From Dark Energy of the Very Early Universe to Dim Energy of the Mind

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Abstract

We use a top-down approach to explain physics of consciousness. We first focuse on the universe and propose a model discretization of the universe based on a T3-torus. An attempt is made to relate natural Planck units to the parameters of elementary geometric cells. We mention a way of approaching the horizon problem in discrete contest, as well. A suggestion for the discretization of the matter lagrangian part is also given. Then, by introducing a many-body method, we speculate on the binding energy in the very early universe and attempt to explain the source of a kind of dark energy that caused the inflation period. Finally, we focuse on the mind as a subset of the universe which is embeded in it and attempt to explain the source of consciousness as the "mind energy".

Key Words: Poset, Causal Set, Discrete Space-time, Superspace, Planck Epoch, Horizon Problem, Very Early Universe, Many-body Method, Cluster Expansion, Binding Energy of the Very Early Universe, T3-torus, Dark Energy, Consciousness, Binding Energy of Neurons, Correlated Neurons, Mind Energy, Near-death Experience (NDE).

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Introduction

Time is but on thoughts
taken to be many
Same time for many thoughts
In space
Time and space coming
Together is causality
From them arises the world
Around
(An Indian proverb)[i]

Some years ago we suggested that a top-down approach is more useful than a bottom-up approach to explain consciousness [Khoshbin-e-Khoshnazar, 2007]. So, we start with the universe and review and improve our proposal for the very early universe which had published some years ago [Khoshbin-e-Khoshnazar, 2013] and then focuse on the mind as a subset of the universe which is embedded in it. But we should emphasis that they are not different things in our model and you should not think that the first part does not relate to the second part. The first part is the structure of whole theory and we should find the corresponding counterpart's meanings in the universe and the mind.

A feature of the FRW cosmology for the very early universe and also the inflationary models, is that they explain the flatness of the universe, and hence the value $k = 0$ of the Riemann curvature constant [Kolb and Turner, 1991]. This flatness poses a very difficult problem of cosmologists, because it requires that the universe contains a certain amount of energy. Such speculations are necessarily based upon some theory of the fundamental interactions at very high energies - energies approaching the Planck scale. However, because the underlying physics is still cloudy, it is not clear how one should approach the Planck epoch.

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In the past decades some very interesting and important speculations about particle physics at very short distances has been producted.

However, all of the models are based on the Minkowski space-time, while in more ambitious models like those using string, there is no indication of any discrete structure associated with space or time. But there are occasional theorists proposing the idea of discrete space-time ['T Hooft, 1979; Wheeler, 1982; Bombelli, 1987]; Since, if we have continuum, we can have infinitely large wave numbers and infinitely large momenta which give rise to divergence. Also, our metric is no longer well defined if we want to measure distance between two very close points, because this distance is no longer well defined concept. Also, it has shown [Chardin, 1994] that the idea of discrete space-time arises from the link between gravitation and time asymmetry through the Bekenestein relation and its geometric interpration. This idea is not new and T.Rgge [Regge, 1961] in a fundamental work in 1961 gave rise to a number of attempts both on classical and quantum level. We should also mention a paper by Russian geometrician M.Sh. Yakupov [Yakupov, 1998], Who was trying, in the 90s, to build a gravitation theory on the basis of this idea.

We first mix the above two ideas (discrete and flat universe) and use a poset model [Sorkin, 1991], for superspace proposed by John Wheeler [Wheeler, 1968]. In superspace the indeterminstic interperation of quantum theory is added to space as an postulate, which causes space to flactuate from one curved configuration to another. At this stage one evolutionary history may be coupled with other dynamical histories and *the usual concepts before, after, and causality may loss their all embracing meaning.* At this stage, the relevant physical dimensions reduce comparable to the Planck length and may considered as forming a substratum, where the very concept of time fails. One of the themes of this paper is the possible breakdown of causality at Planck scale. Our candidate model for the flat universe is a three-torus in the four-dimensional Euclidean space. Then we speculate on the scalar field action. Subsequently, by introducing a supersymetry at the point level we propose a many-body method (variational cluster expansion technique) [Clark and Westhaus, 1966; Khoshbin-e-Khoshnazar, 2002] for calculating the binding energy of the very early universe and attempting to explain origion of dark energy in the very early universe. Inflation was a period of the universe's acceleration and we don't know what caused that acceleration. It is possible that there was a kind of dark energy back then. We attempt to explain this kind of dark energy based upon our superspace. This article is also a criticism of causal set theory. These topics may be difficult or even impossible to understand for neuroscientists. But such a physical theory should be elegant and must have a complete mathematics.

If our mind is "woven" or "embeded" in the universe, consciousness could occur at the spacetime geometry when the brain stops being perfused. It doesn't dissipate but remains together by entanglement. But how nonlocal properties of consciousness correlate with the measurement is not clear. There are some evidences that show consciousness is *caused* by the way energetic activity is dynamically and recursively organized in the brain, and then consciousness, in principle, could be caused by energetic activity and the way it is organized [Pepperell, 2018]. Many leading near death experience (NDE) researchers have proposed that a new model is need to explain consciousness [Fracasso and Friedman, 2011]. Skills such as [Zvonimiv *et al*., 2019]confirmed these ideas. In 2016 we assumed brain as a condensed matter and considered neurons and other brain cells as quantum objects and used the term "Ground State" for bining energy of these quantum objects [Khoshbin-e-Khoshnazar, 2016]. We suggested that variational cluster expansion technique in many-body physics may be used to model correlated neural activities which may be treated as complex projection amplitudes that do not follow a signal path. It should be noted that this is not related to dissipative quantum model of the brain (Vitiello, 1995; Freeman and Vitiello, 2006).

The Partial Order Set (POSET) Model

What we call beginning is
Often the end and to make
An end is make a beginning.
The end is where we start from
(T.S. Eliot)

R.D. Sorkin [Sorkin, 1991] considered the finite approximation $F \equiv P(Q)$ for a continous topological space Q. Let (Q, τ) be a topological space and $u = \{O_\alpha\}_{\alpha=I}$ be an open cover. The equivalence relation ~ over Q is defined as follows: for $x,y \in Q$, $x \sim y$ if x and y are not separated or distinguished by O_α i.e every set O_α containing either point contains also the other one. We replace

Q by $(Q) \equiv Q/\sim$. If Q is compact then $P(Q)$ is an approximation to Q by a finite set. When Q is not compact, we assume instead that each point has a neighborhood intersected by only finitely many O_α, so that $P(Q)$ is a finitary approximation for Q. Balachandran [Balachandran *et al.*,1994] discussed these considerations for a covering of $Q = S^1$ (the circle) by four open sets O_1, O_2, O_3, O_4. Suppose that Φ is the map from S^1 to $P_4(S^1)$ obtained by identifying equivalent points and denote the images of sets in S^1 under Φ by x_i (Fig.1). i.e

$$O_1 \rightarrow x_1 \quad O_2 \backslash [O_2 \cap O_4] \rightarrow x_2$$
$$O_3 \rightarrow x_3 \quad O_4 \backslash [O_2 \cap O_4] \rightarrow x_4$$

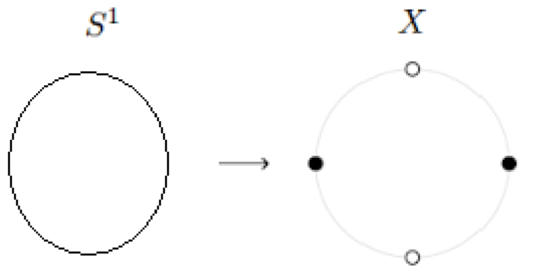

Fig. 1. Map from S^1 to $P_4(S^1)$ (X space) obtained by identifying equivalent points and denote the images of sets in S^1 under Φ by $\boldsymbol{x_i}$.

Now consider the quotient topology on $P_4(S^1)$. In the quotient topology, a set in $P_4(S^1)$ is declared to be open if its inverse image under Φ is open in S^1. A subbase for topology of $P_4(S^1)$ is:

$\delta = \{\{x_1\},\{x_3\}, \{x_1,x_2, x_3\},\{x_1,x_4,x_3\}\}$

If we take finite intersections of sets in δ, we will obtain a base B for topology of $P_4(S^1)$:

$B = \{\{x_1\},\{x_3\}, \{x_1,x_3\},\{x_1,x_2, x_3\},\{x_1,x_4,x_3\}\}$

Finally the topology for $P_4(S^1)$ is obtained by taking the unions of sets in B i.e.

$\tau = \{\emptyset,\{x_1\},\{x_3\}, \{x_1,x_3\},\{x_1,x_2, x_3\},\{x_1,x_4,x_3\}, \{x_1,x_2, x_3,x_4\}\}$

A partial order $\leq$ can be introduced in $P_4(S^1)$ by declaring that $x \leq y$ if every open set containing y contains also also x. Thus

$x_1 \leq x_2, x_1 \leq x_4, x_3 \leq x_2, x_3 \leq x_4$

We write $x < y$ to indicate that $x \leq y$ and $x \neq y$. Any poset can be represented by a Hasse diagram constructed as follows: if $x < y$, then y is higher than x and if $x < y$ and there is no z such that $x < z < y$, then x and y are connected by a line called a link. In general case, a cover of S^1 is given by $2N$ open sets O_α.

A POSET T³-torus Model as the Very Early Universe

There was a young lady called Bright
Who could travel much faster than light
She went out one day
The Einsteinian way
And returned the previous night
(An old limerick)[i]

Let $Q = T^3 = S^1 \times S^1 \times S^1$. The T^3-torus is compact and admits a flat connection in the R^4 Euclidean space. Take flat Minkowskii space-time. Pick some Lorentz frame, and in it pick a cube of so many light years (e.g. 10^{10}) on each side. Identify opposite faces of the cube so that a geodesic exiting across one face enters across the other. The result is topologically a three-torus: a closed universe of finite volume with flat Minkowskii geometry and with a form that does not change as Lorentz time t passes (no expansion, no contracion) [Kolb and Turner,1991; Nakahara,1990]. As we mentioned earlier, one of the thems of this paper is the possible breakdown of causality at the Planck scale and we do not consider any difference between time and space in the origion of creation. Our discussion is based on the Hartle-Hawking proposal [Hartel and Hawking, 1983] for disappearing the classical singularity, which states there is no origin of time. Benjamin Dribus took exactly opposite view point in his book [Dribus,2017] and noted causal structure is the only structure that remains at this level. This is ultimately based on the metric recovery theorems of Malament-Hawking-King-McCarthy-Levichev (MHKML) in the late 1970s [Malament,1977]. But he wrote me in private communication:" I will point out, however, that these two viewpoints are not necessarily contradictory when one moves to the quantum setting and begins superposing causal structures with each other. This is because a superposition of causal structures is not itself an individual causal structure. In particular, it makes no sense to talk about causal relations between discrete elements belonging to different members of the superspace. Near the region of superspace typically associated with the initial singularity, the different causal structures involved are quite distinct, and there are not enough of them for a particular type to dominate statistically in any obvious way. So perhaps this can be reconciled with your discussion of the Hartle-Hawking viewpoint that space and time become indistinguishable in this regime." The time dimension gradually turns into a space dimension as one reaches Planck time. Therefore the four-dimensional space-time has become a four-dimensional spatial manifold.

If (X,τ_1), (Y,τ_2), (Z,τ_3) are topological spaces with bases B,C,D respectively, then the cartesian product of them will be a base for the topology of the

product space $X \times Y \times Z$ [Munkres,1973]. Therefore a base for the topology of $P_4(S^1) \times P_4(S^1) \times P_4(S^1)$ is given by the cartesian product of B,C,D where
$B = \{\{x_1\},\{x_3\}, \{x_1,x_3\},\{x_1,x_2, x_3\},\{x_1,x_4,x_3\}\}$
$C = \{\{y_1\},\{y_3\}, \{y_1,y_2\},\{y_1,y_2, y_3\},\{y_1,y_4,y_3\}\}$
$D = \{\{z_1\},\{z_3\}, \{z_1,z_3\},\{z_1,z_2,z_3\},\{z_1,z_4,z_3\}\}$
We would use $(x_1,y_1, z_1) \leq (x_2,y_2,z_2)$ if $x_1 \leq x_2, y_1 \leq y_2$ and $z_1 \leq z_2$ as this correspond to the partial order derived from the cartesian product of the coverings on the S^1s. It is easy to see that $P_{2N}(S^1) \times P_{2N}(S^1) \times P_{2N}(S^1)$ is homeomorphic to P_{8N^3} $(S^1 \times S^1 \times S^1)$ $=P_{8N^3}(T^3)$. So a subbase for topology of $P_{8N^3}(T^3)$. has $8N^3$ elements. Let $8N^3 = \rho_{Planck}$, where ρ_{Planck} is the Planck density. Then a suggestion for the number of elements approximating the universe would be $N= \rho_{Planck}{}^{1/3}/2$. If we consider the partial order on $P_{8N^3}(T^3)$ as a correlation in space-time (however, *since the usual concepts before, after, and causality may loss their universal meaning we cannot assign any usual causal interpretation to them*) then as N approaches its finial value $N= \rho_{Planck}{}^{1/3}/2$, the "*microscopic*" correlations will be more and more complicated. *It seems this idea might be solved the horizon problem*. This is not mystery whatsover. Since causality loss its present meaning in the very early universe. In our opinion correlation is the best meaning for it. This correlation gradually turns into present meaninig of causality.

As we mentioned earlier, in the simplest case (N=2), the number of elements for covering T^3 is 64. When drawing the Hass diagram, e.g. for $P_{64}(T^3)$ (Fig.2), we will find a *complicated self- similarity structure*, and it seems we have a *fractal structure*. Since we use *correlations* instead of *causal relations*, we can mix different uses of posets: posets as finite topological spaces and posets as correlation sets (a weak interpration of causal sets), which I call **corset**s. Links show only the dependence, since the causal concepts of "before" and "after" lose their all embracing meaning.

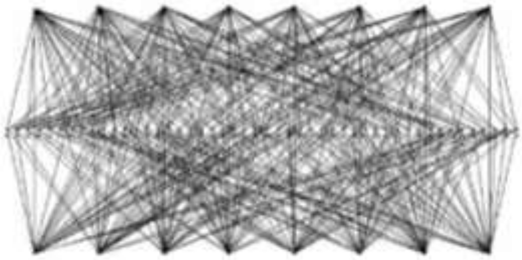

Fig. 2. Corset Hass diagram for $P_{64}(T^3)$

Investigation of large N verifies our claim about complexity of correlations. for example, consider N=4. In this case, a base for topology of $P(T^3)$ is $B \times C \times D$ where B and C and D are bases for topologies of $P(S^1)$. $P_8(S^1)$ are generated by the following subbases respectively
$\delta_1 = \{\{x_1\},\{x_3\},\{x_5\},\{x_7\},\{x_1,x_2,x_3\},\{x_3,x_4,x_5\},\{x_5,x_6,x_7\},$
$\{x_1,x_8,x_7\}\}$
$\delta_2 = \{\{y_1\},\{y_3\},\{y_5\},\{y_7\},\{y_1,y_2,y_3\},\{y_3,y_4,y_5\},\{y_5,y_6,y_7\},$
$\{y_1,y_8,y_7\}\}$
$\delta_3 = \{\{z_1\},\{z_3\},\{z_5\},\{z_7\},\{z_1,z_2,z_3\},\{z_3,z_4,z_5\},\{z_5,z_6,z_7\},$
$\{z_1,z_8,z_7\}\}$
The Hasse diagrams for N=4 and N=5 verify our claim [Khoshbin-e-Khoshnazar, 2013].

Scalar Field Action

Ubi materia, ibi geometria
(Johans Kepler)

Let us consider, the continuum of the scalar field action:

$$S_\varphi = \frac{1}{2}\int (\, g^{\mu\nu}\partial_\mu \, \phi \, \partial_\nu \phi + m^2\phi^2]\sqrt{\beta g}\; dx$$

The geometry is lorentzian or Euclidean according the sign of β. Imagine a discrete analog of the β, such that its size could be measured by counting [Bombelli, 1987]. Then when the metric g is expressed in the natural units, $\sqrt{\beta g}\; dx$ directly counts elements of poset, which in a conventionally defined spase-time volume, such as 1cm^3.sec to be equal the Planck density ρ_{Planck}. Also, we introduce a scalar field ϕ_n defined on the points of $P(T^3)$ and assume the scalar field inherits the partial order. *It can be seen as an axiom*. This is readily done: we set $\phi\,(x_1,y_1,z_1) \leq \phi\,(x_2,y_2,z_2)$ whenever $(x_1, y_1, z_1) \leq (x_2, y_2, z_2)$. The boundary operator ∂ for $P(T^3)$ can be defined by

$$\partial\phi_{2n-1} = \phi_{2n+i} - \phi_{2n+j} + \phi_{2n+k} - \phi_{2n+l}, \; \partial\phi_{even} = 0$$

Which is a counterpart of regular boundary operator for the poset [Balachandran *et al.*, 1994]. Note that we write $2n$-1 instead of $(2n\text{-}1,i, j,k,l)$ for simplicity, and Einstein's sum rule is used. The values of $2n+i, 2n+j, 2n+k, 2n+l$ are covering $2n$-1 *with* constraint $i < j < k < l$ (where identify them uniquly), and domain of n would be $1 \leq n \leq (8N^3\text{-}l)/2 = (\rho_{Planck} - l\,)/2$ which restrict our boundary operator with above constraint. Clearly, the property of $\partial, \partial^2=0$, is trivial, as should be.

After this steps, the discrete analog of the scalar field action can be written as

$$S_\varphi = \frac{1}{2}\sum_{n=1}^{\rho_{Planck}}\frac{n}{2}(n+1)[(\phi_{2n+i} - \phi_{2n+j} + \phi_{2n+k} - \phi_{2n+l})^2 + m^2{\phi_n}^2]$$

(In the presence of the signature dynamics with spatially flat Robertson-Walker mertric (k=0) interacting with a "small" real scalar field ϕ [Dereli and Tucker, 1993] we reach to a novel term which has shown in [Khoshbin-e-Khoshnazar, 2013])

It is trivial, if n is greater than $(\rho_{Planck} - l)/2$, the first term will be turn off, automatically. However, there is one piece lacking in this action. Since, in the absence of the scalar field, $\sqrt{\beta g}\ dx$ should be equal to the Planck density. Now, by equiting

$\sum_{n=1}^{n_f} \frac{n}{2}(n+1) = \rho_{Planck}$

we get $n_f \cong \sqrt{2\rho_{Planck}}$. Therefore we have to substract the term $\sum_{\sqrt{2\rho_{Planck}}}^{\rho_{Planck}} \frac{n}{2}(n+1)$ from the action. Note that we have changed the limits of summing and actually added a term in the action. This term might be seemed novel. But, we consider it as the *"Cosmological Constant"* term in the very early universe and it is an evidence of *expanding universe*. Then the scalar field action would be

$$S_{\varphi} = \frac{1}{2}\sum_{n=1}^{\rho_{Planck}} \frac{n}{2}(n+1)\left[(\phi_{2n+i} - \phi_{2n+j} + \phi_{2n+k} - \phi_{2n+l})^2 + m^2\phi_n{}^2\right] - \sum_{\sqrt{2\rho_{Planck}}}^{\rho_{Planck}} \frac{n}{2}(n+1)$$

Varying the action with respect to ϕ_n (by using boundary operator which is introduced above), after simple but cumbersome calculation, gives (Although cosmological constant does not affect the dynamic, but is very important to our model)

$$\phi_{2n+i} - 2\phi_{2n+j} + 2\phi_{2n+k} - 2\phi_{2n+l} - 2\phi_{2n+j+k-i} - 2\phi_{2n+k+l-i} - 2\phi_{2n+l+j-i} + \phi_{2n+2j-i} + \phi_{2n+2k-i} + \phi_{2n+2l-i} = m^2\phi_n$$

In comparison this equation with usual Laplacian equation for the "small" real scalar field ϕ interacting with gravity in the absence of the signature dynamics

$$\Delta\phi = \frac{\partial U}{\partial \phi} = m^2\phi$$

This equation looks like the discrete Laplacian in this example. (Note that, if we introduced the fields on the $P(S^1)$, this variation would yield the usual discrete Laplacian.

$$\Delta\phi_n = \phi_{n+2} + \phi_{n-2} - 2\phi_n$$

which is introduced in [Balachanran *et al.*, 1994]). The causal set theorists have done a lot of work involving scalar fields on posets, and much of this work has been done since our paper was published. However, Benjamin Deribus is very confident that most or all such approaches would benefit by using his general relation space methods described in his chapter 5.

Anyway, Still, a dynamical relation between space and matter parts lacks in these Laplacians, and the operator Δ does not mix the values of field at points of rank zero and rank one. However, Balachandaran et al. in very interesting paper [Balachandran et al., 1995] have discussed a remarkable connection of posets to noncommutative C^*-algebra [Fell and Doran, 1988] and therefore a quite deep connection between finite approximations to quantum physics and non-commutative geometry [Connes, 1994]. We have shown [Khoshbin-e-Khoshnazar, 2013], by some new defining, we will be able to obtain a similar Laplacian for the torus. The latter prevents us from giving independent values to continuous probability densities at these two kind of points. Regarding non-commutative geometry, Dribus states in his book [Dribus, 2017] that there are natural path algebras associated with partially ordered sets, and more generally, with directed graphs. These algebras are highly non-commutative, and encode all the order-theoretic structure in an algebraic way. So the associated non-commutative spaces (in the sense of Connes) give us a completely different geometric way of thinking about this structure.

Since $P_\infty(T^3)$ is essentially the space T^3 (a non-Hausdorff space containing T^3 as a dense subspace) [Sorkin, 1991] with which we began, it is clear in the limit $n \to \infty$, the discretized Laplacian converges to its continuum conterpart.

The Cluster Expansion of Correlated Posets and Binding Energy

We are no other than a moving row
Of visionary shaps that come and go
Round with this Sun-ilumin'd Latern held
In Midnight by Master of Show
(Omar Khayyam- An old Iranian poet)

Are the space time points fermions or bosons? Since there is no reason to choose one way or the other, we expect that there is some probability for them to be one state or the other. In quantum mechanical terms, *we assume that points are mixed states. Thus the model has supersymetry at the point level*. Fermionic and bosonic points form a doublet and turn into each other. Since poset points are indistinguishable, this situation is identical to having two separate fields. Therefore, the two fields are coupled interact. The result is that as the bosonic points seek each other out and gradually tend to cluster together, they carry the fermionic points with them. This bosonic points try to pull everything together (which looks like gravity) while the fermionic points resist getting any closer together than some minimum distance [Dolan, 2008]. This idea has an essential role in evaluating the binding energy in the very early universe. We will concentrate on fermionic points. Now, by introducing correlation functions which are related to links (clusters) between the points and using the cluster expansion method [Clark and Westhaus, 1966; Khoshbin-e-Khoshnazar, 2002], we can suggest an expression for binding energy of the clusters of points (*which is equal to the binding energy of the very early universe.*) A Hamiltonian H has the form $-\lambda\Delta + W, \lambda > 0$ where W is potential which acts on a wave function ϕ according to $\phi \rightarrow \phi W$, where $(\phi W)(x) = \phi(x)W(x)$. Now, by defining

$$I(\beta) = < \phi| \exp \beta(H) | \phi >$$

we will have

$$E = \left(\frac{\partial}{\partial\beta}\right) \ln I(\beta)|_{\beta=0}$$

then we define

$$I_{ijkl} = < ijkl| F_A^{\dagger}(1 \dots A) e^{\beta H} F_A(1 \dots A)|ijkl >$$

where *i,j,k,l* are points fields which related to *2n-1, 2n+j, 2n+k, 2n+l* respectively, *F(1...A)* is a correlation function in generally, and a maximum of A is equal to 4. Whence we will have:

$$I_i\,(\beta) = < i|e^{\beta H_i}|i > = 1$$

$$I_{ij}\,(\beta) = < ij|\,F_2^{\dagger}(12)e^{\beta H_{ij}}F_2(12)|ij >$$

$$I_{ijk}\,(\beta) = < ijk|\,F_3^{\dagger}(123)e^{\beta H_{ijk}}F_2(123)|ijk >$$

$$I_{ijkl}\,(\beta) = < ijkl|\,F_3^{\dagger}(1234)e^{\beta H_{ijkl}}F_2(1234)|ijkl >$$

After a complicated but straightforward calculation which has shown in [Khoshbin-e-Khoshnazar, 2013] we will be able to calculate effective two, three, and four points energy by knowing type of correlations and potential functions. In other words, if we know the type of correlations and potential functions between points in the very early universe we can evaluate the binding energy in the very early universe. However, the type of correlations and potential functions between points in the very early universe is not clear. But we could do an approximate calculation. There is an unwritten law in many-body problems that states:" Any point like particle cosumes approximately 8Mev energy" ([Khoshbin-e-Khoshnazar, 2002]). To cover the space based on 8 $N^3 = \rho_{Planck}$, we need approximately 10^{47} points, which yields a binding energy is about $8{\times}10^{47}$Mev. This approximates the binding energy in the very early universe. In other words, *The magnitude of the binding energy will be finite value, and it is worthful.* It can regulate the Big Bang. This model could explain the origion of dark energy. Note that binding energy is not an energy that resides in the poset superspace. If we were to able separte a poset superspace to its points, we would have to transfer a total energy to those poset points. The binding energy is a measure of how well poset points are held together, in the sense that it measures how difficult the poset superspace would be taken apart. What caused the release of that energy? It seems to be caused by breaking of supersymmetry at the point level and dominating fermionic part during the inflationary period. As we discusse in the next section we expect a similar mechanism in the mind.

For a precise calculation, we need some axioms which are given in [Khoshbin-e-Khoshnazar, 2013] such as the Wheeler-Dewitt equation [Wheeler, 1968] for potentials, *Jastrow* correlation function [Clark and Westhaus, 1966; Khoshbin-e-Khoshnazar, 2002] for correlations, and "no boundary" wave function of Hartle and Hawking [Hartel and Hawking, 1983] for wave functions. We can proceed to calculate the binding energy of the very early universe by means of the variational principle implying minimization with respect to the variational Parameters.

Towards a Physics of Consciousness

Knowledge is one. Its devision into subjects is a concession to human weakness.

(Sir. H.J. Mockinder)[i]

It seems that such ideas also have a unique role in solving the consciences problem of philosopher of mind. Some years ago, Stuart Hameroff and Roger Penrose [Hameroff and Penrose, 2003] have proposed a model of consciousness based on Penrose's "objective Reduction" in quantum gravity [Penrose, 1998]. Although we have rejected their proposal [Khoshbin-e-Khoshnazar, 2007], we agree with Penrose, when he says [Penrose, 2009]:" In my view the conscious brain does not act according to classical physics. It doesn't even act according to conventional quantum mechanics. It acts according to a theory we don't yet have. This is being a bit big-headed, but I think it's a little bit like William Harvey's discovery of the circulation of blood. He worked out that it had to circulate, but the veins and arteries just peter out, so how could the blood get through from one to the other? And he said, "Well, it must be tiny little tubes there, and we can't see them, but they must be there." Nobody believed it for some time. So I'm still hoping to find something like that—some structure that preserves coherence, because I believe it ought to be there." Or when he says [Penrose, 2005]: "As for myself, I perhaps have enough of physicist's arrogance about me to believe that a physical theory of everything should at least explain the seeds of an explanation of the phenomenon of consciousness." We are now searching to find such explanation in brain and retina [Khoshbin-e-Khoshnazar, 2014].

As we noted before, if our mind is "woven" or "embeded" in the universe, consciousness could occur at the spacetime geometry when the brain stops being perfused. It doesn't dissipate, but remains together by entanglement in the geometery of the universe. So we can use same approach and formalism which has given in above section to find "mind energy" which is equal to binding energy of neurons. We should, merely, find the corresponding counterparts meanings in the universe and the mind, such as

Scalar Field →Neural Field
Potentials between particles→Potentials between cell bodies
Correlation between particles→Correlation between cell bodies
Planck density→Neural density
Poset-Particles→Poset-Neurons,etc.

Some years ago, two studies came out measuring brain activity at the end of life. One was from Lakhmir Chawla et al., at George Washington University [Chawla *et al.*, 2009] when the heart of his patients had stopped or was about to end, there was a burst of activity in the brain monitor up to conscious levels, at about 80, which lasted anywhere from 90 seconds to 20 minutes in one case. Then the patient died. Then it abruptly stopped again. Another study from a group from Virginia Mason Hospital in Seattle [Auyung *et al.*, 2010]. They reported on three patients for what's called post-cardiac death organ donation. They monitored these patients and they saw the exact same thing in terms of when the awareness number dwindled to 0. Then there was this sudden burst of activity up to near 80, indicating awareness that lasted minutes and then it went away. It seems consciousness could occur at the space time geometry when the brain stops being perfused. It doesn't dissipate and consciousness could be caused by energetic activity. Note that binding energy is not an energy that resides in the poset-neurons superspace. If we were to able separte a poset-neurons superspace to its points, we would have to transfer a total energy to those poset points. The binding energy is a measure of how well poset neurons are held together, in the sense that it measures how difficult the poset neurons superspace would be taken apart. What caused the release of that energy? It seems the release of that energy, could be consequence of spontaneous breakdown of a symmetry in the mind at death moment. The binding energy of neurons could be calculated numerically by cluster expansion method, via minimization of variational parameters of the model, as well. To evaluate number of poset-neurons we should replace ρ_{Planck} with ρ_{neuron} which yields $8\ N^3 = \rho_{neuron}$. Since there are almost 100 billion neurons in brain and mind's volume is almost 0.0035 m3, a simple calculation shows that the number of poset-neurons is nearly 16000. We need only 16000 poset-neurons to cover poset-neurons superspace. However, to calculate binding energy, we need to use of electroencephalography data to find an analytical form of our desired potentials and correlations [Dorion *et al.*, 2016] (It is interesting if any institution or researcher that could find an analytical form of our desired potentials and correlations.) However, We could still to do an approximate calculation, again. If we assume, yet, that any pointlike particle cosumes approximately 8Mev energy we find125 Gev for the binding energy of correlated neurons that experiences such as Chawla experience apparently show this energy that we call it "dim energy"!

Recently, an astonishing finding [Zvonimir *et al.*, 2019] is demonstrated that the isolated, intact large mammalian brain possess an "underappreciated" capacity for restoration of microcirculation and molecular and cellular activity after a prolonged post-mortem interval. We believe that we could not explain such "underappreciated" restoration without unifying mind and universe. When the brain stops being perfused, consciousness doesn't disappear but remains in the geometry of the universe. In addition, If we can consider consciousness as a state of matter [Tegmark, 2015], it seems there is consciousness in two phases and similar to the thermodynamics phase transition [Khoshbin-e-Khoshnazar, 2016], to transform from one phase to another, an energy should be released or supplied.

Concluding Remarks and Discussion

Science never makes an advance until philosophy authorizes and encourages it to do so.
(Herbert Spencer)[i]

We consider the mind as a subset of the universe which is embeded in it and emphsise that they are not different things in our model The first part of this article is the structure of the whole of our theory. Einstein gave us deterministic space-time instead of the deterministic flat Eucledean space. In our propose the indeterministic interperation of quantum theory is added to space as a postulate, which causes space to flactuate from curve configuration to discret substratum. We proposed that a discretized T^3-torus as a superspace can be a suitable candidate for the very early universe, and we showed that when $8N^3$ approaches the ρ_{planck}, the correlations would be complicated. It seems that this idea *might be solved the horizon problem*. Then we construct a scalar field action on the $P(T^3)$, indicating how an appropriate construction of scalar field action could be reproduced its general relativity continuum counterpart. In our opinion, this method is much better than other approaches such as that of e.g. [Riedeout and Sorkin, 2004] in which they are thinking of the individual membes of a superspace a representing causal structure and those causal relations appear with some probalilies. These models are somewhat artificial and use Bell's inequality. In our opinion (as well as that of Sir Karl Popper [Popper, 1990]), there is no causality in probability, and probability is only trend. Then our weak interperation of causality (correlation) is the stronger of these artificial structures which are based on probability. In addition, Bell's inequality violates locality [Clauser and Shimony, 1978], and therefore these models can not represent a significiant contribution to the idea of discrete space-time. This does not mean that we don't respect causal set theory. We give a good deal of credit to the causal set theory, in general. But we think it has limitations and misconceptions. Fortunately, we are not alone! Benjamin Deribus in our private communication wrote to me:" I think that discrete causal structure should not be assumed to be transitive, because of the distinction between direct and indirect causation. I think that the condition they call *local finiteness* is not a good choice because it is not actually a local condition. I also disagree with some of the machinery used in sequential growth dynamics, as you suggest in your paper." We also speculate on the binding energy in the very early universe and attempt to explain the source of a kind of dark energy which caused the inflation period. For the last 20years there have been two or three papers a week on dark energy explanation. But, as Saul Perlmutter says [Perlmutter, 2010], if you ask these theorists if they believe their particular model is the answer, almost every one of them would say: "No. I'm not just trying of different ideas and hoping we can get some clues. "I hope that we will not be one of them! Finally, we focused on physics of consciousness based upon our model which have considered the mind as a subset of the universe. If our mind is "woven" or "embedded" in the universe, consciousness could occur at the spacetime geometry when the brain stops being perfused. It doesn't dissipate but remains together by entanglement in the geometry of the universe. We also introduced some corresponding counterparts between universe and mind in our model. There are some evidences that show consciousness is *caused* by the way energetic activity is dynamically and recursively organized in the brain and then consciousness, in principle, could be caused by energetic activity and the way it is organized. So, we assumed brain as a condensed matter and considered neurons and other brain cells as quantum objects. Unlike models that used of Granger causality (such as e.g. [Pizzi *et al.* 2016]) we have used correlations instead of causal relations in neural matter, for the same reason as we mentioned above. We suggested that variational cluster expansion technique in many-body physics may be used to model correlated neural activities, as well. We also proposed a technique to evaluate of "mind energy", and evaluated an approximate value of binding energy of the neurons based upon our model, that may be explained some experiences such as Chawla experience with dying paitient who did not appear to be concious. It could be also explained experiences such as findings of Zvonimir et al. It may seem that the we drop a lot of buzz words and there is no coherence between these different concepts and notions. However, we believe the art is figuring out how to combine them, just like cookery! We believe that the problems discussed in this paper seeds for a radical theory of a physical theory of everything that, as Penrose said, could at least explain the seeds of an explanation of the phenomenon of consciousness-a theory that we hope would not be fashion or fantasy [Penrose, 2016].

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[i] These quatations are adapted from:
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