Extra dimensions and the arrow of time

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Abstract

“The increase of disorder or entropy is what distinguishes the past from the future, giving a direction to time “– Stephen Hawking, A brief history of time. This statement arises two questions: Time is a universal concept, but order and disorder are both a subjective concept of our human brain. How can a subjective concept like disorder distinguish a universal concept like time? Why was the past in a lower entropy compared to the future?

This paper suggests that by quantizing space time and by adding an extra non local three dimensional (3D) grid like dimensions (grid dimension) these two questions can be approached.

Introduction

Let’s imagine a quantized space time, where each space quanta is a 3D symmetrical shape in the size of Planck’s length in each dimension (will be referred to as “space bubble”). Between these local space bubbles lays a non-local grid like dimension (the grid dimension). This new approach enables to illustrate a multiverse based on an infinite number of quantized parallel worlds floating symmetrically staggered next to each other in the grid dimension (figure 1).At the big bang all these quantized parallel worlds are exactly the same and this is what we refer to as low entropy. As suggested by Hugh Everett in the many worlds interpretation [1], these parallel worlds branch differently from one another in every quantum event. The branching is illustrated in both figure2 and figure 3. Assuming that space-time are quantized to Planck’s length and Planck’s time the branching might happen in every discrete time pulse in the length of Planck’s time. This branching of the parallel worlds is a much more universal concept than the idea of entropy which deals with the ability of our brain to distinguish between different configuration setups (what we refer to as order and disorder).

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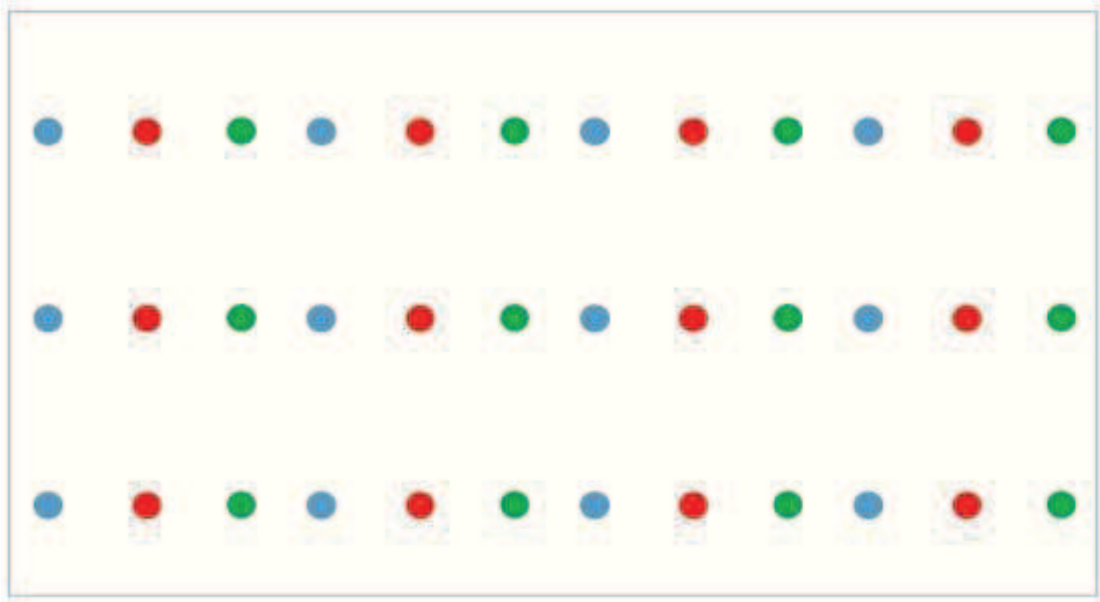

Figure 1: A two dimensional (2D) illustration of three parallel quantized worlds (out of the infinite potential number of parallel worlds) staggered next to each other floating in the grid dimension. In the small region illustrated in figure 1 the three worlds are identical to each other. The blue circles illustrate the quantized space of universe A, the red circles illustrate the quantized space of universe B and the green circles illustrate the quantized space of universe C. The yellow region between them illustrates the non-local extra grid dimension (or dimensions) .

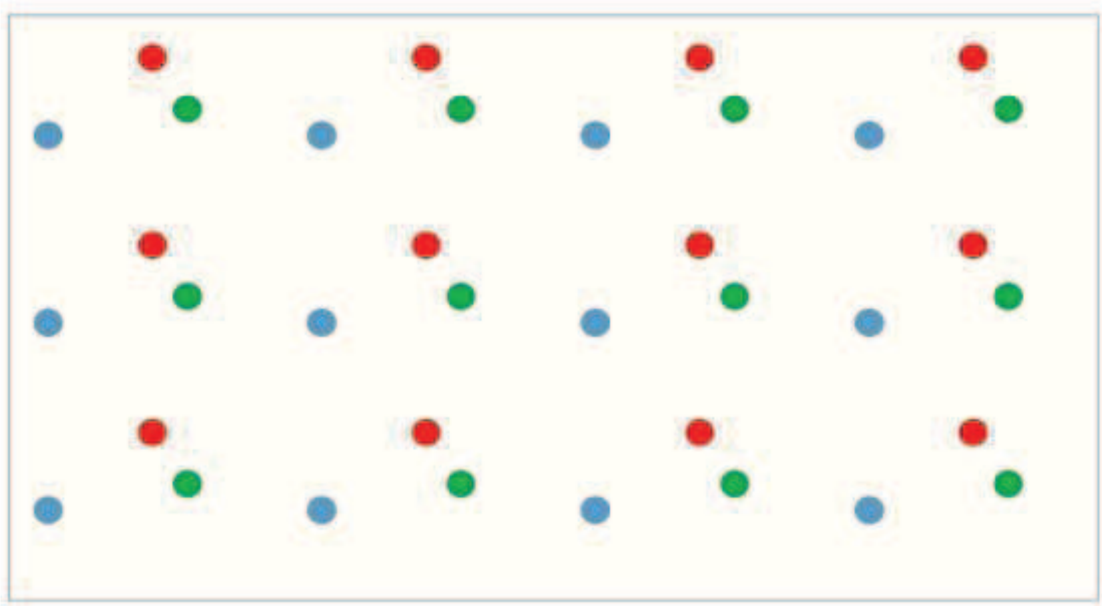

Figure 2: The same illustration as in figure 1 after a few quantum events. The quantized space in this small region is not the same any more in the three parallel worlds, and this change is illustrated by changing the symmetrical structure of the three colored circles.

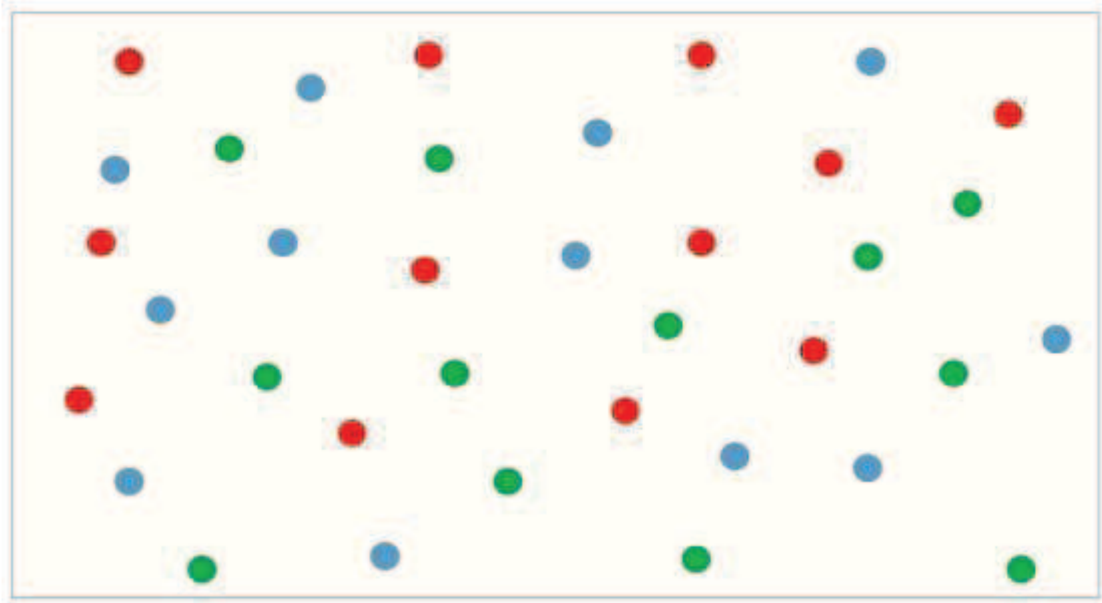

Figure 3: The same illustration as in figure 2 after a few more quantum events. The difference between the parallel worlds increases. This increase is illustrated by the mix-up of the circles. The difference between the three parallel worlds is correlative to the increase in entropy but it is not the rate of disorder which is a subjective point of view, but the rate of difference in the symmetry of the multiverse structure, which is a universal definition like the universal definition of time. The different worlds can also represent different frames of reference based on Einstein's special theory of relativity [2].

Conclusion

The new approach of local quantized space time floating in an extra non local grid dimension enables to visualize an infinite number of staggered worlds next to each other as suggested in the many worlds interpretation. These many worlds start in a uniform symmetric pattern at the big bang and they branch away from this uniformity in every quantum event (the collapse of Schrodinger's wave function as described by the Copenhagen interpretation [3]).

Prediction based on the new approach

The concept in which a wave length must be a discrete number (N) of Planck's length (l) leads to the prediction that when observing energetic photonic light rays, we expect that the measured peaks will be quantized in their energy level as detailed in the equations below:

$$N = 1,2,3,\ldots$$

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$$N \gg n$$

$$E_N \;\; = the\ N_{th}\ photonic\ energy$$

$$h = Planck's\ constant, c = sped\ of\ light,$$

$$\lambda_N = the\ N_{th}\ photonic\ wave\ length\ , l = Planck's\ length$$

$$\Delta E_N = the\ quantization\ level\ of\ the\ N_{th}\ photonic\ energy$$

$$due\ to\ the\ quantization\ of\ spacetime$$

$$N = \frac{\lambda_N}{l}$$

$$\lambda_N = lN$$

$$E_N \;\; = \frac{hc}{\lambda_N}$$

$$E_N \;\; = \frac{hc}{lN}$$

$$\frac{hc}{l} = Const$$

$$E_N \;\; = \frac{Const}{N}$$

1.

$$\boxed{\Delta E_{N,n} \; = E_N \; - \; E_{N+n} \;\; \approx \frac{nhc}{lN^2} = \frac{nConst}{N^2}}$$

$$n \geq 1\ , \quad N \gg n$$

2.

$$\boxed{\Delta E_N \; = E_N \; - \; E_{N+1} \;\; = \frac{Const}{N^2}}$$

3.

$$\frac{\Delta E_N}{E_N} = \frac{1}{N}$$

This represents the sensitivity (noise to signal ratio) needed to sense the photonic quantization due to the quantized space.

APPENDIX B: EXAMPLE 1

For example in a Gamma Ray Burst that can reach 1 Peta electron volt

$E_N = 1000TeV = 1000 * 10^{12}eV = 1000 * 1.6 * 10^{-7}J$

$E_N = \frac{h*c}{\lambda_N} = 1000 * 1.6 * 10^{-7}\ J$

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

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

The wave length of the created photon:

$\lambda_N = \frac{\mathbf{6.6*10^{-34}*3*10^{8}}}{\mathbf{1000*1.6*10^{-7}}} \approx 1 * 10^{-21}\mathrm{m}$

Let's calculate N

$$\lambda_N = N * l$$

N$= \lambda_N / l = 10^{-21}/1.62 * 10^{-35} < 10^{14}$

$$\boldsymbol{\frac{\Delta E_N}{E_N} > 10^{-14}}$$

When measuring a gamma ray burst of 1000Tev (1 Peta electron volt), the noise to signal ratio should be lower than 10^{-14} in order to measure the quantization in the photonic wave lengths due to the quantization of space (figure 4).

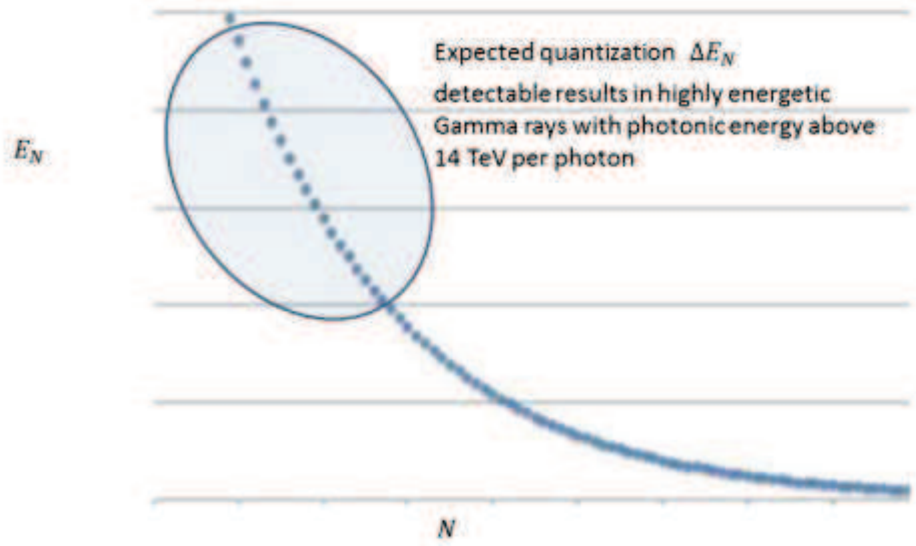

Figure 4: As N decreases to the left hand side E_N increases like $\frac{1}{N}$ and the quantization level ΔE_N increases like $\frac{1}{N^2}$. At the energy level of 1000Tev (a gamma burst in space), the quantization level can be detected with sensitive measurement equipment with a noise to signal level (measurement error vs. the measured signal), lower than 10^{-14} .

$$\frac{\Delta E_N}{E_N} > \frac{measurement\ error}{E_N}$$

REFERENCES:

[1] https://en.wikipedia.org/wiki/Many-worlds_interpretation

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

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