

Research Article

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Zero-Point Energy State of the Brain

Mukhopadhyay AK*

Professor of Pathology, North DMC Medical College, India

***Corresponding author:** Mukhopadhyay AK, Professor of Pathology, North DMC Medical College, Delhi, India.**Received Date:** February 20, 2019**Published Date:** February 27, 2019

Abstract

Zero-point energy state of the brain has been chosen as the central issue which could make a platform for addressing the leading-edge ideas in cognitive neuroscience and cell biology, physics and cosmology to initiate multidisciplinary research with a view to expanding the horizon of present science. Zero-point energy state of the brain has been considered as the most comfortable and restful state of the brain, full of activities like healing and regeneration when the brain might remain potentially open for further cognitive evolution. Dark energy-visible energy homeostasis within the brain cells (neurons and glial cells) has been conceptually linked with the gymnastics in cognitive activities, which in turn is logistically supported by plasticity of proteomics and metabolomics of cells.

Abbreviations: ZPE: Zero Point Energy; LCMS: Liquid Chromatography Mass Spectrometry; GCMS: Gas Chromatography Mass Spectrometry; BOLD: Blood Oxygen Level Dependent; DMN: Default Mode Networking; CSF: Cerebrospinal Fluid; ISF: Interstitial Fluid

Introduction

Science has been longing for expansion of its horizon for a considerable period of time and looking for ways how can it embrace humanity as well as consciousness. The Galileo Commission for expanding the scope of Science (<https://www.galileocommission.org>) launched in 2018 has taken up this issue seriously. At this specific Galileo Moment, the author who happened to be a member of the Advisory Board of this Commission, has chosen zero-point energy state of the brain as an important central issue for this purpose which might initiate multidisciplinary research to push the envelope of science farther. The leading-edge idea of dark energy in cosmology, zero-point energy (ZPE) in physics, ladder and canvas of cognition in neuroscience, energy consumption in proteomics of cell biology could be arranged on a broad canvas with a number of logically interconnected initial assumptions. The basis of such assumption remains a hunch from the existing experience in the respective fields! However, interweaving of several assumptions could never be possible without proper logic. The construction thus made should be verifiable by leading edge technology such as applied neutrino technology in physics, magnetoencephalography and fMRI in neuroscience, live cell imaging in cell biology and MuldiTOF mass spectrometry/Liquid Chromatography Mass

Spectrometry (LCMS), Gas Chromatography Mass Spectrometry (GCMS) and high-resolution two-dimensional electrophoresis in metabolomics and proteomics. At zero-point energy state, the systems brain in its finite live situation has possibility to get connected with the Infinite Whole and to exhibit the highest bid for self-healing, regeneration, plasticity, and display potential for further cognitive evolution.

Energy Consumption Issue of the Brain

We begin with a known unsolved issue in metabolomics of the human brain. The human brain constitutes 2% of body weight but consumes about 20% of body's energy. Most of its energy consumption could not be accounted by its signal processing activity and therefore, much is left to be understood on this issue. Perhaps this might be explained by consumption of energy in information generation, thought formation, knowledge building and in experiencing, supported logistically by concomitant protein folding within neurons and glial cells. Astrocyte produces 20 times more number of ATP as compared to neuron and passes its ATPs to neuron. We do not have another example of one cell passing its hard cash, ATPs, so profusely and easily to another cell. There is

no requirement of such astrocyte where neurons do not handle information and is concerned with transmission of only signal (as in a ganglion or a nucleus)!

Dark Energy Inside the Brain

The issue perhaps could be resolved if we begin with a series of assumptions. The first assumption is that visible energy of the human brain gets converted into dark energy during its cognitive activities; brain's processing of signal into information, developing it into knowledge, transforming knowledge into experience and sublimation of knowledge into wisdom. Dark energy is not any black energy. It is invisible energy. It has been presumed that there is dark energy in the brain as in the universe. This comes as a prediction from author's theory that when information splits [1] into space, time and energy, delivery of this energy happens from dark energy domain. Energy released, however, is visible energy, although this release happens in a very small negligible quantum.

Source of Unexplained Small Energy Could be Dark Energy

Involvement of this kind of very small quantity of energy has also been observed in what has been described as Casimir effect in physics. In chemistry and biology, we come across this kind of energy in van der Waals force holding the two strands of DNA together and keeping folded protein intact. This kind of small quantum of energy was also probably in mind of Ilya Prigogine when he thought of conformational energy of DNA more important than DNA as a chemical molecule in the context of explaining 'life'. We are also not certain what is that small quantity of energy in ZPE of physics? The origin and relationship between such energies, (i) energy released during information split phenomenon, (ii) energy responsible for Casimir effect, (iii) conformational energy of DNA, (iv) energy in relation to van der Waals force, (v) energy to hold folding of protein molecules and (vi) small quantity of energy in ZPE of physics, is worth pursuing. The source of all such small quantum of negligible energy in different situations could be the dark energy!

Since the brain is an information hub, and the neurons and glial cells are rich in folded proteins besides DNA, it is likely that the brain has to handle a lot of dark energy.

Dark Energy of the Universe

It is not known what the source-field of so much dark energy within the universe is, which fills about its 70%, and is responsible for its incessant expansion, countered only by attractive force of dark matter filling about 25% of the universe! We do not know yet how Einstein's cosmological constant is related to this dark energy although many scientists equate the both!

Imagine the early universe with incessant process of symmetry-breaking and symmetry making! The universe, full of dark invisible energy had been expanding relentlessly, constrained only by attractive force of dark matter. Uncertainty had been cast on the very existence of the universe. The universe, therefore, had been suffering simultaneously from three crises; asymmetry crisis, dark energy crisis and uncertainty crisis! Mother Nature had been restless to get a solution. A great concern had been bothering her how to save this

universe. She did not probably succeed in saving many universe(s) before, but for our universe at that near-breakdown situation of critical instability she decided for a momentous event, to put the wandering DNA/RNA within the enclosure of what has been called the cell wall or cell membrane. Near-break down situation thus had been converted into an intelligent systems breakthrough! With this single master stroke, thus appeared "life-form" in the universe and started growing and evolving.

Today we identify "life" in any system which exhibits this phenomenon of three homeostasis; homeostasis of dark energy and visible energy, homeostasis of uncertainty and certainty, and homeostasis of asymmetry and symmetry.

Lesson for Biotechnologist from 'Life-form'

So far what has been observed is that the conversion of dark energy into visible energy in a spectacular way is a feat of 'life-form'. We do not have any equipment, device or instrument which could execute this inter-conversion! Also, it is the life-form, not any other natural or human-made device so far, which could spontaneously exhibit uncertainty and symmetry management! Probably that is the reason of presence of trillions of 'life-forms' in this universe. That could also be the reason why so many glial cells are there around every precious and highly evolved neuron in the brain! Homeostasis of dark energy-visible energy is essential during different kind of cognitive gymnastics!

Source of Dark Energy Inside the Brain

The source of dark energy for the universe is not known. What is the source of this dark energy inside the brain? In author's paper on the ladder of cognition [2], it is argued that whenever a signal is converted (operation I) into information there is conversion of visible energy into dark energy and vice versa. Similarly, during development (operation II) of information into invariant knowledge structure and transformation (operation III) of knowledge architecture into a design of experience and sublimation (operation IV) of experience into wisdom, there is formation of dark energy in expense of visible energy and vice versa (Figure 1).

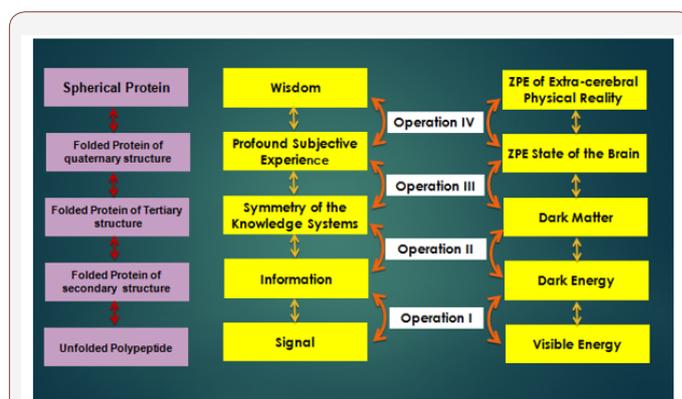


Figure 1: The ladder of cognition, from the signal at the bottom to the wisdom at the top, is intertwined with inter-conversion of visible energy into dark energy and vice versa, by four designated operations, I, II, III and IV. The logistic required for such cognitive gain is offered by accompanying polypeptide folding (shown on the left column), which also participates in inter-conversion of dark energy into visible energy.

In fact, in the operation when knowledge acquires an invariant architecture, there is perhaps conversion of dark energy into dark matter and so also during passage of knowledge into experience. In the same way, there is consumption of visible energy and production of dark energy while a polypeptide (signal) molecule folds into its secondary structure (informed protein), tertiary structure (knowledgeable protein), quaternary structure (experienced protein like DNA-repairing enzyme), and spherical structure (e.g., histone, the wisdom protein of DNA). Down the ladder when neurotransmitter is produced from wise council of histone, through the machinery of DNA, there is release of visible energy from the dark energy.

Misfolding of protein induces endoplasmic reticulum stress in a cell and one can imagine the amount of stress the brain has to go through when its hundred billion neurons and two to ten times of glial cell have been suffering from such endoplasmic reticulum stress due to mis-folded protein! In the sense as mentioned above, dark matter and dark energy inside the brain (neuroscientist's dark energy) is same, similar or identical to dark energy and dark matter outside the brain in this universe (cosmologist's dark energy). Both the brain and the universe, although, appear finite could be, through ZPE, in communion with the Infinity, the Whole, which is fathomless and eternal.

Brain's Dark Energy and Default Mode Networking

Marcus E Raichle [3], who published the first paper on dark energy of the brain in *Science* and subsequently developed the idea further [4,5], equated task-negative Default Mode Networking (DMN) as the signature of brain's dark energy. DMN in fMRI supposedly arises from spontaneous low frequency fluctuations in the blood oxygen level dependent (BOLD) functional state of the brain. Many of us are clueless how DMN could be a signature of the dark energy of the brain! DMN simply tells us that the brain is never at rest, even when the senses slumber and the mind is at rest. DMN has been shown to have a number of variants depending on the varied resting states of mind.

The newborn's brain remains in default mode till it learns how to convert a signal into information. The brain is very near to default mode in deep experiential state and in dreamless sleep state as well.

ZPE state in Physics and ZPE state of the Brain

ZPE in physics is about energy state in the vacuum of space. It falls within the present framework and horizon of physics and yet is a contentious issue and has been stated to be the 'worst prediction of theoretical physics', which leads to 'vacuum catastrophe' because of gross disagreement between the observed values of energy in vacuum of space as compared to what is predicted by quantum field theory [6]. Einstein in such situation included cosmological constant for non-zero vacuum energy which subsequently has been equated with dark energy. Energy in Einstein's equation, $E=mc^2$, is visible energy and is nothing to do with the dark energy or its domain. No one has clue about relationship between visible energy and information and so also between the dark energy and visible energy. Present author in his paper of 2008 has speculated and

argued that space time and energy are delivered during information-split phenomenon. From the discussion now, it can be argued that this has been happening deeper within this empty space. On the reverse, construction of information from the space-time-energy format of any signal also occurs deep within this empty space.

Currivan extends the concept of ZPE with infodynamics. According to her, "It's more that the Universal cycle essentially follows the two laws of infodynamics (expanded from the two laws of thermodynamics to view information expressed in complementary ways as conserved energy-matter and intropic space-time) - so it ends when the expansion of space reduces its temperature to at or very near absolute zero and its information content is maximized. Throughout the entire cycle the entirety of energy-matter within space-time is conserved and balances to zero" (email communication on 05-02-2019).

This can also be said that vacuum is the space state where the domain of visible energy and the domain of dark energy meet. Dark energy, ZPE and visible energy are, however, parts of a finite system, the largest such one is our universe. Therefore, dark energy domain is not the end. Beyond the boundary of the universe there is more to observe, more to see and more for looking forward to. That domain is called by the author the *essence* of the Multiversity, the source field of spiritual Light which is separated from Einstein's light, photon, by the domain of dark energy. However, if anyone wants to drag photon in that domain it is not photon as it is known. There it is Photon Equivalent of Consciousness (Phot-E-C).

How can one harness this infinite source of energy (dark energy) from the vacuum space? No answer yet! There is experimental evidence of changes in the zero-point energy of the protons as the source of the binding energy of water to A-phase of DNA [7]! However, we can look at what has been probably happening in nature. This meeting space of the domains of visible and dark energy, as the present author thinks, is also the playground of evolution for any life-form, which have in its possession the systems psyche [8], the elements of which are information, mind, self, life and consciousness. Of all five elements, "life" has a very important role to play while within this empty space.

"Life" in observable forum is seen as life-form. In non-observable sub-Planckian scale, from where the psyche operates, "life" has been described variously as life-principle, *prana* or principle of life. By mere presence of this "life", the meeting zone of visible and invisible dark energy at empty space is transformed into a great junction of the finite systems with the Infinity, the systems whole, the systems of multiple universe(s). For having this property, it is "life", which has the ability to turn the near-breakdown situation of the system into a breakthrough by the systems!

Although, it is easier for the simple unicellular or even multicellular life-forms to exploit this empty space for multiple breakthroughs on their way to the complexity, the human brain during cognitive gymnastics, possesses the unique property to have the kiss of this empty space through act of which it could get connected with the love of Infinite whole. This phase of prolonged connectivity of the brain with the Infinity could be described as the ideal ZPE state of the brain.

ZPE state should not be mistaken for ground consciousness. It is the ground energy state. Perhaps, future research might prove that ZPE operates under supervision of consciousness.

Ideal DMN should Represent the Zero Point Energy State of the Brain

The ideal DMN, which is independent of external stimuli and stimuli of internal thought, would better represent the lowest energy state of the brain, near or equivalent of Zero Point Energy (ZPE) in the physical world.

It is not difficult to prove experimentally that ZPE state is the most comfortable and restful state of the living systems since at this state homeostasis of dark energy and visible energy is perfect and near ideal for the live systems. At ZPE state, the system is at ease. There is negligible dis-ease or ailments! This restfulness state, however, is not a static but a dynamic state. Through this state, a finite live system gets connected with the infinite systems of multiple universe(s). Therefore, at ZPE state the live systems exhibit self-healing, plasticity, stem cell activity, regeneration and evolutionary potential of the highest order.

ZPE state thus is very important for the living systems and especially for the organ brain. However, the switch over from the finite state to infinite state through ZPE is subject to two conditions. It demands two more levels of integrations of the systems brain in addition to classical and quantum integration which lead the brain to this state. These are phenomenological/informational integration of the brain, and further integration of the systems to remain in conducive state for operation of Mother Nature.

The human subject is (i) near to ZPE state of the brain during deep sleep, NREM sleep, when there are no external stimuli and the mind remains non-functional and therefore, the cascading ladder of cognition falls silent. (ii) This could also happen in profound unity experience during meditation. DMN then reflects a physical reality, representing the informational template at a deeper plane of nature. (iii) ZPE state of the brain is exemplified in newborn's brain which is yet to learn the signal-information transformation.

From deep sleep state, the DMN of brain could take any of the following three pathways.

1. DMN gets connected with Mind's operations, and from ZPE state of the brain begins pixilation of space and time resulting in image and form, and the subject enters into dream sleep.
2. Operation of 'life' connects with operations of self and consciousness that leads to waking up of the subject from sleep.
3. The systems brain, being alive, connects at ZPE state with the reality of the Infinity, the systems of multiple universe(s). Having done so, there is huge information gain by the brain.

We still do not know what is this "life"? But if this "life" is switched off while the brain is in sleep state, the being never wakes up. Although the processes of "life" are autonomous, hooking of its operations with those of 'self' and consciousness is essential for sleep-wakeful cycle to continue. "Life" is also essential, as discussed above, for connecting the finite systems with the Infinite Whole through zero-point energy state.

Information Loss and Gain During Sleep

Crick and Mitchison [9] have suggested Suggested that there could be permanent loss of information from the brain during REM sleep. Upanishads suggest such possibility in deep sleep too. Not only loss but there could be gain of some useful information [10] in sleep. This gain or loss of information does not happen through senses. The phenomenon is transcortical or, cortico-supracortical and supracortico-cortical!

Across ZPE there happens in sub-Planckian scale a phenomenon of inside becoming out and outside becoming in, where (i) information's inside becomes out as *form* with release of energy and when from the outside signal's space-time-energy format becomes "in" to construct the information, (ii) cerebral cortex of the brain and supra-cortex cross over each other's domain. In both ways, there emerges possibility of the systems brain gaining important information for growth towards more organized complexity.

Sleep Deprivation and Progress of Neurodegeneration

Besides physiological alteration in body function and immune dysfunction, chronic sleep deprivation is associated with several neuropsychiatric problems such as irritability, depression and loss of libido, and cognitive disorder such as memory disturbance. Amyloid beta protein level in brain's interstitial fluid (ISF) of mice (a nocturnal animal) and in cerebrospinal fluid (CSF) of human being is regulated by sleep-wake cycle. However, it is tau, not A-beta, which appears to spread tau-pathway. Holth et al. [11] have shown that chronic sleep deprivation raises tau protein level considerably in ISF and CSF and is the principal factor in seeding and spreading of tauopathy. This piece of data supports the proposition in this paper that mis-folded protein such as tau within the cells, makes the pathological basis of psychological stress which could be restored to normalcy by having good sleep-wakeful cycle. Good sleep in which the brain is near to ZPE state is thus a life-style therapy for tauopathic neurodegenerative disorders both from preventive and curative point of view.

ZPE State Of The Brain Remains Its Best Healing Condition

Comatose state of the brain is a pathological state with severe compromise in its many known operations. In several situations the coma is based on severe organic damage. When a comatose patient shows clinical signs of frequent deep sleep and awakening, hope dawns for the brain coming near to ZPE state with fair chance of recovery. At this zero-point energy state of the brain, the self-repair and self-healing activities in DNA and proteins within the cells of the brain (neurons and glial cells) and rest of the body supposedly take place in a quietude which is bereft of irregular and arbitrary space time fluctuations generally evoked by external signal or internal thoughts. The processes of 'life' keep on operating in a mode of being hooked with the operations of 'self' and consciousness.

The Systems Whole, in general, does not have any disease or ailments. Pathological state originates within the systems when it gets disconnected with the Whole. Perhaps this is the state of the brain which has been looked forward to by practitioners of deep

meditation to fulfill the aspiration of Homo sapiens to become Homo spiritualis.

Concluding Remark and New Perspectives

I am afraid that this paper might be initially unnerving to many mainstream conventional neuroscientists, dark to many similar cognitive scientists, foggy to many similar cell biologists and appear vitalistic to many physicists. The reason is everything is not clear in the construction! There are a number of gaps. However, this paper could be considered as the conceptual framework for initiating multidisciplinary research involving the frontier issues in physics and cosmology (ZPE and dark energy), cognitive neuroscience (the ladder and canvas of cognition and brain's potential for cognitive evolution), and proteomics and metabolomics as supportive logistics for dark energy-visible energy homeostasis in cell biology. The ideas, which seem as mere assumptions could be examined in details and might be reframed as research questions and research hypothesis. Judgment on whether I have succeeded for the desired construction is left to the readers and researchers.

In this paper, the most comfortable restful state of the live brain has been brought into focus in which healing and regenerative activities as well as the potential for further evolution of the living being are in play. The paper also opens up new frontier on sleep research with the role of self, 'life' and consciousness. During conclusion we raise another important possibility of latest technological help in achieving this state. Could focused exposure of the brain to neutrino-beam restore this zero-point energy state of the brain? Could tau-neutrinos remove tau-protein of Alzheimer's brain? Could applied research technology developing on neutrino-physics come forward in Alzheimer's therapy? This is an objective way of exploiting brain-neutrino interaction [12], which might prevent and might cure neurodegenerative disorders!

On a completely different perspective we could look forward to such human beings who could easily switch on and off their brain to ZPE state as the best choice for interplanetary space craft travel.

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Conflict of Interest

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