UDC 530

ABOUT INTERRELATION OF ENERGY, CHARGE AND MASS WITHIN THE FRAMEWORK OF CLASSIC CONCEPTS

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Interrelation is analysed between energy, charge and mass on the basis of classic laws of mechanics, new ideas about motion and about the quanta of light. A row over of dependences that provide stability of co-operations of quanta of light is brought, their numerical analysis is given.

Key words: energy, charge, mass, acceleration, tension, force, quantum of light.

Entry. Concepts about energy, charge and mass are inalienable part of modern natural science. However to present tense there are clear ideas about their nature, their community and distinctions. Here, that for example, concerning nature of energy in the known lectures a Nobel laureate talked after a physicist Feynman: «it unknown physics of today, what energy» [2], [т.1, p. 73]. In the real article on the basis of the results got in-process [1], and on the basis of new ideas about the quanta of light (light in his wide understanding) the analysis of intercommunications is executed between energy, charge and mass and some are analysed of the got results. This article is logical continuation of work [1], essence of that, briefly taken to the following. In-process [1] the all-sufficientness of motion is reasonable it is shown that speed-up motion can be presented as a flexon from the way of body on the way of light. Thus there is a physical size - the analogue of acceleration, unit of that, equals reverse length

$$\xi = \frac{d^2 s}{d\tau^2} \quad [\mathrm{m}^{-1}]. \tag{1}$$

where s and τ - respectively a way of a body and a way of light.
Further, in work [1] connection between traditional acceleration of an and analog of acceleration – inertial intensity of the field ξ is established

$$a = \frac{\xi \tau^2}{t^2} = \xi c^2, \tag{2}$$

where t - time; with - velocity of light.
On the basis of the second law of Newton and dependence (2) it is established that the accelerating force

$$F = ma = mc^2 \xi\,. \tag{3}$$

According to the known formula of Einstein connecting energy and mass of $W=mc^2$ the analog of the second law of Newton is received

$$F = W\xi \tag{4}$$

The analysis of dimensions in system of units where as one of the main force is accepted, but not weight shows that in a formula

$$\mathrm{W} = \mathrm{mc}^2 \tag{5}$$

there are excess entities $[W] = FL^{-1}T^2L^2T^{-2} = FL$

Energy in a formula (4) is equal in our case to force relation to inertial intensity

$$W = F/\xi \text{ [FL]} \quad (6)$$

Problem. In dependence (4) as in obvious, and implicitly, there are no time, mass, speed and acceleration. At measurement of time in terms of a way of light, that is in terms of length, excess "entities" are eliminated, as is the true reason of emergence of dependence of $W=mc^2$. There is a question how energy of W which has found the place in the second law of Newton, more precisely, in its analog (4), corresponds to other physical quantities? What, in this case, will be the energy relation to a charge and a charge to mass? There is also a question of communication of energy of W and a charge of q with kinetic energy of T.

Results of researches. Considering that laws of mechanics for macroscopic bodies are a consequence of laws of a microcosm, we will address consideration of the relevant laws of interaction at the microscopic level. As we see, the considered power interactions very closely are connected with light radiation. Light quanta – the stablest and ubiquitous, observable even with the naked eye in a set of both electric, and mechanical manifestations. It gives us an opportunity and very strong reasons for search of interrelations between mechanical and electrical physical quantities by the analysis of interactions of quanta of light. In spectroscopy the size measured in units of the return length and called sometimes by wave number $1/\lambda$ is well-known. The analysis has shown that the wave number can be considered as intensity of quantum of light. Also it has turned out that inertial intensity ξ and intensity of quantum of light $\xi=1/\lambda$ is mutually intertwining cause and effect. We will show it having written down equality which validity, precisely at anybody won't raise doubts

$$\frac{1}{\lambda} = \frac{1}{\lambda}. \quad (7)$$

We will increase and will divide the right part into F force

$$\frac{1}{\lambda} = \frac{F}{F\lambda} = \frac{F}{W} = \xi. \quad (8)$$

Work of force of F at quantum length λ gives energy of interaction of quantum of light. It is also analog of the second law of Newton (4), but written down already proceeding from other reasons

$$F = W\xi. \quad (4')$$

We see that the analog of the second law of Newton (4) arises also by consideration of interactions at the level of light quanta. This coincidence leads to a conclusion that emergence of inertial intensity of the field ξ at the accelerated movement of macro bodies and existence of intensity in quanta of light is two parties of the same process – interaction of quanta of light with substance. Existence of excess entities by consideration of movements, such as time, speed, acceleration and mass was an obstacle to his identification.

The way of light in one second equals velocity of light in number

$$\tau_c = ct = \lambda\nu = 299792458\,m. \quad (9)$$

where λ - length of quanta of light, ν - dimensionless frequency.

At measurement of time in terms of length the analog of traditional frequency gets sense of dimensionless size, that is number of pieces of quanta of light which are placed on length $\tau_c=\lambda\nu=299792458$ *m* (in our case dimensionless frequency ν shouldn't be confused to the traditional frequency measured in s^{-1}). Respectively instead of wavelength we will operate with light quantum length $\lambda=\tau_c/\nu$ as it will to a large extent be coordinated with our ideas of light. Such approach has allowed to establish a number of dependences between various characteristics of quanta of light. The received dependences and calculations for them are for descriptive reasons reduced in tab. 1 where the characteristic of interactions of quanta of light is given. Calculations for frequency ν=1 are given in a line 1; in line 2 – for quantum length λ=1 m; in line 3 to – for a potential difference of U=1 V; in line 4 to – for a charge of q=1 C; in line 5 to – for U=0,511MV potential difference; in line 6 to – for F force = 1N; in line 7 to – for electric intensity E =1 V/m; in line 8 – for energy of W=1 J and, at last, in line 9 – for the mass of m=1kg. These tab. 1 are provided for comparisons, it is clear that in actual practice so broad dispersion of parameters can't be.

Table 1. **Characteristic of interactions of quanta of light.**

U_0 = 4,135667662E-15 V– potential difference of quanta of light; F_0= 2,210219057E-42 N– elementary force of quantum of light; $\tau_c = ct = \lambda\nu = 299792458$ m – way of light in a second (not to confuse to velocity of light). λ – light quantum length;					
№	**Difference potentials, at to dimensionless frequency ν $U = U_o\nu$.**	**Dimensionless frequency $\nu = \frac{\tau_c}{\lambda} = \frac{U}{U_0}$; $\nu = \frac{\tau_c a}{c^2}$; ν2=F/F0**	**Electric intensity of quantum of light $E = \frac{U_0}{\lambda} = \xi U_0$; $E = \frac{aU_0}{c^2}$.**	**Length light quantum $\lambda = \frac{\tau_c}{\nu}$; $\lambda = \frac{\tau_c U_0}{U}$; $\lambda = \frac{c^2}{a}$.**	**Inertial intensity light quantum $\xi = \frac{1}{\lambda} = \frac{E}{U_o}$; $\xi = \frac{a}{c^2}$.**
	[V]	**[1], (pieces)**	**[U/m]**	**[m]**	**[m^{-1}]**
1	4,135667662E-15	1,000000000E+00	1,379510242E-23	2,997924580E+08	3,335640952E-09
2	1,239841974E-06	2,997924580E+08	4,135667662E-15	1,000000000E+00	1,000000000E+00
3	1,000000000E+00	2,417989263E+14	3,335640952E-09	1,239841974E-06	8,065544005E+05
4	2,581280746E+04	6,241509126E+18	8,610225763E-05	4,803204673E-11	2,081943344E+10
5	5,109989461E+05	1,235589965E+20	1,704509011E-03	2,426310237E-12	4,121484487E+11
6	2,781813257E+06	6,726394585E+20	9,279130219E-03	4,456956163E-13	2,243683724E+12
7	2,997924580E+08	7,248949444E+22	1,000000000E+00	4,135667662E-15	2,417989263E+14
8	6,241509126E+18	1,509190205E+33	2,081943344E+10	1,986445824E-25	5,034116652E+24
9	5,609586167E+35	1,356391912E+50	1,871156534E+27	2,210220036E-42	4,524436408E+41
	a	**b**	**c**	**d**	**e**

Continuation of Table 1

№	Charge $q = F/E;$ $q = \frac{W}{U_0};$ $q = \frac{mc^2}{U_0}.$	Energy $W = \frac{F}{\xi};$ $W = qU_0;$ $W = mc^2.$	Force quantum $F = W\xi;$ $F = qE;$ $F = ma;$ $F = F_o v^2.$	Mass $m = \frac{W}{c^2};$ $m = \frac{F\lambda}{c^2};$ $m = \frac{qU_0}{c^2}.$	Acceleration $a = \frac{c^2}{\lambda};$ $a = \xi c^2;$ $a = \frac{Ec^2}{U_o};$
	[Кл]	[Дж]	[Н]	[кг]	[м/с^2]
1	1,602176621E-19	6,626070039E-34	2,210219057E-42	7,372497201E-51	2,997924580E+08
2	4,803204673E-11	1,986445824E-25	1,986445824E-25	2,210219057E-42	8,987551787E+16
3	3,874045866E-05	1,602176621E-19	1,292242604E-13	1,782661907E-36	7,248949444E+22
4	1,000000000E+00	4,135667662E-15	8,610225764E-05	4,601550856E-32	1,871157363E+27
5	1,979633355E+01	8,187105647E-14	3,374302891E-02	9,109383557E-31	3,704205526E+28
6	1,077687215E+02	4,456956163E-13	1,000000000E+00	4,959032525E-30	2,016522366E+29
7	1,161409732E+04	4,803204673E-11	1,161409732E+04	5,344285949E-28	2,173180372E+31
8	2,417989263E+14	1,000000000E+00	5,034116652E+24	1,112650056E-17	4,524438411E+41
9	2,173179410E+31	8,987547809E+16	4,066358853E+58	1,000000000E+00	4,066360653E+58
	f	g	h	i	j

The maximum length of quantum of light can be estimated from the law of removal of Win who for the known temperature of a space 2,73 K makes about $1*10^{-3}$ m. As for the minimum length of quanta of light, it, most likely, is limited, the sizes of particles of a microcosm. As a result of the analysis of interactions according to the data provided in tab. 1 existence of a number of the laws providing stability of interactions of quanta of light with substance and the field is established. We will call them laws of stability of interactions of quanta of light (further for brevity simply – laws of stability). As a result of the analysis of these tab. 1 and some other reasons connection between length of quanta of light λ and field U potential difference along which intensity vector they extend is established (move)

$$\lambda = \frac{\lambda \nu U_0}{U}, \quad (10)$$

where Uo - a potential difference of quanta of light.

From where the law of stability of interactions of quanta of light follows

$$K_{\lambda U} = \lambda U = \lambda \nu U_o = 1{,}23984 * 10^{-6}\ Vm\,. \quad (11)$$

where Uo - a potential difference of quanta of light.

From where the law of stability of interactions of quanta of light follows

$$U_o = \frac{K_{\lambda U}}{\tau_c} = \frac{1{,}23984 * 10^{-6}}{299792458} = 4{,}13567 * 10^{-15}\ V\,. \quad (12)$$

Existence of electric intensity of quanta of light follows from the law of quantization of a potential difference (12) with inevitability

$$E = U_0/\lambda\ [\mathrm{Vm}^{-1}]. \quad (13)$$

In turn, follows from dependence (13) that electric intensity *E* quanta of light are defined, eventually, only by their length (or dimensionless frequency). On the other hand, work of length of quantum of light λ on his electric intensity is the

constant equal to quantum of a potential difference which follows from laws (11) and (12)

$$U_0 = \lambda E = \lambda \frac{U_0}{\lambda} = 4{,}13567 * 10^{-15}\, V\,, \qquad (14)$$

therefore difference of potentials, that is brought pithily supervision by the quanta of light $U = \nu U_0$ [V], (15)

that is is defined by the dimensionless frequency of quanta of light.

It is established that work of length of quanta of light λ on their inertial intensity ξ = 1/λ equals to unit

$$\lambda\xi = 1\,, \qquad (16)$$

what, by the way, coincides with equality (7).

We will notice that the formula (16) supports all the unique primary essence light quantum length λ, simpler formula in physics is unknown to us.

Also follows from tab. 1: – work of force excited by quantum of light on a square of its length is equal to work of energy of quantum at its length and is a constant

$$K_{\lambda W} = F\lambda^2 = W\lambda = 1{,}98645 * 10^{-25}\ [\mathrm{J \cdot m}]\,, \qquad (17)$$

where W=F/ξ=F/(1/λ)=Fλ [J] - the energy created by light quantum at the time of his power interaction with substance; to – work of length of quantum on the charge excited by light quantum at the time of his power interaction with substance is a constant

$$K_{\lambda q} = \lambda q = \frac{F\lambda^2}{U_0} = \frac{W\lambda}{U_0} = 4{,}80321 * 10^{-11}\ [\mathrm{J \cdot m \cdot V^{-1}}] = [\mathrm{C \cdot m}], \qquad (18)$$

where $q = \frac{W}{U_0} = \frac{F\lambda}{U_0} = \frac{F}{\frac{U_0}{\lambda}} = \frac{F}{E}$ [C] .

– communication between length of quantum of light and traditional mass and energy

$$K_{\lambda m} = \lambda m = \lambda \frac{W}{c^2} = 2{,}21022 * 10^{-42}\ [\mathrm{kg \cdot m}], \qquad (19)$$

– communication between length of quantum of light and its intensity expressed in traditional units of acceleration

$$\lambda a = c^2 = 8{,}98755 * 10^{16}\ [\mathrm{m^2 s^{-2}}]\,. \qquad (20)$$

From joint consideration of dependences (10) and (17); (10) and (18); (10) and (19) respectively for energy, a charge and mass we have

$W = \nu \frac{K_{\lambda W}}{\tau_c}$ (21); $q = \nu \frac{K_{\lambda q}}{\tau_c}$ (22); $m = \nu \frac{K_{\lambda m}}{\tau_c}$ (23).

On formulas (21) - (23) we find the corresponding values of energy, a charge and mass excited by one quantum of light at his interaction with substance that is with a dimensionless frequency ν=1

$$W = \frac{1*1{,}98645*10^{-25}}{299792458} = 6{,}62607 * 10^{-34}\ \mathrm{J}; \qquad (21)$$

$$q = \frac{1*4{,}80321*10^{-11}}{299792458} = 1{,}60218 * 10^{-19}\ [\mathrm{J \cdot U^{-1}}] = [\mathrm{C}]; \qquad (22)$$

$$m = \frac{1*2,21022*10^{-42}}{299792458} = 7,37250 * 10^{-51}\ \text{kg}\,. \quad (23)$$

We will notice that in our case energy of W at ν=1, coincides with Planck's constant in number, it is only measured at the same time, as well as there has to be in our case, in [J] unlike of the action measured in [J·c]. These numerical values of energy, a charge and mass correspond to the numerical values existing now for frequency in 1 Hz [3].

For frequency $\nu=1,23559*10^{20}$ which is equal to the Compton frequency of an electron and potential differences $U=\nu U_0=1,23559*10^{20}*4,13567 * 10^{-15}=0,511$ of MV energy, a charge and mass respectively will be

$$W = 1,23559 * 10^{20} * 6,62607 * 10^{-34} = 8,18711 * 10^{-14}\ \text{J.}$$

$$q = 1,23559 * 10^{20} * 1,60218 * 10^{-19} = 19,7963\ \text{C.}$$

$$m = 1,23559 * 10^{20} * 7,37250 * 10^{-51} = 9,10939 * 10^{-31}\text{kg}$$

Corresponding to energy, a charge and mass at ν=1 intensity: inertial ξ, electric E and acceleration of a will be

$$\xi = \frac{1}{\lambda} = \frac{1}{299792458} = 3,33564 * 10^{-8}\ \text{m}^{-1}; \quad (24)$$

$$E = U_0 \frac{1}{\lambda} = \frac{4,13567*10^{-15}}{299792458} = 1,37951 * 10^{-23}\ \text{V/m}\ ; \quad (25)$$

$$\text{a} = c^2 \frac{1}{\lambda} = \frac{299792458^2}{299792458} = 299792458\ \text{m/s}^2\ . \quad (26)$$

At interaction of light with substance, quanta of intensity of light interacts with intensity of the field of substance, this interaction is resulted by force. Force relation to quantum of intensity of light, depending on that how this intensity is presented, gives respectively energy, a charge or mass that for energy, a charge and mass looks as follows

$$W = \frac{F}{\frac{1}{\lambda}} = F\lambda = \frac{F}{\xi}; \quad (27)$$

$$q = \frac{F}{\frac{U_0}{\lambda}} = \frac{F\lambda}{U_0} = \frac{F}{E}; \quad (28)$$

$$m = \frac{F}{\frac{c^2}{\lambda}} = \frac{F\lambda}{c^2} = \frac{F}{a}. \quad (29)$$

Therefore, expressed by means of various physical quantities, force

$$F = W\xi \quad (30); \qquad F = qE \quad (31); \qquad F = ma \quad (32).$$

Taking into account numerical values of energy of W and inertial intensity ξ from dependences (21') and (24) force arising at interaction of quantum of light

$$F = W\xi = 6{,}62607 * 10^{-34} * 3{,}33564 * 10^{-8} = 2{,}21022 * 10^{-42}\ \text{N}.$$

Taking into account numerical values of a charge of q and electric intensity *E* of dependences (22') and (25) force arising at interaction of quantum of light

$$F = qE = 1{,}60218 * 10^{-19} * 1{,}37951 * 10^{-23} = 2{,}21022 * 10^{-42}\ \text{N}.$$

Taking into account numerical values of mass of m and acceleration and from dependences (23') and (26) force arising at interaction of quantum of light

$$F = ma = 7{,}37250 * 10^{-51} * 299792458 = 2{,}21022 * 10^{-42}\ \text{N}.$$

As we see the forces which are indisputable criterion when comparing interactions, expressed in different units coincide and, to some extent, duplicate each other.
We will define the energy relation to a charge and mass, and the charge relation to mass

$$\frac{W}{q} = \frac{6{,}62607*10^{-34}}{1{,}60218*10^{-19}} = 4{,}13567 * 10^{-15}\ V, \quad (33)$$

$$\frac{W}{m} = \frac{6{,}62607*10^{-34}}{7{,}37250*10^{-51}} = 8{,}98755 * 10^{16}\ [\text{J} \cdot \text{kg}^{-1}] = [\text{m}^2 \cdot \text{t}^{-2}], \quad (34)$$

$$\frac{q}{m} = \frac{1{,}60218*10^{-19}}{7{,}37250*10^{-51}} = 2{,}17318 * 10^{31}\ \text{C} \cdot \text{kg}^{-1}. \quad (35)$$

Communication of energy, charge and mass with kinetic energy is of interest

$$\text{T} = \frac{mv^2}{2}. \quad (36)$$

Considering that the mass of m=W/c^2, we will write down

$$\text{T} = \frac{mv^2}{2} = \frac{Wv^2}{2c^2} \quad (37)$$

or

$$2T = mv^2 = W\beta^2, \quad (38)$$

where β=v/c - speed coefficient.
For light quanta, that is at v=c speed, the speed coefficient β=1, at the same time doesn't arise problems: what concerning what moves. Therefore from (38) follows at once that energy of interaction of quantum of light is equal to his doubled kinetic energy

$$W = 2\text{T} = 2\frac{mc^2}{2} = mc^2 \quad . \quad (39)$$

Existence of the two in a formula (36) is explained by the fact that kinetic energy of a body in an initial formula (36) appears at the expense of his accelerated the movement. The two in a denominator of a formula (36) leads the final speed of v acquired at the accelerated movement to average speed on all way of the accelerated body, as is the reason of emergence of the two in a formula (36). The

formula (36), as we know, has arisen from subjective idea of work which in the elementary case, is work of force on movement under the influence of this force.

Follows from dependence (18) that energy of W and a charge of q are connected among themselves as follows

$$W = qU_0 \ , \tag{40}$$

then equality (38) taking into account (40) takes a form

$$2T = mv^2 = qU_o\beta^2, \tag{41}$$

from where at v=c speed communication between energy of W, q charge, kinetic energy of T and mass of m

$$W = \frac{F}{\frac{1}{\lambda}} = F\lambda = qU_0 = 2T = mc^2 \ \text{[J]}. \tag{42}$$

From (41) communication between a charge and mass for any particle also follows

$$\frac{q}{m} = \frac{v^2}{U_0\beta^2} \ , \tag{43}$$

For light quantum at v=c and β=1 dependence (43) has an appearance

$$\frac{q}{m} = \frac{c^2}{U_0} = \frac{8{,}987552*10^{16}}{4{,}135668*10^{-15}} = 2{,}17318 * 10^{31} \ \text{C/kg} \tag{44}$$

Numerical value of this relation has coincided with the relation calculated on a formula (35) where we proceeded from laws of stability of interactions. We will note that for the so-called Compton frequency of an electron $\nu=1{,}23559\cdot10^{20}$, transferred by the specified number of quanta of light, potential difference $U=\nu U_0=1{,}23559\cdot10^{20}\cdot4{,}13567\cdot10^{-15}=0{,}511$MV and the relation

$$\frac{q}{m} = \frac{c^2}{\nu U_0} = \frac{8{,}987552*10^{16}}{1{,}23559*10^{20}*4{,}135668*10^{-15}} = 1{,}7588 * 10^{11} \ \text{C/kg},$$

what coincides with a so-called specific charge of an electron.

Conclusions. New approach by consideration of movements has allowed on the basis of analog of the second law of Newton and ideas of light as about quanta of intensity of the field to establish a number of laws of stability of interactions. Simple ratios between various parameters of conditions of quanta of light are as a result received. This enabled, in turn, set the ratio between the energies of the W and T, charge q and mass m.

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О ВЗАИМОСВЯЗИ ЭНЕРГИИ, ЗАРЯДА И МАССЫ В РАМКАХ КЛАССИЧЕСКИХ ПРЕДСТАВЛЕНИЙ

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Ключевые слова: движение, энергия, заряд, масса, ускорение, напряженность, сила, квант света.

Резюме

Проанализирована связь между энергией, зарядом и массой на основании классических законов механики, новых представлений о движении и о квантах света. Приведен ряд зависимостей, которые обеспечивают стабильность взаимодействий квантов света, дан их численный анализ.

ABOUT INTERRELATION OF ENERGY, CHARGE AND MASS WITHIN THE FRAMEWORK OF CLASSIC CONCEPTS

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Sammary

Interrelation is analysed between energy, charge and mass on the basis of classic laws of mechanics, new ideas about motion and about the quanta of light. A row over of dependences that provide stability of co-operations of quanta of light is brought, their numerical analysis is given.