Structure Formation in the Early Universe and the 3-Body Problem.Modification of GravityPossible Replacement DE

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Abstract

We find that having the scale factor close to zero due to a given magnetic field value in, an early universe magnetic field affects how we would interpret Mukhanov's chapter on 'self-reproduction of the universe' The stronger an early universe magnetic field is, the greater the likelihood of production of about 20 new domains of size 1/ H, with H early universe Hubble's constant, per Planck time interval in evolution.. We mention fluctuations in the Hubble expansion parameter, H, may affect structure. We close with statements as to the value of α in a gravitational potential proportional to $r^{-\alpha}$ and how this adjustment affects the 3-body problem. Introduction

I. Introduction

We first of all recall that the scale factor is affected by the NLED in cosmology paradigm which in fact also is linked to the idea of 'self-reproduction' as given in [1], which is a different way as to outline how this affects the evolution of density in the early universe leading to equation for setting the value of α in a gravitational potential proportional to $r^{-\alpha}$. This α has real and complex values, unlike the Newtonian real value, i.e. the problem of the α in a gravitational potential proportional to $r^{-\alpha}$

II. Certain pertinent details to developing our idea

To review this, we need to look at [1] where we can use the following treatment of the Klein Gordon equation which we write as

$$\ddot{\varphi}_k + 3H\dot{\varphi}_k + \frac{k^2}{a^2}\varphi_k = 0, \quad \varphi_k \approx \frac{H\tau}{\sqrt{2k}} \cdot \left(1 + \left(ik\tau\right)^{-1}\right) \cdot \exp\left[-ik\tau\right], \quad \& \, \tau = -H^{-1} \cdot \exp\left[-H \cdot t\right] \quad (1)$$

Here, k is the value of wave number, and H is assumed, in the early universe to be a constant. The net result is that $k = 2\pi / \lambda$, with λ proportional to the 'width' of a would be pre universe 'bubble' as seen in[1] place of a singularity, and also that one would have, for a constant H, during this time as seen by

$$H = \sqrt{\frac{8\pi G}{3} \cdot \rho - \frac{\kappa}{a^2}}, \rho = 'energy - density', \kappa = 'curvature' \, (2)$$

Further use of [1] will lead to the situation that

$$H \approx \sqrt{\frac{8\pi G}{3}} \cdot \sqrt{V(\varphi) - \frac{\dot{\varphi}^2}{2}} \Leftrightarrow \frac{\dot{\varphi}^2}{2} = \left(\frac{3}{8\pi G} \cdot \frac{\kappa}{a^2} + V(\varphi) \right) - \rho \, (3)$$

Chaotic inflation uses that $V(\varphi) \approx \frac{k^2}{a^2} \cdot \varphi^2$ and the time derivative is $d/d\tau$, and $\varphi \equiv \varphi_k$, and if so,

$$\frac{\dot{\varphi}_k^2}{2} = \left(\frac{3}{8\pi G} \cdot \frac{\kappa}{a^2} + \frac{k^2}{a^2} \cdot \varphi_k^{\,2} - \frac{16}{3} \cdot c_1 \cdot B^4 \right) \& \, \Delta E \approx \left(\frac{3}{8\pi G} \cdot \frac{\kappa}{a^2} + \frac{k^2}{a^2} \cdot \varphi_k^{\,2} - \frac{16}{3} \cdot c_1 \cdot B^4 \right) (4)$$

The last line of Eq.(4)states that , if we apply it to the Pre Planckian to Planckian regime, that there will be a change in the energy, We then will call this shift in energy, as equivalent to a change in KINETIC energy,

$$\begin{aligned} &\left\langle \psi \,|\, \left[Kinetic - Energy \approx \left(\frac{3}{8\pi G} \cdot \frac{\kappa}{a^2} + \frac{k^2}{a^2} \cdot \varphi_k^{\,2} - \frac{16}{3} \cdot c_1 \cdot B^4 \right) \right] | \, \psi \right\rangle \\ &\approx \left\langle \psi \,|\, \left(r \cdot \nabla \left[V(Potential - energy) \approx c_2 / r^\alpha \right] \right) | \, \psi \right\rangle \end{aligned} \quad (5)$$

In the Pre Planckian to Planckian space time, we will approximate, in the instant before time is initialized, formally, the mean value theorem with the results that we obtain

$$\begin{aligned} &\left(\frac{3}{8\pi G} \cdot \frac{\kappa}{a^2} + \frac{k^2}{a^2} \cdot \varphi_k^{\,2} - \frac{16}{3} \cdot c_1 \cdot B^4 \right) \approx -\alpha / r^\alpha \equiv -\alpha / (Planck - length)^\alpha \\ &\Leftrightarrow \left[\alpha / (Planck - length)^\alpha \right] \approx \frac{16}{3} \cdot c_1 \cdot B^4 - \left(\frac{3}{8\pi G} \cdot \frac{\kappa}{a^2} + \frac{k^2}{a^2} \cdot \varphi_k^{\,2} \right) \end{aligned} \quad (6)$$

Here, the magnetic field would be determined in part by the value of B, and the scale factor a , is given , and φ_k is given by Eq.(6)This shows in part that α is no longer strictly real valued but is strongly influence by the input from φ_k, i.e. which has real and imaginary components. What we should endeavour through judicious application of Eq. (6) is to remove dependence upon the smallness of the third mass, and to examine if this can still, with a non-trivial third mass recover still much of the stability analysis. Later, at an appropriate time this question in terms of a serious application of the value of Eq. (6) will be pursued, Secondly, as of [2], the section give on page 154, entitled **"6.4 Orbital changes in encounters with planets", which is a restricted 3-body problem, frequently is used as to the interaction of say comets (comparatively small mass) with a planet, circulating the Sun, where we have**

2 'massive' masses, and the third body, in this case a comet, which gives usually parameters of how a hyperbolic orbit for a comet, should be reviewed again. This is meant to be in tandem with results as far as self-reproduction of structure given in [3] which is how we started [1]

III. Concluding observations

We argue that Equation (6) in its limiting characterization may allow certain classical 3 body simulations more flexibility than what exist presently. We also leave the door open as to other applications of Equation (6), especially in early universe conditions.

In closing, we also refer to further references which may allow for additional research refinement of the relationship of our document with the use of nonlinear Electrodynamics in cosmology paradigm which may allow for good applications of our idea, i.e. [4] [5] [6] which may further refine our results, and which bear consideration. This should be also an extension of what we have been doing in [7] and we will be attempting to find such a connection in the regime of space-time in the Pre Planckian to Planckian regime transition where we use NLED approximations as to scale factor, assuming in this regime a relatively constant, presumably extraordinarily hot initial cosmological temperature. The details of all this, as well as other details pertinent to the creation of presumed mini black holes will be the subject of our inquiry as to modified gravity. Further follow ups of this idea as to modified gravity should be compared with [4] and the applications of modified gravity can be ascertained as far as their possible inter relationships with [5], [6], [7], and [8]

We should note the following, in developing our idea

IV. Overall Goal independent of NLED applications to the Cosmological scale factor.

What we are doing is to consider the following as a gravity research goal. The KAM theorem seems to be very useful for studying global stability in the three-body problem; however, some of its applications are limited only to small masses of the third body. The limitation stated by KAM theory is that MOST of the time, we have that the KAM results require a third body to be low mass. This is a classical dynamical system result. What we should endeavor is to remove dependence upon the smallness of the third mass, and to examine if this can still, with a non-trivial third mass recover still much of the stability analysis. Later, at an appropriate time, this question in terms of a serious application of the value of Equation (6) will be pursued.

Acknowledgements

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