Universe. Relations between Time, Matter, Volume, Distance, and Energy.

(part 1)

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Abstract

Author has developed a theory which allows derivation of the unknown relations between main parameters in a given field of nature. He applied this theory for estimation of some values of our Universe and received both well-known and new unknown relations.

Author offers possibly valid relations between time, matter, volume, distance, and energy. The net picture derived is that in the Universe exists ONLY one substance – ENERGY. Time, matter, volume, fields are evidence of the energy and they can be transformed one to other. Author gives the equations which allow to calculate these transformation like the famous formula $E = mc^2$. Some assumptions about the structure of the Universe follow from these relations.

Most offered equations give results close to approximately known data of Universe, the others allow checking up by experiment.

1. Introduction

Universe.

The universe is commonly defined as the totality of everything that exists, including all physical matter and energy, the planets, stars, galaxies, and the contents of intergalactic space. The term *universe* may be used in slightly different contextual senses, denoting such concepts as the *cosmos*, the *world*, or *nature*.

Observations of earlier stages in the development of the universe, which can be seen at great distances, suggest that the universe has been governed by the same physical laws. The Solar System is embedded in a galaxy composed of billions of stars, the Milky Way, and that other galaxies exist outside it, as far as astronomical instruments can reach. Careful studies of the distribution of these galaxies and their spectral lines have led the modern cosmology. Discovery of the red shift and cosmic microwave background radiation revealed that the universe is expanding and apparently had a beginning. This high-resolution image of the Hubble ultra deep field shows a diverse range of galaxies, each consisting of billions of stars.

According to the prevailing scientific model of the universe, known as the Big Bang, the universe expanded from an extremely hot, dense phase called the Planck epoch, in which all the matter and energy of the observable universe was concentrated. Since the Planck epoch, the universe has been expanding to its present form, possibly with a brief period (less than 10^{-32} seconds, 15 billions of years) of cosmic inflation. Several independent experimental measurements support this theoretical expansion and, more generally, the Big Bang theory. Recent observations indicate that this expansion is accelerating because of dark energy, and that most of the matter in the universe may be in a form which cannot be detected by present instruments, and so is not accounted for in the present models of the universe; this has been named dark matter. The imprecision of current observations has hindered predictions of the ultimate fate of the universe.

Current interpretations of astronomical observations indicate that the age of the universe is 13.75 ±0.17 billion years, and that the diameter of the observable universe is at least 93 billion light years, or 8.80×10^{26} meters. According to general relativity, space can expand faster than the speed of light, although we can view only a small portion of the universe due to the limitation imposed by light speed. Since we cannot observe space beyond the limitations of light (or any electromagnetic radiation), it is uncertain whether the size of the universe is finite or infinite.

More customarily, the universe is defined as everything that exists, has existed, and will exist. According to this definition and our present understanding, the universe consists of three elements: space and time, collectively known as space-time or the vacuum; matter and various forms of energy and momentum occupying space-time; and the physical laws that govern the first two. A related definition of the term *universe* is everything that exists at a single moment of cosmological time, such as the present, as in the sentence "The universe is now bathed uniformly in microwave radiation".

The universe is very large and possibly infinite in volume. The region visible from Earth (the observable universe) is about 92 billion light years across, based on where the expansion of space has taken the most distant objects observed. For comparison, the diameter of a typical galaxy is only 30,000 light-years, and the typical distance between two neighboring galaxies is only 3 million light-years. As an example, our Milky Way Galaxy is roughly 100,000 light years in diameter, and our nearest sister galaxy, the Andromeda Galaxy, is located roughly 2.5 million light years away. There are probably more than 100 billion (10^{11}) galaxies in the observable universe. Typical galaxies range from dwarfs with as few as ten million (10^7) stars up to giants with one trillion (10^{12}) stars, all orbiting the galaxy's center of mass. Thus, a very rough estimate from these numbers would suggest there are around one sextillion (10^{21}) stars in the observable universe; though a 2003 study by Australian National University astronomers resulted in a figure of 70 sextillion (7×10^{22}).

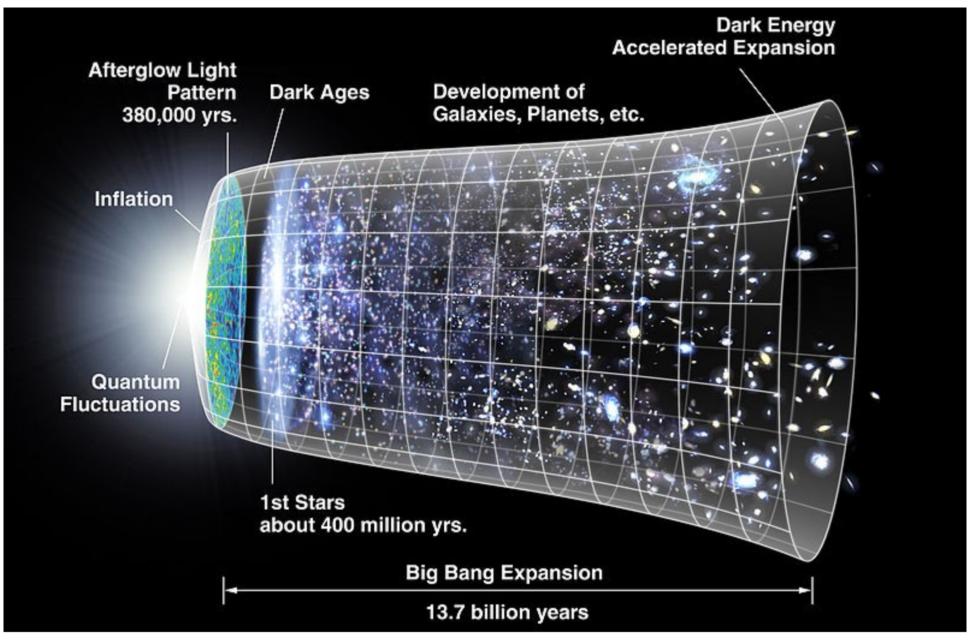

Fig.1. Creating and development of Universe

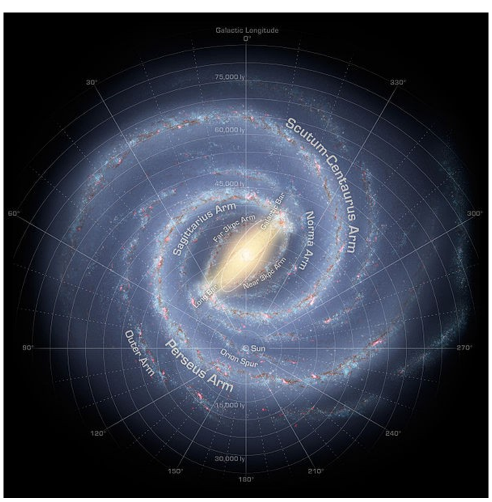

Fig. 2 (Left): Artist's conception of the spiral structure of the Milky Way with two major stellar arms and a bar.
Fig.3 (Right): Photograph of the "Great Andromeda Nebula" from 1899, later identified as the Andromeda Galaxy.

The universe is believed to be mostly composed of dark energy and dark matter, both of which are poorly understood at present. Less than 5% of the universe is ordinary matter, a relatively small contribution.

The observable matter is spread uniformly (*homogeneously*) throughout the universe, when averaged over distances longer than 300 million light-years. However, on smaller length-scales, matter is observed to form "clumps", i.e., to cluster hierarchically; many atoms are condensed into stars, most stars into galaxies, most galaxies into clusters, superclusters and, finally, the largest-scale structures such as the Great Wall of galaxies. The observable matter of the universe is also spread *isotropically*, meaning that no direction of observation seems different from any other; each region of the sky has roughly the same content. The universe is also bathed in a highly isotropic microwave radiation that corresponds to a thermal equilibrium blackbody spectrum of roughly 2.725 kelvin. The hypothesis that the large-scale universe is homogeneous and isotropic is known as the cosmological principle, which is supported by astronomical observations.

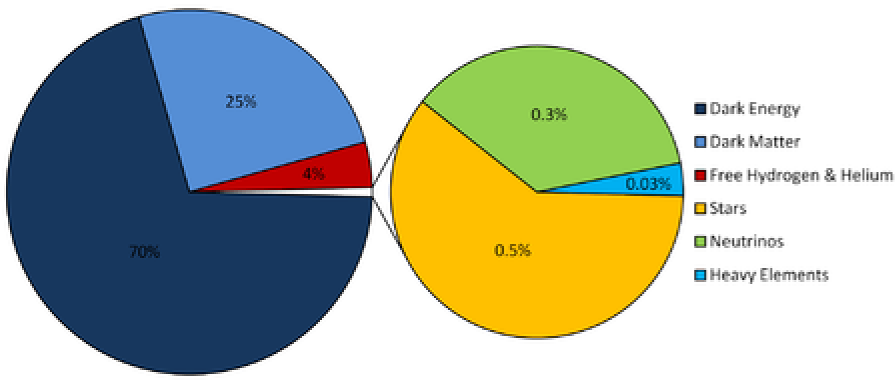

Fig.4. Composition of Universe

The present overall density of the universe is very low, roughly 9.9×10^{-30} grams per cubic centimeter. This mass-energy appears to consist of 73% dark energy, 23% cold dark matter and 4% ordinary matter. Thus the density of atoms is on the order of a single hydrogen atom for every four cubic meters of volume. The properties of dark energy and dark matter are largely unknown. Dark matter gravitates as ordinary matter, and thus works to slow the expansion of the universe; by contrast, dark energy accelerates its expansion.

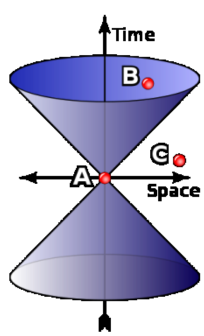

Fig.5. Visible and invisible part of Universe. *B* is visible. C is invisible. If star located in distance 100 million light years is burn now, we will see it only 100 million light years later.

The most precise estimate of the universe's age is about 13.73±0.12 billion years old, based on observations of the cosmic microwave background radiation. This expansion accounts for how Earth-bound scientists can observe the light from a galaxy 30 billion light years away, even if that light has traveled for only 13 billion years; the very space between them has expanded. This expansion is consistent with the observation that the light from distant galaxies has been redshifted; the photons emitted have been stretched to longer wavelengths and lower frequency during their journey. The rate of this spatial expansion is accelerating, based on studies of Type Ia supernovae and corroborated by other data.

As such the conditional probability of observing a universe that is fine-tuned to support intelligent life is 1. This observation is known as the anthropic principle and is particularly relevant if the creation of the universe was probabilistic or if multiple universes with a variety of properties exist.

Of the four fundamental interactions, gravitation is dominant at cosmological length scales; that is, the other three forces are believed to play a negligible role in determining structures at the level of planets, stars, galaxies and larger-scale structures. Given gravitation's predominance in shaping cosmological structures, accurate predictions of the universe's past and future require an accurate theory of gravitation. The best theory available is Albert Einstein's general theory of relativity.

That leads to a single form for the metric tensor, called the Friedmann-Lemaître-Robertson-Walker metric. This metric has only two undetermined parameters: an overall length scale *R* that can vary with time, and a curvature index *k* that can be only 0, 1 or −1, corresponding to flat Euclidean geometry, or spaces of positive or negative curvature. In cosmology, solving for the history of the universe is done by calculating *R* as a function of time, given *k* and the value of the cosmological constant *Λ*, which is a (small) parameter in Einstein's field equations. The equation describing how *R* varies with time is known as the Friedmann equation, after its inventor, Alexander Friedmann.

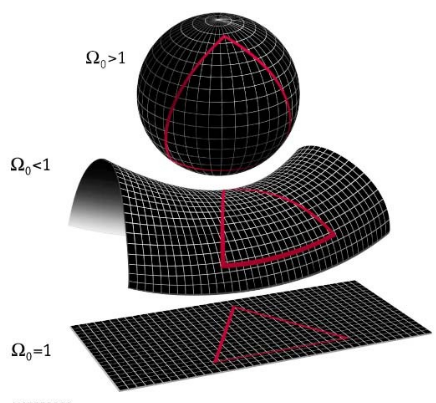

Fig.6. Curvature of two dimensional plate. Here is $\Omega_0 = k$, (52KB).

The solutions for *R(t)* depend on *k* and *Λ*, but some qualitative features of such solutions are general. First and most importantly, the length scale *R* of the universe can remain constant *only* if the universe is perfectly isotropic with positive curvature (*k* = 1) and has one precise value of density everywhere, as first noted by Albert Einstein. However, this equilibrium is unstable and since the universe is known to be inhomogeneous on smaller scales, *R* must change, according to general relativity. Einstein's field equations include a cosmological constant (*Λ*), that corresponds to an energy density of empty space.

Russian physicist Zel'dovich suggested that *Λ* is a measure of the zero-point energy associated with virtual particles of quantum field theory, a pervasive vacuum energy that exists everywhere, even in empty space. Evidence for such zero-point energy is observed in the Casimir effect.

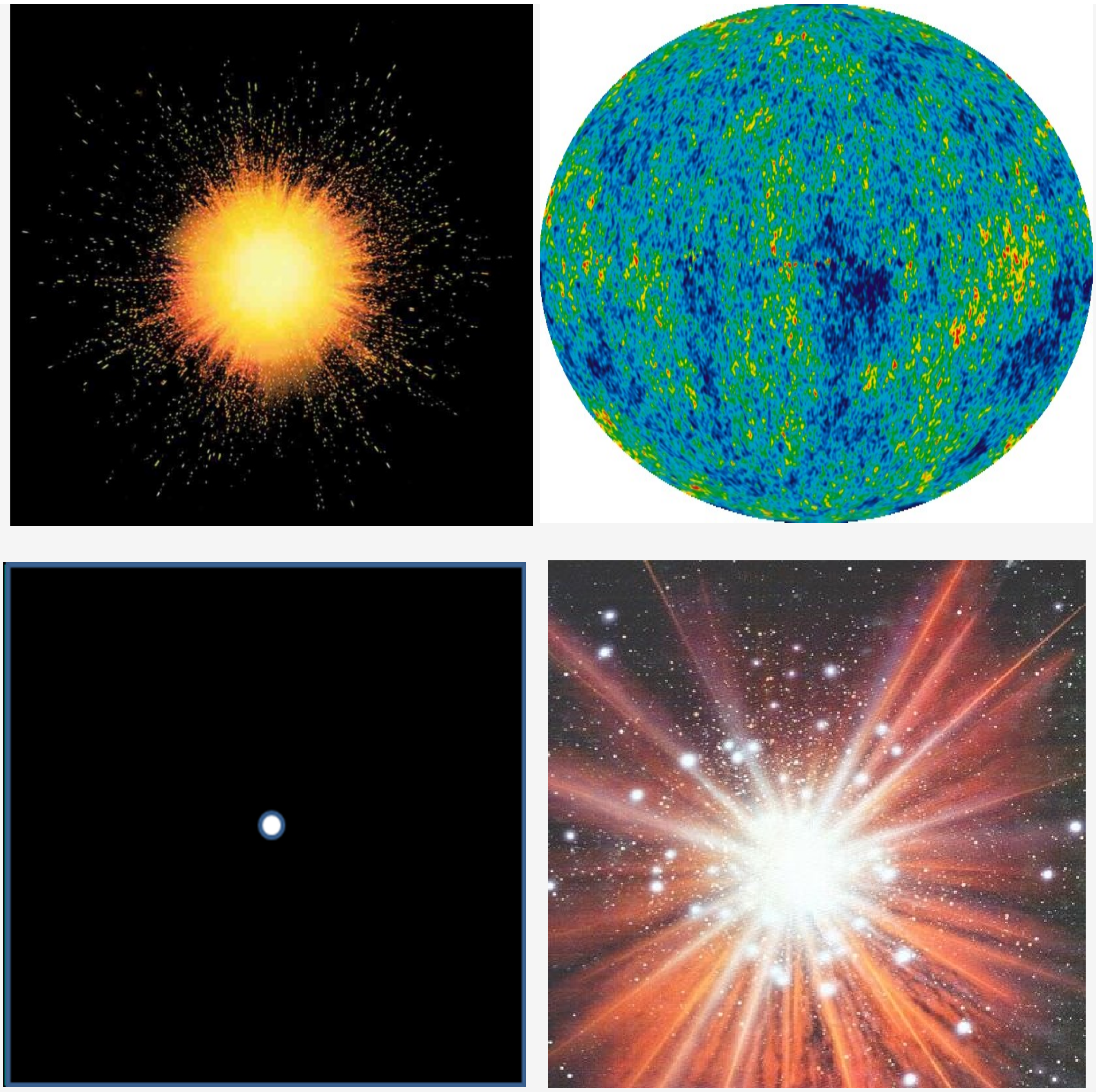

Fig. 7 – 10. History and possible future of Universe: Big Bang, Current Universe, Big Crunch into dot of singularity, New Big Bang.

The ultimate fate of the universe is still unknown, because it depends critically on the curvature index *k* and the cosmological constant *Λ*. If the universe is sufficiently dense, *k* equals +1, meaning that its average curvature throughout is positive and the universe will eventually recollapse in a Big Crunch, possibly starting a new universe in a Big Bounce. Conversely, if the universe is insufficiently dense, *k* equals 0 or −1 and the universe will expand forever, cooling off and eventually becoming inhospitable for all life, as the stars die and all matter coalesces into black holes (the Big Freeze and the heat death of the universe). As noted above, recent data suggests that the expansion speed of the universe is not decreasing as originally expected, but increasing; if this continues indefinitely, the universe will eventually rip itself to shreds (the Big Rip). Experimentally, the universe has an overall density that is very close to the critical value between recollapse and eternal expansion; more careful astronomical observations are needed to resolve the question.

2. Relation between time, matter, volume, distance and energy.

The author presents an original theory which allows derivation of unknown relations between main parameters in a given field of nature. He applies his hypotheses to theory of Universe. The next well-known constants used in his equations are below:

$$c = 2.997925\cdot 10^{8} \quad m/s, \quad e = 1.60219\cdot 10^{-19} \quad C, \quad G = 6.6743\cdot 10^{-11} \quad Nm^2/kg^2 , \qquad (1)$$

$$\varepsilon_0 = \frac{1}{36\pi\cdot 10^{9}} = 8.8542\cdot 10^{-12} \quad \frac{F}{m}, \quad \mu_0 = 4\pi\cdot 10^{-7} = 1.257\cdot 10^{-6} \quad \frac{H}{m},$$

$$h = 6.6261\cdot 10^{-34} \quad J\cdot s , \quad \hbar = h/2\pi , \quad \sigma = 5.67032\cdot 10^{-8} \quad W/m^2K^4 ,$$

where *c* is speed of light in vacuum, m/s; *e* is electronic charge, C; *G* is gravitation constant, Nm^2/kg^2; ε_o is electric constant, F/m; μ_o is magnetic constant, H/m; *h* is Planck constant, J·s; *σ* is Stefan – Boltzmann constant, W/m^2K^4 .

The author postulated the following relations:

1. Relations between time , matter , volume , distance, specific density of matter and energy :

$$T = \frac{G}{c^5}E, \quad T = \frac{G}{c^3}M, \quad T = c^{-1}v^{1/3}, \quad T = \frac{R}{c}, \quad T = G^{-2}\rho^{-2}, \qquad (2)$$

$$or \quad T = 2.756144\cdot 10^{-53}E, \quad T = 2.47709939\cdot 10^{-36}M,$$

$$T = 3.33564\cdot 10^{-9}R , \quad T = 2.2448563\cdot 10^{-24}\rho^{-2},$$

where *T* is time in sec; *E* is energy in J; *M* is mass, kg; *v* is volume in m^3; *R* is distance, m; *ρ* is specific density of matter in given point, kg/m^3. (Only the first 4 - 6 digits are right in all our formulas).

The dimensional theory is employed; that way these relations are obtained to within a constant factor. That factor may be derived from experiment. This factor has been neglected in cosmology and high energy physics. But these equations (2)-(6) cannot be derived ONLY from dimensional theory because dimensional theory does not contain the physical constant.

Equations (2) may be written in form as functions of time:

$$E = \frac{c^5}{G}T, \quad M = \frac{c^3}{G}T, \quad v = c^3T^3, \quad R = cT, \quad \rho = 1/(GT^2), \qquad (2a)$$

$$or \quad E = 3.62825745\cdot 10^{52}T, \quad M = 4.454628\cdot 10^{35}T, \quad \rho = 1.5\cdot 10^{10}/T^2.$$

From these equations follow some interesting propositions. Time is energy, time depends upon mass, volume, length and density of matter. Time can create the energy, mass, distance, volume and change the density of matter in the Universe.

2. Relations between volumes, energy, matter, time, and distance

$$v = \frac{G^3}{c^{12}}E^3 \quad v_n = \frac{G^n}{c^{4n}}E^n, \quad v = c^3T^3, \quad v = \frac{G^3}{c^6}M^3, \quad v = \frac{4\pi}{3}R^3, \qquad (3)$$

$$or \quad v = 5.64115466\cdot 10^{-133}E^3, \quad v = 2.694401\cdot 10^{25}T^3, \quad v = 4.095365\cdot 10^{-82}M^3,$$

where *v* is volume of 3-demantional space, m^3; v_n is n-dimensional space, m^n.

3. Relations between matter, time, volume and distance

$$M = \frac{c^3}{G}T, \quad M = \frac{c^2}{G}v^{1/3}, \quad M = \frac{c^2}{G}R, \qquad (4)$$

$$M = 4.0369797\cdot 10^{35}T, \quad M = 1.34659\cdot 10^{27}v^{1/3}, \quad M = 1.34659\cdot 10^{27}R .$$

4. We can receive from equations (2) - (4) the expressions for the energy from time, volume, distance and matter

$$E = \frac{c^5}{G}T, \quad E = \frac{c^4}{G}v^{1/3}, \quad E_n = \frac{c^{4n}}{G^n}v_n^{1/n}, \quad E = \frac{c^4}{G}R , \quad E = c^2M, \qquad (5)$$

$$E = 3.62825745\cdot 10^{52}T, \quad E = 1.2102562\cdot 10^{44}v^{1/3}, \quad E = 1.2102562\cdot 10^{44}R ,$$

$$E = 8.98755\cdot 10^{16}M .$$

Last equation in (5) is the well known relation between energy and matter. This relationship follows from (2) – (4) as a special case. This indirectly confirms the correctness of the equations (2) – (5) as a special case.

Let us to estimate the real size and parameters (mass, radius, time, density, etc.) of the Universe. We can make it if we accurately know at least one of its parameters.

Thus the most reliable parameter is the lifetime of the Universe after the Big Bang. Estimates of the observed mass and radius are growing all the time. Estimation of the time specified, and it is about 14 billion years now

$$M=\frac{c^3}{G}T\,,\quad E=\frac{c^5}{G}T\,,\quad R=cT,\quad v=\frac{4}{3}\pi R^3\,,\quad \rho=\frac{1}{GT^2}\,,$$
$$or\quad M=4.0369787\cdot 10^{35}T,\quad E=3.62825745\cdot 10^{52}T\,,$$
$$R\approx 3\cdot 10^8 T\,,\quad \rho=1.5\cdot 10^{10}/T^2,\quad \rho_E=1.3465913\cdot 10^{27}/T^2. \qquad (6)$$

Here ρ_E is dencity of vacuum energy, J/m^3 or vacuum pressure N/m^2.

Substitute in (6) the age of University after Big Bang (T=14 billions years = $4.4\cdot 10^{17}$ sec) we receive:

$$M=1.78\cdot 10^{53}\ kg>1.4\cdot 10^{53}kg,\quad E=1.6\cdot 10^{70}\ J,\quad R=1.32\cdot 10^{26}\ m<4.4\cdot 10^{26}\ m\,,$$
$$v=10^{79}\ m^3,\quad \rho=7.75\cdot 10^{-26}\ kg/m^3>10^{-26}\ kg/m^3,\quad \rho_E=6.9555335\cdot 10^{-9}\ J/m^3>10^{-9}\ J/m^3\,. \qquad (7)$$

In right side of the inequality (7) is given the estimations of universal parameters made by other researchers. They are very different. The author took average or approximate values.

As you see the values received by offered equations and others methods have the closed magnitudes. The mass of the Universe is little more because we do not see the whole Universe (only the closer bodies). The estimation of radius is more than light can travel in the time since the origin of the Universe. It is possible the Universe in initial time had other physical laws than now or the expansion of space may account for this. The difference of space density is result of the old methods that do not include invisible matter, dark matter and dark energy.

The main fields are acceleration, gravity, electric, magnetic and photon/radiation. Density of energy in given point of these fields compute by equations:

$$w_a=\frac{1}{G}\frac{a^2}{2},\quad w_g=\frac{1}{G}\frac{g^2}{2},\quad w_e=\varepsilon_0\frac{E^2}{2},\quad w_m=\mu_0\frac{H^2}{2},\quad w_r=\frac{\sigma}{c}t^4\,,\quad w_E=\frac{c^2}{GT^2}\,, \qquad (8)$$

where w_a is density of acceleration energy, J/m^3; w_g is density of gravitation energy, J/m^3; w_e is density of electric energy, J/m^3; w_m is density of magnetic energy, J/m^3; a is acceleration, m/s^2; g is gravitation, m/s^2; E is electric intensity, V/m or N/C; H is magnetic intensity, T or Vs/m^2 or Wb/m^2; w_r is density of radiation energy, J/m^3; t is temperature , K; w_E is vacuum energy density, J/m^3. The first two formulas show the energy density depends from acceleration in given point. The 3rd and 4th formulas are well-known in electrodynamics. The last two formulas show the energy density depends from temperature and time.

Full energy, W, we find by integration of density to a full volume.

$$W=\int_v w\,dv\,. \qquad (9)$$

These computations in analytical form we can take as relating to simple geometric figures as, for example, the spherical forms of fields.

The equations (8) may be also used for computation the pressure of energy in given point.

Note: In many cases the light speed in the equations (2)-(6) may be changed in conventional speed V. That means we can verify the formulas (2)-(6) and find the correct constant factor.

Discussion

Main result of this research is equations with result that energy can be the universal source of Universe (see Eq.(5)). Energy can produce time, mass, volume. The same role/factor also can acts the time (see Eq.(2)). All main components of Universe (size, mass, energy, volume, time) are closely connected and can transformed from one to another.

That means in base of Universe is ONE factor (for example, energy or so on?) which creates our diverse World.

The reader can ask: How we can convert time to energy? I can ask a counter question: The equation $E=c^2m$ (here m is mass) was open about hundred years ago. In that (past) time nobody could answer: How to convert the matter into this big energy using this equation? Only tens of years later the scientists opened that certain nuclei of atoms can convert one to another, significantly change their mass and emit or absorb the big energy. In 2006 the author offered the method which can convert any matter in full energy with according to the equation $E=c^2m$ [7] – [8].

Only time and experiments can confirm, correct or deny the proposed formulae.

The works in this field are [1] – [9].

Acknowledgement

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References:

1. Bolonkin A.A., Universe, Human Immortality and Future Human Evaluation. Scribd. 2010r. 124 pages, 4.8 Mb. http://www.scribd.com/doc/52969933/ **http://www.archive.org/details/UniverseHumanImmortalityAndFutureHumanEvaluation or**
2. Bolonkin A.A., Universe, Human Immortality and Future Human Evaluation, Elsevier, 2011. http://www.scribd.com/doc/75519828/ , **http://www.archive.org/details/UniverseHumanImmortalityAndFutureHumanEvaluation,**
3. Bolonkin A.A., "Non Rocket Space Launch and Flight". Elsevier, 2006. 488 pgs. http://www.scribd.com/doc/24056182 or http://www.archive.org/details/Non-rocketSpaceLaunchAndFlight
4. Bolonkin A.A., Cathcard R.B., Macro-Projects: Environment and Technology, NOVA, 2008, 2008, 536 pgs. http://www.scribd.com/doc/24057930 or **http://www.archive.org/details/Macro-projectsEnvironmentsAndTechnologies**
5. Bolonkin A.A., "New Concepts, Ideas, Innovations in Aerospace, Technology and the Human Sciences", NOVA, 2006, 510 pgs. http://www.scribd.com/doc/24057071 , **http://www.archive.org/details/NewConceptsIfeasAndInnovationsInAerospaceTechnologyAndHumanSciences**
6. Bolonkin A.A., "New Technologies and Revolutionary Projects", Scribd, 2010, 324 pgs, http://www.scribd.com/doc/32744477 **http://www.archive.org/details/NewTechnologiesAndRevolutionaryProjects** or
7. Bolonkin A.A., Femtotechnologies and Revolutionary Projects. Lambert, Germany, 2011. 538 ps. 16 Mb. http://www.scribd.com/doc/75519828/ , **http://www.archive.org/details/FemtotechnologiesAndRevolutionaryProjects**
8. Bolonkin A.A., Converting of Any Matter to Nuclear Energy by-AB-Generator American Journal of Engineering and Applied Science, Vol. 2, #4, 2009, pp.683-693. http://www.scribd.com/doc/24048466/
9. Bolonkin A.A., LIFE. SCIENCE. FUTURE. Scribd, 2010, 208 pgs. 16 Mb. http://www.scribd.com/doc/48229884, **http://www.archive.org/details/Life.Science.Future.biographyNotesResearchesAndInnovations or http://www.lulu.com ,**