Gedankenexperiment about the E and B fields, and the link to Gravitons and by extension Gravitational Waves in the Early Universe

Andrew Walcott Beckwith

Physics Department, Chongqing University, College of Physics, Chongqing University Huxi Campus, No. 44 Daxuechen Nanlu, Shapinba District, Chongqing 401331, People's Republic of China

Rwill9955b@gmail.com; abeckwith@uh.edu

Abstract. We examine what Padmanabhan presented in an exercise as of a linkage to (Electromagnetic) E and M fields with Gravitation. The modifications we bring up take the nonrelativistic approximation as the beginning of an order of magnitude estimate as to gravitons, E and M fields, and are by definition linked to the total angular momentum of an initial configuration of 'particles' of space-time import. The innovation put into Padmanbhan'/s calculation is to for total mass M, used, to substitute in M ~ N(gravitons) times m(g), where m(g) is about 10^-62 grams, as well as specify distances, for the object spinning as being about Planck length in size, give or take a few orders of magnitude. The results are by definition very crude, and do not take into account relativistic effects, but are probably within an order of magnitude important comparisons.

1. Introduction, Reviewing what was done by Padmanabhan as far as Electromagnetic waves being set up so as to have up for calculation of using the results of initial energy as due to $\delta t \Delta E = \frac{\hbar}{\delta g_{tt}} \equiv \frac{\hbar}{a^2(t)\cdot \phi}$ and comparing it to a more general energy expression given below

What we are doing is to consider [1] in pages 278-79 of the form , from exercise 6.15 of a magnetic and electric field being generated by a source with arbitrary density , as to having the following two lowest order perturbations, as given in the exercise to be, if M is total mass, $J^{\alpha\beta}$ the angular momentum tensor with also $p^{\alpha}(y)$ a momentum density defined by $p^{\alpha}(y) = \rho(y)\cdot u^{\alpha}(y)$, to yield the Gravo-electric tensor $\Phi_g(x)$, and Gravo-magnetic tensor $A_g(x)$. Then

$$
\begin{aligned}
&\bar{h}^{0\alpha} = -\frac{2G}{c^3|x|} x_\beta J^{\alpha\beta} + \vartheta\left(\frac{1}{|x|^3}\right) \\
&M = \int \rho(y)\cdot d^3y \\
&J^{\alpha\beta} = \int_V \left[y^\alpha p^\beta(y) - y^\beta p^\alpha(y) \right]\cdot d^3 y \\
&\Leftrightarrow \Phi_g(x) = -\frac{GM}{|x|} \\
&A_g(x) = -\frac{GM}{c^2|x|^3}(S\times x)
\end{aligned}
\tag{1}
$$

Then again by [1], and exercise 6.15, page 279

$$E_g(x) = -\frac{GM}{|x|^2}\hat{x}$$
$$B_g(x) = \frac{G}{c^2|x|^3}\left(S - 3(S\cdot\hat{x})\hat{x}\right) \tag{2}$$

Here, $\hat{x}$ is a unit vector in the radial direction, and S an angular velocity, which will then lead to the following angular frequency, that by [1], and exercise 6.15, page 279

$$\omega^2 = \frac{G\cdot M}{r^3} \mp \frac{2\cdot G\cdot S}{c^2 r^4}\sqrt{\frac{GM}{r}} \tag{3}$$

From here, we will proceed to modify M, and S by gravitational Graviton physics

2. Modify M, and S by gravitational Graviton physics

What we are going to do, is the restrict M to the case of heavy gravity in the Planckian regime, call G the usual gravitational physics variable, and define S, as following for M and S. N being the number of initial universe gravitons, and a radii as Planck length $\times 10^{\aleph}$, with $\aleph > 0$, so up to a good approximation

$$\begin{aligned} M &\approx N_{gravitons}\cdot m_{graviton} \\ S &\approx \sum_{j=1}^{N_{gravitons}} \left(R_j \times m_j v_j(velocity)\right) \\ &\approx N_{gravitons} \times \left(l_{Planck} \times 10^{\aleph}\right)\cdot m_{graviton} \end{aligned} \tag{4}$$

Then the maximum initial value of the angular frequency of Eq. (3) is

$$\omega^2 = \frac{G\cdot N_{gravitons}\cdot m_{graviton}}{r^3} \mp \frac{2\cdot G\cdot N_{gravitons}\times\left(l_{Planck}\times 10^{\aleph}\right)\cdot m_{graviton}}{c^2 r^4}\sqrt{\frac{G\cdot N_{gravitons}\cdot m_{graviton}}{r}} \tag{5}$$

3. Modify M, and S by gravitational Graviton physics with numerical inputs into Eq.(5) for Frequency.

$N_{gravitons} \approx 10^{37}$, due to and a rest massive gravity graviton mass of about 10^-62 grams , due to [2] plus a radial distance r from the source of the graviton production would lead to relic gravitational waves reduced dramatically from the beginning radii presumably about 1 meter, to the present radii of the universe, presumably of the value of about $4.4\times 10^{26}\,meters$.

If so, then, the energy would be represented, if $\lambda_{graviton} = \frac{2\pi v(velocity)_{graviton}}{\omega_{graviton}}$ and we have [3]

$$\left(\frac{v_{graviton}}{c}\right)^2 = 1 - \frac{m_{graviton}^2 c^4}{E_{graviton}^2} \tag{6}$$

Then from [4] we have for gravitons an energy value of about, if m is the mass of a ‘massive’ graviton, using in this case the relativistic formula as given in [4] , to approximate to first order

$$E \sim 2\pi\hbar \cdot \frac{c}{2\lambda}\left(1 \pm \sqrt{1+\frac{4m^2c^4}{\left(\frac{2\pi\hbar c}{\lambda}\right)^2}}\right) \sim \frac{2\pi\hbar c}{2\lambda}\left(2+\frac{2m^2\lambda^2c^4}{\left(2\pi\hbar\cdot c\right)^2}\right) \tag{7}$$

Compare this value of energy, by making the following scaling, namely equate Eq. (5) and Eq.(7) such that

$$\begin{aligned} \omega^2 &= \frac{G\cdot N_{gravitons}\cdot m_{graviton}}{r^3} \mp \frac{2\cdot G\cdot N_{gravitons}\times\left(l_{Planck}\times 10^{\aleph}\right)\cdot m_{graviton}}{c^2r^4}\sqrt{\frac{G\cdot N_{gravitons}\cdot m_{graviton}}{r}} \\ &\approx \left(\frac{2\pi c}{\lambda}\right)^2\left(1+\frac{m^2_{gravitons}\lambda^2c^4}{\left(2\pi\hbar\cdot c\right)^2}\right)^2 \end{aligned} \tag{8}$$

To get to the present value of what the relic wavelength for produced gravitons initially would be, take in the upper value of the λ given that $m_{graviton} \approx 10^{-62}\,grams$, would be if r in Eq.(8) is $4.4\times 10^{26}\,meters$

$$\lambda \approx 10^{9} - 10^{10}\,meters(today) \tag{9}$$

Whereas if r in Eq. (8) is significantly less than 1 meter, emergent radiation would be

$$\lambda \approx 10^{-29} - 10^{-30}\,meters(initially) \tag{10}$$

Based upon Eq.(9) and Eq. (10), then

$$\begin{aligned} &\omega\left(initial\right) \approx 10^{30}(or-more)Hertz \\ &\omega\left(Today\right) \approx 10^{-10}(or-less)Hertz \end{aligned} \tag{11}$$

This is using extremely rough estimates

4. Conclusions- Future work, putting in $\delta t \Delta E = \frac{\hbar}{\delta g_{tt}} \equiv \frac{\hbar}{a^2(t)\cdot\phi}$

Assuming that $a\left(initial-start\right) \sim 10^{-55}$,

$$\begin{aligned} &\delta t\Delta E = \frac{\hbar}{\delta g_{tt}} \equiv \frac{\hbar}{a^2(t)\cdot\phi} \\ &\Leftrightarrow \phi(initial) \approx \frac{1}{t\left(Planck\right)}\cdot\frac{1}{\left[a\left(initial-start\right)\sim 10^{-55}\right]^2\cdot\left[\omega\left(initial\right)\approx 10^{30}(or-more)Hertz\right]} \end{aligned} \tag{12}$$

This enormous value for the inflaton, initially, needs to be examined further.[5] as to further prospects.

Acknowledgements

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

References

[1] T. Padmanabhan, *Gravitation, Foundations and Frontiers* Cambridge University Press, New York, New York, USA, 2010
[2] A. Goldhaber, and M. Nieto, "Mass of the Graviton", PRD Volume 9, Number 4, February 15, 1954
[3] C. Will. The confrontation between General Relativity and Experiment, Living Reviews in Relativity, http://relativity.livingreviews.org/Articles/lrr-2006-3/
[4] M. Giovannini *A primer on the Physics of the Cosmic Microwave Background* , World Scientific, Singapore, Republic of Singapore, 2008
[5] A. Beckwith, "Gedankenexperiment for degree of flatness, or lack of, in early Universe conditions', accepted for publication in **JHEPGC** October 22,2015, http://vixra.org/pdf/1510.0108v4.pdf