Counting bits, numerical entropy, and its relationship to a presumed cosmological 'constant' and modified HUP for initial Inflaton value

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Abstract

We look at early universe space-time and a linkage between quantum bits of information along the lines of what was done by Yan – Gang Miao, Ying- Jie Zhao , and compare it with quantum computing and cosmology which was brought up by Ganbini, Porto and Pullin. Namely the purported number of quantum computing operations. If the two are equivalent, there is an implied relationship to determine an optimal radial distance. Afterwards, we use that in conjunction with a modified Heisenberg Uncertainty principle to come up with some fundamental cosmological phenomenology. In particular a first ever guess as to the value of an initial inflaton.

Key words, Quantum Computing , Cosmological constant, Modified HUP, inflaton

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1. **Bringing up the screed of quantum bits of information along the lines of what was done by Yan – Gang Miao, Ying- Jie**

Using [1] we will be obtaining a Vacuum energy value, with $n(count) = 'n'$, and if we use [2],, $n(count) = 'n'$ is a measure of entropy, so to first order for significant initial entropy, we would have

$$\Lambda \sim \frac{\hbar c}{8\pi^2} \cdot \frac{1}{(\Delta x)^4} \cdot \frac{1}{n(count)} \tag{1}$$

If so, then simply put,

$$'n' \sim \frac{\hbar c}{8\pi^2} \cdot \frac{1}{(\Delta x)^4} \cdot \frac{1}{\Lambda} \tag{2}$$

This should be compared with [3], namely if $n(count) = 'n' \leq \# operations \equiv N \propto ('n')^{4/3}$. ,making use of Eq. (3) in [3] then we have using [4]

$$\begin{aligned} &If \quad R = \Delta x \\ &L = \# quidbits \sim 10^{31} \\ &d_P = \# simul.operations \sim 10^{10} \\ &t_{Planck} \sim 5.39 \times 10^{-44}\ \mathrm{s} \\ &N \propto ('n')^{4/3} \sim \left(\frac{1}{t_{Planck}}\right)^{4/7} \left(\frac{c \cdot L}{\Delta x}\right)^{3/7} d_P^{4/7} \end{aligned} \tag{3}$$

The number, N is operations per second, and in the calculation preliminarily give, , R ~ .1 meter, so that the lower calculation, N was given in [4] as N ~ 10^47 operations/ second, with a comparatively very large R term.

We will be using the same values for L, and for d(p) as given above as well as Planck time. Our values of R will be different. What we will be doing is to compare Eq. (2) and Eq. (3) with a suggested optimal radii, from the start of the universe for when the quantum computational effects kick in.

2. Comparing Eq. (2) and Eq. (3) to suggest an optimal R value

Doing so, we get a value which scales as

$$R \sim \Delta x \sim \left(\frac{1}{\left(\frac{1}{t_{Planck}}\right)^{4/7} \left(c \cdot L\right)^{3/7} d_P^{4/7} \Lambda^{4/3} \left(\frac{\hbar c}{8\pi^2}\right)^{4/3}} \right)^{21/93} \tag{4}$$

3. Examining the HUP as to uncertainty principles and the value of Eq. (4)

Start with

$$\begin{aligned} (\Delta l)_{ij} &= \frac{\delta g_{ij}}{g_{ij}} \cdot \frac{l}{2} \\ (\Delta p)_{ij} &= \Delta T_{ij} \cdot \delta t \cdot \Delta A \end{aligned} \tag{5}$$

If we use the following, from the Roberson-Walker metric [5,6,7] [11, 12, 13].

$$\begin{aligned} g_{tt} &= 1 \\ g_{rr} &= \frac{-a^2(t)}{1-k \cdot r^2} \\ g_{\theta\theta} &= -a^2(t) \cdot r^2 \\ g_{\phi\phi} &= -a^2(t) \cdot \sin^2\theta \cdot d\phi^2 \end{aligned} \tag{6}$$

Following Unruh [14, 15], write then, an uncertainty of metric tensor as, with the following inputs

$$a^2(t) \sim 10^{-110}, r \equiv l_P \sim 10^{-35} meters \tag{7}$$

Then, the surviving version of Eq. (1) and Eq. (2) is, then, if $\Delta T_{tt} \sim \Delta\rho$ [5,8,9] [11, 14, and 15]

$$\begin{aligned} & V^{(4)} = \delta t \cdot \Delta A \cdot r \\ & \delta g_{tt} \cdot \Delta T_{tt} \cdot \delta t \cdot \Delta A \cdot \frac{r}{2} \geq \frac{\hbar}{2} \\ & \Leftrightarrow \delta g_{tt} \cdot \Delta T_{tt} \geq \frac{\hbar}{V^{(4)}} \end{aligned} \tag{8}$$

Using the value of

$$V^{(4)} \sim \left(\Delta x\right)^3 \cdot \delta t \sim R^3 \cdot \delta t \sim \left(\frac{1}{\left(\frac{1}{t_{Planck}}\right)^{4/7} \left(c \cdot L\right)^{3/7} d_P^{4/7} \Lambda^{4/3} \left(\frac{\hbar c}{8\pi^2}\right)^{4/3}} \right)^{63/93} \cdot \delta t \tag{9}$$

A preliminary reading of the last equation of the Eq.(8) grouping could be to first order that in the case of Pre Planckian space time, we would see

$$\delta g_{tt} \geq \left(\left(\frac{1}{t_{Planck}} \right)^{4/7} \left(c \cdot L \right)^{3/7} d_P^{4/7} \Lambda^{4/3} \left(\frac{\hbar c}{8\pi^2} \right)^{4/3} \right)^{63/93} \cdot \left(\delta t \right)^{-1} \cdot \frac{\hbar}{\Delta T_{tt}} \tag{10}$$

Now, if we use $\delta g_{tt} \sim \phi_{initial} \cdot a^2{}_{\min}$ as given in Giovannini [10] , we can write the expression for an early Inflaton as of the order of

$$\phi_{initial} \approx \left(\left(\frac{1}{t_{Planck}} \right)^{4/7} \left(c \cdot L \right)^{3/7} d_P^{4/7} \Lambda^{4/3} \left(\frac{\hbar c}{8\pi^2} \right)^{4/3} \right)^{63/93} \cdot \left(\delta t \right)^{-1} \cdot \frac{\hbar}{\Delta T_{tt}} \cdot a^{-2}{}_{\min} \tag{11}$$

4. Conclusion, coming to terms with inputs into Eq. (11)

In order to do this, we need to have suggestions as to the bounds to some of the inputs. i.e. as an example.

$$T_{ii} = diag(\rho, -p, -p, -p) \tag{12}$$

Then by [5]

$$\Delta T_{tt} \sim \Delta \rho \sim \frac{\Delta E}{V^{(3)}} \tag{13}$$

Then,

$$\delta t \Delta E \geq \frac{\hbar}{\delta g_{tt}} \neq \frac{\hbar}{2} \tag{14}$$

$$Unless \quad \delta g_{tt} \sim O(1)$$

Here, we have that

$$V^{(3)} \sim \left(\Delta x \right)^3 \sim R^3 \sim \left(\frac{1}{\left(\frac{1}{t_{Planck}} \right)^{4/7} \left(c \cdot L \right)^{3/7} d_P^{4/7} \Lambda^{4/3} \left(\frac{\hbar c}{8\pi^2} \right)^{4/3}} \right)^{63/93} \tag{15}$$

To come up with inputs into Eq(11) and Eq.(15) need inputs into *L*, the d(p) parameter, and of course the cosmological constant. We have only begun to specify an emergent inflaton, and this is a statement of principle as to its emergent structure. With a lot more to go. I.e. examining the issues in [11] and [12] as follow ups. Also in examining comparisons with Dr. Corda's [13] about "gravity's breath".

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References

[1] Yan – Gang Miao, Ying- Jie Zhao, "**Interpretation of the Cosmological Constant Problem within the Framework of Generalized Uncertainty Principle", http://arxiv.org/abs/1312.4118**

[2] Ng, Y. J. Entropy **10**(4), pp. 441-461 (2008)

[3] Lloyd, Seth, http://arxiv.org/pdf/quant-ph/0110141v1.pdf

[4] Gambini, R. Porto, R. Pullin, ArXiv: Quantum- Ph/0507262

[5] E. Kolb, S. Pi, S. Raby, "Phase Transitions in Super symmetric Grand Unified Models", pp 45-70, of *Cosmology in the Early Universe*, edited by L. Fang and R. Ruffini, in World Press Scientific, Pte. Ltd. Co, Singapore, Republic of Singapore, 1984

[6] Beckwith, A. (2016) Gedanken Experiment for Refining the Unruh Metric Tensor Uncertainty Principle via Schwartz Shield Geometry and Planckian Space-Time with Initial Nonzero Entropy and Applying the Riemannian-Penrose Inequality and Initial Kinetic Energy for a Lower Bound to Graviton Mass (Massive Gravity). *Journal of High Energy Physics, Gravitation and Cosmology*, **2**, 106-124. doi: 10.4236/jhepgc.2016.21012

[7] D. Gorbunov, V. Rubakov, ***Introduction to the Theory of the Early Universe, Cosmological Perturbations and Inflationary Theory***, World Scientific Publishing Pte. Ltd, Singapore, Republic of Singapore, 2011

[8] W. G. Unruh; "Why study quantum theory?", **Canadian Journal of Physics,** 1986, Vol. 64, No. 2 : pp. 128-130; (doi: 10.1139/p86-019)

[9] W. G. Unruh; "Erratum: Why study quantum gravity?", Can. J. Phys. 64, 128 (1986)

[10] M. Giovannini, ***A Primer on the Physics of the Cosmic Microwave Background*** World Press Scientific, Hackensack, New Jersey, USA, 2008

[11] Gao, C. (2012) A Model of Nonsingular Universe. Entropy, 14, 1296-1305. http://dx.doi.org/10.3390/e14071296

[12] R. Wilson, "Octonions", http://www.maths.qmul.ac.uk/~raw/talks_files/octonions.pdf

[13]. Corda, C. " Gravity's Primordial Breath, " Electronic Journal of Theoretical physics, EJTP 9, No. 26 (2012) 1–10; http://www.ejtp.com/articles/ejtpv9i26p1.pdf