The light velocity in the special relativity theory in the Earth's gravity field

Sangwha-Yi

Department of Math , Taejon University 300-716

ABSTRACT

The theory is the light velocity's theory in the special relativity theory in the gravity field. You can consider that this gravity field treats the Earth gravity field. In this time, if Earth mass is M and Earth radius is R_0, the light's velocity is $\frac{c}{\alpha_0} = c\sqrt{1 - \frac{2GM}{R_0 c^2}}$ instead of c.Hence, In the Earth, every special relativity's experiment is more accurate by using the light speed $c(M, R_0) = \frac{c}{\alpha_0} = c\sqrt{1 - \frac{2GM}{R_0 c^2}}$ is measured in the Earth.

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e-mail address:sangwha1@**nate.com**

Tel:051-624-3953

I. Introduction

The article treats that the light velocity theory is in the special relativity theory in the gravity field. You can consider that this gravity field treats the Earth gravity field.

In the general relativity theory, the light speed is

$$d\tau^2 = (1-\frac{2GM}{rc^2})dt^2 - \frac{1}{c^2}[\frac{dr^2}{(1-\frac{2GM}{rc^2})} + r^2 d\theta^2 + r^2 \sin^2\theta d\phi^2] = 0 \quad (1)$$

In the Earth, if the Earth radius is R_0 and the Earth mass is M, the light speed V is

$$r = R_0, dr = 0, V = \frac{ds}{dt} = \sqrt{R_0^{\ 2}(\frac{d\theta}{dt})^2 + R_0^{\ 2}\sin^2\theta(\frac{d\phi}{dt})^2} = c\sqrt{1-\frac{2GM}{R_0c^2}} = \frac{c}{\alpha_0}$$

$$\alpha_0 = 1/\sqrt{1-\frac{2GM}{R_0c^2}} \quad (2)$$

Hence, the light's velocity of this theory is $\frac{c}{\alpha_0}$ in the Earth. In this theory, be able to consider that the light has the velocity $\frac{c}{\alpha_0}$. Therefore, in the free time-space, the speed of Electro-magnetic wave c is

$$c = \frac{1}{\sqrt{\varepsilon_0\mu_0}} \quad (3)$$

ε_0 is the permittivity constant in the free time-space,

μ_0 is the permeability constant in the free time-space

$$\frac{c}{\alpha_0} = c\sqrt{1-\frac{2GM}{R_0c^2}} = \frac{1}{\sqrt{\varepsilon_0(M,R_0)\mu_0(M,R_0)}} \quad (4)$$

$\varepsilon_0(M,R_0)$ is the permittivity constant in the Earth's gravity field ,

$\mu_0(M,R_0)$ is the permeability constant in the Earth's gravity field.

In the Earth, every special relativity's experiment is more accurate by using the light speed $c(M,R_0) = \frac{c}{\alpha_0} = c\sqrt{1-\frac{2GM}{R_0c^2}}$ is measured in the Earth.

II. Additional chapter

Therefore, in the Earth, in the special relativity theory, if it uses the light speed $\frac{c}{\alpha_0} = c\sqrt{1-\frac{2GM}{R_0c^2}}$ instead of c.

$$t = \frac{\tau}{\sqrt{1-\alpha_0{}^2\frac{u^2}{c^2}}} \qquad (5) \quad \alpha_0 = 1/\sqrt{1-\frac{2GM}{R_0c^2}}\ .$$

In this theory,

$$d\tau^2 = dt^2(1-\alpha_0{}^2\frac{u^2}{c^2}) = dt^2 - \alpha_0{}^2\frac{1}{c^2}(dx^2+dy^2+dz^2)$$

$$= dt^2(1-\alpha_0{}^2\frac{u^2}{c^2}) = dt^2 - \frac{1}{c^2}\alpha_0{}^2(dx^2+dy^2+dz^2)$$

$$= dt'^2(1-\alpha_0{}^2\frac{u'^2}{c^2}) = dt'^2 - \frac{1}{c^2}\alpha_0{}^2(dx'^2+dy'^2+dz'^2) \quad (6)$$

$$x = \frac{x'+v_0t'}{\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}}}, t = \frac{t'+\alpha_0{}^2\frac{v_0}{c^2}x'}{\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}}}, x' = \frac{x-v_0t}{\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}}},\ \ t' = \frac{t-\alpha_0{}^2\frac{v_0}{c^2}x}{\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}}} \quad (7)$$

$$y = y', z = z'$$

$$V = \frac{dx}{dt} = \frac{\frac{dx'}{dt'}+v_0}{1+\alpha_0{}^2\frac{v_0}{c^2}\frac{dx'}{dt'}} = \frac{u+v_0}{1+\alpha_0{}^2\frac{v_0}{c^2}u}, \quad u = \frac{dx'}{dt'} \qquad (8)$$

In the example, the light is

$$d\tau^2 = dt^2(1-\alpha_0{}^2\frac{u^2}{c^2}) = dt^2 - \frac{1}{c^2}\alpha_0{}^2(dx^2+dy^2+dz^2) = 0$$

$$cdt = \alpha_0 ds,\ \ ds = \sqrt{dx^2+dy^2+dz^2}\ , \frac{ds}{dt} = \frac{c}{\alpha_0}$$

$$d\tau^2 = dt'^2 - \frac{1}{c^2}\alpha_0{}^2(dx'^2+dy'^2+dz'^2) = 0$$

$$cdt' = \alpha_0 ds', ds' = \sqrt{dx'^2+dy'^2+dz'^2}\ , \frac{ds'}{dt'} = \frac{c}{\alpha_0} \qquad (9)$$

The light's velocity of the this theory is $\frac{c}{\alpha_0}$

In this time, the mass m_0 is

$$m = \frac{m_0}{\sqrt{1-\alpha_0{}^2\frac{u^2}{c^2}}} \qquad (10)$$

$$m = \frac{E}{c^2}\alpha_0{}^2$$

In this theory, the particle's the force F and the kinetic energy KE, the power P, the momentum p, the total energy E are

$$p^{\alpha} = m_0 \frac{dx^{\alpha}}{d\tau}$$

$$F = m_0 a = \frac{d}{dt}\left(\frac{m_0 u}{\sqrt{1-\alpha_0{}^2 \frac{u^2}{c^2}}}\right) = \frac{dp}{dt}$$

$$KE = \int_0^u u d\left(\frac{m_0 u}{\sqrt{1-\alpha_0{}^2 \frac{u^2}{c^2}}}\right) = \frac{m_0 c^2 / \alpha_0{}^2}{\sqrt{1-\alpha_0{}^2 \frac{u^2}{c^2}}} - m_0 c^2 / \alpha_0{}^2 = E - m_0 c^2 / \alpha_0{}^2$$

$$P = \frac{d(KE)}{dt} = \frac{d}{dt}\left(\frac{m_0 c^2 / \alpha_0{}^2}{\sqrt{1-\alpha_0{}^2 \frac{u^2}{c^2}}} - m_0 c^2 / \alpha_0{}^2\right) = F \cdot u = \frac{d}{dt}\left(\frac{m_0 u}{\sqrt{1-\alpha_0{}^2 \frac{u^2}{c^2}}}\right) \cdot u \quad (11)$$

And

$$E^2 = \frac{m_0{}^2 c^4 / \alpha_0{}^4}{1-\alpha_0{}^2 \frac{u^2}{c^2}} = m_0{}^2 c^4 / \alpha_0{}^4 + p^2 c^2 / \alpha_0{}^2 = m_0{}^2 c^4 / \alpha_0{}^4 + \frac{m_0{}^2 u^2 c^2}{1-\alpha_0{}^2 \frac{u^2}{c^2}}$$

$$= \frac{m_0{}^2 c^4 (1-\alpha_0{}^2 \frac{u^2}{c^2}) \frac{1}{\alpha_0{}^4} + m_0{}^2 u^2 c^2 / \alpha_0{}^2}{1-\alpha_0{}^2 \frac{u^2}{c^2}} = \frac{m_0{}^2 c^4 / \alpha_0{}^4}{1-\alpha_0{}^2 \frac{u^2}{c^2}}$$

$$E' = \frac{m_0 c^2 / \alpha_0{}^2}{\sqrt{1-\alpha_0{}^2 \frac{u^2}{c^2}}}\ ,\ p' = \frac{m_0 u}{\sqrt{1-\alpha_0{}^2 \frac{u^2}{c^2}}},$$

$$V = \frac{dx}{dt} = \frac{\frac{dx'}{dt'} + v_0}{1+\alpha_0{}^2 \frac{v_0}{c^2}\frac{dx'}{dt'}} = \frac{u+v_0}{1+\alpha_0{}^2 \frac{v_0}{c^2} u}, \quad u = \frac{dx'}{dt'}$$

$$E=\frac{m_0c^2/\alpha_0{}^2}{\sqrt{1-\alpha_0{}^2\frac{V^2}{c^2}}}=\frac{m_0c^2(1+\alpha_0{}^2\frac{v_0}{c^2}u)\frac{1}{\alpha_0{}^2}}{\sqrt{1-\alpha_0{}^2\frac{u^2}{c^2}}\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}}}=\frac{E'+v_0p'}{\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}}}$$

$$,p=\frac{m_0V}{\sqrt{1-\alpha_0{}^2\frac{V^2}{c^2}}}=\frac{m_0(u+v_0)}{\sqrt{1-\alpha_0{}^2\frac{u^2}{c^2}}\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}}}=\frac{p'+\frac{v_0}{c^2}\alpha_0{}^2E'}{\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}}} \qquad (12)$$

If $a=a_0$,

$$a=a_0=\frac{d}{dt}\left(\frac{u}{\sqrt{1-\alpha_0{}^2\frac{u^2}{c^2}}}\right),\ u=\frac{dx}{dt}=\frac{a_0t}{\sqrt{1+\frac{\alpha_0{}^2a_0{}^2t^2}{c^2}}}$$

$$x=\frac{c^2}{a_0\alpha_0{}^2}\left(\sqrt{1+\frac{\alpha_0{}^2a_0{}^2t^2}{c^2}}-1\right) \quad (13)$$

In this theory, the Maxwell-equation is

$$\left(\frac{\partial E_x}{\partial x}+\frac{\partial E_y}{\partial y}+\frac{\partial E_z}{\partial z}\right)=\vec{\nabla}\cdot\vec{E}=4\pi\rho$$

$$[(\frac{\partial B_z}{\partial y}-\frac{\partial B_y}{\partial z})i-(\frac{\partial B_z}{\partial x}-\frac{\partial B_x}{\partial z})j+(\frac{\partial B_y}{\partial x}-\frac{\partial B_x}{\partial y})k]=\vec{\nabla}\times\vec{B}$$

$$=\frac{1}{c/\alpha_0}[(\frac{\partial E_x}{\partial t}+4\pi j_x)i+(\frac{\partial E_y}{\partial t}+4\pi j_y)j+(\frac{\partial E_z}{\partial t}+4\pi j_z)k]=\frac{1}{c/\alpha_0}(\frac{\partial\vec{E}}{\partial t}+4\pi\vec{j})$$

$$\left(\frac{\partial B_x}{\partial x}+\frac{\partial B_y}{\partial y}+\frac{\partial B_z}{\partial z}\right)=\vec{\nabla}\cdot\vec{B}=0$$

$$[(\frac{\partial E_z}{\partial y}-\frac{\partial E_y}{\partial z})i-(\frac{\partial E_z}{\partial x}-\frac{\partial E_x}{\partial z})j+(\frac{\partial E_y}{\partial x}-\frac{\partial E_x}{\partial y})k]=\vec{\nabla}\times\vec{E}$$

$$=-\frac{1}{c/\alpha_0}[\frac{\partial B_x}{\partial t}i+\frac{\partial B_y}{\partial t}j+\frac{\partial B_z}{\partial t}k]=-\frac{1}{c/\alpha_0}\frac{\partial\vec{B}}{\partial t} \qquad (14)$$

Therefore,

$$\vec{B}=\vec{\nabla}\times\vec{A} \qquad ,\vec{E}=-\vec{\nabla}\phi-\frac{1}{c/\alpha_0}\frac{\partial\vec{A}}{\partial t} \qquad (15)$$

In this time, uses Lorentz gauge.

$$\frac{1}{c/\alpha_0}\frac{\partial\phi}{\partial t}+\vec{\nabla}\cdot\vec{A}=0 \text{ (Lorentz gauge)} \quad (16)$$

Therefore,

$$(\frac{1}{c^2/\alpha_0{}^2}\frac{\partial^2}{\partial t^2}-\nabla^2)\phi=4\pi\rho \quad ,(\frac{1}{c^2/\alpha_0{}^2}\frac{\partial^2}{\partial t^2}-\nabla^2)\vec{A}=\frac{4\pi}{c/\alpha_0}\vec{j} \quad (17)$$

The transformation of 4-vector operator $(\frac{1}{c/\alpha_0}\frac{\partial}{\partial t},\vec{\nabla})$ is

$$\frac{1}{c/\alpha_0}\frac{\partial}{\partial t}=\gamma(\frac{1}{c/\alpha_0}\frac{\partial}{\partial t'}-\frac{v_0}{c/\alpha_0}\frac{\partial}{\partial x'}),\frac{\partial}{\partial x}=\gamma(\frac{\partial}{\partial x'}-\alpha_0\frac{v_0}{c}\frac{1}{c/\alpha_0}\frac{\partial}{\partial t'})$$

$$\frac{\partial}{\partial y}=\frac{\partial}{\partial y'} \ , \ \frac{\partial}{\partial z}=\frac{\partial}{\partial z'} \ , \ \gamma=1/\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}} \quad (18)$$

The transformation of the Electro-magnetic 4-vector potential $(\phi,\vec{A})$ is

$$\phi=\gamma(\phi'+\alpha_0\frac{v_0}{c}A_{x'}), \quad A_x=\gamma(A_{x'}+\alpha_0\frac{v_0}{c}\phi')$$

$$A_y=A_{y'} \ , \ A_z=A_{z'}, \quad \gamma=1/\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}} \quad (19)$$

Therefore, the transformation of Electro-magnetic field $\vec{E},\vec{B}$ is

$$E_x=E_{x'},E_y=\gamma E_{y'}+\gamma\alpha_0\frac{v_0}{c}B_{z'}, \ E_z=\gamma E_{z'}-\gamma\alpha_0\frac{v_0}{c}B_{y'}$$

$$B_x=B_{x'},B_y=\gamma B_{y'}-\gamma\alpha_0\frac{v_0}{c}E_{z'}, \ B_z=\gamma B_{z'}+\gamma\alpha_0\frac{v_0}{c}E_{y'}$$

$$\gamma=1/\sqrt{1-\alpha_0{}^2\frac{v_0{}^2}{c^2}} \quad (20)$$

In the quantum theory,

$$E=\frac{m_0c^2/\alpha_0{}^2}{\sqrt{1-\alpha_0{}^2\frac{u^2}{c^2}}}=h\upsilon \quad (21)$$

The Compton effects is

$$\lambda'-\lambda=\frac{h}{m_0c/\alpha_0}(1-\cos\phi) \quad (22)$$

De Broglie wavelength λ is

$$\lambda = \frac{h}{p} = \frac{h}{mu} \quad , \quad m = \frac{m_0}{\sqrt{1 - \alpha_0^{\ 2} \frac{u^2}{c^2}}} \qquad (23)$$

III. Conclusion

If $M = 0, \alpha_0 = 1$, this theory does the special relativity theory in the free time-space.

Reference

[1]A.Miller,Albert Einstein's Special Theory of Relativity(Addison-Wesley Publishing Co., Inc., 1981)

[2]W. Rindler, Special Relativity(2nd ed., Oliver and Boyd, Edinburg, 1966)

[3]P.Bergman,Introduction to the Theory of Relativity(Dover Pub. Co.,Inc., New York,1976),Chapter V

[4]D.Halliday &R.Resnick, Fundamentals of PHYSICS(John Wiley & Sons,Inc.,1986)

[5]R.L.Liboff, Quantum Mechanics(Addison-Wesley Publishing Co., Inc.,1990)

[6]A.Beiser, Concept of Modern Physics(McGraw-Hill,Inc.,1991)