Quantization of photonic energy and photonic wave length

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Abstract

Assuming that space is quantized by Planck-length, we show that Mass and Velocity of elementary particles as well as photonic energy must be also quantized. Furthermore, since the photonic energy is quantized it is a type of discrete function and might be measured from observations of energetic cosmological photonic radiations or even with the Large Hadron Collider in CERN (LHC). Such successful measurements can prove that space is quantized.

Once assuming that space-time is quantized it obviously raises the question what is there between the Planck-length quanta pieces of space. We suggest a new theory claiming that between the quantum cells there are extra non local grid like dimensions that divide space and connect all the pieces together. These non-local new dimensions might explain today's Quantum Theory's non-local phenomena's like Schrodinger's probability wave instant collapse all over space, entanglement, etc.

Quantized fabric of space and time

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1. HOW TO PROVE THAT SPACE-TIME IS QUANTIZED

We don't know what space-time may be like at the quantum scale. Some physicists believe strongly that space-time will turn out to be quantized [1].

In this article we suggest an experiment that might prove that the space-time is quantized. We claim that if it is true that space-time is quantized to small pieces of a Planck Length then also the wave length of a photon must be an integer number of Planck lengths. Hence:

$$\lambda = N * h^* \tag{1}$$

Where

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

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

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

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

$$E_N = \frac{h\,c}{\lambda} = \frac{c\,h}{N\,h^*} = \frac{A\,c}{N} \tag{2}$$

Where

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

c — Is 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 of Photons is a discrete function of N rather than a continuous one (see Fig 1.)

$E_N = \frac{Ac}{N}$

Expected quantization($\Delta E_N = \frac{Ac}{N*(N+1)}$) detectable results in highly energetic Gamma rays with photonic energy above 14 TeV per photon
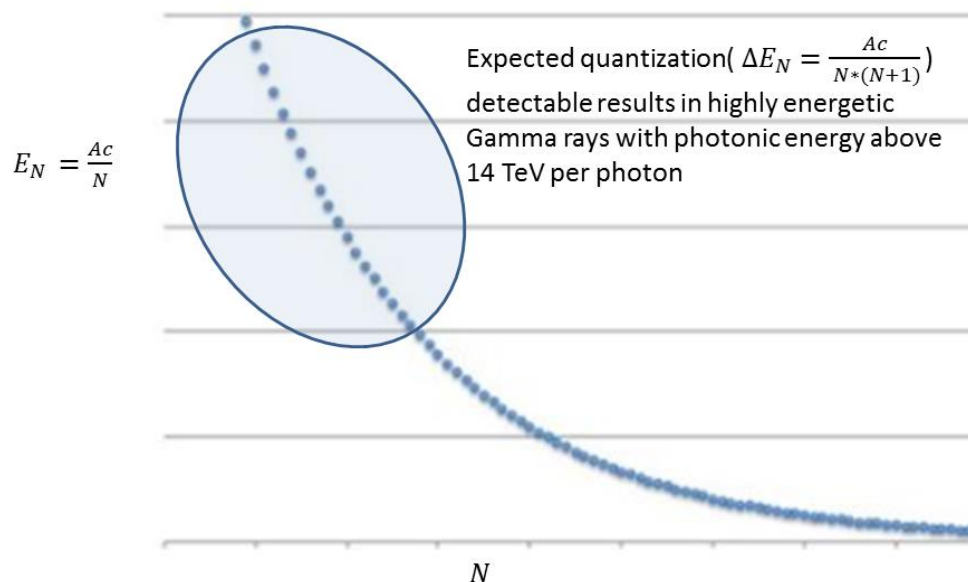
N

Figure 1. Photonic energy 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

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

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

We expect that future measurements of cosmological energetic photonic radiations will show that the energy 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 = $5.4*10^{15}$). 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 for such energy quantization 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.

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

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

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

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

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

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

c. The quantized velocity of an elementary particle is

$$v_N = c * \sqrt{\frac{A^2}{[(Mass_0*c*N)^2+A^2]}} \tag{5}$$

Where

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

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

$$v_{Max} = c * \sqrt{\frac{A^2}{[(Mass_0*c)^2+A^2]}} \tag{6}$$

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*

$$Mass_N = Mass_0 * \sqrt{\frac{c^2}{c^2-v_N{}^2}} \tag{7}$$

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)**

$$Mass(Max) = Mass_0 * \sqrt{\frac{c^2}{c^2-v_{Max}{}^2}} \tag{8}$$

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 changes in the rest mass ($Mass_0$).

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, faster than light phenomena like the entanglement of two particles ["spooky action at a distance" – Albert Einstein [2], 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 "space" that divides the quantized space fabric into small, Planck's length pieces. 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 2D illustration of the non-local 3D GRID dimensions (white grid lines) and the 3D Planck length sized cells, quantized universe, (blue rectangles)].

A small region of the 3D space fabric.
Each 2D rectangle illustrates a 3D quantum of space.
Between these quantum cells are located the new dimensions

Zoom

1

2

2. new dimensions **between**
The quantum particles.
They can be arranged one layer
Above the other ,or one layer
Next to the other ,wrapped
Together etc.

1

1. Quantum particles of space.

The 2D rectangle image
(instead of 3D spherical
shapes) is for easier drawing
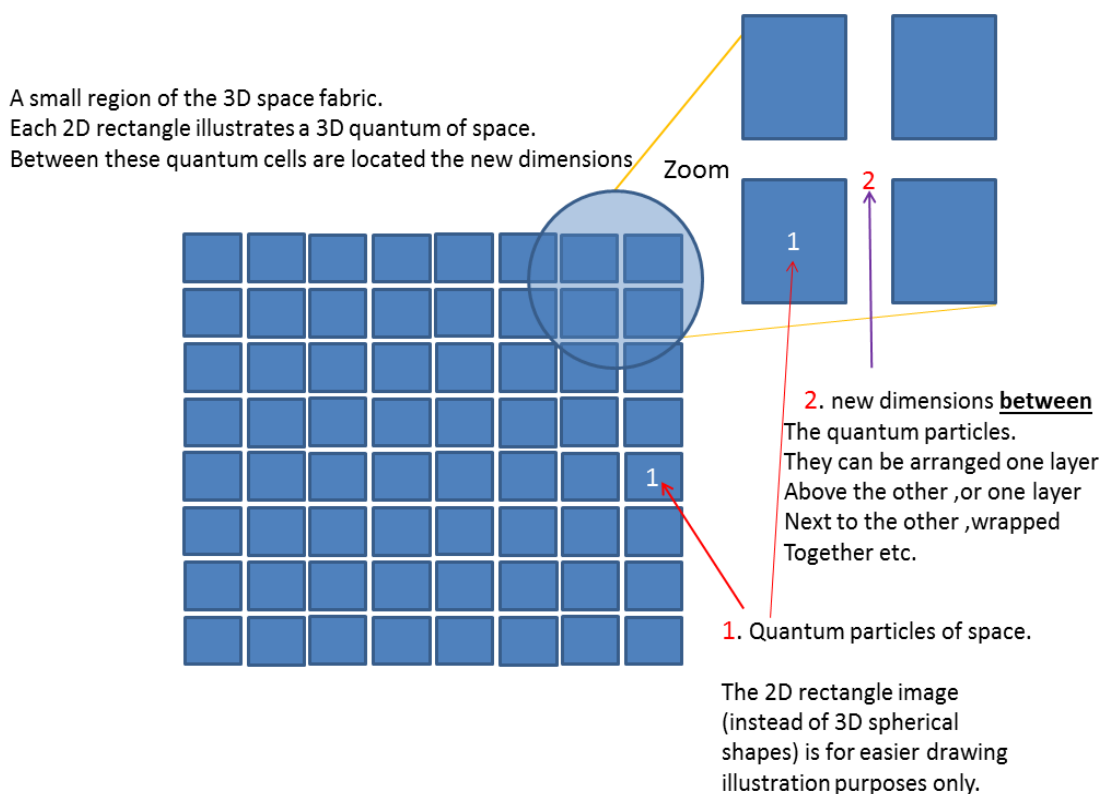illustration purposes only.

Figure 2. Space-time 2D illustration of the non-local 3D GRID dimensions (white grid lines) and the 3D Planck length sized cells of the quantized universe, (blue rectangles).

Although the 2D illustration in Fig. 2. Is of a line GRID and quantum rectangle cells, the expected quantized cells are probably a 3D symmetric spherical shape moving or rotating within the 3D GRID dimensions.

The Quantum of space (pieces built up from unit quanta cells) are obeying all the known space and time laws like Newtonian , special and general relativity ,electro-magnetic (Maxwell equations) ,thermodynamics ,gravity, speed of light limitation, strong force, weak force, atoms, protons, neutrons, electrons, quarks, photons, chemistry, etc. Despite the fact that in the space-time quantum pieces all the classical physics law are apply able, we claim that the GRID dimensions do not obey the known space-time rules. There is no meaning for time or space as we define and measure it today since they are not made from the same fabric as the space-time 4D known universe and they are shaped as a non-local grid connecting all the space–time quantized pieces together. For example, through this GRID fabric, entangled particles might synchronize spin direction faster than light.

 The quantized space cells are probably a 3D symmetric spherical shapes moving or rotating within the additional 3D grid dimensions. The additional grid dimensions might contain (or made of) the exotic dark matter and dark energy.

3. CONCLUTION

   We show that the Photonic energy as well as momentum, mass and velocity of elementary particles are quantized and might be measurable in the near future. Therefore. Successful measurements might prove that space-time is quantized. Furthermore, we claim, that between the space quanta's there exist an extra grid dimensions (GRID) that is dividing the space fabric into Planck Length quantized pieces and hold them together. We claim that this new extra dimension do not obey the Known rules of physics and therefore it is responsible for the unexplained quantum non locality phenomena. It is as if all the quantum space cells are connected together through the extra 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, etc. The GRID extra dimensions might contain (or made of) the exotic dark matter and dark energy.

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 $\dfrac{h^*}{c}$ 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 $\lambda\left(\text{wave length}\right) = \dfrac{h}{p}$ 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 $=1,2,3,4,5, ...$

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

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

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

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

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

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

e. Maximum value for the velocity of an elementary particle

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

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

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

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

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 = $6.63 * 10^{-34}$ m² kg sec⁻¹.

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

The wave length of the created photon:

$$\lambda = \frac{6.6*10^{-34} *3*10^8}{14*1.6*10^{-7}} = 0.88 * 10^{-19} m \tag{B1}$$

Let's calculate N

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

$$N= \lambda/h^* = 0.88 * 10^{-19}/1.62 * 10^{-35}= 5.4*10^{15} \tag{B2}$$

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

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

Let's calculate the equivalent wave langth of a photon
with the Energy quantization of $\Delta E_N = 4.2 * 10^{-22}$ J

$$\Delta E_{N \text{ photon}} = \frac{h*c}{\lambda} \tag{B4}$$

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

$$\Delta\lambda = \frac{h*c}{\Delta E_N} = \frac{6.6*10^{-34}*3*10^8}{4.2*10^{-22}} = 4.7*10^{-4} \text{ m} \tag{B5}$$

References

[1] John Baez, William G. Unruh and William G. Tifft. Scientific American, **21** (1999).
http://www.scientificamerican.com/article/is-time-quantized-in-othe/

[2] A. Einstein, B. Podolsky, and N. Rosen. Phys. Rev. **47**, 777 (1935).
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Figure legends:

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. Space-time 2D illustration of the non-local 3D GRID dimensions (white grid lines) and the 3D Planck length sized cells of the quantized universe, (blue rectangles).