Mathematical derivation of a quantized space-time

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Abstract

Based on Prof. Bekenstein and Prof. Hawking, the black hole maximal entropy[1], the maximum amount of information that a black hole can conceal, beyond its event horizon, is proportional to the area of its event horizon surface divided by quantized area units, in the scale of Planck area (the square of Planck length). This is a surprising result since it limits the amount of information bits in a volume of space to the amount of Planck area units that can fit into its surrounding surface area. Taking this information limit to the event horizon of a sphere in the size of Planck length in each of its three dimensions, will open up a new approach to our space - time structure.

Introduction

The Hawking Bekenstein equation of black hole entropy, limits the amount of the entropy in the volume of space within the event horizon to be proportional to the area of the event horizon divided by Planck's area (the square of Planck's length). Since any volume of space will contain less information than a black hole, the information in a sphere is limited by its surrounding surface divided by Planck area units. This means that a three-dimensional sphere of space is the radius size of Planck length can contain only one bit of information since its surface area is in the size of one Planck area.

Equation 1: $S \approx \frac{A}{{l_p}^2}$

S – The amount of information bits in a sphere of space, A – the area of its surrounding surface, ${l_p}^2$ – Planck area (information unit area).

Equation 2: $S_P \approx \frac{A_P}{{l_P}^2} \approx \frac{{l_P}^2}{{l_P}^2} = 1$

S_P – The amount of information bits in a sphere of space with a radius of Planck length. A_P – the area of its surrounding surface which is equivalent to one Planck area. ${l_p}^2$ – Planck area (the Hawking Bekenstein information unit area).

This means that a volume of space in the radius of Planck length can contain only one bit of information. As can be seen in figures 1 & 2, there are endless combinations of energy (information) setups in a Planck sized volume of space. This contradicts equation 2.

Figure 1: Three regions in space with energy focused to a dot in the size of Planck length in each dimension. The two-dimensional (2D) yellow filled circle, illustrate three-dimensional (3D) sphere shaped dot in the size of Planck length in each dimension representing 1 or -1 quantum information units.

Figure 2: There are infinite number of combinations which can be drawn between arbitrary spherical shaped regions in space at the size of Planck length (the dashed circles) and the spherical regions with the focused energy (the yellow filled circles). In figure 2 there are only three examples out of the infinite combinations. This infinite number of combinations (infinite size of information) contradicts equation 2 that enables only one bit of information to any Planck sized spherical shape in space-time.

Conclusion

Based on the Hawking Bekenstein formula, a volume of space in the radius of Planck length can contain only one bit of information. This restriction can be achieved only by

quantizing space-time into non-arbitrary, spherical, local, unit cells of space, with a Planck sized radius, where each unit cell can either occupy every Planck time a Planck information qbit (1 or -1) or no information at all (0), as illustrated in figure 3. This new quantum space-time approach opens the question, how we define the extra three-dimensional grid shaped space between these quantized, spherical, unit cells of space. This extra grid like space will be defined as the "grid dimension". The non-locality of the grid dimension can explain the non-locality of quantum mechanics (e.g. quantum entanglement). The grid dimension will influence the movement of energy from one-unit space cell to the next and by that influence the mass of elementary particles. Since this is the role of the Higgs field, the non-local grid dimension and the Higgs field might be the same thing. Every Planck time, light can transfer energy from one Planck sized space unit to its nearest neighbor limiting the speed of light to one Planck length for each Planck time, as defined by Einstein's special relativity.

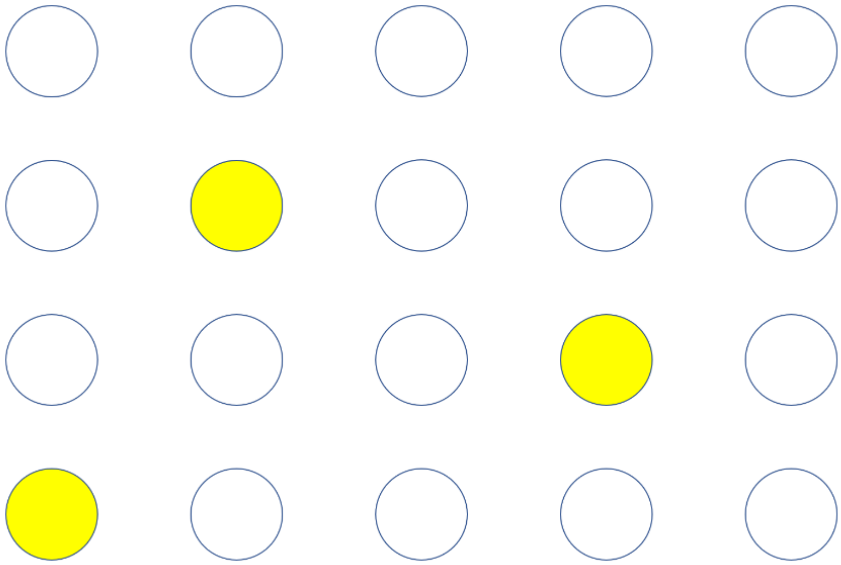

Figure 3: Two-dimensional circles, illustrating three-dimensional quantized spherical space units in the size of Planck length in each dimension, with a restriction that each space unit can contain either '1' or '-1' information quantum bits. With this quantum space-time configuration, there will be no contradiction with the Hawking Bekenstein information formula. The borders for each circle illustrate the bordering of the spherical space units. The yellow filled circles are the spherical space units with an information quantum bit 1 or -1. The empty circles contain no information at all. The grid dimension (its name comes from its grid structure), is illustrated by the white space between the quantized three-dimensional spherical space units. The non-locality of the grid dimension enables non-local connections through space time as required by quantum mechanics (e.g. quantum entanglement). There are infinite number of space units floating in the grid dimension, but only finite number of units are illustrated as an example in this figure. The quantization of space-time into Planck sized spherical units (quantum space-time), together with the Hawking-Bekenstein information formula (equation 1) , leads to the Heisenberg uncertainty principle.

REFERENCES:

[1] https://journals.aps.org/prd/abstract/10.1103/PhysRevD.7.2333