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"How Graviton Power Values and heavy gravity Values (leads to) (Necessity of $m_g \neq 0$ to detect relic G.W.)"

Windows on the Universe

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How graviton power values and a graviton count from the electroweak era give strain and heavy gravity values Leads to (necessity of $m_g \neq 0$ to detect relic G.W.)

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Abstract. The following was achieved: general and particular solutions to the strain equation as outlined by Durrer and others**.** The general solution unsurprisingly has a strain value which is too small for any detector to pick up, namely $h \sim 10^{-36}$, so the problem is that the particular solution, due to quark-gluon turbulence toward the end of the `electroweak era, is neglected. But this particular solution, as described herein, has a much larger strain value, namely $h \sim 10^{-25}$. This is a derivation which would allow a much better chance of detection than the general strain value, which is 11 orders of magnitude smaller. Secondly, we also find arguments as to the existence of heavy gravity and a GW frequency of at least 10^7 and then these two together argue for investigation of relic gravity waves in a matter not considered when the earlier prohibitive strain value of $h \sim 10^{-36}$ was unchallenged. The particular solution presented herein argues for investigating updates of the laser interferometer system pioneered by LIGO and Thorne.

1. Introduction

We first of all can mention the results of a problem in Lightman, Press, Price, and Teukolsky [1] which in their problem book gives answers as to GW generated by an explosion generating energy *E*. The results given on page 509 [1] give arguments for characteristic quadrupole gravitational wave power of a physical process, the 'internal power flow', E/τ, and the typical graviton numerical count which is given in [1] via $N_{gravitons} \sim \left(E^2/\tau\right)/\left(\hbar/\tau\right)$ [illegible] E^2/τ, and τ is the characteristic time, where we have $N_{gravitons} \sim E^2/(10^{16} ergs)^2$ and all this will be used to quantify inputs into the particular solution of how to solve the evolution equation for tensor perturbation of the space-time metric given by [2] which has h_{ij}^T as strain, and $\frac{\dot{a}}{a} = H_c$ = Hubble equation which we call constant in the early universe, and a as scale factor and Π_{ij} as anisotropic strain. h_{ij}^T convention we will be using is to call the right hand side of the first equation initially to be a constant, which will allow for a particular solution to h_{ij}^T

$$\ddot{h}_{ij}^T + 2\frac{\dot{a}}{a}\dot{h}_{ij}^T + k^2 h_{ij}^T = 8\pi G a^2 p \Pi_{ij} \qquad (1)$$

Here we have h_{ij}^T as having general and particular solutions, with the particular solution having a strain magnitude of $h \sim 10^{-25}$, the general solution having a magnitude of $h \sim 10^{-36}$, and the

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general solution being the preferred solution by the GW community, i.e. the solution of the following equation is too small to be evaluated experimentally, namely the following is worthless to experimental inquiry if we are looking at the behavior of h_{ij}^{T} from the electro-weak era $(10^{-36} - 10^{10}\,\mathrm{sec})$ to today. Note that the following equation is given in Fourier momentum space. As is Eq.(1) above. These both will be inverse Fourier transformed back to position space to conclude our analysis of the homogeneous and particular solutions. We find that h_{ij}^{T} as given as a general solution of Eq.(1) which has analytic behavior as given by Eq.(2) below will, in position space be such that it effectively does not contribute experimentally.

$$\ddot{h}_{ij}^{T} + 2\frac{\dot{a}}{a}\dot{h}_{ij}^{T} + k^{2}h_{ij}^{T} = 0 \qquad (2)$$

To consider h_{ij}^{T} from the electro-weak era to today we fix $\frac{\dot{a}}{a} = H_{c} =$ as constant in the early universe, meaning the general solution obeys the damping conventions for differential equations given by [3] whereas we will examine first the k space particular solution, namely if the r.h.s. of Eq.(1) may be approximated by a constant, with regards to time, then Eq. (1) has a time independent solution as given by

$$h_{ij}^{T}\left(particular\right) = 8\pi G a^{2} p \Pi_{ij} / k^{2} \qquad (3)$$

This Eq.(3) as it stands is what gives us the $h \sim 10^{-25}$ as an experimentally measurable contribution which is new , as opposed to the general solution for h_{ij}^{T} we outline which has $h \sim 10^{-36}$ as an unmeasurable contribution . We will be evaluating solutions to Eq.(2) and Eq.(3) in k space, and then inverse Fourier transform back to position space. In three dimensions this means using, here integrating back to r via

$$\int_{-\infty}^{\infty} (4\pi)\cdot dk \cdot k^{2} \cdot \exp(-ikr) \qquad (4)$$

2. Conditions permitting an evaluation of Eq. (2), in k and then position space, whereas afterwards evaluating Eq.(3) in k and then position space

Looking at Eq. (2) is the same as looking at the following, analyzing how [3] leads to the following k space solution, namely in k space

$$h_{ij}^{T}(general) \propto \left[\exp(-H_{c}\tau)\right]\cdot\left[A\cdot\exp\left(i\cdot\sqrt{k^{2}-H_{c}^{2}}\cdot\tau\right) + A^{*}\cdot\exp\left(-i\cdot\sqrt{k^{2}-H_{c}^{2}}\cdot\tau\right)\right] \qquad (5)$$

Inverse Fourier transformed back to position space the general position space looks like

$$h_{ij}^{T}(general - r) \propto \sqrt{\frac{2}{\pi}}\left[\exp(-H_{c}\tau)\right]\cdot\int_{-\infty}^{\infty} dk \cdot k^{2} e^{-ikr}\left[A\cdot\exp\left(i\cdot\sqrt{k^{2}-H_{c}^{2}}\cdot\tau\right) + A^{*}\cdot\exp\left(-i\cdot\sqrt{k^{2}-H_{c}^{2}}\cdot\tau\right)\right] \qquad (6)$$

This Eq.(6) had an experimentally unmeasurable value of $h \sim 10^{-36}$. Or smaller. As given by Maggiore [4] this above equation should be compared as similar to

$$h_{ij}^{T}(general-r) \sim \begin{pmatrix} h_{\oplus} & h_{\otimes} & 0 \\ h_{\otimes} & -h_{\oplus} & 0 \\ 0 & 0 & 0 \end{pmatrix}_{ij} \cdot \cos\left[\omega \cdot \left(\tau - \frac{z}{c}\right)\right] \quad (7)$$

We therefore look at the inverse Fourier transform of Eq. (3) using Eq.(4) in order to obtain , if Eq. (3) is time independent, which is an approximation, namely we look at

$$h_{ij}^{T}\left(particular-r\right) \propto \frac{16\pi}{\sqrt{2\cdot\pi}} \int_{-\infty}^{\infty} dk \cdot e^{-ikr} G a^{2} p \Pi_{ij} \quad (8)$$

Note that the strain Π_{ij} has values from [1] which will be put into Eq. (7) in order to justify values $h \sim 10^{-25}$

3. Conclusion: Arguing for $h \sim 10^{-25}$ value for Eq. (8) due to explicit inputs into Π_{ij}

The entire Π_{ij} proof of $h \sim 10^{-25}$; the value of such lies upon Π_{ij} with a magnetic field from the quark gluon Plasma of the sort from [1] and [5] ,[6] , and [7] so then that

$$\left\langle h_{ij}^{T}\left(particular-r\right)\right\rangle_{spatially-averaged} \propto \frac{(2\pi)^{9}}{\sqrt{2\cdot\pi}} G \cdot p \cdot \frac{B_0^4}{k_c^3} \quad (9)$$

The conjecture for evaluating Eq. (9) is in looking at B_0 and $N_{gravitons} \sim E^2/(10^{16} ergs)^2$ and having an energy value, E with $\mathrm{E} \sim \frac{B_0^2}{2}$. Of which then if the electroweak interval has 10 to the 50 th power number of gravitons, then the following are to be expected

a). Mass of the graviton : $10^{-31} eV/c^2 < m_{graviton} < 10^{-29} eV/c^2$

b) $\omega_c > 10^7 Hz$ (Final) from ω_c(initial) $> 10^{15}$ Hz (initial)

c) $h \sim 10^{-25}$

d) massive redshifting of ω_c (see notes)

e) $m_g \neq 0 \Rightarrow$ Relic GW could be detected

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STRAIN EQUATION CASE 1

(Mandatory to use if $m_g = 0$)

$$\ddot{h}_{ij}^{T} + 2\frac{\dot{a}}{a}\dot{h}_{ij}^{T} + k^2 h_{ij}^{T} = 0$$

(EQ. 2)

ASSUMPTION: NO ANISOTROPIC STRESS IN THE INTERSTELLAR MEDIUM.

PROBLEM: NO ELECTRIC OR MAGNETIC FIELDS, SO Π_{ij} =0, AND THE STRAIN CREATED BY GW ($h \sim 10^{-36}$) IS NOT MEASURABLE.

1st **CONCLUSION**: THIS USUAL GW ANALYSIS IS USELESS EXPERIMENTALLY. usual

2nd (usual) GW analysis correct when $m_g \equiv 0$!!

STRAIN EQUATION CASE 2

ASSUMPTION: Π_{ij} NOT EQUAL TO ZERO

RESULT: $h \sim 10^{-25}$ (will not change during red shifting)

ASSUMPTION: Π_{ij} NOT EQUAL TO ZERO CAN BE UNDERSTOOD BY RELIC MAGNETIC FIELDS, AS WRITTEN BY DURRER*. (or earlier space-time equivalents)

1st **CONCLUSION**: A MUCH MORE MEASURABLE EXPERIMENTAL INPUT TO BE READ BY GW DETECTORS

* A. Lightman, W. Press, R. Price, and S. Teukolsky, *Problem book in relativity and Gravitation*, Princeton University Press, Princeton, NJ, 1975

2nd conclusion : $h \sim 10^{-25}$ only happens if $m_g \neq 0$

OVERALL CONCLUSIONS

(red shift affects ω_c, but not h (strain) values)

1. SOLUTION TO THE STRAIN EQUATION CAN BE INVERSE-FOURIER-TRANSFORMED TO X SPACE.

2. THIS LEADS TO A SMALL MASS FOR THE GRAVITON, WHICH IS NECESSARY. $m_g \neq 0$ means larger strain values

3. SO THE STRAIN CAN BE MEASURED AT $h \sim 10^{-25}$

4. red shifting of ω_c & ω frequency

$\omega_{c\,(\text{initially})} \sim 10^{15}$ HZ $\rightarrow \omega_{c\,(\text{today})} \sim 10^{7}$ HZ

&

$\omega_{c\,(\text{initially})} \sim 10^{16}$ HZ $\rightarrow \omega_{c\,(\text{today})} \sim 10^{8}$ HZ

5. <u>no redshifting of h</u>

Red shifting of ω_c would not change h (magnitude) from about 10^{25}

Important comment : 1

Initial we can be
in EW (Electro Weak)
as high as
$10^{15} - 10^{16}$ Hz*, as start
*(if $m_g \neq 0$)

forms almost
Delta Function spike

we use "tempered
distribution" instead of
Pure delta function.

Pure delta function
is a fiction which
is good approximation
only

Important comment 2

Future work

see reference

to Penrose

ccc below:

seeking development

of initial

space-time for

formation of

ultra high ω_c initial

values*

* (if $m_g \neq 0$, but very small)

Important comment 3

$h_{\oplus}$ and $h_{\otimes}$

Due to $m_g \equiv 0$

and work by many

(as by) Durrer & others

As to why / how

relic GW so weak

today correct

If $m_g \neq 0$, i.c. uses particular soln. for strain outlined

$m_g \neq 0$ Leads to different h_{ij} conclusion (Maggiorie)

Important Comment 4

(1) If $m_g = 0$, $h \sim 10^{-36}$
i.e. spin 2 polarization states
massless Graviton (EW era)
__not__ __detectable__

reaffirms Dr. Durrer (CERN)
Analysis

(2) If $m_g \sim 10^{-29}$ eV, $h \sim 10^{-25}$
i.e. spin (5) polarization states
massive Graviton (EW) era

situation (2) leads to __GW red-shift__

(3) f_{EW} (initial) $\sim 10^{13}$ HZ $\xrightarrow[\text{shift}]{\text{red}}$ $f_{Today} \sim 10^{7}$ HZ
f_{EW} (initial) $\sim 10^{14}$ HZ $\xrightarrow[\text{shift}]{\text{red}}$ $f_{Today} \sim 10^{8}$ HZ

no change in GW h magnitude
due to red shifting
$f_{today} \sim 10^{8}$ HZ "optimal"

(4) massive (GW) graviton ⇒ GW early
universe 'astronomy' possible

PAGE 10 - restated

Important comment 4a - restated:

If $m_g = 0$

(no 'heavy' gravity)

There is no change from well done analysis as to relic GW being undetectable.

Detectable relic GW depend upon m_g small but not $= 0$

Warning | $m_g = 0 \Rightarrow$ Relic GW undetectable |

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To be continued Setup i.e. Geometry forming w. [early EW].

"Refining black hole physics to obtain Planck's constant from information shared from cosmological cycle to cycle (avoiding super-radiance)"

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Abstract. Padmanabhan [1] elucidated the concept of super radiance in black hole physics which would lead to loss mass of a black hole, and loss of angular momentum due to infall of material into a black hole. As Padmanabhan explained it, to avoid super radiance, and probable break down of black holes, from infall, one would need infall material frequency, divided by mass of particles undergoing infall in the black hole to be greater than the angular velocity of the black hole event horizon in question. We should keep in mind we bring this model up to improve the chance that Penrose's conformal cyclic cosmology will allow for retention of enough information for preservation of Planck's constant from cycle to cycle, as a counterpart to what we view as unacceptable reliance upon the LQG quantum bounce and its tetrad structure to preserve memory . In addition we are presuming that at the time of z=20 in red shift that there would be roughly about the same order of magnitude of entropy as number of operations in the electro weak era, and that the number of operations in the z=20 case is close to the entropy at redshift z=0 . Finally we have changing Λ with the result that after redshift =20 there is a rapid collapse to the present day vacuum energy value. I.e. by z=12 likely Λ the same as today which would be about when Galaxies form.

1. Introduction

We start with the premise that LQG tetrad structure [2] will in itself not be sufficient to preserve cosmological memory from cosmological cycle to cycle. Appendix A gives the rudiments of the GR stress energy tensor while Appendix B outlines how we view the well intentioned LQG memory preservation program and the alternative, a refinement of the conformal cyclic cosmology program of Penrose [3]which will make use of refining the concept of super radiance and how to avoid it, so as to heighten the chance of preserving cosmological 'memory' from one cycle of creation to another One of the candidates for memory transfer would be given by data as supplied by Natarajan in GR 20 [4] in pre galactic black holes formed at about z = 20 to z=12 (red shift) times by super massive black holes at least 500 times the mass of our star, Sol. The candidate for information inflow into the initially massive black holes as we choose it would be manifest in relic gravitational waves. To quantify infall into these primordial black holes we will represent GW by massive gravitons, with the mass of a graviton as given by [5]

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$$-3m_{graviton}^2 h = \frac{\kappa}{2} \cdot T \tag{1}$$

Our work uses Visser's [6] analysis of non zero graviton mass for both T and h.

Furthermore, his version of $g_{uv} = \eta_{uv} + h_{uv}$ can be written as setting

$$h_{uv} \equiv 2\frac{GM}{r} \cdot \left[\exp\left(\frac{-m_g r}{\hbar} \right) \right] \cdot \left(2 \cdot V_\mu V_\nu + \eta_{uv} \right) \tag{2}$$

If one adds in velocity 'reduction' put in with regards to speed propagation of gravitons[5]

$$v_g = c \cdot \sqrt{1 - \frac{m_g^2 \cdot c^4}{\hbar^2 \omega_g^2}} \tag{3}$$

One can insert all this into Eq. (1) to obtain a real value for the square of frequency > 0, i.e.

Kim's article [7] is with regards to Gravitons in brane / string theory, but it is likely that the same dynamic for semi classical representations of a graviton with mass.

2. Conditions allowing for recycling of Plancks constant in Penroses cyclic universe model revisited

The main methodology in the Penrose proposal[3] has been in Eq. (4) evaluating a change in the metric g_{ab} by a conformal mapping $\hat{\Omega}$ to

$$\hat{g}_{ab} = \hat{\Omega}^2 g_{ab} \tag{4}$$

Penrose's suggestion has been to utilize the following[3]

$$\hat{\Omega} \xrightarrow[ccc]{} \hat{\Omega}^{-1} \tag{5}$$

Infall into cosmic black hopes has been the main mechanism which the author asserts would be useful for the recycling apparent in Eq.(5) above with the caveat that $\hbar$ is kept constant from cycle to cycle as represented by

$$\hbar_{old-\text{cosmology}-cycle} = \hbar_{present-\text{cosmology}-cycle} \tag{6}$$

What would be crucial in doing both Eq. (5) and Eq.(6) would be in specifying how massive black holes as of at least 500 times the mass of the sun, i.e. 500 $M_\odot$, large mass of a black hole formed between z=20 and z=12 redshifts i.e before galaxy formation, would tend toward conditions for which Eq. (6) could be fulfilled. We do this by looking at details for $\hat{\Omega}$ satisfied by information gathering which we bring up now.

2a. Necessary construction details for the mapping $\hat{\Omega}$

The procedures for giving linkage to a formulation of $\hat{\Omega}$ means that one must consider basic constructions given by Penrose as to his ccc proposal which we will outline below, namely that [3]

$$E = 8\pi \cdot T + \Lambda \cdot g$$
$$E = source \quad for \quad gravitational \quad field$$
$$T = mass \quad energy \quad density \tag{7}$$
$$g = gravitational \quad metric$$

$$\Lambda = vacuum \quad energy, rescaled \quad as \quad follows$$

$$\Lambda = c_1 \cdot [Temp]^{\beta} \tag{8}$$

For an invariant E for cycle to cycle no matter what Eq. (8) gives us, this leads to the following statement as to a formulation of $\hat{\Omega}$ I.e.

$$E\big|_{initial} = E\big|_{final} \Leftrightarrow \Lambda \cdot g\Big|_{initial} = \Lambda \cdot g\big|_{final}$$
$$\Lambda \cdot g\big|_{final} = \left(\Lambda\big|_{final}\right) \cdot \hat{\Omega}^2 \cdot \left(g_{ab}\big|_{initial}\right) \tag{9}$$

I.e. is this possible ? Only if there are very small initial wavelengths at/ before the electro weak regime. I.e. a wave length perhaps as small as Planck length. The problem is that in doing so, and this appears to be intuitive and obvious, something which is contradicted by Durrer's [7] treatment of early universe plasma waves generating early universe GW. We then state for hypothesis that if N is a numerical count which has lead us to hypothesize using

$$\hat{\Omega} \propto S_{entropy} \sim N \tag{10}$$

3. Information infall into early universe black holes and avoiding Super-radiance

Note that Beckwith[8] has used Y. Ng's [9] counting algorithm with regards to entropy, and non zero mass (massive) gravitons , where $S \approx N \cdot \left(\log\left[V/\lambda^3\right] + 5/2\right) \approx N$. Furthermore, making an initial count of gravitons with $S \approx N \sim 10^7$ gravitons' with Seth Lloyd's[10] $I = S_{total} / k_B \ln 2 = [\#operations]^{3/4} \sim 10^7$ as implying at least one operation per unit graviton, with gravitons being one unit of information, per produced graviton. **Note,** Smoot [11]gave initial values of the operations as

$$[\#operations]_{initially} \sim 10^{10} \tag{11}$$

The number of operations, if tied into bits of 'information' may allow for space time linkages of the following value of the fine structure constant, as from a prior to a present universe, once initial conditions of inflation may be examined experimentally, i.e. looking at inputs into[8], i.e. The fine structure constant given in [8], which has presumably the value of

$$\tilde{\alpha} \equiv e^2 / \hbar \cdot c \equiv \frac{e^2}{d} \times \frac{\lambda}{hc} \tag{12}$$

As of the electroweak era

$$S_{entropy}\Big|_{ew} \sim N \sim 10^{53}\Big|_{ew} \propto [\#operations]^{3/4}\Big|_{ew}$$
$$\Leftrightarrow [\#operations]\big|_{ew} \sim 10^{71} \tag{13}$$

We are presuming that at the time of z=20 in red shift that there would be roughly about the same order of magnitude of entropy as number of operations in the electro weak era, and that the number of operations in the z=20 case is close to the entropy at redshift z=0

$$S_{entropy}\Big|_{redshift=20} \sim N \sim 10^{67}\Big|_{redshift=20}$$
$$\propto [\#operations]^{3/4}\Big|_{redshift=20} \qquad (14)$$
$$\Leftrightarrow [\#operations]\Big|_{redshift=20} \sim 10^{89}$$

After this is done it is useful to note that the number of operations as to the redshift =20 at the formation of the first set of super massive black holes would be about the same as entropy today which the author views as no accident. I.e. the number of super massive black holes is at least 100,000 or more with a mass of at least $\left(10^{2}-10^{5}\right)\cdot M_{\odot} \sim$ one hundred to ten thousand times the mass of the sun Then there could be an infall of less than $10^{84}-10^{87}\, operations\,/\,black-hole$ .After this is done, note that the particle infall per black hole is less than 10^{62} value. Interstellar space has 2.73 Kelvin and was only semi hotter at a red shift at z=20. The situation then is that a black hole five times the mass of the sun would have a temperature 12×10^{-9}Kelvin , and that could easily drop to about 10^{-11} Kelvin, which is about the temperature for a black hole 20-50 times the mass of the sun, and that due to[1]

$$T_{BH} = \frac{\hbar c^{3}}{8\pi kGM} \qquad (15)$$

Then the next step would be to look at the resulting temperature differential flowing into the black hole which would be

$$\Delta T\Big|_{near-BH} = T_{Background} - T_{BH} \sim 10^{\alpha}\, Kelvin \geq 2.73 Kelvin \qquad (16)$$

We look at a black hole of would be mass $10^{22} Kg \propto 10^{58} eV/c^{2}$, mass of this value would be for a black hole having the temperature given in Eq.(16), leading to if each graviton having $10^{-29} eV/c^{2}$ number of gravitons of about 10^{87} gravitons; then leading to for 1000 super massive black holes an intake of $\sim 10^{90} \sim later-entropy$ value into 100-1000 black holes. This is close to the present value of entropy today and is similar to values given by Lloyd [11]as to the entropy of the present universe, which we do not think is an accident. Therefore, the inflow of heat into 100-1000 pre galactic black holes which is a thermal energy, as given by 100-1000 super massive early black holes is equivalent to $10^{90} \sim later-entropy$ equivalent. Also the value of about $10^{84}-10^{87}\, operations\,/\,black-hole$, we look at less than or equal values of the number of operations set up to be processed as given by the electroweak era to be eventually generating approximately a $10^{90} \sim later-entropy$ numerical count as created about z=20 , which again we think is no accident.

4. A way to create conditions for Planck value from cycle to cycle, while tackling the problem of super radiance [1] and black hole physics as of about z= 20 and making sense of $\hat{\Omega}$

To do this note that $\hat{\Omega}$ we write as proportional to entropy, specifically because of $\Lambda \cdot g\big|_{final} = \left(\Lambda\big|_{final}\right)\cdot \hat{\Omega}^{2}\cdot\left(g_{ab}\big|_{initial}\right)$; we write entropy as given by first Ng[12] and then also presented by Cai [13] as , if $S \sim r_{\oplus}^{2}$ and $r_{\oplus}$ is the radius of the black hole horizon, then if M is the mass of a black hole

$$S \le N = 3\pi G^{-1}/\Lambda \Leftrightarrow \hat{\Omega} \sim 3\pi G^{-1}/\Lambda \Leftrightarrow S_{BH} \approx M^{2} \tag{17}$$

Also for the angular velocity, as given by $\Omega_{H} \sim 1/r_{\oplus}$

$$\Omega_{H} \sim 1/r_{\oplus} \propto 1/\sqrt{S} \propto 1/\sqrt{N} \propto 1/\sqrt{Temp^{\beta}} \tag{18}$$

We write the angular velocity as intertwined into Padmanabhlan's [1]description of super radiance by noting that for infall into a black hole creating instability and loss of angular momentum for the black hole we would have super radiance for frequency and for mass of an infalling particle into a black hole

$$0 < \omega_{particles}/\tilde{m} < \Omega_{H} \tag{19}$$

To avoid super radiance, we would have, conversely

$$\omega_{particles}/\tilde{m} > \Omega_{H} \tag{20}$$

Or

$$\omega_{particles} > \tilde{m}/\sqrt{N} \tag{21}$$

The frequency of incoming particles allowing for stable black holes would be extremely low, ie almost any gravitational radiation and graviton infall into Penrose mandated black holes [3] would do it. If one looks at the contribution of four and five dimensional black holes to entropy, with L being the dimension of a fifth dimension we obtain[14]

$$S_{BH}\big|_{4D} = 4\pi M^{2} \tag{22}$$

$$S_{BH}\big|_{5D} = 4\pi M^{2} \cdot \sqrt{8L/27\pi M} \tag{23}$$

The outcome would be to have for five dimensional black holes [13]no super radiance [1]if

$$\omega_{particles}\big|_{5D} > \left(\tilde{m}/\sqrt{N}\right) \cdot \left(27\pi M/8L\right)^{1/4} \tag{24}$$

The frequency goes down as L increases in size.

4. a: black hole physics as of about z= 20 and making sense of $\hat{\Omega}$

We also can write the following relation as to infall frequency which avoids irradiance, i.e avoiding instability as to black hole behaviour. If the 5th dimension, L, grows, the frequency threshold drops

$$\omega_{particles}\big|_{5D} > \left(\tilde{m}/\sqrt{\hat{\Omega}}\right) \cdot \left(27\pi M/8L\right)^{1/4} \tag{25}$$

From $\hat{\Omega}$ ~ Entropy and using S similar to $\hat{\Omega}$ and then subsequently $\hat{\Omega} \sim 3\pi G^{-1}/\Lambda$ [13] and $\Lambda = c_{1} \cdot [Temp]^{\beta}$, [15] , and making use of the relations $T_{BH} = \frac{\hbar c^{3}}{8\pi k G M}$ [1] , $\Delta T\big|_{near-BH} = T_{Background} - T_{BH}$, due to $\hbar$ in the relations we are able to ascertain per black hole

$$\hbar\big|_{per-BH} \propto \Delta T\left[background - BH\right] \cdot \left(8\pi k G M_{eff}/c^{3}\right) \tag{26}$$

Also if at z=20 there is the number of $N_{z=20BH}$ black holes at z=20, the contribution to $\hbar_{old-\text{cosmology}-cycle} = \hbar_{present-\text{cosmology}-cycle}$ then can be said to be

$$\hbar\big|_{z=20} \propto N_{z=20BH} \cdot \Delta T\left[background - BH\right] \cdot \left(8\pi kGM_{eff}/c^3\right) \tag{27}$$

We also look then at the value of $\hat{\Omega}$ at z= 20 and get from Eq. 27

$$\Omega\big|_{redshift=20} \sim N \sim 10^{67}\Big|_{redshift=20} \tag{28}$$

And we keep in mind that

$$\left[\Omega\big|_{redshift=20} \sim N \sim 10^{67}\Big|_{redshift=20}\right] \cdot \Lambda_{redshift=20} = \left[\Omega\big|_{redshift=0} \sim N \sim 10^{89}\Big|_{redshift=0}\right] \cdot \Lambda_{redshift=0} \tag{29}$$

The above hypothesizes changing Λ with the result that after redshift =20 there is a rapid collapse to the present day vacuum energy value. I.e. by z=12 likely Λ the same as today which would be about when Galaxies form.

5. Conclusion: black hole physics as of about z= 20 sets up $\hat{\Omega}$ we write as congruent to Eq.(29)

From Eq. (29) one will have at $\left[\Omega\big|_{redshift=20} \sim N \sim 10^{67}\Big|_{redshift=20}\right]$ an infall of 'information' into many black holes such that the following will be gathered for Planck's constant. Here, $N_{z=20BH}$ is for the number of super massive black holes at z=20, namely as given before, we have

$$\hbar\big|_{z=20} \propto N_{z=20BH} \cdot \Delta T\left[background - BH\right] \cdot \left(8\pi kGM_{eff}/c^3\right) \tag{27}$$

This is at z=20. This redshift corresponds to 150 million years after the big bang. The idea being that up to 150 million years after the big bang, there would be enough uploaded information put in to formulate filling in Eq. (27) which would probably be enough to insure resetting $\hbar_{old-\text{cosmology}-cycle} = \hbar_{present-\text{cosmology}-cycle}$ so as to maintain the constancy of physical law from cycle to cycle. The infall as represented by Eq.(27)above tied in with Eq. (29) is the basis of saying that the formula for E in Eq. (7) remains invariant from the beginning to the end of a cosmological cycle, whereas then afterwards the term $\hat{\Omega}$ undergoes what is given in Eq.(5), namely[3]

$$\hat{\Omega} \xrightarrow[ccc]{} \hat{\Omega}^{-1} \tag{5}$$

Keep in mind that after z=12, one billion years after the big band we have that if we use Park's treatment of quinessence [15], we can get Λ to almost the level it is today, and it drives inflow into BHs.[15]

$$\Lambda = c_1 \cdot [Temp]^{\beta} \tag{8}$$

If the temperature we call Temp is ~ $\Delta T|_{near-BH} = T_{Background} - T_{BH}$ we have via the procedure outlined above a way to get entropy and also Eq. (27) filled in as inflow which may be falsifiable procedure.

Appendix A: The generalized Stress Energy component of GR considered. Which part we evaluate.

To do this we look at, from [17] a GR Einstein stress energy tensor we write as, with u_a the four vector velocity. Also, ρ is the relativistic energy density, q_a the relativistic momentum density, and p is pressure, and π_{ab} the relativistic anisotropic stress tensor due to viscosity, magnetic fields. ρ has a gravitational radiation component . Effectively, Eq. (A1) has $\rho = \rho_{GW} + \rho_{Everything-else}$ such that

$$\begin{aligned} &T_{ab} = \rho u_a u_b + q_a u_b + u_a q_b p h_{ab} + \pi_{ab} \\ &\Leftrightarrow T_{ab} = T_{GW/Gravtitons} + T_{everthing-else} \end{aligned} \tag{A1}$$

Appendix B: Preservation of memory in LQG so $\hbar_{old-\text{cosmology}-cycle} = \hbar_{present-\text{cosmology}-cycle}$

LQG has its non singular quantum bounce as given by Amoros, de Haro , and Odintsov[17] . We refer the readers to look at Figure 2, and ask if the tetrad structure as outlined in the article is provable as well as linkable to the necessity of not running afoul of the Tolman restriction on entropy and cyclical models [18]

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