On the Art of Programming an Intelligent Universe

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The topic “How can mindless mathematical laws give rise to aims and intention?” combines 2 thesis that would appear to be mutually exclusive; that a random physical universe operating according to impersonal mathematical laws somehow meshes seamlessly with a non-random intention found in the organic world. We may reconcile these 2 positions if we accept that what is observed as intention is an illusion, a monkey, given a typewriter and enough millennium could type the complete works of Shakespeare (or an essay for this contest) but that the appearance of intelligence is statistical, the monkey at no time can be said to have actually considered a plot for Hamlet as it randomly hits the keyboard. Somewhat arrogantly however I claim an intelligent intention to write this essay, this essay then becomes evidence of that intent and I thus can reconcile the above-noted contradiction best with the argument that the separation between the organic and the physical is artificial, that the laws of physics are a subset of the laws of nature. The analogy would be of the physical laws as the operating system upon which the organic world functions as distinct programs or apps but with the laws of nature as the underlying programming language from which both are constructed.

Premise

In this essay I suggest that the universe could have been programmed according to a set of rules that were selected such that a swarm intelligence would then emerge. I then give an example of a virtual (mathematical) universe that uses expansion applied to geometry to simulate a dimensioned (physical) universe. Using simple rules and formulas for circular forms, Pythagoras theorem and wave addition, I show how we might simulate electrons, dimensions, relativity and the forces within a mathematical (software) framework. Complexity, as with organic systems, would arise from time (iterations of the algorithm).

Swarm Intelligence

Swarm intelligence (SI) is the collective behavior of decentralized, self-organized systems. The common example used in nature studies and AI is the ant colony [26]. An individual ant can achieve nothing by itself but in a colony ants can solve complex problems using swarm intelligence. There is no central control directing the colony, although there are specialized tasks (soldier ants etc.), no ant is in charge; even a colony of a million ants has no visible organization, instead each ant is presumed to be following a set of basic rules that sum together to create the complexity of the colony [1]. If we place a barrier between a line of ants and its food supply there is a flurry of activity as the ants appear to run in random directions, yet in a short space of time they will have rerouted around the barrier. They have used swarm intelligence to solve a problem.

When ants go exploring in search of food they end up choosing collective routes that fit statistical distributions of probability, a mixture of Gaussian and Pareto distributions, that dictate how much the ant 'turns' at each step and the direction it will travel in [2].

Science is still puzzled by the workings of the human brain [3][28]. It comprises about 100 billion neurons and we form more than 1 million new connections among these neurons each day, each neuron with an average 7,000 synaptic connections to other neurons. During early pregnancy, neurons have shown to multiply at a rate of 250,000 neurons per minute [27]. If the same set of natural rules are common to all organic systems then we might suppose that each neuron may be akin to an ant following a simple set of rules, there is no-one (no neuron) in charge, instead there is a neuron colony and thoughts are the complex behavior of that colony. And so perhaps I am not a ‘me’, I am the collective ‘me’; I am a neuron colony, my ego comes from this neuron swarm intelligence. With 100 billion neurons working for me I can solve more complex problems than can the smaller ant colony.

The DNA information set is surprisingly simple yet very quickly creates great complexity. As cells multiply specialization occurs, we may conclude that each iteration (cell division) creates new information based on the previous information. These iterations are akin to a time dimension for the organism which may be a contributing factor for why calorie-restriction studies involving organisms ranging from microscopic yeast to humanlike rhesus monkeys have shown extended life spans of the semi-starved as much as 50% [4]. Could these growth processes also be applying some form of mathematical algorithms or logic, each cell following a set of rules?

Lee Smolin first popularized in his 1997 book ‘The Life of the Cosmos’ the concept that a cosmological natural selection might occur via the same rules as those which apply in biology [5]. In context of this essay, in the beginning was encoded a set of initial conditions such that after the big-bang, as the universe mass-density and temperature is of extreme proportions, there would be a plethora of sub atomic species formed… slowly however, as the universe grows, the mass density reduces and the universe cools, the most stable forms (electrons, protons etc.) would then tend to predominate… the less successful ‘species’ returning to the particle pool to be recycled.

As time progressed, the universe continued to specialize, as atoms and molecules and crystals began to form… the universe constantly growing in complexity. It would not be necessary for the laws of physics, the structure of particles; the 4 forces or other such minutiae as would be required by an engineered design. These details could all be natural outcomes of the initial condition (the DNA) of the big-bang via a cosmological natural selection acting over time. As we may predict eye-color from an analysis of our genetic code, so too analysis of the big-bang could perhaps show that 14 billion years later there would be a small planet capable of supporting life orbiting a mid-sized star in an obscure region of an obscure galaxy. Evolution becomes programmed evolution in the sense that life on earth may have evolved coherently from the big bang according to a precise set of mathematical rules.

Maths and nature link. The largest ever research project into mathematical patterns in flowers has proved a link between number sequences and nature, Manchester scientists said [6].

Cellular automation

Cellular automaton consists of a regular grid of cells, each in one of a finite number of states, such as on and off. For each cell, a set of cells is defined relative to that cell. An initial state (time t=0) is selected by assigning a state for each cell. The game evolves according to fixed rule(s) that determine the new state of each cell in terms of the current state of that cell and the states of its neighboring cells.

The 1970s ‘Game of Life’ rules are: If a cell has 2 black neighbors, it stays the same. If it has 3 black neighbors, it becomes black. In all variations it becomes white. Although the rules are simple, the system fluctuates between an apparent randomness and order. In 1969, Konrad Zuse (Calculating Space), proposed that the physical laws of the universe are discrete by nature, and that the universe is the output of a deterministic computation on a single cellular automaton; this field of study is called digital physics. Stephen Wolfram’s 2002 book ‘A New kind of Science’ argues that the complexity in nature may be due to cellular automata [7].

Programmable Universe

The following example describes a solution for programming a virtual universe that is based on a Max Tegmark style Mathematical Universe: Our external physical reality is a mathematical structure. That is, the physical universe is mathematics in a well-defined sense, and "in those [worlds] complex enough to contain self-aware substructures SAS [they] will subjectively perceive themselves as existing in a physically 'real' world" [8].

There are 6 principal dimensioned physical constants; (G, h, e, c, m_e, k_B) used to measure our physical reality and these are referenced in terms of 5 SI units; M=kg, T=s, L=m, A=ampere, K=kelvin. The numerical value for c = 299792458 *m/s*, this value depends on the definition of *m* and *s*, we could equally write c = 186280 miles/s, likewise if we were to meet aliens their dimensioned constants would depend on the system of units they use [9]. There are also dimensionless mathematical constants such as the fine structure constant alpha whose numerical values are independent of the system of units used; these values are not only galaxy independent, but they may co-exist in a mathematical universe. The first problem we face is how to reproduce these dimensioned constants and dimensional units within the constraints of a mathematical framework. For this I will take a rotating black-hole electron inside a virtual universe that expands in incremental steps, this introduces virtual motion and also gives a clock-rate and provides for an arrow of time (that outward expansion).

Black hole electron

I first simplify wave-particle duality to where the electron oscillates between an electric wave-state and a mass point-state. The wave-state is constructed from magnetic monopoles = ampere meters AL (e×c) and time T. The point-state equates to a unit of (Planck) mass M, and so measured electron mass becomes the frequency of the mass point-state, electron wavelength the frequency of the wave-state and so we can combine $E = hv = mc^2$. This electron could thus be envisaged as a micro black-hole center surrounded by a periodic magnetic-monopole cloud.

Magnetic-monopole wave state

We begin with a mathematical formula for a virtual electron $\mathbf{f_e}$ that embeds the parameters that we require of a physical electron; M=mass, A=charge, L=length (wavelength), T=time (period or frequency), V=velocity (spin) – and as spin can be left or right we will require our formula to have a geometry that permits a N-S spin axis.

Combining length L with charge A gives us magnetic monopoles = ampere-meter AL = e×c. These are our quarks albeit we add the exponents rather than the charge $(AL)^{1+1+1=3}$. For frequency we require time T. Our formula then becomes $f_e = (AL)^3/T$. For our electron to be equivalent to the modern electron requires $f_e = .12692 \times 10^{23}$. To give (Planck) mass, the monopole cloud disappears periodically exposing the point-state black-hole center ($1m_P$, $1t_p$), rotation continues (driven by the universe expansion) and the electric cloud returns. This occurs because the monopoles overlap with time after each complete cycle and cancel; units $f_e = (AL)^3/T = 1$ (f_e is dimensionless). Thus we may create dimensions as we wish with the proviso that they sum to unity = 1.

For spin we need a left and a right momentum for which I will define P = sqrt of momentum. Our base units MLTVPA become (right column). They are defined by a dimensionless geometrical form (in brackets) in terms of 2 mathematical constants (α, Ω) and by a dimensioned unit which I have denoted *m* as mass, *l* as length, *t* as time, *v* as velocity, *a* as charge, *p* as sqrt of momentum. As they are simply different aspects of the electron geometry $\mathbf{f_e}$ and so overlapping, we require only 2 of these units to define the others. In the following examples I use mass and time (***k***, ***t***) and also momentum and velocity (***p***, ***v***). We can thus for example define length L, i.e.: the distance between LA and NYC, using mass M and time T.

$$M = (1)m,\ (mass)$$

$$T = (2\pi)t,\ (time)$$

$$P = (\Omega)p,\ (sqrt\ of\ momentum)$$

$$V = (2\pi\Omega^2)v,\ (velocity)$$

$$L = (2\pi^2\Omega^2)l,\ (length)$$

$$A = \left(\frac{64\pi^3\Omega^3}{\alpha}\right)a^3,\ (ampere)$$

$$M = (1)k$$

$$T = (2\pi)t$$

$$P = (\Omega)\ \frac{k^{4/5}}{t^{2/15}}$$

$$V = \frac{2\pi P^2}{M},\ L = \frac{TV}{2},\ A = \frac{8V^3}{\alpha P^3}$$

$$P = (\Omega)p$$

$$V = (2\pi\Omega^2)v$$

$$T = (2\pi)\ \frac{p^{9/2}}{v^6}$$

$$M = (1)\ \frac{p^2}{v},\ L = \frac{TV}{2},\ A = \frac{8V^3}{\alpha P^3}$$

From MLTVPA we can now derive generic formulas for the dimensioned constants (G, h, V=c, e, m_e, k_B …). In the example (right) I solve these using (***p***, ***v***) … I could have used (***k*** = m_P, ***t*** = $t_p/2\pi$) or any other suitable combination (***a***, ***l*** etc). As α and Ω are mathematical constants their values are fixed, we therefore need only to scale our 2 (**p**, **v**) units to their SI values. To convert to SI values I use $\mu_0^* = 4\pi/10^7$ (exact) to solve **p** and $V = c = 2\pi\Omega^2\mathbf{v}$ (exact), thus we can solve (G, h, c, e, m_e, k_B) with a high precision, see table 1 [17];

α = 137.035999139 (CODATA 2014 mean)
Ω = 2.007134949636
p = 0.50774534… q; **v** = 11843707.85 m/s (from $c = 2\pi\Omega^2\mathbf{v}$)

$$G^* = \frac{V^2L}{M} = (8\pi^4\Omega^6)\ \frac{p^{5/2}}{v^2}$$

$$T_P^* = \frac{AV}{\pi} = \left(\frac{128\pi^3\Omega^5}{\alpha}\right)\ \frac{v^4}{p^3}$$

$$\mu_0^* = \frac{\pi V^2 M}{\alpha L A^2} = \left(\frac{\alpha}{2048\pi^5\Omega^4}\right)\ p^{7/2}$$

$$e^* = AT = \left(\frac{128\pi^4\Omega^3}{\alpha}\right)\ \frac{p^{3/2}}{v^3}$$

$$h^* = 2\pi LVM = (8\pi^4\Omega^4)\ \frac{p^{13/2}}{v^5}$$

$$k_B^* = \frac{\pi VM}{A} = \left(\frac{\alpha}{32\pi\Omega}\right)\ \frac{p^5}{v^3}$$

Table 1	Calculated using α, Ω, p, v	CODATA 2014
Planck constant	$h^* = 6.626\ 069\ 134$ e-34	$h = 6.626\ 070\ 040(81)$ e-34
Elementary charge	$e^* = 1.602\ 176\ 511\ 30$ e-19	$e = 1.602\ 176\ 6208(98)$ e-19
Electron mass	$m_e^* = 9.109\ 382\ 312\ 56$ e-31	$m_e = 9.109\ 383\ 56(11)$ e-31
Boltzmann's constant	$k_B^* = 1.379\ 510\ 147\ 52$ e-23	$k_B = 1.380\ 648\ 52(79)$ e-23
Gravitation constant	$G^* = 6.672\ 497\ 192\ 29$ e-11	$G = 6.674\ 08(31)$ e-11

Here I list MLTVPA ratios (right) in dimensionless groups; units = 1, we thus could, for example, solve the SI unit for time **t** in terms of other the SI units;

$$\frac{L^{15}}{M^9T^{11}},\ \frac{P^{15}T^2}{M^{12}},\ \frac{V^{12}T^2}{P^9},\ \frac{T}{A^3L^3}\ldots;\ units = 1$$

t = $t_p/(2\pi) = 0.1715855 \times 10^{-43}$s;
m = $m_P = 0.2176728 \times 10^{-7}$kg;
l = $lp/(2\pi^2\Omega^2) = 0.20322087 \times 10^{-36}$m;
a = $0.126918589 \times 10^{23}$A

$$t = \frac{l^{15/11}}{m^{9/11}} = \frac{m^6}{p^{15/2}} = \frac{p^{9/2}}{v^6} = a^3l^3 = \frac{l^{6/5}}{p^{9/10}} = \frac{1}{a^2p^{3/2}}\ldots$$

t = $(0.203\ldots\times10^{-36})^{(15/11)}/(0.217\ldots\times10^{-7})^{(9/11)} = (0.1269\ldots\times10^{23})^3 \times (0.203\ldots\times10^{-36})^3 \ldots$

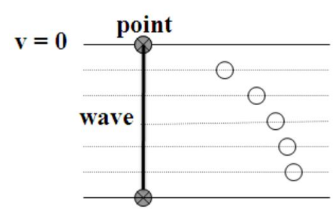
The units M=1 (cycle), T=2π (radians) are conferred via rotation. This rotation is virtual, it is a result of the universe expansion. For further discussion a full list of formulas and derivations can be found at [10].

Relativity and the mass point-state

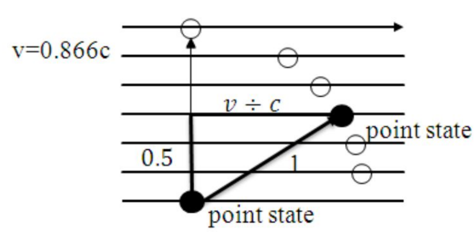
Our visible universe is the mass-gravity point-state universe. A virtual universe has no center and so it is by placing particles within it that I can create a map of their positions and motion relative to each other and thus construct my co-ordinate system. Let us initially define this universe as a constantly expanding in incremental steps (the clock-rate) 4-axis hyper-sphere with the 3-axis (x, y, z) hyper-sphere surface analogous to 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 by Planck time t_p and 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) 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.

I replaced electron wave-particle duality with 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 my universe undergoes an incremental expansion 0.12692×10^{23} times.

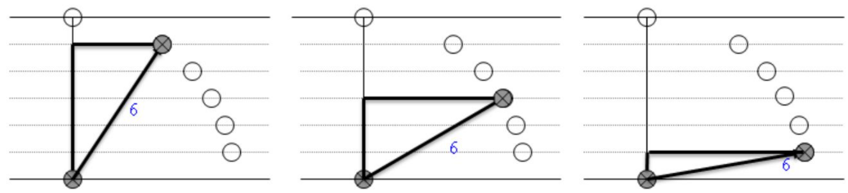
In the following diagrams the vertical w-axis is the timeline axis. The horizontal x-axis represents 1 axis of x-y-z space. A particle is depicted right with a frequency = 6; $5t_p$ in the wave-state and $1t_p$ in the point-state. As the universe expands it pulls the particle with it such that after 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 ($1m_P$) every 6th unit of time; thus particle mass = $m_P/6$.



I 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 this 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 mass and so the average mass of my particle has doubled = $\mathbf{m_P}/3$ instead of $\mathbf{m_P}/6$.

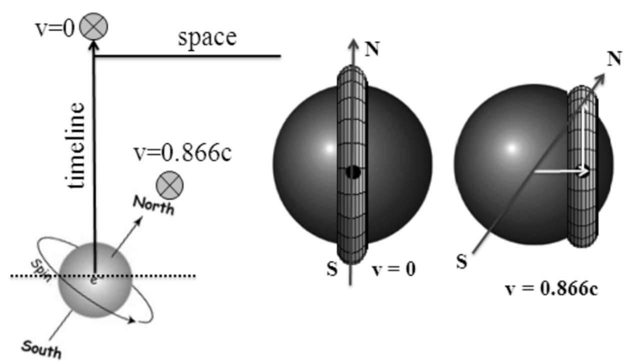


For a particle with a frequency of 6, there are 6 valid solutions (diagram below) where $(\text{w-axis})^2 + (\text{x-axis})^2 = (\text{diagonal})^2$, for the purpose of illustration we may assume a solution for v = 0. In the right diagram the velocity is almost at velocity **c** along the x-axis, along 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 m_P (as it goes from point to point to point along the w-axis without any intervening wave-state). Particle period (diagonal) is a construct of the 2 axis; w (timeline), x (space).



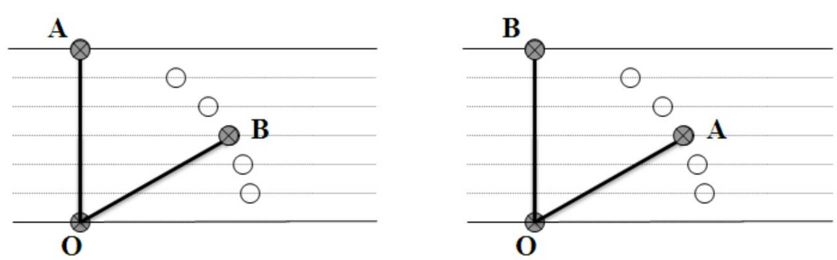
The w-axis is commonly measured as gamma; $1/\gamma = \sqrt{(1^2 - v^2/c^2)}$. For a particle that has only 6 divisions (6 steps from point to point), the maximum $\boldsymbol{\gamma} = 6$. A small particle such as an electron has more possible divisions and so a higher possible $\boldsymbol{\gamma}$ 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) … $\gamma_{electron} = m_P/m_e$, $\gamma_{proton} = m_P/m_p$

I use the expansion of the universe to replace independent motion in 3-D space. Our particle spins on its N-S axis, the radius of the black sphere as particle frequency, the torus as particle wavelength from $L = 2\pi^2\Omega^2$ [25];



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 is this angle of incline of that N-S axis that is the real measure of motion. 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. However to objects in 3-D space this virtual motion will appear as a physical motion.

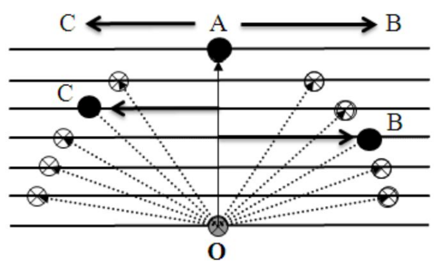
In this diagram particles **A** (v = 0) and **B** (v = 0.866c) begin at the origin **O** together (left diagram). After 1s, **B** will have travelled (0.866 * 299792458m) from **A** in 3-D space, but both diagonals are the same **O-A** = **O-B** = 6 and so **B** can equally claim (right diagram) that **B** (v = 0) and **A** (v = 0.866c). The confusion arises because my space-time axis are artificial, 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 space-time.



We could imagine that in the wave state the electron expands equally in all directions (that 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 a double slit experiment, our electron would leave 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.

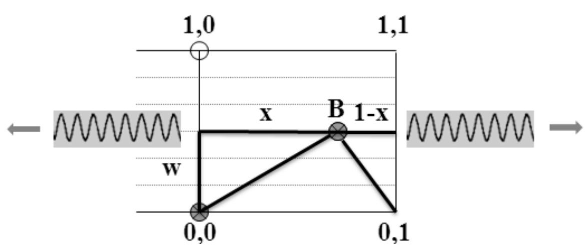
In the following diagram we have particles **C-A-B** with observer **A** in the center. Although **OA**, **OB**, **OC** are all the same radial length, the horizontal distance along the x-axis that separates **CA** and **AB** is what registers in 3-D space for observer **A**, for the w-axis is invisible to 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 (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 of the virtual universe) is not the same as the time dimension of physics.



In this context a 4-D space-time co-ordinate system would be like those satellite photos, a map of relative position and relative motion with the Lorentz transformation as a translation from space-time to this radial co-ordinate system. In the absence of particles the virtual universe would be dimensionless.

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

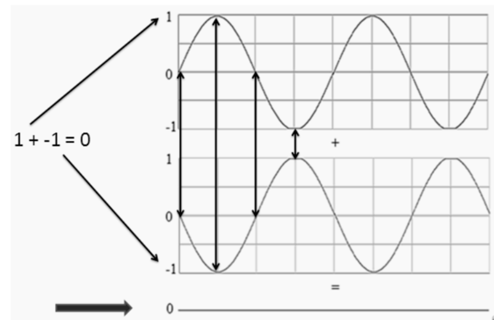
Stephen Hawking once queried on "that which breathes fire into these equations (of physics) and makes a universe for them to describe"[12] … that fire, and indeed all motion, in this model derives from the enlargement of the virtual universe.

Black-hole

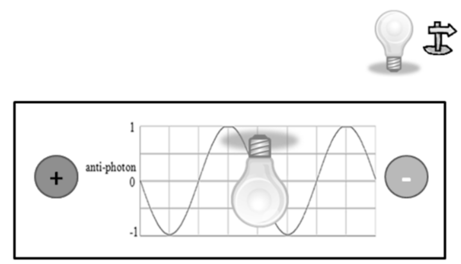
The virtual black-hole universe expands in Planck steps, enlarging by units of Planck mass, Planck (spherical) volume, Planck time incrementally… and if temperature drops by a simple sqrt progression, then we can calculate the parameters and compare with the cosmic microwave background [11][19].

	Black-hole	Cosmic microwave background
Age (billions of years)	14.624	13.8 [21]
Age (units of Planck time)	0.428 x 10^{61}	
Cold dark matter	0.21 x $10^{-26} kg.m^{-3}$ (eq.1)	0.247 x $10^{-26} kg.m^{-3}$ [23]
Radiation density	0.417 x $10^{-13} kg.m^{-3}$ (eq.9)	0.417 x $10^{-13} kg.m^{-3}$ [21]
Hubble constant	66.86 km/s/Mpc (eq.12)	67.6 km/s/Mpc [22]
CMB temperature	2.7272K (eq.6)	2.72548K [21]
CMB peak frequency	160.200GHz (eq.15)	160.23GHz [21]
Cosmological constant	1.0137 x 10^{123} (eq.19)	1 x 10^{122} [20]

Wave addition and the forces



Instead of 4 forces I can use physical links to provide the scaffolding for particles. The low energy rule: there is a natural tendency towards a lower energy state. Let us imagine a free proton and a free electron. Between them is virtual space. This virtual space divides into 2 waves of momentum, these waves are of inverse phase such that they sum to zero using the zero rule (if we have zero then we can create a **+x** and a **–x** as long as the virtual universe sums to zero; **x** + **-x** = **0**). We can define these 2 waves as a photon λ and an antiphoton $-\lambda$ ($\lambda + -\lambda$ = zero).



The photon leaves at the speed of light, the antiphoton remains trapped between the electron and proton thus forming an orbital. Having lost the photon, the total energy of that region now comprises $E_{electron+proton+antiphoton}$ which is less than $E_{electron+proton+zero}$ although total energy in the universe still sums to zero. Such low energy regions of space are called atoms. Likewise a molecule is a localised region of space which has a lower energy than its respective atoms.

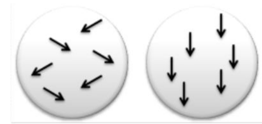
An incoming photon λ hits an atom, the electron jumps from an n1 orbital to an n2 orbital. That photon is actually 2 photons; $\{\lambda = \lambda_1 - \lambda_2\}$, the 1st photon λ_1 hits the n1 antiphoton $-\lambda_1$ orbital, as they are of opposite phase they cancel $\{\lambda_1 + -\lambda_1$ = zero$\}$ and the atom reverts back to a free proton and free electron; proton+electron+zero.

However we still have to subtract that 2nd photon λ_2 such that {zero – $\lambda_2 = -\lambda_2$} which is an antiphoton n2 orbital. After this 2-step process of wave addition, we now have a new atom, but this time filling the space between the electron and the proton is an n2 anti-photon orbital, which is bigger than a n1 anti-photon orbital. And so the atom is now larger, with the electron further from the proton, although neither the electron nor the proton was an active participant in this 'jump'. In fact we are not even sure if the electron moved at all… if the orbital provides a boundary for the electron then the electron simply found itself within the larger n2 orbital boundary. We see this in the Rydberg formula which is normal written as $\{\lambda = R(1/n_1^2 - 1/n_2^2)\}$ but for clarity we could write $\{\lambda = R/n_1^2 - R/n_2^2 = \lambda_1 - \lambda_2\}$ where $\{\lambda_1 = R/n_1^2\}$ and $\{\lambda_2 = R/n_2^2\}$. Thus I eliminate the requirement for both empty space within the atom and for an electric force, replacing them both with this physical orbital.

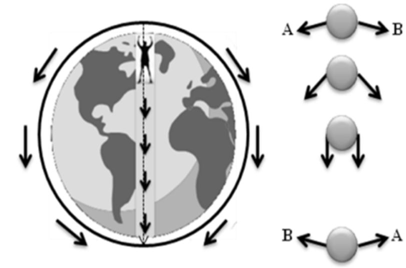
Gravitational orbitals are the mass point-state version of electric orbitals. I wish to put a (mass m = 1kg) satellite into a 35786km geoschronous orbit. The wavelength of an earth orbital at 6375km from the earth center; $2\pi 6375$ = 40500km = 7.485Hz. A geoschronous orbit = $2\pi(35786+6375)$ = 1.132Hz. The energy required to lift my satellite from earth to this orbit (mass earth M = 5.972×10^{24}kg) [18];

$$\lambda_{graviton} = 7.485\text{Hz} - 1.132\text{Hz} = 6.354\text{Hz}$$
$$E_{graviton} = h\lambda_{graviton} = .421 \times 10^{-32}\ \text{J}$$
$$N_{gravitons} = M/m_P \times m/m_P = .126 \times 10^{41}$$
$$E_{total} = E_{graviton} \times N_{gravitons} = .53 \times 10^{8}\ (\text{J/kg})$$

$N_{gravitons}$ (number of gravitons = gravitational orbitals) suggests that every particle in the satellite is linked to every particle in the earth. If we replace M and m (Mm/m_P^2) with m_e then we have the gravitational coupling constant a_G = (m_e^2/m_P^2) . $N_{gravitons}$ is simply a multi-particle version of a_G.



Rather than a gravitational force, we can use these orbitals (of momentum); they provide both the path and the momentum for the satellite (they pull the satellite with them). When all orbitals are unaligned the sum of the orbital direction vectors = 0 and the satellite is said to have gravitational potential energy and will seem to 'fall', when all the orbitals are aligned the satellite is said to have gravitational kinetic energy and it will 'orbit' in the direction of alignment at v = orbital velocity; GPE and GKE are measures of the degree of alignment.



In the diagram (right) I stand at the north pole over a hole in the earth and I am connected to 2 orbitals; A and B. In the beginning the 2 orbital vectors of A and B are opposing and sum to zero, and so I am motionless. As A and B circle the earth at orbital velocity they pull me with them, gradually they begin to align until they reach the equator where they are both now aligned pointing in the same direction, thus I will seem to accelerate until I reach the center where my velocity is maximum (orbital) velocity (velocity of A and B). After the equator A and B continue towards the south pole where their vectors once again oppose. As a result I will seem to decelerate until I reach the south pole where I stop momentarily before being pulled back into the hole for a return trip. In the earth satellite example there are $.126\times10^{41}$ orbitals. If they are all unaligned they will circumnavigate the earth in random directions, the net result is that satellite will travel down (towards the earth center). If they are all perfectly aligned in the same direction the satellite will be pulled following their circular path at orbital velocity; if they are partly aligned the satellite will follow an elliptical path. Thus the satellite path is a measure of orbital alignment, the degree of alignment of the orbitals. Orbitals can form the scaffolding around which atoms and planets can be suspended in a virtual environment.

To keep electrons and satellites from flying off into space I can use buoyancy. A submarine is 1000m below sea-level (the 1000m orbital). It may travel across the entire ocean at this depth (i.e.: motion within this orbital) via a propeller motion but to change its equilibrium = 1000m depth and return to the surface or go deeper (i.e.: to change to a different orbital), it must change its density (take on or expel water). Likewise gravitational momentum keeps my satellite following its orbital path but it is buoyancy which keeps it from flying off into space for the mass of the satellite depends on the orbital it inhabits. Escape velocity adds the required relativistic mass to the satellite such that its greater mass density then permits it to sink downwards into space [15][18].

Fine tuning cosmology

The fine-tuned Universe is the proposition that the conditions that allow life in the Universe can only occur when certain universal fundamental constants lie within a very narrow range, so that if any of several fundamental constants were only slightly different, the Universe would be unlikely to be conducive to the establishment and development of matter, astronomical structures, elemental diversity, or life as it is understood [13][14]. This model fixes the values of (G, h, e, c, m_e, k_B) in terms of the geometry of the mathematical constants alpha and Omega and so these dimensioned constants cannot vary independently. Omega is a presumed constant, there is a close natural number (sqrt) solution for Ω, noteworthy because P = Ω is also a sqrt solution.

$$\Omega = \sqrt{\left(\frac{\pi^e}{e^{(e-1)}}\right)} = 2.0071\ 349\ 5432...$$

In the article "Surprises in numerical expressions of physical constants", Amir et al write ... In science, as in life, `surprises' can be adequately appreciated only in the presence of a null model, what we expect a priori. In physics, theories sometimes express the values of dimensionless physical constants as combinations of mathematical constants like pi or e. The inverse problem also arises, whereby the measured value of a physical constant admits a `surprisingly' simple approximation in terms of well-known mathematical constants. Can we estimate the probability for this to be a mere coincidence? [24].

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