A New Gravitational Formula: $\overline{F} = -\frac{mc^2}{R}$

[一个新的引力公式]

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Abstract: We find a new gravitational formula, establish the expansion theory of the Universe, show that gravitons can be converted into rest mass, prove that Einstein's gravitational mass is greater than inertial mass, derive Newtonian gravitational formula, and prove that tachyon is unobservable.

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In the Universe there are two matters: (1) observable subluminal matter called tardyon and (2) unobservable superluminal matter called tachyon which coexist in motion. Tachyon can be converted into tardyon, and *vice versa*. Tardyonic rotating motion produces the centrifugal force, but tachyonic rotating motion produces the centripetal force, that is gravity. In this paper using tardyonic and tachyonic coexistence principle we find a new gravitational formula, establish the expansion theory of the Universe, prove that Einstein's gravitational mass is greater than inertial mass.

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

$$Z = \begin{pmatrix} ct & x \\ x & ct \end{pmatrix} = ct + jx, \tag{1}$$

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 as Euler form

$$Z = ct_0 e^{j\theta} = ct_0(\mathrm{ch}\,\theta + j\,\mathrm{sh}\,\theta), \tag{2}$$

where ct_0 is the tardyonic invariance, θ tardyonic hyperbolical angle.

From (1) and (2) we have

$$ct = ct_0\,\mathrm{ch}\,\theta, \quad x = ct_0\,\mathrm{sh}\,\theta \tag{3}$$

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

From (3) we have

$$\theta = \mathrm{th}^{-1}\frac{x}{ct} = \mathrm{th}^{-1}\frac{u}{c}. \tag{5}$$

where $c \geq u$ is the tardyonic velocity.

Using the morphism $j: z \to jz$, we have

$$jz = \overline{x} + jc\overline{t} = \overline{x}_0 e^{j\overline{\theta}} = \overline{x}_0(\mathrm{ch}\,\overline{\theta} + j\,\mathrm{sh}\,\overline{\theta}), \tag{6}$$

where $\overline{x}$ and $\overline{t}$ are the tachyonic space and time coordinates, $\overline{x}_0$ is tachyonic invariance, $\overline{\theta}$ tachyonic

hyperbolical angle.
From (6) we have

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

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

From (7) we have

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

where $\bar{u} \geq c$ is the tachyonic velocity.

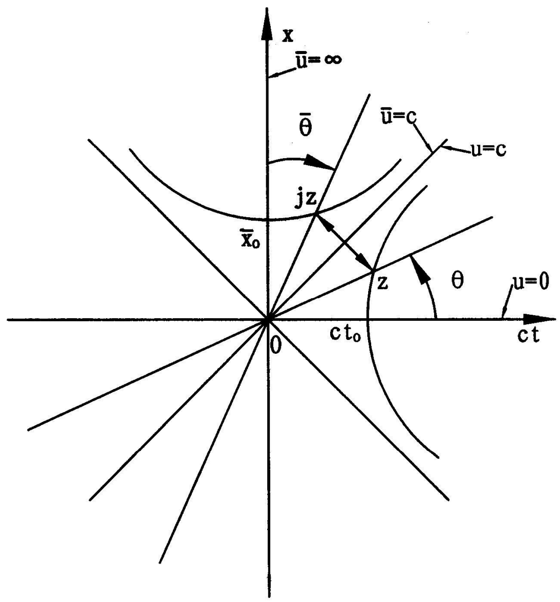

Fig. 1. Tardyonic and tachyonic coexistence principle

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

$$L_0 = \lim_{\substack{\bar{u} \to \infty \\ t \to 0}} \bar{u} t = \text{constant}. \tag{10}$$

Since at rest the tachyonic time $t = 0$ and $\bar{u} = \infty$, we prove that tachyon is unobservable. Assume $\theta = \bar{\theta}$, from (5) and (9) we get the tardyonic and tachyonic coexistence principle [2-3]

$$u\bar{u} = c^2. \tag{11}$$

Differentiating (11) by the time, we get

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

$\frac{du}{dt}$ 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 the tardyonic rotation produces centripetal acceleration

$$\frac{du}{dt} = \frac{u^2}{R}, \tag{13}$$

where R is rotating radius.
Substituting (13) into (12) we have the tachyonic centrifugal acceleration

$$\frac{d\overline{u}}{dt} = -\frac{c^2}{R}. \tag{14}$$

(13) and (14) are twin formulas, which have the same form. From (13) we get the tardyonic centrifugal force

$$F = \frac{Mu^2}{R}, \tag{15}$$

where M is the inertial mass.
From (14) we get the tachyonic centripetal force, that is gravity

$$\overline{F} = -\frac{mc^2}{R}, \tag{16}$$

where m is the gravitational mass converted into by tachyonic mass $\overline{m}$.
(15) and (16) are twin formulas, which have the same form. (16) is a new gravitational formula.
Now we study the freely falling body. Tachyonic mass $\overline{m}$ can be converted into tardyonic mass m, which acts on the freely falling body and produces the gravitational force

$$\overline{F} = -\frac{mc^2}{R}, \tag{17}$$

where R is the Earth radius.
We have the equation of motion

$$\frac{mc^2}{R} = Mg, \tag{18}$$

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

From (18) we define the gravitational coefficient

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

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 $M_i = M$ [4]. We prove

$$M_g > M_i. \tag{20}$$

Therefore we prove that the principle of equivalence and the universality of free fall are nonexistent.

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 flow, which forms the tachyonic field. Tachyonic mass $\overline{m}$ acts on body B, which produces its rotation ω_2, revolution u and gravitational force

$$\overline{F}_1 = -\frac{mc^2}{R}, \tag{21}$$

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

$$F_1 = \frac{M_B u^2}{R}, \tag{22}$$

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

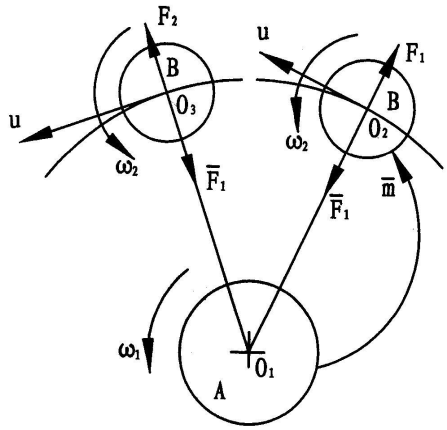

Fig. 2. A expansion model of the Universe

$$F_1 + \overline{F}_1 = 0. \tag{23}$$

From (21)-(23) we have the gravitational coefficient

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

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

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

Since $F_2 + \overline{F}_1 > 0$, centrifugal force F_2 is greater than gravitational force $\overline{F}_1$, then the body B expands 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; $\cdots$. If the body A is the Sun and body B is the planet. We calculate the gravitational coefficient η as shown in table 1.

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 $M_i = M_B$ [4].

We prove

$$M_g > M_i. \tag{26}$$

Therefore we prove that the principle of equivalence in the Solar system is nonexistent.

From (21) we derive Newtonian gravitational formula. The m is proportional to M_A, which denotes 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]

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

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

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

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]

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

where $G_0 = 5.2\times10^{-10}$ cm^9/g^3 • sec^2 is a new gravitational constant.

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

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