A new theory of the double-slit experiment

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Abstract

The double-slit experiment is a fundamental experiment in physical optics and is 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 revealed 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 new direction for research into double-slit experiments.

Key words: 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[1-5], the field has been continuously evolving. 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 have observed interference patterns using various improved methods in double-slit experiments and refined the coherent wave theory that we currently exist, the questions of whether light is a wave or a particle[10-14], as well as through which slit a photon passes to reach the screen, remain unresolved[1,15-18]. Despite these unanswered questions, the scientific community has no doubt of the veracity of coherent wave theory. In recent years, with the advancement of technology, experimental equipment has become more precise, and observation techniques have become more accurate[19-24; however], many phenomena associated with double-slit experiments have not been fully elucidated[15,25]. Since microscopic investigations have not clarified the underlying 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). Based on these findings, 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 barrier, 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 10 mm. When the barriers were sufficiently large, the light source illuminated only the barrier, 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; conversely, the handle could be rotated in the opposite direction to transition from the double-slit experiment to single -thread diffraction. The uniqueness of this device lies in its ability to integrate single-thread diffraction and double-slit diffraction, allowing observation of the continuous transition between single-thread diffraction and double-slit diffraction (Figure 2).

To avoid strong light interference, the author used a low-power laser with a wavelength of 635 nm as the light source and selected a 0.1 mm diameter aluminum wire as the barrier, setting the distance from the double slit to the light screen at 3000 mm. Under conditions where the double-slit width was 10 mm (with a secondary fringe spacing of approximately 4 mm) and the secondary fringe spacings were approximately 9 mm, 12 mm, and 16 mm, 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 subfringes 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 (Figure 3b and Figure 2b).

3.2. Changes in Spacing

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

3.3. Continuity

The subfringes indicated by the three yellow arrows in the k-0 order primary fringes remained consistent throughout the single-filament diffraction phase. to the double-slit experiment phase (Figure 3).

4. DISCUSSION

In classical double-slit experiments, the widths of 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 several 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 subwaves. To date, we have been able to describe how photons pass through only a double slit using wave functions; however, this approach is clearly incomplete and relies on 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 double-slit diffraction. 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).

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 subfringes 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 proposed 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 either of the other two Right-angle side, which means that the path along the Right-angle side 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 apparatuses 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 toward the center and the curved spacetimes overlap, the curved spacetimes produced by the baffles, which are oriented toward the sides of the double slits, are in the opposite direction to those produced by the barrier. This causes the photons to experience a new opposing force, stretching them toward 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 is, the greater the spacing between the stripes. Furthermore, the shape also changes from longitudinal olive-shaped substripes to transverse olive-shaped stripes, as observed in the double-slit experiment (Figure 2b), thus explaining the evolution of the stripes in the double-slit separation experiment.

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 a single filament breaks the equilibrium of the photon path. To maintain its balance, the photon tries to return to its initial path, generating a centripetal force. Under the action of kinetic energy and 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 or right to achieve balance and can only move up or 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 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 explain the single-electron double-slit experiment well.

Diffraction waves consist of multiple oscillation cycles, and each peak or trough represents an energy level corresponding to a diffraction band, with the central band 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 to the center of a double slit forms diffraction fringes. Take the central axis 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 subjected to only the force directed toward the inside of the double slit by the curved spacetime formed by the central partition, resulting in the subfringe 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 those produced by the central partition, a new set of forces acting on the photons toward both sides of the double slit is formed, resulting in a double-slit experimental fringe diffraction angle (Figure 5b). Here, the double-slit diffraction angle is simply the angle of the subfringe 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.

The further 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 that at arc D, and relative to the right baffle, the gravitational force at arc A is greater than that at arc B (Figure 6a). The curved spacetimes of the left and right baffles are directed toward the sides of the double slit, opposite to the direction of curvature of the spacetime of the central partition. 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 influenced only 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 toward both sides of the double slit is applied to the photons (Figure 6b). The subfringes of the single-filament diffraction are stretched to both sides. As the overlapping area increases, the gravitational forces produced by the central partition and the left and right baffles increase, and the spacing between the subfringes also increases, eventually transforming from single-slit diffraction fringes to double-slit experimental 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.

From this, the following 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, and
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 sides during the experimental process and recording and analyzing the relevant data, the author concluded that alternating light and dark stripes are natural phenomena in which 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 are 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.), 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 possible 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 should pass through, and the stripes will remain unchanged. If the polarizer's polarization direction is perpendicular to that of the coherent waves, the propagation of the coherent waves will be blocked, and the stripes will disappear.
If, as the author suggested, 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 disappear (Figure 7b).

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Explanation

The coherent waves described in this article refer to the waves that illustrate how photons pass through a double slit and form alternating light and dark stripes on a screen rather than describing light as an electromagnetic wave with wave-like properties.

Commitment

The author pledges that this paper was completed independently by the author alone and is not subject to any form of dispute with others.

Availability Statement

The data used and/or analyzed during the current study are included within the article.

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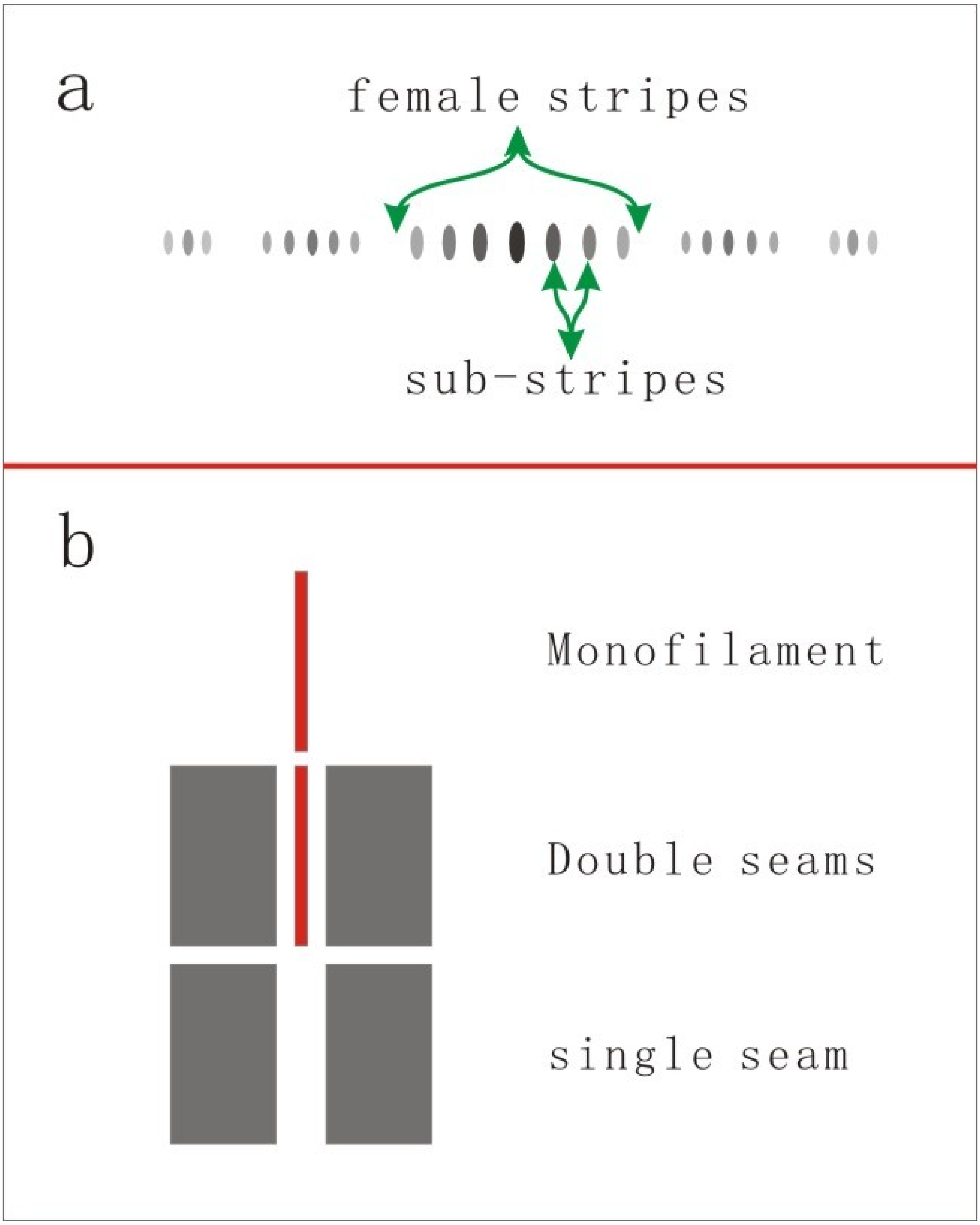


Figure 1

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 single filaments and single slits.

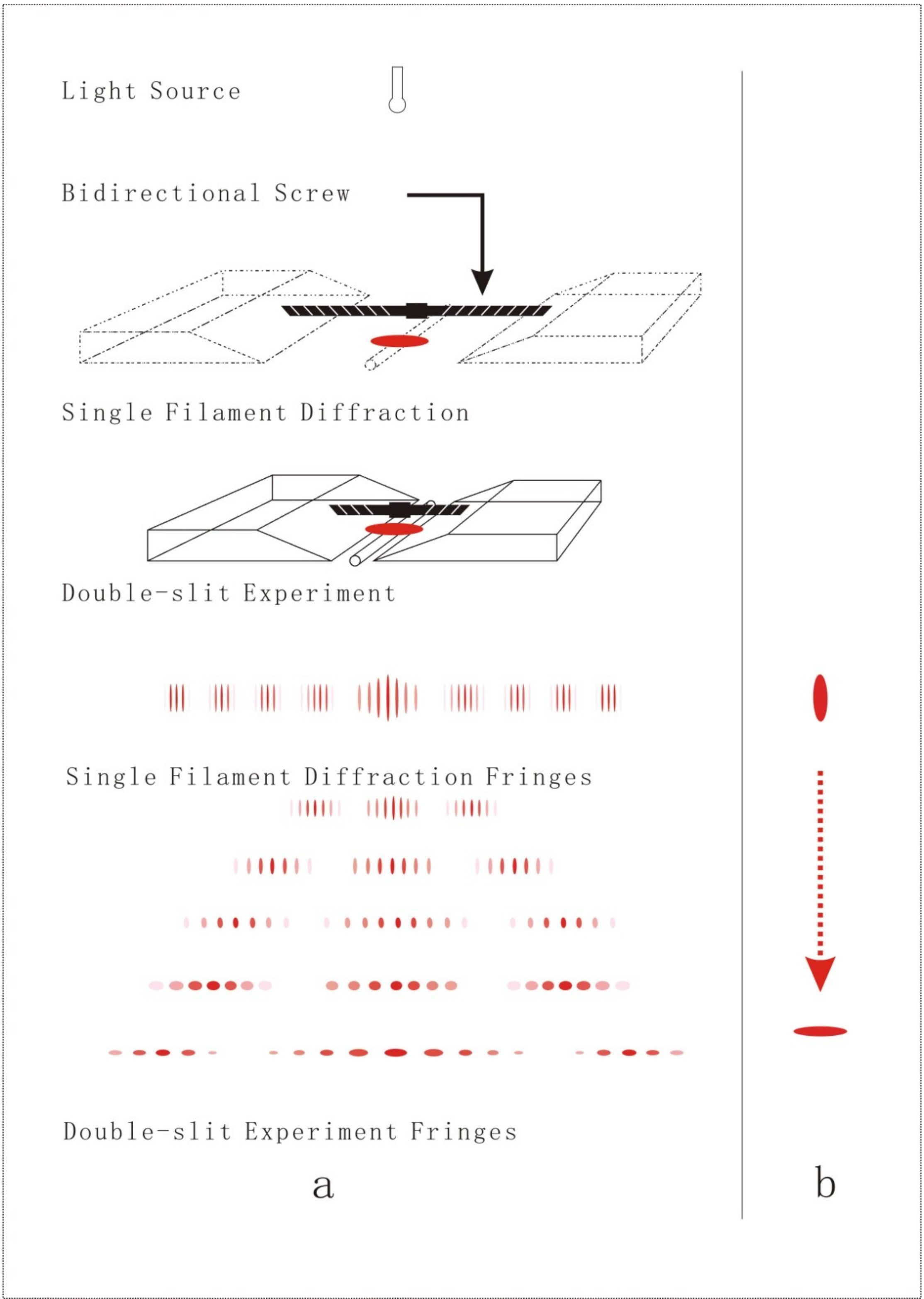


Figure 2

a. The evolution of the fringes from single-filament diffraction to the double-slit experiment.

b. The subfringes evolve from vertical ellipses to horizontal ellipses.

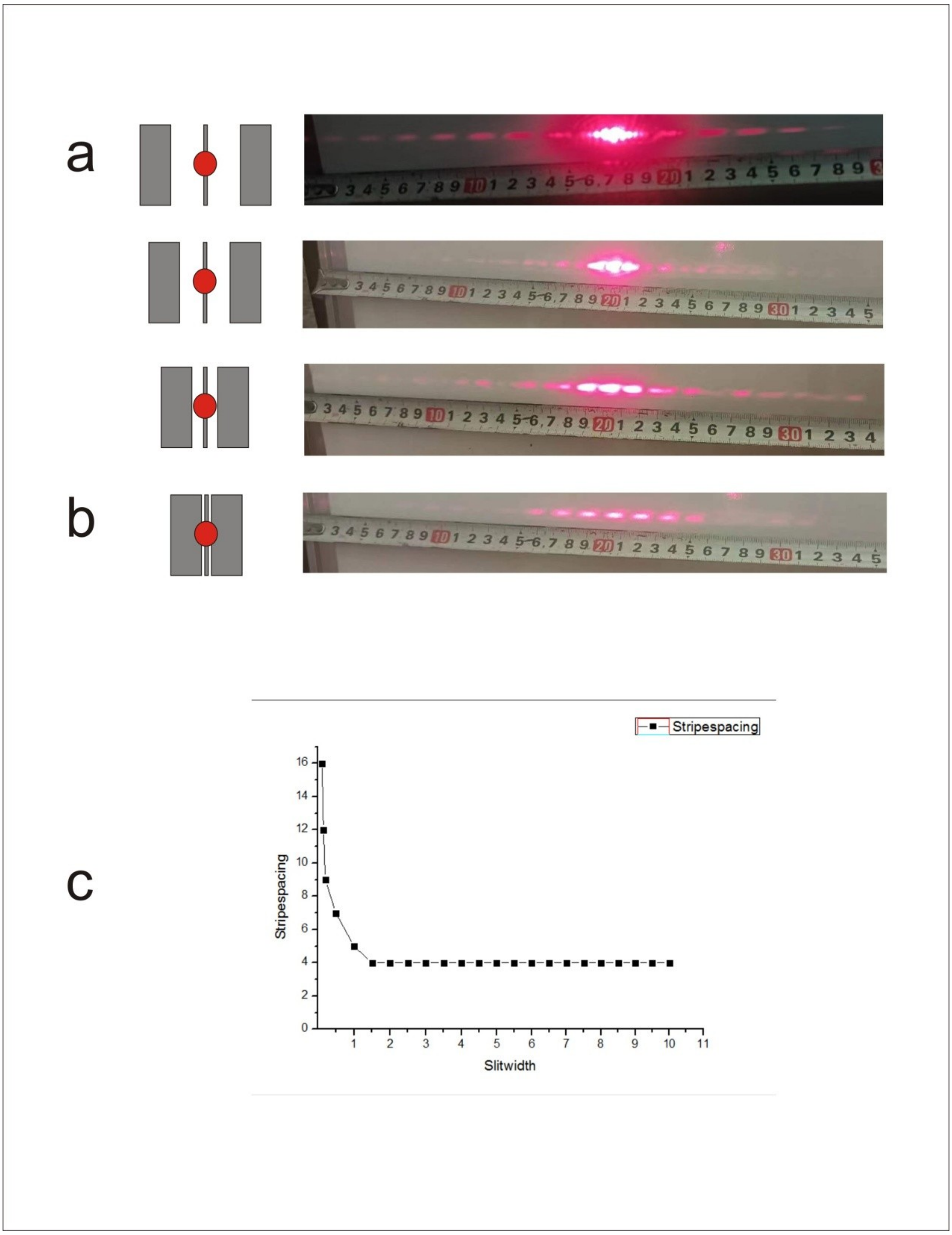


Figure 3

a. During the single-filament diffraction phase, as the double-slit width is reduced from 10 mm to approximately 1.5 mm, the fringe shape and spacing change insignificantly. The fringes consist of approximately 9 elliptical primary fringes with a spacing of approximately 25 mm. The k-0 order primary fringes can be clearly distinguished and contain approximately 6-7 bright secondary fringes, with a spacing of approximately 4 mm 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 double-slit experimental fringes. At a slit width of approximately 0.12 mm, approximately 3 sets of horizontal elliptical primary fringes can be observed, with a spacing of approximately 90 mm between them. The k-0 order primary fringes contain approximately 7 secondary fringes, with a spacing of approximately 12 mm between them.

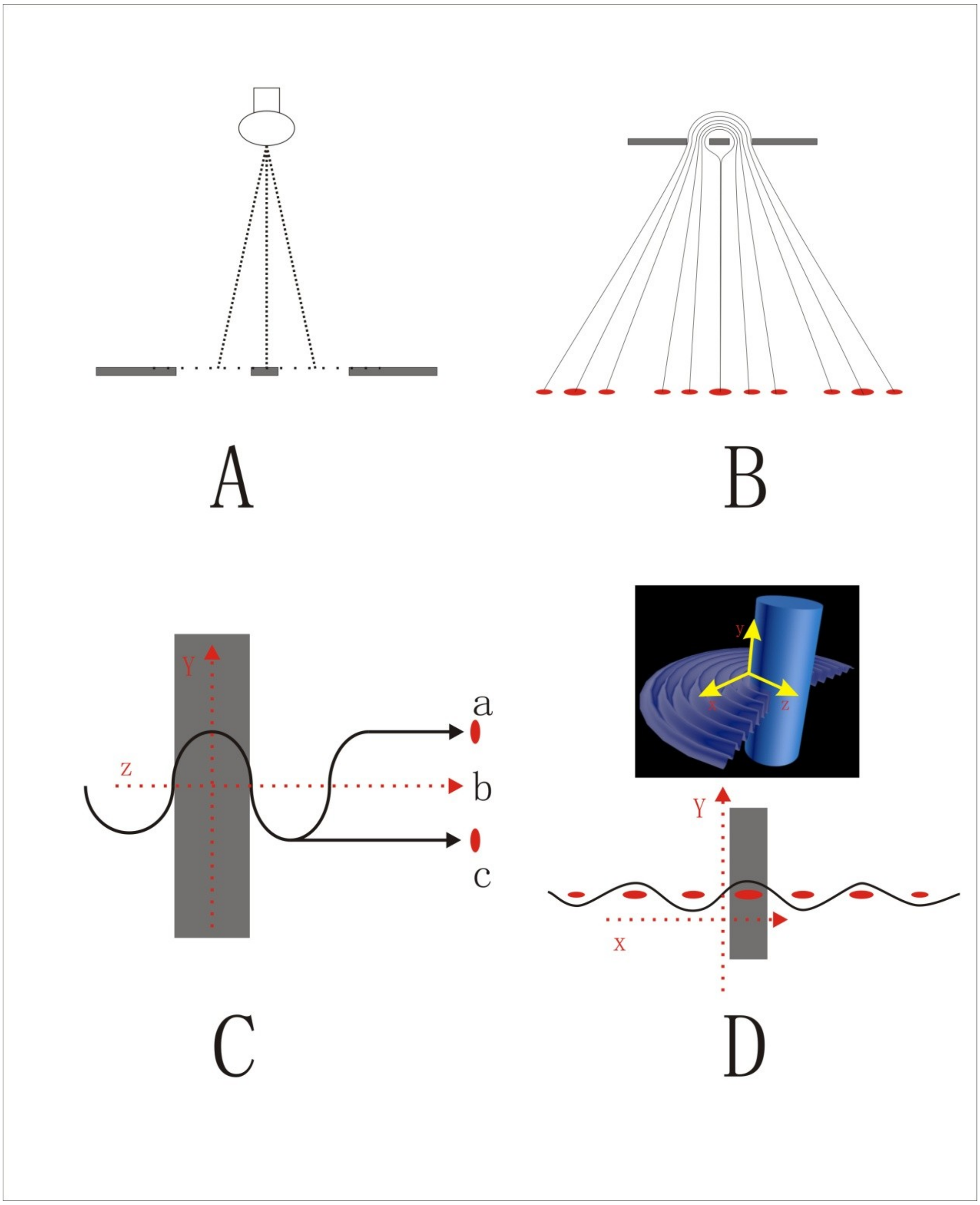
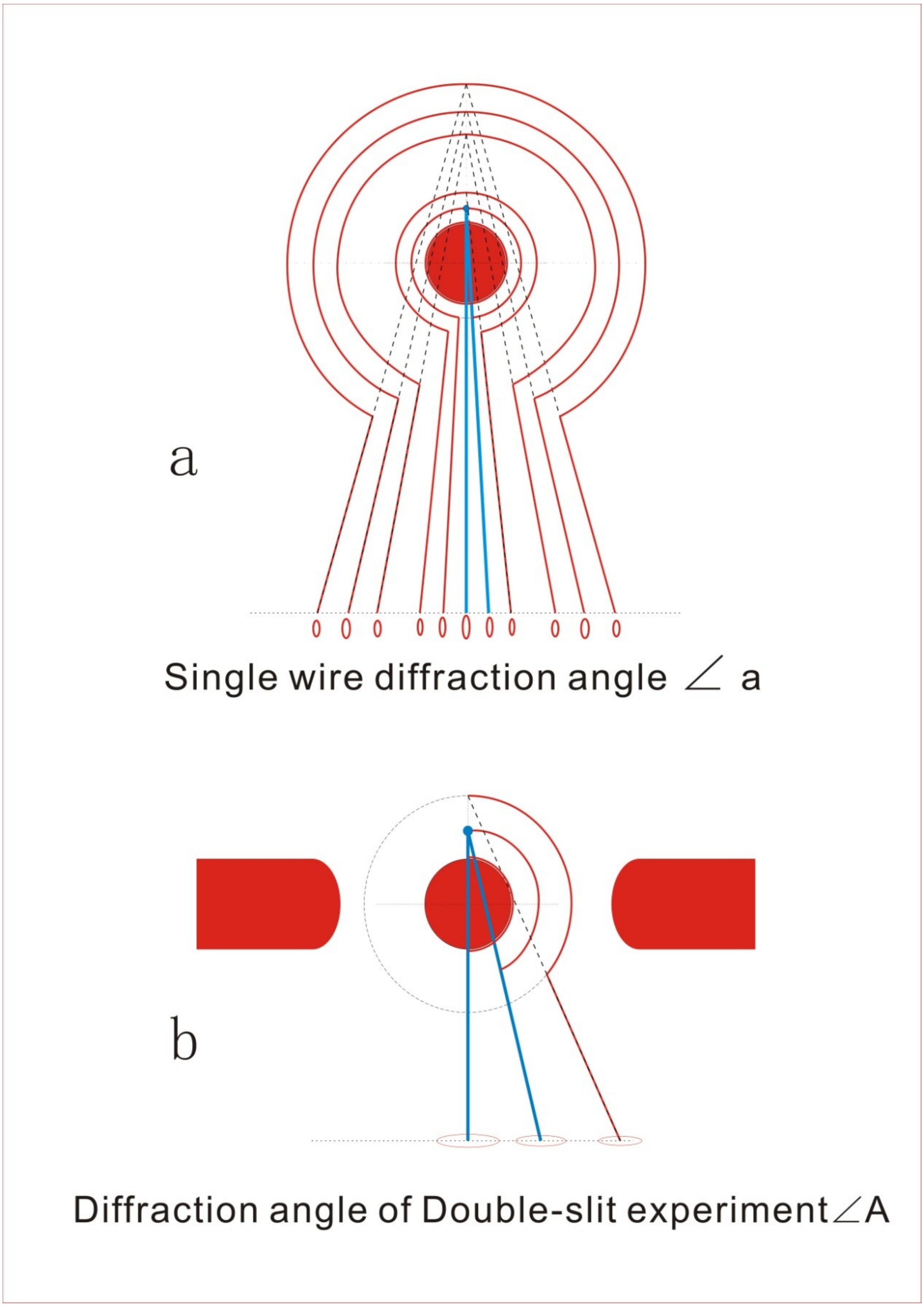


Figure 4

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 path along the hypotenuse. As a result, when light emitted from the source impinges perpendicularly to the midpoint of the double slits, photons initially encounter the central barrier separating the slits.

C. The curved spacetime formed by a single filament breaks the balance of the photon's path. To maintain 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 centripetal force, the photon forms a diffraction wave by repeatedly switching its trajectory.
D. Due to the presence of an obstacle along the x-axis, photons cannot swing left or right to achieve balance and thus can only swing up or 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 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 so-called dark fringes (C-b) because no photons fall in that region.



Single wire diffraction angle ∠ a

Diffraction angle of Double-slit experiment∠A

Figure 5

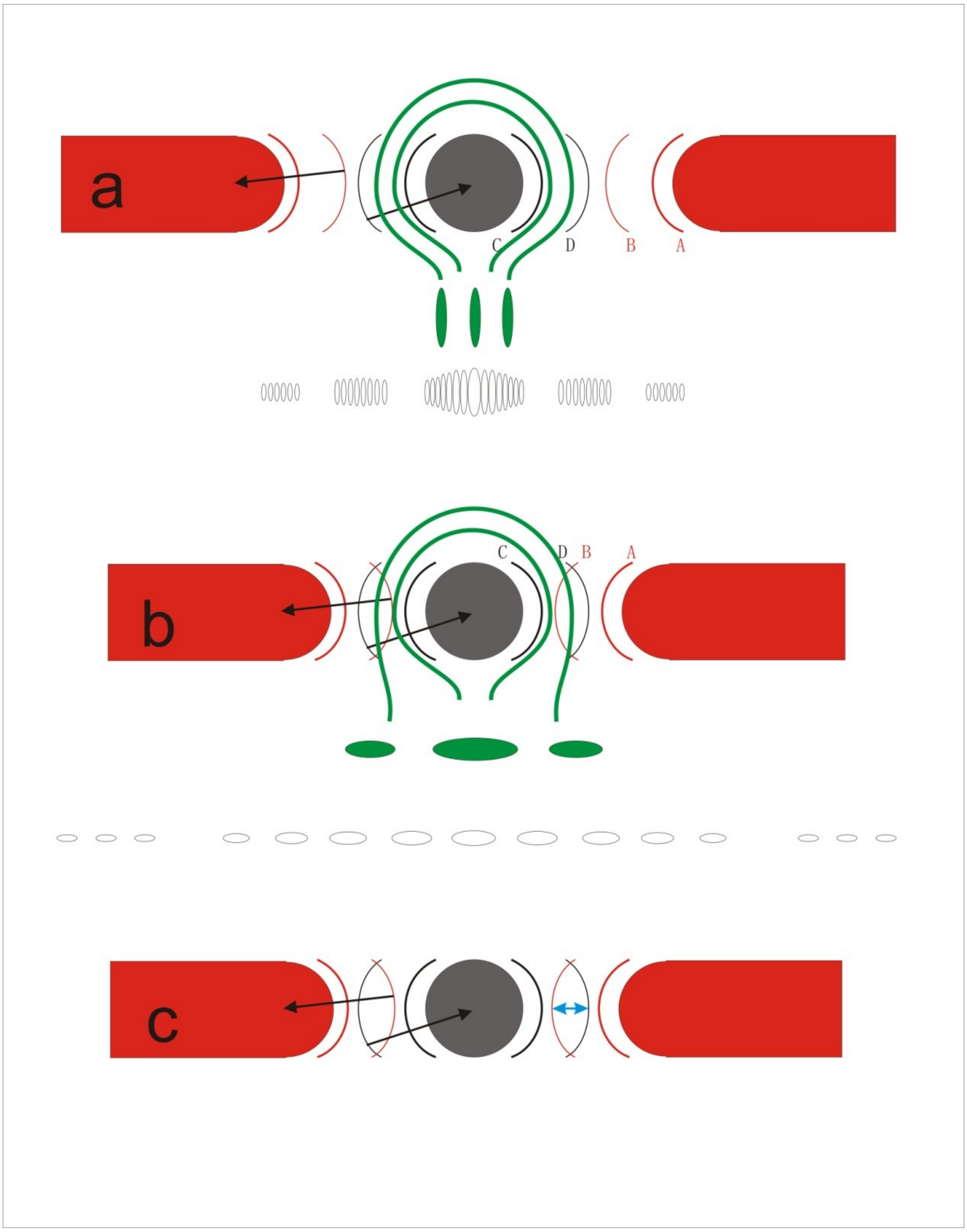


Figure 6

a. The curvature of spacetime decreases with increasing distance from the center of an object, resulting in a corresponding decrease in gravitational force. Conversely, the closer to the center of the object, the greater the curvature of the spacetime is, as is the gravitational force. Relative to that at the central barrier, the gravitational force at arc C is greater than that at arc D. In relation to the right barrier, the gravitational force at arc A is greater than that at arc B. The curvature of spacetime induced by the left and right barriers is directed toward 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 toward both sides of the double slit is applied to the photons (Figure 6b), stretching the subfringes 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 increase, and the spacing between the subfringes also increases, eventually transforming from single-slit diffraction fringes to double-slit experimental 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.

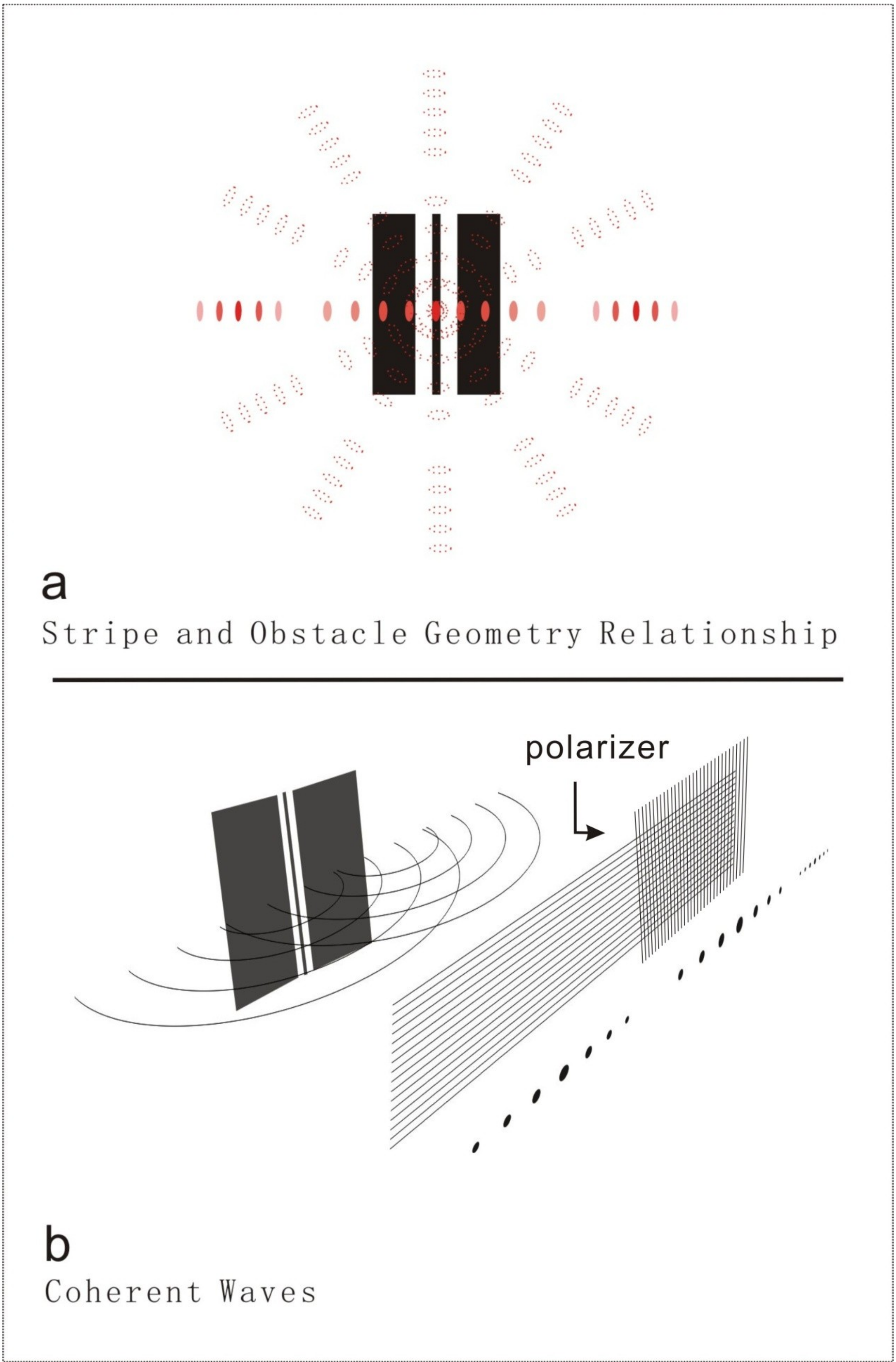


Figure 7

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 exist in only 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, 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, the propagation of the coherent waves will be blocked, and the fringes will disappear. If, as the author suggested, photons form diffraction waves at the incident surface of the central partition, then the photons will maintain their respective polarizations 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 where the brightness of the fringes decreases due to the obstruction of a single polarizer, and one region where the fringes disappear due to the obstruction of two mutually perpendicular polarizers.