IS QUANTUM MECHANICS INVOLVED AT THE START OF COSMOLOGICAL EVOLUTION? DOES A MACHIAN RELATIONSHIP BETWEEN GRAVITONS AND GRAVITINOS ANSWER THIS QUESTION?

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Abstract

The Machs principle as unveiled in this paper is really a statement as to information conservation, with gravitons and gravitinos being information carriers.This Mach's principle application has tremendous implications as far as if quantum mechanics is essential to formation of information in early universe physics In addition, we review Gryzinski's inelastic scattering results which have close fidelity to a normally quantum result of inelastic scattering in atomic hydrogen calculations and suggest that forming Planck's parameter we set as $\hbar(t)$ in this document could also be due to semiclassical processes, initially, leaving open the possibility quantum processes, initially are not mandatory in terms of formation of initial formulation of constants put into the Machian relations used in this paper.

Key words: Maxwell's equations, Octonionic Geometry, Mach's principle, Planck's constant, Gryzinski's inelastic scattering

1 Introduction

In models going back to Dirac as to evolution of the physics fine structure constant, there has been no real statement as to why physical constants, such as Planck's constant, or the fine structure constant would remain invariant in cosmological expansion. The motivation of using two types of Mach's principle, one for the Gravitinos in the electroweak era, and then the 2nd modern day Mach's principle, as organized by the author are as seen in [1] are set as equivalent for the purpose of a core kernel of information being preserved during the expansion of the universe.

$$\frac{GM_{electro-weak}\big|_{Super-partner}}{R_{electro-weak}c^2} \approx \frac{G\,M_{today}\big|_{Not-Super-Partner}}{R_0 c^2} \tag{1}$$

The equation above is really a statement of information conservation. The amount of information stored in the left hand side of (1) is the same as the information as in the right hand side of (1) above. Here, M as in the electroweak era refers to M = N times m, where M is the total 'mass' of the gravitinos, N the number of Gravitinos, and R for the electroweak as an almost infinitely small spatial radius. Where the Right hand side is for M for (4 dimensional) gravitons (not super partner objects) = N as the (number of gravitons) and m (the ultra low rest mass of the 4 dimensional graviton) in the right hand side of (1). We argue that this setting of an equivalence of information in both the left and right hand sides of (1) states that the amount of seed information as contained for maintaining the uniformity of values of say, h bar, is expressed in this above equation. This interpretation of (1) should be compared with a change in entropy formula given by Lee [2] about the inter relationship between energy, entropy and temperature as given by

$$m\cdot c^2 = \Delta E = T_U \cdot \Delta S = \frac{\hbar \cdot a}{2\pi \cdot c \cdot k_B}\cdot \Delta S \tag{2}$$

If the mass m, i.e. for gravitons is set by acceleration (of the net universe) and a change in entropy $\Delta S \sim 10^{38}$ between the electroweak regime and the final entropy value of, if $a \cong \frac{c^2}{\Delta x}$ for acceleration is used, so then we obtain

$$S_{Today} \sim 10^{88} \tag{3}$$

Then we are really forced to look at (1) as a paring between gravitons (today) and gravitinos (created during the electroweak era) in the sense of preservation of net information. This information will be used in cosmological evolution in order to keep key cosmological parameters invariant during cosmological evolution. An interpretation we will develop further in the manuscript below. The obvious reason for this kernel of information transfer from the electroweak and today would be in constant values for the cosmological parameters such as Planck's constant, as seen below.

2 Minimum amount of information needed to initiate placing values of fundamental cosmological parameters

Avessian's [4] article about alleged time variation of Planck's constant from the early universe depends heavily upon initial starting points for $\hbar(t)$, as given below, where we pick:

$$\hbar(t) \equiv \hbar_{initial}\left[t_{initial} \leq t_{Planck}\right] \cdot \exp\left[-H_{macro} \cdot \left(\Delta t \sim t_{Planck}\right)\right] \tag{4}$$

The idea is that we are assuming a granular, discrete nature of space-time. Furthermore, after a time we will state as t ~ t $_{\text{Planck}}$ there is a transition to a present value of space-time. It is easy to, in this situation, to get an inter relationship of what $\hbar(t)$ is with respect to the other physical parameters, i.e., having the values of α written as $\alpha(t) = e^2/\hbar(t) \cdot c$, as well as note how little the fine structure constant actually varies. Note that if we assume an 'unchanging' Planck's mass $m_{Planck} = \sqrt{\hbar(t)c/G(t)} \sim 1.2 \times 10^{19}\,GeV$, this expression for Planck's mass means that G has a time variance, too. This time variance in G leads to us asking what can be done to get a starting value of $\hbar_{initial}\left[t_{initial} \leq t_{Planck}\right]$ recycled from a prior universe, to our present universe value. What is the initial value, and how does one insure its existence. We obtain a minimum value as far as 'information' via appealing to Hogan's [5] argument with entropy stated as

$$S_{\max} = \pi/H^2 \tag{5}$$

And this can be compared with Avessian's article [4] value of, where we pick $\Lambda \sim 1$

$$H_{macro} \equiv \Lambda \cdot \left[H_{Hubble} = H\right] \tag{6}$$

What can be done is to note how there is a choice as to how $\hbar(t)$ has an initial value, and entropy as scale valued by $S_{\max} = \pi / H^2$ [5]. The initial values given to the Planck's constant constant and entropy allow for estimates as to compressed values of $\hbar_{initial}\left[t_{initial} \leq t_{Planck}\right]$ which would be transferred from a prior universe, to today's universe. If by [5] the initial total entropy $S_{\max} = \pi / H^2 \sim 10^5$, this value of entropy would mean an incredibly small value for the initial H parameter, i.e. in pre inflation, we would have practically no increase in expansion, just before the introduction vacuum energy, or emergent field energy from a prior universe, to our present universe. The point of the low initial entropy means there is before the big bang no cosmological expansion.

Note that low entropy values in cosmological space-time happens before the electroweak regime (EW), and then there is a Machian bridge between the electroweak regime and what is in the present era which may permit consistency in the value of (4) from the past era to today which deserves to experimentally investigated . To understand this bridge between the early electroweak (EW) regime to today, we will state what happens in the pre Machian regime, before the electroweak (EW) regime. Afterwards form a bridge from the electroweak regime (EW) to today's physics which may keep variations in (4) above within bounds.

The hypothesis being presented is that the start of this process has an initially low entropy state as a pre quantum state of matter-energy. To get to the regime of space time after the Planckian regime there would be at least 100 degrees of freedom and rapidly rising temperature values. Doing this three part transformation, lead to the concept of Octonionic geometry, and a pre Octonionic state of matter-energy, with three regimes of space-time delineated as follows

1. The strictly pre Octonionic regime of space-time has no connections with quantum mechanics. None what so ever. This pre Octonionic state would be with only two degrees of freedom present and if done along the lines of what Crowell [6] and also present would be saying that , specifically the commutation relationship [x(i),x(j)] = 0 , for coefficient i, not being the same as j, as well as an undefined [x(i),p(j)] value which would not be linked to the Octonionic commutation relations as given in Crowell(6). This strictly pre Octonionic space-time would be characterized by a low number of degrees of freedom of space-time.
2. The Octonionic regime of space time would have [x(i),x(j)] not equal to zero, and also [x(i),p(j)] [6] [7] proportional to a value involving a

length value, which is called in the literature a structure constant, for Octonionic commutation relations. This regime of space-time with [x(i),p(j)] not equal to zero, would be characterized by rapidly increasing temperature, and also rapidly increasing degrees of freedom.

3. The strictly quantum mechanical [x(i),p(j)] = [Kroniker delta (i.j)] i times h bar is non zero when i = j, and zero otherwise. This is where we have quantum mechanics, and a rapid approach to flat Euclidian space-time.

Needless to say though that [x(i),x(j)] = 0 is when QM holds. Before, if [x(i),x(j)] does not equal to zero, there is a regime of space-time where QM does not hold. This transition point from pre QM space time, to QM space-time will be very important in the formation of Planck's constant. This last value for the position and momentum commutation relationships would be in the post Octonionic regime of space-time and would be when the degrees of freedom would be maximized (from 100 to at most 1000)[8].

To answer these questions, not only is the stability of the graviton very important, with its connotations of either time dependence or time independence of DE (Dark energy), the other question it touches upon is how we can infer the existence of the speed up of acceleration of the universe.

Note that in terms of the Hubble parameter,

$$H = \frac{1}{a} \cdot \frac{da}{dt} \tag{7}$$

The scale factor of expansion of the universe so brought up, a, which is 1 in the present era, and infinitesimal in the actual beginning of space-time expansion, is such that $\frac{da}{dt}$ gets smaller when a increases, leading to the rate of expansion slowing down. When one is looking at a speed up of acceleration of the universe, $\frac{da}{dt}$ gets larger as a increases.

The given (7) above, the Hubble parameter is a known experimental 'candle' of astronomy. The point in which (7) denotes a slowing down of acceleration of the universe, then quantity so H must get smaller than $\frac{1}{a}$. In fact, as is frequently stated in astronomy text books the net energy density of the universe is proportional to H^2 which is stating then that the energy density of the universe must get smaller faster than $\frac{1}{a^2}$ in the situation where the rate of expansion of the universe is slowing down. In fact, this is what happens as long as you have a universe that is made of nothing but matter and radiation. Normal matter, as the universe expands, just gets further apart. We have the same amount of mass in a larger volume. So normal matter dilutes as $\frac{1}{a^3}$. So when normal matter predominates in cosmological evolution, we observe deceleration. With radiation, we get even more deceleration, because radiation not only dilutes in number, it also gets red-shifted, so that radiation dilutes as $\frac{1}{a^4}$.

So basically the very early universe, when most of the energy was in radiation, was decelerating, But the radiation's energy dropped more rapidly than the normal matter, and so later on the normal matter ended up dominating the energy in the universe. The universe continued to decelerate, but more slowly. As time moved on, the normal matter continued to get more and more dilute, its energy dropping more and more, until the originally much smaller (but not decreasing!) energy density in dark energy came to dominate. When the dark energy became to dominate, as it did one billion years ago, the rate of deceleration slowed down dramatically, then reversed.

Beckwith [9] specifically plotted when the deceleration of the universe switched sign, which happened one billion years ago. As the rate of deceleration became negative one billion years ago, this signified reacceleration of the universe. As Beckwith [9] stated, the sign change in deceleration of the universe was consistent with what is known as massive gravitons, i.e. 4 dimensional gravitons having a rest mass of the order of 10^{-62} grams (or even smaller). A very low mass for a hugely important speed up. .

Now, today, the energy density of the universe is still decreasing, because the matter is still getting more and more dilute, but with matter already at only about 25% of the energy density and falling, the constant (or nearly so) energy density of dark energy has caused the expansion to accelerate.

As Beckwith indicates [9], the value of the ‘massive graviton’ in all these calculations is to answer if DE (dark energy) has a time component, which is slowly varying. The additional feature of what a massive graviton would be doing would be to answer yet another very foundational question. Why is it that the entropy of the universe increases? Current theory as to early universe cosmology has an extremely low level of initial entropy, namely of the order of [7]

$$S_{entropy-initial} \sim 10^{5} - 10^{6} \text{ at or about } 10^{-43} \text{ seconds} \tag{8}$$

into the evolution of the present universe. As has been stated in talks with Beckwith attended in Rencontres de Blois, 2010, in question and answer sessions Beckwith had with Hingsaw of the CMBR NASA project, what is so extraordinary is the initial highly uniform low entropy nature of the universe as can be inferred by the CMBR measurements, and why did the entropy increase in the first place.

In rough scaling, as indicated in the manuscript. The initial conditions at or before radiation domination of the universe corresponded to low entropy, i.e. entropy many orders of magnitude lower than today. The present value of entropy of the universe, if connected to when DE in terms of gravitons dominates would look approximately like what Beckwith generalized [8],[9] from Ng [10], [11], [12] namely as quoting Carroll [3] as was already stated by

$$S_{entropy} \sim 10^{88} - 10^{90} \text{ (“Massive graviton”)} \tag{3}$$

What we are suggesting about (7) is that there is a point of time when entropy tops off as linkable to DE (dark energy), and possibly massive gravitons, delineating when reacceleration occurs.

I.e. in effect changing the dynamics of (1) and our discussion about why $\frac{da}{dt}$ gets larger as a increases $\frac{da}{dt}$ gets larger when our candidate for DE (massive gravitons?) becomes a dominant contribution to net contributed energy density of cosmological expansion. In terms of applications as to Mach's principle, what we will see can be summarized as follows. From the electroweak era to today [1] sets

$$\begin{aligned} M_{electro-weak} &= N_{electro-weak} \cdot m_{3/2} = N_{electro-weak} \times 10^{38} \cdot m_{graviton} \\ &= N_{today} \cdot m_{graviton} \approx 10^{88} \cdot m_{graviton} \end{aligned} \tag{9}$$

Then the electroweak regime would have a numerical particle count of

$$N_{electro-weak} \sim 10^{50} \tag{10}$$

Using quantum infinite statistics, this is a way of fixing the early electroweak entropy as $\sim 10^{50}$ vs. 10^{88} today.

The argument as stated so far uses Ng's quantum infinite statistics, to get S ~ N via 'infinite quantum statistics' [10], [11], [12]. Later on, we shall use this information storage paradigm as a way to justify having $\hbar(t)$ being a constant value, next

3 Lessons from Gryzinski, as far as semiclassical derivation of a usually assumed quantum derivation of Inelastic Scattering in Atomic Hydrogen and its implications as to $\hbar(t)$ arising from Maxwell's equations instead of being derived from Quantum Mechanics.

We will review the derivation of what is normally assumed to be a quantum result, with the startling implications that a cross section formula, normally quantum, does not need usual Hilbert space construction (usually Hilbert space means quantum mechanics). If such a presumed quantum result can arise from semiclassical derivations, what is to forbid the same thing happening with regards to $\hbar(t)$? Note that we are assuming $\hbar(t)$ has essentially no variation, but what is to forbid $\hbar(t)$ from being a semiclassical result in the manner of Gryzinski [13], [14]. We will briefly review the Gryzinski result [13], [14] which came from something other than Hilbert space construction and then make our comparison with the likelihood of doing the same thing with respect to forming $\hbar(t)$ without mandating the existence of Hilbert spaces in the electroweak era. Gryzinski [13], [14] starts off with what is called an excitation cross section given by

$$Q(U_n) = \frac{\sigma_0}{U_n^2} g_j \left(\frac{E_2}{U_n}; \frac{E_1}{U_n} \right) \tag{11}$$

Where

$$g_j \left(\frac{E_2}{U_n}; \frac{E_1}{U_n} \right) = \left(\frac{E_2}{E_1 + E_2} \right)^{3/2} \cdot \Phi \tag{12}$$

And

$$\Phi \equiv \frac{2}{3} \cdot \frac{E_1}{E_2} + \frac{U_n}{E_2} \cdot \left(1 - \frac{E_1}{E_2} \right) - \left(\frac{U_n}{E_2} \right) \quad if \quad U_n + E_1 \le E_2 \tag{13}$$

And

$$\Phi \equiv \left[\frac{2}{3} \cdot \frac{E_1}{E_2} + \frac{U_n}{E_2} \cdot \left(1 - \frac{E_1}{E_2} \right) - \left(\frac{U_n}{E_2} \right) \right] \cdot \sqrt{\;} \quad if \quad U_n + E_1 \geq E_2 \tag{14}$$

With

$$\sqrt{\;} = \sqrt{\left(1 + \frac{U_n}{E_1} \right) \cdot \left(1 - \frac{U_n}{E_2} \right)} \tag{15}$$

The write up of (11) to (15) has $\sigma_0 = 6.53 \times 10^{-14} cm^2 eV^2$, and U_n being energy of level n, and E_1 being the energy of the bound electron , and E_2 being the energy of the incident electron. We refer the reader to access [11] as to what the value of the Born approximation used as a comparison with (15) above. The result was that the Gryzinski's approximation gives scattering cross sections lower than those of the Born approximation although the shape of the curves for cross sectional values are almost the same, with the difference between the Gryzinski approximation and the Born approximation in value closed in magnitude, with principal quantum numbers increased The net effect though is that having a Hilbert space, I.e. assuming that the presence of a Hilbert space implies the Quantum condition, is not always necessary for a typical quantum result. Now, how does that argument as to Hilbert spaces not being necessary for presumed quantum results relate to how to obtain $\hbar(t)$?

Note that there is a semiclassical derivation for at least $\hbar$ as given by [13], [14] by Bruchholz where he uses Maxwell's fields to deduce $\hbar$, from an electromagnetics assuming a definite physical boundary. We submit that the transition from the Octonionic regime of where the Octonionic regime of space-time would have [x(i),x(j)] not equal to zero [6] [7] would constitute such a boundary to where we have [x(i),x(j)] equal to zero. Where [x(i),x(j)] not equal zero would be when we did not have a Hilbert space construction, but that as was shown in [13], [14] there is even in the absence of Hilbert spaces the possibility of semiclassical arguments yielding a quantum result existing. We also submit that the boundary between octonian geometry as given when [x(i),x(j)] not equal to zero to where [x(i),x(j)]is zero, is enough to give a boundary condition so that the following argument as given by [16] holds, namely if electromagnetic fields exist at/ before the electroweak regime [1] then we can write [15] in the electroweak regime of space time, namely that given the prime in both (16) and (17) is for a total derivative

$$E_y = \frac{\partial A_y}{\partial t} = \omega \cdot A'_y \left(\omega \cdot (t - x) \right) \tag{16}$$

Similarly [15]

$$B_z = -\frac{\partial A_y}{\partial x} = \omega \cdot A'_y \left(\omega \cdot (t - x) \right) \tag{17}$$

The A field so given would be part of the Maxwell's equations given by [15] as, when $[\ ]$ represents a D'Albertain operator, that in a vacuum, one would have for an A field [15], [16]

$$[\ ]A = 0 \tag{18}$$

And for a scalar field ϕ

$$[\ ]\phi = 0 \tag{19}$$

Following this line of thought we then would have an energy density given by, if ε_0 is the early universe permeability[15]

$$\eta = \frac{\varepsilon_0}{2} \cdot \left(E_y^2 + B_z^2 \right) = \omega^2 \cdot \varepsilon_0 \cdot A_y'^2 \left(\omega \cdot (t - x) \right) \tag{20}$$

We integrate (20) over a specified E and M boundary, so that, then we can write the following condition namely [15].

$$\iiint \eta d\left(t - x\right) dydz = \omega \varepsilon_o \iiint A_y'^2 \left(\omega \cdot (t - x) \right) d\left(t - x\right) dydz \tag{21}$$

(21) would be integrated over the boundary regime from the transition from the Octonionic regime of space time, to the non Octonionic regime, assuming an abrupt transition occurs, and we can write, the volume integral as representing [15],[16]

$$E_{gravitational-energy} = \hbar \cdot \omega \tag{22}$$

Our contention for the rest of this paper, is that Mach's principle will be necessary as an information storage container so as to keep the following, i.e. having no variation in the Planck's parameter after its formation from electrodynamics considerations as in (21) and (22). Then by applying [15],[16]

$$\hbar(t) \xrightarrow[Apply-Machs-\mathrm{Re}lations]{} \hbar\,(Constant\ value) \tag{23}$$

4 Why include in Mach's principle at all. Mishra’s use of Mach's principle to have a quantum big bang.

We have, through (23) above outlined an application of Mach’s principle as far as the constant value of $\hbar(t)$.Next will be describing how and why Mach’s principle can be applied to the gravitino. Note, Mishra [15] used a spin 3/2 particle, and we suggest this is in sync with using a Gravitino.

Mishra, and Mishra & Christian in [18] came up with a Fermionic particle description of the number of particles in the universe, and since gravitons have spin 2, we are lead to gravitinos of spin 3/2, a super partner description many times larger in mass than the super partner graviton. The Mistra approximation was for a fermionic treatment of kinetic energy as given by $\rho\left(\vec{X}\right)$ as a single particle distribution function, such that Mishra used[17] $\rho\left(\vec{X}\right) \equiv A \cdot e^{-x} / x^3$, where $x = \sqrt{r/\lambda}$, and $r = \left|\vec{X}\right|$, with λ a variational parameter, and KE is written as given by [1], [17],[18],[19]

$$\langle KE \rangle = \left(\frac{3\hbar^2}{10m}\right) \cdot \left(3\pi^2\right)^{3/2} \cdot \int d\vec{X} \cdot \left[\rho\left(\vec{X}\right)\right]^{5/3} \tag{24}$$

This $\rho\left(\vec{X}\right)$ has a normalization such that

$$\int d\vec{X} \cdot \left[\rho\left(\vec{X}\right)\right] = N \tag{25}$$

Furthermore, the potential energy is modeled via a Hartree-Fock approximation given by

$$\langle PE \rangle = -\left(\frac{g^2}{2}\right) \cdot \int d\vec{X} \cdot d\vec{X}' \left(\left[\rho\left(\vec{X}\right) \cdot \rho\left(\vec{X}'\right)\right] \Big/ \left|\vec{X} - \vec{X}'\right| \right) \tag{26}$$

These two were combined together by Mistra to reflect the self gravitating fictitious particle Hamiltonian [1], [17],[18]

$$H = -\sum_{i=1}^{N} \left(\frac{\hbar^2}{2m}\right) \cdot \nabla_i^2 - g^2 \sum_{i=1, i \neq j}^{N} \sum_{j=1}^{N} \frac{1}{\left|\vec{X}_i - \vec{X}'_j\right|} \tag{27}$$

So then a proper spatial averaging of the Hamiltonian will lead, for $\langle H \rangle = E$ quantum energy of the universe given by [17],[18],[19]

$$\langle H \rangle = E(\lambda) = \left(\frac{12}{25\pi}\right)\cdot\left(\frac{\hbar^2}{m}\right)\cdot\left(\frac{3\pi N}{16}\right)^{5/3}\cdot\frac{1}{\lambda^2} - \left(\frac{g^2 N^2}{16}\right)\cdot\frac{1}{\lambda} \qquad (28)$$

Note that the value m, is the mass of the fermionic particle, and that (26) when minimized leads to a minimum energy value of the variational parameter, which at the minimum energy has $\lambda = \lambda_0$ for which (26) becomes

$$E(\lambda = \lambda_0) = E_0 = -(.015442) N^{7/3} \cdot \left(\frac{mg^4}{\hbar^2}\right) \qquad (29)$$

The tie in with Mach's principle comes as follows; i.e. Mishra sets a net radius value [17],[18],[19]

$$r = R_0 = 2 \cdot \lambda_0 = \frac{\hbar^2}{mg^2} \times \left(4.0147528\right) \big/ N^{1/3} \qquad (30)$$

This spatial value is picked so that the potential energy of the system becomes equal to the total energy, and note that a total mass, M of the system is computed as follows, i.e. having a mass as given by $M = M_{total} = N \cdot m$ Mistra [1],[17] then next assumes that then, there is due to this averaging a tie in, with M being the gravitational mass a linkage to inertial mass so as to write, using (28) and (29) a way to have inertial mass the same as gravitational mass via

$$E_{gr} = \frac{G \cdot M \cdot m_{grav}}{R_0} = m_{inertial} \cdot c^2 \equiv m_{grav} \cdot c^2 \Leftrightarrow \frac{GM}{R_0 c^2} \approx 1 \qquad (31)$$

This is for total mass M of the universe, and so if we wish to work with a subsystem as what we did with gravitinos, in the electroweak era, we will then change (31) to read instead as a sub set of this Mach's principle, i.e.an electroweak version, i.e. a subset of the Mach's principle

$$\frac{GM_{gravitinos}}{R_{EW} c^2} \approx const \qquad (32)$$

We shall outline the consequences of the Machian equation, of the sort given by (32) and from there say something about the limits, next of the Wheeler De Witt equation.

5 Machian physics and the linkage to the Wheeler De Witt Equation and the limits of the Wheeler De Witt equation

Barbour and Pfizer [20] write a very interesting and useful document and intepretation as far as Hamiltonian systems and general relativity. According to [20], the dynamics of general relativity can be written up in terms of a constrained Hamiltonian “with the configuration space for pure gravity being given by the space of all Riemanian metrics on a 3 dimensional manifold Σ of fixed but arbitrary topology. We call this topology $Q(\Sigma)$" and have that $g_{ab}\left(s\right)$ is the trajectory (of all paths) on $Q(\Sigma)$ In their derivation the vacuum Einstein equations take the form of

$$g''_{ab}+\Gamma^{ijkl}_{ab}g'_{ij}g'_{kl}=-2\cdot(R_{ab}-\frac{1}{4}g_{ab}R) \tag{33}$$

This has a Hamiltonian constraint given by

$$G^{abcd}g'_{ab}g'_{cd}-4\sqrt{g}R=0 \tag{34}$$

And a momentum constraint given by

$$G^{abcd}\nabla_{b}g'_{cd}=0 \tag{35}$$

Here, ∇^{a} is the Levi-Civita for a metric g_{ab} with a corresponding Ricci scalar R and Ricci tensor R^{ab} with the Γ^{ijkl}_{ab} terms associated with the De Witt metric [20]. As cited by [20], if (34) and (35) are satisfied initially, then by (33) , (34) and (35) are continually satisfied Now in what Barbor calls the Machian derivation of General relativity" [20], [21] there is one constant linkage of his formalism with the Wheeler De Witt equation, which is that there is no formal time flow, i.e., that the Wheeler De Witt equation in its classical form as in [22] has NO time component added to it. Note that in [21] it is stated that there is no general flow of time, at best there are what Barbor called "time capsules" and that Quantum physics is a way of giving "high probability" to "time capsules". What the author has proposed doing with the Machian perspective is to give a dynamical trajectory as to the Hamiltonian and momentum constraints given as (34) and (35).Needless to say though that what is attempted by (32) is to set up a precondition, independent of (34) and (35) as to set up a configuration for the set of (33), (34) and (35) via (32), and that we regard (32) as a precondition for fulfilling (34) and (35) which are then dynamically satisfied via (33).The idea is that (1) which forms as a byproduct of result of (32) is a precondition for then the formation of the WdW equation as we know it, which we accept as a time independent quantity[22].

This construction of the WdW equation leads to the following question. If Barbor is right about there not being a 'flow of time' as we think of it, can we interpret (1) and then (32) as a Machian set up of the WdW equations via (33), (34) and (35)? We submit that what is happening is that if there is no flow of time, that still there is a dynamical set up period, and a conservation of information flow as represented by the formation of $\hbar$ as given in (21) and (22), with then (1), (33) to (35) as preconditions as to keeping the same value of $\hbar$ during cosmological evolution, with the WdW equation forming after the set up of the initial $\hbar$ which then remains constant.

6 How to outline the resulting precondition for constant value for $\hbar$

In this note what we do is to organize the interrelationship of the formation of Planck’s constant with a necessary and sufficient condition for Quantum processes to form. In a word what we are seeing is that when Planck's constant is being formed, as in the electrodynamic argument given in this paper, that a boundary condition created by Octonian space-time physics exists, which is a boundary of where orthodox QM does not apply and that then later we are applying QM with the formation of Planck's constant after we enter in the regime after the formation of Planck’s constant. After the formation of Planck's constant we then are in a position where the Machian relations between gravitinos and gravitons exist, which we claim is a necessary and sufficient condition for a no changing value of $\hbar$ **.** What is done below is to summarize a very sophisticated interrelationship of formation of Planck's constant, the zone of where Octonian geometry no longer holds as separated by a boundary from where Octonian geometry does hold as a necessary and sufficient condition for the onset of using this boundary between Octonionic and non Octonionic geometry as the necessary condition to use relic electromagnetic fields to construct Planck's constant. Note that we are assuming very high electromagnetic fields during and before the electroweak regime [1] which allows, with the presence of a boundary between Octonionic and non Octonionic geometry Planck's constant to form.

TABLE 1

.Time Interval	Dynamical consequences	Does QM/WdW apply?
Just before Electroweak era	Form $\hbar$ from early E & M fields, and use Maxwell's Equations with necessary to implement boundary conditions created from change from Octonionic geometry to flat space	NO Use (32) as Pre QM set up
Electro-Weak Era	$\hbar$ kept constant due to Machian relations	YES Use (1) as linkage
Post Electro-Weak Era to today	$\hbar$ kept constant due to Machian relations	YES Wave function of Universe

In so may words, the formation period for $\hbar$ is our pre quantum regime. This is incidentally the boundary region before the break down of Octonionic gravity, to our present cosmology. When we get to the present era, and the breakdown of Octonionic geometry, exemplified by spatial commutation relations equaling zero, is when QM applies. Before that regime, QM does not apply Furthermore, with the formation of a WdW cosmology, we then have confluence with Barbor’s dismissal of the flow of time, as given in [20] and [21] which is in adherence as to [22] in its treatment of the WdW equation as time independent.

7 Conclusion: Getting the template as to keeping information content available for (32) right and its implications for (1) and (4)

The Machian hypothesis [1],[17] and actually (9) are a way to address a serious issue. The issue is how to keep the consistency of physical law intact, in cosmological evolution. So far, using the template of gravitons and their superpartners, gravitinos, as information carriers, the author has provided a way to argue that Planck’s constant remains invariant as from the EW(electroweak era) to the present era. As one can deduce from physical evolution of the cosmos, time variance of Planck’s constant and time variation of the fine structure constant would lead to dramatically different cosmological events than what is deduced by obervational astronomy. What we are arguing, using Mach's principle is

a. Physical law remains invariant in cosmological evolution due to the constant nature/ magnitude of h bar, the fine structure constant, and G itself. As seen in (4).

b. The linkage in information from a prior to the present universe can be thought of as far as the constancy of (19) concerning gravitinos. While we are aware that gravitinos have a short life time, we argue that (19) would have significant continuity at/before the big bang, and also that this is a way of answering the memory question as to how much cosmological memory is preserved from a prior to the present universe structures. Needless to say though there is a complete breakdown in causality before the formation of the gravitinos which is incidentally the pre quantum regime of space-time, i.e. where Octonionic geometry predominates as given by [6] and [7].

The main task the author sees is in experimental verification of the following identity. See (1) as reproduced below

The motivation of using two types of Mach's principle, one for the Gravitinos in the electroweak era, and then the 2nd modern day Mach's principle, as organized by the author are as seen in (1) as re stated below [1]

$$\frac{GM_{electro-weak}\big|_{Super-partner}}{R_{electro-weak}c^{2}} \approx \frac{G\,M_{today}\big|_{Not-Super-Partner}}{R_{0}c^{2}} \qquad (1)$$

Once making the double Mach's principle with (1) equal to a constant is done, with M = N times m, where N is the number of a particular particle species, and m is the net mass of the particle species, then an embedding of quantum mechanics using Mach's principle as part of an embedding space can be ventured upon and investigated experimentally. Also, we will be then getting ready for the main prize, i.e. finding experimental constraints leading to (4), Planck's constant being invariant. That will do researchers a valuable service as to forming our view of a consistent cosmological evolution of our present cosmology from cycle to cycle. It also would allow for eventually understanding if entropy can also be stated in terms of gravitons alone in early universe models as was proposed by Kiefer & Starobinsky, et al.[23]. Finally, it would address if QM is embedded in a larger deterministic theory as advocated by t' Hooft [24], as well as degrees of freedom in early universe cosmology as brought up by Beckwith in Dice 2010 [8].The end result would be in examine the following, in terms of h_{ij} values as influenced by massive gravitons. We can use this Machian relationship to understand the h_{ij} values as influenced by massive gravitons. As read from Hinterbichler [25], if $r = \sqrt{x_i x_i}$, and we look at a mass induced h_{ij} suppression factor put in of $\exp(-m \cdot r)$, then if

$$h_{00}(x) = \frac{2M}{3M_{Planck}} \cdot \frac{\exp(-m \cdot r)}{4\pi \cdot r} \tag{36}$$

$$h_{0i}(x) = 0 \tag{37}$$

$$\begin{aligned} h_{ij}(x) &= \left[\frac{M}{3M_{Planck}} \cdot \frac{\exp(-m \cdot r)}{4\pi \cdot r} \right] \cdot \\ &\left(\frac{1 + m \cdot r + m^2 \cdot r^2}{m^2 \cdot r^2} \cdot \delta_{ij} - \left[\frac{3 + 3m \cdot r + m^2 \cdot r^2}{m^2 \cdot r^4} \right] \cdot x_i \cdot x_j \right) \end{aligned} \tag{38}$$

Here, we have that these h_{ij} values are solutions to the following equation, as given by [25], [26], with D a dimensions value put in.

$$\left(\partial^2 - m^2 \right) h_{\mu\nu} = -\kappa \cdot \left[T_{uv} - \frac{1}{D-1} \cdot \left(\eta_{uv} - \frac{\partial_\mu \partial_\nu}{m^2} \right) \cdot T \right] \tag{39}$$

To understand the import of the above equations, and the influence of the Machian hypothesis, for GW and massive graviton signatures from the electroweak regime, set

$$\begin{aligned} M &= 10^{50} \cdot 10^{-27} g \equiv 10^{23} g \propto 10^{61} - 10^{62} eV \\ M_{Plank} &= 1.22 \times 10^{28} eV \end{aligned} \tag{40}$$

And use the value of the radius of the universe, as given by r $= 1.422 \times 10^{27}\, meters$, and rather than a super partner gravitino, use the $m_{massive-graviton} \sim 10^{-26} eV$ If the h_{ij} values are understood, then we hope we can make sense out of the general uncertainty relationship given by [27]

$$\left\langle \left(\delta g_{uv} \right)^2 \left(\hat{T}^{uv} \right)^2 \right\rangle \geq \frac{\hbar^2}{V_{vol}{}^2} \tag{41}$$

The hope is to find tests of this generalized uncertainty due to h_{ij} values and to review [24], i.e. to find experimentally falsifiable criteria to determine if Quantum mechanics is actually embedded within a semiclassical super structure.

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