

# Curved Interference Patterns—Novel Double Slit and Cross-double Slit Experiments (2)

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## Research Article

**Keywords:** double slit experiments, cross-double slit experiments, interference pattern, wave interpretation

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# Curved Interference Patterns

## ---Novel Double Slit and Cross-double Slit Experiments (2)

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**Abstract** Young's double slit experiments represent the mystery of quantum mechanics. To explore the mystery, varieties of the double slit and cross-double slit experiments were performed. In this article, we show novel phenomena that the interference patterns of the double slit/cross-double slit experiments can be curved.



The curvatures depend on the orientation of the diaphragms of the double slit/cross-double slit. Those experiments provide comprehensive data for developing/testing a theoretical model.

**Keywords:** double slit experiments, cross-double slit experiments, interference pattern, wave interpretation

**Declaration:** The author declares that there is no potential conflicts of interest

### 1. Introduction

Young's double slit experiment was performed in 1801 [1] [2], which, 100 years later, led to wave-particle duality. Feynman called it "a phenomenon [...] has in it the heart of quantum mechanics. In reality, it contains the only mystery [of quantum mechanics]" [3]. Moreover, the nature of photons truly puzzled Einstein. He wrote to M. Besso: "All these 50 years of conscious brooding have brought me no nearer to the answer to the question: What are light quanta?" [4].

Recently, to further explore the mystery, it has been shown that the photons' behaviors depend on the orientations of the diaphragms of the double slit and cross-double slit [5].

In this article, we study further the dependence of the interference patterns of the double slit/cross-double slit experiments on the orientations of the diaphragms. We show novel phenomena that the certain orientations lead to curved interference patterns.

## 2. Apparatuses

The experiments utilize a laser source, the diaphragms of the double slit (Figure 1a) and cross-double slit (Figure 1b), and a protractor (Figure 1c).

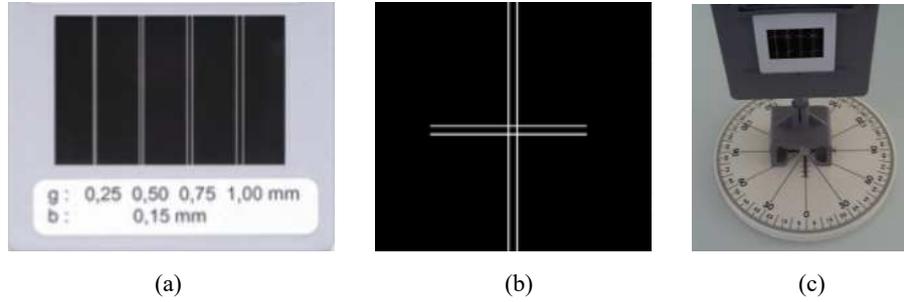


Figure 1 Apparatus

## 3. Curved Interference pattern of Double Slit Experiments

### 3.1. Rotating Discrete Angles Around Y-axis

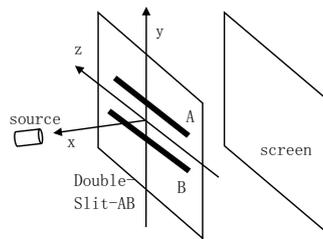


Figure 2 Schematic drawing of apparatus

**Experiment-1:** rotating the double slit-AB clockwise around Y-axis with different discrete angles,  $45^\circ$ ,  $60^\circ$  and  $75^\circ$ .

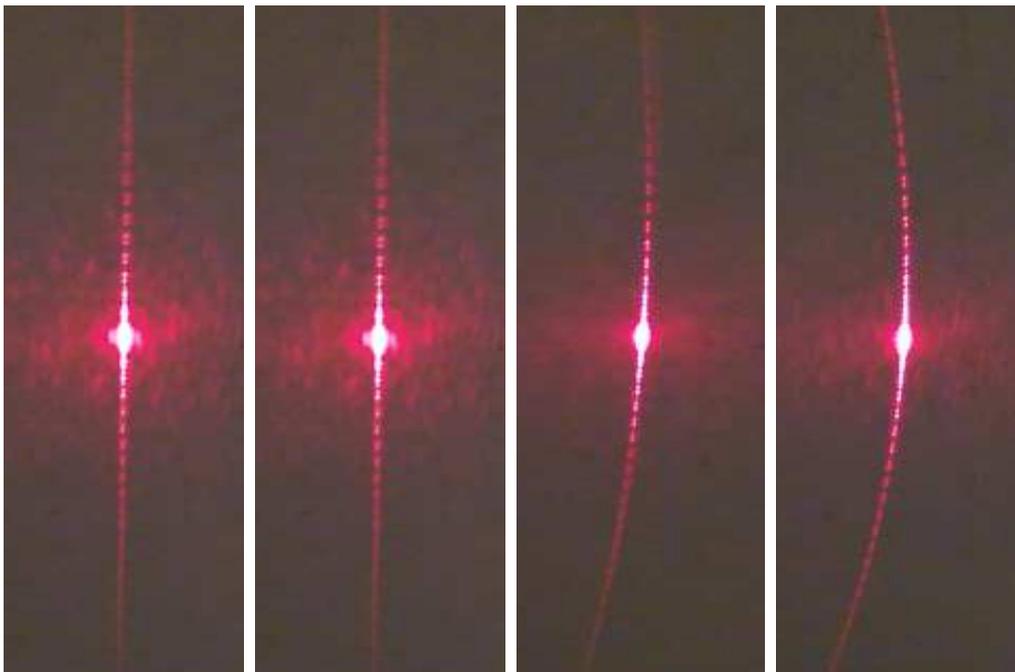


Figure 3a rotating  $0^\circ$

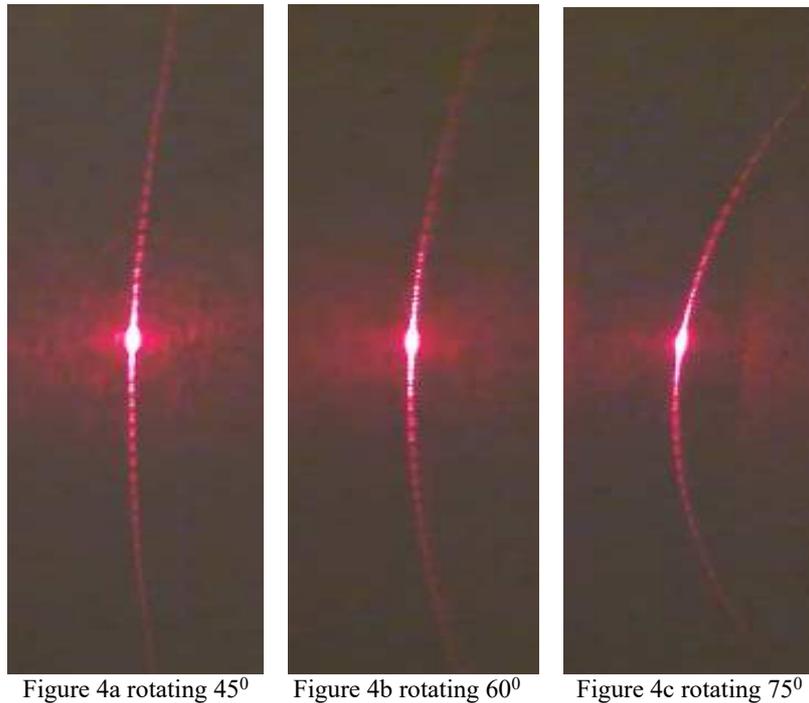
Figure 3b rotating  $45^\circ$

Figure 3c rotating  $60^\circ$

Figure 3d rotating  $75^\circ$

**Observation** (Figure 3): the larger the rotation angle, the more bending of the interference patterns.

**Experiment-2:** rotating the double slit counterclockwise with different discrete angles (Figure 4):



**Observation:** the interference patterns curve towards the side that is opposite to that of the curved interference pattern created by rotating the double slit clockwise.

### 3.2. Rotating Continuously

Let us start with placing the double slit at the position that the double slit rotates  $75^{\circ}$  counterclockwise. Turning on the laser source, we observed the curved interference pattern. Then start to taking video. Rotating the double slit clockwise continuously and the curved pattern continuously change. We reach a position that the laser light is perpendicular to the plane of the double slit and at that position, recorded the regular interference pattern. Then continuously rotating the double slit clockwise. The interference pattern starts to curve but to the opposite direction. See the Video.

## 4. Curved Interference pattern of Cross-Double Slit Experiments

### 4.1. Rotating Around Y-axis

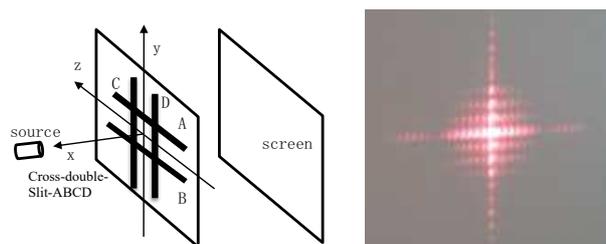


Figure 5 Schematic drawing of cross-double slit and its regular pattern

Note that the spacing between the double slit-AB is different with that of the double slit-CD. The schematic drawing in Figure 5 is not to scale.

**Experiment-3:** Rotating the cross-double slit-ABCD clockwise around Y-axis with different discrete angles.

**Observation** (Figure 6): (1) the fringes created by the double slit-CD is separated wider; (2) the interference pattern is curved towards left side.

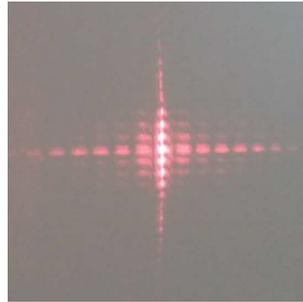


Figure 6 rotating  $75^{\circ}$  clockwise

**Experiment-4:** rotating the cross-double slit-ABCD counterclockwise around Y-axis with different discrete angles.

**Observation** (Figure 7): (1) the fringes created by the double slit-CD is separated wider; (2) the interference pattern is curved towards right side.

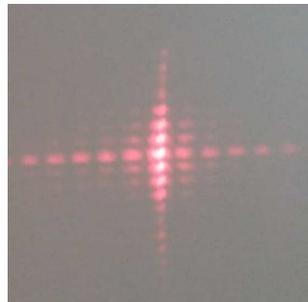


Figure 7 rotating  $75^{\circ}$  counterclockwise

Note that those phenomena have been shown in Figure 7 and Figure 20 of reference 5.

## 5. Summation

We show that the interference patterns of the double slit and cross-double slit depend on the orientation of the diaphragms. More specifically, the interference patterns are bended by rotating the diaphragms of the double slit and cross-double slit around Y-axis. It is a challenge to interpret the phenomena/experiments consistently.

The significances of the novel double slit and cross-double slit experiments are to disclose new phenomena and provide comprehensive phenomena/data for developing theoretical model to explore the mystery of the double slit experiments.

## References

### References

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## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [20210630evolutionofcurvedinterferencepattern.mp4](#)