

IF A MACHIAN RELATIONSHIP BETWEEN GRAVITONS AND GRAVITINOS EXISTS, WHAT DOES SUCH A RELATIONSHIP IMPLY AS TO SCALE FACTOR AND QUINCESSENCE EVOLUTION AND THE EVOLUTION OF DM?

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We investigate the relationship between gravitons and gravitinos with a revision of SUSY assuming a massive graviton, this leads to an entropy value for the electroweak era. Further consequences including the value of the weak fermi scale occur naturally

1. Introduction

We start off with the following mass scales, using [1] as a guide while using [2], as well. This leads to the following mass scales [1] as given by $M_X \geq 10^{15} GeV$ - grand unification scale, then $M_W \geq 2 GeV$, M_S - super symmetry scale, and M_P as a Planck mass value. From here, [1] gives a preliminary value for the gravitino

of $m_{3/2} \approx \frac{M_S^2}{\sqrt{3}M_P} = \frac{M_W M_X}{\lambda^2 M_P}$ which can have a mass as high as a 1 or more TeV, although we will use a

different scaling value to fill in our subsequent tables. The coefficient λ is roughly a measure of how closely the gravitino can couple to matter fields, which is relevant as to the electro weak regime. This will be used to make an estimate [2] as to relevant graviton to gravitino mass values. I.e. we relate this synthesis of gravitino to massive gravitons [2] to a machian relationship which will be delved into in the body of our text.

2. Forming $m_{3/2}$ for a gravitino and linking it to Massive Graviton Contributions in electro weak era: For the Machian relationship

The idea was to mix results in [1] with

$$\begin{aligned} M_{electro-weak} &= N_{electro-weak} \cdot m_{3/2} = N_{electro-weak} \times 10^{38} \cdot m_{graviton} \\ &= N_{today} \cdot m_{graviton} \approx 10^{88} \cdot m_{graviton} \end{aligned} \quad (1)$$

Then the electro weak regime would have an entropy value of [1], whereas the $m_{3/2}$ is a gravitino mass value. With (2) below being the initial entropy value in electro weak regime which grows to 10^{88} today, i.e.

$$N_{electro-weak} \sim 10^{50} \quad (2)$$

The first and second eqn. form our Machian relationship for making an linkage of massive gravitons linked to SUSY gravitinos This would lead to, say

$$\sum m_{BOSONS} - \sum m_{FERMIONS} = 0 \quad (3)$$

Table 1, mass of different particles and cosmological parameters (rounded off)

M_{Planck}	$M_{TEV} \sim M_{DM} \sim M_{Gravitino}$	M_{DE}	$M_{Graviton}$
$10^{-8} kg \sim 10^{16} TeV$	$10^{-24} kg = 10^{12} eV$	$10^{-16} M_{DM}$	$10^{-65} kg$

3. Conclusion for forming the Eq(1) Machian relationship, reviewed

We can make an argument that a “massive” Graviton is formed due to a Lorentz violation, and that due in part to the argument made by Bjorken [3] in his “Zeldovitch relationship”, i.e.

$$\frac{4\pi \cdot \gamma \cdot \rho_A}{\sqrt{1 + \gamma^2}} \approx 10^{-60} M_{Planck} \approx [\Lambda_{QCD}]^3 \quad (4)$$

Here, we have that the Lorentz violating term has a magnitude due to

$$b_\mu = \frac{\eta_\mu \cdot 2\pi\rho_A\gamma}{M_{Planck} \cdot (1 + \gamma^2)} \leq 10^{-33} eV \quad (5)$$

This assumes that there is a Lorentz violating Lagrangian term of [3]

$$L_{Lorentz-Violation} \approx b_\mu \bar{\psi} \gamma^\mu \gamma_5 \psi \quad (6)$$

The assertion being asked is if the formation of the Lorentz violating Lagrangian term in (5) would be necessary for the (1) and (2) conditions to form, which among other things is that the mass of a gravitino is $\sim 10^{+41} M_{Graviton}$ whereas the M_{DE} is about $10^{-16} M_{DM}$. The masses alone argue as to a coherent bunching of gravitons to represent DE, in line with string theory, but the real action will be to perhaps link Λ_{EW} in its initial configuration with a) DM initial creation, at / about the electro-weak regime, b) possibly by Machian physics make an inter relationship between DM and DE as through the rise of Λ_{EW} as outlined below in (7). The more general situation may arise due to a Casimir type force between the IR and UV Randal-Sundrum model branes with the DE transmitted to our present universe. Partly because Casimir energy = vacuum energy, which may be the easiest way to generate dark energy. Here the overall density value due to a scale factor of $a(t) \propto \frac{const}{\rho_\bullet} \approx \exp(H \cdot t) \Rightarrow \rho_\bullet \propto \Lambda \sim \exp(-H \cdot t)$

$$\rho_\bullet|_{Today} \sim \frac{\Lambda_{EW}}{8\pi} \exp(-H_{EW} \cdot t|_{Today}) \Leftrightarrow \Lambda_{Today} \sim \Lambda_{EW} \exp(-H_{EW} \cdot t|_{Today}) \quad (7)$$

And $\Lambda_{EW} \sim 10^{-38} - 10^{-40}$ or more to the tiny present Λ_{Today} for vacuum energy, assuming $\Lambda_{Today} \sim \Lambda_{EW} \exp(-H_{EW} \cdot t|_{Today})$ and this leading to [1], if M is the total mass affected by the Machian relationship as is given in the cubic equation of

$$(a \cdot r)^3 - \frac{E}{(\beta + H)^2} \cdot (a \cdot r) - \frac{M}{(\beta + H)^2} = 0 \quad (8)$$

References

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3 J. D. Bjorken, “Emergent Photons and Graviton: The problem of Vacuum Structure”, arXiv:1008.0033v1 [hep-ph]