Grand Unification of Force Using Complex Affine Space Time

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Abstract

This paper unifies all 4 fundamental forces, Dark energy and Dark matter with help of complex affine space time curvature.

Keywords – *Grand unification theory, Dark matter, Dark Energy, fundamental forces, space time curvature*

I. INTRODUCTION

In paper Electroweak field equations [1] it was shown that electro weak force can be explained with help of space time curvature, which is given by following expression.

$$E_{\mu\nu} = K(T_e)_{\mu\nu} \rightarrow \text{Eq1}$$

Where $E_{\mu\nu}$ is given by

$$E_{\mu\nu} = M_{\mu\nu} - \frac{1}{2} Me_{\mu\nu} \rightarrow \text{Eq2}$$

Our goal would be to find field equation for strong force and later we will unify all fundamental forces and after that we will unify dark matter, dark energy with fundamental forces.

II. STRONG FORCE FIELD EQUATION

From paper Space time interval for all fundamental forces [2], we know that strong force space time interval is given by following expression.

$$s^2 = \overset{ii}{\eta}_{\mu\nu} x_\mu x_\nu \rightarrow \text{Eq3}$$

If we follow same procedure as we followed in paper "Electroweak field equations" we can write strong force field equation as

$$\boxed{S_{\mu\nu} = K(T_s)_{\mu\nu}} \rightarrow \text{Eq4}$$

$$\boxed{S_{\mu\nu} = I_{\mu\nu} - \frac{1}{2} Is_{\mu\nu}} \rightarrow \text{Eq5}$$

Where $S_{\mu\nu}$ is strong force tensor, T_s is strong force stress-energy tensor, $I_{\mu\nu}$ is Ricci curvature tensor, I is curvature scalar and $s_{\mu\nu}$ is metric tensor.

III. METRIC NOTATION OF GRAVITY, ELECTROWEAK FORCE AND STRONG FORCE

We know that gravity, electro weak force and strong force space time interval is given by following expression [3].

$$s^2 = \overset{c}{C}_{\mu\nu} x_\mu x_\nu \rightarrow \text{Eq6}$$

We know that above matrix curvature produces Gravity, Electroweak force and strong force, we can write field equation for gravity, electroweak force and strong force in matrix form as.

$$\begin{bmatrix} G_{\mu\nu} & E_{\mu\nu} \\ E_{\mu\nu} & S_{\mu\nu} \end{bmatrix} = \begin{bmatrix} R_{\mu\nu} - \frac{1}{2} Rg_{\mu\nu} & M_{\mu\nu} - \frac{1}{2} Me_{\mu\nu} \\ M_{\mu\nu} - \frac{1}{2} Me_{\mu\nu} & I_{\mu\nu} - \frac{1}{2} Is_{\mu\nu} \end{bmatrix} = K \begin{bmatrix} (T_g)_{\mu\nu} & (T_e)_{\mu\nu} \\ (T_e)_{\mu\nu} & (T_s)_{\mu\nu} \end{bmatrix} \rightarrow \text{Eq7}$$

We know from Einstein field equations [4] constant K is

$$K = \frac{8\pi G}{c^4} \rightarrow \text{Eq8}$$

Putting Eq8 value in Eq7 we get

$$\begin{bmatrix} G_{\mu\nu} & E_{\mu\nu} \\ E_{\mu\nu} & S_{\mu\nu} \end{bmatrix} = \begin{bmatrix} R_{\mu\nu} - \frac{1}{2} Rg_{\mu\nu} & M_{\mu\nu} - \frac{1}{2} Me_{\mu\nu} \\ M_{\mu\nu} - \frac{1}{2} Me_{\mu\nu} & I_{\mu\nu} - \frac{1}{2} Is_{\mu\nu} \end{bmatrix} = \frac{8\pi G}{c^4} \begin{bmatrix} (T_g)_{\mu\nu} & (T_e)_{\mu\nu} \\ (T_e)_{\mu\nu} & (T_s)_{\mu\nu} \end{bmatrix} \rightarrow \text{Eq9}$$

IV. UNIFICATION OF GRAVITY , ELECTROWEAK FORCE AND STRONG FORCE

From paper Dark matter and Dark Energy Space Time Interval we know that space time interval is given as [5]

$$\overset{c(-1)}{\eta} = \begin{bmatrix} \overset{rr(-1)}{\eta} & \overset{ir(-1)}{\eta} \\ \overset{ir(-1)}{\eta} & \overset{ii(-1)}{\eta} \end{bmatrix} \rightarrow \text{Eq10}$$

$\overset{ir(-1)}{\eta}$ is metric tensor , in which we are interested in because this metric curvature will give unification of Gravity , Electroweak and strong force.

$\overset{ir(-1)}{\eta}$ is 4X4 matrix unlike $\overset{c}{C}_{\mu\nu}$ which is 8X8 matrix. $\overset{ir(-1)}{\eta}$ is mix matrix (which is combination of real and imaginary components).

If we follow similar approach which we followed for electroweak field equation we will get following field equation for unified gravity, electroweak force and strong force.

$$B_{\mu\nu} = K(T_{GES})_{\mu\nu} \rightarrow \text{Eq11}$$

$$B_{\mu\nu} = \frac{8\pi G}{c^4}(T_{GES})_{\mu\nu} \rightarrow \text{Eq12}$$

$$B_{\mu\nu} = \overset{(-1)}{M}_{\mu\nu} - \frac{1}{2}\overset{(-1)}{M}\, w_{\mu\nu} \rightarrow \text{Eq13}$$

Where

$$B_{\mu\nu} \square \begin{bmatrix} G_{\mu\nu} & E_{\mu\nu} \\ E_{\mu\nu} & S_{\mu\nu} \end{bmatrix} \rightarrow \text{Eq14}$$

$$(T_{GES})_{\mu\nu} \square \begin{bmatrix} (T_g)_{\mu\nu} & (T_e)_{\mu\nu} \\ (T_e)_{\mu\nu} & (T_s)_{\mu\nu} \end{bmatrix} \rightarrow \text{Eq15}$$

Where $B_{\mu\nu}$ is fundamental force tensor, T_{GES} is stress energy tensor of gravity, electroweak and strong force, $\overset{(-1)}{M}_{\mu\nu}$ is Ricci curvature tensor (-1 is for one level above our 8 dimensional world and M because it is now form of mix matrix), $\overset{(-1)}{M}$ is curvature scalar.

V. DARK ENERGY FIELD EQUATIONS

Space time interval for dark energy is given by [6]

$$s^2 = \overset{rr(-1)}{\eta}_{\mu\nu} x_\mu x_\nu \rightarrow \text{Eq16}$$

If we follow same procedure as we followed in paper "Electroweak field equations" we can write strong force field equation as

$$(D_e)_{\mu\nu} = K(T_{DE})_{\mu\nu} \rightarrow \text{Eq17}$$

$$(D_e)_{\mu\nu} = \overset{(-1)}{R}_{\mu\nu} - \frac{1}{2}\overset{(-1)}{R}(d_e)_{\mu\nu} \rightarrow \text{Eq18}$$

Where $(D_e)_{\mu\nu}$ is dark energy tensor, $(T_{DE})_{\mu\nu}$ is dark energy stress-energy tensor, $\overset{(-1)}{R}_{\mu\nu}$ is Ricci curvature tensor (use of R because it contains all the real components), $\overset{(-1)}{R}$ is curvature scalar and $(d_e)_{\mu\nu}$ is metric tensor.

VI. DARK MATTER FIELD EQUATIONS

Space time interval for dark matter is given by [7]

$$s^2 = \overset{rr(-1)}{\eta}_{\mu\nu} x_\mu x_\nu \rightarrow \text{Eq19}$$

If we follow same procedure as we followed in paper "Electroweak field equations" we can write strong force field equation as

$$(D_m)_{\mu\nu} = K(T_{DM})_{\mu\nu} \rightarrow \text{Eq20}$$

$$(D_m)_{\mu\nu} = \overset{(-1)}{I}_{\mu\nu} - \frac{1}{2}\overset{(-1)}{I}(d_m)_{\mu\nu} \rightarrow \text{Eq21}$$

Where $(D_m)_{\mu\nu}$ is dark matter tensor, $(T_{DM})_{\mu\nu}$ is dark matter stress-energy tensor, $\overset{(-1)}{I}_{\mu\nu}$ is Ricci curvature tensor (use of I because it contains all the imaginary components), $\overset{(-1)}{I}$ is curvature scalar and $(d_m)_{\mu\nu}$ is metric tensor.

VII. DARK MATTER , DARK ENERGY AND FUNDAMENTAL FORCE FIELD EQUATION IN MATRIX FORM

From Eq10 we know that dark energy, dark matter and all fundamental force space time interval is given by

$$\overset{c(-1)}{\eta} = \begin{bmatrix} \overset{rr(-1)}{\eta} & \overset{ir(-1)}{\eta} \\ \overset{ir(-1)}{\eta} & \overset{ii(-1)}{\eta} \end{bmatrix} \rightarrow \text{Eq22}$$

From Eq20, Eq21, Eq17, Eq18, Eq11, Eq12 and Eq13 we can write

$$\begin{bmatrix} (D_e)_{\mu\nu} & B_{\mu\nu} \\ B_{\mu\nu} & (D_m)_{\mu\nu} \end{bmatrix} = \begin{bmatrix} \overset{(-1)}{R}_{\mu\nu} - \frac{1}{2}\overset{(-1)}{R}(d_e)_{\mu\nu} & \overset{(-1)}{M}_{\mu\nu} - \frac{1}{2}\overset{(-1)}{M}w_{\mu\nu} \\ \overset{(-1)}{M}_{\mu\nu} - \frac{1}{2}\overset{(-1)}{M}w_{\mu\nu} & \overset{(-1)}{I}_{\mu\nu} - \frac{1}{2}\overset{(-1)}{I}(d_m)_{\mu\nu} \end{bmatrix}$$
$$= \frac{8\pi G}{c^4}\begin{bmatrix} (T_{DE})_{\mu\nu} & (T_{GES})_{\mu\nu} \\ (T_{GES})_{\mu\nu} & (T_{DM})_{\mu\nu} \end{bmatrix}$$
$\rightarrow$Eq23

VIII. FINAL FIELD EQUATION FOR UNIFICATION OF DARK MATTER , DARK ENERGY AND ALL FUNDAMENTAL FORCES

To unify dark matter, dark energy and all fundamental forces we would have to go one level above dark matter and dark energy dimensions (as done while unifying gravity , electroweak and strong force).

If we go above one dimension above

$$\overset{c(-2)}{\eta} = \begin{bmatrix} \overset{rr(-2)}{\eta} & \overset{ir(-2)}{\eta} \\ \overset{ir(-2)}{\eta} & \overset{ii(-2)}{\eta} \end{bmatrix} \rightarrow \text{Eq24}$$

We are interested in $\overset{ir(-2)}{\eta}$ because its curvature can explain dark energy, dark matter and all fundamental forces.

Space time interval for this can be written as

$$s^2 = \overset{ir(-2)}{\eta}_{\mu\nu} x_\mu x_\nu \rightarrow \text{Eq25}$$

If we follow similar approach which we followed for electroweak field equation we will get following field equation for unified gravity, electroweak force and strong force.

$$Z_{\mu\nu} = K(T_{all})_{\mu\nu} \rightarrow \text{Eq26}$$

$$Z_{\mu\nu} = \frac{8\pi G}{c^4}(T_{all})_{\mu\nu} \rightarrow \text{Eq27}$$

$$Z_{\mu\nu} = \overset{(-2)}{M}_{\mu\nu} - \frac{1}{2}\overset{(-2)}{M}a_{\mu\nu} \rightarrow \text{Eq28}$$

Where

$$Z_{\mu\nu} \square \begin{bmatrix} (D_e)_{\mu\nu} & B_{\mu\nu} \\ B_{\mu\nu} & (D_m)_{\mu\nu} \end{bmatrix} \rightarrow \text{Eq29}$$

$$(T_{all})_{\mu\nu} \square \begin{bmatrix} (T_{DE})_{\mu\nu} & (T_{GES})_{\mu\nu} \\ (T_{GES})_{\mu\nu} & (T_{DM})_{\mu\nu} \end{bmatrix} \rightarrow \text{Eq30}$$

Where $Z_{\mu\nu}$ is super force tensor, $(T_{all})_{\mu\nu}$ is energy stress-energy tensor due to all forces, $\overset{(-2)}{M}_{\mu\nu}$ is Ricci curvature tensor (use of M because it contains all the real and imaginary (mix) components and -2 because it is 2 levels above our normal 8 dimensional world), $\overset{(-2)}{M}$ is curvature scalar and $a_{\mu\nu}$ is metric tensor.

And final field equation which unifies all forces can be written as

$$Z_{\mu\nu} = \frac{8\pi G}{c^4}(T_{all})_{\mu\nu} \rightarrow \text{Eq31}$$

IX. CONCLUSION

Unification of dark matter, dark energy and all fundamental forces can be given by equation $Z_{\mu\nu} = \frac{8\pi G}{c^4}(T_{all})_{\mu\nu}$.

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