Abstract



Gravitational Periodicity from Special Relativity by Jack Bidnik

This is my derivation of the sinusoidal variation of planetary orbits by means of relativistic relative momentum of two masses. It may be considered Chapter 3 of my paper Gravitational Forces Revisited (GFR), http://vixra.org/abs/1707.0128

where I derived a force, $F_m$, which I analogized to Newton's force of gravity by the equation

$F_m = G_s Mm / r^2$, where $G_s$ is a velocity dependent variable.

Here I derive the same force, but I use a separate method to show that it is the force of gravity. This chapter can be seen as a completely independent, stand alone, method of deriving gravity from Special Relativity, and that $F_m$ is both a necessary and a sufficient condition for the gravitational force.

We begin, as in GFR with differentiation of the relativistic relative momentum of two moving masses, with $\mu_0$ being the reduced mass

$$F_T = \frac{d}{dt}\frac{(\mu_0 v)}{\sqrt{1-\frac{v^2}{c^2}}} = \mu_0 \frac{c^3}{(\sqrt{c^2-v^2})^3}\left(\frac{dv}{dt}\right)$$

This can be broken into two parts $F_m$ and $F_c$ with $F_c$ being negligible at low speeds.

$$F_T = F_m + F_c \quad = c\mu_0 \frac{1}{(\sqrt{c^2-v^2})}\left(\frac{dv}{dt}\right) + c\mu_0 \frac{v^2}{(\sqrt{c^2-v^2})^3}\left(\frac{dv}{dt}\right)$$

It is instructive and necessary to point out that $F_m$ is inherently sinusoidal. In fact $F_m$ is an elliptic integral of the first kind:

$$\int F_m dt = \int c\mu_0 \frac{1}{(\sqrt{c^2-v^2})}\left(\frac{dv}{dt}\right)dt = c\mu_0 \int \frac{1}{(\sqrt{c^2-v^2})}dv$$

$= c\mu_0 \arcsin(v/c) + constant$ , so that, assuming the constant =0, we have, for some $\theta$ ,

$v/c = \sin\theta = \sin(\int F_m/(c\mu_0)dt)$ , and setting $\int F_m/(c\mu_0)dt = Q/(c\mu_0)$ so

$v = c\sin\theta$ ; $v = c\sin(Q/(c\mu_0))$ , and if we choose $Q = kr$ , where k is a constant

and r is the radial distance travelled from the centre of radial motion, along the focal line.

$v = c\sin(kr/(c\mu_0))$ , which,for $\theta$ being a small angle, makes $v = c(kr/(c\mu_0)) = kr/\mu_0$ .

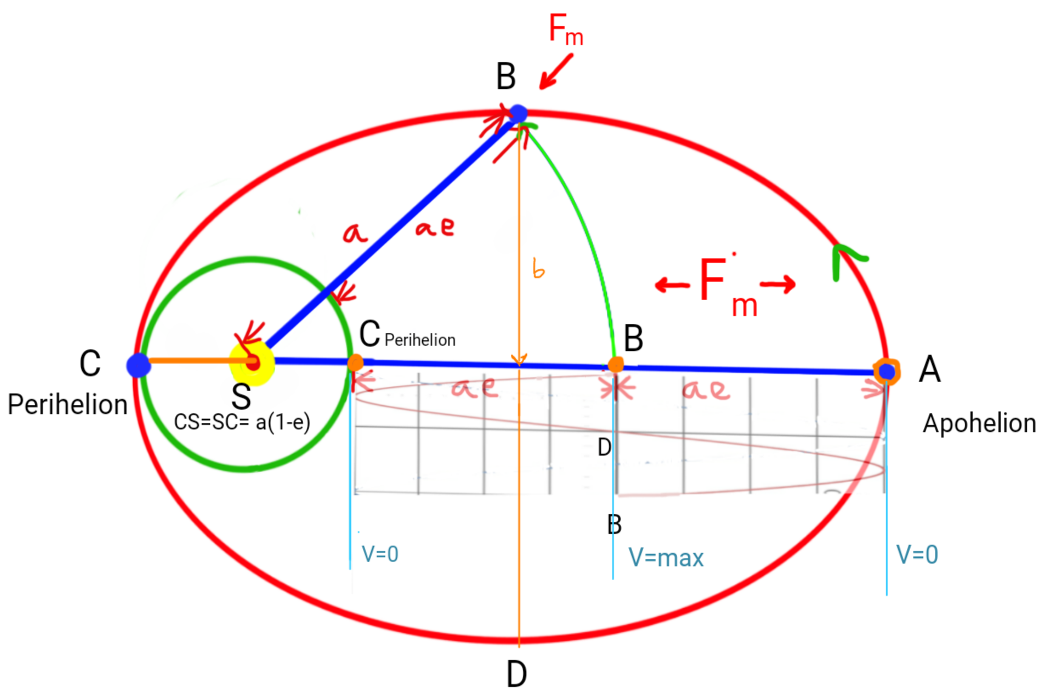
The quantity v/r can be determined from average radial velocity and distance, and has dimensions of frequency $\omega$ . This can be illustrated from elliptical planetary orbits, see Fig. 1.

At peak excursion at the centre of radial motion, where peak radial velocity is reached, at the minor axis point of the orbit $r = ae$ , where $a$ is the semi-major axis and $e$ is the eccentricity so $v = k\ ae/\mu_0$ . k can be determined from peak radial velocity which is average v divided by 0.637.

Then if the angular frequency is $\omega = k/\mu_0$ , which, as it turns out from data from astronomy, it is, then the frequency, $f = \omega/2\pi$ and the orbital period ( a year for Earth) is $T = 2\pi/\omega$ and $T = 2\pi\mu_0/k$ .

This can be seen from the Basic Program (Fig. 2) results (Fig. 3) below, for a number of planets, that is that the results of this equation corresponds very well with the actual known periods of the planets.

Figure 1




The radial path, ABC, is shown, starting at B, where radial velocity is greatest.
The corresponding points on the elliptical orbit are shown by corresponding letter.
The corresponding sinewave of the radial position is labelled by the same letters.

Figure 2

```
REM Start of BASIC! Program

print "For Earth"
m1= 5.97219e24       rem mass of Earth
a1=1.49598262e11     rem semi-major axis
ec=0.01671123        rem eccentricity
orbper=365.26        rem known orbital period in Earth days
gosub calculation


print "Mars "
m1=0.641693e24
a1=  2.27943824e11
ec= 0.0933941
orbper=686.98        rem known orbital period in Earth days
gosub calculation


print "Venus"
m1=4.867320e24
a1=  1.08209475e11
ec= 0.00677672
orbper=224.70
gosub calculation


print "Mercury"
m1=0.330104e24
a1= 5.7909227e10
ec= 0.20563593
orbper=88
gosub calculation


print "Jupiter"
m1=1898.130e24
a1= 7.78340821e11
ec=0.04838624
orbper=4332.82
gosub calculation

print "Saturn"
m1= 568.319e24
a1= 1.426666422e12
ec= 0.05386179
orbper=10755.7
gosub calculation

print "Neptune"
m1=102.41e24
a1= 4.498396441e12
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```
ec= 0.00859048
orbper=60190.03
gosub calculation

print "Uranus"
m1=86.8103e24
a1= 2.870658186e12
ec= 0.04725744
orbper=30687.15
gosub calculation

 end

Calculation:

M2=1.9891e30     rem mass of the Sun
Gn=0.667384e-10  rem Newton's constant
c=2.99792458e8
pi=2*asin(1)

mu=m1*m2/(m1+m2) rem reduced mass virtually = m1
rap=a1*(1-ec)          rem perihelion radius
raa=a1*(1+ec)          rem aphelion radius

distra=(raa-rap)*2      rem distance travelled
timtra=orbper*24*60*60  rem time travelled
vav=distra/timtra    rem average radial velocity  "m/s"

sinetheta=vav/c
theta=asin(vav/c)

vav=c*sinetheta      rem sinusoidal equation

c=2.99792458e8
pi=2*asin(1)

r=a1*ec           rem the approximate radius at max radial vel.
vp=vav/0.637      rem the peak radial velocity

rem vp=c*sin(k*r) peak velocity

k=asin(vp/c)/r


rem vp=c*sin(r*k/(c*m1))
rem vp= r*k/m1
k=vp* m1/r
w=(k/m1) rem angular frequency
orbper2=(2*pi* m1/k)/(60*60*24) rem derived orbital period in days
print orbper, "orbper"
print orbper2, "orbper2"

RETURN
```

Figure 3


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BASIC! Program Output
For Earth
365.26, orbper
365.4781552490908, orbper2
Mars
686.98, orbper
687.3903057904519, orbper2
Venus
224.7, orbper
224.83420435982893, orbper2
Mercury
88.0, orbper
88.05255889481472, orbper2
Jupiter
4332.82, orbper
4335.407820802631, orbper2
Saturn
10755.7, orbper
10762.12395119271, orbper2
Neptune
60190.03, orbper
60225.97910745036, orbper2
Uranus
30687.15, orbper
30705.47821237511, orbper2
END