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Starting from the Nested Fringes of the Double-Slit Experiment

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Abstract
The double-slit experiment is a fundamental experiment in physical optics, currently regarded as a demonstration of the wave-like properties of microscopic particles. This is due to the pattern of alternating bright and dark fringes that appear on the screen as a result of the experiment. However, another characteristic of the double-slit fringe pattern—the nested fringes—has not been previously discussed. In this paper, the authors propose a novel theory of double-slit separation based on this feature and design a new double-slit experimental apparatus to conduct the experiment, allowing for the adjustment of the slit width during the process and thus observing the variation in the fringe pattern. The experiment reveals that the double-slit fringe pattern is actually a localized magnification at the center of the Single filament diffraction pattern, inheriting the nested feature of the Single filament diffraction fringes. A set of obstruction theories utilizing relativity is summarized to explain the double-slit experiment. This new discovery opens up a fresh direction for research into the double-slit experiment.

Keywords: Flow Blocking Theory, Coherent Wave, Relativity

1. Introduction

Since the British physicist Thomas Young first demonstrated the wave nature of light using the double-slit experiment in 1801, the field has been continuously evolving [1-5]. In September 1923, the French scientist Louis de Broglie introduced the concept of matter waves in his thesis "On the Quantum Theory of Light, Diffraction, and Interference," explaining the interference patterns of the double-slit experiment and predicting the existence of circular hole diffraction [6-9]. Although subsequent scientists observed interference patterns using various improved methods of the double-slit experiment and refined the coherent wave theory that we have today, the question of whether light is a wave or a particle, as well as through which slit a photon passes to reach the screen, remains unresolved [10-18]. Despite these unanswered questions, the scientific community apparently has no doubt about the veracity of the coherent wave theory. In recent years, with the advancement of technology, experimental equipment has become more precise, and observation techniques more accurate, yet many phenomena of the double-slit experiment remain unclear [19-25]. Since microscopic investigations have not clarified the reasons, perhaps we can attempt to find answers from a macroscopic perspective. In this paper, the author will present a relatively macroscopic method of the double-slit experiment to demonstrate that coherent waves do not exist.

2. Method

While observing the interference fringes in the double-slit experiment, the author discovered that the fringes exhibited a nested structure. These fringes could be decomposed into several sets of primary fringes, each consisting of multiple secondary fringes (Figure 1a). Additionally, The double-slit can be decomposed into a single filament and a single slit(Figure 1b).

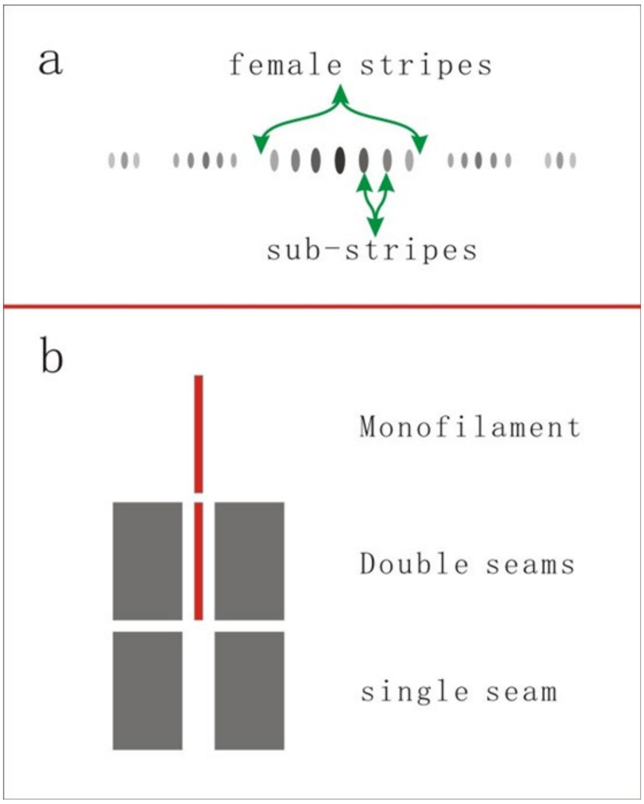


Figure: 1

a. The interference fringes in the double-slit experiment exhibit a distinct hierarchical nested structure. These fringes can be

decomposed into several sets of primary fringes, each consisting of multiple secondary fringes.
b. The double-slit can be decomposed into forms of single filament and single slit.

Based on this finding, the author designed an experimental apparatus capable of real-time adjustment of the double-slit width. This apparatus utilized a bidirectional screw with both forward and reverse threads, in conjunction with a set of reduction gears, to precisely control the position of the side barriers of the double-slit. At the center of the experimental instrument, a thin wire was fixed as a separator, splitting the single slit formed by the left and right barriers into a double-slit. The width of the double-slit could be adjusted within a range of 0 to 10mm. When the barriers were sufficiently apart, the light source would only illuminate the separator, creating single thread diffraction fringes. The operator could rotate the handle to reduce the width of the left and right gaps until double-slit interference fringes appeared on the light screen, or conversely, turn the handle in the opposite direction to transition from the double-slit experiment to single thread diffraction. The uniqueness of this device lies in its integration of single thread diffraction and double-slit experiments, allowing the observation of the continuous transition between single thread diffraction and double-slit experiments (Figure 2).

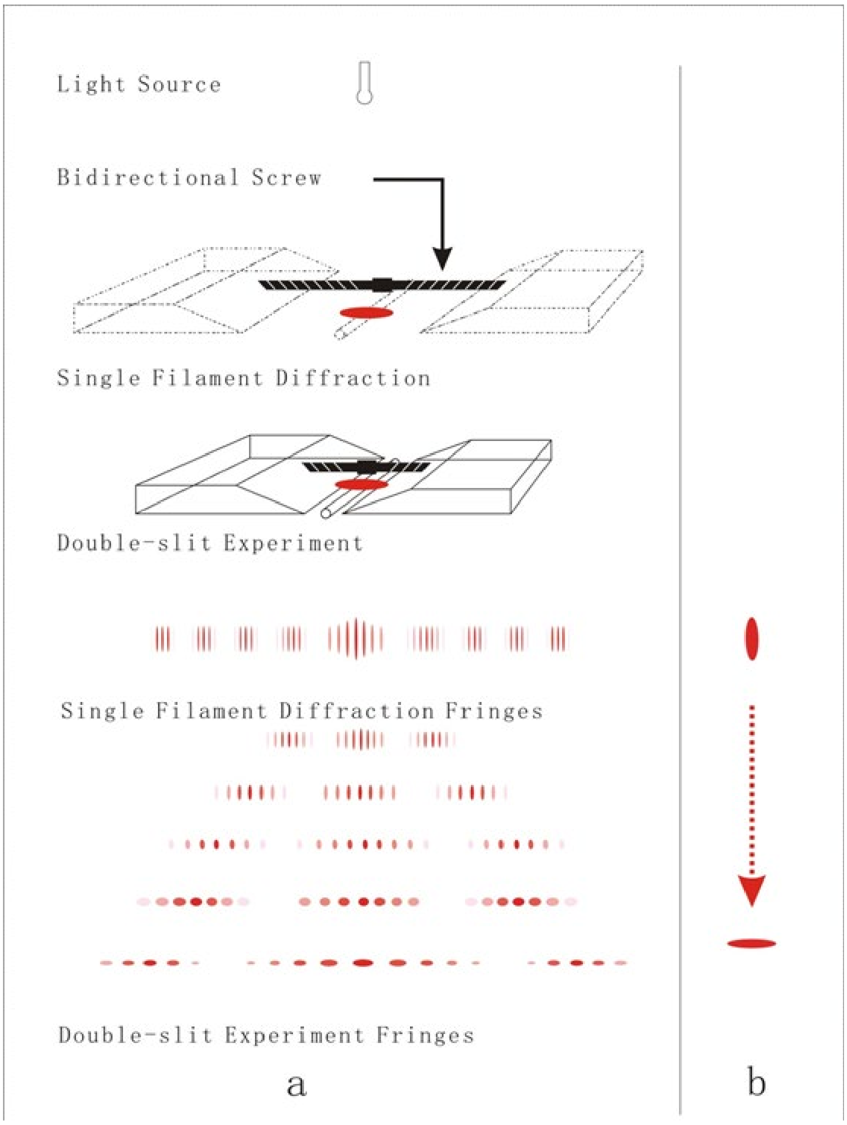


Figure: 2

a. The evolution of the fringes from single-filament diffraction to the double-slit experiment.
b. The sub-fringes evolve from vertical ellipses to horizontal ellipses.
c. To avoid strong light interference, the author used a low-power laser with a wavelength of 635nm as the light source and selected a 0.1mm diameter aluminum wire as the separator, setting the distance from the double-slit to the light screen at 3000mm. Under conditions where the double-slit width was 10mm (with secondary fringe spacing of about 4mm) and secondary fringe spacings were approximately 9mm, 12mm, and 16mm, the fringe patterns were photographed and recorded (Figure 3c).

3. Results

3.1 Changes in Fringe Patterns

The change in the fringe pattern is primarily manifested in the sub-fringes of the k-0 order parent fringe, evolving from the longitudinal olive shape during the single filament diffraction stage to the transverse olive shape during the double-slit experiment stage(Figures 3b and Figures 2b).

3.2.Changes in Spacing

The spacing between sub-fringes increased from approximately 4mm during the Single filament diffraction phase. to about 12mm during the double-slit diffraction phase (Figure 3c).

3.3.Continuity

The sub-fringes indicated by the three yellow arrows in the k-0 order primary fringes remained consistently highlighted from the Single filament diffraction phase. to the double-slit experiment phase (Figure 3).

4. Discussion

In the classical double-slit experiment, the widths of the two slits are usually fixed, and experimenters typically record a set of fixed fringe data. Another variation is the Feynman double-slit experiment, where the left and right slit widths are asymmetric, resulting in asymmetrically recorded fringes. Additionally, we often treat the single thread diffraction experiment and the double-slit experiment as two separate experiments, leading to some one-sided conclusions, such as the idea that the double-slit experiment results from the interference of two coherent wave sources, while single thread diffraction is formed by the superposition of sub-waves. Up to now, we have only been able to describe how photons pass through a double slit using wave functions, which is clearly incomplete and remains merely a mathematical theoretical model.

In this experiment, by changing the width of the double slits during the experiment, we can dynamically and visually observe the transformation process of the fringes from single thread diffraction to the double-slit experiment. The experimental results show that the fringes in the double-slit experiment are a localized magnification of the center of the single thread diffraction fringes, and the double-slit experiment continues the single thread diffraction fringes, inheriting the nested characteristics of the single thread diffraction fringes (Figure 3).

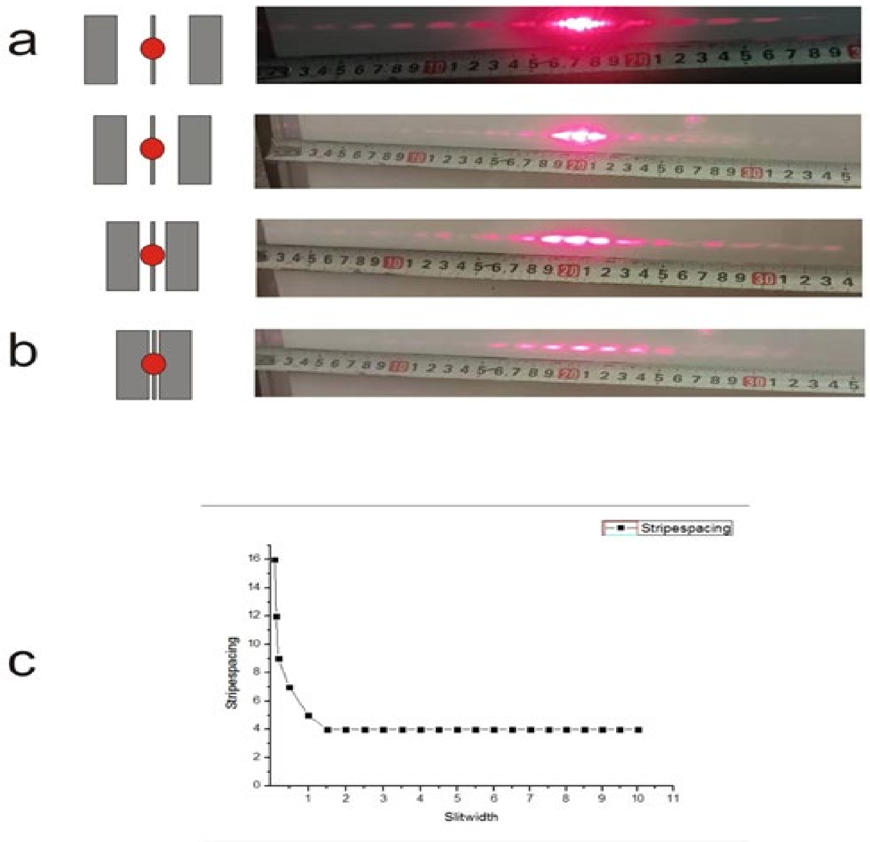


Figure: 3

a. During the single-filament diffraction phase, as the double-slit width is reduced from 10mm to approximately 1.5mm, the fringe shape and spacing change insignificantly. The fringes consist of about 9 elliptical primary fringes with a spacing of approximately 25mm. The k-0 order primary fringes can be clearly distinguished and contain about 6-7 bright secondary fringes, with a spacing of about 4mm between them. The edges of the secondary fringes overlap. The secondary fringes of the k-1, k-2, k-3… order primary fringes are not easily distinguishable.

b. As the double-slit gap gradually narrows, the spacing between the secondary fringes increases, forming the double-slit experiment fringes. At a slit width of approximately 0.12mm, about 3 sets of horizontal elliptical primary fringes can be seen, with a spacing of about 90mm between them. The k-0 order primary fringes contain about 7 secondary fringes, with a spacing of about 12mm between them.

According to the current theory of coherent waves, the production of interference fringes requires the fulfillment of three conditions: consistent frequency, constant phase difference, and the same direction of vibration. The condition for the formation of diffraction is that the size of the slit or obstacle must be equal to or smaller than the wavelength of the light wave. In our experiment, the sub-fringes of the k-0 order parent fringe penetrated the entire experimental process, and the continuity displayed obviously cannot be explained solely by the theory of coherent waves.

5. Flow Blocking Theory

Through observation, the author proposes the Flow Blocking Theory to explain the phenomena observed in the double-slit experiment (Figure 4). A right-angled triangle is formed by connecting the center points of the light source, the barrier, and one of the slits (Figure 4a). In a right-angled triangle, the length of the hypotenuse is greater than that of any of the other two sides, which means the path along the sides is shorter than that along the hypotenuse. Therefore, when light from the source is projected perpendicularly to the center of the double slits, photons first reach the barrier. According to relativity, objects with mass can cause the curvature of spacetime around them, and the commonly used experimental apparatus in double-slit, single-slit, or single-filament experiments have mass and thus can bend the surrounding spacetime (Figure 6). When the left and right baffles are far from the barrier, the curved spacetime around them does not overlap with that produced by the barrier, and photons only pass through the curved spacetime created by the barrier, forming diffraction waves and single-filament diffraction patterns on the light screen. As the left and right baffles move towards the center and the curved spacetimes overlap, the curved spacetimes produced by the baffles, which are oriented towards the sides of the double slits, are in the opposite direction to that produced by the barrier. This causes the photons to experience a new opposing force, stretching them towards the sides of the slits (Figure 4b). As the slits narrow and the overlapping curved spacetimes increase, the force acting on the photons strengthens, causing the photons to change their final impact points on the light screen according to the change in the force they experience. This leads to the observed phenomenon where the smaller the slit, the larger the spacing between the stripes. Furthermore, the shape also changes from the longitudinal olive-shaped sub-stripes to the transverse olive-shaped stripes seen in the double-slit experiment (Figure 2b), thus well explaining the evolution of the stripes in the double-slit separation experiment.

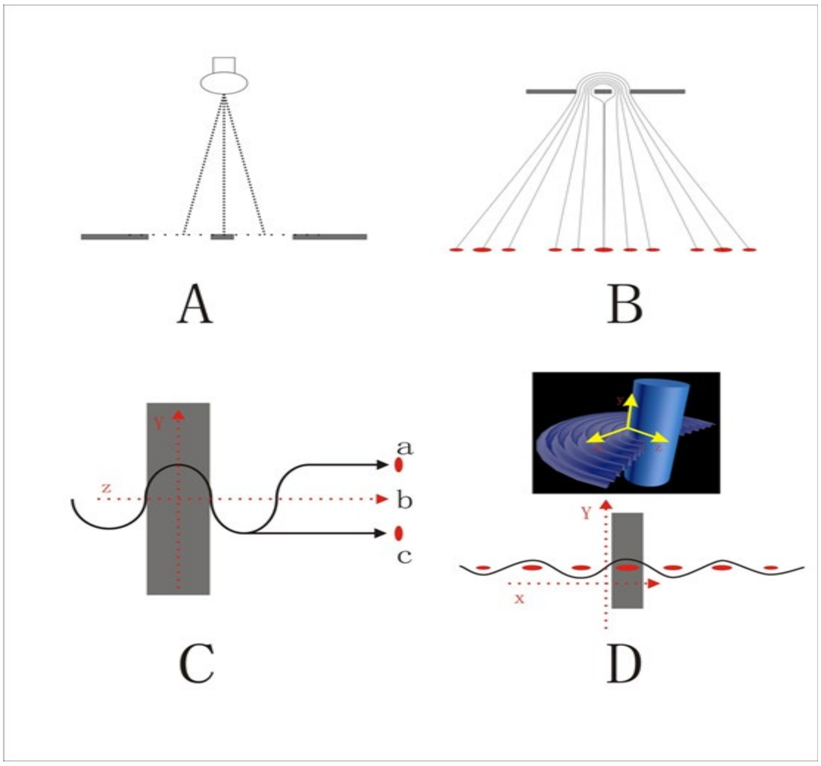


Figure: 4

a. The alignment of the light source, the central barrier, and the midpoint of one slit constitutes a right-angled triangle. Within this geometric configuration, the length of the hypotenuse exceeds that of either of the other two sides, which are perpendicular to each other. Consequently, the path traversed along these perpendicular sides is shorter than the one along the hypotenuse. As a result, when light emitted from the source impinges perpendicularly upon the midpoint of the double slits, photons initially encounter the central barrier separating the slits.
b. The curved spacetime formed by a single filament breaks the balance of the photon's path. To maintain its equilibrium, the photon needs to return to its initial path as much as possible, which generates a centripetal force. Under the influence of its kinetic energy and the centripetal force, the photon forms a diffraction wave by repeatedly switching its trajectory.
c. Due to the presence of an obstacle along the x-axis, photons cannot swing left and right to achieve balance and thus can only swing up and down along the y-axis following the single filament to reach their own equilibrium, moving around the obstacle to the other side. Therefore, the fringes that ultimately form are perpendicular to the obstacle. Since photons are in a discrete state, once they move behind the filament, they are not subjected to new external forces. After reaching the last diffraction wave peak or trough, they no longer form new oscillation cycles and will maintain their position near the peak or trough, propagating in a straight line to the screen to form diffraction fringes. The zero-axis area between the peaks and troughs appears as the so-called dark fringes (C-b) because no photons fall in that region.

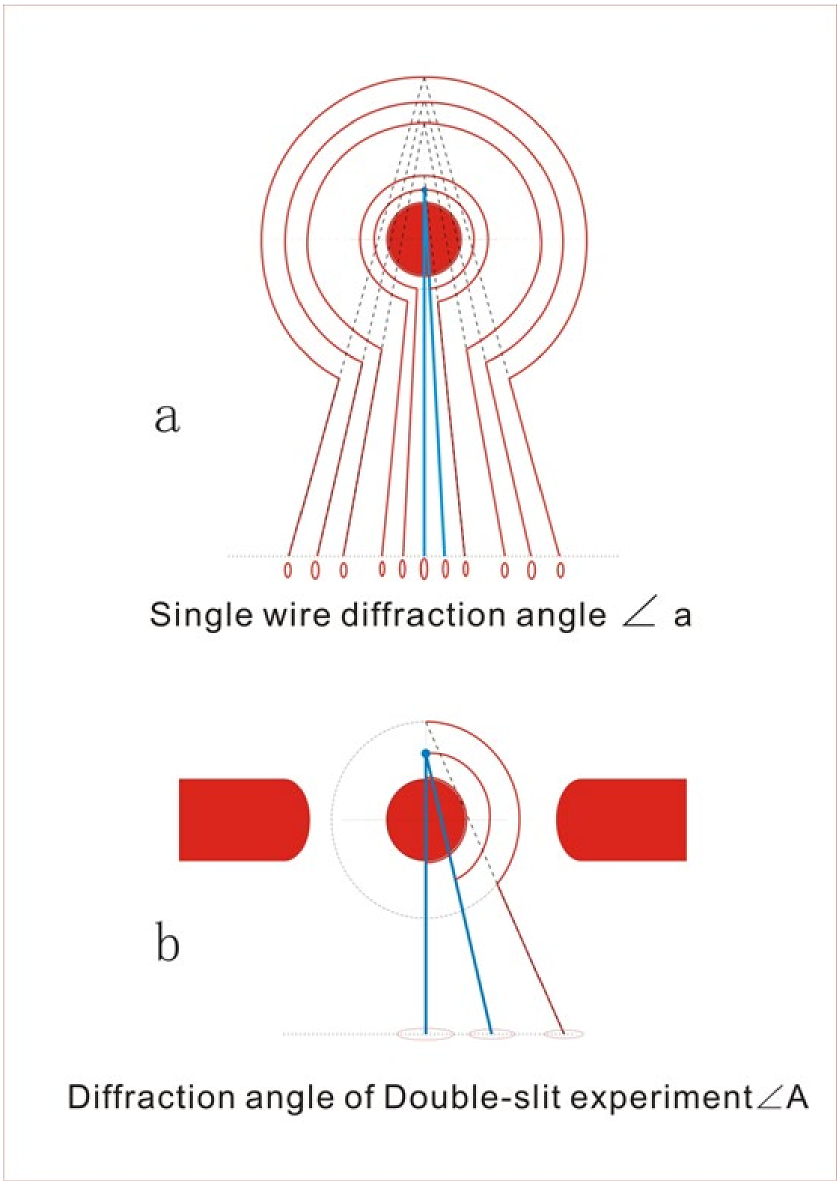
Photons with kinetic energy, under the influence of the same force (i.e., the curved spacetime produced by a single filament), exhibit consistent physical behavior and move along the same curved spacetime path. The curved spacetime formed by the single filament breaks the equilibrium of the photon's path. To maintain its balance, the photon tries to return to its initial path, generating a centripetal force. Under the action of its kinetic energy and the centripetal force, the photon forms diffraction waves by repeatedly switching its trajectory (Figure 4C). Due to the presence of obstacles along the x-axis, the photon cannot swing left and right to achieve balance and can only move up and down along the y-axis following the single filament to reach its own equilibrium. Therefore, the final pattern formed is vertical to the obstacle (Figure 4D). Since the photon is in a discrete state and is not subject to new external forces after moving behind the single filament, it will maintain its position near the last diffraction wave peak or trough after reaching it (Figure 4C-a, c), propagating in a straight line to the light screen to form diffraction patterns. The areas between the peaks and troughs, the so-called dark stripes, appear because no photons fall in these zones (Figure 4C-b). The specific stripe on which a photon lands mainly depends on the point of incidence. In this way, photons as quantized individuals pass through the double slits to the light screen, carrying clear path information, and the double-slit experiment is explained with a more concise quantum principle.

The alternating light and dark stripes are the result of the regular interval distribution of microscopic particles. The Flow Blocking Theory can well explain the single-electron double-slit experiment.

Diffraction waves consist of multiple oscillation cycles, each peak or trough represents an energy level corresponding to a diffraction stripe, with the central stripe being the zero level (Figure 4-D).

6. Mechanical Derivation

According to Einstein's theory of relativity, "matter tells spacetime how to curve, and curved spacetime tells matter how to move." A light source shining perpendicularly onto the center of a double slit forms diffraction fringes. By taking the line connecting the light source and the center of the double slit as one of the right-angle sides, and the line connecting the diffraction fringe to the corresponding diffraction wave peak as the hypotenuse, one can form the corresponding energy level diffraction angle (Figure 5). In the Single filament diffraction phase, when the left and right baffles are far from the central partition, the curved spacetimes they produce do not overlap, and photons are only subjected to the force directed towards the inside of the double slit by the curved spacetime formed by the central partition, resulting in the sub-fringe diffraction angle of the Single filament diffraction. (Figure 5a). In the double-slit diffraction phase, as the slit size decreases and the curved spacetimes produced by the left and right baffles overlap with that of the central partition, a new set of forces acting on the photons towards both sides of the double slit is formed, resulting in the double-slit experiment fringe diffraction angle (Figure 5b). Here, the double-slit diffraction angle is simply the angle of the sub-fringe diffraction angle of the Single filament diffraction. being stretched larger. Experiments with a multifunctional diffractometer show that as the slit narrows, the spacing between the fringes gradually increases, that is, the diffraction angle gradually increases.



Single wire diffraction angle ∠ a

Diffraction angle of Double-slit experiment∠A

Figure: 5

The farther from the center of an object, the smaller the curvature of spacetime and the weaker the gravitational force; conversely, the closer to the center, the greater the curvature and the stronger the gravitational force. Relative to the central partition, the gravitational force at arc C is greater than at arc D, and relative to the right baffle, the gravitational force at arc A is greater than at arc B (Figure 6a). The curved spacetimes of the left and right baffles are directed towards the sides of the double slit, opposite to the direction of curvature of the central partition's spacetime. During the Single filament diffraction phase, since the central partition is far from the left and right baffles, their respective curved spacetimes do not overlap (Figure 6a), and photons are only influenced by the curved spacetime of the central partition to form Single filament diffraction fringes. As the left and right baffles move closer to the center, the curved spacetimes overlap, and at this time, a new set of forces acting towards both sides of the double slit is applied to the photons (Figure 6b),Stretch the sub-fringes of the single filament diffraction to both sides.As the overlapping area increases, the gravitational forces produced by the central partition and the left and right baffles become stronger, and the spacing between the sub-fringes also increases, eventually transforming from single-slit diffraction fringes to double-slit experiment fringes. When the slit size is fixed, this interactive force is in a state of equilibrium (Figure 6c). The blue bidirectional arrows in the figure are a schematic representation of the gravitational interaction between the central partition and one side baffle corresponding to the energy level diffraction fringes.

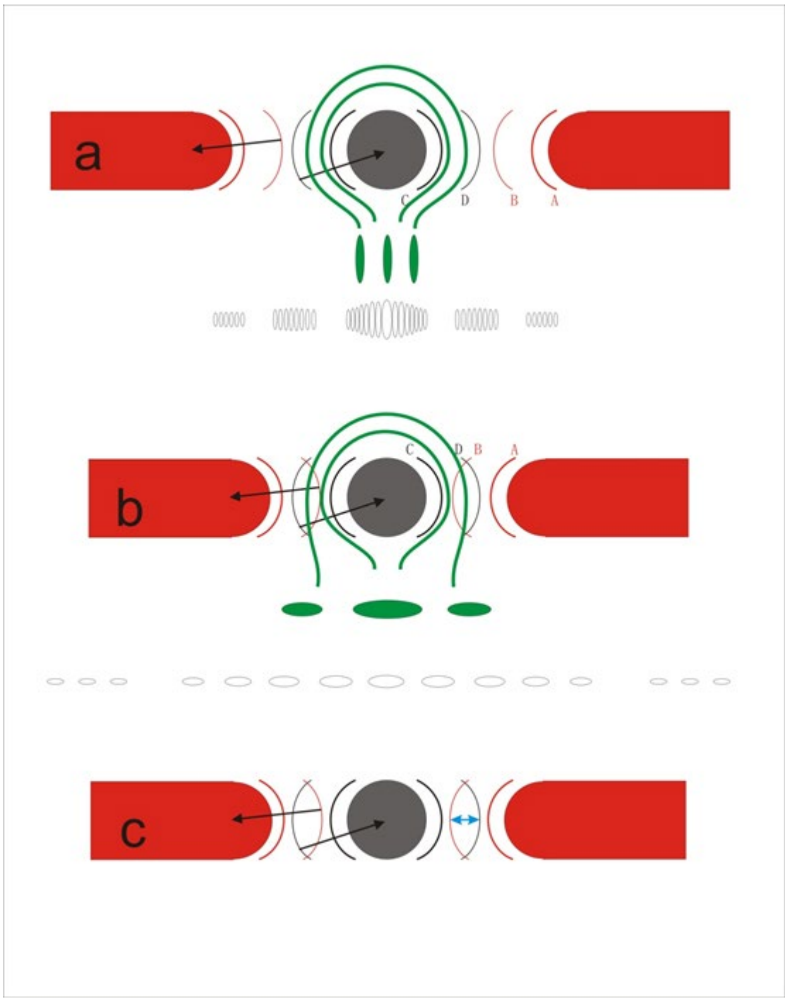


Figure: 6

a. The curvature of spacetime decreases with increasing distance from the center of an object, resulting in a corresponding decrease in gravitational force. Conversely, closer to the center of the object, the curvature of spacetime is greater, and so is the gravitational force. Relative to the central barrier, the gravitational force at arc C is greater than at arc D. In relation to the right barrier, the gravitational force at arc A is greater than at arc B. The curvature of spacetime induced by the left and right barriers is directed towards the sides of the double slits, which is the opposite direction to the curvature caused by the central barrier. During the single-filament diffraction stage, since the central barrier is far from the left and right barriers, their respective spacetime curvatures do not overlap, and photons are influenced solely by the curvature of spacetime around the central barrier, forming single-filament diffraction patterns.

b. As the left and right baffles move closer to the center, the curved spacetimes overlap, and at this time, a new set of forces acting towards both sides of the double slit is applied to the photons (Figure 6b),Stretch the sub-fringes of the single filament diffraction to both sides.As the overlapping area increases, the gravitational forces produced by the central partition and the left and right baffles become stronger, and the spacing between the sub-fringes also increases, eventually transforming from single-slit diffraction fringes to double-slit experiment fringes.

c. The blue bidirectional arrows in the figure are a schematic representation of the gravitational interaction between the central partition and one side baffle corresponding to the energy level diffraction fringes.

From this, a rule can be deduced: the size of the double-slit experiment fringe diffraction angle corresponding to the energy level is linearly related to the gravitational interaction force between the corresponding side baffle and the central partition.

$$F = (\angle A - \angle a) * f$$

Where F represents the magnitude of the gravitational interaction force between the baffle and the partition at the corresponding energy level,

$\angle A$ is the diffraction angle in the double-slit experiment at the corresponding energy level,

$\angle a$ is the diffraction angle in the single-filament diffraction at the corresponding energy level,

f is a constant described as: x Newtons per 1 degree of diffraction angle, which is influenced by the wavelength of light.

7. Conclusions

By symmetrically adjusting the sizes of the slits on the left and right during the experimental process and recording and analyzing the relevant data, the author concludes that the alternating light and dark stripes are a natural phenomenon where matter affects the movement paths of microscopic particles, causing these particles to change their state of motion and form a regularly spaced distribution on the light screen. Coherent waves do not exist, and as Einstein stated, quantum mechanics is not complete. We should re-examine physical phenomena such as quantum entanglement. The double-slit experiment can reveal aspects of gravitational phenomena.

8. Prediction

If coherent waves truly exist, since the stripes are always perpendicular to the obstacles (single filament, single slit, double slit, etc.), then coherent waves should only have one polarization direction (Figure 7a). Coherent waves, composed of light waves and exhibiting wave characteristics, can be blocked by a polarizer. Therefore, it should also be able to block coherent waves. By inserting a polarizer between the double slit and the light screen, aligning the polarizer's polarization direction with that of the coherent waves, the coherent waves should pass through and the stripes will remain unchanged. If the polarizer's polarization direction is perpendicular to that of the coherent waves, it will block the propagation of the coherent waves and the stripes will disappear.

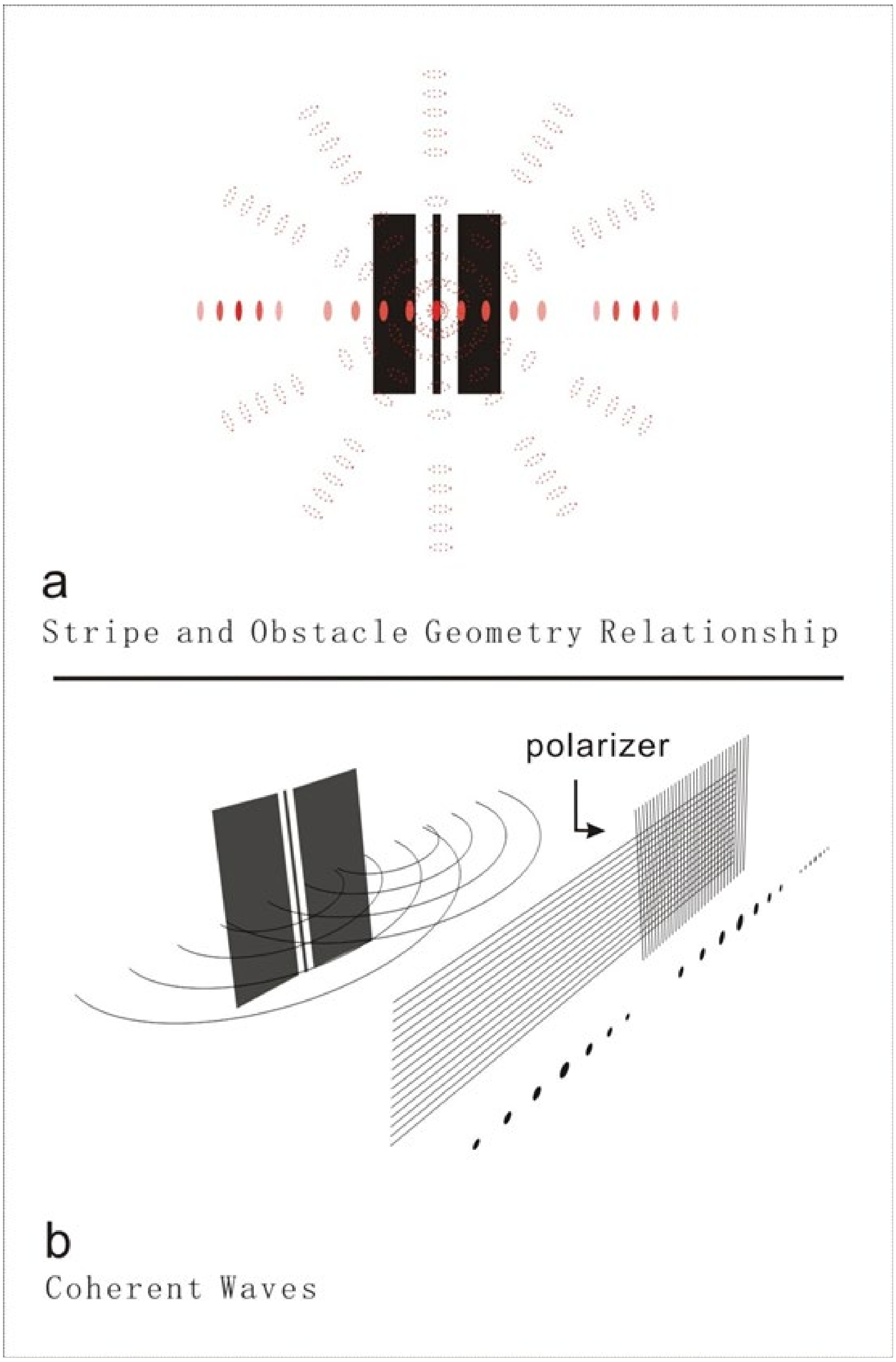


Figure: 7

a. If coherent waves truly exist because the fringes are always perpendicular to the obstacles (single filament, single slit, double slit, etc.), then the coherent waves should only exist in one polarization direction.
b. Coherent waves, composed of light waves and exhibiting wave characteristics, can be blocked by polarizers, which should also be able to block coherent waves. By inserting a polarizer between the double slit and the light screen, and aligning the polarizer's polarization direction with that of the coherent waves, the coherent waves can pass through and the fringes will remain unchanged. If the polarizer's polarization direction is perpendicular to that of the coherent waves, it will block the propagation of the coherent waves and the fringes will disappear. If, as the author suggests, photons form diffraction waves at the incident surface of the central partition, then the photons will maintain their respective polarization after passing through the double slits. Therefore, by inserting two polarizers perpendicular to each other between the double slits and the light screen, the fringes can be divided into four regions according to the light intensity: one region without a polarizer where the fringe brightness remains unchanged, two regions with the brightness of the fringes reduced due to the obstruction of a single polarizer, and one region where the fringes will disappear due to the obstruction of two mutually perpendicular polarizers.

If, as the author suggests, photons first form diffraction waves at the incident surface of the partition, then the photons will maintain their respective polarization characteristics after passing through the double slits. By inserting two polarizers perpendicular to each other between the double slits and the light screen, the stripes can be divided into four regions according to light intensity. In one region without a polarizer, the brightness of the stripes remains unchanged. In two regions, with only one polarizer obstructing, the brightness of the stripes is reduced. In the remaining region, due to the obstruction of two perpendicular polarizers, the stripes will disappear (Figure 7b).

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