Relativity in a Planck-level Black-hole Universe Simulation, a Simulation Hypothesis

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The Simulation Hypothesis proposes that all of reality is in fact an artificial simulation, analogous to a computer simulation, and as such our reality is an illusion. It is predicated upon the assumption that enormous amounts of computing power are available. In this article I outline a method with low computational cost for reproducing relativistic mass, space and time at the Planck level. Virtual particles that oscillate between an electric wave-state and a mass point-state are mapped within an expanding black-hole hyper-sphere virtual universe; Planck time (the simulation clock-rate) and velocity of expansion c are constants. All particles and objects travel at c however photons, as the means of information exchange, are restricted to lateral movement across the hyper-sphere. Lorentz formulas are used to translate between the '3-D space' surface and the hyper-sphere.

1 Virtual Universe

The Simulation Hypothesis proposes that all of reality, including the earth and the universe, is in fact an artificial simulation, analogous to a computer simulation [1].

In an article on the virtual electron was shown how localized units of mass, space and time can be constructed from mathematical (virtual) particles [2].

As an extension to that article, here is discussed a method that can simulate at the Planck level relativity at a minimal computational cost by using an expanding hypersphere artifice in which these virtual particles are embedded.

In the hypersphere co-ordinates all particles and objects travel at and only at the speed of light however information between them is exchanged by photons which are restricted to lateral motion. Relativity is the mathematics of perspective. The expansion of the universe is used to drive motion and time (and the arrow of time). The axis of the particle is used to simulate transfer of momentum. Particle half-life is built into the particle geometry. The hyper-sphere virtual universe is analogous to a black-hole.

Virtual particles oscillate between an electric wave state (the particle frequency/wavelength) and a Planck-mass $1m_P$, Planck-time $1t_p$ (mass) point state. The point-state has defined co-ordinates within the hypersphere. Wave-particle duality is replaced by this wave-point oscillation. The oscillation is driven by the expansion of the hyper-sphere.

2 Space-time

Particle A is mapped onto a space-time graph (fig.1). Although A does not move in space ($v = 0$), it does move in time (vertical axis).

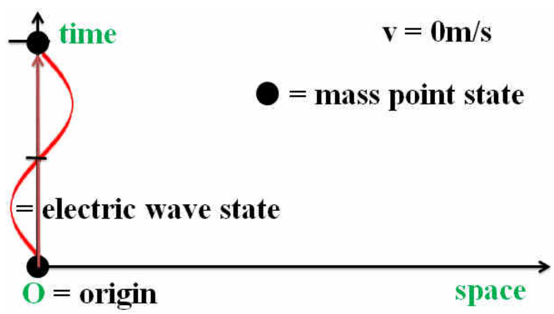

Fig. 1: particle A, v = 0

Particle B, $v = 0.866c$ is added (fig.2). After 1s B will have traveled 0.866 x 299792458 = 259620km from A along the horizontal space axis.

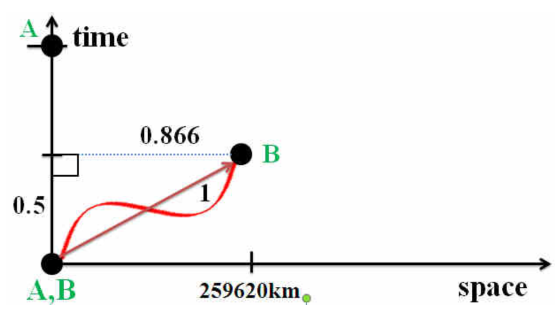

Fig. 2: particle B, v = 0.886c

Particles A and B both have a frequency = 6 ($5t_p$ in the wave-state then $1t_p$ in the point-state). As the A point-state occurs once every $6t_p$, mass of A $m_A = m_P/6$, however the point-state of B occurs after $3t_p$ and so $m_B = m_P/3$ (fig.3).

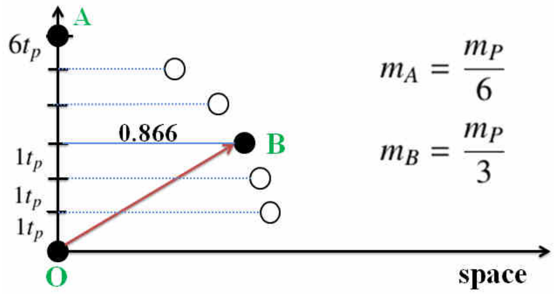

Fig. 3: particle B, relative mass

B ($v = v_{max}$, $m_B = m_P/1$). As each step on the time axis involves $1t_p$, there are 6 possible velocity solutions, this also means that m_B can reach Planck mass m_P, but B can never reach the (horizontal axis) speed of light c (fig.4). The vertical axis would be measured as $1/\gamma$. For a particle that has only 6 divisions (6 steps from point to point), the maximum $\gamma = 6$. To determine the maximum velocity that a particle can attain (y-axis = v/c) we simply calculate when that particle will have reached Planck mass, because from there it can go no faster. A small particle such as an electron has more possible divisions along the vertical axis and so a higher possible γ and so can go faster in 3-D space than a larger particle such as a proton with a smaller γ (a smaller number of divisions).

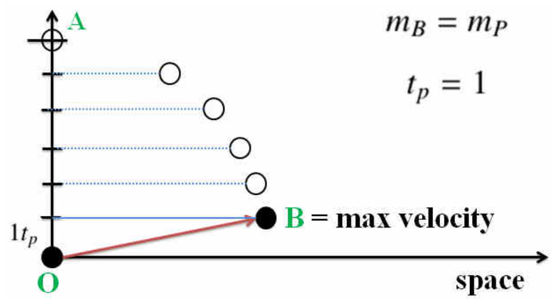

Fig. 4: particle B, maximum velocity

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

$$\gamma_{electron} = m_P/m_e, \gamma_{proton} = m_P/m_p$$

3 Virtual universe

3.1. Replacing the above with a 4-axis graph (h, x, y, z), to illustrate the concept are shown the $(+h, x)$ axis with particles as semi-circles. Depicted is particle B at some arbitrary universe time t. B begins at origin O and is pulled along by the virtual universe expansion (fig.5, 6, 7).

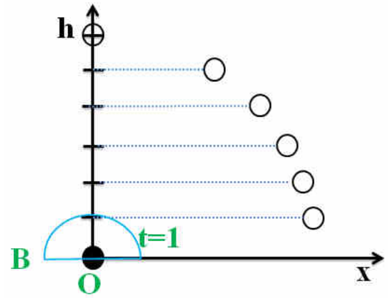

Fig. 5: $t = 1$

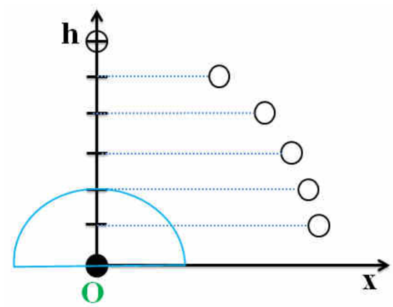

Fig. 6: $t = 2$

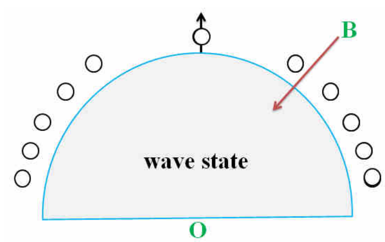

Fig. 7: $t = 6$

At $t = 6$, B collapses into the mass point state and now has a defined co-ordinate position which becomes the new origin O’ (fig.8), the above repeating ad infinitum $t = 7, 8, \ldots$ (fig.9, 10).

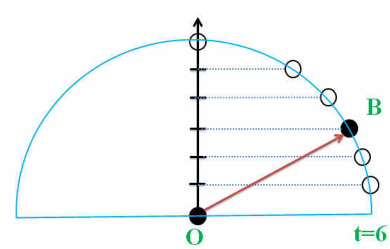

Fig. 8: $t = 6$, point-state

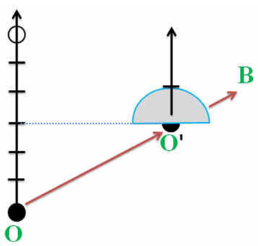

Fig. 9: t = 6+1

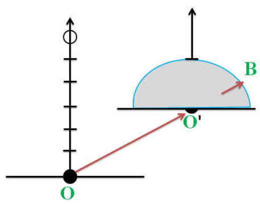

Fig. 10: t = 6+2

The process also repeats for A (fig.11). The virtual universe hyper-sphere can be understood as a particle presently in the wave-state.

Each particle origin point is thus repeating fractal-like within the greater universe-as-particle hyper-sphere, of which the origin O is the big bang.

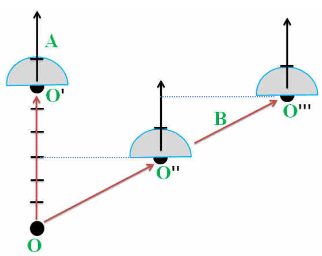

Fig. 11: Origin points; A, B

3.2. In the space-time examples was depicted graphs A; v = 0, $m_A = m_P/6$ and for B; $v = 0.866c, m_B = m_P/3$ (fig.12).

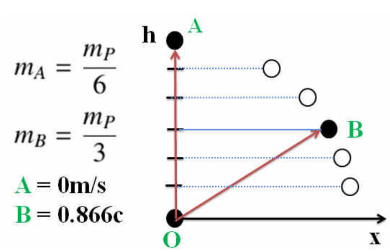

Fig. 12: relative mass A to B

However in the (h, x) graphs we find that as A and B have the same frequency, f = 6, the lengths OA = OB = 6, this is because the hyper-sphere expands radially. As a consequence B can rightly claim that it is A whose velocity is at v = 0.866c and for B velocity v = 0 (fig.13).

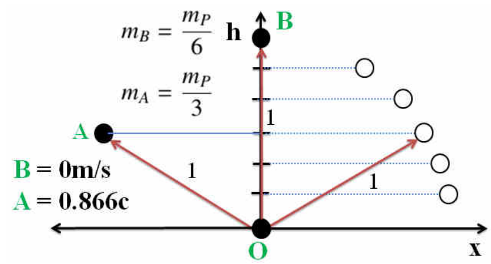

Fig. 13: relative mass B to A

Both A and B are traveling at the speed of expansion (which translates to c) from the origin O. In the virtual co-ordinate system everything travels at, and only at, the speed of expansion as this is the origin of all motion, particles and planets do not have any inherent motion of their own, they are simply pulled by this expansion. After 1 second both A and B will therefore have traveled the equivalent of 299792458m in virtual co-ordinates from origin O. Each of the 11 depicted solutions are equally valid as the radii are the same (fig.14).

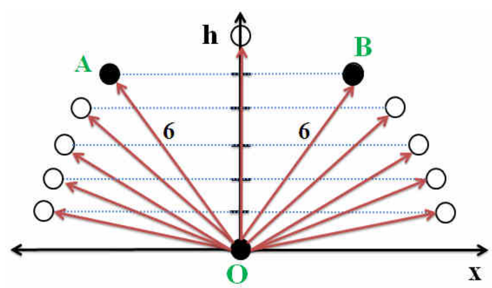

Fig. 14: radial expansion

3.3. Particles are assigned an N-S spin axis. As the universe expands, it stretches particle A (position and motion of the wave-state are undefined). When t = 6, the wave state collapses to the defined point state, as represented by the N. This means that of all the possible solutions, it is the particle N-S axis which determines where the point state will actually occur.

Thus if we can change the N-S axis angle of B, then as the universe expands the B wave state will be stretched as with A. But the point of collapse will now reflect the new N-S axis angle. B does not need to have an independent motion; B is simply being dragged by the universe in a different direction as the universe expands.

We can simulate the addition of a physical momentum to B by simply changing the N-S axis. The radial universe expansion does the rest (fig.15).

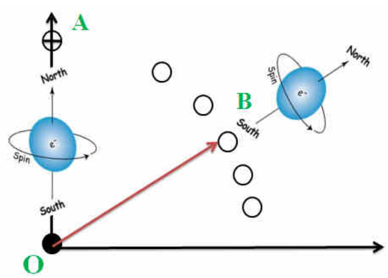

Fig. 15: N-S axis; A v = 0, B v = 0.886c

3.4. Information between particles is exchanged by photons. Photons do not have a point-state and so travel horizontally. In the following example A emits a photon whose frequency = 6. The emission is represented as a series of dots. Although the photon travels horizontally, and so at the speed of light, it is also pulled in the same direction as A (by the universe expansion) and so travels horizontally at an angle (fig.16).

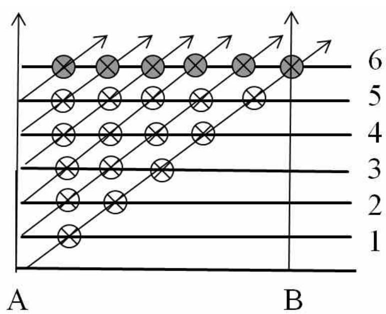

Fig. 16: photon emission

The photon is absorbed and then re-emitted by B as A and B play photon ping-pong along the vertical axis.

B now heads towards A (fig.17). As a result B will take less that 6 units of time to absorb the photon. If the x-axis length $x = v/c$, then the h-axis length $h = \sqrt{1^2 - x^2}$ and the common relativistic Doppler equation can be written;

$$v_{observed} = v_{source} \cdot \frac{\sqrt{1 - \frac{v^2}{c^2}}}{1 - \frac{v}{c}} = v_{source} \cdot \frac{h}{1 - x} \tag{2}$$

In the article on the virtual electron [2], the electron enters the mass point-state when the condition $(AL)^3/T$ is reached where $T=2\pi$. If time T is not circular (rotation around an axis) but linear then this condition is not reached and the photon will remain in the wave-state. Thus photons travel horizontally, particles radially.

$E_{wave} = hv$ applies to both particle and photon wave-states but $E_{mass} = mc^2$ applies only to the mass point state. For each particle oscillation there is 1 Planck energy wave-state followed by 1 Planck mass point-state; and thus $E_{wave} = E_{mass}$,

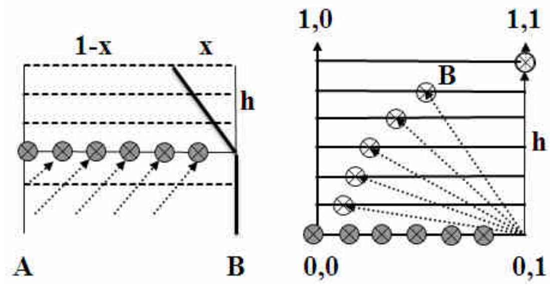

Fig. 17: Doppler shift

however as particle mass is the average frequency of occurrence of units of Planck mass then the formula $E = mc^2$ in the context of this model is misleading for $E = mc^2$ assumes particles have a constant property defined as mass.

3.5. Returning to our ABC particles, as photons (information) can only be exchanged along the horizontal axis which are the (x, y, z) axis, ABC will only 'see' this horizontal information. Instead of OA, OB and OC, the (x, y, z) axis will be able to measure only the horizontal AB, BC and AC (fig.18). There is no depth perception, akin to watching 3-D airspace on a 2-D radar screen.

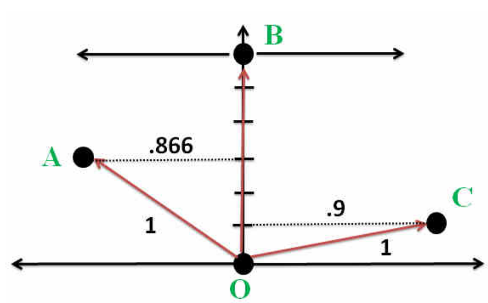

Fig. 18: 3-axis hyper-sphere surface

Thus although in Virtual Universe co-ordinates mass, velocity and frequency are constants, when projecting only the (x, y, z) axis, particles ABC will see only the horizontal (AB, BC, AC) co-ordinates (representing our 3-D space).

And so if we define our virtual space as a black-hole, then the information (particles ABC) will appear to be on the surface of that black-hole, the radius of the black-hole being dimensionless (entropy only increases when the surface area of the black hole changes, not the volume).

Furthermore time for ABC translates as motion, without motion in the (x, y, z) axis there will be no means to measure time, thus the dimension time for the ABC world derives from simulation time and may equate to simulation time (as measured in units of Planck time), but it is a measure of particle motion and not the simulation time (clock-rate).

4 Virtual electron

The article on the virtual electron [2] forms the basis of this article and so a brief mention. The oscillation frequency of this electron $f_e = (AL)^3/T$. Thus instead of measuring 3-D space in terms of length L^3, we can propose virtual space in terms of a 3-D ampere-meter $(AL)^3$, aka an aether. As the point-state (a Planck-size black hole around which the particle is centered) is carried by the wave-state and momentum orbitals, this model may also be classified as a pilot-wave model [3].

References

1. Nick Bostrom, Philosophical Quarterly 53 (211):243–255 (2003)
2. Macleod, Malcolm J., Programming Planck units from a virtual electron; a Simulation Hypothesis
   Eur. Phys. J. Plus (2018) 133: 278
3. https://en.wikipedia.org/wiki/Pilot-wave-theory