Black-hole entropy leads to the non-local GRID dimensions theory

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Abstract

Based on Prof. Bekenstein and Prof. Hawking, the black hole maximal entropy , the maximum amount of information that a black hole can absorb, beyond its event horizon is proportional to the area of its event horizon divided by quantized area units, in the scale of Planck area (the square of Planck length).[1]

This quantization in entropy and information in the quantized units of Planck area leads us to the assumption that space is not "smooth" but rather divided into quantized units ("space cells"). Although the Bekenstein-Hawking entropy equation describes a specific case regarding the quantization of the 2D event horizon, this idea can be generalized to the standard 3 dimension (3D) flat space, outside and far away from the black hole's event horizon. In this general case we assume that these quantized units of space are 3D quantized space "cells" in the scale of Planck length in each of its 3 dimensions.

If this is truly the case and the universe fabric of space is quantized to local 3D space cells in the magnitude size of Planck length scale in each dimension, than we assume that there must be extra non-local space dimensions situated in the non-local bordering's of these 3D space cells since there must be something dividing space into these quantized space cells.

Our assumption is that these bordering's are extra non local dimensions which we named as the "GRID" (or grid) extra dimensions, since they look

like a non-local 3D grid bordering of the local 3D space cells. These non-local grid dimensions are responsible for all unexplained non-local phenomena's like the well-known non-local entanglement or in the phrase of Albert Einstein "spooky action at a distance" [2].So by proving that space-time is quantized we prove the existence of the non-local grid dimension that divides space-time to these quantized 3D Planck scale cells.

Key Words: Entanglement, Quantization, Non-local dimensions, Space–Time

1. HOW TO PROVE BY EXPERIMENT THAT SPACE IS QUANTIZED:

In this article we suggest that if it is true that space-time is quantized into Planck Length scale (in each dimension), it leads to the assumption that electromagnetic wave length is quantized and it is an integer number of Planck lengths. Hence:

(1) $\quad \lambda = Nh^* = N * h^*$

Where

$N = 1,2,3.. -$ Positive integer (results from Photon's wave length divided by Planck's length).

$\lambda -$ Wave length (meter)

$h^* -$ Planck's length in each of space's 3 dimensions.

$h^* = 1.62 * 10^{-35}$ (meter).

The convention of the multiplication sign ($*$) in the equations will be used in some equations and ignored in others in this article (for example see equation (1)).

From Einstein's photoelectric equation and Eq. (1), the energy E_N of a Photon is

(2) $\quad E_N = \dfrac{h\,c}{\lambda} = \dfrac{c\,h}{N\,h^*} = \dfrac{A\,c}{N}$

$h -$ Planck Constant $= 6.63 * 10^{-34} \, m^2 \, \text{kg} \, sec^{-1}$

$c -$ The velocity of light

kg – kilogram

sec – second

m - meter

$$A = \frac{h}{h^*} = \sqrt{\frac{2\pi\, c^3\, h}{G}} \approx 41\ m\ kg\ sec^{-1}$$

G − Is gravitational constant = $6.674*10^{-11}\ m^3\ Kg^{-1}sec^{-2}$.

The meaning of Eq. (2) is that the energy scale of Photons is a discrete function of N rather than a continuous one (see Fig 1.)
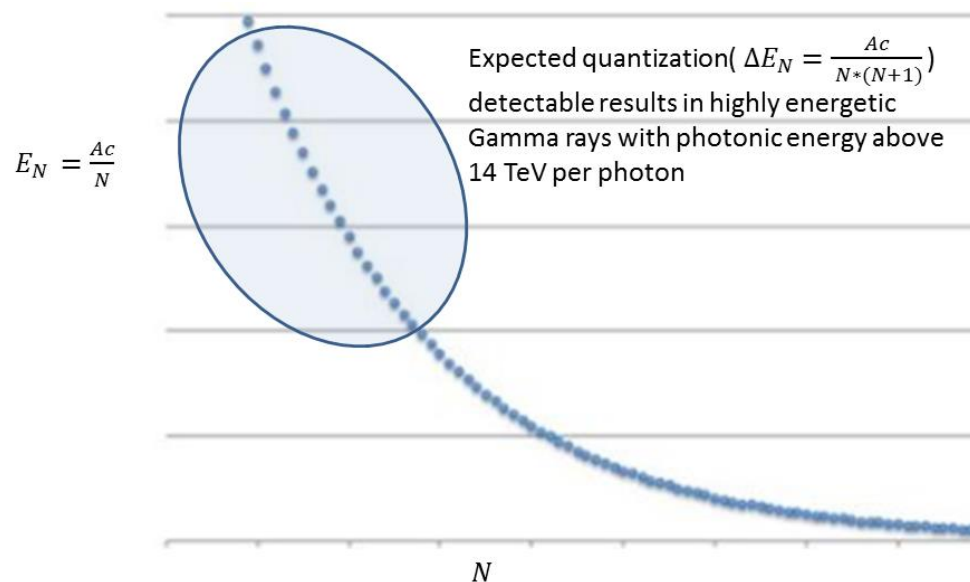

Figure 1. Photonic energy scale as a discrete function of N. The Photonic energy quantization ΔE_N increases as a function of the increase of E_N

The energy difference between two successive Photons (N, N+1) is

$$\Delta E_N = E_N - E_{N+1} = \frac{A*c}{N*(N+1)} \approx \frac{Ac}{N^2}$$

Since the energy difference ΔE_N increases as function of the increase of the photonic energy E_N (and the decrease of N, see Fig. 1),

We expect that future measurements of cosmological energetic photonic radiations will show that the energy radiation level of the detected Photons is a discrete function rather than a continuous one (see Fig [1]). We strongly believe that in the near future, the technology will be able to measure drastic cosmic Gamma radiation with sufficient resolution to measure this energetic quantization. Even the powerful Large Hadron

Collider in CERN (LHC) is already able today to produce huge energy of 14TeV. For example, at that level of energy (see Appendix II, Example 1), the collision of two protons might result in creation of photon with wave length of about $0.88 * 10^{-19} m$. (N = 5.4*10¹⁵). The energy difference between two successive photons is $\Delta E_N = E_N - E_{N+1} = 4.2*10^{-22} J$.   The equivalent wave length quantization for such energy levels is $\lambda = 4.7*10^{-4}$ m. We strongly believe that in the near future the technology will be advanced so it will be able to detect and measure the quantization gaps in the order of magnitude of $10^{-22} \ Joule$ in order to prove the quantized universe theory by measuring the quantization in the wavelength of the measured photons.

 Assuming that space-time is quantized, we will show that the momentum, mass and velocity of elementary particles must be also quantized and there exists limits on their maximum values. Those expressions and values might be also tested in the future, by using super energetic accelerators of elementary particles or observing into space searching for highly energetic cosmic radiation. For the convenience of the reader we summarized here the final quantized expressions for the momentum, mass and velocity of elementary particles. For detailed development of the expressions please see APPENDIX A.

a. The maximum value of the momentum of an elementary particle (N=1) is

$p \le \frac{h}{h^*}$, Since $A = \frac{h}{h^*} = \sqrt{\frac{c^3 * 2\pi * h}{G}}$ the upper limit of the momentum is

$$p \le A = \sqrt{\frac{c^3 * 2\pi * h}{G}} \tag{3}$$

b. The quantized value for the momentum of an elementary particle

$p_{N=} \frac{A}{N}$, Hence

$$p_N - p_{N+1} = \frac{A}{N*(N+1)} \tag{4}$$

c. The quantized velocity of an elementary particle is

$$v_N = c * \sqrt{\frac{A^2}{[(Mass_0 * c * N)^2 + A^2]}}$$

(5)

Where

$Mass_0$ = the mass of an elementary particle in its rest position.

d. *The maximum value for the velocity of an elementary particle*

$$v_{Max} = c * \sqrt{\frac{A^2}{[(Mass_0 * c)^2 + A^2]}}$$

(6)

From Eq. (6) results that the maximum velocity is limited and is always smaller than the velocity of light (c).

e. *Quantized value for the mass of an elementary particle*

$$Mass_N = Mass_0 * \sqrt{\frac{c^2}{c^2 - v_N^2}}$$

(7)

Where

$Mass_N$ — The quantized mass Of an elementary particle.

$Mass_0$ — The mass of an elementary particle in its rest position.

f. *Maximum value for the relativistic mass of an elementary particle*, Mass (Max)

$$Mass(Max) = Mass_0 \sqrt{\frac{c^2}{c^2 - v_{Max}^2}}$$

(8)

When applying enough energy, a particle might reach its maximum velocity and relativistic mass. This is a singular point and if an extra force is applied, since the velocity and mass cannot increase, the extra energy must cause some singular changes in space time for example a formation of a micro black hole.

2. "GRID" EXTRA DIMENSIONS" THEORY

Modern physics has two leading theories that contradict each other: (1) The Einstein's deterministic, local, "smooth" General Relativity theory for large scales. (2) Quantum theory with the quantized characteristics, non–local Schrodinger wave equations and Heisenberg uncertainty rules for atomic scale. In order to unify both theories and explain non-local phenomena like the entanglement of two particles ["spooky action at a distance" – Albert Einstein], we developed the quantized space-time and the Grid Extra Dimensions Theory.

Let's assume that we already proved that space-time fabric is made from separate individual pieces in the size of Planck Length, It is reasonable to ask what is between those pieces. Or in other words, what is the extra "space" that divides the space fabric into small, local, Planck's length magnitude 3D cell. We suggest a new revolutionary theory. We claim that between those quantum cells there are non-local grid like dimensions connecting all the cells together [see Fig. 2 – the symmetrical spheres represent the local 3D quantized space "cells" in the scale of Planck's length in each dimension. They are "floating" in the non-local dimensions. These dimensions connect all the quantized space cells like a grid. We will refer to these non-local dimensions, as the GRID non-local dimensions.]
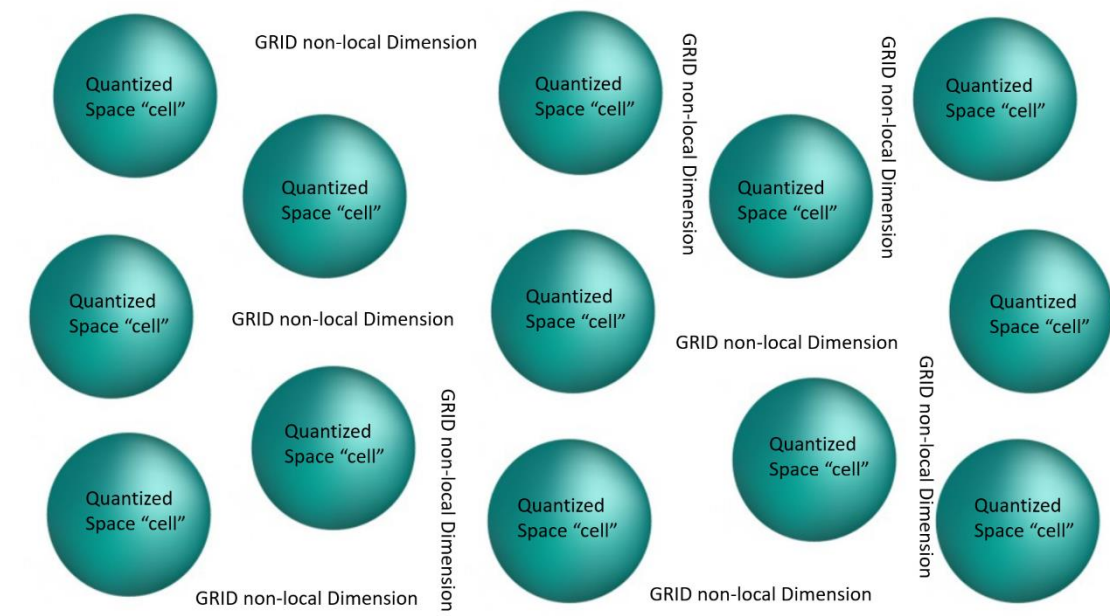
Figure 2. Space-time illustration of the non-local 3D GRID dimensions and the 3D Planck length sized cells of the quantized universe.

The expected quantized cells are probably a local 3D symmetric spherical shape floating, twisting, moving or rotating within the 3D non-local GRID dimensions. In every Planck time sequence energy can move from one quantized space "cell" to its nearest neighbor quantized space cell (a distance of Planck length) limiting the movement of energy to the speed of light. The quantized space "cells" are responsible to all the known local (limited by the speed of light) physical laws like gravity, electromagnetic forces, thermodynamics etc.

3. CONCLUSION

We show that the theory of quantized space, predicts that the photonic wave length as well as momentum, mass and velocity of elementary particles are all quantized and the quantization might be measurable in the near future. Therefore. Successful measurements might prove that space-time is quantized. Furthermore, we claim, that between these quantized space cells there must exist extra grid dimensions (GRID) that are dividing the space fabric into Planck Length quantized "cells" and hold them together. We claim that this new extra dimensions do not obey the Known rules of physics and therefore they are responsible for the unexplained quantum non locality phenomena. It is as if all the local quantum space cells are connected together through the extra non-local dimensions in a way that they can influence the quantum space cells instantaneously. That might explain the Schrodinger's probability wave instant collapse all over space, entanglement, Pauli's Exclusion Principle, the high uniformity in the cosmic microwave background radiation temperature etc. These grid like dimension might have clues regarding the source of the dark matter, dark energy and the virtual particles that "pop-out" from the vacuum space.

APPENDIX A: QUANTIZED EXPRESSIONS AND LIMITS FOR THE MAXIMUM VALUES OF MOMENTUM, MASS AND VELOCITY OF ELEMENTARY PARTICLES

Based on the quantized space-time theory, space is built from quantized cells in the size of Planck's length.

h^* − Planck's length in each of its 3 dimensions. $h^* = 1.62 * 10^{-35}$ m .

m = meter, sec = seconds, Kg = kilogram, J = joule.

t^* − The quantum of time is in the size of $\frac{h^*}{c}$ sec. where C = speed of light.

$Mass$ − $Mass\ of\ an\ elementary\ particle\ (electron, proton, etc)$.

$Mass_0$ − The mass of an elementary particle in its rest position.

h − Planck constant = $6.63 * 10^{-34}$ m^2 kg sec^{-1}.

G− Gravitational constant = $6.674*10^{-11}\ m^3\ Kg^{-1}sec^{-2}$.

a. Quantized expression for the momentum of an elementary particle.

De Broglie wave length under these assumptions is λ(wave length) $= \frac{h}{p}$ where

h is Planck Constant $= 6.63 * 10^{-34}\ m^2$ kg sec^{-1}

p is the Momentum (Mass ∗ Velocity).

$\lambda\ is\ wave\ length.$

Based on the quantized space–time theory $\lambda = N * h^*$ Where

N positive integer results by particle's wave length devided by Planck's length

N $= 1,2,3,4,5, \dots$

A slight rearrangement of terms then gives

$$p = \frac{h}{\lambda} = \frac{h}{N*h^*} \tag{A1}$$

b. The maximum value of the momentum of a elementary particle is when N=1 is

For N>1 $\quad p \leq \frac{h}{h^*} = A$

Since $A = \frac{h}{h^*} = \sqrt{\frac{c^3*2\pi*h}{G}}$

$$p \leq A = \sqrt{\frac{c^3*2\pi*h}{G}} \tag{A2}$$

*c. **Quantized value for the momentum of an elementary particle***

From Eq. (A1), the quantized expression for the momentum is

$$p_N = \frac{A}{N} \ m \ kg \ sec^{-1} \tag{A3}$$

*d. **Quantized value for the velocity of an elementary particle***

Based on Einstein's relativity theory

$$Mass = Mass_0 \sqrt{\frac{c^2}{c^2-v^2}} \tag{A4}$$

Where $c = speed \ of \ light$.

From Eq. (A3) and Eq. (A4)

$$p_N = Mass_0 \sqrt{\frac{c^2}{c^2-v^2}} * v = \frac{A}{N} \tag{A5}$$

Hence, Momentum quantization (Δp_N) is

$$\Delta p_N = p_N - p_{N+1} = \frac{A}{N*(N+1)} \tag{A6}$$

Hence, when applying super energetic velocities, *N* might become small enough to enable the measurement of the quantum leap of the quantized momentum.

A slight rearrangement of terms of Eq. (A5) gives

$$Mass_0 * c * v * N = A * \sqrt{c^2 - v^2}$$

After squaring both side of the above equation and a slight rearrangement of terms

$$[(Mass_0 * c * N)^2 + A^2] * v^2 = A^2 * c^2$$

Hence, the quantized velocity of an elementary particle is

$$v_N = c * \sqrt{\frac{A^2}{[(Mass_0 * c * N)^2 + A^2]}}$$
(A7)

e. *Maximum value for the velocity of an elementary particle*

From Eq. (A7) the maximum velocity is for N=1 is

$$v_{Max} = c * \sqrt{\frac{A^2}{[(Mass_0 * c)^2 + A^2]}}$$
(A8)

From Eq. (A8) Results that the maximum velocity is limited and is always smaller than the velocity of light (c).

f. *Quantized value for the mass of an elementary particle*

Based on Einstein's relativity theory, the quantized mass ($Mass_N$) of an elementary particle is

$$Mass_N = Mass_0 * \sqrt{\frac{c^2}{c^2 - v_N^2}}$$
(A9)

g. *Maximum value for the mass of an elementary particle*

From Eq. (A9), the mass of an elementary particle is maximal when its quantized velocity is maximal. According to Eq. (A8), the maximum velocity is when v_N (quantized velocity) *is maximal* (N=1).

$$Mass(max) = Mass_0 * \sqrt{\frac{c^2}{c^2 - v_{Max}^2}}$$
(A9)

When applying enough energy, a particle might reach its maximum velocity and mass. This is a singular point and if an extra force is applied, since the velocity and mass cannot increase, the extra energy must cause some changes in the space and time fabric [for example, by curving space and slowing time]

APPENDIX B: EXAMPLE 1

$E = 14 TeV = 14 * 10^{12} eV = 14 * 1.6 * 10^{-7} J$

$E = \frac{h*c}{\lambda} = 14 * 1.6 * 10^{-7} \ J$

h = Planck constant = $6.63 * 10^{-34}$ m^2 kg sec^{-1}.

$h^* = $ Planck's length= $1.62 * 10^{-35}$ m.

The wave length of the created photon:

$\lambda = \frac{6.6*10^{-34} *3*10^{8}}{14*1.6*10^{-7}} = 0.88 * 10^{-19}$m

 (B1)

Let's calculate N

$$\lambda = N * h^*$$

N= λ/h^* = $0.88 * 10^{-19}/1.62 * 10^{-35}$= 5.4*10^{15}
(B2)

Let's calculate *Energy quantization*: $E_N - E_{N+1}$

$E_N - E_{N+1} = \frac{A*c}{N*(N+1)} = \frac{41*3*10^{8}}{5.4*10^{15}*5.4*10^{15}} =$
4.2*10^{-22}J
 (B3)

Let's calculate the equivalent wave langth of a photon

with the Energy quantization of $\Delta \ E_N = 4.2 * 10^{-22} $ J

$\Delta E_{N \ photon} = \frac{h*c}{\lambda}$
(B4)

From Eq. (B3) and Eq. (B4)

$$\Delta\lambda = \frac{h*c}{\Delta E_N} = \frac{6.6*10^{-34}*3*10^8}{4.2*10^{-22}} = 4.7*10^{-4} \ \text{m}$$

(B5)

REFERENCES:

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

[2] https://journals.aps.org/pr/abstract/10.1103/PhysRev.47.777

Figure legends:

References
Figure 1. Photonic energy as function of N. The Photonic energy quantization ΔE_N increases as a function of the increase of E_N.

Figure 2. Illustration of the non-local 3D GRID dimensions, and the 3D Planck length sized, local "cells" of the quantized universe.