Unified Theory of Gravity and Electromagnetic Field

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ABSTRACT

Solutions of unified theory equations of gravity and electromagnetism satisfy Einstein-Maxwell equation. Hence, solutions of the unified theory is Reissner-Nodstrom solution in vacuum. We found revised Einstein gravity tensor equation is satisfied the condition by 2-order contra-invariant metric tensor two times product.

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1.Introduction

This theory's aim is that we discover the revised Einstein gravity equation had Reissner-Nodstrom solution in vacuum..

First, we can think the following formula (the revised Einstein gravity equation).

$$R_{\mu\upsilon} - \frac{1}{2} g_{\mu\upsilon} R + \Lambda g_{\mu\upsilon} (g^{\theta\theta})^2 = -\frac{8\pi G}{c^4} T_{\mu\upsilon}$$

In this time, $\Lambda = -k \frac{GQ^2}{c^4}$ (1)

If Eq(1) take co-invariant differential operator,

$$(R_{\mu\upsilon} - \frac{1}{2} g_{\mu\upsilon} R)_{;\mu} + \Lambda g_{\mu\upsilon} 2 g^{\theta\theta} g^{\theta\theta}{}_{;\mu} = -\frac{8\pi G}{c^4} T_{\mu\upsilon;\mu} = 0 \quad \text{(2-i)}$$

$$(R_{\mu\upsilon} - \frac{1}{2} g_{\mu\upsilon} R)_{;\upsilon} + \Lambda g_{\mu\upsilon} 2 g^{\theta\theta} g^{\theta\theta}{}_{;\upsilon} = -\frac{8\pi G}{c^4} T_{\mu\upsilon;\upsilon} = 0 \quad \text{(2-ii)}$$

In this time,

$$g^{\theta\theta}{}_{;\rho} = \frac{\partial g^{\theta\theta}}{\partial x^{\rho}} + 2\Gamma^{\theta}{}_{\sigma\rho} g^{\sigma\theta} = \frac{\partial g^{\theta\theta}}{\partial r} + 2\Gamma^{\theta}{}_{\theta r} g^{\theta\theta}$$

$$= \frac{\partial}{\partial r}\left(\frac{1}{r^2}\right) + 2 \cdot \frac{1}{r} \cdot \frac{1}{r^2} = 0 \quad (3)$$

If $g^{\theta\theta}{}_{;\rho} = V_{\rho}$, the vector transformation is

$$0 = V_{\rho} = \frac{\partial x'^{\alpha}}{\partial x^{\rho}} V'_{\alpha} \quad , \quad V'_{\alpha} = 0 \quad (4)$$

Therefore, if the coordinate is not the spherical coordinate, the co-invariant differential of $g^{\theta\theta} = \frac{1}{r^2}$ is still zero in the changed coordinate

2. The revised Einstein gravity equation and Reissner-Nodstrom solution

In this theory, Eq(1) can change the following equation.

$$R_{\mu\upsilon} = -\frac{8\pi G}{c^4} (T_{\mu\upsilon} - \frac{1}{2} g_{\mu\upsilon} T^{\lambda}{}_{\lambda}) + \Lambda g_{\mu\upsilon} (g^{\theta\theta})^2 \quad (5)$$

In this time, in vacuum, Eq(5) is

$$R_{\mu\upsilon} = \Lambda g_{\mu\upsilon} (g^{\theta\theta})^2 = \Lambda g_{\mu\upsilon} \frac{1}{r^4} \quad (6)$$

Reissner-Nodstrom solution of Einstein-Maxwell equation is

$$g_{00} = -1 + \frac{2GM}{rc^2} - \frac{kGQ^2}{r^2c^4}, g_{11} = 1/(1 - \frac{2GM}{rc^2} + \frac{kGQ^2}{r^2c^4})$$
$$g_{22} = r^2, g_{33} = r^2 \sin^2\theta \tag{7}$$

The proper time of spherical coordinates is

$$d\tau^2 = A(t,r)dt^2 - \frac{1}{c^2}[B(t,r)dr^2 + r^2 d\theta^2 + r^2 \sin^2\theta d\varphi^2] \tag{8}$$

If we use Eq(3), we obtain the Ricci-tensor equations.

$$R_{tt} = -\frac{A''}{2B} + \frac{A'B'}{4B^2} - \frac{A'}{Br} + \frac{A'^2}{4AB} + \frac{\ddot{B}}{2B} - \frac{\dot{B}^2}{4B^2} - \frac{\dot{A}\dot{B}}{4AB} = -\Lambda A \frac{1}{r^4} \tag{9}$$

$$R_{rr} = \frac{A''}{2A} - \frac{A'^2}{4A^2} - \frac{A'B'}{4AB} - \frac{B'}{Br} - \frac{\ddot{B}}{2A} + \frac{\dot{A}\dot{B}}{4A^2} + \frac{\dot{B}^2}{4AB} = \Lambda B \frac{1}{r^4} \tag{10}$$

$$R_{\theta\theta} = -1 + \frac{1}{B} - \frac{rB'}{2B^2} + \frac{rA'}{2AB} = \Lambda r^2 \frac{1}{r^4} = \Lambda \frac{1}{r^2} \tag{11}$$

$$R_{\varphi\varphi} = R_{\theta\theta} \sin^2\theta \tag{12}$$

$$R_{tr} = -\frac{\dot{B}}{Br} = 0 \tag{13}$$

$$R_{t\theta} = R_{t\varphi} = R_{r\theta} = R_{r\varphi} = R_{\theta\varphi} = 0 \tag{14}$$

In this time, $' = \frac{\partial}{\partial r}$, $\cdot = \frac{1}{c}\frac{\partial}{\partial t}$

If we calculate,

$$\frac{R_{tt}}{A} + \frac{R_{rr}}{B} = -\frac{1}{Br^5}(\frac{A'}{A} + \frac{B'}{B}) = -\frac{(AB)'}{r^5AB^2} = 0 \tag{15}$$

Hence, we obtain this result.

$$A = \frac{1}{B} \tag{16}$$

If Eq(16) inserts Eq(11),

$$R_{\theta\theta} = -1 + \frac{1}{B} - \frac{rB'}{2B^2} + \frac{rA'}{2AB} = -1 + (\frac{r}{B})' = \Lambda \frac{1}{r^2} \tag{17}$$

If we solve Eq(16),

$$\frac{r}{B} = r + C - \frac{\Lambda}{r}$$
$$\rightarrow A = \frac{1}{B} = 1 - \frac{2GM}{rc^2} + \frac{kGQ^2}{r^2c^4}, \ \Lambda = -k\frac{GQ^2}{c^4}, C = -\frac{2GM}{c^2} \tag{18}$$

Therefore, in vacuum, the spherical solution of the revised Einstein gravity equation is Reissner-Nodstrom solution.

$$d\tau^2 = (1 - \frac{2GM}{rc^2} + \frac{kGQ^2}{r^2c^4})dt^2 - \frac{1}{c^2}[\frac{dr^2}{(1 - \frac{2GM}{rc^2} + \frac{kGQ^2}{r^2c^4})} + r^2 d\theta^2 + r^2 \sin^2\theta d\varphi^2] \quad (19)$$

3. Conclusion

We found the revised Einstein equation of unified theory(the gravity and electromagnetic field).This theory's strong point is 4-dimensional theory. This theory is different from 5-dimensional Kaluza-Klein theory. But as the method of describing universe, Einstein normal gravity equation is equal with the revised Einstein equation of the unified theory because the electric charge has to be zero. .

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