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### **FUNDAMENTAL FORM OF MOTION OF MATTER AND TRADITIONAL PROBLEMATIC ISSUES OF PHYSICS**

**Problem formulation.** Physics is the modern science and it solves the complex issues of understanding the world. However, there are many fundamental physics problematic issues that were relevant a hundred years ago and have remained unresolved today. Physics researchers are solving modern problems, but teachers of physics in high school face not only with methodological, but also with physical problems from the past. There are a number of problems for which have no single answer or contradicting answers within the established concepts. A lot of problematic issues have fundamental ideological nature. Here are some of them:

1. The basis of the universe is a matter, which can be in two forms – substance and field. The matter is in motion. Is mutual transition of matter from one form to another a fundamental form of motion?

2. Electromagnetic waves and in particular light are related to "field". Light has a dual nature – it is both wave and particle. But the waves – a phenomenon spatial and particle – localized. How to reconcile the contradiction between these properties?

3. If the light is wave – what is the medium for dissemination?

If the light is particle, then where is the oscillation process?

4. The electromagnetic wave – a fluctuation of the electric and magnetic fields. What happens to the energy of the electromagnetic wave in the oscillation?

5. Traditionally a phenomenon of diffraction regarded to the wave. Why does wave approach contradict corpuscular?

6. Uniform motion of a particle in quantum mechanics is considered as a de Broglie wave. Where is an oscillating process in the de Broglie wave?

7. We know two types of interaction between bodies – exchange through the medium and exchange between the particles. Both types give repulsion. What is the mechanism of gravitational attraction?

It so happened that in high school do not pay much attention to physical traditional problems. Problematic issues in physics textbooks, manuals, even those for teachers, are not discussed. However, the problematic issues can and should be a powerful means of outlook and competence development of future professionals, so they can be and should be considered on the level of accessibility and visibility, making them of particular interest. We also need scientific debate on fundamental problems in physics and related experimental and theoretical studies.

**Discussion of the problem.** If we accept that there is a fundamental form of motion as a mutual transition of matter from one form to another (the substance in the field and vice versa), named problematic issues cease to be problematic. As an example, consider an unusual interpretation of one of the problematic issues, which relates to the dual nature of matter. But the point is not only that, according to our modern ideas matter exists in two forms – in the form of substance and field, and especially in that **it is a property of matter stay in continuous motion – in transition from one form to another that is from the state of the substance to the state of field and vice versa.** A good example of this type of movement is an electromagnetic wave (EMW), and in particular light. The problem of dualism of light appeared over a hundred years ago and has remained unsolved until our time. It consists in the fact that at the same time the light particles (photons) are localized, and like a wave – spread out in space that seemingly can not be combined. Furthermore, light to be propagated as a wave needs a medium for oscillations. One hundred years ago it was suggested that this medium is a hypothetical ether, but on the basis of experiments of Michelson concluded that there is no ether.

If we accept that there is a mutual transition of matter from one form to another (the substance in the field and vice versa) as a fundamental form of motion, named problematic issues cease to be problematic. Particular cases of transfer of substances in the field are well known. For example, the amount mass of uranium fragments during fission is not equal to the mass of the nucleus (mass defect). Part of the mass is converted to gamma radiation (or field). The inverse processes are also known: a collision of two gamma-ray quanta forms electron and a positron. These are individual acts of transfer of matter from one form to another. We want to show that there is a transition from one type of matter to another as a **continuous oscillating form of motion.**

We consider this point more specifically at the nature of electromagnetic radiation in particular light. This is a problem of duality: light is a wave and a particle at the same time. There is no doubt that light is a wave and particles, but in physics there are two approaches to explain the properties of light – wave and corpuscular. For an explanation of the wave properties of light have to use one theory, and for explaining the corpuscular nature – another. Einstein wrote about it in his latest book [1]:

***"What is light – a wave or a shower of light corpuscles?.. It seems that there is no chance consistently describe the phenomena of light by just any one of the two possible theories. Condition is that we must use sometimes one theory, and sometimes another... We met with the difficulty of a new type. There are two opposing pictures of reality, but none of the theories alone does not explain all the phenomena of light, while together they explain them."***

However, the problem is not just that these approaches do not agree with each other – the wave and corpuscular approaches are contradictory. We will demonstrate this.

The basis of the approach is the Huygens' wave principle, which states that each point of the wave surface is a source of new waves. Let the waves propagate from the source O. According to Huygens' principle light from wave surface element dS, which is in the oscillating state, can pass through to the observation point K (Fig. 1).

But state that we consider waves as vibrations of the medium. It is important to stress that Huygens' principle has the physical meaning only for waves in a medium that varies, so the element dS is indeed in a state of fluctuation and is a source of new waves.

If we consider light as a stream of photons (Fig. 2), the photon as a particle that moves with speed c, has the momentum  $\vec{p}$ , and can not change its direction of motion at the point dS. It cannot reach the point of observation K as well. Therefore, it is important to note **that light as a stream of particles due to the Huygens' principle has no physical meaning.**

wave approach

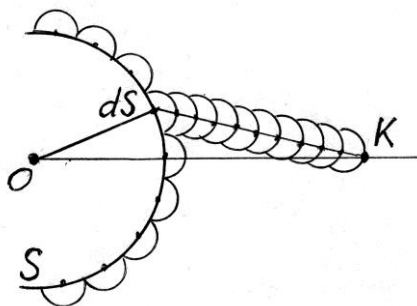


Fig. 1. Wave as an oscillation of environment can reach from the point dS the point K

corpuscular approach

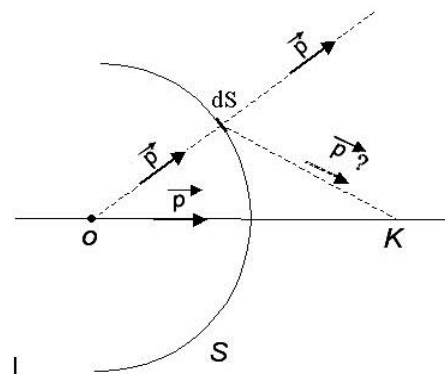


Fig. 2. Wave-particle as a photon from point dS can not reach the point K

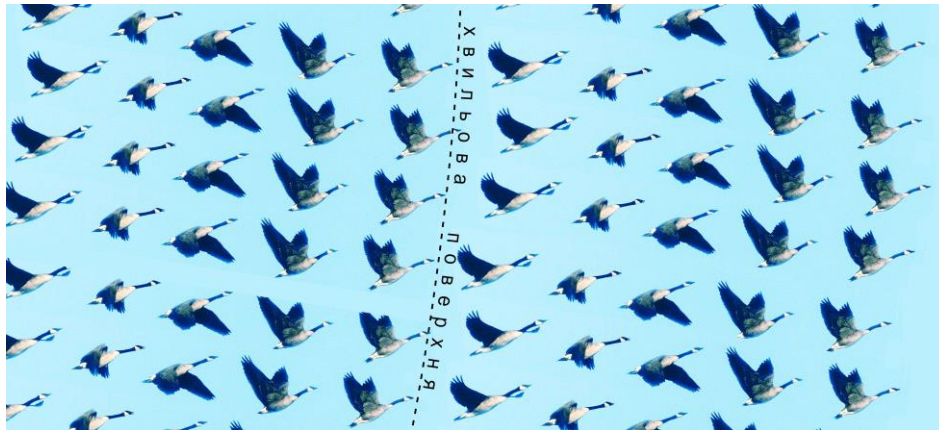
Thus, in explaining the nature of light, there is a **contradiction between the wave and corpuscular approaches**. This means that one of the two approaches is wrong. And the wrong one is wave approach.

The whole problem of the duality of light that have been used in order to explain the traditional meaning of the waves as propagation of oscillations in the medium. However, **it could be an entirely different type of wave propagation for which the medium is not necessary**. These are wave particles. Not conventional particles but specific, each of which is located in the inner oscillating state. Examples of such waves are known. A flock of birds in flight can be the model (Fig. 3).

And this vibrational state is a consequence of the fundamental type of motion of matter, which is also has not received adequate attention in physics. This movement of matter, which is determined from the well-known in theory of relativity mutual dependence of mass and energy:  $W = c^2 m$ .

Within this approach, it is clear that the transition of an electron from one energy level to another is a change of energy  $\Delta W$  which is accompanied by an equivalent change in mass  $\Delta m$ :  $\Delta W = c^2 \Delta m$ . This mass changing (dynamic), so it in turn leads to a corresponding change in the energy, which determines the type of oscillatory motion energy-mass-energy-mass... :

$$\Delta W \rightarrow \Delta m \rightarrow \Delta W \rightarrow \Delta m \rightarrow \dots$$



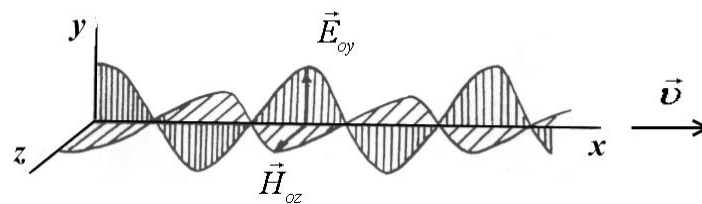
*Fig. 3. Flight flock of birds as a model of the motion of oscillating particles (photons) Each bird – a "particle", which oscillates and moves in space. Traditionally, these wave motions in physics are not considered, but it is this type of oscillation that can explain the problem of the duality of light and show that light is a wave and a particle at the same time. Light – a set of particles (photons), each of which varies with the particular intrinsic frequency.*

Traditionally fluctuations regarded as a mutual transition of kinetic and potential energy from one form to another. In this case, however, dealing with the transition of matter from one form to another. So we, quite rightly come to the conclusion that the light – is the matter fluctuations as a result of its transformation from a state of matter (mass) into the "field" (energy) and vice versa. Becomes clear also another feature of electromagnetic waves. According to the Maxwell's theory electromagnetic wave is an oscillation of the electric and magnetic fields:

$$E_y = E_{0y} \cos(\omega t - kx + \psi_1)$$

$$H_z = H_{0z} \cos(\omega t - kx + \psi_2)$$

Importantly, that electric and magnetic fields oscillate in the same phase (see Fig. 4).



*Fig. 4. The oscillations of the electric ( $\vec{E}$ ) and magnetic ( $\vec{H}$ ) field of the electromagnetic wave; – Oscillation amplitudes –  $\vec{E}_{oy}$ ,  $\vec{H}_{oz}$ .*

The electric (E) and magnetic (H) fields have the energy. But since (E) and (H) are changed, energy is also changed. In this regard, the question arises: what happens to the energy of the electromagnetic wave in its variation with oscillation? Maxwell's theory can not answer this question. The explanation is in the dual nature of matter. According to the relation  $\Delta W = c^2 \Delta m$  energy variations, such as its reduction, should be accompanied by a corresponding change in weight – it increases.

Fig. 5 qualitatively demonstrates dynamic mass variations m compared with intensity fluctuations of the electric and magnetic fields of the wave.

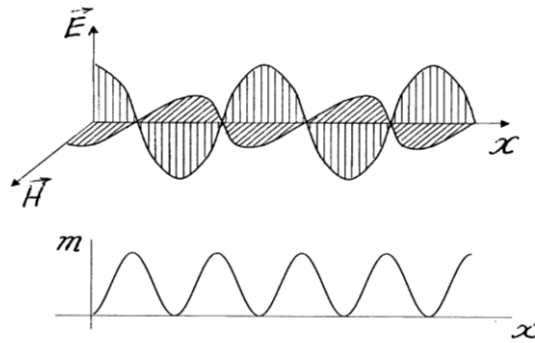


Fig. 5. Field intensity fluctuations  $E$  and  $H$  of the electromagnetic wave that have energy must be accompanied by a change in the mass  $m$ .

The dual nature of matter at this interpretation is regarded as a perfectly natural phenomenon and traditional problematic issues get a consistent explanation. From this point of view, we consider fluctuations occurring in the de Broglie waves, buyout form the basis of quantum mechanics.

By analogy to the light de Broglie hypothesized that not only the particles of light have wave properties, but also any particle moving with velocity  $v$ . Where de Broglie wavelength equals

$$\lambda_{\text{д}} = \frac{h}{p} = \frac{h}{mv}, \tag{1}$$

where  $mv = p$  – “impulse” (momentum) of particle.

De Broglie hypothesis was put into life without any hesitation, but the question is: why particle which moves uniformly with constant velocity  $v$ , can be regarded as a wave process? What is the nature of oscillations in the de Broglie waves? To answer this question, we consider body motion in space and time rather more detailed.

Body (particle) motion is a movement of substance in space and time. Characteristics of a substance is the mass  $m$ , and the characteristics of movement – speed  $v$ . Thus, the characteristics of motion is that what moves – the mass  $m$ , and how it moves – the speed  $v$ . Such a physical quantity is called momentum:

$$K = m \times v. \tag{3}$$

If the force applied to the body, there is an impact and there is a change in momentum  $dK$ . The more time  $dt$  of impact duration, the greater the change in momentum  $dK$ . Therefore, we can write:

$$dK = F dt. \tag{4}$$

The change in momentum per unit time is called the force exerted on the body:

$$F = dK / dt. \tag{5}$$

Under the influence of force work is performed, so, the body moves and changes its energy. Since, a connection between energy and mass:  $W = c^2 \cdot m$ , it means that during the energy changes body weight changes as well:

$$\Delta W = c^2 \cdot \Delta m. \tag{6}$$

Therefore, the change in body weight should be considered when determining the force:

$$F = \frac{dK}{dt} = \frac{d(mv)}{dt} = m \frac{dv}{dt} + v \frac{dm}{dt}. \tag{7}$$

Since the force impacts on the body it changes its velocity and mass, then the work of force when moving the body to a distance  $dx$

$$dA = F dx = \left( m \frac{dv}{dt} + v \frac{dm}{dt} \right) \cdot dx = m \frac{dv}{dt} dx + v \frac{dm}{dt} \cdot dx. \quad (8)$$

That is, the work of force is to change the velocity and acceleration imposition to a body, as well as to change mass  $dm$ . This mass arising in the course of energy imposition to a body is advisable to call dynamic (traditionally the total dynamical mass and rest mass called relativistic). And it is the relativistic increase (dynamic) of mass that is the cause of the oscillation process [2]. Indeed, according to (6) in the acceleration of the particle its energy  $\Delta W$  increases and mass  $\Delta m$  gains. When the particle velocity becomes constant, the mass discontinues growth. But since this mass variable (dynamic), in accordance with the equation  $\Delta W = c^2 \Delta m$  then it begins to decrease and there is an oscillatory process such as:

$$\Delta W \rightarrow \Delta m \rightarrow \Delta W \rightarrow \Delta m \rightarrow \dots \quad (9)$$

Thus, accelerated microparticle goes into oscillation, with the pulsation of mass and energy. And this oscillating particle is called as de Broglie wave.

The occurrence of oscillatory process can be demonstrated by means of a pendulum. For example, in the vehicle, which moves uniformly there is suspending object on a string. The object moves with the car at a speed,  $v$  without oscillations. Fig. 6 shows a video frame, when the car is moving uniformly, fluctuations do not occur. But according to de Broglie's hypothesis that body (particle) is a wave, and it means to be an oscillatory process. And it is.

What is the essence of this oscillatory process in the de Broglie wave? The thing is that the particle just with the speed  $v$  is not moving – it should get this speed as a result of acceleration. During the accelerating of vehicle pendulum deviates and conditions for the emergence of an oscillatory process are created.

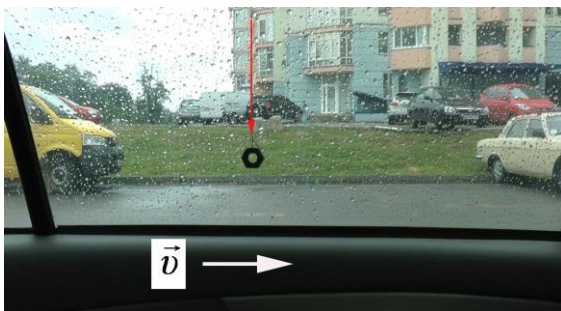


Fig. 6. The vehicle moves uniformly with velocity  $v$ .  
The pendulum does not oscillate



Fig. 7. The vehicle moves uniformly after acceleration.  
The pendulum starts to oscillate

And when the vehicle comes to a constant speed, the body actually starts to oscillate. Element of the acceleration process is presented in Fig. 7.

**Conclusion.** In nature, there is mutual transition of matter from one type (a substance) into another (the field) as a fundamental form of motion :

the *mass–energy–mass–energy–...*

which follows from the relation  $W = c^2 m$ . Examples of this form of oscillating motion are electromagnetic waves and de Broglie waves.

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**Анотація. Сусь Б.А., Сусь Б.Б. Фундаментальна форма руху матерії і традиційні проблемні питання фізики.**

Показано, що існує фундаментальна форма руху матерії як безперервний перехід з одного виду (речовини) в інший (поле). Основу цього коливального процесу становить відоме в теорії відносності співвідношення  $W = c^2 \times m$ , яке доцільно розуміти як закон збереження матерії. Запропонований підхід дозволяє зняти ряд фундаментальних традиційних проблемних питань фізики, пов'язаних з подвійністю природи матерії.

**Ключові слова:** матерія, речовина, частинки, маса, енергія, хвилі, дуалізм, релятивістське рух, коливальний рух.

**Аннотация. Сусь Б.А., Сусь Б.Б. Фундаментальная форма движения материи и традиционные проблемные вопросы физики.**

Показано, что существует фундаментальная форма движения материи как непрерывный переход из одного вида (вещества) в другой (поле). Основу этого колебательного процесса составляет известное в теории относительности соотношение  $W = c^2 \times m$ , которое целесообразно понимать как закон сохранения материи. Предложенный подход позволяет снять ряд фундаментальных традиционных проблемных вопросов физики, связанных с двойственностью природы материи.

**Ключевые слова:** материя, вещество, частицы, масса, энергия, волны, дуализм, релятивистское движение, колебательное движение.

**Abstract. Sus B.A , Sus B.B. Fundamental Form Of Motion Of Matter And Traditional Problematic Issues Of Physics**

In the article it is shown that there is a continuous transition from one form (substance) to another (the field) as a fundamental form of motion of matter. The basis of this oscillatory process is known in the theory of relativity as the ratio  $W = c^2 \times m$  which is suitable to understand as the law of conservation of matter. Proposed approach makes it possible to remove a number of fundamental traditional problematic issues of physics related to the dual nature of matter.

**Key words:** matter, substance, particle mass, energy, waves, dualism, relativistic motion, oscillatory motion.