The Sun's Orbit Radius, and Period

H. Vic Dannon
vic0@comcast.net
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Abstract: We assume that the Gravitational Power Radiation is proportional to the acceleration squared. Then, at Radiation Power Equilibrium between the Sun and its nine Planets, the Sun's Orbit radius is

$$\rho = \underbrace{r\sqrt{\frac{m}{M}}}_{2.592622676\times 10^{8}\,\mathrm{m}} \sqrt{\frac{m_1}{m}+\frac{m_2}{m}+\frac{m}{m}+...+\frac{m_9}{m}}\,\frac{1}{\sqrt[4]{\frac{r^4}{r_1^4}+\frac{r^4}{r_2^4}+\frac{r^4}{r^4}+...+\frac{r^4}{r_9^4}}}$$

where

Mercury has $\frac{m_1}{m} = 0.055274$, $\frac{r_1}{r} = 0.3871$, and $\frac{r^4}{r_1^4} \approx 44.5356$

Venus has $\frac{m_2}{m} = 0.815$, $\frac{r_2}{r} = 0.72335$, and $\frac{r^4}{r_2^4} \approx 3.65263$

Earth has $\frac{m}{m} = 1$, $\frac{r}{r} = 1$, and $\frac{r^4}{r^4} = 1$

Mars has $\frac{m_4}{m} = 0.10745$, $\frac{r_4}{r} = 1.52371$, and $\frac{r^4}{r_4^4} \approx 0.18552$

Jupiter has $\frac{m_5}{m} = 317.85$, $\frac{r_5}{r} = 5.20253$, and $\frac{r^4}{r_5^4} \approx \frac{1.365}{1000}$

Saturn has $\frac{m_6}{m} = 95.159$, $\frac{r_6}{r} = 9.5756$, and $\frac{r^4}{r_6^4} \approx \frac{1.1894}{10,000}$

Uranus has $\frac{m_7}{m} = 14.5$, $\frac{r_7}{r} = 19.2934$, and $\frac{r^4}{r_7^4} \approx \frac{7.217}{1,000,000}$

Neptune has $\frac{m_8}{m} = 17.204$, $\frac{r_8}{r} = 30.2459$, and $\frac{r^4}{r_8^4} \approx \frac{1.1949}{1,000,000}$

Pluto has $\frac{m_9}{m} = 0.00251$, $\frac{r_9}{r} = 39.509$, and $\frac{r^4}{r_9^4} \approx \frac{4.10408}{10,000,000}$

Consequently, $\rho \approx 20.67006689 \times 10^8 \mathrm{m}$.

About 3 times the Sun's Radius of 6.96×10^8

And the $\text{Sun's year} = \left(\frac{\rho}{r}\right)^{\frac{3}{2}} \sqrt{\frac{M}{m}} T_{earth} \approx 0.937188048$ earth years

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Physics & Astronomy Classification Scheme: 41.60-m; 32; 32.10-f; 31.15.B-;

Contents

Gravity & Electromagnetics

The Theory of Gravitation is based on Newton's Gravitational Law: Any two masses m_1, and m_2, at a distance r, in the vacuum, are attracted by the force

$$F_G = G\frac{m_1 m_2}{r^2},$$

where

$$F \text{ is measured in Newton} = \text{kg}\frac{\text{m}}{\text{sec}^2},$$

and

$$G = 6.67259 \times 10^{-11}\frac{\text{m}^3}{\text{kg}\cdot\text{sec}^2},$$

is the Constant of Gravitation.

Electromagnetism is based on Coulomb Electric Law under Lorentz Transformations that account for moving charges. Coulomb Law is modeled after Newton's law: Any two charges q_1, and q_2, at a distance r are attracted by the force

$$F_e = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2},$$

where

$$\varepsilon_0 = 8.854\ 187\ 817 \times 10^{-12}\ \text{Coul}^2\frac{\text{kg}\cdot\text{sec}^2}{\text{m}^3}$$

is the Permittivity of the vacuum. And

$$\frac{1}{4\pi\varepsilon_0} = 8.987551788 \times 10^9 .$$

On comparison of the coefficients of the two forces,

$$\frac{\frac{1}{4\pi\varepsilon_0}}{G} = \frac{8.987551788 \times 10^9}{6.67259 \times 10^{-11}} = 1.346\ 936\ 016 \times 10^{20} \frac{1}{\text{Coul}^2} .$$

Thus, the Electric Force is far more powerful than the Gravitational, and allows precise laboratory measurements.

The Gravitational force is observed in the cosmos where convenient laboratory conditions are unavailable, and where Electromagnetic, and Nuclear reactions interfere with, and mask the much weaker effects of Gravitation.

For instance, we have shown [Dan3], that Neutron Stars are created by Electric Collapse. Gravitational forces are negligible in the Collapse of a Star into a Neutron Star.

Consequently, the Theory of Electromagnetics have developed further than the theory of Gravitation, and it is time to model Gravitation after Electromagnetics.

In [Dan1] we established that *Supernova Models indicate that the Neutrino is the Quantum of The Gravitational Radiation*. And proposed that the Carrier of the Gravitational Field is the Neutrino.

Einstein suggested that similarly to spectral electrons that emit photons when they move from a higher energy orbit to a lower energy orbit, the origin of gravitation is transition between nucleus energy levels. And we proposed that *The Origin of Gravitation is the Transition between the d-quark energy level, and the u-quark energy level of a Nucleon*.

Here, in analogy with the radiation of photons by an accelerating charge, we propose the radiation of Neutrinos from an accelerating mass.

We shall assume that the Gravitational Radiation power lost by the earth in its orbit around the Sun, is compensated by the Radiation showered on the earth by the Sun moving in its own orbit, predicted hundreds of years ago by Kepler's first law.

Under further assumption we may derive, as in [Dan2], Inertial Moments equilibrium between the earth and the Sun, and obtain the Sun's orbit.

We proceed to develop Gravitational Radiation of an accelerating mass by analogy with Electromagnetic Radiation of an accelerating electric charge.

1.
Gravitational Permittivity in the Vacuum

In analogy with Electricity, we put

$$G = \frac{1}{4\pi\varepsilon_G}$$

This defines the Gravitational Permittivity in the vacuum

$$\varepsilon_G = \frac{1}{4\pi G}$$

$$= \frac{1}{4\pi \cdot 6.67259 \times 10^{-11}}$$

$$= 1.192\ 602\ 446 \times 10^{9}\,\frac{\text{kg} \cdot \text{sec}^2}{\text{m}^3}.$$

2.

Gravitational Radiation Speed

In his theory of General Relativity, Einstein assumed that Gravitational radiation propagates at the speed of light.

That assumption has no basis in any experiment, in Einstein's time, or in any other time.

Nor there is any theory that substantiates Einstein's belief:

Even if Einstein believed the false claim that the speed of light is the largest possible, he still had to explain what the speed of Electromagnetic Radiation has to do with the speed of Gravitational Radiation.

Einstein's assumption perceived by physicists who never read him as truth beyond a doubt, served to hinder the identification of the neutrinos as the carrier of the Gravitational Radiation.

Cherenkov Radiation establishes that Neutrinos may move at speeds greater than light speed in the vacuum, and when you look for Gravitational Radiation at speeds no more than light speed, Neutrinos will be ruled out as the Quantum of Gravitational Radiation.

Einstein used the non-physical CGS system of units, that replaces the vacuum permittivity

$$\varepsilon_0,$$

with a meaningless $\frac{1}{4\pi}$.

and the vacuum permeability

$$\mu_0,$$

with a puzzling $\frac{1}{c^2}$.

The system is not even a bad joke because there never existed a measurement instrument in its units. No meter was ever scaled in Stat-Volts, or Stat-Amperes.

Consequently, having no idea about Volts and Amperes, the CGS followers are prone to gross errors in Electricity, and like Einstein in Gravitation. See [Dan4], and [Dan5].

In the physical MKS-Ampere unit system, when we assume that light propagates as an electromagnetic wave, its vacuum speed c, is given by

$$c^2 = \frac{1}{\varepsilon_0 \mu_0}.$$

Experiments determined

$$c \approx 300,000,000 \text{ m/sec}$$

This is the average vacuum speed of the photons that carry the Electromagnetic Radiation.

At this time, we do not know what is the average vacuum speed of the Neutrinos that carry the Gravitational Radiation. But it need not equal light speed. In fact, it is likely to be higher.

In analogy to electromagnetics, when we assume that Gravitational Radiation propagates as a Gravitational wave, we shall denote its vacuum speed by

$$c_G.$$

In analogy to electromagnetics we may assume that Gravitational wave propagation involves the Gravitational Radiation Field E_G, and another Field perpendicular to it.

That perpendicular field, the analog of the Magnetic Field in electricity, will be much weaker than E_G, and involves the Gravitational Permeability

$$\mu_G = \frac{1}{c_G^2 \varepsilon_G}.$$

But we can obtain our results without it, and to keep our derivation simple, will not use it in the proceedings.

3.

Gravitational Radiation Power

In analogy to Electromagnetic Radiation, a unit volume of a Gravitational Radiation Field

$$E_G,$$

contains the Gravitational energy,

$$\varepsilon_G E_G^2.$$

The Gravitational Radiation propagates at speed

$$c_G,$$

in direction perpendicular to the plane spanned by the Gravitational Field, and by the Field perpendicular to it.

At time interval

$$dt,$$

the Gravitational Radiation that crosses an Area

$$dA,$$

is in the volume

$$dA\, c_G dt.$$

The rate of change per unit area is the Gravitational Radiation Power

$$\frac{(\varepsilon_G E_G^2)(dA\, c_G dt)}{dA\, dt} = \varepsilon_G c_G E_G^2.$$

The θ component of the Electromagnetic Radiation Field of a point charge q orbiting a charge Q, and accelerating at a_q towards Q is

$$E_\theta = \frac{1}{c^2}\frac{1}{4\pi\varepsilon_0}\frac{q}{r}a_q \sin\theta .$$

Replacing

$$q \to m,$$

$$\varepsilon_0 \to \varepsilon_G,$$

$$c \to c_G,$$

$$E_\theta \to E_G,$$

$$a_q \to a_m,$$

we may assume that the θ component of the Gravitational Radiation Field of a point mass m orbiting mass M, and accelerating at a_m towards M is

$$E_G = \frac{1}{c_G^2}\frac{1}{4\pi\varepsilon_G}\frac{m}{r}a_m \sin\theta .$$

Then, the Gravitational Radiation Power is

$$\varepsilon_G c_G E_G^2 = \frac{1}{c_G^3}\frac{1}{(4\pi)^2\varepsilon_G} m^2 a_m^2 \frac{1}{r^2}\sin^2\theta .$$

Integrating over a spherical shell of radius r

$$\int_{\phi=0}^{\phi=2\pi}\int_{\theta=0}^{\theta=\pi}\frac{1}{r^2}\sin^2\theta(r^2\sin\theta d\theta d\phi) = 2\pi\int_{\theta=\pi}^{\theta=0}\sin^2\theta d(\cos\theta),$$

$$= 2\pi \int_{\theta=\pi}^{\theta=0} \underbrace{\sin^2\theta}_{1-\cos^2\theta} d(\cos\theta)$$

$$= 2\pi \Big[\cos\theta - \tfrac{1}{3}\cos^3\theta \Big]_{\theta=\pi}^{\theta=0}$$

$$= 2\pi[2 - \tfrac{2}{3}]$$

$$= \frac{8\pi}{3}.$$

Thus, following the derivation of Larmor's Formula in Electromagnetics, the Gravitational Radiation Power flux through a sphere of radius r is

$$\frac{8\pi}{3}\frac{1}{c_G^3}\frac{1}{(4\pi)^2\varepsilon_G}m^2a_m^2 = \frac{2}{3}\frac{1}{c_G^3}\frac{1}{4\pi\varepsilon_G}m^2a_m^2$$

$$= \frac{2}{3}\frac{1}{c_G^3}Gm^2a_m^2.$$

This Formula fails to determine the Sun's orbit radius

4.

The Failure of the Radiation Formula to determine the Sun's Orbit Radius

We approximate the earth's orbits about the Sun by a circle with radius r.

The earth accelerates towards the sun with

$$a_m = \frac{1}{m} G \frac{mM}{r^2},$$

and radiates Neutrinos into the Sun's Gravitational field. By the Gravitational Larmor Formula, the Earth's Radiation Power is

$$\frac{2}{3} G \frac{m^2}{c_G^3} a_m^2 = \frac{2}{3} G \frac{m^2}{c_G^3} \left(G \frac{M}{r^2} \right)^2$$

The Sun orbits with radius ρ an earth mass m, accelerates towards it at

$$A_M = \frac{1}{M} G \frac{mM}{\rho^2},$$

and radiates Neutrinos into the earth's field.

By the Gravitational Larmor Formula, the Sun's Radiation

Power is

$$\frac{2}{3} G \frac{M^2}{c_G^3} A_M^2 = \frac{2}{3} G \frac{M^2}{c_G^3} \left(G \frac{m}{\rho^2} \right)^2$$

At equilibrium, the Radiation Power absorbed by the Sun, equals the Radiation Power absorbed by the earth.

$$\frac{2}{3} G \frac{m^2}{c_G^3} \left(G \frac{M}{r^2} \right)^2 = \frac{2}{3} G \frac{M^2}{c_G^3} \left(G \frac{m}{\rho^2} \right)^2$$

That is,

$$r = \rho \,,$$

which is nonsense.

Hence, the radiation formula fails to determine the Sun's orbit radius

5.

The Sun's Orbit Radius From the Accelerations of the Earth and the Sun

The Earth-Sun system served to model the Electron-Proton Hydrogen Atom.

In [Dan2], we established that when the Radiation Power absorbed by the proton, equals the Radiation Power absorbed by the electron., the inertia moments of the electron and the proton are equal

$$m_e r^2 = M_p \rho^2$$

Hence,

$$\frac{1}{m_e}\frac{1}{4\pi\varepsilon_0}\frac{e^2}{r^2} = \frac{1}{M_p}\frac{1}{4\pi\varepsilon_0}\frac{e^2}{\rho^2}$$

That is, the electron's acceleration towards the proton, equals the Proton's acceleration towards the electron.

Since the Force Rule for the Electron-Proton Atom is modeled after the Force rule for the Earth-Sun System, the Earth's acceleration towards the Sun

$$G\frac{M}{r^2}$$

should equal the Sun's acceleration towards the earth.

$$G\frac{m}{\rho^2}$$

Then,

$$mr^2 = M\rho^2$$

Consequently,

5.1 The Sun's Orbit Radius is

$$\rho \approx r\sqrt{\frac{m}{M}} \approx 2.592622676 \times 10^8 \mathrm{m}$$

Compare with the Sun's Radius of 6.96×10^8

Proof:
$$\rho = r\sqrt{\frac{m}{M}}$$
$$= 1.495979 \times 10^{11}\sqrt{3.0035 \times 10^{-6}}$$
$$= 2.592622676 \times 10^8.$$

In fact, $2.592622676 \times 10^8 \mathrm{m}$ is a poor approximation for the Sun's Orbit Radius. In the following, the effects of the other planets weigh in, and we obtain a far better approximation to the Sun's Orbit Radius.

6.

The Sun's Orbit Radius From the Accelerations of the Planets and the Sun

For two planets, orbiting the Sun, we shall assume, as we in fact did above, that the Gravitational Power Radiation is proportional to the acceleration squared,

$$a^2.$$

Hence, at Radiation Power Equilibrium between the Sun and the two planets,

$$ka_1^2 + ka_2^2 = kA^2,$$

$$a_1^2 + a_2^2 = A^2,$$

$$\left(G\frac{M}{r_1^2}\right)^2 + \left(G\frac{M}{r_2^2}\right)^2 = \left(G\frac{m_1 + m_2}{\rho^2}\right)^2,$$

$$M^2\left(\frac{1}{r_1^4} + \frac{1}{r_2^4}\right) = \frac{(m_1 + m_2)^2}{\rho^4},$$

$$\rho = \sqrt{\frac{m_1 + m_2}{M}}\frac{1}{\sqrt[4]{\frac{1}{r_1^4} + \frac{1}{r_2^4}}}$$

For the Nine Planets, the Sun's Orbit radius is

$$\rho = \sqrt{\frac{m_1 + m_2 + m + ...m_9}{M}} \frac{1}{\sqrt[4]{\frac{1}{r_1^4} + \frac{1}{r_2^4} + \frac{1}{r^4} + ... + \frac{1}{r_9^4}}}$$

$$= \underbrace{r\sqrt{\frac{m}{M}}}_{2.592622676\times 10^8\,\mathrm{m}} \sqrt{\frac{m_1}{m} + \frac{m_2}{m} + \frac{m}{m} + ... + \frac{m_9}{m}} \frac{1}{\sqrt[4]{\frac{r^4}{r_1^4} + \frac{r^4}{r_2^4} + \frac{r^4}{r^4} + ... + \frac{r^4}{r_9^4}}}$$

where [Woan, p.176],

Mercury has $\frac{m_1}{m} = 0.055274$, $\frac{r_1}{r} = 0.3871$, and $\frac{r^4}{r_1^4} \approx 44.5356$

Venus has $\frac{m_2}{m} = 0.815$, $\frac{r_2}{r} = 0.72335$, and $\frac{r^4}{r_2^4} \approx 3.65263$

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$$\sqrt{\frac{m_1}{m} + \frac{m_2}{m} + \frac{m}{m} + ... + \frac{m_9}{m}} \approx \sqrt{\frac{m_2}{m} + \frac{m}{m} + ... + \frac{m_8}{m}}$$
$$= \sqrt{0.815 + 1 + 0.10745 + 317.85 + 95.159 + 14.5 + 17.204}$$
$$= 21.13375144$$

$$\frac{1}{\sqrt[4]{\frac{r^4}{r_1^4} + \frac{r^4}{r_2^4} + \frac{r^4}{r^4} + ... + \frac{r^4}{r_9^4}}} \approx \frac{1}{\sqrt[4]{\frac{r^4}{r_1^4} + \frac{r^4}{r_2^4} + \frac{r^4}{r^4} + \frac{r^4}{r_4^4}}}$$
$$\approx \frac{1}{\sqrt[4]{44.5356 + 3.65263 + 1 + 0.18552}}$$
$$= 0.377247153$$

Consequently, $\rho \approx 20.67006689 \times 10^8 \mathrm{m}$.

6.1 The Sun's Orbit Radius is

$$\boxed{\rho \approx 20.67 \times 10^8 \mathrm{m}}$$

About 3 times the Sun's Radius of 6.96×10^8

7.

The Sun's Period

The force on the earth orbiting the sun at radius r, with period $T_e = \frac{2\pi}{\omega}$ is

$$m\omega^2 r = G\frac{mM}{r^2}.$$

Therefore,

$$\frac{\omega^2 r^3}{M} = G.$$

Or

$$T_e^2 = \frac{4\pi^2}{GM}r^3.$$

For the Sun,

$$M\Omega^2\rho = G\frac{mM}{\rho^2},$$

$$\frac{\Omega^2\rho^3}{m} = G$$

Or

$$T_{Sun}^2 = \frac{4\pi^2}{Gm}\rho^3$$

Therefore,

$$\left(\frac{T_{Sun}}{T_e}\right)^2 = \left(\frac{\rho}{r}\right)^3\frac{M}{m},$$

$$\frac{T_{Sun}}{T_e} = \left(\frac{\rho}{r}\right)^{3/2}\sqrt{\frac{M}{m}}\,.$$

7.1 $$\boxed{\text{Sun year} = \left(\frac{\rho}{r}\right)^{\frac{3}{2}}\sqrt{\frac{M}{m}}T_e \approx 0.937188048 \text{ earth years}}$$

<u>Proof</u>: **For** $T_e = 1.00004$ earth year,

$$\left(\frac{\rho}{r}\right)^{\frac{3}{2}}\sqrt{\frac{M}{m}}T_e = \left(\frac{2.067\times 10^{9}}{1.495979\times 10^{11}}\right)^{\frac{3}{2}}\sqrt{0.332946\times 10^{6}}\,(1.00004)$$

$$= (1.624136286)10^{-3}(0.577014731)10^{3}(1.00004)$$

$$\approx 0.937188048 \text{ earth years}.\square$$

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