Gravity visualized through the field of reference frames approach

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Abstract

Einstein's special theory of relativity, describes a fabric of space-time in which the speed of light is the same for all observers regardless on their inertial frame of reference (might also be referred to as reference frame or frame of reference). Based on that assumption, Einstein concluded in his special theory of relativity that two observers in two separate frames of reference will measure a difference in the flow of time, in length and in the exact time that events occur (relativity of simultaneity). A new approach that will enable to visualize the structure of this unique fabric of space - time in a single four dimensional (4D) image, will be the key to unify gravity with the quantum world.

Introduction

Let us try to visualize the twin paradox [1] scenario. Twin A stays in his original reference frame A for a proper time sequence of t while his twin brother B leaves reference frame A and travels during that same time through reference frames B and C until they meet again at reference frame A. Although the symmetrical relativistic relationship between all the reference frames, twin B will age slower than twin A, just because he did not stay the entire time in his original reference frame A. This is the main difference between the twin brothers. The only way to visualize this non intuitive result is to visualize a field of different symmetrical reference frames in which, each reference frame behaves like a different space time dimension and each observer will age symmetrically the same like all the other observers in all the other dimensions as long as he never leaves his own frame of reference (his space - time dimension) .In order to visualize in one symmetrical image a field of reference frames (can be referred to as reference frames field or frame of reference field), we need to go one bold step ahead and suggest that the fabric of space-time is quantized into local space time units ,and add an extra non local grid like dimension (grid dimension) between these quantized local space–time units. Based on these new assumptions, we can visualize the fabric of space time as a field of quantized (discrete) reference frames staggered together (figure 1). The greater their velocity difference is from one another the farther they are in

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the staggered formation. The proper quantized units for space time as measured by a standing still observer in each reference frame, are Planck's length and Planck's time, since these are the limits to our physical understanding of space-time [2]. Each reference frame has its own quantized arrow of time (proper time), quantized in the units of Planck time, and each reference frame is quantized into three dimensional (3D) units in the size of Planck's length in each dimension, where for each pulse of Planck time, matter can travel in each reference frame always zero or one unit of space in the size of Planck's length. Light will always travel one unit of quantized space in the size of Planck length for each pulse of Planck time in all the reference frames. This explains why light travels always at the same speed of light in all reference frames, why nothing can travel faster than light and why we cannot define physical behavior in scales smaller than Planck length and Planck time. Between these local quantized space time units lays an extra non local grid like dimension (or dimensions) connecting these quantized units of space-time together. The non-local grid dimension connects between the quantized units of each reference frame and between the different reference frames in the reference frames field. Using this new approach enables to visualize multiple reference frame dimensions (the "reference frame field"), staggered together in the grid dimension (figure 1). When an observer in reference frame A will observe Planck length or Planck time measurements done by an observer in reference frame B he will not agree with the measurement results (due to length contraction and time dilation) and vice versa. The farther these reference frames (A&B) are from one another in the reference frame field, the larger will be the disagreement between them on these basic measurements. This enables us to visualize and illustrate a 4D structure (based on figure 1) which obeys to Einstein's special theory of relativity. Since every pulse of Planck time an object can stay still in his reference frame, or move to a new reference frame by moving one quantum space in the size of Planck length, to its nearest quantized space unit, we can assume that a new reference frame might be added to the reference frames field every pulse of Planck time. This limits the number of reference frames in the field of reference frames to be less or equal to the age of the universe divided by Planck time. It is a huge number but it is not infinity.
We refer to an observer (Alice or Bob) as someone who is standing still entirely in one specific reference frame, but this is an approximation since the observer is made from moving elementary particles, and each particle is standing still in its own frame of reference.

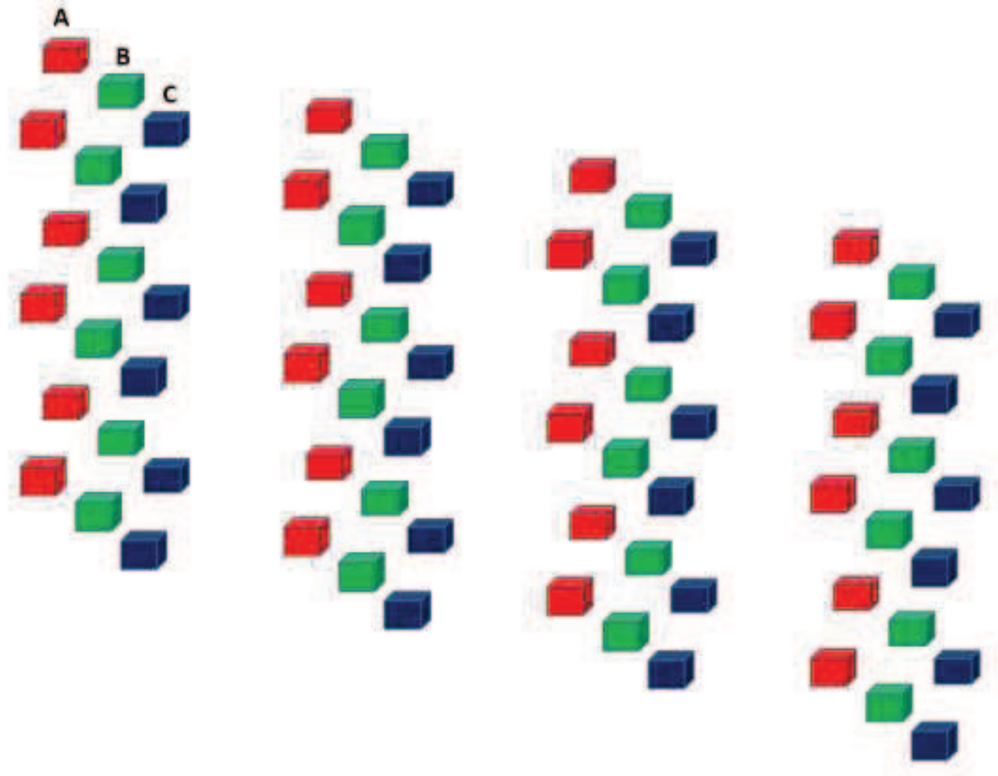

Figure 1 – The field of reference frames: Illustration of a small region in the quantized space time of reference frames A (red colored) , B (green colored) and C (blue colored) which represent only three out of the multiple parallel reference frames, staggered next to each other, in the staggered field of reference frames, during one Planck time unit. A, B & C are staggered together in the non-local grid dimension. Each cube represents a 3D Planck sized quantized unit of space, and the grid dimension (or dimensions) is the white colored space between them. Observers A, B and C cannot measure directly the extra non local grid dimension since it is not part of the reference frames field, it is the mediator between the reference frames and the mediator between the quantized units that build each one of reference frames. The quantized local units of space time are probably not a cube as illustrated in figure 1, but rather a symmetric spherical shaped space, rotating, vibrating and moving around in the surrounding grid dimension. The existence of the non-local grid dimension can be measured indirectly by the measurements of non-local quantum phenomena's like the "spooky action at a distance" of quantum entanglement [3] or by the Casimir effect [4] due to virtual particles that pop in and out of existence from the grid dimension. If the grid dimension is the Higgs field than the Higgs boson is a direct measured evidence to this extra non local grid

dimension. The extra grid dimension (or dimensions) can be also the source for dark matter and dark energy.

Explaining gravity through the reference frames model

Einstein's special relativity theory is based on the fact that each observer has his own reference frame in which he is not moving, with his own proper time relevant to his reference frame. In order to move from one reference frame to the next the observer needs to accelerate. Einstein's general relativity theory defines an equivalence principle between acceleration and gravity. This equivalence principal leads to a model in which gravity is not curvature in the 4D space time image which we cannot visualize, but a curvature in the arrow of time direction, through the staggered field of reference frames. At empty space without any gravitational effect or acceleration, the arrow of time will lead the observer to stay always in his own reference frame for every pulse of the Planck time (figure 2).

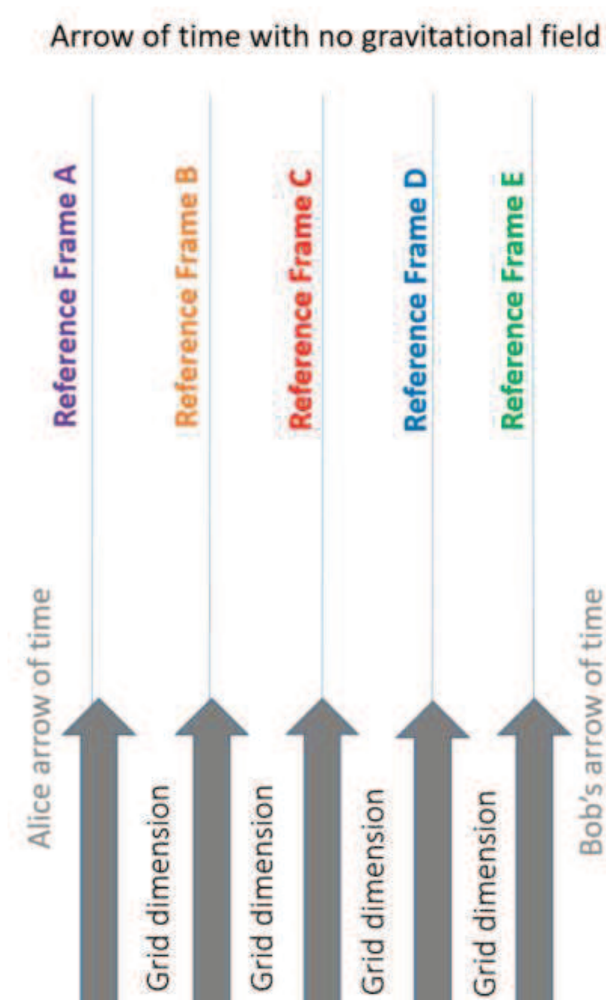

Figure 2: This illustration represents one dimensional staggered field of reference frames (A to E) in empty space with no gravitational effect or acceleration. The arrow of time in all the parallel frames of reference stays parallel and each observer stays in its own frame of reference (reference frame), as the arrow of time advances through space time . If they will not apply force and accelerate, Alice will stay at reference frame A and Bob will stay at reference frame E. The grid dimension is illustrated as the white space between the one dimensional reference frame lines. It separates between the reference frames and serves as a mediator between them. This illustration of a staggered field of reference frames can be achieved due to the assumption that space-time is quantized and there is unlimited, non-local new space between the quantized space units, which this paper refers to as the grid dimension. Although the arrow of time is illustrated as a continuous line it might be quantized into units in the size of Planck time.

When gravity is applied, the arrow of time will tilt (curve) and the observer will start travelling as time elapses, from one reference frame to the next (figure 3). This tilt in the arrow of time is measured through the gravitational time dilation.

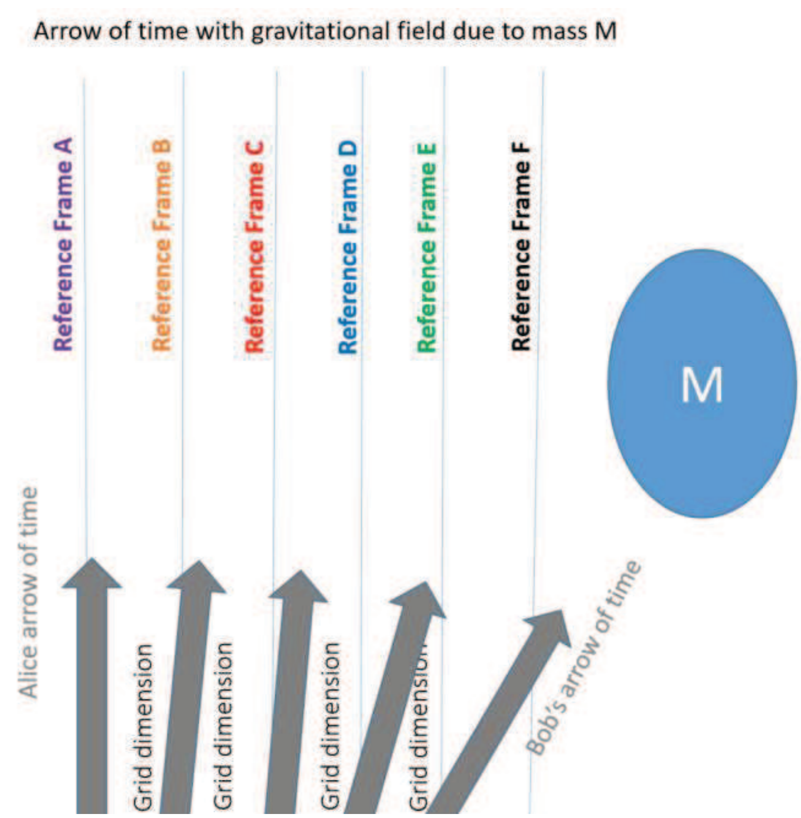

Figure 3: The same illustration of the one dimensional reference frame field, as in figure 2, but now with the gravitational effect, due to mass M, the arrow of time loses its parallel behavior. As the gravitational field increases the non-parallel behavior increases and the observer moves from one reference frame to the next as the arrow of time advances through space time .The movement from one reference frame to the next as the arrow of time advances is the equivalent behavior of acceleration (the Einstein equivalence principle).Since Bob is closer to mass M than Alice, he experiences a stronger tilt (curvature) in the direction of the arrow of time and he experiences a stronger time dilation effect and will seem to accelerate from Alice point of view.

Conclusion

Albert Einstein's special theory of relativity requires that light will travel at the same constant speed for all observers, even if they are in different frames of reference relative to one another. Due to this constant speed of light requirement, each observer has his own proper time. There is no proper universal symmetrical visualization representing the point of view of all the possible frames of reference in one four dimensional (4D) space time image. Any standard 4D image will represent always the point of view of only one specific frame of reference. This paper suggests that space time should be visualized in a new approach, as a symmetrical mosaic structure of multiple reference frames (dimensions), staggered one next to the other (the reference frame field). With no gravity the arrow of time will be in a parallel direction to keep the observer within his reference frame (within his dimension) throughout his journey in the reference frame field. When gravity is applied due to matter, energy, momentum or pressure, the arrow of time is tilted (curved) towards the gravitational source leading the observer from one reference frame to the next as time elapses. As the observer's distance from the gravitational source decreases the angle of the tilt in the arrow of time increases. As the angle of the tilt in the arrow of time increases the time dilation increases (time runs slower).The Einstein field equations describe how matter energy, momentum and pressure tilt (or in another words, curve) the arrow of time in the reference frame field. The tilt (or in another words, curvature) in the arrow of time, in the field of reference frames, tell matter how to move from one reference frame to the next. Since applying an accelerating force also changes the reference frame as time elapses we can apply Einstein's equivalence principle between gravity and acceleration. This new concept, connecting the Planck length to gravity, and adding an extra non local grid like dimension (or dimensions) enables a visualization of the special and general theory of relativity. The non -local grid dimension can explain the non- local behavior of quantum mechanics like quantum entanglement, quantum tunneling, the Pauli Exclusion Principle and the Schrodinger's wave function instantaneous collapse when measurements are applied.

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