

THE NATURE AND SPEED OF LIGHT

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ABSTRACT

It has been shown in the article “The basic space-time equation of the Universe” www.wbabin.net/philos/kohut3.pdf that the speed of light expresses the speed of cosmic expansion as it is an escaping speed by which the Universe escapes from itself (escaping speed of opposite sides of the Universe). So many mysterious speculations have been made about the light and its speed, that it is necessary to find reasonable explanations for them.

DEFINITION OF LIGHT

Light as a quantum of radiation (photon) represents an elementary particle consisting of bipolar connection of anti-poles “+,-“, which thanks their mutual attraction and repulsions perform a permanent oscillation (vibration, pulsation) manifesting outwards as an electromagnetic wave during a flight. This fact is a consistent and factual explanation of the “wave-particle” duality of light. The radiation, as a bipolar unity of anti-poles, manifests in the form of elementary particles (quanta, photons), but as a form of their mutual attraction and repulsion (oscillation) represents a wave of electromagnetic field. The mutual dynamics of electric and magnetic parts of energy of radiation is described by Maxwell’s theory of the electromagnetic field. The photon is an elementary quantum of electromagnetic field manifesting outwards by electric and magnetic characteristics being in a mutual dynamic unity, which is a clear evidence of the bipolar unity of light. Only a bipolar dynamic unity of contradictions can be an internal source for the oscillation and energy of a photon.

The photon is an oscillating elementary quantum dipole or a beam of pulsating quanta. It is not a point-like particle, but represents the elementary quantum of space, which, through its external relations, is connected with all other parts of the Universe (its positive pole “+” is connected with all negative ones “-“ of the Universe and its negative pole “-“ with all positive ones “+”). Photons do not move “in” a free space-like vacuum, but thanks to their external connections, they move “towards” all other parts of the Universe, which are also spatial holders (carriers). We do not need any background, such as an undefined vacuum in order to allow particles to move in it. All elementary particles, interactions, force fields, as well as the vacuum are only certain structures of elementary bipolar quantum connections directly and mutually connected. As everything is connected with everything else, so every part moves towards all others thanks their mutual connections. The vacuum consists of elementary quantum connections between particles. We need no background as necessary condition for the motion of objects and so it is incorrect to say that particles move in space. We can only say that they, as holders of space, move towards other spatial objects thanks their mutual connections, which all are also space holders. The expression that something moves in space is only an approximation, which is incorrect at the quantum level. This is the main reason for the huge interpretational problems of quantum theory, which does not know the real essence of quantum reality, as it accepts moving particles as independent of space (vacuum). All

interpretational problems of quantum physics are a consequence of trying to describe the motion of elementary particles “in” space represented by coordinate system.

There is a cardinal difference between dialectical understanding of “wave-particle” duality and Bohr’s complementary principle, accepting this duality as a strange property of Nature without its deeper understanding. Bohr’s explanation was necessary because of the relentless and atrocious fight between supporters of both conceptions – particle and wave. W. Heisenberg created a matrix model of quantum mechanics and was a supporter of the particle conception and discreteness. He argued that the transitions between different states are performed by quantum jumps and no continuous waves are needed for an explanation of the jumps. E. Schrodinger, as a creator of a famous wave equation, was deeply convinced of the wave character of all elementary material components, being packages of interfering waves of matter. But he did not know how to explain how to keep these waves in stable structures and prevent their disintegration.

Einstein as a discoverer of light quanta (photons) tried to explain a “wave-particle” duality as a consequence of different densities of photons in places with different amplitudes of electromagnetic wave manifested by different brightness. He supposed elementary particles to be compact corpuscles with a homogeneous interior and without any internal structure. Einstein interpreted the wave character of photons and other particles, as well as probabilistic Schrodinger’s “psi-wave”, as a consequence of a group flight of many corpuscles and refused the wave character of a separate particle. But experiments later showed that individual movement of an electron (particle) manifests itself as a wave.

While “wave-particle” dualism divided quantum physicists into two categories, none doubted the probable character of the micro-world. But Einstein categorically denied this explanation considering quantum mechanics to be an incomplete theory. The reason for probabilistic and statistical manifestations of quantum reality was quite logically explained by A.N. Whitehead. For him Nature was one common cumulative process with mysterious a property: every separate phenomenon influences the whole Universe and at the same time is influenced by it. Although this understanding was correct, the mechanism of connection of everything with everything was not explained. N. Bohr was also convinced of this property of Nature, as it corresponded with his knowledge of Eastern philosophies. So he considered Einstein’s view about the non-existence of direct action at-a-distance to be naive. Later experiments showed that Bohr was right.

Let us come back to light. Quanta of electromagnetic radiation – photons, in comparison with other elementary particles, have some specific properties. A photon is an elementary connection of opposite poles + and – (quantum dipole) with spatial characteristics – volume and length. Just the simplicity of a photon allows its perfect oscillation (vibration) in a plane perpendicular to the direction of its flight. As it is a free quantum, it cannot resist its dragging by an expanding Universe in a direction perpendicular to its oscillation and so it has no rest mass and its speed expresses the speed of cosmic expansion. Such is the nature of the speed of light as one of the basic physical constants, unknown until now.

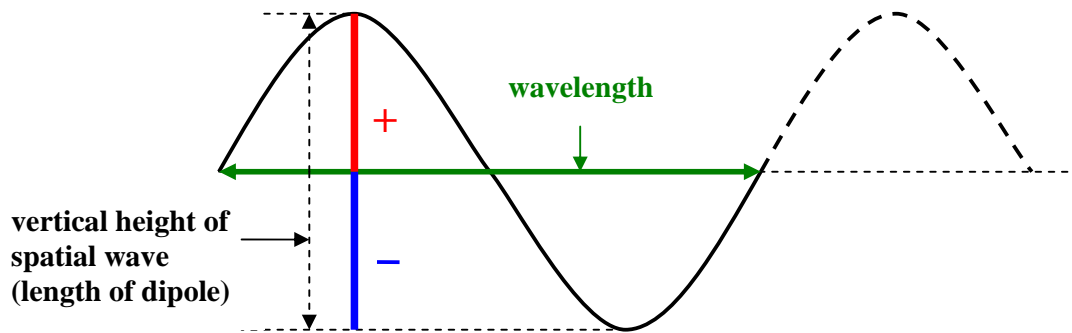
In more complicated structures (particles) with more quantum connections, it is impossible to guarantee the oscillation of all quantum dipoles simultaneously in one plane, and such particles resist their dragging by an expanding Universe, which is manifested by their rest mass.

A light quantum is an oscillator, whose oscillation can be represented by the rotation of a quantum dipole \mathbf{i} with circumferential velocity \mathbf{v} :

$$\mathbf{v} = 2\pi r_i / T_{ot} = \pi \mathbf{d}_i \nu_i$$

T_{ot} – time of one rotation of the quantum dipole,
 ν_i - $1/ T_{ot}$ – frequency of quantum dipole oscillation,
 r_i - radius of dipole (half of its length),
 d_i - length of dipole.

A photon performs two types of motion: horizontal and vertical. Horizontal motion represents its flight as a consequence of its dragging by cosmic expansion. Vertical motion is manifested by its oscillation (rotation) thanks mutual attraction and repulsion of its opposite poles.



As we can see, a photon manifests its characteristics not only by frequency or wavelength, but by being an elementary quantum of space, it represents the flying quantum of waving space with its vertical height (equal to its dipole length). As a moving, waving quantum of space, thanks to its external quantum connections, it manifests outwards like a moving, waving electromagnetic field. As a moving quantum of space, the light wave does not move “in” space, but “towards” other elementary spatial quanta, influencing them by its internal oscillation.

From the dialectical relation between the internal energy e_i and length d_i of a quantum dipole, derived in the article “The unity of Newton’s and Coulomb’s laws” www.wbabin.net/philos/kohut4.pdf

$$e_i d_i = \alpha hc / \pi$$

we can obtain the following relation between the vertical height d_i and horizontal wavelength λ_i :

$$d_i / \lambda_i = \alpha / \pi$$

A photon is not only an electromagnetic wave but, at the same time, the oscillating moving spatial particle. From the relations $\nu_i = c / \lambda_i = \alpha c / \pi d_i$ and $\mathbf{v} = \pi \mathbf{d}_i \nu_i$ follows:

$$\mathbf{v} = \alpha \mathbf{c}$$

So we have derived the circumferential velocity \mathbf{v} which is the same for all photons. It is irrelevant, whether we interpret the internal motion of a photon as an oscillation, vibration or rotation, because the rotation projects to the perpendicular plane as an oscillation. The internal motion of a photon can be detected only through its action (by its external quantum connections) on its surroundings and is interpreted as an electromagnetic wave. This means that the internal motion of a photon manifests outwards as a changing intensity of its action on measuring instruments, what can be interpreted as a changing and pulsating electromagnetic field or wave.

A photon can oscillate in all possible directions perpendicular to the direction of its flight. If it oscillates in only one direction, it is polarized. Then we say that the vector of intensity of its electric (or magnetic) field oscillates in one direction.

Oscillation or rotation of a quantum dipole of photon clearly shows that it has a spin as an external manifestation of its internal structure and motion. But elementary particles are understood to be corpuscles without any internal structure. When an electron demonstrated its ability to deflect in an unexpected way, this property was named as the electron's ambiguity, later as a spin, because similar properties were also demonstrated by other particles. Physicists do not know the real reason for spin and only accept it as a specific manifestation of matter, although spin is clear evidence for the existence of an internal structure of an elementary particle. First idea, that the spin of electron is a manifestation of its rotation, was refused, because its circumferential velocity showed to be higher than speed of light. The internal motion of a particle as a result of its internal structure was not accepted, although spin is only an external manifestation of its internal motion. The internal motion of elementary connections inside a particle also influences the motion of its external connections, through which the particle moves towards other objects. At the same time, the motions of external mutual connections between particles influence their internal motions. The various possible manifestations of a particle towards a magnetic field means, that the particle has various possibilities to perform its internal motion and manifest itself outwards. The so-called motion of a particle "in" a magnetic field is, in reality, the motion of mutual elementary quantum connections (dipoles) between particle and objects, creating the magnetic field.

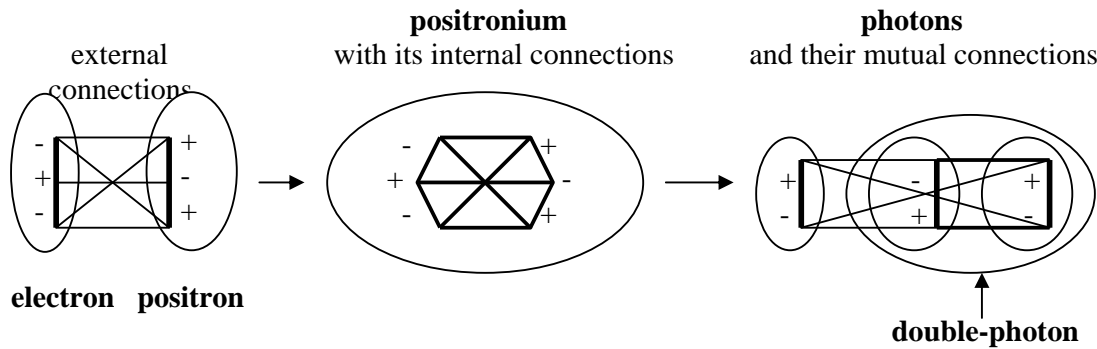
A magnetic field is created by moving external connections coming from electrically charged objects. It is interesting to state that Einstein, interpreting the motion of one system in relation to the others, at the same time, did not represent the motion of a particle as a motion of its space towards spaces of other objects, but as a motion of a mass point inside a space. In this aspect Einstein and other physicists did not overcome the Newtonian mechanistic model where massive objects move in space.

As has been mentioned, a photon has a clear and simple structure. It is created by a single elementary quantum dipole, and it seems that sometimes, it can exist in the form of an interconnected double-dipole, which really is a structure of four quantum dipoles. A photon can associate with other particles without disturbing their internal structure and so bring them into excited states. It can also associate with itself without creating a new particle. Its spin $j=1$ means that the intermediate state known as positronium, created after an electron-positron collision, can decay either into two or three photons. A photon in relation to a magnetic field can deflect to the north or south magnetic poles or stay without any deflection. This means that the dipole is right-handed or left-handed, or will perform both these motions

simultaneously, meaning that it exists as a double-dipole, where one dipole is right-handed and the other left-handed with a neutral manifestation towards a magnetic field.

A photon can exist in the form of an elementary quantum dipole consisting of opposite poles “+” and “-“ or as an associated composition of two “+” and two “-“ poles. The basic structure of the electron is created by one positive and two negative poles, so an electron consists of two quantum dipoles. Its structure can be excited by associated photons.

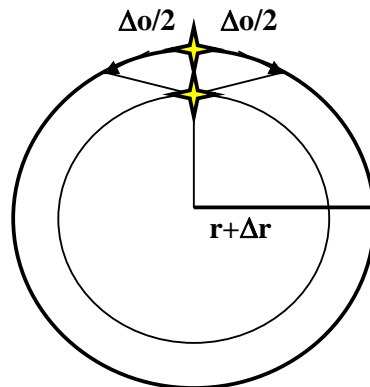
The collision between an electron and positron and the consequent decay of an intermediate positronium into two or three photons, can be illustrated by the following scheme:



SPEED OF LIGHT

Emission of a quantum of electromagnetic energy (photon) is a release of elementary quantum dipole (+,-) from a certain complicated composition of quantum connections (source).

Existence of any source of radiation in a certain place causes an unceasing emission of energy quanta – photons, which, thanks cosmic expansion, are dragged in all directions creating spherical waves, because the Universe, as a three-dimensional surface of a four-dimensional sphere, expands in all directions uniformly. For a better understanding we can imagine the Universe as a circle:



The source of radiation is presented as a point on this circle. From this point the radiation spreads by the expanding Universe in two opposite directions and creates a curved abscissa. The speed of increase of this abscissa is just the speed of increase of the circumference of the Universe:

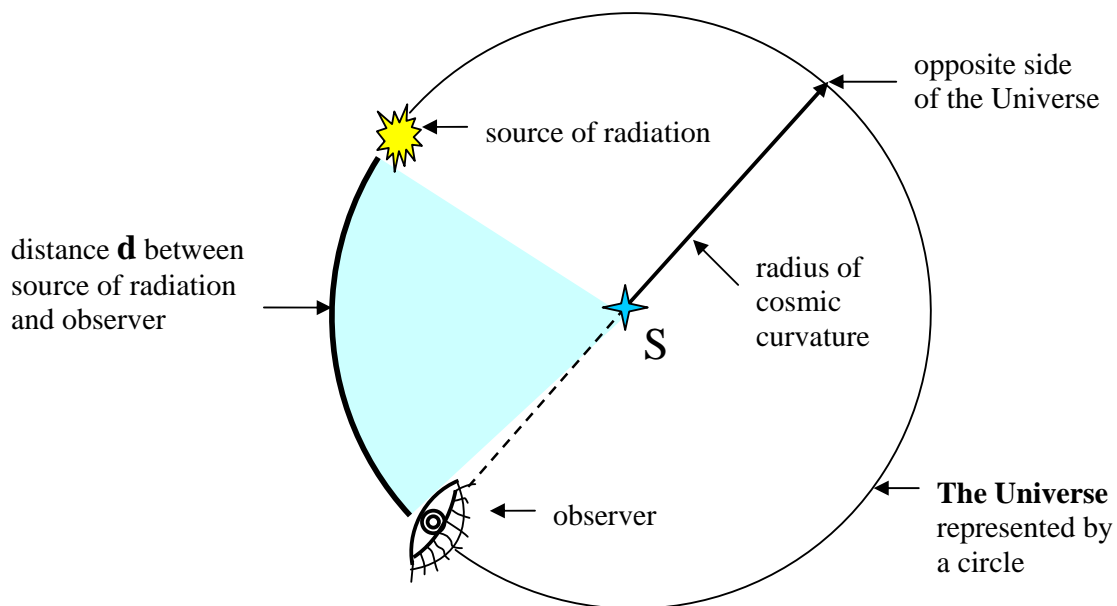
$$\dot{o} = \dot{d}o/dt = 2\pi\dot{r}$$

As light spreads from the point of radiation in all directions, its speed in one direction is:

$$c = \dot{o}/2 = \pi\dot{r}$$

If the light ray is radiated from the opposite side of the Universe, its speed towards us is equal to zero, $v = 0$, so it is at rest, and the opposite side escapes from us with the speed of light, which is the escaping speed for the Universe. Einstein's formula for a summation of speeds is not valid. The classical formula is correct. The speed of light has its speed c just towards near surroundings. The speed of light is at rest towards us at opposite side of the Universe, which represents for us the horizon of observation. This light gradually goes away from the opposite side and its speed starts to increase towards us. When it comes to us, its actual speed is c , which is lower than it was at the moment of its radiation, as cosmic expansion decelerates. If the source of radiation is at a distance d from us, it moves from us (as observers), thanks to cosmic expansion, by the speed v_d . Then the speed of light, after its emission, starts to move towards us with the following speed:

$$c_d = c - v_d = c - 2c(d/o) = c(1 - 2d/o), \quad \text{where: } o - \text{circumference of the Universe}$$



It could seem that the speed of light adds with the speed of the source. But light after emission moves towards the source with the actual speed c . Only its speed c_d towards us adds with the speed of the source flying from us (observer) by an expanding speed v_d thanks cosmic expansion.

If we take into account that the speed of light decreases during cosmic expansion and the circumference of the Universe increases, than we have:

$$c_d = c_t - v_d = c_t (1 - 2d/o_t)$$

where : $v_d = H \cdot d$

H – Hubble's constant,

d – the actual distance of the light ray from us (observer)

c_d - speed of light towards us from a distance d ,

v_d - speed of increase of actual distance d thanks to cosmic expansion,

c_t – actual speed of light in time t of cosmic expansion,

o_t – the circumference of the Universe in time t .

As all mentioned characteristics change in time, the above relation, after elapsing of time interval $\Delta\tau$, obtains the following form:

$$c_{d+\Delta\tau} = c_{t+\Delta\tau} - v_{d+\Delta\tau} = c_{t+\Delta\tau} (1 - 2d_{\Delta\tau}/o_{t+\Delta\tau})$$

The light ray gradually increases the speed of its approach to us. When it arrives, its speed is the actual speed of light $c_{t+\Delta\tau}$:

$$c_{d+\Delta\tau} = c_{t+\Delta\tau}$$

Before light comes to us from a certain distance, it must travel through an expanding trajectory. Thanks to the deceleration of cosmic expansion, the speed of light decreases. The time of light travelling $\Delta\tau$ from the distance d , can be expressed by its average approach speed c_a towards us, which changes from the starting speed c_d to the actual $c_{t+\Delta\tau}$. Then the next relation is valid:

$$\Delta\tau = d/c_a$$

As the speed of light expresses the speed of cosmic expansion, the real trajectory, through which the light travels to us in the time $\Delta\tau$, is equal to the extension of a half of the cosmic circumference during this time interval $\Delta\tau$ and is higher than the initial distance d . If we know the initial distance from which light comes to us, we can determine the time of its travel and the real length of its trajectory. Analogically we can determine the initial distance if we know the time of its travel. This distance increases during cosmic expansion and the actual speed of light decreases because of the deceleration of cosmic expansion. If we know how the speed of light changes during cosmic expansion, we can determine its value in the future, and so it is no problem to calculate what time light needs to travel to us from a certain distance.

As the speed of light decelerates proportionally to the deceleration of cosmic expansion, it could seem as if this deceleration does not exist, if we measure the speed of cosmic expansion

by the actual speed of light. So if we fix the speed of light as a constant, then the speed of cosmic expansion looks to be constant, too.

But according to new observations, cosmologists state, that the speed of cosmic expansion accelerates. This acceleration was deduced from observations showing that very distant supernovas look darker as they should by constant or decelerating cosmic expansion. Not all cosmologists agree with accelerating expansion. They suppose the existence of cosmic fog of dust or other barriers weakening light. But the real reason for this misleading interpretation is quite different. The larger is the distance, from which the light travels to us, the slower is its initial speed towards us, as its actual speed c must be reduced by the speed of extension of this distance caused by cosmic expansion.

So time and trajectory, through which the light must travel to us, are much bigger than they would be with a constant speed c of light approaching us. The larger is the distance between us and light, the slower is its speed towards us. So the cosmic objects seem to be much more distant than they really are.

The “discovery” of accelerating cosmic expansion is a consequence of an erroneous understanding of the speed of light. So we need no dark energy to explain the acceleration of cosmic expansion, as it does not exist.

The supporters of accelerating cosmic expansion try to find its source inside a vacuum, not knowing its real essence, but supposing the existence of an additional force named the fifth force or quintessence, expressed in Einstein’s equation of gravitational field by a famous cosmological constant λ , which Einstein later rejected after the discovery of cosmic expansion. Of course, a huge amount of energy is contained in a vacuum consisted of an enormous number of elementary quantum dipoles connecting all visible material objects mutually. The higher the number of material objects taken into the system, the more the number of mutual elementary quantum connections between them and the higher the whole energy of the system. So the system with many objects has, thanks to mutual vacuum connections, much more energy than is contained in visible matter. But it is not dark energy causing the fictional acceleration of cosmic expansion.