Applied Physics Research; Vol. 15, No. 2; 2023
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

Study on the Diffraction-like and Interference-like Mechanisms of Particle Flow

Jiqing Zeng[1] & Tianhe Zeng[2]

[1] South China Botanical Garden, Chinese Academy of Sciences, Guangzhou, China

[2] School of Environment, Jinan University, Guangzhou, China

Correspondence: Jiqing Zeng, South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, Guangdong, China. E-mail: zengjq@scib.ac.cn

Received: July 18, 2023 Accepted: September 21, 2023 Online Published: October 29, 2023

doi:10.5539/apr.v15n2p157 URL: https://doi.org/10.5539/apr.v15n2p157

Abstract

This paper demonstrates that the light and dark fringe in Young's double-slit experiment is not actually the diffraction and interference pattern of light wave. We investigate the scattering phenomenon after the particle flow passes through the gaps and find that the scattering type and scattering degrees of freedom of the particle flow depend on the physical parameters of the particles and the gaps. When the particle flow undergoes uniform scattering, a uniform "yes" and "no" interspersed discrete distribution pattern will form on the receiving screen. Based on the diffraction-like and interference-like mechanism of particle flow, this paper explains the electron diffraction and interference experiment, as well as the Young's double-slit interference experiment and the diffraction of light through circular holes and plates. This article provides an in-depth discussion on Einstein's concept of wave particle duality and de Broglie's matter wave hypothesis, as well as an analysis of Feynman's experimental idea of electron double slit interference. Our research shows that the matter wave hypothesis is not valid, which has shaken the foundation of modern quantum mechanics and has significant scientific significance. In addition, this study has important application value for the development of technology for detecting and analyzing particles or gaps.

Keywords: electron diffraction, double slit interference, wave-particle duality, quantum mechanics

1. Introduction

In 1905, Einstein put forward the quantum explanation of the photoelectric effect, believing that light has wave-particle duality (Einstein, A., 2017). In 1923, de Broglie was inspired by this and put forward the matter wave hypothesis, believing that all physical particles have volatility (de Broglie, 1923). In 1927, Davison and Germer projected a 100 eV electron beam onto the surface of nickel single crystal to observe the scattering of the electron beam. It was found that the scattering beam intensity was discontinuous with the spatial distribution (Davisson, C. & Germer, L. H., 1927). Almost at the same time, G. P. Thomson (1927) penetrated the polycrystalline film with an electron beam with energy of 20 keV, and also observed the discrete characteristics of the scattered electron beam in space distribution. They interpreted the dispersion of the spatial distribution of the electron scattering beam as an electron diffraction phenomenon, similar to the diffraction pattern of light and dark. Therefore, people believe that their experimental results prove that electrons have wave properties, thus confirming de Broglie's matter wave hypothesis.

It is generally believed that since the electron beam can diffract, interference should also occur in theory. Although the electronic double-slit interference experiment is discussed as a fact in many textbooks, in fact, no one has actually done this experiment. As Feynman said, "Never try to do this experiment, because this device must be manufactured on an unimaginable scale" (Feynman, R. P., *et al.* 2011). Until 1961, Jönsson of the University of Tubingen in Germany processed a set of 300 nm wide slits on the copper sheet, and then irradiated them with the 40 keV electron beam of the electron microscope, and finally got the bright and dark stripes similar to those seen by Thomas Young 160 years ago (Jönsson, C.,1961). This bright and dark fringe has become a strong evidence of the interference of the electron beam, which seems to prove once again that the electron has wave property and the correctness of the de Broglie matter wave hypothesis. It is generally believed that the electronic double-slit interference experiment has been completed. However, because the light and dark stripes are formed by electron beams, some people think it is difficult to prove whether a single electron also has wave-particle duality. Therefore, people began to challenge the so-called "single-electron double-slit interference experiment" (Tonomura, A., *et al.*, 1998; Bach, R., *et al.*, 2012; Frabboni, S., *et al.*, 2012) and claimed to have realized the single-electron double-slit interference thought experiment conceived by Feynman. They reached the same conclusion, that is, the experiment proved that a single electron has volatility. In 1909, Taylor conducted Young's double-slit interference experiment with weak light (single photon) (Taylor, G. I., 1909). Dirac explained: "Each photon only interferes with itself. Interference will never occur between different photons." Therefore, many people think that a single electron can also pass through two slits at the same time and interfere with itself.

Obviously, the reason for believing that electrons have volatility is the discovery of so-called electron diffraction and interference phenomena. However, the so-called electron diffraction and interference phenomenon is only the pattern of light and dark. This paper proves that the light and dark fringe in Young's double-slit experiment is not the diffraction or interference pattern of light wave, so it can not be considered that the electron has diffraction and interference phenomenon according to the electron beam crystal scattering and the light and dark fringe in the double-slit experiment, and it can not be proved that the electron has wave motion. The research in this paper shows that the light and dark pattern in the double-slit experiment is the spatial distribution accumulated by the scattering effect of particle flow on the receiving screen after passing through the slit. In this paper, the formation mechanism of Young's double-slit experiment, circular hole diffraction and Poisson's bright spot is explained from the viewpoint of light quantum flow, and the stereotyped cognition that light and dark fringe is diffraction and interference pattern is further denied. Our research shows that physical particles have no wave property at all, the so-called wave-particle duality of physical particles is not established, and the foundation of quantum mechanics is completely shaken.

2. The Light and Dark Pattern in Young's Double-slit Experiment Is Not the Interference Pattern of Light Waves

In Young's double-slit experiment, the light and dark stripes are interpreted as interference patterns formed by the coherent superposition of waves. This explanation has never been questioned for more than 200 years since Thomas Young, so that people take the light and dark stripes as interference patterns of waves without thinking. People observed the pattern of light and dark when conducting the crystal scattering and double-slit experiment of electrons, so they took it for granted that this is the diffraction and interference phenomenon of electrons, and then believed that the electrons have wave characteristics, thus confirming de Broglie's matter wave hypothesis. However, is the pattern of light and dark in Young's double-slit experiment really the interference pattern formed by the coherent superposition of waves?

The bright and dark stripes in Young's double-slit experiment are considered as interference patterns of light waves, mainly because people have compared the bright and dark stripes with the interference patterns of water waves. It is possible to analogize light waves to water waves, but it is wrong to analogize light and dark stripes to interference patterns of water waves.

First of all, the diffraction phenomenon of water waves is that a series of water waves form a new series of water waves after passing through the gap. Therefore, the so-called diffraction pattern of water waves is the wave shape of a new series of water waves. If the light wave is compared with the water wave, the diffraction pattern of a light passing through a single slit should also be the wave shape of a new light wave. However, the wavelength of visible light is only a few hundred nanometers, which can't be distinguished by human eyes. We can't see the wave shape of light wave at all. Obviously, the light and dark stripes appearing on the screen after light passes through a single slit are not the diffraction pattern of light.

Secondly, the interference phenomenon of water waves is the coherent superposition of two water waves on the water surface, and the interference pattern that the amplitude increases after the superposition of wave crest and wave crest or wave trough and wave trough, and the amplitude cancels after the superposition of wave crest and wave trough. The interference pattern of water waves is presented on the water surface (we call it the interference surface), which is parallel to the propagation direction of water waves. However, due to the very small wavelength of visible light, we cannot see the wave of light, and the interference pattern of light wave cannot be seen on the interference plane after light passes through the double slit. Obviously, the light and dark stripes seen on the screen perpendicular to the propagation direction of light are not interference patterns of light waves.

Third, the movement of water waves can be seen by the human eye with the help of light, but we cannot observe the movement of light waves with the help of light. Even if the wavelength of light is very long, we can't see the propagation of light in the vacuum. Only when the light enters the human eye can we feel its bright light. When light travels in the medium, the light propagation path we see is formed by the light scattered by the medium entering the human eye, and we can't see the wave shape of the light wave on the propagation path. Therefore, even if the light wave interferes, we can't see the interference pattern of the light wave at all. In the double-slit experiment, the bright lines on the screen are the images formed by the light scattering from the material on the screen and entering our eyes, not the images generated by the superposition of light wave peaks. The dark streak is that there is no light scattering and no light enters our eyes, not because the wave crest and wave trough of the light wave cancel.

Fourth, since the light energy will not be offset due to the opposite phase, two beams of coherent light with opposite phase hit the same point on the screen, and the light intensity at that point should be enhanced. It can be seen that the dark stripe interpretation of Young's double-slit experiment obviously violates the principle of energy conservation and basic experimental facts.

Finally, the experiment has proven that dark stripes are not formed by the destructive interference of light, but because there is no light reaching that point at all. For example, A. R. Nejad *et al*. (2020) conducted a series of novel experiments that demonstrated that no photons could be detected in dark stripes.

To sum up, the single-slit diffraction of light and the bright and dark fringe in Young's double-slit experiment are not the diffraction and interference patterns of light. Therefore, the light and dark stripes cannot be used as the basis for wave diffraction and interference.

So how is the light and dark stripes formed? Next, we analyze the mechanism of light and dark stripes produced by particle flow through the gap.

3. The Essence of Particles Passing Through the Gap Is to Interact With the Gap

Suppose that the diameter of the particle is D and the width of the gap is d. Only when $D \leq d$, the particle can pass through the gap. When particles pass directly through the edge of the gap without collision, their maximum emission angle θ meets cos $\theta = D/d$ (Figure 1). Obviously, the smaller the D/d ratio is, the higher the θ value. When the diameter D of the particle is slightly smaller than the width d of the gap, the value of θ is very small (approaching 0 degrees), then the emission angle is slightly greater than 0 degrees, and the particle will collide with the edge of the gap, thus changing the direction of motion of the particle. If the particles have electromagnetic interaction with the material at the edge of the gap, even if there is no direct collision, the close interaction can change the direction of the particles. It can be seen that the gap provides a spatial constraint structure that allows particles to interact with the material at the edge of the gap. When a particle passes through a gap, it is essentially scattering after interacting with the material at the edge of the gap.

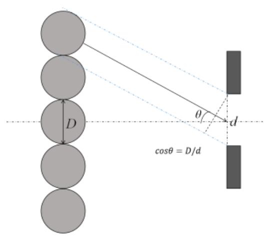

Figure 1. Maximum emission angle of particles directly passing through the gap

4. Physical Parameters of Particle Flow and Gap

Because the essence of particles passing through the gap is that particles interact with the gap to generate scattering, the physical parameters of particle flow and the gap determine the direction and spatial distribution of scattering.

The physical parameters of particle flow include the particle's material properties (particle type or material composition), shape, size, mass and particle motion speed. In addition, the emission angle and emission mode of particles are also important parameters that determine particle flow. From the quantity of each shot, it can be divided into single particle emission (or point emission) and multi-particle emission (or surface emission); From the perspective of whether the time interval (or frequency) of each launch is fixed, it can be divided into periodic launch and non-periodic launch. Suppose the particle diameter is D and the particle velocity is u. When particles are periodically emitted, the emission frequency is f, that is, the interval between each emission of particles is

$\Delta t=1/f$. When $\Delta t=D/u$, particles are emitted continuously in series one by one, which is called periodic continuous emission; When $\Delta t>D/u$, there is a certain distance between the particles emitted before and after, which is called periodic interval emission. When surface emission is performed, particles on the emission surface can be emitted at the same time or not.

The physical parameters of the gap include the shape, size and scale of the gap and the physical properties of the material at the edge of the gap. When people consider the gap, they often only consider its shape and size, ignoring the physical properties of the edge material that forms the gap. In fact, the gap itself is not a physical entity, but the edge material that constitutes the gap.

5. Scattering Degrees of Freedom and Scattering Types of Particle Flow

The moving particles will change the direction of motion after colliding with the material at the edge of the gap, thus causing scattering. If the same particle collides with the same speed, direction and position of the same gap each time, the direction of motion changed after each collision should be the same. Then the particle flow of the same particle with the same velocity will have a fixed scattering direction as long as it collides with the gap in a fixed direction. If a launching device can launch in a fixed direction, the particle flow it emits will have only one definite particle flow parameter, and only one definite scattering direction after collision with the gap. If the emission device of particle flow is surface emission, then this set of fixed surface emission will form a set of determined particle flow parameters, and there will be a set of determined scattering directions after collision with the gap (Figure 2). If the launching device vibrates regularly during point emission, and the movement direction of particles emitted by point emission changes regularly, then the launching device will form a set of determined particle flow parameters within a certain time. When the particle type and emission device of particle flow are determined, the physical parameters of particle flow are determined; When the gap is determined, its physical parameters are also determined. Obviously, after a group of particle flows that determine physical parameters collide with a slot that determines physical parameters, a group of determined scattering directions will naturally occur. The number of scattering directions of particle flow is called scattering degrees of freedom. The number of scattering directions of particle flow is the number of scattering degrees of freedom. For example, if there are Ns discrete scattering directions in the range of maximum scattering angle α, we can say that the scattering degree of freedom of particle flow is Ns. Therefore, the scattering degree of freedom of particle flow is determined by particle flow parameters and slot parameters. That is to say, as long as the type of particles emitted and the device for emitting particles are selected, and the gap for experiment is selected, the particle flow emitted by the emission device will have a certain degree of scattering freedom after passing through the gap.

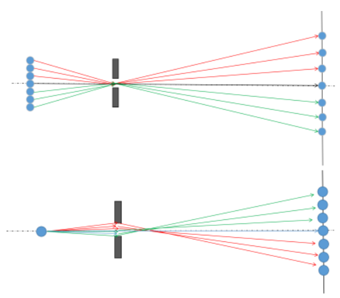

Figure 2. A set of determined particle parameters and determined slot parameters determine a set of determined scattering directions

According to whether the spatial distribution of scattering direction of particle scattering is uniform within a certain range of scattering angle, it can be divided into two types of scattering: uniform scattering and non-uniform scattering. Combined with the emission types of particle flow, uniform scattering can be classified into the following types: simultaneous and periodic continuous scattering; Simultaneous and periodic interval scattering; Non-synchronous and periodic scattering; Non-synchronous and non-periodic scattering.

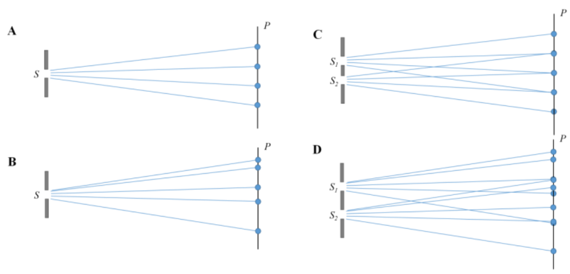

Figure 3. Scattering type, diffraction and interference pattern of particle flow

A. Diffraction-like pattern of uniform scattering; B. Diffraction-like pattern of non-uniform scattering; C. Interference like pattern of uniform scattering; D. Non-uniform scattering interference pattern

6. Diffraction-like and Interference-like of Particle Flow

6.1 Regardless of the Shape and Size of the Gap

Assuming that the particle flow hits the gap *S* in the range of scattering angle α and uniformly scatters, with a total of N_s scattering directions (or scattering degrees of freedom), then uniformly spaced N_s particles will be formed at the receiving screen *P*. The motion path of particles in the scattering direction is called the scattering path of particles. There are N_s scattering directions, and there are N_s scattering paths. Figure 3A shows the uniform scattering of the particle flow after hitting the gap *S*. There are four scattering directions in a cross section, and finally the "diffraction like pattern" of four uniformly distributed particles appears on the receiving screen.

Suppose there are two identical particle uniform scattering sources S_1 and S_2. When they are close to each other, the particle scattering path will have a crossing point (we call it a interference-like point). The scattering path is also called the interference-like line. A receiving screen *P* is set near the interference-like point. The receiving screen will display the interference-like pattern with "yes" and "no" particle distribution, and more particles will accumulate at the interference-like point (Figure 3C).

Obviously, as long as the particle flow undergoes uniform scattering after passing through the gap, the diffraction-like pattern can appear on the receiving screen. If the uniform scattering occurs on the two adjacent slits, the uniform interface-like pattern can appear on the receiving screen (Figure 3C). If it is non-uniform scattering, a non-uniform interference pattern is formed (Figure 3D).

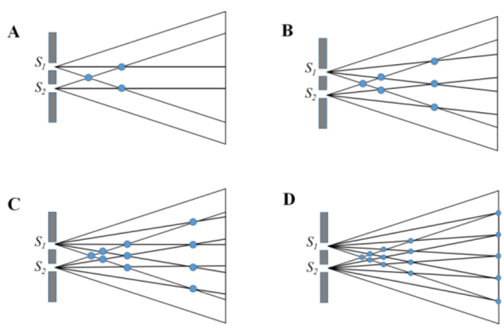

Figure 4. Relationship between scattering degrees of freedom of particle flow and interference points

The particle flow will scatter after passing through the gap, and its degree of freedom depends on the physical parameters of the particle flow and the gap. As long as the scattering degree of freedom N_s of the slot is determined, its interference-like pattern can be predicted. Figure 4 shows the interference-like pattern of two uniform scattering sources S_1 and S_2 with 3, 4, 5 and 6 scattering degrees of freedom, with a maximum of 2, 3, 4 and 5 interference-like points respectively. In other words, the double-slit interference-like pattern of particle flow is related to N_s, and the maximum number of interference points is N_{s-1}.

Assume that the scattering degrees of freedom of slot S_1 and S_2 are N_s, and the maximum scattering angle is α. Set the receiving screen at the interference point, and mark it as P_1, P_2, P_3, ..., P_n, mark the interference-like point as f_{n-k} (Figure 5). When the number of interference-like points n on the receiving screen P_n is an odd number, there is a case where the interference-like point is at the center O of the receiving screen, and k=0. The distance between the receiving screen P_n and the double seam is

$$L_n = \frac{d}{2tan\left(\frac{N_S - n}{N_S - 1}\alpha\right)} \tag{1}$$

It can be measured that the distance between the receiving screen and the double slit is l, the maximum scattering width of particles on the receiving screen is L_s, and the distance between the two slits is d, then the maximum scattering angle can be obtained from the following formula:

$$tan\alpha = \frac{L_S - d}{2l} \tag{2}$$

It can be seen that as long as the scattering degrees of freedom N_s, the maximum scattering angle and the double-slit distance d of the slot scattering source are determined, the interference-like pattern on the receiving screen P_n is determined. In fact, as long as the physical parameters of the experimental device and particles and gaps are determined, the double-slit interference-like pattern of particle flow is determined. The interference-like pattern on the receiving screen is only related to the distance between the receiving screen and the double-slit.

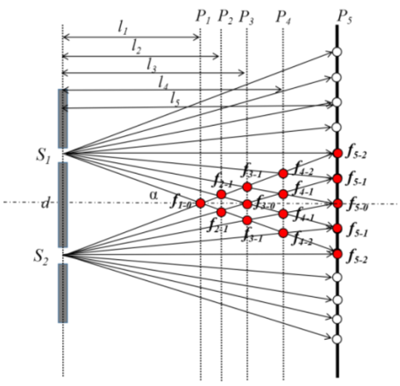

Figure 5. Schematic diagram of particle double-slit scattering interference

We first consider the first case: the particle flow hits at the gap and generates uniform, simultaneous and periodic continuous scattering (Figure. 6A). Assuming that the two particles emitted from S_1 and S_2 reach the same position P on the observation screen at the same time, the distance difference between the two particles to the same position is Δr. From Figure. 6C, it can be seen that

$$\Delta r = r_2 - r_1 \approx dsin\theta = \frac{dx}{l} \tag{3}$$

Obviously, when Δr is an integral multiple of particle diameter D, that is, $\Delta r=kD$ (k is a positive integer), the two particles emitted from S_1 and S_2 reach P at the same time. When $\Delta r=(2k+1) D/2$, the time interval between the two particles reaching P is the longest, but the difference is only half a particle. Therefore, the two particles emitted from the two slits will accumulate more particles in the same time as long as they reach the same position (the intersection of particle scattering path), whether they reach the receiving screen at the same time or successively. Where the particle scattering path does not reach, particles will not accumulate on the receiving screen. In this way, in a certain period of time, evenly spaced particle stacks will be formed on the receiving screen. Since the intersection of particle scattering paths is in the middle of the receiving screen, there are more particle stacks in the middle. This is the interference-like pattern of particle double-slit scattering.

It can be obtained from formula (3)

$$x = k\frac{l}{d}D \tag{4}$$

Interval between interference fringes Δx is

$$\Delta x = \frac{l}{d} D \tag{5}$$

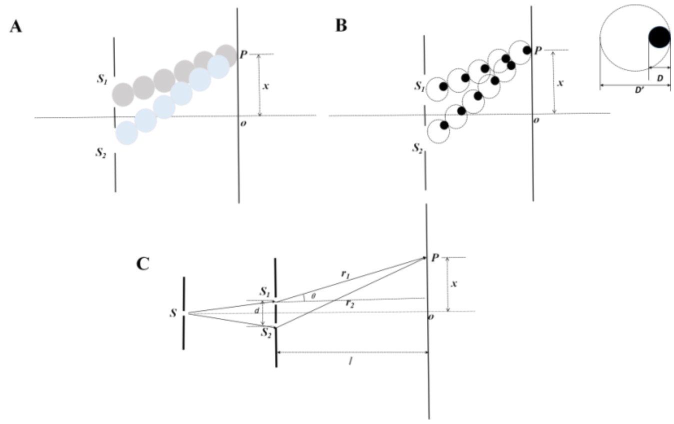

Figure 6. Double slit interference-like of uniformly, simultaneously and periodically emitted particle flow

The second case is uniform, simultaneous and periodic interval scattering (Figure.6B). Suppose that particles are emitted at a fixed frequency *f*, that is, the interval between each emission of particles is $\Delta t=1/f$. When $\Delta t=D/v$, it is obvious that particles are emitted continuously one by one. When $\Delta t>D/v$, that is, particles are not close to each other but have a certain interval. Let $D'=v\ \Delta t$, when $\Delta r=kD'$, particles from S_1 and S_2 reach *P* at the same time. If $D'>D$, the extension of the emission time interval is equivalent to expanding the particle diameter to *D*', which we call "virtual particle diameter". Therefore, no matter whether the particles are emitted one by one continuously or periodically, the interference-like pattern can be obtained.

The third case is uniform, non-simultaneous and non-periodic scattering. It is assumed that particles have N_s scattering degrees of freedom in the range of scattering angle α. Due to the uniform scattering of particles, the probability of particles reaching N_s positions on the receiving screen after passing through the gap is equal. Therefore, the probability of particles passing through each scattering path is the same regardless of whether particles are emitted at the same time and periodically. It can be seen that in the double-slit experiment with particles, the probability of particles passing through each scattering path is the same as long as the particles are uniformly scattered after passing through the slit. Even if only one particle is emitted at a time, the time interval of each emission is different. After a certain amount of particles are accumulated, a stable interference-like pattern can be formed on the receiving screen. Since S_1 and S_2 are uniform scattering sources within the range of scattering angle α, the probability of each particle passing through any scattering path after hitting S_1 or S_2 is $1/N_s$. Assuming that the total number of particles scattered by S_1 and S_2 in the scattering angle range is N_t in *T* time, the number of particles passing through any scattering path is N_t/N_s. If the interference-like point is on the receiving screen, the number of particles at the interference-like point is $2N_t/N_s$. Therefore, on the receiving screen, more particles will be accumulated at the position of the interference-like point, and it can be seen from Figure 5 that the central position of the receiving screen presents a clearer band.

The fourth case is non-uniform scattering. This situation can be divided into two types, one is deterministic non-uniform scattering, and the other is nondeterministic non-uniform scattering. Deterministic non-uniform scattering means that the spatial distribution of the scattering path is uneven, but the scattering path is determined. This kind of scattering source can also produce double-slit interference pattern due to the existence of certain scattering path, but the strip distribution is uneven. Non-deterministic non-uniform scattering refers to the uneven spatial distribution of the scattering path. The scattering of particles rarely has the same scattering path, and the particles passing through different scattering paths are also random. This kind of nondeterministic non-uniform scattering can be considered as random scattering with infinite scattering degrees of freedom. In general, it is difficult to obtain a stable double-slit interference pattern. However, complete randomness rarely occurs.

6.2 When the Gap Is Rectangular Square Hole

Assume that the gap is rectangular and the length is a and the width is b. The particle flow is surface emission, and it is periodic continuous emission. The uniform, simultaneous and periodic continuous scattering occurs at the gap. The scattering path is a trapezoidal platform, and the scattering angle is α, the lateral divergence angle of each trapezoidal platform is θ, the longitudinal divergence angle is β. The scattering degree of freedom of the slot is N_s. The distance between the receiving screen and the gap is l. Then, the area of the "strip" displayed on the receiving screen is (Figure 7):

$$S_t = (l + \frac{b}{2tan\theta})^2 tan\beta[cos(\alpha - \theta)tan(\alpha + \theta) + sin(\alpha + \theta) - sin(\alpha - \theta) - cos(\alpha + \theta)tan(\alpha - \theta)] \quad (6)$$

Set

$$K_s = tan\beta[cos(\alpha - \theta)tan(\alpha + \theta) + sin(\alpha + \theta) - sin(\alpha - \theta) - cos(\alpha + \theta)tan(\alpha - \theta)] \quad (7)$$

then

$$S_t = K_s(l + \frac{b}{2tan\theta})^2 \quad (8)$$

When the material and size of the gap and the particle flow are determined, the divergence angle α and β of the scattering path (trapezoidal platform), the scattering degree of freedom N_s and the maximum scattering angle are determined. When calculating the area of each strip on the receiving screen, the K_s value is only related to the scattering angle α of the scattering path corresponding to the strip. The larger the scattering angle α, the greater the K_s value. When the distance l between the receiving screen and the slot is fixed, the band area S_t increases with the increase of the scattering angle α. Assuming that the number of particles passing through the slot S per unit time is N, the number of particles in each strip on the receiving screen is N/N_s. Then the particle density of each strip on the receiving screen per unit time is:

$$\rho = \frac{N}{N_s S_t} \quad (9)$$

Obviously, the larger the scattering angle α of the strip, that is, the farther away from the central strip position O, the larger the area of the strip S_t, and the smaller the particle density ρ of each strip on the receiving screen per unit time.

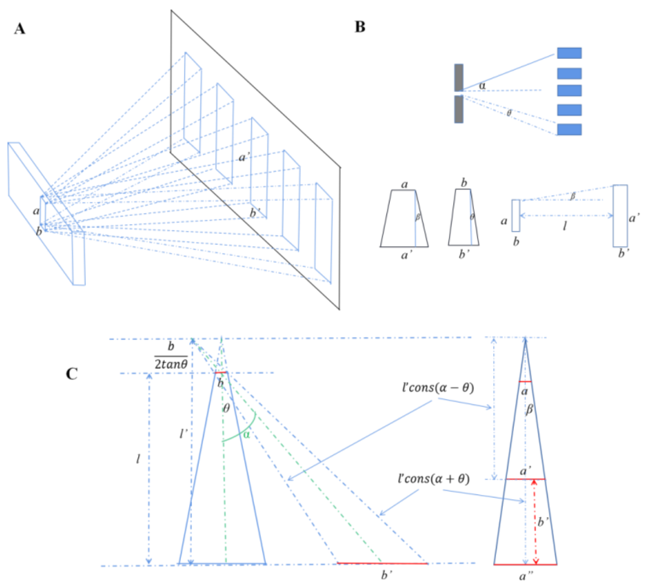

Figure 7. Particle flow diffraction-like pattern and schematic diagram of rectangular slot

When two identical rectangular slots S_1 and S_2 are used for the double-slit experiment, the number of particles received per unit time on the "strip" of the interference-like point is $2N/N_s$, while the quasi-interference point is concentrated in the middle of the receiving screen, the "strip" area S_t is smaller, the number of particles received per unit time is more, the particle density is greater, and the middle "strip" of the interference-like pattern is more obvious.

7. Diffraction and Interference of Light

We have previously proved that the bright and dark stripes in Young's double-slit interference experiment are not interference patterns of light waves. So how is the light and dark stripes formed?

According to the classical electromagnetic theory, light is an electromagnetic wave. According to our latest research, an electromagnetic wave with an electromagnetic oscillation period or a wavelength is an optical quantum, and its energy is ε (numerically equal to Planck constant h) (Zeng, J., 2021; 2022). Each photon is an independent energy unit, just as a particle has a certain amount of energy. Therefore, a beam of light can be regarded as a beam of light quantum flow moving at the speed of light. In this way, the light intensity can be expressed as the number of photons received per unit area per unit time. Therefore, when two beams of light hit the same place, the light intensity will increase with the increase of the number of photons. Even if the phase of the two beams of light is opposite, although the amplitude of the electromagnetic wave is offset, the electromagnetic energy will not be offset, the quantum of light will not disappear, the light intensity is doubled, and will not become dark. Therefore, in Young's double-slit interference, the bright fringe is the place where the light quantum reaches, while the dark fringe is the place where the light quantum does not reach. It can be seen that light is regarded as light quantum flow, and the so-called diffraction and interference phenomenon of light should essentially be the diffraction and interference like phenomenon of light quantum flow after uniform scattering through the gap. In fact, Taylor's weak light double-slit interference experiment proved that the light and dark stripes are formed by the gradual exposure of light quanta on the photographic film (Taylor, G. I., 1909). Some studies have found that when ultra-black materials are used for laser diffraction experiments, only one bright stripe appears on the fluorescent screen, and the usual light and dark stripes disappear (Yang Facheng, private communication). This experimental result shows that if the light quantum is completely absorbed by the material at the edge of the gap, there is no scattering effect of the light quantum flow, and the light and dark stripes disappear.

7.1 Double Slit Interference of Light

If light is regarded as a quantum flow of light, then the monochromatic light passing through the gap or barrier conforms to the uniform, simultaneous, periodic continuous scattering of the particle flow (Figure 6). Without considering the size of the gap, the wavelength λ of the light wave is regarded as the diameter D of the particle, which is replaced by the formula (4) (5), i.e. the position x and the spacing of the interference fringe Δx:

$$x = k\frac{l}{d}\lambda \tag{10}$$

$$\Delta x = \frac{l}{d}\lambda \tag{11}$$

This is the same as the result obtained in the current textbooks. It can be seen that in the light diffraction and Young's double-slit experiment, the light and dark diffraction and interference patterns we see on the fluorescent screen are not actually the diffraction and interference patterns generated by light as an electromagnetic wave, but the "diffraction and interference like" patterns of light quantum flow.

If the gap is rectangular, suppose that the light intensity hit on the gap is I_0, the frequency of the light is v, there are n beams of light with the same frequency passing through the gap with an area of S_0, the total light quantum number passing through the gap is N_0, the scattering degree of freedom of the gap is N_s, and the light quantum density of the bright lines on the fluorescent screen is given by formula (9). Due to the energy of a photon is ε (Zeng, J.,2021), therefore the light intensity I_k of the k-th bright line on the fluorescent screen P_n is:

$$I_k = \frac{I_0 S_0}{N_s S_{t-k}} = \frac{\varepsilon N_0}{N_s S_{t-k}} = \frac{\varepsilon n v}{N_s S_{t-k}} \tag{12}$$

Where, S_{t-k} is the area of the k-th bright line on the fluorescent screen P_n:

$$S_{t-k} = K_{s-k}\left(l + \frac{b}{2tan\theta}\right)^2 \tag{13}$$

K_{s-k} is the K_s value of the k-th bright line on the fluorescent screen P_n:

$$K_{s-k} = tan\beta[cos(k\alpha/N_s - \theta)tan(k\alpha/N_s + \theta) + sin(k\alpha/N_s + \theta) - sin(k\alpha/N_s - \theta) - cos(k\alpha/N_s + \theta)tan(k\alpha/N_s - \theta)] \tag{14}$$

With the increase of *k*, that is, the farther the bright line is from the central bright line, the larger K_{s-k} is, the larger the bright line area S_{t-k} is, and the smaller the light intensity I_k is, which is why the diffraction line of light is the brightest in the central bright line, and the brighter the light is on both sides.

When the "double slit interference" of light occurs, the light intensity on the "interference-like point" is the "superposition" of the light intensity on the "diffraction-like" pattern of two rectangular slits, so the light intensity on the "interference-like point" near the central bright spot is greater. Because of the uniform scattering in the range of scattering angle, the light intensity of the interference-like point is twice that of the non-interference-like point.

7.2 Diffraction of Light From Circular Hole and Circular Plate

When the gap is a circular hole, the two points where each section perpendicular to the circular hole intersects on the circular hole are equivalent to the two slits S_1 and S_2 of the particle flow double-slit experiment (see Figure 4). Obviously, when the gap is a circular hole, it is equivalent to countless double seams forming a ring. If the particle flow is evenly scattered on the wall of the circular hole, a concentric ring of particles with "yes" and "no" will appear on the receiving screen. If the interference-like point is at the center *O*, a central bright spot will be formed. If it is uniform scattering and there are N_s scattering degrees of freedom, then N_{s-1} concentric rings will appear (Figure 8).

Assuming that the light intensity of the circular hole wall irradiated by light is I_0, the thickness of the circular hole wall irradiated is *d*, and the circular hole wall is a ring with a width of *d*, then the width of the ring on the fluorescent screen is $d' = d + 2l\tan\theta$. Assume that the ring scattering angle is θ, the ring scattering degree of freedom is N_s, and the maximum scattering angle is α, then the area of the concentric ring from inside to outside is S_k:

$$S_k = \pi[d + 2l(tan(\theta + \frac{(k+1)\alpha}{N_s})]^2 - \pi[d + 2l(tan(\theta + \frac{k\alpha}{N_s})]^2 \tag{15}$$

The light intensity of the ring is

$$I_k = \frac{\pi d I_0 (2r+d)}{S_k N_s} \tag{16}$$

The larger the *k*, the larger the S_k area, that is, the area of the outer concentric ring is larger than the area of the inner ring, the smaller the light intensity I_k of the ring, which can explain that the more outward the ring flare is, the darker the brightness is.

Assuming the radius of the circular hole is *r*, the maximum angle of light after directly passing through the circular hole is β, then the radius of the circular spot formed in the center of the fluorescent screen is $R = r + 2l\tan\beta$, the area is $\pi(r + 2ltan\beta)^2$. Assuming that the light intensity directly passing through the circular hole is I_0, the light intensity of the circular spot on the fluorescent screen is

$$I_c = I_0 r^2 / R^2 = \frac{I_0 r^2}{(r + 2ltan\beta)^2} \tag{17}$$

If the circular light spot formed by the circular hole wall scattering is within the circular light spot, the light intensity of the circular light spot shall be added to the light intensity of the circular light spot. Therefore, circular light spots are often bright.

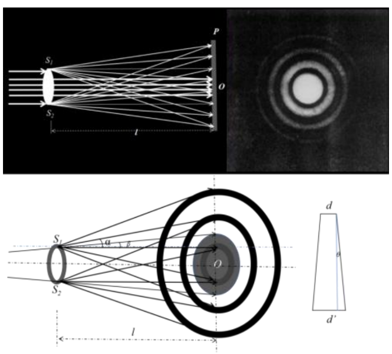

Figure 8. Diffraction pattern and schematic diagram of particle flow circular hole

The ratio of circumference to area of circular hole is $C/S=2/r$. The smaller the radius r is, the larger the C/S ratio is, which means that the more particles that pass through the circular hole and interact with the edge of the circular hole to produce scattering, and the more obvious the diffraction-like phenomenon is in a certain time; On the contrary, more particles directly pass through the circular hole, less scattering particles, and the diffraction like phenomenon is not obvious within a certain time. Therefore, when light is diffracted by a circular hole, the smaller the radius of the circular hole is, the more obvious the diffraction pattern of the circular hole is. When the radius of the circular hole is large to a certain extent, it is not obvious.

The circular plate diffraction of light is similar to the circular hole diffraction. The difference is that the light is blocked by a circular plate and cannot hit the receiving screen, while a circular shadow is formed on the fluorescent screen (Figure 9). Because the circular aperture diffraction time forms a bright circular spot on the fluorescent screen through the circular aperture, it cannot be observed that the interference point forms a central bright spot at the central *O*. If it is a circular plate diffraction, because the center of the fluorescent screen is just a circular shadow, the concentric halo and the central bright spot can be observed. This central bright spot is called Poisson's bright spot. In fact, with the movement of the phosphor screen P_n, the interference-like points at the center *O* of the phosphor screen appear alternately. This can explain that the so-called Poisson bright spots appear alternately with the moving of the fluorescent screen, and concentric halos appear in the shadow.

When the light shines on an opaque circular plate obstacle, like circular hole diffraction, the circular plate diffraction will also appear on the fluorescent screen with bright and dark concentric rings. These bright and dark rings can also be seen in the shadow of the circular plate. The light intensity of the bright rings can be calculated according to formula (17). If the interference-like point is at the center *O* of the fluorescent screen, the so-called "Poisson spot" will appear. If the area of Poisson's spot is S_b, the light intensity of Poisson's spot is:

$$I_b = \frac{\pi d I_0 (2r+d)}{S_b N_s} \tag{18}$$

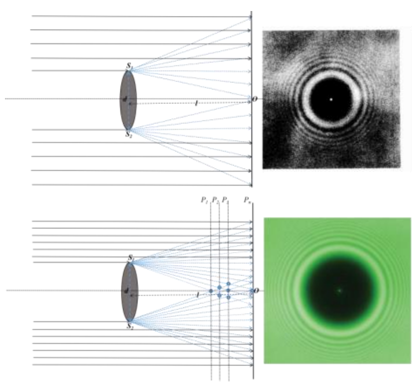

Figure 9. Circular plate diffraction - Poisson bright spot

As the fluorescent screen moves from P_1 to P_n, the Poisson bright spots at central *O* will appear alternately.

8. Discussion

The Young's double slit interference experiment is regarded as a classic physical experiment that proves that light is a type of wave, and its evidence is the observation of alternating light and dark stripes, which are believed to be formed by the interference of waves. From then on, the alternating light and dark stripes became the characteristic marks of waves. In 1927, Davidson and Gamer conducted nickel single crystal scattering experiments using electron beams, and found that the scattering beam intensity exhibited discontinuity or dispersion with spatial distribution. Thomson (1927) conducted polycrystalline thin film scattering experiments using electron beams, and found circular rings with alternating light and dark. In 1961, Jönsson conducted a double slit interference experiment using an electron beam and obtained results similar to the Young's double slit interference experiment. These experiments are believed to have discovered electron diffraction and interference phenomena due to the observation of alternating light and dark stripes, thereby confirming the wave nature of electrons and proving the correctness of de Broglie matter waves.

However, this article proves that the light dark alternating stripes in the Young's double slit interference experiment are not interference patterns generated by light waves. Our research indicates that the observed light dark alternating stripes in the experiment are formed by diffraction-like and interference-like of particle flow. Therefore, the observation of alternating light and dark stripes in experiments does not prove that particles have wave properties, and de Broglie's theory of matter waves cannot be considered experimentally confirmed.

In fact, G I. Taylor's (1909) "feeble light double slit interference experiment" clearly revealed that the alternating light and dark stripes are formed by a single photon being exposed one by one on a photosensitive film. Similarly, the "single electron double slit interference experiment" by Tonomura *et al*. (1989) and Bach *et al*. (2013) clearly recorded the fact that the alternating light and dark stripes were formed by the accumulation of individual electrons hitting the fluorescent screen one by one. These experimental results clearly indicate that the alternating light and dark stripes are formed by the accumulation of a large number of particles scattered through the gaps on the receiving screen. Unfortunately, people have ignored the fact that the alternating light and dark stripes are accumulated by particles one by one, and based on the observation of the alternating light and dark stripes in experiments, they have come to the absurd conclusion that a single particle has wave characteristics and can pass through two slits at the same time, interfering with themselves.

People even use neutrons (Hartmut *et al*. 2022), atoms (Murray, A., 2020; Halban, H. v. Jr & Preiswerk, P., 1936), as well as larger molecules such as C_{60} (Arndt, M. *et al*. 1999), organic macromolecules composed of 810 atoms (Eibenberger, S. *et al*. 2013), and even bacteria (Coles, D., *et al*. 2017; Shayeghi, A., *et al*. 2020) for diffraction and double slit interference experiments, Attempting to prove that physical particles larger than electrons even exhibit volatility in macroscopic matter. However, these evidence, which were mistakenly regarded as supporting de Broglie's matter wave theory in the past, became strong evidence against the theory and supporting our new theory after we revealed the diffraction-like and interference-like mechanisms of particle flow.

De Broglie's theory of matter waves was inspired by Einstein's photon hypothesis of light. Einstein's quantum hypothesis of light suggests that light not only has wave like properties, but also has particle like properties, thus possessing wave particle duality. In fact, Einstein's photon hypothesis itself has problems. On the one hand, the concept of light quantum itself contradicts itself. He believes that light is composed of discontinuous photons, and electrons emit or absorb a photon in units of energy $h\nu$. However, the so-called light quantum refers to the smallest energy unit, but Einstein's light quantum energy is a variable with frequency. In addition, Einstein emphasized that the emission or absorption of a quantum of light by an electron is instantaneous and discontinuous. But from the dimension of Planck's constant and frequency, $h\nu$ is actually the energy absorbed or radiated per unit time (1 second). On the other hand, Einstein's concept of quantum of light is easily regarded as a real particle. For example, he believes that a quantum of light has momentum, and the energy and momentum of a quantum of light should satisfy the relationship $E=h\nu=pc$. His explanation of the photoelectric effect and Compton's explanation of Compton scattering both adopt the viewpoint of treating photons as real particles. It can be seen that the viewpoint of wave particle duality of light is misleading, to the extent that people mistakenly believe that light quantum is a real particle, which was later referred to as "photon".

However, our previous research (Zeng, J., 2021; 2022) has shown that electron transitions are a continuous process in which electrons accelerate or decelerate around the nucleus. During this process, the electromagnetic waves released or absorbed by electrons are also continuous. Specifically, an electron accelerating its motion around the nucleus releases a quantum of light, while an electron absorbing a quantum of light slows down its motion around the nucleus. A quantum of light is an electromagnetic wave of one wavelength, which contains the smallest energy unit ε, its magnitude is numerically equal to the Planck constant h. Due to the continuous nature of electromagnetic waves, the quantum of light is not a discontinuous, independent entity, but a continuous electromagnetic wave divided by a wavelength. In addition, according to the motion law of massless "objects", light as an electromagnetic wave has no mass, so it propagates along a straight line at a constant speed in a vacuum (Zeng, J.& Zeng, T., 2023). The fact that the propagation of electromagnetic waves does not require a medium also indicates that light propagates in a straight line in a vacuum, rather than spreading in a spherical manner. So, when a quantum of light propagates in a vacuum, it looks like a particle moving uniformly in a straight line. In addition, the speed at which electrons emit and absorb a quantum of light is extremely fast (a period of electron motion around the nucleus), which gives the interaction between quantum of light and electrons an instantaneous property similar to collisions between particles. Therefore, the essence of light is electromagnetic waves, which are neither mechanical waves nor physical particles. However, its instantaneous characteristics of uniform linear motion and interaction with electrons make it exhibit particle like properties, creating the illusion that light is both a wave and a particle.

The concept of wave particle duality is a vague and ambiguous term. Firstly, waves and particles are two completely different physical phenomena. Waves are continuous vibrations that can propagate in space, while particles are physical entities with definite positions and momentum. Therefore, putting these two completely different concepts together can lead to conceptual confusion. Secondly, the meaning of wave particle duality is not always clear. For example, when we say that light is both a wave and a particle, this statement may raise some questions. Because light itself is an electromagnetic wave, it is a wave, and particle properties refer to the instantaneous propagation of light and its interaction with electrons. It can be seen that the concept of wave particle duality is not an accurate scientific term, it can cause confusion and misleading for people. Einstein's concept of wave particle duality of light led people to mistakenly believe that photons are a real particle, while de Broglie's matter wave hypothesis of wave particle duality of physical particles led people to mistakenly believe that physical particles are also real waves. Obviously, the concept of wave particle duality confuses two completely different physical phenomena, particles and waves, seriously disrupting people's normal cognition.

In fact, when de Broglie first proposed the hypothesis that physical particles have wave particle duality, his so-called wave property of physical particles did not mean that the particles were real waves, but rather a "hypothetical, non material wave (phase wave)" associated with the physical particles (de Broglie 1923). Schrodinger established the Schrodinger equation based on de Broglie's "phase wave" hypothesis. In order to explain the physical meaning of the wave function, he renamed de Broglie's "phase wave" to "matter wave" (Schrodinger, E., 1926). Afterwards, de Broglie's theory was also known as the theory of matter waves. M. Born (1926) believed that a wave function is a "probability wave" that is a mathematical tool used to describe the state and behavior of particles, but not to accurately describe their position. On the contrary, the modulus squared of the wave function $|\Psi|^2$ represents the probability density of particles appearing at a certain spatial location. Obviously, in order to express the viewpoint that physical particles have wave particle duality and to avoid the contradiction of physical particles moving in the form of waves, both de Broglie and Born carefully fabricated a mathematical wave. This approach seems to solve the contradiction between the concepts of waves and particles, however, the mathematical waves they introduce can easily be confused with physical waves, causing cognitive confusion for people. Even de Broglie himself was influenced by conceptual confusion, mistakenly believing that his phase wave theory could be verified through electron diffraction experiments. As is well known, only physical waves can undergo diffraction and interference phenomena, while mathematical "waves" cannot undergo diffraction and interference phenomena. Essentially, de Broglie's theory of matter waves cannot be verified by diffraction and interference experiments.

However, because the light and dark stripes have long been regarded as diffraction and interference patterns of waves, when people observe the light and dark stripes in electron diffraction and interference experiments, it is considered to confirm the matter wave theory that physical particles have wave particle duality. Of course, this also brings confusion and controversy to people: if the fluctuation of electrons is regarded as a physical real wave, it clearly violates the basic knowledge and fact that physical particles cannot move in the form of waves. On the contrary, if the fluctuation of electrons only refers to mathematical waves rather than real physical waves, then the observed electron diffraction and interference phenomena in experiments cannot be reasonably explained. Due to the prevalence of scientific positivism, people believe that the correctness of scientific theories must be determined by experiments. Therefore, it is widely believed that since the experiment observed the alternating patterns of light and dark characterizing the diffraction and interference phenomena of waves, the physical particles must have true wave characteristics. Although this conclusion contradicts common sense or basic facts, in the face of conclusive experimental results, people firmly believe that the theory of matter waves has been experimentally confirmed and has become the correct theory. As a result, viewpoints such as "electrons are waves" and "electrons move in the form of waves" have become widely popular in the scientific community. This viewpoint, which clearly contradicts the basic facts, often leads to controversy, but the probabilistic interpretation of matter waves attempts to cleverly avoid this contradiction. However, in quantum mechanics, there is still a problem of confusion about the concept of particle volatility. The volatility of particles is sometimes seen as physical waves and sometimes as mathematical waves, which inevitably leads to confusion in concepts, logic, and philosophical thinking. This chaotic understanding has always influenced the development of quantum mechanics, making it difficult to get rid of confusion in understanding and controversy in interpretation. Although the interpretation of quantum mechanics often goes against common sense, the mainstream physics community has not reflected on its theoretical errors. Instead, it believes that quantum mechanics, unlike classical physics, is difficult to understand, which is precisely the main characteristic of quantum mechanics. N. Bohr once said, "If anyone is not confused by quantum theory, then they simply do not understand quantum mechanics". However, our research clearly indicates that the root of these confusions and controversies lies in mistakenly treating the alternating light and dark stripes as diffraction and interference patterns of waves. Obviously, if it is recognized that the stripes between light and dark are diffraction-like and interference-like patterns of particle flow rather than wave diffraction and interference patterns, even with the results of so-called electron diffraction and interference experiments, de Broglie's theory of matter waves cannot be considered to have been experimentally confirmed, and quantum mechanics loses its theoretical basis.

Feynman said that the phenomenon of electronic interference is the core of quantum mechanics, which contains the only mysteries of quantum mechanics. Feynman proposed the famous experimental idea of electronic double slit interference, attempting to use quantum mechanics theory to explain hypothetical experimental results and demonstrate the correctness of quantum mechanics theory (Feynman, R. P *et al*., 2011). However, by analyzing this thought experiment, we can also reveal the errors of quantum mechanics. In this thought experiment, Feynman mainly fabricated two experimental results: (1) when the electron only passes through a small hole, the probability of particle distribution detected by the motion detector on the backstop is a continuous distribution curve, representing no interference pattern; When electrons pass through two small holes, the probability of particle distribution detected by the detector is a wavy distribution curve, representing an interference pattern; (2) In the double slit experiment, as long as electrons are observed, the interference fringes will disappear; When not observed, interference fringes will appear again. Then, he used quantum mechanics theory to explain it: when electrons pass through small holes S_1 or S_2 with wave functions ϕ_1 and ϕ_2 respectively, the quantum probability distribution of reaching the receiving screen $|\phi_1|^2$ or $|\phi_2|^2$ is equal to the classical probability distribution P_1 or P_2, and no interference occurs. When electrons pass through two small holes S_1 and S_2 simultaneously in the superposition state of the wave function ($\phi=\phi_1+\phi_2$), the quantum probability distribution of reaching the receiving screen is $P_{12}=|\phi_1+\phi_2|^2$, forming interference fringes. When tracking and observing which small hole an electron passes through, the wave function collapses, and the probability distribution of reaching the receiving screen becomes the classical probability distribution $P_{12}'=P_1+P_2$, and the interference fringes disappear.

In fact, what Feynman refers to as interference fringes is a pattern of alternating light and dark. He mistakenly believed that interference fringes would only form when electrons pass through two small holes simultaneously, and completely ignored the experimental fact that electrons can also form alternating light and dark fringes through a single small hole. Obviously, according to the electron diffraction experimental results of Davidson-Gamer and Thomson, both the classical probability distributions P_1 and P_2 represent discontinuous spatial distributions (equivalent to alternating light and dark stripes), rather than Feynman's fictional continuous distribution curve. Therefore, the classical probability P_1+P_2 also necessarily represents the alternating light and dark stripes. Even if, as Feynman said, observing electrons leads to the collapse of the wave function, and the probability distribution of electrons changes from quantum probability $|\phi_1+\phi_2|^2$ to classical probability P_1+P_2, the interference fringes (alternating light and dark fringes) will not disappear. In fact, Bach *et al*. (2013) used a camera to record the process of electrons falling one by one on the receiving screen, forming alternating light and dark stripes, indicating that observing electrons does not cause the so-called "interference fringes" to disappear. It can be seen that Feynman's thought experiment on electronic double slit interference was completely fabricated by him, and based on this, he gave a wrong explanation.

In addition, Feynman also proposed a contradictory viewpoint: he believed that electrons always move in the form of particles, but at the same time denied that electrons pass through small holes in the form of particles. Like many quantum physicists, they seem to understand that the volatility of electrons only refers to the probability distribution of these particles reaching the receiving screen, similar to the intensity distribution of waves. However, when they explained in detail how electrons pass through small holes, they surprisingly changed their perspective. They no longer emphasize the concept of particles, but believe that electrons pass through small holes in the form of wave functions or wave function superposition states. Obviously, they were influenced by the de Broglie theory of matter waves and were unable to get rid of the confusion caused by the concept of wave particle duality. They could not distinguish whether the wave function (superposition state) of electrons was a real physical state or a fictional mathematical model. The reason why Feynman fabricated the experimental results is to make them appear to conform to the theory of matter waves, thereby making the probability interpretation theory of quantum mechanics more scientific and credible. However, it is precisely these fabricated experimental results that often contradict common sense and make quantum mechanical interpretations difficult to understand and confusing.

In fact, the probability distribution of electrons on the receiving screen after passing through the gap can be fully explained through the diffraction-like and interference-like mechanisms of particle flow, without the need for the probability wave theory of quantum mechanics to explain it. Generally speaking, the probability of a specific event occurring is determined by the structure of the material or system. Once the structure of a substance or system is determined, the probability of specific events related to it is also determined accordingly. Various uncontrollable conditions or states provide randomness for the occurrence of events. Due to the existence of these random conditions or states, we cannot subjectively determine whether a specific event will occur, so we believe that the occurrence of an event is uncertain. In the experiments of quasi diffraction and quasi interference in particle flow, as long as the experimental equipment and physical parameters of the particle flow and gap are determined, the scattering degree of freedom (N_s) of the particle flow is determined, and the quasi diffraction or quasi interference pattern of the particle flow is determined. Due to our inability to accurately control the speed, angle, and position at which particles are emitted, each emission becomes a random event. Although we cannot accurately predict the exact location where each emitted particle falls on the receiving screen, by emitting a large number of particles and calculating the ratio (n/N) of the number of times (n) they fall at a certain position on the receiving screen to the total number (N) of emitted particles, or by observing the alternating pattern of light and dark formed on the receiving screen, we can calculate the probability of particles falling at a certain position on the receiving screen after passing through the gap. Experiments have shown that the alternating light and dark stripes on the receiving screen are accumulated by particles hitting the screen one by one. The bright stripes are where the particles arrive, and the dark stripes are where they do not. Therefore, in the case of completely uniform scattering of particles, when the particle flow undergoes diffraction-like phenomena through a gap, the probability of the particles reaching the bright stripe on the receiving screen is $1/N_s$, and the probability of reaching the dark stripe is 0. When a particle flow undergoes an interference-like phenomenon through a double slit, the probability of the particle reaching the central interference-like point stripe on the receiving screen is $1/N_s$, while the probability of reaching the non quasi interference illuminated stripe on both sides is $1/2N_s$, and the probability of reaching the dark stripe is 0. Obviously, the probability distribution of electrons reaching the receiving screen in electronic double slit interference fully conforms to classical probability calculus, and there is no need to introduce quantum probability, so there is no problem that quantum probability does not equal classical probability. In fact, there are serious problems with so-called quantum probabilities, such as people often treating superposition states as real physical states and confusing physical states with physical structures. For example, they believe that microscopic particles are in a superposition state of various possible physical states, or even a superposition state of contradictory states. Dice is a uniform hexahedral structure that can combine six different possibilities, which is determined by the structure of the object. However, an object has only one definite physical state, and it cannot combine different physical states, let alone contradictory states. These confusions have led to many errors in quantum mechanics' understanding of the randomness, uncertainty, and probability of microscopic particles, thereby affecting traditional philosophical ideas and concepts.

In addition, our in-depth research on the diffraction-like and interference-like mechanisms of particle flow shows that once the physical properties, shape and size of particles, the velocity and frequency of emitting particles, the material, width, thickness and shape of gaps, the distance between double gaps, and the distance between the detection screen and double gaps are determined, the quasi interference fringes of particles will appear in a determined state. Therefore, we can also infer the physical properties of particles and gaps, as well as the velocity and frequency characteristics of emitted particles, from diffraction-like or the interference-like pattern of particles. These specific information have important guiding significance for designing corresponding instruments and equipment to achieve particle or slit detection and analysis. Therefore, our research also has broad application value in the future.

9. Conclusion

This article proves that the light dark fringes in the Young's double slit experiment are not interference fringes of light waves. Further research has found that the light dark fringes are diffraction like and interference like patterns generated by particle flow passing through the slit. Therefore, all experimental conclusions that claim to confirm the wave nature of particles based on the observation of alternating light and dark stripes are incorrect. This means that the matter wave theory of physical particles with wave particle duality is not valid, and the physical foundation of quantum mechanics is completely shaken. In addition, this study also provides important theoretical basis and experimental methods for the detection and analysis of particles or gaps, which is of great significance for future scientific research and technological development.

References

Arndt, M., Nairz, O., Vos-Andreae, J., *et al*.. (1999). Wave-particle duality of C_{60} molecules. *Nature*, *401*(6754), 680-2. https://doi.org/10.1038/44348

Bach, R., Pope, D., Liou, S. H., *et al*.. (2012). Controlled double-slit electron diffraction. *New Journal of Physics*, *15*(3), 33018-33024(7). https://doi.org/10.1088/1367-2630/15/3/033018

Born, M. (1926). Quantum Mechanics of Scattering. *Proceedings of the Cambridge Philosophical Society*, *23*, 56-65.

Coles, D., Flatten, L. C., Sydney, T., *et al*.. (2017). A Nanophotonic Structure Containing Living Photosynthetic

Bacteria. *Small*, *13*(38). https://doi.org/10.1002/smll.201701777

Davisson, C., & Germer, L. H. (1927). Diffraction of Electrons by A Crystal of Nickel. *Physical Review*, *6*(30), 705-40. https://doi.org/10.1002/j.1538-7305.1928.tb00342.x

de Broglie, L. V. (1923). Ondes rayonnantes et quantiques. *Comptes rendus*, *177*, 507-510.

Eibenberger, S., Gerlich, S., Arndt, M., *et al*.. (2013). Matter-wave interference of particles selected from a molecular library with masses exceeding 10,000 amu. *Phys Chem Chem Phys*., *15*(35), 14696-700. https://doi.org/10.1039/c3cp51500a

Einstein, A. (2017). *Einstein's Essays* (Volume II). Compiled by Fan DN, Zhao ZL, and Xu LY. Commercial Press, Beijing.

Feynman, R. P., Leighton, R. B., & Sands, M. (2011). *The Feynman Lectures on Physics*. vol. III: Quantum Mechanics. New Millennium Edition. Basic Books, New York.

Frabboni, S., Gabrielli, A., Gazzadi, G. C., *et al*.. (2012). The Young-Feynman two-slits experiment with single electrons: build-up of the interference pattern and arrival-time distribution using a fast-readout pixel detector. *Ultramicroscopy*, *116*, 73-6. https://doi.org/10.1016/j.ultramic.2012.03.017

Halban, H. v. Jr., & Preiswerk, P. (1936). Preuve expérimentale de la diffraction des neutrons. *C.R. Acad. Sci*., *203*, 73-75.

Jönsson, C. (1961). Elektroneninterferenzen an mehreren künstlich hergestellten feinspalten. *Zeitschrift Für Physi*k, *161*(4), 454-474. https://doi.org/10.1007/BF01342460

Lemmel, H., Geerits, N., Danner, A., *et al*.. (2022). Quantifying the presence of a neutron in the paths of an interferometer. *Phys. Rev. Research*, *4*, 23-75.

Murray, A. (2020). Double slits with single atoms. *Physics World*, *2*, 31.

Nejad, A. R., & Nejad, P. R. (2020). Are there any photons in the dark fringes of double slit experiment?. *Proc. SPIE 11481*, *Light in Nature VIII*, 114810A (21 August 2020). https://doi.org/10.1117/12.2565899

Schrodinger, E. (1926). Quantization as an eigenvalue problem. *Ann Der Physik*, *79*(4), 489-527. https://doi.org/10.1177/1469787413481132

Shayeghi, A., Rieser, P., Richter, G., *et al*.. (2020). Matter-wave interference of a native polypeptide. *Nat Commun*., *11*(1), 1447. https://doi.org/10.1038/s41467-020-15280-2

Taylor, G. I. (1909). Interference fringes with feeble light. *Proc. Camb. Phil. Soc*., *15*, 114-115.

Thomson, G. P. (1927). Diffraction of cathode ray s by a thin film. *Nature*, 119(3007):890

Tonomura, A., Endo, J., Matsuda, T., *et al*.. (1998). Demonstration of single-electron buildup of an interference pattern. *American Journal of Physics*, *57*(2), 117-120. https://doi.org/10.1119/1.16104

Zeng, J. (2021). Classical physical mechanism of quantum production and its explanation for hydrogen atom structure and photoelectric effect. *Physics Essays*, *34*(4), 529-537. https://doi.org/10.4006/0836-1398-34.4.529

Zeng, J. (2022). Classical physics derivation of quantization of electron elliptical orbit in hdrogenlike atom. *Physics Essays*, *35*, 147-151. https://doi.org/10.4006/0836-1398-35.2.147

Zeng, J., & Zeng, T. (2023). The motion of massless "object" and the physical essence and motion law of light. *Physics Essays*, *36*(2), 216-222. https://doi.org/10.4006/0836-1398-36.2.216