Electrostatics, Gravity, and Galactic Force

by Jack Bidnik

This paper is a continuation of my paper entitled Gravitational Forces Revisited (GFR), http://vixra.org/abs/1707.0128 and may be considered as Chapter 2 of the concepts developed in that paper.
Two corollaries of the derivation of G_s in GFR are elaborated here to show that the formula can be extended to include both the smallest and the largest masses and spaces. The same formula can give both the electrostatic force of the Hydrogen atom and also the force which counteracts the centrifugal force of large galaxies. I believe this development nullifies the most basic motive for postulating dark matter, which is that the gravitational force at such high speeds could not hold the galaxy together. Examples are given for galaxies of various size.

The paper starts with continuing analysis of the mathematical conclusion in GFR that the derived force F_t is equivalent to the centripetal force of the orbit v_o^2/r. This analysis is perhaps superfluous since there is no other acceleration present radially than the one derived for F_t, but I present various looks at the math to dispel any nagging doubts.
Another set of doubts to be dispelled involves the idea of frames of motion. It suffices to point out that when one uses the reduced mass, it is the equivalent of the motion of either mass in the frame of the other, since it is the equivalent of one mass being stationary.

We assume a mass is moving in orbit with respect to a second mass with a velocity whose tangential component is v_o, and whose radial component is v. Then, in the absence of an external force, there is a central force or acceleration, due only to the kinematic property of centripetal acceleration, along the line of the radius joining the two masses. I have called this force F_T in the first chapter, my paper entitled "Gravitational Forces Revisited" (GFR), identifying it with the force derived from relativistic relative momentum. The numerical results in GFR for the value of Newton's constant for the planets and moons have borne this out, and I will enlarge upon this further below. So:

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

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

and associated with it by the formulas presented in the above paper GFR is the force F_m ,with the following property which we have derived there:

$$F_m = \frac{Mm}{r^2}\left[\left(\frac{1}{Mm}\right)\cdot F_T \frac{(\mu_0 c^2)^2}{(F_T^2 + 2F_T(\mu_0 c^2)/r + (\mu_0 c^2)^2/r^2)}\right] , \quad F_T = \mu_0 a_T ,$$

where $\mu_0 \equiv \frac{Mm}{(M+m)}$, the reduced mass.

The part in the square brackets reduces to a function,

$$G = \left[\frac{(\mu_0^2)\cdot\left(\frac{1}{(M+m)}\right)\cdot(a_T c^4)}{((\mu_0^2)(a_T^2 + 2a_T c^2/r + c^4/r^2))}\right]$$ and, since $a_T = \frac{v_o^2}{r}$, the centripetal acceleration,

$$G = \left(\frac{1}{(M+m)}\right)\frac{\left(\frac{v_o^2}{r}\right)c^4}{\left(\frac{v_o^2}{r}\right)^2 + 2\left(\frac{v_o^2}{r}\right)c^2/r + c^4/r^2} .$$

This function, G, has been shown in chapter1 (GFR) to have the value of Newton's Gravitational Constant for points nearby the semi-minor axis point of a planetary orbit, which for purposes of this paper I call the "equinox" point. This is a point which yields a good value for average orbital velocity when the eccentricity is small. (see calculations and BASIC program above in GFR.)
Now we will rename this G, G_S , for "Special G".

From the above, $G_S = \left(\frac{1}{(M+m)}\right)\frac{\left(\frac{v_o^2}{r}\right)c^4}{\left(\frac{v_o^2}{r}+\frac{c^2}{r}\right)^2}$ or $G_S = \left(\frac{1}{(M+m)}\right)\frac{r\ v_o^2 c^4}{(v_o^2+c^2)^2}$

So, again looking at Fm , $F_m = G_S \frac{Mm}{r^2}$ has the form of Newton's equation, and for planets it is. For the case of the orbit of an electron about the nucleus of Hydrogen we might expect this formula to give us a value for the gravitational force between the proton and electron, 3.623E-47 N , a very small value, but this is not the case. The value of G, ie. G_S , has changed here, as it is dependent on the orbital speed, and the force F_m is now actually equal to the electrostatic force between them, 8.213E-8 N. So we see that both planetary gravitation and atomic orbits are special cases of the same force formula.

The classical way of determining the Bohr orbit force:

$F = Z\ k_e e^2 / r^2$ in the case of hydrogen, Z=1. So electrostatic force F=8.2187E-8 N.

```
F= Z~k_{e}e^{2} /r^{2}

ke=8.99e9   REM Coulomb's constant NM^2/C^2
e=1.6e-19  REM charge of electron in Coulombs in SI units
m=9.1e-31  REM mass of the electron in kg
r=5.29172e-9  REM radius of H, Bohr radius, meters
```

In both cases, the assumption that $F_T = \mu \frac{v_o^2}{r}$ leads to valid physical conclusions about the attracting force, that it is F_m .

So we see that the formula $F_m = G_S \frac{Mm}{r^2}$ is equal to $k_e e^2 / r^2$, even though the numerator of F_m does not give any specific information about Coulomb's constant or the charge of an electron or proton. By F_m being equal to the electrostatic force of the atom, this does point out qualitatively the nature also of the electromagnetic force.

F_m is derived mathematically from relativistic relative momentum and F_T . If, as we have shown, that $F_T = \mu \frac{v_o^2}{r}$ as an average, in between periapsis and apapsis, then F_m is a legitimate function also of centripetal acceleration, and takes the place of Newton's gravitational and Coulomb's attractive force.

Further evidence that F_T is equal to the centripetal acceleration:

In the previous paper "Gravitational Forces Revisited"(GFR), I assumed it was reasonable to suppose that $F_T = \mu \frac{v_o^2}{r}$, and the real-world calculations bore this out.

What is the evidence that we can assume that F_T is equal to the centripetal force? For an elliptical orbit, at the narrow ends of the orbit, periapsis and apapsis, the radial velocity is zero, however there is an acceleration of $\frac{v_o^2}{r}$ at these points, greater at the former than the latter. Since there is zero radial motion at these extrema, this acceleration, or force, must derive only from the tangential velocity, that is to say, the radial velocity under the square root sign of F_T disappears, and leaves unity for the fraction:

$$F_T = \mu_0 \frac{c^3}{(\sqrt{c^2 - v^2})^3} (\frac{dv}{dt}) \text{ , so } \quad F_T = \mu_0 (\frac{dv}{dt}) \text{ ,}$$

but the acceleration term in F_T remains, and is equal to the centripetal acceleration. Thus

$$F_T = \mu_0 \frac{v_o^2}{r} = \mu_0 (\frac{dv}{dt}) \text{ .}$$

This is represented by an average value of $\frac{v_o^2}{r}$ as calculated at the 'equinox', as in the GFR paper above, even though both F_T and F_m are periodic functions, as will be discussed in the next chapter.

We must note that although F_m is necessarily close to F_T , at these speeds, much lower than c, this is entirely analogous to Newton's force being assumed equal to centripetal force .

To summarize: F_T is derived from relativistic relative velocity, and for an elliptical orbit, it has the apsidal value of $\mu_0 \frac{v_o^2}{r}$, and a similar average value.

F_m is part of F_T , and is also related to F_T by the formula involving G_S , derived by the methods in GFR. For low velocities F_m is very close to F_T ,and parallels Newton's Law by

$$F_m = G_S \frac{Mm}{r^2}$$

This applies to all forms of orbits, from planets to atoms, and if the orbital velocities of the galaxies are correct, ***it may obviate the need to postulate dark matter.***

The fact is that, however great the centripetal acceleration of a star on the outside rim of a galaxy, F_m has a value which is very close to it, unlike the force using Newton's constant. The following BASIC program illustrates this. Substituting a few values for n, d, x, v and M1, will show this. Included are the values for a Milky Way type galaxy.

```
n=4         REM scale factor
l=9.46e15   REM light year in meters
d=10^n      REM scale factor
r=l*d       REM distance in meters (light years *scale) from galaxy C of M
sm=1.99e30  REM one solar mass
x=100
stmr=x    REM input a value for x, the star mass ratio of the star
m2=stmr*sm REM mass of star = star mass ratio * sm
M1=200e9*sm   REM number of sm's
v=10e5      REM orbital velocity m/s
c=2.99e8    REM speed of light in meters/s

Gs=(r/(M1+1))*(v^2)*(c^4)/(((v^2)+(c^2)))^2     REM value of gravitational
term
print "scale factors:  ";  "n=";n,"d=";d,"x=";x
```

```
print "For a radius of    " ;    r;  "  meters","For a galactic mass of  " ;M1;" kg", "Gs="; Gs

Gn=0.667384e-10
Fn=Gn*M1*m2/r^2
print "using Gn, Newton's constant, force=" ;  Fn ;"   N"
Fm=Gs*M1*m2/r^2
print "force using Gs =" ;Fm ;"  N"
CF=m2*(v^2)/r    REM centripetal force of star
print "centripetal force =" ;CF ;"  N"
```

OUTPUT

```
scale factors:  n=4.0, d=10000.0, x=100.0
For a radius of  9.46E19  meters, For a galactic mass of 3.98E41 kg, Gs=2.37683124944934E-10
using Gn, Newton's constant, force=5.906492628134932E23  N
force using Gs =2.1035470213839805E24  N
centripetal force =2.1035940803382664E24  N

scale factors:  n=5.0, d=100000.0, x=100.0
For a radius of  9.46E20  meters, For a galactic mass of 3.98E41 kg, Gs=2.3768312494493396E-9
using Gn, Newton's constant, force=5.906492628134932E21  N
force using Gs =2.1035470213839804E23  N
centripetal force =2.1035940803382664E23  N

scale factors:  n=6.0, d=1000000.0, x=100.0
For a radius of  9.46E21  meters, For a galactic mass of 3.98E41 kg, Gs=2.3768312494493396E-8
using Gn, Newton's constant, force=5.906492628134933E19  N
force using Gs =2.1035470213839808E22  N
centripetal force =2.1035940803382664E22  N

scale factors:  n=4.0, d=10000.0, x=200.0
For a radius of  9.46E19  meters, For a galactic mass of 3.98E41 kg, Gs=2.37683124944934E-10
using Gn, Newton's constant, force=1.1812985256269863E24  N
force using Gs =4.207094042767961E24  N
centripetal force =4.207188160676533E24  N

scale factors:  n=5.0, d=100000.0, x=200.0
For a radius of  9.46E20  meters, For a galactic mass of 3.98E41 kg, Gs=2.3768312494493396E-9
using Gn, Newton's constant, force=1.1812985256269863E22  N
force using Gs =4.207094042767961E23  N
centripetal force =4.207188160676533E23  N

scale factors:  n=5.0, d=100000.0, x=300.0
For a radius of  9.46E20  meters, For a galactic mass of 3.98E41 kg, Gs=2.3768312494493396E-9
using Gn, Newton's constant, force=1.7719477884404797E22  N
force using Gs =6.310641064151941E23  N
centripetal force =6.3107822410148E23  N
```

The following is a copy of the post I made to Prof. Leonard Susskind's blog on March 11, 2015
Blogger: Susskind's Blog: Physics for Everyone - Post a Comment

https://www.blogger.com/comment.g?blogID=2240954547063076010&postID=7797502399248012496&page=3&token=1426115932807&bpli=1

If you use the formula for force in Newton 's Gravitational Equation: F =G Mm/r ^ 2,

on the proton and electron of the Hydrogen atom you will find that the attraction is a very small number, compared to the electrostatic force.

If , however, instead of G, you use the following expression:

Gs = (1/ (M+m))*r*Vo^2*c^4/(Vo^2 +c^2)^2 ,

where Vo is orbital velocity, c is speed of light, and Gs is what I call Special G, thus:

F =Gs* M*m/r ^ 2,

you will find that the calculation yields the accepted figure for the electrostatic force of the Bohr Hydrogen atom.

In fact, if you use Gs instead of G for the equation of force for any planet, with r being the length of the semi-major axis and Vo being the average orbital speed, then the result will be the same as if you had used only G, Newton's constant, in the first place, for under those conditions Gs=G.

This is a result of the equation's dependency on the orbital speed; in the atomic case, this speed is high, and it translates to a much larger attraction, while in the planetary case the speed is slow relative to the speed of light, giving the classical force value.

This is not a mere mathematical contrivance. It is a fact of nature, derived from physical laws and equations.

In fact, from understanding how these equations have been derived one can see that this establishes the relationship between gravity and electrostatics and, by extension, electromagnetic forces .

m=9.1e-31 ,mass of the electron kg

M=m*1836.15 ,mass of proton

r=5.29172e-11 ,radius of H, Bohr radius, meters

c=2.99792458e8 ,speed of light in M/s

ke=8.99e9 ,Coulomb's constant NM^2/C^2

q1,q2=1.6e-19 , charge of electron and proton in H atom

Vo=sqr((ke*q1^2)/(m*r)) = 2.186153e6 m/s ,orbital speed

Force from electrostatic formula, fe= ke* q1*q2/ r^2 = 8.21875e-8 N

Force from Special G formula, Fg=Gs* M*m/r ^ 2 = 8.2134e-8 N

For planetary cases: F =Gs* M*m/r ^ 2, a few examples:

Sun's mass M= 1.9891e30 kg, Newton's G=0.667384e-10 N(m/kg)^2

For Earth m= 5.97219e24 kg, r= 1.49598262e11 m, Vo= 29788 m/s, F= 3.53e22 N, Gs=.66735e-10

Mars m=.641693e24, r= 2.27943824e11, Vo= 24136, F= 1.64e21 , Gs=.66759e-10

Jupiter m=1898.130e24, r= 7.78340821e11, Vo= 13065, F= 4.1589e23, Gs=.66732e-10

Saturn m= 568.319e24, r= 1.426666422e12, Vo= 9647.7, F= 3.7067e22, Gs=.66732e-10