

# Subjective Experience Aspect of Consciousness

## Part I

### Integration of Classical, Quantum, and Subquantum Concepts

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#### **Abstract**

It was previously hypothesized that (1) strings or elementary particles have two aspects (material and mental) and are *carriers* of subjective experiences (SEs)/proto-experiences (PEs) aspect of consciousness in their mental aspect in superimposed form (Vimal, 2008: J Integr Neurosci, 7(1), 49-73) and (2) a specific SE is selected by the matching and selection processes in a neural-net (Vimal, 2009: J Integr Neurosci, 8(3)). This closes the Type-1 explanatory gap (how SEs can *emerge* from non-experiential matter). The current article (Part I of this series) unpacks the quantum view of superposition in terms of subquantum dual-aspect primal entities (*bhutatmas*). This also integrates eastern and western perspectives, but leads to another type of subquantum Type-2 explanatory gap: how it is possible that our SEs (such as happiness, sadness, painfulness, and similar SEs) were already present in the primal entities, whereas there is no shred of evidence that such SEs were conceived at the onset of universe. To address both gaps, the previous working hypothesis ( $H_1$ ) is extended, which is proposed as follows: (1) String, elementary particles, and inert matter are the *carriers* of superimposed fundamental (not derived) SEs/PEs (Vimal, 2008b). (2) *Neural Darwinism* and the matching and selection processes assist in embedding and selecting a specific SE in a neural-net (Vimal, 2009d). (3) Some of the SEs (such as happiness, sadness, and the like) that entail Type-2 explanatory gap can be derived from the fundamental SEs/PEs (such as emotion-related PE) and the stimulus-context (such as emotional stimuli). (4) To eliminate any the residual Type-2 explanatory gap, (a) we assumed that fundamental SEs/PEs follow the principle of the *emergence* of SE and anti-SE (or *bhutatma* and *anti-bhutatma*) in a dual-aspect vacuum at the onset of universe, which is similar to the principle involved in the *emergence* of matter and anti-matter in vacuum; and/or (b) the cycles of universe (that may have memory) might have preserved irreducible fundamental SEs/PEs in the mental aspect of primal entities. And (5) SEs *occur/emerge* in neural-networks when essential ingredients of SEs (such as wakefulness, attention, re-entry, working memory and so on) are satisfied. Alternative hypotheses ( $H_2$ )-(H<sub>5</sub>) are discussed in Part II of this series (Vimal, 2009h).

**Key Words:** dual-aspect model, explanatory gaps, subquantum metaphysics, *bhutatma* primal entities, fundamental and derived experiences, co-development of mind and brain, *Neural Darwinism*, matching and selection processes, chaos theory

**NeuroQuantology 2009; 3: 390-410**

## 1. Introduction

In (Vimal, 2008b, 2009d), the dual-aspect<sup>2</sup>-dual-mode PE-SE framework (non-reductive physicalism) was presented where classical and quantum concepts related to subjective experiences (SEs) and proto-experiences (PEs) aspect of consciousness<sup>3</sup> were discussed. To address the explanatory gap (Chalmers, 2003; Levine, 1983) of the monistic and materialistic emergentism (the null hypothesis  $H_0$ ), and 'the mind-brain interaction problem and the mental causation problem' in substance dualism, we proposed three competing hypotheses (Vimal, 2009i): the *superposition* based  $H_1$ , the *superposition-then-integration-emergence* based  $H_2$ , and the *integration-emergence* based  $H_3$  where superposition is not required. In  $H_1$ , the fundamental entities<sup>4</sup> and inert matter are the

*carriers* of superimposed<sup>5</sup> fundamental subjective experiences (SEs)/proto-experiences (PEs). In  $H_2$ , the fundamental entities and inert matter are the *carriers* of superimposed fundamental PEs (not SEs), which are *integrated* by *neural-Darwinism* (co-evolution, co-development, and sensorimotor co-tuning by the evolutionary process of adaptation and natural selection). In  $H_3$ , a string has its own string-PE; a matter is not a *carrier* of PE(s) in superposed form as it is in  $H_2$ , rather matter is a proto-experiential entity and has two aspects at every level;  $H_3$  is a dual-aspect panpsychism. This implies that inert matter is simply the *carrier* of SEs/PEs because it contains all types of fundamental SEs/PEs and hence it is non-specific to SEs/PEs, and it behaves as a non-experiential entity. When the specificity is higher than its critical value (such as in neural-nets of brain), a specific SE occurs via *neural Darwinism*, matching and selection processes<sup>6</sup>. In this framework, co-evolution and 'co-development and sensorimotor tuning' (*neural Darwinism*) play important role as discussed in (Vimal, 2008b). One could argue that fundamental SEs are irreducible and they appear unique and independent to each other. In that case, each fundamental SE/PE should exist inherently, as superposed in the mental aspect of matter in the dual-aspect framework. In this article, the superposition of all types of fundamental SEs/PEs in fundamental entities is further unpacked in terms of subquantum dual-aspect primal entities. While doing that, we encountered another type of explanatory gap

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<sup>2</sup> "Historically, the dual-aspect view (neutral monism) has seen its ups and downs over 6000 years. In RigVedic period (4000 BC-2000 BC: (Vimal & Pandey-Vimal, 2007)), the dual-aspect framework was conceived along with other views (Rao, 1998): *Brahma* (*Prakriti* or matter) and *Vishnu* (*Purusha* or consciousness) were considered as the two aspects of Ādi-Shiva [(Sarasvati, 1974-89; Vimal, 2009b)]." (Vimal, 2009d). Further history is concisely given in (Vimal, 2009d).

<sup>3</sup> (Vimal, 2009e) describes, "meanings (or aspects) attributed to the term consciousness, extracted from the literature and from recent online discussions. Forty such meanings were identified and categorized according to whether they were principally about function or about experience; some overlapped but others were apparently mutually exclusive – and this list is by no means exhaustive. Most can be regarded as expressions of authors' views about the basis of consciousness, or opinions about the significance of aspects of its contents. The prospects for reaching any single, agreed definition of consciousness thus appear remote. However, much confusion could be avoided if authors were always to specify which aspects of consciousness they refer to when using the term. An example is outlined of how this can be done (using a 'PE-SE' framework)." In the PE-SE framework, consciousness and SE are interchangeably used. Therefore, the term NCC (neural correlates of consciousness) initiated by (Crick & Clark, 1994; Crick & Koch, 2003) may differ from the use of term 'subjective experiences (SEs)/proto-experiences (PEs) aspect of consciousness' in this article. NCC may also differ from the term 'self-referential processing' used by (Northoff et al., 2006); however, our use of the term 'Self' for SE of subject in (Bruzzo & Vimal, 2007) may be somewhat closer to (Northoff et al., 2006).

<sup>4</sup> In this article, the term 'fundamental entities' or 'fundamental particles' means 'strings' and/or 'elementary particles' (fermions and bosons).

<sup>5</sup> One could argue from the argument related to Dirac's equation of the electron in (Nunn, 2007) as follows: The concept of superposition of SEs/PEs in the fundamental particles may not have *real* existence. Rather, the superposition of SEs/PEs may be simply *potentialities* or *possibilities* that manifest *reality* 'only in the context of particular observations or experiments'. For example, when long wavelength light is presented to the 'V4/V8/VO' Red-Green neural network, the *potentiality* of SE redness turns into *reality* via (conjugate) matching and selection processes (Vimal, 2009d).

<sup>6</sup> In (Vimal, 2009d), we proposed that the quantum 'conjugate matching' (Globus, 2006; Globus, 1995a, 1995b; Globus, 1998; Globus, 2005) between input signal and cognition is more related to quantum dendritic-dendritic microtubule (MT) (dendritic webs) pathway. Whereas the classical 'matching and selection' is for the pathways related to (i) classical axonal-dendritic neural spikes, (ii) Ca-related astro-glia-neural activity, (iii) extracellular volume transmission, and (iv) soliton propagation.

(Type-2). We propose mechanisms to close the gap.

#### Abbreviations list

1T-physics : one time physics  
2T-physics : two time physics  
EPR : Einstein, Podolsky, and Rosenberg  
LGN : lateral geniculate nucleus  
MDR : mind-dependent-reality  
MIR : mind-independent-reality  
MT : microtubule  
Mya : million years ago  
NCC : neural correlates of consciousness  
OR : objective reduction  
Orch OR : orchestrated objective state-reduction  
PE(s) : proto-experience(s)  
R-G : Red-Green  
SE(s) : subjective experience(s)  
SQ : subquantum  
TOE : Theory of Everything  
V1 : visual area 1

## 2. The PE-SE Framework and Classical, Quantum, and Subquantum Concepts

### 2.1. The PE-SE framework

The PE-SE framework is a dual-aspect-dual-mode view (Vimal, 2008b, 2009d).<sup>7</sup> In (Vimal, 2008b), we hypothesized that elemental PEs are the properties of fundamental entities (strings, elementary particles: fermions and bosons), i.e.,

<sup>7</sup> If the dual-aspect view is correct, then consciousness (Vimal, 2009e) must have some causal impact (Vimal, 2009b). "One could argue that consciousness causes (Van Gulick, 2008): (i) increased flexibility and sophistication of control such as in novel situations, (ii) enhanced capacity for social coordination such as enhanced self-awareness and understanding of other's minds, (iii) more unified and densely integrated representation of reality such as the unity of experienced space, (iv) more global informational access such as in global broadcasting (Baars, 1996), (v) increased freedom of choice or free will such as in the selection of our own action, and (vi) intrinsically motivating states such as in the functional and motivational roles of conscious affective states (e.g., pleasures and pains)." (Vimal, 2009d). In addition, "1. By relating input to its context, consciousness defines input, removing its ambiguities in perception and understanding. 2. Consciousness is required for successful problem solving and learning, particularly where novelty is involved. 3. Making an event conscious raises its "access priority," increasing the chances of successful adaptation to that event. 4. Conscious goals can recruit subgoals and motor systems to carry out voluntary acts. Making choices conscious helps to recruit knowledge resources essential to arriving at an appropriate decision. 5. Conscious inner speech and imagery allow us to reflect on and, to an extent, control our conscious and unconscious functioning. 6. In facing unpredictable conditions, consciousness is indispensable in allowing flexible responses" (Velmans, 2009). Moreover for the coordination of skeletal muscles, , consciousness is essential (Morsella, 2005; Pereira Jr. & Rieke, 2009). In addition, "In sum, consciousness appears to be the major way in which the central nervous system adapts to novel, challenging and informative events in the world" (Baars & McGovern, 1996).

all types of fundamental SEs/PEs are *superimposed* in the fundamental entities. Therefore, elementary particles are not specific to any SE/PE and hence appear as non-experiential material entities. The difference between the dual-aspect-dual-mode PE-SE framework (Vimal, 2008a, 2008b, 2009b, 2009d) and materialism is that the former acknowledges the existence of experiential entities in physics whereas the latter proposes that consciousness somehow *emerges* from non-experiential matter. In the PE-SE framework, fundamental entities are *carriers* of SEs in their mental aspect and they are not proto-conscious, whereas they are (proto)conscious in panpsychism (Strawson, 2000, 2006).

In (Vimal, 2009d), we proposed that a specific SE in a neural-net is precisely selected by the matching and selection processes and argued that the dual-aspect-dual-mode-PE-SE (or simply PE-SE) framework is optimal because it has the least number of problems. This led us to propose the *optimal* definition of consciousness (that has the least number of problems) in (Vimal, 2009g) as: "*consciousness is a mental aspect of a system or a process, which has two sub-aspects: conscious experience and conscious function.*"

### 2.2. String theory and the PE-SE framework

String theory is a 'sub-elementary particle' theory because elementary particles (fermions and bosons) can be derived from strings as different vibrating modes. Quantum mechanics was invented to introduce fuzziness by uncertainty principle to address the classical physics problem of  $1/r^2$  singularity as  $r \rightarrow 0$  at micro-level. However, the  $1/r^2$  singularity in gravitational force was still not resolved, i.e., the problem of combining general relativity and quantum physics still remained. To address this problem, a new sort of fuzziness was needed. For this purpose, 'point particles' was replaced by 'strings' via string theory (Witten, 1998). In string theory (including superstring theory and M-theory) both bosons (force carriers, such as photons and gravitons) and fermions (constituents of matter, such as electrons) are simply the same string vibrating in different modes. The harmonics of strings give rise to the

whole of the field of matter (Robbins, 2007); different harmonics correspond to different elementary particles; their interactions are simply 'splitting or joining' of strings. For example, a proton can be thought of as three vibrating strings, one for each quark. The splitting of a string into two strings and the joining of two strings into one correspond to particle emission (such as photon) and absorption, respectively, giving rise to the interactions between particles. The vibration of strings at different frequencies determines mass, electric charge, color charge, and spin. Furthermore, in string theory landscape, "[a]ny scientists who study nature must live in a part of the landscape where physical parameters take values suitable for the appearance of life and its evolution into scientists" (Weinberg, 2007). This is consistent with the ultimate ensemble theory based on the anthropic principle: "all structures that exist mathematically exist also physically [...] [they] contain self-aware substructures [...], [which] subjectively perceive themselves as existing in a physically "real" world" (Tegmark, 1998).

The M-theory (Witten, 1998) and F-theory (Vafa, 1996, 1997) might be close to theory of everything. However, the critical problem of observer dependent reality still remained, and the theory of everything must explain SEs or consciousness (Chalmers, 1996).<sup>8</sup> This problem is addressed in the PE-SE framework, such as in our previous articles (Bruzzo & Vimal, 2007; MacGregor & Vimal, 2008; Vimal, 2007a, 2008b, 2009i) and the current article. String theory and consciousness might be connected.<sup>9</sup> One could speculate that SEs might have something to do with hidden variables, 'internal' dimensions of gauge theory, and/or the compactified dimensions of string/M-theory; for example 4 spatial dimensions are

needed in Kaluza-Klein theory for unifying electromagnetism and gravity, 11D in M-theory, and 12D in F-theory to unify all 4 forces (Flanagan, 2003). Furthermore, in the PE-SE framework (Vimal, 2008b, 2009i), the superposition of all fundamental SEs/PEs in one or more extra-dimensions (7 or 8 extra-dimensions in addition to our usual 3 spatial and 1 temporal dimension) of string/M-/F-theory implies that if a string is split into two during emission of say photon or if two strings join into one during absorption, all SEs are conserved (i.e., the number of SEs do not double in the joined string or do not halve in the splitted strings, rather they just passed on *as it is* to resulting string(s) in superposed form). In F-theory, the metric signature (10, 2) indicates that two of the 12 dimensions have negative eigenvalues, i.e., one could interpret these two dimensions as representing non-material entities, one for phenomenal space and one for phenomenal time. In other words, SEs/PEs might be superimposed in these two dimensions, although it is not clear; it is possible that the superposition of PE/SEs does not depend on dimension, i.e., it could be any or all of 12 dimensions. Further details for introducing consciousness in physics are given in (Vimal, 2009i).

According to (Bars & Quelin, 2008) "The relation between two time physics (2T-physics) and the ordinary one time formulation of physics (1T-physics) is similar to the relation between a 3-dimensional object moving in a room and its multiple shadows moving on walls when projected from different perspectives. The multiple shadows as seen by observers stuck on the wall are analogous to the effects of the 2T-universe as experienced in ordinary 1T spacetime." Observers stuck on the wall must work hard to find relationship between shadows to make sense of them and integrate them. Problems with consciousness are somewhat similar. Problems with (3+1)-Physics (assuming that Physics needs to explain everything) are:  
(i) How consciousness *emerges*, whereas mind and matter seems different but are related (mind-brain duality/dual-aspect in space) and (ii) phenomenal time (subjective experience of time) and physical clock time look different but

<sup>8</sup>According to Chalmers, "a complete theory will have two components: physical laws, telling us about the behavior of physical systems from the infinitesimal to the cosmological, and what we might call psychophysical laws, telling us how some of those systems are associated with conscious experience. These two components will constitute a true theory of everything" (Chalmers, 1995b).

<sup>9</sup>According to (Ruquist, 2008), "Spin of a collection of particles or loops equal to zero [in his 26D superstring model] is the basis of both the EPR experiments and the Conway-Kochen 'Free Will' Theorem, which may be a connection to consciousness."

are related (mind-brain duality/dual-aspect in time). String theory has addressed various other types of duality problems, such as T-duality (small and large distance between string theories), S-duality (strong and weak coupling strengths between string theories), U-duality, Gauge-gravity duality, and so on. Can (4+2)-Physics and/or string theory address the consciousness related mind-brain duality in (3+1)-Physics? One could hypothesize that mind-brain duality/dual-aspects could be unified at higher dimensions.

### **2.3. The three level treatment of mind-brain problem**

In the PE-SE framework, the mind-brain problem is addressed at three levels as follows:

**(1) At classical-quantum-neuronal level,** we hypothesize that the SEs aspect of consciousness *occurs/emerges/arises/springs up* in neural-nets of brain. Here the term 'occurs/emerges/arises/springs up' needs unpacking. On evolutionary scale, various aspects consciousness (Vimal, 2009e, 2009g) might have *emerged* during Cambrian explosions about 540 million years ago (Mya) (Hameroff, 1998a). However, the fundamental SEs are irreducible mental entities in hypothesis  $H_1$  of the dual-aspect-dual-mode PE-SE framework (Vimal, 2008b, 2009d).

Penrose-Hameroff model (Hameroff, 1998b, 2001, 2003; Hameroff, 2007b; Penrose, 1994, 1996; Penrose, 2001; Penrose & Clark, 1994; Penrose & Hameroff, 1995) is based on (a) the brain action being 'both physically controlled and beyond computational simulation' and (b) consciousness being non-computational (and non-random) activities at the quantum/classical borderline (Penrose, 2001). This hypothesis bypasses Gödel's incompleteness theorem<sup>10</sup> of mathematical logic (Penrose & Clark, 1994). The model appears to imply that SEs reside in spacetime geometry ('Platonic values in fundamental spacetime geometry') and a specific SE is selected during orchestrated

objective state-reduction (Orch OR) in microtubule (MT) network (dendritic web or hyper-neuron)<sup>11</sup>. According to (Hameroff, 2003), "There are several types of descriptions of the Planck scale: string theory, "quantum foam", and loop quantum gravity. In the context of loop quantum gravity, Penrose (Penrose, 1971) portrayed the Planck scale as a dynamical spider-web of spin. Taking spin as an irreducible, fundamental entity, spin networks define spectra of discrete Planck scale volumes and configurations which dynamically evolve and define spacetime geometry [...] So the universe may be constructed of Planck scale spin networks whose configurations and dynamics lead to all matter and energy. If, as Whitehead and others proposed, consciousness derives from fundamental, irreducible entities which are 'proto-conscious' (what philosophers call 'qualia'), then proto-conscious qualia must also be embedded in Planck scale spin networks (where else could they be embedded? Fundamental spacetime geometry is all there is!). We can envision proto-conscious qualia as specific, nonlocal distributed configurations of Planck scale spin networks." Here, 'the fundamental spacetime geometry' or 'Planck scale spin networks' seem to contain both bosons and fermions. It is not clear that their 'fundamental, irreducible entities' include SEs, such as redness.

Furthermore, "Within the OR scheme, we consider that consciousness occurs if an appropriately organized system is able to develop and maintain quantum coherent superposition until a specific 'objective' criterion (a threshold related to quantum gravity) is reached; the coherent system then self-reduces

<sup>10</sup> The Gödel's incompleteness theorem implies, "for any potential algorithm for determining mathematical truth, no matter how intricate, there must be propositions whose truth it cannot determine"; Penrose argued, "the human mind has a capacity which is not wholly algorithmic" (Penrose & Clark 1994).

<sup>11</sup> The rationale for the hypothesis that consciousness is via dendritic web rather than action potentials includes (i) gamma synchrony being NCC can be explained by dendritic web rather than action potentials, and (ii) there may be billions of distinguishable states of consciousness and hence billions of corresponding distinguishable neural states, which can be supported better by larger scale structures (interference fringes, fractals, braids, etc in dendritic/astroglial plexi) rather than axonal-dendritic pathway [(ii) is adapted from (Nunn, 2008)]. Furthermore, "Penrose and Stuart Hameroff have speculated that human consciousness is the result of quantum gravity effects in microtubules, which they dubbed Orch-OR (orchestrated object reduction)".

(objective reduction: OR). We contend that this type of objective self-collapse introduces non-computability, an essential feature of consciousness which distinguishes our minds from classical computers. Each OR is taken as an instantaneous event—the climax of a self-organizing process in fundamental spacetime—and a candidate for a conscious Whitehead ‘occasion of experience’ ... Sequences of OR events give rise to a ‘stream’ of consciousness. Micro- tubule-associated proteins can ‘tune’ the quantum oscillations of the coherent superposed states; the OR is thus self-organized, or ‘orchestrated’ (‘Orch OR’)” (Hameroff, 2001). This seems to suggest that a robotic zombie (functionally identical with human but not made of biological materials as humans are) cannot have consciousness unless (a) non-computability (necessary ingredient of consciousness) is somehow implemented in it and (b) it is capable of OR.

In addition, “The quantum computation is algorithmic but at the instant of OR a non-computable influence (i.e. from Platonic values in fundamental spacetime geometry) occurs. [...] The Planck scale is approached in modern physics through string theory, quantum gravity, twistor theory, spin networks etc. Although the correct description is unknown, it is known that the Planck scale is quantized and nonlocal, and the level at which Penrose suggests quantum superpositions occur as separations, and where Platonic values exist. It is also at this ubiquitous level that proto-conscious qualia are proposed to be embedded (Hameroff & Penrose, 1996), hence pan-protopsychnism” (Hameroff, 2007a).

In the loop quantum gravity based Orch OR framework, PEs seem to be superimposed/embedded in spin network. If PEs are superposed in fundamental spins, then spins cannot be specific to any PE and hence these PEs are latent, covert or ‘recessive’ in spin network, i.e., spins, the fundamental entities, are not proto-conscious to any specific PE, rather they simply *carry* PEs until Orch OR collapse occurs. There are two problems with this framework: (i) how SEs, such as redness, *arise/emerge* out of PEs; this is called ‘combination problem’ (Seager, 1995; Vimal, 2008b, 2009i) and (ii) loop quantum

gravity, when compared with string theory, has its own problems that need to be addressed.

In the PE-SE framework, proto-conscious qualia or SEs/PEs could be embedded as superimposed SEs/PEs in strings or elementary particles, which can be considered as *carriers* of SEs/PEs. The elementary particles consist of (a) matter particles or fermions, and (b) force carrier particles or bosons that includes graviton, which is the theorized force carrier of gravity (graviton propagator from LQG has been theorized: (Alesci, Bianchi, & Rovelli, 2008)). The ‘virtual-reservoir’ in the PE-SE framework (Vimal, 2008b) is equivalent to ‘Planck scale spin networks’ or ‘fundamental spacetime geometry’ in Orch OR framework, which appears to be the neutral monism: the neutral reality is the fundamental quantum spacetime geometry and Penrose OR is the psycho-physical bridge between mind and matter (Hameroff & Powell, 2009). One could argue that a neutral monism is substance-monism but has property dualism (which is a dual-aspect view): the neutral entity ‘quantum spacetime geometry’ has two aspects, namely, mind and matter. In both frameworks, PEs/SEs are inserted in physics by ‘hand’, i.e., they need to be derived from the first principle; this needs further research.

The above concepts (especially SEs/PEs residing in space-time geometry or virtual-reservoir) need further unpacking, which is done to some extent in (Vimal, 2009d). For example, the classical matching, the quantum conjugate matching, and the selection processes are used for the selection of a specific SE, where the complex-conjugate framework of (Franck, 2004; Globus, 2003; Umezawa, 1993) was useful. Alternatively, one could argue that SEs could *emerge* in the neural-nets of brain via the chaotic process of self-organizing system. The chaos theory framework seems to encompass all three hypotheses ( $H_1$ ,  $H_2$  and  $H_3$ ) along with materialism. In subquantum<sup>12</sup> (SQ) framework

<sup>12</sup> Bókkon has used the term ‘subquantum’ for the scalar field or geometric information field of vacuum. He suggested, “brain regulation can be achieved by scalar waves, so it also can avoid noises from the environment, because it takes place in subquantum fields [...] It is in the structured and coherent quantum vacuum from which our material world was originated and which works as a geometrical information field. [...] vacuum is not only a field where the laws of physics originate from, but it is also a field,

(Boyd & Klein, 2007), the activity in a neural-net resonates, which assigns a specific neural-net state to a specific SE embedded in the SQ-field. In the PE-SE framework, the specificity for SE is addressed in (Vimal, 2008b, 2009d, 2009f).

**(2) At quantum-elementary-particle level,** the 'quantum spacetime geometry' and the classical 'emergence' are unpacked as follows: The PEs/SEs residing in the fundamental 'quantum space-time geometry' in the Orch OR framework is unpacked as the superimposition of the fundamental SEs/PEs in the fundamental entities (strings or fermions and bosons) acting as a 'virtual reservoir', which are considered as 'carriers' of SEs in the PE-SE framework (Vimal, 2008b). The classical 'emergence' is unpacked in terms of the selection of a specific SE by matching and selection process (Vimal, 2009d). Further details are given in (MacGregor & Vimal, 2008; Vimal, 2007b, 2008b; Vimal, 2009a; Vimal, 2009b, 2009c, 2009d, 2009e, 2009f, 2009g, 2009h, 2009i; Vimal & Davia, 2008a, 2008b).

**(3) At subquantum level,** the topic of current article, the quantum concept of superposition of fundamental SEs/PEs in string is further unpacked into dual-aspect primal entities, which can be called *bhutatmas*<sup>13</sup>, *Ädi-Shiva*, sub-strings, or *rupa-dhatu/dharma-dhatu*<sup>14</sup>. Since fundamental SEs/PEs are irreducible, each of them can be considered as a fundamental subquantum mental entity. Even a string, the smallest quantum entity, is packed with all types of fundamental SEs/PEs in superimposed form. It is true that each fundamental SE/PE appears to be independent of other SEs/PEs in the sense that one cannot be derived from other; for example, the SE redness cannot be derived from the SE blueness; or the SE yellowness cannot be obtained by mixing the SEs redness and greenness, even though

yellowness appears by mixing appropriately the long wavelength light ('red') and middle wavelength ('green') light as primaries. This is just a psychophysical mixing of primaries (material photons) (Vimal, Pokorny, & Smith, 1987). Each SE is unique and appears irreducible. This implies that each SE/PE must exist somehow somewhere independently. This necessitates postulating dual-aspect primal entities, each with unique SE/PE. In other words, each *bhutatma* (or sub-string) must have a specific SE as its mental aspect. For example, there should be a *bhutatma* that has the SE/PE redness as its mental aspect; we can call it redness-*bhutatma*; similarly we can have greenness-*bhutatma*, blueness-*bhutatma*, and so on. Thus, each *bhutatma* type is in all types of fundamental entities (strings or elementary particles) and each fundamental entity has all types of *bhutatmas* in superimposed form. Since primal entities do not satisfy the essential ingredients of having SE, each *bhutatma* must be considered to 'carry' simply *bhutatmic* proto-experience. This avoids (a) proto-panpsychism that proposes inert matter is proto-conscious or (b) panpsychism that proposes inert matter is also conscious (Strawson, 2000, 2006). The PE-SE framework is a dual-aspect-dual-mode (Vimal, 2009d) 'non-reductive physicalism' (where physicalism = materialism + PE/SE) and is close to the Type-F view (Chalmers, 2003) with substance-monism and property-dualism.<sup>15</sup>

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which can keep all information of the material world, among others, as background information for the brain. [...] geometry, the accelerating motion of molecules [translation, rotation, and vibration; primarily DNA motions], and virtual particles [quantums of scalar waves] are the key factors for the communication between the coherent structured vacuum and the decoherent material levels [such as brain]. [...] I believe consciousness is a result not only of neuro-quantum interactions but also neuro-subquantum interactions, where the subquantum level is the vacuum information field" (Bókkon, 2003).

<sup>13</sup> Alternative less common spelling is *bhootatmas*.

<sup>14</sup> This term is adapted from Buddhism (Wallace, 2007).

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<sup>15</sup> Chalmers' Type-F view can be further classified into 2 subgroups (email correspondence with McQueen on 8-Feb-2008, who has major contribution in this footnote): (i) Type-F1: 'panprotopsychism', where all entities exemplify intrinsic properties (unreachable through the third-person method), our brains (or something more specific) intrinsically exemplify conscious, or, phenomenal properties, while other parts of our bodies, and (perhaps) all other physical entities, intrinsically exemplify what Chalmers calls 'protophenomenal' properties - intrinsic properties that are not conscious or phenomenal, but are nonetheless constitutive of our phenomenal properties such that phenomenal properties supervene on protophenomenal properties. (ii) Type-F2: 'panpsychism', where everything is intrinsically conscious in some way or another.

In Chalmers' framework, there appears to be 3 steps: (i) treat consciousness as irreducibly fundamental entity, (ii) describe its correlations with fundamental physical phenomena, (iii) which will then entail fundamental psychophysical laws. For example, logarithmic law in visual psychophysics: "Fechner's aim in the *Elemente* [[Fechner, 1860/1966]] was to establish an exact science of the functional relationship between physical and mental phenomena. Distinguishing between inner (the relation between sensation and nerve excitation) and outer (the relation between

## 2.4. Hypotheses to address the two types of explanatory gaps

The first explanatory gap is the well-known Levine's explanatory gap (Chalmers, 1995a; Levine, 1983): the gap between what we believe subjectively about our qualitative experiences (i.e. SE), and scientific descriptions (i.e., internal representation or associated neural correlates) of those experiences. In other words, how precisely SEs occur/emerge/arise/spring up from non-experiential material entity such as neural-nets of brain. This gap can be called as Type-1 explanatory gap of materialism at classical neural level.

The second explanatory gap arises at quantum and subquantum levels: how it is possible that some of our SEs (such as happiness, sadness, painfulness, and similar SEs) were already present in (a) superposed form in quantum string or elementary particles or (b) subquantum primal entities (*bhutatmas*), whereas there is no shred of evidence that such SEs were conceived at the onset of universe. This gap can be called as Type-2 explanatory gap of dual-aspect framework at quantum/subquantum level. To address these two gaps, we argue for two hypotheses  $H_1$  and  $H_2$ . In this article (Part I of this series) we focus on  $H_1$  and in Part II (Vimal, 2009h), we focus on  $H_2$ . In Part II, other hypotheses ( $H_3$ - $H_5$ ) are also discussed.

### Hypothesis $H_1$ related to fundamental PEs/SEs superimposed in fundamental entities

One could argue that those SEs (such as happiness, sadness, and so on) that cause Type-2 explanatory gap might not be fundamental SEs. They could be derived from some fundamental proto-experiences (PEs)/SEs, such as from emotion-related-PEs/SEs. However, let us suppose some of them cannot be derived and still lead to this gap, then one could further hypothesize that all fundamental SEs/PEs are

somehow preserved in the mental aspect of space-time geometry and/or matter by the cycles of universe, such as (i) *Shiva's* creation-maintenance-annihilation cycle of universe (Sarasvati, 1974-89), (ii) continuum hypothesis of Buddhist centrist framework (Wallace, 1989), (iii) Big-Bang  $\leftrightarrow$  Big-Crunch cycle of universe, or (iv) the cyclic universe predicted from quantum bounce model (Ashtekar, Pawlowski, & Singh, 2006; Bojowald, Kagan, Singh, Hernandez, & Skirzewski, 2007; Corichi & Singh, 2008), where this cyclic universe where this cyclic universe might have memory as some cosmologists suggest (Corichi & Singh, 2008). The first cycle might not have all fundamental SEs/PEs superimposed in strings at its onset. As universe evolved, a new SEs/PEs might have arisen from old SEs/PEs by the process of co-evolution of mind and matter. The later cycles may have acquired all fundamental SEs/PEs superimposed in the mental aspect of strings. The current cycle of our universe might not be the first one; it might be the second or one of the later evolved cycles. If this hypothesis is correct, then those SEs, which appear to cause Type-2 explanatory gap might have emerged somehow from other fundamental SEs/PEs via co-evolution and/or some chaotic processes<sup>16</sup> of self-organization in the first cycle. One could also argue that it would be the same question for the material aspect as well: how precisely string appeared at the onset of universe. Whatever the mechanism is for the material aspect; it has to be the same mechanism for the mental aspect as well because they are not separate/independent aspects in a dual-aspect view; i.e., they are two aspects glued together as the two sides of a coin. Another hypothesis is that matter and anti-matter are created from Aether or vacuum (Greiner, 2006; Pitkänen, 2003).<sup>17</sup> If this is true,

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sensation and physical stimulation) psychophysics, Fechner formulated his famous principle that the intensity of a sensation increases as the log of the stimulus-intensity ( $S = k \log R$ ) to characterize outer psychophysical relations, [where  $S$  = sensation-intensity,  $R$  = stimulus-intensity, and  $k$  = proportionality constant]. In doing so, he believed that he had arrived at a way of demonstrating a fundamental philosophical truth: mind and matter are simply different ways of conceiving of one and the same reality" (Wozniak, 1995).

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<sup>16</sup> A major question is how do non-specific proto-experiences leads to specific subjective experience and/or how do SEs occur/arise/emerge from neural signal interactions related to PEs? This is addressed in (Vimal, 2008b, 2009d, 2009h). The embedding process may itself be chaotic memory consolidation process (Abraham, 1995) with neural-net PEs being chaotic attractors.

<sup>17</sup> "In particular, highly curved vacuum extremals represent high energy densities of matter and antimatter, and the generation of this kind of space-time sheets followed by a generation of Kähler fields represent a creation of matter and antimatter from vacuum

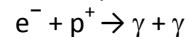


then one could argue that SE and anti-SE (or *bhutatma* and *anti-bhutatma*: see Section 3 for *bhutatma*) might also have been created from the same Aether or vacuum (see below). This implies that the vacuum might be a dual-aspect vacuum.

To elaborate further, consider again the following: The problem is how we justify that emotion related SEs such as happiness, sadness, painfulness, and the like were present at the onset of universe. If we cannot justify then they might be derived entities from some irreducible fundamental entities in the context of stimuli. In other words, one could ask: are these types of SEs fundamental or can they be derived from some fundamental PEs/SEs and the stimulus context? If they can, then it will help in deflating the Type-2 explanatory gap. For example, since elementary particles were formed within 1 second after the on-set of Big-Bang (MacGregor & Vimal, 2008), the system might have predicted photon related fundamental SEs/PEs, charge related fundamental SEs/PEs, and so on. One could argue that the emotion related SEs might have evolved from the emotion related fundamental PEs/SEs, stimulus-context, and other relevant PEs in the context of self-organization.<sup>18</sup> One could also argue, in layman's terms, that although each color SE appears to be irreducible and fundamental, all colors can be derived from three cardinal/primary colors (such as 'red', 'green', and 'blue'). These three primary colors can be considered as fundamental PEs/SEs, which can be a candidate for the superposition in the mental aspect of string. In other words, one needs to investigate cardinal (primary) SEs and then fundamental PEs/SEs. These fundamental PEs/SEs are superimposed in the mental aspect of string. This hypothesis can address both types of explanatory gaps. However, looking closely, we argue that the three primaries with dominant long wavelength ('red'), dominant middle wavelength ('green') and dominant short wavelength ('blue') are experimentally derived from psychophysical

'color-mixing' experiments (Vimal et al., 1987). The SE yellowness appears when we view the mixture of the long wavelength ('red') and the middle wavelength ('green') primaries with appropriate proportion. However, SE yellowness is a fundamental and irreducible to redness and/or greenness.

Alternatively, one can address the Type-2 explanatory gap as follows: "Corresponding to most kinds of particle, there is an associated antiparticle with the same mass and opposite charge. For example, the antiparticle of the electron is the positively charged antielectron, or positron, which is produced naturally in certain types of radioactive decay. [...] If a particle and antiparticle are in the appropriate quantum states, then they can annihilate each other and produce other particles. Reaction such as



(the two-photon annihilation of an electron-positron pair) is an example". Mixing "matter and antimatter would lead to the annihilation of both in the same way that mixing antiparticles and particles does, thus giving rise to high-energy photons (gamma rays) or other particle-antiparticle pairs". Since matter + antimatter = annihilation of both material entities, SEs + anti-SEs = annihilation of both mental entities. Creation operators can create a SE and also anti-SE in addition to matter and antimatter by perturbation method. Moreover, a string is created in vacuum by creation operator. In addition, "strings vibrate or move in ten dimensions"; the "four fundamental forces arise from these string vibrations" (Pythagoras, 2008). Thus, idea of arising mind and matter from vacuum is interesting and needs further investigation. This idea is further developed in the Part II of this series (Vimal, 2009h) as a separate hypothesis H<sub>5</sub>, where it is argued that the extra burden of *carrying* superposed SEs/PEs in the mental aspect of elementary particles and matter from the beginning of universe may not be necessary. However, H<sub>5</sub> is close to the substance dualism that has a number of problems; in addition, all these views are untested hypotheses, therefore caution must be observed.

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followed by the emission of particles or anti particles inducing the Kähler field." (Pitkänen, 2003).

<sup>18</sup> It has been argued that the SE in 'love' may be a form of human entanglement, which may be due to the Bose-Einstein-Condensate of discrete Calabi-Yau manifolds inside the brain as they are involved in every particle interaction (Ruquist, 2008).

In our email correspondence (12 September 2007), Baer commented as follows, "According to the least action principle, a particle's behavior (*choosing* the path of minimum action in the alternative possibilities between times  $t_1$  and  $t_2$ ) can be anthropomorphically interpreted as *feeling*. However, such interpretation is a projected feeling, PE, placed onto the particle by the physicist observer and falls in the same category as a conscious feeling, SE, projected onto other living humans by our first person selves for the purpose of understanding their behavior. To make further progress this association, or projection of feeling, must itself be identified with the measurement and state preparation processes of quantum theory. This theory, in my opinion, is still incomplete. The work of eliminating the independent external world model of particles and fields in physics, in favor of interacting processes (Whitehead, 1978) implemented as action cycles (measured in units of angular momentum), is a work in progress (Baer, 2007). If we are to speculate on the world view emerging from such development then you would not simply be a body in a space time-continuum looking at independent objects in front of yourself. Instead you would be a process that can be modeled by action cycles. In this world view these letters in front of you would be manifestations in your personal action cycles and not independent external objects. You *see* (i.e. incorporate disturbances in your base state action cycles) by first absorbing action quanta from external processes as internal deviations from your own ground state process and second interpreting those disturbances as conscious and illusionary external experiences. For example, this word *Now* is in you. The photon that brought the information so you could build *Now* inside of you, hit your retina some time ago. You can never see the source from whence the experience *Now* in you came, directly, but only experience your accommodation of its interactions. So, in my opinion, your PE concept is correct to the extent that primitive experience should be incorporated into physics and personal experiences SE should be cumulative PE's. If collective PE are combined to form your

SE, then the SE associated with the ground state process feels like your experience of empty space. The SE associated with deviations from that ground state process is your experience of particles and fields that constitutes your every day experience. However it should not be associated with classic particles and fields. Such an association simply returns us to the mysterious mind body connections of dualistic theories, which have already been identified with the measurement process in post classic physics, and is a step backwards. Instead it should be associated with action cycles defining your actual independent self, because such action cycles describe the entire object, measurement, subject, state preparation process within which conscious experience is held." In the PE-SE framework, (i) the PE associated with ground state process of a particle is "a bit of space", which can be combined to form a cumulative SE identified as the pure experience of space called *Nirvana*<sup>19</sup> in isolated human consciousness. And (ii) the oscillations in Whitehead framework can represent every day SE (a set of many SEs embedded as neural-net PEs in neural-nets) as long as the neural net identified as classic object is recognized as the object phase of an entire

<sup>19</sup> The eighth step of the *Patanjali's Ashtanga Yoga* is *Samadhi*, which has two subdivisions: (i) *Sasmita Samadhi* and (ii) *Asamprajnata Samadhi*. In the state of *samadhi*, the data is two fold: (i) meditator feels 'oneness' with environment, or (ii) the matter, which is a structure that crystallizes within mind, virtually disappears for meditators at *Sasmita* level. Furthermore, the state of *Turyaga* (ineffability) is reached at *Asamprajnata Samadhi* level, which is equivalent to *Nirvana* (also known as *Moksha*, salvation, liberation, or enlightenment). Good data is data that is valid over time (over 6000 years), subjects (over thousands), and location (all over world). Interpretations may vary. One of the interpretations is that the long-term open eye meditation leads to the dominance of internal neural-activity: the observer (*drasta, karta*), the objects observed (*dristi, karm*), and the process of observation (*darsana, kriya*) are all the same neural-activity in neural-nets due to re-entry process. This entails oneness and may lead to the virtual disappearance of material structures crystallized by mind (*maya*), though the environment continues to exist. In long-term closed eye meditation, all sensory systems shut down and endogenous neural-activities may dominate. At *Asamprajnata Samadhi* state, both types of meditation may lead to *Nirvana*, which is a state of bliss; although *Nirvana* is acausal, but meditation appears to set up appropriate environment for *Nirvana* to happen/occur; for example Buddha might have attained *Nirvana* during deep meditation and/or during *Asamprajnata Samadhi*. According to (Müller, 2007), *nirvana* state is free of paradoxes. [This footnote is a modified version of author's personal communication with Vemuri Ramesam who has significant contribution in this footnote ((Ramesam, 2007)).

object, measurement, subject, or state preparation process.

Alternative hypotheses (H<sub>2</sub>) and (H<sub>3</sub>-H<sub>5</sub>) are presented in the second part (Vimal, 2009h) of this series of articles.

### 3. Subquantum *Bhutatma* (or Sub-string) for Hypothesis H<sub>1</sub>

Our hypothesis implies that non-experiential matter (mass, charge, and space-time) and related elemental proto-experiences (PEs) co-evolved and co-developed, leading to neural-nets and associated PEs, respectively (Vimal, 2008b). A hypothesis in the neural-based PE-SE framework is that there exist a virtual reservoir that stores all possible SEs, which is discussed in (Vimal, 2008b) in classical and quantum terms. Here subquantum concept is introduced. An alternative 'neurally backed *modus operandi*' model<sup>20</sup> for *virtual reservoir* using some of terms of subquantum (SQ) framework (Boyd & Klein, 2007)—which requires extending physics and is the extension of Bohm's Implicative Order (Bohm, 1983) from a bi-directional vector connecting a couple of mutually complementary domains (the implicate and explicate ones) to information based infinite array of SQ complexity states—is as follows:

(i) The SQ-field composed of a large number of complexity-sensitive implicate orders reminding the Vedic concept of *bhutatmas* (Boyd & Klein, 2007; Radhakrishnan, 1993) or *Ādi-Shiva* entities that are infinitesimal, irreducible, fundamental primal structures with 'pure information'.

(ii) Each *bhutatma* has two aspects: material aspect (*Brahma, Prakriti*) and mental aspect (*Vishnu, Purusha*) such as proto-experience (*bhutatmic-PE*). The dual-aspect *bhutatma* view seems to be consistent with double-aspect model (Chalmers, 1995b). The mental aspect of *bhutatma* (subquantum dual-aspect primal entity) can be considered as unit of subjective experience. The material aspect of *bhutatma* can be viewed as the material aspect of string. In other words, a *bhutatma* is like a string with a single experience (SE/PE), such as

*redness*, from the large number of multiple coexisting possibilities/potentialities of experiences.

(iii) I assume that *bhutatmic-PEs* are subjective experiences (SEs) or first person fundamental experiences (1Es), such as redness. They are PEs because *bhutatma* cannot experience redness, as humans do. To experience redness, the redness-related neural-net is needed, which satisfies the essential ingredients of SEs, namely, wakefulness, re-entry, attention, stimulus at above threshold, working memory, and neural-net PEs (Vimal, 2009f). The number of *bhutatmas* is at least equal to the number of fundamental SEs/PEs; the available SQ combinatorial options are practically infinite. This is consistent with fractional quantum Hall effect (Laughlin, 1998). The set of all fundamental SEs/*bhutatmic-PEs* constitutes *virtual reservoir*.

(iv) SE, such as redness, is a SQ structure displaying resonant associative properties both with lower and higher orders of PEs. A specific SE such as redness is specific to a specific *bhutatma* (call it redness-*bhutatma*).

(v) SE redness is experienced by redness-related neural-net (that includes self-related areas) because it has complexity index greater than its critical threshold value; every mental or physical entity is SQ-field with different complexity indices.

(vi) Different PE/SE levels can be ascribed to different Information-based orders of reality corresponding to specific complexity indices and combinations thereof.

A quantum particle, such as electron, is composed of a large number of *bhutatmas* of SQ-field and hence a large number of superimposed *bhutatmic-PEs/SEs*. In addition, the electrons are involved in the neural signals of all neural-nets at classical level. Therefore, electrons in neural signals (or otherwise) are non-specific with respect to SEs/PEs. However, the neural signals in the redness-related V4/V8/VO-neural-net are specific to SE redness of Red-Green color opponent channel.<sup>21</sup> When

<sup>20</sup> The author takes full responsibility; the model does not necessarily reflect the views of other investigators/commentators.

<sup>21</sup> The color area 'V8/V4/VO' refers to visual area V8 of Tootell-group (Hadjikhani, Liu, Dale, Cavanagh, & Tootell, 1998; Tootell, Tsao, & Vanduffel, 2003), visual area V4 of Zeki-group (Bartels &

long wavelength light is presented to our visual system, we experience redness.<sup>22</sup> This is because the redness-*bhutamic*-PE from the SQ-based 'virtual reservoir' is assigned to the redness-specific state of our red-green V4/V8/VO-neural-net as discussed in (Vimal, 2008b). In addition, a specific SE is selected by the matching and selection processes (Vimal, 2009d).

Furthermore, the quantum elemental PEs can be unpacked a little bit using Bivacuum model (Kaivarainen, 2001), which proposes a dynamic matrix of the Universe, composed of subquantum particles and antiparticles, forming vortical structures. In this model, attraction (or repulsion) is caused by the shifts of opposite (or similar) Bivacuum dipoles charge symmetry. The attraction (or repulsion) between opposite (or similar) charges is a consequence of exchange interaction between Bivacuum fermions with opposite (or similar) sign virtual clouds. The virtual clouds and virtual anticlouds "exist in form of collective excitation of subquantum particles and antiparticles of opposite energies. [...] They can be considered as 'drops' of virtual Bose condensation of subquantum particles of positive and negative energy" (Kaivarainen, 2001). In other words, the Bivacuum-PEs are composed of all kinds of subquantum (Boyd & Klein, 2007) *bhutamic*-PEs in superimposed format.

In the PE-SE extended framework (under neurally backed *modus operandi*), I emphasize that *bhutamic*-PEs — such as redness, greenness, blueness, and so on — are not subjectively experienced by *bhutamas*. In other words, the inert matter of universe is neither 'conscious' nor 'proto-conscious'; rather the inert matter of universe is their *carrier*. That is, the matter has a potential or a possibility of being conscious after evolution when neural-nets are formed; otherwise, inert entities are *carriers* of SEs/PEs aspect of consciousness. Humans and some lower species can be

conscious if they satisfy the essential requirements of consciousness (such as wakefulness, re-entry, attention, working memory, and so on) (Vimal, 2009f), and if they have complexity indices or specificity greater than the critical threshold value. Here, the term 'consciousness' is used for the first person experience or SE. The *bhutamic*-PEs are superimposed and packed in elemental-PEs as 'virtual reservoir'; these are further packed in neural signals as neural-net PEs. However, the non-specificity of elemental-PEs is evolved into higher specificity of neural-net-PEs. These *bhutamic*-PEs are virtual because they (a) are simply 'potentials' or 'possibilities', and (b) cannot be experienced unless neural-net with essential ingredients of SEs (such as wakefulness, re-entry, attention, stimulus at above threshold, working memory, and neural-net PEs) (Vimal, 2009f)) are satisfied and 'collapse' or 'objective reduction' occurs when a stimulus is presented. That is why, one could argue, it took billions of years to evolve and create neural-nets in brains. One could argue that these superimposed 'possibilities' in 'virtual reservoir' might be one of the motivations for Nature to evolve *bhutamas* into neural-nets and associated PEs in various species for various SEs.

The *bhutama*-dual-aspect model is consistent with Baer's model (Baer, 2007) based on the extension of Whiteheads actual occasions as a cyclic process with subjective experience on one node (sensation node) and material basis of that experience on the other (explanation node).

In our neural-based PE-SE framework, at classical level, our hypothesis is that (i) both the SE redness and the 'redness related V4/V8/VO-neural-net' are subquantum-structures, (ii) the 'redness related V4/V8/VO-neural-net' is the neural correlate of the SE redness, (iii) redness *emerges* from the interaction<sup>23</sup> of 'long wavelength light dependent feed-forward signals' and 'reentrant feedback attentional neural signals' in the 'red-green V4/V8/VO-

Zeki, 2000), and VO of Wandell-group (Wandell, 1999); they are the same human color area (Tootell et al., 2003). VO is ventral-occipital cortex.

<sup>22</sup> In the case of endogenously general color SEs, such as in phosphenes (Bókkon & Vimal, 2009; Vimal & Pandey-Vimal, 2007), the color related V4/V8/VO-neural-net will still be activated (details are given in (Vimal, 2009d)).

<sup>23</sup> For example, "spatiotemporal processing emerges from the interaction between incoming stimuli and the internal dynamic state of neural networks, including not only their ongoing spiking activity but also their 'hidden' neuronal states, such as short-term synaptic plasticity" (Buonomano & Maass, 2009).

neural-net' in neural-correlated *modus operandi* of SE under certain given associative circumstances, and (iv) the SE redness is experienced by the 'red-green V4/V8/VO-neural-net'.

The PE of a neuron (neural-PE) is the PE that arose during the interaction of ions in spike-generation, and has specificity higher than elemental-PEs. One could argue that the ions may be the proto-experiencers of this neuronal ionic-PE and neuron may be the proto-experiencer of the neural PE; i.e., they are *proto-conscious*, which is different from our regular consciousness. However, it would be parsimonious to state that they are *carriers* of SEs.

As discussed in Section 2.3, one could explain SEs aspect of consciousness at all three levels: classical (coarse), quantum (fine), and subquantum (very fine) levels. Only subquantum treatment for **hypothesis H<sub>1</sub>** needs extending physics to include dual-aspect primal entities (*bhutatmas*). **At classical level**, a specific SE is selected precisely by the matching and selection processes along classical axonal-dendritic neural pathway for hypothesis H<sub>1</sub> (Vimal, 2009d). However, for H<sub>2</sub> and H<sub>3</sub>, we need to use the mysterious term 'emergence': SEs *somehow emerges* from the interaction between stimulus-dependent feed-forward neural signals and re-entrant feedback signals in neural-nets; this is elaborated in Part II of this series (Vimal, 2009h). **At quantum level**, we used the concept of quantum superposition (Franck, 2004; Vimal, 2008b, 2009f) and quantum conjugate matching (Vimal, 2009d): all types of fundamental SEs/PEs are superimposed in the mental aspect of fundamental entities (strings, or fermions and bosons) and a fewer types of SEs are superimposed in the mental aspect of a neural-net as neural-net-PEs that are embedded in the neural-net, which 'collapse' to a specific SE when a specific stimulus is presented. In addition, a specific SE is selected precisely by the quantum conjugate matching and selection processes along quantum dendritic-dendritic microtubule (MT) (dendritic webs) pathway for hypothesis H<sub>1</sub> (Vimal, 2009d). The elemental-PEs can be further unpacked *at SQ-level* (under neurally backed

*modus operandi*) by hypothesizing that fundamental entities are non-specific and composed of a set of dual-aspect *bhutatmas*, where the mental aspect of a *bhutatma* is a specific bhutatmic-PE (such as redness-*bhutatmas*) that resides in the 'virtual reservoir'. In other words, the 'virtual reservoir' consists of dual-aspect primal entities (*bhutatmas*). The elemental-PEs are the properties of fundamental entity (such as string or elementary particle). One could argue that there is an interaction between *bhutatmas* of one fundamental entity and that of another one because this corresponds to the concept of subquantum informational resonance. In this view, for mental entities, it appears that the specific *bhutatmic*-PEs at subquantum level (such as redness-Ädi-Shiva or redness-*bhutatmas* entity) transform into non-specific elementary-PEs at quantum level (such as in electron), which then evolve into specific SE at classical level (such as SE redness in the redness related neural-net). The same goes for the material aspect.

In RigVedic terms, a dual-aspect primal Ädi-Shiva entity has two aspects: its material aspect is *Brahma* and its mental aspect is *Vishnu*. Thus, the co-evolution can be elaborated as *Brahma* aspect → elementary particles → neural-net and *Vishnu* aspect → elementary PEs → neural-net-PEs. Then, for example, the color related neural-net PEs could collapse into the specific SE redness upon the presentation of long wavelength light. These transformations are necessary because a neural-net is needed to have a subjective experience in addition to essential ingredients of awareness such as wakefulness, re-entry, attention, stimulus at above threshold, working memory, and neural-net PEs (Vimal, 2009f). Without these ingredients, a system such as an inert matter is the *carrier* of associated PEs/SEs. That is why specific primal entities such as redness-*bhutatma* cannot have SE redness; it has only redness-*bhutatmic* PE in unexpressed form, i.e., it is a *carrier* of its PE, and it behaves as if it is non-experiential entity. This entails a possible motivation for Nature to create specific neural-net to have specific SE, such as redness related 'V4/V8/VO' neural-net to have SE redness.

In the PE-SE framework, the terms 'specificity' and 'non-specificity' need further clarification. For example, electron (quantum particle) is non-specific because it has all fundamental SEs/PEs superimposed and is found everywhere; however, redness-related neural-net, in classical domain, is specific because it has single SE/PE redness (a neural-net will have the SE when all essential ingredients of SE is satisfied in neural-net, otherwise the neural-net carries the PE in embedded form). On the other hand, the redness-*bhutatma* (primal dual-aspect entity) is specific because it carries single PE redness in subquantum domain. Thus, the change of specificity can be elaborated as 'specificity in subquantum domain' → 'non-specificity in quantum domain' → 'specificity of various degrees in classical domain'.

Richard Wilson commented (personal email communication on October 12, 2007), "I cannot see anything in your paper that closes the explanatory gap. [...] The hard problem of how (some) brain activity generates conscious experiences remains." To address this comment, elemental-PEs need to be unpacked. Unpacking process leads to speculation without solid evidence. In other words, elemental-PEs are packed and I have assumed that *somehow* they carry proto-experiential entities and hence the PE-SE framework is less 'brute' than straightforward materialism (types A-C). To summarize the unpacking process, elemental-PEs are composed of a set of all fundamental SEs/PEs (dual aspect primal entities: *bhutatmic*-PEs) in superimposed form and hence they are non-specific. The *neural Darwinism*, i.e., the co-evolution and co-developmental processes (via sensorimotor tuning) yield neural-nets and associated neural-net PEs and a higher degree of specificity arises. For example, the 'red-green channel related V4/V8/VO-neural-net' and the associated color neural-net-PEs are co-developed, which is basically the red-green opponent channel containing all color SEs between redness and greenness. This has higher specificity than elemental PEs. When long wavelength light is presented, the specific SE redness is selected out of these embedded color-SEs in the 'red-green channel related

V4/V8/VO-neural-net' by the matching and selection processes (Vimal, 2008b, 2009d). Thus, the PE-SE framework assists in closing the explanatory gaps using hypothesis  $H_1$ . If we can unpack quantum elemental-PEs or classical 'emergence' without extending physics to subquantum domain, it will be a great achievement because associated problems will be minimized. This is done via hypothesis  $H_2$ , however, the mystery of 'emergence' is not fully addressed in both material and mental domains: (a) precisely how and why the material property of salt (NaCl) *emerges* from the interaction of its constituents  $Na^+$  and  $Cl^-$  ions, and (b) precisely how and why the mental property SE redness of V4/V8/VO-redness-related-neural-net *emerges* from the interaction of its constituent PEs. The latter query is addressed to some extent in Part II of this series (Vimal, 2009h).

#### 4. Conceptual Analysis and Philosophical Basis of Hypothesis $H_1$

A conceptual analysis (Vimal et al., 2007) and the philosophical basis of hypothesis  $H_1$  are provided for the integration of subquantum, quantum, and classical concepts in the PE-SE framework using analytical philosophy, which addresses both Types 1 and 2 explanatory gaps. Let us take the example of color related subjective experience 'redness'. The term 'redness' refers to subjective experience (SE), i.e., the first person experience; this SE is more or less the same for all trichromats. The term 'red-color' refers to a property of objects (such as reflectance property of object: (Byrne & Hilbert, 2003)) and may also refer to the content of 'redness'.

(Q) We have color related subjective experience (SE) 'redness' (Vimal et al., 1987).

(P) We have redness related V4/V8/VO-neural-net (Bartels & Zeki, 2000; Hadjikhani et al., 1998; Tootell et al., 2003; Wandell, 1999) that includes self-related areas such as cortical midline structures (Northoff et al., 2006).

(Gap) Question is how (Q) arises from (P), i.e., how 'redness' occurs in its neural-net.

##### 4.1. Conceptual analysis for hypothesis $H_1$

Consider the following premises related to hypothesis H<sub>1</sub>, where (1) is conceptual analysis and (2.1)-(2.9) are scientific explanations.

(1) Redness is a SE of a 'red-color' object and is typically caused in an experiencing normal healthy trichromat when that trichromat looks at a red-color object (such as a ripe tomato) that reflects long wavelength light.

(2.1) There are subquantum dual-aspect primal fundamental entities such as redness-*bhutatma*, greenness-*bhutatma*, yellowness-*bhutatma*, blueness-*bhutatma*, and so on.<sup>24</sup> Each of them has a fundamental specific SE/PE in its mental aspect, its essence might be preserved via the cycles of the universe, in analogy to the essence of material aspect might be preserved. Furthermore, the fundamental SEs/PEs could have emerged via the principle of the *emergence* of SE and anti-SE (or *bhutatma* and *anti-bhutatma*) in a dual-aspect vacuum at the onset of universe, in analogy to the principle involved in the *emergence* of matter and anti-matter in vacuum. If this is true, then the dual-aspect primal entities (*bhutatmas*) were created in the dual-aspect vacuum at the onset of universe.

(2.2) The mental aspects (specific SEs/PEs) of all subquantum dual-aspect primal entities (*bhutatmas*) are *superimposed* in the mental aspect of fundamental entities (strings, or fermions (such as electrons) and bosons (such as photons and gravitons))<sup>25</sup>. The material aspect of a *bhutatma* is the same as that of a string. Fundamental entities and inert matter are the 'carriers' of SEs/PEs and behave as if they are non-experiential entities.

<sup>24</sup> If phenomenal SEs are irreducible/fundamental entities, they have to be precisely the same at all levels such as micro or macro level, and classical, quantum, or subquantum level. Therefore, prefixing dual-aspect primal entities *bhutatmas* with associated SE is justified. It is basically extension of Chalmers' dual-aspect model (Chalmers, 1995) for color to subquantum level.

<sup>25</sup> The subquantum entity redness-*bhutatma* can be considered as a sub-string with SE/PE redness as its mental aspect, i.e., this sub-string can be called redness-substring. Similarly, greenness-*bhutatma* = greenness-substring, and so on. Their material aspect is the same as that of strings. Therefore, one can consider that all these SEs/PEs (very large number indeed) are superposed in the mental aspect of a string. Since elementary particles (bosons and fermions) are different vibrational modes of string, all these SEs/PEs are also superposed in the mental aspect of each of elementary particles.

(2.3) Superimposition<sup>26</sup> of many *bhutatmic* proto-experiences (PEs) into one entity leads to non-specificity. Therefore, strings, fermions such as electron, or bosons such as photon and graviton are non-specific.

(2.4) The two aspects of an entity are material aspect (such as charge, mass, spin) and mental aspect (such as SEs redness, greenness, yellowness, blueness, and so on).

(2.5) From (2.1)-(2.4), an electron is a dual-aspect entity that has material aspect (such as charge, mass, spin, space-time, and so on) and mental aspect (such as SEs redness, greenness, yellowness, blueness, and so on).

(2.6) The material and mental aspects co-evolve and co-develop into red-green

<sup>26</sup> The term 'superimposition' or 'superposition' refers to the process in which all kinds of SEs are laid over on say electron. This means that an electron is not specific to any specific SE; and the electron acts as if it is a non-experiential material entity. In the PE-SE framework, an electron is a sort of proto-experiential (not proto-conscious) entity. This is because (a) electron cannot have SEs and (b) to have SE the entity/system needs to satisfy the necessary ingredients of having SEs such as wakefulness, attention, re-entry, and memory (that is possible in neural-nets) (Vimal, 2009f). That is why Nature took billions of years to evolve from elementary particles to neural-nets. Thus, though SEs are irreducible entities, they cannot be experienced at various levels. It is only when observation is made then a specific SE is experienced by a specific neural-net after objective-reduction (or collapse) of many neural-net-PEs into one specific SE say 'redness' when stimulus say long wavelength light is presented and necessary ingredients of the SE are satisfied (Vimal, 2009f). Therefore, all (from quantum electrons to classical neural-nets) are considered to have PEs rather than SEs, except when essential ingredients for having SEs are satisfied. In other words, elemental-PEs and PEs at other levels can be considered as they have potential or possibilities for generating SEs. The term 'superimposition' is used more or less same sense as the term 'superposition' used in the quantum mechanics. For example, "In the first process, a physical system constantly evolves into a superposition of possibilities or tendencies, [...] for actual events to occur. [...] In the second process, the transition from the "possible" to the "actual" takes place [...] when observation is made, in which one of states superimposed in the probability function is selected and becomes real in the ordinary sense" (Schäfer, 1997). For example, if Red-Green V4/V8/VO neural-net can have SEs redness, orangeness, yellowness, yellowish-greenness, and greenness, then these SEs can be embedded in this neural-net in superposed form:  
$$\alpha_{\text{redness}}|\text{redness}\rangle + \alpha_{\text{orangeness}}|\text{orangeness}\rangle + \dots + \alpha_{\text{greenness}}|\text{greenness}\rangle = \sum \alpha_i |SE_i\rangle$$
, where  $\alpha$  is a coefficient related to probability distribution of SE in the net during embedding process. "The linear combination of two or more eigenstates results in quantum superposition of two or more values of the quantity. If the quantity is measured, the value of the physical quantity will be random, with a probability equal to the square of the coefficient of the superposition in the linear combination. [...] The probability in quantum mechanics is equal to the square of the absolute value of the amplitude". When a stimulus is presented, then a specific SE is selected out of many embedded SEs and the coefficient  $\alpha$  corresponding to the specific SE takes the values of 1 and all other coefficients changes to zero.

V4/V8/VO neural-net and associated color related neural-net PEs (such as SEs redness, greenness, yellowness, blueness, and so on), respectively, that are embedded in that neural-net.

(2.7) Subjective experience 'redness' is selected from the set of color related subjective experiences (that are embedded in 'red-green V4/V8/VO neural-net') when long wavelength light is presented to our visual system for the matching and selection processes. We call this specific state of 'red-green V4/V8/VO neural-net' as specific 'redness-related-V4/V8/VO-neural-net-state' and this network experiences the specific SE 'redness'.

(2.8) Embedding process involves *neural Darwinism* (Vimal, 2008b) for generating specificity. In addition, SEs superimposed in ionic/electronic neural-PEs interact with that in stimuli and/or related signals for selecting a specific SE via matching and selection processes.

(2.9) From (2.1)-(2.8), the 'redness-related V4/V8/VO neural-net' that embeds the specific SE 'redness' plays a red-color related role.

(3) From (1), (2.7)-(2.9), the specific SE 'redness' is experienced by the 'redness-related V4/V8/VO neural-net'.

(4) From (3), the redness related Type-1 explanatory gap is deflated. Premises (2.1) and (2.2) close the Type-2 explanatory gap.

If one wants to be limited to quantum physics, premises (2.1)-(2.3) can be replaced by quantum scientific explanation premises (2.1') and (2.2'):

(2.1') It is hypothesized that all types of irreducible fundamental SEs/PEs are *superimposed* in fundamental entities (strings, or fermions (such as electrons) and bosons (such as photons and gravitons)); they *carry* SEs/PEs.

(2.2') The superimposition of all fundamental SEs/PEs into one entity leads to non-specificity; therefore, an electron is a non-specific entity.

If one wants to be limited to classical physics, premises (2.1)-(2.9) and (3) can be replaced by classical scientific explanation:

(2) The 'redness-related V4/V8/VO neural-net' that embeds the specific SE 'redness' plays a red-color related role.

(3') Hence, the 'redness-related V4/V8/VO neural-net' is the neural correlate of the SE 'redness', i.e., the SE 'redness' *occurs/arise* in this net. For this, the term 'occurs/arise' needs to be unpacked as done above in premises (2.1)-(2.9), but then physics needs to be extended to include subquantum entities.

#### 4.2. The philosophical basis of hypothesis H<sub>1</sub>

Its philosophical basis can be examined using the procedure in (Chalmers, 2006):

(I) Let P be the material aspect of the redness related neural-network and its activities.

(II) Let Q be SE redness, i.e., the mental aspect of the redness related neural-network and its activities.

(III) Let us assume that the neural-network for Q has related signature in terms of P. For example, assume that sodium, potassium, chlorine, calcium ionic activities (such as in NMDA-receptors (Pereira Jr., 2007a, 2007b; Pereira Jr. & Furlan, 2007a, 2007b)) can represent subject's SE redness in the interaction between 'the long wavelength light dependent feed-forward neural signals that *carry* redness related neural-PE' and 'the feedback fronto-parietal attentional signals' in the redness-related-V4/V8/VO-neural-net. Color related SEs including redness are embedded in V4/V8/VO color related neural-net during co-development and sensorimotor tuning (*neural Darwinism*), and then a specific SE redness is precisely selected from the embedded SEs via the matching and selection processes (Vimal, 2008b, 2009d).

(IV) If assumption (III) is correct, then one could explain the truth of Q wholly in terms of the truth of P; therefore, the truth of Q is deducible by *a priori*<sup>27</sup> reasoning from the truth of P.

<sup>27</sup> By definition, '*a priori*' knowledge is independent of all experiences, whereas '*a posteriori*' knowledge is derived from experience.



Furthermore, all 3 arguments in (Chalmers, 2006) can be satisfactorily addressed for the cognition related thesis C = 'in the dual-aspect-dual-mode PE-SE framework, the co-evolution and co-development of fundamental entities and associated PEs lead to neural-nets and associated SEs in the cognition, respectively':

(I) C is true because P and Q are true.

(II) Physically identical zombie with Q (conscious zombie) —after appropriate sensorimotor tuning/training same as human twin, share our epistemic situation and beliefs—is conceivable in C (and hence the explanatory gap is deflated for P-Q). This is consistent with "Option 3: Assert That Zombies Share Our Epistemic Situation" in (Chalmers, 2006). In addition, beliefs are also the same for both human and zombie twin because it is *conscious zombie* and basically the same human because of the dual-aspect framework. Moreover, P&~Q is **inconceivable** because P and Q are true in C.

Conceivability and explanation are linked, i.e., explaining Q in terms of P is consistent with the conceivability of Q with P.

(III) Both P and hence Q can be explained in physical terms, where physicality also includes the mental-aspect of the dual-aspect in fundamental entities.

## 5. Conclusions

The dual-aspect-dual-mode PE-SE framework (Vimal, 2008a, 2008b, 2009b, 2009d) consists of four essential factors that lead to *structural*, *functional*, and *experiential* coherence between mind and brain:

(i) dual-aspect primal entities (*bhutatmas*),

(ii) *neural-Darwinism*: the co-evolution and co-development of the mental aspect and associated material aspect of subquantum primal entities (*bhutatmas*) at the **subquantum** level **to** elemental proto-experiences (PEs) and the associated material aspect of fundamental entities at the **quantum** level **to** subjective experiences (SEs) and associated neural-nets at the **classical level**, respectively, involving internal-representation and sensorimotor interaction,

(iii) matching and selection processes (Vimal, 2009d), and

(iv) the necessary ingredients of SEs (such as wakefulness, attention, re-entry, working memory, stimulus at or above threshold level, and neural-net PEs) (Vimal, 2009f).

We face two types of explanatory gaps:

(i) Type-1 explanatory gap (how SEs can *emerge* from non-experiential matter) and

(ii) Type-2 explanatory gap (how it is possible that our SEs — such as happiness, sadness, painfulness, and similar SEs— were already present in primal entities.

To address these gaps, a working hypothesis (**H<sub>1</sub>**) is proposed:

(i) Fundamental entities and inert matter are the 'carriers' of superimposed irreducible/fundamental SEs/PEs (Vimal, 2008b),

(ii) a specific SE *occurs/arises* in a neural-net via matching and selection processes (Vimal, 2009d),

(iii) some of the SEs (such as happiness, sadness, and the like) that entails Type-2 explanatory gap can be derived from fundamental SEs/PEs (such as emotion-related PEs) and the stimulus-context (such as emotional stimuli), and

(iv) to eliminate any the residual gap in Type-2 explanatory gap, it is assumed that fundamental SEs/PEs follow the principle of the *emergence* of SE and anti-SE (or *bhutatma* and *anti-bhutatma*) in a dual-aspect vacuum at the onset of universe, in analogy to the principle involved in the *emergence* of matter and anti-matter in vacuum. In addition, the cycles of universe (that may have memory (Corichi & Singh, 2008)) might have preserved irreducible fundamental SEs/PEs in primal entities.

(v) SEs *occur/arise/emerge* when essential ingredients of SEs (such as wakefulness, attention, re-entry, working memory and so on) are satisfied.

Alternative hypotheses (**H<sub>2</sub>**)-(H<sub>5</sub>) are presented in the second part (Vimal, 2009h) of this series of papers.

## Acknowledgments

The work was partly supported by VP-Research Foundation Trust and Vision Research Institute research Fund. A part of this work is posted as Target Article 104 in Karl Jaspers Forum (KJF: <http://www.kjf.ca/>). Author would like to thank (1) anonymous reviewers, David Chalmers, Ronald J. MacGregor, Adrian Klein, Zoran Josipovic, Lothar Schäfer, Wolfgang Baer, Robert Neil Boyd, Jim Beran, Roulette William Smith, Chris Schriener, Richard Wilson, Alfredo Pereira Jr., Robert Karl Stonjek, Kelvin J. McQueen, Robert G Kybird, Leon Maurer, John Mikes, Joseph McCard, Ivars Fabricius, Vemuri Ramesam, Sultan Tarlaci, István Bókkon, Manju-Uma C. Pandey-Vimal, Vivekanand Pandey Vimal, Shalini Pandey Vimal, and Love (Shyam) Pandey Vimal for their critical comments, suggestions, grammatical corrections and/or email correspondences, (2) Bjorn Merker and A. Byrne for email correspondence, and (3) Herbert FJ Müller for posting in KJF, comments, and discussion.

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