On the Speed of Light and the Continuity of Physical Vacuum

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It is shown that the speed of light can be calculated on the basis of the velocity equation of the waves propagating along a liquid surface. This gives a reason to believe that the vacuum medium, being discrete, simultaneously possesses the property of continuity like the surface of an ideal fluid.

The speed of light is one of a few fundamental values, which are not deducible from theory. However, it turns out that the propagation of light is similar to wave motion on a liquid surface, and *has a maximum, which is equal to the speed of light*. This maximum is determined on the basis of the well-known equation

$$v^2 = \frac{g\lambda}{2\pi} + \frac{2\pi\sigma}{\rho\lambda}\,, \tag{1}$$

where g is the acceleration, λ is the wavelength, σ is the surface tension (force-to-perimeter ratio, [N/m]), while ρ is the specific density. The first term means the influence of gravity on the wave speed, the second — the influence of surface tension.

Of course, various physical phenomena described by the same equations are not reducible to each other. Nevertheless, there must be something common between them. In this case, the common feature should be the *continuity of the medium* (physical vacuum). Thus, the physical vacuum, being discrete and being a source of virtual particles, at the same time also possesses the property inherent in the inviscid continuous medium surface through which electromagnetic oscillations propagate in the form of surface transverse waves!

In order to apply formula (1) and determine the parameters entering into it, it is necessary to isolate some unit element of the medium (a radiating cell), which they would apply to. In [1], when determining the critical vacuum density, it was shown that such an element can be a hydrogen atom as the most common element in the Universe.

From the point of view of John Wheeler's geometrodynamic concept, charged microparticles are singular points on a the three-dimensional surface of our world, connected by a "wormhole", i.e. a vortex tube or power current line (of the input-output kind) located in an additional dimension. As a result, a closed contour is formed along which the physical vacuum or some other medium circulates. The presence of contours (vortex tubes) is also postulated, for example, in [2], where the vacuum structure is considered as a network of one-dimensional flow tubes (knotted/linked flux tubes) and it is claimed that it is such a network that provides the spatial three-dimensionality of the Universe. Such a tube or a vacuum unit can be regarded as a field unit, in contrast to an atom — a matter unit [3].

Geometrodynamics in the mechanistic interpretation does not introduce any additional entities. On the contrary, it reduces them. So, from the dimensions set, Coulomb is eliminated: it is replaced by the ultimate momentum of the electron $m_e c$ [4]. In this case, the vortex tube is characterized by the electric constant and magnetic constant ε_0 and μ_0, where the electric constant becomes linear density of the vortex tube, and the reciprocal of the magnetic constant is the centrifugal force produced by rotation of a vortex tube element with the light velocity c along the electron radius r_e. It is also the force acting between elementary charges at a distance r_e:

$$\varepsilon_0 = m_e / r_e\,, \tag{2}$$

$$\mu_0 = \frac{1}{c^2\varepsilon_0} = \frac{r_e}{m_e c^2}\,. \tag{3}$$

It is assumed that the medium circulating along a contour with a radius R in the same time rotates spirally inside it, so that the contour (toroid) contains z structurally ordered units (in this case — the waves or photons). The speed of circulation and rotation is:

$$v = \frac{c\,c_0^{1/3}}{a^2 n^2}\,, \tag{4}$$

where c_0 is the dimensionless speed of light c/[m/sec], a is the inverse fine structure constant, and n is the main quantum number. In this interpretation for the single element (hydrogen atom) accepted, there is only g — the centrifugal acceleration appearing when the medium moves along the contour, i.e. square of the velocity-to-the radius of the spiral rotation ratio:

$$g = \frac{v^2}{R/z} = \frac{zc^2 c_0^{2/3}}{a^4 n^4 R}\,, \tag{5}$$

where

$$R = n^2 R_B = n^2 a^2 r_e\,, \tag{6}$$

where R_B is the Bohr radius.

The surface tension of a unit cell [N/m], using the force $1/\mu_0$ (there is no other force there), is represented as:

$$\sigma = \frac{1/\mu_0}{R} = \frac{m_e c^2}{r_e R}\,, \tag{7}$$

and the hydrogen atom density for an arbitrary n is:

$$\rho_H = \frac{m_p m_e}{R^3}\,, \tag{8}$$

where m_p is the proton relative mass in units of m_e. The wavelength is defined for the case of ionization:

$$\lambda = \frac{n^2}{R_\infty}\,, \tag{9}$$

where R_∞ is the Rydberg constant. As a result, assuming the speed of light to be unknown, replacing c by v and bearing in mind the above formulas, (1) can be represented as:

$$v^2 = \frac{z\, v^2 v_0^{2/3}}{2\pi a^4 n^4 R_B R_\infty} + \frac{2\pi a^2 n^2 R_B R_\infty v^2}{m_p}\,. \tag{10}$$

Making the transformations and bearing in mind that $R_B R_\infty = 1/(4\pi a)$, we obtain from (10):

$$v_0^{2/3} = \left(1 - \frac{an^2}{2m_p}\right)\frac{a^3 n^4}{2z}\,, \tag{11}$$

when differentiating (11) with respect to n, the value of n for the maximum velocity is found:

$$n_m = \sqrt{\frac{4m_p}{3a}} = 4.23. \tag{12}$$

It is noteworthy that the radiation wavelength during ionization, i.e. at the transition $n_m \leftarrow \infty$, corresponds to the temperature of blackbody radiation 1840°K, which is close to the temperatures of the red and brown dwarfs — the most common bodies in the Universe.

Further, replacing n^2 in formula (11) with the value n_m^2, from (11) the maximum of the velocity is determined by:

$$v_m = \left(\frac{a^3 n^4}{6\,z}\right)^{3/2} \times [\text{m/sec}] = 2.81\times 10^8 \left(\frac{n^4}{z}\right)^{3/2} \times [\text{m/sec}]. \tag{13}$$

In [4], we give additional relations connecting the parameters v_0, z, n, and also the sine of the projection angle (the cosine of the Weinberg angle), which follow from that n^4/z does not depend on n and this value is slightly more than one. As a result, we obtained the value of v, which is very close to the speed of light and is determined only by the fine structure constant and velocity dimensionality as well as the Weinberg angle cosine. The last calculations as not having fundamental importance are not given here.

The obtained solution can be considered as a special case of the wave velocity maximum. However, unlike a liquid where the surface wave velocity has a minimum and these capillary and gravitational waves velocity depends on the surface tension and the basin depth, there is a natural mechanism for electromagnetic waves ensuring the independence of their speed from the wavelength. This follows even from the above formulas, which have a model-simplified character.

Indeed for this, it is necessary that there in formula (11) the ratio n^2/m_p remains constant. Since the wavelength is proportional to n^2, then, with increasing the interval between waves, the mass of the medium in a given interval must grow proportionally, which means that the medium remains homogeneous in the direction of wave propagation. This is true, because equation (1) is based on the law of a simple one-dimensional oscillation of a pendulum. Perhaps, someday, a more accurate equation for the general case made in electrodynamics terms will be deduced.

It should be noted that the fundamental difference between long-wave radiations and particle-like X-rays (gamma radiations) is associated with their different nature: the first is due to the medium surface tension, while the second is due to the medium acceleration in the radiating cell of the contour.

Thus, the physical vacuum as a medium is discrete at a certain level, and its unit is a vortex tube (the field unit). At the same time, it is capable of being infinitely densely filled with such units forming a continuous surface (the possibility of this was proved in the 19th century by J. Peano [5]). This surface, in turn, as it becomes more complex, can form three-dimensional material objects. When driving in such a continuous medium body does not feel any resistance up to the speed of light, i.e., until a surface wave forms, and, for the observer, the vacuum medium remains undetectable. Recall that even when moving in a real liquid body, an observer does not feel a resistance up to the speed when a surface wave is formed (for water, the speed is 0.3 … 0.5 m/sec).

Conclusion

The fact that the vacuum manifests properties of a continuous surface while electromagnetic waves propagate in the form of surface waves gives grounds to combine the light speed constancy with its wave nature and with the physical vacuum as a transmitting medium (and, at the same time, we can remain within the framework of Newtonian space and time). For this it is sufficient to accept the postulate that *an observer is always at rest with respect to the vacuum medium, and a source always moves with respect to it and, accordingly, with respect to the observer*. Thus, the passive element (an observer) does not detect the vacuum medium, but at the same time he receives an evidence of its existence as a continuous medium, namely — a change in the radiation wavelength (the Doppler effect) due to the motion of the active element (source).

Received on August 28, 2018

References

1. Belyakov A.V. On the independent determination of the ultimate density of physical vacuum. *Progress in Physics*, 2011, v.7, issue 2, 27–29.
2. Berera A., Buniy R. V., Kephart T. W., Päs H., and Rosa J. G. Knotty inflation and the dimensionality of spacetime. arXiv: 1508.01458.
3. Belyakov A.V. On Materiality and Dimensionality of the Space. *Progress in Physics*, 2014, v.10, issue 4, 203–206.
4. Belyakov A.V. Charge of the electron, and the constants of radiation according to J. A. Wheeler's geometrodynamic model. *Progress in Physics*, 2010, v.6, issue 4, 90–94.
5. Peano G. Sur une courbe, qui remplit toute une aire plane. *Mathematische Annalen*, 1890, v.36, issue 1, 157–160.