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# ABOUT PHYSICAL ESSENCE OF INFORMATION

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***Abstract***
*At the initial level information physics is studied. The assumption of the primacy of information naturally leads to the idea of the existence of God.*
*The total differential of information and the laws of conservation of information are obtained. It is pointed out that the physics of information is a quantum mechanic that studies the motion of information quantum in the channels of information transmission. This subject is well studied science and is known as Coding Theory.*
***Keywords****: information, physics, impulse, total differential, conservation laws.*

In the beginning was a word
The word was at the God
And the word was - God

The problem of physical essence of information has exceptional importance because of significance of expected scientific results. Analysis of known researches in the field of thermodynamics, Brownian motion, Markov chains, fuzzy sets, synergetic, and our results, concerning coding theory and versatility of informational model of organization and management, allows us to come to the general logical conclusion. The nature and processes of surrounding and social environment have one and the same informational foundation that allows their interpretation from the position of general approach, and it is important that this approach was adequate.

In this context, it is essential to find out what is the uniform and general basis for the phenomena and universe.

It is necessary to note also, that specified rhetorical question for a long time excites mankind, and, as it seems to us, this thought is maximally compressed general information, uncertainty (entropy) of which equals to zero, or that is the same, it’s certainty (negentropy) equal s to infinity, e. i. this is the God – absolute truth.

At present, there are two basic opinions concerning definition of information. Some consider it as initial form of other kinds of materia [1]. Others consider that information can not be separate by existing substances. It is not subjected to laws of preservation, and function of informational processes is impossible to express as full differential [2].

We, of course, support the first point of view. Even more, we think that general field, which is known in scientific literature as super field, is the informational field.

In this field mass and charge are considered as one quantity - informational content in informational formation. This quantity is measured in bits, and information itself has energy [2], and impulse which is called -informational impulse-, and designated by IR, where I-is the mass of information, and R – is speed of transfer.

Different kinds of information, reflecting one and the same phenomenon, influence to each other with definite strength, diminishing or enhancing this influence that can be described similarly to the law of universal attraction.

Below we will deal only with law of attraction.

## I. The law of conservation of information.

Let’s consider the channel of information transfer, inputs and outputs of which are presented by pair of x and y, where x- is the output of source of information, and y-is output of receiver.

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These outputs can accept values from sets $\{a_1, a_2, ..., a_n\}$ and $\{b_1, b_2, ... b_n\}$ correspondingly. Let's call the set $\{a_i\}(i = \overline{1,k})$ -the set of choices of x , and set $\{b_j\}(j = \overline{1,l})$ – the set of choices of y.

The reciprocal information of transmitter and receiver could be written as

$$I = I(x, y) = I(x) - I_x(x)$$

Thereby, amount of information on output x, which contains output y, turns out equal to own information, necessary for defining the output x minus amount of uncertainty of this output under given output y[3].

If the above-stated equality to average on assemble XY, then it is possible to find that average mutual information of x and y is equal to the difference between entropy X and conditional entropy of X under given Y.

$$I(X,Y) = S(X) - S_Y(Y).$$

From above mentioned, it is possible to conclude that the information on output of receiver could be defined by amount of negentropy, which represents difference between maximum entropy of source S(X) and conditional entropy Sy(X) of transferred information x, when information y is received. It is quantitatively equals to that work which is necessary for removal of the specified uncertainty, and can be reached by introduction of corresponding redundancy into initial information.

Own information, which contains event $x = a_k$ is equal to

$$I(x) = -\log P(x)$$

Conditional own information, which contains event $x = a_k$, under condition that y receives the value $b_j$, will be

$$I_y(x) = -\log P_y(x)$$

Infinitely small change of information in the process of its transfer will be written as:

$$dI = dI(x, y) - dI(x) - dI_y(x)$$

where $dI$ is the full differential of information. It is not difficult to see the analogy with infinitely small changes of energy.

$$dU = TdS - PdV$$

where T is absolute temperature, P-is the pressure and V is the volume. $dU$ is full differential of energy, and

$$\frac{\partial U}{\partial S} = T \text{ and } \frac{\partial U}{\partial V} = -P.$$

Similarly to energy, full differential of information will look like

$$dI = \frac{\partial I}{\partial I(x)} dI(x) - \frac{\partial I}{\partial I_y(x)} dI_y(x), \text{ where}$$

$$\frac{\partial I}{\partial I(x)} = 1, \text{ and } \frac{\partial I}{\partial I_y(x)} = -1,$$

since entropial and informational variables are one and the same.

It also should be mentioned that information, as well as the energy, has two forms – uncertainty or entropy, and certainty, or negentropy. Generally uncertainty is transformed into certainty and conversely. Uncertainty may be characterized as kinetic energy. Certainty in turn as potential energy. Written for average mutual information $I(x, y)$, the above mentioned leads to

$$dI = dI(x, y) = \frac{\partial I}{\partial S(x)} dS(x) - \frac{\partial I}{\partial S_y(x)} dS_y(x)$$

where $\frac{\partial I}{\partial S(x)} = 1$, and $\frac{\partial I}{\partial S_y(x)} = -1$ , because entropial and negentropial variables are the same.

For the information it is possible to record Hamiltonian

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$$H_I = I(x,y) + I_y(x),$$

and, since this expression represents full information and doesn't contain time in obvious way, its derivative by time is equal to zero, i.e.

$$\frac{d}{dt} H_I = 0 .$$

In turn, this circumstance specifies the law of conservation of the information.

In the mean time, as it is known from classical mechanics [5], Hamiltonian provides the way to record equality of motion

$$q^{'} = \frac{\partial H}{\partial p_i} \quad \text{and} \quad p^{'} = \frac{\partial H}{\partial q_i}, \quad (i = \overline{1,n})$$

Where $p$ and $q$ -are phase coordinates, and $n$ -is degree of freedom.

During information transfer, as well as in case of movement of micro particles, classic form of Hamiltonian doesn't allow to define the coordinates. It occurs because, that information, as well as movement of micro particles, is the subject of quantum mechanics.

Quantum mechanics, considering specifics of information exists, and it is the theory of antijamming coding, studying transfer of information in the communication channels.

The theory of coding considers the operators of coding and decoding G and M. They represent basic matrixes of mutually orthogonal subareas of n-dimentional vector area. i.e. $GM^T = 0$.

The coding of transferring information is produced with the help of matrix G, i.e. by introduction of such structure of informational redundancy into initial message, which is necessary for eliminating of residual uncertainty $S_y(X)$, caused by disturbances in the communication channel.

Decoding operator M allows to establish the uncertainty remained in the received information in the process of its acceptance, and restores the initial message. Thus, eliminating distortion, we are transforming full uncertainty of received initial information into full certainty. That means that full entropy is transformed into full negentropy.

It is necessary to mention of course that not always is possible fully restore initial information, since it depends on frequency of disturbances and channel capacity. When we are talking about full reversibility of information, we mean its high probability, following from probabilistic character of the process of restoring of initial message.

The coded information, which is influenced by distortions in the communication channel with certain frequency, is possible to present the following way.

If there was transferred the code vector $u_j$ and disturbance $e_j$ was present in its symbols $u_{j_1}, u_{j_2}, ..., u_{j_t}$, then received vector will look as $u_j + e_j$, where $e_j$- is the vector of error, components $(j_1, j_2, ..., j_t)$ of which differ from zero, and all others are zeros. Then

$$(u_j + e_j)M^T = u_j M^T + e_j M^T = e_j M^T = c_j$$

where $M^T$ – is a transpositioned matrix. Since, following from the expression $GM^T = 0$, $u_j M^T = 0$, then vector $u_j$ belongs to the area of matrix G lines. In this case, compressed vector

$$c_j = e_j M^T$$

is called sindrom, and allows to restore transferred vector with the help of matrix M, i.e real initial information.

In the connection with this it makes sense to mention additionally one more important circumstance offered by K. Shennon[4]

$$R = S(X) - S_Y(X)$$

And also the definition of mutual information $I(X,Y)$, in which component $I(X)$, which corresponds by quantity to entropy $S(X)$ in previous expression, is the maximum speed of formation of information by source. Some "owkwardness" here caused by presenting of maximum negentropy by maximum speed. Because of this, it seems expedient to present full negentropy, i.e. transferred full information as full potential energy, and $S(X)$ - as full kinetic energy, which information obtains on the outputs of receiver and source correspondingly. It seems to us that Hamiltonian for information indicates just (exactly) this circumstance.

## 2. Impulse

Since we present information as an analog of energy, we can record impulse with the help of Lagrangian for information.

$$L_I = I_y(x) = I(x) - I(x, y)$$

Infinitely small shifting of information during its transfer we will designate by $\varepsilon$, and require that function of Lagrange remained unchanged. At that, infinitely small change of function $L_I$ at infinitely small change of coordinate, when speed remains unchanged will look as

$$\Delta L_I = \frac{\partial L_I}{\partial d} = \Delta d = \varepsilon \frac{\partial L}{\partial d}$$

Where $d$ is Hemming distance during shifting.

As long as $\varepsilon$ takes values arbitrary, the demand $\Delta L_I = 0$ is equivalent to $\frac{\partial L_I}{\partial d} = 0$. Using Lagrange equality [5], we can write

$$\frac{d}{dt}\frac{\partial L_I}{\partial R} = \frac{\partial L_I}{\partial d} = 0,$$

where $R$ is the speed of information transfer.

From above mentioned, we can conclude that value $p = \frac{\partial L_I}{\partial R}$, in the process of motion, remains unchanged, and differentiating the Lagrange function, we will receive $p = IR$, which is the impulse of information. Since informational vectors are coded in the process of transferring of messages by including of definite redundancy and they are on such distance from each other, that potential energy of their interaction could be considered equal to zero (by the analogy with area of fussed up gases).

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