On deterministic quantum gravity from linear cosmology.

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Abstract

Recent advances in linear cosmology have led us to a deterministic approach to quantum gravity based on the Planck force in a flat universe. In this context, we propose generalizing the Planck force equation from linear cosmology to the entirety of deterministic quantum gravity. We try to extend the notion of force in relativity to a quantum context.

Keywords: Deterministic quantum gravity, Linear cosmology, Flat universe, Planck force, Relativity.

Introduction:

The temperature inside the Hubble sphere, i.e. a growing black hole, was proposed by Tatum et al. [1, 2] to be determined by a Hawking temperature formula with the geometric mean of the Hubble mass, $\mathrm{M_H}$, and the Planck mass m_p:

$$T_H = T_{CMB} = \frac{\hbar c^3}{\mathrm{k_B 8\pi G}\sqrt{\mathrm{M_H\ m_p}}} = \frac{\hbar c}{k_B 4\pi\sqrt{R_H 2\, l_p}} \approx 2.725K \quad (1)$$

Where k_B is the Boltzmann constant, c the light speed, $\hbar$ is the reduced Planck constant and G the Newtonian constant of gravitation.

Haug and Wojnow [3] demonstrated this formula, and Haug recently published a summary of the demonstration [4]. This advancement in linear cosmological models, or in other words RH = ct models, provides optimism for future progress in this field.

Observations on the method and approach of the deterministic quantum gravity:

Tatum et al. based their hypothesis on a geometric mean between a cosmological quantity and its equivalent in Planck units, applied to a formula known from physics. To reproduce this method, we will use Newton's law of universal gravitation for a flat universe observed, i.e. at the critical density:

$$F_H = F_{CMB} = G\frac{M_H m_p}{R_H l_p} = \frac{F_p}{2} \quad (2)$$

Where F_p is the Planck force. Indeed, with $\mathrm{M_H} = \frac{\mathrm{m_p t_H}}{2\mathrm{t_p}}$, see [5], $\mathrm{R_H} = \mathrm{ct_H}$,where H is the Hubble constant, $t_H = \frac{1}{H}$ the Hubble time, and $\mathrm{c} = \frac{\mathrm{l_p}}{\mathrm{t_p}}$ we have from Eq.2:

$$\mathrm{G}\frac{\mathrm{M_H m_p}}{\mathrm{R_H l_p}} = \mathrm{G}\frac{\mathrm{m_p t_H m_p}}{2\mathrm{ct_H t_p l_p}} \quad (3)$$

$$\mathrm{G}\frac{\mathrm{M_H m_p}}{\mathrm{R_H l_p}} = \mathrm{G}\frac{\mathrm{m_p m_p}}{2\frac{\mathrm{l_p}}{\mathrm{t_p}}\mathrm{t_p l_p}} \quad (4)$$

$$\mathrm{G}\frac{\mathrm{M_H m_p}}{\mathrm{R_H l_p}} = \mathrm{G}\frac{\mathrm{m_p m_p}}{2\mathrm{l_p^2}} \quad (5)$$

$$\mathrm{G}\frac{M_H m_p}{R_H l_p} = \frac{F_p}{2} \quad (6)$$

Eq.5 can also be derived as follows: $\frac{\mathrm{M_H}}{\mathrm{R_H}} = \frac{\mathrm{m_p}}{2\mathrm{l_p}}$, see [6].

According to Eq.3 to Eq.6, there could be a quantum force in the vacuum, F_q, acting on a mass smaller than $\mathrm{m_p}$, $\mathrm{m_i}$, at a distance, $\mathrm{d_j}$, from $\mathrm{m_p}$:

$$\mathrm{F_q} = G\frac{\mathrm{m_i m_p}}{\mathrm{d_j l_p}} \quad (7)$$

It is obvious that with $\mathrm{d_j}$ small, the three other fundamental interactions, the electromagnetic interaction, the weak interaction, and the nuclear interaction, play a significant role but this is not in the scope of this paper. We limit ourselves here to trying to propose a plausible approach to deterministic quantum gravity in vacuum. This statement may not be entirely baseless because we can observe that:

$$\mathrm{G}\frac{\mathrm{m_p}}{\mathrm{l_p}} = \mathrm{c}^2 \quad (8)$$

So, we can see from Eqs. 7 and 8 that:

$$\mathrm{F_q} = \frac{\mathrm{m_i c^2}}{\mathrm{d_j}} \quad (9)$$

This combination of relativistic force and deterministic quantum physics is not absurd from a physical standpoint. When $\mathrm{m_i} \leq \mathrm{m_p}$ and $\mathrm{d_j} \geq l_p$, we obtain the following from Eqs. 7 and 9:

$$\mathrm{F_q} \leq \mathrm{F_p} \quad (10)$$

With $n_i = \frac{m_p}{m_i}$ and $\mathrm{n_j} = \frac{\mathrm{l}_p}{\mathrm{d}_j}$, we can also quantify Eq.7 as follows,

$$F_q = \frac{n_j F_p}{n_i} \quad (11)$$

and Eq.9 as follows:

$$F_q = \frac{n_j m_p c^2}{n_i l_p} \tag{12}$$

The maximum value of F_q is F_p. Therefore, we have from Eqs. 10 and 11:

$$1 \geq \frac{n_i}{n_j} \tag{13}$$

$$n_j \geq n_i \tag{14}$$

Conclusion:

We propose a deterministic approach to quantum gravity from linear cosmology. In other words, and surprisingly, we extend the notion of force in relativity to a quantum context. This approach could possibly be tested in space, in a weightless environment, by observing and measuring the phenomenon between a Planck mass and a much lighter body that is placed at a sufficient distance from it. Only future experiments will determine the validity of this concept. However, it should be noted that the density of the best synthetic materials is only 0.9 mg/cm^3, which makes it very difficult to produce and manipulate the Planck's mass sphere. Nevertheless, Eq.9 or Eq.11 can give the scientific community one or more ideas for experiments based on power, by treating it as a force times c.

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