Planck's units and the expansion of spacetime

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Abstract

This paper will suggest a way to test the idea in which space-time itself is quantified into discrete building blocks in the size of Planck's length and Planck's time, by correlating between the expansion of spacetime, the increase in the gravitational constant G, number of black holes and the Schwarzschild radius of the black hole.

Introduction

Planck's length (l_p) and Planck time (t_p) are the smallest spacetime units known to physics. Based on Hawking – Bekenstein equations, the number of information bits within a black hole is limited by its surface area divided by the Planck area (${l_p}^2$). The Planck length is built by the three basic universal constants: G, c, h (equation 1).

Equation 1:

$$l_p = \sqrt{\frac{hG}{c^3}}$$

$l_p = Planck's\ length,$ G$= Gravitational\ constant,\ \ c = speed\ of\ light, h = Planck'sconstant$

If spacetime is quantified into discrete building blocks in the size of Planck's length and Planck's time (figure 1), since space-time expands with time, (based on redshift measurements), the Planck length and Planck time should increase assuming it's the basic building block of spacetime and no new building blocks are added to spacetime. As space-time expands, photonic energy decreases (red shifted) and based on equation 2, we can assume that hc is a constant meaning h & c are constant even as space-time expands (This is an assumption which can be wrong).

Equation 2:

$$E_{ph} = \frac{hc}{\lambda}$$

$E_{ph} = Photonic\ energy,\ \ h = Planck's\ constant\ ,\ \lambda = Wave\ length,\ \ c = speed\ of\ light$

Based on equation 1, if Planck length l_p increases as space time expands, and h and c are constants, it means that the gravitational constant G increases (it means that G is not a constant but a function of the Planck's length). If we visualize G as the curvature parameter for spacetime, we can intuitively visualize that as the fabric of spacetime expands (“stretches”) its curvature “flexibility” G increases. As spacetime expands, the photonic wavelength increases and based on equation 2, the photonic energy decreases. The loss of photonic energy, due to the expanding spacetime, is transferred into gravitational waves in the fabric of spacetime. As the “flexibility” of the spacetime fabric increases, the ability to transfer the loss of photonic energy through gravitational waves in the fabric of spacetime, increases.

Conclusion:

If space time is quantified into units in the size of Planck’s length (and Planck time), the expansion of spacetime should be proportional to the expansion of the Planck’s length (and Planck time) units (assuming that no new Planck length and Planck time units are added during the expansion of spacetime. This assumption can be wrong). If h and c are constants (not dependent on Planck’s length and Planck time), from equation 1 we can derive that the square root of G is dependent on Planck’s length and Planck time.

Equation 3:

$$l_p \propto \sqrt{G}$$

$$t_p \propto \sqrt{G}$$

$\propto$ $this\ symbol\ represents\ "behaves\ like, proportional"$

$l_p = Planck's\ length,$ G= $Gravitational\ constant$

$t_p = Planck's\ time,$ G= $Gravitational\ constant$

Predictions for future astrophysics observations:

The Schwarzschild radius of the black hole event horizon is linearly dependent on the gravitational constant G (equation 4).

Equation 4:

$$r_s = \frac{2GM}{c^2}$$

$r_s =$ $the\ Schwarzschild\ radius\ of\ a\ black\ hole$

$G =$ $gravitational\ constant$

M = mass

c = speed of light

From equation 3 and equation 4, we can mathematically derive that the square root of the Schwarzschild radius of black holes, will increase proportional to the increase in Planck's length and Planck time due to the expansion of spacetime (equation 5). An increase in the square root of the Schwarzschild radius of black holes, might lead to an increase in the number of stars, that will reach the required Schwarzschild radius and lead to an increase in the number of black holes.

Equation 5

$$\boxed{Expansion\ of\ spacetime \propto l_p\, , t_p \propto \sqrt{r_s}}$$

Both the expansion of spacetime, the gravitational structure of galaxies, number of black holes, and the Schwarzschild radius of black holes, can be observed with the James Webb telescope, CMB observatories and LIGO. Any logical theory which can be tested is one that should be taken seriously.

This paper assumes that h and c stay constant as spacetime expands. If they also change as spacetime expands, this can influence equation 2 and influence our observations as if the expansion rate of spacetime is accelerating. Based on equation 3, the increase in l_p leads to an increase in G ("flexibility to expand"), which will lead to a larger increase in l_p which will lead to a larger increase in G and so on. This positive feedback loop can generate an accelerated expansion of the spacetime fabric.

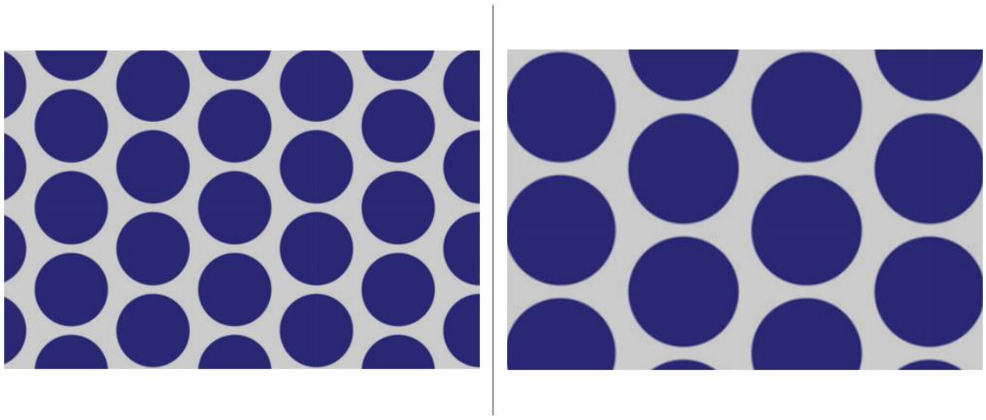

Figure 1: A two-dimensional matrix illustration of a local region within a four-dimensional quantified fabric of spacetime. Each quantized unit is in the scale of Planck length and Planck time (illustrated by the blue circles). The image on the right illustrates an expansion in space time relative to the image on the left. The nonlocal space between these Planck length/Planck time units (the gray background between the blue circles), is an extra nonlocal grid like dimension which can explain the non-local features of quantum entanglement ("spooky action at a distance" – Albert Einstein). The degree of freedom in defining the distance between the discrete units (in this illustration they nearly touch each other but there can be an unlimited distance between them), enables us to add as many extra dimensions as string theory requires and as many worlds as the Everettian "many worlds" theory requires, by adding infinite grid space between the quantized units of spacetime, and infinite number of staggered matrix structures into this basic quantized matrix structure of figure 1.