# 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**

**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.

**PACS Number**:**04,04.90.+e,04.12**

**Key words: 4-order curvature term;**

**New gravity field equation;**

**Einstein's 2-order terms;**

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

**Tel:010-2496-3953**

## 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

$$R_{\mu\upsilon}-\frac{1}{2}g_{\mu\upsilon}R=0 \tag{1}$$

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

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

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

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

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

Einstein's 2-order contra-variant gravitational equation is

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

Also, if energy-momentum tensor is zero and we deal with the co-variant derivative of 2-order contra-variant gravitational equation, we get

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

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.

## References


[1]S.Yi, "Unified Theory of Gravity and Electromagnetic Field in Reissner-Nodstrom Solution, Kerr-Newman Solution",**6**,11(2019),pp1-3

[2]K.Rosquist, "Interacting Kerr-Newman Fields",International Center for Relativistic Astrophysics, MG12,Paris (2009)

[3]S.Yi, "Spherical Solution of Classical Quantum Gravity", International Journal of Advanced Research in Physical Science,**6**,8,(2019),pp3-6

[4]S.Weinberg,Gravitation and Cosmology(John wiley & Sons,Inc,1972)

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

[6]C.Misner, K,Thorne and J. Wheeler, Gravitation(W.H.Freedman & Co.,1973)

[7]S.Hawking and G. Ellis,The Large Scale Structure of Space-Time(Cam-bridge University Press,1973)

[8]R.Adler,M.Bazin and M.Schiffer,Introduction to General Relativity(McGraw-Hill,Inc.,1965)