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New Gravity Field Equation is derived by Einstein Field Equation in General Relativity Theory

Sangwha-Yi*

Department of Math , Taejon University 300-716 , South Korea

Corresponding Author:** ***Sangwha-Yi, *Department of Math , Taejon University 300-716 , South Korea*

Abstract: *We found the 4-order curvature term satisfied the co-variant derivative. Einstein gravity field equation is consist of 2-order curvature terms. Hence, the 4-order curvature term and 2-order curvature terms make new gravity field equation. In this point, Einstein's gravity field equation can be modified by new 4-order curvature term because gravity field equation's term doesn't have to be 2-order term. Indeed, Einstein himself was like that, 0-order term, the cosmological term. Therefore, our theory is based on legitimate facts.*

Keywords: *4-order curvature term; New gravity field equation; Einstein's 2-order terms;*

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1. Introduction

We found the 4-order curvature term satisfied the co-variant derivative. Einstein gravity field equation is consist of 2-order curvature terms. Hence, the 4-order curvature term and 2-order curvature terms make new gravity field equation. In this point, Einstein's gravity field equation can be modified by new 4-order curvature term because gravity field equation's term doesn't have to be 2-order term. Indeed, Einstein himself was like that, 0-order term, the cosmological term. Therefore, our theory is based on legitimate facts. If energy-momentum tensor is zero, Einstein gravity field equation is

$$R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R=0 \qquad (1)$$

Or if energy-momentum tensor is zero, the equation is add the cosmological term (0-order term)

$$R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R+\Lambda g_{\mu\upsilon}=0 \qquad (2)$$

2. Derived 4-Order Curvature Term and New Gravity Field Equation

Einstein gravity field equation is satisfied by co-variant derivative.

$$(R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R)_{;\rho}=0 \qquad (3)$$

If energy-momentum tensor is zero, Einstein's 2-order contra-variant gravitational equation is

$$R^{\mu\upsilon}-\frac{1}{2}g^{\mu\upsilon}R=0 \qquad (4)$$

Also, if we deal with the co-variant derivative of 2-order contra-variant gravitational equation, we get

$$(R^{\mu\upsilon}-\frac{1}{2}g^{\mu\upsilon}R)_{;\rho}=0 \qquad (5)$$

If Eq(1) multiply Eq(4), then

$$(R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R)(R^{\mu\upsilon}-\frac{1}{2}g^{\mu\upsilon}R)$$

$$=R_{\mu\upsilon}R^{\mu\upsilon}-\frac{1}{2}g^{\mu\upsilon}R_{\mu\upsilon}R-\frac{1}{2}g_{\mu\upsilon}R^{\mu\upsilon}R+\frac{1}{4}g_{\mu\upsilon}g^{\mu\upsilon}R^{2}, \quad g^{\mu\upsilon}R_{\mu\upsilon}=R, g_{\mu\upsilon}R^{\mu\upsilon}=R, g_{\mu\upsilon}g^{\mu\upsilon}=4$$

$$=R_{\mu\upsilon}R^{\mu\upsilon}-\frac{1}{2}R^{2}-\frac{1}{2}R^{2}+R^{2}=R_{\mu\upsilon}R^{\mu\upsilon} \tag{6}$$

New 4-order curvature term's co-variant derivative is

$$(R_{\mu\upsilon}R^{\mu\upsilon})_{;\rho}=R_{\mu\upsilon;\rho}R^{\mu\upsilon}+R_{\mu\upsilon}R^{\mu\upsilon}{}_{;\rho}$$

$$=\{(R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R)(R^{\mu\upsilon}-\frac{1}{2}g^{\mu\upsilon}R)\}_{;\rho}$$

$$=(R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R)_{;\rho}(R^{\mu\upsilon}-\frac{1}{2}g^{\mu\upsilon}R)+(R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R)(R^{\mu\upsilon}-\frac{1}{2}g^{\mu\upsilon}R)_{;\rho}=0 \tag{7}$$

Hence, new gravity field equation is consist of 2-order curvature terms and new 4-order curvature term.

$$R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R+\Lambda' g_{\mu\upsilon}R_{\rho\sigma}R^{\rho\sigma}=-\frac{8\pi G}{c^{4}}T_{\mu\upsilon} \tag{8}$$

Or new gravity field equation is consist of 0-order term (cosmological term) and 2-order terms and 4-order term

$$\Lambda g_{\mu\upsilon}+R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R+\Lambda' g_{\mu\upsilon}R_{\rho\sigma}R^{\rho\sigma}=-\frac{8\pi G}{c^{4}}T_{\mu\upsilon} \tag{9}$$

3. CONCLUSION

We found the 4-order curvature term and new gravity field equation satisfied the co-variant derivative. In new gravity field equation, Schwarzschild solution and Kerr solution do not change.

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