A NEW GRAVITATION LAW

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Abstract - Newton's law of universal gravitation $F=-GMm/r^2$ has a problem, i.e. when r=0, the force goes to infinity. A new gravitation law is proposed to solve this problem. And I show that this new gravitation law meets 4 criteria of observed phenomena.

Keywords - Gravitation, Infinity, Law, Newton I

I. PROBLEM OF NEWTON'S GRAVITATION LAW

Newton's gravitation force F=-GMm/r^2 [1] has a problem, i.e. when r=0, the force goes to infinity. Infinite energy is released, which is unreasonable.

When two rocks collide, or when a husband hugs his wife, or when we knock on the doors, the distances r are all 0, but no infinity happens.

II. A NEW GRAVITATION LAW

Here I propose a new gravitation law, it can remove the infinity problem.

F=-GMm/$(r+H)^2$

where H is a constant. When r=0, the force is a constant GMm/H^2, not an infinity.

III. 4 CRITERIA OF OBSERVED PHENOMENA MUST BE MET BY THE NEW GRAVITATION LAW

1. Far away stars have less gravitational effects.
2. Surface gravity constant is close to 9.8m/s^2 [2].
3. Planets have ellipse motions around the sun.
4. A husband hugs his wife where the distance r=0, and they have negligible gravity forces.

In the following, I show how the new gravitation law meets the above 4 criteria of observed phenomena.

1. Far away stars have less gravitational effects.

In the new gravitation law F=-GMm/$(r+H)^2$, when r increases, |F| decreases. So remote stars have less gravitational effects.

2. Surface Gravity constant is close to 9.8 m/s^2 [2].
Let R_e be the radius of earth, the new surface gravity constant is

$$GM/(R_e+H)^2=$$

$$GM/R_e{}^2*(1+H/R_e)^{-2}$$

The Maclaurin series[3] of

$$(1+H/R_e)^{-2}$$

is1-2H/R_e+…

Let $2H/R_e<10^{-6}$ (1)

$$GM/(R_e+H)^2$$

$$=GM/R_e{}^2*(1+H/R_e)^{-2}$$

$$=GMm/R_e{}^2*(1-2H/R_e+..)$$

$\cong GMm/R_e{}^2*(1-10^{-6})$

$\cong GMm/R_e{}^2$

So we have a new surface gravity constant which is close to the old constant with the accuracy of 10^{-6}.

By(1), $2H/R_e<10^{-6}$, we have

H <R_e/2 *10^-6

Because R_e=6,371km[4] so
H<6371*10^3/2*10^-6=3.186m

i.e. H<3.186m (2)

This inequality imposes a constraint on H to make new gravity constant close to the old constant 9.8m/s^2

3. Planets have ellipse motions around the sun

The calculation below follows from 維基百科(Wikipedia in Taiwan) 克普勒定律(Kepler's laws) [5].

A. Kepler's second law : angular momentum L is conserved.

$L=mr^2\dot{\theta}$

So $\dot{\theta}=L/(mr^2)$ (3)

$d/dt=\dot{\theta}*d/d\theta=L/(mr^2)*d/d\theta$

Let u=1/r (4)

thend/dt=Lu^2/m * d/dθ

Thus $\dot{r}$=dr/dt=d/dt * r

=Lu^2/m * d(1/u)/dθ

=-Lu^2/m * 1/u^2 * du/dθ

=-L/m*du/dθ

$\ddot{r}$=d$\dot{r}$/dt=(d/dt)*$\dot{r}$

=(Lu^2/m * d/dθ) * (-L/m*du/dθ)

=-$L^2/m^2*u^2*(d^2u/d\theta^2)$ (5)

B. Following the radial equation from 維基百科(Wikipedia in Taiwan), 克普勒定律(Kelpler's laws).[6]

$\ddot{r} - r\dot{\theta}^2$=-GM/$(r+H)^2$

$= -GM/r^2*(1+H/r)^{-2}$ (6)

The Maclaurin series[2] on H is

$-GM/r^2 * (1+H/r)^{-2}$

= -GM/r^2 * (1-2H/r+…)

Make H sufficient small such that H/r can be neglected to the accuracy of 10^{-6}.For example of the planet Mercury moving around the sun, the shortest distance of the ellipse motion is about 46,001,200km[7], let

2H/r< 2H/46001200km<10^{-6}

⇨ H<23,000m

So the previous constraint on H which is H<3.186m (2) for the second criterion is enough for the third criterion.

By neglecting H, we have come back to the Newtonian acceleration by (6)

$\ddot{r} - r\dot{\theta}^2$=-GM/$r^2$

Substituting $\ddot{r}$ (5), r (4), and $\dot{\theta}$(3),

$-L^2/m^2*u^2*(d^2u/d\theta^2)-L^2/m^2*u^3$

$= -GMu^2$

Divide both sides by $-L^2/m^2*u^2$, we have

$d^2u/d\theta^2$+ u = GMm^2/L^2

We firstly list a particular solution for this differential equation :

u=GMm^2/L^2

Then solve the homogeneous equation

$d^2u/d\theta^2$ + u = 0

⇨ u=C*cos(θ)

The general solution is

u=GMm^2/L^2+C*cos(θ)

By u=1/r, we have the ellipse equation

1/r=GMm^2/L^2 * (1+e*cos(θ))

Where e is the eccentricity of the ellipse :

e=CL^2/(GMm^2)

Therefore planets have ellipse motions around the sun. The third criterion is met.

4. A husband hugs his wife where the distance=0, and they have negligible gravity forces.

   Assume each of the couple weighs 100kg, and let the gravity force at r=0 be smaller than 10^{-6} instead of going to infinity.

   GMm/$(r+H)^2$=G*100kg*100kg/H^2

   <10^{-6}

   So H^2>G*10,000/ 10^{-6}

   Because the Newtonian constant of gravitation[8] is

   G=6.674*$10^{-11}m^3kg^{-1}s^2$

   So H^2>G*10,000/ 10^{-6}=0.6674

   ⇨ H>0.817m (7)

5. Hence, the new gravitation law.meets the 4 criteria.

IV. Conclusion

The new gravitation law F=-GMm/$(r+H)^2$ removes the infinity problem of Newton's gravitation law F=-GMm/r^2 when r=0. And the new law meets the 4 criteria of observed phenomena if H is chosen such that

0.817m < H < 3.186m

by inequality (7) and inequality(2).

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