

**An equation that changed the universe:  $\bar{F} = -mc^2/R$**

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**Abstract**

This paper explains the behavior of the entire universe from the smallest to the largest scales, found an equation that changed the universe:  $\bar{F} = -mc^2/R$ , established the expansion theory of the universe without dark matter and dark energy, It shows that gravity is action-at-a-distance and that a gravitational wave is unobservable. Thus, a new universe model is suggested that the universe has a centre consisting of the tachyonic matter.

Keywords: The universe equation; the universe expansion theory

## Introduction

According to Jiang(1975),in the Universe there are two kinds of matter: (1) observable subluminal matter called tardyons(locality) and (2) unobservable superluminal matter called tachyons(nonlocality). They coexist in motion. What are tachyons? Historically tachyons are described as particles which travel faster than light.Describing tachyon as a particle with an imaginary mass is wrong ( Mignani and Recami1974 ) . In our theory( Jiang1975) tachyon has no rest time and no rest mass. It is unobservable. Tachyons can be converted into tardyons and vice versa. Tardyonic rotating motion produces the centrifugal force but tachyonic rotating motion produces the centripetal force which is force of gravity.Using the coexistence principle of tardyons and tachyons it follows that

an equation that changed the universe:  $\bar{F} = -mc^2/R$ . We establish the expansion theory of

a universe without dark matter and dark energy. We unify the gravitational theory and particle theory and explain the behavior of the entire universe from the smallest to the largest scales. In this universe there are no quarks , no Higgs particles ,and no black holes. The geometrization of all physical fields is a mathematical guess which has no basis in physical reality, because it does not consider and understand the tachyonic theory.It shows that gravity is action-at-a-distance and that a gravitational wave is unobservable.We suggest a new universe model that the universe has a centre consisting of the tachyonic matter.

## An equation that Changed the Universe: $\bar{F} = -mc^2/R$

We first define two-dimensional space and time ring( Jiang1975)

$$z = \begin{pmatrix} ct & x \\ x & ct \end{pmatrix} = ct + jx, \quad (1)$$

where  $x$  and  $t$  are the tardyonic space and time coordinates,  $c$  is light velocity in

vacuum,  $j = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ .

(1) can be written in Euler form

$$z = ct_0 e^{j\theta} = ct_0 (\text{ch } \theta + j \text{sh } \theta), \quad (2)$$

where  $ct_0$  is the tardyonic invariance, and  $\theta$  is the tardyonic hyperbolic angle.

From (1) and (2) it follows

$$ct = ct_0 \operatorname{ch} \theta, \quad x = ct_0 \operatorname{sh} \theta \quad (3)$$

$$ct_0 = \sqrt{(ct)^2 - x^2}. \quad (4)$$

From (3) it follows

$$\theta = \operatorname{th}^{-1} \frac{x}{ct} = \operatorname{th}^{-1} \frac{u}{c}. \quad (5)$$

where  $c \geq u$  is the tardyonic velocity,  $\operatorname{ch} \theta = \frac{1}{\sqrt{1-(u/c)^2}}$  and

$$\operatorname{sh} \theta = \frac{u/c}{\sqrt{1-(u/c)^2}}.$$

The  $z$  denotes space-time of the tardyonic theory.

Using the morphism  $j : z \rightarrow jz$ , it follows

$$jz = \bar{x} + jc\bar{t} = \bar{x}_0 e^{j\bar{\theta}} = \bar{x}_0 (\operatorname{ch} \bar{\theta} + j \operatorname{sh} \bar{\theta}), \quad (6)$$

where  $\bar{x}$  and  $\bar{t}$  are the tachyonic space and time coordinates,  $\bar{x}_0$  is tachyonic invariance,  $\bar{\theta}$  tachyonic hyperbolic angle.

From (6) it follows

$$\bar{x} = \bar{x}_0 \operatorname{ch} \bar{\theta}, \quad c\bar{t} = \bar{x}_0 \operatorname{sh} \bar{\theta}. \quad (7)$$

$$\bar{x}_0 = \sqrt{(\bar{x})^2 - (c\bar{t})^2}. \quad (8)$$

From (7) it follows

$$\bar{\theta} = \operatorname{th}^{-1} \frac{c\bar{t}}{\bar{x}} = \operatorname{th}^{-1} \frac{c}{\bar{u}}. \quad (9)$$

where  $\bar{u} \geq c$  is the tachyonic velocity,  $\operatorname{ch} \bar{\theta} = \frac{1}{\sqrt{1-(c/\bar{u})^2}}$  and

$$\operatorname{sh} \bar{\theta} = \frac{c/\bar{u}}{\sqrt{1-(c/\bar{u})^2}}.$$

The  $jz$  denotes space-time of the tachyonic theory. Both the  $z$  and the  $jz$  form the

entire world but the  $jz$  world is unexploited and unstudied.

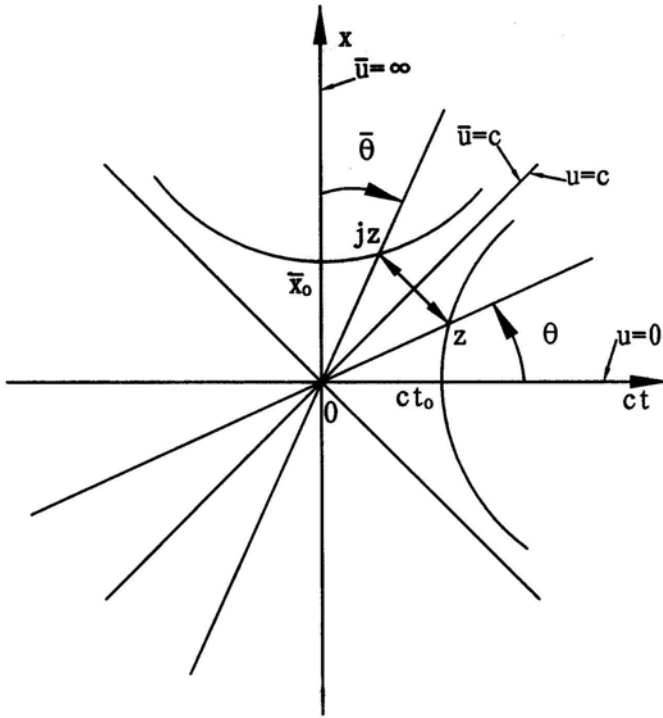


Fig. 1. Minkowskian spacetime diagram

Figure 1 shows the formulas (1)-(9).  $j : z \rightarrow jz$  shows that a tardyon can be converted into a tachyon, but  $j : jz \rightarrow z$  shows that a tachyon can be converted into a tardyon.  $u = 0 \rightarrow u = c$  is a tardyonic velocity, but  $\bar{u} = \infty \rightarrow \bar{u} = c$  is a tachyonic velocity, which coexist. At the  $x$ -axis we define the tachyonic string length

$$\bar{x}_0 = \lim_{\substack{\bar{u} \rightarrow \infty \\ t \rightarrow 0}} \bar{u}t = \text{constant}. \quad (10)$$

where  $t$  is the rest time.

Since at rest the tachyonic string time  $t = 0$  and  $\bar{u} = \infty$ , it shows that the tachyon is a string which is unobservable. In the rest system the tachyonic string motion is an action-at-a distance motion. This simple thought made a deep impression on me. It impelled me toward the only string theory (Jiang1975). Other string theories all are guesses.

Assume  $\theta = \bar{\theta}$ , from (5) and (9) it follows that the tardyonic and tachyonic coexistence

principle(Jiang 1975,1967,2001)

$$u\bar{u} = c^2 \quad (11)$$

Differentiating (11) by the time, it follows

$$\frac{d\bar{u}}{dt} = -\left(\frac{c}{u}\right)^2 \frac{du}{dt}. \quad (12)$$

$\frac{du}{dt}$  and  $\frac{d\bar{u}}{dt}$  can coexist in motion, but their directions are opposite.

We study the tardyonic and tachyonic rotating motions. The tardyonic rotation produces centripetal acceleration

$$\frac{du}{dt} = \frac{u^2}{R}, \quad (13)$$

where  $R$  is rotating radius.

Substituting (13) into (12) it follows that the tachyonic rotating produces centrifugal acceleration

$$\frac{d\bar{u}}{dt} = -\frac{c^2}{R}. \quad (14)$$

It is independent of tachyonic velocity  $\bar{u}$ , only inversely proportional to radius  $R$ .

(13) and (14) are dual formulas, which have the same form. It is unique and perfect. From (13) it follows the tardyonic centrifugal force

$$F = \frac{Mu^2}{R}, \quad (15)$$

where  $M$  is the inertial mass.

From (14) it follows the tachyonic centripetal force, that is gravity

$$\bar{F} = -\frac{mc^2}{R}, \quad (16)$$

where  $m$  is the gravitational mass converted into by tachyonic mass  $\bar{m}$  which is unobservable but  $m$  is observable.

Whether  $u = 0$  or  $u \neq 0$ , all matter produces gravity. (15) and (16) are dual formulas, which have the same form. (16) is a new gravitational formula called an equation that changed the universe. This simple thought made a deep impression on me. It impelled me

toward a theory of gravitation. It has simplicity, elegance and mathematical beauty. It is the foundations of gravitational theory and cosmology. In the universe there are two main forces: the tardyonic centrifugal force (15) and tachyonic centripetal force (16) which make structure formation of the universe.

Now we study the freely falling body. Tachyonic mass  $\bar{m}$  can be converted into tardyonic mass  $m$ , which acts on the freely falling body and produces the gravitational force

$$\bar{F} = -\frac{mc^2}{R}, \quad (17)$$

where  $R$  is the Earth radius.

We have the equation of motion

$$\frac{mc^2}{R} = Mg, \quad (18)$$

where  $g$  is gravitational acceleration,  $M$  is mass of freely falling body.

From (18) it follows the gravitational coefficient

$$\eta = \frac{m}{M} = \frac{Rg}{c^2} = 6.9 \times 10^{-10}. \quad (19)$$

Eötvös(1922) experiment  $\eta \sim 5 \cdot 10^{-9}$  and Dicke experiment  $\eta \sim 10^{-11}$  (Misner 1973).

Since the gravitational mass  $m$  can be transformed into the rest mass in freely falling body, we define Einstein's gravitational mass  $M_g = M_i + m$  and inertial mass  $M_i = M$  (Enstein1967). It follows

$$M_g > M_i. \quad (20)$$

Therefore it shows that the principle of equivalence is nonexistent.

## **The expansion theory of the universe**

The Big Bang threw all the matter in the universe outwards. Both Newton's and Einstein's theories of gravity predict that the expansion must be slowing down to some degree: the mutual gravitational attraction of all the matter in all the galaxies should be pulling them inwards. But measurements of distant supernovae show just the opposite Perlmutter(2003). All the matter in the universe appears to be accelerating outwards. Its speed is picking up. There is no agreement yet about how to explain these mysterious observations. Now we explain our accelerating universe.

Using (16) we study the expansion theory of the Universe. Figure 2 shows a expansion model of the Universe. The rotation  $\omega_1$  of body  $A$  emits tachyonic flow, which forms the tachyonic field. Tachyonic mass  $\bar{m}$  acts on body  $B$ , which produces its rotation  $\omega_2$ , revolution  $u$  and gravitational force

$$\bar{F}_1 = -\frac{mc^2}{R}, \quad (21)$$

where  $R$  denotes the distance between body  $A$  and body  $B$ ,  $m$  is gravitational mass converted into by tachyonic mass  $\bar{m}$  which is unobservable but  $m$  is observable. The revolution of the body  $B$  around body  $A$  produces the centrifugal force

$$F_1 = \frac{M_B u^2}{R}, \quad (22)$$

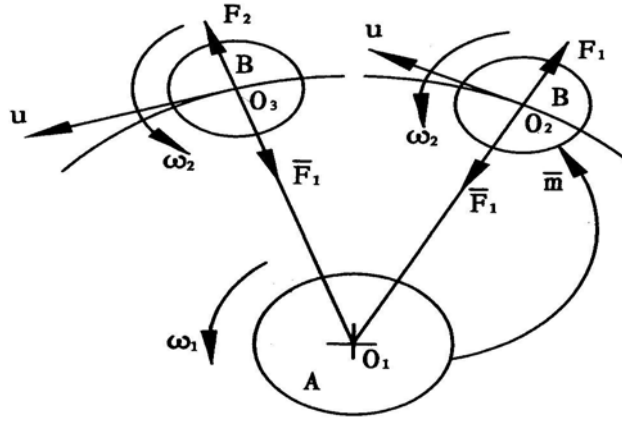


Fig. 2. A expansion model of the Universe

where  $M_B$  is the inertial mass of body  $B$ ,  $u$  is the orbital velocity of body  $B$ . At the  $O_2$  point we assume

$$F_1 + \bar{F}_1 = 0. \quad (23)$$

From (21)-(23) it follows the gravitational coefficient

$$\eta = \frac{m}{M_B} = \left(\frac{u}{c}\right)^2. \quad (24)$$

At the  $O_3$  point the tachyonic mass  $\bar{m}$  can be converted into the rest mass  $m$  in body  $B$ , it follows

$$F_2 = \frac{M_B u^2}{R} + \frac{m u^2}{R}. \quad (25)$$

Since  $F_2 + \bar{F}_1 > 0$ , centrifugal force  $F_2$  is greater than gravitational force  $\bar{F}_1$ , then the body  $B$  expands outwards and its mass increases. This is a expansion mechanism of the Universe. If body  $A$  is the Earth, then body  $B$  is the Moon; if body  $A$  is the Sun, then body  $B$  is the Earth;  $\dots$ . It can explain our accelerating universe. In this model universe there are no dark matter and no dark energy. This simple thought made a deep impression on me. It impelled me toward a expansion theory of the universe without dark matter and dark energy.

If the body  $A$  is the Sun and body  $B$  is the planet. We calculate the gravitational coefficients  $\eta$  as shown in table 1.

Table 1: Values of the gravitational coefficients  $\eta$

Planet	$u$ (km/sec)	$\eta(10^{-10})$
Mercury	47.89	255.2
Venus	35.03	136.5
Earth	29.79	98.7
Mars	24.13	64.8
Jupiter	13.06	19.0
Saturn	9.64	10.3
Uranus	6.81	5.2
Neptune	5.43	3.3
Pluto	4.74	2.5

Since gravitational mass  $m$  can be transformed into the rest mass in body  $B$ , we define Einstein's gravitational mass  $M_g = M_i + m$  and inertial mass  $M_i = M_B$  (Einstein1967).

It follows

$$M_g > M_i. \quad (26)$$

Therefore it shows that the principle of equivalence in the Solar system is nonexistent. Of all the principles at work in gravitation, none is more central than the principles of equivalence (Misner1973), which could be wrong.

The tachyonic mass  $\bar{m}$  can be converted into electrons and positrons which are the basic building-blocks of elementary particles (Jiang1979,1988). In this universe there are no Higgs particles. They have not been produced at the Large Hadron Collider and other particle accelerators.

From (21) it follows Newtonian gravitational formula. The  $m$  is proportional to  $M_A$ , which denotes inertial mass of body  $A$ , in (24)  $m$  is proportional to  $M_B$ , is inversely proportional to the distance  $R$  between body  $A$  and body  $B$ . It follows

$$m = k \frac{M_A M_B}{R}, \quad (27)$$

where  $k$  is a constant.

Substituting (27) into (21) it follows Newtonian gravitational formula( Jiang1975,1976)

$$\bar{F}_1 = -G \frac{M_A M_B}{R^2}, \quad (28)$$

where  $G = kc^2$  is a gravitational constant.

We have Einstein's gravitational mass

$$M_g = M_i + m = M_i(1 + \eta). \quad (29)$$

Substituting (29) into (28) it follows Newtonian generalized gravitational formula

$$\bar{F}_1 = -G \frac{M_A(1 + \eta_A)M_B(1 + \eta_B)}{R^2}, \quad (30)$$

where  $\eta_A$  and  $\eta_B$  denote gravitational coefficients of body  $A$  and body  $B$  separately.

Assume  $\rho_A$  and  $\rho_B$  denote the densities of body  $A$  and body  $B$  separately. In the same way from (21) it follows a unified formula of the gravitational and strong forces Jiang(2001)

$$\bar{F}_1 = -G_0 \frac{\rho_A M_A(1 + \eta_A)\rho_B M_B(1 + \eta_B)}{R^2} \quad (31)$$

where  $G_0 = 5.2 \times 10^{-10} \text{ cm}^9/\text{g}^3 \cdot \text{sec}^2$  is a new gravitational constant.

In the nucleus exists the strong interactions. It follows(Jiang2001)

$$\frac{\text{Strong interaction}}{\text{Gravitational interaction}} = \frac{G_s}{G_g} = 10^{38} \quad (32)$$

where  $G_g = 6.7 \times 10^{-8} \text{ cm}^3/\text{g} \cdot \text{sec}^2$  and  $G_s = 6.7 \times 10^{30} \text{ cm}^3/\text{g} \cdot \text{sec}^2$

In the nucleus we assume  $\rho_A = \rho_B = \rho$ . From (31) it follows

$$G_s = G_0 \rho^2 \quad (33)$$

From (33) it follows the formula of the particle radii

$$r = 1.55[m(\text{Gev})]^{1/3} \text{ jn}, \quad (34)$$

where  $1 \text{ jn} = 10^{-15} \text{ cm}$  and  $m$  (Gev) is the mass of the particles.

From (34) it follows that the proton and neutron radii are 1.5 jn (Jiang1996). Pohl et al (2010) measure the proton diameter 3 jn.

We have the formula of the nuclear radii

$$r = 1.2(A)^{1/3} \text{ fm}, \quad (35)$$

where  $1 \text{ fm} = 10^{-13} \text{ cm}$  and  $A$  is its mass number.

It shows that (34) and (35) have the same form. The particle radii  $r < 5 \text{ jn}$  and the nuclear radii  $r < 7 \text{ fm}$ .

Similar to equation (10) we define the tachyonic momentum of a string length  $\bar{x}_0$  (Jiang1975,2001).

$$\bar{P}_0 = \lim_{\substack{m_0 \rightarrow 0 \\ \bar{u} \rightarrow \infty}} m_0 \bar{u} = \text{const}, \quad (36)$$

where  $m_0$  is tachyonic string rest mass.

Since  $\bar{u} \rightarrow \infty$  and  $t = 0$ , tachyonic string has no rest mass and no rest time, it shows that tachyon is unobservable, that gravity is action-at-a-distance and gravitational wave is unobservable. If quantum teleportation, quantum computation and quantum information (Horodechi et al.2009) are the tachyonic motion, then they are unobservable.

## A new universe model

From above we suggest a new universe model. The universe is infinite, but it has a centre consisting of the tachyonic matter, which dominates motion of the entire universe. Therefore the universe is stable.....In the sun there is a centre consisting of the tachyonic matter, which dominates motion of the sun system. In the earth there is a centre consisting of the tachyonic matter, which dominates motion of the earth and the moon. In the moon there is a centre consisting of the tachyonic matter, which dominates motion of the moon. In atomic nucleus there is a centre consisting of the tachyonic matter, which dominates motion of the nucleus. Therefore atomic nuclei are stable.

## Remarks

Special relativity is the tardyonic theory. Einstein pointed out that velocities greater than that of light have –as in our previous results–no possibility of existence (Einstein1905) , which could be wrong. But gravitation is the tachyonic theory and an action-at-a-distance.

What is gravity? Newton wrote, “I have not been able to discover the cause of those properties of gravity from phenomena, and I frame no hypotheses ...”. Einstein’s theory of general relativity answered Newton’s question: mass causes space-time curvature which is wrong. Gravity is the tachyonic centripetal force.

Where did we come from? Where are we going ? What makes up the universe? These questions have occupied mankind for thousands of years. Over the course of history, our view of the world has changed. Theologians and philosophers, physicists and astronomers have given us very different answers. Where did we come from ? We answer this questions this way  $\bar{m} \rightarrow m$  ,tachyons  $\rightarrow$  tardyons, that is gravitons can be converted into the electrons and positrons which are the basic building-blocks of particles. In this model Universe there are no quarks and no Higgs particles. Where are we going? We answer this question this way  $m \rightarrow \bar{m}$  , that is the tardyons produce tachyons. The tardyons and tachyons make up the Universe.

Jiang(1976) found a gravitational formula :  $\bar{F} = -\bar{m}c^2/R$ , where  $\bar{m}$  is the tachyonic mass. Jiang(2004) studied the Universe expansion and found  $\bar{F} = -mc^2/R$ , where  $m$  is gravitational mass converted into by tachyonic mass  $\bar{m}$  .

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