Special relativity and entropy

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Abstract

String theory and loop quantum gravity defines the elementary blocks of matter and space to be within the size of the Planck length. Einstein's special relativity requires that any two frames of reference will experience length contraction in the direction of their relative movement one towards the other. Since the Planck length is a universal constant in all frames of reference, and it is the building block of matter and maybe even the fabric of space, how can this length contraction occur? This is the question that this paper will try to answer.

Introduction

Planck length (1) 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:

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

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

Based on string theory (2), this is the scale of the building blocks of all particles. Based on loop quantum gravity (3), the fabric of space is built by loops in the size of this Planck fundamental scale. Based on the holographic principle (4), all the information

bits (entropy) in a volume of space, is limited by the area of its surrounding surface, divided by Planck area units (the square of Planck length). This enters a conflict with Einstein's special relativity, since it requires length contraction (5) when an observer on one frame of reference measures the length of an object in another frame of reference in the direction of the relative movement between the two frames of reference. Planck length cannot undergo length contraction since there is no meaning to a size smaller than the Planck length. This leads to the conclusion that length contraction requires a quantified decrease in the number of Planck length building blocks of matter (string theory) and/or space (Loop Quantum Gravity - LQG). Based on the holographic principle it means a decrease in the amount of information (figure 1). Since information is never lost, this brings us to a paradox.

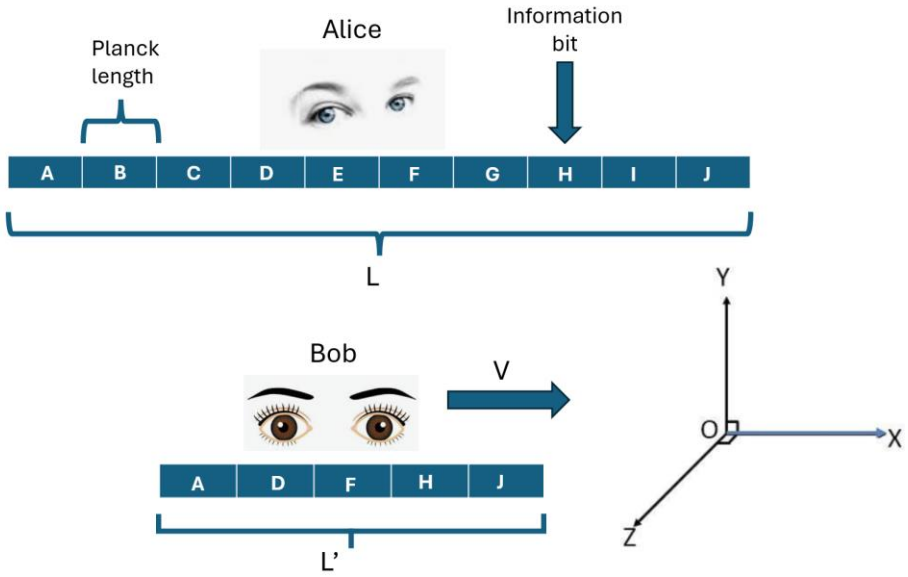

Figure 1: Alice measures an object in her frame of reference with proper length L in her x axis direction, with the information bits at the Planck length scale: A, B, C, D, E, F, G, H, I, J.

Bob, who is travelling at velocity V in the same X axis direction, relative to Alice, will measure a length L' < L due to length contraction in the X axis direction.

Since the information bits in the Planck length cannot undergo length contraction, L' will contain less information bits than the number of information bits in L. In this illustration, L' will contain the information bits: A, D, F, H. J and will miss the information bits: B, C, E, G, I.

Conclusion

Based on string theory, LQG and the holographic principle, information from Alice frame of reference is lost in Bob's frame of reference. Since information is never lost, this is a paradox that requires a new model of spacetime. To visualize a model in which different frames of reference represent different amounts of information (entropy), and no information is lost, we need to visualize a new structure of reference frame dependent spacetime. This paper suggests a structure in which each of the infinite number of reference frames represents a different quantized spacetime, staggered next to each other (figure 2). The size of the quantized building blocks is universal (same in all frames of reference), in the size unit of Planck length. All the staggered quantized frames of reference probably share a universal extra nonlocal grid like dimension (grid dimension). The nonlocal grid like dimension connects between all frames of reference and can explain the non-local behavior of quantum mechanics like the non-locality behavior of quantum entanglement "spooky action at a distance". This non-local grid-like dimension can also be the time dimension, combining with the quantized space dimension, building up the combined fabric of spacetime.

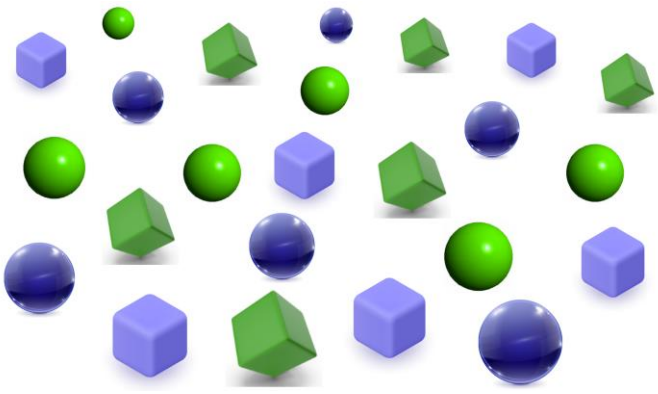

Figure2: illustration of The staggered matrix approach. Alice quatized local reference frame at t1 is illustrated by blue marbles illustrating the Planck length sized building blocks of space in Alice frame of reference. Bob quatized local reference frame at t1', is illustrated by green marbles illustrating the Planck length sized building blocks of space in Bob's frame of reference. Alice quatized local reference frame at t2 is illustrated by blue cubes illustrating the Planck length sized building blocks of space in Alice frame of reference. Bob quatized local reference frame at t2', is illustrated by green cubes illustrating the Planck length sized building blocks of space in Bob's frame of reference. The white grid shaped space between these quantized building blocks illustrate the non local grid dimension. The grid dimension can be time itself connecting all the staggered reference frames together. In this illustration only two reference frames are illustrated but the real matrix of space time is built from infinite number of staggered reference frames with the extra grid dimension connecting them together into the fabric of spacetime (it might be that the time dimension is the grid dimension). Each frame of refernce contains a different structure and amount of information, but in the entire three dimensional matrix of staggered infinite (in number and size), quantized frames of reference with the time dimension (grid dimension) between them, connecting every thing together, no information is ever lost. We can call this three dimensional matrix structure , the fabric of spacetime. We illustrate in a three dimensions model, all frames of reference in space and time.

REFERENCE:

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

[5] https://en.wikipedia.org/wiki/Length_contraction