Black hole entropy defines limitations on the radius of spacetime

Corresponding author: Eran Sinbar, Ela 13, Shorashim, Misgav, 2016400, Israel,

Telephone: +972-4-9028428, Mobile phone: +972-523-713024, ID 024649014

Email: eyoran2016@gmail.com

Abstract

This paper will prove mathematically, based on Bekenstein – Hawking black hole entropy equation [1], and based on the holographic principle [2], that space cannot have an infinite size.

Introduction

Planck length [3], is the minimal length emerging from the most basic universal constants: Planck constant (quantum mechanics), gravitational constant (general relativity) and the speed of light (special relativity).

Equation 1:

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

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

Bekenstein – Hawking black hole entropy equation, proves mathematically that the amount of information bits inside a volume of the black hole are limited by the area of the event horizon divided by Planck area units. This leads to the surprising conclusion that information within any volume of space inside a sphere with the radius R, is limited by the surface area of the sphere divided by the Planck area sized units. This led to the holographic principle which suggests that our three-dimensional sphere of space is a holographic projection of its two-dimensional surface area, where the surface area is quantized to information bits in the size of Planck area.

Equation2:

$$Number\ of\ information\ bits\ in\ a\ sphere\ of\ space \le \frac{4\pi R^2}{{l_p}^2}$$

$R = Spherical\ radius\ of\ space\ (relative\ to\ an\ observer),\ {l_p}^2 = Planck\ area$

Assuming an isotropic, homogeneous, symmetric spherical space (a sphere), with radius R, the number of Planck volume units of space within this sphere is the volume of the entire sphere divided by the Planck volume unit of space.

Equation 3

$$Number\ of\ Planck\ volume\ units\ of\ space\ within\ the\ sphere = \frac{4\pi R^3}{3{l_p}^3}$$

$$R = Spherical\ radius\ of\ the\ sphere\ \ {l_p}^3 = Planck\ volume\ unit\ of\ space$$

Let's define that for each Planck volume unit of space, there is an average probability q, that it will contain 1 bit of information. The information capacity in in this volume of space is defined by equation 4.

Equation 4:

$$Number\ of\ information\ bits\ in\ a\ sphere\ of\ space = \frac{4\pi R^3}{3{l_p}^3} * q$$

$$R = Spherical\ radius\ of\ the\ sphere\ \ {l_p}^3 = Planck\ volume\ unit\ of\ space$$

$$q = probability\ of\ having\ an\ information\ bit\ in\ a\ Planck\ volume\ unit\ of\ space.$$

$$1 \gg q > 0$$

Based on equation 2 and equation 4 we can limit the number of information bits in a sphere of space with radius R.

Equation 5:

$$\frac{4\pi R^2}{{l_p}^2} \geq \frac{4\pi R^3 q}{3{l_p}^3}$$

This leads to the conclusion that the radius of space is limited in length.

Equation 5:

$$\infty > \frac{3l_p}{q} > R$$

This leads to the conclusion that the spherical radius of space is not infinite.

$$\infty > R$$

Conclusion

This paper proves mathematically that the Radius of space, for an observer in any frame of reference, is not infinite in length. Relativity assumes that space is homogeneous, isotropic and symmetrical, for all frames of reference. This leads to the conclusion that each frame of reference will measure that it is in rest relative to other frames of reference, and that it is in the center of the sphere, and not near its boundaries (The radius of the sphere R should be the same to all observers in all frames of reference). This leads to the idea that frames of reference are staggered next to each other where each frame of reference has its own perception of spacetime (always in rest if no force is applied and always in the center of space, within distance R from its boundaries). This can be visualized by a quantized spacetime model, where each frame of reference is a quantized matrix, and all frames of reference are staggered next to each other. The extra spacetime between the quantized spacetime units is an extra nonlocal grid like dimension. The quantized spacetime units are in the scale of Planck time and Planck length. The quantized spacetime reference frames are staggered together floating in a non-local grid like dimension (four-dimensional, space time, non-local grid dimension) connecting all the quantized frames of reference together (figure 1).

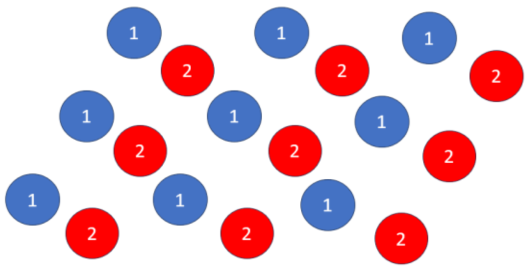

Figure1: Illustration of staggered, quantized, four dimensional, spacetime reference frames 1(blue) and 2(red) . In this illustration there are only two frames of reference in a specific moment in time, in a small region of space, in only two dimensions of space, out of infinite number of reference frames, staggered next to each other . The circles illustrate the quantized Planck length sized units of space. The white space between them with the grid like structure illustrates the four dimensional non-local extra grid dimension.

REFERENCES:

[1] http://www.scholarpedia.org/article/Bekenstein-Hawking_entropy

[2] https://en.wikipedia.org/wiki/Holographic_principle

[3] https://en.wikipedia.org/wiki/Planck_units