

## A NEW VIEW OF THE PROCESS OF LIGHT DIFFRACTION.

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### ABSTRACT

Based on empirical studies, we show that the "diffractive-interferential" images produced in laser light experiments are generated by a completely unknown, non-wave phenomenon. We show that the phenomenon is generated by barriers that create the slits. Presumably, the mechanism of this phenomenon is related to the scattering caused by collisions of photon beams with strange spatial structures of physical fields of a strange nature and which are generated by charged particles of the barrier's atomic lattice. We indicate the probable mechanism of the physical phenomenon corresponding to these scatterings. We hypothesize that the same phenomenon also gives rise to the characteristic quantum discreteness of the microscale, and that further, more detailed empirical and theoretical investigation of this phenomenon will lead to the necessity of implementing significant changes in fundamental concepts of physics.

**Keywords:** diffraction, spatial discreteness, strange field.

### Introduction

The 20th century began with the notion that the "Luminiferous Aether" did not exist and that light could not be a propagation of vibrations in an "Aetheric Medium" by a wave mechanism. In the new physical conception, in which light was declared a stream of corpuscular photons, it was necessary to somehow combine the wave and corpuscular nature of light, because the so-called "diffraction-interference" patterns characteristic of light had not disappeared anywhere. This was achieved by introducing the principle of "Corpuscular-Wave dualism," but in quantum mechanics, the wave nature was attributed not to the quantum objects themselves as an intrinsic property, but to the probability amplitudes introduced to describe the statistical outcomes of events in which these quantum objects participate. The most popular version of this quantum phenomenology is considered to be the theoretical model proposed by R. Feynman and co-authors, which was introduced into the discussion based on the analysis of thought experiments [1]. This version also acquired the status of a principle of quantum mechanics.

The arguments for the quantum-mechanical and classical versions of the representations were critically examined by us in [2], and we expressed our view in the form of an assertion: Versions

based on the principle of "wave-particle" dualism are in contradiction with empirical facts. In this regard, the comment by Louis de Broglie - the author of this "dualism" idea, is very interesting. We found it in the Russian translation of the French book "Sur les Chemins de la science." [3]:

"... thus, in all its breadth, in all physical phenomena, the exciting problem of the duality of waves and particles was posed. Despite the elegance of the mathematical apparatus with which it was clothed, it is doubtful that we have reached a complete solution to it. Reflecting on this problem throughout my life, I have come to the conclusion that the way in which this association of waves and particles can be rationally understood is not entirely clear. Its understanding undoubtedly remains one of the most important future tasks for theoretical physics."

We agree with the spirit of the comment cited here and, based on phenomenological studies of simple empirical facts, we assert: The explanation of the essence of the physical phenomenon corresponding to the "interferential-diffractive" images produced by streams of photons remains an unresolved issue.

The aim of our study is to determine which physical phenomenon in the photonic representation of light could correspond to the formation of these images.

## **Chapter I - Statement of the Problem.**

To address the essence of the task, it will be necessary to first define the meanings of two frequently used terms. For the terms "interference" and "diffraction," we will use the meanings by which they were introduced to describe optical processes:

1: **"Diffraction"** originates from the 17th-century New Latin *diffractiō* ("a breaking to pieces"), coined by the Italian scientist Francesco Maria Grimaldi to describe light breaking into different directions around obstacles. It derives from the Latin *diffringere* ("to break apart"), formed by *dis-* ("apart") and *frangere* ("to break"). **Coined in Physico-mathesis de lumine (1665) by Francesco Maria Grimaldi.** [4]

2: **"Interference"** originates from the mid-15th century *enterferen* (later *interferere*), derived from Old French *entreferir*, meaning "to exchange blows, strike each other," from Latin *inter-* ("between") and *ferire* ("to strike"). In the early 1800s, it was applied to physics, popularized by Thomas Young in 1801. [5]

These specified meanings of the terms are in full accordance with the images obtained by passing narrow beams of light generated by simple laser devices through linear cuts. Many such images and corresponding videos can be found on open platforms of the electronic space, and therefore, we will only point to images that help us understand the essence of our specific task. Let's begin the discussion with the following images:



Fig.1

The image in Fig.1a represents a simulation of the physical circumstance in which a laser beam strikes a vertical slit created by two rectangular iron barriers. The diameter of the circular cross-section of the real beam was approximately 2 mm, while the width of the slit opening was 0.3 mm. Only the central portion of the beam passed through the slit opening, while the right and left portions struck the surfaces of the barriers and could no longer continue moving. We call this form of beam collision interferential. The image in Fig.1b is obtained on a IWB screen that is parallel to the surfaces of the large faces of the barriers and is distanced 20 m from them. If we rotate the construction of the barriers such that the surfaces of the large faces remain in the same plane, we will observe that — at whatever angle we rotate the line of the slit opening, the axis of arrangement of the bright spots rotates by the same angle. This axis always remains perpendicular to the linear direction of the slit boundaries. That is, the diffraction phenomenon corresponds to a fixed "axis of spatial polarization."

The facts described here allow us to propose the following: The spatially discrete set of bright spots depicted in Fig.1b may be generated by the phenomenon of the appearance of diffracted photon streams of the laser beam, as simulated in Fig.2a:

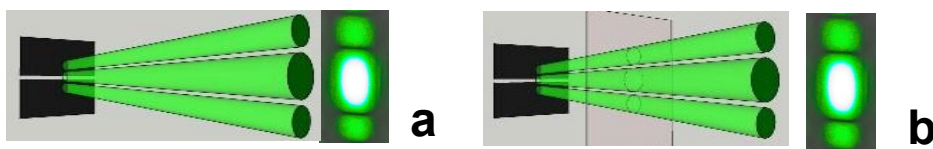
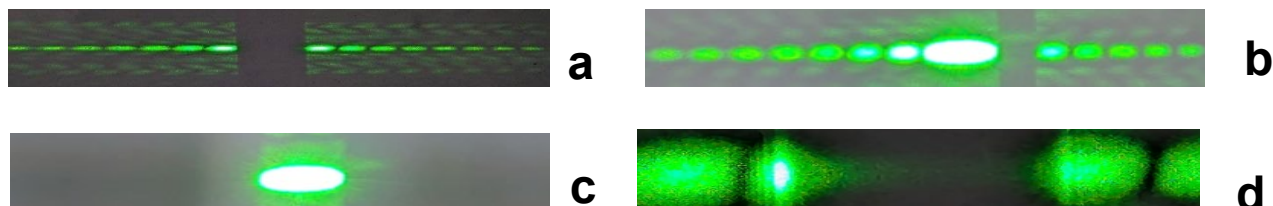


Fig.2

And that this is indeed the case is proven by simple experiments: A large piece of thin glass, parallel to the screen surface, is placed halfway between the IWB screen and the slit — 10 m from the slit, as simulated in Fig.2b. A similar multitude of spots will appear on the glass surface, identical to those that appear on the IWB screen. The linear sizes of these spots will be approximately half of those on the IWB screen. If this piece of glass is moved even closer to the slit, the linear sizes of the spots will be reduced even further. This fact suggests that the diffracted stream of the laser beam emerging from the slit may indeed have the form of conical streams, as is simulated in Fig.2a. A more convincing verification of this fact is achieved by the following experiments: to the images of spots outlined on the glass surface, we superimpose blocking barriers of corresponding sizes, so that this barrier completely blocks the corresponding



currents from the desired spot, or a certain multitude of them, while at the same time not affecting other spots. Let us observe how the diffraction patterns of bright spots on the surface of the IWB screen change. Below, we show an image for several such cases:

Fig.3

Fig.3a corresponds to the situation where only the central spot on the glass surface is blocked. Fig.3b is obtained when one bright spot adjacent to the central spot is blocked. Fig.3c is obtained when all spots are blocked except for the central one. Fig.3d is obtained when the barrier covering the central spot also touches and partially covers the two adjacent spots. Both of these spots exhibit signs of secondary diffraction. If these diffractive spots were formed by some kind of wave mechanism — whether classical or quantum — some signs of secondary diffraction should also have appeared in Fig.3a,b,c (details see in [2]). Since no signs of secondary diffraction are observed on these images, this indicates that the diffracted stream emerging from the slit truly acquires the spatial form indicated in Fig.2a. And if this is indeed the case, then it also becomes clear what the spatially discrete multitude of bright spots, projected on the IWB screen, corresponds to. Consequently, we can unequivocally conclude: Photons propagate according to a corpuscular principle that has nothing to do with either classical or quantum wave mechanics.

The generation of such diffractive currents has also been observed and noted by other researchers (see e.g. [6], [7]), who also point out that these currents have nothing to do with the wave nature of light. And since empirical evidence indicates that this is indeed the case, the question naturally arises: **what physical process is taking place in the slit area that causes the generation of such diffracted streams of photons?**

The authors of [7] suggest that the appearance of diffractive spots corresponds to the same class of phenomena of spatial discretization which led to the introduction of principles of quantum discretization into quantum mechanical representations. We agree with this view, but we do not share their second view:

*Diffractive fragments are produced by the collision of photons with electrons on the discrete energy levels of an atom, and the mechanism of the scattering of these photons is controlled by the discrete numerical values of the energies of the spatial orbital momenta of the electrons moving in the corresponding orbitals. The results of this are displayed on the screen as images of bright spots arranged according to the spatial discretization rule."*

It is highly doubtful that the formation of conical shapes of diffractive light fragments can be explained by a mechanism of scattering caused by point collisions. We will become even more convinced of this when we point to strange empirical facts in the next chapter.

Ultimately, it can be said with confidence that at the current stage, the problem of "interferential diffraction" is as mature, as the idea of spatial discretization was in 20th-century wave and quantum mechanics. Consequently, indicating the physical mechanism for generating diffractive fragments, which would clearly show us how diffractive bright spots arranged by the principle of

spatial discretization are generated becomes quite relevant. We will point to such a proposed mechanism in the next chapter.

## Chapter II – The Supposable Mechanism of Interferential Diffraction

Since the problem boils down to what happens inside the slit, we observed such areas visually, without laser beam collision. As a result, we observed the phenomenon of strange lines, which could prove to be the key to understanding the mechanism of origin of diffractive flows. This phenomenon can be observed under ordinary household conditions: create the rigidly bound structure shown in Fig.1b using two plastic cards, which can be easily moved through space. The width of the slit should be  $(1 \div 2)$  mm. In a dimly lit room, hold the structure in your hand so that one of its faces is directed toward a dim light source—for example, the room's window. Close one eye and bring the other close to the notch—from the side opposite the light source, at a distance of  $10 \div 20$  cm. If we focus our vision on the slot, we will notice dark lines parallel to its boundaries and light bands between them in the opening, which are simulated in Fig.4a:



Fig.4

When the intensity of the light entering the slit increases significantly, the visual perception of this system of lines becomes impossible against the background of the intense photon flux. For this reason, it becomes quite difficult to capture an image of these line patterns using modern photographic equipment. For this reason, it might seem that this system of lines corresponds to a phenomenon caused solely by subjective factors of perception. However, this is not the case, as is confirmed by a simple empirical fact: When the system of lines is visually perceived, it is easy to magnify and reduce their image using optical lenses— one cannot magnify and reduce what does not exist.

If we place the slit boundaries so that the slit becomes shaped like the letter “V”, and if we increase the width of its open part to 3 mm, we will notice two systems of lines in the opening that are parallel to the cut boundaries - Simulation Fig.4b. Near the vertex of the “V”, the lines converge into a single system, creating the impression that as the barrier boundaries approach each other, the systems of lines reinforce each other.

If we use objects with circular boundaries as barriers, in the resulting slit opening we will again notice a system of lines whose linear geometries repeat the geometries of the boundaries forming the slit - Simulation Fig.4c.

**Conclusion: The systems of lines are generated by the boundaries of individual barriers - Simulation Fig.4d.**

With only one barrier, the lines become quite difficult to see, and this should not be surprising: When the second barrier removed, the background created by the photon flux at the boundary of the single barrier increases so much that, in this "noise," it becomes difficult to observe the faint lines.

A simple question arises - **what could these lines and the bright bands between them correspond to:**

**1: Photons from the light source enter the space between the slit edges, emerge in the corresponding spatial areas of the bright bands, and reach our eye. In our visual perception, this fact is reflected in the form of a bright stripe;**

**2: When photons fail to emerge from certain spatial areas of the slit opening, we see dark lines. The widths of the areas corresponding to these lines are much smaller than those of the bright bands.**

If this view corresponds to reality, and we believe it most likely does, the question arises: **what physical basis could there be for this phenomenon of "diffractive areas"?**

As noted in the introduction, we fully agree with the spirit of de Broglie's comment and express the following opinion:

**Since the "diffractive areas" are observed in the slit opening, they cannot be generated by photon collisions and subsequent scattering on the corresponding atomic lattice of the barrier boundaries. The fact that photons cannot pass through barriers is proven by a simple empirical fact: both this phenomenon and the images produced by laser beams disappear when the slit is completely closed. This leaves only one option: both the phenomenon of these lines and the phenomenon of diffraction - observed in laser beams, arise from the collision of photons and their subsequent scattering by a field (or fields) of a strange spatial nature, that arise adjacent to the boundaries of the barriers. This field, which we have called the "S-field", is generated by charged objects of the barrier atomic lattice, and presumably causes all phenomena of spatial discretization, including the spatial discretization upon which quantum mechanics was founded.**

To see the connection between the systems of lines described above and the diffractive phenomena of laser light, let us point out some characteristic features:

**Characteristic I: When a laser beam interferes at the barrier's boundary, a diffractive image of the following type is obtained on the IWB screen:**

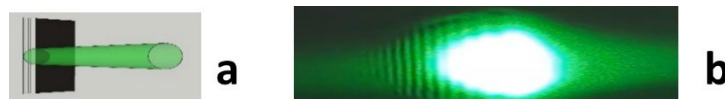


Fig.5

According to picture Fig.5a, photons are scattered by the corresponding strange spatial structure of bright stripes and lines of the strange field, and in the space not covered by the barrier, the diffracted photon streams create a spatially discrete set of bright spots extending vertically on the

IWB screen – Fig.5b. The boundary of the barrier ends in the middle of the central spot, and a diffractive bright spot also forms in the spatially barred area, but not as a discrete entity, but rather along the direction of the "polarization axis" - as a continuously stretched spot. This fact likely indicates that this spot is generated by the bright region immediately adjacent to the boundary, which scatters photons more intensely than all the other bright regions;

**Characteristic II: Diffraction of laser beams is always accompanied by the presence of an “axis of spatial polarization” for discretely located bright spots, which is also observed for dark line systems;**

This fact is clearly observed in the case of the laser beam in Figure 1a, and in the case of the lines in Fig.4(a,b,c,d).

**Characteristic III: When the barriers approach each other, the diffractive mechanism corresponding to each barrier undergoes a change.**

The diffraction spots on the IWB screen begin to stretch and move along the "polarization axis":

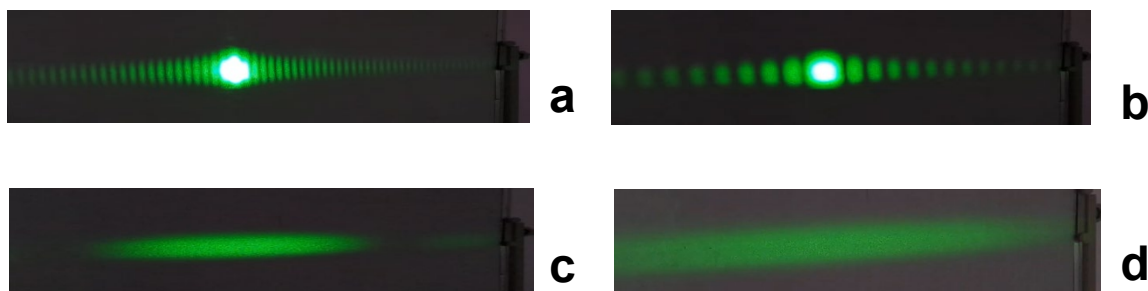


Fig.6

In Fig.6a, the bright spots to the left of the central spot stretch and move to the left, while those to the right stretch and move to the right. The center of the central spot remains stationary, and the spot stretches in both directions. Just before the slit closes, the central spot stretches across almost the entire width of the screen. Similar to the cases described, line systems generated by individual barriers also undergo significant changes as the barriers move apart and approach each other.

Based on the images shown above, we can say the following: When the corresponding bright areas of the diffraction patterns from two barriers approach each other, it creates the impression that these areas are undergoing a non-trivial superposition. In the case of laser beams, this causes the bright spots to stretch and spatially shift, while in the case of "systems of lines," it causes noticeable visual changes in the spatial arrangements of the lines and their representations.

Based on the S-fields, it is possible to explain the phenomenon of bright spot stretching in the language of line systems. Indeed, from a physical point of view, the assertion seems completely natural: **The further an area of the bright band is from the boundary of the barrier, the more its physical characteristics, which would cause the scattering of photon fluxes, should quantitatively diminish.**

Accordingly, as the barriers approach each other, regions that scatter photons more intensely begin to overlap regions with less intense scattering. This creates new regions that scatter photons more intensely than those regions did before the overlap. When the overlap affects two regions adjacent to the boundaries that are expected to scatter photons most strongly, the stretching and spatial motion of the bright spots also intensifies. And when these two bright regions overlap, the central spot stretches even further.

All of **this** gives us reason to say that: **the phenomenon of lines and the phenomenon of diffraction of photon streams may indeed be based on the same physical mechanism.**

If even more empirical evidence supporting this idea is found and observed, then the following hypothesis may also turn out to be true:

**Two phenomena of spatial discreteness - the diffraction of streams of quantum objects in the regime of positive energies of scattering and the discretization of energy levels in the corresponding negative energy regime of bound states may be caused by the same S-fields, which have a strange spatial nature.**

If our opinion regarding the "S-fields" is correct, and the discreteness of quantum properties is due to the strange spatial nature of these fields, this will necessitate a critical re-examination of existing notions of the interactions of quantum objects. A fundamental change will have to be made to both the Schrödinger equation and the Maxwell equations, on which quantum field theory will be based.

Let us conclude the discussion as follows:

## CONCLUSION

We fully agree with the above-mentioned opinion of de Broglie, and we state: the physical community must necessarily take an interest in the problem described above and intensively conduct an in-depth study of the corresponding phenomena. For this, it will be necessary to gather numerous empirical facts and analyze them competently.

### Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

## Ethics Statement

This study did not involve human participants or animals, and therefore ethical approval was not required.

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