

Does QM embedded in 5th dimensional embedding come about due to an initial Inflaton field?

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Abstract

We consider if a generalized HUP set greater than or equal to Planck's constant divided by the square of a scale factor as well as an inflation field, yield the result that Delta E times Delta t is embedded in a 5 dimensional field which is within a deterministic structure. Our proof ends with Delta t as of Planck time yielding an enormous potential energy. If that potential energy is induced by a repeating universe structure, we get for free a value of Delta E Delta t almost infinite in value which supports a prior conclusion

I. Introduction and summary as of the ideas of this document'

In this document we are revisiting the following statement made earlier [1] [2]

Quote

Using the following

$$T_{ii} = \text{diag}(\rho, -p, -p, -p) \quad (1)$$

Then

$$\Delta T_{tt} \sim \Delta \rho \sim \frac{\Delta E}{V^{(3)}} \quad (2)$$

Then, Eq. (1) and Eq. (2) together yield

$$\delta t \Delta E \geq \frac{\hbar}{\delta g_{tt}} \neq \frac{\hbar}{2} \quad (3)$$

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

What we are going to do is to, in the initial variation of the GUP is to look hard at the initial idea given in Eq.(3) is to make the following treatment at the start of expansion of the Universe[1][2][3]

$$\delta g_{tt} \sim a^2(t) \cdot \phi \ll 1 \quad \text{Goes to become effectively almost ZERO.} \quad (4)$$

If this is effectively almost zero, the effect would be to embed Quantum mechanics within a 5 dimensional structure

Snip

I.e. this deterministic embedding is in part in spirit similar to what is given by Wesson [3]

End of quote

What we will be doing is to add more context to this is to use the Wesson result directly in our own work and use it to in effect prove a deterministic contribution in line with Eq. (3) and Eq. (4) of this document

II. Modus operandi, state clearly what is given in terms of an inflaton field

Before proceeding we should state that the inflaton field so used in Eq. (3) and Eq. (4) satisfies the following [4][5][6]

$$\begin{aligned} a(t) &= a_{initial} t^\nu \\ \Rightarrow \phi &= \ln \left(\sqrt{\frac{8\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t \right)^{\sqrt{\frac{\nu}{16\pi G}}} \\ \Rightarrow \dot{\phi} &= \sqrt{\frac{\nu}{4\pi G}} \cdot t^{-1} \\ \Rightarrow \frac{H^2}{\dot{\phi}} &\approx \sqrt{\frac{4\pi G}{\nu}} \cdot t \cdot T^4 \cdot \frac{(1.66)^2 \cdot g_*}{m_p^2} \approx 10^{-5} \end{aligned} \quad (5)$$

In the spirit of use of the inflaton field what we will propose is that

$$\phi = \ln \left(\sqrt{\frac{8\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t \right)^{\sqrt{\frac{\nu}{16\pi G}}} \approx \sqrt{\frac{\nu}{16\pi G}} \cdot \left(\sqrt{\frac{8\pi G V_0}{\nu \cdot (3\nu - 1)}} \cdot t - 1 \right) \quad (6)$$

i.e. assume that if the initial time step is near Planck time which is normalized to 1 that

$$V_0 \approx \text{initial - energy} \quad (7)$$

In addition we will go to Wesson [7] and to make the following adjustments

III. Wesson's treatment of embedding of the HUP in deterministic structure [7]

$$|dp_\alpha dx^\alpha| \approx \frac{L}{l} \cdot \frac{h}{c} \cdot \left[\frac{dl}{l} \right]^2 \quad (8)$$

Where we will define l and L as follows

First, define L in terms of the cosmological "constant" by [7]

$$\Lambda = \frac{1}{3L^2} \quad (9)$$

Also[7]

$$dS_{5-d}^2 = \frac{L^2}{l^2} dS_{4-d}^2 - \frac{L^4}{l^4} dl^2 \quad (10)$$

Also 5 dimensional wave number is defined via

$$K_l = 1/l \quad (11)$$

In the case of Pre Planckian space-time the idea is to do the following[7]

$$\begin{aligned} |dp_\alpha dx^\alpha| &\approx \frac{L}{l} \cdot \frac{h}{c} \cdot \left[\frac{dl}{l} \right]^2 \\ \xrightarrow{\alpha=0} |dp_0 dx^0| &= |\Delta E \Delta t| \approx (h / a_{init}^2 \phi(t)) \quad (12) \\ \Rightarrow \frac{L}{l} \cdot \frac{h}{c} \cdot \left[\frac{dl}{l} \right]^2 &\approx (h / a_{init}^2 \phi(t_{init})) \end{aligned}$$

Making use of all this leads to[7]

$$\int_{l_1}^{l_2} dl / l^{3/2} \approx \frac{(l_2 - l_1)}{l^{3/2}(c)} \approx \frac{(3\Lambda)^{1/4}}{a_{init} \cdot \left(\frac{\nu}{16\pi G} \right)^{1/4} \cdot \left(\sqrt{\nu \cdot (3\nu - 1)} \cdot t - 1 \right)^{1/2}} \quad (13)$$

IV. Extracting time initial from Eq. (13) and what if time is equal to Planck time? Extract V_0

Our approximation is to set $G = 1 = h$ (Planck units) with Planck time normalized to 1. Then

$$t = t_{planck} \rightarrow 1 = \sqrt{\frac{\nu(3\nu-1)}{8\pi V_0}} + \sqrt{\frac{2 \cdot (3\nu-1)}{V_0} \cdot \frac{a_{init}^2 \cdot (l_2 - l_1)^2}{l^3(c) \cdot (3\Lambda)^{1/2}}} \quad (14)$$

Then we have that at Planck time, normalized to 1 we look at

$$V_0 = \left(\sqrt{\frac{\nu(3\nu-1)}{8\pi}} + \sqrt{2 \cdot (3\nu-1)} \cdot \frac{a_{init}^2 \cdot (l_2 - l_1)^2}{l^3(c) \cdot (3\Lambda)^{1/2}} \right)^2 \quad (15)$$

V. End game, in initial configuration in Planck time, make the following assumption

We assume that we have an emergent space-time. If so, and

$$V_0 = \left(\sqrt{\frac{\nu(3\nu-1)}{8\pi}} + \sqrt{2 \cdot (3\nu-1)} \cdot \frac{a_{init}^2 \cdot (l_2 - l_1)^2}{l^3(c) \cdot (3\Lambda)^{1/2}} \right)^2 \approx \Delta E \quad (16)$$

Implication is, that if we use the present value of the cosmological constant, Λ that the initial energy, as induced by Eq. (16) becomes almost infinite, thereby confirming by default what is brought up by Eq. (4)

VI. Conclusion, i.e. our value of the initial energy specifies an almost infinite value, so does this confirm deterministic embedding of the HUP initially in 5 dimensions, in a deterministic structure ?

We argue it does, because Eq. (16) still uses the 5 dimensional inputs specified by l which is one over a wave number in an additional dimension of space time. Furthermore we can also compare this expression in (16) with[4]

$$V_0 = \left(\frac{.022}{\sqrt{qN_{efolds}}} \right)^4 = \frac{\nu(\nu-1)\lambda^2}{8\pi Gm_p^2} \quad (17)$$

‘ λ ’ as a dimensionless parameter. From [4] we have a Chamelon mechanism for fifth force as [4]

$$F_{5th-force} = -\frac{\tilde{\beta} \cdot (\vec{\nabla} \phi)}{m_p} \quad (18)$$

We use here in Pre Planckian conditions

$$t = \frac{r}{\omega c} \quad (19)$$

First, r is almost Planck in length, if so then

Using this instead of the ω_{gw}^6 expression, then write the rest of it as follows which would have a minimum value as[4][8]

$$\begin{aligned}
\omega_{gw}^6 &\approx c^7 \times \frac{\tilde{\beta}}{2m_p r} \cdot \sqrt{\frac{v}{\pi G}} \times \frac{1}{Gc \cdot (M_{mass})^2 \langle r^2 \rangle^2} \\
\Rightarrow \omega_{gw} &\approx G, m_p, r \approx \ell_p \xrightarrow{\text{Planck-normalization}} 1 \\
M_{mass} &\approx \zeta \cdot m_p \xrightarrow{\text{Planck-normalization}} \zeta \\
\langle r^2 \rangle^2 &\approx \ell_p^4 \xrightarrow{\text{Planck-normalization}} 1 \\
\therefore \omega_{gw} &\xrightarrow{\text{Planck-normalization}} \left(\sqrt{\frac{v}{4\pi}} \times \frac{\tilde{\beta}}{(\zeta)^2} \right)^{1/6}
\end{aligned} \tag{20}$$

$$\omega_{gw} \approx \frac{c^{7/6} \tilde{\beta}^{1/6}}{(2m_p r)^{1/6}} \cdot \left(\frac{v}{\pi G} \right)^{1/12} \cdot \frac{1}{\left(Gc M_{Mass}^2 \cdot \langle r^2 \rangle^2 \right)^{1/6}} \text{ so if } G = m_p = \ell_p = 1 \tag{21}$$

We then will conclude this by stating the join with Eq. (16) and (17) so (22)

$$\lambda = \left(\sqrt{\frac{v(3v-1)}{8\pi}} + \sqrt{2 \cdot (3v-1) \cdot \frac{a_{init}^2 \cdot (l_2 - l_1)^2}{l^3(c) \cdot (3\Lambda)^{1/2}}} \right) \cdot \sqrt{\frac{8\pi}{v(v-1)}}$$

In doing so, we have thoroughly planted 5 dimensional lengths as given by l into our analysis, with the caveat the value of Eq. (16) and Eq. (17) can become enormous with a small enough value of

the cosmological constant. Note that the expression $\frac{(l_2 - l_1)^2}{l^3(c)}$ has two lengths, l_2 and l_1 in 5

dimensions, with the first length, l_2 larger in magnitude than l_1 and $l^3(c)$ being the cube of the length,

$$l_2 > l(c) > l_1 \tag{23}$$

And

$$a_{init} \approx 10^{-40} \tag{24}$$

Finally the power of initial gravitational waves at the start of the universe is such that[4][8][9]

$$\begin{aligned}
P_{GW} &\approx \frac{Gc \cdot (M_{mass})^2 \omega_{gw}^6 \langle r^2 \rangle^2}{c^6} \\
&\approx c \times \left| F_{5th-force} \right| = \left| -c \times \frac{\tilde{\beta} \cdot (\vec{\nabla} \phi)}{m_p} \right| \approx c \times \frac{\tilde{\beta}}{2m_p r} \cdot \sqrt{\frac{v}{\pi G}}
\end{aligned} \tag{25}$$

This will allow for setting $\tilde{\beta}$

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