Online ISSN: 2249-4626
Print ISSN: 0975-5896

Global Journal of Science Frontier Research: A

Physics and Space Science

Highlights

HTc Superconductors

Double Slit Experiment

Eintein's General Relativity

Exact Traveling Wave Solutions

Discovering Thoughts, Inventing Future

Volume 14 Issue 2 Version 1.0

Global Journal of Science Frontier Research: A
Physics & Space Science

Global Journal of Science Frontier Research: A
Physics & Space Science

Volume 14 Issue 2 (Ver. 1.0)

Open Association of Research Society

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: *Open Association of Research Society*
Open Scientific Standards

Publisher's Headquarters office

Global Journals Headquarters
301st Edgewater Place Suite, 100 Edgewater Dr.-Pl,
Wakefield MASSACHUSETTS, Pin: 01880,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Including by Air Parcel Charges):

For Authors:

22 USD (B/W) & 50 USD (Color)

Yearly Subscription (Personal & Institutional):

200 USD (B/W) & 250 USD (Color)

Integrated Editorial Board
(Computer Science, Engineering, Medical, Management, Natural Science, Social Science)

Dr. Bart Lambrecht
Director of Research in Accounting and FinanceProfessor of Finance
Lancaster University Management School
BA (Antwerp); MPhil, MA, PhD (Cambridge)

Dr. Carlos García Pont
Associate Professor of Marketing
IESE Business School, University of Navarra
Doctor of Philosophy (Management), Massachusetts Institute of Technology (MIT)
Master in Business Administration, IESE, University of Navarra
Degree in Industrial Engineering, Universitat Politècnica de Catalunya

Dr. Fotini Labropulu
Mathematics - Luther College
University of ReginaPh.D., M.Sc. in Mathematics
B.A. (Honors) in Mathematics
University of Windso

Dr. Lynn Lim
Reader in Business and Marketing
Roehampton University, London
BCom, PGDip, MBA (Distinction), PhD, FHEA

Dr. Mihaly Mezei
ASSOCIATE PROFESSOR
Department of Structural and Chemical Biology, Mount Sinai School of Medical Center
Ph.D., Etvs Lornd University
Postdoctoral Training,
New York University

Dr. Söhnke M. Bartram
Department of Accounting and FinanceLancaster University Management SchoolPh.D. (WHU Koblenz)
MBA/BBA (University of Saarbrücken)

Dr. Miguel Angel Ariño
Professor of Decision Sciences
IESE Business School
Barcelona, Spain (Universidad de Navarra)
CEIBS (China Europe International Business School).
Beijing, Shanghai and Shenzhen
Ph.D. in Mathematics
University of Barcelona
BA in Mathematics (Licenciatura)
University of Barcelona

Philip G. Moscoso
Technology and Operations Management
IESE Business School, University of Navarra
Ph.D in Industrial Engineering and Management, ETH Zurich
M.Sc. in Chemical Engineering, ETH Zurich

Dr. Sanjay Dixit, M.D.
Director, EP Laboratories, Philadelphia VA Medical Center
Cardiovascular Medicine - Cardiac Arrhythmia
Univ of Penn School of Medicine

Dr. Han-Xiang Deng
MD., Ph.D
Associate Professor and Research Department Division of Neuromuscular Medicine
Davee Department of Neurology and Clinical NeuroscienceNorthwestern University
Feinberg School of Medicine

Contents of the Volume

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 14 Issue 2 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Exact Traveling Wave Solutions for the (2+1)- Dimensional ZK-BBM Equation by Exp $(-\Phi(\eta))$ - Expansion Method

By Harun-Or-Roshid, Md. Nur Alam, Mohammad Mobarak Hossain, Mohammad Safi Ullah, Rafiqul Islam & M. Ali Akbar
Pabna University of Science and Technology, Bangladesh

Abstract- In this work, the $\exp(-\Phi(\eta))$ -expansion method is applied to solve the (2+1)-dimensional ZK-BBM equation. The traveling wave solutions are expressed in terms of the exponential functions, the hyperbolic functions, the trigonometric functions and the rational functions. The procedure is simple, direct and constructive without the help of a computer algebra system. The $\exp(-\Phi(\eta))$ –expansion method will be used in further works to establish more entirely new solutions for other kinds of nonlinear evolution equations arising in mathematical physics and engineering.

Keywords: the $\exp(-\Phi(\eta))$ -expansion method; the (2+1)-dimensional ZK-BBM equation; complixiton soliton solutions; traveling wave solutions; solitary wave solutions.

GJSFR-A Classification : FOR Code: 240501, 249999

EXACTTRAVELINGWAVESOLUTIONSFORTHE2+1DIMENSIONALZKBBMEQUATIONBYEXPEXPANSIONMETHOD

Strictly as per the compliance and regulations of :

Exact Traveling Wave Solutions for the (2+1)-Dimensional ZK-BBM Equation by Exp $(-\Phi(\eta))$ - Expansion Method

Harun-Or-Roshid [α], Md. Nur Alam [σ], Mohammad Mobarak Hossain [ρ], Mohammad Safi Ullah [ω], Rafiqul Islam [¥] & M. Ali Akbar [§]

Abstract- In this work, the $\exp(-\Phi(\eta))$ -expansion method is applied to solve the (2+1)-dimensional ZK-BBM equation. The traveling wave solutions are expressed in terms of the exponential functions, the hyperbolic functions, the trigonometric functions and the rational functions. The procedure is simple, direct and constructive without the help of a computer algebra system. The $\exp(-\Phi(\eta))$ -expansion method will be used in further works to establish more entirely new solutions for other kinds of nonlinear evolution equations arising in mathematical physics and engineering.

Keywords: the $\exp(-\Phi(\eta))$ -expansion method; the (2+1)-dimensional ZK-BBM equation; complixiton soliton solutions; traveling wave solutions; solitary wave solutions.

PACS: 05.45.Yv, 02.30.Jr, 02.30.Ik.

I. Introduction

Nonlinear intricate physical phenomena are related to nonlinear partial differential equations (PDEs) which are involved in many fields of sciences, especially fluid mechanics, solid state physics, plasma physics, plasma wave and chemical physics, biology, chemistry, mechanics, etc. Searching for exact solutions of nonlinear PDEs plays an main role in the study of these physical phenomena and gradually becomes one of the most imperative and major farm duties. A huge deal of research work has been carried out during the past decades for the study of the nonlinear evolution equation. Powerful methods which make it possible to generate exact traveling wave solutions to nonlinear equations have emerged from the literatures in the past decades. Among them are the complex hyperbolic function method [1, 2], the Jacobi elliptic function expansion method [3, 4], the F-expansion method [5, 6], the (G′ / G) -expansion method [7-15], the Hirota's bilinear method [16], the Backlund transformation method [17], the Darboux transformation method [18], the homotopy perturbation method [19, 20], the $\exp(-\varphi(\eta))$ -expansion method [21- 25] and soon.

The objective of this article is to put into practice the $\exp(-\varphi(\eta))$ -expansion method to put up the exact solutions for nonlinear evolution equations in mathematical physics via the (2+1)-dimensional ZK-BBM equation for the first time.

The rest of the paper is organized as follows: In Section 2, we give the description of the $\exp(-\varphi(\eta))$ -expansion method. In Section 3, we apply this method to the (2+1)-dimensional ZK-BBM equation. Conclusions are given in the last section.

II. Description of the Exp$(-\Phi(\eta))$-Expansion Method

Let us consider a general nonlinear PDE in the form

$$F(u,u_t,u_x,u_{xx},u_{tt},u_{tx},\ldots), \qquad (1)$$

where $u = u(x, t)$ is an unknown function, F is a polynomial in $u(x,t)$ and its derivatives in which highest order derivatives and nonlinear terms are involved and the subscripts stand for the partial derivatives. In the following, we give the main steps of this method:

Step 1: We combine the real variables x and t by a complex variable η

$$u(x,t)=u(\eta), \quad \eta = x \pm V\,t, \qquad (2)$$

where V is the speed of the traveling wave. The traveling wave transformation (2) converts Eq. (1) into an ordinary differential equation (ODE) for $u = u(\eta)$:

$$\Re(u,u',u'',u''',\cdots), \qquad (3)$$

where $\Re$ is a polynomial of u and its derivatives and the superscripts indicate the ordinary derivatives with respect to η .

Step 2: Suppose the traveling wave solution of Eq. (3) can be expressed as follows:

$$u(\eta)=\sum_{i=0}^{N} A_i(\exp(-\Phi(\eta)))^i, \qquad (4)$$

Author α σ ¥ : Department of Mathematics, Pabna University of Science and Technology, Bangladesh. e-mail: harunorroshidmd@gmail.com
Author § : Department of Applied Mathematics, University of Rajshahi, Bangladesh.
Author ρ : Department of Mathematics, Hamdard University Bangladesh.
Author ω: Department of Mathematics, Comilla University, Bangladesh.

Global Journal of Science Frontier Research (A) Volume XIV Issue II Version I Year 2014 1

where A_i $(0 \le i \le N)$ are constants to be determined, such that $A_N \neq 0$ and $\Phi = \Phi(\eta)$ satisfies the following ordinary differential equation:

$$\Phi'(\eta) = \exp(-\Phi(\eta)) + \mu \exp(\Phi(\eta)) + \lambda, \tag{5}$$

Eq. (5) gives the following solutions:

Family 1: When $\mu \neq 0$, $\lambda^2 - 4\mu > 0$,

$$\Phi(\eta) = \ln\left(\frac{-\sqrt{(\lambda^2 - 4\mu)}\tanh\left(\frac{\sqrt{(\lambda^2 - 4\mu)}}{2}(\eta + E)\right) - \lambda}{2\mu}\right) \tag{6}$$

Family 2 : When $\mu \neq 0$, $\lambda^2 - 4\mu < 0$,

$$\Phi(\eta) = \ln\left(\frac{\sqrt{(4\mu - \lambda^2)}\tan\left(\frac{\sqrt{(4\mu - \lambda^2)}}{2}(\eta + E)\right) - \lambda}{2\mu}\right) \tag{7}$$

Family 3 : When $\mu = 0$, $\lambda \neq 0$, and $\lambda^2 - 4\mu > 0$,

$$\Phi(\eta) = -\ln\left(\frac{\lambda}{\exp(\lambda(\eta + E)) - 1}\right) \tag{8}$$

Family 4 : When $\mu \neq 0$, $\lambda \neq 0$, and $\lambda^2 - 4\mu = 0$,

$$\Phi(\eta) = \ln\left(-\frac{2(\lambda(\eta + E) + 2)}{\lambda^2(\eta + E)}\right) \tag{9}$$

Family 5 : When $\mu = 0$, $\lambda = 0$, and $\lambda^2 - 4\mu = 0$,

$$\Phi(\eta) = \ln(\eta + E) \tag{10}$$

A_N,......,V, λ, μ are constants to be determined latter, $A_N \neq 0$, the positive integer N can be determined by considering the homogeneous balance between the highest order derivatives and the nonlinear terms appearing in Eq. (3).

Step 3: We substitute Eq. (4) into Eq. (3) and then we account the function $\exp(-\Phi(\eta))$. As a result of this substitution, we get a polynomial of $\exp(-\Phi(\eta))$. We equate all the coefficients of same power of $\exp(-\Phi(\eta))$ to zero. This procedure yields a system of algebraic equations whichever can be solved to find A_N,.....V, λ, μ. Substituting the values of A_N,......V, λ, μ into Eq. (4) along with general solutions of Eq. (5) completes the determination of the solution of Eq. (1).

III. Applications of the Method

In this section, we will apply the $\exp(-\Phi(\eta))$ - expansion method to make the exact solutions and then the solitary wave solutions of the (2+1)-dimensional ZK-BBM equation. Let us consider the generalized form of the (2+1)-dimensional ZK-BBM equation,

$$u_t - u_x - a(u^2)_x + (bu_{xt} - ku_{yt})_x = 0. \tag{11}$$

where a , b and k are arbitrary constants. It arises as a description of gravity water waves in the long-wave regime.

We apply of the traveling wave variable $u(\eta) = u(x, y, t)$, $\eta = x + y - ct$, Eq. (11) is carried to an ODE

$$u'(1-c) - 2auu' + cu'''(b-k) = 0. \tag{12}$$

Eq. (12) is integrable, therefore, integrating twice with respect to η once yields:

$$P + u(1-c) - au^2 + cu''(b-k) = 0, \tag{13}$$

where P is an integration constant that is to be determined later.

Proceeding in a similar manner as in the above section and considering the homogeneous balance between u^2 and u'' in Eq. (13), we obtain $N = 2$. Therefore, the solution of Eq. (13) is of the form:

$$u(\eta) = A_0 + A_1(\exp(-\Phi(\eta))) + A_2(\exp(-\Phi(\eta)))^2, \tag{14}$$

Where A_0, A_1, A_2 are constants to be determined such that $A_N \neq 0$, while λ, μ are arbitrary constants. Substituting Eq. (14) into Eq. (13) and then equating the coefficients of $\exp(-\Phi(\eta))$ to zero, we obtain

$$-6cA_2k+6cA_2b-aA_2^{\,2}=0, \tag{15}$$

$$10cA_2\lambda b-2aA_1A_2-10cA_2\lambda k+2cA_1b-2cA_1k=0, \tag{16}$$

$$-3cA_1\lambda k+A_2-2aA_0A_2-8cA_2\mu k+3cA_1\lambda b-A_2c-4cA_2\lambda^2k-aA_1^{\,2}+8cA_2\mu b+4cA_2\lambda^2b=0, \tag{17}$$

$$-A_1c+2cA_1\mu b-6cA_2\mu\lambda k+A_1+6cA_2\mu\lambda b-cA_1\lambda^2k-2cA_1\mu k-2aA_0A_1+cA_1\lambda^2b=0, \tag{18}$$

$$A_0+cA_1\lambda\mu b+P+2cA_2\mu^2b-2cA_2\mu^2k-aA_0^{\,2}-cA_1\lambda\mu k-A_0c=0, \tag{19}$$

Solving the Eqs. (15)-(19) yields

$$P=\frac{1}{4a}(-c^2-1+2c+16c^2\lambda^2\mu bk+16c^2\mu^2b^2+16c^2\mu^2k^2+k^2\lambda^4c^2$$
$$+b^2\lambda^4c^2-8c^2\lambda^2\mu b^2-32c^2\mu^2bk-2b\lambda^4c^2k-8k^2\lambda^2c^2\mu),$$

$$c=c,\quad A_0=\frac{1}{2a}(b\lambda^2c+8b\mu c-k\lambda^2c-c-8k\mu c+1),\quad A_1=\frac{6c\lambda(b-k)}{a},\quad A_2=\frac{6c(b-k)}{a}.$$

Where λ, μ are arbitrary constants.

Now substituting the values of V, A_o, A_1, A_2 into Eq. (14) yields

$$\begin{aligned}u(\eta)&=\frac{1}{2a}(b\lambda^2c+8b\mu c-k\lambda^2c-c-8k\mu c+1)\\&+\frac{6c\lambda(b-k)}{a}(\exp(-\Phi(\eta)))+\frac{6c(b-k)}{a}(\exp(-\Phi(\eta)))^2,\end{aligned} \tag{20}$$

Where $\eta=x-ct$.

Now substituting Eqs. (6)-(10) into Eq. (20) respectively, we get the following five traveling wave solutions of the (2+1)-dimensional ZK-BBM equation.

When $\mu\neq 0$, $\lambda^2-4\mu<0$,

$$u_1(\eta)=\frac{1}{2a}(b\lambda^2c+8b\mu c-k\lambda^2c-c-8k\mu c+1)-\frac{6c\lambda(b-k)}{a}\left(\frac{2\mu}{\sqrt{\lambda^2-4\mu}\tanh(\frac{\sqrt{\lambda^2-4\mu}}{2}(\eta+E))+\lambda}\right)$$
$$+\frac{6c\lambda(b-k)}{a}\left(\frac{2\mu}{\sqrt{\lambda^2-4\mu}\tanh(\frac{\sqrt{\lambda^2-4\mu}}{2}(\eta+E))+\lambda}\right)^2.$$

where $\eta=x-ct$ and E is an arbitrary constant.

When $\mu\neq 0$, $\lambda^2-4\mu<0$,

$$u_2(\eta)=\frac{1}{2a}(b\lambda^2c+8b\mu c-k\lambda^2c-c-8k\mu c+1)+\frac{6c\lambda(b-k)}{a}\left(\frac{2\mu}{\sqrt{4\mu-\lambda^2}\tan(\frac{\sqrt{4\mu-\lambda^2}}{2}(\eta+E))-\lambda}\right)$$
$$+\frac{6c\lambda(b-k)}{a}\left(\frac{2\mu}{\sqrt{4\mu-\lambda^2}\tan(\frac{\sqrt{4\mu-\lambda^2}}{2}(\eta+E))-\lambda}\right)^2.$$

where $\eta=x-ct$ and E is an arbitrary constant.

Global Journal of Science Frontier Research (A) Volume XIV Issue II Version I Year 2014 3

When $\mu = 0$, $\lambda \neq 0$, and $\lambda^2 - 4\mu > 0$,

$$u_3(\eta) = \frac{1}{2a}(b\lambda^2 c + 8b\mu c - k\lambda^2 c - c - 8k\mu c + 1) + \frac{6c\lambda(b-k)}{a}\left(\frac{\lambda}{\exp(\lambda(\eta+E)) - 1}\right) + \frac{6c\lambda(b-k)}{a}\left(\frac{\lambda}{\exp(\lambda(\eta+E)) - 1}\right)^2.$$

where $\eta = x - ct$ and E is an arbitrary constant.

When $\mu \neq 0$, $\lambda \neq 0$, and $\lambda^2 - 4\mu = 0$,

$$u_4(\eta) = \frac{1}{2a}(b\lambda^2 c + 8b\mu c - k\lambda^2 c - c - 8k\mu c + 1) + \frac{6c\lambda(b-k)}{a}\left(\frac{\lambda^2(\eta+E)}{2(\lambda(\eta+E)) + 2)}\right) + \frac{6c\lambda(b-k)}{a}\left(\frac{\lambda^2(\eta+E)}{2(\lambda(\eta+E)) + 2)}\right)^2.$$

where $\eta = x - ct$ and E is an arbitrary constant.

When $\mu = 0$, $\lambda = 0$, and $\lambda^2 - 4\mu = 0$,

$$u_5(\eta) = \frac{1}{2a}(b\lambda^2 c + 8b\mu c - k\lambda^2 c - c - 8k\mu c + 1) + \frac{6c\lambda(b-k)}{a}\frac{1}{(\eta+E)} + \frac{6c\lambda(b-k)}{a}\left(\frac{1}{(\eta+E)}\right)^2.$$

where $\eta = x - ct$ and E is an arbitrary constant.

IV. Conclusion

In this paper, the traveling wave solutions of the (2+1)-dimensional ZK-BBM equation is found successfully through the use of the $\exp(-\Phi(\eta))$ -expansion method, which includes the exponential functions solutions, the hyperbolic functions solutions, the trigonometric functions solutions and the rational functions solutions. It is shown that the $\exp(-\Phi(\eta))$ -expansion method provides a very effective and powerful mathematical tool for solving nonlinear equations in mathematical physics and engineering.

References Références Referencias

1. E. M. E. Zayed, A. M. Abourabia, K. A. Gepreel, M. M. Horbaty, On the rational solitary wave solutions for the nonlinear HirotaCSatsuma coupled KdV system, Appl. Anal. 85 (2006) 751-768.
2. K.W. Chow, A class of exact periodic solutions of nonlinear envelope equation, J. Math. Phys, 36 (1995) 4125-4137.
3. D. Liu, Jacobi elliptic function solutions for two variant Boussinesq equations, Chaos solitons and Fract., 24 (2005) 1373-85.
4. Y. Chen and Q. Wang, Extended Jacobi elliptic function rational expansion method and abundant families of Jacobi elliptic functions solutions to (1+1)-dimensional dispersive long wave equation, Chaos solitons and Fract., 24 (2005) 745-57.
5. M.L. Wang and Y. B. Zhou, The periodic wave solutions for the Klein-Gordon- Schrodinger equations, Phys. Lett. A 318 (2003) 84-92.
6. M.L. Wang and X. Z. Li, Extended F-expansion method and periodic wave solutions for the generalized Zakharov equations, Phys. Lett. A, 343 (2005) 48-54.
7. M.L. Wang, X. Z. Li, J. Zhang, The (G′ / G)-expansion method and traveling wave solutions of nonlinear evolution equations in mathematical physics, Phys. Lett. A, 372 (2008) 417-423.
8. R.K. Gupta, S. Kumar and B. Lai, New exact traveling wave solutions of generalized sinh-Gordon and the (2+1)-dimensional ZK-BBM equations, Maejo Int. J. Sci. Technol., 6(03), (2012), 344-355.
9. M.N. Alam, M.A. Akbar and S.T. Mohyud-Din, A novel (G′/ G) -expansion method and its application to the Boussinesq equation, Chin. Phys. B, Vol. 23(2), 2014, 020203- 020210, DOI: 10.1088/1674-1056/23/2/020203.
10. M.N. Alam and M.A. Akbar, Exact traveling wave solutions of the KP-BBM equation by using the new generalized (G′/G) -expansion method, Springer Plus, 2(1), 2013, 617. DOI: 10.1186/2193-1801-2-617.
11. A. Bekir, Application of the (G′/G) -expansion method for nonlinear evolution equations, Phys. Lett. A, 372 (2008) 3400-3406.
12. H. O. Roshid, M.A. Akbar, M. N. Alam , M. F. Hoque, and N. Rahman, New extended (G′/G) -expansion method to solve nonlinear evolution equation: The

(3+1)-dimensional potential-YTSF equation, SpringerPlus , 2014, 3:122 doi:10.1186/2193-1801-3-122.
13. M.N. Alam and M. A. Akbar, H. O. Roshid, Traveling wave solutions of the Boussinesq equation via the new approach of generalized (G'/G) -Expansion Method, SpringerPlus 2014, 3:43 doi:10.1186/2193-1801-3-43.
14. M.N. Alam and M. A Akbar, Application of the the new approach of generalized (G'/G) - expansion method to find exact solutions of nonlinear PDEs in mathematical physics, BIBECHANA, 10 (2014): 58-70.
15. M.N. Alam, M.A. Akbar and K. Khan, Some new exact traveling wave solutions to the (2+1)-dimensional breaking soliton equation, World Applied Sci. J., 25(3), 2013, 500- 523.
16. R. Hirota, The direct method in soliton theory, Cambridge University Press, Cambridge, 2004.
17. M.R. Miura, Backlund transformation, Springer, Berlin, 1978.
18. V.B. Matveev and M. A. Salle, Darboux transformation and solitons, Springer, Berlin, 1991.
19. S.T. Mohyud-Din, Homotopy perturbation method for solving fourth-order boundary value problems, Math. Prob. Engr., 1-15, 2007, Article ID 98602, doi: 10.1155/2007/98602.
20. S.T. Mohyud-Din and M.A. Noor, Homotopy perturbation method for solving partial differential equations, Zeitschrift fur Naturforschung A-A J. Phys. Sci., 64a (2009): 157- 170.
21. N. Rahman, H. O. Roshid, M.N. Alam and S. Zafor, Traveling Wave Solutions of The (1+1)-Dimensional Compound KdVB equation by Exp$(-\Phi(\eta))$ -Expansion Method, Inter. J. Sci. Eng. Tech., Vol. 3(2), 2014, 93-97.
22. N. Rahman, S. Akter, H. O. Roshid and M. N. Alam, Traveling Wave Solutions of The (1+1)-Dimensional Compound KdVB equation by Exp $(-\Phi(\eta))$ –Expansion Method, Global Journal of Science Frontier Research, Vol. 13 (8), 2014, 7-13.
23. R. Islam, M. N. Alam, A. K. M. K. S. Hossain, H. O. Roshid and M. A. Akbar, Traveling wave solutions of nonlinear evolution equations via exp $(-\Phi(\eta))$ - expansion method, Global Journal of Scientific Frontier Research, Vol. 13 (11), 2014, 63-71.
24. N. Rahman, M. N. Alam, H. O. Roshid, S. Akter and M. A. Akbar, Application of exp $(-\Phi(\eta))$ -expansion method to find the exact solutions of Shorma-Tasso-Olver equation, African Journal of Mathematics and Computer Science Research, Vol. 7(1), pp. 1-6, February, 2014, DOI: 10.5897/AJMCSR2014.0532.
25. M. S. Uddin, M. N. Alam, S.M.S. Hossain, M.S. Hasan and M.A. Akbar, Some new exact traveling wave solutions to the (3+1)-dimensional Zakharov-Kuznetsov equation and the Burgers equations via Exp $(-\Phi(\eta))$ -Expansion Method, Frontiers of Mathematics and Its Applications, 1(1): 1-8, 2014. DOI: 10.12966/fmia.03. 01.2014, (USA).

This page is intentionally left blank

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 14 Issue 2 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

The Question of E = mc^2 and Rectification of Einstein's General Relativity

By C. Y. Lo
Applied and Pure Research Institute, United States

Abstract- The formula E = mc^2 is a speculation that was confirmed by Nuclear fission and fusion, but is not valid for the electromagnetic energy alone because the electromagnetic energy-stress tensor is traceless. On the other hand, for the light rays satisfying E = mc^2 necessitates the existence of a photonic tensor with an anti-gravity coupling added to the Einstein equation with the source of an electromagnetic wave. This is consistent with the massive dynamic case that the Einstein equation must be rectified to the Lorentz-Levi-Einstein equation. Moreover, because the couplings in the Einstein equation must have different signs for the dynamic case that involves gravitational waves, the space-time singularity theorems of Hawking and Penrose actually are irrelevant to physics. The misinterpretation of E = mc^2 as generally valid, is responsible for overlooking the charge-mass interaction, which is crucial for the unification of gravitation and electromagnetism. General validity of E = mc^2 is also in disagreement with experiments. It is pointed out that the interpretations of E = mc^2 of both Nobel Laureates, 't Hooft and Wilczek, just like many others, are also incorrect.

Keywords: *einstein's equivalence principle; dynamic solution; gravitational wave; E = mc^2.*

GJSFR-A Classification : *FOR Code: 249999*

THEQUESTIONOFEMC2ANDRECTIFICATIONOFEINSTEINSGENERALRELATIVITY

Strictly as per the compliance and regulations of :

The Question of $E = mc^2$ and Rectification of Einstein's General Relativity

C. Y. Lo

Abstract- The formula $E = mc^2$ is a speculation that was confirmed by Nuclear fission and fusion, but is not valid for the electromagnetic energy alone because the electromagnetic energy-stress tensor is traceless. On the other hand, for the light rays satisfying $E = mc^2$ necessitates the existence of a photonic tensor with an anti-gravity coupling added to the Einstein equation with the source of an electromagnetic wave. This is consistent with the massive dynamic case that the Einstein equation must be rectified to the Lorentz-Levi-Einstein equation. Moreover, because the couplings in the Einstein equation must have different signs for the dynamic case that involves gravitational waves, the space-time singularity theorems of Hawking and Penrose actually are irrelevant to physics. The misinterpretation of $E = mc^2$ as generally valid, is responsible for overlooking the charge-mass interaction, which is crucial for the unification of gravitation and electromagnetism. General validity of $E = mc^2$ is also in disagreement with experiments. It is pointed out that the interpretations of E = mc^2 of both Nobel Laureates, 't Hooft and Wilczek, just like many others, are also incorrect.

Keywords: einstein's equivalence principle; dynamic solution; gravitational wave; $E = mc^2$.
04.20.-q, 04.20.Cv

I. Introduction

The formula $E = mc^2$ can be traced back to special relativity, which suggested a rest inertial mass m_0 of a particle that has the rest energy of m_0c^2. This is supported by the nuclear fissions (or fusions) with $\Delta E = \Delta mc^2$, where Δm is the mass difference after the fission (or fusion) and ΔE the total energy created and is usually a combination of different types of energy. However, the general validity of the formula $E = mc^2$ is only a speculation that has never been verified [1]. In fact, Einstein had tried very hard for years (1905-1909) to prove this formula to be generally valid, but failed [2].

Experimentally, it has been observed that the particle π^0 meson decays into two photons (i.e.,$\pi^0 \rightarrow \gamma + \gamma$). This was mistakenly considered as evidence that the electromagnetic energy is equivalent to mass. However, there would be a conflict if a photon includes only electromagnetic energy since the electromagnetic energy-stress tensor is traceless. Therefore, this experiment means only that the photons must consist of non-electromagnetic energy.

Some define an electromagnetic mass for a photon in terms of $m = E/c^2$. However, in physics, a definition must be supported with experiments. Thus, it would be necessary to show that the electromagnetic mass can generate the same gravity that would have been generated by the inertial mass. However, when Einstein proposed the notion of photon [2; p. 177], Einstein had not yet conceived general relativity then. Moreover, according to general relativity, such a claim is incorrect for electromagnetic energy. The Einstein field equation [3, 4] is,

$$G_{\mu\nu} \equiv R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = -K T_{\mu\nu} , \quad (1)$$

where the energy stress tensor $T_{\mu\nu}$ is the sum of any type of energy-stress tensor. The electromagnetic energy-stress tensor, being traceless, cannot affect R in eq. (1). Therefore, the electromagnetic energy is not equivalent to mass.

Nevertheless, since Hawking and Penrose claimed that general relativity was not applicable in microscopic scale [5],1) the possibility of including gravitational energy in photons was ignored. It will be shown that Hawking and Penrose are incorrect (see section 2). Moreover, the energy of photons is, indeed, the sum of the energies of the electromagnetic wave component and that of the gravitational wave component [6]. Since a charged particle has mass, it is natural that the non-electromagnetic energy is the gravitational energy.

From the Reissner-Nordstrom Metric [7], it is clear that the electromagnetic energy is not equivalent to mass [1]. However, because of the misinterpretation of $E = mc^2$ as generally valid, the charge-mass interaction [8] that can lead to prove the non-equivalence between mass and electromagnetic energy experimentally was overlooked for more than 80 years.

It will be shown the fact that $E = mc^2$ demands a photonic Energy-Stress Tensor, is also required by general relativity. On the other hand, it can be shown also that $E = mc^2$ is not generally valid experimentally. However, theorists including some Nobel Laureates (see Section 4), still misinterpreted this formula as unconditional.

II. Necessity of a Photonic Energy-Stress Tensor and the Anti-Gravity Coupling

To have a solution of gravity for an electromagnetic wave, it turns out that the Einstein equation

Author : Applied and Pure Research Institute, Amherst, NH.
e-mail: c_y_lo@yahoo.com

$G_{\mu\nu} = -K\,T(E)_{\mu\nu}$ is inadequate because it is impossible to have a meaningful solution in physics (see section 2.1). Then, the calculation for the bending of light could be invalid since it was implicitly assumed that the gravity due to the light is negligible [3].

To have a meaningful solution, it is necessary to modify the Einstein equation [6] to

$$G_{\mu\nu} = -K\,[T(E)_{\mu\nu} - T(P)]_{\mu\nu} = Kt(g)_{\mu\nu}, \qquad (2)$$

where $T(E)_{\mu\nu}$ is the energy-stress tensor of the electromagnetic wave, and $T(P)_{\mu\nu}$ is the photonic energy-stress tensor. Thus, the existence of the photonic energy-stress tensor is a necessary result of general relativity, that is consistent with $E = mc^2$. Moreover, the necessity of the anti-gravity coupling is not limited to the case that involves an electromagnetic wave. The anti-gravity coupling is necessary when the gravitational wave is involved [9]. To have a physical solution for massive sources, it has been shown that a gravitational energy-stress tensor with an anti-gravity coupling sign must be added [10-12], i.e., the massive Einstein equation must be modified to the Lorentz-Levi-Einstein equation,[2)]

$$G_{\mu\nu} = -K\,[T(m)_{\mu\nu} - t(g)]_{\mu\nu} \qquad (3)$$

where $T(m)_{\mu\nu}$ is the massive energy-stress tensor, and $t(g)_{\mu\nu}$ is gravitational energy-stress tensor.

It should be noted that the linearized equation in general relativity is a valid linearization of the Lorentz-Levi-Einstein equation [13], but is not a valid linearization of the Einstein equation that has no bounded dynamic solution.

In short, for the dynamic case when gravitational wave is involved, Einstein was wrong. However, Gullstrand [14], Chairman (1922-1929) of the Nobel Committee for Physics is right. Thus, the long dispute on Einstein's calculation on the perihelion is settled as invalid because it is not possible to derive his calculation from a many-body problem although the results are correct [9]. In conclusion, general relativity is incomplete although it has a good start. Nevertheless, Einstein is a winner because his conjecture, the unification of electromagnetism and gravitation is confirmed [15].

a) Physical Gravitational Solutions for Electromagnetic Plane-Waves

Analysis indicates that an electromagnetic wave would generate an accompanying gravitational wave [7, 16, 17]. The calculation of the bending of light assumes that such gravitational waves are very weak and negligible [3, 4]. To verify this, one should calculate such a gravitational wave with the Einstein equation that has the electromagnetic wave as the source. For this case, Einstein [18] believed the field equation is

$$G_{ab} = -KT(E)_{ab} \text{ where } T(E)_{ab} = -g^{mn}F_{ma}F_{nb} + (1/4)g_{ab}F^{mn}F_{mn} \qquad (4)$$

and F_{ab} is the electromagnetic field tensor. Thus, $R = 0$ since the trace of $T(E)_{ab}$ is zero.

Now, let us consider a ray of uniform electromagnetic waves (i.e. a laser beam) propagating in the z-direction. Within the ray, one can assume that the wave amplitude is independent of x and y (see also [7, 17]). Thus, the electromagnetic potentials are plane-waves, and in the unit that the light velocity c = 1,

$$A_k(x, y, z, t) = A_k(t - z), \text{ where } k = x, y, z, \text{ or } t\,. \qquad (5)$$

Due to the principle of causality [10], the metric g_{ab} is functions of u (= t - z), i.e.,

$$g_{ab}(x, y, z, t) = g_{ab}(u)\,, \text{ where } a, b = x, y, z, \text{ or } t\,. \qquad (6)$$

Let P^k be the momentum of a photon. Then, one obtains the conditions,

$$P^z = P^t,\; P^x = P^y = 0, \text{ and } P^m g_{mk} = P_k = 0\,, \text{ for } k = x, y, \text{ or } v, \qquad (7a)$$

where $v \equiv t + z$. Compatibility with weak gravity is used [17] in deriving eq. (7a) which is equivalent to

$$g_{xt} + g_{xz} = 0\,,\; g_{yt} + g_{yz} = 0\,, \text{ and } g_{tt} + 2g_{tz} + g_{zz} = 0\,, \qquad (7b)$$

or

$$g^{xt} - g^{xz} = 0\,, g^{yt} - g^{yz} = 0\,, \text{ and } g^{tt} - 2g^{zt} + g^{zz} = 0\,. \qquad (7c)$$

Note that eq. (7) implies that the harmonic gauge may not be valid. The wave transversality implies

$$P^m A_m = 0\,, \quad \text{or equivalently} \quad A_z + A_t = 0\,. \qquad (8)$$

Eqs. (6) to (8) imply that not only the geodesic equation, the Lorentz gauge, but also Maxwell's equation are satisfied. Moreover, the Lorentz gauge becomes equivalent to a covariant expression.

The above analysis suggests that an electromagnetic plane-wave can be an exact solution in a non-flat manifold. In a coordinate system where P_m are constants, the scalar $\int P_m\, dx^m$ would equal to $P_m x^m$. Moreover,

$$R_{tt} = - R_{tz} = R_{zz} \,, \tag{9a}$$

because $F^{mn}F_{mn} = 0$ due to eq. (7). The other components give eq. (7), and are zero [8]. Then, we have

$$R_{tt} \equiv -\partial\Gamma^{m}{}_{tt}/\partial x^{m} + \partial\Gamma^{m}{}_{mt}/\partial t - \Gamma^{m}{}_{mn}\Gamma^{n}{}_{tt} + \Gamma^{m}{}_{nt}\Gamma^{n}{}_{mt} = -KT(E)_{tt} = K\, g^{mn}F_{mt}F_{nt}. \tag{9b}$$

After some lengthy algebra [17], eq. (9b) is simplified to a differential equation of u as follows:

$$G'' - g_{xx}'g_{yy}' + (g_{xy}')^2 - G'(g'/2g) = 2K\,(F_{xt}{}^2 g_{yy} + F_{yt}{}^2 g_{xx} - 2F_{xt}F_{yt}\, g_{xy}) \tag{10}$$

$$= 2GR_{tt}, \quad \text{where} \quad G \equiv g_{xx}\, g_{yy} - g_{xy}{}^2, \text{ and } g = |g_{ab}|$$

is the determinant of the metric. The metric elements are connected by the following relation:

$$- g = G\, g_t{}^2, \text{ where } g_t \equiv g_{tt} + g_{tz}; \tag{11}$$

and

$$g^{xx} = g_{yy}/G, \quad g^{yy} = g_{xx}/G, \text{ and } g^{xy} = -g_{xy}/G \tag{12}$$

Note that eqs. (35.31) and (35.44) in reference [7] and eq. (2.8) in reference [19] are special cases of eq. (10). However, their solutions are unbounded [17]. On the other hand, compatibility with Einstein's notion of weak gravity is required by the light bending calculation and is implied by the equivalence principle [11].

Equations (5), (6), (8), and (9) allow A_t, g_{xt}, g_{yt}, and g_{zt} to be set to zero. In any case, these assigned values have little effect in subsequent calculations. For the remaining metric elements (g_{xx}, g_{xy}, g_{yy}, and g_{tt}), it will be shown, however, eq. (10) is sufficient to show that there is no physical solution for an Einstein equation. In other words, in contrast to Einstein's belief [18], the difficulty of this equation is not limited to mathematics.

Now, let us consider a circularly polarized monochromatic electromagnetic plane-wave,

$$A_x = (1/\sqrt{2})\, A_0 \cos\, \omega u, \text{ and } A_y = (1/\sqrt{2})\, A_0 \sin \omega\, u\,. \tag{13}$$

Then $P_t = \omega$ (since h = 1). The rotational invariants with respect to the z-axis are constants. These invariants are: R_{tt}, $T(E)_{tt}$, G, $(g_{xx} + g_{yy})$, g_{tz}, g_{tt}, g, and etc. Let us assume the invariant,

$$g_{xx} + g_{yy} = -2 - 2C, \text{ then } g_{xx} = -1 - C + B\,, \text{ and } g_{yy} = -1 - C - B. \tag{14}$$

Thus,

$$B^2 + g_{xy}{}^2 = (1+C)^2 - G\,, \text{ and } (B')^2 + (g_{xy}')^2 = 2GR_{tt} \geq 0 \tag{15}$$

obtained from $G = gxx\ gyy - gxy^2$ and eq. (10), are constants. It follows that eq. (15) implies

$$B = B_\alpha \cos(\,\omega_1 u + \alpha), \quad \text{and} \quad g_{xy} = \pm B_\alpha \sin(\omega_1 u + \alpha\,)\,, \tag{16a}$$

where

$$\omega_1{}^2 = 2R_{tt}\, G/B_\alpha{}^2\,, \quad \text{and} \quad B_\alpha{}^2 = (1+C)^2 - G \geq 0. \tag{16b}$$

Thus, it is proven that the metric is a periodic function. Also, as implied by causality, the metric is not an invariant under a rotation (since a transverse electromagnetic wave is not such an invariant).

On the other hand, since $T(E)_{tt}$ is a constant, it is necessary to have

$$\omega_1 = 2\omega\,, \quad \text{and} \quad T(E)_{tt} = (1/2G)\, \omega^2 A_0{}^2\, (1 + C - B_\alpha \cos\alpha) > 0. \tag{16c}$$

Eq. (16a) implies that the metric is a circularly polarized wave with the same direction of polarization as the electromagnetic wave (13). However, it is not possible to satisfy Einstein's equation because both $T(E)_{tt}$ and R_{tt} have the same sign. Thus, there is no possibility, within the current theory, to construct an acceptable metric representing the accompanying gravitational wave for a circular polarized electromagnetic plane-wave.

Now, consider also a wave linearly polarized in the x-direction,

$$A_x = A_0 \cos \omega(t - z) . \quad (17a)$$

Then, one has

$$T_{tt} = - (g_{yy}/2G)\omega^2 A_0^2[1 - \cos 2\omega(t - z)] . \quad (17b)$$

If a circularly polarized electromagnetic plane-wave results in a circularly polarized gravitational wave, one may expect that a linearly polarized electromagnetic plane-wave results in a linearly polarized gravitational wave. From the viewpoint of physics, the principle of causality would require that, for an x-directional polarization, gravitational components related to the y-direction, remains the same. In other words,

$$g_{xy} = 0 , \text{ and } g_{yy} = -1 . \quad (18)$$

Mathematically, condition (18) is compatible with semi-unitary (i.e., g is a constant).
Equation (18) means that the gravitational wave is also linearly polarized. It follows that equation (10) becomes

$$G'' = - 2 K G T_{tt} \text{ and } G = - g_{xx}. \quad (19)$$

Then, different from the circular polarization, eq. (19) would have a solution

$$-g_{xx} = 1 + C_1 - (K/4) A_0^2\{2\omega^2(t - z)^2 + \cos [2\omega (t - z)]\} + C_2(t - z) , \quad (20)$$

where C_1 and C_2 are constants. However, (20) is invalid in physics since $(t - z)^2$ grows very large as time goes by.

On the other hand, since physical influences can be propagated at most with a light speed, the influence of an electromagnetic wave on its accompanying gravitational wave would essentially be spatially local. This means that the electromagnetic plane-wave, a well-tested spatial local idealization, is a valid physical modeling for gravity. Thus, if general relativity is fundamentally valid, there must be a way in physics to modify the equation such that a physical solution can be obtained for a plane-wave. Otherwise, general relativity would not be a valid theory in physics.

The formula $E = mc^2$ gives us a clear suggestion. Since the Einstein tensor is supported by causality, it would be sufficient to modify the source tensor [6]. The additional energy term should be a constant of different sign, and is larger in absolute value. Moreover, calculation shows that a physical solution requires that in the flat metric approximation, an electromagnetic wave energy tensor and the unknown tensor with an antigravity coupling carry, on the average, the same energy-momentum [6]. This is expected for a photonic energy tensor, according to experiments.

Thus, physics requires that the unknown tensor must be the energy-stress tensor of photons. Given that an electromagnetic wave moving with the velocity of light, its gravitational influence must be moving along according to special relativity. This means that the photonic energy-stress tensor would be the sum of the electromagnetic energy-stress tensor and the gravitational energy-stress tensor, i.e., $T(P)_{ab} = T(E)_{ab} + T(g)_{ab}$.

b) *A Photonic Energy-Stress Tensor and the Anti-Gravity Coupling*

As required by the bending of light, one must show that a valid modification can be obtained with a photonic energy-stress tensor, i.e. it would also lead to a physical solution and generate a geodesic equation for photons. From the previous analysis, the appropriate Einstein equation would be

$$G_{ab} = -K[T(E)_{ab} - T(p)_{ab}], \text{ and } T_{ab} = - T(g)_{ab} = T(E)_{ab} - T(P)_{ab} , \quad (21)$$

where $T(E)_{ab}$ and $T(P)_{ab}$ are the energy-stress tensors for the electromagnetic wave and the related photons.

Note that the energy-stress tensor of photons has an anti-gravity coupling. Since both $T(E)_{ab}$ and $T(g)_{ab}$ (due to $\nabla^c G_{cb} \equiv 0$ and eq. [7a]) are divergence free and traceless, $T(P)_{ab}$ must also be divergence free and traceless.

Given that a photonic energy tensor should produce a geodesic equation, for a monochromatic wave, the tensor form should be similar to that of massive matter. Observationally, there is very little interaction, if any, among photons of the same ray. Theoretically, since photons travel at the velocity of light, there should not be any interaction among them. Therefore, the photonic energy tensor should be dust-like as follows:

$$T^{ab}(P) = \rho P^a P^b, \quad (22a)$$

where ρ is a scalar which, according to causality, is a function of u. The geodesic equation, $P^c \nabla_c P^b = 0$, is implied by $\nabla c(\rho P^c) = 0$, and $\nabla c\, T(P)^{cb} = 0$. ρ (u) should be a non-zero function of the electromagnetic potentials and/or fields. This implies $\rho = \lambda A_m g^{mn} A_n$, where λ is a scalar constant to be determined.

Since light intensity is proportional to the square of the wave amplitude, ρ can be considered as the density function of photons if $\lambda = -1$. Due to R = 0 and eqs. (5) and (6) remain valid, $\rho(u)$ is Lorentz gauge invariant. Then, one obtains

$$T_{ab} = T(E)_{ab} - T(P)_{ab} = T(E)_{ab} - \lambda A_m g^{mn} A_n P_a P_b . \qquad (22b)$$

Thus, a photonic energy tensor changes nothing in calculation, but gives another term for eq. (10) only. To determine λ, let us consider a circularly polarized monochromatic wave (10). Then, we have,

$$T_{tt} = (1/2G)\,\omega^2 A_0^2\,[(1 + C)(1 + \lambda) - (1 - \lambda)B_\alpha \cos\alpha] \le 0 \qquad (23)$$

since $P_t = \omega$ (in the units $c = h = 1$) and eq. (16b) requires R_{tt} to be of second order and positive. Eq. (23) requires that $\lambda \le -1$ because the constants C and B_α are much smaller than 1. Causality requires that, in a flat metric approximation, the time average of T_{tt} is zero. This implies that, as expected,

$$\lambda = -1, \quad T_{ab} = T(E)_{ab} - T(P)_{ab} = T(E)_{ab} + A^m g^{mn} A_n P_a P_b$$

and

$$T_{tt} = -(1/G)\,\omega^2 A_0^2 B_\alpha \cos\alpha \le 0, \quad \text{since} \quad B_\alpha = (K/2)\,A_0^2 \cos\alpha . \qquad (24)$$

Thus, the energy density of the photonic energy tensor is indeed larger than that of the electromagnetic wave. Then, (16a) and (16b) are valid for eq. (10). Note that, pure electromagnetic waves can exist since $\cos\alpha = 0$ is possible.

To confirm the general validity of $\lambda = -1$, consider also the wave linearly polarized in the x-direction,

$$A_x = A_0 \cos\omega(t - z) . \qquad (17a)$$

Then, one has

$$T_{tt} = (g_{yy}/2G)\,\omega^2 A_0^2\,(-\lambda - 1) + (1 - \lambda)\cos[2\omega(t - z)] . \qquad (25a)$$

Thus, the flat metric approximation again requires that $\lambda = -1$. Then,

$$T_{tt} = (g_{yy}/G)\,\omega^2 A_0^2 \cos[2\omega(t - z)] . \qquad (25b)$$

Eq. (25b) implies $(g_{xx} + g_{yy})'$ to be of first order [8], and therefore its polarization has to be different. Note that T_{tt} is allowed to be positive, since the gravitational component is not an independent wave. Then the solution is

$$-g_{xx} = 1 + C_1 - (K/2)\,A_0^2 \cos[2\omega(t - z)], \text{ and } g_{tt} = -g_{zz} = (g/g_{xx})^{1/2}, \qquad (26)$$

where C_1 is a constant. The frequency ratio is the same as the other case and, as expected, the average of T_{tt} is negative.

Thus, $T_{ab}(P)$ has been derived from the electromagnetic wave. In spite of the demanding physical requirements, a photonic energy tensor has been obtained. Note that the photonic energy tensor of Misner et al. [7, Section 22], is an approximation of the time-average of $T_{ab}(P)$. For a circularly polarized electromagnetic wave, the phase difference controls the amplitude of the gravitational wave (see eq. [24]), and the amplitude of the electromagnetic wave gives an upper bound. This is different from the case of linearly polarized waves for which the amplitude of gravity is fixed.

Most important, it is the anti-gravity coupling of the photonic energy-stress tensor that illustrates general relativity to be a viable theory. Thus, what Einstein has missed is that *the anti-gravity coupling is necessary in general relativity*. Accordingly, the space-time singularity theorems of Hawking and Penrose are actually irrelevant to physics since the physical assumption of their energy conditions will not be satisfied.

Historically, the existence of the antigravity coupling was first proposed for the gravitational energy-stress tensor $t(g)_{\mu\nu}$ [2)] by Lorentz [20] in 1916 and Levi-Civita [21] in 1917. However, Einstein [22] incorrectly rejected their proposal on the ground that $t(g)_{\mu\nu} = 0$ in his equation. In 1995, Lorentz and Levi-Civita are proven right [10-12]

III. The Reissner-Nordstrom Metric and the Repulsive Effect

A problem of the above analysis is that it is difficult to verify experimentally. In this section, we shall discuss the experimental verification of the non-equivalence between mass and electromagnetic energy.

General relativity makes it explicit that the gravity generated by mass and that by the electromagnetic energy are different, as shown by the existence of repulsive effect in the Riessner-Nordstrom metric [15],

Global Journal of Science Frontier Research (A) Volume XIV Issue II Version I Year 2014

$$ds^2 = \left(1 - \frac{2M}{r} + \frac{q^2}{r^2}\right)dt^2 - \left(1 - \frac{2M}{r} + \frac{q^2}{r^2}\right)^{-1} dr^2 - r^2 d\Omega^2 , \tag{27}$$

where q and M are the charge and mass of a particle and r is the radial distance, in terms of the Euclidean-like structure [23] from the particle center.

In metric (27), the gravitational components generated by electricity have not only a very different radial coordinate dependence but also a different sign that makes it a new repulsive gravity [1].

Some argued that the effective mass in metric (27) is M - q^2/2r (in the units, the light speed $c = 1$) since the total electric energy outside a sphere of radius r is $q^2/2r$. However, from metric (27), the gravitational force is different from the force created by the "effective mass" $M - q^2/2r$ because

$$-\frac{1}{2}\frac{\partial}{\partial r}\left(1 - \frac{2M}{r} + \frac{q^2}{r^2}\right) = -\left(\frac{M}{r^2} - \frac{q^2}{r^3}\right) > -\frac{1}{r^2}\left(M - \frac{q^2}{2r}\right). \tag{28}$$

They achieved only exposing further an inadequate understanding in the theory of relativity. Some theorists claimed that M should include the electric energy, and this exposes an even deeper error related to the derivation.

a) Derivation of the Reissner-Nordstrom Metric

It seems that mass M in (2) as a "total mass" that includes the electric energy, would be allowed if you were careless. However, a close examination shows that this is invalid.

According to Einstein, for the Reissner-Nordstrom metric, the static field equation includes at least the massive energy-stress tensor and the electromagnetic energy-stress tensor. They differ by that the electromagnetic energy-stress tensor is traceless whereas the massive energy-stress tensor is not.

If one assumes that the metric has the following form,

$$ds^2 = f\,dt^2 - h\,dr^2 - r^2(d\theta^2 + \sin\theta^2 d\phi^2) , \tag{29}$$

then, as shown by Wald [5], at the region outside the particle ($r > r_0$) we have

$$-R_{00} = \frac{1}{2}(fh)^{-1/2}\frac{d}{dr}\left[(fh)^{-1/2} f'\right] + (fhr)^{-1} f' , \tag{30a}$$

$$-R_{11} = -\frac{1}{2}(fh)^{-1/2}\frac{d}{dr}\left[(fh)^{-1/2} f'\right] + (h^2 r)^{-1} h' , \tag{30b}$$

$$-R_{22} = -\frac{1}{2}(rfh)^{-1} f' + \frac{1}{2}(h^2 r)^{-1} h' + r^{-2}(1 - h^{-1}) \tag{30c}$$

Moreover, outside the particle we have

$$T(m)_{\mu\nu} = 0 \qquad \text{for} \qquad r > r_0 \tag{31a}$$

But

$$T(m)_{00} = \rho(r), \quad T(m)_{11} = T(m)_{22} = T(m)_{33} = P(r), \quad \text{when } r < r_0 \tag{31b}$$

where P(r) is the pressure of the perfect fluid model.
Because the electric energy-stress tensor $T(E)_{\mu\nu}$ is traceless, we also have, for $r > r_0$,

$$R_{00} = -R_{11} = R_{22} = -E^2, \quad \text{where } \vec{E} = \frac{q}{r^3}\vec{r} \tag{32}$$

is the electric field, according to Misner et al. [7; p. 841]. If $h = 1/f$ in metric (29), then (30) is reduced to

$$-R_{00} = R_{11} = \frac{1}{2} f'' + r^{-1} f' = E^2 \tag{33a}$$

And

$$-R_{22} = -r^{-1} f' + r^{-2}(1 - f) = E^2 \tag{33b}$$

Moreover, if $f = \left(1 - \frac{2M}{r} + \frac{q^2}{r^2}\right)$ as in metric (27), then we have, in consistent with (32),

$$\frac{q^2}{r^2} = r^2 E^2 \tag{34}$$

Thus, it might seem there is no restriction on the mass M of metric (29). However, from (32), it is clear that M in metric (29) cannot include the electric energy (outside the particle) since it has been represented in (32).

b) Misinterpretations of the Reissner-Nordstrom Metric

Nevertheless, Herrera, Santos, & Skea [24], argued that M in (27) involves the electric energy. They follow the error of Whittaker [25] and Tolman [26]. They defined the active gravitational mass density μ with the electromagnetic energy tensor $E^{\alpha}{}_{\beta}$ as $\mu = E_0^0 - E_i^i$ and the active mass in a volume V_a is given by

$$m_a(r) = \int_{V_a} \mu(-g)^{1/2} dx^1 dx^2 dx^3 , \tag{35}$$

where g is the determinant of the metric $g_{\mu\nu}$. It thus follows that, for a particle with charge Q, one has

$$m_a(\infty) - m_a(r) = \int_r^\infty \frac{Q^2}{r^2} dr , \quad \text{and } m_a(r) = M - \frac{Q^2}{r} , \quad \text{where } m_a(\infty) = M \tag{36}$$

Thus $m_a(r)$ would be in agreement with that the total force is proportion to

$$\frac{1}{2}\frac{\partial}{\partial r}\left(1 - \frac{2M}{r} + \frac{Q^2}{r^2}\right) = (M - \frac{Q^2}{r})\frac{1}{r^2} = \left(m_a(r_0) + Q^2(\frac{1}{r_0} - \frac{1}{r})\right)\frac{1}{r^2} \tag{37a}$$

$$\text{since } M = m_a(r) + Q^2/r = \left(m_a(r_0) + Q^2/r_0\right), \tag{37b}$$

where r_0 is the radius of the particle. However, (36) does not agree with (28) since

$$-2(M - \frac{Q^2}{r})\frac{1}{r} \neq \left(-\frac{2M}{r} + \frac{Q^2}{r^2}\right) \tag{37c}$$

Eq. (37a) implies that the weight of a charged metal ball would increase when the charge Q is increased. According to eq. (35), $m_a(r_0)$ would increase as the charge Q increases. Thus, no repulsive effects can be detected.

However, it should be noted that as shown in (37b), M includes energy outside the particle, in conflict with (32). On the other hand, if the mass M is the inertial mass of the particle, the weight of a charged metal ball can be reduced [27] (see Appendix). Thus, as expected [8], experiments of two metal balls [28] reject eq. (36). The repulsive force on a charged ball is an important experiment to be completed for the details *since it is a test of general relativity*.

The inertial mass of the particle should be smaller than M defined in (37b) since an acceleration of the charged particle would not immediately affect the electric energy at long distances. However, 't Hooft also claimed in his Nobel Lecture [29] that M in (37c) is the inertial mass subjected to Newton's second law. Thus, it is clear that 't Hooft is only an excellent applied mathematician, but a questionable physicist. Understandably, 't Hooft also does not understand the principle of causality adequately [30, 31]. Note that the radius r_e of an electron *e* is about a half of its classical radius e^2/m_0c^2 [32], where m_0 is its inertial mass. Thus, the electric energy e^2/r_e would be larger than m_0.

The problem started from the assumption of equivalence between mass and electric energy. Should the electric energy be considered as part of the gravitational mass of the particle? If it is, then gravitational mass and inertial mass are different. If it is not, then any electromagnetic energy should assign a mass. However, this is invalid because it is not supported by experiments. Thus, the electric energy should not be equivalent to mass. Unfortunately, 't Hooft is not alone, and Wilczek [33] also mistaken $m = E/c^2$ as unconditional in his Nobel speech (see Section 4).[3)]

The above approach is essentially the same as that of Pekeris [34], who gets a similar metric as follows:

$$ds^2 = e^{\nu} dt^2 - e^{-\nu} dR^2 - R^2 d\Omega^2 \quad \text{where } R^3 = r^3 + r_0^3 \tag{38a}$$

$$e^{\nu} = \left(1 - \frac{2M_{mat}}{R} - \frac{2M_{em}}{R} + \frac{Q^2}{R^2}\right) = \left(1 - \frac{2M}{R} + \frac{Q^2}{R^2}\right), \quad \text{where } M_{em} = Q^2/r_0, \text{ and } M = M_{mat} + M_{em} \tag{38b}$$

The difference is due to that Pekeris [34] requires that $|g_{\mu\nu}| = g = -1$. Thus, what Herrera et al. [24] does is essentially what Pekeris had done. Apparently, theorists have run out of ways that can be used against the repulsive force.

In summary, misinterpretations of the Riessner-Nordstrom metric delay the recognition of the charge-mass interaction for more than 80 years. An experimental verification of the charge-mass repulsive interaction gives a clear statement that the electro-magnetic energy and mass are not equivalent. The charge-mass interaction leads to the necessity of unification. However, for the case of such force acting on a charged capacitor, this is beyond general relativity.

Nevertheless, the necessary existence of the anti-gravity coupling shows that the theoretical developments without the anti-gravity coupling are incorrect. This is an important development because it is beyond Einstein.

c) *The Charge-mass Interaction and Five-Dimensional Theory*

To show the repulsive effect, one needs to consider only g_{tt} in metric (27). According to Einstein [3, 4],

$$\frac{d^2x^\mu}{ds^2} + \Gamma^\mu{}_{\alpha\beta}\frac{dx^\mu}{ds}\frac{dx^\nu}{ds} = 0, \quad \text{where} \quad \Gamma^\mu{}_{\alpha\beta} = (\partial_\alpha g_{\nu\beta} + \partial_\beta g_{\nu\alpha} - \partial_\nu g_{\alpha\beta})g^{\mu\nu}/2 \tag{39}$$

and $ds^2 = g_{\mu\nu}dx^\mu dx^\nu$ are defined by the metric $g_{\mu\nu}$. Consider the static case, $dx/ds = dy/ds = dz/ds = 0$. Thus,

$$\frac{d^2x^\mu}{ds^2} = -\Gamma^\mu{}_{tt}\frac{dct}{ds}\frac{dct}{ds}, \quad \text{where} \quad -\Gamma^\mu{}_{tt} = -\frac{1}{2}\left(2\frac{\partial g_{t\nu}}{\partial ct} - \frac{\partial g_{tt}}{\partial x^\nu}\right)g^{\mu\nu} = \frac{1}{2}\frac{\partial g_{tt}}{\partial x^\nu}g^{\mu\nu} \tag{40}$$

since $g_{\mu\nu}$ would also be static. (Note that the gauge affects only the second order approximation of g_{tt} [35].) For a particle P with mass m at **r**, the force on P is

$$-m\frac{M}{r^2} + m\frac{q^2}{r^3} \tag{41}$$

in the first order approximation since $g^{rr} \cong -1$. Thus, the second term is a repulsive force.

If the particles are at rest, then the force acts on the charged particle Q has the same magnitude

$$\left(m\frac{M}{r^2} - m\frac{q^2}{r^3}\right)\hat{r}, \quad \text{where } \hat{r} \text{ is a unit vector} \tag{42}$$

since the action and reaction forces are equal and in the opposite directions. However, for the motion of the charged particle with mass M, if one calculates the metric according to the particle P of mass m, only the first term is obtained. Thus, the geodesic equation is inadequate for the equation of motion. Moreover, it is necessary to have a repulsive force with the coupling q^2 to the charged particle Q in a gravitational field generated by masses. In conclusion, force (42) to particle Q is beyond current theoretical framework of gravitation + electromagnetism.

However, this problem would be solved in a five-dimension theory [36], where the geodesic equation would include the coupling of q^2. The geodesic is

$$\frac{d}{ds}\left(g_{ik}\frac{dx^k}{ds}\right) = \frac{1}{2}\frac{\partial g_{kl}}{\partial x^i}\frac{dx^k}{ds}\frac{dx^l}{ds} + \left(\frac{\partial g_{5k}}{\partial x^i} - \frac{\partial g_{5i}}{\partial x^k}\right)\frac{dx^5}{ds}\frac{dx^k}{ds} - \Gamma_{i,55}\frac{dx^5}{ds}\frac{dx^5}{ds} - g_{i5}\frac{d^2x^5}{ds^2} \tag{43a}$$

$$\frac{d}{ds}\left(g_{5k}\frac{dx^k}{ds} + \frac{1}{2}g_{55}\frac{dx^5}{ds}\right) = \Gamma_{k,55}\frac{dx^5}{ds}\frac{dx^k}{ds} - \frac{1}{2}g_{55}\frac{d^2x^5}{ds^2} + \frac{1}{2}\frac{\partial g_{kl}}{\partial x^5}\frac{dx^l}{ds}\frac{dx^k}{ds}, \tag{43b}$$

where $ds^2 = g_{\mu\nu}dx^\mu dx^\nu$, μ, ν = 0, 1, 2, 3, 5 $\quad (d\tau^2 = g_{kl}dx^k dx^l$; k, l = 0, 1, 2, 3) .

If instead of s, τ is used in (43), the Lorentz force suggests

$$\frac{q}{Mc^2}\left(\frac{\partial A_i}{\partial x^k} - \frac{\partial A_k}{\partial x^i}\right) = \left(\frac{\partial g_{i5}}{\partial x^k} - \frac{\partial g_{k5}}{\partial x^i}\right)\frac{dx^5}{d\tau}$$

Thus,

$$\frac{dx^5}{d\tau}=\frac{q}{Mc^2}\frac{1}{K}, \qquad K\left(\frac{\partial A_i}{\partial x^k}-\frac{\partial A_k}{\partial x^i}\right)=\left(\frac{\partial g_{i5}}{\partial x^k}-\frac{\partial g_{k5}}{\partial x^i}\right) \quad \text{and} \quad \frac{d^2x^5}{d\tau^2}=0 \tag{44}$$

where K is a constant. It thus follows that

$$\frac{d}{d\tau}\left(g_{ik}\frac{dx^k}{d\tau}\right)=\frac{1}{2}\frac{\partial g_{kl}}{\partial x^i}\frac{dx^k}{d\tau}\frac{dx^l}{d\tau}+\left(\frac{\partial A_k}{\partial x^i}-\frac{\partial A_i}{\partial x^k}\right)\frac{q}{Mc^2}\frac{dx^k}{d\tau}-\Gamma_{i,55}\left(\frac{q}{Mc^2}\right)^2\frac{1}{K^2} \tag{45a}$$

$$\frac{d}{d\tau}\left(g_{5k}\frac{dx^k}{d\tau}+\frac{1}{2}g_{55}\frac{q}{KMc^2}\right)=\Gamma_{k,55}\frac{q}{KMc^2}\frac{dx^k}{d\tau}+\frac{1}{2}\frac{\partial g_{kl}}{\partial x^5}\frac{dx^l}{d\tau}\frac{dx^k}{d\tau}\text{。} \tag{45b}$$

One may ask what the physical meaning of the fifth dimension is. Some claim that those higher dimensions are curl up. Our position is, however, that the physical meaning the fifth dimension is not yet very clear, except some physical meaning is given in equation (44). The fifth dimension is assumed as part of the physical reality, and the metric signature is (+,-,-,-,-). However, our approach is to find out the full physical meaning of the fifth dimension as our understanding gets deeper. Unlike mathematics, in physics things are not defined right at the beginning. For example, it took us a long time to understand the physical meaning of energy-momentum conservation.

For a static case, it follows (42) and (45) that the forces on the charged particle Q in the ρ-direction are

$$-\frac{mM}{\rho^2}\approx\frac{Mc^2}{2}\frac{\partial g_{tt}}{\partial\rho}\frac{dct}{d\tau}\frac{dct}{d\tau}g^{\rho\rho}, \text{ and } \frac{mq^2}{\rho^3}\approx-\Gamma_{\rho,55}\frac{1}{K^2}\frac{q^2}{Mc^2}g^{\rho\rho} \tag{46a}$$

and

$$\Gamma_{k,55}\frac{q}{KMc^2}\frac{dx^k}{d\tau}=0, \qquad \text{where} \qquad \Gamma_{k,55}\equiv\frac{\partial g_{i5}}{\partial x^5}-\frac{1}{2}\frac{\partial g_{55}}{\partial x^k}=-\frac{1}{2}\frac{\partial g_{55}}{\partial x^k} \tag{46b}$$

in the (-*r*)-direction. Here particle P is at the origin of spatial coordinate system (ρ, θ', φ'). The meaning of (46b) is the energy momentum conservation. Thus,

$$g_{tt}=1-\frac{2m}{\rho c^2}, \quad \text{and} \quad g_{55}=\frac{mMc^2}{\rho^2}K^2+\text{constant。} \tag{47}$$

In other words, g_{55} is a repulsive potential. Since g_{55} depends on *M*, it is a function of local property, and thus is difficult to calculate. This is different from the metric element g_{tt} that depends on a distant source of mass m.

Since g_{55} is independent of q, $(\partial g_{55}/\partial\rho)/M$ depends only on the distant source with mass m. Thus, this force, though acting on a charged particle, would penetrate electromagnetic screening. This would make such a force easier to be identified. From (47), it is possible that a charge-mass repulsive potential would exist for a metric based on the mass *M* of the charged particle *Q*. However, since *P* is neutral, there is no charge-mass repulsion force (from $\Gamma_{k,55}$) on *P*.

In terms of physics, since the static repulsive force is independent of the charge sign, it should not be subjected to electromagnetic screening. From the viewpoint of the five-dimensional theory, the charge would create an independent field to react with the mass. To test this, one should observe whether there is a repulsive force from a charged capacitor to a mass particle since a capacitor would screen out the electromagnetic field outside the capacitor in current theories. Experimentally, such a force is observed since a charge capacitor reduces its weight [37-40].

It should be noted that Einstein and Pauli [41] had investigated the five-dimensional relativity. However, they failed because they did not recognize the emerging of new interactions as Maxwell did. Thus they failed to see the existence of a coupling with the charge square from the metric element g_{55}.

IV. Conclusions and Discussions

In physics, the most famous formula is probably E = mc². Ironically, it is also this formula that many physicists do not understand properly. This formula means that there is an energy related to a mass, but it does not necessarily mean that, for any type of energy, there is a related mass. It is interesting that E = mc² demands that the light must include non-

Global Journal of Science Frontier Research (A) Volume XIV Issue II Version I Year 2014

electromagnetic energy. On the other hand, general relativity naturally requires that a photonic energy-stress tensor, which is different from the electromagnetic energy-stress tensor, must have an anti-gravity coupling.

An anti-gravity coupling implies that the energy-conditions in the singularity theorems of Penrose and Hawking are invalid, and thus these theorems are irrelevant in physics. The existence of anti-gravity coupling is crucial in general relativity. For this is a major problem that many theorists overlooked. In fact, the existence of the antigravity coupling was first proposed by Lorenz [20] and Levi-Civita [21]. However, Einstein incorrectly rejected their proposal, and Einstein was wrong in his claim on the existence of dynamic solutions [10-12].

Because of the blind faith on Einstein, Misner et al. [7] claimed to have an explicit bounded wave solution and supported their errors with invalid mathematics [9]. Wald [5] claimed to be able to solve a second order equation, but without any solution. Christodoulou and Klainerman [42] have mistaken that they could construct the dynamic solutions [43]. Taylor [44] claimed to have a bounded dynamic solution and won a Nobel Prize [45], but failed to justify his calculation [46]. 't Hooft [30, 31] come up with an explicit solution that cannot have appropriate sources, etc. This is also why the positive mass theorem of Schoen and Yau [47] (and Witten [48]) is misleading in physics.[4)]

General relativity also makes it explicit that the gravity generated by mass and that by the electromagnetic energy are different as shown by the Riessner-Nordstrom metric. Since not every type of energy is equivalent to mass, the study of gravity must be extended beyond massive sources. It is the recognition of non-equivalence between electromagnetic energy and mass that naturally leads to unification of electromagnetism and gravitation.

It should be noted that Wilczek also misinterpreted in his Nobel lecture [33] that $m = E/c^2$ is generally valid. He claimed, "Stated as $m = E/c^2$, Einstein's law suggests the possibility of explaining mass in terms of energy. That is a good thing to do, because in modern physics energy is a more basic concept than mass. He further claimed, "In fact, the title is a question: 'Does the Inertial of a body Depend upon its energy content?' From the beginning, Einstein was thinking about the origin of mass ... Modern QCD answer Einstein's question with a resounding "Yes!" Indeed, the mass of ordinary matter derived almost entirely from energy-the energy of massless gluons and nearly massless quarks, which are the ingredients from which protons, Neutrons and atomic nuclei are made." Thus, 't Hooft is not the only Nobel Laureate who made an incorrect interpretation of $E= mc^2$.

However, the formula $E = mc^2$ has already answered Einstein's question affirmatively. The equivalence of a particular energy to mass is beyond the issue of whether the mass of a body depends on its energy contents. Wilczek was aware that there are difference between $E = mc^2$ and $m = E/c^2$, but failed to see the crucial difference. Thus, modern QCD did not answer Einstein's question, but only uses his formula as he speculated. Since electromagnetic energy is not equivalent to mass, to use the formula $m = E/c^2$ needs justifications in physics that Wilczek [33] failed to provide.

Moreover, the notion of photon is established not as an assumption, but as a necessary consequence of general relativity. Concurrently, the notion of anti-gravity coupling is naturally established. So, Einstein is still the final winner. Had Einstein known that his conjecture of unification was that close, he might have the desire to live longer [49]. Einstein was right that he should have more mathematics [49]. Einstein's weakness is that he had too much confidence on himself. His curiosity did not help him to discover his own errors. In any case, it is up to us to complete what he started.

V. Acknowledgments

The author gratefully acknowledges stimulating discussions with Professors S. -J. Chang, A. J. Coleman, Eric J. Weinberg, and C. Wong. Special thanks are to D. Rabounski for valuable comments. This work is supported in part by the Chan Foundation, Hong Kong.

Appendix A

Experimental Verification of the Mass-Charge Repulsive Force

The repulsive force in metric (27) can be detected with a neutral mass. To see the repulsive effect, one must have

$$\frac{1}{2}\frac{\partial}{\partial r}\left(1-\frac{2M}{r}+\frac{q^2}{r^2}\right)=\frac{M}{r^2}-\frac{q^3}{r^3}< 0 \qquad \text{(A1)}$$

Thus, repulsive gravity would be observed at $q^2/M > r$. For the electron the repulsive gravity would exist only inside the classical electron radius $r_0(= 2.817 \times 10^{-13} cm)$. Thus, it would be very difficult to test a single charged particle.

However, for a charged metal ball with mass M and charge Q, the formula is similarly $0 > M/R^2 – Q^2/R^3$, where R is the distance from the center of the ball [27]. Consequently, the attractive effect in gravity is proportional to mass related to the number of electrons, but the repulsive effect in gravity is proportional to square of charge related to the square of the number of electrons. Thus, when the electrons are numerous enough accumulated in a metal ball, the effect of repulsive gravity will be shown in a macroscopic distance.

Consider Q and M consist of N electrons, i.e., $Q = Ne$, $M = Nm_e + M_0$, where M_0 is the mass of the metal ball, m_e and e are the mass and charge of an electron. To have sufficient electrons, the necessary condition is

$$N > \frac{R}{r_0}, \quad \text{when} \quad r_0 = \frac{e^2}{m_e c^2} = 2.817\times 10^{-13}\ \text{cm.} \tag{A2}$$

For example, if $R = 10\ cm$, then it requires $N > 3.550x10^{13}$. Thus $Q = 5.683\times 10^{-7}$ *Coulomb*. Then, one would see the attractive and repulsive additional forces change hands. For this case, the repulsive force is

$$\frac{Q^2 m_p}{R^3} \quad \text{where} \quad m_p \text{ is the mass of the testing particle P.} \tag{A3}$$

And the total force is

$$\left(\frac{M_0 + Nm_e}{R^2} - \frac{N^2 e^2}{R^3}\right) m_p \tag{A4}$$

When condition (A2) is satisfied for a certain R, the repulsive effect will be observed as the charge increases. The verification of this formula also disproves the equivalence between mass and electric energy. However, the majority of theorists failed gravity by following Einstein's error.

However, since the repulsive force is very small, for a large charge, the interference of electricity would be comparatively large. Thus, it would be desirable to screen the electromagnetic effects out. The modern capacitor is such a piece of simple equipment. When a capacitor is charged, it separates the electron from the atomic nucleus, but there is no change of mass due to increase of charged particles. Before such separation the effect of the charge-mass interaction is cancelled out by the current-mass interaction (see Appendix B). Thus, after charged, the capacitor would have less weight due to the charge-mass repulsive force, a nonlinear force towards charges.

One may ask whether the lighter weight of a capacitor after charged could be due to a decrease of mass. Such a speculation is ruled out. Inside a capacitor the increased energy due to being charged would not be pure electromagnetic energy such that, for the total internal energy, Einstein's formula is valid.

Thus, this simple experiment would confirm the mass-charge repulsive force, and thus the unification.

In the case of charged capacitor, the repulsive force would be proportional to the potential square, V^2 where V is the electric potential difference of the capacitor. This has been verified by the experiments of Musha [38]. However, the weigh reduction phenomenon is currently mixed up with the B-B effect which is directional to the electric field applied. However, the weight reduction effect is not directional and it stays if the potential does not change. This is verified by Liu [40], who measured the effect of weight reduction with the roll-up capacitors.

Appendix B

The Current-Mass Interaction

If the electric energy leads to a repulsive force toward a mass, the magnetic energy would lead to an attractive force from a current toward a mass [50, 51]. The existence of such a current-mass attractive force has been verified by Martin Tajmar and Clovis de Matos [52] from the European Space Agency.

They found that a spinning ring of superconducting material increases its weight much more than expected. Thus, they believed that general relativity had been proven wrong. However, according to quantum theory, spinning super-conductors should produce a weak magnetic field. Thus, they are also measuring the interaction between an electric current and the earth, i.e. an effect of the current-mass interaction!

The existence of the current-mass attractive force would solve a puzzle, i.e., why a charged capacitor exhibits the charge-mass repulsive force since a charged capacitor has no additional electric charges? In a normal situation, the charge-mass repulsive force would be cancelled by other forms of the current-mass force as Galileo, Newton and Einstein implicitly assumed. This general force is related to the static charge-mass repulsive force in a way similar to the Lorentz force is related to the Coulomb force.

One may ask what is the formula for the current-mass force? However, unlike the static charge-mass repulsive force, which can be derived from general relativity; this general force would be beyond general relativity since a current-mass interaction would involve the acceleration of a charge, this force would be time-dependent and generates electromagnetic radiation. Moreover, when the radiation is involved, the radiation reaction force and the variable of the fifth dimension must be considered [36].

Nevertheless, we may assume that, for a charged capacitor, the resulting force is the interaction of net macroscopic charges with the mass [52]. A spinning ring of superconducting material has the electric currents that are attractive to the earth. This also explains a predicted phenomenon, which is also reported by Liu [39] that it takes time for a capacitor to recover its weight after being discharged [53]. This was observed by Liu because his rolled-up capacitors keep heat better. A discharged capacitor needs time to dissipate the heat generated by discharging, and the motion of its charges would accordingly recover to normal. Thus, it is natural to predict that a piece of heated up metal would have reduced weight, and this has been verified by experiments [53].

ENDNOTES

1. Hawking in his visit (June 2006) to China, still misleadingly told his audience that his theory was based on general relativity only. The root of his problem would be that he still does not understand the formula $E = mc^2$.
2. This equation was first proposed by Lorentz [20] and later Levi-Civita [21] as a possibility in the following form,

$$\kappa t(g)_{ab} = G_{ab} + \kappa T_{ab} \qquad \text{(LL)}$$

   where $t(g)_{ab}$ is the gravitational energy-stress tensor, G_{ab} is the Einstein tensor, and T_{ab} is the sum of other massive energy-stress tensors. Then, the gravitational energy-stress tensor takes a covariant form, although they have not proved its necessity with calculations.
3. An independent evidence for the absence of a bounded dynamic solution for the Einstein equation is that the calculated gravitational radiation would depend on the approach used [54].
4. Many theorists such as Hawking & Penrose have also mistaken that $m = E/c^2$ is unconditionally valid.
5. S. T. Yau won a Fields Medal in 1982 and Witten won a Fields Medal in 1990. Their works on the positive mass (or energy) were cited as an achievement because the mathematicians do not understand the related physics [54].
6. The correct formula would be the single-directional mc^2 => E, but not necessarily E/c^2 => m.

REFERENCES RÉFÉRENCES REFERENCIAS

1. C. Y. Lo, "*The Invalid Speculation of m = E/c², the Reissner-Nordstrom Metric, and Einstein's Unification,*" Phys. Essays, **25** (1), 49-56 (2012).
2. "*Einstein's Miraculous Year*" edited and introduced by John Stachel, Princeton Univ. Press (1998), p. 118.
3. A. Einstein, H. A. Lorentz, H. Minkowski, H. Weyl, *The Principle of Relativity* (Dover, New York, 1923).
4. A. Einstein, **The Meaning of Relativity** (Princeton Univ. Press, 1954).
5. R. M. Wald, *General Relativity* (The Univ. of Chicago Press, Chicago, 1984).
6. C. Y. Lo, "*Completing Einstein's Proof of E = mc²,*" Progress in Phys., Vol. 4, 14-18 (2006) .
7. C. W. Misner, K. S. Thorne, & J. A. Wheeler, *Gravitation* (W. H. Freeman, San Francisco, 1973).
8. C. Y. Lo, Comments on Misunderstandings of Relativity, and the Theoretical Interpretation of the Kreuzer Experiment, Astrophys. J. **477,** 700-704 (March 10, 1997).
9. C. Y. Lo, On the Question of a Dynamic Solution in General Relativity, Journal of Space Exploration 4 (2013).
10. C. Y. Lo, "*Einstein's Radiation Formula and Modifications to the Einstein Equation,*" Astrophysical Journal **455**, 421-428 (Dec. 20, 1995); Editor S. Chandrasekhar suggests and approves the appendix therein.
11. C. Y. Lo, "*Compatibility with Einstein's Notion of Weak Gravity: Einstein's Equivalence Principle and the Absence of Dynamic Solutions for the 1915 Einstein Equation,*" Phys. Essays **12** (3), 508-526 (1999).
12. C. Y. Lo, "*On Incompatibility of Gravitational Radiation with the 1915 Einstein Equation,*" Phys. Essays **13** (4), 527-539 (December, 2000).
13. C. Y. Lo, The Non-linear Einstein Equation and Conditionally Validity of its Linearization, International Journal of Theoretical and Mathematical Physics, Vol.3, No.6 (2013).
14. A. Gullstrand, Ark. Mat. Astr. Fys. 16, No. 8 (1921); ibid, Ark. Mat. Astr. Fys. 17, No. 3 (1922).
15. C. Y. Lo, "*Gravitation, Physics, and Technology,*" Physics Essays, **25** (4), 553-560 (Dec. 2012).
16. D. Kramer, H. Stephani, E. Herlt, and M. MacCallum, Exact Solutions of Einstein's Field Equations, ed. E. Schmutzer (Cambridge Univ. Press, Cambridge, 1980).
17. C. Y. Lo, Phys. Essays, 10 (5), 424-436 (1997); ibid., in Proc. Sixth Marcel Grossmann Meeting On Gen. Relati. Kyoto 1991, ed. H. Sato, & T. Nakamura, 1496 (World Sci., Singapore, 1992).
18. A. Einstein, 'Physics and Reality (1936)' in Ideas and Opinions (Crown, New York, 1954), p. 311.
19. H. Bondi, F. A. E. Pirani, & I. Robinson, "*Gravitational waves in general relativity III. Exact plane waves,*" **Proc**. Roy. **Soc**. **London A251** (**1959**).
20. H. A. Lorentz, Versl gewone Vergad Akad. Amst., vol. 25, p. 468 and p. 1380 (1916).

21. T. Levi-Civita, R. C. Accad Lincei (7), vol. 26, p. 381 (1917).
22. A. Einstein, Sitzungsber Preuss. Akad. Wiss, vol. 1, p. 167 (1916).
23. C. Y. Lo, "*Space Contractions, Local Light Speeds, and the Question of Gauge in General Relativity,*" Chinese J. of Phys. (Taipei), **41** (4), 233-343 (August 2003).
24. L. Herrera, N. O. Santos and J. E. F. Skea, Gen. Rel. Grav. Vol. 35, No. 11, 2057 (2003).
25. E. T. Whittaker, Proc. R. Soc. (London) A **149**, 384, (1935).
26. R. Tolman, Phys. Rev. **35**, 875 (1930).
27. C. Y. Lo & C. Wong, Bull. of Pure and Applied Sciences, Vol. 25D (No.2), 109-117 (2006).
28. D. Yu. Tsipenyuk, V. A. Andreev, Physical Interpretations of the Theory of Relativity Conference (Bauman Moscow State Technical University, Moscow 2005).
29. G. 't Hooft, "A CONFONTATION WITH INFINITY", Nobel Lecture, December, 1999.
30. C. Y. Lo, Bulletin of Pure and Applied Sciences, **27D** (2), 149-170 (2008).
31. C. Y. Lo, "On Physical Invalidity of the 'Cylindrical Symmetric Waves' of 't Hooft," Phys. Essays, **24** (1), 20-27 (2011).
32. J. D. Jackson, ***Classical Electrodynamics***, (John Wiley & Sons, New York, 1962).
33. Frank A. Wilczek, Asymptotic Freedom: From Paradox to Paradigm, Noble Lecture (Dec. 8, 2004).
34. C. L. Pekeris, Proc. Nat. L Acad. Sci. USA Vol. 79, pp. 6404-6408 (1982).
35. S. Weinberg, ***Gravitation and Cosmology*** (John Wiley Inc., New York, 1972).
36. C. Y. Lo, G. R. Goldstein and A. Napier, Electromagnetic Radiation Reaction Force and Radiation Potential in General Five-Dimensional Relativity, Hadronic Journal **12** (2) 75-89 (1989).
37. T. Musha and T. Kanamoto, Proc. of the 38th Space Science and Technology Conference, JSASS, 1994, pp. 31.
38. T. Musha, Proceedings of the 37th Conference on Aerospace Propulsion, JSASS, 1997, pp. 342–349.
39. D. R. Buehler, J. of Space Mixing 2, 1 (2004); see also electrogravitics in Wikipedia.30.
40. W. Q. Liu, private communication (August 2007).
41. A. Einstein & W. Pauli, Ann. Math. **44**, 133 (1943).
42. D. Christodoulou & S. Klainerman, ***The Global Nonlinear Stability of the Minkowski Space*** (Princeton. Univ. Press, 1993); No. 42 of the Princeton Mathematical Series.
43. C. Y. Lo, "*The Question of Validity of the 'Dynamic Solutions' Constructed by Christodoulou and Klainerman,*" Phys. Essays **13** (1), 109-120 (March 2000).
44. T. Damour & J. H. Taylor," ***Strong-field tests of relativistic gravity and binary pulsars,*** Phys. Rev. D, **45** (6), 1840-1868 (1992).
45. The 1993 Press Release of the Nobel Prize Committee (The Royal Swedish Academy of Sciences, 1993).
46. C. Y. Lo, "*On the Nobel Prize in Physics, Controversies and Influences,*" GJSFR Vol. 13-A Issue 3 Version 1.0, 59-73 (June 2013).
47. R. Schoen and S.-T. Yau, "Proof of the Positive Mass Theorem. II," Commun. Math. Phys. **79**, 231-260 (1981).
48. E. Witten, "A New Proof of the Positive Energy Theorem," Commun. Math. Phys., **80**, 381-402 (1981).
49. Walter Isaacson, Einstein - His Life and Universe (Simon & Schuster, New York 2008).
50. C. Y. Lo, The Necessity of Unifying Gravitation and Electromagnetism, Mass-Charge Repulsive Effects, and the Five Dimensional Theory, Bulletin of Pure and Applied Sciences, **26D** (1), 29 - 42 (2007).
51. K. S. Thorne, ***Black Holes and Time Warps*** (Norton, New York, 1994), pp. 105, 456.
52. http://news.softpedia.com/news/The-First-Test-That-Proves-General-Theory-of-Relativity-Wrong-20259.s html
53. C. Y. Lo, "*On the Weight Reduction of Metals due to Temperature Increments,*" GJSFR Vol. 12 Issue 7 (Ver. 1.0) (Sept. 2012).
54. N. Hu, D.-H. Zhang, & H.-G. Ding, Acta Phys. Sinica, 30 (8), 1003-1010 (Aug. 1981).
55. C. Y. Lo, The Errors in the Fields Medals, 1982 to S. T. Yau, and 1990 to E. Witten, GJSFR Vol. 13 Issue 11 Version 1.0 (2014).

This page is intentionally left blank

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 14 Issue 2 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Investigations of the Defects Influence on I-V Curves of HTc Superconductors

By Sosnowski J.
Electrotechnical Institute, Poland

Abstract- Analysis of the influence of defects, created in irradiation process at nuclear accelerators or during mechanical and heat treatment of superconducting tapes in the technological process, on the current-voltage characteristics of superconducting multi-layered materials is given. New approach taking into account inter-layers interaction is proposed and results of calculations presented, which are in accordance with experiment. The magnetic field dependence of the critical current is theoretically deduced, which relation is useful then for analysis of the dynamical anomalies of the current-voltage characteristics in HTc superconductors. New solution of the magnetic diffusion equation into HTc superconductors is proposed, which predicts results concerning dynamical anomalies being in agreement with experimental data.

GJSFR-A Classification : FOR Code: 091299, 240000

INVESTIGATIONSOFTHEDEFECTSINFLUENCEONI-VCURVESOFHTCSUPERCONDUCTORS

Strictly as per the compliance and regulations of :

Investigations of the Defects Influence on I-V Curves of HTc Superconductors

Sosnowski J.

Abstract- Analysis of the influence of defects, created in irradiation process at nuclear accelerators or during mechanical and heat treatment of superconducting tapes in the technological process, on the current-voltage characteristics of superconducting multi-layered materials is given. New approach taking into account inter-layers interaction is proposed and results of calculations presented, which are in accordance with experiment. The magnetic field dependence of the critical current is theoretically deduced, which relation is useful then for analysis of the dynamical anomalies of the current-voltage characteristics in HTc superconductors. New solution of the magnetic diffusion equation into HTc superconductors is proposed, which predicts results concerning dynamical anomalies being in agreement with experimental data.

I. Introduction

High temperature oxide superconductors are multi-layered materials, therefore their subtle structure is very sensitive to existence of nano-sized defects. Topic of nano-defects created by irradiation concerns especially superconductors used in the nuclear reactors [1], constructed by applying the superconducting windings as for instance it has the place in CERN and JINR in Dubna [2-3]. Neutron irradiation will appear also in the constructed ITER reactor and will influence therefore the current-voltage characteristics of using here superconducting wires and then critical current, which makes this problem very actual. The work of the HTc superconducting cables transporting current, which subject is close to the Author's scientific interests, is influenced too by the microscopic interaction of the defects with the magnetic vortices, what indicates also on relevance of this phenomenon. The multi-layered structure of HTc superconductors plays here additionally important function, what will be shown in this paper.

II. Model Presentation

Neutron irradiation created defects influence strongly properties of low dimensional superconductors, such as layered HTc materials but also they are important for low temperature superconductors of an A15 type crystal structure. Destruction of linear chains of transition metals by fast neutron or heavy ions irradiation is presented in Fig. 1, showing elementary cell of an A15 type superconductor. Materials crystalizing in this structure, as Nb3Sn are used continuously in the technology of the superconducting wires and really their superconducting properties, especially critical temperature is sensitive to heavy ions irradiation. From other side critical temperature of 3-dimensional type of conductivity NbTi materials is only slightly affected by punctual, irradiation induced defects.

Author: *Electrotechnical Institute, Warsaw, Poland.*
e-mail: sosnowski.jacek@wp.pl

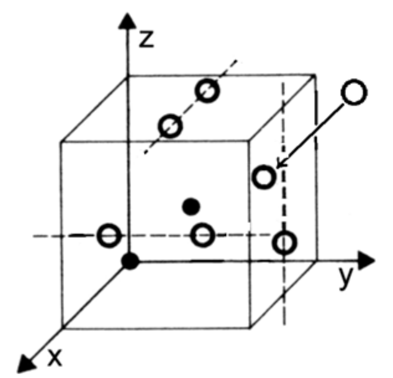


Figure 1 : Crystal structure of Nb3Sn A15 type superconductor, with shown linear chains of (O) transition metals, (•) positions of Sn atoms. The irradiation caused damage of the linear chain is also presented

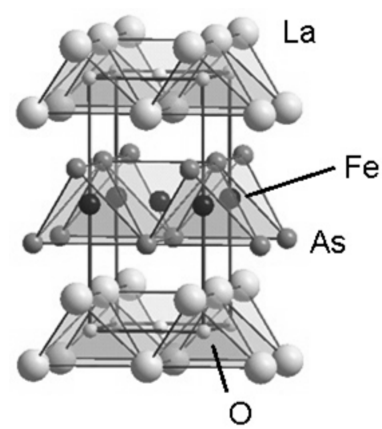


Figure 2 : Crystal structure of HTc iron superconductor LaFeAsO of the critical temperature above 40K

The multi-layered structure of HTc superconductors is shown in Fig. 2 for LaFeAsO material, while Fig. 3 presents such multi-layered structure for YBaCuO and BiSrCaCuO composition with CuO_2 planes responsible for superconductivity.

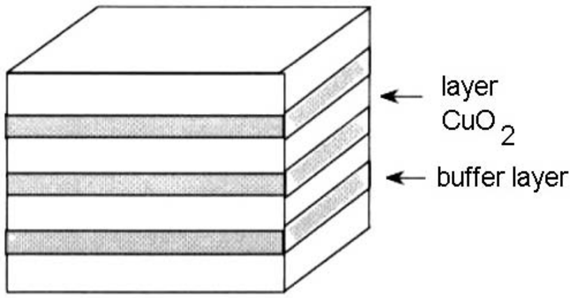


Figure 3 : Schematic structure of the multi-layered HTc superconductor with shown CuO_2 planes in YBaCuO or BiSrCaCuO compound

This structure is very sensitive therefore to the nano-defects appearance and on the other hand to the interplane interaction. Model of the capturing interaction has been elaborated for 2D layered HTc superconductors, in which pancake shape vortices are formed. Change of the free energy of the Ginzburg-Landau type has been analysed for an arrangement of the vortices captured on the regularly ordered nano-defects, acting as the pinning centers, in the function of vortex deflection from initial, equilibrium position. Shift of the vortex from this position causes an increase in the normal energy of the system. The energy barrier arises, which is function of the vortex displacement, according to the notation of Fig. 4 given by:

$$\Delta U_2(x) = \frac{\mu_o H_c^{\ 2} l d x}{2} \tag{1}$$

for $x<x_c$, where x_c is any critical distance, dependent on ratio $d/2\xi$. In opposite case appears relation:

$$\Delta U_3(x) = \frac{\mu_o H_c^{\ 2} l \xi^2}{2}\left[\arcsin\frac{x}{\xi} - \frac{\pi}{2} + \arcsin\frac{d}{2\xi} + \frac{x}{\xi}\sqrt{1-\left(\frac{x}{\xi}\right)^2} + \frac{d}{2\xi}\sqrt{1-\left(\frac{d}{2\xi}\right)^2}\right] \tag{2}$$

H_c denotes in Eqs. 1-2 thermodynamic critical magnetic field, μ_0 is magnetic permeability, while parameter x shown in Fig. 4 describes the deflection of the vortex core against the pinning center formed by the nano-defect of the width d. ξ is coherence length and describes the radius of the core of the vortex, while l is the thickness of the pancake type vortex, equal to the thickness of the superconducting layer in oxide HTc superconductor. In the paper has been considered an initial captured vortex position on the depth of the coherence length inside the pinning center, which is favorable from the point of view of the shielding current

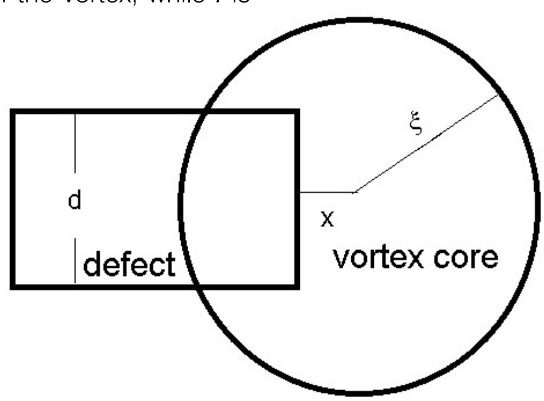


Figure 4 : Schematic view of the vortex captured on the depth (ξ - x) inside the nano-defect

distribution, however other configurations can be also regarded. While taking into account the Lorentz forces as well as elasticity energy of the vortex lattice expressed by the coefficient α an energy barrier height ΔU is received in the current representation as follows:

$$\Delta U = \frac{\mu_0 H_c^2 l \xi^2}{2}\left[-\arcsin\ i + \arcsin\frac{d}{2\xi} + \frac{d}{2\xi}\sqrt{1-\left(\frac{d}{2\xi}\right)^2} - i\sqrt{1-i^2}\right] + \alpha\xi^2\sqrt{1-i^2}\left(\sqrt{1-i^2}-2\right) \tag{3}$$

Tilting of the potential energy wells is caused by the current flow of the reduced density $i = j/j_c$, where j_c is received in the present model critical current density, expressing the transition between flux creep and flux flow states. S in Eq. 4 denotes the defect cross-section, while a lattice constant of regularly arranged defects:

$$j_c = \frac{\mu_0 H_c^2}{\pi\xi\ B}\cdot\frac{S(1-S/a^2)}{a^2} \tag{4}$$

In the present paper interaction between the neighboring superconducting planes shown in Fig. 3

Global Journal of Science Frontier Research (A) Volume XIV Issue II Version I Year 2014

has been taken into account. Results of preliminary calculations of the influence of number of interacting planes on the current-voltage characteristics, performed inserting the scaling coefficient, connected with shielding effects in individual planes, is shown in Fig. 5. Above described model predicts too the magnetic field dependence of the current-voltage characteristics of the HTc superconductors. The results of calculations are shown in Fig. 6 and are in qualitative agreement with the experimental data measured on $Bi_2Sr_2Ca_2Cu_3O_x$ superconductor at liquid nitrogen temperature in external magnetic field, presented in Fig. 7.

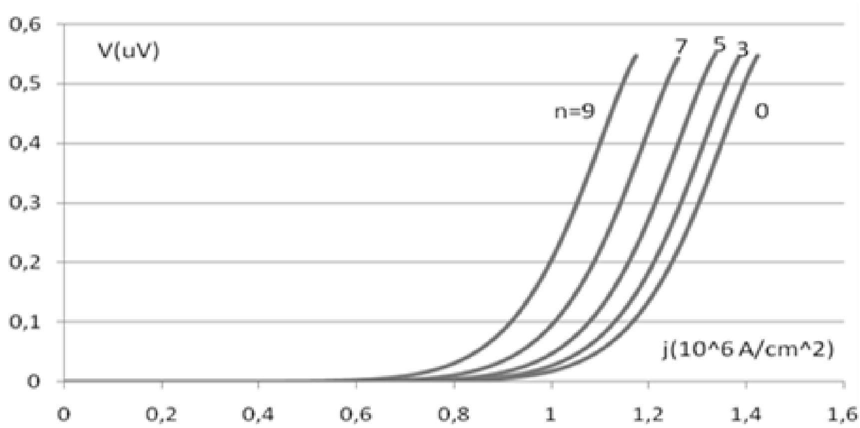


Figure 5 : Influence of the number of interacting planes (n) in HTc multilayered superconductor on the current-voltage characteristics of the irradiation defected sample n=0, 1, 3, 7, 9.

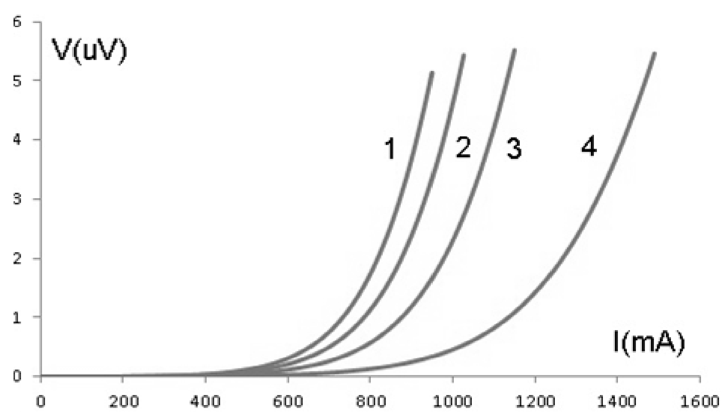


Figure 6 : Theoretically calculated current-voltage characteristics of HTc superconductor in static magnetic field: (1) B=35 mT, (2) 33 mT, (3) 30 mT, (4) 24 mT

Experimental magnetic field dependence of the critical current for that sample is shown in Fig. 8 and really confirms significant influence of magnetic induction on this parameter, as predicts theoretically Eq. 4.

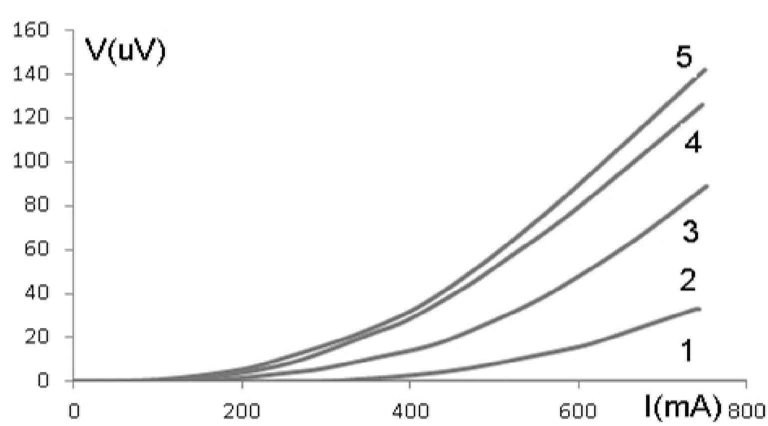


Figure 7 : Experimental current-voltage characteristics for $Bi_2Sr_2Ca_2Cu_3O_x$ superconductor in liquid nitrogen temperature for various magnetic fields: (1) B=0, (2) 13,5 mT, (3) 24 mT, (4) 33 mT, (5) 35 mT.

Figure 8 presents the experimental critical current dependence on the magnetic induction in the liquid nitrogen temperature basing on experimental data of Fig. 7.

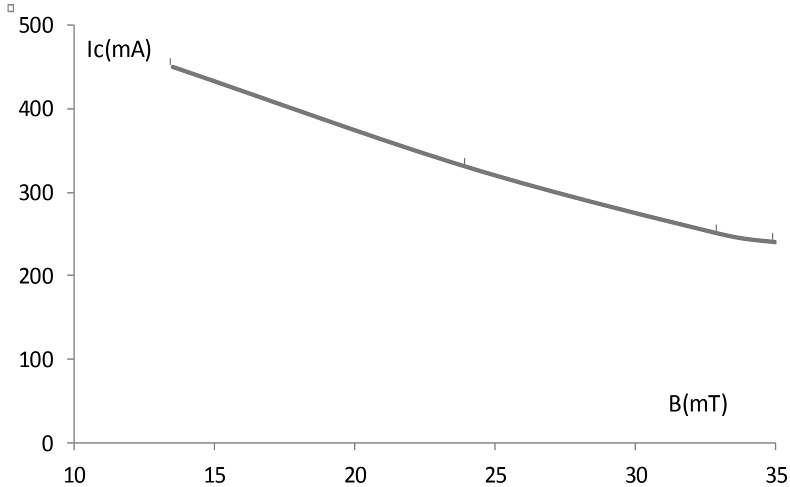


Figure 8 : Critical current magnetic field dependence for BiSrCaCuO ceramic superconductor in 77 K.

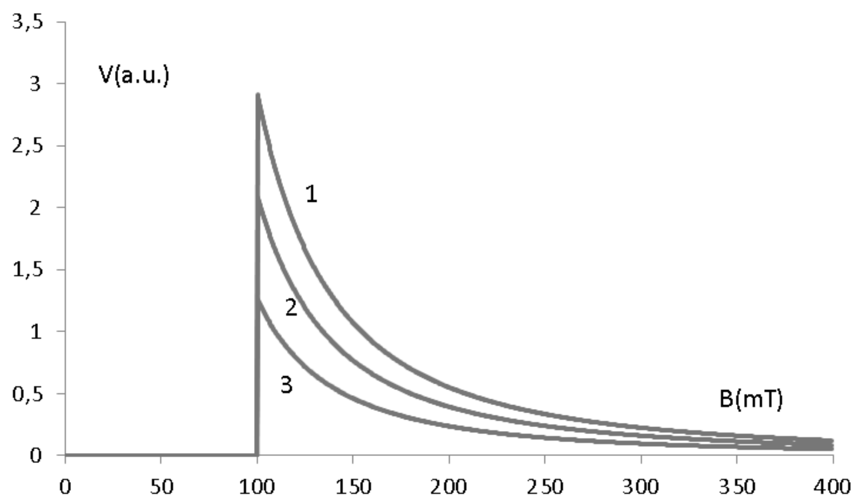


Figure 9 : Theoretically calculated dynamical anomalies of the current-voltage characteristics of HTc superconductor in slowly varying magnetic field 10 mT/s for transport current: (1) I=350 mA, (2) 250 mA, (3) 150 mA.

Elaborated model leading to the inverse magnetic field dependence of the critical current density given by Eq. 4 describes too, observed us experimentally dynamical anomalies of the current-voltage characteristics of the HTc superconductors, in slowly varying external magnetic field, which are also the subject of present investigations. New model of this phenomenon has been deduced basing on the solution of the magnetic diffusion equation. This new solution in the polynomial form, with additional constrains appropriate to description of superconductivity phenomenon, has been applied for analysis of the current-voltage characteristics in dynamically varying magnetic field. Some results of calculations are given in Fig. 9 and indicate on sensitivity of anomalies to the transport current, which makes them promising new tool for detecting current amplitude, as well as other electromagnetic quantities. Similar behavior has been measured us previously and shows the dependence of anomalies on such electromagnetic quantities as magnetic field sweep rate, current amplitude and frequency, temperature and generally superconducting sample quality.

III. Conclusions

Performed investigations are devoted to the phenomenon of the transport current flow through the HTc ceramic, multi-layered superconductors with nano-defects, especially under point of view of analysis their current-voltage characteristics. This topic is related to the issue of applications of HTc superconductors in such electric devices as coils and cryocables, which are in the scope of author scientific interest. The relevance from the point of view of applied superconductivity, of the interaction of defects with pancake vortices is indicated, especially taking into account its influence on the critical current of HTc superconductors. The interplane interaction in these multilayered superconductors was investigated too in the paper and comparison of the theoretical model with experimental data is enclosed. It have been predicted theoretically dynamical anomalies of the current-voltage characterristics in varying magnetic field basing on new polynomial type solution of magnetic diffusion equation, which gives results in accordance with experimental data.

References Références Referencias

1. Sosnowski J. 2012, *Superconducting Cryocables, Electrot*. Institute Book Publisher, p. 101 (in polish).
2. Agapov N. N., Sosnowski J., Mitrofanova Y. A., 2012, *Cryogenic Sources of Irradiation,* Electrotechnical Institute Works, 256, p. 369-377.
3. Khodzhibagiyan H., Bazanov A. et al, 2012, *Experimental Study of Superconducting Magnets for the NICA Accelerator Complex,* The 12-th Cryogenics Conference Proceedings, Dresden, p. 53-58.

This page is intentionally left blank

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 14 Issue 2 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Rethinking the Double Slit Experiment

By Ke Xiao

Abstract- The wave-particle duality relate to the space-time property of matter by Planck constant. The fine structure constant is linked to the double-slit and the uncertainty principle in Quantum Mechanics. Compton scattering and interference of doubleslit is established by the cross-linked angle $T_1 = T_c \cos(\theta_2)$, and vice versa. The single-slit diffraction is described by Sinc-function which could combine the classical diffraction and quantum interference effect in the same experiment. This space-time model explain the experimental mystery of the double-slit.

GJSFR-A Classification : FOR Code: 029999p

RETHINKINGTHEDOUBLESLITEXPERIMENT

Rethinking the Double Slit Experiment

Ke Xiao

Abstract- The wave-particle duality relate to the space-time property of matter by Planck constant. The fine structure constant is linked to the double-slit and the uncertainty principle in Quantum Mechanics. Compton scattering and interference of doubleslit is established by the cross-linked angle $T_1 = T_c \cos(\theta_2)$, and *vice versa*. The single-slit diffraction is described by Sinc-function which could combine the classical diffraction and quantum interference effect in the same experiment. This space-time model explain the experimental mystery of the double-slit.

I. Introduction

The interference of Young's double-slit experiments is the "central paradox" of Quantum Mechanics. [3] The quanta exhibit strange behavior after passing through the double-slits: (a) There is a definite symmetric interference pattern for the multi-quanta (photon or electron), regardless of whether they all come together or one at a time; (b) The individual quanta has a random path and target point; (c) There is a white background noise, a photon can be found even at the node; and (d) No interference for single-slit. There are many controversies surrounding wave-particle duality, determinative, causality, localization. Beyond the Copenhagen interpretation, other interpretations include Path-Integral, Hidden Variable, de Broglie-Bohm, etc, each with its own compromises. The fine-structure constant α is deeply involved in the Quantum theory. [1,2] Pauli considered quantum mechanics to be inconclusive without understanding of the fine structure constant. [2] Feynman also said that nobody understands quantum mechanics. [3] As a new approach, this paper discuss a fine structure constant interpretation of double-slit. [4]

II. Wavefunction and Wave-Particle Duality

A plane wave function $\Psi(\mathbf{r},t)$ and the Born probability density $|\Psi(\mathbf{r},t)|^2$ are [6]

$$\begin{aligned} \Psi(\mathbf{r},t) &= Ae^{-\frac{i}{\hbar}(\mathbf{p}\cdot\mathbf{r}-Et)} = Ae^{-\frac{i}{\hbar}Et}\psi(\mathbf{r}) = f(t)\psi(\mathbf{r}) \\ |\Psi(\mathbf{r},t)|^2 &= \Psi\Psi^* = [Ae^{-\frac{i}{\hbar}Et}\psi(\mathbf{r})][Ae^{-\frac{i}{\hbar}Et}\psi(\mathbf{r})]^* \\ &= Ae^{-\frac{i}{\hbar}Et}\psi(\mathbf{r})\cdot Ae^{\frac{i}{\hbar}Et}\psi^*(\mathbf{r}) = A^2|\psi(\mathbf{r})|^2 \end{aligned} \tag{1}$$

The fine structure constant can be defined as the conservation of angular momentum related to the same dimensional $\mathbf{p}\cdot\mathbf{r}-Et$

$$\frac{\mathbf{e}^2}{c} = \pm\alpha\hbar = \mathbf{p}\cdot\mathbf{r}-Et \tag{2}$$

The wavefunction had an entropy format $S = k\ln\Psi$ for $\hat{\boldsymbol{H}}\Psi = \boldsymbol{E}\Psi$ in the first paper of Schrödinger in 1926. [5,12] The Boltzmann constant k is linked to α by the dimensionless blackbody radiation constant α_R and primes $\alpha_R = \mathbf{e}^2(\frac{4\sigma}{ck^4})^{1/3} = (\prod\frac{\mathbf{p}^2}{\mathbf{p}^2+1})^{1/3}\alpha = 0.86976680\alpha = \frac{1}{157.555}$. [7] The Einstein/de Broglie **wave-particle duality is linked to the reciprocal space-time properties of matter**. [8,9] Note that period $T = 1/\nu$ [T] and wavelength $\lambda = 1/k$ [L], the property of *particle-wave* is defined by the spin over *time-space*.

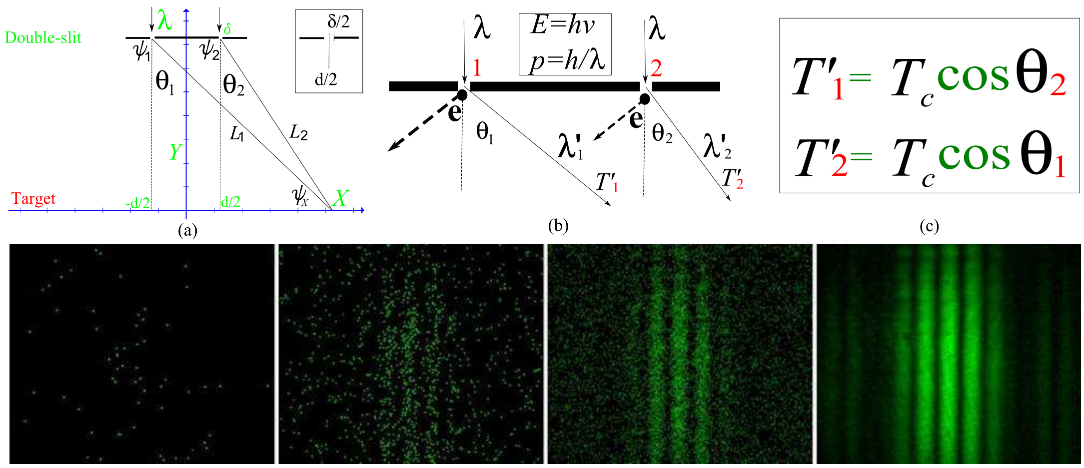
$$\begin{aligned} E &= \hbar\omega \quad \text{i.e.} \quad E = h\nu = h/T \qquad \text{(spin/time)} \\ \mathbf{p} &= \hbar\mathbf{k} \quad \text{i.e.} \quad \mathbf{p} = hk = h/\lambda \qquad \text{(spin/space)} \end{aligned} \tag{3}$$

Author: *Manhattan Beach, CA 90267, USA. e-mail: XK6771@gmail.com*

where the conservation of angular momentum in the reduced Planck (Dirac) constant $h = ET = \mathbf{p}\lambda$ (i.e., $\hbar = E/\omega = \mathbf{p}/\mathbf{k}$), and the electron spin $\hbar/2$ can only be interpreted by the 4-dimensional space-time of the relativistic Dirac equation. [10, 11]

III. Compton Scattering and Interference

In **Fig. 1** (a), the 2D double-slit plane is illustrated so that the slits 1 and 2 are at $\frac{d}{2}$ and $-\frac{d}{2}$, with the slit width δ, a moving target receiver at the point X, with distance Y between the double-slit and target, $L_1 = [Y^2 + (X + \frac{d}{2})^2]^{1/2}$ and $L_2 = [Y^2 + (X - \frac{d}{2})^2]^{1/2}$. Note that the experimental condition requests $Y \gg X \gg |d| \gg \lambda$, so $\triangle L \cong aX$ is linear.



(d)

Figure 1 : The 2D illustration of Double-slit (a), the cross-linked photon scattering (b), (c), and (d) the experimental data recorded by Antoine Weis in 2003.

Since the phase velocity $c = \nu\lambda = \omega\lambda\!\!\!^{-} = \omega/k$ and $T = \omega^{-1}$, from Compton scattering $\lambda\!\!\!^{-}{}' - \lambda\!\!\!^{-} = \lambda\!\!\!^{-}_c(1 - \cos\theta)$ (i.e., $\frac{c}{\omega'} - \frac{c}{\omega} = \frac{c}{\omega_c}(1 - \cos\theta)$), we have $T' - T = T_c(1 - \cos\theta)$ in **Fig. 1** (b). [13] For the each slit in **Fig. 1** (c)

$$\begin{aligned} T_1' - T &= T_c[1 - \cos(\theta_1)] \qquad (1) \\ T_2' - T &= T_c[1 - \cos(\theta_2)] \qquad (2) \end{aligned} \tag{4}$$

Let (4-2) subtract (4-1), and $T_c = \lambda\!\!\!^{-}_c/c = \hbar/m_e c^2 = 1.288 \times 10^{-21}$[sec], then

$$\triangle T = T_2' - T_1' = T_c[\cos(\theta_1) - \cos(\theta_2)] \tag{5}$$

(5) establishes ***the cross-linked angle for the double-slit***

$$\text{If} \quad T_1' = T_c \cos(\theta_2) \quad \text{then} \quad T_2' = T_c \cos(\theta_1) \tag{6}$$

where the T_1' on the slit-1 is related to the scattering angle θ_2 on the slit-2, and *vice versa*. It is a random variable for each particle noted as $\triangle T = \delta T$, and the experimental data shows in **Fig. 1** (d).

Assuming $\psi_1 = A_1 e^{-i\omega T_1'}$ and $\psi_2 = A_2 e^{-i\omega T_2'}$ after the photon scattering for slits 1 and 2, where $|A| \simeq |A_1| \simeq |A_2|$ is real number. The target wavefunction at X is $\psi_X = Ae^{-i\omega T_1'}e^{ikL_1} + Ae^{-i\omega T_2'}e^{ikL_2} = \psi_1 e^{i2\pi L_1/\lambda} + \psi_2 e^{i2\pi L_2/\lambda}$, where λ is the wavelength of the quanta (photon or electron). The probability given for the quanta at the target point X is the same as (1) in the exponential form

$$|\psi_X|^2 = (Ae^{-i\omega T_1'}e^{ikL_1} + Ae^{-i\omega T_2'}e^{ikL_2})(Ae^{i\omega T_1'}e^{-ikL_1} + Ae^{i\omega T_2'}e^{-ikL_2})$$

$$
\begin{aligned}
&= |A|^2 \cdot [1 + 1 + e^{i(kL_1 - \omega T_1' - kL_2 + \omega T_2')} + e^{-i(kL_1 - \omega T_1' - kL_2 + \omega T_2')}] \\
&= |A|^2 \{ \underbrace{2}_{\substack{\text{White}\\ \text{noise}}} + 2\cos[\underbrace{k(L_1 - L_2)}_{\substack{\text{Wave}\\ \text{interference}}} - \underbrace{\omega(T_1' - T_2')}_{\substack{\text{Particle}\\ \text{scattering}}}]\} \qquad (7) \\
&= 2|A|^2[1 + \cos(\underbrace{k\triangle L}_{\text{space}} - \underbrace{\omega\delta T'}_{\text{time}})]
\end{aligned}
$$

The angle term in (7) is same as $\frac{1}{\hbar}(\mathbf{p}\cdot\mathbf{r} - Et) = (\mathbf{k}\cdot\mathbf{r} - \omega t) = \mathbf{k}(\mathbf{r} - ct)$ in (1), i.e., related to the fine structure constant in (2). It is $\lambdabar_c = \alpha a_0 = \frac{\alpha^2}{4\pi R_\infty} = \frac{r_e}{\alpha}$ for the free electron and $\frac{\hbar}{m_i c} = \frac{m_p}{m_i}\frac{\alpha}{\beta}a_0 = \frac{m_p}{m_i}\frac{\alpha^2}{\beta}\frac{1}{4\pi R_\infty}$ for the atomic bonding electron in the Compton scattering. (7) clearly show that the wave-particle duality by the wave-vector k and the photon-frequency ω linked separately to the space $\triangle L$ and time $\delta T'$.

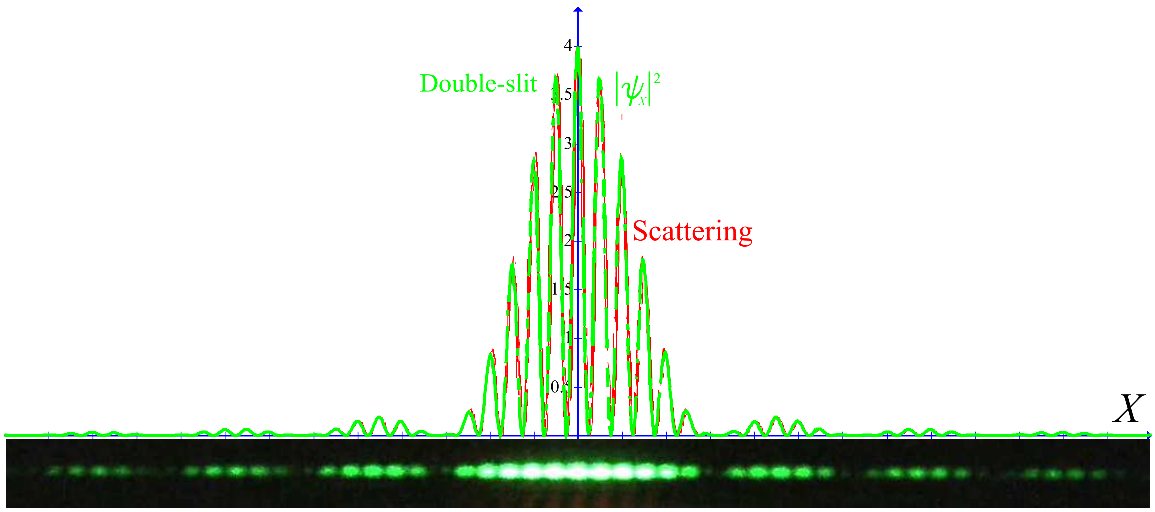


Figure 2 : The scatter graph of the probability density $|\psi_X|^2_{DS}$ in (7) by author (top); and the Laser double-slit experimental data for the *far* target from MIT (bottom).

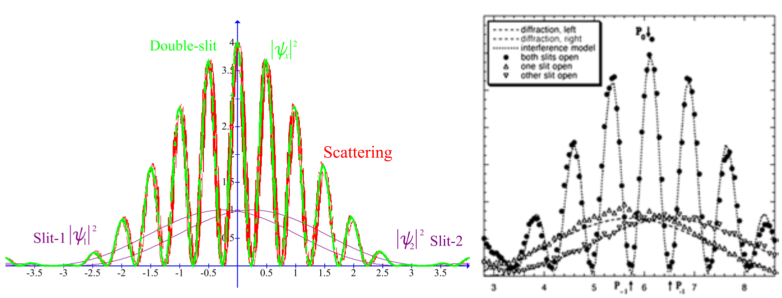


Figure 3 : The scatter graph of $|\psi_X|^2_{DS}$, $|\psi_1|^2$ and $|\psi_2|^2$ in (7) by author (left); and the "one photon at a time" double-slit experimental data for the *near* target from Teachspin (right)

The visible photon-frequency is about $\omega \sim 10^{14}[Hz]$. The term of $\omega\delta T'$ are random and small effect on the visible-light scattering by the tightly bound electron ($m_i \gg m_e$). Therefore, the term $\frac{2\pi}{\lambda}(L_1 - L_2) = akX$ is the major-variable in control. The cosine term becomes $\{-1, 0, 1\}$ when $\frac{2\pi}{\lambda}(L_1 - L_2) - \omega(T_1 - T_2) = akX - \omega\delta T' = \{(2n \pm 1)\pi, (n + \frac{1}{2})\pi, 2n\pi\}$ where $k = \frac{2\pi}{\lambda}$, $n = 0, \pm1, \pm2, \cdots$, and let $|\psi_X|^2 = \{0, 2, 4)\}|A|^2$. The continued distribution is changes into a quantum interference pattern during coherence and cross-correlation. [14] Assuming $A = \mathrm{sinc}[k\triangle L]$ and $A_{1,2} = \mathrm{sinc}[k(\triangle L \pm \frac{d}{2})]$, the graph of (7) matches perfectly with experimental data from MIT for the *far* target using lasers (**Fig.**

2),[1] and Teachspin for the *near* target with "one photon at a time" (**Fig. 3**).[2] The scatter graph in **Fig. 2** and **Fig. 3** clearly show that the interference pattern with the random scattering effect as the individual particle of "one photon at a time."

(7) indicates that the double-slit experiment has the interference pattern (a) with a random quantum scatting (b) and a background white noise (c). Notice that the cosine function is an even function responsible for making the symmetric interference pattern appearing on the target plate. It also shows that there is no interference pattern for the *narrow* single-slit (d), since $|\psi_j e^{i2\pi L_j/\lambda}|^2 = (A_j e^{-i\omega t_j} e^{ikL_j})(A_j e^{i\omega t_j} e^{-ikL_j}) = |A_j|^2$ where $j = 1, 2$ (**Fig. 3**).

IV. Diffraction and Interference of N-Slits

As an exception, a slit which is wider than a wavelength produces Fraunhofer diffraction similar to the *weak* interference, due to the slit-edge electron-photon scattering effect. The probability for the diffraction of a *wide* single-slit at the target point X can be derived as a Taylor-Maclaurin series or Euler-Viete infinite product,

$$\begin{aligned} |\psi_X|^2_{SS} &= |A|^2 = |\mathrm{sinc}(akX)|^2 = [\sum_{n=1}^{\infty}(-1)^n \tfrac{(akX)^{2n}}{(2n+1)!}]^2 \\ &= \{\prod_{n=1}^{\infty}[1-(\tfrac{akX}{n\pi})^2]\}^2 = [\prod_{n=1}^{\infty}\cos(\tfrac{akX}{2^n})]^2 \end{aligned} \tag{8}$$

where $akX = \frac{\pi d}{\lambda}\sin\theta$ and slit width d. Unlike θ in the Fraunhofer approximation for the *far* field limitation, X can be measured directly regardless *far* or *near* target. (8) looks like but is not Gaussian distribution. **Fig. 4** shows the graph of (8) compared with the single-slit diffraction experimental data using laser and adjustable slit-width.

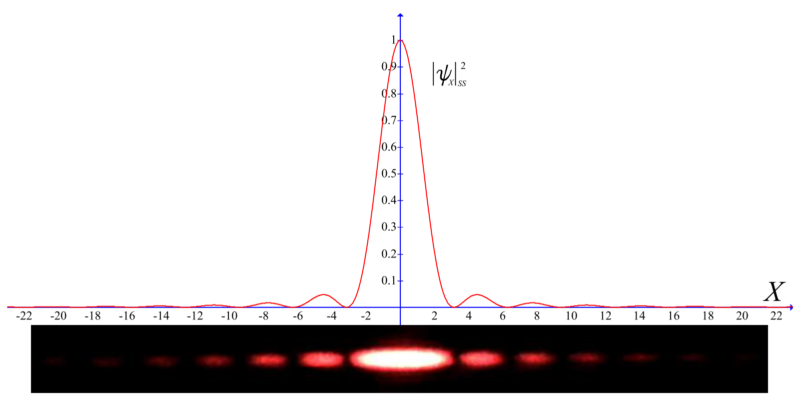


Figure 4: The graph of the probability density $|\psi_X|^2_{SS}$ in (8) by author (top); and the single-slit diffraction experimental data from MIT (bottom)

Therefore, the double-slit equation is simply the diffraction of two *narrow* single-slits with wave interference and photon scattering. This is supported by the experimental result of very narrow but widely separated double-slit, i.e., moving two single-slits closer, in the double-slit experiment of electron. [15] From (7) and (8), the double-slit equation is

$$\begin{aligned} |\psi_X|^2_{DS} &= \underset{\text{two}}{2} \cdot \underset{\text{diffraction}}{|\mathrm{sinc}(a'kX)|^2}[1+\cos(\underset{\text{interference}}{akX} \underset{\text{scattering}}{-\ \omega\delta T'})] \\ &= \{2\cdot \mathrm{sinc}(a'kX)\cdot\cos[(akX-\omega\delta T')/2]\}^2 \end{aligned} \tag{9}$$

[1]http://scripts.mit.edu/_tsg/www/demo.php?letnum=P%2010 (2011)
[2]http://www.teachspin.com/instruments/two_slit/experiments.shtml (2011)

where $a'kX = \frac{\pi\delta}{\lambda}\sin\theta$ and δ is the narrow slit width; $akX = \frac{\pi d}{\lambda}\sin\theta$ ($d > \delta$ in **Fig. 2-3**). The total number of fringes are $N = 2m - 1$, where $m = d/\delta = a/a'$ equal to the ratio of the width of two-slits d divides the slit width δ. The double-slit experiment is a combination of the diffraction, scattering, and interference processes.

The same principle can be applied to *N-narrow* slit experiments (**Fig. 5**). [15]

$$\begin{aligned} \psi_X &= \sum_{n=0}^{N/2}\psi_{\pm n} = A\sum_{n=1}^{N/2}\cos(akX - \omega\delta T^{'}) \\ &= A\frac{\sin[N(akX+\omega\delta T^{'})/2]}{\sin[(akX+\omega\delta T^{'})/2]} \end{aligned} \tag{10}$$

The probability for the diffraction grating of *N-narrow* slits at the target point X is

$$\begin{aligned} |\psi_X|^2_{NS} &= \mathrm{sinc}^2(a'kX)\{\frac{\sin[N(akX-\omega\delta T^{'})/2]}{\sin[(akX-\omega\delta T^{'})/2]}\}^2 \\ &= \frac{1-\cos(2a'kX)}{2(a'kX)^2}\cdot\frac{1-\cos[N(akX-\omega\delta T^{'})]}{1-\cos(akX-\omega\delta T^{'})]} \end{aligned} \tag{11}$$

If $N = 2$, $\left[\frac{\sin(2\phi/2)}{\sin(\phi/2)}\right]^2 = [2\cos(\phi/2)]^2 = 2\,(1+\cos(\phi)) = 4\cos^2(\phi/2)$, (11) go back the double-slit equation (9). Unfortunately, the wave pattern is so attractive in the classical grating equation, and the particle scattering is ignored. (11) contains a particle scattering term $\omega\delta T^{'}$, and its scatter graph compare with experiment from UTPD is shown in **Fig. 5** [3]

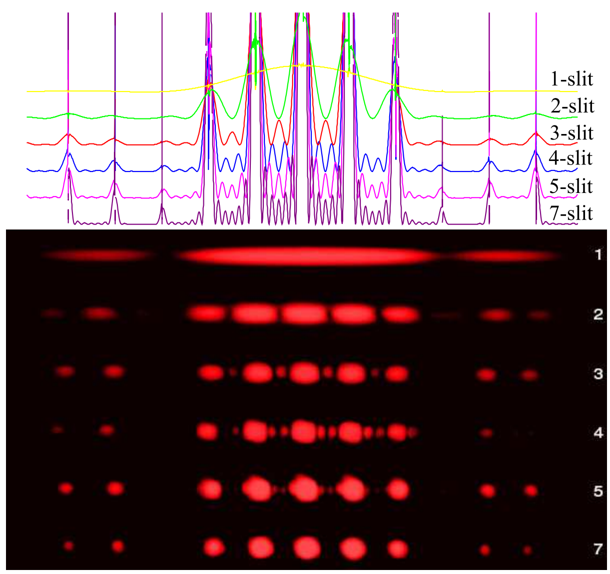


Figure 5: The scatter graph of the probability density $|\psi_X|^2_{1,2,3,4,5,7}$ in (11) by author (top); and the *N-narrow* slits (1,2, 3, 4, 5, 7) diffraction data from UTPD (bottom)

V. Combination of Quantum and Classical Slit

In this model, the slit-edge electron-photon scattering plays a hidden role (each slit has two edges), which is linked to the fine structure constant. [7] Compton scattering creating redshift has been confirmed by sunlight. The fine structure constant must also play critical rule in the double-slit experiment of electron, neutron, He-atoms, and C-60 molecules.

[3] http://electron9.phys.utk.edu/phys136d/modules/m9/diff.htm (2011)

Fig. 6 shows that there is a classical distribution (or de-coherent) if the quanta-slit interaction is weak (e.g., the double-slit experiment for neutron, C-60 and other heavy atoms). Other types of quantum scattering (e.g., Møller) may be involved. The Neutron double-slit data can be described as [16]

$$|\psi_X|^2_{NDS} = [2\mathrm{sinc}(a'kX)\cos(akX - \omega\delta T")]^2 + \sum|\mathrm{sinc}[a'k(X \pm x))]|^2 \tag{12}$$

Fig. 6 shows that many quanta have passed the slit without interaction (leaking), they are not taking place in the interference. This is also true for the photon-recoil atomic interferometry, and the light-quanta passing a widely separated double-slit. [16] **Fig. 7** shows the Young's interference patterns of synchrotron radiation. The photon energy is fixed at 180 eV, while the spacing of the double slit is changed from 30 to 200 µm. [17]

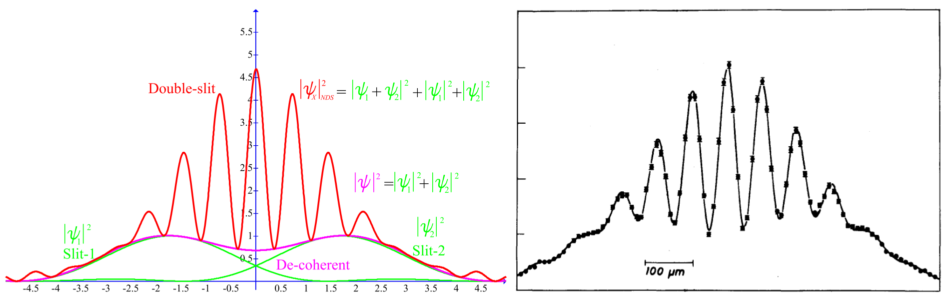


Figure 6 : The scatter graph of the probability density $|\psi_X|^2_{NDS} = |\psi_1+\psi_2|^2 + |\psi_1|^2 + |\psi_2|^2$ in (12) by author (left); and the Neutron double-slit data (right) [16]

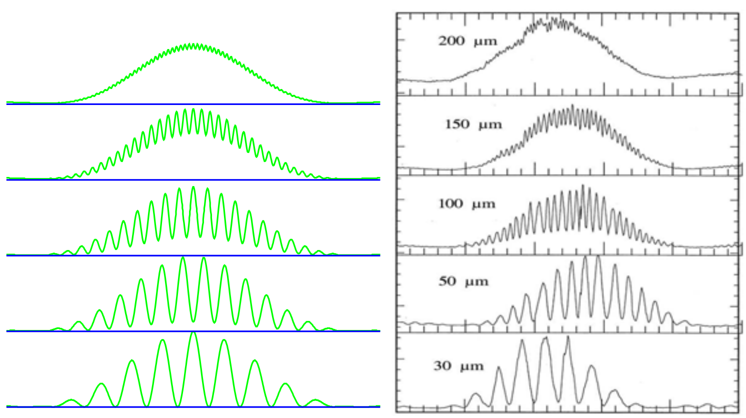


Figure 7 : The graphic $|\Psi|^2$ in (12) by author (left) compare to the Young's interference patterns of synchrotron radiation (right), $h\nu = 180eV$, the spacing of the double slit d is changed from 30 to 200 µm. [17]

VI. Space-Time 3D Model of Double-Slit

Applying the time evolution $e^{-kct} = e^{-bY}$ to the diffraction, interference and scattering in (12), the 3D expression of the double-slit is

$$\begin{aligned} |\psi_X|^2 &= (1 - e^{-kct}) \cdot |\psi_X|^2_{DS} + e^{-kct} \cdot \left\{|\psi_{X+d/2}|^2_{SS} + |\psi_{X-d/2}|^2_{SS}\right\} \\ &= (1 - e^{-bY})[2\mathrm{sinc}(a'kX)\cos(akX - \omega\delta T")]^2 + e^{-bY}\sum|\mathrm{sinc}[a'k(X \pm \tfrac{d}{2})]|^2 \end{aligned} \tag{13}$$

where $aX = [Y^2+(X+\frac{d}{2})^2]^{0.5} - [Y^2+(X-\frac{d}{2})^2]^{0.5}$ and $\delta T" = T_c\{[1+(\frac{X+d/2}{Y})^2]^{-0.5} - [1+(\frac{X-d/2}{Y})^2]^{-0.5}\}$. The contour map of (13) compare with the He-atom, and the 3D graph of (13) with the weak measurement are shown in **Fig. 8**. [18]

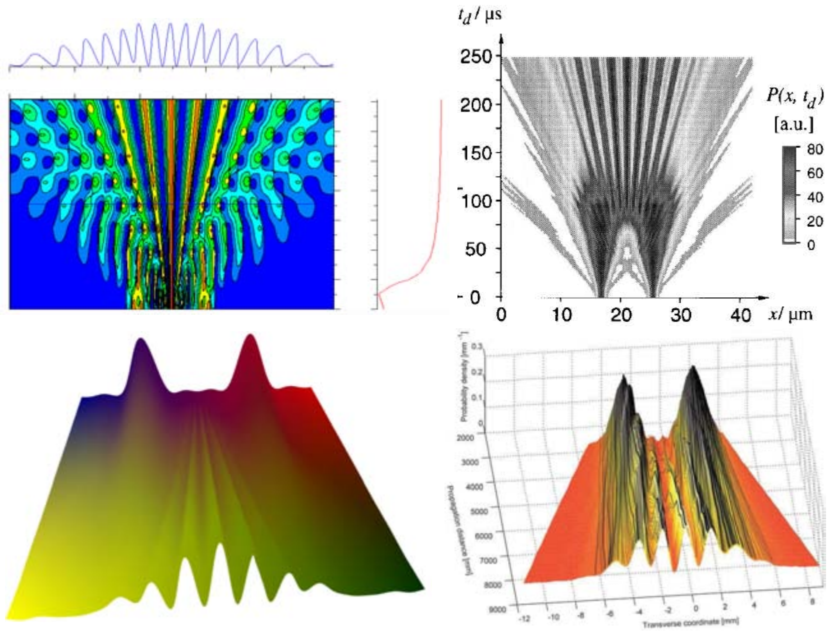


Figure 8 : The contour map and 3D graph of $|\Psi|^2$ in (13) by author (left) to compare with the He-atom and the weak measurement (right), originally explored by Wigner function and Bohmian trajectories. [18]

In (13), the wave-particle $\mathbf{P} \cdot \mathbf{r} - Et = akX - \omega\delta T' = k(aX - c\delta T')$ link to the space-time, and the X-enlarge distorted 3D graph shows in **Fig. 9**.

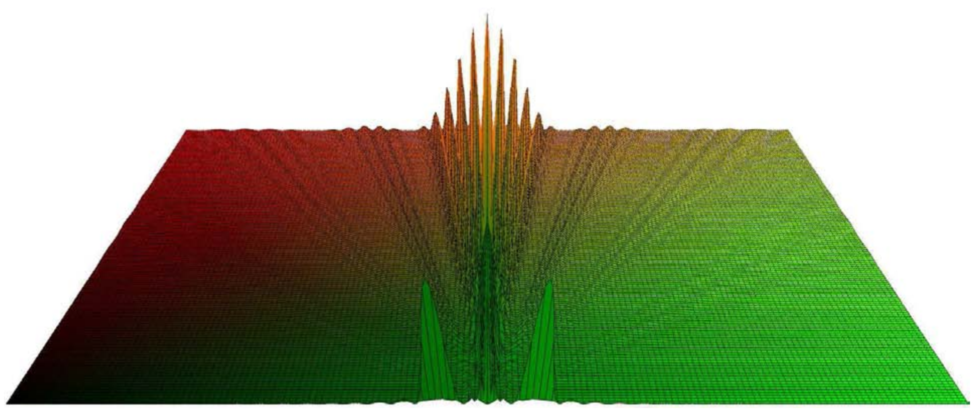


Figure 9 : The double-slit distorted 3D graph of $|\Psi|^2_{3D}$ in (13) by author

The experiment for which-way also show the de-coherent by the secondary scattering after the quanta passed slit. [19] It further prove that the quantum scattering is a critical issue behind the geometric parameters for the wave-pattern. In other word, ***there will be no interference if without relativistic quantum scattering.*** The fine structure constant is the magic hand behind the double-slit experiment. This model clearly displays the particle-wave duality by particle scattering and wave-interference. The quanta can be counted as one *particle* at a *time*, and the multi-quantas are displaced as the cosine-type *wave*-pattern in *space*. The electromagnetic wave frequency is in the region of $\omega = kc = 10^0 \sim 10^{24}$[Hz]. Since $T_c = 1.288 \times 10^{-21}$[sec], the double-slit wave interference can be tested from soft-X-ray (10^{18}[Hz]) to microwave (10^8[Hz]). The visible light ($\sim 10^{14}$[Hz]) is a *wave*-like rather than the *particle*-like, and the γ-ray (10^{20-24}[Hz]) is a *particle*-like rather than the *wave*-like. This physical reality was obscured by the trigonometric identities, however, there are many different versions of the classical grating equations. The quantum physical principle is the same and independent of the mathematical expression and coordinate system.

VII. Conclusion

The wave-particle duality relate to the space-time property of matter by Planck constant. The fine structure constant is linked to the double-slit and the uncertainty principle in Quantum Mechanics. Compton scattering and interference of double-slit is established by the cross-linked angle $T_1' = T_c\cos(\theta_2)$, and *vice versa*. The single-slit direction is described by Sinc-function which could combine the classical and quantum interference effect in the same experiment. This space-time model of double-slit explain the experimental mystery of the double-slit.

VIII. Acknowledgments

The Author thanks Bernard Hsiao for discussion.

References Références Referencias

[1] Max Born, "The Mysterious Number 137." *Proceedings of the Indian Academy of Sciences,* 2 (1935)

[2] Wolfgang Pauli, "Exclusion Principle and Quantum Mechanics." *Nobel Lecture* (1946); "The Connection Between Spin and Statistics." *Physical Review*, 58, (1940); 716-722.

[3] Richard P. Feynman, "The Character of Physical Law." *BBC Publications,* (1965)

[4] Ke Xiao, "The Fine Structure Constant and Interpretations of Quantum Mechanics." *Electronic Journal of Theoretical Physics*, 9, (2011); 135-146

[5] Eewin Schrödinger, "Quantisierung als Eigenwertproblem." *Annalen der Physik* (Leipzig) 79 (1926); 361, 489. 80 (1926); 437. 81 (1926); 109.

[6] Max Born, "Zur Quantenmechanik der Stoßvorgänge, *Zeitschrift für Physik."* 37 (1926); 863-867; The Statistical Interpretations of Quantum Mechanics, *Nobel Lecture* (1954)

[7] Ke Xiao, "Dimensionless Constants and Blackbody Radiation Laws." *Electronic Journal of Theoretical Physics*, 8 (2011); 379-388.

[8] Albert Einstein, "Concerning an Heuristic Point of View Toward the Emission and Transformation of Light." *Annalen der Physik*. 17 (1905);132-148.

[9] Louis de Broglie, "Ondes et Quanta." *Comptes Rendus,* 177 (1923); 507-510.

[10] Max Planck, "Ueber das Gesetz der Energieverteilung im Normalspectrum." *Annalen der Physik.* 309 (1901); 553–563.

[11] Paul Adrien Maurice Dirac, "Zur Quantentheorie des Elektrons." *Leipziger Vorträge* (*Quantentheorie und Chemie*), (1928); 85-94.

[12] Josiah Willard Gibbs, "Elementary Principles in Statistical Mechanics." *New York: Scribner* (1902)

[13] Arthur Holly Compton, "A Quantum Theory of the Scattering of X-Rays by Light Elements." *Physical Review,* 21 (1923); 483-502.

[14] Roy J. Glauber, "The quantum theory of optical coherence." *Physical Review,* 130 (1963); 2529-2539.

[15] Claus Jönsson, "Interferenz von Elektronen am Doppelspalt. *Zeitschrift für Physik*." 161 (1961), 454-474; "Electron Diffraction at Multiple Slit." *American Journal of Physics,* 42 (1974); 4-11.

[16] Anton Zeilinger, *et. al.*, "Single- and double-slit diffraction of neutron." *Rev. Mod. Phys.*, 60, (1988); 1067-1073. David S. Weiss, *et. al.*, "Precision Measurement of the Photon Recoil of an Atom Using Atomic Interferometry." *Physical Review Letters,* 70 (1993); 2706-2709.

[17] T. Miyahara, "From First-Order Coherence to Higher-Order Coherence of Synchrotron Radiation." *Journal of Synchrotron Radiation*. 5 (1998); 305-308.

[18] Christian Kurtsiefer, *et. al.*, "Measurement of the Wigner function of an ensemble of helium atoms." *Nature* 386 (1997), 150-153; Sacha Kocsis, *et. al.*, "Observing the Average Trajectories of Single Photons in a Two-Slit Interferometer." *Science*. 332(6034) (2011); 1170-1173.

[19] Michael S. Chapman, *et. al.*, "Photon Scattering from Atoms in an Atom Interferometer: Coherence Lost and Regained." *Physical Review Letters,* 75 (1995); 3783-3787.

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 14 Issue 2 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Selfvariations Vs Standard Cosmological Model using as Criterion the Cosmological Data

By Emmanuil Manousos

National and Kapodistrian University of Athens, Greece

Abstract- We compare the Standard Cosmological Model with the Model of the Selfvariations, based upon the cosmological data as we collect them since the time of Hubble. We selected to examine the 14 most fundamental pieces of data. The Standard Cosmological Model can justify four of these, it can justify two additional with some further assumptions, while it cannot justify the remaining eight. The Cosmological Model of the Selfvariations justifies eleven, while the completeness of justification of the remaining two is a matter of further investigation. We did not identify any piece of cosmological data that contradicts the predictions of the Model of the Selfvariations.

Keywords: *cosmological model, SCM, selfvariations.*

GJSFR-A Classification : FOR Code: 240101

SELFVARIATIONSVSSTANDARDCOSMOLOGICALMODELUSINGASCRITERIONTHECOSMOLOGICALDATA

Strictly as per the compliance and regulations of :

Selfvariations Vs Standard Cosmological Model using as Criterion the Cosmological Data

Emmanuil Manousos

Abstract- We compare the Standard Cosmological Model with the Model of the Selfvariations, based upon the cosmological data as we collect them since the time of Hubble. We selected to examine the 14 most fundamental pieces of data. The Standard Cosmological Model can justify four of these, it can justify two additional with some further assumptions, while it cannot justify the remaining eight. The Cosmological Model of the Selfvariations justifies eleven, while the completeness of justification of the remaining two is a matter of further investigation. We did not identify any piece of cosmological data that contradicts the predictions of the Model of the Selfvariations.

Keywords: cosmological model, SCM, selfvariations.

I. Introduction

The Standard Cosmological Model prevailed over other models mostly because it justifies the redshift of distant astronomical objects, the Cosmic Microwave Background Radiation, and the nucleosynthesis of the elements. This success of the model, attenuated the strictness of the scientific community resulting in the introduction of many hypotheses into the model in an attempt to justify the ever increasing amount of cosmological data, ranging from the hypothesis of Cosmic Inflation in the 1980's, up to the most recent hypothesis of Dark Matter to justify the increased luminosity distances of type Ia supernovae. At the same time, many similar cosmological models were developed, which, at their core, justified the redshift by the expansion of the Universe. Finally we came to the anisotropies recorded by the Planck satellite, the temperature difference between the Northern and Southern hemisphere of the Universe, the recording of the variation of the fine structure constant, the Sloan Great Wall, and to the extremely large extent of the 73 quasars structure, the Huge-LQC group, which was recently observed. These recent data are in complete opposition to the Standard Cosmological Model. The same holds for the luminosity distances of type Ia supernova. The Dark Energy hypothesis momentarily justifies these distances by alluding to a Universe that expands at an accelerating rate. But in combination with the fact that we know, from successive measurements by the COBE, WMAP and Planck satellites, that the Universe is flat, there arises an insurmountable problem: the time required for the electromagnetic radiation we observe from astronomical objects with a redshift $z>1$ to reach the Earth, is greater than the age of the Universe predicted by the Standard Cosmological Model.

The correlation of redshift with the distance of far distant astronomical objects, as conducted by Edwin Hubble at the begin of the past century, leads to a certain conclusion: one, or more physical quantities from these considered as constant, vary within the universe. To SCM justifies the redshift with macroscopic causes via the expansion of the universe. However the redshift can be perfectly justified with microscopic causes. From a slight continuous increase of the rest mass and a slight continuous increase/ decrease of the electric charge of material particles. This increase/ decrease is expressed by the law of selfvariations.

Actually Hubble himself had serious doubts about the interpretation of reshifts as 'recession' velocities. As expressed by Hubble and Humason in the most influential paper [1,2]:

"The interpretation of redshifts as actual velocities, however, does not command the same confidence, and the term 'velocity' will be used for the present in the sense of 'apparent' velocity, without prejudice as to its ultimate significance… The writers are constrained to describe the 'apparent velocities – displacements' without venturing on the interpretation and its cosmological significance."

According to Allan Sandage [3]:

"Hubble believed that his count data gave a more reasonable result concerning spatial curvature if the redshift correction was made assuming *no recession.* To the very end of his writings he maintained this position, favouring (or at the very least keeping open) the model where no true expansion exists, and therefore that the redshift *"represents a hitherto unrecognized principle of nature"."*

The model of selfvariations predicts and justifies all of the cosmological data. Some of the predictions of the model demand further investigation as to their completeness, which is natural for a new model. There is no cosmological observation that contradicts the predictions of the model. Essentially, the totality of cosmological data is contained as information in a single equation for the rest mass of material particles and an analogous equation for the electric charge that express the law of selfvariations in the macrocosm. The consequences of the selfvariations at the scale of the

Author : Astrophysics Laboratory, Department of Physics, National and Kapodistrian University of Athens, Panepistimiopolis, Athens, Greece.
e-mail: emanoussos@phys.uoa.gr

Universe, are recorded in the most direct way in the cosmological data.

The redshift and the increased distance brightnesses of distant astronomical objects, the microwave background radiation and the flatness of the universe are mainly due to the selfvariation of the rest mass and less to that of the of the electric charge. The fluctuations of the CMBR temperature and the fine structure parameter, the temperature difference of the northern and southern hemispheres of the universe and the absence of antimatter in the universe are solely due to the selfvariation of the electric charge. The Dark Matter relates both to the selfvariation of the electrical charge and the original form of the universe.

In the distant past, the equations predict that the original form of the universe differs only minimally from the vacuum. The ionization energy of atoms and the synthesizing energy of nucleons tend to zero as we go backwards in time. The universe went through a phase of ionized atoms when the nucleosynthesis of the elements could be made at temperatures near 0 K.

The law of selfvariations incorporates the arrow of time in the macrocosm and predicts that there is no arrow of time in the microcosm. Starting from a situation that differed only minimally from the vacuum the universe has evolved over the years because of the selfvariations, to the form we observe today. Nevetheless the universe remains consistent with its origin since at every stage of its evolution, at any time, the total energy content is zero. The law of the selfvariations expresses the unique relationship between matter and vacuum .

The equations of the model of the selfvariations allow us to go back in time as far as we want. The period considered as the age of the universe by the SCM is only the recent time period where matter has taken the form we observe today. According to the law of the selfvariations, beyond the limits of the universe we observe today there is no Big Bang, but an immense period of time evolution of the universe. This evolution is determined by the selfvariations.

II. The Fundamental Cosmological Data and the Predictions of the Two Models

We list the main cosmological data and the corresponding prediction of each model.

a) The redshift of distant astronomical objects

The Standard Cosmological Model justifies the redshift macroscopically, as a result of the expansion [4] of the Universe. On the contrary, in the model of selfvariations the redshift results from microscopic causes, as a consequence of the decrease of the rest masses of material particles [5, 6] at distant astronomical objects.

b) The Cosmic Microwave Background Radiation

The Standard Cosmological Model predicts the Cosmic Microwave Background Radiation as a remnant of the Big Bang [7]. The Model of the selfvariations predicts the Cosmic Microwave Background Radiation as the consequence of the enormous, theoretically infinite, values of the Thomson and Klein-Nishina scattering coefficients in the very early Universe. The enormous values of the scattering coefficients render the very early Universe opaque at a temperature close to OK [5, 6].

c) The increased luminosity distances of type Ia supernovae

In order to justify the increased luminosity distances of type Ia supernovae, the Standard Cosmological Model has to introduce further hypotheses, such as the one of dark energy [8, 9]. Knowing from observational data that the Universe is flat, the great distances measured for these supernovae constitute an insurmountable problem for the Standard Cosmological Model, as we shall see in the following subparagraph d.

In the model of the selfvariations the luminosity distances are predicted to be greater than the real distances for all distant astronomical objects. Because of the selfvariations, the energy generated by fusion, and by any conversion of rest mass into energy, is less at distant astronomical objects compared to the corresponding laboratory amount. The mass of distant supernovae is smaller than the mass of the prototype "standard candle" supernova. After performing the relevant calculations we obtain the correct relation between the luminosity distance and the redshift of astronomical objects [5, 6].

The model of the selfvariations predicts that at distant astronomical objects, the degree of opacity of the stellar surfaces increases, but at the same time the degree of atomic ionization also increases. These two factors affect the luminosity of distant astronomical objects for large values of the redshift z. It is important that for small values of the redshift, where we only measure the consequences of the selfvariation of the rest masses, the prediction of the law of the selfvariations is exactly confirmed.

d) The Flatness of the Universe

The COBE, WMAP and Planck satellites have successively confirmed that the Universe is flat. Since the Universe is flat for the time interval $T(z)$ required for the electromagnetic radiation to reach Earth from a distant astronomical object with redshift z, it holds that [5].

$$T(z) > \frac{z}{H} .$$

For $z > 1$ we get $T(z) > \frac{1}{H}$, that is, the time interval $T(z)$ is greater than the age of the Universe predicted by the Standard Cosmological Model. The problem created by the combination of the flatness of the Universe and the increased luminosity distances of the supernovae, for the time interval $T(z)$, has been completely silenced. Since the Universe is flat, the hypothesis of Dark Energy is not enough to render the supernovae luminosity distances compatible with the Standard Cosmological Model. We remind that the initial measurements [8, 9] were conducted in order to confirm that the luminosity distances are smaller than those given by Hubble's law, since that was predicted by the Standard Cosmological Model. To this insurmountable problem for the Standard Model we have to add the case of star HD140283, which seems to have an age greater than the age of the Universe [10]. We come to the conclusion, mainly because of the first reason, that the Standard Cosmological Model is not in accordance with the observed flatness of the Universe.

The model of the selfvariations predicts that the total energy content of the Universe is zero and, therefore, the Universe is flat.

e) The Nucleosynthesis of the Chemical Elements

The Standard Cosmological Model predicts the nucleosynthesis of the chemical elements [11]. The very high temperatures in the very early Universe result in the decomposition of particles into their partial, constituent particles. As the Universe expands and cools, the phases of nucleosynthesis are predicted in detail.

The model of the selfvariations predicts [5, 6] that the binding energies of elementary particles for the formation of complex particles decrease at distant astronomical objects down to the value $\Delta m_0 c^2 (1-A)$. Regarding parameter we know that $A \to 1^-$, while $\Delta m_0 c^2$ is the laboratory value of the binding energy. Therefore, nucleosynthesis can take place at very low temperatures, close to $0K$, which are predicted by the model in the very early Universe.

Nucleosynthesis can take place in two distinctly different phases during the evolution of the Universe, as predicted by the model of the selfvariations: in the very early Universe, at a temperature close to 0K, but also during the accumulation of matter for the formation of the large scale structures in the Universe. The decreased binding energies of the material particles during the phase of accumulation of matter allow for the nucleosynthesis of heavy elements at temperatures at which, until today, nucleosynthesis was considered impossible. Thus, we can justify the existence of heavy elements in the Sun and other stars.

The model predicts that with the passage of time the selfvariations strengthen the binding energies of the particles, resulting in the enormous cohesion energies we measure in the laboratory today. The model is self-consistent, but a complete study is demanded as far as the completeness of the prediction is concerned.

f) The ionization of atoms in the very early Universe

The Standard Cosmological Model predicts that the Universe underwent a phase of atomic ionization [4], because of the high temperatures after the Big Bang.

The model of the selfvariations predicts [5, 6] a decrease in the values of atomic ionization energies at distant astronomical objects, down to value $X_n(1-A)$, where X_n is the laboratory value of the ionization energy of an atom. Taking into consideration that $A \to 1^-$, the ionization of atoms in the very early Universe follows.

g) The Sloan Great Wall

During the recent measurements for the large - scale structures of matter in the Universe, the Sloan Digital Sky Survey [12] recorded huge structures of matter followed by enormous voids. The largest recorded structure, the Sloan Great Wall, spans a length of $1.38 \times 10^9\ ly$, while it is estimated that its formation requires about $80 \times 10^9\ yr$. The size of the Sloan Great Wall introduces an issue of anisotropy of the Universe for the Standard Cosmological Model. Furthermore, the time needed for its formation exceeds the age of the Universe predicted by the model.

The equations of the model of the selfvariations are compatible with the condition $r \to \infty$ [5, 6], which means that we can go back in time as much as we want. Therefore, the size, and the time interval needed for the formation of the Sloan Great Wall, are compatible with the model of the selfvariations.

h) The Variation of the Fine Structure Constant

In the Standard Cosmological Model the fine structure constant has to actually be constant. As we have already mentioned, the Standard Cosmological Model explains the main cosmological data based on macroscopic and not microscopic causes.

The cosmological model of the selfvariations predicts a slight variation of the electric charge [5, 6]. Indeed, this variation can take place in two directions, either towards the increase, or towards the decrease of the absolute value of the electric charge. This potential for the evolution of the selfvariation of the electric charge in two directions is due to the fact that the electric charge exists in the Universe in the form of pairs of opposite quantities. Such a potential does not exist for the rest mass, which evolves only the direction of increase. The fine structure constant depends on the electric charge and is, therefore, affected by the selfvariations.

Recent measurements [13-27] have recorded a slight variation of the fine structure constant. Indeed, the measurements have shown that in the Northern hemisphere of the sky the fine structure constant had in the past a smaller than laboratory value, and in the Southern hemisphere a greater one. The Standard Cosmological Model cannot explain such results, while they don't pose a problem for the model of the selfvariations.

i) The Temperature Difference between the North and the South Hemisphere of the Universe

Recently, the Planck satellite confirmed the initial measurements of WMAP, according to which the temperature of the Northern hemisphere of the Universe is slightly lower than the temperature of the Southern hemisphere. According to the Standard Cosmological Model this temperature difference should not exist.

The difference in the value of the fine structure constant between the two hemispheres, as we already mentioned in the previous subparagraph, is due to the difference in the value of the electric charge [5, 6]. This difference in the electric charge is responsible also for the difference in temperature between the two hemispheres of the Universe. In the regions of the Universe where we measure a smaller fine structure constant, therefore a smaller value of the electric charge, it is predicted that the Universe will have a lower temperature [28]. We propose the measurement of the value of the fine structure constant in the direction of the cold spot identified by the Planck satellite in the Northern hemisphere. We predict that the value of the fine structure constant measured along this direction will be smaller than its laboratory value.

j) The Anisotropies in the Distribution of Quasars

The model of the selfvariations predicts an important factor as the main cause of the anisotropies that are already recorded in the observable Universe. According to the model, we only observe a small part [5, 6] of the Universe. The more our observational instruments improve, the more detailed our observations become, the larger the observed anisotropies due to this factor are going to be.

The recent observation [29] of a group of 73 quasars, the Huge-LQC group, which spans a distance of $4\times10^9\ yr$, is just such an anisotropy. The size of this group exceeds by far the limits set by the Standard Cosmological Model. This anisotropy is recorded in the cosmological data exactly because we only observe a small part of the Universe. According to the Model of the Selfvariations, the Universe is isotropic at larger distances, far larger than the part of the Universe we observe today.

k) Dark Matter

The existence of Dark Matter is known since the beginning of the last century from its contribution to the cohesion of galaxies. However, recent measurements [30] by modern, improved observational instruments have shown that Dark Matter does not behave as expected based on the Standard Cosmological Model. Of course we could, to some degree, assume that the observations are not problematic for the model, but expose our ignorance about the nature of Dark Matter.

The Model of the Selfvariations predicts that in the initial phase of the evolution of the Universe, part of the matter accumulates and creates the large-scale structures of the Universe at high temperatures. The rest of the matter remains permanently [5, 6] at a temperature close to $0K$. The different conditions in which the selfvariations evolve, could lead to the creation of particles with different properties. Additionally the equations of the model predict that the antimatter which existed in the early universe is converted to Dark Matter particles with the passage of time. Of course, further investigation is necessary, in order to evaluate the completeness of the prediction.

l) The temperature fluctuations of the CMBR

The SCM can only make some assumptions about the causes of fluctuations in the CMBR. It cannot provide a clear theoretical prediction.

The model of the selfvariations in detail provides for the temperature fluctuations in the CMBR with accurate theoretical predictions [6]. This is a consequence of the selfvariation of the electric charge.

m) The absence of antimatter in the universe.

The SCM can not justify the absence of antimatter in the universe. The quantity of matter and antimatter should be equal.

The model of the selfvariations predicts that over time antimatter is converted to neutral particles of Dark Matter. This is a consequence of the evolution of the selfvariation of the electric charge [6].

n) The Horizon problem

From the observational data we know that different regions of the universe located billions of light years from each other have interacted in the past. This fact is referred in Cosmology as the "Horizon problem".

In order to solve the Horizon problem, the hypothesis of cosmic inflation is introduced into Standard Cosmological Model (SCM), according to which the universe expands exponentially during a tiny fraction of a second just after the Bing Bang. With this hypothesis the SCM justifies further the flatness of the universe, while it bypasses the fact that immediately after the Bing Bang the universe shall collapse again to a point. During the 1970s we already knew the density of matter of the universe and that the equations of General Theory of Relativity lead to this catastrophic result for the

SCM. Without the cosmic inflationary hypothesis the SCM cannot survive the consequences of the Big Bang.

The equations of the Cosmological Model of the Selfvariations predict that the rest masses, as well as the velocity of material particles tend to vanish towards the very early universe. Therefore the uncertainty of the momentum ΔP of each material particle tends to zero, $\Delta P \rightarrow 0$.This in turn implies by the Uncertainty Principle of Heisenberg that the uncertainty of the position of each material particle towards the very early universe tends to infinity, $\Delta x \rightarrow \infty$. The early particles tend to occupy the whole extant spacetime which means that the universe literally 'emerges from everywhere'. The consequences from this phase of evolution of the universe are recorded in our times by the observational instruments. The Horizon problem does not arise as 'a problem', within the Cosmological Model of the Selfvariations. The article, with the analytical predictions and the mathematical calculations about this issue, has been accepted for publication in the Journal 'Physics International'. The article also contains additional information such as the dependence of the rest mass and the volume of the white dwarfs and the neutron stars on redshift. Also the redshift decelerates the rate of evolution of certain phenomena, such as the process of excitation and de-excitation of atoms.

III. Discussion

Based on the physical theories of the past century, the only reliable justification of the redshift of the far distant astronomical objects can be accomplished by the expansion of the universe. This had resulted in the SCM. As we go back in time we are leaded towards a singularity of infinite density and temperature. Thus, we are led to the Bing Bang hypothesis. Immediately after the Bing Bang the material particles are completely decomposed to constituent particles, due to the extremely high temperatures. As the universe expands and cools down, the synthesis of particles takes place while the CMBR remains as a remnant.

The improvement of the observational instruments and the accretion of cosmological data for almost a century, led to the introduction of several fundamental hypotheses into the SCM, in order for this model to remain in accordance with the cosmological data. The main hypotheses refer to the introduction of cosmic inflation and Dark Energy. However current cosmological data is not anymore in accordance with the predictions of the SCM. The fine structure parameter variation, the temperature difference between the Northern and the Southern hemispheres of the universe, the estimated immense age of the Sloan Great Wall, the enormous structure of 73 quasars discovered in 2013 and the existence of galaxies in proximity to the Bing Bang, are some examples. There is currently no single hypothesis which can justify these data within the framework of the SCM. If we attempt for example to justify theoretically the fine structure parameter variation, we are led to a theory analogous to the Theory of Selfvariations and finally to the justification of redshift within a static and not within an expanding universe.

During the 1990s the luminosity distances of the Ia supernovae have been measured with the target to verify that these luminosity distances were smaller than those provided by the Hubble law, in accordance to the prediction of the SCM. Today we know that the luminosity distances of the type Ia supernovae are not only larger than those predicted by Hubble's law, but they seemed unrealistic for the framework of the SCM. The difficulty of the introduction of the Dark Energy hypothesis, in order for the SCM to remain in accordance with the available data, can not go unnoticed. This remark does not refer to the researchers who introduced this hypothesis and who have contributed largely and obtained excellent work as pioneers for the exploration of the universe. The origin of the Dark Energy hypothesis lies in the physical theories of the past century and is based on the wrong assumption that these theories have the necessary completeness in order to justify the cosmological data.

There are many reasons which lead to the assumption that the fundamental physical theories of the past century are not complete. We shall refer only to one, the ignorance about the cause of the quantum phenomena. Einstein insisted on this subject up to the end of his life. The Theory of Selfvariations sets the foundations of a common cause for the quantum and the cosmological phenomena. Especially the cosmological data are included as information and are justified by the Law of the Selfvariations on cosmological scales.

The Law of Selfvariations predicts that the state of the very early universe only slightly differs from the state of vacuum at a temperature close to OK. The evolution of the selfvariations with the passage of time leads the universe from its initial state to the state we observe it today. During each phase of evolution, the universe remains consistent with its origin, since its total energy content remains zero. The Law of Selfvariations does not answer to the question posed by Leibniz "why does something exist rather than nothing?". Nevertheless it provides us with the unique relation between matter and the vacuum.

As we go backwards in time, the binding energies of the nucleons, the ionization energies and the excitation energies of the atoms, as well as the gravitational energy are reduced, until they vanish. The material particles are totally decomposed into constituent particles. With the passage of time and the evolution of the selfvariations, the synthesis of particles takes place. The CMBR is predicted to originate from the whole space of the universe i.e. it originates 'from everywhere'.

The Law of Selfvariations justifies the totality of the current cosmological data. As we observe the universe as it was in the past, the consequences of the selfvariations are recorded within the cosmological data. The parameters appearing in Astrophysics, in Thermodynamics and in Quantum Mechanics, as well as the conclusions derived by their propositions, are affected by the selfvariations. It is these consequences that are recorded by the observational instruments in the cosmological data.

IV. Results

The evidence presented in the previous paragraph results in the following table. The table shows a clear superiority of the Cosmological Model of the Selfvariations over the Standard Cosmological Model.

Cosmological Data	Standard Cosmological Model	Cosmological Model of The Selfvariations
Redshift	direct consequence of the expansion of the Universe	direct consequence of the selfvariations
Cosmic Microwave Background Radiation	remnant of the Big Bang	consequence of the enormous values of the Thomson and Klein-Nishina scattering coefficients in the early Universe
increased luminosity distances of type Ia supernova	not in agreement	direct consequence of the selfvariations
flatness of the Universe	not in agreement	the total energy content of the Universe is predicted to be zero, therefore the Universe is flat
nucleosynthesis of the chemical elements	predicted	predicted, further investigation of completeness of the prediction is required
ionization of atoms in the early Universe	predicted as a consequence of the high temperatures after the Big Bang	direct consequence of the selfvariations
size and age of the Sloan Great Wall	not predicted	predicted
variation of the fine structure constant	not predicted	direct consequence of the selfvariation of the electric charge
temperature difference between the Northern and Southern hemisphere of the Universe	not predicted	direct consequence of the selfvariation of the electric charge
anisotropies in the distribution of quasars	not predicted	predicted
Dark Matter	further investigation required, mainly due to recent observations	predicted, further investigation of completeness of the prediction is required
temperature fluctuations of the CMBR	not predicted	direct consequence of the selfvariation of the electric charge
absence of antimatter in the universe	not predicted	direct consequence of the selfvariation of the electric charge
the Horizon problem	the introduction of the inflationary hypothesis is demanded	it is included as information within the equations of the model

References Références Referencias

1. E. Hubble, A relation between distance and radial velocity among extra-galactic nebulae. *PNAS* **15** (3), 168-173 (1929).
2. E. Hubble, M. L. Humason, The velocity-distance relation among extra-galactic nebulae. *Astrophys. J.* **74**, 43 (1931).
3. A. Sandage, Edwin Hubble 1889-1953. *JRASC* **83**, 351 (1989).
4. T. L. Chow, Gravity, Black Holes, and the Very Early Universe: An Introduction to General Relativity and Cosmology (New York : Springer, 2008).
5. E. Manousos, Cosmological data could have a microscopic, not macroscopic, cause. *Am. J. Space Sci.* **1**, 9-21 (2013).
6. E. Manousos, On the absence of antimatter from the universe, dark matter, the fine structure parameter, the fluctuations of the cosmic microwave background radiation and the temperature difference between the northern and southern hemisphere of the universe. *Phys. Int.* **4**, 120-134 (2013).
7. A. A Penzias, R. W. Wilson, A Measurement of Excess Antenna Temperature at 4080 Mc/s. *Astrophys. J.* **142,** 419-421 (1965).

8. A.G. Riess, *et al*, Observational evidence from supernovae for an accelerating universe and a cosmological constant. *Astronomical J*. **116**, 1009-1038 (1998).
9. S. Perlmutter, M.S. Turner, M. White, Constraining dark energy with type Ia supernovae and Large-Scale structure. *Phys. Rev. Lett*. **83**, 670-673 (1999).
10. H. E. Bond, E. P. Nelan, D. A. VandenBerg, G. H. Schaefer, D. Harmer, HD 140283: A Star in the solar neighborhood that formed shortly after the big bang. *Astrophys. J. Lett.***765**, L12-29 (2013).
11. R. A. Alpher, H. Bethe, G. Gamow, The origin of chemical elements. *Phys. Rev*. **73**, 803-804 (1948).
12. J. R. Gott, *et al*, A Map of the Universe. *ApJ* **624**, 463-484 (2005).
13. H. Chand, R. Srianand, P. Petitjean, B. Aracil, Probing the cosmological variation of the fine-structure constant: Results based on VLT-UVES sample. *A&A* **417** (3), 853 – 871 (2004).
14. J. R. De Laeter, K. J. R. Rosman, C. L.Smith, The Oklo Natural Reactor: Cumulative Fission Yields and Retentivity of the Symmetric Mass Region Fission Products. *EPSL* **50** (1), 238–246 (1980).
15. V.A. Dzuba, V. V. Flambaum, J. K. Webb, Space-Time Variation of Physical Constants and Relativistic Corrections in Atoms. *Phys. Rev. Lett.* **82**, 888-891 (1999).
16. F. Gauthier-Lafaye, 2 billion year old natural analogs for nuclear waste disposal: the natural nuclear fission reactors in Gabon (Africa). *C. R. Physique* **3** (7), 839–849 (2002).
17. J. A. King, M. T. Murphy, W. Ubachs, J. K. Webb, New constraint on cosmological variation of the proton -to- electron mass ratio from Q0528-250. *MNRAS* **417** (4), 3010—3024 (2011).
18. A. P. Meshik, C. M. Hohenberg, O. V. Pravdivtseva, Record of Cycling Operation of the Natural Nuclear Reactor in the Oklo/Okelobondo Area in Gabon. *Phys. Rev. Lett*. **93** (18), 182302 (2004).
19. P. Molaro, et al, UVES radial velocity accuracy from asteroid observations. Implications for the fine structure constant variability. *A&A* **481**, 559-569 (2008).
20. M. T. Murphy, J. K. Webb, V. V. Flambaum, Revision of VLT/UVES constraints on a varying fine - structure constant. *MNRAS* **384**, 1053-1062 (2008).
21. M. T. Murphy, P. Tzanavaris, J. K. Webb, C. Lovis, Selection of ThAr lines for wavelength calibration of echelle spectra and implications for variations in the fine-structure constant. *MNRAS* **378**,221-230 (2007).
22. M.T. Murphy, J. K. Webb, V. V. Flambaum, Further evidence for a variable fine-structure constant from Keck/HIRES QSO absorption spectra. *MNRAS* **345**, 609 (2003).
23. Yu. V. Petrov, A. I. Nazarov, M. S. Onegin, E. G. Sakhnovsky, Natural nuclear reactor at Oklo and variation of fundamental constants: Computation of neutronics of a fresh core. *Physical Review C* **74** (6), 064610 (2006).
24. P. Tzanavaris, J. K. Webb, M. T. Murphy, V. V. Flambaum, S. J. Curran, Limits on variations in fundamental constants from 21-cm and ultraviolet Quasar absorption lines. *Phys. Rev. Lett*. **95**, 41301-41304 (2005).
25. J. K. Webb, et al, Indications of a Spatial Variation of the Fine Structure Constant. *Phys. Rev. Lett.* **107**, 191101 (2011).
26. J. K. Webb, et al., Further Evidence for Cosmological Evolution of the Fine Structure Constant. *Phys. Rev. Lett.* **87**, 091301 (2001).
27. J. K. Webb, V.V. Flambaum, C.W. Churchill, M.J. Drinkwater, J.D. Barrow, Search for time variation of the fine structure constant. *Phys. Rev. Lett.* **82**, 884-887 (1999).
28. G. Hinshaw, et al, Five-Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Data Processing, Sky Maps, and Basic Results. *ApJS* **180**, 225-245 (2009).
29. R. G. Clowes, *et al*, A structure in the early universe at z $\sim$ 1.3 that exceeds the homogeneity scale of the R-W concordance cosmology. *MNRAS* **429**, 2910-2916 (2013).
30. M. G. Walker, *et al*, A universal mass profile for dwarf spheroidal galaxies?. *Astrophys. J*. **704**, 1274-1287 (2009).

This page is intentionally left blank

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 14 Issue 2 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

A Stocastic Explination of Newton's Law and Coulombs' Law

By John Laurence Haller Jr.
CCC Information Services, United States

Abstract- Assuming that a particle follows the discrete Bernoulli process with a step size proportional to one over twice its mass and that the vacuum is made up of particles with the reduced Planck mass, one can derive both Newton's Law of Gravitation and Coulomb's Law of Electric Force using slightly different parameters of the process. Two classes of experiments, which could affirm the hypothesis, would indicate a preferred reference frame.

Keywords: discrete space, discrete time, discrete vacuum, dark particle, black hole, diffusion, quantum gravity, stochastic process, bernoulli process, coulomb's law, newton's law, preferred reference frame, absolute velocity.

GJSFR-A Classification : *FOR Code: 249999*

ASTOCASTICEXPLINATIONOFNEWTONSLAWANDCOULOMBSLAW

Strictly as per the compliance and regulations of :

A Stocastic Explination of Newton's Law and Coulombs' Law

John Laurence Haller Jr.

Abstract- Assuming that a particle follows the discrete Bernoulli process with a step size proportional to one over twice its mass and that the vacuum is made up of particles with the reduced Planck mass, one can derive both Newton's Law of Gravitation and Coulomb's Law of Electric Force using slightly different parameters of the process. Two classes of experiments, which could affirm the hypothesis, would indicate a preferred reference frame.

Keywords: discrete space, discrete time, discrete vacuum, dark particle, black hole, diffusion, quantum gravity, stochastic process, bernoulli process, coulomb's law, newton's law, preferred reference frame, absolute velocity.

I. Introduction

If one assumes that the information in the Universe is finite, one should conclude that space-time is discrete because not enough information exists to describe a variable or an observable to a continuous value. Haller [1] gives reasons why one would believe that the information in a system with finite energy and finite time is finite.

We must also understand the length scale of the discrete step size of a particle and that of the gravity field before we can make a viable theory. Haller [2] shows that the step size of a particle is equal to one over twice the particle mass and that of the vacuum is one over twice the reduced Planck mass.

With this we can derive an understanding of how gravity and electricity work; how they are similar and how they are different.

Work is still needed to fully integrate this derived stochastic process with relativity, however clues are left which indicates that the probability a particle steps to the left or steps to the right, is a feedback between the particle's state and the curvature of space.

II. Bernoulli Process

Introducing the Bernoulli process as reviewed by Chandrasakhar and Reif [3,4], we see a stochastic process where the result of a sample of a uniform distribution between zero and one is compared against the process parameter β. If the sample is less than β, the particle steps to the right, otherwise it steps to the left.The time between steps is quantized to δt and the length of the steps is also quantized to δx.

Author : Chicago, IL, USA. e-mail: jlhaller@gmail.com

The process can be expanded to 3+1 dimensions but for the purposes here we will forgo relativistic effects of the +1 time dimension and further align the particles on the x axis so we can focus on only the 1 spatial dimension.

a) Step size of a particle

Building on analysis by Kubo on the fluctuation dissipation theorem [5], we formalize the 2 time constants for a diffusing free particle: the collision time, δt and the relaxation time, τ . When the relaxation time is equal to the thermal time , $\tau = \hbar/2k_BT$, the diffusion constant becomes, $D = \hbar/2m$, [1,2,5-7] and the spatial variance is $(\Delta x(t))^2 = 2Dt = \hbar t/m$.

To derive the step size, δt , (or the collision time) we can look at the variance. The contribution to the spatial variance is balanced between drift and diffusion; when the probability parameter is ½ the variance is,

$$(\Delta x(K))^2 = \delta x^2 K + (\Delta v_K)^2 (\delta t K)^2$$

Here δx is the spatial step size, K is the number of steps $t = K \cdot \delta t$ is the duration of the process and $(\Delta v_K)^2$ is the variance in velocity after K steps. From Dirac, we know that $\delta x = c \cdot \delta t$ [8] which allows us to calculate $(\Delta v_K)^2$.

When K is large, the average variance of the sum of K samples of a distribution is equal to the variance of the individual sample divided by K [9].

$$(\Delta v_K)^2 = \frac{(\Delta v_1)^2}{K} = \frac{\frac{1}{2}\left(\frac{\delta x}{\delta t}\right)^2 + \frac{1}{2}\left(\frac{-\delta x}{\delta t}\right)^2}{K} = \frac{c^2}{K}$$

Equating $(\Delta x(t))^2$ and $(\Delta x(K))^2$ which $\hbar t/m = 2\delta x^2 K$, results in,

$$\delta t = \frac{\hbar}{2mc^2}$$

Thus when the relaxation time is equal to one over twice the temperature $\tau = \hbar/2k_BT$, the collision time is one over twice the energy $\delta t = \hbar/2mc^2$, and visa versa.

b) Gravitational scale

I will not go into the detailed theory of dark particles as a tradeoff of simplicity overdeep insight, yet one can find that analysis here [2].

The gist is that the vacuum is made up of particles with the reduced Planck mass

$$m_p = \sqrt{\frac{\hbar c}{8\pi G}}$$

A number of special conditions arise at this value of mass. One of these is that the quantum step, $\delta x = \hbar/2mc$, is equal to a circle's circumference with the Schwarzschild radius.

$$\ell_p = 2\pi R_S = \frac{4\pi G m_p}{c^2} = \delta x = \frac{\hbar}{2m_p c}$$

c) Electrical scale

The step size, or scale of the electric field, of a particle can be derived with the help of an old idea; namely electromagnetic mass[10,11].

Consider the electromagnetic energy, E_{em}, equal to the mass energy of the particle,

$$mc^2 = E_{em}$$

To find E_{em}, we add the electrostatic energy, E_{es}, to the Poincaré stresses, $E_{ps} = E_{es}/3$, we get the total electromagnetic energy, E_{em} [10], or

$$mc^2 = 4E_{es}/3 = 4E_{ps}$$

We can solve for r_e byusing an ansatz, such that the resulting r_e gives the correct form for Coulomb's Law. Note that appendix A gives further reason why this ansatz is reasonable.

The ansatz is that the Poincaré stresses are equal to the electrostatic energy of a spherical shell of total charge equal to the minimum quantum charge, $q_e/3$.

$$E_{ps} = \frac{(q_e/3)^2}{2(4\pi\varepsilon_0)r_e}$$

Or,

$$r_e = \frac{2{q_e}^2}{9(4\pi\varepsilon_0)mc^2}$$

However the length we are interested in is, ℓ_e, the wavelength that fits around a sphere of this radius, (just like $\ell_p = 2\pi R_S$) thus

$$\ell_e = 2\pi r_e = \frac{{q_e}^2}{9\varepsilon_0 mc^2}$$

III. Force as a Stochastic Process

a) Velocity as a probability

Going back to the Bernoulli process of motion we can see a relationship between the average velocity and the probability parameter, β.

$$\overline{x(K)} = (2\beta - 1)\delta x K$$

Where $\delta x K = c\delta t K = ct$. We know from above the relaxation time is $\tau = \hbar/2k_B T$ and is representative of how long the process stays coherent. In other words, τ is the time over which the particle forgets its state. Thus we can define the moving average velocity as

$$\bar{v} = \frac{\overline{x\left(K = \frac{\tau}{\delta t}\right)}}{\tau} = c(2\beta - 1)$$

Or,

$$\beta = \frac{\overline{x\left(K = \frac{\tau}{\delta t}\right)}}{2c\tau} + \frac{1}{2}$$

Note that the instantaneous velocity is one of the two velocity Eigen values, ±c, however $\bar{v}$ ∈[-c,c]; which is mathematically nice since $\beta \in [0,1]$.

b) Resistive Force – an aside

In the derivation of dark particles [2], one finds a resistive force for dark particles that we need to briefly consider here as it adjusts our expression for β. The force can be derived a few ways and has the simple expression $F = -mx/\tau^2$. Haller shows that when this force is in play, it contributes to β an amount $\beta = -x/4c\tau + 1/2$ [2].

Thus our expression for β for dark particles becomes,

$$\beta - \frac{1}{2} = \frac{\overline{x\left(K = \frac{\tau}{\delta t}\right)}}{2c\tau} - \frac{\overline{x\left(K = \frac{\tau}{\delta t}\right)}}{4c\tau} = \frac{\overline{x\left(K = \frac{\tau}{\delta t}\right)}}{4c\tau}$$

c) β changing due to a force

With this definition of $\bar{v}$ we can consider how $\bar{v}$ and β (through feedback) are a function of time and thus also a function of space as it moves.

As stated above we will limit ourselves to non-relativistic particles, thus we have the relationship between the force on a particle of mass m_1 and β

$$F = \frac{dp}{dt} = m_1\frac{d\bar{v}}{dt} = 2cm_1\frac{d\beta}{dt}$$

d) Stocastic process

Now imagine the force between two particles. For the sake of simplicity (since we assume Newton's third law), we will consider only the force on particle 1 due to interaction with particle 2. Again for simplicity we take particle 1 at the origin and particle 2 on the x axis at R.

Particle 2, like particle 1, follows the Bernoulli process. As such it accelerates between its two velocity Eigen values, ±c. As it accelerates at each step, it radiated energy δt_2. Thus $dt = \Phi\delta t_2$, or

$$dt = \Phi\frac{\hbar}{2m_2c^2}$$

Where Φ is the probability the emitted radiation from particle 2 is in the direction of particle 1 and captured (and processed).

Since the direction of the radiation wave vector is random and uniformly distributed across solid angle, Φ, is the cross section of particle 1, σ, divided by the surface area of a sphere, A, with a radius equal to the distance between particle 1 and particle 2, R.

Global Journal of Science Frontier Research (A) Volume XIV Issue II Version I Year 2014

$$\Phi = \frac{\sigma}{A} = \frac{\sigma}{4\pi R^2}$$

Putting this together we have,

$$F = \frac{4m_1 m_2 \sigma c^3 d\beta}{4\pi R^2 \hbar}$$

e) *Findingd* β

Now if particle 1 captures the emitted radiation the effect is to change the probability parameter β, by artificially (outside the Bernoulli process) stepping the particle towards or away from the direction of the radiation a distance ζ.

If particle 1 artificially steps the distance ζ, then the difference in average displacement (to first order in low velocity) between the artificial step and no artificial step is ζ.

$$\overline{x\left(\frac{\tau}{\delta t}\right)}_{extra\ step} - \overline{x\left(\frac{\tau}{\delta t}\right)}_{no\ extra\ step} = \zeta$$

IV. Gravity

Using our result above for the quantization of the gravity scale, we have the artificial step size,ζ, equal to the quantum step size of the dark particle, or

$$\zeta = \ell_p \hat{\boldsymbol{k}}$$

Where $\hat{\boldsymbol{k}}$ is in either the positive or negative direction of the vector pointing from particle 1 to particle 2.

Using our expression for β for dark particles from section 3.2, we find

$$d\beta = \frac{\zeta}{4c\tau} = \frac{\ell_p}{4c\tau}\hat{\boldsymbol{k}}$$

To find the cross section, σ, of dark particles Haller uses a modified Langevin equation that accounts for the resistive force mentioned in section 3.1 [2]. Or,

$$\sigma = (\Delta x)_p^2 = \frac{\hbar^2}{2m_p k_B T}$$

Plugging these in and reducing we have,

$$F = \frac{Gm_1 m_2}{R^2}\hat{\boldsymbol{k}}$$

We learn through empirical evidence that the artificial step of particle $1, \zeta$,is always in the direction towards particle 2, $\hat{\boldsymbol{k}} = -\hat{\boldsymbol{R}}$, thus we derive Newton's Law of Gravity,

$$F = \frac{-Gm_1 m_2}{R^2}\hat{\boldsymbol{R}}$$

V. Electricity

Using our result above for the quantization of the electric scale, we have the artificial step size,ζ, equal to the circumference, ℓ_e, of a sphere of radius, r_e.

$$\zeta = \ell_e \hat{\boldsymbol{k}} = \frac{{q_e}^2}{9\varepsilon_0 m_2 c^2}\hat{\boldsymbol{k}}$$

Using our original expression for β from section 3.1,

$$d\beta = \frac{\zeta}{2c\tau}$$

However this is not the whole picture as we must account for the charge of either particle 1 or particle 2 being a multiple ofthe minimum quantum charge, $q_e/3$. If $|q_2|/(q_e/3)$ is greater than one, then the frequency of interaction, $1/dt$, will go up by this amount since there are more charged particles which are radiating. Thus

$$\frac{1}{dt} \to \frac{3|q_2|}{q_e}\frac{1}{dt}$$

Also if $|q_1|/(q_e/3)$ is greater than one, thenζwill go up by this amount. It is as if the massive charged particle is a Turing Machine [12] that executes the following computer code:

for $\quad$ i = 1 to $(3|q_1|/q_e)$

$$\beta = \beta + \tfrac{\zeta}{2c\tau}\hat{\boldsymbol{k}}$$

The cross section will be similar to σ from section 4, in that σ equals the spatial variance. However in this case the resistive force is not in play, thus $(\Delta x)_{m1}^2$ reduces to the common expression [10].

$$\sigma = (\Delta x)_{m1}^2 = \frac{\hbar^2}{4m_1 k_B T}$$

Plugging these in and reducing we have,

$$F = \frac{|q_1||q_2|}{4\pi\varepsilon_0 R^2}\hat{\boldsymbol{k}}$$

Again through empirical evidence

$$\hat{\boldsymbol{k}} = \frac{q_1}{|q_1|}\frac{q_2}{|q_2|}\hat{\boldsymbol{R}}$$

We thus returnCoulomb's Law,

$$F = \frac{q_1 q_2}{4\pi\varepsilon_0 R^2}\hat{\boldsymbol{R}}$$

VI. Discussion

Since most experiments require many data points to find the signal of interest, we are in the realm of the weak law of large numbers; which means the mean (or measurements) approaches the expectation (or calculation) of the underlying continuous theory.

However if we look at the individual measurement we might be able to identify tell tale signs of particles being more stochastic in Nature.

Another way to find evidence of this stochastic description of motion and of force is to change the notion of evidence away from the average value to the value of the variance. One example comes in the nuances of an attempt to make this theory conform to special relativity.

Sparing the reader more details, the gist can be found by looking at the quantum step size , δt. If we consider δt proportional to the inverse of the relativistic energy and not the rest mass [13], we have

$$\delta t_\gamma = \frac{\hbar}{2\gamma m_0 c^2}$$

Where

$$\frac{1}{\gamma} = \sqrt{1 - \left(\frac{v}{c}\right)^2}$$

Now looking at the variance of the displacement which contracts with relative velocity we have from the continuous solution

$$(\Delta x(t))^2 = \frac{2Dt}{\gamma^2} = 2Dt\left(1 - \left(\frac{v}{c}\right)^2\right)$$

From the stochastic solution when $\beta \neq \frac{1}{2}$ we have

$$(\Delta x(K))^2 = 4\beta(1-\beta)(\delta x^2 K + (\Delta v_K)^2(\delta t K)^2)$$
$$= 4\beta(1-\beta)2Dt$$

Plugging in our relationship $\bar{v} = c(2\beta - 1)$

$$(\Delta x(K))^2 = 2Dt\left(1 - \left(\frac{\bar{v}}{c}\right)^2\right)$$

At first one might claim success and equate $(\Delta x(K))^2$ with $(\Delta x(t))^2$. However at second glance there are two problems wrong with this. First we used, δt not δt_γ. Plugging in for δt_γ

$$(\Delta x(K))^2 = 2Dt\left(1 - \left(\frac{v}{c}\right)^2\right)\left(1 - \left(\frac{\bar{v}}{c}\right)^2\right)$$

We now have two factors, $\left(1 - \left(\frac{\bar{v}}{c}\right)^2\right)$ and $\left(1 - \left(\frac{v}{c}\right)^2\right)$. We know the later is related to the contraction of space due to special relativity. However the former has a different origin.

We can see this origin by looking at the second problem, which is that β is the probability the particle steps to the right. A sample of this process will have the particle step to the left or step to the right. This distinction is absolute and does not dependent on reference frame.

The conclusion is that a preferred reference frame exists and $\bar{v} = c(2\beta - 1)$ is the velocity of the particle in the preferred frame. One might find more background on what this preferred frame looks like from Lorenz's ether theory [11].

a) Experiment

I propose two classes of experiments. One class is to measure the variance of diffusion and look for the additional factor of $\left(1 - \left(\frac{\bar{v}}{c}\right)^2\right)$. The other class is to determine the direction of a particle's discrete step.

i. *Variance*

Two experiments within this class are to measure the variance of a particle 1) at rest in the laboratory frame, or 2) highly relativistic.

The first will require very high precision. A good guess for the preferred reference frame is that of the cosmic microwave background which moves at $0.001c$ relative to Earth. Thus $\left(1 - \left(\frac{\bar{v}}{c}\right)^2\right) \sim 0.999999$ and any experiment would need to be more accurate than this.

Another experiment (which is more complicated to conduct but with a bigger signal) is measuring the variance of displacement of a relativistic particle.

If the theory proposed here is true, a measurement of $(\Delta x(t))^2$ of a relativistic particle will be

$$(\Delta x(t))^2 = 2Dt\left(1 - \left(\frac{v}{c}\right)^2\right)\left(1 - \left(\frac{\bar{v}}{c}\right)^2\right)$$

At high v one has $\bar{v} \sim v$, or

$$(\Delta x(t))^2 \sim 2Dt\left(1 - \left(\frac{v}{c}\right)^2\right)^2$$

As v approaches c this will be a big difference between accepted theories. However Nature is not so easy to give away her secrets; there is also another source of variance from the Fourier diffusion [2], which grows proportional to the square of t.

ii. *Discrete step*

The other class of experiments is to determine if a particle steps to the left or steps to the right and with what probability.

One should start with two particles at rest a distance L apart. One (denoted the laboratory) will have a heavy mass and be on the left; the other (denoted the test particle) will have a mass much much lighter than the laboratory and be to the right. In this case, the laboratory will look like it has a more continuous trajectory and have smaller variance.

After the quantum step of the test particle, δt, the laboratory will drift in the perfered reference frame the amount $\bar{v}\delta t$. The test particle after one step will be displaced from the laboratory either a) $L + c\delta t - \bar{v}\delta t$ or b) $L - c\delta t - \bar{v}\delta t$.

The distinction between a) and b), should be observable at cold temperatures. Note that over many steps the displacement will be

$$\beta(L + c\delta t - \bar{v}\delta t) + (1-\beta)(L - c\delta t - \bar{v}\delta t)$$
$$= L + c(2\beta - 1)\delta t - \bar{v}\delta t = L$$

The trick will be to measure the individual step not the average. If K_x is the number of times out of K that the particle steps to the right, then the unbiased estimator of β_x isK_x/K.

V. Acknowledgements

JLH is grateful to his wife and two boys.

Appendix A

Poincaré stresses are also known as rubber bands that hold the electron together [10]. They might be just that.

If we look at the electrostatic energy of an elementary unit of charge, E_{es}

$$E_{es} = \frac{{q_e}^2}{2(4\pi\varepsilon_0)r_{es}}$$

And consider the relationship in section 2.4,

$$mc^2 = 4E_{es}/3 = 4E_{ps}$$

One can see that $r_{es} = 3r_e$. If $2\pi r_e$ is the length of a wave that fits the boundary conditions around a quantum of charge $q_e/3$, then three wavelengths places end to end would fit the boundary condition around an electron or elementary unit of charge.

I interpret this as saying that three quantum charges fit together to wrap themselves around the electron or elementary charge to hold it together. Perhaps all mass is electrical!

References Références Referencias

1. J. Haller Jr., "Measuring a Quantum System's Classical Information," Journal of Modern Physics, Vol. 5 No. 1, 2014, pp. 8-16. doi: 10.4236/jmp.2014.51002.
2. J. Haller Jr., "Dark Particles Answer Dark Energy," Journal of Modern Physics, Vol. 4 No. 7A1, 2013, p. 85-95 doi: 10.4236/jmp.2013.47A1010.
3. Chandrasekhar, *Reviews of Modern Physics*, Vol. 15, 1943., pp. 1-89.
4. Reif, *Fundamentals of Statistical and Thermal Physics*, McGraw Hill, Boston, MA 1965.
5. R Kubo, "The fluctuation-dissipation theorem," Rep. Prog. Phys. 1966, 29 255.
6. J. Haller Jr., "Entropy Rate of Thermal Diffusion," Journal of Modern Physics, Vol. 4 No. 10, 2013, p. 1393-1399. doi: 10.4236/jmp.2013.410167.
7. E. Nelson, "Derivation of the Schrödinger Equation from Newtonian Mechanics," Phys. Rev., 1966, Vol. 150 No. 4 pp. 1079.
8. P. A. M. Dirac, *The Principles of Quantum Mechanics, 4th Edition*, Oxford University Press, Oxford, 1958, p. 262.
9. Ronald N. Bracewell, *The Fourier Transform and Its Applications 2nd ed.,* McGraw-HillInc., New York, NY, 1986.
10. R. Feynman, *Lectures on Physics*, Addison-Wesley Publishing, Reading, 1965.
11. H.A. Lorentz, *The theory of electrons and tis application to the phenomena of light and radiant heat*, B.G. Teubner, &G.E. Stechert in Leipzig, New York, 1916.
12. T. Cover & J. Thomas, *Elements of Information Theory*, John Wiley & Sons Inc., New York, NY, 1991.
13. A. Einstein, *The Meaning of Relativity*, Princeton University Press, Princeton NJ, 1953.

This page is intentionally left blank

Global Journals Inc.

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 14 Issue 2 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Grab Sampling and Continuous Monitoring Techniques for Radon Measurements at Controlled Environmental Conditions

By Hassan S. F, Tawfik M. N., Shalaby M. H., Hussien M. I. & Ibrahim I. H

Nuclear materials authority, Egypt

Abstract- The continuous monitoring of radon concentrations is a useful method to study the effects of ventilation on radon concentration levels. The determination of average radon concentration is preferable than the active-type. For this purpose a model chamber, of cubic shape, made of plexy glass with a volume of 0.65 m^3, is constructed.

For this purpose, two devices RDA - 200 and TRI - MET 372 are used for active-type. Devices RGM I/I and CRM- 1027 are used for continuous monitoring. The experiments are carried out at two different environmental conditions, one by using high temperature (40°C) and relative humidity (100%), the other by using low temperature (16°C) and low relative humidity (50%).

Radon calibration chamber is a good tool in testing for radon measurements to different devices and techniques, a 65m^3 plexy glass chamber is constructed to compare different detecting devices with the change of environmental conditions (temperature – relative humidity – samples concentration) as well as the use of devices inside or outside the chamber. This chamber resemble to a great extend the mines atmosphere which help in using it as a pilot plant.

GJSFR-A Classification : FOR Code: 029999

GRAB SAMPLINGANDCONTINUOUSMONITORINGTECHNIQUESFORRADONMEASUREMENTSATCONTROLLEDENVIRONMENTALCONDITIONS

Grab Sampling and Continuous Monitoring Techniques for Radon Measurements at Controlled Environmental Conditions

Hassan S. F [α], Tawfik M. N. [σ], Shalaby M. H. [ρ], Hussien M. I. [Ѡ] & Ibrahim I. H. [¥]

Abstract- The continuous monitoring of radon concentrations is a useful method to study the effects of ventilation on radon concentration levels. The determination of average radon concentration is preferable than the active-type. For this purpose a model chamber, of cubic shape, made of plexy glass with a volume of 0.65 m^3, is constructed

For this purpose, two devices RDA - 200 and TRI - MET 372 are used for active-type. Devices RGM I/I and CRM-1027 are used for continuous monitoring. The experiments are carried out at two different environmental conditions, one by using high temperature (40ºC) and relative humidity (100%), the other by using low temperature (16ºC) and low relative humidity (50%).

Radon calibration chamber is a good tool in testing for radon measurements to different devices and techniques, a 65m^3 plexy glass chamber is constructed to compare different detecting devices with the change of environmental conditions (temperature – relative humidity – samples concentration) as well as the use of devices inside or outside the chamber. This chamber resemble to a great extend the mines atmosphere which help in using it as a pilot plant.

The obtained results show that: Lower stability of measurements with the change in environmental conditions, more stability for the RDA - 200 and Tri - met devices at high temperature and high humidity. From the other hand a more stability for both RGM and CRM devices clearly appeared at low temperature and low humidity conditions. This may be attributed to that the measurements depend mainly on an electronic circuit which have a higher performance at these environmental conditions.

I. Introduction

There are two main categorized measuring techniques, active *technique and passive technique.*

The Grab Sampling Techniques (Active-type): In this case, air is sampled by drawing it through a filter material, housed in an adequate filter holder by means of air sampling pump. Radioactivity counting is carried out after the sampling period.

i) In case of Rn-gas measurements. The examined air sample is collected by filling a container, either previously evacuated or by a flow-through type in the sampling area and releasing the container. The radon from the sample is then later (may be days later) transferred to a measuring chamber, which may be ionization chamber or scintillation cell Lucas, (1957).

An integrated count method has been described (Jonassen, N. and Clements, W. E., (1974)., where the counting of radon activity may start at any time after filling the cell with daughter-free air. The accuracy of the method is shown to depend on the counting period rather than upon the time elapsed since filling. Another active method for measuring radon concentration using a metal cylinder and two filters (two filter method). In this case air is drawn through a cylinder fitted with a filter on either end. The front filter will remove all daughters in the air sampled, and the second filter will collect those daughters' products being produced by decaying of radon in the air, while it passes through the cylinder. The alpha activity from the filter at the end of sampling is then a measure of the radon concentration in the sampled air. (Fontan et al, (1962), Jacobi, (1964), Thomas and Le Clare, (1970)).

The measurement of radon daughters is often used not only for the determination of individual daughter concentrations but also for measurement (or estimation) of the potential alpha energy concentration of these daughters (WL). All methods used for both types of measurements are based on the analysis of the activity from a filter (or detector) on which the daughters have been deposited. The daughter's activity from the filter may be counted during and/or after sampling. Evans, (1969). If the air is drown through a filter, and the gross alpha activity is counted after a waiting a certain period for one time this called one count method [Kusntez, (1956)] and Rolle [Rolle, (1972)] methods, which differ only in the choice of sampling, waiting and counting times.

To overcome the low accuracy in the one count methods a lengthy operating procedure uses two uncorrelated counts. The most common two-count method is the Hill Method [Hill, (1975)]. The total alpha activity is integrated over two counting periods of two minutes after the end of sampling with the integrated counts I_0 and I_1 respectively. Using a special relation including this ratio and detector efficiency, the (PAEC) can be calculated. Methods for three uncorrected counts during and /or after sampling is called three-count methods, there are two techniques for the three count methods:

Author α σ ρ : Nuclear materials authority, Cairo, Egypt.
e-mail: sayed_fahmy@yahoo.com
Author Ѡ : National centre for nuclear safety, atomic energy authority.
Author ¥ : Ain shams university, faculty of science., physics department.

Global Journal of Science Frontier Research (A) Volume XIV Issue II Version I Year 2014

a) Alpha gross count method, where the sum of RaA and RaĆ activities is measured. The most commonly used α-gross count method was developed by Tsivoglou [Tsivoglou, et al, (1953)] in which the activity from a filter is measured at three intervals after sampling. The amount of air sampled is about 50 liters. Because count rates are used instead of integrated counts, even at high concentrations (tens of thousands Bq/m^3), the reproducibility may only be good within 20-30 percent. By integrating the alpha activity over time intervals instead of measuring the rate at three times, it is possible to reduce the uncertainty of the Tsivoglou method considerably as proposed by Thomas [Thomas, (1972)].

The uncertainty is usually high for RaA, especially if the atmosphere is near radioactive equilibrium. From three different gross-alpha count rates it is possible to calculate the concentrations of RaA (Po-218), RaB (Pb-214) and RaC (Bi-214), by solving a system of three Bateman linear differential equations with three unknowns [Evans, (1969)].

b) Alpha spectroscopy methods, where RaA and RaC activities are measured individually. In these methods, the alpha particles from radon daughters can be counted separately and the daughter concentration can be obtained by distinguishing between the 6-MeV and 7.69 MeV alpha particles energy groups. A method employing only alpha radiation has been developed by Martz et al [Martz et al, (1969)].

In case of Continuous Monitoring Techniques: air samples are taken on a continuous basis lasting typically from several days to several weeks. Counting of radioactivity is conducted by the same instrument and concurrently with air sampling. Hence, the radioactivity count, or activity is being "integrated" by the instrument. Also, the continuous monitoring of radon concentrations is the most useful method for studying the effects of ventilation on radon concentration levels and determination of average radon concentration.

In continuous monitoring of radon daughters, the air is sampled continuously and the alpha and/or beta activities are integrated over intervals ranging from minutes to hours. [Dalu, G. A. and Dalu, G., (1971), Thomas, (1977), McVey et al, (1977) and Wrenn et al, (1975)].

In radon daughter measurement systems, the daughters are collected on a filter, which is placed in front of a detector. A common calibration procedure uses an essentially mono-energetic alpha emitter, americium-241, uniformly deposited on a metal disc as pseudo radon daughter calibration source. An absolute method for calibration of radon daughter system has been developed by Falk [Falk, (1982)]. Beckman [Beckman, (1975)] described calibration of air sampling equipment and counting equipment including field checks, calibration equipment and data treatment. For radon daughter calibration, Thomas (Modified Tsivoglou) and alpha spectrometric methods have been suggested as the most suitable primary counting methods [Lawrence Berkeley Laboratory, (1981)].

II. Experimental Techniques

a) Calibration chamber and samples

The chamber is made of (0.5 cm thick) plexy glass sheets. It is of cubic shape with volume of 0.65 m^3. On top, a removable ceiling contains four wholes of (1 cm in diameter) each. Two wholes are used for the intake of samples from the chamber, the other two are used for the electricity cables needed for the devices inside the chamber. It has also the possibility for use active techniques for radon and its daughter's detection (Tawfik, M. N 2011).

Figure 1 : Radon calibration chamber

Five different samples were selected from Gattar Mountain (Hurghada, Red Sea, Egypt). The uranium content of these samples was experimentally measured in the NMA. Laboratories (Salem, 2008). The chosen samples are nearly equal weight, size, and physical state (solid rocks) with no fractures or any crushing to smaller grains. The samples are labelled from one to five according to their uranium ppm measurements as follows: Sample 1 (35 ppm), sample 2 (200 ppm), sample 3 (330 ppm), sample 4 (470 ppm), sample 5 (850 ppm).

b) Devices and methods

A total of four devices are used, two of them (RDA - 200 and TRI - MET 372 for the grab sampling (active) techniques

i. *RDA – 200:* It is designed to measure alpha activity originated from radon and its daughters. The alpha particles register on the ZnS (Ag) phosphor coating of the scintillator cell or tray in the form of light flashes. Each flash of light, as seen by the high gain photomultiplier tube, is transformed into an electrical impulse. These impulses are accumulated, counted and then digitally displayed on a five digit, seven segments L.E.D. digital display, after a preset counting time has been completed. The device weight is about 3 kg. (EDA Instruments INC).
ii. *TRI-MET 372:* It is designed as an alpha counter, equipped with a foil type open Zinc Sulphide detector. The instrument is manufactured by (Tri-Met Instruments LTD). This type of detector is inexpensive, readily obtainable and is easily replaced. The sample holders can accommodate membrane filter samples of 25 mm, 37 mm. and 47 mm diameter. The device weight is about 2.5 kg, the Tri-Met was used for measuring (WL) by Roll – method. (Tri-Met instruments LTD).

The second category is for continuous radon gas monitoring

i. Portable Radioactive Gas Monitor type RGM I/I is a self-contained instrument for measuring the concentration of radioactive gases in air, it is calibrated for Tritiated Water Vapour (HTO) in air, for direct radon gas determination; a single portable, battery operated device is used to monitor radon gas. The device is of weight (14.5Kg). (Nuclear Enterprises Ltd) .
ii. Professional continuous radon monitor model 1027 is a patented electronic detecting device using a diffused-Junction photodiode sensor to measure the concentration of radon gas. The unit is operated from standard line power and includes a 9-volt battery which provides backup power. For continuous radon monitoring; a single fixed, electricity operated device is used for monitoring of radon gas. It has an internal detector for measuring radon gas and it is equipped with a digital screen for displaying of results. It has a weight of (1 Kg). (Sun Nuclear Corporation).

c) Measuring procedures

The experiment is done according to the variable factors, the plan can be divided into two parts: one using high temperature (40°C) and relative humidity (100%) conditions and the other by using low temperature (16°C) and low relative humidity (50%).

Each sample is put separately inside the radon chamber and the measurements started from zero time till 168 hours (one week), the measurements are taken for all devices at the same time every four hours resulting in 42 measurements for each device. The temperature is adjusted to reach 40 °C and a by using a water bath as water source to ensure a relative humidity level of 100 % (Tawfik, M. N 2011).

The procedures are done as follows:

i. For the total potential alpha energy concentration expressed as working level PAEC. Rolle method is used, using a portable air sampler to withdraw up to 5 l/min of air through a filter paper.

Radon daughters are collected on a high-efficiency filter paper for 10 minutes and then alpha-counted with either a rate meter or scalar after a prescribed delay of about 5 to 10 minutes. (Rolle, 1968).

The working level is calculated by the following formula (Safety Series No. 43, (1979)]:

$$WL = \frac{R - B}{EvtF} \qquad (1)$$

Where:
R = Count rate at T minutes from the end of sampling (in counts/min)
B = Count rate due to background measurement
E = Counting efficiency, decimal fraction
v = Volumetric sampling rate in L/min
t = Sampling time in minutes
F = Conversion factor =212 for sampling periods of from 1 to 20 min

ii. For direct radon gas measurement using RGM I/I: The technique starts by withdrawing a sample of air by the air pump followed by a direct measurement by the ionization chamber detector to obtain the result of the measurements in a few seconds from sampling. **(Grossi, 2001).**
iii. For continuous radon monitoring: A sensitive semiconductor detector is exposed to radon to start the measuring processes, by this way the radon can be continuously monitored. These values are stored using a small internal memory for future revision.

III. The Annual Dose Conversion Factors were Done as Follows

1) For the data information from (RDA - 200 and TRI-MET 372) instruments .The total working hours per one year will be two thousand (2000) hours per year. The **ICRP-31 (1980)** (International Commission for Radiation Protection) submits a conversion factor (CF)) for the calculation of annual dose from the WLM to be five times greater, so according to the previous information the final formula can be written as:

$$\text{Annual dose (mSv/y)} = \frac{(WL)X(2000h)X(5CF)}{(170h)} \tag{2}$$

2) The calculation of annual dose using the data information from the RGM 1/1 (Radioactive Gas Monitor) which gives the data in μCi/m^3.

$$\text{Annual dose (mSv/y)} = \frac{(\mu Ci/m^3)X(1000UC)X(0.2331CF)}{(1000DUC)} \tag{3}$$

3) The calculation of annual dose using the data information from the CRM -1027 (Continuous Radon Monitoring) which gives the data in pCi/l.

$$\text{Annual dose (mSv/y)} = (pCi/l)X(0.2331CF) \tag{4}$$

Where :

UC: is the unit conversion from μCi/m^3 to pCi/l.

DUC: is the device conversion factor from Tritiated Water Vapour (HTO) in air to μCi/m^3.

IV. Results and Discussion

a) Active techniques (grab sampling) one count method

i. *At High Temperature and Humidity*

For the Tri-Met 372, figure (1) shows the experimental results of the calculated annual doses using equation (2) with the five samples, a low annual doses (mSv/y) are reported for low sample concentrations and minimum time period (4-20 h) while high values for annual doses (mSv/y) are reported for maximum sample concentrations and maximum time periods (140-164 h)

At low samples concentrations a smoothly increasing in the calculated values are observed which may indicate that the instrument was able to discriminate between small concentrations at the harsh environmental conditions. At a high samples concentrations a high ability for the discrimination between high and low concentrations epically at the harsh environmental conditions was observed

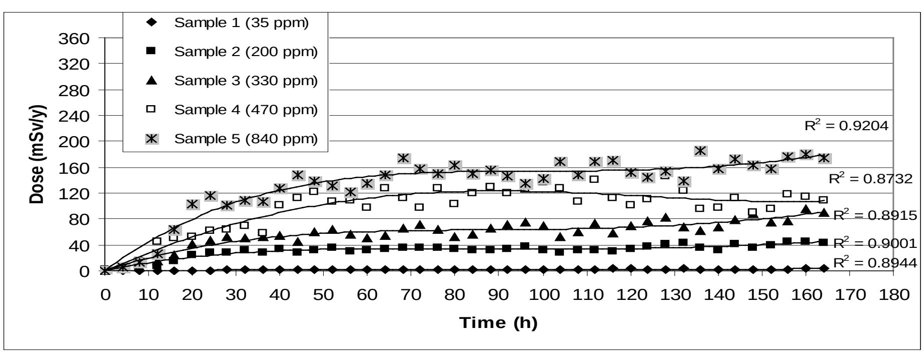


Figure 1 : Calculated annual dose (mSv/y) using the measurements of Tri-met device for all samples at high relative humidity and temperature versus time (h).

For RDA 200, figure (2) shows experimental results of the calculated annual doses using equation (2) with the five samples the time interval.

It is obvious, low annual doses (mSv/y) were reported for low sample concentrations and minimum time period (4 – 20 h) While high values for annual doses (mSv/y) was reported for maximum sample concentrations maximum time periods (140 – 163 h).

At low samples concentrations a smooth variation are observed which may indicate that the instrument is able to discriminate between small concentrations at the harsh environmental conditions. Also it is shown that at high samples concentrations a complete separation between the measured values, which means that the instrument has the ability to discriminate between high and low concentrations at harsh environmental conditions that may gives it advantages for using in such cases.

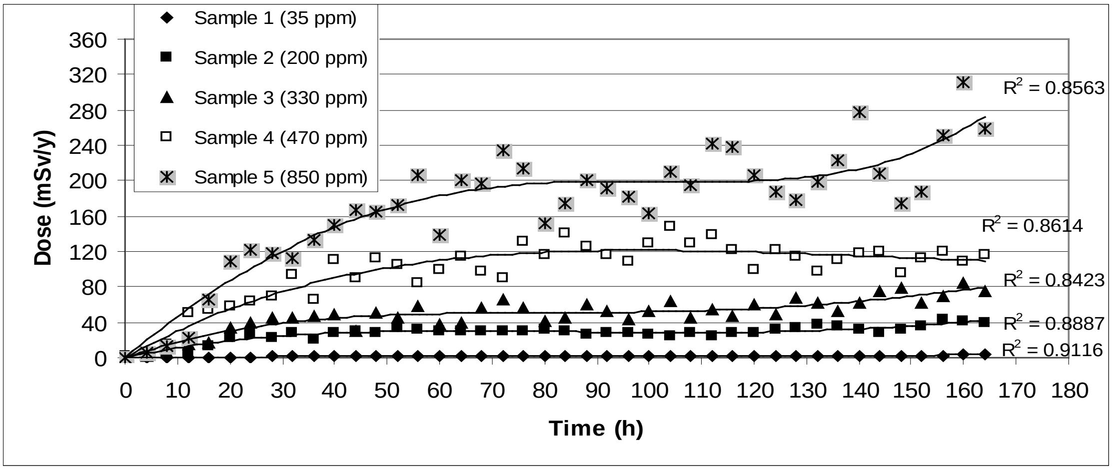


Figure 2 : Calculated annual dose (mSv/y) using the measurements of RDA 200 device for all samples at high relative humidity and temperature versus time (h).

ii. *At Low Temperature and Humidity*

For the Tri-Met 372, figure (3) shows that low annual doses (mSv/y) are reported for low sample concentrations and minimum time period (4 – 20 h), while high values for annual doses (mSv/y) are reported for maximum sample concentrations maximum period (140 – 164 h).

From the table also we can get that, an increase in the calculated annual doses with time when using different samples from sample (1) to sample (5). A nearly closed data appears for sample (2) and sample (3) also a slight overlap appears for sample (4) and sample (5).

There is some coincidence in some measured values in case of high and low samples concentrations where there is a complete difference between the two groups, which means that the instrument does not have the ability to discriminate between high and low samples concentrations at normal environmental conditions.

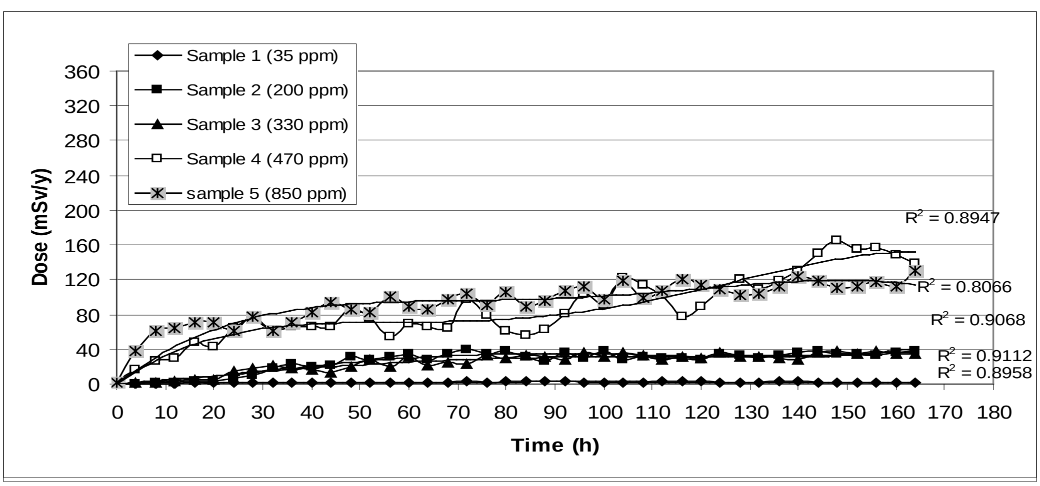


Figure 3 : Calculated annual dose (mSv/y) using the measurements of Trimet device for all samples at low relative humidity and temperature versus time (h).

For RDA 200, figure (4) shows that low annual doses (mSv/y) are reported for low sample concentrations and minimum time period (4 – 20 h). While high values for annual doses (mSv/y) was reported for maximum sample concentrations maximum period (140 – 164 h)

An increase in the calculated annual doses with time when using different samples, from sample (1) to sample (5). A slight overlap appears for sample (4) and sample (5).

At low samples concentrations a normally increases in the calculated annual dose with time.

There is an overlap in some measured values in case of high and low samples concentrations where there is a complete separation between the two groups, which means that the instrument does not have the ability to discriminate between high and low samples concentrations at normal environmental conditions.

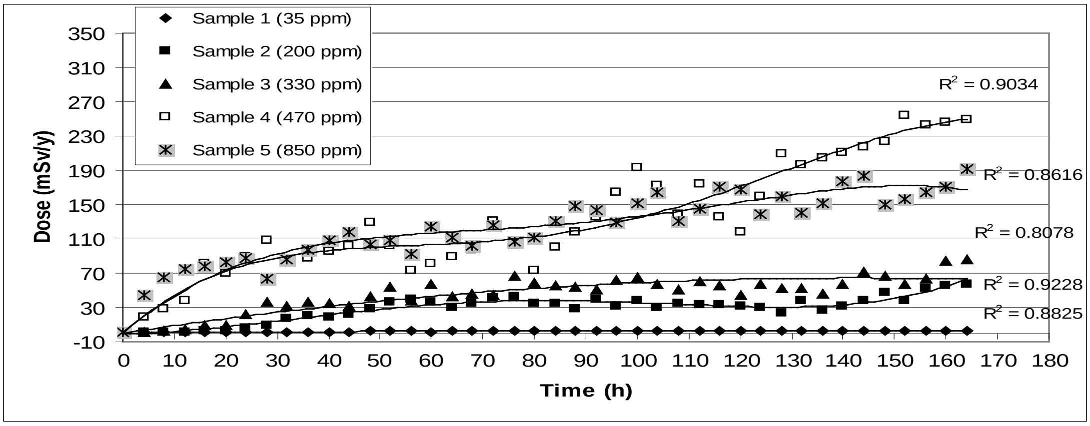


Figure 4 : Calculated annual dose (mSv/y) using the measurements of RDA 200 device for all samples at low relative humidity and temperature versus time (h).

b) Continuous radon monitoring

i. *At High Temperature and Humidity*

For the RGM 1/1, figure (5) shows experimental results of the calculated annual doses using equation (3) with the five samples

It is obvious that there is a gradually increase in the annual doses measured in (mSv/y) goes from low sample concentrations and minimum time period (4 – 20 h) to maximum sample concentrations maximum period (140 – 164 h).

At low samples concentrations a highly nearly closed values are observed while in the measured annual dose values for the most high two samples concentrations, there is a completely difference between them especially at high one (850ppm), which indicate a low performance for this instrument as it could not discriminate between high and low sample concentrations at harsh environmental conditions that may gives it disadvantages for using in such cases.

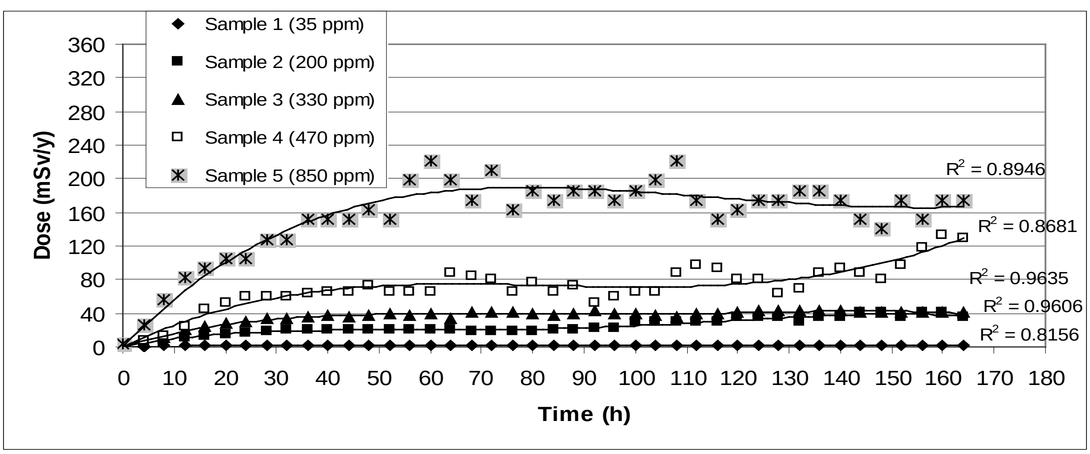


Figure 5 : Calculated annual dose (mSv/y) using the measurements of RGM device for all samples at high relative humidity and temperature versus time (h).

For the CRM- 1027, figure (6) shows experimental results of the calculated annual doses using equation (4) with the five samples

It is obvious that there is a gradually increase in the annual doses measured in (mSv/y) goes from low sample concentrations and minimum time period (4 – 20 h) to maximum sample concentrations maximum period (140 – 164 h).

From the data we can get that: At low samples concentrations a highly closed values with small resolution and discrimination at these low concentration values. While for the high samples concentrations there is a close separation with small over lapping at small time intervals, which indicate a slightly confusion in the performance of the instrument at high and low concentrations at harsh environmental conditions.

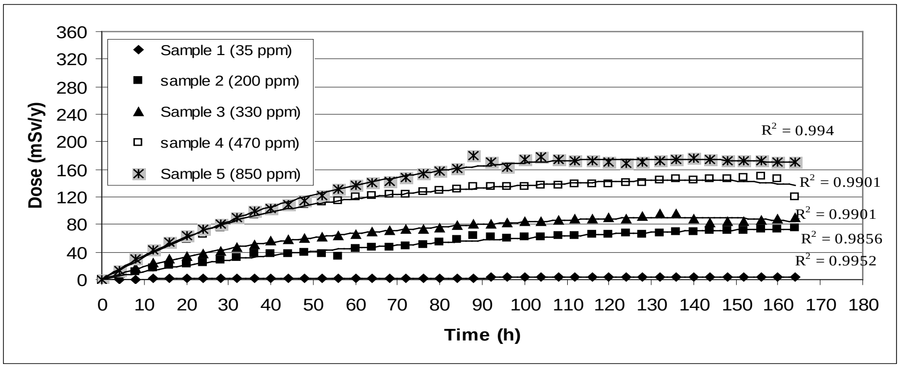


Figure 6 : Calculated annual dose (mSv/y) using the measurements of CRM device for all samples at high relative humidity and temperature versus time (h).

ii. *At Low Temperature and Humidity*

For the RGM 1/1, figure (7) shows experimental results of the calculated annual doses using equation (3) with the five samples. A gradually increase in the annual doses measured in (mSv/y) goes from low sample concentrations and minimum time period (4 – 20 h) to maximum sample concentrations maximum period (140 – 164 h)

At low samples concentrations, highly smoothed closed values are observed with minimum values.

A complete separation between the measured values for the annual dose of low and high samples concentrations and at low and high values for temperature and humidity, which indicate a high performance for this instrument at high and low samples concentrations and at normal environmental conditions that may gives it advantages for using in such cases.

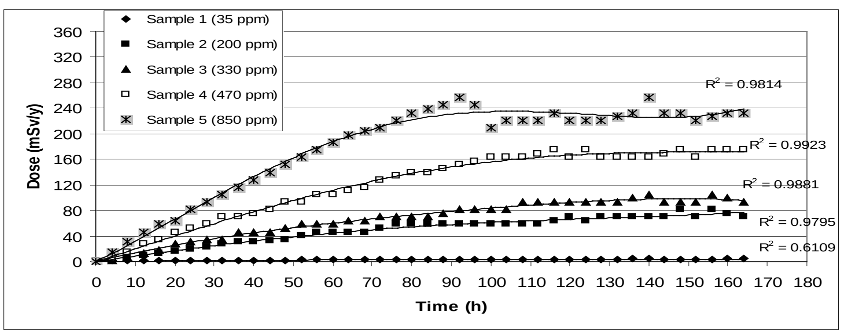


Figure 7 : Calculated annual dose (mSv/y) using the measurements of RGM device for all samples at low relative humidity and temperature versus time (h).

For the CRM- 1027, figure (8): At low and high samples concentrations, highly smoothed closed values with high resolution and discrimination at these concentrations values. This indicates high performance for this device at normal environmental conditions, giving it advantage for use in such cases. However at very high sample concentration it goes out of device range after 80 hours.

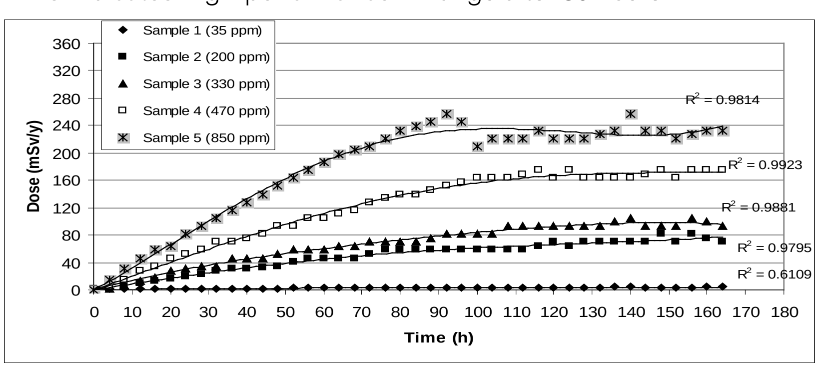


Figure 8 : Calculated annual dose (mSv/y) using the measurements of CRM device for all samples at low relative humidity and temperature versus time (h).

V. Conclusions

The comparison of used devices showed a higher time is required to complete the surveillance process (from the beginning till the end of measurements) is 13 min. for both Tri-met and RDA 200 devices while it needs from 1 to 3 min. for RGM device, the CRM device takes about 1 to 2 sec. for the measurement but it needs to run at least 1 h for before each measurement. That is based on the principals of the measuring devices and the theory of operation of used instruments.

Higher cost estimation to complete the surveillance process (from the beginning till the end of measurements) is 4.75 L.E. for the use of RDA - 200 device for both the cost of filter paper and required batteries, 4 L.E. for the use of Tri-Met device for both the cost of filter paper and required batteries, 1 L.E. for the use of CRM device for the cost of the required batteries while no cost is required for the use of RGM device.

Lower stability of measurements with the change in environmental conditions showed a more stability for the RDA - 200 and Tri - met devices at high temperature and high humidity due to the limited effect of high temperature and relative humidity on the sampling and counting instruments. From the other hand a more stability for both RGM and CRM devices clearly appeared at low temperature and low humidity conditions this may be attributed to that they depend mainly on an electronic circuits which have a higher performance at these environmental conditions.

No human mistakes are found when using CRM device but a small human mistakes can be found when using RGM device in the misreading of its analogue scale, while there are many expected human mistakes when using RDA - 200 and Tri - met device due to the use of stop watch for sampling time, the handling of the filter paper when removing from the sampling pump and applying to the RDA - 200 or Tri - Met devices.

Small maintenance operations can be done easily and in short time for both RDA - 200 and Tri - Met devices while it is difficult to do maintenance for both RGM and CRM device which requires a specialist to do them.

Large number of steps needed for the use of RDA - 200 and Tri - Met devices which are 7 steps. While RGM device needs 3 steps and CRM device requires only 1 step to complete the whole process from the beginning till the end of measurements.

Higher weight of RGM device is the larger one of 14.5 Kg followed by the use of RDA 200 device and its accessories of 3 Kg. the weight of Tri - met device and its accessories is 2.5 Kg, while a weight of only 1 Kg is for CRM device.

Table (1) shows the comparison between different used devices according to the comparison matrix (time, cost, efficiency and ease of use).

Table 1 : the inter-comparison between the used instruments

		Grab Sampling Technique		Continuous monitoring	
		Tri-met	RDA 200	RGM	CRM
Time		Medium	Medium	Low	High
Cost		High	High*	Low	Medium
Efficiency		Medium*	Medium*	Medium	Medium
Ease of use	No. of steps	High	High	Medium	Low
	Weight	Medium	Medium*	High	Low
	Training ease	High	High	Medium	Low

**is noted for the slight increase.*

This study recommends the application of RDA 200 and Tri- Met devices at mines and mills according to their high performance and limited requirements to work at these places.

The application of CRM and RGM devices at laboratories according to their high performance and limited requirements to work at these places.

It is very important to construct a complete comparison when choosing the set of devices and techniques for the use during the surveillance process.

Good preparation for surveillance and monitoring radiation programs including the best use of techniques and devices will achieve the goal of radiation protection which will help in decreasing the life-shortening percentage from(10%-15%) to less than that.

References Références Referencias

1. Dalu, G. A. and Dalu, G., Automatic counter for direct measurement of Radon concentration, J. Aerosol Sci 2 247 (1971).
2. EDA Instruments INC., Toronto, Canada M4H1H1.
3. Evans, R. D., "Engineer's Guide to the Elementary Behaviour of Radon Daughters". Health Phys., 17, 229-252 (1969).
4. Falk J., "Kalibrering av radondottermature". National Institute of Radiation Protection Rep., No. a 82 –19 (1982).

5. Fontan, J., Blanc, D. and Bouville, A., “Emploi d'un System de Coincidences dans le Dosage Selectif du Radon et du Thoron Atmosphériques”. Le Journ. de Phys., et le Radium Iome 23, 333 (1962).
6. Grossi C., “Inter-comparison of different direct and indirect methods to determine radon flux from soil”. Radiation Measurements 46, 112-118 (2001).
7. Hill A., “Rapid Measurement of Radon Decay Products, Unattached Fractions and Working Level Values of Mine Atmospheres”. Health Phys., 28, 472 – 474 (1975).
8. ICRP Publication 31, Report of the ICRP Task Group on Biological Effects of inhaled Radionuclides, Annals of the ICPR, 4(1/2), Pergamon Press. Oxford. (1980).
9. Jacobi, W., “A Double-filter Device to Measure Radon and Thoron in the Breath”. Assessm. of Radioact. in Man. I, IAEA, Vienna, Austria (1964).
10. Jonassen, N. and Clements, W. E., “Determination of 222Rn Concentrations by Integrated Count Method”. Health Phys., 27, 347 (1974).
11. Kusnetz, H. L., Radon daughters in mine atmospheres – A filed method for determining concentrations, Am. Ind. Hyg. Assoc. J. 17 85 (1956).
12. Lawrence Berkeley Laboratory, “Proceedings of The Meeting of An AD Hoc Committee on Interlaboratory Calibration of Radon and Radon Daughters Instrumentation”. Lawrence Berkeley Laboratory, Report, Berkeley, Calif., USA (1981).
13. Lucas, H. F., “Improved Low-level Alpha-scintillation Counter for Radon”. Rev. Sci. Inst., 28, 680 – 683 (1957).
14. Martz, D. E., Holleman, D. F. McCurdy, D. E. and Schiager, K. J. “Analysis of Atmospheric Concentrations of RaA, RaB and RaC by Alpha Spectroscopy”. Health Phys., 17, 131 – 138 (1969).
15. McVey, J. R., Franklin, J. C. and Show, D. M., Min. Cong. J., 63, 49 (1977).
16. Nuclear Enterprises Ltd., Edinburgh-Beenham, England.
17. Rolle, R., “Improved radon daughter monitoring procedure”, Am. Ind. Hyg. Assoc. J. 30 2 153 (1968).
18. Rolle. R., “Rapid Working Level Monitoring”. Health Phys., 22, 233-238 (1972).
19. Safety Series No. 43, The International Atomic Energy Agency and The International Labour Organization. “Manual on Radiological Safety in Uranium and Thorium Mines and Mills”. Vienna (1979).
20. Salem M.M.A., “Radio Element Distribution in Some Underground Mining Works in Gabal Qattar Area and their Impact on Environmental Conditions, Eastern Desert, Egypt” PhD Thesis, Faculty of Science, Banha University, Egypt (2008).
21. Sun Nuclear Corporation, Florida, USA.
22. Tawfik, M. N , " Radon Evaluation Studies Using Various Monitoring Devices ,Pilot Plant Case Study " M.Sc Thesis ,Faculty of Science , Ain Shams University ,Egypt (2011).
23. Thomas, J. W. and Le Clare, P. C., “A study of the 2-Filter Method for 222Rn”. Health Phys., 18, 113 (1970).
24. Thomas, J. W., “An Environmental Radon and Thoron Monitor”. HASL – 325 (NTIS) (1977).
25. Thomas, J.W., “Measurement of radon daughters in air”, Health Phys. 23 783 (1972). Tri-Met Instruments LTD., Winnipeg, Canada.
26. Tsivoglou, E. C., Ayer, H. E. and Holady, D. A., “Occurrence of Non-equilibrium Atmospheric Mixtures of Radon and Its Daughters”. Nucleonics., 11, 40 – 46 (1953).
27. Wrenn, M. W., Spitz, H. and Cohen, N. “Design of A Continuous Digital-output Environmental Radon Monitor”. IEEE Trans. Nucl. Sci., NS – 22, 645 (1975).

This page is intentionally left blank

Global Journal of Science Frontier Research: A
Physics and Space Science
Volume 14 Issue 2 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Rotating and Expanding Universe in the Light of Flyby Anomaly and Path Distribution

By Janez Špringer

The Flyby Anomaly- The flyby anomaly is an unexpected energy change during Earth flybys of spacecraft which causes a significant speed change of over 0,013 m/s [1].The difference of speed Δv is given by Anderson's empirical prediction formula [1]:

GJSFR-A Classification : *FOR Code: 020199*

ROTATINGANDEXPANDINGUNIVERSEINTHELIGHTOFFLYBYANOMALYANDPATHDISTRIBUTION

Strictly as per the compliance and regulations of :

Rotating and Expanding Universe in the Light of Flyby Anomaly and Path Distribution

Janez Špringer

In this paper one tries to explain the rotation and expansion of the Universe in the light of Anderson's flyby-anomaly prediction formula. The result of the effort is a prediction that the Universe rotates with the equatorial speed of half the speed of light and we land at the Pole of that Universe with the speed of expansion of the Universe which is apparently zero since in such circumstances the inbound speed equals the maximal decrement of speed. The maximal speed of expansion of the future Universe $100\frac{\mathrm{km}}{\mathrm{s}} < \mathrm{v}_{\mathrm{maximal}}^{\mathrm{future\ \ Universe}} < 123\frac{\mathrm{km}}{\mathrm{s}}$ is predicted on the basis of a comparison of the flyby and path distribution energy.

I. The Flyby Anomaly

The flyby anomaly is an unexpected energy change during Earth flybys of spacecraft which causes a significant speed change of over 0,013 m/s [1].The difference of speed Δv is given by Anderson's empirical prediction formula [1]:

$$\Delta \mathrm{v} = \frac{2v_{ekuatorial}}{c} v_{inbound}\,(\cos\delta_{inbound} - \cos\delta_{outbound}). \tag{1}$$

Here $v_{ekuatorial}$ is the equatorial speed of Earth, and $\delta_{inbound}$ and $\delta_{outbound}$ are the equatorial angles of the spacecraft. The maximal difference of speed Δv_{max} is given by the simplified Anderson's formula in the case where the inbound and outbound equatorial angles are 0 and $\frac{\pi}{2}$, respectively:

$$\Delta v_{max} = \frac{2v_{ekuatorial}}{c} v_{inbound}. \tag{2}$$

Since the maximal inbound speed is the escape speed the maximal difference of Earth-flyby speed yields:

$$\Delta v_{max}^{Earth} = 0.035\frac{m}{s} \tag{3}$$

If the mentioned anomaly has a physical background then it is reasonable to expect to take place in the gravity field of a rotating massive body in general. Neglecting the insignificant relativistic effects the maximal difference of kinetic energy of the mass body with mass m in any gravity field can be written as:

$$\Delta W_{kinetic} = m\frac{(v_{inbound})^2}{2} - m\frac{(v_{inbound} - \Delta v_{max})^2}{2}. \tag{4}$$

Due to conservation law the negative kinetic energy increment of mass body should equal the same positive energy increment of that body, let us denote it E_{flyby} so that the whole energy of mass body remains unchanged:

$$-\Delta \mathrm{W}_{\mathrm{kinetic}} + \mathrm{E}_{\mathrm{flyby}} = 0. \tag{5}$$

Then taking into account the equations (2), and (5) we have:

$$\frac{E_{flyby}}{m} = v_{inbound}\,.\Delta v_{max} - \frac{\Delta v_{max}{}^2}{2} \tag{6a}$$

$$\frac{\mathrm{E}_{\mathrm{flyby}}}{\mathrm{mc}^2} = \frac{2\mathrm{v}_{\mathrm{inbound}}^2}{\mathrm{c}^2}\left(\frac{\mathrm{v}_{\mathrm{equatorial}}}{\mathrm{c}} - \frac{\mathrm{v}_{\mathrm{equatorial}}^2}{\mathrm{c}^2}\right). \tag{6b}$$

The expression on the $\frac{E_{flyby}}{mc^2}$ is the flyby energy share resulting from the negative kinetic energy increment after the perpendicular change of the direction of motion of the mass body m in the gravity field at the $\frac{\pi}{2}-$ latitude of the rotating massive body. It can be written in the more transparent form using the ratio of speeds $\mathrm{a} = \mathrm{v}/\mathrm{c}$

$$\frac{\mathrm{E}_{\mathrm{flyby}}}{\mathrm{mc}^2} = 2\mathrm{a}_{\mathrm{inbound}}^2\,(\mathrm{a}_{\mathrm{equatorial}} - \mathrm{a}_{\mathrm{equatorial}}^2). \tag{6c}$$

It is evident from the equations (6*b*), and (6*c*) that the flyby energy share is zero at the zero equatorial speed as well as that one of the speed of light. Both of them are the equatorial speeds enabling the minimal flyby energy share where no flyby anomaly is expected. On the other hand the optimal equatorial speed and flyby anomaly exists at the given inbound speed where the energy share of the flyby energy occupies the maximal value. The latter is found with the help of the derivation of the function (6c):

$$\left(\frac{\mathrm{E}_{\mathrm{flyby}}}{\mathrm{mc}^2}\right)' = 2\mathrm{a}_{\mathrm{inbound}}^2\,(1 - 2\mathrm{a}_{\mathrm{equatorial}}).$$

Author: Janez Špringer Cankarjeva cesta 2, 9250 Gornja Radgona, Slovenija, EU. e-mail: info@lekarna-springer.si

$$2a_{inbound}^2\left(1-2a_{equatorial}^{optimal}\right)=0$$

$$a_{equatorial}^{optimal}=\frac{1}{2} \text{ or } v_{equatorial}^{optimal}=\frac{1}{2}c. \quad (7)$$

The optimal equatorial speed for all inbound speeds equals half of the speed of light. The maximal flyby energy share belonging to this speed is given by the equation (6c):

$$\left(\frac{E_{flyby}}{mc^2}\right)_{maximal}=\frac{1}{2}a_{inbound}^2. \quad (8)$$

The maximal flyby energy share is only of the inbound speed dependent and equals half of the square of the inbound speed expressed in the units of the speed of light. Possessing the maximal flyby energy share the mass body apparently stops moving according to the equations (2) and (7) since the maximal difference of flyby speed Δv_{max} equals the inbound speed $v_{inbound}$:

$$\Delta v_{max}=\frac{2v_{ekuatorial}}{c}v_{inbound}=\frac{2}{c}\frac{c}{2}v_{inbound}=v_{inbound}. \quad (9)$$

The mass body slows down the speed so much that it stays at apparent zero speed.

$$v_{apparent}=-\Delta v_{max}+v_{inbound}=0. \quad (10)$$

At maximal flyby energy share of the mass body where the massive body rotates with the equatorial speed $\frac{c}{2}$ the whole kinetic energy is transformed into the flyby energy. Its value is given using the equation (6*b*):

$$E_{flyby}^{max}=E_{flyby}\left(v_{equatorial}=\frac{c}{2}\right)=\frac{m.v_{inbound}^2}{2}. \quad (11)$$

At the first sub-maximal flyby energy share of the mass body where the massive body rotates with the equatorial speed lower than $\frac{c}{2}$ only a part of kinetic energy is transformed into the flyby energy:

$$E_{flyby}\left(v_{equatorial}<\frac{c}{2}\right)<\frac{m.v_{inbound}^2}{2}. \quad (12)$$

The mass body slows down the speed but keeps the same apparent direction as the inbound speed:

$$v_{apparent}=-\Delta v_{max}+v_{inbound}>0. \quad (13)$$

At the second sub-maximal flyby energy share the mass body where the massive body rotates with the the equatorial speed higher than $\frac{c}{2}$ again only a part of the kinetic energy is transformed into the flyby energy:

$$E_{flyby}\left(v_{equatorial}>\frac{c}{2}\right)<\frac{m.v_{inbound}^2}{2}. \quad (14)$$

The mass body slows down the speed so much that it takes the opposite apparent direction than the inbound speed:

$$v_{apparent}=-\Delta v_{max}+v_{inbound}<0. \quad (15)$$

At the equatorial speed of light the apparent speed has also the opposite value than the inbound speed:

$$v_{apparent}=-2v_{inbound}+v_{inbound}=-v_{inbound}. \quad (16)$$

II. The Rotating and Expanding Universe

The Universe expands with the apparent zero speed:

$$v_{apparent}=-v_{expansion}+v_{expansion}=0. \quad (17)$$

The equation (17) resembles to the equation (10), so we can propose that the maximal flyby decrement of speed $-\Delta v_{max}$ and the inbound speed $+v_{inbound}$ equal the speed of the expansion of Universe in the negative direction $-v_{expansion}$ and positive direction $+v_{expansion}$, respectively. If the flyby concept holds true for the whole Universe, one can consider we are making right now the pure flyby at apparent zero speed in the circumstances of our maximal flyby energy share. In such case we are landing at the Pole of the Universe which rotates with the equatorial speed of half of the speed of light $\frac{1}{2}c$. The inbound and outbound equatorial angles are 0 and $\frac{\pi}{2}$, respectively, and the inbound speed is the speed of the expansion of Universe [2]:

$$v_{inbound}^{Universe}=v_{expansion}^{Universe}\approx 70\ \frac{km}{s}. \quad (18)$$

With the help of the equation (8) the maximal present Universe-flyby energy share is given:

$$\left(\frac{E_{flyby}}{mc^2}\right)_{maximal}^{present\ Universe}\approx 3\times 10^{-8}. \quad (19)$$

It increases with time since the expansion of Universe is speeding up. [3],[4] The maximal possible future Universe-flyby energy share could be limited with the path distribution energy share of the electron in the ground state of Hydrogen atom [5][6] ,of course, if the latter appears as a true physical phenomenon since with the greater energy share no path distribution would be possible:

$$\left(\frac{E_{flyby}}{mc^2}\right)_{maximal}^{future\ Universe} < \frac{E_{distribution}^{2-sided}}{mc^2} \approx 5.6\ x\ 10^{-8} \leq \frac{E_{distribution}^{\infty-sided}}{mc^2} \approx 8.4\ x\ 10^{-8}. \quad (20)$$

Then with the help of the equation (8) and regarding the sidedness of the path distribution of the electron in the ground state of Hydrogen atom the maximal speed of the expansion of the future Universe is predicted:

$$100\frac{\text{km}}{\text{s}} < v_{\text{maximal}}^{\text{future Universe}} < 123\frac{\text{km}}{\text{s}}. \quad (21)$$

III. Conclusions

We analyzed Anderson's flyby-anomaly prediction formula in the case where the inbound and outbound equatorial angles are 0 and $\frac{\pi}{2}$, respectively. Extending the validity of the discussed concept to the flybys in the gravity field of a rotating massive body in general, including that one of the whole Universe, the flyby inbound speed and the speed of expansion of the Universe were related in the circumstances of the maximal flyby-energy share increment and the latter compared with the path distribution energy share of the electron in the ground state of Hydrogen atom.

The next the critical reader needs to consider:"The speculation of the maximal speed of the future Universe-expansion $100\frac{\text{km}}{\text{s}} < v_{\text{maximal}}^{\text{future Universe}} < 123\frac{\text{km}}{\text{s}}$ was made on the proposal of the general validity of Anderson's flyby prediction formula which has been otherwise verified only at the relatively low equatorial speed of the Earth as well as on the basis of a comparison of the Universe-flyby energy share with the path distribution energy share of the electron which is not a proven physical phenomenon."

The physical reality is the twin sister of good imagination. (Author)

IV. Acknowleddgment

Thanking Dr.R.K.Dixit for the polite invitation to submit the article in GJSFR.

Dedication

This fragment is dedicated to my birthplace Maribor and place of childhood Selnica ob Dravi.

References Références Referencias

1. Anderson D. J. Anomalous Orbital-Energy Changes Observed during Spacecraft Flybys of Earth. Physical Review Letters. PRL 100, 2008.
2. http://wmap.gsfc.nasa.gov/universe/uni_expansion.html. Retrieved April 2014.
3. Adam G. Riess et al. (Supernova Search Team) (1998). "Observational evidence from supernovae for an accelerating universe and a cosmological constant". *Astronomical J.*116 (3): 1009–38.
4. S. Pelrmutter et al. (The Supernova Cosmology Project) (1999). "Measurements of Omega and Lambda from 42 high redshift supernovae". *Astrophysical Journal* 517 (2): 565–86.
5. Špringer J. Geometric Distribution of Path and Fine Structure. Progress in Physics. 2013, v.4, 83-84.
6. Špringer J. Path Distribution Energy and Possible Consequences. Progress in Physics. 2013, v.4, 147-14.8.

Global Journals Inc. (US) Guidelines Handbook 2014

www.GlobalJournals.org

Fellows

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (FARSS)

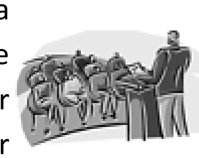
Global Journals Incorporate (USA) is accredited by Open Association of Research Society (OARS), U.S.A and in turn, awards "FARSS" title to individuals. The 'FARSS' title is accorded to a selected professional after the approval of the Editor-in-Chief/Editorial Board Members/Dean.

- The "FARSS" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSS or William Walldroff, M.S., FARSS.

FARSS accrediting is an honor. It authenticates your research activities. After recognition as FARSB, you can add 'FARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

The following benefits can be availed by you only for next three years from the date of certification:

FARSS designated members are entitled to avail a 40% discount while publishing their research papers (of a single author) with Global Journals Incorporation (USA), if the same is accepted by Editorial Board/Peer Reviewers. If you are a main author or co-author in case of multiple authors, you will be entitled to avail discount of 10%.



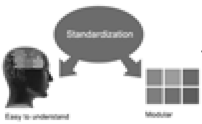
Once FARSB title is accorded, the Fellow is authorized to organize a symposium/seminar/conference on behalf of Global Journal Incorporation (USA). The Fellow can also participate in conference/seminar/symposium organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent.

You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The FARSS can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSS, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.



The FARSS will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSS member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A. Once you are designated as FARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

The FARSS members can avail the benefits of free research podcasting in Global Research Radio with their research documents. After publishing the work, (including published elsewhere worldwide with proper authorization) you can upload your research paper with your recorded voice or you can utilize chargeable services of our professional RJs to record your paper in their voice on request.

The FARSS member also entitled to get the benefits of free research podcasting of their research documents through video clips. We can also streamline your conference videos and display your slides/ online slides and online research video clips at reasonable charges, on request.

The FARSS is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSS can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSS member can decide its price and we can help in making the right decision.

The FARSS member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (MARSS)

The ' MARSS ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The “MARSS” is a dignified ornament which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., MARSS or William Walldroff, M.S., MARSS.

MARSS accrediting is an honor. It authenticates your research activities. After becoming MARSS, you can add 'MARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSS designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSS, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSS member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

Institutional Fellow of Global Journals Incorporation (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as "Institutional Fellow of Open Association of Research Society" (IFOARS).

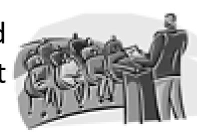
The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.



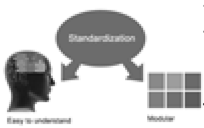
The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.



After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.

The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

Other:

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone. "

Process of submission of Research Paper

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

(II) Choose corresponding Journal.

(III) Click 'Submit Manuscript'. Fill required information and Upload the paper.

(B) If you are using Internet Explorer, then Direct Submission through Homepage is also available.

(C) If these two are not conveninet , and then email the paper directly to dean@globaljournals.org.

Offline Submission: Author can send the typed form of paper by Post. However, online submission should be preferred.

MANUSCRIPT STYLE INSTRUCTION (Must be strictly followed)

Page Size: 8.27" X 11'"

- Left Margin: 0.65
- Right Margin: 0.65
- Top Margin: 0.75
- Bottom Margin: 0.75
- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, “Abstract” word in Italic Bold.
- Main Text: Font size 10 with justified two columns section
- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
- Large Images must be in One Column
- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
- Numbering of Second Main Headings (Heading 2) must be in Alphabets, Italic, and Font Size of 10.

You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

The Global Journals Inc. (US) welcome the submission of original paper, review paper, survey article relevant to the all the streams of Philosophy and knowledge. The Global Journals Inc. (US) is parental platform for Global Journal of Computer Science and Technology, Researches in Engineering, Medical Research, Science Frontier Research, Human Social Science, Management, and Business organization. The choice of specific field can be done otherwise as following in Abstracting and Indexing Page on this Website. As the all Global

Journals Inc. (US) are being abstracted and indexed (in process) by most of the reputed organizations. Topics of only narrow interest will not be accepted unless they have wider potential or consequences.

2. ETHICAL GUIDELINES

Authors should follow the ethical guidelines as mentioned below for publication of research paper and research activities.

Papers are accepted on strict understanding that the material in whole or in part has not been, nor is being, considered for publication elsewhere. If the paper once accepted by Global Journals Inc. (US) and Editorial Board, will become the copyright of the Global Journals Inc. (US).

Authorship: The authors and coauthors should have active contribution to conception design, analysis and interpretation of findings. They should critically review the contents and drafting of the paper. All should approve the final version of the paper before submission

The Global Journals Inc. (US) follows the definition of authorship set up by the Global Academy of Research and Development. According to the Global Academy of R&D authorship, criteria must be based on:

1) Substantial contributions to conception and acquisition of data, analysis and interpretation of the findings.

2) Drafting the paper and revising it critically regarding important academic content.

3) Final approval of the version of the paper to be published.

All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

Acknowledgements: Contributors to the research other than authors credited should be mentioned under acknowledgement. The specifications of the source of funding for the research if appropriate can be included. Suppliers of resources may be mentioned along with address.

Appeal of Decision: The Editorial Board's decision on publication of the paper is final and cannot be appealed elsewhere.

Permissions: It is the author's responsibility to have prior permission if all or parts of earlier published illustrations are used in this paper.

Please mention proper reference and appropriate acknowledgements wherever expected.

If all or parts of previously published illustrations are used, permission must be taken from the copyright holder concerned. It is the author's responsibility to take these in writing.

Approval for reproduction/modification of any information (including figures and tables) published elsewhere must be obtained by the authors/copyright holders before submission of the manuscript. Contributors (Authors) are responsible for any copyright fee involved.

3. SUBMISSION OF MANUSCRIPTS

Manuscripts should be uploaded via this online submission page. The online submission is most efficient method for submission of papers, as it enables rapid distribution of manuscripts and consequently speeds up the review procedure. It also enables authors to know the status of their own manuscripts by emailing us. Complete instructions for submitting a paper is available below.

Manuscript submission is a systematic procedure and little preparation is required beyond having all parts of your manuscript in a given format and a computer with an Internet connection and a Web browser. Full help and instructions are provided on-screen. As an author, you will be prompted for login and manuscript details as Field of Paper and then to upload your manuscript file(s) according to the instructions.

To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5.STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

Color Charges: It is the rule of the Global Journals Inc. (US) for authors to pay the full cost for the reproduction of their color artwork. Hence, please note that, if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a color work agreement form before your paper can be published.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

6.1 Proof Corrections

The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

As changes to proofs are costly, we inquire that you only correct typesetting errors. All illustrations are retained by the publisher. Please note that the authors are responsible for all statements made in their work, including changes made by the copy editor.

6.2 Early View of Global Journals Inc. (US) (Publication Prior to Print)

The Global Journals Inc. (US) are enclosed by our publishing's Early View service. Early View articles are complete full-text articles sent in advance of their publication. Early View articles are absolute and final. They have been completely reviewed, revised and edited for publication, and the authors' final corrections have been incorporated. Because they are in final form, no changes can be made after sending them. The nature of Early View articles means that they do not yet have volume, issue or page numbers, so Early View articles cannot be cited in the conventional way.

6.3 Author Services

Online production tracking is available for your article through Author Services. Author Services enables authors to track their article - once it has been accepted - through the production process to publication online and in print. Authors can check the status of their articles online and choose to receive automated e-mails at key stages of production. The authors will receive an e-mail with a unique link that enables them to register and have their article automatically added to the system. Please ensure that a complete e-mail address is provided when submitting the manuscript.

6.4 Author Material Archive Policy

Please note that if not specifically requested, publisher will dispose off hardcopy & electronic information submitted, after the two months of publication. If you require the return of any information submitted, please inform the Editorial Board or dean as soon as possible.

6.5 Offprint and Extra Copies

A PDF offprint of the online-published article will be provided free of charge to the related author, and may be distributed according to the Publisher's terms and conditions. Additional paper offprint may be ordered by emailing us at: editor@globaljournals.org .

Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

ADMINISTRATION RULES LISTED BEFORE
SUBMITTING YOUR RESEARCH PAPER TO GLOBAL JOURNALS INC. (US)

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation)
by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

Index

save our planet

Global Journal of Science Frontier Research

Visit us on the Web at www.GlobalJournals.org | www.JournalofScience.org
or email us at helpdesk@globaljournals.org

ISSN 9755896