

## ORDER IN COSMOS AND MAN ON EARTH

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### ABSTRACT

In 2014 I published a paper "Theory of Order in Cosmos" ("Scientific Israel-Technological Advantages", vol. 16, no.1, 2014 under the rubric "New Concepts in Science"). Previously I had published in the same journal two letters: "Theory of order" Part 1 and Part 2". **This paper is the follow up and elucidation of the theory submitted in the preceding papers.**

The papers were written, I willingly admit it, with my mind in a state of mild confusion. Despite the valiant efforts of my editor, to whom I am greatly indebted, the confusion contributed to a number of misprints, spelling and grammatical mistakes and a couple of misprints in the Table of numerical results in the papers. In the end of this paper I placed the Table of results with the misprints weeded out, hopefully.

My confusion had been rooted in the results of the published theory. Some of them are embarrassingly different from certain cosmological beliefs advanced by some contemporary iconic cosmologists and physicists. I was also confused by the generality of applications of the submitted theory.

The theory follows the contemporary astronomical data since 1998. That year two independent groups of astronomers in the USA and Australia discovered that our Cosmos is dominated by an invisible matter. This invisible matter is called dark energy. Two decades earlier astronomers had discovered that all visible lumps of matter in Cosmos, galaxies, clusters of galaxies, filaments of clusters and so forth are dominated by another kind of invisible matter called dark matter, not to be confused with dark energy. What is left of normal visible matter in Cosmos is the mere 4.9%. All the rest 95.1% of matter in Cosmos are the invisible dark energy with 68.3% contribution and dark matter with 26.3% contribution. It is irrefutably proved by astronomers that dark energy accelerates the Cosmos space expansion and thus acts as a sort of antigravitational, repulsive force, while dark matter is contracting gravitationally.

The above extraordinary findings are fashionable to consider as the last "mysteries" of science. It is a convenient position for scientists who for several decades have been heralding their successes of being on the verge of creating a "theory of everything". The discovery of totally dominating invisible matter with no clue whatsoever to their nature dealt a death blow to this fantasy. However, natural sciences are not a set of beliefs. Science must explain firmly established observational and experimental facts and predict the new ones. Although, recognized by a few leading physicists and cosmologists as fairly shattering I know of no serious attempts to reconsider from the beginning the prevailing approach to these phenomena. On the contrary, as far as I can judge the attempts to understand invisible matter have been focused on finding ways how invisible matter, primarily dark matter, can be explained as some peculiar manifestation of "normal matter". Much more constructive approach has been voiced by Sir. Roger Penrose as regards dark energy. His view gathered from the lectures is that dark energy is just the Einstein cosmological constant introduced by Einstein and later refuted by him in his gravitation equations-the modified EGE. As far as the nature of cosmological constant this is just a given, fundamental property of Cosmos, say as Newton gravitational constant, or the speed of light. My view is not far to this position, but I believe that much more can be done to elucidate the nature of dark energy and dark matter. This was done in (E. Levich, 2014) and the present work is the continuation with some new results, corrections and more philosophical discussion, while the basic calculations are all the cited paper.

The observation of dominating invisible matter inexorably points at the existence of primordial, primeval source of all order in our Cosmos, galaxies and stars, our solar system and Earth; the source of life and of conscious mind of Man on Earth; *the pinnacle of order in Cosmos*. This primeval source

is the timeless continuum of dark energy-the DEC- into which our Cosmos is embedded as subdomain. Dark energy permeates the global 4D space/time of (4dimensional)-4D Cosmos through all and every 4D space/time point of Cosmos from the birth in Big Bang 13 billion years ago until death in ten quadrillion quadrillions years from now. It is not that dark energy and dark matter are somehow the modalities of visible matter. On the contrary, the coherent visible matter, from microworld to galaxies is formed by dark energy. It is not that dark matter is some peculiar manifestation of visible matter. Dark matter is just chaos disposed by any and all visible matte entities to remain and sustain their coherence.

I call the proposed theory (E. Levich, 2014) the "kinetic theory of order in Cosmos", or KTOC. The KTOC starts from cosmogony, the birth of Cosmos that is briefly as follows. Cosmos is born within the *timeless, dark energy continuum*, the DEC as a supremely coherent light of Big Bang. The perfectly coherent light of Big Bang is emitted within the timeless dark energy continuum by what is known theoretically as the flux of virtual Planck particle. The Planck particle has been an object of long existing curiosity of physicists since the advent of quantum field theories. But the Planck particle has neither been observed nor its existence proven and hence may be in doubt. Nevertheless, the birth of virtual Planck particles does not violate any of the classical laws of physics<sup>1</sup>. These days directly and indirectly the Planck particle or Planck string is used in fashionable string/brane theories as the most elementary unit of matter and/or a minimal possible corpuscle of space/time. It also obviously appears in the acclaimed theory of quantum evaporation of black hole-BH- developed by renowned Jacob Bekenstein and Stephen Hawking in the late 20<sup>th</sup> century. The Planck particle isotropically emits a perfectly coherent light having a tremendous momentum/energy triggering the dark continuum expansion and thus the first isotropic and perfectly coherent 3D space, but not time is created. This is the Big Bang event.

Although triggering the space expansion the light speed is limited while the speed of empty space expansion by inertia is not. There is no time concept yet, the stable physical matter has not been borne yet, except of light and light by itself is not enough for measuring of time by virtue of ESR. This timeless space expansion within the dark continuum can be called the inflation stage. This name associates with the inflation hypothesis that is widely discussed by cosmologists. However, the KTOC inflation has a totally different nature from the inflation theory of Alan Guth and Andrei Linde. The KTOC inflation is caused by the perfect coherence of Big Bang<sup>2</sup>.

The initial "temperature" of space is extremely high. It is not the thermodynamical temperature since the Planck particle as a tiny black body emitting perfectly coherent radiation. Perfectly coherent radiation is the quantum equilibrium of perfect order. The quantum equilibrium is the opposite of classical physics equilibrium, which by definition and meaning is the state of maximal possible chaos. In astrophysics the sources of highly non-equilibrium radiation in the primarily low frequency part of the spectrum, e.g., of quasars, pulsars, radio-galaxies are characterized by the so-called brightness temperature. Their radiation is very far from the classical equilibrium of chaos and closer to the coherent radiation of quantum equilibrium. But as there is no time yet there is no chaos, only order. Therefore the Big Bang event could not be chaotic. The KTOC asserts that the ultimate coherence of the Big Bang radiation is the state of quantum equilibrium with all photons having one Planck

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<sup>1</sup> If a virtual Planck particle pops out from the DEC in the usual terminology as a fluctuation from the quantum "vacuum" it lives extremely short time, the shortest possible and returns back into the DEC. However, it does not mean that it cannot pop out again and again flickering with the extremely high, maximal possible Planck frequency. This virtual flickering into our 4D space/time is equivalent to the momentum/energy flux of the virtual Planck particles. *For an observer this flux would be impossible to distinguish from the permanent presence of matter in the volume through which this flux passes, since the frequency at which the observer is functioning is much lower than the Planck frequency. The observer can reach this frequency only at the black hole quantum "singularity", but then he will be just a part of the DEC because this singularity is the entry into the DEC. For those not familiar with the terminology used in this footnote it may be necessary to read through the text to understand it rather simple, but slightly twisted logic of assuming the contrary and proving that it is contradictory; that is if something is possible the consequences would be contradictory and hence this something is not possible.*

<sup>2</sup> The perfect coherence of Big Bang is the cornerstone of the "Cycles of Time" infinitely sequential Cosmos theory of Sir. Roger Penrose, e.g., (R. Penrose "Cycles of Time", 2010).

frequency. This is the state similar to Bose-Einstein condensation of photons-the BEC of photons (Ya. Zeldovich, E. Levich, 1970, R.A. Sunyaev, 2013, Klaers J., Schmitt J., Vewinger F., & Martin Weitz), 2010, except that the classical BEC frequency is zero, rather than the extremely high Planck frequency. But the latter is the only energy state that had existed as should become clear in what follows (E. Levich, 2014).

Thus the KTOC concludes that the Big Bang ultimately coherent radiation is a state similar to the BEC of photons, but with the highest possible *brightness temperature* in Cosmos. As Cosmos space expands the initially perfectly coherent radiation thermalizes via interaction with the virtual electron/positron pairs popping out of the coherent radiation and immediately annihilated back into the radiation. But thermalization is abrupt like a break of symmetry at the birth of physical four dimensional-4D space/time.

The very fact of light emission by the Planck particle as a tiny black body asserts that the birth of Cosmos is a quantum event. Strangely a quantum event with the Planck particle may occur even if the observable time concept does not exist yet. The life time of the Planck particle is the shortest that ever has been and will be in Cosmos and hence impossible to observe. Also strangely such event can be formally described as a solution of the classical Einstein gravitation equations-the EGE (Roger Penrose, 2010)<sup>3</sup>.

As a descendant of the primordial coherent the thermal radiation has a normal temperature sufficiently cold for the first stable, not virtual bricks of matter other than photons of light to be born from the dark continuum<sup>4</sup>. This happens when the Cosmos space volume reaches  $10^{24} \text{ cm}^3$  and the first building bricks of would be macroscopic matter pop out from the DEC. These are protons and/or antiprotons, it is immaterial how we call them, with a slight excess of one over another. However, if even two, say protons do not annihilate with antiprotons they appear in Cosmos as stable particles. Since now space contains protons and light the ESR requirements of the Einstein special relativity theory-for the time measuring are met. This latter is the necessary, *but not necessarily sufficient* condition for the time concept to exist.

But first it is necessary that light catches up with the space expansion that is many orders of magnitude faster than the speed of light. In KTOC it occurs at the phase transition time  $\sim 3 \cdot 10^{-3}$  sec when the expanding 3D space has the volume of  $10^{24} \text{ cm}^3$ . This is the start of physical time, the irreversible time concept in conjunction with and inseparable from the *second law* of thermodynamics and distinction between order and chaos with entropy as quantitative measure of chaos. Entropy  $S$  is rigorously defined in the science of statistical thermodynamics.

At the beginning of time the space is still flat, since the curvature would have meant chaos and chaos does not exist prior to the physical, sensual time concept. On the other hand since the first protons are born the coherent radiation of Big Bang suddenly becomes thermal equilibrium radiation with normal, not brightness temperature appropriate for the birth of stable protons. This is the birth of 4D space/time Cosmos dominated by radiation.

The KTOC calculations show that at the beginning of physical time count from  $\sim 3 \cdot 10^{-3}$  sec the matter density dominated by light is critical and Cosmos is flat from the view point of EGE and Friedman equations. Thus the space expands by inertia caused by now anomalous speed of inflation. This is a phase transition of the time quality, from a formal mathematical parameter into the physical,

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<sup>3</sup> It is a remarkable property of coherent phenomena, in particular of low frequency nonequilibrium radiation and BEC of photons that although quantum phenomena and would have not existed if not for the quantum structure of Cosmos, still in many aspects can be described by classical field theories. The reason for this is the rigorous cancellation in final results the quantum constant  $\hbar$  cancels out. Although, Penrose does not invoke the above reasoning he is right that the Big Bang event, as well as the death of Cosmos events can be described by a classical solution of the Einstein gravitation equations. The two are not the real singularities. However, I argue that neither would happen if not for the quantum mechanics. It is a slightly twisted reasoning, but such is the general nature of perfectly coherent phenomena.

<sup>4</sup> The distinction between the virtual and stable matter is subtle in KTOC. It is determined by the life time which can be as small as the Planck time and as big as the life time of Cosmos. Since the KTOC asserts that all matter in Cosmos is a mapping of the dark energy flux in the 4D momentum/energy space into the physical 4D space/time this distinction is not substantial. In this context all matter in Cosmos is virtual having finite life time span prior to returning to the DEC.

sensual time and the subsequent phase transition of light from the perfectly coherent state of quantum equilibrium to the state of classical state equilibrium of chaos with Planck distribution spectrum.

Since the phase transition, or spontaneous break of symmetry cannot happen instantaneously there is a finite time span during which the abstract time metamorphoses into the physical time. The time transition in the quality of time will never and cannot be observed but what can be observed is the accompanying phase transition deceleration of the space expansion adjusting to the normal rate of expansion of flat Cosmos, both the decelerating and normally accelerating Cosmos existing for billions of years of normal time. The celebration of Cosmos expansion starts with the birth of genuine observable time. The regular for Cosmos geometry is nearly flat with total matter comprising the dark matter, visible matter and dark matter at almost critical density about  $10^{-29} \text{ g / cm}^3$  (see the Table of results).

The KTOC asserts that the consciousness is born as the intrinsic quality of Cosmos in conjunction with the time concept. In about 13 billion years since the birth it is ported, "breathed: into the Man species brain, one and only species, likely in the whole Cosmos that is aware of being an intrinsic part of Cosmos, comprehending the irreversible time concept, reaches with his consciousness into the deep past, nearly to the birth of time, strives to leave mark on the future for posterity far beyond the life time of the species individuals and is eternally concerned with the meaning, reason and source of our existence in Cosmos<sup>5</sup>. There is no contradiction with relatively recent appearance of human species. Cosmos in KTOC is a globally phase coherent entity and consciousness per se must not be localized in 4D space/time. At a certain time, better to say in a certain subdomain of 4D space/time consciousness is localized. This domain is the total space volume of all, or most human brains and the life time of Man species.

I would like to reiterate. From the viewpoint of Einstein special relativity- the ESR theory for the time concept to exist it is necessary that Cosmos contains at least two particles serving as clocks and the light, photons shuttling between the two for the clocks synchronization. This is the foundation of the ESR. The problem for some thinkers that they likely hold for themselves is that when there is no one to observe and measure time what meaning does the time have<sup>6</sup>?

As a follow up of the above question the KTOC asserts that the consciousness is born in conjunction with the birth of time as an intrinsic phenomenon of Cosmos in conjunction with protons at the mathematical, abstract time  $t_{\text{parametric}} = 3 \cdot 10^{-3}$  sec that is the genuine time zero, the observable time, the birth of 4D space/time Cosmos with the *second law* of thermodynamics and the distinction between order and chaos. From now on the amount of chaos is defined by entropy.

Astronomical evidence of the Planck telescope mission indicates the age of Cosmos of about 13 billion years. The KTOC calculation shows a few hundred million years younger Cosmos<sup>7</sup> (see the Table below). The KTOC asserts that the whole 4D space/time of Cosmos is one phase coherent subdomain within the DEC with all past and all future intertwined and will have remained phase coherent till the death of Cosmos and consciousness in ten quadrillion, quadrillion ( $10^{31}$ ) years.

During all the preceding 13 billion years the inanimate matter has evolved in accordance with the classical theories of Ralph Alpher and Fred Hoyle respectively for the Big Bang nucleosynthesis of light elements, hydrogen, helium and lithium and nucleosynthesis in the stars generating all other elements from the Mendeleyev periodic table, stars combined into galaxies, galaxies into clusters and so forth. But not much new is anticipated for the inanimate matter in the future. Only when the above

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<sup>5</sup> I read in a brilliant book of Alan Guth that the three eternal questions that we ask are How, Why and For What. How is the task of science to determine, but the other two questions are not in the scope of what we believe science is. I as many others have speculations or the beliefs about How and For What. I will touch upon my beliefs below.

<sup>6</sup> This view point was shared with me by the renowned physicist and cosmologist Isaak Khalathikov in private discussions about 15 years ago. He told me that the internationally famous physicist Lev Landau had firmly believed that time has no sense, except as a mathematical parameter prior to conscious appreciation of time by an observing and measuring entity and this can be done only a conscious being.

<sup>7</sup> I do not see this discrepancy as an issue. The KTOC age is really the Hubble time that should not exactly coincide with the age of Cosmos. On the other hand the age of Cosmos determined astronomically is based on a regular Big Bang cosmological model that is empirical and not necessarily precise in this case.

life time span of Cosmos is nearly over the inanimate matter will start to disappearing with stars being sucked into the massive black holes-MBH and being erased by the quantum friction with the permeating dark energy, the friction that the KTOC establishes and calculates. The eventual end will be the return of all matter, inanimate and animate alike into the DEC that had given its birth and fed it with the ever existing dark energy coherent flux of momentum/energy, the primeval source of everything that has existed and been happening in Cosmos since its birth.

One of the most successful astrophysical theories of the 20<sup>th</sup> century is the evolution of stars theory, an amazingly well understood and predictive. The star evolution theory is affirmed by astronomical observations at all stages of stars evolution. Since astronomers observe a large number of stars born within a huge time period, which would be correct to call the ensemble of stars, the observation of this ensemble diversity is equivalent to observing the total life of individual stars of different types, including the majority of normal stars as probably, but I guess not exactly known is our sun, nova and supernova violently exploding stars, white dwarfs, neutron stars and pulsars, and the most enthralling for imagination black holes-BH. Indeed, the theory of star evolution based on the quantum theory of nuclear and thermonuclear reactions, fission and fusion respectively, the Einstein special and general relativity gravitation theory, plasma physics, high energy physics, fluid mechanics and shock waves physics, celestial mechanics, chemistry, the incredible Big Bang predictions of Cosmos Microwave Background-CMB- radiation and at last the top results obtained by astronomers, space scientists and astrophysicists observing the CMB since its actual discovery CMB in 1966, all this fusion and synergy is an incredible achievement of science of the 20<sup>th</sup> century. It is wonderful that so many theoretical predictions made by physicists, cosmologists and astrophysicists have been confirmed by astronomical data. We know greatly more about Cosmos in 21<sup>st</sup> century<sup>8</sup>.

Nevertheless, many classical problems remained unsolved. It is not known quantitatively how galaxies and clusters of galaxies and filaments of clusters and quasars were formed, although serious hypothesis based on the inflation theory do exist. It is not known, in my view even qualitatively how planets have been formed. Science has no clue how such an amazing planet as Earth could be formed. Earth is unique in Cosmos. The coherent conditions so perfectly matched with the set of requirements for the existence and evolution of carbon based life and mysterious conscious life of Man are so incomprehensibly complex and unique that one must have enormous imagination and I would say reckless courage to sincerely believe that Earth, life and conscious Man on Earth originated via random accidents, random genetic mutations and "natural", unassisted evolution driven by selection of the fittest. Indeed, scientists have been endowed not only with the gift of uncovering the amazing phenomena of Cosmos and explaining them, but also with rich imagination shaming that of the most imaginative science fiction writers. Many scientists, most probably from vested interests, as most people do, argued for Earth in the center of solar system till the times of Kepler and Newton.

It is not that the great Darwinian principle of survival of the fittest is not correct.<sup>9</sup> In my view it is immensely correct and valid in a much larger realm of applications than the evolution of live species. However, this principle is the mechanism serving the dictates of the *kinetic second law* extracting order from the coherent flux of dark energy, the primeval source of order in Cosmos.

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<sup>8</sup> Astronomical observations are invaluable for the basic physics as has been the case in many instances. For example it had been believed that neutrinos elementary particles are as photons massless. However, the insufficient flux of solar neutrinos detected on Earth led to the prediction made by Bruno Pontecorvo that at least some neutrinos have a tiny nonzero rest mass. After the death of Pontecorvo the Japanese scientists were awarded the Nobel Prizes for experimental confirmation of this prediction by the late Pontecorvo. In recent years the science fiction has been waning and gave way to fairy tales called fantasies and computer games in which everything is possible except common sense. Although fantasies and computer games in my view are very useful for imagination and **high**-tech development I think that a part of contemporary science claiming it is closing on the "theory of everything" is pure nonsense on the level of pagan religions. One should smoke a lot of pot and add some hashish to believe this nonsense.

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As we discussed above the most remarkable scientific discoveries of the last decades are dark energy and dark matter. The two discoveries transformed the primeval source of order in Cosmos hypothesis from an esoteric belief into quantitative theory. In difference to many contemporary scientific beliefs that are hardly falsifiable the primeval source of order has been astronomically observed since 1998 when the above mentioned astronomical groups established that the Cosmos space expansion, the Hubble expansion, is accelerating with ever increasing speed proportional to the distance between the points in 3D space. This expansion proves that the global order of Cosmos is continuously growing as will be explained shortly. This means that there is a source pumping order into Cosmos externally and this means that Cosmos that we see is not a closed system and this source of all order in Cosmos and the progenitor of Cosmos itself is dark energy.

It is surprising that the relation between dark energy and the primeval source of order in Cosmos had not been understood prior to the publications cited above (E. Levich, 2013 and 2014). The reason I believe is to a large extent psychological probably caused by excessive distancing of contemporary leading cosmologists from religious beliefs simultaneously substituting them with their own beliefs. Fortunately dark energy and dark matter are astronomical facts as unambiguous as stars and galaxies and round Earth and the facts lead to the quantitative and predictive KTOC. From the view point of KTOC dark energy and dark matter are quite natural kinds of matter that can be quantitatively described simply by looking at the available facts strictly in the framework of existing physical theories not constrained by non-falsifiable opinions not based on experimental evidence and numbers.

The acceleration of Hubble expansion is almost universally believed to be caused by a mysterious media called *dark energy* that is usually identified with the Einstein cosmological constant term in the EGE. No one knows what this cosmological constant is except that it is associated with the fame of Einstein. Dark matter or cosmological constant matter uniformly fills the 4D space/time of Cosmos and forces it to expand with acceleration. This latter follows from the modified Friedman equations derived from the EGE with the cosmological constant term added. Dark energy cannot be seen, this is why it is called dark. But *dark energy* whatever it is irrefutably observed by anti-gravitational, repulsive action forcing all points of space and all objects in space to recede from each other not only with the speed proportional to the distance between any two points in space, the well-known Hubble expansion but to recede with acceleration that is also proportional to the distance between any two points in space. The puzzling conclusion unambiguously followed from the Einstein gravitation equations of general relativity-the EGE of EGR- that subsequent to the acceleration of Hubble expansion is the ever growing order and hence ever diminishing chaos in Cosmos. That is to say that as time goes on our Cosmos is becoming more and more coherent. Moreover astronomical observations show unambiguously that our Cosmos geometry is nearly flat and this means Cosmos space on large scales has no very orderly coherent place to live in. If our Cosmos is a closed system as had been believed for generations this would contradict the *second law* of thermodynamics, the *second law* that cannot be violated. The conclusion made in KTOC is that our Cosmos is not a closed system and this seems pretty obvious and contrary to the nostalgic vision of Cosmos that we have been taught that is all inclusive with nothing else but Cosmos. This vision is dead with the discovery of acceleration of Hubble expansion.

It has become clear for many contemporary thinkers that the most complex organization, the most orderly and coherent entity in all Cosmos is the truly divine conscious brain of Man. The enormous coherence of huge galaxies consisting of 80-90 billion stars all tied up with each other by gravitation in weakly coherent unity is a joke when compared with the coherent complexity of conscious brain cortex of Man species with a cognitive cortex having typical mass of about 1000 g. What is the source for this incomprehensible coherence of human brain? Darwinian evolution of some smart apes that came from Africa, made whoopee with robust but backward European Neanderthals and started thinking about time, Cosmos and the meaning of life? Hardly credible hypothesis on the origin of conscious Man, especially if all experimental support is a few broken skulls integrated from pieces of bones subjected to dubious genetic analysis that has nothing to do with consciousness magnified by unlimited fantasy of some anthropologists. All of the above incomprehensible coherent complexity needs the existence of a primeval source of order.

When I started suspecting that *dark energy* is a realistic candidate to be the primeval source giving birth to Cosmos and everything in Cosmos, the inanimate matter and animate matter and consciousness I proceeded with calculations using all contemporary available astronomical data on the dark energy in Cosmos. The approximate density distribution of dark energy that follows from the observed acceleration of expansion and Friedman equations was all I needed to formulate the KTOC. The KTOC started furnishing sense and the quantitative, numerical results that could be immediately compared with experimental values of classical cosmological constants and parameters that had been always believed fundamental constants of Cosmos that cannot be theoretically calculated, but only empirically determined. The KTOC shows this is a false belief.

With the quantitative numbers obtained and sincerely puzzled by their astonishing agreement and with the experimental values and the clearly improbable scenario of numerological coincidences due to the diversity of unconnected numerical results based on well formulated theoretical physics foundation I told myself that "audentes Fortuna iuvat" and submitted the above papers to the judgment of potential readers. In the present work, beside the corrected Table of results I would like to elucidate the KTOC in a more philosophical manner and report some new results. For the details of transparent and comprehensive calculations that may interest some readers I refer to (E. Levich, 2014).

I still would like to make clear the two reasons that helped justifying my audacity and do away with all traces of confusion. The first reason is that the KTOC relies strictly on the classical theoretical physics disciplines, e.g., the Einstein special and general relativity theories, the basics of quantum mechanics, statistical mechanics, etc., and is not allowed dangerous temptations of excessive imagination. The theory has an advantage of relying on the latest astronomical data of Planck telescope mission in addition to classical experimental data. Despite the lack of imagination, but maybe due to this constraint, the theory leads inexorably to explicit quantitative and predictive results. In particular, as mentioned above it furnishes the numerical values of certain most fundamental cosmological and physical parameters and constants, e.g., the mass of electron and proton and their life time span, the Hubble constant and others that I will mention shortly. Although, the calculated values of constants hitherto had been universally considered empirical fundamental constants of Universe they are not.

The genuinely fundamental constants are the speed of light  $c = 3 \cdot 10^{10} \text{ cm/sec}$ , the Newton's gravitational constant  $G \approx 6.67 \cdot 10^{-8} \text{ cm}^3/\text{sec}^2$ , the Planck quantum mechanical constant  $\hbar = 10^{-27} \text{ erg} \cdot \text{sec}$ , the Boltzmann constant of statistical mechanics connecting thermodynamical energy of a system and its temperature, say in Kelvin degrees  $k_B \approx 1.38 \cdot 10^{-16} \text{ erg} \cdot \text{K}^{-1}$ , the dimensionless fine structure constant of quantum electrodynamics  $\alpha = e^2 / \hbar \cdot c = 1/137$ , or equivalently the electrical charge unit  $e$ , the dark energy density, or the Einstein *cosmological quasi-constant* empirically determined as  $\Lambda \approx 10^{-29} \text{ g/cm}^3$ . Although, the dark energy density itself is not really constant the contemporary value of dark energy density  $\Lambda \approx 10^{-29} \text{ g/cm}^3$  is fundamental for the reasons clear from the Table of results. Indeed, the total mass density calculated by the KTOC is slightly less than the critical density of flat Cosmos and the latter is with high accuracy is calculated in KTOC as the above value of  $\Lambda \approx 10^{-29} \text{ g/cm}^3$ . What it means is that Cosmos is approaching the state where only dark energy will be left with this density, although this approach will take the above ten quadrillion quadrillions years till the end of visible Cosmos. But during all this time all matter in Cosmos combined is equal in density to the dark matter density in the end. As soon as visible matter disappears dark matter disappears, since dark matter is the chaos disposal by coherent visible matter. But the above reasoning combined shows that visible matter consists, made up from dark energy. This was rigorously proved in (E. Levich, 2013).

Adding this value contemporary dark energy density  $\Lambda \approx 10^{-29} \text{ g/cm}^3$  to the list of universal constants allows an unique and only dimensionless combination, a large number  $\text{Re}_c = 10^{41}$ . Together the two dimensionless numbers  $\text{Re}_c = 10^{41}$  and  $\alpha = 1/137$  are pivotal for the KTOC. In the end of this work there is a Table of theoretical results versus the classical experimental and latest astronomical data. It is borrowed from the previously cited article (E. Levich, 1914) with corrected misprints. Readers having no patience to read through the text can skip it and consider the final Table

below. They will find the quantitative agreement between the diverse theoretical results on one hand and available experimental data on the other fairly impressive, or so I hope.

A story tells that once Napoleon Bonaparte demanded an explanation from his general of the reasons why the general had lost a battle with the Austrians. The general defended himself by referring to nine main reasons of which the first one had been lacking artillery shells. Napoleon waved the general away commenting that this one reason is enough.

However, the second reason that convinced me to publish the above papers and the theory therein is so important that I must discuss it. Indeed, the theory explicitly complies with and relies on the second law of thermodynamics, the venerable second law, although in the *kinetic interpretation* that is novel, in particular novel for cosmology, but rigorously formulated in the cited papers and their foreshadows. The *kinetic second law, or reverse second law-RS-* is as unshakeable as the second law of thermodynamics of Gibbs, Boltzmann, Carnot and other giants who created the sciences of thermodynamics and statistical mechanics in the late 19th century, as well as the more recent nonequilibrium thermodynamics generalization developed by the late Nobel Prize recipient Ilya Prigogine. Nevertheless, the *kinetic second law* is subtly but decisively different, although follows naturally from the familiar *second law*. It is the compliance with the *kinetic second law* that furnishes the quantitative success to KTOC.

The *second law* is known for about 150 years. It was iconized as truly elemental by Sir. Arthur Eddington, an outstanding British mathematician, astrophysicist, philosopher and cosmologist who on the top of his many original contributions was the first to understand the possibility of observing the bending of light in the gravitational field of Sun during the total eclipse and decisively observed it. This is a crucial prediction of the Einstein gravitation equations of general relativity that is widely used since then for astronomical observations. Arthur Eddington thus famously spoke of the *second law*: "The law that entropy always increases, holds, I think, the supreme position among the laws of Nature. If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations — then so much the worse for Maxwell's equations. If it is found to be contradicted by observation — well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation". I hope that after acquainting themselves with this work the readers will appreciate the indomitable power of this historical statement by Arthur Eddington.

I would like to summarize the main assertions and conclusions made above. The coherent dark energy flux had given birth to our Cosmos in the ultimate order of Big Bang, has been furnishing all order of inanimate matter and life on Earth since the Big Bang, created consciousness in conjunction with time and protons. in Cosmos since and will of ever growing order of Cosmos and of Man on Earth, connects all points the locations at dark energy as the primeval, primordial and continuous source of all growing order of Cosmos, of life and conscious Man on Earth. Moreover everything that exists in Cosmos, visible matter, inanimate and animate alike and dark matter is the kinetic manifestations of primordial dark energy. Our visible Cosmos and observable Cosmos is a subdomain of the timeless continuum of dark energy, the DEC that provides the coherent flux of momentum/energy into our Cosmos while our Cosmos metabolizes this coherent flux, digests it and exudes the same amount of momentum/energy but transfigured into the chaotic one. That is to say that the DEC is the inexhaustible source of negative entropy flux into our Cosmos subdomain. While the amount of momentum/energy is conserved, momentum/energy does not accumulate in Cosmos all order is extracted from the DEC coherent flux. This order does accumulate and is the cause of growing order of our Cosmos and as importantly of growing order of animate life and conscious Man on Earth.

Dark energy flux creates and permeates all matter in Cosmos. Everything that is happening in our subdomain Cosmos is transfiguration of the momentum/energy flux from coherent state into the chaotic one that is disposed back into the DEC. This transfiguration is achieved by a long chain, a hierarchical mechanisms cascading the constant, *averaged over a large space/time chunk of our subdomain momentum/energy flux* to smaller scales in the space of inverse scales/frequencies, or he 4D momentum/energy space. where it eventually dissipates as ultimate chaos at the smallest possible space/time Planck scale achieved only in the black holes-BH. This is the role and the reason, not the

mechanism of how they exist, but why the BH's exist as a sink for chaos, the regurgitated nourishment donated by the DEC to our subdomain Cosmos.

It was determined in the cited above papers that the coherent momentum/energy flux enters our subdomain Cosmos from the DEC at the typical space/time scale:  $L_{DEC}^{FROM} = 10^8$  cm;  $T_{DEC}^{Coherent Flux} = L_{DEC}^{FROM} / c \approx 3.3 \cdot 10^{-3}$  sec. where  $c$  is the speed of light. On the other hand the dissipation, the disposal of the chaotic momentum/energy at the quantum "singularity" of BH's is at the Planck space/scale  $l_p = 10^{-33}$  cm;  $t_p = l_p / c \approx 3.3^{-44}$  sec . Since the amount of momentum/energy IN and OUT is the same it means that that the number of degrees of freedom flowing OUT from our Cosmos back INTO the DEC is huge by comparison with the number of degrees of freedom in the flux IN.

Indeed,  $S_{DEC}^{ourCOSMOS} = R_C^3 \cdot S_{ourCOSMOS}^{DEC} = (L_C / l_p)^3 \cdot S_{ourCOSMOS}^{DEC}$ , where  $R_C = 10^{41}$  is the fundamental, dimensionless constant of our Cosmos as I asserted above (E. Levich, 2013, 2014). I designated the number of degrees of freedom as

$S_{ourCOSMOS}^{DEC} = 10^{41} \cdot S_{DEC}^{ourCOSMOS} = R_C \cdot S_{DEC}^{ourCOSMOS}$  on purpose to associate this number with entropy  $S$ , the quantitative measure of chaos. Entropy is the product of the Boltzmann constant  $k_B \approx 1.38 \cdot 10^{-16}$  erg·K<sup>-1</sup> and the number of independent degrees of freedom. Since the flux OUT from our Cosmos into the DEC has so many more degrees of freedom it means that the flux OUT is greatly more chaotic than the flux IN. Hence entropy of our subdomain Cosmos is continuously diminishing and order grows with time.

Thus the growing order follows from the observed accelerating expansion of Cosmos and the fact is that globally Cosmos is nearly flat, although wrinkled and curved locally by the randomly distributed clusters of matter. Astronomers in part correctly assign this phenomenon of expansion acceleration to dark energy, or the Einstein cosmological constant  $\Lambda$ , although they have no clue to what dark energy and the cosmological constant are. The EGE of EGR and Friedman equations alone are not enough.

If Cosmos expands with acceleration it means that there is some external force acting on the space inducing the space points to recede from each other with acceleration and obviously our Cosmos is not a closed system.

There is no such force if the space expands with no acceleration. The space of Cosmos had been found expanding in 1929 by an American astronomer Edwin Hubble. It is only in 1998 that two groups in the USA and Australia discovered that the Cosmos expands with acceleration, as great discovery as the discovery of Hubble expansion in 1929<sup>10</sup>. If there is external force acting on the space/time of our Cosmos and subsequently our Cosmos is not a closed system but a mere subdomain embedded into something infinitely larger and furnishing order to our Cosmos from the birth as Big Bang. This order can be furnished only as a coherent momentum/energy flux, digestion mechanism and disposal of chaotic momentum/energy flux. The realization that our Cosmos is not a closed system was shocking. That the growing order of Cosmos means that it is fed with the flux of negative entropy was inescapable. Similarity with the mechanism of order on Earth and life on Earth as the negative entropy flux from solar radiation, as had been first understood by Erwin Schrödinger was then obvious. It was just necessary to develop the qualitative concept into a quantitative theory with numbers that could be compared with experimental and astronomical data.

The constant momentum/energy flux cascades not in the 4D physical space of space and time but in the conjugate to physical 4D space of inverse scales/frequencies, or what is the same the 4D momentum/energy space. The mapping of this flux from the 4D momentum/energy space into the physical 4D space/time generates all the coherent matter structures that we observe in Cosmos including ourselves. Coherence of the momentum/energy flux, by definition of coherence, means the

<sup>10</sup> It should be noted that the Hubble expansion had been predicted by a Russian mathematician Alexander Friedman in 1922, the author of Friedman equations and the model of homogeneous, isotropic Universe that remains as the basic model of Big Bang cosmology. Later the possibility of Big Bang and expanding Universe was independently confirmed by a Belgian Priest Georges Lemaitre in 1927. Both of them based the expanding model of Universe and Big Bang possibility on, the EGE..

*phase coherence*. The phase coherence in conjugate 4D momentum/energy space intrinsically results in the acute intermittency of matter distribution in 4D physical space/time (E. Levich. 2009).

The momentum/energy flux is constant only in the sense of averaging over a very large space/time. On relatively small scales it fluctuates greatly. Hence the different amounts of order flow in physical 4D space/time through the different space/time subdomains. The inanimate and animate matter is distinguished by a hugely different magnitude of coherent density flux of which they consist. As strange as it may sound it is even possible to relate the dark energy flux density in conjunction with the maximal life span of Man 120 years with weight, mass of human brain cortex (see the Table of results below).

I would like to emphasize again that all matter in the 4D physical space/time actually consist of the flux cascading in the 4D momentum/energy space; former is the conjugate of the latter. It is in this sense that matter in 4D physical space/time is kinetic and transient. This may sound bizarre for some, but it is quite clear. For instance we think that our bodies are whole and almost static except that we are ageing. But we also know, at least some of us do, that the cells of our bodies are in a flux and renew due to the metabolism every several hours, or days or slower, or faster. Our bodies look the same as if they are composed of the same cells. They are not. We notice it with ageing and blame the genes. Indeed, our genes get tired and stamp the cells with bugs in them. The genes are the mechanism for the cells renewal. In this sense we are kinetic conglomerates of constantly renewing cells disposing old, tired, dead cells as chaos, excrements, sweat. By disposing chaos we allow order from outside sources to flow into our bodies and brain. Man species is distinguished by self-conscious awareness of being and creative activity that requires deliberate giving away of brain order. When we do it we feel very tired and need to sleep. When we sleep we dispose chaos from our brains as dreams. New order now can flow into our brains. This is the reason why all live species must sleep and hibernate. But all live species also need food as the source of coherent momentum/energy with order extracted and chaotic momentum/energy disposed as refuse. Food is the source of negative entropy.

In the same manner the molecules in the cells are in the flux, although the properties of the new ones remain nearly the same, atoms in the molecules are in the flux, although the new ones have the same properties as the old ones, and protons and electrons and quarks are in the flux, although their properties remain almost the same. However, even these elemental units of matter are ageing and have finite although very large life time before extinction. All visible matter in this sense is the intermittent flux of dark energy of different density into 4D space/time. This is the kinetic concept of our Cosmos and the phenomena in Cosmos that is indeed unusual, but there is nothing strange in it. This is just how Cosmos exists.

Since the space/time scales are enormous for astronomical entities we have a chance to observe the macroscopic evolution of these entities. The renewal of the entities of microworld is on the contrary very fast and we cannot observe it. In order to observe the dark energy flux forming them we must reach the Planck momentum/energy, but if we reach it we become a part of the DEC. Indeed, the only space/time domains where the Planck momentum/energy is reached are the BH and massive MBH. They are separated from the usual space/time almost entirely, except certain quantum penetrability per the theory of quantum evaporation of Bekenstein and Hawking. To reach them we must pass the surface that is called the trapping surface after (R. Penrose, 1964) and reach the quantum singularity. As soon as one touches the trapping surface there is no escape out and the daredevil who does it reaches the point of quantum mechanical singularity that in reality is the entry into the DEC. All what is left of the dare devil will merge with the DEC and this is all information that his/her body and brain carry. Information does not disappear in a closed system. Since the DEC with our Cosmos subdomain embedded is a closed system this information, including the new information that Man creates, rather than obtains from the DEC, will merge with the DEC. In this world picture the DEC creates our Cosmos as a subdomain for a purpose. Indeed, Man creates information that the DEC does not provide and brings it to the DEC. Although, the DEC is timeless continuum of order and coherent information it still can gain for more created by Man himself/herself. But this is almost a theological discussion that I would like avoiding in this work. This does not mean at all that theology is not a worthy subject. As much as I can I will return to the issue of WHAT FOR the DEC creates us in a separate work.

I note that the *kinetic second law*, or the reverse second law-RSL briefly that are the thermodynamical *second law* rigorously reformulated for kinetic systems and processes in the above cited papers, impose the inverse cascade upscale. It means the growth of structures over the scale  $L_{DEC}^{FROM} = 10^8$  cm;  $T_{DEC}^{Coherent Flux} = L_{DEC}^{FROM} / c \approx 3.3 \cdot 10^{-3}$  sec. This is how the large scale structures in Cosmos grow, galaxies made of stars, clusters made of galaxies, filaments made of clusters. This mechanism of formation large lumps of matter and even the Hubble space expansion as resulting from the inverse cascade was suggested in (V. Krishnan, 1993, R.D. Prabhu and V. Krishnan, 1993) with reference to the inverse cascade in atmospheric turbulence predicted in (E. Levich and E. Tzvetkov, 1987) and totally ignored by the scientific community. It is a fundamental conclusion that is made in (E. Levich 2014) that all matter in Cosmos is phase correlated, or phase coherent. The visible matter can be imagined as a string, twisted, knotted and intermittent naturally, as far as the density matter is concerned and still in instantaneous phase communication. This phase coherence is quite equivalent to the quantum mechanical phase entanglement and I argue are one and the same. For all mathematical details of the above features of the theory I refer to E. Levich, 2014 and references therein. The results with most misprints taken out I refer to the Table below.

When astronomers peer in the sky they reach to the cosmological horizon, the last matter casually connected with us on Earth. Since our Cosmos is expanding with acceleration the farther they look the older is the matter that they, almost to the birth of our Cosmos. The distribution of matter had been then strictly uniform, since and no lumps of matter had been yet formed. Cosmos had been filled with primordial light separated from dark energy continuum and this follows quantitatively from the theory that I call the kinetic theory of order in Cosmos-KTOC.

The shocking realization that I arrived at a few years back was that the fundamental Hamiltonian equations of physics, the time reversible equations and by their time reversibility do not, cannot respect the *second law*. Although, superficially familiar from the university bench the *second law* is surprisingly neglected. If the *second law* is as special as Arthur Eddington believed how the time reversible equations of physics can be possibly adequate for describing a great diversity of phenomena in Cosmos that are obviously not time reversible? Neither Cosmos evolution itself is time reversible. In my view the awesome *implications of the second law* are not sufficiently appreciated by some researchers. The consequences can be dramatic, fatal for certain fundamental phenomena and for some this death warrant is obvious can be easily demonstrated. The rigorous *kinetic second law*, the KTOCK foundation, had not been formulated prior to the above referred publications, although on a quantitative level the principles were advanced by one of the famous creators of quantum physics Erwin Schrodinger in his profound essay "What is Life" first published as a book in 1944. I will refer to this book a number of times in this work. In the recent years Sir. Roger Penrose has been outstandingly promoting and explaining the *second law* and of the role that the *second law* has is playing in Cosmic phenomena, the Cosmos itself, its birth, life, death and reincarnation. The ideas of Roger Penrose are exposed for laymen and professionals alike in a book of extraordinary intellectual power "Cycles of Time" first published in 2010. The above two books greatly influenced me, I am sure I am among many, in formulation of the KTOCK. In this sense I am humbly following in the steps of the two brilliant scientists and profound thinkers.

I was raised in a scientific community that held a rather conservative attitude to physical theories. It is bred in my bone that physical theories that are neither predictive nor falsified within a reasonable time span are rather beliefs and should be seen as such. Beliefs, e.g., religious can stay not falsifiable forever. If they do not they are not beliefs but facts. Physical theories need rigorous mathematical foundation, equations, group symmetries and eventually formulas and numbers. Or they are not serious theories. But on the top of mathematical clarity physical theories require experimental proof of validity within well-defined boundaries of accuracy. Some objects in Cosmos, say black holes cannot be directly experimented with. However, indirect astronomical evidence of their existence and properties must be available and there is one. This is how we know that black holes exist, although their precise nature is still debated.

Astronomers and astrophysicists meticulously observe Cosmos testing the data and analyzing it against different cosmological models. Indeed, the opinions of leading theoretical physicists and cosmologists, as regards the origin and evolution of Cosmos, remain mere beliefs, unless predictive and verified astronomically by observations of ever increasing accuracy. Indeed, certain popular and

widely acclaimed contemporary theories are lacking both the predictability and falsifiability. It seems impossible to verify them since they furnish no results that can be tested by observations and at the same time the theories cannot be refuted by a logical argument or experiment. Such is for instance the extremely fashionable string and brane theories that are not falsifiable for the last half a century and not likely will be in the future. As was noted by one of their former protagonist they are "not even wrong".

The leading  $\Lambda$ CDM (Lambda cold dark matter) cosmological model, called standard is much more successful. The  $\Lambda$ CDM model is based on the firm ground of Einstein gravitation equations-EGE- of general relativity and subsequent Friedman equations of homogeneous isotropic-HI-Universe. Nevertheless, the  $\Lambda$ CDM model is still empirical since it uses the constants and parameters furnished by astronomical observations, e.g., the values of Hubble constant  $H$ , the Einstein cosmological constant  $\Lambda = const$  usually interpreted as dark energy, dark matter density that is the major component of matter in galaxies, clusters of galaxies and all other large lumps of matter in Cosmos, etc. With these empirical values of parameters inferred from astronomical observations the  $\Lambda$ CDM model is in many aspects compatible with many contemporary astronomical observations of large scale structure of Cosmos.

In many fundamental aspects  $\Lambda$ CDM remains unsatisfactory since it is empirical and although not contradicting most of observations does not explain many observations, e.g., the intermittent distribution of visible and dark matter in Cosmos the way it is observed. It cannot and does not pretend to explain why the values of empirical parameters it uses are such as they are. Also, the model does not try to explain what **dark energy** and **dark matter**, the biggest "mysteries of science" as it is fashionable to call them in popular media, are. The **dark energy** medium, as a rule is identified with the Einstein cosmological constant introduced, although later repudiated, by Einstein as an additional term in his gravitation equations compatible with the principles of general relativity. Since no one knows what the Einstein cosmological constant is this identification does not help much<sup>11</sup>. As enigmatic is **dark matter**, the dominant component of the total matter of galaxies, clusters of galaxies and other huge lumps of matter in Cosmos.

What is this invisible media, the two types of matter that do not interact with electromagnetic waves, the visible light in particular, except by gravitation? It is a poignant question demanding answers. Indeed, it has been well established since the discovery of dark energy in 1998 and recently affirmed confidently by precise astronomical observations of the Planck telescope mission that the combined contribution of dark energy and dark matter is ~95.1% of the total matter in observable Cosmos. At the same time all visible matter, stars, galaxies, quasars, radio galaxies and X-ray sources, inter-galactic gas, planets, comets, everything that can be detected by interaction with or emission of electromagnetic waves, everything that we can see in the sky is a mere ~4.9 % contribution into the total matter of observable Cosmos.

There are other legitimate questions that can be addressed to modern physics and cosmology, although these questions are rarely raised and even considered heretical by some. For instance why the masses of electrons and protons, the two main constituent building blocks of matter are such as they are well known experimentally and why do they exist at all? The almost automatic answer of a physicist would be, at least in my case that they exist and have their masses and other properties as they do so that the familiar atoms can exist. And atoms exist so that the molecules made of atoms exist and the molecules exist so that all visible matter exist, inanimate and animate as well. But why mater, whether inanimate or live should exist at all? Is the existence of matter imposed by any fundamental law of science? Is the existence of electrons, protons, neutrons, atoms, molecules and matter made of molecules imposed by fundamental laws of science, say as solutions of fundamental equations of physics, the queen of natural sciences believed by many physicists to be able to explain all other sciences? Or does physics impose protons and neutrons and mesons consisting of quarks that cannot be directly observed, except of one strange quark? And as regards the quarks why do they have to be? Just that protons and neutrons and atoms and molecules and matter, inanimate and live exist?

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<sup>11</sup> Roger Penrose believes that the cosmological constant values is a given fundamental property of Cosmos, say as gravitational constant. This work in part supports his view, although the nature and specific value of the cosmological constant is shown to be intimately connected with the quantum mechanical structure of Cosmos.

One of the greatest physicists of the second half of 20th century Richard Phillip Feynman, the creator of fundamental quantum electrodynamics, the preeminent among all other field theories, in his famous lectures on physics for laymen made the following comment:

*"We have just seen that the complexities of things can so easily and dramatically escape the simplicity of the equations which describe them. The next great era of awakening of human intellect may well produce a method of understanding the qualitative content of equations. Today we cannot see that the water flow equations contain such things as the barber pole structure of turbulence that one sees between rotating cylinders. Today we cannot see whether Schrödinger equation contains frogs, musical composers, or morality".*

If Feynman was still with us he would be pleased to know that the barber pole structures and the uncountable diversity of other coherent entities/structures are in fact the exact solutions of the water flow equations flows known as the Navier-Stokes equations, the NSE (E. Levich, 2009). This uncountable complexity of coherence is the gist of turbulence phenomenon. However, there are indeed no frogs, composers and scientists in the Schrödinger equation or any other fundamental Hamiltonian equation of physics.

There are only two fundamental equations imposing order and coherent structures. These are the NSE, the equations describing the flows of fluids, like water, gas and all other so-called Newtonian fluids and the EGE-Einstein gravitation equations. The NSE and EGE are very different. The NSE are not Hamiltonian, *time irreversible* equations that explicitly take into consideration the friction forces intrinsic to any motion, including the motion of fluids. The truly staggering complexity of order in turbulent motion of fluids is all due to the friction forces (E. Levich, 2009). The EGE are different in a more subtle way. This is explained in detail in the cited above work (E. Levich, 2014).

It can be confidently asserted that none of the existing laws of Hamiltonian physics imposes the existence of even a single coherent entity mentioned above. None of these coherent entities is a solution of the time reversible equations of physics. Therefore a natural question is why the time reversible Hamiltonian equations of physics are fundamental if they are obviously lacking the coherent solutions that when combined make up our Cosmos?

It is true that the laws of physics and chemistry are such that they allow the inanimate matter to exist and show that if say composite protons made of quarks and gluons held together by the mechanism of strong interactions and neutrons, formed from protons by a mechanism of electro-weak theory and held together with protons by the mechanism of nuclear forces and electrons, believed to be non-composite fundamental particles, all exist they can together form atomic nuclei and atoms with the properties determined by the laws of quantum mechanics, i.e., the Schrodinger equation. Similarly as per the Schrodinger equation atoms are capable to combine via electromagnetic mechanisms into molecules and molecules via other mechanisms, e.g., van der Waals electrostatic forces and assisted by the mechanism of However, none of the time reversible physical laws imposes the existence of the constituent bricks of matter or forces their amalgamation into hierarchically larger, more complex organized entities. And what do we know about live matter? We know that live matter consists of the same hierarchy starting from the quarks literally enslaved into protons and neutrons that are combined with electrons into atoms that are combined into molecules that are combined into cells that are combined into bodies of live creatures, from viruses to cockroaches to ants to fish to mammals to humans. Live matter is constituted of the same bricks as inanimate matter, but live matter is infinitely more complex, infinitely more coherent and all based on carbon, oxygen, hydrogen molecules. Ostensibly because the carbon based molecules have a large number of bonds and together with oxygen and hydrogen molecules and atoms can form extremely large and superbly coherent conglomerates, coherent structures built somewhat like Lego is built, but in the myriads of modifications and configurations that eventually combine into live cells and further into giant amalgamation of cells that make truly divine in complexity of coherence multicellular bodies of live species.

Our bodies consist of ten trillion,  $10^{13}$  cells. They are all in perfect order with each other and each of them in constant communication with each other. How such order is possible and what imposes it to be? Why at all our cells hold together in this divine order? Our brain and brains of other advanced mammals are made of nearly 100 billion,  $10^{11}$  neuron cells, as many as there are stars in large galaxies. These neurons are connected by about one quadrillion,  $10^{15}$  so-called synapses that

furnish, must furnish a constant flux of information exchange, communications between  $10^{11}$  neurons that in their turn command and hold in coherence  $10^{13}$  cells of the body. By comparison the complexity and the level of coherence of galaxies of stars, or anything else in Cosmos is a joke.<sup>12</sup>

Still this is a small task by comparison with the totality of coherent work done by the brain. The *brain cortex* is the neurons and synapses between them that are responsible for all cognitive activity. Animals must live, hunt, dominate weaker fauna and flora, eat it, breed and procreate descendants fit to survive by being increasingly coherent, or at least more coherent than the lower species upon which they dominate and use as food.

However, all the above pales when we consider the Man species. Man uses his/her cortex for creation of things. Man creates technology to live better, or so Man believes. But Man is self-conscious. Man recognizes himself as a part of Cosmos and recognizes the current of time, the past, present and future. Our mind reached into the past of Cosmos almost to the beginning of time. Man tries to predict the future. Man creates art, music and mathematics.

No one really knows what consciousness that distinguishes Man from all other life is. My personal view that comprehension of the time current concept, even although we do not really know scientifically what the time concept is and creation of art, the music especially, and abstract mathematics are among the unique traits of consciousness. However, unless there is a quantitative, mathematical comprehension of consciousness, rather than intuitive, science is blind to this phenomenon of Cosmos.

Science is blind as far as much simpler phenomena are concerned. Biochemists and chemists know large number of mechanisms that allow all this growth of coherent divinity of life to occur. But they have no clue as to why it occurs, what drives and imposes the growth of incomprehensible coherent complexity. Most dramatically that science has no clue what life is. How it is that inanimate matter becomes animate. Although, humans have been thinking about what life is for thousands of years scientists are as ignorant about life as our ancestors. Even more perhaps, since the ancestors had a consolation of believing in divine origin of life. Scientists while rejecting the divine suggest nothing instead except genetic engineering that has nothing to do with what life is.

However this does not make biochemists and biologists less advanced than physicists and chemists since physicists and chemists have no clue what compels formation of ever growing coherent structures of trivial inanimate matter, when compared with animate, , from quarks all the way up to filaments composed of clusters of galaxies and quasars, the largest observed coherent structures in Cosmos.

Cosmos is full of well observed complex order and coherent organization. From the wall of superclusters of galaxies at the very edge of observable Cosmos all the way down the scale to galaxies, from galaxies to stars, from our solar system to planetary atmospheres, from the great red spot on Jupiter to general circulation of Earth's atmosphere and Gulfstream, to tropical hurricanes, tornadoes, clouds in the sky and the unique order of animate matter of biological life. The beehives, the ant hills, the packs of wolves and flocks of birds, the swarms of insects and schools of fish are all the amazingly complex coherent entities. And at last Man made coherent entities, human tribes, states and empires, the human civilizations run by the pieces of paper called money, everywhere on Earth and in far Cosmos we see complex order and organization arising, evolving, reaching the peak of potency and suddenly decomposing only for other organized entities even more coherent and potent to emerge on the ruins of the fallen. As ordered is the microworld of protons and other hadrons, electrons and other leptons, matter elements from the Mendeleev periodic table all of the above are coherent entities arising from more elemental building units and growing in complexity with the growth of united coherent components.

Whatever is the complexity of coherent entities it is impossible not to see the oneness of complex organized entities consisting of inanimate atoms and molecules, atoms and molecules

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<sup>12</sup> The amazing complexity of live species and Man as a pinnacle of organization and coherence in Cosmos was explained to me many years ago by a distinguished space scientist and great visionary Carl Sagan. I met him at his modest home in Connecticut in 1976. I was sincerely puzzled by what he explained to me. It triggered my passion to the problems of kinetic coherence in complex systems and I owe the debt of gratitude to the late Carl Sagan for helping my comprehension of the divine order of intelligence in Cosmos.

consisting of protons and electrons, manmade states consisting of human units instead of atoms and the animate matter, our bodies consisting of the live cells clinging to each other for unfathomable reason .

The oneness is obvious in three aspects. The first aspect is the cycle of life; organized entities having each its own lifespan. The second aspect of oneness is in coherence of elementary units of which the entities are made of. As long as quarks are in coherent interaction with each other protons stay stable unless broken in colliders. Even when broken rather than being free the quarks immediately unite again. Quarks are ultimately coherent and are never free. If there is tight coherence between molecules in inanimate matter the latter stays stable. Such are crystals where the molecular coherence is very high due to symmetry. The more humans in the manmade entities, states, tribes, societies and Empires are united by a coherent common purpose the longer these entities survive. The tighter is the biological coherence of a racial group the more stable and enduring it is, unless destroyed by a biologically more biologically coherent group. As long as the cells of fauna and flora or human bodies cling tightly to each other the body lives, although the molecules in the cells are in the flux and correlate with each other only weakly. As soon as the coherence of purpose between the units starts weakening the entities are waning and irreversibly on the road of no return to decomposition of chaos.

The third imperative aspect of oneness is that the organized entities are never static, but kinetic and transient. They are kinetic to start with by receiving order from external sources of order. There is no such thing as self-organization from chaos; there is always an external source giving away its own order and by sacrificing its own order imposing order, or coherence that is the same between the composite units of the entity. In their turn the kinetic coherent entities must dispose chaos that any nonequilibrium, kinetic entity inevitably accumulates with time. Kinetic coherent systems are transient by their very definition. A kinetic coherent entity exist as such as long as it receives coherent energy from an external source, has properly working mechanisms to digest it, has proper mechanisms to metamorphose this energy into the chaotic one, has properly working mechanisms to dispose this metamorphosed chaotic energy out while order from the received coherent energy remains and maintains the entities coherence. These continuous in time transfigurations are the essence of kinetic coherence. As soon as one of the mechanisms of transfiguration of order into chaos and chaos disposal is in trouble the coherent entity is sick and may day if the mechanism is not cured. As soon the source of coherent energy, the source of order is weakening the entity is waning, ageing and dying.

There are many inanimate coherent entities that are so stable that they are often thought of as static and eternal. They are not really static. It is just that their metabolism is very slow and their aging is subsequently slow. Nevertheless they all have the finite lifespan, although for instance the lifespan of protons and electrons is equal to the lifespan of visible Cosmos. However, since visible Cosmos has a well-defined finite lifespan the protons and electrons will also die. They die together, since visible Cosmos has sense only if there is visible matter in it and someone to observe it.

All kinetic coherent entities in Cosmos are aging by accumulation of chaos. The lifespan depends on the ability to absorb order from the external sources willing to donate their own order, digest order by converting it into chaos and dispose chaos outside. As long as the external source donates order and the mechanisms of order absorption, digestion and chaos disposal are functioning properly the entity lives, inanimate or animate alike. This kinetic chain of transfigurations from order to chaos rules the existence and evolution of visible Cosmos. The whole visible Cosmos is a kinetic coherent entity.

I would like to explain in a simplest possible manner what the *second law* is and how the *kinetic second law* is different from the thermodynamical *second law*. In our everyday life we experience these two laws routinely and even don't notice them as they manifest in a manner obvious for us. We should remember several words; order, or coherence on one hand and chaos on the other. Order, or more scientifically coherence is the opposite of chaos. Chaos is something that was defined quantitatively by the great physicists and chemists who created the sciences of thermodynamics and statistical mechanics in the second half of 19<sup>th</sup> century, James Clerk Maxwell, Ludwig Eduard Boltzmann, Josiah Willard Gibbs, Nicolas Léonard Sadi Carnot, Rudolf Clausius, Lord Kelvin and their followers. I remind these great names again with their first names on purpose. If not for these

scientists, their great predecessors, contemporaries and followers the modern technological Judeo-Christian civilization would have not existed.

Let us begin. Assume that an elderly man/woman, a person sick and weak lives in a room that is mostly isolated from outside world. The person spends most of the time in bed and fully dependent on a nurse who comes every week to tidy up the room. While the person is alone he/she makes mess in the room and the lavatory, all objects, glasses, plates, dress are scattered around, the bed is mess and soiled, food gets rotten in the corner, rots in the etc. If we peer into the room we would be shocked with chaos. Then the nurse comes and in 6 hours all items are nicely placed *Vis a Vis* each other, the bed cloth is cleaned, starched and ironed with no messy soiled wrinkles, garbage is taken out, the person is washed and brushed and looks lush, rotten food is disposed and everything in the room is harmonious. The person is happy. If you peer into the room you would exclaim: what a wonderful order in the room, someone was here and did a good job of disposing chaos and bringing coherence, order into the room. It is trivial what I just described, but let us proceed. The nurse gets sick and does not come. The room is closed from the outside room. The person is alone and goes on making mess in the room. Each next day the chaos grows and of all order gradually nothing is left. Eventually the poor person dies, decomposes into gases and molecules. The inorganic items in the room will also decompose eventually, but much later. When at last this happens the room will be filled with a variety of molecules. If we wait for even much longer the molecules will also decompose into the constituent elements. This will be the state of thermodynamical equilibrium, the state of maximal possible chaos. This is the manifestation of the regular thermodynamical *second law*. In a closed system such that is not influenced by anything outside of the system chaos can only grow, or remain constant but cannot get less. The room that we described is a closed system. The main consequence of the *second law* is that order cannot grow in a closed system. Subsequently if it happens that an observer notices that order is growing in a closed system it means that this system is not closed. If the person in the room wakes up and sees that suddenly the items in the room are placed differently and more esthetically the person would be sure that the nurse convalesced, entered the room and made it up. The room is not a closed system any more. This is exactly what we see in Cosmos via its accelerating expansion and global flatness.

If the nurse comes and make up the room she has two tasks. The first task is the chaos disposal and the second task she rearranging items in the room in an orderly, esthetic fashion. But the second task cannot be implemented unless the first one is also implemented. To arrange coherence in the room chaos should be disposed. To maintain coherence, or order in the room it is necessary to get rid of chaos continuously. But where this chaos in the room comes from? Chaos is inevitable since the person is sick. All the person is doing is disposing the chaos of his/her sickness out to stay alive, coherent. But even if the person is healthy he/she must eat.

Meat and vegetables are highly coherent nourishment. The healthy person eats and receives coherent energy from this food. Then the person regurgitates the coherent food and excretes much more chaotic substances. But although chaotic the substances have exactly the same energy amount. If the energy balance is skewed the person would start getting obese, or on the contrary too skinny. But order remains in the body and this is why the bodies of biological species are whole with all cells holding together. The healthy person, say a sportsmen exert efforts and spend order and while exerting efforts must also get rid of chaos, e.g., via sweating to remain coherent for as long as possible till the finish.

Therefore the nurse in the room is the source of order, or the source of negative entropy that allows the person in the room to exist. She gives away her order and exudes chaos to remain coherent. Her order transforms into order in the room that helps maintaining coherence of the sick person, etc. This positively affects the mechanisms of the sick person and he/she uses these improved mechanisms to exude the chaos of sickness and so forth. In the same manner food is the source of negative entropy for all animate matter, from viruses to humans. In the same manner the coherent part of solar radiation is the source of negative entropy and positive order to Earth. All order on Earth is caused by the coherent energy flux of solar radiation and disposal of the same amount of chaotic energy into outer space. This remarkable, yet another divine phenomenon first qualitatively understood by Erwin Schrödinger and further by Roger Penrose. Quantitatively the cascade of order from the solar radiation to life itself is considered in many details in (E. Levich, 2014).

What I described above is the *kinetic second law*, or the *reverse second law-RSL* that imposes order in open systems by kinetic mechanism. In each phenomenon of a system, or an entity that shows growing order, or maintains coherence by extracting it from the coherent flux from an external source of coherent momentum/energy, regurgitating this energy and disposing the same amount of chaotic momentum/energy.

The issue that I have not covered is the "mysterious" dark matter that contributes over 90% of all matter in large lumps of matter, e.g., galaxies, clusters of galaxies, filaments, etc., and are 26.3% mass contribution globally in Cosmos. There is no mystery in dark matter. Dark matter is the chaotic energy exuded by visible coherent matter so that visible matter remains coherent. The total contribution of dark matter, as well as visible matter is calculated by KTOC in remarkable agreement with astronomical data from the Planck telescope mission published in 2013-2014. It can be seen from Table of results below. Indeed, the kinetic second law, or the reverse second law-RSL is behind all non-equilibrium, kinetic phenomena and coherent entities in our Cosmos. At least I have not found a counter example and I do not find it surprising. Nevertheless, I welcome readers to find one.

In real Cosmos all physical phenomena must account for the effect of friction and dissipative losses due to friction. This had been understood clearly by Leonardo Da Vinci even prior to Newton's theory of friction. Let us consider fluids as an important case study because the all-important phenomenon of turbulence is the phenomenon in fluids. Friction in fluids is accounted for by the so-called kinematic viscosity parameter  $\nu$ , a number having the dimension  $cm^2/sec$ . Water viscosity is about  $0.1cm^2/sec$  and for air it is quite smaller, but for honey it is much larger. This is obvious. Viscosity is created by molecules of which all matter including fluids consist of. In fluids molecules move randomly, free from each with different velocities for different temperatures unless they collide with each other.

When molecules collide they exchange momentum and energy and some of it is lost to heat. This is friction and a loss due to friction. Mathematically it is described by the kinematic viscosity of fluids parameter  $\nu$ . There is no general theoretical way to calculate viscosity parameter, except for the most trivial case of ideal gases. Quantitatively viscosity is a very complicated parameter that is almost always an empirical number subject to precise experiments. Since friction forces and energy loss due to molecular viscosity are imperative for machinery and hardware the determination of viscosity is a wonderfully advanced experimental skill.

When a solid body moves through fluid media, or fluids flow around a solid body, say an airfoil, the molecular interaction with the solid surface is so tremendous that the fluid velocity is exactly zero at the surface. The molecules of fluids, air or water alike simply cannot disattach from the solid surface. This naturally decelerates the adjacent layers of fluids and causes the momentum/energy flow from fluids to the surface. Hence, naturally, the friction experienced by the solid body, say airfoil is fundamentally important. To be specific we will discuss an airfoil, like an aircraft flying through the air. The airfoil is driven by the engine that burns petrol and creates the propelling momentum of the airfoil. In conjunction with the equations of motion of the airfoil through the air, called the Navier-Stokes equations the source of momentum/energy, the burning petrol generates coherent motion of the airfoil through the air. In other words the airfoil engine is the source of coherent momentum/energy manifested by orderly, coherent flight of the airfoil. This can be reformulated as a flux of coherent momentum/energy from the engine furnishes the airfoil coherent flight through the air. But by definition of Newtonian mechanics the momentum/energy flux is the force acting on the airfoil. The force must create acceleration by the second law of Newton. But we know that most of the time the aircrafts fly with constant velocity and no acceleration, although the engine works continuously and the momentum/energy flux acts on the airfoil uninterruptedly. The reason why the airfoil does not accelerate is the force/or momentum/energy flux  $f$  the same value but in the opposite direction to the flight direction. This is the friction force due to air viscosity. As much momentum/energy is spent by the airfoil engine to propel the airfoil that much is lost to heat resulting from the air viscosity and subsequent friction. This is just the momentum/energy conservation law that must be complied with since the airfoil flies with constant velocity. But if to think about it a bit more deeply the question can be asked. Indeed, where is the order, the coherence of the airfoil flight comes from? Why the airfoil does not wander about randomly, say by the action of air masses that do move randomly around the

airfoil? The answer a pilot would give is that the coherence of the flight is maintained by the special devices that use different mechanisms to allow the airfoil to stay the course. This is all true, but there is a deeper reason for the airfoil flight coherence.

Indeed, the momentum/energy flux furnished by the engine is coherent. It is enough to watch the ejection of gases from the reaction engines giving coherent propulsion to the plane. The direction of this propulsion can be regulated by the devices mentioned above. But propulsion is always coherent. On the other hand the momentum/energy lost to friction is heat. Heat is chaotic. The momentum/energy lost to heat is the chaotic momentum/energy. In other words while the momentum/energy flux furnished to the airfoil is coherent the momentum/energy lost due to friction is chaotic. While the airfoil stays the course with no acceleration the very ability to stay the course is due to order extracted by the airfoil from the burned petrol. Therefore the very ability of any airfoil or a bird in the air, but also the submarines and fish to fly and swim coherently in fluid media is due to the fact that the propulsion momentum/energy generated by fuel or muscles is coherent while the momentum/energy lost to friction is chaotic. The difference in positive order or negative chaos is the source of very ability of flying and swimming bodies to fly and swim coherently. This is true provided that the mechanisms transforming coherent momentum/energy flux from a source of order into the chaotic one that can be disposed of. Fuel or muscle exertion is the source of negative entropy for the flying and swimming objects. A remarkable conclusion that can be deduced is that if not for viscosity the aeronautics and swimming would have not existed. This is again the RSL that makes possible aeronautics and swimming. The NSE mentioned above as imposing the uncountable complexity of order and coherent structures in turbulent fluids are not Hamiltonian and in rigorous compliance with the *second law* and *RSL*

There is a special case of ideal fluids that are ideal having zero viscosity  $\nu = 0$ . The ideal fluids are known for the phenomenon of superfluidity and similar phenomenon of superconductivity in various materials at low temperatures. Both phenomena are purely quantum mechanical. Such fluids move with no friction and in superconductors the electric current moves through metals, or ceramics with no friction and hence there is no Ohm resistance and power loss to heat. But even these are not the exact statement since in reality even superfluid liquids and best possible superconductors have some tiny losses of energy to heat. Hence a special kind of turbulence exists in a superfluid. Again there is an source of negative entropy, the quantum fluctuations in this case and associated disposal of chaos. The second law and RSL are indeed the universal laws of Cosmos, as was anticipated by Arthur Eddington.

There is a greatly important, subtle property of the NSE. The motion of a media, rather a mathematical abstraction of ideal fluids with  $\nu \equiv 0$  is described by the famous Euler equations. These are Hamiltonian, time reversible equations of such complexity that despite hundreds of years of efforts mathematicians do not know if they have regular, smooth solutions globally, everywhere in space/time, although likely not. Nevertheless, they have been used effectively in civil engineering for centuries with most useful results. The Euler equations are just the Newton equations modified from point like masses and objects to continuous media of fluids. This passing over to continuous media makes them so complicated. However, as I mentioned above the most important phenomenon of turbulence in fluids is not possible in ideal fluids. Turbulence is one of the most typical phenomena in Cosmos and on Earth. With few exceptions, e.g., some capillary biological flows, the fluid flows are almost always turbulent. For us turbulence is semantically associated with erratic, chaotic motion and state of affairs in general, e.g., in life. This is totally wrong. Coherence and order of uncountable complexity and diversity is the gist of turbulence. The associated chaos is disposal necessary for the coherence to survive. It is important to repeat over and over again that complex order itself generates chaos as a protective shield against destruction. Turbulence intrinsic order generates chaos of wondrous beauty. Coherent visible matter "string" generates dark matter and coherent quarks in protons and neutrons generate the chaos of gluons, but also dark matter. All natural atmospheric phenomena on Earth and other planets are extremely turbulent, not to say about stars, solar wind, galactic gas, etc. If turbulence in fluids would not exist the very life of Man on Earth would have not been possible. It is once again the truly divine turbulent coherence of atmosphere and oceans that creates and maintains conditions such that the carbon based life is possible. As always the prime source of order is the coherent flux of solar radiation that in the first stages of transfiguration

transforms into the order of turbulent atmosphere and ocean currents, e.g., Gulfstream (E. Levich, 2009 and E. Levich, E, Tzvetkov, 1987) and into photosynthesis by plankton and by green forests<sup>13</sup>.

But why in ideal fluids turbulence is not possible? The ideal fluids are subject to the Hamiltonian Euler equations that do not respect the second law and RSL. By their nature the Euler equations cannot impose coherent complexity and hence turbulence cannot exist in ideal fluids.

If there would be no turbulence phenomenon in fluids the life on Earth would not exist, stars would not exist, the whole Cosmos as we see it would have not existed. It is that bad and what it tells us that we need viscosity and friction in the equations of physics to be able to understand order of Cosmos. The conclusions of KTOC narrated above will be now discussed below philosophically.

**Keywords:** Genesis, Visible Cosmos, Kosmos, Universe, Second low and reverse second low, Dark energy, Dark matter, Light, Order and coherence, Entropy and mathematical entropy, Acceleration of Hubble expansion, Bose-Einstein Condensation of photons, Dark energy and brain cortex

## CONCEPTUAL MODEL OF UNIVERSE

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### ABSTRACT

**Metaphysical concept of Universe, implicitly or explicitly accepted by the majority of scientists, is analyzed. This concept portrays the Reality as closed, self-sufficient physical reality, i.e. single-tier Reality exhausted by a single physical layer. On the other hand, comparison and joint consideration of new ideas and trends in various fields of knowledge reveals their similarity in leading beyond a single-tier model of Reality and pointing to multi-tier Reality. Summarizing the above ideas and trends that have emerged in various fields of modern science, a prototype of a more complex model of Reality - a two-tier model is introduced. New properties and features of Reality that can be predicted and explained by this model are discussed.**

**Keywords:** Reality, Universe, Model, Cause and effect, Synchronicity, Cosmology, Standard Model.

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<sup>13</sup> Plankton plays a very special role in the order cascade, since its mass in oceans is huge and a sizeable part of coherent energy is absorbed by plankton and regurgitated by photosynthesis into oxygen (Yu. Magarshak, private communication).

## PROCESSES OF NEOPENTYLGLYCOL EXTRACTION FROM WATER ORGANIC MIXTURES

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### ABSTRACT

The results of the solubility research of the polycomponent water organic systems with neopentylglycol, sodium formate and organic solvents are presented. The temperature concentration parameters of the extraction and crystallization processes of neopentylglycol and sodium formate are identified on the bases of the solubility diagrams obtained, the technological diagrams of the processes are given theoretical basis and enlarged laboratory experiment was carried out.

**Keywords:** Neopentylglycol, Water Organic Systems, Solubility Diagrams, Extraction, Crystallization

## SIMULATION OF HARDENING PROCESSES IN SILICATE SYSTEMS

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### ABSTRACT

This paper presents the quasi-homogeneous approximation for properties description of disperse systems. We used the statistical polymer method based on the consideration of averaged structures of all possible macromolecules of the same weight. Equations allowing to evaluate many additive parameters of macromolecules and their systems are obtained. The statistical polymer method allows to simulate the branched crosslinked macromolecules and their systems in equilibrium or non-equilibrium states. The fractal consideration of statistical polymer allows to model all kinds of random fractals and other objects studied by fractal theory. The statistical polymer method is applicable not only to polymers but also to composites, gels, associates in polar liquids and other aggregates. State of colloidal solutions of silicon oxide from the viewpoint of statistical physics is described. It is founded on fact that a colloidal solution of silica - silica sol consists of a very large number of interacting with each other particles that are in continuous motion. The paper is concentrated on study of an idealized system of colliding but non-interacting particles of a sol. Analysis of the silica sol behavior and calculation of the mean free path of the colloidal particles were carried out in terms of Maxwell-Boltzmann distribution. The number of particles capable to overcome the potential barrier at collision was calculated. Modeling of the sol-gel transition kinetics is considered by various ways.

**Keywords:** Quasi-homogeneous approximation, Statistical polymer method, Crosslink formation, Fractal method, Colloidal solutions, Silica sol, Sol-Gel transition, Mean free path.

## DEVELOPMENT AND APPLICATION OF NANODRILLING MUDS

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### ABSTRACT

The monograph deals with drilling complications, applied drilling mud, information on the stage of development of nanotechnologies and new methodological principles for the control of drilling mud via nanosystems. Nano effects forming at the unity of synergetic principles on the base of analytic surveys laid the foundation of a new theory. The main idea of the theory is that by creating early turbulence, nanomemory, effect of longevity nanodrilling systems (smart solutions) developed on "small and super small concentration effects" wholly provides aggregative stability of nanostructured drilling mud and creates controlling mechanism for structure-mechanical and colloid-chemical indices for a long term. If drilling mud is regarded as static, relatively non-resistant system reflecting weakly-connected medium, drilling mud rich in nano-dimensional particles can be evaluated as stable wholly controlled medium reflecting dynamic condition. Due to new relations formed among components in drilling mud in dynamic condition, self-control mechanism enables early turbulence in nanostructured drilling mud. In other words, a new regime from chaos to controllability is formed. This, in its turn, can be evaluated as the increase of internal energy of the solution to a new level, both in quality and quantity. The effect of "nanomemory" was found out in nanodrilling mud. The essence of this effect is characterized by maintenance of stability of drilling mud indices for a long time after nano influence. "Nanomemory" effect forms the effect of "longevity". Thus, the sustainability of the system is maintained, the indices of the system are controlled as well as the system controls itself during a long period.

**Keywords:** Nanodrilling, Nanosystem, Nanoparticle, Nanomemory, Early Turbulence, Durability, "Nanopetroleum", "Nanobitumen", "Nanooil", "Nanogoudron", "Nanomay", "Nanotampon", "Nanobufer"

## **EFFECTIVE CONCRETE BASED ON COMPOSITE LOW WATER-DEMAND CEMENT**

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### **ABSTRACT**

**In the article physical and mechanical properties of concrete based on composite low water-demand cements using powdered industrial wastes at different values of water-cement ratio (W/C), consumption of superplasticizer and workability of concrete mixes are analyzed. Using the methodology of mathematical planning of experiments, models of the compressive strength of concrete which hardened at normal curing and steaming were obtained. The influence of the main factors of concrete compositions and regime parameters of steaming on the strength values of concrete was researched. The possibility of achieving a high coefficient of efficiency of the Portland cement clinker use at the application of concrete based on a low water-demand cement (LWDC) is shown.**

**Keywords:** Concrete, Portland Cement, Superplasticizer, Cement Dust, Blast Furnace Slag, Fly Ash.

## **CREEP OF CONCRETE AND ITS INSTANTANEOUS NONLINEARITY OF DEFORMATION IN THE STRUCTURAL CALCULATIONS**

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### **ABSTRACT**

**This article is the continuation of the previous publications of the authors which are dedicated to calculations of the instantaneous non-linear deformations of concrete. This theory is the essential elaboration of the methods for calculating sustained resistance of the building structures. In this theory the instantaneous non-linear deformations of concrete are practically exactly took into account.**

**Keywords:** Non-Linear Creep Theory, Instantaneous Non-Linear Deformations, Sustained Resistance of the Building Structures.

## **NANOTECHNOLOGY FOR MANAGING PLANT ORGANISMS WITH THE HELP OF "TARGETED IMPACT" USING THE SIGNALS OF THE PHYSICAL NATURE**

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### **ABSTRACT**

One of the major problems of agricultural production has been to improve the sowing qualities of seeds to increase yields of various crops. In this regard, of particular interest is the control technology of vegetable organisms by "address the impact of" signals of the physical nature. Plasma treatment of seeds influences the growth and development of the amaranth. The effectiveness of treatment depends on the exposure time of the exposure. The largest positive treatment effect of the plasma on the growth, development and yield of amaranth has been observed when the exposure 60 sec. leading to increased yields.

**Keywords:** Pre-Treatment, Seeds, Plasma, Amaranth, Harvest, Elicitors, Nanochips, Pre-sowing seed treatment.

## **INNOVATIVE APPLICATION TECHNOLOGY FOR CHALLENGING INDUCERS OF DISEASE RESISTANCE IN SPRING RAPE IN NANOCIPS**

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### **ABSTRACT**

The present level of development of agricultural science has led to the emergence of a new method of plant protection, it is based on improving the immune potential of plants using elicitors, but not on the destruction of pathogens using pesticides. We have studied the effect of disease resistance inducers based on chitosan, organic acids and other substances with elicitor activity, being part of (nano) chips of different composition (matrix carrier - modified natural minerals, activated carbons, nanotubes, graphene, etc..) for pre-sowing seed treatment and for foliar fertilizing. We have studied their influence on growth, development, the incidence of rape plants, the quantity and quality of their crop. We have also determined the efficiency of nanochips depending upon their nature and carrier matrix composition.

**Keywords:** Elicitors, Nanochips, Pre-sowing seed , Rape plants

## UNAMBIGUOUS ENTROPIC EVALUATION OF COMPLICATED CONSTRUCTION PROCESS

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### ABSTRACT

There exist very complicated creative fields of human activities. As a rule, these fields comprise a large number of internal objects involving huge amounts of people, where large financial and material resources are concentrated. Operative management of such objects is extremely difficult due to their complicacy and multidisciplinary character, as well as due to the absence of criteria allowing an unambiguous estimation of the completeness of works both at a separate object and at the created system on the whole. The availability of such a criterion will make it possible to redirect resources more rationally so that to save time and means while completing the intended project. The suggested criterion of such kind is based on the properties of entropy, which is the principal invariant of today's natural science. This parameter is perceived ambiguously, being permanently discussed in technical literature. Physical character of this parameter has been validated in detail by the Author [1, 2] who has shown its universality for the analysis of complicated systems at their modification. In the present paper, the development of such a criterion for a complicated engineering project is considered. However, this approach can be used for the analysis of complicated technical projects in other fields of human activities, as well.

**Keywords:** Entropy, Criterion of Estimation, Optimization.