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1ST THEOREM OF GRAVITODYNAMICS, 7TH JANUARY 2010

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1st THEOREM OF GRAVITODYNAMICS

We shall first state the theorem, calculate the energy radiated by an accelerated mass particle, state fundamentals Kepler's laws and last but not least introduce the ***quasi stationary variable constant*** in Kepler's law, thereby proving the **1th theorem of gravitodynamics.** This is part of the frontier physics evidence that explains **mercury perihelion advance.**

We affirm that with time all orbiting spherical bodies undergoing no physical deformation and no matter transfer;

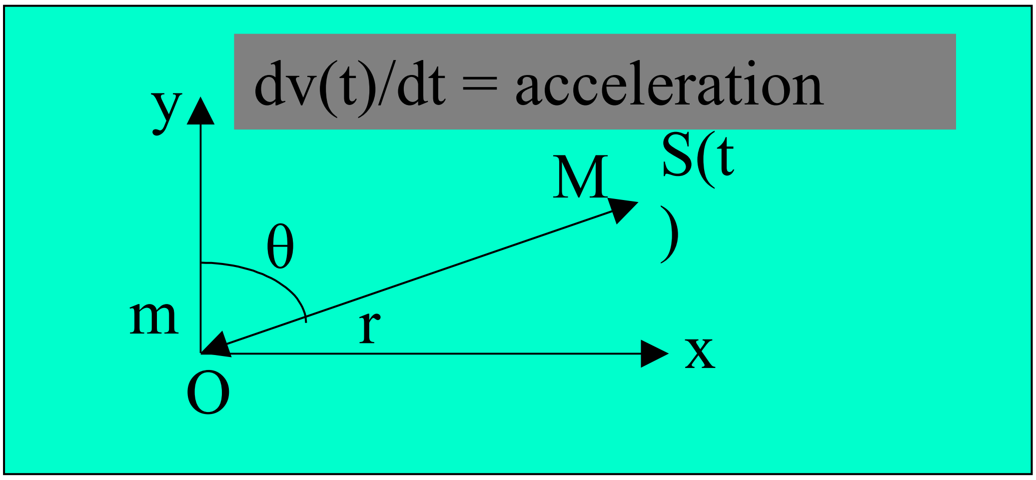
1) Loose their angular momentum thus **angular momentum loss**
2) Spiral into each other (the radial distance at any given orbital point decreases)
3) Have decreasing orbital periods

This is due to the energy loss through gravitational radiation. Since the system is open, the energy conservation law no longer holds as stated by the Newton's dynamics. The third dimension which is time always increases, consequently all systems associated with this dimension change, this is in accordance with the general laws of nature, thus no system is static in the universe.

We have to point out that the force between interacting bodies is not radial as described by the Newton's dynamics, this is due to the fact that the gravitational propagation interaction travels at a finite speed but not instantaneous. This speed is thought by most scientist to be equal to the speed of light but this is not necessarily true because it is just a conjecture. In the coming years we shall attempt to give a rough estimate of the gravitational interaction propagation speed by using indirect methods and we shall also attempt to elaborate, in a quantitative approach, the gravitational synchrotron radiation.

Power radiated by an accelerated mass particle

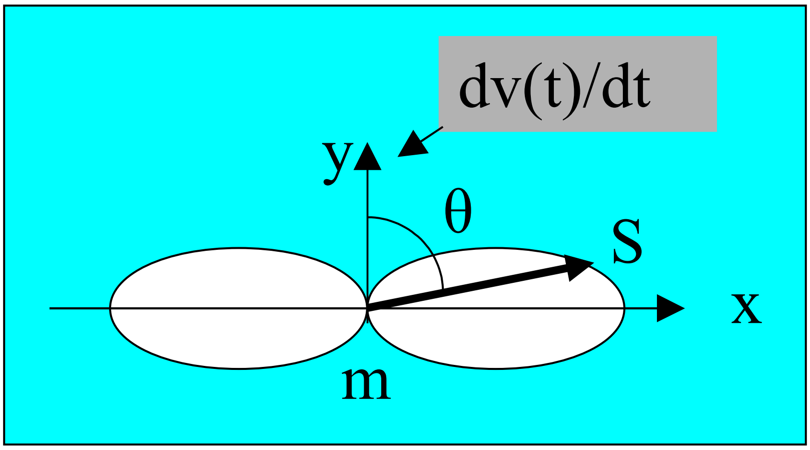
Let us consider far area radiation power at a distance r (point M) by a mass particle of mass m accelerated at dv(t)/dt in the y axis direction as shown in the following diagram;



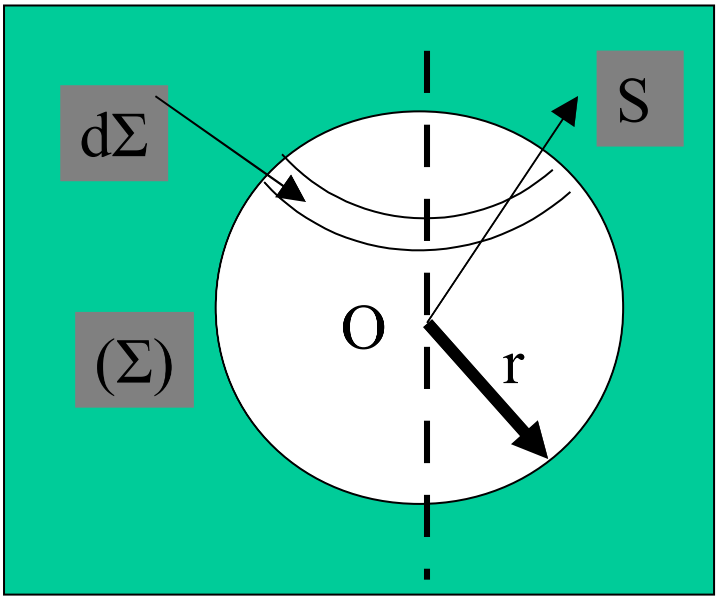
The Poynting vector S is given by;

$$S(t) = \frac{\mu_g m^2}{16\pi^2 c\, r^2} \left\{ \frac{dv(t)}{d(t)} \right\}^2 \sin^2(\theta)$$

Where θ is the angle between the Poyting vector and the y axis. We notice the radiated power is null along y axis thus the axis of acceleration and it is maximum along the x axis perpendicular to acceleration y axis. The radiation diagram is shown in the following diagram;



We obtain the radiated total power by calculating the total flux thru the surface area of the sphere (Σ) having centre at C and of radius r.



We obtain the following formula of Larmor.

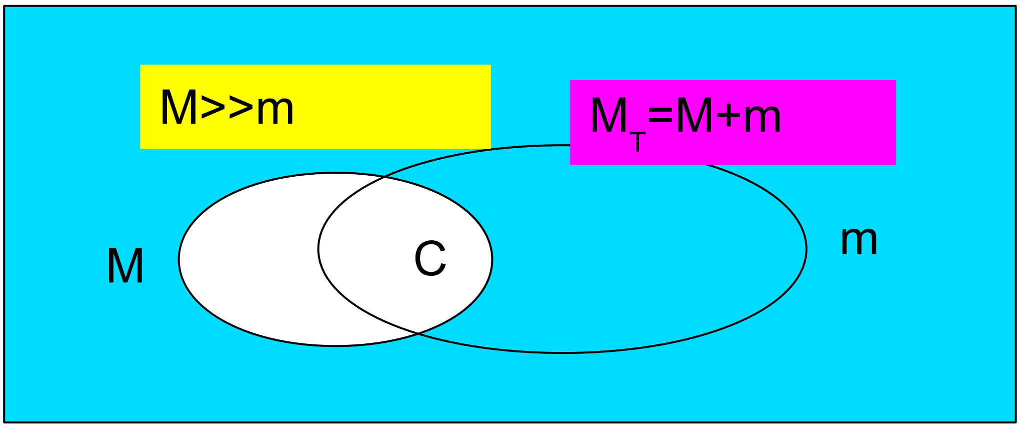
$$P(t) = \frac{\mu_g m^2}{6\pi c}\left\{\frac{dv(t)}{d(t)}\right\}^2$$

We obtain the radiated energy at time t by integrating power P(t) as shown below.

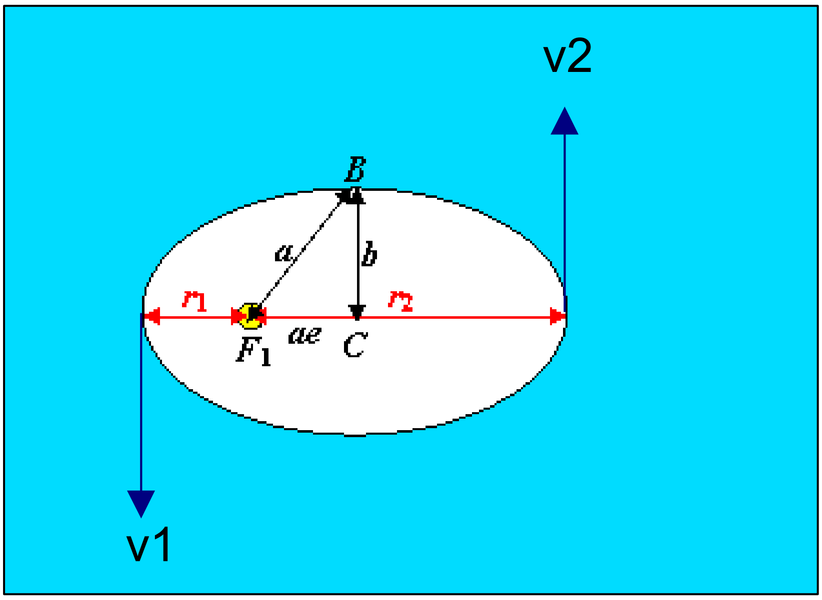
$$E(t) = \int_0^t P(t)\, d(t) = \int_0^t \frac{\mu_g m^2}{6\pi c}\left\{\frac{dv(t)}{d(t)}\right\}^2 d(t)$$

Basic facts about elliptical orbits Kepler's law

Consider 2 solid bodies orbiting around each and point C being the center of mass. Such that;
M >> m and $M_T = M + m$



Consider mass m around it's orbit as shown in the following diagram, F_1 = focal point;



1) The time T_2 to go around an elliptical orbit depends only on the length *a* of the semimajor axis.

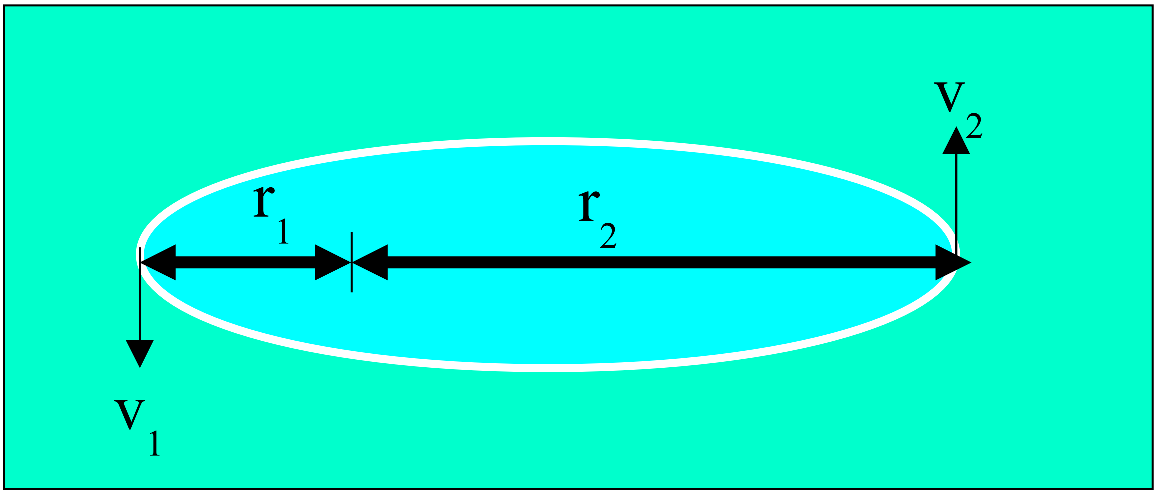
$$T^2 = \frac{4\pi^2 a^3}{GM_T}$$

2) The total energy of a planet in an elliptical orbit depends on the length *a* of the semimajor axis, such that:

$$E_T = -\frac{GM_T m}{2a}$$

Newtons conservation laws throughout the elliptical orbital motion is considered as a closed system where gravitational radiation is not put in account;

total energy is constant
angular momentum is constant



Let r_1 be the minimum distance (perihelion) of mass m from the center of mass M_T and v_1 the maximum speed. Let r_2 be the maximum distance (aphelion) of mass m and v_1 the minimum speed.

Angular momentum $L = m_1 v_1 r_1 = m_2 v_2 r_2$

$$L = \left\{ \frac{2m^2 G M_T}{\left[\frac{1}{r_1} + \frac{1}{r_2} \right]} \right\}^{1/2} \qquad L > 0$$

Since $r_1 = a(1-\varepsilon)$ and $r_2 = a(1+\varepsilon)$ then L is given by;

$$L = \left\{ a(1-\varepsilon^2)m^2GM_T \right\}^{1/2} \quad L > 0$$

$$r^2\,\omega = \text{constant} = r_{min}^{\,2}\,\omega_{max} = r_1^{\,2}\,\omega_1$$

Quasi stationary variable constant

In gravitodynamics the system is considered as an open system where the system losses energy thru gravitational radiation. We still consider the energy conservation law but we shall put into account the energy loss thru gravitational radiation E_R, thus;

$$E_T + E_R = \text{ quasi stationary variable constant}$$

$$E_R(t) = \int_0^t P(t)\, d(t) = \int_0^t \frac{\mu_g m^2}{6\text{лc}} \left\{ \frac{dv(t)}{d(t)} \right\}^2 d(t)$$

$$E_R(t) = \int_0^t \frac{\mu_g m^2}{6\pi c}\left\{\frac{dv(t)}{d(t)}\right\}^2 d(t) = \int_0^t \frac{\mu_g m^2}{6\pi c}\left\{\frac{GM_T}{r^2}\right\}^2 dt$$

$$E_R(t) = \int_0^t \frac{\mu_g m^2}{6\pi c}\frac{G^2 M_T^2}{r^2 r^2}\, dt$$

$$\frac{1}{r^2} = \frac{\omega}{r_1^2\omega_1} = \frac{1}{r_1^2\omega_1}\frac{d\theta}{dt}$$

$$E_R(t) = \int_0^t \frac{\mu_g m^2}{6\pi c}\frac{G^2 M_T^2}{r_1^2\omega_1 r^2}\frac{d\theta\, dt}{dt}$$

$$E_R(t) = \int_0^\theta \frac{\mu_g m^2}{6\pi c}\frac{G^2 M_T^2}{r_1^2\omega_1 r^2}\frac{d\theta\, dt}{\cancel{dt}}$$

$$t: 0 \longrightarrow T$$
$$\theta: 0 \longrightarrow 2\pi + \delta\theta$$

$$r = r_1 \frac{(1+\varepsilon)}{(1+\varepsilon\cos(\theta))}$$

$$E_R(t) = \int_0^\theta \frac{\mu_g}{6\pi c} \frac{m^2 G^2 M_T^2 [1+\varepsilon\cos(\theta)]^2}{r_1^4 \omega_1 (1+\varepsilon)^2} d\theta$$

By integration from 0 to θ, we get;

$$E_R(t) = \left[\frac{\mu_g}{24\pi c} \frac{m^2 G^2 M_T^2 [4\theta+8\varepsilon\sin(\theta)+\varepsilon^2\{2\theta+\sin(\theta)\}]}{r_1^2 \omega_1 (1+\varepsilon)^2} \right]_0^\theta$$

It gives the following expression,

$$E_R(T_0) = \frac{\mu_g m^2 G^2 M_T^2 [2+\varepsilon^2]}{6c\, r_1^4 \omega_1\, (1+\varepsilon)^2}$$

$E_T(t)$ denotes the total energy of the orbiting body at time t.
T_n denotes the n^{th} period of revolution
$E_R(T_n)$ denotes radiated energy during the n^{th} period of revolution
a_n denotes the n^{th} length of the semimajor axis of the orbit
r_{1n} denotes the n^{th} minimum distance (perihelion)
$n \in [1,2,3,4,5 \ldots\ldots n\ldots\ldots]$

0) At $t = 0$ $E_T(0) = E_T(0)$ = quasi-stationary variable constant = $-GM_Tm/2a_0$, $E_R(0) = 0$

1) At $t = T_1$ $E_T(T_1) + E_R(T_0) = E_T(T_0)$

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n) At $t = T_{n+1}$ $E_T(T_{n+1}) + E_R(T_n) = E_T(T_n)$

In general the nth total energy is given by,

$$E_T(T_n) = E_T(T_0) - \sum_{i=0}^{n-1} E_R(T_i) \qquad n > 0$$

Consider the $(n+1)^{th}$ revolution as follows

$$E_T(T_{n+1}) + E_R(T_n) = E_T(T_n)$$

Thus

$$-\frac{GM_Tm}{2a_{n+1}} + E_R(T_n) = -\frac{GM_Tm}{2a_n}$$

But $E_R(T_{n+\&}) > 0$ as seen before in this paper, then;

➔

$$-\frac{GM_T m}{2a_{n+1}} < -\frac{GM_T m}{2a_n}$$

➔ $\mathbf{a_{n+1} < a_n}$

And since the square of the orbital period T^2 is proportional to the cube of the length a^3 of the semimajor axis of the orbit then we can affirm;

$$\mathbf{T_{n+1} < T_n}$$

The angular momentum is given by ;

$$L = \left\{ a(1-\varepsilon^2)m^2GM_T \right\}^{1/2} \quad L > 0$$

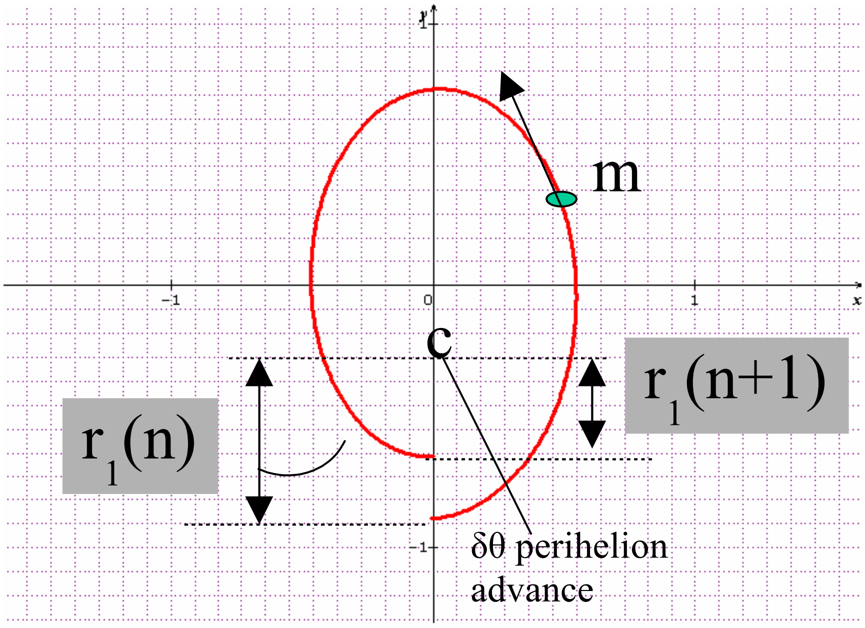
When the length of the semi-major axis a of the orbit decreases, the angular momentum L decreases.

Conclusion

With time all orbiting spherical bodies undergoing no physical deformation and no matter transfer;

4) **Lose their angular momentum thus angular momentum loss**
5) **Spiral into each other (the radial distance at any given orbital point decreases)**
6) **Have decreasing orbital periods**
7)

The diagram below shows mass m as it spirals in, resulting in perihelion advance.



Since the orbital period decreases, an over shoot of angular position δθ above 2л occurs, the system turns into the counter clockwise direction. This explains the mercury perihelion advance. Computing must be done and should be compared to astronomical observations.

Quasi stationary variable constant approach

The total energy of the system at the n^th lap (n^th revolution, number of period of time) is given by;

$$E_T(T_n) = E_T(T_0) - \sum_{i=0}^{n-1} E_R(T_i) \qquad n > 0$$

Since system is quasi stationary $E_R(T_i) \approx E_R(T_0)$, $E_R(T_0)$ being the gravitational energy radiated during the 1st lap (1st revolution) and T_0 being the period of revolution, then we can admit that;

$$E_T(T_n) = E_T(T_0) - n\,E_R(T_0)$$
$$n > 0$$

➔

$$\frac{1}{E_T(T_n)} = \frac{1}{[E_T(T_0) - n\,E_R(T_0)]}$$

➔

$$\frac{1}{E_T(T_n)} = \frac{1}{E_T(T_0)[1 - n\,E_R(T_0)/ E_T(T_0)]}$$

But $E_R(T_0) << E_T(T_0)]$
We can us the geometrical series sum approximation, thus;

$$\frac{1}{E_T(T_n)} = \frac{[1 + n\, E_R(T_0)/\, E_T(T_0)]}{E_T(T_0)}$$

But;

$$E_T(T_n) = -\frac{GM_T m}{2a_n}$$

Then

$$a_n = -\frac{GM_T m[1 + n\, E_R(T_0)/\, E_T(T_0)]}{2 \quad E_T(T_0)}$$

But;

$$E_T(T_0) = -\frac{GM_T m}{2a_0}$$

Then

$$a_n = a_0[1 + n\,E_R(T_0)/\,E_T(T_0)]$$

But

$$T_n^2 = \frac{4\pi^2 a_n^3}{GM_T}$$

Then,

$$T_n = T_0[1 + n\,E_R(T_0)/\,E_T(T_0)]^{3/2}$$

➔

$$T_n - T_0 = T_0\left(1 - [1 + n\,E_R(T_0)/\,E_T(T_0)]^{3/2}\right)$$

By using Taylor-Lagrange approximation method, we get the following formula

$$T_n - T_0 = \frac{-3T_0\,n\,E_R(T_0)}{2\quad E_T(T_0)}$$

The perihelion advance δθ is give by;

$$\delta\theta = \frac{2\pi(T_n - T_0)}{T0} = \frac{-3\pi\,n\,E_R(T_0)}{E_T(T_0)}$$

The $E_R(T_0)$ is given by;

$$E_R(T_0) = \frac{\mu_g m^2 G^2 M_T^2 [2+\varepsilon^2]}{6\pi c\, r_1^4 \omega_1 (1+\varepsilon)^2}$$

$E_T(T_0)$ is given by;

$$E_T(T_0) = -\frac{GM_T m}{2a_0}$$

Then

$$\frac{E_R(T_0)}{E_R(T_0)} = -\frac{a_0 \mu_g mG M_T [2+\varepsilon^2]}{3 c\, r_1^4 \omega_1 (1+\varepsilon)^2}$$

The perihelion advance is given by;

$$\delta\theta = \pi n \frac{a_0 \mu_g mG M_T [2+\varepsilon^2]}{c\, r_1^4 \omega_1 (1+\varepsilon)^2}$$

But $\mu_g = 4\pi G/c^2$

➔

$$\delta\theta = \frac{4\pi^2 n\, a_0 G^2 M_T m[2+\varepsilon^2]}{c^3 r_1^4 \omega_1 (1+\varepsilon)^2}$$

But $r_1\omega_1$ = Vmax, after substitution we get;

$$\delta\theta = \frac{4\pi^2 n\, a_0 G^2 M_T m[2+\varepsilon^2]}{c^3 r_1^3 \, Vmax(1+\varepsilon)^2}$$

The perihelion advance is given by;

$$\delta\theta = \frac{2\pi(T0 - Tn)}{T_0}$$

The trouble is we do not know the speed of gravitational interaction!

Assume the speed of gravitional interaction is equal to the speed c of light.
Consider Mercury;

The calculated perihelion advance $\delta\theta$ = 15.4" per century, this is not a surprise because we did too much Taylor-Lagrange approximation and to make things worse we assumed the energy lost per revolution is constant, this is not true.

Final conclusion but not the least

Since the result we got is of the same numerical order as the observed one, We affirm that the gravitational interaction speed is close to the speed of light.