Indian Journal of Biochemistry & Biophysics
Vol. 63, June 2026, pp. 668-677
DOI: 10.56042/ijbb.v63i6.28166

Modelling the Dynamic Cognitive System (DCS) interfacing brain and the classical Zero-Point Field (ZPF) conceptualized within the framework of stochastic electrodynamics

Rajeshwar Mukherjee[1]*, and Khushi Kothari[2]

[1]Department of Mathematics; & [2]School of Buddhist Studies, Nalanda University, Rajgir-803 116, Bihar, India

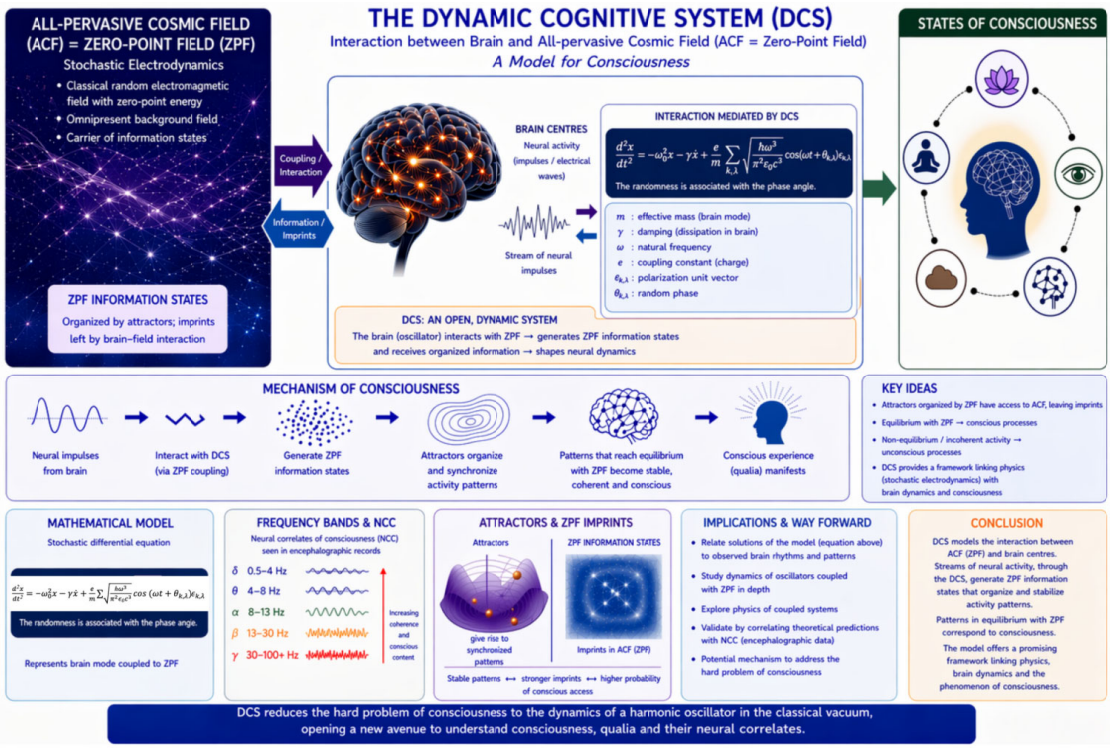
Received 01 February 2026; *revised 29 March 2026*

The paper is an attempt to model the Dynamic Cognitive System (DCS) in order to describe the interaction between the brain and the all-pervasive cosmic field, which is equated with the zero-point Field (ZPF) of physics, theorized within the framework of stochastic electrodynamics. The interaction has been modelled in terms of the DCS, of which the all-pervasive cosmic field is considered to be an integral component. The modelling of the DCS, inspired by some recent works, aims at addressing the hard problem of consciousness and further exploring some novel features of the brain corresponding to the different states of consciousness. The model is a scientific conceptualization informed by some philosophical insights. The empirical ideas are scientifically characterized and mapped on to the framework of stochastic electrodynamics. The problem thus has been reduced to the dynamics of a harmonic oscillator dipped in the classical vacuum, which is characterized by the ZPF. The differential equation with a noise term becomes the representative model for the DCS, opening up an enormous scope for interpretation in regard to the physics of the cognitive response of the brain and also that of the qualia. The model is expected to have a bearing on the neural correlates on consciousness.

Keywords: ACF, Hard Problem of Consciousness, NCC, Normal modes, Qualia, Vacuum

Treating the concept of 'psyche' or consciousness in the domain of physics[1-5] and biology[6] is no longer an enigma. From a biological standpoint, this new paradigm has been supported by advances in neurobiology and biophysics, which reveal that cognition arises from complex interactions among molecular processes, excitable membranes, synaptic communication and large-scale neural coordination[7,8]. Several other master minds like Schrödinger[4], Wigner etc. attempted to formalize the same in terms of the theories of physics. The wave function collapse poses a challenge to the measurement in the microscopic world which is popularly known as the measurement problem. It is interpreted that human consciousness is conceived as the possible cause of the wave function collapse[9,10]. However, Wilhelm Wundt, William James, Erwin Schrödinger, Wolfgang Pauli and Carl Gustav Jung are considered to be the pioneers who facilitated the entry of 'psyche' to the arena of scientific inquiry. Subsequently, serious endeavours were made by a group of scientists to interpret psyche in terms of matter considering consciousness as epiphenomenon of physical and biological processes. In biological systems, such interpretations have largely relied on electrochemical signalling, ion channel dynamics and synaptic transmission as the primary explanatory mechanisms underlying cognition[6]. However, the hard problem of consciousness remains as a stumbling block to such interpretations as purely biochemical or electrophysiological descriptions appear insufficient to explain subjective experience in its entirety. The situation leads to the emergence of some new scientific theories in which matter and consciousness are considered to be two fundamental realities. Remarkably, the concept echoes with some philosophical ideas of ancient India[11,12]. From a biological and biophysical perspective, this view encourages the examination of collective neural dynamics, coherence and field-level interactions that extend beyond localized neuronal events[8]. In this context, the modelling of the Dynamic Cognitive System (DCS) is a serious effort to develop a scientific framework which not only addresses the Hard problem but also sheds new insights on the mechanism of individual human cognition. The theory of Stochastic Electrodynamics (SED) has been used in this context following the works of Keppler. This approach gains biological relevance by attempting to link physical

*Correspondence:
E-mail: mukherjee.rajeshwar@nalandauniv.edu.in



Graphical abstract

field dynamics with the spatiotemporal organization of neural activity, suggesting that conscious experience may be closely associated with large-scale dynamical patterns in brain matter[7]. Though QED (Quantum Electrodynamics) is a general formalism to develop such a framework, the application of SED to model the DCS is preferred in this context as it is a classical system which is able to reproduce quantum effects. It is indeed true that QED cannot be totally replaced by SED, nevertheless SED has the potential to describe quantum systems along with some new insights[12,13]. It is a simpler formalism which is a direct approach to model the DCS. Though SED has the potential to explain the quantum effects, its inadequacy in certain areas is not totally ignorable. But the formalism of SED has proved to be very consistent in modelling the cognitive system responding to the hard problem of consciousness[12]. In fact, every physical or biological theory has its strength and weakness and some inherent limitations; therefore, even the objective reality can hardly be described by it exactly in its entirety. Theory is an attempt to develop a model of natural phenomena by virtue of which the human mind can comprehend reality to the highest possible extent. Still the gap between theory and reality unavoidably persists as profoundly put by Einstein: *Any serious consideration of a physical theory must take into account the distinction between the objective reality, which is independent of any theory, and the physical concepts with which the theory operates. These concepts are intended to correspond with the objective reality, and by means of these concepts we picture this reality to ourselves*[14].

Emergence of a Scientific Theory from Philosophical Ideas

Ancient Indian thinkers have developed consistent theories of consciousness which are being authenticated by the modern scientific works. Schrödinger, Planck, Pauli, Jung, Huxley, Eccles[15] are some of the prominent figures in the field of science who have endorsed these ancient insights and paved the way to the emergence of the new science of consciousness. It is remarkable that some of these scientists are the early fathers of quantum mechanics. Keppler, Shani and others[16-18], in their recent works, have not only put a seal of approval but intensively researched and attempted to develop scientific models on the basis of these ancient insights. These works are being vindicated in the contemporary world and serious attempts are made to develop a proper scientific framework which can potentially address the hard problem of consciousness. How and why the

subjective experience arises from the objective brain processes is an unsolved mystery. The conscious experience is the one which is known most intimately, yet it is hard to explain. Experiences such as the quality of redness, the warmth associated with joy, the characteristic experience of tasting a lemon and the feeling of nostalgia are inherently subjective, and it remains challenging to account for how such experiences arise only from electrochemical activity in the brain[19,20]. Recent developments in the field of psychology have endorsed the concept which considers matter and consciousness to be distinct from each other and are considered to be two fundamental realities which echoes the age-old concept of dualism as upheld in Indian Philosophy.

A 'positive science'[21,22], inspired by the ancient Indian insights[23], upholds a coherent theory of consciousness, the tenets of which can be used as the cornerstone of the scientific model. This school of thought conceives of a unitary and all-pervasive background reality of which matter and consciousness are two fundamental aspects[24]. Pushing the concept forward, Carl Gustav Jung has developed a scientific theory along with Wolfgang Pauli which lays down the scientific foundation of this theory of dual-aspect monism[25]. They upheld the existence of a unitary, all-pervading background of which *physis* (matter) and *psyche* (consciousness) are two fundamental aspects. Both matter and psyche are grounded in that primary background reality[25]. David Bohm, in one of his seminal works also conceived a background reality called the implicate order. The implicate order has reference to holomovement and it is the source of life-explicit and inanimate matter. The background is primary, self-existent and universal. The idea of wholeness is fundamental to his philosophy and he propounded that the universe, which includes both matter and consciousness, is of the nature of unbroken wholeness[26]. The background reality is often identified with a vacuum which has the inherent imprint of consciousness. Vacuum plays a significant role in understanding matter but also it plays a significant role in understanding the nature of consciousness[27]. As a matter of fact, matter and consciousness are closely related and understanding of one requires the understanding of the other[14]. The physicists are often interested in exploring the nature of vacuum which has a major bearing on the understanding of the nature of matter and consciousness. Celebrated physicist Eddington profoundly puts: *The physical atom is…a schedule of pointer readings…attached to some unknown background… I have an insight which is not limited to evidence of pointer reading. That insight shows that they are attached to a background of consciousness*[28].

Joachim Keppler and others[17] developed a scientific framework deriving inspirations from the insights of ancient Indian philosophy. These scientists have also conspicuously conceived of vacuum as source of the universe of space and time. Arguably Keppler's model is a seminal contribution to the field in which he developed a scheme using the framework of theoretical physics in which the hard problem of consciousness has been potentially addressed. Deriving inspiration from the ancient insights and making use of the ideas embedded in his scheme, an attempt has been made to theorize the DCS which will not only open up new vistas of ideas about consciousness but may emerge as a scientific theory which will potentially validate a wide range of practices prescribed in the ancient texts contributing to health and wellness of human being. It is to be noted that the DCS conceived here is different compared to cognitive systems in contemporary cognitive studies. The latter refers to individual processing of stimuli - from perception to thinking and consciousness. Here DCS is conceptualized as the interface between the brain and an all-pervasive field having reference to the theories of physics.

Objectives of Modelling DCS

1. It will contribute to addressing the hard problem of consciousness.
2. It can possibly explain the conscious response of the brain within a scientific framework.
3. If the model is developed and validated on the basis of the foundational theories of physics, it will scientifically authenticate a traditional Indian system of practices aimed at human well-being.

Materials and Methods

To model the DCS, a transdisciplinary approach rooted in theoretical physics, neurophysiology and a philosophy is adopted. A novel insight lies in the framework of random electrodynamics, which is a classical analogue of quantum mechanics, having the potential to explain many significant quantum phenomena[13]. Moreover, firing of neurons triggers conscious processes in the human brain, which is considered as the prominent seat of consciousness. The brain waves represent the neural correlates of consciousness (NCC) and also contain the imprint of the qualitative patterns[17]. Therefore, concepts of

Table 1 — Characteristic Features of the Components of Dynamic Cognitive System

Components of DCS	Characteristic Features
All-pervasive Cosmic Field (ACF)	An infinite ocean of activity constituted of normal modes where each normal mode has an individual frequency and phenomenal colour.
Cosmic Space-time Grid (CSG)	It is a dynamic grid which selects some normal modes from the ocean (ACF) and transmits to the physical systems.
Sensorial Processing Region (SPR)	It receives the filtered normal modes and facilitates their interaction with the subtle brain centres.

neurophysiology are also invoked to scientifically characterize the philosophical ideas. An attempt has been made to put the physical ideas together to the framework of random electrodynamics (stochastic electrodynamics) towards developing a model which will create a pathway to understand how coherence and order may arise from the randomness at the fundamental level and how individual awareness may be coupled with the cosmic field that is defined in the parlance of theoretical physics.

Fundamental Postulates:

The theory of DCS is based on the following postulates:

1. Consciousness and matter are the two fundamental realities of the universe.
2. There is an omnipresent background field termed All-pervasive cosmic field (ACF), which has reference to the core foundations of physics as its extrinsic feature and simultaneously bears the fabric of consciousness as its intrinsic feature. Individual consciousness of human beings is the result of the interaction between the brain and DCS.

Modelling the Dynamic Cognitive System

The DCS is functionally defined as a cognitive apparatus having a well-defined structure. It consists of three components: an all-pervasive cosmic field (ACF), a cosmic space-time grid (CSG) and a sensorial processing unit (SPR) that interfaces the interaction between the filtered modes of the cosmic field and the brain (Table 1). The interaction between the brain and the selected modes of ACF is mediated through subtle brain centres (SBC) which connect the DCS with the brain. The present modelling has derived insights from Keppler's work on the 'conceptual framework of consciousness.' However, the present model has its own uniqueness and novel approach[12].

The ACF is an omnipresent field which has reference to the core foundations of physics as its extrinsic feature and simultaneously bears the fabric of consciousness as its intrinsic feature. The concept of such a field is firmly rooted[11,12,29] in the theoretical framework of modern physics[13]. The ACF may be

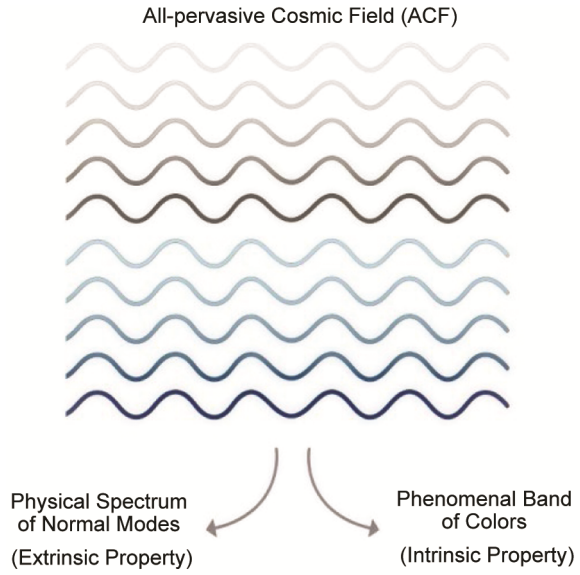


Fig. 1 — ACF exhibiting intrinsic and extrinsic properties

conceived of as the unitary and all-pervasive background having extrinsic and intrinsic aspects. The extrinsic aspect is described, with reference to modern physics, as a spectrum of uncorrelated oscillations called the normal modes which fulfil the symmetry requirements like Lorentz invariance homogeneity, isotropy and scale invariance (Fig. 1). However, the concept is derived from some earlier works with reference to the ubiquitous field of consciousness.[17] The ACF represents a formless ocean of activity described by the collection of the normal modes each of which bears a characteristic frequency of its own and is imbued with an intrinsic awareness, represented by a potential hue. The hues do not denote the colours, as such, in the ordinary sense. But the analogy of hues has been used metaphorically to suggest the different traits of awareness'. This formless ocean of energy has the potential for all forms of appearance. The spectrum of normal modes represents the 'extrinsic property' of the ocean and the band of 'phenomenal hues', in potential form, represents its intrinsic property[29]. The extrinsic property and the intrinsic property depict the material aspect and the conscious aspect of ACF respectively.

In view of the discrete nature and a lattice-like structure beyond the Planck scale[30] the concept of cosmic space time-grid has been conceived. The CSG is the cosmic interface between ACF and physical systems by which some selected normal modes percolate to influence the dynamics of the individual physical system. On the other hand, the individual physical system also impacts the ACF leaving its imprint on it. It allows a two-way interaction between the macrocosmic field and microcosmic system. In the present context of discussion, the physical system refers to the human brain.

The CSG is also a macrocosmic entity which plays a significant role in interfacing the macrocosmic ACF with the individual brains. It allows a few select normal modes which are percolated to the brain centres of an individual brain.

This interaction between ACF and the brain is processed through a sensorial processing region (SPR), which is interfaced with the human brain. This unit receives the inputs from the brain in the form of the oscillation of the brain centres. This region serves as a link between an individual human brain with the macro-cosmic entity, the ACF[22]. It receives impulse from the brain and simultaneously captures the percolated normal modes from the CSG. It facilitates the interaction between the subtle brain centres and the selected normal modes. This interaction on one hand impacts the brain activities and on the other hand influences the cosmic space-time grid CSG and thereby leaves the imprint on ACF. The components of the DCS may be mapped with the concepts of physics for the sake of modelling (Table 2).

Interaction of DCS with the Brain

The stimuli from the external world causes the firing of neurons in certain areas of the brain causing excitation of some specific areas. These excitations give rise to the oscillations of the subtle brain centres. On the other hand, these brain centres are subjected to normal modes of the ACF selected by the CSG. These interactions between the oscillatory brain centres, which are considered to be electrically charged, and the ACF gives rise to several cognitive perceptions and motor actions[31]. The information states arising out of the interaction may explain the neural correlates of consciousness. Additionally, the information states arising out of this interaction may be the possible explanation for qualia, addressing the hard problem of consciousness. Qualia can be regarded as the irreducible features of human consciousness which is purely nonphysical in nature. It refers to the conscious state which gives the feeling of firsthand experience like the conscious experiences of music, pain, joy, colour, *etc*. Experts define it as the 'ineffable, intrinsic, private and directly and immediately apprehensible in consciousness'[32] (Figs. 2 & 3).

Brain as a Noisy and Macroscopic Quantum System

The human brain is a complex, noisy processor where neural activity involves a mixture of predictable, rhythmic patterns and unpredictable, random fluctuations[33]. Thus the neural systems generate significant internal noise from various microscopic functions or processes[34], such as synaptic transmission, ion channel gating, and thermal fluctuations. This intrinsic randomness means that brain activity is not perfectly predictable or deterministic processes.

While classical physics explains most brain activity, some researchers propose quantum effects in structures like microtubules (neural cytoskeletons) could offer a deeper understanding of complex cognitive processes, challenging the view that the brain's "warm, wet" environment prevents such delicate interactions[35]. Recent experiments hint at quantum-like correlations in brain activity.

In fact, a quantum system is a physical entity, the behaviour of which is governed by the rules of quantum mechanics. It has features like superposition (being in multiple states at once), entanglement (linked fates), and energy existing in discrete levels, and this requires a wave function to describe it and collapse upon measurement[36].

Table 2 — Components of DCS and its Correspondence with the Concepts of Physics

Components of Dynamic Cognitive System	Correspondence with the Concepts of Physics
All-pervasive Conscious Field (ACF)	Zero-point field (ZPF) with reference to Stochastic Electrodynamics
Cosmic Space-time Grid (CSG)	A cosmic entity which dynamically selects the normal modes
Neural Correlates of Consciousness (NCC)	Frequency of the resultant Information States
Qualia	Phenomenal response of the resultant information states
Sensorial Processing Region (SPR)	It captures, receives and processes neuronal inputs of the brain
Subtle Brain Centres (SBC)	Charged oscillators at the interface of Brain and DCS

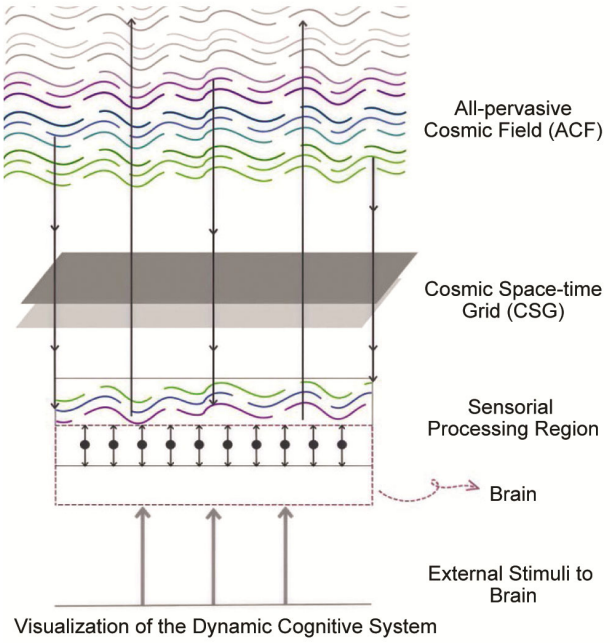


Fig. 2 — Visualization of the DCS

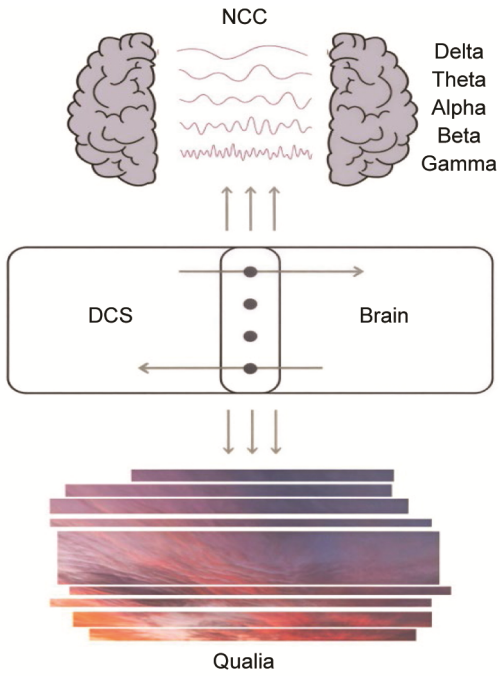


Fig. 3 — DCS- Brain Interaction

Macroscopic quantum systems are characterized by long-range coherence[37,38], rapid phase transitions[39], self-organized criticality[40,41]. The emergence of long-range coherence, which may have fundamental association with consciousness, is basically the system allowing itself to function as a macroscopic whole through the dissolution of individuality of the microscopic boundaries. On the other hand, the abrupt and the simultaneous shift of the brain's activity pattern is expressed in terms of rapid phase transitions. Self-organized criticality is also a characteristic which is exhibited by the brain. As the framework of stochastic electrodynamics can reproduce the quantum effects therefore it may be considered as a potential candidate for describing the response of the macroscopic quantum system like the brain.

Framework of stochastic electrodynamics:

The framework of stochastic electrodynamics is principally characterized by the concept of vacuum. The vacuum is portrayed as the infinite ocean of energy or more philosophically as the infinite sea of light which is the source of the building blocks of the universe. According to the standard model, quantum fields are the causes of all the elementary particles and fundamental forces. The self-consistent formulation of field theory gives rise to the concept of the ever-present sea of energy, which is identified as the quantum vacuum, characterized by the vacuum fluctuations.

Classical zero-point radiation is described with reference to a classical vacuum which is filled with a ubiquitous stochastic field. The radiation is based on the hypothesis that a classical background field prevails even at absolute zero. The theory arises from the framework of stochastic electrodynamics. The framework of stochastic electrodynamics adds several mathematical specifications in describing the nature of the background field called the Zero-point Field (ZPF) imposing several symmetries on the field equations, like homogeneity, isotropy, Lorentz invariance, scale invariance. The field is depicted as the sum of plane electromagnetic waves, called the normal modes, with random phase and characteristic power spectrum[42]. As some of the quantum effects emerge from the framework of SED, it is anticipated that further research in this area will be able to shed new light relating to some more quantum effects not hitherto explained with reference to SED[13].

This leads to an endeavour to derive the concept of quantum mechanics and quantum dynamics from the fundamental theory of SED. The SED engenders some novel insights into the fundamental nature of quantum mechanical systems[43].

It requires mention here that SED is neither an effort to substitute quantum electrodynamics (QED) nor it enriches the conclusions of QED. There is no doubt that quantum systems can be almost correctly described by QED[43]. But the SED has some special

advantages. It provides the perspectives by which a quantum system can be studied within the classical framework. It incorporates Planck's constant into the classical framework and thus, reproduces the predictions of the QED within the purview of the classical systems.

Now there may be an argument as to why stochastic electrodynamics, which is classical in nature, has been preferred in the present context than quantum electrodynamics, given that quantum theory is more fundamental to classical physics. There are several advantages of invoking the formalism of stochastic electrodynamics. First, SED, as claimed, has the potential to derive the laws of quantum physics from the first principles enabling people to explain the emergence of quantum properties like non-locality, stability of matter, *etc*. and, as such, the fundamental mechanism behind quantum phenomena can be explained rather than developing only mathematical description of the system. The formalism helps develop a proper understanding as to how the brain, though being a macroscopic system, exhibits quantum properties. The SED approach not only describes quantum behaviour but also unravels the underlying natural phenomena which cause the manifestation of the quantum properties[12].

SED is a theory of point charges and electromagnetic fields. It describes the dynamics of charged point masses in electromagnetic fields. The theory applies Newton's laws of motion for the point masses and Maxwell's differential equations for electromagnetic fields along with the relevant boundary conditions. It is based on the theory of relativity and rests on the following fundamental concepts:

1. The electromagnetic fields, of which point charges are the sources, satisfy Maxwell's equation.
2. The particles move following Newton's laws of motion under the action of Lorentz force, which is of the form $dp/dt = e\ (E + v \times B/c)$
3. The classical electromagnetic zero-point radiation provides the solution of the source-free Maxwell's equations.
4. The classical electromagnetic zero-point radiation may be understood in terms of the Lorentz invariant spectrum of random classical radiation having an energy per normal mode, $\varepsilon\ (\omega) = \frac{\hbar\omega}{2}$.

The assumptions are primarily based on the experiments in macroscopic electrodynamics along with the consideration of classical zero-point radiation that arose with experimental works of Casimir effect, i.e.; the forces manifesting between closely placed conducting parallel plates[42].

The motion of a small dipole oscillator which is immersed in classical radiation may be given by Braffort-Marshall equation[43]:

$$m\ddot{x} = -m\omega_0^2 x + m\tau\dddot{x} + e\,E_x(x,t) \quad \ldots (1)$$

$e = Charge, m = mass, \omega_0$ = angular frequency of the oscillator.

The τ is given by,

$$\tau = \frac{2e^2}{3mc^3} \quad \ldots (2)$$

The random electric field E_x is considered to be at the centre of the dipole. The harmonic oscillator is driven by the classical radiation into a random oscillation with a mean oscillator energy equal to the random energy in the electromagnetic field with the same frequency as that of the oscillator. Such a calculation for random classical radiation is ascribed to Max Planck who has done the calculation in terms of thermal radiation at non-zero temperature without taking into account the possibility of classical radiation at zero temperature[44]. Whenever $e \to 0$, the mechanical motion of the oscillator gets uncoupled from the random radiation and assumes the form of mechanical oscillator exhibiting 'stochastic mechanics.' If the random radiation takes on Planck thermal spectrum (including the zero-point radiation) before taking the small e limit, then the average values of the position $x^n$and momentum p^n, for any power n, are identical between the classical and quantum theory for every temperature $T \geq 0$.

The charged harmonic oscillator in the random driving radiation behaves classically while it absorbs energy from classical radiation and loses energy following Newton's laws of motion and Maxwell's equations[45]. It is a fact that harmonic oscillators can describe several aspects of natural events. As the calculated average energy of the classical and the quantum oscillators at all temperatures in equilibrium are the same, the results of the classical and quantum calculations of the charged harmonic oscillators match[46].

The classical vacuum is not an empty space. It has a background electromagnetic field like the zero-point vacuum field[43]. The classical vacuum could be first experimentally traced in 1947 by Lamb and Rutherford with a peculiar shift in the hydrogen atom fine structure spectrum[47]. It is general convention to

approximate $\ddot{x}$ by $-\omega_0^2\dot{x}$ for the atomic systems in the SED framework. So, equation (1) may be written as[43],

$$m\frac{d^2x}{dt^2} = -m\omega_0^2 x - m\tau\dot{x}\omega_0^2 + eE(x,t) \quad \ldots (3)$$

Considering $E(x,t) \approx E(0,t)$, this reduces to

$$\frac{d^2x}{dt^2} = -\omega_0^2 x - \gamma\dot{x} + \frac{eE(0,t)}{m} \quad \ldots (4)$$

where, $\gamma = \tau\omega_0^2$ … (5)

Now the randomness may be added to the term involving electric field. The randomness enters into the system in the form of noise which can be described in terms of white noise.

The value of E in the framework of zero-point radiation is given by[48].

$$E = \sum\sqrt{\frac{\hbar\omega^3}{\pi^2\epsilon_0 c^3}}\, cos\,(\omega t + \theta_{k,\lambda})\epsilon_{k,\lambda} \quad \ldots (6)$$

where $\hbar = \frac{h}{2\pi}$, ω is the angular frequency of the periodic force due to the ZPF.

So, the value of E can be substituted in equation (4)

$$\frac{d^2x}{dt^2} = -\omega_0^2 x - \gamma\dot{x} + \frac{e}{m}\sum\sqrt{\frac{\hbar\omega^3}{\pi^2\epsilon_0 c^3}}cos\,(\omega t + \theta_{k,\lambda})\epsilon_{k,\lambda} \ldots (7)$$

The randomness is associated with the phase angle.

The differential equation is a second order non-linear equation which is similar to the equation which represents forced vibration with an impressed force having a random phase angle. The particle oscillates with a natural frequency ω and γ is the damping factor and $\frac{e}{m}\sum\sqrt{\frac{\hbar\omega^3}{\pi^2\epsilon_0 c^3}}cos\,(\omega t + \theta_{k,\lambda})\epsilon_{k,\lambda}$ is the externally imposed periodic force having a phase angle with an additive noise term $\theta_{k,\lambda}$ varying from $0\ to\ 2\pi$.

The equation (7) represents the interaction between the brain and DCS. The L.H.S. of the equation suggests the oscillatory pattern of an element of the SPR. The R.H.S. gives the term for the impressed periodic force containing white noise along with the other terms containing the natural angular frequency and system level damping of the oscillator. The equation takes the form of Langevin equation which is of immense physical significance.

It is argued that the brain is a resonant oscillator under the action of a ubiquitous field called the ZPF. A suitable sensory input to the brain excites different brain centres causing them to oscillate. Due to the interfacing of the brain with the SPR, it can be supposed that the SPR also is driven by the ZPF. A sensory input obtained via the brain through the senses creates a disturbance in the SPR causing the assembly oscillators to oscillate in such a way that the assembly of oscillators falls into an attractor. With the attainment of the stationary state the set of oscillators enters a quantum domain exhibiting a long-range coherence and also puts some imprints on the local ACF. Dynamical systems in equilibrium exhibit quantum characteristics[43]. Thus, it is explained that the ZPF helps orchestrate the brain activity giving rise to the quantum states which develop the conscious perceptions in the brain. The recurrent formation and dissolution of quantum states constitute the fundamental mechanism of the brain. Therefore, classically every stable attractor in the brain arising out of the interaction of ZPF with the brain represents a conscious perception[31]. The model is based on the mechanism in the brain in which the DCS has its corresponding impact on the brain mechanisms and vice versa. This may lead to a consistent explanation of the NCC & its dynamical properties[13].

Conclusion

The DCS is a model describing the interaction between the ACF and brain centres which may be a possible response to the hard problem of consciousness. The electrical activities of the brain, through its interaction with the DCS, generates ZPF information states, which facilitates the manifestation of stream of consciousness. It is an approach that provides an explanation as to why certain NCC have 'privileged relationship with consciousness'[31]. The attractors which give rise to the synchronised patterns, organized by the ZPF, can have access to the ACF, leaving imprints in it. The activity patterns which reach the state of equilibrium with the ZPF give rise to conscious processes as distinguished from the unconscious processes[31]. But arguably this model needs further validation by corroborating theoretical data with the characteristic nature of NCC. The NCC is characterized by the encephalographic records of brain response at different states of consciousness. The long-range coherence of the brain is characterized by the conscious state the manifestations which are predominantly found in the beta and gamma frequency band. It is also established from the experimental results that the relation between long range coherence and consciousness becomes highly pronounced[49]. The way forward is to study as to how the results of the solution of equation (6) or that of its modified form

helps understand the patterns of the rhythms of the brain observed as the brain waves. Moreover, the dynamics of the oscillators coupled with the ZPF may further be studied in depth to explore novel dimensions of the physics of coupled systems and at the same time derive fresh insights in regard to the DCS addressing the hard problem of consciousness. The modelling of DCS and its interaction with the brain may open up new vistas of research with its possibilities to address the hard problem of consciousness and shed new light on the essential nature of qualia. Moreover, meditative practices and concentration techniques, enshrined in the ancient Indian texts, have a colossal impact on human health and wellbeing. In the recent times, the methods and practices are being validated through serious scientific experiments. However, the system is still deficient of a structured scientific framework. The work may potentially formalize a theoretical framework compatible with experimental results contributing abundantly to the advancement of science, human health and wellbeing.

Acknowledgment

The authors thankfully acknowledge Prof. Kakali Ghosh, Dr. Krishna Roy, Dr. Gordana Jovanovic, Ms. Namrata Ray, Ms. Epsita Sinha, Mr. Gitartha Patowary and Mr. Harsharaj Gogoi for their meaningful academic suggestions and assistance.

Conflict of interest

Both the authors declare no conflict of interest.

References

1 Schwartz JM, Stapp HP & Beauregard M, Quantum physics in neuroscience and psychology: A neurophysical model of mind–brain interaction. *Philos Trans R Soc Lond B Biol Sci*, 360 (2005) 1309.
2 Stapp HP, Mindful universe: Quantum mechanics and the participating observer. Springer, (2007).
3 Wilson JA, Eccles's physiological evidence for a self-conscious mind. *Brain Behav Evol*, 18 (1981) 33.
4 Schrödinger E, What is life? & Mind and matter. Cambridge Univ Press, (1967).
5 Popper KR & Eccles JC, The self and its brain. Springer, (1977).
6 Hodgkin AL & Huxley AF, A quantitative description of membrane current and its application to conduction and excitation in nerve. *J Physiol*, 117 (1952) 500.
7 Buzsáki G, Rhythms of the brain. Oxford Univ Press, (2006).
8 Deco G, Jirsa VK & McIntosh AR, Emerging concepts for the dynamical organization of resting-state activity in the brain. *Nat Rev Neurosci*, 12 (2011) 43.
9 Wigner EP, Remarks on the mind-body question. Heinemann, (1961).
10 Stapp H, Mind, matter, and quantum mechanics. Springer, (1993).
11 Mukherjee R & Dixit US, Understanding cosmopsychism based on stochastic electrodynamics from the perspective of the Indian knowledge system. *Sci Temper*, 14 (2023) 642.
12 Keppler J, A conceptual framework for consciousness based on a deep understanding of matter. *Philos Stud*, 2 (2012) 689.
13 Keppler J, On the universal mechanism underlying conscious systems and the foundations for a theory of consciousness. *Open J Philos*, 6 (2016) 346.
14 Einstein A, Podolsky B & Rosen N, Can quantum-mechanical description of physical reality be considered complete? *Phys Rev*, 47 (1935) 777.
15 Mukherjee R, Unravelling the reality: Interface between physics and Vedānta. Kaivalyadham, (2020).
16 Keppler J, Building blocks for the development of a self-consistent electromagnetic field theory of consciousness. *Front Hum Neurosci*, 15 (2021) 723415.
17 Shani I & Keppler J, Beyond combination: How cosmic consciousness grounds ordinary experience. *J Am Philos Assoc*, 4 (2018) 390.
18 Feuerstein G, The philosophy of classical Yoga. Inner Traditions, (1996) 15.
19 Chalmers DJ, Facing up to the problem of consciousness. *J Conscious Stud*, 2 (1995) 200.
20 Nagel T, What is it like to be a bat? *Philos Rev*, 83 (1974) 435.
21 Seal B, The positive sciences of the ancient Hindus. Longmans Green & Co, (1915) 4.
22 Swami Vivekananda, Raja Yoga. Advaita Ashrama, (2016) 107.
23 Chatterji KC (Ed.), Vedic selections, Part II. (1961) 348.
24 Vyāsa, Śrīmadbhagavad Gītā. Advaita Ashrama, 2nd ed. (2016) 152.
25 Atmanspacher H & Fach W, Mind–matter correlations in dual-aspect monism. Rowman & Littlefield, (2015) 198.
26 Bohm D, Wholeness and the implicate order. Routledge & Kegan Paul, (1980).
27 Wilczek F, The lightness of being: Mass, ether, and the unification of forces. Basic Books, (2008).
28 Eddington A, The nature of the physical world. Macmillan, (1928).
29 Keppler J, The role of the brain in conscious processes: A new way of looking at the neural correlates of consciousness. *Front Psychol*, 9 (2018) 1346.
30 Requardt M, Cellular networks as models for Planck-scale physics. *J Phys A Math Gen*, 31 (1998) 5.
31 Keppler J, A new perspective on the functioning of the brain and the mechanisms behind conscious processes. *Front Psychol*, 4 (2013) 242.
32 Levin J, Qualia. *Routledge Encycl Philos*, (1998).
33 Uddin LQ, Bring the noise: Reconceptualizing spontaneous neural activity. *Trends Cogn Sci*, 24 (2020) 734.
34 Faisal AA, Selen LPJ & Wolpert DM, Noise in the nervous system. *Nat Rev Neurosci*, 9 (2008) 292.
35 Hameroff S & Penrose R, Consciousness in the universe: A review of the 'Orch OR' theory. *Phys Life Rev*, 11 (2014) 39.
36 Griffiths DJ & Schroeter DF, Introduction to quantum mechanics. Cambridge Univ Press, (2018).

37 Durfee DS & Ketterle W, Experimental studies of Bose–Einstein condensation. *Opt Express*, 2 (1998) 299.
38 Fröhlich H, Long-range coherence and energy storage in biological systems. *Int J Quantum Chem*, 2 (1968) 641.
39 Haravifard S, Quantum phase transitions. Elsevier, (2015).
40 Bak P, Tang C & Wiesenfeld K, Self-organized criticality: An explanation of 1/f noise. *Phys Rev Lett*, 59 (1987) 381.
41 Walter N & Hinterberger T, Self-organized criticality as a framework for consciousness: A review study. *Front Psychol*, 13 (2022) 911620.
42 Boyer TH, Stochastic electrodynamics: The closest classical approximation to quantum theory. *Atoms*, 7 (2019) 29.
43 De la Peña L & Cetto AM, The quantum dice: An introduction to stochastic electrodynamics. Springer Sci+Bus Media, (1996) 199.
44 Planck M & Masius M, The theory of heat radiation. P Blakiston's Son & Co, (1914) 177.
45 Boyer TH, General connection between random electrodynamics and quantum electrodynamics for free electromagnetic fields and for dipole oscillator systems. *Phys Rev D*, 11 (1975) 809.
46 Milonni PW & Eberlein C, The quantum vacuum: An introduction to quantum electrodynamics. *Am J Phys*, 62 (1994) 1154.
47 Lamb WE & Retherford RC, Fine structure of the hydrogen atom by a microwave method. *Phys Rev*, 72 (1947) 241.
48 Boyer TH, Classical statistical thermodynamics and electromagnetic zero-point radiation. *Phys Rev*, 186 (1969) 1304.
49 Crick F & Koch C, Towards a neurobiological theory of consciousness. *Semin Neurosci*, 2 (1990) 263.