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AN ALTERNATIVE TO QUANTUM MECHANICS, PART II: INTERFERENCE OF BEAMS COMING FROM A SINGLE SOURCE

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An interference experiment that tests the particle probability density given by the wave theory and quantum mechanics is suggested. The idea of this experiment is inspired by the philosophy of the model of the interacting particle.

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1. Introduction

More than a decade ago it was suggested that interference experiments performed with photons, electrons and other particles can be explained without the superposition of the waves that took different paths in an interferometer [1]. The reason behind this unusual suggestion was not to rediscover formulations of quantum mechanics that do not use the notion of the Ψ wave, but to get an appropriate platform, a way of thinking that inspires to propose tests of quantum mechanics. The approach that explains the existence of fringes without any interference between two waves that took different paths came to be called "the model of the interacting particle". The following two Sections (2 and 3) review the main ideas of the model of the interacting particle that are relevant to the new proposal, which is then presented in Section 4. Section 5 discusses some conceptual issues that relate to the specific formulation of the model of the interacting particle.

2. Model of the interacting particle

The model of the interacting particle given in Ref. [1] and further developed in Refs. [2] and [3] is based on two postulates:

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Postulate P1: *The particle is a localized entity that interacts with its environment at a distance.*

Postulate P2: *The supposed interaction of the particle with its environment is of such a character that a large number of particles creates the interference or diffraction pattern that is given by the mathematical formalism of the wave theory.*

Postulates P1 and P2 together imply that the waves associated with particles do not exist, and that the wave theory supplies just a mathematical algorithm that needs to be invoked to get the particle density (or particle probability density) in interference and diffraction patterns. According to the model of the interacting particle, in a common interferometer where two beams derived from a single source come together again, each particle (e.g. photon) takes just one of the two possible paths, but it interacts also with the other possible path. In other words this means that each photon interacts also with the environment of the path that it did not travel. Hence each photon interacts with the environments of both possible paths, and this is confirmed by all existing experiments.

A quick look at postulates P1 and P2 may give a false impression that they do not include so called "two-photon interference". In the case of the two-photon interference, we face a situation where two waves coming from two independent lasers meet and interfere. As it was demonstrated by Pfleegor and Mandel [4], the two-photon interference persists even if the intensity of light is so low, that with a high probability, there is at most one photon in the experimental area at any given time. The model of the interacting particle can explain the two-photon interference, and in this case postulates P1 and P2 imply the following statement:

"A photon coming from a source interacts also with the environment of other possible paths leading to the place of interference (this is not applicable here) and with the environments of the paths leading from other sources to the place of interference. This interaction is always present, but it becomes effective when other sources and the paths leading from them are under conditions that, according to the wave theory the interference between the wave coming from the source that supplied the photon and the waves coming from other sources would occur." (This statement can be found in Refs. [1] and [2].)

Considering the phenomenon of the two-photon interference, the difference between the wave theory and the model of the interacting particle is now quite clear. According to the wave theory, the interference between two independent laser beams is due to an interaction between the two waves coming from two different sources. According to the model of the interacting particle the interference between two independent laser beams is due to the photon interaction with the other laser and with the path from that laser.

To demonstrate the interference between two independent laser beams, which means to demonstrate the existence of an interaction between them, the photon interaction with the path from the other laser (including that laser) has to be excluded. If this condition is not satisfied, there is always a possibility that the interference between two independent laser beams actually proves the existence of the photon interaction with the other laser and with the environment of the path leading from that laser! From the point of view of the model of the interacting particle, all two-photon interference experiments performed so far demonstrate the existence of the photon interaction with the other laser and with the path leading from that laser. To find out which of the two approaches, namely the wave theory or the model of the interacting particle is realized by nature, it is necessary to perform an appropriate experiment. Such experiment has been proposed in Ref. [2].

While Ref. [2] shows that the model of the interacting particle can explain the two-photon interference, Ref. [3] shows how the model of the interacting particle explains Bohr's complementarity principle, Bohr's philosophy of quantum physics, Schroedinger cat paradox, the collapse of the state vector, measurements of magnetic momentum and spin, EPR paradox, delayed choice experiments, quantum eraser experiments and which-way experiments. However, the main purpose of the model of the interacting particle is not to find an alternative explanation for interference of waves associated with particles for the sake of having something different, but to explain interference fringes created by the waves associated with particles using the smallest number of axioms – postulates. This approach shows that the existence of quantum, or matter waves is an unnecessary assumption. Since quantum physics is based on the concept of quantum waves, and the model of the interacting particle says that quantum waves do not exist, the model of the interacting particle naturally leads to ideas how to test the existence of quantum waves, and that is exactly its main purpose.

3. *Particles and formation of interference fringes*

For the purpose of clarity it is necessary to recall some of features of the particle interaction that are given in Refs. [2] and [3].

Consider the experiment in Fig. 1. According to the wave theory and quantum mechanics, interference between the beam reflected from the mirror M1 and the beam reflected from the mirror M2 occurs localy in front of the frame, in the

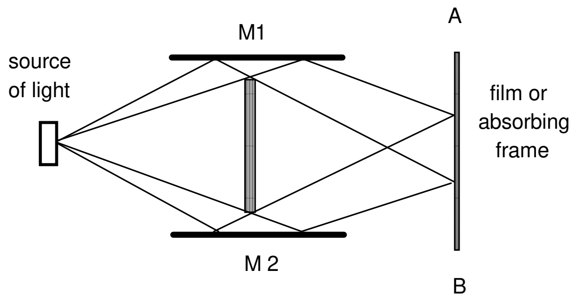

Fig. 1. Two beams radiated from a point source meet at a film or absorbing frame and demonstrate the effect of interference. According to the wave theory, the interference fringes exist in the area where the two beams overlap. According to the model of the interacting particle, the paths of photons are straight and the interference fringes exist within each of the two beams starting from the source.

area where the two beams overlap. This means that according to the wave theory, the density of the photons across any of the two beams prior to their merge is a flat non-sinusoidal function. When the beams merge, their amplitudes are added. The photon density function becomes sinusoidal, which means that interference is realized and can be observed on the film.

According to the model of the interacting particle, the waves associated with particles do not exist, and in the same way there is no mutual interaction between different photons. Assuming that the paths of the photons are straight and realizing that the distribution of photons at the film (or plate) in Fig. 1 is detected or measured as sinusoidal, it is inevitable that the density of photons is sinusoidal across any of the two beams starting from the source. Such feature of the density of photons is possible if and only if the photon physical state, e.g. its position in space, depends on both the photon's past and photon's future. This means that each photon, while being generated in the source, is already influenced by its future interaction with the frame and thus it sets on a straight path that contributes to the interference pattern at the frame.

If the film in Fig. 1 is removed, the interference fringes are not observed, see Fig. 2. In this case each of the photons, while leaving the source, is affected by its

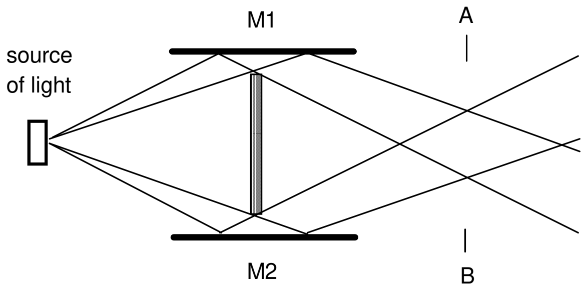

Fig. 2. Two beams from a point source pass through each other. Interference is not observed if we look at the light from the right. According to the wave theory, interference fringes exist in the area where the two beams overlap. According to the model of the interacting particle, the interference fringes do not exist at all – not even in the area where the two beams overlap.

future and thus it "already knows" that there will be no encounter with a film in the area where the two beams overlap, and therefore it behaves accordingly. This means that each photon is affected by its future and it sets on a path that does not contribute to interference. According to the model of the interacting particle the intensity of the beams in the plane A – B in Fig. 2 (or in any other plane of this figure) is a non-sinusoidal function. This tells us that there is no interference there. If, however, we want to check, or measure the interference in the plane A – B in Fig. 2 by either scanning through this plane with a detector, or placing there a film, see Fig. 1, or, perhaps placing there a light-scattering material, see Fig. 3, then interference fringes are observed. This happens because the interaction of each of the photons with the material placed in the plane A – B influences photons

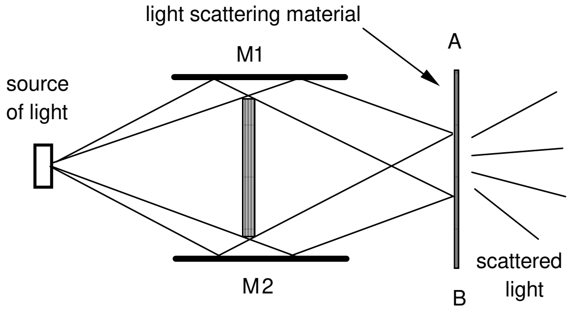

Fig. 3. Two beams emerge from a point source. As they merge, they strike a thin light-scattering plate. Looking at this material from right we observe interference fringes regardless the fact that this experiment has the same geometry as that in Fig. 2. According to the wave theory, the interference fringes exist only in the area where the two beams overlap. According to the model of the interacting particle, the paths of photons are straight and the interference fringes exist within each of the two beams starting from the source up to the scattering plate.

backward in time, so that while being born in the source, they are already selecting straight paths that do contribute to the interference. This also suggests that the interference in the plane A − B in is made by the act of measurement of the photon density in that plane, which can be facilitated, e.g., by the presence of a film or a light-scattering material, see again Figs. 1 and 3.

A common and widespread belief is that the existence of the interference fringes in the areas where the two beams overlap in Figs. 1 and 3 implies the existence of interference in the overlapping areas in Figs. 2 and 4. This belief, however, cannot be experimentally demonstrated.

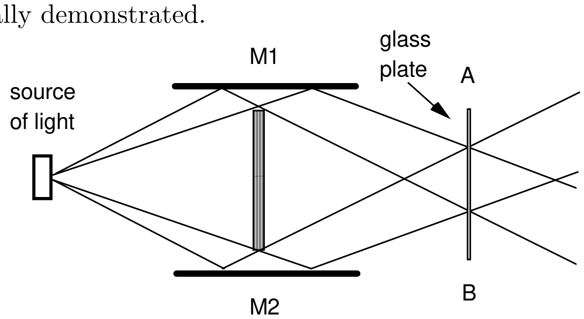

Fig. 4. Two beams emerge from a point source. A thin glass plate is placed in the area where the beams merge. The beams pass through the glass plate and start to separate. According to the wave theory, interference fringes exist in the areas where the two beams overlap. According to the model of the interacting particle, interference fringes exist neither in the area where the beams overlap, nor in any other parts of the beams.

It is obvious that it is the photon-detection interaction in Figs. 1 and 3 that makes the fringes, and it is the act of measurement of the density of photons that determines what this density will be. If we place a sheet of a light-scattering material in the plane A – B in and look at it from the right, we can observe fringes on that sheet, see Fig. 3. If, in the same figure, we remove the light-scattering sheet and replace it with a glass plate and look into the light from the right, see Fig. 4, no fringes are observed, which is similar to what is happening in Fig. 2. To generalize, we can say that the physical quantity, which in this case is the density of photons at the plane A – B, depends on how we observe or measure it. In Figs. 1 and 3 we observe fringes, but in Figs. 2 and 4 we do not. The density of photons in the plane A – B can become either sinusoidal or non-sinusoidal depending on technical details of the physical realization of our measurement.

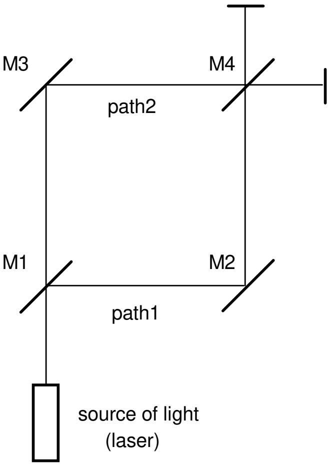

Fig. 5. A Mach-Zender interferometer set in a way that light appears only in one of the outputs, either to the right or upward. According to the wave theory, the interference of the two beams leaving mirror M4 is always present. According to the model of the interacting particle, the interference of the two beams leaving M4 comes into existence only if it is measured.

If two coherent beams are merged in such a way that they perfectly overlap, and thus the angle between them is zero, then interference is always observed. The experiment shown in Figs. 1 – 4 does not allow parallel and perfectly overlapping beams, but to see that such an arrangement is possible, let us consider the experiment in Fig. 5. In this figure, a beam of light coming from a laser enters a Mach-Zender interferometer formed by the mirrors M1 – M4. If all four mirrors are parallel, then the two half-beams that make each of the two output beams are perfectly overlapping, and not divergent as those in Figs. 1 – 4. The distances between the mirrors in Fig. 5 can be adjusted so that all light from M4 goes either upwards or to the right. In this experimental set-up, the effect of interference does not depend on how we measure it, because each of the output beams always contains a 1 to 1 mixture of the two waves, one that inside the interferometer took path 1, and the other that inside the interferometer took path 2. Therefore in this case the interference fringes are always observed.

Interference in the plane A – B in in Figs. 1 and 3 is observed because of the presence of two beams, and because the photons, in order to be detected at these planes, are either absorbed (Fig. 1) or scattered (Fig. 3). Similarly, the interference in Fig. 5 occurs because each of the output beams contains in itself two (perfectly) overlapping beams and because the photons are detected to demonstrate the existence of interference. Therefore, if the photons coming out of the interferometer in Fig. 5 do not interact with anything for the whole eternity, they will not form interference fringes, but this cannot be demonstrated experimentally. If, however, we check the presence of interference by any conceivable technical means, then by the very act of the detection of photons we make them to interfere.

4. Suggested experiment

The experiment shown in Fig. 6 will be considered. The light from a laser is attenuated, then separated into two beams. A part of the beam 1 that is reflected from the semi-transparent mirrors M1, M2 and M4 reaches the film where it reunites with the beam 2 that went along the path 2 (mirrors M1, M3 and M4). The experiment in Fig. 6 is again a Mach-Zender interferometer, but in this case the size of the beam – that means its cross section, the distances between the mirrors and also the width of the interference fringes – are thought to be similar, or perhaps the same as in the experiment of Pfleegor and Mandel [4]. If all four mirrors are exactly parallel, and then one or more mirrors are slightly rotated, the width of the interference fringes can be set e.g. to two millimeters, and they can be observed on the film or by means of other suitable detectors.

According to the wave theory interference fringes appear on the film in Fig. 6 because of two assumptions. The first assumption is that the waves belonging to

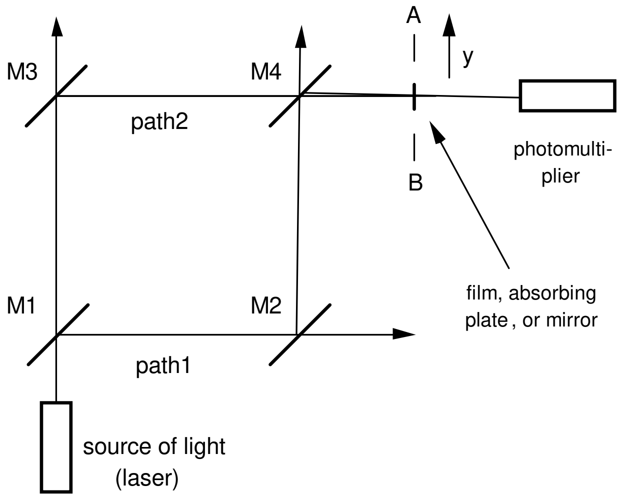

Fig. 6. Light from a laser is attenuated, and led through a Mach-Zender interferometer to strike the film with a slit as wide as a single interference fringe. The film is movable along the y co-ordinate to find the highest and the lowest rate of the counts detected with the photomultiplier. According to the wave theory, the ratio of the maximum and the minimum rates should be as given by Eq. (3). According to the model of the interacting particle, this ratio should be smaller, and dependent on the surface properties of the plate.

the two beams interfere. This means that the amplitudes belonging to two different beams are added. The second assumption is that the square of the resultant amplitude is the particle probability density, or the density of photons, see Fig. 7a. If the film is removed from its place, beams 1 and 2 diverge. If they happen to separate completely, then a film placed in one of the beams at right angles to the direction of the light would not show any fringes because of the lack of the other beam, and therefore, the lack of interference. Respecting the wave theory, we believe that if the film is not present, as e.g. shown in Fig. 6, the interference fringes are still formed, not just at the plane where the film was, but throughout the whole region where the two beams overlap. (Compare with the experiment shown in Fig. 2.)

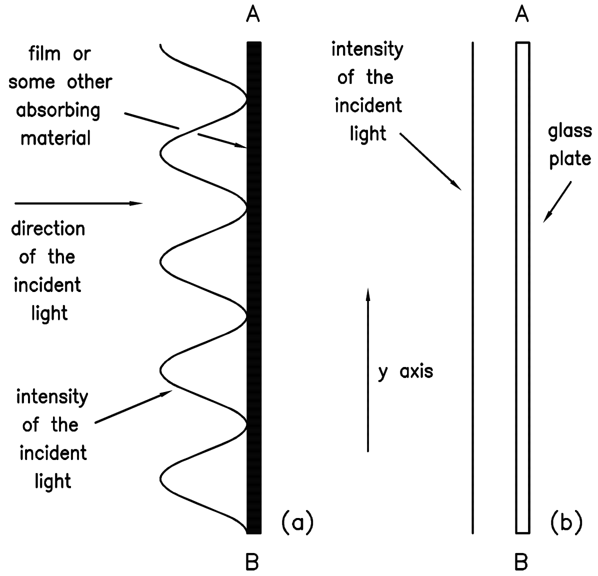

Fig. 7. a) (left). According to the model of the interacting particle, the intensity of light incident at the film is sinusoidal because the film provides a detection interaction. b) (right). If the film is replaced with a glass plate, then according to the model of the interacting particle the intensity of the incident light is a flat non-sinusoidal function.

According to the model of the interacting particle, the interference fringes form only if the photographic film, or some other light-absorbing or light-scattering material is placed somewhere in the region where the two beams overlap, see the plane A – B in Fig. 6 and Fig. 7a. Therefore, if the film is not placed as in Fig. 6, the density of the photons in the region of space where the two beams overlap does not form strips of low and high density of photons, see Fig. 7b. This is similar to the experiment shown in Figs. 1 – 4. From the point of view of the model of the interacting particle, the interference fringes on the film in Fig. 6, and shown directly in Fig. 7a, are formed by the interaction of the film with each of the photons. Because the state of every photon depends also on its future, each of the photons, while emitted from the source, is already under the influence of its future interaction with the film. The effect of the photon's future interaction with the film is such that the paths of many photons, while remaining straight, are adjusted in a way as to form fringes that exist within the beams starting from the source.

If the film in Fig. 6 is removed, or replaced with a glass plate, then according to the model of the interacting particle no fringes are formed in the area where the beams overlap. The reason for this is that the beams are divergent and not absorbed in the area where they overlap. Being divergent, the beams will separate and they will be detected or absorbed separately. Since a single beam cannot interfere, the density of photons across such a beam is non-sinusoidal. Assuming that the paths of photons are straight, the density of photons across any of the beams has to be non-sinusoidal starting from the source. This tells us that according to the model of the interacting particle, there is no interference in the area where the beams overlap if the film in Fig. 6 is removed, or, if it is replaced with a glass plate, see again Fig. 7b.

Conditions of the experiment in Fig. 6 are similar to those of the experiment shown in Figs. 1 – 4 except that the angle between the two beams in Fig. 6 is small, and the rays within any of the two beams in Fig. 6 are not diverging, but parallel.

While the wave theory and the model of the interacting particle are conceptually quite different, they give the same predictions for a common interferometer. They have to, because this is required by Postulate 2. According to the wave theory, the interference at the plane A – B in Fig. 6 does not depend on the presence of a film there, but according to the model of the interacting particle, a film placed in the plane A – B literally does make the interference fringes. This difference between the two approaches discussed here is of crucial importance because it can be used to suggest the following experiment. Let us cut a slit in the film in Fig. 6a that is as wide as one interference fringe, and move the film along the y axis so that the position of the slit coincides with a single interference fringe – a maximum, see Fig. 7c. A photomultiplier is positioned at a distance, say 0.5 to 5 meters, behind the film to measure the intensity of the light passing through the slit. If the film is moved upwards (or downwards) along the y axis so that the slit matches with an adjacent interference minimum, the intensity of the light detected with the photo-multiplier will decrease to a fraction of its former value.

In considerations that follow further in the text, the ratio of the maximum and the minimum intensities passing through the slit is of interest, so we will obtain its theoretical value using the wave theory. When the angle between the two light beams striking the film is very small, which is the case here, the intensity of the light at the film can be approximated with the function

$$i = i_0 \sin^2(ky) , \tag{1}$$

where i_0 and k are appropriate constants and y is the co-ordinate shown in Figs. 7a and b. Since the width of the slit is equal to the size of the interference minima

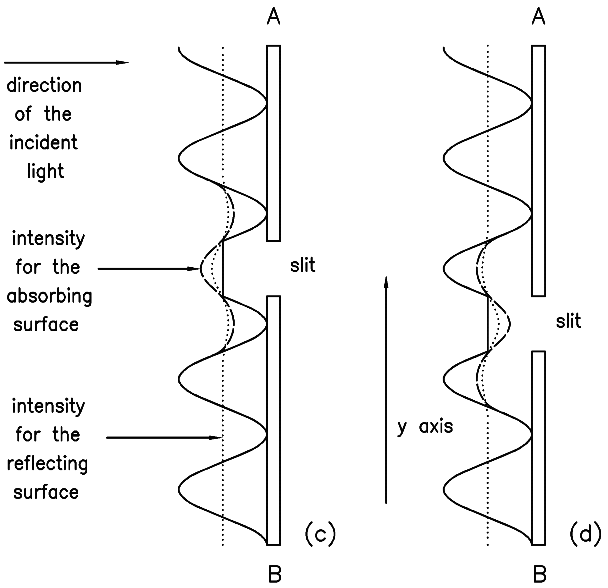

Fig. 7. c) (left) Intensities of light in the region of the maximum and d) (right) in the region of the interference minimum. The wave theory predicts the intensity proportional to $\sin^2(ky)$ *in the whole interference region (not shown in the figures). Full lines show the intensities according to the interacting particle model when the effects of slit edges are not taken into account. The dashed and dotted lines show the predicted intensities for absorbing and reflecting (mirror) slits, respectively, when the effects of slit edges are taken into account.*

(or maxima), the wave theory says that the value of the ratio of the maximum and minimum intensities passing through the slit,

$$R = I_{\max}/I_{\min} \, , \tag{2}$$

is equal to

$$R = \int\limits_{\pi/4k}^{3\pi/4k} i\,\mathrm{d}y \Bigg/ \int\limits_{-\pi/4k}^{+\pi/4k} i\,\mathrm{d}y = \frac{\pi/2+1}{\pi/2-1} = 4.504\,, \tag{3}$$

where i is given by Eq. (1).

According to the wave theory, the ratio of the maximum and minimum intensities (2), measured with the photo-multiplier should be given by (3). According to the model of the interacting particle ratio, the ratio R acquires a value that is smaller than (3), and it also depends on the reflective/absorbing properties of the film or plate placed at the plane A − B in Fig. 6. Let us recall that, according to the model of the interacting particle, interference maxima and minima form because of the interaction between photons and the film that absorbs them. So, if there is a slit in the film, the photons that pass through the slit do not tend to contribute to the interference. This, however, does not describe the situation in every detail, and therefore, the ratio R defined by Eq. (2) will be larger than 1. The reasoning is as follows.

If in the plane A − B in Fig. 6 we have a film or some other absorber as shown, then according to the model of the interacting particle, the intensity of the incident light is as shown in Fig. 7a. If the plate is removed, or if it is replaced with a glass plate, then according to the model of the interacting particle the intensity of the incident light in the plane A − B in Fig. 6 is as shown in Fig. 7b. Now, if another plate with a slit, which is as wide as the size of a single fringe, is put in the plane A − B, so that the position of the slit coincides with a maximum, the intensity of the incident light should be as that shown with the full line in Fig. 7c. Considering the problem in more detail it is necessary to recall that according to Postulate 1 the photon interacts at a distance. For this reason, the photons flying through the slit and those striking the frame close to the slit edges are influenced in such a way that they tend to form a low contrast maximum in the slit and somewhat not fully formed minima next to the slit, see the dashed line in Fig. 7c. If the frame in Fig. 7c is moved along the y axis so that the slit coincides with an interference minimum, then using arguments similar to those that led to the dashed line in Fig. 7c, the intensity of the incident light will be approximately as that shown with the dashed line in Fig. 7d.

The knowledge that the interference fringes are formed only when two coherent beams strike either light-absorbing or light-scattering material, and that the visibility of the fringes is also affected by a nearby slit brings us to the intensities that are shown with dashed lines in Figs. 7c and d. The dashed lines representing intensities $I_{\max}$ and $I_{\min}$ imply that the ratio (2) should be certainly smaller than the value given by (3) derived from the wave theory, but certainly larger than 1.

If the photographic film in Fig. 6 is replaced with a reflecting mirror containing a slit of the same dimensions as the one in the film, the ratio (2) will be even smaller as compared to its former value for the film or some other absorbing material. This will be so because the photons that were previously striking the film in the vicinity of the slit did contribute to interference significantly, but now the photons striking the mirror in the vicinity of the slit contribute to the interference only marginally, and this happens because they interact with the edges of the slit. A reflective surface as such does not influence photons (backward in time) to contribute to the interference.

The results can be summarized in this way: Full lines in Figs. 7cd show the intensity of photons for the absorbing slit frame and the model of the interacting particle, while the effect of the photon interaction with the slit edges is neglected. This follows from the densities in Figs. 7ab. The dashed lines in Figs. 7cd show the intensity of photons for the absorbing surface, model of the interacting particle and the photon interaction with the slit edges included. The dotted lines in Figs. 7cd represent the photon density for the reflecting surface (mirror) model of the interacting particle and the photon interaction with the slit edges included. The wave theory predicts that the ratio (2) should have the value given by (3) for both the film and reflecting mirror

$$R_{\text{mirror}}^{\text{wave theory}} = R_{\text{absorber}}^{\text{wave theory}} = 4.504\,. \tag{4}$$

The model of the interacting particle (MIP) predicts that the ratio (2) for the reflecting mirror is smaller than that for the photographic film, and the latter is smaller than the theoretical value (3)

$$1 < R_{\text{mirror}}^{\text{MIP}} < R_{\text{absorber}}^{\text{MIP}} < 4.504\,. \tag{5}$$

Looking at the intensities shown in Figs. 7cd with dashed and dotted lines, the difference between the two middle terms in (5) can be expected somewhere between 5 and 20 %. Similarly, the difference between the last two terms in (5) can be in the same range.

While the most relevant part of the suggested experiment is to decide between (4) and (5), there are few details worth mentioning. It is advantageous to replace the film with an absorbing foil and to decrease the intensity of light to single-state wave packets so that the photo-multiplier measures the intensity of light by counting the photons. Otherwise, the intensity of light plays no role in this experiment.

When a film, or other absorber is used and the width of the slit is significantly decreased, say by an order of magnitude, the interaction of the photon with the edges of the slit is so significant that the photons passing through the slit tend to contribute to the formation of the fringes. Therefore, the second and the third term in (5) are almost the same as the theoretical value 4.504, even if the model of the interacting particle is considered. Hence the differences between the values of the three terms in the relation (5) are unnoticeable within experimental errors. This also explains why experiments in which interference patterns obtained by scanning with a narrow slit do not reveal any deviation from the prediction given by the wave theory. Slits as wide as the size of one fringe are not used to scan interference patterns. Nobody scans an interference pattern with a slit as wide as a single fringe, and nobody suspects a decreased visibility of the interference pattern when the absorbing plate containing an unreasonably wide slit is replaced with a mirror bearing a slit of the same size.

The photon interaction with the slit edges depends on how close to the slit edges the photon passes. The smaller the distance between the photon path and a slit edge, the stronger the interaction. Let us recall, for instance, that in diffraction experiments a narrower slit means a broader diffraction pattern. Therefore, if there are no waves, the narrower slit means that photons are closer to the slit edges, and the broader diffraction pattern implies stronger interaction. In the problem discussed here, the density of photons according to the model of the interacting particle is shown with full lines in Figs. 7cd, assuming that there is no photon interaction with the slit edges. If the photon interaction with the slit edges is included, the photon density is expected to be as shown with the dashed lines. Now, if the slit is adjusted to be, say, narrower by the factor of 10, the photon density would become the same as the full lines in Figs. 7a. This is because 90 % of the slit has been covered and the photon interaction with the two slit edges is sufficiently large to result in photon density that is virtually the same as that in Fig. 7a. Therefore, the suggested experiment will not distinguish between the wave theory and the model of the interacting particle if the slit is significantly smaller than the width of the interference fringes.

According to the model of the interacting particle, the intensity of the light coming through the slit may slightly depend on the distance between the slit and the photo-multiplier. This prediction is quite weird, but according to the model of the interacting particle formation of the interference maximum inside the slit in Fig. 7c is the same as on the nearby film, if the detection of the photons passing through this slit is done immediately behind the slit. If, however, the detector is placed at a distance behind the slit, formation of the density of photons inside the slit relates more to the plane where the light is detected. So if we move the photo-multiplier, we move this plane, and the conditions for interference at this plane will change too.

In the proposal in Fig. 6, the photo-multiplier can be replaced with a photographic film. The diffraction/interference pattern created by the slit can be then compared with the prediction given by the wave theory, but more importantly, it is possible to check whether the structure of the interference pattern changes if the absorbing film/plate is replaced with a reflecting one. According to the wave theory such effect cannot exist.

The experiment in Fig. 6 can be also performed with two or more slits providing that their widths and the distances between them are the same as the size of a single fringe.

5. Discussion

The idea of the model of the interacting particle is to take the actual physical evidence given to us by the interference experiments performed with photons, electrons or neutrons, and to summarize it into few statements, or postulates without any additional assumptions such as the existence of quantum waves. For this reason, postulates P1 and P2 describe only behavior of nature. This assures that the model of the interacting particle is not burdened with additional and unnecessary concepts.

If someone objects that the reality of quantum waves is actually not relevant, then this objection is of no importance because the suggestion given in Sect. 4 tests directly the quantum-mechanical prediction for the particle probability density, namely $\rho = |\Psi|^2$. Equation $\rho = |\Psi|^2$ is offered to us by the formalism of quantum mechanics regardless of whether wave function Ψ has a physical reality, or not. In other words, it can be said that the suggested experiment tests the correctness of equation $\rho = |\Psi|^2$ and the existence of the function Ψ as a concept and as a mathematical tool, by means of which ρ or any other physical quantity can be obtained. If, in quantum mechanics Ψ is correct, then everything else is correct; if Ψ gives an incorrect value then everything else is incorrect, and it makes no difference whether it has a physical meaning or not.

Postulates P1 and P2 are not unclear and not vague as someone might be tempted to think. They are as clear and as vague as quantum mechanics itself, because for all interference experiments performed so far they give predictions that are exactly the same as those given by quantum mechanics!

Postulates P1 and P2 cannot be supported by a mathematical model a priori for two reasons. First, since postulates P1 and P2 do not include any unnecessary concepts, they are not restricted by anything, and thus their purpose is to describe the reality of nature in a "raw and unprocessed way". Secondly, if we want to test quantum mechanics against postulates P1 and P2, then these postulates assure that quantum mechanics is genuinely tested against "raw nature", and not against man-made models, or perhaps semi-classical approaches that are certainly doomed to fail.

Postulates P1 and P2 cannot be supported by a mathematical model. That is not their purpose. If a good mathematical model is given, then equations and formulae of quantum mechanics should be obtainable from that model. If this works, then no test is needed. However, if a suggested mathematical model does not yield equations and formulae of quantum mechanics into the least detail, then this model is inferior to quantum mechanics, and therefore it would probably fail if tested against quantum mechanics. The main and the uppermost purpose of the model of the interacting particle based on the postulates P1 and P2 is to test quantum mechanics against the reality of nature and not against anything else. This is the reason that postulates P1 and P2 are what they are, and they cannot be changed in any way. The model of the interacting particle has no intention to suggest a mathematical model, or reinterpret quantum mechanics, and as such, it is completely unrelated to any of the known interpretations of quantum mechanics. If the suggested experiment agrees with relation (4) within the experimental error, quantum mechanics is perfectly confirmed. If, however, the experiment yields intensities that satisfy the inequalities (5), then quantum mechanics will need some changes.

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INAČICA KVANTNOJ MEHANICI, II DIO: INTERFERENCIJA SNOPOVA IZ JEDNOG IZVORA

Predlaže se eksperiment za provjeru gustoće čestične vjerojatnosti prema valnoj teoriji i kvantnoj mehanici. Zamisao eksperimenta zasniva se na postavkama modela međudjelujućih čestica.