Programming gravitational orbitals (gravitons) using orbital momentum in Planck Universe Simulation Hypothesis

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The Simulation Hypothesis proposes that all of reality is an artificial simulation, analogous to a computer simulation. Even assuming massive computing resources are available, programming gravity between macro objects in a Planck level simulation (where all events occur at unit Planck time) can present challenges. Here is described a method whereby gravitational force between objects is replaced with units of orbital momentum that can be used to directly link the object particles together (as gravitational orbitals or gravitons). The orbital angular momentum of a planetary orbit becomes the sum of the planet-sun particle-particle orbital angular momentum and the rotational angular momentum of a planet the sum of its particle-particle rotational angular momentum. As orbits have different momentum densities, movement between orbits occurs via a change in momentum, an orbital (momentum) buoyancy. Extending this approach to the atom, instead of the electron orbiting a nucleus according to an electric force, the electron is confined within the orbital region by the geometry of the orbital momentum. Instead of an electron transition between orbitals, the existing orbital is exchanged for the new orbital by the momentum of the incoming photon, the electron then confined within a new orbital region. The Rydberg formula is suited for this.

1 Introduction

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.

Planck units are suitable for use in deep universe simulations as they are by definition discrete units, however simulations at the Planck level, even with the availability of massive computer resources, are difficult to implement as all events occur at unit Planck time.

A method for programming the Planck units for mass, length, time and charge from a virtual (dimensionless) electron has been proposed [2]. This approach uses frequencies (the frequency of occurrence of an event at unit Planck time) instead of probabilities (the probability of occurrence) and where macro events occur at the intersection of underlying sub-events. In this article we discuss a method by which gravity can be simulated by replacing a (continuous) gravitational force between objects with (digital) units of orbital momentum (gravitational orbitals or gravitons) that link all particles in the objects respectively at unit Planck time. The observed gravitational orbit is the sum of the underlying gravitational orbitals. This is predicated upon digital time where time is an incrementing variable measured in units of Planck time and not a continuous (analog) time. We can then simplify wave-particle duality at the Planck level to an oscillation between an electric wave-state to a (discrete) unit of Planck-mass (for 1 unit of Planck-time) point-state, and by assigning graviton links between all particles that are simultaneously in the point-state (for any chosen unit of Planck time), we can sum their respective orbital angular momentum.

The gravitational force can thereby be replaced by these Planck-mass to Planck-mass at Planck time graviton links. The moon for example will not orbit the earth, rather the moon will be pulled along an orbit path by the sum orbital angular momentum of the underlying gravitons; they are both the track and the locomotive. Gravitational potential and kinetic energy then become measures of the alignment of these gravitons.

In quantum mechanics an atomic orbital is a mathematical function that can be used to calculate the probability of finding any electron of an atom in any specific region around the atom's nucleus. In the atom we can also replace probability with frequency, using an analogous unit of momentum whereby the atomic orbital becomes the source of the electron orbital momentum and also confers the wave-function (region) within which the electron may be found (there is no 'empty space' in the atom). As particles are 'physically' linked by these orbitals an electric force is also not required. Gravitational orbitals become an extension of atomic orbitals.

Movement between orbitals becomes a function of orbital 'buoyancy', while the momentum of the orbital keeps electrons and satellites following their orbits, it is this momentum 'buoyancy' which keeps the satellite from 'floating' off into space or 'falling' to the earth and which keeps the electron within a particular energy level.

To change orbits, atomic or gravitational, will require a change of orbital(s), i.e: a change in total orbit momentum.

2 Gravitational orbitals

2.1. The gravitational coupling constant α_G characterizes the gravitational attraction between a given pair of elementary particles in terms of the electron mass to Planck mass ratio;

$$\alpha_G = \frac{Gm_e^2}{\hbar c} = \frac{m_e^2}{m_P^2} = 1.75...x10^{-45} \tag{1}$$

If we replace wave-particle duality with an electric wave-state to Planck-mass (for 1 unit of Planck-time) point-state oscillation then at any unit of Planck time t a certain number of particles will simultaneously be in the Planck mass point-state. For example a 1kg satellite orbits the earth, for any t, satellite (A) will have $1kg/m_P = 45.9\ x10^6$ particles in the point-state. The earth (B) will have $5.97\ x10^{24}kg/m_P = 0.274\ x10^{33}$ particles in the point-state. If we assign a graviton to link each respective point-state then for any given unit of Planck time the number of gravitons;

$$N_{gravitons} = \frac{m_A m_B}{m_P^2} = 0.126\ x10^{41} \tag{2}$$

The observed satellite orbit around the earth derives from the sum of these $0.126\ x10^{41}$ gravitons. If A and B are respectively Planck mass particles then $N_{gravitons} = 1$. If A and B are respectively electrons then

$$N_{gravitons} = \alpha_G = \frac{m_e^2}{m_P^2} = 1.75...x10^{-45} \tag{3}$$

The frequency of an electron oscillation cycle = $(m_P/m_e)t_p$ and so the probability that any 2 electrons are simultaneously in the mass point-state for any chosen $t = (m_P/m_e)^2 = 1/\alpha_G$. $N_{gravitons}$ is simply the sum of all the respective particle α_G's between both objects at any t, as a consequence for objects whose mass is less than Planck mass there will be units of time t when there are no graviton links and wave-state interactions will predominate. Gravity becomes the sum of discrete interactions between units of Planck mass.

2.2. Although the atom has a complex geometry, gravitational orbits are an average of all the underlying gravitational orbitals (gravitons) and so more closely approximate a classical geometry, it is therefore not necessary to know the individual graviton (orbital) structure. Consequently we can adapt the Bohr model to gravitational orbits albeit n, being an average of all the individual graviton n's, is not an integer.

We have 2 homogeneous objects A and B, with B orbiting A ($m_A >> m_B$). The point-states, if scattered evenly throughout A (even mass distribution) may be treated as a point mass concentrated in the center and so the Schwarzschild radius $\lambda_A = (m_A/m_P)2l_p$ can be used where m_A/m_P = average number of Planck mass point-states in A per unit of Planck time, the fine structure constant $\alpha = 137.03599....$

$$r_g = \alpha n^2 \lambda_g \tag{4}$$

$$v_g = \frac{c}{\sqrt{2\alpha}n} \tag{5}$$

$$a_g = \frac{c^2 \lambda_g}{2r_g^2} = \frac{c^2}{2\alpha^2 n^4 \lambda_g} \tag{6}$$

$$T_g = \frac{r_g}{v_g} = \sqrt{2\alpha}(\frac{2\pi\alpha n^3 \lambda_g}{c}) \tag{7}$$

2.2.1. Example - Earth radius = 6371km

$\mu_{earth} = 3.986004418(9)x10^{14}$ (std grav. parameter)
$\lambda_{earth} = 2\mu_{earth}/c^2 = .00887$m
$r_g = 6371.0\ km$ (n = 2289.408...)
$a_g = 9.820\ m/s^2$
$T_g = 5060.837\ s$
$v_g = 7909.792\ m/s$

Geosynchronous orbit radius = 42164km
$r_g = 42164.0\ km$ (n = 5889.66...)
$a_g = 0.2242\ m/s^2$
$T_g = 86163.6\ s$
$v_g = 3074.666\ m/s$

2.2.2. The energy that was required to lift that 1kg satellite into geosynchronous orbit is the difference between the energy of each of the 2 orbits (geosynchronous and earth).

$$R_{(gravity\ orbital)} = \frac{1}{2\pi r_g}(\frac{1}{n_1^2} - \frac{1}{n_2^2}) \tag{8}$$

$$f = R_{(gravity\ orbital)}c \tag{9}$$

Earth surface $n = 2290$ (6371km)
Geosynchronous orbit $n = 5890$ (42169km)

$$f_{graviton} = n_{2290}\ orbit - n_{5890}\ orbit = 7.485 - 1.132 = 6.354Hz$$

$$E_{graviton} = 0.412x10^{-32}J$$

$$N_{gravitons} = Mm/m_P^2 = 0.126x10^{41}$$

$$E_{total} = E_{graviton}\ .\ N_{gravitons} = 53MJ/kg$$

2.2.3 Angular momentum
2.2.3.1 Orbital angular momentum L_{oam}

$$L_{oam} = 2\pi\frac{Mr^2}{T} = N_{gravitons}\ n\frac{h}{2\pi}\sqrt{2\alpha},\ \frac{kgm^2}{s} \tag{10}$$

$$N_{gravitons} = (\frac{M_{planet}M_{sun}}{m_P^2}) \tag{11}$$

Angular momentum of a point-point orbital ($N_{gravitons} = 1$);

$$L_{oam} = (\frac{m_P^2}{m_P^2})\ n\frac{h}{2\pi}\sqrt{2\alpha} = n\frac{h}{2\pi}\sqrt{2\alpha} \tag{12}$$

Orbital angular momentum L_{oam} of the planets;
mercury = .9153 x10^{39} (n = 378.2733)
venus = .1844 x10^{41} (n = 517.0853)
earth = .2662 x10^{41} (n = 607.9927)
mars = .3530 x10^{40} (n = 750.4850)
jupiter = .1929 x10^{44} (n = 1387.0157)
pluto = .365 x10^{39} (n = 3820.2628)

2.2.3.2 Rotational angular momentum L_{ram}

The planetary orbital period derives from the sum orbital angular momentum of the gravitons and so can be calculated from $N_{gravitons}$ and n, furthermore a change in orbital momentum (such as a collision with an asteroid) should theoretically result in an orbital period adjustment, planet rotation however is less flexible as external momentum is absorbed. The following gives the rotational angular momentum for an even mass distribution with no extraneous factors.

$$T_{rot} = \frac{2\pi r_g}{v_{rot}} = 2\pi\alpha n^2\lambda_g\frac{2\alpha n}{c} = \frac{4\pi\alpha^2 n^3\lambda_g}{c} \tag{13}$$

$$L_{ram} = \frac{2}{5}\frac{2\pi M r^2}{T} = (\frac{2}{5})N_{orbitals}\ n\frac{h}{2\pi},\ \frac{kgm^2}{s} \tag{14}$$

Using n_{earth} = 2290, if the earth were an idealized sphere whose rotation depended solely on rotational angular momentum then 1 day would equal 83848s (86400s) and Mars 99208s (88643s);

$$T_{rot} = \frac{4\pi\alpha^2 n_{earth}^3\lambda_{earth}}{c} = 83847.7s \tag{15}$$

$$L_{ram} = (\frac{2}{5})(\frac{M_{earth}}{m_P})^2 n_{earth}\frac{h}{2\pi} = .7275\ 10^{34} \tag{16}$$

2.3. Time dilation.

2.3.1. Velocity: In the article 'Programming Relativity in a Planck unit Universe', a model of a virtual hyper-sphere universe expanding in Planck steps was proposed [3]. In that model objects are pulled along by the expansion of the hyper-sphere irrespective of any motion in 3-D space. As such, while B (satellite) has a circular orbit in 3-D space co-ordinates it has a cylindrical orbit around the A (planet) time-line axis in the hyper-sphere co-ordinates with orbital period $T_g c$ (from B^1 to B^2) at radius r_g and orbital velocity v_g. If A is moving with the universe expansion (albeit stationary in 3-D space) then the orbital time t_g alongside the A time-line axis (fig. 1) becomes;

$$t_g = \sqrt{(T_g c)^2 - (2\pi r_g)^2} = (T_g c)\sqrt{1 - \frac{v_g^2}{c^2}} \tag{17}$$

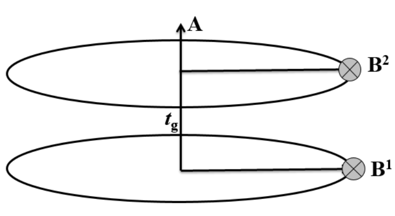

Fig. 1: orbit relative to A timeline axis

2.3.2. Gravitational:

$$v_s = v_{escape} = \sqrt{2}.v_g \tag{18}$$

$$\sqrt{1 - \frac{2GM}{r_g c^2}} = \sqrt{1 - \frac{v_s^2}{c^2}} \tag{19}$$

2.4. Binding energy in the nucleus can be simplified using the same approach.

$$m_{nuc} = m_p + m_n \tag{20}$$

$$\lambda_s = \frac{l_p m_P}{m_{nuc}} \tag{21}$$

$$r_0 = \sqrt{\alpha}\lambda_s \tag{22}$$

$$R_s = \alpha\lambda_s \tag{23}$$

$$v_s^2 = \frac{c^2}{\alpha} \tag{24}$$

The gravitational binding energy (μ) is the energy required to pull apart an object consisting of loose material and held together only by gravity.

$$\mu_G = \frac{3Gm_{nuc}^2}{5R_s} = \frac{3m_{nuc}c^2}{5\alpha} = \frac{3m_{nuc}v_s^2}{5} \tag{25}$$

Nuclear binding energy is the energy required to split a nucleus of an atom into its component parts. The electrostatic coulomb constant;

$$a_c = \frac{3e^2}{20\pi\epsilon r_0} \tag{26}$$

$$E = \sqrt{(\alpha)}a_c = \frac{3m_{nuc}c^2}{5\alpha} = \frac{3m_{nuc}v_s^2}{5} = \mu_G \tag{27}$$

Average binding energy in nucleus = μ_G = 8.22MeV/nucleon.

2.5. Anomalous precession

semi-minor axis: $b = \alpha l^2\lambda_{sun}$

semi-major axis: $a = \alpha n^2\lambda_{sun}$

radius of curvature L

$$L = \frac{b^2}{a} = \frac{\alpha l^4\lambda_{sun}}{n^2} \tag{28}$$

$$\frac{3\lambda_{sun}}{2L} = \frac{3n^2}{2\alpha l^4} \tag{29}$$

$$precession = \frac{3n^2}{2\alpha l^4}.1296000.(100T_{earth}/T_{planet}) \tag{30}$$

Table 1	GR [6]	Observed
Mercury = 42.9814	42.9195	43.1 ± 0.5
Venus = 8.6248	8.6186	8.4 ± 4.8
Earth = 3.8388	3.8345	5.0 ± 1.2
Mars = 1.3510	1.3502	
Jupiter = 0.0623	0.0623	

2.6. F_p = Planck force, λ = Schwarzschild radius;

$$F_p = \frac{m_P c^2}{l_p}$$

$$M_a = \frac{m_P \lambda_a}{2l_p},\ m_b = \frac{m_P \lambda_b}{2l_p} \tag{31}$$

$$F_g = \frac{M_a m_b G}{R^2} = \frac{\lambda_a \lambda_b F_p}{4R_g^2} = \frac{\lambda_a \lambda_b F_p}{4\alpha^2 n^4 (\lambda_a + \lambda_b)^2} \tag{32}$$

a) If $M_a = m_b$, the object mass is not required

$$F_g = \frac{F_p}{(4\alpha n^2)^2} \tag{33}$$

b) If $M_a >> m_b$, $(\lambda_a + \lambda_b = \lambda_a)$, then relative mass is used and $F_g = m_b a_g$

$$F_g = \frac{\lambda_b F_p}{(2\alpha n^2)^2 \lambda_a} \tag{34}$$

$$F_g = \frac{m_b c^2}{2\alpha^2 n^4 \lambda_a} = m_b a_g \tag{35}$$

2.7 The hole in the Earth (a thought experiment [1]). An apple on a tree-top is in the 6371.005km orbit. To dissociate that apple we have to add sufficient momentum to cancel the (gravitational) momentum of the 6371.005 orbit. This can be achieved when the apple reaches escape velocity v_s.

If our apple drops from the tree-top orbit and lands on the ground it will transfer momentum to the earth and subsequently change to the lower earth-surface = 6371km orbit.

However if there is a hole through the center of the earth then the apple will fall through it to the other side of the earth, then fall back into the hole returning to the tree-top 84mins later. Having no means to transfer momentum it will remain throughout its journey in the 6371.005 tree-top orbit, oscillating back and forth through that hole ad infinitum. The orbital (gravitational) angular momentum is conserved. The apple can only change orbits by changing its total orbit momentum.

3 Atomic orbits

3.1. Atomic electron transition is defined as a change of an electron from one energy level to another but the method and so time-line of the transition is not clear, yet we need to define the state of the electron during this transition period. One method to resolve this is by applying the above momentum orbital approach to the atom as the Rydberg formula is suited for this. In the following we have a transition between an initial i and a final f orbit in a Hydrogen atom, the incoming photon λ_R causes the electron to 'jump' from the $n = i$ to $n = f$ orbit.

$$\frac{1}{\lambda_R} = R.(\frac{1}{n_i^2} - \frac{1}{n_f^2}) = \frac{R}{n_i^2} - \frac{R}{n_f^2} \tag{36}$$

The above could be interpreted as referring to 2 photons;

$$\lambda_R = (+\lambda_i) - (+\lambda_f)$$

Let us suppose a region between a free proton p^+ and a free electron e^- which we may define as zero. This region then divides into 2 waves of momentum of inverse phase (i.e,: we are using virtual photons) which we may designate as photon $(+\lambda)$ and anti-photon $(-\lambda)$ whereby;

$$(+\lambda) + (-\lambda) = zero$$

The photon $(+\lambda)$ leaves (at the speed of light), the anti-photon $(-\lambda)$ however is trapped between the electron and proton and forms a standing wave orbital. Due to the loss of the photon, the energy of $(p^+ + e^- + -\lambda) < (p^+ + e^- + 0)$ and so is stable.

Let us define an $(n = i)$ orbital as $(-\lambda_i)$. The incoming Rydberg photon $\lambda_R = (+\lambda_i) - (+\lambda_f)$ arrives in a 2-step process. First the $(+\lambda_i)$ adds to the existing $(-\lambda_i)$ orbital.

$$(-\lambda_i) + (+\lambda_i) = zero$$

The $(-\lambda_i)$ orbital is canceled and we revert to the free electron and free proton; $p^+ + e^- + 0$ (ionization). However we still have the remaining $-(+\lambda_f)$ from the Rydberg formula.

$$0 - (+\lambda_f) = (-\lambda_f)$$

From this wave addition followed by subtraction we have replaced the $n = i$ orbital with an $n = f$ orbital. The electron was not involved in this process (it has not moved, there was no transition from an n_i to an n_f orbital), however the electron region (boundary) is now determined by the new $n = f$ orbital $(-\lambda_f)$.

3.2. As gravitational orbits are a statistical sum of the underlying orbitals, it is not necessary to know precisely the geometry of the individual orbitals and so a gravitational Bohr model can be used. In the atom however we must deal with individual orbitals in the wave-state and these geometries are at present unknown, furthermore we must again translate from probabilities to frequencies. The following approach can be applied to simple atoms, it presumes that the geometry of the particles can be used to influence the atomic spectra; the frequency (wavelength) of the orbital as a function of the underlying particles themselves, and subsequent rotation as a result of an *incompressibility of momentum*. Thereby spectra could naturally emerge from geometrical imperatives. The actual rotation itself, as with gravitational orbits, derives from the expansion of the universe in Planck steps [3].

For example, we take A and B, where A is a sphere of points with radius r, B is a single point and $L = r\omega$ = distance from the center of sphere A to point B. We then measure the average distance S between B and each point in A and find this relationship;

$$S = L(1 + V),\ V = \frac{3}{10\omega^2} \tag{37}$$

If S is a measure of the momentum between A and B, and if $S > L$, and if momentum cannot be compressed then B may be forced to rotate (orbit) around A to compensate.

L is the orbital, S a function of proton and electron wavelength and the V term suggesting a spatial geometry (and so used instead of the 1-D reduced mass formula).

$$L = S(\sqrt{1-2V}) \tag{38}$$

$$R_{atomic\ orbital} = \frac{1}{(2\alpha^2)2\pi L}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \tag{39}$$

The following are best-fit geometries;
Positronium: $f_P(1s-2s) = 1233607\ 216.4$ MHz [4]

$$S_P = 2(\lambda_e + \frac{\lambda_p}{8}) \tag{40}$$

$$L_P = S_P.\sqrt{(1 - \frac{48}{25\alpha^3})} \tag{41}$$

$$\frac{c}{2\alpha^2 2\pi L_P}.(\frac{1}{1^2} - \frac{1}{2^2}) = 1233607\ 214.9\ MHz \tag{42}$$

Hydrogen:
$f_H(1s-2s) = 2466061\ 413\ 187.035$ kHz [5]

$$S_H = (\lambda_e + \lambda_p) \tag{43}$$

$$L_H = S_H.\sqrt{(1 - \frac{48}{\alpha^3})} \tag{44}$$

$$\frac{c}{2\alpha^2 2\pi L_H}.(1 - \frac{1}{4}) = 2466061\ 422\ 987\ kHz \tag{45}$$

$$\frac{L_P}{L_H}.\frac{2f_P(1s-2s)}{f_H(1s-2s)} = 1.000\ 000\ 005 \tag{46}$$

$f_H(1s-3s) = 97492.221701$ [7]

$$2V = \frac{54.75}{\alpha^3} = 97492.222\ 354$$

$f_H(1s-4s) = 102823.8530211$

$$2V = \frac{56}{\alpha^3} = 102823.853\ 2377$$

$f_H(1s-\infty) = 109678.77174307$

$$2V = \frac{55.75}{\alpha^3} = 109678.771\ 45923$$

Ionization energy positronium:

$$P = 13.59844\ (\frac{L_H}{2L_P}) = 6.8024eV \tag{47}$$

Note: in calculating the above, the wavelengths of the electron and proton are known precisely to only about 9 digits. In the following we use the mass of the nucleus λ_{nuc}.

$$L = (\lambda_e + \lambda_{nuc}).\sqrt{(1 - \frac{56}{\alpha^3})} \tag{48}$$

Deutrium (m_{nuc} = 3.343583719e-27 kg):
f_D = 13.6021343eV, L_H/L_D = 1.00027365
Tritium (m_{nuc} = 5.00818575e-27 kg):
f_T = 13.6033658eV, L_H/L_T = 1.000364
Helium 1st IE = 24.587375eV (24.587387eV)

$$L_{He} = (\frac{5\lambda_e}{9} - (2\lambda_p + 2\lambda_n)).\sqrt{(1 - \frac{6}{5\alpha^2})} \tag{49}$$

4 Sqrt of momentum

The above describes a simple nucleus and an orbiting electron, the premise being that the spectrum is strongly influenced by the respective geometries of the electron, proton and neutron. The gravitational orbital (graviton) is a mass-mass link, the atomic orbital an electric-electric link, consequently atomic (electric) and gravitational (mass) angular momentums must be distinguishable. In an article 'Programming Planck units from a virtual electron' [2], the sqrt of Planck momentum (denoted Q) was used as an independent constant (where Planck momentum = $2\pi Q^2$, $units = kgm/s = q^2$) linking the mass domain with the charge domain. This Q appears in mass constants as Q^2 and in charge constants as Q^3 and Q^5 and in the electron as Q^{15}. As a sqrt, Q can have a plus or a minus solution $\pm Q$, however as the mass constants use only Q^2, they are always plus (with integer units q^2 = kg.m/s). If the particle units are non-integer then their geometries and so the orbitals will reflect this.

$$Q = 1.019\ 113\ 411...,\ unit = q \tag{50}$$

$$m_P = \frac{2\pi Q^2}{c},\ unit = kg \tag{51}$$

$$e = \frac{8c^3}{\alpha Q^3}.\frac{2l_p}{c} = \frac{16 l_p c^2}{\alpha Q^3},\ units = A.s = \frac{q^3 s}{kg^3} \tag{52}$$

5 Summary

I have argued that it could be feasible to simulate gravitational effects between macro objects in a Planck level simulation using 'physical' units of momentum in lieu of analog forces, predicate upon a digital time and a particle electric-to-mass oscillation, both of which are well suited to programmed applications.

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