

THE CONSCIOUS PENDULUM : A PHYSICIST'S APPROACH

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1. Introduction

It is now well known that the laws of objective sciences in general and that of physics in particular show ^{1,2} limitations as and when the role of consciousness and/or of free-will of the being (sometimes known as "uncontrollable parameters" from the point of view of science) in the description of a phenomenon is invoked. For example, an inanimate piece of stone when thrown in space will follow a parabolic trajectory, however, not necessarily an alive bird. While several examples can be cited to this effect, here in this article, we shall concentrate on the case of a so called 'simple' pendulum.

The simple pendulum, very widely studied and used in physics and engineering since the time of Newton, is, in fact, an idealized picture not only in mathematical terms but also in terms of mental constructs. As a matter of fact the simplicity of such a system is attributed³ to the facts that (i) the string used is assumed to be massless, (ii) the suspended mass, (called 'bob') is assumed to be a (geometrical) point mass. On the top of these two assumptions there is a third one, namely (iii) during the oscillations the restoring force on the point mass at any instant is (linearly) proportional to its displacement from the mean position. Such an idealized picture when used to explain a variety of phenomena, whose occurrence in Nature ranges from micro (atomic) scales to mega and giga (cosmic) scales, has provided highly satisfactory results in the lowest-order itself vis-a-vis experiments. As far as the use of this mental construct at different space-time scales is concerned the same has been carried out mainly on the basis of structural

analogy⁴ which either appears or sometimes made to appear at different levels in the description of the phenomenon.

Departures from such a simplicity of the “physics pendulum have been discussed^{3,5} at length in many books (starting from school level to research level) and in many ways on all the three fronts arising from the underlying assumptions or ingredients of the pendulum mentioned above. In this context, an extensive literature can be found where not only the cases of a massive string (with reference to assumption (i)), an extended suspended bob (assumption (ii)), a nonlinear force-law (assumption (iii)) can be found but also the cases⁶ of time varying length and/or mass of the pendulum are discussed. To the best of my knowledge the role of consciousness in the use of a simple (!) pendulum has not so far been invoked in the description of a phenomenon. In fact in the description of physical phenomenon one does not require this role of uncontrollable parameters, particularly when the bob (suspended mass) and the observer of the time of oscillations of the pendulum are the inanimate objects. As a matter of fact the laws of physics work ideally for such a situation. But there are several other situations (with a reference to the biological systems) where the laws of physics are bound² to fail. Besides biological systems the situation can as well arise in the modelling of phenomenon in ecology and social sciences.

Now the question arises as to how to account for these uncontrollable parameters attributed to the consciousness either of bob or of observer or of both. To this effect we shall make use of a philosophical atom-type model^{7,8} (in brief called ‘patomic’ model) of the human being for the conscious bob and/ or observer and see as to what extent the role of consciousness can be quantified as far as the study of such processes is concerned. Before proceeding further a mention of the patomic model of human being at this stage is essential. For the human being, who happens to be the common factor in the processes of realizing (an inward-subjective process based on the outward experiences) and describing (an outward-objective process based on inward experiences) a phenomenon occurring in Nature, this model offers⁷ an arrangement of the essences of life within the framework of the Vedantic philosophy. While this arrangement is capable of accounting for the functioning of both the inner and outer faculties

of understanding (at least in the lowest-order) of the human being, is, however very much similar to the Bohr atomic model of matter.

In the next section we categorize the situations pertaining to the conscious pendulum and introduce the terminology needed to describe these situations in philosophical terms. The process of measurement of the time period in different situations are analysed in detail in Section³. In section⁴, we look for an account for the consciousness arising from various essences of life of the being and suggest some possible ways (of course under highly simplifying assumptions) to accommodate it in the formal tools of physics. Concluding remarks are made in Section⁵.

2. Conscious Pendulum and the Types of Interactions

As compared to the past, the 'simple' (physics) pendulum at present seems more idealized in mathematical terms and definitely very far from the reality of Nature, in view of the presently advanced computing techniques. Moreover, in the spirit of the three-world concept of Popper and Eccless⁹, one can understand the role of physics pendulum as follows. One world is that which actually exists in Nature (absolute reality), the second one which a human being perceives through its sense organs including mind, intellect and the faculty of memory, and the third is one which physical laws (or mathematical models) describe. It is perhaps the last world (i.e., only a restricted component of the whole) that is dealt with by the physics pendulum. Depending upon the characteristics of the bob and of the observer (who is measuring the number of oscillations or the time period, defined as the time required for one oscillation of the pendulum) one can have the following three situations:

(A) The bob is performing the oscillations and an instrument (say a photo-cell arrangement) is measuring the time period or counting the oscillations in accordance with the rules set by the physical laws.

(B) The bob is performing the oscillations and a human being (student) is directly measuring the time period and counting the oscillations in the laboratory with a stop watch.

(C) An alive object (say, a bird, or a charming girl is singing) suspended from the string (rope), is performing the oscillations and then (c₁) an instrument is measuring the time period and counting the oscillations,

and (c_2) a human being (student, say a boy) is directly measuring the time period and counting the oscillations. There are several other particular situations of the case (c_2), namely when (c_3) the oscillating mother is watched by her crying baby who is waiting for the breast feed and also counting the oscillations, (c_4) the oscillating bird is very hungry and the student in close proximity is holding a piece of bread (to the liking of the bird) in his hand while counting the oscillations.

(D) When the oscillating being itself is measuring the time period and there is no external observer.

Note that it is only the case (A) in which the laws of physics perform a fair play after accounting for all the departures from the simplicity of physics pendulum discussed in Section 1. Of course, we neglect in this case also the interactions between the pendulum and the measuring instrument and write the physical Hamiltonian H_{phy} purely for the motion of the pendulum including the effect of damping due to air resistance. While the consciousness is going to play an important role in all the other cases (cf. cases (B)-(D)), the case (B) and (c_1) can be considered alike to some extent. In cases (B)-(D), in addition to H_{phy} one should also have another term H_{nonphys} in the total Hamiltonian of the system under study beside the role of the measuring apparatus, mainly to account for the role of nonphysical processes or of uncontrollable parameters.

Before embarking on the role of consciousness in these processes through the H_{nonphys} term in the Hamiltonian (a measure of energy) H in the next section we introduce here, following our earlier work (of. Ref (8), chapter 4), some more terminology for the purpose. In fact, within the framework of the atomic model we present the following alternative (or supplementary, depending upon the situation) ways to classify the above situations at subtle level.

1. If x is the physical (p) matter (as detected by the instrument/apparatus alone), then x + consciousness is defined ⁸ as the epiphysical (EP) matter (as perceived by a living being, say a human being). If x also happens to be the source of consciousness (living being), then it would be designated as x + consciousness + source of consciousness and denoted by SEP, i.e., the special epiphysical matter, Note that S, E and P here may

refer to the same or different objects and a prime on them will be attributed for different objects.

2. In the reduced version of the atomic model one groups the ingredients (WO, B, SE, M, I, E, SO), of a human being into three subsets, namely $\mathcal{G} \equiv (\text{WO, B, SE})$, $\mathcal{M} \equiv (\text{M, I, E})$, $\epsilon \equiv (\text{SO})$ and respectively terms them as 'gross', 'micro' and 'causal' bodies of the being. In fact, while the presence of the subset \mathcal{G} is essential for the existence of a being, the human being b is the union of \mathcal{G} , \mathcal{M} and ϵ , viz., $b \equiv \mathcal{G} \cup \mathcal{M} \cup \epsilon$. Further, for the purposes of describing the interactions between the human beings one needs ⁸ only five (minimal number) quanta (Tanmatras) for b-b interaction, namely ${}^t\mathcal{G}\mathcal{G}$, ${}^t\mathcal{G}\mathcal{M}$, ${}^t\mathcal{G}\epsilon$, ${}^t\mathcal{M}\mathcal{M}$, ${}^t\mathcal{M}\epsilon$. under some simplifying assumptions.

3. Description of Interactions

Note that the space-time motivated physical laws account only for a limited part of the total interactions taking place within and among the living beings. The so-called 'motion' of an oscillating bob itself is purely an outcome of the space time structure of Nature. It is the space time concept which leads to the physics terminology like motion, position, velocity, acceleration etc. and finally the nature of various physical forces, such as contact force, action at a distance, action at a time and to some extent action at a space time type forces. While the contact and action at a distance type forces are much talked about in physics and physical processes, the discussion of the third, action at a time and the fourth, action at a space time type forces, is tactfully avoided often either by incorporating convenient assumptions in the theory (such as the constancy of velocity of light in vacuum) or by limiting the validity of physical laws in terms of the causality principle. No doubt there is enough scope for a 'generalized' causality principle in the Vedantic philosophy⁸, however, physicists are afraid of entering in a domain beyond space and time since "even angels fear to tread" in that.

For the 'physics' pendulum a highly limited local part of the totality of interaction, described by the Hamiltonian $H_{\text{phys}} = (p^2/2m) + (w^2x^2/2)$, where m is the mass of the bob and $T = (2\pi/w)$ is the time period of the pendulum, is found to describe the physical (space-time based) properties

of the system. Of course a damping term (again of local nature) is also present in H_{phys} which accounts for the air resistance during the motion. In these descriptions, not only some important nonlocal (derived again from the space and time) interactions but also the interactions beyond the domain of space and time are ignored. In what follows we outline briefly some processes (of different situations of Section 2) whose origin can be attributed to this latter class of interactions, namely the interactions (of their effects) which are not based on the space-time structure of Nature, however, manifest through the time period of the pendulum. Clearly, the situation (A) of section 2 is well within the domain of physics. For other situations of section 2, the following description, based on the atomic model of human being, can be advanced. (B) In this case the student measuring the time period of the suspended bob can be considered as the extended 'apparatus' (in the language of Von Neumann¹⁰) in the sense that beside the gross body \mathcal{G} (which plays the role somewhat similar to the physical apparatus of case (A)), the student is also using his micro body \mathcal{M} in the presence of ϵ . As a matter of fact, the actions like holding the stop watch in his hand and later seeing the time in it while counting the oscillations etc, are the functions of B and SE in \mathcal{G} and the same are performed in the presence of \mathcal{M} and SO. In fact it is the intellect I of \mathcal{M} which records the increasing time in the watch and the rules of measurement¹¹ as well. Further, the faculty of memory E of \mathcal{M} , where the numerals are stored for the purpose of counting, is also used by the student. Besides the mood of the student (attributed to the role of mind, \mathcal{M} , in the measurement process), B, SE, I and E all work in consonance and that too in the presence of the consciousness which originates from SO, the ultimate observer in the language of Vedantic philosophy¹². Thus, in the situation (B) the interactions are EP - SEP type. (C) In general, this is the case of interaction of two beings (designated as b-b type or S, E, P, - SEP type (cf. Ref. (8), Chapter 6). If both the suspended bob and the measuring instrument are replaced by the human beings (cf. case (c₂)) then in general all the five quanta of interaction ${}^t\mathcal{G}\mathcal{G}$, ${}^t\mathcal{G}\mathcal{M}$, ${}^t\mathcal{G}\epsilon$, ${}^t\mathcal{M}\mathcal{M}$, ${}^t\mathcal{M}\epsilon$. will come into play, otherwise some of them will be suppressed for other beings (like bird) and also for some particular situations (cf. cases (c₃) and (c₄)) of the b-b' case, However, if the measuring apparatus is a physics instrument (cf. case

(c₁) then this situation is analogous to the situation (B) since in that case one considers the SEP-EP interactions provided the instrument need to be watched by a 'living bob'. As in situation (B), the exchanged quanta here will be ${}^t\mathcal{G}\mathcal{G}$, ${}^t\mathcal{G}\mathcal{M}$, ${}^t\mathcal{G}\mathcal{E}$, which will mediate the interaction. On the other hand, if the instrument is watched by another 'living' observer, then this is the case of SEP - \acute{E} , \acute{P} , interaction.

Now consider the cases (c₃) and (c₄) as examples of the suppression of some of the interactions. In these cases the self-organizing forces, which originate from the domain of m and manifest through the domain of \mathcal{G} , will come into play and clearly dampen the motion and thereby enhance the time period of the oscillating system. To elaborate further, in both cases (c₃) and (c₄) the essence of life M will dominate the interactions by suppressing more I and relatively less E . However, in the two cases different biological processes (attributed to the essence. B) will take place and the interaction will be mediated through different vertices in the same domain of \mathcal{G} , i.e., through SE . Even in SE , the skin in consonance with M will dominate the process in case (c₃) whereas in case (c₄) it is the tongue which will dominate the process in consonance with M . In either case the time period is going to decrease provided the crying baby (or the student holding the bread-piece) is near the equilibrium position of the pendulum. If they stand near either of the end points of the pendulum then the situation will be different and the chances of enhancing the time period of the pendulum are there. On the other end, the crying baby in case (c₃), hopefully, is unaware of the processes going on inside the mother, whereas the boy holding the bread for the hungry bird in case (c₄) is very well aware of the weakness of the oscillating bird and can as well play some tricks to control the time period further.

(D) This is an interesting case in the sense that one can visualize/realize the role of self *reference/consciousness* and see as to how the consciousness can create the space and time. If the oscillating being b decides (the role of I) to withdraw from the extroworld and uses his free-will toward, SO , then the role of space and time even as a functional of E may not be there. Otherwise, the space and time start originating in E and project themselves in the extroworld (constituted by WO) through all or some of the essences of life out of I , M , SE and B . Again at the level of I ,

out of many choices for the space and time which can finally be projected through SE and B for the search of a reference point outside (extroworld) to recount the time period, the being b decides one such a choice. Also, this reference point outside could be sensitive to any of the sense organs in SE through which the consciousness will manifest in the process of counting the oscillations. Note that the time period will again depend not only on the priorities predecided at the level of the functionals of E, I and M but also on the situation of the reference point outside.

4. Accounting for the Consciousness in Physical Theories

In this section, we make an attempt to quantify various interactions taking place in the process of measurement of the time period of the conscious pendulum and that too under highly simplifying assumptions. Note that for the case (A), as mentioned before, the Hamiltonian H_{phys} describes the system in a restricted sense, i.e., when one ignores the effects of interaction of the bob with the physical apparatus (PA), otherwise for the total Hamiltonian, in general, one should write

$$H_{\text{tot}} = H_{\text{phys}} + H_{\text{int}} \quad (1)$$

where $H_{\text{int}} = H_{\text{P-PA}}$ is the interaction of the suspended bob (P) with the apparatus PA. For the case (B), the H_{int} takes the form

$$H_{\text{int}} = H_{\text{b-p}} + H_{\text{b-PA}} = H_{\text{P-PA}} \quad (2)$$

where $H_{\text{b-p}}$ and $H_{\text{b-PA}}$ are the interactions arising due to the presence of the living being b and attributed mainly to its consciousness manifesting in the system (which now consists of both the suspended and the measuring objects). As a matter of fact one can as well consider the student, who is measuring the time period, as a part of the extended measuring apparatus which will now consist not only of PA but also of B, SE, M, I and E as well. Within the framework of the atomic model one can, in general, write $H_{\text{b-p}}$ as ⁸

$$H_{\text{b-p}} = H_{\text{B-P}} + H_{\text{SE-P}} + H_{\text{M-P}} + H_{\text{I-P}} + H_{\text{E-P}} \quad (3)$$

and a similar expression for $H_{\text{b-PA}}$. In fact it will be only the $H_{\text{b-PA}}$ - type term on the r. h. s. of (2) that will be present for the case (C₁). Here onward we use a prime on the quantities designating the suspended object.

While the interaction Hamiltonian H_{int} will be very simple for case

(D), namely $H_{int} = H_{b^*b^*}$, for cases (c₂)-(c₄) however the being-being interaction¹³, H_{b^*p} will come into play and H_{int} in general will involve 32 terms within the framework of the atomic model, viz.,

$$\begin{aligned}
 H_{int} &= H_{b-PA} + H_{b^*-PA} + H_{b^*-b} \\
 &= H_{b-PA} + H_{b^*-PA} + H_{B^*-B} + H_{B^*-SE} + H_{B^*-M} + H_{B^*-I} + H_{B^*-E} \\
 &+ H_{B^*-SO} + H_{SE^*-B} + H_{SE^*-SE} + H_{SE^*-M} + H_{SE^*-I} + H_{SE^*-E} \\
 &+ H_{SE^*-SO} + H_{M^*-B} + H_{M^*-SE} + H_{M^*-M} + H_{M^*-I} + H_{M^*-E} + H_{M^*-SO} \\
 &+ H_{I^*-B} + H_{I^*-SE} + H_{I^*-M} + H_{I^*-I} + H_{I^*-E} + H_{I^*-SO} + H_{E^*-B} \\
 &+ H_{E^*-SE} + H_{E^*-M} + H_{E^*-I} + H_{E^*-E} + H_{E^*-SO} \tag{4}
 \end{aligned}$$

As such it is difficult to analyse the effect of these 32 terms in a process. Indeed the various terms in (4) involve highly varying degree of couplings (strengths) in terms of consciousness. The relative importance of these terms is decided on the basis of the phenomenon under study in the intro and extro-world⁸. It is the consciousness which creates⁸ the space, time and geometry pertaining to this phenomenon. However, some simplifications can be achieved for the following reasons. Recall that all the essences of life, namely B, SE, M, I, and E are active (or operative) only in the presence of SO of b, i. e., in the presence of the consciousness. Also, SO of b and SO of b* are the manifestations of the same⁸ cosmic consciousness. As a result, one not only ignores the terms H_{SO^*-SO} and H_{SO-SO^*} in (4) (as they provide the cosmic background for the existence of objects) but also ignores H_{SO^*-B} , H_{SO^*-SE} , H_{SO^*-M} , H_{SO^*-I} , H_{SO^*-E} and notes that $H_{B^*-B} = H_{B-B}$, $H_{SE^*-SE} = H_{SE-SE}$, $H_{M^*-M} = H_{M-M}$, $H_{I^*-I} = H_{I-I}$ and $H_{E^*-E} = H_{E-E}$, hold under certain approximations. Thus, some of the terms in (4) can easily be dropped to avoid double counting of the effect or due to their relatively less importance in the sense of intensity of consciousness.

Alternatively, one can start with the reduced version of the atomic model to write (4) as

$$H_{int} = H_{b-PA} + H_{B^*-B} + H_{SE^*-SE} + H_{M^*-M} + H_{I^*-I} + H_{E^*-E}, \tag{5}$$

where again some of the terms like H_{M^*-SO} , H_{E^*-SO} , H_{E^*-M} , H_{E^*-I} are dropped for the reasons mentioned above. Corresponding to the last five terms on the r. h. s. of (5), there exist⁸ five quanta of interaction between the human beings as mentioned in section 2.

With regard to the situations in cases (c_3) and (c_4) only a few terms in (4) will dominate and the rest can be considered as perturbation. For example, for the case (c_3), $H_{B'-B}$, $H_{SE'-B}$, $H_{SE'-SE}$, $H_{M'-B}$, $H_{M'-SE}$, will dominate the processes. On the other hand, the processes in case (c_4) are more complicated from the point of view of analysis. In case (c_3), while the baby has resorted to crying only, in case (c_4) the student holding the bread-piece has lot of free will. Suppose the student decides to feed the bird emotionally, then beside the interactions H_{b-PA} , $H_{b'-PA}$ the other dominating interactions in (4) are $H_{B'-B}$, $H_{B'-SE}$, $H_{B'-M}$, $H_{SE'-B}$, $H_{SE'-SE}$, $H_{SE'-M}$, $H_{m'-B}$, $H_{M'-SE}$, $H_{M'-M}$, $H_{I'-B}$, $H_{I'-SE}$, $H_{I'-M}$, which will help the bird in snatching the bread-piece from the student.

Broadly speaking whenever a living being is involved in the system under study the total Hamiltonian can be written as :

$$H_{\text{tot}} = H_{\text{phys}} + H_{\text{nonphys}} \quad (6)$$

where H_{phys} now accounts for all space-time mediated interactions, and H_{nonphys} accounts for all other interactions attributed to noncontrollable parameters arising from the free will of the being. The Hamiltonians (3) and (4) account for some of these interactions at the level of fine-tuning of subtle nature. In the quantum domain, if H_{tot} in (6) alongwith its pieces is hermitian, then, in general, the effects of measurement and consciousness together will manifest⁸ through the physical 'action', viz.

$$\exp [-i H_{\text{phys}} t/\hbar - i H_{\text{nonphys}} \mathcal{M}/g] |\psi \rangle \quad (7)$$

where $|\psi \rangle$ is the wavefunction of the system¹⁴ which now includes the apparatus and the human being. Here u is the meditation parameter responsible for the change of decisions of the free will in the being and its role in the action (7) can be considered to be the same as that of t in H_{phys} , and g is another Planck-like constant analogous to \hbar . The constant g can appropriately be attributed to the quantum of consciousness if the same plays any role what so ever in the above mentioned situations, even though at the quantum level.

5. Concluding Discussion

With a view to quantifying the role of consciousness in physical theories, the example of a simple pendulum from physics is investigated in great detail with reference to different choices of the oscillating bob and

the measuring apparatus. The atomic model of the human being is frequently used to analyse the underlying (non space-time mediated) interactions and the corresponding processes. While the space-time mediated interactions, which account for the laws of physics and the physical processes, are however found inadequate for the description of consciousness-manifesting-phenomena in nature. An explanation of this latter class of phenomena definitely requires the interactions which are beyond the concept of space and time. In that domain, however, the variables like meditation parameter, the number of degrees of freedom of the free will of the being *b* etc are introduced in this work for the first time. The effect of different physio -psychic processes on the time period of the 'conscious' pendulum is analysed and demonstrated through examples.

It may be mentioned that the physical laws are capable of accounting for every characteristic of the bob (e.g., when the bob is massive, charged of magnetic etc.) except for its conscious character, if it is there. This may be because of the lack of understanding of this concept in living beings or due to the inadequacies persisting in the methods used for this purpose. In the present work the efforts are made, perhaps for the first time, to accommodate both these features through the popular example of simple pendulum. Moreover, an account of these features in the formal tools of physics can not be denied indefinitely in view of the advancing technologies in science in general and in biosciences in particular.

It is true that in physics we always come across the space-time based observables and their origin lies again in the space time mediated interactions. In recent years, several experimental situations have been noticed^{2,15} (and many more are expected in future) where non-space-time inspired interactions can affect the space-time-based observables discussed in this Article. Conversely, space-time based interactions of physics can as well affect the non-space time inspired observables in the process of measurement such as the pain, pleasure, feeling etc. The conscious pendulum discussed here is one such example from classical mechanics. In the quantum domain, however, there have been considerable efforts since the birth of quantum mechanics (1925-26) to understand properly its foundational aspects, however by keeping aside the consciousness again. It may be of interest to study a conscious double-slit

experiment on the lines of the present conscious pendulum. This might give some clue towards the role of consciousness in quantum measurement problem.

NOTES

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1. See, for example, Pro. First National Conf. on "*Scientific and Philosophical Studies on Consciousness*" ed. by Sangeetha Menon et. al (National Inst. of Ad. Studies, NIAS, Bangalore, 1999)
2. Roger Penrose, "*Shadows of the Mind : A Search for the Missing Science of Consciousness*", (Oxford Univ. Press, Oxford, 1994)
3. See, for example, R. S. Kaushal, "*Is the Simple Pendulum Really Simple? : A Theoretical Perspective*", to appear in 'Physics Teacher' (Calcutta), and the references therein.
4. Radhey Shyam Kaushal, "*The Role of Structure Analogy in Physical Sciences*", *Ind. Phil. Quarterly* 26 (1999) 543-73.
5. See, for example, D. S. Mathur, "*Mechanics*", (S. Chand & Co., Ltd., New Delhi, 1985), P. Hagedorn, "*Non linear Oscillations*" 2nd ed., (Oxford Univ. Press, 1988).
6. R. S. Kaushal, "*Construction of Exact Invariants for Time Dependent Classical Dynamical Systems*", *Int. Jour. Theo. Phys.* 37 (1998) 1793-1856.
7. Based on the spirit of Vedantic philosophy, in this model the essences of life, namely wordly objects (WO), biological body (B), ten sense organs responsible for the knowledge and action (SE), mind (M), intellect (I), ego (E), the innermost existence in its purest form, i.e. soul (SO), and the seed of life, i. e., being (b) constitute the ingredients. The functioning and the arrangement of these ingredients in the human being is quantified in analogy (see, for example, R. S. Kaushal, *Ind. Phil. Quarterly* 26 (1999) 543) with the

atomic model of matter, viz., $WO \equiv$ nucleus, $b \equiv$ electron, B, SE M, I, $E \equiv$ discrete energy levels in a loose sense, $SO \equiv$ continuum. The being b, when placed in one of the states B, SE, M, I and E (which are arranged in an ascending order towards the continuum SO), is capable of performing both upward (rare) and downward (frequent) transitions in the same way as the electron performs the transitions in an atom. Such an arrangement is considered as to be placed in the field (the finest possible one) of cosmic consciousness of which the SO is a part and the same is manifestly in tune constantly with the functioning of b in this world (characterized by WO) since the downward transitions of b are more frequent than the upward ones. As a matter of fact the upward transitions. In some sense provide (emanate) relatively more peace to the individual whereas the downward ones lead to more pleasure as the peace and pleasure are complementary in their essence "ānanda" (unlike the emission and the absorption processes in the case of Bohr model of matter). It may be noted that while this philosophical atom-type model (appropriately coined as 'patomic' model) is designed for the human being (the 'perfect' creation of God), it can as well be used for other living beings with appropriate changes with references to the essences of life. For further details see, Radhey Shyam Kaushal, "Human Beings : From the point of view of a philosophical atomic model", *Journal of Scientific & Ind. Res.* (New Delhi) 49 (1990) 578-82 and Ref. (8) below.

8. Radhey Shyam Kaushal, "The Philosophy of the Vedānta : A Modern Scientific Perspective", Garib Das Oriental Series No. 179. Sri Satguru Publications, Indian Books Centre, Delhi, 1994, Also see, Radhey Shyam Kaushal, Ph. D. Thesis, "Patomic Model of the Human Being in the Context of Modern Science" (unpublished), Delhi Univ., 1998.
9. K. Popper and J. Eccles, "*The Self and the Brain*" (Springer Verlag, Berlin, 1981). Actually, the definitions of the three worlds of Popper and Eccles is slightly different in philosophical terms. What is given here is their somewhat simplified version.
10. J. Von Neumann, "*Mathematical Foundations of Quantum Mechanics*" (Princeton Univ. Press, Princeton, NJ, 1955)

11. As a matter of fact it is consciousness of the human being in general (or of any other being for that matter) which creates space and time. This fact can easily be understood as follows. Suppose a person, who has withdrawn himself from the extroworld (namely from the functional domains not only of the biological body B but also of the ten sense organs SE) is trying to sit in 'Sāmdhi' to concentrate on the questions of "where", "When,", "Who", "Why", "Whom", "Whose" etc. with reference to a particular event occurred in his actions/behaviour. For him, it is only the answer of "where" and "when" which will bring in the maximum role of space and time respectively in an understanding the event during the meditation, otherwise the answers of other questions can be sought without any reference to space and time. The meditation again comprises of three sub-processes, namely the processes of feeling, analysing and recalling which respectively can be attributed to the functional domains of M, I and E of b. Note that out of the infinite degrees of freedom of the free-will of b which come into play at the initial stages of the Samadhi/meditation, the search for the answers of "where" and "when" requires only two degrees of freedom of the free will and the same leads to the concept of space and time for b with reference to its extroworld.
12. *Srīmad-Bhagavad -Gītā*, Chapter 3, Verse 42.
13. R. S. Kaushal, "Human Communication and Cognition : A Scientific Outlook in Vedantic Philosophy". *Int. Jour. of Commun.* 5 (1995) p. 111-124, Also, in "Indian Theory of Language and Knowledge" ed. by R. C. Sharma (Bahri Publications, New Delhi, 1996).
14. Radhey Shyam Kaushal, "Plurality of Consciousness in Vedantic Philosophy and its role in Scientific Observations", in Pro. First Nat. Conf. On "Scientific and Philosophical Studies on Consciousness" ed. by S. Menon et al. (National Inst. of Ad. Studies, Bangalore, 1999) p. 346-361.
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