Mystery Needing Theoretical Interpretation

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Abstract

Young's double slit experiment is the mystery of the quantum mechanics (Feynman). To explore the mystery, the double slit experiments have been extended to cross double slit experiments.

cross double slit

L = 20

L = 50 mm

L = 130 mm

L = 250 mm

L = 1200 mm

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In this article, we utilize the fact that each slit of the cross double slit (a double slit crossing a double slit) is divided into three segments by other two slits crossing, and experimentally show the function of each segment in producing both non-interference patterns (including Pre-Particle patterns, Particle patterns and Transition Patterns) and the Interference patterns by eliminate the segment and then, compare with the patterns of the standard cross double slit experiment. Although the non-interference patterns of different modified cross double slits are obviously different, the final interference patterns are surprisingly similar. This phenomenon needs a consistent theoretical interpretation, which would motivate the further development of optics. When applying the interference patterns of the cross double slit diaphragms, this phenomenon allows a tolerance on the defect of making the cross double slit diaphragm.

How Segments of Each Slit Affecting Non-interference Patterns and Interference Patterns in Double-Slit-Crossing-Double-Slit Experiments --- New Phenomenon/Mystery

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Abstract

Young's double slit experiment is the mystery of the quantum mechanics (Feynman). To explore the mystery, the double slit experiments have been extended to cross double slit experiments.

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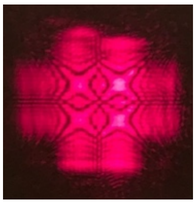
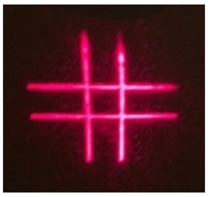
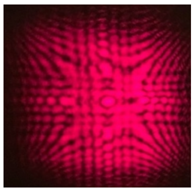
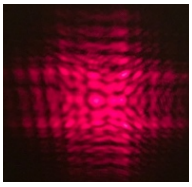
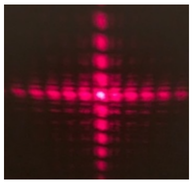
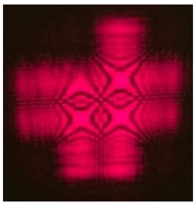
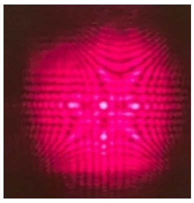
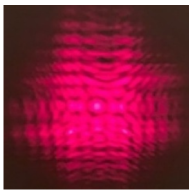
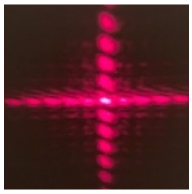
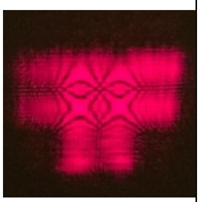
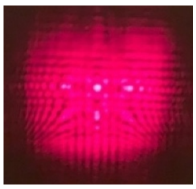
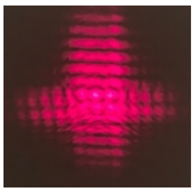
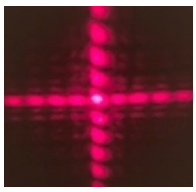
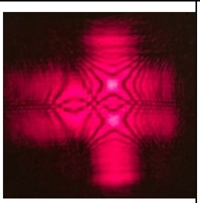
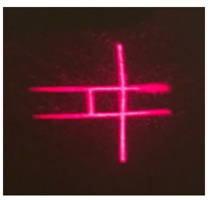
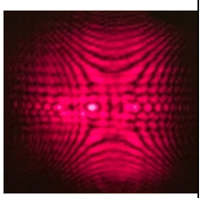
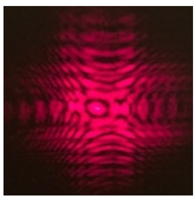
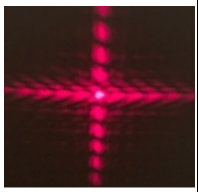
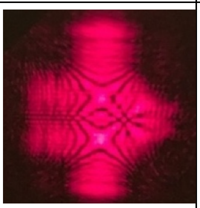
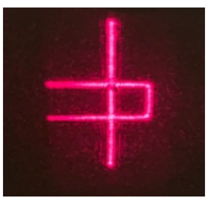
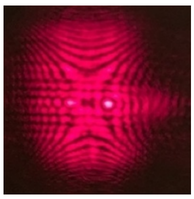
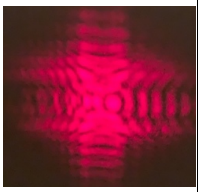
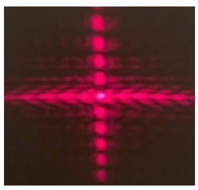
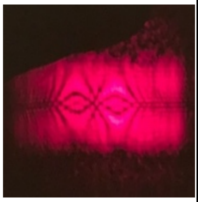
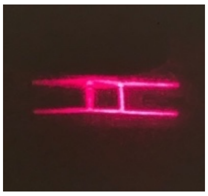
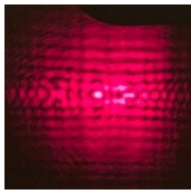
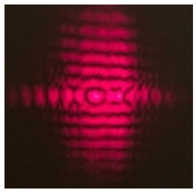
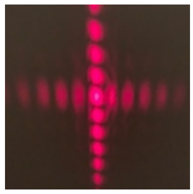
 Exp. A.1					
 Exp. A.2					
 Exp. A.3					
 Exp-A.4					
 Exp. A.5					

 Exp A.6					

In this article, utilize the fact that each slit of the cross double slit (e.g., one double slit crossing another double slit) is divided into three segments by other two slits crossing, we experimentally show the function of each segment of each slit in producing both non-interference patterns (including Pre-Particle patterns, Particle patterns and Transition Patterns) and the Interference patterns by eliminate the segments respectively and then, compare with the standard patterns of the cross double slit experiment. Although the non-interference patterns of different modified cross double slits are obviously different, the final interference patterns are surprisingly similar. This phenomenon is a new mystery and needs a consistent theoretical interpretation. In the case of applying the interference patterns of the cross double slit diaphragms, this phenomenon allows a bigger tolerance on the defect of making the cross double slit diaphragm.

Keywords: *double slit, cross double slit, non-interference patterns, particle patterns, pre-particle patterns, Transition patterns, Interference patterns, evolution of patterns, convex lens, Zone*

1. Introduction

Young's double slit experiment is the mystery of the quantum mechanics (Feynman). To explore the mystery, the double slit experiments has been modified, and extended to the double-slit-crossing-double-slit (referred as cross double slit) [1-3], and then, the evolution of the non-interference patterns to the interference patterns is shown [4-7].

In this article, we utilize the fact that each slit of an orthogonal cross double slit is divided into three segments. In each modified cross double slit, at least one segment is absence. Then to check the function of each segment in producing both non-interference patterns and the interference patterns, we study the evolution of the patterns of each modified cross double slit and then, compare the patterns with correspond patterns of the standard cross double slit. We show: (1) the non-interference patterns (in Zone-1-1, Zone-1-2 and Zone-2) of different modified cross double slit experiments are tremendously different by eliminate, at least one segment, in each modified cross double slit; (2) each modified cross double slit produces an interference pattern in Zone-3; (3) those interference patterns are similar.

2. Experimental setup

2.1. Modified orthogonal cross double slit

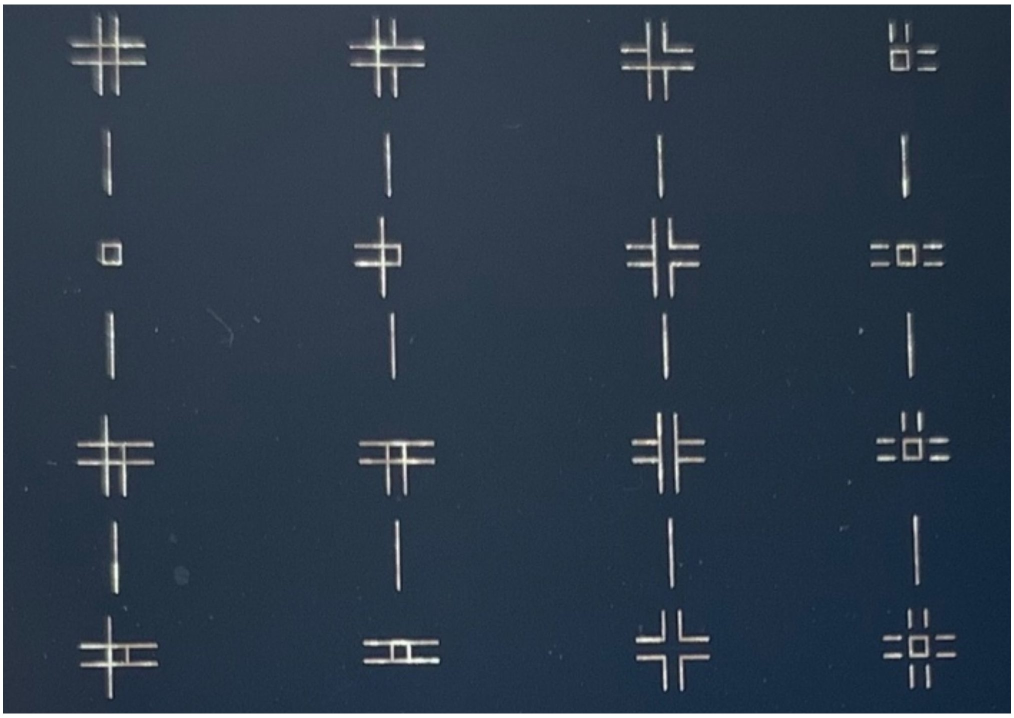


Figure 2.1. Diaphragm of modified cross double slit

Figure 2.1 shows the modified cross double slits we utilized in this article.

2.2. Laser beam illuminating cross double slit

The diameter of the laser beam (shown by the red circle) is slightly bigger than the center section of the cross double slit (Figure 2.2).

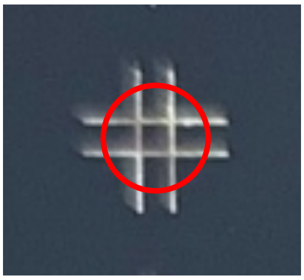


Figure 2.2. Laser beam illuminating cross double slit

2.3. Zones

The patterns are distance dependent. To show the pattern-evolution, we divide the space between the diaphragm of the double slit/cross double slit and screen into four Zones (Figure 2.3).

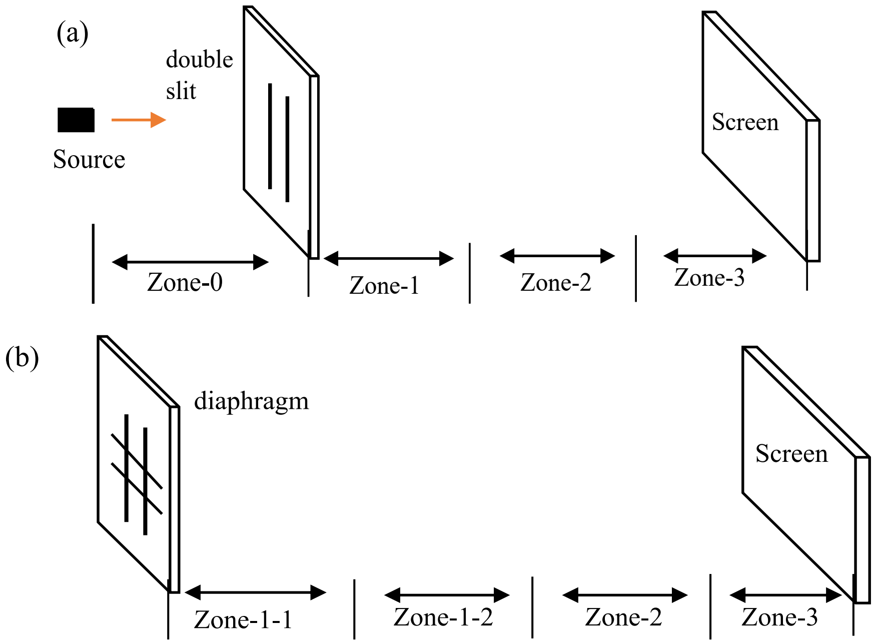


Figure 2.3. Four Zones

(0) **Zone-0**: between the source and the double slit, in which the pattern is non-wave (Figure 2.3a);

(1a) **Zone-1** (Figure 2.3a): for describing the single slit experiments, the double slit experiments, multi-slits experiments, and 1D grating experiments (in which, all slits are parallel to each other), Zone-1 is near the double slit, in which the pattern is the image of the slits, i.e., *non-interference*, and is referred as P***article pattern***;

(1b) **Zone-1-1 and Zone-1-2** (Figure 2.3b): for describing the cross double slit, and 2D grating experiments (in which, all slits are cross to each other), we divide Zone-1 into two sub-Zones, Zone-1-1 and Zone-1-2; the patterns are *non-interference in both sub-Zones*;

In Zone-1-1, the patterns are referred as ***Pre-particle pattern*****;** in Zone-1-2, the patterns are referred as ***Particle pattern*** that is the same as that for the double slit experiments in Zone-1**;** For simplicity, we still call Zone-1-1 and Zone-1-2 as Zone-1;

(2) **Zone-3**: near the screen, in which the patterns are ***Interference patterns***;

(3) **Zone-2**: transition Zone, between Zone-3 and Zone-1 or Zone-1-2, in which Particle patterns gradually evolves to Interference patterns, referred the patterns as ***Transition patterns*** that are also the non-interference pattern.

2.4. Postulates of convex lens utilized in wave experiments

The theory of convex lens is a part of the geometrical optics. In standard Textbook, the theory of the convex lens is directly applied to the wave experiments of the physical optics.

Utilizing a convex lens to study the evolution of patterns, we propose new Postulates of convex lens [8]. In the classical wave experiments, the diaphragm stays at the same location. The light coming out the slits has the certain pattern. But we have shown that the pattern changes with the distance from the diaphragm.

To study the evolution of the patterns, the convex lens moves between the diaphragm and the screen and thus, the patterns arriving at the input surface of the convex lens change. Namely, the light patterns arriving at the input surface of the convex lens are different. Based on above consideration, we suggest the postulates.

Postulates: Experiments in this article are based on Postulates and confirm them.

(1) the convex lens enlarges the input image that arrives at the input surface (Figure 2.4).

(2) The convex lens breaks the evolution of the patterns.

(3) The convex lens does not change the nature of the input pattern.

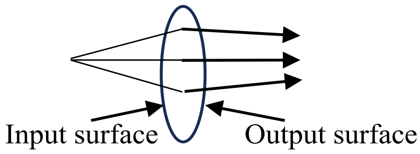


Figure 2.4. Convex lens

Example-1: for a regular object, the shape of the image of the object does not change. Thus, the input image, that arrives at the input surface of the convex lens, is the same image of the object.

Example-2: for the wave experiments, for example, the double slit experiment, the input image that arrives at the input surface of the convex lens is the pattern that is distance-dependent and thus, the shapes of the input images are different, even in the same experiment.

Example-3: After passing a convex lens, the patterns keep the same nature: e.g.,

(a) if the input patter is a particle pattern, the output pattern is still the particle pattern, and vice versa;

(b) if the input patter is a transition pattern, the output pattern is still the transition pattern, and vice versa;

(c) if the input patter is an interference pattern, the output pattern is still the interference pattern, and vice versa.

2.5. Experimental setup (Figure 2.5)

We use the same experimental setup for all of experiments, Experiment-1 to Experiment-16: Placing the lens between the diaphragm and the screen at difference distance L from the diaphragm.

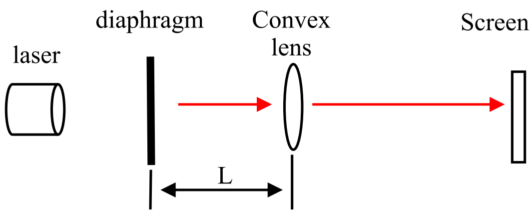


Figure 2.5. Experimental setup

Where, L = 10 – 1200 mm; the distance between the diaphragms to the screen is 1700 mm. The focal length of the convex lens is 50 mm.

3. Summary of Experiments

With the experimental setup (Figure 2.5), we report 16 experiments of different modified double-slit-crossing-double-slit (Figure 2.1, referred all as modified cross double slit, except the one at the up-left corner). In this section we present the summary table to compare the different modified cross double slit experiments, their non-interference patterns (including the pre-particle patterns, particle patterns and transition patterns), and interference patterns. The different experiments show different patterns, which suggest the functions of each segment.

In the Table we only compare the non-interference patterns (at certain L as shown) and the interference patterns (at L = 1200 mm) of different experiments.

Table: Summary of Patterns of Experiments

<table>
<tr><th>Modified cross double slit</th><th>Pre-particle patterns: Zone-1-1 (e.g., L = 20 mm)</th><th>Particle patterns: Zone-1-2 (e.g., L = 50 mm)</th><th>Transition Patterns: Zone-2 (e.g., L = 130)</th><th>Transition Patterns: Zone-2 (e.g., L = 250)</th><th>Interference patterns: Zone-3 (L = 1200 mm)</th></tr>
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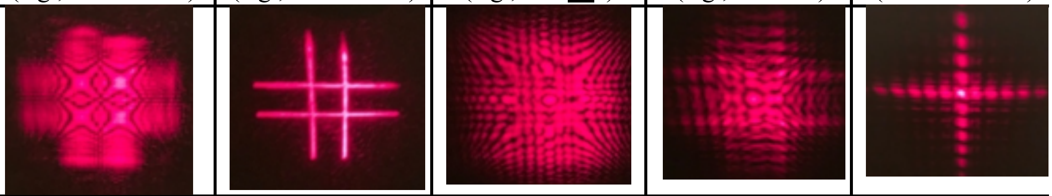
Exp. A.1</td><td colspan="5"></td></tr>
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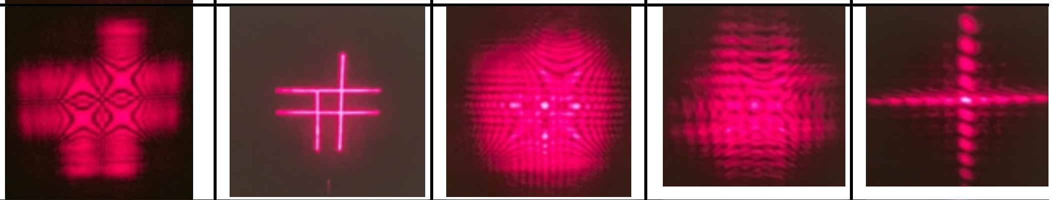
Exp. A.2</td><td colspan="5"></td></tr>
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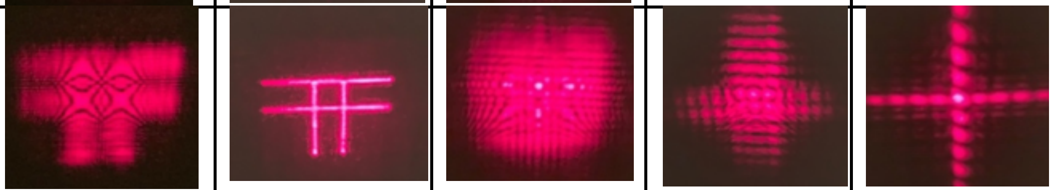
Exp. A.3</td><td colspan="5"></td></tr>
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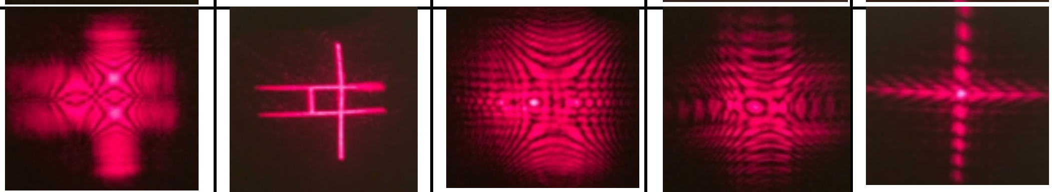
Exp-A.4</td><td colspan="5"></td></tr>
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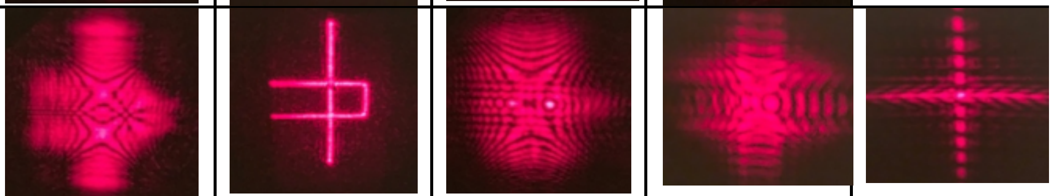
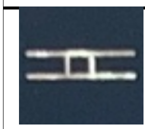
Exp. A.5</td><td colspan="5"></td></tr>
<tr><td>
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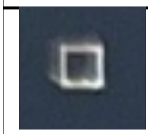
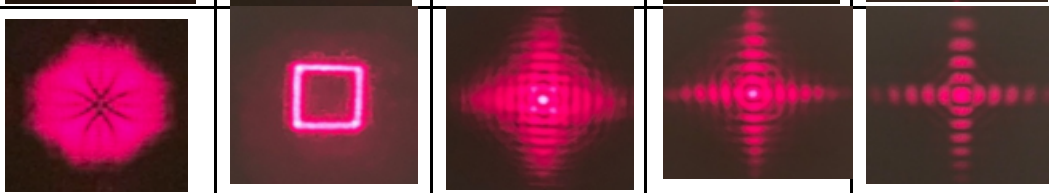
<tr><td>
Exp A.7</td><td colspan="5"></td></tr>
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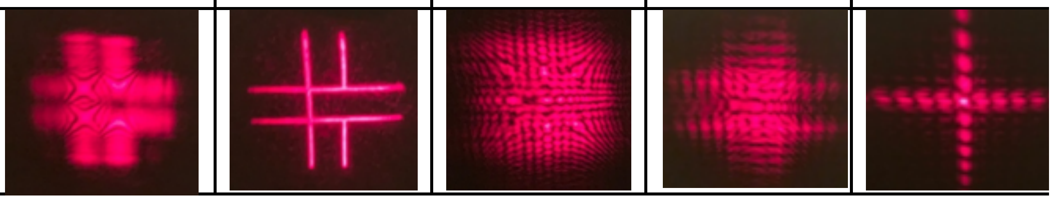
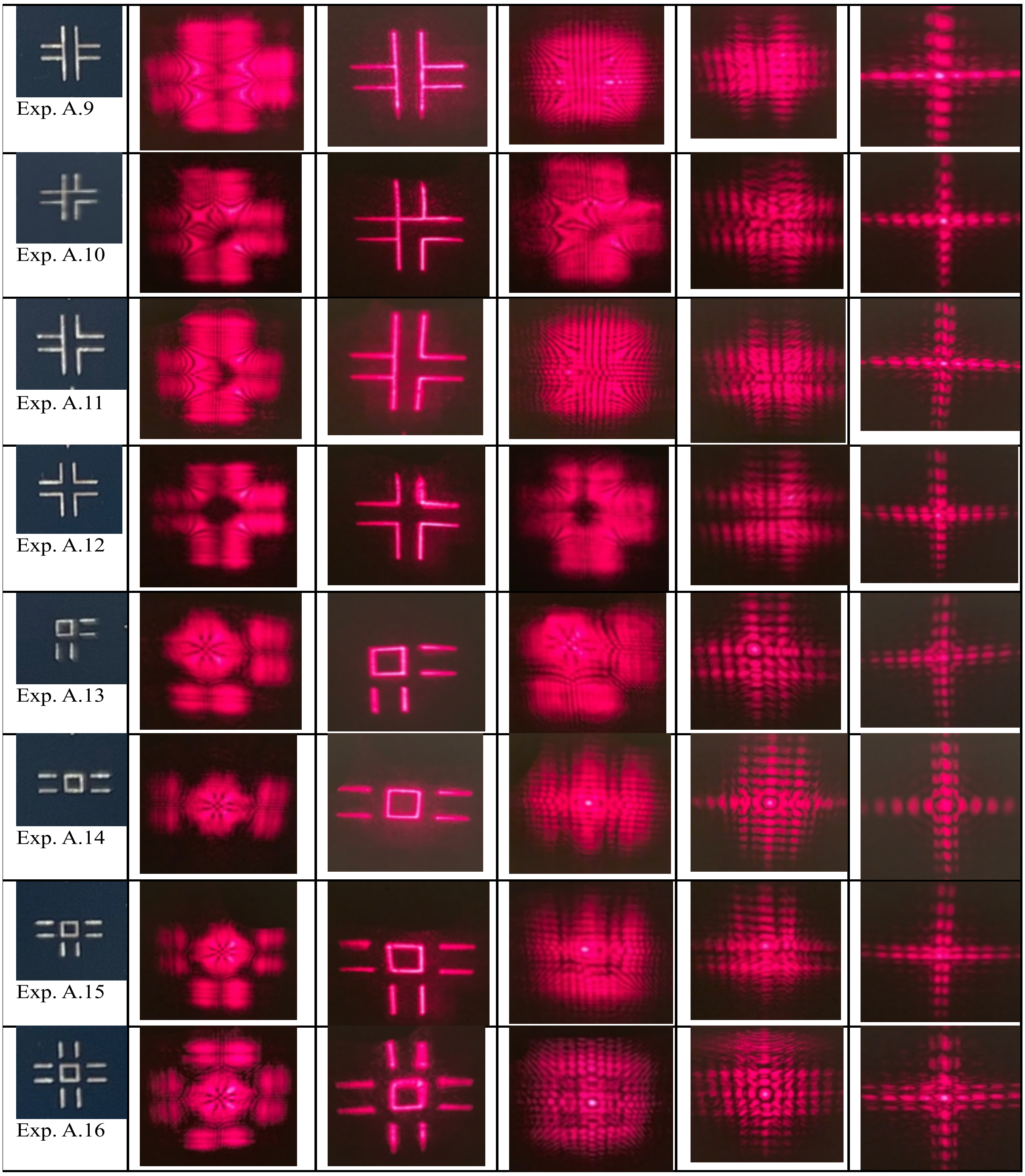
Exp. A.8</td><td colspan="5"></td></tr>
</table>



4. Conclusion

For different modified cross double slit experiments, the Pre-Particle patterns, the Particle patterns and the Transition Patterns are obviously different from the correspond standard patterns of the cross double slit experiment, however, the Interference patterns are quite similar.

This phenomenon requires a consistent theoretical interpretation.

When apply the interference patterns of the cross double slit diaphragms, this phenomenon allows a tolerance on the defect of making the cross double slit.

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