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Emerging patterns in the complexity: Their organization within Systems Science

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Abstract: This innovative essay covering frontier areas of science crystallizes research ideas with translational potentials. It begins with a motivation to simplify the complexity by identification of emerging patterns within it. Overarching the properties of self-organization, organization by life and organization of consciousness, the article unfolds what could be the future of science of information leading from signal to information, to knowledge and wisdom, and vice versa, and also delineates the principles of sensor development for robotics. An emerging new psychology has been identified where the psyche could be considered a five-piece structure and process, which has relevance in cell biology where the cellular cognition is dynamically supported by signal networks of downstream informational molecules. The overall map thus constructed is non-reductive, holistic and falls within the ambits of systems science. The model is testable at micro level of systems cell and at macro level of systems brain. It is applicable also at mega level of a self-conscious, mindful and live universe.

Keywords: Complexity, Systems science, Self-organization, Life-organization, Consciousness, Holographic sensors

Highlights

(i) The decision-making complexity stands, connects and operates in between classical linearity and simplicity of consciousness.
(ii) The terrain appears complex because of unidentified operators stratified in layers, their non-observable operations and their interactions. Those have been identified and described.
(iii) Three novel properties of 'life' have been described; uncertainty management, holistically symmetry sensing and 'life's access to dark energy.
(iv) The spin-offs from the discourse in the paper are a possible science of information and knowledge organization, and research ideas for developing holographic sensors for robotics.
(v) Operation of consciousness has been connected non-reductively with systems informatics through systems psyche and systems 'life'.

1. Introduction

A complex system is characterized by its qualitatively and quantitatively unpredictable and variable response for a given standard stimulus. The absolute complexity stands between and connects classical linearity and simplicity of consciousness. It begins with the role of information in what we see as quantum puzzles and paradoxes and extends deeper through sub-quantum and sub-sub-quantum nests of nature to consciousness. Through its various checks and balances, openings and closures the complexity, while

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dealing with multitude of intentions, maintains the concern and perfection of the systems by its several independent, autonomous and interconnected operations arranged in stratified layers. The complex system has multiple structures at different scales and a number of processes with different temporal dynamics. This leads to generation of multiple characteristics for the systems (Weaver, 1948, Auyang, 1998, Ji, 2012). The systems appear complex because the properties of a number of variables working within it are not yet totally understood. The difficulty in unwinding this complexity lies in proper identification and description of all of its operators, operations, their interaction and stratification. Paul Nurse (2014), taking cue from physical systems pointed out that the answers to queries on many ill-understood functions of cell systems remain in the complexity biology. According to him (Nurse, 2008), not only the information flow, but also the logic circuits are to be looked into, and to be followed by network analysis.

The motivation to write this paper was to identify and classify the non-observable operations into different groups, understand their connectivity according to the purpose they serve, catalogue those on priority and finally segregate the operations in layers with sole objective of simplifying the issues. As we walk the talk we would see that the novel outcomes of this paper are (i) the future of the science of information leading from signal to information, to knowledge, to wisdom and vice versa (ii) crystallization of the principles of sensor development for robotics (iii) surfacing of an emerging new psychology, where the psyche could be considered a five-piece polylithic structure and process, with its (iv) relevance in cell psychology and cell biology, which is dynamically supported by signal networks of downstream informational molecules. (v) Finally, we draw an overarching non-reductive, holistic map that brings consciousness, self, life and mind and information within the ambits of systems science.

2. Layers of complexity in systems science

The complexity is spread all over the systems science. Systems chemistry and systems physics are amalgamated in systems biology; a courtesy from systems informatics. Systems informatics is connected with systems psychology and systems consciousness. This paper identifies three broad layers in the complexity consisting of a ground, the fabrics and the embroidery. The ground is a supportive and participating ground with a holographic sensor of a dynamically self-renewing wisdom, the crystallized knowledge within consciousness. The fabrics are constituted by the stratified labyrinth of hierarchically nested several independent autonomous operations of information, mind, self and life. [It is interesting to note here Christian de Duve's opinion on 'life'. "Life and mind emerge not as by some freak accident, but as a natural manifestation of tendencies in matter written in the fabric of the Universe" (Duve, 1995). We would be working on what could be this fabric of this mindful and live universe? And, what are these tendencies in matter?]. Embroider on the fabrics are constituted by the signal networks of informational molecules of systems chemistry embedded within systems biology. In our journey from the known to the unknown besides wading through existing knowledge we will look into informatics of self-organization, organization by life and organization by consciousness with introduction of several novel ideas.

2.1. Informatics of Self-organization

In the most surface layer of complexity there is self-organizing systems where the entire creation is maintained autonomously without a creator attending to its details. Self-organization has been described in both non-living and living state and we will see that it has never achieved the desirable level of perfection

without life. What make self-organization apparently autonomous are its efficient informatics; signal network, logic modules and a sensor with global focus. The operations are distributed over three layers, as shown in Table 1, as layer A, B and C run respectively by the currency of signal, digital information and non-digital information. Layer A deals with flow of signals. Layer B is having the logic modules on the basis of which flow operates, and the layer C as the global sensor is engaged in network analysis. Three layers are nested one over the other. There are recent publications in cell biology with a message that mere information flow is not sufficient for understanding the complexity at the micro level of a cell. The logic behind such flow is far more important (Ortega and van der Donk, 2016). Layers A and B have their own spatio-temporal dynamics, mono-planer or multi-planner, while network analysis in the Layer C is more global in its approach and in operation.

Table 1: Three layers of Self-organization (from surface to depth; A, B, C)

Layer	Structure	Space-Time Dynamics	Currency	Process	Openness
A	Signal circuits	Mono/multi-layered Temporal dynamics	Signal	Flow of signal	"Self-organized-critical instability"
B	Logic Modules	Mono/multi-layered Temporal dynamics	Digital/Shannonian/quantized information (Informative knowledge)	Information Organization	
C	Global sensor	Global	Non-digital/non-Shannonian /non-quantized/non-reductive /Godelian information (Formative knowledge)	Network Analysis	"Event-Horizon"

Self-organized system, however, may break down as suggested by Alex Hankey at the level of self-organized critical instability (Hankey, 2015) or reform in case of a live systems (see below). What is described as self-organized critical instability at microscopic nano-, pico- or femto level of cellular complexity is perhaps at the macro level, in other words, the 'event horizon' in vortices of several macro or mega operations.

The crucial part in the autonomy of self-organization is its information systems. Information is generally considered to be bipolar, spindle shaped, with a subjective and an objective pole. This is, however, the structure of information when it is in inactive phase. Information when gets involved in the process of organization, it becomes active and appears like a trifoliate leaf (Mukhopadhyay, 2013): its measurable folium is the signal, its logic folium contains organized contents for logic modules and its intent folium displays its non-digital state, which is useful for the global sensor. The stalk of the trifoliate structure of information is connected with its source in 'life', which is the storehouse of information-manifold. This occurrence might be described as information entanglement, entangling a number of operations (Figure1), which also includes Shannonian to Godelian transformation of information for global sensing, and Shannonian to signal transformation for the physical signal networking.

Signal's transformation into information (which has meaning) essentially requires an operation, which we ascribe to mind. As of now, information is known as only digital, binary or Shannonian (Shannon, 1948). Non-binary information has been in the conceptual realm as non-computable information (Penrose, 1999), non-reductive information (Chalmers, 1997), Godelian information (http://romanpoznanski.blogspot.in, 2016), integrated information (Tononi, 2015), information in global workspace (Baars, 1997), or as complexity-based information state (Hankey, 2015). However, all of these concepts miss the mandatory operation of 'life' necessary in transformation of digital information into non-digital information and vice versa. Sungchul Ji (2012), however, accepts such state as 'gnergy' (information and 'life' combined).

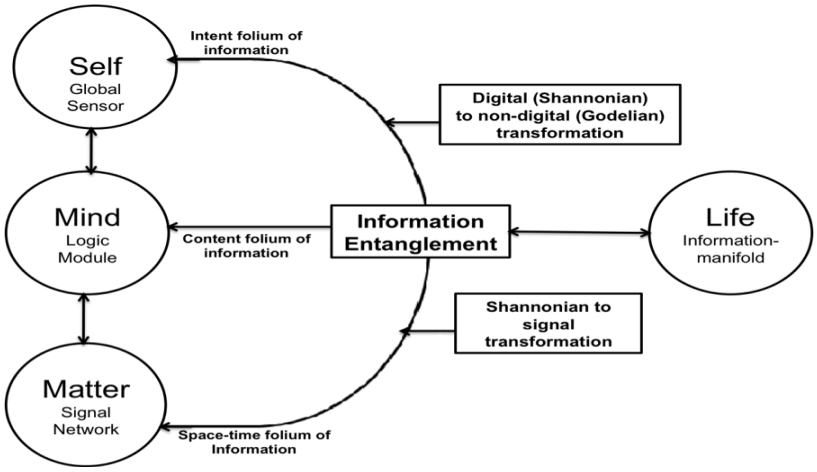

Figure 1: Information Geometry and its entanglement spectrum

In an exclusive process of self-organization, information entanglement, as shown in figure 1, is incomplete. With involvement of the organization by 'life', as we see below, the entanglement gets completed. How? In three steps! (i) The petiole of the trifoliate geometrical structure of information is embedded within 'life', which activates information from inactive state. (ii) The global sensor for self-organization, in absence of 'life', works with only digital information as classical holographic sensor at macroscopic classical physics level and as quantum holographic sensor at microscopic quantum physics level. Quantum holographic sensor works on the principle of phase conjugate adaptive resonance (PCAR) (Mitchell and Staretz, 2011). With incorporation of 'life', Shannonian to Godelian transformation of information happens inside the sensor. (iii) The 'self' of self-organizing systems, which is rudimentary and feeble, gets prominence in presence of 'life'. Alternatively, we can say that information entanglement acts as the bridging link between self-organization and organization by 'life'.

2.2. Organization by 'life'

Self-organized system works on closed logic. The set logic keeps on creating identical pattern as infinite truth table. As stated, a self-organizing system could be open at the event horizon, at the point of self-organized critical instability. This openness, however, is not active. It is a passive mechanistic opening without any alternative. In contrast, the active openness with emergence of a faculty of choice, as often found if we ever have a probability machine like a living brain (Ridder et al, 2014), is conferred to the systems by 'life'. 'Life' activates information to acquire the trifoliate shape and makes information entanglement complete. Life makes the global sensing, the operation of a rudimentary sentience more

observable as that of 'self' as a result of which the systems evloved from having a quantum holographic sensor into one having a larger scale sensor of non-digital information (see below). 'Life' makes transformation of digital information into non-digital information possible and the outcome is what we call knowledge. 'Life' is thus an active (or rather proactive) complex system, which is minimally disorganized, partly self-organized and mainly life-organized, often showing negative entropy (negentropy of Schrodinger). The question is what 'life' adds to the system over and above those, which are already possessed by self-organized system? In other words, what are the additional advantages of life-organization over self-organization?

Self-organized system cannot redefine itself. A life-organized system (which is inclusive of self-organization) can do this, although not completely. This is done by addition to the systems of three new and interconnected properties: ability to manage uncertainty, ability to maintain symmetry homeostasis and ability to have access to invisible (dark) energy and its homeostasis with visible ('white') energy. The new disciplines of computational biology and computational neuroscience are yet to take note of these three properties.

2.2.1 Uncertainty management

A self-organized system cannot manage itself without 'life' when confronted with any uncertainty. Its activity dwindles, stops or degenerates. Fractals, Tsunami could be taken as examples, which although have hierarchically nested self-similar patterns, cannot thrive on the face of uncertainty. Uncertainty in life-organized systems can be managed, to some extent, by life's ability to access new information from the recess of surrounding nature. The property is interlinked with its property of total energy homeostasis (see below). This is what is probably called intuition. 'Life' is embedded with information-manifold. It is well known that Shannonian information reduces uncertainty and in author's view it is only systems 'life', which can transform intuitive information into readily useable Shannonian form. Most difficult uncertainties are overcome by means of information acquired by intuition. Often it could not be done with information that already exists inside logic modules under 'self'. The communication between 'self' and 'life' is most likely to occur at the event horizon, where self-organized critical instability and life-organized critical instability interact. There is complimentary role of logic and intuition, self and 'life' at the elementary level of evolution and adaptation of the systems. Campbell (2012) has expressed a similar view on the role of logic and intuition in evolution of species, brain and science.

2.2.2. Symmetry sensing and symmetry homeostasis

The property of sensing symmetry holistically within, is absolutely a unique property of 'life'. If a system can ever sense symmetry holistically within, one must smell the presence of 'life' in it. Life senses the symmetry with the whole and maintains conformity of symmetry in the signal network, logic modules and global sensor, the three components of self-organization. This offers us some clue on how 'life' can reset the global sensor of self-organization. What had been global sensor at self-organization scale is taken over by holistic symmetry-sensing mechanism at the scale of organization by life. On the basis of this sensing, 'life' can question the validity and stability of logic modules and might alter it by probable deletion of some existing information or addition of new information. Such entire activity of 'life', of symmetry sensing, symmetry breaking and symmetry making by choice could be called symmetry-homeostasis. The

process of symmetry homeostasis might be seen as an amalgamation of physics and biology. This could not be observed in any self-organized system, which is not live.

Downstream inside a cell, chiralty-memory molecule is known to sense molecular symmetry (Furusho et al 1997). Perhaps in this cellular symmetry sensing mechanism, there is also a role of 'Attractor' molecules. Water molecules in certain situations act as 'attractor'. Water molecule in ice is a part of a fixed-point attractor. While in a stream, the same water molecule becomes a part of limit-cycle attractor and in a river a part of non-linear strange attractor (Butz, 1978)! What is it then when inside a cell? The question throws open a totally new frontier to work with. In the physical plane, attractor structures (Szalay et al 2014) have been identified within the signal networks of a cell for conformational barcode hypothesis. Invisible dark matter (?) also behaves as an attractor, responsible for rhythmic contraction of the universe. It is unlikely that 'life' processes are bereft of any dark matter, which constitutes approximately 20% of the universe! The symmetry homeostasis is most likely maintained at cellular molecular level in the final common path by alteration of the symmetry of the most abundant molecule in the living systems, i.e., water. We are reminded of how change of valence electron in one molecule of water could affect the whole structure of water lattice. By analysis of such facts are we near to justification of the age-old proverb, "Water is life"! Besides, symmetry-sensing property has been observed in some kind of pearls and gems obtained from the seabed (recovered from their past life!). There are symmetry-sensing artifacts as well. All such bits of knowledge could be joined together to make the first investigating line for developing symmetry sensor, which in turn has translational value in robotics.

Organization by life is nested almost parallel to organization of self. They exhibit a tangled hierarchy. If self-organization is chosen to be described as 'masculine' (Yang), life-organization in the same tone is much more 'feminine' (Yin), what in Kant's word is found in the difference between 'beautiful' and 'sublime' and what in other philosophical description (e.g., Sri Aurobindo) might be the difference between 'integration' and 'integral'! While integration is arithmetic, algebraic or geometric combination of different variables, the process integral is a development by a totally new set-up of knowledge organization. It is the feminine nature of life, which makes the beauty of self-organization sublime and transforms robust equations of integration into non-reductive integral. The readers are referred to the concept of 'Kantian Whole' as advocated by Stuart Kauffman (2016).

What for the description's sake is called non-digital information becomes formative knowledge in interaction with sentient self in presence of 'life' and becomes transformative knowledge when amalgamated with 'life'. A silicon chip stores digital information. Even the Global Positioning System (GPS) deals with digital information. A specific organic chemical jelly has been reported (Ghosh et al, 2015) to form infinite number of logic gates. However, we certainly require life-processes for knowledge organization.

2.2.3 Life's Access to dark energy and total energy homeostasis

What could be the physical mechanism for this knowledge organization? This is suggested being done by another extraordinary properties of 'life', the homeostasis of dark-energy-visible-energy.

No conversion or transformation in biology can be executed free of cost! All conversion or transformation

costs and consumes energy, which may not be always visible. Where from this required energy is accessed? The source field might be invisible or dark energy! In fact, author has published (Mukhopadhyay, 2012) his idea that one of the purposes of formation of 'life form' was to accomplish this homeostasis. The critical instability of the universe due to a tug of war between contraction (dark matter) and expansion (dark energy) had been overcome by 'enclosure' of wandering DNA as 'life-form'. Life form continues to respond to physical signals and extracts meaning from the signal. This is a process, which consumes a large chunk of dark energy and perhaps it helps to restore the balance for a dynamically unstable universe.

While considering energy-homeostasis, one must account for both visible and invisible energy. Approximately 70% of the universe is invisible energy. At present we do not have any artifact, which can harness this dark energy. It is most unlikely that 'life' has been functioning being absolutely clueless or independent of this dark energy! Many functions of life, like spontaneity, negentropy, handling of uncertainty and information generation could not be explained simply without a plausible explanation construed once we can demonstrate life's access to this infinite domain of dark energy! Dark energy as well as dark matter have recently been related as a function of a possible scalar potential added to the equation(s) of General Relativity (Hernandez et al, 2015, Ma and Wang, 2012). Arithmetic, algebraic, geometric equations are formulated to describe the integration in relationship of visible energy in different phases. It is the homeostasis of visible energy with dark energy by life, which makes the integration process integral. The author is of the view that conversion of signal into digital information consumes dark energy (Figure 2). Conversion of digital information into signal is associated with generation of dark energy. Nothing is also known about the possibility of dark energy consumption during conversion of digital information into non-digital Godelian information or release of dark energy during the reverse process. Upstream, there is organization of formative knowledge (Godelian information), transformative knowledge (information manifold) and wisdom (Information crystal), possibly dependent on consumption of invisible energy and/or associated production of dark matter, the "black diamond"! The process of transformation of signal to wisdom offers a direction on the trajectory of evolution of robotics, subject to technological evolution on how to harness dark energy and develop different levels of holographic sensors.

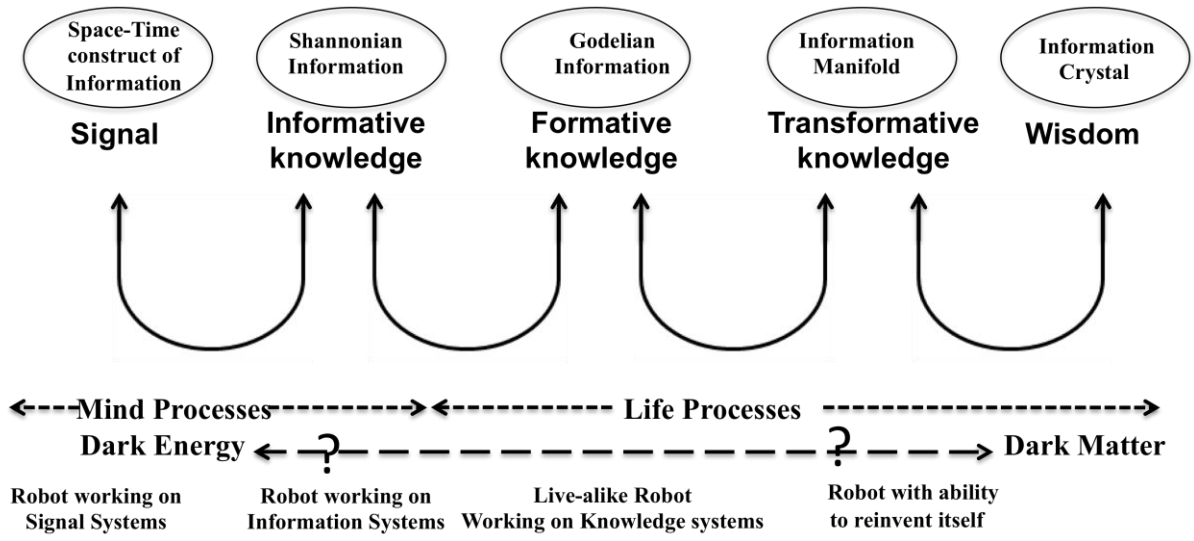

Figure 2: Knowledge organization by life-process with (?) involvement of dark energy and dark matter. The course of evolution of different robotics

The question is how do life-processes do it? The author has a suggestion in his publication referred above. This is possible because "life form", unknowingly or knowingly, stands and oscillates on the boundary between two natures; nature within Planck's scale and nature outside Planck's scale. From outside Planck's scale the live-systems can continue to do abstraction of holographic knowledge. Within Planck's scale its behavior appears rational for operating with Shannonian currency. The subtle operation of 'life' has been speculated to have relation with Higgs boson, which Leon Lederman to popularize the great scientific endeavor of particle physicists amongst common man has cleverly named 'God Particle'. While beneath Planck's scale, visible energy transforms into visible matter coming in contact with Higgs boson, 'life' is involved in inter-conversion of dark matter and dark energy on the other side of nature (Figure 3). Jibu et al (1997) connect 'life' with bosonic particle on the cell membrane. 'Life' and Higgs boson have been speculated to have some kind of stable relationship.

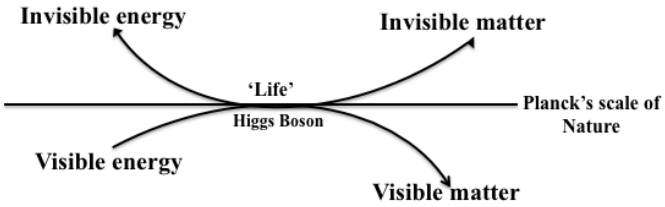

Figure 3: Two natures; within and outside Planck's scale

Table 2 shows the difference between self-organization and live-organization. The difference also exists at the biophysical level as well. Photon and phonon are sufficient to construct signal networking, logic modules and to some extent for making global sensor. For a live-organization the systems require, in addition, conformon and neutrinos. Not the DNA, but the conformity of DNA, maintained by conformon, is nearer to 'life', said Prigogine. Conformon is said to be a particle/wave package of energy, which also has knowledge (Ji, 2016). Many vital life-processes are conformon-based. On the other hand, the omnipresent particles/waves, which pervade all and everything, are neutrinos. Electrons are generated when Weak Force and neutrinos interact. From subtle realm, neutrinos can thereby alter cell electrics. During transmutation of element (think of life-organized critical instability), when neutron is converted into proton, Weak Force is liberated. Since his 1987 publication the author associates neutrinos with symmetry-breaking process (Mukhopadhyay, 1987). Recent publication by Perez and Randall (2009) speaks for the same. Activities of conformon and neutrinos are more intangible than that of photon and phonon. The issue is how to tackle conformon and neutrino technologically?

Table 2: Difference between Self-organization and Organization by Life

	Self-Organization	Organization by 'Life'
1	Not inclusive of organization by 'life'	Inclusive of self-organization
2	The system, although open at self-organized critical instability, cannot redefine itself	The system, open at life-organized critical instability, can redefine itself
3	Cannot manage uncertainty	Can manage uncertainty by production of information
4	No ability for symmetry-sensing and symmetry-homeostasis	Symmetry-sensing and symmetry-homeostasis is the hall-mark of organization by 'life'
5	No ability for dark energy-visible energy homeostasis	Robust homeostatic mechanism for invisible (dark) energy and visible energy

6	Works on established logic; number one or two	Can question the validity of logic gate and changes it if necessary. Operates through multiple logic gates
7	At the biophysical level, Photon-Phonon interaction is necessary and sufficient	At the biophysical level, Conformon-Photon-Phonon-Neutrino interaction is necessary and sufficient

While classical and quantum holographic sensor were working at the scale of self-organization, this function at the scale of life-organization is taken over by a knowledge-based symmetry-sensor operating on the principle of information hologram. Information hologram (Mukhopadhyay, 2012) has 'self' at the center and is armed with Conformon, Photon, Phonon and Neutrino. Three novel properties of life, namely access to and management of dark energy, capability of maintaining symmetry-homeostasis and the capacity of uncertainty management work together closely. This might also explain why in contrast to self-organizing system, which operates with one or rarely two logic gates, 'life' operates with changeable logic gates in multiple modules and why a live system is capable of redefining itself and also how!

2.3. Organization by consciousness

Organization by 'life' cannot take place in absence of organization by self within the systems. In absence of any of self-organization and organization by life no sensible observation could be made on the organization by consciousness within the systems. Systems working with Infinity (read consciousness) will have hierarchical levels in such a way that it would not contradict the individual autonomous dynamics of the subsystems across the entire spectrum of spatiotemporal scale and would yet maintain continuity as dynamical systems. This is what we have been calling 'nesting', where each nest is seamlessly sculptured to maintain the continuity with others. Take the example of a spiraling coil model of consciousness creating universe. The spring is continuous and leads from and to a point (The Source Field, the Point of Wisdom, Pointillism), although on lateral view the spring looks like having separate levels having the wisdom distributed throughout with fading of definition as one moves away from the point of origin.

Systems cell is a dynamic system, neither chaotic nor random! Its response is solution-centric. The systems respond as a whole. Is it ever possible by any system without having a holistic sense of feelings within? Has anybody ever seen an artificial system, an artifact, which has feelings along with the power of cognition and which can 'will'/volunteer? If yes, it must be a conscious system. In fact we do not have manufactured such systems or artifact (Mukhopadhyay, 2015) so far! Self-organizing system in absence of life is said to have no global-sensing mechanism for the whole. Interlinked discrete systems are its components. The global sensing mechanism or rudimentary sentience (Theise and Kafatos, 2013) is observed better in presence of 'life'. There are numerous evidences, which suggest that a biological cell is a sentient entity. 'Bacteria are small but not stupid' (Shapiro, 2007). Social amoeba, confronted with diverse nutritional situations can select an optimal ratio of nutrients (Dussutour et al, 2010). Physarum polycephalum, a kind of slime mold, one single cell about 10 cm in diameter, shows habituation, a form of learning. This is happening in a single cell organism without having any neuron or nervous system (Boisseau et al, 2016). However, feelings and emotion are not clearly yet demonstrated in a singular live cell, although in pathology we publish picture captioned 'frustrated phagocytosis'! However, in the metazoan with nervous system, the emotion and feeling start surfacing. 'Will', the *sine-qua-non* of the presence of consciousness, is observed in self-organized and life-organized evolved conscious systems.

What does this active presence of consciousness add to the systems over and above which are already present in life-organized and self-organized systems? Consciousness acts as the supporting ground, holds the fabrics of operations together although otherwise mostly remains non-interfering and dynamically silent. Consciousness is the primal essence, which drives 10^{11} neurons and almost similar number of glial cells inside the brain, and 10^{11} stars in a galaxy and 10^{11} galaxies within our universe. That consciousness from the depth of its recess supports both organization-by-life and self-organization in nature is evident from the observation of deteriorating consciousness in a brain-trauma or a progressive brain-tumor patient. There is failure of information flow in the bio-molecules; there is failure of logic modules, and failure of network analysis as the subject plunges into the depth of unconsciousness. Consciousness also actively intervenes when on the fabrics of various operations there is conflict of autonomy. If required, consciousness redefines autonomy of self and life. Consciousness actively adds to the ability of cognition, which is far more than sentience of self, feelings (emotion), which is far more than perception, and will (volition), which is far more than environment-guided movement and locomotion. As said, a self-organized system cannot redefine itself although a life-organized system can do so. A consciousness-organized system can not only redefine but also can rediscover and reinvent itself. By new cognition consciousness rediscovers, and by a new 'will' consciousness reinvents itself. What we describe ordinarily as cognitive function of life is, in fact, a combined function of consciousness, life and self. Emotion and feelings are functional expression of consciousness through life-processes. Volition and will could not be found in any system other than conscious system. It is self, which executes consciousness's will within the system.

In self-organizing systems the detectable properties of 'self' is extremely feeble. 'Self' takes its shape and position of executive during organization by 'life'. Self is robust in conscious systems where it represents consciousness and acts as the CEO (Chief Executive Officer) on behalf of it. The bridging link between life-organization and organization by consciousness is this strong emergent 'self'.

As long as a reasonable and desirable level of perfection is observed in the systems for the purpose the systems is meant for, the autonomy of activities in information flow, in logic modules and in network analysis is maintained. There is no requirement for 'application of mind' on the logic modules by self within the systems. However, when information flow fails and the logic runs clueless, active involvement of a global sensing mechanism, a sentient self, is essential for network analysis to apply mind for examining the failed logic. Therefore, the system becomes conscious of the situation for any information/event/phenomenon, when there is turbulence in information flow, which the logic modules cannot repair, also when there is disturbance in symmetry homeostasis or an encounter with a new symmetry. The systems become conscious when network analysis by sentient self picks up information with *intention-threshold* that does not concur with the *concern-threshold* expressed through 'life' and the *perfection-threshold* for the systems as desired in conscious systems. Event horizon for operation of consciousness is a mismatch situation between these three thresholds. Otherwise, when everything is fair consciousness in its wisdom pushes the issue down to operate autonomously at subconscious level.

While 'life' and 'self" observe a tangled hierarchy between themselves, consciousness maintains a pyramidal hierarchy in respect to organization by both self and 'life' (Figure 4). Examples of tangled hierarchy are relationship between 'yang' and 'yin' and as seen in the picture of "two faces or a vase". Example of a pyramidal hierarchy is the layers of pyramid itself from its base to top. From top-down, consciousness requires for its sensible observable behavioral manifestation, life-organized and

self-organized systems without presence of which ('life' and 'self') consciousness cannot sensibly manifest, cannot make its presence felt!

It is not yet known on the basis of what consciousness operates with assertion of its 'will'. The 'will' might be system-bound or free. This basis is supposed in this paper to be the *wisdom*, the crystal form of information, crystallized out of accumulated experience in the systems, which had stood the test of time. The wisdom has a self-renewal capacity from both bottom-up (accumulation of daily experience) and top-down sense (freedom of will). This wisdom acts as a holographic sensor and constitutes the dynamic ground of the canvas. By nature, wisdom is all-inclusive, holographic and independent of any conditioning but surely humble (c.f., T.S. Elliot's wisdom of humility!). Wisdom has distributive property with definition and resolution best at the center that fade in periphery.

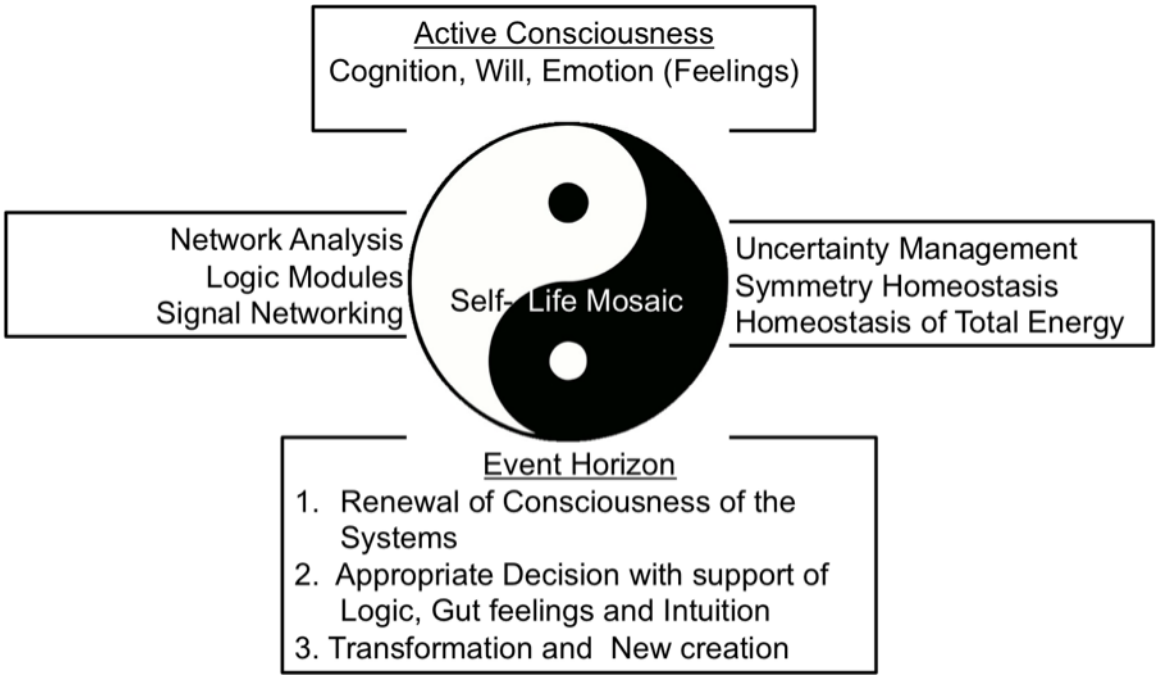

Figure 4: Self-Life Mosaic is like Yang and Yin

Wisdom has it all under its grip: self-organization, live-organization and organization by consciousness. With will, cognitive power and feelings/emotion, consciousness with its wisdom senses symmetry, manages uncertainty, harnesses dark energy, does network analysis, creates logic and converts signal into information. Through the power of will of consciousness wisdom renews itself, takes appropriate decision to transform the systems and often create new systems. For ontological consciousness, wisdom could be its epistemological facet. Ontology is a hard issue but epistemic processes are amenable to science.

What we identify as global sensor at the scale of self-organization is taken over by the holistic symmetry-sensing mechanism at the scale of life-organization. This is further taken over by the holographic sensor of wisdom at the scale of organization by consciousness. Therefore, depending on how much of the whole it represents, the concept of hologram evolves from classical hologram to quantum hologram, information hologram and hologram of wisdom. This offers us the required thread for technological evolution of corresponding holographic sensor. As seen, information hologram comes with

'life'. While signal mediated operations are fast, knowledge mediated symmetry sensing operation is slow. At the scale of the brain, symmetry sensing is intimately connected with feelings, generation of which is a slow process mediated mostly by slow-conducting non-myelinated or thinly myelinated nerves having plenty of non-synaptic side-to-side orthogonal communications (Damasio and Carvalho, 2013). The outcome of operation of wisdom through the infrastructure of the brain depends on several factors, most important being the priming, preparedness and conduciveness of the brain.

It is not completely known how organization by self and organization by 'life' interact, get dissociated or connected! It is also not known how organization by self and organization by 'life' interact individually or collectively with the operation by consciousness! Does all three operations meet and communicate through the respective vortices or funneling of operations at the seam of self-organized critical instability, life-organized critical instability (transmutation of elements, change of water lattice, disruption of protein connecting microtubules with membrane structures of cell) and at three thresholds in the 'event horizon' of consciousness? Perhaps yes, we assume this as shown in the Fig 5. Activity realizes at the event horizon from the grounded wisdom embedded within the systems.

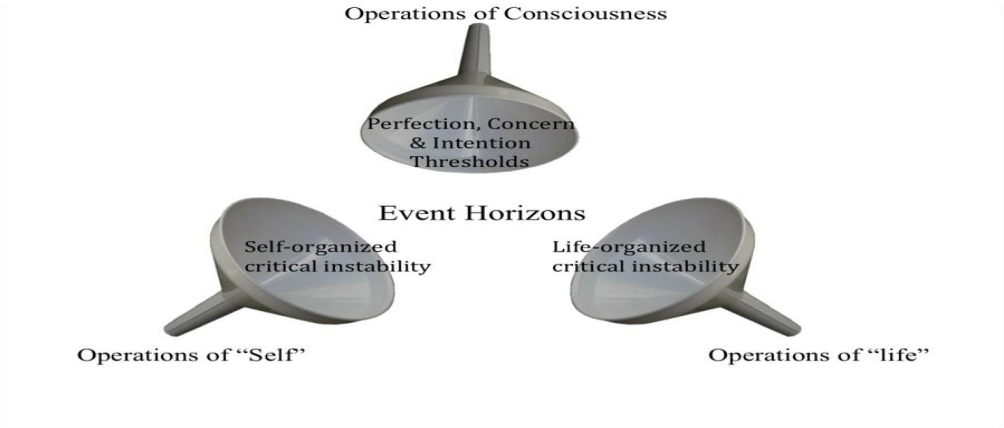

Figure 5: Operations of Self and Life funnel out with operations of Consciousness at the Event Horizon

3. Has the Psyche been undone or redone?

Following understanding of the reasons for the complexity, the layers, operations and operators, one could target consciousness for scientific understanding without bringing subjectivity of psychology into it and being free from getting trapped by any specific ideology. The signal circuits involved in information flow are in the physical plane, in layer A of self-organization. In layer B of self-organization, which is having logic modules, there are several intangible operations, which conventionally and on consensus basis we have imagined as that of 'mind'. Signal cannot be converted into information without involvement of such operation (of 'mind'). Layer C of self-organization, engaged in network analysis, works globally and the operation is ascribed to that of a global sensor mechanism, which could be described as an operation what conventionally and with general consensus has been imagined as that of rudimentary intangible 'self'. These autonomous operations of self become more tangible in the presence of life.

Symmetry homeostasis, uncertainty management and homeostasis of total (invisible + visible) energy are functions of 'life'. All such operations are supported by the ground consciousness so that the information flow within a conscious system remains perfect regarding its homeostasis. Consciousness actively

intervenes to redefine autonomy in case of conflict, to rediscover itself by transforming the systems and to reinvent itself by new creation. Complexity biology, therefore, is inclusive of apparently intangible operations of information, mind, self, life and consciousness. What we have been calling Psyche is, therefore, not monolithic. It has five pieces (Mukhopadhyay, 2013) on the basis of which we are in the process of constructing a new model of it. With this map one can explain the difference between intuition and logic, distinguish evolution from creation and understand what we call decision-making from the brain, from the heart and from the gut! Operation of consciousness, 'life' and information, although, arguably could exist diffusely spread all over as 'pan' processes, the self is always discrete and is confined to the systems, and is therefore most crucial for systems science, and might be the link between panpsychism and science. Information could be discrete as well as global and connects tangible (energy, matter, time and space) with intangible (mind, life, self and consciousness) within the systems!

3.1 Dealing with awareness

One important issue in psychology is the issue of awareness. Only a live system can become aware, and aware of 'contents' of consciousness. The system having a sentient self can only become aware. Life and self can operate fully with support of consciousness. Without coordinated connected operations of self, life and consciousness, no awareness is possible and no cognition becomes complete! Following is a table (Table 3) where three components of this cognitive triangle constituted by consciousness, life and self have been related with eight broad areas of philosophy and science namely, (i) components in decision-making, (ii) irreducible components of experience (iii) Chinese Trinity (iv) three thresholds for consciousness, (v) consciousness in David Bohm's approach, (vi) different levels of knowledge, (vii) Peirce's Architectonic Triad and, most important (viii) representations at the level of molecules.

Tables 3: Relating eight areas with the components of Awareness Triangle.

Components of Cognitive Triangle	(i) Components of Decision-making apparatus	(ii) Irreducible components of experience	(iii) Chinese Trinity	(iv) Three Thresholds of consciousness
Self	Logic	Reasoning	Yang	Intention-Threshold of Information
Life	Gut-feelings	Feelings	Yin	Concern-Threshold
Consciousness	Intuition	Instinct	Chi	Perfection-threshold

Components of Cognitive Triangle	(v) Bohmian Approach to Consciousness	(vi) Levels of Knowledge	(vii) Peirce's irreducible Architectonic Triad	(viii) Representation at Molecular level in cell/neuron

Self	Explicate order	Formative Knowledge	Idea (Idealism)	Supramolecular chemistry of Proteins of Ion Pumps and Ca^{++} ion channel. MHC-I molecules also represent self. Ca^{++} waves in astrocytic network represents 'mind' at molecular level
Life	Implicate order	Transformative Knowledge	Name (Nominalism)	Supramolecular property of water molecules. Protein molecules maintaining the junction of membrane and cytoskeleton
Consciousness	Superimplicate order	Wisdom	Reality (Realism)	Protein polarization that changes membrane potential. 'Polarity' of the membrane causing consciousness-philia in neurons

3.2 Complexity biology at micro level of systems cell

Of the eight related areas, column eight is relevant in complexity biology dealing with the molecular representations of the cognitive triangle inside a cell; proteins responsible for membrane polarization, proteins of the ion pumps and ion channels, proteins at the junction of microtubules and membrane structure of cells and the supramolecular chemistry of interfacial water in relation to these proteins. The suggestions of Albert Szent-Gyorgyi (1941) for a new biochemistry on the basis of observation that the valence in ground state of atoms in crystal lattice belongs to the whole structure require redeeming. Cook et al. (2014) have published paper relating ion pumps and cognitive function in metazoa. The author has related ion-channels, ion pumps and various protein molecules as operational representatives in systems cell (Mukhopadhyay, 2015) and in the context of neural fabrics of mind (Mukhopadhyay, 2015). Roman Poznanski (http://romanpoznanski.blogspot.in, 2016) has been working relating consciousness with interfacial water. Water molecules in contact with and at interface of metallic molecules behave weirdly as published by Gerald Pollack (2013) following a number of ingenious experiments. Mary Jibu and Kunio Yasue (1997) advocate involvement of water dipole, dendritic dipole and quantum fields in production of conscious state of the brain.

The empirical science could make a beginning for a science for consciousness with these proteins. However, the complexity biology of systems cell should not restrict itself to the proteins, the history of which is recursive; one protein is produced by the activity of another protein enzyme and so on. The question is where those proteins come from? The answer is DNA. The complexity biology of systems cell should also not restrict itself to conventional protein-DNA-protein circularity. DNA itself is driven by information evident when one considers DNA fluidics and jumping genes, which alter the grammar for the language of genes. Information extends to different levels of knowledge as explained in Figure 2 and

shown in Table 3. What could be the molecular representation of this DNA-driver? When DNA molecules are considered as the repository of information-manifold/transformative knowledge, nuclear chromatin retains the wisdom as the crystallized information. This nuclear chromatin could act as the 'driver' (Baumann, 2015 and Therizols et al, 2014) of DNA. Appropriate modification of histone in chromatin alters the whole nuclear organization (Mattout et al, 2015 and Bartova, 2008) and makes it conducive for epigenetic mechanism to play. It is interesting to note that specificity and plasticity of circadian clock transcriptional systems is intricately regulated by chromatin remodeling at the epigenetic level (Sassone-Corsi and Masri, 2010). Processes of 'life' largely influence epigenetic modifications both at macro level by modification of life-style and diet, and certainly at micro molecular level by influencing DNA replication and transcription to mRNA. How chromatin gets this wisdom? There are suggestions that it is perhaps because of chromatin's connection with dark matter (dark diamond!) but certainly through operations of 'life' and consciousness. Microtubules in a cell integrate information distributed over nuclear DNA and chromatin, cell membrane, lysozome, mitochondria and endoplasmic reticulum. Therefore, microtubules are important for maintaining conscious state.

3.2.1 A new orientation towards investigation of cell psychology:

We have made a tentative scheme (Figure 6) to highlight the emerging directions in cell psychology, which is dynamically connected with the informational molecules and the cellular signal network.

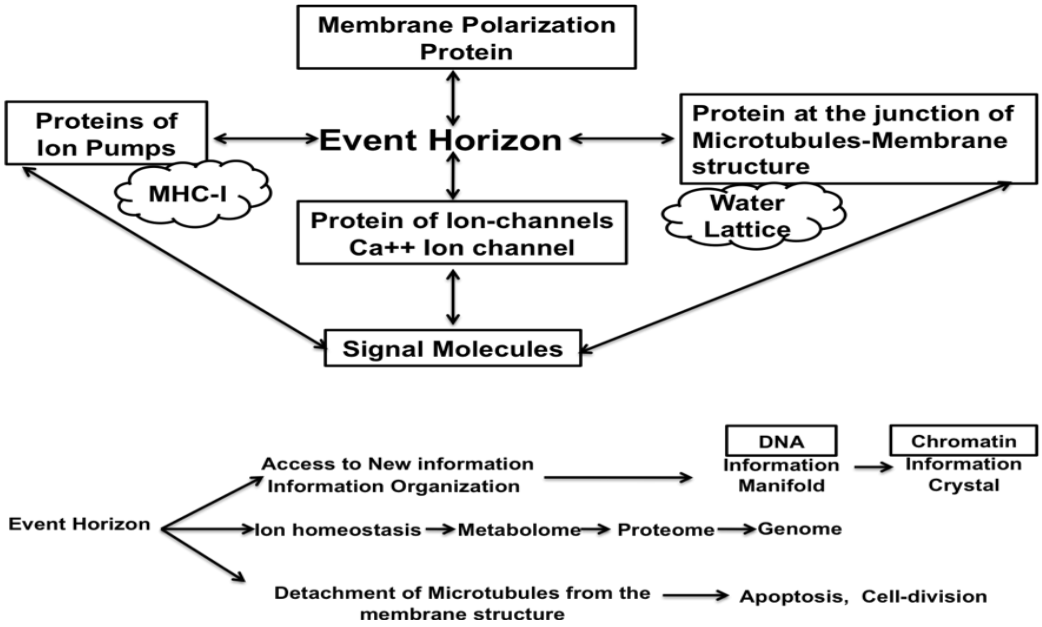

Figure 6: A different orientation towards exploring cell Biology

3.2.2 Holographic sensor within the Cell

The nucleus of the cell acts as its global holographic sensor having both information–manifold in DNA and 'wisdom' in chromatin. The nucleus can act so because of a *specific information-packing pattern* in its two meters stretch of DNA contained in 23 pairs of chromosome of human cell. There is no consensus yet on how DNA is packed (Dekker et al, 2016) inside the tiny nucleus of 5-6-micron diameter! Generally, the nuclear information package acts as an internal sensor. However, in some cells this nucleus works as

surveillance sensor. The spectrum of cells having such sensors ranges from non-nucleated red blood cells that have lost sensor activities, to memory lymphocytes engaged in immune surveillance with competence. In between the ends of the spectrum, there are cells having nuclei with tradeoff between sensor and differentiated functions by requisite alteration of proportion and quality of euchromatin and heterochromatin.

4. Layers between matter and consciousness

Wisdom is distributed hierarchically from consciousness to matter. Matter and consciousness is not a binary divide. In matter-based study of consciousness or in consciousness-based study of matter, what we call matter (classical and quantum level) forms only one end of the spectrum. Consciousness is on the other end (Fig. 7).

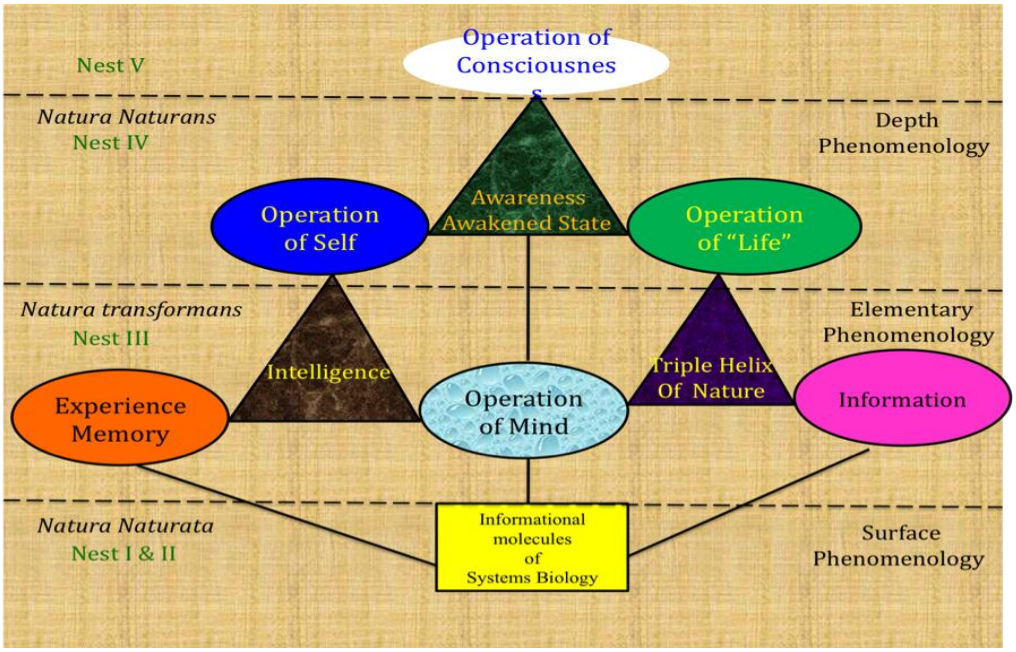

Figure 7: Stratified and hierarchically nested decision-making labyrinth of Conscious Systems

From superficial to deep the layers/nests are, - (i) nature's nest I, which follows the principles of classical physics (ii) nature's nest II, which follows that of quantum physics. Nests II and I constitute *natura naturata* or created nature. Nest III is loaded with elementary phenomena (*natura transformans*) and is the working office for mind, information, intelligence and memory, regulated from deeper within (iv) the nest IV of nascent nature, which operates through 'life' and 'self' which in turn are connected with unconditional consciousness in nest V. Nests IV and V constitute *natura naturans*, the creative nature. This pentaune (Five in One) model of nature-consciousness has been elaborated in author's book, *The Millennium Bridge* (Mukhopadhyay, 2000). The logic of this division has been based on extended uncertainty principle. To quote from author's earlier publication (Mukhopadhyay, 2008),

"Uncertainty limits our cognitive ability and imposes epistemological constrains in observation. That nature observes a stratified nested hierarchy in organization could be logically constructed on the basis of an extended uncertainty principle. Perceived uncertainty in describing simultaneously the paired properties, which are canonically conjugate to each other in Hamiltonian sense (e.g. position and velocity or angular

momentum and angular position, energy of the particle and the time at which it is measured) is the characteristic of description of quantum nature (nest II). In classical nature (nest I) no such uncertainty is encountered. The nature subtler than what is measured in Planck's scale could be reached by penetrating through 'quantum discontinuity' or 'quantum void'. This is sub-quantum nest of nature (nest III) that deals with existential phenomena that are most 'elementary' in character. Within this nest the perceived uncertainty in describing observer-dependent reality is between *properties* of the object and its very *existence*! The ability to distinguish properties from the existence reflects a sharper cognitive function. With further sharpening of cognitive faculty this principle of uncertainty could be extended into a sub-sub-quantum nature (nest IV) where in description of observer-depended reality uncertainty is encountered between *existence* and *non-existence*. Properties are totally irrelevant here. In the deepest recess of nature (nest V) perceived uncertainty in observer-dependent reality is seen to play between *non-existence* and a *new existence*! Unconditioned consciousness as a perceived reality *either* does not exist *or* it exists as a reality that is new, novel and hither-to-unknown. It appears in a new 'form', every time one tries to observe and describe it. Four levels of perceived uncertainty, therefore, determine four different depths of nature beyond the classical nature. Uncertainty is measurable and, therefore, could be an issue for science."

When one tries to connect nest I with nest V directly, one faces the problem of Singularity. When one tries to connect nest II with nest V directly, one faces the problem of Measurement. And, when one tries to connect nest III with nest V directly, one faces the problem of Infinity, as has happened in the discipline of Physics! In the whole canvas, nest V is the ground, nests IV and III are the fabrics and nests II and I are embroidering.

4.1 The pathways from signal to wisdom

The pathway has already been described in Figure 2. Here we would elaborate on certain operations. Wisdom of live conscious systems is experience-based, which gathers over time and crystallizes following success and failure in several tests of life. This involves interaction of operations of self with that of life, consciousness, mind and information. The process begins with distinguishing information from signal (Table 4).

Table 4: Difference between Signal and Information

	Signal	Information
1.	Operates in the physical plane	Operates in the mental plane
2.	Can be reduced to space-time geometry/pattern	Digital information can be reduced. Non-digital information cannot be reduced. Non-reductive information is knowledge
3.	Can be automated. Signal systems might be conferred autonomy	Cannot be automated. Information systems require constant supervision
4.	The source of signal is information	The source of information is 'life'
5.	Signal can be converted into information by operation of mind with consumption of invisible (dark) energy. Operation of 'life' maintains this energy-homeostasis	Information is converted into signal by mind-like structure and processes with release of invisible (dark) energy. Operation of 'life' maintains this energy-homeostasis

Signal is in the material/physical plane and information is in the 'mind'. To convert signal into information and vice versa, the system requires operation of 'mind' and 'life'.

4.2 Operation of mind

The mind might act as internal sense organ downloading information from environment with the help of 'life'. Independent of the operations of 'life' or self, mind also operates as the organ of communication between two conscious systems. The mind is sensitive to signal and information. Conversions of signal into information and vice versa are functions of mind. While the source of signal is information, the source of information is 'life'. The strength of mind is derived from its connection with 'life'. Self seeks help of 'life' to control disturbed mind (compare the efficacy of *pranayam* in quieting mind). Further, bereft of consciousness, mind is sterile. Mind owes its fecundity to consciousness and infidelity to its informational connection with matter. Mind's own operations are shown within a circle and functions borrowed from consciousness, self, life and matter are shown by rectangles in Fig. 8.

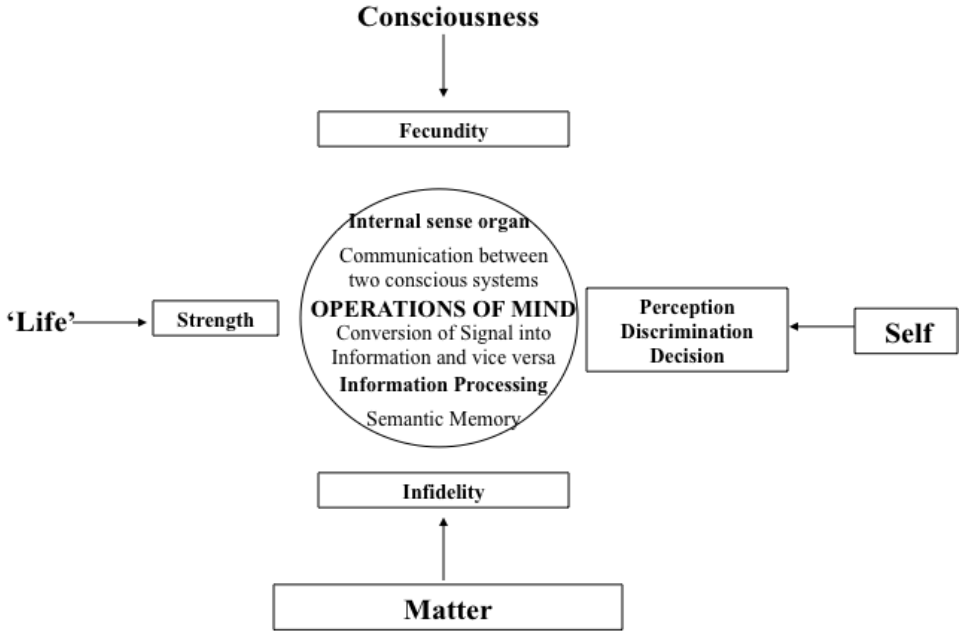

Figure 8: Mind's 'own' (within circle) and 'borrowed' (within rectangle) properties

Mind cannot read information. It processes information in the logic modules as programmed by the self, the global sensor. What are generally ascribed as perception, discrimination and decision as functions of mind are actually borrowed functions from self. Mind reports to self. Mind stores informational/semantic memory.

4.3 Life Operation

When we deal with a living system we should clearly distinguish signal-mediated fast operations and knowledge-mediated slow operations (Table 5) within the systems. Symmetry homeostasis is much more subtle than information management and homeostasis. Symmetry-sensor has been operating with knowledge of the whole, and not singularly with any specific information!

Table 5: Difference between Signal-mediated Operation and Knowledge-mediated Operation

	Signal-mediated Operation	Knowledge-mediated Operation
1.	Operates in grosser plane. Quite fast. Relevant in Self-organization	Operates in subtler plane. Quite slow. Relevant in Life-Organization
2.	Operating with signal/digital information. Sensor is Mind (and Self). Executed by global sensor. Mechanism: classical and quantum hologram	Operating with knowledge. Sensor is 'Life'. Executed by holistic symmetry sensing within. Mechanism: Information hologram
3.	Supervised and often supervened by 'life'	Supervised and supervened by consciousness
4.	Calcium-ion channels are in the downstream molecular level of biological systems	Water molecules are in the downstream molecular level of biological systems.
5.	In multisystem body, such operations are 'concentrated' within the brain because of extensive neuron-neuron-astrocyte-neuron communication networks	In multisystem body, such operations are 'concentrated' within the heart because of numerous vortices of bloody water created by 'vortices cordis', the twisted cardiac muscle

4.4 Operation of consciousness

Operation of mind is responsible for conversion of signal into information, operation of life is responsible for conversion of information into knowledge and it is by operation of consciousness knowledge is transformed into wisdom (also examine Figure 2). Wisdom renews itself bottom-up from accumulating experience and top-down from the experience gathered following new 'will' of consciousness.

4.5 Sri Aurobindo's "Supramental" and David Bohm's "Superimplicate" Order

Consciousness is a supportive and dynamically participating ground for activities happening on its foreground. For its observable manifestation it requires 'life'. When 'life' becomes a system, two more operations emerge. One is of 'self' as CEO representing consciousness within the systems of life. With creation of such duality in otherwise homogenous consciousness emerges mind, which acts as an organ of communication between two conscious systems. Operations of life, self and consciousness, therefore are above/deeper than that of mind (see Fig. 7). Probably this is what Sri Aurobindo meant by "supramental" and perhaps what he expected in emergence of a 'greater psychology'. To speak in Bohmian language, the root is the Guiding Consciousness (according to Bohm, Quantum Potential), which is everywhere and undiminished in intensity with distance, the superimplicate order. The implicate order may house the predecessors of and evolutionary mechanisms of life as well as life itself, and the explicate order begins with the self, the observational representative of individual personal consciousness within the systems.

4.6 Relationship between life and consciousness

4.6.1. Life, death and Consciousness

The relationship between life and consciousness could be best investigated at the macro level of the brain. An unconscious brain might remain alive but a dead brain is never conscious! A live brain could be

conscious but a dead brain is not, in spite of having hundred billion neurons, almost similar number of astrocytes, extensive communication network studded with tripartite synapses, microtubules and gap junctions. Alas, water lattice has changed the situation! Proteins maintaining the junction of cytoskeleton and the membrane structures are non-functional! There is no membrane protein polarization, no ion pumps within cells and no calcium waves in astrocyte network! The facts lead to conclusion that life-mechanism at critical level supports conscious operations, while permanent cessation of operation of consciousness makes 'life' unsustainable in the systems.

To make Christof Koch's and Giulio Tononi's description of discrete brain consciousness 'here' and consciousness 'there' into consciousness diffused 'everywhere' in the brain, one requires life's contagiousness.

4.6.2. Life, Sleep and Consciousness

Life is involved in sleep-wakefulness cycle. We awaken from sleep spontaneously because of operation of 'life'. If 'life' ceases functioning while sleeping there is no mechanism to get awakened. Sleep disorders have now been combined with pulmonary medicine to make a composite discipline.

4.6.3 Life, Self and Mind

Operation of life connects operations of mind with that of self and in the process connects the process of cognition with that of phenomenology. 'Life' enables mind to act as internal sense organ for which it can 'download' information from different source-fields of nature. 'Life' is necessary for completion of operation of 'mind uploading' from different 'connectomes' within the brain irrespective of whether the process is discrete and focal, or diffuse and global.

4.7 Physics of Experience at the level of the brain

In the context of the live brain, experience is not prerogative of only neurons or only glial cells or in combination. A meticulous count of cells in Einstein's brain suggested that Einstein had no increased number of neurons but glial cells in the regions of the cortex specifically associated with memory, attention and cognition (Diamond et al, 1985), although it did not account for his extraordinary imagination, the openness necessary for invention! Every cell, neuron or astrocyte, is therefore privy to its own experience. In a multicellular system, it is proposed that cell-to-cell inter-phasing of experience is executed through information hologram (Mukhopadhyay, 2012) operating on and through cell membrane.

Human experience has 'I', 'Me' and 'Mine' components. 'I' is in the instinct. The flesh of 'me' is added by feelings and emotion. The ownership ('mine') experience is concomitant with boundary experience uniting/separating the environment with/from the systems. While having experience, the brain has to behave as a whole, structurally functionally and environmentally with integrations at several levels; classical integration (nest I), quantum integration (nest II), phenomenological integration (nest III) and axiological integration (nest IV &V). Structurally, the minimal brain requirement for instinctual consciousness (basic 'I' sense) is rostral brainstem and adjacent thalamus (mesodiencephalic sructure). For feelings-consciousness one requires the limbic system, the medial hemispherical rim-like structures such as

cingulate gyrus, septal nuclei, medial temporal lobe, insula, hippocampus, hippocampal gyrus, anterior thalamus, hypothalamus and amygdala. For reasoning consciousness, one requires thalamo-cortical reticular formations, fronto-parietal communications and the cerebral cortex involved in perception and association.

Functionally, during experiencing there is interactive concurrence of reasoning, feelings and instincts. There is coordination of the corresponding neuronal structures. There happens classical integration of the brain both at the molecular level and signal networking level. Quantum holographic integration of concerned logic modules might lead the brain structures to behave as a macro-quantum object (unified Bose-Einstein condensates). Molecular phenomenology, signal networks, logic modules, quantum sensors are then integrated. There is formation of information holograms of individual cells, groups of cells and collectively for the brain as a whole. The holographic nuclear sensors of vast majority of hundred billion neurons and almost similar number of glial cells in the brain are primed to speak in one language.

No experience is independent of surrounding environment, interaction with which brings the ownership of the experience with a sense of 'mine'. Having achieved classical, quantum and phenomenological integration, all such phenomenology of complexity biology within the brain leads to a specific information-geometry pattern, the information hologram of the brain as a whole which, equipped with axiological integrity of an open system as required for a stable conscious experience to happen in harmony with the environment around, must necessarily have an interaction with 'that' in the 'environment' outside the cerebral cortex! This sense of the boundary provides ownership of the experience, the sense of 'mine'. This interactive mechanism spans over a variety of conscious experience particularly evident when the experience is global (i) at the sensory level like of synaesthesia (cross-modality sensory perception), (ii) at the elementary phenomenological level like experience of love, sex, ego, life-or-death situation, and experience of being reborn in the same body and (iii) at the cognitive level such as experiencing intuition, illumination and revelation (wisdom). Intuition unites sense experience (Einstein) and instincts while logic connecting different concepts and patterns. In this context, the dynamic boundary between consciousness outside and consciousness within the brain could be located precisely over the cerebral cortex, in its intimate contact at a supracortical location, which could be looked as the "event horizon" for systems-bound consciousness of the brain. This is similar to the event horizon where the systems universe communicates with the systems of multiple universe(s), *The Multiversity*, the largest intellectually comprehensible systems. Supracortical consciousness (Mukhopadhyay, 1985) and the systems of the Multiversity are twin theory (Mukhopadhyay, 2006). A parallel has been drawn (Ross, 2009) between present proposition and Penrose's position on realization of OR (Orchestrated Reduction of Objective Realty) over the cerebral cortex. Like the theory of Hameroff and Penrose (2014) on conscious experience there is also orchestration in the author's theory (of information, mind, self, life and consciousness). Unlike theirs, here is no direct reduction of consciousness to space time or vibration (signal) ignoring the terrain in between. There is labyrinthine stratified orchestration of several independent operations (Fig. 7) leading to a resonance between axiologically primed and phenomenologically integrated state of brain and information hologram without. At the interface of systems-bound and systems-independent consciousness this resonance, felt as supracortical consciousness, creates bottomless self-similar, life-similar and consciousness-similar patterns. While there is fusion and assimilation within, the process results in an experience of universal nature.

This is probably why Hippocrates, the father of modern medicine, in fifth century BC regarded the brain as both messenger and interpreter of consciousness, the view widely upheld by Penfield and many others like Henri Bergson (radio reception theory), Aldous Huxley (brain is a biological reducing valve), George Wald (television theory of brain function), Popper and Eccles (*Self and its brain*) and William James (transmissive theory of brain function). Awareness of this supracortical involvement for a stable conscious experience is a property found not only in a gifted few individuals but it happens to be a universal trait! This is the key for renewal of consciousness within the brain, a mechanism unique to human being, which offers him the capacity not only to redefine (courtesy of life) and rediscover (courtesy of system-bound consciousness), but to reinvent itself (courtesy of resonance between systems-bound consciousness within and systems-independent-consciousness without) again and again with the help of wisdom embedded within the fabrics of the universe! This awareness that we all fundamentally are supracortical creatures is very crucial for further evolution of individual in particular and human species in general.

4.8 Several Nobel laureates on the science of consciousness

The great doyens of science, who brought consciousness into focus while doing science, unknowingly highlighted one or the other of the five operations described in this paper. Since early twentieth century when the quantum physicists such as Niels Bohr, Werner Heisenberg and Erwin Schrodinger recognized that conscious observation by experimenter altered quantum measurement, consciousness was brought into the focus in science. However, leaving an unproductive discourse on consciousness, Schrodinger (1944) took a realistic step towards the enquiry, *What is life?* Sir John Eccles had realized that synaptic transmission in the brain could be a quantum phenomenon. However, Popper and Eccles' celebrated book (1977), *The Self and its Brain*, brought 'self' into the realm of scientific philosophical discourse. By this time the tussle between behaviorists and mentalists in neuroscience had reached a peak and Roger Sperry (1987) penned down an article "Structure and Significance of the Consciousness Revolution" leaning on the role of *mind*. (Sperry sent a signed copy of this paper to the present author). The shift of research interest of Francis Crick (1994, 2003) and Gerald Edelman (2004) towards neuroscience of consciousness brought *information signaling* in neuronal network into limelight for any research on consciousness. Since Crick's publication of *Astonishing Hypothesis*, we have been reduced to "pack of neurons"! However, we are left with the thread in hand of information of all kinds, Shannonian (with mind), Godelian (with self) and information manifold (embedded in life), and with wisdom in the chromatin of nuclear sap driving our DNA. DNA was Crick's original research interest. We are reminded of Edelman's oft-quoted statement, "Consciousness is the guarantor of all we hold to be human and precious. Its permanent loss is considered equivalent to death, even if the body persists in its vital signs."

5. Concluding remarks and perspectives

Are we anywhere near to some kind of solution to the issue of decision-making complexity for science? The paper can conclude in affirmative since (i) imaginary operators in such complexity have been identified as consciousness, life, self, mind and information. (ii) Their operations although non-observable, have been described. (iii) Operations have been categorized, prioritized and catalogued. (iv) Their interactions at the event horizons have been described and (v) the layers of operations have been identified. Therefore, we are in a position to conclude that a way has been made to investigate hierarchically nested decision-making labyrinth of conscious systems.

The decision-making process in live conscious systems is complex. It is neither totally autocratic nor totally democratic. It takes care of autonomy of several operators, which have accomplished to achieve the desirable level of perfection. It regularly censors intentions, which might cross road with the set purpose of the systems. The decision takes care of the concern of the self to respond holistically in an ideology-neutral way for a solution of the problem the system is in. Decision-making apparatus of consciousness as elaborated above is thus non-reductive, labyrinthine, stratified and nested hierarchically (Fig.7).

Our construction is within the ambit of systems science. System's wisdom is distributed throughout as organized knowledge, as information manifold, Godelian information, and Shannonian information, which through what seems to be mind-operations is connected with signal network. Operation of consciousness in this paper has been conclusively connected non-reductively with systems psyche, systems life and systems informatics. The proposed theme has far reaching implications in Systems management.

In the art of systems organization at the micro level, cellular wisdom seems exemplary, unparallel and second to none. The decision it takes is ideology-neutral, solution-centric and holistic. This has made the biological cell a testable model for systems holism. In the dynamical systems, both entry and exit points are important. When our entry point is a matter, say a molecule and the exit point is consciousness, there in between one finds the labyrinth of complexity biology.

The issue is, however, not as simple as stated. To conquer nature, the entrepreneurship in science has to go through three consecutive vertical leaps. First one is elucidation of operation, which can convert signal into meaningful information. At present this is seen being done by human mind! The second leap is in understanding of how digital information could be converted into non-digital information? This transformation of Shannonian to Godelian information can happen only within a live-system! Only life is privy to the mechanism of knowledge organization. We have stated that it involves dark energy homeostasis. The final leap is to engineer a system, which can redefine, rediscover and reinvent itself! This presupposes a free 'will' within the systems, which consciousness is only privy to! The predicted vertical leaps for science clearly describes the axiology of the perspectives from the propositions in this paper. Historically, every vertical leap of science is predicted to happen at the turn of a century. This charted program is likely to be a massive work spanning over three hundred years.

Such ambitious program requires new ideas, new resources and new technology. The new ideas introduced in this paper are capability of 'life' to change or alter the logic modules by information production and deletion. The new resource is life's access to dark energy and homeostasis of dark and visible energy, because of which only 'life' can organize knowledge. There is supposed connection of life with Higgs boson at the boundary of nature within and outside Planck's scale. Other new ideas linked to new resource are symmetry homeostasis, information hologram and the role of neutrinos in cell biology particularly during its transformation and during new creation.

We do not yet have any artifact for harnessing dark energy, nor do we have holographic sensors at quantum and information level. We also do not have any live artifact or conscious artifact. New technology for harnessing dark energy remains an essential requirement. Development of holographic sensors at different levels is also felt mandatory. To explore different specific pattern of *information packaging* in silicon chips, antennae, chemical jelly, DNA strand and microtubules could perhaps be the right direction in developing

physical chemical biological and hybrid sensors. One can learn lesions from specific information-packaging pattern in the nuclear DNA-Chromatin of a cell to develop holographic sensor with knowledge-wisdom. In a recently published paper (Cao et al, 2016) it is shown how in engineered bacteria collective space-sensing coordinates pattern scaling, which might have implications in understanding scale invariance, the mechanism of maintaining constant ratio between organ and body size.

The important message of this paper is that the skill of experiencing involves the systems as a whole in communion with different recess/nest of nature, environment, around it. For a single cell, this inter-phasing is done through its boundary, the cell membrane while its nucleus acts as a holographic sensor. For a multisystem organism like ours it is done through the brain which when operates as a whole makes us aware of our universal trait, the interface of supracortical consciousness. This is a concept, which offers so far the best explanation (Chopra, 2016) for how the human being is capable of re-inventing him/herself again and again. This is also how over accumulated experience of the systems brain the human wisdom constantly renews itself with the help of the wisdom embedded within the fabrics of our universe!

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6. References

1. Auyang, S. Y., 1998. Foundations of complex systems theories in economics biology and statistical physics, Cambridge University Press, Cambridge.
2. Baars, B., 1997. In the Theatre of Consciousness: Global workspace Theory, A rigorous Scientific Theory of Consciousness, Journal of Consciousness Studies, 4(41), 292-309.
3. Bártová, E. Eva, Krejčí, J., Harničarová, A., Galiová, G., and Kozubek, S., 2008. Histone Modifications and Nuclear Architecture: A Review, Journal Histochemistry Cytochemistry, 56, 711-721
4. Baumann, K., 2015. Drivers of Nuclear Organization, Nature Reviews Molecular Cell Biology. 16, 67.
5. Boisseau, R. P., Vogel, D., and Dussutour, A., 2016. Habituation in non-neural organisms: evidence from slime moulds, Proceedings of the Royal Society B: Biological Sciences, 283, 1829. 20160446.
6. Butz, M. R., 1978. Chaos and Complexity. Implications for Psychological Theory and Practice, Taylor and Francis, Washington, DC, USA.

7. Campbell, R., 2012. Intuition and Logic in human evolution, Communicative & Integrative Biology, 5, 422-433.
8. Cao, Y., Ryser, M. C., Payne, S. B., Li, Rao, C. V., and You, L., 2016. Collective Space-Sensing Coordinates Pattern Scaling in Engineered Bacteria, Cell, 165, 620-630.
9. Chalmers, D., 1997. The Conscious Mind. Oxford University Press, Oxford.
10. Chopra, D., 2016. What's the Point of being Human? The Best Answer so Far.
11. Cook, N. D., Carvalho, G. B., and Damasio, A., 2014. From membrane excitability to metazoan psychology, Trends in Neuroscience, 37, 698-705.
12. Crick, F., 1994. The Astonishing Hypothesis: The scientific search for the soul, Simon & Schuster, New York.
13. Crick, F., and Koch, C., 2003. A framework for consciousness, Nature Neuroscience, 6, 119-126.
14. Damasio, A., and Carvalho, G.B., 2013. The nature of feelings: evolutionary and neurobiological origins, Nature Reviews Neuroscience 14,143-152.
15. Dekker, J., Guttman, M., and Lomvardas, S., 2016. A Guide to Packing your DNA. Cell, 165, 259-260.
16. Diamond, M. C., Scheibel, A. B., Murphy, G. M., and Harvey, T., 1985. On the brain of a scientist: Albert Einstein., Experimental Neurology 88, 198-204.
17. Dussutour, A., Latty, T., Beekman, M., Stephen J., and Simpson, S. J., 2010. Amoeboid organism solves complex nutritional challenges, Proceedings of the National Academy of Sciences.
18. Duve, C. de., 1995. Vital Dust, New York, Basic Books.
19. Edelman, G. M., 2004. Wider than the sky: The phenomenal gift of consciousness, New Haven, CT: Yale University Press.
20. Furusho, Y., Kimura, T., Mizuno, Y., and Aida, T., 1997. Chirality-Memory Molecule: A D2-Synmmetric fully substituted Porphyrin as a Conceptually New Chirality Sensor. Journal of the American Chemical Society. 119, 5267–5268.
21. Ghosh, S., Fujita, D., Bandyopadhyay, A., 2015. An organic jelly made fractal logic gate with an infinite truth table, Scietific Reports. 5, 11265.
22. Hameroff, S., and Penrose, R., 2014. Consciousness in the universe: a review of the 'Orch OR' theory, Physics Life Review. 11, 39-78.
23. Hankey, A., 2015. A complexity basis for phenomenology: How information states at criticality offer a new approach to understanding experience of self, being and time, Progress in Biophysics and Molecular Biology. 119.
24. Hernandez, M., Ma, T., and Wang, S., 2015. Theory of Dark Energy and Dark Matter, J. Math. Study. 48, 199-221.
25. Ji, S., 2012. Molecular Theory of the Living Cell: Concepts, Molecular mechanisms and Biomedical Applications, Springer, New York, 127-129.
26. Ji, S., 2012. Molecular Theory of the Living Cell. www.conformon.net. Accessed on 25th April, 2016, 4-25 PM IST.

27. Jibu, M., Yasue, K., and Hagan, S., 1997. Evanescent (Tunneling) photon and cellular 'vision'. BioSystems.42, 65-73.
28. Jibu, M., and Yasue, K., 1997. What is mind? Quantum field theory of evanescent photons in brain as quantum theory of consciousness, Informatica. 21, 471–490.
29. Kaufmann, S., 2016. Humanity in a Creative Universe, Oxford University Press, Oxford.
30. Ma, T., and Wang, S., 2012. Unified Theory of Dark Energy and Dark Matter.
31. Mattout, A., Cabianca, D. S., and Gasser, S. M., 2015. Chromatin states and nuclear organization in development — a view from the nuclear lamina, Genome Biology, 16, 174.
32. Mitchell, E. D., and Staretz, R., 2011. The Quantum Hologram and the Nature of Consciousness. Journal of Cosmology. 14.
33. Mukhopadhyay, A. K., 2008. A Radical view of information. Its Nature and Science, Frontier Perspectives. 16, 19-28.
34. Mukhopadhyay, A. K., 2012. God Particle to Consciousness: Life-science, Neuroscience and Nonlocal Science Hold the Key, The Science and Spiritual Quest. Integrating Capabilities with values. Ed. S. C. Mishra, Sudipto Ghosh, Varun Agarwal. Proceedings of the 7th AISSQ Conference, Bangalore. Pub. Bhaktivedanta Institute, Kolkata, India, 108-123.
35. Mukhopadhyay, A. K., 2012. Information Holograph. The Structure, the Source and its Operation, International Journal of BioEngineeringNeuroSciences and Technology. 2, 12-32.
36. Mukhopadhyay, A. K., 2015. Neural Fabrics of the Mind: Systems Neuroscience, Systems Psychology and Consciousness, Annals of Psychiatry and Mental Health. 3, 1049.
37. Mukhopadhyay, A. K., 2013. Non-observable Influential(s) in the domain of Consciousness, Psychology Research. 3, 637-652. http://akmukhopadhyayconsciousness.com/pdf/LINK15.pdf
38. Mukhopadhyay, A. K., 2013. Setting the agenda for Science of Information. Power point presentation at TSC-2013. http://akmukhopadhyayconsciousness.com/pdf/LINK14.pdf
39. Mukhopadhyay, A. K., 1985. States of Consciousness - A Holistic Hypothesis. Supracortcal consciousness - An existing realty, Frontiers of Research for Human Biologists, Next hundred years. Conscious Publications, New Delhi.
40. Mukhopadhyay, A. K., 2006. Supracortical Consciousness. An opening to multiple new doors of Science, The Enworlded Subjectivity, Its Three Worlds and Beyond. Project History of Indian Science, Philosophy and Culture (PHISPC). Center for Studies in Civilization, New Delhi.
41. Mukhopadhyay, A. K., 2015. Systems Cell: a Testable Model for Systems Holism, International Archives of Medicine. 8, 1-10.
42. Mukhopadhyay, A. K., 1987. The Dynamic web of Supracortical Consciousness, Conscious Publications, New Delhi.
43. Mukhopadhyay, A. K., 2000. The Millennium Bridge. Conscious Publications, New Delhi.
44. Mukhopadhyay, A. K., 2015. The Outline of Systems Engineering for Developing a Conscious Ware, International Journal of Emerging Trends in Electrical and Electronics. 11, 25-33.
45. Nurse, P., 2014. Complexity and biology. Cell, 157, 272
46. Nurse, P., 2008. Life, logic and information, Nature. 454, 424-426.

47. Ortega, M. A., and van der Donk, A. W., 2016. New Insights into the Biosynthetic Logic of Ribosomally Synthesized and Post-translationally Modified Peptide Natural Products, Cell Chemical Biology. 23, 31-44.
48. Penrose, R., 1999. The Emperor's New Mind: Concerning Computers, Minds and the Laws of Physics, Oxford University Press, Oxford.
49. Perez, G., and Randall, L., 2009. Natural Neutrino masses and mixing from warped geometry, Journal of High Energy Physics, 01 (2009) 077, 1-28.
50. Pollack, G. H., 2013. The Fourth Phase of Water. Beyond Solid, Liquid and Vapor, Ebner and Sons Publishers, Seattle WA, USA.
51. Popper, K. R., and Eccles, J. C., 1977. The Self and its Brain. Springer-Verlag, Berlin, Heidelberg, London, New York.
52. Ridder, D. De., Vanneste, S., and Freeman, W., 2014. The Bayesian brain: Phantom percepts resolve sensory uncertainty. Neuroscience & Biobehavioral Reviews. 44, 4–15.
53. Ross, J. A., 2009. Mindworlds, A decade of Consciousness Studies, Imprint Academic, VA, USA. https://books.google.co.in/books?id=ZXHZCgAAQBAJ&pg=PT246&lpg=PT246&dq=supracortical+consciousness
54. Sassone-Corsi, P., and Masri, S., 2010. Plasticity and specificity of the circadian epigenome, Nature Neuroscience. 13, 1324-1329.
55. Schrodinger, E., 1944. What is Life? Cambridge: Cambridge University Press.
56. Shannon, C. E., 1948. A mathematical theory of communication, Bell System Technical Journal 27, 379–423 & 623–656.
57. Shapiro, J. A., 2007. Bacteria are small but not stupid: cognition, natural genetic engineering and socio-bacteriology, Stud Hist Philos Biology Biomedical Science, 38, 807-819.
58. Sperry, R. W., 1987. Structure and significance of the consciousness revolution. Journal of Mind and Behavior. 8, 37-65.
59. Szalay, K. Z., Nussinov, R., and Csermely, P., 2014. Attractor structures of signaling networks: Consequences of different conformational barcode dynamics and their relations to network-based drug design. Molecular Informatics. 33, 463-468.
60. Szent-Gyrogyi, A., 1941. Towards a New Biochemistry, Science. 93, 609-611.
61. Theise, N. D., and Kafatos, M., 2013. Sentience Everywhere: Complexity Theory, Panpsychism & the Role of Sentience in Self-Organization of the Universe, Journal of Consciousness Exploration and Research. 4, 378-390.
62. Therizols, P., Illingworth, R. S., Courilleau, C., Boyle, S., Wood, A. J., and Bickmore, W. A., 2014. Chromatin decondensation is sufficient to alter nuclear organization in embryonic stem cells, Science. 346, 1238–1242.
63. Tononi, G., and Koch, C., 2015. Consciousness: here, there and everywhere? Philosophical Transaction B Royal Society 370:20140167.
64. Weaver, W., 1948. Science and Complexity, American Scientist. 36, 536-544.