Model of nuclear, atomic, molecular, gravitational anti-photon orbitals

Malcolm Macleod

E-mail: maclem@planckmomentum.com

In this essay I describe an orbital model that replaces the 4 fundamental forces with physical links of momentum that resemble photons albeit of inverse phase such that notional orbit is replaced physical orbital. In this context an electron does not orbit around a nucleus but rather is pulled along an orbital path by this orbital momentum, there is no empty space within the atom or nucleus, likewise a gravitational orbit is the sum of individual gravitational orbitals, the moon is not orbiting the earth, instead it is propelled by these orbital momenta, its path the vector sum of this momentum. As orbitals have different momentum densities, movement between orbitals requires a change in momentum, an orbital buoyancy. As such, although gravitational momentum propels a satellite along that orbital path, it is this buoyancy which prevents the satellite from changing orbitals much as a submarine cannot change depth with changing ballast. Nuclear binding energy, ionization energy and escape velocity are measures of the momentum required to delete the orbital links, in this model this is analogous to the strong force.

1 Introduction

This is an outline of an orbital model where, instead of the 4 forces linking particles, there are orbitals, physical units of momentum. These orbitals could be described as anti-photons, being photons albeit of inverse phase such that photon + anti-photon = zero (in the sense as when waves of inverse phase are added they cancel each other).

At the atomic level they may be described by atomic and molecular orbital theories, although they are actual waves of momentum.

In this model there is no empty space within the atom and the electron is linked to the nucleus, not by an electrostatic force, but by a physical standing wave orbital (a unit of momentum).

What we typically consider as a gravitational orbit around the earth then becomes the sum of many individual gravitational orbitals, standing waves around the earth.

In this model, the moon does not orbit the earth, rather the moon is pulled along its orbit path by the momentum of these gravitational orbitals; they are both the track and the locomotive. As these orbitals curve around the earth, the motion of the moon derives from the sum of their vectors. Consequently, if they are unaligned, the moon will fall to the earth with a constant acceleration. If they are all perfectly aligned, the moon orbit will be circular at orbital velocity.

We may then define gravitational potential energy GPE as the state when the orbitals are completely unaligned and thus all vector motion sums to zero, and gravitational kinetic energy GKE as when the orbitals are completely aligned in 1 direction. The actual gravitational orbit then becomes a reflection of the degree of this alignment.

This however leads to the curious observation that, as these orbitals are standing waves, the frequency and so energy of a single gravitational orbital around the moon is higher than that of a corresponding gravitational orbital around the larger earth, ie: the smaller the object, the shorter the wavelength (circumference), and so the lower the frequency; E=hv.

Movement between orbitals becomes a function of orbital 'buoyancy', for example, a submarine may travel across the ocean at a fixed depth (i.e. 100m) via propeller motion (a motion within the 100m orbit), but to change from this equilibrium depth in order to rise to the surface or sink further, it must change its mass density (add or eject ballast). And so, while gravitational momentum keeps the satellite following its orbit, it is this momentum ballast 'buoyancy' which keeps the satellite from floating off into space or falling to the earth.

In a region of 'empty' space there is a free electron and a free proton. This region collapses into a photon+antiphoton. The photon escapes at the speed of light, the antiphoton is trapped between the electron and proton and forms an orbital, a physical link. This region of space now incorporates 2 particles and an antiphoton orbital, it is an atom. As the photon has left (at the speed of light), the atom is that same region of space albeit now with less energy than before (via the loss of the photon) and so is 'stable'.

When an incoming photon strikes an electron in an atom it does not cause the electron to jump between orbitals, rather the original orbital (i.e.: n=1 anti-photon) is deleted (n=1 photon + n=1 anti-photon cancel) and then replaced with the new orbital (i.e.: n=2 anti-photon) via a simple wave addition and subtraction (see Rydberg formula). The electron itself doesn't move within the atom to different orbitals, rather its orbital boundary changes. In the above example the n=1 orbital boundary is replaced by an n=2 orbital boundary.

Photons are a means of information exchange.

2 Bohr model:

The Niels Bohr model depicts the atom as a small positively charged nucleus surrounded by electrons that travel in circular orbits around the nucleus—similar in structure to the solar system, but with electrostatic forces providing attraction, rather than gravity.

Although considered incorrect by physicists; it does give correct results for selected systems. It was later replaced with a more useful wave model (depicting the electron and proton as waves). Nevertheless, for certain simple orbits, the Bohr model was extremely accurate and still no one knows why.

The basic Bohr model depicted these orbits as fixed, only certain orbits were allowed ('particle in a box'). In its most elementary form, it incorporates 4 values: the speed of light c, the Sommerfeld fine structure constant alpha $\alpha \sim 137.036$, the principal quantum number n and electron wavelength λ_e.

In the following we describe a Bohr model that includes nuclear and gravitational orbitals. The model is confined to the simplest n orbits.

3 Electric orbits

Traditional Bohr model:

$\lambda_a = \lambda_p + \lambda_e$ (reduced mass equivalent)
R_a = Bohr radius
v_a = orbital velocity
a_a = acceleration (hypothetical)
T_a = orbital period (hypothetical)

$$m_{reduced} = \frac{m_e m_p}{m_e + m_p} = \frac{1}{\frac{1}{m_e} + \frac{1}{m_p}} \tag{1}$$

$$\lambda_a = \lambda_e + \lambda_p = \frac{m_P l_p}{m_e} + \frac{m_P l_p}{m_p} = \frac{m_P l_p}{m_{reduced}} \tag{2}$$

$$R_a = \alpha n^2 \lambda_a \tag{3}$$

$$v_a = \frac{c}{\alpha n} \tag{4}$$

$$a_a = \frac{c^2}{\alpha^3 n^4 \lambda_a} \tag{5}$$

$$T_a = \frac{2\pi\alpha^2 n^3 \lambda_a}{c} \tag{6}$$

$$E_n = \frac{m_e v_a^2}{2} \tag{7}$$

4 Nuclear orbits

$$m_{nuc} = m_p + m_n \tag{8}$$

$$\lambda_s = \frac{\lambda_p + \lambda_n}{4} = \frac{l_p m_P}{m_{nuc}} \tag{9}$$

$$r_0 = \sqrt{\alpha}\lambda_s \tag{10}$$

$$R_s = \alpha\lambda_s \tag{11}$$

$$v_s^2 = \frac{c^2}{\alpha} \tag{12}$$

$$E = \frac{m_{nuc} v_s^2}{2} \tag{13}$$

4.1. Gravitational binding energy (μ):

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

$$\mu = \frac{3GM^2}{5R} \tag{14}$$

$$G = \frac{l_p c^2}{m_P} \tag{15}$$

$$R = \sqrt{(\alpha)} r_0 = \alpha\lambda_s \tag{16}$$

$$M = m_P$$

$$\mu = \frac{3m_{nuc}c^2}{5\alpha} \tag{17}$$

$$\mu = \frac{3m_{nuc}v_s^2}{5} \tag{18}$$

Average GBE in the nucleus = 8.22MeV/nucleon

4.2. Strong binding energy (SBE):

Nuclear binding energy is the energy required to split a nucleus of an atom into its component parts. The component parts are neutrons and protons, which are collectively called nucleons.

The electrostatic coulomb constant;

$$a_c = \frac{3e^2}{20\pi\epsilon r_0} \tag{19}$$

$$\frac{e^2}{\epsilon} = \frac{4\pi l_p m_P c^2}{\alpha} \tag{20}$$

$$a_c = \frac{3l_p m_P c^2}{5\alpha r_0} \tag{21}$$

$$SBE = \sqrt{(\alpha)} a_c \tag{22}$$

$$SBE = \frac{3l_p m_P c^2}{5\sqrt{\alpha} r_0} \tag{23}$$

$$SBE = \frac{3m_{nuc}c^2}{5\alpha} \tag{24}$$

$$SBE = \frac{3m_{nuc}v_s^2}{5} \tag{25}$$

Average SBE in the nucleus = 8.22MeV/nucleon

4.3. Fermi term:

The density of nucleons in a nucleus:

$$n = \frac{3}{4\pi r_0^3} \tag{26}$$

$$E_f = \frac{h^2}{4\pi^2 m_{nuc}}.(\frac{3\pi^2 n}{2})^{2/3} \tag{27}$$

$$E_f = \frac{m_P^2 l_p^2 c^2}{m_{nuc}}.(\frac{9\pi}{8})^{2/3}.\frac{1}{r_0^2} \tag{28}$$

$$E_f = \frac{m_{nuc}c^2}{\alpha}.(\frac{9\pi}{8})^{2/3} \tag{29}$$

$$E_f = m_{nuc}v_s^2.(\frac{9\pi}{8})^{2/3} = 31.5MeV \tag{30}$$

5 Gravitational orbitals

5.1. Gravitational wavelength = Schwarzschild radius r_S

$$\lambda_g = \frac{2G(m_a+m_b)}{c^2} = \frac{2l_p.m_a}{m_P} + \frac{2l_pm_b}{m_P} = r_{Sa} + r_{Sb} \tag{31}$$

$$R_g = \alpha n^2 \lambda_g \tag{32}$$

$$v_g^2 = \frac{c^2}{2\alpha n^2} \tag{33}$$

$$a_g = \frac{c^2}{2\alpha^2 n^4 \lambda_g} \tag{34}$$

$$T_g^2 = \frac{8\pi^2\alpha^3 n^6 \lambda_g^2}{c^2} \tag{35}$$

$$E_n = \frac{mv_g^2}{2} \tag{36}$$

$$L_g = \frac{\sqrt{(2\alpha)}n\mu_{planet}\mu_{sun}m_P}{l_pc^3} \tag{37}$$

$$n = (\frac{Tc^3}{\sqrt{(2\alpha)}4\pi\alpha\mu})^{1/3} \tag{38}$$

Example - Earth orbit (see on-line calculator [2]). Note, I use here the standard gravitational parameter μ as this is known with greater precision than the planet mass:
$\mu_{earth} = 3.986004418(9)x10^{14}$
$\lambda_{earth} = 2\mu_{earth}/c^2 = .00887m\ (r_S)$

$n = 2290$; earth surface
- $R_g = 6374.293km$
- $a_g = 9.81m/s^2$
- $T_g = 5064.8s$ = 84.4mins
- $v_g = 7907.75m/s$

$n = 2291$; earth surface
- $R_g = 6380km$
- $a_g = 9.79m/s^2$
- $T_g = 5071.4s$
- $v_g = 7904m/s$

$n = 5890$; geosynchronous orbit
- $R_g = 42164km$
- $a_g = 0.2242m/s^2$
- $T_g = 86164s$
- $v_g = 3074.66m/s$

5.2. Gravitational potential energy between 2 orbits

$$\delta.\mu_{GPE} = \frac{GMm}{r_1} - \frac{GMm}{r_2} \tag{39}$$

where r = radius...

$$r_1 = \alpha n_1^2 \lambda_g$$

$$r_2 = \alpha n_2^2 \lambda_g$$

As Planck units...

$$\frac{GMm}{r_n} = \frac{l_pc^2}{m_P}\frac{Mm}{1}\frac{1}{\alpha n^2 \lambda_{M+m}} \tag{40}$$

$$= \frac{hc}{2\pi\alpha n^2\lambda_{M+m}}\frac{Mm}{m_P^2} \tag{41}$$

Rydberg (gravity)...

$$R = \frac{1}{2\pi r}(\frac{1}{n_1^2} - \frac{1}{n_2^2}) = \frac{1}{2\pi\alpha\lambda_{M+m}}(\frac{1}{n_1^2} - \frac{1}{n_2^2}) \tag{42}$$

$$f = Rc(\frac{1}{n_1^2} - \frac{1}{n_2^2}) \tag{43}$$

$$E_{tot} = hf\frac{Mm}{m_P^2} \tag{44}$$

$$N_{graviton} = \frac{Mm}{m_P^2} \tag{45}$$

$$E_{graviton} = hRc(\frac{1}{n_i^2} - \frac{1}{n_f^2}) \tag{46}$$

$$E_{tot} = E_{graviton}\, N_{graviton} \tag{47}$$

Example (see on-line calculator [2]):
Earth mass $M = 5.97x10^{24}kg$
Satellite mass $m = 1kg$
Earth surface $n = 2290$ ($r = 6374km$)
Geosynchronous orbit $n = 5890$ ($r = 42169km$)

$$f_{graviton} = n_{2290}\ orbit - n_{5890}\ orbit$$

$$f_{graviton} = 7.485 - 1.132 = 6.354Hz$$

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

$$N_{gravitons} = M.m/m_P^2 = 0.126x10^{41}$$

$$E_{total} = E_{graviton}\ .\ N_{gravitons} = .53x10^8(J/Kg)$$

Note that c/7.485Hz = 40050km corresponds to the circumference of the earth, and so gravitational orbitals are standing waves that encircle the earth.

The formula for $N_{gravitons}$ (i.e.: the total number of gravitational waves = orbitals) suggests that there are as many orbital links as there are atoms to link.

If these $0.126x10^{41}$ orbital waves of momentum are all unaligned as they circumnavigate the earth, the net result of summing their vectors of motion is that the satellite will appear to fall (accelerate) downwards, if they are all aligned, the satellite will be pulled by them in a circular orbit.

5.3. Escape velocity

v_{escape}

$$\frac{2GM}{r_g c^2} = \frac{r_S}{r_g} = \frac{r_S}{\alpha n^2 r_S} = \frac{v_{escape}^2}{c^2} = \frac{1}{\alpha n^2} \quad (48)$$

v_{orbit}

$$\frac{v_g^2}{c^2} = \frac{1}{2\alpha n^2} \quad (49)$$

Example: n=2290 (R=6374km):

$$v_{orbit} = \sqrt{\frac{c^2}{2\alpha n^2}} = 7907.75m/s \quad (50)$$

$$v_{escape} = \sqrt{\frac{c^2}{\alpha n^2}} = 11183.25m/s \quad (51)$$

5.4. Gravitational time dilation

Gravitational time dilation is the difference of elapsed time in regions with different gravitational potential. The lower the gravitational potential (the closer the clock is to the source of gravitation), the more slowly time passes.

Circular orbits:

$$\frac{v_{escape}^2}{c^2} + \frac{v_{orbit}^2}{c^2} = \frac{1}{\alpha n^2} + \frac{1}{2\alpha n^2} = \frac{3}{2\alpha n^2} \quad (52)$$

5.5. The classical tests of relativity

5.5.i) Perihelion precession of Mercury's orbit

semi-minor axis: $b = \alpha l^2 \lambda_g$

semi-major axis: $a = \alpha n^2 \lambda_g$

Radius of curvature:

$$L = \frac{b^2}{a} = \frac{al^4 \lambda_g}{n^2} \quad (53)$$

$$\frac{3\lambda_g}{2L} = \frac{3n^2}{2\alpha l^4} \quad (54)$$

Using n=378, l=374

$b = 0.566x10^{11}m$ $(0.5667x10^{11})$

$a = 0.578x10^{11}m$ $(wiki\ 0.579x10^{11})$

Mercury orbit = 87.9691days

$$\frac{3n^2}{2\alpha l^4} * 1296000 * 100 * 365.252/87.9691 = 43.015 \quad (55)$$

precession = 43.015 arc secs (per 100yrs)

5.5.ii) Gravitational redshift

$$z_{approx} = \frac{GM}{c^2 r_g} = \frac{1}{2\alpha n^2} \quad (56)$$

5.5.iii) Deflection of light $r_{star} = r_g$

$$\frac{2r_{S\,star}}{r_{star}} = \frac{2}{\alpha n^2} \quad (57)$$

5.6. Elliptical orbits

As a gravitational orbit is the sum of many individual orbitals, we need an additional term. The semi-major axis R_a can be calculated from T (period of gravitational orbit) [2];

$$3a_n = R_g\ (1 + \frac{2T}{T_g}) \quad (58)$$

$\mu_{sun} = 1.32712440018(9)x10^{20}$ [1]

$\lambda_{sun} = 2\mu_{sun}/c^2 = 2953.25m$

Mercury (n = 378): $\mu_{mercury} = 2.2032(9)x10^{13}$
- T = 87.9691 days * 86400sec
- a_o = 57 909 050km (NASA factsheet)
- a_n = 57 909 096km (semi major axis, eq58)
- $v_g = 47.907km/s$ (average velocity, eq33)
- $L_g = 0.915x10^{39}$ (orbital angular momentum, eq37)

Venus (n = 517): $\mu_{venus} = 3.24859(9)x10^{14}$
- T = 224.7 days
- a_o = 108 208 000km
- a_n = 108 208 620km
- $v_g = 35.026km/s$ (35.02)
- $L_g = 0.1845x10^{41}$

Earth (n = 608): $\mu_{earth} = 3.986004418(9)x10^{14}$
- T = 365.256363 days
- a_o = 149 598 023km
- a_n = 149 597 724km
- $v_g = 29.784km/s$
- $L_g = 0.2662x10^{41}$

Mars (n = 750): $\mu_{mars} = 4.282837(2)x10^{13}$
- T = 686.971 days
- a_o = 227 939 200km
- a_n = 227 939 143km
- $v_g = 24.145km/s$
- $L_g = 0.353x10^{40}$

Jupiter (n = 1419): $\mu_{jupiter} = 1.26686534(9)x10^{17}$
- T = 4, 332.59 days
- a_o = 778 299 000km
- a_n = 778 499 963km
- $v_g = 12.761km/s$
- $L_g = 0.197x10^{44}$

5.7. Gravitation formula (r_s = Schwarzschild radius)

$$r_S = \frac{2l_p M}{m_P} \quad (59)$$

$$\frac{GM}{R_g c^2} = \frac{l_p c^2}{m_P} M \frac{1}{\alpha n^2 r_S c^2} = \frac{1}{2\alpha n^2} \quad (60)$$

5.8. Gravitational force as a function of Planck force

$$F_p = \frac{E_p}{l_p} \quad (61)$$

$$F = \frac{M_a M_b G}{R^2} = \frac{r_{Sa} r_{Sb} F_p}{4R_g^2} = \frac{r_{Sa} r_{Sb} F_p}{4\alpha^2 n^4 \lambda_g^2} \quad (62)$$

a) If $r_{Sa} = r_{Sb}$, the object mass is not required

$$F = \frac{F_p}{16\alpha^2 n^4} \tag{63}$$

b) If $r_{Sa} >> r_{Sb}$, the relative mass is used

$$F = \frac{r_{Sb} F_p}{4\alpha^2 n^4 r_{Sa}} \tag{64}$$

and so the force formula reduces to $F_g = m_b.a_g$

$$a_g = \frac{c^2}{2\alpha^2 n^4 (r_{Sa} + r_{Sb})} \tag{65}$$

$$F.c^2 = \frac{r_{Sa}.r_{Sb} a_g F_p}{2r_{Sa} + 2r_{Sb}} = \frac{r_{Sa} r_{Sb} a_g F_p}{2r_{Sa}} \tag{66}$$

$$r_{Sb} = \frac{2l_p m_b}{m_P} \tag{67}$$

$$F = \frac{2l_p m_b}{m_P} \frac{a_g E_p}{2l_p} \frac{1}{c^2} = m_b a_g \tag{68}$$

5.9. Gravitational energy ($m_{object} << M_{earth}$)

$$E_{graviton} = hf = \frac{hc}{2\pi r_g} = \frac{m_P c^2 l_p}{r_g} = \frac{m_P c^2 l_p}{\alpha n^2 \lambda_{earth}} = \frac{m_P^2 v_g^2}{M_{earth}} \tag{69}$$

energy per graviton to reach escape velocity

$$E_{ev} = \frac{m_P^2 v_s^2}{M} \tag{70}$$

- earth as black hole; n = 1, E = .325e-6eV
earth surface; r = 6374.3km, n = 2290, E = .619e-13eV
- moon as black hole; n = 1, E = .264e-4eV
moon surface; r = 1737.1km, n = 10735, E = .229e-12eV
- M = .1426e18kg (i.e.: a small planet);

$$M = \frac{2\alpha m_P^2}{m_e} = .1426e18 \tag{71}$$

$$E_{ev} = \frac{m_P^2 v_s^2}{2\alpha m_P^2 / m_e} = \frac{m_e c^2}{2\alpha^2} = 13.6eV \tag{72}$$

The number of orbitals per orbit;

$$N_{earth} = \frac{M_{earth} m}{m_P^2} = .126e41 \tag{73}$$

$$N_{moon} = \frac{M_{moon} m}{m_P^2} = .155e39 \tag{74}$$

$E_{tot} = E_{ev}.N$ reduces to

$$E_{tot} = m v_g^2 = \frac{m v_s^2}{2} \tag{75}$$

$$V_{earth} = \sqrt{\frac{c^2}{\alpha 2290^2}} = 11.183 km/s \tag{76}$$

$$V_{moon} = \sqrt{\frac{c^2}{\alpha 10735^2}} = 2.386 km/s \tag{77}$$

6 Molecular Orbitals

The standard molecular orbital model can be adequately applied to this model and so is not repeated here. Listed here for reference are some dissociation energies for homonuclear diatomic molecules in approximate geometrical terms.
Li-Li (1.12eV)

$$Li - Li = \frac{2m_e v_a^2}{25} = 1.09eV \tag{78}$$

F-F (1.6eV)

$$F - F = \frac{3m_e v_a^2}{25} = 1.63eV \tag{79}$$

B-B (3.0eV)

$$B - B = \frac{2m_e v_a^2}{9} = 3.02eV \tag{80}$$

H-H (4.52eV)

$$H - H = \frac{m_e v_a^2}{3} = 4.54eV \tag{81}$$

O-O (5.2eV)

$$O - O = \frac{3m_e v_a^2}{8} = 5.10eV \tag{82}$$

Positronium

$$(+)e - (-)e = \frac{m_e v_a^2}{2} = 6.8eV \tag{83}$$

N-N (9.8eV)

$$N - N = \frac{18m_e v_a^2}{25} = 9.8eV \tag{84}$$

7 Atomic orbital transitions

According to consensus, an incoming photon hits the atom and an electron jumps to a higher orbital. How this instantaneous process occurs and what constitutes empty space in the atom (which is 99.99999999999 percent of the atom) remains a mystery.

Here I have proposed that the orbital is a physical entity, in the sense that it is a photon albeit of opposite phase that has been trapped to form a standing wave and so I have denoted it as an anti-photon.

Analysis of the Rydberg formula suggests the incoming photon is actually 2 photons; the first photon has the same frequency as the present electron orbital, the 2nd photon dictates the new orbital.

And so the incoming photon ($+\lambda$) does not cause the electron to jump between orbitals, rather it deletes the present $n = i$ orbital and replaces it with the new $n = f$ orbital.

The Rydberg formula re-written as 2 photons;

$$(+\lambda) = \frac{R}{n_i^2} - \frac{R}{n_f^2} = (+\lambda_i) - (+\lambda_f) \tag{85}$$

(incoming) photon $(+\lambda) = (+\lambda_i)$ - $(+\lambda_f)$
antiphoton (standing wave) orbital = $(-\lambda_i)$
step 1: photon + antiphoton = $(+\lambda_i)$ + $(-\lambda_i)$ = zero
step 2: zero - $(+\lambda_f)$ = $(-\lambda_f)$

For an $n = i$ orbital, orbital wavelength = λ_a

$$(-\lambda_i) = (-)\ \frac{c}{4\pi\alpha^2 n_i^2 \lambda_a} \tag{86}$$

Incoming photon $(+\lambda) = (+\lambda_i)$ - $(+\lambda_f)$

$$(+\lambda) = (+)\ \frac{c}{4\pi\alpha^2 n_i^2 \lambda_a}\ -\ (+)\ \frac{c}{4\pi\alpha^2 n_f^2 \lambda_a} \tag{87}$$

Change of orbitals from $n = i$ to $n = f$:

$$(+\lambda_i)\ +\ (-\lambda_i) = zero \tag{88}$$

$$zero\ -\ (+\lambda_f) = (-\lambda_f) = (-)\ \frac{c}{4\pi\alpha^2 n_f^2 \lambda_a} \tag{89}$$

From this wave addition followed by subtraction, we have simply replaced the $n = i$ orbital with the $n = f$ orbital. The electron has not moved, however the boundary of its orbital has changed.

In molecular orbital theory, the terminology used is bonding and anti-bonding orbitals, nevertheless the principle is the same, i.e.: the molecular bonding orbital is an anti-photon ($E < 0$), the anti-bonding orbital is the inverse photon ($E > 0$). When summed, the molecular bonding and anti-bonding orbitals cancel.

References

1. NASA planetary factsheet
   http://nssdc.gsfc.nasa.gov/planetary/factsheet/
2. Online orbital calculator
   planckmomentum.com/orbitals/