

To Demonstrate That Gravity Is Action-at-a-distance

Chun-Xuan. Jiang

P. O. Box 3924, Beijing 100854, P. R. China

Jiangchunxuan@vip.sohu.com

Abstract

In this paper we explain the behavior of the entire universe from the smallest to the largest scales. We found the only tachyonic string theory (other string theories all are guesses), find an equation that changed the universe: $\bar{F} = -mc^2/R$, establish the expansion theory of the universe without dark matter and dark energy, and prove that the principle of equivalence is nonexistent. We demonstrate that gravity is action-at-a-distance and that a gravitational wave is unobservable. We suggest a new universe model.

PACS numbers: 04. 90. +e, 11. 25.-w.

1 Introduction

According to [1], in the Universe there are two stuffs: (1) observable subluminal matter called tardyons(locality) and (2) unobservable superluminal string 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. In our theory [1] tachyon is a string which 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 string rotating motion produces the centripetal force which is force of gravity. Using the tachyonic string length \bar{x}_0 we found the only string theory, other string theories are guesses. Using the coexistence principle of tardyons and tachyons we find

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 and no Higgs particles. We prove that Einstein's principle of equivalence is nonexistent. Therefore in this model universe the general theory of relativity is wrong. In this universe there are 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 string theory. We demonstrate that gravity is action-at-a-distance and that a gravitational wave is unobservable. We suggest a new universe model.

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

We first define two-dimensional space and time ring [1]

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

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 θ is the tardyonic hyperbolic angle.

From (1) and (2) we have

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

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

From (3) we have

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

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 $j : z \rightarrow jz$, we have

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

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) we have

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

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

From (7) we have

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

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.

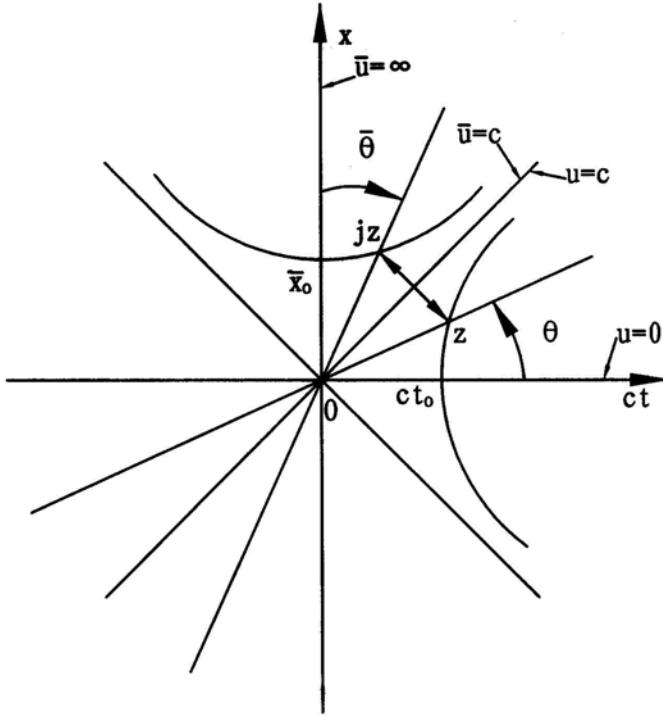


Fig. 1. Minkowskian spacetime diagram

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 $\bar{u} = \infty$, we prove 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 [1]. Other string theories all are guesses.

Assume $\theta = \bar{\theta}$, from (5) and (9) we get the tardyonic and tachyonic coexistence principle [1-3]

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

Differentiating (11) by the time, we get

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

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

We study the tardyonic and tachyonic rotating motions. In 1673 Huygens discovered that rotation produces centripetal acceleration

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

where R is rotating radius.

Substituting (13) into (12) we have the tachyonic string centrifugal acceleration

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

It is independent of tachyonic velocity \bar{u} and tardyonic velocity 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) we get the tardyonic centrifugal force

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

where M is the inertial mass.

From (14) we get the tachyonic string centripetal force, that is gravity

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

where m is the gravitational mass converted into by tachyonic string 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 string centripetal force (16) which make structure formation of the universe.

Now we study the freely falling body. Tachyonic string 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) we define the gravitational coefficient

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

In 1922 Eötvös experiment $\eta \sim 5 \cdot 10^{-9}$ and in 1964 Dicke experiment $\eta \sim 10^{-11}$ [4]. 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 $M_i = M$ [5]. We prove

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

Therefore we prove that the principle of equivalence is nonexistent. At the heart of the general theory of relativity is the principle of equivalence. Therefore the general theory of relativity and conjecture that black holes exist could all be wrong.

3 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 [6]. 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 ω_1 of body A emits tachyonic string flow, which forms the tachyonic string field. Tachyonic string mass \bar{m} acts on body B , which produces its rotation ω_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 string mass \bar{m} which is unobservable but m is observable. The revolution of the body B around body A produces the centrifugal force

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

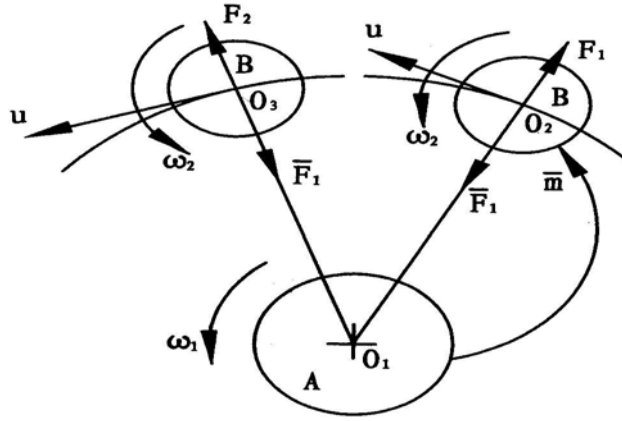


Fig. 2. A expansion model of the Universe

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) we have the gravitational coefficient

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

At the O_3 point the tachyonic string mass \bar{m} can be converted into the rest mass m in body B , we have

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

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 coefficient η as shown in table 1.

Table 1.

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 $M_i = M_B$ [5].

We prove

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

Therefore we prove 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 [4], which could be wrong.

The tachyonic string mass \bar{m} can be converted into electrons and positrons which are the basic building-blocks of elementary particles [7, 8]. In this universe there are no Higgs particles. They have not been produced at the Large Hadron Collider and other particle accelerators.

From (21) we derive 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 . We have

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

where k is a constant.

Substituting (27) into (21) we have Newtonian gravitational formula [2-3]

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

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) we have Newtonian generalized gravitational formula

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

where η_A and η_B denote gravitational coefficients of body A and body B separately.

Assume ρ_A and ρ_B denote the densities of body A and body B separately. In the same way from (21) we get a unified formula of the gravitational and strong forces[3]

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

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. We have [3]

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

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) we have

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

From (33) we have 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) we have that the proton and neutron radii are 1.5 jn [3].

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 is 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 [1, 3]

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

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, we prove tachyon is unobservable. We demonstrate that gravity is action-at-a-distance and gravitational wave is unobservable. If quantum teleportation, quantum computation and quantum information are action-at-a-distance, then they are unobservable.

4 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.

5 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 [9], which could be wrong. But gravitation is the tachyonic string theory and an action-at-a-distance.

It had long been known that gravitational mass (the m in $F = GMm/r^2$, where F is the gravitational attraction between two masses a distance r apart and G is Newton's gravitational constant) is the same as *inertial* mass (the m in $F = ma$, where a is the acceleration caused by a force F). In 1907 Einstein realized that this seeming coincidence was in fact a consequence of something much deeper, which he later named the principle of equivalence. Gravity could therefore be regarded as a result of moving between accelerating (or non-inertial) frames of reference. Since Newton's law of gravitation $F = GMm/r^2$ and Newton's second law of motion $F = ma$ are two different laws, the principle of equivalence is nonexistent.

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 string centripetal force.

Evolution of the theory of black holes. In 1915 Albert Einstein's general theory of relativity describes how matter and energy bend space-time. In 1916 Karl Schwarzschild solves

Einstein's equations for the case of a very dense point mass. In 1965 Roger Penrose develops the idea of a singularity, a point where space becomes infinitely dense. In 1967 John Wheeler coins the term "black hole" to describe a star that collapses to a singularity. In 1969 Penrose suggests that singularities are hidden behind an event horizon. In 1973 Stephen Hawking and Jacob Bekenstein calculate the entropy – a measure of the amount of information-in a black hole and get a very large answer. In 1975 Hawking shows quantum mechanics predicts that energy escapes from black holes. He and colleague Kip Thorne bet John Preskill that this Hawking radiation cannot carry information. In 1996 Andrew Strominger and Cumrun Vafa use string theory to calculate the entropy of a black hole, getting the same answer as Hawking and Bekenstein. In 2004 calculations in quantum mechanics and string theory suggest that information can escape from black holes. Hawking concedes the bet. Models of black holes from string theory cast doubt on the idea of the singularity. Since general theory of relativity is wrong, in the Universe there are no black holes.

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.

Einstein experience with the creation of general relativity: *But the creative principle resides in mathematics. In a certain sense, therefore, I hold it true that pure thought can grasp reality, as the ancients dreamed. (A passage in Einstein's 1933 Herbert Spencer Lecture.)*. It gave direction to later theoretical research, and its influence on fundamental physics will extend well into the 21st century. They can conjecture the physical reality in studying Riemannian geometry, curved spacetime, superstrings, supersymmetry, black holes, dark matter, dark energy, cosmological constant, brane world, theory of everything, Big Bang, inflation, Higgs physics and other, which could all be guesses, because they do not consider and understand the gravitational nature, the tachyonic string theory and an equation that changed the Universe : $\bar{F} = -mc^2/R$.

Note. In 1976 I find a gravitational formula [2]: $\bar{F} = -\bar{m}c^2/R$, where \bar{m} is the

tachyonic string mass. In 2004 I study the Universe expansion and find $\bar{F} = -mc^2/R$, where m is gravitational mass converted into by tachyonic string mass \bar{m} .

References

1. C. X. Jiang, A theory of morphisms between the tardyons and tachyons, *Wuli (Physics) (Chinese)*, 4, 119-125 (1975).
2. C. X. Jiang, On nature of gravity, *J. Beijing Observatory (Chinese)*, 7, 32-38 (1976).
3. C. X. Jiang, A unified theory of the gravitational and strong interactions, *Hadronic J.* 24, 629-638 (2001).
4. C. W. Misner, K. S. Thorne and J. A. Wheeler, *Gravitation* (Freeman, 1973), P. 1050, 1060.
5. A. Einstein, *The Meaning of Relativity* (6th ed., Chapman and Hall, London, 1967), p. 56.
6. S. Perlmutter, Supernovae, dark energy, and the accelerating universe, *Physics Today*, 53-59, April (2003).
7. C. X. Jiang, A simple approach to the computation of the total number of hadronic constituents in Santilli model, *Hadronic J.* 3, 256-292 (1979).
8. C. X. Jiang, A mathematical model for particle classification, *Acta Math. Scientia*, 8, 133-144 (1988).
9. A. Einstein, Zur elektrodynamik bewegter Korper, *Ann. Phys.*, 17, 891-921 (1905).

