

Photon Model with Duality of Particle and Wave

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Abstract

Light is quantum which indicates the duality of particles and waves. Therefore, it is not possible to make a model of light to explain two antithetical characters at the same time. But, I succeeded to draw a model of light having simultaneously both characteristics of particles and waves based on “energy body theory”. The reason why light makes interference fringes in Young double slit experiment became clear by this. Particularly, the reason why interference fringes are made, even when photons are emitted one by one, if many photons are emitted, were also made clear. More, this photon model gives the reason to the phenomena such as reflection, refraction and invariable velocity of light.

1. Introduction

"Light is particles, and is waves too. Light is quantum that has both characters of particles and waves." [2] "So, it is meaningless to ask which is substantial, or what is the interpretation." [1] Also, light has the feature that "its relative speed does not change, despite the moving speeds of a light source and an observer". [2] When light is emphasized a character of waves, it indicates the nature of refraction, reflection, intervention, diffraction and polarization. [2] When light is emphasized a character of particles, it becomes one kind of elementary particles that is a quantum state of all electromagnetic waves including light, and is a force carrier of electromagnetic force. [3]

Light is explained like those, but a concrete image of photon has not been drawn, because of the incomprehensible character of the duality of particles and waves. Therefore, questions to these fundamental causes has been remaining, why light speed is invariable, why light is particles and waves, why light selects the channel with the shortest time, why some light reflect, and some light refract, and why light carry electromagnetic force, even though phenomena regarding light have been analyzed in detail.

But, it came to be explained the fundamental cause of the quantum phenomena by light because a clear image of light which displays both particles and waves at the same time has completed by energy body theory this time.

Further, this article makes energy body theory a premise, but energy body theory is not recognized widely, so somethings basic are explained somewhere in this article as supplements, even if they are directly not related to this article. [4] Reference symbols will not be put from now on.

2. Model of Photon

2.1. Generation of Photon

At first, let me start to explain the situation in which photons generate. Photons and electrons in this article are the model of energy body theory.

"Energy body theory is the theory by which we assume that both space and elementary particles are the same "energy body". Energy body is made of energy cell bodies on the scale of the Planck length which is quite smaller than elementary particles. Elementary particles are formed by energy body waves which are revolving focusing on a self-axis. Its central particle part expresses the character of particles, and its wide-based foot area spreading, and attenuating expresses the character of field. A drop or a rise of energy level happens, and it causes attractive force or repulsive force because of the direction of each wave".

Photons (electromagnetic waves) are the ones which electronic kinetic energy separated from electrons.

Electrons are formed by energy body waves which are revolving counterclockwise focusing on a self-axis. Its central particle part expresses the character of particles, and its wide-based foot area spreading, and attenuating expresses the character of electromagnetic field.

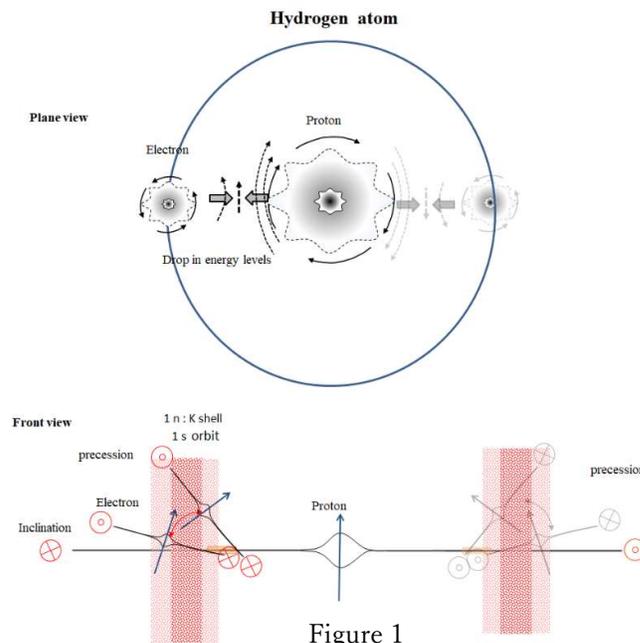


Figure 1

Protons are formed by energy body waves which are revolving clockwise focusing on a self-axis. Its central particle part expresses the character of particles, and its wide-based foot area spreading, and attenuating expresses the character of electro field. The both revolving waves focusing on a self-axis of electrons and protons runs in the same direction between electrons and protons. Therefore, wave speed gets faster, and energy level goes down.

The center parts in high energy state are attracted to low energy part, then electrons combine with protons. Further, electrons at a proton's orbit tilt its posture with its expansive face facing to the central part of a proton.

When energy is given to atoms, electrons start to move in the direction of its expansive face. At the time, the electronic expansive face presses static energy body (space). Therefore, kinetic energy which is the energy rising in static energy body is generated as undulation. Electrons are dragged to this kinetic energy and move.

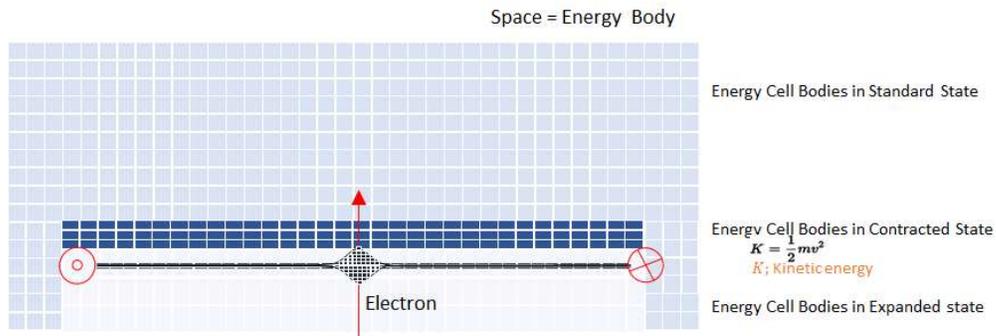


Figure 2

When an electron changes the moving direction, a kinetic energy separates from the electron. And that is a photon (or an electromagnetic wave). (The image is like that you fan a fan and cause a wind)

Therefore, photons are electronic kinetic energy, and take over the posture and inertia movement of electrons just before kinetic energy get away from electrons. The next figure is a plane and a side of a photon. Photon are not accompanied with kinetic energy like electrons. A photon itself is a wave, and is kinetic energy too. Therefore, photons are not possible to be accelerated.

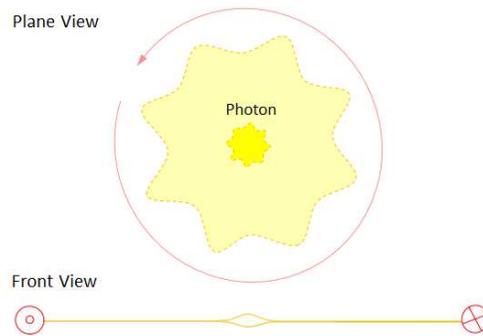


Figure 3

2.2. Electrical Transition

Bright line spectrums emitted by electronic transition are explained here as an example, though light occurs in various cause. When energy is given to atoms, an electron in ground state transits to the orbit in the excited state. [5] The reason is because the waves of protons revolving clockwise focusing on a self-axis are spreading widely, and attenuating. If energy is given to an atom, the energy level at the near place to the center of a proton becomes higher than the outside, so it is because an electron is forced away to the outside of lower energy level. (It is compared to that when one side of a seesaw is lifted, a person on it is compared to slip down.)

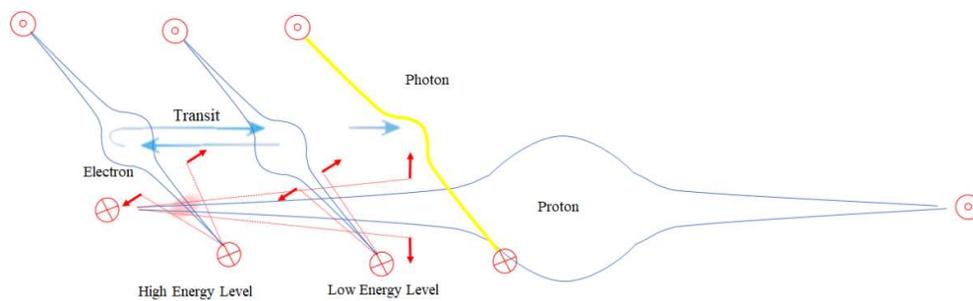


Figure 4

In this way, an electron shifts to the orbit in high energy state. At this time, the energy-rise of a proton which forces an electron away shifts to the electron, so the energy-rise of the proton returns to the standard condition, after the electron slipped down. In other words, the resistance force has been missing along with an electronic moving, so instantaneous electronic transit is possible. When an electron moved to the orbit in high

energy state, conversely, the force in the opposite direction acts on the electron, so, the electron transits to the orbit in low energy state. The reason is in the posture of the electron on an orbit of a proton. The reason is because the waves of electrons revolving counterclockwise focusing on a self-axis are spreading widely, and attenuating in the same way of protons. The energy level of the waves of electrons revolving counterclockwise focusing on a self-axis rises in the opposite direction of a proton. Therefore, if an electron is forced to move far and far away outside the proton, the bonding part is supposed to come nearer and nearer to the center part of the electron. In other words, the opposite side of a seesaw against a proton is lifted. The electron bears against pressure for a while because of waves-knots of the electron and a proton. But when the electron come to give way under the pressure, it transits to the orbit in low energy state. The reason the electron stops there is because that the number of knots of wave revolving focusing on a self-axis of a proton is integral multiple of an electronic ones. When an electron stops at the orbit in low energy state, the kinetic energy accompanied by an electronic transition goes away from the electron, and occurs a photon. The figure 5 is explaining an energy state of an electron and a photon.

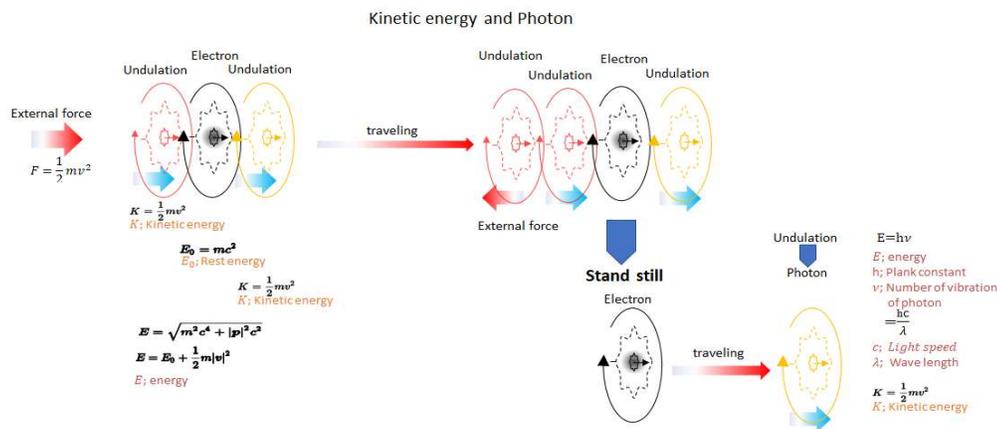


Figure 5

A repeat of these electronic transitions and occurrences of photons are the frequencies of light. The wavelength of light is an interval of frequencies, and the thickness of a board of a photon seen from the side. Electrons travel in the direction of its expansive face. It is the same as electrons transit. Therefore, photons which are separated from electrons travel in the direction of its expansive face, too.

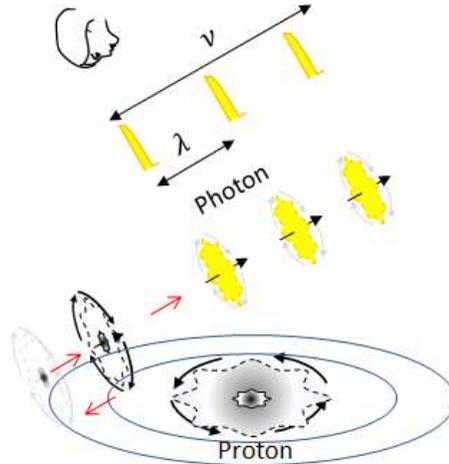


Figure 6

2.3 Photon Model by Energy Body Theory

A photon model by energy body theory is the one which was separated from an electron, and is transcribed the form of an electron. Photons are not accompanied by kinetic energy, but matter particles are done. Photons themselves are kinetic energy. Photons are the waves which revolve focusing on the self-axis, and express a character of spin. The center part of photons shows a character of a particle and is spreading and attenuating in space (static energy body). Photons show various characters by being viewed from different points.

*Photons travel in the direction which is perpendicular to photon's expansive face.

*Photons are observed as light when its expansive face is seen from the thin side

At the time, photons are observed as line spectrums.

*That is the wavelength of light too.

*Photons are also observed as light when its expansive face is seen from the front.

At the time, photons are observed as dots.

When photons travel, its expansive face is delayed for 1 second per 300,000km from its central part in vacuum space. A photon's expansive face is delayed more in material than in vacuum space because of resistance by material energy density. Light refracts for this. According to the traveling direction and incident angle of expansive face of photons, expansive face of photon reflects or refracts.

There is two ways to think of light speed.

*One is the speed when expansive face of photon reaches at an observer.

Currently well-known light speed is this, and it is 300,000 km per second. [6]

Further, light dose not advance toward an observer from a light source.

*The other one is the speed when photons advance. It is in the photon's moving direction.

The speed of photons is the same as electronic speed just before photons are separated from electrons.

Further electronic inertia movement in inertial frame is also taken over.

A frequency of light is not formed by one photon. When many photons are emitted from electrons, a group of photons can be regarded as waves. And its intervals are a frequency of light. Amplitude of light cannot be defined. But, the following two cases can sometimes be regarded as the amplitude of light.

1. The amplitude of undulation which revolves focusing on a self-axis of photons.
2. Radiation width of photons from a light source.

Lastly, the reason how photons select the route of the shortest time, not a shortest distance is understood as the nature of photons which try to hold resistance to a minimum.

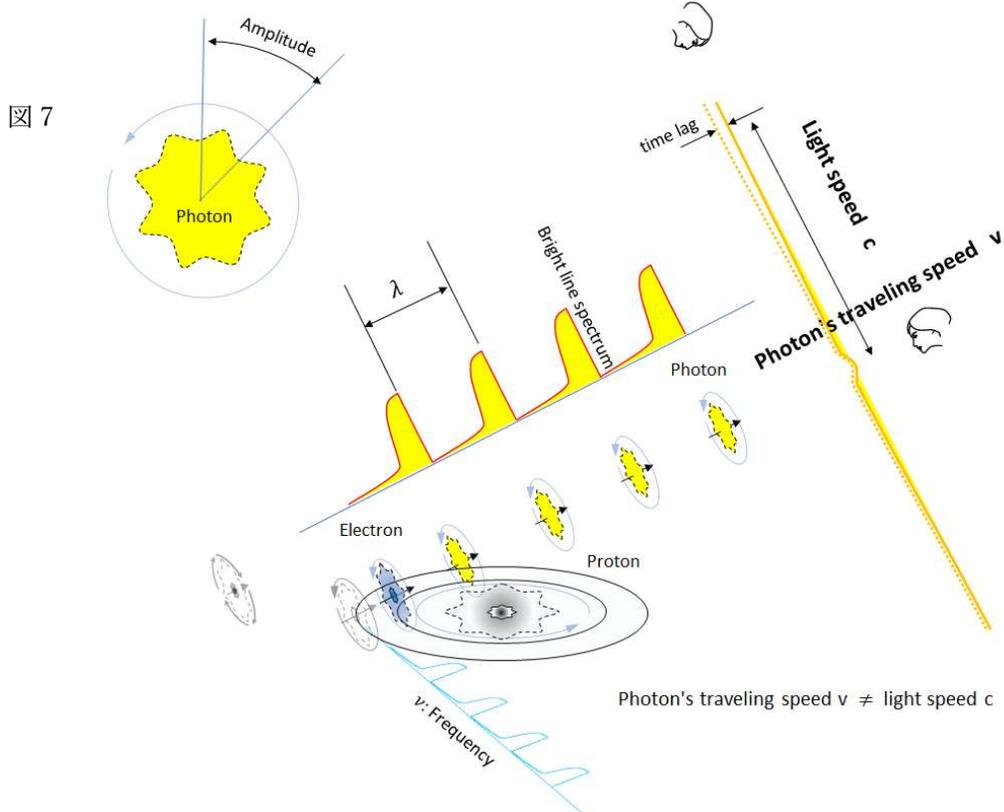


Figure 7

2.4 Double-slit experiment

Next let us think the phenomenon that photons collide with a board with slits, and intervention happens. Electrons are moving in various directions in a light source, so photons emitted from electrons move in various directions. but let it be limited to only photons which advance to the board facing its front, for easiness. There are energy of photons and kinetic energy in a photon. Just before photons collide with a board, energy of the space between photons and the board rises. This is because energy cell bodies of space are pressed, and contracted.

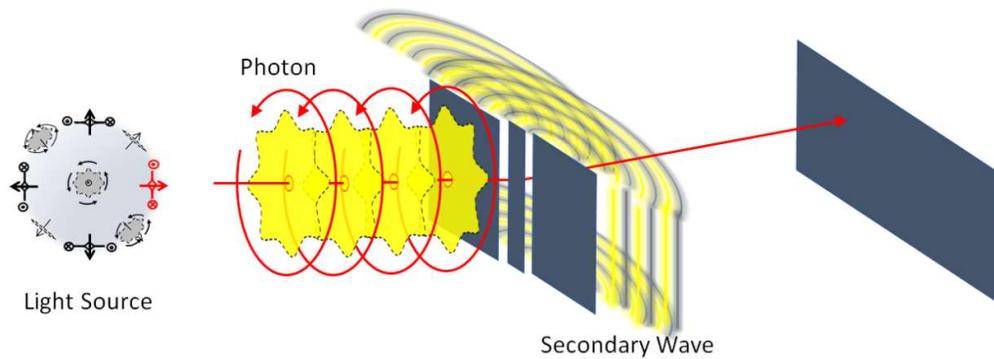


Figure 8

The figure 9 is a plane view.

The photons look like plane waves.

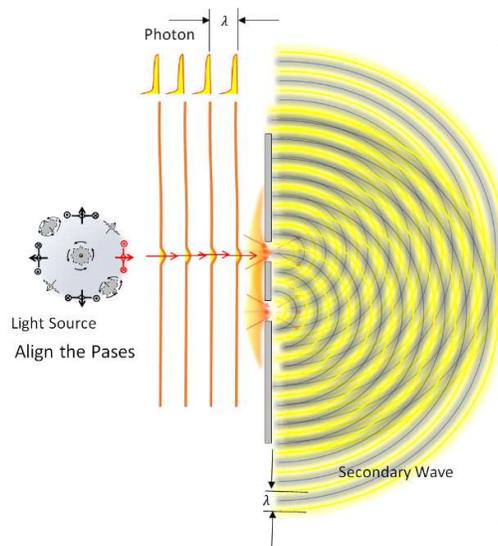


Figure 9

The rise of energy between photons and the board passes through the two slits concentrating, and is released explosively. The rise of energy is contraction of energy cell bodies. This is secondary diffraction waves generated by photons. It is found that two diffraction waves are generated because one photon passes through two slits at the same time. But, it needs an attention that the diffraction waves which are generated around two slits are different from photons' wave, and are ones newly occurred in space.

The figure 10 draws the situation that mountains and valleys of waves in space are made with energy cell bodies. But, the figure makes the roles of energy cell bodies easy to understand, so it is not a realistic figure.

The mountains of waves in the state that energy cell bodies group is compressed and put in high energy level are always followed by the valleys of waves in the state that energy cell bodies group is expanded and put in low energy level. Expansion and contraction of energy cell bodies certainly occur in a pair.

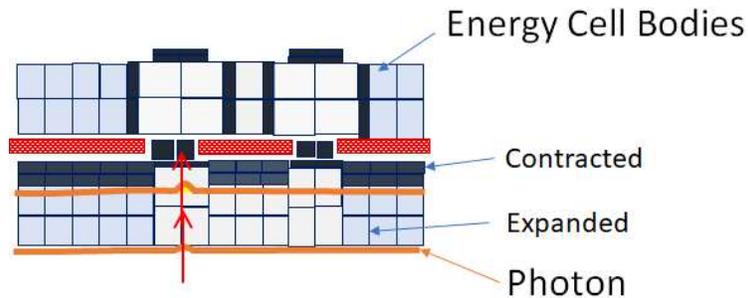


Figure 10

The wavelength of this newly made diffraction waves becomes the same as the wavelength of photons. It is because the pressure is added to two slits according to the frequency of photons. And interference fringes are created at the space ahead of the slits because of the two diffraction waves. The energy level becomes in higher state at the interference fringes where each two mounts of diffraction waves overlap. And, the energy level becomes in lower state at the interference fringes where each two valleys of diffraction waves overlap. Therefore, the central particle part of photons travels through the valleys of interference fringes in the low energy state. Also, the expansive face side of photons pass through there. The reason is because force acts from energy body systems in high energy state to ones in low energy state. Therefore, the screen ahead of the valley of interference fringe becomes bright, and the screen of the mountain of interference fringe becomes dark.

[A. No Arrangement of Phases]

A board with two slits is put in front of a light source. Photons are emitted from the light source in all directions, so they collide with the board. There are some photons which conflict with the board, while its expansive face facing to the board, or some photons which conflict with the board, while its expansive face facing obliquely to the board.

An experimental result: When a board with two slits is put in front of a light source, lines of interference fringes appear on the screen. [7]

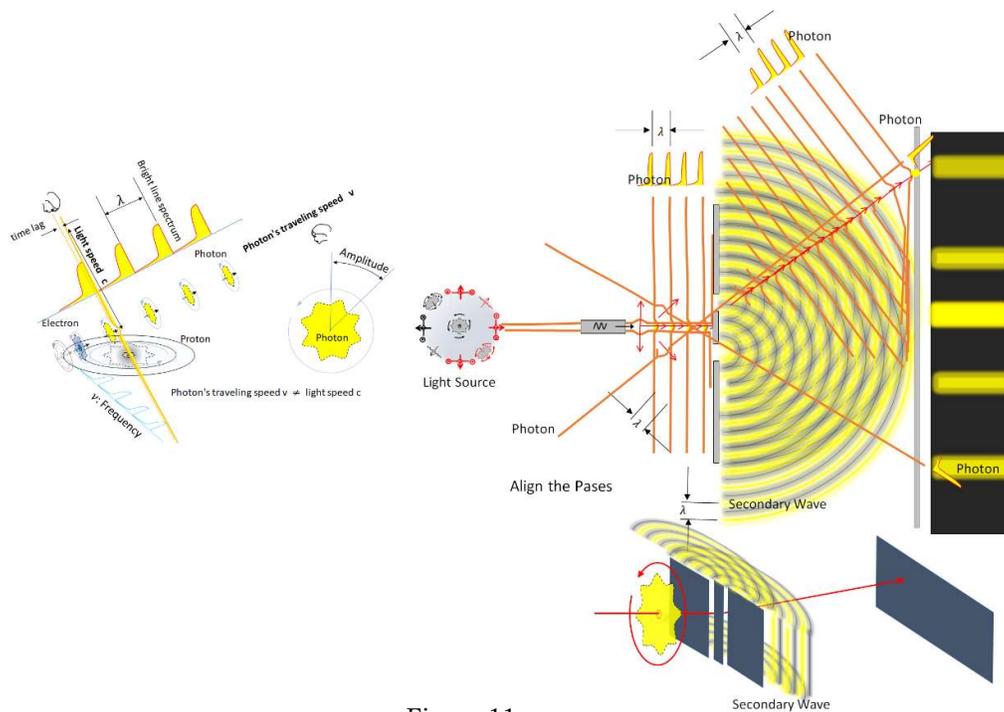


Figure 11

Two diffraction waves are generated from two slits and interfere each other at the space between the board and the screen.

○ Dot marks

Photons with its expansive face facing to the board stop there, if the central particle part of photons collides with the board. There are a few photons of which the central particle part goes through the slits. These photons travels through the valleys of interference fringes in the low energy state created between the board and the screen, and leave dots of light on the screen.

O line marks

Almost all the other photons head for the board, its expansive face facing obliquely to the board. Therefore, its expansive face side inevitably passes through the slits. Certain of photons collide with the board vertically.

At the time, the side of an expansive face of photons perpendicularly pass the slits. Therefore, the side of an expansive face of photons is refracted at the slit, and passes on the valleys of interference fringes in the low energy state between the board and the screen. As a result, lines of light are left on the screen.

A lot of the side of photons passes on the screen, so the same stripes as the interference fringes which are generated in the space between the board and the screen are drawn on the screen.

Attention: The interference fringes on the screen consist of the dots which are left by the particle part in the center of photons collided with the screen, and the lines which are left by the side of an expansive face of photons.

【B. Arrangement of Phases】

The first board with one slit is put between the secondary board with two slits and light sources to arrange the phase. The phase of the photons released from a light source in all directions is arranged by one slit of the first board, so that the expansive face of photons collide with the secondary board from the front. Therefore, photons which passed through a slit of the secondary board collides with the screen from the front, too.

An experimental result: the interference fringes made of dots appear on the screen, when the board with one slit and the board with two slits. [7]

The secondary diffraction waves are generated in the space between the first board and the secondary board, but interference fringes are not generated.

Photons which can pass through the first board are only ones of which a central particle part passed through the slit of the first board. The other photons are cut. When the particle part in the center of the photons passes through a slit of the first board, an expansive face of foot part collides with the board, and becomes small. But when photons pass through the slit, they spread over the original size. And photons head for the secondary board.

Photons which head for the secondary board makes secondary diffraction waves in the space ahead of the two slits in the secondary board, and interference fringes are generated. The diffraction-angle of photons is various by the posture and places of photons passing through the slits of the first board. Therefore, there are, not so many

but, some photons which enter one of two slits in the secondary board. Photons which went into the slit of the secondary board travel through interference fringes in a low energy state, and leave dots scarred with light on the screen.

Even one photon makes secondary diffraction waves, because the expansive face of photons necessarily touches two slits of the board. And interference fringes are formed by two secondary diffraction waves. Therefore, even one photon which went into the slit of the secondary board travel through an interference fringe in a low energy state, and leaves a dot scarred with light on the screen.

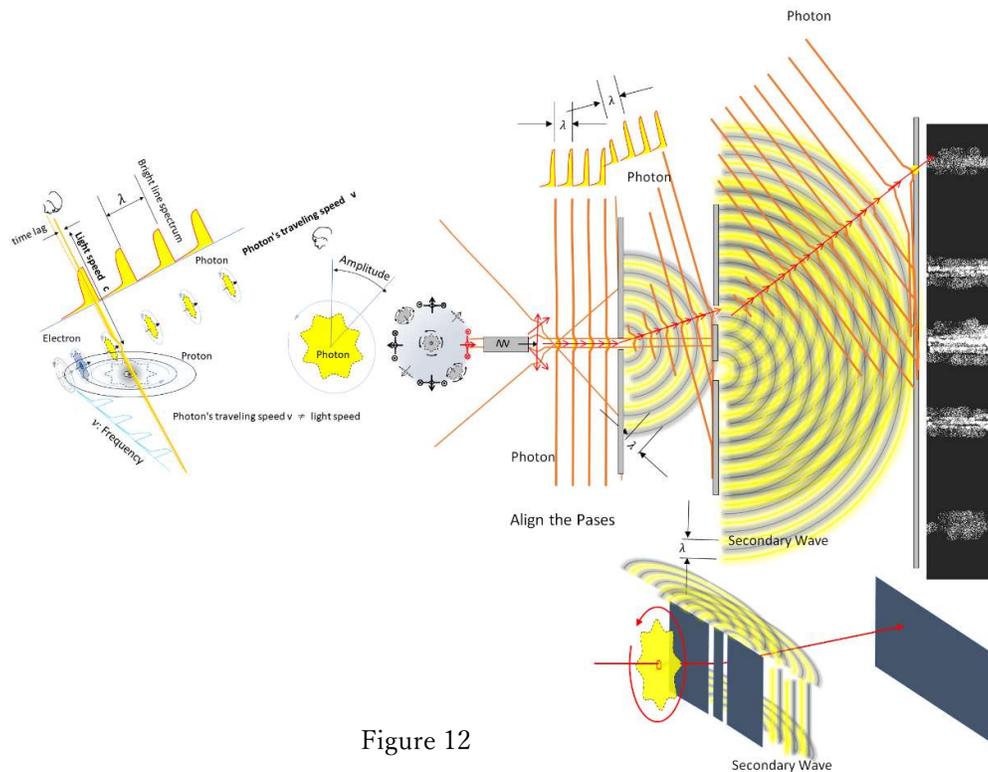


Figure 12

The interpretation of Young double slit experiment is that light is quantum, and quantum shows both nature of a particle which exists at a point in space and nature of waves which spreads in space. Also, the size of the amplitude of waves indicates the probability of electronical existence by the probability interpretation.

Before, Young double slit experiment, there was an idea that a wave is composed of more than one particle, but it was also expected that it is difficult to think that a wave is composed of more than one particle because of number of photons in the space. [8] But, Young double slit experimental result could be explained by the photon model of energy body theory which unites a particle with a wave.

It can be said that the photon model of energy body theory elucidated the perfect form of the light.

Acknowledgment

While writing this article, I referred to many sites on the internet. I'd like to record thankful intention on Photon terrace produced by HAMAMATU and Wikipedia here in particular.

References

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