Non Linear electrodynamics and the question of minimum time length/Modification of initial singularities in Early Universe cosmology and DM/DE

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Abstract

Basic summary is as follows. Initially we discuss a minimum time length. We form DM from considerations as to a minimum time step, and then generate DM via axions. Through Ng's quantum infinite statistics, we compare a DM count, giving Entropy. The remainder of the document is in terms of DE as well as asking the question of comparing Entropy in Galaxies versus Entropy in the Universe, through a lens of Subotha Mistra's Quantum theory of the big bang

Introduction:

1st We discuss minimum time length

First, this article poses the question of a minimum time length at the start of cosmological space-time evolution. Using the methodology of Zeldovich [1] (1972) as to a problem with electron-positron pair production we propose an upper bound to the problem of minimum time length. This ought to be compared with work that is done with graviton mass, which will be initially along the lines discussed in [2].

1a we discuss a minimum length, i.e. no cosmic singularities. After considering non zero graviton mass. Eq. (8) shows a minimum scale factor which is not zero.

1b. Showing How to use a temperature varying $\Lambda \quad \Lambda_{Max} \sim c_2 \cdot T_{temperature}{}^{\tilde{\beta}}$

1b is following Park et.al. [3]

1c. More representations of density to use in Eq. (4a)

1d: Comparing density in the case of certain strengths for the magnetic field, in the case of a non-rotating universe, i.e. the weak energy condition versus a more generalized expression

1e: Examining what Lagrangian system to work with, i.e. how to reconcile nonlinear dynamics with gravitational physics [4]

2nd. we discuss DM which we identify with axions [5]

The minimum magnetic field will be crucial, next to our venture of setting up DM. For the purpose of this talk, the resulting DM consistent with identifying DM with axions, with a certain generated entropy. The answer for entropy, and mass of the particles, is in line with Dr. Mishra's article about a quantum theory of the big bang, and application of a Machian universe.

2a. Numerical count of Entropy [6, 7]?

2b. Does Eq. (28) and Eq. (30) pertain to DM, to DE, or both Entropy (numerical)

2c. Refining Eq. (23) in lieu of Eq. (33)

2d. Filling in DM contribution to entropy, 380 thousand years after big bang?

2e. Discussing radical idea of Black hole atom as DM candidate, as alternative to Axions [8].

3rd The DE we identify with gravitons.

In both the DM and the DE, we are using entropy as linked to a 'particle count' along the lines of Ng (Chapel Hill, USA) and infinite quantum statistics, as well as work done by Rong-Gen Cai, giving S (entropy) as less than or equal to N ('numerical' bound to entropy) which also has N with a connection with a cosmological constant (N inversely proportional to the cosmological constant) numerical count (linkable to entropy) in the case of DM directly links to an 'average' particle mass which in turn, could lead to a radii of the universe

3a The DE we identify with DE energy density and its role in cosmology.

4th Entropy of Galaxies due to SMBH, versus Entropy of the Universe

Finally, discussion of how entropy, due to DM could answer question as to not only radii of the universe, but an old question as to entropy in galaxies, versus entropy of the Universe. If there are one million galaxies, and most of generated entropy is due to supermassive black holes, then axion style DM would provide, at least a start to rendering DM particle count, implying entropy, whereas one million SMBHs in the center of galaxies would be the building blocks to total entropy in the universe. We discuss the implication of such methodology toward not only BH physics, but the inter relationship of DM with DE..

5th. Introducing an argument for a multiverse

5, a Number of universes affecting partition function and averaging

5b Ergodic mixing of partition function contribution

5c. Our review of CCC cosmology with our revision of a multiverse put in [9, 10]

6. Conclusion

1st First of all, if there are massive gravitons, i.e. gravitons with mass, as well as Mishra's quantum universe [5] procedure, with Machian universe behavior [5], then one should consider the multiverse[9].

2nd Secondly, a straightforward application of Mishra's quantum universe [5], if there is no mass attached to the graviton, yields an average mass of the universe consistent with axions [5,11] as a preferred DM candidate. If that is the case, then the DE value as given in Figure 1 above is consistent with another candidate than massive gravitons.

3rd. The most unusual suggestion the author for DM is a candidate for DM consistent with mini black hole "atoms". As reviewed by the author, this suggestion appears to be contravened by Mishra's quantum cosmology model [5]. But Mishra's quantum cosmology model appears to require Machian universe dynamics. Should Machian [5] dynamics for the present universe not hold, then this innovative approach cannot be discarded. Finally, as an extension the implications of Ergodic mixing cannot be overlooked, and should be further developed along the lines in [30]

Key words: massive gravitons, cosmological vacuum energy, DM, DE

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1st Minimum time step argument

If we consider the role of an electromagnetic charge, as freely given in this presentation, we should also look at a derivation of what Zel'dovich [1] gave as far as charge and anti-charge particles, in an applied E and M field could yield, which would be of the form (when ξ is an energy expression, and E an applied electric field of the value of)

$$\frac{d\xi}{dt} < \frac{eE\xi}{mc} \tag{1}$$

Again to generalize this, we consider if the electric field is such that the commensurate bulk charge will have the following relationship to the given electromagnetic charge, to read as

$$\begin{aligned}
& dE = -4\pi\, j dt \Rightarrow E = -4\pi\, jt \\
& \&\, j = 2enc \Rightarrow \\
& (\Delta t)^2\, e \cdot n \cdot c = \frac{m}{4\pi c} \ln \frac{\xi_{init}}{\xi_{final}} \quad . \\
& \Rightarrow e = \frac{m}{4\pi n c^2 \cdot (\Delta t)^2} \ln \frac{\xi_{init}}{\xi_{final}}
\end{aligned} \tag{2}$$

Picking the time variation as given by Δt, the number of charges as given by n, and $m_{E\&M}$ the mass of a hypothetical 'magnetic' charge as,

$$\begin{aligned}
& e = \frac{m}{4\pi n c^2 \cdot (\Delta t)^2} \ln \frac{\xi_{init}}{\xi_{final}} = e_{E\&M} \\
& \sim \sqrt{\frac{B^2 \cdot r_{\min}}{\mu_0 \cdot \left[1 - 2 \cdot \frac{B^2 \cdot r_{\min}}{c} \cdot \mathrm{X}_0\left(\frac{B_c}{B}\right)\right]}}
\end{aligned} \tag{3}$$

Then the minimum time step is given by

$$\Delta t \sim \frac{1}{\left(\frac{B^2}{\mu_0} \cdot r_{\min}^2 \,/ \left[1 - 2\frac{B^2}{c} \cdot r_{\min} \cdot \mathrm{X}_c\left(\frac{B_c}{B}\right)\right]\right)^{1/4}} \cdot \left(\frac{4\pi n c^2}{m \cdot \ln\left(\frac{\xi_{initial}}{\xi_{final}}\right)}\right)^{1/2} \tag{4}$$

How does a minimum time step relate to having no cosmic singularities? Magnetic fields

The basic working took as identified above is to make use of the massive graviton mass value given by Garattini in [12] of the following formulation: In it, he examined the one loop effective action in a Schwarzschild background to compute the cosmological constant in presence of massive gravitons

$$\Lambda_{0,M} = \frac{G}{32\pi} \cdot m_0^4 \cdot \exp\left[3 \cdot \left(\frac{m_g}{m_0}\right)^4\right] \tag{4a}$$

Aside from the results in Eq. (1) and [12] we compare what we can infer as to its relationship with density with the following directly proportional to an initial density which is directly proportional to [12]

$$m_0^2(M) = 3MG/r_0^3 \tag{4b}$$

Camara et al, [13] has an expression as to density, with a B field, and we also can used the Weinberg result [14] of scaling density with one over the fourth power of a scale factor, which we will remark upon in the general section, as well the Corda and Questa result of [15] for density of (note this is for a star)

$$\rho_\gamma = \frac{16}{3} \cdot c_1 \cdot B^4 \tag{4c}$$

1a, Showing a non-zero initial radius of the universe due to nonlinear space-time E&M (no cosmic singularities)- due to Non Linear Electrodynamics: Eq. (8) shows a minimum scale factor which is not zero

What we are asserting is, that the very process of an existent E and M field which contributes to a massive graviton in addition to being a Lorentz violation, also, according a non-zero initial radii to the universe. I.e. in [1] there exists a scaled parameter λ , and a parameter a_0 which is paired with α_0 . For the sake of argument, we will set the $a_0 \propto \sqrt{t_{Planck}}$, with t_{Planck} ~ 10^ - 44 seconds. Also

$$\alpha_0 = \sqrt{\frac{4\pi G}{3\mu_0 c}} B_0 \tag{5}$$

$$\lambda = \Lambda c^2/3 \tag{6}$$

Then if , initially, Eq. (6) is large, due to a very large Λ the time, given in Eq.(53) of [13] is such that we can write , most likely, that if Eq. (4) holds, that one could then set Eq.(4) with the bottom Eq.(7)

$$t_{\min} \approx t_0 \equiv t_{Planck} \sim 10^{-44} s \tag{7}$$

Whenever one sees the coefficient like the magnetic field, with the small 0 coefficient, for large values of Λ, this should be the initial coefficient at the beginning of space-time which helps us make sense of the non-zero but tiny minimum scale factor [13]

$$a_{\min} = a_0 \cdot \left[\frac{\alpha_0}{2\lambda}\left(\sqrt{\alpha_0^2 + 32\lambda\mu_0\omega B_0^2} - \alpha_0\right)\right]^{1/4} \tag{8}$$

The minimum time, as referenced in Eq.(7) most likely means, due to large Λ that Eq. (8) is of the order of about 10^{-55}, i.e. 33 orders of magnitude smaller than the square root of Planck time, in magnitude. We next will be justifying the relative size of the large Λ

1b Showing How to use a temperature varying Λ $\Lambda_{Max} \sim c_2 \cdot T_{temperature}{}^{\tilde{\beta}}$

A temperature varying quintessence version of vacuum energy is given by [3]

$$\Lambda_{Max} \sim c_2 \cdot T_{temperature}{}^{\tilde{\beta}} \qquad (9)$$

This work uses reference [8] and we also will be considering the following

$$\Lambda(t) > 8\pi G\rho / c^4 \qquad (10)$$

Looking at Eq.(9) and also what Eq.(10) is saying, i.e. we can look then at what happens if we look at the Hubble "constant" parameter at the start of the inflationary era

$$\Lambda(t) \sim \left(H_{\text{inflation}}\right)^2 \qquad (11)$$

Note that Eq. (9) to Eq. (11) is arguing in favor of a very small scale factor, implying a large density. In addition, note that the left hand side of Eq. (1) uses Eq. (9), Eq. (10), and Eq. (11) regardless of if the universe is "stationary" or rotating.

After that, we should consider what we would do if there is no negative pressure, which leads to the strange situation given by Eq. (2) above. In that case, with no negative pressure, we get a 'simple' temperature dependent massive graviton, in a way given in the next section.

1c. More representations of density to use in Eq. (4a)

We will be examining the import of Eq. (8) from first principles. Note, if we wish to look at Eq. (2) with

$$T = 3p - \rho \qquad (12)$$

And if we write a minimum value of the density linked to the "cosmological constant" for which there is no magnetic field. We view this as only plausible if there is a zero pressure value, which we doubt, since pressure is less than zero, i.e. negative, in beginning cosmology. If it, the pressure were zero, then maybe

$$\rho_{\Lambda}(t) = \Lambda(t) \cdot c^4 / 8\pi G \qquad (13)$$

If the pressure is not negative, but, say zero, then one may be able to write, say something not dependent upon the B field, i.e. temperature dependent [2].

$$m_g^2 = \frac{\tilde{\kappa} \cdot \Lambda_{\max} \cdot c^4}{48 \cdot h \cdot \pi \cdot G} \qquad (14)$$

We have reason to believe, though, that this is false, i.e. that the pressure is less than zero, hence, then at a minimum the value of density has a magnetic field component, and that in Eq. (1) that the relevant density may be the one obtained by 1 / fourth power of Eq.(8), due to using Eq.(5). Keep in mind that if we do so, we are possibly assuming that there is no rotation of the universe.

If there is a rotation of the universe, we may up to a point treat the density as what was done in [15], for stars, i.e. examine if $m_0^2(M)$ of Eq.(1) may be written as [15]

$$m_0^2(M) = 3MG / r_0^3 \sim \rho_\gamma = \frac{16}{3} \cdot c_1 \cdot B^4 \qquad (15)$$

Once again, this probably assumes a rotating universe,

If there is no rotating universe, we go back to [12] and consider, then we do the more complex version along the lines of

$$m_0^2(M) = 3MG/r_0^3 \sim \rho \sim 1/a_{\min}^4 \tag{16}$$

The minimum scale factor, in Eq. (16) has a complicated magnetic field dependence as given in Eq.(8),
.

1d: Comparing density in the case of certain strengths for the magnetic field, in the case of a non-rotating universe, i.e. the weak energy condition versus a more generalized expression

In [13], there is a generalized density. Keep in mind that this example is to be used if we have a non-rotating universe, and otherwise, we will use what is done in [15] for density in the case of a rotating universe. Using [13]

$$\rho = \frac{1}{2\mu_0} \cdot B^2 \cdot \left(1 - 8 \cdot \mu_0 \cdot \omega \cdot B^2\right) \tag{17}$$

This has a positive value only if [13]

$$B < \frac{1}{2 \cdot \sqrt{2\mu_0 \cdot \omega}} \tag{18}$$

We do believe that Eq. (16) is more general, although the magnetic field dependence is far more complicated.

1e. Examining what Lagrangian system to work with, i.e. how to reconcile nonlinear dynamics with gravitational physics

Our focus from now on will be to be looking at the. relevant Lagrangians, used for analyzing both the minimum radius problem, but also the gravitational physics.

First, of all, in reference [15], the authors specifically use a spinning star. We believe that their analysis, should be extended via [18, 19] i.e. and that ultimately, the material in [19] as to a Goldstone theorem and nonlinear E and M analysis.

The problem in a nutshell is this. First of all, to use the formalism in [12], we need to determine if we have a spinning universe, or a non-spinning universe. If it is a non-spinning universe, then the relevant density to consider in Eq.(1) (not the cosmological 'constant') is likely 1/ the fourth power of the minimum scale factor, as to making a relationship between a massive graviton, and a cosmological 'constant' parameter

If it is a spinning universe, then the Corda derived value for density, proportional to the fourth power of the magnetic field, should be used, and we can also then use the values for the Lagrangian given in [19].

In either case, the issues brought up in [19] need to be addressed, as far as a Goldstone theorem, and its connections to nonlinear electrodynamics. In fact if there is a rotating universe, a bridge between nonlinear electro dynamics, and energy loss due to the phenomenon of Quantum vacuum friction, which could be adopted for graviton production and the like, exists, which may allow for linking NLED, and gravity.

Note that in reference [19], Dupays and other authors bring up the idea of a generalized Lagrangian for a rotating star as

$$
\begin{aligned}
L_{Star} &= L_0 + L_1 \\
L_0 &= \frac{1}{2} \cdot \left[-\frac{B^2}{\mu_0} \right] \\
L_1 &= \frac{e^2 \cdot B^2}{h_{Plank} \cdot c} \cdot \mathrm{X}_0 \left(\frac{B_c}{B} \right) \\
B_c &\sim 4.4 \times 10^9 T \left(torr \right) \\
B &\sim B_{star-surface} \sim \mu_0 \cdot m / 4\pi r^3
\end{aligned}
\tag{19}
$$

The function $\mathrm{X}_0 \left(\frac{B_c}{B} \right)$ is defined in reference [10], and if there is quantum vacuum friction, then the decay in rotation of the star goes as

$$
\dot{\nu} = -K_r \nu^3 + K_{qV} \nu \tag{20}
$$

Here, the coefficients in the right hand side of Eq. (20) above are defined in reference [19].

Our supposition is that in the case of a rotating universe, that we have a magnetic field being generated and a set of Lagrangians, similar in part to the construction given in Eq. (19) above. Also, that Eq. (20) would hold but, of course, we would need a very different moment of inertia, I, for a non-zero in radii, but still rapidly spinning 'early universe, ' space-time which would be still decaying, along the lines given in Eq.(20) above.

Now, as to the case of a rotating universe, we think that quantum vacuum friction, may lead to generation of gravitons, which would mean that the goldstone theorem developments in reference [19]

If we have, in the case of a rotating universe, decaying rate of rotation similar to Eq.(20) above, we may see then a natural solution to power loss which will allow for the formation of Goldstone modes, which are discussed in reference [19], as given by the following quote.

Quote
Next we identify the Goldstone modes. In the case of the Lorentz group in four dimensions, only two inequivalent vacua exist
End of quote

This result should be confirmed, if possible, and done as to generalize our inquiry. The graviton mass, should be constrained to be of the order of 10 to the minus 62 grams, in line with experiments. The analysis if done correctly can, eventually determine if quintessence, or lack of (time varying cosmological "constant" parameter) is commensurate with experimental details.

We submit that this inquiry and also a choice as to $m_0^2(M) \sim function - of - density$ in Eq.(1) above will lead to falsifiable experimental conditions as to determining if Quintessence in the cosmological 'constant' exists, as well as experimental verification of if the universe is rotating, or not rotating. If not rotating, then how we specified $m_0^2(M) \sim function - of - density$ will then depend likely upon a density proportional to 1 divided by the fourth power of the minimum scale factor will be what we need to help obtain experimental verification of massive gravitons. If rotation of the universe exists, then we state that $m_0^2(M) \sim function - of - density$ is then directly proportional to the fourth power of the magnetic field, as given in reference [5]. This detail, should be settled as quickly as possible, and is important as to making NLED experimentally verifiable. Note that if the universe spins, that Eq. (4) is intuitively useful, and easily fulfills the negative pressure requirement needed for inflation. If the universe does not spin, then pressure still has a NLED signature, but requires, especially within the Planck regime of space-time far more complex magnetic field behavior and verification.

2[nd]. We discuss DM which we identify with axions

In [20], one million or more BHs in the center of an equal number of galaxies numbers of galaxies lead to an entropy

$$S_{Total} \sim 10^{102} \approx 10^{6} \times 10^{96} \sim \# Galaxies(SMBH - center) \times [entropy, SMBH] \quad (21)$$

To understand what this means, we will review our version of Mishra's "The Quantum Theory of the big bang" in order to find linkages to axions, for DM and other issues. Begin now with Mach's principle, with M being the mass (of the universe) , and R_0 being a radii of a presumed spherical space, then if R_0 is the presumed radii of the universe

$$GM / R_0 c^2 \approx 1 \quad (22)$$

$$\begin{aligned} M_{Total} &\sim M_{DM} + M_{Baryon} + M_{DE} \\ &= N_{DM} m_{DM} + N_{Baryon} m_{Baryon} + N_{DE} m_{DE} \\ &\approx S_{DM} m_{DM} + S_{Baryon} m_{Baryon} + S_{DE} m_{DE} \end{aligned} \quad (23)$$

Here, total entropy of the Universe is assumed to be in the present era

$$S_{Total} \sim S_{DM} + S_{Baryon} + S_{DE} \quad (24)$$

2a. Does Eq. (30) pertain to DM, to DE, or both Entropy (numerical) counts?

The use of entropy as akin to particle count comes from two sources. First source is due to 'infinite quantum statistics' as given by Ng, i.e.

Begin with a partition function. As given by Ng [6]

$$Z_N \sim \left(\frac{1}{N!}\right) \cdot \left(\frac{V}{\lambda^3}\right)^N \quad (25)$$

This, according to Ng, leads to entropy of the limiting value of

$$S \approx N \cdot \left(\log\left[V / N\lambda^3\right] + 5/2\right) \quad (26)$$

But $V \approx R_H^3 \approx \lambda^3$, so unless N in Eq. (26) above is about 1, S (entropy) would be < 0, which is a contradiction. Now this is where Jack Ng introduces removing the N! term in Eq. (25) above, i.e., inside the Log expression we remove the expression of N in Eq. (26) above. This is a way to obtain what Ng refers to as Quantum Boltzmann statistics, so then we obtain for sufficiently large N

$$S \approx N \quad (27)$$

Alternately, but in the limit of late time cosmological constant behavior, Ron-Gen Cai writes [7]

$$S \le N \tag{28}$$

We will refer to a bound value as referenced by Cai [7], and also Bousso [21]. As given by

$$N \equiv \left[3\pi / G\Lambda \right] \tag{29}$$

Note, that the N of Eq.(29) refers, to degrees of FREEDOM, which is interesting, i.e. the total degrees of freedom will be shown to become enormous for sufficiently small Λ [21]

Pending a review of the situation, the following could be entertained, namely

$$N \equiv \left[3\pi / G\Lambda \right] \Leftrightarrow \Lambda(\text{large}) \Rightarrow N(\text{small}) \,\&\, \Lambda(\text{small}) \Rightarrow N(\text{large}) \tag{30}$$

2b. Does Eq. (28) and Eq. (30) pertain to DM, to DE, or both Entropy (numerical) counts?

What is being referred to is, the applicability of [21] Specifically, [21] refers to DM, and we should in answering our question ascertain if DM is the preferred venue for explaining the behavior of Eq. (30). In fact, if there is quintessence in terms of the cosmological constant parameter, as given by Eq.(9), then this may be able to explain why there is

$$\Lambda(\text{field}-\text{theory}) \sim 10^{122} \times \Lambda(actual - today) \tag{31}$$

As given by [22], there IS a linkage of black hole entropy with Λ as Vacuum energy, and L as a spatial length associated with Black holes. Then

$$\begin{aligned} & L^3\Lambda^3 \le S_{BH} = \pi L^2 M_p^2 \\ & \& L^3\Lambda^4 \le L M_p^2 \\ & \Leftrightarrow S_{Max} \sim S_{BH}^{3/4} \end{aligned} \tag{32}$$

Furthermore the following Figure 1 gives one an indication that DE may not be created in the beginning of space time evolution but is an artifact of later cosmological evolution.

If DE is not due to massive gravitons, as could be the case, then either quintessence (i.e. a varying vacuum energy over space-time due to perhaps a background average temperature) should be considered, as is indicated in our document, or else one of the Chapyron DM-DE models with DM and DE as different facets of the same evolutionary cosmological dynamic should be considered.

The question of DE as due to massive gravitons will be referenced as to determining if a multiverse is a feasible conjecture. The multiverse as will show up later is a way of making sense of the light value of a graviton mass, and Mistra's quantum cosmology conjecture. How the quantum cosmology conjecture works is also dependent upon if entropy is determined by a counting algorithm

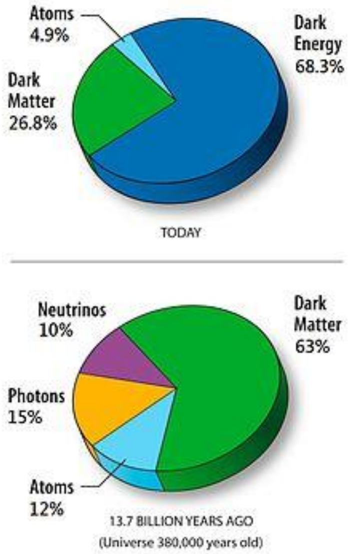

Figure 1, **as giving an initial configuration of space-time with no DE but with DM**

We argue that if there is temperature dependence, in vacuum energy as given by Eq. (9) And that if N, as a bound to entropy, is inversely proportional to vacuum energy, that according to Figure 1, that DM will NOT be affected, but that DE is an artifact of vacuum energy.

What the author deduces from the above, is that the bound to entropy, which is called N, as given by Eq. (29), with Λ given by Eq. (9), with Eq.(11) as backup is an artifact of DE, not DM. and that as a result, Figure 1, is saying that a bound to entropy which changes over time is likely due to quintessence, at least in the beginning, as given by the dynamics as of Figure 1 above. As of 13.7 billion years ago, the background temperature given by first light about 380 thousand years after the big bang was $10^5 Kelvin$, according to[23] As opposed to 3 degrees Kelvin today, so if Eq. (9) for vacuum energy is used, then if we associate Λ with DE

$$\begin{aligned} & Eq(9) \Rightarrow \Lambda_{DE}\left(10^5 \ Kelvin\right) << \Lambda_{DE}\left(3 \ Kelvin\right) \\ & \Leftrightarrow N_{DE}\left(10^5 \ Kelvin\right) >> N_{DE}\left(3 \ Kelvin\right) \end{aligned} \tag{33}$$

The temperature scaling given in Eq. (9) plus Figure 1 above, argues strongly against DM being created by Λ

2c. Refining Eq. (23) in lieu of Eq. (33)

As of about 380 thousand years after the big bang

$$\begin{aligned} & M_{Total} \sim M_{DM} + M_{Baryon} \\ & + M_{DE}(no - contribution - 380 - thousand - years - after - big - bang) \quad (34) \\ & \sim M_{DM} + M_{Baryon} \sim N_{DM} m_{DM} + N_{Baryon} m_{Baryon} \approx S_{DM} m_{DM} + S_{Baryon} m_{Baryon} \end{aligned}$$

2d. Filling in DM contribution to entropy, 380 thousand years after big bang

From Subodha Mistra [5] his quantum model of the big bang has the following

R is the presumed present radii of the universe, **m**, is the mass of an 'average' constituent particle , and **N** is the number of particles in a (model) universe, with tau being the time after the big bang, to the present era.

$m \times 10^{-35} g$	$R \times 10^{28} cm$	$N \times 10^{91}$	$M_{total} \times 10^{56} gm$	$\tau_0 \times 10^9 yr$
1.07299	1.896	2.38429	2.5582	20
1.23891	1.422	1.54865	1.91875	15
1.51744	0.948	0.84297	1.27916	10
2.14598	0.474	0.29804	0.639588	5

Table 1, From Subhodha Mistra, "The Quantum Theory of the Big Bang", p212 [5]

Assume there is a situation analogous to the Figure 1 circumstance 380 thousand years after the big bang, assume then that M, as a total mass of the universe does not change. Then, according to Mistra, [5] the average particle of the quantum universe is of the order of magnitude of an axion DM particle, i.e. $1.23 \times 10^{-35} g \sim 5.609 \times 10^{-2} eV$, whereas we are assuming that the entropy is similar to a numerical count of 'average' particles. Then

Axions have range of $10^{-6} - 20 \quad eV$ in value. Then by **Figure 1&table 1**, $S_{DM} \propto 10^{90} - 10^{91}$ (35)

Should we use Axions for DM, we have to look at the role of DE. I.e. DE is roughly 3-4 times more mass than DM. (figure 1).

2e. Discussing radical idea of Black hole atom as DM candidate, as alternative to Axions

[8] brings this idea to the fore with the adage that

Quote:

The idea of "black hole atoms" goes back a long way in several variations. Markov et al. proposed and studied in detail the model of maximons (or friedmons) [These objects are the particle-like gravitating systems (semi-closed worlds) with mass close to the Planck mass $10^{-5} grams$]. They may have in principle a large gravitational mass defect. Maximons are interesting for cosmological applications, in particular, because they have the particle-like properties and may be the enigmatic dark matter particles. The idea of micro black hole carrying the electric charge and having the orbiting electrons or protons at the outer (outside the horizon) orbits was discussed by Hawking

End of quote

Were this candidate chosen, then we should consider the feasibility of the following: **Are black holes, not only linked to cosmological information, as has been commonly supposed, but also to, to the formation (and destruction) of most cosmological matter-energy? The jury is out on this one. Black holes, as intense generators of GW, also may be linked to gravitons. Which leads to our next question,**

3^{rd} The DE we identify with gravitons. How feasible is this choice?

Then there are several alternatives, if say massive gravitons are an active source for DE, as has been postulated by [24, 25]

http://www.nature.com/news/fat-gravity-particle-gives-clues-to-dark-energy-1.13707

As well as Beckwith, http://journalofcosmology.com/BeckwithGraviton.pdf

If graviton has a mass of $2\times10^{-62}\,grams \sim 2.8\times10^{-30}\,eV$, then $S_{DE} \propto 10^{117} - 10^{118}$ (36)

This value for Eq. (35) is for the present era. I.e. if one is looking at say N in Eq. (29), Eq. (30), Eq. (31), with an initial temperature of, say 3 degrees Kelvin, and then Eq. (35) would hold. If $10^{32}\,Kelvin$ is used in Eq. (29), Eq. (30), Eq. (31), then

$$S_{DE}(10^{32}\,Kelvin) \approx \varepsilon^{+} << S_{DE} \propto 10^{117} - 10^{118}(present) \quad (37)$$

If there is no mass connected with gravitons, then gravitons cannot be conflated with DE.

A graviton mass of $2\times10^{-62}\,grams \sim 2.8\times10^{-30}\,eV$, will lead to gravitons as a candidate for DE. If the gravitons are massless, then the procedure of Mistra, with summation of the mass and information of Table 1 does not apply to DE. If so then, one can look at another representation of DE

So: the density of dark energy is constant, which means the curvature of space-time is constant, which means that the universe expands at a fixed rate.

3a The DE we identify with DE energy density and its role in cosmology.

What is DE energy density? If not connected with massive gravitons,

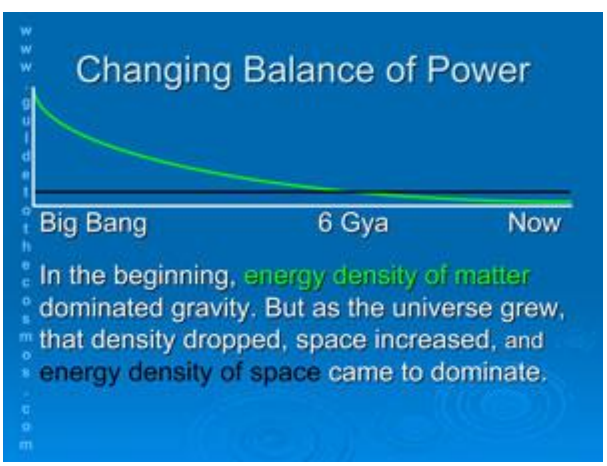

Figure 2, a conservative extrapolation as to DM/DE dynamics.

If massive Gravitons are not connected with Dark Energy, then what is the energy density of space? [26] , http://arxiv.org/pdf/1303.4067v3.pdf talks about using The Casimir effect as a candidate of Dark energy. i.e. use of fermionic structures, as opposed to the bosonic approach, of massive gravitons. I.e. if the casmir effect is used, then one is not going to need to refer to a particle-mass interpretation of DE. i.e. the Mistra quantum universe approach to DE is not valid. However,

[27], http://www.astro.caltech.edu/~george/ay21/readings/carroll.pdf gives that regardless of the mass, or lack of of a graviton, and if it is DE that one observes

$$\rho_{vacuum}\Big|_{Observed-today} \sim \rho_{vacuum}\Big|_{QFT-Calculated} \times 10^{112} \tag{38}$$

The factor of 10^{112} for difference in energy density due to vacuum energy This Eq. (38) should be compared with entropy from DE as calculated with 'todays' value of entropy of DE created by 'massive' gravitons

$$S_{DE} \propto 10^{117} - 10^{118} \tag{36}$$

The value of 10^{112} versus 10^{118} , i.e. Six orders of magnitude difference, will be discussed next

4th Entropy of Galaxies due to SMBH, versus Entropy of the Universe

We can assume that there are possibly many more than 1 million galaxies, i.e. 10^{6} to 10^{20} super massive black holes in the center of galaxies, and that up to a point, the entropy of a super massive black hole in the center of a galaxy is at most 10^{112}. To get an idea of what is going on, look at http://cds.cern.ch/record/549082/files/0204081.pdf

$$S_{BH}^{Total} \sim 3.2 \times 10^{101} \cdot \left(\frac{N}{10^{11}} \right) \times \left(\frac{M}{10^{7} \cdot M_{Sun}} \right) \sim S_{universe} \tag{37}$$

If so, then does the following make cosmological sense?

$$M \sim 10^{10} \cdot M_{Sun} \Leftrightarrow (?) N \sim 10^{20} - 10^{23} (?) \tag{38}$$

I.e. the numerical factor is then so high, if there are indeed many more than 1 million galaxies contributing to entropy, we may be indeed looking at the confluence of multiple universe contributions to our present entropy, if gravitons have a small mass i.e. We will first of all give a brief introduction to the Penrose CCC hypothesis generalized to a multiverse.

5th. Introducing an argument for a multiverse [10, 29]

Extending Penrose's suggestion of cyclic universes, black hole evaporation, and the embedding structure our universe is contained within, i.e. using the implications of a multi verse. This multiverse embeds BHs and may resolve what appears to be an impossible dichotomy.

That there are no fewer than N universes undergoing Penrose 'infinite expansion' (Penrose) [29] contained in a mega universe structure. Furthermore, each of the N universes has black hole evaporation, with the

Hawking radiation from decaying black holes. If each of the N universes is defined by a partition function, called $\{\Xi_i\}_{i\equiv N}^{i\equiv 1}$, then there exists an information ensemble of mixed minimum information correlated as about $10^7 - 10^8$ bits of information per partition function in the set $\{\Xi_i\}_{i\equiv N}^{i\equiv 1}\Big|_{before}$, so minimum information is conserved between a set of partition functions per universe

$$\{\Xi_i\}_{i\equiv N}^{i\equiv 1}\Big|_{before} \equiv \{\Xi_i\}_{i\equiv N}^{i\equiv 1}\Big|_{after} \tag{39}$$

However, there is non-uniqueness of information put into each partition function $\{\Xi_i\}_{i\equiv N}^{i\equiv 1}$. Furthermore Hawking radiation from the black holes is collated via a strange attractor collection in the mega universe structure to form a new big bang for each of the N universes represented by $\{\Xi_i\}_{i\equiv N}^{i\equiv 1}$. Verification of this mega structure compression and expansion of information with a non-uniqueness of information placed in each of the N universes favors ergodic mixing treatments of initial values for each of N universes expanding from a singularity beginning. The n_f value, will be using (Ng, 2008) $S_{entropy} \sim n_f$. . How to tie in this energy expression, as in Eq. (30) will be to look at the formation of a nontrivial gravitational measure as a new big bang for each of the N universes as by $n(E_i)$. the density of states at a given energy E_i for a partition function.

$$\{\Xi_i\}_{i\equiv 1}^{i\equiv N} \propto \left\{\int_0^\infty dE_i \cdot n(E_i)\cdot e^{-E_i}\right\}_{i\equiv 1}^{i\equiv N}. \tag{40}$$

Each of E_i identified with Eq. (40) above, are with the iteration for N universes (Penrose,) [29] .Then the following holds, namely

5, a Number of universes affecting partition function and averaging.

$$\frac{1}{N}\cdot\sum_{j=1}^{N}\Xi_j\Big|_{j-before-nucleation-regime}\xrightarrow{vacuum-nucleation-tranfer}\Xi_i\Big|_{i-fixed-after-nucleation-regime} \tag{41}$$

For N number of universes, with each $\Xi_j\Big|_{j-before-nucleation-regime}$ for j = 1 to N being the partition function of each universe just before the blend into the RHS of Eq. (41) above for our present universe. Also, each of the independent universes given by $\Xi_j\Big|_{j-before-nucleation-regime}$ are constructed by the absorption of one to ten million black holes taking in energy**. I.e. (Penrose)** [29]. Furthermore, the main point is similar to what was done in [29] in terms of general ergodic mixing

5b Ergodic mixing of partition function contribution[30]

$$\Xi_j\Big|_{j-before-nucleation-regime} \approx \sum_{k=1}^{Max}\tilde{\tilde{\Xi}}_k\Big|_{black-holes-jth-universe} \tag{42}$$

What is done in **5a and 5b** is to come up with a protocol as to how a multi-dimensional representation of black hole physics enables continual mixing of space-time largely as a way to avoid the Anthropic principle, as to a preferred set of initial conditions. With investigations, this complex multiverse allows bridging what seems to be an unworkable dichotomy between ultra-low graviton frequency, corresponding roughly to 10^-65 grams in rest mass , easily satisfied by Kerr black holes with rotational frequencies, as given in out text as many times greater, combined with the absurdity of what is Eq. (29). How can a graviton with a wavelength 10^ - 4 the size of the universe interact with a Kerr black hole, spatially. Embedding the BH in a multiverse setting may be the only way out. **5c** is particularly important. The idea here is to use what is known as CCC cosmology, which can be thought of as the following.

5c. Our review of CCC cosmology with our revision of a multiverse put in [10, 29]

First. Have a big bang (initial expansion) for the universe. After redshift z = 10, a billion years ago, SMBH formation starts. Matter- energy is vacuumed up by the SMBHs, which at a much later date than today (present era) gather up all the matter-energy of the universe and recycles it in a cyclic conformal translation, as follows, namely

$$
\begin{aligned}
&E = 8\pi \cdot T + \Lambda \cdot g \\
&E = source \quad for \quad gravitational \quad field \\
&T = mass \quad energy \quad density \\
&g = gravitational \quad metric
\end{aligned} \tag{43}
$$

$$\Lambda = vacuum \quad energy, rescaled \quad as \quad follows$$

$$\Lambda = c_1 \cdot [Temp]^{\beta} \tag{44}$$

C1 is, here a constant. Then

The main methodology in the Penrose proposal has been in Eq. (44) evaluating a change in the metric g_{ab} by a conformal mapping $\hat{\Omega}$ to

$$\hat{g}_{ab} = \hat{\Omega}^2 g_{ab} \tag{45}$$

Penrose's suggestion has been to utilize the following [17]

$$\hat{\Omega} \xrightarrow[ccc]{} \hat{\Omega}^{-1} \tag{46}$$

In fall into cosmic black hopes has been the main mechanism which the author asserts would be useful for the recycling apparent in Eq.(46) above with the caveat that $\hbar$ is kept constant from cycle to cycle as represented by

$$\hbar_{old-\text{cosmology}-cycle} = \hbar_{present-\text{cosmology}-cycle} \tag{47}$$

Eq. (46) is to be generalized, as given by a weighing averaging. Also, if Eq. (47) does not happen, we are in for chaos as far as consistency in physical law. Changing Eq. (47) would lead to most universes not having consistent cosmological evolution. I.e. most universes not adhering to Eq. (47) would not be stable and would collapse and fail to evolve.

6. Conclusions

As stated on page two, and restated here:

1st First of all, if there are massive gravitons, i.e. gravitons with mass, as well as Mishra's quantum universe procedure, with Machian universe behavior, then one should consider the multiverse.

2nd Secondly, a straightforward application of Mishra's quantum universe, if there is no mass attached to the graviton, yields an average mass of the universe consistent with axions as a preferred DM candidate. If that is the case, then the DE value as given in Figure 1 above is consistent with another candidate than massive gravitons.

3rd. The most unusual suggestion the author for DM is a candidate for DM consistent with mini black hole "atoms". As reviewed by the author, this suggestion appears to be contravened by Mishra's quantum cosmology model. But Mishra's quantum cosmology model appears to require Machian universe dynamics. Should Machian dynamics for the present universe not hold, then this innovative approach cannot be discarded.

Finally, the implications of Ergodic mixing cannot be overlooked, and should be further developed along the lines in [30]. If the multiverse hypothesis is to be entertained and investigated, seriously, then another older idea should be vetted and explored. As given in [31], open universes from bubbles, which would lead to understanding the dynamics of the following system of space-time evolution, i.e.

$$\left(\Box - \left. \frac{\delta^2 V}{\delta \phi^2} \right|_{\phi = \phi_{bkgd}} \right) \delta\phi = 0 \qquad (48)$$

This would be using the Bunch Davies vacuum fluctuation, and the question would be in identifying different bubbles which may have starting points due to [9,10], as well as [30].

Acknowledgements

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