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Interpretations about gravity and Holographic conjecture in the context of Quantum mechanics and sub quantum theories : New insights on strings and quantization with information theoretic and cosmological significance

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Abstract

Gravity and various possibilities about its proper combination with Quantum mechanics is a central topic in theoretical physics. In this article we explain various links which bridge between different views about Quantum Gravity theories. It turns out that these have very close relation with different interpretations about what quantization mean.We try to justify basic questions like what a string tension mean. First, we start with qualitative analysis and then we confirm these with quantitative results. These are shown to have relation with Quantum Gravity noise, Dark Energy, Hogan's noise and the Holographic conjecture. We clarify a long standing confusion in entropic Gravity, whether increase in entropy (Δ s) makes the particle to move (Δ x) or vice-versa. We indicate the possibility about non-local entanglement and distanglement operation carried out by space-time which will increase and decrease entropy sequentially and a particle in space will move causing Δ x. We relate noise with dissipation, much like a statisti- cal system. In this context, we discuss the hierarchy issue. We try to see string as naturally related to intrinsic computation in space-time in planck scale. We clarify that although we talk about dissipative sub-quantum mod- els, as quantization track only equivalence class (according to T'Hooft), it does not contradict with information conservations in quantum mechanics; equivalence class informations are conserved. We try to describe why we can attach entropy to an arbitrary spatial surface (like a black hole horizon) and can derive Einstein's equation as the second law of thermodynamics. Here we initiate new and important links rather than giving thorough proof. We do so, as our thoughts are spectacularly new and only after a series of works we can justify their validity, although the link between these thoughts is understandable.

Qualitative view about modern developments

General relativity has got many intelligent interpretations in various recent works [1,7]. Before starting we will like to describe the sequence at a glance.

When we try to realise about different interpretations on quantization and try to link them with Gravity, our world seems to be in some middle stage between causal (Interactions, potential etc.) and etheral (Wave function, nonlocality etc.). Let us concentrate on Gravity before linking it with quantum mechanics. Perhaps, the most important and modern understanding about Gravity is its relation with bits on surface and its link with energy. The relation which plays the role is the 2nd Law of Thermodynamics [1,7]

$$\Delta E = T \Delta S$$

with symbols in their usual meaning. Energy flow is equivalent to mass and temperature is either unruh temperature or average temperature arising out of energy [3] contained in bits on a spatial surface . In what follows after this we will use information and bits with interchangable meaning.

Gravity and sub-quantum dissipative models

In this section we will elaborate about what could string tension possibly mean from information theoretic perspective. In this paper, the central motivation we keep is not to give up intuition (as T'Hooft did suggest in [4]) while going through the process of quantization. So we try to show how qualitative analysis can link with equations which justify physics from new perspectives. Recently there has been proposal that holographic conjecture could be a consequence of the fact that our structure of physics (and, perhaps, conscious mind) allow to talk of only limited information [4], the information contained in so called equivalence class. According to T'Hooft, ignoring sub-quantum randomness one can arrive to the picture of unitary quantum mechanical laws, which shows no dissipation. However, there is ontological dissipation in planckian scales. If we believe that l_s is much greater than l_p, i.e., string emerges at a much larger sale than planck length (but in much smaller scale than stanadrd model scales), then these dissipative models do not contradict string theories, string theory track only equivalence class. We suspect, as quantum mechanics relates with the issues of free will, consciousness etc. [2,5], the equivalence class is the best possible information, which conscious mind and today's physics can track. The ontological dissipation is like informations which we are not causally aware about, it sounds like so called hidden phase space description of this universe. Cyclic time evolution models showing such dissipation of information has been proposed [14,15]. Holographic conjecture and the above mentioned cyclic models allow large scale structure of space-time to mimic some structures in very small scale. Before proceeding, it will be instructive to note few ideas that will be recurring and prove useful for the concepts introduced in this article. These are, The holographic principle [22], The information theoretic version of Einstein equation [7], Verlinde's entropic

Gravity [1] and entropic formulation of Newton's second Law, Some interpretations given to these thoughts [12], search of information theoretic origin of Gravity and Dark energy [7,9], some ersatz justification of Holographic conjecture by cyclic time evolution models [4,15] etc and Zeilingers information theoretic view about Quantum mechanics [13]. We also refer to some deterministic models which according to Thooft and few others are candidates for explaining why the physical content or information show a sort of holographic behavior. As already mentioned, these include some dissipative models. Also, in some situations we will take help from "Hole argument" given by Einstein [20].

Gravity, entropy, information and string tension

As pointed out by Verlinde Newton's 2nd law can be written in the form $F \Delta x = T \Delta s$ [1]. As a result of interpretations, information theoretic origin of inertia was proposed [12]. It is worth noting that when this Δs is intrinsic to the sub-quantum time evolution process of the particle (as in models in [15]) it may give rise to a dimensionful parameter (like force, tension etc.), which we can attach to the particle, although the classical equations themselves are not valid (It is much like taking a classical system, then quantizing it and then working with the quantum version. Although we took help from a classical like picture, prior to the quantization itself, the classical equations are no longer valid!) In the end of the next section we will attach some quantitative structure with these statements. Also, as we are searching for possible interpretations it would be enough for us to search dimensionful parameters (like force, tension etc.) from above equation which we can attach to fundamental particles. So, while seeing the above equation as a representation of sub quantum level fluctuations, although the particle is not moving in some external field, it motivates attaching a dimensionful parameter to the particle.

These are related to a basic question in quantization: we take a classical particle and then quantize this; then if we do not have some classical like picture at least in ersatz ontological level, where from the classical particle comes apriori. Before quantizing we consider strings, its tension etc as a outproduct of Newton's equation which itself is not correct until classical limit! In this situation dimensionful parameters of some classical like equations could as well justify which quantities we can attach to fundamental particles apriori, as stated above. We know, in certain situations , the view that string contain bits [8] resolve the Black Hole information paradox partially. (we should not confuse that we are talking of information conservation in the context of dissipative models, as clarified by T'hooft, even in planck scale there is ontological dissipation, the trackable equivalence class (which is taken care by quantization), conserves information. This is consistent with the thoughts that string emerges in a scale much greater than planck scale i.e, $l_s >> l_p$). Here we reverse the view and try to see whether information could be taken as an ingredient in understanding strings, which could provide an yet unseen link between planck scale computer view and string view about space-time. So the entropic formulation as stated above attaches information or bit contents to the particles themselves. So, we have Δ s. The intrinsic uncertainty in position wave-function spread gives Δ x . We note from [3] that disorderness of bits supply the ingredient for T. In other word we have Δ x, Δ s and T attached to a particle. So, we can write an dimensional equation dim [force] multiplied by dim [position] = dim [entropy] multiplied by dim [temp] much like verlinde's reinterpretation of Newton's law in entropic form [1]. However, as here dissipation is intrinsic to particle content and space-time itself, we did never say about an exter- nal force field but only about a dimensionful parameter with dimension of force. First, we think of a theory with intrinsic dimension like force etc. and then we try seeing about interaction, external force etc. We could identify the intrinsic force (where, we trust attaching the dimensionful parameters to fundamental particles, as suggested above, alhough the particle is not moving in a force field) as implied by the equation is just a dimensionful parameter of a theory, the tension of a string. This view is consistent with the interpretation that strings contain bits[8] as evident in Δ s term etc. In the equivalence class formalism, if it is pre-assumed that physics (as we know today) [seen as closely related with free will, consciousness (which in- formations we perceive as physical) etc issues] track only equivalence class (as introduced by Thooft) then there is no contradiction with the string theoretic view that information (say, in a black hole) is conserved. These simply mean the trackable equivalence class conserves information. [This qualitative picture (which aims toward string theory) is further confirmed by a striking similarity of string quantization spectrum and spectrum aris- ing from a (semi) deterministic model (as these issues, as we believe are related to issues of free will in quantum mechanics, we call such models semi-deterministic). In T'hooft deterministic model, [15] the free cyclic field $\varphi(x, t)$ corresponds with eigenmodes $\varphi_n(x)$, energies with multiple of hw, and

$$\varphi(x, t) = A_n \varphi_n u_n(t)$$

with $u_n(t) = \exp(-iw_n t)$ and summation convention is understood.

Its relation with periodically vibrating strings, as noted in [4,15] initiates and strengthen our thoughts.]

At this point we show that there is indeed a possible mechanism in space-time which will increase and decrease sequentially its local entropy spontaneously and hence Δ s is likely to cause Δ x. Without this link, it was not clear whether Δ s cause displacement or otherwise. As we will see after a few sections [6,10] space-time in planck scale can be seen as self computing machine. If the nonlocality issue of holographic conjecture is true, then realizable operations should be non-local (as intrinsic string non-locality or noise-type non-locality [18]). Also, in a general Gravitational field space-time states should be seen as mixed states. So, it turns out to be a crucial point to search whether a total order (such as A can be converted to B by adiabatic process if entropy S(A) is less or equal to S(B) [25])under the computation of space-time. When a particle enclosed in a small volume (comparable to its compton wavelength) approaches the screen of the surface (which encloses the volume) the corresponding entropy increases and as it goes out of the volume, the entropy of the surface decreases. So, we are searching non-local non-entangling operation (which decreases entropy) followed by non-local entangling operation (which increases entropy). We have to search a set of operations which does so in a sequence. Here we have to link mathematical constructions with logic gate operations performed in space-time. There are proposals that space-time increases local entropy which is linked with Gravity, the particular issue, that von-neumann entropy assigned to a pure state always decrease in local non-entangling operations does not concern here, as we are searching non-local entangling (and non-entangling) operations assigned to mixed states which will give rise to a total order (increase and decrease in a sequence). Otherwise (if entropy were ever increasing) continuous dissipation of quantum-mechanical information (unlike ontological acausal planck scale dissipation, which could be linked with hidden phase-space information) would have given rise to enormous heat. As, recently there is proposal about the existence of [25] total orders in mixed state, it is sufficient to justify our believe that if we go to a more general set showing entangling operations (together with non-entangling [25] set which is a part of the sequence showing decrease in entropy in recessiding from the screen phase) we are likely to get a total entropy-increasing order (moving into the screen phase), consistent with earlier belief. It is instructive to try to reconcile them with space-time logic gate operations. In short, we should have sequences showing both increase and decrease in entropy as the particle moves in and out of screen. The similar situation occurs (as described below) if we think of fluctuation of virtual Black Holes, which, unlike Hawking's belief, should keep equivalence class information conserved. Very fast increase and decrease in entropy (yet keeping global information conserved), as suggested [26] by virtual black holes could be seen as a result of very fast passing sequence of entangling and non-entangling operations. String counting of Black-Hole entropy has also its entangle counter part [27], so it motivates us in thinking its relation with underlying (non)entangling operations of space-time bits which is quantitatively related to "measures" of entanglement. Search in this line might give rise to underlying reasons why S_{BH} happens to be equal to the concurrence of entanglement in situations as referred in [28].

Different views, Interpretations: cosmological significance etc.

There are conjectures like nonlocality (as area entropy relation suggest) origin of quantum probabilities [4]. Even if we consider just information theoretic part of such conjectures, these seem to have a close relation with information theoretic origin of quantum randomness. Here we go a step further, which surprisingly lead us with some quantitative results which have implication in cosmology (considered in next paragraph). We note that black-hole information paradox has at least to do with something with the thoughts that string contain bits (as in susskind's notes [8]).

Then what is the relation between these bits and the bits which give rise to quantum randomness as proposed by Zeilinger? Can we modify Zeilinger's interpretation so as give some reasonable understanding about the bit contents in strings.

Here we attempt this question. But before we proceed it will be extremely helpful for us to have a qualitative understanding of some concepts that will play a very crucial role in our analysis. First we understand new explanations thoroughly and then we turn for few quantitative estimations as necessary. First, we note that information theoretic structure of Gravity attach bits with spatial surface (Quantum Gravity calculates possible number of states on a Black-Hole event horizon etc.) and also bits are contained in the counting of string states (which also give rise to the expression of Black-Hole entropy). This gives us a motivation of not thinking space-time as completely separate from its particle contents. We clearly state, what could a bit, a fuzzy bit and its relation with wave-function can mean; but before doing that let us get a rough idea about it.

Secondly, we note that holographic conjecture tells that the number of degrees freedom in isolated bulk grows like the area of the surface, rather than volume. Consequently (as noted by Hogan etc. [18]) the bits, we are talking about, inside the bulk are fuzzy (certain ontolological bits dissipate, giving trace only of the average information in an average interval, which is like Thooft's equivalence class information) [see [21] for what a fuzzy bit could mean, though we give some new insights below]. (here we at- tach bits to particles, which we believe not completely independent of space surrounding it (curved space view), so, we think about the particle's information content in position space representation (and to account for internal degrees we just multiply with spin etc. space's dimension); as we will see it has relation with planck scale computer view (with nonlocality modification) of space-time). So, here we attach bits to spatial surface (described below) and get its relation with the particle. We then describe what could be the relation between spatial arrangement of bits and position space wave function of the particle. We can track the fuzzy interval and get a probabilistic description suggested by wavefunction etc. So dissipation of information, according to our view creates fuzziness and we know these as noisy bits. There are two things where I differ from Thoof't. Thoof't did take a very skeptical view about nonlocality, but we assume it to be true. Secondly, we interpret Thoof'ts ontological basis as hinting the existence of unobservable, acausal other universe [whose internal structure could give us a more complete theory] (many world picture [30], which Thoof't did not interpret in his works), and observable Q.mechanical set as only causal information. (and this view is crucial to understand that after ontological dissipation the observable causal information scale like area rather than volume). So, as a consequence of this intrinsic nonlocality of bits, space-time noise gets a new meaning. It is not just a consequence of low probe experimental interferometry . Space-time, together with its particle content, generates intrinsic noise (nonlocality), say, as a self computing device (this is a sort of extension of Hogan's view). So, we try to see, whether some average fuzziness scale set by the present era of this universe (intrinsic property), is related to natural mass scale etc. This gives answer to hierarchy questions. This fuzziness of bits give us an option of thinking about effective densities (less or more fuzzy bits, this fuzziness is related to a region consisting of many ontological planck bits, which dissipate when averaged. So, what we call an interval below, can be thought as points for Q.Mech scales). This density function might have relation with probability density as implied by position space wave-function of a particle (which is thought from information viewpoint), as described below. Suppose, getting a particle (or rather its primodial constituents as described by Thoof't) somewhere is denoted by a "yes" bit on a planckian surface. Similarly, not getting is denoted by a "no" bit. These bits are ontological rather than observable equivalence class of Q.M.(Were the basis bits not ontological, information would have scaled like volume rather than area) (we get a similar yet different view as Thoof't). So, we have an ontological set of bits, yes and no which are thoroughly mixing and dissipating in planckian scale. These ontological bits corresponds, in some sense, to the primodial basis of Thoof't. So, the yes or no in this array is not about the particle's deterministic observability in a particular place, but rather the ontological existence of primodial basis, whose statistical average give us the notion of particle or its wavefunction. Suppose, in a quantum measurement, in a certain interval, large number of "no" bits dissipate, then the "yes" bit and the particle's position become detectable with high probability within a shorter interval (there is always a probabilistic scope that while averaging in some interval (compared to Q.M scales), the yes bit moves (in the course of planckian fluctuations) outside the interval and we do not observe the particle, this is why we observe probabilistic events). In short, if, in a certain interval, while averaging many ontological bits, if we have more number of "yes" bits, then,it is more probable, that in the course of mixing, we measure the particle within a relatively short interval (as if, one bit of information gets fuzzy (upto certain extend depending on dissipation), from planck scale to an extended interval, which corresponds to observable basis). We call such bits less fuzzy (yes conclusion within a shorter interval) and it corresponds to high probability density of the wavefunction (according to our interpretation). The high probability of occurring an event (say, getting a particle somewhere) which is average of many ontological planck scale events) is denoted by a ”yes” (fuzzy) bit. If this bit become sufficiently fuzzy (ontological dissipation) (which is denoting on an average less probability, rather than strictly specific ontological event), we can take it as ”no” (fuzzy) bit. In a certain interval, if we have more and more independent number of yes bits after thorough mixing, then the interval become less ”fuzzy”. We can think, the outcome of getting a particle in such interval is high as many yes bits independently can response for occurring an event there. If we denote (in some region or interval, which, for Q.M. scale we can take as point), the effective density of bits (fuzzy) in some interval (or effectively in point) as D then, position space probability density $\psi\psi^* \propto D$. In infinity, the bits are infinitely fuzzy (no information about particle) and the wave function tends to 0.

Let me relate above mentioned noise models (seen in an intrinsic sense) with the models concerning quantum state reduction via Gravity (as suggested by Penrose etc.). We note that when we look from the perspective of a single world (this view is important for individual measurements, our interpretation covers all other interpretations as special situation of interests, without contradicting measurement outcomes), a wavefunction corresponds to a (set of) ontological planck bits [which is natural when we think information interpretations of quantum mechanics and in the context of planck bit computing view of space-time] which is fuzzy (or noisy as stated above) in different proportions in different places (variation of probability density). Such dissipation- fuzziness relation motivates its similarity with random motion [as we told earlier,see [11] to link noise with random motion] of an etheral particle (we are not directly observing such classical like motion, so as it is etheral, its velocity in principle could be infinite). This movement is related to the variation of fuzziness with time. Since, fuzziness corresponds to probability density, such motion of ontological bits are related with the dynamics of the wavefunction. As if, it moves slower where the dissipation is slower and probability density of finding it is greater (similar to classical world). It is plausible, given enough time the random walk of such ensemble of bits might get localized (which we identify as spontaneous state reduction)(from consideration as in [23] (or referred therein) models this time could be a billion year or so when a single particle (like electron) is considered and when a classical apparatus containing many large quanta interacts with a quantum system (during measurement) the time taken in reduction just becomes a “fraction in a second” time, which is the characteristic time in quantum measurement [this is described lucidly in penrose’s “shadow of the mind"]. Our approach is different (link with noise), but the time scale can be estimated from above mentioned models without any loss of generality). Since, noise has its origin in Gravity, it motivates linking Gravitation with quantum state reduction. This is a new link between models concerning quantum state reduction by Gravity and noise in space-time. We justify that Hogans noise (which is described by empirical M-theory and quantum mechanics) is not so different from quantum geometry induced noise. It should be noted that average fuzziness of the cosmos is highly different from the fuzziness (short scale) arising out of the presence of an electron or its corresponding wave-function. In this context, we get a new interpretation of probability wave function of quantum-mechanics. Thoof't also did suggest whether quantum probabilities could have relation with with holographic conjecture [4].Here, unifying that concept with intrinsic noise (nonlocality etc.) concept, we give a new interpretation to quantum mechanics, which is a sort of holographic completion of Zeilinger's thoughts [13]. We have already told, where the particle has greater probability to be found, its related bit contents are less fuzzy in that place (we do not think of an electron here giving significant bits in a far away place, otherwise we would have to antisymmetrize all electrons in the universe even if we wished to talk about a single electron). This is essentially related to the link between energy density (as suggested by presence of a massive particle, to which wavefunction description apply appropriately) and fuzziness of bits (also it sheds new light on what $|\psi|^2$ (probability density) means). We can talk about average fuzziness (as implied in Hogan's noise, (now taken in intrinsic sense as nonlocality has been taken as necessary in the theory) which we think as equivalence class information, which survives after ontological dissipation in nontrackable true planck length) λ (not to confuse with cosmic constant) ; effectively

$$l_p \to \lambda l_p .$$

The more the dissipation, the more fuzzy the bits are. This fuzziness just implies that nearby spatial points does not give rise to independently observable configuration. To be a little specific, if the rate at which information dissipates in cyclic models [15] is f (more dissipation, more fuzziness), then roughly

$$\lambda \propto f .$$

It should be noted, like strain noises, it is also an energy density dependent effect. If we probe space with such an energy density that the probe becomes comparable with the length scale λl_p then the noise and hence λ itself will get shorter and with high energy experiments we get planck scale behavior only in true planck scale which is not fuzzy.

It is similar in spirit, with random walk noise model [ontological planck scale bits move(s) in a larger noisy interval [11], [18]], but here the dissipation (which is etheral and not tracked by equivalence class quantum evolution) is intrinsic to space-time machine (which resembles quantum computer models described in next section). As if, instead frequency (g) of experiments done in lab, here space-time measures itself (as a planckian computer, as elucidated below), with a characteristic frequency, g, giving strain noise spectrum, roughly

$$p_h \propto cL_p \frac{1}{g^2}$$

with h, representing strain [11]. String theory motivates relating above scales with string length scale l_s. (we note that dissipation and hence noise depends on energy scale).

Such interpretations, that bits becomes fuzzy as a consequences of holographic noise, has been given. But the suggested link in above equations is new. We will shortly give an average estimate of this fuzziness and its implications in cosmology. According to Hogan, the bits are blurred [18].

We will try to resolve the hierarchy problem in this context (thinking average fuzziness and natural scales as intrinsic property (in the context of this era) of the cosmos. If we get to some empirical view about M theory this will give rise to some quantitative results about dark energy problem. That will require further improvement about our view on how information and spatial bits are best pictured.

Although, some quantitative estimate about how fuzzy the bits are, have been given, here we rethink the issue as it gives some idea about why standard model predicts dark energy much much higher than one observes (10^{120} times or so). As, our model is empirical, so we justify our model with a range of magnitude rather than its true magnitude.

If the volume of an isolated space is V, the bits inside are fuzzy by λ times than the original (as λl_p in above equation suggests) then

$$\frac{V}{\lambda^3 l_p^3} = \frac{A}{l_p^2} \qquad (1)$$

Giving the cosmological scales (Radius roughly a bit greater than 10 billion light years etc) as input in the above equation it turns out $\lambda = 10^{18}$ or so. As we are dealing with cosmic scale and concerns only average estimate we relax our interval upto multiplication or division by 100 etc, so we specify interval rather than true value). So, the average size of noisy bits are around 10^{-16} metres [21].

We are now ready to talk about hierarchy problem in this context (Later we indicate its relation with renormalization group techniques, which also answers this question). It will get cleaner in the context of quantum computer view of space-time, which we discuss later. From information theoretic view of inertia, the dissipation in planck scale should have effect on inertia and hence on mass-energy content of a particle. As, we have discussed earlier, such dissipative models can explain why physical information content should grow like area rather than volume. We then should note that what we call mass of a particle is not the mass that would have been if no dissipation were present, rather the mass that we observe in holographic space-time including sub-quantum ontological dissipation. So, we can conclude the natural mass scale should be close to $\frac{10^{-18}}{l_p}$ (much smaller than planck mass, (much smaller than planck mass, we express these in natural unit (here and in subsequent writing)) rather than $\frac{1}{l_p}$ itself. We shortly show its relation with renormalization group itself. We shortly show its relation with renormalization group technique, as one commonly adopt to solve the hierarchy issue. As we are just concerned about empirical scale, we give plausibility argument about transformation from planck to QFT scale [2] rather than going into detailed model of specific interactions.

According to T'Hooft [2], the theory about fluctuations in planck scale, when seen and averaged on a large scale through renormalization group technique (as 10^{17} times or so which resembles above numbers) give rise to ordinary quantum field theory. Some proposed models are also there. We try to relate these planckian scale fluctuations with the random motion of a ontological planck bit (which is of 10^{-35} metres) to a fuzzy interval (as 10^{-16} m.). Hogan and others also suggested such random motion origin of noise. So, as we track only the fuzzy interval, we neglect some underlying fluctuations, to arrive in the laws and scale of quantum mechanics (which track so called equivalence class). So, the above mentioned empirical reasoning has indeed relation with the magnification via renormalization group which gives results after a huge scaling [2].

Let us see, whether some empirical models from M theory can explain why Dark energy is so small than standard model expectations. According to some empirical models (holographic) based on M theory [18], it produces equation of motion which looks like wave equation in quantum mechanics. As in Hogan's explanation, the macroscopic wavefunctions of position transverse to a light sheet (in mostly flat space with suitable choice of coordinate) obey the paraxial wave equation,

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} - \frac{4\pi i}{\lambda_0}\frac{\partial u}{\partial z} = 0$$

$= 0$

with fundamental wavelength λ_0.

This was shown to give intrinsic correlation between two different spatial points [18] and justifies that bits (within emergent bulk) are not localized and hence are fuzzy.

We adopt the same meaning of this equation as given by Hogan. This is not the equation of motion of particle in standard sense. It refers to the quantum wave-function of position as limited by the holographic nature of unification. In a sense, it is wavefunction of space itself together with its particle content with respect to a classical reference frame. Now if we recall about the hypothesis of the bit origin of quantum mechanics, we see that spatial bits are not quite independent of bits which we assign to counting states (say as in strings).

It is common to assign energy content with bits in information theoretic view about Gravity equation [7] and in the context of Dark energy [9]. In the context of considering elasticity of the bit contents of space [apart from previous works we newly get it as initiated by the ”dimensionful parameter” analysis done in the beginning of this paper and also with the interpretations that information content in bit together with entanglement force implies Gravity] [7] and as in M theory we are allowed to talk about such elastic bits (ersatzly as spatial wavefunction of particles together with space itself) with reference to a classical space time , we can attach energy to the bits as if coming from its intrinsic elastic nature. So, we now have two parameters. One is the average fuzziness of the bits in our universe and second is the force constant of the elasticity of the bits. We did note earlier that the average fuzziness of the cosmos is highly different from the short scale fuzziness in the presence of a wavefunction. It is also known, string theory, in its present form, can not explain the late time acceleration of the universe. So, although we attach dimension of force to spatial bits, our model can be different from standard string theory which is more concerned with (the fuzziness arising out of) the presence of the wavefunction. We take our universe’s bits as more and more relaxing as their average length increases as a consequence of expansion of the universe in the large scale limit (all small scale behaviors are averaged out) unlike the strings (whose tension increases as a consequence of stretching) (compare with the fact although in small scale limit gravity is attractive, it is repulsive (vacuum contribution) in the large scale limit.) In particular, on an average, we can assume spatial bits being highly dense in the earlier universe, where the bits were less fuzzy (radius of the event horizon comparatively smaller). (the fuzziness parameter, $\lambda = 1$ corresponds to highest average energy density, as energy density goes as inverse 4th power of length.). As we decrease (relax from the squeezed state) the energy density in the bits gets more and more relaxed with decreasing energy density (i.e, bits become fuzzy). So, in a noisy space for an arbitrary surface, $S \rightarrow \frac{S}{\lambda^2}$, and entropy is still proportional to area. [we should note, these give only empirical result which are useful to check models in cosmic scale.] Our proposed model is a new addition in this line. So, apart from the factor λ^4, which comes as energy density corresponds to the 4th power of inverse length, to get the correct factor (in which the true vacuum energy is lesser than the energy with respect to non holographic models) we should model the bits as stretching or relaxing like membranes (which could be simplified to be made of elastic strings, as we are interested in modelling the relaxation vs. energy. So, we can think we are relaxing a squeezed string (as mentioned earlier, it is not necessarily standard string theory, but just a modelling) with particular dependence in which the energy (density) is decreased like αx (where x denote the factor by which the strings are relaxed and it is like saying relaxing the string 10 times causes its energy to decrease $\alpha 10$ times, as we are modelling with the purpose of getting just an elastic constant, the particular power dependence does not concern here, it leaves the comparative tests for different Dark Energy (DE) models unaffected). So, the discrepancy factor is just $\alpha^4 10^{72}$ (we did get average fuzziness and λ above. We get the 4th power as in standard literature because inverse length in this power correspond to energy density). Although, at this point, it seems to be situation of adjusting α, as we will see, this in turn verifies other things. As we know the discrepancy in DE scale (as lesser than predicted by standard model) to be 10^{122} or so, it is easy to estimate α apriori.

If we note that the increasing the fuzziness λ implies [as relaxing the string bits] decreasing the corresponding energy density then time varying radius models give decaying dark energy model as the consequence of our model. This is simply because

$$\lambda \propto R_h^{\frac{1}{3}}$$

So, taking α to be an adjustable parameter apriori we can verify different DE models empirically.

We note another interesting point that, in a De-sitter (as our) universe, although its fuzziness of bits is just calculable from its radius, this fuzziness is not independent of its total mass-energy content (as the words like, faster the dissipation of information and energy, fuzzier the bits show). In other words its mass energy is not independent of its total space and vacuum energy and hence holographic conjecture itself initiates for interacting vacuum energy model.

We wish to link above considerations with the view that in the smallest scale space-time could be seen as self computing internet (we believe some modifications are required to these models, but that will leave our analysis unaffected) [also, such relations are suggested in [6,10]). As bits are related to information theoretic interpretations and strings, we will give few quantitative similarities with such views and strings. It is notable that such views also give rise to concept of physically trackable (time scale) [6,10] as we scale $l >> l_P$, which justifies the view that technique of quantization tracks only equivalence class. In brief, in such a view, N-qubit states are associated with surfaces that are punctured in N points by spin networks edges labelled by the spin $\frac{1}{2}$ representation of su(2),which are in a superposed state of two possible spin orientation. The picture of a De-sitter expanding horizon emerges. We associate 2^N strings of length N (with our earlier view about information vs. entanglement force a dimensionful parameter (string tension) naturally arise out of entanglement force. so we suspect such computational strings (with possible non-locality modifications) has indeed relation with vibrating strings. We generally consider spin network states associated with graphs embedded in 3-space with edges labelled by spins

$$j = 0, \frac{1}{2} \text{ etc.}$$

If the surface is punctured in n points, the area is proportional to:

$l_p^2 j_n(j_n + 1)$ with summation convention implied. Logarithm of the dimension of the Hilbert-space on a surface can be shown to be proportional to the area. Associating these with entropy, we can derive the notion of time as shown in [10]. In particular, for De-sitter horizon,

$A_n = (n+1)^2 L^2$ at times $t_n = (t+1)T$ with planck scale indicated as capital letter. We denote area eigenvalue of the horizon with n = 0, 1.. etc and N denoting the number of pixels and associated qubits. The computational process on a De-sitter horizon is generally expressed as

$$\psi(t_n) = \psi(t_0)^{(n+1)(n+1)}$$

where $\psi(t_0)$ is the short-hand for initial ket state.

As shown in [10] even if we start with a initial state that is not in a superposed state, quantum logic gate makes them superposed as time passes.

For the ket A such transformations are shown as

$A \rightarrow U_\theta(\text{Gate}) \rightarrow U_\theta A$

We add the following interpretations to it (apart from the string tension that has been given earlier). We should have some understanding about elementary particle, its mass etc in this context.

It is natural, in the course of computation, if we start with some specific state it will in general give rise to that initial state after some steps. It is plausible that the different possible arrangement of such sequence will correspond to different fundamental particles, i.e we are likely to find its relation with vibrating strings. (this is unlike the large scale structure (as in DE models), it is like string wavefunctions etc., in the region where string theory could have relation with computational structure). Consider the periodic bits of computational strings (not string theory), [a, b, c...a], where it is understood that the shown kets are undergoing logic gate transformations. We believe (much like Thooft's opinion [17]), Such periodic logic gate transformation bear a very close relation with some periodic model [most simple starting thought models of sub-quantum theories]. What could the number of steps mean if we want to see its relation with strings (vibrating) and information. If we assume the number (period) of computational steps bear relation with the length of a string then we arrive in a verifiable result as described below. As the computation process requires energy (here we recall our information theoretic interpretations about inertia) it is plausible that longer the loop, higher the energy it requires to run (and after dissipation in planckian scale, the energy which survives is the measure of mass energy of the particle, which, being intrinsic to the particle itself (a consequence of equivalence class), does not dissipate, this might retrieve from vacuum fluctuation etc, in short as equivalence class information corresponds to its observed mass-energy, so it does not dissipate). So more massive the particle is, more long is the string of bit. (the particle should have more than one bit to perform computation, see [6]) Here, we keep in mind, that as the

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bits are fuzzy (and such fuzziness bears close relation with the origin of quantum fluctuation, superposition etc) this discretized model could be just of empirical interest, we are not claiming that mass is in some multiple of an integer. So, in computational model, roughly,

$$L_{computation} \propto m$$

This mass and length proportionality relation is roughly true also for vibrating strings [29]. We have told earlier that we can attach dimension of tension to set of bits. So, such bits while performing computation could be reconcilable with the concepts of vibrating strings and it is plausible that different approaches to quantum gravity (after nonlocality modifications) bear similarities within them.

Also, as told above, as space-time bit computations [and its relating informations etc. [5]] are related to the issue of our conscious perception, if we exclude all mass from universe, we perhaps, can not think of existing space-time itself. This principle (no gravitational field (mass) imply no space-time [20]) holds for a covariant theory of gravity as Einstein has shown (we are dealing with the present view, though all these statements could be under criticism from other non-standard viewpoints about space-time and information). The view about virtual Black-Hole suggests, any spatial surface watched with very small probe, reveals Black-Hole characteristic. So, the 1st order approximation will be just the classical Black-Hole thermodynamics. Hence we reinterpret covariant [second law of thermodynamics] of space-time equation (Einstein equation) with

$$dE = \kappa\lambda \int_{\Sigma} T_{\alpha\beta}\, \xi^{\alpha} d\Sigma^{\beta}$$

$$ds_h = \eta\lambda \int_{\Sigma} R_{\alpha\beta}\, \xi^{\alpha} d\Sigma^{\beta}$$

in the context of the hole argument (which relates with covariant structure as described above).

[see, [7] to get usual meaning of symbols where differential spatial surface is taken through which mass-energy moves].

Here we have unified several views about space-time together with few interpretations of quantum-mechanics. We have also discussed about planckian scale fluctuation, dissipation, noise, quantum computing view and conservation of information in emergent quantum mechanics and did try to link between them. We also did try to indicate few verifiable cosmological results which together with other interpretations seem to shed new look in our view about physics.

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References

1. On the Origin of Gravity and the Laws of Newton, Erik p. Verlinde. arXiv:1001.0785v1 [hep-th].

2. Hilbert space in deterministic theories, G Thooft.Stueckelberg Lectures, Pescara, Italy.

3. Newtonian gravity in loop quantum gravity,Lee Smolin, arXiv:1001.3668

4. Quantum Gravity as a Dissipative Deterministic system, G'thooft. arXiv:gr-qc/9903084v3.

5. The Strong Free Will Theorem, J. Conway and S. Kochen, arXiv:0807.3286 [quant-ph].

6. Space-time at the planck scale: Quantum computer view. P.A. Zizzi, arxiv:gr-qc/0304032v2.

7. Gravity from quantum information, Jae-Weon Lee, Hyeong-Chan Kim, Jungjai Lee. arXiv:1001.5445v2 [hep-th].

8. The Black Hole War, Susskind.

9. Dark energy from vaccum entanglement, arXiv:hep-th/0701199v6.

10. Holography, Quantum Geometry and Quantum information theory. P.A Zizzi, arxiv:gr-qc/9907063.

11. A phenomenological description of space-time noise in quantum gravity. by G Amelino-Camelia, Nature (2001) Volume: 410, Issue: 6832, Pages: 1065-1067

12. On the origin of entropic Gravity and inertia, J-W Lee, arXiv:1003.4464v3 [hep-th]

13. A foundational principle for quantum mechanics, A Zeilinger, Foundation of physics, Vol.29, No. 4.

14. Compact Time and Determinism for Bosons: foundations, Donatello Dolce, Arxiv:0903.3680[hep-th]

15. Clockwork Quantum Universe, An essay for the FQXi constest Is Reality Digital or Analog?: Donatello Dolce

16. Classical and quantum logic gates by Ashok Muthukrishnan is a good introduction to the subject.

17. Quantization of discrete theories by Hilbert space extension Nuclear Physics B (1990) Volume: 342, Issue: 3, Pages: 471-485

18. Holographic noise in interferometer by C. Hogan.

19. Quantum computation toward quantum Gravity, P.A. Zizzi, ArXiv:gr-qc/0008049v3.

20. Einsteins hole argument,Alan Macdonald, American Journal of physics.

21. Our World May Be A Giant Hologram - Mind power news.

22. The world as a hologram, ArXiv:hep-th/9409089 v27sept.

23. On Gravity's role in Quantum State Reduction, General Relativity and Gravitation, Volume 28, Number 5, 581-600, DOI: 10.1007/BF02105068

24. "The holographic principle". Bousso, Raphael (2002). Reviews of Modern Physics 74 (3): 825874. arXiv:hep-th/0203101.

25. Entanglement theory and the second law of thermodynamics, Fernando G. S. L. Brandao and Martin B. Plenio, Nature Physics 4, 873 - 877 (2008)

26. Virtual black holes, Stephen W. Hawking, arXiv:hep-th/9510029v1.

27. Entanglement interpretation of black hole entropy in string theory,Brustein, RamEinhorn, Martin B.Yarom, Amos, jhep012006098.pdf.

28. Stringy black holes and the geometry of entanglement, P. Levay, Phys. Rev. D 74, 024030 (2006)

29. A first course in string theory, B. Zwiebach (2004 edition, chapter 16)

30. The many-worlds interpretation of quantum mechanics: psychological versus physical bases for the multiplicity of worlds. Howard Barnum. Los Alamos National Laboratory, MS B256, Los Alamos, NM 87545