Method for programming gravitons as units of orbital momentum $\hbar c$ for mathematical-universe simulation-hypothesis models

Malcolm Macleod

E-mail: maclem@platoscode.com

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 continuous gravitational force between objects is replaced with discrete units of orbital momentum (defined as gravitational orbitals or gravitons) that directly link the individual object particles together. The orbital angular momentum of the planetary orbits derives from the sum of the planet-sun particle-particle orbital angular momentum irrespective of the angular momentum of the sun itself and the rotational angular momentum of a planet approximated by the sum of its particle-particle rotational angular momentum. Particles oscillate between a wave-state to a Planck-time Planck-mass point-state (a Planck black-hole), gravitational interactions as interactions between the Planck black holes. Each graviton is a single unit of $\hbar c$ albeit with a variable length and velocity component. As orbits have different momentum densities, movement between orbits occurs via a change in the graviton length:velocity ratio, an orbital buoyancy, such that moving the earth to a different galaxy will result in a change to this length:velocity ratio, the number of graviton units of $\hbar c$ however remaining the same. As the simulation uses digital time, all particle point-states will share a common time frame as measured in units of Planck time.

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 Planck unit model simulations, even with the availability of massive computer resources, are difficult to implement as all events occur at unit Planck time.

A method for programming Planck units for mass, length, time and charge from a virtual (dimensionless) electron has been proposed [1]. This approach uses frequencies (the frequency of occurrence of an event at unit Planck time) instead of probabilities. In this article we discuss a method by which gravity can likewise be simulated by replacing a (continuous) gravitational force between objects with discrete units of $\hbar c$ (defined here as gravitational orbitals or gravitons) that link all particles in the objects respectively at (digital) unit Planck time.

Simplifying 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 (a Planck black-hole), 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 to construct the observed gravitational orbit.

Although each graviton is a single discrete unit of $\hbar c$, its relative length and velocity components adjust for distance. As orbits have different momentum densities, movement between orbits occurs via a change in the graviton length:velocity ratio, an orbital buoyancy.

While the momentum of the orbital keeps satellites following their orbits, it is the length:velocity ratio that keeps the satellite from 'floating' off into space or 'falling' to the earth.

2 Gravitons

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;

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

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 = $(m_P/m_e)t_p$ 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. Gravitational interactions becomes the sum of discrete interactions between units of Planck mass.

2.2. Although atomic orbitals have an unknown 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 [5])
$\lambda_{earth} = 2\mu_{earth}/c^2 = .00887$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 a geosynchronous orbit is the difference between the energy of each of the 2 orbits (geosynchronous and earth).

$$E_{graviton} = \frac{hc}{2\pi r_{6371}} - \frac{hc}{2\pi r_{42164}} \tag{8}$$

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

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

2.2.3 Angular momentum
2.2.3.1 Orbital angular momentum L_{oam}

$$L_{oam} = 2\pi\frac{Mr^2}{T} = N_{gravitons}\ n\frac{h}{2\pi}\sqrt{2\alpha},\ \frac{kgm^2}{s} \tag{9}$$

$$N_{gravitons} = (\frac{M_{planet}M_{sun}}{m_P^2}) \tag{10}$$

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)

Mean orbital velocity v_g
mercury = 47.87km/s (47.87km/s [4])
venus = 35.02km/s (35.02km/s [4])
earth = 29.78km/s (29.78km/s [4])
mars = 24.13km/s (24.13km/s [4])
jupiter = 13.06km/s (13.07km/s [4])
pluto = 4.74km/s (4.72km/s [4])

The angular momentum term L_{oam} depends on n leading to the dilemma whereby infinite distance results in infinite angular momentum. The orbital velocity v_g decreases proportionately suggesting the graviton combines angular momentum with velocity. From;

$$L_{oam}v_g = (m_P v_g r_g)(v_g)$$

$$L_{oam}v_g = (m_P\frac{c}{\sqrt{2\alpha n}}\alpha n^2 2l_p)(\frac{c}{\sqrt{2\alpha n}})\frac{1}{2\pi} = \frac{hc}{2\pi} \tag{11}$$

2.2.3.2 Rotational angular momentum L_{ram}

The rotational angular momentum contribution to planet rotation.

$$T_{rot} = \frac{2\pi 2\alpha^2 n^3 \lambda}{c} \tag{12}$$

$$v_{rot} = \frac{c}{2\alpha n} \tag{13}$$

$$r_{orbital} = \alpha n^2 \lambda \tag{14}$$

$$L_{ram} = (\frac{2}{5})\frac{2\pi M r^2}{T} = (\frac{2}{5}) N_{orbitals}\ n\frac{h}{2\pi},\ \frac{kgm^2}{s} \tag{15}$$

$$(m_P \frac{c}{2\alpha n}\alpha n^2 2 l_p)(\frac{c}{2\alpha n})\frac{1}{2\pi} = \frac{hc}{2\pi 2\alpha} \tag{16}$$

Rydberg formula

$$E = \frac{hc}{2\pi 2\alpha}\frac{1}{\alpha \lambda_{orbital}}(\frac{1}{n_i^2} - \frac{1}{n_f^2}) \tag{17}$$

$n_{earth} = 2289.4$ (r = 6371km)
$T_{rot} = 83847.7s$ (86400)
$v_{rot} = 477.8m/s$ (463.3)
$L_{ram} = .727\ x10^{34}\ \frac{kgm^2}{s}$ (.705)
$n_{mars} = 5094.7$ (r = 3390km)
$T_{rot} = 99208s$ (88643)
$v_{rot} = 214.7m/s$ (240.29)
$L_{ram} = .187\ x10^{33}\ \frac{kgm^2}{s}$ (.209)

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 [2]. In that model the universe hyper-sphere expands in all directions evenly, 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;

$$t_g = \sqrt{(T_g c)^2 - (2\pi r_g)^2} = (T_g c)\sqrt{1 - \frac{v_g^2}{c^2}} \tag{18}$$

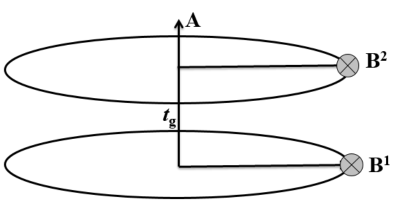

Fig. 1: orbit relative to A timeline axis

2.3.2. Gravitational:

$$v_s = v_{escape} = \sqrt{2}.v_g \tag{19}$$

$$\sqrt{1 - \frac{2GM}{r_g c^2}} = \sqrt{1 - \frac{v_s^2}{c^2}} \tag{20}$$

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

$$m_{nuc} = m_p + m_n \tag{21}$$

$$\lambda_s = \frac{l_p m_P}{m_{nuc}} \tag{22}$$

$$r_0 = \sqrt{\alpha}\lambda_s \tag{23}$$

$$R_s = \alpha \lambda_s \tag{24}$$

$$v_s^2 = \frac{c^2}{\alpha} \tag{25}$$

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

$$\mu_G = \frac{3Gm_{nuc}^2}{5R_s} = \frac{3m_{nuc}c^2}{5\alpha} = \frac{3m_{nuc}v_s^2}{5} \tag{26}$$

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

$$a_c = \frac{3e^2}{20\pi\epsilon r_0} \tag{27}$$

$$E = \sqrt{(\alpha)}a_c = \frac{3m_{nuc}c^2}{5\alpha} = \frac{3m_{nuc}v_s^2}{5} = \mu_G \tag{28}$$

Average binding energy in nucleus;
$\mu_G = 8.22$MeV/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

$$L = \frac{b^2}{a} = \frac{al^4\lambda_{sun}}{n^2} \tag{29}$$

$$\frac{3\lambda_{sun}}{2L} = \frac{3n^2}{2\alpha l^4} \tag{30}$$

$$precession = \frac{3n^2}{2\alpha l^4}.1296000.(100T_{earth}/T_{planet}) \tag{31}$$

Table 1	GR [3]	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;

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

$$M_a = \frac{m_P \lambda_a}{2l_p},\ m_b = \frac{m_P \lambda_b}{2l_p} \tag{32}$$

$$F_g = \frac{M_a m_b G}{R^2} = \frac{\lambda_a \lambda_b F_p}{4R_g^2} = \frac{\lambda_a \lambda_b F_p}{4\alpha^2 n^4 (\lambda_a + \lambda_b)^2} \tag{33}$$

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

$$F_g = \frac{F_p}{(4\alpha n^2)^2} \tag{34}$$

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

$$F_g = \frac{\lambda_b F_p}{(2\alpha n^2)^2 \lambda_a} \tag{35}$$

$$F_g = \frac{m_b c^2}{2\alpha^2 n^4 \lambda_a} = m_b a_g \tag{36}$$

3 Rydberg formula

The Rydberg formula suggests a mechanism by which transition between orbits may occur. Atomic electron transition is defined as a change of an electron from one energy level to another within an atom, theoretically this should be a discontinuous electron 'jump' from one energy level to another although the mechanism for this is not clear. The following uses the wavelengths of the orbitals.

Let us consider the Hydrogen Rydberg formula for transition between and initial i and a final f orbit. The incoming photon λ_R causes the electron to 'jump' from the $n = i$ to $n = f$ orbit.

$$\lambda_R = R.(\frac{1}{n_i^2} - \frac{1}{n_f^2}) = \frac{R}{n_i^2} - \frac{R}{n_f^2} \tag{37}$$

The above can be interpreted as referring to 2 photons;

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

Let us suppose a region of space between a free proton p^+ and a free electron e^- which we may define as zero. This region then divides into 2 waves of inverse phase 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 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 has not moved (there was no transition from an n_i to n_f orbital), however the electron region (boundary) is now determined by the new $n = f$ orbital $(-\lambda_f)$.

References

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