An Extension of Maxwell Representation of Non-Abelian SU(3) Yang-Mills theory on Cantor Sets

Victor Christianto[1]

Abstract

This paper was written in the context of a new concept of Maxwellian neutrino suggested by Valerii Temnenko [1][2]. Assuming that his classical model of neutrino may be considered close to real description, then it seems also possible to write down Maxwell representation of SU(3) Yang-Mills theory. In fact, such an idea has been proposed by Sanchez-Monroy & Quimbay [3]. Therefore, in this paper I extend further such a Maxwell representation of SU(3) Yang-Mills theory on Cantor Sets. However, I should emphasize that the proposed model as outlined here is not complete yet. It is still a long way from a complete classical description of elementary particles including neutrino masses. Therefore, more research is needed, be it theoretical and also experimental.

a. Introduction

This paper was written in the context of a new concept of Maxwellian neutrino suggested by Valerii Temnenko [1][2]. Provided his classical model of neutrino is close to real description, then it seems also possible to write down Maxwell representation of SU(3) Yang-Mills theory. In fact, such an idea has been proposed by Sanchez-Monroy & Quimbay [3]. Therefore, in this paper I extend further such a Maxwell representation of SU(3) Yang-Mills theory on Cantor Sets. The purpose is to emphasize that many physical phenomena both at small scales and also at large scales can reduce to some versions of classical electrodynamics equation.

Despite more than 30 years of efforts given to the String Theories (ST), many physicists think that String Theories still lack testable predictions. Of course, there are a few achievements too, such as ST is supposed to be able to yield general relativity, but apparently no more than that. Other physicists also derived that the prediction of cosmological constant by ST yields a

[1] Correspondence email: victorchristianto@gmail.com. Phone: (62) 878-59937095. URL: http://www.researchgate.net/profile/Victor_Christianto

value that is more than 10^10 times the observed value, that is why some physicists such as Peter Woit called String theories as "*Not Even Wrong*" theory (to quote Pauli's remark). [14]

In order to overcome such a predictability problem, in this paper I would like to introduce a different approach. Instead of trying to re-derive quantum mechanics and general relativity from ST, I will instead show that almost everything can be expressed in terms of classical electrodynamics equation, be it small scale phenomenon or large scale phenomenon. This philosophy can be called as "*String without String*", which is a term coined to indicate that the classical String (classical wave) equation can be obtained without having to begin with the standard String theory.

It may be expected that the classical string/wave vibration equation can become an alternative model which is more testable, compared to standard String theories which lack observation or predictability so far. However, I should emphasize that the proposed model as outlined here is not complete yet. More research is needed.

By giving up wave mechanics [9][10][11],[2] I have argued in some previous papers that it is possible to model many physical phenomena in terms of classical electrodynamics equation [4][5]. I will also recall a classical wave model of electron by Guenther Poelz [8]. In his paper, Poelz presented a classical model of the electron based on Maxwell's equations, in which the wave character is described by classical physics. His model of electron shows a wave like behavior at small distances defined in 1924 by Louis de Broglie with a wave length related to its

[2] For more discussion concerning why we shall give up the Wave Mechanics, first we should remember that the Schrödinger equation yields an imaginary wave which cannot be compared with physical wave whatsoever. Second, the Schrödinger equation uses a variable k which yields unphysical wave. And third, the Schrödinger equation was derived by combining relativistic de Broglie equation and Hamilton-Jacobi equation; this procedure yields non-relativistic equation which is in contradiction with its basic premise. Therefore the Schrödinger equation is full of flaws both from logical viewpoint or from physical wave viewpoint. See also my paper : Victor Christianto. A Review of Schrödinger Equation and Classical Wave Equation. *Prespacetime Journal*, May 2014. URL: www.prespacetime.com. Also available at: http://vixra.org/abs/1404.0020

momentum p by: $\lambda_{DB} = \frac{2\pi\hbar}{p}$. Poelz admitted that almost everyone is accustomed to the view that classical mechanics and wave mechanics describe two different worlds, perfectly described for the electron by electrodynamics and by quantum electrodynamics with its extensions. A wide gap between both still exists which is not closed up to now by a satisfactory classical description. Therefore, he hopes that his electron model can serve to show that the electron may be described by an electromagnetic wave also in the classical region and thus a smooth transition between classical electrodynamics and quantum mechanics can be established.[8]

It is my view that Poelz's approach can be one example where a classical description of physical reality is suitable to provide a clear window of observation. Here in this paper I shall extend it further to Maxwell representation of SU(3) Yang-Mills Theory. In previous papers, I have argued that it is possible to model many physical phenomena in terms of classical electrodynamics equation on Cantor sets [5]. I have also shown how linearized version of Einstein's field equations reduces to wave equation form too. The latter can be generalized further into a fractal wave equation for Cantor sets [12]. Provided that the above new proposals are near to experimental findings, then they may indicate a new approach different from the Standard String theory.

- Motivation: This paper is part of greater question: whether it is possible to explain Chromodynamics theory in the classical electrodynamics language. This question went back to a lecture that I followed in 2009, the lecture was about Yang-Mills and QCD. I did not follow the entire complicated language of QCD, but I recalled that Yang-Mills theory is a classical theory, and since QCD is based on SU(3) Yang-Mills theory, then a question came to my mind: does it seem possible to look for and express QCD in classical language? I asked this question to my professor, and he answered with a mysterious smile: "Of course." But since then I never found any paper or book discussing this issue, except a book by Kosyakov discussing classical Yang-Mills theory [15]. Only a few days ago I found two papers by Valerii Temnenko [1][2] and also one more paper discussing Maxwell equations representation for Yang-Mills theory. [3]

- Purpose: the purpose of this paper is to offer an alternative classical form of chromodynamics theory, which may be called Classical Chromodynamics. In literature, this may be an old issue, see [16][17], but there is a recent paper discussing this issue [3a]. The goal is of course not to say a last word on this topic, but instead to trigger further discussion on such a possibility.

However, I should emphasize that the proposed model as outlined here is not complete yet. It is still a long way from a complete classical description of elementary particles including neutrino masses. Therefore, more research is needed, be it theoretical and also experimental.

b. How to write down Maxwell representation of SU(3) Yang-Mills theory

In this section I shall show that it is possible to write down Maxwell representation of SU(3) Yang-Mills theory.

Field theories describing the behavior of pure vectorial gauge fields are known as Yang-Mills theories. Symmetries and properties of Yang-Mills theories are basic ingredients for the theoretical treatment of the fundamental interactions between elementary particles. On the other hand, the classical properties of non-abelian Yang-Mills theories is a subject less studied in the field theory literature. Based on [3], I shall show how to write these non-abelian Maxwell's equations in both differential and integral forms as it is usual for Maxwell's equations of

Classical Electrodynamics.[13] I restrict our interest to the case of the SU(3) Yang-Mills theory, however the analysis is the same for any group SU(N). [3]

According to Sanchez-Monroy & Quimbay, the four Maxwell's equations for the SU(3) Yang-Mills theory with color charge sources in vectorial notation are given by : [3, p.5]

a. $\vec{\nabla} \cdot \vec{E}^a = gC^a_{bc}\vec{A}^b \cdot \vec{E}^c + g\rho^a$ (1)

b. $\vec{\nabla} \times \vec{B}^a - \partial_t \vec{E}^a = g\vec{J}^a + gC^a_{bc}A^b_o\vec{E}^c - gC^a_{bc}\vec{A}^b \times \vec{B}^c$ (2)

c. $\vec{\nabla} \cdot \vec{B}^a = -\frac{1}{2}gC^a_{bc}\nabla \cdot (\vec{A}^b \times \vec{A}^c)$ (3)

d. $\vec{\nabla} \times \vec{E}^a + \partial_t \vec{B}^a = -\frac{1}{2}gC^a_{bc}\partial_t \cdot (\vec{A}^b \times \vec{A}^c) + gC^a_{bc}\left[\vec{\nabla} \times (A^b_o\vec{A}^c)\right]$ (4)

The above four equations are comparable to the conventional Maxwell equations.

c. How to generalize the Nabla Operator to Cantor sets: the case of Maxwell equations

Zhao et al. were able to write the local fractional differential forms of Maxwell equations on Cantor sets as follows [7, p.4-5]:

- Gauss's law for the fractal electric field: $\nabla^\alpha \cdot D = \rho$, (5)

- Ampere's law in the fractal magnetic field: $\nabla^\alpha \times H = J_a + \frac{\partial^\alpha D}{\partial t^\alpha}$, (6)

- Faraday's law in the fractal electric field: $\nabla^\alpha \times E = -\frac{\partial^\alpha B}{\partial t^\alpha}$, (7)

- magnetic Gauss's law in the fractal magnetic field: $\nabla^\alpha \cdot B = 0$, (8)

and the continuity equation can be defined as:

$$\nabla^\alpha \cdot J = -\frac{\partial^\alpha \rho}{\partial t^\alpha}, \quad (9)$$

where $\nabla^{\alpha} \cdot r$ and $\nabla^{\alpha} \times r$ are defined as follows:

1. In Cantor coordinates:

$$\nabla^{\alpha} \cdot u = div^{\alpha} u = \frac{\partial^{\alpha} u_1}{\partial x_1^{\alpha}} + \frac{\partial^{\alpha} u_2}{\partial x_2^{\alpha}} + \frac{\partial^{\alpha} u_3}{\partial x_3^{\alpha}}, \tag{10}$$

$$\nabla^{\alpha} \times u = curl^{\alpha} u = \left(\frac{\partial^{\alpha} u_3}{\partial x_2^{\alpha}} - \frac{\partial^{\alpha} u_2}{\partial x_3^{\alpha}} \right) e_1^{\alpha} + \left(\frac{\partial^{\alpha} u_1}{\partial x_3^{\alpha}} - \frac{\partial^{\alpha} u_3}{\partial x_1^{\alpha}} \right) e_2^{\alpha} + \left(\frac{\partial^{\alpha} u_2}{\partial x_1^{\alpha}} - \frac{\partial^{\alpha} u_1}{\partial x_2^{\alpha}} \right) e_3^{\alpha}\ . \tag{11}$$

2. In Cantor-type cylindrical coordinates [7, p.4]:

$$\nabla^{\alpha} \cdot r = \frac{\partial^{\alpha} r_R}{\partial R^{\alpha}} + \frac{1}{R^{\alpha}} \frac{\partial^{\alpha} r_{\theta}}{\partial \theta^{\alpha}} + \frac{r_R}{R^{\alpha}} + \frac{\partial^{\alpha} r_z}{\partial z^{\alpha}}, \tag{12}$$

$$\nabla^{\alpha} \times r = \left(\frac{1}{R^{\alpha}} \frac{\partial^{\alpha} r_{\theta}}{\partial \theta^{\alpha}} - \frac{\partial^{\alpha} r_{\theta}}{\partial z^{\alpha}} \right) e_R^{\alpha} + \left(\frac{\partial^{\alpha} r_R}{\partial z^{\alpha}} - \frac{\partial^{\alpha} r_z}{\partial R^{\alpha}} \right) e_{\theta}^{\alpha} + \left(\frac{\partial^{\alpha} r_{\theta}}{\partial R^{\alpha}} + \frac{r_R}{R^{\alpha}} - \frac{1}{R^{\alpha}} \frac{\partial^{\alpha} r_R}{\partial \theta^{\alpha}} \right) e_z^{\alpha}\ . \tag{13}$$

d. How to generalize Maxwell representation of SU(3) Yang-Mills theory to Cantor sets

Provided we can follow the above expressions for extending Nabla operator in Cantor coordinate and also in Cantor-type cylindrical coordinates, then it is possible to rewrite and generalize the four Maxwell's equations for the SU(3) Yang-Mills theory with color charge sources to Cantor Sets as follows :

e. $$\vec{\nabla}^{\alpha} \cdot \vec{E}^{a} = gC_{bc}^{a} \vec{A}^{b} \cdot \vec{E}^{c} + g\rho^{a} \tag{14}$$

f. $$\vec{\nabla}^{\alpha} \times \vec{B}^{a} - \partial^{\alpha}{}_{t} \vec{E}^{a} = g\vec{J}^{a} + gC_{bc}^{a} A_{o}^{b} \vec{E}^{c} - gC_{bc}^{a} \vec{A}^{b} \times \vec{B}^{c} \tag{15}$$

g. $$\vec{\nabla}^{\alpha} \cdot \vec{B}^{a} = -\frac{1}{2} gC_{bc}^{a} \nabla^{\alpha} \cdot (\vec{A}^{b} \times \vec{A}^{c}) \tag{16}$$

h. $$\vec{\nabla}^{\alpha} \times \vec{E}^{a} + \partial^{\alpha}{}_{t} \vec{B}^{a} = -\frac{1}{2} gC_{bc}^{a} \partial^{\alpha}{}_{t} \cdot (\vec{A}^{b} \times \vec{A}^{c}) + gC_{bc}^{a} \left[\vec{\nabla}^{\alpha} \times (A_{o}^{b} \vec{A}^{c}) \right] \tag{17}$$

We can use several advanced methods to solve such a fractal wave equation, in accordance with Zhao, Baleanu, Cattani, Cheng & Yang's paper on Maxwell equations on Cantor sets [7].

As far as my knowledge, such generalizations of equations (1)-(4) into Cantor sets have never been considered elsewhere before.

However, I should emphasize that the proposed model as outlined here is not complete yet. It is still a long way from a complete classical description of elementary particles including neutrino masses. Therefore, more research is required, be it theoretical and also experimental.

e. Concluding remarks

This paper was written in the context of a new concept of Maxwellian neutrino suggested by Valerrii Temnenko [1][2]. Provided his classical model of neutrino is close to real description, then it seems also possible to write down Maxwell representation of SU(3) Yang-Mills theory. In fact, such an idea has been proposed by Sanchez-Monroy & Quimbay [3]. Therefore, in this paper I extend further such a Maxwell representation of SU(3) Yang-Mills theory on Cantor Sets.

As far as my knowledge, such generalizations of equations (1)-(4) into Cantor sets have never been considered elsewhere before. Provided the proposed new relations correspond to experimental data, then they may indicate that it is possible to describe elementary particle interaction in terms of classical Maxwell representation of SU(3) Yang-Mills theory.

In previous papers, I have argued that it is possible to model many physical phenomena in terms of classical electrodynamics equation on Cantor sets [5]. I have also shown how linearized version of Einstein's field equations reduces to wave equation form too. The latter can be generalized further into a fractal wave equation for Cantor sets [12]. Provided that the above new proposals are near to experimental findings, then they may indicate a new approach different from the Standard String theory. This philosophy can be called as "*String without String*", which is a term coined to indicate that the classical String (classical wave) equation can be obtained without having to begin with the standard String theory.

However, I should emphasize that the proposed model as outlined here is not complete yet. It is still a long way from a complete classical description of elementary particles including neutrino masses. Therefore, more research is required, be it theoretical and also experimental.

Conflict of Interest

The author declares that there is no conflict of interests regarding the publication of this article.

Acknowledgement

Special thanks to Prof. Florentin Smarandache who has shared many valuable insights over more than 9 years. And many thanks to Prof. Guenther Poelz for his remark on a question posted at www.researchgate.net. The writer would like to express his gratitude to Dr. George Shpenkov or sending his books and papers. Special thanks to Dr. Xin-an Zhang for sending his book and papers too, and to Dr. Andrew Messing for answering some questions in www.researchgate.net. And also thanks to Prof. Akira Kanda for clarifying his opinions concerning some fundamental flaws of Schrödinger equation and quantum mechanics in general. Last but not least, this author also extend his gratitude to Prof. Hardev Singh Virk for his encouraging works. This paper is dedicated to Prof. Yu P. Rybakov and Prof. V.V. Kassandrov who have taught this author some excellent theories including Maxwell theories, back in 2009.

References:

[1] Temnenko, Valerrii. Physics of Current and Potentials I: Classical Electrodynamics with non-point charge. *Electronic Journal of Theoretical Physics* 11, No. 31 (2014) 221-256. http://www.ejtp.com

[2] Temnenko, Valerrii. Physics of Current and Potentials II: Classical Singlet-Triplet Electroeweak Theory with non-point Particles. *Electronic Journal of Theoretical Physics* 12, No. 32 (2015) 179-294. http://www.ejtp.com

[3] Sanchez-Monroy, J.A. & C.J. Quimbay. Some classical properties of the non-abelian Yang-Mills theories. arXiv:hep-ph/0702173 (2007); [3a] Sanchez-Monroy, J.A. & C.J. Quimbay, http://arxiv.org/abs/hep-th/0607203

[4] Christianto, Victor. 2014. A Review of Schrödinger Equation and Classical Wave Equation. *Prespacetime Journal*, May 2014. URL: www.prespacetime.com. Also available at: http://vixra.org/abs/1404.0020

[5] Christianto, Victor & Rahul, Biruduganti. 2014. A derivation of Proca equations on Cantor Sets: A Local Fractional Approach. *Bull. Mathematical Sciences and Applications* (BMSA), Nov. 2014. URL: www.bmsa.us

[6] Zhang, Xin-an. 2013. A wave vibration model basing on classical theory interpret the photoelectric effect, Compton effect, atomic hydrogen spectrum formula, as well as the blackbody radiation, in Xin-an Zhang, Researches in the Nature of Quantum Wave. Xiaotong Publisher, 2014. Available upon request at: 876840956@qq.com

[7] Zhao, Y., Baleanu, D., Cattani, C., Cheng, D-F., & Yang, X-J. 2013. Maxwell's equations on Cantor Sets: A Local Fractional Approach. *Advances in High Energy Physics* Vol. 2013 Article ID 686371, http://dx.doi.org/10.1155/2013/686371, or http://downloads.hindawi.com/journals/ahep/2013/686371.pdf

[8] Poelz, Guenther. On the wave character of Electron. arXiv: 1206.0620 [physics.class-ph]; URL: arxiv.org/pdf/1206.0620.pdf

[9] Shpenkov, George P. 2013. *Dialectical View of the World: The Wave Model (Selected Lectures).* Volume I: Philosophical and Mathematical Background. URL: http://shpenkov.janmax.com/Vol.1.Dialectics.pdf

[10] Shpenkov, George P. & Kreidik, Leonid G. 2005. Schrödinger's error in principle. *Galilean Electrodynamics* Vol. 16, No. 3, 51-56, (2005); URL: http://shpenkov.janmax.com/Blunders.pdf

[11] Kreidik, Leonid G., & Shpenkov, George P. 2002. Important Results of Analyzing Foundations of Quantum Mechanics. *Galilean Electrodynamics & QED-EAST*, Vol. 13, Special Issues No. 2, 23-30; URL: http://shpenkov.janmax.com/QM-Analysis.pdf

[12] Christianto, Victor. String without String: How Linearised Einstein's Field Equations lead to wave equation and how to generalize it to fractal case. Submitted in April 2015 to *Advances in Astronomy* journal, www.hindawi.com.

[13] Schwinger, Julian, DeRaad, Jr., Lester L., Milton, Kimball A., & Tsai, Wu-yang. 1998. *Classical Electrodynamics*. Reading, Massachusetts: Perseus Books. 591 p.

[14] Woit, Peter. *Not even wrong: The failure of string theory*. http://theor.jinr.ru/~kuzemsky/Peter_%20Woit-Not_Even_Wrong.pdf

[15] Boris Pavlovich Kosyakov. Introduction to the Classical Theory of Particles and Fields. Berlin: Springer, 2007.

[16] F.J. Vanhecke. Classical Chromodynamics, A geometrical approach. Revista Brasileira de Fisica Vol. 12 NP2 (1982), URL: http://www.sbfisica.org.br/bjp/download/v12/v12a24.pdf

[17] H. Arodz. On Classical Chromodynamics of external charges and fields. Acta Physica Polonica Vol. B14 no. 11 (1983), URL: http://www.actaphys.uj.edu.pl/_old/vol14/pdf/v14p0825.pdf

Version 1.0: 28 May 2015, Version 1.1: 16 June 2015

VC, email: victorchristianto@gmail.com