Journal of High Energy Physics, Gravitation and Cosmology, 2018, 4, 8-13
http://www.scirp.org/journal/jhepgc
ISSN Online: 2380-4335
ISSN Print: 2380-4327

Gedankenexperiment for Contributions to Cosmological Constant from Kinematic Viscosity Assuming Self Reproduction of the Universe with Non-Zero Initial Entropy

Andrew Walcott Beckwith

Physics Department, College of Physics, Chongqing University Huxi Campus, Chongqing, China
Email: Rwill9955b@gmail.com

How to cite this paper: Beckwith, A.W. (2018) Gedankenexperiment for Contributions to Cosmological Constant from Kinematic Viscosity Assuming Self Reproduction of the Universe with Non-Zero Initial Entropy. *Journal of High Energy Physics, Gravitation and Cosmology*, **4**, 8-13.
https://doi.org/10.4236/jhepgc.2018.41002

Received: September 15, 2017
Accepted: December 30, 2017
Published: January 2, 2018

Abstract

This paper is to address using what a fluctuation of a metric tensor leads to, in pre Planckian physics, namely with a small δg_{tt}, affected by a small nonsingular region of space-time. The resulting density will be of the form $\frac{\Delta\rho}{\Delta t} \sim (\text{visc}) \times \left(H_{\text{int}}^2\right) \times a^4$ with the first term, on the right viscosity, of space-time, the 2nd on the right the square of an initial expansion rate, and due to the nonsingular nature of initial space time the fourth power of a scale factor, with $a \sim a_{\text{init}} \sim 10^{-55}$. We apply these density alteration tools to a criterion of self-replication of the universe, as written up by Mukhanov, as to how classical and quantum inflaton variations lead to understanding if the initial inflaton field of the Universe will be "growing", or shrinking with. The first contribution to the initial alteration of the inflaton is classical, equivalent to minus the inverse of the inflaton field, and the second quantum mechanically based alteration of the inflaton is a "mass" term times an initial inflaton field. If this change in inflaton is positive, it means that domains of space time are increasing, and this is dependent upon the effective mass term we calculate in this manuscript. Finally after we do this we state how this relates to a formulation of the initial change in the Cosmological "constant" as given by $\Delta\Lambda_{\text{initial}} \sim M_{\text{total-space-time-mass}}$ as well as heavy gravity issues.

Keywords

Emergent Time, Heavy Gravity, Metric Tensor Perturbations, HUP

1. Introduction

We use Mukhanov's "self-reproduction of the universe" criteria [1] plus Padmahan's inflaton value [2] in the case of $a(t) \sim a_{\text{starting-point}} \cdot t^{\alpha}$ in order to come up with a criterion as to initial mass. We also will be examining the influence of [3]

$$\frac{\Delta\rho}{\Delta t} \sim (\text{visc}) \times \left(H_{\text{int}}^2\right) \times a^4 . \tag{1}$$

With the initial Hubble parameter, in this situation a constant value in the Pre Planckian regime of space-time, instead of the usual

$$H_{\text{Hubble}} = \dot{a}/a . \tag{2}$$

Also, visc in Equation (1) is for a viscous "fluid" approximation in a non-singular regime of space-time , where we are using [4] explicitly, namely, that we have initially due to [5] and the proportionality of energy to Boltzman's constant times temperature [6]

$$\Delta t_{\text{initial}} \sim \frac{\hbar}{\delta g_{tt} E_{\text{initial}}} \sim \frac{2\hbar}{\delta g_{tt} k_B T_{\text{initial}}} . \tag{3}$$

If so, then Equation (1) and Equation (3) will give, to first approximation

$$\begin{aligned} \Delta\rho &\sim (\text{visc}) \times \left(H_{\text{int}}^2\right) \times a^4 \times \frac{2\hbar}{\delta g_{tt} k_B T_{\text{initial}}} \\ &\sim (\text{visc}) \times \left(H_{\text{int}}^2\right) \times a_{\text{init}}^2 \times \frac{2\hbar}{\phi_{\text{inf}} k_B T_{\text{initial}}} \end{aligned} . \tag{4}$$

Here, we will be using an inflaton given by [2]

$$\begin{aligned} & a \approx a_{\min} t^{\gamma} \\ & \Leftrightarrow \phi \approx \sqrt{\frac{\gamma}{4\pi G}} \cdot \ln\left\{\sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma - 1)}} \cdot t\right\} \end{aligned} . \tag{5}$$

Which is also in tandem with a Potential term given by

$$V \approx V_0 \cdot \exp\left\{-\sqrt{\frac{16\pi G}{\gamma}} \cdot \phi(t)\right\} . \tag{6}$$

These will be used in the rest of this paper, for our derivations, which will be in tandem with an emergent Cosmological Constant parameter which is in tandem with an alteration of the initial Penrose singularity theorem as brought up in [7] [8], which would also be in tandem with an emergent cosmological constant parameter which we bring up next.

2. Emergent Cosmological Parameter, in the Pre Planckian to Planckian Space-Time Regime

Start off with a definition of

$$\Delta\Lambda \sim \left(\alpha^2 \sim \frac{1}{(137)^2}\right) \times M_{\text{initial}}^4 . \tag{7}$$

With volume defined in four space by

$$V_{\text{volume(initial)}} \sim V^{(4)} = \delta t \cdot \Delta A_{\text{surface-area}} \cdot \left(r \le l_{\text{Planck}}\right). \tag{8}$$

And with the "three volume" defined above, with the time factored out. So then we will be looking at initial mass given by

$$M_{\text{initial}} \sim \Delta A_{\text{surface-area}} \cdot \left(r \le l_{\text{Planck}}\right) \times (\text{visc}) \times \left(H_{\text{int}}^{2}\right) \times a_{\text{init}}^{2} \times \frac{2\hbar}{\phi_{\text{inf}} k_B T_{\text{initial}}}. \tag{9}$$

And initial scale factor given as [4]

$$\begin{aligned} &\alpha_0 = \sqrt{\frac{4\pi G}{3\mu_0 c}} B_0 \\ &\hat{\lambda}(\text{defined}) = \Lambda c^2/3 \\ &a_{\min} = a_0 \cdot \left[\frac{\alpha_0}{2\hat{\lambda}(\text{defined})}\left(\sqrt{\alpha_0^2 + 32\hat{\lambda}(\text{defined}) \cdot \mu_0 \omega \cdot B_0^2} - \alpha_0\right)\right]^{1/4} \end{aligned} \tag{10}$$

Here, the minimum scale factor has a factor of Λ which we interpret as today's value of the cosmological constant. B is the early cosmological B field, the Frequency of the order of 10 ^ 40 Hz, and $a_{\min} \sim a_{\text{initial}} \sim 10^{-55}$.

We will be combining the above into a commentary on Equation (7) to Equation (10) next.

3. The Emergent Cosmological Constant Parameter Is Affected, Immediately by a Visc (Viscous) Fluid Parameter

We also can restate the above behavior with an initial mass density we can give as

$$\Delta\rho \sim \left[V_3(\text{volume})\right]^{-1} \times N_{\text{initial-count}} \times m_{\text{graviton}}. \tag{11}$$

And, after Using Ng. Infinite quantum statistics [9] and a massive graviton [10]

$$\begin{aligned} &M_{\text{initial}} \sim \Delta A_{\text{surface-area}} \cdot \left(r \le l_{\text{Planck}}\right) \times (\text{visc}) \times \left(H_{\text{int}}^{2}\right) \times a_{\text{init}}^{2} \times \frac{2\hbar}{\phi_{\text{inf}} k_B T_{\text{initial}}} \\ &\quad \sim N_{\text{gravitons}} \cdot m_{\text{gravitons}} \\ &\Leftrightarrow N_{\text{gravitons}} \sim \frac{\Delta A_{\text{surface-area}}}{m_{\text{gravitons}}} \cdot \left(r \le l_{\text{Planck}}\right) \times (\text{visc}) \times \left(H_{\text{int}}^{2}\right) \times a_{\text{init}}^{2} \times \frac{2\hbar}{\phi_{\text{inf}} k_B T_{\text{initial}}} \end{aligned} \tag{12}$$

We found that the above would yield an $N \sim 10^4$ or so, which is not zero, but is only nonzero if we have the visc term not equal to zero in the initial bubble of space-time, and also that we observe having

$$\begin{aligned} &a \approx a_{\min} t^{\gamma} \\ &\Leftrightarrow \phi \approx \sqrt{\frac{\gamma}{4\pi G}} \cdot \ln\left\{\sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma - 1)}} \cdot t\right\}. \\ &\& \ \phi > 0 \ \text{iff} \sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma - 1)}} \cdot \delta t > 1 \end{aligned} \tag{13}$$

This puts a major restriction upon admissible V_0 and δt terms, for our problem.

In addition we postulate that the existende of massive gravitons is syominous with the classical-quantum mechanics linkage as given in [11], *i.e.* on page 121 of [11] the authors manage to convert a D' Alembert wave equation is converted to a Schrodinger equation, if the group velocity is included as having the form

$$v_{\text{group}} \propto E \Big/ \sqrt{2(E-V)} < c \,. \tag{14}$$

Presumably in [11] the normalization of $c = 1$ means that (14) is if it refers to an equation like the D'Alembert equation one for which it has classical behavior, to the Schrodinger equation.

Note that as given in [4] that massive gravitons travel at less than the speed of light. Our suggestion is that by inference, those massive gravitons, then would be commensurate with the HUP which we brought up in this document and that the formulation is consistent.

All this should also be tied into an investigation of how the viscosity of Equation (4) would also tie into the results above, with the interplay of Equation (3) and Equation (4) maybe giving by default some information as to condition for which the quantization condition linkage in the classical regime (represented by the Classical De Alembert equation) and the quantum Schrodinger equation have analogies in our model.

4. Conclusions: And Now for the Use of the Idea of Mukhanov's Self Reproduction of the Universe

And now back to [1]. We have defined the initial mass, and done it with an eye toward a constraint condition upon the entries into Equation (12). It is now time to go to the problem of if evolution of the inflaton will allow us to have classical and quantum contributions to the inflaton which if we follow Mukhanov's will lead to the inflaton growing if and only if

$$\begin{aligned}&\Delta\phi_{\text{total}} = \Delta\phi_{\text{classical}} + \Delta\phi_{\text{quantum}} \sim -\phi_{\text{inf}}^{-1} + M_{\text{total}}\phi_{\text{inf}} > 0 \\ &\Leftrightarrow \phi_{\text{inf}} > \left(1/M_{\text{total}}\right)^{1/2}\end{aligned} \,. \tag{15}$$

We need to satisfy Equation (11) and Equation (12) in order to make sense out of Equation (15).

Furthermore, though, the number *N*, of Equation (12) will be nonzero and well behaved with a nonzero real value for positive *N* and entropy only if we have

$$\phi > 0 \ \text{ iff } \sqrt{\frac{8\pi G V_0}{\gamma \cdot (3\gamma - 1)}} \cdot \delta t > 1 \,. \tag{16}$$

This also is the same condition for which we would have to have visc, *i.e.* the viscosity of the initial spherical starting point for expansion, nonzero as well as reviewing the issues as of [12]-[18].

We argue that the formulation of Equation (15) and Equation (16) would be, with the inclusion of the mass of the graviton, especially as in $\phi_{\inf} > \left(1/M_{\text{total}}\right)^{1/2}$ as a precondition for steady growth of the inflaton, in cosmological expansion as out lined in [1] will provide a template for a non zero initial entropy as that N, in the denominator of $\phi_{\inf} > \left(1/M_{\text{total}}\right)^{1/2}$ if set equal to zero would imply far more stringent conditions than what is given in Equation (16) above, *i.e.* Infinite initial values of the inflaton, initially even in the Pre Planckian regime. We find that this is doubtful. Also issues of the graviton mass as given in [12] [13] may prove to be extremely important. Next, confirmation of the usefulness of the restriction of the $\phi_{\inf} > \left(1/M_{\text{total}}\right)^{1/2}$ limit needs to be reconciled with [14] as to the initial conditions of inflaton. Whereas how we do it may allow for the Corda references [15] [17] to be experimentally investigated. Finally the Abbot articles of [16] [18] must be adhered to as far as the formation of Gravitational signatures even from the early universe [19] [20].

Acknowledgements

This work is supported in part by National Nature Science Foundation of China grant No. 11375279.

References

[1] Mukhanov, V. (2005) Physical Foundations of Cosmology. Cambridge University Press, New York. https://doi.org/10.1017/CBO9780511790553

[2] Padmanabhan, T. (2006) An Invitation to Astrophysics. World Scientific Series in Astronomy and Astrophysics, Volume 8. World Press scientific, Singapore. https://doi.org/10.1142/6010

[3] Hu, B. (1984) Vacuum Viscosity and Entropy Generation in Quantum Gravitational Processes in the Early Universe. In: Fang, L. and Ruffini, R, Eds., *Cosmology of the Early Universe*, Advanced Series in Astrophysics and Cosmology-Volume 1, World Press Scientific, Singapore, 23-44.

[4] Camara, C.S., de Garcia Maia, M.R., Carvalho, J.C. and Lima, J.A.S. (2004) Nonsingular FRW Cosmology and Non Linear Dynamics. Arxiv astro-ph/0402311 Version 1.

[5] Beckwith, A.W. (2016) Gedankenexperiment for Refining the Unruh Metric Tensor Uncertainty Principle via Schwartzshield Geometry and Planckian Space-Time with Initial Non Zero Entropy. http://vixra.org/pdf/1509.0173v6.pdf

[6] Landau, L.D. and Lifshitz, E.M. (2011) Statistical Physics, Part 1. Volume 5 of the Course in Theoretical Physics. Elsevier, Butterworth and Heinmann, New York.

[7] Hawking, S.W. and Ellis, G.F.R. (1994) The Large Scale Structure of Space Time. Cambridge University Press, Cambridge.

[8] Hawking, S. and Penrose, R. (1996) The Nature of Space and Time. Princeton University Press, Princeton.

[9] Ng, Y.J. (2008) Spacetime Foam: From Entropy and Holography to Infinite Statistics and Nonlocality. *Entropy*, **10**, 441-461. https://doi.org/10.3390/e10040441

[10] Will, C. (2014) The Confrontation between General Relativity and Experiment. *Living Reviews in Relativity*, **17**, 4. https://doi.org/10.12942/lrr-2014-4

[11] Yourgau, W. and Madelstam, S. (1979) Variational Principles in Dynamics and Quantum Theory. Dover Publications, Mineola.

[12] Hassan, S.F. and Rosen, R.A. (2012) Bimetric Gravity from Ghost-Free Massive Gravity. *JHEP*, **1202**, 126. https://doi.org/10.1007/JHEP02(2012)126

[13] Zakharov, V.I. (1970) Linearized Gravitation Theory and the Graviton Mass. *JETP Letters*, **12**, 312.

[14] Freese, K. (1992) Natural Inflaton. In: Nath, P. and Recucroft, S., Eds., *Particles, Strings, and Cosmology, Northeastern University*, World Scientific Publishing Company, Pte. Ltd, Singapore, 408-428.

[15] Corda, C. (2009) Interferometric Detection of Gravitational Waves: The Definitive Test for General Relativity. *International Journal of Modern Physics D*, **18**, 2275-2282. https://arxiv.org/abs/0905.2502 https://doi.org/10.1142/S0218271809015904

[16] Abbott, B.P., *et al.* (2016) Observation of Gravitational Waves from a Binary Black Hole Merger. *Physical Review Letters*, **116**, Article ID: 061102.

[17] Corda, C. (2017) Primordial Gravity's Breath. 1-10. http://www.ejtp.com/articles/ejtpv9i26.pdf

[18] Abbott, B.P., *et al.* (2016) GW151226: Observation of Gravitational Waves from a 22-Solar-Mass Binary Black Hole Coalescence. *Physical Review Letters*, **116**, Article ID: 241103.

[19] https://ned.ipac.caltech.edu/level5/Sept02/Padmanabhan/Pad1_2.html

[20] https://ned.ipac.caltech.edu/level5/Sept02/Padmanabhan/Pad7.html