Upper Bound in Change in Initial Value for "Time Component" of Pre Planckian Metric Tensor, for a Cosmological "Constant" Universe

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Abstract

Beginning with Pebble's restatement of the Roberson-Walker line element, we obtain a way, afterwards, to calculate the relationship between an initial value of the "cosmological constant" and the value of fluctuations in the time component of the metric tensor g (tot). We assume, in doing so that the value of the cosmological "constant" does not change from its initial formation. We close with speculations as to how this ties into other issues in the conclusion.

Keywords

1. Basics, *i.e.* Roberson Walker Metric, Hubble Parameter, and Initial Density

We start off with using the Roberson Walker metric, *i.e.* using [1] and in doing so, referencing page 74 of [1] we have that if we access using R as the radius of a 3 sphere, in the Line metric, for the Roberson-Walker formulation, as well as a fixed volume of space, occupied cosmologically after a world line time, *t*, as

$$V\left(\text{3-sphere-volume}\right) = 2\pi^2 \left(a(t)\cdot R\right)^3 \qquad (1)$$

Here, $a(t)$ is a scale factor, with the scale factor = 1 in the present era, and being as low as 10 - 55 in Planck time regimes. If so then, if we speculate upon a density drop off, given phenomenologically by

$$\rho\left(\text{Space-time-energy-density}\right) \sim \rho = \rho\left(\text{initial}\right)\cdot \exp\left(-\tilde{\tilde{\alpha}}t\right) \qquad (2)$$

And, then use of the evolution Equation (3), on the LHS, the time derivative of density, as given by

$$\dot{\rho} = -3H \cdot \left(\rho + \left(P/c^2 \right) \right) \tag{3}$$

As well as looking at the generalized Chapyron Gas model for DM and DE [2] given as

$$P = -A/\rho^\omega ; 0 \le \omega \le 1 \tag{4}$$

Then the density function for space time, as referenced in Equation (2) has an initial value of the form, if the volume is proportional to the cube of Planck length, l_P^3, then we will write, to first approximation, where $A = 1/3$ by the radiation regime of space-time. Here we are assuming an invariant Λ for the cosmological constant, with its value in early time the same as today, *i.e.* no Quintessence

$$\rho \sim \frac{3}{\tilde{\tilde{\alpha}}} \cdot (1 \pm A) \cdot \Lambda + H.O.T \tag{5}$$

The rest of this document will use a derivation by the author modified HUP [3] as to this Equation (5).

2. Basic Background on the Heisenberg Uncertainty Principle, as Used by This Document

$$\left(\Delta l \right)_{ij} = \frac{\delta g_{ij}}{g_{ij}} \cdot \frac{l}{2}$$
$$\left(\Delta p \right)_{ij} = \Delta T_{ij} \cdot \delta t \cdot \Delta A \tag{6}$$

If we use the following, from the Roberson-Walker metric [3] [4] [5] [6].

$$g_{tt} = 1$$
$$g_{rr} = \frac{-a^2(t)}{1 - k \cdot r^2}$$
$$g_{\theta\theta} = -a^2(t) \cdot r^2 \tag{7}$$
$$g_{\phi\phi} = -a^2(t) \cdot \sin^2\theta \cdot d\phi^2$$

Following Unruh [5] [6], write then, an uncertainty of metric tensor as, with the following inputs

$$a^2(t) \sim 10^{-110}, r \equiv l_P \sim 10^{-35} \text{ meters} \tag{8}$$

Then, the surviving version of Equation (6) and Equation (7) is, then, if $\Delta T_{tt} \sim \Delta\rho$ [3] [4] [5] [6]

$$V^{(4)} = \delta t \cdot \Delta A \cdot r$$
$$\delta g_{tt} \cdot \Delta T_{tt} \cdot \delta t \cdot \Delta A \cdot \frac{r}{2} \ge \frac{\hbar}{2} \tag{9}$$
$$\Leftrightarrow \delta g_{tt} \cdot \Delta T_{tt} \ge \frac{\hbar}{V^{(4)}}$$

Equation (9) is such that we can extract, up to a point the HUP principle for uncertainty in time and energy, with one very large caveat added, namely if we use the fluid approximation of space-time [7]

$$T_{ii} = diag\left(\rho, -p, -p, -p\right) \tag{10}$$

Then by [3]

$$\Delta T_{tt} \sim \Delta\rho \sim \frac{\Delta E}{V^{(3)}} \tag{11}$$

Then, by [3]

$$\delta t \Delta E \geq \frac{\hbar}{\delta g_{tt}} \neq \frac{\hbar}{2} \tag{12}$$

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

3. Estimating of the Δg_{tt} Term in Equation (12), as the Conclusion, with Consequences

The summary of what we obtain here, is if

$$\rho \sim \frac{3}{\tilde{\tilde{\alpha}}} \cdot (1 \pm A) \cdot \Lambda + H.O.T \sim \frac{\Delta E}{l_p^3}$$

$$\& \ A = 1/3 \, (\text{radiation}) \tag{13}$$

$$\Leftrightarrow \Delta g_{tt} \sim \frac{\hbar \tilde{\tilde{\alpha}}}{\left(t_{\min} \sim \text{Planck-time}\right)} \cdot l_p^3 \cdot (1 \pm A) \cdot \Lambda_{\text{Today's-value}}$$

For our purposes, this corresponds to having $\tilde{\tilde{\alpha}}$ fairly large but not infinite, but also the decisive factor in the reduction of energy density as given in Equation (2), *i.e.* that even in the Pre Planckian regime, that we position the energy density for a dramatic drop in value. We do this preparation for a reduction in the energy density so that the value of Δg_{tt} is very small and consistent with [8]. And also, what we are referring to as a phase shift, as for a change of state in the HUP, as delineated below:

$$\delta t \Delta E \geq \left.\frac{\hbar}{\delta g_{tt}}\right|_{\text{Pre-Octonionic}} \xrightarrow[\text{change in phase, given byp phase } \delta_0]{} \delta t \Delta E \geq \hbar\big|_{\text{Octonionic}} \tag{14}$$

$$\text{with } \delta t \geq \frac{\hbar}{\delta g_{tt} \Delta E} \text{FIXED}$$

This matter of Octonionic and Pre Octonionic is being pursued separately by the author, but the notice of a phase shift, is in work which is consistent with work which Dr. Li and Dr. Yang did, in [9] and the reader can access Octonionic and Pre Octonionic states by the following:

Keep in mind one basic fact. If we restrict ourselves solely to Octonionic geometry, we are embedded deeply in only what the Standard Model of physics allows. We should though understand what is implied by the physics of the Octonionic structure and so the rest of this first discussion is devoted to it.

In [10], Wilson gives a generalized structure as to Octonionic geometry, and it is a generalized way to introduce higher level geometry into the formation of standard model physics. Crowell, in [11] examines its applications as to pre-

sumed space-time structure. Also note what is said in [12] the take away from it, is that as quoted from [12], that there exists

Quote:

(A linkage to the) *mathematics of the division algebras and the Standard Model of quarks and leptons with* U (1) × SU (2) × SU (3) *gauge fields.*

End of quote:

Once again, if we have only U (1) × SU (2) × SU (3) *gauge fields, we have only the standard model, and that if we wish to have a minimum time step, we need to go beyond the standard model.*

The division algebras are linked to Octonionic structure in a way which is touched upon by Crowell [11], but the main take away is that in the Pre-Planckian space-time regime, that there was specific inputs which may explain some of the findings of [13] from a different perspective. As well as [14], it is worth reading, *i.e.* the reader, [15] as well as Reference [16] for Baez's summary as to the properties of Octonions as well. We also claim that resolution of these details will be important in falsification of the argument given in [17] as well. The uncertain principle as utilized can be checked against the generalized HUP as given in [18], and if or not a phase shift in early universe signals, GW, or what have you as given in [19] occurs, may give insight as to if there are extra dimensions as alleged in [20].

It is worth reviewing if this construction meets the experimental gravitational tests mentioned in [21] by Abbot *et al.* of LIGO which started experimental gravitational astronomy. Furthermore, the considerations of Octonionic space-time theory should be checked against the experimental tests mentioned by Corda, in [22] which could confirm or falsify different gravitational theoretical models. In addition, this can be further refined by the 2nd Abbot paper, [23] which did a different mass range of black hole binary, as of [21].

In addition, all these can be used to also vet if [24], by Penrose, *i.e.* cyclic conformal cosmology, as written, is ruled out or confirmed by various experimental and modeling tests.

Acknowledgements

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