Relativity and the Topology of a Virtual Universe

In this essay I describe a geometrical model of a virtual universe that is expanding in integer steps (the universe clock-rate). In dimensional terms this expansion occurs at the speed of light in Planck unit increments. This essay is an extract from the chapter on Time in the book Plato's Cave [1].

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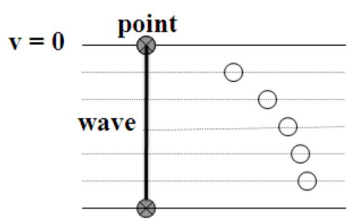
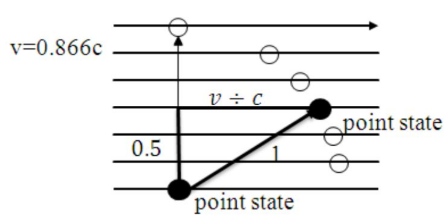
Let us initially define our universe as a constantly expanding in incremental steps (the universe clock-rate) 4-axis hyper-sphere whereby the 3-axis (x, y, z) hyper-sphere surface correspond to our 3-D space and the w-axis is the radius and corresponds to the universe expansion time-line. After each clock-cycle the universe expands in time (a unit of Planck time t_p) and space (a unit of spherical Planck space, radius = Planck length l_p). We have a 4-axis (w, x, y, z) co-ordinate system, but as this is depicted on a 2-D surface I shall illustrate only the (w, x) axis, the other 2 (y, z) space axis may be presumed; the x-axis incrementing in units of l_p, the w-axis in units of t_p and points graphed as velocity relative to the speed of light; x-axis/w-axis = m/s.

Let us suppose that electron wave-particle duality is an oscillation between an *electric* wave-state (period = 0.12692×10^{23}) and a *mass* point-state (period = 1). For an electron at (near) rest, which for simplicity I will write v = 0, during 1 wave-point oscillation cycle the universe undergoes an incremental expansion 0.12692×10^{23} times (electron frequency = $0.12692 \times 10^{23}\ t_p$).

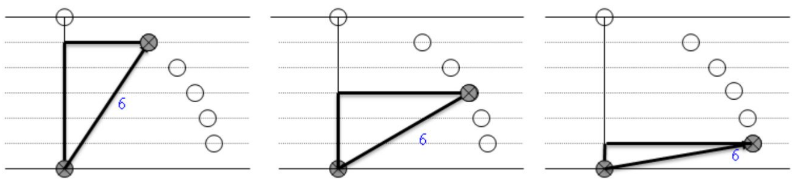
In the following diagrams the vertical w-axis is the timeline axis. The horizontal x-axis represents 1 axis of our 3-D x-y-z space. A particle is depicted below with a frequency = 6; 5 units of (Planck) time in the wave-state and 1 unit of (Planck) time in the point-state. As the universe expands it pulls the particle with it such that after every 6 units of time the particle has gone from point-state to wave-state and back to point-state along the universe timeline (1 particle oscillation cycle). As mass is a function of the point-state, this particle has mass (1 unit of Planck mass) every 6th unit of time; thus particle mass = Planck mass $m_P/6$.



We now add momentum to this particle until it is moving at v = 0.866c (0.866 * 299792458m/s). For convenience the horizontal particle axis is measuring velocity relative to c (v/c) such that our triangle can be solved as $0.5^2 + 0.866^2 = 1^2$. At (v = 0.866c), the point-state occurs after 3 units of time instead of 6. The frequency of occurrence of units of Planck mass and so the average (measured) mass of the particle has now doubled = $\mathbf{m_P}/3$ instead of $\mathbf{m_P}/6$.



For a particle with a frequency of 6, there are 6 valid solutions (diagram below) where $(\text{w-axis})^2 + (\text{x-axis})^2 = (\text{diagonal})^2$, for the purpose of illustration we may assume a solution for v = 0. In the right diagram the velocity is almost at velocity **c** along the x-axis, along the w-axis it goes from point-state to point-state without an intervening wave-state for each increment and so the particle cannot go faster than this, it has reached its maximum velocity. The mass of the particle is now equivalent to Planck mass (as it goes from point to point to point along the w-axis without any intervening wave-state). This particle period (diagonal) is thus a construct of the 2 axis; w (timeline), x (space).



The w-axis is commonly measured as gamma;

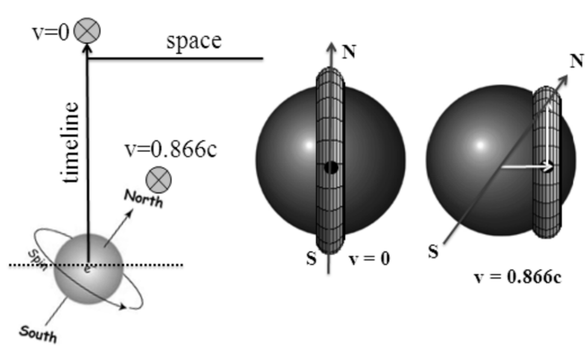
$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

For a particle that has only 6 divisions (6 steps from point to point), the maximum $\boldsymbol{\gamma} = 6$. A small particle such as an electron has more possible divisions and so a higher possible $\boldsymbol{\gamma}$ and so can go faster in 3-D space than a larger particle such as a proton with a smaller $\boldsymbol{\gamma}$ (smaller number of divisions).

· If Planck mass = electron mass * gamma ($m_P = m_e * \gamma_{electron}$) then $\gamma_{electron} = m_P/m_e$

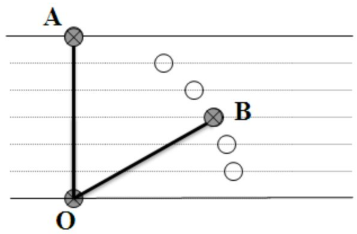
· If Planck mass = proton mass * gamma ($m_P = m_p * \gamma_{proton}$) then $\gamma_{proton} = m_P/m_p$

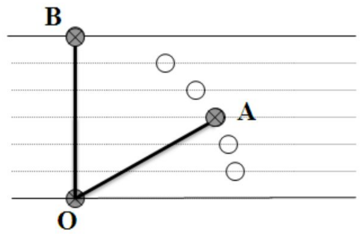
Could independent motion in 3-D space itself be an illusion? Our particle spins on its N-S axis, the radius of the black sphere as particle frequency, the torus as wavelength;



Let us suppose that the N-S axis is vertical when (v = 0) but angled when (v > 0), see diagram above, and that the N represents the direction in which the particle travels. By adding momentum to **B** we are not giving **B** an independent velocity in 3-D space but instead we are simply altering the direction (the angle of the N-S axis) along which **B** is being pulled, as if two boats A and B are drifting on a flowing river, 1 whose rudder is straight, the other whose rudder is at an angle. Both boats will slowly drift apart. The result will be the same. If, instead of an independent electron velocity in space, by adding momentum to the electron we are changing its axis of orientation, then it may be that this angle of incline of that N-S axis is the real measure of motion from the universe perspective. The electron is not moving, *the electron is being pulled by the expanding universe*, adding momentum simply changes the direction (N-S axis) along which it is being pulled.

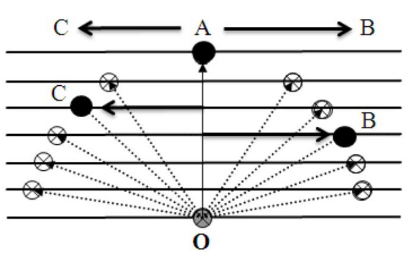
In this diagram particles **A** (v = 0) and **B** (v = 0.866c) begin at the origin **O** together (left diagram). After 1s, **B** will have travelled (0.866 * 299792458m) from **A** in 3-D space, but both diagonals are the same **O-A** = **O-B** = 6 and so **B** can equally claim (right diagram) that **B** (v = 0) and **A** (v = 0.866c). The confusion arises because time and length are our units, from the perspective of the universe there are these 6 equal solutions and they represent the radial axis, the universe is expanding radially and equally at the speed of light from each origin **O**. thus each of these solutions are equivalent from the universe perspective but not in terms of our space-time, in this respect my 4-D space-time graph is misleading.



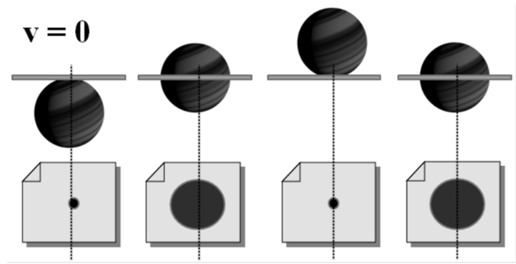


We could imagine that in the wave state the electron expands equally in all directions (the black sphere) but when it collapses into the point state, which in wave terms would be the region of maximum amplitude (along the N-S axis), it has a defined 'position' on our map. In the double slit experiment, the electron leaves the double slits in the wave state, the waves interfere and change the region of maximum amplitude = N-S axis. The direction which the electron travels has changed. The screen reflects the events that occurred at the slits.

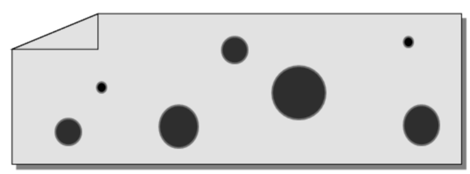
In the following diagram we have particles **C-A-B** with observer **A** in the center. Although **OA**, **OB**, **OC** are all the same radial length, the horizontal distance along the x-axis that separates **CA** and **AB** is what registers in our 3-D space for observer **A**, for the w-axis is invisible to our 3-D space. It is as if we look at a 2-D photo of an airport taken above from a satellite, because there is no height dimension we do not know which planes are parked and which are flying and if so, what are their heights. We only know the position of the planes relative to each other. If we take a series of photos then we can also determine the motion of the planes relative to each other, this will give us a 1-D time to go with our 2-D photos. We can then create a 3-D space-time movie that shows changes in position and thus gives the motion of the planes relative to each other over time (the frame rate of our movie), but we can only speculate on an unseen (height) axis when some planes seem to pass through each other without impact (because of course they are flying at different heights). As noted, the time dimension of this movie is the movie frame rate, thus although it derives from, as all motion is driven by, the universe expansion, it is actually a measure of relative motion. If there were no change in position of particles and so no motion, then we could not record time, nevertheless the universe continues to increment. Universe time (the clock-rate) is thus not the same as the time dimension of physics.



In this context our 4-D space-time co-ordinate system is a model that, like our satellite photo, is a map of relative position and relative motion. The Lorentz transformation then becomes the means by which we may translate from our space-time (the co-ordinate system of physics) to this radial co-ordinate system. In the absence of particles the universe would be dimensionless. Our dimensions are thus relative measures. We could use this analogy. Let us suppose that we live on a blank 2-dimensional piece of paper. A rotating spherical ball travels up and down through our paper world. We cannot see the ball; we can however detect a disturbance on our paper world. In the beginning we see a dot, this dot grows to form a circle (the size of the ball), the circle then shrinks, becomes a dot again, and then the cycle begins again, the ball falls back down.

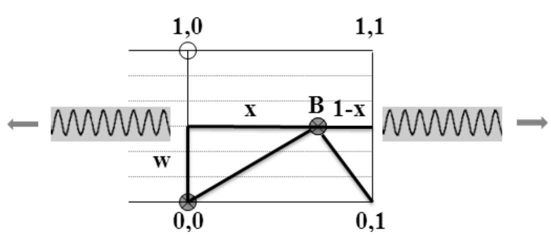


Before the ball came our paper was blank, now we have a dot and a circle. We can use the dot as a unit of length, we find that the radius of the circle is 12 dots; this gives us a length reference so we assign 12-dots as 1 length-unit. We can notice that the circle is rotating such that it takes 24 rotations to go from dot to circle and back to dot; this gives us a time reference so we assign 24-rotations as 1 time-unit. We then find other dots/circles appearing in different places on our paper and so by using our time-unit and length-unit we can make a map of these dots and circles relative to each other.



Our dimensioned map can measure our surroundings. These dimensions however are simply different aspects of the same phenomena, those oscillating balls. If there were no balls then there would be no parameters to measure. There would be no dimensions, our paper universe blank, devoid of information.

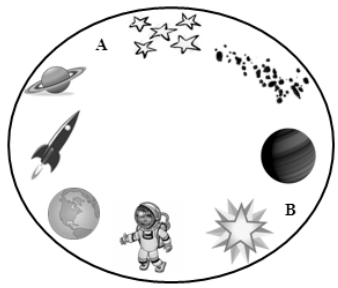
As **B** travels, it emits a photon. The wavelength of the photon changes by (1-x)/w or w/(1-x) depending on whether the observer is in front or behind **B**, i.e.: the Doppler effect.



At v = 0.866c, $+\lambda_{.866} = \lambda_0 \times (1\text{-}0.866)/0.5$; $-\lambda_{.866} = \lambda_0 \times 0.5/(1\text{-}0.866)$

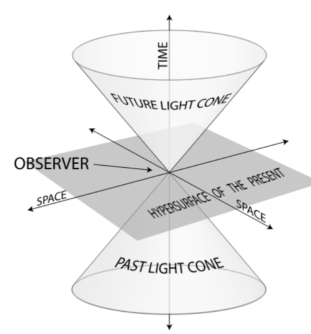
1: If our 3D space is constructed from the relative position and motion of the particles themselves, then the physical dimensions of the observable universe are a function of the particle universe. And so if a black-hole were to appear within our physical space-time then the parameters of that black-hole (size, mass…) would be defined by the physical information content of that black-hole and this information would appear as the surface of the black-hole much as a soap bubble is surface. Because the w-axis is invisible all information would appear to be on the same plane.

In other words, it is not the black-hole that we detect, for a black-hole itself is dimensionless, rather it is the information stored in that black-hole that we are measuring. An astronaut falling into that black-hole would add information to, and so appear to increase the surface area of, that black-hole.



2: In mathematics, 4-D space is a geometric space with 4 space dimensions. It typically is more specifically 4-D Euclidean space, generalizing the rules of 3-D Euclidean space (with 3D space as the surface of the 4D sphere). In modern physics, space and time are unified in a four-dimensional Minkowski continuum called space-time, whose metric treats the time dimension differently from the 3 spatial dimensions. Space-time is not a Euclidean space [2].

3: In special and general relativity, a light cone is the path that a flash of light, emanating from a single event (localized to a single point in space and a single moment in time) and traveling in all directions, would take through space-time. If one imagines the light confined to a two-dimensional plane, the light from the flash spreads out in a circle after the event occurs, and if we graph the growing circle with the vertical axis of the graph representing time, the result is a cone, known as the future light cone. The past light cone behaves like the future light cone in reverse, a circle which contracts in radius at the speed of light until it converges to a point at the exact position and time of the event. In reality, there are three space dimensions, so the light would actually form an expanding or contracting sphere in three-dimensional (3D) space rather than a circle in 2D, and the light cone would actually be a four-dimensional version of a cone whose cross-sections form 3D spheres (analogous to a normal three-dimensional cone whose cross-sections form 2D circles), but the concept is easier to visualize with the number of spatial dimensions reduced from three to two [3].



[1] Plato's Cave: http://platoscode.com/

[2] https://en.wikipedia.org/wiki/Four-dimensional_space

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