On the origin of gravitational force

Zhi Cheng

（9 Bairong st. Baiyun District, Guangzhou, China. 510400. gzchengzhi@hotmail.com）

Abstract: Equivalence principle is the basement of general relativity theory. It points out that the gravitational force is equivalent to the inertial force. However, the general relativity theory does not give the reason. In this paper, we assume the space is a kind of elastic media. The energy can take pressure on the space. It will make the space curved. The curved space-time produces gravitational force. This paper gives the mathematical calculation based on elasticity theory to show that this assumption is true. It also gives the accurate relationship between mass and gravitational force. The relationship is in line with the conclusion of general relativity.

Key words: Gravitational force; curved space time; curvature

0 Introduction

In 2012, Cheng assumed that there is a three dimensional time plus one dimensional space structure of space-time besides the well-known three dimensional space plus one dimensional time[1]. And then he constructed the new Maxwell equations which had high symmetric characteristic in space and time [1-3].

The two space-time structure can be distinguished by the velocity of particles. It also affects the length measurement unit. We will analyze the length measurement difference between these two space-time structures. And then we will analyze how the mass compress the space.

1 The length measurement unit in two difference space-time structures

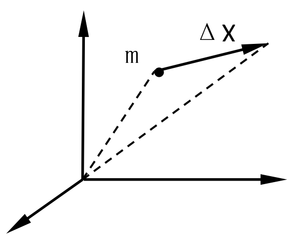

Figure 1. The moving distance of particle m in three dimensional space

We assume a particle “m” moves in the reference frame of three dimensional space. The distance it moved is ΔX as shown in figure 1. Then it will be ΔY in three dimensional time space-time structure unit.

There is the function shown below.

$$\Delta Y = f(\Delta X) \tag{1}$$

Since the two space-time structures are symmetric, then we have

$$\Delta X = f(\Delta Y) \tag{2}$$

Then

$$\frac{\Delta X}{\Delta Y} = \frac{f(\Delta Y)}{f(\Delta X)} \tag{3}$$

So

$$\Delta X f(\Delta X) = \Delta Y f(\Delta Y) = Const.$$

Since

$$\Delta X \Delta Y = f(\Delta Y) f(\Delta X)$$

We have

$$\Delta X \cdot \Delta Y = l_p^{\,2} \tag{4}$$

Where l_p is the constant.

It is the same for time unit.

$$c^2\, \Delta t_x \cdot \Delta t_y = l_p^{\,2} \tag{5}$$

2 The velocity relationships between two difference space-time structures

By differentiating with respect to time in formula (4), we have

$$\frac{d\,\Delta X}{d\Delta t_x} \cdot \Delta Y + \Delta X \cdot \frac{d\,\Delta Y}{d\Delta t_x} = 0$$

That is

$$v \cdot \Delta Y + \Delta X \cdot \frac{d\,\Delta Y}{d\Delta t_x} = 0 \tag{6}$$

Where v is the particle's velocity in three dimensional space reference frame.

By considering formula (4) and (5), we can have

$$v = -\frac{\Delta X}{\Delta Y} \cdot \frac{d\,\Delta Y}{d\Delta t_x} = -\frac{\Delta X^2}{l_p^{\,2}} \cdot \frac{d\,\Delta Y}{d\Delta t_x} \tag{7}$$

$$V = -\frac{\Delta X^2}{l_p^{\ 2}} \cdot \frac{d\,\Delta Y}{d\Delta t_y}\left(-\frac{c^2 \Delta t_y^{\ 2}}{l_p^{\ 2}}\right)$$

$$= \frac{\Delta X^2}{l_p^{\ 2}} \cdot \frac{c^2 \Delta t_y^{\ 2}}{l_p^{\ 2}}\omega$$

Where ω is the particle's velocity measured in three dimensional time's unit.

So we have

$$V = \frac{\Delta X^2}{c^2 \Delta t_x^{\ 2}}\omega$$

If the particle is doing uniform motion, we can always find a reference frame to make

$$\frac{\Delta X}{\Delta t_x} = V$$

If the particle is doing accelerated motion, we can always find a localized inertial reference frame according to general relativity [4]. So we can use the same method to study the velocity relationships between two space-time structures.

Therefore

$$V \cdot \omega = c^2 \qquad (8)$$

Formula (8) reflects the velocities measured in two difference space-time structures units. It is consistent with the conclusions drawn from paper [1-3]. That means the two space-time structures analyzed in this paper is same as the two space-time structures assumed in paper [1,2].

3 The assumption of elastic space-time structures

For totally spherically symmetric space-time structure, we can calculate the results by separating the space and time according to the theory of general relativity [4].

Therefore, we only need to assume that the three dimensional space is made of elastic media.

For a spherical shell which has the inner radius "a", and the outer radius "b", the inner pressure is p_i, and outer pressure is p_o. We can calculate the stress produce by the pressures according to the knowledge of elasticity theory [5]. However, we only need to consider the condition that "b" approaches infinity and p_0 equals zero. So we have

$$k_R = \frac{2\sigma_R}{p_i a^2} = -\frac{2a}{R^3} \qquad (9)$$

$$k_t = \frac{2\sigma_t}{p_i a^2} = \frac{a}{R^3} \qquad (10)$$

The unit of "k_R" and "k_t" is m^{-2} in formula （9）and（10）, which is same as the curvature of three dimensional space.

By comparing formula (9) (10) with the curvature tension of spherically symmetric space that calculated by theory of general relativity [4], we have

$$a = \frac{GM}{c^2} \qquad (11)$$

It shows that the parameter "a" represents the radius of a space hole produced by the mass. The hole will take pressure on the space to turn the flat space into the curved space. The calculation is consistent with the theory of general relativity. We will analyze the deep meaning of "a" in section 4.

4 How mass take pressure on space

The static and motion are relatively in two space-time structure. The so called energy in three dimensional space is refer to the motion energy in generally. This motion energy is produced by the virtual photons according to paper [2,3]. The static energy is referring to mass. However, the static mass in three dimensional space cannot be static in three dimensional time structure according to the analysis in section 1 and 2 in this paper. So we can assume that the mass in one space-time structure is the motion energy or virtual photon energy in other space-time structure. So we can use the virtual photon's wave length to represent the value of mass instead of Compton wave length.

For a particle "m", the correspondent virtual photon's energy in three dimensional time can be expressed as below.

$$mc^2 = \frac{\hbar c}{r_y} \qquad (12)$$

Where r_y is the wavelength radius of three dimensional time. We can use formula (4) to convert it to the length unit of three dimensional space. That is

$$r_y = \frac{l_p^2}{a} \qquad (13)$$

We can obtain formula (14) by entering formula (13) into formula (12).

$$m = \frac{\hbar a}{c l_p^2} \qquad (14)$$

By entering formula (11) into formula (14), we can obtain

$$l_p = \sqrt{\frac{G\hbar}{c^3}} \qquad (15)$$

Obviously, formula (15) is the calculation formula of Planck length [6,7]. However formula (15) has no special demands of the mass. It provides strong theories and experiments support for this paper.

We can find the meaning of parameter “a” from formula (14) now. Formula (9)(10)(11) show that the hole radius “a” is the wavelength of a mass in other space-time structure (three dimensional time). After converting it into the unit of three dimensional space, we can find that it proportional to the mass.

5 Conclusion

So we can make the conclusion from formula (9)(10)(11)(14)(15). The conclusion is that the matter (including one or many particles) will form a space hole. The hole’s radius is proportional to the mass. The hole will take pressure on the space, and make it curved. The curved space will produce gravitational force according to the theory of general relativity.

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