THE MAIN RESULTS OF GUREVICH I.M.

Physical Informatics contains fundamental results to get which only by physical methods is impossible.

• A general definition of information. Information - the continuing a certain time heterogeneity.

• Definitions of basic information characteristics heterogeneities (physical systems) information entropy, information divergence, the joint information entropy, information communication, differential information capacity.

• Definitions of the information laws of the nature (the laws of informatics):

Law simplicity of complex systems. Realized survives selected the option of a complex system, which has the lowest complexity.

The law of conservation of uncertainty (information). Uncertainty (information) isolated (closed) system is preserved under transformations and physically realizable only when physically realizable transformations.

Law the finiteness characteristics of complex systems. All kinds of interaction between systems, their parts and components have a finite speed of propagation. Is also limited by the rate of change of states of system elements.

Ashby's Law of Requisite Variety. For the effective functioning of the diversity of the governing body must be at least the diversity of control object.

Gödel Theorem of Incompleteness . In a sufficiently rich theory (including arithmetic), there are always unprovable true expression.

Law of complexity systems. During the evolution system its uncertainty (the information in it) is growing.

• It is shown that the laws of informatics define and limit the laws of physics.

• It is shown that the laws of informatics defines the action of physical conservation laws (energy, momentum, angular momentum, ...).

• Because, in all possible universes have laws of Informatics (in all universes is heterogeneities), then in all possible universes are the physical conservation laws.

• It is shown the time irreversibility.

• Open the existence of several types of matter with a different dependence the volume of information on the mass (including, linear for ordinary matter $I \propto M$, quadratic for black holes $I \propto M^2$, linear-logarithmic $I \propto M \log_2 M$ for neutron holes and white dwarfs).

• Open the existence of a fifth type of interaction - information interaction.

• It is shown that for the formation the fundamental particles must be at least 6 q-bits.

• Detected the forms of the gravitational potential $\propto \frac{1}{r}$, gravitational field strength $\propto \frac{1}{r^2}$.

• The resulting estimates of the joint entropy indicate of a unified information and physical nature of the strong and electroweak interactions.

• Estimates are given of the information volume in the basic and elementary particles, atoms, molecules, gases, liquids, solids, stars, galaxies, the Universe.

• Are designed the information models of cosmological objects (black holes, neutron stars, white dwarfs, solar-type stars).

• Derived the Hawking formula for black holes (information spectrum of a black hole emission).

• Derived the formula for the information spectrum of the emission of neutron stars and white dwarfs.

• Were obtained information constraints on the formation and merging of black holes.

• Openly the existence and characteristics of optimal black holes (minimizing the volume of information in the areas of the Universe, in the Universe as a whole).

• The estimation of the mass of the initial heterogeneities of the Universe is given.

• It is shown that the expansion of the Universe is the source of information formation , wherein a variety of physical processes in an expanding Universe provide information formation.
• It is shown that the volume of information emerging in the reference system moving with an acceleration equal to $I(x') = -\ln J = -\ln \sqrt{-g'} = \ln \sqrt{1 + \dfrac{2ax}{c^2}} \approx \dfrac{ax}{c^2}$.

• Estimates are given the main information characteristics of the Universe, including the maximum and minimum of possible, the current volume of information in the Universe.
It is shown that along with the physical constants, there are informational universal constants:

• information border IB = 10^{90} bits,

• constant memory M = 10^{28} bits/kg,

• Constant speed ISH , defined by the basis states of the hydrogen atom ISH = $1,9 \cdot 10^{10}$ op/s,

• constant speed (defined by the ionization energy of hydrogen atoms ISIH, does not exceed the $3,81 \cdot 10^{16}$ op/s,

• constant speed defined by the ionization energy of the atoms (not hydrogen) ISIA, does not exceed the $7,4 \cdot 10^{16}$ op/s,

• performance of the computer mass of one kilogram, which was built from hydrogen atoms, does not exceed the $2,28 \cdot 10^{43}$ op/s,

• performance of the computer mass of one kilogram, which was built from atoms (not hydrogen) does not exceed $1,12 \cdot 10^{43}$ op/s.

• information costs IC = $3 \cdot 10^{-38}$ kg/bit.
These constants should be added to a number of fundamental physical constants: Planck's constant, the gravitational constant, the speed of light, the Boltzmann constant, ... Information universal constants determine the processes of formation and development of natural and man-made objects. Achieve universal constants in development of information systems is impossible - they are the restrictions that must be considered is the extent to which it is necessary to strive for.
• It is shown that the universe, with the ultimate information absolutely knowable.
• Because heterogeneity exist in all universes, the approach based on the information characteristics of the heterogeneities of any nature and relevant laws (laws of informatics), applies to all possible universes, even universes with different physical laws. Does this mean the identity of all possible universes, or the uniqueness of the Universe?
• Using the laws of informatics together with the physical laws allow to reveal all the secrets of nature, in particular, to construct a theory of quantum gravity.

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