

Light is Different

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Abstract

In my present articles, nothing new, I just tell the light story as I understand it from the physics textbooks.

Introduction

The target of physics is to devise theories and laws that can help to understand the universe. In order to make predictions, theories use model, and abstract concepts. A model is a kind of analogy or mental picture (image). The purpose of a model is to give us a mental or visual picture when we cannot see what actually happen i.e. the analogy to a known system. A model will allows us to draw conclusions and make prediction which in turn can be checked by further experiments. i.e. we can always check the model by comparing nature with what the model says. Often, as a model is developed and modified, it may come to be referred to as a theory. So, models are very helpful and then often lead to important theories [1].

Both the particle and the wave models are abstractions of human mind which are arrived at by extrapolation from macroscopic world of grains of sand and waves of a pond. Both models have been constructed in attempting to describe the nature. The ideal particle can be localized completely, an ideal wave, one whose wavelength and frequency can be known with infinite precession, cannot be confined to any particular region of space rather the wave must have an infinite extension along the direction in which it propagate.

Physicists believe that;

These two models represent the only two possible modes of the transport of energy [2].

The wave model has been very useful in studying sound, water vibrations, and the vibrations of a string... etc. The particle model has been very useful in studying the planetary motion, atomic structure, and varies motions of material bodies... etc. These two models still contribute to our understanding a lot of physical phenomena.

LIGHT

If we travelled back to the 17th century, it was known that light is a type of energy, and it was known also that energy transfer via particle motion (as grains of send) or as a wave motion (as waves of a pond) as we said before. So, in 1690 Newton ask his famous question; does light propagate as waves or as particles? Newton would claim that light is made of tiny indivisible particles, while Huygens, disagreements with Newton would counter that light is a wave that propagates on (a medium that pervade all of space), the either [3].

In 1802 young performed beautiful experiments showing that light differacted as passed through small slits, just like water waves were known to do. Light would move through the slits and the waves would interfere (superpose) with one another creating bright and dark fringes. Particles could not do that. This is what we called "The classical wave description of the double-slit pattern". Maxwell's in 1865 conclude and confirm that light is waves, i.e. during the 19th century the particle theory of light was mostly forgotten, because the wave theory was so successful. In 1905 Eistein completely changed the way we picture light (and all reality) by assuming his photon concept.

It should be noted that;

a) Einstein in 1905 succeeded in interpreting the photoelectric effect by assuming his famous photon concept. Compton succeeded in interpreting the scattering of x-rays using (and confirming) Einstein photon assumption for the nature of light. This experiments more than anything else convinced the physicists with the reality of the photons (i.e. the particle nature of light). The physics accept the photon as the fundamental unit of light on faith.

b) So there is a feeling that gradually grew up that somehow both the wave and the particle theories must be simultaneously right. Beside a deeper understanding of some excellent Modern experiments suggests that both theories are essentially correct.

Comments

“The First Connectivity between the two Models”:

a) Einstein was the first person who suggests the connection between the corpuscle and the wave theory of light, considering the energy and momentum of the photon (corpuscle) is a function of the frequency and the wavelength of the (wave) of light.

b) i.e. for the first time in history of physics. In the twentieth century, Einstein who start the thinking that the two theories could be merging together. i.e. Einstein was the first one who is responsible for duality paradigm (and who open the door for Max Born to joined the two Models statistically as we shall see later [4].

“Now, let us see where does this photon leads us in our quest to understand the reality of both light and Matter”

c) The physicists begin to consider light as waves keeping in Mind that there are situations for which this description, is inadequate while the quanta description is good enough.

d) The physicist conclude that light has a dual wave-particle Nature (i.e. light is the origin and the Birth of the dual (wave-particle) paradigm.

e) But Reason of such light duality is still a mystery to scientists up till now.

f) i.e., The “wave-particle” duality paradigm is originated essentially from studies concentrated on the nature of light.

g) Physicists conclude that; light carries with it the secretes of reality in ways we cannot completely understand But understanding light (wave - particle) duality was an important step for our perplexed mind. They conclude that which of the two light Models is more appropriate will depend on the properties the Model is seeking to explain, that is because the photon is an entity Not precisely a particle. It is much a wave as it is a particle.

The “wave-particle” duality and Bohr’s view

a) Bohr interpretation for the duality idea [5]

Earlier bohr:

a) Bohr consider that sometimes there is a real wave but No particles, and some other times there are particles but No

Waves. Sometimes the light entities can act as particle following a well-defined Path like a tiny projectile, and sometimes as a wave overlapping with its ILK produce interference wave pattern.

b) However, Bohr view is not readily accepted the main reason for this is the apparently contradictory aspects of the two natures - We cannot imagine any image that could leads to such conflicting behavior, that part of time it is a wave (a wave spreads out and occupies a relatively large region of space) and the other part of time it is a particle (a particle occupy a definite position in space, it must be very small).

c) i.e., Reason of such light “wave-particle” duality is still considered as the central mystery to physicists.

d) Bohr understand quite rapidly that the only way out of this frustrating dilemma is the “wave-particle” complementarity; the concept that a single Model alone may not be adequate to explain all light phenomena. These two different but complementary concepts are needed to treat light phenomena [6,7].

Even if this concept is hardly comprehensive from logical point of view, that light waves carrying energy may have a corpuscular aspect!

Later Bohr and fundamental particles:

a) Bohr; argued that; “a space-time” description of actual atoms and electrons is Not possible. Yet a description of experiments on atoms or electrons must be given in terms of space and time and other concepts familiar to ordinary experience, such as waves and particles. Bohr tell us, we must not let our description of experiments leads us into believing that atoms or electrons themselves actually exists in space and time as particles also he concludes that.

b) The distinction between our interpretations of experiments and what is really happening in Nature is crucial – to proving that Bohr’s opinion is right, the physicists witnessed philosopher “Immanuel KANT” who wrote in his critique of pure reason; “What May be the Nature of objects considered as things in themselves (...) is quite unknown to us. We know nothing more than our own node of perceiving them, which is peculiars us” [8-11].

And finally, Bohr conclude that; physics is not How Nature behaves, But what we can say about nature.

My comments:

a) In my previous work, I showed that light has not a wave nature, the wave view of light is not true. Also, I clarified that there is no particle nature of light waves - there are no photons.

b) Neither the wave model nor the particle model nor both together could interpret the light nature. Light is innocent from our false interpretations for its nature using the particle and the wave models. i.e., Bohr view of light is originated from invalid induction and invalid deduction for light experiments.

Max born

Physicists wrote:

A. Introduction: The Quantum Mechanics is a collection of postulates. These postulates underlie the Mathematical Machinery of Quantum Mechanics. They considered as the heart and the soul of Quantum Physics [12].

Any theory we dream up, of the physics of microscopic world must be able to explain the weird behavior of photons (or electrons) in the double-slit experiment (the reasons they occurs, the way they do). The dual "wave particle" nature must be built into any theory that purports to describe the micro world. This "wave-particle" duality characterize all the whole panoply of Quantum particles; electrons, protons, neutrons, atoms, molecules ... etc [13].

i.e., The "wave-particle" duality consider the central concept of the whole modern quantum physics.

B. Physicists believe that:

a) The first and the second postulates of Quantum Mechanics provide a way out of the double-slit logical conundrum; "By assuming that there is a complex wave functions exist that are somehow associated with the state of microscopic system and these wave functions carry probabilistic information about the outcomes of measurement of the observables of the system. Finally, they can interfere according to the principle of superposition - and their lies in the explanation of the weird observed behavior of quantum particles in the double slit experiment".

b) So let me tell you the story from its beginning

Max born story

Physicists wrote:

a) The double-slit experiment beautifully illustrates such central mystery "the dual "Wave-particle" Nature of the photons. Since the double-slit pattern occur even when we use very "low" faint light, such that the proposed photons coming one by one at the apparatus, so we understand that the double-slit pattern does not arise from the interaction of one photon with another [14], But it is clear that each photon passed through both slits at the same time, it behaves as a wave as though they wave fronts because as we knows that the wave is certainly travel through both slits at once. (When the photon behaves as a wave and passing through both slits at the some time, this means that the amount of energy "hv" divided through both slits which means that the light should change its colour, but this is never happen in laboratory). Yet, each photon produces a tiny spot on the screen as if it were a particle.

So the physicists consider the double-slit experiment as decisive experimental demonstration that the photon has a dual "wave particle" nature.

b) By other words, Max Born noticed that;

c) The double-slit pattern is formed by a cumulative arrival of a large number of the proposed photons (which they beginning

randomly and finally they constitute the pattern) [15].

d) And because Max Born thought that the double-slit pattern is an interference wave pattern, so he concludes that there must be associated with the motion of every proposed photon a kind of wave this is the origin of the idea that at its Most basic level, his theory must be formulated in terms of some sort of wave.

e) So, Max Born conclude that;

f) There must be some sort of radiation field governed by the wave theory and showing the properties of interference and diffraction patterns, but which did not carry energy, but merely served in some way to guide the photons which produces spots on the screen. Also, there could obviously some sort of "statistical relation" between the wave field and the number of photons because:

1) The double-slit pattern consists of a central very bright fringe (most light intensity) surrounded by alternative bright and dark fringes of weakness in light intensity.

2) So Max Born start the thinking of replacing the strict causality concept by probabilistic one.

3) Also it should be noted that;

After de Broglie suggestion that matter posseses wave nature. The physicists strategy was transferring the results they got about the behavior of the proposed photons in the double-slit experiment, to all micro particles such as the electrons - physicists construct a "double-slit" experiment But with sending electrons instead of the proposed photons, Replacing the light source by electron gun and Replacing the photographic plate by an electron detector (A screen covered with phosphor), and they confirm that each electron pass through the two slits as if it were a wave (i.e. Non localized wave front, Non concentrated lumps). Yet each electron produces a spot when arrive at the screen as a particle.

So max born inventing the new wave function Ψ :

a) As we saw, the double-slits experiment showing us How misleading the idea that the proposed photons follow "classical paths in geometrical space (trajectories), since each single photon passes through both slit together as a wave, consequently the trajectory is implacable to microscopic particles, we had to postulate a new state descriptor more suited to the Micro-particles, which is the wave function. So, the physicists constitute the first postulate of Quantum Mechanics [16].

b) "Every physical-Realizable state of a system is described in Quantum Mechanics by a state function Ψ that contain all accessible physical information about the system in that state".

c) It should be noted that here the physicists began to use new neutral words such as "physical systems" instead of strict words such as "particles" or "waves" also they not using the word "Amplitude" but "state function". The main reason is that they believe in "wave particle" duality so if they treat electrons (and other matter) as if they were waves, then Ψ represents the wave amplitude - However if they treat them as particles, then they

must treat them on a probabilities basis. Such that these wave functions carry probabilities information about the outcomes of measurements of the observables of the system [17].

d) Since the variable quantity characterizing deBroglie wave which is called the wave function denoted by ψ the value of which associated with a moving body at the particular point x, y, z in space and time should be related the Likelihood of finding the body there at the time t . (It should be noted that “the micro particles that described by Max Born are well-defined particles as had always been supposed”. But since the amplitude of any wave may be negative as well as positive, and negative probability is Meaningless- Hence Ψ cannot be observable quantity. So Max Born avoid this objection by saying it does not apply to the square of the wave function - \therefore so Ψ^2 is the probability density.

e) So max born conclude the second fundamental postulate of quantum mechanics, if the observable is the position for example:

“If a system is in quantum state represented by wave function Ψ then $p_{dv} = |\Psi|^2 dv$ is the probability that in an experimentally position measurement at time “t” the particle will be detected in the infinitesimal volume element dv ”.

Physicists wrote:

a) The Born interpretation for the wave function is the most widely held view of quantum mechanics called “the Copenhagen interpretation” physicists wrote, the Born interpretation of the state function is the Bulwork of Quantum theory, define the very character of that theory as intrinsically probabilistic, statistical and limited. Finally, they study the evolution of the Quantum state descriptor “the state wave function (i.e., how the physical properties of the system change with time) by time dependent schrodinger’s equation [17].

i.e. The physicists consider the double-slit experiment as the decisive experimental proof for introducing the probability language to physics.

They conclude that:

b) All kinds of particles are associated with waves statistically and all wave motion has its energy in the form of quanta.

c) All carriers of energy and Momentum propagate as waves and exchange energy like particles.

Born view is the second connectivity between the particle Model and the Wave Model (Statistically).

Comments

Physicists wrote:

a) As if by magic, the first and the second postulates of Quantum Mechanics have transformed of de Broglie’s vague notion of a Matter waves into a workable, beautiful mathematical constructs the state function.

About “The reality behind the state function”

b) The question now is, Do wave functions really exists? or it is just a Mathematical device.

c) Werner Heisenberg wrote, “The probability wave ... [stands] in the middle between the idea of an event and the actual event, a strange kind of physical reality just in the middle between possibility and reality”.

d) I think Heisenberg realized that the wave function could not be neither a mathematical device nor has an actual physical existence.

e) We will see that both assumptions are not possible [18,19].

Physicists wrote:

1) Ψ as a mathematical device

a) The foundation of your thinking about wave functions should be not the classical concept of wave, but rather the Novelation that state functions carry “probabilistic Information” about “How the particle whose state they represent would behave were their properties measured”, it does not carry energy.

b) However the physicists attribute to de Broglie Matter waves all the characteristics of classical waves as wavelength, frequency and amplitude.

One could ask “the famous question” in what space the following elements do exists?

λ Wavelength of what? and in what space it do exists.

ν Frequency of what? and in what space it do exists.

A Amplitude of what? and in what space it do exists.

c) For example, in a sound waves pressure varies in space and time - the question now, what is that entity whose variation in space and time constitute de Broglie’s waves.

d) Physicists answer is.

e) When thinking about Matter waves we naturally tend to envision a wave in the classical sense. However, Dirac has frequently stressed the fundamental differences between the waves of classical physics and the Matter of wave Mechanics.

f) Matter waves carry probabilistic information only, so the question now become: Does the probabilistic Information propagation could be in a wave form!!!!???

g) Beside these wave functions are complex functions, so it does not exist in our geometrical space – consequently.

The natural result that These matter waves could not interfere (superpose) in our geometrical space.

h) So, it couldn’t justify nor interpret the double-slit pattern. We need a real wave such that it could divide through both slit and then recombine again, mathematical device couldn’t divide and recombine.

Some physicists wrote;

2) Ψ as having an actual physical existence

a) These wave functions manifest themselves only indirectly

through their influence on the Behavior of Quantum particles as they propagate through space.

b) How the Matter wave could affect or influence on quantum particles despite its not energy nor matter, it does not have an actual physical existence.

c) Also, for those physicists who wrote that matter waves may have an actual physical existence, they should remember that the results of the double-slit experiment “rule out such hypothesis; the pattern of dots seen at the detector after short time clearly shows the particle-like qualities of electrons (as the physicists believes) [20].

Comments

First: I clarified in my previous articles the following:

a) Neither the double-slit pattern is an interference wave pattern, nor the single slit pattern is a diffraction wave pattern.

b) Neither the photoelectric effect nor Compton effect demonstrating the particle nature of light.

c) Light does not have a wave-particle nature.

d) There are no photons. No one could imagine such photon.

Second: Max born never said one single word about “How physically the microscopic particle could acquire such property. In My view.

Invalid induction and invalid deduction for the double-slit experiment leads us to such new drastic alteration to the philosophy of the whole physical science by introducing the probabilistic language to physics instead of strict causality.

Third: What max born mean physically by saying that “the micro-particles exists through the whole wave (potentially presence, mysteriously omnipresent) Does he mean that the micro particle is localized only at the instant of observation, or does he mean that the particle does exists at a particular but unknown point with respect to us. In the first case No comments because such thinking is contrary to what we have seen in the Wilson cloud chamber and is contrary to the principles of sound scientific thought, however in the second case such thinking is in complete agreement with the classical idea that “the particle cannot exist at two points at the same time. Consequently, the particle does have a trajectory whatever we know it or not, which Means that the classical deterministic (philosophy) view is not touched.

a) About my first question, In the present article where does this proposed photon leads us in our quest to understand the reality behind light and matter.

b) My answer: such photons with its “wave-particle” duality leads us astray.

c) In my view each of the particle and the wave models exclude each other and there is not any possible physical connectivity between them [21].

d) Light is not waves, nor particles, nor both, light is different. In my previous work, I tried to find out a new possible model for the

transport of light energy the wavy-ray model. Now, we should look for a new different light propagation form.

e. However, if you believe in the quantum physics then remember that you should accept the following genius ideas.

f. Concerning the questions such as:

g. What happened to the electron during its jurny from the electron gum to the obstacle of two holes toward the phosphoric screen?

h. Quantum physicists telling you.

1. This question is not scientific question, its meaningless, of course not because we cannot answer it, but because, only questions about the results of the experiments has a real significance as Dirac Said; No scientific meaning for any question between two observations such questions should be regarded as outside the domain of science.

OR

2. When we are not looking at microscopic particles, they behave in ways that correspond to the classical wave model; yet, when we measure their properties they behave like classical particles.

OR

3. When both slits are open, each electron passes through both slits, as if it were a wave. Yet each makes a tiny spot on the screen, as if it were a particle.

OR

4. There is no strict causality, the same causes do not always produce the same results... etc.

Notes “1”

A. I will assume that the classical view of light is true; that light is E.M. waves, let us see what is the particle properties of such waves what is that photons?

Einstein “The creator of the dual” wave-particle” paradigm”.

i.e., Einstein in 1905 introduce his photon concept to physics ($E=nh\nu$). The physicists accept the photon concept on faith and consider light as a group of photons (i.e., that the photon is the fundamental unit of light). This is the birth of the dual “wave-particle” paradigm [22]. However.

a) It should be noted that Einstein himself wrote later, all physicists think that he knows what a photon is, I spent my life try to find what a photon is, and I still don’t know it.

b) Let us see now, the wave properties of quantum particles:

B. de Broglie; “the creator of matter waves:” the physicists accept it on faith.

a) In the beginning de Broglie thought that the electron for example is tied to some wave train, such that the pilot wave carries electrons on its crests. i.e., electrons guided through space by such wave. However, such explanation assumes that electrons

follow trajectories, and we know from "HUP" that trajectories are forbidden for micro entities. In his subsequent paper, de Broglie tried several different interpretations of his elusive waves.

b) In his book "current interpretation of wave mechanics, he ends up with suggesting the existence of two waves instead of one vague wave.

c) In "understanding of quantum physics" by Michael A. Morrison page 37; he wrote.

d) "It is not clear that de Broglie himself knows what he meant by his matter wave".

e) i.e., At the beginning there is no specific physical meaning was attributed to matter waves or wave functions.

At the end:

f) Physicists have been unable to agree on the nature of such matter waves. The physicists differ considerably on this issue – No consensus among them. The physicists use the wave-functions in their calculations without really means what they are talking about.

C. Schrodinger: The creator of the fundamental equation of quantum mechanics.

a) The "wave-particle" duality is considered as the central concept of the whole quantum physics. Physicists wrote.

b) Schrodinger's equation describes the evolution of the physical systems in which the "wave-particle" duality is significant.

Schrodinger's view

Earlier Schrodinger:

A. First Schrodinger thought that Matter waves are just three-dimensional waves in space and time like electromagnetic waves - for a time he believed that he could use wave mechanics with the same kind of concepts as Maxwell's theory in his first paper, Schrodinger was not very certain, he believed that the intensity of the wave function (that is the square of its amplitude) represented the actual density of charge in the atom.

B. However, Schrodinger's view is not accepted for the following reasons:

a) How we could interpret the following facts about the electrons; we could count them, we can measure their masses, charges ... etc.

b) How we could interpret the electron track in Wilson-Cloud chamber.

He denied the observable particle localization upon which all our knowledge of the micro-physical world is based.

c) It is impossible to describe the collision of two electrons according to Schrodinger's view.

C. It should be noted that.

D. Again, the physicists accept Schrodinger's equation on faith. However, later: When Schrodinger knows that whatever Ψ is,

it is not a conventional undulation in space like a classical wave, he regretted for his contribution in the Quantum mechanics as written in "Quantum Reality" By Jim Baggott, page 56, 2022.

E. Quantum mechanics postulates create an upside-down situation.

It should be noted that;

a) For the first time in the history of physics. We have the mathematical equations that we do not know what is its physical meaning. In contrast to the natural situation that we have our own particular physical meaning first, and then we try to represent it by formulating a shorthand illustration i.e. a mathematical equation.

Heisenberg: the creator of the uncertainty principle. In the beginning when he created his principle he was thought that there is a definite limit to the accuracy of certain measurements due to the act of measurement itself, i.e. due to the alteration of the micro systems by the energy of observation by unpredictable ways, because we use macroscopic instruments to detect the microscopic entities.

However, Bohr disagreed with him and it was the Bohr advice that uncertainty is inherent in nature, due to the dual "wave-particle" nature of the micro-verse. Consequently, the act of measurement has nothing to do with it. (Baggot, page 57, 58).

Notes "2"

About information propagation

The Birth of Information travelling idea

Physicists wrote:

a) In the double-slit experiment we cannot obtain the pattern by closing one slit and opening the other vice-versa with equal time intervals, in such a case we obtain two single-slit patterns, which leads us to the idea that the behavior of the photons depends on (by mystery way) whether the other slit which it didn't pass is open or closed; Each of the proposed photons knows precisely whether the other slit which it didn't pass is open or closed, it can be informed precisely where it should go to contribute to the pattern. So, information could travel a way and it is faster than the speed of light itself.

b) In 1972; Clauser and Freedman confirmed the information travelling idea by showing that; Two entangled quanta responded instantly across space when one or the other was detected.

c) In 1979; the delayed choice experiment showed that despite the photon could not have been informed whether to behave like a particle and take a definite route or to behave like a wave and propagate simultaneously along the two routes, it actually knows.

i.e., this experiment confirms that information travels faster than the speed of light and confirms the strangeness of the Quantum world.

d) In 2015; the physics textbook titled "What is a photon" and because all the results of the modern experiments (using the duality paradigm) are contrary to human logic-physicists advise us to abandon human logic and replace it with cosmic logic instead!

e) Finally in 2022, the physicists confirm the quantum entanglement, the prediction of quantum mechanics that; If we measured the property of two widely separated pairs of quantum particles, then measuring one particle in one place can immediately (Instantaneously) affect the measure of the other particle even it is million of miles away (No local causality) [23].

My comment

Physics study how nature behave-our universe is composed of four components: "Matter, energy, space and time".

Matter can be moved either by a translational motion (in straight line or in curved path) or as periodic motion (osillatory motion or wave motion) - Energy can be propagate either by wave motion (transverse waves or longitudinal waves) or particle motion.

I wonder; to what component of the universe does this "information" belong? it is not a matter nor energy nor space, not time of course. In my view, we need something that has an actual real physical existence to travel or to (propagate). In my view "Information travelling" is a "Misleading expression" it leads us a stray too.

Final word

I have classical mind, the wave model and the particle model are incompatible, neither Einstein photon nor Max Born statistical view succeeded in Reconciling these two contradicting models. These two models cannot be joining together by any physical means because they are mutually exclusive and logically, they are antitheses. In my view the wave particle duality paradigm is the main obstacle for us to approach the actual light propagation form.

There is a new undiscovered model, which has completely a new pictorial description for the transport of the energy of light, and we cannot approach such light propagation form using the particles and the waves languages. Such undiscover model is completely different than the transport of energy between material objects.

Conclusion

Light is different. Let the future be the judge between us.

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