron：

$E = k\, e/r^2$

$= 9.0\text{x}10^9\text{x}1.602\text{x}10^{-19}/1^2$

E = 1.442x10-9 v/m

The electric field energy density at the spherical surface，where r=1m away from the electron：

$w = (1/2)\, \varepsilon E^2$

$= (1/2)\ 8.85\text{x}10^{-12}$（$1.442\text{x}10^{-9}$ ）^{2}

$w = 9.20\text{x}10^{-30}$ J/m^3

The speed of the electric field is C, and the power emitted by the electron in one second：

$p_1 =$（$4\,\pi\, r^2$）C w

$= 4\text{x}3.14\text{x}1^2\text{ x }3.0\text{x }10^8\text{ x}9.20\text{x }10^{-30}$

$p_1 = 3.467\text{x}10^{-20}$ J/s

The total energy of a static electron is p_e, which is emitted outward at the power of p_1, and its

emission time is:

$Te = p_e / p_1 =（8.198x10^{-14}）/（3.467x10^{-20}）$

$Te = 2.365x10^6$ second = 656.9 hour

Although the above calculation is only an approximate estimate, it can be concluded that if the electric field is a particle emission field wave, a static electron is left for hundreds to thousands of hours, its energy will be completely consumed and the electron will no longer exist, which must be wrong. Therefore, the electric field wave must not be the particle emission wave.

When the frequency of the mechanical wave is zero, that is, the objects involved in the vibration are relatively stationary, the acting and reaction force between objects are equal and opposite, and there is no energy propagation. When the frequency of mechanical wave is greater than zero, energy can propagate. The electric field wave has the same characteristics as the above mechanical wave: When the DC power supply is used to charge the capacitive bipolar plates, the voltage is constant, the charges of the bipolar plates are relatively static, the electric field acting and reaction force between the bipolar plates are equal, the direction is opposite, and there is no energy propagation; When AC power is used to charge the capacitive bipolar plates, an alternating electric field wave is formed between the bipolar plates, and there is transmission of electric field energy. Therefore, it is more reasonable that the electric field wave is a medium conduction wave.

Magnetic field wave and gravitational field wave have the same characteristics as electric field wave, and they are also medium conduction waves. The medium of electric field wave, magnetic field wave and gravitational field wave are respectively defined as electric field medium quantum, magnetic field medium quantum and gravitational field medium quantum. They are all energy quantum with extremely small energy.

To sum up, we can draw the following conclusion: Electric field wave, magnetic field wave and gravitational field wave must not be particle emission wave, and it is more reasonable that electric field wave, magnetic field wave and gravitational field wave are medium conduction wave. The medium of electric field wave, magnetic field wave and gravitational field wave are electric field medium quantum, magnetic field medium quantum and gravitational field medium quantum respectively. Vacuum is filled with electric field medium quantum, magnetic field medium quantum and gravitational field medium quantum. They are particles with extremely small energy.

5. Conclusion

Mechanical wave is a kind of medium conduction wave, which is the propagation process of mechanical vibration in the medium. **Mechanical wave is the phenomenon of the collective movement of many particles participating in vibration at the same time.** The physical principle of mechanical wave is Newton's classical dynamics, and there is no new physical fundamental principle for mechanical wave.

In 1905, Einstein proposed the photoelectric effect and established the wave-particle duality of light. This paper reveals that light wave is the emission wave of light particles. The essence of photon is particle, and photon is a kind of field energy particles with phase property. The wave characteristics of photon are only the movement phenomenon of its phase property. Based on the particle nature and phase property of photons, this paper theoretically denies the superposition principle of single photon double-slit interference. A single photon cannot pass through the two slits at the same time, and a single photon can pass through one of the two slits in turn to achieve double-slit interference. **Light wave is the cumulative phenomenon of the individual movement of a single photon particle with phase property at different times.** Furthermore, a verification experiment to check the superposition principle of single photon double-slit interference is presented in this paper. Using a light shield to block one of the two slits in turn to ensure that each single photon can only pass through one of the two slits separately.

Light field wave is the emission wave of light particles, and its propagation in vacuum does not need any medium. Light field wave can propagate in absolute vacuum without any energy.

Electric field wave, magnetic field wave and gravitational field wave must not be particle emission wave, and it is more reasonable that electric field wave, magnetic field wave and gravitational field wave are medium conduction wave. Electric field wave, magnetic field wave and gravitational field wave need the participation of electric field medium quantum, magnetic field medium quantum and gravitational field medium quantum respectively to propagate in vacuum. Electric field medium quantum, magnetic field medium quantum and gravitational field medium quantum are all particles with extremely small energy.

6. Further work and Prospects

Light wave is the emission wave of photon, which is a kind of field energy particle with phase property. What makes photon have phase property.

The photon is an energy particle with spin. When the energy centroid of the photon is eccentric to its spin center axis, according to the law of momentum conservation, the track of photon is a spiral in space, the pitch of the spiral is equal to the wavelength of the photon, and the spin speed is equal to the frequency of the photon. As shown in Figure 6.1. The typical wavelength of visible light is 570nm, then the pitch of the spiral in the figure is 570nm. Modern technology cannot measure the diameter of photons, but the diameter of electrons is about 10^{-13}nm, and the diameter of photons must be much smaller than that of electrons.

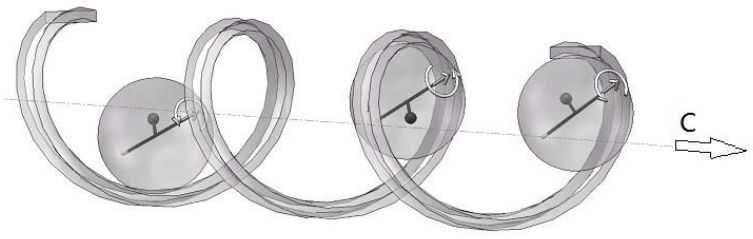

Figure 6.1 Photon phase property caused by eccentric spin

The above spiral movement of photon caused by its eccentric spin，which cannot explain the polarization of photon. A reasonable explanation is that the energy centroid of the photon has an eccentric plane vibration, so that the track of photon is a wave curve in its vibration plane. As shown in Figure 6.2.

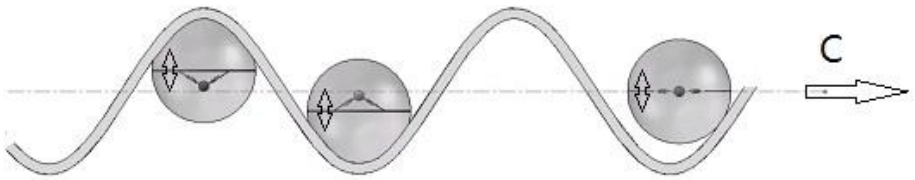

Figure 6.2 Photon phase property caused by eccentric plane vibration

Based on modern quantum observations, there are energy fluctuations in the vacuum field. The vacuum energy fluctuation makes the photon has phase property, just like a boat sailing in the river, it moves up and down under the action of water waves. As shown in Figure 6.3.

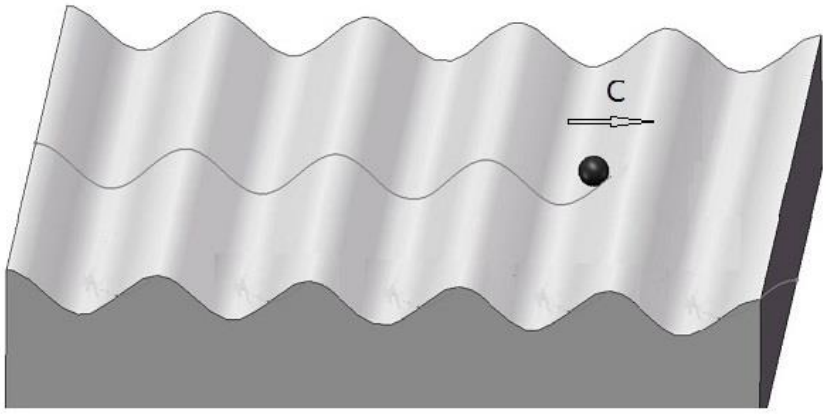

Figure 6.3 Photon phase property caused by vacuum energy fluctuation

The above-mentioned wave properties of photon also exist in microscopic particles such as electrons. According to Figure 6.1, Figure 6.2 and Figure 6.3, the movement track of photons is a spiral curve with plane fluctuation in space, which is also the movement track of many galaxies in the universe. In the macro physical world, the wave characteristics are only the movement external phenomenon of physical matter, there is no new physical fundamental principle. Regarding the micro quantum world, whether the wave characteristics are also the external phenomenon of quantum motion, and is not the essence of the quantum world.

The single photon double-slit experiments in Figure3.2 and Figure3.3 challenge the Superposition Principle in quantum mechanics. Whether there are more fundamental physical principles of Heisenberg Uncertainty Principle, Quantum Identical Principle and Quantum Entanglement.

In this paper, the four classical physical field matters are divided into particle emission wave and medium conduction wave. The Superposition Principle of single photon double-slit interference is denied based on theory, and a verification experiment is proposed.

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Availability of Data and Materials:

All data generated or analysed during this study are included in this published article and its supplementary information files.

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