A new nature of light

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Abstract

This work is a part of unpublished ideas about the fundamental physics and there evolution over time. In this paper, I started by speaking about light and its nature as the cornerstone of physics. Then we describe the evolution of ideas about light and interpretations of its nature in terms of *waves* and *particles*; A duality which lead us to suggest a new nature of light at a halfway between these two interpretations. We reinvented the photon that we renamed "photillon". However, it remains to test this new approach in the interpretation of light-related phenomena. An attempt to interpret Young's interference fringes is made on the basis of this new conception of light and a new interpretation of the Planck constant has emerged naturally from this new nature.

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1. The evolution of ideas about the nature of light.

The nature of light is sometimes described as a wave and sometimes as a current of photons. What is the right description? Who is right? Who's wrong? Thus, for Greek atomistic objects emit particles reproducing the shape of objects so small in our eyes. For Euclid and Pythagoras it’s our eye that emits a "quid" and allows the vision. This description will be refuted by Aristotle because then we could see objects at night, even in the absence of light. However, this is the side of Egypt that geometrical optics has been thoroughly studied the work of Alhazen (Al Hassan Ibn Al-Haytham). He describes the light mechanistically, as a stream of heavy spheres emitted from point sources in straight rays could be reflected, refracted and perceived by the eye. The seventeenth century will develop a detailed description of what is now called geometrical optics (with the work of Kepler, Galileo, Descartes and Bacon). In 1665, Francesco Maria Grimaldi described the phenomenon of diffraction, so that at the end of this century two models of light are competing for the upper hand: the particle model of Newton and the wave model of Huygens.

Both models are convincing, though contradictory, they can explain some observations of geometrical optics. However, they differ on how light interacts with matter. With their experimental means it was impossible to determine which model was right or not. It was not until Foucault's experiments (1850) and Fizeau (1851) to determine the speed of light in water that gave reason to the model of Huygens.

Thus, from the mid-nineteenth century, scientists were convinced that light was a wave. It remained to determine the properties of the medium in which the wave is propagated: ether. It is in this view that Michelson and Morley (1887) proposed an experiment that has now become a classical physics. The Michelson and Morley allowed a very accurate measurement of the difference in speed of light in two perpendicular directions: they discovered that there was none! The speed of light is the same in all directions (idea at the basis of the Einstein theory of relativity), which contradicts the idea of a light propagation medium. The light is a wave but not material, which corresponds to a perturbation of the vacuum itself!

In the vacuum, one can find energy as an electromagnetic field. This is what scientists discovered in the late nineteenth century (with the experimental work of Faraday) and Maxwell (1864) provides a very detailed theoretical description of electromagnetic phenomena to realize both electrical phenomena, magnetic and of the propagation of light.

In 1905, Einstein, in a paper which became a classic of physics, suggested that it was the light itself made up of "quanta." It aims to describe light as consisting of small particles named “photons”. This helps to explain photoelectric, Compton effects, and black body absorption; some phenomena that the description of Maxwell fails to explain. Does this means that all physical nineteenth century which has rejected the model of Newton. This is not quite true, we had to take into account both aspects of light if we account for all experiences that we can do with it, consider that light is both wave and particle.

This is called the dual nature of light. It’s a wave if we consider diffraction experiments and is corpuscle if we consider the black body radiation and the phenomena mentioned above.

In reality, and this is all the subtlety of quantum mechanics, it is not possible to decide between the two approaches and one should speak at the microscopic level called “warticle”, which is a contraction of wave and particle, ie an object that is appear as wave or particle depending on how it apprehends ... this description is beyond our usual understanding of the world,

Now we are forced to accept this duality because there is no other way to consider all phenomena of light with only one or another of its aspects. The aspect wave was established in watching and interpreting a number of optical phenomena, and was reinforced by the appearance of the Maxwell equations describing electromagnetic phenomena, often light sources, as waves. The great success of this interpretation in the explanation of physical phenomena was the fact that we are attached to an image of a wave as a mechanical one. This aspect has become indisputable; this is evidence that the development of a theory can't be unconnected without imagination in the real world objects. The "electromagnetic wave" object is etched forever in the imagination of physicists.

On the other hand, with the great success of the corpuscular aspect to explain the photoelectric, Compton Effect and quantum mechanics, it became imperative to take it into account. It remained still questions regarding this nature which were not resolved: When we talk, for example, the Compton effect: it's said there is "decomposition" of the photon to a "smaller" photon with lower frequency than the initial photon frequency, and a transmit momentum electron. In the readings about this, it was not question of how is this decomposition of the photon energy is made. It is just seen how energy and momentum conservation is done. From a photon with hν value of energy to another with hν' energy appears simple for someone, but is not clear for others.

In summarizing; every time we are faced with a problem of light, we always place it in one or other of its natures. In all cases, we can find a solution to the problem. There was therefore no need to invent a new nature. However, an objection is obvious: It is not easy to admit two different types of the same object. The problem is so rational. The advent of quantum mechanics between 1924 since Louis de Broglie and to this day has, in some ways, framed the two natures in the second quantization formalism. Photons and electrons are well described in the context of quantized fields. Since you might not look for an alternative to the issue of this "wave-particle" duality.

2. A new nature of light

Before going further, it is important to agree on the idea that the interpretation of a physical phenomenon is a logical representation to our senses, but may not necessarily reflect reality. On this basis, it begs the question that if it possible to reconcile these two natures? I think we have already tried to do, but without success. Yet it seems to me that this reconciliation is possible by rereading and reinterpreting different phenomena related to light and electromagnetic waves.

We will try to explain the phenomena of light through a new idea: The manifestation of such light we know it is very different. We will consider some phenomena to establish this new nature. Then we will try to see if this idea would stand up well in the other phenomena of light description.

Let's start with the photoelectric effect: A light, with a ν given frequency strikes an electron, it tear it off its atomic state and makes it in a free state with a certain kinetic energy. The energy value required to pull electron and its kinetic energy value released by making an experiment on several values of the frequency of the incident light. According to the layout diagram, we understand immediately that the electron needs a certain amount of energy, and therefore a certain ν value of the frequency of the light; the electron release frequency related to its atom. A higher energy, and therefore a ν value greater than this threshold value νt allows this electron to acquire a speed according to the difference (ν - νt) between the used frequency ν and the threshold frequency νt.

The Compton Effect is not far from this description. An incident photon is absorbed, which results in: an electron acquires part of the energy, and the other part is taken by a photon with a frequency smaller than the frequency of the incident photon.

Based on these two phenomena, we can deduce that: The light has an energy proportional to its observed frequency E = νh: A well-known relationship between "energy" and "frequency" of the light, but I believe, is misinterpreted. What one says is that light energy is proportional to its frequency: In other words, the light seen as waves or "photons" depends on its frequency and measurable energy. Frequency is a measurable experimental fact, like energy. We tend to systematically link frequency to a wave. Will we follow this trend in this way? Behind this apparent reality may be another deeper reality. The experience can be misleading or misinterpreted.

To elucidate this idea, we give an opposite example and make the shooting experience with an automatic rifle that can shoot balls in a successive manner. One can calculate the repetition frequency of these balls by trusting his hearing. The frequency, in this case, has no relationship with wave phenomenon, because it is perfectly understandable. Similarly one can imagine a multitude of elementary particles of light of the same species that gives the sense of a frequency and therefore a wave if the production of these particles of light is sufficiently intense and evenly distributed to occupy all the space surrounding their source. This image alone can explain the nature of light without going further, since frequency is therefore the result of our receivers, sensors, or a human sensory technology created by man. In addition, the imagination of a wave is no more than a statement of a mathematical result related to the historical evolution of ideas in physics far from unanimous and undisputed.

On the other hand, we gave the image of particles of light (photons) with variable frequency and variable energy, however, we do an image of "large grains" of light and "small grains ", since these grains are reliant on their respective frequencies. Then one can also imagine smaller grains energy proportional to their frequencies. Following, through this scheme we must converge to the smallest grain of light which is the basis of all others, where ν = 1. Therefore the photon that has the smallest energy has a frequency equal to 1 unit/s.

In a real experience, things happen differently. We measure, rather the frequency of light, then to say that this light are photons which have the measured frequency. It is confusion between the experimental fact and conception of the object.

In other words, one can observe that the "photon" is loaded with too much information since it communicates its energy value and its frequency for the sole purpose is to move in space. Accordingly, to use this information, frequency (inversely proportional to wavelength λ) must be a manifestation of something extended in space, and energy must be a manifestation of something extended in time. It must be the addition (superposition) of several smallest photons over a time of a second (1s), and the frequency must be the manifestation of many of these new smallest "photons" for a second. Which is, in a way, the principle Heisenberg uncertainty about space and time: namely the relationship $\Delta x.\Delta p \geq h/2$ or $\Delta E.\Delta t \geq h/2$: a very familiar relationship to physicists.

In clearly; one can provide an image of light characterized by frequency ν as a set of small grains which manifest a frequency detected by measuring means. They move at the speed C in "Indian file" ie. ”a line of people standing behind each other”. The distance λ, between two successive grains, determines the observed frequency of the light in accordance with the relationship $\nu=C/\lambda$. The frequency ν obtained in a detector is thus an apparent frequency (measured). It’s refers to the number of these photons per second. The energy measured by a time unit by a measuring device is the energy of the "small photon" multiplied by the number "ν" passed per a second.

It appears therefore, easy to see light having a number ν for frequency and a value $h\nu$ for energy, not as a compact object that is commonly known as "photon," but rather as a discreet continuity, distributed in space and time of small energy packets. A sequence created by a source with a rate of production equal to ν in a given direction. I have baptized these particles "photillons" referring to an image of small photons (equal to photons when frequency $\nu=1$), but with one crucial difference; The light source, instead of saying that it generates a photon of ν frequency and have $h\nu$ value of energy, it is more reasonable to say that it generates ν photillons per second each one having an energy value equal to $h\nu/\nu = h.1$ (in absolute value of energy). In a second, the measured energy is obviously equal to $h\nu$.

Once the new concept of light is well-defined, it must be put to the test to interpret optical phenomena and electromagnetism

3. Planck's Constant

From this description of light, we can beautifully interpreting the value of h. This Planck’s constant appears in this context as an energy manifestation of the smallest grain of light. Rather, it is the action of this grain of light (photillon). This constant is totally related to light. It is found in the explanation of the black body, in the photoelectric effect, the Compton Effect, and all reactions that involve the calculation of light energy.

4. The experimental event

The experience is often an essential way to elucidate a theory in physics. To convince the scientific community, the emphasis is usually on an interpretation of one or more experiments to argue the validity of a theory. However, from an experience to another, we often see the nature of a physical phenomenon changing. I refer to our famous case of light that during the evolution of science, its nature changed several times, using different interpretations to our sensations and experiences.

The experience gives us so raw information, but it remains to our sensory receptors to interpret with a logic which coincides with the human sense, but not necessarily in all cases (I note the case of the rate constant light in all repositories that is contrary to common sense). If we do not object to this interpretation, then, it persists over time and becomes an acceptable theory by the scientific community. Over time, a theory can be edited, modified or totally frustrated, and then leads to a new theory.

In order to elucidate this new nature of light, we must confront one or more optical phenomena and electromagnetism. The interference phenomenon is one I would like to confront.

5. The Young's interference phenomenon

A monochromatic light beam passes through two identical slits, it is observed on a screen, of bright and dark interference fringes. To interpret this experimental fact, we will resume known explanation and redesign it to fit with our new concept.

In the Huygens theory the passage of light in the slit is interpreted as spherical source dots on its surface. The interference pattern and the step of the fringes are given according to $k\lambda$; the walk path of the incident rays. The dark fringes on a corresponding to a walk path equal to $(2k+1)\times(2/\lambda)$.

It is true that Huygens theory of waves explains well the interference phenomenon. The wave function or the wave equation is a very powerful mathematic tool in describing the physical objects, because they give us a good representation. Now we have a new concept of light, We wonder if we give a good analysis to the experimental fact? See this description:

On arrival slits, the light scatters in spherical form (we use the same image made by the Huygens theory). We don't consider that light is a wave; it's then considered a queue of photillons which begin from a slit throughout all directions. It is important in this context, that's difficult to see how light scatters in passing through the slit, because this phenomenon involves interaction between light and matter. So we used a complex quantum phenomenon which we will not consider.

Calculating the optical path difference between the two rays is the same, so we obtain bright fringes as a result of the superposition of rays relative to a walking difference corresponding to $k\lambda$, and dark fringes on a walking difference corresponding to $(2k+1)\lambda/2$. The question is now: how to explain these obscure fringes with this path difference?

If we call the value $\lambda/2$ as a new wavelength λ', then we get a path difference as $k'\lambda'$ which may correspond to a short wavelength of light equal half of the original wavelength.

In other words, the dark fringes can be seen as a manifestation of a light with a shorter wavelength in half (or a frequency twice that of the origin one). I use, obviously the word "wave" for ease of understanding, but it is understood a superposition of two light rays leading to a ray with a step equal to $\lambda/2$.

But why the fringe is dark? We said so, we do not see it, because, if the light used is in the band of visible light with a wavelength λ, the obtained light in dark fringes is in the ultraviolet band with a $\lambda/2$ wavelength. It's invisible to our perception, but we can perhaps measure it, allowing us to verify the validity of this theory.

An important point that should not be ignored; it is clear that in this context, we have not discussed light-matter interaction. We stuck to a simplistic interpretation of the experience. We just said that there is a reflection of visible light on the interference screen. Thus explanation above can't be satisfactory.

Another way that we can use to consolidate our conception of the nature of light is to get spectroscopy information (the diffraction which is close in its explanation to interference) to see if there are spectrum in the near infrared, which duplicate in the band of visible light or visible spectrum which are duplicated in the ultraviolet band.

7. The spectrum red-shift

Other phenomena can be explained with this new concept of light. I evoke the case of the spectral red-shift which can be seen as a simple Doppler effect of light. Stars and galaxies motions can be done through relative speed of light calculation using this red-shift measured of theirs chemical elements. However, we must abandon the principle of the constancy of the speed of light in vacuum, le basis of Einstein special and general relativity. It appears natural to say that the spectroscopic wavelength measured reflects the spreading of the distance between two successive photillons due to a moving source (stars).