

Interference + Diffraction Hybrid Patterns of Novel Double Slit Experiment — Interference Pattern Embedding in Diffraction Pattern

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Abstract

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It is a challenge to theoretically interpret/describe.

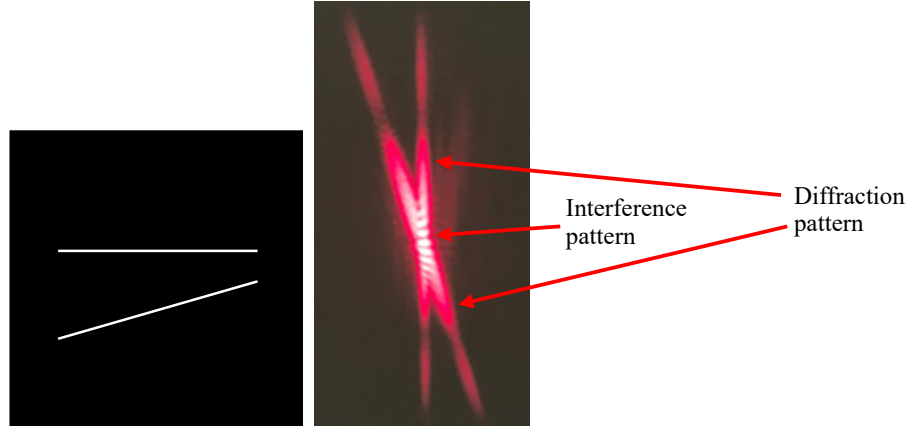
Interference + Diffraction Hybrid Patterns of Novel Double Slit Experiment

--- Interference Pattern Embedding in Diffraction Pattern

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The interference and diffraction are two fundamental phenomena in optics. The patterns evolution phenomena have been shown for the interference and diffraction experiments respectively. In this article, we show for the first time the novel patterns, the Interference + Diffraction Hybrid Patterns of the novel double slit experiment, namely the interference pattern embedded in diffraction patterns. We also show how the patterns evolve, i.e., how the Interference + Diffraction Hybrid Patterns are formed.



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Keywords: interference pattern, diffraction pattern, double slit, pattern evolution, particle pattern, transition pattern

1. Introduction

The interference and diffraction are two fundamental phenomena in optics.

The two slits of the standard double slit are parallel.

Recently, the pattern evolution phenomena have been shown, such as the non-interference patterns evolving to the interference patterns in the double slit/cross double slit experiments [1], and the non-diffraction patterns evolving to the diffraction patterns in single slit/cross single slit experiment [2].

In this article, we (1) propose/perform a novel double slit experiment, in which the two slits are not parallel, and observe for the first time the novel Interference + Diffraction Hybrid Patterns; (2) show how the Particle patterns evolving to the Interference + Diffraction Hybrid Patterns.

The phenomenon is the challenge to interpret theoretically.

2. Experiment setup

2.1. Non-parallel double slit

In the standard double slit experiments, the two slits are parallel. In this article we use a non-parallel double slit. The angle between two slits is 17.5° as show in Figure 1.

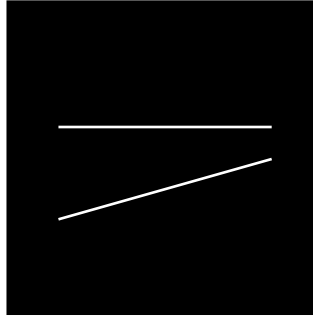


Figure 1. Non-parallel double slit

For studying the evolution of the patterns by utilizing convex lens, we adopt three Postulates on the convex lens:

Postulates:

- (1) the convex lens enlarges the input image that arrives at the input surface;
- (2) The convex lens breaks the evolution of the patterns;
- (3) The convex lens does not change the nature of the input pattern.

The Postulates have been confirmed experimentally [1,2].

2.2. Experimental setup

The experimental setup is shown in Figure 2. The lens is placed at 10 mm to 1400 mm, $L = 10 - 1400$ mm, from the novel double slit. The screen is 1700 mm from the double slit.

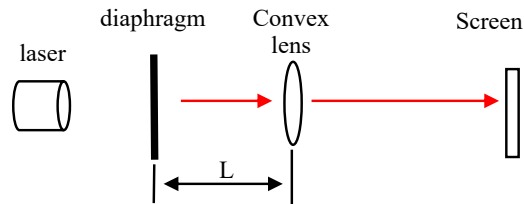


Figure 2 Experimental setup

3. Experiments

The experiment contains two steps.

First step: utilizing the experimental setup in Figure 2, but without the lens. We observe the novel pattern (Figure 3):

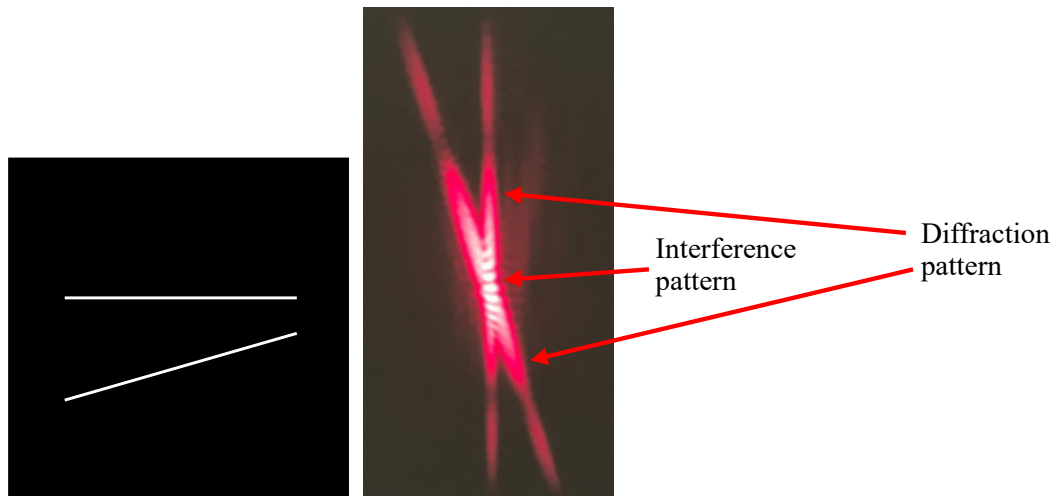


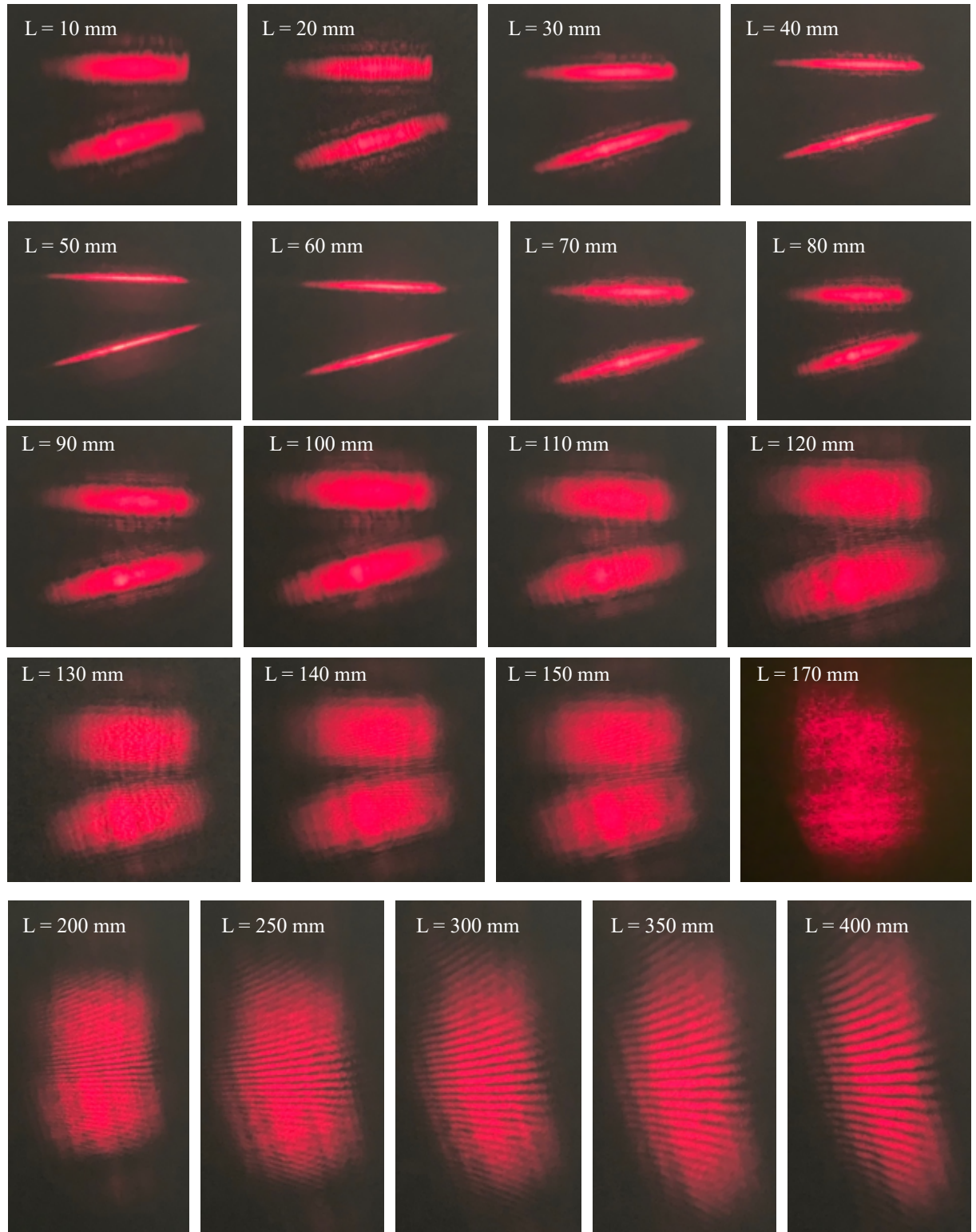
Figure 3. Novel pattern: interference pattern embedded in two diffraction patterns

Observation: The interference pattern is embedded in the two diffraction patterns; we referred the pattern as the

Interference pattern + diffraction hybrid pattern. Two slits produce two diffraction patterns respectively as they are independent single slit. While two slits produce the interference pattern as they are forming the double slit.

The mysterious phenomenon is that the interference pattern is embedded in the two diffraction patterns.

Second step: to study how this phenomenon takes place, let us study the pattern evolution by utilizing the experimental setup in Figure 2 with the lens.



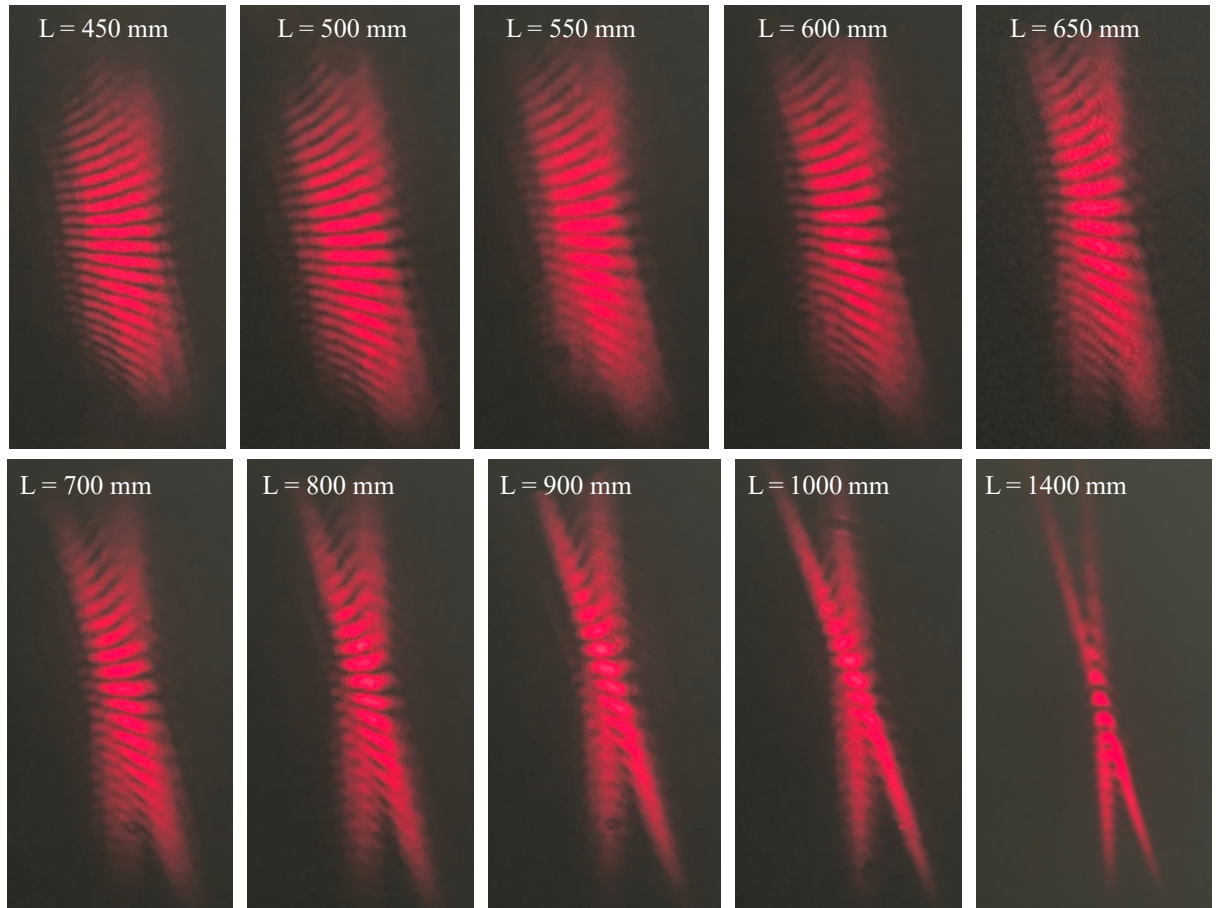


Figure 4. Pattern evolution: from Particle Patterns to Interference + Diffraction Hybrid Patterns

Observation: Figure 4 shows the pattern evolution. The patterns are the Particle patterns, when the lens is placed at $L = 10 - 150$ mm. For the lens at $L = 170 - 700$ mm, we call the patterns as the Transition patterns. When the lens at $L \geq 800$ mm, the patterns are the Interference + Diffraction Hybrid Patterns.

4. Discussion and conclusion

We propose the non-parallel double slit, and perform the experiments. We observed for the first time the phenomenon that the interference pattern is embedding in the diffraction patterns, referred as the Interference + diffraction hybrid patterns.

The challenge is to interpret physically and describe mathematically the phenomenon.

Acknowledgement

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Reference

- [1] Hui Peng, "Photoelectric Effect to Photowaves Phenomena --- New Phenomena Requiring Interpretation". TechRxiv. Preprint. <https://doi.org/10.36227/techrxiv.22659172.v1> April 2023
- [2] Hui Peng, "Non-Diffraction Patterns Evolving to Diffraction Patterns in Classical Wave Experiments --- New Challenge". Optica Open. Preprint. <https://doi.org/10.1364/opticaopen.24282667.v1> Oct. 2023.